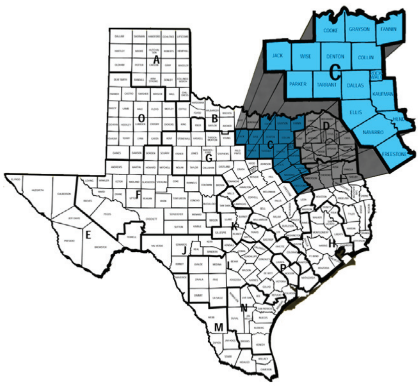
2011 Region C Water Plan

Volume 3 of 3

Appendices Q through BB

October 2010



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October 2010

Prepared for
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2011 Region C Water Plan

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2011 REGION C WATER PLAN

TABLE OF CONTENTS

		Page
Executive Summary		**ES.1**
ES.1	**Current Water Needs and Supplies in Region C**	**ES.3**
	Physical Setting	ES.3
	Water-Use	ES.3
	Current Sources of Water Supply	ES.4
	Water Providers in Region C	ES.4
ES.2	**Projected Need for Water**	**ES.4**
	Population Projections	ES.4
	Demand Projections	ES.5
	Comparison of Supply and Demand	ES.6
	Socio-Economic Impacts of Not Meeting Projected Water Needs	ES.7
ES.3	**Identification and Selection of Water Management Strategies**	**ES.7**
	Water Conservation and Reuse	ES.7
	Recommended Water Management Strategies	ES.8
	Cost of the Proposed Plan	ES.9
	County Summaries	ES.10
Introduction to Region C		**I.1**
1.	**Description of Region C**	**1.1**
1.1	**Economic Activity in Region C**	**1.1**
1.2	**Water-Related Physical Features in Region C**	**1.7**
1.3	**Current Water Uses and Demand Centers in Region C**	**1.13**
1.4	**Current Sources of Water Supply**	**1.21**
	Surface Water Sources	1.28
	Groundwater Sources	1.31
	Water Reclamation	1.35
	Springs in Region C	1.38
1.5	**Water Providers in Region C**	**1.38**
	Wholesale Water Providers	1.40
	Regional Wholesale Water Provider	1.41
	Local Wholesale Water Providers	1.56
	Retail Water Suppliers	1.57

Table of Contents, Continued **Page**

1.6 Pre-Existing Plans for Water Supply Development **1.62**
Previous Water Supply Planning in Region C 1.62
Recommendations in the *2006 Region C Water Plan* and the *2007 State Water Plan* 1.63
Conservation Planning in Region C 1.66
Preliminary Assessment of Current Preparations for Drought in Region C 1.68
Other Water-Related Programs 1.69

1.7 Agricultural and Natural Resources in Region C **1.71**
Springs in Region C 1.71
Wetlands 1.71
Endangered or Threatened Species 1.72
Stream Segments with Significant Natural Resources 1.74
Navigation 1.77
Agriculture and Prime Farmland 1.77
State and Federal Natural Resource Holdings 1.80
Oil and Gas Resources 1.80
Lignite Coal Fields 1.81

1.8 Summary of Threats and Constraints to Water Supply in Region C **1.83**
Need to Develop Additional Supplies 1.83
Surface Water Quality Concerns 1.83
Invasive Species 1.86
Groundwater Drawdown 1.87
Groundwater Quality 1.88

1.9 Water-Related Threats to Agricultural and Natural Resources in Region C **1.96**
Changes to Natural Flow Conditions 1.96
Water Quality Concerns 1.97
Inundation Due to Reservoir Development 1.97

Chapter 1 List of References **1.99**

2. Population and Water Demand Projections **2.1**

2.1 Historical Perspective **2.1**

2.2 Population Projections **2.1**
Basis for Population Projections 2.3
Water User Group Projections 2.4

Table of Contents, Continued **Page**

2.3 Water Demand Projections 2.9
Basis for Water Demand Projections 2.9
Water User Group Projections 2.10
Input for Future Planning 2.24
Wholesale Water Provider Projections 2.25

Chapter 2 List of References 2.27

3. Analysis of Water Supply Currently Available to Region C 3.1

3.1 Overall Water Supply Availability 3.1
Surface Water Availability 3.3
Groundwater Availability 3.8

3.2 Currently Available Water Supplies 3.12

3.3 Water Availability by Wholesale Water Provider (WWP) 3.15

3.4 Water Supplies Currently Available to Regional Wholesale Water Providers 3.16
Dallas Water Utilities 3.21
Tarrant Regional Water District 3.22
North Texas Municipal Water District 3.23
City of Fort Worth 3.23
Trinity River Authority 3.24
Upper Trinity Regional Water District 3.24
Greater Texoma Utility Authority 3.24
Dallas County Park Cities MUD 3.25
City of Corsicana 3.25
Sabine River Authority 3.25
Sulphur River Water District 3.26
Upper Neches River Municipal Water Authority 3.26

3.5 Current Water Supplies Available to Local Wholesale Water Providers 3.26

3.6 Water Availability by Water User Group (WUG) 3.28

3.7 Summary of Current Water Supply in Region C 3.28

Chapter 3 List of References 3.34

4. Identification, Evaluation, and Selection of Water Management Strategies 4A.1

Table of Contents, Continued **Page**

4A. Comparison of Current Water Supply and Projected Demand 4A.2

4A.1 Regional Comparison of Supply and Demand 4A.2

4A.2 Comparison of Connected Supply and Projected Demand by Wholesale Water Provider 4A.6

4A.3 Comparison of Connected Supply and Projected Demand by Water User Group 4A.6

4A.4 Summary of Projected Water Shortages 4A.9

4A.5 Socio-Economic Impacts of Not Meeting Projected Shortages 4A.9

Section 4A List of References 4A.12

4B. Water Conservation and Reuse 4B.1

4B.1 Water Conservation 4B.1

Currently Implemented Water Conservation Strategies in Region C 4B.1
Information Developed Since the *2006 Region C Water Plan* 4B.4
New Regional Planning Requirements 4B.5

4B.2 Reuse 4B.5

4B.3 Drought Management Measures 4B.9

4B.4 Summary of Water Conservation and Reuse Recommendations 4B.9

Section 4B List of References 4B.13

4C. Methodology for Evaluation and Selection of Water Management Strategies 4C.1

Major Water Management Strategies Implemented since the *2006 Region C Water Plan* 4C.1
Previous Planning Efforts 4C.2
Most Recent State Water Plan 4C.3

4C.1 Types of Water Management Strategies and Potentially Feasible Strategies for Water Supply in Region C 4C.3

Reservoir System Operation 4C.5
Connecting Existing Supplies 4C.5
Conjunctive Use of Groundwater and Surface Water 4C.8
Reallocation of Reservoir Storage 4C.8
Voluntary Redistribution of Water Resources 4C.9
Voluntary Subordination of Water Rights 4C.9
Enhancement of Yields of Existing Sources 4C.9

Table of Contents, Continued **Page**

	Control of Naturally Occurring Chlorides	4C.10
	Brush Control	4C.10
	Precipitation Enhancement	4C.11
	Desalination	4C.11
	Water Rights Cancellation	4C.12
	Aquifer Storage and Recovery	4C.12
	Development of New Surface Water Supplies	4C.13
	Development of New Groundwater Supplies	4C.15
	Interbasin Transfers	4C.15
	Other Measures - Renewal of Contracts	4C.16
	Other Measures – Temporary Overdrafting	4C.18
	Other Measures – Groundwater Conservation Districts	4C.19
	Other Measures – Supplemental Wells	4C.19
	Other Measures – Sediment Control Structures	4C.19
	Summary of Potentially Feasible Strategies	4C.20
4C.2	**Methodology for Evaluating Water Management Strategies**	**4C.20**
	Factors Considered in Evaluation	4C.23
	Environmental Evaluation	4C.24
	Agricultural Resources and Other Natural Resources	4C.25
	Costs of Water Management Strategies	4C.25
	Recommended Water Management Strategies	4C.25
Section 4C List of References		**4C.27**
4D.	**Evaluation of Major Water Management Strategies**	**4D.1**
4D.1	**Toledo Bend Reservoir**	**4D.1**
4D.2	**Gulf of Mexico with Desalination**	**4D.7**
4D.3	**Marvin Nichols Reservoir**	**4D.8**
4D.4	**Wright Patman Lake**	**4D.9**
4D.5	**Lake Texoma**	**4D.11**
4D.6	**Lake Livingston**	**4D.12**
4D.7	**Ogallala Groundwater (Roberts County)**	**4D.13**
4D.8	**Water from Oklahoma**	**4D.13**
4D.9	**Tarrant Regional Water District and Dallas Integrated Pipeline**	**4D.14**
4D.10	**Lower Bois d'Arc Creek Reservoir**	**4D.14**
4D.11	**George Parkhouse Lake (North)**	**4D.15**
4D.12	**Lake Palestine**	**4D.15**

Table of Contents, Continued **Page**

4D.13 Neches River Run-of-the-River Diversion 4D.16

4D.14 George Parkhouse Lake (South) 4D.16

4D.15 Tarrant Regional Water District Wetlands Project 4D.17

4D.16 Carrizo-Wilcox Aquifer Groundwater (Brazos County and Vicinity) 4D.17

4D.17 Cypress Basin Supplies (Lake O' the Pines) 4D.18

4D.18 Tawakoni Pipeline 4D.18

4D.19 Southside (Lake Ray Hubbard) Reuse 4D.19

4D.20 Lewisville Lake Reuse 4D.19

4D.21 Main Stem Trinity River Pump Station 4D.19

4D.22 Tehuacana Reservoir 4D.20

4D.23 Lake Ralph Hall and Reuse 4D.20

4D.24 Lake Columbia 4D.20

4D.25 Summary of Recommended Major Water Management Strategies 4D.21

Section 4D List of References 4D.22

4E. Recommended Water Management Strategies for Wholesale Water Providers 4E.1

4E.1 Recommended Strategies for Regional Wholesale Water Providers 4E.2

Strategies for Multiple Wholesale Water Providers 4E.2
Dallas Water Utilities 4E.4
Tarrant Regional Water District 4E.14
North Texas Municipal Water District 4E.21
City of Fort Worth 4E.30
Trinity River Authority 4E.34
Upper Trinity Regional Water District 4E.43
Greater Texoma Utility Authority 4E.49
Dallas County Park Cities Municipal Utility District 4E.53
City of Corsicana 4E.55
Sabine River Authority 4E.59
Sulphur River Water District 4E.60
Upper Neches River Municipal Water Authority 4E.60

4E.2 Recommended Strategies for Local Wholesale Water Providers 4E.60

Argyle Water Supply Authority 4E.60
City of Arlington 4E.62
Athens Municipal Water Authority 4E.63

Table of Contents, Continued **Page**

Bartonville Water Supply Corporation 4E.67
Bolivar Water Supply Corporation 4E.68
Dallas County Water Control and Improvement District Number 6 4E.70
City of Denton 4E.71
East Cedar Creek Fresh Water Supply District 3E.73
City of Ennis 4E.75
City of Forney 4E.77
City of Gainesville 4E.78
City of Garland 4E.82
City of Grand Prairie 4E.84
Lake Cities Municipal Utility Authority 4E.86
City of Mansfield 4E.87
City of Midlothian 4E.89
Mustang Special Utility District 4E.91
City of North Richland Hills 4E.93
City of Princeton 4E.94
Rockett Special Utility District 4E.95
City of Rockwall 4E.97
City of Seagoville 4E.98
City of Sherman 4E.100
City of Terrell 4E.102
Walnut Creek Special Utility District (SUD) 4E.103
Waxahachie 4E.106
City of Weatherford 4E.109
West Cedar Creek Municipal Utility District 4E.111
Wise County Water Supply District 4E.113

Section 4E List of References **4E.115**

4F. Recommended Water Management Strategies for Water User Groups by County **4F.1**

4F.1 Collin County **4F.1**

4F.2 Cooke County **4F.44**

4F.3 Dallas County **4F.62**

4F.4 Denton County **4F.100**

4F.5 Ellis County **4F.149**

4F.6 Fannin County **4F.186**

4F.7 Freestone County **4F.209**

4F.8 Grayson County **4F.225**

Table of Contents, Continued **Page**

4F.9 Henderson County 4F.257

4F.10 Jack County 4F.280

4F.11 Kaufman County 4F.293

4F.12 Navarro County 4F. 322

4F.13 Parker County 4F. 344

4F.14 Rockwall County 4F. 367

4F.15 Tarrant County 4F. 386

4F.16 Wise County 4F. 434

Section 4F List of References 4F. 459

4G. Texas Water Development Board Required Tables 4G.1

4H. Summary of Special Studies 4H.1

4H.1 Biennium Studies 4H.1

Water Conservation and Reuse Study 4H.1
Toledo Bend Study 4H.3
Reuse Pilot Project Studies 4H.4
Regional System Implementation Plans 4H.6

4H.2 Summary of 2011 Special Studies 4H.7

Saline Water Study 4H.8
Cooke and Grayson County Water Supply Study 4H.10
Fannin County Water Supply Study 4H.12
Freestone County Water Supply Study 4H.13
Navarro County Water Supply Study 4H.14
Kaufman County Water Supply Study 4H.14

Section 4H List of References 4F.16

5. Impacts of Recommended Water Management Strategies 5.1

5.1 Impacts of Recommended Water Management Strategies on Key Water Quality Parameters 5.1

Selection of Key Water Quality Parameters 5.2
Evaluation of Water Quality Impacts 5.4

Table of Contents, Continued **Page**

5.2 Impacts of Recommended Water Management Strategies on Moving Water from Rural and Agricultural Areas and Impacts to Third Parties 5.9

5.3 Invasive and Harmful Species 5.11

Chapter 5 List of References 5.13

6. Water Conservation and Drought Management Recommendations 6.1

6.1 Introduction 6.1
Definitions 6.2
Information Developed Since 2006 *Region C Water Plan* 6.3
New Regional Planning Requirements 6.4

6.2 Summary of Region C Water Planning Group Decisions 6.4
Water Conservation 6.5
Reuse of Treated Wastewater Effluent 6.5
Drought Management 6.7

6.3 Trends in Per Capita Water Use in Various Regions 6.8
Comparison of Historical Per Capita Municipal Water Use in Various Parts of the State 6.10
Seasonal Assessment 6.13

6.4 Water Conservation and Reuse in Region C 6.15
Historical Water Use in Region C 6.16
Recommended Conservation Strategies for Region C 6.16
Current Water Conservation in Region C 6.20
Case Studies 6.21
Summary of Existing Conservation Efforts in Region C 6.29
Existing Reuse Projects 6.29
Recommended Reuse Projects 6.29

6.5 Per Capita Water Use in Region C with the Implementation of the Recommended Plan 6.30
Region C Per Capita Municipal Water Use 6.36
Region C Per Capita Municipal and Manufacturing Water Use 6.36

6.6 Water Conservation Policy Recommendations 6.37

6.7 Model Water Conservation Plans 6.37
Who Must Develop a Water Conservation Plan 6.40
Municipal Water Conservation Plan Requirements 6.40
Implementation of House Bill 1656 6.42

Table of Contents, Continued **Page**

Irrigation Water Conservation Plan Requirements 6.43
Manufacturing and Steam Electric Power Water Conservation Plan Requirements 6.43

6.8 Drought Management 6.44
Who Must Develop a Drought Contingency Plan 6.44
Required Content for Drought Contingency Plans 6.45
Review of Existing Drought Contingency Plans 6.46
Model Drought Contingency Plans 6.46

6.9 Evaluation of Water Conservation and Drought Management Planning Requirements 6.47

6.10 Conservation Requirements for Interbasin Transfers of Water 6.47

6.11 Evaluation of Reuse Efforts in Region C 6.50

6.12 Water Loss Audit 6.52

Chapter 6 List of References 6.55

7. Description of How the Regional Water Plan is Consistent with Long-Term Protection of the State's Water Resources, Agricultural Resources, and Natural Resources 7.1

7.1 Introduction 7.1

7.2 Consistency with the Protection of Water Resources 7.1

7.3 Consistency with Protection of Agricultural Resources 7.4

7.4 Consistency with Protection of Natural Resources 7.5
Threatened/Endangered Species 7.5
Wetland Habitats 7.5
Parks and Public Lands 7.6
Energy Reserves 7.7

7.5 Consistency with Protection of Navigation 7.7

7.6 Consistency with State Water Planning Guidelines 7.7

Chapter 7 List of References 7.9

8. Unique Stream Segments, Unique Reservoir Sites, and Legislative Recommendations 8.1

8.1 Summary of Recommendations 8.1

Table of Contents, Continued **Page**

8.2 Recommendations for Ecologically Unique River and Stream Segments 8.2

8.3 Recommendations for Unique Sites for Reservoir Construction 8.7
Muenster 8.7
Ralph Hall 8.7
Lower Bois d'Arc Creek 8.7
Marvin Nichols 8.8
Fastrill 8.8
Tehuacana 8.8
Recommendations 8.8

8.4 Policy and Legislative Recommendations 8.9
Senate Bill One Planning Process 8.9
TCEQ Policy and Water Rights 8.10
State Funding for Water Supply Programs 8.12
Water Reuse and Desalination 8.14
State and Federal Program – Water Supply Issues 8.15

Chapter 8 List of References 8.17

9. Infrastructure Funding Recommendations 9.1

9.1 Infrastructure Financing Questionnaires for Recommended Water Management Strategies 9.1
Water User Groups (WUGs) 9.2
Wholesale Water Providers (WWPs) 9.3
9.2 Wholesale Water Provider and Water User Group Funding Summary 9.4
9.3 Additional Funding Mechanisms 9.4

10. Plan Approval Process and Public Participation 10.1

10.1 Regional Water Planning Group 10.1

10.2 Outreach to Water Suppliers, Water User Groups, and Regional Planning Groups 10.2
Questionnaires 10.3
Meetings with Wholesale Water Providers and Other Suppliers 10.4

10.3 Outreach to Public 10.5
Newsletters 10.5
Media Outreach 10.6
Region C Web Site 10.8

Table of Contents, Continued **Page**

10.4	**Public Meetings and Public Hearings**	**10.9**
	Initial Public Hearing	10.9
	Regular Public Meetings	10.9
	Public Hearing on Initially Prepared Plan	10.9
	Public Input	10.10
10.5	**Study Commission on Region C Water Supply**	**10.10**
Chapter 10 List of References		**10.13**

Appendix A	List of References
Appendix B	Bibliography of Previous Water Plans for Entities in Region C
Appendix C	Summary Tables for Water User Groups
Appendix D	Questionnaires on Population and Water Demand Projections, Water Management Strategies, Conservation Practices, and Water Planning Issues
Appendix E	Region C Adjustments to Population and Water Demand Projections
Appendix F	Population Projections
Appendix G	Demand Projections
Appendix H	Demand Projections for Wholesale Water Providers
Appendix I	Availability of Current Water Supplies
Appendix J	Current Supplies by Water User Group
Appendix K	Estimation of Savings and Costs for Water Conservation Strategies
Appendix L	Model Water Conservation Plans
Appendix M	Key Water Quality Parameters
Appendix N	Socio-Economic Impacts of Not Meeting Water Needs
Appendix O	Potentially Feasible Water Management Strategies
Appendix P	Strategy Evaluation
Appendix Q	Cost Estimates
Appendix R	Saline Study
Appendix S	Cooke-Grayson County Water Supply Study
Appendix T	Fannin County Water Supply Study
Appendix U	Freestone County Water Supply Study
Appendix V	Navarro County Water Supply Study

Table of Contents, Continued

Appendix W Kaufman County Water Supply Study

Appendix X Infrastructure Financing Information

Appendix Y Region C Newsletters

Appendix Z TWDB Required Tables

Appendix AA Comments on the Initially Prepared Plan

Appendix BB Response to Comments

APPENDIX Q

COST ESTIMATES

APPENDIX Q
COST ESTIMATES

TABLE OF CONTENTS

	Page
Q-1 Introduction	Q.1
Q-2 Assumptions for Capital Costs	Q.1
Conveyance Systems	Q.1
Water Treatment Plants	Q.2
New Groundwater Wells	Q.2
New Reservoirs	Q.3
Other Costs	Q.3
Q-3 Assumptions for Annual Costs	Q.4
Q-4 Cost Estimates for Strategies	Q.6

List of Tables

Q-1	Pipeline Costs (Does Not Include ROW)	Q.6
Q-2	Pump Station Costs for Transmission Systems	Q.7
Q-3	Costs for Ground Storage Tanks	Q.8
Q-3A	Costs for Elevated Storage Tanks	Q.8
Q-4	Discharge Structures	Q.9
Q-5	Conventional Water Treatment Plant Costs	Q.9
Q-5A	Additional Cost for Reverse Osmosis Treatment	Q.10
Q-5B	Groundwater Nitrate Treatment	Q.10
Q-6	Cost Elements for Water Wells	Q.10
Q-7	Cost Elements for Reservoir Sites	Q.11
Q-8	Pipeline Easement Costs	Q.11
Q-9	Factors for Interest during Construction	Q.11
Q-10	Supply and Costs by User Group for Basic Conservation Package	
Q-11	Supply and Costs by User Group for Expanded Conservation Package	
Q-12	Supply and Costs by User Group for Non-Municipal Water Conservation Package	
Q-13	Cost Estimates for Supplemental Wells to Maintain Current Groundwater Production Capacity	
Q-14	New WTPs	
Q-15	WTP expansions	
Q-16	Toledo Bend to SRA Upper Basin, DWU, NTMWD, and TRWD	

List of Tables, Continued

Q-17 Toledo Bend to SRA Upper Basin, NTMWD, and TRWD
Q-18 Gulf of Mexico Water with Desalination
Q-19 Cost of Marvin Nichols IA Reservoir and Transmission System
Q-20 Cost of Marvin Nichols IA Reservoir and Transmission System - North Texas MWD, Tarrant Regional WD, and Upper Trinity RWD
Q-21 Wright Patman to Dallas Water Utilities - Purchase 100,000 Acre-Feet per Year from Texarkana
Q-22 Wright Patman to North Texas Municipal Water District - Purchase 100,000 Acre-Feet per Year from Texarkana
Q-23 Wright Patman to Tarrant Regional Water District - Purchase 100,000 Acre-Feet per Year from Texarkana
Q-24 Wright Patman to Dallas Water Utilities - Develop 112,100 Acre-Feet per Year from Lake Wright Patman
Q-25 Wright Patman to Dallas Water Utilities - Develop 180,000 Acre-Feet per Year from Lake Wright Patman
Q-26 Wright Patman to North Texas Municipal Water District - Develop 180,000 Acre-Feet per Year from Lake Wright Patman
Q-27 Wright Patman to Tarrant Regional Water District - Develop 180,000 Acre-Feet per Year from Lake Wright Patman
Q-28 Wright Patman to DWU, NTMWD, and TRWD - Develop 390,000 Acre-Feet per Year from Lake Wright Patman
Q-29 Lake Texoma Already Authorized with Blending - WTP at Leonard
Q-30 NTMWD Substantial Additional Lake Texoma Supply with Desalination
Q-31 Additional Lake Texoma Supply with Blending
Q-32 Substantial Additional Lake Texoma Supply with Desalination
Q-33 Lake Livingston to Dallas Water Utilities
Q-34 Lake Livingston to North Texas Municipal Water District
Q-35 Lake Livingston to Tarrant Regional Water District
Q-36 Tawakoni Replacement
Q-37 Dallas Main Stem Pump Station
Q-38 Roberts County Water Supply Project - Ogallala Groundwater to Lake Ray Roberts
Q-39 Roberts County Water Supply Project - Ogallala Groundwater to Lake Ray Lavon near Princeton, Texas
Q-40 Roberts County Water Supply Project - Ogallala Groundwater to Eagle Mountain Lake via Lake Bridgeport
Q-41 TRWD & DWU Integrated Pipeline
Q-42 DWU Oklahoma Water - From Hugo to Lake Lewisville
Q-43 NTMWD Oklahoma Water - From Hugo to Lake Chapman
Q-44 TRWD Oklahoma Water - From Hugo to Eagle Mountain
Q-45 UTRWD and Irving Oklahoma Water - From Hugo to Lake Chapman to Lavon
Q-46 Oklahoma Water for NTMWD, TRWD, and UTRWD
Q-47 Cost of Lower Bois d'Arc Creek Reservoir Site
Q-48 Cost of George Parkhouse North Reservoir for Dallas Water Utilities

List of Tables, Continued

Q-49	Cost of George Parkhouse North Reservoir for North Texas Municipal Water District
Q-50	TRWD Wetlands Reuse
Q-51	Cost of Neches River Run-of-the-River Diversions Project for Dallas Water Utilities
Q-52	Cost of George Parkhouse South Reservoir for North Texas Municipal Water District
Q-53	Cost of George Parkhouse South Reservoir for Dallas
Q-54	Groundwater from the Carrizo-Wilcox from Brazos County for Dallas Water Utilities
Q-55	Groundwater from the Carrizo-Wilcox from Brazos County for North Texas MWD
Q-56	Carrizo-Wilcox Groundwater from the Brazos County Area
Q-56	DWU Lake of the Pines - Pump from Lake of the Pines to Lake Fork to TBR and gravity flow to East Side WTP
Q-58	NTMWD Lake of the Pines - From Lake of the Pines to New WTP at Farmersville
Q-59	TRWD Lake of the Pines- From Lake of the Pines to Rolling Hills WTP
Q-60	Dallas Water Utilities - Lake Ray Hubbard Indirect Reuse Project
Q-61	Dallas Water Utilities - Lake Lewisville Indirect Reuse Project
Q-62	Tarrant Regional Water District Lake Tehuacana
Q-63	Lake Ralph Hall and Reuse for UTRWD
Q-64	DWU Lake Columbia (formerly Lake Eastex)
Q-65	Dallas Direct Reuse Projects
Q-66	Lake Texoma Supply with Blending in Elm Fork
Q-67	DWU Water Treatment Plant Construction and Expansion
Q-68	Lake Chapman Pump Station Expansion, NTMWD and Irving
Q-69	North Texas Municipal Water District Interim Purchase from DWU
Q-70	North Texas Municipal Water District Water District Lake Texoma (Interim GTUA)
Q-71	Lake Texoma Pump Station Expansion, NTMWD and GTUA
Q-72	NTMWD Treatment & Treated Water Distribution Improvements
Q-73	Fannin County Water Supply Project
Q-74	Ellis County Water Supply Project
Q-75	Trinity River Authority Las Colinas Reuse (Dallas County Irrigation)
Q-76	Trinity River Authority Dallas County Reuse for Steam Electric Power
Q-77	Trinity River Authority Ellis County Reuse for Steam Electric Power
Q-78	Trinity River Authority Freestone County Reuse for Steam Electric Power
Q-79	Trinity River Authority Kaufman County Reuse for Steam Electric Power
Q-80	Trinity River Authority - Tarrant County Water Supply Project Expansions
Q-81	Trinity River Authority Reuse from Denton Creek Wastewater Treatment Plant
Q-82	Freestone County S. E. Power by TRA from Tarrant Regional Water District
Q-83	Upper Trinity Regional Water District Direct Reuse
Q-84	UTRWD Water Treatment Plant and Treated Water Distribution System Water Management Strategies
Q-85	Upper Trinity Regional Water District Alternative Strategy Costs

List of Tables, Continued

Q-86	Grayson County Water Supply Project
Q-87	GTUA Collin-Grayson Municipal Alliance East-West Water Line
Q-88	GTUA Collin-Grayson Municipal Alliance Water Transmission System - Phase 2
Q-89	Athens MWA New Wells
Q-90	Athens MWA Reuse
Q-91	Obtain Water from Forest Grove Reservoir and Transport All to Lake Athens
Q-92	Athens MWA Forest Grove to WTP
Q-93	Athens MWA Cedar Creek to WTP
Q-94	Purchase water from Lake Palestine for Athens MWA
Q-95	Purchase Water from DWU for Athens MWA
Q-96	Corsicana WTP at Navarro Mills Lake
Q-97	Corsicana WTP at Lake Halbert
Q-98	GTUA Reuse for Steam Electric Power
Q-99	Cooke County Water Supply Project
Q-100	Muenster: Pipeline from Gainesville to Muenster
Q-101	Gainesville Direct Reuse
Q-102	City of Fort Worth Parallel Pipeline to Eagle Mountain Lake with Raw Water Pump Station Expansion
Q-103	City of Fort Worth Pipeline to New Southwest Water Treatment Plant
Q-104	Fort Worth Future Direct Reuse*
Q-105	Fort Worth Direct Reuse - Alliance Corridor
Q-106	Fort Worth Direct Reuse - Village Creek*
Q-107	Walnut Creek SUD (Parallel) Pipeline to Rhome
Q-108	Walnut Creek - Pipeline from Bridgeport with 12 MGD WTP
Q-109	Walnut Creek SUD - Azle pipeline to Rhome
Q-110	Walnut Creek SUD Intake and Pipeline from Eagle Mountain Lake to New WTP
Q-111	Walnut Creek SUD Pipeline from Eagle Mountain Lake to Boyd and Rhome
Q-112	Dallas Supply to Ellis County Customers - Rockett SUD, Red Oak, and Waxahachie
Q-113	Waxahachie Additional TRA/Waxahachie Indirect Reuse
Q-114	Weatherford Increase Pump Station Capacity by 7 MGD
Q-115	Celina to NTMWD
Q-116	Blue Ridge to NTMWD
Q-117	Frisco Direct Reuse
Q-118	Prosper Additional NTMWD
Q-119	Weston to NTMWD
Q-120	Collin County Mining - Additional NTMWD
Q-121	Collin County SEP - Additional NTMWD
Q-122	Navarro County SEP from Corsicana
Q-123	Navarro County SEP from Corsicana

List of Tables, Continued

Q-124	Muenster Water Treatment Plant
Q-125	Cooke County Irrigation - Overdraft Trinity Aquifer with Existing Wells
Q-126	Cooke County Mining - Overdraft Trinity Aquifer with New Wells
Q-127	Gainesville - Overdraft Trinity aquifer with Existing Wells
Q-128	Addison Aquifer Storage and Recovery
Q-129	Pipeline from DWU to Carrollton, Lewisville, and The Colony
Q-130	Combine WSC pipeline to Seagoville
Q-131	Grand Prairie - Pipeline from Mansfield
Q-132	Grand Prairie - Pipeline from Midlothian
Q-133	Grand Prairie - Pipeline from Arlington
Q-134	Princeton Pump Station Improvements
Q-135	Irving Indirect Reuse
Q-136	Irving Direct Reuse
Q-137	Irving - Oklahoma to Lake Lewisville
Q-138	Irving Alternatives
Q-139	Lake Hugo to Irving through Chapman
Q-140	Ovilla - Additional water from Dallas
Q-141	Sardis-Lone Elm WSC - Water from Rockett SUD
Q-142	Lancaster New DWU Delivery Point
Q-143	Dallas County Irrigation - Pipeline for Reuse
Q-144	Dallas County Mining Pipeline
Q-145	Dallas County SEP Direct Reuse
Q-146	Hackberry Additional NTMWD
Q-147	Denton County Other - Woodbine Wells
Q-148	Denton County Other - Trinity Wells
Q-149	Pilot Point (Denton County) - Trinity Wells
Q-150	Northlake, Roanoke, and Trophy Club to Fort Worth
Q-151	Southlake to Fort Worth
Q-152	The Colony Aquifer Storage and Recovery
Q-153	Denton County Mining - Woodbine Wells
Q-154	Denton County Manufacturing - Trinity Wells
Q-155	Denton County SEP - Trinity Wells
Q-156	Denton County Irrigation - Trinity Wells
Q-157	Buena Vista-Bethel SUD - Overdraft Trinity with Existing Wells
Q-158	Buena Vista-Bethel SUD Purchase Water from Rockett SUD
Q-159	Buena Vista - Bethel SUD Parallel Pipeline from Waxahachie
Q-160	Community Water Company Additional Water from Ennis
Q-161	Ennis Indirect Reuse

List of Tables, Continued

Q-162 Ennis Raise Bardwell
Q-163 Ferris Water from Rockett SUD
Q-164 Glenn Heights Additional Water from Dallas
Q-165 Mountain Peak SUD - Cost of Overdrafting
Q-166 Mountain Peak SUD Additional Water from Midlothian
Q-167 Mountain Peak SUD Water from Rockett SUD
Q-168 Mountain Peak SUD - Trinity Wells
Q-169 Oak Leaf Additional Water from Glenn Heights
Q-170 Palmer Purchase Water from Rockett SUD
Q-171 Ellis County SEP Water from Waxahachie
Q-172 Rice WSC Additional Water from Ennis
Q-173 Sardis-Lone Elm WSC - Cost of Overdrafting
Q-174 Ellis County Other - Trinity Wells
Q-175 Ellis County Other - Woodbine Wells
Q-176 Ellis County Irrigation - Woodbine Wells
Q-177 Ellis County Manufacturing Additional Water from Waxahachie
Q-178 Ellis County Manufacturing Additional Water from Midlothian
Q-179 Ellis County Manufacturing Additional Water from Ennis
Q-180 Ellis County Steam Electric Power Additional Water from Midlothian
Q-181 Ladonia from UTRWD - Ralph Hall
Q-182 Fannin County SEP - Lake Texoma
Q-183 Fairfield New Wells in Carrizo-Wilcox Aquifer
Q-184 Fairfield Connect to TRWD (Richland-Chambers)
Q-185 Teague New wells in Carrizo-Wilcox Aquifer
Q-186 Wortham Purchase Water from TRWD
Q-187 Wortham Purchase Water from Corsicana
Q-188 Freestone County SEP Water from TRA (TRWD)
Q-189 Freestone County SEP TRA Reuse
Q-190 Denison Infrastructure Improvements
Q-191 Southmayd New or Purchased Wells in Woodbine Aquifer
Q-192 Grayson County Manufacturing Purchase water from Howe
Q-193 Bryson Purchase Water from Graham
Q-194 Bryson Connect to Jacksboro
Q-195 Jack County Other Transmission System
Q-196 Henderson County SEP - Transmission Facilities from Cedar Creek Lake
Q-197 Crandall Pipeline to Seagoville (DWU)
Q-198 Kaufman County Irrigation Pipeline to NTMWD (reuse)
Q-199 Kaufman County SEP Pipeline for Forney/Garland
Q-200 Kaufman County SEP Pipeline for water from Forney (NTMWD)

List of Tables, Continued

Q-201 Kaufman County SEP - TRA Reuse
Q-202 Ables Springs Connection to NTMWD Tawakoni WTP
Q-203 College Mound Upsize Existing Line from Terrell
Q-204 Forney Pump Station - Increase Capacity
Q-205 Terrell New Water Line
Q-206 Terrell New Line off of NTMWD Delivery Line
Q-207 Terrell New Line off of NTMWD Delivery Line
Q-208 Terrell New Line off of NTMWD Delivery Line
Q-209 Terrell Ground Storage Tank and Pump Station Expansions
Q-210 Terrell Second NTMWD Delivery Point
Q-211 Terrell New Line to Serve Wholesale Customers
Q-212 Kaufman Connect to NTMWD (Alternative WMS)
Q-213 East Parker County - Pipeline from Weatherford to Annetta, Annetta South, and Willow Park
Q-214 Aledo Purchase Water from Fort Worth (Wholesale System)
Q-215 West Parker County - Pipeline from BRA to Parker County SUD
Q-216 Springtown Pipeline to Walnut Creek SUD (TRWD)
Q-217 Parker County SEP Additional Water from Weatherford
Q-218 Blackland WSC Purchase Water from NTMWD
Q-219 RCH WSC Purchase Water from NTMWD
Q-220 Bethesda Parallel Pipeline to Fort Worth
Q-221 Burleson Purchase Water from Fort Worth
Q-222 Crowley Purchase Water from Fort Worth
Q-223 Kennedale - New well in Trinity Aquifer
Q-224 Kennedale Purchase Additional Water from Fort Worth
Q-225 Kennedale Pipeline to Arlington
Q-226 Lakeside New well in Trinity Aquifer
Q-227 Lakeside Pipeline to Azle
Q-228 Watauga (North Richland Hills) to Fort Worth
Q-229 Pantego Pipeline to Fort Worth
Q-230 Pantego Pipeline to Arlington
Q-231 Pelican Bay Pipeline to Azle
Q-232 Tarrant County SEP Direct Reuse
Q-233 Tarrant County Irrigation TRWD reuse
Q-234 Alvord Pipeline to Chico
Q-235 Aurora Pipeline to Rhome
Q-236 Bridgeport Pump Station - Increase Capacity
Q-237 Bridgeport Parallel Pipeline to TRWD
Q-238 Chico Pipeline to Bridgeport
Q-239 Decatur Parallel Pipeline to Bridgeport

List of Tables, Continued

Q-240 New Fairview Pipeline to Rhome
Q-241 Newark Pipeline to Rhome
Q-242 Wise County SEP Pipeline for Bridgeport reuse
Q-243 Wise County SEP Pipeline for Decatur reuse
Q-244 Blooming Grove New Well in Trinity Aquifer
Q-245 Navarro Mills WSC New Well in Woodbine Aquifer
Q-246 MEN WSC New Well in Other Aquifer (Alternative WMS)
Q-247 Chatfield WSC New Well in Other Aquifer (Alternative WMS)
Q-248 M E N WSC - Upsize Lake Halbert Connection
Q-249 Chatfield WSC New WTP on Cedar Creek Reservoir (Alternative WMS)
Q-250 M E N WSC New WTP on Cedar Creek Reservoir (Alternative WMS)
Q-251 Chatfield WSC New WTP on Richland-Chambers Reservoir (Alternative WMS)
Q-252 M E N WSC New WTP on Richland-Chambers Reservoir (Alternative WMS)
Q-253 Athens WTP Expansion
Q-254 Melissa - Treated water Connection to NTWMD
Q-255 Springtown - New Well in Trinity Aquifer
Q-256 Payne Springs - New Well in Carrizo-Wilcox Aquifer
Q-257 Lake Worth - New Well in Trinity Aquifer
Q-258 Little Elm - New Well in Woodbine Aquifer

Q-1 Introduction

The evaluation of water management strategies requires developing cost estimates. Guidance for cost estimates may be found in the TWDB's "General Guidelines for Regional Water Plan Development (2007-2012)", Section 4.1.2. Costs are to be reported in September 2008 dollars.

Cost estimates are based on standard unit costs for installed pipe, pump stations and standard treatment facilities developed from experience with similar projects throughout the State of Texas. All unit costs include the contractors' mobilization, overhead and profit. The unit costs **do not** include engineering, contingency, financial and legal services, costs for land and rights-of-way, permits, environmental and archeological studies, or mitigation. These costs are included in estimates outside of the unit costs.

The cost estimates have two components:

- Initial capital costs, including engineering and construction costs
- Average annual costs, including annual operation and maintenance costs and debt service.

Q-2 Assumptions for Capital Costs

Conveyance Systems

Standard pipeline costs used for these cost estimates are shown in Table Q-1. Pump station costs are based on required Horsepower capacity and are listed in Table Q-2. The power capacity is to be determined from the hydraulic analyses conducted from a planning level hydraulic grade line evaluation (or detailed analysis if available). Pipelines and pump stations are to be sized for peak pumping capacity.

- Pump efficiency is assumed to be 75 percent.
- Peaking factor of 2 times the average demand for strategies when the water is pumped directly to a water treatment plant. (or historical peaking factor, if available)
- Peaking factor of 1.2 to 1.5 is to be used if there are additional water sources and/or the water is transported to a terminal storage facility.
- Ground storage is to be provided at each booster pump station along the transmission line unless there is a more detailed design.
- Ground storage tanks should provide sufficient storage for 2.5 to 4 hours of pumping at

peak capacity. Costs for ground storage are shown in Table Q-3. Covered storage tanks are used for all strategies transporting treated water.

- Costs for elevated storage tanks are shown in Table Q-3A.
- When a pipeline discharges into a reservoir or river, use project-specific discharge structure costs if available. If no project-specific information is available, the costs in Table Q-4 may be used to estimate discharge structure costs.

Water Treatment Plants

Water treatment plants are to be sized for peak day capacity (assume peaking factor of 2 if no specific data is available). Costs estimated for new conventional surface water treatment facilities and expansions of existing facilities are listed in Table Q-5. Conventional treatment does not include advanced technologies, such as ozone or UV treatment. All treatment plants are to be sized for finished water capacity.

- For reverse osmosis plants for surface water, increase construction costs shown on Table Q-5 by the amount shown on Table Q-5A for the appropriate size plant that will be used for RO. If groundwater is the raw water source, use only the costs in Table Q-5A. These costs were based on actual cost estimates of similar facilities.
- The amount of reject water generated by reverse osmosis treatment is dependent upon the incoming quality of the raw water. Final treatment goals should be between 600 and 800 mg/l of TDS. (This provides a safety margin in meeting secondary treatment standards.) For reverse osmosis treatment of brackish water (1,000 – 3,000 mg/l of TDS), assume that 20 percent of the raw water treated with membranes is discharged as reject water, unless project-specific data is available. For brackish water with TDS concentrations between 3,000 and 10,000 mg/l, assume 30% reject water. Desalination of seawater or very high TDS water will have a higher percent of reject water (50 to 60%). Minimal losses are assumed for conventional treatment facilities.
- Costs for ion exchange facilities are shown on Table Q-5B. For these facilities it is assumed that 2 to 3 percent of the raw water would be discharged as reject water.

New Groundwater Wells

The costs for new water wells can be calculated using the formulas in Table Q-6. Costs include well pumps and motors. It is assumed that the cost of irrigation wells is approximately 60% of the cost for municipal and industrial wells. Well depth will be estimated by county and aquifer.

For expansion of existing well fields for municipal water providers, an additional $160,000 per well for connection to the existing distribution system is assumed.

Connection costs and conveyance systems for new well fields will be determined on a case-by-case basis.

New Reservoirs

Site-specific cost estimates will be made for reservoir sites. The elements required for reservoir sites are included in Table Q-7. Lake intake structures for new reservoirs will be determined on a case-by-case basis. Generally, costs for construction of such facilities prior to filling of the reservoir will be less than shown on Table Q-2 because they can be constructed on dry ground.

Other Costs

- Engineering, contingency, construction management, financial and legal costs are to be estimated at 30 percent of construction cost for pipelines and 35 percent of construction costs for pump stations, treatment facilities and reservoir projects as required by TWDB Exhibit B.
- Permitting and mitigation for transmission and treatment projects are to be estimated at 1 percent of the total construction costs. For reservoirs, mitigation and permitting costs are assumed equal to twice the land purchase cost for the conservation pool, unless site specific data are available.
- Right-of-way costs for transmission lines are estimated per linear foot of ROW using the unit costs in Table Q-8. If a small pipeline follows existing right-of-ways (such as highways), no additional right-of-way cost is assumed. Large pipelines will require ROW costs regardless of routing.
- The costs for property acquisition for reservoirs are to be based on previous cost estimates, if available. If no site specific data is available, land costs will be based on the median rural land cost published by the Texas A&M Real Estate Center website for 2007 or a minimum of $2,000 per acre, whichever is higher.
- Costs for power supply to pump stations, water treatment plants, and well sites have not been included in the unit costs. If a detailed study including power supply costs is available for a particular project, the costs will be included accordingly. The costs for power supply can be highly variable and depend on the location of the project and available power supply in the area. Power supply costs may or may not be a significant cost element of a project.

Interest during construction is the total of interest accrued at the end of the construction period using a 6 percent annual interest rate on total borrowed funds, less a 4 percent rate of return on investment of unspent funds. This is calculated assuming that the total estimated project cost (excluding interest during construction) would be drawn down at a constant rate per month during the construction period. Factors were determined for different lengths of time for project construction. These factors were used in cost estimating and are presented in Table Q-9.

Q-3 Assumptions for Annual Costs

Annual costs are to be estimated using the following assumptions:

- Debt service for all transmission and treatment facilities is to be annualized over 30 years, but not longer than the life of the project. Debt service for reservoirs is to be annualized over 30 years. State participation projects can be annualized over 35 years. (Note: uniform amortization periods should be used when evaluating similar projects for an entity.) The 30-year amortization period for all projects deviates from the Regional Planning Guidelines, however Region C felt it necessary to use this uniform amortization period for all projects. Reasons for this are that it allows projects costs to be compared on the same basis and in actuality most water suppliers are financing most projects for 30 years. In addition, the *2006 Region C Water Plan* used 30 year debt service terms for all projects.
- Annual interest rate for debt service is 6 percent.
- Water purchase costs are to be based on wholesale rates reported by the selling entity when possible. In lieu of known rates, a typical regional cost for treated water and raw water will be used.
- Operation and Maintenance costs are to be calculated based on the construction cost of the capital improvement. Engineering, permitting, etc. should not be included as a basis for this calculation. However, a 20% allowance for construction contingencies should be included for all O&M calculations. Per the "General Guidelines for Regional Water Plan Development (2007-2012)", O&M should be calculated at:
  - 1 percent of the construction costs for pipelines
  - 1.5 percent for dams
  - 2.5 percent of the construction costs for pump stations, storage tanks, meters and SCADA systems
  - Assume O&M costs for treatment facilities are included in the treatment cost
- Surface water treatment costs are estimated at $0.70 per 1,000 gallons for conventional plants and $1.24 per 1,000 gallons of finished water for surface water plants with reverse osmosis. Assume cost for treatment of groundwater by reverse osmosis is $0.65 per 1,000 gallons. If only a portion of the water will be treated with RO, apply costs proportionately. Treatment for nitrates is estimated at $0.40 per 1,000 gallons. Treatment for groundwater (assuming chlorination only) is estimated at $0.30 per 1,000 gallons. These costs include chemicals, labor and electricity and should be applied to amount of finished water receiving the treatment.

- Reject water disposal for treatment of brackish water is to be estimated on a case-by-case basis depending on disposal method. If no method is defined, assume a cost of $0.35 per 1,000 gallons of reject water. [This value represents a moderate cost estimate. If the water were returned to a brackish surface water source, the costs could be lower. If evaporation beds or deep well injection were used, the costs could be much higher.]
- Pumping costs are to be estimated using an electricity rate of $0.09 per Kilowatt Hour. If local data is available, this can be used.

Q-4 Cost Estimates for Strategies

Tables Q-10 through Q-320 include cost estimates for individual strategies.

Table Q-1
Pipeline Costs (Do Not Include ROW)

Diameter	Base Installed Cost	Rural Cost with Appurtenances	Urban Cost with Appurtenances	Assumed ROW Width	Assumed Temporary Easement Width
(Inches)	($/Foot)	($/Foot)	($/Foot)	(Feet)	(Feet)
6	24	26	39	15	50
8	31	34	52	15	50
10	39	43	65	20	60
12	47	52	77	20	60
14	55	60	90	20	60
16	62	69	103	20	60
18	70	77	116	20	60
20	82	90	135	20	60
24	105	116	174	20	60
30	132	145	215	20	60
36	167	184	276	20	60
42	196	215	323	30	70
48	244	269	374	30	70
54	288	317	435	30	70
60	332	366	495	30	70
66	401	441	591	30	70
72	469	516	697	30	70
78	538	591	799	40	80
84	616	677	914	40	80
90	704	774	1,045	40	80
96	782	860	1,161	40	80
102	870	957	1,290	40	80
108	977	1,075	1,451	40	80
114	1,075	1,183	1,596	50	100
120	1,212	1,333	1,801	50	100
132	1,466	1,613	2,177	50	100
144	1,730	1,903	2,569	50	100

Notes:
a Costs are based on PVC class 150 pipe for the smaller long, rural pipelines.
b Appurtenances assumed to be 10% of installed pipe costs.
c For urban pipelines, costs were increased by 35% for cost with appurtenances. For pipes 42"and smaller, additional costs were added.
d Adjust costs for obstacles (rock, forested areas) and easy conditions (soft soil in flat country).

Table Q-2
Pump Station Costs for Transmission Systems

	Booster PS	Lake PS with Intake
Horsepower	Costs	Costs
5	$516,000	
10	$538,000	
20	$564,000	
25	$591,000	
50	$645,000	
100	$742,000	
200	$1,118,000	$1,484,000
300	$1,441,000	$1,914,000
400	$1,795,000	$2,387,000
500	$2,032,000	$2,698,000
600	$2,150,000	$2,860,000
700	$2,268,000	$3,021,000
800	$2,516,000	$3,343,000
900	$2,634,000	$3,505,000
1,000	$2,870,000	$3,817,000
2,000	$4,182,000	$5,562,000
3,000	$5,020,000	$6,677,000
4,000	$6,095,000	$8,107,000
5,000	$6,988,000	$9,293,000
6,000	$8,063,000	$10,723,000
7,000	$8,923,000	$11,867,000
8,000	$9,890,000	$13,154,000
9,000	$10,965,000	$14,583,000
10,000	$12,255,000	$16,299,000
20,000	$20,425,000	$27,165,000
30,000	$26,875,000	$35,744,000
40,000	$33,325,000	$44,322,000
50,000	$38,700,000	$51,471,000
60,000	$44,075,000	$58,620,000
70,000	$49,450,000	$65,769,000

Note:
1. Lake PS with intake costs include intake and pump station.
2. Adjust pump station costs upward if the pump station is designed to move large quantities of water at a low head (i.e. low horsepower). See Rusty Gibson for appropriate factor.
3. Assumed multiple pump setup for all pump stations.

Table Q-3
Costs for Ground Storage Tanks

Size (MG)	With Roof	Without Roof
0.05	$125,000	$106,000
0.1	$183,000	$156,000
0.5	$438,000	$333,000
1	$634,000	$469,000
1.5	$796,000	$591,000
2	$957,000	$714,000
2.5	$1,086,000	$821,000
3	$1,215,000	$928,000
3.5	$1,355,000	$1,023,000
4	$1,505,000	$1,118,000
5	$1,720,000	$1,303,000
6	$2,075,000	$1,505,000
7	$2,446,000	$1,740,000
8	$2,822,000	$2,069,000
10	$3,746,000	$2,752,000
12	$4,671,000	$3,419,000
14	$5,595,000	$4,085,000

Note: Costs assume steel tanks smaller than 1 MG, concrete tanks 1 MG and larger.

Table Q-3A
Costs for Elevated Storage Tanks

Size (MG)	Cost
0.5	$1,333,000
0.75	$1,537,000
1.0	$1,742,000
1.5	$2,301,000
2.0	$2,870,000
2.5	$3,376,000

Table Q-4
Discharge Structures

Capacity (MGD)	Cost
0.5	$32,000
1	$33,000
2	$37,000
5	$43,000
10	$54,000
60	$140,000
80	$160,000
120	$240,000

Table Q-5
Conventional Water Treatment Plant Costs

Plant Capacity (MGD)	New Conventional Plants	Conventional Plant Expansions
1	$5,800,000	$2,900,000
3	$10,600,000	$7,400,000
7	$17,500,000	$12,900,000
10	$22,400,000	$16,000,000
15	$29,100,000	$20,900,000
20	$35,400,000	$26,100,000
30	$47,600,000	$35,700,000
40	$60,000,000	$45,500,000
50	$72,600,000	$54,400,000
60	$84,900,000	$63,500,000
70	$96,600,000	$72,200,000
80	$107,900,000	$81,400,000
90	$118,500,000	$90,500,000
100	$130,200,000	$100,200,000

Note: Plant is sized for finished peak day capacity.

Table Q-5A
Additional Cost for Reverse Osmosis Treatment

Plant Capacity (MGD)	Reverse Osmosis Facilities Cost
0.5	$1,300,000
1	$1,600,000
3	$3,200,000
7	$7,200,000
10	$9,800,000
15	$14,200,000
20	$18,300,000
30	$25,500,000
40	$31,400,000
50	$36,600,000
60	$40,700,000

Note: Plant is sized for finished water capacity.

Table Q-5B
Groundwater Nitrate Treatment

Treatment Capacity (MGD)	Ion Exchange Plant Cost
0.25	$800,000
1.0	$1,700,000
3.0	$3,900,000

Note: Plant is sized for finished water capacity.

Table Q-6
Cost Elements for Water Wells

Well Diameter (inches)	Typical Production Range (gpm)	Estimated Cost (A=1 for PWS/Industrial and 0.6 for Irrigation)
6	50-100	($80,000 + $125 x depth in feet) x A
8	100-250	($80,000 + $175 x depth in feet) x A
10	250-400	($85,000 + $200 x depth in feet) x A
12	400-500	($85,000 + $250 x depth in feet) x A
15	500-600	($90,000 + $300 x depth in feet) x A

Table Q-7
Cost Elements for Reservoir Sites

Capital Costs	Studies and Permitting
Embankment	Environmental and archeological studies
Spillway	Permitting
Outlet works	Terrestrial mitigation tracts
Site work	Engineering and contingencies
Land	Construction management
Administrative facilities	
Supplemental pumping facilities	
Flood protection	

Table Q-8
Pipeline Easement Costs

Pipeline Diameter (inches)	Cost per Linear Foot			
	Rural County	Suburban County	Urban County	Highly Urbanized Area
6 to 8	$3.00	$9.00	$21.00	Evaluate on a case-by-case basis
10 to 36	$5.00	$12.00	$28.00	
42 to 72	$7.00	$17.00	$41.00	
78 to 108	$9.00	$23.00	$55.00	
114 to 144	$12.00	$29.00	$69.00	

Note: Suburban County is defined as a county immediately bordering the Dallas/Fort Worth Metroplex.

Table Q-9
Factors for Interest during Construction

Construction Period	Factor
6 months	0.02167
12 months	0.04167
18 months	0.06167
24 months	0.08167
36 month construction	0.12167

Table Q-10
Supply and Costs by User Group for Basic Conservation Package

Water User Group Name	Capital Costs						Total Annual Cost per Acre-Foot						Value of Total Supply from Basic Conservation (Acre-Feet)						Total Annual Cost					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
ABLES SPRINGS WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	9	33	52	69	91	118	$0	$0	$0	$0	$0	$0
ADDISON	$0	$0	$0	$0	$0	$0	$220	$153	$121	$101	$87	$76	189	340	465	587	707	826	$41,500	$52,079	$56,335	$59,301	$61,368	$62,700
ALEDO	$0	$5,000	$0	$0	$0	$0	$80	$323	$258	$221	$199	$182	5	54	108	166	193	212	$436	$17,418	$27,820	$36,768	$38,417	$38,417
ALLEN	$0	$8,711	$0	$0	$0	$0	$4	$146	$104	$90	$81	$73	192	1,115	1,672	1,914	2,145	2,376	$759	$163,259	$173,259	$173,125	$173,125	$173,125
ALVORD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2	7	10	12	14	17	$0	$0	$0	$0	$0	$0
ANNA	$0	$0	$0	$0	$0	$0	$0	$261	$204	$169	$138	$104	24	141	261	397	574	1,061	$0	$36,833	$53,167	$67,000	$79,000	$110,000
ANNETTA	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	3	11	16	19	23	27	$0	$0	$0	$0	$0	$0
ANNETTA SOUTH	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	1	4	6	8	9	10	$0	$0	$0	$0	$0	$0
ARGYLE	$0	$0	$0	$0	$0	$0	$307	$182	$145	$125	$109	$97	34	135	238	305	386	475	$10,486	$24,601	$34,460	$38,117	$42,158	$46,167
ARGYLE WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$212	$189	$169	14	38	50	78	88	98	$0	$0	$0	$16,644	$16,644	$16,644
ARLINGTON	$0	$0	$0	$0	$0	$0	$189	$110	$87	$76	$68	$61	2,123	3,969	5,273	6,290	7,031	7,798	$400,523	$437,500	$458,333	$476,721	$476,721	$476,721
ATHENS	$0	$25,605	$0	$0	$0	$0	$20	$278	$191	$165	$144	$125	21	170	290	383	505	662	$436	$47,234	$55,397	$63,054	$72,947	$82,612
AUBREY	$0	$0	$0	$0	$0	$0	$0	$308	$0	$0	$0	$0	6	48	61	88	126	181	$0	$14,910	$0	$0	$0	$0
AURORA	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	3	9	13	15	18	22	$0	$0	$0	$0	$0	$0
AZLE	$5,000	$0	$0	$0	$0	$0	$751	$5	$3	$0	$0	$0	98	83	145	209	279	350	$73,536	$436	$436	$0	$0	$0
BALCH SPRINGS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	28	95	132	149	164	180	$0	$0	$0	$0	$0	$0
BARDWELL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	1	6	8	11	13	16	$0	$0	$0	$0	$0	$0
BARTONVILLE	$0	$0	$0	$0	$0	$0	$497	$231	$196	$174	$157	$143	9	54	71	80	88	97	$4,361	$12,528	$13,889	$13,889	$13,889	$13,889
BARTONVILLE WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$194	3	10	15	18	20	33	$0	$0	$0	$0	$0	$6,332
BEDFORD	$0	$0	$0	$0	$0	$0	$365	$213	$166	$145	$128	$114	274	481	628	734	841	953	$100,001	$102,395	$104,407	$106,098	$107,519	$108,713
BELLS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2	11	17	22	26	30	$0	$0	$0	$0	$0	$0
BENBROOK	$5,000	$0	$0	$0	$0	$0	$388	$222	$175	$146	$125	$109	172	328	445	602	800	1,045	$66,603	$72,686	$77,936	$88,000	$100,250	$113,750
BETHEL-ASH WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	3	11	17	21	25	30	$0	$0	$0	$0	$0	$0
BETHESDA WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	30	95	120	150	186	231	$0	$0	$0	$0	$0	$0
BLACKLAND WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	7	28	43	55	69	87	$0	$0	$0	$0	$0	$0
BLOOMING GROVE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$269	$240	$216	2	5	6	10	11	12	$0	$0	$0	$2,691	$2,691	$2,691
BLUE MOUND	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	4	12	16	17	18	19	$0	$0	$0	$0	$0	$0
BLUE RIDGE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	5	23	47	80	125	150	$0	$0	$0	$0	$0	$0
BOLIVAR WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	19	70	162	356	601	862	$0	$0	$0	$0	$0	$0
BONHAM	$0	$0	$0	$0	$0	$0	$0	$339	$256	$214	$174	$145	16	99	162	259	401	555	$0	$33,574	$41,500	$55,500	$70,000	$80,500
BOYD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	3	10	16	20	25	27	$0	$0	$0	$0	$0	$0
BRANDON-IRENE WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	2	2	3	3	3	$0	$0	$0	$0	$0	$0
BRIDGEPORT	$0	$0	$0	$0	$0	$0	$0	$277	$214	$183	$160	$141	11	83	150	205	270	360	$0	$23,014	$32,169	$37,524	$43,033	$50,684
BRYSON	$0	$0	$0	$0	$0	$0	$588	$321	$255	$229	$207	$189	3	5	7	7	8	9	$1,626	$1,677	$1,710	$1,710	$1,710	$1,710
BUENA VISTA - BETHEL SUD	$0	$0	$0	$0	$0	$0	$341	$118	$99	$86	$76	$71	108	352	475	616	778	963	$36,891	$41,436	$46,772	$52,833	$59,459	$68,008
BURLESON	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	13	34	50	64	82	104	$0	$0	$0	$0	$0	$0
CADDO BASIN SUD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	11	39	55	70	87	106	$0	$0	$0	$0	$0	$0
CARROLLTON	$10,000	$0	$0	$0	$0	$0	$268	$157	$125	$110	$98	$89	753	1,307	1,690	1,952	2,205	2,459	$202,122	$205,872	$211,497	$214,150	$216,813	$218,500
CASH SUD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	1	4	6	8	11	13	$0	$0	$0	$0	$0	$0
CEDAR HILL	$31,256	$0	$0	$0	$0	$0	$262	$126	$98	$88	$80	$74	371	948	1,304	1,501	1,645	1,789	$97,108	$119,453	$128,085	$131,622	$131,622	$131,622
CELINA	$5,000	$0	$0	$0	$0	$0	$422	$223	$151	$108	$86	$75	37	314	780	1,570	2,696	3,449	$15,575	$69,910	$117,683	$169,084	$232,128	$260,148
CHATFIELD WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	6	30	49	65	83	105	$0	$0	$0	$0	$0	$0
CHICO	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2	8	12	16	21	27	$0	$0	$0	$0	$0	$0
COCKRELL HILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	6	21	28	31	33	36	$0	$0	$0	$0	$0	$0
COLLEGE MOUND WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	13	55	86	108	136	172	$0	$0	$0	$0	$0	$0
COLLEYVILLE	$0	$24,497	$0	$0	$0	$0	$289	$145	$103	$92	$84	$77	220	477	649	725	799	874	$63,469	$69,136	$67,000	$67,000	$67,000	$67,000
COLLINSVILLE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	4	15	24	32	40	49	$0	$0	$0	$0	$0	$0
COMBINE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	4	15	23	28	34	43	$0	$0	$0	$0	$0	$0
COMBINE WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	8	30	46	60	77	100	$0	$0	$0	$0	$0	$0
COMMUNITY WATER COMPANY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	3	13	21	27	34	43	$0	$0	$0	$0	$0	$0
COMMUNITY WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	7	25	27	29	31	33	$0	$0	$0	$0	$0	$0
COPPELL	$7,192	$0	$0	$0	$0	$0	$268	$159	$130	$114	$103	$93	360	609	748	847	942	1,039	$96,353	$96,637	$96,878	$96,456	$96,631	$96,778
COPPER CANYON	$0	$0	$0	$0	$0	$0	$393	$227	$180	$157	$140	$125	10	20	30	40	51	63	$3,817	$4,633	$5,450	$6,267	$7,083	$7,900
CORINTH	$0	$0	$0	$0	$0	$0	$374	$222	$175	$150	$132	$117	142	271	366	445	531	615	$53,241	$60,167	$64,000	$67,000	$70,000	$72,250
CORSICANA	$0	$0	$0	$31,760	$0	$0	$10	$3	$2	$193	$149	$129	45	137	194	423	567	665	$436	$436	$436	$81,520	$84,373	$85,545
CRANDALL	$0	$19,942	$0	$0	$0	$0	$200	$325	$225	$200	$180	$162	9	60	103	140	189	253	$1,739	$19,651	$23,115	$27,961	$33,914	$40,966
CRESSON	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	1	3	4	5	7	9	$0	$0	$0	$0	$0	$0
CROSS ROADS	$0	$0	$0	$0	$0	$0	$277	$192	$159	$137	$121	$109	16	55	67	77	88	98	$4,361	$10,622	$10,622	$10,622	$10,622	$10,622
CROWLEY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	20	67	109	160	207	239	$0	$0	$0	$0	$0	$0
CULLEOKA WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	18	74	102	126	154	185	$0	$0	$0	$0	$0	$0
DALLAS	$0	$0	$0	$0	$0	$0	$307	$179	$148	$130	$116	$105	10,808	19,933	25,343	30,684	37,818	48,848	$3,313,395	$3,560,726	$3,753,433	$4,002,082	$4,403,054	$5,111,462
DALLAS COUNTY WCID #6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
DALWORTHINGTON GARDENS	$0	$0	$0	$0	$0	$0	$0	$230	$177	$153	$135	$120	5	33	44	53	61	69	$0	$7,492	$7,821	$8,036	$8,178	$8,268
DANVILLE WSC	$0	$0	$0	$0	$0	$0	$0	$258	$219	$196	$174	$156	11	68	99	133	172	219	$0	$17,469	$21,674	$25,986	$30,069	$34,185
DAWSON	$0	$0	$0	$0	$0	$0	$0	$0	$0	$259	$227	$202	2	5	7	13	15	19	$0	$0	$0	$3,289	$3,517	$3,798
DE SOTO	$0	$0	$0	$0	$0	$0	$677	$361	$283	$243	$213	$192	310	663	934	1,181	1,473	1,669	$209,905	$239,229	$264,171	$287,450	$313,656	$320,835
DECATUR	$0	$5,000	$0	$0	$0	$0	$34	$296	$222	$187	$162	$144	13	88	158	234	341	445	$436	$26,001	$34,926	$43,570	$55,190	$64,165
DENISON	$0	$0	$25,961	$0	$0	$0	$53	$16	$183	$144	$129	$116	43	145	382	496	566	641	$2,263	$2,263	$70,000	$71,500	$73,000	$74,500
DENTON	$0	$10,000	$0	$0	$0	$0	$5	$177	$126	$103	$88	$75	186	1,514	2,651	3,904	5,428	8,290	$872	$268,347	$333,333	$402,917	$477,218	$623,362

Water User Group Name	Capital Costs						Total Annual Cost per Acre-Foot						Value of Total Supply from Basic Conservation (Acre-Feet)						Total Annual Cost					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
DENTON COUNTY FWSD No.1A	$0	$0	$0	$0	$0	$0	$293	$177	$145	$127	$113	$99	30	78	127	184	251	330	$8,695	$13,758	$18,519	$23,419	$28,265	$32,727
DOUBLE OAK	$0	$0	$0	$0	$0	$0	$409	$245	$194	$171	$153	$139	21	34	43	49	55	61	$8,444	$8,444	$8,444	$8,444	$8,444	$8,444
DUNCANVILLE	$0	$0	$0	$0	$0	$0	$481	$213	$190	$178	$169	$160	358	810	910	968	1,020	1,081	$172,523	$172,523	$172,523	$172,523	$172,523	$172,523
EAST CEDAR CREEK FWSD	$0	$0	$0	$0	$0	$0	$567	$294	$227	$201	$181	$164	48	103	156	189	227	267	$27,427	$30,249	$35,347	$38,159	$40,970	$43,782
EAST FORK SUD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	24	66	84	98	113	130	$0	$0	$0	$0	$0	$0
ECTOR	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	1	4	5	6	6	7	$0	$0	$0	$0	$0	$0
EDGECLIFF	$0	$0	$0	$0	$0	$0	$0	$326	$250	$222	$202	$183	4	22	29	32	36	39	$0	$7,219	$7,219	$7,219	$7,219	$7,219
ENNIS	$27,821	$0	$0	$0	$0	$0	$775	$379	$302	$264	$232	$202	150	377	559	775	1,065	1,462	$116,591	$143,214	$169,164	$204,488	$246,944	$295,578
EULESS	$0	$48,804	$0	$0	$0	$0	$408	$217	$151	$135	$123	$113	264	597	865	977	1,080	1,182	$107,701	$129,775	$130,620	$131,938	$132,983	$133,498
EUSTACE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2	5	7	7	8	8	$0	$0	$0	$0	$0	$0
EVERMAN	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	9	30	40	42	45	47	$0	$0	$0	$0	$0	$0
FAIRFIELD	$0	$0	$0	$5,000	$0	$0	$65	$18	$12	$252	$219	$194	7	24	37	73	95	116	$436	$436	$436	$18,408	$20,786	$22,569
FAIRVIEW	$0	$5,000	$0	$0	$0	$0	$15	$181	$127	$108	$97	$88	29	179	312	468	523	578	$436	$32,503	$39,736	$50,667	$50,667	$50,667
FARMERS BRANCH	$5,502	$0	$0	$0	$0	$0	$426	$224	$188	$166	$149	$135	369	747	940	1,114	1,293	1,480	$157,125	$167,334	$176,617	$184,579	$192,250	$199,222
FARMERSVILLE	$0	$0	$0	$0	$0	$0	$0	$330	$266	$222	$192	$160	6	59	103	176	290	437	$0	$19,333	$27,500	$39,167	$55,500	$70,000
FATE	$0	$0	$0	$0	$0	$0	$0	$196	$155	$132	$115	$102	21	164	253	349	443	531	$0	$32,183	$39,311	$45,987	$50,826	$54,051
FERRIS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	4	14	20	25	31	37	$0	$0	$0	$0	$0	$0
FILES VALLEY WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2	6	9	10	12	14	$0	$0	$0	$0	$0	$0
FLO COMMUNITY WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	1	2	2	2	2	$0	$0	$0	$0	$0	$0
FLOWER MOUND	$42,253	$0	$0	$0	$0	$0	$194	$92	$63	$57	$51	$47	620	1,399	2,254	2,528	2,795	3,063	$120,351	$129,239	$143,000	$143,000	$143,000	$143,000
FOREST HILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	14	56	81	94	109	121	$0	$0	$0	$0	$0	$0
FORNEY	$0	$0	$0	$0	$0	$0	$0	$281	$216	$182	$158	$140	28	214	324	426	529	639	$0	$60,167	$70,000	$77,500	$83,500	$89,205
FORNEY LAKE WSC	$0	$0	$0	$0	$0	$0	$0	$272	$218	$186	$163	$143	17	80	124	176	246	342	$0	$21,715	$27,075	$32,878	$40,056	$49,027
FORT WORTH	$0	$0	$0	$0	$0	$0	$152	$93	$75	$66	$59	$53	4,872	10,202	15,717	22,042	30,118	40,789	$742,597	$950,587	$1,181,683	$1,454,650	$1,773,210	$2,161,533
FRISCO	$0	$38,971	$0	$0	$0	$0	$11	$163	$89	$79	$73	$69	310	3,277	7,657	10,222	12,374	13,114	$3,398	$535,006	$678,643	$808,862	$898,917	$898,917
FROST	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	1	3	4	4	4	4	$0	$0	$0	$0	$0	$0
GAINESVILLE	$0	$0	$0	$0	$0	$0	$0	$0	$241	$208	$180	$155	27	95	225	288	359	441	$0	$0	$54,100	$59,933	$64,600	$68,500
GARLAND	$0	$81,051	$0	$0	$0	$0	$21	$153	$105	$95	$87	$80	340	2,259	3,305	3,667	4,002	4,353	$7,066	$344,604	$346,119	$346,583	$346,583	$346,583
GASTONIA-SCURRY SUD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	12	46	68	88	114	147	$0	$0	$0	$0	$0	$0
GLENN HEIGHTS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	21	71	107	132	158	186	$0	$0	$0	$0	$0	$0
GRAND PRAIRIE	$10,000	$0	$0	$0	$0	$0	$494	$234	$199	$178	$162	$151	1,212	2,886	3,878	4,753	5,725	6,128	$598,232	$675,939	$770,032	$845,983	$926,782	$926,782
GRAPEVINE	$0	$45,647	$0	$0	$0	$0	$233	$131	$88	$78	$71	$65	453	939	1,437	1,597	1,756	1,919	$105,332	$122,730	$125,733	$125,000	$125,000	$125,000
GUN BARREL CITY	$0	$0	$0	$0	$0	$0	$0	$278	$217	$189	$167	$147	11	72	105	136	174	224	$0	$19,881	$22,752	$25,698	$29,035	$32,923
GUNTER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	3	16	28	39	51	62	$0	$0	$0	$0	$0	$0
HACKBERRY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2	9	14	17	19	20	$0	$0	$0	$0	$0	$0
HALTOM CITY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	56	221	303	340	371	401	$0	$0	$0	$0	$0	$0
HASLET	$0	$5,000	$0	$0	$0	$0	$77	$209	$164	$137	$120	$106	6	60	131	154	176	198	$436	$12,603	$21,519	$21,083	$21,083	$21,083
HEATH	$0	$0	$0	$0	$0	$0	$0	$237	$183	$155	$134	$118	16	114	180	254	348	469	$0	$27,111	$33,011	$39,302	$46,722	$55,425
HEBRON	$0	$0	$0	$0	$0	$0	$0	$320	$237	$207	$184	$165	0	5	6	7	8	9	$0	$1,500	$1,500	$1,500	$1,500	$1,500
HICKORY CREEK	$0	$0	$0	$0	$0	$0	$477	$275	$224	$199	$180	$164	24	57	80	110	122	133	$11,575	$15,522	$17,972	$21,895	$21,895	$21,895
HICKORY CREEK SUD	$0	$0	$0	$0	$0	$0	$568	$308	$247	$225	$204	$187	1	3	4	5	6	7	$732	$855	$957	$1,047	$1,140	$1,245
HIGH POINT WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	4	21	33	42	53	68	$0	$0	$0	$0	$0	$0
HIGHLAND PARK	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	22	61	86	102	117	132	$0	$0	$0	$0	$0	$0
HIGHLAND VILLAGE	$0	$0	$5,000	$0	$0	$0	$14	$4	$200	$158	$142	$129	31	98	253	321	356	391	$436	$436	$50,746	$50,667	$50,667	$50,667
HONEY GROVE	$0	$5,000	$0	$0	$0	$0	$139	$1,022	$489	$404	$347	$302	3	30	67	85	105	127	$436	$31,142	$32,769	$34,366	$36,399	$38,433
HOWE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	5	22	39	54	66	78	$0	$0	$0	$0	$0	$0
HUDSON OAKS	$0	$5,000	$0	$0	$0	$0	$118	$348	$269	$225	$200	$181	4	23	36	48	61	76	$436	$7,960	$9,547	$10,681	$12,167	$13,653
HURST	$0	$33,764	$0	$0	$0	$0	$52	$228	$158	$143	$130	$119	56	393	546	605	665	727	$2,944	$89,444	$86,500	$86,500	$86,500	$86,500
HUTCHINS	$0	$0	$0	$0	$0	$0	$398	$232	$185	$161	$143	$124	23	48	75	111	163	298	$8,989	$11,167	$13,889	$17,972	$23,417	$36,833
IRVING	$10,000	$0	$0	$0	$0	$0	$204	$121	$96	$82	$71	$63	1,574	2,856	3,767	4,580	5,378	6,167	$321,713	$344,312	$361,379	$373,397	$383,131	$390,481
ITALY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	4	13	19	23	27	32	$0	$0	$0	$0	$0	$0
JACKSBORO	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	6	19	26	28	30	33	$0	$0	$0	$0	$0	$0
JOHNSON COUNTY SUD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	7	23	30	39	50	63	$0	$0	$0	$0	$0	$0
JOSEPHINE	$0	$0	$0	$0	$0	$0	$0	$249	$194	$166	$145	$129	2	15	22	31	41	52	$0	$3,648	$4,326	$5,145	$5,926	$6,776
JUSTIN	$19,324	$0	$0	$0	$0	$0	$451	$264	$200	$171	$154	$140	23	69	130	235	313	375	$10,156	$18,270	$25,900	$40,142	$48,083	$52,627
KAUFMAN	$0	$22,543	$0	$0	$0	$0	$144	$333	$5	$0	$0	$0	14	103	81	100	120	155	$1,965	$34,197	$436	$0	$0	$0
KELLER	$0	$0	$0	$0	$0	$0	$318	$339	$220	$202	$186	$172	268	592	1,009	1,101	1,196	1,290	$85,191	$200,610	$222,033	$222,033	$222,033	$222,033
KEMP	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2	9	14	15	16	17	$0	$0	$0	$0	$0	$0
KENNEDALE	$0	$0	$0	$0	$0	$0	$516	$281	$227	$200	$181	$164	37	89	122	147	169	190	$19,333	$24,952	$27,766	$29,423	$30,540	$31,294
KERENS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	4	10	14	16	17	19	$0	$0	$0	$0	$0	$0
KIOWA HOMEOWNERS WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	6	20	28	31	34	38	$0	$0	$0	$0	$0	$0
KRUGERVILLE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	3	10	14	20	28	42	$0	$0	$0	$0	$0	$0
KRUM	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	9	25	34	41	49	59	$0	$0	$0	$0	$0	$0
LADONIA	$0	$0	$0	$0	$0	$0	$0	$200	$159	$137	$120	$106	2	23	36	46	59	80	$0	$4,633	$5,722	$6,267	$7,083	$8,444
LAKE DALLAS	$0	$0	$0	$0	$0	$0	$540	$299	$240	$213	$193	$175	40	84	114	128	142	156	$21,789	$25,055	$27,318	$27,318	$27,318	$27,318
LAKE WORTH	$0	$0	$0	$0	$0	$0	$1,387	$686	$536	$465	$409	$369	29	62	84	102	121	138	$40,692	$42,776	$45,066	$47,356	$49,646	$50,791
LAKESIDE	$0	$0	$0	$18,728	$0	$0	$555	$175	$31	$601	$322	$274	3	9	14	50	96	117	$1,633	$1,633	$436	$29,775	$30,828	$32,073
LANCASTER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	62	281	378	411	442	474	$0	$0	$0	$0	$0	$0
LAVON WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	10	96	149	197	262	363	$0	$0	$0	$0	$0	$0
LEONARD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	3	12	22	37	58	77	$0	$0	$0	$0	$0	$0
LEWISVILLE	$61,985	$0	$0	$0	$0	$0	$246	$136	$109	$95	$85	$76	721	1,422	1,868	2,308	2,878	3,569	$177,540	$192,907	$203,374	$220,003	$243,753	$270,644
LINCOLN PARK	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	1	5	7	9	10	13	$0	$0	$0	$0	$0	$0

Water User Group Name	Capital Costs						Total Annual Cost per Acre-Foot						Value of Total Supply from Basic Conservation (Acre-Feet)						Total Annual Cost					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
LINDSAY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2	5	7	8	8	9	$0	$0	$0	$0	$0	$0
LITTLE ELM	$5,000	$0	$0	$0	$0	$0	$373	$207	$163	$140	$127	$116	179	371	540	684	753	823	$66,603	$76,623	$87,823	$95,649	$95,649	$95,649
LOG CABIN	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	1	6	8	9	9	10	$0	$0	$0	$0	$0	$0
LOWRY CROSSING	$0	$0	$0	$0	$0	$0	$0	$312	$247	$217	$195	$176	4	22	33	39	43	48	$0	$6,904	$8,199	$8,444	$8,444	$8,444
LUCAS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	14	56	83	116	175	254	$0	$0	$0	$0	$0	$0
LUELLA WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	5	18	27	33	36	43	$0	$0	$0	$0	$0	$0
M E N WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	6	18	26	30	34	39	$0	$0	$0	$0	$0	$0
MABANK	$0	$5,000	$0	$0	$0	$0	$73	$547	$239	$209	$185	$164	6	69	169	206	253	313	$436	$37,767	$40,499	$43,077	$46,802	$51,422
MACBEE SUD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	2	3	3	4	6	$0	$0	$0	$0	$0	$0
MALAKOFF	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	3	11	15	17	20	22	$0	$0	$0	$0	$0	$0
MANSFIELD	$28,819	$0	$0	$0	$0	$0	$215	$107	$81	$69	$61	$55	507	1,232	1,872	2,499	3,085	3,733	$109,224	$131,882	$152,364	$173,016	$188,409	$203,800
MARILEE SUD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	9	42	65	84	111	143	$0	$0	$0	$0	$0	$0
MAYPEARL	$0	$0	$0	$0	$0	$0	$0	$311	$243	$217	$196	$178	2	12	18	20	22	24	$0	$3,681	$4,361	$4,361	$4,361	$4,361
MCKINNEY	$0	$53,573	$0	$0	$0	$0	$15	$207	$116	$103	$95	$89	303	3,347	7,621	10,503	12,257	13,108	$4,671	$691,692	$886,546	$1,084,326	$1,163,787	$1,163,787
MCLENDON-CHISHOLM	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	4	11	15	18	22	27	$0	$0	$0	$0	$0	$0
MELISSA	$0	$0	$0	$0	$5,000	$0	$36	$3	$2	$0	$150	$127	12	146	255	401	916	1,151	$436	$436	$436	$0	$137,500	$146,305
MESQUITE	$0	$62,452	$0	$0	$0	$0	$25	$137	$93	$83	$75	$69	221	1,609	2,478	2,821	3,113	3,402	$5,445	$220,448	$230,004	$233,168	$233,445	$233,501
MIDLOTHIAN	$23,236	$0	$0	$0	$0	$0	$617	$285	$235	$206	$182	$164	156	591	905	1,198	1,527	1,890	$96,518	$168,270	$212,204	$246,478	$277,961	$309,443
MILFORD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	1	4	5	5	6	6	$0	$0	$0	$0	$0	$0
MILLIGAN WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	3	10	12	13	13	14	$0	$0	$0	$0	$0	$0
MINERAL WELLS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	10	19	25	27	29	32	$0	$0	$0	$0	$0	$0
MOUNTAIN PEAK SUD	$0	$0	$0	$0	$0	$0	$495	$285	$228	$203	$180	$160	37	73	96	125	170	231	$18,492	$20,719	$21,958	$25,306	$30,545	$36,906
MT ZION WSC	$0	$0	$0	$0	$0	$0	$0	$274	$212	$184	$163	$146	3	18	23	27	30	34	$0	$4,906	$4,906	$4,906	$4,906	$4,906
MUENSTER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$252	$221	$197	3	9	13	23	27	32	$0	$0	$0	$5,722	$5,994	$6,267
MURPHY	$0	$0	$0	$0	$0	$0	$0	$185	$150	$129	$114	$102	42	367	452	524	595	667	$0	$67,750	$67,750	$67,750	$67,750	$67,750
MUSTANG SUD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	16	64	101	202	315	434	$0	$0	$0	$0	$0	$0
NAVARRO MILLS WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	5	18	27	33	41	49	$0	$0	$0	$0	$0	$0
NEVADA	$0	$0	$0	$0	$0	$0	$0	$208	$165	$138	$119	$100	2	21	31	73	139	392	$0	$4,361	$5,178	$10,078	$16,611	$39,167
NEW FAIRVIEW	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	4	13	20	26	32	40	$0	$0	$0	$0	$0	$0
NEW HOPE	$0	$0	$0	$0	$0	$0	$0	$226	$173	$147	$128	$113	2	16	33	57	98	244	$0	$3,544	$5,722	$8,444	$12,528	$27,500
NEWARK	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2	9	15	22	32	47	$0	$0	$0	$0	$0	$0
NORTH COLLIN WSC	$0	$0	$0	$0	$0	$0	$0	$268	$226	$204	$183	$165	12	67	95	123	157	196	$0	$17,999	$21,533	$25,153	$28,737	$32,195
NORTH HUNT WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	1	2	3	3	4	4	$0	$0	$0	$0	$0	$0
NORTH RICHLAND HILLS	$0	$54,029	$0	$0	$0	$0	$46	$197	$133	$117	$106	$97	103	744	1,131	1,315	1,485	1,652	$4,710	$146,589	$150,048	$154,108	$157,439	$159,689
NORTHLAKE	$0	$0	$0	$0	$0	$0	$0	$0	$279	$239	$204	$181	3	29	57	125	207	276	$0	$0	$15,939	$29,971	$42,349	$50,096
OAK GROVE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2	6	9	12	15	19	$0	$0	$0	$0	$0	$0
OAK LEAF	$0	$0	$0	$0	$0	$0	$445	$252	$201	$177	$159	$144	10	20	29	37	47	58	$4,367	$5,107	$5,837	$6,582	$7,415	$8,336
OAK POINT	$0	$5,000	$0	$0	$0	$0	$50	$338	$270	$235	$210	$189	9	77	140	177	219	267	$436	$26,079	$37,700	$41,550	$45,864	$50,421
OVILLA	$0	$0	$0	$0	$0	$0	$389	$216	$176	$154	$136	$122	28	78	130	187	219	260	$10,758	$16,802	$22,845	$28,685	$29,950	$31,807
PALMER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	4	11	16	18	20	23	$0	$0	$0	$0	$0	$0
PANTEGO	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	4	13	18	21	23	25	$0	$0	$0	$0	$0	$0
PARADISE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2	4	6	7	10	12	$0	$0	$0	$0	$0	$0
PARKER	$0	$0	$0	$0	$0	$0	$0	$183	$142	$115	$88	$71	12	162	292	555	929	1,433	$0	$29,600	$41,500	$64,000	$82,000	$102,000
PAYNE SPRINGS	$0	$0	$0	$0	$0	$0	$477	$274	$218	$193	$174	$157	5	9	11	14	16	20	$2,190	$2,343	$2,493	$2,646	$2,835	$3,065
PECAN HILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	1	5	7	9	11	13	$0	$0	$0	$0	$0	$0
PELICAN BAY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	3	10	14	17	20	24	$0	$0	$0	$0	$0	$0
PILOT POINT	$0	$0	$0	$0	$0	$0	$0	$339	$263	$0	$0	$0	9	58	122	90	103	117	$0	$19,516	$32,167	$0	$0	$0
PLANO	$0	$0	$0	$0	$0	$0	$0	$105	$80	$69	$60	$54	506	2,954	3,892	4,578	5,246	5,916	$0	$309,250	$312,500	$314,167	$315,833	$316,667
PONDER	$0	$0	$0	$0	$0	$0	$0	$297	$248	$205	$181	$163	3	47	111	202	262	297	$0	$13,889	$27,500	$41,500	$47,333	$48,500
POST OAK BEND CITY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2	6	12	20	35	61	$0	$0	$0	$0	$0	$0
POTTSBORO	$0	$5,000	$0	$0	$0	$0	$70	$346	$278	$242	$216	$194	6	45	77	112	151	181	$436	$15,575	$21,519	$27,028	$32,583	$35,167
PRINCETON	$0	$0	$0	$0	$0	$0	$0	$276	$215	$170	$129	$96	12	119	215	413	777	1,300	$0	$32,997	$46,167	$70,000	$100,000	$125,000
PROSPER	$0	$0	$0	$0	$0	$0	$0	$211	$151	$118	$89	$78	22	241	514	848	1,344	1,609	$0	$50,833	$77,500	$100,000	$120,000	$125,000
R-C-H WSC	$0	$0	$0	$0	$0	$0	$0	$318	$257	$229	$206	$187	7	46	58	67	74	82	$0	$14,651	$14,978	$15,250	$15,250	$15,250
RED OAK	$0	$0	$0	$0	$0	$0	$0	$280	$222	$189	$165	$145	27	190	288	354	424	503	$0	$53,167	$64,000	$67,000	$70,000	$73,000
RENO	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	4	13	17	19	21	22	$0	$0	$0	$0	$0	$0
RHOME	$0	$0	$0	$0	$0	$0	$279	$174	$141	$121	$107	$96	17	43	85	137	199	270	$4,691	$7,464	$11,983	$16,611	$21,239	$25,867
RICE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$222	$192	$169	2	7	10	20	26	34	$0	$0	$0	$4,334	$4,955	$5,717
RICE WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	13	48	74	95	119	150	$0	$0	$0	$0	$0	$0
RICHARDSON	$0	$10,000	$0	$0	$0	$0	$4	$140	$105	$91	$80	$71	196	1,400	1,861	2,151	2,433	2,728	$872	$195,872	$195,872	$195,000	$195,000	$195,000
RICHLAND HILLS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	11	39	56	65	73	79	$0	$0	$0	$0	$0	$0
RIVER OAKS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	10	34	45	49	52	55	$0	$0	$0	$0	$0	$0
ROANOKE	$0	$0	$0	$0	$0	$0	$0	$249	$191	$161	$138	$119	16	111	182	261	396	538	$0	$27,687	$34,873	$42,060	$54,602	$64,296
ROCKETT SUD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	64	235	371	466	533	569	$0	$0	$0	$0	$0	$0
ROCKWALL	$0	$0	$0	$0	$0	$0	$0	$155	$115	$93	$81	$73	88	739	1,135	1,537	1,793	2,008	$0	$114,647	$130,000	$143,595	$146,067	$146,067
ROWLETT	$0	$0	$0	$0	$0	$0	$0	$182	$136	$116	$102	$91	115	664	956	1,189	1,410	1,641	$0	$120,856	$130,178	$137,714	$143,811	$148,747
ROYSE CITY	$0	$0	$0	$0	$0	$0	$0	$247	$190	$152	$128	$107	31	215	357	532	733	979	$0	$53,167	$67,669	$80,776	$93,469	$105,000
RUNAWAY BAY	$0	$0	$0	$0	$0	$0	$0	$311	$242	$210	$187	$167	3	16	25	32	41	50	$0	$4,960	$5,986	$6,811	$7,628	$8,444
SACHSE	$0	$19,826	$0	$0	$0	$0	$36	$222	$153	$138	$125	$115	48	275	429	476	524	572	$1,728	$61,195	$65,500	$65,500	$65,500	$65,500
SAGINAW	$0	$0	$0	$0	$0	$0	$0	$301	$235	$201	$178	$160	35	191	271	331	388	443	$0	$57,374	$63,567	$66,744	$69,060	$70,749
SAINT PAUL	$0	$0	$0	$0	$0	$0	$0	$292	$238	$209	$187	$169	2	24	58	106	140	163	$0	$7,083	$13,889	$22,056	$26,139	$27,500
SANCTUARY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2	10	16	20	25	29	$0	$0	$0	$0	$0	$0

Water User Group Name	Capital Costs						Total Annual Cost per Acre-Foot						Value of Total Supply from Basic Conservation (Acre-Feet)						Total Annual Cost					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
SANGER	$0	$0	$0	$0	$0	$0	$517	$279	$224	$197	$178	$162	41	122	206	274	339	386	$21,375	$33,917	$46,043	$54,100	$60,162	$62,500
SANSOM PARK VILLAGE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	6	22	30	33	35	38	$0	$0	$0	$0	$0	$0
SARDIS-LONE ELM WSC	$0	$0	$0	$0	$0	$0	$419	$241	$192	$171	$154	$140	77	173	265	298	330	363	$32,251	$41,584	$50,917	$50,917	$50,917	$50,917
SAVOY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	1	4	5	6	6	7	$0	$0	$0	$0	$0	$0
SCURRY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2	4	6	8	9	11	$0	$0	$0	$0	$0	$0
SEAGOVILLE	$0	$0	$0	$0	$0	$0	$566	$0	$0	$0	$0	$0	61	73	112	144	174	201	$34,540	$0	$0	$0	$0	$0
SEVEN POINTS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2	8	12	15	18	23	$0	$0	$0	$0	$0	$0
SHADY SHORES	$0	$0	$0	$0	$0	$0	$0	$328	$0	$0	$0	$0	5	28	27	29	31	33	$0	$9,065	$0	$0	$0	$0
SHERMAN	$0	$0	$0	$33,049	$0	$0	$43	$13	$0	$273	$190	$165	67	217	333	880	1,411	1,850	$2,881	$2,881	$0	$240,553	$267,507	$305,185
SOUTH GRAYSON WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	6	22	31	39	48	60	$0	$0	$0	$0	$0	$0
SOUTHLAKE	$0	$0	$0	$0	$0	$0	$265	$160	$126	$107	$93	$82	253	434	556	679	821	963	$67,029	$69,454	$70,161	$72,886	$76,282	$79,000
SOUTHMAYD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2	8	13	21	33	43	$0	$0	$0	$0	$0	$0
SOUTHWEST FANNIN COUNTY SUD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	15	44	62	72	82	93	$0	$0	$0	$0	$0	$0
SPRINGTOWN	$19,443	$0	$0	$0	$0	$0	$554	$288	$221	$196	$181	$167	20	48	71	93	117	144	$10,890	$13,862	$15,575	$18,111	$21,083	$24,056
SUNNYVALE	$0	$0	$0	$0	$0	$0	$0	$200	$157	$133	$114	$101	14	97	157	224	303	348	$0	$19,333	$24,778	$29,833	$34,500	$35,200
TALTY	$0	$0	$0	$0	$0	$0	$0	$177	$140	$118	$102	$88	5	60	104	160	238	345	$0	$10,709	$14,586	$18,881	$24,201	$30,326
TEAGUE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	6	22	32	38	45	52	$0	$0	$0	$0	$0	$0
TERRELL	$0	$21,683	$0	$0	$0	$0	$66	$176	$112	$91	$78	$69	28	535	1,024	1,490	1,875	2,332	$1,890	$94,398	$115,000	$135,000	$147,000	$160,000
THE COLONY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	77	299	416	462	505	540	$0	$0	$0	$0	$0	$0
TIOGA	$0	$18,528	$0	$0	$0	$0	$760	$353	$232	$203	$186	$172	2	26	48	60	72	81	$1,615	$9,324	$11,116	$12,167	$13,356	$13,950
TOM BEAN	$5,000	$0	$0	$0	$0	$0	$1,216	$417	$356	$311	$278	$259	22	67	81	93	108	117	$27,075	$27,889	$28,702	$29,079	$29,893	$30,299
TOOL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	4	15	21	26	31	38	$0	$0	$0	$0	$0	$0
TRENTON	$0	$0	$0	$0	$0	$0	$0	$1,246	$462	$326	$249	$207	2	22	69	115	181	255	$0	$27,891	$31,708	$37,433	$45,066	$52,699
TRINIDAD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2	6	8	9	10	11	$0	$0	$0	$0	$0	$0
TROPHY CLUB	$0	$0	$0	$0	$0	$0	$0	$208	$161	$136	$118	$104	20	123	174	219	270	325	$0	$25,614	$27,992	$29,822	$31,796	$33,770
TWO WAY SUD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	9	34	51	65	80	96	$0	$0	$0	$0	$0	$0
UNIVERSITY PARK	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	45	131	184	213	241	270	$0	$0	$0	$0	$0	$0
VALLEY VIEW	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	3	16	31	46	83	110	$0	$0	$0	$0	$0	$0
VAN ALSTYNE	$0	$0	$0	$0	$0	$0	$0	$296	$234	$201	$178	$161	5	70	152	218	265	305	$0	$20,694	$35,667	$43,833	$47,333	$48,967
VENUS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
VIRGINIA HILL WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	4	14	20	21	22	24	$0	$0	$0	$0	$0	$0
WALNUT CREEK SUD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	40	159	307	406	454	498	$0	$0	$0	$0	$0	$0
WATAUGA	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	36	122	165	178	189	200	$0	$0	$0	$0	$0	$0
WAXAHACHIE	$0	$0	$0	$0	$0	$0	$0	$414	$267	$225	$192	$166	56	433	769	1,090	1,528	2,134	$0	$179,256	$205,274	$245,254	$293,409	$355,052
WEATHERFORD	$5,000	$0	$0	$0	$0	$0	$418	$225	$176	$151	$133	$115	173	370	527	670	832	1,027	$72,471	$83,186	$92,575	$100,931	$110,353	$118,499
WEST CEDAR CREEK MUD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	25	113	179	232	298	383	$0	$0	$0	$0	$0	$0
WEST WISE RURAL SUD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	5	18	27	32	38	45	$0	$0	$0	$0	$0	$0
WESTON	$0	$0	$0	$0	$0	$0	$0	$289	$210	$170	$133	$99	5	39	92	299	584	1,108	$0	$11,167	$19,333	$50,833	$77,500	$110,000
WESTOVER HILLS	$0	$18,461	$0	$0	$0	$0	$1,035	$314	$151	$111	$100	$91	2	12	17	19	21	24	$1,609	$3,748	$2,574	$2,139	$2,139	$2,139
WESTWORTH VILLAGE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	6	17	23	27	30	35	$0	$0	$0	$0	$0	$0
WHITE SETTLEMENT	$27,254	$0	$0	$0	$0	$0	$268	$34	$4	$0	$0	$0	349	70	99	115	134	154	$93,459	$2,376	$436	$0	$0	$0
WHITESBORO	$0	$5,000	$0	$0	$0	$0	$61	$374	$289	$251	$225	$204	7	42	61	78	100	147	$436	$15,575	$17,655	$19,597	$22,569	$30,000
WHITEWRIGHT	$0	$0	$0	$0	$0	$0	$0	$303	$242	$213	$191	$172	3	30	52	72	95	121	$0	$9,065	$12,615	$15,345	$18,076	$20,806
WILLOW PARK	$0	$0	$0	$0	$0	$0	$0	$320	$0	$0	$0	$0	8	51	56	74	88	100	$0	$16,260	$0	$0	$0	$0
WILMER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	5	19	29	44	88	147	$0	$0	$0	$0	$0	$0
WOODBINE WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	8	28	39	46	52	59	$0	$0	$0	$0	$0	$0
WORTHAM	$0	$0	$0	$0	$0	$0	$1,934	$731	$593	$511	$452	$401	14	38	49	58	68	78	$26,937	$27,891	$28,845	$29,799	$30,563	$31,326
WYLIE	$0	$5,000	$0	$0	$0	$0	$5	$419	$253	$222	$207	$193	89	567	1,075	1,391	1,496	1,601	$436	$237,469	$272,100	$309,443	$309,443	$309,443
COLLIN COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	11	36	42	41	39	37	$0	$0	$0	$0	$0	$0
COOKE COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	13	47	65	70	74	78	$0	$0	$0	$0	$0	$0
DALLAS COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	1	5	5	5	4	3	$0	$0	$0	$0	$0	$0
DENTON COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	113	378	543	661	788	929	$0	$0	$0	$0	$0	$0
ELLIS COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	17	54	73	81	87	94	$0	$0	$0	$0	$0	$0
FANNIN COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	16	53	70	74	75	76	$0	$0	$0	$0	$0	$0
FREESTONE COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	14	47	64	69	73	77	$0	$0	$0	$0	$0	$0
GRAYSON COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	37	123	165	168	164	155	$0	$0	$0	$0	$0	$0
HENDERSON COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2	7	9	10	11	12	$0	$0	$0	$0	$0	$0
JACK COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	7	23	33	39	44	50	$0	$0	$0	$0	$0	$0
KAUFMAN COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	25	68	91	99	105	112	$0	$0	$0	$0	$0	$0
NAVARRO COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	2	8	11	12	13	14	$0	$0	$0	$0	$0	$0
PARKER COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	44	166	233	254	253	251	$0	$0	$0	$0	$0	$0
ROCKWALL COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	4	9	13	14	15	17	$0	$0	$0	$0	$0	$0
TARRANT COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	53	173	183	194	204	215	$0	$0	$0	$0	$0	$0
WISE COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	49	166	216	232	245	259	$0	$0	$0	$0	$0	$0
Total	$354,084	$673,086	$30,961	$88,537	$5,000	$0	$30,110	$34,817	$25,524	$24,194	$21,195	$19,074	34,315	90,410	134,913	172,423	213,256	260,299	$8,411,506	$14,403,484	$16,289,806	$18,461,967	$20,393,786	$22,378,450

Table Q-11
Supply and Costs by User Group for Expanded Conservation Package

Water User Group Name	Capital Costs						Total Annual Cost per Acre-Foot						Value of Total Supply from Expanded Conservation (Acre-Feet)						Total Annual Cost					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
ABLES SPRINGS WSC	$0	$5,000	$0	$0	$0	$0	$357	$295	$287	$280	$272	$266	5	7	9	11	13	16	$1,638	$2,068	$2,510	$3,000	$3,607	$4,359
ADDISON	$0	$0	$0	$0	$0	$0	$0	$184	$184	$184	$184	$184	0	11	13	13	15	15	$0	$2,005	$2,406	$2,439	$2,673	$2,673
ALEDO	$0	$5,000	$0	$0	$0	$0	$222	$282	$270	$270	$272	$273	5	14	24	33	35	35	$1,113	$4,020	$6,397	$8,845	$9,513	$9,562
ALLEN	$0	$8,711	$0	$0	$0	$0	$103	$181	$196	$224	$225	$225	206	344	418	433	434	434	$21,259	$62,113	$82,123	$96,945	$97,629	$97,663
ALVORD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
ANNA	$0	$5,000	$0	$0	$0	$0	$292	$408	$409	$427	$424	$413	9	24	38	51	66	108	$2,686	$9,647	$15,351	$21,671	$28,058	$44,620
ANNETTA	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
ANNETTA SOUTH	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
ARGYLE	$0	$0	$0	$0	$0	$0	$0	$0	$158	$158	$158	$158	0	0	1	2	2	2	$0	$0	$174	$267	$267	$267
ARGYLE WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$674	$542	$542	0	0	0	5	6	6	$0	$0	$0	$3,511	$3,511	$3,511
ARLINGTON	$0	$0	$0	$0	$0	$0	$0	$756	$488	$481	$482	$483	0	267	516	619	627	628	$0	$201,494	$251,777	$297,539	$302,421	$303,248
ATHENS	$0	$5,000	$0	$0	$0	$0	$149	$313	$345	$382	$379	$383	25	39	55	69	84	99	$3,738	$12,169	$18,854	$26,461	$31,667	$38,056
AUBREY	$0	$5,000	$0	$0	$0	$0	$558	$656	$353	$359	$347	$338	2	6	7	9	13	17	$1,143	$4,108	$2,625	$3,378	$4,389	$5,749
AURORA	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
AZLE	$0	$5,000	$0	$0	$0	$0	$271	$206	$218	$218	$215	$214	17	22	29	38	47	55	$4,674	$4,635	$6,304	$8,201	$10,106	$11,776
BALCH SPRINGS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
BARDWELL	$0	$5,000	$0	$0	$0	$0	$899	$778	$706	$648	$599	$557	1	1	1	1	1	2	$645	$705	$763	$822	$889	$963
BARTONVILLE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
BARTONVILLE WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$656	0	0	0	0	0	2	$0	$0	$0	$0	$0	$1,308
BEDFORD	$0	$0	$0	$0	$0	$0	$0	$584	$409	$416	$421	$422	0	48	72	73	74	75	$0	$28,186	$29,324	$30,220	$31,067	$31,721
BELLS	$0	$5,000	$0	$0	$0	$0	$593	$495	$450	$431	$416	$406	1	2	2	3	3	4	$786	$961	$1,123	$1,248	$1,361	$1,436
BENBROOK	$0	$5,000	$0	$0	$0	$0	$151	$236	$239	$239	$240	$240	61	95	103	123	146	172	$9,270	$22,348	$24,672	$29,346	$34,955	$41,330
BETHEL-ASH WSC	$0	$5,000	$0	$0	$0	$0	$814	$766	$739	$712	$688	$656	1	1	2	2	2	2	$942	$1,054	$1,165	$1,279	$1,417	$1,592
BETHESDA WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
BLACKLAND WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
BLOOMING GROVE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$853	$715	$716	0	0	0	1	1	1	$0	$0	$0	$484	$484	$484
BLUE MOUND	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
BLUE RIDGE	$0	$5,000	$0	$0	$0	$0	$407	$304	$266	$248	$238	$235	2	5	8	13	19	21	$936	$1,436	$2,186	$3,186	$4,436	$4,936
BOLIVAR WSC	$0	$5,000	$0	$0	$0	$0	$293	$258	$216	$209	$206	$205	10	14	27	55	88	119	$3,032	$3,552	$5,887	$11,617	$18,148	$24,395
BONHAM	$0	$0	$0	$0	$0	$0	$0	$1,269	$641	$593	$612	$600	0	4	13	23	30	39	$0	$5,198	$8,567	$13,455	$18,314	$23,341
BOYD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
BRANDON-IRENE WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
BRIDGEPORT	$0	$5,000	$0	$0	$0	$0	$149	$260	$276	$304	$307	$305	13	23	38	47	55	65	$1,911	$6,090	$10,363	$14,286	$16,796	$19,917
BRYSON	$0	$0	$0	$0	$0	$0	$1,031	$1,024	$1,029	$1,044	$1,048	$1,048	0	0	0	0	0	0	$73	$363	$363	$363	$363	$363
BUENA VISTA - BETHEL SUD	$0	$5,000	$0	$0	$0	$0	$197	$253	$256	$256	$254	$251	9	15	19	24	29	35	$1,732	$3,682	$4,872	$6,178	$7,455	$8,810
BURLESON	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
CADDO BASIN SUD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
CARROLLTON	$0	$10,000	$0	$0	$0	$0	$146	$215	$217	$219	$220	$220	295	425	437	442	447	452	$43,039	$91,321	$94,570	$96,821	$98,395	$99,577
CASH SUD	$0	$5,000	$0	$0	$0	$0	$899	$726	$637	$574	$519	$474	1	1	1	1	2	2	$595	$651	$699	$751	$812	$884
CEDAR HILL	$0	$0	$0	$0	$0	$0	$480	$563	$573	$582	$583	$583	9	49	58	61	61	61	$4,315	$27,491	$33,082	$35,285	$35,600	$35,600
CELINA	$0	$0	$0	$0	$0	$0	$507	$177	$293	$334	$343	$359	0	3	11	23	37	48	$25	$469	$3,172	$7,556	$12,626	$17,273
CHATFIELD WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
CHICO	$0	$5,000	$0	$0	$0	$0	$736	$695	$646	$596	$552	$513	1	1	1	2	2	2	$761	$811	$886	$986	$1,111	$1,261
COCKRELL HILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
COLLEGE MOUND WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
COLLEYVILLE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	2	2	2	2	2	$0	$0	$0	$0	$0	$0
COLLINSVILLE	$0	$5,000	$0	$0	$0	$0	$333	$296	$275	$265	$255	$247	3	4	5	6	7	8	$945	$1,145	$1,345	$1,545	$1,745	$1,945
COMBINE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
COMBINE WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
COMMUNITY WATER COMPANY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
COMMUNITY WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
COPPELL	$0	$7,192	$0	$0	$0	$0	$95	$146	$146	$145	$146	$146	155	200	208	216	216	216	$14,695	$29,118	$30,277	$31,398	$31,453	$31,479
COPPER CANYON	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
CORINTH	$0	$5,000	$0	$0	$0	$0	$118	$179	$198	$212	$212	$212	68	97	108	120	128	136	$8,041	$17,337	$21,448	$25,348	$27,105	$28,786
CORSICANA	$0	$5,000	$0	$0	$0	$0	$163	$165	$167	$325	$297	$293	44	46	47	70	80	86	$7,219	$7,521	$7,835	$22,585	$23,791	$25,139
CRANDALL	$0	$5,000	$0	$0	$0	$0	$238	$350	$330	$328	$308	$301	6	12	16	20	26	32	$1,529	$4,225	$5,288	$6,501	$7,906	$9,668
CRESSON	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
CROSS ROADS	$0	$5,000	$0	$0	$0	$0	$307	$355	$371	$371	$371	$371	3	9	9	9	9	9	$956	$3,081	$3,323	$3,323	$3,323	$3,323
CROWLEY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
CULLEOKA WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0

Water User Group Name	Capital Costs						Total Annual Cost per Acre-Foot						Value of Total Supply from Expanded Conservation (Acre-Feet)						Total Annual Cost					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
DALLAS	$0	$0	$0	$0	$0	$0	$616	$761	$488	$433	$438	$445	270	1,003	2,345	3,450	3,710	4,140	$166,450	$763,444	$1,144,835	$1,493,788	$1,624,960	$1,843,936
DALLAS COUNTY WCID #6	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
DALWORTHINGTON GARDENS	$0	$0	$0	$0	$0	$0	$0	$297	$286	$312	$310	$308	0	4	5	5	5	5	$0	$1,111	$1,430	$1,663	$1,676	$1,684
DANVILLE WSC	$0	$0	$0	$0	$0	$0	$0	$989	$643	$636	$661	$685	0	4	9	11	12	13	$0	$4,359	$5,569	$6,683	$7,870	$9,177
DAWSON	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,251	$1,134	$1,094	0	0	0	0	1	1	$0	$0	$0	$605	$702	$726
DE SOTO	$0	$0	$0	$0	$0	$0	$414	$456	$467	$485	$489	$489	12	58	75	88	98	104	$5,155	$26,571	$34,968	$42,813	$47,912	$50,654
DECATUR	$0	$5,000	$0	$0	$0	$0	$172	$326	$352	$371	$373	$381	12	20	32	45	58	68	$2,137	$6,494	$11,154	$16,657	$21,514	$25,955
DENISON	$0	$0	$0	$0	$0	$0	$0	$0	$775	$653	$661	$664	0	0	27	38	39	40	$0	$0	$20,564	$25,030	$25,952	$26,739
DENTON	$0	$10,000	$0	$0	$0	$0	$150	$340	$326	$340	$341	$341	208	378	641	896	1,114	1,486	$31,053	$128,210	$209,206	$304,848	$380,278	$507,244
DENTON COUNTY FWSD No.1A	$0	$5,000	$0	$0	$0	$0	$91	$78	$120	$119	$118	$117	17	56	48	61	76	90	$1,572	$4,362	$5,792	$7,307	$8,931	$10,567
DOUBLE OAK	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
DUNCANVILLE	$0	$0	$0	$0	$0	$0	$455	$560	$540	$544	$548	$549	8	31	32	32	32	32	$3,828	$17,301	$17,535	$17,535	$17,535	$17,535
EAST CEDAR CREEK FWSD	$0	$5,000	$0	$0	$0	$0	$361	$623	$611	$622	$622	$622	12	17	20	21	23	24	$4,407	$10,463	$12,011	$13,159	$14,187	$15,215
EAST FORK SUD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
ECTOR	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
EDGECLIFF	$0	$0	$0	$0	$0	$0	$0	$608	$481	$469	$476	$477	0	2	3	3	3	3	$0	$1,213	$1,239	$1,262	$1,262	$1,262
ENNIS	$0	$5,000	$0	$0	$0	$0	$227	$350	$363	$370	$373	$373	35	53	74	102	129	164	$7,826	$18,411	$26,876	$37,693	$48,082	$61,356
EULESS	$0	$0	$0	$0	$0	$0	$0	$732	$498	$524	$527	$529	0	43	78	86	87	87	$0	$31,710	$39,044	$44,922	$45,784	$46,225
EUSTACE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
EVERMAN	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
FAIRFIELD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,197	$1,040	$1,047	0	0	0	3	4	4	$0	$0	$0	$3,293	$3,777	$4,165
FAIRVIEW	$0	$5,000	$0	$0	$0	$0	$58	$101	$94	$94	$96	$96	48	73	97	128	130	130	$2,761	$7,383	$9,179	$12,076	$12,487	$12,504
FARMERS BRANCH	$0	$5,502	$0	$0	$0	$0	$91	$151	$159	$165	$166	$166	127	163	204	239	252	264	$11,601	$24,633	$32,430	$39,584	$41,889	$43,952
FARMERSVILLE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
FATE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
FERRIS	$0	$5,000	$0	$0	$0	$0	$420	$409	$400	$392	$382	$371	3	3	3	4	4	5	$1,094	$1,186	$1,286	$1,411	$1,561	$1,686
FILES VALLEY WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
FLO COMMUNITY WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
FLOWER MOUND	$0	$10,000	$0	$0	$0	$0	$100	$127	$114	$116	$116	$116	240	399	568	595	598	598	$23,880	$50,765	$64,855	$69,339	$69,614	$69,614
FOREST HILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
FORNEY	$0	$0	$0	$0	$0	$0	$0	$596	$524	$515	$513	$522	0	16	24	28	32	34	$0	$9,347	$12,325	$14,480	$16,248	$17,943
FORNEY LAKE WSC	$0	$0	$0	$0	$0	$0	$0	$519	$434	$404	$401	$412	0	7	10	14	17	21	$0	$3,494	$4,403	$5,544	$6,972	$8,776
FORT WORTH	$0	$0	$0	$0	$0	$0	$0	$808	$537	$519	$522	$527	0	553	1,287	1,880	2,285	2,760	$0	$446,696	$691,865	$975,442	$1,193,513	$1,455,634
FRISCO	$0	$6,743	$0	$0	$0	$0	$65	$136	$135	$139	$140	$142	428	785	1,087	1,366	1,564	1,580	$27,756	$106,896	$147,237	$189,488	$218,709	$223,634
FROST	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
GAINESVILLE	$0	$0	$0	$0	$0	$0	$0	$0	$776	$633	$646	$655	0	0	13	19	20	22	$0	$0	$10,412	$11,720	$12,955	$14,262
GARLAND	$0	$10,000	$0	$0	$0	$0	$141	$289	$268	$276	$278	$279	418	554	681	726	723	722	$59,043	$160,307	$182,722	$200,747	$201,205	$201,248
GASTONIA-SCURRY SUD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
GLENN HEIGHTS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
GRAND PRAIRIE	$0	$0	$0	$0	$0	$0	$537	$612	$581	$581	$582	$579	31	144	182	207	231	238	$16,451	$88,320	$105,896	$120,210	$134,440	$137,622
GRAPEVINE	$0	$8,412	$0	$0	$0	$0	$75	$161	$161	$172	$173	$173	180	254	316	334	333	333	$13,571	$40,905	$50,821	$57,336	$57,585	$57,585
GUN BARREL CITY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
GUNTER	$0	$5,000	$0	$0	$0	$0	$617	$502	$460	$440	$426	$418	2	3	4	5	6	6	$936	$1,311	$1,686	$2,061	$2,436	$2,686
HACKBERRY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
HALTOM CITY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
HASLET	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
HEATH	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	1	2	2	2	$0	$0	$0	$0	$0	$0
HEBRON	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
HICKORY CREEK	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
HICKORY CREEK SUD	$0	$5,000	$0	$0	$0	$0	$1,772	$1,440	$1,520	$1,497	$1,391	$1,281	0	0	0	1	1	1	$521	$628	$734	$765	$773	$782
HIGH POINT WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
HIGHLAND PARK	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
HIGHLAND VILLAGE	$0	$5,000	$0	$0	$0	$0	$89	$90	$170	$169	$170	$170	47	52	75	81	80	80	$4,223	$4,653	$12,802	$13,615	$13,640	$13,643
HONEY GROVE	$0	$0	$0	$0	$0	$0	$0	$1,381	$1,032	$957	$952	$967	0	1	2	3	3	4	$0	$1,223	$1,848	$2,540	$2,949	$3,463
HOWE	$0	$5,000	$0	$0	$0	$0	$294	$264	$246	$236	$233	$229	4	6	8	11	12	14	$1,186	$1,561	$2,061	$2,561	$2,879	$3,131
HUDSON OAKS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
HURST	$0	$0	$0	$0	$0	$0	$0	$613	$467	$488	$492	$493	0	34	57	65	64	64	$0	$20,571	$26,490	$31,620	$31,620	$31,620
HUTCHINS	$0	$0	$0	$0	$0	$0	$983	$219	$955	$922	$917	$860	0	8	3	5	7	11	$344	$1,811	$3,035	$4,624	$5,959	$9,294
IRVING	$0	$10,000	$0	$0	$0	$0	$136	$209	$222	$233	$233	$234	605	922	1,115	1,256	1,301	1,335	$82,412	$192,823	$248,011	$292,522	$303,716	$312,034
ITALY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
JACKSBORO	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
JOHNSON COUNTY SUD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
JOSEPHINE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0

Water User Group Name	Capital Costs						Total Annual Cost per Acre-Foot						Value of Total Supply from Expanded Conservation (Acre-Feet)						Total Annual Cost					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
JUSTIN	$0	$5,000	$0	$0	$0	$0	$270	$306	$296	$286	$284	$283	6	13	20	34	44	49	$1,521	$3,880	$6,017	$9,782	$12,457	$13,869
KAUFMAN	$0	$5,000	$0	$0	$0	$0	$211	$213	$204	$203	$202	$199	12	16	18	20	23	27	$2,500	$3,327	$3,691	$4,124	$4,557	$5,407
KELLER	$0	$0	$0	$0	$0	$0	$0	$426	$364	$367	$367	$368	0	42	61	66	66	66	$0	$18,053	$22,176	$24,328	$24,427	$24,427
KEMP	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
KENNEDALE	$0	$0	$0	$0	$0	$0	$745	$748	$773	$730	$712	$714	1	6	8	11	13	13	$764	$4,186	$6,284	$8,355	$8,942	$9,241
KERENS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
KIOWA HOMEOWNERS WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
KRUGERVILLE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
KRUM	$0	$5,000	$0	$0	$0	$0	$269	$255	$252	$250	$243	$237	6	6	7	7	8	9	$1,486	$1,586	$1,686	$1,811	$1,986	$2,186
LADONIA	$0	$5,000	$0	$0	$0	$0	$220	$227	$234	$249	$242	$238	3	8	10	11	13	15	$636	$1,729	$2,368	$2,828	$3,099	$3,629
LAKE DALLAS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
LAKE WORTH	$0	$0	$0	$0	$0	$0	$790	$767	$867	$913	$919	$922	1	3	5	6	7	7	$551	$2,501	$4,201	$5,842	$6,369	$6,760
LAKESIDE	$0	$5,000	$0	$0	$0	$0	$153	$143	$134	$193	$178	$171	5	6	6	10	11	13	$749	$799	$850	$1,848	$2,034	$2,231
LANCASTER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
LAVON WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
LEONARD	$0	$5,000	$0	$0	$0	$0	$362	$350	$317	$284	$264	$255	3	3	4	6	9	12	$973	$1,061	$1,311	$1,811	$2,436	$2,936
LEWISVILLE	$0	$10,000	$0	$0	$0	$0	$196	$313	$325	$338	$338	$339	190	276	351	419	472	537	$37,125	$86,439	$114,057	$141,355	$159,881	$181,729
LINCOLN PARK	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
LINDSAY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
LITTLE ELM	$0	$5,000	$0	$0	$0	$0	$196	$271	$275	$280	$283	$283	44	74	92	105	106	106	$8,712	$20,200	$25,258	$29,378	$29,928	$29,967
LOG CABIN	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
LOWRY CROSSING	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
LUCAS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
LUELLA WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
M E N WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
MABANK	$0	$0	$0	$0	$0	$0	$0	$822	$714	$714	$718	$704	0	2	3	4	4	5	$0	$1,865	$2,228	$2,591	$3,051	$3,535
MACBEE SUD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
MALAKOFF	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
MANSFIELD	$0	$0	$0	$0	$0	$0	$316	$355	$323	$305	$303	$301	17	89	140	192	222	251	$5,283	$31,674	$45,270	$58,575	$67,258	$75,462
MARILEE SUD	$0	$5,000	$0	$0	$0	$0	$297	$274	$264	$258	$250	$245	5	7	10	12	15	19	$1,511	$2,036	$2,599	$3,106	$3,804	$4,576
MAYPEARL	$0	$0	$0	$0	$0	$0	$0	$563	$480	$492	$499	$500	0	1	1	1	1	1	$0	$484	$581	$605	$605	$605
MCKINNEY	$0	$10,000	$0	$0	$0	$0	$94	$172	$163	$163	$164	$165	356	762	1,120	1,430	1,569	1,579	$33,372	$131,264	$182,025	$233,223	$257,673	$260,288
MCLENDON-CHISHOLM	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
MELISSA	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$909	$835	0	0	0	0	51	67	$0	$0	$0	$0	$46,480	$55,973
MESQUITE	$0	$0	$0	$0	$0	$0	$0	$967	$541	$474	$468	$467	0	76	173	228	234	234	$0	$73,573	$93,637	$108,133	$109,250	$109,400
MIDLOTHIAN	$0	$5,000	$0	$0	$0	$0	$132	$129	$136	$141	$141	$141	37	74	125	176	210	244	$4,905	$9,562	$17,096	$24,768	$29,669	$34,363
MILFORD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
MILLIGAN WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
MINERAL WELLS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
MOUNTAIN PEAK SUD	$0	$5,000	$0	$0	$0	$0	$301	$424	$436	$441	$433	$415	9	13	14	16	20	26	$2,695	$5,325	$6,026	$7,121	$8,539	$10,621
MT ZION WSC	$0	$0	$0	$0	$0	$0	$0	$358	$290	$293	$296	$297	0	2	2	2	2	2	$0	$605	$605	$605	$605	$605
MUENSTER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$768	$697	$717	0	0	0	2	2	3	$0	$0	$0	$1,642	$1,678	$1,810
MURPHY	$0	$0	$0	$0	$0	$0	$0	$256	$238	$244	$244	$244	0	44	55	56	56	56	$0	$11,264	$13,051	$13,526	$13,526	$13,526
MUSTANG SUD	$0	$5,000	$0	$0	$0	$0	$309	$270	$260	$248	$242	$240	7	11	14	27	39	51	$2,081	$2,910	$3,690	$6,561	$9,436	$12,186
NAVARRO MILLS WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
NEVADA	$0	$0	$0	$0	$0	$0	$0	$439	$404	$434	$443	$437	0	1	2	3	6	13	$0	$533	$702	$1,404	$2,446	$5,763
NEW FAIRVIEW	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
NEW HOPE	$0	$0	$0	$0	$0	$0	$0	$356	$318	$334	$328	$337	0	1	2	4	6	12	$0	$460	$775	$1,235	$1,816	$3,971
NEWARK	$0	$5,000	$0	$0	$0	$0	$531	$430	$385	$343	$312	$287	1	2	3	4	5	7	$720	$879	$1,021	$1,261	$1,550	$1,990
NORTH COLLIN WSC	$0	$0	$0	$0	$0	$0	$0	$1,221	$759	$748	$786	$813	0	4	7	9	10	11	$0	$4,528	$5,497	$6,465	$7,531	$8,620
NORTH HUNT WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
NORTH RICHLAND HILLS	$0	$0	$0	$0	$0	$0	$0	$474	$361	$364	$368	$370	0	71	101	106	109	111	$0	$33,585	$36,612	$38,622	$39,954	$40,874
NORTHLAKE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
OAK GROVE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
OAK LEAF	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
OAK POINT	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	1	2	2	2	$0	$0	$0	$0	$0	$0
OVILLA	$0	$0	$0	$0	$0	$0	$405	$413	$425	$425	$400	$392	1	6	8	10	12	14	$318	$2,354	$3,387	$4,336	$4,904	$5,354
PALMER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
PANTEGO	$0	$5,000	$0	$0	$0	$0	$153	$155	$157	$157	$160	$160	7	7	6	6	6	6	$1,015	$1,015	$1,015	$1,015	$1,015	$1,015
PARADISE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
PARKER	$0	$0	$0	$0	$0	$0	$0	$190	$175	$177	$177	$176	0	23	39	61	91	126	$0	$4,334	$6,804	$10,848	$16,103	$22,229
PAYNE SPRINGS	$0	$5,000	$0	$0	$0	$0	$362	$435	$428	$413	$422	$403	2	3	3	3	3	4	$715	$1,212	$1,249	$1,262	$1,374	$1,418
PECAN HILL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0

Water User Group Name	Capital Costs						Total Annual Cost per Acre-Foot						Value of Total Supply from Expanded Conservation (Acre-Feet)						Total Annual Cost					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
PELICAN BAY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
PILOT POINT	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
PLANO	$0	$0	$0	$0	$0	$0	$0	$358	$272	$273	$274	$274	0	354	473	475	478	480	$0	$126,520	$128,700	$129,838	$130,806	$131,388
PONDER	$0	$5,000	$0	$0	$0	$0	$350	$352	$331	$337	$347	$353	2	11	24	38	45	47	$773	$3,892	$7,862	$12,961	$15,680	$16,538
POST OAK BEND CITY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
POTTSBORO	$0	$5,000	$0	$0	$0	$0	$202	$287	$273	$269	$260	$257	6	14	20	25	32	35	$1,186	$3,914	$5,382	$6,754	$8,198	$9,029
PRINCETON	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
PROSPER	$0	$5,000	$0	$0	$0	$0	$87	$125	$122	$121	$121	$123	28	103	187	271	379	411	$2,436	$12,894	$22,794	$32,864	$45,904	$50,592
R-C-H WSC	$0	$0	$0	$0	$0	$0	$0	$508	$430	$451	$459	$460	0	4	5	5	4	4	$0	$1,816	$1,937	$2,034	$2,058	$2,058
RED OAK	$0	$0	$0	$0	$0	$0	$0	$550	$428	$440	$447	$451	0	16	26	28	29	31	$0	$8,572	$11,066	$12,277	$13,148	$13,996
RENO	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
RHOME	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
RICE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
RICE WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
RICHARDSON	$0	$10,000	$0	$0	$0	$0	$68	$138	$128	$129	$130	$130	390	611	670	663	658	658	$26,592	$84,185	$85,444	$85,444	$85,444	$85,444
RICHLAND HILLS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
RIVER OAKS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
ROANOKE	$0	$0	$0	$0	$0	$0	$0	$484	$455	$500	$507	$513	0	13	26	35	45	56	$0	$6,320	$11,651	$17,579	$22,817	$28,495
ROCKETT SUD	$0	$5,000	$0	$0	$0	$0	$289	$293	$296	$297	$299	$299	32	41	51	59	64	64	$9,350	$12,051	$15,122	$17,644	$19,014	$19,174
ROCKWALL	$0	$0	$0	$0	$0	$0	$0	$349	$295	$298	$297	$297	0	81	125	146	154	155	$0	$28,379	$36,903	$43,610	$45,789	$46,007
ROWLETT	$0	$0	$0	$0	$0	$0	$0	$476	$407	$409	$415	$417	0	57	76	84	89	93	$0	$27,169	$31,091	$34,167	$36,685	$38,719
ROYSE CITY	$0	$0	$0	$0	$0	$0	$0	$614	$601	$633	$641	$642	0	14	25	35	43	52	$0	$8,837	$14,866	$21,932	$27,462	$33,413
RUNAWAY BAY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
SACHSE	$0	$0	$0	$0	$0	$0	$0	$420	$371	$383	$385	$385	0	23	32	34	34	34	$0	$9,625	$11,867	$13,013	$13,066	$13,066
SAGINAW	$0	$0	$0	$0	$0	$0	$0	$661	$560	$600	$609	$614	0	14	21	23	25	25	$0	$9,452	$11,890	$14,047	$14,923	$15,576
SAINT PAUL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
SANCTUARY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
SANGER	$0	$0	$0	$0	$0	$0	$0	$176	$176	$175	$171	$171	0	1	2	2	3	3	$0	$174	$267	$301	$535	$535
SANSOM PARK VILLAGE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
SARDIS-LONE ELM WSC	$0	$5,000	$0	$0	$0	$0	$201	$284	$291	$303	$305	$305	23	39	48	48	48	48	$4,632	$10,996	$13,949	$14,606	$14,637	$14,637
SAVOY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
SCURRY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
SEAGOVILLE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
SEVEN POINTS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
SHADY SHORES	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
SHERMAN	$0	$0	$0	$0	$0	$0	$0	$0	$0	$617	$546	$553	0	0	0	78	102	119	$0	$0	$0	$48,180	$55,603	$65,593
SOUTH GRAYSON WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
SOUTHLAKE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	2	2	2	2	2	$0	$0	$0	$0	$0	$0
SOUTHMAYD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
SOUTHWEST FANNIN COUNTY SUD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
SPRINGTOWN	$0	$5,000	$0	$0	$0	$0	$442	$409	$392	$378	$369	$360	3	4	4	5	6	7	$1,186	$1,436	$1,686	$1,936	$2,186	$2,436
SUNNYVALE	$0	$0	$0	$0	$0	$0	$0	$251	$217	$207	$201	$201	0	11	17	21	26	27	$0	$2,736	$3,584	$4,431	$5,182	$5,424
TALTY	$0	$0	$0	$0	$0	$0	$0	$200	$181	$178	$181	$182	0	6	9	12	16	20	$0	$1,187	$1,719	$2,204	$2,882	$3,705
TEAGUE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
TERRELL	$0	$0	$0	$0	$0	$0	$0	$905	$624	$583	$579	$581	0	20	61	102	125	143	$0	$18,426	$38,108	$59,737	$72,196	$82,923
THE COLONY	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
TIOGA	$0	$5,000	$0	$0	$0	$0	$484	$496	$482	$494	$498	$502	1	4	7	8	9	9	$711	$2,173	$3,206	$3,938	$4,386	$4,647
TOM BEAN	$0	$5,000	$0	$0	$0	$0	$330	$358	$353	$351	$347	$338	2	4	4	5	5	6	$808	$1,342	$1,513	$1,684	$1,855	$1,905
TOOL	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
TRENTON	$0	$5,000	$0	$0	$0	$0	$442	$512	$447	$423	$413	$404	2	3	5	8	13	17	$686	$1,610	$2,393	$3,567	$5,205	$6,819
TRINIDAD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
TROPHY CLUB	$0	$0	$0	$0	$0	$0	$0	$456	$322	$278	$271	$271	0	9	17	24	26	28	$0	$4,330	$5,534	$6,635	$7,119	$7,605
TWO WAY SUD	$0	$5,000	$0	$0	$0	$0	$358	$314	$308	$302	$298	$294	5	7	8	10	11	13	$1,706	$2,116	$2,499	$2,891	$3,281	$3,672
UNIVERSITY PARK	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
VALLEY VIEW	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
VAN ALSTYNE	$0	$5,000	$0	$0	$0	$0	$355	$449	$443	$464	$455	$460	3	12	26	35	41	43	$1,186	$5,611	$11,361	$16,295	$18,584	$19,672
VENUS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
VIRGINIA HILL WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
WALNUT CREEK SUD	$0	$5,000	$0	$0	$0	$0	$309	$307	$307	$308	$308	$308	19	27	42	52	55	57	$5,772	$8,349	$12,967	$15,936	$16,811	$17,436
WATAUGA	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
WAXAHACHIE	$0	$0	$0	$0	$0	$0	$0	$875	$548	$499	$505	$508	0	19	46	73	91	116	$0	$16,958	$25,264	$36,202	$46,162	$59,076
WEATHERFORD	$0	$5,000	$0	$0	$0	$0	$215	$357	$384	$404	$406	$406	50	75	100	123	138	154	$10,773	$26,810	$38,312	$49,535	$55,817	$62,634
WEST CEDAR CREEK MUD	$0	$5,000	$0	$0	$0	$0	$354	$302	$289	$289	$287	$284	13	20	26	31	38	46	$4,711	$6,078	$7,458	$8,941	$10,767	$13,047

Water User Group Name	Capital Costs						Total Annual Cost per Acre-Foot						Value of Total Supply from Expanded Conservation (Acre-Feet)						Total Annual Cost					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
WEST WISE RURAL SUD	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
WESTON	$0	$5,000	$0	$0	$0	$0	$310	$296	$221	$201	$200	$199	3	11	25	72	128	219	$936	$3,276	$5,503	$14,395	$25,579	$43,622
WESTOVER HILLS	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
WESTWORTH VILLAGE	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
WHITE SETTLEMENT	$0	$0	$0	$0	$0	$0	$917	$0	$0	$0	$0	$0	2	1	0	0	0	0	$1,550	$0	$0	$0	$0	$0
WHITESBORO	$0	$0	$0	$0	$0	$0	$0	$867	$778	$803	$805	$734	0	3	5	6	7	10	$0	$2,665	$3,821	$5,016	$5,721	$7,286
WHITEWRIGHT	$0	$5,000	$0	$0	$0	$0	$572	$721	$689	$688	$681	$673	2	4	5	7	8	9	$941	$2,696	$3,724	$4,507	$5,243	$5,978
WILLOW PARK	$0	$5,000	$0	$0	$0	$0	$361	$549	$305	$314	$311	$308	4	8	8	9	10	11	$1,477	$4,301	$2,505	$2,936	$3,236	$3,436
WILMER	$0	$5,000	$0	$0	$0	$0	$622	$579	$564	$525	$479	$460	2	3	3	4	8	13	$1,386	$1,536	$1,736	$2,311	$3,936	$5,936
WOODBINE WSC	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
WORTHAM	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
WYLIE	$0	$5,000	$0	$0	$0	$0	$181	$323	$303	$303	$306	$306	58	106	138	165	166	166	$10,436	$34,333	$41,877	$49,793	$50,786	$50,786
COLLIN COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
COOKE COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
DALLAS COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
DENTON COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
ELLIS COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
FANNIN COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
FREESTONE COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
GRAYSON COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
HENDERSON COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
JACK COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
KAUFMAN COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
NAVARRO COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
PARKER COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
ROCKWALL COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
TARRANT COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
WISE COUNTY-OTHER	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	0	0	0	0	0	0	$0	$0	$0	$0	$0	$0
Total	$0	$436,559	$0	$0	$0	$0	$32,132	$56,442	$52,088	$57,090	$56,899	$56,985	5,021	10,839	16,207	20,297	22,462	24,617	$802,775	$3,703,155	$5,057,382	$6,440,294	$7,238,053	$8,129,441

Table Q-12
Supply and Costs by User Group for Non-Municipal Water Conservation Package

Water User Group Name	Total Annual Cost per Acre-Foot						Value of Total Supply from Non-Municipal Conservation (Acre-Feet)						Total Annual Cost					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
COLLIN COUNTY-IRRIGATION	$278	$278	$278	$278	$278	$278	6	99	190	238	283	328	$1,665	$27,476	$52,871	$66,192	$78,682	$91,171
COOKE COUNTY-IRRIGATION	$278	$278	$278	$278	$278	$278	0	6	11	15	18	22	$91	$1,550	$3,097	$4,062	$5,038	$5,982
DALLAS COUNTY-IRRIGATION	$278	$278	$278	$278	$278	$278	26	429	825	1,032	1,227	1,422	$7,221	$119,143	$229,260	$287,026	$341,181	$395,337
ELLIS COUNTY-IRRIGATION	$278	$278	$278	$278	$278	$278	1	15	29	37	44	51	$257	$4,248	$8,173	$10,233	$12,163	$14,094
KAUFMAN COUNTY-IRRIGATION	$278	$278	$278	$278	$278	$278	4	72	140	177	212	247	$1,210	$20,094	$38,910	$49,126	$58,878	$68,550
ROCKWALL COUNTY-IRRIGATION	$278	$278	$278	$278	$278	$278	2	37	71	89	106	123	$626	$10,321	$19,860	$24,864	$29,555	$34,246
TARRANT COUNTY-IRRIGATION	$278	$278	$278	$278	$278	$278	17	274	527	660	785	910	$4,618	$76,199	$146,626	$183,571	$218,207	$252,843
WISE COUNTY-IRRIGATION	$278	$278	$278	$278	$278	$278	0	5	10	13	15	18	$90	$1,477	$2,842	$3,558	$4,230	$4,901
COLLIN COUNTY-MANUFACTURING	$0	$278	$278	$278	$278	$278	0	6	72	108	119	130	$0	$1,724	$20,146	$30,054	$33,158	$36,117
COOKE COUNTY-MANUFACTURING	$0	$278	$278	$278	$278	$278	0	1	7	10	11	12	$0	$166	$1,916	$2,802	$3,026	$3,253
DALLAS COUNTY-MANUFACTURING	$0	$278	$278	$278	$278	$278	0	68	781	1,135	1,212	1,258	$0	$18,898	$217,106	$315,398	$336,954	$349,837
DENTON COUNTY-MANUFACTURING	$0	$278	$278	$278	$278	$278	0	2	29	44	49	53	$0	$689	$8,095	$12,172	$13,539	$14,808
GRAYSON COUNTY-MANUFACTURING	$0	$278	$278	$278	$278	$278	0	15	175	255	272	291	$0	$4,250	$48,770	$70,799	$75,715	$81,009
HENDERSON COUNTY-MANUFACTURING	$0	$278	$278	$278	$278	$278	0	0	3	4	5	5	$0	$66	$768	$1,156	$1,314	$1,493
KAUFMAN COUNTY-MANUFACTURING	$0	$278	$278	$278	$278	$278	0	1	15	22	23	25	$0	$371	$4,225	$6,076	$6,493	$6,944
NAVARRO COUNTY-MANUFACTURING	$0	$278	$278	$278	$278	$278	0	1	16	23	25	27	$0	$377	$4,361	$6,421	$6,988	$7,545
PARKER COUNTY-MANUFACTURING	$0	$278	$278	$278	$278	$278	0	1	6	9	9	10	$0	$141	$1,637	$2,414	$2,630	$2,844
ROCKWALL COUNTY-MANUFACTURING	$0	$278	$278	$278	$278	$278	0	0	1	1	1	1	$0	$13	$150	$224	$249	$274
TARRANT COUNTY-MANUFACTURING	$0	$278	$278	$278	$278	$278	0	35	413	630	711	784	$0	$9,687	$114,859	$175,022	$197,604	$217,841
WISE COUNTY-MANUFACTURING	$0	$278	$278	$278	$278	$278	0	1	12	18	19	21	$0	$284	$3,315	$4,917	$5,376	$5,833
TOTAL							57	1,069	3,334	4,518	5,147	5,737	$15,778	$297,174	$926,987	$1,256,087	$1,430,980	$1,594,922

Table Q-13																
Cost Estimates for Supplemental Wells to Maintain Current Groundwater Production Capacity																
Water User Group	**County**	**Aquifer**	**# Wells in 2008**	**Installation Schedule**						**Construction Costs (incl eng/contingencies/permitting)**						
				2010	**2020**	**2030**	**2040**	**2050**	**2060**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Anna	Collin	Woodbine	1	1						$612,000					
Anna	Collin	Trinity (Paluxy)	1			1						$769,000			
Blue Ridge	Collin	Woodbine	2	1		1				$764,000		$764,000			
Celina	Collin	Trinity (Paluxy)	2	1					1	$513,000					$513,000
Celina	Collin	Trinity (Travis Peak)	1		1						$829,000				
Celina	Collin	Trinity (Twin Mountains	1				1						$983,000		
Collin County Irrigation	Collin	Trinity	2		1		1				$304,000		$304,000		
Collin County Livestock	Collin	Other	1		1						$304,000				
Collin County Manufacturing	Collin	Woodbine	1	1						$506,000					
Collin County Steam Electric Power	Collin	Woodbine	1	1						$506,000					
Collin County-Other	Collin	Trinity & Woodbine	1	1						$595,000					
Marilee SUD	Collin	Trinity (Twin Mountains	3	1		1		1		$869,000		$869,000		$869,000	
Marilee SUD	Collin	Trinity (Antlers)	2		1		1				$850,000		$850,000		
Melissa	Collin	Woodbine	2	1			1			$665,000			$665,000		
Prosper	Collin	Woodbine	6	1	1	1	1	1	1	$763,861	$763,861	$763,861	$763,861	$763,861	$763,861
South Grayson WSC	Collin	Trinity	4	1		1	1		1	$769,000		$769,000	$769,000		$769,000
South Grayson WSC	Collin	Woodbine	5	1	1	1	1	1		$764,000	$764,000	$764,000	$764,000	$764,000	
Weston	Collin	Woodbine	2	1		1				$584,000		$584,000			
Cooke County Irrigation	Cooke	Trinity	8	2	1	1	2	1	1	$419,000	$210,000	$210,000	$419,000	$210,000	$210,000
Cooke County Livestock	Cooke	Trinity	22	4	4	3	4	4	3	$839,000	$839,000	$629,000	$839,000	$839,000	$629,000
Cooke County Manufacturing	Cooke	Trinity	3	1		1		1		$528,000		$528,000		$528,000	
Cooke County Mining	Cooke	Trinity	2	1			1			$210,000			$210,000		
Cooke County-Other	Cooke	Trinity	10	2	1	2	1	2	1	$1,412,000	$706,000	$1,412,000	$706,000	$1,412,000	$706,000
Gainesville	Cooke	Trinity (Antlers)	8	2	1	1	2	1	1	$1,412,000	$706,000	$706,000	$1,412,000	$706,000	$706,000
Kiowa Homeowners WSC	Cooke	Trinity (Antlers)	2	1			1			$974,000			$974,000		
Lindsay	Cooke	Trinity (Antlers)	3	1		1		1		$460,000		$460,000		$460,000	
Muenster	Cooke	Trinity (Antlers)	5	1	1	1	1	1		$430,000	$430,000	$430,000	$430,000	$430,000	
Valley View	Cooke	Trinity	1		1						$456,000				
Woodbine WSC	Cooke	Trinity (Antlers)	6	1	1	1	1	1	1	$642,000	$642,000	$642,000	$642,000	$642,000	$642,000
Carrollton	Dallas	Trinity (Travis Peak)	1 emergency	1						$1,173,000					
Cedar Hill	Dallas	Woodbine	1	1						$472,000					
Cedar Hill	Dallas	Trinity (Travis Peak)	2			1		1				$1,168,000		$1,168,000	
Dallas County Irrigation	Dallas	Other	1	1						$316,000					
Dallas County Livestock	Dallas	Woodbine	1	1						$186,000					
Dallas County Manufacturing	Dallas	Trinity	1	1						$705,000					
Dallas County Manufacturing	Dallas	Woodbine	1	1						$705,000					
Dallas County Mining	Dallas	Trinity	1	1						$316,000					
Dallas County-Other	Dallas	Other	1	1						$794,000					
Glenn Heights	Dallas	Woodbine	3	1		1		1		$553,000		$553,000		$553,000	
Grand Prairie	Dallas	Trinity (Travis Peak)	7	2	1	1	1	1	1	$2,398,000	$1,199,000	$1,199,000	$1,199,000	$1,199,000	$1,199,000
Grand Prairie	Dallas	Trinity (Twin Mountains	3		1		1	1			$1,218,000		$1,218,000	$1,218,000	
Wilmer	Dallas	Trinity (Twin Mountains	1	1						$1,521,000					
Wilmer	Dallas	Trinity (Travis Peak)	1			1						$1,456,000			
Argyle WSC	Denton	Trinity (Twin Mountains	4	1		1		1	1	$709,000		$709,000		$709,000	$709,000
Aubrey	Denton	Trinity (Twin Mountains	3	1		1		1		$598,000		$598,000		$598,000	
Bartonville WSC	Denton	Trinity (Travis Peak)	1	1						$617,000					
Bartonville WSC	Denton	Trinity (Paluxy)	4	1	1		1		1	$556,000	$556,000		$556,000		$556,000
Bartonville WSC	Denton	Trinity (Twin Mountains	5		1	1	1	1	1		$635,000	$635,000	$635,000	$635,000	$635,000
Bolivar WSC	Denton	Trinity (Antlers)	18	3	3	3	3	3	3	$1,575,000	$1,575,000	$1,575,000	$1,575,000	$1,575,000	$1,575,000
Bolivar WSC	Denton	Trinity	2	1			1			$348,000			$348,000		
Corinth	Denton	Trinity	1	1						$541,606					

Table Q-13

Cost Estimates for Supplemental Wells to Maintain Current Groundwater Production Capacity

Water User Group	County	Aquifer	# Wells in	Installation Schedule						Construction Costs (incl eng/contingencies/permitting)					
			2008	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
Denton County Irrigation	Denton	Trinity	1	1						$116,000					
Denton County Livestock	Denton	Trinity	1	1						$116,000					
Denton County Manufacturing	Denton	Trinity	1	1						$504,000					
Denton County Mining	Denton	Trinity	1	1						$196,000					
Denton County Mining	Denton	Woodbine	1			1						$71,000			
Denton County-Other	Denton	Trinity	1	1						$593,000					
Denton County-Other	Denton	Woodbine	1	1						$577,000					
Hackberry	Denton	Trinity	1	1						$363,000					
Hackberry	Denton	Trinity	1				1						$596,000		
Highland Village	Denton	Trinity (Travis Peak)	3	1		1		1		$944,000		$944,000		$944,000	
Highland Village	Denton	Trinity (Twin Mountains	2		1		1				$1,080,000		$1,080,000		
Justin	Denton	Trinity (Travis Peak)	4	1		1		1	1	$547,000		$547,000		$547,000	$547,000
Krum	Denton	Trinity (Paluxy)	2	1				1		$398,000				$398,000	
Krum	Denton	Trinity (Travis Peak)	1			1						$484,000			
Krum	Denton	Trinity (Twin Mountains	2		1		1				$493,000		$493,000		
Lake Cities MUA	Denton	Trinity	2		1		1				$600,000		$600,000		
Lake Cities MUA	Denton	Woodbine	3		1		1		1		$385,000		$385,000		$385,000
Lincoln Park	Denton	Trinity	1	1						$500,000					
Little Elm	Denton	Woodbine	5	1	1	1	1	1		$400,700	$400,700	$400,700	$400,700	$400,700	
Mustang SUD	Denton	Trinity (Twin Mountains	5	1	1	1	1	1		$674,000	$674,000	$674,000	$674,000	$674,000	
Mustang SUD	Denton	Trinity (Travis Peak)	2			1			1			$537,000			$537,000
Northlake	Denton	Woodbine	1	1						$499,561					
Pilot Point	Denton	Trinity (Antlers)	6	1	1	1	1	1	1	$667,000	$667,000	$667,000	$667,000	$667,000	$667,000
Ponder	Denton	Trinity (Twin Mountains	3		1		1		1		$495,000		$495,000		$495,000
Ponder	Denton	Trinity (Paluxy)	1	1						$417,000					
Roanoke	Denton	Trinity (Paluxy)	4	1		1		1	1	$411,000		$411,000		$411,000	$411,000
Roanoke	Denton	Trinity (Travis Peak)	1		1						$520,000				
Sanger	Denton	Trinity (Antlers)	6	1	1	1	1	1	1	$560,000	$560,000	$560,000	$560,000	$560,000	$560,000
The Colony	Denton	Trinity (Travis Peak)	2	1				1		$1,387,000				$1,387,000	
The Colony	Denton	Trinity (Twin Mountains	1			1						$1,444,000			
Trophy Club Mud #1	Denton	Trinity (Travis Peak)	1	1						$847,000					
Trophy Club Mud #2	Denton	Trinity (Paluxy)	3		1		1		1		$444,000		$444,000		$444,000
Bardwell	Ellis	Woodbine	1	1						$581,000					
Buena Vista - Bethel SUD	Ellis	Trinity (Travis Peak)	4	1	1		1		1	$933,000	$933,000		$933,000		$933,000
Ellis County Irrigation	Ellis	Trinity	1	1						$394,000					
Ellis County Livestock	Ellis	Woodbine	2	1			1			$194,000			$194,000		
Ellis County Manufacturing	Ellis	Trinity	13	3	2	2	2	2	2	$2,503,000	$1,669,000	$1,669,000	$1,669,000	$1,669,000	$1,669,000
Ellis County Manufacturing	Ellis	Woodbine	5	1	1	1	1	1		$502,000	$502,000	$502,000	$502,000	$502,000	
Ellis County Mining	Ellis	Woodbine	2	1			1			$194,000			$194,000		
Ellis County-Other	Ellis	Woodbine	4	1	1		1		1	$591,000	$591,000		$591,000		$591,000
Ellis County-Other	Ellis	Trinity	7	1	1	2	1	1	1	$923,000	$923,000	$1,847,000	$923,000	$923,000	$923,000
Ferris	Ellis	Woodbine	2	1			1			$650,000			$650,000		
Grand Prairie	Ellis	Trinity	1	1						$1,218,000					
Italy	Ellis	Trinity (Travis Peak)	2	1			1			$975,000			$975,000		
Italy	Ellis	Woodbine	1	1						$484,000					
Maypearl	Ellis	Woodbine	2	1			1			$379,000			$379,000		
Maypearl	Ellis	Trinity (Twin Mountains	1	1						$801,000					
Milford	Ellis	Woodbine	2		1		1				$479,000		$479,000		
Mountain Peak WSC	Ellis	Trinity (Travis Peak)	2	1			1			$881,000			$881,000		
Mountain Peak WSC	Ellis	Trinity (Twin Mountains	2		1			1			$848,000			$848,000	
Ovilla	Ellis	Woodbine	1 emergency	1						$466,000					
Palmer	Ellis	Woodbine	2	1			1			$576,000			$576,000		
Red Oak	Ellis	Woodbine	3	1		1		1		$583,000		$583,000		$583,000	
Sardis Lone Elm WSC	Ellis	Trinity (Travis Peak)	4	1		1		1	1	$1,236,000		$1,236,000		$1,236,000	$1,236,000
Sardis Lone Elm WSC	Ellis	Trinity (Twin Mountains	2		1		1				$1,167,000		$1,167,000		

Table Q-13

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Water User Group	County	Aquifer	# Wells in 2008	Installation Schedule						Construction Costs (incl eng/contingencies/permitting)					
				2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
Ector	Fannin	Woodbine	3	1		1		1		$444,000		$444,000		$444,000	
Fannin Co. Manufacturing	Fannin	Woodbine	2		1		1				$485,000		$485,000		
Fannin Co. SEP	Fannin	Woodbine	2		1		1				$593,000		$593,000		
Fannin County Irrigation	Fannin	Other	65	11	11	11	11	11	10	$867,000	$867,000	$867,000	$867,000	$867,000	$788,000
Fannin County Livestock	Fannin	Woodbine	4	1		1		1	1	$268,000		$268,000		$268,000	$268,000
Fannin County Livestock	Fannin	Trinity	1		1						$400,000				
Fannin County-Other	Fannin	Woodbine	11	2	2	2	2	1	2	$1,605,000	$1,605,000	$1,605,000	$1,605,000	$803,000	$1,605,000
Fannin County-Other	Fannin	Trinity	5	1	1	1	1	1		$934,000	$934,000	$934,000	$934,000	$934,000	
Honey Grove	Fannin	Woodbine	2	1			1			$922,000			$922,000		
Ladonia	Fannin	Trinity	2		1		1				$1,125,000		$1,125,000		
Leonard	Fannin	Woodbine	3	1		1		1		$814,000		$814,000		$814,000	
North Hunt WSC	Fannin	Woodbine	2		1		1				$1,143,000		$1,143,000		
Savoy	Fannin	Woodbine	3		1		1		1		$456,000		$456,000		$456,000
SW Fannin Co. SUD	Fannin	Woodbine	8	1	2	1	2	1	1	$686,000	$1,372,000	$686,000	$1,372,000	$686,000	$686,000
Trenton	Fannin	Woodbine	2		1		1				$613,000		$613,000		
Fairfield	Freestone	Carrizo-Wilcox	4	1		1		1	1	$639,000		$639,000		$639,000	$639,000
Flo Community WSC	Freestone	Carrizo-Wilcox	5	1	1	1		1	1	$461,000	$461,000	$461,000		$461,000	$461,000
Freestone County Irrigation	Freestone	Carrizo-Wilcox	1		1						$75,000				
Freestone County Livestock	Freestone	Carrizo-Wilcox & Queer	1		1						$75,000				
Freestone County Mining	Freestone	Carrizo-Wilcox	1		1						$118,000				
Freestone County Steam Electric Power	Freestone	Carrizo-Wilcox	1		1						$374,000				
Freestone County-Other	Freestone	Carrizo-Wilcox	1		1						$463,000				
Teague	Freestone	Carrizo-Wilcox	4	1	1	1		1		$581,000	$581,000	$581,000		$581,000	
Bells	Grayson	Trnity (Antlers)	2	1				1		$799,000				$799,000	
Bells	Grayson	Woodbine	1			1						$435,000			
Collinsville	Grayson	Trnity (Antlers)	5	1	1	1	1	1		$598,000	$598,000	$598,000	$598,000	$598,000	
Denison	Grayson	Trnity (Antlers)	1	1						$676,000					
Denison	Grayson	Woodbine	4		1	1	1	1			$435,000	$435,000	$435,000	$435,000	
Grayson County Irrigation	Grayson	Woodbine	49	9	8	8	8	8	8	$1,842,000	$1,638,000	$1,638,000	$1,638,000	$1,638,000	$1,638,000
Grayson County Livestock	Grayson	Woodbine	5	1	1	1	1	1		$205,000	$205,000	$205,000	$205,000	$205,000	
Grayson County Manufacturing	Grayson	Woodbine	25	5	4	4	4	4	4	$2,597,000	$2,077,000	$2,077,000	$2,077,000	$2,077,000	$2,077,000
Grayson County Mining	Grayson	Trinity	4	1		1		1	1	$465,000		$465,000		$465,000	$465,000
Grayson County Mining	Grayson	Woodbine	5	1	1	1	1	1		$205,000	$205,000	$205,000	$205,000	$205,000	
Grayson County-Other	Grayson	Trnity	15	3	3	2	3	2	2	$3,394,000	$3,394,000	$2,263,000	$3,394,000	$2,263,000	$2,263,000
Grayson County-Other	Grayson	Woodbine	21	4	3	4	3	4	3	$2,790,000	$2,093,000	$2,790,000	$2,093,000	$2,790,000	$2,093,000
Gunter	Grayson	Woodbine	3	1		1		1		$825,000		$825,000		$825,000	
Howe	Grayson	Woodbine	3	1		1		1		$762,000		$762,000		$762,000	
Luella WSC	Grayson	Woodbine	7	2	1	1	1	1	1	$1,204,000	$602,000	$602,000	$602,000	$602,000	$602,000
Pottsboro	Grayson	Woodbine	3	1		1		1		$375,000		$375,000		$375,000	
Sherman	Grayson	Trinity	17	3	3	3	3	3	2	$3,394,000	$3,394,000	$3,394,000	$3,394,000	$3,394,000	$2,263,000
Sherman	Grayson	Woodbine	21	4	3	4	3	4	3	$2,790,000	$2,093,000	$2,790,000	$2,093,000	$2,790,000	$2,093,000
South Grayson WSC	Grayson	Trinity	5	1	1	1	1	1		$869,000	$869,000	$869,000	$869,000	$869,000	
South Grayson WSC	Grayson	Woodbine	5	1	1	1	1		1	$646,000	$646,000	$646,000	$646,000		$646,000
Southmayd	Grayson	Trinity	1			1						$747,000			
Southmayd	Grayson	Woodbine	2	1				1		$386,000				$386,000	
Southwest Fannin County SUD	Grayson	Woodbine	7	2	1	1	1	1	1	$1,133,000	$566,000	$566,000	$566,000	$566,000	$566,000
Tioga	Grayson	Trnity (Antlers)	3	1		1		1		$610,000		$610,000		$610,000	
Tom Bean	Grayson	Woodbine	2	1			1			$598,000			$598,000		
Two Way SUD	Grayson	Trinity	5	1	1	1	1	1	1	$662,000	$662,000	$662,000	$662,000	$662,000	$662,000

Table Q-13

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Two Way SUD	Grayson	Trnity (Antlers)	5	1	1	1	1	1		$683,000	$683,000	$683,000	$683,000	$683,000	
Van Alstyne	Grayson	Trnity (Antlers)	4	1	1		1		1	$961,000	$961,000		$961,000		$961,000
Van Alstyne	Grayson	Woodbine	1			1						$578,000			
Whitesboro	Grayson	Trnity (Antlers)	4	1	1		1		1	$677,000	$677,000		$677,000		$677,000
Whitewright	Grayson	Woodbine	6	1	2	1	1	1	1	$574,000	$1,147,000	$574,000	$574,000	$574,000	$574,000
Whitewright	Grayson	Woodbine	4	1	1		1		1	$541,000	$541,000		$541,000		$541,000
Athens	Henderson	Carrizo-Wilcox	3	1		1		1		$653,000		$653,000		$653,000	
Bethel-Ash WSC	Henderson	Carrizo-Wilcox	8	2	1	2	1	1	1	$928,000	$464,000	$928,000	$464,000	$464,000	$464,000
Eustace	Henderson	Carrizo-Wilcox	3	1		1		1		$345,000		$345,000		$345,000	
Henderson County Irrigation	Henderson	Carrizo-Wilcox	1	1						$56,000					
Henderson County Livestock	Henderson	Carrizo-Wilcox, Queen C	1	1						$56,000					
Henderson County Manufacturing	Henderson	Carrizo-Wilcox	1	1						$315,000					
Henderson County Mining	Henderson	Carrizo-Wilcox	1	1						$82,000					
Henderson County-Other	Henderson	Carrizo-Wilcox	1	1						$404,000					
Log Cabin	Henderson	Carrizo-Wilcox	4	1		1		1	1	$350,000		$350,000		$350,000	$350,000
Malakoff	Henderson	Carrizo-Wilcox	4	1		1		1	1	$378,000		$378,000		$378,000	$378,000
Payne Springs	Henderson	Carrizo-Wilcox	2		1		1				$344,000		$344,000		
Virginia Hill WSC	Henderson	Carrizo-Wilcox	6	1	1	1	1	1	1	$516,000	$516,000	$516,000	$516,000	$516,000	$516,000
Bryson	Jack	Other (Cisco formation)	1	1						$372,000					
Jack County Irrigation	Jack	Other	1	1						$43,000					
Jack County Livestock	Jack	Other	1	1						$43,000					
Jack County Mining	Jack	Other	1	1						$63,000					
Jack County-Other	Jack	Other	1	1						$372,000					
Kaufman County Irrigation	Kaufman	Nacatoch	1	1						$56,000					
Kaufman County Livestock	Kaufman	Nacatoch	1	1						$56,000					
Kaufman County-Other	Kaufman	Nacatoch	1	1						$404,000					
Frost	Navarro	Woodbine	1 emergency		1					$558,000					
Navarro County Livestock	Navarro	Carrizo-Wilcox	1	1						$105,000					
Navarro County Mining	Navarro	Carrizo-Wilcox & Nacat	2	1		1				$174,000		$174,000			
Navarro County-Other	Navarro	Woodbine	1		1						$558,000				
Aledo	Parker	Trinity (Paluxy)	6	1	1	1	1	1	1	$372,000	$372,000	$372,000	$372,000	$372,000	$372,000
Annetta South	Parker		10	2	2	2	1	2	1	$722,000	$722,000	$722,000	$361,000	$722,000	$361,000
Annetta	Parker		10	2	2	2	1	2	1	$722,000	$722,000	$722,000	$361,000	$722,000	$361,000
Hudson Oaks	Parker	Trinity (Paluxy)	21	4	3	4	3	4	3	$1,432,000	$1,074,000	$1,432,000	$1,074,000	$1,432,000	$1,074,000
Parker County Irrigation	Parker	Trinity	1	1						$28,000					
Parker County Livestock	Parker	Trinity	1	1						$28,000					
Parker County Manufacturing	Parker	Trinity	1	1						$242,000					
Parker County Mining	Parker	Trinity	1	1						$38,000					
Parker County-Other	Parker	Trinity & Other	1	1						$331,000					
Reno	Parker	Trinity (Paluxy)	6	1	1	1	1	1	1	$386,000	$386,000	$386,000	$386,000	$386,000	$386,000
Springtown	Parker	Trinity (Paluxy)	2	1				1		$530,000				$530,000	
Springtown	Parker	Trinity (Travis Peak)	1			1						$361,000			
Willow Park	Parker	Trinity (Paluxy)	17	3	3	3	3	3	2	$994,000	$994,000	$994,000	$994,000	$994,000	$663,000
Rockwall County Livestock	Rockwall	Other	1	1						$28,000					
Rockwall County-Other	Rockwall	Other	1	1						$331,000					
Bedford	Tarrant	Trinity	2	1			1			$1,031,000			$1,031,000		
Benbrook	Tarrant	Trinity (Paluxy)	14	3	3	2	2	2	2	$1,047,000	$1,047,000	$698,000	$698,000	$698,000	$698,000
Bethesda WSC	Tarrant	Trinity (Paluxy)	24	4	4	4	4	4	4	$1,746,000	$1,746,000	$1,746,000	$1,746,000	$1,746,000	$1,746,000
Blue Mound	Tarrant	Trinity (Paluxy)	3	1			1			$764,084			$764,084		
Crowley	Tarrant	Trinity (Travis Peak)	6	1	1	1	1	1	1	$533,000	$533,000	$533,000	$533,000	$533,000	$533,000
Crowley	Tarrant	Trinity (Paluxy)	2	1			1			$408,000			$408,000		
Dalworthington Gardens	Tarrant	Trinity (Travis Peak)	1	1						$705,000					
Dalworthington Gardens	Tarrant	Trinity (Paluxy)	1				1						$460,000		
Euless	Tarrant	Trinity (Travis Peak)	2	1			1			$1,125,000			$1,125,000		

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Everman	Tarrant	Trinity (Paluxy)	4	1		1		1	1	$414,000		$414,000		$414,000	$414,000
Everman	Tarrant	Trinity (Twin Mountains	2		1		1				$626,000		$626,000		
Everman	Tarrant	Trinity (Travis Peak)	1		1						$616,000				
Haslet	Tarrant	Trinity (Paluxy)	3	1			1		1	$430,000			$430,000		$430,000
Haslet	Tarrant	Trinity (Travis Peak)	1			1						$583,000			
Hurst	Tarrant	Trinity (Travis Peak)	6	1	1	1	1	1	1	$993,000	$993,000	$993,000	$993,000	$993,000	$993,000
Keller	Tarrant	Trinity (Paluxy)	2		1						$711,000				
Kennedale	Tarrant	Trinity (Twin Mountains	3	1		1		1		$862,000		$862,000		$862,000	
Kennedale	Tarrant	Trinity (Paluxy)	3		1		1		1		$433,000		$433,000		$433,000
Kennedale	Tarrant	Trinity (Travis Peak)	1	1						$847,000					
Lake Worth	Tarrant	Trinity (Paluxy)	4	1		1		1	1	$368,000		$368,000		$368,000	$368,000
Lake Worth	Tarrant	Trinity (Travis Peak)	1		1						$479,000				
Lakeside	Tarrant	Trinity	5	1	1	1	1	1		$413,000	$413,000	$413,000	$413,000	$413,000	
North Richland Hills	Tarrant	Trinity (Travis Peak)	1	1						$502,000					
Pantego	Tarrant	Trinity (Travis Peak)	5	1		1	1	1	1	$612,000		$612,000	$612,000	$612,000	$612,000
Pantego	Tarrant	Trinity (Paluxy)	1		1						$450,000				
Pelican Bay	Tarrant	Trinity (Travis Peak)	3	1		1		1		$402,000		$402,000		$402,000	
Pelican Bay	Tarrant	Trinity (Paluxy)	6	1	1	1	1	1	1	$336,000	$336,000	$336,000	$336,000	$336,000	$336,000
Pelican Bay	Tarrant	Trinity (Twin Mountains	2		1		1				$359,000		$359,000		
Richland Hills	Tarrant	Trinity (Travis Peak)	3	1		1		1		$716,000		$716,000		$716,000	
Richland Hills	Tarrant	Trinity (Paluxy)	3		1		1		1		$411,000		$411,000		$411,000
Sansom Park Village	Tarrant	Trinity (Paluxy)	9	2	1	2	1	2	1	$768,000	$384,000	$768,000	$384,000	$768,000	$384,000
Tarrant County Irrigation	Tarrant	Trinity	1	1						$75,000					
Tarrant County Livestock	Tarrant	Trinity	1	1						$75,000					
Tarrant County Mining	Tarrant	Trinity	2		1		1				$78,000		$78,000		
Tarrant County-Other	Tarrant	Trinity	1	1						$463,000					
White Settlement	Tarrant	Trinity (Paluxy)	6	1	1	1	1	1	1	$349,000	$349,000	$349,000	$349,000	$349,000	$349,000
White Settlement	Tarrant	Trinity (Twin Mountains	3	1		1		1		$461,000		$461,000		$461,000	
White Settlement	Tarrant	Trinity (Travis Peak)	1		1						$492,000				
Alvord	Wise	Trinity (Paleozoic Erathe	4	1		1		1	1	$377,000		$377,000		$377,000	$377,000
Aurora	Wise		4	1	1		1		1	$378,000	$378,000		$378,000		$378,000
Bolivar WSC	Wise	Trinity	2	1			1			$348,000			$348,000		
Boyd	Wise	Trinity (Paleozoic Erathe	2	1			1			$380,000			$380,000		
Chico	Wise	Trinity (Antlers)	7	2	1	1	1	1	1	$639,000	$320,000	$320,000	$320,000	$320,000	$320,000
New Fairview	Wise		4	1	1		1		1	$335,000	$335,000		$335,000		$335,000
Newark	Wise	Trinity (Paluxy)	6	1	1	1	1	1	1	$397,000	$397,000	$397,000	$397,000	$397,000	$397,000
Rhome	Wise	Trinity (Paluxy)	3	1		1		1		$394,000		$394,000		$394,000	
Wise County Irrigation	Wise	Trinity	1	1						$35,000					
Wise County Livestock	Wise	Trinity	1	1						$35,000					
Wise County Manufacturing	Wise	Other	1	1						$259,000					
Wise County Mining	Wise	Trinity	1	1						$49,000					
Wise County-Other	Wise	Trinity	1	1						$348,000					

Table Q-14
Cost Estimates for New Water Treatment Plants

WUG	Water Management Strategies	County	New MGD	Capital Costs (including engineering, contingencies & interest)					
				2010	2020	2030	2040	2050	2060
Lewisville	New WTP of 10 MGD	Denton	10				$31,621,000		
Fairfield	New 0.7 MGD WTP on Richland - Chambers	Freestone	0.7				$6,151,000		
East Cedar Creek FWSD	New WTP of 2 MGD	Henderson	2			$11,576,000			
Gun Barrel City	New WTP of 2 MGD	Henderson	2		$11,576,000				
Chatfield WSC - Alternative WMS*	New WTP of 2 MGD on Richland-Chambers Reservoir	Navarro	2		$4,000,000				
Chatfield WSC - Alternative WMS*	New WTP of 2 MGD on Cedar Creek Reservoir	Navarro	2		$4,500,000				
M E N WSC - Alternative WMS*	New WTP of 2 MGD on Richland-Chambers Reservoir	Navarro	2		$4,000,000				
M E N WSC - Alternative WMS*	New WTP of 2 MGD on Cedar Creek Reservoir	Navarro	2		$4,500,000				
Corsicana**	New WTP of 8 MGD - Lake Halbert/Richland-Chambers (to replace existing 4 MGD WTP)	Navarro	8		$28,665,000				
Dawson	New WTP of 0.1 MGD on Navarro Mills	Navarro	0.1		$1,044,000				
Walnut Creek SUD	New WTP of 2 MGD	Parker	2			$11,576,000			
Springtown	New WTP of 1 MGD	Parker	1		$8,188,000				
Fort Worth	New West WTP 12 MGD	Tarrant	12		$57,915,000				
Fort Worth	New Southwest WTP 25 MGD	Tarrant	25		$42,702,000				
Mansfield	New WTP of 15 MGD	Tarrant	15		$41,080,000				
Azle	New WTP of 3 MGD	Tarrant	3				$14,964,000		
Bridgeport	New WTP of 2 MGD	Wise	2		$11,576,000				
Wise County WSD (Decatur)	New WTP of 2 MGD	Wise	2			$11,576,000			
West Wise SUD	New WTP of 0.5 MGD	Wise	0.5			$4,871,000			

*Costs provided by WUG's engineer
**See Q-97 for details

Table Q-15
Water Treatment Plant Expansions

WUG	Water Management Strategies	Number of expansions	County	Each Expansion (MGD)	Capital Costs (including engineering, contingencies & interest)					
					2010	2020	2030	2040	2050	2060
Denton	Ray Roberts WTP Exp. of 30 MGD	2	Denton	30			$51,111,000		$51,111,000	
Denton	Ray Roberts WTP Exp. of 20 MGD	2	Denton	20		$37,367,000		$37,367,000		
Denton	Water treatment plant expansion	2	Denton	25						$88,478,000
Lewisville	Water treatment plant expansion	2	Denton	8	$19,669,000	$19,669,000				
Lewisville	New Water treatment plant expansion	1	Denton	5						$14,328,000
Wortham	Plant rehabilitation and upgrades	1	Freestone	1.2	$4,662,000					
Denison	Water treatment plant expansion	1	Grayson	2		$7,270,000				
East Cedar Creek	Water treatment plant expansion	2	Henderson	2		$7,270,000				$7,270,000
Athens MWA	Water treatment plant expansion	1	Henderson	4						$12,387,000
Mabank	Water treatment plant expansion	1	Kaufman	1			$4,094,000			
MacBee WSC	Water treatment plant expansion	1	Kaufman	2		$7,270,000				
West Cedar Creek MUD	Water treatment plant expansion	2	Kaufman	5			$14,328,000			$14,328,000
Corsicana* - Alternative WMS	Water treatment plant expansion	1	Navarro	8				$14,548,000		
Weatherford	Water treatment plant expansion	2	Parker	7			$18,211,000			$18,211,000
Walnut Creek SUD	Water treatment plant expansion	7	Parker	2		$7,270,000	$14,540,000	$14,540,000	$7,270,000	$7,270,000
Springtown	Water treatment plant expansion	1	Parker	1			$4,094,000			
Cash SUD	Water treatment plant expansion	1	Rockwall	2			$7,270,000			
Benbrook	Water treatment plant expansion	3	Tarrant	1.5		$5,682,000		$5,682,000	$5,682,000	
Fort Worth	Eagle Mountain WTP Expansion of 35 MGD	1	Tarrant	35			$58,126,000			
Fort Worth	Rolling Hills WTP Expansion	1	Tarrant	50		$77,883,000				
Fort Worth	Water treatment plant expansion	5	Tarrant	50					$77,883,000	$77,883,000
Fort Worth	Eagle Mountain WTP Exp. of 70 MGD	1	Tarrant	70				$103,367,000		
Fort Worth	New West WTP Exp. of 35 MGD	1	Tarrant	35				$58,126,000		
Fort Worth	New Southwest WTP Exp. of 25 MGD	1	Tarrant	25					$44,239,000	
Fort Worth	New West WTP Exp. of 23 MGD	1	Tarrant	23				$41,490,000		
Mansfield	Water treatment plant expansion	5	Tarrant	15		$59,008,000	$29,504,000	$29,504,000		$29,504,000
Azle	Water treatment plant expansion	2	Tarrant	3		$10,446,000			$10,446,000	
Arlington	Water treatment plant expansion	1	Tarrant	32.5				$54,618,000		
Bridgeport	Water treatment plant expansion	2	Wise	2				$7,270,000		$7,270,000
Wise County WSD (Decatur)	Water treatment plant expansion	3	Wise	2		$7,270,000		$7,270,000		$7,270,000
Runaway Bay	Water treatment plant expansion	1	Wise	0.5		$2,735,000				
West Wise SUD	Water treatment plant expansion	1	Wise	1						$4,094,000

*See Q-96 for details

Table Q-16

WWPNAME:	**Sabine River Authority**	
STRATEGY:	**Toledo Bend Pipeline Project**	
Quantity:	**700,000**	**Ac-ft per year**

CONSTRUCTION COSTS
TRANSMISSION FACILITIES

Pipeline	**No.**	**Size**	**Quantity**	**Unit**	**Cost**
Segment A	2x	120 in.	1,129,920	LF	$1,506,183,000
Segment B	2x	114 in.	168,425	LF	$199,246,000
Segment C	1x	120 in.	502,495	LF	$743,957,000
Segment D	1x	90 in.	172,995	LF	$180,780,000
Segment E	1x	114 in.	224,077	LF	$265,083,000
Segment F	1x	96 in.	63,231	LF	$54,378,000
Engineering and Contingencies (30%)					$884,888,000
Subtotal of Pipeline					**$3,834,515,000**
Right of Way					
Rural ROW			2201	AC	$22,006,000
Urban ROW			341	AC	$20,440,000
Pump Station(s)					
Lake Intake - Toledo Bend			1		$22,348,800
Booster Pump Station 1		41000 HP	2	EA	$67,725,000
Booster Pump Station 2		37000 HP	2	EA	$62,780,000
Booster Pump Station 3		41000 HP	2	EA	$67,725,000
Booster Pump Station 4		15000 HP	1	EA	$16,340,000
Booster Pump Station 5		22000 HP	1	EA	$21,715,000
Booster Pump Station 6		40000 HP	1	EA	$33,325,000
Booster Pump Station 7		20000 HP	1	EA	$20,425,000
Booster Pump Station 8		12000 HP	1	EA	$13,889,000
Booster Pump Station 9		12000 HP	1	EA	$13,889,000
Engineering and Contingencies (35%)					$119,057,000
Subtotal of Pump Station(s)					**$459,218,800**
Storage					
Ground Storage Tank 1		98.0 MG	2	EA	$15,422,000
Ground Storage Tank 2		91.0 MG	1	EA	$7,408,000
Ground Storage Tank 3		49.0 MG	3	EA	$13,512,000
Ground Storage Tank 4		28.0 MG	2	EA	$6,894,000
Engineering and Contingencies (35%)					$15,133,000
Subtotal of Storage					**$58,369,000**
CONSTRUCTION TOTAL					**$4,394,548,800**
Permitting and Mitigation					**$33,755,000**
Interest During Construction					**$538,792,000**
TOTAL COST					**$4,967,095,800**

Table Q-16, Continued

Capital Cost by User:		
SRA	100,000 AF/Y	**$462,190,000**
NTMWD	200,000 AF/Y	**$1,211,114,000**
TRWD	200,000 AF/Y	**$1,860,018,000**
DWU	200,000 AF/Y	**$1,433,774,000**

ANNUAL COSTS for SRA	
Debt Service (6% for 30 years)	$33,577,538
Electricity ($0.09 kWh)	$13,850,500
Operation & Maintenance	$4,211,011
Raw Water Purchase	$0
Total Annual Costs	**$51,639,049**
UNIT COSTS (Until Amortized)	
Per Acre-Foot	$516
Per 1,000 Gallons	$1.58
UNIT COSTS (After Amortization)	
Per Acre-Foot	$181
Per 1,000 Gallons	$0.55

ANNUAL COSTS for NTMWD	
Debt Service (6% for 30 years)	$87,986,154
Electricity ($0.09 kWh)	$34,096,000
Operation & Maintenance	$10,994,330
Raw Water Purchase ($0.10/Kgal)	$6,517,020
Total Annual Costs	**$139,593,504**
UNIT COSTS (Until Amortized)	
Per Acre-Foot	$698
Per 1,000 Gallons	$2.14
UNIT COSTS (After Amortization)	
Per Acre-Foot	$258
Per 1,000 Gallons	$0.79

Table Q-16, Continued

ANNUAL COSTS for TRWD	
Debt Service (6% for 30 years)	$135,128,154
Electricity ($0.09 kWh)	$50,481,000
Operation & Maintenance	$16,808,044
Raw Water Purchase	$6,517,020
Total Annual Costs	**$208,934,218**
UNIT COSTS (Until Amortized)	
Per Acre-Foot	$1,045
Per 1,000 Gallons	$3.21
UNIT COSTS (After Amortization)	
Per Acre-Foot	$369
Per 1,000 Gallons	$1.13
ANNUAL COSTS for DWU	
Debt Service (6% for 30 years)	$104,162,154
Electricity ($0.09 kWh)	$38,958,500
Operation & Maintenance	$12,965,615
Raw Water Purchase	$6,517,020
Total Annual Costs	**$162,603,289**
UNIT COSTS (Until Amortized)	
Per Acre-Foot	$813
Per 1,000 Gallons	$2.50
UNIT COSTS (After Amortization)	
Per Acre-Foot	$292
Per 1,000 Gallons	$0.90
TOTAL ANNUAL COSTS for REGION C (Excludes SRA)	
Debt Service (6% for 30 years)	$327,276,462
Electricity ($0.09 kWh)	$123,535,500
Operation & Maintenance	$40,767,989
Raw Water Purchase ($0.10 per kGal)	$19,551,060
Total Annual Costs	**$511,131,011**
UNIT COSTS (Until Amortized)	
Per Acre-Foot	$852
Per 1,000 Gallons	$2.61
UNIT COSTS (After Amortization)	
Per Acre-Foot	$306
Per 1,000 Gallons	$0.94

Table Q-17

WWPNAME:	**Sabine River Authority**				
STRATEGY:	**Toledo Bend Pipeline Project**				
Quantity:	**500,000 Ac-ft per year**				

CONSTRUCTION COSTS
TRANSMISSION FACILITIES

Pipeline	**No.**	**Size**	**Quantity**	**Unit**	**Cost**
Segment A	2x	102 in.	1,129,920	LF	$1,081,333,000
Segment B	2x	96 in.	168,425	LF	$144,845,000
Segment C	1x	90 in.	502,495	LF	$431,858,000
Segment D	1x	90 in.	172,995	LF	$180,780,000
Segment E	1x	102 in.	224,077	LF	$214,441,000
Segment F	1x	96 in.	63,231	LF	$54,378,000
Engineering and Contingencies (30%)					$632,291,000
Subtotal of Pipeline					**$2,739,926,000**
Right of Way					
Rural ROW			1772	AC	$17,722,000
Urban ROW			304	AC	$18,258,000
Pump Station(s)					
Lake Intake - Toledo Bend			1		$19,866,000
Booster Pump Station 1		35000 HP	2	EA	$60,200,000
Booster Pump Station 2		30000 HP	2	EA	$53,750,000
Booster Pump Station 3		32500 HP	2	EA	$56,975,000
Booster Pump Station 4		13000 HP	1	EA	$14,706,000
Booster Pump Station 5		19000 HP	1	EA	$19,608,000
Booster Pump Station 6		26000 HP	1	EA	$24,295,000
Booster Pump Station 7		22000 HP	1	EA	$21,715,000
Booster Pump Station 8		15000 HP	1	EA	$16,340,000
Booster Pump Station 9		12000 HP	1	EA	$13,889,000
Engineering and Contingencies (35%)					$105,470,000
Subtotal of Pump Station(s)					**$406,814,000**
Storage					
Ground Storage Tank 1		70.0 MG	2	EA	$12,954,000
Ground Storage Tank 2		63.0 MG	1	EA	$6,158,000
Ground Storage Tank 3		28.0 MG	5	EA	$17,235,000
Engineering and Contingencies (35%)					$12,721,000
Subtotal of Storage					**$49,068,000**
CONSTRUCTION TOTAL					**$3,231,788,000**
Permitting and Mitigation					**$24,813,000**
Interest During Construction					**$396,231,000**
TOTAL COST					**$3,652,832,000**

Table Q-17, Continued

Capital Cost by User:		
SRA	100,000 AF/Y	**$475,650,000**
NTMWD	200,000 AF/Y	**$1,239,762,000**
TRWD	200,000 AF/Y	**$1,937,420,000**
ANNUAL COSTS for SRA		
Debt Service (6% for 30 years)		$34,555,400
Electricity ($0.09 kWh)		$15,718,800
Operation & Maintenance		$4,420,622
Raw Water Purchase		$0
Total Annual Costs		**$54,694,822**
UNIT COSTS (Until Amortized)		
Per Acre-Foot		$547
Per 1,000 Gallons		$1.68
UNIT COSTS (After Amortization)		
Per Acre-Foot		$201
Per 1,000 Gallons		$0.62
ANNUAL COSTS for NTMWD		
Debt Service (6% for 30 years)		$90,067,600
Electricity ($0.09 kWh)		$37,997,600
Operation & Maintenance		$11,454,489
Raw Water Purchase ($0.10 per kGal)		$6,518,000
Total Annual Costs		**$146,037,689**
UNIT COSTS (Until Amortized)		
Per Acre-Foot of treated water		$730
Per 1,000 Gallons		$2.24
UNIT COSTS (After Amortization)		
Per Acre-Foot		$280
Per 1,000 Gallons		$0.86

Table Q-17, Continued

ANNUAL COSTS for TRWD	
Debt Service (6% for 30 years)	$140,751,000
Electricity ($0.09 kWh)	$58,295,600
Operation & Maintenance	$17,858,889
Raw Water Purchase ($0.10 per kGal)	$6,518,000
Total Annual Costs	**$223,423,489**
UNIT COSTS (Until Amortized)	
Per Acre-Foot	$1,117
Per 1,000 Gallons	$3.43
UNIT COSTS (After Amortization)	
Per Acre-Foot	$413
Per 1,000 Gallons	$1.27
TOTAL ANNUAL COSTS for Region C (excludes SRA)	
Debt Service (6% for 30 years)	$230,818,600
Electricity ($0.09 kWh)	$96,293,200
Operation & Maintenance	$29,313,378
Raw Water Purchase ($0.10 per kGal)	$13,036,000
Total Annual Costs	**$369,461,178**
UNIT COSTS (Until Amortized)	
Per Acre-Foot	$924
Per 1,000 Gallons	$2.83
UNIT COSTS (After Amortization)	
Per Acre-Foot	$347
Per 1,000 Gallons	$1.06

Table Q-18
Gulf of Mexico Water with Desalination

Probable Owner: Multiple
Amount: 200,000 Acre-Feet/Year

CONSTRUCTION COSTS

TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline Rural (2 pipelines)	78 in.	1,465,625	LF	$591	$1,732,369,000
Pipeline Urban (2 pipelines)	78 in.	65,625	LF	$799	$104,869,000
Right of Way Easements (Rural)		2,931,250	LF	$9	$26,381,000
Right of Way Easements (Urban)		131,250	LF	$55	$7,219,000
Engineering and Contingencies (30%)					$551,171,000
Subtotal of Pipeline					**$2,422,009,000**
Pump Station(s)					
Intake and Pump Station at Gulf	535 MGD	1	EA	$2,343,000	$2,343,000
Booster Pump Station	33478 HP	5	EA	$29,118,000	$145,590,000
Ground Storage Tanks (covered)	8 MG	20	EA	$2,822,000	$56,440,000
Engineering and Contingencies (35%)					$71,531,000
Subtotal of Pump Station(s)					**$275,904,000**
Terminal Storage in North Texas					
Ground Storage Tanks (covered)	10 MG	12	EA	$3,746,000	$44,952,000
Permitting and Mitigation		1	LS		$25,039,000

WATER TREATMENT FACILITIES

Additonal water treatment capacity in North Texas	110	MGD	$126,343,000
Treatment Plant with RO	250	MGD	$700,416,000
Engineering and Contingencies (35%)			$289,366,000
Subtotal of Water Treatment			**$1,116,125,000**
Permitting of treatment plant and reject stream			$9,921,000
CONSTRUCTION TOTAL			**$3,893,950,000**
Interest During Construction		**(36 months)**	**$473,777,000**
TOTAL CAPITAL COST			**$4,367,727,000**

Table Q-18, Continued

ANNUAL COSTS	
Debt Service (6% for 30 years)	$317,311,000
Raw water purchase	NA
Electricity ($0.09 per kWh)	$56,582,000
Facility Operation & Maintenance	$29,527,000
Water Treatment ($1.24/1,000 gal finished water)	$80,811,000
Reject water disposal ($0.35/1,000 gal)	$22,810,000
Total Annual Costs	**$507,041,000**
UNIT COSTS (Until Amortized)	
Per Acre-Foot of treated water	$2,535
Per 1,000 Gallons of treated water	$7.78
UNIT COSTS (After Amortization)	
Per Acre-Foot of treated water	$949
Per 1,000 Gallons of treated water	$2.91

Table Q-19
Cost of Marvin Nichols IA Reservoir and Transmission System

Probable Owner:	NTMWD	172,800	AF/Y	34.9%	170,895	
	TRWD	165,500	AF/Y	33.4%	163,676	
	Dallas	97,000	AF/Y	19.6%	95,931	
	Irving	25,000	AF/Y	5.0%	24,724	
	Upper Trinity RWD	35,000	AF/Y	7.1%	34,614	
	Total	495,300	AF/Y		489,840	80% of yield with Ralph Hall lake built

CONSTRUCTION COSTS

DAM & RESERVOIR	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Land Purchase Costs		77,427	AC	$1,250	$96,784,000
Mobilization		1	LS	$8,545,000	$8,545,000
Spillway Construction					
Mass Concrete		87,300	CY	$165	$14,362,000
Reinforced Concrete		26,800	CY	$625	$16,754,000
Soil Cement		3,600	CY	$41	$148,000
Spillway Bridge		640	LF	$1,450	$928,000
Gates, Including Anchoring System		14,040	SF	$309	$4,338,000
Gate Hoist and Operating System		13	EA	$296,000	$3,848,000
Stop Gate and Lift Beam		640	LF	$2,110	$1,350,000
Instrumentation		640	LF	$921	$589,000
Excavation		2,894,000	CY	$4	$11,426,000
Structural Fill		121,000	CY	$16	$1,911,000
Subtotal of Spillway Construction					**$55,654,000**
Embankment Construction					
Random Fill		6,049,600	CY	$2.60	$15,729,000
Impervious Core		1,455,000	CY	$3.30	$4,802,000
Borrow		4,731,600	CY	$2.60	$12,302,000
Foundation Drain (Filter Material)		502,500	CY	$40.80	$20,502,000
Soil Cement		337,800	CY	$46.10	$15,573,000
Slurry Trench Cutoff		1,770,000	SF	$11.20	$19,824,000
Asphalt Paving on Embankment Crest		68,350	SY	$23.00	$1,572,000
Containment Levee		79,100	CY	$3.30	$261,000
Subtotal of Embankment Construction					**$90,565,000**
Other Items					
Barrier Warning System		640	LF	$118	$76,000
Electrical System		1	LS	$658,000	$658,000
Power Drop		1	LS	$263,200	$263,000
Spillway Low-Flow System		1	LS	$460,600	$461,000
Stop Gate Monorail System		640	LF	$1,050	$672,000
Grassing		100	AC	$4,500	$450,000
Clearing and Grubbing/ Site Preparation		27960	LF	$39	$1,090,000
Care of Water (3% of construction)		1	LS	$4,387,000	$4,387,000
Reservoir Land Clearing		16800	AC	$990	$16,632,000
Subtotal of Other Items					**$24,689,000**

Table Q-19, Continued

Conflicts		1	LS	$ 69,341,000	$69,341,000
Engineering and Contingencies (35%)					$87,078,000
Permitting and Mitigation					$213,968,000
Total Dam and Reservoir					**$646,624,000**
Subtotal for Region C Part of Dam & Reservoir					**$646,624,000**
NTMWD Portion of Dam & Reservoir	*34.9%*				*$225,672,000*
Dallas Portion of Dam & Reservoir	*19.6%*				*$126,738,000*
TRWD Portion of Dam & Reservoir	*33.4%*				*$215,972,000*
Irving Portion of Dam & Reservoir	*5.0%*				*$32,331,000*
Upper Trinity RWD Portion Dam & Reservoir	*7.1%*				*$45,910,000*
Subtotal Check					*$646,623,000*

TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline Rural (Reservoir to Lk. Lavon) x 2	108 in	419,200	LF	$1,075	$901,280,000
Pipeline Urban (Reservoir to Lk. Lavon) x 2	108 in	10,000	LF	$1,451	$29,020,000
Right of Way Easements Rural (ROW)		838,400	LF	$9	$7,546,000
Right of Way Easements Urban (ROW)		20,000	LF	$55	$1,100,000
Engineering and Contingencies (30%)					$279,090,000
Permitting & Mitigation					$11,164,000
Subtotal of Pipeline (Reservoir to Lake Lavon)					**$1,229,200,000**
Pipeline Rural (Lake Lavon to Lewisville) x 2	96 in	69,000	LF	$860	$118,680,000
Pipeline Urban (Lake Lavon to Lewisville) x 2	96 in	103,500	LF	$1,161	$240,327,000
Right of Way Easements Rural (ROW)		138,000	LF	$9	$1,242,000
Right of Way Easements Urban (ROW)		207,000	LF	$55	$11,385,000
Engineering and Contingencies (30%)					$107,702,000
Permitting & Mitigation					$4,308,000
Subtotal of Pipeline (Lake Lavon to Lake Lewisville)					**$483,644,000**

Table Q-19, Continued

Pipeline Rural (Lake Lewisville to Eagle Mountain Lake) x 2	72 in	136,290	LF	$516	$140,651,000
Pipeline Urban (Lake Lewisville to Eagle Mountain Lake) x 2	72 in	58,410	LF	$697	$81,424,000
Right of Way Easements Rural (ROW)		272,580	LF	$7	$1,908,000
Right of Way Easements Urban (ROW)		116,820	LF	$41	$4,790,000
Engineering and Contingencies (30%)					$66,623,000
Permitting & Mitigation					$2,665,000
Subtotal of Pipeline (Lake Lewisville to Eagle Mountain Lake)					**$298,061,000**
Total Pipeline Cost					**$2,010,905,000**
NTMWD Portion of Pipeline	*34.9% (Res to Lavon)*				*$428,991,000*
Dallas Portion of Pipeline	*19.6% (Res to Lavon) & 30.1% (Lavon to Lewisville)*				*$386,403,000*
TRWD Portion of Pipeline	*33.4% (Res to Lavon) & 51.3% (Lavon to Lewisville) & 100% (Lewisville to Eagle Mountain)*				*$956,819,000*
Irving Portion of Pipeline	*5% (Res to Lavon) & 7.75% (Lavon to Lewisvville)*				*$98,942,000*
Upper Trinity RWD Portion of Pipeline	*7.1% (Res to Lavon) & 10.85% (Lavon to Lewisville)*				*$139,749,000*
Total Check					*$2,010,904,000*

Pump Station(s)	**Size (per PS)**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pump Stations with Intake (Reservoir to Lake Lavon)	55800 HP	2	LS	$55,617,000	$111,234,000
Ground Storage Tanks at booster station	10 MG	7	EA	$2,752,000	$19,264,000
Engineering and Contingencies (35%)					$45,674,000
Permitting & Mitigation					$1,566,000
Subtotal of Pump Station(s) (Reservoir to Lake Lavon)					**$177,738,000**
Pump Station (Lake Lavon to Lake Lewisville)	20300 HP	1	LS	$20,619,000	$20,619,000
Ground Storage Tanks	10 MG	4	EA	$2,752,000	$11,008,000
Engineering and Contingencies (35%)					$11,069,000
Permitting & Mitigation					$380,000
Subtotal of Pump Station(s) (Lake Lavon to Lake Lewisville)					**$43,076,000**
Pump Stations (Lewisville to Eagle Mountain Lake)	7700 HP	2	LS	$9,600,000	$19,200,000
Ground Storage Tanks	10 MG	4	EA	$2,752,000	$11,008,000
Engineering and Contingencies (35%)					$10,573,000
Permitting & Mitigation					$362,000
Subtotal of Pump Station(s) (Lake Lewisville to Eagle Mountain Lake)					**$41,143,000**
Total Pump Station Costs (Including Storage Tanks)					**$261,957,000**

Table Q-19, Continued

NTMWD	*34.9 (Res to Lavon)*	*$62,031,000*
Dallas	*19.6% (Res to Lavon) & 30.1% (Lavon to Lewisville)*	*$47,794,000*
TRWD	*33.4% (Res to Lavon) & 51.3% (Lavon to Lewisville) & 100%*	*$122,615,000*
Irving	*5% (Res to Lavon) & 7.75% (Lavon to Lewisvville)*	*$12,225,000*
UTRWD	*7.1% (Res to Lavon) & 10.85% (Lavon to Lewisville)*	*$17,293,000*
Total Check		*$261,958,000*
CONSTRUCTION TOTAL		**$2,919,486,000**
Interest During Construction	**(36 months - pipeline) (48 months for reservoir)**	**$381,079,000**
TOTAL COST		**$3,300,565,000**
NTMWD		*$810,244,000*
Dallas		*$634,154,000*
TRWD		*$1,464,495,000*
Irving		*$162,229,000*
Upper Trinity RWD		*$229,443,000*
Total Check		*$3,300,565,000*

TOTAL COST ANALYSIS	
NTMWD	**Cost**
Debt Service (6% for 30 years)	$58,863,000
Electricity ($0.09 kWh)	$16,977,000
Operation & Maintenance	$6,336,000
Total Annual Costs (NTMWD)	**$82,176,000**
Dallas	
Debt Service (6% for 30 years)	$46,071,000
Electricity ($0.09 per kWh)	$12,210,000
Operation & Maintenance	$5,140,000
Total Annual Costs (Dallas)	**$63,421,000**
TRWD	
Debt Service (6% for 30 years)	$106,394,000
Electricity ($0.09 kWh)	$28,037,000
Operation & Maintenance	$12,332,000
Total Annual Costs (TRWD)	**$146,763,000**
Irving	
Debt Service (6% for 30 years)	$11,786,000
Electricity ($0.09 kWh)	$3,147,000
Operation & Maintenance	$1,315,000
Total Annual Costs (Irving)	**$16,248,000**
Upper Trinity RWD	
Debt Service (6% for 30 years)	$16,669,000
Electricity ($0.09 kWh)	$4,406,000
Operation & Maintenance	$1,859,000
Total Annual Costs (Upper Trinity RWD)	**$22,934,000**

Table Q-19, Continued

TOTAL ANNUAL	
Debt Service (6% for 30 years)	$239,783,000
Electricity ($0.09 kWh)	$64,777,000
Operation & Maintenance	$26,982,000
Total Annual Costs (All Users)	**$331,542,000**
UNIT COSTS (Before Amortization)	
NTMWD	
Per Acre-Foot	$481
Per 1,000 Gallons	$1.48
Dallas	
Per Acre-Foot	$661
Per 1,000 Gallons	$2.03
TRWD	
Per Acre-Foot	$897
Per 1,000 Gallons	$2.75
Irving	
Per Acre-Foot	$657
Per 1,000 Gallons	$2.02
Upper Trinity RWD	
Per Acre-Foot	$663
Per 1,000 Gallons	$2.03
TOTAL ALL USERS	
Per Acre-Foot	$677
Per 1,000 Gallons	$2.08
ANNUAL COSTS (After Amortization)	
NTMWD	**Cost**
Electricity ($0.09 kWh)	$16,977,000
Operation & Maintenance	$6,336,000
Total Annual Costs (NTMWD)	**$23,313,000**
Dallas	
Electricity ($0.09 kWh)	$12,210,000
Operation & Maintenance	$5,140,000
Total Annual Costs (Dallas)	**$17,350,000**
TRWD	
Electricity ($0.09 kWh)	$28,037,000
Operation & Maintenance	$12,332,000
Total Annual Costs (TRWD)	**$40,369,000**
Irving	
Electricity ($0.09 kWh)	$3,147,000
Operation & Maintenance	$1,315,000
Total Annual Costs (Irving)	**$4,462,000**

Table Q-19, Continued	
Upper Trinity RWD	
Electricity ($0.09 kWh)	$4,406,000
Operation & Maintenance	$1,859,000
Total Annual Costs (Upper Trinity RWD)	**$6,265,000**
TOTAL ALL USERS	
Electricity ($0.09 kWh)	$64,777,000
Operation & Maintenance	$26,982,000
Total Annual Costs	**$91,759,000**
UNIT COSTS (After Amortization)	
NTMWD	
Per Acre-Foot	$136
Per 1,000 Gallons	$0.42
Dallas	
Per Acre-Foot	$181
Per 1,000 Gallons	$0.55
TRWD	
Per Acre-Foot	$247
Per 1,000 Gallons	$0.76
Irving	
Per Acre-Foot	$180
Per 1,000 Gallons	$0.55
Upper Trinity RWD	
Per Acre-Foot	$181
Per 1,000 Gallons	$0.56
TOTAL ALL USERS	
Per Acre-Foot	$187
Per 1,000 Gallons	$0.57

Table Q-20
Cost of Marvin Nichols IA Reservoir and Transmission System
North Texas MWD, Tarrant Regional WD, and Upper Trinity RWD

Total Yield =	612,300	acre-feet per year (with Ralph Hall senior, system operation with Wright Patman)				
		Region D	122,460		20.0%	Portion of Region C
		NTMWD	174,840	AF/Y	28.6%	35.8%
		TRWD	280,000	AF/Y	45.7%	57.1%
		Upper Trinity RWD	35,000	AF/Y	5.7%	7.1%
		Total	612,300	AF/Y		

CONSTRUCTION COSTS

DAM & RESERVOIR	Size	Quantity	Unit	Unit Price	Cost
Land Purchase Costs		77,427	AC	$1,250	$96,784,000
Mobilization		1	LS	$8,545,000	$8,545,000
Spillway Construction					
Mass Concrete		87,300	CY	$165	$14,362,000
Reinforced Concrete		26,800	CY	$625	$16,754,000
Soil Cement		3,600	CY	$41	$148,000
Spillway Bridge		640	LF	$1,450	$928,000
Gates, Including Anchoring System		14,040	SF	$309	$4,338,000
Gate Hoist and Operating System		13	EA	$296,000	$3,848,000
Stop Gate and Lift Beam		640	LF	$2,110	$1,350,000
Instrumentation		640	LF	$921	$589,000
Excavation		2,894,000	CY	$4	$11,426,000
Structural Fill		121,000	CY	$16	$1,911,000
Subtotal of Spillway Construction					**$55,654,000**
Embankment Construction					
Random Fill		6,049,600	CY	$2.60	$15,729,000
Impervious Core		1,455,000	CY	$3.30	$4,802,000
Borrow		4,731,600	CY	$2.60	$12,302,000
Foundation Drain (Filter Material)		502,500	CY	$40.80	$20,502,000
Soil Cement		337,800	CY	$46.10	$15,573,000
Slurry Trench Cutoff		1,770,000	SF	$11.20	$19,824,000
Asphalt Paving on Embankment Crest		68,350	SY	$23.00	$1,572,000
Containment Levee		79,100	CY	$3.30	$261,000
Subtotal of Embankment Construction					**$90,565,000**
Other Items					
Barrier Warning System		640	LF	$118	$76,000
Electrical System		1	LS	$658,000	$658,000
Power Drop		1	LS	$263,000	$263,000
Spillway Low-Flow System		1	LS	$461,000	$461,000
Stop Gate Monorail System		640	LF	$1,050	$672,000
Grassing		100	AC	$4,500	$450,000
Clearing and Grubbing/ Site Preparation		27960	LF	$39	$1,090,000
Care of Water		1	LS	$4,387,000	$4,387,000
Reservoir Land Clearing		16800	AC	$990	$16,632,000
Subtotal of Other Items					**$24,689,000**

Table Q-20, Continued

	Size	Quantity	Unit	Unit Price	Cost
Conflicts		1	LS	$ 69,341,000	**$69,341,000**
Engineering and Contingencies (35%)					$87,078,000
Permitting and Mitigation					$213,968,000
Total Dam and Reservoir					**$646,624,000**
Subtotal for Region C Part of Dam & Reservoir					**$646,624,000**
NTMWD Portion of Dam & Reservoir	*35.8%*				*$231,491,000*
TRWD Portion of Dam & Reservoir	*57.1%*				*$369,222,000*
Upper Trinity RWD Portion Dam & Reservoir	*7.1%*				*$45,910,000*
Subtotal Check					*$646,623,000*
TRANSMISSION FACILITIES					
Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline Rural (Reservoir to Lk. Lavon) x 2	108 in	419,200	LF	$1,075	$901,280,000
Pipeline Urban (Reservoir to Lk. Lavon) x 2	108 in	10,000	LF	$1,451	$29,020,000
Right of Way Easements Rural (ROW)		838,400	LF	$9	$7,546,000
Right of Way Easements Urban (ROW)		20,000	LF	$55	$1,100,000
Engineering and Contingencies (30%)					$279,090,000
Permitting & Mitigation					$11,164,000
Subtotal of Pipeline (Reservoir to Lake Lavon)					**$1,229,200,000**
Pipeline Rural (Lake Lavon to Lewisville) x 2	90 in	69,000	LF	$774	$106,812,000
Pipeline Urban (Lake Lavon to Lewisville) x 2	90 in	103,500	LF	$1,045	$216,315,000
Right of Way Easements Rural (ROW)		138,000	LF	$9	$1,242,000
Right of Way Easements Urban (ROW)		207,000	LF	$55	$11,385,000
Engineering and Contingencies (30%)					$96,938,000
Permitting & Mitigation					$3,878,000
Subtotal of Pipeline (Lake Lavon to Lake Lewisville)					**$436,570,000**
Pipeline Rural (Lake Lewisville to Eagle Mountain Lake) x 2	90 in	136,290	LF	$774	$210,977,000
Pipeline Urban (Lake Lewisville to Eagle Mountain Lake) x 2	90 in	58,410	LF	$1,045	$122,077,000
Right of Way Easements Rural (ROW)		272,580	LF	$9	$2,453,000
Right of Way Easements Urban (ROW)		116,820	LF	$55	$6,425,000
Engineering and Contingencies (30%)					$99,916,000
Permitting & Mitigation					$3,997,000
Subtotal of Pipeline (Lake Lewisville to Eagle Mountain Lake)					**$445,845,000**
Total Pipeline Cost					**$2,111,615,000**
NTMWD Portion of Pipeline	*35.8% (Res to Lavon)*				*$440,054,000*
TRWD Portion of Pipeline	*57.1% (Res to Lavon) & 88.9% (Lavon to Lewisville) & 100% (Lewisville to Eagle Mountain)*				*$1,535,780,000*
Upper Trinity RWD Portion of Pipeline	*7.1% (Res to Lavon) & 11.1% (Lavon to Lewisville)*				*$135,781,000*
Total Check					*$2,111,615,000*
Pump Station(s)	**Size (per PS)**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pump Stations with Intake (Reservoir to Lake Lavon)	55800 HP	2	LS	$55,617,000	$111,234,000
Ground Storage Tanks at booster station	10 MG	7	EA	$2,752,000	$19,264,000
Engineering and Contingencies (35%)					$45,674,000
Permitting & Mitigation					$1,566,000
Subtotal of Pump Station(s) (Reservoir to Lake Lavon)					**$177,738,000**

Table Q-20, Continued

Pump Station (Lake Lavon to Lake Lewisville)	24200 HP	1	LS	$23,134,000	$23,134,000
Ground Storage Tanks	9 MG	5	EA	$2,410,500	$12,053,000
Engineering and Contingencies (35%)					$12,315,000
Permitting & Mitigation					$422,000
Subtotal of Pump Station(s) (Lake Lavon to Lake Lewisville)					**$47,924,000**
Pump Stations (Lewisville to Eagle Mountain	26900 HP	1	LS	$24,875,500	$24,876,000
Ground Storage Tanks	10 MG	4	EA	$2,752,000	$11,008,000
Engineering and Contingencies (35%)					$12,559,000
Permitting & Mitigation					$431,000
Subtotal of Pump Station(s) (Lake Lewisville to Eagle Mountain Lake)					**$48,874,000**
Total Pump Station Costs (Including Storage Tanks)					**$274,536,000**
NTMWD	*35.8% (Res to Lavon)*				*$63,630,000*
TRWD	*57.1% (Res to Lavon) & 88.9% (Lavon to Lewisville) & 100%*				*$192,962,000*
UTRWD	*7.1% (Res to Lavon) & 11.1% (Lavon to Lewisville)*				*$17,944,000*
Total Check					*$274,536,000*
CONSTRUCTION TOTAL					**$3,032,775,000**
Interest During Construction	**(36 months - pipeline)** **(48 months for reservoir)**				**$394,863,000**
TOTAL COST					**$3,427,638,000**
NTMWD					*$830,894,000*
TRWD					*$2,371,116,000*
Upper Trinity RWD					*$225,628,000*
Total Check					*$3,427,638,000*
TOTAL COST ANALYSIS					
NTMWD					**Cost**
Debt Service (6% for 30 years)					$60,364,000
Electricity ($0.09 kWh)					$17,177,000
Operation & Maintenance					$5,292,000
Total Annual Costs (NTMWD)					**$82,833,000**
TRWD					
Debt Service (6% for 30 years)					$172,259,000
Electricity ($0.09 kWh)					$48,093,000
Operation & Maintenance					$19,825,000
Total Annual Costs (TRWD)					**$240,177,000**
Upper Trinity RWD					
Debt Service (6% for 30 years)					$16,392,000
Electricity ($0.09 kWh)					$4,524,000
Operation & Maintenance					$1,836,000
Total Annual Costs (Upper Trinity RWD)					**$22,752,000**

Table Q-20, Continued

TOTAL ANNUAL	
Debt Service (6% for 30 years)	$249,015,000
Electricity ($0.09 per kWh)	$69,794,000
Operation & Maintenance	$26,953,000
Total Annual Costs (All Users)	**$345,762,000**
UNIT COSTS (During Amortization)	
NTMWD	
Per Acre-Foot	$474
Per 1,000 Gallons	$1.45
TRWD	
Per Acre-Foot	$858
Per 1,000 Gallons	$2.63
Upper Trinity RWD	
Per Acre-Foot	$650
Per 1,000 Gallons	$1.99
Total All Users	
Per Acre-Foot	$706
Per 1,000 Gallons	$2.17
ANNUAL COSTS (After Amortization)	
NTMWD	**Cost**
Electricity ($0.09 kWh)	$17,177,000
Operation & Maintenance	$5,292,000
Total Annual Costs (NTMWD)	**$22,469,000**
TRWD	
Electricity ($0.09 kWh)	$48,093,000
Operation & Maintenance	$19,825,000
Total Annual Costs (TRWD)	**$67,918,000**
Upper Trinity RWD	
Electricity ($0.09 kWh)	$4,524,000
Operation & Maintenance	$1,836,000
Total Annual Costs (Upper Trinity RWD)	**$6,360,000**
Total All Users	
Electricity ($0.09 kWh)	$69,794,000
Operation & Maintenance	$26,953,000
Total Annual Costs (All Users)	**$96,747,000**
UNIT COSTS (After Amortization)	
NTMWD	
Per Acre-Foot	$129
Per 1,000 Gallons	$0.39
TRWD	
Per Acre-Foot	$243
Per 1,000 Gallons	$0.74

Table Q-20, Continued

Upper Trinity RWD	
Per Acre-Foot	$182
Per 1,000 Gallons	$0.56
All Users	
Per Acre-Foot	$198
Per 1,000 Gallons	$0.61
COST ANALYSIS FOR PHASE I	
TOTAL COST	
NTMWD	*$555,228,000*
TRWD	*$1,448,098,000*
Upper Trinity RWD	*$143,042,000*
Total	***$2,146,368,000***
NTMWD	
Debt Service (6% for 30 years)	$40,337,000
Electricity ($0.09 kWh)	$8,588,500
Operation & Maintenance	$3,066,000
Total Annual Costs (NTMWD)	**$51,991,500**
TRWD	
Debt Service (6% for 30 years)	$105,203,000
Electricity ($0.09 kWh)	$24,046,500
Operation & Maintenance	$11,174,000
Total Annual Costs (TRWD)	**$140,423,500**
Upper Trinity	
Debt Service (6% for 30 years)	$10,392,000
Electricity ($0.09 kWh)	$2,262,000
Operation & Maintenance	$1,066,000
Total Annual Costs (Upper Trinity)	**$13,720,000**
Total, All Users	
Debt Service (6% for 30 years)	$155,932,000
Electricity ($0.09 kWh)	$34,897,000
Operation & Maintenance	$15,306,000
Total Annual Costs (All Users)	**$206,135,000**
PHASE I UNIT COSTS (During Amortization)	
NTMWD	
Per Acre-Foot	$595
Per 1,000 Gallons	$1.83
TRWD	
Per Acre-Foot	$1,003
Per 1,000 Gallons	$3.08
Upper Trinity	
Per Acre-Foot	$784
Per 1,000 Gallons	$2.41

Table Q-20, Continued

All Users	
Per Acre-Foot	$842
Per 1,000 Gallons	$2.58
COST ANALYSIS FOR Phase II	
TOTAL COST	
NTMWD	*$275,666,000*
TRWD	*$923,018,000*
Upper Trinity RWD	*$82,586,000*
Total	***$1,281,270,000***
NTMWD	**Cost**
Debt Service (6% for 30 years)	$20,027,000
Electricity ($0.09 kWh)	$8,588,500
Operation & Maintenance	$2,226,000
Total Annual Costs (NTMWD)	**$30,841,500**
TRWD	
Debt Service (6% for 30 years)	$67,056,000
Electricity ($0.09 kWh)	$24,046,500
Operation & Maintenance	$8,651,000
Total Annual Costs (TRWD)	**$99,753,500**
Upper Trinity	
Debt Service (6% for 30 years)	$6,000,000
Electricity ($0.09 kWh)	$2,262,000
Operation & Maintenance	$770,000
Total Annual Costs (Upper Trinity)	**$9,032,000**
All Users	
Debt Service (6% for 30 years)	$93,083,000
Electricity ($0.09 kWh)	$34,897,000
Operation & Maintenance	$11,647,000
Total Annual Costs (All Users)	**$139,627,000**
UNIT COSTS FOR PHASE II (During Amortization)	
NTMWD	
Per Acre-Foot	$353
Per 1,000 Gallons	$1.08
TRWD	
Per Acre-Foot	$713
Per 1,000 Gallons	$2.19
Upper Trinity	
Per Acre-Foot	$516
Per 1,000 Gallons	$1.58
Total All Users	
Per Acre-Foot	$570
Per 1,000 Gallons	$1.75

Table Q-21
Wright Patman to Dallas Water Utilities
Purchase 100,000 Acre-Feet per Year from Texarkana

Probable Owner:	DWU	100,000	Acre-Feet per Year
Peak Delivery:		112	MGD (1.25 Peaking Factor)

Note: Pipeline straight to East Side WTP.

CONSTRUCTION COSTS					
TRANSMISSION FACILITIES					
Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline (Rural)	78 in	777,000	LF	$591	$459,207,000
Pipeline (Urban)	78 in	8,000	LF	$799	$6,392,000
ROW Easements (Rural)		777,000	LF	$9	$6,993,000
ROW Easements (Urban)		8,000	LF	$55	$440,000
Engineering and Contingencies (30%)					$139,680,000
Subtotal of Pipeline					**$612,712,000**
Pump Station(s)	**Size (per PS)**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Lake Wright Patman Pump Station	8700 HP	1	LS	$14,154,300	$14,154,000
Booster Pump Stations	8700 HP	2	Ea	$10,642,500	$21,285,000
Ground Storage Tanks	8 MG	4	Ea	$2,069,000	$8,276,000
Engineering and Contingencies (35%)					$15,300,000
Subtotal of Pump Stations					**$59,015,000**
CONSTRUCTION TOTAL					**$671,727,000**
Permitting and Mitigation		**1**	**LS**		**$6,112,000**
Interest During Construction	**(36 months)**				**$81,729,000**
TOTAL COST					**$759,568,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$55,182,000
Raw Water (31 cents per 1,000 gallons)					$10,101,000
Electricity ($0.09 per kWh)					$10,110,000
Operation & Maintenance					$6,899,000
Total Annual Costs					**$82,292,000**
UNIT COSTS (Until Amortized)					
Per Acre-Foot					$823
Per 1,000 Gallons					$2.53
UNIT COSTS (After Amortization))					
Per Acre-Foot					$271
Per 1,000 Gallons					$0.83

Table Q-22
Wright Patman to North Texas Municipal Water District
Purchase 100,000 Acre-Feet per Year from Texarkana

Probable Owner:	NTMWD	100,000	Acre-Feet per Year
Peak Delivery:		112	MGD (1.25 Peaking Factor)

Note: Pipeline straight to Lake Lavon.

CONSTRUCTION COSTS
TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline (Rural)	78 in.	647,000	LF	$591	$382,377,000
Pipeline (Urban)	78 in.	20,000	LF	$799	$15,980,000
ROW Easements (Rural)		647,000	LF	$9	$5,823,000
ROW Easements (Urban)		20,000	LF	$55	$1,100,000
Engineering and Contingencies (30%)					$119,507,000
Subtotal of Pipeline					**$524,787,000**
Pump Station(s)	**Size (per PS)**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Lake Wright Patman Pump Station	9700 HP	1	LS	$15,784,200	$15,784,000
Booster Pump Stations	9700 HP	2	Ea	$11,868,000	$23,736,000
Lavon Raw Water Pump Station	4900 HP	1	LS	$9,174,400	$9,174,000
Ground Storage Tanks	8 MG	4	Ea	$2,822,000	$11,288,000
Engineering and Contingencies (35%)					$20,994,000
Subtotal of Pump Stations					**$80,976,000**
CONSTRUCTION TOTAL					**$605,763,000**
Permitting and Mitigation		**1**	**LS**		**$5,500,000**
Interest During Construction	**(36 months)**				**$73,703,000**
TOTAL COST					**$684,966,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$49,762,000
Raw Water (31 cents per 1,000 gallons)					$10,101,000
Electricity ($0.09 per kWh)					$14,781,000
Operation & Maintenance					$6,580,000
Total Annual Costs					**$81,224,000**
UNIT COSTS (Until Amortized)					
Per Acre-Foot					$812
Per 1,000 Gallons					$2.49
UNIT COSTS (After Amortization)					
Per Acre-Foot					$315
Per 1,000 Gallons					$0.97

Table Q-23
Wright Patman to Tarrant Regional Water District
Purchase 100,000 Acre-Feet per Year from Texarkana

Probable Owner:	TRWD	100,000	Acre-Feet per Year
Peak Delivery:		112	MGD (1.25 Peaking Factor)

Note: Pipeline to Eagle Mountain Lake

CONSTRUCTION COSTS					
TRANSMISSION FACILITIES					
Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline (Rural)	78 in	864,200	LF	$591	$510,742,000
Pipeline (Urban)	78 in	170,000	LF	$799	$135,830,000
ROW Easements (Rural)		864,200	LF	$9	$7,778,000
ROW Easements (Urban)		170,000	LF	$55	$9,350,000
Engineering and Contingencies (30%)					$193,972,000
Subtotal of Pipeline					**$857,672,000**
Pump Station(s)	**Size (per PS)**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Lake Wright Patman Pump Station	10900 HP	1	LS	$17,276,940	$17,277,000
Booster Pump Stations	10900 HP	3	Ea	$12,990,300	$38,971,000
Ground Storage Tanks	8 MG	6	Ea	$2,822,000	$16,932,000
Engineering and Contingencies (35%)					$25,613,000
Subtotal of Pump Stations					**$98,793,000**
CONSTRUCTION TOTAL					**$956,465,000**
Permitting and Mitigation		**1**	**LS**		**$8,637,000**
Interest During Construction	**(36 months)**				**$116,373,000**
TOTAL COST					**$1,081,475,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$78,568,000
Raw Water (31 cents per 1,000 gallons)					$10,101,000
Electricity ($0.09 per kWh)					$18,117,000
Operation & Maintenance					$9,954,000
Total Annual Costs					**$116,740,000**
UNIT COSTS (Until Amortized)					
Per Acre-Foot					$1,167
Per 1,000 Gallons					$3.58
UNIT COSTS (After Amortization))					
Per Acre-Foot					$382
Per 1,000 Gallons					$1.17

Table Q-24
Wright Patman to Dallas Water Utilities
Develop 112,100 Acre-Feet per Year from Lake Wright Patman

Probable Owner:	DWU	112,100	Acre-Feet per Year
Peak Delivery:		125	MGD (1.25 Peaking Factor)

Note: Pipeline straight to East Side WTP

CONSTRUCTION COSTS

RAW WATER IMPROVEMENTS

	Size	Quantity	Unit	Unit Price	Cost
Storage Purchase from COE			L.S.	$14,477,000	$14,477,000
Real Estate Purchase from COE			L.S.	$13,161,000	$13,161,000
Relocation Cost (facilities)			L.S.	$17,109,000	$17,109,000
Mitigation			L.S.	$26,322,000	$26,322,000
NEPA Evaluation			L.S.	$2,468,000	$2,468,000
Engineering, Acquisition and Contingencies at 35%			L.S.	$25,738,000	$25,738,000
Subtotal of Raw Water Improvements					**$99,275,000**

TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline (Rural)	78 in	777,000	LF	$591	$459,207,000
Pipeline (Urban)	78 in	8,000	LF	$799	$6,392,000
ROW Easements (Rural)		777,000	LF	$9	$6,993,000
ROW Easements (Urban)		8,000	LF	$55	$440,000
Engineering and Contingencies (30%)					$139,680,000
Subtotal of Pipeline					**$612,712,000**

Pump Station(s)	**Size (per PS)**	**Quantity**	**Unit**	**Unit Price**	**Cost**
New Pump Station for Texarkana	2200 HP	1	LS	$5,785,000	$5,785,000
Lake Wright Patman Pump Station	11500 HP	1	LS	$17,929,000	$17,929,000
Booster Pump Stations	11500 HP	2	Ea	$13,480,500	$26,961,000
Ground Storage Tanks	7 MG	4	Ea	$2,446,000	$9,784,000
Engineering and Contingencies (35%)					$21,161,000
Subtotal of Pump Stations					**$81,620,000**

CONSTRUCTION TOTAL		**$793,607,000**
Permitting and Mitigation for Pipelines and Pump Stations		**$6,313,000**
Interest During Construction	**(36 months)**	**$96,558,000**
TOTAL COST		**$896,478,000**

Table Q-24, Continued

ANNUAL COSTS	
Debt Service (6% for 30 years)	$65,128,000
Electricity ($0.09 per kWh)	$13,060,000
Operation & Maintenance	$7,227,000
Total Annual Costs	**$85,415,000**
UNIT COSTS (Until Amortized)	
Per Acre-Foot	$762
Per 1,000 Gallons	$2.34
UNIT COSTS (After Amortization))	
Per Acre-Foot	$181
Per 1,000 Gallons	$0.56

Table Q-25
Wright Patman to Dallas Water Utilities
Develop 180,000 Acre-Feet per Year from Lake Wright Patman

Probable Owner:	DWU	180,000	Acre-Feet per Year
Peak Delivery:		201	MGD (1.25 Peaking Factor)
Note: Pipeline straight to East Side WTP			

CONSTRUCTION COSTS

RAW WATER IMPROVEMENTS

	Size	Quantity	Unit	Unit Price	Cost
Storage Purchase from COE			L.S.	$14,477,000	$14,477,000
Real Estate Purchase from COE			L.S.	$13,161,000	$13,161,000
Relocation Cost (facilities)			L.S.	$17,109,000	$17,109,000
Mitigation			L.S.	$26,322,000	$26,322,000
NEPA Evaluation			L.S.	$2,468,000	$2,468,000
Engineering, Acquisition and Contingencies at 35%			L.S.	$25,738,000	$25,738,000
Subtotal of Raw Water Improvements					**$99,275,000**

TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline (Rural)	72 in	777,000	LF	$516	$498,834,000
Pipeline (Urban)	72 in	8,000	LF	$697	$7,184,000
ROW Easements (Rural)		1,554,000	LF	$7	$10,878,000
ROW Easements (Urban)		16,000	LF	$41	$656,000
Engineering and Contingencies (30%)					$151,805,000
Subtotal of Pipeline					**$669,357,000**

Pump Station(s)	**Size (per PS)**	**Quantity**	**Unit**		**Cost**
New Pump Station for Texarkana	2200 HP	1	LS	$5,785,000	$5,785,000
Lake Wright Patman Pump Station	18200 HP	1	LS	$25,209,000	$25,209,000
Booster Pump Stations	18200 HP	2	Ea	$18,954,400	$37,909,000
Ground Storage Tanks	8 HP	6	Ea	$2,069,000	$12,414,000
Engineering and Contingencies (35%)					$28,461,000
Subtotal of Pump Stations					**$109,778,000**

CONSTRUCTION TOTAL		**$878,410,000**
Permitting and Mitigation for Pipelines and Pump Stations		**$7,048,000**
Interest During Construction	**(36 months)**	**$106,876,000**
TOTAL COST		**$992,334,000**

Table Q-25, Continued

ANNUAL COSTS	
Debt Service (6% for 30 years)	$72,092,000
Electricity ($0.09 per kWh)	$20,739,000
Operation & Maintenance	$8,338,000
Total Annual Costs	**$101,169,000**
UNIT COSTS (Until Amortized)	
Per Acre-Foot	$562
Per 1,000 Gallons	$1.72
UNIT COSTS (After Amortization))	
Per Acre-Foot	$29,077,000
Per 1,000 Gallons	$0.50

Table Q-26
Wright Patman to North Texas Municipal Water District
Develop 180,000 Acre-Feet per Year from Lake Wright Patman

Probable Owner:	NTMWD	180,000	Acre-Feet per Year
Peak Delivery:		201	MGD (1.25 Peaking Factor)

Note: Pipeline straight to Lake Lavon.

CONSTRUCTION COSTS

RAW WATER IMPROVEMENTS	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Storage Purchase from COE			L.S.	$14,477,000	$14,477,000
Real Estate Purchase from COE			L.S.	$13,161,000	$13,161,000
Relocation Cost (facilities)			L.S.	$17,109,000	$17,109,000
Mitigation			L.S.	$26,322,000	$26,322,000
NEPA Evaluation			L.S.	$2,468,000	$2,468,000
Engineering, Acquisition and Contingencies at 35%			L.S.	$25,738,000	$25,738,000
Subtotal of Raw Water Improvements					**$99,275,000**

TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline (Rural) x 2	72 in	647,000	LF	$516	$415,374,000
Pipeline (Urban) x 2	72 in	20,000	LF	$697	$17,960,000
ROW Easements (Rural)		1,294,000	LF	$7	$9,058,000
ROW Easements (Urban)		40,000	LF	$41	$1,640,000
Engineering and Contingencies (30%)					$130,000,000
Subtotal of Pipeline					**$574,032,000**

Pump Station(s)	**Size (per PS)**	**Quantity**	**Unit**		**Cost**
New Pump Station for Texarkana	2200 HP	1	LS	$5,785,000	$5,785,000
Lake Wright Patman Pump Station	19400 HP	1	LS	$26,513,000	$26,513,000
Booster Pump Stations	19400 HP	2	Ea	$19,935,000	$39,870,000
Lavon Raw Water Pump Station	8800 HP	1	LS	$10,750,000	$10,750,000
Ground Storage Tanks	8 MG	6	Ea	$2,069,000	$12,414,000
Engineering and Contingencies (35%)					$33,366,000
Subtotal of Pump Stations					**$128,698,000**
CONSTRUCTION TOTAL					**$802,005,000**
Permitting and Mitigation for Pipelines and Pump Stations					**$6,344,000**
Interest During Construction	**(36 months)**				**$97,580,000**
TOTAL COST					**$905,929,000**

Table Q-26, Continued

ANNUAL COSTS	
Debt Service (6% for 30 years)	$65,815,000
Electricity ($0.09 per kWh)	$24,088,000
Operation & Maintenance	$7,886,000
Total Annual Costs	**$97,789,000**
UNIT COSTS (Until Amortized)	
Per Acre-Foot	$543
Per 1,000 Gallons	$1.67
UNIT COSTS (After Amortization))	
Per Acre-Foot	$178
Per 1,000 Gallons	$0.55

Table Q-27
Wright Patman to Tarrant Regional Water District
Develop 180,000 Acre-Feet per Year from Lake Wright Patman

Probable Owner:	TRWD	180,000	Acre-Feet per Year
Peak Delivery:		201	MGD (1.25 Peaking Factor)

Note: Pipeline straight to Eagle Mountain Lake

CONSTRUCTION COSTS

RAW WATER IMPROVEMENTS

	Size	Quantity	Unit	Unit Price	Cost
Storage Purchase from COE			L.S.	$14,477,000	$14,477,000
Real Estate Purchase from COE			L.S.	$13,161,000	$13,161,000
Relocation Cost (facilities)			L.S.	$17,109,000	$17,109,000
Mitigation			L.S.	$26,322,000	$26,322,000
NEPA Evaluation			L.S.	$2,468,000	$2,468,000
Engineering, Acquisition and Contingencies at 35%			L.S.	$25,738,000	$25,738,000
Subtotal of Raw Water Improvements					**$99,275,000**

TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline (Rural)	96 in	864,200	LF	$860	$743,212,000
Pipeline (Urban)	96 in	170,000	LF	$1,161	$197,370,000
ROW Easements (Rural)		864,200	LF	$9	$7,778,000
ROW Easements (Urban)		170,000	LF	$55	$9,350,000
Engineering and Contingencies (30%)					$282,175,000
Subtotal of Pipeline					**$1,239,885,000**

Pump Station(s)	**Size (per PS)**	**Quantity**	**Unit**		**Cost**
New Pump Station for Texarkana	2200 HP	1	LS	$5,785,000	$5,785,000
Lake Wright Patman Pump Station	22000 HP	1	LS	$28,881,000	$28,881,000
Booster Pump Stations	22000 HP	3	Ea	$21,715,000	$65,145,000
Ground Storage Tanks	8 MG	9	Ea	$2,069,000	$18,621,000
Engineering and Contingencies (35%)					$41,451,000
Subtotal of Pump Stations					**$159,883,000**

CONSTRUCTION TOTAL		**$1,499,043,000**
Permitting and Mitigation for Pipelines and Pump Stations		**$12,708,000**
Interest During Construction	**(36 months)**	**$182,389,000**
TOTAL COST		**$1,694,140,000**

Table Q-27, Continued

ANNUAL COSTS	
Debt Service (6% for 30 years)	$123,077,000
Electricity ($0.09 per kWh)	$34,018,000
Operation & Maintenance	$14,666,000
Total Annual Costs	**$171,761,000**
UNIT COSTS (Until Amortized)	
Per Acre-Foot	$954
Per 1,000 Gallons	$2.93
UNIT COSTS (After Amortization))	
Per Acre-Foot	$270
Per 1,000 Gallons	$0.83

Table Q-28
Wright Patman to DWU, NTMWD, and TRWD
Develop 390,000 Acre-Feet per Year from Lake Wright Patman

Probable Owner:	Multiple	390,000	Acre-Feet per Year
Peak Delivery:		435	MGD (1.25 Peaking Factor)

Note: Water includes 100,000 acre-feet per year purchased from Texarkana, 182,000 acre-feet per year new supply, and 108,000 acre-feet per year system operation. Pipeline to Lake Lavon, Lake Lewisville, and Eagle Mountain Lake.

CONSTRUCTION COSTS

RAW WATER IMPROVEMENTS (all Phase 1)

	Size	Quantity	Unit	Unit Price	Cost
Storage Purchase from COE			L.S.	$14,477,000	$14,477,000
Real Estate Purchase from COE			L.S.	$13,161,000	$13,161,000
Relocation Cost (facilities)			L.S.	$17,109,000	$17,109,000
Mitigation			L.S.	$26,322,000	$26,322,000
NEPA Evaluation			L.S.	$2,468,000	$2,468,000
Engineering, Acquisition and Contingencies at 35%			L.S.	$25,738,000	$25,738,000
Subtotal of Raw Water Improvements					**$99,275,000**
- NTMWD					$33,092,000
- DWU					$33,091,000
- TRWD					$33,092,000

TRANSMISSION FACILITIES

Pipeline Phase 1	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Segment 1 (WP to Chapman - Total Capacity = 614 mgd, Phase 1 capacity = 307 mgd)					
Pipeline	108 in	426,149	L.F.	$1,075	$458,110,000
ROW Easements (80 Ft.)		426,149	L.F.	$9	$3,835,000
Engineering and Contingencies (30%)					$137,433,000
Segment 1 Subtotal					$599,378,000
Segment 2 (Chapman to Lavon - Total Capacity = 435 mgd, Phase 1 capacity = 218 mgd)					
Pipeline (rural)	96 in	188,450	L.F.	$860	$162,067,000
Pipeline (urban)	96 in	20,000	L.F.	$1,161	$23,220,000
ROW Easements (80 Ft., rural)		188,450	L.F.	$9	$1,696,000
ROW Easements (80 Ft., urban)		20,000	L.F.	$55	$1,100,000
Engineering and Contingencies (30%)					$55,586,000
Segment 2 Subtotal					$243,669,000

Table Q-28, Continued

Segment 3 (Lavon to Lewisville - Capacity = 290 mgd, phase 1 capacity = 145 mgd)					
Pipeline (rural)	84 in	69,000	L.F.	$677	$46,713,000
Pipeline (urban)	84 in	103,500	L.F.	$914	$94,599,000
ROW Easements (80 Ft., rural)		69,000	L.F.	$9	$621,000
ROW Easements (80 Ft., urban)		103,500	L.F.	$55	$5,693,000
Engineering and Contingencies (30%)					$42,394,000
Segment 3 Subtotal					$190,020,000
Segment 4 (Lewisville to EM - Capacity = 145 mgd)					
Pipeline (rural)	84 HP	136,290	L.F.	$677	$92,268,000
Pipeline (urban)	84 HP	58,410	L.F.	$914	$53,387,000
ROW Easements (40 Ft., rural)		136,290	L.F.	$9	$1,227,000
ROW Easements (40 Ft., urban)		58,410	L.F.	$55	$3,213,000
Engineering and Contingencies (30%)					$43,697,000
Segment 4 Subtotal					$193,792,000
Phase 1 Pipeline Total					**$1,226,859,000**
- NTMWD					$281,016,000
- DWU					$376,026,000
- TRWD					$569,819,000
Pipeline Phase 2	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Segment 1 (WP to Chapman - Total Capacity = 614 mgd)					
Pipeline	108 HP	426,149	L.F.	$1,075	$458,110,000
Engineering and Contingencies (30%)					$137,433,000
Segment 1 Subtotal					$595,543,000
Segment 2 (Chapman to Lavon - Total Capacity = 435 mgd)					
Pipeline (rural)	96 HP	198,450	L.F.	$860	$170,667,000
Pipeline (urban)	96 HP	10,000	L.F.	$1,161	$11,610,000
Engineering and Contingencies (30%)					$54,683,000
Segment 2 Subtotal					$236,960,000
Segment 3 (Lavon to Lewisville - Total Capacity = 290 mgd)					
Pipeline (rural)	84 HP	69,000	L.F.	$677	$46,713,000
Pipeline (urban)	84 HP	103,500	L.F.	$914	$94,599,000
Engineering and Contingencies (30%)					$42,394,000
Segment 3 Subtotal					$183,706,000
Phase 2 Pipeline Total					**$1,016,209,000**
- NTMWD					$277,501,000
- DWU					$369,354,000
- TRWD					$369,354,000
PIPELINE TOTAL					**$2,243,068,000**
- NTMWD					$558,517,000
- DWU					$745,380,000
- TRWD					$939,173,000

Table Q-28, Continued

Pump Station Phase 1	**Size**	**Quantity**	**Unit**		**Cost**
Segment 1 (WP to Chapman - Capacity = 614 mgd)					
New Pump Station for Texarkana	2200 HP	1	LS	$5,785,000	$5,785,000
Lake Wright Patman Pump Station	28000 HP	1	LS	$34,028,000	$34,028,000
Booster Pump Station 1	32500 HP	1	Ea	$28,488,000	$28,488,000
Booster 1 Ground Storage Tanks	8 HP	5	Ea	$2,069,000	$10,345,000
Engineering and Contingencies (35%)					$27,526,000
Segment 1 Total					$106,172,000
Segment 2 (Chapman to Lavon - Capacity = 435 mgd)					
Lake Chapman Pump Station	28300 HP	1	LS	$34,286,000	$34,286,000
Engineering and Contingencies (35%)					$12,000,000
Segment 2 Total					$46,286,000
Segment 3 (Lavon to Lewisville - Capacity = 290 mgd)					
Lake Lavon Pump Station	13000 HP	1	LS	$19,559,000	$19,559,000
Engineering and Contingencies (35%)					$6,846,000
Segment 3 Total					$26,405,000
Segment 4 (Lewisville to EM - Capacity = 145 mgd)					
Lake Lewisville Pump Station	13000 HP	1	LS	$19,559,000	$19,559,000
Engineering and Contingencies (35%)					$6,846,000
Segment 4 Total					$26,405,000
Phase 1 Pump Station Total					**$205,268,000**
- NTMWD					$50,819,000
- DWU					$64,022,000
- TRWD					$90,426,000

Pump Station Phase 2	**Size**	**Quantity**	**Unit**		**Cost**
Segment 1 (WP to Chapman - Capacity = 614 mgd)					
Lake Wright Patman Pump Station	28000 HP	1	LS	$34,028,000	$34,028,000
Booster Pump Station 1	32500 HP	1	Ea	$28,488,000	$28,488,000
Booster 1 Ground Storage Tanks	8 HP	5	Ea	$2,069,000	$10,345,000
Engineering and Contingencies (35%)					$25,501,000
Segment 1 Total					$98,362,000
Segment 2 (Chapman to Lavon - Capacity = 435 mgd)					
Lake Chapman Pump Station	28300 HP	1	LS	$34,286,000	$34,286,000
Engineering and Contingencies (35%)					$12,000,000
Segment 2 Total					$46,286,000
Segment 3 (Lavon to Lewisville - Capacity = 290 mgd)					
Lake Lavon Pump Station	13000 HP	1	LS	$19,559,000	$19,559,000
Engineering and Contingencies (35%)					$6,846,000
Segment 3 Total					$26,405,000

Table Q-28, Continued

Segment 4 (Lewisville to EM - Capacity = 145 mgd)					
Lake Lewisville Pump Station	5300 HP	1	LS	$9,722,000	$9,722,000
Engineering and Contingencies (35%)					$3,403,000
Segment 4 Total					$13,125,000
Phase 2 Pump Station Total					**$184,178,000**
- NTMWD					$48,216,000
- DWU					$61,419,000
- TRWD					$74,543,000
PUMP STATION TOTAL					**$389,446,000**
- NTMWD					$99,035,000
- DWU					$125,441,000
- TRWD					$164,969,000
CONSTRUCTION TOTAL					
Phase 1					**$1,531,402,000**
- NTMWD					$364,927,000
- DWU					$473,139,000
-TRWD					$693,337,000
Phase 2					**$1,200,387,000**
- NTMWD					$325,717,000
- DWU					$430,773,000
-TRWD					$443,897,000
TOTAL					**$2,731,789,000**
- NTMWD					$690,644,000
- DWU					$903,912,000
-TRWD					$1,137,234,000
Permitting and Mitigation (All Phase 1)					**$24,006,000**
- NTMWD					$8,002,000
- DWU					$8,002,000
-TRWD					$8,002,000
Interest During Construction (36 months)					
Phase 1					**$186,326,000**
- NTMWD					$44,401,000
- DWU					$57,567,000
-TRWD					$84,358,000
Phase 2					**$142,601,000**
- NTMWD					$38,694,000
- DWU					$51,174,000
-TRWD					$52,733,000
TOTAL					**$328,927,000**
- NTMWD					$83,095,000
- DWU					$108,741,000
-TRWD					$137,091,000

Table Q-28, Continued

TOTAL COST	
Phase 1	**$1,741,734,000**
- NTMWD	$417,330,000
- DWU	$538,708,000
-TRWD	$785,697,000
Phase 2	**$1,342,988,000**
- NTMWD	$364,411,000
- DWU	$481,947,000
-TRWD	$496,630,000
TOTAL	**$3,084,722,000**
- NTMWD	$781,741,000
- DWU	$1,020,655,000
-TRWD	$1,282,327,000
ANNUAL COSTS - PHASE 1	
Debt Service (6% for 30 years)	**$126,535,000**
- NTMWD	$30,319,000
- DWU	$39,137,000
-TRWD	$57,080,000
Raw Water (100,000 Acre-Feet at $0.31 per 1,000 gallons)	**$10,101,000**
- NTMWD	$3,367,000
- DWU	$3,367,000
-TRWD	$3,367,000
Electricity ($0.09 per kWh)	**$33,001,000**
- NTMWD	$8,269,000
- DWU	$10,869,000
-TRWD	$13,863,000
Operation & Maintenance	**$16,816,000**
- NTMWD	$4,067,000
- DWU	$5,206,000
-TRWD	$7,543,000
Total Annual Costs	**$186,453,000**
- NTMWD	$46,022,000
- DWU	$58,579,000
-TRWD	$81,853,000

Table Q-28, Continued

ANNUAL COSTS - PHASE 2	
Debt Service (6% for 30 years)	**$97,567,000**
- NTMWD	$26,474,000
- DWU	$35,013,000
-TRWD	$36,080,000
Raw Water (100,000 Acre-Feet at $0.31 per 1,000 gallons)	**$0**
- NTMWD	$0
- DWU	$0
-TRWD	$0
Electricity ($0.09 kWh)	**$34,794,000**
- NTMWD	$8,269,000
- DWU	$10,869,000
-TRWD	$15,656,000
Operation & Maintenance	**$13,223,000**
- NTMWD	$3,550,000
- DWU	$4,692,000
-TRWD	$4,981,000
Total Annual Costs	**$145,584,000**
- NTMWD	$38,293,000
- DWU	$50,574,000
-TRWD	$56,717,000
ANNUAL COSTS - PHASES 1 & 2	
Debt Service (6% for 30 years)	**$224,102,000**
- NTMWD	$56,793,000
- DWU	$74,150,000
-TRWD	$93,160,000
Raw Water (100,000 Acre-Feet at $0.31 per 1,000 gallons)	**$10,101,000**
- NTMWD	$3,367,000
- DWU	$3,367,000
-TRWD	$3,367,000
Electricity ($0.09 kWh)	**$67,795,000**
- NTMWD	$16,538,000
- DWU	$21,738,000
-TRWD	$29,519,000
Operation & Maintenance	**$30,039,000**
- NTMWD	$7,617,000
- DWU	$9,898,000
-TRWD	$12,524,000
Total Annual Costs	**$332,037,000**
- NTMWD	$84,315,000
- DWU	$109,153,000
-TRWD	$138,570,000

Table Q-28, Continued

UNIT COSTS (Phase 1)	
Per Acre-Foot	
Overall	**$956**
- NTMWD	$708
- DWU	$901
- TRWD	$1,259
Per 1,000 Gallons	
Overall	**$2.93**
- NTMWD	$2.17
- DWU	$2.77
- TRWD	$3.86
UNIT COSTS (Phase 2)	
Per Acre-Foot	
Overall	**$747**
- NTMWD	$589
- DWU	$778
- TRWD	$873
Per 1,000 Gallons	
Overall	**$2.29**
- NTMWD	$1.81
- DWU	$2.39
- TRWD	$2.68
UNIT COSTS (Phases 1 & 2)	
Per Acre-Foot	
Overall	**$851**
- NTMWD	$649
- DWU	$840
- TRWD	$1,066
Per 1,000 Gallons	
Overall	**$2.61**
- NTMWD	$1.99
- DWU	$2.58
- TRWD	$3.27

Table Q-28, Continued

UNIT COSTS AFTER AMORTIZATION (Phases 1 & 2)	
Per Acre-Foot	
Overall	**$277**
- NTMWD	$212
- DWU	$269
- TRWD	$349
Per 1,000 Gallons	
Overall	**$0.85**
- NTMWD	$0.65
- DWU	$0.83
- TRWD	$1.07

Table Q-29
Lake Texoma Already Authorized with Blending
WTP at Leonard

Probable Owner: North Texas MWD
Amount: 113,000 Acre-Feet/Year

CONSTRUCTION COSTS

TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline (Rural)	90 in.	274,791	LF	$774	$212,688,000
Right of Way Easements (ROW)	40 ft.	274,791	LF	$9	$2,473,000
Engineering and Contingencies (30%)					$63,806,000
Subtotal of Pipeline					**$278,967,000**
Pump Station(s)					
Add 2 Pumps to existing Facility	100 MGD	2	EA	$2,600,000	$5,200,000
Engineering and Contingencies (35%)					$1,820,000
Subtotal of Pump Station(s)					**$7,020,000**
Two Day Terminal Storage (400 MG)					
Compacted Fill		1,147,844	CY	$6.60	$7,576,000
12" Soil Cement		80,424	CY	$65.80	$5,292,000
HDPE Liner		241,272	SY	$4.15	$1,001,000
Roads		11,336	SY	$20.00	$227,000
Grassing		20	AC	$4,500	$89,000
Control structures		4	EA	$329,000	$1,316,000
Fencing		6,996	LF	$20.00	$140,000
Mobilization		1	LS	5.00%	$782,000
Engineering and Contingencies (35%)					$5,748,000
Subtotal Terminal Storage					**$22,171,000**
Permitting and Mitigation		**1**	**LS**		**$2,802,000**
CONSTRUCTION TOTAL					**$310,960,000**
Interest During Construction			**(24 months)**		**$25,396,000**
TOTAL CAPITAL COST					**$336,356,000**

Table Q-29, Continued

ANNUAL COSTS	
Debt Service (6% for 30 years)	$24,436,000
Raw water purchase	$3,027,000
Electricity ($0.09 per kWh)	$3,840,000
Facility Operation & Maintenance	$2,990,000
Total Annual Costs	**$34,293,000**
UNIT COSTS (Until Amortized)	
Per Acre-Foot of raw water	$303
Per 1,000 Gallons of raw water	$0.93
UNIT COSTS (After Amortization)	
Per Acre-Foot of raw water	$87
Per 1,000 Gallons of raw water	$0.27

Table Q-30
NTMWD Substantial Additional Lake Texoma Supply with Desalination

Probable Owner: North Texas MWD
Amount: 113,000 Acre-Feet/Year pumped. 105,000 ac-ft/yr delivered after desalination.

CONSTRUCTION COSTS

TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline	90 in.	274,791	LF	$774	$212,688,000
Right of Way Easements (ROW)	40 ft.	274,791	LF	$9	$2,473,000
Engineering and Contingencies (30%)					$63,806,000
Subtotal of Pipeline					**$278,967,000**
Pump Station(s)					
Add 2 Pumps to existing Facility	100 MGD	2	EA	$2,600,000	$5,200,000
Engineering and Contingencies (35%)					$1,820,000
Subtotal of Pump Station(s)					**$7,020,000**
Two Day Terminal Storage (400 MG)					
Compacted Fill		1,147,844	CY	$6.60	$7,576,000
12" Soil Cement		80,424	CY	$65.80	$5,292,000
HDPE Liner		241,272	SY	$4.15	$1,001,000
Roads		11,336	SY	$20.00	$227,000
Grassing		20	AC	$4,500	$89,000
Control structures		4	EA	$329,000	$1,316,000
Fencing		6,996	LF	$20.00	$140,000
Mobilization		1	LS	5.00%	$782,000
Engineering and Contingencies (35%)					$5,748,000
Subtotal Terminal Storage					**$22,171,000**
Permitting and Mitigation		**1**	**LS**		**$2,802,000**

WATER TREATMENT FACILITIES

Desalination					
Treatment Plant with RO (70 MGD)		200	MGD		$271,510,000
Brine disposal wells	200 gpm	30	EA	$1,184,000	$35,520,000
Disposal conveyance system		1	LS	$5,328,000	$5,328,000
Engineering and Contingencies (35%)					$109,325,000
Subtotal of Desalination					**$421,683,000**
Permitting of treatment plant and reject stream					**$3,748,296**

Table Q-30, Continued

CONSTRUCTION TOTAL		**$736,391,296**
Interest During Construction	**(24 months)**	**$60,141,000**
TOTAL CAPITAL COST		**$796,532,296**
ANNUAL COSTS		
Debt Service (6% for 30 years)		$57,867,000
Raw water purchase		$3,027,000
Raw Water Electricity ($0.09 per kWh)		$3,840,000
Facility Operation & Maintenance		$4,119,600
Water Treatment		$30,988,000
Reject water disposal		$4,562,000
Total Annual Costs		**$104,403,600**
UNIT COSTS (During Amortization)		
Per Acre-Foot of treated water		$994
Per 1,000 Gallons of treated water		$3.05
UNIT COSTS (During Amortization)		
Per Acre-Foot of treated water		$443
Per 1,000 Gallons of treated water		$1.36

Table Q-31
Additional Lake Texoma Supply with Blending

Probable Owner:	Multiple	
Amount:	113,000	Acre-Feet/Year
Peak Delivery	201.6	MGD

CONSTRUCTION COSTS

TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline (rural)	96 in.	223,959	LF	$860	$192,605,000
Pipeline (urban)	96 in.	109,375	LF	$1,161	$126,984,000
Right of Way Easements (Rural)	40 ft.	223,959	LF	$9	$2,016,000
Right of Way Easements (Urban)	40 ft.	109,375	LF	$55	$6,016,000
Engineering and Contingencies (30%)					$95,877,000
Subtotal of Pipeline					**$423,498,000**
Pump Station(s)					
Lakeside Pump Station	23900 HP	1	EA	$30,511,000	$30,511,000
Engineering and Contingencies (35%)					$10,679,000
Subtotal of Pump Station(s)					**$41,190,000**
Terminal Storage (400 MG)					
Compacted Fill		1,147,844	CY	$6.60	$7,576,000
12" Soil Cement		80,424	CY	$65.80	$5,292,000
HDPE Liner		241,272	SY	$4.15	$1,001,000
Roads		11,336	SY	$20.00	$227,000
Grassing		20	AC	$4,500	$89,000
Control structures		4	EA	$329,000	$1,316,000
Fencing		6,996	LF	$20.00	$140,000
Mobilization		1	LS	5.00%	$782,000
Engineering and Contingencies (35%)					$5,748,000
Subtotal Terminal Storage					**$22,171,000**
Permitting and Mitigation		**1**	**LS**		**$4,398,300**
CONSTRUCTION TOTAL					**$491,257,300**
Interest During Construction			**(24 months)**		**$40,121,000**
TOTAL CAPITAL COST					**$531,378,300**

Table Q-31, Continued

ANNUAL COSTS	
Debt Service (6% for 30 years)	$38,604,000
Raw water purchase	$3,027,000
Electricity ($0.09 per kWh)	$3,638,000
Facility Operation & Maintenance	$5,032,000
Total Annual Costs	**$50,301,000**
UNIT COSTS (During Amortization)	
Per Acre-Foot of raw water	$445
Per 1,000 Gallons of raw water	$1.37
UNIT COSTS (After Amortization)	
Per Acre-Foot of treated water	$104
Per 1,000 Gallons of treated water	$0.32

Table Q-32
Substantial Additional Lake Texoma Supply with Desalination

Probable Owner: Multiple
Amount: 113,000 Acre-Feet/Year pumped.
Amount: 105,000 ac-ft/yr delivered after desalination.

CONSTRUCTION COSTS

TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline (rural)	90 in.	223,959	LF	$774	$173,344,000
Pipeline (urban)	90 in.	109,375	LF	$1,045	$114,297,000
Right of Way Easements (Rural)	40 ft.	223,959	LF	$9	$2,016,000
Right of Way Easements (Urban)	40 ft.	109,375	LF	$55	$6,016,000
Engineering and Contingencies (30%)					$86,292,000
Subtotal of Pipeline					**$381,965,000**
Pump Station(s)					
Lakeside Pump Station	10400 HP	1	EA	$16,734,000	$16,734,000
Engineering and Contingencies (35%)					$5,857,000
Subtotal of Pump Station(s)					**$22,591,000**
Permitting and Mitigation		**1**	**LS**		**$3,849,600**
Two Day Terminal Storage (400 MG)					
Compacted Fill		1,147,844	CY	$6.60	$7,576,000
12" Soil Cement		80,424	CY	$65.80	$5,292,000
HDPE Liner		241,272	SY	$4.15	$1,001,000
Roads		11,336	SY	$20.00	$227,000
Grassing		20	AC	$4,500	$89,000
Control structures		4	EA	$329,000	$1,316,000
Fencing		6,996	LF	$20.00	$140,000
Mobilization		1	LS	5.00%	$782,000
Engineering and Contingencies (35%)					$5,748,000
Subtotal Terminal Storage					**$22,171,000**

Table Q-32, Continued

WATER TREATMENT FACILITIES

Desalination					
Treatment Plant with RO (70 MGD)		200	MGD		$271,510,000
Brine disposal wells	200 gpm	30	EA	$1,184,000	$35,520,000
Disposal conveyance system		1	LS	$5,328,000	$5,328,000
Engineering and Contingencies (35%)					$109,325,000
Subtotal of Desalination					**$421,683,000**
Permitting of treatment plant and reject stream					**$3,748,296**
CONSTRUCTION TOTAL					**$856,007,896**
Interest During Construction			**(24 months)**		**$69,910,000**
TOTAL CAPITAL COST					**$925,917,896**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$67,267,000
Raw water purchase					$3,027,000
Raw Water Electricity ($0.09 per kWh)					$4,201,000
Facility Operation & Maintenance					$5,365,620
Water Treatment					$30,988,000
Reject water disposal					$4,562,000
Total Annual Costs					**$115,410,620**
UNIT COSTS (During Amortization)					
Per Acre-Foot of treated water					$1,099
Per 1,000 Gallons of treated water					$3.37
UNIT COSTS (After Amortization)					
Per Acre-Foot of treated water					$459
Per 1,000 Gallons of treated water					$1.41

Table Q-33
Lake Livingston to Dallas Water Utilities

Probable Owner:	Dallas		200,000	Acre-Feet per Year		
Peak Delivery:			223	MGD (1.25 Peaking Factor)		

CONSTRUCTION COSTS

TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline (Rural) x 2	78 in	919,000	LF	$591	$1,086,258,000
Pipeline (Urban) x 2	78 in	33,000	LF	$799	$52,734,000
ROW Easements (Rural)		1,838,000	LF	$9	$16,542,000
ROW Easements (Urban)		66,000	LF	$55	$3,630,000
Engineering and Contingencies (30%)					$341,698,000
Subtotal of Pipeline					**$1,500,862,000**
Pump Station(s)	**Size (per PS)**	**Quantity**	**Unit**		**Cost**
Lake Pump Station	17000 HP	1	LS	$23,905,200	$23,905,200
Booster Pump Stations	17000 HP	3	Ea	$17,974,000	$53,922,000
Ground Storage Tanks	10 MG	9	Ea	$2,752,000	$24,768,000
Engineering and Contingencies (35%)					$35,908,000
Subtotal of Pump Stations					**$138,503,200**
Permitting and mitigation		1	LS		$14,899,000
CONSTRUCTION TOTAL					**$1,654,264,200**
Interest During Construction	**(36 months)**				**$201,274,000**
TOTAL COST					**$1,855,538,200**

ANNUAL COSTS	
Debt Service (6% for 30 years)	$134,803,000
Raw Water ($95 per acre-foot)	$19,000,000
Electricity ($0.09 per kWh)	$25,840,000
Operation & Maintenance	$16,746,000
Total Annual Costs	**$196,389,000**
UNIT COSTS (Until Amortized)	
Per Acre-Foot	$982
Per 1,000 Gallons	$3.01
UNIT COSTS (After Amortization))	
Per Acre-Foot	$308
Per 1,000 Gallons	$0.95

Table Q-34
Lake Livingston to North Texas Municipal Water District

Probable Owner:	NTMWD	200,000	Acre-Feet per Year
Peak Delivery:		223	MGD (1.25 Peaking Factor)

CONSTRUCTION COSTS

TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline (Rural) x 2	78 in	938,000	LF	$591	$1,108,716,000
Pipeline (Urban) x 2	78 in	120,000	LF	$799	$191,760,000
ROW Easements (Rural)		1,876,000	LF	$9	$16,884,000
ROW Easements (Urban)		240,000	LF	$55	$13,200,000
Engineering and Contingencies (30%)					$390,143,000
Subtotal of Pipeline					**$1,720,703,000**
Pump Station(s)	**Size (per PS)**	**Quantity**	**Unit**		**Cost**
Lake Pump Station	19000 HP	1	LS	$26,078,400	$26,078,400
Booster Pump Stations	19000 HP	3	Ea	$19,608,000	$58,824,000
Ground Storage Tanks	10 MG	9	Ea	$2,752,000	$24,768,000
Engineering and Contingencies (35%)					$38,385,000
Subtotal of Pump Stations					**$148,055,400**
Permitting and mitigation		1	LS		$16,922,000
CONSTRUCTION TOTAL					**$1,885,680,400**
Interest During Construction	**(36 months)**				**$229,431,000**
TOTAL COST					**$2,115,111,400**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$153,661,000
Raw Water ($95 per acre-foot)					$19,000,000
Electricity ($0.09 per kWh)					$28,945,000
Operation & Maintenance					$18,896,000
Total Annual Costs					**$220,502,000**
UNIT COSTS (Until Amortized)					
Per Acre-Foot					$1,103
Per 1,000 Gallons					$3.38
UNIT COSTS (After Amortization))					
Per Acre-Foot					$334
Per 1,000 Gallons					$1.03

Table Q-35
Lake Livingston to Tarrant Regional Water District

Probable Owner:	TRWD	200,000	Acre-Feet per Year
Peak Delivery:		223	MGD (1.25 Peaking Factor)

CONSTRUCTION COSTS

TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline (Rural) x 2	78 in	973,000	LF	$591	$1,150,086,000
Pipeline (Urban) x 2	78 in	77,000	LF	$799	$123,046,000
ROW Easements (Rural)		1,946,000	LF	$9	$17,514,000
ROW Easements (Urban)		154,000	LF	$55	$8,470,000
Engineering and Contingencies (30%)					$381,940,000
Subtotal of Pipeline					**$1,681,056,000**
Pump Station(s)	**Size (per PS)**	**Quantity**	**Unit**		**Cost**
Lake Pump Station	22000 HP	1	LS	$28,880,800	$28,880,800
Booster Pump Stations	22000 HP	3	Ea	$21,715,000	$65,145,000
Ground Storage Tanks	10 MG	9	Ea	$2,752,000	$24,768,000
Engineering and Contingencies (35%)					$41,578,000
Subtotal of Pump Stations					**$160,371,800**
Permitting and mitigation		1	LS		$16,703,000
CONSTRUCTION TOTAL					**$1,858,130,800**
Interest During Construction	**(36 months)**				**$226,079,000**
TOTAL COST					**$2,084,209,800**

ANNUAL COSTS	
Debt Service (6% for 30 years)	$151,416,000
Raw Water ($95 per acre-foot)	$19,000,000
Electricity ($0.09 per kWh)	$34,719,000
Operation & Maintenance	$18,841,000
Total Annual Costs	**$223,976,000**
UNIT COSTS (Until Amortized)	
Per Acre-Foot	$1,120
Per 1,000 Gallons	$3.44
UNIT COSTS (After Amortization))	
Per Acre-Foot	$363
Per 1,000 Gallons	$1.11

Table Q-36
Replace Tawakoni Pipeline

Owner:	Dallas	
Quantity:	77,994	AF/Y

Item	Quantity	Unit	Unit Price	Cost
Capital Costs (144-inch pipeline & pumping facilities)	1	LS	$362,000,000	$362,000,000
Engineering, permitting and contingencies				$114,392,000
TOTAL CONSTRUCTION COST				**$476,392,000**
Interest During Construction		**(12 months)**		**$19,851,000**
TOTAL CAPITAL COST				**$496,243,000**
Annual Costs				
Debt Service (6 percent for 30 years)				$36,052,000
Electricity (incremental for 69,128 af/yr increase)				$2,325,000
Operation and Maintenance				$5,126,000
Total Annual Cost				**$43,503,000**
Available Project Yield (ac-ft/yr)				**77,994**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$558**
Water Cost ($ per 1,000 gallons)				**$1.71**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$96**
Water Cost ($ per 1,000 gallons)				**$0.29**

Capital costs provided by DWU

Table Q-37
Main Stem Pump Station

Owner:	Dallas	
Quantity:	41,029	AF/Y

Item	Quantity	Unit	Unit Price	Cost
Capital Costs (90 MGD Pump Station + 10 mile 60-inch pipeline)	1	LS	$104,000,000	$104,000,000
Engineering, permitting and contingencies				$32,864,000
TOTAL CONSTRUCTION COST				**$136,864,000**
Interest During Construction		**(12 months)**		**$5,703,000**
TOTAL CAPITAL COST				**$142,567,000**
Annual Costs				
Debt Service (6 percent for 30 years)				$10,357,000
Electricity				$705,000
Operation and Maintenance				$1,472,000
Total Annual Cost				**$12,534,000**
Available Project Yield (ac-ft/yr)				**41,029**
UNIT COSTS (Until Amortized)				
Water Cost ($ per ac-ft)				**$305**
Water Cost ($ per 1,000 gallons)				**$0.94**
UNIT COSTS (After Amortization)				
Water Cost ($ per ac-ft)				**$53**
Water Cost ($ per 1,000 gallons)				**$0.16**

Capital costs provided by DWU

Table Q-38
Roberts County Water Supply Project
200,000 AFY Water Supply to DWU
Ogallala Groundwater to Lake Ray Roberts
Panhandle Water Project

Item	Size		Quantity	Unit	Unit Price	Cost
Groundwater Costs						
Groundwater Rights	1	Acre	300,000	Acre	$700	$210,000,000
Subtotal						**$210,000,000**
Capital Costs						
Roberts & Hemphill Counties Well Field						
Test Holes [1]			176	EA	$9,600	$1,689,600
Groundwater Wells [2]	225	HP (Avg)	88	EA	$400,000	$35,200,000
Monitoring Wells	1	LS	1	EA	$1,000,000	$1,000,000
69 KV Transmission System [15]	1	Miles	41	MI	$198,000	$8,118,000
Electrical Substations [15]	1	LS	6	EA	$1,485,000	$8,910,000
Power to Wells [15]			810	MI	$33,000	$26,730,000
Wellfield Collection Lines to Wellfield Pump Sta. or Transmission System [3]	14	inch (Avg)	370,000	FT	$60	$22,200,000
Transmission from Wellfield Pump or Booster Sta. to Main Line Pump Sta. [3]	42	inch (Avg)	542,000	FT	$215	$116,530,000
Landowner Well Site and Pipeline Damages Compensation	1	LS	1	EA	$6,345,000	$6,345,000
20% Standby Wells	1	LS	1	EA	$18,433,000	$18,433,000
Pump Station 1 (600 Hp)	600	HP	4	EA	$2,150,000	$8,600,000
Pump Station 2 (3200 Hp)	3200	HP	2	EA	$5,235,000	$10,470,000
Pump Station 3 (400 Hp)	400	HP	4	EA	$1,795,000	$7,180,000
Pump Station 4 (75 Hp)	75	HP	4	EA	$693,500	$2,774,000
Pump Station 2 Ground Storage Tank	1.5	MG	2	EA	$591,000	$1,182,000
Pump Station 3 Ground Strorage Tank	0.8	MG	2	EA	$414,600	$829,200
Pump Station 4 Ground Storage Tank	0.2	MG	2	EA	$200,250	$400,500
Pump Station 5 Ground Storage Tank	2	MG	2	EA	$714,000	$1,428,000
Pump Station 6 Ground Storage Tank	5.1	MG	2	EA	$1,323,200	$2,646,400
Standpipe	1.6	MG	1	EA	$615,600	$615,600
Terminus Tank at Connection to Transmission Main	5.8	MG	2	EA	$1,464,600	$2,929,200
Terminus Tank at Connection to Transmission Main	9	MG	2	EA	$2,410,500	$4,821,000
Unpaved Access Roads to Wells	15	Feet	316,800	FT	$13	$3,960,000
Pipeline Easements outside of Mesa Water Rights	1	Acre	200	AC	$3,500	$700,000
Environmental Studies, Permitting & Mitigation			1	LS	$2,536,000	$2,536,000
Subtotal						**$296,227,500**
Panhandle Water Transmission System to Lake Ray Roberts						
Pipeline - Roberts County to Lake Ray Roberts - Rural, Soil [5]	90	inch	1,372,000	FT	$774	$1,061,928,000
Pipeline - Roberts County to Lake Ray Roberts - Rural, Soil/Rock [5]	90	inch	64,000	FT	$968	$61,920,000
Pump Station No. 1 - Roberts County to Lake Ray Roberts[6]	3,500	HP	1	EA	$5,557,500	$5,557,500

Table Q-38 (Continued)						
Pump Station No. 2 - Roberts County to Lake Ray Roberts [6]	25,000	HP	1	EA	$23,650,000	$23,650,000
Storage Tanks (10.8% of Peak Daily Flow) [7] - Three - 8 MG Tanks Per Station	8	MG	6	EA	$2,069,000	$12,414,000
Pressure Reducing Station [8]			2	EA	$329,000	$658,000
Discharge Structure			1	EA	$250,000	$250,000
Easement - Rural [9]			1,436,000	LF	$9	$12,924,000
Environmental Studies, Permitting & Mitigation			1	LS	$13,993,500	$13,993,500
Subtotal						**$1,193,295,000**
Engineering and Contingencies (35% for pump stations, 30% for other items)						$440,722,000
Total Capital Cost						**$1,930,244,500**
Interest During Construction [10]	3	YR				$234,853,000
Total Construction Cost						**$2,165,097,500**
Development Costs						
Preliminary Expenses			1	LS	$25,000,000	$25,000,000
Development Fee for wellfield only	7.0	%	1	LS	$35,436,000	$35,436,000
Subtotal						**$60,436,000**
Total Project Cost						**$2,435,533,500**
Pre-Amortization Annual Cost						
Debt Service (6 percent for 30 years) [11]						$176,939,000
Well Field and Transmission System Operation and Maintenance [12]						$18,792,000
Well Field and Transmission System Energy [13]						$23,434,000
Electric Substation Lease [14]						$1,089,711
Supplemental Wells & Infrastructure (.5% of Wellfield Capital Cost)			1	EA	$1,490,000	$1,490,000
Total Annual Cost						**$221,744,711**
Available Project Yield (ac-ft/yr)						**200,000**
Annual Cost of Water ($ per ac-ft)						**$1,109**
Annual Cost of Water ($ per 1,000 gallons)						**$3.40**
Post Amortization Annual Cost						
Well Field and Transmission System Operation and Maintenance [12]						$18,792,000
Well Field and Transmission System Energy [13]						$23,434,000
Electric Substation Lease [14]						$1,089,711
Supplemental Wells & Infrastructure (3% of Wellfield Capital Cost)			1	EA	$1,490,000	$1,490,000
Total Annual Cost						**$44,805,711**
Annual Cost of Water ($ per ac-ft)						**$224**
Annual Cost of Water ($ per 1,000 gallons)						**$0.69**

1 Number of test holes per R.W. Harden & Assoc. (4/01/08). Unit cost based on average 600 ft deep test hole @ $16/ft.

2 Number of wells based on preliminary well field layout (R.W. Harden & Assoc., 04/01/08) for 100,000 ac-ft/year project. Well requirements doubled for estimate of 200,000 ac-ft/year project.

3 Average collection line size per preliminary well field collection and transmisson system layout and calculations by RPS / PBS&J.

PBS&J. Well field pump stations and storage requirements doubled for estimate of 200,000 ac-ft/year project. HP = .17536 x mgd x TDH/ 75% Eff.

5 Unit costs for pipelines from Freese and Nichols' Updated November 30, 2004 Memorandum Cost Estimating for SB1 Projects; unit cost for rur

6 Pump Station costs based on peak HP requirements from preliminary design using WaterCAD version 5.0 and 75% pump and motor efficiency.

7 Storage tanks costs from referenced Freese and Nichols' Updated November 30, 2004 Memo.

8 Cost for pressure reducing station from water supply study - Providing Groundwater from the Texas Panhandle to Communities throughout the S

[9] ROW acquisition unit cost from referenced Freese and Nichols' Updated November 30, 2004 Memo.

[10] A 6% interest rate with a 4% annual rate of return for a construction period of 3 years.

[11] Interest rate is 6% per year simple interest.

[12] Assumes O&M costs of 1% of non-pump station construction costs and 2.5% of pump station construction costs plus 20% contingency. Does n

[13] Based on Roberts County well field and transmission system average-flow power requirements @ $0.055/kWh.

[14] Cost equal to 150% of cost previously provided by Universal Utility Services (subsidiary of Xcel Energy) for wellfield located only in western I

[15] Costs for 69KV transmission line, overhead power lines and substations were provided July 21, 2008 by Burns & McDonnell. Costs were adjus

[14] Cost equal to 150% of cost previously provided by Universal Utility Services (subsidiary of Xcel Energy) for wellfield located only in western I

[15] Unit costs from Universal Utility Services. Length of power lines equal to length of well field collection and transmission lines. Substation long

Table Q-39
Roberts County Water Supply Project
200,000 AFY Water Supply to NTMWD - Scenario 5B
Ogallala Groundwater to Lake Lavon Near Princeton, Texas
Panhandle Water Project

Item	Size		Quantity	Unit	Unit Price	Cost
Groundwater Costs						
Groundwater Rights			300,000	Acre	$700	$210,000,000
Subtotal						**$210,000,000**
Capital Costs						
Roberts and Hemphill Counties Well Field						
Test Holes [1]			176	EA	$9,600	$1,689,600
Groundwater Wells [2]	225	HP (Avg)	88	EA	$400,000	$35,200,000
Monitoring Wells	1	LS	1	EA	$1,000,000	$1,000,000
69 KV Transmission System [15]	1	Miles	41	MI	$198,000	$8,118,000
Electrical Substations [15]	1	LS	6	EA	$1,485,000	$8,910,000
Power to Wells [15]			810	MI	$33,000	$26,730,000
Wellfield Collection Lines to Wellfield Pump Sta. or Transmission System [3]	14	inch (Avg)	370,000	FT	$60	$22,200,000
Transmission from Wellfield Pump or Booster Sta. to Main Line Pump Sta. [3]	42	inch (Avg)	542,000	FT	$215	$116,530,000
Landowner Damages Compensation	1	LS	1	EA	$6,345,000	$6,345,000
20% Standby Wells	1	LS	1	EA	$18,433,000	$18,433,000
Pump Station 1 (600 Hp)	600	HP	4	EA	$2,150,000	$8,600,000
Pump Station 2 (3200 Hp)	3200	HP	2	EA	$5,235,000	$10,470,000
Pump Station 3 (400 Hp)	400	HP	4	EA	$1,795,000	$7,180,000
Pump Station 4 (75 Hp)	75	HP	4	EA	$693,500	$2,774,000
Pump Station 2 Ground Storage Tank	1.5	MG	2	EA	$591,000	$1,182,000
Pump Station 3 Ground Strorage Tank	0.8	MG	2	EA	$414,600	$829,200
Pump Station 4 Ground Storage Tank	0.2	MG	2	EA	$200,250	$400,500
Pump Station 5 Ground Storage Tank	2	MG	2	EA	$714,000	$1,428,000
Pump Station 6 Ground Storage Tank	5.1	MG	2	EA	$1,323,200	$2,646,400
Standpipe	1.6	MG	1	EA	$615,600	$615,600
Terminus Tank at Connection to Transmission Main	5.8	MG	2	EA	$1,464,600	$2,929,200
Terminus Tank at Connection to Transmission Main	9	MG	2	EA	$2,410,500	$4,821,000
Unpaved Access Roads to Wells	15	Feet	316,800	FT	$13	$3,960,000
Rights	1	Acre	200	AC	$3,500	$700,000
Environmental Studies, Permitting & Mitigation			1	LS	$2,536,000	$2,536,000
Subtotal						**$296,227,500**

Table Q-39, Continued						
Panhandle Water Transmission System to Lake Lavon						
Pipeline - Roberts County to Lake Lavon - Rural, Soil [5]	90	inch	1,627,000	FT	$774	$1,259,298,000
Pipeline - Roberts County to Lake Lavon - Rural, Rock [5]	90	inch	53,000	FT	$968	$51,278,000
Pipeline - Roberts County to Lake Lavon - Urban, Soil [5]	90	inch	25,000	FT	$1,045	$26,125,000
Pump Station No. 1 - Roberts County to Lake Lavon (Peak - 3,500 HP) [6]	3,500	HP	1	EA	$5,557,500	$5,557,500
Pump Station No. 2 - Roberts County to Lake Lavon (Peak - 26,000 HP) [6]	26,000	HP	1	EA	$24,295,000	$24,295,000
Pump Station No. 3 - Roberts County to Lake Lavon (Peak - 2,000 HP) [6]	2,000	HP	1	EA	$4,182,000	$4,182,000
Storage Tanks (10.8% of Peak Daily Flow) [7] - Three - 8 MG Tanks Per Station	8	MG	9	EA	$2,069,000	$18,621,000
Pressure Reducing Station [8]			2	EA	$329,000	$658,000
Discharge Structure			1	EA	$250,000	$250,000
Easement - Rural [9]	80'/40'		1,680,000	FT	$9	$15,120,000
Easement - Urban [9]	80'/40'		25,000	FT	$55	$1,375,000
Environmental Studies, Permitting & Mitigation			1	LS	16,680,000	$16,680,000
Subtotal						**$1,423,439,500**
Engineering and Contingencies (35% for pump stations, 30% for other items)						$505,909,000
Total Capital Cost						**$1,929,348,500**
Interest During Construction [10]	3	YR				$234,744,000
Total Construction Cost						**$2,164,092,500**
Development Costs						
Preliminary Expenses			1	LS	$25,000,000	$25,000,000
Development Fee	7.0	%	1	LS	$35,436,000	$35,436,000
Subtotal						**$60,436,000**
Total Project Cost						**$2,434,528,500**
Pre-Amortization Annual Cost						
Debt Service (6 percent for 30 years) [11]						$176,866,000
Well Field and Transmission System Operation and Maintenance [12]						$21,677,000
Well Field and Transmission System Energy Costs [13]						$24,316,000
Electric Substation Lease [14]						$1,090,000
Supplemental Wells & Infrastructure (0.5% of Initial Wellfield Capital Cost			1	EA	$1,482,000	$1,482,000
Total Annual Cost						**$225,431,000**
Available Project Yield (ac-ft/yr)						**200,000**
Water Cost ($ per ac-ft)						**$1,127**
Water Cost ($ per 1,000 gallons)						**$3.46**
Post Amortization Annual Cost						
Well Field and Transmission System Operation and Maintenance [12]						$21,677,000
Well Field and Transmission System Energy Costs [13]						$24,316,000
Electric Substation Lease [14]						$1,090,000
Supplemental Wells & Infrastructure (0.5% of Initial Wellfield Capital Cost)						$1,482,000
Total Annual Cost						**$48,565,000**
Water Cost ($ per ac-ft)						**$243**
Water Cost ($ per 1,000 gallons)						**$0.75**

Table Q-40
Roberts County Water Supply Project
200,000 AFY Water Supply to TRWD
Ogallala Groundwater to Eagle Mountain Lake Via Lake Bridgeport

Item	Size		Quantity	Unit	Unit Price	Cost
Groundwater Costs						
Groundwater Rights	1	Acre	300,000	Acre	$700	$210,000,000
Subtotal						**$210,000,000**
Capital Costs						
Roberts & Hemphill Counties Well Field						
Test Holes [1]			176	EA	$9,600	$1,689,600
Groundwater Wells [2]	225	HP (Avg)	88	EA	$400,000	$35,200,000
Monitoring Wells	1	LS	1	EA	$1,000,000	$1,000,000
69 KV Transmission System [15]	1	Miles	41	MI	$198,000	$8,118,000
Electrical Substations [15]	1	LS	6	EA	$1,485,000	$8,910,000
Power to Wells [15]			810	MI	$33,000	$26,730,000
Wellfield Collection Lines to Wellfield Pump Sta. or Transmission System [3]	14	inch (Avg)	370,000	FT	$60	$22,200,000
Transmission from Wellfield Pump or Booster Sta. to Main Line Pump Sta. [3]	42	inch (Avg)	542,000	FT	$215	$116,530,000
Landowner Damages Compensation	1	LS	1	EA	$6,345,000	$6,345,000
20% Standby Wells	1	LS	1	EA	$18,433,000	$18,433,000
Pump Station 1 (600 Hp)	600	HP	4	EA	$2,150,000	$8,600,000
Pump Station 2 (3200 Hp)	3200	HP	2	EA	$5,235,000	$10,470,000
Pump Station 3 (400 Hp)	400	HP	4	EA	$1,795,000	$7,180,000
Pump Station 4 (75 Hp)	75	HP	4	EA	$693,500	$2,774,000
Pump Station 2 Ground Storage Tank	1.5	MG	2	EA	$591,000	$1,182,000
Pump Station 3 Ground Strorage Tank	0.8	MG	2	EA	$414,600	$829,200
Pump Station 4 Ground Storage Tank	0.2	MG	2	EA	$200,250	$400,500
Pump Station 5 Ground Storage Tank	2	MG	2	EA	$714,000	$1,428,000
Pump Station 6 Ground Storage Tank	5.1	MG	2	EA	$1,323,200	$2,646,400
Standpipe	1.6	MG	1	EA	$615,600	$615,600
Terminus Tank at Connection to Transmission Main	5.8	MG	2	EA	$1,464,600	$2,929,200
Terminus Tank at Connection to Transmission Main	9	MG	2	EA	$2,410,500	$4,821,000
Unpaved Access Roads to Wells	15	Feet	316,800	FT	$13	$3,960,000
Pipeline Easements outside of Mesa Water Rights	1	Acre	200	AC	$3,500	$700,000
Environmental Studies, Permitting & Mitigation			1	LS	$2,536,000	$2,536,000
Subtotal						**$296,227,500**
Panhandle Water Transmission System to Lake Bridgeport						
Pipeline - Roberts County to Lake Bridgeport - Rural, Soil [5]	90	inch	1,235,000	FT	$774	$955,890,000
Pipeline - Roberts County to Lake Bridgeport - Rural, Soil/Rock [5]	90	inch	61,000	FT	$968	$59,018,000
Pump Station No. 1 - Roberts County to Lake Bridgeport[6]	3,000	HP	1	EA	$5,020,000	$5,020,000
Pump Station No. 2 - Roberts County to Lake Bridgeport[6]	17,500	HP	1	EA	$18,382,500	$18,382,500
Storage Tanks (10.8% of Peak Daily Flow) [7] -	24	MG (Per Sta.)	6	EA	$2,069,000	$12,414,000
Pressure Reducing Station [8]			2	EA	$329,000	$658,000
Discharge Structure			1	EA	$250,000	$250,000
Easement - Rural [9]			1,296,000	LF	$9	$11,664,000
Environmental Studies, Permitting & Mitigation			1	LS	$12,616,600	$12,616,600
Subtotal						**$1,075,913,100**

Engineering and Contingencies (35% for pump stations, 30% for other items)						$406,009,000
Total Capital Cost						**$1,778,149,600**
Interest During Construction [10]	3	YR				$216,347,000
Total Construction Cost						**$1,994,496,600**
Development Costs						
Preliminary Expenses			1	LS	$25,000,000	$25,000,000
Development Fee for wellfield only	7.0	%	1	LS	$35,436,000	$35,436,000
Subtotal						**$60,436,000**
Total Project Cost						**$2,264,932,600**
Pre-Amortization Annual Cost						
Debt Service (6 percent for 30 years) [11]						$164,545,000
Well Field and Transmission System Operation and Maintenance [12]						$17,310,000
Well Field and Transmission System Energy[13]						$21,200,000
Electric Substation Lease [14]						$1,089,711
Supplemental Wells & Infrastructure (0.5% of Wellfield Capital Cost)			1	EA	$1,490,000	$1,490,000
Total Annual Cost						**$205,634,711**
Available Project Yield (ac-ft/yr)						**200,000**
Annual Cost of Water ($ per ac-ft)						**$1,028**
Annual Cost of Water ($ per 1,000 gallons)						**$3.16**
Post Amortization Annual Cost						
Well Field and Transmission System Operation and Maintenance [12]						$17,310,000
Well Field and Transmission System Energy[13]						$21,200,000
Electric Substation Lease [14]						$1,089,711
Supplemental Wells & Infrastructure (0.5% of Wellfield Capital Cost)			1	EA	$1,490,000	$1,490,000
Total Annual Cost						**$41,089,711**
Annual Cost of Water ($ per ac-ft)						**$205**
Annual Cost of Water ($ per 1,000 gallons)						**$0.63**

Table Q-41
TRWD & DWU Integrated Pipeline

Owners:	TRWD and DWU	
Amount - (total):	290,776	Ac-Ft/Yr
- TRWD	179,000	Ac-Ft/Yr
- DWU	111,776	Ac-Ft/Yr

		Ownership		**Flow (Ac-Ft)**	**Peak (MGD)**
Segments:	**ID:**	**TRWD**	**DWU**		
Lake Palestine to Cedar Creek Connection	**A**	0.0%	100.0%	111,776	150
Cedar Creek Connection to Richland-Chambers Connection	**B**	45.8%	54.2%	227,176	277
Richland-Chambers Connection to Bachman Take-off Point	**C**	56.8%	43.2%	290,776	347
Bachman Take-off Point to Connection to Benbrook Pipeline	**D**	100.0%	0.0%	179,000	197
Cedar Creek Resevoir to Connection to the Main Pipeline	**E**	100.0%	0.0%	115,400	127
Richland-Chambers to Connection to the Main Pipeline	**F**	100.0%	0.0%	63,600	70
Main Pipeline to Existing TRWD Lines	**G**	56.8%	43.2%	290,776	347
Existing TRWD Lines to Bachman WTP	**H**	0.0%	100.0%	111,776	150

CONSTRUCTION COSTS

TRANSMISSION FACILITIES

Pipeline & appurtenances	**Size**	**Quantity**	**Unit**	**Cost**
Pipeline - A	84 in.	215,980	LF	$166,810,160
Pipeline - B	108 in.	24,969	LF	$26,980,667
Pipeline - C	108 in.	307,637	LF	$310,424,355
Pipeline - D	84 in.	122,118	LF	$93,131,452
Pipeline - E	72 in.	8,263	LF	$5,441,541
Pipeline - F	60 in.	54,244	LF	$30,545,507
Pipeline - G	108 in.	8,114	LF	$8,853,172
Pipeline - H	84 in.	146,158	LF	$133,715,691
ROW and Land Acquisition - A		1	LS	$32,668,500
ROW and Land Acquisition - BCD		1	LS	$68,599,500
ROW and Land Acquisition - F		1	LS	$5,423,000
ROW and Land Acquisition - G		1	LS	$1,566,000
ROW and Land Acquisition - H		1	LS	$31,088,000
Permitting & Mitigation				$9,310,800
Engineering and Contingencies				$262,226,323
Subtotal of Pipeline				**$1,186,784,669**

Table Q-41, Continued

Pump Stations				
Intake and Pump Station - Lake Palestine		1	LS	$30,895,551
Intake and Pump Station - Cedar Creek Res		1	LS	$30,895,551
Intake and Pump Station - Richland-Chambers Res		1	LS	$17,555,826
Booster Pump Stations & 40 MG Storage Tank		2	LS	$81,040,293
Power Supply		1	LS	$30,000,000
Permitting & Mitigation				$2,284,600
Engineering and Contingencies				$54,204,941
Subtotal of Pump Stations				**$246,876,763**
TERMINAL STORAGE				
Crowley Balancing Reservoir	200 MG	1	LS	$15,000,000
Bachman	150 MG	1	LS	$11,250,000
Permitting & Mitigation				$421,700
Engineering and Contingencies				$9,581,000
Subtotal of Terminal Storage				**$36,252,700**
CONSTRUCTION TOTAL				**$1,469,914,133**
Interest During Construction (24 months)				$120,048,000

TOTAL COST	**TRWD**	**Dallas**	**Total**
	$702,008,046	**$887,954,087**	**$1,589,962,133**
ANNUAL COSTS			
Debt Service (6% for 30 years)	$51,000,100	$64,508,900	$115,509,000
Electricity ($0.09 kWh)	$21,642,925	$13,732,820	$35,375,745
Operation & Maintenance	$6,444,000	$8,151,000	$14,595,000
Total Annual Costs	**$79,087,025**	**$86,392,720**	**$165,479,745**
UNIT COSTS (Until Amortized)			
Per Acre-Foot	$442	$773	$569
Per 1,000 Gallons	$1.36	$2.37	$1.75
UNIT COSTS (After Amortization)			
Per Acre-Foot	$157	$196	$172
Per 1,000 Gallons	$0.48	$0.60	$0.53

Table Q-42
DWU Oklahoma Water
From Hugo to Lake Lewisville

Probable Owner: Dallas
Quantity: 50,000 AF/Y

CONSTRUCTION COSTS					
TRANSMISSION FACILITIES					
Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline	60 in	600,000	LF	$366	$219,600,000
30-ft Right of Way Easements (ROW)		600,000	LF	$7	$4,200,000
Red River Tunnel		1,000	LF	$994	$994,000
Engineering and Contingencies (30%)					$66,178,000
Subtotal of Pipeline					**$290,972,000**
Pump Station(s)					
Lake Hugo Pump Station	5700 HP	1	LS	$10,294,000	$10,294,000
Booster 1	5700 HP	1	LS	$7,740,500	$7,741,000
Engineering and Contingencies (35%)					$6,312,000
Subtotal of Pump Station(s)					**$24,347,000**
CONSTRUCTION TOTAL					**$315,319,000**
Permitting and Mitigation					**$2,864,000**
Interest During Construction			**(24 months)**		**$25,751,000**
TOTAL COST					**$343,934,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$24,986,000
Electricity ($0.09 per kWh)					$4,484,000
Operation & Maintenance					$3,188,000
Raw Water Purchase					$2,444,000
Total Annual Costs					**$35,102,000**
UNIT COSTS (During Amortization)					
Per Acre-Foot					$702
Per 1,000 Gallons					$2.15
UNIT COSTS (After Amortization)					
Per Acre-Foot					$202
Per 1,000 Gallons					$0.62

Table Q-43
NTMWD Oklahoma Water
From Hugo to Lake Chapman

Probable Owner: NTMWD
Quantity: 50,000 AF/Y

CONSTRUCTION COSTS
TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline Rural	60 in	274,560	LF	$366	$100,489,000
30-ft Right of Way Easements (ROW)		274,560	LF	$7	$1,922,000
Red River Tunnel		1,000	LF	$994	$994,000
Engineering and Contingencies (30%)					$31,022,000
Subtotal of Pipeline					**$134,427,000**
Pump Station(s)					
Pumps with intake & building	6800 HP	1	LS	$11,638,200	$11,638,200
Chapman Pump Station Expansion					$709,000
Booster on Chapman-Lavon Line					$8,516,000
Engineering and Contingencies (35%)					$7,302,120
Subtotal of Pump Station(s)					**$28,165,320**
CONSTRUCTION TOTAL					**$162,592,320**
Permitting and Mitigation					**$1,468,000**
Interest During Construction			**(12 months)**		**$6,775,000**
TOTAL COST					**$170,835,320**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$12,411,000
Electricity ($0.09 per kWh)					$7,148,000
Operation & Maintenance					$1,844,000
Raw Water Purchase					$2,444,000
Total Annual Costs					**$23,847,000**
UNIT COSTS (Before Amortization)					
Per Acre-Foot					$477
Per 1,000 Gallons					$1.46
UNIT COSTS (After Amortization)					
Per Acre-Foot					$229
Per 1,000 Gallons					$0.70

Note: Cost for buying raw water is assumed to be $0.15 per 1,000 gallons

Table Q-44
TRWD Oklahoma Water
From Hugo to Eagle Mountain

Probable Owner:	TRWD				
Quantity:	50,000 AF/Y				
CONSTRUCTION COSTS					
TRANSMISSION FACILITIES					
Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline	60 in	800,000	LF	$366	$292,800,000
30-ft Right of Way Easements (ROW)		800,000	LF	$7	$5,600,000
Red River Tunnel		1,000	LF	$994	$994,000
Engineering and Contingencies (30%)					$88,138,000
Subtotal of Pipeline					**$387,532,000**
Pump Station(s)					
Lake Hugo Pump Station	5000 HP	1	LS	$9,293,000	$9,293,000
Booster 1	5000 HP	1	LS	$6,988,000	$6,988,000
Booster 2	5000 HP	1	LS	$6,988,000	$6,988,000
Engineering and Contingencies (35%)					$8,144,000
Subtotal of Pump Station(s)					**$31,413,000**
CONSTRUCTION TOTAL					**$418,945,000**
Permitting and Mitigation					**$3,805,000**
Interest During Construction			**(24 months)**		**$34,214,000**
TOTAL COST					**$456,964,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$33,198,000
Electricity ($0.09 per kWh)					$5,659,000
Operation & Maintenance					$4,224,000
Raw Water Purchase					$2,444,000
Total Annual Costs					**$45,525,000**
UNIT COSTS (During Amortization)					
Per Acre-Foot					$911
Per 1,000 Gallons					$2.79
UNIT COSTS (After Amortization)					
Per Acre-Foot					$247
Per 1,000 Gallons					$0.76

Table Q-45
UTRWD and Irving Oklahoma Water
From Hugo to Lake Chapman to Lavon

Probable Owner: UTRWD and Irving
Quantity: 50,000 AF/Y

CONSTRUCTION COSTS
TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline Rural	60.0 in	274,560	LF	$366	$100,489,000
30-ft Right of Way Easements (ROW)		274,560	LF	$7	$1,922,000
Red River Tunnel		1,000	LF	$994	$994,000
Engineering and Contingencies (30%)					$30,445,000
Subtotal of Pipeline					**$133,850,000**
Pump Station(s)					
Pumps with intake & building	6100.0 HP	1	LS	$10,837,400	$10,837,400
Chapman Pump Station Expansion					$709,000
Booster on Chapman-Lavon Line					$8,516,000
Engineering and Contingencies (35%)					$7,021,840
Subtotal of Pump Station(s)					**$27,084,240**
CONSTRUCTION TOTAL					**$160,934,240**
Permitting and Mitigation					**$1,459,000**
Interest During Construction			**(18 months)**		**$9,924,000**
TOTAL COST					**$172,317,240**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$12,519,000
Electricity ($0.09 per kWh)					$7,148,000
Operation & Maintenance					$1,820,000
Raw Water Purchase					$2,444,000
Total Annual Costs					**$23,931,000**
UNIT COSTS (During Amortization)					
Per Acre-Foot					$479
Per 1,000 Gallons					$1.47
UNIT COSTS (After Amortization)					
Per Acre-Foot					$228
Per 1,000 Gallons					$0.70

Note: Cost for buying raw water is assumed to be $0.15 per 1,000 gallons

Table Q-46
Oklahoma Water for NTMWD, TRWD, and UTRWD

Probable Owners:	NTMWD	50,000	AF/Y
	TRWD	50,000	AF/Y
	UTRWD	15,000	AF/Y

CONSTRUCTION COSTS
TRANSMISSION FACILITIES
Pipelines

	Size	**Quantity**	**Unit**	**Unit Price**	**Cost**
Hugo to Lavon	84.0 in	470,300	LF	$677	$318,393,000
Lavon to Lewisville (Rural)	66.0 in	69,000	LF	$441	$30,429,000
Lavon to Lewisville (Urban)	66.0 in	103,500	LF	$591	$61,169,000
Lewisville to Eagle Mountain Lake (Rur	60.0 in	136,290	LF	$366	$49,882,000
Lewisville to Eagle Mountain Lake (Urb	60.0 in	58,410	LF	$495	$28,913,000
Right of Way Easements (Rural 42'-72')		205,290	LF	$7	$1,437,000
Right of Way Easements (Rural 78'-108')		470,300	LF	$9	$4,233,000
Right of Way Easements (Urban)		161,910	LF	$41	$6,638,000
Red River Tunnel		1,000	LF	$1,316	$1,316,000
Engineering and Contingencies (30%)					$150,723,000
Subtotal of Pipeline					**$653,133,000**
Pump Station(s)					
Lake Hugo Pump Station	10300 HP	1	LS	$16,624,980	$16,625,000
Booster (Hugo-Lavon)	10300 HP	1	LS	$12,500,100	$12,500,000
Storage Tanks (Hugo-Lavon Booster)	8.0 MG	2	Ea.	$2,069,000	$4,138,000
Booster (Lavon)	3000 HP	1	LS	$5,020,000	$5,020,000
Storage Tanks (Lavon Booster)	10.0 MG	1	Ea.	$2,752,000	$2,752,000
Booster (Lewisville)	4400 HP	1	LS	$6,452,200	$6,452,000
Storage Tanks (Lewisville Booster)	7.0 MG	1	Ea.	$1,740,000	$1,740,000
Engineering and Contingencies (35%)					$17,229,000
Subtotal of Pump Station(s)					**$66,456,000**
CONSTRUCTION TOTAL					**$719,589,000**
Permitting and Mitigation					**$6,472,000**
Interest During Construction			**(12 months)**		**$29,983,000**
TOTAL COST					**$756,044,000**
ANNUAL COSTS (Pre-Amortization)					
Debt Service (6% for 30 years)					
NTMWD					$15,282,000
TRWD					$32,571,000
UTRWD					$7,073,000
Total					**$54,926,000**

Table Q-46, Continued

Electricity ($0.09 per kWh)	
NTMWD	$3,526,000
TRWD	$6,196,000
UTRWD	$1,303,000
Total	**$11,025,000**
Operation & Maintenance	
NTMWD	$2,102,000
TRWD	$4,317,000
UTRWD	$938,000
Total	**$7,357,000**
Raw Water Purchase	
NTMWD	$2,444,000
TRWD	$2,444,000
UTRWD	$733,000
Total	**$5,621,000**
Total Annual Costs	
NTMWD	$23,354,000
TRWD	$45,528,000
UTRWD	$10,047,000
Total	**$78,929,000**
UNIT COSTS (Before Amortization)	
Per Acre-Foot	
NTMWD	$467
TRWD	$911
UTRWD	$670
Total	$686
Per 1,000 Gallons	
NTMWD	$1.43
TRWD	$2.80
UTRWD	$2.06
Total	**$2.11**
UNIT COSTS (After Amortization)	
Per Acre-Foot	
NTMWD	$161
TRWD	$259
UTRWD	$198
Total	$209

Table Q-46, Continued

Per 1,000 Gallons	
NTMWD	$0.49
TRWD	$0.79
UTRWD	$0.61
Total	**$0.64**

Note: Cost for buying raw water is assumed to be $0.15 per 1,000 gallons

Table Q-47
Cost of Lower Bois d'Arc Creek Reservoir Site

Owner: NTMWD
Quantity 123,000 AF/Y

CONSTRUCTION COSTS

Dam & Reservoir	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Mobilization		1	LS	$2,836,600	$2,836,600
Clearing and Grubbing		85	Ac	$6,000	$510,000
Care of Water During Construction		1	LS	$419,800	$419,800
Required Excavation		2,339,400	CY	$2.40	$5,614,600
Borrow Excavation		2,030,000	CY	$1.80	$3,654,000
Random Compacted Fill		3,261,000	CY	$2.40	$7,826,400
Core Compacted Fill		711,200	CY	$2.40	$1,706,900
Soil Bentonite Slurry Trench		497,700	SF	$14.40	$7,166,900
Soil Cement		114,900	CY	$54.00	$6,204,600
Flex Base Roadway		7,300	CY	$30.00	$219,000
Sand Filter Drain		293,000	CY	$36.00	$10,548,000
Grassing		41	AC	$4,500	$184,500
Intake Tower for Low-Flow Outlet		527	CY	$750	$395,300
Conduit for Low-Flow Outlet		660	CY	$500	$330,000
Impact Basin for Low-Flow Outlet		160	CY	$500	$80,000
Gates and Miscellaneous for Low-Flow Outlet		1	LS	$200,000	$200,000
Electrical System and Instrumentation for Low-Flow Outlet		1	LS	$195,000	$195,000
Spillway Structure and Reinforced Concrete		19,700	CY	$375	$7,387,500
Roller Compacted Concrete		49,900	CY	$65	$3,243,500
Bridge		3,000	SF	$150	$450,000
Barrier and Warning System		1	LS	$50,000	$50,000
Embankment Instrumentation		1	LS	$250,000	$250,000
Timber Guard Posts and Guard Rail		1	LS	$55,000	$55,000
Misc. Internal Drainage		1	LS	$50,000	$50,000
Engineering and Contingencies					$17,870,900
Subtotal for Dam & Reservoir					**$77,448,500**
Conflicts					**$24,543,300**

TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline to Leonard WTP					
Pipe (installed)	90 in.	166,230	LF	$797	$132,438,000
Appurtenances		1	LS	$800,000	$800,000
Crossings		1	LS	$1,974,850	$1,975,000
Right of Way Easements (ROW)		166,230	LF	$9	$1,496,000
Pipeline to Pilot Grove Creek					
Pipe (installed)	66 in.	65,625	LF	$409	$26,850,000
Appurtenances		1	LS	$420,000	$420,000
Crossings		1	LS	$1,974,850	$1,975,000
Right of Way Easements (ROW)		65,625	LF	$7	$459,000
Engineering and Contingencies					$36,011,300
Subtotal of Pipeline					**$202,424,300**

Table Q-47, Continued

Intake Pump Station				
Intake Pump Station	1	LS	$27,973,340	$27,973,000
Powerline and Substation	1	LS	$5,000,000	$5,000,000
Engineering and Contingencies (35%)				$11,541,000
Subtotal of Pump Station				**$44,514,000**
Terminal Storage at Leonard WTP*				
Dam and spillway modification		LS	$5,000,000	$5,000,000
Control structures	4	EA	$300,000	$1,200,000
Mobilization	1	LS	5.00%	$310,000
Engineering and Contingencies (35%)				$2,279,000
Subtotal Terminal Storage				**$8,789,000**
Outlet Structure at Lake Lavon				
Stilling basin	1	LS	$200,000	$200,000
Excavation & rip rap	1	LS	$490,000	$490,000
Engineering and Contingencies (35%)				$242,000
Subtotal Outlet Structure at Lake Lavon				**$932,000**
Permitting and Mitigation for Conveyance System				**$2,258,000**
CONSTRUCTION TOTAL				**$360,909,100**
Land Acquisition - Conservation Pool				**$82,875,000**
Land Acquisition - Flood Pool				**$3,750,000**
Permitting and Mitigation of reservoir and terminal storage				
Permitting (includes EIS)				$10,000,000
Mitigation Lands				$35,000,000
Mitigation construction and monitoring				$40,000,000
Archeology survey and mitigation				$3,000,000
Contingencies (15%)				$13,200,000
Subtotal Reservoir Permitting and Mitigation				**$101,200,000**
Interest During Construction (36 months)				**$66,764,000**
TOTAL COST				**$615,498,100**
ANNUAL COSTS				**Cost**
Debt Service (6% for 30 years)				$44,715,000
Electricity ($0.09 kWh)				$4,573,000
Operation & Maintenance				$3,962,000
Total Annual Costs				**$53,250,000**
UNIT COSTS (Before Amortization)				
Per Acre-Foot				$433
Per 1,000 Gallons				$1.33
UNIT COSTS (After Amortization)				
Per Acre-Foot				$69
Per 1,000 Gallons				$0.21

* Preliminary cost esimtates for modification of existing structure.

Table Q-48
Cost of George Parkhouse North Reservoir for Dallas Water Utilities

Probable Owner: DWU — Total yield = 148,700 AF/Y
Quantity: 112,000 AF/Y

CONSTRUCTION COSTS

Dam & Reservoir	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Excavation					
Approach Channel		107,400	CY	$3	$283,000
Discharge Channel		114,600	CY	$3	$302,000
Spillway		472,200	CY	$3	$1,243,000
Fill					
Random Compacted Fill		4,790,900	CY	$3	$12,610,000
Impervious Fill		1,107,200	CY	$3	$3,643,000
Filter		558,600	CY	$39	$22,055,000
Bridge		390	LF	$1,448	$565,000
Roadway		96,067	SY	$24	$2,276,000
Slurry Trench		1,092,500	SF	$16	$17,254,000
Soil Cement		324,340	CY	$86	$27,746,000
Elevator		1	LS	$131,608	$132,000
Barrier Warning System		936	LF	$118	$111,000
Gates					
Gate & Anchor		4,480	SF	$309	$1,386,000
Stop Gate & Lift		160	LF	$2,106	$337,000
Hoist		8	Ea	$296,117	$2,369,000
Electrical		1	LS	$658,038	$658,000
Power Drop		1	LS	$263,215	$263,000
Spillway Low-Flow System		1	LS	$460,627	$461,000
Stop Gate Monorail System		390	LF	$1,053	$411,000
Embankment Internal Drainage		39,300	LF	$70	$2,760,000
Guardrail		780	LF	$33	$26,000
Grassing		28	Ac	$5,264	$147,000
Concrete (mass)		97,000	CY	$165	$15,957,000
Concrete (walls)		7,000	CY	$625	$4,376,000
Mobilization (5% of subtotal)					$5,869,000
Clearing/Grubbing, care of water (6% of subtotal)					$7,042,000
Land Clearing		950	Ac	$987	$938,000
Engineering and Contingencies (35%)					$45,927,000
Subtotal for Dam & Reservoir					**$177,147,000**

Table Q-48, Continued

Conflicts	**$13,086,000**
Engineering and Contingencies (35%)	$4,580,000
Subtotal of Conflicts	**$17,666,000**
Land Acquisition	$19,007,000
Permitting and Mitigation of Reservoir	$38,014,000
Total Reservoir Construction Cost	**$251,834,000**
Interest during construction (36 months)	$30,641,000
Amount Attributed to DWU (75%)	**$211,856,000**

TRANSMISSION FACILITIES

Pump from George Parkhouse Reservoir to Lake Ray Hubbard.
DWU would use existing infrastructure to convey water from Lake Ray Hubbard to East Side WTP

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline (Rural)	84 in.	279,900	LF	$677	$189,492,000
ROW Easements (Rural)		279,900	LF	$9	$2,519,000
Engineering and Contingencies (30%)					$56,848,000
Subtotal of Pipeline					**$248,859,000**
Intake Pump Station					
George Parkhouse Pump Statio	6500 HP	1	LS	$9,894,000	$9,894,000
Booster Pump Station (Fairline	6500 HP	1	LS	$8,493,000	$8,493,000
Lake Ray Hubbard Pump Stati	900 HP	1	LS	$3,505,000	$3,505,000
Ground Storage Tanks	8 MG	2	Ea	$2,069,000	$4,138,000
Engineering and Contingencies (35%)					$9,111,000
Subtotal of Pump Station					**$35,141,000**
CONSTRUCTION TOTAL					**$284,000,000**
Permitting and Mitigation - Conveyance System					**$2,586,000**
Interest During Construction (24 months)					**$23,194,000**
TOTAL COST (DWU)					**$521,636,000**

Table Q-48, Continued

ANNUAL COSTS	Cost
Debt Service (6% for 30 years)	$37,896,000
Electricity ($0.09 per kWh)	$5,456,000
Operation & Maintenance	$7,929,000
Total Annual Costs	**$51,281,000**
UNIT COSTS (Until Amortized)	
Per Acre-Foot	$458
Per 1,000 Gallons	$1.41
UNIT COSTS (After Amortization)	
Per Acre-Foot	$120
Per 1,000 Gallons	$0.37

Table Q-49

Cost of George Parkhouse North Reservoir for North Texas Municipal Water District

Probable Owner: NTMWD   Total yield = 148,700 AF/Y

Quantity: 118,960 AF/Y

CONSTRUCTION COSTS

Dam & Reservoir	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Excavation					
Approach Channel		107,400	CY	$3	$283,000
Discharge Channel		114,600	CY	$3	$302,000
Spillway		472,200	CY	$3	$1,243,000
Fill					
Random Compacted Fill		4,790,900	CY	$3	$12,610,000
Impervious Fill		1,107,200	CY	$3	$3,643,000
Filter		558,600	CY	$39	$22,055,000
Bridge		390	LF	$1,448	$565,000
Roadway		96,067	SY	$24	$2,276,000
Slurry Trench		1,092,500	SF	$16	$17,254,000
Soil Cement		324,340	CY	$86	$27,746,000
Elevator		1	LS	$131,608	$132,000
Barrier Warning System		936	LF	$118	$111,000
Gates					
Gate & Anchor		4,480	SF	$309	$1,386,000
Stop Gate & Lift		160	LF	$2,106	$337,000
Hoist		8	Ea	$296,117	$2,369,000
Electrical		1	LS	$658,038	$658,000
Power Drop		1	LS	$263,215	$263,000
Spillway Low-Flow System		1	LS	$460,627	$461,000
Stop Gate Monorail System		390	LF	$1,053	$411,000
Embankment Internal Drainage		39,300	LF	$70	$2,760,000
Guardrail		780	LF	$33	$26,000
Grassing		28	Ac	$5,264	$147,000
Concrete (mass)		97,000	CY	$165	$15,957,000
Concrete (walls)		7,000	CY	$625	$4,376,000
Mobilization (5% of subtotal)					$5,869,000
Clearing/Grubbing, care of water (6% of subtotal)					$7,042,000
Land Clearing		950	Ac	$987	$938,000
Engineering and Contingencies (35%)					$45,927,000
Subtotal for Dam & Reservoir					**$177,147,000**

Table Q-49, Continued

Conflicts					**$13,086,000**
Engineering and Contingencies (35%)					$4,580,000
Subtotal of Conflicts					**$17,666,000**
Land Acquisition					$19,007,000
Permitting and Mitigation of Reservoir					$38,014,000
Total Reservoir Construction Cost					**$251,834,000**
Interest during construction (36 months)					$30,641,000
Amount Attributed to NTMWD (80%)					**$225,980,000**
TRANSMISSION FACILITIES					
Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline to Lake Lavon (by way of Lake Chapman)	84.0 in	271,000	LF	$677	$183,467,000
Right of Way Easements (ROW)		271,000	LF	$9	$2,439,000
Engineering and Contingencies (30%)					$55,040,000
Subtotal of Pipeline					**$240,946,000**
Intake Pump Station					
Intake Pump Station (at Parkhouse)		10000 HP	LS	$14,277,000	$14,277,000
Pump Station Expansion at Chapman		1	LS	$4,610,000	$4,610,000
Engineering and Contingencies (35%)					$6,610,000
Subtotal of Pump Station					**$25,497,000**
CONSTRUCTION TOTAL					**$266,443,000**
Permitting and Mitigation - Conveyance System					**$2,402,000**
Interest During Construction (24 months)					**$21,760,000**
TOTAL COST (NTMWD)					**$516,585,000**

Table Q-49, Continued

ANNUAL COSTS	Cost
Debt Service (6% for 30 years)	$37,529,000
Electricity ($0.09 per kWh)	$8,738,000
Operation & Maintenance	$4,659,000
Total Annual Costs	**$50,926,000**
UNIT COSTS (Until Amortized)	
Per Acre-Foot	$428
Per 1,000 Gallons	$1.31
UNIT COSTS (After Amortization)	
Per Acre-Foot	$113
Per 1,000 Gallons	$0.35

Table Q-50
TRWD Wetlands Reuse

Owner:	TRWD	
Quantity:	105,500	AF/Y

TRWD Richland-Chambers Wetlands

Item	Size	Quantity	Unit	Unit Price	Cost
Wetlands cells and pump stations		1	LS	$52,000,000	$52,000,000
Engineering & permitting		1	LS	$3,000,000	$3,000,000
Subtotal					**$55,000,000**

TRWD Cedar Creek Wetlands

Item	Size	Quantity	Unit	Unit Price	Cost
Wetland cells and pump stations		1	LS	$114,850,000	$114,850,000
Engineering & permitting					$19,525,000
Subtotal					**$134,375,000**

TOTAL CONSTRUCTION COST		**$189,375,000**
Interest During Construction	**(36 months)**	**$23,041,000**
TOTAL CAPITAL COST		**$212,416,000**
Annual Costs		
Debt Service (6 percent for 30 years)		$15,432,000
Electricity - Pumping from River to Wetlands		$1,140,000
Operation and Maintenance		$5,006,000
Total Annual Cost		**$21,578,000**
Available Project Yield (ac-ft/yr)		**105,500**
UNIT COSTS (Until Amortized)		
Water Cost ($ per ac-ft)		**$205**
Water Cost ($ per 1,000 gallons)		**$0.63**
UNIT COSTS (After Amortization)		
Water Cost ($ per ac-ft)		**$58**
Water Cost ($ per 1,000 gallons)		**$0.18**

Costs for wetland cells and pump stations provided by TRWD. Costs include contingency.

Table Q-51
Cost of Neches River Run-of-the-River Diversions Project for Dallas Water Utilities

Probable Owner:	DWU		
Quantity:	134,500	AF/Y	20% Retained for Local Use (~20 MGD)
Quantity for DWU:	112,100	AF/Y	

CONSTRUCTION COSTS	Size	Quantity	Unit	Unit Price	Cost
Dam and Reservoir					
Dams and Reservoirs Construction		1	LS	$193,450,000	$193,450,000
Engineering and Contingencies (35%)					$67,708,000
Land Acquisition and Mitigation		1	LS	$65,969,000	$65,969,000
Total Dams and Reservoirs					**$327,127,000**
Transmission Systems					
Intake and Pump Station at River	235808 HP	1	LS	$308,292,000	$308,292,000
Diversion Pipelines to DWU OCRs (Rural)	144 in	148,000	LF	$1,903	$281,644,000
Diversion Pipeline to Local OCR (Rural)	114 in	17,400	LF	$1,183	$20,584,000
Intake and Pump Station at DWU OCRs	10370 in	1	LS	$26,452,000	$26,452,000
Booster Pump Stations from DWU OCRs	Varies	3	LS	$17,105,000	$51,315,000
Transmission Pipeline from DWU OCRs (Rural)	72 in	536,838	LF	$530	$284,524,000
Transmission Pipeline from DWU OCRs (Urban)	72 in	156,546	LF	$714	$111,774,000
ROW Easements					$7,588,000
					$1,092,173,000
Engineering and Contingencies (30% for pipelines, 35% for other)					$344,678,000
Permitting & Mitigation - Conveyance System					$4,095,000
Construction					**$1,768,073,000**
Interest During Construction (36 months)					**$212,205,000**
TOTAL CAPITAL COST					**$1,980,278,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$143,865,000
Electricity ($0.09 per kWh)					$30,021,000
Operation & Maintenance					$19,415,000
Total Annual Costs					**$193,301,000**
UNIT COSTS (Until Amortized)					
Per Acre-Foot					$1,437
Per 1,000 Gallons					$4.41
UNIT COSTS (After Amortization)					
Per Acre-Foot					$368
Per 1,000 Gallons					$1.13

Cost estimates provided by HDR, Inc.

Table Q-52
Cost of George Parkhouse South Reservoir for North Texas Municipal Water District

Probable Owner:	NTMWD		Total yield = 135,600 AF/Y
Quantity:	108,480	AF/Y	
Peak:	121.0	MGD	

CONSTRUCTION COSTS

Dam & Reservoir	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Excavation					
Approach Channel		140,200	CY	$2.63	$369,000
Discharge Channel		123,000	CY	$2.63	$323,000
Spillway		289,300	CY	$2.63	$761,000
Emergency Spillway		434,300	CY	$2.63	$1,142,000
Fill					
Random Compacted Fill		7,169,400	CY	$2.63	$18,856,000
Impervious Fill		1,567,800	CY	$3.29	$5,158,000
Filter		668,200	CY	$39.50	$26,394,000
Bridge		190	LF	$1,450	$276,000
Roadway		63,067	SY	$23.70	$1,495,000
Slurry Trench		800,000	SF	$15.80	$12,640,000
Soil Cement		394,130	CY	$85.50	$33,698,000
Elevator		1	LS	$132,000	$132,000
Barrier Warning System		456	LF	$118	$54,000
Gates					
Gate & Anchor		2,240	SF	$395	$885,000
Stop Gate & Lift		160	LF	$2,110	$338,000
Hoist		8	Ea	$296,000	$2,368,000
Electrical		1	LS	$658,000	$658,000
Power Drop		1	LS	$263,000	$263,000
Spillway Low-Flow System		1	LS	$461,000	$461,000
Stop Gate Monorail System		390	LF	$1,050	$410,000
Embankment Internal Drainage		39,300	LF	$70.20	$2,759,000
Guardrail		780	LF	$33.30	$26,000
Grassing		28	Ac	$4,500	$126,000
Concrete (mass)		52,000	CY	$165	$8,580,000
Concrete (walls)		5,600	CY	$625	$3,500,000
Mobilization (5% of subtotal)					$6,084,000
Clearing/Grubbing, care of water (6% of subtotal)					$7,300,000
Land Clearing		950	AC	$987	$938,000
Engineering and Contingencies (35%)					$47,598,000
Subtotal for Dam & Reservoir					**$183,592,000**

Table Q-52, Continued

Conflicts					**$48,513,000**
Engineering and Contingencies (35%)					$16,980,000
Subtotal of Conflicts					**$65,493,000**
Land Acquisition		31,741	AC	$1,201	$38,121,000
Permitting and Mitigation of Reservoir					$84,605,000
Total Reservoir Construction Cost					**$371,811,000**
Interest during construction (36 months)					$45,238,000
Amount Attributed to NTMWD (80%)					**$333,639,000**
TRANSMISSION FACILITIES					
Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline to Lake Lavon (by way of Lake Chapman)	78 in	317,000	LF	$591	$187,347,000
Right of Way Easements (ROW)		317,000	LF	$9	$2,853,000
Engineering and Contingencies (30%)					$56,204,000
Subtotal of Pipeline					**$246,404,000**
Intake Pump Station					
Intake Pump Station (at Parkhouse)	11000 HP	1	LS	$16,657,000	$16,657,000
Pump Station Expansion at Chapman		1	LS	$4,610,000	$4,610,000
Storage Tanks	8 MG	4	EA	$2,069,000	$8,276,000
Engineering and Contingencies (35%)					$10,340,000
Subtotal of Pump Station					**$39,883,000**
CONSTRUCTION TOTAL					**$286,287,000**
Permitting and Mitigation - Conveyance System					**$2,503,000**
Interest During Construction (24 months)					**$23,381,000**
TOTAL COST (NTMWD)					**$645,810,000**

Table Q-52, Continued

ANNUAL COSTS	Cost
Debt Service (6% for 30 years)	$46,917,000
Electricity ($0.09 per kWh)	$8,563,000
Operation & Maintenance	$5,092,000
Total Annual Costs	**$60,572,000**
UNIT COSTS (Until Amortized)	
Per Acre-Foot	$558
Per 1,000 Gallons	$1.71
UNIT COSTS (After Amortization)	
Per Acre-Foot	$126
Per 1,000 Gallons	$0.39

Table Q-53
Cost of George Parkhouse South Reservoir for City of Dallas

Probable Owner:	City of Dallas		Total yield = 135,600 AF/Y
Quantity:	115,260	AF/Y	
Peak:	129	MGD	

CONSTRUCTION COSTS

Dam & Reservoir	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Excavation					
Approach Channel		140,200	CY	$2.63	$369,000
Discharge Channel		123,000	CY	$2.63	$323,000
Spillway		289,300	CY	$2.63	$761,000
Emergency Spillway		434,300	CY	$2.63	$1,142,000
Fill					
Random Compacted Fill		7,169,400	CY	$2.63	$18,856,000
Impervious Fill		1,567,800	CY	$3.29	$5,158,000
Filter		668,200	CY	$39.50	$26,394,000
Bridge		190	LF	$1,450	$276,000
Roadway		63,067	SY	$23.70	$1,495,000
Slurry Trench		800,000	SF	$15.80	$12,640,000
Soil Cement		394,130	CY	$85.50	$33,698,000
Elevator		1	LS	$132,000	$132,000
Barrier Warning System		456	LF	$118	$54,000
Gates					
Gate & Anchor		2,240	SF	$395	$885,000
Stop Gate & Lift		160	LF	$2,110	$338,000
Hoist		8	Ea	$296,000	$2,368,000
Electrical		1	LS	$658,000	$658,000
Power Drop		1	LS	$263,000	$263,000
Spillway Low-Flow System		1	LS	$461,000	$461,000
Stop Gate Monorail System		390	LF	$1,050	$410,000
Embankment Internal Drainage		39,300	LF	$70.20	$2,759,000
Guardrail		780	LF	$33.30	$26,000
Grassing		28	Ac	$4,500	$126,000
Concrete (mass)		52,000	CY	$165	$8,580,000
Concrete (walls)		5,600	CY	$625	$3,500,000
Mobilization (5% of subtotal)					$6,084,000
Clearing/Grubbing, care of water (6% of subtotal)					$7,300,000
Land Clearing		950	AC	$987	$938,000
Engineering and Contingencies (35%)					$47,598,000
Subtotal for Dam & Reservoir					**$183,592,000**

Table Q-53, Continued

	Size	Quantity	Unit	Unit Price	Cost
Conflicts					**$48,513,000**
Engineering and Contingencies (35%)					$16,980,000
Subtotal of Conflicts					**$65,493,000**
Land Acquisition		31,741	AC	$1,250	$39,676,000
Permitting and Mitigation of Reservoir					$87,715,000
Total Reservoir Construction Cost					**$376,476,000**
Interest during construction (36 months)					$45,806,000
Amount Attributed to Dallas (85%)					**$358,940,000**
TRANSMISSION FACILITIES					
Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline (Rural)	78 in	325,900	LF	$591	$192,607,000
Right of Way Easements (ROW)		325,900	LF	$9	$2,933,000
Engineering and Contingencies (30%)					$57,782,000
Subtotal of Pipeline					**$253,322,000**
Intake Pump Station					
Intake Pump Station (at Parkhouse)	12500 HP	1	LS	$16,657,000	$16,657,000
Booster Pump Station	12500 HP	1	LS	$14,298,000	$14,298,000
Storage Tanks	8 MG	4	EA	$2,069,000	$8,276,000
Engineering and Contingencies (35%)					$13,731,000
Subtotal of Pump Station					**$52,962,000**
CONSTRUCTION TOTAL					**$306,284,000**
Permitting and Mitigation - Conveyance System					**$2,683,000**
Interest During Construction (24 months)					**$25,014,000**
TOTAL COST (Dallas)					**$692,921,000**

Table Q-53, Continued

ANNUAL COSTS	Cost
Debt Service (6% for 30 years)	$50,340,000
Electricity ($0.09 per kWh)	$9,649,000
Operation & Maintenance	$5,446,000
Total Annual Costs	**$65,435,000**
UNIT COSTS (Until Amortized)	
Per Acre-Foot	$568
Per 1,000 Gallons	$1.74
UNIT COSTS (After Amortization)	
Per Acre-Foot	$131
Per 1,000 Gallons	$0.40

Table Q-54
Groundwater from the Carrizo-Wilcox from Brazos County for Dallas Water Utilities

Owner:	DWU	
Quantity:	100,000	AF/Y
Peak Flow:	111.5	MGD

Item	Size		Quantity	Unit	Unit Price	Cost
Capital Costs						
Wellfield and Treatment						
Wells	500	gpm	168	Ea.	$90,300	$15,170,000
Connection to Pump Station			168	Ea.	$160,000	$26,880,000
Chlorination			1	LS	$23,163,000	$23,163,000
Storage Tank (Closed)	8	MG	2	Ea.	$2,069,000	$4,138,000
Engineering and Contingencies (35% for pump stations, 30% for other items)						$24,273,000
Subtotal for Wellfield and Treatment						**$93,624,000**
Transmission System						
Pipeline Brazos Co. to Dallas - Rural	78	inch	740,400	LF	$591	$437,576,000
Pipeline Brazos Co to Dallas - Urban	78	inch	25,200	LF	$799	$20,135,000
Pump Station	12,900	HP	1	LS	$14,624,300	$14,624,000
Booster Pump Station	12,900	HP	1	LS	$14,624,300	$14,624,000
Storage Tanks (Closed - South and Booster)	8	MG	2	Ea.	$2,069,000	$4,138,000
Easement - Rural			740,400	LF	$9	$6,664,000
Easement - Rural			25,200	LF	$55	$1,386,000
Engineering and Contingencies (30% for pipleines, 35% for other items)						$148,998,000
Subtotal for Transmission						**$648,145,000**
TOTAL CONSTRUCTION COST						**$741,769,000**
Interest During Construction				**(24 months)**		**$52,934,000**
Permitting and Mitigation						**$6,725,000**
TOTAL CAPITAL COST						**$801,428,000**
Annual Costs						
Debt Service (6 percent for 30 years)						$58,223,000
Coverage for Debt Service (Represents profit for developer)						$14,556,000
Electricity (Transmission)						$10,105,000
Electricity (Wells)						$817,650
Chemicals						$921,000
Operation and Maintenance						$8,575,000
Groundwater Rights						$21,452,000
Groundwater District Fees						$7,502,000
Total Annual Cost						**$122,151,650**
UNIT COSTS (Until Amortized)						
Water Cost ($ per ac-ft)						**$1,222**
Water Cost ($ per 1,000 gallons)						**$3.75**
UNIT COSTS (After Amortization)						
Water Cost ($ per ac-ft)						**$494**
Water Cost ($ per 1,000 gallons)						**$1.52**

Table Q-55
Groundwater from the Carrizo-Wilcox from Brazos County for North Texas MWD

Owner:	NTMWD	
Quantity:	100,000	AF/Y
Peak Flow:	111.5	MGD

Item	Size		Quantity	Unit	Unit Price	Cost
Capital Costs						
Wellfield and Treatment						
Wells	500	gpm	168	Ea.	$90,300	$15,170,000
Connection to Pump Station			168	Ea.	$160,000	$26,880,000
Chlorination			1	LS	$23,163,000	$23,163,000
Storage Tank (Closed)	8	MG	2	Ea.	$2,069,000	$4,138,000
Engineering and Contingencies (35% for pump stations, 30% for other items)						$24,273,000
Subtotal for Wellfield and Treatment						**$93,624,000**
Transmission System						
Pipeline to Wylie - Rural	78	inch	804,000	LF	$591	$475,164,000
Pipeline to Wylie - Urban	78	inch	71,000	LF	$799	$56,729,000
Pump Station	14,300	HP	1	LS	$15,768,100	$15,768,000
Booster Pump Station	14,300	HP	1	LS	$15,768,100	$15,768,000
Storage Tanks (Closed - South and Booster)	8	MG	2	Ea.	$2,069,000	$4,138,000
Easement - Rural			804,000	LF	$9	$7,236,000
Easement - Rural			71,000	LF	$55	$3,905,000
Engineering and Contingencies (30% for pipleines, 35% for other items)						$172,054,000
Subtotal for Transmission						**$750,762,000**
TOTAL CONSTRUCTION COST						**$844,386,000**
Interest During Construction				**(24 months)**		**$61,315,000**
Permitting and Mitigation						**$7,643,000**
TOTAL CAPITAL COST						**$913,344,000**
Annual Costs						
Debt Service (6 percent for 30 years)						$66,353,000
Coverage for Debt Service (Represents profit for developer)						$16,588,000
Electricity (Transmission)						$11,056,000
Electricity (Wells)						$8,176,500
Chemicals						$921,000
Operation and Maintenance						$9,534,000
Groundwater Rights						$21,452,000
Groundwater District Fees						$7,502,000
Total Annual Cost						**$141,582,500**
UNIT COSTS (Until Amortized)						
Water Cost ($ per ac-ft)						**$1,416**
Water Cost ($ per 1,000 gallons)						**$4.35**
UNIT COSTS (After Amortization)						
Water Cost ($ per ac-ft)						**$586**
Water Cost ($ per 1,000 gallons)						**$1.80**

Table Q-56
Carrizo-Wilcox Groundwater from the Brazos County Area
Preliminary Cost Estimate - 30-Year Amortization @ 6% ($0.09/KW-hr Power Cost)
50,000 AFY Water Supply to TRWD
Carrizo-Wilcox Groundwater in Brazos, Burleson, Milam, and Robertson Counties to Richland-Chambers Reservoir

Item	Size		Quantity	Unit	Unit Price	Cost
Capital Costs						
Transmission System to Richland Chambers Reservoir						
Pipeline - Rural (parallel pipelines)	60	inch	510,400	LF	$366	$186,806,000
Pump Station #1 from Well Field to Booster	4,600	HP	1	EA	$8,818,600	$8,819,000
Pump Station #2 - from Booster PS to Richland-Chambers Reservoir	4,600	HP	1	EA	$6,630,800	$6,631,000
Storage Tanks - no roof	8	MG	1	EA	$2,069,000	$2,069,000
Discharge Structure	45	MGD	1	EA	$114,200	$114,000
Easement - Rural			1,020,800	LF	$7	$7,146,000
Engineering and Contingencies (30% for pipleines, 35% for other items)						$62,213,000
Subtotal						**$273,798,000**
Transmission System from Richland Chambers Reservoir to Tarrant County						
Pipeline - Rural (not parallelled - other lines)	60	inch	321,150	LF	$366	$117,541,000
Pipeline - Urban (not parallelled - other lines)	60	inch	93,000	LF	$495	$46,035,000
Pump Station at R-C	4,200	HP	1	LS	$8,344,200	$8,344,000
Booster Pump Station at Ennis	3,800	HP	1	LS	$5,880,000	$5,880,000
Booster Pump Station at Waxahachie	2,700	HP	1	LS	$4,768,600	$4,769,000
Storage Tanks at Boosters	8	MG	2	EA	$2,069,000	$4,138,000
Easement - Rural			321,150	LF	$7	$2,248,000
Easement - Urban			93,000	LF	$41	$3,813,000
Engineering and Contingencies (35% for pump stations, 30% for other items)						$57,169,000
Subtotal						**$249,937,000**
TOTAL CONSTRUCTION COST						**$523,735,000**
Interest During Construction				**(24 months)**		**$22,361,000**
Permitting and Mitigation						**$4,694,000**
TOTAL CAPITAL COST						**$550,790,000**
Annual Costs						
Debt Service (6 percent for 30 years)						$40,014,000
Purchase Water (includes all well field costs)			50,000	Ac-ft	$162.93	$8,146,000
Royalties to Land Owners (10% of sales)						$814,600
Transmission System Operation and Maintenance						$5,424,000
Transmission System Energy Costs						$8,270,000
Total Annual Cost						**$62,668,600**
Available Project Yield (ac-ft/yr)						**50,000**
UNIT COSTS (Until Amortized)						
Water Cost ($ per ac-ft)						**$1,253**
Water Cost ($ per 1,000 gallons)						**$3.85**
UNIT COSTS (After Amortization)						
Water Cost ($ per ac-ft)						**$453**
Water Cost ($ per 1,000 gallons)						**$1.39**

Table Q-57
DWU Lake of the Pines
Pump from Lake of the Pines to Lake Fork to TBR and gravity flow to East Side WTP

Probable Owner:	DWU	
Quantity:	89,600	AF/Y

CONSTRUCTION COSTS
TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline Rural	72 in	525,600	LF	$516	$271,210,000
Pipeline Urban	72 in	87,200	LF	$697	$60,778,000
Right of Way Easements (Rural)		525,600	LF	$7	$3,679,000
Right of Way Easements (Urban)		87,200	LF	$41	$3,575,000
Engineering and Contingencies (30%)					$99,596,000
Subtotal of Pipeline					**$438,838,000**
Pump Station(s)					
Lake of the Pines Pump Station	9100 HP	1	LS	$14,754,600	$14,755,000
Booster Pump Station	9000 HP	1	LS	$10,965,000	$10,965,000
Booster Pump Station	9000 HP	1	LS	$10,965,000	$10,965,000
Ground Storage Tanks	6 MG	4	Ea	$1,505,000	$6,020,000
Engineering and Contingencies (35%)					$14,946,750
Subtotal of Pump Station(s)					**$57,651,750**
CONSTRUCTION TOTAL					**$496,489,750**
Permitting and Mitigation					**$4,496,000**
Interest During Construction			**(24 months)**		**$40,548,000**
TOTAL COST					**$541,533,750**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$39,342,000
Raw Water Purchase		80 MGD	$/1000 gal	$0.30	$8,752,000
Electricity ($0.09 per kWh)					$9,821,000
Operation & Maintenance					$5,265,000
Total Annual Costs					**$63,180,000**
UNIT COSTS (Until Amortized)					
Per Acre-Foot					$705
Per 1,000 Gallons					$2.16
UNIT COSTS (After Amortization)					
Per Acre-Foot					$266
Per 1,000 Gallons					$0.82

Table Q-58
NTMWD Lake of the Pines
From Lake of the Pines to New WTP at Farmersville

Probable Owner: NTMWD
Quantity: 87,900 AF/Y

CONSTRUCTION COSTS
TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline Rural (from LOTP to Chapma	72 in	451,700	LF	$516	$233,077,000
Pipeline Rural (end of existing					
Chapman line to new WTP at	72 in	11,000	LF	$516	$5,676,000
30-ft Right of Way Easements (ROW)		462,700	LF	$7	$3,239,000
Engineering and Contingencies (30%)					$71,626,000
Subtotal of Pipeline					**$313,618,000**
Pump Station(s)					
Pump at LOTP with intake & building	7500 HP	1	LS	$12,510,500	$12,511,000
Booster Pump Station	5000 HP	1	LS	$6,988,000	$6,988,000
Pump Station at Lake Chapman	12000 HP	1	LS	$18,472,200	$18,472,000
Engineering and Contingencies (35%)					$13,289,850
Subtotal of Pump Station(s)					**$51,260,850**
Ground Storage					
Ground Storage Tanks at Booster	6 MG	2	LS	$1,505,000	$3,010,000
Engineering and Contingencies (35%)					$1,053,500
Subtotal of Ground Storage					**$4,063,500**
CONSTRUCTION TOTAL					**$368,942,350**
Permitting and Mitigation					**$3,357,000**
Interest During Construction			**(24 months)**		**$30,132,000**
TOTAL COST					**$402,431,350**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$29,236,000
Electricity ($0.09 per kWh)					$8,748,000
Operation & Maintenance					$4,094,000
Raw Water Purchase					$8,593,000
Total Annual Costs					**$50,671,000**

Table Q-58, Continued

UNIT COSTS (Until Amortized)	
Per Acre-Foot of Raw water	$576
Per 1,000 Gallons	$1.77
UNIT COSTS (After Amortization)	
Per Acre-Foot	$244
Per 1,000 Gallons	$0.75

Table Q-59
TRWD Lake of the Pines
From Lake of the Pines to Rolling Hills WTP

Probable Owner: TRWD
Quantity: 87,900 AF/Y

CONSTRUCTION COSTS
TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline Rural (from LOTP to WTP)	72 in	869,778	LF	$516	$448,805,000
30-ft Right of Way Easements (ROW)		869,778	LF	$7	$6,088,000
Engineering and Contingencies (30%)					$134,642,000
Subtotal of Pipeline					**$589,535,000**
Pump Station(s)					
Pump at LOTP with intake & building	12500 HP	1	LS	$19,015,500	$19,016,000
Booster Pump Station #1	12500 HP	1	LS	$14,297,500	$14,298,000
Booster Pump Station #2	12500 HP	1	LS	$14,297,500	$14,298,000
Engineering and Contingencies (35%)					$16,664,200
Subtotal of Pump Station(s)					**$64,276,200**
Ground Storage					
Ground Storage Tanks at Pump Station:	6 MG	4	LS	$1,505,000	$6,020,000
Engineering and Contingencies (35%)					$2,107,000
Subtotal of Ground Storage					**$8,127,000**
CONSTRUCTION TOTAL					**$661,938,200**
Permitting and Mitigation					**$6,029,000**
Interest During Construction			**(36 months)**		**$80,538,000**
TOTAL COST					**$748,505,200**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$54,378,000
Electricity ($0.09 per kWh)					$13,778,000
Operation & Maintenance					$6,995,000
Raw Water Purchase					$8,593,000
Total Annual Costs					**$83,744,000**

Table Q-59, Continued

UNIT COSTS (Until Amortized)	
Per Acre-Foot	$953
Per 1,000 Gallons	$2.92
UNIT COSTS (After Amortization)	
Per Acre-Foot	$334
Per 1,000 Gallons	$1.02

Table Q-60
Dallas Water Utilities
Lake Ray Hubbard Indirect Reuse Project

Owner Dallas Water Utilities
Amount 67,253 Ac-Ft/Yr

	Size	Quantity	Unit	Unit Price	Cost
CONSTRUCTION COSTS					
		Quantity	**Unit**	**Unit Price**	**Cost**
FILTERS AND WETLANDS FACILITIES					
Filter		1	L.S.	$6,230,000	$6,230,000
Wetlands		1	L.S.	$14,384,000	$14,384,000
Engineering & Contingencies					$7,215,000
Subtotal Filters and Wetlands					**$27,829,000**
TRANSMISSION FACILITIES					
Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
78" Pipeline - Urban	78 in.	197,400	LF	$ 799	$157,723,000
Right of Way Easements - Urban		197,400	LF	$ 55	$10,857,000
Engineering & Contingencies					$47,317,000
Subtotal Pipeline					**$215,897,000**
Pump Stations					
Pump Station 1	8472 HP	1	L.S.	$13,828,488	$13,828,000
Pump Station 2	1150 HP	1	L.S.	$4,078,750	$4,079,000
Engineering & Contingencies					$6,267,000
Subtotal Pump Stations					**$24,174,000**
ENVIRONMENTAL AND ARCHAEOLOGICAL STUDIES					**$2,355,000**
CONSTRUCTION TOTAL					**$270,255,000**
Interest During Construction		24 Months			$22,072,000
TOTAL COST					**$292,327,000**
ANNUAL COSTS (1st 30 years)					
Debt Service (6%, 30 years)					$21,237,000
Electricity ($0.09 per kWh)					$3,630,000
Operation and Maintenance					$2,876,000
Total Annual Costs					**$27,743,000**
UNIT COSTS (Average over 1st 30 years)					
Per Acre-Foot					$413
Per 1,000 Gallons					$1.27
UNIT COSTS (after 30 years)					
Per Acre-Foot					$97
Per 1,000 Gallons					$0.30

Table Q-61
Dallas Water Utilities
Lake Lewisville Indirect Reuse Project

Owner	Dallas Water Utilities				
Amount	67,253 Ac-Ft/Yr				
CONSTRUCTION COSTS					
		Quantity	**Unit**	**Unit Price**	**Cost**
Additional Wastewater Treatment					
Filtration and Phosphorous Removal		1	L.S.	$12,758,000	$12,758,000
Engineering & Contingencies					$4,465,000
Subtotal Filters and Wetlands					**$17,223,000**
TRANSMISSION FACILITIES					
Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
78" Pipeline - Urban	78 in.	209,200	LF	$ 799	$167,151,000
Right of Way Easements - Urban		209,200	LF	$ 55	$11,506,000
Engineering & Contingencies					$50,145,000
Subtotal Pipeline					**$228,802,000**
Pump Station					
Pump Station 1	7600 HP	1	L.S.	$12,639,200	$12,639,200
Engineering & Contingencies					$4,424,000
Subtotal Pump Stations					**$17,063,200**
ENVIRONMENTAL AND ARCHAEOLOGICAL STUDIES					**$2,311,000**
CONSTRUCTION TOTAL					**$265,399,200**
Interest During Construction	24 Months				$21,675,000
TOTAL COST					**$287,074,200**
ANNUAL COSTS (1st 30 years)					
Debt Service (6%, 30 years)					$20,856,000
Electricity ($0.09 per kWh)					$1,975,500
Operation and Maintenance					$2,768,000
Total Annual Costs					**$25,599,500**
UNIT COSTS (Average over 1st 30 years)					
Per Acre-Foot					$381
Per 1,000 Gallons					$1.17
UNIT COSTS (after 30 years)					
Per Acre-Foot					$71
Per 1,000 Gallons					$0.22

Table Q-62
Tarrant Regional Water District Lake Tehuacana

Owner: TRWD
Amount: 56,800 Ac-Ft/Yr
Peak 63 MGD

CONSTRUCTION COSTS

DAM & RESERVOIR	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Excavation					
Channel		2,250,000	C.Y.	$2.63	$5,922,000
Core trench & borrow		1,764,000	C.Y.	$2.63	$4,643,000
Fill Material					
Embankment		3,488,000	C.Y.	$3.29	$11,476,000
Waste Material		80,000	C.Y.	$2.63	$211,000
Filter, 1 & 2 (foundation drainage)		181,800	C.Y.	$39.48	$7,178,000
Stabilized base roadway		59,555	S.Y.	$23.69	$1,411,000
Cutoff slurry trench		514,800	S.F.	$15.79	$8,130,000
Soil cement including cement		137,800	C.Y.	$85.54	$11,788,000
Guard posts		1,680	each	$33.26	$56,000
Grassing		34	acres	$4,500	$153,000
Subtotal of Dam and Reservoir					**$50,968,000**
Conflicts					**$40,523,054**
Engineering and Contingencies (35%)					**$32,022,000**
CONSTRUCTION TOTAL					**$123,513,054**
LAND AND LIGNITE ACQUISITION		**1**	**L.S.**	**$109,682,000**	**$109,682,000**
Interest During Construction			**(36 months)**		**$15,028,000**
Permitting and Mitigation of Reservoir					**$219,364,000**
TOTAL RESERVOIR COST					**$467,587,054**

Transmission System from Richland Chambers Reservoir to Ennis

Item	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline - Rural	60 in	157,800	LF	$366	$57,755,000
Pump Station at Richland-Chambers	5200 HP	1	LS	$9,579,000	$9,579,000
Engineering and Contingencies (30% for pipelines, 35% for other items)					$20,679,000
Subtotal					**$88,013,000**

Table Q-62, Continued

Transmission System from Ennis to Balancing Reservoir

Item	Size	Quantity	Unit	Unit Price	Cost
Pipeline - Rural	60 in	158,680	LF	$366	$58,077,000
Pipeline - Urban	60 in	65,320	LF	$495	$32,333,000
Ennis Booster Pump Station	4600 HP	1	LS	$6,630,800	$6,631,000
Waxahachie Booster Pump	3400 HP	1	LS	$5,450,000	$5,450,000
Ground Storage Tanks	7 MG	2	Ea.	$1,740,000	$3,480,000
Engineering and Contingencies (30% for pipelines, 35% for other items)					$32,569,000
Subtotal					**$138,540,000**

Transmission System from Balancing Reservoir to Rolling Hills

Item	Size	Quantity	Unit	Unit Price	Cost
Pipeline - Urban	60 in	31,000	LF	$495	$15,345,000
Engineering and Contingencies (30% for pipelines, 35% for other items)					$4,604,000
Subtotal					**$19,949,000**

Interest During Construction	**(36 months)**	**$29,992,000**
Permitting and Mitigation of Transmission		**$2,264,000**
TOTAL TRANSMISSION COST		**$278,758,000**
TOTAL CAPITAL COST		**$746,345,054**

ANNUAL COSTS	
Debt Service (6% for 30 years)	$54,221,156
Operation & Maintenance - Reservoir	$917,000
Operation & Maintenance - Transmission	$2,716,000
Electricity ($0.09 per kWh)	$5,637,000
Total Annual Costs	**$63,491,156**

UNIT COSTS (During Amortization)	
Per Acre-Foot	$1,118
Per 1,000 Gallons	$3.43

UNIT COSTS (After Amortization)	
Per Acre-Foot	$163
Per 1,000 Gallons	$0.50

Table Q-63
Lake Ralph Hall and Reuse for UTRWD

Probable Owner:	UTRWD		
Quantity:	34,050	Ac-Ft/Yr from Ralph Hall	
	18,387	Ac-Ft/Yr from Reuse (60% return flows on 30645 ac-ft/yr delivered)	
Peak:	38.0	MGD	(1.25:1 peak)

CONSTRUCTION COSTS
Dam, Reservoir and Conflicts

	Size	Quantity	Unit	Unit Price	Cost
Mobilization and Demobilization		1	LS	$6,712,000	$6,712,000
Stormwater Prevention		1	LS	$1,201,000	$1,201,000
Clearing & Grubbing		450	AC	$2,760	$1,242,000
Roadways		23,800	LF	$283	$6,735,000
Bridges		13,080	LF	$1,890	$24,721,000
Utility Relocations		53,500	LF	$105	$5,618,000
Embankment Random Fill		2,447,520	CY	$3.95	$9,668,000
Embankment Core		1,928,515	CY	$5.26	$10,144,000
Principal Spillway Reinf. Conc.		36,835	CY	$362	$13,334,000
Emergency Spillway Reinf. Conc.		38,170	CY	$362	$13,818,000
Rock Riprap		215,000	SY	$132	$28,380,000
Miscellaneous Relocations		1	LS	$2,632,000	$2,632,000
Care of Water		1	LS	$265,000	$265,000
Engineering and Contingencies (35%)					$43,565,000
Subtotal for Dam, Reservoir and Conflicts					**$168,035,000**

TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline to Balancing	48 in	158,400	LF	$269	$42,610,000
Right of Way Easements		158,400	LF	$7	$1,109,000
Engineering and Contingencies (30%)					$12,783,000
Subtotal of Pipeline					**$56,502,000**
Intake Pump Station					
Pump Station	2400 HP	1	LS	$6,008,000	$6,008,000
Engineering and Contingencies (35%)					$2,103,000
Subtotal of Pump Station					**$8,111,000**

CONSTRUCTION TOTAL **$232,648,000**

Table Q-63, Continued

Land Acquisition	**$22,600,000**
Mitigation	**$7,500,000**
Interest During Construction (30 months)	**$23,653,000**
TOTAL COST	**$286,401,000**
ANNUAL COSTS	**Cost**
Debt Service (6% for 30 years)	$20,807,000
Electricity ($0.09 per kWh)	$1,848,000
Operation & Maintenance	$2,099,000
Total Annual Costs	**$24,754,000**
UNIT COSTS (Until Amortized)	
Per Acre-Foot (Ralph Hall and Reuse)	$472
Per 1,000 Gallons	$1.45
UNIT COSTS (After Amortization)	
Per Acre-Foot (Ralph Hall and Reuse)	$75
Per 1,000 Gallons	$0.23

Table Q-64
DWU Lake Columbia (formerly Lake Eastex)

Probable Owner:	DWU	
Quantity:	35,800	AF/Y
Quantity:	40	MGD peak

Construction Costs					
Dam and Spillway	**Size**	**Amount**	**Unit**	**Unit Cost**	**Cost**
Mobilization		1	LS	$1,975,036	$1,975,000
Care of Water During Construction		1	LS	$1,150,514	$1,151,000
Clearing and Grubbing		78	Ac	$3,948	$309,000
Foundation Preparation		1	LS	$283,220	$283,000
Excavation		3,679,202	CY	$3	$9,684,000
Embankment, Select Fill		1,131,894	CY	$3	$3,724,000
Embankment, Random		1,872,136	CY	$3	$4,928,000
Berm Fill		475,623	CY	$3	$1,252,000
Soil Bentonite Slurry Trench		200,125	SF	$16	$3,161,000
Drains					
Sand		98	CY	$20	$2,000
Gravel		1,150	CY	$59	$68,000
Toe Drains					
Gravel		4,029	CY	$59	$239,000
Pipe		6,800	LF	$26	$179,000
Outlets		5	EA	$19,741	$99,000
Soil Cement		47,888	CY	$72	$3,466,000
Seeding for Erosion Control		163	Ac	$3,290	$536,000
Topsoil 6 inches		34,285	CY	$9	$316,000
Flex Base Roadway 8 inch		18,133	SY	$13	$239,000
Service Spillway		1	LS	$5,292,206	$5,292,000
Spillway Bridge		1	LS	$473,787	$474,000
Outlet Works two 48-inch pipes		1	LS	$1,188,154	$1,188,000
Erosion and Sediment Control		1	LS	$98,706	$99,000
Clearing		5,000	Ac	$329	$1,645,000
Instrumentation		1	LS	$484,316	$484,000
Office Building		1	LS	$394,823	$395,000
Boat Ramp		1	LS	$263,215	$263,000
Bouy System		1	LS	$26,322	$26,000
Engineering and Contingencies (35%)					$14,517,000
Subtotal for Dam & Reservoir					**$55,994,000**
Conflicts					$95,559,000
Engineering and Contingencies (35%)					$33,446,000
Subtotal for Conflicts					**$106,055,000**
Total Reservoir Construction					**$162,049,000**
DWU portion of dam (50%)					**$81,025,000**

Table Q-64, Continued

Transmission Facilities (DWU)

Pump from Lake Columbia to Lake Palestine. Assume sufficient capacity in Integrated Pipeline to deliver water from Columbia.

Pipeline					
Pipeline Columbia to Palestine (Rural)	48 in	74,000	LF	$269	$19,906,000
ROW Easements (Rural)		74,000	LF	$7	$518,000
ROW Easements (Urban)		0	LF	$69	$0
Engineering and Contingencies (30%)					$5,972,000
Subtotal of Pipeline					**$26,396,000**
Pump Station					
Lake Columbia Pump Station	1700 HP	1	LS	$5,038,500	$5,039,000
Ground Storage Tanks	5 MG	1	Ea	$1,303,000	$1,303,000
Engineering and Contingencies (35%)					$2,220,000
Subtotal of Pump Station					**$8,562,000**
CONSTRUCTION TOTAL					**$197,007,000**
CONSTRUCTION TOTAL (DWU Portion)					**$115,983,000**
Permitting and Mitigation Transmission					**$299,000**
(assume no additional costs for transmission from Palestine to WTP)					
Interest During Construction			**(36 months)**		**$23,970,000**
Interest During Construction (DWU Portion)			**(36 months)**		**$14,112,000**
Land Acquisition					**$33,034,000**
DWU Portion of Land Acquisition					**$16,517,000**
Permitting and Mitigation Reservoir (DWU Portion)					**$33,034,000**
TOTAL COST					**$287,344,000**
TOTAL COST (DWU Portion)					**$179,945,000**
DWU Annual Costs					
Debt Service (6% for 30 years)					$13,072,810
Electricity ($0.09 per kWh)					$5,317,000
Operation & Maintenance					$802,000
Total Annual Costs					**$19,191,810**

Table Q-64, Continued

UNIT COSTS (Until Amortized)	
Per Acre-Foot	**$536**
Per 1,000 Gallons	**$1.65**
UNIT COSTS (After Amortization)	
Per Acre-Foot	**$171**
Per 1,000 Gallons	**$0.52**

Table Q-65
Dallas Direct Reuse Projects

Owner: Dallas
Amount: 20,456 Ac-Ft/Yr

Item No. & Description	**Qty.**	**Units**		**Unit Cost**		**Total Cost**
Construction Costs						
PIPELINE						
McCommas Bluff						
16" Reclaimed Water Line	10,700	FT	$	237	$	2,536,000
Cedar Crest						
20" Reclaimed Water Line	15,100	FT	$	267	$	4,032,000
12" Reclaimed Water Line	1,700	FT	$	208	$	354,000
White Rock Alternate						
42" Reclaimed Water Line	52,800	FT	$	356	$	18,797,000
36" Reclaimed Water Line	58,200	FT	$	326	$	18,973,000
24" Reclaimed Water Line	10,200	FT	$	297	$	3,029,000
16" Reclaimed Water Line	7,600	FT	$	237	$	1,801,000
12" Reclaimed Water Line	12,600	FT	$	208	$	2,621,000
Subtotal Piping					**$**	**52,143,000**
PUMP STATIONS						
McCommas Bluff	62	hp			$	1,423,995
Cedar Crest	181	hp			$	1,542,441
White Rock Alternate	2,478	hp			$	5,339,321
Subtotal Pump Station					**$**	**8,306,000**
Permitting and Mitigation	1%				$	604,000
Engineering, Contingency, Construction Management, Financial and Legal Costs						
Pipeline	30%				$	15,643,000
Pump Station	35%				$	2,907,000
Capital Cost Subtotal					**$**	**79,603,000**
Interest During Construction		(12 months)			$	3,317,000
Total Capital Costs					**$**	**82,920,000**

Table Q-65, Continued

Annual Costs			
Debt Service			$6,024,000
Operation and Maintenance Costs			
Pipeline	1.00%	$	626,000
Pump Station	2.50%	$	249,000
Estimated Annual Power Cost	$0.09/kWh	$	1,225,500
Total Annual Costs		**$**	**8,124,500**
UNIT COSTS (First 30 Years)			
Per Acre-Foot		$	397
Per 1,000 Gallons		$	1.22
UNIT COSTS (After 30 Years)			
Per Acre-Foot		$	103
Per 1,000 Gallons		$	0.32

Table Q-66
Lake Texoma Supply with Blending in Elm Fork

Probable Owner: DWU
Amount: 20,000 Acre-Feet/Year

CONSTRUCTION COSTS					
TRANSMISSION FACILITIES					
Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline (rural)	36 in.	187,501	LF	$184	$34,500,200
Pipeline (urban)	36 in.	0	LF	$276	$0
Right of Way Easements (Rural)		187,501	LF	$5	$937,500
Right of Way Easements (Urban)		0	LF	$28	$0
Engineering and Contingencies (30%)					$10,350,000
Subtotal of Pipeline					**$45,787,700**
Pump Station(s)					
Lakeside Pump Station	2200 HP	1	EA	$5,785,000	$5,785,000
Engineering and Contingencies (35%)					$2,025,000
Subtotal of Pump Station(s)					**$7,810,000**
Permitting and Mitigation		**1**	**LS**		**$483,400**
CONSTRUCTION TOTAL					**$54,081,100**
Interest During Construction			**(12 months)**		**$2,253,000**
TOTAL CAPITAL COST					**$56,334,100**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$4,092,611
Raw water purchase					$535,752
Electricity ($0.09 per kWh)					$896,805
Facility Operation & Maintenance					$587,552
Total Annual Costs					**$6,112,720**
UNIT COSTS (During Amortization)					
Per Acre-Foot of raw water					$306
Per 1,000 Gallons of raw water					$0.94
UNIT COSTS (After Amortization)					
Per Acre-Foot of treated water					$101
Per 1,000 Gallons of treated water					$0.31

Table Q-67
DWU Water Treatment Plant Construction and Expansion

OWNER: Dallas Water Utilities

	Size	Cost
2012 Eastside Expansion		
Construction Costs		
Eastside WTP Expansion (2012)	100 MGD	$100,200,000
Engineering and Contingencies (35%)		$35,070,000
Total Construction Cost		**$135,270,000**
Interest during Construction (24 months)		$11,048,000
Total Capital Costs		**$146,318,000**
Annual Costs		
Debt Service (30 years at 6%)		$10,630,000
Operation and Maintenance (@ $0.70 per 1000 gal)	18,262,500	$12,784,000
Total Annual Costs		**$23,414,000**
Annual Cost ($ per acre-foot)		**$418**
Annual Cost ($ per 1000 gallons)		**$1.28**
Annual Cost after Amortization ($ per acre-foot)		**$228**
Annual Cost after Amortization ($ per 1000 gallons)		**$0.70**
2018 New Water Plant		
Construction Costs		
New WTP (2018)	100 MGD	$130,200,000
Engineering and Contingencies (35%)		$45,570,000
Total Construction Cost		**$175,770,000**
Interest during Construction (24 months)		$14,355,000
Total Capital Costs		**$190,125,000**
Annual Costs		
Debt Service (30 years at 6%)		$13,812,000
Operation and Maintenance (@ $0.70 per 1000 gal)	18,262,500	$12,784,000
Total Annual Costs		**$26,596,000**

Table Q-67, Continued

Annual Cost ($ per acre-foot)		**$475**
Annual Cost ($ per 1000 gallons)		**$1.46**
Annual Cost after Amortization ($ per acre-foot)		**$228**
Annual Cost after Amortization ($ per 1000 gallons)		**$0.70**
2025, 2035, 2045, 2052 & 2058 WTP Expansions		
Construction Costs		
WTP Expansion	100 MGD	$100,200,000
Engineering and Contingencies (35%)		$35,070,000
Total Construction Cost		**$135,270,000**
Interest during Construction (24 months)		$11,048,000
Total Capital Costs		**$146,318,000**
Annual Costs		
Debt Service (30 years at 6%)		$10,630,000
Operation and Maintenance (@ $0.70 per 1000 gal)	18,262,500	$12,784,000
Total Annual Costs		**$23,414,000**
Annual Cost ($ per acre-foot)		**$418**
Annual Cost ($ per 1000 gallons)		**$1.28**
Annual Cost after Amortization ($ per acre-foot)		**$228**
Annual Cost after Amortization ($ per 1000 gallons)		**$0.70**
OVERALL TOTAL CAPITAL		**$1,068,033,000**

Table Q-68
Lake Chapman Pump Station Expansion

Owner:	North Texas Municipal Water District and Irving
Amount:	0 Ac-Ft/Yr

Pump Station Expansion at Lake Chapman (225 MGD capacity)

	Quantity	Unit	Unit Price	Total Price
New 4,000 HP Vertical Centrifugal Pumps	6	EA	$ 1,300,000	$ 7,800,000
Piping, Values and Misc. Equipment	1	LS	$ 8,003,600	$ 8,003,600
Electrical and Instrumentation	1	LS	$ 3,610,000	$ 3,610,000
Ground Storage Tanks (10 MG)	2	EA	$ 2,752,000	$ 5,504,000
Subtotal				$24,917,600
Engineering & Contingencies (35%)				$8,721,000
Capital Cost Subtotal				**$33,638,600**
Interest During Construction				$729,000
Power Supply				$2,000,000
Total Capital Costs				**$36,367,600**
Irving Share (25%)				**$9,092,000**
NTMWD Share (75%)				**$27,275,600**
ANNUAL COSTS				
Debt Service				$2,642,000
Operation and Maintenance				$748,000
Total Annual Cost				**$3,390,000**
Irving Share (25%)				**$713,000**
NTMWD Share (75%)				**$2,677,000**

Table Q-69
North Texas Municipal Water District Interim Purchase from DWU

Owner:	North Texas Municipal Water District		
Amount:	11,210	Ac-Ft/Yr	(20 years only)

Construction Cost for Meter	$1,316,000
Engineering and Contingencies	$460,600
	$1,776,600
Annual Costs	
Debt Service (6% for 20 years)	$155,000
Treated Water Purchase ($1.3689 per 1000 gallons)	$5,000,000
Operation and Maintenance	$39,000
	$5,194,000
UNIT COSTS (during Amortization)	
Per Acre-Foot	$463
Per 1,000 gallons	$1.42
UNIT COSTS (after Amortization)	
Per Acre-Foot	$450
Per 1,000 gallons	$1.38

Table Q-70
North Texas Municipal Water District Water District Lake Texoma (Interim GTUA)

Owner:	North Texas Municipal Water District (interim purchase from GTUA)	
Amount:	21,900	Ac-Ft/Yr

Uses existing facilities

ANNUAL COSTS	
Electricity	$1,071,000
Raw Water	$305,000
Total Annual Costs	**$1,376,000**
UNIT COSTS (Before Amortization)	
Per Acre-Foot	$63
Per 1,000 Gallons	$0.19
UNIT COSTS (After Amortization)	
Per Acre-Foot	$63
Per 1,000 Gallons	$0.19

Table Q-71
Lake Texoma Pump Station Expansion

Owner:	North Texas Municipal Water District and GTUA
Amount:	0 Ac-Ft/Yr

Pump Station Expansion at Texoma (from 90 MGD to 125 MGD)

	Quantity	Unit	Unit Price	Total Price
New 6,000 HP pumps	2	EA	$ 3,025,000	$ 6,050,000
Piping, Values and Misc. Equipment	1	LS	$ 522,000	$ 522,000
Electrical and Instrumentation	1	LS	$ 935,000	$ 935,000
Subtotal				$7,507,000
Engineering & Contingencies (35%)				$2,627,000
Capital Cost Subtotal				$10,134,000
Interest During Construction				$220,000
Total Capital Costs				**$10,354,000**
GTUA Share (20%)				**$2,071,000**
NTMWD Share (80%)				**$8,283,000**
ANNUAL COSTS				
Debt Service				$752,000
Operation and Maintenance				$225,000
Total Annual Costs				**$977,000**
GTUA Share (20%)				**$195,000**
NTMWD Share (80%)				**$782,000**

Table Q-72
NTMWD Water Treatment Plant and
Treated Water Distribution System Improvements

OWNER: NTMWD

Construction Costs (Including Engineering and Contingencies)	**Cost**
2010-2020	
Water Distribution System Improvements - Pipelines	88,961,800
Water Distribution System Improvements - Pump Stations	355,200,760
WTP Construction and Expansion (180 MGD)	61,796,420
Subtotal	**$505,958,980**
Interest during Construction (12 months)	$21,083,000
Total 2010-2020 Cost	**$527,041,980**
Annual Costs (2010-2020 Improvements)	
Debt Service (30 years at 6%)	$38,289,000
Facility Operation and Maintenance	$8,304,000
WTP Operation and Maintenance (@ $0.70/1000 gal - 2.25 Peak)	$20,454,000
Total Pre-Amortization	**$67,047,000**
Total After Amortization	**$28,758,000**
2020-2030	
Water Distribution System Improvements - Pipelines	88,350,500
Water Distribution System Improvements - Pump Stations	126,310,500
WTP Construction and Expansion (210 MGD)	308,579,000
Subtotal	**$523,240,000**
Interest during Construction (12 months)	$21,803,000
Total 2020-2030 Cost	**$545,043,000**
Annual Costs (2020-2030 Improvements)	
Debt Service (30 years at 6%)	$39,597,000
Facility Operation and Maintenance	$3,435,000
WTP Operation and Maintenance (@ $0.70/1000 gal - 2.25 Peak)	$23,863,000
Total Pre-Amortization	**$66,895,000**
Total After Amortization	**$27,298,000**

Table Q-72, Continued

2030-2040	
Water Distribution System Improvements - Pipelines	$88,350,500
Water Distribution System Improvements - Pump Stations	$126,310,500
WTP Construction and Expansion (140 MGD)	$144,400,000
	$359,061,000
Interest during Construction (12 months)	$14,962,000
Total 2030-2040 Cost	**$374,023,000**
Annual Costs (2030-2040 Improvements)	
Debt Service (30 years at 6%)	$27,172,000
Facility Operation and Maintenance	$3,435,000
WTP Operation and Maintenance (@ $0.70/1000 gal - 2.25 Peak)	$15,909,000
Total Pre-Amortization	**$46,516,000**
Total After Amortization	**$19,344,000**
2040-2050	
Water Distribution System Improvements - Pipelines	$88,350,500
Water Distribution System Improvements - Pump Stations	$126,310,500
WTP Construction and Expansion (210 MGD)	$216,600,000
	$431,261,000
Interest during Construction (12 months)	$17,971,000
Total 2040-2050 Cost	**$449,232,000**
Annual Costs (2040-2050 Improvements)	
Debt Service (30 years at 6%)	$32,636,000
Facility Operation and Maintenance	$3,435,000
WTP Operation and Maintenance (@ $0.70/1000 gal - 2.25 Peak)	$23,863,000
Total Pre-Amortization	**$59,934,000**
Total After Amortization	**$27,298,000**

Table Q-72, Continued

2050-2060	
Water Distribution System Improvements - Pipelines	$88,350,500
Water Distribution System Improvements - Pump Stations	$126,310,500
WTP Construction and Expansion (140 MGD)	$144,400,000
	$359,061,000
Interest during Construction (12 months)	$14,962,000
Total 2050-2060 Cost	**$374,023,000**

Table Q-72, Continued

Annual Costs (2050-2060 Improvements)	
Debt Service (30 years at 6%)	$27,172,000
Facility Operation and Maintenance	$3,435,000
WTP Operation and Maintenance (@ $0.70/1000 gal - 2.25 Peak)	$15,909,000
	$46,516,000
Total Capital Costs	**$2,269,362,980**

Table Q-73
Fannin County Water Supply Project

Owner: NTMWD
Amount: 6,744 ac-ft/yr

Item No. & Description	Qty.	Units	Unit Cost		Total Cost	
Construction Costs						
PIPELINE						
20" Water Line from Leonard to Bonham						
Pipe	70,000	FT	$	90	$	6,300,000
ROW	70,000	FT	$	5	$	350,000
14" Water Line from Leonard to Trenton						
Pipe	26,600	FT	$	60	$	1,596,000
ROW	26,600	FT	$	5	$	133,000
10" Water Line from Bonham to Honey Grove						
Pipe	86,500	FT	$	43	$	3,720,000
ROW	86,500	FT	$	5	$	433,000
10" Water Line from Bonham line to SW SUD						
Pipe	50,000	FT	$	43	$	2,150,000
ROW	50,000	FT	$	5	$	250,000
12" Water Line to Leonard						
Pipe	2,000	FT	$	77	$	154,000
ROW	2,000	FT	$	12	$	24,000
Subtotal Piping					**$**	**15,110,000**

Table Q-73, Continued

PUMP STATION						
Station 1						
Pump, building, & appurtances	600	hp			$	2,860,000
Storage Tank	5,833,000	gal			$	1,720,000
Subtotal Pump Station					**$**	**4,580,000**
Bonham WTP Expansion	3.00	MGD				$7,400,000
Permitting and Mitigation	1%				$	222,000
Engineering, Contingency, Construction Management, Financial and Legal Costs						
Pipeline	30%				$	4,176,000
Pump Station	35%				$	1,603,000
Plant Expansion	35%				$	2,590,000
Capital Cost Subtotal					**$**	**35,681,000**
Interest During Construction		(24 months)				$2,790,000
Total Capital Costs					**$**	**38,471,000**
Annual Costs						
Debt Service					$	2,795,000
Operation and Maintenance Costs						
Pipeline	1%				$	167,000
Pump Station	2.50%				$	137,000
Estimated Annual Power Cost	$0.09/kWh				$	176,000
WTP Operation	2,197,539	1000 gal	$	0.70	$	1,538,000
Total Annual Costs					**$**	**4,813,000**
UNIT COSTS (First 30 Years)						
Per Acre-Foot					$	714
Per 1,000 Gallons					$	2.19
UNIT COSTS (After 30 Years)						
Per Acre-Foot					$	299
Per 1,000 Gallons					$	0.92

Table Q-74
Ellis County Project

Sponsor	Ac-Ft/Yr	MGD (Avg)	MGD (Peak)
Ennis	9,655	8.6	17
Midlothian	11,999	11	21
Rockett SUD	8,232	7.3	15
Waxahachie	18,023	16	32
TRA	5,313	4.7	9.5
Total	53,222	47	95

Item & Description	**Size**	**Quantity**	**Units**	**Unit Cost**	**Total Cost**
Construction Costs					
WATER TREATMENT PLANTS					
New Midlothian WTP	9 MGD	1	LS	$20,766,667	$20,767,000
Midlothian WTP expansion 1	9 MGD	1	LS	$14,966,667	$14,967,000
Midlothian WTP expansion 2	9 MGD	1	LS	$14,966,667	$14,967,000
Midlothian WTP expansion 3	9 MGD	1	LS	$14,966,667	$14,967,000
Waxahachie/Rockett SUD Sokoll expansion 1	20 MGD	1	LS	$26,100,000	$26,100,000
Waxahachie/Rockett SUD Sokoll expansion 2	20 MGD	1	LS	$26,100,000	$26,100,000
Ennis WTP expansion 1	6 MGD	1	LS	$11,525,000	$11,525,000
Ennis WTP expansion 2	6 MGD	1	LS	$11,525,000	$11,525,000
Engineering & Contingencies (35%)					$49,321,000
Permitting and Mitigation (1%)					$1,691,000
SUBTOTAL WATER TREATMENT PLANTS					$191,930,000
PIPELINES & PUMP STATIONS					
Raw water line TRWD/TRA to Waxahachie					
Pipe	20 in.	52,800	LF	$90	$4,752,000
ROW		52,800	LF	$12	$634,000
Treated water Waxahachie to Sardis/Lone Elm					
Tap fee		1	LS	$60,000	$60,000
Pipe	30 in.	25,000	LF	$145	$3,625,000
	20 in.	40,000	LF	$90	$3,600,000
ROW		65,000	LF	$5	$325,000
Pump Station	105 HP	1	LS	$761,000	$761,000
Pump Station	203 HP	1	LS	$1,128,000	$1,128,000
Treated water Waxahachie to Buena Vista/Bethel					
Tap fee		1	LS	$60,000	$60,000
Pipe	30 in.	33,075	LF	$145	$4,796,000
ROW		33,075	LF	$5	$165,000
Pump Station	40 HP	2	LS	$623,000	$1,246,000
Pump Station	100 HP	2	LS	$742,000	$1,484,000
Treated water Waxahachie to Files Valley & Maypearl					
Tap fee		1	LS	$60,000	$60,000
Pipe	8 in.	58,080	LF	$34	$1,975,000
	6 in.	47,520	LF	$26	$1,236,000
ROW		105,600	LF	$3	$317,000
Pump Station	11 HP	1	LS	$541,000	$541,000
Pump Station	8 HP	1	LS	$529,000	$529,000
Treated water Waxahachie to Italy & Ellis Co Other					
Tap fee		1	LS	$60,000	$60,000
Pipe	12 in.	79,200	LF	$52	$4,118,000
ROW		79,200	LF	$5	$396,000
Pump Station	32 HP	1	LS	$606,000	$606,000
Treated water from Midlothian to Mountain Peak					
Pipe	10 in.	31,680	LF	$43	$1,362,000
ROW		31,680	LF	$5	$158,000
Pump Station	15 HP	1	LS	$551,000	$551,000
Treated water from Ennis to Bardwell					
Pipe	6 in.	36,960	LF	$26	$961,000
ROW		36,960	LF	$3	$111,000
Pump Station	9 HP	1	LS	$534,000	$534,000
Enigneering & Contingencies (30% pipelines, 35% for pump stations)					$10,511,000
Permitting and Mitigation (1%)					$406,000
SUBTOTAL PIPELINES & PUMP STATIONS					$47,068,000

Table Q-74, Continued

	Ennis	Midlothian	Rockett SUD	Waxahachie	TRA	Total
Capital Cost Subtotal	**$31,394,000**	**$89,440,000**	**$35,548,000**	**$35,548,000**	**$47,068,000**	**$238,998,000**
Interest During Construction (24 Months)	$2,563,900	$7,304,600	$2,903,200	$2,903,200	$3,844,100	$19,519,000
TOTAL CAPITAL COST	**$33,957,900**	**$96,744,600**	**$38,451,200**	**$38,451,200**	**$50,912,100**	**$258,517,000**
ANNUAL COSTS	**Ennis**	**Midlothian**	**Rockett SUD**	**Waxahachie**	**TRA**	**Total**
Debt Service	$2,467,100	$7,028,400	$2,793,400	$2,793,400	$3,698,700	$18,781,000
Operation and Maintenance Costs						
Pipeline (1%)					$317,000	$317,000
Pump Station (2.5%)					$221,000	$221,000
Estimated Annual Power Cost					$3,000	$3,000
Treated Water Cost	$1,534,000	$4,602,000	$2,557,000	$2,557,000		$11,250,000
Water Purchase from TRWD					$11,059,000	$11,059,000
Total Annual Costs	**$4,001,100**	**$11,630,400**	**$5,350,400**	**$5,350,400**	**$15,298,700**	**$41,631,000**
UNIT COSTS (Pre-Amortization)						
Per Acre-Foot	$ 595	$ 576	$ 477	$ 477	$ 2,879	$ 782
Per 1,000 Gallons	$ 1.83	$ 1.77	$ 1.46	$ 1.46	$ 8.84	$ 2.40
UNIT COSTS (After Amortization)						
Per Acre-Foot	$ 228	$ 228	$ 228	$ 228	$ 218	$ 429
Per 1,000 Gallons	$ 0.70	$ 0.70	$ 0.70	$ 0.70	$ 0.67	$ 1.32

Table Q-75
Trinity River Authority Las Colinas Reuse (Dallas County Irrigation)

Owner: Trinity River Authority
Amount: 7,000 Ac-Ft/Yr

	Size	Quantity	Unit	Unit Price	Cost
CAPITAL COSTS					
Cost of Additional Pipeline	24 in	44,500	LF	$ 174	$7,743,000
Engineering & Contingencie (30%)					$2,323,000
Total Pipeline Cost					**$10,066,000**
Cost of Pump Station	770 HP	1	LS	$ 2,441,600	$2,442,000
Engineering & Contingencie (35%)					$855,000
Total Pump Station Cost					**$3,297,000**
TOTAL CAPITAL COST					**$13,363,000**
Permitting and Mitigation					**$122,000**
Interest during Construction (24 months)					**$1,045,000**
TOTAL COST					**$14,530,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$1,055,589
Electricity ($0.06 kWh)					$199,418
Operation & Maintenance					$166,176
Purchase of Treated Wastewater for Reuse			$81.46/ac-ft		$570,220
Total Annual Costs					**$1,991,403**
UNIT COSTS (Pre-Amortization)					
Per Acre-Foot					$284
Per 1,000 gallons					$0.87
UNIT COSTS (After Amortization)					
Per Acre-Foot					$134
Per 1,000 gallons					$0.41

Note: Cost to purchase reuse water is assumed to be $81.46 per acre-foot.

Table Q-76
Trinity River Authority Dallas County Reuse for Steam Electric Power

Owner: Trinity River Authority
Amount: 4,500 Ac-Ft/Yr

CAPITAL COSTS	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Cost of Pipeline	20 in	52,800	LF	$ 135	$7,128,000
Right of Way Easements (ROW)		52,800	LF	$ 28	$1,478,000
Engineering & Contingencies (30%)					$2,138,000
Total Pipeline Cost					**$10,744,000**
Cost of Pump Station	830 HP	1	LS	$ 2,551,400	$2,551,000
Engineering & Contingencies (35%)					$893,000
Total Pump Station Cost					**$3,444,000**
TOTAL CAPITAL COST					**$14,188,000**
Permitting and Mitigation					**$116,000**
Interest during Construction (12 months)					**$591,000**
Total Raw Water Delivery Capital Cost					**$14,895,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$1,082,000
Electricity ($0.09 kWh)					$141,000
Operation & Maintenance					$162,000
Purchase of Reuse Water					$367,000
Total Annual Costs					**$1,752,000**
UNIT COSTS (During Amortization)					
Per Acre-Foot					$389
Per 1,000 gallons					$1.19
UNIT COSTS (During Amortization)					
Per Acre-Foot					$149
Per 1,000 gallons					$0.46

Note: Cost to purchase reuse water is assumed to be $0.25 per thousand gallons.

Table Q-77
Trinity River Authority Ellis County Reuse for Steam Electric Power

Owner: Trinity River Authority
Amount: 2,200 Ac-Ft/Yr

CAPITAL COSTS	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Cost of Pipeline	16 in	52,800	LF	$ 103	$5,438,000
Right of Way Easements (ROW)		52,800	LF	$ 12	$634,000
Engineering & Contingencies (30%)					$1,631,000
Total Pipeline Cost					**$7,703,000**
Cost of Pump Station	350 HP	1	LS	$ 1,618,000	$1,618,000
Engineering & Contingencies (35%)					$566,000
Total Pump Station Cost					**$2,184,000**
TOTAL CAPITAL COST					**$9,887,000**
Permitting and Mitigation					**$85,000**
Interest during Construction (12 months)					**$412,000**
Total Raw Water Delivery Capital Cost					**$10,384,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$754,000
Electricity ($0.09 kWh)					$64,000
Operation & Maintenance					$114,000
Purchase of Reuse Water					$179,000
Total Annual Costs					**$1,111,000**
UNIT COSTS (During Amortization)					
Per Acre-Foot					$505
Per 1,000 gallons					$1.55
UNIT COSTS (During Amortization)					
Per Acre-Foot					$162
Per 1,000 gallons					$0.50

Note: Cost to purchase reuse water is assumed to be $0.25 per thousand gallons.

Table Q-78
Trinity River Authority Freestone County Reuse for Steam Electric Power

Owner: Trinity River Authority
Amount: 6,672 ac-ft/yr

CAPITAL COSTS

Phase 1

	Size	Quantity	Units	Unit Price	Cost
Transmission Facilities					
Pipeline (Rural)	24 in.	79,200	LF	$116	$ 9,195,000
Right of Way Easements (Rural)	20 ft.	79,200.0	LF	$5	$ 396,000
Pipeline Eng &Contingencies (30%)					$ 2,759,000
Pipeline Subtotal					**$ 12,350,000**
Pump Station (Intake)	700 HP	1	LS	$3,021,000	$ 3,021,000
Engineering and Contingencies (35%)					$ 1,057,000
Pump Station Subtotal					**$ 4,078,000**
Permitting and Mitigation					**$ 147,000**
Interest During Construction			**(12 months)**		**$ 691,000**
TOTAL CAPITAL COST					**$ 17,266,000**

ANNUAL COSTS

	Cost
Debt Service (6%, 30 years)	$ 1,254,000
Pipeline O&M (1%)	$ 110,000
Pump O&M (2.5%)	$ 91,000
Electricity	$ 188,000
Purchase of Reuse Water	$ 543,768
TOTAL ANNUAL COST	**$ 2,186,768**

Phase 1 Unit Costs (Pre-Amortization)

Cost per acre-ft	$ 312
Cost per 1000 gallons	$ 0.96

Phase 1 Unit Costs (After Amortization)

Cost per acre-ft	$ 133
Cost per 1000 gallons	$ 0.41

Table Q-79
Trinity River Authority Kaufman County Reuse for Steam Electric Power

Owner: Trinity River Authority
1,000 ac-ft/yr

CAPITAL COSTS

	Size	Quantity	Units	Unit Price	Cost
Transmission Facilities					
Pipeline (Suburban)	16 in.	79,200	LF	$69	$ 5,449,000
Right of Way Easements (Suburban)	20 ft.	79,200	LF	$12	$ 950,000
Pipeline Eng &Contingencies (30%)					$ 1,635,000
Pipeline Subtotal					**$ 8,034,000**
Pump Station	80 HP	1	LS	$933,076	$ 933,076
Engineering and Contingencies (35%)					$ 327,000
Pump Station Subtotal					**$ 1,260,076**
Permitting and Mitigation					**$ 77,000**
Interest During Construction			**(12 months)**		**$ 390,000**
TOTAL CAPITAL COST					**$ 9,761,076**

ANNUAL COSTS

	Cost
Debt Service (6%, 30 years)	$ 709,000
Pipeline O&M (1%)	$ 65,000
Pump O&M (2.5%)	$ 28,000
Electricity	$ 17,000
Purchase of Reuse Water	$ 82,000
TOTAL ANNUAL COST	**$ 901,000**
Phase 1 Unit Costs (Pre-Amortization)	
Cost per acre-ft	$ 901
Cost per 1000 gallons	$ 2.77
Phase 1 Unit Costs (After Amortization)	
Cost per acre-ft	$ 192
Cost per 1000 gallons	$ 0.59

Table Q-80
Trinity River Authority - Tarrant County Water Supply Project Expansions

Owner:	Trinity River Authority		
Supply:	7,473	Ac-Ft/Yr	

WATER TREATMENT PLANT EXPANSION # 1 (2014)	**Quantity**	**Unit**	**Cost**
Cost of WTP Expansion	15	MGD	$20,900,000
Engineering & Contingencies (35%)			$7,315,000
Subtotal			**$28,215,000**
Interest During Construction	**(18 months)**		**$1,289,000**
TOTAL COST FOR EXPANSION #1			**$29,504,000**
ANNUAL COSTS FOR EXPANSION #1			
Debt Service (6% for 30 years)			$2,143,000
Raw Water Purchase ($0.68/1,000 gallons)			$1,655,000
Operation & Maintenance ($0.35/1,000 gallons)	2,433,333	1,000 gal.	$852,000
Total Annual Costs			**$4,650,000**
UNIT COSTS (Pre-Amortization)			
Per Acre-Foot			$622
Per 1,000 Gallons			$1.91
UNIT COSTS (After Amortization)			
Per Acre-Foot			$335
Per 1,000 Gallons			$1.03

WATER TREATMENT PLANT EXPANSION # 2 (2020)	**Quantity**	**Unit**	**Cost**
Cost of WTP Expansion	15	MGD	$20,900,000
Engineering & Contingencies (35%)			$7,315,000
Subtotal			**$28,215,000**
Interest During Construction	**(18 months)**		**$1,289,000**
TOTAL COST FOR EXPANSION #2			**$29,504,000**

Table Q-80, Continued

ANNUAL COSTS FOR EXPANSION #2			
Debt Service (6% for 30 years)			$2,143,000
Raw Water Purchase ($0.68/1,000 gallons)			$1,655,000
Operation & Maintenance ($0.35/1,000 gallons)	2,433,333	1,000 gal.	$852,000
Total Annual Costs			**$4,650,000**
UNIT COSTS (Pre-Amortization)			
Per Acre-Foot			$622
Per 1,000 Gallons			$1.91
UNIT COSTS (After Amortization)			
Per Acre-Foot			$335
Per 1,000 Gallons			$1.03

Table Q-81
Trinity River Authority Reuse from Denton Creek Wastewater Treatment Plant

Owner:	Trinity River Authority		
Amount:	15,000	Ac-Ft/Yr	
Irrigation	7,500	Ac-Ft/Yr	Denton and Tarrant Counties
Municipal	7,500	Ac-Ft/Yr	Tarrant County

IRRIGATION FOR DENTON AND TARRANT COUNTIES

	Size	Quantity	Unit	Unit Price	Cost
Cost of Additional Pipeline					
Main Pipeline	24 in	18,000	LF	$174	$3,132,000
Distribution Pipeline	8 in	17,500	LF	$52	$910,000
Right of Way Easements (Urban)		18,000	LF	$28	$504,000
		17,500	LF	$21	$368,000
Engineering & Contingenices (30%)					$1,213,000
Total Pipeline Cost					**$6,127,000**
Pump Station					$798,000
Chlorine Bleach Facility					$145,000
3 - 7 MG Storage Ponds					$571,000
Potable Water Supply Backup Water					$87,000
Engineering and Contingencies (35%)					$560,000
Total Pump Station & Facilities Cost					**$2,161,000**
Cost of Permitting					**$500,000**
Interest During Construction			**(24 months)**		**$718,000**
Total Capital Cost					**$9,506,000**
Denton County Capital Cost					**$6,337,000**
Tarrant County Capital Cost					**$3,169,000**
ANNUAL COSTS (Denton County)					
Debt Service (6% for 30 years)					$460,000
Electricity					86,000
Chlorine Cost					75,000
Operation & Maintenance					$58,000
Purchase of Reuse Water					$407,000
Total Annual Costs					**$1,086,000**

Table Q-81, Continued

UNIT COSTS - Denton County (With Debt Service)	
Per Acre-Foot	$217
Per 1,000 gallons	$0.67
UNIT COSTS - Denton County (Without Debt Service)	
Per Acre-Foot	$125
Per 1,000 gallons	$0.38
ANNUAL COSTS (Tarrant County)	
Debt Service (6% for 30 years)	$230,000
Electricity	
Chlorine Cost	
Operation & Maintenance	$29,000
Purchase of Reuse Water	$204,000
Total Annual Costs	**$463,000**
UNIT COSTS - Tarrant County (With Debt Service)	
Per Acre-Foot	$185
Per 1,000 gallons	$0.57
UNIT COSTS - Tarrant County (Without Debt Service)	
Per Acre-Foot	$93
Per 1,000 gallons	$0.29
MUNICIPAL REUSE TO LAKE GRAPEVINE	
Assume no Capital Costs	$0.00
ANNUAL COSTS (Tarrant County)	
Purchase of Reuse Water	$611,000
UNIT COSTS - Tarrant County	
Per Acre-Foot	$81
Per 1,000 gallons	$0.25

Note: Cost to purchase reuse water is assumed to be $81.46 per acre-foot.

Table Q-82
Freestone County S. E. Power by TRA from Tarrant Regional Water District

Owner: Unknown
Amount: 3,745 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	14 in.	26,400	LF	$60	$1,589,000
Right of Way Easements (ROW)	20 ft.	26,400	LF	$5	$132,000
Engineering and Contingencies (30%)					$516,000
Subtotal of Pipeline					**$2,237,000**
Pump Station(s)					
Booster Pump Station	600 HP	1	LS	$2,150,000	$2,150,000
Engineering and Contingencies (35%)					$753,000
Subtotal of Pump Station(s)					**$2,903,000**
Permitting and Mitigation					**$45,000**
CONSTRUCTION TOTAL					**$5,185,000**
Interest During Construction			**(12 months)**		**$216,000**
TOTAL COST					**$5,401,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$392,000
Electricity ($0.09 kWh)					$181,000
Raw Water ($0.72 per 1,000 gallons)					$879,000
Operation & Maintenance					$84,000
Total Annual Costs					**$1,536,000**
UNIT COSTS (during amortization)					
Per Acre-Foot					$410
Per 1,000 Gallons					$1.26

Table Q-83
Upper Trinity Regional Water District Direct Reuse

Owner: Upper Trinity Regional Water District
Amount: 2,240 Ac-Ft/Yr

CAPITAL COSTS	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Cost of Pipeline	16 in	52,800	LF	$ 103	$5,438,000
Right of Way Easements (ROW)		52,800	LF	$ 28	$1,478,000
Engineering & Contingencies (30%)					$1,631,000
Total Pipeline Cost					**$8,547,000**
Cost of Pump Station	360 HP	1	LS	$ 1,653,400	$1,653,000
Engineering & Contingencies (35%)					$579,000
Total Pump Station Cost					**$2,232,000**
TOTAL CAPITAL COST					**$10,779,000**
Permitting and Mitigation					**$85,000**
Interest during Construction (12 months)					**$449,000**
Total Raw Water Delivery Capital Cost					**$11,313,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$822,000
Electricity ($0.09 kWh)					$66,000
Operation & Maintenance					$115,000
Purchase of Reuse Water					$183,000
Total Annual Costs					**$1,186,000**
UNIT COSTS (During Amortization)					
Per Acre-Foot					$529
Per 1,000 gallons					$1.62
UNIT COSTS (During Amortization)					
Per Acre-Foot					$163
Per 1,000 gallons					$0.50

Note: Cost to purchase reuse water is assumed to be $0.25 per thousand gallons.

Table Q-84
UTRWD Water Treatment Plant and
Treated Water Distribution System Water Management Strategies

OWNER: UTRWD

Project	Date	Capital Budget (Including E&C and Interest)
2010-2019 Projects		
Southwest Pipeline Phase 3	2010	$5,680,000
RTWS Improvements (Power/Communications)	2010	$300,000
Eval of RTWS Hypo-Gen/Ozone System	2010	$1,850,000
Equipment/Vehicle Storage Building	2010	$600,000
Assist Flower Mound-Activate SW Pipeline	2011	$665,000
Northlake Pipeline Point of Delivery	2011	$190,000
Southwest Pipeline Phase 2 Sec 3A	2012	$3,890,000
Southwest Pipeline Phase 2 Sec 3B	2012	$8,000,000
Southwest Pumpstation / Ground Storage	2012	$5,540,000
Lake Chapman Improvements Dredging	2012	$250,000
Harpool Additional Raw Water Storage Lake	2013	$2,205,000
Raw Water Pipeline from Harpool Additional Storage to Harpool WTP	2013	$4,500,000
Harpool Disinfection / Ozone	2013	$3,500,000
Ray Roberts Raw Water Alignment Study / ROW	2014	$18,350,000
Harpool In-Line Booster PS at N.E. Pipeline	2015	$550,000
Aubrey Pipeline	2016	$4,500,000
West Loop, Ponder	2017	$5,610,000
Parallel Pipeline RWTP to Stone Hill PS	2018	$15,100,000
Harpool WTP Expansion - Ph 2 to 30 MGD	2019	$20,000,000
Pilot Point Pipeline (NE Denton Co. Finshed Water Pipeline	2019	$16,600,000
Raw Water Pipeline from Ray Roberts	2019	$25,000,000
Total, 2010-2019 Projects		**$142,880,000**
Annual Costs for 2010-2019 Projects		
Debt Service (6% interest, 30 year bonds)		$10,380,000
Power (Estimated)		$3,004,500
Water Treatment Plant Operation (5,000,000 gallons at $0.70 per 1,000 gallons)		$3,500,000
Operation and Maintenance		$1,074,000
Total Pre-Amortization		**$17,958,500**
Total After Amortization		**$7,578,500**

Table Q-84, Continued

2020-2029 Projects		
Northeast Loop to Sanger (Denton)	2020	$5,000,000
West Loop, Ponder-Krum	2021	$5,860,000
RTWP Expansion (from 70 MGD to 82 MGD)	2021	$28,000,000
Parallel Raw Water Line from Intake	2121	$10,000,000
North Pipeline (PH3) (Harpool WTP to Celina)	2023	$3,820,000
NE Loop - Aubrey to Sanger Pipeline (Denton)	2024	$6,000,000
Parallel Line under Lewisville Lake	2025	$18,000,000
NE Pump Station (Aubrey/Pilot Point/Colonial/Sanger)	2029	$6,000,000
NE Pump Station (Northlake/Ponder/Krum/Sanger)	2029	$6,000,000
Total, 2020-2029 Projects		**$88,680,000**
Annual Costs for 2020-2029 Projects		
Debt Service (6% interest, 30 year bonds)		$6,443,000
Power (Estimated)		$3,000,000
Water Treatment Plant Operation (6,000,000 gallons at $0.70 per 1,000 gallons)		$4,200,000
Operation and Maintenance		$787,000
Total Pre-Amortization		**$14,430,000**
Total After Amortization		**$3,787,000**
2030-2040 Projects		
Water Treatment Plant Expansion (60 MGD)		$63,500,000
Other Pipeline Projects (estimated)		$26,400,000
Other Pump Station Projects (estimated)		$6,600,000
Engineering and Contingencies (30% for Pipelines, 35% for others)		$32,455,000
Interest during Contruction (18 months)		$7,953,000
Total, 2030-2040 Projects		**$136,908,000**
Annual Costs for 2030-2040 Projects		
Debt Service (6% interest, 30 year bonds)		$9,946,000
Power (Estimated)		$3,489,000
Water Treatment Plant Operation (10,950,000 gallons at $0.70 per 1,000 gallons)		$7,665,000
Operation and Maintenance		$515,000
Total Pre-Amortization		**$21,615,000**
Total After Amortization		**$11,669,000**

Table Q-84, Continued

2040-2050 Projects	
Water Treatment Plant Expansion (40 MGD)	$45,500,000
Other Pipeline Projects (estimated)	$26,400,000
Other Pump Station Projects (estimated)	$6,600,000
Engineering and Contingencies (30% for Pipelines, 35% for others)	$26,155,000
Interest during Contruction (18 months)	$6,454,000
Total, 2040-2050 Projects	**$111,109,000**
Annual Costs for 2040-2050 Projects	
Debt Service (6% interest, 30 year bonds)	$8,072,000
Power (Estimated)	$3,489,000
Water Treatment Plant Operation (7,300,000 gallons at $0.70 per 1,000 gallons)	$5,110,000
Operation and Maintenance	$515,000
Total Pre-Amortization	**$17,186,000**
Total After Amortization	**$9,114,000**
2050-2060 Projects	
Water Treatment Plant Expansion (40 MGD)	$45,500,000
Other Pipeline Projects (estimated)	$26,400,000
Other Pump Station Projects (estimated)	$6,600,000
Engineering and Contingencies (30% for Pipelines, 35% for others)	$26,155,000
Interest during Contruction (18 months)	$6,454,000
Total, 2050-2060 Projects	**$111,109,000**
Annual Costs for 2050-2060 Projects	
Debt Service (6% interest, 30 year bonds)	$8,072,000
Power (Estimated)	$2,310,000
Water Treatment Plant Operation (7,300,000 gallons at $0.70 per 1,000 gallons)	$5,110,000
Operation and Maintenance	$515,000
Total Pre-Amortization	**$16,007,000**
Total After Amortization	**$7,935,000**
TOTAL CAPITAL COST	**$590,686,000**

Table Q-85
Upper Trinity Regional Water District Alternative Strategy Costs

Capital Costs

Strategy		**Basis for Cost**		**UTRWD Cost**	
	User	**Amount**	**Capital Cost**	**Amount**	**Capital Cost**
Toledo Bend	NTMWD	200,000	$1,239,762,000	48,000	$297,543,000
Wright Patman - System	DWU	130,000	$1,020,655,000	38,000	$298,345,000
Wright Patman - Raise Flood Pool	DWU	112,100	$896,478,000	38,000	$303,891,000
Wright Patman - Texarkana	DWU	100,000	$759,568,000	38,000	$288,636,000
Texoma - Blend	All	113,000	$531,378,300	25,000	$117,562,000
George Parkhouse North	NTMWD	118,960	$516,585,000	35,000	$151,988,000
George Parkhouse South	NTMWD	108,480	$645,810,000	35,000	$208,364,000
Additional Reuse	Permitting	N/A	N/A	15,000	$1,000,000

Annual Costs

Strategy		**Basis for Cost**		
	User	**Amount**	**Pre-Am**	**Post-Am**
Toledo Bend	NTMWD	200,000	$146,037,689	$55,970,089
Wright Patman - System	DWU	130,000	$109,153,000	$35,003,000
Wright Patman - Raise Flood Pool	DWU	112,100	$85,415,000	$20,287,000
Wright Patman - Texarkana	DWU	100,000	$82,292,000	$27,110,000
Texoma - Blend	All	113,000	$50,301,000	$11,697,000
George Parkhouse North	NTMWD	118,960	$50,926,000	$13,397,000
George Parkhouse South	NTMWD	108,480	$60,572,000	$13,655,000
Additional Reuse	Permitting	N/A		

Strategy		**Basis for Cost**		
	UTRWD Amount	**Pre-Am**	**Post-Am**	**Comments**
Toledo Bend	48,000	$36,613,000	$14,997,000	Add $0.10 per thousand gal to pump to Lewisville
Wright Patman - System	38,000	$31,906,000	$10,232,000	DWU delivered to Lewisville
Wright Patman - Raise Flood Pool	38,000	$28,954,000	$6,877,000	
Wright Patman - Texarkana	38,000	$31,271,000	$10,302,000	
Texoma - Blend	25,000	$11,129,000	$2,588,000	
George Parkhouse North	35,000	$16,124,000	$5,082,000	Add $0.10 per thousand gal to pump to Lewisville
George Parkhouse South	35,000	$20,683,000	$5,546,000	
Additional Reuse	15,000	$72,649	$0.00	No annual costs

Table Q-85, Continued

Unit Costs

	UTRWD Amount	Pre-Am	Post-Am
Toledo Bend	48,000	$2.34	$0.96
Wright Patman - System	38,000	$2.58	$0.83
Wright Patman - Raise Flood Pool	38,000	$2.34	$0.56
Wright Patman - Texarkana	38,000	$2.53	$0.83
Texoma - Blend	25,000	$1.37	$0.32
George Parkhouse North	35,000	$1.41	$0.45
George Parkhouse South	35,000	$1.81	$0.49
Additional Reuse	15,000	$0.01	$0.00

Table Q-86
Grayson County Water Supply Project

Owner:	GTUA
Amount:	24,640 Ac-Ft/Yr
	44 MGD peak

TRANSMISSION FACILITIES

Pipeline(s)	Size	Qty.	Units	Unit Cost	Cost	GTUA Share of Costs	Sherman Share of Costs
16" Water Line							
Pipe	16 in.	181,000	LF	$ 103	$ 18,643,000	$ 18,643,000	
ROW		181,000	LF	$ 12	$ 2,172,000	$ 2,172,000	
12" Water Line							
Pipe	12 in.	124,000	LF	$ 77	$ 9,548,000	$ 9,548,000	
ROW		124,000	LF	$ 12	$ 1,488,000	$ 1,488,000	
8" Water Line							
Pipe	8 in.	259,000	LF	$ 52	$ 13,468,000	$ 13,468,000	
ROW		259,000	LF	$ 9	$ 2,331,000	$ 2,331,000	
Engineering and Contingencies		30%			$ 14,295,000	$ 14,295,000	
Subtotal of Pipeline(s)					**$ 61,945,000**	**$ 61,945,000**	
Pump Station(s)							
Station 1							
Pump, building, & appurtances	300 HP	1	LS	$ 1,441,000	$ 1,441,000	$ 1,441,000	
Storage Tank	2.5 MG	1	LS	$ 1,086,000	$ 1,086,000	$ 1,086,000	
Station 2							
Pump, building, & appurtances	400 HP	1	LS	$ 1,795,000	$ 1,795,000	$ 1,795,000	
Storage Tank	4.0 MG	1	LS	$ 1,505,000	$ 1,505,000	$ 1,505,000	
Engineering and Contingencies		35%			$ 2,039,000	$ 2,039,000	
Subtotal of Pump Station(s)					**$ 7,866,000**	**$ 7,866,000**	
WATER TREATMENT FACILITIES							
New Treatment Plants							
Sherman	10 MGD	1	LS	$ 32,200,000	$ 32,200,000		$ 32,200,000
North Plant	1 MGD	1	LS	$ 7,400,000	$ 7,400,000	$ 7,400,000	
Northwest Plant	2 MGD	1	LS	$ 10,600,000	$ 10,600,000	$ 10,600,000	
Water Treatment Plant Expansions							
Sherman 1	10 MGD	1	LS	$ 25,800,000	$ 25,800,000		$ 25,800,000
Sherman 2	5 MGD	1	LS	$ 15,350,000	$ 15,350,000		$ 15,350,000
New Sherman 1	10 MGD	1	LS	$ 25,800,000	$ 25,800,000		$ 25,800,000
North Plant	3 MGD	1	LS	$ 10,600,000	$ 10,600,000	$ 10,600,000	
Northwest Plant 1	1 MGD	1	LS	$ 4,500,000	$ 4,500,000	$ 4,500,000	
Northwest Plant 2	2 MGD	1	LS	$ 7,550,000	$ 7,550,000	$ 7,550,000	
Engineering and Contingencies		35%			$ 48,930,000	$ 14,227,500	$ 34,702,500
Subtotal of Water Treatment Plant					**$ 188,730,000**	**$ 54,877,500**	**$ 133,852,500**
PERMITTING AND MITIGATION					**$ 2,247,000**	**$ 1,057,500**	**$ 1,189,500**
CONSTRUCTION TOTAL					**$ 260,788,000**	**$ 125,746,000**	**$ 135,042,000**

Table Q-86, Continued

Interest During Construction		(24 months)			**$**	**21,299,000**	**$**	**10,270,000**	**$**	**11,029,000**
TOTAL CAPITAL COST					**$**	**282,087,000**	**$**	**136,016,000**	**$**	**146,071,000**
ANNUAL COSTS										
Debt Service					$	20,493,000	$	9,881,000	$	10,612,000
Operation and Maintenance Costs										
Pipeline	1%				$	500,000	$	500,000		
Pump Station	2.50%				$	175,000	$	175,000		
Estimated Annual Power Cost	$0.09/kWh				$	206,000	$	206,000		
WTP Operation - conventional	4,015,000	1000 gal	$	0.70	$	2,811,000	$	575,000	$	2,236,000
WTP Operation - RO	4,015,000	1000 gal	$	1.24	$	4,979,000	$	1,018,500	$	3,960,500
WTP Brine Disposal	1,003,750	1000 gal	$	0.35	$	351,000	$	72,000	$	279,000
Raw Water Cost	27,720	Ac-Ft	$	163	$	4,518,000	$	924,000	$	3,594,000
Subtotal Annual Costs					**$**	**34,033,000**	**$**	**13,351,500**	**$**	**20,681,500**
UNIT COSTS (Until Amortized)										
Cost per ac-ft						$1,381		$542		$839
Cost per 1000 gallons						$4.24		$1.66		$2.58
UNIT COSTS (After Amortization)										
Cost per ac-ft						$550		$141		$409
Cost per 1000 gallons						$1.69		$0.43		$1.25

Note: Raw water is assumed to cost $163 per acre-foot.

Table Q-87
GTUA Collin-Grayson Municipal Alliance East-West Water Line

Owner:	GTUA (water from NTMWD)	
2060 Amount:	11,400	Ac-Ft/Yr

Transmission Facilities Estimate provided by GTUA

CONSTRUCTION COSTS

TRANSMISSION FACILITIES

Description	**Qty.**	**Units**	**Unit Cost**	**Total Cost**
18" Water Line (urban)	11,418	LF	$116	$1,324,488
18" Water Line by Boring (U.S. 75)	316	LF	$475	$150,100
18" Water Line by Boring (City Streets)	180	LF	$400	$72,000
18" Line Valves	5	EA	$10,500	$52,500
Air Release Valves	8	EA	$6,500	$52,000
Blow-off Assemblies	7	EA	$7,000	$49,000
Cathodic Test Stations	4	EA	$2,000	$8,000
Class G Embedment	80	LF	$60	$4,800
Crushed Stone for Trench Stabilization	50	CY	$40	$2,000
Replace Asphalt Pavement	100	SY	$45	$4,500
Replace Gravel Driveways	100	SY	$25	$2,500
Raise or Lower Waterline	30	LF	$100	$3,000
Replace Sewer Line	20	LF	$100	$2,000
Trench Safety	11,418	LF	$2	$22,836
SWPPP	11,418	LF	$1	$11,418
Clearing	34	STA	$500	$17,000
36" Water Line (rural)	2,930	LF	$184	$539,120
Total Construction Cost				$2,317,262
Engineering & Contingencies (20%)				$463,452
Inflation (5%)				$139,036
TRANSMISSION SUBTOTAL				$2,919,750
Easements	14,348	LF	$12	$172,000
Permitting & Mitigation				$29,000
Construction Total				**$3,120,750**
Interest During Construction (12 months)				$130,000
TOTAL CAPITAL COST				**$3,250,750**

Table Q-87, Continued

ANNUAL COSTS					
Debt Service					$236,000
Operation and Maintenance	1%				$23,000
Estimated Annual Power Cost	$0.09/kWh				$364,000
Treated Water Cost	3,714,701	1000 gal	$	2.50	$9,287,000
Total Annual Cost					$9,910,000
UNIT COSTS (First 30 Years)					
Cost per ac-ft					$869
Cost per 1000 gallons					$2.67
UNIT COSTS (After 30 Years)					
Cost per ac-ft					$849
Cost per 1000 gallons					$2.60

Table Q-88
GTUA Collin-Grayson Municipal Alliance Water Transmission System - Phase 2

Probable Owner: GTUA (water from NTMWD)
Quantity: 24,200 AF/Y

CONSTRUCTION COSTS
TRANSMISSION FACILITIES

Pipeline		**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
McKinney to Melissa Pipeline	Urban	42 in.	18,000	LF	$323	$5,814,000
McKinney to Melissa Pipeline	Rural	42 in.	15,000	LF	$215	$3,225,000
Melissa to Anna Pipeline	Rural	36 in.	23,000	LF	$184	$4,232,000
Anna to Weston Pipeline	Rural	30 in.	37,000	LF	$145	$5,365,000
Right of Way Easements Rural (ROW)			75,000	LF	$5	$375,000
Right of Way Easements Urban (ROW)			540,000	LF	$41	$22,140,000
Engineering and Contingencies (30%)						$5,591,000
Subtotal of Pipeline						**$46,742,000**
Pump Station(s)						
McKinney Pump Station		2200 HP	1	LS	$4,349,600	$4,350,000
Melissa Booster Pump Station		1800 HP	1	LS	$3,919,600	$3,920,000
Anna Booster Pump Station		1400 HP	2	LS	$3,394,800	$6,790,000
Engineering and Contingencies (35%)						$5,271,000
Subtotal of Pump Station(s)						**$20,331,000**
Ground Storage						
Ground Storage Tank at Melissa		5 MG	1	LS	$1,720,000	$1,720,000
Ground Storage Tank at Anna		3 MG	1	LS	$1,215,000	$1,215,000
Engineering and Contingencies (35%)						$1,027,250
Subtotal of Ground Storage						**$3,962,250**
CONSTRUCTION TOTAL						**$71,035,250**
Permitting and Mitigation						**$120,000**
Interest During Construction				**(12 months)**		**$2,960,000**
TOTAL COST						**$74,115,250**
ANNUAL COSTS						
Debt Service (6% for 30 years)						$5,384,000
Electricity ($0.09 kWh)						$1,058,000
Operation & Maintenance						$764,000
Treated Water Purchase			7,889,200	1000 gal	$ 2.50	$19,723,000
Total Annual Costs						**$26,929,000**

Table Q-88, Continued

UNIT COSTS (Until Amortized)	
Per Acre-Foot of treated water	$1,113
Per 1,000 Gallons	$3.41
UNIT COSTS (After Amortization)	
Per Acre-Foot	$890
Per 1,000 Gallons	$2.73

Table Q-89
Athens MWA - New Wells in Carrizo-Wilcox Aquifer
Henderson County, Carrizo-Wilcox Aquifer

Supply	1400	Ac-ft/yr	868 gpm
Depth to Water	106		
Well Depth	490		
Well Yield	434	gpm	
Well Size	12	in	
Wells Needed	4		

Construction Costs	Number	Unit Cost	Total Cost
Water Wells	4	$250,000	$1,000,000
Connection to Transmission System	4	$50,000	$200,000
Engineering and Contingencies (30%)			$360,000
Subtotal of Well(s)			**$1,560,000**

Transmission System	Size	Quantity	Unit	Unit Cost	Total Cost
Pipeline - Rural	14 in.	15,840	LF	$60	$950,000
Pump Station	66 HP	1	EA	$500,000	$500,000
Ground Storage Tank	0.25MG	1	EA	$219,000	$219,000
Easement - Rural (assume 40% on MWA prop)					$15,000
Engineering and Contingencies (30% for pipelines, 35% for other items)					$460,000
Subtotal for Transmission					**2,144,000**

Permitting and Mitigation				$14,000
Construction Total				$3,718,000
Interest During Construction	6	months		$81,000
Total Capital Cost				**$3,799,000**
Debt Service - Total Capital				$276,000
O&M				
Transmission	1%			$14,000
Well(s) and Pump Station	2.5%			$45,000
Add Chemicals etc.	456,191	$0.30	per 1000 gal	$136,900
Pumping Costs				$42,000
		Total Annual Cost		**$513,900**

UNIT COSTS (First 30 Years)	
Cost per ac-ft	$367
Cost per 1000 gallons	$1.13

UNIT COSTS (After 30 Years)	
Cost per ac-ft	$170
Cost per 1000 gallons	$0.52

Table Q-90
Augmentation of Lake Athens with Reclaimed Water
Athens Municipal Water Authority

Treatment Scenario Number:	7
Lake Athens Limiting Factor:	50% Maximum Blend (Limiting Condition 4)
Polishing Treatment Choice:	Wetlands B

	Total Project
Annual Supply (ac-ft/yr)	1,938

CONSTRUCTION COSTS

RECLAIMED WATER TREATMENT FACILITIES

Wetlands B	Qty.	Units		Unit Cost		Total Cost
Facilities	82.0	acres	$	30,000	$	2,460,000
Land	82.0	acres	$	5,000	$	410,000
Engineering and Contingencies	35%				$	861,000
Subtotal of Wetlands B					**$**	**3,731,000**

TRANSMISSION FACILITIES

Pipeline(s)	Name	Qty.	Units		Unit Cost		Total Cost
10" Water Line	B-1						
Pipeline		19,395	ea	$	65	$	1,261,000
ROW		19,395	lf	$	28	$	543,000
14" Water Line	B-2-a						
Pipeline		17,000	ea	$	90	$	1,530,000
ROW		17,000	lf	$	28	$	476,000
14" Water Line	B-2-b						
Pipeline		32,643	ft	$	60	$	1,959,000
ROW		32,643	lf	$	5	$	163,000
14" Water Line	B-3						
Pipeline		14,128	ea	$	60	$	848,000
ROW		14,128	lf	$	5	$	71,000
Discharge Structure		1.73	mgd			$	36,000
Engineering and Contingencies		30%				$	1,690,000
Subtotal of Pipeline(s)						**$**	**11,363,000**

Pump Station(s)	Qty.	Units	Unit Cost		Total Cost
West WWTP					
Pump, Building, & Appurtenances	37	hp			$617,000
North WWTP					
Pump, Building, & Appurtenances	110	hp			$780,000
Storage Tank	0.3	mg		$	311,000
Wetlands B					
Pump, Building, & Appurtenances	47	hp			$639,000
Engineering and Contingencies	35%			$	821,000
Subtotal of Pump Station(s)				**$**	**3,168,000**

Q-90, Continued

PERMITTING AND MITIGATION						
Pipelines	1%				$	108,000
Wetlands	3%				$	89,000
Water Rights and TPDES Discharge					$	100,000
Deep Well Injection					$	-
Subtotal of Permitting and Mitigation					**$**	**297,000**
CONSTRUCTION TOTAL					**$**	**18,559,000**
Interest During Construction		(24 months)			**$**	**1,516,000**
TOTAL CAPITAL COST					**$**	**20,075,000**
ANNUAL COSTS	**Qty.**	**Units**		**Unit Cost**		**Total Cost**
Debt Service					$	1,458,000
Treatment Facilities O&M Costs						
Wetlands B	82	acres	$	1,000	$	82,000
Transmission Facilities O&M Costs						
Pipeline	1%				$	80,000
Pump Station	2.50%				$	70,000
Power	168	hp	$	0.090	$	99,000
Brine Disposal Facilities O&M Costs						
Well	1.00%				$	-
Chemicals	0	1000 gal	$	0.11	$	-
Power	0	hp	$	0.09	$	-
TOTAL ANNUAL COST (First 30 Years)					**$**	**1,789,000**
TOTAL ANNUAL COST (After 30 Years)					**$**	**331,000**

UNIT COSTS	
Cost per Acre-Foot	**Full Project**
First 30 Years	$923
After 30 Years	$171
Cost per 1,000 Gallons	
First 30 Years	$2.83
After 30 Years	$0.52

Table Q-91

Obtain Water from Forest Grove Reservoir and Transport to New 4 MGD WTP West side of Athens with 4 MGD WTP expansion in 2060

Probable Owner:	Athens MWA		Year:	2040	
Amount:	4,480	Acre-Feet/Year		8.0	MGD design for pipeline
Initial WTP	2240	ac-ft/yr		4.0	MGD design
WTP Expansion	2240	ac-ft/yr		4.0	MGD design

CONSTRUCTION COSTS

TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline Rural	24 in.	21,120	LF	$116	$2,450,000
Pipeline Urban	24 in.	5,280	LF	$174	$919,000
Right of Way Easements (Rural)		21,120	LF	$5	$106,000
Right of Way Easements (Urban)		5,280	LF	$28	$148,000
Engineering and Contingencies (30%)					$1,011,000
Subtotal of Pipeline					**$4,634,000**
Pump Station(s)					
Intake and Pump Station	450 HP	1	EA	$2,540,000	$2,540,000
Engineering and Contingencies (35%)					$889,000
Subtotal of Pump Station(s)					**$3,429,000**
Water Treatment Plant					
Cost of WTP			4	MGD	$12,325,000
Engineering & Contingencies (35%)					$4,314,000
Subtotal					**$16,639,000**
Permitting and Mitigation		1	LS		$182,000
CONSTRUCTION TOTAL					**$24,884,000**
Interest During Construction			**(18 months)**		**$1,535,000**
Permitting associated with Water Rights Transfer					$200,000
TOTAL CAPITAL COST					**$26,619,000**
ANNUAL COSTS TREATED WATER					
Debt Service (6% for 30 years)					$1,934,000
Raw water purchase					$0
Electricity ($0.09 kWh)					$58,000
Treatment, Operation & Maintenance					$627,562
Total Annual Costs					**$2,619,562**

Table Q-91, Continued

UNIT COSTS - (During Amortization)	
Per Acre-Foot of water	$585
Per 1,000 Gallons of raw water	$1.79
UNIT COSTS - (After Amortization)	
Per Acre-Foot of water	$153
Per 1,000 Gallons of raw water	$0.47

Table Q-92
Water Treatment Plant Expansion at City of Athens - Forest Grove

Probable Owner: Athens MWA
Amount: 2,240 Acre-Feet/Year

CONSTRUCTION COSTS					
WATER TREATMENT FACILITIES					
New Treatment Plant at City	4.0 MGD	1	LS	$12,325,000	$12,325,000
Engineering and Contingencies (35%)					$4,314,000
Subtotal of Treatment					**$16,639,000**
Permitting of treatment plant					$147,900
CONSTRUCTION TOTAL					**$16,786,900**
Interest During Construction			**(18 months)**		**$1,035,000**
TOTAL CAPITAL COST					**$17,821,900**
ANNUAL COSTS TREATED WATER					
Debt Service (6% for 30 years)					$1,294,700
Electricity ($0.09 kWh)					$58,000
Facility Operation & Maintenance					$0
Water Treatment ($.70/1,000 gal finished water)		2,240	af/y		$510,900
Total Annual Costs					**$1,863,600**
UNIT COSTS (During Amortization)					
Per Acre-Foot of treated water					$832
Per 1,000 Gallons of treated water					$2.55
UNIT COSTS (After Amortization)					
Per Acre-Foot of treated water					$254
Per 1,000 Gallons of treated water					$0.78

Table Q-93

Obtain Water from Cedar Creek and Transport Portion to New 4 MGD WTP West side of Athens with 4 MGD WTP expansion in 2060

Probable Owner:	Athens MWA	Year:	2040	
Amount:	4,480 Acre-Feet/Year		8.0	MGD design for pipeline
Initial WTP	2240 ac-ft/yr		4.0	MGD design
WTP Expansion	2240 ac-ft/yr		4.0	MGD design

CONSTRUCTION COSTS

TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline Rural	24 in.	55,440	LF	$116	$6,431,000
Pipeline Urban	24 in.	5,280	LF	$174	$918,700
Right of Way Easements (Rural)		55,440	LF	$5	$277,200
Right of Way Easements (Urban)		5,280	LF	$28	$147,800
Engineering and Contingencies (30%)					$2,205,000
Subtotal of Pipeline					**$9,979,700**
Pump Station(s)					
Intake and Pump Station	690 HP	1	EA	$3,000,000	$3,000,000
Engineering and Contingencies (35%)					$1,050,000
Subtotal of Pump Station(s)					**$4,050,000**
Water Treatment Plant					
Cost of WTP			4	MGD	$12,325,000
Engineering & Contingencies (35%)					$4,313,750
Subtotal					**$16,638,750**
Permitting and Mitigation		1	LS		$226,700
CONSTRUCTION TOTAL					**$30,895,150**
Interest During Construction			**(18 months)**		**$1,905,000**
Permitting associated with Water Rights Transfer					$200,000
TOTAL CAPITAL COST					**$33,000,150**
ANNUAL COSTS RAW WATER					
Debt Service (6% for 30 years)					$2,397,400
Raw water purchase					$1,007,000
Electricity ($0.09 kWh)					$123,000
Treatment, Operation & Maintenance					$1,200,065
Total Annual Costs					**$4,727,465**

Table Q-93, Continued

UNIT COSTS - (During Amortization)	
Per Acre-Foot of treated water	$1,055
Per 1,000 Gallons of treated water	$3.24
UNIT COSTS - (After Amortization)	
Per Acre-Foot of treated water	$520
Per 1,000 Gallons of treated water	$1.60

Table Q-94
Purchase water from Lake Palestine for Athens MWA

Probable Owner: Athens MWA
Amount: 4,000 Acre-Feet/Year 4.46 MGD design

CONSTRUCTION COSTS

TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline Rural	24 in.	80,000	LF	$116	$9,280,000
Pipeline Urban	24 in.	0	LF	$174	$0
Right of Way Easements (Rural)		80,000	LF	$5	$400,000
Right of Way Easements (Urban)		0	LF	$28	$0
Engineering and Contingencies (30%)					$2,784,000
Subtotal of Pipeline					**$12,464,000**
Pump Station(s)					
Intake and Pump Station at Lake Palestine	210 HP	1	EA	$1,527,000	$1,527,000
Engineering and Contingencies (35%)					$534,000
Subtotal of Pump Station(s)					**$2,061,000**
Permitting and Mitigation		1	LS		$108,100
CONSTRUCTION TOTAL					**$14,633,100**
Interest During Construction			**(12 months)**		**$610,000**
UNRMWA Buy-in Cost					$100,000
TOTAL CAPITAL COST					**$15,343,100**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$1,114,660
Raw water purchase					$195,511
Electricity ($0.09 kWh)					$91,000
Facility Operation & Maintenance					$157,170
Total Annual Costs					**$1,558,341**
UNIT COSTS (During Amortization)					
Per Acre-Foot of raw water					$390
Per 1,000 Gallons of raw water					$1.20
UNIT COSTS (After Amortization)					
Per Acre-Foot of raw water					$111
Per 1,000 Gallons of raw water					$0.34

Table Q-95
Purchase Water from DWU for Athens MWA

Probable Owner: Athens MWA
Amount: 4,000 Acre-Feet/Year 4.46 MGD design

CONSTRUCTION COSTS

TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline Rural	24 in.	2,000	LF	$116	$232,000
Pipeline Urban	24 in.	0	LF	$174	$0
Incremental cost for DWU pipeline					$1,115,125
Right of Way Easements (Rural)		2,000	LF	$5	$10,000
Right of Way Easements (Urban)		0	LF	$28	$0
Engineering and Contingencies (30%)					$70,000
Subtotal of Pipeline					**$1,427,125**
Pump Station(s)					
Assume sufficient head at junction to reach Lake Athens					$0
Engineering and Contingencies (35%)					$0
Subtotal of Pump Station(s)					**$0**
Permitting and Mitigation		1	LS		$16,200
CONSTRUCTION TOTAL					**$1,443,325**
Interest During Construction			**(6 months)**		**$31,000**
TOTAL CAPITAL COST					**$1,474,325**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$107,100
Raw water purchase					$536,700
Electricity ($0.09 kWh)					$0
Facility Operation & Maintenance					$16,200
Total Annual Costs					**$660,000**
UNIT COSTS (During Amortization)					
Per Acre-Foot of raw water					$165
Per 1,000 Gallons of raw water					$0.51
UNIT COSTS (After Amortization)					
Per Acre-Foot of raw water					$138
Per 1,000 Gallons of raw water					$0.42

Table Q-96
Corsicana WTP Expansion at Navarro Mills Lake - Alternative Strategy

Owner: Corsicana

WATER TREATMENT PLANT		**Quantity**	**Unit**	**Cost**
Cost of WTP Expansion		5	MGD	$10,150,000
Engineering & Contingencies (35%)				$3,552,500
Subtotal				**$13,702,500**
Interest During Construction	**(18 months)**			**$845,000**
TOTAL COST FOR EXPANSION				**$14,547,500**
ANNUAL COSTS FOR EXPANSION				
Debt Service (6% for 30 years)				$1,057,000
Operation & Maintenance ($0.70/1,000 gal)		912,500	1,000 gal	$639,000
Total Annual Costs				**$1,696,000**
UNIT COSTS (1st 30 years)				
Per Acre-Foot				$605
Per 1,000 Gallons				$1.86
UNIT COSTS (after 30 years)				
Per Acre-Foot				$228
Per 1,000 Gallons				$0.70

Table Q-97
Corsicana WTP at Lake Halbert
(To replace existing 4 MGD WTP)

Owner: Corsicana
Amount: 4,480 acre-feet/year

Pump Station(s)	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pump Station at Richland-Chambers	500 HP	1	LS	$2,698,000	$2,698,000
Engineering and Contingencies (30%)					$809,400
Subtotal of Pump Station(s)					**$3,507,400**
WATER TREATMENT FACILITIES					
New Water Treatment Plant (2020)					
Cost of WTP		8	MGD		$20,000,000
Engineering & Contingencies (35%)					$7,000,000
Subtotal					**$27,000,000**
Interest During Construction		**(18 months)**			**$1,881,000**
TOTAL COST FOR NEW WATER TREATMENT PLANT (2020)					**$32,388,400**
ANNUAL COSTS FOR NEW WATER TREATMENT PLANT					
Debt Service (6% for 30 years)					$2,353,000
Electricity ($0.09 kWh)					$62,000
Operation & Maintenance (pump station)					$81,000
Total Annual Costs					**$2,496,000**
UNIT COSTS (first 30 years)					
Per Acre-Foot					$557
Per 1,000 Gallons					$1.71
UNIT COSTS (after 30 years)					
Per Acre-Foot					$32
Per 1,000 Gallons					$0.10

Table Q-97, Continued

2040 EXPANSION			
WATER TREATMENT PLANT EXPANSIONS	**Quantity**	**Unit**	**Cost**
Cost of WTP Expansions	8	MGD	$13,933,000
Engineering & Contingencies (35%)			$4,876,550
Subtotal			**$18,809,550**
Interest During Construction	**(18 months)**		**$1,160,000**
TOTAL COST FOR 2040 EXPANSION			**$19,969,550**
ANNUAL COSTS FOR YEAR 2040 EXPANSION			
Debt Service (6% for 30 years)			$1,451,000
Operation & Maintenance ($0.70/1,000 gal)	1,460,000	1,000 gal	$1,022,000
Total Annual Costs			**$2,473,000**
UNIT COSTS			
Per Acre-Foot			$552
Per 1,000 Gallons			$1.69

Table Q-98
GTUA Reuse for Grayson County Steam Electric Power

Owner: Greater Texoma Utility Authority
Amount: 6,726 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Cost of Pipeline	24 in	79,200	LF	$ 174	$13,781,000
Right of Way Easements (ROW)		79,200	LF	$ 12	$950,000
Engineering & Contingencies (30%)					$4,134,000
Total Pipeline Cost					**$18,865,000**
Cost of Pump Station	1480 HP	1	LS	$ 3,499,760	$3,500,000
Engineering & Contingencies (35%)					$1,225,000
Total Pump Station Cost					**$4,725,000**
TOTAL CAPITAL COST					**$23,590,000**
Permitting and Mitigation					**$207,000**
Interest during Construction (12 months)					**$983,000**
Total Raw Water Delivery Capital Cost					**$24,780,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$1,800,000
Electricity ($0.09 kWh)					$234,000
Operation & Maintenance					$270,000
Purchase of Reuse Water					$548,000
Total Annual Costs					**$2,852,000**
UNIT COSTS (During Amortization)					
Per Acre-Foot					$424
Per 1,000 gallons					$1.30
UNIT COSTS (During Amortization)					
Per Acre-Foot					$156
Per 1,000 gallons					$0.48

Note: Cost to purchase reuse water is assumed to be $0.25 per thousand gallons.

Table Q-99
Cooke County Water Supply Project

Probable Owner:	Cooke County		
Quantity:	2,242	AF/Y	2020
	4,484	AF/Y	2040

CONSTRUCTION COSTS

				2020	2040	
TRANSMISSION FACILITIES						
Pipeline(s)	**Qty.**	**Units**	**Unit Cost**	**Phase I Cost**	**Phase II Cost**	**Total Cost**
24" Water Line to Gainesville						
Pipe	66,000	FT	$ 116	$7,656,000	$0	$7,656,000
ROW	66,000	FT	$5	$330,000	$0	$330,000
14" Water Line to Valley View						
Pipe	56,760	FT	$ 60	$3,406,000	$0	$3,406,000
ROW	56,760	FT	$5	$284,000	$0	$284,000
8" Water Line to Lindsay						
Pipe	21,120	FT	$ 34	$718,000	$0	$718,000
ROW	21,120	FT	$3	$63,000	$0	$63,000
8" Water Line (Kiowa, Woodbine, Bolivar)						
Pipe	43,560	FT	$ 34	$1,481,000	$0	$1,481,000
ROW	43,560	FT	$3	$131,000	$0	$131,000
Engineering and Contingencies	30%			$3,978,000	$0	$3,978,000
Subtotal of Pipeline(s)				**$18,047,000**	**$0**	$18,047,000
Pump Station(s)						
Station 1						
Pump, bldg, & appurtenances	400	hp		$2,387,000	$0	$2,387,000
Storage Tank		gal		$1,355,000	$0	$1,355,000
Engineering and Contingencies	35%			$1,310,000	$0	$1,310,000
Subtotal of Pump Station(s)				**$5,052,000**	**$0**	$5,052,000
WATER TREATMENT FACILITIES						
Water Treatment Plant						
Phase 1 Plant Expansion	4.00	MGD		$8,775,000	$0	$8,775,000
Phase 2 Plant Expansion	2.00	MGD		$0	$5,150,000	$5,150,000
Phase 3 Plant Expansion	2.00	MGD		$0	$5,150,000	$5,150,000
Engineering and Contingencies	35%			$3,071,000	$1,803,000	$4,874,000
Subtotal of Water Treatment Plant				**$11,846,000**	**$12,103,000**	$23,949,000
PERMITTING AND MITIGATION	1%			**$220,000**	**$0**	$220,000
CONSTRUCTION TOTAL				**$35,165,000**	**$12,103,000**	$47,268,000
Interest During Construction						
Phase 1		(24 months)		**$2,750,000**	**$0**	**$3,012,000**
Phase 2		(6 months)		**$0**	**$262,000**	
TOTAL CAPITAL COST				**$37,915,000**	**$12,365,000**	**$50,280,000**

Table Q-99, Continued

ANNUAL COSTS						
Debt Service				$2,754,000	$898,000	$3,652,000
Operation and Maintenance Costs						
Pipeline	1%			$159,000	$0	$159,000
Pump Station	2.50%			$112,000	$0	$112,000
Estimated Annual Power Cost	$0.09/kWh			$59,000	$59,000	$118,000
WTP						
Phase 1	730,558	1000 gal	$0.70	$511,000	$0	$1,022,000
Phase 2	730,558	1000 gal	$0.70	$0	$511,000	
Raw Water Cost				$119,000	$299,000	$418,000
Total Annual Costs				**$3,714,000**	**$1,767,000**	**$5,481,000**
UNIT COSTS (During Amortization)						
Per Acre-Foot of treated water				$1,657	$788	$1,222
Per 1,000 Gallons of treated water				$5.09	$2.42	$3.75
UNIT COSTS (After Amortization)						
Per Acre-Foot of treated water				$428	$388	$408
Per 1,000 Gallons of treated water				$1.31	$1.19	$1.25

Note: Raw water is assumed to cost $163 per acre-foot. Raw water costs are only applied to wholesale customers, not Gainesville.

Table Q-100
Muenster: Pipeline from Gainesville to Muenster

Owner:	Muenster			
Amount:	200	ac-ft/yr		
CONSTRUCTION COSTS				
TRANSMISSION FACILITIES				
Pipeline(s)	**Qty.**	**Units**	**Unit Cost**	**Total Cost**
8" Water Line from Lindsay to Muenster				
Pipe	40,920	FT	$ 34	$ 1,391,000
ROW	40,920	FT	$ 3	$ 123,000
Engineering and Contingencies	30%			$ 417,000
Upsize to 12" Water Line from Gainesville to Lindsay				
Pipe	19,800	FT	$ 52	$ 1,030,000
ROW	19,800	FT	$ 5	$ 99,000
Subtotal				$ 1,129,000
Muenster Cost Share				$ 903,000
Engineering and Contingencies	30%			$ 247,000
Subtotal of Pipeline(s)				$ 3,081,000
PERMITTING AND MITIGATION	**1.0%**			**$ 31,000**
CONSTRUCTION TOTAL				**$ 3,017,833**
Interest During Construction		(24 months)		$236,000
TOTAL CAPITAL COST				**$ 3,253,833**
ANNUAL COSTS				
Debt Service				$ 236,000
Operation and Maintenance Costs				
Pipeline	1.0%			$ 23,000
Treated Water Cost		ac-ft	$ 815	$ 163,000
Total Annual Costs				**$ 422,000**
UNIT COSTS (First 30 Years)				
Per Acre-Foot				$ 2,110
Per 1,000 Gallons				$ 6.48
UNIT COSTS (After 30 Years)				
Per Acre-Foot				$ 930
Per 1,000 Gallons				$ 2.85

Table Q-101
Gainesville Direct Reuse

Owner: City of Gainesville
Amount: 169 Ac-Ft/Yr

CAPITAL COSTS	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Cost of Pipeline	6 in	15,840	LF	$ 39	$618,000
Right of Way Easements (ROW)		15,840	LF	$ 12	$190,000
Engineering & Contingencies (30%)					$185,000
Total Pipeline Cost					**$993,000**
Cost of Pump Station	16 HP	1	LS	$ 553,600	$554,000
Engineering & Contingencies (35%)					$194,000
Total Pump Station Cost					**$748,000**
TOTAL CAPITAL COST					**$1,741,000**
Permitting and Mitigation					**$14,000**
Interest during Construction (12 months)					**$73,000**
Total Raw Water Delivery Capital Cost					**$1,828,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$133,000
Electricity ($0.09 kWh)					$4,000
Operation & Maintenance					$24,000
Purchase of Reuse Water					$14,000
Total Annual Costs					**$175,000**
UNIT COSTS (During Amortization)					
Per Acre-Foot					$1,036
Per 1,000 gallons					$3.18
UNIT COSTS (During Amortization)					
Per Acre-Foot					$249
Per 1,000 gallons					$0.76

Note: Cost to purchase reuse water is assumed to be $0.25 per thousand gallons.

Table Q-102
City of Fort Worth Parallel Pipeline to Eagle Mountain Lake
with Raw Water Pump Station Expansion

Owner: Fort Worth
Amount: 0 Ac-Ft/Yr
Zero additional supply is provided by this strategy.

CAPITAL COSTS	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline					
Pipeline	72 in.	19,100	LF	$516	$9,855,600
Contingencies (20%)					$1,971,100
Subtotal of Pipeline					**$11,826,700**
Pump Station(s)					
Pump Station Expansion	35 MGD	1	LS	$11,634,000	$11,634,000
Contingencies (20%)					$2,326,800
Subtotal of Pump Station(s)					**$13,960,800**
Subtotal					**$25,787,500**
Engineering (10%)					**$2,578,750**
TOTAL COST					**$28,366,250**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$2,061,000
Electricity ($0.09 kWh)					$0
Operation & Maintenance					$467,000
Total Annual Costs					**$2,528,000**

Costs provided by City of Fort Worth - CIP Master Plan

Table Q-103
City of Fort Worth Pipeline to New Southwest Water Treatment Plant

Owner: Fort Worth
Amount: 0 Ac-Ft/Yr
Zero additional supply provided by this strategy.

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	42 in.	53,000	LF	$215	$11,395,000
Right of Way Easements (ROW)		53,000	LF	$ 7	$371,000
Engineering and Contingencies (30%)					$3,530,000
Subtotal of Pipeline					**$15,296,000**
Pump Station(s)					
Booster Pump Station	3500 HP	1	LS	$5,557,500	$5,557,500
Engineering and Contingencies (35%)					$1,945,000
Subtotal of Pump Station(s)					**$7,502,500**
Permitting and Mitigation					**$203,000**
CONSTRUCTION TOTAL					**$23,001,500**
Interest During Construction			**(12 months)**		**$958,000**
TOTAL COST					**$23,959,500**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$1,741,000
Electricity ($0.09 kWh)					$547,000
Operation & Maintenance					$304,000
Total Annual Costs					**$2,592,000**

Table Q-104
Fort Worth Future Direct Reuse*

Owner: Fort Worth
Amount: 7,979 Ac-Ft/Yr

CONSTRUCTION COSTS

TRANSMISSION FACILITIES

Pipeline(s)	**Qty.**	**Units**	**Unit Cost****		**Total Cost****
Water Line					
36" Pipe	36,900	LF	$245.40	$	9,055,000
ROW	6,300	LF	$14.81	$	93,000
30" Pipe	28,000	LF	$213.39	$	5,975,000
ROW	13,200	LF	$14.81	$	195,000
24" Pipe	38,700	LF	$181.38	$	7,019,000
ROW	38,700	LF	$14.81	$	573,000
20" Pipe	5,100	LF	$148.41	$	757,000
ROW	5,100	LF	$14.81	$	76,000
18" Pipe	16,900	LF	$132.30	$	2,236,000
ROW	16,900	LF	$14.81	$	250,000
16" Pipe	65,400	LF	$110.96	$	7,257,000
ROW	65,400	LF	$14.81	$	969,000
14" Pipe	1,100	LF	$90.96	$	100,000
ROW	1,100	LF	$14.81	$	16,000
12" Pipe	11,700	LF	$85.86	$	1,005,000
ROW	11,700	LF	$14.81	$	173,000
10" Pipe	13,900	LF	$71.48	$	994,000
ROW	13,900	LF	$14.81	$	206,000
8" Pipe	12,600	LF	$48.01	$	605,000
ROW	12,600	LF	$11.66	$	147,000
6" Pipe	12,500	LF	$41.61	$	520,000
ROW	12,500	LF	$11.66	$	146,000
Engineering and Contingencies	30%			$	11,510,000
Subtotal of Pipeline(s)				**$**	**49,877,000**

Table Q-104, Continued

Pump Station(s)				
Station 1				
Pump, building, & appurt.	70	HP	$	543,826
Storage Tank	2	MG	$	895,777
Station 2				
Pump, building, & appurt.	1,785	HP	$	3,638,233
Storage Tank	0	MG	$	-
Station 3				
Pump, building, & appurt.	1,483	HP	$	3,247,059
Storage Tank	0	MG	$	-
Station 4				
Pump, building, & appurt.	1,196	HP	$	2,896,169
Storage Tank	2	MG	$	895,777
Station 5				
Pump, building, & appurt.	2,078	HP	$	3,936,840
Storage Tank	4	MG	$	1,844,400
Station 6				
Pump, building, & appurt.	99	HP	$	681,580
Storage Tank	2	MG	$	895,777
Station 7				
Pump, building, & appurt.	624	HP	$	2,034,140
Storage Tank	0	MG	$	-
Engineering and Contingencies	35%		$	7,528,000
Subtotal of Pump Station(s)			**$**	**29,037,578**
WASTEWATER TREATMENT FACILITIES				
Satellite Wastewater Treament Plant 1	6	MGD	$	28,746,000
Satellite Wastewater Treament Plant 2	4	MGD	$	13,662,340
Engineering and Contingencies	35%		$	14,843,000
Subtotal of Wastewater Treatment Plant			**$**	**57,251,340**
PERMITTING AND MITIGATION			**$**	**729,444**
CONSTRUCTION TOTAL			**$**	**136,895,362**
Interest During Construction		(18 months)	**$**	**7,884,000**
TOTAL CAPITAL COST			**$**	**144,779,362**

Table Q-104, Continued

ANNUAL COSTS					
Debt Service				$	10,518,000
Operation and Maintenance Costs					
Pipeline	1%			$	499,000
Pump Station	2.50%			$	726,000
Estimated Annual Power Cost	$0.09/kWh			$	452,000
WWTP Operation		1000 gal	$0.35	$	1,303,050
Total Annual Costs				**$**	**13,498,050**
UNIT COSTS (First 30 Years)					
Per Acre-Foot				$	1,692
Per 1,000 Gallons				$	5.19
UNIT COSTS (After 30 Years)					
Per Acre-Foot				$	373
Per 1,000 Gallons				$	1.14

*The cost information reflected in this strategy incorporates the following reuse systems: Central Business District, Mary's Creek, and Southern Business District.

**These costs are from the Fort Worth Reclaimed Water Master Plan (2006) and the Draft Mary's Creek Water Reuse Feasibility Study (2004) and have been updated to 2008 Dollars

Table Q-105
Fort Worth Direct Reuse
Alliance Corridor

Owner:	Fort Worth				
Amount:	4,694	Ac-Ft/Yr			

CONSTRUCTION COSTS

TRANSMISSION FACILITIES

Pipeline(s)	**Qty.**	**Units**	**Unit Cost***		**Total Cost***
Water Line					
30" Pipe	7,800	LF	$213.39	$	1,664,000
ROW	7,800	LF	$14.81	$	116,000
20" Pipe	12,200	LF	$148.41	$	1,811,000
ROW	12,200	LF	$14.81	$	181,000
18" Pipe	25,600	LF	$132.30	$	3,387,000
ROW	25,600	LF	$14.81	$	379,000
16" Pipe	25,300	LF	$110.96	$	2,807,000
ROW	25,300	LF	$14.81	$	375,000
12" Pipe	4,000	LF	$85.86	$	343,000
ROW	4,000	LF	$14.81	$	59,000
10" Pipe	15,200	LF	$71.08	$	1,080,000
ROW	15,200	LF	$14.81	$	225,000
8" Pipe	8,300	LF	$48.01	$	398,000
ROW	8,300	LF	$11.66	$	97,000
6" Pipe	300	LF	$41.61	$	12,000
ROW	0	LF	$11.66	$	-
Engineering and Contingencies	30%			$	3,880,000
Subtotal of Pipeline(s)				**$**	**16,814,000**

Pump Station(s)					
Station 1					
Pump, building, & appurt.	743	HP		$	2,198,629
Storage Tank	0.5	MG		$	530,045
Engineering and Contingencies	35%			$	955,000
Subtotal of Pump Station(s)				**$**	**3,683,674**

Table Q-105, Continued

PERMITTING AND MITIGATION		$	**140,992**
CONSTRUCTION TOTAL		$	**20,638,666**
Interest During Construction	(18 months)	$	**1,189,000**
TOTAL CAPITAL COST		$	**21,827,666**
ANNUAL COSTS			
Debt Service		$	1,586,000
Operation and Maintenance Costs			
Pipeline	1%	$	168,000
Pump Station	2.50%	$	92,000
Estimated Annual Power Cost	$0.09/kWh	$	93,000
Total Annual Costs		$	**1,939,000**
UNIT COSTS (First 30 Years)			
Per Acre-Foot		$	413
Per 1,000 Gallons		$	1.27
UNIT COSTS (After 30 Years)			
Per Acre-Foot		$	75
Per 1,000 Gallons		$	0.23

* These costs are from the Fort Worth Reclaimed Water Master Plan (2006) and have been updated to 2008 Dollars

Table Q-106
Fort Worth Direct Reuse
Village Creek*

Owner:	Fort Worth	
Amount:	3,526	Ac-Ft/Yr

CONSTRUCTION COSTS

TRANSMISSION FACILITIES					
Pipeline(s)	**Qty.**	**Units**	**Unit Cost**		**Total Cost**
Parts 1 and 4				$	2,331,119
Part 2				$	4,762,729
Part 3				$	3,287,350
Subtotal of Pipeline(s)				**$**	**10,381,198**
Pump Station				**$**	**3,167,580**
CONSTRUCTION TOTAL				**$**	**13,548,778**
Design/Permitting Rate Study				**$**	**1,805,486**
Construction Administration				**$**	**570,000**
ARRA Administration				**$**	**170,388**
Interest During Construction (Zero Interest Loan)				**$**	**-**
TOTAL CAPITAL COST				**$**	**16,094,652**
ANNUAL COSTS					
Debt Service (Zero Interest, 20 Year loan)				$	805,000
Operation and Maintenance Costs					
Pipeline	1%			$	104,000
Pump Station	2.50%			$	79,000
Estimated Annual Power Cost	$0.09/kWh			$	85,000
Total Annual Costs				**$**	**1,073,000**
UNIT COSTS (First 20 Years)					
Per Acre-Foot				$	304
Per 1,000 Gallons				$	0.93
UNIT COSTS (After 20 Years)					
Per Acre-Foot				$	76
Per 1,000 Gallons				$	0.23

* This project is currenlty under construction. These costs came directly from the "Bid Tab" for this construction project.

Table Q-107
Walnut Creek SUD (Parallel) Pipeline to Rhome

Owner: Walnut Creek SUD
Amount: 1,996 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline - Segment 1	16 in.	15,840	LF	$ 69	$1,093,000
Right of Way - Segment 1		15,840	LF	$ 5	$79,000
Pipeline - Segment 2	16 in.	15,840	LF	$ 69	$1,093,000
Right of Way - Segment 2		15,840	LF	$ 5	$79,000
Pipeline - Segment 3	16 in.	15,840	LF	$ 69	$1,093,000
Right of Way - Segment 3		15,840	LF	$ 5	$79,000
Pipeline - Segment 4	16 in.	15,840	LF	$ 69	$1,093,000
Right of Way - Segment 4		15,840	LF	$ 5	$79,000
Pipeline - Segment 5	16 in.	15,840	LF	$ 69	$1,093,000
Right of Way - Segment 5		15,840	LF	$ 5	$79,000
Engineering and Contingencies (30%)					$1,758,000
Subtotal of Pipeline					**$7,618,000**
Pump Station(s)					
Booster Pump Station	200 HP	1	LS	$1,118,000	$1,118,000
Ground Storage at Rhome	0.40 MG	1	LS	$374,250	$374,000
Engineering and Contingencies (35%)					$522,000
Subtotal of Pump Station(s)					**$2,014,000**
Permitting and Mitigation					**$57,000**
CONSTRUCTION TOTAL					**$9,689,000**
Interest During Construction			**(12 months)**		**$404,000**
TOTAL COST					**$10,093,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$733,000
Electricity ($0.09 kWh)					$28,000
Operation & Maintenance					$47,000
Total Annual Costs					**$808,000**
UNIT COSTS (Pre-Amort.)					
Per Acre-Foot					$405
Per 1,000 Gallons					$1.24
UNIT COSTS (Post-Amort.)					
Per Acre-Foot					$38
Per 1,000 Gallons					$0.12

Table Q-108
Walnut Creek - Pipeline from Bridgeport with 12 MGD WTP

Owner: Walnut Creek SUD
Amount: 6,726 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	30 in.	52,800	LF	$ 145	$7,656,000
Right of Way Easements (ROW)		52,800	LF	$ 5	$264,000
Engineering and Contingencies (30%)					$2,376,000
Subtotal of Pipeline					**$10,296,000**
Pump Station(s)					
Booster Pump Station	500 HP	1	LS	$2,032,000	$2,032,000
Engineering and Contingencies (35%)					$711,000
Subtotal of Pump Station(s)					**$2,743,000**
Water Treatment Plant					
New Water Treatment Plant		12	MGD	$25,080,000	**$25,080,000**
Engineering and Contingencies		35%			**$8,778,000**
Subtotal of Water Treatment Plant					**$33,858,000**
Permitting and Mitigation					**$116,000**
CONSTRUCTION TOTAL					**$47,013,000**
Interest During Construction					**$1,959,000**
TOTAL COST					**$48,972,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$3,558,000
Electricity ($0.09 kWh)					$116,000
Raw Water Purchase ($1.25 per 1,000 gallons)					$2,740,000
Treatment, Operation & Maintenance					$1,686,000
Total Annual Costs					**$8,100,000**
UNIT COSTS (Pre-Amort.)					
Per Acre-Foot					$1,204
Per 1,000 Gallons					$3.70
UNIT COSTS (Post-Amort.)					
Per Acre-Foot					$675
Per 1,000 Gallons					$2.07

Table Q-109
Walnut Creek SUD - Azle pipeline to Rhome

Owner: Walnut Creek SUD
Amount: 6,726 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	30 in.	79,200	LF	$ 145	$11,484,000
Right of Way		79,200	LF	$ 5	$396,000
Engineering and Contingencies (30%)					$3,564,000
Subtotal of Pipeline					**$15,444,000**
Pump Station(s)					
Booster Pump Station	500 HP	1	LS	$2,032,000	$2,032,000
Ground Storage at Rhome	1.25 MG	1	LS	$715,000	$715,000
Engineering and Contingencies (35%)					$961,000
Subtotal of Pump Station(s)					**$3,708,000**
Permitting and Mitigation					**$176,000**
CONSTRUCTION TOTAL					**$19,328,000**
Interest During Construction			**(12 months)**		**$805,000**
TOTAL COST					**$20,133,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$1,463,000
Electricity ($0.09 kWh)					$148,000
Treated Water Purchase ($2.50 per 1,000 gallons)					$5,479,000
Operation & Maintenance					$199,000
Total Annual Costs					**$7,289,000**
UNIT COSTS (Pre-Amort.)					
Per Acre-Foot					$1,084
Per 1,000 Gallons					$3.33
UNIT COSTS (Post-Amort.)					
Per Acre-Foot					$866
Per 1,000 Gallons					$2.66

Table Q-110
Walnut Creek SUD Intake and Pipeline from Eagle Mountian Lake to New WTP

Owner: Walnut Creek SUD
Amount: 6,700 Ac-Ft/Yr (When new WTP is built-out at 12 MGD)

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	24 in.	5,000	LF	$ 116	$580,000
Right of Way Easements (ROW)		5,000	LF	$ 5	$25,000
Engineering and Contingencies (30%)					$182,000
Subtotal of Pipeline					**$787,000**
Pump Station(s)					
Intake Pump Station	230 HP	1	LS	$1,613,000	$1,613,000
Engineering and Contingencies (35%)					$565,000
Subtotal of Pump Station(s)					**$2,178,000**
Permitting and Mitigation					**$26,000**
CONSTRUCTION TOTAL					**$2,991,000**
Interest During Construction			**(12 months)**		**$125,000**
TOTAL COST					**$3,116,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$226,000
Electricity ($0.09 kWh)					$57,000
Operation & Maintenance					$55,000
Total Annual Costs					**$338,000**
UNIT COSTS (Pre-Amort.)					
Per Acre-Foot					$50
Per 1,000 Gallons					$0.15
UNIT COSTS (Post-Amort.)					
Per Acre-Foot					$17
Per 1,000 Gallons					$0.05

Table Q-111
Walnut Creek SUD Pipeline from Eagle Mountain Lake to Boyd and Rhome

Owner: Walnut Creek SUD
Amount: 6,700 Ac-Ft/Yr (When new WTP is built-out at 12 MGD)

CAPITAL COSTS	Size	Quantity	Unit	Unit Price		Cost
Pipeline						
Pipeline	24 in.	53,000	LF	$	174	$9,222,000
Right of Way Easements (ROW)		53,000	LF	$	12	$636,000
Engineering and Contingencies (30%)						$2,957,000
Subtotal of Pipeline						**$12,815,000**
Permitting and Mitigation						**$111,000**
CONSTRUCTION TOTAL						**$12,926,000**
Interest During Construction			**(12 months)**			**$539,000**
TOTAL COST						**$13,465,000**
ANNUAL COSTS						
Debt Service (6% for 30 years)						$978,000
Electricity ($0.09 kWh)						$115,000
Operation & Maintenance						$111,000
Total Annual Costs						**$1,204,000**
UNIT COSTS (Pre-Amort.)						
Per Acre-Foot						$180
Per 1,000 Gallons						$0.55
UNIT COSTS (Post-Amort.)						
Per Acre-Foot						$34
Per 1,000 Gallons						$0.10

Table Q-112
Dallas Supply to Ellis County Customers - Rockett SUD, Red Oak, and Waxahachie

Owners:	Rockett SUD, Red Oak, Waxahachie	**Cost Distribution (%)**		
Total Amount:	19,186 Ac-Ft/Yr	61.6%	19.6%	18.8%
		Projected Supply Distribution (Ac-Ft/Yr)		
		11,301	1,159	6,726

CONSTRUCTION COSTS

TRANSMISSION FACILITIES	**Qty.**	**Units**	**Unit Cost**	**Total Cost**	**Rockett SUD Total Cost**	**Red Oak Total Cost**	**Waxahachie Total Cost**
System Pipeline							
60" Water Line							
Pipe	35,000	LF	$ 495	$ 17,325,000			
ROW	35,000	LF	$ 41	$ 1,435,000			
54" Water Line							
Pipe	8,200	LF	$ 317	$ 2,599,000			
ROW	8,200	LF	$ 7	$ 57,000			
48" Water Line							
Pipe	32,700	LF	$ 269	$ 8,796,000			
ROW	32,700	LF	$ 7	$ 229,000			
Engineering and Contingencies	30%			$ 8,616,000	$ 5,307,000	$ 1,690,000	$ 1,619,000
Subtotal of System Pipeline				**$ 39,057,000**	**$ 24,055,000**	**$ 7,663,000**	**$ 7,339,000**
Waxahachie Pipeline							
36" Water Line							
Pipe	26,200	FT	$ 184	$ 4,821,000			
ROW	26,200	FT	$ 5	$ 131,000			
Engineering and Contingencies	30%			$ 1,446,000			$ 1,446,000
Subtotal of Waxahachie Pipeline				**$ 6,398,000**			**$ 6,398,000**
PERMITTING AND MITIGATION							
System Pipeline	1%			**$ 345,000**	**$ 212,000**	**$ 68,000**	**$ 65,000**
Waxahachie Pipeline	1%			**$ 58,000**			**$ 58,000**
CONSTRUCTION TOTAL				**$ 45,858,000**	**$ 24,267,000**	**$ 7,731,000**	**$ 13,860,000**
Interest During Construction		(18 months)		**$ 2,828,000**	**$ 882,000**	**$ 281,000**	**$ 471,000**
TOTAL CAPITAL COST				**$ 48,686,000**	**$ 25,149,000**	**$ 8,012,000**	**$ 14,331,000**
ANNUAL COSTS							
Debt Service				$ 3,537,000	$ 1,827,000	$ 582,000	$ 1,041,000
Operation and Maintenance Costs							
System Pipeline	1%			$ 345,000	$ 212,000	$ 68,000	$ 65,000
Waxahachie Pipeline	1%			$ 58,000			$ 58,000
Estimated Annual Power Cost	$0.06/kWh			$ -	$ -	$ -	$ -
Treated Water Demand Charge	26	MGD	$ 123,190	$ 3,203,000	$ 1,973,000	$ 628,000	$ 602,000
Treated Water Volume Charge	6,251,796	1000 gal	$ 0.70	$ 4,376,000	$ 2,695,000	$ 859,000	$ 822,000
Total Annual Costs				**$ 11,519,000**	**$ 6,707,000**	**$ 2,137,000**	**$ 2,588,000**
UNIT COSTS (First 30 Years)							
Per Acre-Foot				$ 600	$ 568	$ 568	$ 718
Per 1,000 Gallons				$ 1.84	$ 1.74	$ 1.74	$ 2.20
UNIT COSTS (After 30 Years)							
Per Acre-Foot				$ 416	$ 413	$ 413	$ 429
Per 1,000 Gallons				$ 1.28	$ 1.27	$ 1.27	$ 1.32

Table Q-113
Waxahachie Additional TRA/Waxahachie Indirect Reuse

Owner:	TRA			
Amount:	3,112	Ac-Ft/Yr		

CONSTRUCTION COSTS

TRANSMISSION FACILITIES				
Pipeline(s)	**Qty.**	**Units**	**Unit Cost**	**Total Cost**
20" Water Line				
Pipe	15,420	LF	$ 90	$ 1,388,000
ROW	15,420	LF	$ 5	$ 77,000
Engineering and Contingencies	30%			$ 416,000
Subtotal Piping				**$ 1,881,000**
Pump Station(s)				
Station 1				
Pump, building, & appurtenances	107	hp		$ 767,000
Storage Tank	0	gal		$ -
Engineering and Contingencies	35%			$ 268,000
Subtotal of Pump Station(s)				**$ 1,035,000**
WATER TREATMENT FACILITIES				
Water Treatment Plant Expansion	12.00	MGD		$ 17,960,000
Plant Expansion	35%			$ 6,286,000
Subtotal of Water Treatment Plant				**$ 24,246,000**
PERMITTING AND MITIGATION	1%			**$ 26,000**
CONSTRUCTION TOTAL				**$ 27,188,000**
Interest During Construction		(18 months)		**$ 1,677,000**
TOTAL CAPITAL COST				**$ 28,865,000**

Table Q-113, Continued

ANNUAL COSTS						
Debt Service					$	2,097,000
Operation and Maintenance Costs						
Pipeline	1%				$	17,000
Pump Station	2.50%				$	23,000
Estimated Annual Power Cost	$0.09/kWh				$	55,000
WTP Operation	1,013,940	1000 gal	$	0.35	$	355,000
Raw Water Cost	3,112	ac-ft		$0	$	-
Total Annual Costs					**$**	**2,547,000**
UNIT COSTS (First 30 Years)						
Per Acre-Foot					$	819
Per 1,000 Gallons					$	2.51
UNIT COSTS (After 30 Years)						
Per Acre-Foot					$	132
Per 1,000 Gallons					$	0.41

Note: Assumes no raw water cost.

Table Q-114
Weatherford Increase Pump Station Capacity by 7 MGD

Probable Owner: Weatherford
Quantity: 6,278 AF/Y

Existing Infrastructure

Pipeline	36	in.
Distance	100,000	LF
Pump Capacity	15	MGD
Pump Station Can Accommodate	22	MGD

CONSTRUCTION COSTS

TRANSMISSION FACILITIES

Pump Station(s)	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Add Pump to Existing Pump Station		1	LS	$395,000	$395,000
Engineering and Contingencies (35%)					$138,000
Subtotal of Pump Station(s)					**$533,000**
CONSTRUCTION TOTAL					**$533,000**
Permitting and Mitigation					**$0**
Interest During Construction			**(6 months)**		**$12,000**
TOTAL COST					**$545,000**

ANNUAL COSTS

Debt Service (6% for 30 years)	$40,000
Electricity ($0.09 kWh)	$67,000
Raw water purchase ($0.68/ kgal)	$1,391,000
Operation & Maintenance	$12,000
Total Annual Costs	**$1,510,000**

UNIT COSTS - (With Debt Service)

Per Acre-Foot	$241
Per 1,000 gallons	$0.74

UNIT COSTS - (After Debt Service)

Per Acre-Foot	$234
Per 1,000 gallons	$0.72

Table Q-115
City of Celina Purchase Treated Water from North Texas MWD

Owner: Celina
Amount: 5,000 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	36 in.	46,000	LF	$184	$8,464,000
Right of Way Easements (ROW)		46,000	LF	$12	$552,000
Engineering and Contingencies (30%)					$2,705,000
Subtotal of Pipeline					**$11,721,000**
Pump Station(s)					
Pump station	275 HP	1	LS	$1,360,250	$1,360,250
Ground Storage with Roof	1.5 MG	1	LS	$796,000	$796,000
Engineering and Contingencies (35%)					$755,000
Subtotal of Pump Station(s)					**$2,911,250**
Permitting and Mitigation					**$127,000**
CONSTRUCTION TOTAL					**$14,759,250**
Interest During Construction			**(18 months)**		**$910,000**
TOTAL COST					**$15,669,250**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$1,138,000
Treated Water ($1.30 per 1,000 gallons)					$2,118,000
Electricity ($0.09 kWh)					$73,000
Operation & Maintenance					$167,000
Total Annual Costs					**$3,496,000**
UNIT COSTS (2010-2030)					
Per Acre-Foot					$699
Per 1,000 Gallons					$2.15
UNIT COSTS (2040-2060)					
Per Acre-Foot					$48
Per 1,000 Gallons					$0.15

Table Q-116
Blue Ridge Connection to NTMWD

Owner: NTMWD
Amount: 2,800 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline from Farmersville to Blue Ridge	24 in.	5,000	LF	$116	$580,000
Right of Way Easements (ROW)	20 ft.	5,000	LF	$5	$25,000
Engineering and Contingencies (30%)					$182,000
Subtotal of Pipeline					**$787,000**
New 24" Tap & Metering Facilities					
New 24" Tap & Metering Facilities		1	LS	$400,000	$400,000
Ground Storage with Roof	1 MG	1	LS	$634,000	$634,000
Engineering and Contingencies (35%)					$362,000
Subtotal of Tap and Metering					**$1,396,000**
Permitting and Mitigation					**$19,000**
CONSTRUCTION TOTAL					**$2,202,000**
Interest During Construction			**(12 months)**		**$92,000**
TOTAL COST					**$2,294,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$167,000
Treated Water ($1.30 per 1,000 gallons)					$1,186,000
Operation & Maintenance					$38,000
Total Annual Costs					**$1,391,000**
UNIT COSTS (2010-2030)					
Per Acre-Foot					$497
Per 1,000 Gallons					$1.52
UNIT COSTS (2040-2060)					
Per Acre-Foot					$437
Per 1,000 Gallons					$1.34

Table Q-117
Frisco Direct Reuse

Owner: Frisco
Amount: 5,650 Ac-ft/yr

CAPITAL COSTS*	Description	Size	Quantity	Unit	Unit Price	Cost
Cost of Pipeline	20" line on Main St, Teel to DNT; 12" line on Legacy, Main to Eldorado	20 in	7,500	LF	$ 120	$900,000
Cost of Pipeline		12 in	8,800	LF	$ 72	$633,600
Pavement Repair			1,250	LF	$ 40	$50,000
Cost of Pipeline	8"/12"/16" line in Lebanon from 4th Army to Legacy and in Legacy from Lebanon to Chippeewa	16 in	1,000	LF	$ 96	$96,000
Cost of Pipeline		12 in	8,200	LF	$ 72	$590,400
Cost of Pipeline		8 in	3,500	LF	$ 48	$168,000
16" Boring and Casing		16 in	100	LF	$ 195	$19,500
Pavement Repair			1,270	LF	$ 40	$50,800
Cost of Pipeline	16"/24" line on Gary Burns and Hutson Dr. from Main St to Frisco #2	16 in	1,800	LF	$ 96	$172,800
Cost of Pipeline		24 in	5,200	LF	$ 144	$748,800
36" Boring and Casing		36 in	100	LF	$ 432	$43,200
Pavement Repair			6,000	LF	$ 40	$240,000
Reuse Pump Station	P.S. at Panther Creek WWTP		1	LS	$ 2,500,000	$2,500,000
Cost of Pipeline	24" line from Panther Creek WWTP along Teel Pkwy to existing 24" reuse line	24 in	17,600	LF	$ 144	$2,534,400
36" Boring and Casing		36 in	400	LF	$ 432	$172,800
Pavement Repair			9,000	LF	$ 40	$360,000
Cost of Pipeline	12" line in John W. Elliot Dr. from Main St. to Senior Center**	12 in	1,600	LF	$ 72	$115,200
Pavement Repair			160	LF	$ 40	$6,400
Cost of Pipeline	Eldorado Pkwy from Frisco St. to Preston Rd, in Preston Rd. to Main St.	24 in	19,500	LF	$ 144	$2,808,000
36" Boring and Casing		36 in	350	LF	$ 432	$151,200
Pavement Repair			3,000	LF	$ 40	$120,000
Yard Pipe	Piping Changes at Frisco 2 Site		1	LS	$ 70,000	$70,000
Cost of Pipeline	16" line in Hutson Dr. from Preston Rd. to Frisco #2 and in Preson Rd. from Hutson Dr. to Stonebrook Pkwy; 0.5 MG Reuse Elevated Storage Tank	16 in	5,500	LF	$ 96	$528,000
Cost of Pipeline		12 in	4,300	LF	$ 72	$309,600
30" Boring and Casing		30 in	100	LF	$ 360	$36,000
24" Boring and Casing		24 in	100	LF	$ 288	$28,800
Pavement Repair			980	LF	$ 40	$39,200
Elevated Tank		.5 MG	1	LS	$ 600,000	$600,000
Cost of Pipeline	24" line in Eldorado Pkwy. From Tell Pkwy. To Frisco St.	24 in.	11,800	LF	$ 144	$1,699,200
36" Boring and Casing		36 in.	100	LF	$ 432	$43,200
Pavement Repair			1,180	LF	$ 40	$47,200
Cost of Pipeline	20" line in Main St. from Frisco #2 to Coit Rd, in Coit Rd to Southeast Community Park	20 in.	10,300	LF	$ 120	$1,236,000
30" Boring and Casing		30 in.	200	LF	$ 360	$72,000
Pavement Repair			1,030	LF	$ 40	$41,200

Table Q-117, Continued

Cost of Pipeline	12" line in Coit Rd from 20" line to Rolater Rd, 8" line in Rolater Rd. to Hillcrest Rd.	12 in.	4,500	LF	$	72	$324,000
Cost of Pipeline		8 in.	5,700	LF	$	48	$273,600
24" Boring and Casing		24 in.	200	LF	$	288	$57,600
Pavement Repair			1,020	LF	$	40	$40,800
Cost of Pipeline	8" line in Stonebrook Pkwy from Preston Rd. to Dallas Pkwy.	8 in.	8,600	LF	$	48	$412,800
16" Boring and Casing		16 in.	100	LF	$	195	$19,500
Pavement Repair			860	LF	$	40	$34,400
Cost of Pipeline	12" line in Preston Rd from Stonebrook/Rolater to Wade Blvd	12 in.	4,300	LF	$	72	$309,600
24" Boring and Casing		24 in.	300	LF	$	288	$86,400
Pavement Repair			430	LF	$	40	$17,200
Cost of Pipeline	8" line in Wade Blvd from Preston Rd to Ohio Dr.	8 in.	4,500	LF	$	48	$216,000
16" Boring and Casing		16 in.	100	LF	$	195	$19,500
Pavement Repair			450	LF	$	40	$18,000
Cost of Pipeline	8" line in Ohio Dr. from Wade Blvd to Hillcrest Rd; 8" in Hillcrest from Ohio Dr. to Rolater Rd.**	8 in.	5,900	LF	$	48	$283,200
Pavement Repair			285	LF	$	40	$11,400
Cost of Pipeline	12" line in Preston Rd from Wade Blvd to Lebanon Rd; 8" line in Lebanon, Preston to Colby Drive	12 in.	2,900	LF	$	72	$208,800
Cost of Pipeline		8 in.	4,500	LF	$	48	$216,000
Pavement Repair			600	LF	$	40	$24,000
Cost of Pipeline	12" line in Rogers Rd from the Warren Sports Complex to existing 12" in McKinney Rd	12 in.	7,800	LF	$	72	$561,600
24" Boring and Casing		24 in.	200	LF	$	288	$57,600
Pavement Repair			780	LF	$	40	$31,200
Cost of Pipeline	8" line in College Parkway to Plantation Golf Course	8 in.	3,600	LF	$	48	$172,800
16" Boring and Casing		16 in.	100	LF	$	195	$19,500
Pavement Repair			300	LF	$	40	$12,000
Cost of Pipeline	16" line in Coit Road to Eldorado Pkwy & 12" line in Coit Road and Panther Creek to Northeast Community Park	16 in.	8,200	LF	$	96	$787,200
Cost of Pipeline		12 in.	8,300	LF	$	72	$597,600
24" Boring and Casing		24 in.	400	LF	$	288	$115,200
Pavement Repair			1,500	LF	$	40	$60,000
Cost of Pipeline	8" line in High Shoals Dr from 24" in Teel Pkwy to Pioneer Heritage Middle School	8 in.	4,200	LF	$	48	$201,600
16" Boring and Casing		16 in.	100	LF	$	195	$19,500
Pavement Repair			300	LF	$	40	$12,000
Subtotal							$22,452,100
Contingencies (20%)							$4,490,420
Total Construction Cost							$26,942,520
Engineering, Surveying & Geotech (12%)							$3,248,086
Construction Total							**$30,190,606**
Interest during Construction (12 months)							**$1,258,000**
Total Capital Costs							**$31,448,606**

Table Q-117, Continued

ANNUAL COSTS	
Debt Service (6% for 30 years)	$2,285,000
Operation & Maintenance	$299,000
Purchase of Reuse Water	$460,000
Total Annual Costs	**$3,044,000**
UNIT COSTS (During Amortization)	
Per Acre-Foot	$539
Per 1,000 gallons	$1.65
UNIT COSTS (After Amortization)	
Per Acre-Foot	$134
Per 1,000 gallons	$0.41

*Costs obtained from Frico's Reuse Master Plan

**Engineering, Surveying & Geotech for this project are 15%

Table Q-118
Additional Water from North Texas MWD

Owner: Prosper
Amount: 4,272 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
					$0
ANNUAL COSTS					
Treated Water ($1.30 per 1,000 gallons)					$1,810,000
Electricity ($0.09 kWh)					$0
Total Annual Costs					**$1,810,000**
UNIT COSTS					
Per Acre-Foot					$424
Per 1,000 Gallons					$1.30

Table Q-119
City of Weston Purchase Treated Water from North Texas MWD

PHASE I
Owner: Weston
Amount: 4,300 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	30 in.	45,000	LF	$145	$6,525,000
Right of Way Easements (ROW)		45,000	LF	$12	$540,000
Engineering and Contingencies (30%)					$2,120,000
Subtotal of Pipeline					**$9,185,000**
Pump Station(s)					
Pump station	300 HP	1	LS	$1,441,000	$1,441,000
Ground Storage with Roof	1.5 MG	1	LS	$796,000	$796,000
Engineering and Contingencies (35%)					$783,000
Subtotal of Pump Station(s)					**$3,020,000**
Permitting and Mitigation					**$105,000**
CONSTRUCTION TOTAL					**$12,310,000**
Interest During Construction			**(18 months)**		**$759,000**
TOTAL COST					**$13,069,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$949,000
Treated Water ($1.30 per 1,000 gallons)					$1,822,000
Electricity ($0.09 kWh)					$76,000
Operation & Maintenance					$145,000
Total Annual Costs					**$2,992,000**
UNIT COSTS (2010-2030)					
Per Acre-Foot					$696
Per 1,000 Gallons					$2.14
UNIT COSTS (2040-2060)					
Per Acre-Foot					$51
Per 1,000 Gallons					$0.16

Table Q-119, Continued
PHASE II

Owner: Weston
Amount: 8,400 Ac-Ft/Yr (For a total of 12,700 Ac-Ft/Yr)

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	42 in.	45,000	LF	$145	$6,525,000
Right of Way Easements (ROW)		45,000	LF	$17	$765,000
Engineering and Contingencies (30%)					$2,187,000
Subtotal of Pipeline					**$9,477,000**
Pump Station(s)					
Pump station	500 HP	1	LS	$2,032,000	$2,032,000
Ground Storage with Roof	2.5 MG	1	LS	$1,086,000	$1,086,000
Engineering and Contingencies (35%)					$1,091,000
Subtotal of Pump Station(s)					**$4,209,000**
Permitting and Mitigation					**$116,000**
CONSTRUCTION TOTAL					**$13,802,000**
Interest During Construction			**(18 months)**		**$851,000**
TOTAL COST					**$14,653,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$1,065,000
Treated Water ($1.30 per 1,000 gallons)					$3,558,000
Electricity ($0.09 kWh)					$146,000
Operation & Maintenance					$172,000
Total Annual Costs					**$4,941,000**
UNIT COSTS (2010-2030)					
Per Acre-Foot					$588
Per 1,000 Gallons					$1.81
UNIT COSTS (2040-2060)					
Per Acre-Foot					$38
Per 1,000 Gallons					$0.12

Table Q-120
Collin County Mining - Additional NTMWD

Owner: Unknown
Amount: 68 Ac-Ft/Yr

CAPITAL COSTS	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
TOTAL COST					**$0**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$0
Electricity ($0.09 kWh)					$0
Raw Water ($0.68 per 1,000 gallons)					$15,000
Operation & Maintenance					$0
Total Annual Costs					**$15,000**
UNIT COSTS					
Per Acre-Foot					$221
Per 1,000 Gallons					$0.68

Table Q-121
Collin County Steam Electric Power - Additional NTMWD

Owner: Unknown
Amount: 932 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
CONSTRUCTION TOTAL					**$0**
Interest During Construction					**$0**
TOTAL COST					**$0**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$0
Electricity ($0.09 kWh)					$0
Raw Water ($0.68 per 1,000 gallons)					$207,000
Operation & Maintenance					$0
Total Annual Costs					**$207,000**
UNIT COSTS					
Per Acre-Foot					$222
Per 1,000 Gallons					$0.68

Table Q-122
Navarro County Steam Electric Power Pipeline from Corsicana by 2020

Owner:
Amount: 8,000 AF/Y

CAPITAL COSTS

	Size	Quantity	Units	Unit Price	Cost
Transmission Facilities					
Pipeline (Rural)	30 in.	52,800	LF	$ 145	$7,663,000
Right of Way Easements		52,800	LF	$ 5	$264,000
Pipeline Eng &Contingencies (30%)					$2,378,000
Pipeline Subtotal					**$10,305,000**
Pump Station	740 HP	1	LS	$ 3,149,800	$3,149,800
Engineering and Contingencies (35%)					$1,102,000
Pump Station Subtotal					**$4,251,800**
Permitting and Mitigation					**$130,000**
Interest During Construction			**(12 months)**		**$612,000**
TOTAL CAPITAL COST					**$15,298,800**

ANNUAL COSTS

	Cost
Debt Service (6%, 30 years)	$1,111,000
Pipeline O&M (1%)	$92,000
Pump O&M (2.5%)	$94,000
Electricity ($0.09 kWh)	$148,000
Raw Water ($0.72 per 1,000 gallons)	$1,877,760
TOTAL ANNUAL COST	**$3,322,760**
Unit Costs (First 30 years)	
Cost per acre-ft	$415
Cost per 1000 gallons	$1.27
Unit Costs (After 30 years)	
Cost per acre-ft	$276
Cost per 1000 gallons	$0.85

Table Q-123
Navarro County Steam Electric Power Pipeline from Corsicana by 2030

Owner:
Amount: 5,440 AF/Y

CAPITAL COSTS

	Size	Quantity	Units	Unit Price	Cost
Transmission Facilities					
Pipeline (Rural)	24 in.	52,800	LF	$ 116	$6,130,000
Right of Way Easements		52,800	LF	$ 5	$264,000
Pipeline Eng &Contingencies (30%)					$1,918,000
Pipeline Subtotal					**$8,312,000**
Pump Station	630 HP	1	LS	$ 2,908,300	$2,908,300
Engineering and Contingencies (35%)					$1,018,000
Pump Station Subtotal					**$3,926,300**
Permitting and Mitigation					**$108,000**
Interest During Construction			**(12 months)**		**$514,000**
TOTAL CAPITAL COST					**$12,860,300**

ANNUAL COSTS	**Cost**
Debt Service (6%, 30 years)	$934,000
Pipeline O&M (1%)	$74,000
Pump O&M (2.5%)	$87,000
Electricity ($0.09 kWh)	$111,000
Raw Water ($0.72 per 1,000 gallons)	$1,276,877
TOTAL ANNUAL COST	**$2,482,877**
Unit Costs (First 30 years)	
Cost per acre-ft	$456
Cost per 1000 gallons	$1.40
Unit Costs (After 30 years)	
Cost per acre-ft	$285
Cost per 1000 gallons	$0.87

Table Q-124
Muenster Additional Water from Lake Muenster

Owner:	Muenster					
Amount:	280	ac-ft/yr				
WATER TREATMENT FACILITIES						
Water Treatment Plant(s)	**Qty.**	**Units**	**Unit Cost**			**Total Cost**
New Water Treatment Plant	1.00	MGD			$	5,800,000
Engineering and Contingencies	35%				$	2,030,000
Subtotal of Water Treatment Plant					**$**	**7,830,000**
PERMITTING AND MITIGATION	1.0%				**$**	**58,000**
CONSTRUCTION TOTAL					**$**	**7,888,000**
Interest During Construction		(12 months)			**$**	**329,000**
TOTAL CAPITAL COST					**$**	**8,217,000**
ANNUAL COSTS						
Debt Service					$	597,000
Operation and Maintenance Costs						
Estimated Annual Power Cost	$0.09/kWh				$	10,000
WTP Operation	91,238	1000 gal	$	0.70	$	64,000
Raw Water Cost		ac-ft	$	163	$	46,000
Total Annual Costs					**$**	**717,000**
UNIT COSTS (First 30 Years)						
Per Acre-Foot					$	2,561
Per 1,000 Gallons					$	7.86
UNIT COSTS (After 30 Years)						
Per Acre-Foot					$	429
Per 1,000 Gallons					$	1.32

NOTE: Assume raw water costs $163 per acre-foot.

Table Q-125
Cooke County Irrigation - Overdraft Trinity Aquifer with Existing Wells in 2010
Cooke County, Trinity Aquifer

Need	140	Af/Y	87	gpm
Depth to Water	413			
Well Depth	969			
Well Yield	180	gpm	290	ac-ft (peak)
			145	ac-ft (average)

Annual Costs	
Annual Cost of Pumping Existing Wells	$8,000
Annual Chemical Costs	$14,200
Total Annual Cost	**$22,200**
UNIT COSTS	
Per Acre-Foot	$153
Per 1,000 Gallons	$0.47

Table Q-126
Cooke County Mining - Overdraft Trinity Aquifer with New Wells in 2010
Cooke County, Trinity Aquifer

Need	75	ac-ft/yr			
Water Depth	413	ft			
Well Depth	969	ft			
Well Yield	100	gpm		161	ac-ft (peak)
Well Size	6	in		80.5	ac-ft (average)
Wells Needed	1				

WELLS						
Well(s)	**Number**			**Unit Cost**		
Water Wells	1		$	201,000	$	201,000
Connection to Transmission System	0		$	160,000	$	-
Engineering and Contingencies					$	60,000
Subtotal of Well(s)					**$**	**261,000**
PERMITTING AND MITIGATION	1%				**$**	**2,000**
CONSTRUCTION TOTAL					**$**	**263,000**
Interest During Construction		(6 months)			**$**	**6,000**
TOTAL CAPITAL COST					**$**	**269,000**
ANNUAL COSTS						
Debt Service - Total Capital					$	20,000
O&M						
Transmission	1%				$	-
Well(s)	2.5%				$	6,000
Add Chemicals, Etc.	24,439	1000 gal	$	0.30	$	7,000
Pumping Costs			$	0.09	$	4,000
Total Annual Cost					**$**	**37,000**
UNIT COSTS (First 30 Years)						
Cost per ac-ft					$	493
Cost per 1000 gallons					$	1.51
UNIT COSTS (After 30 Years)						
Cost per ac-ft					$	227
Cost per 1000 gallons					$	0.70

Table Q-127
Gainesville - Overdraft Trinity Aquifer in Red Basin with Existing Wells in 2010
Cooke County, Trinity Aquifer, Red Basin

Need	103	ac-ft/yr		
Water Depth	413	ft		
Well Depth	969	ft		
Well Yield	100	gpm	161	ac-ft (peak)
Well Size	6	in	80.5	ac-ft (average)
Wells Needed	2			

Annual Costs	
Annual Cost of Pumping Existing Wells	$4,400
Annual Chemical Costs	$7,900
Total Annual Cost	**$12,300**
UNIT COSTS	
Per Acre-Foot	$153
Per 1,000 Gallons	$0.47

Table Q-128
Addison - Aquifer Storage and Recovery

Owner: Addison
Amount: 0 AF/Y

No.	Description	Quantity	Units	Unit Price	Amount
1	Mobilization & Demobilization	1	Ls	$65,804	$65,804
2	Drill 30-Inch Borehole	50	Ft	$230	$11,500
3	Drill 22-Inch Borehole	2050	Ft	$197	$403,850
4	Drill 15-Inch Borehole	300	Ft	$428	$128,400
5	24-Inch Steel Casing	50	Ft	$230	$11,500
6	16-Inch SS304L Casing 0.5" Wall Thickness	2100	Ft	$329	$690,900
7	Neat Cement	2100	Ft	$41	$86,100
8	Pilot Hole to 2100 ft	1	Ls	$11,845	$11,845
9	Reamed Borehole to 2100 ft	1	Ls	$13,161	$13,161
10	Cemented Casing to 2100 ft	1	Ls	$3,948	$3,948
11	15" Hole to 2400 ft	1	Ls	$11,845	$11,845
12	Well Screen	1	Ls	$2,632	$2,632
13	Screen Assembly Complete	200	Ft	$428	$85,600
14	Well Development	80	Hours	$1,152	$92,160
15	Pump Setup	1	Ls	$32,902	$32,902
16	Pumping test	48	Hours	$263	$12,624
17	Disinfection	1	Ls	$19,741	$19,741
18	Standby Time	16	Hours	$329	$5,264
19	Set/Pull 200 GPM Pump	1	Ls	$12,898	$12,898
20	Rent Interim Pump	4	Months	$3,948	$15,792
21	2000 GPM Vertical Turbine Pump	1	Ls	$288,616	$288,616
22	Piping, Valves & Flowmeter	1	Ls	$151,086	$151,086
23	Chlorine & Ammonia System	1	Ls	$120,289	$120,289
24	Chlorine, Ammonia & Electrical Building	1	Ls	$57,776	$57,776
25	Electrical	1	Ls	$153,718	$153,718
26	Instrumentation & Control	1	Ls	$84,624	$84,624
27	Painting & Misc.	1	Ls	$11,187	$11,187
28	Allowance	1	Ls	$65,804	$65,804
	Total				**$2,651,566**

Note: Item No. 8 thru 12 is for Geophysical Logging
Costs provided by The Colony for *2006 Region C Water Plan*. Increased unit costs using ENR Index.

Table Q-129
Dallas/Denton Counties - Pipeline from DWU to Carrollton, Lewisville and The Colony

Owner: Various

Amount:	22,420	Ac-Ft/Yr	Carrollton1	32%	
	7,735	Ac-Ft/Yr	Carrollton 2	11%	16%
	6,280	Ac-Ft/Yr	Carrollton 3	9%	13%
	16,815	Ac-Ft/Yr	Lewisville	24%	35%
	16,815	Ac-Ft/Yr	The Colony	24%	35%
	70,065	Ac-Ft/Yr	Total		

CAPITAL COSTS	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline					
Pipeline (everyone)	54 in.	1,000	LF	$317	$317,000
Right of Way Easements (ROW)		1,000	LF	$7	$7,000
Engineering and Contingencies (30%)					$97,000
Permitting and Mitigation					$4,000
Subtotal of Pipeline (everyone)					**$425,000**
Pipeline (20MGD Carrollton)	36 in.	15,840	LF	184	$2,915,000
Right of Way Easements (ROW)		15,840	LF	$5	$79,000
Engineering and Contingencies (30%)					$898,000
Permitting and Mitigation					$35,000
Subtotal of Pipeline (20MGD to Carrolton)					**$3,927,000**
Pipeline (junction to Lewisville)	48 in.	20,000	LF	290	$5,800,000
Right of Way Easements (ROW)		20,000	LF	$14	$276,000
Engineering and Contingencies (30%)					$1,823,000
Permitting and Mitigation					$70,000
Subtotal of Pipeline (junction to Lewisville)					**$7,969,000**
Pipeline (Hebron Pkwy)	42 in.	10,000	LF	237	$2,370,000
Right of Way Easements (ROW)		10,000	LF	$14	$138,000
Engineering and Contingencies (30%)					$752,000
Permitting and Mitigation					$28,000
Subtotal of Pipeline (Hebron Pkwy)					**$3,288,000**
Pipeline (Josey Ln)	36 in.	7,500	LF	202	$1,515,000
Right of Way Easements (ROW)		7,500	LF	$10	$75,000
Engineering and Contingencies (30%)					$477,000
Permitting and Mitigation					$18,000
Subtotal of Pipeline (Josey Ln)					**$2,085,000**

Table Q-129, Continued

Pipeline (Lewisville)	30 in.	21,850	LF	159	$3,474,000
Right of Way Easements (ROW)		21,850	LF	$10	$219,000
Engineering and Contingencies (30%)					$1,108,000
Permitting and Mitigation					$42,000
Subtotal of Pipeline (Lewisville)					**$4,843,000**
Pipeline (The Colony)	36 in.	15,400	LF	202	$3,111,000
Right of Way Easements (ROW)		15,400	LF	$10	$154,000
Engineering and Contingencies (30%)					$980,000
Permitting and Mitigation					$37,000
Subtotal of Pipeline (The Colony)					**$4,282,000**
Total of Pipeline Cost					**$26,819,000**
Carrolton portion of pipelines	*52% of 54 in,100% 36 in, 30% of 48 in, 45% of 42 in, 27% of 36 in*				*$8,581,250*
Lewisville portion of pipelines	*24% of 52in, 35% of 48in,100% of 30in*				*$7,734,150*
The Colony portion of pipelines	*24% of 52in, 35% of 48in,55% of 42in,73% of 36in and 100% of 36in*				*$10,503,600*
					$26,819,000
Pump Stations					
Booster Pump Station 1	4300 HP	1	LS	$6,363,000	$6,363,000
Engineering and Contingencies (35%)					$2,227,000
Permitting and Mitigation					$76,000
Subtotal of Pump Station 1					**$8,666,000**
Booster Pump Station 2	650 HP	1	LS	$2,209,000	$2,209,000
Engineering and Contingencies (35%)					$773,000
Permitting and Mitigation					$27,000
Subtotal of Pump Station 2					**$3,009,000**
Booster Pump Station 3	350 HP	1	LS	$1,618,000	$1,618,000
Engineering and Contingencies (35%)					$566,000
Permitting and Mitigation					$19,000
Subtotal of Pump Station 3					**$2,203,000**
Total of Pump Stations					**$13,878,000**

Table Q-129, Continued

Carrolton portion of P.S	*52% of P.S 1*	*$4,506,000*
Lewisville portion of P.S	*24% of P.S 1, 100% of P.S2*	*$5,089,000*
The Colony portion of P.S	*24% of P.S 1, 100% of P.S 3*	*$4,283,000*
		$13,878,000
CONSTRUCTION TOTAL		**$40,697,000**
Interest During Construction		**$ 2,510,000**
TOTAL COST		**$43,207,000**
Carrolton		*$13,894,400*
Lewisville		*$13,614,000*
The Colony		*$15,699,000*
		$43,207,400

ANNUAL COSTS

Carrolton	
Debt Service (6% for 30 years)	$1,009,000
Electricity ($0.09 kWh)	$629,000
Operation & Maintenance	$116,000
Total Annual Costs	**$1,754,000**
Lewisville	
Debt Service (6% for 30 years)	$989,000
Electricity ($0.09 kWh)	$481,000
Operation & Maintenance	$112,000
Total Annual Costs	**$1,582,000**
The Colony	
Debt Service (6% for 30 years)	$1,141,000
Electricity ($0.09 kWh)	$662,000
Operation & Maintenance	$130,000
Total Annual Costs	**$1,933,000**

Table Q-129, Continued

TOTAL ANNUAL COSTS

Debt Service (6% for 30 years)	$3,139,000
Electricity ($0.09 kWh)	$1,772,000
Operation & Maintenance	$358,000
Total Annual Costs	**$5,269,000**

UNIT COSTS

Carrollton	
Per Acre-Foot	$48
Per 1,000 Gallons	$0.15
Lewisville	
Per Acre-Foot	$94
Per 1,000 Gallons	$0.29
The Colony	
Per Acre-Foot	$115
Per 1,000 Gallons	$0.35

Note: As of July 2010, Carrollton portion of this project is complete; Lewisville portion is underway; and The Colony portion is in the future.

Table Q-130
Dallas/Kaufman County Combine WSC - Parallel Pipeline to Seagoville

Owner: Combine WSC
Amount: 912 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	10 in.	2,640	LF	$65	$172,000
Right of Way Easements (ROW)		2,640	LF	$28	$74,000
Engineering and Contingencies (30%)					$74,000
Subtotal of Pipeline					**$320,000**
Pump Station(s)					
Booster Pump Station	50 HP	1	LS	$645,000	$645,000
Engineering and Contingencies (35%)					$226,000
Subtotal of Pump Station(s)					**$871,000**
Permitting and Mitigation					**$10,000**
CONSTRUCTION TOTAL					**$1,201,000**
Interest During Construction					**$50,000**
TOTAL COST					**$1,251,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$91,000
Electricity ($0.09 kWh)					$14,000
Operation & Maintenance					$21,000
Total Annual Costs					**$126,000**
UNIT COSTS					
Per Acre-Foot					$138
Per 1,000 Gallons					$0.42

Table Q-131
Dallas/Ellis/Tarrant Counties Grand Prairie - Pipeline from Mansfield

Owner: Grand Prairie
Amount: 6,726 Ac-Ft/Yr

CAPITAL COSTS	Size			Unit Cost*	Cost
Pipeline					
Pipeline (Grand Priaire Portion only)	36 in.	1	LS	$3,800,000	$3,800,000
Future Parallel Pipeline (GP Portion O	36 in.	1	LS	$3,800,000	$3,800,000
Engineering (12%)					$912,000
Subtotal of Pipeline					**$8,512,000**
Pump Station & Ground Storage					
6 MGD Pump Station & 3 MG Ground Storage		1	LS	$5,500,000	$5,500,000
Engineering (12%)					$660,000
Subtotal of Pump Station(s)					**$6,160,000**
Permitting and Mitigation					**$157,000**
CONSTRUCTION TOTAL					**$14,829,000**
Interest During Construction (12 month)					**$618,000**
TOTAL COST					**$15,447,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$1,122,000
Electricity ($0.09 kWh)					$55,000
Treated Water ($2.50 per 1,000 gallons)					$5,479,000
Operation & Maintenance					$256,000
Total Annual Costs					**$6,912,000**
UNIT COSTS (Until Amortized)					
Per Acre-Foot					$1,028
Per 1,000 Gallons					$3.15
UNIT COSTS (After Amortization)					
Per Acre-Foot					$861
Per 1,000 Gallons					$2.64

* Unit costs for this project provided by Grand Prairie's Engineers. Unit Costs includes only Grand Prairie's portion of the project. Unit Cost included 20% for Contingencies but not Engineering cost.

Table Q-132
Dallas/Ellis/Tarrant Counties Grand Prairie - Pipeline from Midlothian

Owner: Grand Prairie
Amount: 7,287 Ac-Ft/Yr

CAPITAL COSTS	**Size**			**Unit Cost***	**Cost**
Pipeline					
Pipeline (Grand Priaire Portion only)	36 in.	1	LS	$3,500,000	$3,500,000
Future Parallel Pipeline (GP Portion O	36 in.	1	LS	$3,500,000	$3,500,000
Engineering (12%)					$840,000
Subtotal of Pipeline					**$7,840,000**
Pump Station & Ground Storage					
5 MGD Pump Station & 3 MG Ground Storage		1	LS	$5,000,000	$5,000,000
Engineering (12%)					$600,000
Subtotal of Pump Station(s)					**$5,600,000**
Permitting and Mitigation					**$144,000**
CONSTRUCTION TOTAL					**$13,584,000**
Interest During Construction (12 months)					**$566,000**
TOTAL COST					**$14,150,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$1,028,000
Electricity ($0.09 kWh)					$61,000
Treated Water ($2.50 per 1,000 gallons)					$5,936,000
Operation & Maintenance					$234,000
Total Annual Costs					**$7,259,000**
UNIT COSTS (Until Amortized)					
Per Acre-Foot					$996
Per 1,000 Gallons					$3.06
UNIT COSTS (After Amortization)					
Per Acre-Foot					$855
Per 1,000 Gallons					$2.62

* Unit costs for this project provided by Grand Prairie's Engineers. Unit Costs includes only Grand Prairie's portion of the project. Unit Cost included 20% for Contingencies but not Engineering cost.

Table Q-133
Dallas/Ellis/Tarrant Counties Grand Prairie - Pipeline from Arlington

Owner: Grand Prairie
Amount: 4,484 Ac-Ft/Yr

CAPITAL COSTS	Size			Unit Cost*	Cost
Pipeline					
Pipeline	20 in.	1	LS	$1,000,000	$1,000,000
Future Parallel Pipeline	20 in.	1	LS	$1,000,000	$1,000,000
Engineering (12%)					$240,000
Subtotal of Pipeline					**$2,240,000**
Pump Station					
4 MGD In-line Pump Station		1	LS	$1,500,000	$1,500,000
Engineering (12%)					$180,000
Subtotal of Pump Station(s)					**$1,680,000**
Permitting and Mitigation					**$42,000**
CONSTRUCTION TOTAL					**$3,962,000**
Interest During Construction (12 months)					**$165,000**
TOTAL COST					**$4,127,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$300,000
Electricity ($0.09 kWh)					$11,000
Treated Water ($2.50 per 1,000 gallons)					$3,653,000
Operation & Maintenance					$69,000
Total Annual Costs					**$4,033,000**
UNIT COSTS (Until Amortized)					
Per Acre-Foot					$899
Per 1,000 Gallons					$2.76
UNIT COSTS (After Amortization)					
Per Acre-Foot					$833
Per 1,000 Gallons					$2.55

* Unit costs for this project provided by Grand Prairie's Engineers. Unit Cost included 20% for Contingencies but not Engineering cost.

Table Q-134
Princeton Pump Station Improvements

Owner: Irving
Amount: 0 Ac-Ft/Yr

	Quantity	Unit	Unit Price	Total Price
Pump Station Improvements	1	LS	$ 9,338,000	$ 9,338,000
Engineering & Contingencies (35%)				$3,268,000
Capital Cost Subtotal				**$12,606,000**
Interest During Construction				$273,000
Total Capital Costs				**$12,879,000**
ANNUAL COSTS				
Debt Service				$936,000
Operation and Maintenance				$280,000
Total Annual Cost				**$1,216,000**

Table Q-135
Dallas County Irving - Indirect Reuse from Trinity River Authority

Owner: Irving
Amount: 26,000 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Transmission from WWTP to confluence of Elm Fork River and Denton Creek					
Pipeline					
Pipeline	54 in.	88,000	LF	$435	$38,280,000
Right of Way Easements (ROW)		88,000	LF	$41	$3,608,000
Engineering and Contingencies (30%)					$12,566,000
Subtotal of Pipeline from WWTP					**$54,454,000**
Pump Station(s)					
Booster Pump Station	2000 HP	1	LS	$4,182,000	$4,182,000
Pump Station to WTP	3150 HP	1	LS	$6,892,000	$6,892,000
Engineering and Contingencies (35%)					$3,876,000
Subtotal of Pump Station(s)					**$14,950,000**
Water treatment plant at loop 12 and Elm Fork River					
Water Treatment Plant	46 MGD	1	LS	$67,560,000	$67,560,000
Engineering and Contingencies (35%)					$23,646,000
Subtotal of Water Treatment Plants					**$91,206,000**
Transmission from WTP to Irving					
Pipeline					
Pipeline	54 in.	26,200	LF	$435	$11,397,000
Right of Way Easements (ROW)		26,200	LF	$41	$1,074,000
Engineering and Contingencies (30%)					$3,741,000
Subtotal of Pipeline from WTP to Irving					**$16,212,000**
Pump Station(s)					
Booster Pump Station	1400 HP	1	LS	$3,395,000	$3,395,000
Engineering and Contingencies (35%)					$1,188,000
Subtotal of Pump Station(s)					**$4,583,000**

Table Q-135, Continued

Permitting and Mitigation	**$1,498,000**
CONSTRUCTION TOTAL	**$182,903,000**
Interest During Construction	**$11,280,000**
TOTAL COST	**$194,183,000**
ANNUAL COSTS	
Debt Service (6% for 30 years)	$14,107,000
Electricity ($0.09 kWh)	$741,000
Reuse water ($0.25 per 1,000 gallons)	$2,118,000
Water treatment ($0.70 per 1,000 gallons)	$5,930,000
Operation & Maintenance	$1,030,000
Total Annual Costs	**$23,926,000**
UNIT COSTS	
Per Acre-Foot	$920
Per 1,000 Gallons	$2.82

Table Q-136
Irving - Direct Reuse

Owner: Irving
Amount: 12,000 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Phase I - Using existing DCURD Pipeline		**Amount: 6,000 acre-feet per year**			
Pipeline					
Pipeline (urban)	6 in.	10,264	LF	$39	$400,000
Pipeline (urban)	8 in.	12,018	LF	$52	$625,000
Pipeline (urban)	12 in.	10,796	LF	$77	$831,000
Pipeline (urban)	14 in.	6,239	LF	$90	$562,000
Pipeline (urban)	24 in.	17,783	LF	$174	$3,094,000
Right of Way Easements (ROW)		34,818	LF	$28	$975,000
Right of Way Easements (ROW)		22,282	LF	$21	$468,000
Engineering and Contingencies (30%)					$1,654,000
Subtotal of Pipeline					**$8,209,000**
Pump Station and Storage Tanks					
DCURD Pump Station Improvements		1	LS	$250,000	$250,000
Pump Stations (4)		1	LS	$2,646,000	$2,646,000
Ground Storage Tanks (4)		1	LS	$1,731,000	$1,731,000
Elevated Storage Tanks (2)		1	LS	$1,247,500	$1,247,500
Land Acquisition for Storage Tanks		2	LS	$70,000	$70,000
Engineering and Contingencies (35%)					$2,056,000
Subtotal of Pump Station(s) and Storage Tanks (s)					**$8,000,500**
Permitting and Mitigation					**$1,318,000**
CONSTRUCTION TOTAL - Phase 1					**$17,527,500**
Interest During Construction (12 months)					**$730,000**
TOTAL COST - Phase 1					**$18,257,500**

Table Q-136, Continued

Phase II - New Parallel Pipeline to DCURD Pipeline		**Amount = 6,000 acre-feet per year**			
Pipeline					
Parallel pipeline	36 in.	57,832	LF	$276	$15,962,000
Pipeline	24 in.	15,339	LF	$174	$2,669,000
Pipeline	16 in.	3,301	LF	$103	$340,000
Pipeline	12 in.	10,344	LF	$77	$796,000
Right of Way Easements (ROW)		28,984	LF	$28	$812,000
Engineering and Contingencies (30%)					$6,174,000
Subtotal of Pipeline from WTP to Irving					**$26,753,000**
Pump Station(s)					
Pump Stations (4)		1	LS	$7,348,000	$7,348,000
Ground Storage Tanks (3)		1	LS	$754,000	$754,000
Engineering and Contingencies (35%)					$2,836,000
Subtotal of Pump Station(s)					**$10,938,000**
Permitting and Mitigation					**$334,000**
CONSTRUCTION TOTAL - Phase II					**$38,025,000**
Interest During Construction					**$2,345,000**
TOTAL COST - Phase II					**$40,370,000**
TOTAL COST - Phase I and Phase II					**$58,627,500**
ANNUAL COSTS - Phase I					
Debt Service (6% for 30 years)					$1,326,000
Electricity ($0.09 kWh)		2477620	kWh		$223,000
Reuse water ($0.25 per 1,000 gallons)					$489,000
Operation & Maintenance					$242,000
Total Annual Costs					**$2,280,000**
ANNUAL COSTS - Phase II					
Debt Service (6% for 30 years)					$2,933,000
Electricity ($0.09 kWh)		11907395	kWh		$1,072,000
Reuse water ($0.25 per 1,000 gallons)					$489,000
Operation & Maintenance					$480,000
Total Annual Costs					**$4,974,000**
UNIT COSTS - Phase I and II					
Per Acre-Foot					$605
Per 1,000 Gallons					$1.86

Table Q-137
Irving Oklahoma Water
From Hugo to Lake Lewisville

Probable Owner: Irving
Quantity: 25,000 AF/Y

CONSTRUCTION COSTS					
TRANSMISSION FACILITIES					
Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline	42 in.	600,000	LF	$215	$129,000,000
30-ft Right of Way Easements (ROW)		600,000	LF	$7	$4,200,000
Red River Tunnel		1,000	LF	$1,000	$1,000,000
Engineering and Contingencies (30%)					$39,000,000
Subtotal of Pipeline					**$173,200,000**
Pump Station(s)					
Lake Hugo Pump Station	4230 HP	1	LS	$8,379,000	$8,379,000
Booster 1	4230 HP	1	LS	$6,300,126	$6,300,000
Engineering and Contingencies (35%)					$5,138,000
Subtotal of Pump Station(s)					**$19,817,000**
CONSTRUCTION TOTAL					**$193,017,000**
Permitting and Mitigation					**$1,736,000**
Interest During Construction			**(12 months)**		**$72,000**
TOTAL COST					**$194,825,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$14,154,000
Electricity ($0.09 kWh)					$2,881,000
Operation & Maintenance					$2,000,000
Raw Water Purchase					$1,222,000
Total Annual Costs					**$20,257,000**
UNIT COSTS (2020-2040)					
Per Acre-Foot					$810
Per 1,000 Gallons					$2.49
UNIT COSTS (2050-2060)					
Per Acre-Foot					$244
Per 1,000 Gallons					$0.75

Note: Cost for buying raw water is assumed to be $0.15 per 1,000 gallons

Table Q-138
City of Irving Alternative Strategy Costs

Capital Costs

Strategy	Basis for Cost			Irving Cost	
	User	Amount	Capital Cost	Amount	Capital Cost
Marvin Nichols Reservoir	UTRWD	35,000	$225,628,000	50,000	$322,326,000
Parkhouse North	DWU	112,000	$521,636,000	50,000	$232,873,000
Parkhouse South	DWU	115,260	$692,921,000	50,000	$300,590,000
Ralph Hall and Reuse	UTRWD	52,437	$286,401,000	26,219	$143,201,000
Wright Patman - System	DWU	180,000	$992,334,000	50,000	$275,648,000
Wright Patman - Raise Flood Pool	DWU	112,100	$896,478,000	50,000	$399,856,000
Wright Patman - Texarkana	DWU	100,000	$759,568,000	50,000	$379,784,000

Cost associated with additional transmission from DWU east side WTP to Lake Lewisville

	size	Quantity	Unit	Unit Cost	Total Cost
Pipeline (urban)	60 in	175,000	LF	$495	$86,625,000
Pipeline ROW		175,000	LF	$41	$7,175,000
Additional pumping capacity	2920 HP	1	EA	$4,953,000	$4,953,000
Engineering and Contingencies					$27,721,000
Permitting and mitigation (1%)					$1,265,000
Subtotal additional capital cost for DWU base strategies					**$127,739,000**

Summary of Capital Costs - Irving Alternatives

	Amount	Total Capital Cost
Marvin Nichols Reservoir	50,000	$322,326,000
Parkhouse North	50,000	$360,612,000
Parkhouse South	50,000	$428,329,000
Ralph Hall	26,219	$143,201,000
Wright Patman - System	50,000	$403,387,000
Wright Patman - Raise Flood Pool	50,000	$527,595,000
Wright Patman - Texarkana	50,000	$507,523,000

Annual Costs

Strategy	Basis for Cost			
	User	Amount	Pre-Am	Post-Am
Marvin Nichols Reservoir	UTRWD	35,000	$22,752,000	$6,360,000
Parkhouse North	DWU	112,000	$51,281,000	$13,385,000
Parkhouse South	DWU	115,260	$65,435,000	$15,095,000
Ralph Hall and Reuse	UTRWD	52,437	$24,754,000	$3,947,000
Wright Patman - System	DWU	180,000	$101,169,000	$29,077,000
Wright Patman - Raise Flood Pool	DWU	112,100	$85,415,000	$20,287,000
Wright Patman - Texarkana	DWU	100,000	$82,292,000	$27,110,000

Table Q-138, Irving Alternative Strategies (continued)

Annual Costs associated with additional transmission	
Debt Service	$9,280,000
Electricity ($0.09 kWh)	$1,131,000
Operation & Maintenance	$1,188,000
Subtotal of additional annual costs for DWU base strategies	**$11,599,000**

Strategy	**Summary of Annual Costs**		
	Irving Amount	**Pre-Am**	**Post-Am**
Marvin Nichols Reservoir	50,000	$32,503,000	$9,086,000
Parkhouse North	50,000	$34,492,000	$8,294,000
Parkhouse South	50,000	$39,985,000	$8,867,000
Ralph Hall and Reuse	26,219	$12,377,000	$1,974,000
Wright Patman - System	50,000	$39,702,000	$10,396,000
Wright Patman - Raise Flood Pool	50,000	$49,697,000	$11,368,000
Wright Patman - Texarkana	50,000	$52,745,000	$15,874,000

Unit Costs

	Irving Amount	**Pre-Am**	**Post-Am**
Marvin Nichols Reservoir	50,000	$1.99	$0.56
Parkhouse North	50,000	$2.12	$0.51
Parkhouse South	50,000	$2.45	$0.54
Ralph Hall and Reuse	26,219	$1.45	$0.23
Wright Patman - System	50,000	$2.44	$0.64
Wright Patman - Raise Flood Pool	50,000	$3.05	$0.70
Wright Patman - Texarkana	50,000	$3.24	$0.97

Table Q-139
Irving Oklahoma Water
From Hugo to Lake Chapman

Probable Owner: City of Irving
Quantity: 25,000 AF/Y

CONSTRUCTION COSTS
TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline Rural	42 in	274,560	LF	$215	$59,030,000
30-ft Right of Way Easements (ROW)		274,560	LF	$7	$1,922,000
Red River Tunnel		1,000	LF	$1,000	$1,000,000
Engineering and Contingencies (30%)					$18,009,000
Subtotal of Pipeline					**$79,961,000**
Pump Station(s)					
Pumps with intake & building	3950 HP	1	LS	$8,035,500	$8,035,500
Chapman Pump Station Expansion					$567,000
Booster on Chapman-Lavon Line					$6,813,000
Engineering and Contingencies (35%)					$5,395,425
Subtotal of Pump Station(s)					**$20,810,925**
CONSTRUCTION TOTAL					**$100,771,925**
Permitting and Mitigation					**$905,000**
Interest During Construction			**(18 months)**		**$6,215,000**
TOTAL COST					**$107,891,925**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$7,838,000
Electricity ($0.09 per kWh)					$6,269,000
Operation & Maintenance					$1,182,000
Raw Water Purchase					$1,222,000
Total Annual Costs					**$16,511,000**
UNIT COSTS (During Amortization)					
Per Acre-Foot					$660
Per 1,000 Gallons					$2.03
UNIT COSTS (After Amortization)					
Per Acre-Foot					$347
Per 1,000 Gallons					$1.06

Note: Cost for buying raw water is assumed to be $0.15 per 1,000 gallons

Table Q-140
Ovilla Additional Water from Dallas

Owner:	Ovilla					
Amount:	1,111	Ac-Ft/Yr				
CONSTRUCTION COSTS						
TRANSMISSION FACILITIES						
Pipeline(s)	**Qty.**	**Units**		**Unit Cost**		**Total Cost**
14" Water Line						
Pipe	45,778	LF	$	69	$	3,159,000
ROW	45,778	LF	$	5	$	229,000
Engineering and Contingencies	30%				$	948,000
Subtotal of Pipeline(s)					**$**	**4,336,000**
Pump Station(s)						
Station 1						
Pump, building, & appurtenances	98	HP			$	738,000
Storage Tank	0.31	MG			$	317,000
Engineering and Contingencies	35%				$	369,000
Subtotal of Pump Station(s)					**$**	**1,424,000**
PERMITTING AND MITIGATION	1%				**$**	**51,000**
CONSTRUCTION TOTAL					**$**	**5,811,000**
Interest During Construction		(12 months)			**$**	**358,000**
TOTAL CAPITAL COST					**$**	**6,169,000**
ANNUAL COSTS						
Debt Service					$	448,000
Operation and Maintenance Costs						
Pipeline	1%				$	38,000
Pump Station	2.50%				$	32,000
Estimated Annual Power Cost	$0.09/kWh				$	4,000
Treated Water Demand Charge	2	MGD	$	123,190	$	246,000
Treated Water Volume Charge	362,020	1000 gal	$	0.70	$	253,000
Total Annual Costs					**$**	**1,021,000**

Table Q-140, Continued

UNIT COSTS (First 30 Years)		
Per Acre-Foot	$	919
Per 1,000 Gallons	$	2.82
UNIT COSTS (After 30 Years)		
Per Acre-Foot	$	288
Per 1,000 Gallons	$	0.88

Table Q-141
Sardis-Lone Elm WSC Purchase Water from Rockett SUD

Owner:	Sardis-Lone Elm WSC			
Amount:	2,456	Ac-Ft/Yr		
CONSTRUCTION COSTS				
TRANSMISSION FACILITIES				
Pipeline(s)	**Qty.**	**Units**	**Unit Cost**	**Total Cost**
18" Water Line				
Pipe	48,200	LF	$ 90	$ 4,338,000
ROW	48,200	LF	$ 5	$ 241,000
Engineering and Contingencies	30%			$ 1,301,000
Subtotal of Pipeline(s)				**$ 5,880,000**
Pump Station(s)				
Station 1				
Pump, building, & appurtenances	384	HP		$ 1,738,000
Storage Tank	0.54	MG		$ 454,000
Engineering and Contingencies	35%			$ 767,000
Subtotal of Pump Station(s)				**$ 2,959,000**
PERMITTING AND MITIGATION	1%			**$ 78,000**
CONSTRUCTION TOTAL				**$ 8,917,000**
Interest During Construction		(12 months)		**$ 550,000**
TOTAL CAPITAL COST				**$ 9,467,000**
ANNUAL COSTS				
Debt Service				$ 688,000
Operation and Maintenance Costs				
Pipeline	1%			$ 52,000
Pump Station	2.50%			$ 66,000
Estimated Annual Power Cost	$0.09/kWh			$ 13,000
Treated Water Cost	800,290	1000 gal	$ 1.21	$ 969,000
Total Annual Costs				**$ 1,788,000**

Table Q-141, Continued

UNIT COSTS (First 30 Years)		
Per Acre-Foot	$	728
Per 1,000 Gallons	$	2.23
UNIT COSTS (After 30 Years)		
Per Acre-Foot	$	448
Per 1,000 Gallons	$	1.37

Table Q-142
City of Lancaster - New Delivery Point for DWU

Owner: Lancaster
Amount: 3,733 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	16 in.	1,000	LF	$103	$103,000
Right of Way Easements (ROW)	20 ft.	1,000	LF	$28	$28,000
Engineering and Contingencies (30%)					$39,000
Subtotal of Pipeline					**$170,000**
Pump Station(s)					
Ground Storage Tank	0.8 MG	1	LS	$555,600	$555,600
New metering facilities		1	LS	$1,000,000	$1,000,000
Engineering and Contingencies (35%)					$544,000
Subtotal of Pump Station(s)					**$2,099,600**
Permitting and Mitigation					**$8,000**
CONSTRUCTION TOTAL					**$2,277,600**
Interest During Construction (12 months)					**$95,000**
TOTAL COST					**$2,372,600**
ANNUAL COSTS					
Debt Service (6%, 30 years)					$172,000
Pipeline O&M (1%)					$1,000
Storage and Metering O&M (2.5%)					$47,000
Treated Water Volume Charge ($0.38/1000 gal)		1,216,958	1000 gal		$462,444
Treated Water Demand Charge ($179,991/mgd)		3.0	mgd		$539,973
TOTAL ANNUAL COST					**$1,222,417**
UNIT COSTS (Until Amortized)					
Per Acre-Foot of treated water					$327
Per 1,000 Gallons					$1.00
UNIT COSTS (After Amortization)					
Per Acre-Foot					$281
Per 1,000 Gallons					$0.86

Table Q-143
Dallas County Irrigation - Pipeline for Reuse

Owner: Unknown
Amount: 2,700 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	16 in.	15,840	LF	$103	$1,632,000
Right of Way Easements (ROW)		15,840	LF	$28	$444,000
Engineering and Contingencies (30%)					$623,000
Subtotal of Pipeline					**$2,699,000**
Pump Station(s)					
Booster Pump Station	230 HP	1	LS	$1,215,000	$1,215,000
Engineering and Contingencies (35%)					$425,000
Subtotal of Pump Station(s)					**$1,640,000**
Permitting and Mitigation					**$34,000**
CONSTRUCTION TOTAL					**$4,373,000**
Interest During Construction					**$182,000**
TOTAL COST					**$4,555,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$331,000
Electricity ($0.09 kWh)					$48,000
Reuse Water ($.25 per 1,000 gallons)					$220,000
Operation & Maintenance					$56,000
Total Annual Costs					**$655,000**
UNIT COSTS					
Per Acre-Foot					$243
Per 1,000 Gallons					$0.74

Table Q-144
Dallas County Mining - Pipeline

Owner: Unknown
Amount: 300 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	8 in.	15,840	LF	$52	$824,000
Right of Way Easements (ROW)		15,840	LF	$21	$333,000
Engineering and Contingencies (30%)					$347,000
Subtotal of Pipeline					**$1,504,000**
Pump Station(s)					
Booster Pump Station	12 HP	1	LS	$543,000	$543,000
Engineering and Contingencies (35%)					$190,000
Subtotal of Pump Station(s)					**$733,000**
Permitting and Mitigation					**$16,000**
CONSTRUCTION TOTAL					**$2,253,000**
Interest During Construction					**$94,000**
TOTAL COST					**$2,347,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$171,000
Electricity ($0.09 kWh)					$5,000
Raw Water ($.49 per 1,000 gallons for DWU)					$48,000
Operation & Maintenance					$26,000
Total Annual Costs					**$250,000**
UNIT COSTS					
Per Acre-Foot					$833
Per 1,000 Gallons					$2.56

Table Q-145
Dallas County S. E. Power - Direct Reuse

Owner: Unknown
Amount: 4,600 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	24 in.	52,800	LF	$116	$6,125,000
Right of Way Easements (ROW)		52,800	LF	$28	$1,478,000
Engineering and Contingencies (30%)					$2,281,000
Subtotal of Pipeline					**$9,884,000**
Pump Station(s)					
Booster Pump Station	250 HP	1	LS	$1,280,000	$1,280,000
Engineering and Contingencies (35%)					$448,000
Subtotal of Pump Station(s)					**$1,728,000**
Permitting and Mitigation					**$89,000**
CONSTRUCTION TOTAL					**$11,701,000**
Interest During Construction			**(12 months)**		**$488,000**
TOTAL COST					**$12,189,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$886,000
Electricity ($0.09 kWh)					$86,000
Reuse Water ($0.25 per 1,000 gallons)					$375,000
Operation & Maintenance					$112,000
Total Annual Costs					**$1,459,000**
UNIT COSTS (Pre-Amortization)					
Per Acre-Foot					$317
Per 1,000 Gallons					$0.97
UNIT COSTS (Post Amortization)					
Per Acre-Foot					$125
Per 1,000 Gallons					$0.38

Table Q-146
City of Hackberry Purchase Additional Treated Water from North Texas MWD

Owner: Hackberry
Amount: 98 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline					$0
Right of Way Easements (ROW)					$0
Engineering and Contingencies (30%)					$0
Subtotal of Pipeline					**$0**
Pump Station(s)					
Pump station					$0
Ground Storage with Roof					$0
Engineering and Contingencies (35%)					$0
Subtotal of Pump Station(s)					**$0**
Permitting and Mitigation					**$0**
CONSTRUCTION TOTAL					**$0**
Interest During Construction			**(12 months)**		**$0**
TOTAL COST					**$0**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$0
Treated Water ($1.30 per 1,000 gallons)					$42,000
Electricity ($0.09 kWh)					$0
Operation & Maintenance					$0
Total Annual Costs					**$42,000**
UNIT COSTS (2010-2030)					
Per Acre-Foot					$429
Per 1,000 Gallons					$1.30
UNIT COSTS (2040-2060)					
Per Acre-Foot					$0
Per 1,000 Gallons					$0.00

Table Q-147
Denton County-Other
Denton County, Woodbine Aquifer

Need	100	ac-ft/yr		
Water Depth	450	ft		
Well Depth	500	ft		
Well Yield	100	gpm	161	ac-ft (peak)
Well Size	6	in	80.5	ac-ft (average)
Wells Needed	2			

WELLS						
Well(s)	**Number**			**Unit Cost**		
Water Wells	2		$	142,500	$	285,000
Connection to Distribution System	2		$	160,000	$	320,000
Engineering and Contingencies					$	182,000
Subtotal of Well(s)					**$**	**787,000**
PERMITTING AND MITIGATION	1%				**$**	**7,000**
CONSTRUCTION TOTAL					**$**	**794,000**
Interest During Construction		(6 months)			**$**	**17,000**
TOTAL CAPITAL COST					**$**	**811,000**
ANNUAL COSTS						
Debt Service - Total Capital					$	59,000
O&M						
Transmission	1%				$	3,840
Well(s)	2.5%				$	8,600
Add Chemicals, Etc.	32,585	1000 gal	$	0.30	$	9,800
Pumping Costs					$	6,200
Total Annual Cost					**$**	**87,440**
UNIT COSTS (First 30 Years)						
Cost per ac-ft					$	874
Cost per 1000 gallons					$	2.68
UNIT COSTS (After 30 Years)						
Cost per ac-ft					$	284
Cost per 1000 gallons					$	0.87

Table Q-148
Denton County-Other
Denton County, Trinity Aquifer

Need	100	ac-ft/yr		
Water Depth	500	ft		
Well Depth	550	ft		
Well Yield	100	gpm	161	ac-ft (peak)
Well Size	6	in	80.5	ac-ft (average)
Wells Needed	2			

WELLS							
Well(s)	**Number**			**Unit Cost**			
Water Wells	2		$	148,800	$	298,000	
Connection to Distribution System	2		$	160,000	$	320,000	
Engineering and Contingencies					$	185,000	
Subtotal of Well(s)					**$**	**803,000**	
PERMITTING AND MITIGATION	1%				**$**	**7,000**	
CONSTRUCTION TOTAL					**$**	**810,000**	
Interest During Construction		(6 months)			**$**	**18,000**	
TOTAL CAPITAL COST					**$**	**828,000**	
ANNUAL COSTS							
Debt Service - Total Capital					$	60,000	
O&M							
Transmission	1%				$	3,840	
Well(s)	2.5%				$	8,900	
Add Chemicals, Etc.	32,585	1000 gal	$	0.30	$	9,800	
Pumping Costs					$	6,800	
Total Annual Cost					**$**	**89,340**	
UNIT COSTS (First 30 Years)							
Cost per ac-ft					$	893	
Cost per 1000 gallons					$	2.74	
UNIT COSTS (After 30 Years)							
Cost per ac-ft					$	293	
Cost per 1000 gallons					$	0.90	

Table Q-149
Pilot Point - New Wells in the Trinity Aquifer
Denton County, Trinity Aquifer

Need	167	ac-ft/yr		
Water Depth	444	ft		
Well Depth	521	ft		
Well Yield	210	gpm	338	ac-ft (peak)
Well Size	8	in	169.0	ac-ft (average)
Wells Needed	1			

WELLS						
Well(s)	**Number**			**Unit Cost**		
Water Wells	1		$	171,200	$	171,000
Connection to Distribution System	1		$	160,000	$	160,000
Engineering and Contingencies					$	99,000
Subtotal of Well(s)					**$**	**430,000**
PERMITTING AND MITIGATION	1%				**$**	**4,000**
CONSTRUCTION TOTAL					**$**	**434,000**
Interest During Construction		(6 months)			**$**	**9,000**
TOTAL CAPITAL COST					**$**	**443,000**
ANNUAL COSTS						
Debt Service - Total Capital					$	32,000
O&M						
Transmission	1%				$	1,920
Well(s)	2.5%				$	5,100
Add Chemicals, Etc.	54,417	1000 gal	$	0.30	$	16,300
Pumping Costs					$	10,300
Total Annual Cost					**$**	**65,620**
UNIT COSTS (First 30 Years)						
Cost per ac-ft					$	393
Cost per 1000 gallons					$	1.21
UNIT COSTS (After 30 Years)						
Cost per ac-ft					$	201
Cost per 1000 gallons					$	0.62

Table Q-150
Northlake, Roanoke, and Trophy Club to Fort Worth (Share of Cost to connect to Fort Worth)

Probable Owner: Northlake/Roanoke/Trophy Club/Fort Worth
Amount: 4,600 acre-ft/year

CONSTRUCTION COSTS

TRANSMISSION FACILITIES

Pipelines*	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline (24 in.)	24 in.	5,000	LF	$158	$790,000
Pipeline (36 in.)	36 in.	30,000	LF	$237	$7,110,000
ROW Easements		35,000	LF	$28	$980,000
48" Boring and casing		263	LF	$632	$166,000
Engineering and Contingencies (30%)					$2,714,000
Subtotal of Pipelines					**$11,760,000**
Permitting and mitigation					$95,000
CONSTRUCTION TOTAL					**$11,760,000**
Interest During Construction	**(18 months)**				**$725,000**
TOTAL COST					**$12,580,000**
Fort Worth's Share (50%)					**$6,290,000**
Northlake's Share (30%)					**$3,774,000**
Roanoke's Share (10%)					**$1,258,000**
Trophy Club (10%)					**$1,258,000**

ANNUAL COSTS FOR NORTHLAKE	
Debt Service (6% for 30 years)	$274,000
Electricity ($0.06 kWh)	$39,000
Operation & Maintenance	$95,000
Total Annual Costs	**$408,000**

ANNUAL COSTS FOR ROANOKE	
Debt Service (6% for 30 years)	$91,000
Electricity ($0.09 kWh)	$26,000
Operation & Maintenance	$95,000
Total Annual Costs	**$212,000**

ANNUAL COSTS FOR TROPHY CLUB	
Debt Service (6% for 30 years)	$91,000
Electricity ($0.09 kWh)	$39,000
Operation & Maintenance	$95,000
Total Annual Costs	**$225,000**

Notes:
* Pipeline and storage tank information and costs based on information provided in Fort Worth Master Plan.

Table Q-151
Southlake to Fort Worth (Share of Cost to Connect to Fort Worth)

Probable Owner: Southlake/Fort Worth

CONSTRUCTION COSTS

TRANSMISSION FACILITIES

Pipelines*	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline (30 in.)	30 in.	25,000	LF	$215	$5,375,000
ROW Easements		25,000	LF	$12	$300,000
54" Boring and casing		263	LF	$711	$187,000
Miscellaneous Improvements		1	LS	$921,000	$921,000
Engineering and Contingencies (30%)					$2,035,000
Subtotal of Pipelines					**$8,818,000**
Permitting and mitigation					$65,000
CONSTRUCTION TOTAL					**$8,818,000**
Interest During Construction	**(18 months)**				**$544,000**
TOTAL COST					**$9,427,000**

ANNUAL COSTS FOR SOUTHLAKE	
Debt Service (6% for 30 years)	$685,000
Operation & Maintenance	$65,000
Total Annual Costs	**$750,000**

Notes:
* Pipeline and storage tank information and costs based on information provided in Fort Worth Master Plan; Westlake may pay for small portion of line

Table Q-152
The Colony - Aquifer Storage and Recovery

Owner: The Colony
Amount: 0 AF/Y

No.	Description	Quantity	Units	Unit Price	Amount
1	Mobilization & Demobilization	1	Ls	$66,000	**$66,000**
2	Drill 30-Inch Borehole	50	Ft	$230	**$12,000**
3	Drill 22-Inch Borehole	2050	Ft	$200	**$410,000**
4	Drill 15-Inch Borehole	300	Ft	$430	**$129,000**
5	24-Inch Steel Casing	50	Ft	$230	**$12,000**
6	16-Inch SS304L Casing 0.5" Wall Thickness	2100	Ft	$330	**$693,000**
7	Neat Cement	2100	Ft	$41	**$86,000**
8	Pilot Hole to 2100 ft	1	Ls	$12,000	**$12,000**
9	Reamed Borehole to 2100 ft	1	Ls	$13,000	**$13,000**
10	Cemented Casing to 2100 ft	1	Ls	$4,000	**$4,000**
11	15" Hole to 2400 ft	1	Ls	$12,000	**$12,000**
12	Well Screen	1	Ls	$3,000	**$3,000**
13	Screen Assembly Complete	200	Ft	$430	**$86,000**
14	Well Development	80	Hours	$1,200	**$96,000**
15	Pump Setup	1	Ls	$33,000	**$33,000**
16	Pumping test	48	Hours	$260	**$12,000**
17	Disinfection	1	Ls	$20,000	**$20,000**
18	Standby Time	16	Hours	$330	**$5,000**
19	Set/Pull 200 GPM Pump	1	Ls	$13,000	**$13,000**
20	Rent Interim Pump	4	Months	$3,900	**$16,000**
21	2000 GPM Vertical Turbine Pump	1	Ls	$289,000	**$289,000**
22	Piping, Valves & Flowmeter	1	Ls	$151,000	**$151,000**
23	Chlorine & Ammonia System	1	Ls	$120,000	**$120,000**
24	Chlorine, Ammonia & Electrical Building	1	Ls	$58,000	**$58,000**
25	Electrical	1	Ls	$154,000	**$154,000**
26	Instrumentation & Control	1	Ls	$85,000	**$85,000**
27	Painting & Misc.	1	Ls	$11,000	**$11,000**
28	Allowance	1	Ls	$66,000	**$66,000**
	Total				**$2,667,000**

Note: Item No. 8 thru 12 is for Geophysical Logging
Costs provided by The Colony.

Table Q-153
Denton County Mining - New Wells in Woodbine Aquifer
Denton County, Woodbine Aquifer

Need	202	Ac-ft/yr	125	gpm
Depth to Water	104			
Well Depth	300			
Well Yield	300	gpm	483	ac-ft (peak)
Well Size	10	in	242	ac-ft (average)
Wells Needed	2			

Construction Costs

Water Wells	2	$145,000	$290,000
Connection to Transmission System	2	$160,000	$320,000
Storage tank	1	$183,000	$183,000
Subtotal			$793,000
Engineering and Contingencies			$238,000
Mitigation and Permitting			$10,000
Subtotal			$1,041,000
Interest During Construction			$23,000
	Total Capital		**$1,064,000**
Debt Service - Total Capital			$77,000
O&M			
Transmission			$10,000
Well(s)			$10,000
Add Chemicals etc.		0.3	$47,000
Pumping Costs			$14,000
	Total Annual Cost		**$158,000**
UNIT COSTS			
Cost per ac-ft			$327
Cost per 1000 gallons			$1.00

Table Q-154
Denton County Manufacturing - New Well in Trinity Aquifer
Denton County, Trinity Aquifer

Need	200	Ac-ft/yr	124	gpm
Depth to Water	473			
Well Depth	1450			
Well Yield	260	gpm	419	ac-ft (peak)
Well Size	10	in	210	ac-ft (average)
Wells Needed	1			

Construction Costs				
	Number		Unit Cost	Total Cost
Water Wells	1		$375,000	$375,000
Connection to Transmission System	1		$160,000	$160,000
Engineering and Contingencies (30%)				$161,000
Subtotal of Well(s)				**$696,000**
Permitting and Mitigation				$6,000
Construction Total				$702,000
Interest During Construction	6 months			$15,000
Total Capital Cost				**$717,000**
Debt Service - Total Capital				$52,000
O&M				
Transmission	1%			$2,000
Well(s)	2.5%			$11,000
Add Chemicals etc.	65,170	$0.30	per 1000 gal	$19,600
Pumping Costs				$13,000
		Total Annual Cost		**$97,600**
UNIT COSTS (First 30 Years)				
Cost per ac-ft				$488
Cost per 1000 gallons				$1.50
UNIT COSTS (After 30 Years)				
Cost per ac-ft				$228
Cost per 1000 gallons				$0.70

Table Q-155
Denton County Steam Electric Power - New Well in Trinity Aquifer
Denton County, Trinity Aquifer

Need	200	Ac-ft/yr	124	gpm
Depth to Water	473			
Well Depth	1450			
Well Yield	260	gpm	419	ac-ft (peak)
Well Size	10	in	210	ac-ft (average)
Wells Needed	1			

Construction Costs

	Number		Unit Cost	Total Cost
Water Wells	1		$375,000	$375,000
Connection to Transmission System	1		$160,000	$160,000
Engineering and Contingencies (30%)				$161,000
Subtotal of Well(s)				**$696,000**
Permitting and Mitigation				$6,000
Construction Total				$702,000
Interest During Construction	6	months		$15,000
Total Capital Cost				**$717,000**
Debt Service - Total Capital				$52,000
O&M				
Transmission	1%			$2,000
Well(s)	2.5%			$11,000
Add Chemicals etc.	65,170	$0.30	per 1000 gal	$19,600
Pumping Costs				$13,000
		Total Annual Cost		**$97,600**
UNIT COSTS (First 30 Years)				
Cost per ac-ft				$488
Cost per 1000 gallons				$1.50
UNIT COSTS (After 30 Years)				
Cost per ac-ft				$228
Cost per 1000 gallons				$0.70

Table Q-156
Denton County Irrigation - New Well in Trinity Aquifer
Denton County, Trinity Aquifer

Need	200	Ac-ft/yr	124	gpm
Depth to Water	473			
Well Depth	1450			
Well Yield	260	gpm	419	ac-ft (peak)
Well Size	10	in	210	ac-ft (average)
Wells Needed	1			

Construction Costs	Number		Unit Cost	Total Cost
Water Wells	1		$375,000	$375,000
Connection to Transmission System	1		$160,000	$160,000
Engineering and Contingencies (30%)				$161,000
Subtotal of Well(s)				**$696,000**
Permitting and Mitigation				$6,000
Construction Total				$702,000
Interest During Construction	6	months		$15,000
Total Capital Cost				**$717,000**
Debt Service - Total Capital				$52,000
O&M				
Transmission	1%			$2,000
Well(s)	2.5%			$11,000
Add Chemicals etc.	65,170	$0.30	per 1000 gal	$19,600
Pumping Costs				$13,000
		Total Annual Cost		**$97,600**
UNIT COSTS (First 30 Years)				
Cost per ac-ft				$488
Cost per 1000 gallons				$1.50
UNIT COSTS (After 30 Years)				
Cost per ac-ft				$228
Cost per 1000 gallons				$0.70

Table Q-157

Buena Vista-Bethel SUD - Cost of Overdrafting
Trinity Aquifer Using Existing Pumps
Ellis County, Trinity Aquifer

Need	366	Ac-ft/yr	227	gpm
Depth to Water	839			
Well Depth	2579			
Well Yield	455	gpm	733	ac-ft (peak)
			366.5	ac-ft (average)

Annual Cost		
Pumping Costs		$40,162
Chemical Costs	0.13	$15,525
Total Annual Cost		**$55,687**
UNIT COSTS		
Cost per ac-ft		$152
Cost per 1000 gallons		$0.47

Table Q-158
Buena Vista - Bethel SUD Purchase Water from Rockett SUD

Owner:	Buena Vista - Bethel SUD				
Amount:	658	Ac-Ft/Yr			

CONSTRUCTION COSTS

TRANSMISSION FACILITIES					
Pipeline(s)	**Qty.**	**Units**	**Unit Cost**		**Total Cost**
14" Water Line					
Pipe	96,860	LF	$ 60	$	5,812,000
ROW	96,860	LF	$ 5	$	484,000
Engineering and Contingencies	30%			$	1,744,000
Subtotal of Pipeline(s)				**$**	**8,040,000**
Pump Station(s)					
Station 1					
Pump, building, & appurtenances	60	HP		$	665,000
Storage Tank	0.20	MG		$	247,000
Engineering and Contingencies	35%			$	319,000
Subtotal of Pump Station(s)				**$**	**1,231,000**
PERMITTING AND MITIGATION	1%			**$**	**81,000**
CONSTRUCTION TOTAL				**$**	**9,352,000**
Interest During Construction		(18 months)		**$**	**577,000**
TOTAL CAPITAL COST				**$**	**9,929,000**
ANNUAL COSTS					
Debt Service				$	721,000
Operation and Maintenance Costs					
Pipeline	1%			$	70,000
Pump Station	2.50%			$	27,000
Estimated Annual Power Cost	$0.09/kWh			$	2,000
Treated Water Cost	214,472	1000 gal	$ 1.21	$	260,000
Total Annual Costs				**$**	**1,080,000**

Table Q-158, Continued

UNIT COSTS (First 30 Years)		
Per Acre-Foot	$	1,641
Per 1,000 Gallons	$	5.04
UNIT COSTS (After 30 Years)		
Per Acre-Foot	$	545
Per 1,000 Gallons	$	1.67

Table Q-159
Buena Vista - Bethel SUD Parallel Pipeline from Waxahachie

Owner:	Buena Vista - Bethel SUD			
Amount:	2,280	Ac-Ft/Yr		
CONSTRUCTION COSTS				
TRANSMISSION FACILITIES				
Pipeline(s)	**Qty.**	**Units**	**Unit Cost**	**Total Cost**
18" Water Line				
Pipe	52,800	LF	$77	$4,066,000
ROW	52,800	LF	$12	$634,000
Engineering and Contingencies	30%			$1,220,000
Subtotal of Pipeline(s)				**$5,920,000**
Pump Station(s)				
Station 1				
Pump, building, & appurtenances	245	HP		$1,264,000
Storage Tank	0.50	MG		$438,000
Engineering and Contingencies	35%			$596,000
Subtotal of Pump Station(s)				**$2,298,000**
PERMITTING AND MITIGATION	1%			**$69,000**
CONSTRUCTION TOTAL				**$8,287,000**
Interest During Construction		(18 months)		**$511,000**
TOTAL CAPITAL COST				**$8,798,000**
ANNUAL COSTS				
Debt Service				$639,000
Operation and Maintenance Costs				
Pipeline	1%			$49,000
Pump Station	2.50%			$51,000
Estimated Annual Power Cost	$0.09/kWh			$11,000
Treated Water Cost	742,940	1000 gal	$ 0.72	$535,000
Total Annual Costs				**$1,285,000**

Table Q-159, Continued

UNIT COSTS (First 30 Years)	
Per Acre-Foot	$564
Per 1,000 Gallons	$1.73
UNIT COSTS (After 30 Years)	
Per Acre-Foot	$283
Per 1,000 Gallons	$0.87

Table Q-160
Community Water Co. Additional Water from Ennis

Owner:	Community Water Co.				
Amount:	204	Ac-Ft/Yr			
Item No. & Description	**Qty.**	**Units**	**Unit Cost**		**Total Cost**
TOTAL CAPITAL COST				**$**	**-**
ANNUAL COSTS					
Debt Service				$	-
Operation and Maintenance Costs					
Pipeline	1%			$	-
Pump Station	2.50%			$	-
Estimated Annual Power Cost	$0.09/kWh			$	-
Treated Water Cost	66,474	1000 gal	$ 2.67	$	177,000
Total Annual Costs				**$**	**177,000**
UNIT COSTS (First 30 Years)					
Per Acre-Foot				$	868
Per 1,000 Gallons				$	2.66
UNIT COSTS (After 30 Years)					
Per Acre-Foot				$	868
Per 1,000 Gallons				$	2.66

Table Q-161
Ennis WWTP Indirect Reuse

Owner:	Ennis					
Indirect Reuse Amount:	3,696	Ac-Ft/Yr				
CONSTRUCTION COSTS						
TRANSMISSION FACILITIES						
Pipeline(s)	**Qty.**	**Units**		**Unit Cost**		**Total Cost**
20" Reclaimed Water Line						
Pipe	32,855	LF	$	90	$	2,957,000
ROW	32,855	LF	$	5	$	164,000
20" Raw Water Line						
Pipe	4,752	LF	$	90	$	428,000
ROW	4,752	LF	$	5	$	24,000
Engineering and Contingencies	30%				$	1,016,000
Subtotal of Pipeline(s)					**$**	**4,589,000**
Pump Station(s)						
Station 1						
Pump, building, & appurtenances	65	HP			$	674,000
Storage Tank	0	MG			$	-
Station 2						
Pump, building, & appurtenances	385	HP			$	2,317,000
Storage Tank	0	MG			$	-
Engineering and Contingencies	35%				$	1,047,000
Subtotal of Pump Station(s)					**$**	**4,038,000**
WATER TREATMENT FACILITIES						
Wastewater Treatment Plant Expansion						
Advanced Wastewater Treatment	4.00	MGD			$	4,200,000
Engineering and Contingencies	35%				$	1,470,000
Subtotal of Wastewater Treatment Plant					**$**	**5,670,000**
Water Treatment Plant Expansion						
Water Treatment Plant Expansion	6.00	MGD			$	11,525,000
Engineering and Contingencies	35%				$	4,034,000
Subtotal of Water Treatment Plant					**$**	**15,559,000**

Table Q-161, Continued

PERMITTING AND MITIGATION	1%				**$**	**77,000**
CONSTRUCTION TOTAL					**$**	**29,933,000**
Interest During Construction		(18 months)			**$**	**1,846,000**
TOTAL CAPITAL COST					**$**	**31,779,000**
ANNUAL COSTS						
Debt Service					$	2,309,000
Operation and Maintenance Costs						
Pipeline	1%				$	41,000
Pump Station	2.50%				$	90,000
RO Operation	1,204,345	1000 gal	$	1.24	$	1,493,000
WTP Operation	1,204,345	1000 gal	$	0.70	$	843,000
Estimated Annual Power Cost	$0.09/kWh				$	132,000
Raw Water Cost	3,696	ac-ft	$	-	$	-
Total Annual Costs					**$**	**4,908,000**
UNIT COSTS (First 30 Years)						
Per Acre-Foot					$	1,328
Per 1,000 Gallons					$	4.08
UNIT COSTS (After 30 Years)						
Per Acre-Foot					$	703
Per 1,000 Gallons					$	2.16

Assume no raw water cost.

Table Q-162
Ennis from TRA (Reallocation of Flood Storage at Bardwell)

Owner:	Ennis				
Amount:	1,760	Ac-Ft/Yr			
CONSTRUCTION COSTS					
SITE WORK					
Relocation(s)	**Qty.**	**Units**	**Unit Cost**		**Total Cost**
Recreational Facilities				$	2,797,000
Brazos Electric Power Lines				$	1,211,000
Navarro County Electric Power Lines				$	17,000
Engineering and Contingencies	35%			$	1,408,000
Subtotal of Relocation(s)				**$**	**5,433,000**
Modification(s)					
Outlet Works				$	50,000
Engineering and Contingencies	35%			$	17,000
Subtotal of Modification(s)				**$**	**67,000**
UPDATED STORAGE COST	(Based on 10 Percent Discount)			**$**	**20,167,000**
WATER TREATMENT FACILITIES					
Water Treatment Plant Expansion	4.00	MGD			$8,775,000
Engineering and Contingencies	35%			$	3,071,000
Subtotal of Water Treatment Plant				**$**	**11,846,000**
PERMITTING AND MITIGATION				**$**	**91,000**
CONSTRUCTION TOTAL				**$**	**37,604,000**
Interest During Construction		(6 months)		**$**	**815,000**
TOTAL CAPITAL COST				**$**	**38,419,000**
ANNUAL COSTS					
Debt Service				$	2,791,000
Operation and Maintenance Costs					
Project				$	112,000
Mitigation				$	18,000
WTP Operation	573,498	1000 gal	$ 0.70	$	401,000
Total Annual Costs				**$**	**3,322,000**
UNIT COSTS (First 30 Years)					
Per Acre-Foot				$	1,888
Per 1,000 Gallons				$	5.79
UNIT COSTS (After 30 Years)					
Per Acre-Foot				$	302
Per 1,000 Gallons				$	0.93

NOTES:

(1) With the exception of the storage costs, the ENR Construction Cost Index was used to update the project costs from December 1988 to September 2008.

(2) Original (1965) total storage costs were $9,540,000. Estimated updated total storage cost in December 1988 was approximately $41,913,000, for an average increase of 6.36 percent per year.

Table Q-163
Ferris Purchase Water from Rockett SUD

Owner:	Ferris					
Amount:	188	Ac-Ft/Yr				
Item No. & Description	**Qty.**	**Units**	**Unit Cost**			**Total Cost**
TOTAL CAPITAL COST					**$**	**-**
ANNUAL COSTS						
Debt Service					$	-
Operation and Maintenance Costs						
Pipeline	1%				$	-
Pump Station	2.50%				$	-
Estimated Annual Power Cost	$0.09/kWh				$	3,000
Treated Water Cost	61,260	1000 gal	$	1.21	$	74,000
Total Annual Costs					**$**	**77,000**
UNIT COSTS (First 30 Years)						
Per Acre-Foot					$	410
Per 1,000 Gallons					$	1.26
UNIT COSTS (After 30 Years)						
Per Acre-Foot					$	410
Per 1,000 Gallons					$	1.26

Table Q-164
Glenn Heights Additional Water from Dallas

Owner:	Glenn Heights				
Amount:	1,107	Ac-Ft/Yr			

Item No. & Description	**Qty.**	**Units**	**Unit Cost**		**Total Cost**
TOTAL CAPITAL COST				**$**	**-**
ANNUAL COSTS					
Debt Service				$	-
Operation and Maintenance Costs					
Pipeline	1%			$	-
Pump Station	2.50%			$	-
Estimated Annual Power Cost	$0.09/kWh			$	-
Treated Water Demand Charge	2	MGD	$ 123,190	$	246,000
Treated Water Volume Charge	360,717	1000 gal	$ 0.70	$	253,000
Total Annual Costs				**$**	**499,000**
UNIT COSTS (First 30 Years)					
Per Acre-Foot				$	451
Per 1,000 Gallons				$	1.38
UNIT COSTS (After 30 Years)					
Per Acre-Foot				$	451
Per 1,000 Gallons				$	1.38

Table Q-165

Mountain Peak SUD - Cost of Overdrafting
Trinity Aquifer Using Existing Wells
Ellis County, Trinity Aquifer

Need	301	Ac-ft/yr	187	gpm
Depth to Water	131			
Well Depth	389			
Well Yield	390	gpm	628	ac-ft (peak)
			314	ac-ft (average)

Annual Cost		
Pumping Costs		$6,049
Chemical Costs	0.13	$13,301
Total Annual Cost		**$19,350**
UNIT COSTS		
Cost per ac-ft		$62
Cost per 1000 gallons		$0.19

Table Q-166
Mountain Peak WSC Purchase Additional Water from Midlothian

Owner:	Mountain Peak WSC				
Amount:	368	Ac-Ft/Yr			

Item No. & Description	**Qty.**	**Units**	**Unit Cost**		**Total Cost**
TOTAL CAPITAL COST				**$**	**-**
ANNUAL COSTS					
Debt Service				$	-
Operation and Maintenance Costs					
Pipeline	1%			$	-
Pump Station	2.50%			$	-
Estimated Annual Power Cost	$0.09/kWh			$	-
Treated Water Cost	119,913	1000 gal	$ 3.29	$	395,000
Total Annual Costs				**$**	**395,000**
UNIT COSTS (First 30 Years)					
Per Acre-Foot				$	1,073
Per 1,000 Gallons				$	3.29
UNIT COSTS (After 30 Years)					
Per Acre-Foot				$	1,073
Per 1,000 Gallons				$	3.29

Table Q-167
Mountain Peak WSC Purchase Water from Rockett SUD

Owner:	Mountain Peak WSC					
Amount:	2,041	Ac-Ft/Yr				
CONSTRUCTION COSTS						
TRANSMISSION FACILITIES						
Pipeline(s)	**Qty.**	**Units**		**Unit Cost**		**Total Cost**
18" Water Line						
Pipe	100,000	LF	$	77	$	7,700,000
ROW	100,000	LF	$	5	$	500,000
Engineering and Contingencies	30%				$	2,310,000
Subtotal of Pipeline(s)					**$**	**10,510,000**
Pump Station(s)						
Station 1						
Pump, building, & appurtenances	395	HP			$	1,777,000
Storage Tank	0.61	MG			$	481,000
Engineering and Contingencies	35%				$	790,000
Subtotal of Pump Station(s)					**$**	**3,048,000**
PERMITTING AND MITIGATION	1%				**$**	**129,000**
CONSTRUCTION TOTAL					**$**	**13,687,000**
Interest During Construction		(18 months)			**$**	**844,000**
TOTAL CAPITAL COST					**$**	**14,531,000**
ANNUAL COSTS						
Debt Service					$	1,056,000
Operation and Maintenance Costs						
Pipeline	1%				$	92,000
Pump Station	2.50%				$	68,000
Estimated Annual Power Cost	$0.09/kWh				$	16,000
Treated Water Cost	665,062	1000 gal	$	1.21	$	805,000
Total Annual Costs					**$**	**2,037,000**

Table Q-167, Continued

UNIT COSTS (First 30 Years)		
Per Acre-Foot	$	998
Per 1,000 Gallons	$	3.06
UNIT COSTS (After 30 Years)		
Per Acre-Foot	$	481
Per 1,000 Gallons	$	1.48

Table Q-168
Mountain Peak WSC - New Wells
Ellis County, Woodbine Aquifer

Need	200	ac-ft/yr		
Water Depth	1123	ft		
Well Depth	2360	ft		
Well Yield	325	gpm	523	ac-ft (peak)
Well Size	8	in	261.5	ac-ft (average)
Wells Needed	1			

WELLS					
Well(s)	**Number**		**Unit Cost**		
Water Wells	1		$ 493,000	$	493,000
Connection to Transmission System	1		$ 160,000	$	160,000
Engineering and Contingencies				$	196,000
Subtotal of Well(s)				**$**	**849,000**
PERMITTING AND MITIGATION	1%			**$**	**8,000**
CONSTRUCTION TOTAL				**$**	**857,000**
Interest During Construction		(6 months)		**$**	**19,000**
TOTAL CAPITAL COST				**$**	**876,000**
ANNUAL COSTS					
Debt Service - Total Capital				$	64,000
O&M					
Transmission	1%			$	1,900
Well(s)	2.5%			$	14,800
Add Chemicals, Etc.	65,170	1000 gal	$ 0.30	$	19,600
Pumping Costs				$	28,900
Total Annual Cost				**$**	**129,200**
UNIT COSTS (First 30 Years)					
Cost per ac-ft				$	646
Cost per 1000 gallons				$	1.98
UNIT COSTS (After 30 Years)					
Cost per ac-ft				$	326
Cost per 1000 gallons				$	1.00

Table Q-169
Oak Leaf Additional Water from Glenn Heights

Owner:	Oak Leaf					
Amount:	320	Ac-Ft/Yr				

Item No. & Description	**Qty.**	**Units**	**Unit Cost**			**Total Cost**
TOTAL CAPITAL COST					**$**	**-**
ANNUAL COSTS						
Debt Service					$	-
Operation and Maintenance Costs						
Pipeline	1%				$	-
Pump Station	2.50%				$	-
Estimated Annual Power Cost	$0.09/kWh				$	-
Treated Water Cost	104,272	1000 gal	$	3.25	$	339,000
Total Annual Costs					**$**	**339,000**
UNIT COSTS (First 30 Years)						
Per Acre-Foot					$	1,059
Per 1,000 Gallons					$	3.25
UNIT COSTS (After 30 Years)						
Per Acre-Foot					$	1,059
Per 1,000 Gallons					$	3.25

Table Q-170
Palmer Purchase Water from Rockett SUD

Owner: Palmer
Amount: 39 Ac-Ft/Yr

CONSTRUCTION COSTS

TRANSMISSION FACILITIES						
Pipeline(s)	**Qty.**	**Units**	**Unit Cost**			**Total Cost**
8" Water Line						
Pipe	61,700	LF	$	34	$	2,098,000
ROW	61,700	LF	$	3	$	185,000
Engineering and Contingencies	30%				$	629,000
Subtotal of Pipeline(s)					**$**	**2,912,000**
Pump Station(s)						
Station 1						
Pump, building, & appurtenances	0	HP			$	-
Storage Tank	0.01	MG			$	20,000
Engineering and Contingencies	35%				$	7,000
Subtotal of Pump Station(s)					**$**	**27,000**
PERMITTING AND MITIGATION	1%				**$**	**25,000**
CONSTRUCTION TOTAL					**$**	**2,964,000**
Interest During Construction		(12 months)			**$**	**124,000**
TOTAL CAPITAL COST					**$**	**3,088,000**
ANNUAL COSTS						
Debt Service					$	224,000
Operation and Maintenance Costs						
Pipeline	1%				$	25,000
Pump Station	2.50%				$	1,000
Estimated Annual Power Cost	$0.09/kWh				$	-
Treated Water Cost	12,708	1000 gal	$	1.21	$	15,000
Total Annual Costs					**$**	**265,000**

Table Q-170, Continued

UNIT COSTS (First 30 Years)		
Per Acre-Foot	$	6,795
Per 1,000 Gallons	$	20.85
UNIT COSTS (After 30 Years)		
Per Acre-Foot	$	1,051
Per 1,000 Gallons	$	3.23

Table Q-171
Ellis County Steam Electric Power - Supply from Waxahachie

Owner:
Amount: 4,454 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	24 in.	52,800	LF	$116	$6,125,000
Right of Way Easements (ROW)		52,800	LF	$12	$633,600
Engineering and Contingencies (30%)					$2,028,000
Subtotal of Pipeline					**$8,786,600**
Pump Station(s)					
Pump station	993 HP	1	LS	$2,853,480	$2,853,480
Ground Storage with Roof	1.3 MG	1	LS	$739,110	$739,110
Engineering and Contingencies (35%)					$1,257,000
Subtotal of Pump Station(s)					**$4,849,590**
Permitting and Mitigation					**$117,000**
CONSTRUCTION TOTAL					**$13,753,190**
Interest During Construction			**(12 months)**		**$573,095**
TOTAL COST					**$14,326,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$1,041,000
Electricity ($0.09 kWh)					$54,000
Raw Water ($.70 per 1,000 gallons)					$1,016,000
Operation & Maintenance					$62,000
Total Annual Costs					**$2,173,000**
UNIT COSTS (2010-2030)					
Per Acre-Foot					$488
Per 1,000 Gallons					$1.50
UNIT COSTS (2040-2060)					
Per Acre-Foot					$254
Per 1,000 Gallons					$0.78

Table Q-172
Rice WSC Additional Water from Ennis

Owner:	Rice WSC				
Amount:	37	Ac-Ft/Yr			

Item No. & Description	**Qty.**	**Units**	**Unit Cost**		**Total Cost**
TOTAL CAPITAL COST				**$**	**-**
ANNUAL COSTS					
Operation and Maintenance Costs					
Debt Service				$	-
Pipeline	1%			$	-
Pump Station	2.50%			$	-
Estimated Annual Power Cost	$0.09/kWh			$	-
Treated Water Cost	12,056	1000 gal	$ 2.67	$	32,000
Total Annual Costs				**$**	**32,000**
UNIT COSTS (First 30 Years)					
Per Acre-Foot				$	865
Per 1,000 Gallons				$	2.65
UNIT COSTS (After 30 Years)					
Per Acre-Foot				$	865
Per 1,000 Gallons				$	2.65

Table Q-173

Sardis-Lone Elm WSC - Cost of Overdrafting
Trinity Aquifer Using Existing Wells
Ellis County, Trinity Aquifer

Need	1,258	Ac-ft/yr	780	gpm
Depth to Water	736			
Well Depth	2100			
Well Yield	390	gpm	628	ac-ft (peak)
Wells Used	4		314	ac-ft (average)

Annual Cost		
Pumping Costs		$121,133
Chemical Costs	0.13	$53,205
Total Annual Cost		**$174,338**
UNIT COSTS		
Cost per ac-ft		$139
Cost per 1000 gallons		$0.43

Table Q-174
Ellis County-Other - New Wells Trinity Aquifer
Ellis County, Trinity Aquifer

Need	201	ac-ft/yr		
Water Depth	839	ft		
Well Depth	2579	ft		
Well Yield	100	gpm	161	ac-ft (peak)
Well Size	6	in	80.5	ac-ft (average)
Wells Needed	3			

WELLS						
Well(s)	**Number**			**Unit Cost**		
Water Wells	3		$	402,000	$	1,206,000
Connection to Transmission System	3		$	160,000	$	480,000
Engineering and Contingencies					$	506,000
Subtotal of Well(s)					**$**	**2,192,000**
PERMITTING AND MITIGATION	1%				**$**	**20,000**
CONSTRUCTION TOTAL					**$**	**2,212,000**
Interest During Construction		(6 months)			**$**	**48,000**
TOTAL CAPITAL COST					**$**	**2,260,000**
ANNUAL COSTS						
Debt Service - Total Capital					$	164,000
O&M						
Transmission	1%				$	6,000
Well(s)	2.5%				$	36,000
Add Chemicals, Etc.	65,553	1000 gal	$	0.30	$	20,000
Pumping Costs					$	22,000
Total Annual Cost					**$**	**248,000**
UNIT COSTS (First 30 Years)						
Cost per ac-ft					$	1,233
Cost per 1000 gallons					$	3.78
UNIT COSTS (After 30 Years)						
Cost per ac-ft					$	418
Cost per 1000 gallons					$	1.28

Table Q-175
Ellis County-Other - New Wells Woodbine Aquifer
Ellis County, Woodbine Aquifer

Need	1,121	ac-ft/yr			
Water Depth	481	ft			
Well Depth	1484	ft			
Well Yield	100	gpm		161	ac-ft (peak)
Well Size	6	in		80.5	ac-ft (average)
Wells Needed	14				

WELLS							
Well(s)	**Number**			**Unit Cost**			
Water Wells	14		$	265,000	$	3,710,000
Connection to Transmission System	14		$	160,000	$	2,240,000
Engineering and Contingencies					$	1,785,000
Subtotal of Well(s)					**$**	**7,735,000**
PERMITTING AND MITIGATION	1%				**$**	**71,000**
CONSTRUCTION TOTAL					**$**	**7,806,000**
Interest During Construction		(6 months)			**$**	**169,000**
TOTAL CAPITAL COST					**$**	**7,975,000**
ANNUAL COSTS						
Debt Service - Total Capital					$	579,000
O&M						
Transmission	1%				$	27,000
Well(s)	2.5%				$	111,000
Add Chemicals, Etc.	365,279	1000 gal	$	0.30	$	110,000
Pumping Costs					$	74,000
Total Annual Cost					**$**	**901,000**
UNIT COSTS (First 30 Years)						
Cost per ac-ft					$	804
Cost per 1000 gallons					$	2.47
UNIT COSTS (After 30 Years)						
Cost per ac-ft					$	287
Cost per 1000 gallons					$	0.88

Table Q-176
Ellis Irrigation - New Wells
Ellis County, Woodbine Aquifer

Need	563	ac-ft/yr			
Water Depth	481	ft			
Well Depth	1484	ft			
Well Yield	100	gpm		161	ac-ft (peak)
Well Size	6	in		80.5	ac-ft (average)
Wells Needed	7				

WELLS					
Well(s)	**Number**		**Unit Cost**		
Water Wells	7		$ 265,000	$	1,855,000
Connection to Transmission System	0		$ 160,000	$	-
Engineering and Contingencies				$	557,000
Subtotal of Well(s)				**$**	**2,412,000**
PERMITTING AND MITIGATION	1%			**$**	**22,000**
CONSTRUCTION TOTAL				**$**	**2,434,000**
Interest During Construction		(6 months)		**$**	**53,000**
TOTAL CAPITAL COST				**$**	**2,487,000**
ANNUAL COSTS					
Debt Service - Total Capital				$	181,000
O&M					
Transmission	1%			$	-
Well(s)	2.5%			$	56,000
Add Chemicals, Etc.	183,454	1000 gal	$ 0.30	$	55,000
Pumping Costs				$	37,000
Total Annual Cost				**$**	**329,000**
UNIT COSTS (First 30 Years)					
Cost per ac-ft				$	584
Cost per 1000 gallons				$	1.79
UNIT COSTS (After 30 Years)					
Cost per ac-ft				$	263
Cost per 1000 gallons				$	0.81

Table Q-177
Ellis Manufacturing Additional Water from Waxahachie

Owner:	Manufacturing				
Amount:	354	Ac-Ft/Yr			

Item No. & Description	**Qty.**	**Units**	**Unit Cost**		**Total Cost**
TOTAL CAPITAL COST				**$**	**-**
ANNUAL COSTS					
Debt Service				$	-
Operation and Maintenance Costs					
Pipeline			1%	$	-
Pump Station			2.50%	$	-
Estimated Annual Power Cost/kWh			$0.09	$	-
Treated Water Cost	115,351	1000 gal	$3.49	$	403,000
Total Annual Costs				**$**	**403,000**
UNIT COSTS (First 30 Years)					
Per Acre-Foot				$	1,138
Per 1,000 Gallons				$	3.49
UNIT COSTS (After 30 Years)					
Per Acre-Foot				$	1,138
Per 1,000 Gallons				$	3.49

Table Q-178
Ellis Manufacturing Additional Water from Midlothian

Owner:	Manufacturing				
Amount:	495	Ac-Ft/Yr			

Item No. & Description	Qty.	Units	Unit Cost		Total Cost
TOTAL CAPITAL COST				**$**	**-**
ANNUAL COSTS					
Debt Service				$	-
Operation and Maintenance Costs					
Pipeline			1%	$	-
Pump Station			2.50%	$	-
Estimated Annual Power Cost/kWh			$ 0.09	$	-
Treated Water Cost	161,296	1000 gal	$ 3.05	$	492,000
Total Annual Costs				**$**	**492,000**
UNIT COSTS (First 30 Years)					
Per Acre-Foot				$	994
Per 1,000 Gallons				$	3.05
UNIT COSTS (After 30 Years)					
Per Acre-Foot				$	994
Per 1,000 Gallons				$	3.05

Table Q-179
Ellis Manufacturing Additional Water from Ennis

Owner:	Manufacturing	
Amount:	76	Ac-Ft/Yr

Item No. & Description	Qty.	Units	Unit Cost		Total Cost
TOTAL CAPITAL COST				**$**	**-**
ANNUAL COSTS					
Debt Service				$	-
Operation and Maintenance Costs					
Pipeline			1%	$	-
Pump Station			2.50%	$	-
Estimated Annual Power Cost			$ 0	$	-
Treated Water Cost	24,765	1000 gal	$ 2.67	$	66,000
Total Annual Costs				**$**	**66,000**
UNIT COSTS (First 30 Years)					
Per Acre-Foot				$	868
Per 1,000 Gallons				$	2.67
UNIT COSTS (After 30 Years)					
Per Acre-Foot				$	868
Per 1,000 Gallons				$	2.66

Table Q-180
Ellis Steam Electric Power Additional Water from Midlothian

Owner:	Ellis County-Steam Electric Power			
Amount:	118 Ac-Ft/Yr			

Item No. & Description	**Qty.**	**Units**	**Unit Cost**	**Total Cost**
TOTAL CAPITAL COST				**$ -**
ANNUAL COSTS				
Debt Service				$ -
Operation and Maintenance Costs				
Pipeline			1%	$ -
Pump Station			2.50%	$ -
Estimated Annual Power Cost			$ 0.09	$ -
Treated Water Cost	38,450	1000 gal	$ 4.52	$ 174,000
Total Annual Costs				**$ 174,000**
UNIT COSTS (First 30 Years)				
Per Acre-Foot				$ 1,475
Per 1,000 Gallons				$ 4.53
UNIT COSTS (After 30 Years)				
Per Acre-Foot				$ 1,475
Per 1,000 Gallons				$ 4.53

Table Q-181
Ladonia from UTRWD Ralph Hall Reservoir Project

Owner: Ladonia/UTRWD
Amount: 1,120 ac-ft/yr

CONSTRUCTION COSTS

TRANSMISSION FACILITIES						
Pipeline(s)	**Qty.**	**Units**	**Unit Cost**			**Total Cost**
14" Water Line						
Pipe	4,265	LF	$	52	$	222,000
ROW	4,265	LF	$	5	$	21,000
Engineering and Contingencies	30%				$	67,000
Subtotal of Pipeline(s)					**$**	**310,000**
Pump Station(s)						
Station 1						
Pump, building, & appurtenances	85	HP			$	712,000
Storage Tank	0.5	MG			$	442,000
Engineering and Contingencies	35%				$	404,000
Subtotal of Pump Station(s)					**$**	**1,558,000**
WATER TREATMENT FACILITIES						
Water Treatment Plant	2.00	MGD			$	8,200,000
Plant Expansion	0.7	MGD			$	2,030,000
Subtotal of Water Treatment Plant					**$**	**10,230,000**
PERMITTING AND MITIGATION	1%				**$**	**115,000**
CONSTRUCTION TOTAL					**$**	**12,213,000**
Interest During Construction		(18 months)			**$**	**753,000**
TOTAL CAPITAL COST					**$**	**12,966,000**

Table Q-181, Continued

ANNUAL COSTS						
Debt Service					$	942,000
Operation and Maintenance Costs						
Pipeline	1%				$	3,000
Pump Station	2.50%				$	35,000
Estimated Annual Power Cost	$0.09/kWh				$	-
WTP Operation	364,953	1000 gal	$	0.35	$	128,000
Raw Water Cost		ac-ft	$	163	$	183,000
Total Annual Costs					**$**	**1,291,000**
UNIT COSTS (First 30 Years)						
Per Acre-Foot					$	1,153
Per 1,000 Gallons					$	3.54
UNIT COSTS (After 30 Years)						
Per Acre-Foot					$	312
Per 1,000 Gallons					$	0.96

NOTE: Assume raw water costs $163 per acre-foot.

Table Q-182
Fannin County Steam Electric Power

Owner:
Amount: 8,400 Ac-Ft/Yr from Lake Texoma

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	36 in.	79,200	LF	$184	$14,573,000
Right of Way Easements (ROW)		79,200	LF	$5	$396,000
Engineering and Contingencies (30%)					$4,491,000
Subtotal of Pipeline					**$19,460,000**
Pump Station(s)					
Pump station	480 HP	1	LS	$1,984,600	$1,984,600
Ground Storage with Roof	2.5 MG	1	LS	$1,085,425	$1,085,425
Engineering and Contingencies (35%)					$1,075,000
Subtotal of Pump Station(s)					**$4,145,025**
Permitting and Mitigation					**$212,000**
CONSTRUCTION TOTAL					**$23,817,025**
Interest During Construction			**(12 months)**		**$992,455**
TOTAL COST					**$24,809,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$1,802,000
Electricity ($0.09 kWh)					$89,000
Raw Water ($.70 per 1,000 gallons)					$1,916,000
Operation & Maintenance					$86,000
Total Annual Costs					**$3,893,000**
UNIT COSTS (2010-2030)					
Per Acre-Foot					$463
Per 1,000 Gallons					$1.42
UNIT COSTS (2040-2060)					
Per Acre-Foot					$249
Per 1,000 Gallons					$0.76

Table Q-183
Fairfield - New Wells in Carrizo-Wilcox Aquifer
Freestone County, Carrizo-Wilcox Aquifer

Need	282	Ac-ft/yr	175	gpm
Depth to Water	175			
Well Depth	730			
Well Yield	350	gpm	564	ac-ft (peak)
Well Size	10	in	282	ac-ft (average)
Wells Needed	1			

Construction Costs	Quantity	Unit	Unit Price	Cost
Water Wells	1	LS	$85,200	$85,200
Connection to Transmission System	1	LS	$160,000	$160,000
Storage tank 0.1 MG	1	LS	$183,000	$183,000
Subtotal				**$428,200**
Engineering and Contingencies				$128,000
Mitigation and Permitting				$5,138
Subtotal				$561,338
Interest During Construction				$12,000
		Total Capital		**$573,338**
Debt Service - Total Capital				$41,652
O&M				
Transmission				$7,410
Well(s)				$2,556
Add Chemicals etc.	91,890	1,000 gal	$0.30	$27,567
Pumping Costs	86,000	kW-h	$0.09	$7,740
		Total Annual Cost		**$86,925**
UNIT COSTS				
Cost per ac-ft				$308
Cost per 1,000 gallons				$0.95

Table Q-184
City of Fairfield Connection to Tarrant Regional Water District (Richland-Chambers)

Owner: Fairfield
Amount: 400 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	10 in.	26,400	LF	$43	$1,135,000
Right of Way Easements (ROW)		26,400	LF	$5	$132,000
Engineering and Contingencies (30%)					$380,000
Subtotal of Pipeline					**$1,647,000**
Pump Station(s)					
Booster Pump Station	20 HP	1	LS	$564,000	$564,000
Engineering and Contingencies (35%)					$197,000
Subtotal of Pump Station(s)					**$761,000**
Water Treatment Plant					
Water Treatment Plant	0.7 MGD	1	LS	$4,060,000	$4,060,000
Engineering and Contingencies (35%)					$1,421,000
Subtotal of Water Treatment Plant					**$5,481,000**
Permitting and Mitigation					**$20,000**
CONSTRUCTION TOTAL					**$7,889,000**
Interest During Construction			**(12 months)**		**$329,000**
TOTAL COST					**$8,218,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$597,000
Electricity ($0.09 kWh)					$4,000
Raw Water ($0.72 per 1,000 gallons)					$94,000
Treatment Cost ($0.70 per 1,000 gallons)					$91,000
Operation & Maintenance					$31,000
Total Annual Costs					**$817,000**
UNIT COSTS					
Per Acre-Foot					$2,043
Per 1,000 Gallons					$6.27

Table Q-185
Teague - New Wells in Carrizo-Wilcox Aquifer
Freestone County, Carrizo-Wilcox Aquifer

Need	443	Ac-ft/yr	275	gpm
Depth to Water	175			
Well Depth	677			
Well Yield	300	gpm	483	ac-ft (peak)
Well Size	10	in	242	ac-ft (average)
Wells Needed	2			

Construction Costs

Water Wells	2		$85,200	$170,400
Connection to Transmission System	2		$160,000	$320,000
Storage tank 0.1 MG	1		$183,000	$183,000
Subtotal				$673,400
Engineering and Contingencies				$202,000
Mitigation and Permitting				$8,000
Subtotal				$883,400
Interest During Construction (6 months)				$19,000
		Total Capital		**$902,400**
Debt Service - Total Capital				$65,558
O&M				
Transmission				$9,330
Well(s)				$5,112
Add Chemicals etc.	157,712	1,000 gal	$0.30	$47,314
Pumping Costs	148,000	kW-h	$0.09	$26,640.00
		Total Annual Cost		**$153,954**

UNIT COSTS

Cost per ac-ft	$318
Cost per 1,000 gallons	$0.98

Table Q-186
City of Wortham Purchase Raw Water from Tarrant Regional Water District

Owner: Wortham
Amount: 300 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	8 in.	104,000	LF	$34	$3,578,000
Right of Way Easements (ROW)		104,000	LF	$3	$312,000
Engineering and Contingencies (30%)					$1,167,000
Subtotal of Pipeline					**$5,057,000**
Pump Station(s)					
Booster pump station	60 HP	1	LS	$664,400	$664,400
Engineering and Contingencies (35%)					$233,000
Subtotal of Pump Station(s)					**$897,400**
Permitting and Mitigation					**$51,000**
CONSTRUCTION TOTAL					**$6,005,400**
Interest During Construction			**(12 months)**		**$250,000**
TOTAL COST					**$6,255,400**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$454,000
Electricity ($0.09 kWh)					$10,000
Raw Water ($0.72 per 1,000 gallons)					$70,000
Treatment Cost ($0.70 per 1,000 gallons)					$68,000
Operation & Maintenance					$63,000
Total Annual Costs					**$665,000**
UNIT COSTS (2010-2030)					
Per Acre-Foot					$2,217
Per 1,000 Gallons					$6.80
UNIT COSTS (2040-2060)					
Per Acre-Foot					$703
Per 1,000 Gallons					$2.16

Table Q-187
City of Wortham Purchase Treated Water from Corsicana

Owner:
Amount: 300 Ac-Ft/Yr

CAPITAL COSTS	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline					
Pipeline	8 in.	104,000	LF	$34	$3,578,000
Right of Way Easements (ROW)	15 ft.	104,000	LF	$3	$312,000
Engineering and Contingencies (30%)					$1,167,000
Subtotal of Pipeline					**$5,057,000**
Pump Station(s)					
Pump station	50 HP	1	LS	$645,000	$645,000
Ground Storage with Roof	0.1 MG	1	LS	$183,000	$183,000
Engineering and Contingencies (35%)					$290,000
Subtotal of Pump Station(s)					**$1,118,000**
Permitting and Mitigation					**$53,000**
CONSTRUCTION TOTAL					**$6,228,000**
Interest During Construction			**(12 months)**		**$260,000**
TOTAL COST					**$6,488,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$471,000
Electricity ($0.09 kWh)					$6,000
Treated Water ($3.25 per 1,000 gallons)					$318,000
Operation & Maintenance					$23,000
Total Annual Costs					**$818,000**
UNIT COSTS (2010-2030)					
Per Acre-Foot					$2,727
Per 1,000 Gallons					$8.37
UNIT COSTS (2040-2060)					
Per Acre-Foot					$1,157
Per 1,000 Gallons					$3.55

Table Q-188
Freestone County S. E. Power by TRA from Tarrant Regional Water District

Owner: Unknown
Amount: 3,278 Ac-Ft/Yr

CAPITAL COSTS	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline					
Pipeline	20 in.	26,400	LF	$90	$2,376,000
Right of Way Easements (ROW)		26,400	LF	$5	$132,000
Engineering and Contingencies (30%)					$752,000
Subtotal of Pipeline					**$3,260,000**
Pump Station(s)					
Booster Pump Station	160 HP	1	LS	$967,600	$967,600
Engineering and Contingencies (35%)					$339,000
Subtotal of Pump Station(s)					**$1,306,600**
Permitting and Mitigation					**$40,000**
CONSTRUCTION TOTAL					**$4,606,600**
Interest During Construction			**(12 months)**		**$192,000**
TOTAL COST					**$4,798,600**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$349,000
Electricity ($0.09 kWh)					$75,000
Raw Water ($0.72 per 1,000 gallons)					$769,000
Operation & Maintenance					$58,000
Total Annual Costs					**$1,251,000**
UNIT COSTS (during amortization)					
Per Acre-Foot					$382
Per 1,000 Gallons					$1.17

Table Q-189
Trinity River Authority Freestone County Reuse for Steam Electric Power

Owner: Trinity River Authority
Amount: 6,672 ac-ft/yr

CAPITAL COSTS

Phase 1

	Size	Quantity	Units	Unit Price	Cost
Transmission Facilities					
Pipeline (Rural)	24 in.	79,200	LF	$116	$ 9,195,000
Right of Way Easements (Rural)	20 ft.	79,200.0	LF	$5	$ 396,000
Pipeline Eng &Contingencies (30%)					$ 2,759,000
Pipeline Subtotal					**$ 12,350,000**
Pump Station (Intake)	700 HP	1	LS	$3,021,000	$ 3,021,000
Engineering and Contingencies (35%)					$ 1,057,000
Pump Station Subtotal					**$ 4,078,000**
Permitting and Mitigation					**$ 147,000**
Interest During Construction			**(12 months)**		**$ 691,000**
TOTAL CAPITAL COST					**$ 17,266,000**

ANNUAL COSTS

	Cost
Debt Service (6%, 30 years)	$ 1,254,000
Pipeline O&M (1%)	$ 110,000
Pump O&M (2.5%)	$ 91,000
Electricity	$ 188,000
Purchase of Reuse Water	$ 543,768
TOTAL ANNUAL COST	**$ 2,186,768**
Phase 1 Unit Costs (Pre-Amortization)	
Cost per acre-ft	$ 312
Cost per 1000 gallons	$ 0.96
Phase 1 Unit Costs (After Amortization)	
Cost per acre-ft	$ 133
Cost per 1000 gallons	$ 0.41

Table Q-190
Denison Infrastructure Improvements

Owner: Denison
Amount: 0 Ac-Ft/Yr

Item No. & Description	Qty.	Units	Unit Cost		Total Cost	
Construction Costs						
New 2 MG Clearwell	1	LS	$	1,850,000	$	1,850,000
Randell WTP improvements	1	LS	$	1,025,000	$	1,025,000
Pipeline from Texoma to Lake Randell	1	LS	$	400,000	$	400,000
New intake and pump station at Lake Randell	1	LS	$	3,500,000	$	3,500,000
Lake Randell spillway and dam improvements	1	LS	$	3,000,000	$	3,000,000
Subtotal Construction					**$**	**9,775,000**
Permitting and Mitigation	1%				$	117,000
Engineering, Contingency, Construction Management, Financial and Legal Costs					$	3,401,000
Capital Cost Subtotal					**$**	**13,293,000**
Interest During Construction		(12 months)				$554,000
TOTAL CAPITAL COST					**$**	**13,847,000**
ANNUAL COSTS						
Debt Service					$	1,006,000
Operation & Maintenance					$	164,000
Total Annual Costs					**$**	**1,170,000**

Table Q-191
Southmayd - New or Purchased Wells
Grayson County, Woodbine Aquifer

Need	60	ac-ft/yr		
Water Depth	300	ft		
Well Depth	486	ft		
Well Yield	80	gpm	129	ac-ft (peak)
Well Size	6	in	64.5	ac-ft (average)
Wells Needed	1			

WELLS							
Well(s)	**Number**			**Unit Cost**			
Water Wells	1		$	140,750	$	141,000
Connection to Transmission System	1		$	131,600	$	131,600
Engineering and Contingencies					$	82,000
Subtotal of Well(s)					**$**	**354,600**
PERMITTING AND MITIGATION	1%				**$**	**3,000**
CONSTRUCTION TOTAL					**$**	**357,600**
Interest During Construction		(6 months)			**$**	**8,000**
TOTAL CAPITAL COST					**$**	**365,600**
ANNUAL COSTS						
Debt Service - Total Capital					$	27,000
O&M						
Transmission	1%				$	1,579
Well(s)	2.5%				$	4,230
Add Chemicals, Etc.	19,551	1000 gal	$	0.30	$	5,900
Pumping Costs					$	2,600
Total Annual Cost					**$**	**41,309**
UNIT COSTS (First 30 Years)						
Cost per ac-ft					$	688
Cost per 1000 gallons					$	2.11
UNIT COSTS (After 30 Years)						
Cost per ac-ft					$	238
Cost per 1000 gallons					$	0.73

Table Q-192
Grayson Manufacturing - Purchase Water from Howe

Owner:	Manufacturing	
Amount:	48	Ac-Ft/Yr

Item No. & Description	Qty.	Units	Unit Cost		Total Cost
TOTAL CAPITAL COST				**$**	**-**
ANNUAL COSTS					
Debt Service				$	-
Treated Water Cost	15,641	1000 gal	$ 3.75	$	58,700
Total Annual Costs				**$**	**58,700**
UNIT COSTS (First 30 Years)					
Per Acre-Foot				$	1,223
Per 1,000 Gallons				$	3.75
UNIT COSTS (After 30 Years)					
Per Acre-Foot				$	1,223
Per 1,000 Gallons				$	3.75

Note: Raw water is assumed to cost $163 per acre-foot.

Table Q-193
Bryson to Graham

Owner: Bryson
Quantity: 200 AF/Y

CONSTRUCTION COSTS
TRANSMISSION FACILITIES

Pipeline	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline Rural	6 in.	50,000	LF	$26	$1,300,000
Right of Way Easements Rural (ROW)		50,000	LF	$3	$150,000
Engineering and Contingencies (30%)					$390,000
Subtotal of Pipeline					**$1,840,000**
Pump Station(s)					
Booster Pump Station	60 HP	1	LS	$664,400	$664,000
Engineering and Contingencies (35%)					$232,000
Subtotal of Pump Station(s)					**$896,000**
Ground Storage					
Ground Storage Tanks at Booster	60,000	1	Gal	$65,800	$66,000
Engineering and Contingencies (35%)					$23,000
Subtotal of Ground Storage					**$89,000**
CONSTRUCTION TOTAL					**$2,825,000**
Permitting and Mitigation					**$24,000**
Interest During Construction			**(12 months)**		**$118,000**
TOTAL COST					**$2,967,000**
ANNUAL COSTS					
Debt Service (6% for 20 years)					$216,000
Electricity ($0.09 kWh)					$5,000
Operation & Maintenance					$38,000
Raw Water Purchase		65,200	1000 gal	$ 0.50	$32,600
Total Annual Costs					**$291,600**
UNIT COSTS (Until Amortized)					
Per Acre-Foot of treated water					$1,458
Per 1,000 Gallons					$4.47
UNIT COSTS (After Amortization)					
Per Acre-Foot					$378
Per 1,000 Gallons					$1.16

Table Q-194
Connecting Bryson to Jacksboro (Lost Creek/Jacksboro System)

Owner: City of Jacksboro
Amount: 200 Ac-Ft/Yr

CONSTRUCTION COSTS

TRANSMISSION FACILITIES

CAPITAL COSTS	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
New pipeline	8 in.	84,480	LF	$34	$2,872,000
15-ft Right of Way Easements (ROW)		84,480	LF	$3	$253,000
Engineering and Contingencies (30%)					$938,000
Subtotal of Pipeline					**$4,063,000**
Pump Station	50 HP	1	LS	$645,000	$645,000
Engineering and Contingencies (35%)					$226,000
Subtotal of Pump Station(s)					**$871,000**
CONSTRUCTION TOTAL					**$4,934,000**
Permitting and Mitigation					**$42,000**
Interest During Construction			**(12 months)**		**$206,000**
TOTAL COST					**$5,182,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$344,000
Electricity ($0.09 kWh)					$6,600
Operation & Maintenance					$53,000
Raw Water Purchase ($0.50 per 1,000 gallons)					$33,000
Total Annual Costs					**$436,600**
UNIT COSTS (2010-2030)					
Per Acre-Foot					$2,183
Per 1,000 Gallons					$6.70
UNIT COSTS (2040-2060)					
Per Acre-Foot					$463
Per 1,000 Gallons					$1.42

Table Q-195
Jack County-Other Transmission System

Owner: unknown
Amount: 300 Ac-Ft/Yr

CAPITAL COSTS	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline					
Pipeline	10 in.	53,000	LF	$43	$2,279,000
Right of Way Easements (ROW)		53,000	LF	$5	$265,000
Engineering and Contingencies (30%)					$763,000
Subtotal of Pipeline					**$3,307,000**
Pump Station(s)					
Pumps with intake & building	35 HP	1	LS	$612,600	$612,600
Ground Storage with Roof	0.1 MG	1	LS	$183,000	$183,000
Engineering and Contingencies (35%)					$278,000
Subtotal of Pump Station(s)					**$1,073,600**
Permitting and Mitigation					**$37,000**
CONSTRUCTION TOTAL					**$4,417,600**
Interest During Construction			**(12 months)**		**$184,000**
TOTAL COST					**$4,601,600**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$334,000
Electricity ($0.09 kWh)					$6,800
Treated Water ($2.00 per 1,000 gallons)					$196,000
Operation & Maintenance					$45,000
Total Annual Costs					**$581,800**
UNIT COSTS (2010-2030)					
Per Acre-Foot					$1,939
Per 1,000 Gallons					$5.95
UNIT COSTS (2040-2060)					
Per Acre-Foot					$826
Per 1,000 Gallons					$2.53

Table Q-196
Henderson County Steam Electric Power - Transmission Facilities from Cedar Creek Lake (TRWD)

Owner:	Unknown	
Quantity:	6,726	AF/Y

CONSTRUCTION COSTS
TRANSMISSION FACILITIES

Pipeline	Size	Quantity	Unit	Unit Price	Cost
Pipeline Rural	24 in.	53,000	LF	$116	$6,148,000
Right of Way Easements Rural (ROW)		53,000	LF	$5	$265,000
Engineering and Contingencies (30%)					$1,844,000
Subtotal of Pipeline					**$8,257,000**
Pump Station(s)					
Booster Pump Station	1000 HP	1	LS	$2,870,000	$2,870,000
Engineering and Contingencies (35%)					$1,005,000
Subtotal of Pump Station(s)					**$3,875,000**
Ground Storage					
Ground Storage Tanks at Booster	2.0 MG	1	LS	$957,000	$957,000
Engineering and Contingencies (35%)					$335,000
Subtotal of Ground Storage					**$1,292,000**
CONSTRUCTION TOTAL					**$13,424,000**
Permitting and Mitigation					**$120,000**
Interest During Construction			**(12 months)**		**$559,000**
TOTAL COST					**$14,103,000**
ANNUAL COSTS					
Debt Service (6% for 20 years)					$1,025,000
Electricity ($0.09 kWh)					$153,000
Operation & Maintenance					$189,000
Raw Water Purchase		2,192,676	1000 gal	$ 0.72	$1,578,727
Total Annual Costs					**$2,945,727**
UNIT COSTS (Until Amortized)					
Per Acre-Foot of treated water					$438
Per 1,000 Gallons					$1.34
UNIT COSTS (After Amortization)					
Per Acre-Foot					$286
Per 1,000 Gallons					$0.88

Table Q-197
Pipeline from Crandall to Seagoville (DWU)

Owner: Crandall
Amount: 2,400 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	12 in.	33,264	LF	$52	$1,716,000
Right of Way Easements (ROW)		33,264	LF	$12	$399,000
Engineering and Contingencies (30%)					$635,000
Subtotal of Pipeline					**$2,750,000**
Pump Station(s)					
Booster Pump Station	700 HP	1	LS	$2,268,000	$2,268,000
Engineering and Contingencies (35%)					$794,000
Subtotal of Pump Station(s)					**$3,062,000**
Permitting and Mitigation					**$48,000**
CONSTRUCTION TOTAL					**$5,860,000**
Interest During Construction (12 months)					**$244,000**
TOTAL COST					**$6,104,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$443,000
Electricity ($0.09 kWh)					$63,000
Treated water Demand Charge		2 MGD		$179,991 per MGD	$359,982
Treated water Volume Charge	782,042			$0.38 per 1,000 gal	$299,209
Operation & Maintenance					$89,000
Total Annual Costs					**$1,254,191**
UNIT COSTS					
Per Acre-Foot					$523
Per 1,000 Gallons					$1.60

Table Q-198
Kaufman County Irrigation - Pipeline with Reuse from NTMWD

Owner: Unknown
Amount: 1,805 Ac-Ft/Yr

CAPITAL COSTS	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline					
Pipeline	14 in.	31,680	LF	$60	$1,907,000
Right of Way Easements (ROW)		31,680	LF	$12	$380,000
Engineering and Contingencies (30%)					$686,000
Subtotal of Pipeline					**$2,973,000**
Pump Station(s)					
Booster Pump Station	50 HP	2	Ea	$645,000	$1,290,000
Engineering and Contingencies (35%)					$452,000
Subtotal of Pump Station(s)					**$1,742,000**
Permitting and Mitigation					**$38,000**
CONSTRUCTION TOTAL					**$4,753,000**
Interest During Construction (12 months)					**$198,000**
TOTAL COST					**$4,951,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$360,000
Electricity ($0.09 kWh)					$9,000
Reuse Water ($0.25 per 1,000 gallons)					$147,108
Operation & Maintenance					$62,000
Total Annual Costs					**$578,108**
UNIT COSTS					
Per Acre-Foot					$320
Per 1,000 Gallons					$0.98

Table Q-199
Kaufman County Steam Electric Power Pipeline for Forney/Garland

Owner: Forney/Garland
Amount: 6,621 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	24 in.	26,400	LF	$116	$3,065,000
Right of Way Easements (ROW)		26,400	LF	$12	$317,000
Engineering and Contingencies (30%)					$1,015,000
Subtotal of Pipeline					**$4,397,000**
Pump Station(s)					
Booster Pump Station	600 HP	1	LS	$ 2,150,000	$2,150,000
Engineering and Contingencies (35%)					$753,000
Subtotal of Pump Station(s)					**$2,903,000**
Permitting and Mitigation					**$63,000**
CONSTRUCTION TOTAL					**$7,363,000**
Interest During Construction					**$307,000**
TOTAL COST					**$7,670,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$557,000
Electricity ($0.09 kWh)					$123,000
Reuse Water ($0.25 per 1,000 gallons)					$539,612
Operation & Maintenance					$102,000
Total Annual Costs					**$1,321,612**
UNIT COSTS					
Per Acre-Foot					$200
Per 1,000 Gallons					$0.61

Table Q-200
Kaufman County Steam Electric Power Pipeline for Treated Water from Forney (NTMWD)

Owner: NTMWD
1,121 ac-ft/yr

CAPITAL COSTS

	Size	Quantity	Units	Unit Price	Cost
Transmission Facilities					
Pipeline NTMWD	14 in.	15,840	LF	$60	$ 954,000
Right of Way Easements (Suburban)		15,840	LF	$12	$ 190,000
Pipeline Eng &Contingencies (30%)					$ 286,000
Pipeline Subtotal					**$ 1,430,000**
Pump Station	70 HP	1	LS	$683,800	$ 683,800
Engineering and Contingencies (35%)					$ 239,000
Pump Station Subtotal					**$ 922,800**
Permitting and Mitigation					**$ 20,000**
Interest During Construction			**(12 months)**		**$ 99,000**
TOTAL CAPITAL COST					**$ 2,471,800**

ANNUAL COSTS

	Cost
Debt Service (6%, 30 years)	$ 180,000
Pipeline O&M (1%)	$ 11,000
Pump O&M (2.5%)	$ 21,000
Electricity ($0.09 kWh)	$ 17,000
Reuse Water ($0.25 per 1,000 gallons)	$ 91,362
TOTAL ANNUAL COST	**$ 320,362**
Phase 1 Unit Costs (Pre-Amortization)	
Cost per acre-ft	$ 286
Cost per 1000 gallons	$ 0.88
Phase 1 Unit Costs (After Amortization)	
Cost per acre-ft	$ 125
Cost per 1000 gallons	$ 0.38

Table Q-201
Trinity River Authority Kaufman County Reuse for Steam Electric Power

Owner: Trinity River Authority
1,000 ac-ft/yr

CAPITAL COSTS

	Size	Quantity	Units	Unit Price	Cost
Transmission Facilities					
Pipeline (Suburban)	16 in.	79,200	LF	$69	$ 5,449,000
Right of Way Easements (Suburban)		79,200	LF	$12	$ 950,000
Pipeline Eng &Contingencies (30%)					$ 1,635,000
Pipeline Subtotal					**$ 8,034,000**
Pump Station	80 HP	1	LS	$933,076	$ 933,076
Engineering and Contingencies (35%)					$ 327,000
Pump Station Subtotal					**$ 1,260,076**
Permitting and Mitigation					**$ 77,000**
Interest During Construction			**(12 months)**		**$ 390,000**
TOTAL CAPITAL COST					**$ 9,761,076**

ANNUAL COSTS

	Cost
Debt Service (6%, 30 years)	$ 709,000
Pipeline O&M (1%)	$ 65,000
Pump O&M (2.5%)	$ 28,000
Electricity	$ 17,000
Purchase of Reuse Water	$ 82,000
TOTAL ANNUAL COST	**$ 901,000**
Phase 1 Unit Costs (Pre-Amortization)	
Cost per acre-ft	$ 901
Cost per 1000 gallons	$ 2.77
Phase 1 Unit Costs (After Amortization)	
Cost per acre-ft	$ 192
Cost per 1000 gallons	$ 0.59

Table Q-202
Ables Springs WSC - Connection to NTMWD Tawakoni Plant

Owner:	Ables Springs WSC	
Amount:	280	Ac-Ft/Yr

Total Construction Costs*	**$1,012,000**
Total Engineering Costs*	**$118,640**
Total Other Costs*	**$5,000**
TOTAL COST	**$1,135,640**
ANNUAL COSTS	
Debt Service (6% for 30 years)	$83,000
Electricity ($0.09 kWh)	$4,000
Treated Water ($1.30 per 1,000 gallons)	$119,000
Operation & Maintenance	$24,000
Total Annual Costs	**$230,000**
UNIT COSTS (Until Amortized)	
Per Acre-Foot of treated water	$821
Per 1,000 Gallons	$2.52
UNIT COSTS (After Amortization)	
Per Acre-Foot	$525
Per 1,000 Gallons	$1.61

Table Q-202, Continued
Upsize Existing NTMWD Delivery System

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Upsize Pipeline	16 in.	10,900	LF	$69	$752,000
Engineering and Contingencies (30%)					$226,000
Subtotal of Pipeline					**$978,000**
Pump Station					
Booster Pump Station	100 HP	1	LS	$742,000	$742,000
Ground Storage Tank	0.2 MG	1	LS	$246,750	$246,750
Engineering and Contingencies (35%)					$346,000
Subtotal of Pump Station(s)					**$1,334,750**
Permitting and Mitigation					**$21,000**
CONSTRUCTION TOTAL					**$2,333,750**
Interest During Construction (12 months)					**$97,000**
TOTAL COST					**$2,430,750**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$177,000
Electricity ($0.09 kWh)					$29,000
Treated Water ($1.30 per 1,000 gallons)					$828,000
Operation & Maintenance					$39,000
Total Annual Costs					**$1,073,000**
UNIT COSTS (Until Amortized)					
Per Acre-Foot of treated water					$549
Per 1,000 Gallons					$1.68
UNIT COSTS (After Amortization)					
Per Acre-Foot					$535
Per 1,000 Gallons					$1.64

*Cost estimate provided by Ables Springs WSC

Table Q-203
Upsizing of College Mound WSC line to Terrell

Owner: College Mound WSC
Amount: 1,400 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	12 in.	18,480	LF	$52	$954,000
Engineering and Contingencies (30%)					$286,000
Subtotal of Pipeline					**$1,240,000**
Pump Station(s)					
Booster Pump Station	140 HP	1	LS	$ 892,400	$892,400
Engineering and Contingencies (35%)					$312,000
Subtotal of Pump Station(s)					**$1,204,400**
Permitting and Mitigation					**$22,000**
CONSTRUCTION TOTAL					**$2,466,400**
Interest During Construction (12 months)					**$103,000**
TOTAL COST					**$2,569,400**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$187,000
Electricity ($0.09 kWh)					$26,000
Treated Water ($1.25 per 1,000 gallons)					$570,000
Operation & Maintenance					$38,000
Total Annual Costs					**$821,000**
UNIT COSTS					
Per Acre-Foot					$586
Per 1,000 Gallons					$1.80

Table Q-204
Forney Pump Station Capacity Increase in 2020 and 2040

Owner: Forney
Amount: 33,600 Ac-Ft/Yr

	Size	Quantity	Unit	Unit Cost	Cost
Total Capital Cost of Pump Station Expansions*	15 MGD	2	LS	$5,000,000	**$10,000,000**
ANNUAL COSTS (During Amortization					
Debt Service (6% for 30 years)					$726,000
Operation & Maintenance					$300,000
Total Annual Costs					**$1,026,000**

*Cost estimates provided by the City of Forney's engineer

Table Q-205
Terrell - New water line from Terrell to CR 305

Owner: Terrell
Amount: 10,000 acre-feet/year

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline*					
Pipeline	30 in.	4,700	LF	$223	$1,048,100
Boring and Casing	48 in.	300	LF	$1,091	$327,300
Subtotal of Pipeline					**$1,375,400**
Contingency (25%)*					$343,850
Engineering/Survey (13%)*					$223,503
CONSTRUCTION TOTAL					**$1,942,800**
Interest During Construction (12 months)					**$81,000**
TOTAL COST					**$2,023,800**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$147,000
Electricity ($0.09 kWh)					$117,000
Treated Water ($1.30 per 1,000 gallons)					$4,236,000
Operation & Maintenance					$17,000
Total Annual Costs					**$4,517,000**
UNIT COSTS (Until Amortized)					
Per Acre-Foot of treated water					$452
Per 1,000 Gallons					$1.39
UNIT COSTS (After Amortization)					
Per Acre-Foot					$437
Per 1,000 Gallons					$1.34

* Values obtained from City of Terrell's Impact Fee Update : Water CIP Costs

Table Q-206
Terrell - New line off of NTMWD delivery line to serve wholesale customers

Owner: Terrell
Amount: 7,000 acre-feet/year

CAPITAL COSTS	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline*	20 in.	1,000	LF	$149	$149,000
Water meter & Appurtenances*		1	LS	$200,000	$200,000
Subtotal of Pipeline					**$349,000**
Contingency (25%)*					$87,250
Engineering/Survey (16%)*					$69,910
CONSTRUCTION TOTAL					**$506,200**
Interest During Construction (12 months)					**$21,000**
TOTAL COST					**$527,200**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$38,000
Electricity ($0.09 kWh)					$81,000
Treated Water ($1.30 per 1,000 gallons)					$2,965,000
Operation & Maintenance					$4,000
Total Annual Costs					**$3,088,000**
UNIT COSTS (Until Amortized)					
Per Acre-Foot of treated water					$441
Per 1,000 Gallons					$1.35
UNIT COSTS (After Amortization)					
Per Acre-Foot					$436
Per 1,000 Gallons					$1.34

* Values obtained from City of Terrell's Impact Fee Update : Water CIP Costs

Table Q-207
Terrell - New line off of NTMWD delivery line to serve wholesale customers

Owner: Terrell
Amount: 7,000 acre-feet/year

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline*	20 in.	2,000	LF	$149	$298,000
Boring and Casing*	30 in.	200	LF	$577	$115,400
Subtotal of Pipeline					**$413,400**
Contingency (25%)*					$103,350
Engineering/Survey (16%)*					$80,420
CONSTRUCTION TOTAL					**$597,200**
Interest During Construction (12 months)					**$25,000**
TOTAL COST					**$622,200**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$45,000
Electricity ($0.09 kWh)					$83,000
Treated Water ($1.30 per 1,000 gallons)					$2,965,000
Operation & Maintenance					$5,000
Total Annual Costs					**$3,098,000**
UNIT COSTS (Until Amortized)					
Per Acre-Foot of treated water					$443
Per 1,000 Gallons					$1.36
UNIT COSTS (After Amortization)					
Per Acre-Foot					$436
Per 1,000 Gallons					$1.34

* Values obtained from City of Terrell's Impact Fee Update : Water CIP Costs

Table Q-208
Terrell - New line off of NTMWD delivery line to serve wholesale customers

Owner: Terrell
Amount: 4,500 acre-feet/year

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline*	16 in.	2,000	LF	$119	$238,000
Water meter & Appurtenances*		1	LS	$200,000	$200,000
Subtotal of Pipeline					**$438,000**
Contingency (25%)*					$109,500
Engineering/Survey (15%)*					$84,580
CONSTRUCTION TOTAL					**$632,100**
Interest During Construction (12 months)					**$26,000**
TOTAL COST					**$658,100**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$48,000
Electricity ($0.09 kWh)					$55,000
Treated Water ($1.30 per 1,000 gallons)					$1,906,000
Operation & Maintenance					$5,000
Total Annual Costs					**$2,014,000**
UNIT COSTS (Until Amortized)					
Per Acre-Foot of treated water					$448
Per 1,000 Gallons					$1.37
UNIT COSTS (After Amortization)					
Per Acre-Foot					$437
Per 1,000 Gallons					$1.34

* Values obtained from City of Terrell's Impact Fee Update : Water CIP Costs

Table Q-209
Terrell - Ground Storage Tank and Pump Station Expansions at existing NTMWD Delivery Point

Owner: Terrell
Amount: 10,000 Ac-Ft/Yr

CAPITAL COSTS	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pump Station Expansion*	6 MGD	1	LS	$496,000	$496,000
Ground Storage Tank*	3.0 MG	1	LS	$2,170,000	$2,170,000
Subtotal of Pump Station(s)					**$2,666,000**
Contingency (25%)*					$666,500
Engineering/Survey (13%)*					$421,790
CONSTRUCTION TOTAL					**$3,754,300**
Interest During Construction (12 months)					**$156,000**
TOTAL COST					**$3,910,300**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$284,000
Electricity ($0.09 kWh)					$110,000
Treated Water ($1.30 per 1,000 gallons)					$4,236,000
Operation & Maintenance					$80,000
Total Annual Costs					**$4,710,000**
UNIT COSTS (Until Amortized)					
Per Acre-Foot of treated water					$471
Per 1,000 Gallons					$1.45
UNIT COSTS (After Amortization)					
Per Acre-Foot					$443
Per 1,000 Gallons					$1.36

* Values obtained from City of Terrell's Impact Fee Update : Water CIP Costs

Table Q-210
Terrell - Second Point of Delivery Connection to NTMWD

Owner: Terrell
Amount: 6,720 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline*					
Pipeline	30 in.	21,000	LF	$223	$4,683,000
Pipeline	24 in.	16,500	LF	$179	$2,953,500
Boring and Casing	38 in.	200	LF	$744	$148,800
Boring and Casing	48 in.	300	LF	$1,091	$327,300
Subtotal of Pipeline					**$8,112,600**
Pump Station(s)*					
Booster Pump Station		1	LS	$3,596,000	$3,596,000
Ground Storage Tank	3.0 MG	1	LS	$2,170,000	$2,170,000
Subtotal of Pump Station(s)					**$5,766,000**
Contingency (25%)*					$3,469,650
Engineering/Survey (10%)*					$1,734,830
CONSTRUCTION TOTAL					**$19,083,100**
Interest During Construction (12 months)					**$795,000**
TOTAL COST					**$19,878,100**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$1,444,000
Electricity ($0.09 kWh)					$82,000
Treated Water ($1.30 per 1,000 gallons)					$2,847,000
Operation & Maintenance					$265,000
Total Annual Costs					**$4,638,000**
UNIT COSTS (Until Amortized)					
Per Acre-Foot of treated water					$690
Per 1,000 Gallons					$2.12
UNIT COSTS (After Amortization)					
Per Acre-Foot					$475
Per 1,000 Gallons					$1.46

* Values obtained from City of Terrell's Impact Fee Update : Water CIP Costs

Table Q-211
Terrell - New line to serve wholesale customers

Owner: Terrell
Amount: 7,000 acre-feet/year

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline*	20 in.	21,000	LF	$149	$3,129,000
Boring and Casing*	32 in.	400	LF	$614	$245,600
Subtotal of Pipeline					**$3,374,600**
Contingency (25%)*					$843,650
Engineering/Survey (12%)*					$516,380
CONSTRUCTION TOTAL					**$4,734,630**
Interest During Construction (12 months)					**$197,000**
TOTAL COST					**$4,931,630**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$358,000
Electricity ($0.09 kWh)					$144,000
Treated Water ($1.30 per 1,000 gallons)					$2,965,000
Operation & Maintenance					$40,000
Total Annual Costs					**$3,507,000**
UNIT COSTS (Until Amortized)					
Per Acre-Foot of treated water					$501
Per 1,000 Gallons					$1.54
UNIT COSTS (After Amortization)					
Per Acre-Foot					$450
Per 1,000 Gallons					$1.38

* Values obtained from City of Terrell's Impact Fee Update : Water CIP Costs

Table Q-212
City of Kaufman - Pipeline to Connect to the NTMWD
Alternative WMS

Owner: Kaufman
Amount: 3,000 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	16 in.	155,760	LF	$69	$10,716,000
Right of Way Easements (ROW)		155,760	LF	$12	$1,869,000
Engineering and Contingencies (30%)					$3,776,000
Subtotal of Pipeline					**$16,361,000**
Pump Station(s)					
Booster Pump Station	750 HP	1	LS	$2,392,000	$2,392,000
Ground Storage Tank	0.7 MG	1	LS	$516,400	$516,400
Engineering and Contingencies (35%)					$1,018,000
Subtotal of Pump Station(s)					**$3,926,400**
Permitting and Mitigation					**$163,000**
CONSTRUCTION TOTAL					**$20,450,400**
Interest During Construction (12 months)					**$852,000**
TOTAL COST					**$21,302,400**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$1,548,000
Electricity ($0.09 kWh)					$164,000
Treated Water ($1.30 per 1,000 gallons)					$1,271,000
Operation & Maintenance					$216,000
Total Annual Costs					**$3,199,000**
UNIT COSTS (Until Amortized)					
Per Acre-Foot of treated water					$1,066
Per 1,000 Gallons					$3.27
UNIT COSTS (After Amortization)					
Per Acre-Foot					$550
Per 1,000 Gallons					$1.69

Table Q-213
East Parker County System - Pipeline from Weatherford to Annetta, Annetta South and Willow Park

Owner:	Unknown			
Amount:	800	Ac-Ft/Yr	Willow Park	69.6%
	250	Ac-Ft/Yr	Annetta	21.7%
	100	Ac-Ft/Yr	Annetta South	8.7%
	1,150	Ac-Ft/Yr	Total	

CAPITAL COSTS	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline					
Pipeline (everyone)	14 in.	38,000	LF	$60	$2,280,000
Right of Way Easements (ROW)		38,000	LF	$5	$190,000
Engineering and Contingencies (30%)					$741,000
Permitting and Mitigation					$27,000
Subtotal of Pipeline (everyone)					**$3,238,000**
Pipeline (Willow Park)	10 in.	8,000	LF	$43	$344,000
Right of Way Easements (ROW)		8,000	LF	$5	$40,000
Engineering and Contingencies (30%)					$115,000
Permitting and Mitigation					$4,000
Subtotal of Pipeline (Willow Park)					**$503,000**
Pipeline (Annetta & Annetta S.)	8 in.	13,300	LF	$34	$452,000
Right of Way Easements (ROW)		13,300	LF	$3	$40,000
Engineering and Contingencies (30%)					$148,000
Permitting and Mitigation					$5,000
Subtotal of Pipeline (Annetta & Annetta S.)					**$645,000**
Pipeline (Annetta S.)	6 in.	27,000	LF	$26	$702,000
Right of Way Easements (ROW)		27,000	LF	$3	$81,000
Engineering and Contingencies (30%)					$235,000
Permitting and Mitigation					$8,000
Subtotal of Pipeline (Annetta S.)					**$1,026,000**
Total of Pipeline Cost					**$5,412,000**

Willow Park portion of pipelines	*70% of 14 in line, 100% of 10 in line*	*$2,755,522*
Annetta portion of pipelines	*22% of 14 in line, 71% of 8 in line*	*$1,164,627*
Annetta S. portion of pipelines	*9% of 14 in line, 29% of 8 in line, 100% 6 in*	*$1,491,851*
		$5,412,000

Table Q-213, Continued

Pump Stations					
Booster Pump Station 1	119 HP	1	LS	$815,054	$815,054
Engineering and Contingencies (35%)					$285,000
Permitting and Mitigation					$10,000
Subtotal of Pump Station 1					**$1,110,054**
Booster Pump Station 2	47 HP	0	LS	$638,694	$0
Engineering and Contingencies (35%)					$0
Permitting and Mitigation					$0
Subtotal of Pump Station 2					**$0**
Total of Pump Stations					**$1,110,054**
Willow Park portion of P.S	*59% of P.S 1*				*$660,087*
Annetta portion of P.S	*27% of P.S 1*				*$296,507*
Annetta S. portion of P.S	*14% of P.S 1*				*$153,459*
					$1,110,054
CONSTRUCTION TOTAL					**$6,522,054**
Interest During Construction					**$272,000**
TOTAL COST					**$6,794,054**
Willow Park					*$3,558,100*
Annetta portion					*$1,522,100*
Annetta S. portion					*$1,713,900*
					$6,794,100
ANNUAL COSTS					
Willow Park					
Debt Service (6% for 30 years)					$258,000
Electricity ($0.09 kWh)					$12,000
Treated Water ($2.50 per 1,000 gallons)					$652,000
Operation & Maintenance					$40,000
Total Annual Costs					**$962,000**

Table Q-213, Continued

Annetta	
Debt Service (6% for 30 years)	$111,000
Electricity ($0.09 kWh)	$6,000
Treated Water ($2.50 per 1,000 gallons)	$204,000
Operation & Maintenance	$15,000
Total Annual Costs	**$336,000**
Annetta S.	
Debt Service (6% for 30 years)	$125,000
Electricity ($0.09 kWh)	$4,000
Treated Water ($2.50 per 1,000 gallons)	$81,000
Operation & Maintenance	$14,000
Total Annual Costs	**$224,000**

Table Q-213, Continued

TOTAL ANNUAL COSTS

Debt Service (6% for 30 years)	$494,000
Electricity ($0.09 kWh)	$22,000
Treated Water ($2.50 per 1,000 gallons)	$937,000
Operation & Maintenance	$69,000
Total Annual Costs	**$1,522,000**

UNIT COSTS

Willow Park	
Per Acre-Foot	$1,203
Per 1,000 Gallons	$3.69
Annetta	
Per Acre-Foot	$1,344
Per 1,000 Gallons	$4.12
Annetta S.	
Per Acre-Foot	$2,240
Per 1,000 Gallons	$6.87

Table Q-214
Aledo to Fort Worth (Aledo's Share of Cost for the Wholesale Water System Extension)

Probable Owner: Aledo/Fort Worth
Amount: 1,146 AF/Y (Aledo's share)

CONSTRUCTION COSTS

TRANSMISSION FACILITIES

Pipelines*	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline from Fort Worth	12 in.	7,000	LF	$77	$539,000
Pipeline Westside IV (100% Aledo)	16 in.	24,000	LF	$103	$2,472,000
Pipeline Westside IV (100% Aledo)	20 in.	14,000	LF	$135	$1,890,000
Pipeline Littlepage Ave. (22.5% Aledo)	30 in.	3,000	LF	$215	$145,000
Pipeline 9th Ave to University (8.5% Aledo)	36 in.	17,500	LF	$276	$411,000
20" Borings Fort Worth (100% Aledo)	20 in.	200	LF	$263	$53,000
36" Borings @ Westside IV (100% Aledo)	36 in.	300	LF	$474	$142,000
48" borings @ 9th Ave to University (8.5% Aledo)	48 in.	500	LF	$632	$27,000
Meter Station		1	LS	$230,313	$230,000
ROW Easements Westside IV (100% Aledo)		38,000	LF	$28	$1,064,000
ROW Easements Littlepage Ave (22.5% Aledo)		3,000	LF	$28	$19,000
ROW Easements 9th to University (8.5% Aledo)		17,500	LF	$28	$42,000
Engineering and Contingencies (30%)					$2,110,000
Subtotal of Pipelines					**$8,605,000**

Pump Station(s)*	**Size**	**Quantity**	**Unit**		**Cost**
7.5 MGD Pump Station (30% Aledo)	7.5 MGD	1	LS	$1,700,000	$510,000
Pump Station Expansion (100% Aledo)		1	Ea	$1,200,000	$1,200,000
0.5 MG Ground Storage Tank (100%)	0.5 MG	1	Ea	$438,000	$438,000
Engineering and Contingencies (35%)					$752,000
Subtotal of Pump Stations					**$2,900,000**

Permitting and mitigation		$91,000
CONSTRUCTION TOTAL		**$11,505,000**
Interest During Construction	**(18 months)**	**$710,000**
TOTAL COST (Aledo's Share)		**$12,306,000**

Table Q-214, Continued

ANNUAL COSTS	
Debt Service (6% for 30 years)	$894,000
Treated Water ($1.50 per 1,000 gallons)	$560,000
Electricity ($0.06 kWh)	$10,000
Operation & Maintenance	$123,000
Total Annual Costs	**$1,587,000**
UNIT COSTS (Until Amortized)	
Per Acre-Foot	$1,385
Per 1,000 Gallons	$4.25
UNIT COSTS (After Amortization))	
Per Acre-Foot	$605
Per 1,000 Gallons	$1.86

Notes:
* Costs are based on more detailed information and do match the standard pipeline and pump station costs.

Table Q-215
West Parker County System - Pipeline from BRA
to Parker County SUD

Owner: Parker County-Other
Amount: 500 Ac-Ft/Yr Parker County SUD

CAPITAL COSTS	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline					
Pipeline	10 in.	17,000	LF	$43	$731,000
Right of Way Easements (ROW)		17,000	LF	$5	$85,000
Engineering and Contingencies (30%)					$245,000
Permitting and Mitigation					$9,000
Subtotal of Pipeline					**$1,070,000**
Diversion Structure					
Brazos River diversion structure		1	EA	$300,000	$300,000
Engineering and Contingencies (35%)					$105,000
Permitting and Mitigation					$3,600
Subtotal of Diversion Structure					**$408,600**
Pump Stations					
Pump Station	22 HP	1	LS	$574,800	$574,800
Engineering and Contingencies (35%)					$201,000
Permitting and Mitigation					$7,000
Subtotal of Pump Station					**$782,800**
Water Treatment Plant					
Water Treatment Plant	1	1	LS	$3,650,000	$3,650,000
Engineering and Contingencies (35%)					$1,278,000
Land, Permitting and Mitigation					$72,000
Subtotal of Water Treatment Plant					**$5,000,000**
CONSTRUCTION TOTAL					**$7,261,400**
Interest During Construction					**$303,000**
TOTAL COST					**$7,564,400**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$550,000
Electricity ($0.09 kWh)					$5,000
Raw Water ($0.7 per 1,000 gallons)					$114,000
Treatment costs ($1.24 per 1,000 gallons)					$202,000
Operation & Maintenance					$30,000
Total Annual Costs					**$901,000**
UNIT COSTS					
Per Acre-Foot					$1,802
Per 1,000 Gallons					$5.53

Table Q-216
Parker County Springtown - Pipeline to Walnut Creek SUD (TRWD)

Owner: Springtown
Amount: 663 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	10 in.	15,840	LF	$43	$681,000
Right of Way Easements (ROW)		15,840	LF	$12	$190,000
Engineering and Contingencies (30%)					$261,000
Subtotal of Pipeline					**$1,132,000**
Pump Station(s)					
Booster Pump Station	40 HP	1	LS	$623,400	$623,400
Engineering and Contingencies (35%)					$218,000
Subtotal of Pump Station(s)					**$841,400**
Permitting and Mitigation					**$16,000**
CONSTRUCTION TOTAL					**$1,989,400**
Interest During Construction					**$83,000**
TOTAL COST					**$2,072,400**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$151,000
Electricity ($0.09 kWh)					$7,000
Treated Water ($3.63 per 1,000 gallons)					$784,000
Operation & Maintenance					$27,000
Total Annual Costs					**$969,000**
UNIT COSTS					
Per Acre-Foot					$1,462
Per 1,000 Gallons					$4.49

Table Q-217
Parker County Steam Electric Power - Additional Weatherford

Owner: Unknown
Amount: 50 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	6 in.	26,400	LF	$26	$686,000
Right of Way Easements (ROW)		26,400	Acre	$12	$317,000
Engineering and Contingencies (30%)					$301,000
Subtotal of Pipeline					**$1,304,000**
Pump Station(s)					
Booster Pump Station	5 HP	1	LS	$516,000	$516,000
Engineering and Contingencies (35%)					$181,000
Subtotal of Pump Station(s)					**$697,000**
Permitting and Mitigation					**$14,000**
CONSTRUCTION TOTAL					**$2,015,000**
Interest During Construction					**$84,000**
TOTAL COST					**$2,099,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$152,000
Electricity ($0.06 kWh)					$1,000
Reuse Water ($.25 per 1,000 gallons)					$4,000
Operation & Maintenance					$23,000
Total Annual Costs					**$180,000**
UNIT COSTS					
Per Acre-Foot					$3,600
Per 1,000 Gallons					$11.05

Table Q-218
Blackland WSC Purchase Treated Water from North Texas MWD

Owner: Blackland WSC
Amount: 700 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	12 in.	20,000	LF	$52	$1,040,000
Meter		1	LS	$200,000	$200,000
Right of Way Easements (ROW)		20,000	LF	$12	$240,000
Engineering and Contingencies (30%)					$444,000
Subtotal of Pipeline					**$1,924,000**
Pump Station(s)					
Ground Storage with Roof	1.2 MG	1	LS	$698,800	$698,800
Engineering and Contingencies (35%)					$245,000
Subtotal of Pump Station(s)					**$943,800**
Permitting and Mitigation					**$21,000**
CONSTRUCTION TOTAL					**$2,888,800**
Interest During Construction			**(18 months)**		**$178,000**
TOTAL COST					**$3,066,800**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$223,000
Treated Water ($1.30 per 1,000 gallons)					$297,000
Electricity ($0.09 kWh)					$11,000
Operation & Maintenance					$12,000
Total Annual Costs					**$543,000**
UNIT COSTS (2010-2030)					
Per Acre-Foot					$776
Per 1,000 Gallons					$2.38
UNIT COSTS (2040-2060)					
Per Acre-Foot					$457
Per 1,000 Gallons					$1.40

Table Q-219
RCH WSC Purchase Treated Water from North Texas MWD

Owner: RCH WSC
Amount: 500 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	10 in.	16,000	LF	$43	$688,000
Meter		1	LS	$200,000	$200,000
Right of Way Easements (ROW)		16,000	LF	$12	$192,000
Engineering and Contingencies (30%)					$324,000
Subtotal of Pipeline					**$1,404,000**
Pump Station(s)					
Ground Storage with Roof	1.0 MG	1	LS	$634,000	$634,000
Engineering and Contingencies (35%)					$222,000
Subtotal of Pump Station(s)					**$856,000**
Permitting and Mitigation					**$16,000**
CONSTRUCTION TOTAL					**$2,276,000**
Interest During Construction			**(18 months)**		**$140,000**
TOTAL COST					**$2,416,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$176,000
Treated Water ($1.30 per 1,000 gallons)					$212,000
Electricity ($0.09 kWh)					$8,000
Operation & Maintenance					$8,000
Total Annual Costs					**$404,000**
UNIT COSTS (2010-2030)					
Per Acre-Foot					$808
Per 1,000 Gallons					$2.48
UNIT COSTS (2040-2060)					
Per Acre-Foot					$456
Per 1,000 Gallons					$1.40

Table Q-220
Bethesda Parallel Pipeline to Fort Worth

Probable Owner:		Bethesda/Fort Worth
Amount:	4,000	ac-ft/yr

CONSTRUCTION COSTS

TRANSMISSION FACILITIES

Pipelines	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline (16 in.)	16 in.	65,500	LF	$103	$6,747,000
Pipeline (20 in.)	20 in.	11,400	LF	$135	$1,539,000
ROW Easements (16 in)		65,500	LF	$28	$1,834,000
ROW Easements (20 in)		11,400	LF	$28	$319,200
Yard Piping		1	LS	$132,000	$132,000
36" Boring and casing		200	LF	$474	$95,000
Engineering and Contingencies (30%)					$3,200,000
Subtotal of Pipelines					**$13,866,200**
Storage Facility	**Size**	**Quantity**	**Unit**		**Cost**
1 MG Elevated Storage Tank	1.0 MG	1	LS	$1,742,000	$1,742,000
Engineering and Contingencies (35%)					$610,000
Subtotal of Storage Facilities					**$2,352,000**
Permitting and mitigation					$123,000
CONSTRUCTION TOTAL					**$16,341,200**
Interest During Construction	**(18 months)**				**$1,008,000**
TOTAL COST					**$17,349,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$1,260,000
Operation & Maintenance					$154,000
Treated Water ($1.50 per 1,000 gallons)					$3,421,436
Total Annual Costs					**$4,835,436**
UNIT COSTS (2010-2030)					
Per Acre-Foot					$1,209
Per 1,000 Gallons					$3.71
UNIT COSTS (2040-2060)					
Per Acre-Foot					$894
Per 1,000 Gallons					$2.74

Table Q-221
Burleson to Fort Worth (Burleson's Share of Cost to Connect to Fort Worth)

Probable Owner: Burleson/Fort Worth

CONSTRUCTION COSTS

TRANSMISSION FACILITIES

Pipelines*	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline (24 in.)	24 in.	27,000	LF	$120	$3,240,000
Pipeline (30 in.)	30 in.	37,800	LF	$150	$5,670,000
ROW Easements		30	Acres	$3,000	$90,000
Yard Piping		1	LS	$100,000	$100,000
42" Boring and casing		400	LF	$420	$168,000
48" Boring and casing		200	LF	$480	$96,000
Engineering and Contingencies (30%)					$2,809,000
Subtotal of Pipelines					**$12,173,000**
Storage Facility*	**Size**	**Quantity**	**Unit**		**Cost**
3 MGD Pump Station	3 MGD	1	LS	$1,000,000	$1,000,000
1.5 MG Elevated Storage Tank	1.5 MG	1	LS	$1,950,000	$1,950,000
Engineering and Contingencies (35%)					$1,033,000
Subtotal of Pump Stations					**$3,983,000**
Permitting and mitigation					$130,000
CONSTRUCTION TOTAL					**$16,156,000**
Interest During Construction	**(18 months)**				**$996,000**
TOTAL COST					**$17,282,000**
Fort Worth's Share (85%)					**$14,690,000**
Burleson's Share (15%)					**$2,592,000**

ANNUAL COSTS FOR BURLESON	
Debt Service (6% for 30 years)	$188,000
Operation & Maintenance	$25,000
Total Annual Costs	**$213,000**

Notes:
* Pipeline and storage tank information and costs based on information provided in Fort Worth Master Plan.

Table Q-222
Crowley to Fort Worth (Crowley's Share of Cost to Upsize Connection to Fort Worth)

Probable Owner: Crowley/Fort Worth

CONSTRUCTION COSTS

TRANSMISSION FACILITIES

Pipelines*	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline (16 in.)	16 in.	17,000	LF	$80	$1,360,000
Pipeline (24 in.)	24 in.	8,500	LF	$120	$1,020,000
Pipeline (30 in.)	30 in.	13,500	LF	$150	$2,025,000
ROW Easements		18	Acres	$3,000	$54,000
Engineering and Contingencies (30%)					$1,338,000
Subtotal of Pipelines					**$5,797,000**
Permitting and mitigation					$53,000
CONSTRUCTION TOTAL					**$5,797,000**
Interest During Construction	**(18 months)**				**$358,000**
TOTAL COST					**$6,208,000**
Fort Worth's Share (90%)					**$5,587,000**
Crowley's Share (10%)					**$621,000**
ANNUAL COSTS FOR CROWLEY					
Debt Service (6% for 30 years)					$45,000
Operation & Maintenance					$5,000
Total Annual Costs					**$50,000**

Notes:
* Pipeline and storage tank information and costs based on information provided in Fort Worth Master Plan.

Table Q-223
Kennedale - New Well in Trinity Aquifer
Tarrant County, Trinity Aquifer

Need	216	Ac-ft/yr	134	gpm
Depth to Water	473			
Well Depth	1450			
Well Yield	270	gpm	435	ac-ft (peak)
Well Size	10	in	218	ac-ft (average)
Wells Needed	1			

Construction Costs				
	Number		Unit Cost	Total Cost
Water Wells	1		$375,000	$375,000
Connection to Transmission System	1		$160,000	$160,000
Engineering and Contingencies (30%)				$161,000
Subtotal of Well(s)				**$696,000**
Permitting and Mitigation				$6,000
Construction Total				$702,000
Interest During Construction	6 months			$15,000
Total Capital Cost				**$717,000**
Debt Service - Total Capital				$52,000
O&M				
Transmission	1%			$2,000
Well(s)	2.5%			$11,000
Add Chemicals etc.	70,384	$0.30	per 1000 gal	$21,100
Pumping Costs				$14,000
		Total Annual Cost		**$100,100**
UNIT COSTS (First 30 Years)				
Cost per ac-ft				$463
Cost per 1000 gallons				$1.42
UNIT COSTS (After 30 Years)				
Cost per ac-ft				$223
Cost per 1000 gallons				$0.68

Table Q-224
Tarrant County Kennedale - Additional Fort Worth

Owner: Kennedale
Amount: 196 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline					$0
Right of Way Easements (ROW)					$0
Engineering and Contingencies (30%)					$0
Subtotal of Pipeline					**$0**
Pump Station(s)					
Booster Pump Station					$0
Engineering and Contingencies (35%)					$0
Subtotal of Pump Station(s)					**$0**
Permitting and Mitigation					**$0**
CONSTRUCTION TOTAL					**$0**
Interest During Construction					**$0**
TOTAL COST					**$0**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$0
Electricity ($0.09 kWh)					$0
Treated Water ($1.50 per 1,000 gallons)					$96,000
Operation & Maintenance					$0
Total Annual Costs					**$96,000**
UNIT COSTS					
Per Acre-Foot					$490
Per 1,000 Gallons					$1.50

Table Q-225
Tarrant County Kennedale - Pipeline to Arlington

Owner: Kennedale
Amount: 705 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	10 in.	9,400	LF	$43	$404,000
Right of Way Easements (ROW)		9,400	LF	$5	$47,000
Engineering and Contingencies (30%)					$135,000
Subtotal of Pipeline					**$586,000**
Pump Station(s)					
Booster Pump Station	20 HP	1	LS	$564,000	$564,000
Engineering and Contingencies (35%)					$197,000
Subtotal of Pump Station(s)					**$761,000**
Permitting and Mitigation					**$12,000**
CONSTRUCTION TOTAL					**$1,359,000**
Interest During Construction					**$57,000**
TOTAL COST					**$1,416,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$103,000
Electricity ($0.09 kWh)					$3,000
Treated Water ($1.50 per 1,000 gallons)					$345,000
Operation & Maintenance					$22,000
Total Annual Costs					**$473,000**
UNIT COSTS					
Per Acre-Foot					$671
Per 1,000 Gallons					$2.06

Table Q-226
Lakeside - New Well in Trinity Aquifer
Tarrant County, Trinity Aquifer

Need	264	Ac-ft/yr	164	gpm
Depth to Water	473			
Well Depth	1450			
Well Yield	330	gpm	531	ac-ft (peak)
Well Size	10	in	266	ac-ft (average)
Wells Needed	1			

Construction Costs

	Number			Unit Cost	Total Cost
Water Wells	1			$333,750	$333,750
Connection to Transmission System	1			$160,000	$160,000
Engineering and Contingencies (30%)					$148,000
Subtotal of Well(s)					**$641,750**
Permitting and Mitigation					$6,000
Construction Total					$647,750
Interest During Construction	6	months			$14,000
Total Capital Cost					**$661,750**
Debt Service - Total Capital					$48,000
O&M					
Transmission	1%				$2,000
Well(s)	2.5%				$10,000
Add Chemicals etc.	86,025	$0.30	per 1000 gal		$25,800
Pumping Costs					$17,000
		Total Annual Cost			**$102,800**

UNIT COSTS (First 30 Years)

Cost per ac-ft	$389
Cost per 1000 gallons	$1.20

UNIT COSTS (After 30 Years)

Cost per ac-ft	$208
Cost per 1000 gallons	$0.64

Table Q-227
Tarrant County Lakeside - Pipeline to Azle (TRWD)

Owner:	Lakeside				
Amount:	579 Ac-Ft/Yr				

CAPITAL COSTS	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline					
Pipeline	10 in.	31,000	LF	$43	$1,333,000
Right of Way Easements (ROW)		31,000	LF	$5	$155,000
Engineering and Contingencies (30%)					$446,000
Subtotal of Pipeline					**$1,934,000**
Pump Station(s)					
Booster Pump Station	45 HP	1	LS	$634,200	$634,200
Engineering and Contingencies (35%)					$222,000
Subtotal of Pump Station(s)					**$856,200**
Permitting and Mitigation					**$24,000**
CONSTRUCTION TOTAL					**$2,814,200**
Interest During Construction					**$117,000**
TOTAL COST					**$2,931,200**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$213,000
Electricity ($0.09 kWh)					$8,000
Treated Water ($2 per 1,000 gallons)					$377,000
Operation & Maintenance					$35,000
Total Annual Costs					**$633,000**
UNIT COSTS					
Per Acre-Foot					$1,093
Per 1,000 Gallons					$3.36

Table Q-228
North Richland Hills from Fort Worth

Probable Owner: North Richland Hills
Amount 3,323 Ac-ft/yr

Capital Costs*	**Description**	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Pipeline (24 in.)	Proposed 24" Water Line	24 in.	9,450	LF	$156	$1,474,200
40" Boring and Casing	along Watauga Road	40 in.	300	LF	$615	$184,500
Pavement Repair			7,560	LF	$50	$378,000
Pump Station Expansion	Watauga Pump Station		1	LS	$1,750,000	$1,750,000
Ground Storage Tank	Improvements	5.0 MG	1	LS	$2,750,000	$2,750,000
Pipeline (30")	Offsite Water Supply	30 in.	5,900	LS	$195	$1,150,500
40" Boring and Casing	Improvements from Fort	40 in.	500	LF	$615	$307,500
Pavement Repair	Worth		4,720	LF	$50	$236,000
New Wholesale Meter			1	LS	$200,000	$200,000
Subtotal						$8,430,700
Engineering and Contingencies (20%)						$1,686,140
Subtotal						$10,116,840
Eng/Survey (12%)						$1,214,021
CONSTRUCTION TOTAL						**$11,331,000**
Interest During Construction		**(12 months)**				**$472,000**
TOTAL COST						**$11,803,000**
ANNUAL COSTS						
Debt Service (6% for 30 years)						$857,000
Treated Water ($2 per 1,000 gallons)						$2,166,000
Operation & Maintenance						$166,000
Total Annual Costs						**$3,189,000**
UNIT COSTS (First 30 years)						
Per Acre-Foot						$960
Per 1,000 Gallons						$2.95
UNIT COSTS (After 30 years)						
Per Acre-Foot						$702
Per 1,000 Gallons						$2.15

Notes:
* Capital Costs obtained from the North Richland Hills Capital Improvements Plan

Table Q-229
Tarrant County Pantego - Pipeline to Fort Worth

Owner: Pantego
Amount: 100 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	6 in.	5,300	LF	$26	$138,000
Right of Way Easements (ROW)		5,300	LF	$21	$111,000
Engineering and Contingencies (30%)					$75,000
Subtotal of Pipeline					**$324,000**
Pump Station(s)					
Booster Pump Station	4 HP	1	LS	$516,000	$516,000
Engineering and Contingencies (35%)					$181,000
Subtotal of Pump Station(s)					**$697,000**
Permitting and Mitigation					**$8,000**
CONSTRUCTION TOTAL					**$1,029,000**
Interest During Construction					**$43,000**
TOTAL COST					**$1,072,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$78,000
Electricity ($0.09 kWh)					$800
Treated Water ($1.79 per 1,000 gallons)					$58,000
Operation & Maintenance					$17,000
Total Annual Costs					**$153,800**
UNIT COSTS					
Per Acre-Foot					$1,538
Per 1,000 Gallons					$4.72

Table Q-230
Tarrant County Pantego - Pipeline to Arlington

Owner: Pantego
Amount: 100 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	4 in.	5,300	LF	$26	$138,000
Right of Way Easements (ROW)		5,300	LF	$21	$111,000
Engineering and Contingencies (30%)					$75,000
Subtotal of Pipeline					**$324,000**
Pump Station(s)					
Booster Pump Station	4 HP	1	LS	$516,000	$516,000
Engineering and Contingencies (35%)					$181,000
Subtotal of Pump Station(s)					**$697,000**
Permitting and Mitigation					**$8,000**
CONSTRUCTION TOTAL					**$1,029,000**
Interest During Construction					**$43,000**
TOTAL COST					**$1,072,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$78,000
Electricity ($0.09 kWh)					$400
Treated Water ($1.79 per 1,000 gallons)					$58,000
Operation & Maintenance					$17,000
Total Annual Costs					**$153,400**
UNIT COSTS					
Per Acre-Foot					$1,534
Per 1,000 Gallons					$4.71

Table Q-231
Tarrant County Pelican Bay - Pipeline to Azle (TRWD)

Owner: Pelican Bay
Amount: 157 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	8 in.	13,000	LF	$34	$442,000
Right of Way Easements (ROW)	15 ft.	13,000	LF	$5	$65,000
Engineering and Contingencies (30%)					$152,000
Subtotal of Pipeline					**$659,000**
Pump Station(s)					
Booster Pump Station	6 HP	1	LS	$520,400	$520,400
Engineering and Contingencies (35%)					$182,000
Subtotal of Pump Station(s)					**$702,400**
Permitting and Mitigation					**$12,000**
CONSTRUCTION TOTAL					**$1,373,400**
Interest During Construction					**$57,000**
TOTAL COST					**$1,430,400**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$104,000
Electricity ($0.09 kWh)					$2,000
Treated Water ($2 per 1,000 gallons)					$102,000
Operation & Maintenance					$21,000
Total Annual Costs					**$229,000**
UNIT COSTS					
Per Acre-Foot					$1,459
Per 1,000 Gallons					$4.48

Table Q-232
Tarrant County S. E. Power - Direct Reuse from Fort Worth

Owner: Unknown
Amount: 2,600 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	24 in.	52,800	LF	$116	$6,125,000
Right of Way Easements (ROW)		52,800	LF	$5	$264,000
Engineering and Contingencies (30%)					$1,917,000
Subtotal of Pipeline					**$8,306,000**
Pump Station(s)					
Booster Pump Station	200 HP	1	LS	$1,118,000	$1,118,000
Engineering and Contingencies (35%)					$391,000
Subtotal of Pump Station(s)					**$1,509,000**
Permitting and Mitigation					**$87,000**
CONSTRUCTION TOTAL					**$9,902,000**
Interest During Construction			**(12 months)**		**$413,000**
TOTAL COST					**$10,315,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$749,000
Electricity ($0.09 kWh)					$41,000
Reuse Water ($0.25 per 1,000 gallons)					$212,000
Operation & Maintenance					$108,000
Total Annual Costs					**$1,110,000**
UNIT COSTS (Pre-Amortization)					
Per Acre-Foot					$427
Per 1,000 Gallons					$1.31
UNIT COSTS (Post Amortization)					
Per Acre-Foot					$139
Per 1,000 Gallons					$0.43

Table Q-233
TRWD Reuse for Tarrant County Irrigation

Owner: Tarrant County Irrigation
Amount: 1,327 Ac-Ft/Yr

CAPITAL COSTS	**Size**	**Quantity**	**Unit**	**Unit Price**	**Cost**
Cost of Pipeline	12 in	26,400	LF	$ 77	$2,033,000
Right of Way Easements (ROW)		26,400	LF	$ 12	$317,000
Engineering & Contingencies (30%)					$610,000
Total Pipeline Cost					**$2,960,000**
Cost of Pump Station	180 HP	1	LS	$ 1,042,800	$1,043,000
Engineering & Contingencies (35%)					$365,000
Total Pump Station Cost					**$1,408,000**
TOTAL CAPITAL COST					**$4,368,000**
Permitting and Mitigation					**$37,000**
Interest during Construction (12 months)					**$182,000**
Total Raw Water Delivery Capital Cost					**$4,587,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$333,000
Electricity ($0.09 kWh)					$36,000
Operation & Maintenance					$56,000
Purchase of Reuse Water					$108,000
Total Annual Costs					**$533,000**
UNIT COSTS (During Amortization)					
Per Acre-Foot					$402
Per 1,000 gallons					$1.23
UNIT COSTS (During Amortization)					
Per Acre-Foot					$151
Per 1,000 gallons					$0.46

Note: Cost to purchase reuse water is assumed to be $0.25 per thousand gallons.

Table Q-234
Wise County Alvord - Pipeline to Chico (TRWD)

Owner: Alvord
Amount: 150 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	6 in.	39,400	LF	$26	$1,024,000
Right of Way Easements (ROW)		39,400	LF	$5	$197,000
Engineering and Contingencies (30%)					$366,000
Subtotal of Pipeline					**$1,587,000**
Pump Station(s)					
Booster Pump Station	50 HP	1	LS	$645,000	$645,000
Engineering and Contingencies (35%)					$226,000
Subtotal of Pump Station(s)					**$871,000**
Permitting and Mitigation					**$20,000**
CONSTRUCTION TOTAL					**$2,478,000**
Interest During Construction					**$103,000**
TOTAL COST					**$2,581,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$188,000
Electricity ($0.09 kWh)					$2,000
Treated Water ($2 per 1,000 gallons)					$98,000
Operation & Maintenance					$31,000
Total Annual Costs					**$319,000**
UNIT COSTS					
Per Acre-Foot					$2,127
Per 1,000 Gallons					$6.53

Table Q-235
Wise County Aurora - Pipeline to Rhome

Owner: Aurora
Amount: 120 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	6 in.	9,979	LF	$26	$259,000
Right of Way Easements (ROW)		9,979	LF	$5	$50,000
Engineering and Contingencies (30%)					$93,000
Subtotal of Pipeline					**$402,000**
Pump Station(s)					
Booster Pump Station		1	LS	$591,000	$591,000
Ground storage Tank	0.04 MG	1	LS	$125,000	$125,000
Engineering and Contingencies (35%)					$251,000
Subtotal of Pump Station(s)					**$967,000**
Permitting and Mitigation					**$12,000**
CONSTRUCTION TOTAL					**$1,381,000**
Interest During Construction					**$58,000**
TOTAL COST					**$1,439,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$105,000
Electricity ($0.09 kWh)					$400
Operation & Maintenance					$24,000
Total Annual Costs					**$129,400**
UNIT COSTS					
Per Acre-Foot					$1,078
Per 1,000 Gallons					$3.31

Table Q-236
Bridgeport Pump Station Capacity Increase

Owner: Bridgeport
Amount: Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pump Station(s)					
Pump Station Upgrade		1	LS	$658,000	$658,000
Engineering and Contingencies (35%)					$230,000
Subtotal of Pump Station(s)					**$888,000**
CONSTRUCTION TOTAL					**$888,000**
Interest During Construction			**(6 months)**		**$19,000**
TOTAL COST					**$907,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$66,000
Operation & Maintenance					$20,000
Total Annual Costs					**$86,000**

Table Q-237
Bridgeport Parallel Pipeline Connection to TRWD in 2020

Owner: Bridgeport
Amount: 2,319 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Parallel pipeline to Bridgeport	24 in.	26,000	LF	$116	$3,016,000
Right of Way Easements (ROW)		26,000	LF	$5	$130,000
Engineering and Contingencies (30%)					$944,000
Subtotal of Pipeline					**$4,090,000**
Pump Station(s)					
Pump Station with Intake Structure	70 HP	1	LS	$742,000	$742,000
Engineering and Contingencies (35%)					$260,000
Subtotal of Pump Station(s)					**$1,002,000**
Permitting and Mitigation					**$45,000**
CONSTRUCTION TOTAL					**$5,137,000**
Interest During Construction			**(12 months)**		**$214,000**
TOTAL COST					**$5,351,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$389,000
Electricity ($0.09 kWh)					$19,300
Operation & Maintenance					$58,000
Total Annual Costs					**$466,300**
UNIT COSTS (2010-2030)					
Per Acre-Foot					$201
Per 1,000 Gallons					$0.62
UNIT COSTS (2040-2060)					
Per Acre-Foot					$33
Per 1,000 Gallons					$0.10

Table Q-238
Wise County Chico - Pipeline to Bridgeport

Owner: Chico
Amount: 230 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	10 in.	34,200	LF	$43	$1,471,000
Right of Way Easements (ROW)		34,200	LF	$5	$171,000
Engineering and Contingencies (30%)					$493,000
Subtotal of Pipeline					**$2,135,000**
Pump Station(s)					
Booster Pump Station	10 HP	1	LS	$538,000	$538,000
Engineering and Contingencies (35%)					$188,000
Subtotal of Pump Station(s)					**$726,000**
Permitting and Mitigation					**$24,000**
CONSTRUCTION TOTAL					**$2,885,000**
Interest During Construction					**$120,000**
TOTAL COST					**$3,005,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$218,000
Electricity ($0.09 kWh)					$2,000
Treated Water ($2 per 1,000 gallons)					$150,000
Operation & Maintenance					$34,000
Total Annual Costs					**$404,000**
UNIT COSTS					
Per Acre-Foot					$1,757
Per 1,000 Gallons					$5.39

Table Q-239
Wise County Decatur - Parallel Pipeline to Bridgeport

Owner: Decatur/Wise County WSD
Amount: 3,631 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	24 in.	68,640	LF	$116	$7,962,000
Right of Way Easements (ROW)		68,640	LF	$5	$343,000
Engineering and Contingencies (30%)					$2,492,000
Subtotal of Pipeline					**$10,797,000**
Pump Station(s)					
Booster Pump Station	300 HP	1	LS	$1,441,000	$1,441,000
Engineering and Contingencies (35%)					$504,000
Subtotal of Pump Station(s)					**$1,945,000**
Permitting and Mitigation					**$113,000**
CONSTRUCTION TOTAL					**$12,855,000**
Interest During Construction					**$536,000**
TOTAL COST					**$13,391,000**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$973,000
Electricity ($0.09 kWh)					$65,000
Operation & Maintenance					$139,000
Total Annual Costs					**$1,177,000**
UNIT COSTS					
Per Acre-Foot					$324
Per 1,000 Gallons					$0.99

Table Q-240
Wise County New Fairview - Pipeline to Rhome

Owner: New Fairview
Amount: 318 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	10 in.	23,540	LF	$43	$1,012,000
Right of Way Easements (ROW)		23,540	LF	$5	$118,000
Engineering and Contingencies (30%)					$339,000
Subtotal of Pipeline					**$1,469,000**
Pump Station(s)					
Booster Pump Station	5 HP	1	LS	$516,000	$516,000
Ground storage Tank	0.1 MG	1	LS	$171,400	$171,400
Engineering and Contingencies (35%)					$241,000
Subtotal of Pump Station(s)					**$928,400**
Permitting and Mitigation					**$20,000**
CONSTRUCTION TOTAL					**$2,417,400**
Interest During Construction					**$101,000**
TOTAL COST					**$2,518,400**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$183,000
Electricity ($0.09 kWh)					$1,000
Operation & Maintenance					$33,000
Total Annual Costs					**$217,000**
UNIT COSTS					
Per Acre-Foot					$682
Per 1,000 Gallons					$2.09

Table Q-241
Wise County Newark - Pipeline to Rhome

Owner: Newark
Amount: 564 Ac-Ft/Yr

CAPITAL COSTS	Size	Quantity	Unit	Unit Price	Cost
Pipeline					
Pipeline	10 in.	20,000	LF	$43	$860,000
Right of Way Easements (ROW)		20,000	LF	$5	$100,000
Engineering and Contingencies (30%)					$288,000
Subtotal of Pipeline					**$1,248,000**
Pump Station(s)					
Booster Pump Station	20 HP	1	LS	$564,000	$564,000
Ground storage Tank	0.17 MG	1	LS	$186,975	$186,975
Engineering and Contingencies (35%)					$263,000
Subtotal of Pump Station(s)					**$1,013,975**
Permitting and Mitigation					**$19,000**
CONSTRUCTION TOTAL					**$2,280,975**
Interest During Construction					**$95,000**
TOTAL COST					**$2,375,975**
ANNUAL COSTS					
Debt Service (6% for 30 years)					$173,000
Electricity ($0.09 kWh)					$2,000
Operation & Maintenance					$33,000
Total Annual Costs					**$208,000**
UNIT COSTS					
Per Acre-Foot					$369
Per 1,000 Gallons					$1.13

Table Q-242
Wise County Steam Electric Power Pipeline for Bridgeport Reuse by 2040

Owner: Unknown
Amount: 2,000 AF/Y

CAPITAL COSTS

Phase 1 (2020)

	Size	Quantity	Units	Unit Price		Cost	
Transmission Facilities							
Pipeline Bridgeport	20 in.	21,120	LF	$	90	$	1,901,000
Right of Way Easements		21,120	LF	$	5	$	106,000
Pipeline Eng &Contingencies (30%)						$	570,000
Pipeline Subtotal						**$**	**2,577,000**
Pump Station	150 HP	1	LS	$	930,000	$	930,000
Engineering and Contingencies (35%)						$	326,000
Pump Station Subtotal						**$**	**1,256,000**
Permitting and Mitigation						**$**	**34,000**
Interest During Construction			**(12 months)**			**$**	**161,000**
TOTAL CAPITAL COST						**$**	**4,028,000**

Phase 1 ANNUAL COSTS

	Size	Quantity	Units	Unit Price	Cost	
Debt Service (6%, 30 years)					$	293,000
Pipeline O&M (1%)					$	23,000
Pump O&M (2.5%)					$	28,000
Electricity					$	20,000
Reuse Water ($0.25 per 1,000 gallons)					$	163,000
TOTAL ANNUAL COST					**$**	**527,000**

Phase 1 Unit Costs (Pre-Amortization)

Cost per acre-ft	$	264
Cost per 1000 gallons	$	0.81

Phase 1 Unit Costs (After Amortization)

Cost per acre-ft	$	117
Cost per 1000 gallons	$	0.36

Table Q-243
Wise County Steam Electric Power Pipeline for Decatur Reuse by 2040

Owner: Unknown
Amount: 2,000 AF/Y

CAPITAL COSTS

Phase 1 (2020)

	Size	Quantity	Units	Unit Price			Cost
Transmission Facilities							
Pipeline Decatur	20 in.	21,120	LF	$	90	$	1,901,000
Right of Way Easements		21,120	LF	$	5	$	106,000
Pipeline Eng &Contingencies (30%)						$	570,000
Pipeline Subtotal						**$**	**2,577,000**
Pump Station	150 HP	1	LS	$	930,000	$	930,000
Engineering and Contingencies (35%)						$	326,000
Pump Station Subtotal						**$**	**1,256,000**
Permitting and Mitigation						**$**	**34,000**
Interest During Construction			**(12 months)**			**$**	**161,000**
TOTAL CAPITAL COST						**$**	**4,028,000**

Phase 1 ANNUAL COSTS

	Size	Quantity	Units	Unit Price	Cost	
Debt Service (6%, 30 years)					$	293,000
Pipeline O&M (1%)					$	23,000
Pump O&M (2.5%)					$	28,000
Electricity					$	20,000
Reuse Water ($0.25 per 1,000 gallons)					$	163,000
TOTAL ANNUAL COST					**$**	**527,000**

Phase 1 Unit Costs (Pre-Amortization)

Cost per acre-ft	$	264
Cost per 1000 gallons	$	0.81

Phase 1 Unit Costs (After Amortization)

Cost per acre-ft	$	117
Cost per 1000 gallons	$	0.36

Table Q-244
Blooming Grove - New Well in Trinity Aquifer
Navarro County, Trinity Aquifer

Need	160	Ac-ft/yr	99	gpm
Depth to Water	400	ft		
Well Depth	3000	ft		
Well Yield	112	gpm	180	ac-ft (peak)
Well Size	8	in	90	ac-ft (average)
Wells Needed	1			

Total capital cost of well and treatment facility*				**$1,495,400**
Annual Cost (6% for 30 years)				$108,639
O&M				
Well				$44,862
Add Chemicals etc.	29,327	1,000 gal	$0.30	$8,798
Pumping Costs	55,000	kW-h	$0.09	$4,950
		Total Annual Cost		**$167,249**
UNIT COSTS				
Cost per ac-ft				$1,858
Cost per 1,000 gallons				$5.70

*Cost is based on information provided by Blooming Grove

Table Q-245
Navarro Mills WSC - New Well in Woodbine Aquifer
Navarro County, Woodbine Aquifer

Need	180	Ac-ft/yr	112	gpm
Depth to Water	259	ft		
Well Depth	1500	ft		
Well Yield	112	gpm	180	ac-ft (peak)
Well Size	8	in	90	ac-ft (average)
Wells Needed	1			

Total capital cost of well*				**$1,200,000**
Annual Cost (6% for 30 years)				$87,179
O&M				
Well				$36,000
Add Chemicals etc.	29,327	1,000 gal	$0.30	$8,798
Pumping Costs	38,000	kW-h	$0.09	$3,420
		Total Annual Cost		**$135,397**
UNIT COSTS (First 30 years)				
Cost per ac-ft				$1,504
Cost per 1,000 gallons				$4.62
UNIT COSTS (After 30 years)				
Cost per ac-ft				$536
Cost per 1,000 gallons				$1.64

*Cost is based on information provided by Navarro Mills WSC

Table Q-246
M E N WSC - New Well in Other Aquifer (Alternative WMS)
Navarro County, Other Aquifer

Need	2,240	Ac-ft/yr	1,389	gpm
Depth to Water	175			
Well Depth	730			
Well Yield	1,389	gpm	2,240	ac-ft (peak)
Well Size	15	in	1,120	ac-ft (average)
Wells Needed	1			

Construction Costs	Quantity	Unit	Unit Price	Cost
Water Wells*	1	LS	$1,500,000	$1,500,000
Booster pump station*	1	LS	$500,000	$500,000
Transmission system*	1	LS	$1,500,000	$1,500,000
Total Capital Cost				**$3,500,000**
Debt Service - Total Capital				$254,271
O&M				
Transmission				$51,000
Well(s)				$45,000
Add Chemicals etc.	364,953	1,000 gal	$0.30	$109,486
Pumping Costs	343,000	kW-h	$0.09	$30,870
		Total Annual Cost		**$490,627**
UNIT COSTS				
Cost per ac-ft				$438
Cost per 1,000 gallons				$1.34

*Cost estimate provided by M E N WSC's engineer

Table Q-247
Chatfield WSC - New Well in Other Aquifer (Alternative WMS)
Navarro County, Other Aquifer

Need	2,240	Ac-ft/yr	1,389	gpm
Depth to Water	175			
Well Depth	730			
Well Yield	1,389	gpm	2,240	ac-ft (peak)
Well Size	15	in	1,120	ac-ft (average)
Wells Needed	1			

Construction Costs	Quantity	Unit	Unit Price	Cost
Water Wells*	1	LS	$1,500,000	$1,500,000
Booster pump station*	1	LS	$500,000	$500,000
Transmission system*	1	LS	$1,500,000	$1,500,000
Total Capital Cost				**$3,500,000**
Debt Service - Total Capital				$254,271
O&M				
Transmission				$51,000
Well(s)				$45,000
Add Chemicals etc.	364,953	1,000 gal	$0.30	$109,486
Pumping Costs	343,000	kW-h	$0.09	$30,870
		Total Annual Cost		**$490,627**
UNIT COSTS				
Cost per ac-ft				$438
Cost per 1,000 gallons				$1.34

*Cost estimate provided by Chatfield WSC's engineer

Table Q-248
Upsizing of M E N WSC Lake Halbert Connection

Owner: M E N WSC
Amount: 600 AF/Y

CAPITAL COSTS

	Size	Quantity	Units	Unit Price	Cost
Transmission Facilities					
Pipeline (Rural)	12 in.	10,560	LF	$52	$545,000
Right of Way Easements	20 ft.	10,560	LF	$5	$52,800
Pipeline Eng. & Contingencies (30%)					$179,000
Pipeline Subtotal					**$776,800**
New 12" Tap & Metering Facilities					
New 12" Tap & Metering Facilities		1	LS	$250,000	$250,000
Engineering and Contingencies (35%)					$88,000
Tap & Metering Subtotal					**$338,000**
Elevated Storage Tank					
Elevated Storage Tank	0.5 MG	1	LS	$1,333,000	$1,333,000
Engineering and Contingencies (35%)					$467,000
Storage Subtotal					**$1,800,000**
Permitting and Mitigation					**$23,000**
Interest During Construction			**(6 months)**		**$64,000**
TOTAL CAPITAL COST					**$3,001,800**

ANNUAL COSTS

	Cost
Debt Service (6%, 30 years)	$218,000
Pipeline O&M (1%)	$7,000
Storage and Metering O&M (2.5%)	$47,000
Treated Water ($3.25 per 1,000 gallons)	$635,700
TOTAL ANNUAL COST	**$907,700**
Unit Costs (First 30 years)	
Cost per acre-ft	$1,513
Cost per 1000 gallons	$4.64
Unit Costs (After 30 years)	
Cost per acre-ft	$1,150
Cost per 1000 gallons	$3.53

Table Q-249
Chatfield WSC 2 MGD WTP on Cedar Creek Reservoir
Alternative WMS

Owner:	Chatfield WSC
Amount:	1,120 AF/Y

CAPITAL COSTS

	Cost
Transmission Facilities*	$1,000,000
WTP*	$3,500,000
Total Capital Cost	**$4,500,000**

ANNUAL COSTS

	Cost
Debt Service (6%, 30 years)	$327,000
Pipeline O&M (1%)	$12,000
Raw Water ($.72 per 1,000 gallons)	$262,886
TOTAL ANNUAL COST	**$601,886**

Unit Costs (First 30 years)	
Cost per acre-ft	$537
Cost per 1000 gallons	$1.65
Unit Costs (After 30 years)	
Cost per acre-ft	$245
Cost per 1000 gallons	$0.75

*Cost estimate provided by Chatfield WSC's engineer

Table Q-250
M E N WSC 2 MGD WTP on Cedar Creek Reservoir
Alternative WMS

Owner:	M E N WSC
Amount:	1,120 AF/Y

CAPITAL COSTS

	Cost
Transmission Facilities*	$1,000,000
WTP*	$3,500,000
Total Capital Cost	**$4,500,000**

ANNUAL COSTS

	Cost
Debt Service (6%, 30 years)	$327,000
Pipeline O&M (1%)	$12,000
Raw Water ($.72 per 1,000 gallons)	$262,886
TOTAL ANNUAL COST	**$601,886**

Unit Costs (First 30 years)	
Cost per acre-ft	$537
Cost per 1000 gallons	$1.65
Unit Costs (After 30 years)	
Cost per acre-ft	$245
Cost per 1000 gallons	$0.75

*Cost estimate provided by M E N WSC's engineer

Table Q-251
Chatfield WSC WTP on Richland-Chambers Reservoir
Alternative WMS

Owner:	Chatfield WSC	
Amount:	1,120	AF/Y

CAPITAL COSTS

	Cost
Transmission Facilities*	$500,000
WTP*	$3,500,000
Total Capital Cost	**$4,000,000**

ANNUAL COSTS

	Cost
Debt Service (6%, 30 years)	$291,000
Pipeline O&M (1%)	$6,000
Raw Water ($.72 per 1,000 gallons)	$262,886
TOTAL ANNUAL COST	**$559,886**

Unit Costs (First 30 years)

Cost per acre-ft	$500
Cost per 1000 gallons	$1.53

Unit Costs (After 30 years)

Cost per acre-ft	$240
Cost per 1000 gallons	$0.74

*Cost estimate provided by Chatfield WSC's engineer

Table Q-252
M E N WSC WTP on Richland-Chambers Reservoir
Alternative WMS

Owner:	M E N WSC	
Amount:	1,120	AF/Y

CAPITAL COSTS	
	Cost
Transmission Facilities*	$500,000
WTP*	$3,500,000
Total Capital Cost	**$4,000,000**

ANNUAL COSTS	
	Cost
Debt Service (6%, 30 years)	$291,000
Pipeline O&M (1%)	$6,000
Raw Water ($.72 per 1,000 gallons)	$262,886
TOTAL ANNUAL COST	**$559,886**

Unit Costs (First 30 years)	
Cost per acre-ft	$500
Cost per 1000 gallons	$1.53

Unit Costs (After 30 years)	
Cost per acre-ft	$240
Cost per 1000 gallons	$0.74

*Cost estimate provided by M E N WSC's engineer

Table Q-253
1.5 MGD Water Treatment Plant Expansion at Lake Athens

Probable Owner: Athens MWA
Amount: 840 Acre-Feet/Year
Expansion at Lake Athens 840 ac-ft/yr 1.5 MGD design

CONSTRUCTION COSTS				
Modify Fish Hatchery Intake	1	LS	$1,000,000	$1,000,000
Engineering and Contingencies (35%)				$350,000
Subtotal of Intake Modifications				**$1,350,000**
Pump Station(s)				
Expand intake at Athens by 1.5 MGD	1	LS	$197,000	$197,000
Engineering and Contingencies (35%)				$69,000
Subtotal of Pump Station(s)				**$266,000**
Permitting and Mitigation	1	LS		$14,400
WATER TREATMENT FACILITIES				
Additional Treatment Capacity at Lake	1.5	MGD		$4,025,000
Engineering and Contingencies (35%)				$1,409,000
Subtotal of Treatment				**$5,434,000**
Permitting of treatment plant				$48,300
CONSTRUCTION TOTAL				**$7,112,700**
Interest During Construction		**(12 months)**		**$296,000**
TOTAL CAPITAL COST				**$7,408,700**

Table Q-253, Continued

ANNUAL COSTS TREATED WATER			
Debt Service (6% for 30 years)			$538,200
Electricity ($0.09 kWh)			$15,000
Facility Operation & Maintenance			$23,900
Water Treatment ($.70/1,000 gal finished water)	840	af/y	$191,600
Total Annual Costs			**$768,700**
UNIT COSTS (During Amortization)			
Per Acre-Foot of treated water			$915
Per 1,000 Gallons of treated water			$2.81
UNIT COSTS (After Amortization)			
Per Acre-Foot of treated water			$274
Per 1,000 Gallons of treated water			$0.84

Table Q-254
Melissa - South Water Take Point Project (Supply from NTMWD)*

Owner:	Melissa					
Amount:	0	Ac-Ft/Yr				

Item No. & Description	Qty.	Units		Unit Cost		Total Cost
Construction Costs						
Construction Costs	1	LS	$	1,500,000	$	1,500,000
Easement, surveying and legal	1	LS	$	5,240	$	5,240
Program Management	1	LS	$	36,050	$	36,050
Subtotal Construction					**$**	**1,541,290**
Permitting and Mitigation	1%					
Engineering, Contingency, Construction Management, Financial and Legal Costs					$	297,250
Capital Cost Subtotal					**$**	**1,838,540**
Interest During Construction		(12 months)				$77,000
TOTAL CAPITAL COST					**$**	**1,915,540**
ANNUAL COSTS						
Debt Service					$	139,200
Operation & Maintenance					$	-
Total Annual Costs					**$**	**139,200**

* Costs provided by City of Melissa's Engineer

Table Q-255
Springtown - New Well in Trinity Aquifer
Parker County, Trinity Aquifer

Need	184	Ac-ft/yr	114	gpm
Depth to Water	310			
Well Depth	370			
Well Yield	114	gpm	184	ac-ft (peak)
Well Size	8	in	92	ac-ft (average)
Wells Needed	1			

Construction Costs

	Number		Unit Cost	Total Cost
Water Wells	1		$144,750	$144,750
Connection to Transmission System	1		$160,000	$160,000
Engineering and Contingencies (30%)				$91,000
Subtotal of Well(s)				**$395,750**
Permitting and Mitigation				$4,000
Construction Total				$399,750
Interest During Construction	6	months		$9,000
Total Capital Cost				**$408,750**
Debt Service - Total Capital				$30,000
O&M				
Transmission	1%			$2,000
Well(s)	2.5%			$4,000
Add Chemicals etc.	59,957	$0.30	per 1000 gal	$18,000
Pumping Costs				$8,000
		Total Annual Cost		**$62,000**
UNIT COSTS (First 30 Years)				
Cost per ac-ft				$337
Cost per 1000 gallons				$1.03
UNIT COSTS (After 30 Years)				
Cost per ac-ft				$174
Cost per 1000 gallons				$0.53

Table Q-256
Payne Springs - New Well in Carrizo-Wilcox Aquifer
Henderson County, Carrizo-Wilcox Aquifer

Need	154	Ac-ft/yr	95	gpm
Depth to Water	200			
Well Depth	240			
Well Yield	95	gpm	154	ac-ft (peak)
Well Size	6	in	77	ac-ft (average)
Wells Needed	1			

Construction Costs

	Number		Unit Cost	Total Cost
Water Wells	1		$122,000	$122,000
Connection to Transmission System	1		$160,000	$160,000
Engineering and Contingencies (30%)				$85,000
Subtotal of Well(s)				**$367,000**
Permitting and Mitigation				$3,000
Construction Total				$370,000
Interest During Construction	6	months		$8,000
Total Capital Cost				**$378,000**
Debt Service - Total Capital				$27,000
O&M				
Transmission	1%			$2,000
Well(s)	2.5%			$4,000
Add Chemicals etc.	50,181	$0.30	per 1000 gal	$15,100
Pumping Costs				$5,000
		Total Annual Cost		**$53,100**
UNIT COSTS (First 30 Years)				
Cost per ac-ft				$345
Cost per 1000 gallons				$1.06
UNIT COSTS (After 30 Years)				
Cost per ac-ft				$169
Cost per 1000 gallons				$0.52

Table Q-257
Lake Worth - New Well in Trinity Aquifer
Tarrant County, Trinity Aquifer

Need	105	Ac-ft/yr	65	gpm
Depth to Water	275			
Well Depth	400			
Well Yield	65	gpm	105	ac-ft (peak)
Well Size	6	in	53	ac-ft (average)
Wells Needed	1			

Construction Costs	Number		Unit Cost	Total Cost
Water Wells	1		$150,000	$150,000
Connection to Transmission System	1		$160,000	$160,000
Engineering and Contingencies (30%)				$93,000
Subtotal of Well(s)				**$403,000**
Permitting and Mitigation				$4,000
Construction Total				$407,000
Interest During Construction	6	months		$9,000
Total Capital Cost				**$416,000**
Debt Service - Total Capital				$30,000
O&M				
Transmission	1%			$2,000
Well(s)	2.5%			$5,000
Add Chemicals etc.	34,214	$0.30	per 1000 gal	$10,300
Pumping Costs				$4,000
		Total Annual Cost		**$51,300**
UNIT COSTS (First 30 Years)				
Cost per ac-ft				$489
Cost per 1000 gallons				$1.50
UNIT COSTS (After 30 Years)				
Cost per ac-ft				$203
Cost per 1000 gallons				$0.62

Table Q-258
Little Elm - New Wells in Woodbine Aquifer
Denton County, Woodbine Aquifer

Need	410	Ac-ft/yr	254	gpm
Depth to Water	240			
Well Depth	370			
Well Yield	254	gpm	409	ac-ft (peak)
Well Size	10	in	205	ac-ft (average)
Wells Needed	1			

Construction Costs

	Number		Unit Cost	Total Cost
Water Wells	1		$154,000	$154,000
Connection to Transmission System	1		$160,000	$160,000
Engineering and Contingencies (30%)				$94,000
Subtotal of Well(s)				**$408,000**
Permitting and Mitigation				$4,000
Construction Total				$412,000
Interest During Construction	6	months		$9,000
Total Capital Cost				**$421,000**
Debt Service - Total Capital				$31,000
O&M				
Transmission	1%			$2,000
Well(s)	2.5%			$5,000
Add Chemicals etc.	133,599	$0.30	per 1000 gal	$40,100
Pumping Costs				$15,000
		Total Annual Cost		**$93,100**

UNIT COSTS (First 30 Years)	
Cost per ac-ft	$227
Cost per 1000 gallons	$0.70
UNIT COSTS (After 30 Years)	
Cost per ac-ft	$151
Cost per 1000 gallons	$0.46

APPENDIX R
SALINE STUDY

Saline Water Special Study

September 2010

Prepared for:
Region C Water Planning Group

STATE OF TEXAS
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9/2/10

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Saline Water Special Study
Region C Water Planning Group

TABLE OF CONTENTS

	Introduction	1
1.	Saline Surface Water Available to Region C	1-1
1.1	Sources	1-1
1.2	Quality	1-2
1.3	Quantities	1-7
1.4	Saline Surface Water Summary	1-17
2.	Sources of Saline Groundwater Available to Region C	2-1
2.1	Sources	2-4
2.2	Quality	2-5
2.3	Quantities	2-14
2.4	Cost Analysis for Brackish Groundwater Production, Transportation, and Treatment	2-16
2.5	Saline Groundwater Summary in Region C	2-26
3.	Survey of Operating Desalination Facilities	3-1
4.	General Water Quality and Water Quality Impacts of Brackish Supplies	4-1
4.1	Water Quality of Brackish Supplies	4-1
4.2	Potential Effects of Brackish or Partially Treated Brackish Water on Potable Infrastructure	4-2
4.3	Conclusions	4-3
5.	Analysis of Concentrate Disposal	5-1
5.1	Current Techniques	5-8
5.2	Capital and O&M Costs Associated with Each Type of Concentrate Disposal	5-20
6.	Regulatory Requirements	6-1
6.1	Regulatory Overview	6-1
6.2	Concentrate Disposal Requirements	6-5
7.	Conclusions and Recommendations	7-1

APPENDICES

Appendix A ....TDS Data for the Brazos River
Appendix B .... USGS Assessment of Selected Water Quality Data on the Lower Red River
Appendix C .... TCEQ Surface Water Quality Data – Brazos and Red River Basins
Appendix D...UNT Lake Texoma Water Quality Data
Appendix E ....TWDB Well Data
Appendix F.. Fort Worth Demand Center Cost Information
Appendix G ....Gainesville Demand Center Cost Information
Appendix H...Survey Responses
Appendix I.. Disposal Cost Models
Appendix J... Regulatory Models

LIST OF TABLES

		Page
Table 1-1	TCEQ Water Quality Data for the Brazos River	1-3
Table1-2	TCEQ Water Quality Data for the Red River	1-5
Table 1-3	Thirteen month Water Quality Data for Lake Texoma at all stations, all depths, and all sampling dates.	1-6
Table 1-4	Unappropriated Flow Estimates for Various Locations on the Brazos River	1-17
Table 2-1	Status of Brackish Groundwater in Region C	2-2
Table 2-2	Estimated Volume of Brackish Groundwater in Region C by Aquifer	2-3
Table 2-3	Estimated Brackish Groundwater Volume By Regional Water Planning Group	2-15
Table 2-4	Capital Cost for Supplying Water to Eagle Mountain Center	2-18
Table 2-5	Capital Cost for Supplying Water to Rolling Hills	2-18
Table 2-6	Existing Wells	2-19
Table 2-7	Capital Cost for Supplying Water to Gainesville Demand Center	2-19
Table 2-8	RO Pretreatment Costs	2-21
Table 2-9	Feed Pumps Cost	2-22
Table 2-10	Number of Elements Required by Permeate Flow Rate	2-23
Table 2-11	Capital Costs for RO Process	2-24
Table 2-12	O&M Costs for RO Process	2-25
Table 2-13	Cost for CIP System	2-26
Table 3-1	Summary of Survey Group	3-2
Table 4-1	Major Dissolved Salts Occurring in Brackish Waters	4-2
Table 5-1	Concentrate Disposal Options Summary	5-5
Table 5-2	Environmental Concerns Associated with Various Concentrate Management Techniques	5-6
Table 5-3	General Feasibility of Concentrate Disposal Options Relative to Concentrate Flow	5-7
Table 5-4	Injection Well Types	5-13
Table 5-5	Capital and Operation and Maintenance Cost Considerations	5-26
Table 6-1	Summary of Potential Regulatory Authorizations for a Desalination Project	6-3

Table 6-2	Injection Well Types	6-7
Table 7-1	Summary of Future Recommendations for Utilizing Additional Brackish Water in Region C	7-4

LIST OF FIGURES

		Page
Figure 1-1	Lower Red River (Reach 5)	1-2
Figure 1-2	TCEQ Water Quality Stations on the Brazos and Red Rivers	1-4
Figure 1-3	Estimated Annual Unappropriated Flow at Brazos River at South Bend	1-8
Figure 1-4	Estimated Annual Unappropriated Flow at Brazos River at Glen Rose	1-9
Figure 1-5	Estimated Annual Unappropriated Flow at Brazos River near Aquilla	1-9
Figure 1-6	Estimated Annual Unappropriated Flow at Brazos River near Bryan	1-10
Figure 1-7	Estimated Annual Unappropriated Flow at Brazos River near Hempstead	1-10
Figure 1-8	Estimated Annual Unappropriated Flow at Brazos River at Richmond	1-11
Figure 1-9	Water Availability for New Perpetual Rights	1-12
Figure 1-10	Water Availability for New Term Rights	1-13
Figure 1-11	Water Availability for New Perpetual Rights	1-15
Figure 1-12	Water Availability for New Term Rights	1-16
Figure 2-1	Groundwater Quality in the Trinity Aquifer	2-7
Figure 2-2	Section B of the Trinity Aquifer	2-8
Figure 2-3	Section C of the Trinity Aquifer	2-9
Figure 2-4	Groundwater Quality in the Nacatoch Aquifer	2-10
Figure 2-5	Section A of the Nacatoch Aquifer	2-11
Figure 2-6	Groundwater Quality in the Woodbine Aquifer	2-12
Figure 2-7	Section A of the Woodbine Aquifer	2-13
Figure 2-8	Pretreatment System Costs	2-21
Figure 2-9	500 psi Feed Pump Cost	2-22
Figure 2-10	Cost vs. Number of Membranes (500 psi)	2-24
Figure 2-11	CIP System Cost	2-26
Figure 3-1	Temperature Survey Data	3-5
Figure 3-2	pH Survey Data	3-5
Figure 3-3	Alkalinity Survey Data	3-5
Figure 3-4	Turbidity Survey Data	3-5
Figure 3-5	Conductivity Survey Data	3-6
Figure 3-6	TDS Survey Data	3-6

Figure 3-7	TOC Survey Data	3-6
Figure 3-8	Treatment Cost Survey Data	3-6
Figure 5-1	Prevalence of Concentrate Disposal Options by Size of Desalination	5-2
Figure 5-2	Map of Desalination Facilities in Texas by Concentrate Disposal Technique	5-3
Figure 5-3	Average Annual Gross Reservoir Evaporation	5-17
Figure 5-4	Average Annual Precipitation	5-17
Figure 5-5	Rate of Precipitation in an Evaporation Pond	5-18
Figure 5-6	Relative Costs of Conventional Disposal Options	5-20
Figure 5-7	Deep Well Disposal Capital Cost Summary	5-22
Figure 5-8	Evaporation Pond Disposal Capital Cost Summary	5-23
Figure 5-9	Spray Irrigation Capital Cost Summary	5-24

ABBREVIATIONS

Demand Centers	DC
Disinfection Byproducts	DBP
Gallons per Minute	GPM
Groundwater Conservation Districts	GCD
Heterotrophic Plate Counts	HPC
Microsiemens per Centimeter	µS/cm
Milligrams per Liter	mg/L
Million Gallons per Day	MGD
National Pollutant Discharge Elimination System	NPDES
Railroad Commission of Texas	RRC
Red River Authority of Texas	RRA
Reverse Osmosis	RO
United States Army Corps of Engineers	USACE
United States Geological Survey	USGS
Texas Department of Transportation	TxDOT
Texas Pollutant Discharge Elimination System	TPDES
Total Dissolved Solids	TDS
Total Organic Carbon	TOC
United States Bureau of Reclamation	USBR
Water Treatment Plant	WTP

Region C Water Planning Group
Saline Water Special Study

Introduction

The Region C Regional Water Planning Group is committed to the exploration and promotion of viable water sources and water management strategies to meet the region's water needs. Region C's water conservation strategies, including reuse, have emerged as key water management strategies. An additional emerging strategy that is being considered by Region C as a potential source is the utilization of brackish surface and groundwater. There are a number of issues associated with the viability of brackish water such as water quality considerations (desalination and inland concentrate disposal), regulatory considerations, and costs.

Naturally occurring waters contain dissolved or suspended inorganic or organic compounds. Total dissolved solids are the sum of all dissolved inorganic and organic constituents in water. Total suspended solids are the sum of all material in water that is not dissolved. Freshwater is generally considered to have a dissolved solids concentration of less than 1,000 milligrams per liter (mg/L). Brackish waters are generally considered to have a dissolved solids concentration between 1,000 and 10,000 mg/L. Typically seawater dissolved solids concentrations are in the range of 30,000 – 40,000 mg/L.

In the 2007 State Water Plan [(1)], seawater and brackish groundwater desalination was included as a recommended strategy in eight of the regional water planning groups, representing approximately 313,000 acre-feet/year of new supply. Approximately 175,000 acre-feet/year of this supply was from brackish groundwater desalination projects in six of the planning regions.

The 2001 and 2006 Region C Water Plans included brackish water from several sources including the Red River, Possum Kingdom Lake, Lake Texoma, and the Brazos River. In order to evaluate the potential to utilize additional water from these and other sources, a "Study on the Use of Saline Water and Refinement of Costs" was included as Task 4.d in the scope for the 2011 Region C Water Plan. The purpose of this study is to further define the sources available to Region C, review the regulatory requirements, review and evaluate strategies for concentrate disposal, and evaluate the potential applicability of brackish sources to Region C. The current study involves the following major tasks:

- Data Collection
    - Identify sources and potential quantities of saline surface and groundwater available to Region C (based on a review of existing information).
    - Survey operational desalination facilities to gather information about the technology being applied, the quality of raw water being treated, the treatment performance, the concentrate disposal process and the actual costs.
    - Determine the water quality characteristics of potential brackish water quality supplies.
    - Determine the potential effects of introducing treated saline water into water supplies or existing infrastructure.
    - Develop cost ranges to produce, treat, and transport brackish groundwater to up to three major demand centers.
- Analysis of Concentrate Disposal
    - Document concentrate disposal techniques that may have application to Region C.
    - Identify and assess potential methods for disposal of the concentrate water.
    - Determine capital and operation and maintenance costs associated with treatment of the water and disposal of concentrate.
- Recommendation and Regulatory Requirements
    - Develop future recommendations for Region C, including identifying research and/or pilot studies required to develop the information required for implementation of a system to treat and deliver additional saline water for use in Region C.
    - Identify potential permitting and regulatory requirements associated with implementation of these projects.

INTRODUCTION
LIST OF REFERENCES

(1) Texas Water Development Board, “2007 State Water Plan”, 2007.

1.0 Saline Surface Water Available to Region C

Three major brackish surface water sources are located in close proximity to Region C – the Brazos River, the Red River, and Lake Texoma. This chapter discusses the water quality and potential quantity available to the Region from these sources. This list is not intended to be inclusive of all brackish surface water sources that may be technically feasible to the Region, but rather sources that have been identified in previous regional water planning efforts as potentially feasible options.

1.1 Sources

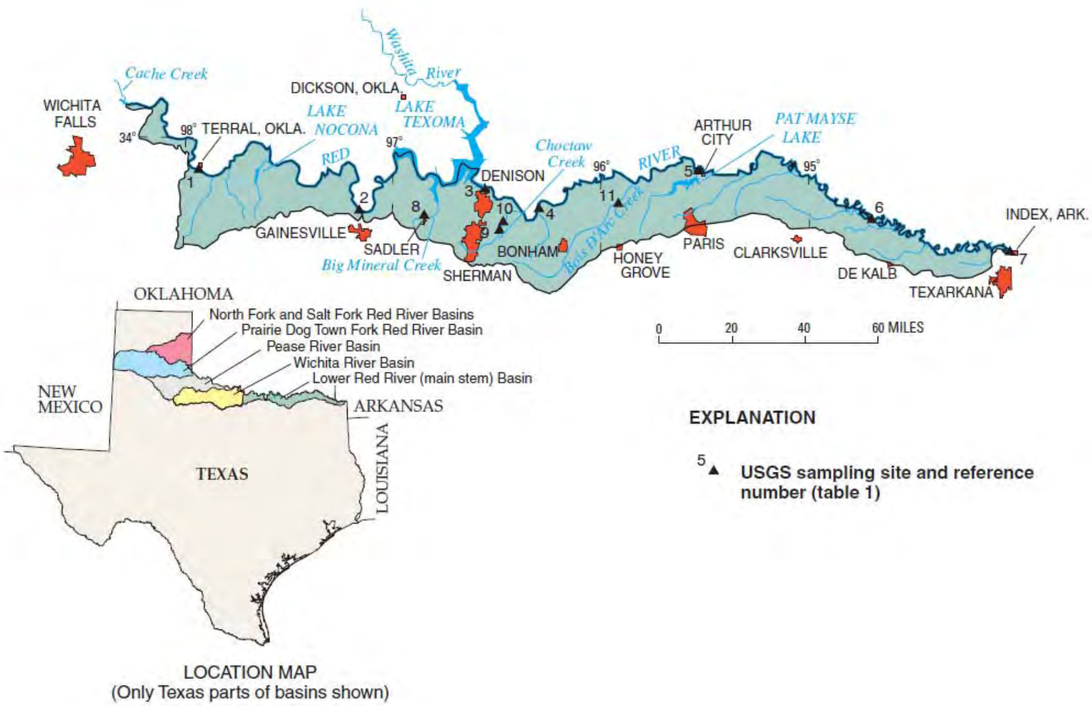
Brazos River

The Brazos River Basin includes an area of approximately 45,000 square miles in two states, although the majority of the watershed lies in Texas. The Brazos is the longest river system in the state of Texas, and the basin accounts for about 16% of the state's total land area. The Brazos River Basin is included in Regions A, B, C, F, G, H, and O, with the majority of the basin being located in Region G.

Red River

The United States Geological Survey (USGS), in cooperation with the Red River Authority of Texas (RRA), divided the Red River Basin into five subbasins for the purpose of planning, monitoring, geographical analysis, and dissemination of information. [1] Reach 5, the Lower Red River (main stem) extends from east of Wichita Falls, Texas to Index, Arkansas and includes two major Region C cities: Sherman and Denison (see Figure 1-1). The drainage basin associated with the Lower Red River in Texas covers approximately 3,600 square miles. The main stem is characterized by channels greater than 1,000 feet wide and stable, smaller tributary channels. The primary impoundments in the Red River Basin in this reach are Lake Nocona, Lake Texoma, Pat Mayse Lake, and Hugo Lake. The Red River Basin is included in Regions A, B, C, D, and O. For the purpose of analyzing water available to Region C, all references to the Red River in this chapter are intended to describe the Lower Red River.

Figure 1-1. Lower Red River (Reach 5) (1)



Source: Figure 1, *Assessment of Selected Water-Quality Data Collected in the Lower Red River (Main Stem) Basin, Texas, 1997-1998*

Lake Texoma

Lake Texoma is an 89,000 acre reservoir located on the Red River on the Texas-Oklahoma border and drains an area of nearly 40,000 square miles. Two major rivers, the Red and Washita River, flow into Lake Texoma. Lake Texoma is currently used for flood control, hydropower, water supply, recreation, streamflow regulation, and navigation. Lake Texoma is located on the northern border of Region C, in Cooke and Grayson Counties.

1.2 Quality

Descriptions of water quality studies conducted on the three potential surface saline water sources are included in this section. Additionally, TCEQ data for each water body is presented in this section. A map describing the locations of the TCEQ water quality stations is provided in Figure 1-2. Freshwater is generally considered to have a dissolved solids concentration of less than 1,000 mg/L. Brackish waters are generally considered to have a dissolved solids concentration between 1,000 and 10,000 mg/L. Typically seawater dissolved solids concentrations are in the range of 30,000 – 40,000 mg/L.

Brazos River

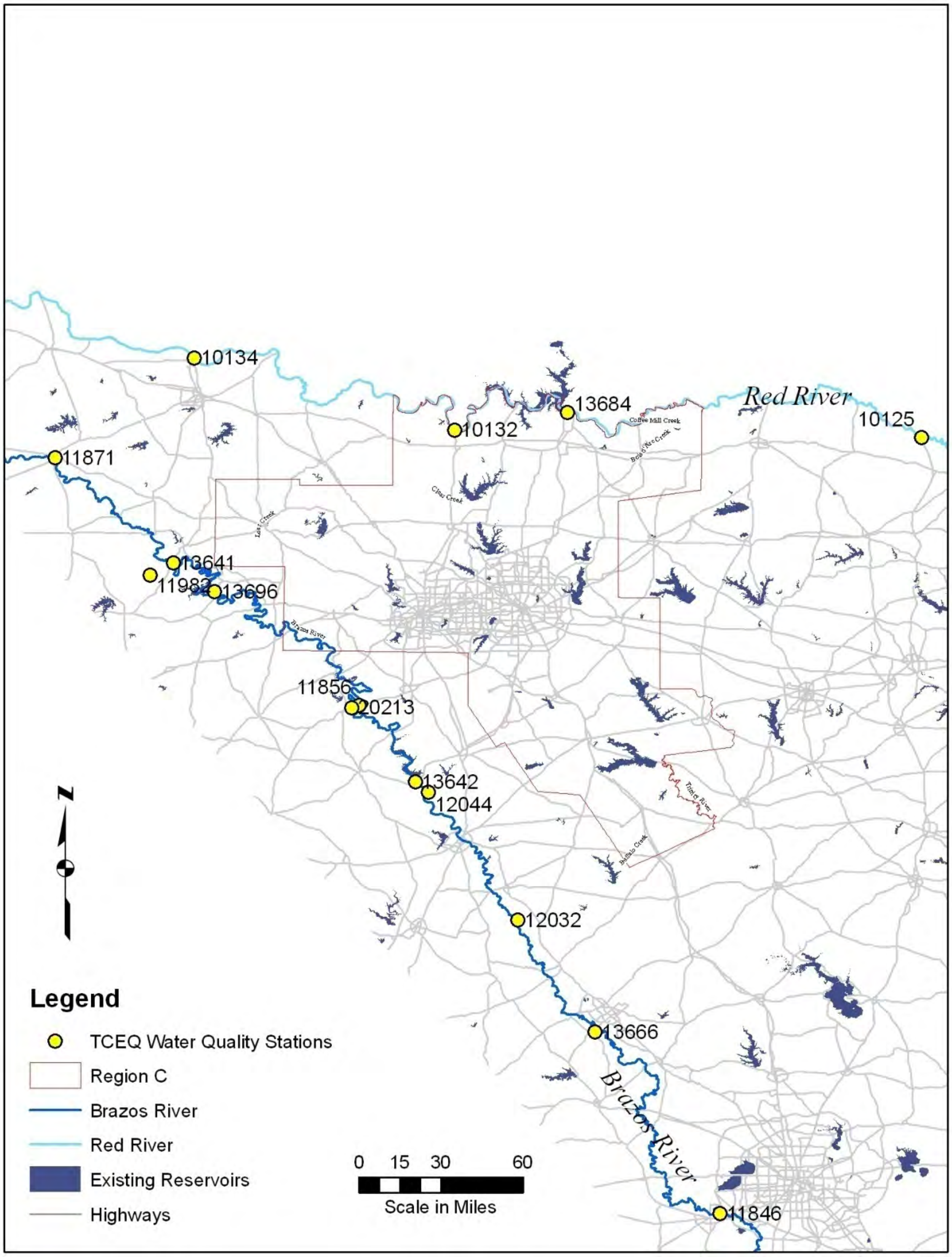
Geologic formations underneath the Double Mountain Fork, Salt Fork, and the North Croton Creek in the upper Brazos watershed are the primary source of the salt in the river. Generally, the dissolved solids concentration decreases in the downstream direction due to dilution effects from tributaries. The dissolved solids concentrations in major tributaries are typically significantly less than those in the mainstem of the Brazos. However, streamflows, salt loading, and dissolved solids concentrations vary over time and by location. Temporal variations are an important consideration throughout the Brazos River basin, particularly above Possum Kingdom Reservoir. [(2)] Appendix C and Table 1-1 present the TCEQ water quality data for various locations along the Brazos River.

Table 1-1. TCEQ Water Quality Data for the Brazos River

Station	Basin	Min	Max	Median	Mean	Standard Deviation	Number of Samples	10th Percentile	90th Percentile	Quartile 1	Quartile 3
11846	Brazos	172	811	467	446	189	17	242	705	300	568
11856	Brazos	596	1,890	845	1,027	425	18	612	1,600	676	1,383
11871	Brazos	660	17,600	7,400	7,908	4,808	14	1,475	12,600	5,790	10,450
11982	Brazos	332	3,410	757	1,385	1,354	6	338	3,060	346	2,323
12032	Brazos	647	958	743	783	128	8	654	936	680	909
12044	Brazos	694	707	701	701	8	4	694	707	694	707
13641	Brazos	615	6,370	4,440	3,996	1,946	9	1,235	5,834	3,100	5,180
13642	Brazos	654	969	829	836	93	24	706	956	798	898
13666	Brazos	433	814	636	629	120	7	498	744	584	678
13696	Brazos	484	944	794	747	179	8	534	919	585	906
20213	Brazos	667	1,890	1,275	1,222	395	12	737	1,600	908	1,533

The 1993 Natural Salt Pollution Study [(2)] found that from 1964-1986 the mean total dissolved solids concentration decreased from 3,600 mg/L at the Seymour gage (150 miles upstream of the Possum Kingdom Dam) to 340 mg/L at the Richmond gage (92 miles above the gulf). Water quality information from the Natural Salt Pollution Study is included in Appendix A.

Figure 1-2. TCEQ Water Quality Stations on the Brazos and Red Rivers



Red River

The major constituents contributing to salinity in the Lower Red River Basin are dissolved chloride and dissolved sulfate ions. The main source of these, the salt springs located in the headwaters of the Lower Red River Basin, have extremely high salinity levels. Appendix C and Table 1-2 present the TCEQ water quality data for various locations along the Red River.

Table 1-2. TCEQ Water Quality Data for the Red River

Station	Basin	Min	Max	Median	Mean	Standard Deviation	Number of Samples	10th Percentile	90th Percentile	Quartile 1	Quartile 3
10125	Red	104	1,080	424	474	288	16	154	946	326	492
10132	Red	157	3,670	2,510	2,265	1,050	9	943	3,126	2,180	2,850
10134	Red	644	9,670	5,030	4,840	1,679	85	2,448	6,406	3,970	6,080
13684	Red	422	1,240	670	760	310	17	450	1,210	497	1,060

The USGS/RRA study (1) analyzed data collected at 11 sites along the Red River during 1997-1998. A summary of this information is presented in Appendix B. Specific conductance was measured at each of the 11 sites in the USGS/RRA study and it was generally found that specific conductance (and chloride and sulfate ion concentrations) decrease in the downstream direction. Average specific conductance at the most upstream location, the Red River near Terral, Oklahoma was approximately 5,000 microsiemens per centimeter (µS/cm) and decreased to approximately 596 µS/cm at the most downstream location, Bois D'Arc Creek near Honey Grove, Texas.

The USGS/RRA study also monitored dissolved oxygen concentrations at two sites on the main stem, at Arthur City, Texas and at Index, Arkansas. During the summer months, dissolved oxygen concentrations were above the TCEQ 24-hour average standard of 5.0 mg/L. (1)

Lake Texoma

Lake Texoma, which contains large concentrations of chloride, sulfate, sodium, and calcium ions, has a natural brackish quality due to the contribution of flows from the Red River Basin. The ionic composition of Lake Texoma is influenced by the soils and geology of its contributing watershed, which has abundant quantities of calcium carbonate, calcium sulfate, and sodium chloride deposits. Moderate to high levels of mineralization occur with a predominance of sodium and calcium salts of chloride and sulfate. [3] Appendix C presents the TCEQ water quality data for Lake Texoma.

A chemical, physical, and biological water quality survey of Lake Texoma was performed from 1996-1997 for the U.S. Army Corps of Engineers (USACE) by the University of North Texas. A summary of the water quality data from this study is included in Table 1-3. More detailed water quality results from this report are included in Appendix D.

Table 1-3. Thirteen Month Water Quality Data for Lake Texoma at All Stations, All Depths, and All Sampling Dates.

Parameter	Min	Max	Median	Mean	Standard Deviation	Number of Samples
Chloride (mg/L)	24.1	791.0	290.0	303.4	144.79	1509
Sulfate (mg/L)	163.0	570.0	348.0	350.8	75.32	1509
Nitrate (mg/L)	0.0	1.31	0.26	0.25	0.211	1500
Total Phosphorous (mg/L)	0.01	0.47	0.05	0.06	0.048	1509
Total Nitrogen (mg/L)	0.0	2.41	0.56	0.60	0.221	1269
Turbidity* (NTU),	1.6	79.5	5.8	9.1	9.57	1108
Total Suspended Solids (mg/L)	0.0	427	7.6	13.4	28.25	1508
Ortho Phosphorous (mg/L)	0.0	0.26	0.02	0.02	0.034	1509
Chlorophyll a (µg/L)	2.1	71.3	15.2	17.6	12.36	1114

*Samples were taken only at a depth of 1 meter below the surface.

1.3 Quantities

Brazos River

The Region G Initially Prepared 2011 Brazos G Regional Water Plan includes a discussion of unappropriated flows in the Brazos River. This unappropriated flow was computed assuming no additional instream flow restrictions and full use of all existing water rights. Unappropriated flows were calculated using the TCEQ Water Availability Model at the following locations on the Brazos River:

- Brazos River at South Bend
- Brazos River near Glen Rose
- Brazos River near Aquilla
- Brazos River near Bryan
- Brazos River near Hempstead
- Brazos River at Richmond

While unappropriated flow is available at these locations during wetter periods, any new water rights requiring a firm supply would require storage. Table 1-4 provides the monthly and annual unappropriated flows at these locations for the future conditions run. Figures 1-3 through 1-8 display the annual time series of unappropriated flows at each location.(4)

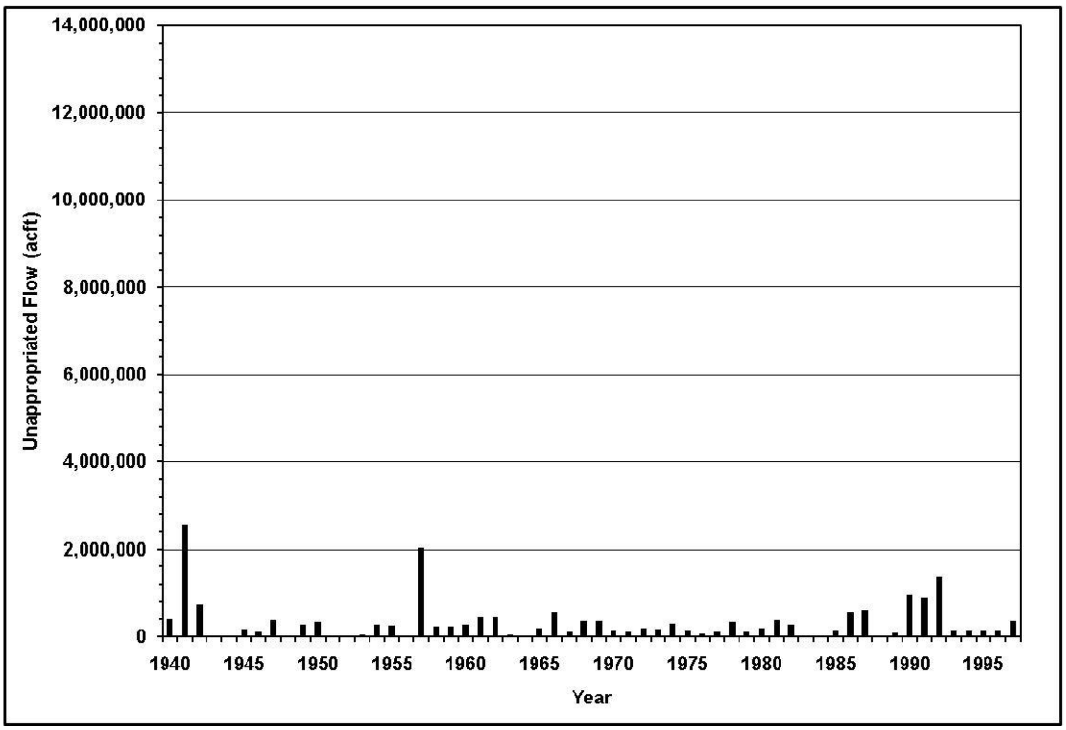
Water availability maps for the Upper Brazos are presented in Figure 1-9 and 1-10 and represent both perpetual and term rights. The availability of storage, the total amount requested, the type of use, environmental flow needs and other factors could affect the availability of unappropriated water for a particular project. The water availability maps presented in this chapter do not show the availability of water at any given point in time, and are subject to change based on new water rights being issued, or amendments to existing water rights. (5)

Table 1-4. Unappropriated Flow Estimates for Various Locations on the Brazos River [4]

Location	Unappropriated Flow Estimates							
	Monthly Unappropriated Flows (acre-feet/year)				Annual Unappropriated Flows (acre-feet/year)			
	Maximum	Minimum	Mean	Median	Maximum	Minimum	Mean	Median
Brazos River at South Bend	1,218,059	0	27,190	0	2,554,843	0	326,275	194,673
Brazos River near Glen Rose*	2,668,738	0	51,487	0	3,947,718	0	617,841	408,217
Brazos River near Aquilla*	2,906,261	0	69,617	439	4,437,714	0	835,404	623,870
Brazos River near Bryan	4,424,667	0	206,991	16,898	10,234,346	0	2,483,895	2,107,394
Brazos River near Hempstead	5,136,258	0	249,358	24,218	12,195,215	0	2,992,300	2,685,328
Brazos River at Richmond	5,466,122	0	303,777	60,233	13,432,834	0	3,645,321	3,320,507

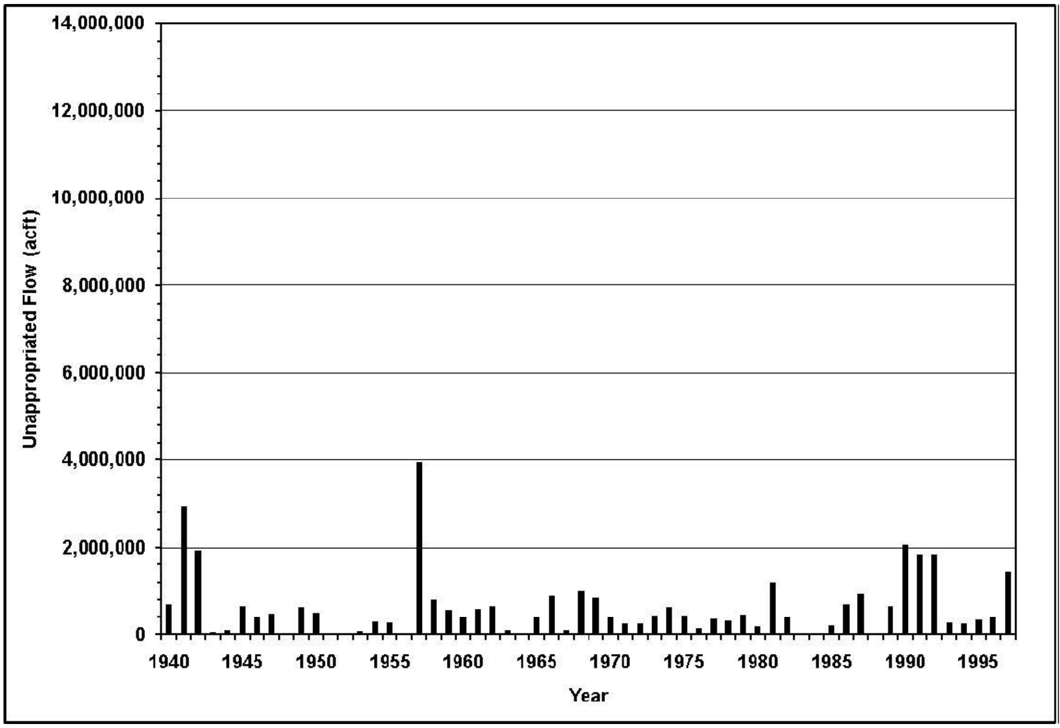
* Locations nearest to Region C area.

Figure 1-3. Estimated Annual Unappropriated Flow at Brazos River at South Bend[4]



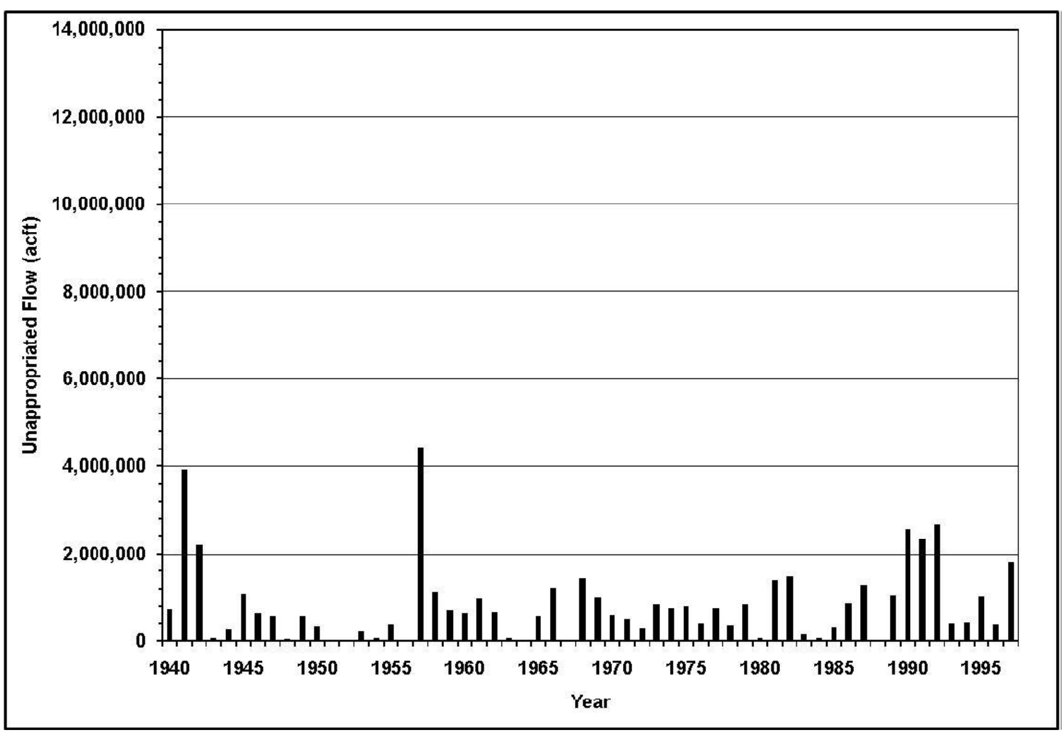
Source: Brazos Region G 2011 Initially Prepared Plan

Figure 1-4. Estimated Annual Unappropriated Flow at Brazos River at Glen Rose[4]



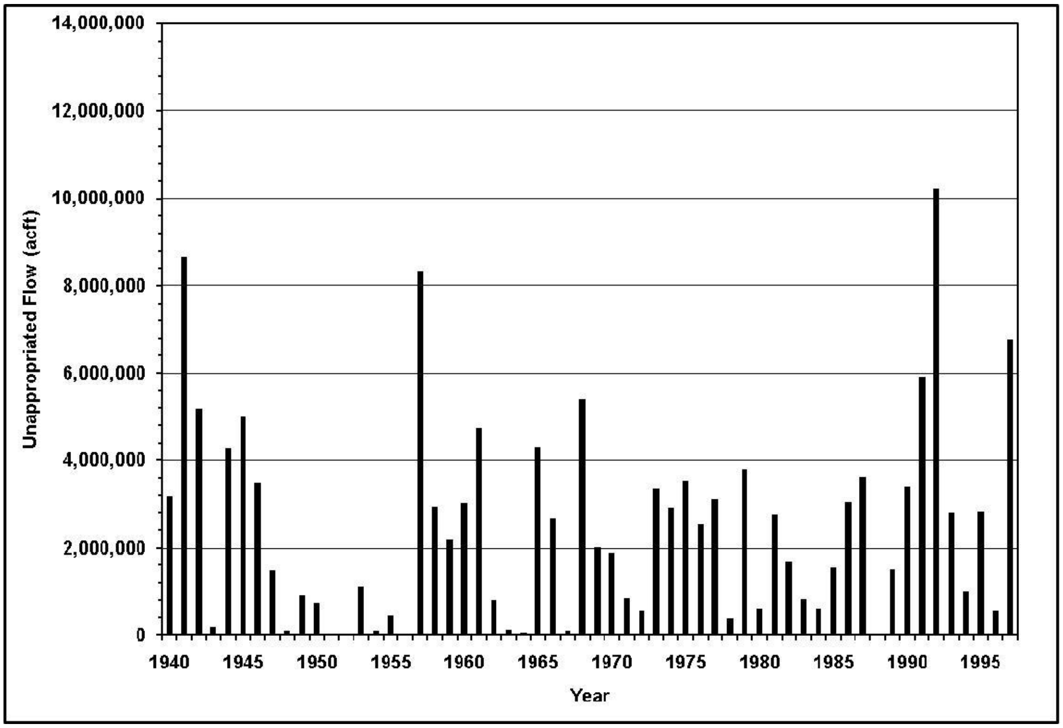
Source: Brazos Region G 2011 Initially Prepared Plan

Figure 1-5. Estimated Annual Unappropriated Flow at Brazos River near Aquilla[4]



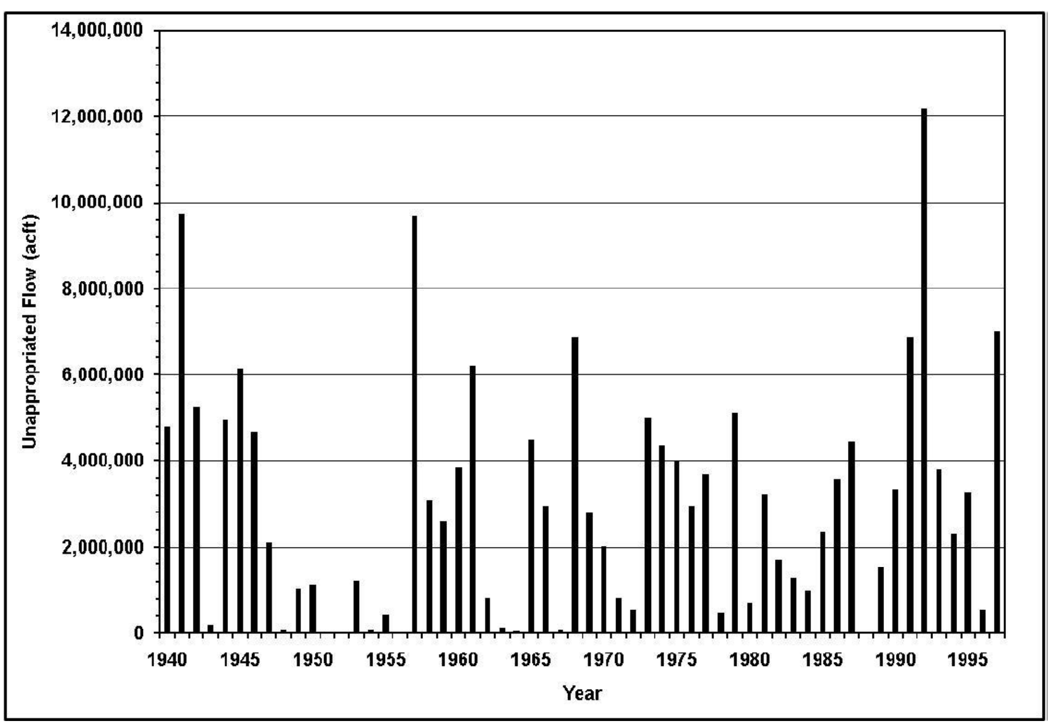
Source: Brazos Region G 2011 Initially Prepared Plan

Figure 1-6. Estimated Annual Unappropriated Flow at Brazos River near Bryan[4]



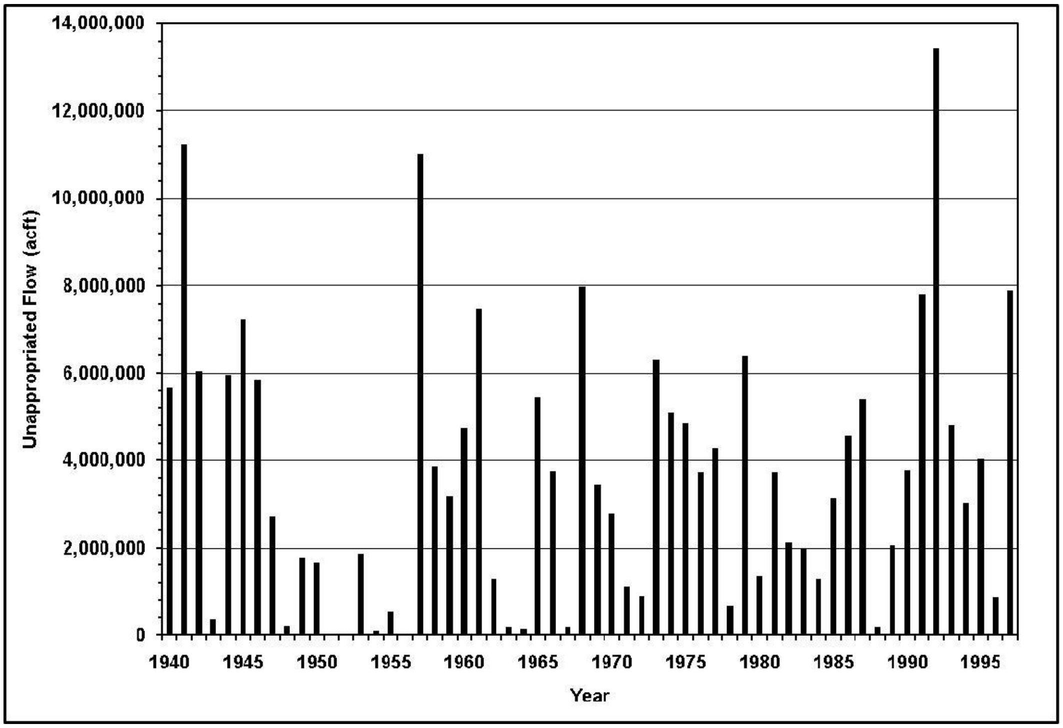
Source: Brazos Region G 2011 Initially Prepared Plan

Figure 1-7. Estimated Annual Unappropriated Flow at Brazos River near Hempstead[4]



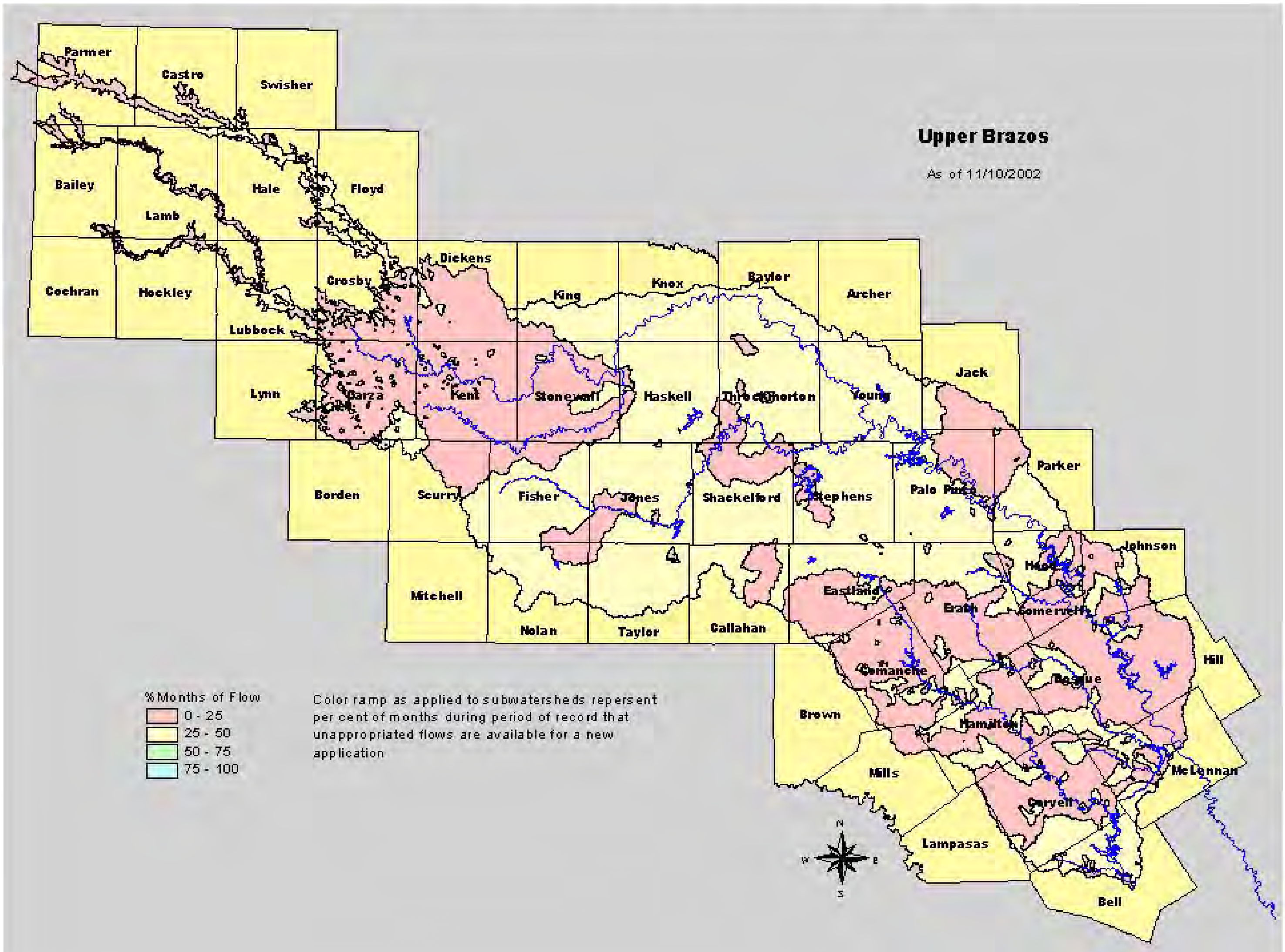
Source: Brazos Region G 2011 Initially Prepared Plan

Figure 1-8. Estimated Annual Unappropriated Flow at Brazos River at Richmond[4]



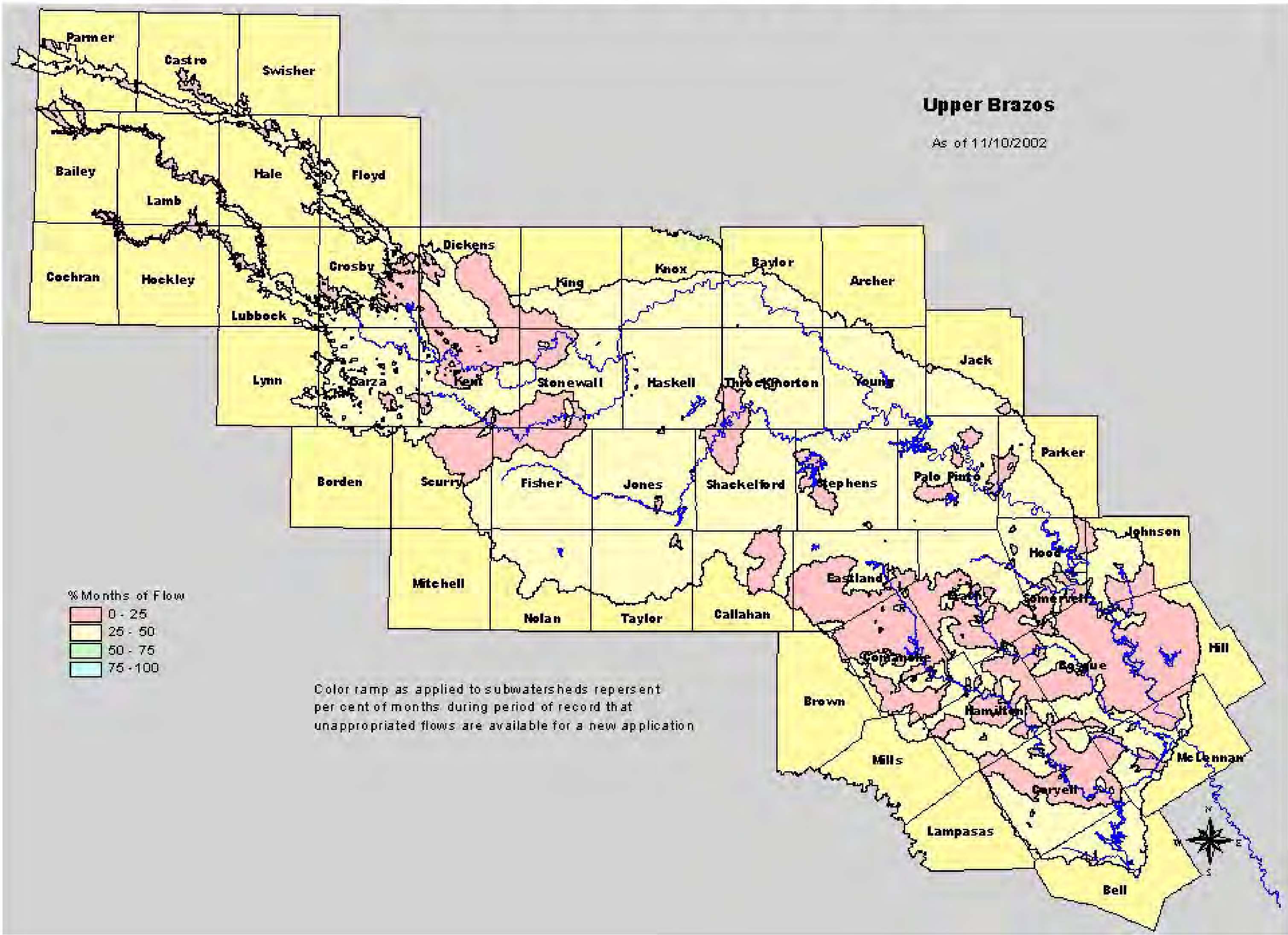
Source: Brazos Region G 2011 Initially Prepared Plan

Figure 1-9. Water Availability for New Perpetual Rights[5]



Source: TCEQ

Figure 1-10. Water Availability for New Term Rights[5]



Source: TCEQ

Lake Texoma

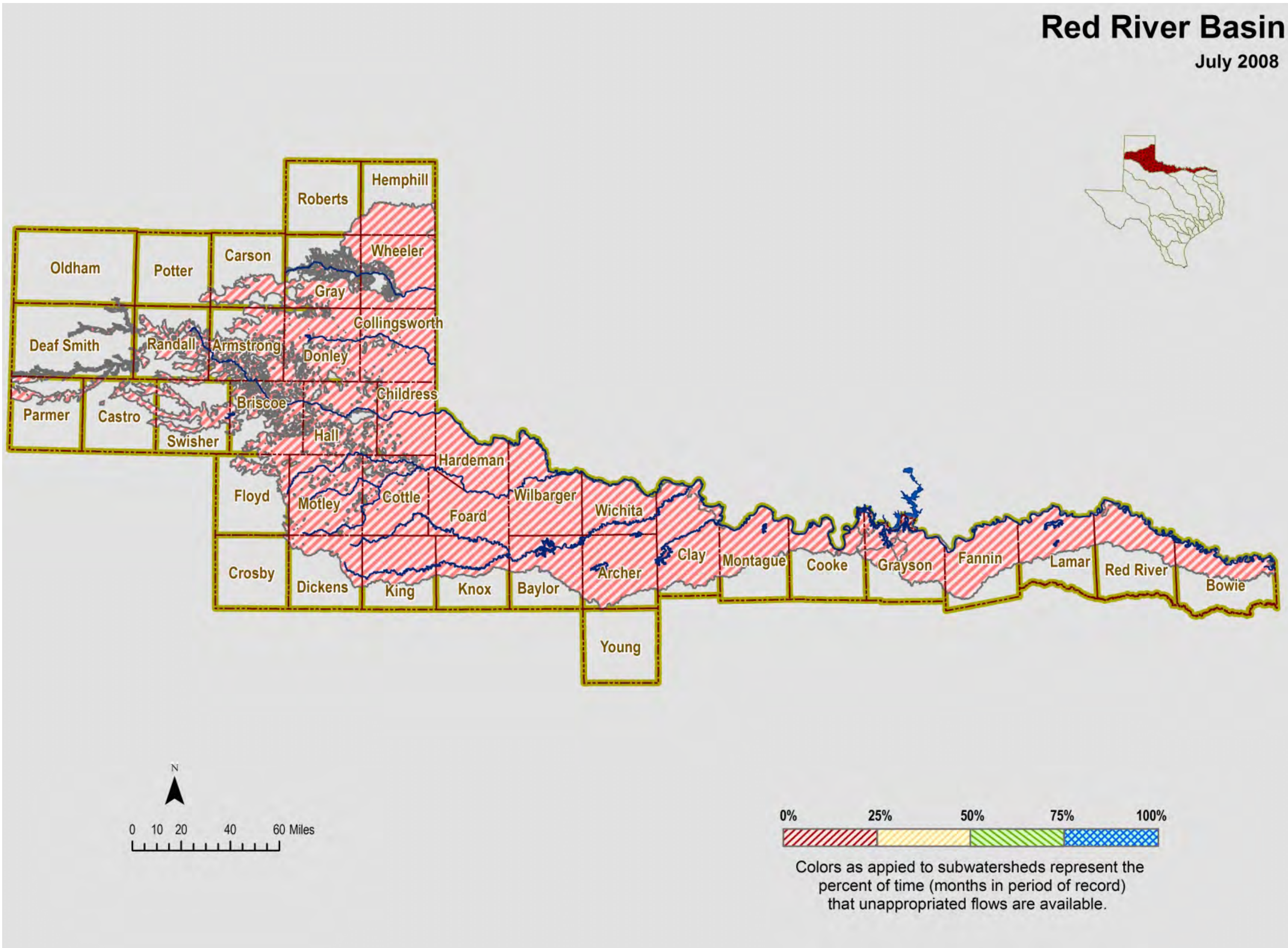
In 1986, the U.S. Congress passed a law allowing the USACE to reallocate additional amounts of storage in Lake Texoma from hydropower use to water supply. According to the USACE, the firm yield of Lake Texoma including that associated with storage allocated to hydropower water supply would be 1,088,500 acre-feet/year. (6) Such a reallocation of hydropower storage to water supply would increase the available yield. Of the 1,088,500 acre-feet/year, Texas' share would be 544,250 acre-feet/year. That reallocation action would result in Texas gaining about 220,000 acre-feet/year of additional supply beyond the currently authorized conservation storage. Further reallocation would require a new authorization from Congress.

Red River

Like the Brazos River, while unappropriated flow may exist in the Red River, any new water rights requiring a firm supply would need to be permitted with storage. For this reason, previous regional water planning efforts have not evaluated potential available quantities to Region C.

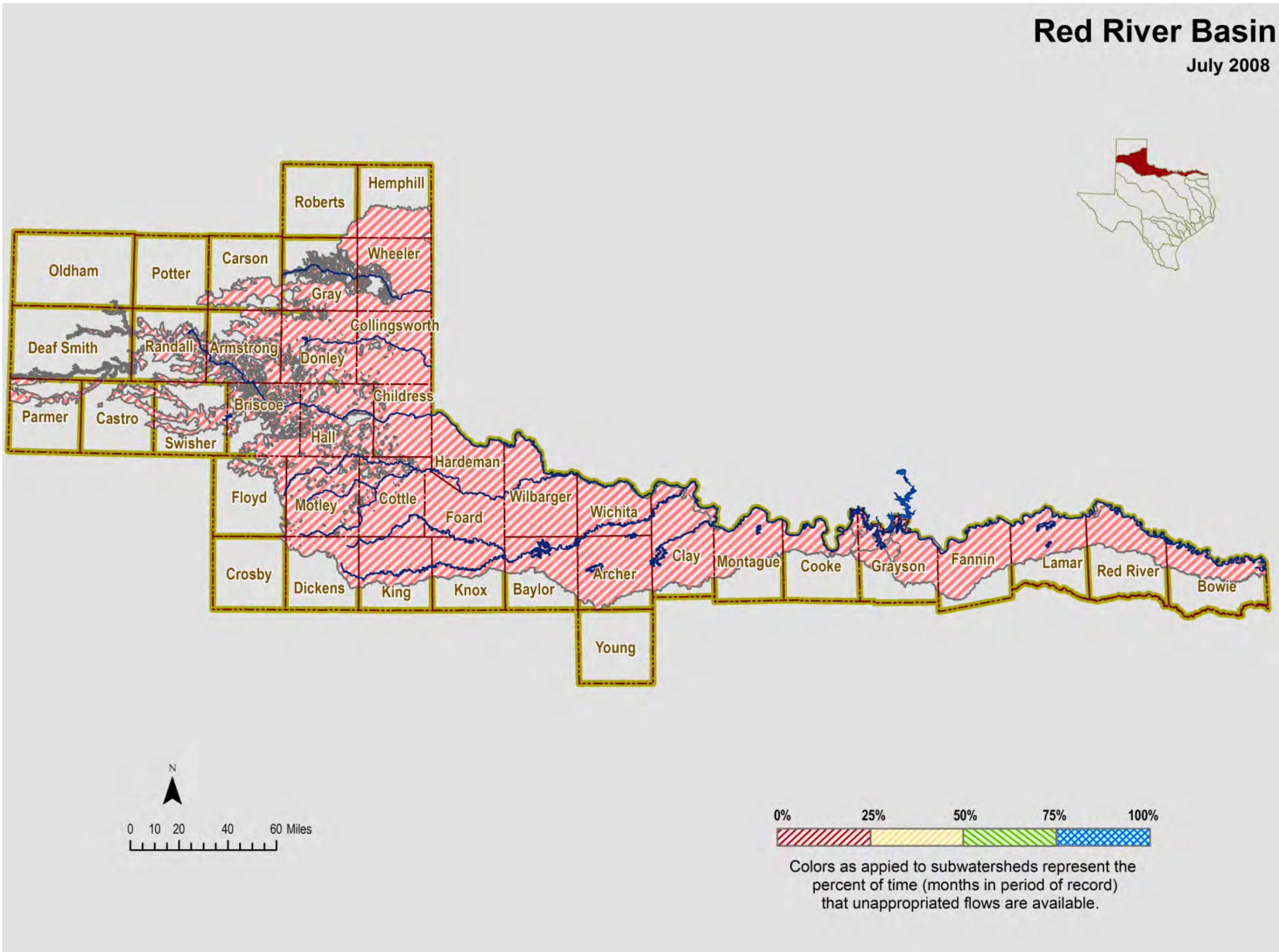
Water availability maps for the Red River are presented in Figures 1-11 and 1-12 and represent both perpetual and term rights. The availability of storage, the total amount requested, the type of use, environmental flow needs and other factors could affect the availability of unappropriated water for a particular project. The water availability maps presented in this chapter do not show the availability of water at any given point in time, and are subject to change based on new water rights been issued, or amendments to existing water rights. (5)

Figure 1-11. Water Availability for New Perpetual Rights[5]



Source: TCEQ

Figure 1-12. Water Availability for New Term Rights[5]



Source: TCEQ

1.4 Saline Surface Water Summary

Brackish surface water in the three potential sources is of a quality that would need to be blended with fresh water and/or treated by a desalination process. Both the Brazos River and Red River Basin have historically included unappropriated water. Additionally, a reallocation of Lake Texoma water, previously allocated to hydropower, may result in water being available from this source. The actual brackish surface water quantities available for Region C are dependent upon water management strategies for other regional water planning groups, permitting, availability of storage, and contracts with the USACE for water from Lake Texoma.

CHAPTER 1
LIST OF REFERENCES

(1) United States Geological Survey, in cooperation with the Red River Authority of Texas, Assessment of Selected Water-Quality Data Collected in the Lower Red River (Main Stem) Basin, Texas, 1997-1998, November 2004.

(2) Wurbs, R., Karama, A., Saleh, I., Ganze, C., Natural Salt Pollution and Water Supply Reliability in the Brazos River Basin, Texas Water Resources Institute, August 1993.

(3) Atkinson, S., Dickson, K., Waller, W., Amman, L., Franks, J., Clyde, T., Gibbs, J., Rolbiecki, D., A Chemical, Physical and Biological Water Quality Survey of Lake Texoma: August 1996 – September 1997 Final Report, Institute of Applied Science, University of North Texas, Performed for the U.S. Army Corps of Engineers Tulsa District, June 1999.

(4) Brazos G Regional Water Planning Group, Region G Initially Prepared 2011 Brazos G Regional Water Plan, prepared for the Texas Water Development Board, 2010.

(5) Texas Commission on Environmental Quality, Water Availability Models, accessed online at http://www.tceq.state.tx.us/permitting/water_supply/water_rights/wam.html, February 2010.

(6) U.S. Army Corps of Engineers, Tulsa District, Final Environmental Assessment, Lake Texoma Storage Reallocation Study, Lake Texoma, Oklahoma and Texas, Tulsa, May 2006.

2.0 Sources of Saline Groundwater Available to Region C

When considering the implementation of brackish groundwater as a supply, two fundamental conditions should be met. The aquifer should be capable of adequate yields over the life of a project and the dissolved mineral concentrations should allow for economical treatment. This chapter discusses both conditions in general terms for aquifers within Region C.

A review of available data was conducted as a part of this study and is included in this chapter and referenced appendices. Prior to the implementation of any projects, further study should be conducted on both the yield and quality of a specific brackish groundwater resource. Volumes of brackish groundwater have been identified, but groundwater availability models to determine yield information for brackish supplies have not been developed.

The *Texas Groundwater Manual for Regional Planning Groups* provides information related to quality and quantity of brackish groundwater sources by Regional Water Planning Group. Information from this manual is used throughout this chapter. [1] Table 2-1 provides a description of the general status of brackish groundwater in Region C. Table 2-2 provides an estimated volume of brackish groundwater in Region C by aquifer. The information provided in Table 2-2 indicates the volumes of water available, and not the actual yield of the aquifer. Groundwater availability models to determine yield information have not been developed. Groundwater availability models would aid the planning group in determining the reliable supply of the aquifer. Information on the aquifer parameters used to estimate the brackish groundwater volumes is provided below:

- *Estimated average specific yield* – Specific yield is used to describe the amount of water an unconfined aquifer will yield per unit decline in the water level in an aquifer. Estimated average specific yield is used to estimate the total volume of unconfined brackish groundwater available.

- *Estimated storativity* – Also referred to as the coefficient of storage, this term describes the volume of water a confined aquifer will release when the water level (also called the potentiometric surface) in an aquifer is lowered. Estimated storativity is used to estimate the minimum volume of brackish groundwater currently in confined storage in the aquifer

- *Approximate areal extent 1,000 to 3,000 and 3,000 to 10,000 Total Dissolved Solids (TDS) water* – used in volume calculations

- *Estimated average thickness of productive units* – The average total thickness of aquifer material containing brackish groundwater that can be produced by wells, which was used in volume

- *Assumed aquifer drawdown* – For confined aquifer sections, the volume of reasonably retrievable brackish groundwater in storage was estimated by assuming the water levels would decline a specified amount during development

- *Estimated volume of brackish groundwater "in place"* – Estimate of the total amount of brackish groundwater currently in unconfined storage in the aquifer. If the aquifer is unconfined, the volume of brackish groundwater currently in place is an estimate of the total availability if the aquifer were completely dewatered.

- *Estimated confined availability* – represents the volume of brackish groundwater currently in place that could be developed if the water levels were decreased by the assumed aquifer drawdown for confined aquifers or aquifer sections.

Table 2-1. Status of Brackish Groundwater in Region C (1)

	Status of Brackish Groundwater		
Aquifer	**Availability**	**Productivity**	**Source Water Production Cost**
Nacatoch	Low	Low	Moderate to High
Queen City and Sparta	None	--	--
Carrizo-Wilcox	None	--	--
Trinity	Moderate	Low	Moderate to High
Woodbine	High	Low to Moderate	Moderate to High

Adapted from: Brackish Groundwater Manual for Texas Regional Planning Groups

Table 2-2. Estimated Volume of Brackish Groundwater in Region C by Aquifer (1)

Aquifer	Estimated Average Specific Yield	Estimated Storativity	Approximate Areal Extent 1000-3000 TDS (mi^2)	Approximate Areal Extent 3000-10000 TDS (mi^2)	Estimated Average Thickness of Productive Units (feet)	Assumed Aquifer Drawdown (feet)	Estimated Volume "In Place" (acre-feet)	Estimated Confined Availability (acre-feet)
Woodbine	0.1	0.0002	1,850	1,870	100	100	23,808,000	35,700
Nacatoch	0.1	0.0001	390	140	50	50	1,696,000	1,700
Trinity	0.1	0.0002	945	910	500	200	59,360,000	47,500

Note: The information in this table represents volumes of water stored in the aquifer, not the actual yield. Yield estimates provide a time reference, and would be necessary to determine the suitability of brackish groundwater as a reliable source to Region C.
Adapted from: Brackish Groundwater Manual for Texas Regional Planning Groups

In Texas, Groundwater Conservation Districts (GCDs) manage groundwater conservation, preservation, protection, recharging, and waste prevention within their borders. Typical GCD responsibilities include: permitting wells, developing management plans, and adopting rules to implement management plans. Four GCDs exist within the Region C boundaries:

- Mid-East Texas GCD, which includes Freestone County,
- Neches and Trinity Valley GCD, which includes Henderson County,
- Northern Trinity GCD, which is comprised of only Tarrant County, and
- Upper Trinity GCD, which includes Parker and Wise Counties.

The Northern and Upper Trinity GCDs were both established in 2007 and are expected to publish management plans in 2010. The Mid-East Texas and Neches and Trinity Valley GCDs currently have management plans in place. In the 2009 session of the Texas Legislature, three additional GCDs in Region C were created, but these districts have not yet begun operation. They include:

- Prairielands GCD, which includes Ellis County
- North Texas GCD, which is comprised of Collin, Cooke, and Denton Counties, and
- Red River GCD, which is comprised of Grayson and Fannin Counties.

Coordination with the GCD in the project area is essential to the planning of a groundwater desalination project.

2.1 Sources

In Region C, two major aquifers contain brackish groundwater supplies – the Carrizo-Wilcox and Trinity Aquifer. In addition, several minor aquifers, the Nacatoch, Queen City, Sparta, and Woodbine aquifers contain brackish groundwater. However, supply availability only exists in the Trinity, Nacatoch, and Woodbine aquifers at this time in Region C. (1)

Trinity Aquifer

The Trinity Aquifer is a major aquifer system that is composed of individual aquifers in Central and North Central Texas. Trinity group deposits include sands, limestones, shales and clays. Current uses for Trinity Aquifer groundwater include irrigation, municipal, industrial, domestic and livestock purposes. Brackish water of significant quantities may be found in the down-dip areas of the Trinity Aquifer. However, wells in the down-dip areas would be fairly deep and low-producing due to decreasing permeabilities. In other parts of the Trinity Aquifer, small to moderate volumes of brackish water may be produced, but these areas will be limited in areal and vertical extent. The availability of brackish groundwater in the Trinity Aquifer in Region C should be considered moderate, with a low productivity (brackish groundwater is likely found at greater depths with less transmissivity), and a moderate to high production cost.

Nacatoch Aquifer

The Nacatoch Aquifer is a minor aquifer system in Northeast Texas extending to Arkansas and Louisiana. The Nacatoch is composed of sand beds separated by impermeable layers of mudstone or clay. Current uses for Nacatoch Aquifer groundwater include irrigation, municipal, industrial, domestic and livestock purposes, with municipal and industrial accounting for the most water use. The area in the down-dip from the outcrop of the Nacatoch appears to be brackish, although the transition zone from fresh to brackish groundwater is small and produces a limited brackish resource. The availability of brackish groundwater in the Nacatoch Aquifer in Region C should be considered low, with a low productivity, and a moderate to high production cost. In addition, availability of brackish groundwater is significantly less in Kaufman and Navarro counties.

Woodbine Aquifer

The Woodbine Aquifer is a minor aquifer system in North Central Texas extending to the Oklahoma border along the Red River. The Woodbine consists of water-bearing sandstone beds interbedded with shale and clay. Current uses for Woodbine Aquifer groundwater include irrigation, municipal, industrial, domestic and livestock purposes, with municipal accounting for the largest percentage of water use. The primary source of brackish groundwater in the Woodbine is in the down-dip sections. In some areas of the outcrop, particularly in the Upper Woodbine, brackish groundwater may be found. The Woodbine outcrops at its western boundary and descends to levels over 2,500 feet below ground on the eastern side of the aquifer. The availability of brackish groundwater in the Woodbine Aquifer in Region C should be considered high, with a low to moderate productivity (brackish groundwater is likely found at greater depths with less transmissivity), and a moderate to high production cost.

2.2 Quality

As a general rule, groundwater quality deteriorates with increased depth; water sources with low salinity and mineral content are typically located near the surface. The water quality of the three aquifers with available supply in Region C varies, and a brief description of the general quality is provided in this section. Once an area for exploration is identified, test wells could be drilled to provide more detailed data on well yield and water quality. The samples obtained from test wells may be used during the design phase of a project or for information to support modeling of the resource. Test wells may be converted to production or monitoring wells, following the testing phase.

Trinity Aquifer General Quality

The location of slightly to moderately saline water within the aquifer is variable and may be above and/or beneath another fresh water layer. Additionally, a saline well may be located adjacent to a fresh water well from another zone in the Trinity Aquifer. Figure 2-1 displays a plan view of the Trinity Aquifer with1,000 mg/L, 3,000 mg/L, and 10,000 mg/L TDS contours. Figures 2-2 and 2-3 show profile views of several sections of the aquifer.

Lower permeabilities in the down-dip direction and greater distances from the recharge zones result in increasing salinities in the down-dip direction.

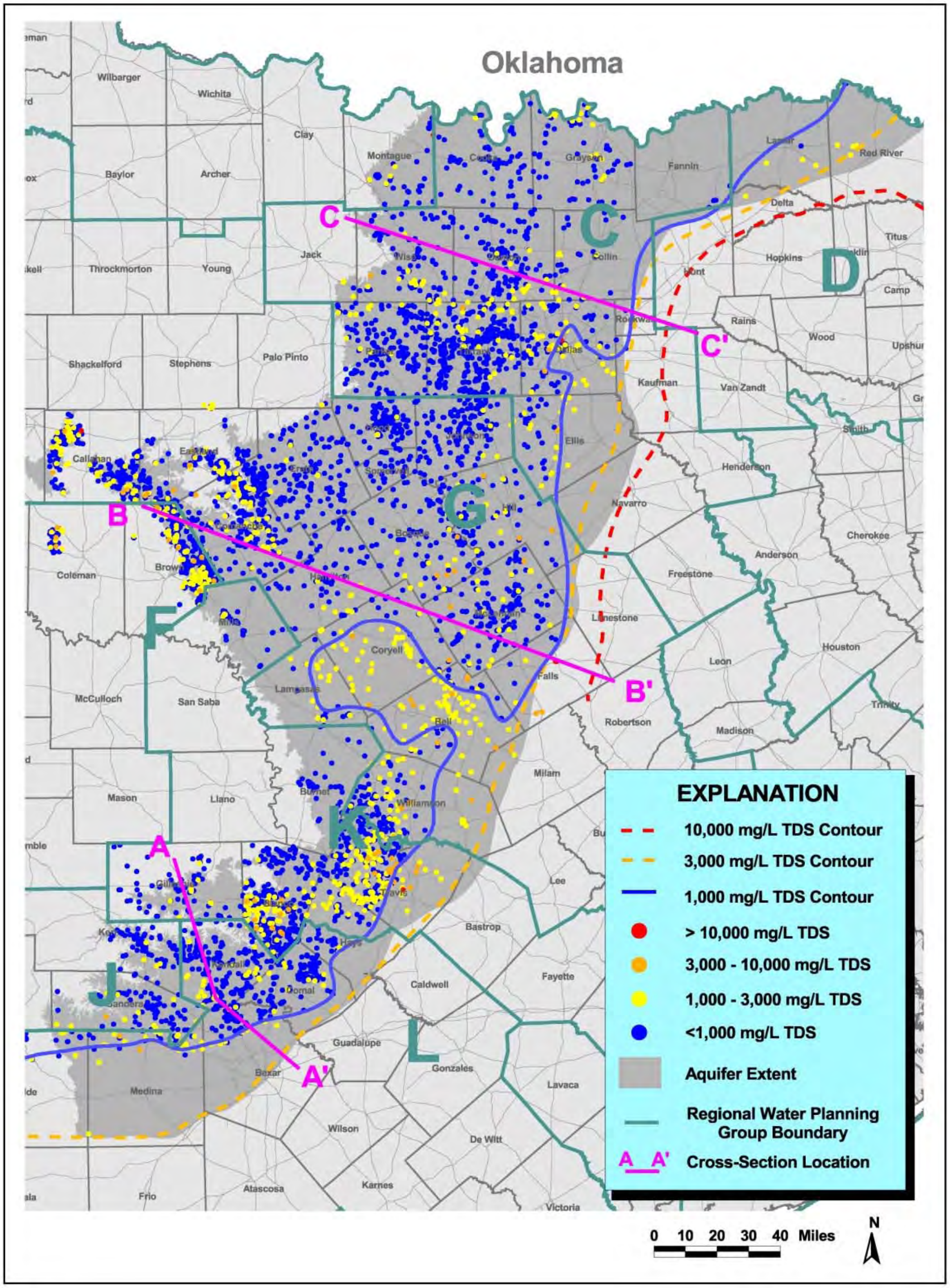
Nacatoch Aquifer General Quality

The overall quality of the Nacatoch Aquifer is alkaline and high in sodium bicarbonate. In general, in areas with multiple sand layers, the upper sand layer contains the highest quality water. The 3,000 mg/L TDS line is generally controlled by the Mexia-Talco fault zone. Figure 2-4 displays a plan view of the Trinity Aquifer with1,000 mg/L, 3,000 mg/L, and 10,000 mg/L TDS contours. Figure 2-5 shows a profile view of Section A of the aquifer.

Woodbine Aquifer General Quality

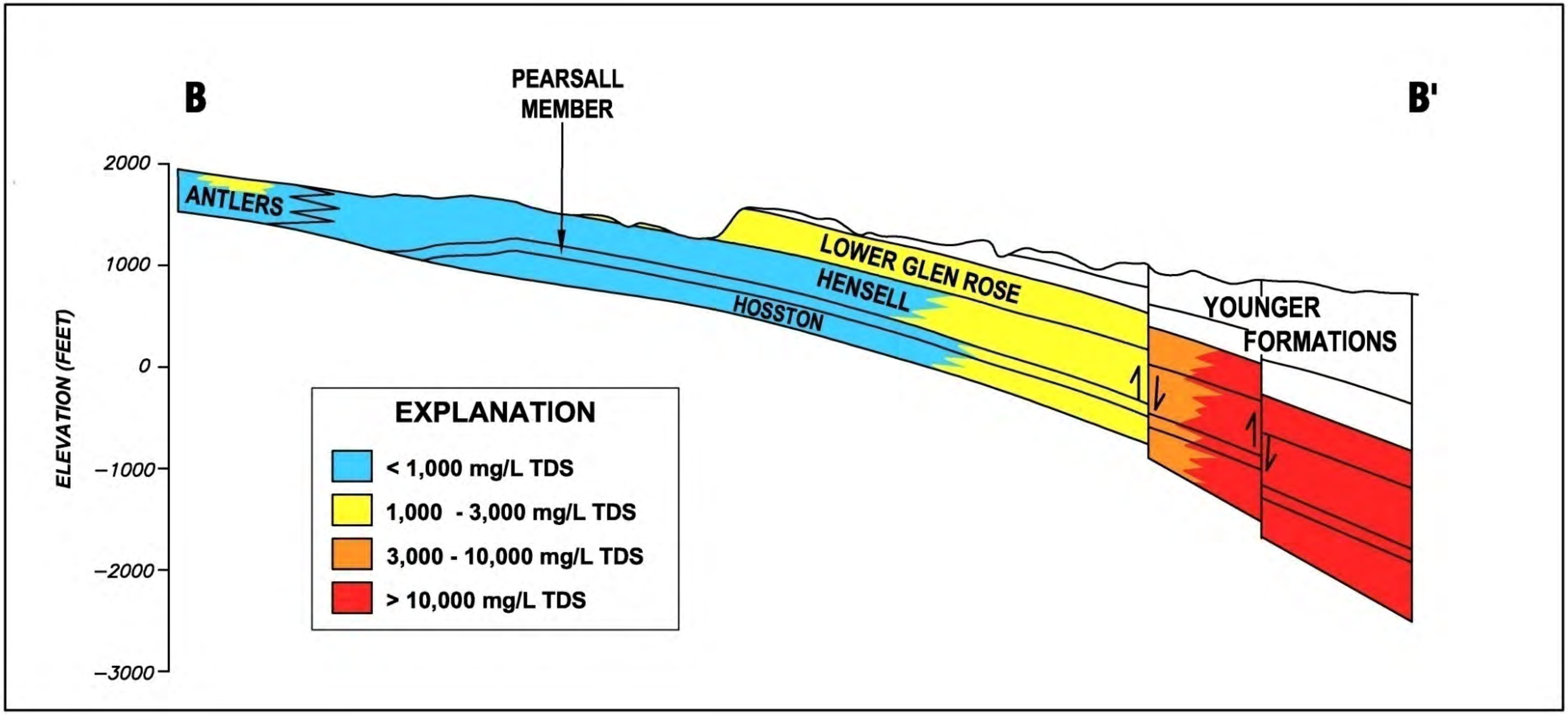
The overall quality of the Woodbine Aquifer declines with depth, particularly below 1,000 feet. Shallow zones in and around the outcrop may reach TDS levels of 3,000 mg/L. Figure 2-6 displays a plan view of the Trinity Aquifer with1,000 mg/L, 3,000 mg/L, and 10,000 mg/L TDS contours. Figure 2-7 shows a profile view of Section A of the aquifer.

Figure 2-1. Groundwater Quality in the Trinity Aquifer (1)



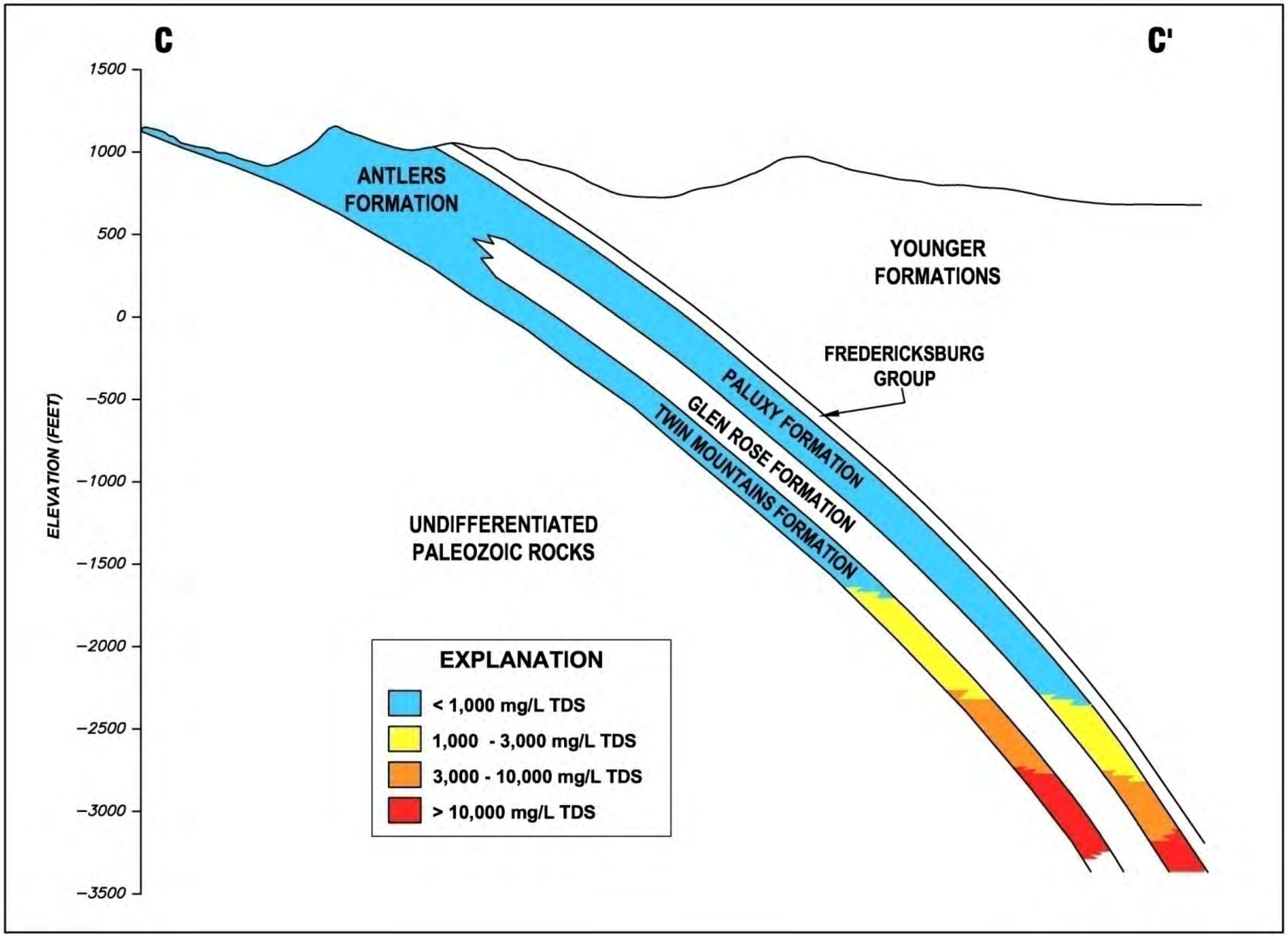
Reference: Figure 15, Brackish Groundwater Manual for Texas Regional Planning Groups

Figure 2-2. Section B of the Trinity Aquifer [1]

3. 

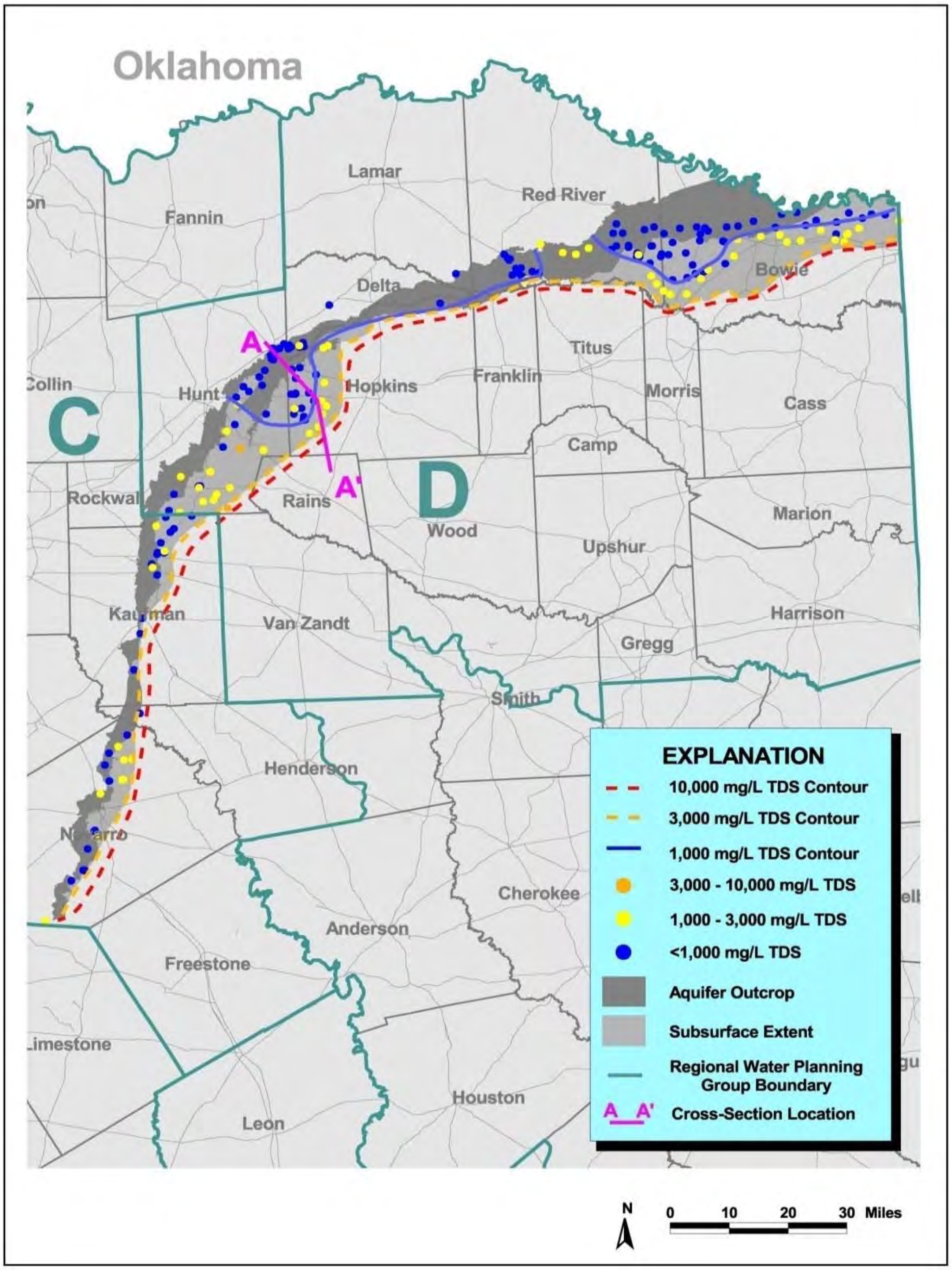
Reference: Figure 18, Brackish Groundwater Manual for Texas Regional Planning Groups

Figure 2-3. Section C of the Trinity Aquifer [1]



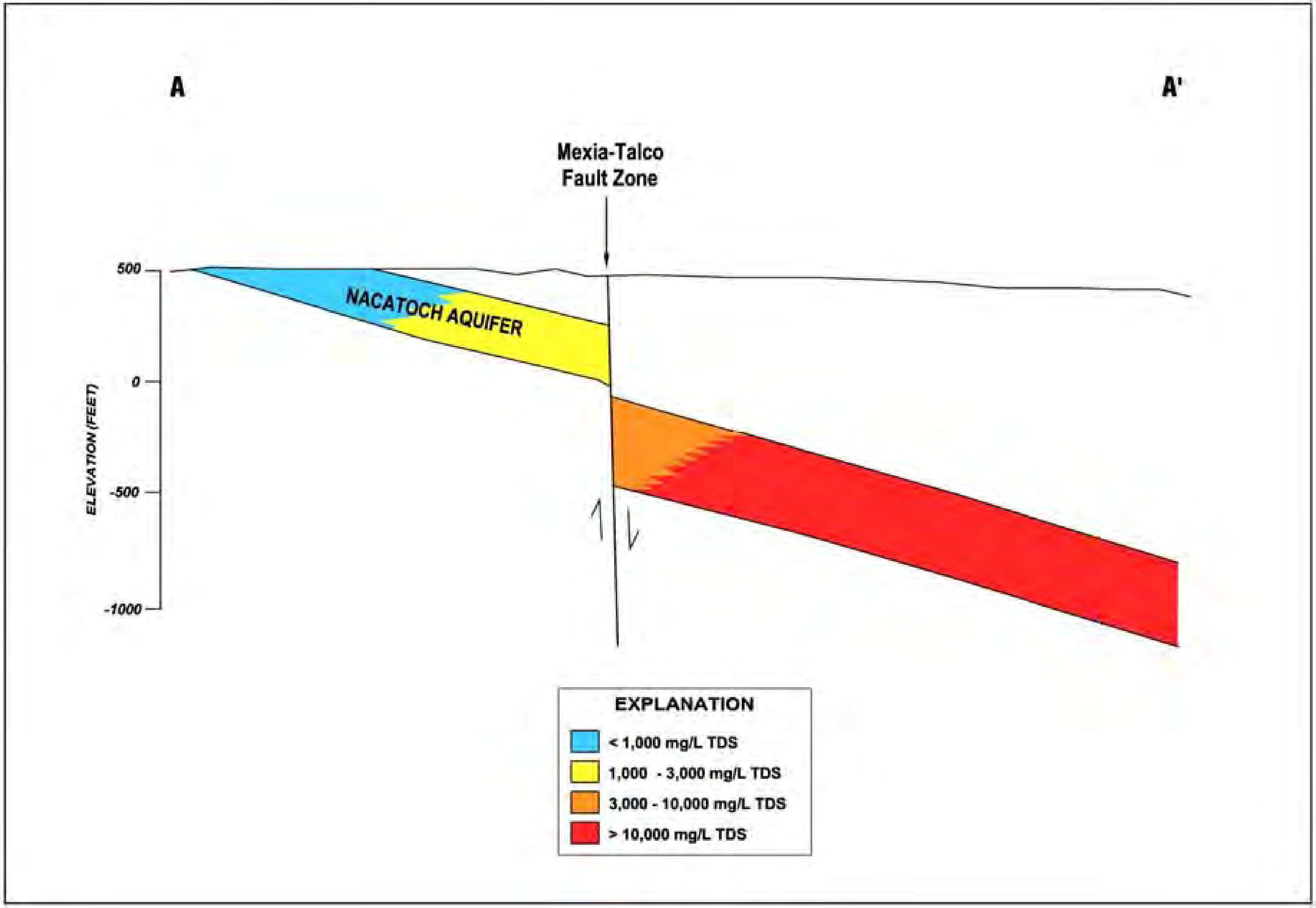
Reference: Figure 19, Brackish Groundwater Manual for Texas Regional Planning Groups

Figure 2-4. Groundwater Quality in the Nacatoch Aquifer [1]



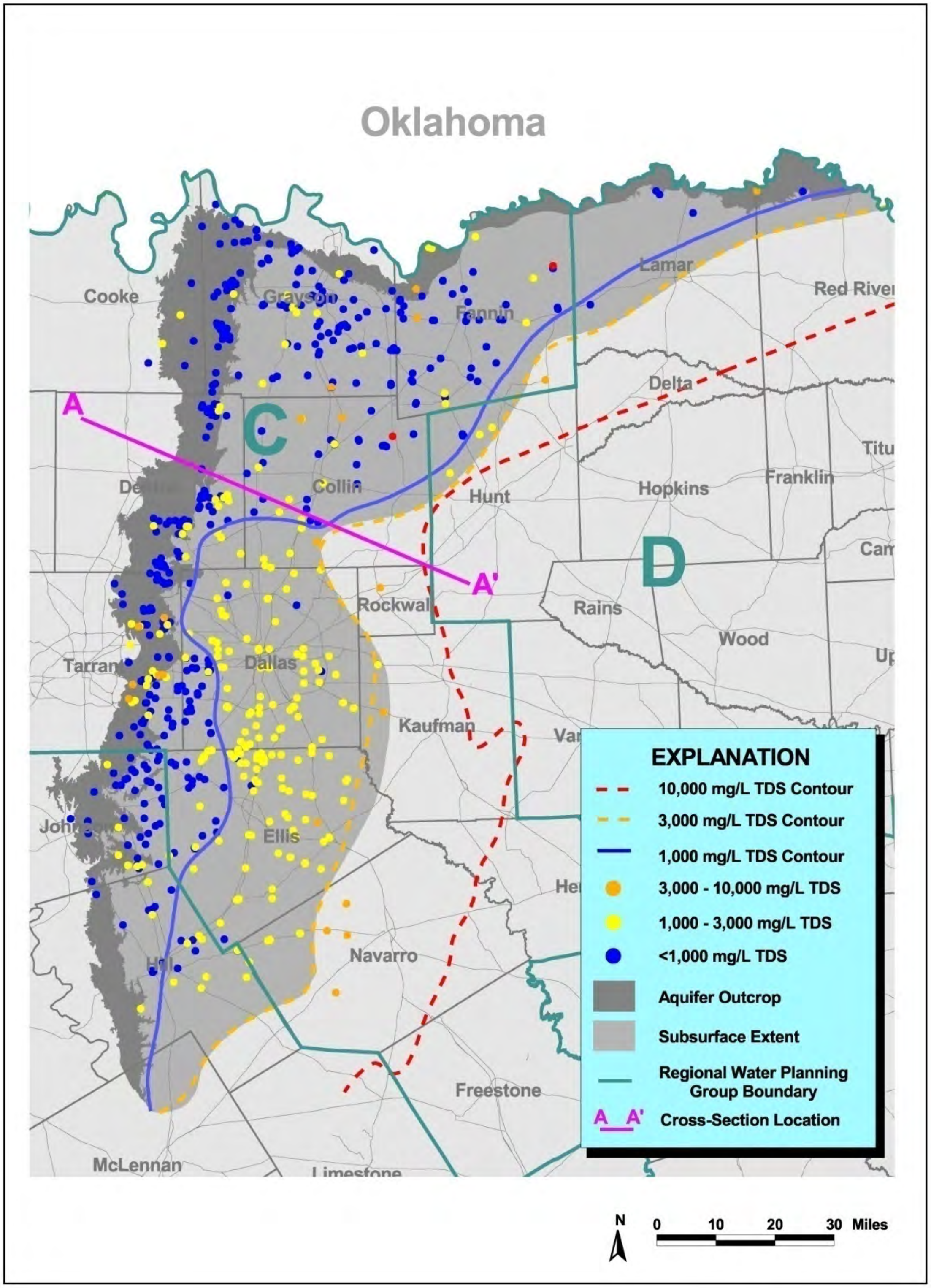
Reference: Figure 61, Brackish Groundwater Manual for Texas Regional Planning Groups

Figure 2-5. Section A of the Nacatoch Aquifer (1)



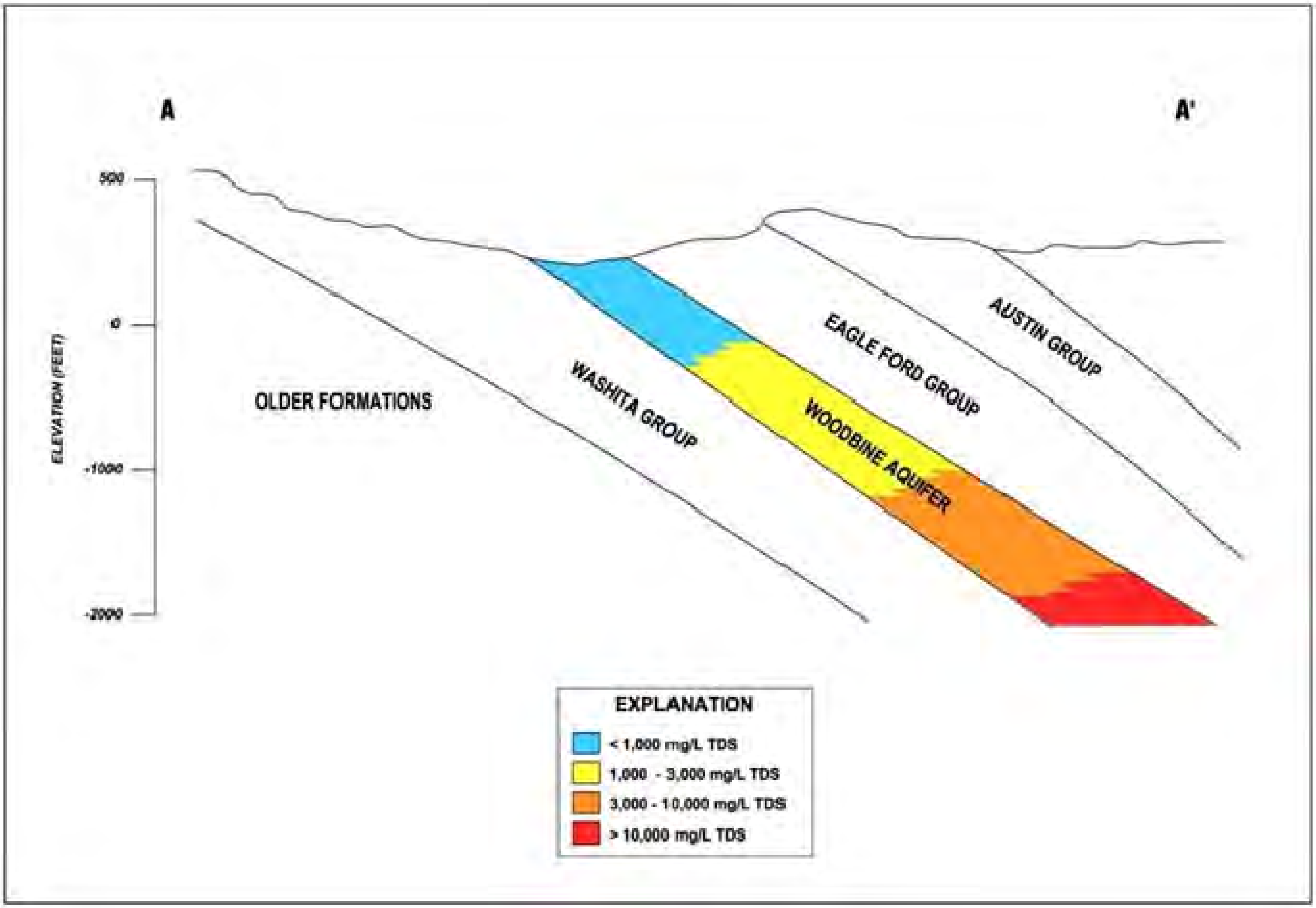
Reference: Figure 62, Brackish Groundwater Manual for Texas Regional Planning Groups

Figure 2-6. Groundwater Quality in the Woodbine Aquifer (1)



Reference: Figure 57, Brackish Groundwater Manual for Texas Regional Planning Groups

Figure 2-7. Section A of the Woodbine Aquifer (1)



Reference: Figure 58, Brackish Groundwater Manual for Texas Regional Planning Group

2.3 Quantities

Historically, most data regarding the quantity of brackish groundwater has not been extensively recorded and evaluated, due in large part to the focus on obtaining fresh groundwater. Most studies of brackish groundwater in Texas have been the product of unsuccessful attempts to locate fresh groundwater. (2) Groundwater evaluations have typically been reserved for establishing the extents and characteristics of freshwater aquifers, while evaluations of saline water have been dedicated to determining the effects of freshwater movement. (3) In 2003, an evaluation of each major and minor aquifer in Texas was conducted and an estimated volume of groundwater falling between 1,000 and 10,000 mg/L TDS was estimated. A summary of this evaluation by regional water planning group is included in Table 2-3. Region C contains approximately 43.4 million acre-feet of slightly brackish groundwater (1,000 to 3,000 mg/L) and 41.6 million acre-feet of brackish groundwater (3,000 to 10,000 mg/L). Note that volumes available in these aquifers represent the amount of water stored in the aquifer, not the actual yield. Yield estimates provide a time reference, and would be necessary to determine the suitability of brackish groundwater as a reliable supply for Region C. This represents approximately 3% of the brackish groundwater available in the state. Monitoring of test wells would be required prior to the implementation of a brackish groundwater desalination project.

Table 2-3. Estimated Brackish Groundwater Volume By Regional Water Planning Group (all volumes in millions of acre-feet) [(2)]

Planning Region	1,000 to 3,000 mg/L TDS	3,000 to 10,000 mg/L TDS	Total
A - Panhandle	7.9	11.2	19.1
B - Region B	6.0	8.6	14.6
C - Region C	**43.4**	**41.6**	**85.0**
D - Northeast Texas	28.9	26.9	55.8
E - Far West Texas	121.9	3.5	125.4
F - Region F	267.2	105.7	372.9
G - Brazos	122.0	73.6	195.6
H - Region H	122.6	73.3	195.9
I - East Texas	114.2	79.2	193.4
J - Plateau	3.2	5.4	8.6
K - Lower Colorado	101.8	100.1	201.9
L - South Central Texas	301.0	116.8	417.8
M - Rio Grande	270.8	125.3	396.1
N - Coastal Bend	200.3	132.1	332.4
O - Llano Estacado	46.7	45.1	91.8
P - Lavaca	1.4	6.5	7.9
Total	**1,759.0**	**954.8**	**2,713.8**
Percentage in Region C	**2.47%**	**4.36%**	**3.13%**

Note: The information in this table represents volumes of water stored in the aquifer, not the actual yield. Yield estimates provide a time reference, and would be necessary to determine the suitability of brackish groundwater as a reliable supply for Region C.

Trinity Aquifer Available Quantities

The Trinity Aquifer is the largest aquifer in North Central Texas, and has seen water level declines of more than 500 feet from pre-development levels in some areas. However, water levels have been fairly stable for the last two decades. [(4)]

Transmissivity describes the ability of groundwater to flow through the entire thickness of an aquifer and is the product of hydraulic conductivity and the thickness of the aquifer. Therefore, as the thickness of an aquifer increases, the transmissivity increases. Well testing in the Trinity Aquifer has indicated that transmissivities range from less than 4,000 to more than 14,000 gpd/ft.. Coefficients of storage are estimated to average approximately 1 x 10^{-4} to 5 x 10^{-4} and specific yields near the outcrop are estimated to be 0.15 to 0.25. Well yields may be as high as 2,000 gpm in the northern section of the aquifer.

Nacatoch Aquifer General Quantities

Well testing in the Nacatoch aquifer has been limited, but transmissivities at test wells have ranged from about 1,500 to nearly 15,000 gpd/ft. Storage coefficients are estimated to average approximately 1 x 10^{-4} to 1 x 10^{-5} and specific yields near the outcrop are estimated to be 0.10 to 0.20. Well yields may be as high as 300 gpm.

Woodbine Aquifer Available Quantities

The Woodbine Aquifer has been producing water for many years, and in high production areas, long-term water level declines have been observed. The Woodbine has seen water level declines of more than 150 feet in some areas from pre-development levels. However, water levels have been fairly stable in the last two decades, and in some cases recovered. [(4)] Recharge is achieved at a rate of one inch/year primarily from precipitation infiltration on the outcrop. Average well yields between 100 to 300 gpm have been observed throughout the aquifer, although well yields of up to 1,000 gpm has been reported. The Lower Woodbine tends to yield the most water, while the Upper Woodbine tends to yield limited quantities with high levels of iron. Well testing in the Woodbine aquifer indicates transmissivities ranging from 1,000 to 15,000 gpd/ft.

2.4 Cost Analysis for Brackish Groundwater Production, Transportation, and Treatment

Two potential water demand centers (DC) are proposed for Region C – a Fort Worth Demand Center, located in Tarrant County, and a Gainesville Demand Center, located in Cooke County. These demand centers are proposed solely to illustrate the logistics of a major brackish groundwater desalination project in Region C. As discussed in this chapter, further study of availability and yield would be needed to identify the feasibility of these demand center options. Additionally, the Fort Worth and Gainesville Demand Centers were chosen to provide the reader with implementation information for a large scale and small scale system and to provide good geographic representation in the region.

Cost estimates for delivery of brackish groundwater to each of the two demand centers are presented in the following sections in August 2008 dollars. Each cost estimate includes the construction of a conveyance system, including water wells, pipelines, pumps, storage ponds, and potential lift stations.

Fort Worth Groundwater Demand Center

The location of a potential Fort Worth DC was considered at each of the City of Fort Worth's three existing water treatment plants (Rolling Hills, Holly, and Eagle Mountain Water Treatment Plants). However, the Holly Water Treatment Plant, which is located in close proximity to the downtown area, was not included in the final cost estimate due to the high cost of construction associated with new pipelines in a highly developed area. Figures 2-8 and 2-9 display the DCs graphically with a red box enclosing the areas of interest.

Well construction costs for demand center scenarios were developed based on industry input. Well construction costs are highly variable, and the availability of electrical power and existing pipelines should be a site specific consideration.

As previously noted, the Trinity Aquifer is located with the boundaries of Fort Worth, and the Woodbine Aquifer is located along the eastern boundary. More specifically, the Eagle Mountain Water Treatment Plant (WTP) is located within the Trinity Aquifer and the Rolling Hills WTP is located near the outcrop of the Woodbine Aquifer. Wells in the vicinity of the Eagle Mountain WTP are shallow and water productivity is low, about 25 – 80 gpm. If wells were drilled approximately 6 miles from the Eagle Mountain WTP, where existing wells are 1,000 – 1,300 feet below the surface, water production could be boosted to approximately 600 – 700 gpm. Similarly, areas of high well production (600 – 700 gpm) can be found approximately 20 miles to the east of the Rolling Hills WTP.

In order to estimate the cost of brackish water delivery to the Eagle Mountain WTP and the Rolling Hills WTP, an average well depth of 1,200 feet and a yield of 600 gpm was assumed with an 85% water recovery rate. Detailed cost information is included in Appendix F. Tables 2-4 and 2-5 provide a summary of the cost information based on capacity.

Table 2-4. Capital Cost for Supplying Water to Eagle Mountain Center

Capacity (MGD)	No. of Wells	Well Drilling Cost	Land (acre)	Land Purchase Cost	Storage Pond Construction Cost	Pipeline Cost	Lift Station Cost	Capital Cost
2.5	6	$2,400,000	320	$960,000	$140,000	$2,210,000	$340,000	$6,650,000
5	9	$3,600,000	640	$1,920,000	$220,000	$2,760,000	$510,000	$9,920,000
7.5	14	$5,600,000	1120	$3,360,000	$300,000	$3,840,000	$510,000	$14,970,000
10	16	$6,400,000	1440	$4,320,000	$370,000	$5,210,000	$550,000	$18,530,000
12.5	20	$8,000,000	1920	$5,760,000	$430,000	$6,960,000	$710,000	$24,050,000
15	24	$9,600,000	2400	$7,200,000	$500,000	$7,820,000	$890,000	$28,610,000

(1) Total cost includes 10% contingency

Table 2-5. Capital Cost for Supplying Water to Rolling Hills

Capacity (MGD)	No. of Wells	Well Drilling Cost	Land (acre)	Land Purchase Cost	Storage Pond Construction Cost	Pipeline Cost	Lift Station Cost	Capital Cost
2.5	6	$2,400,000	320	$960,000	$140,000	$6,370,000	$680,000	$11,600,000
5	9	$3,600,000	640	$1,920,000	$220,000	$7,720,000	$1,020,000	$15,930,000
7.5	14	$5,600,000	1120	$3,360,000	$300,000	$9,600,000	$1,020,000	$21,860,000
10	16	$6,400,000	1440	$4,320,000	$370,000	$14,160,000	$1,220,000	$29,110,000
12.5	20	$8,000,000	1920	$5,760,000	$430,000	$17,510,000	$1,360,000	$36,370,000
15	24	$9,600,000	2400	$7,200,000	$500,000	$19,220,000	$1,700,000	$42,050,000

(1) Total cost includes 10% contingency

The construction cost for a Fort Worth DC utilizing the Eagle Mountain WTP is substantially lower than for the Rolling Hills WTP, primarily due to the shorter distance between the water source and the WTP. From a cost perspective, the Eagle Mountain WTP is a better location for desalination of the brackish water. Well yields may be as high as 300 gpm.

Gainesville Groundwater Demand Center

A potential Gainesville Demand Center was assumed to be centered around the location of the existing Gainesville WTP. The Gainesville WTP, which currently performs both surface water and groundwater treatment, was also assumed to be the entry point of treated brackish groundwater into the distribution system.

The area encompassed in the Gainesville DC contains four existing wells which are summarized in Table 2-6. The proposed Gainesville DC has high groundwater productivity and is located in a rural area, making it well suited for well drilling and operation.

In order to estimate the cost of brackish water delivery to the Gainesville WTP, an average well depth of 1000 feet and a yield of 700 gpm was assumed with an 85% water recovery rate. The pipe length from the lift station to the treatment facility is assumed to be 0.5 miles. Detailed cost information is included in Appendix G. Table 2-7 provides a summary of the cost information based on the number of wells and capacity required.

Table 2-6. Existing Wells [4]

Well Number	Well Depth	Pump hp	Yield (gpm)
1923201	920		910
1923502	940	100	650
1923503	912	150	720
1923504	890		920

Table 2-7. Capital Cost for Supplying Water to Gainesville Demand Center

Capacity (MGD)	No. of Wells	Well Drilling Cost	Land (acre)	Land Purchase Cost	Storage Pond Construction Cost	Pipeline Cost	Lift Station Cost	Capital Cost
2.5	6	$2,000,000	320	$960,000	$140,000	$2,520,000	$230,000	$6,430,000
5	9	$3,000,000	640	$1,920,000	$220,000	$2,760,000	$340,000	$9,070,000
7.5	12	$4,000,000	960	$2,880,000	$300,000	$3,000,000	$340,000	$11,570,000
10	16	$5,330,000	1,440	$4,320,000	$370,000	$3,650,000	$370,000	$15,440,000
12.5	18	$6,000,000	1760	$5,280,000	$432,000	$3,624,000	$450,000	$17,365,000
15	20	$8,000,000	1,920	$5,760,000	$500,000	$4,310,000	$560,000	$21,050,000

Treatment

The cost methodology presented in this section was developed from "Desalination for Texas Water Supply" by HDR (2000) [5] and modified to reflect September 2008 dollars using the ENR construction cost index (hereafter referred to as the Desalination Report).

The desalination cost estimates are based on the following process assumptions:

Pretreatment (pH control and anti-scalant, cartridge filters) →

Feed Water Pumping → Membrane Process + Chemical Cleaning System

Labor and energy costs are presented as hr/year and MW-hr/year respectively.

Pretreatment

The degree of pretreatment can vary to a great extent depending on source water type. The pretreatment process may include adding anti-scalant and acid prior to cartridge filtration. Other necessary equipment may include:

- Cartridge filters (number of equipment depends on capacity of the plant, the Desalination Report assumed 5 MGD per filter)
- Chemical system:
  1. Fiberglass tank (one per chemical) and sized to hold 30 days of supply (maximum 12,500 gallon)
  2. Metering pump (one duty one stand by per chemical)
  3. Chemical feed system
  4. Control panel

The costs associated with pretreatment are shown in Figure 2-8 and Table 2-8.

Figure 2-8. Pretreatment System Costs

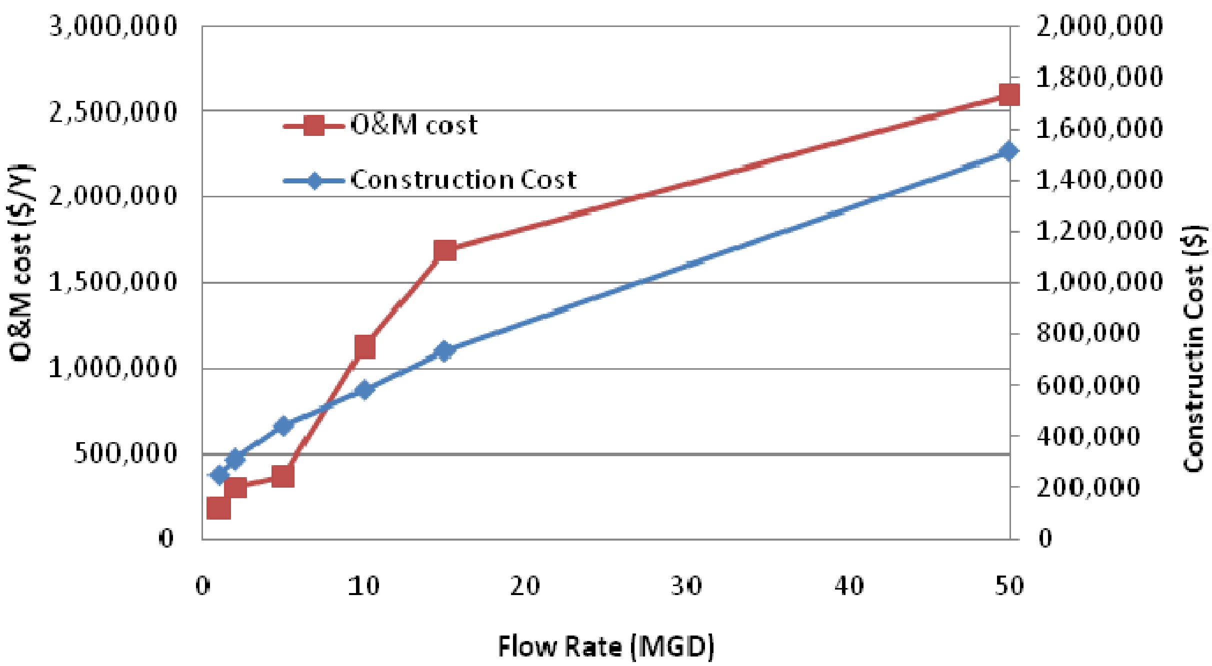


Table 2-8. RO Pretreatment Costs

Flow (MGD)	Construction ($)	Construction ($/gpd)	O&M ($/year) [(a)]	O&M [(a)] ($/1000 gal)	Building Area [(b)] (sf)
2.5	$340,000	$0.13	$310,000	$0.21	
5	$440,000	$0.09	$370,000	$0.20	447
7.5	$510,000	$0.07	$750,000	$0.27	
10	$580,000	$0.06	$1,130,000	$0.31	651
12.5	$810,000	$0.06	$1,410,000	$0.31	
15	$740,000	$0.05	$1,690,000	$0.31	837
17.5	$1,570,000	$0.09	$1,750,000	$0.27	
20	$1,620,000	$0.08	$1,820,000	$0.25	

(a) Labor cost included in O&M cost is assumed to be $20/hr at present for an experienced water treatment plant operator. The Desalination Report reported labor by hr/year. Use a factor of 1.375 to calculate dollar value for the year of 2000.

(b) Listed surface area values were taken from the Desalination Report.

(c) Electricity usage was not estimated in the Desalination Report for pretreatment

Feed Pump

The brackish groundwater present in the Region C area would likely only require a medium discharge pressure (500 psi). The costs associated with feed pumps are shown in Figure 2-9 and Table 2-9.

Figure 2-9. 500 psi Feed Pump Cost

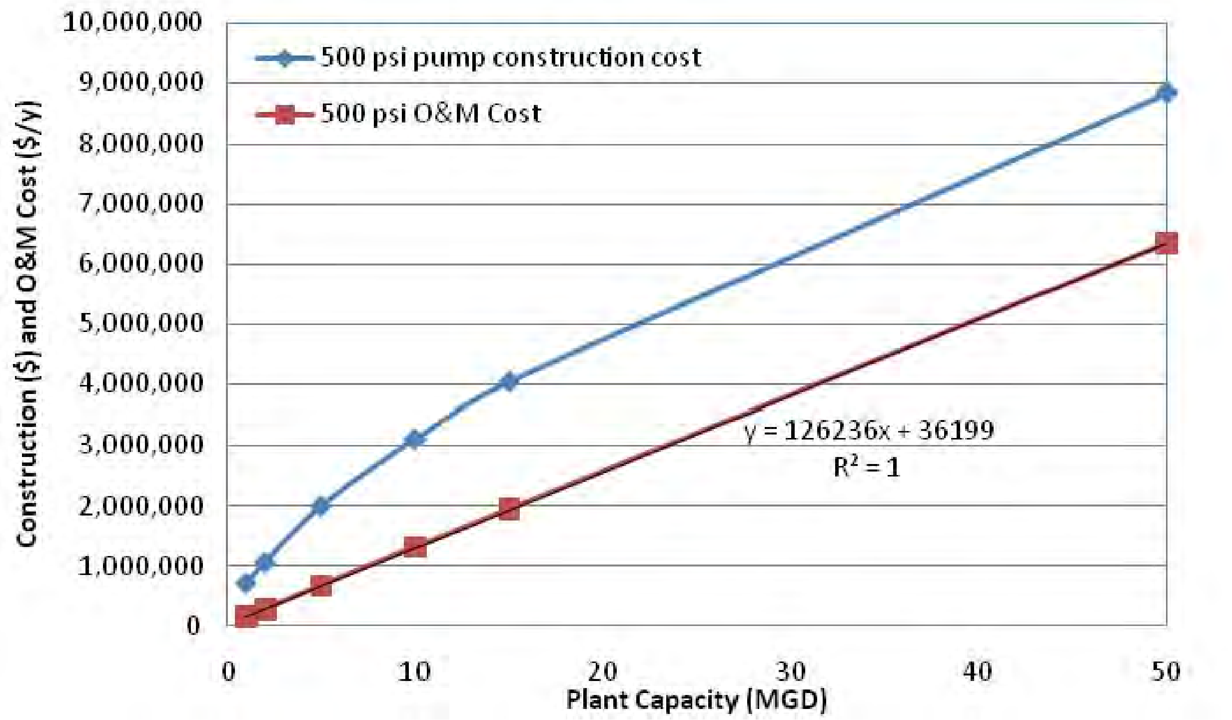


Table 2-9. Feed Pumps Cost

Flow	Construction Costs		Construction Costs ($/gpd)		O&M [(a)]	($/year)	O&M [(a)(c)] ($/1000 gal)		Building Area
MGD	500 psi	700 psi	500 psi	700 psi	500 psi	700 psi	500 psi	700 psi	sf
2.5	1,213,440	1,703,770	$0.49	$0.68	351,790	481,614	$0.39	$0.53	
5	1,993,750	2,475,000	$0.40	$0.50	671,080	929,720	$0.37	$0.51	624
7.5	2,550,625	3,169,375	$0.34	$0.42	982,970	1,363,290	$0.36	$0.50	
10	3,107,500	3,863,750	$0.31	$0.39	1,312,800	1,815,910	$0.36	$0.49	727
12.5	3,575,000	4,441,250	$0.29	$0.36	1,614,150	2,244,960	$0.35	$0.49	
15	4,042,500	5,018,750	$0.27	$0.33	1,945,030	2,702,110	$0.35	$0.49	780
17.5	4,452.050	5,445,000	$0.36	$0.44	2,245,330	3,126,640	$0.35	$0.49	
20	4,861,600	5,871,250	$0.24	$0.29	2,560,920	3,567,480	$0.35	$0.49	

(a) Labor cost included in O&M cost is assumed to be $20/hr at present for an experienced water treatment plant operator. The Desalination Report reported labor by hr/year. Use a factor of 1.375 to calculate dollar value for the year of 2000

(b) The Desalination Report reported energy cost by MWh/y. $0.05/Kw.h is used to convert energy usage from MWh/y for 2000 and then multiplied by 1.375 for dollar value of 2008

(c) Electricity cost for the year of 2000 is fromhttp://www.eia.doe.gov/cneaf/electricity/epa/epat7p4.html

(d) O&M costs at different plant capacities are calculated from the formula of the trend lines

RO Process

The number of RO membrane units is a function of the number of elements required. The following equation may be used to determine the number of membrane units required and is a function of plant capacity (see Table 2-10):

$$\text{Number of Membrane Elements} = \frac{\text{Q(product water MGD)x}10^6}{\text{Module unit area (sf)x permeat flux}} \text{x}(1 + \text{Safty factor})$$

Table 2-10. Number of Elements Required by Permeate Flow Rate

Flow Rate (MGD)	No. Elements	No Elements/1000 gal
0.05	9	0.180
0.1	18	0.180
0.2	35	0.175
0.5	86	0.172
1	172	0.172
2	344	0.172
5	860	0.172
10	1719	0.172
15	2579	0.172
50	8594	0.172
100	17188	0.172
	Average	0.174

The capital and O&M costs associated with the RO process are shown in Figure 2-10 and Tables 2-11 and 2-12.

Figure 2-10. Cost vs. Number of Membranes (500 psi)

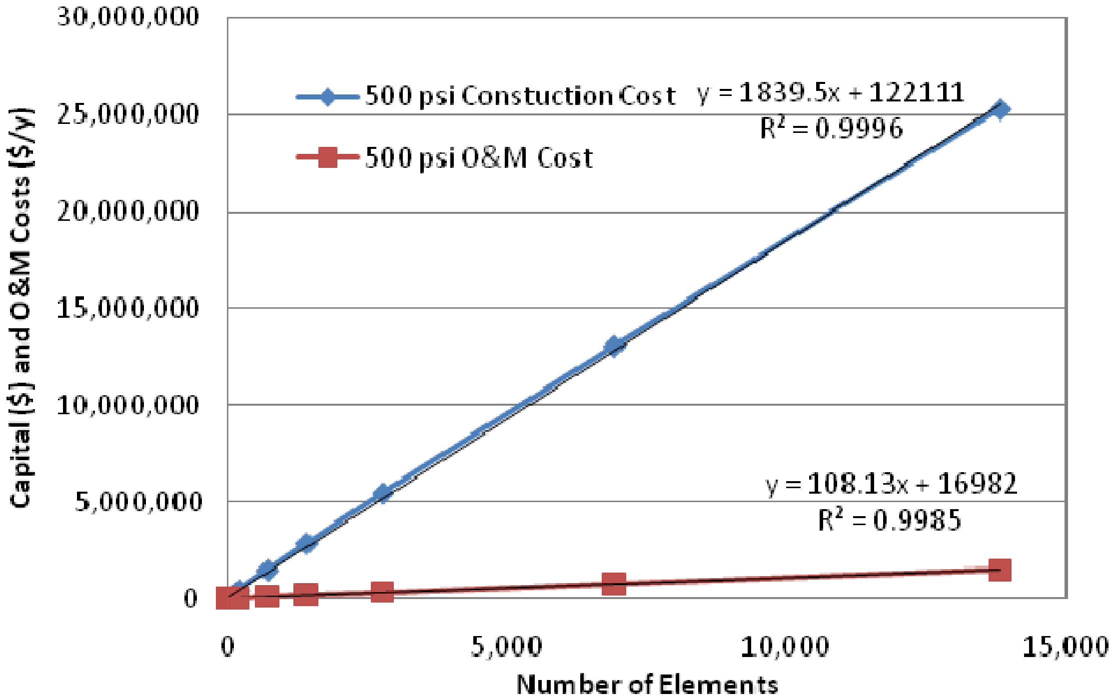


Table 2-11. Capital Costs for RO Process

Number of Elements	Flow rate MGD	Construct. 500 psi	$ 700 psi	Construct 500 psi	$/gpd 700 psi	Building Area sf
430	2.5	$972,605	$1,100,010	$0.39	$0.44	
860	5	$1,760,765	$1,986,620	$0.35	$0.40	447
1290	7.5	$2,548,925	$2,873,230	$0.34	$0.38	
1720	10	$3,337,085	$3,759,830	$0.33	$0.38	651
2150	12.5	$4,125,245	$4,646,440	$0.33	$0.37	
2580	15	$4,913,405	$5,533,050	$0.33	$0.37	837
3010	17.5	$5,701,565	$6,419,660	$0.33	$0.37	
3440	20	$6,489,725	$7,306,260	$0.32	$0.37	

Table 2-12. O&M Cost for RO Process

No. Elements	Flow rate MGD	O&M 500 psi	$/y 700 psi	O&M[(a)] 500 psi	$/1000 gal 700 psi	Building Area sf
430	2.5	$71,180	$80,270	$0.08	$0.09	
860	5	$117,310	$133,360	$0.06	$0.07	447
1290	7.5	$163,440	$186,460	$0.06	$0.07	
1720	10	$209,570	$239,550	$0.06	$0.07	651
2150	12.5	$255,700	$292,640	$0.06	$0.06	
2580	15	$301,830	$345,730	$0.06	$0.06	837
3010	17.5	342,450	392,780	$0.05	$0.06	
3440	20	388,950	446,270	$0.05	$0.06	

(a) Labor cost included in O&M cost is assumed to be $20/hr at present for an experienced water treatment plant operator. The Desalination Report reported labor by hr/year. Use a factor of 1.375 to calculate dollar value for the year of 2000

RO Chemical Cleaning System

The RO chemical cleaning system generally consists of several cycles of an acid wash followed by several cycles of caustic wash. The number of cleaning systems required was calculated by the following formula:

$$No. of\ Cleaning\ Systems = \frac{\text{No. of pressure vessle}}{100\ \frac{\text{Cleaning interval}}{2}}$$

The equipment required for a RO chemical cleaning system includes the following:

- Fiberglass tank (one per chemical) is sized by multiplying the total volume of the pressure vessels by 3
- Flushing pumps (one duty one standby per chemical) at average 40 gpm and TDH of 150 psi. Pump efficiency was assumed to be 75%
- Chemical fill station (large systems only)
- Control panel

The capital costs associated with the RO chemical cleaning process are shown in Figure 2-11 and Table 2-13.

Figure 2-11. CIP System Cost

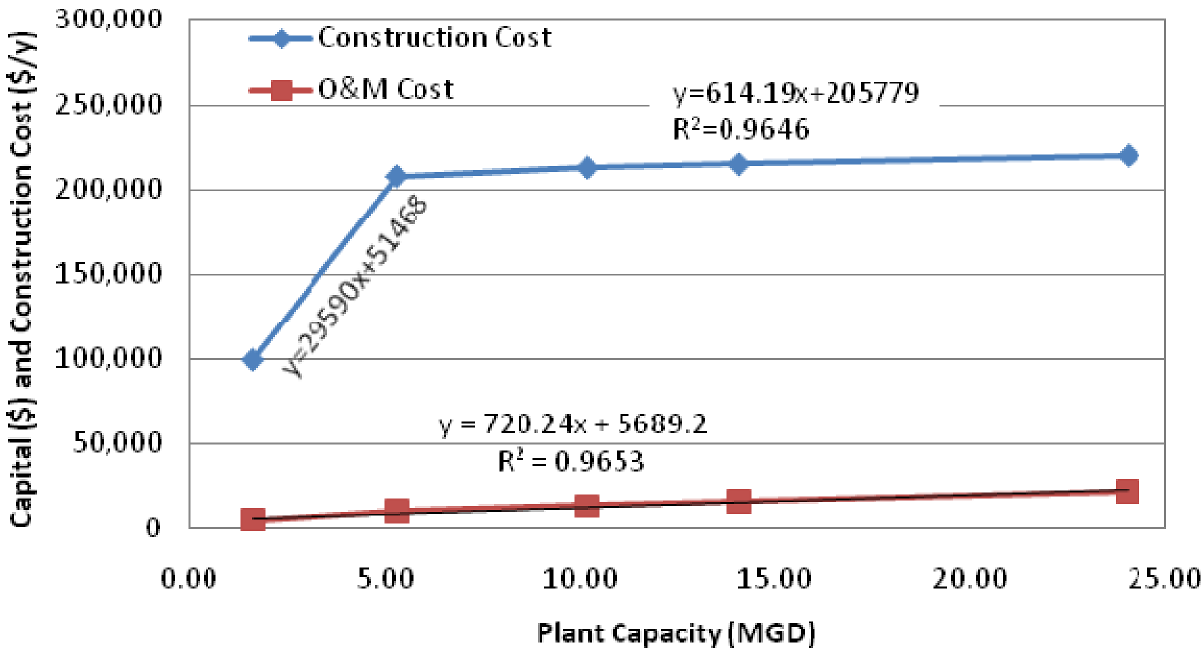


Table 2-13. Cost for CIP System

Flow rate MGD	Construction $	Construction $/gpd	O&M $/y	O&M $/1000gal	Building Area sf
2.5	125,443	0.05	7,490	$0.01	900
5	199,418	0.04	9,291	$0.01	1,710
7.5	210,385	0.03	11,091	$0.00	1,710
10	211,921	0.02	12,892	$0.00	1,710
12.5	213,456	0.02	14,693	$0.00	1,710
15	214,992	0.01	16,494	$0.00	1,710
17.5	216,527	0.01	18,294	$0.00	1,710
20	218,063	0.01	20,095	$0.00	1,710

(1) Labor cost included in O&M cost is assumed to be $20/hr at present for an experienced water treatment plant operator. The Desalination Report reported labor by hr/year. Use a factor of 1.375 to calculate dollar value for the year of 2000

(2) The Desalination Report reported energy cost by MWh/y. $0.05/Kw.h is used to convert energy usage from MWh/y for 2000 and then multiplied by 1.375 for dollar value of 2008

(3) Electricity cost for the year of 2000 is fromhttp://www.eia.doe.gov/cneaf/electricity/epa/epat7p4.html

2.5 Saline Groundwater Summary in Region C

Saline groundwater in the aquifers within the Region C area are of a quality that would need to be blended with fresh water and/or be treated by a desalination process. The primary sources of saline groundwater for Region C are the Trinity, Nacatoch, and

Woodbine aquifer. The actual quantities of saline groundwater that will be available are dependent upon the management plans to be adopted by the applicable GCDs that have jurisdiction over each of the aquifers.

CHAPTER 2
LIST OF REFERENCES

(1) LBG-Guyton Associates, NRS Consulting Engineers, Brackish Groundwater Manual for Texas Regional Planning Groups, prepared for the Texas Water Development Board, February 2003.

(2) NRS Consulting Engineers, R.W. Harden and Associates, Dietrich Consulting Group, TRC, Electrical Expertise, Inc., WaterPR. "Guidance Manual for Brackish Groundwater Desalination in Texas." Prepared for Texas Water Development Board, April 2008.
3) United States Geological Survey, Desalination of Ground Water: Earth Science Perspectives, accessed online at http://pubs.usgs.gov/fs/fs075-03/pdf/AlleyFS.pdf , October 2003.

(3) Bene, J., Harden, B., Griffin, S., Nicot, J., "Northern Trinity/Woodbine Aquifer Groundwater Availability Model." Prepared for the Texas Water Development Board, January 2007.

(4) Texas Water Development Board Groundwater Database, accessed online at http://www.twdb.state.tx.us/gwrd/waterwell/well_info.asp, January 2010.

(5) HDR Engineering, Inc., Water Resources Associates, Malcolm Pirnie, Inc. and PB Water, 2000. Desalination for Texas Water Supply, Part A: Membrane Technologies and Costs.

3.0 Survey of Operating Desalination Facilities in Region C

During late 2009, a survey of operating desalination facilities in Texas and around the United States was conducted as a component of this study. The purpose of this survey was to gather information about technologies being applied, the quality of raw water being treated, treatment performance, the concentrate disposal process, and actual treatment and disposal costs. Both groundwater and surface water facilities were surveyed, and a variety of disposal types were represented. The list of Texas surveyees was compiled by reviewing the TWDB's *A Desalination Database for Texas.* (1)

A range in plant size, disposal type, and source water type amongst surveyees was intended to provide results applicable to a variety of possible applications in Region C. The largest facility surveyed was Tampa Bay Water's Seawater Desalination Plant, which has a design hydraulic capacity of 28.75 MGD. The smallest facility surveyed was the City of Bardwell Desalination Plant, with a design hydraulic capacity of 0.036 MGD. Table 3-1 includes a summary of the survey group. Surveys were provided to fifteen facilities and responses were received from five facilities – the Southmost Regional Water Authority Reverse Osmosis (RO) Facility in Brownsville, Texas, the Kay Bailey Hutchison Desalination Plant in El Paso, Texas, the Robinson Water Treatment Plant in Robinson, Texas, the Sherman Water Treatment Plant in Sherman, Texas, and the Tampa Bay Seawater Desalination Plant in Clearwater, Florida. A copy of the survey results is included in Appendix H.

Of the five survey respondents, two facilities characterized their feed water as low brackish groundwater, with a TDS concentration of 1,000 to 5,000 mg/L. One facility characterized their feed water as fresh surface water with a TDS concentration less than 1,000 mg/L, and one facility as low brackish surface water, with a TDS concentration of 1,000 to 2,500 mg/L. The remaining facility, the Tampa Bay Seawater Desalination Plant, is characterized as a seawater application, with a TDS concentration between 20,000 and 35,000 mg/L. Although seawater desalination is not included as a recommended strategy for Region C, the Tampa Bay Seawater Desalination Plant was surveyed based on its relevance as a large scale facility and the lack of brackish surface water desalination applications outside of Texas. The bay conditions of the feed water were intended to

Table 3-1. Summary of Survey Group

Entity	State	Response Received?	Design Hydraulic Capacity of Desalination Unit (MGD)	Disposal Type	Source Water Type
City of Abilene	TX	no	8	evaporation pond	surface water
City of Bardwell	TX	no	0.036	WWTP	groundwater
Brazos River Authority	TX	no	6	surface	surface water
Brownsville Public Utilities Board	TX	yes	6	surface	groundwater
El Paso Water Utilities	TX	yes	15.5	injection wells	ground water
City of Fort Stockton	TX	no	6	WWTP	groundwater
City of Granbury	TX	no	0.11	WWTP	surface water
Town of Jupiter	FL	no	unknown	unknown	groundwater
Newport News Waterworks	VA	no	unknown	unknown	groundwater
North Alamo Water Supply Corporation*	TX	no	2.88	surface	groundwater
City of Robinson	TX	yes	1.8	surface	surface water
City of Sherman	TX	yes	7.5	WWTP	surface water
Sportsman World MUD	TX	no	0.083	surface	surface water
The Cliffs Resort	TX	no	0.2	surface	surface water
Tampa Bay Water	FL	yes	28.75	surface	surface water

*On behalf of the North Cameron Facility.

provide a closer approximation to inland saline surface waters than open ocean water. A range of concentrate management options – surface, sanitary sewer, and deep well injection were represented in the survey respondents.

The operational age of the survey respondent facilities ranges from seventeen years to one year of operation. Two of the largest facilities in Texas, Brownsville (6.0 MGD design desalination hydraulic capacity) and El Paso (27.5 MGD design desalination hydraulic capacity) began operation in the 2000s. Another large application, the Sherman facility (7.5 MGD design desalination hydraulic capacity) began operation in 1993 and currently provides potable and industrial water to Region C. The brackish surface and groundwater respondents all reported design RO Feedwater Recoveries between 75 and 87%. Tampa Bay reported a design RO Feedwater Recovery of 60%, which is typical of highly saline source waters. In addition, the design maximum and minimum pressures for the Tampa Bay facility were much larger than the brackish applications in Texas – with a maximum design pressure of 1,000 psi and a minimum design pressure of 700 psi. By comparison, the El Paso facility has a maximum design pressure of 185 psi and a minimum design pressure of 125 psi.

The post-treatment methods varied amongst the five survey respondents and included: degasification/decarbonation, caustic chemical addition, corrosion inhibitor addition, blending with treated surface water, and blending with treated groundwater. Four of the respondents utilize chlorine for disinfection, while the Brownsville facility utilizes chloramine. Post-treatment issues identified at the respondent facilities include: colored or red water, taste and odor, disinfection byproducts, and detention time considerations (both prior to and after entry point into distribution system). All of the respondents have the capability to blend with water from another source, although not all are currently blending. A summary of the treated water quality of the respondents is included in Figures 3-1 through 3-8.

The surveyees were also asked about permitting and regulatory obstacles they overcame. The City of Robinson experienced varying river concentrations of chlorides, sulfates, and TDS which sometimes resulted in exceedance of their discharge permit. Tampa Bay Facility indicated that sensitivity of public input to regulatory authorities, inexperience of permitting staff with technology, toxicity testing protocols and interpretation of results, and an unfavorable public opinion were all obstacles that were overcome to obtain permits. Concentrate disposal obstacles experienced by the respondents included: acquiring a National Pollutant Discharge Elimination System (NPDES) permit, flow restrictions in discharge piping, toxicity protocols and interpretation of results.

The Tampa facility noted that pilot testing is essential to any desalination project. Pilot testing will aid in evaluation and development of information and standards for the development of a full scale operation. Information regarding pilot testing, as well as information gained from the "lessons learned" section of the survey is incorporated into Chapter 7. The information obtained from the survey is included in Appendix H.

Figure 3-1. Temperature Survey Data

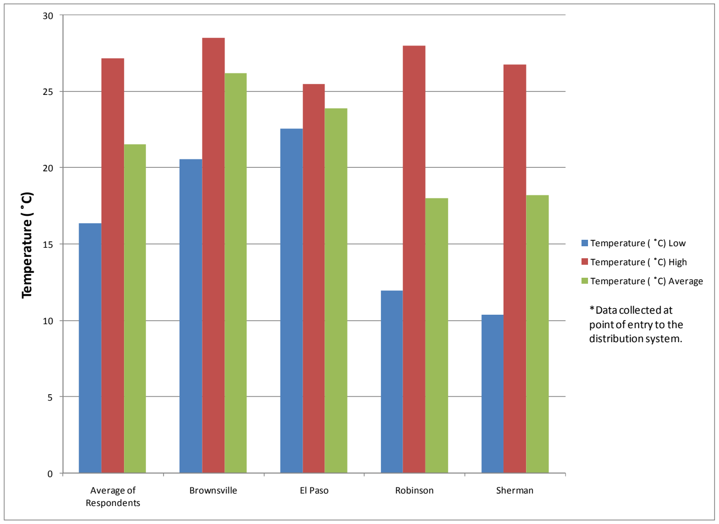


Figure 3-2. pH Survey Data

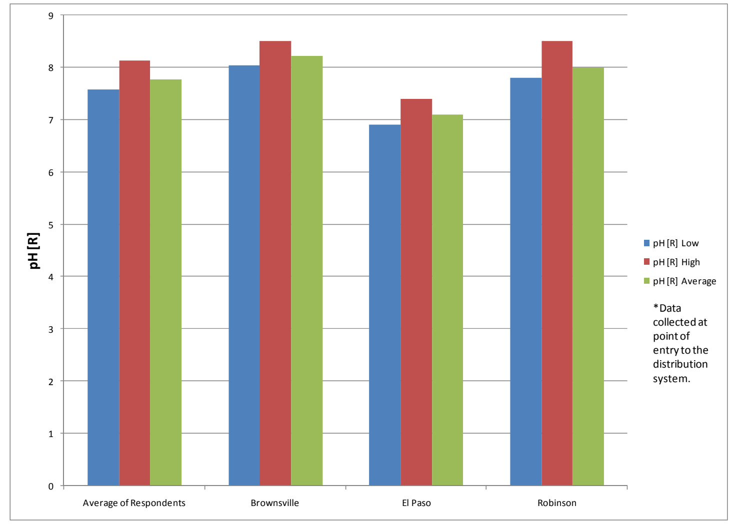


Figure 3-3. Alkalinity Survey Data

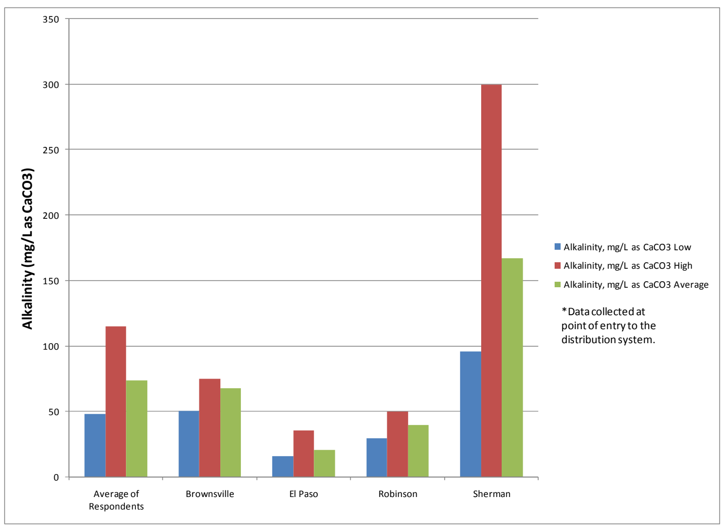


Figure 3-4. Turbidity Survey Data

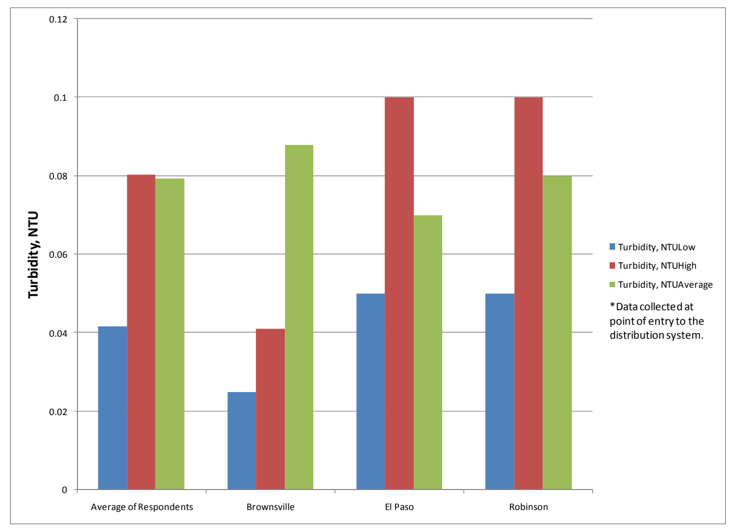
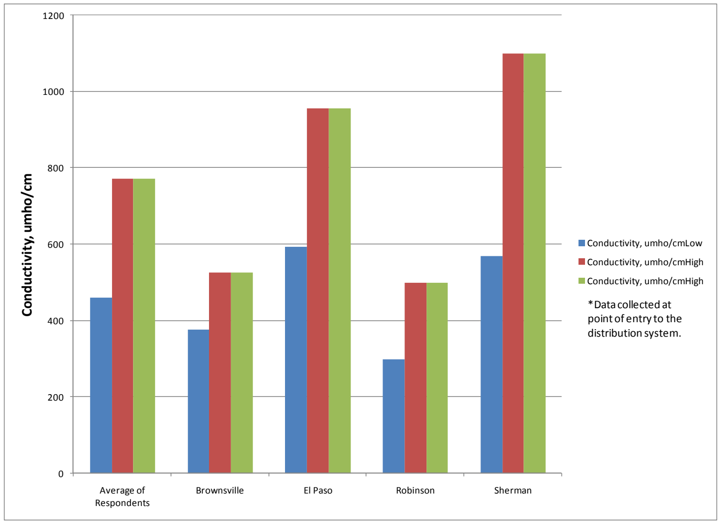


Figure 3-5. Conductivity Survey Data

Figure 3-6. TDS Survey Data



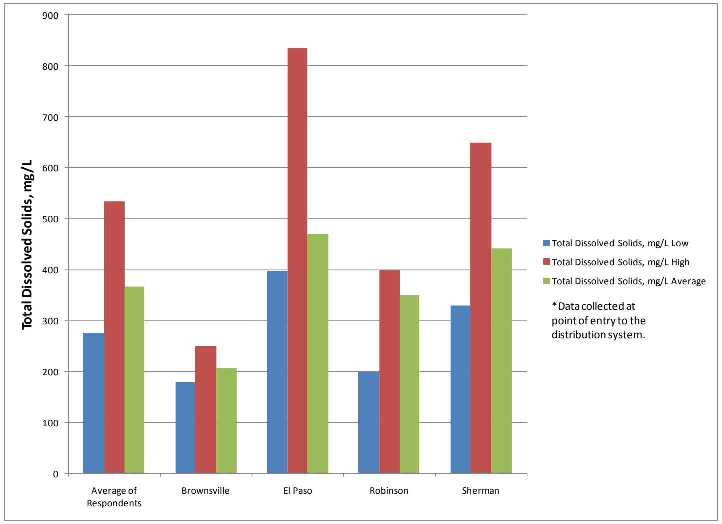


Figure 3-7. TOC Survey Data

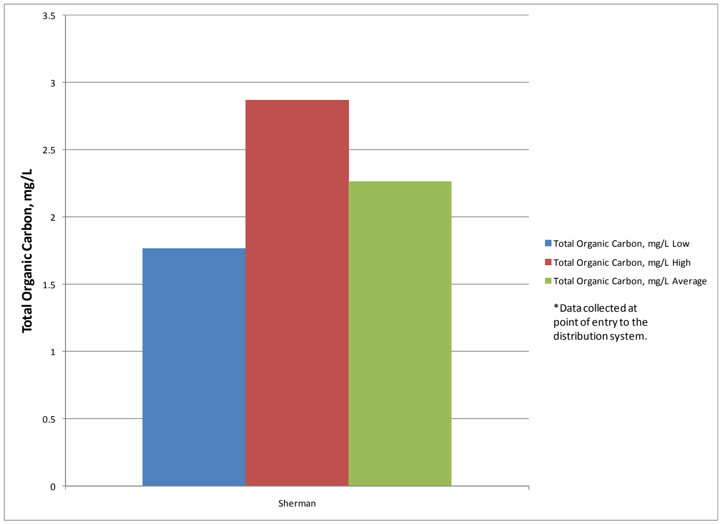
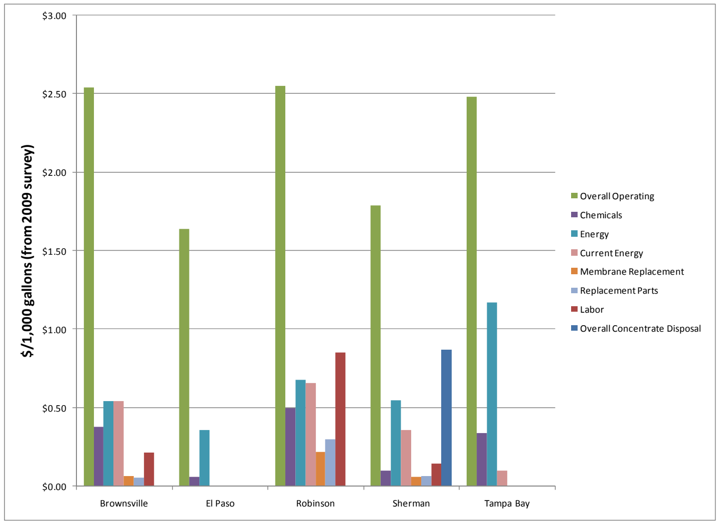


Figure 3-8. Treatment Cost Survey Data



CHAPTER 3
LIST OF REFERENCES

(1) Bureau of Economic Geology, "A Desalination Database for Texas." Prepared for Texas Water Development Board, October 2006.

4.0 General Water Quality and Water Quality Impacts of Brackish Supplies

This chapter addresses the general water quality of brackish supplies and provides an outline of the potential water quality impacts of introducing a brackish supply into potable infrastructure. A detailed evaluation of source water should be conducted to define the water quality and to aid in future evaluations prior to project implementation.

4.1 Water Quality of Brackish Supplies

Naturally occurring waters contain dissolved or suspended inorganic or organic compounds. Total dissolved solids are the sum of all dissolved inorganic and organic constituents in water. Total suspended solids are the sum of all inorganic and organic material in water that is not dissolved. The components found in Table 4-1 are common in naturally occurring brackish water. (1) The water quality of brackish groundwater and surface water should be considered in the decision related to treatment facilities and disposal options. Figures 2-1, 2-4, and 2-6 (Chapter 2) provide quality data for brackish groundwater wells throughout Region C. Appendix C provides quality data for brackish surface water in Region C.

Table 4-1. Major Dissolved Salts Occurring in Brackish Waters (1), (2)

Cations		Anions	
Name	**Symbol**	**Name**	**Symbol**
Calcium	Ca^{2+}	Carbonate	CO_3^{2-}
Magnesium	Mg^{2+}	Bicarbonate	HCO_3^-
Sodium	Na^+	Sulfate	SO_4^{2-}
Potassium	K^+	Chloride	Cl^-
Iron (ferrous)	Fe^{2+}	Hydroxide	OH^-
Iron (ferric)	Fe^{3+}	Fluoride	F^-
Manganese	Mn^{2+}	Nitrate	NH^{4+}, NO^{2-}, NO_3^-,
Aluminum	Al^{3+}	Silica	$Si(OH)_4$
Barium	Ba^{2+}	Sulfide	S^{2-}. $(H_2S)(aq)$
Stronium	Sr^{2+}		

Adapted from: Table 5, Guidance Manual for Brackish Groundwater Desalination in Texas

4.2 Potential Effects of Brackish or Partially Treated Brackish Water on Potable Infrastructure

Predicting the exact water chemistry of a blended water at any point in time is a precarious exercise, and chemistry will vary in time based on seasonal water quality changes and operational factors. While it is impossible to predict the precise water chemistry in an infinite number of mixtures, a qualitative evaluation of potential issues will provide water planners in Region C with a basis for planning pilot studies and water quality modeling. Prior to the blending of dissimilar waters, detailed evaluations of potential distribution system impacts and impacts on existing treatment processes should be conducted. In this report, a general discussion is provided regarding the potential impacts related to introducing untreated or partially treated brackish water to the treatment and distribution system is provided. all inclusive, and should be developed on a project specific basis.

Distribution System Water Quality Impacts

Potential distribution system water quality issues associated with the blending of supplies includes: taste and odor (associated with algae), staining (associated with Manganese and Iron), discolored water, elevated coliform or heterotrophic plate counts (HPC), pathogens, disinfection byproducts (DBPs), residual disinfection issues, elevated total organic carbon (TOC), biological growth, and the contaminants listed on the

Contaminate Candidate List 3. These considerations may be associated with brackish supplies themselves, or when mixing dissimilar waters in a distribution system. This list is not all inclusive, and should be developed on a project specific basis.

Consumer Impacts

The impact on the consumer is a key consideration when evaluating a desalination application, and consumer confidence may be impacted. Potential consumer impacts include perceived health issues, taste and odor problems, discoloration, and an increase in water rates associated with the implementation of a desalination facility. Good communication with the public can help mitigate these concerns.

Impacts on Existing Water Treatment Processes

When introducing brackish water into an existing water treatment process, an evaluation of source water should be conducted and treatment modifications may be required. In general, current treatment plants are capable of handling the additional TOC load associated with saline water. Treatment plant modifications may be required to address taste and odor concerns, TDS, *iron, and m**anganese*** **present in saline water.**

If precipitated out of solution during the treatment process, dissolved solids have the potential to cause membrane scaling. Suspended solids can affect a membrane by physically blocking or plugging membrane pores. Biological or organic material can cause or contribute to growth on the surface of a membrane, thereby reducing recovery.

4.3 Conclusions

The water quality characteristics of potential brackish water supplies will vary in quality depending on location of source, seasonal water quality, and factors which are generally case and site specific. Although the water quality of a brackish water may be generalized, prior to the implementation of any desalination project, a detailed water quality evaluation should be conducted to help identify potential considerations for treatment. The potential effects of introducing saline water into existing water supplies and current infrastructure can be more readily evaluated with additional project specific information relating to source water quality.

CHAPTER 4
LIST OF REFERENCES

(1) Watson, I., Morin, O., Henthorne, L., "Desalting Handbook for Planners" Prepared for the Bureau of Reclamation, Third Edition, July 2003.

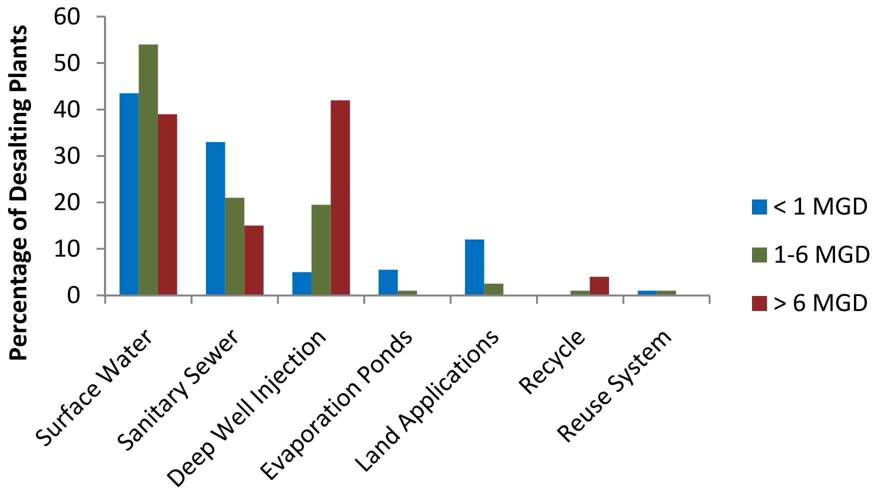
(2) NRS Consulting Engineers, R.W. Harden and Associates, Dietrich Consulting Group, TRC, Electrical Expertise, Inc., WaterPR. "Guidance Manual for Brackish Groundwater Desalination in Texas." Prepared for Texas Water Development Board, April 2008.

5.0 Analysis of Concentrate Disposal

The five most common concentrate management options – surface water disposal, sanitary sewer disposal, deep well injection, land application, and evaporation ponds account for over 98% of all disposal cases in the United States. The United States Bureau of Reclamation (USBR) conducted a survey in 2003 of the 234 operating desalination plants in the United States and found that surface water disposal, sanitary sewer disposal, and deep well injection account for 85% of all disposal cases in the United States (see Figure 5-1). Approximately 9% of the disposal cases not using surface or sanitary sewer disposal in the United States are located in Texas. Approximately 96% of the desalination plants surveyed were utilized for inland brackish seawater desalination, with the Tampa Bay plant being the only seawater desalination plant larger than 2 MGD in size. Florida (114 plants), California (33 plants), and Texas (20 plants) contain the majority of desalination facilities in the United States. The study also noted a number of facilities under construction in these three states as of 2003. (1)

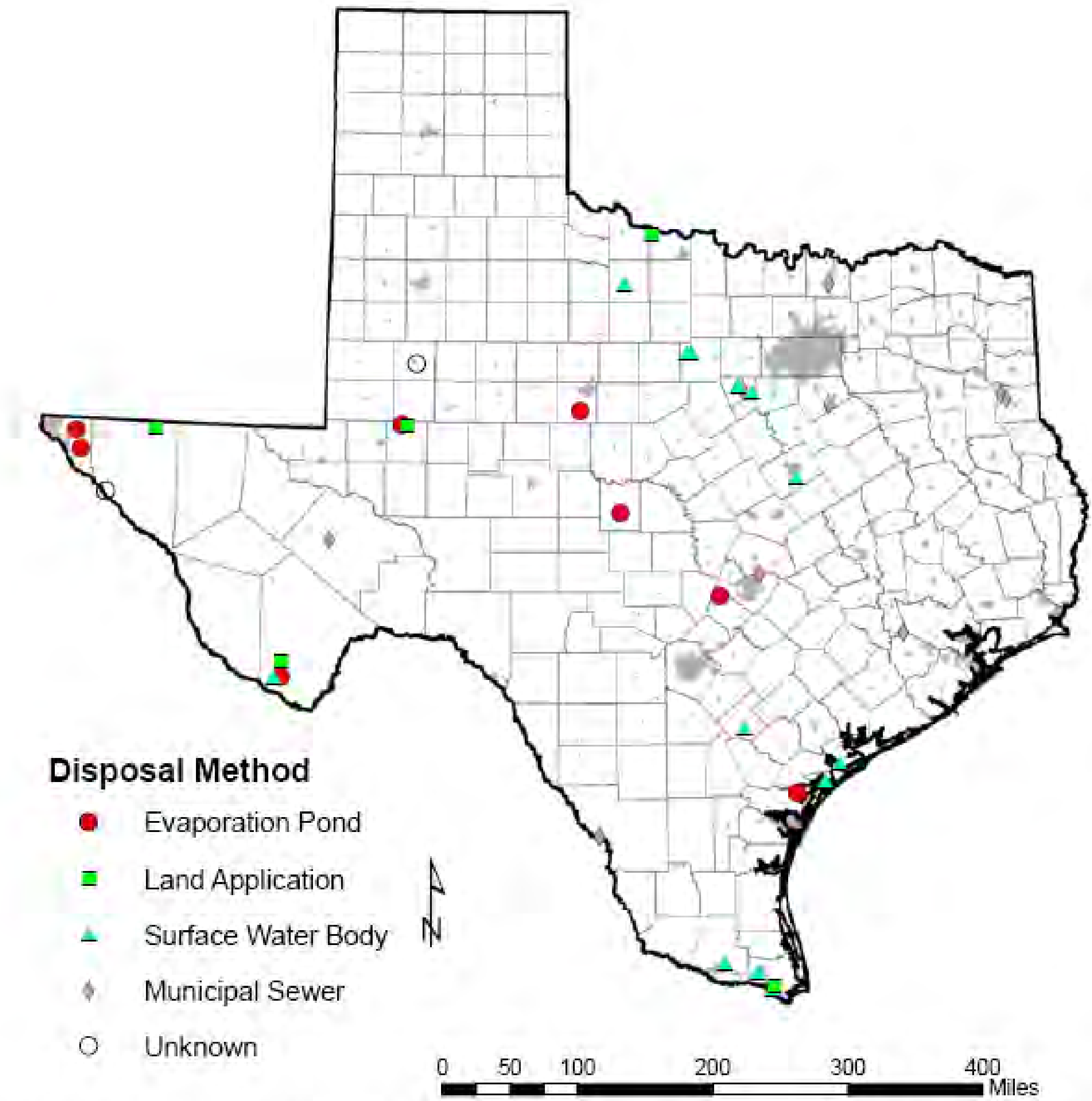
While the USBR study surveyed plants nationwide, in 2005 the TWDB conducted a survey of operating desalination plants within Texas larger than 0.025 MGD. The TWDB study identified 38 facilities. Fourteen of these facilities, with a combined cumulative design capacity of 20.7 MGD, utilized a surface water body for disposal. Nine of these facilities, with a combined cumulative design capacity of 15.3 MGD, utilized a sanitary sewer for disposal. Eight of these facilities, with a combined cumulative design capacity of 12.1 MGD, utilized an evaporation pond for disposal. Five of these facilities, with a combined cumulative design capacity of 3.3 MGD, utilized land application for disposal. The disposal techniques were scattered throughout the state, with no specific technique being utilized in a specific region (see Figure 5-2). (2)

Figure 5-1. Prevalence of Concentrate Disposal Options by Size of Desalination Plant (1)



Adapted from Figure 3-6, "Treatment of Concentrate," 2009.

Figure 5-2. Map of Desalination Facilities in Texas by Concentrate Disposal Technique



NOTE: Location of some facilities is only approximate; Texas Statewide Mapping System projection

Source: Figure 4-14, "A Desalination Database for Texas," 2006.

*NOTE: This report was published prior to the implementation of the Kay Bailey Hutchison Plant in El Paso. This facility utilizes groundwater injection.

The surveyees from Figure 5-1 were provided the following definitions to describe concentrate disposal options:

- Surface: Discharge to any surface water requiring an NPDES-type permit.
- Sewer: Discharge to the sewer or directly to the front end of a WWTP.
- Subsurface Injection: Injection into a deep or shallow well including for aquifer recharge.
- Evaporation pond: Concentrate is impounded in a pond and gradually evaporates over time, causing precipitation and accumulation of salt at the bottom of the pond.
- Land: Disposal that may influence underlying ground water such as disposal via a percolation pond, disposal via spray irrigation, or disposal via a leach field.
- Recycle: Recycle of concentrate to the front of the process.
- Reuse system: Further treatment of concentrate by a reuse facility.

This section contains a description of each of the major concentrate management options, as well as a description of general design considerations that should be incorporated into a preliminary feasibility investigation. The development of a concentrate disposal plan for a desalination facility is extremely case specific and will depend on a variety of environmental and legal constraints. A summary of the major advantages and constraints for each of the concentrate management options is provided in Table 5-1. In addition, a summary of the environmental considerations associated with each management option is included in Table 5-2.

Table 5-1. Concentrate Disposal Options Summary [3]

Concentrate Management Option	Advantages	Considerations	Remarks
Surface Water Disposal	* Low capital cost	* Requires available receiving water body *Potential difficulty in obtaining permit * Future regulations may become more restrictive * Monitoring program	
Sewer Disposal	* Low capital cost - depending on proximity to wastewater infrastructure * Concentrate treated at a WWTP may provide an extra quantity of reclaimed water	* Higher wastewater treatment costs * Impacts on treatment process *Impacts on wastewater treatment plant discharge permitting	
Deep Well Injection	* Avoids introducing salt to surface water bodies.	* Potential difficulty in obtaining permit * High capital and operating cost * Public perception	
Land Application		* Difficulty in siting and permitting	* Best suited for smaller facilities
Evaporation Ponds		* Level land terrain must be present *Requires significant land area *Requires suitable climatic conditions	* Best suited for smaller facilities

Adapted from: Table 8, Brackish Groundwater Manual for Texas Regional Planning Groups

Table 5-2. Environmental Concerns Associated with Various Concentrate Management Techniques [(1),(4)]

Concentrate Management Technique	Environmental Concerns
Surface Water Disposal	Raw water contaminants
	Imbalance in essential ions
	Low dissolved oxygen, high H_2S, etc.
	Toxicity of additives
	Low pH (due to acid addition)
	Different salinity than receiving water
	Salt and mineral loading (TDS)
	Impact on environmentally sensitive areas (effect on aquatic life)
	CO_2 emissions from discharged alkaline waters
	Public perception concerns
	Mitigation: mixing and dispersion - diffuser, outfall design, pre-dilution
Sewer Disposal	Contamination of eventual receiving water
	TDS, specific constituents, etc. compatibility with existing system
	Effect of concentrate salinity (and constituents) on microorganisms used during treatment
Deep Well Injection	Long-term sustainability - fate and compatibility studies
	Concern with overpressure causing fracture and earthquakes
	Contamination of overlying drinking water aquifers due to well leakage
Land Application	Possible surface runoff and downstream impacts
	Compatibility concerns: with underlying groundwater, with vegetation, with soil
	Concern with salt loading
	Contamination of underlying groundwater, and of soil
Evaporation Ponds	Exposure to wildlife can produce adverse impacts
	Produces a concentrated brine or solid which by itself requires safe disposal means
	Risk of CO2 emission from high alkaline waters
	Source of salt spray to the surrounding environment
	Contamination of underlying higher quality aquifers due to pond leakage

In general, there is a relationship between concentrate flow volume and the number of concentrate management strategies available to a facility. The feasibility of evaporation ponds and land application options generally decreases as flow increases, and is typically only feasible for very small applications (see Table 5-3). At low plant flows (up to 1 MGD), all five of the management options may be feasible. However for plants greater than 1 MGD, surface discharge, sanitary sewer discharge and deep well injection are typically the only feasible options (see Table 5-3). When concentrate flows reach a high enough rate relative to wastewater flows, disposal to the sanitary sewer is no longer feasible due to impacts on the WWTP. The salinity of the concentrate is an important factor that should be considered on an application specific basis; surface water discharge, sewer discharge, and land application feasibility may be impacted by salinity values.

Table 5-3. General Feasibility of Concentrate Disposal Options Relative to Concentrate Flow (1)

General Plant Size	Feasibility of Conventional Processing*				
	Very Small	**Small**	**Medium**	**Large**	**Very Large**
Plant size (MGD)	<0.15	0.15 to 1	1 to 6	6 to 15	>15
Concentrate size (MGD)	<0.06	0.06 to 0.4	0.4 to 2.6	2.5 to 6.4	>6.4
Surface discharge	yes	yes	yes	depends[6]	depends[6]
Sewer discharge	yes	yes	yes	no[4]	no[5]
Deep well injection	yes	yes	yes	depends[5]	depends[5]
Evaporation pond	yes	depends[1]	no[3]	no[3]	no[3]
Land application	yes	depends[2]	no[3]	no[3]	no[3]

*Arbitrarily based on 70% recovery.

[1] Land and capital costs can be significant.

[2] Land, dilution water, distribution system, and associated costs can be significant.

[3] Land cost can become prohibitive.

[4] Dependent on salt load, but at some level impact to WWTP becomes significant and unacceptable.

[5] Multiple wells will likely be needed, if many wells are required, a distribution system is needed, and costs escalate due to the complexity of the system.

[6] As concentrate flow increases, the impact on receiving water increases and at some level discharge is no longer feasible.

Adapted from: Table 3.6, Treatment of Concentrate, 2009.

5.1 Current Techniques

Surface Water Disposal

Surface water disposal involves the conveyance of concentrate to a surface water discharge location and often utilizes additional techniques to promote adequate mixing in the receiving water body. Surface water disposal can generally be defined as any discharge to surface water which requires an NPDES permit. The state of Texas assumed the authority to administer the NPDES program in 1998 and is referred to as the Texas Pollutant Discharge Elimination System (TPDES). Surface water disposal is the most common of all concentrate disposal techniques and is used as the disposal method at 45% of all desalination facilities in the United States. [1] Surface water disposal is also the most common of all concentrate disposal techniques in Texas and is used as the disposal method at 37% of all desalination facilities in the state. [2] When technically feasible, surface water discharge is typically one of the lowest cost options available to desalination facilities. However, like all concentrate disposal methods, the feasibility of surface water disposal is highly case specific. Receiving water bodies for concentrate disposal may include freshwater rivers and streams, tidal rivers and streams, coastal water, estuaries and bays, and freshwater lakes and ponds, provided a sufficient volume of receiving water is available year round. Surface water disposal has been successfully used in most regions of the country for inland applications and for a variety of plant sizes.

At the point of entry into a surface water, the concentrate creates a plume of high salinity, also known as a mixing zone, which may vary in size depending on factors that affect dilution and mixing. Mixing zones are defined by the TCEQ and allow for a region of mixing within which the surface water quality standard for the water body can be exceeded. As concentrate enters a surface water, the concentrate plume may sink, float or stabilize, depending on the density of the surface water and the density of the concentrate. A variety of design and environmental factors can affect the mixing zone and the approval of an NPDES/TPDES permit. The “end-of-pipe” characteristics of the concentrate and the quality of the receiving water body will affect the design of the discharge structure and the level of dilution that must be achieved, whether that be in the water body, or prior to discharge. If proper dilution will not occur in the receiving water, other alternatives, such as dilution with wastewater effluent, may be considered prior to disposal. A variety of design factors, such as the configuration of the outfall structure, discharge location, and dilution prior to discharge, can affect dilution in the receiving water body. Without proper dilution, the plume may extend beyond the mixing zone. The discussion of design considerations is divided into pre-discharge management and discharge management of concentrate. Depending on the quality of the receiving water body and the concentrate, pre-discharge techniques to optimize mixing in the receiving water body may be optional.

The regulatory requirements associated with surface water disposal will be discussed in a subsequent section of this report. However, regulatory considerations which may affect the design are described below. The location of discharge and levels of concentrate treatment prior to discharge are determined by the TCEQ through water quality standards and bioassay toxicity testing.

Pre-Discharge Management. Concentrate dilution can be achieved through efficient blending, diffusers, or within mixing zones prior to surface disposal. Blending of concentrate can involve the mixing of concentrate with wastewater effluent, cooling water, feedwater, or any other low TDS water prior to disposal. Diffusers aid in enhancing mixing so dilution occurs more quickly in the receiving water. Pretreatment options, such as aeration, degasification and dechlorination techniques may further improve the water quality of the concentrate prior to entering the receiving stream. Pre-discharge management techniques are site-specific and should be evaluated based on the regulatory limits of the receiving stream.

Discharge Management. When evaluating surface water disposal, several considerations should be evaluated to determine the feasibility of the project. Ambient conditions such as the geometry of the receiving water, receiving water salinity, density, and velocity should all be evaluated with respect to water depth, distance from discharge point, and time of day and year. Discharge conditions, such as discharge geometry and discharge flow conditions, should be included as part of the design phase of a project. Discharge geometry can vary depending on the application, and may include simple "end-of-pipe" scenarios or a lengthy multi-port diffuser. A discharge may occur at the surface or be submerged. Factors such as the local ecosystem, the composition of the discharge, and the degree of dilution at the point of contact may have an impact on benthic disturbance. In general, the potential for adverse impacts can be reduced by greater dilution prior to discharge or at the point of contact through outfall design.

The regulatory considerations associated with a surface water discharge include end-of-pipe characteristics of concentrate. An end-of-pipe discharge may be acceptable in highly turbulent receiving waters with a large volume of water available for dilution relative to the concentrate. All other situations will most likely involve the use of an outfall structure that is consistent with the regulatory requirements of the State of Texas. The purpose of the outfall structure is to aid in the attainment of dilution requirements. Diffuser design may incorporate the following: diameter of the diffuser pipe, length of the diffuser pipe, pipe material, length of riser between pipe and ports/valves, riser material, port or valve materials, number of diffuser ports or valves, distance between diffuser ports or valves, and angles of diffuser ports with respect to the diffuser pipe. In addition, orientation characteristics of the diffuser to be evaluated include: distance from shore, depth from surface, angles with respect to receiving water boundaries and flow, trenched or not.

Sanitary Sewer Discharge

Sanitary sewer discharge involves the discharge of concentrate to an existing sanitary sewer system. In some cases, concentrate may be directly discharged to a public sewer system, provided the wastewater treatment facility discharge meets standards established by the Clean Water Act. If not, concentrate may require some level of pretreatment prior to sewer discharge or a special permit from the local sewer system. Sanitary sewer disposal offers the advantage of utilizing existing wastewater infrastructure in addition to lowering the biological oxygen demand of domestic sewage effluent. Sanitary sewer discharge typically offers a simple and cost-effective method of concentrate disposal, but like all other concentrate disposal techniques, is highly case specific.

In recent years, disposal to a publically owned treatment facility has become common. Discharge to a sanitary sewer system offers the advantage of not having to obtain a NPDES/TPDES permit, but the impact of concentrate on a WWTP could impact a WWTP's NPDES/TPDES permit. For this reason, prior to choosing sewer discharge as a concentrate management disposal technique, an analysis of the impacts on a wastewater treatment plant and permission from the plant owner and/or operator should be obtained. Studies should be conducted on the impact of addition of concentrate on both a WWTP and wastewater infrastructure. The concentrate discharger may be required to pay fees based on concentrate volume or composition. In general, the feasibility of sanitary sewer disposal increases as the ratio of concentrate flow to WWTP influent flow decreases and/or as the salinity of the concentrate decreases. Factors that may influence the feasibility of a sewer discharge include:

- distance between the concentrate source and discharge location
- whether the two facilities are owned by the same entity
- future capacity increases (at both facilities)
- flow volume – capacity buffer
- flow composition – increased TDS levels of WWTP effluent may affect discharge permits, concentrate may lower the BOD of effluent
- compatibility of concentrate with other wastewater flows
- potential impact on WWTP microorganisms
- existing waste water infrastructure – capacity and condition

Deep Injection Wells

Deep injection wells involve the disposal of concentrate by injection into porous subsurface geologic formations. In the State of Texas, an injection well is defined as "artificial excavation or opening in the ground made by digging, boring, drilling, jetting, driving, or some other method, and used to inject, transmit, or dispose of industrial and municipal waste or oil and gas waste into a subsurface stratum; or a well initially drilled to produce oil and gas which is used to transmit, inject, or dispose of industrial and municipal waste or oil and gas waste into a subsurface stratum; or a well used for the injection of any other fluid; but the term does not include any surface pit, surface excavation, or natural depression used to dispose of industrial and municipal waste or oil and gas waste."(4) Typically, disposal well depths can range from 1,000 to 8,000 feet, depending on unique hydrogeological conditions. Unlike other concentrate disposal management methods, deep well injection does not provide for the potential reuse of concentrate (i.e. surface water, sewer disposal). In addition, very specific aquifer conditions, such as structural isolation from and location below drinking water aquifers, poor quality of receiving aquifer, and sufficient permeability and porosity are required. Aquifers with these characteristics are fairly rare, and capital costs may be high. However, good economy of scale is associated with deep well injection, and for this reason it is primarily used for larger volumes. The cost of investigation and installation are prohibitive for small volumes. Only large volume disposal warrants feasibility investigations.

Concentrate derived from treatment of brackish waters is classified as an industrial waste, and specifically coded as municipal drinking water plant waste. This classification requires concentrate to be disposed into a Class I well, which must utilize aquifers that are structurally isolated from overlying drinking water aquifers (any aquifer having a TDS less than 10,000 mg/L). In addition, monitoring and design requirements (such as tubing/packer arrangement, shallow monitoring wells and total cement casing) can add significant cost to injections wells. Table 5-4 provides a description of various well types in Texas. Generally, requirements for Class I disposal wells include:

- Depth – below the depth of potential drinking water sources.
- Layering – hydraulically confined and isolated from overlying drinking water sources.
- Salinity of water in the receiving stratum must be greater than 10,000 mg/L.
- Receiving aquifer capacity – capable of accommodating concentrate volume over life of desalination plant. The capacity is determined by porosity, permeability, and areal extent of the receiving formation.
- Absence of seismic activity – earthquakes associated with deep well disposal have been documented, however these are usually associated with high injection pressures, which are typically greater than fracture pressure. Class I wells by permit are prohibited from using injection pressures that are greater than overburden pressures. Seismic activity is usually unlikely unless wells are located in a fault zone.

Table 5-4. Injection Well Types [6]

Well Class	Disposal Use
Class I	Deep injection - inject hazardous and radioactive waste, or nonhazardous industrial and municipal waste, below all underground sources or drinking water.
Class II	Energy byproducts - inject nonhazardous fluids for enhanced oil recovery, oil and gas exploration and production wastes, or liquid hydrocarbons for underground storage.
Class III	Extracted minerals other than oil and gas - inject fluids for insitu production of minerals ("solution-mining wells").
Class IV	Certain environmental cleanup operations - inject hazardous and/or radioactive wastes into or above underground sources of drinking water.
Class V	Various activities not related to oil, gas, or industrial waste - miscellaneous injection not fitting other well classes.

Source: Table 16, Guidance Manual for Brackish Groundwater Desalination in Texas, 2008.

Capital costs associated with deep well injection can be significant, although there is good economy of scale where large volumes are involved. As of 2009, deep well disposal injection is only allowed in Class I wells, although legislative changes to allow disposal to other well types may reduce costs. The hydrogeological condition requirements make the application of deep injection wells only feasible only in certain areas. Injection rates depend on the permeability and porosity of the formation. Therefore, aquifers with lower permeability and porosity will require multiple injection wells and may require increase spacing between wells.

One of the largest desalination facilities in Texas, the Kay Bailey Hutchison Desalination Plant in El Paso, utilizes deep well injection for concentrate disposal. Brackish desalination facilities typically obtain a permit for Class I non-hazardous or hazardous wells. Class V well permits have been authorized for brackish desalination in Texas in the past, but depend on the quality of the aquifer used for disposal and the water quality parameters of the concentrate. The main advantage of obtaining a Class V permit is the potential for less operational monitoring than a Class I well. A permitting procedure was created with a Class V injection well authorization for El Paso and strict well construction standards instead of a Class I injection well permit. The less stringent regulatory standard enabled the project to be permitted in an expedited manner and at a considerably lower cost. The TDS concentration of the concentrate is less than the receiving aquifer and is non-hazardous. This application specific information was used to allow the Kay Bailey Hutchison plant to utilize Class V wells that were built to Class I standards. Regulatory information associated with deep well injection is discussed in Chapter 6.

Evaporation Ponds

Evaporation ponds involve the disposal of concentrate into ponds which in turn convert the water in the pond to water vapor. Evaporation ponds are most appropriate for smaller volumes and regions in which solar evaporation exceeds annual precipitation. In addition, the presence of level terrain and low land cost also makes the implementation of evaporation ponds more desirable. Therefore, the majority of evaporation pond implementation has occurred in the southwestern United States. In applications located in these areas, with relatively small volume flows, evaporation ponds may be the least costly of all disposal options. When considering evaporation ponds, it is important to consider the salinity of the concentrate; since as salinity increases, the evaporation rate decreases. Evaporation ponds are relatively easy to construct, and when properly constructed, have low maintenance cost and require less operator attention than concentrate disposal techniques involving mechanical equipment. Ponds should either be designed for the life of the plant, or the costs associated with solids disposal should also be considered. Evaporation ponds may however, require large tracts of land, depending on evaporation and disposal rates. Texas also requires the use of clay or synthetic membrane liners, which would increase the cost of ponds. In addition, if poorly constructed, evaporation ponds have the potential to contaminate aquifers. Evaporation ponds do not require an NPDES/TPDES permit, assuming the responsible party can provide evidence no leakage will occur from the pond. However, parties typically obtain an NPDES/TPDES permit, if the potential exists for leakage to surface water or a drinking water aquifer.

It is important to note that there is little economy of scale for evaporation ponds and for this reason this disposal technique is better suited for small plants. While other disposal techniques may recover concentrate, water evaporated from the ponds will be lost to the atmosphere.

Enhanced evaporation systems may optimize exposure of concentrate to air, thereby increasing evaporation rates. Such systems, which include spraying or misting concentrate in the air, may reduce required land and capital costs, but are still considered an emerging technology. Factors such as appropriate buffer zones, wind sensitivity, and energy costs should be taken into account when considering enhanced evaporation systems. In good conditions, enhanced evaporation systems may increase net evaporation by a factor of 5 to 7.

The selection of appropriate pond size involves the determination of both the required surface area and depth. The surface area is primarily a function of the evaporation rate. The design depth should consider both contingency water storage and available water storage, as well as the desired storage capacity of salts, and freeboard for precipitation and wave action.

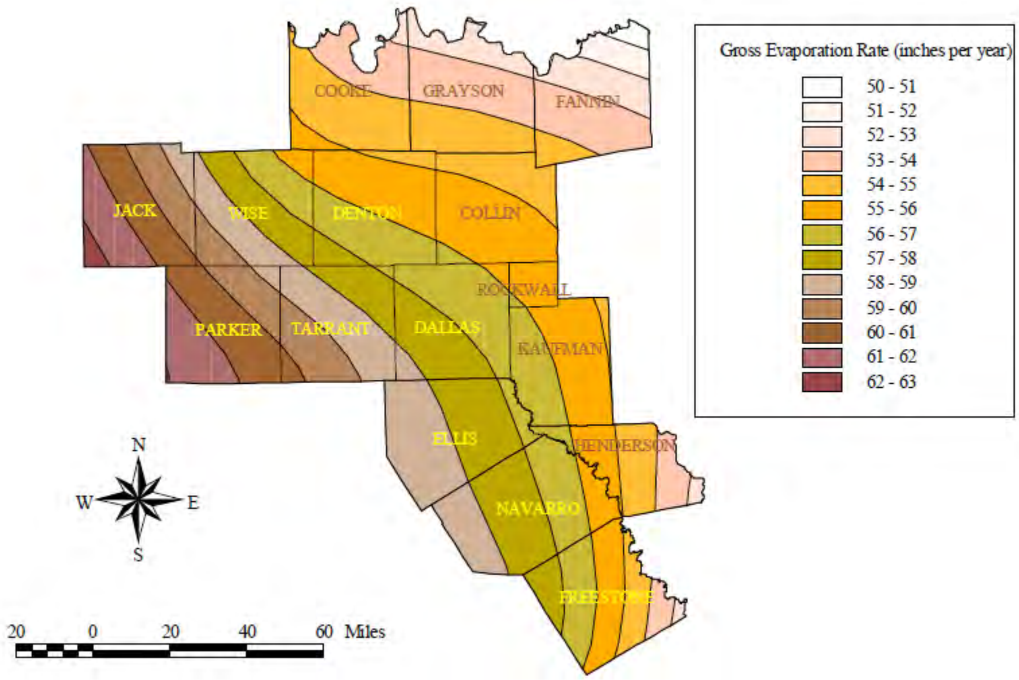
In an area with as much rainfall as Region C, the applicability of evaporation ponds, at least on a large scale, is unlikely. Region C's average annual precipitation increases from west to east from slightly more than 30 inches per year in western Jack County to more than 44 inches per year in the northeast corner of Fannin County. Figure 5-3 shows gross reservoir evaporation in Region C, which is higher to the west. (Gross reservoir evaporation indicates the amount lost to evaporation from the surface of a reservoir.) The rate of evaporation from a reservoir surface exceeds rainfall throughout Region C, but the margin is much greater in the western part of the region than in the east. Subtracting the gross reservoir evaporation from the mean annual precipitation (shown in Figure 5-4) will give net lake surface evaporation. However, this value is for freshwater reservoirs, not brine. Evaporation is directly proportional to vapor pressures, and the vapor pressure of saline water is lower than freshwater.

The Kay Bailey Hutchison Desalination Plant conducted a test of enhanced evaporation for 3. 2 MGD of concentrate which was projected to decrease the capital costs of evaporation ponds of the 46% and increase operating costs by 330%. (1)

The relationship between salinity and evaporation is affected by complex relationships among site specific factors such as air temperature, wind velocity, relative humidity, barometric pressure, water surface temperature, heat exchange rate with the atmosphere, incident solar absorption and reflection, thermal currents in the pond, and depth of the pond. However, as a general guideline for water saturated with sodium chloride salt, the solar evaporation rate is generally about 70 percent of the rate for freshwater. This ratio may also be used for evaporation ponds that are expected to reach salt saturation during their anticipated service life.

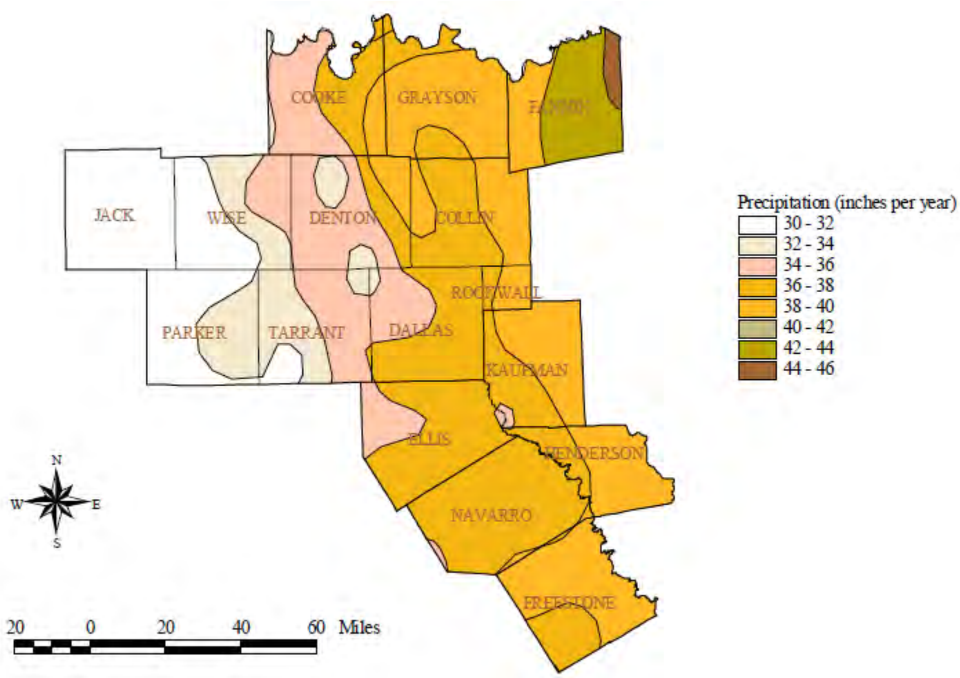
The depth of an evaporation pond should be designed not only to evaporate water, but also to include surge capacity, storage capacity for precipitated salts, and freeboard for precipitation and wave action. For evaporation ponds to be a feasible concentrate disposal technique, they should be able to accept concentrate under all conditions and not restrict desalination plant operations. Safety factors should be incorporated into design to account for unforeseen events. After the initial startup phase (approximately two years), a 20% allowance may be applied to the surface area of the pond or its capacity to evaporate water. During the first two years, additional allowances of up to 50 percent may be applied to the depth holding capacity of the pond. The pond should be sized to accommodate a desalination facility for the life of the project. During the lifecycle of the pond, the water will most likely reach saturation and precipitate salts. Allowance in pond depth for precipitate salts should be accounted for (see Figure 5-5).

Figure 5-3. Average Annual Gross Evaporation



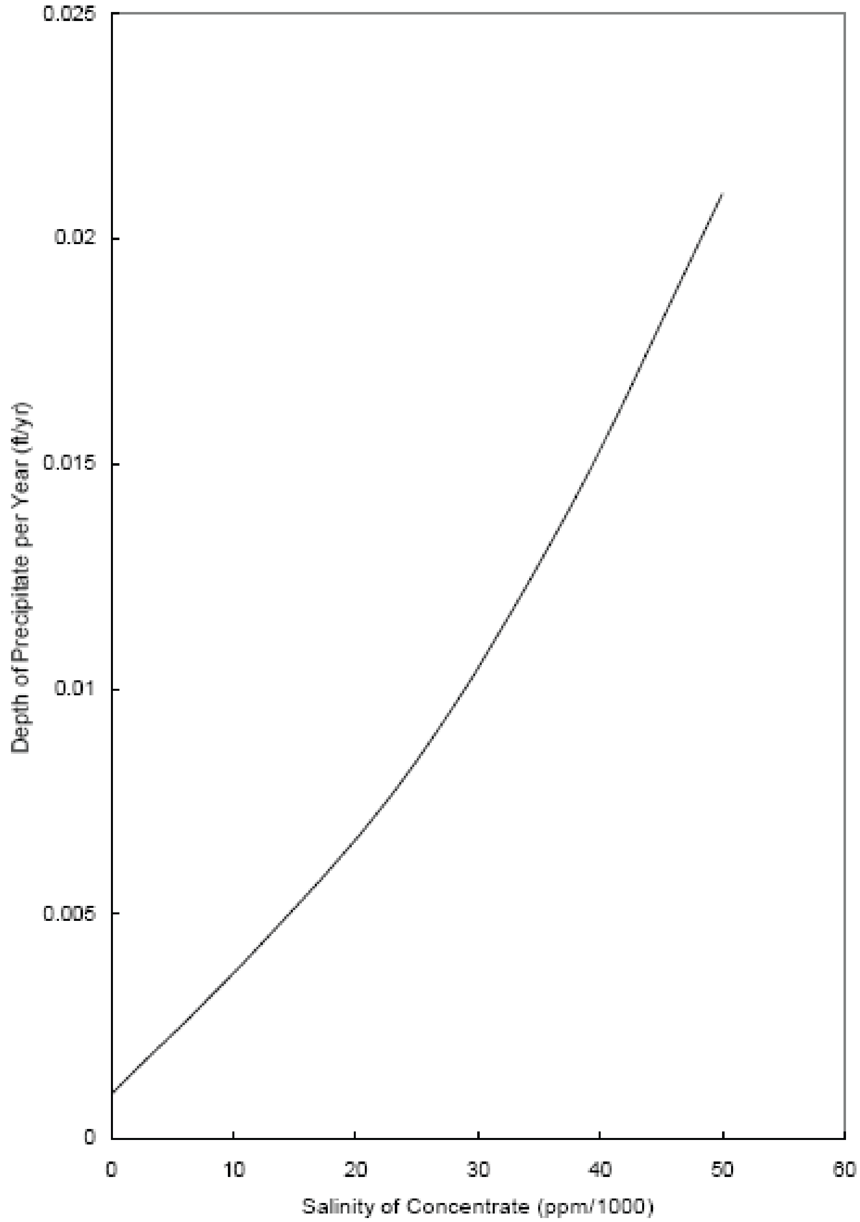
Source: Figure 1-4, 2011 Region C Initially Prepared Plan

Figure 5-4. Average Annual Precipitation



Source: Figure 1-2, 2011 Region C Initially Prepared Plan

Figure 5-5. Rate of Precipitation in an Evaporation Pond (7)



Source: Membrane Concentrate Disposal: Practices and Regulation, 2006.

Land Applications

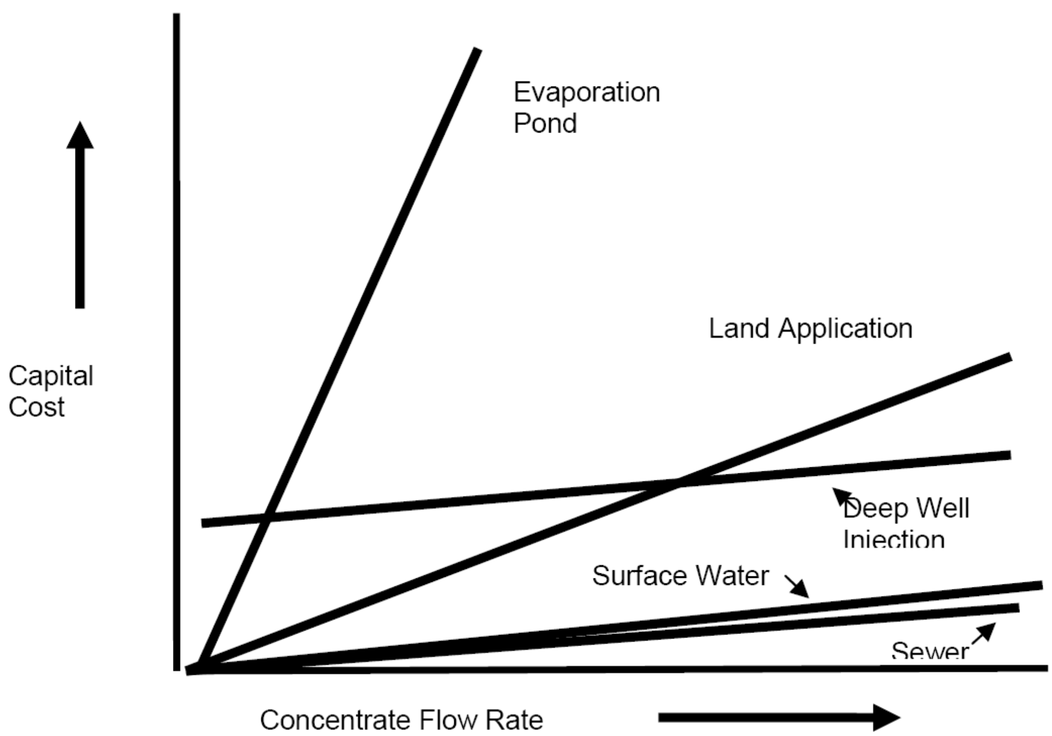
Land application is a viable concentrate disposal technique in areas of the country where climate would facilitate a year round operation and where relatively flat and suitable land is available. For these reasons, an application in Region C would be unlikely. Land application may include irrigation systems, rapid infiltration, and overland flow systems. Concentrate may be land applied to cropland or vegetation, and depending on the desired nutrient concentration, hydraulic loading can be maximized. In these cases, salt tolerant grasses with a high irrigation demand may be most suitable. When considering the land application disposal technique, it is important to have a good understanding of the concentrate characteristics, the vegetation of the proposed land application site, and regulatory requirements. A need for irrigation water should exist near the treatment plant – the closer the land application site, the lower the capital and operational costs. In addition, backup disposal options may be required.

The biggest obstacle to a successful land application system is state and local ground water protection regulations associated with salinity and use classification of groundwater. Typically, concentrate is diluted prior to land application, and the volume of dilution water may be several time that of the concentrate, depending on regulations. Once diluted, substantial land may be required for discharge. When considering a land application system, a knowledge of the concentrate characteristics – salinity, toxicity, and the soil permeability should be incorporated.

5.2 Capital and O&M Costs Associated with Each Type of Concentrate Disposal

Estimation of capital and operational costs associated with the various concentrate disposal strategies is difficult on a generic basis. In general, the capital and operating costs of all concentrate disposal strategies increase with flow, but some economy of scale can be gained with larger facilities (see Figure 5-6). Therefore, unit capital costs for smaller facilities may be higher than for larger facilities (particularly for deep well injection). Evaporation ponds and land application have low economies of scale, and are therefore more suitable for smaller applications. Cost factors such as piping and pumping have a large economy of scale. Site specific cost factors are not included in this section, and are highly variable. Therefore, costs associated with specific concentrate disposal techniques included in this document should be used for preliminary planning purposes only - specific design parameters should be incorporated into a final, detailed cost analysis.

Figure 5-6. Relative Costs of Conventional Disposal Options [1]

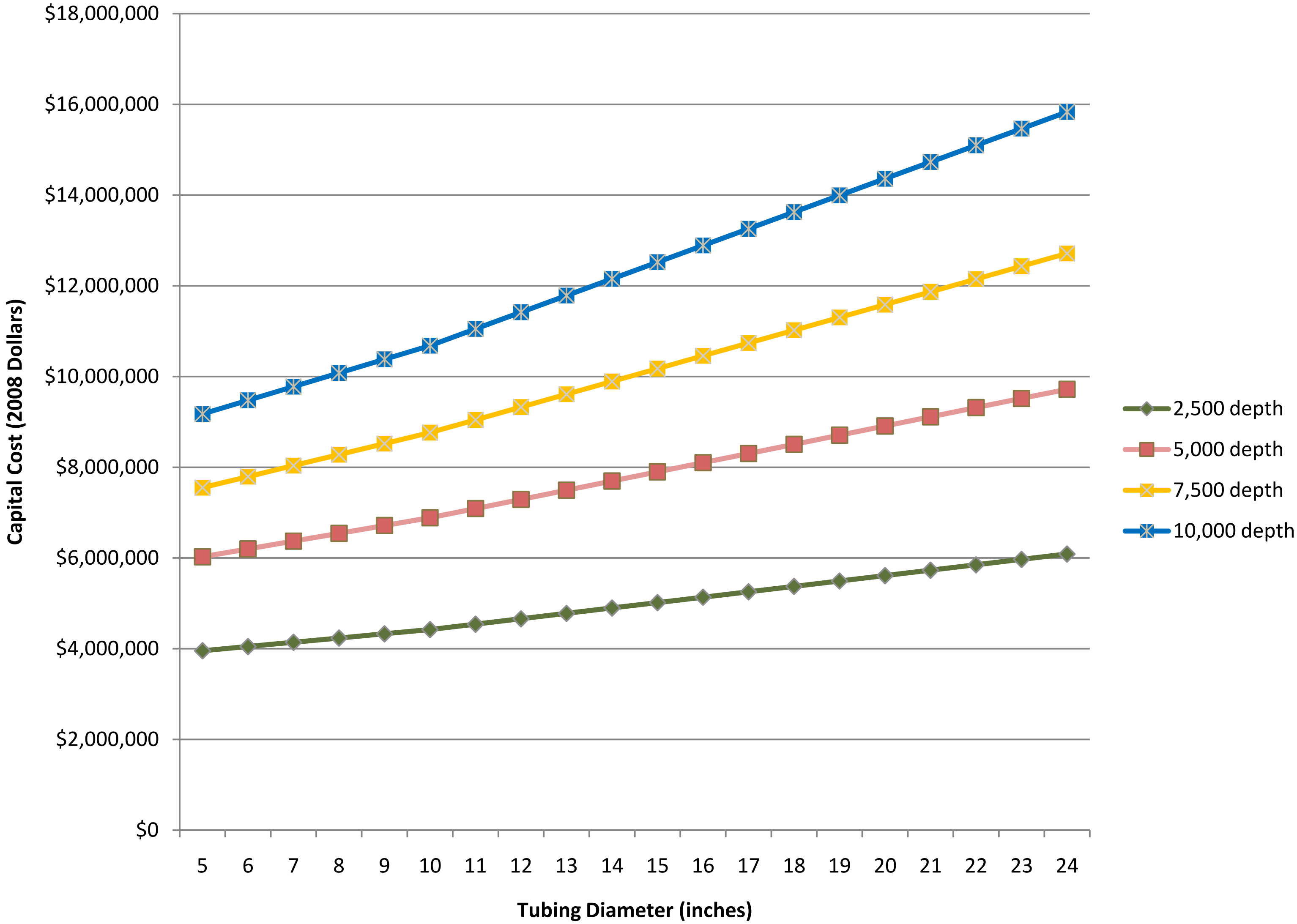


Source: Figure 3-7, Treatment of Concentrate, 2009.

In general, annual operating costs for conventional concentrate disposal methods are approximately 5% of the capital costs. The USBR developed cost worksheets for preliminary planning purposes for deep well injection, evaporation ponds, and spray irrigation disposal (land application). (7) A cost worksheet for surface water discharge was not developed due to the large number of site-specific factors. A cost worksheet for sanitary sewer disposal was not developed due to the wastewater treatment contractual fee variance – if owned by the same entity the associated cost could be zero. A summary showing the maximum and minimum calculated cost for each disposal type is included in Figure 5-7 to 5-9. Each of the worksheets and the text associated with the design of the cost model is included in Appendix I. The USBR provided the following disclaimer associated with the use of these cost models:

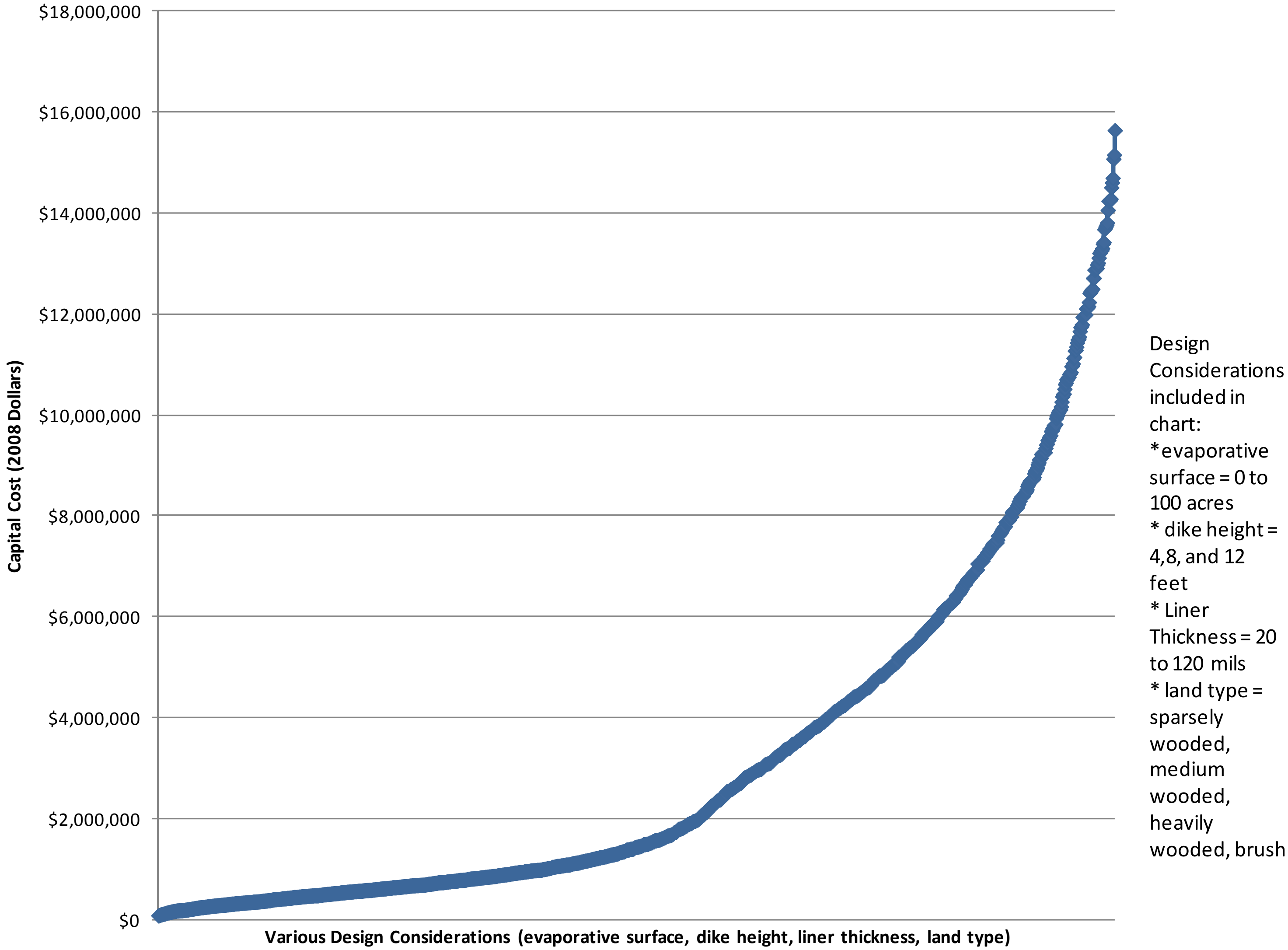
> "It is recommended that the model user read the chapter discussing the model in question to understand the assumptions made, the design parameters involved, and the cost factors associated with each model. By understanding the design approach and the model limitations, other costs not included in the model may be added to provide a more accurate site-specific cost estimate. The worksheet model provides a blueprint for developing more accurate, site-specific cost estimates."

Figure 5-7. Deep Well Disposal Capital Cost Summary (7)



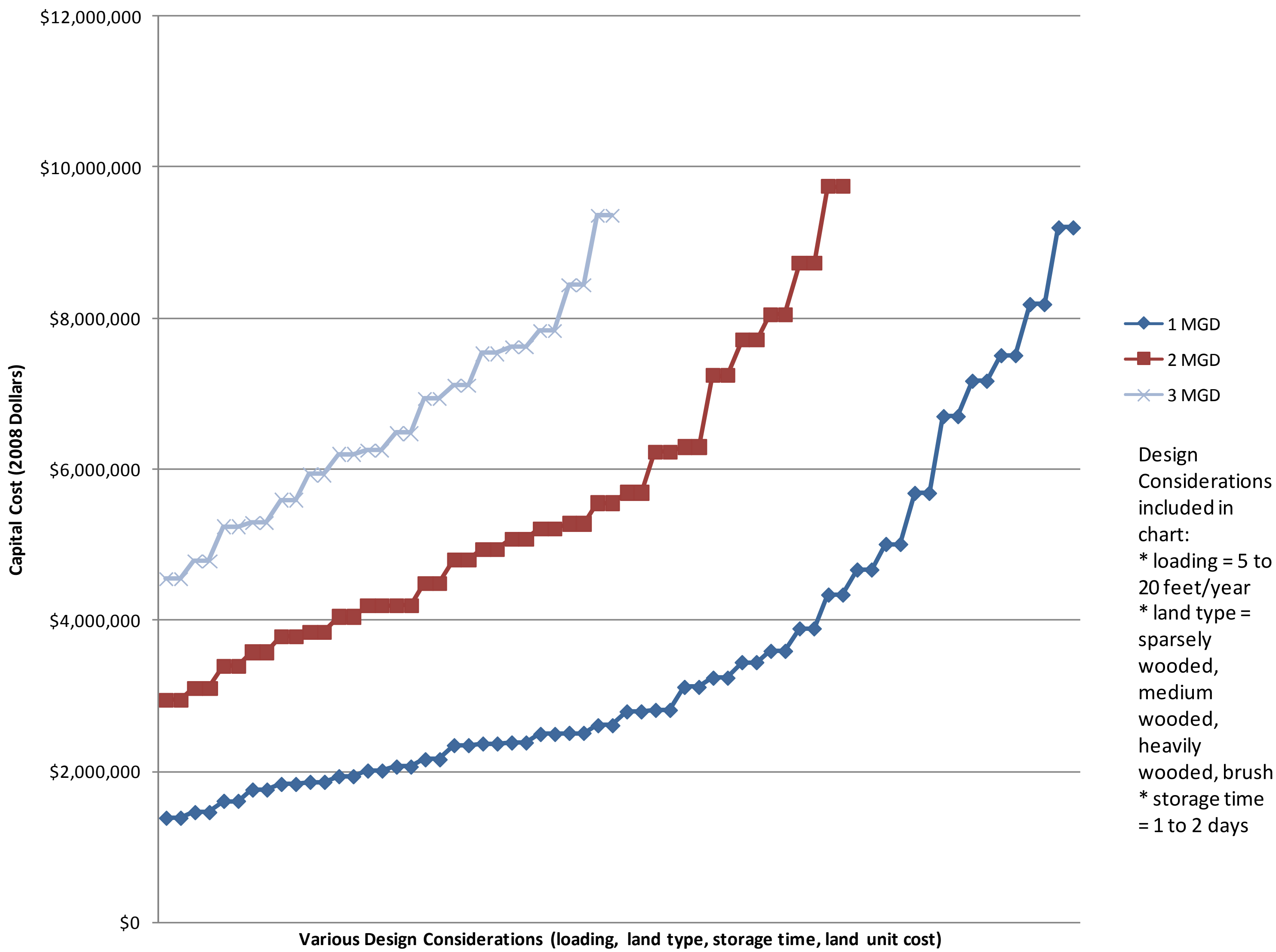
Adapted from: Cost Models in Membrane Concentrate Disposal: Practices and Regulation, 2006

Figure 5-8. Evaporation Pond Disposal Capital Cost Summary (7)



Adapted from: Cost Models in Membrane Concentrate Disposal: Practices and Regulation, 2006

Figure 5-9. Spray Irrigation Capital Cost Summary [7]



Adapted from: Cost Models in Membrane Concentrate Disposal: Practices and Regulation, 2006

These costs are intended to be a starting point for more specific costs estimates. Included in Table 5-5 is a listing of potential capital and operation and maintenance cost considerations for each of the concentrate disposal techniques.

Table 5-5. Capital and Operation and Maintenance Cost Considerations [1]

	Capital Cost Considerations	Operation and Maintenance Cost Considerations
Surface Water Disposal	Piping Pumps Outfall structure Pre-treatment prior to disposal • Potential for aeration to increase dissolved oxygen levels • Degasification for hydrogen sulfide, carbon dioxide • pH adjustment to meet receiving water standards	Pipe maintenance Pumping costs Monitoring
Sewer Discharge	Piping Pumps	Pipe maintenance Pumping costs Fee charged by WWTP
Deep Injection Wells	Piping Pumps Pre-treatment prior to injection Land preparation Mobilization Testing Well construction Backup disposal system for use during periodic system integrity tests Monitoring well construction	Pipe maintenance Pumping costs Monitoring wells
Evaporation Ponds	Piping Pumps Land acquisition Land preparation Distribution system • Valves • Controls Synthetic or clay liner	Pipe maintenance Pumping costs Distribution system maintenance Monitoring Solids disposal
Land Applications	Piping Pumps Potential land acquisition Land preparation Storage for use during days with precipitation Distribution system • Valves • Controls Drainage system (may be optional) Runoff control system	Pipe maintenance Pumping costs Distribution system maintenance Dilution costs

CHAPTER 5
LIST OF REFERENCES

(1) Mickley, Mike. "Treatment of Concentrate." Reclamation. U.S. Department of the Interior. May 2009 <http://www.usbr.gov/pmts/water/media/pdfs/report155.pdf>.

(2) Nicot, J., Walden, S., Greenlee, L., Els, J. "A Desalination Database for Texas." Bureau of Economic Geology. Prepared for the Texas Water Development Board, October 2006.

(3) LBG-Guyton Associates, NRS Consulting Engineers, Brackish Groundwater Manual for Texas Regional Planning Groups, prepared for the Texas Water Development Board, February 2003.

(4) Younos, Tamim, "Environmental Issues of Desalination." Virginia Polytechnic Institute and State University, Journal of Contemporary Water Research and Education, Issue 132, Pages 11-18, December 2005.

(5) Texas Water Code, Chapter 27

(6) NRS Consulting Engineers, R.W. Harden and Associates, Dietrich Consulting Group, TRC, Electrical Expertise, Inc., WaterPR. "Guidance Manual for Brackish Groundwater Desalination in Texas." Prepared for Texas Water Development Board, April 2008.

(7) Mickley, Michael C. "Membrane Concentrate Disposal: Practices and Regulation." Reclamation. U.S. Department of the Interior. April 2006 <http://www.usbr.gov/pmts/water/publications/reportpdfs/report123.pdf>.

(8) Watson, I., Morin, O., Henthorne, L., "Desalting Handbook for Planners" Prepared for the Bureau of Reclamation, Third Edition, July 2003.

6.0 Regulatory Requirements

This chapter discusses potential regulatory issues associated with construction and operation of a desalination facility in the State of Texas. With the exception of concentrate disposal requirements, many regulatory requirements for a desalination facility are identical to those for a conventional treatment facility. This chapter begins with a summary of major regulatory issues that may be encountered during development of a desalination project. Following this overview summary, a more detailed discussion of regulatory issues associated with concentrate disposal is provided.

6.1 Regulatory Overview

Regulatory requirements have traditionally played an important role in project feasibility, schedule, and cost, and should be considered a priority during the planning stages of a project. A comprehensive permitting plan should be developed in the early stages of preliminary design. Items such as site selection, raw water sources, and concentrate disposal options will affect the type of permits required, the magnitude of environmental investigations, and the time allotted for permitting. [(1)] The majority of regulatory permits required for a desalination project will be obtained through the TCEQ. Other major regulatory entities may include: the Texas General Land Office, Texas Department of Transportation (TxDOT), Railroad Commission of Texas (RRC), the USACE, and the Texas Historical Commission. Table 6-1 summarizes authorization and review requirements for feed water utilization, facility construction, and residuals management.

Table 6-1 is intended to provide a summary of major permitting requirements for desalination projects and is not intended to be inclusive of all permits required. Other regulatory programs, such as the Federal Clean Water Act, National Environmental Policy Act, Environmental Justice Program, Endangered Species Act, Fish and Wildlife Coordination Act, Floodplain Protection Program, Texas Optimization Program, and Source Water Assessment and Protection Program, may also affect the ultimate regulatory outcome of a desalination project. The *Guidance Manual for Permitting Requirements in Texas for Desalination Facilities Using Reverse Osmosis* [(1)] developed permitting models for groundwater, surface water, new construction, project development, operating, environmental, injection well, evaporation pond, surface water discharge, and concentrate and membrane cleaning disposal to a WWTP. These models are included in Appendix J and provide an overview of the permitting process associated with a desalination project.

Table 6-1. Summary of Potential Regulatory Authorizations for a Desalination Project (2)

Project Component	Purpose of Authorization or Review	Process	Authorization or Review	Issuing Agency
Feed Water - Surface Water	Surface Water Withdrawal	Approval for Permanent or Temporary Water Rights to Surface Water	Water Rights Permit	TCEQ
Feed Water - Groundwater	Test Wells	Approval for well and test hole installation	Well and Test Hole Permits	GCD (where applicable)
	Wells	Licensing of water well drillers and water well pump installers	Licensing	Texas Department of Licensing and Regulation
	Production Wells (existing)	Approval for existing wells	Plan Approval Prior to Conversion to Public Drinking Water Well	TCEQ
		Approval to produce water from existing wells	Water Well Registration Permit to Produce Water	GCD (where applicable)
		Approval to blend raw water with permeate	Plan Approval Prior to Construction	TCEQ
	Production Wells (new)	Approval for new wells or well modifications	Water Well Construction and Alteration Permit	GCD (where applicable)
			Plan Approval Prior to Construction	TCEQ
		Approval to blend raw water with permeate	Plan Approval Prior to Construction	TCEQ
	High Production Wells	Approval to own and operate wells that cross a high production threshold	Application for High-Impact Production Permit	GCD (where applicable)
	Conveyance	Approval to transport produced water	Transport Permit	GCD (where applicable)
Facility Construction	Need Assessment for Desalination Facility	Approval to construct new or modified public water system	Public Water System Plan Review	TCEQ
	Wastewater Treatment	Approval for new or modified wastewater treatment facilities	Approval of plans and specifications by TCEQ executive director or an authorization to construct under Texas Water Code (with authorization from the TCEQ).	TCEQ
	Wetlands and Water Quality Certification	Approval to dredge or place dredge or fill material into state and federal waters and/or wetlands	Section 401 and 404 Permits and Environmental Impact Statement (as needed)	USACE and TCEQ
	Navigable Waters	Approval for construction within navigable waters	Section 10 Permit and Environmental Impact Statement (as needed)	USACE
	Air Emissions	Degasification and other ancillary equipment that emit air pollution	Air Permit - Construction of a New Source	TCEQ
	Petroleum Storage Tanks	Approval to construct above- and below-ground petroleum storage tanks (if applicable)	Petroleum Storage Tanks Registration and Construction Notification	TCEQ
	Buildings	Approval to construct new buildings	Building Permit	City, County, or both
	Tree Removal	Approval for tree removal and replacement	Tree Removal Permit	City, County, or both
	Erosion Prevention	Approval for erosion prevention plans for construction	Erosion Permit	City, County, or both
	Road Crossings and Easements	Approval for easements for miscellaneous, upland surface and commercial leases, and submerged lands	Easement	Texas General Land Office
		Approval for work in a TxDOT roadway or right-of-way	Utility Permit	TxDOT
		Approval for roadway and public way crossings or use	Right-of-way/Easement Use	City, County, or both
		Approval for pipeline crossing over or under railroad property and tracks	Authorization for Crossing	Railroad companies
	Cultural Resources	Review to determine if cultural resources are impacted and necessary mitigation (simultaneously conducted with federally mandated permits)	Section 106 Review	Texas Historical Commission
	Historical Properties and Landmarks	Review to determine if historical properties or landmarks are impacted and necessary mitigation	Antiquities Permit	Texas Historical Commission

* Delivery of potable water is addressed through compliance with federal and state drinking water standards, and is not unique to the desalination process.

Adapted from: Guidance Manual for Brackish Groundwater Desalination in Texas, 2008.

Table 6-1, continued. Summary of Potential Regulatory Authorizations for a Desalination Project (2)

Project Component	Purpose of Authorization or Review	Process	Authorization or Review	Issuing Agency
Residuals Management	Concentrate and/or Wastewater Disposal	Wastewater Disposal via Discharge to Surface Water	NPDES/TPDES	TCEQ
	Concentrate and/or Wastewater Disposal	Disposal via Class I Disposal Well(s)	TCEQ Class I Injection Well Permit, with RRC Oil and Has Non-Endangerment Letter	TCEQ (permit), RRC (letter)
	Concentrate and/or Wastewater Disposal	Disposal via Class V Disposal Well(s)	Class V Injection Well Authorization to Permit Class V Injection Well Authorization Letter Class V Injection Well Permit Oil and Gas Non-Endangerment Letter	TCEQ RRC
	Concentrate and/or Wastewater Disposal	Disposal via publicly owned treatment works or other wastewater treatment facility	NPDES/TPDES - Wastewater	Local regulatory agency authorized by the TCEQ to approve a disposal permit
	Concentrate and/or Wastewater Beneficial Reuse	Beneficial Reuse via Class II Disposal Well(s)	Groundwater Protection Recommendation Letter Class II Underground Injection Control Permit	TCEQ RRC
	Concentrate Disposal	Disposal via evaporation pond	Permit for Land Application of Water Treatment Sludge	TCEQ
	Stormwater	Industrial site stormwater disposal via discharge to surface water	NPDES/TPDES - Stormwater	TCEQ
	Stormwater	Stormwater disposal via discharge to surface water during construction activities	NPDES/TPDES - General Permit TXR040000	TCEQ
	Stormwater	Stormwater disposal via discharge to separate municipal storm sewer system	NPDES/TPDES - General Permit TXR050000 Submit Notice of Intent or No Exposure Certification to Appropriate Municipal Sewer System Operator	TCEQ
	Wastewater	Hydrostatic testing wastewater disposal via discharge to surface water	NPDES/TPDES - General Permit TXG670000	TCEQ
	Onsite Sewage Facilities	Construct and operate onsite sewage treatment facilities	Local Permit	Local regulatory agency authorized by the TCEQ to approve such facilities
	Waste Disposal	Storage and/or treatment of commercial/industrial non-hazardous wastes	Commercial Industrial Non-Hazardous Waste Permit	TCEQ
	Residual Solids	Sand/multi-media filtration sludge disposal	Registration	TCEQ
	Air Emissions	Degasification and other ancillary equipment that emit air pollution	Air Permit - Title V Operating Permit	TCEQ

* Delivery of potable water is addressed through compliance with federal and state drinking water standards, and is not unique to the desalination process.

Adapted from: Guidance Manual for Brackish Groundwater Desalination in Texas, 2008.

6.2 Concentrate Disposal Requirements

There are more regulatory requirements/restrictions associated with the management and disposal of concentrate generated from a desalination facility than those that apply to a conventional water treatment facility.

Surface Water Disposal

A discharge from a desalination facility to waters of the state would require obtaining an Industrial Wastewater Texas Pollutant Discharge Elimination System (TPDES) permit. The TCEQ time frame for issuing an individual wastewater permit is typically 330 days. The timeframe, however, will be lengthened if the proposed permit is protested. TPDES permit applications require preparing an Industrial Administrative Report and an Industrial Technical Report. An Industrial Administrative Report includes facility and applicant information, identification of receiving waters, discharge routes, identification of adjacent and downstream land owners, and site photographs. An Industrial Technical Report requires the following:

- facility information
- wastewater generating process information
- materials and products handled onsite
- identification of flood plains and flood protection measures
- detailed information on treatment processes
- impoundment information
- detailed information on the receiving water(s)
- detailed concentrate analysis (standard parameters, metals, organic priority pollutants, and any expected hazardous substances).

In general, the main parameter of concern in the discharge permitting process for concentrate is total dissolved solids, although other parameters such as metals, may also be of concern. These elements, while often present in raw water, may be concentrated during desalination operations. Maintaining water quality standards in the receiving stream is one of the major issues for TPDES permits for a discharge from a desalination facility.

Sanitary Sewer Discharge

When disposing of desalination concentrate to an existing domestic wastewater treatment facility, a modification of the facility's TPDES (domestic wastewater) permit may be required. In some cases, local authorizations or notifications may be required for treated discharge from a facility treating desalination concentrate. The impacts to the water quality in the receiving stream of the discharge from the sanitary treatment facility is a major consideration when indirect dischargers contribute significant loads of TDS and/or other constituents. In addition, prevention of discharges that may cause inhibitions to the biological treatment processes should be evaluated.

Deep Injection Wells

The State of Texas characterizes injection wells depending on the type of waste to be disposed. There are five categorizes of wells in Texas, and the regulatory authority varies by well type. Desalination concentrate is currently disposed into either Class I or Class V wells in Texas. Class I wells are intended for deep injection of hazardous or radioactive waste, or nonhazardous industrial or municipal waste and are located below all underground sources of drinking water. Class V wells are intended for various activities not related to oil, gas, or industrial waste. Class I and V wells for concentrate disposal are both regulated by the TCEQ with review and comment by the Texas Railroad Commission (see Table 6-2).

Table 6-2. Injection Well Types [2]

Well Class	Disposal Use	Regulatory Agency
Class I	Deep injection - inject hazardous and radioactive waste, or nonhazardous industrial and municipal waste, below all underground sources or drinking water.	TCEQ (with review and comment by RRC)
Class II	Energy byproducts - inject nonhazardous fluids for enhanced oil recovery, oil and gas exploration and production wastes, or liquid hydrocarbons for underground storage.	RRC
Class III	Extracted minerals other than oil and gas - inject fluids for insitu production of minerals ("solution-mining wells").	TCEQ or RRC, depending on well type
Class IV	Certain environmental cleanup operations - inject hazardous and/or radioactive wastes into or above underground sources of drinking water.	TCEQ or US EPA
Class V	Various activities not related to oil, gas, or industrial waste - miscellaneous injection not fitting other well classes.	TCEQ or RRC, depending on well type

Source: Table 16, Guidance Manual for Brackish Groundwater Desalination in Texas, 2008.

Brackish desalination facilities typically obtain a permit for a Class I non-hazardous or hazardous well. Class V well permits have been authorized for brackish desalination in Texas in the past, but depend on the quality of the aquifer used for disposal and the water quality parameters of the concentrate. The main advantage of obtaining a Class V permit, is the potential for less operational monitoring than a Class I well.

In 2007, House Bill 2654 authorized the TCEQ to issue general permits, rather than separate permits for each injection, for Class I injection wells for nonhazardous brine from desalination operations. These general permits can potentially be effective for 10 years. House Bill 2654 also authorized the use of nonhazardous desalination concentrate as an injection fluid for enhanced recovery purposes, without first obtaining a permit from the TCEQ. In July 2008, the TCEQ revised the technical standards in 30 TAC Chapter 331 and is currently developing a new underground injection control general permit.

Evaporation Ponds

Evaporation ponds for disposal of desalination concentrate require a Texas Land Application Permit from the TCEQ. No federal authorizations are required, and no significant regulatory barriers currently exist. [2]

Land Applications

Land applications for disposal of desalination concentrate require a Waste Discharge (wastewater – land application) permit from the TCEQ.

CHAPTER 6
LIST OF REFERENCES

(1) R.W. Beck Inc., “Guidance Manual for Permitting Requirements in Texas for Desalination Facilities Using Reverse Osmosis Processes”, Prepared for the Texas Water Development Board, November 2004.

(2) NRS Consulting Engineers, R.W. Harden and Associates, Dietrich Consulting Group, TRC, Electrical Expertise, Inc., WaterPR. “Guidance Manual for Brackish Groundwater Desalination in Texas.” Prepared for Texas Water Development Board, April 2008.

7.0 Conclusions and Recommendations

With continued advancements in desalination and the potential for blending with fresh water supplies, there is value in considering additional brackish supplies as potential future sources to Region C. In Texas, brackish water sources have not historically been sought out and researched with the same intensity as fresh water sources. Accordingly, research associated with the feasibility, potential quantities, and quality of brackish water supplies has not been as extensive as that for fresh water supplies. In Region C, brackish groundwater sources have not historically been included in planning efforts, while brackish surface water sources have been utilized via desalination or blending with freshwater sources. The 2001 and 2006 Region C Water Plans included brackish water from several sources including the Red River, Possum Kingdom Lake, Lake Texoma, and the Brazos River.

Historical analysis of brackish groundwater and surface water near Region C has been limited. Further coordination with other regional water planning groups should occur to identify brackish surface water supplies that may be utilized by Region C. Unallocated water has been identified in the Brazos and Red Rivers, although storage and water quality concerns would need to be addressed to utilize this water. Additional supplies of surface water in Lake Texoma (in addition to the planned projects by the North Texas Municipal Water District and Greater Texoma Utility Authority) are not available at this time. Executing agreements with the state of Oklahoma for a share of their Texoma water and/or Congressional action to reallocate additional water for municipal supply may provide an opportunity for identifying additional supplies. Coordination with power interests on Lake Texoma may also provide an opportunity for identifying additional supplies. There are a number of challenges associated with these actions and storage and allocation issues would have to be addressed for this to represent a viable additional source.

Volumes of brackish groundwater have been identified, but groundwater availability models to determine yield information have not been developed. Preliminary analysis by a TWDB study (1) indicates that approximately 85,000,000 acre-feet of brackish groundwater supplies may be present within the Region C area, although this estimate is based on generalized aquifer characteristics, and is not intended to represent precise availability values. Further study is needed to determine the specific location of significant brackish groundwater sources within Region C, as well as their location in relationship to areas of need. Additionally, before considering a brackish groundwater water supply project, extensive pilot studies, including monitoring of test wells, would need to be conducted. As area GCDs continue to develop rules and regulations, coordination might aid in providing additional information on regional brackish water supplies.

Prior to the utilization of any brackish water supply, a detailed water quality evaluation of the source water should be conducted to aid during the design phase of a project. Potential distribution system water quality issues associated with the use of brackish supplies include: taste and odor (algae), staining (Magnesium), discolored water, elevated coliform or heterotrophic plate counts (HPC), pathogens, disinfection byproducts (DBPs), bromated DBPs, elevated total organic carbon, and contaminants listed on the Contaminate Candidate List 3. These considerations may be associated with brackish supplies themselves, or when mixing two dissimilar waters in a distribution system.

The issue of brine concentrate disposal represents a major consideration for inland use of brackish water. Concentrate disposal techniques utilized by local inland desalination plants include surface water discharge (Robinson – 1.80 MGD facility and the Brazos River Authority – 6 MGD facility), sanitary sewer disposal (Sherman – 7.50 MGD facility), and deep well injection (El Paso – 27.5 MGD facility). The identification of potential feasible concentrate disposal techniques is application specific and should be investigated prior to the implementation of any project. Water suppliers in Region C may benefit from the development of additional data (i.e. subsurface information for deep well injection) that would aid in the evaluation of appropriate project specific concentrate disposal techniques. Additionally, studies should be conducted to determine whether disposal of concentrate could be achieved in concert with brackish source water management projects.

With the exception of the concentrate disposal requirements, many regulatory requirements for a desalination facility are the same or identical to those for a conventional treatment facility. Regulatory requirements have traditionally played an important role in project feasibility, schedule, and cost, and should be considered a priority during the planning stages of a project. Items such as site selection, raw water sources, and concentrate disposal options will affect the type of permits required, the magnitude of environmental investigations, and the time allotted for permitting.

This study does address the potential costs associated with facility construction, concentrate disposal, and operation and maintenance costs associated with desalination. However, in order to utilize additional brackish water sources in Region C, extensive pilot testing, yield analysis, and regulatory/permitting evaluations will need to be conducted at an additional cost to determine feasibility. In addition to desalination related studies, studies associated with blending of brackish and fresh water sources may provide further opportunities for utilizing brackish water within the region. Table 7-1 provides a summary of the recommendations which, if implemented in the near future, would aid Region C in utilizing additional brackish water sources.

Table 7-1. Summary of Future Recommendations for Utilizing Additional Brackish Water in Region C

Topic	Future Recommendations
Brackish Groundwater in Region C	Further define the feasibility, potential quantities, and quality of brackish water supplies in Region C.
	Determine the specific location of significant brackish groundwater sources within Region C, as well as their location in relationship to areas of need.
	Develop groundwater availability models to determine yield information for brackish aquifers.
	Conduct extensive pilot studies, including monitoring of test wells, prior to the implementation of a brackish groundwater project.
	Coordinate with area GCDs.
Brackish Surface Water in Region C	Further define the availability and quality of brackish surface water supplies in Region C.
	Coordinate with other regional water planning groups with brackish supply sources.
	Coordinate with Oklahoma and assess the potential for achieving Congressional action on Lake Texoma.
	Coordinate with power interests on Lake Texoma.
General Water Quality	Conduct detailed water quality evaluations of the source water as a first task during the design phase of a project.
Concentrate Disposal	Develop data to aid water suppliers in the evaluation of appropriate concentrate disposal techniques (i.e. subsurface info for deep well injection).
	Determine whether disposal of brine could be achieved in concert with brackish source water management projects.

Table 7-1, continued. Summary of Future Recommendations for Utilizing Additional Brackish Water in Region C

Topic	Future Recommendations
Blending of Waters	Conduct studies to determine the potential effects of blending existing Region C surface fresh water sources with brackish water from Lake Texoma, the Red River Basin, and the Brazos River Basin. Investigate the potential effects of blending brackish groundwater sources with fresh groundwater sources or existing Region C surface fresh water sources.

CHAPTER 7
LIST OF REFERENCES

(1) NRS Consulting Engineers, R.W. Harden and Associates, Dietrich Consulting Group, TRC, Electrical Expertise, Inc., WaterPR. "Guidance Manual for Brackish Groundwater Desalination in Texas." <u>Prepared for Texas Water Development Board</u>, April 2008.

Appendix A

TDS Data for the Brazos River

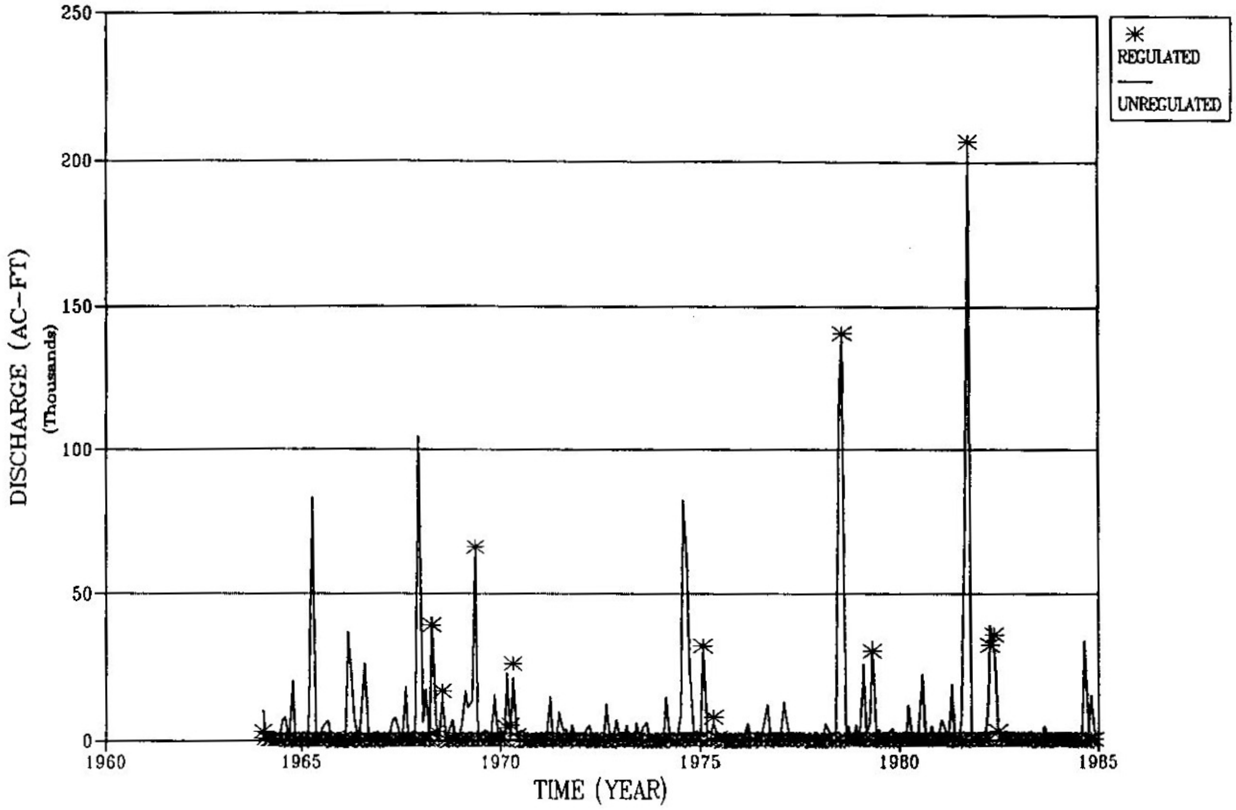


Figure 5.3 Regulated and Unregulated Discharge Hydrographs at Station 10 (Hubbard Gage)

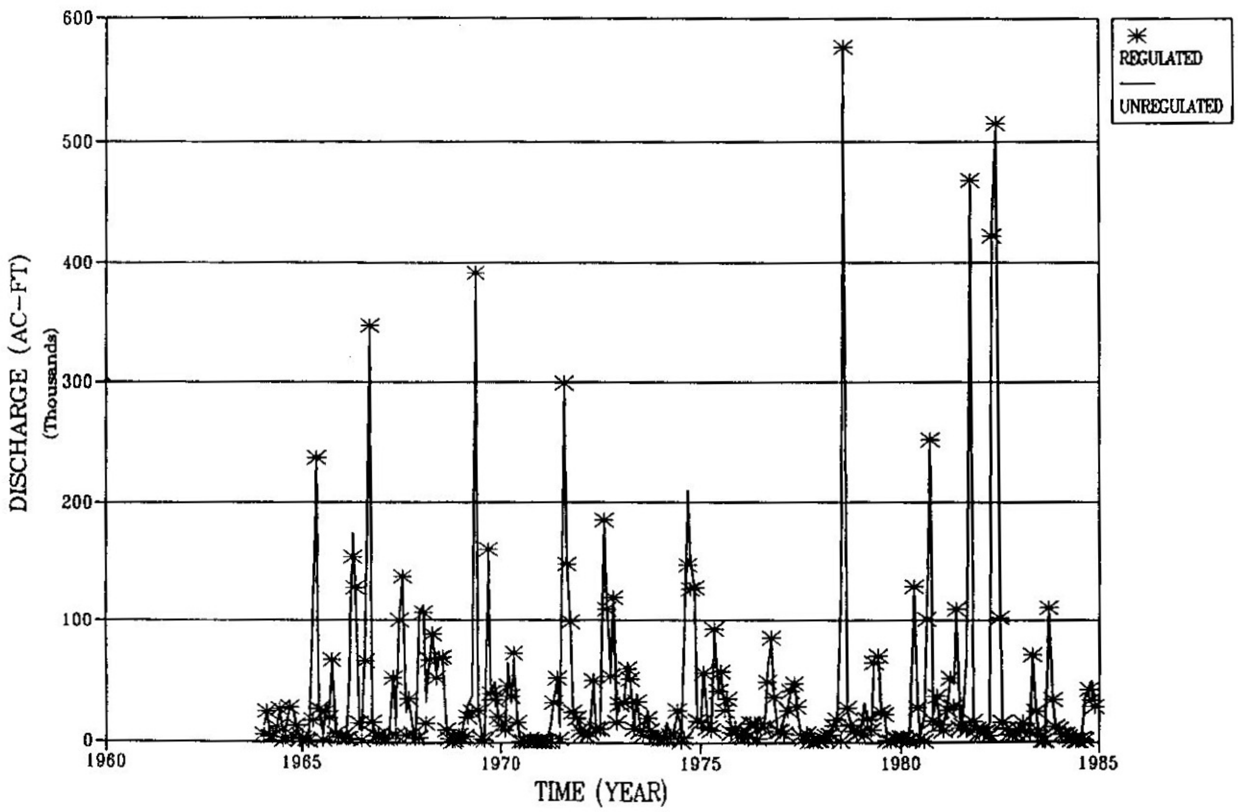


Figure 5.4 Regulated and Unregulated Discharge Hydrographs at Station 12 (Southbend Gage)

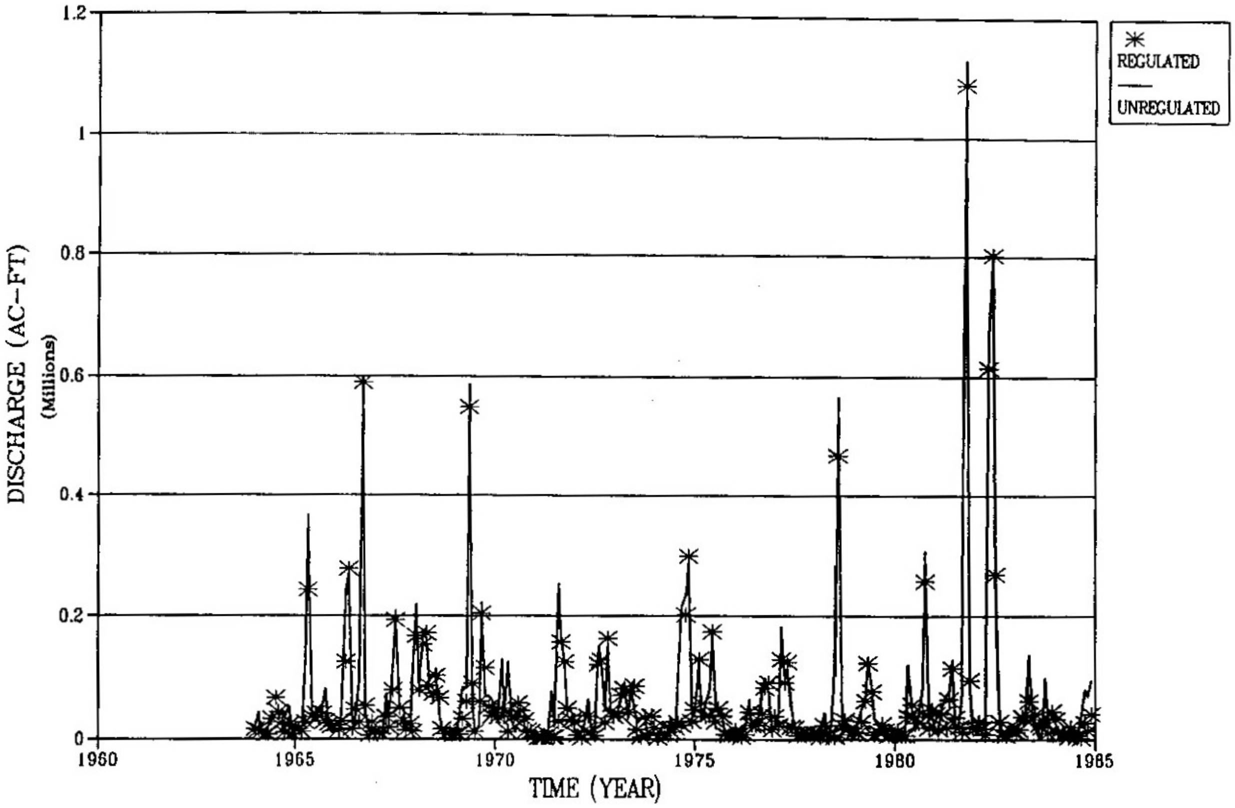


Figure 5.5 Regulated and Unregulated Discharge Hydrographs at Station 14 (Dennis Gage)

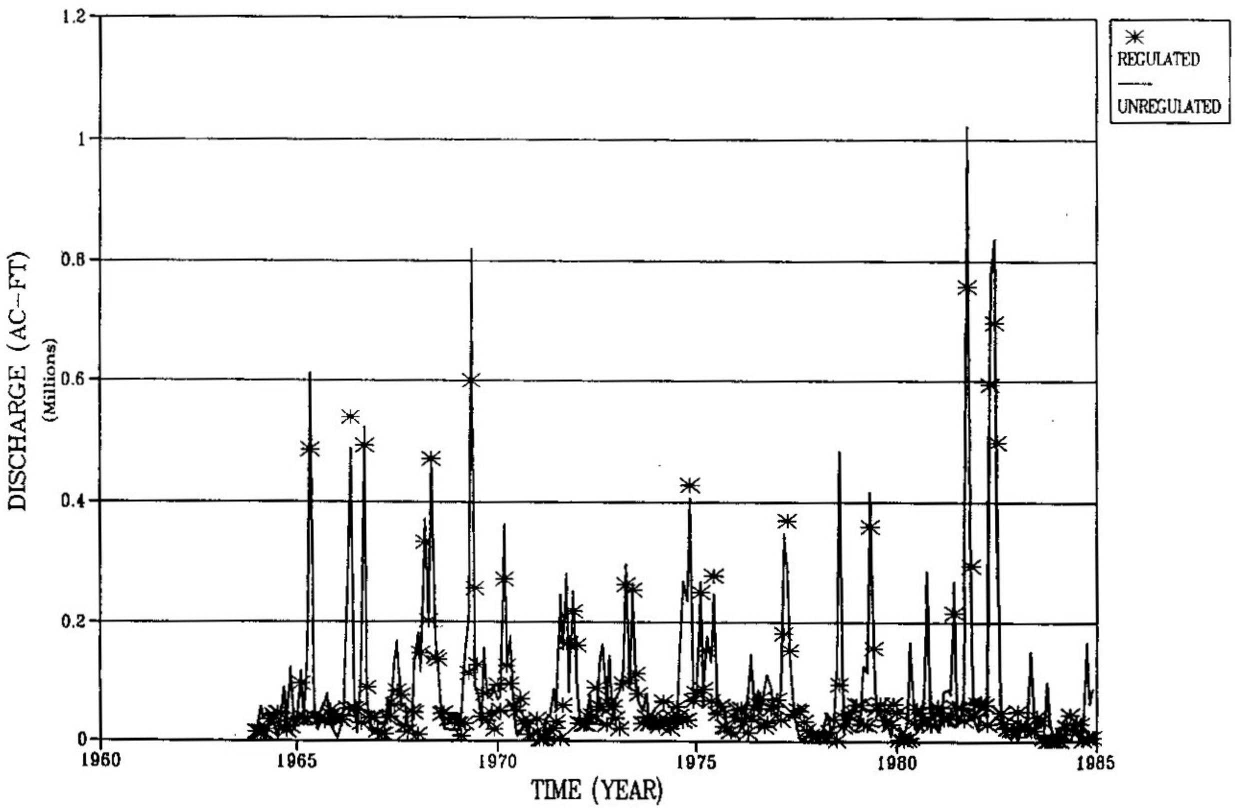


Figure 5.6 Regulated and Unregulated Discharge Hydrographs at Station 15 (Whitney Gage)

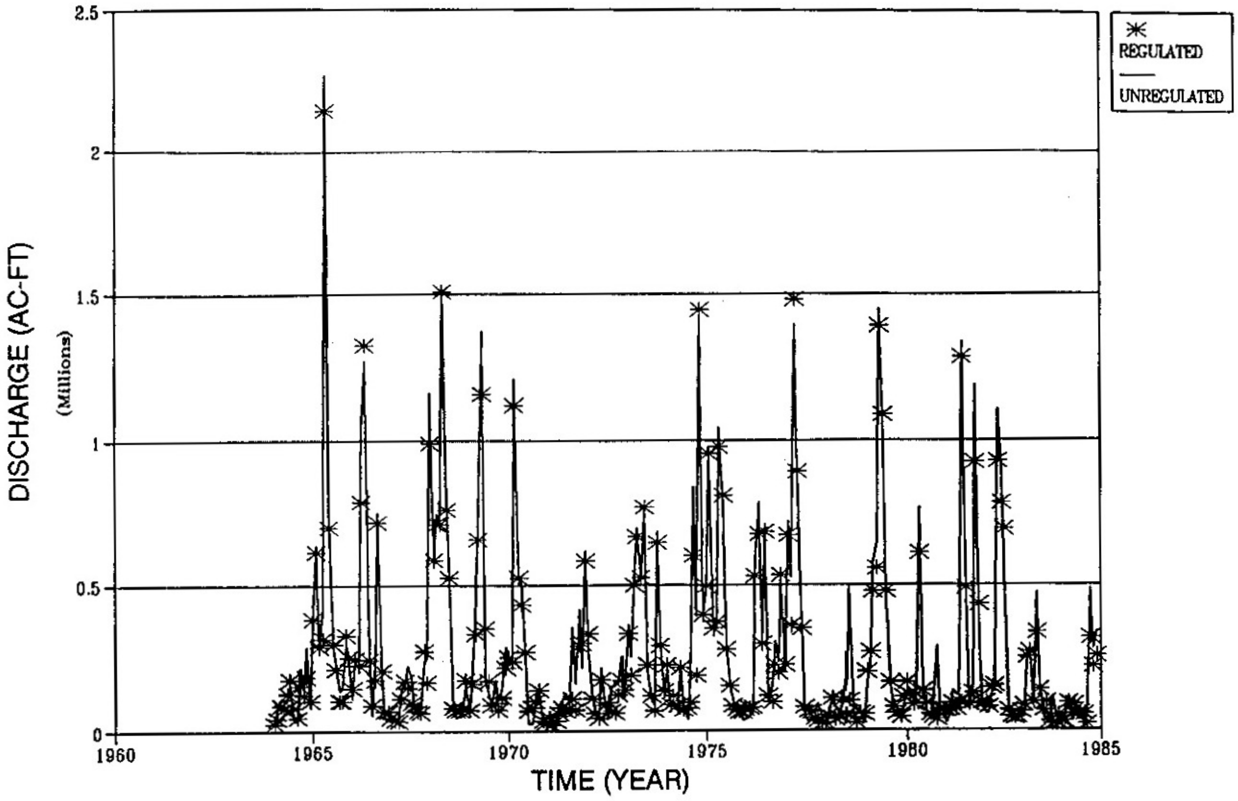


Figure 5.7 Regulated and Unregulated Discharge Hydrographs at Station 21 (College Station Gage)

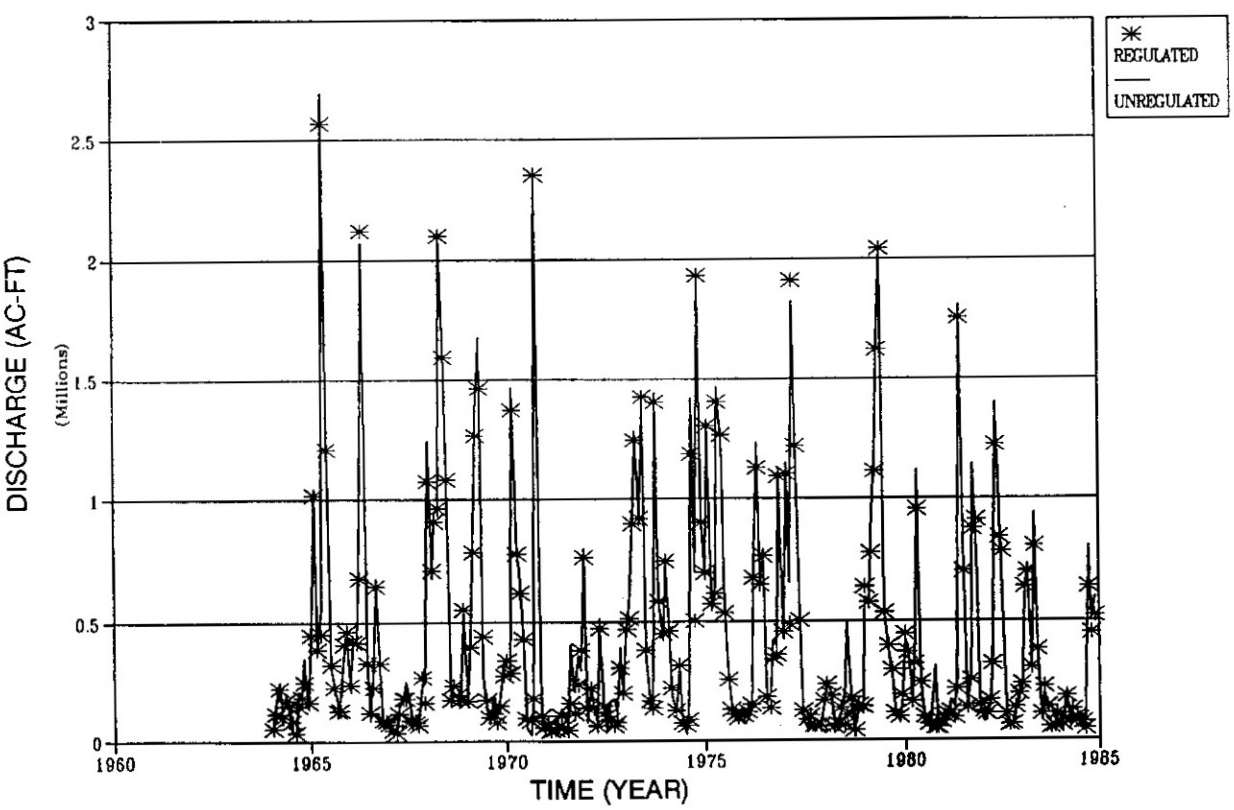


Figure 5.8 Regulated and Unregulated Discharge Hydrographs at Station 25 (Richmond Gage)

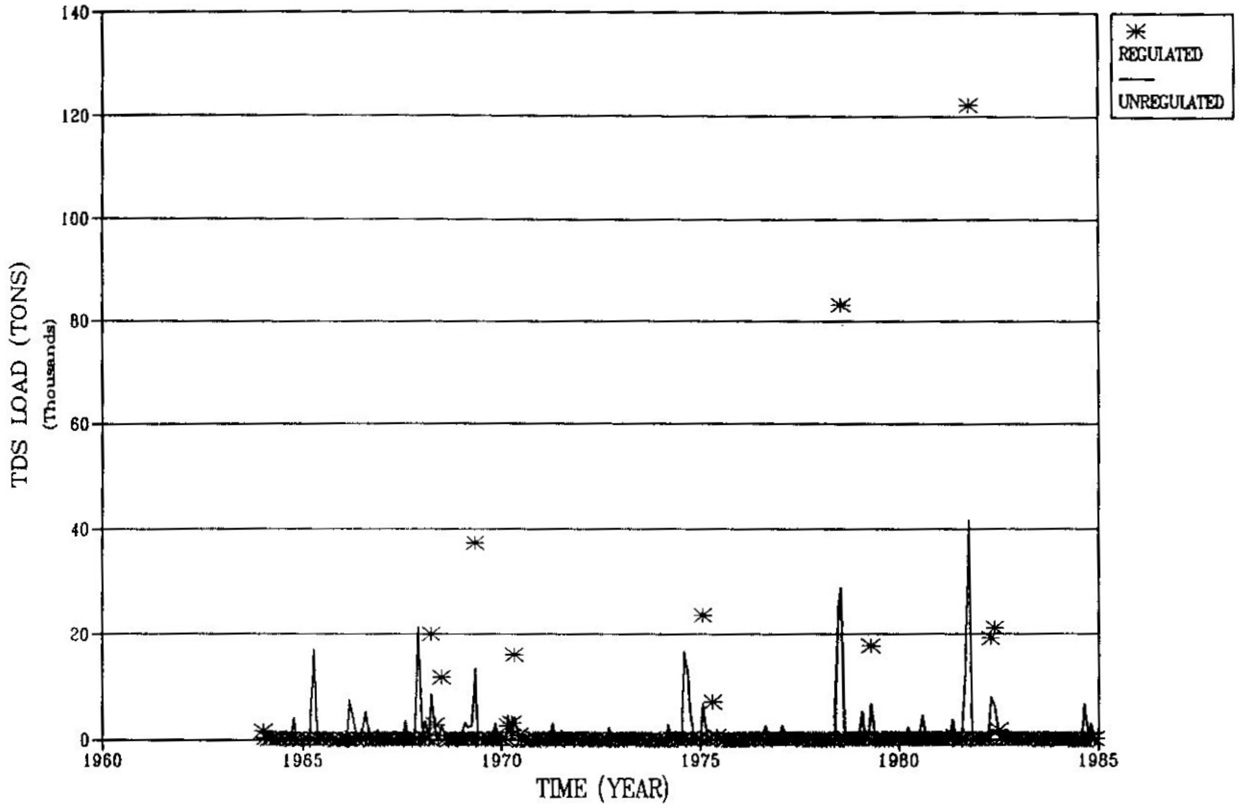


Figure 5.9 Regulated and Unregulated TDS Loads at Station 10 (Hubbard Gage)

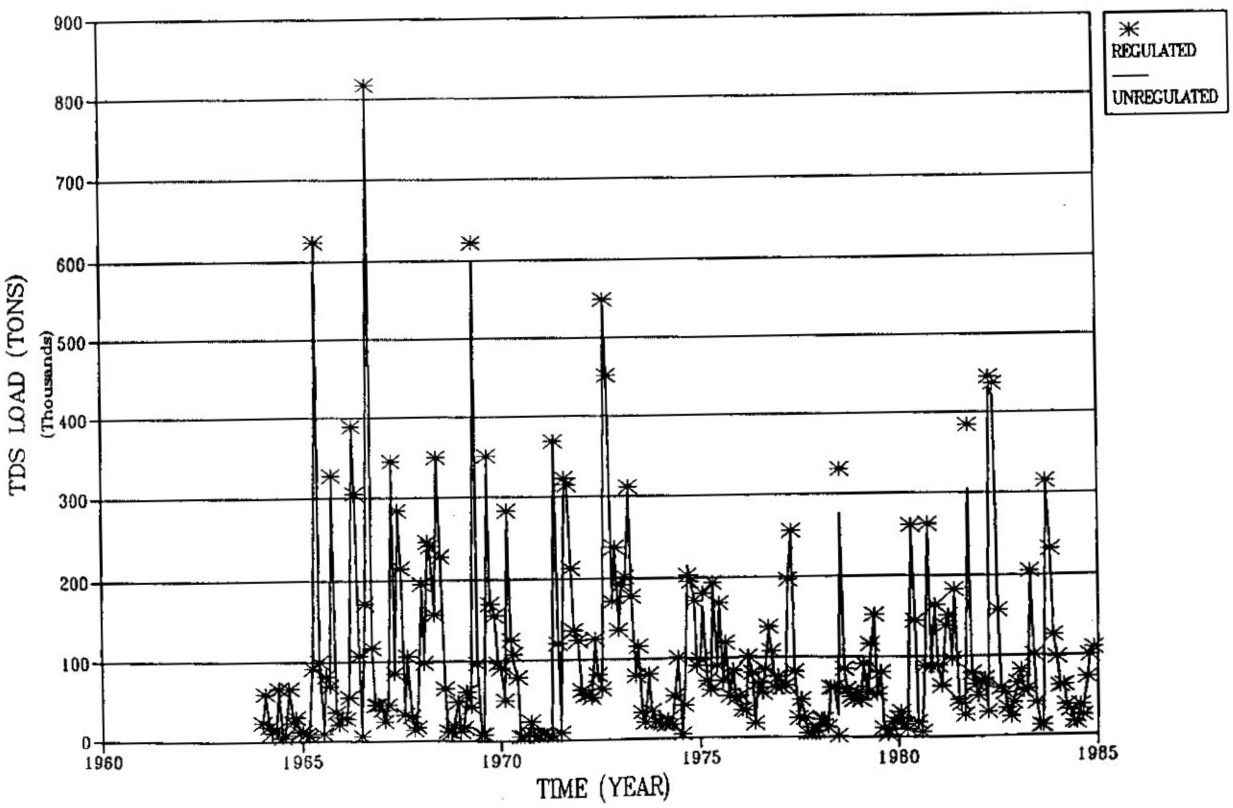


Figure 5.10 Regulated and Unregulated TDS Loads at Station 12 (Southbend Gage)

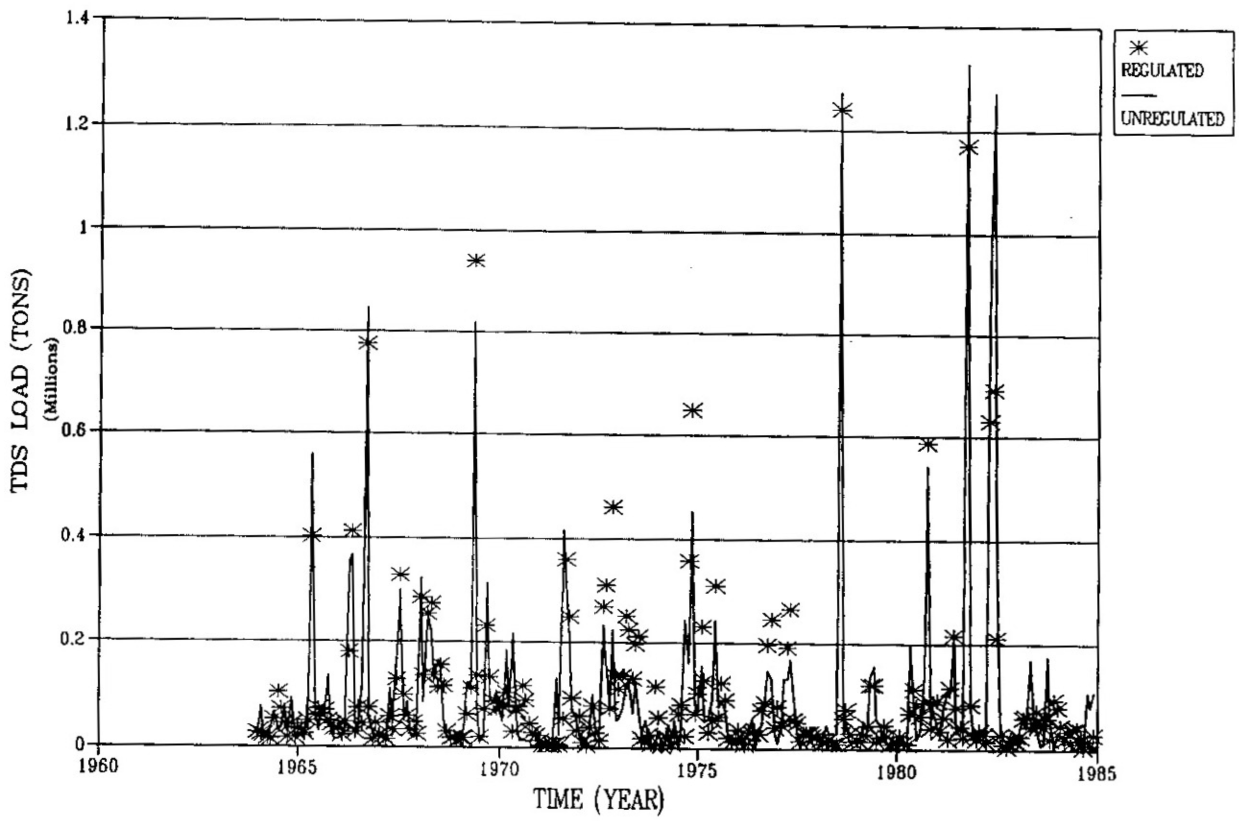


Figure 5.11 Regulated and Unregulated TDS Loads at Station 14 (Dennis Gage)

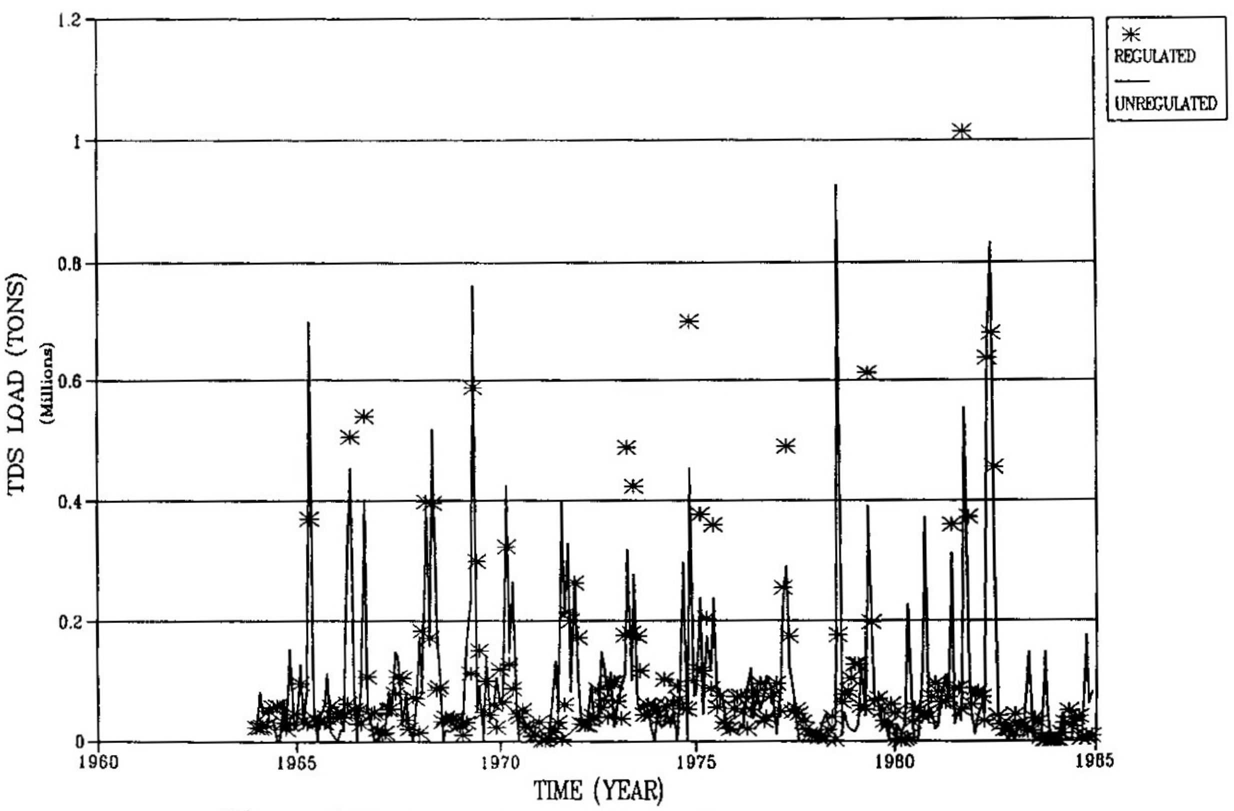


Figure 5.12 Regulated and Unregulated TDS Loads at Station 15 (Whitney Gage)

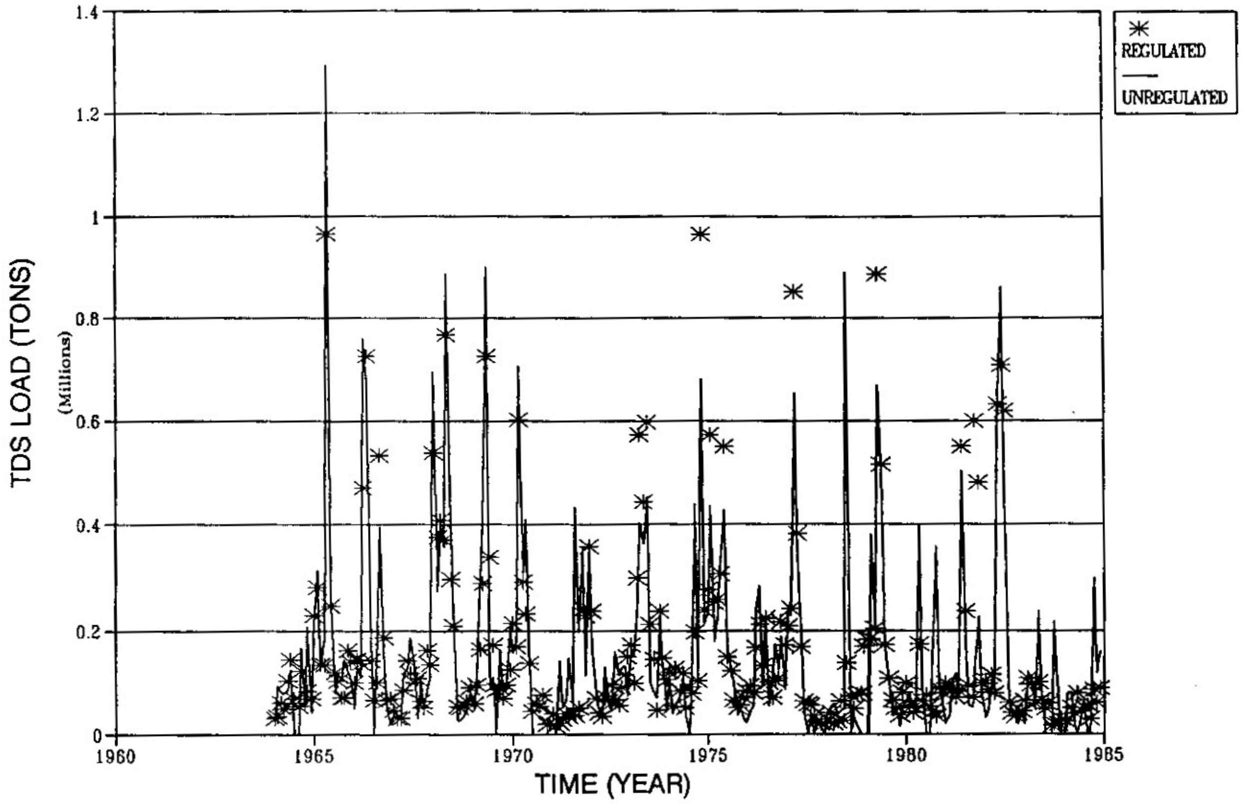


Figure 5.13 Regulated and Unregulated TDS Loads at Station 21 (College Station Gage)

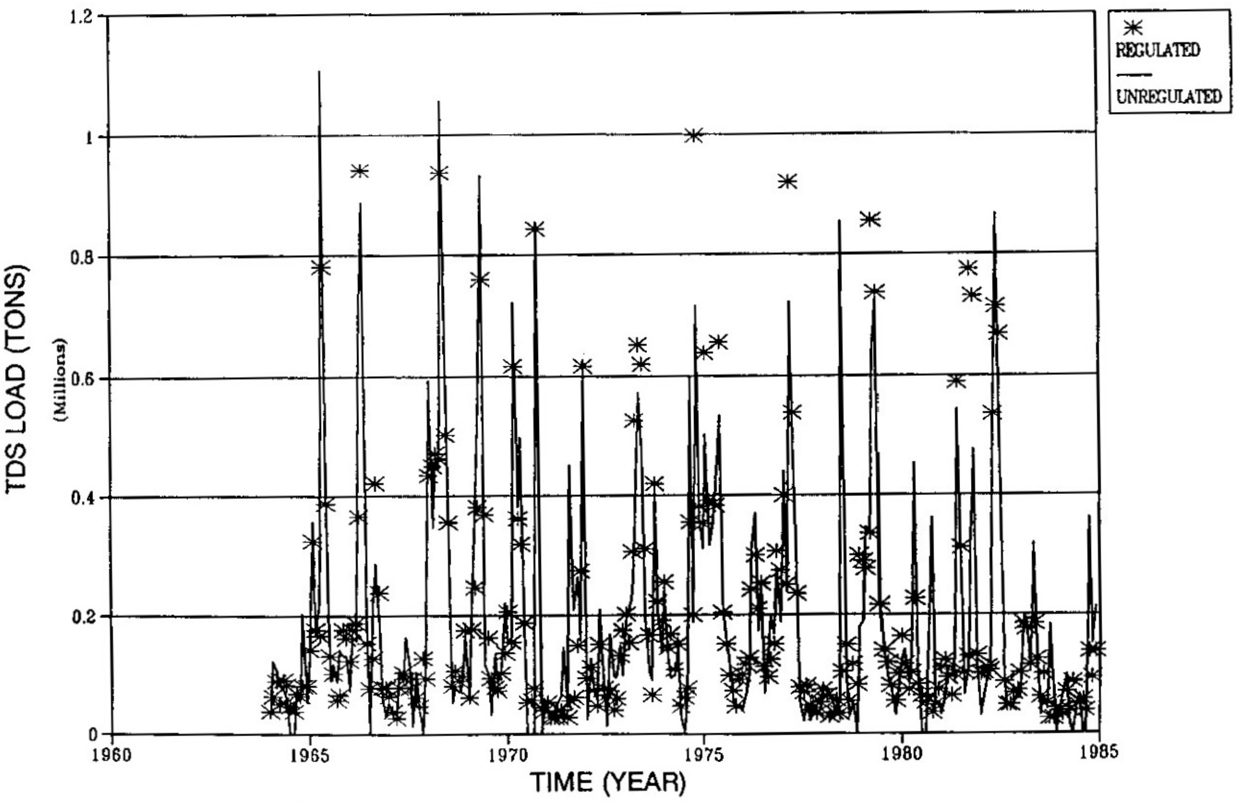


Figure 5.14 Regulated and Unregulated TDS Loads at Station 25 (Richmond Gage)

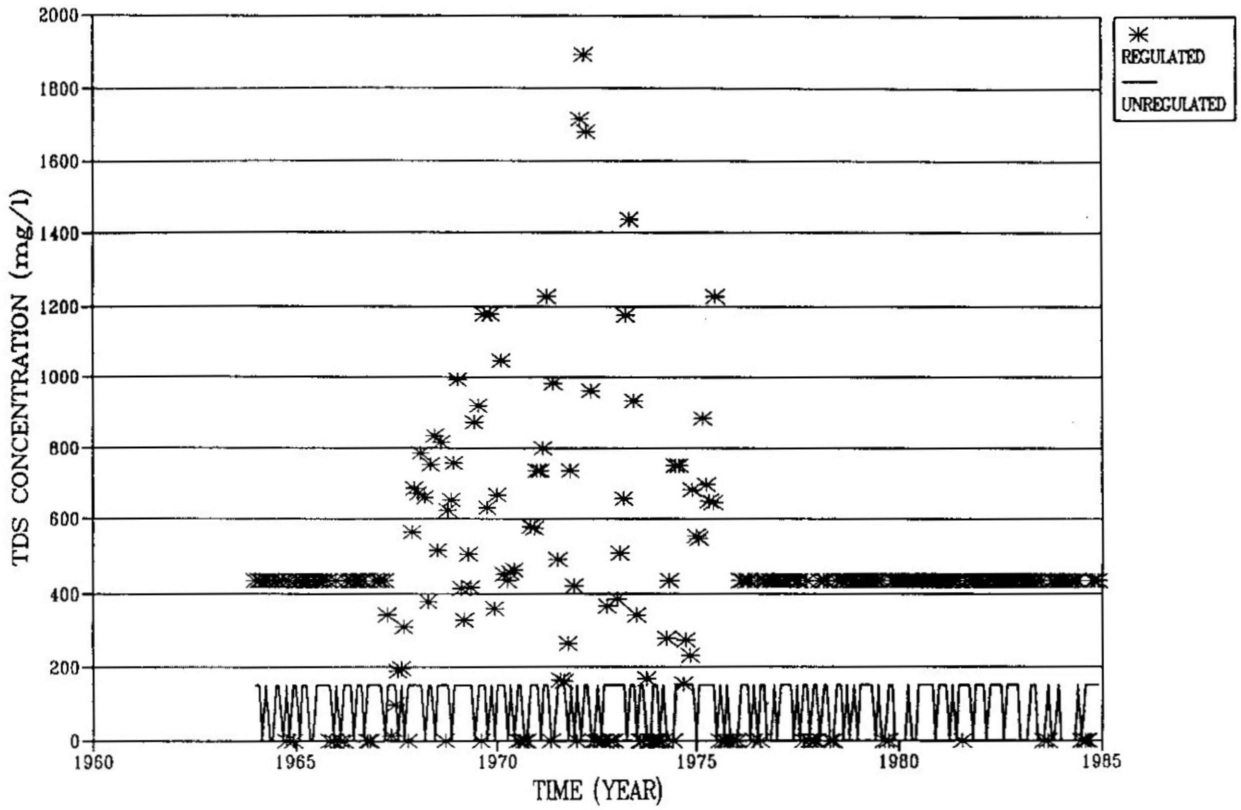


Figure 5.15 Regulated and Unregulated TDS Concentrations at Station 10 (Hubbard Gage)

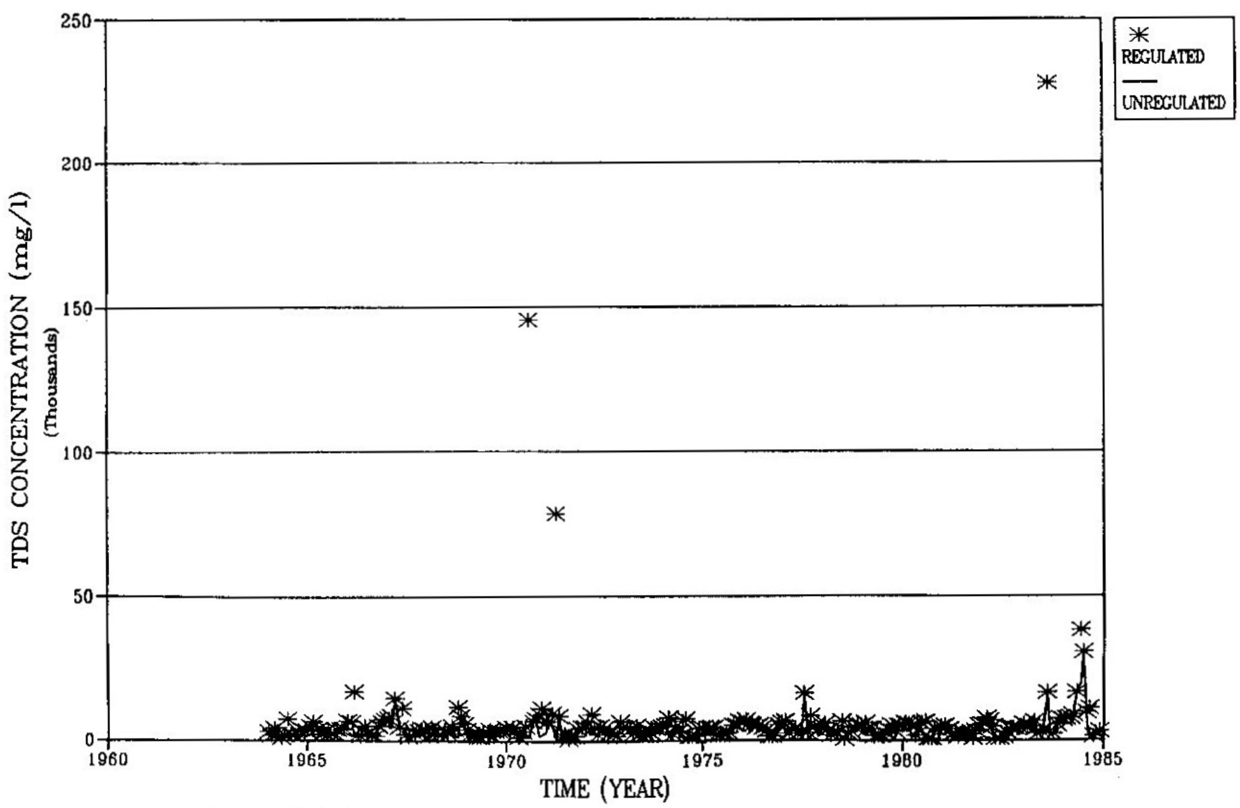


Figure 5.16 Regulated and Unregulated TDS Concentrations at Station 12 (Southbend Gage)

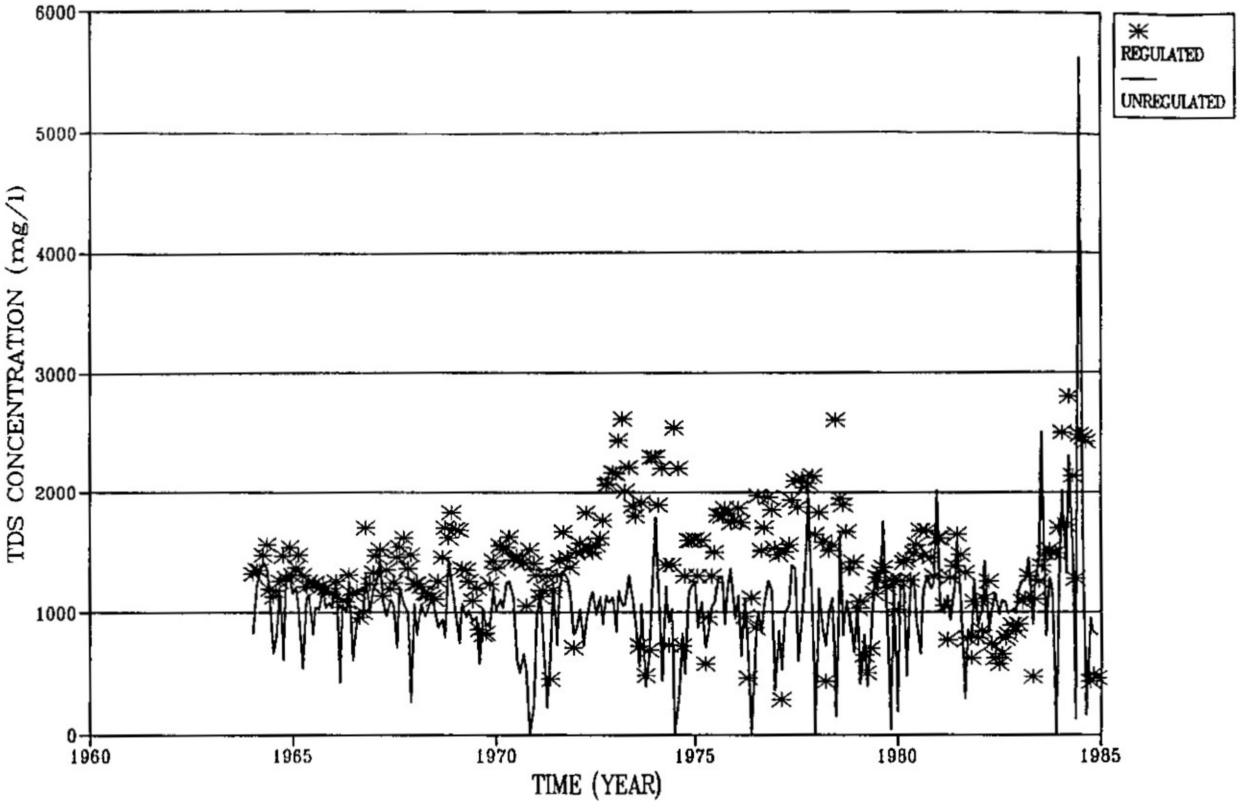


Figure 5.17 Regulated and Unregulated TDS Concentrations at Station 14 (Dennis Gage)

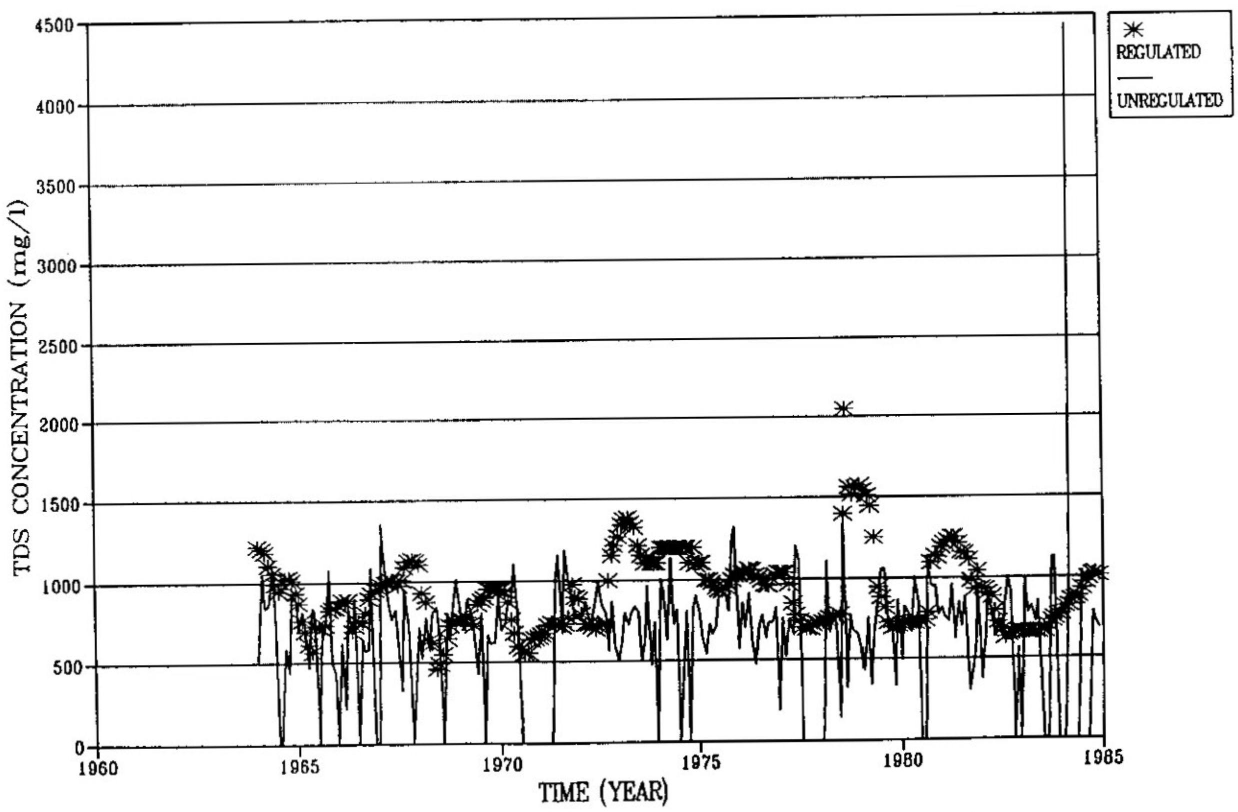


Figure 5.18 Regulated and Unregulated TDS Concentrations at Station 15 (Whitney Gage)

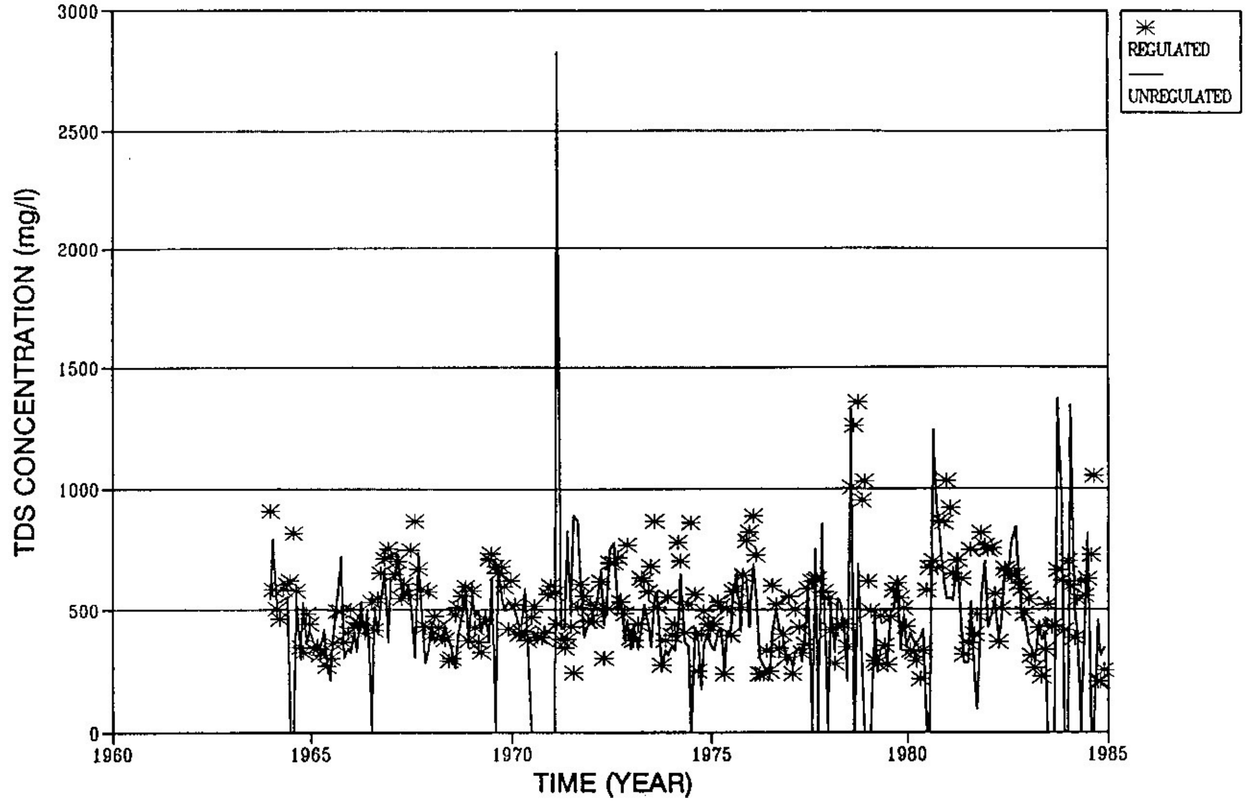


Figure 5.19 Regulated and Unregulated TDS Concentrations at Station 21 (College Station Gage)

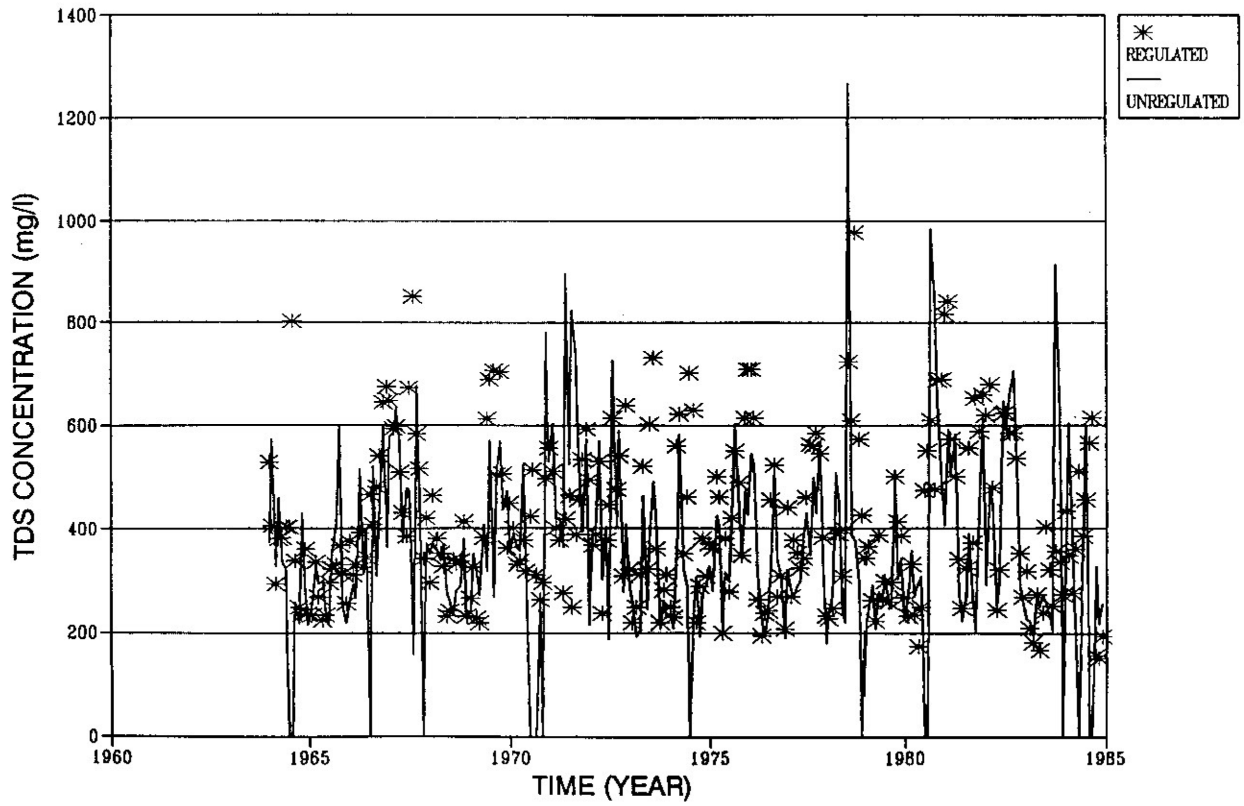


Figure 5.20 Regulated and Unregulated TDS Concentrations at Station 25 (Richmond Gage)

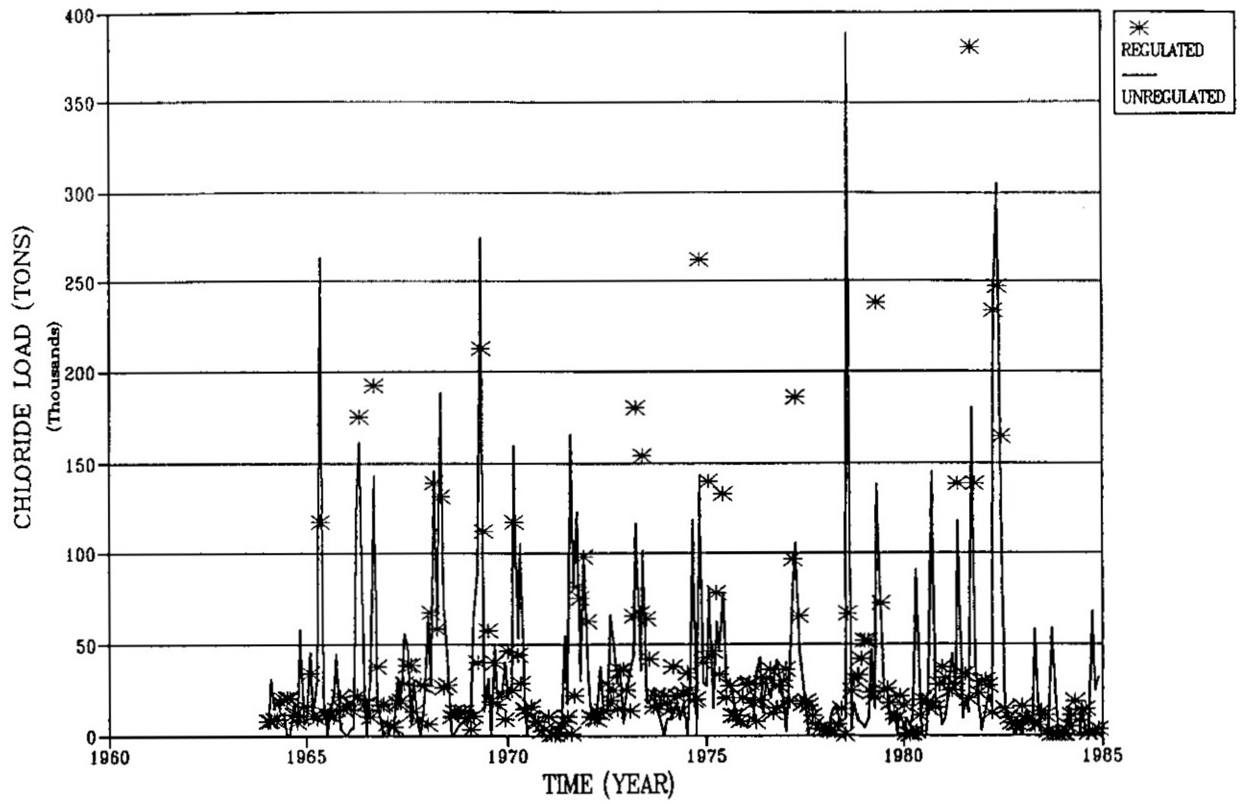


Figure 5.21 Regulated and Unregulated Chloride Loads at Station 15 (Whitney Gage)

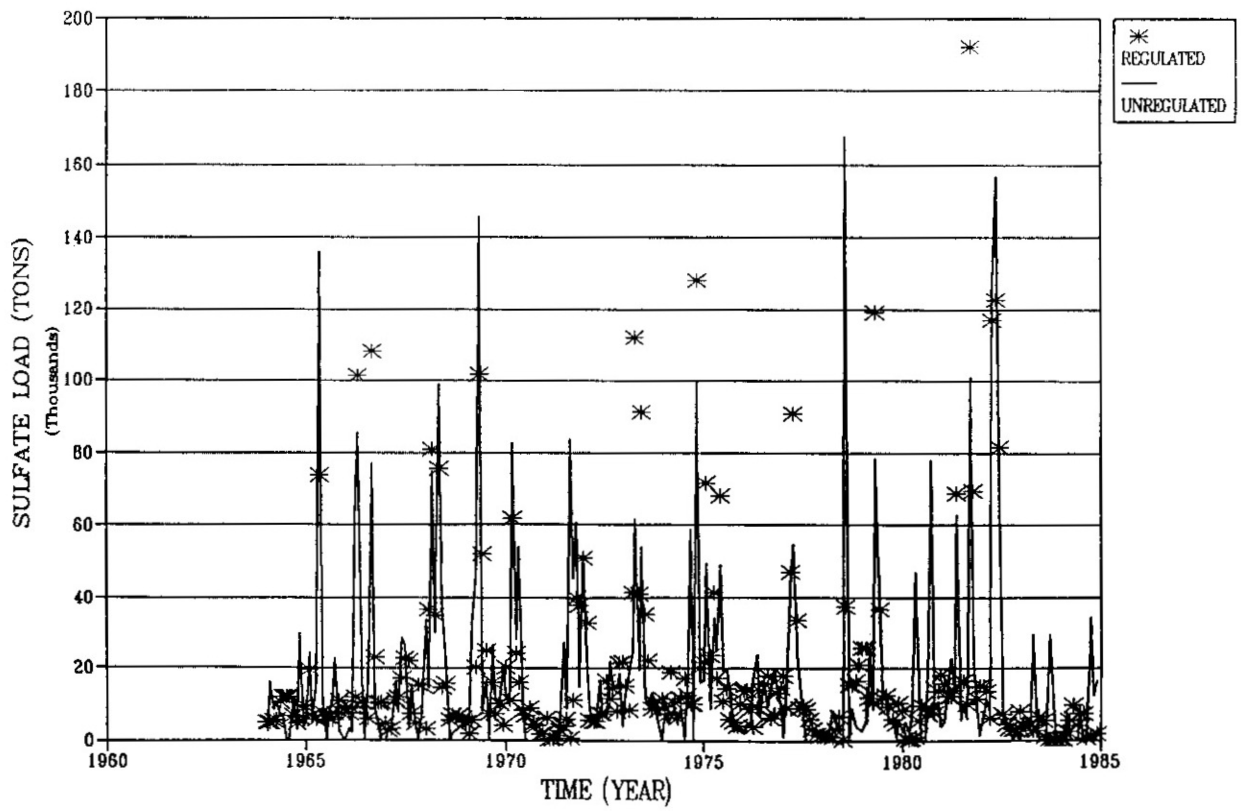


Figure 5.22 Regulated and Unregulated Chloride Concentrations at Station 15 (Whitney Gage)

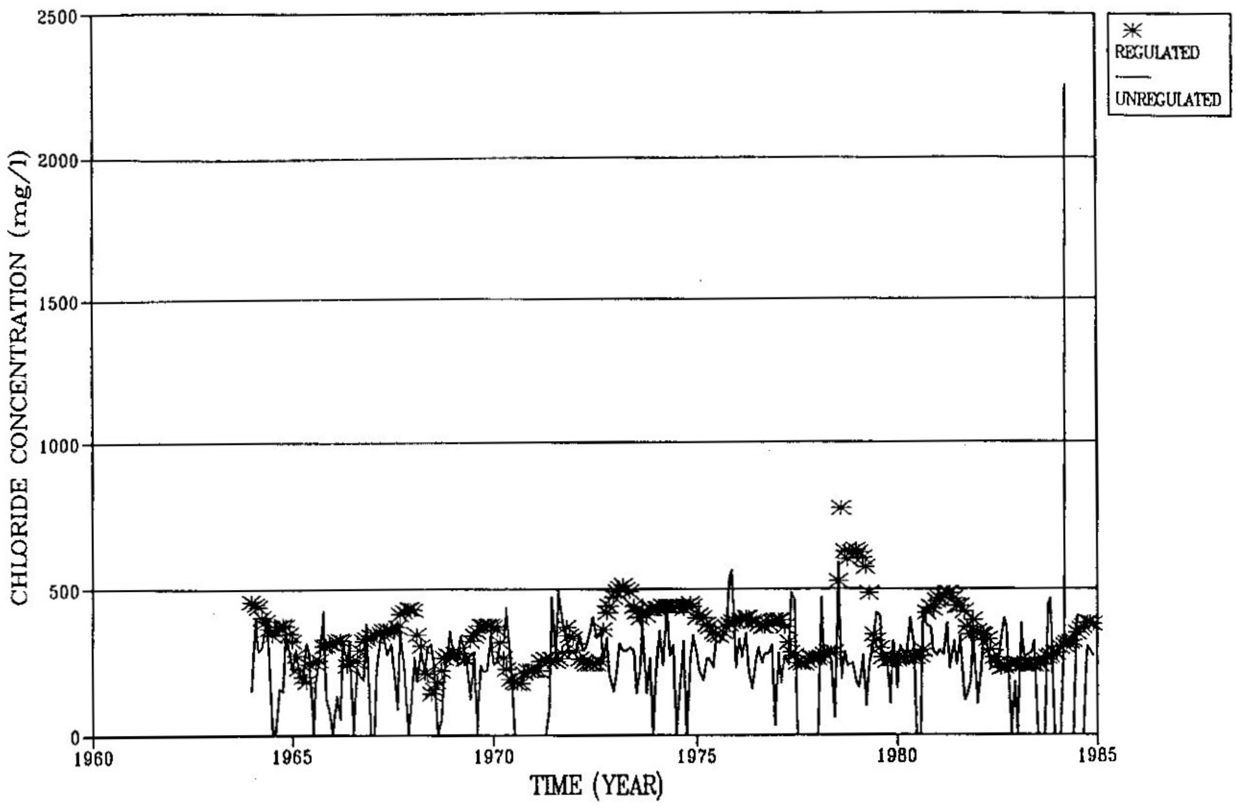


Figure 5.23 Regulated and Unregulated Sulfate Loads at Station 15 (Whitney Gage)

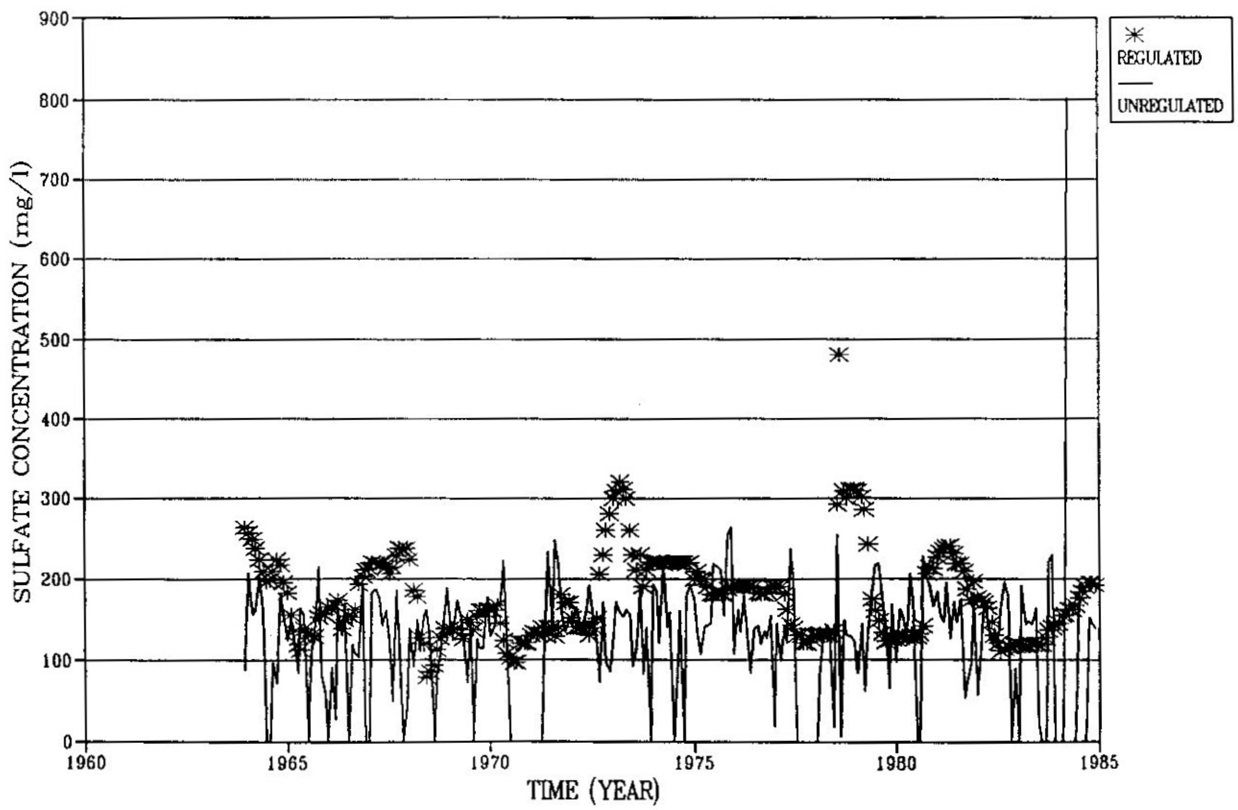


Figure 5.24 Regulated and Unregulated Sulfate Concentrations at Station 15 (Whitney Gage)

Appendix B

USGS Assessment of Selected Water Quality Data Collected on the Lower Red River

In cooperation with the Red River Authority of Texas

Assessment of Selected Water-Quality Data Collected in the Lower Red River (Main Stem) Basin, Texas, 1997–98

The Texas part of the Red River Basin has been divided into five reaches or subbasins (fig. 1) to facilitate improved planning, monitoring, geographical analysis, and dissemination of information. The U.S. Geological Survey (USGS), in cooperation with the Red River Authority of Texas, is studying the five subbasins, each for a period of about 1 year. Baldys and Phillips (1998) discuss various components and the associated scope of study of each of the five reaches. Data from the first reach studied—reach 2, the Wichita River Basin—were presented in a fact sheet by Baldys and Phillips (2000). This fact sheet presents an assessment of data collected at 11 sites during 1997–98 for reach 1—the lower Red River (main stem) Basin from the confluence of Cache Creek downstream to the Texas-Arkansas State Line (fig. 1).

Lower Red River (Main Stem) Basin

The drainage basin of the lower Red River (main stem) reach in Texas covers 3,600 square miles (fig. 1). Four major cities are in this narrow strip of land: Denison (population 22,773), Sherman (population 35,082), Paris (population 25,898), and Texarkana (population 34,782 in Texas, and 26,448 in Arkansas) (Dallas Morning News, 2001). The primary hydrologic influences on the Red River in this reach are Lake Nocona, Lake Texoma, and Pat Mayse Lake in Texas and Hugo Lake in Oklahoma (not shown on map), about 30 miles north of Paris, Tex. The daily mean flow at USGS streamflow-gaging station 07315500 Red River near Terral, Okla. (upstream boundary of lower Red River main stem), was 2,571 cubic feet per second (ft^3/s) for water years 1938–98; daily mean flow at USGS station 07337000 Red River at Index, Ark. (downstream boundary of lower Red River main stem), was 13,310 ft^3/s for water years 1944–98 (table 1) (Gandara and others, 1998, 1999). Annual mean flows at both stations for water years 1997 and 1998 were higher at Terral (60 and 20 percent) and at Index (65 and 25 percent) than the historical averages for both sites. Major tributaries to the main stem of the lower Red River are the Washita River, which flows into the north side of Lake Texoma from Oklahoma (daily mean discharge 2,692 ft^3/s in 1998 and 3,602 ft^3/s in 1997 at station 07331000 Washita River near Dickson, Okla. [Blazs and others, 1998, 1999]), and Big Mineral Creek (ungaged), Choctaw Creek (ungaged), and Bois D'Arc Creek (ungaged) from Texas. Discharge for both the 1997 and 1998 water years measured at station 07331000 was higher than the 1962–98 average annual mean of 1,904 ft^3/s (Blazs and others, 1999).

A. Red River near Bonham, Texas (photograph courtesy of William S. Burns, Red River Authority of Texas).

B. Choctaw Creek at U.S. Highway 69 near Denison, Texas (photograph courtesy of William S. Burns, Red River Authority of Texas).

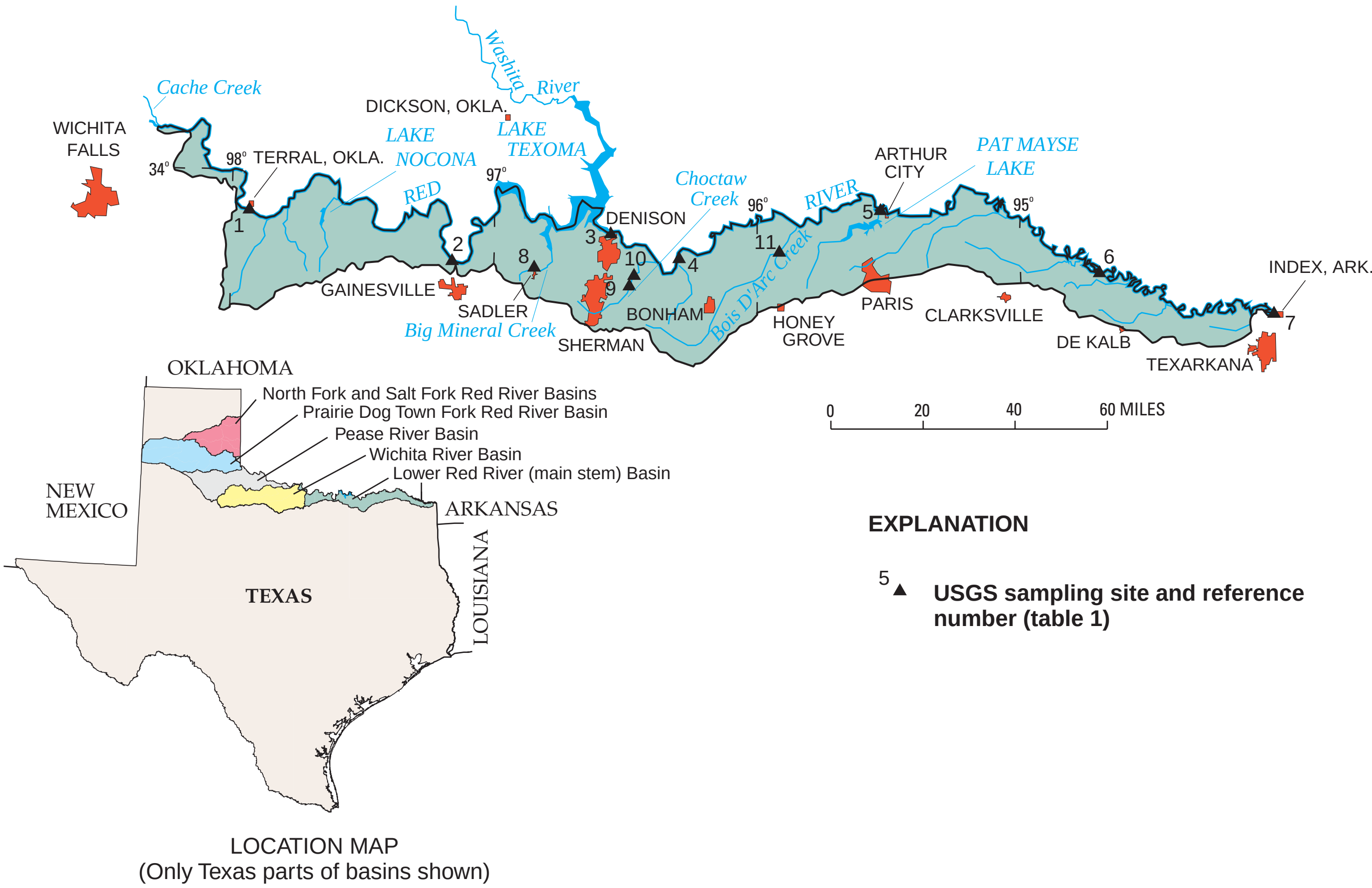


Figure 1. Sampling sites in the lower Red River (main stem) Basin, Texas 1997–98.

The lower Red River in the main stem reach can be quite wide with main channels greater than 1,000 feet (ft) wide (Red River near Bonham, Tex., photograph A) and flood plains wider than 5,000 ft. Channels primarily are composed of highly erodible, mobile sand that often changes the location of the low-flow channel after a flood. The tributaries to the main stem are characterized by more stable, smaller channels with much smaller floodplains that generally are covered with brush and trees (Choctaw Creek at U.S. Highway 69 near Denison, Tex., photograph B).

Water-quality data were collected by the Red River Authority of Texas and the USGS at seven sites on the main

Table 1. Monitoring program in the lower Red River (main stem) Basin, Texas, 1997–98

[TCEQ, Texas Commission on Environmental Quality; USGS, U.S. Geological Survey; C, continuous recording; --, not applicable; I, intermittent recording; Hwy., Highway; FM, Farm to Market Road]

Sampling site no. (fig. 1)	Site name	Station ID		Latitude	Longitude	Discharge monitored
		TCEQ	USGS			
1	Red River near Terral, Okla.	10133	07315500	33°52'43"	97°56'03"	C
2	Red River near Gainesville, Tex.	10132	07316000	33°43'40"	97°09'35'	C
3	Red River at Denison Dam near Denison, Tex.	13684	07331600	33°49'08"	96°33'47"	C
4	Red River near Bonham, Tex.	10127	--	33°45'25"	96°12'07"	I
5	Red River at U.S. Hwy. 271 at Arthur City, Tex.	10126	07335500	33°52'30"	95°30'06"	C
6	Red River near De Kalb, Tex.	10125	07336820	33°40'59"	94°41'39"	C
7	Red River at Index, Ark.	10123	07337000	33°33'07"	94°02'28"	C
8	Big Mineral Creek at FM 901 near Sadler, Tex.	15320	--	33°42'07"	96°50'53"	I
9	Choctaw Creek at U.S. Hwy. 69 near Denison, Tex.	16123	--	33°41'10"	96°28'19"	I
10	Choctaw Creek at FM 1753 near Denison, Tex.	16130	--	33°43'08"	96°27'14"	I
11	Bois D'Arc Creek at FM 100 near Honey Grove, Tex.	15318	--	33°45'32"	95°54'58"	I

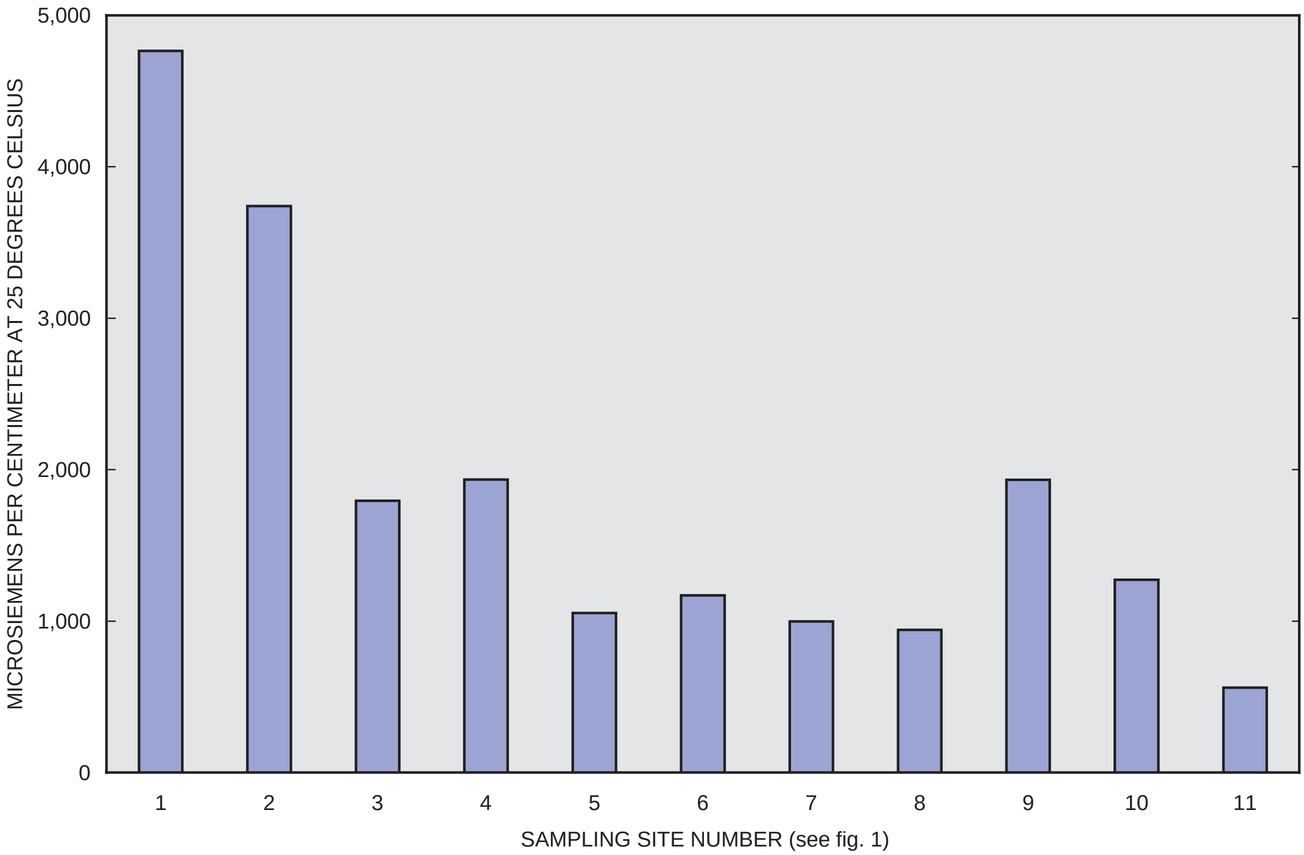


Figure 2. Median specific conductance at lower Red River (main stem) Basin sampling sites decreases in concentration through the basin, 1997–98.

stem of the Red River and four sites on tributaries to the main stem of the Red River (table 1). The major water-quality issues in this reach of the lower Red River Basin identified by the Texas Commission on Environmental Quality (TCEQ) are salinity, bacteria, and dissolved oxygen concentrations (Texas Natural Resource Conservation Commission, 1997). The salinity of a water body refers to its concentration of dissolved solids. Waters with low salinity (freshwater—less than 1,000 milligrams per liter [mg/L] dissolved solids) is suitable for agriculture and potable water supplies, whereas waters with higher salinity make good habitats for certain species of fish. Bacteria have been

Table 2. Specific conductance in the lower Red River (main stem) Basin, Texas, 1997–98

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; USGS, U.S. Geological Survey; RRA, Red River Authority of Texas; --, not applicable; Hwy., Highway; FM, Farm to Market Road]

Sampling site no. (fig. 1)	Site name	Specific conductance (µS/cm)					No. of discrete samples	Data source
		Minimum	Maximum	Median	Average	Continuous monitor average		
1	Red River near Terral, Okla.	[1]653	[1]20,600	[1]4,765	[1]4,902	3,794	24	USGS, RRA
2	Red River near Gainesville, Tex.	[1]1,090	[1]6,030	[1]3,740	[1]3,847	3,527	35	USGS, RRA
3	Red River at Denison Dam near Denison, Tex.	[1]1,400	[1]1,990	[1]1,795	[1]1,786	1,478	24	USGS
4	Red River near Bonham, Tex.	1,402	2,010	1,934	1,876	--	9	RRA
5	Red River at U.S. Hwy. 271 at Arthur City, Tex.	173	1,496	1,053	963	--	15	USGS
6	Red River near De Kalb, Tex.	617	1,570	1,170	1,149	--	16	USGS, RRA
7	Red River at Index, Ark.	276	1,443	998	945	--	24	USGS, RRA
8	Big Mineral Creek at FM 901 near Sadler, Tex.	443	1,337	942	908	--	12	RRA
9	Choctaw Creek at U.S. Hwy. 69 near Denison, Tex.	522	2,509	1,933	1,630	--	8	RRA
10	Choctaw Creek at FM 1753 near Denison, Tex.	658	1,763	1,272	1,242	--	4	RRA
11	Bois D'Arc Creek at FM 100 near Honey Grove, Tex.	210	1,017	560	596	--	12	RRA

[1] Statistics pertain to discrete samples only.

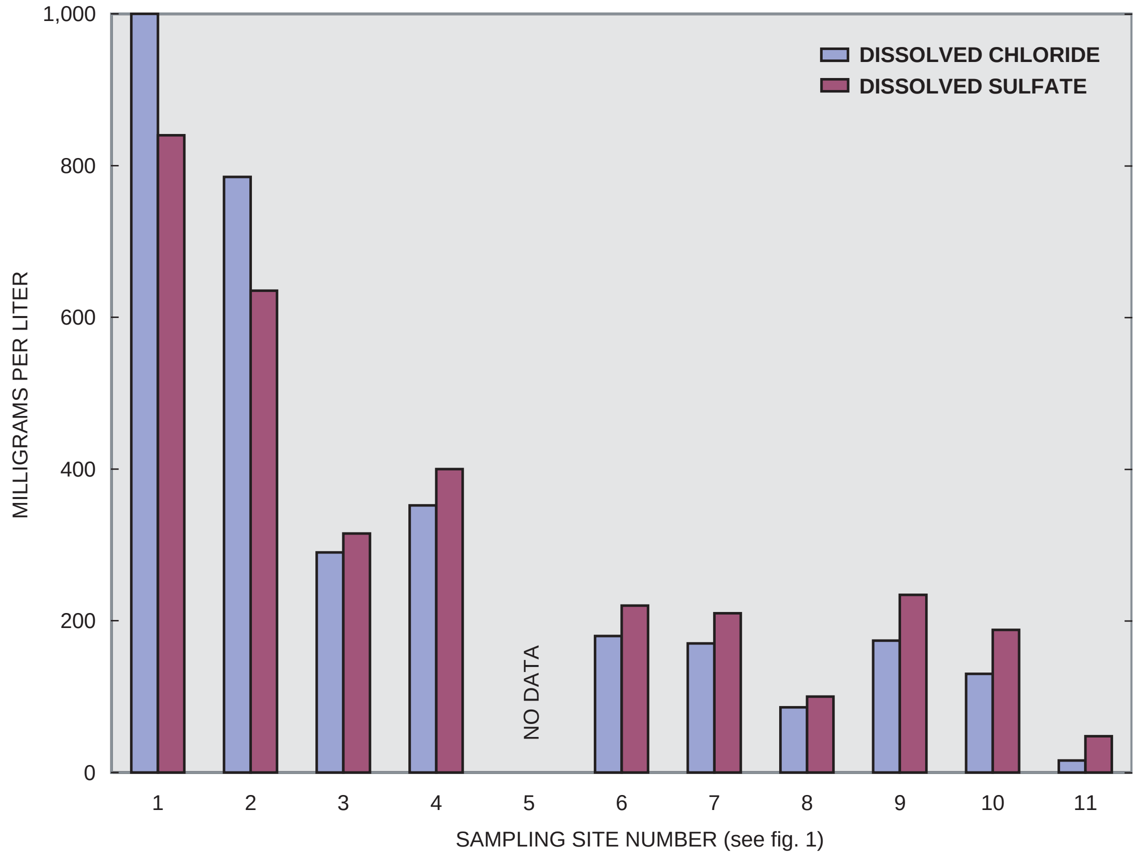


Figure 3. Median dissolved chloride and sulfate at lower Red River (main stem) Basin sampling sites decrease in concentration through the basin, 1997–98.

included on the Clean Water Act 303(d) list for Texas[1] as an indication of an impaired or threatened water body. Dissolved oxygen concentrations need to average at least 5.0 mg/L, with an absolute minimum of 3.0 mg/L, to sustain healthy fish populations (Texas Natural Resource Conservation Commission, 1997).

Salinity

Salinity is an issue in the main stem reach of the lower Red River, especially in Lake Texoma, because of its effects on striped bass fishing, which is a major industry in the area. Specific conductance (table 2) is an indicator of the salinity in a water body and correlates closely with dissolved chloride and dissolved sulfate concentrations. Relations between specific conductance and dissolved sulfate or dissolved chloride concentrations, or both, have been developed at several sites in the Red River Basin and used to compute loads for chloride and sulfate (Gandara and others, 1999).

Specific conductance was measured hourly with an electronic probe at two sites, 07316000 Red River near Gainesville, Tex. (upstream from Lake Texoma), and 07331600 Red River at Denison Dam near Denison, Tex. (downstream from Lake Texoma), and by discrete daily samples at site 07315500 Red River near Terral, upstream from the Gainesville site. The continuous monitor averages for these three sites are lower than the medians for discrete samples collected periodically at the sites during the study period. Specific conductance in the lower Red River generally decreases in a downstream direction (fig. 2), except for the two Choctaw Creek sites (table 2). Median specific conductance decreased substantially from the Terral site (4,765 microsiemens per centimeter at 25 degrees Celsius [µS/cm]), to the Gainesville site (3,740 µS/cm) (both above Lake Texoma), to the outflow site for Lake Texoma at Denison Dam (1,795 µS/cm). Moving downstream, median specific conductance for discrete samples increased slightly at the Bonham site (1,934 µS/cm), decreased to 1,053 µS/cm at the U.S. Highway 271 site at Arthur City, and then increased slightly again to 1,170 µS/cm at the De Kalb site. Median specific conductance for discrete samples in the lower Red River main stem as it leaves the study reach at Index, Ark., is the lowest of all main stem sites, 998 µS/cm.

[1] The Clean Water Act 303(d) list for Texas comprises surface-water bodies identified by the TCEQ as impaired (do not meet applicable water-quality standards) or threatened (are not expected to meet applicable standards in the near future). Section 303(d) of the Federal Clean Water Act (together with related regulations) requires each State to assess the quality of its surface waters and to develop water-quality improvement strategies for impaired and threatened waters.

Table 3. Dissolved chloride and dissolved sulfate concentrations in the lower Red River (main stem) Basin, Texas, 1997–98

[mg/L, milligrams per liter; USGS, U.S. Geological Survey; RRA, Red River Authority of Texas; --, not sampled; Hwy., Highway; FM, Farm to Market Road]

Sampling site no. (fig. 1)	Site name	Dissolved chloride (mg/L)				No. of samples	Dissolved sulfate (mg/L)				No. of samples	Data source
		Minimum	Maximum	Median	Average		Minimum	Maximum	Median	Average		
1	Red River near Terral, Okla.	560	1,400	1,000	950	6	590	950	840	793	6	USGS
2	Red River near Gainesville, Tex.	190	1,400	785	818	24	140	1,000	635	637	24	USGS
3	Red River at Denison Dam near Denison, Tex.	210	360	290	290	24	240	410	315	321	24	USGS
4	Red River near Bonham, Tex.	300	370	352	341	3	280	434	400	371	3	RRA
5	Red River at U.S. Hwy. 271 at Arthur City, Tex.	--	--	--	--	--	--	--	--	--	--	--
6	Red River near De Kalb, Tex.	96	230	180	172	11	120	260	220	202	11	USGS
7	Red River at Index, Ark.	150	190	170	170	5	180	220	210	204	5	USGS
8	Big Mineral Creek at FM 901 near Sadler, Tex.	76	144	86	98	4	90	135	100	114	4	RRA
9	Choctaw Creek at U.S. Hwy. 69 near Denison, Tex.	64	284	174	174	2	150	319	234	234	2	RRA
10	Choctaw Creek at FM 1753 near Denison, Tex.	28	231	130	130	2	105	270	188	188	2	RRA
11	Bois D'Arc Creek at FM 100 near Honey Grove, Tex.	11	21	16	16	2	44	52	48	48	2	RRA

Table 4. Bacteria densities in the lower Red River (main stem) Basin, Texas, 1997–98

[cols./100 mL, colonies per 100 milliliters; <, less than; USGS, U.S. Geological Survey; RRA, Red River Authority of Texas; --, not sampled; Hwy., Highway; FM, Farm to Market Road]

Sampling site no. (fig. 1)	Site name	Fecal coliform (cols./100 mL)			No. of samples	*Escherichia* coliform (cols./100 mL)			No. of samples	Data source
		Minimum	Maximum	Geometric mean		Minimum	Maximum	Geometric mean		
1	Red River near Terral, Okla.	<1	5,800	74	20	4	4,300	252	5	USGS, RRA
2	Red River near Gainesville, Tex.	2	3,000	96	11	--	--	--	--	RRA
3	Red River at Denison Dam near Denison, Tex.	--	--	--	--	--	--	--	--	--
4	Red River near Bonham, Tex.	16	300	77	7	20	300	60	7	RRA
5	Red River at U.S. Hwy. 271 at Arthur City, Tex.	5	500	55	15	--	--	--	--	RRA
6	Red River near De Kalb, Tex.	42	2,100	155	4	--	--	--	--	USGS
7	Red River at Index, Ark.	6	2,000	43	22	<1	13	5.1	5	USGS, RRA
8	Big Mineral Creek at FM 901 near Sadler, Tex.	<1	956	159	11	43	8,325	270	11	RRA
9	Choctaw Creek at U.S. Hwy. 69 near Denison, Tex.	<1	753	38	8	1	<1,000	204	7	RRA
10	Choctaw Creek at FM 1753 near Denison, Tex.	8	453	52	3	21	622	105	4	RRA
11	Bois D'Arc Creek at FM 100 near Honey Grove, Tex.	3	400	107	11	<1	720	95	11	RRA

The primary constituents responsible for salinity are dissolved chloride and dissolved sulfate ions. The primary source of elevated dissolved chloride and sulfate concentrations are salt springs in the western (headwaters) part of the basin, which can have salinities that exceed those of seawater (Keller and others, 1988). Average dissolved chloride concentrations of as much as 10,600 mg/L and dissolved sulfate concentrations of as much as 2,800 mg/L were measured in samples from the South Wichita River, a major upstream tributary to the Red River, during 1996–97 (Baldys and Phillips, 2000). The median dissolved chloride concentration for discrete samples collected at the Red River near Terral site is 1,000 mg/L (table 3). Dissolved chloride concentrations generally decreased in a downstream direction (fig. 3) to a median concentration of 170 mg/L at Red River near Index, Ark. Median concentrations in the tributaries were highest at both Choctaw Creek sites (174 mg/L at the U.S. Highway 69 site and 130 mg/L at the FM 1753 site); however, only two to four samples were collected at each tributary site during the study period.

Dissolved sulfate concentrations (table 3) also generally decreased in a downstream direction (fig. 3). The median dissolved sulfate concentration at the Red River near Terral site was 840 mg/L (table 3). The median concentration at the outflow site, Red River near Index, was 210 mg/L. Median concentrations in the tributaries for small sets of samples (two to four) ranged from 48 mg/L (Bois D'Arc Creek at FM 100 near Honey Grove, Tex.) to 234 mg/L (Choctaw Creek at U.S. Hwy. 69 near Denison).

Bacteria

Bacteria densities in this reach (table 4) are a major concern for environmental managers because of the potential human health risk. Fecal coliform levels, determined from samples collected, resulted in segments of the reach being placed on the Clean Water Act 303(d) list of impaired or threatened waters (Texas Natural Resource Conservation Commission, 1997). Fecal coliform bacteria levels are an indicator of the degree of pollution and, therefore, the sanitary quality of a sample. The State standard for fecal coliforms is the geometric mean of 200 colonies per 100 milliliters (cols./100 mL) for several samples or 400 cols./100 mL for one sample (Texas Natural Resource Conservation Commission, 1997). *Escherichia* coliform densities also are used to assess the quality of recreational waters. *Escherichia* coliform is a natural inhabitant of the intestinal tract of only warm-blooded animals. The presence of *Escherichia* coliforms in water samples is an indication of fecal pollution and the possible presence of enteric pathogens (U.S. Environmental Protection Agency, 1996). Geometric mean densities of fecal coliforms did not exceed the TCEQ multisample standard at any of the sampling sites; however, the single-sample standard was exceeded at all sites except the Red River near Bonham site. The geometric mean density of *Escherichia* coliforms for five samples collected at the Red River near Terral site was 252 cols./100 mL. Geometric mean densities for the remaining sites exceeded the TCEQ standard at Big Mineral Creek at FM 901 (270 cols./100 mL) and Choctaw Creek at U.S. Hwy. 69 near Denison (204 cols./100 mL).

Dissolved Oxygen

Adequate dissolved oxygen concentrations in surface water are necessary to sustain aquatic organisms and can indicate the general health of the water body. Dissolved oxygen concentrations can be depleted by processes that consume dissolved, suspended, or precipitated organic matter; and excess dissolved oxygen can be produced when biota are actively undergoing photosynthesis (Hem, 1985). The dissolved oxygen standard developed by TCEQ for the Red River is a 24-hour average concentration of 5.0 mg/L with an absolute minimum concentration of 3.0 mg/L (Texas Natural Resource Conservation Commission, 1997). Dissolved oxygen concentrations were measured continuously for 24 hours during July 1997 at two sites on the main stem, Red River at Arthur City and Red River near Index. Dissolved oxygen concentrations for Red River at Arthur City during July 30–31 ranged from 6.70 to 8.38 mg/L. Dissolved oxygen concentrations for Red River near Index during July 28–29 ranged from 6.92 to 8.02 mg/L. Dissolved oxygen concentrations generally are lowest during the hot summer months when the water temperature increases. These two data sets indicate that the dissolved oxygen standard was met.

— Stanley Baldys III[1] *and Danna K. Hamilton*[2]

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Information on technical reports and hydrologic data related to this study can be obtained from:

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Austin, TX 78754–4733
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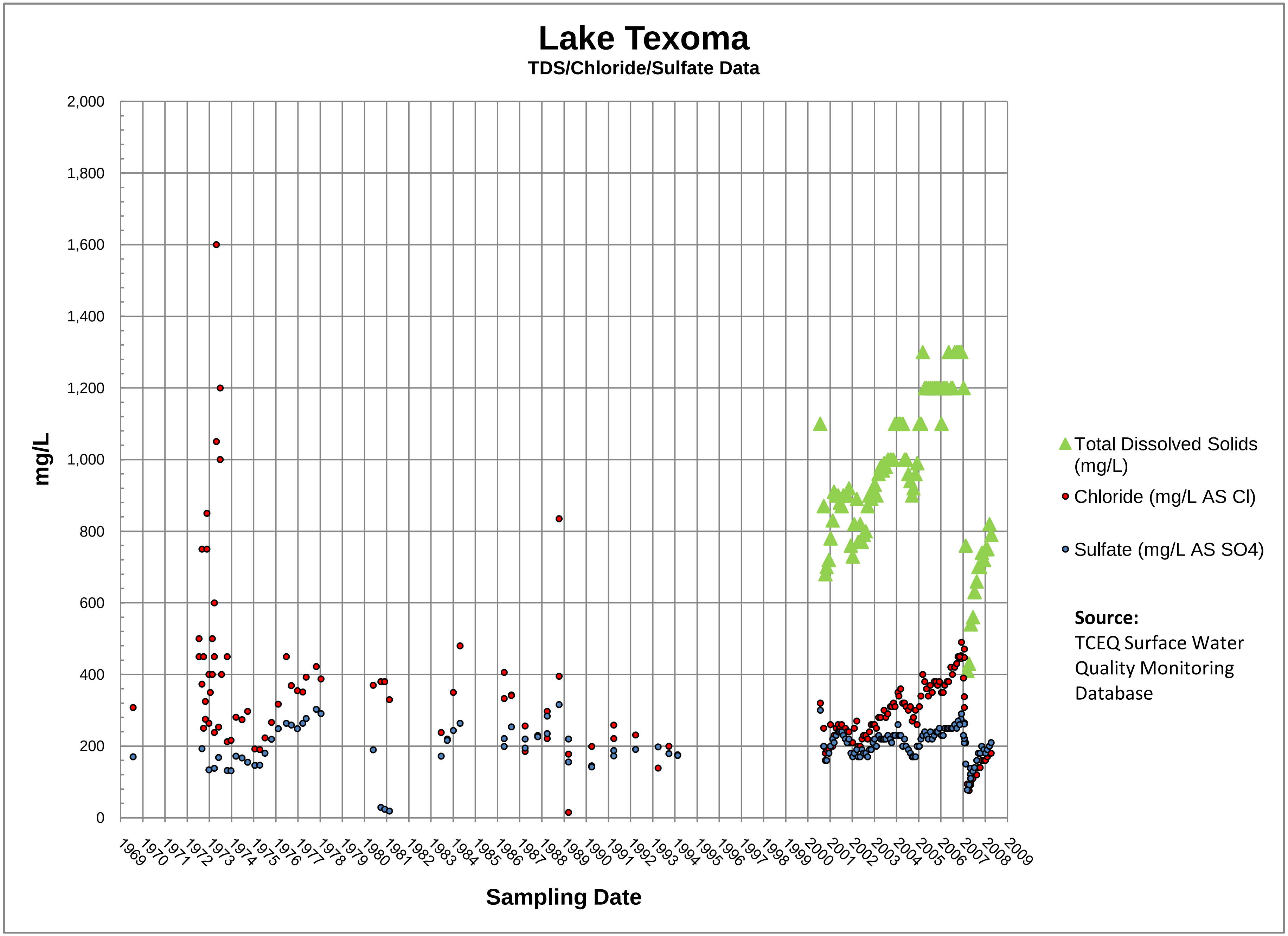
Phone: (512) 927–3500
FAX: (512) 927–3590
World Wide Web:
http://tx.usgs.gov/

[1] U.S. Geological Survey.
[2] Red River Authority of Texas.

Appendix C

TCEQ Surface Water Quality Data – Brazos and Red River Basins



Lake Texoma
TDS/Chloride/Sulfate Data
mg/L
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
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1981
1982
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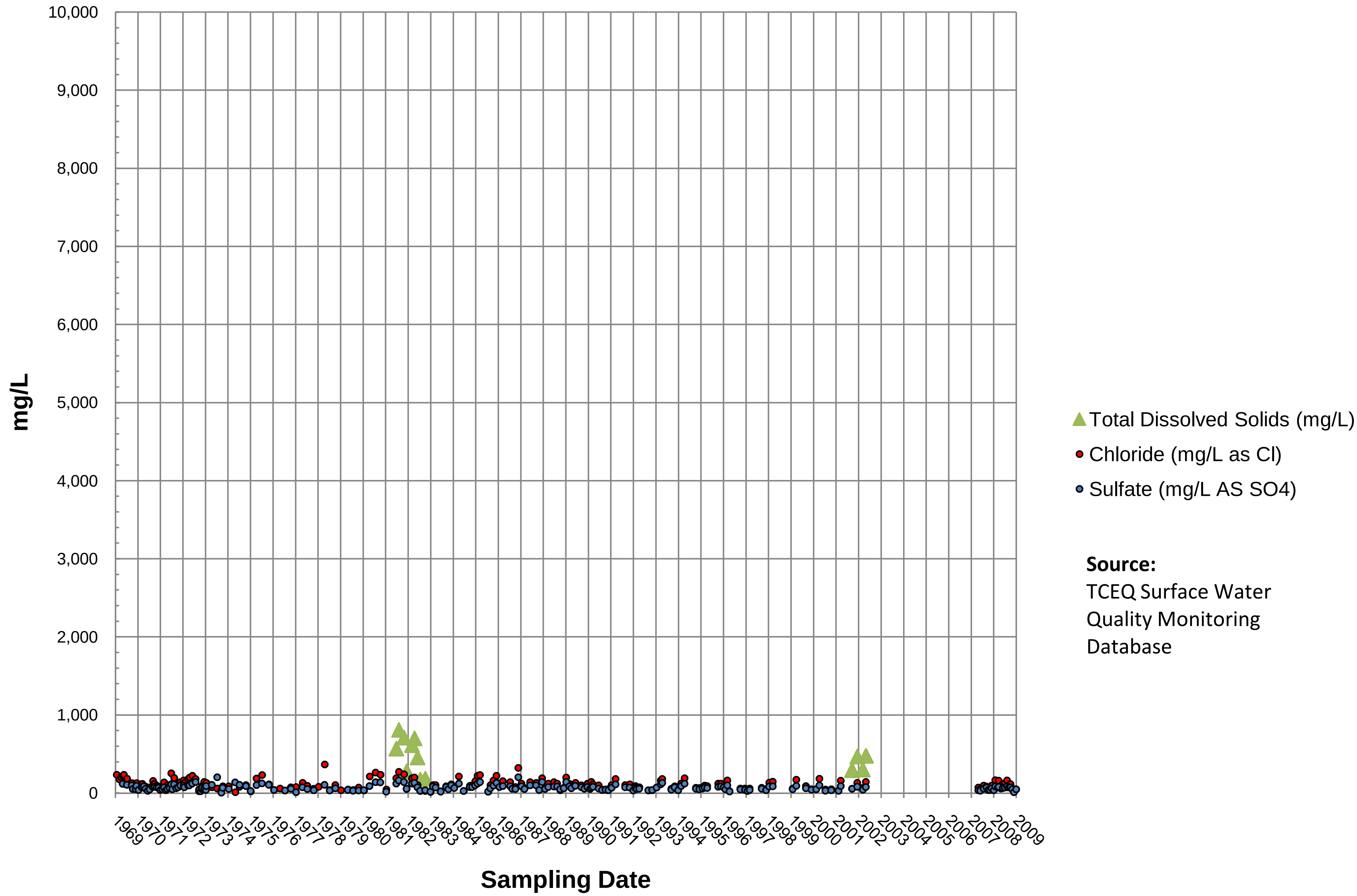
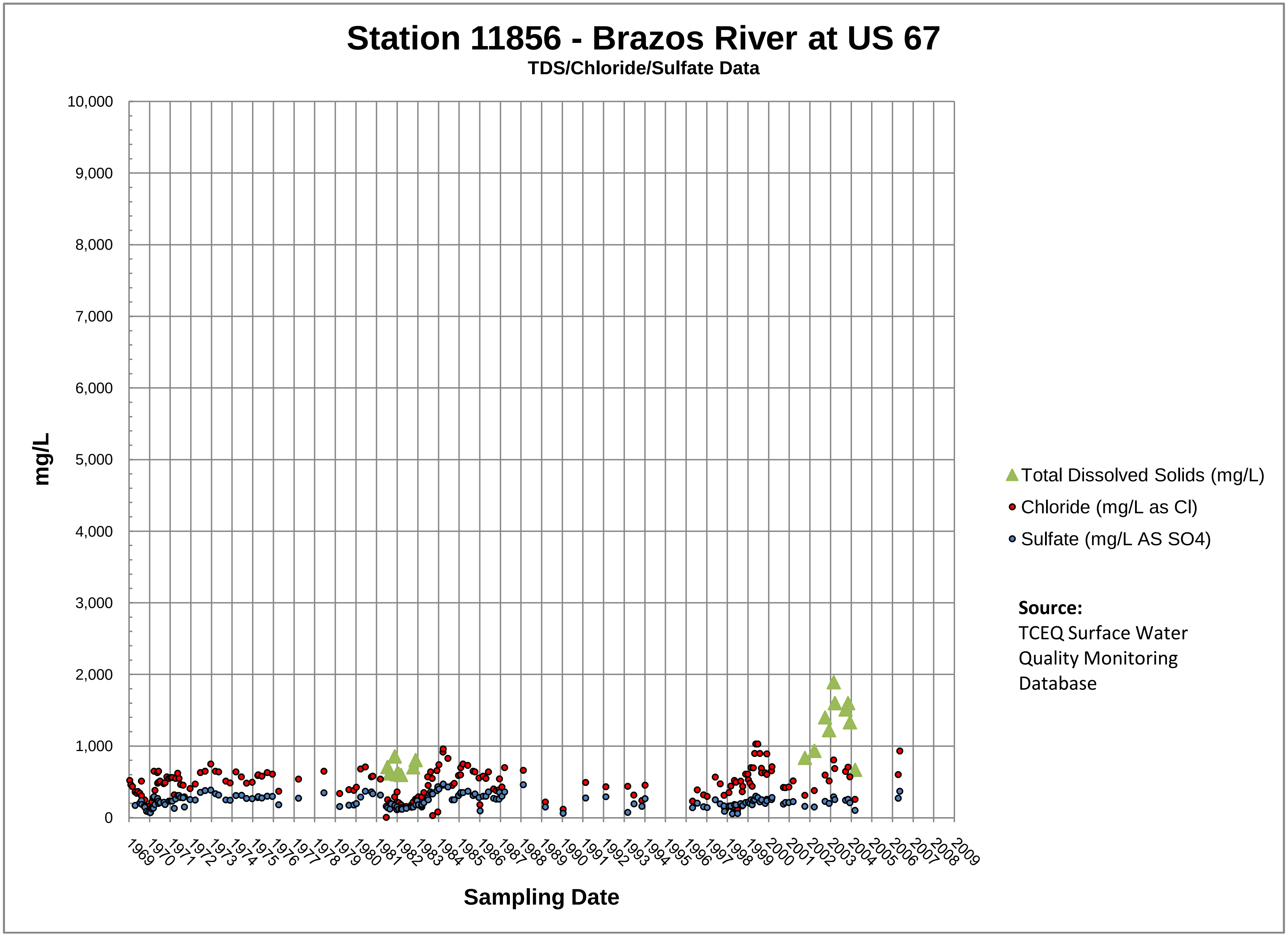
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Sampling Date
Total Dissolved Solids (mg/L)
Chloride (mg/L AS Cl)
Sulfate (mg/L AS SO4)
Source:
TCEQ Surface Water Quality Monitoring Database

Station 11846 - Brazos River at US 90A

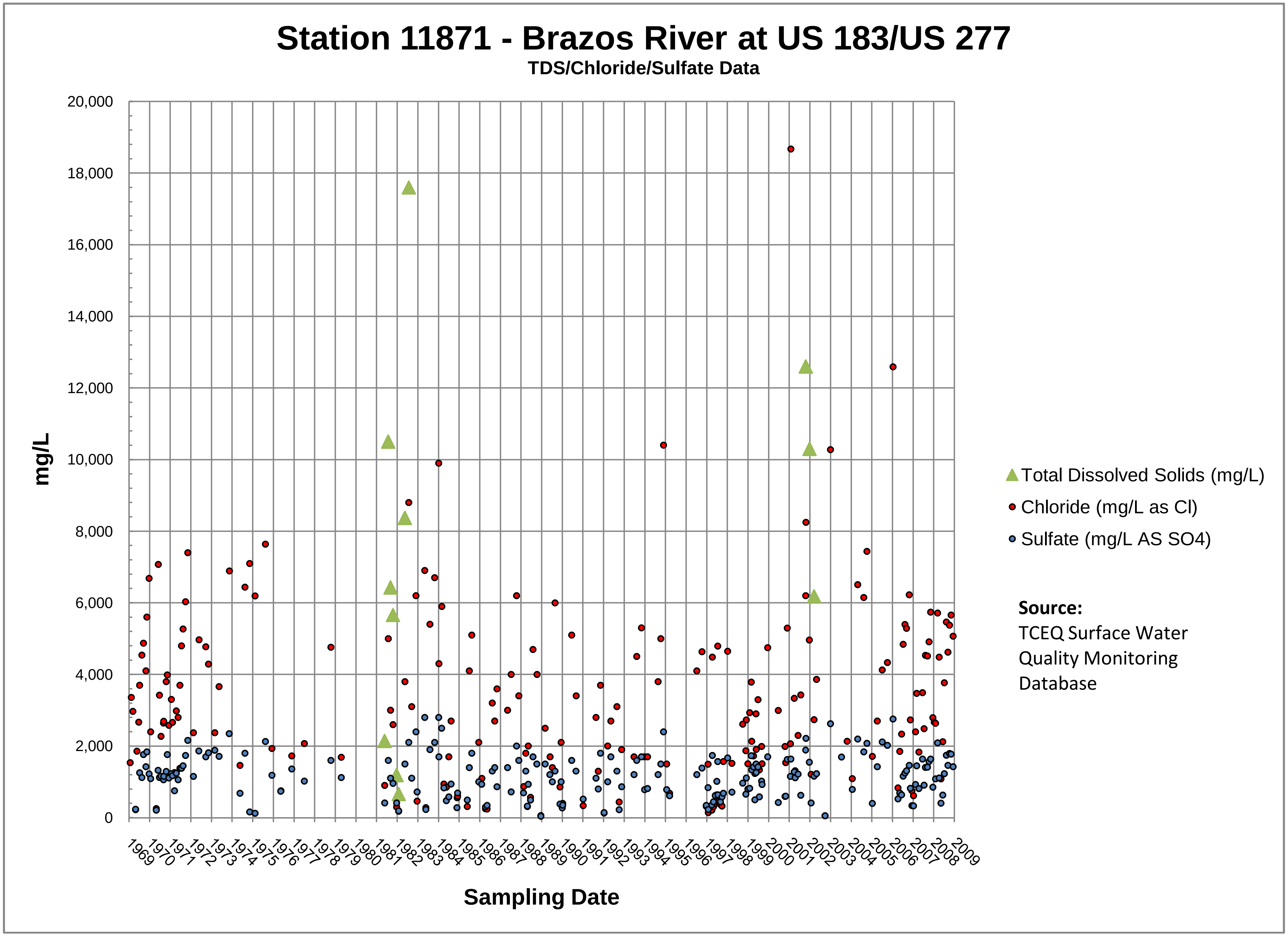
TDS/Chloride/Sulfate Data



Source:
TCEQ Surface Water Quality Monitoring Database



Station 11856 - Brazos River at US 67
TDS/Chloride/Sulfate Data
mg/L
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Sampling Date
Total Dissolved Solids (mg/L)
Chloride (mg/L as Cl)
Sulfate (mg/L AS SO4)
Source:
TCEQ Surface Water Quality Monitoring Database


Station 11871 - Brazos River at US 183/US 277
TDS/Chloride/Sulfate Data
mg/L
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1969
1970
1971
1972
1973
1974
1975
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1977
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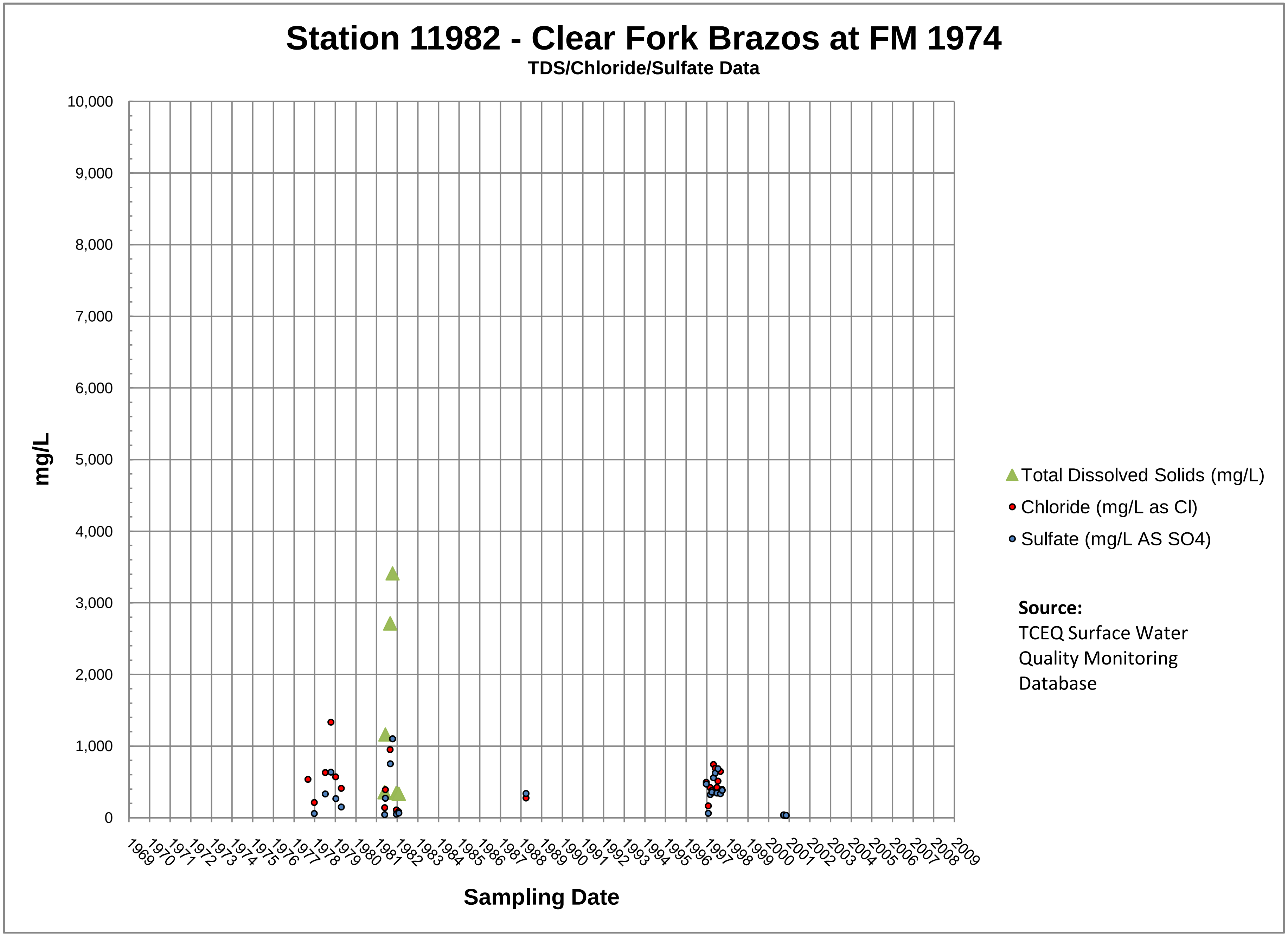
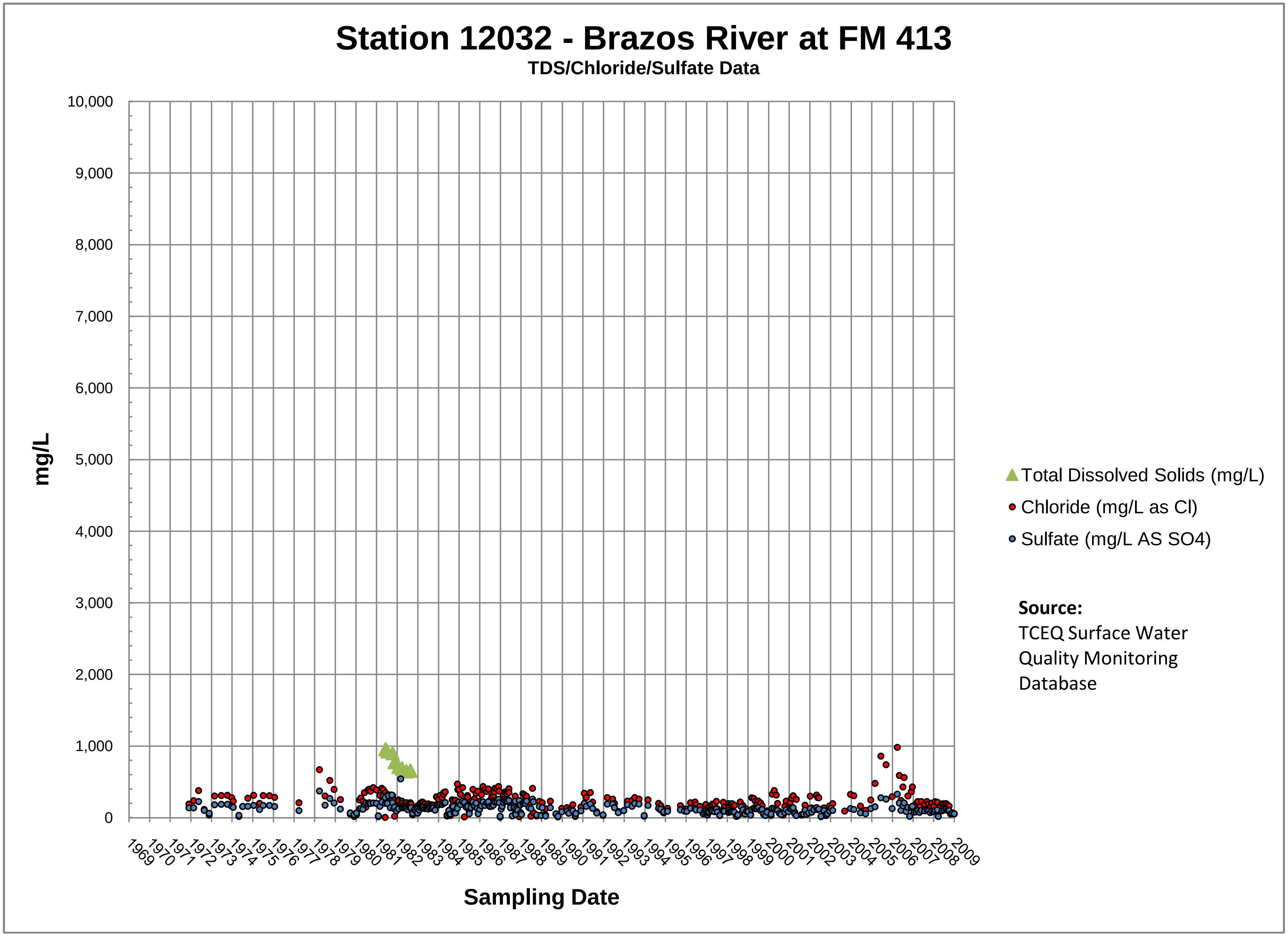
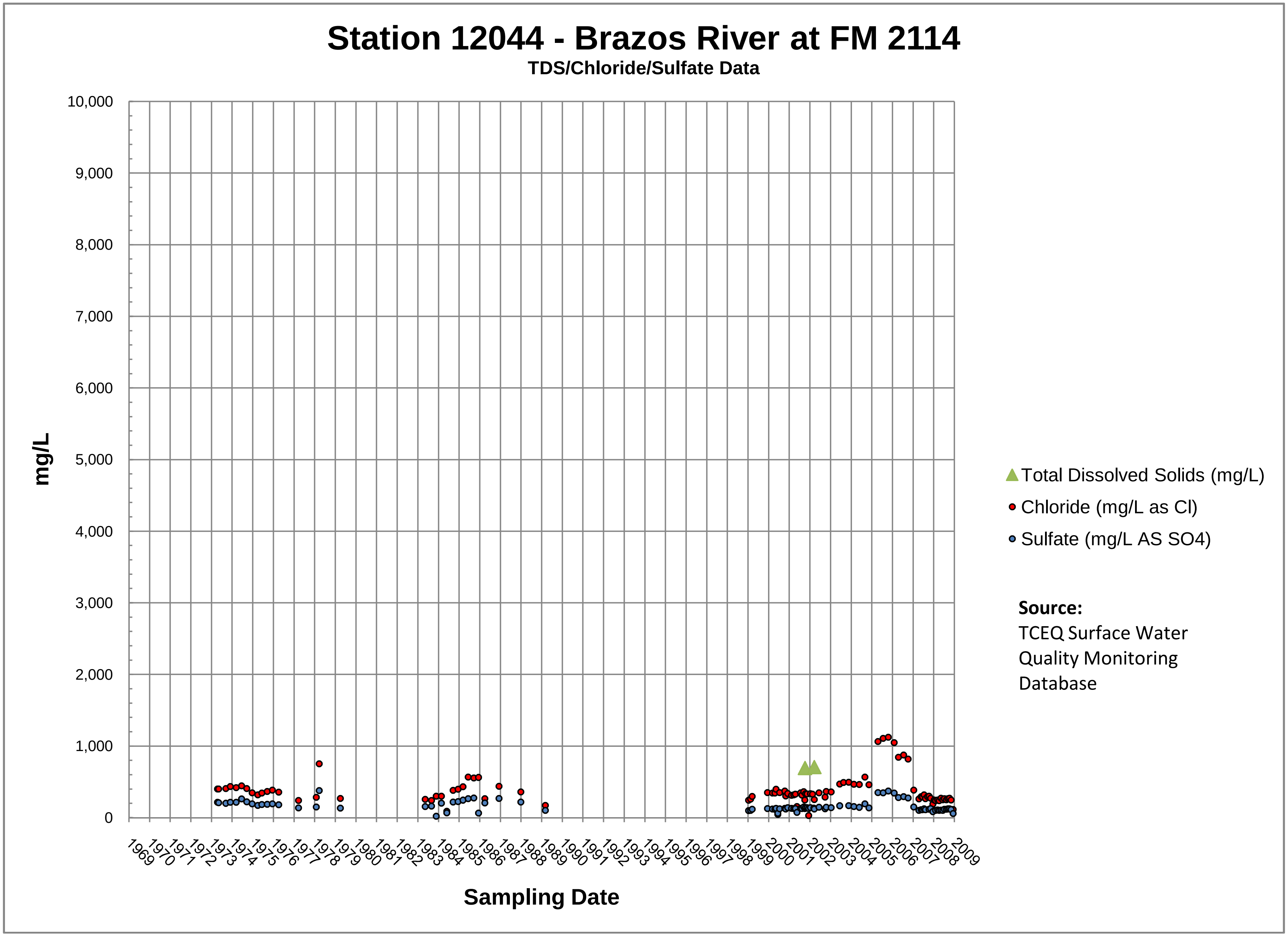
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Sampling Date
Total Dissolved Solids (mg/L)
Chloride (mg/L as Cl)
Sulfate (mg/L AS SO4)
Source:
TCEQ Surface Water Quality Monitoring Database


Station 11982 - Clear Fork Brazos at FM 1974
TDS/Chloride/Sulfate Data
mg/L
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Sampling Date
Total Dissolved Solids (mg/L)
Chloride (mg/L as Cl)
Sulfate (mg/L AS SO4)
Source:
TCEQ Surface Water Quality Monitoring Database



Station 12032 - Brazos River at FM 413
TDS/Chloride/Sulfate Data
mg/L
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Sampling Date
Total Dissolved Solids (mg/L)
Chloride (mg/L as Cl)
Sulfate (mg/L AS SO4)
Source:
TCEQ Surface Water Quality Monitoring Database



Station 12044 - Brazos River at FM 2114
TDS/Chloride/Sulfate Data
mg/L
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
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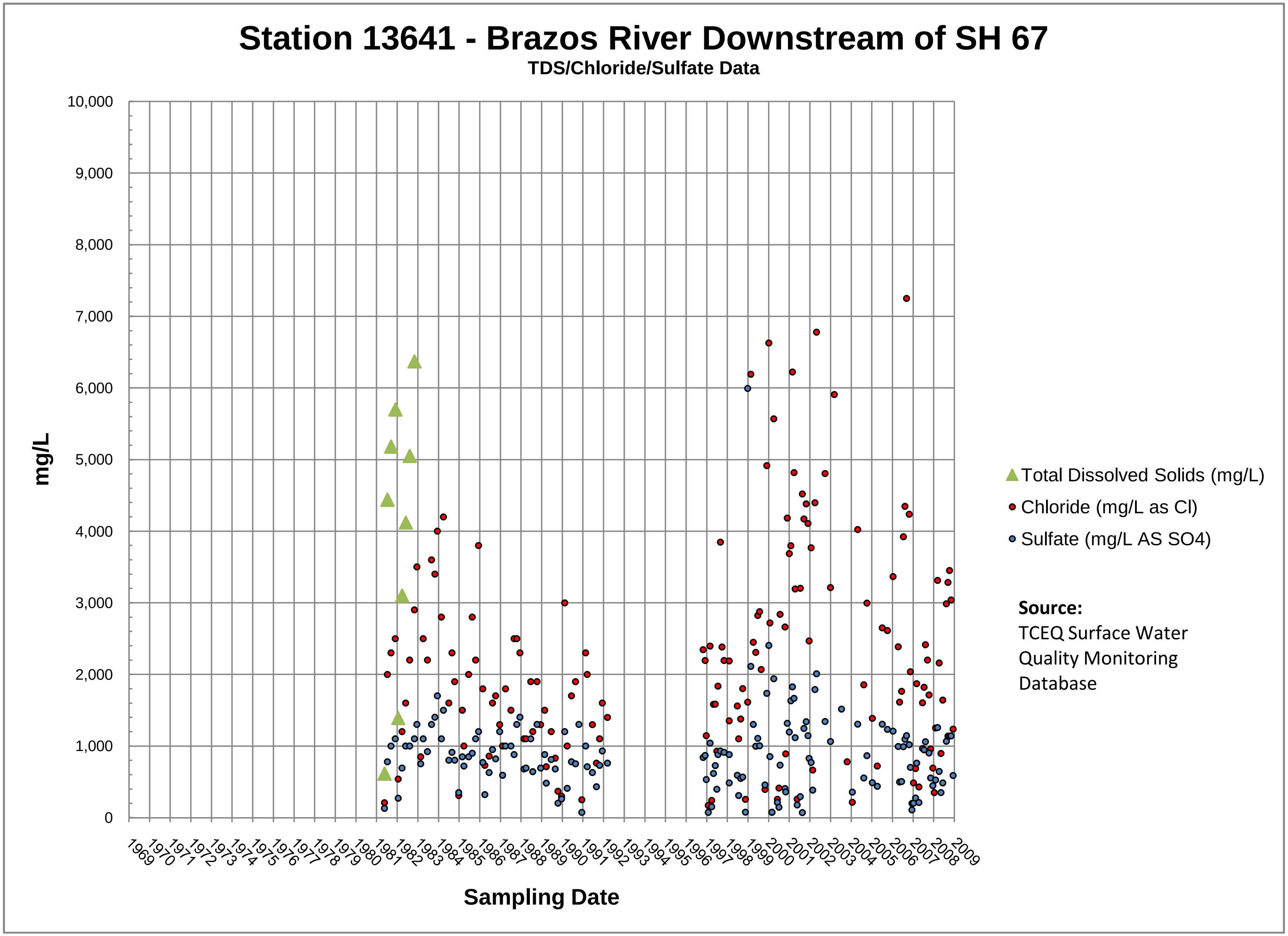
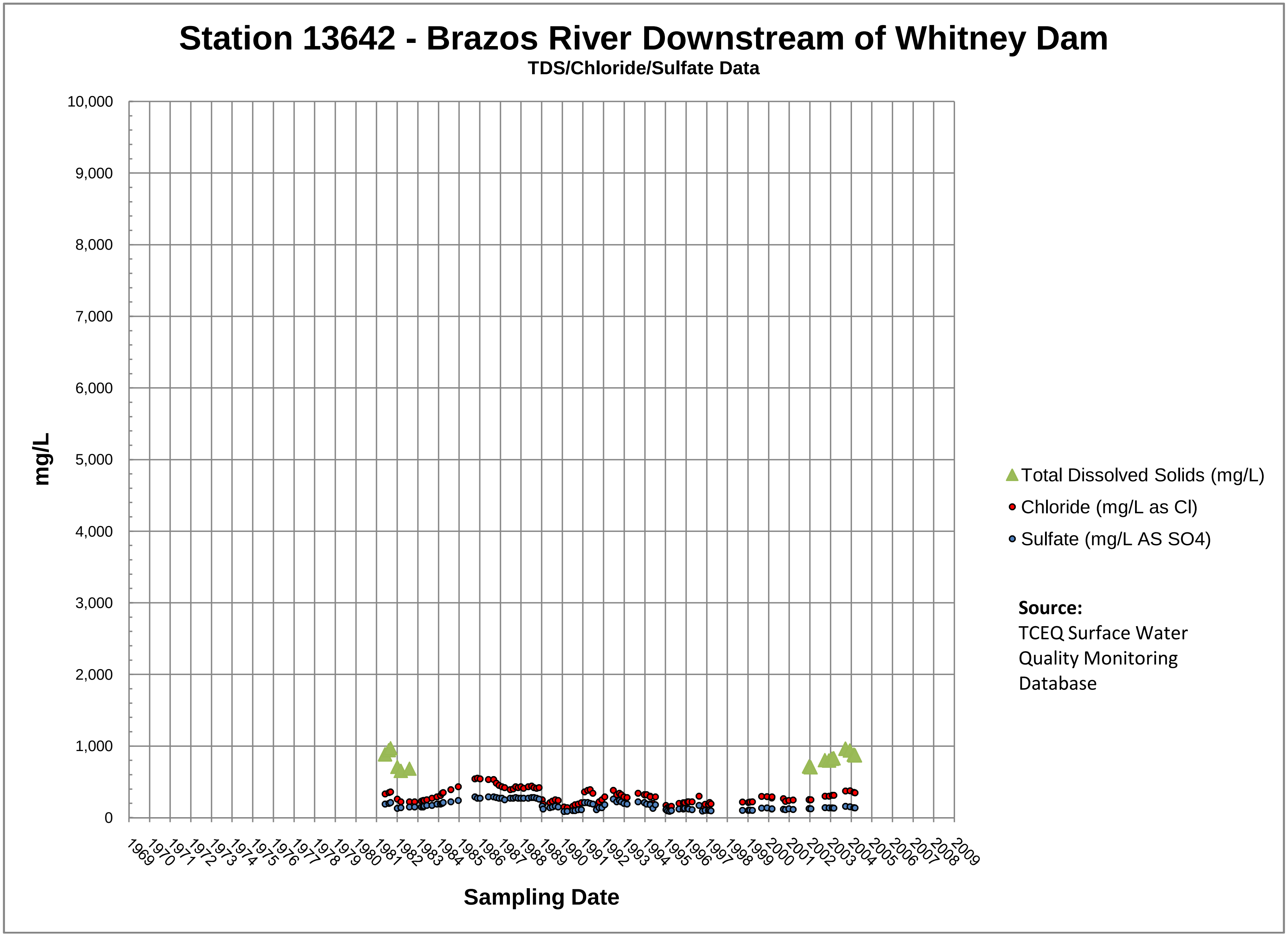
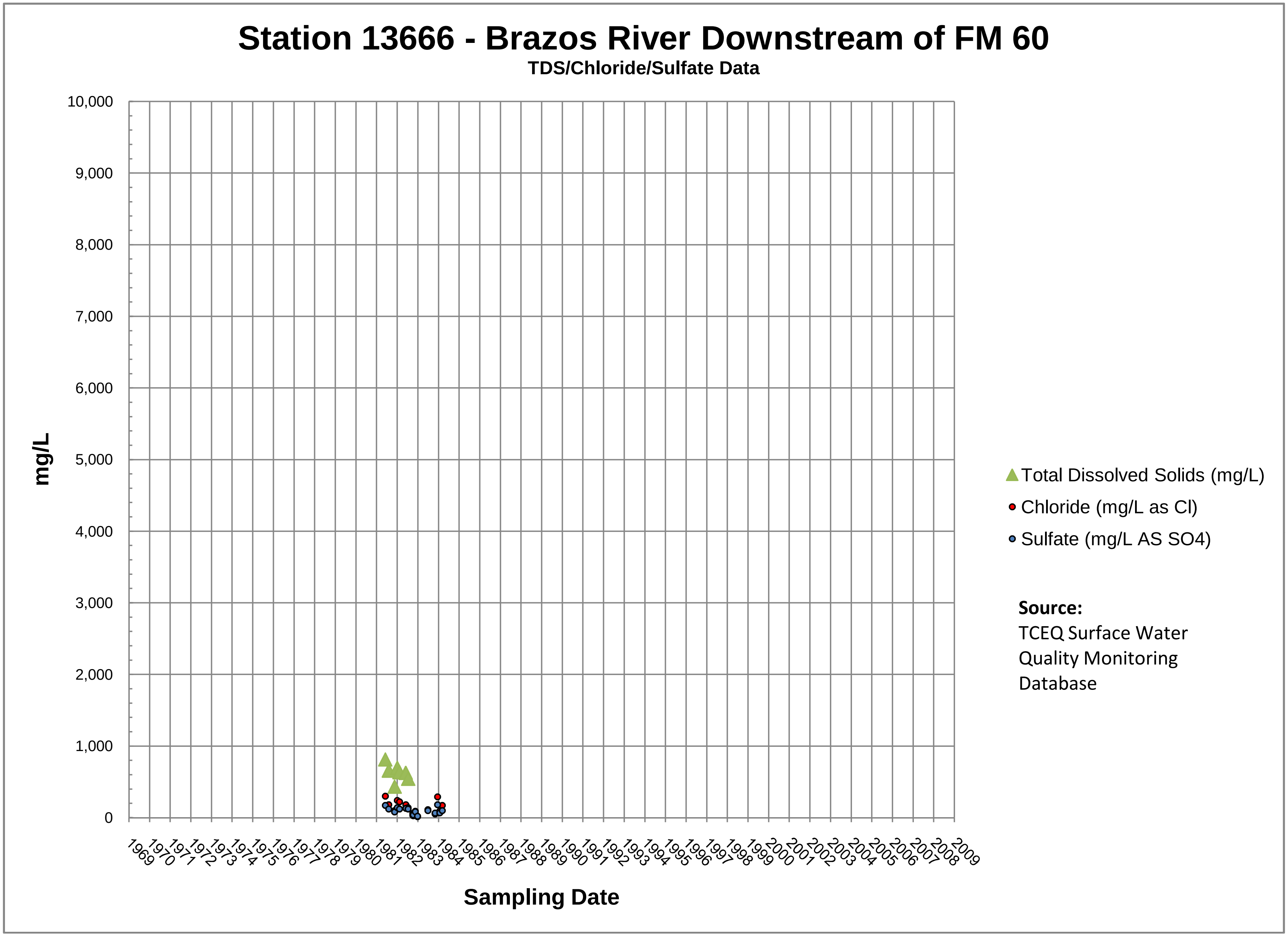
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Sampling Date
Total Dissolved Solids (mg/L)
Chloride (mg/L as Cl)
Sulfate (mg/L AS SO4)
Source:
TCEQ Surface Water Quality Monitoring Database

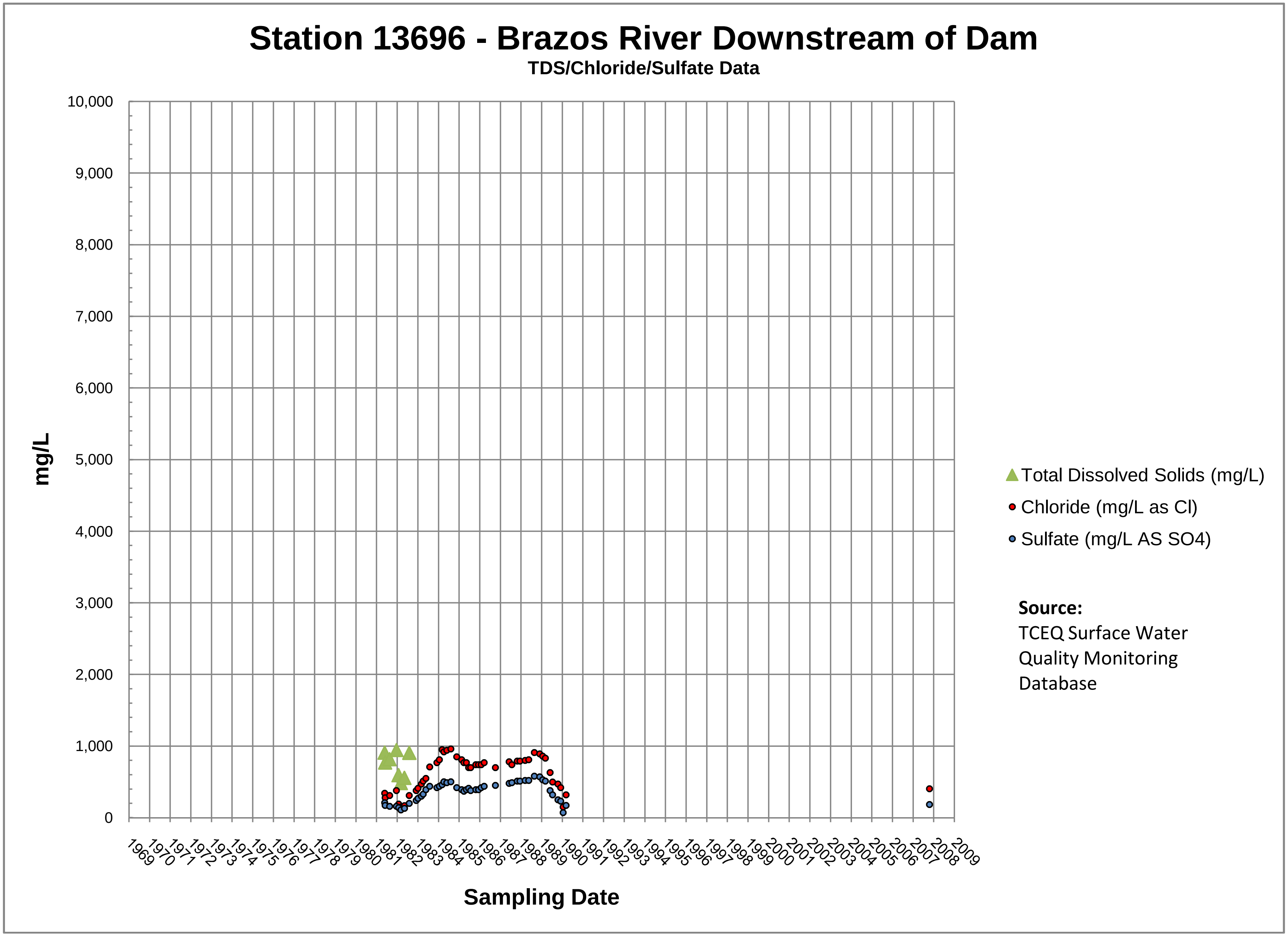

Station 13641 - Brazos River Downstream of SH 67
TDS/Chloride/Sulfate Data
mg/L
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Sampling Date
Total Dissolved Solids (mg/L)
Chloride (mg/L as Cl)
Sulfate (mg/L AS SO4)
Source:
TCEQ Surface Water Quality Monitoring Database



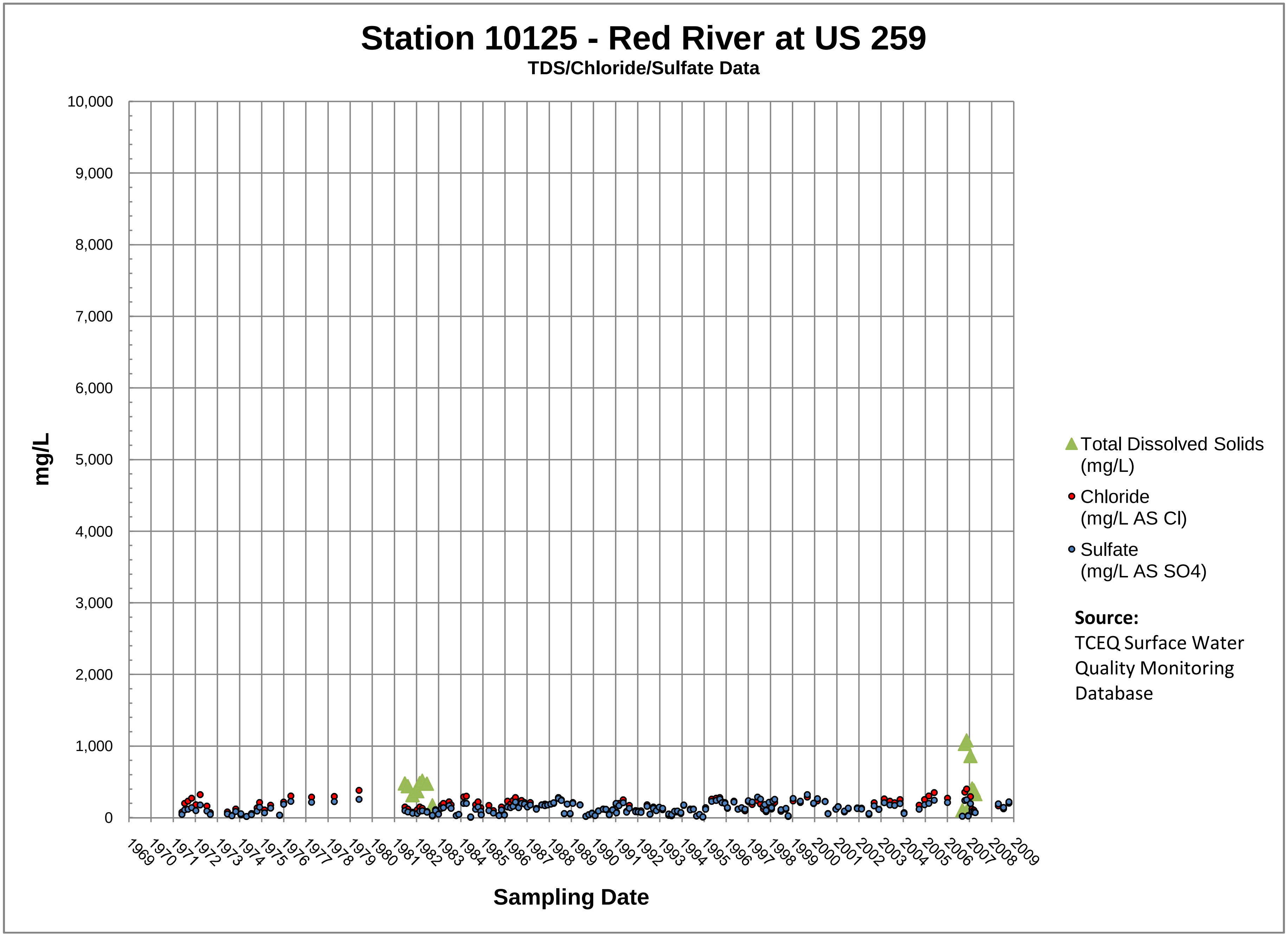
Station 13642 - Brazos River Downstream of Whitney Dam
TDS/Chloride/Sulfate Data
mg/L
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Sampling Date
Total Dissolved Solids (mg/L)
Chloride (mg/L as Cl)
Sulfate (mg/L AS SO4)
Source:
TCEQ Surface Water Quality Monitoring Database



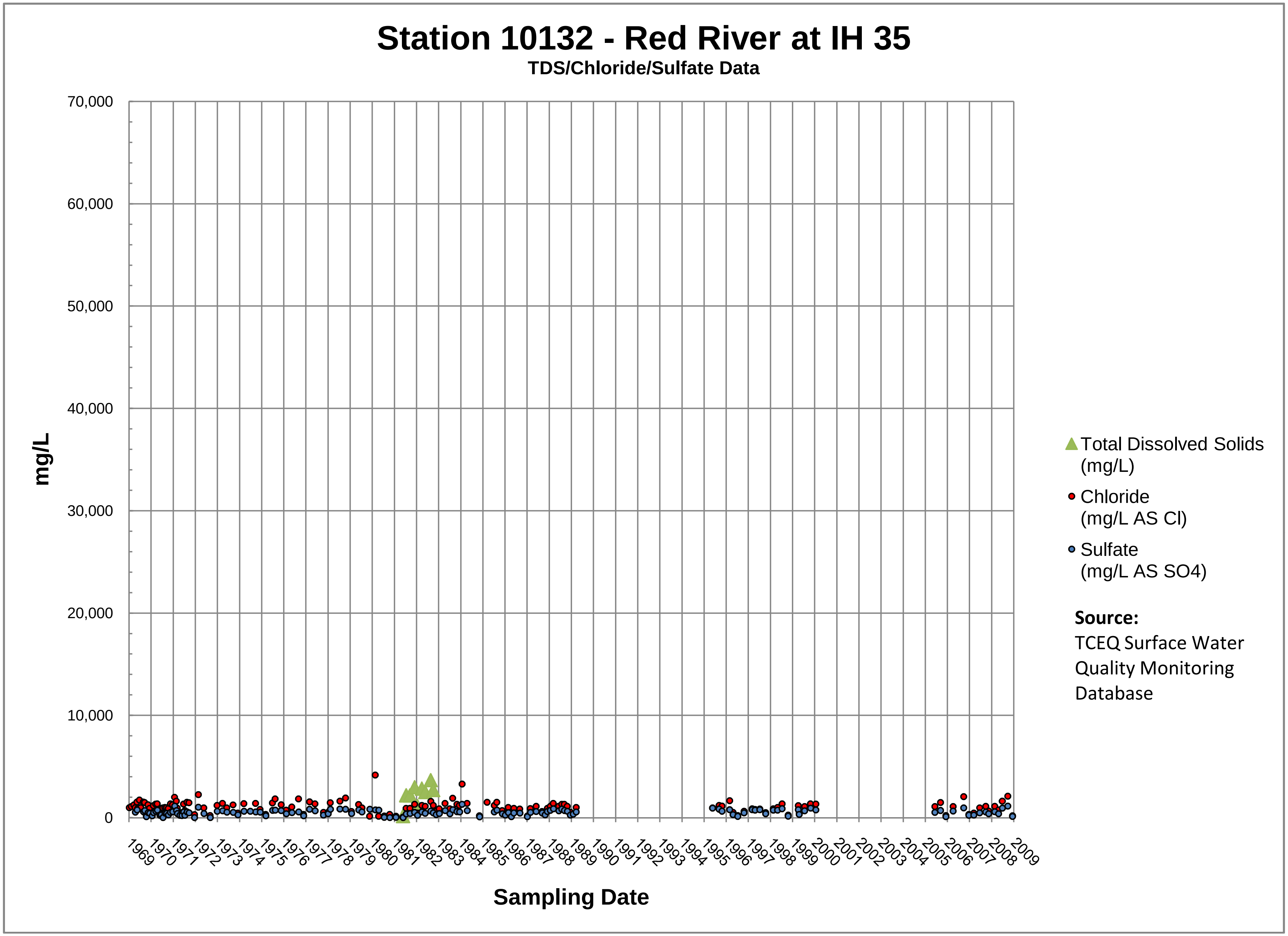
Station 13666 - Brazos River Downstream of FM 60
TDS/Chloride/Sulfate Data
mg/L
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Sampling Date
Total Dissolved Solids (mg/L)
Chloride (mg/L as Cl)
Sulfate (mg/L AS SO4)
Source:
TCEQ Surface Water Quality Monitoring Database



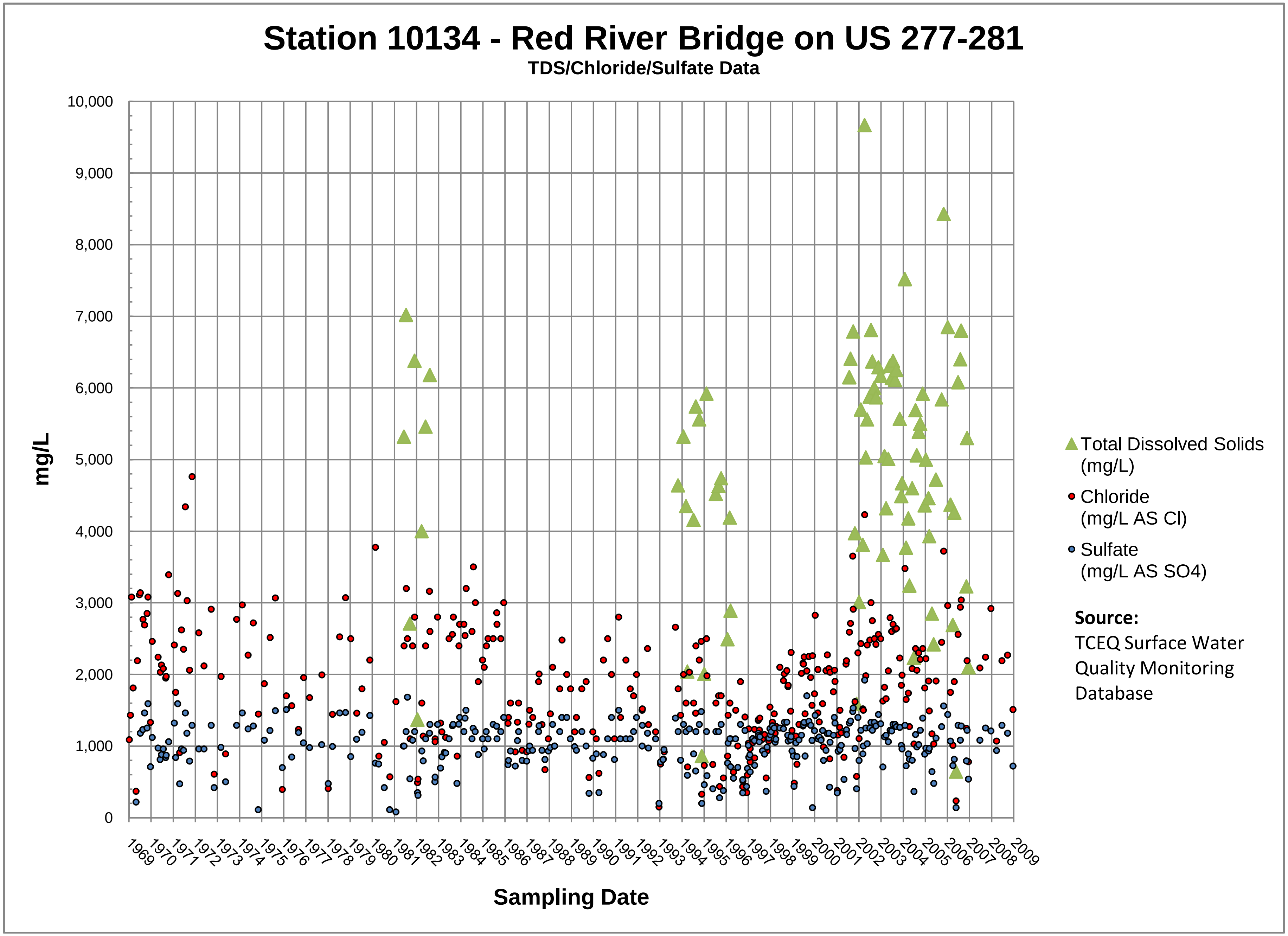
Station 13696 - Brazos River Downstream of Dam
TDS/Chloride/Sulfate Data
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
mg/L
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Sampling Date
Total Dissolved Solids (mg/L)
Chloride (mg/L as Cl)
Sulfate (mg/L AS SO4)
Source:
TCEQ Surface Water
Quality Monitoring
Database



Station 10125 - Red River at US 259
TDS/Chloride/Sulfate Data
mg/L
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Sampling Date
Total Dissolved Solids (mg/L)
Chloride (mg/L AS Cl)
Sulfate (mg/L AS SO4)
Source:
TCEQ Surface Water Quality Monitoring Database



Station 10132 - Red River at IH 35
TDS/Chloride/Sulfate Data
mg/L
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Sampling Date
Total Dissolved Solids (mg/L)
Chloride (mg/L AS Cl)
Sulfate (mg/L AS SO4)
Source:
TCEQ Surface Water Quality Monitoring Database



Station 10134 - Red River Bridge on US 277-281
TDS/Chloride/Sulfate Data
mg/L
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
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1987
1988
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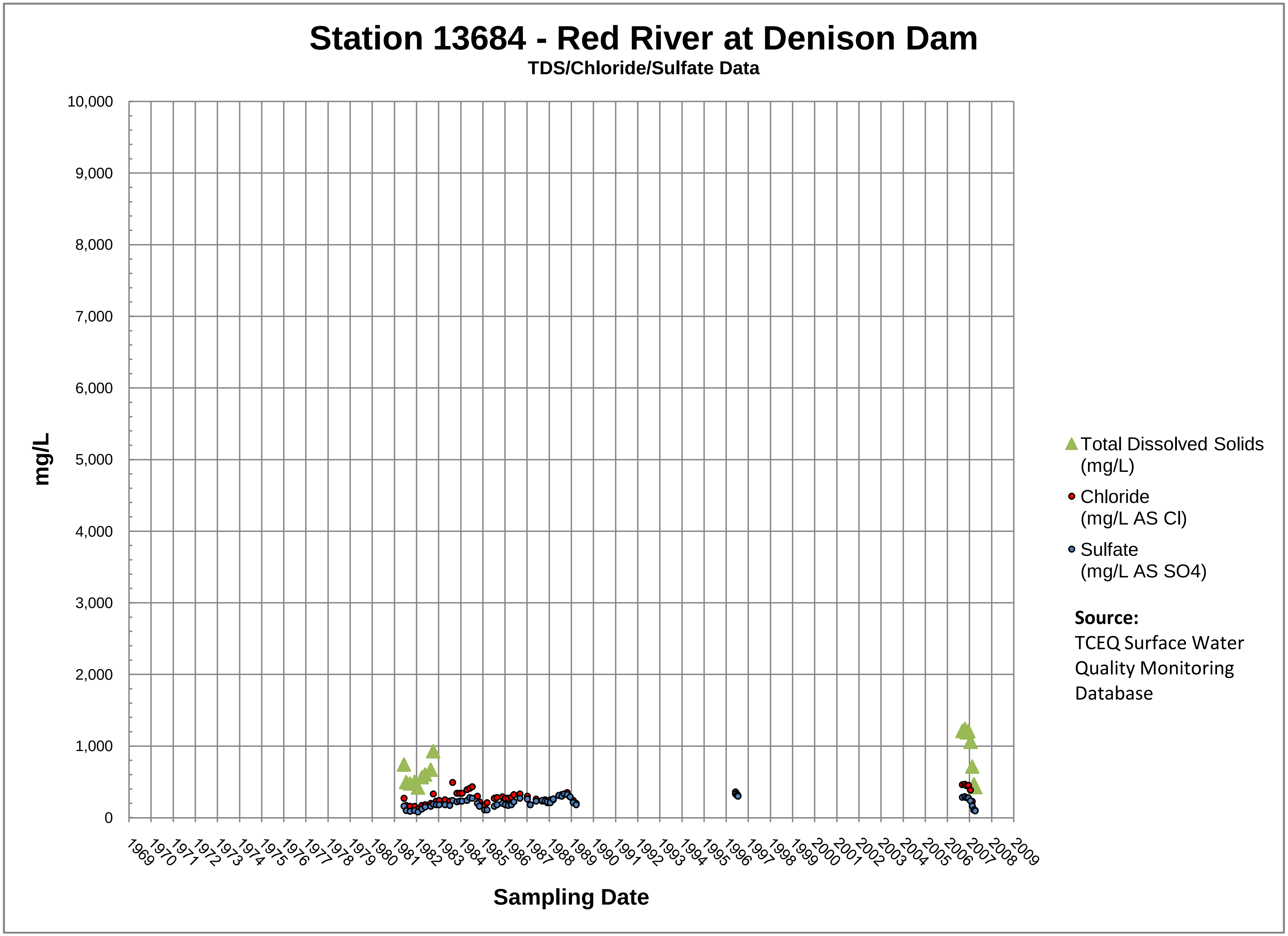
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Sampling Date
Total Dissolved Solids (mg/L)
Chloride (mg/L AS Cl)
Sulfate (mg/L AS SO4)
Source:
TCEQ Surface Water Quality Monitoring Database



Station 13684 - Red River at Denison Dam
TDS/Chloride/Sulfate Data
mg/L
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009
Sampling Date
Total Dissolved Solids (mg/L)
Chloride (mg/L AS Cl)
Sulfate (mg/L AS SO4)
Source:
TCEQ Surface Water Quality Monitoring Database

Appendix D

UNT Lake Texoma Water Quality Data

Table 4.1 Station number, type (R - routine; I - intensive) and location of fixed sampling stations. Zones are identified as Red River Zone (RRZ), Red River Transition Zone (RRTZ), Main Lake Zone (MLZ), Washita River Transition Zone (WRTZ), and Washita River Zone (WRZ).

Station No.	Zone	Station Type	Longitude	Latitude
1	RRZ	R	-96.767	33.825
3	RRZ	I	-96.834	33.874
7	RRTZ	R	-96.806	33.824
8	RRTZ	R	-96.797	33.841
9	RRTZ	I	-96.705	33.871
17	MLZ	I	-96.595	33.821
19	MLZ	R	-96.587	33.892
20	WRTZ	R	-96.583	33.963
22	WRTZ	I	-96.654	34.029
24	WRZ	I	-96.540	34.082
25	WRZ	R	-96.556	33.931

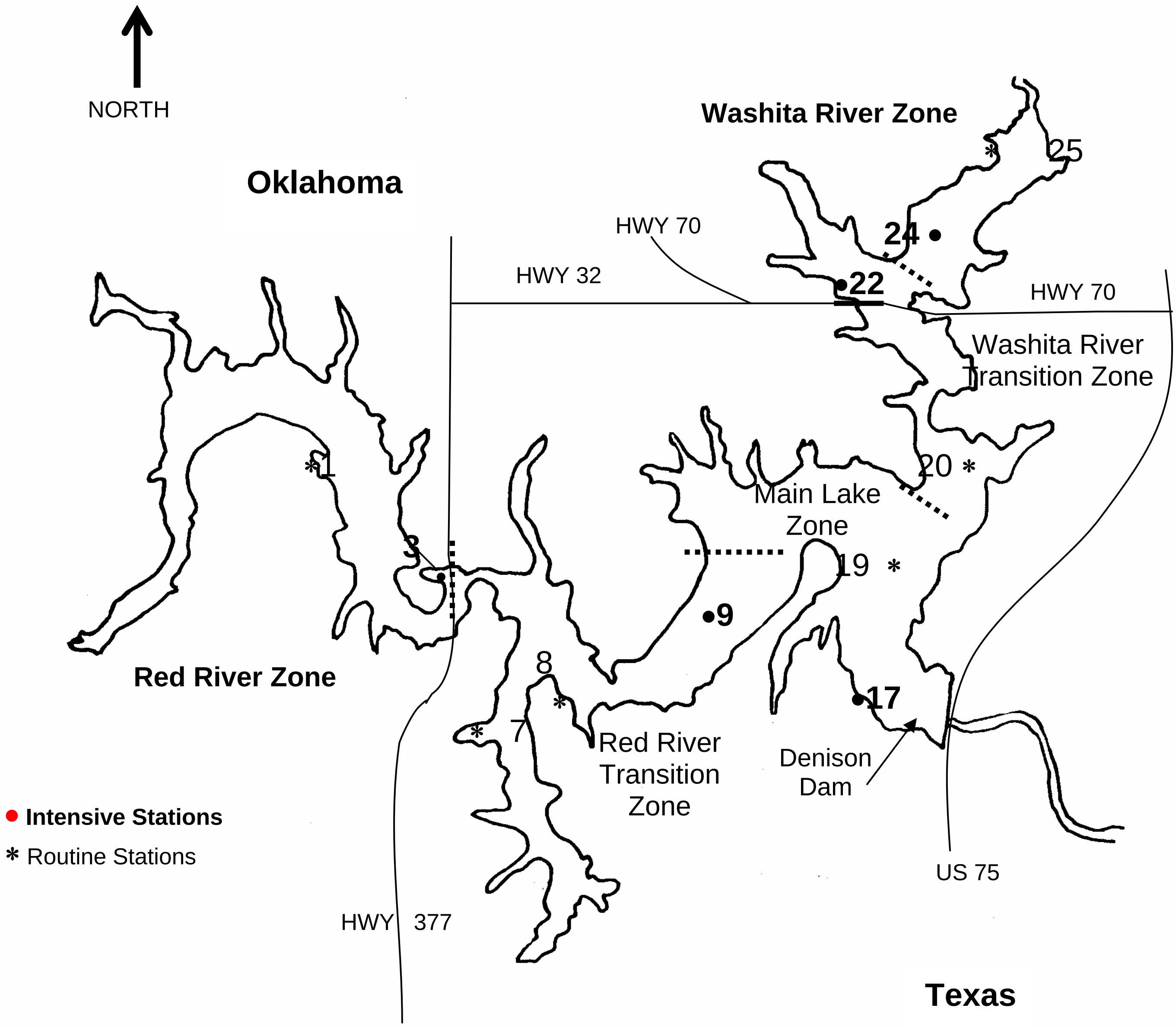


Figure 4.1 Sampling stations and zones within Lake Texoma.
(Note: this is a temporary map. A final map with random locations is pending.)

Table 5.1. Thirteen month summary of chloride (mg/L), sulfate (mg/L), nitrate (mg/L), total phosphorous (mg/L), total nitrogen (mg/L), turbidity* (NTU), total suspended solids (mg/L), ortho phosphorous (mg/L), and Chlorophyll a (µg/L) for Lake Texoma at all stations, all depths, and all sampling dates.

Parameter	Min	Max	Median	Mean	SD	N
Chloride	24.1	791.0	290.0	303.4	144.79	1509
Sulfate	163.0	570.0	348.0	350.8	75.32	1509
Nitrate	0.0	1.31	0.26	0.25	0.211	1500
Total Phosphorous	0.01	0.47	0.05	0.06	0.048	1509
Total Nitrogen	0.0	2.41	0.56	0.60	0.221	1269
Turbidity*	1.6	79.5	5.8	9.1	9.57	1108
Total Suspended Solids	0.0	427	7.6	13.4	28.25	1508
Ortho Phosphorous	0.0	0.26	0.02	0.02	0.034	1509
Chloropyll a*	2.1	71.3	15.2	17.6	12.36	1114

* Samples were taken only at a depth of 1 meter below the surface.

Table 5.2. Thirteen month summary of chloride (mg/L) for the Red River Zone (RRZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	236.0	723.0	437.0	451.5	112.31	246
Top	237.0	708.0	409.0	420.8	100.58	117
M1	347.0	507.0	433.0	429.2	83.25	6
M2	450.0	537.0	493.5	496.0	36.86	6
Bottom	236.0	723.0	466.0	481.1	119.2	117

Table 5.3. Thirteen month summary of chloride (mg/L) for the Red River Transition Zone (RRTZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	195.0	791.0	381.0	390.1	97.98	369
Top	195.0	545.0	349.5	348.7	69.69	156
M1	290.0	604.0	414.0	427.1	85.15	27
M2	329.0	791.0	429.0	473.6	135.89	30
Bottom	235.0	791.0	397.5	409.4	97.71	156

Table 5.4. Thirteen month summary of chloride (mg/L) for the Main Lake Body (MLB) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	147.0	528.0	281.0	309.7	83.16	366
Top	147.0	465.0	266.0	288.9	71.26	156
M1	220.0	479.0	281.1	331.9	91.94	48
M2	234.0	522.0	286.0	353.9	111.42	45
Bottom	208.0	528.0	228.0	331.5	72.75	117

Table 5.5. Thirteen month summary of chloride (mg/L) for the Washita River Transition Zone (WRTZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	58.6	424.4	224.0	223.2	87.81	285
Top	58.6	409.0	198.0	195.1	92.76	117
M1	85.3	339.0	219.0	222.0	62.63	27
M2	178.0	400.0	226.5	255.5	69.96	24
Bottom	83.0	424.0	239.0	244.9	83.26	117

Table 5.6. Thirteen month summary of chloride (mg/L) for the Washita River Zone (WRZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	24.1	264.0	81.3	106.2	57.81	243
Top	24.1	196.0	76.2	89.2	48.62	114
M1	52.8	256.0	140.5	145.6	101.03	6
M2	99.7	264.0	180.0	180.2	69.83	9
Bottom	30.2	264.0	99.8	115.3	55.71	114

Table 5.7. Thirteen month summary of sulfate (mg/L) for the Red River Zone (RRZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	199.0	570.0	395.0	401.6	83.24	246
Top	199.0	517.0	386.0	383.5	81.40	117
M1	289.0	457.0	375.4	373.8	89.67	6
M2	324.0	470.0	399.5	395.5	76.55	6
Bottom	205.0	570.0	410.0	421.1	81.57	117

Table 5.8. Thirteen month summary of sulfate (mg/L) for the Red River Transition Zone (RRTZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	170.0	567.0	370.0	371.5	73.01	369
Top	170.0	473.0	346.0	340.64	66.97	156
M1	360.0	481.0	434.0	421.8	38.29	27
M2	376.0	567.0	441.5	442.8	55.56	30
Bottom	197.0	567.0	374.0	379.9	69.94	156

Table 5.9. Thirteen month summary of sulfate (mg/L) for the Main Lake Body (MLB) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	259.0	452.0	345.0	347.7	47.98	366
Top	259.0	428.0	325.5	335.2	48.83	156
M1	330.0	444.0	372.5	378.5	32.02	48
M2	329.0	449.0	374.0	381.49	37.20	45
Bottom	260.0	452.0	326.0	339.0	44.68	117

Table 5.10. Thirteen month summary of sulfate (mg/L) for the Washita River Transition Zone (WRTZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	206.0	438.0	312.0	322.3	52.43	285
Top	206.0	438.0	294.0	313.9	58.84	117
M1	278.0	397.0	330.0	339.5	35.26	27
M2	246.0	375.0	328.0	328.9	34.14	24
Bottom	206.0	437.0	313.0	325.4	50.99	117

Table 5.11. Thirteen month summary of sulfate (mg/L) for the Washita River Zone (WRZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	163.0	519.0	284.0	305.9	85.29	243
Top	163.0	507.0	278.5	299.1	90.98	114
M1	288.0	321.0	301.0	302.8	16.40	6
M2	300.0	408.0	341.0	350.7	46.50	9
Bottom	175.0	519.0	282.0	309.5	83.15	114

Table 5.12. Thirteen month summary of nitrate (mg/L) for the Red River Zone (RRZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	0.0	1.31	0.32	0.32	0.250	243
Top	0.0	0.83	0.31	0.32	0.235	117
M1	0.0	0.0	0.0	0.0	0.0	3
M2	0.0	0.44	0.21	0.21	0.223	6
Bottom	0.0	1.31	0.34	0.36	0.261	117

Table 5.13. Thirteen month summary of nitrate (mg/L) for the Red River Transition Zone (RRTZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	0.0	0.66	0.16	0.19	0.174	369
Top	0.0	0.56	0.13	0.18	0.168	156
M1	0.0	0.33	0.07	0.10	0.115	27
M2	0.00	0.58	0.14	0.17	0.167	30
Bottom	0.0	0.66	0.25	0.22	0.184	156

Table 5.14. Thirteen month summary of nitrate (mg/L) for the Main Lake Body (MLB) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	0.0	0.68	0.17	0.20	0.171	366
Top	0.0	0.55	0.22	0.19	0.157	156
M1	0.0	0.59	0.09	0.13	0.146	48
M2	0.02	0.59	0.10	0.17	0.157	45
Bottom	0.0	0.68	0.28	0.24	0.193	117

Table 5.15. Thirteen month summary of nitrate (mg/L) for the Washita River Transition Zone (WRTZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	0.0	0.65	0.28	0.23	0.197	285
Top	0.0	0.53	0.12	0.19	0.186	117
M1	0.02	0.63	0.10	0.23	0.218	27
M2	0.09	0.65	0.19	0.30	0.210	24
Bottom	0.0	0.60	0.31	0.26	0.193	117

Table 5.19. Summer (June – September) summary of nitrate (mg/L) across all depths and sampling dates for the Red River Zone (RRZ), Red River Transition Zone (RRTZ), Main Lake Body (MLB), Washita River Transition Zone (WRTZ), and Washita River Zone (WRT).

Zone	Min	Max	Median	Mean	SD	N
RRZ	0.0	0.57	0.12	0.16	0.151	96
RRTZ	0.0	0.66	0.04	0.10	0.149	177
MLB	0.0	0.68	0.07	0.15	0.184	174
WRTZ	0.0	0.65	0.06	0.16	0.203	135
WRZ	0.0	1.13	0.19	0.26	0.248	99

Table 5.20. Fall (September – December) summary of nitrate (mg/L) across all depths and sampling dates for the Red River Zone (RRZ), Red River Transition Zone (RRTZ), Main Lake Body (MLB), Washita River Transition Zone (WRTZ), and Washita River Zone (WRT).

Zone	Min	Max	Median	Mean	SD	N
RRZ	0.0	1.31	0.30	0.35	0.329	57
RRTZ	0.0	0.29	0.04	0.11	0.117	72
MLB	0.0	0.30	0.10	0.12	0.105	87
WRTZ	0.0	0.42	0.07	0.13	0.138	60
WRZ	0.0	0.43	0.30	0.24	0.179	48

Table 5.21. Ten month summary of total nitrogen (mg/L) for the Red River Zone (RRZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	0.33	1.38	0.72	0.72	0.163	210
Top	0.39	1.38	0.68	0.70	0.149	99
M1	0.42	0.74	0.64	0.60	0.135	6
M2	0.72	0.99	0.94	0.90	0.103	6
Bottom	0.33	1.16	0.72	0.73	0.171	99

Table 5.22. Ten month summary of total nitrogen (mg/L) for the Red River Transition Zone (RRTZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	0.15	1.60	0.58	0.63	0.225	312
Top	0.15	1.25	0.58	0.60	0.166	132
M1	0.41	0.75	0.53	0.54	0.101	21
M2	0.33	1.51	0.54	0.67	0.341	27
Bottom	0.34	1.60	0.62	0.67	0.251	132

Table 5.23. Ten month summary of total nitrogen (mg/L) for the Main Lake Body (MLB) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	0.0	2.41	0.50	0.55	0.256	303
Top	0.0	1.02	0.50	0.50	0.153	132
M1	0.21	0.64	0.42	0.44	0.102	36
M2	0.21	1.05	0.46	0.53	0.188	36
Bottom	0.25	2.41	0.54	0.67	0.364	99

Table 5.24. Ten month summary of total nitrogen (mg/L) for the Washita River Transition Zone (WRTZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	0.31	1.36	0.50	0.50	0.170	240
Top	0.31	1.05	0.55	0.56	0.162	99
M1	0.34	0.68	0.45	0.47	0.106	21
M2	0.36	0.70	0.53	0.52	0.077	21
Bottom	0.32	1.36	0.46	0.52	0.202	99

Table 5.25. Ten month summary of total nitrogen (mg/L) for the Washita River Zone (WRZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	0.0	1.53	0.53	0.56	0.198	204
Top	0.28	1.27	0.59	0.58	0.178	96
M1	0.44	0.57	0.48	0.49	0.044	6
M2	0.46	0.63	0.50	0.52	0.063	6
Bottom	0.0	1.53	0.51	0.54	0.225	96

Table 5.26. Thirteen month summary of total phosphorous (mg/L) for the Red River Zone (RRZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	0.02	0.17	0.07	0.07	0.026	246
Top	0.02	0.17	0.06	0.06	0.025	117
M1	0.04	0.07	0.06	0.05	0.012	6
M2	0.06	0.14	0.10	0.10	0.027	6
Bottom	0.04	0.17	0.08	0.08	0.025	117

Table 5.27. Thirteen month summary of total phosphorous (mg/L) for the Red River Transition Zone (RRTZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	0.01	0.36	0.05	0.06	0.048	369
Top	0.01	0.11	0.04	0.05	0.021	156
M1	0.03	0.12	0.05	0.05	0.026	27
M2	0.03	0.26	0.07	0.09	0.061	30
Bottom	0.01	0.36	0.06	0.08	0.062	156

Table 5.28. Thirteen month summary of total phosphorous (mg/L) for the Main Lake Body (MLB) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	0.01	0.47	0.04	0.06	0.066	366
Top	0.01	0.17	0.04	0.04	0.027	156
M1	0.01	0.06	0.03	0.03	0.012	48
M2	0.01	0.13	0.04	0.05	0.035	45
Bottom	0.01	0.47	0.06	0.11	0.095	117

Table 5.29. Thirteen month summary of total phosphorous (mg/L) for the Washita River Transition Zone (WRTZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	0.01	0.25	0.04	0.05	0.034	285
Top	0.01	0.12	0.04	0.04	0.024	117
M1	0.01	0.08	0.04	0.04	0.016	27
M2	0.02	0.12	0.05	0.05	0.024	24
Bottom	0.01	0.25	0.04	0.06	0.044	117

Table 5.30. Thirteen month summary of total phosphorous (mg/L) for the Washita River Zone (WRZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	0.02	0.34	0.07	0.07	0.044	243
Top	0.02	0.23	0.07	0.07	0.031	114
M1	0.05	0.08	0.07	0.06	0.012	6
M2	0.06	0.12	0.06	0.07	0.021	9
Bottom	0.02	0.34	0.06	0.08	0.055	114

Table 5.31. Thirteen month summary of ortho phosphorous (mg/L) for the Red River Zone (RRZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	0.0	0.09	0.02	0.02	0.017	246
Top	0.0	0.05	0.02	0.02	0.013	117
M1	0.01	0.02	0.02	0.02	0.005	6
M2	0.03	0.09	0.06	0.06	0.028	6
Bottom	0.0	0.09	0.02	0.02	0.018	117

Table 5.32. Thirteen month summary of ortho phosphorous (mg/L) for the Red River Transition Zone (RRTZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	0.0	0.24	0.01	0.02	0.034	369
Top	0.0	0.04	0.0	0.01	0.011	156
M1	0.0	0.08	0.01	0.02	0.023	27
M2	0.0	0.15	0.03	0.04	0.041	30
Bottom	0.0	0.24	0.02	0.03	0.044	156

Table 5.33. Thirteen month summary of ortho phosphorous (mg/L) for the Main Lake Body (MLB) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	0.0	0.26	0.02	0.03	0.052	366
Top	0.0	0.11	0.01	0.01	0.018	156
M1	0.0	0.04	0.0	0.01	0.011	48
M2	0.0	0.10	0.01	0.03	0.032	45
Bottom	0.0	0.26	0.03	0.07	0.074	117

Table 5.34. Thirteen month summary of ortho phosphorous (mg/L) for the Washita River Transition Zone (WRTZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	0.0	0.18	0.01	0.02	0.025	285
Top	0.0	0.04	0.0	0.01	0.013	117
M1	0.0	0.04	0.0	0.01	0.017	27
M2	0.0	0.05	0.02	0.02	0.015	24
Bottom	0.0	0.18	0.02	0.03	0.032	117

Table 5.35. Thirteen month summary of ortho phosphorous (mg/L) for the Washita River Zone (WRZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	0.0	0.06	0.03	0.02	0.016	243
Top	0.0	0.05	0.03	0.02	0.016	114
M1	0.0	0.02	0.02	0.02	0.008	6
M2	0.0	0.03	0.02	0.01	0.011	9
Bottom	0.0	0.06	0.03	0.02	0.016	114

Figure 5.36. Thirteen month summary of turbidity (NTU) for the Red River zone (RRZ), Red River Transition zone (RRTZ), Main Lake Body (MLB), Washita River Transition zone (WRTZ), and Washita River zone (WRZ) at 1 meter below the surface.

Zone	Min	Max	Median	Mean	SD	N
RRZ	3.9	57.3	8.2	12.7	10.69	208
RRTZ	2.5	28.0	5.4	7.2	4.85	247
MLB	1.6	8.5	2.8	3.3	1.28	247
WRTZ	2.8	13.5	5.1	6.2	2.77	208
WRZ	4.0	79.5	13.2	18.3	14.19	198

Table 5.37. Thirteen month summary of total suspended solids (mg/L) for the Red River Zone (RRZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	0.0	281.0	15.8	12.7	24.92	246
Top	0.0	55.2	10.0	14.5	10.97	117
M1	7.3	22.7	13.3	14.1	7.26	6
M2	12.4	15.4	14.0	13.7	1.13	6
Bottom	4.6	281.0	19.1	29.7	32.64	117

Table 5.38. Thirteen month summary of total suspended solids (mg/L) for the Red River Transition Zone (RRTZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	0.0	196.0	7.7	9.6	14.89	369
Top	0.0	18.4	6.5	6.8	3.62	156
M1	0.0	9.6	6.0	4.8	3.23	27
M2	0.0	14.5	5.6	6.2	4.33	30
Bottom	0.0	196.0	11.2	13.9	21.82	156

Table 5.39. Thirteen month summary of total suspended solids (mg/L) for the Main Lake Body (MLB) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	0.0	427.0	0.0	5.9	33.69	365
Top	0.0	14.2	0.0	2.2	2.91	155
M1	0.0	7.7	0.0	0.5	1.82	48
M2	0.0	9.9	0.0	1.1	2.86	45
Bottom	0.0	427.0	4.0	14.9	58.52	117

Table 5.40. Thirteen month summary of total suspended solids (mg/L) for the Washita River Transition Zone (WRTZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	0.0	111.0	6.6	6.9	7.31	285
Top	0.0	10.3	6.2	5.7	2.96	117
M1	0.0	9.6	5.6	4.9	3.62	27
M2	0.0	14.4	5.8	6.2	3.78	24
Bottom	0.0	111.1	7.7	8.7	10.52	117

Table 5.41. Thirteen month summary of total suspended solids (mg/L) for the Washita River Zone (WRZ) at 1 meter below the surface (Top), 1 meter above the chemocline (M1), 1 meter below the chemocline (M2), and 1 meter above the bottom (Bottom) for all sampling dates.

Depth	Min	Max	Median	Mean	SD	N
All	0.0	338.0	16.5	29.4	41.83	243
Top	0.0	84.4	12.6	20.14	17.77	114
M1	4.3	21.3	12.9	12.9	8.92	6
M2	13.4	21.8	14.3	16.6	3.57	9
Bottom	4.8	338.0	21.4	40.5	56.5	114

Table 5.42. Thirteen month summary of chlorophyll a (ug/L) for the Red River zone (RRZ), Red River Transition zone (RRTZ), Main Lake Body (MLB), Washita River Transition zone (WRTZ), and Washita River zone (WRZ) at 1 meter below the surface.

Zone	Min	Max	Median	Mean	SD	N
RRZ	2.7	68.1	20.3	22.3	12.19	208
RRTZ	3.2	53.4	16.6	18.5	10.90	247
MLB	2.1	50.2	9.2	12.1	9.07	247
WRTZ	2.1	46.2	15.5	17.0	11.52	208
WRZ	3.2	71.3	11.6	18.9	15.61	204

Appendix E

TWDB Well Data

County	State Well Number	Well Depth	Aquifer	Latitude	Longitude	Dissolved Silica (mg/L as SIO2)	Calcium (mg/L as CaCO3)	Magnesium (mg/L as CaCO3)	Total Sodium (mg/L as Na)	Total Potassium (mg/L as K)	Dissolved Strontium (ug/L as Sr)	Carbonate Ion (mg/L as CO3)	Bicarbonate Ion (mg/L as HCO3)	Total Sulfate (mg/L as SO4)	Total Chloride (mg/L as Cl)	Total Fluoride (mg/L as F)	Total Nitrate Nitrogen (mg/L as NO3)	TDS (mg/L)	Percent Sodium	Sodium Adsorption Ratio (SAR)	Residual Sodium Carbonate
Collin	1836804	2398	MIDWAY GROUP	33.386388	-96.559444	17	1.05 ± 0.06	0.34 ± 0.14	313.67 ± 15.18	0.88 ± 0.03	0.05	28.96 ± 12.05	629.78 ± 53.69	78.77 ± 4.29	20.6 ± 1.78	1.85 ± 0.3	0.07 ± 0.03	766.33 ± 26.03	99	68.54 ± 6.56	11.21 ± 0.57
Collin	1836805	1490	BOLSON DEPOSITS	33.386388	-96.559166	14.3	0.3	0.2	187	0.82	0.02	9.25	386.34	70.2	20.2	1.07	0.07	493	99	64.89	6.61
Collin	1842601	700	ANNUNA CHALK	33.321388	-96.784444	10.9	1.1	0.5	280	0.9	0.09	44.4	471.05	65	50	1.6	2.21	687	99	55.58	9.1
Collin	1842602	1541	REKLAW FORMATION OF CLAIBORNE GROUP	33.321388	-96.784444	13.9	0.31	0.2	148	0.67	0.02	13.8	311.19	52.7	10.6	0.74	0.09	394	99	50.96	5.53
Collin	1842604	2543	TWIN MOUNTAINS FORMATION	33.320832	-96.784999	16.13 ± 0.35	3.56 ± 0.24	1.13 ± 0.05	210 ± 5	1.69 ± 0.18	0.18 ± 0.01	10.94 ± 3.2	376.09 ± 21.97	131.33 ± 8.5	17.6 ± 1.4	0.79 ± 0.1	0.21 ± 0.2	574.33 ± 14.47	96.67 ± 0.58	24.86 ± 1.11	6.14 ± 0.13
Collin	1844204	2359	MIDWAY GROUP	33.353333	-96.551388	17.45 ± 0.49	1.02 ± 0.07	0.36 ± 0.2	310.5 ± 0.71	0.92 ± 0.04	0.06 ± 0.01	37.74 ± 0.42	594.43 ± 18.12	84.6 ± 4.1	24.05 ± 1.34	1.8 ± 0.07	0.78 ± 0.98	771 ± 2.83	99	67.64 ± 5.53	10.92 ± 0.3
Collin	1844205	1500	LOWER GLEN ROSE AND HOSSTON FORMATION	33.359722	-96.566388	16.2	1	0.5	312	0.9	0.05		700.47	93	21	2.5	0.44	792	99	63.61	11.38
Collin	1844803	1512	CHICOT AQUIFER,UPPER	33.284166	-96.573054	13.05 ± 2.19	3.42 ± 3.37	0.86 ± 0.63	294 ± 4.24	1.45 ± 0.21	0.15 ± 0.05	4.13	397.3 ± 44.12	140.5 ± 7.78	141.5 ± 9.19	1.43 ± 0.04	0.27 ± 0.25	793 ± 25.46	98 ± 1.41	45.53 ± 24.18	6.34 ± 1.05
Collin	1845201	2509	TERRACE DEPOSITS	33.363055	-96.458333	17.5 ± 1.91	0.98 ± 0.03	0.4 ± 0.17	310.67 ± 0.58	1 ± 0.18	0.08	33.52 ± 5.2	614 ± 33.07	83.93 ± 3.91	23.2 ± 1.61	1.92 ± 0.33	0.21 ± 0.2	774.67 ± 14.57	99	67.19 ± 5.98	11.09 ± 0.38
Collin	1845604	1900	DAKOTA SANDSTONE OR FORMATION	33.298055	-96.402222	15.3 ± 1.27	2.82 ± 3.08	0.45 ± 0.35	155 ± 50.91	1.2 ± 0.43	0.09 ± 0.06	7.2	266.65 ± 104.42	59.5 ± 57.28	46.2 ± 13.86	0.37 ± 0.38	0.27 ± 0.25	415.5 ± 137.89	96.5 ± 3.54	33.31 ± 28.43	4.31 ± 1.73
Collin	1850205	1765	GOLIAD SAND AND LAGARTO CLAY	33.233888	-96.797499	14.8 ± 0.53	1.02 ± 0.03	0.41 ± 0.15	273.33 ± 3.06	0.89 ± 0.02	0.07 ± 0.01	33.18 ± 2.29	553.79 ± 48.99	85.5 ± 4.36	19.93 ± 0.5	1.37 ± 0.31	0.21 ± 0.2	691.33 ± 10.07	99.33 ± 0.58	58.04 ± 4.5	9.74 ± 0.22
Collin	1850301	958	SIMSBORO SAND MEMBER OF ROCKDALE FORMATION	33.244721	-96.782777	13.35 ± 0.21	0.89 ± 0.73	0.35 ± 0.21	225.5 ± 86.97	0.88 ± 0.18	0.05 ± 0.04	29.4 ± 21.21	435.66 ± 108.72	69.1 ± 26.73	17.9 ± 4.38	1.27 ± 0.47	0.27 ± 0.25	572 ± 193.75	99	53.49 ± 0.71	8.05 ± 2.43
Collin	1850302	1794	SPILLER SAND MEMBER OF COOK MOUNTAIN FORMATION	33.244166	-96.783054																
Collin	1858102	2670	YEGUA FORMATION AND JACKSON GROUP	33.103888	-96.838888	19.15 ± 0.21	3.25 ± 0.21	0.74 ± 0.06	352 ± 2.83	1.41 ± 0.13	0.24 ± 0.01	12.52 ± 1.81	338.2 ± 14.04	84.9 ± 6.65	317.5 ± 13.44	0.45 ± 0.07	0.09	958 ± 11.31	98	45.91 ± 1.17	5.74 ± 0.16
Collin	3303203	3288	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	22.9 ± 1.41	6.11 ± 1.7	1.24 ± 0.05	426 ± 21.21	3.25 ± 0.64	0.33	8.06 ± 5.48	471.16 ± 27.68	361.5 ± 23.33	136.5 ± 10.61	1.8 ± 0.01	0.7 ± 0.86	1199.5 ± 72.83	97.5 ± 0.71	41.61 ± 6.65	7.59 ± 0.73
Cooke	1817402	1400	TAHOKA FORMATION, FREDERICKSBURG GROUP, AND ANTLERS SAND	33.679443	-96.990833	11.2	1.3	0.5	179	0.9	0.06	22.8	380.74	31	8	0.4	0.44	443	99	33.82	6.89
Cooke	1825402	190	QUEEN CITY SAND,CARRIZO SAND AND WILCOX GROUP	33.545277	-96.976666	20.4	16.1	5.19	33.6	1.47	0.24		131.8	17.7	24.6	0.13	0.09	184	54	1.86	0.93
Cooke	1913802	113	TERRACE DEPOSITS	33.756666	-97.456111	22.8	161	15.5	13.2	1.54	0.77		364.88	129	35	0.2	5.8	564	5	0.27	
Cooke	1913902	380	RIO GRANDE ALLUVIUM	33.753888	-97.378054	21	93.9	26.4	27.4	4.09	4.59		402.71	68.1	6.87	0.11	0.21	450	14	0.64	
Cooke	1915101	342	TERRACE DEPOSITS	33.854444	-97.219443	10.8	0.96	0.2	214	0.97	0.02	33.96	329.98	39.2	46.3	0.3	0.09	509	99	51.89	6.48
Cooke	1921202	285	OGALLALA FORMATION,FREDERICKSBURG GROUP,AND ANTLERS SAND	33.744166	-97.426666	18.9	163	16.3	26.3	1.55	1.08		417.36	28.8	115	0.2	1.78	578	10	0.53	
Cooke	1921902	683	TERRACE DEPOSITS	33.649721	-97.379999	10.7 ± 1.27	2.49 ± 0.16	0.91 ± 0.13	183.5 ± 0.71	1.6 ± 0.42	0.2	12.72 ± 4.41	337.18 ± 16.74	41 ± 1.41	60.3 ± 5.23	0.09 ± 0.01	0.29 ± 0.21	479 ± 11.31	97	25.35 ± 1.09	5.75 ± 0.11
Cooke	1922704	660	OGALLALA FORMATION,FREDERICKSBURG GROUP,AND ANTLERS SAND	33.644444	-97.364166	11.6	0.68	0.2	159	0.63	0.05	25.92	317.05	35.5	9.94	0.09	0.09	399	99	43.57	6.01
Cooke	1923805	927	OGALLALA FORMATION,FREDERICKSBURG GROUP,AND ANTLERS SAND	33.641388	-97.18111	10.8 ± 1.27	1.9 ± 0.71	0.48 ± 0.03	176 ± 2.83	0.91 ± 0.42	0.13 ± 0.01	20.28 ± 6.62	372.45 ± 22.09	30.8 ± 1.7	16.15 ± 0.21	0.18 ± 0.03	0.27 ± 0.25	440.5 ± 3.54	98	30.06 ± 4.78	6.64 ± 0.1
Cooke	1924706	1165	REKLAW FORMATION OF CLAIBORNE GROUP	33.629443	-97.108055	10.75 ± 1.34	2.18 ± 0.18	0.72 ± 0.12	184.5 ± 3.54	1.16 ± 0.49	0.17	13.14 ± 6.7	380.26 ± 17.95	29.3 ± 2.4	37.1 ± 0.14	0.26 ± 0.06	0.27 ± 0.25	466.5 ± 0.71	98	27.82 ± 2.09	6.5 ± 0.04
Cooke	1924905	1360	SIMSBORO SAND MEMBER OF ROCKDALE FORMATION	33.649444	-97.034721	10.9	1.7	0.6	180	0.9	0.12	18	385.62	28	16	0.3	0.44	447	98	30.22	6.78
Cooke	1932302	1301	YEGUA FORMATION AND JACKSON GROUP	33.586666	-97.024166	11.4 ± 1.27	3.35 ± 0.06	1.18 ± 0.04	231 ± 12.73	1.22 ± 0.25	0.29 ± 0.03	12.42 ± 2.29	377.46 ± 16.74	32.55 ± 4.88	110.5 ± 19.09	0.28 ± 0.04	0.27 ± 0.25	590 ± 21.21	97	27.68 ± 1.52	6.34 ± 0.19
Cooke	1932604	92	ALLUVIUM,TERRACE DEPOSITS,SEYMOUR FORMATION, AND SAN ANGELO SANDSTONE	33.559444	-97.022221	16.3	22	1.01	237	3	0.23		228.2	37.2	255	0.13	8.85	692	89	13.42	2.56
Cooke	1937201	248	TERRACE DEPOSITS	33.490833	-97.454166	11.25 ± 0.35	1 ± 0.18	0.31 ± 0.12	169.5 ± 3.54	0.46 ± 0.23	0.08	21.84 ± 12.56	333.89 ± 10.7	34.55 ± 1.91	10.49 ± 1.29	0.05 ± 0.04	0.11 ± 0.03	413.5 ± 19.09	98.5 ± 0.71	38.55 ± 4.07	6.13 ± 0.57
Cooke	1938301	794	YEGUA FORMATION AND JACKSON GROUP	33.494721	-97.290277	12.5	0.7	0.28	172	0.2	0.11	26.16	344.63	31.2	5.13	0.13	0.09	417	99	43.95	6.46
Cooke	1938302	820	TERRACE DEPOSITS	33.495277	-97.279166	11.4 ± 0.85	1.04 ± 0.08	0.45 ± 0.07	180 ± 5.66	0.59 ± 0.02	0.12 ± 0.01	30.96 ± 0.34	361.1 ± 8.8	31.4 ± 0.85	5.87 ± 2.64	0.17 ± 0.04	0.27 ± 0.25	440 ± 8.49	98.5 ± 0.71	37.19 ± 0.94	6.86 ± 0.14
Cooke	1939101	950	LOWER CRETACEOUS SERIES	33.460555	-97.220554	10.1	1.8	0.5	188	2.9	0.11	13.2	412.47	31	19	0.2	0.44	470	98	31.95	7.06
Cooke	1939301	817	LOWER CRETACEOUS SERIES	33.489444	-97.165555	12.85 ± 0.07	0.76 ± 0.15	0.26 ± 0.08	178	0.37 ± 0.23	0.07	30.3 ± 6.53	369.16 ± 5.69	30.15 ± 1.63	4.47 ± 0.42	0.18 ± 0.01	0.09	438.5 ± 7.78	99	45.69 ± 5.42	7 ± 0.3
Cooke	1939401	900	LEONA FORMATION AND WILCOX GROUP	33.456388	-97.220832	12.5	0.57	0.2	170	0.48	0.07	14.76	349.51	33.9	6.75	0.13	0.09	411	99	49.35	6.18
Cooke	1940502	1510	UPPER CRETACEOUS SERIES	33.422777	-97.046666	11.87 ± 1.02	13.9 ± 1.81	6.4 ± 0.96	293 ± 15.62	2.17 ± 0.83	1.45 ± 0.07		319.73 ± 18.47	30.9 ± 5.65	302.33 ± 10.97	0.48 ± 0.44	0.21 ± 0.2	819.67 ± 33.72	90.67 ± 0.58	16.36 ± 0.58	4.02 ± 0.15
Dallas	3224307	2070	QUEEN CITY SAND,CARRIZO SAND AND WILCOX GROUP	33.827499	-101.852222	15.9 ± 0.85	81.61 ± 110.86	31.76 ± 42.63	760 ± 664.68	4.45 ± 3.81	4.45 ± 5.9	14.4	388.68 ± 116.49	1544 ± 1945.96	61.85 ± 16.76	1.52 ± 0.49	0.07 ± 0.04	2703.5 ±	88.5 ± 12.02	26.94 ± 8.51	7.91
Dallas	3224908	2040	TERRACE DEPOSITS	33.827499	-101.852222	15.3 ± 1.71	2 ± 0.38	0.75 ± 0.06	265.33 ± 7.51	1.41 ± 0.11	0.14	20.16 ± 9.56	465.44 ± 8.59	87.57 ± 7.67	67.37 ± 4.05	1.28 ± 0.48	0.19 ± 0.22	690 ± 21.79	98.33 ± 0.58	40.69 ± 1.3	8.14 ± 0.18
Dallas	3224909	381	DAKOTA SANDSTONE OR FORMATION	33.827499	-101.852222	12.7 ± 0.28	0.61 ± 0.15	0.42 ± 0.12	171 ± 4.24	0.89 ± 0.16	0.04 ± 0.01	21.9 ± 2.12	365.49 ± 6.04	36.7 ± 0.14	15.65 ± 3.89	1.01 ± 0.05	0.17 ± 0.11	440 ± 5.66	99	41.5 ± 1.83	6.66 ± 0.18
Dallas	3302102	2515	UVALDE GRAVEL	33.827499	-101.852222	18.95 ± 0.21	3.29 ± 0.4	1.01 ± 0.11	360	1.74 ± 0.08	0.25 ± 0.02	12.3 ± 1.44	503.4 ± 2.24	156 ± 4.24	147.5 ± 13.44	1.99 ± 0.09	0.09	950.5 ± 6.36	98	44.68 ± 2.67	8.41 ± 0.06
Dallas	3309103	1184	WECHES FORMATION OF CLAIBORNE GROUP	33.827499	-101.852222	14 ± 0.14	1.5 ± 0.52	0.54 ± 0.05	278.5 ± 3.54	1.02 ± 0.1	0.13 ± 0.01	25.62 ± 1.1	440.91 ± 12.6	187 ± 8.49	16.95 ± 0.64	1.02 ± 0.16	0.07 ± 0.04	743 ± 1.41	98.5 ± 0.71	50.03 ± 3.96	7.97 ± 0.15
Dallas	3309402	2000	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	10.51 ± 7.06	22.91 ± 29.69	2.74 ± 2.55	179.15 ± 202.02	3.13 ± 1.92	0.26 ± 0.11	14.4	283 ± 279.76	123.95 ± 53.81	65.05 ± 53.67	1.31 ± 0.79	2.44 ± 3.39	557.5 ± 427.8	68 ± 42.43	24.53 ± 32.72	8.19
Dallas	3309701	2092	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	13.6	3.5	1.2	346	1.9	0.22	28.8	486.91	219	80	2.5	0.44	937	98	40.7	8.66
Dallas	3309703	2163	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	15.93 ± 1.58	13.06 ± 12.1	5.6 ± 5.39	444 ± 142.5	2.4 ± 0.53	1.41 ± 1.41	12.89 ± 11.41	450.94 ± 28.56	532 ± 393.2	70.4 ± 11.14	1.88 ± 0.69	0.19 ± 0.22	1321 ± 522.84	94.67 ± 3.21	29.46 ± 5.25	6.71 ± 1.79
Dallas	3310205	1590	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	18.4	1.55	0.37	276.05	1.1	0.12	28.08	460.32	144.3	21.2	1.13	0.09	708.5	99	51.74	8.38
Dallas	3310406	1406	EL PICO CLAY	33.827499	-101.852222	15.2	1.23	0.58	284	1.18	0.12	25.2	457.63	180	18.9	1.05	0.13	752	99	52.89	8.23
Dallas	3311701	3184	PEN FORMATION	33.827499	-101.852222	21.8	2.71	0.96	369	2.48	0.21	12	488.14	245	107	1.14	0.04	1002	98	49.04	8.19
Dallas	3317116	2094	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	15.43 ± 1.44	2.86 ± 0.43	1.19 ± 0.16	314 ± 12.17	1.76 ± 0.27	0.28 ± 0.02	17.8 ± 7.45	468.61 ± 7.62	181 ± 24.27	71.77 ± 3.66	2.76 ± 1.58	0.19 ± 0.22	839 ± 41.51	98	39.48 ± 0.67	8.03 ± 0.28
Dallas	3318305	817	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	14.1	3.3	1.42	540	2.33	0.38	5.88	639.71	507	156	3	0.09	1548	98	62.61	10.4
Dallas	3318803	3091	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	22.3 ± 0.85	5.09 ± 1.75	1.78 ± 0.52	354 ± 24.04	2.44 ± 0.16	0.24 ± 0.08	7.23 ± 5.13	511.27 ± 13.89	239 ± 43.84	96.7 ± 10.32	1.54 ± 0.01	0.51 ± 0.59	982 ± 57.98	97	34.94 ± 3.41	8.22 ± 0.18
Dallas	3319704	1353	TERRACE DEPOSITS	33.827499	-101.852222	14.8	2.48	1.03	492	1.84	0.31	2.4	584.55	490	102	2.09	0.22	1396	99	66.28	9.45
Dallas	3325203	895	WOODBINE SAND	33.827499	-101.852222	14.1 ± 0.14	2.43 ± 1.83	0.56 ± 0.05	296 ± 15.56	1.19 ± 0.17	0.13 ± 0.02	14.94 ± 0.76	413.21 ± 4.48	274 ± 4.24	21.35 ± 0.07	0.63 ± 0.15	0.16 ± 0.09	828.5 ± 24.75	98.5 ± 0.71	47.35 ± 11.77	7.11 ± 0.01
Dallas	3325401	2507	TWIN MOUNTAINS FORMATION	33.827499	-101.852222	18.17 ± 2.14	2.24 ± 0.14	0.75 ± 0.07	288.33 ± 10.41	1.69 ± 0.12	0.15 ± 0.02	19.2 ± 8.31	482.85 ± 5.5	99.03 ± 10.33	85.6 ± 7.1	1.53 ± 0.24	0.21 ± 0.2	754 ± 26.63	98.33 ± 0.58	42.56 ± 0.84	8.38 ± 0.28
Dallas	3326105	2824	WECHES FORMATION OF CLAIBORNE GROUP	33.827499	-101.852222	21.6	5.19	2.35	293	2.23	0.28		517.43	132	95	1.51	0.04	807	96	26.8	8.03
Dallas	3326302	3249	UVALDE GRAVEL	33.827499	-101.852222	20.2	4.42	1.36	392	2.72	0.34	9.17	536.61	179	165	1.73	0.09	1039	98	41.82	8.77
Dallas	3326410	1070	FLEMING FORMATION AND BURKEVILLE AQUICLUDE	33.827499	-101.852222	15.3	2.36	0.93	458	1.89	0.23	11.65	512.03	431	94.8	1.22	0.09	1269	99	63.92	8.59
Dallas	3326505	988	REKLAW FORMATION OF CLAIBORNE GROUP	33.827499	-101.852222	12.93 ± 1.69	1.59 ± 0.65	0.78 ± 0.09	427 ± 7.21	1.71 ± 0.17	0.22 ± 0.02	13.24 ± 4.31	454.29 ± 81.11	426.67 ± 10.07	86.03 ± 0.96	1.57 ± 0.25	0.25 ± 0.18	1195 ± 55.24	99	70.42 ± 9.51	7.74 ± 1.21
Dallas	3327205	3572	QUEEN CITY SAND,CARRIZO SAND AND WILCOX GROUP	33.827499	-101.852222	23.1 ± 0.71	4.68 ± 0.29	1.3 ± 0.03	475 ± 25.46	3.58 ± 0.14	0.34 ± 0.05		555.26 ± 22.44	185 ± 2.83	337 ± 4.24	2.13 ± 0.06	0.09	1304.5 ± 28.99	98	50.09 ± 1.79	8.76 ± 0.35
Dallas	3327602	1390	SPILLER SAND MEMBER OF COOK MOUNTAIN FORMATION	33.827499	-101.852222	14.8 ± 1.57	2.69 ± 0.69	1.08 ± 0.09	533.67 ± 15.82	2.17 ± 0.17	0.33 ± 0.02	19.48 ± 11.19	711.3 ± 33.51	340.33 ± 7.51	186.67 ± 6.51	3.23 ± 0.29	0.25 ± 0.18	1454 ± 7.21	98.67 ± 0.58	70.17 ± 8.27	12.08 ± 0.2
Denton	1833703	1514	LEONA FORMATION AND WILCOX GROUP	33.394999	-96.960833	12.25 ± 1.34	1.89 ± 0.44	0.52 ± 0.02	307.5 ± 0.71	1.22 ± 0.4	0.1 ± 0.01	41.52 ± 4.07	532.43 ± 7.42	146.5 ± 14.85	20.1 ± 1.56	1.3 ± 0.14	0.37 ± 0.11	795 ± 15.56	99	51.37 ± 3.68	9.97 ± 0.01
Denton	1833801	1565	OGALLALA FORMATION,FREDERICKSBURG GROUP,AND ANTLERS SAND	33.390277	-96.954722	13.2 ± 1.41	1.64 ± 0.66	0.48 ± 0.04	195.5 ± 0.71	1.12 ± 0.4	0.12	33.36 ± 3.73	304.97 ± 17.09	99.65 ± 8.98	14.3 ± 0.42	0.25 ± 0.07	0.3 ± 0.21	509.5 ± 4.95	98	35.2 ± 5.15	5.99 ± 0.19
Denton	1841207	220	OGALLALA FORMATION,FREDERICKSBURG GROUP,AND ANTLERS SAND	33.37111	-96.941944	16 ± 1.41	9.6 ± 0.35	4.85 ± 0.23	89.75 ± 5.02	2.77 ± 0.3	0.53		169.02 ± 12.94	68.6 ± 18.81	26.35 ± 4.74	0.36 ± 0.01	0.16 ± 0.09	301.5 ± 14.85	81 ± 1.41	5.9 ± 0.45	1.9 ± 0.25
Denton	1841404	1449	YEGUA FORMATION AND JACKSON GROUP	33.302222	-96.984444	15.1	1	0.25	201	0.76	0.05	30.36	282.39	124	15.4	0.25	0.09	527	99	46.58	5.57
Denton	1841407	1533	YEGUA FORMATION AND JACKSON GROUP	33.293055	-96.992499	13.45 ± 1.34	1.17 ± 0.04	0.44 ± 0.08	209 ± 1.41	0.93 ± 0.39	0.07	32.82 ± 5.69	335.35 ± 1.39	105.2 ± 9.62	17.4 ± 2.26	0.5	0.27 ± 0.25	546 ± 4.24	99	41.88 ± 2.31	6.49 ± 0.23
Denton	1842701	415	CALVERT BLUFF FORMATION AND SIMSBORO SAND MEMBER	33.28861	-96.869166	12.4	0.53	0.2	143	0.67	0.02	17.52	287.76	52.7	14.1	0.6	0.09	383	99	42.47	5.26
Denton	1849401	940	YEGUA FORMATION AND JACKSON GROUP	33.182221	-96.99861	13.17 ± 1.02	1.01 ± 0.1	0.32 ± 0.16	250 ± 8.19	0.85 ± 0.14	0.07 ± 0.02	37.04 ± 2.45	450.63 ± 9.37	92.93 ± 1.96	15.77 ± 1.64	0.94 ± 0.31	0.21 ± 0.2	633.67 ± 14.84	99	56.04 ± 4.37	8.54 ± 0.11
Denton	1849708	377	EAGLE FORD SHALE	33.160555	-96.969999	10	0.7	0.5	208	1.2	0.04	25.2	380.74	68	9	1.4	0.44	512	99	46.39	7
Denton	1849712	1100	QUEEN CITY SAND,CARRIZO SAND AND WILCOX GROUP	33.160833	-96.970277	11.6	1.1	0.5	259	1.6	0.08	40.8	473.49	99	19	1.3	0.44	667	99	51.41	9.02
Denton	1849802	317	SALT BOLSON AND TERTIARY VOLCANICS	33.1625	-96.941666	11.8	0.43	0.2	185	0.77	0.02	22.08	385.87	55.4	15.7	1.14	0.12	482	99	58.45	7.02
Denton	1939701	1000	OGALLALA FORMATION,FREDERICKSBURG GROUP,AND ANTLERS SAND	33.39111	-97.233054	10.7 ± 1.27	3.05 ± 0.22	1.21 ± 0.13	187.5 ± 3.54	1.13 ± 0.53	0.27	13.26 ± 3.48	350.12 ± 7.08	32.5 ± 2.12	61.6 ± 4.81	0.19 ± 0.02	0.27 ± 0.25	484 ± 9.9	97	23.02 ± 0.54	5.93 ± 0.02
Denton	1939803	990	UVALDE GRAVEL	33.395555	-97.166943	11.9 ± 1.7	1.06 ± 0.06	0.44 ± 0.08	166.5 ± 0.71	0.88 ± 0.46	0.11 ± 0.01	30.72 ± 2.72	339.01 ± 3.8	41.7 ± 0.99	5.6 ± 0.57	0.17 ± 0.04	0.27 ± 0.25	426 ± 1.41	99	34.44 ± 1.82	6.49 ± 0.04
Denton	1946602	897	ALLUVIUM,TERRACE DEPOSITS,SEYMOUR FORMATION, AND SAN ANGELO SANDSTONE	33.329166	-97.263055	12.03 ± 1.42	0.78 ± 0.2	0.34 ± 0.15	166 ± 3.46	0.61 ± 0.45	0.08	29.96 ± 8.25	322.25 ± 6.52	47.63 ± 1.65	3.48 ± 0.59	0.14 ± 0.06	0.51 ± 0.46	420 ± 8.54	99	40.58 ± 6.66	6.21 ± 0.24
Denton	1946802	864	CHICOT AQUIFER,UPPER	33.291666	-97.315277	12.6	1.67	0.71	161	0.75	0.23	22.08	315.09	46.6	7.73	0.11	0.09	408	98	26.31	5.76
Denton	1947102	852	CHICOT AQUIFER,UPPER	33.366943	-97.218054	11.35 ± 1.63	0.99 ± 0.01	0.41 ± 0.13	162.5 ± 3.54	0.85 ± 0.36	0.08	28.62 ± 1.44	331.08 ± 11.56	41.45 ± 0.64	2.87 ± 0.18	0.16 ± 0.06	0.35 ± 0.13	412.5 ± 6.36	99	34.76 ± 1.58	6.29 ± 0.13
Denton	1947203	822	ANTLERS SAND	33.361944	-97.170832	13.2	0.52	0.2	182	0.24	0.05	23.52	341.45	56.6	6.05	0.13	1.03	451	99	54.37	6.34
Denton	1947207	920	DAKOTA SANDSTONE OR FORMATION	33.363888	-97.184721	12.5	0.91	0.28	174	0.51	0.07	35.4	333.15	44.4	5.3	0.11	0.09	437	99	40.91	6.57
Denton	1947302	1116	DAKOTA SANDSTONE OR FORMATION	33.359722	-97.1575	10	3.2	1.1	228	2.4	0.29	7.2	336.81	40	133	0.3	0.44	592	98	28.04	5.51
Denton	1947707	900	PEN FORMATION	33.262777	-97.239999	12.27 ± 1.1	1.46 ± 0.69	0.4 ± 0.16	180.67 ± 5.13	1.14 ± 0.84	0.1 ± 0.01	30.12 ± 7.45	317.45 ± 22.76	67.8 ± 4.59	11.47 ± 0.61	0.21 ± 0.09	0.21 ± 0.2	461.67 ± 15.28	98.33 ± 0.58	35.78 ± 7.47	6.1 ± 0.1
Denton	1948106	1344	JASPER AQUIFER,UPPER UNIT	33.34611	-97.090555	11.55 ± 1.34	2.75 ± 0.21	0.85 ± 0.07	249.5 ± 2.12	1.58 ± 0.74	0.24 ± 0.01	18.12 ± 6.62	357.32 ± 15.2	30.55 ± 2.05	155 ± 11.31	0.23 ± 0.11	0.27 ± 0.25	646 ± 11.31	98	33.77 ± 1.63	6.25 ± 0.04
Denton	1948302	1585	YEGUA FORMATION AND JACKSON GROUP	33.362777	-97.031666	14.5	1.02	0.33	190	0.62	0.06	39.36	317.78	82.1	10.6	0.16	0.09	495	99	41.84	6.44
Denton	1948303	905	YEGUA FORMATION AND JACKSON GROUP	33.355833	-97.024999	12.1	1.2	0.39	265	0.71	0.06	40.32	503.76	74.9	12.4	0.95	0.09	655	99	53.76	9.51
Denton	1948402	650	LOWER GLEN ROSE AND HOSSTON FORMATION	33.313055	-97.084166	12.9	0.69	0.2	251	0.29	0.07	22.2	444.21	96	15.2	0.53	0.09	617	99	68.45	7.97
Denton	1954605	1040	LOWER GLEN ROSE AND HOSSTON FORMATION	33.172777	-97.282221	12.47 ± 1.18	4.05 ± 1.18	1.43 ± 0.34	218.33 ± 12.74	1.9 ± 1.39	0.56 ± 0.09	19.88 ± 4.85	278.89 ± 8.8	63.4 ± 2.33	122.97 ± 38.78	0.21 ± 0.08	0.21 ± 0.2	582 ± 54.74	96.33 ± 0.58	24.05 ± 1.73	4.91 ± 0.12
Denton	1956104	1200	LOWER GLEN ROSE AND HOSSTON FORMATION	33.24861	-97.115277	12.6	1.45	0.51	263	0.7	0.1	28.32	544.03	76.5	11.4	1.63	0.09	663	99	47.85	9.75
Denton	1956603	1240	MIDWAY GROUP	33.185555	-97.038333	12	1.59	0.71	371	1.12	0.13	27.36	831.54	52.2	19.7	5	0.09	899	99	61.49	14.4

County	State Well Number	Well Depth	Aquifer	Latitude	Longitude	Dissolved Silica (mg/L as SIO2)	Calcium (mg/L as CaCO3)	Magnesium (mg/L as CaCO3)	Total Sodium (mg/L as Na)	Total Potassium (mg/L as K)	Dissolved Strontium (ug/L as Sr)	Carbonate Ion (mg/L as CO3)	Bicarbonate Ion (mg/L as HCO3)	Total Sulfate (mg/L as SO4)	Total Chloride (mg/L as Cl)	Total Fluoride (mg/L as F)	Total Nitrate Nitrogen (mg/L as NO3)	TDS (mg/L)	Percent Sodium	Sodium Adsorption Ratio (SAR)	Residual Sodium Carbonate
Denton	1961902	442	LOWER GLEN ROSE AND HOSSTON FORMATION	33.040833	-97.378888									40	9.5	0.23		440			
Denton	1962203	1003	HENSELL SAND MEMBER OF TRAVIS PEAK FORMATION	33.087221	-97.298055	12.4	1.65	0.67	301	0.69	0.23	24.24	382.7	54.5	201	0.18	0.09	784	98	49.94	6.94
Denton	1962205	0	YEGUA FORMATION AND JACKSON GROUP	33.099444	-97.308055	11.5	1.64	0.63	346	1.25	0.18	12	646.78	114	53.5	3.75	0.16	862	99	58.22	10.87
Denton	1962505	1021	TERRACE DEPOSITS	33.073888	-97.301388	11.1 ± 1.41	3.42 ± 0.12	1.49 ± 0.16	339 ± 8.49	2.17 ± 1.18	0.57	10.8	370.99 ± 3.46	54.7 ± 1.84	286 ± 21.21	0.2 ± 0.14	0.27 ± 0.25	886.5 ± 20.51	98	38.57 ± 2.21	5.97 ± 0.18
Denton	1962805	461	QUEEN CITY SAND,CARRIZO SAND AND WILCOX GROUP	33.029443	-97.322221	11.2	1	0.28	201	0.58	0.07	41.16	410.52	33	5.12	0.52	0.09	495	99	45.78	8.03
Denton	1963102	1352	YEGUA FORMATION AND JACKSON GROUP	33.099166	-97.212777	13.7 ± 1.98	1.52 ± 0.4	0.42 ± 0.11	264 ± 2.83	1.18 ± 0.74	0.13 ± 0.01	27.48 ± 0.17	341.94 ± 10.71	56.25 ± 3.89	140.5 ± 17.68	0.24 ± 0.08	0.29 ± 0.21	673.5 ± 19.09	99	49.49 ± 6.05	6.41 ± 0.21
Denton	1963202	1144	YEGUA FORMATION AND JACKSON GROUP	33.118054	-97.205833	12	1	0.5	226	1.4	0.09	45.6	370.98	85	24	0.8	0.44	579	99	46.07	7.5
Denton	1963703	618	SPILLER SAND MEMBER OF COOK MOUNTAIN FORMATION	33.008611	-97.212222	13.1	1.35	0.95	205	0.57	0.1	36.72	411.01	58.3	6.17	0.45	0.1	524	98	33.06	7.81
Denton	1963704	640	EL PICO CLAY	33.005	-97.219721	10.6	1.4	0.5	191	1.1	0.06	44.4	385.62	31	6	0.5	0.44	477	99	35.26	7.68
Denton	1964211	1708	EL PICO CLAY	33.089444	-97.07861	14.35 ± 1.63	1.59 ± 0.01	0.45 ± 0.08	285.5 ± 2.12	1.28 ± 0.74	0.12 ± 0.01	17.1 ± 10.61	370.98 ± 20.7	82.2 ± 8.2	161.5 ± 7.78	0.33 ± 0.11	0.27 ± 0.25	746.5 ± 17.68	99	51.61 ± 1.21	6.53 ± 0.03
Denton	1964306	308	QUEEN CITY SAND,CARRIZO SAND AND WILCOX GROUP	33.106388	-97.004166	10.5 ± 1.27	1.51 ± 0.69	0.63 ± 0.52	286 ± 5.66	1.36 ± 0.35	0.11 ± 0.04	22.62 ± 4.84	514.74 ± 20.36	114.5 ± 4.95	34.4 ± 18.95	2.41 ± 0.01	0.37 ± 0.1	727 ± 22.63	99	53.16 ± 16.07	9.06 ± 0.58
Denton	1964502	1747	TERRACE DEPOSITS	33.04861	-97.054444	13.6	3.17	0.99	364	1.02	0.33	13.68	310.21	80	359	0.28	0.09	988	98	45.74	5.3
Denton	1964506	1778	TWIN MOUNTAINS FORMATION	33.071666	-97.051111	14 ± 1.56	3.5 ± 0.71	1.19 ± 0.12	339 ± 15.56	2.11 ± 0.69	0.31 ± 0.06	8.52 ± 5.26	365.25 ± 8.11	107 ± 22.63	250.5 ± 19.09	0.55 ± 0.07	0.27 ± 0.25	906.5 ± 21.92	98	40.1 ± 1.5	6
Ellis	3240606	2411	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	17.37 ± 2	2.19 ± 0.1	0.62 ± 0.08	251.67 ± 5.69	1.44 ± 0.1	0.18 ± 0.01	17.88 ± 7.42	440.38 ± 11.82	71.13 ± 5.5	66.2 ± 2.99	1.16 ± 0.22	0.21 ± 0.2	646 ± 17.44	98	38.75 ± 0.71	7.65 ± 0.33
Ellis	3248602	410	SPILLER SAND MEMBER OF COOK MOUNTAIN FORMATION	33.827499	-101.852222	11.05 ± 0.92	1.47 ± 0.19	0.45 ± 0.08	331 ± 26.87	1.36 ± 0.21	0.1 ± 0.01	41.46 ± 16.04	525.24 ± 52.47	151 ± 12.73	37.25 ± 4.6	1.92 ± 0.03	0.27 ± 0.25	835 ± 53.74	99	61.9 ± 9.5	9.88 ± 0.35
Ellis	3248606	2100	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	16.97 ± 2.03	1.85 ± 0.23	0.5 ± 0.09	270 ± 9.54	1.3 ± 0.13	0.15 ± 0.01	23.2 ± 7.03	474.31 ± 5.08	77.57 ± 5.76	68.87 ± 1.95	1.36 ± 0.16	0.32 ± 0.2	695 ± 19.97	98.33 ± 0.58	45.63 ± 1.68	8.41 ± 0.27
Ellis	3256301	2400	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	19.7 ± 2.26	2.09 ± 0.28	0.56 ± 0.04	273.33 ± 10.26	1.74 ± 0.23	0.14 ± 0.01	19.88 ± 9.81	474.96 ± 9.21	81.27 ± 5.47	71.8 ± 2.61	1.25 ± 0.22	0.21 ± 0.2	705 ± 21.66	98.33 ± 0.58	43.43 ± 1.73	8.3 ± 0.31
Ellis	3326822	1178	QUEEN CITY SAND,CARRIZO SAND AND WILCOX GROUP	33.827499	-101.852222	12.25 ± 1.06	2.44 ± 0.09	0.78 ± 0.03	420 ± 18.38	2.01 ± 0.41	0.21 ± 0.03	22.5 ± 10.61	497.29 ± 33.66	391.5 ± 57.28	59.95 ± 11.24	1.48 ± 0.59	0.52 ± 0.11	1157.5 ± 92.63	99	60 ± 3.75	8.71 ± 0.21
Ellis	3333203	2530	TERRACE DEPOSITS	33.827499	-101.852222	19.85 ± 0.49	2.53 ± 0.08	0.77 ± 0.11	268 ± 16.97	1.84 ± 0.26	0.22 ± 0.03	10.02 ± 3.99	474.48 ± 5.52	88 ± 21.21	67.1 ± 1.98	1.33 ± 0.11	0.09	692.5 ± 40.31	98	37.92 ± 1.13	7.92 ± 0.06
Ellis	3334210	3085	TWIN MOUNTAINS FORMATION	33.827499	-101.852222	24.4 ± 0.99	4.42 ± 0.39	1.38 ± 0.03	433 ± 2.83	3.15 ± 0.07	0.46	6.14	493.49 ± 1.07	154 ± 4.24	311.5 ± 2.12	1.6 ± 0.07	0.09	1179 ± 2.83	98	46.13 ± 1.48	7.86 ± 0.15
Ellis	3334211	1180	TERRACE DEPOSITS	33.827499	-101.852222	14.2	2.28	0.7	476	1.9	0.21	17.64	625.55	355	77.1	2.37	0.09	1255	99	70.74	10.67
Ellis	3335503	1522	WECHES FORMATION OF CLAIBORNE GROUP	33.827499	-101.852222	15.3	2.66	0.86	603	2.1	0.27	16.92	782	329	133	3.93	0.09	1491	99	82.23	13.18
Ellis	3341501	2606	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	22.15 ± 1.2	3.41 ± 0.22	0.99 ± 0.14	405 ± 50.91	2.25 ± 0.06	0.33 ± 0.04	5.54 ± 2.74	471.99 ± 3.85	131 ± 8.49	257 ± 62.23	1.06 ± 0.13	0.09	1060 ± 104.65	98	49.63 ± 4.02	7.67
Ellis	3342405	2900	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	22.55 ± 1.2	4.9 ± 0.3	1.43 ± 0.01	462.5 ± 14.85	3.29 ± 0.21	0.38 ± 0.01		547.94 ± 15.54	117 ± 2.83	330.5 ± 12.02	2.07 ± 0.1	0.11 ± 0.02	1214 ± 5.66	98	47.34 ± 2.52	8.62 ± 0.27
Ellis	3343802	1450	OGALLALA FORMATION,FREDERICKSBURG GROUP,AND ANTLERS SAND	33.827499	-101.852222	14.85 ± 0.92	3.17 ± 0.33	1.06 ± 0.06	639.5 ± 2.12	3.05 ± 0.64	0.35 ± 0.01	21.48 ± 12.05	890.49 ± 56.43	389 ± 2.83	192 ± 2.83	6.74 ± 0.8	0.27 ± 0.25	1709.5 ± 6.36	99	79.56 ± 3.19	15.07 ± 0.54
Ellis	3349602	935	REKLAW FORMATION OF CLAIBORNE GROUP	33.827499	-101.852222	13.4	3.13	1.02	537	2.25	0.29	16.32	646.54	499	98.4	3.28	0.09	1492	98	67.42	10.9
Ellis	3349803	2700	SIMSBORO SAND MEMBER OF ROCKDALE FORMATION	33.827499	-101.852222	22 ± 2.62	7.94 ± 0.59	2.43 ± 0.15	353.67 ± 12.86	3.22 ± 0.34	0.83 ± 0.01	16.8	521.49 ± 6.72	114.33 ± 9.45	188.67 ± 4.93	2.04 ± 0.31	0.21 ± 0.2	957 ± 29.51	96	28.2 ± 0.95	8.14 ± 0.19
Ellis	3350202	3204	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	22.1 ± 2.82	4.19 ± 0.35	1.12 ± 0.07	416 ± 15.1	3.54 ± 0.35	0.22 ± 0.01	25.2	598.37 ± 14.56	146.33 ± 7.51	188.67 ± 4.93	2.79 ± 0.37	0.22 ± 0.19	1087.67 ± 22.5	98	46.7 ± 2.88	9.78 ± 0.38
Ellis	3357202	900	SPILLER SAND MEMBER OF COOK MOUNTAIN FORMATION	33.827499	-101.852222	11.9 ± 0.14	3.67 ± 0.47	1.05 ± 0.08	495.5 ± 10.61	2.53 ± 0.67	0.27	21.78 ± 11.62	532.93 ± 9.14	533 ± 31.11	62 ± 8.49	1.56 ± 0.91	0.27 ± 0.25	1395 ± 7.07	98.5 ± 0.71	58.86 ± 2	9.19 ± 0.51
Fannin	1725303	1727	TERRACE DEPOSITS	33.594721	-95.905	16.1 ± 2.9	1.44 ± 0.37	0.49 ± 0.02	357.5 ± 3.54	1.42 ± 0.03	0.11 ± 0.03	15.28 ± 8.94	491.24 ± 32	215 ± 8.49	99.2 ± 29.42	1.74 ± 0.09	0.27 ± 0.25	949.5 ± 16.26	99	66.25 ± 5.45	8.45 ± 0.25
Fannin	1733501	3366	WECHES FORMATION OF CLAIBORNE GROUP	33.426666	-95.946388	23.93 ± 2.47	2.15 ± 0.79	0.34 ± 0.15	340 ± 9.17	1.51 ± 0.17	0.2 ± 0.02	14.24 ± 0.18	682.09 ± 25.74	125.67 ± 7.23	34.1 ± 0.82	2.89 ± 0.53	0.21 ± 0.2	880.33 ± 26.95	98.67 ± 0.58	58.22 ± 7.88	11.51 ± 0.39
Fannin	1733504	3214	YEGUA FORMATION AND JACKSON GROUP	33.425554	-95.957777	23.4 ± 2.52	1.63 ± 0.12	0.34 ± 0.15	352.67 ± 11.02	1.53 ± 0.15	0.2 ± 0.02	14.48 ± 0.84	684.86 ± 31.7	131.33 ± 3.21	42.63 ± 1.35	3.18 ± 0.63	0.21 ± 0.2	908 ± 29.46	99	65.96 ± 3.7	11.6 ± 0.53
Fannin	1733701	3345	YEGUA FORMATION AND JACKSON GROUP	33.395277	-95.983888	25 ± 0.42	1.7 ± 0.06	0.25 ± 0.07	345 ± 12.73	1.48 ± 0.08	0.17 ± 0.02	11.65 ± 3.89	659.09 ± 34.37	138.5 ± 2.12	35.9 ± 0.42	2.54 ± 0.06	0.09	886 ± 31.11	99	65.41 ± 0.28	11.09 ± 0.69
Fannin	1734101	3063	OGALLALA FORMATION,FREDERICKSBURG GROUP,AND ANTLERS SAND	33.491666	-95.865833	23.75 ± 0.49	1.8 ± 0.26	0.25 ± 0.07	345 ± 5.66	1.44 ± 0.01	0.16 ± 0.02	18.66 ± 0.93	696.09 ± 14.84	116.5 ± 0.71	31.85 ± 0.07	2.89 ± 0.19	0.09	884 ± 14.14	99	64.27 ± 4.48	11.92 ± 0.2
Fannin	1823601	1087	REKLAW FORMATION OF CLAIBORNE GROUP	33.692777	-96.150277	12.8 ± 2.26	1.24 ± 0.05	0.48 ± 0.03	321.5 ± 4.95	1.24 ± 0.05	0.07 ± 0.01	23.22 ± 12.98	491.56 ± 39.35	152.5 ± 9.19	82.85 ± 2.62	1.43 ± 0.1	0.27 ± 0.25	839.5 ± 24.75	99	62.19 ± 0.92	8.73 ± 0.22
Fannin	1823701	1047	SIMSBORO SAND MEMBER OF ROCKDALE FORMATION	33.640833	-96.211666	13.1	0.87	0.5	277	1	0.07	13.2	411.26	204	50	0.98	0.22	763	99	58.6	7.1
Fannin	1829905	1330	YEGUA FORMATION AND JACKSON GROUP	33.507777	-96.382221	14.6	0.5	0.5	227	1	0.05	12	390.51	136	31.3	0.66	0.22	615	99	54.32	6.73
Fannin	1830601	437	SPILLER SAND MEMBER OF COOK MOUNTAIN FORMATION	33.578332	-96.273888	12.75 ± 0.64	1.36	0.53 ± 0.04	342 ± 22.63	1.26 ± 0.13	0.12 ± 0.01	38.7 ± 0.42	714.52 ± 25.02	80.55 ± 6.01	32.9 ± 1.7	2.57 ± 0.23	0.16 ± 0.09	864 ± 43.84	99	63.11 ± 3.35	12.89 ± 0.42
Fannin	1831301	1237	CHICOT AQUIFER,UPPER	33.620277	-96.167499	14.15 ± 2.47	1.04 ± 0.09	0.49 ± 0.01	330 ± 8.49	1.31 ± 0.01	0.07	14.98 ± 14.46	463.78 ± 34.59	215.5 ± 14.85	76.65 ± 0.49	1.49 ± 0.16	1.06 ± 0.87	884.5 ± 27.58	99	67.02 ± 3.83	8.01 ± 0.09
Fannin	1832503	1630	BOLSON DEPOSITS	33.574721	-96.076666	16.7	1.04	0.51	351	1.39	0.08	3.31	458.22	259	80.3	1.34	0.09	940	99	70.48	7.53
Fannin	1838404	1602	BEAUMONT CLAY,LISSIE FORMATION AND GOLIAD SAND	33.430554	-96.338055	14.27 ± 1.86	0.82 ± 0.09	0.43 ± 0.13	301 ± 25.87	1.02 ± 0.11	0.06 ± 0.01	12.46 ± 6.53	422.53 ± 24.48	218 ± 13.08	43.8 ± 1.91	1.25 ± 0.17	0.25 ± 0.17	800.67 ± 46.31	99	68.07 ± 12.69	7.26 ± 0.21
Fannin	1839501	1595	CALVERT BLUFF FORMATION AND SIMSBORO SAND MEMBER	33.435833	-96.16861	16	0.93	0.5	307	2.5	0.09	8.4	446.65	189	54	1.22	0.22	799	99	63.83	7.51
Fannin	1839601	1693	CANE RIVER FORMATION	33.458055	-96.165	15.6	1.14	0.5	295	1.15	0.1	8.4	418.58	260	51.3	1.08	0.22	840	99	57.96	7.04
Fannin	1839701	1690	BEAUMONT CLAY,LISSIE FORMATION AND GOLIAD SAND	33.388888	-96.244721	16.2 ± 0.14	0.63 ± 0.18	0.41 ± 0.13	287.5 ± 27.58	1.06 ± 0.05	0.08	5.52 ± 2.71	442.14 ± 7.44	179.5 ± 6.36	39.35 ± 14.78	0.91 ± 0.22	0.16 ± 0.09	748 ± 25.46	99	69.71 ± 7.88	7.37 ± 0.22
Fannin	1840102	1800	BOLSON DEPOSITS	33.469166	-96.091944	17.3	1.06	0.5	288	1.18	0.09	9.6	455.19	202	51.6	1.33	0.22	796	99	57.78	7.69
Freestone	3825104	545	MESILLA BOLSON	33.827499	-101.852222	15.8	15.3	1.73	119	1.27	0.9		245.29	46.5	23.4	0.07	0.22	344	85	7.69	3.11
Freestone	3825105	545	WECHES FORMATION OF CLAIBORNE GROUP	33.827499	-101.852222	15.2	16.8	1.58	105	1.41	0.94	3.77	237.63	46.7	23.3	0.08	0.09	331	82	6.56	3.05
Freestone	3826110	45	LISSIE FORMATION AND GOLIAD SAND	33.827499	-101.852222	44.5	1.89	1.02	16.6	2.08	0.04		15.86	21	9.42	0.03	4.13	108	80	2.42	0.08
Freestone	3907604	333	LISSIE FORMATION AND GOLIAD SAND	33.827499	-101.852222	41.5	40.1	9.56	58.5	2.3	0.66		206.23	35.6	45.8	0.25	0.09	336	48	2.15	0.59
Freestone	3915812	500	LEONA FORMATION AND WILCOX GROUP	33.827499	-101.852222	15.25 ± 3.18	7.77 ± 0.21	1.78 ± 0.01	105 ± 5.66	1.52 ± 0.3	0.34 ± 0.02	3.52 ± 0.11	244.23 ± 15.31	40.1 ± 3.39	12.24 ± 4.61	0.1 ± 0.01	0.16 ± 0.09	307.5 ± 12.02	89	8.85 ± 0.39	3.59 ± 0.25
Freestone	3915813	460	LEONA FORMATION AND WILCOX GROUP	33.827499	-101.852222	15.1	5.93	1.28	126	1.23	0.24	11.96	253.9	32.75	26.9	0.34	0.09	338	93	12.23	4.15
Freestone	3922412	280	LEONA FORMATION AND WILCOX GROUP	33.827499	-101.852222	27.01 ± 1.41	13.95 ± 2.62	5.09 ± 0.91	71.95 ± 3.89	1.72 ± 0.33	0.39 ± 0.05		187.93 ± 3.45	4.46 ± 0.37	45.25 ± 1.63	0.22 ± 0.02	0.16 ± 0.09	262 ± 1.41	73.5 ± 4.95	4.23 ± 0.62	1.97 ± 0.26
Freestone	3922513	340	LEONA FORMATION AND WILCOX GROUP	33.827499	-101.852222	21.9	12.2	3.66	84	1.51	0.39	4.8	189.15	8.79	45.65	0.34	0.51	262	79.5	5.44	2.27
Freestone	3922907	680	LEONA FORMATION AND WILCOX GROUP	33.827499	-101.852222	16.1	3.14	0.77	95.3	0.88	0.12	5.54	229.13	13.1	10.1	0.17	0.09	257	94	12.5	3.72
Freestone	3923104	525	LISSIE FORMATION AND GOLIAD SAND	33.827499	-101.852222	13.6	3.46	0.69	119	0.83	0.13	18.72	246.26	8.53	27.6	0.29	0.09	314	96	15.28	4.43
Freestone	3923303	726	LISSIE FORMATION AND GOLIAD SAND	33.827499	-101.852222	17.15 ± 0.92	1.69 ± 0.88	0.36 ± 0.2	128 ± 9.9	1	0.1 ± 0.01	7.34 ± 1.9	258.43 ± 7.3	24.05 ± 0.64	13.7	0.13	0.16 ± 0.09	320 ± 12.73	97.5 ± 0.71	23.73 ± 4.74	4.37 ± 0.08
Freestone	3923312	648	WILCOX GROUP	33.827499	-101.852222		5.11	0.99	97.7			3.6	253.83	16.8	9.7	0.2	0.04	258	92	10.36	3.94
Freestone	3923314	730	WILLIS SAND	33.827499	-101.852222		4.8	0.9	129.2			14.4	288	15.5	14.4	0.2		321	95	14.19	4.88
Freestone	3923315	700	WILLIS SAND	33.827499	-101.852222	18.7	4.26	0.67	111	0.86	0.19	16.56	239.67	16.3	8.86	0.25	0.09	296	95	13.19	4.21
Freestone	3923508	598	TAHOKA FORMATION, FREDERICKSBURG GROUP, AND ANTLERS SAND	33.827499	-101.852222	14.8	2.19	0.47	149	0.73	0.09	13.8	325.83	9.7	26.2	0.28	0.09	377	97	23.83	5.65
Freestone	3923606	706	QUEEN CITY SAND OF CLAIBORNE GROUP	33.827499	-101.852222	16.4	2.45	0.42	118	0.63	0.13	8.64	278.97	12.8	9.53	0.11	0.09	306	97	18.33	4.7
Freestone	3924104	755	OGALLALA FORMATION,FREDERICKSBURG GROUP,AND ANTLERS SAND	33.827499	-101.852222		0.52	0.5	124			7.2	302.65	9.92	23.9	0.14	0.04	315	98	29.45	5.13
Freestone	3924204	580	LEONA FORMATION AND WILCOX GROUP	33.827499	-101.852222	30.9	34.1	7.82	49.6	2.71	0.96		244.06	20.1	10.5	0.23	0.09	277	48	1.99	1.65
Freestone	3924703	690	LEONA FORMATION AND WILCOX GROUP	33.827499	-101.852222		27.9	6.92	58.2				217.22	34.5	24	0.15	0.09	258	56	2.56	1.6
Freestone	3924704	650	LEONA FORMATION AND WILCOX GROUP	33.827499	-101.852222	26.6	31.4	7.31	57.9	2.34	0.98		218.44	37.1	20.3	0.21	0.09	292	54	2.41	1.41
Freestone	3930303	815	LEONA FORMATION AND WILCOX GROUP	33.827499	-101.852222	18 ± 0.28	6.91 ± 0.76	1.8 ± 0.02	90.4 ± 3.96	1.23 ± 0.08	0.43	5.99	225.17 ± 6.02	12.3 ± 0.42	23.55 ± 1.48	0.25 ± 0.01	0.16 ± 0.09	268.5 ± 3.54	88.5 ± 0.71	7.93 ± 0.03	3.3
Freestone	3930609	472	LEONA FORMATION AND WILCOX GROUP	33.827499	-101.852222	18.4	28.3	7.83	57.5	2.57	1.54		212.34	30	24.9	0.07	0.09	276	55	2.46	1.42
Freestone	3931105	630	LISSIE FORMATION AND GOLIAD SAND	33.827499	-101.852222	15.7	3.44	0.85	96.3	1.13	0.14	4.99	231.47	17.5	9.6	0.12	0.09	264	95	12.05	3.71
Freestone	3931411	395	TAHOKA FORMATION, FREDERICKSBURG GROUP, AND ANTLERS SAND	33.827499	-101.852222	23.15 ± 0.92	37.6 ± 1.27	7.78 ± 0.42	87.85 ± 1.06	2.99 ± 0.19	1.09 ± 0.01		254.44 ± 6.04	60.8 ± 3.39	34.45 ± 3.89	0.1 ± 0.02	0.16 ± 0.09	380.5 ± 10.61	60 ± 1.41	3.41 ± 0.11	1.66 ± 0.01
Freestone	3932209	405	SIMSBORO SAND MEMBER OF ROCKDALE FORMATION	33.827499	-101.852222	27.45 ± 0.49	41.7 ± 2.26	8.1 ± 0.49	39.75 ± 2.47	2.56 ± 0.21	2.21 ± 0.06		232.48 ± 0.86	25.75 ± 0.21	13.05 ± 0.07	0.08	0.16 ± 0.09	275 ± 5.66	38	1.48 ± 0.05	1.07 ± 0.13
Grayson	1803901	291	CHICOT AQUIFER,UPPER	33.889166	-96.64861	20.85 ± 0.92	147 ± 7.07	17.65 ± 0.49	161.5 ± 14.85	3.43 ± 0.03	2.5 ± 0.02		396.62 ± 17.26	65.35 ± 10.96	288.5 ± 37.48	0.24 ± 0.23	0.11 ± 0.02	901.5 ± 24.75	44 ± 2.83	3.36 ± 0.38	
Grayson	1810106	648	DAKOTA SANDSTONE OR FORMATION	33.840555	-96.837777	11.25 ± 0.78	2.9 ± 0.05	0.81 ± 0.12	320.5 ± 34.65	1.91 ± 0.04	0.3 ± 0.04	10.72 ± 3.68	501.12 ± 18.71	93.15 ± 5.87	106.5 ± 3.54	1.42 ± 0.04	1.07 ± 0.76	796 ± 32.53	98	42.92 ± 3.39	8.36 ± 0.17
Grayson	1810107	734	DAKOTA SANDSTONE OR FORMATION	33.834721	-96.836666	9	3.3	1.1	317	1.8			483.26	110	136	0.97		816	98	38.6	7.67
Grayson	1810703	1218	DAKOTA SANDSTONE OR FORMATION	33.764166	-96.867777	11.67 ± 1.47	1.53 ± 0.4	0.43 ± 0.16	230.33 ± 10.02	0.97 ± 0.05	0.12 ± 0.03	24.06 ± 1.44	444.12 ± 39.6	63.3 ± 4.86	34.53 ± 11.08	0.54 ± 0.14	0.52 ± 0.39	578 ± 26.66	99	43.06 ± 4.48	7.7 ± 0.19
Grayson	1811505	615	DAKOTA SANDSTONE OR FORMATION	33.805833	-96.705833	13.45 ± 0.64	85.95 ± 0.64	5.07 ± 0.06	12.49 ± 7.09	0.56 ± 0.04	0.19 ± 0.02		273.97 ± 12.94	15.65 ± 0.64	12.3 ± 7.79	0.18 ± 0.01	4.61 ± 0.06	284.5 ± 21.92	9.5 ± 4.95	0.35 ± 0.2	
Grayson	1811803	458	CALVERT BLUFF FORMATION AND SIMSBORO SAND MEMBER	33.758611	-96.669999	16.6	2.84	0.64	137	1.11	0.07	4.06	335.89	23.2	8.97	0.35	1.6	361	96	19.12	5.45
Grayson	1811806	470	EAGLE FORD SHALE	33.758611	-96.669166	13.5	8.9	2.5	138	2.4	0.17	12	353.9	24	11	0.2	0.44	387	90	10.53	5.55
Grayson	1812401	295	YEGUA FORMATION AND JACKSON GROUP	33.797777	-96.608888	10.4	14.8	4.44	549	3.81	1.54		514.99	81.8	571	1.8	0.49	1492	95	32.15	7.34
Grayson	1817502	1595	QUEEN CITY SAND,CARRIZO SAND AND WILCOX GROUP	33.669721	-96.933333	12.2 ± 1.78	8.06 ± 0.82	2.71 ± 0.3	333.67 ± 20.26	2.74 ± 1.18	0.63 ± 0.04		401.08 ± 12.22	38.97 ± 4.48	279 ± 8.19	0.33 ± 0.18	0.21 ± 0.2	875.33 ± 36.14	95.67 ± 0.58	26 ± 1.39	5.95 ± 0.14
Grayson	1817909	1507	SALT BOLSON AND TERTIARY VOLCANICS	33.663611	-96.902222	13.55 ± 2.9	2.92 ± 0.88	1.25 ± 0.35	249.5 ± 48.79	1.39 ± 0.13	0.21 ± 0.09	16.23 ± 19.48	380.7 ± 51.71	55.95 ± 4.17	109.5 ± 55.86	0.27 ± 0.09	0.28 ± 0.23	638 ± 118.79	97.5 ± 0.71	30.87 ± 1.52	6.53 ± 0.13
Grayson	1818102	1534	DAKOTA SANDSTONE OR FORMATION	33.718332	-96.874721	13.07 ± 1.86	1.09 ± 0.1	0.38 ± 0.11	216.33 ± 8.62	0.86 ± 0.05	0.07 ± 0.01	21.48 ± 15.1	425.25 ± 41.21	54.47 ± 4.24	30.5 ± 2.34	0.33 ± 0.06	0.27 ± 0.25	540.33 ± 15.01	99	45.8 ± 3.73	7.36 ± 0.24
Grayson	1818903	420	LEONA FORMATION AND WILCOX GROUP	33.629443	-96.769443	12.9	0.98	0.27	284	0.83	0.06	41.88	562.82	51.3	8.22	0.76	0.15	678	99	65.51	10.55
Grayson	1820609	1130	LEONA FORMATION AND WILCOX GROUP	33.697499	-96.534166	11.57 ± 1.46	2.28 ± 0.29	0.62 ± 0.08	306 ± 14.11	1.39 ± 0.1	0.13 ± 0.02	21.8 ± 5.82	558.92 ± 11.45	75.73 ± 5.3	65.7 ± 9.25	1.5 ± 0.27	0.21 ± 0.2	761.67 ± 26.1	98.33 ± 0.58	46.48 ± 3.33	9.72 ± 0.36
Grayson	1820703	2136	LEONA FORMATION AND WILCOX GROUP	33.644999	-96.621388	15.23 ± 2.35	3.25 ± 0.39	0.95 ± 0.13	372.67 ± 28.36	2.15 ± 0.31	0.24 ± 0.03	14.76	418.74 ± 15.06	107 ± 8.19	267.67 ± 16.8	0.57 ± 0.24	0.21 ± 0.2	980.33 ± 51.33	98	46.83 ± 2.83	6.78 ± 0.14

County	State Well Number	Well Depth	Aquifer	Latitude	Longitude	Dissolved Silica (mg/L as SIO2)	Calcium (mg/L as CaCO3)	Magnesium (mg/L as CaCO3)	Total Sodium (mg/L as Na)	Total Potassium (mg/L as K)	Dissolved Strontium (ug/L as Sr)	Carbonate Ion (mg/L as CO3)	Bicarbonate Ion (mg/L as HCO3)	Total Sulfate (mg/L as SO4)	Total Chloride (mg/L as Cl)	Total Fluoride (mg/L as F)	Total Nitrate Nitrogen (mg/L as NO3)	TDS (mg/L)	Percent Sodium	Sodium Adsorption Ratio (SAR)	Residual Sodium Carbonate
Grayson	1820801	1025	LEONA FORMATION AND WILCOX GROUP	33.638888	-96.577499	15.9	0.72	0.2	103	0.68	0.03		226.98	39	8.58	0.46	0.09	280	98	27.68	3.67
Grayson	1825201	1400	DAKOTA SANDSTONE OR FORMATION	33.58861	-96.940555	12.57 ± 1.74	1.15 ± 0.14	0.36 ± 0.12	190 ± 10.58	0.83 ± 0.07	0.05 ± 0.01	17.7 ± 14.85	397.83 ± 36.14	40.83 ± 1.36	22.23 ± 0.71	0.23 ± 0.06	0.68 ± 0.74	476 ± 14.8	99	39.88 ± 3.47	6.82 ± 0.21
Grayson	1825601	1524	YEGUA FORMATION AND JACKSON GROUP	33.560555	-96.910277	13.6	1.07	0.24	202	0.83	0.04	31.32	343.89	42.6	57	0.25	0.09	518	99	45.95	6.61
Grayson	1825603	1460	YEGUA FORMATION AND JACKSON GROUP	33.560833	-96.910277	12.45 ± 2.33	1.17 ± 0.04	0.46 ± 0.06	207 ± 4.24	0.6 ± 0.29	0.06	36.24 ± 6.45	361.96 ± 1.04	44 ± 1.41	50.1 ± 8.63	0.21 ± 0.01	0.27 ± 0.25	530 ± 1.41	98.5 ± 0.71	41.17 ± 0.74	7.04 ± 0.18
Grayson	1826102	1575	CHICOT AQUIFER,UPPER	33.622221	-96.864444	13.75 ± 2.62	0.97 ± 0.18	0.39 ± 0.16	218 ± 4.24	0.82 ± 0.12	0.03	33.72	412.96 ± 56.26	49.55 ± 4.88	37.45 ± 6.43	0.27 ± 0.18	1.41 ± 1.37	542.5 ± 7.78	99	48.01 ± 7.54	7.25 ± 0.1
Grayson	1827801	950	GULF COAST AQUIFER	33.532499	-96.701944	12.7 ± 2.97	0.49 ± 0.01	0.35 ± 0.21	177.5 ± 0.71	0.54 ± 0.06	0.03	24.12 ± 1.53	354.88 ± 1.38	72.05 ± 12.66	10.1 ± 0.14	0.86 ± 0.06	0.27 ± 0.25	473.5 ± 10.61	99	48.41 ± 8.57	6.57 ± 0.01
Grayson	1827803	2250	MIDWAY GROUP	33.532499	-96.701944	15.5 ± 2.29	1.25 ± 0.15	0.36 ± 0.12	265.33 ± 23.46	0.84 ± 0.08	0.05 ± 0.01	21.78 ± 17.23	508.23 ± 59.73	90.9 ± 9.4	31.83 ± 4.25	0.84 ± 0.24	0.21 ± 0.2	671 ± 39.36	99	54.18 ± 6.71	8.72 ± 0.87
Grayson	1828403	1090	YEGUA FORMATION AND JACKSON GROUP	33.547221	-96.603055	11.95 ± 2.33	1.06 ± 0.06	0.43 ± 0.11	346.5 ± 33.23	1.02 ± 0.03	0.09	32.22 ± 5.35	600.17 ± 44.53	124.5 ± 14.85	39.8 ± 0.28	1.75 ± 0.08	0.27 ± 0.25	854.5 ± 36.06	99	72.37 ± 11.68	10.82 ± 0.57
Grayson	1828404	2500	EAGLE FORD SHALE	33.553333	-96.602222	16.95 ± 0.49	1.42 ± 0.11	0.43 ± 0.01	281.5 ± 21.92	0.94 ± 0.02	0.1 ± 0.01	18.12 ± 20.53	483.01 ± 34.86	110 ± 2.83	52.65 ± 1.91	0.78 ± 0.07	0.09	720 ± 19.8	99	53.33 ± 5.71	8.42 ± 0.12
Grayson	1828604	1339	CHICOT AQUIFER,UPPER	33.569166	-96.522777	11.7	0.5	0.5	184	1.1	0.02	10.8	336.81	82	21	0.9	0.89	479	99	44.02	5.81
Grayson	1829301	709	CHICOT AQUIFER,UPPER	33.610277	-96.408611	11.95 ± 2.47	1.48 ± 0.67	0.58 ± 0.11	302.5 ± 38.89	1.23 ± 0.6	0.14 ± 0.07	30.54 ± 2.63	354.63 ± 95.6	254 ± 107.48	52.8 ± 23.76	1.84 ± 0.34	0.27 ± 0.25	831.5 ± 123.74	98.5 ± 0.71	54.17 ± 2.67	6.71 ± 1.69
Grayson	1829304	1600	CHICOT AQUIFER,UPPER	33.608055	-96.408611	14.17 ± 2	1.32 ± 0.29	0.33 ± 0.15	346 ± 21.79	1.17 ± 0.38	0.09 ± 0.02	35.04 ± 1.19	658.25 ± 53	108.93 ± 40.88	44.97 ± 9.39	1.94 ± 0.54	0.32 ± 0.2	866 ± 76.37	99	70.59 ± 5.08	11.47 ± 0.18
Grayson	1829702	1475	CHICOT AQUIFER,UPPER	33.520554	-96.485277	14.35 ± 3.46	0.78 ± 0.04	0.41 ± 0.13	302 ± 25.46	0.95 ± 0.06	0.07	14.06 ± 5.57	433.92 ± 99.36	162 ± 11.31	41.1 ± 1.56	1.59 ± 0.16	0.27 ± 0.25	750.5 ± 61.52	99	69.66 ± 11.74	7.51 ± 1.46
Grayson	1829902	1189	CHICOT AQUIFER,UPPER	33.513055	-96.390277	11.5	1.8	0.7	446	1.9	0.18	45.6	744.41	48	180	2.9	0.44	1105	99	71.45	13.57
Grayson	1833303	1500	REKLAW FORMATION OF CLAIBORNE GROUP	33.466943	-96.913611	13 ± 1.82	1.01 ± 0.1	0.33 ± 0.15	186 ± 5.29	0.63 ± 0.14	0.04 ± 0.01	35.2 ± 3.88	325.83 ± 27.3	65.77 ± 1.2	13.77 ± 0.21	0.2	0.21 ± 0.2	476 ± 21.28	99	41.48 ± 3.45	6.44 ± 0.53
Grayson	1835407	2165	QUEEN CITY SAND,CARRIZO SAND AND WILCOX GROUP	33.449166	-96.748055	15.4 ± 1.78	1.22 ± 0.07	0.38 ± 0.12	217.67 ± 8.5	0.82 ± 0.03	0.07 ± 0.02	25.36 ± 6.54	315.34 ± 5.96	145.67 ± 7.02	23.57 ± 4.27	0.21 ± 0.09	0.21 ± 0.2	585 ± 5	99	44.27 ± 2.68	5.92 ± 0.27
Grayson	1835601	1023	SPILLER SAND MEMBER OF COOK MOUNTAIN FORMATION	33.453333	-96.644999	11.4 ± 0.99	1.45 ± 0.21	0.55 ± 0.06	320 ± 5.66	1.17 ± 0.18	0.13 ± 0.05	48.12 ± 16.8	608.1 ± 52.29	84.9 ± 2.97	24.85 ± 1.63	1.27 ± 0.38	0.27 ± 0.25	793	99	57.78 ± 4.85	11.45 ± 0.28
Grayson	1835603	2508	SIMSBORO SAND MEMBER OF ROCKDALE FORMATION	33.423888	-96.644721	15.6 ± 2.4	1.91 ± 0.87	0.78 ± 0.68	239.93 ± 12.41	0.87 ± 0.05	0.09 ± 0.01	25.86 ± 8.47	453.79 ± 23.08	79.73 ± 7.47	26.83 ± 16.85	1.04 ± 0.45	0.27 ± 0.25	607.25 ± 19.24	98.25 ± 0.96	39.88 ± 8.13	8.14 ± 0.14
Grayson	1836302	1450	SPILLER SAND MEMBER OF COOK MOUNTAIN FORMATION	33.482221	-96.536388	12.25 ± 0.92	0.73 ± 0.06	0.42 ± 0.14	223.23 ± 14.68	0.85 ± 0.21	0.06 ± 0.01	13.97 ± 3.49	364.1 ± 3.15	129.2 ± 24.3	23.67 ± 3.21	0.95 ± 0.14	0.27 ± 0.25	580 ± 48.14	99	52.05 ± 5.5	6.36 ± 0.08
Grayson	1836401	2378	SPILLER SAND MEMBER OF COOK MOUNTAIN FORMATION	33.434721	-96.585555	15.53 ± 1.85	1.41 ± 0.24	0.37 ± 0.13	318 ± 54.03	0.92 ± 0.09	0.06 ± 0.01	34.76 ± 13.86	631 ± 81.34	97.03 ± 20.61	23.3 ± 5.12	1.95 ± 0.54	0.21 ± 0.2	803.67 ± 114.18	99	61.6 ± 11.05	11.4 ± 1.48
Grayson	1836508	2396	TAHOKA FORMATION, FREDERICKSBURG GROUP, AND ANTLERS SAND	33.435833	-96.570554	14.8 ± 1.7	1.26 ± 0.08	0.38 ± 0.17	323 ± 24.04	0.94 ± 0.06	0.05 ± 0.01	38.34 ± 13.66	674.36 ± 33.83	93.5 ± 9.19	20.85 ± 1.2	2.45 ± 0.35	0.27 ± 0.24	827.5 ± 38.89	99	65.12 ± 8.34	12.23 ± 0.11
Grayson	1836601	2432	QUEEN CITY SAND,CARRIZO SAND AND WILCOX GROUP	33.431388	-96.503333	15.75 ± 3.32	0.61 ± 0.4	0.2	265 ± 79.2	0.82 ± 0.02	0.04 ± 0.02	26.28 ± 17.99	487.17 ± 148.08	85.35 ± 11.67	23.75 ± 2.19	1.26 ± 0.36	0.09	658.5 ± 164.76	99	75.72 ± 6.11	8.82 ± 3.01
Grayson	1836602	1527	SALT BOLSON AND TERTIARY VOLCANICS	33.431943	-96.504166	12.9 ± 0.99	0.48 ± 0.03	0.35 ± 0.21	214.5 ± 3.54	0.77 ± 0.04	0.04 ± 0.01	18.3 ± 6.36	394.78 ± 6.04	87.6 ± 6.22	19.55 ± 2.05	0.88 ± 0.11	0.27 ± 0.25	549.5 ± 14.85	99.5 ± 0.71	58.81 ± 9.74	7.03 ± 0.09
Grayson	1837602	1598	RIO GRANDE ALLUVIUM	33.428054	-96.401944	13.15 ± 0.78	0.63 ± 0.04	0.37 ± 0.18	263.5 ± 3.54	1.25 ± 0.49	0.06 ± 0.01	15.6 ± 5.09	413.7 ± 15.54	162 ± 4.24	33.85 ± 3.04	0.98 ± 0.54	0.27 ± 0.25	695.5 ± 7.78	99.5 ± 0.71	65.66 ± 6.07	7.23 ± 0.1
Grayson	1837603	1800	TERRACE DEPOSITS	33.42361	-96.402222	13.1 ± 0.85	0.69 ± 0.12	0.39 ± 0.16	278.5 ± 2.12	1.28 ± 0.45	0.06 ± 0.01	16.86 ± 5.01	427 ± 17.09	178.5 ± 0.71	38.6 ± 1.98	1.02 ± 0.59	0.27 ± 0.25	739.5 ± 3.54	99	66.69 ± 3.93	7.49 ± 0.12
Henderson	3356607	430	OGALLALA FORMATION,FREDERICKSBURG GROUP,AND ANTLERS SAND	33.827499	-101.852222	15.45 ± 1.06	1.23 ± 0.69	0.41 ± 0.13	115 ± 7.07	0.94 ± 0.09	0.05 ± 0.01	11.21 ± 1.12	206.02 ± 3.14	5.93 ± 4.44	52.15 ± 1.48	0.1	0.16 ± 0.09	303 ± 12.73	97.5 ± 0.71	23.2 ± 1.45	3.66 ± 0.01
Henderson	3441406	260	GULF COAST AQUIFER	33.827499	-101.852222	29.1 ± 0.71	17.1 ± 0.57	3.58 ± 0.06	86.45 ± 3.89	2.59 ± 0.09	0.41 ± 0.02		208.68 ± 3.45	30 ± 1.84	42.25 ± 0.07	0.1 ± 0.01	0.16 ± 0.09	313.5 ± 3.54	76	4.97 ± 0.15	2.28 ± 0.02
Henderson	3442110	747	MESILLA BOLSON	33.827499	-101.852222	15.6	3.33	0.55	180	1.12	0.13	6.41	268.87	1	126	0.21	0.09	466	97	24.08	4.41
Henderson	3442403	587	WECHES FORMATION OF CLAIBORNE GROUP	33.827499	-101.852222	12.6	5.4	1.2	97.8	1.4	0.17	4.8	162.3	80	16	0.1	0.44	300	92	9.91	2.45
Henderson	3442902	42	LISSIE FORMATION AND GOLIAD SAND	33.827499	-101.852222	28.6	10.7	4.65	75.6	4.76	0.13		18.31	60.4	114	0.04	0.22	308	78	4.86	
Henderson	3442903	30	LISSIE FORMATION AND GOLIAD SAND	33.827499	-101.852222	37.3	39.9	4.07	97.2	3.09	0.17		235.53	44.9	60.1	0.29	16.11	418	64	3.92	1.53
Henderson	3443708	0	LEONA FORMATION AND WILCOX GROUP	33.827499	-101.852222	13.95 ± 0.49	8.41 ± 0.87	1.03 ± 0.01	65.95 ± 3.46	1.26 ± 0.09	0.34 ± 0.01		167.8 ± 0.86	22.5	12.4	0.11 ± 0.02	0.16 ± 0.09	208.5 ± 3.54	84.5 ± 0.71	5.72 ± 0.06	2.25 ± 0.06
Henderson	3443807	980	LEONA FORMATION AND WILCOX GROUP	33.827499	-101.852222	14.1	8.42	0.84	81.2	1.1	0.29		170.84	44.5	16.5	0.14	0.09	251	88	7.14	2.31
Henderson	3443908	35	LEONA FORMATION AND WILCOX GROUP	33.827499	-101.852222	15.9	11	1.99	8.58	2.79	0.07		26.85	15.8	5.18	0.02	18.37	92	34	0.63	
Henderson	3443909	40	LEONA FORMATION AND WILCOX GROUP	33.827499	-101.852222	44.1	5.45	0.99	21.8	1.75	0.02		20.01	7.83	20.3	0.06	16.96	129	72	2.26	
Henderson	3444707	786	REKLAW FORMATION OF CLAIBORNE GROUP	33.827499	-101.852222	15.65 ± 0.49	1.65 ± 0.71	0.42 ± 0.11	106.5 ± 6.36	0.91 ± 0.13	0.1 ± 0.01	7.52	203.47 ± 9.09	33.2 ± 0.28	16.05 ± 0.21	0.1 ± 0.01	0.16 ± 0.09	278 ± 5.66	97.5 ± 0.71	19.44 ± 3.36	3.34
Henderson	3445507	520	QUATERNARY SYSTEM	33.827499	-101.852222		2.4	1.4	96.1			7.2	190.37	31	14.4	0.3		246	94	12.2	3.13
Henderson	3449511	586	SPILLER SAND MEMBER OF COOK MOUNTAIN FORMATION	33.827499	-101.852222	17.6	9.14	1.38	56.5	1.59	0.28		168.4	6.34	8.94	0.16	0.09	185	81	4.6	2.19
Henderson	3450307	540	SIMSBORO SAND MEMBER OF ROCKDALE FORMATION	33.827499	-101.852222	28.6	20.1	3.14	48.63	3.28	0.8	4.8	138.24	36.03	12.6	0.24	0.09	197.75	59.75	4.39	1.05
Henderson	3450409	794	SPILLER SAND MEMBER OF COOK MOUNTAIN FORMATION	33.827499	-101.852222	22.5	7.78	1.34	41.6	1.22	0.29		130.58	6.04	6.18	0.11	0.22	151	78	3.62	1.64
Henderson	3451906	61	QUEEN CITY SAND OF CLAIBORNE GROUP	33.827499	-101.852222	17.9 ± 2.69	28.45 ± 13.93	1.86 ± 0.51	4.48 ± 1.63	3.9 ± 0.56	0.13 ± 0.01		87.99 ± 38.14	4.95 ± 0.31	6.82 ± 3.3	0.02 ± 0.01	12.27 ± 4.01	123.5 ± 44.55	11 ± 1.41	0.22 ± 0.03	
Henderson	3452313	770	TAHOKA FORMATION, FREDERICKSBURG GROUP, AND ANTLERS SAND	33.827499	-101.852222		2.13	0.71	145				237.97	26.76	11.5	0.2	0.01	303	97	21.98	3.74
Henderson	3457406	614	QUEEN CITY SAND,CARRIZO SAND AND WILCOX GROUP	33.827499	-101.852222	13.2	1.47	0.28	247	0.84	0.05	24.36	377.57	1	164	0.38	0.09	638	99	48.94	6.9
Henderson	3458403	1148	SALT BOLSON AND TERTIARY VOLCANICS	33.827499	-101.852222	20	0.5	0.5	69.7	1	0.03		180.61	12.6	3.37	0.11	0.22	196	97	16.68	2.89
Henderson	3460502	64	OGALLALA FORMATION,FREDERICKSBURG GROUP,AND ANTLERS SAND	33.827499	-101.852222	44.7 ± 16.67	8.62 ± 3.82	0.91 ± 0.41	14.3 ± 4.85	1.44 ± 0.12	0.04 ± 0.03		29.65 ± 12.49	14.56 ± 4.86	10.41 ± 3.89	0.06 ± 0.03	10.17 ± 7.04	119.67 ± 42.74	55.67 ± 2.52	1.23 ± 0.14	
Jack	1957101	80	PEN FORMATION	33.097777	-97.991944	28.78	121	60.1	194	2.65	2.31		585.77	242	153	0.34	2.79	1094	43	3.6	
Jack	1957105	98	YEGUA FORMATION AND JACKSON GROUP	33.093055	-97.995277	18	205	120	133	5.3			483.26	300	412	0.87	11.52	1443	22	1.82	
Jack	1957501	90	PEN FORMATION	33.065277	-97.94111	30	113	53.8	60.4	1.73	4.42		479.6	84.1	96.8	0.29	0.82	681	20	1.17	
Kaufman	3313801	3546	TERRACE DEPOSITS	33.827499	-101.852222		2.4	0.9	402.5			16.8	551.6	300.7	65.3	3		1062	98	56.24	9.41
Kaufman	3315402	240	OGALLALA FORMATION,FREDERICKSBURG GROUP,AND ANTLERS SAND	33.827499	-101.852222	18.3	2.53	0.55	282	1.26	0.09	18.24	410.77	151	80.5	0.81	0.09	757	98	41.89	7.17
Kaufman	3323107	230	TERRACE DEPOSITS	33.827499	-101.852222	15	2	0.42	362	1.41	0.09	25.56	356.83	314	106	0.31	0.1	1002	99	60.75	6.57
Navarro	3346707	70	OGALLALA FORMATION,FREDERICKSBURG GROUP,AND ANTLERS SAND	33.827499	-101.852222	35.6	120	5.68	30.7	0.92	0.67		351.46	54.8	29.5	0.5	9.83	461	17	0.74	
Navarro	3358501	1184	OGALLALA FORMATION,FREDERICKSBURG GROUP,AND ANTLERS SAND	33.827499	-101.852222	15.5	2.61	0.74	617	2.22	0.29	26.28	786.15	440	120	4.46	0.09	1615	99	86.82	13.57
Navarro	3904502	32	REKLAW FORMATION OF CLAIBORNE GROUP	33.827499	-101.852222	44.7	93	2.38	40.7	2.05	0.59		377.09	1	10.9	1.35	0.67	382	26	1.14	1.34
Navarro	3907407	163	SIMSBORO SAND MEMBER OF ROCKDALE FORMATION	33.827499	-101.852222	51.7	21.1	10.7	49.9	2.38	0.23		80.54	72.5	46.9	0.26	0.22	295	52	2.21	
Parker	3202103	90	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	28.7	170	72		2.8				305	282	0.64	47.84				
Parker	3202104	160	SPILLER SAND MEMBER OF COOK MOUNTAIN FORMATION	33.827499	-101.852222	30.85	130	47.2	84	3.86	0.02		435.66	108	148	0.25	17.89	784	26	1.6	
Parker	3202303	126	TERRACE DEPOSITS	33.827499	-101.852222	14.1 ± 1.7	106 ± 4.24	3.09 ± 0.16	9.89 ± 0.3	0.76 ± 0.06	0.19 ± 0.01		291.05 ± 6.04	16.25 ± 2.47	15.25 ± 0.35	0.16 ± 0.06	10.8 ± 1	319.5 ± 9.19	7	0.26	
Parker	3203213	395	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	12.02	4.33	2.13	411	1.52	0.51	13.2	458.85	118	297	0.61	0.44	1086	97	40.42	7.57
Parker	3203604	600	UVALDE GRAVEL	33.827499	-101.852222	10.65 ± 1.77	1.69 ± 0.3	0.58 ± 0.03	262.5 ± 6.36	1.02 ± 0.25	0.13	21.9 ± 5.52	448.48 ± 9.48	94.15 ± 0.21	62.8 ± 5.94	1.07 ± 0.04	0.93 ± 1.19	677.5 ± 12.02	98.5 ± 0.71	44.59 ± 1.9	7.95 ± 0.05
Parker	3203617	536	LOWER GLEN ROSE AND HOSSTON FORMATION	33.827499	-101.852222	11.97	1.49	0.56	287	0.95	0.17	25.2	422.24	106	89.6	0.77	0.4	731	99	50.88	7.64
Parker	3203903	580	LOWER GLEN ROSE AND HOSSTON FORMATION	33.827499	-101.852222	11.99	2.23	0.83	327	1.07	0.19	27.6	434.44	112	135	0.95	0.22	832	98	47.47	7.86
Parker	3203904	280	MIDWAY GROUP	33.827499	-101.852222	24.74	163	22.2	61.5	1.51	0.82		401.49	93.1	125	0.2	8.46	697	21	1.2	
Parker	3204405	410	UVALDE GRAVEL	33.827499	-101.852222	11.79	1.45	0.6	288	0.92	0.16	27.6	518.65	81.8	45.5	2.3	0.09	715	99	50.78	9.3
Parker	3204411	420	PEARSALL,SLIGO,AND HOSSTON FORMATIONS	33.827499	-101.852222	8.7	2.2	0.9	303	1.3	0.2	18	594.3	61	72	3.8	0.44	764	99	43.47	10.15
Parker	3204504	528	OGALLALA FORMATION,FREDERICKSBURG GROUP,AND ANTLERS SAND	33.827499	-101.852222	12.03	2.04	0.82	359	1.13	0.27	21.6	439.32	202	135	1.45	0.09	951	98	53.68	7.75
Parker	3210102	230	OGALLALA FORMATION,FREDERICKSBURG GROUP,AND ANTLERS SAND	33.827499	-101.852222	22.3	60.6	22.6	37.4	1.97	1.98		329.49	18.8	24.2	0.15	0.09	352	24	1.04	0.52
Parker	3210714	200	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	14.15 ± 0.64	116.5 ± 2.12	6.27 ± 1.88	5.66 ± 1.2	0.87 ± 0.18	0.39 ± 0.1		323.39 ± 5.18	35.05 ± 1.48	6.15 ± 0.21	0.16 ± 0.06	2.6 ± 0.09	346.5 ± 2.12	3.5 ± 0.71	0.14 ± 0.02	
Parker	3211810	179	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	17.32	121	3.47	20.6	1.03	0.33		322.17	26.9	42.1	0.11	2.21	393	12	0.5	
Parker	3211818	153	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	13.3	114	6.4	7.2	1.1	0.51		341.69	19	4	0.1	0.44	334	5	0.17	
Parker	3211908	650	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	12.01	2.27	0.72	260	1.12	0.16	20.4	490.58	58.9	41.7	0.72	1.24	640	98	38.51	8.55
Parker	3212203	210	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	17.8	108	4.68	6.91	0.89	0.58		305.09	33	6.85	0.14	0.09	328	4	0.18	
Parker	3218105	380	QUEEN CITY SAND,CARRIZO SAND AND WILCOX GROUP	33.827499	-101.852222	18.4 ± 2.4	88.55 ± 2.9	36.05 ± 0.78	52 ± 1.27	3.04 ± 0.08	2.17 ± 0.01		407.59 ± 5.18	75.65 ± 3.32	40.15 ± 4.03	0.18 ± 0.03	0.27 ± 0.25	516.5 ± 13.44	23	1.18 ± 0.01	
Parker	3218402	240	TERRACE DEPOSITS	33.827499	-101.852222	19.98	64.8	34.6	49.2	3.78	3.51		403.93	37.1	27.9	0.26	1.2	440	26	1.23	0.54
Parker	3219303	250	OGALLALA FORMATION,FREDERICKSBURG GROUP,AND ANTLERS SAND	33.827499	-101.852222	19.6 ± 2.4	59.55 ± 2.47	18.6 ± 0.42	41 ± 0.42	2.51 ± 0.01	2.38 ± 0.03		330.1 ± 6.04	32.3 ± 0.99	6.08 ± 1.53	0.1 ± 0.01	0.27 ± 0.25	344.5 ± 3.54	28	1.19 ± 0.01	0.91 ± 0.06
Parker	3219612	580	UVALDE GRAVEL	33.827499	-101.852222	16.5	82.8	10	49.5	1.8	1.43		330.71	61	4	0.2	0.44	390	30	1.36	0.46
Parker	3225101	90	WECHES FORMATION OF CLAIBORNE GROUP	33.827499	-101.852222	30.7	74.7	10.9	28.5	1.41	0.37		245.29	53.4	18.7	0.16	15.1	354	21	0.82	
Parker	3226602	385	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	12.9	1.1	0.44	224	0.99	0.09	30.24	457.14	35	22.3	0.37	0.09	552	99	45.66	8.41
Tarrant	3204601	650	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	12.1	1.71	0.79	329	1.02	0.2	20.88	483.5	203	91.2	1.1	0.78	899	98	52.2	8.47
Tarrant	3204602	535	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	19.75 ± 2.76	38.9 ± 1.98	9.9 ± 1.98	88.4 ± 19.23	2.65 ± 0.21	0.66 ± 0.48		259.32 ± 4.31	49.9 ± 6.93	49.65 ± 9.4	0.49 ± 0.27	60.65 ± 75.76	448.5 ± 116.67	58 ± 5.66	3.28 ± 0.76	1.49 ± 0.13
Tarrant	3205302	419	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	11.9	0.95	0.24	173	0.5	0.06	28.08	333.4	46.8	7.67	0.11	0.09	433	99	41.07	6.33
Tarrant	3205306	1000	SIMSBORO SAND MEMBER OF ROCKDALE FORMATION	33.827499	-101.852222	9.6	8.5	4.4	719	3.5	1.18	4.8	317.28	62	959	1.6	0.44	1930	98	49.88	4.57
Tarrant	3205601	400	OGALLALA FORMATION,FREDERICKSBURG GROUP,AND ANTLERS SAND	33.827499	-101.852222	13.2	0.68	0.2	176	0.46	0.05	40.56	325.1	61.3	8.95	0.13	0.09	461	99	48.23	6.63
Tarrant	3205904	1043	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	11	4.07	2.23	555	1.92	0.48	6.38	735.09	116	360	3.85	0.09	1422	98	54.91	11.87

County	State Well Number	Well Depth	Aquifer	Latitude	Longitude	Dissolved Silica (mg/L as SIO2)	Calcium (mg/L as CaCO3)	Magnesium (mg/L as CaCO3)	Total Sodium (mg/L as Na)	Total Potassium (mg/L as K)	Dissolved Strontium (ug/L as Sr)	Carbonate Ion (mg/L as CO3)	Bicarbonate Ion (mg/L as HCO3)	Total Sulfate (mg/L as SO4)	Total Chloride (mg/L as Cl)	Total Fluoride (mg/L as F)	Total Nitrate Nitrogen (mg/L as NO3)	TDS (mg/L)	Percent Sodium	Sodium Adsorption Ratio (SAR)	Residual Sodium Carbonate
Tarrant	3206403	1190	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	12.53 ± 1.63	2.46 ± 0.13	1.04 ± 0.06	399 ± 11.79	1.32 ± 0.16	0.29 ± 0.01	16.4 ± 1.28	508.88 ± 10.67	185.33 ± 7.09	181.67 ± 7.09	1.27 ± 0.21	0.21 ± 0.2	1051.33 ± 0.58	98.33 ± 0.58	53.87 ± 1.97	8.68 ± 0.12
Tarrant	3206607	625	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	13.2	0.82	0.26	203	0.59	0.06	39	397.83	32	6.69	0.2	0.09	491	99	50.03	7.76
Tarrant	3207404	615	TERRACE DEPOSITS	33.827499	-101.852222	14	0.81	0.27	195	0.59	0.07	41.64	391.24	39.2	6.72	0.52	0.09	491	99	47.93	7.74
Tarrant	3207607	804	REKLAW FORMATION OF CLAIBORNE GROUP	33.827499	-101.852222	13.25 ± 1.48	0.88 ± 0.04	0.37 ± 0.19	213 ± 1.41	0.76 ± 0.2	0.06	35.34 ± 2.46	413.82 ± 5	58.55 ± 6.29	15.83 ± 8.73	0.56 ± 0.06	0.27 ± 0.25	542 ± 12.73	99	48.8 ± 6.15	7.89 ± 0.02
Tarrant	3207903	103	TERRACE DEPOSITS	33.827499	-101.852222	16.3	68.5	9.79	38.4	1.43	0.32		244.07	40.1	43.9	0.17	4.69	343	28	1.15	
Tarrant	3207905	805	TERRACE DEPOSITS	33.827499	-101.852222	14.1	0.95	0.32	225	0.68	0.08	32.16	405.64	85.2	11.7	0.65	0.09	570	99	50.97	7.65
Tarrant	3208113	787	UVALDE GRAVEL	33.827499	-101.852222	14.9	0.86	0.24	207	0.64	0.07	36.24	341.21	77.4	12.4	0.48	0.09	518	99	50.87	6.74
Tarrant	3213103	515	PEARSALL,SLIGO,AND HOSSTON FORMATIONS	33.827499	-101.852222	11.3	1.72	0.82	323	1.11	0.19	25.56	569.17	133	37.1	1.72	0.09	815	98	50.75	10.03
Tarrant	3213415	830	TERRACE DEPOSITS	33.827499	-101.852222	10.1	2.3	1.1	332	1.6	0.24	14.4	593.08	154	65	2.2	0.44	875	99	45.07	9.99
Tarrant	3213616	424	QUEEN CITY SAND,CARRIZO SAND AND WILCOX GROUP	33.827499	-101.852222	12.6	0.76	0.32	182	0.57	0.06	34.68	379.77	50.9	10.1	0.54	0.09	479	99	44.17	7.32
Tarrant	3213714	823	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	10.95 ± 1.06	2.88 ± 0.6	1.26 ± 0.06	296.5 ± 3.54	1.56 ± 0.34	0.27 ± 0.01	12.42 ± 2.29	564.17 ± 2.93	110.5 ± 4.95	33.2 ± 2.55	1.45 ± 0.22	1.82 ± 0.69	750 ± 2.83	98	36.88 ± 3.08	9.41 ± 0.07
Tarrant	3213812	821	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	12.6	2.53	1.19	303	1.31	0.21	18.24	524.26	147	47.6	1.2	0.97	793	98	39.37	8.98
Tarrant	3215205	665	SPILLER SAND MEMBER OF COOK MOUNTAIN FORMATION	33.827499	-101.852222	11.75 ± 1.34	1.15 ± 0.06	0.48 ± 0.03	237.5 ± 13.44	0.77 ± 0.04	0.09 ± 0.01	29.04 ± 2.04	433.96 ± 7.59	96.75 ± 3.89	13.1 ± 0.14	0.85 ± 0.07	0.27 ± 0.25	604.5 ± 16.26	99	47 ± 2.45	7.98 ± 0.06
Tarrant	3215510	1456	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	14.8	1.86	0.7	313	1.17	0.19	19.56	461.78	193	102	1.55	0.09	874	98	49.65	8.07
Tarrant	3216105	1779	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	14.93 ± 2.23	1.93 ± 0.22	0.66 ± 0.06	309.67 ± 13.58	1.17 ± 0.13	0.15 ± 0.01	23.24 ± 5.3	503.51 ± 8.79	87.13 ± 5.35	114.33 ± 5.86	2.01 ± 0.34	0.21 ± 0.2	802.67 ± 18.15	98.33 ± 0.58	49.13 ± 0.53	8.87 ± 0.3
Tarrant	3216203	1746	WECHES FORMATION OF CLAIBORNE GROUP	33.827499	-101.852222	13.7	3.9	2.1	378	2.1	0.39	13.2	510.1	281	112	1.9	0.44	1060	98	38.36	8.43
Tarrant	3220301	300	TERRACE DEPOSITS	33.827499	-101.852222	22.6	60.3	14.7	25	2.9	2.54		288	45.6	7.66	0.18	0.09	323	20	0.75	0.5
Tarrant	3221505	350	RIO GRANDE ALLUVIUM	33.827499	-101.852222	13.4 ± 1.13	9.12 ± 0.82	4.34 ± 0.23	149 ± 1.41	3.43 ± 0.24	0.59		363.66 ± 1.73	58.3 ± 2.4	9.18 ± 0.25	0.7 ± 0.01	1.39 ± 1.34	428 ± 1.41	88.5 ± 0.71	10.19 ± 0.47	5.15 ± 0.04
Tarrant	3221510	855	UVALDE GRAVEL	33.827499	-101.852222	13.1	1.41	0.61	275	1.04	0.13	23.52	445.18	155	49.6	1	0.09	739	99	48.72	7.96
Tarrant	3222607	540	WECHES FORMATION OF CLAIBORNE GROUP	33.827499	-101.852222	13.4	0.98	0.35	204	0.74	0.08	31.68	370.01	69.1	13.9	0.91	0.09	517	99	45.02	7.04
Tarrant	3222611	150	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	13.1	1.18	0.38	208	0.73	0.09	31.32	398.81	65.7	12.8	0.86	0.09	530	99	42.62	7.49
Tarrant	3222907	585	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	11.85 ± 1.77	0.98 ± 0.04	0.42 ± 0.12	190 ± 2.83	0.91 ± 0.28	0.07	33.24 ± 2.88	385.75 ± 3.28	40.15 ± 2.62	10.5 ± 0.71	0.64 ± 0.08	0.27 ± 0.25	478 ± 1.41	99	40.79 ± 3.49	7.35 ± 0.06
Tarrant	3223602	773	OGALLALA FORMATION,FREDERICKSBURG GROUP,AND ANTLERS SAND	33.827499	-101.852222	13.1	2	0.4	253	1.29	0.11	32.4	422.24	111	18.9	1.08	0.09	640	98	42.72	7.87
Tarrant	3223604	1650	REKLAW FORMATION OF CLAIBORNE GROUP	33.827499	-101.852222	14.9	2.1	0.74	320	1.3	0.24	24.96	444.69	217	73.6	1.8	0.09	875	98	48.36	7.95
Tarrant	3223614	800	SIMSBORO SAND MEMBER OF ROCKDALE FORMATION	33.827499	-101.852222	10.5	1.8	0.5	247	1	0.11	27.6	428.34	105	23	1.4	0.44	629	99	41.98	7.8
Tarrant	3223705	1450	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	13.5 ± 1.41	1.89 ± 0.01	0.6	300.5 ± 3.54	1.47 ± 0.33	0.23 ± 0.01	18.66 ± 4.33	480.69 ± 13.97	134 ± 9.9	63.65 ± 3.32	1.58 ± 0.18	0.27 ± 0.25	772.5 ± 12.02	98.5 ± 0.71	48.77 ± 0.7	8.36 ± 0.08
Tarrant	3223707	1490	UVALDE GRAVEL	33.827499	-101.852222	12.3	2.3	0.9	308	2	0.39	13.2	479.59	195	59	2	0.44	831	99	43.6	8.11
Tarrant	3224117	225	TERRACE DEPOSITS	33.827499	-101.852222	15.4	21.2	8.56	141	3.13	1.51		292.88	118	48.5	0.35	0.11	501	77	6.53	3.04
Tarrant	3224501	2150	YEGUA FORMATION AND JACKSON GROUP	33.827499	-101.852222	15.1	1.93	0.93	294	1.54	0.19	14.4	469.83	156	66.2	1.85	0.04	783	98	43.5	8.01
Tarrant	3229206	396	TERRACE DEPOSITS	33.827499	-101.852222	15.35 ± 1.34	16.1 ± 0.71	8.79 ± 0.01	106.5 ± 2.12	3.9 ± 0.01	1.23 ± 0.08		311.19 ± 0.01	43.75 ± 3.18	11.25 ± 0.35	0.19 ± 0.01	0.28 ± 0.23	360.5 ± 4.95	75	5.3 ± 0.04	3.57 ± 0.04
Tarrant	3230110	550	REKLAW FORMATION OF CLAIBORNE GROUP	33.827499	-101.852222	13.4	0.85	0.5	180	0.63	0.06	37.44	357.07	42.8	9.52	0.74	0.09	461	98	38.31	7.02
Tarrant	3230301	590	SALT BOLSON AND TERTIARY VOLCANICS	33.827499	-101.852222	10.6	1	0.5	184	1.1	0.07	32.4	384.4	37	10	0.6	0.44	467	99	37.51	7.28
Tarrant	3230408	1210	PEN FORMATION	33.827499	-101.852222	13.67 ± 1.38	1.59 ± 0.3	0.55 ± 0.05	252.67 ± 28.36	1.16 ± 0.23	0.11 ± 0.01	19.08 ± 6.17	461.94 ± 38.56	78.7 ± 13.79	54.17 ± 14.92	1.49 ± 0.27	0.8 ± 1.22	650.67 ± 45.79	98.33 ± 0.58	44.15 ± 2.71	8.08 ± 0.54
Tarrant	3230605	1526	UVALDE GRAVEL	33.827499	-101.852222	14.1 ± 1.41	11.25 ± 12.8	8.8 ± 10.89	519 ± 336.58	3.2 ± 2.69	4.55 ± 5.69	20.88	427.24 ± 48.49	779 ± 920.65	41.75 ± 12.37	4.3 ± 3.96	0.27 ± 0.25	1606.5 ±	95.5 ± 3.54	34.44 ± 5.93	6.06 ± 2.83
Tarrant	3231301	171	WOODBINE SAND	33.827499	-101.852222	15.5 ± 1.84	21.4 ± 1.41	4.53 ± 0.25	32.55 ± 0.64	1.8 ± 0.28	0.38		144.61 ± 4.31	10.89 ± 5.82	10.65 ± 0.92	0.4	0.27 ± 0.25	169 ± 4.24	49.5 ± 0.71	1.67 ± 0.02	0.93 ± 0.16
Tarrant	3231510	858	REKLAW FORMATION OF CLAIBORNE GROUP	33.827499	-101.852222	14.2	1.23	0.47	248	1.05	0.11	31.2	442.99	99.4	16.2	1.58	0.71	631	99	48.23	8.2
Wise	1934605	110	OGALLALA FORMATION,FREDERICKSBURG GROUP,AND ANTLERS SAND	33.43111	-97.758055	24.1	82.4	3.2	53.6	1.12	0.15		269.7	36.4	40.5	0.1	17.31	391	34	1.58	0.05
Wise	1934801	70	REKLAW FORMATION OF CLAIBORNE GROUP	33.397777	-97.820554	25.6 ± 3.96	129.5 ± 16.26	6.85 ± 2.59	63 ± 21.92	1.43 ± 0.21	0.3 ± 0.13		336.82 ± 8.63	47.85 ± 16.9	88.35 ± 20.72	0.12 ± 0.05	34.62 ± 27.42	562.5 ± 108.19	27 ± 5.66	1.46 ± 0.45	
Wise	1935801	200	SIMSBORO SAND MEMBER OF ROCKDALE FORMATION	33.404166	-97.671943	20.3	103	57.4	30	3.57	4.43		410.04	188	30.4	0.18	0.09	638	11	0.59	
Wise	1936802	304	YEGUA FORMATION AND JACKSON GROUP	33.380832	-97.542499	26.4	102	27.6	42.9	2.96	2.56		428.34	43.1	52.6	0.14	0.09	510	20	0.97	
Wise	1936902	120	SPILLER SAND MEMBER OF COOK MOUNTAIN FORMATION	33.37861	-97.500833	16.5	69.2	9.38	28.3	1.8	0.24		270.92	26.3	28.4	0.19	1.59	315	22	0.85	0.22
Wise	1936903	55	TERRACE DEPOSITS	33.37861	-97.500833	18	26	4.8	122	1			183.05	33	36.5	0.48	6.65	338	75	5.77	1.31
Wise	1937902	900	YEGUA FORMATION AND JACKSON GROUP	33.377221	-97.38861	17.2	24.2	11.7	108	4.35	2.22		325.83	35	23.6	0.09	0.09	386	68	4.51	3.17
Wise	1942608	125	TERRACE DEPOSITS	33.299166	-97.790277	18.6 ± 0.85	135 ± 9.9	40.75 ± 4.03	46.8 ± 1.7	4.7 ± 0.43	2.55 ± 0.02		394.78 ± 0.86	48.95 ± 11.38	149.5 ± 21.92	0.14 ± 0.08	8.22 ± 1.53	649 ± 50.91	16.5 ± 0.71	0.91 ± 0.01	
Wise	1942614	135	LOWER CRETACEOUS SERIES	33.317499	-97.789166	22.8	111	22	39.1	2.07	0.99		338.04	25.2	101	0.09	8.06	498	18	0.89	
Wise	1943904	355	LOWER CRETACEOUS SERIES	33.284444	-97.631666	18.1	81.6	48.2	41.8	4.7	8.17		336.82	158	45.9	0.12	0.09	572	18	0.91	
Wise	1945301	370	LEONA FORMATION AND WILCOX GROUP	33.339166	-97.415277	16.3	21.8	9.75	90.4	3.32	1.22		272.14	55.9	8.34	0.01	0.09	340	67	4.05	2.57
Wise	1945303	469	UPPER CRETACEOUS SERIES	33.360555	-97.393888	21.5	55.3	21.5	40.4	3.59	2.68		294.1	64.4	8.16	0.13	0.09	362	27	1.17	0.29
Wise	1952701	240	PALUXY SAND	33.161388	-97.585277	10.5	0.6	0.32	158.5	0.3			392.95	24	1	0.29	1.77	390	99	41.1	6.38
Wise	1953501	925	TERRACE DEPOSITS	33.207777	-97.417221	16.2	20.8	5.33	105	5.73	1.29		322.17	44.1	11	0.19	0.09	368	75	5.32	3.8
Wise	1958103	115	QUEEN CITY SAND,CARRIZO SAND AND WILCOX GROUP	33.118888	-97.851388	22.15 ± 0.78	220.5 ± 13.44	91.3 ± 5.37	91.5 ± 7.07	4.42 ± 0.4	5.7 ± 0.14		432 ± 20.7	115.5 ± 2.12	468 ± 32.53	0.13 ± 0.04	19.95 ± 0.04	1251.5 ± 45.96	17.5 ± 0.71	1.31 ± 0.06	
Wise	1960201	394	YEGUA FORMATION AND JACKSON GROUP	33.090833	-97.559166	10.75 ± 0.92	10.87 ± 1.74	5.23 ± 1.1	479.5 ± 24.75	2.32 ± 0.4	1.72 ± 0.26	1.86	342.85 ± 12.16	53.5 ± 0.71	571 ± 1.41	0.3 ± 0.14	0.27 ± 0.25	1304.5 ± 31.82	95	30.03 ± 1.2	4.68 ± 0.02
Wise	1960411	260	YEGUA FORMATION AND JACKSON GROUP	33.079166	-97.593055	11.5	4.08	2.48	413	1.33	1	10.93	486.65	205	211	0.45	0.09	1100	97	39.79	7.93
Wise	1961408	580	YEGUA FORMATION AND JACKSON GROUP	33.053055	-97.472499	20.45 ± 0.35	77.4 ± 11.03	11.15 ± 1.2	25.4 ± 11.31	2.02 ± 0.03	2.36 ± 0.03		291.66 ± 1.73	37.65 ± 1.91	5.49 ± 0.69	0.25 ± 0.07	0.27 ± 0.25	325.5 ± 3.54	19 ± 8.49	0.73 ± 0.37	0.44

Appendix F

Fort Worth Demand Center Cost Information

COST FOR BRACKISH WATER DELIVERY FROM WELL TO WATER TREATMENT PLANT
FORT WORTH DEMAND CENTER, TX

Assumption	Use PVC pipe for water conveyence										
	85% water recovery										
Well Drilling	$400,000	depth 1200 ft and well water production of 700 gpm, pump is included					$333.33	$/ft			
Well Water Productivity	600	gpm									
Land purchasing	$3,000	$/acre									
Number of wells to be needed				Min No. Well	No. well to be drilled	Well Cost ($)	Acres to be used	$ purchase well area	Total Cost		
2.5	MGD	2042	gpm	4	6	$2,400,000	320	$960,000	$3,360,000	half square mile	
5	MGD	4085	gpm	7	9	$3,600,000	640	$1,920,000	$5,520,000	1 square mile	
7.5	MGD	6127	gpm	11	14	$5,600,000	1120	$3,360,000	$8,960,000	1.75 square mile	
10	MGD	8170	gpm	14	16	$6,400,000	1440	$4,320,000	$10,720,000	2.25 square mile	
12.5	MGD	10212	gpm	18	20	$8,000,000	1920	$5,760,000	$13,760,000	3 square mile	
15	MGD	12255	gpm	21	24	$9,600,000	2400	$7,200,000	$16,800,000	3.75 square mile	
Well Water Stoage (15% of Capacity)						dimension (sf)	Length (ft)	excavation (cf)	CY	16$/CY	
2.5	MGD	441176	gal	58981	cf	2,949	54	134320	4975	$82,084	
5	MGD	882353	gal	117962	cf	5,898	77	226980	8407	$138,710	
7.5	MGD	1323529	gal	176942	cf	8,847	94	305520	11316	$186,707	
10	MGD	1764706	gal	235923	cf	11,796	109	384420	14238	$234,923	
12.5	MGD	2205882	gal	294904	cf	14,745	121	454020	16816	$277,457	
15	MGD	2647059	gal	353885	cf	17,694	133	529380	19607	$323,510	
Pond Lining		surf. Of pond		$5/sf	Total for Storage						
2.5	MGD	11356	sf	$56,778	$138,863						
5	MGD	16850	sf	$84,248	$222,958						
7.5	MGD	21751	sf	$108,757	$295,464						
10	MGD	26347	sf	$131,734	$366,657						
12.5	MGD	30746	sf	$153,731	$431,187						
15	MGD	35006	sf	$175,032	$498,542						
Total cost for well water drillinging and storage											
2.5	MGD	3498863									
5	MGD	5742958									
7.5	MGD	9255464									
10	MGD	11086657									
12.5	MGD	14191187									
15	MGD	17298542									
Piping											
Piping to eagal mountain	distance	6	mile	d=(0.4081Q/v)^0.5		Cost	Easement Width (ft)	Easement Area (Acre)	Easement Cost	Total	plus well inter piping
2.5	MGD	2042	gpm	12	in	$1,584,000	15	25	$73,632	$1,784,352	$2,206,752
5	MGD	4085	gpm	16	in	$1,900,800	15	25	$73,632	$2,126,496	$2,760,096
7.5	MGD	6127	gpm	20	in	$2,217,600	15	25	$73,632	$2,468,640	$3,841,440
10	MGD	8170	gpm	22	in	$3,484,800	15	25	$73,632	$3,837,216	$5,210,016
12.5	MGD	10212	gpm	24	in	$4,118,400	15	25	$73,632	$4,521,504	$6,963,407
15	MGD	12255	gpm	26	in	$4,435,200	20	33	$98,176	$4,888,192	$7,818,592
Piping to rolling hills	distance	20	mile	d=(0.4081Q/v)^0.5		Cost	Easement Width (ft)	Easement Area (Acre)	Easement Cost	Total	plus well inter piping
2.5	MGD	2042	gpm	12	in	$5,280,000	15	82	$245,441	$5,947,841	$6,370,241
5	MGD	4085	gpm	16	in	$6,336,000	15	82	$245,441	$7,088,321	$7,721,921
7.5	MGD	6127	gpm	20	in	$7,392,000	15	82	$245,441	$8,228,801	$9,601,601
10	MGD	8170	gpm	22	in	$11,616,000	15	82	$245,441	$12,790,721	$14,163,521
12.5	MGD	10212	gpm	24	in	$13,728,000	15	82	$245,441	$15,071,681	$17,513,583
15	MGD	12255	gpm	26	in	$14,784,000	20	109	$327,254	$16,293,974	$19,224,374
Piping - well inter-connection		Diameter							Cost		
		6	in	1 well	3	mile	15840	LF	$554,400		
		8		2 well	3	mile	15840	LF	$712,800		
		10		3 well	3		15840		$792,000		
		12		4 well	3	mile	15840	LF	$871,200		
	Total								**$2,930,400**		

COST FOR BRACKISH WATER DELIVERY FROM WELL TO WATER TREATMENT PLANT
FORT WORTH DEMAND CENTER, TX

Lift Station

Eagal Mountain

Pipe length	31680	LF				HL (ft)	psi	No. of pump	gpm/pump	Price-$/EA	Total
2.5	MGD	2042	gpm	12	in	268	116	2	2042	$70,000	$182,000
5	MGD	4085	gpm	16	in	239	104	3	2042	$70,000	$273,000
7.5	MGD	6127	gpm	20	in	171	74	3	3064	$70,000	$273,000
10	MGD	8170	gpm	22	in	183	79	3	4085	$80,000	$312,000
12.5	MGD	10212	gpm	24	in	181	79	4	3404	$75,000	$390,000
15	MGD	12255	gpm	26	in	172	75	5	3064	$75,000	$487,500

Rolling Hills

Pipe length	105600	LF				HL (ft)	psi	No. of pump	gpm/pump	$/EA	Total
2.5	MGD	2042	gpm	12	in	894	388	2	2042	$200,000	$520,000
5	MGD	4085	gpm	16	in	796	345	3	2042	$200,000	$780,000
7.5	MGD	6127	gpm	20	in	570	247	3	3064	$200,000	$780,000
10	MGD	8170	gpm	22	in	610	265	3	4085	$250,000	$975,000
12.5	MGD	10212	gpm	24	in	604	262	4	3404	$200,000	$1,040,000
15	MGD	12255	gpm	26	in	574	249	5	3064	$200,000	$1,300,000

				Lift Station Total Cost	
Pump Station - builidng cost -include wetwell		$80,000	$/pump	Eagle Mountain	Rolling Hills
2.5	MGD	$160,000		$342,000	$680,000
5	MGD	$240,000		$513,000	$1,020,000
7.5	MGD	$240,000		$513,000	$1,020,000
10	MGD	$240,000		$552,000	$1,215,000
12.5	MGD	$320,000		$710,000	$1,360,000
15	MGD	$400,000		$887,500	$1,700,000

Total Cost for Brackish Water Delivery

To Eagal mountain		include 10% contingency
2.5	MGD	$9,411,177
5	MGD	$12,444,140
7.5	MGD	$16,684,255
10	MGD	$20,246,901
12.5	MGD	$24,588,401
15	MGD	$28,605,098

To Rolling Hills			May not be able to use PVC pipe, as pressure requirement will be very high
2.5	MGD	$14,362,814	
5	MGD	$18,459,847	
7.5	MGD	$23,578,131	
10	MGD	$30,825,056	
12.5	MGD	$36,908,595	
15	MGD	$42,045,208	

Cost to Eagle Mountain WTP

Capacity (MGD)	No. of Wells	Well Drilling ($)	Land (acre)	Land Purchasing ($)	Storage Basin ($)	Pipeline ($)	Lift Station ($)	Total Cost ($)
2.5	6	$2,400,000	320	$960,000	$138,863	$2,206,752	$342,000	$6,652,377
5	9	$3,600,000	640	$1,920,000	$222,958	$2,760,096	$513,000	$9,917,660
7.5	14	$5,600,000	1120	$3,360,000	$295,464	$3,841,440	$513,000	$14,970,895
10	16	$6,400,000	1440	$4,320,000	$366,657	$5,210,016	$552,000	$18,533,541
12.5	20	$8,000,000	1920	$5,760,000	$431,187	$6,963,407	$710,000	$24,051,053
15	24	$9,600,000	2400	$7,200,000	$498,542	$7,818,592	$887,500	$28,605,098

Cost to Rolling Hills WTP

Capacity (MGD)	No. of Wells	Well Drilling ($) ($)	Land (acre)	Land Purchasing ($) ($)	Storage Basin ($)	Pipeline ($)	Lift Station ($) ($)	Total Cost ($)
2.5	6	$2,400,000	320	$960,000	$138,863	$6,370,241	$680,000	$11,604,014
5	9	$3,600,000	640	$1,920,000	$222,958	$7,721,921	$1,020,000	$15,933,367
7.5	14	$5,600,000	1120	$3,360,000	$295,464	$9,601,601	$1,020,000	$21,864,771
10	16	$6,400,000	1440	$4,320,000	$366,657	$14,163,521	$1,215,000	$29,111,696
12.5	20	$8,000,000	1920	$5,760,000	$431,187	$17,513,583	$1,360,000	$36,371,248
15	24	$9,600,000	2400	$7,200,000	$498,542	$19,224,374	$1,700,000	$42,045,208

Appendix G

Gainesville Demand Center Cost Information

COST FOR BRACKISH WATER DELIVERY FROM WELL TO WATER TREATMENT PLANT
GAINESVILLE WATER DEMAND CENTER, COOKE COUNTY

Assumption	Use PVC pipe for water conveyence										
	85% water recovery										
Well Drilling	$333,330	depth 1000 ft and well water production of 700 gpm, pump is included					$277.78	$/ft			
Well Water Productivity	700	gpm	Groundwater from Antlers Sand well yield can be as high as 900 gpm								
Land Purchasing	$3,000	$/acre									
Number of wells to be needed				Min No. Well	No. well to be drilled	Well Cost ($)	Acres to be used	$ purchase land	Total Cost		
2.5	MGD	2043	gpm	3	6	$1,999,980	320	$960,000	$2,959,980	half square mile	
5	MGD	4085	gpm	6	9	$2,999,970	640	$1,920,000	$4,919,970	1 square mile	
7.5	MGD	6128	gpm	9	12	$3,999,960	960	$2,880,000	$6,879,960	1.5 square mile	
10	MGD	8170	gpm	12	16	$5,333,280	1440	$4,320,000	$9,653,280	2.25 square mile	
12.5	MGD	10213	gpm	15	20	$6,666,600	1920	$5,760,000	$12,426,600	3 square mile	
15	MGD	12255	gpm	18	20	$6,666,600	1920	$5,760,000	$12,426,600	3 square mile	
Well Stoage (15% of Capacity)						dimension (sf)	Length (ft)	excavation (cf)	CY	16$/CY	
2.5	MGD	441177	gal	58981	cf	2949	54	134320	4975	$82,084	
5	MGD	882353	gal	117962	cf	5898	77	226980	8407	$138,710	
7.5	MGD	1323530	gal	176943	cf	8847	94	305520	11316	$186,707	
10	MGD	1764706	gal	235923	cf	11796	109	384420	14238	$234,923	
12.5	MGD	2205883	gal	294904	cf	14745	121	454020	16816	$277,457	
15	MGD	2647059	gal	353885	cf	17694	133	529380	19607	$323,510	
Pond Lining		Surf. Of Pond		$5/sf	Total for Storage						
2.5	MGD	11356	sf	$56,779	$138,863						
5	MGD	16850	sf	$84,248	$222,958						
7.5	MGD	21751	sf	$108,757	$295,464						
10	MGD	26347	sf	$131,734	$366,657						
12.5	MGD	30746	sf	$153,731	$431,188						
15	MGD	35006	sf	$175,032	$498,542						
Total cost for well water drillinging and storage											
2.5	MGD	$3,098,843									
5	MGD	$5,142,928									
7.5	MGD	$7,175,424									
10	MGD	$10,019,937									
12.5	MGD	$12,857,788									
15	MGD	$12,925,142									
Piping											
Piping to the WTP	distance	0.5	mile	d=(0.4081Q/v)^0.5		Cost	Easement Width (ft)	Easement Area (Acre	Easement Cost	Total	plus well inter piping
2.5	MGD	2043	gpm	12	in	$132,000	15	2	$6,136	$148,696	$2,102,296
5	MGD	4085	gpm	16	in	$158,400	15	2	$6,136	$177,208	$2,130,808
7.5	MGD	6128	gpm	20	in	$184,800	15	2	$6,136	$205,720	$2,159,320
10	MGD	8170	gpm	22	in	$290,400	15	2	$6,136	$319,768	$2,273,368
12.5	MGD	10213	gpm	24	in	$343,200	15	2	$6,136	$376,792	$2,330,392
15	MGD	12255	gpm	26	in	$369,600	20	3	$8,181	$407,349	$2,360,949

COST FOR BRACKISH WATER DELIVERY FROM WELL TO WATER TREATMENT PLANT
GAINESVILLE WATER DEMAND CENTER, COOKE COUNTY

Piping - well inter-connection									Cost		
	d	6	in	1 well	2	mile	10560	LF	$369,600		
		8		2 well	2	mile	10560	LF	$475,200		
		10		3 well	2	mile	10560	LF	$528,000		
		12		4 well	2	mile	10560	LF	$580,800		
		14		5 wells	**2**	mile	10560	LF	$633,600		
	Total								$1,953,600		
Lift Station											
Pump water from pound to RO facility											
Pipe Length	2640	LF				HL (ft)	psi	No. of pump	gpm/each pump	Price-$/EA	Total
2.5	MGD	2043	gpm	12	in	22.35	9.69	2	2043	$25,000	$65,000
5	MGD	4085	gpm	16	in	19.90	8.63	3	2043	$25,000	$97,500
7.5	MGD	6128	gpm	20	in	14.24	6.17	3	3064	$25,000	$97,500
10	MGD	8170	gpm	22	in	15.26	6.61	4	2723	$25,000	$130,000
12.5	MGD	10213	gpm	24	in	15.11	6.55	4	3404	$25,000	$130,000
15	MGD	12255	gpm	26	in	14.34	6.22	5	3064	$25,000	$162,500
Pump Station - builidng cost -include wetwell		$80,000	$/pump	Cost LIFT station							
2.5	MGD	$160,000		$225,000							
5	MGD	$240,000		$337,500							
7.5	MGD	$240,000		$337,500							
10	MGD	$240,000		$370,000							
12.5	MGD	$320,000		$450,000							
15	MGD	$400,000		$562,500							
Total Cost for Brackish Water Delivery											
		Include 10% contingency									
2.5	MGD	$5,968,753									
5	MGD	$8,372,360									
7.5	MGD	$10,639,468									
10	MGD	$13,929,636									
12.5	MGD	$17,201,997									
15	MGD	$17,433,451									

Capacity (MGD)	No. of Wells	Well Drilling ($)	Land (acre)	Land Purchasing ($)	Storage Pond ($)	Pipeline ($)	Lift Station ($)	Total Cost ($)
2.5	6	$1,999,980	320	$960,000	$138,863	$2,524,696	$225,000	$6,433,393
5	9	$2,999,970	640	$1,920,000	$222,958	$2,764,408	$337,500	$9,069,320
7.5	12	$3,999,960	960	$2,880,000	$295,464	$3,004,120	$337,500	$11,568,748
10	16	$5,333,280	1440	$4,320,000	$366,657	$3,646,168	$370,000	$15,439,716
12.5	20	$6,666,600	1920	$5,760,000	$431,187	$4,283,992	$450,000	$19,350,957
15	20	$8,000,000	1920	$5,760,000	$498,542	$4,314,549	$562,500	$21,049,151

Appendix H

Survey Responses

Water Planning for North Texas

REGION C WATER PLANNING GROUP
OPERATING DESALINATION FACILITY SURVEY

I. BACKGROUND INFORMATION

PLANT NAME:	Robinson Water Treatment Plant
PLANT ADDRESS:	930 E. Tinsley Waco TX 76706
CATEGORIZE BY THE TDS OF FEED:	☐ Seawater: 20,000 – 35,000 mg/L TDS ☐ High Brackish Groundwater: >5,500 - <20,000 mg/L TDS ☐ High Brackish Surface Water: >2,500 - <15,000 mg/L TDS ☐ Low Brackish Groundwater: 1,000 – 5,000 mg/L TDS ☐ Low Brackish Surface Water: 1,000 –2,500 mg/L TDS ☐ Fresh Groundwater: <1,000 mg/L TDS ☒ Fresh Surface Water: <1,000 mg/L TDS ☐ Other (please specify):
CONCENTRATE DISPOSAL METHOD:	Discharge to surface water body
SOURCE WATER NAME:	Trinity Aquifer, Brazos River via off-channel Robinson Reservoir
IS THE GROUNDWATER UNDER THE INFLUENCE OF SURFACE WATER?	☐ yes ☑ no
CONTACT NAME:	Greg Hobbs
CONTACT TELEPHONE NUMBER:	(254) 662-1415
CONTACT EMAIL ADDRESS:	ghwater@sbcglobal.net
WEBSITE:	http://www.robinsontexas.org/utilities.html
OWNER NAME:	City of Robinson
OWNER ADDRESS:	111 West Lyndale Robinson, Texas 76706
OWNERSHIP STATUS:	☒ Public Agency (municipality) ☐ Water Authority ☐ Private Agency ☐ Other (please specify):

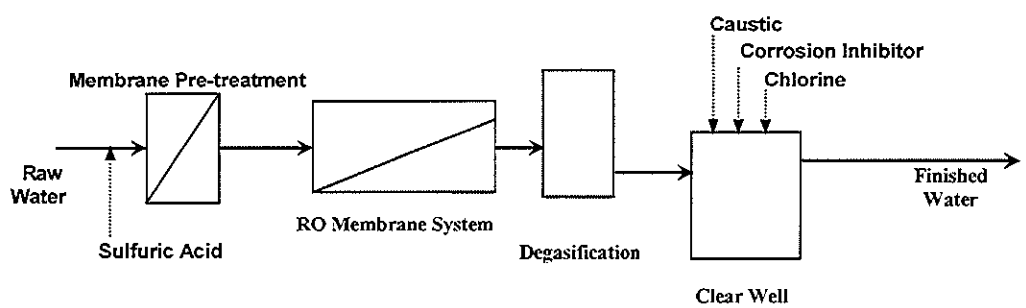
REGION C WATER PLANNING GROUP
OPERATING DESALINATION FACILITY SURVEY

II. RO/NF MEMBRANE PLANT DESIGN CHARACTERISTICS

PLANT PRODUCTION STATE DATE:	1994	
DESIGN HYDRAULIC CAPACITY OF PLANT:	1.80 MGD	
PLANT ORIGINALLY DESIGNED FOR EXPANSION	☑ yes ☐ no	
DESIGN PERCENT RO FEEDWATER RECOVERY:	75	%
DESIGN RO MEMBRANE FLUX:	Avg. 13 GFD	gal/day-ft^2
DESIGN PRESSURE:	240	psi (max)
	160	psi (min)
WHAT IS THE END USE OF THE RO/NF PERMEATE?	☑ Potable Water ☐ Industrial Use ☐ Groundwater recharge (for indirect potable reuse) ☐ Groundwater recharge (seawater intrusion barrier) ☐ Irrigation ☐ Other (please specify):	

III. PLANT SCHEMATIC

PLEASE ATTACH AN OVERALL SCHEMATIC OF THE PLANT SHOWING ANY PRE- AND POST-TREATMENT PROCESSES TO MEMBRANE FILTRATION, INCLUDING THE LOCATION OF CHEMICAL ADDITION:



SAMPLE SCHEMATIC

REGION C WATER PLANNING GROUP
OPERATING DESALINATION FACILITY SURVEY

IV. POST TREATMENT INFORMATION

POST TREATMENT TYPE:	☐ Air stripping/desulfurization ☑ Degasification/decarbonation ☑ Caustic chemical addition ☐ Corrosion inhibitor addition ☑ Blending ☑ Treated surface water ☐ Treated groundwater ☐ Other (please specify)
DISINFECTION:	Primary: ☑ Chlorine ☐ Ozone ☐ UV ☐ Chlorine dioxide ☐ Other (please specify) Secondary: ☑ Chlorine ☐ Chloramine ☐ Other (please specify)
NOT TAKING INTO ACCOUNT THE MEMBRANE PROCESS, WHAT ARE YOUR POST-TREATMENT DISINFECTION AND DISINFECTANT RESIDUAL GOALS?	2.0 Free
HAVE YOU EXPERIENCED ANY POST TREATMENT PROBLEMS WITHIN THE PLANT?	☐ Blending limitation like salt concentration or DBP precursors ☐ Scaling of degasification/stripping towers ☐ Biogrowth in degasifaction/stripping towers ☐ Chemical injector plugging ☐ Specific issues with cleaning post treatment equipment ☐ White water formation ☐ Corrosion events ☐ Colored or red water ☐ Other (please specify)
ANY DISTRIBUTION SYSTEM IMPACTS NOTED?	☐ Corrosion events (infrastructure) ☐ Lead and Copper Rule impacts ☐ Disinfection By-Products ☑ Taste and odor ☐ Detention time prior to point of entry to distribution system ☐ Detention time after point of entry to distribution system ☐ pH stability ☐ Disinfection residual stability ☐ White water ☐ Color ☐ Red water/black water ☐ Biological regrowth ☐ Other (please specify)
PLEASE PROVIDE BLENDED OR BY-PASS DESCRIPTION (IF APPLICABLE):	60% R.O. Water 40% Conventional Water

V. TREATMENT INFORMATION

Please complete the following table. Enter the low, high, and average values for the last year, if known. If not, the average value is requested. If data is not available for any particular parameter, enter N/A. If any analytical result was below detection limit, enter "BDL."

Water Quality Data						
Parameters	Blend Water (if used)			Point of Entry to Distribution System (POE)		
	Low	High	Average	Low	High	Average
Temperature (°C)	10°	30°	19	12°	28°	18°
pH [R]	7.1	7.8	7.5	7.8	8.5	8.0
Alkalinity, mg/L as $CaCO_3$	90	135	110	30	50	40
Turbidity, NTU	.05	.12	.08	.05	.10	.08
Conductivity, umho/cm	800	3000	1000	300	500	400
Total Dissolved Solids, mg/L	500	1000	650	200	400	350
Total Organic Carbon, mg/L	N/A	N/A	N/A	2.0	3.0	2.25

Treated Water Quantity Data (MG/month)			
Month	2006	2007	2008
January	8.7	4.7	8.9
February	6.7	5.0	9.8
March	9.7	4.1	9.1
April	7.1	5.6	8.6
May	.8	3.9	8.4
June	6.2	7.1	19.2
July	26.8	6.8	36.0
August	37.1	20.9	19.1
September	18.9	11.2	13.0
October	9.2	9.3	11.2
November	6.4	8.1	7.9
December	5.0	7.5	6.6
Annual Total	142.6	94.2	157.8

VI. TREATMENT COSTS

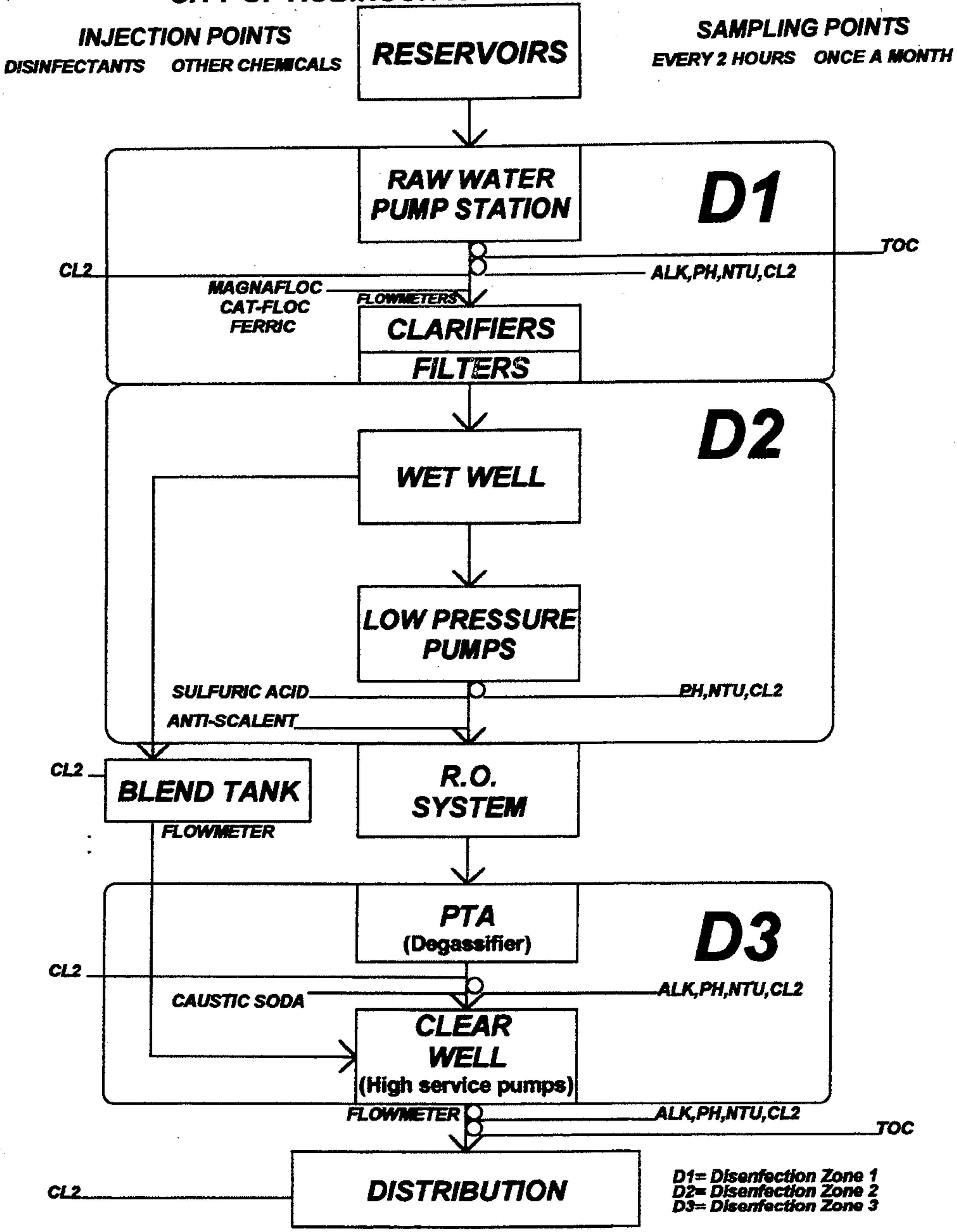
OVERALL OPERATING COST:	2.55	$/1000 gallons
OVERALL CONCENTRATE DISPOSAL:	0	$/1000 gallons
LABOR:	.85	$/1000 gallons
CHEMICALS:	.50	$/1000 gallons
ENERGY:	.68	$/1000 gallons
MEMBRANE REPLACEMENT:	.22	$/1000 gallons
WHAT IS THE TYPICAL LIFE OF A MEMBRANE?	7	years
NF/RO SYSTEM (IF AVAILABLE):	0	$/1000 gallons
REPLACEMENT PARTS (NOT INCLUDING MEMBRANE):	.30	$/1000 gallons
CURRENT ENERGY COSTS:	.66	$/1000 gallons
DOES THIS INCLUDE THE ENERGY COST ASSOCIATED WITH HIGH SERVICE PUMPS USED TO PROVIDE TREATED WATER TO THE DISTRIBUTION SYSTEM? IF SO, PLEASE PROVIDE THE NUMBER OF PUMPS AND TOTAL HORSEPOWER.	Yes 2-125 HP	
OTHER (PLEASE SPECIFY):		$/1000 gallons

VII. **LESSONS LEARNED**

PERMITTING/REGULATION: WHAT OBSTACLES WERE OVERCOME TO OBTAIN PERMITS/CONSENTS?	Varying river concentrations of Chlorides, Sulfates and TDS levels cause some exceedances in discharge permitted amounts. We were able to work this out by the TCEQ raising our levels.
OPERATIONS: ARE THERE ISSUES IN THE DISTRIBUTION SYSTEM THAT HAVE BEEN DIRECTLY RELATED BACK TO POST TREATMENT?	No
CONCENTRATE DISPOSAL: WHAT OBSTACLES WERE OVERCOME DURING CONCENTRATE DISPOSAL?	Acquiring the permit
ADDITIONAL INFORMATION:	

 REV 08/25/2009

CITY OF ROBINSON R.O. PLANT SCHEMATICS



REGION C WATER PLANNING GROUP
OPERATING DESALINATION FACILITY SURVEY

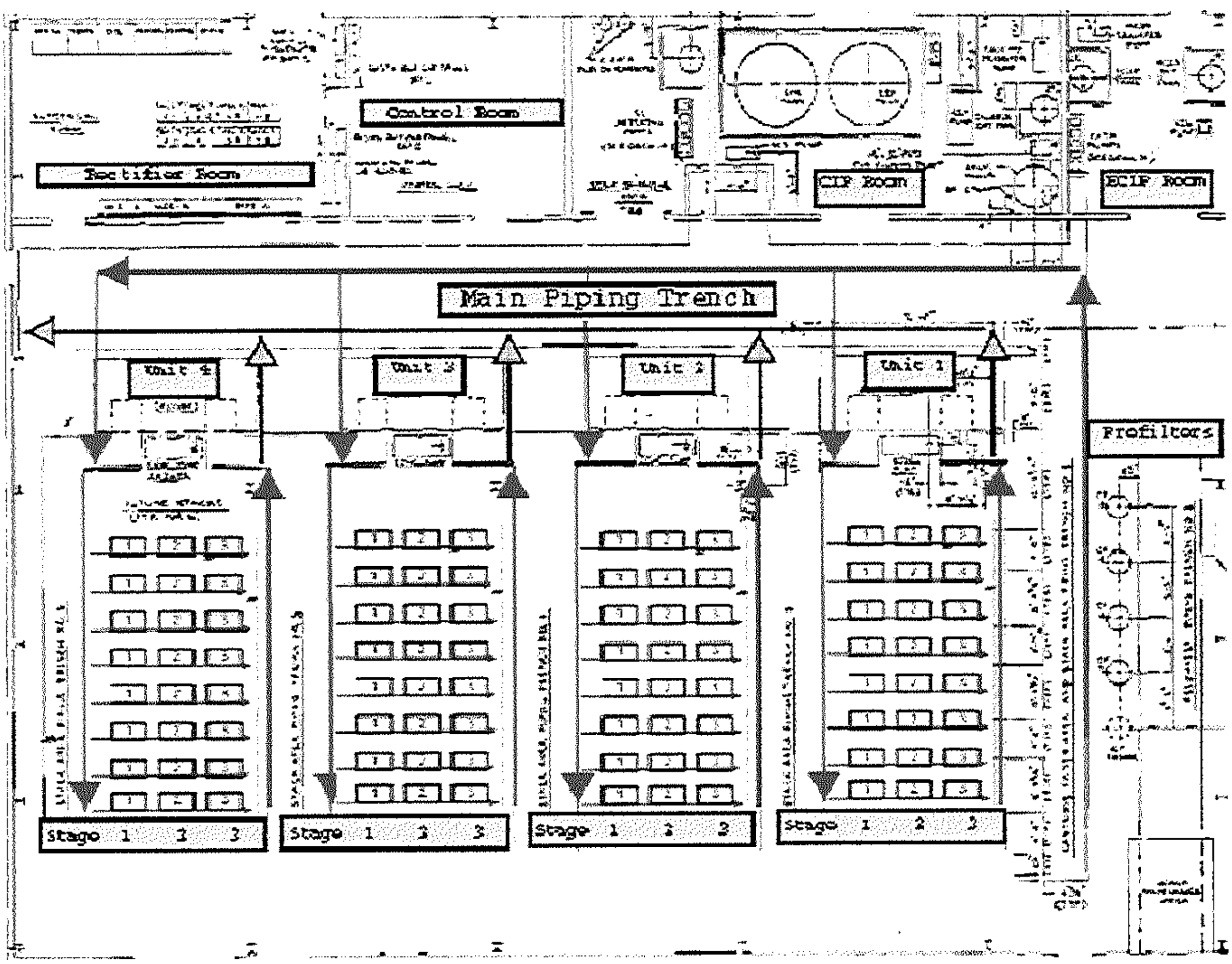
I. BACKGROUND INFORMATION

PLANT NAME:	Sherman Water Treatment Plant
PLANT ADDRESS:	243 LaCima Drive Sherman, Texas 75090
CATEGORIZE BY THE TDS OF FEED:	☐ Seawater: 20,000 – 35,000 mg/L TDS ☐ High Brackish Groundwater: >5,500 - <20,000 mg/L TDS ☐ High Brackish Surface Water: >2,500 - <15,000 mg/L TDS ☐ Low Brackish Groundwater: 1,000 – 5,000 mg/L TDS ☒ Low Brackish Surface Water: 1,000 –2,500 mg/L TDS ☐ Fresh Groundwater: <1,000 mg/L TDS ☐ Fresh Surface Water: <1,000 mg/L TDS ☐ Other (please specify):
CONCENTRATE DISPOSAL METHOD:	sanitary sewer
SOURCE WATER NAME:	Lake Texoma
IS THE GROUNDWATER UNDER THE INFLUENCE OF SURFACE WATER?	☐ yes ☐ no **NA**
CONTACT NAME:	Mark Gibson
CONTACT TELEPHONE NUMBER:	(903) 892-7210
CONTACT EMAIL ADDRESS:	markg@ci.sherman.tx.us
WEBSITE:	http://www.cityofsherman.org/
OWNER NAME:	City of Sherman
OWNER ADDRESS:	P.O Box 1106 Sherman, Texas 75091
OWNERSHIP STATUS:	☒ Public Agency (municipality) ☐ Water Authority ☐ Private Agency ☐ Other (please specify):

REGION C WATER PLANNING GROUP
OPERATING DESALINATION FACILITY SURVEY

II. RO/NF MEMBRANE PLANT DESIGN CHARACTERISTICS

PLANT PRODUCTION STATE DATE:	1993	
DESIGN HYDRAULIC CAPACITY OF PLANT:	7.50 MGD EDR	
PLANT ORIGINALLY DESIGNED FOR EXPANSION	☑ yes ☐ no	
DESIGN PERCENT RO FEEDWATER RECOVERY:	85% to 87%	
DESIGN RO MEMBRANE FLUX:		gal/day-ft^2
DESIGN PRESSURE:	60	psi (max)
	35	psi (min)
WHAT IS THE END USE OF THE RO/NF PERMEATE? EDR	☑ Potable Water ☑ Industrial Use ☐ Groundwater recharge (for indirect potable reuse) ☐ Groundwater recharge (seawater intrusion barrier) ☐ Irrigation ☐ Other (please specify):	



IV. POST TREATMENT INFORMATION

POST TREATMENT TYPE:	☐ Air stripping/desulfurization ☐ Degasification/decarbonation ☐ Caustic chemical addition ☑ Corrosion inhibitor addition ☑ Blending ☑ Treated surface water ☐ Treated groundwater ☐ Other (please specify)
DISINFECTION:	Primary: ☑ Chlorine ☐ Ozone ☐ UV ☐ Chlorine dioxide ☐ Other (please specify) Secondary: ☑ Chlorine ☑ Chloramine ☐ Other (please specify)
NOT TAKING INTO ACCOUNT THE MEMBRANE PROCESS, WHAT ARE YOUR POST-TREATMENT DISINFECTION AND DISINFECTANT RESIDUAL GOALS?	Final disinfection is added after blending
HAVE YOU EXPERIENCED ANY POST TREATMENT PROBLEMS WITHIN THE PLANT?	☑ Blending limitation like salt concentration or DBP precursors ☐ Scaling of degasification/stripping towers ☐ Biogrowth in degasifaction/stripping towers ☐ Chemical injector plugging ☐ Specific issues with cleaning post treatment equipment ☐ White water formation ☐ Corrosion events ☐ Colored or red water ☐ Other (please specify)
ANY DISTRIBUTION SYSTEM IMPACTS NOTED?	☐ Corrosion events (infrastructure) ☐ Lead and Copper Rule impacts ☑ Disinfection By-Products ☑ Taste and odor ☑ Detention time prior to point of entry to distribution system ☑ Detention time after point of entry to distribution system ☐ pH stability ☐ Disinfection residual stability ☐ White water ☐ Color ☐ Red water/black water ☐ Biological regrowth ☐ Other (please specify)
PLEASE PROVIDE BLENDED OR BY-PASS DESCRIPTION (IF APPLICABLE):	EDR product is blended with conventionally treated water to produce final product ratio is increased when finished water reaches 150 ppm hardness

REGION C WATER PLANNING GROUP
OPERATING DESALINATION FACILITY SURVEY

V. TREATMENT INFORMATION

Please complete the following table Enter the low, high, and average values for the last year, if known. If not, the average value is requested. If data is not available for any particular parameter, enter N/A If any analytical result was below detection limit, enter "BDL."

Water Quality Data

Parameters	Blend Water (if used)			Point of Entry to Distribution System		
	Low	High	Average	Low	High	Average
Temperature (°C)	10.4	26.8	18.2	10.4	26.8	18.2
pH [R]						
Alkalinity, mg/L as $CaCO_3$	320	380	342.50	96	300	167.17
Turbidity, NTU						
Conductivity, umho/cm	960	1400	1230	570	1100	778
Total Dissolved Solids, mg/L	650	890	786.67	330	650	441.67
Total Organic Carbon, mg/L	2.93	3.84	3.28	1.77	2.87	2.27

Blended Surface only Treated Water Quantity Data (MG/month)			
Month	2006	2007	2008
January	108.72	89.37	84.85
February	87.87	79.40	80.00
March	97.49	96.11	90.48
April	101.30	92.38	92.06
May	126.42	119.08	104.38
June	168.22	93.64	141.54
July	201.18	96.38	170.88
August	195.71	146.77	170.27
September	138.08	136.01	139.89
October	125.51	127.80	119.69
November	110.96	99.15	96.87
December	95.70	85.56	81.89
Annual Total	1557.15	1261.66	1372.79

REGION C WATER PLANNING GROUP
OPERATING DESALINATION FACILITY SURVEY

VI. TREATMENT COSTS 2008

OVERALL OPERATING COST:	$1.79	$/1000 gallons
OVERALL CONCENTRATE DISPOSAL:	$0.87	$/1000 gallons
LABOR:	$0.147	$/1000 gallons
CHEMICALS:	$0.10	$/1000 gallons
ENERGY:	$0.55	$/1000 gallons
MEMBRANE REPLACEMENT: (Maint)	$0.059	$/1000 gallons
WHAT IS THE TYPICAL LIFE OF A MEMBRANE?	10	years
NF/RO SYSTEM (IF AVAILABLE):	NA	$/1000 gallons
REPLACEMENT PARTS (NOT INCLUDING MEMBRANE):	$.063	$/1000 gallons
CURRENT ENERGY COSTS: 2008	$492,696.25	$/ Total
DOES THIS INCLUDE THE ENERGY COST ASSOCIATED WITH HIGH SERVICE PUMPS USED TO PROVIDE TREATED WATER TO THE DISTRIBUTION SYSTEM? IF SO, PLEASE PROVIDE THE NUMBER OF PUMPS AND TOTAL HORSEPOWER.	YES	HS1 250 HS4 125 HS2 150 HS5 250 HS3 125 HS6 250
OTHER (PLEASE SPECIFY):		$/1000 gallons

REGION C WATER PLANNING GROUP
OPERATING DESALINATION FACILITY SURVEY

VII. LESSONS LEARNED

PERMITTING/REGULATION: WHAT OBSTACLES WERE OVERCOME TO OBTAIN PERMITS/CONSENTS?	Permit denied
OPERATIONS: ARE THERE ISSUES IN THE DISTRIBUTION SYSTEM THAT HAVE BEEN DIRECTLY RELATED BACK TO POST TREATMENT?	No
CONCENTRATE DISPOSAL: WHAT OBSTACLES WERE OVERCOME DURING CONCENTRATE DISPOSAL?	Flow restrictions in discharge piping
ADDITIONAL INFORMATION:	

REGION C WATER PLANNING GROUP
OPERATING DESALINATION FACILITY SURVEY

I. BACKGROUND INFORMATION

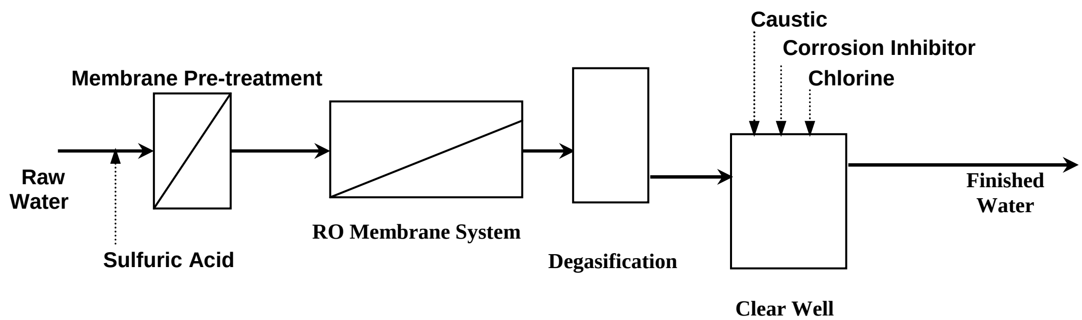
PLANT NAME:	Tampa Bay Seawater Desalination Plant
PLANT ADDRESS:	
CATEGORIZE BY THE TDS OF FEED:	X Seawater: 20,000 – 35,000 mg/L TDS ☐ High Brackish Groundwater: >5,500 - <20,000 mg/L TDS ☐ High Brackish Surface Water: >2,500 - <15,000 mg/L TDS ☐ Low Brackish Groundwater: 1,000 – 5,000 mg/L TDS ☐ Low Brackish Surface Water: 1,000 –2,500 mg/L TDS ☐ Fresh Groundwater: <1,000 mg/L TDS ☐ Fresh Surface Water: <1,000 mg/L TDS ☐ Other (please specify):
CONCENTRATE DISPOSAL METHOD:	Power Plant Discharge Tunnels
SOURCE WATER NAME:	Tampa Bay Marine Waters – Power Plant Discharge Tunnels
IS THE GROUNDWATER UNDER THE INFLUENCE OF SURFACE WATER?	☐ yes ☐ no N/A
CONTACT NAME:	Ron Parker
CONTACT TELEPHONE NUMBER:	813-929-4550
CONTACT EMAIL ADDRESS:	rparker@tampabaywater.org
WEBSITE:	www.tampabaywater.org
OWNER NAME:	Tampa Bay Water
OWNER ADDRESS:	2575 Enterprise Road - Clearwater, Fl 33763
OWNERSHIP STATUS:	☐ Public Agency (municipality) X Water Authority ☐ Private Agency ☐ Other (please specify):

II. RO/NF MEMBRANE PLANT DESIGN CHARACTERISTICS

PLANT PRODUCTION STATE DATE:	Following Remediation – April 2007	
DESIGN HYDRAULIC CAPACITY OF PLANT:	28.75 MGD	
PLANT ORIGINALLY DESIGNED FOR EXPANSION	☐ yes X no	
DESIGN PERCENT RO FEEDWATER RECOVERY:	60	%
DESIGN RO MEMBRANE FLUX:	Average 14.13	Lmh
DESIGN PRESSURE:	1,000	psi (max)
	Estimated at 700	psi (min)
WHAT IS THE END USE OF THE RO/NF PERMEATE?	X Potable Water ☐ Industrial Use ☐ Groundwater recharge (for indirect potable reuse) ☐ Groundwater recharge (seawater intrusion barrier) ☐ Irrigation ☐ Other (please specify):	

III. **PLANT SCHEMATIC**

PLEASE ATTACH AN OVERALL SCHEMATIC OF THE PLANT SHOWING ANY PRE- AND POST-TREATMENT PROCESSES TO MEMBRANE FILTRATION, INCLUDING THE LOCATION OF CHEMICAL ADDITION:



SAMPLE SCHEMATIC

IV. **POST TREATMENT INFORMATION**

POST TREATMENT TYPE:	☐ Air stripping/desulfurization ☐ Degasification/decarbonation ☐ Caustic chemical addition ☐ Corrosion inhibitor addition X Blending X Treated surface water X Treated groundwater X Other (please specify) Lime – CO2 – Water Stability Bleach - Disinfection
DISINFECTION:	Primary: X Chlorine ☐ Ozone ☐ UV X Chlorine dioxide ☐ Other (please specify) Secondary: X Chlorine ☐ Chloramine X Other (please specify) Product Water is chloraminated prior to mixing with finished water from Surface Water Treatment Plant.
NOT TAKING INTO ACCOUNT THE MEMBRANE PROCESS, WHAT ARE YOUR POST-TREATMENT DISINFECTION AND DISINFECTANT RESIDUAL GOALS?	Positive LSI for water stability. Target free chlorine residual prior to chloramination at 4.0 mg/L
HAVE YOU EXPERIENCED ANY POST TREATMENT PROBLEMS WITHIN THE PLANT?	☐ Blending limitation like salt concentration or DBP precursors ☐ Scaling of degasification/stripping towers ☐ Biogrowth in degasifaction/stripping towers ☐ Chemical injector plugging ☐ Specific issues with cleaning post treatment equipment ☐ White water formation ☐ Corrosion events ☐ Colored or red water X Other (please specify) Calcium Turbidity and DBP's leaving plant.
ANY DISTRIBUTION SYSTEM IMPACTS NOTED?	☐ Corrosion events (infrastructure) ☐ Lead and Copper Rule impacts ☐ Disinfection By-Products ☐ Taste and odor ☐ Detention time prior to point of entry to distribution system ☐ Detention time after point of entry to distribution system ☐ pH stability ☐ Disinfection residual stability ☐ White water ☐ Color ☐ Red water/black water ☐ Biological regrowth X Other (please specify) Not pumped into Distribution System.
PLEASE PROVIDE BLENDED OR BY-PASS DESCRIPTION (IF APPLICABLE):	Desalinated water is blended with Surface Water followed by stabilization through Alkalinity Adjustment Facility, and then blends throughout the wholesale system with groundwater. 14 Point of Connections to 6 member governments that receive the blended supplies.

V. TREATMENT INFORMATION

Please complete the following table. Enter the low, high, and average values for the last year, if known. If not, the average value is requested. If data is not available for any particular parameter, enter N/A. If any analytical result was below detection limit, enter "BDL."

Water Quality Data – See attached Contract Requirements						
Parameters	Blend Water (if used)			Point of Entry to Distribution System (POE)		
	Low	High	Average	Low	High	Average
Temperature (°C)						
pH [R]						
Alkalinity, mg/L as $CaCO_3$						
Turbidity, NTU						
Conductivity, umho/cm						
Total Dissolved Solids, mg/L						
Total Organic Carbon, mg/L						

Treated Water Quantity Data (MG/month)			
Month	**2006**	**2007**	**2008**
January			418.95
February			468.04
March			625.43
April		170.85	763.97
May		347.24	779.52
June		463.38	576.23
July		225.29	481.53
August		247.38	730.38
September		212.66	664.31
October		701.38	668.78
November		554.71	582.03
December		332.15	602.23
Annual Total			

VI. **TREATMENT COSTS (2008)**

OVERALL OPERATING COST:	$2.48 -Does not include debt service -Does include contract service fee	$/1000 gallons
OVERALL CONCENTRATE DISPOSAL:		$/1000 gallons
LABOR:		$/1000 gallons
CHEMICALS:	$0.34	$/1000 gallons
ENERGY:	$1.17	$/1000 gallons
MEMBRANE REPLACEMENT:		$/1000 gallons
WHAT IS THE TYPICAL LIFE OF A MEMBRANE?	5 year Warranty	years
NF/RO SYSTEM (IF AVAILABLE):		$/1000 gallons
REPLACEMENT PARTS (NOT INCLUDING MEMBRANE):		$/1000 gallons
CURRENT ENERGY COSTS:	August 2009 - $0.101	kWh
DOES THIS INCLUDE THE ENERGY COST ASSOCIATED WITH HIGH SERVICE PUMPS USED TO PROVIDE TREATED WATER TO THE DISTRIBUTION SYSTEM? IF SO, PLEASE PROVIDE THE NUMBER OF PUMPS AND TOTAL HORSEPOWER.	NO	
OTHER (PLEASE SPECIFY):		$/1000 gallons

The Desalination Facility is contract operated. In 2008 the service fee was 5.55 M. Tampa Bay Water pays for chemicals, electric, and sludge disposal.

VII. **LESSONS LEARNED**

PERMITTING/REGULATION: WHAT OBSTACLES WERE OVERCOME TO OBTAIN PERMITS/CONSENTS?	1. Sensitivity of public input to regulatory authorities. 2. Inexperience of permitting staff with technology. (1st of its size and type in Florida) 3. Toxicity Testing Protocols and interpretation of results. 4. Unfavorable Public opinion.
OPERATIONS: ARE THERE ISSUES IN THE DISTRIBUTION SYSTEM THAT HAVE BEEN DIRECTLY RELATED BACK TO POST TREATMENT?	N/A
CONCENTRATE DISPOSAL: WHAT OBSTACLES WERE OVERCOME DURING CONCENTRATE DISPOSAL?	1. Intimately linked to power plant operations. 2. Obtaining NPDES permit. 3. Toxicity protocols and interpretation of results.
ADDITIONAL INFORMATION:	1. Temperature advantage on flux rates is negated by water quality issues. 2. Pre and Post treatment considerations are key to the process. 3. Pilot testing is essential.

Region C
Water Planning
for North Texas

REGION C WATER PLANNING GROUP
OPERATING DESALINATION FACILITY SURVEY

I. BACKGROUND INFORMATION

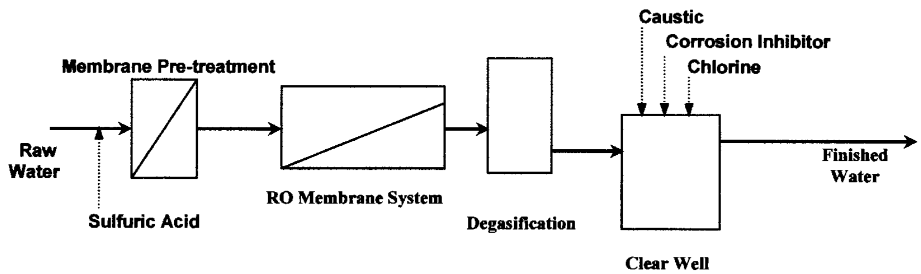
PLANT NAME:	Southmost Regional Water Authority RO Facility
PLANT ADDRESS:	1255 FM 511 Brownsville, TX 78521
CATEGORIZE BY THE TDS OF FEED:	☐ Seawater: 20,000 – 35,000 mg/L TDS ☐ High Brackish Groundwater: >5,500 - <20,000 mg/L TDS ☐ High Brackish Surface Water: >2,500 - <15,000 mg/L TDS ☒ Low Brackish Groundwater: 1,000 – 5,000 mg/L TDS ☐ Low Brackish Surface Water: 1,000 –2,500 mg/L TDS ☐ Fresh Groundwater: <1,000 mg/L TDS ☐ Fresh Surface Water: <1,000 mg/L TDS ☐ Other (please specify):
CONCENTRATE DISPOSAL METHOD:	Surface disposal to drainage channel, outfall to Laguna Madre
SOURCE WATER NAME:	Groundwater Aquifer
IS THE GROUNDWATER UNDER THE INFLUENCE OF SURFACE WATER?	☐ yes ☒ no
CONTACT NAME:	Judy Adams
CONTACT TELEPHONE NUMBER:	956-350-8819
CONTACT EMAIL ADDRESS:	jadams@brownsville-pub.com
WEBSITE:	www.brownsville-pub.com
OWNER NAME:	Southmost Regional Water Authority
OWNER ADDRESS:	1255 FM 511 Brownsville, TX 78521
OWNERSHIP STATUS:	☐ Public Agency (municipality) ☒ Water Authority ☐ Private Agency ☐ Other (please specify):

II. RO/NF MEMBRANE PLANT DESIGN CHARACTERISTICS

PLANT PRODUCTION STATE DATE:	Summer/Fall 2003	
DESIGN HYDRAULIC CAPACITY OF PLANT:	Phase I – 7.5 MGD (6.0 MGD RO permeate + 1.5 MGD raw GW blend)	
PLANT ORIGINALLY DESIGNED FOR EXPANSION	☒ yes ☐ no	
DESIGN PERCENT RO FEEDWATER RECOVERY:	75	%
DESIGN RO MEMBRANE FLUX:	12	gal/day-ft^2
DESIGN PRESSURE:	225	psi (max)
	175	psi (min)
WHAT IS THE END USE OF THE RO/NF PERMEATE?	☒ Potable Water ☐ Industrial Use ☐ Groundwater recharge (for indirect potable reuse) ☐ Groundwater recharge (seawater intrusion barrier) ☐ Irrigation ☐ Other (please specify):	

III. PLANT SCHEMATIC

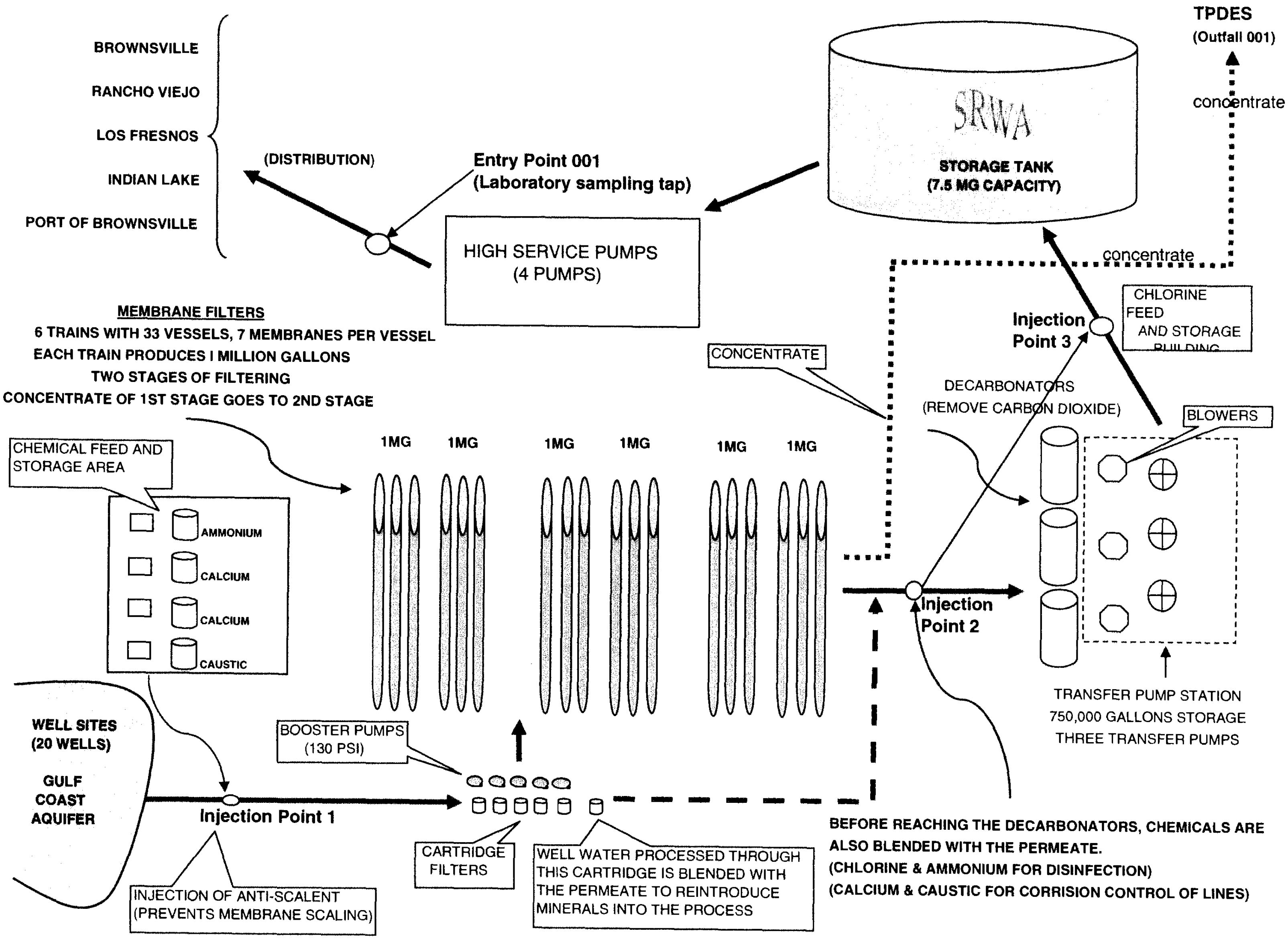
PLEASE ATTACH AN OVERALL SCHEMATIC OF THE PLANT SHOWING ANY PRE- AND POST-TREATMENT PROCESSES TO MEMBRANE FILTRATION, INCLUDING THE LOCATION OF CHEMICAL ADDITION:



SAMPLE SCHEMATIC

Next Page

SOUTHMOST REGIONAL WATER AUTHORITY
REVERSE OSMOSIS TREATMENT PLANT PROCESS



REGION C WATER PLANNING GROUP
OPERATING DESALINATION FACILITY SURVEY

IV. POST TREATMENT INFORMATION

POST TREATMENT TYPE:	[ ] Air stripping/desulfurization [x] Degasification/decarbonation [x] Caustic chemical addition [ ] Corrosion inhibitor addition [ ] Blending [ ] Treated surface water [ ] Treated groundwater [ ] Other (please specify)
DISINFECTION:	Primary: [ ] Chlorine [ ] Ozone [ ] UV [ ] Chlorine dioxide [ ] Other (please specify) Secondary: [ ] Chlorine [x] Chloramine [ ] Other (please specify)
NOT TAKING INTO ACCOUNT THE MEMBRANE PROCESS, WHAT ARE YOUR POST-TREATMENT DISINFECTION AND DISINFECTANT RESIDUAL GOALS?	4mg/L -> 2mg/L
HAVE YOU EXPERIENCED ANY POST TREATMENT PROBLEMS WITHIN THE PLANT?	[ ] Blending limitation like salt concentration or DBP precursors [ ] Scaling of degasification/stripping towers [ ] Biogrowth in degasifaction/stripping towers [ ] Chemical injector plugging [ ] Specific issues with cleaning post treatment equipment [ ] White water formation [ ] Corrosion events [x] Colored or red water [ ] Other (please specify)
ANY DISTRIBUTION SYSTEM IMPACTS NOTED?	[ ] Corrosion events (infrastructure) [ ] Lead and Copper Rule impacts [ ] Disinfection By-Products [ ] Taste and odor [ ] Detention time prior to point of entry to distribution system [ ] Detention time after point of entry to distribution system [ ] pH stability [ ] Disinfection residual stability [ ] White water [ ] Color [x] Red water/black water [ ] Biological regrowth [ ] Other (please specify)
PLEASE PROVIDE BLENDED OR BY-PASS DESCRIPTION (IF APPLICABLE):	Capability of blending 1.5 MG of raw well water. Currently not blending.

V. TREATMENT INFORMATION

Please complete the following table. Enter the low, high, and average values for the last year, if known. If not, the average value is requested. If data is not available for any particular parameter, enter N/A. If any analytical result was below detection limit, enter "BDL."

Water Quality Data						
Parameters	Blend Water (if used)			Point of Entry to Distribution System (POE)		
	Low	High	Average	Low	High	Average
Temperature (°C)				20.6	28.5	26.2
pH [R]				8.04	8.51	8.23
Alkalinity, mg/L as $CaCO_3$				51	75	68
Turbidity, NTU				0.025	0.041	0.088
Conductivity, umho/cm				377	527	435
Total Dissolved Solids, mg/L				180	251	207
Total Organic Carbon, mg/L				N/A	N/A	N/A

Treated Water Quantity Data (MG/month)			
Month	2006	2007	2008
January	91.186	148.235	156.508
February	123.848	136.075	155.266
March	105.274	147.755	161.598
April	147.104	97.191	166.422
May	164.983	154.434	164.344
June	160.232	164.890	170.660
July	149.438	148.103	120.990
August	161.876	154.709	52.911
September	156.090	145.780	36.810
October	156.540	153.235	37.219
November	156.242	158.352	76.401
December	153.030	152.171	139.382
Annual Total	1,725.843	1,760.930	1,438.511

REGION C WATER PLANNING GROUP
OPERATING DESALINATION FACILITY SURVEY

VI. **TREATMENT COSTS**

OVERALL OPERATING COST:	2.543	$/1000 gallons
OVERALL CONCENTRATE DISPOSAL:	—	$/1000 gallons
LABOR:	0.216	$/1000 gallons
CHEMICALS:	0.380	$/1000 gallons
ENERGY:	0.542	$/1000 gallons
MEMBRANE REPLACEMENT:	0.064	$/1000 gallons
WHAT IS THE TYPICAL LIFE OF A MEMBRANE?	5 - 7	years
NF/RO SYSTEM (IF AVAILABLE):		$/1000 gallons
REPLACEMENT PARTS (NOT INCLUDING MEMBRANE):	0.057	$/1000 gallons
CURRENT ENERGY COSTS:	0.542	$/1000 gallons
DOES THIS INCLUDE THE ENERGY COST ASSOCIATED WITH HIGH SERVICE PUMPS USED TO PROVIDE TREATED WATER TO THE DISTRIBUTION SYSTEM? IF SO, PLEASE PROVIDE THE NUMBER OF PUMPS AND TOTAL HORSEPOWER.	2 - 150 H.P. 1390gpm 2 - 600 H.P. 6950gpm	
OTHER (PLEASE SPECIFY):		$/1000 gallons

VII. LESSONS LEARNED

PERMITTING/REGULATION: WHAT OBSTACLES WERE OVERCOME TO OBTAIN PERMITS/CONSENTS?	
OPERATIONS: ARE THERE ISSUES IN THE DISTRIBUTION SYSTEM THAT HAVE BEEN DIRECTLY RELATED BACK TO POST TREATMENT?	
CONCENTRATE DISPOSAL: WHAT OBSTACLES WERE OVERCOME DURING CONCENTRATE DISPOSAL?	
ADDITIONAL INFORMATION:	

REGION C WATER PLANNING GROUP
OPERATING DESALINATION FACILITY SURVEY

I. BACKGROUND INFORMATION

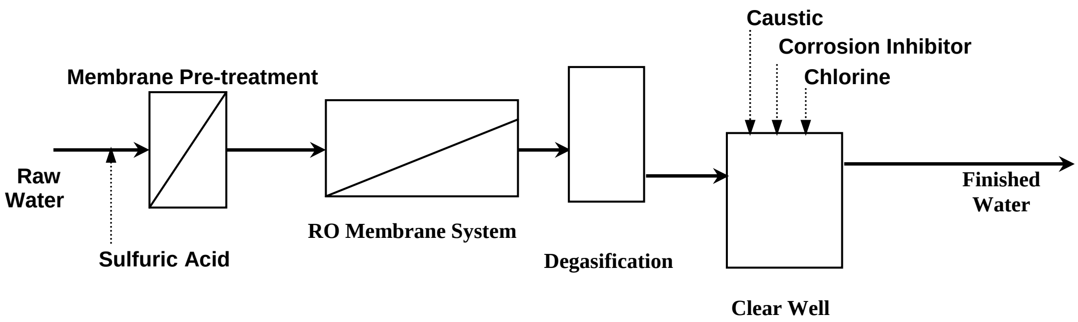
PLANT NAME:	Kay Bailey Hutchison Desalination Plant
PLANT ADDRESS:	10751 Montana Ave. El Paso, Texas, 79935
CATEGORIZE BY THE TDS OF FEED:	☐ Seawater: 20,000 – 35,000 mg/L TDS ☐ High Brackish Groundwater: >5,500 - <20,000 mg/L TDS ☐ High Brackish Surface Water: >2,500 - <15,000 mg/L TDS ☒ Low Brackish Groundwater: 1,000 – 5,000 mg/L TDS ☐ Low Brackish Surface Water: 1,000 –2,500 mg/L TDS ☐ Fresh Groundwater: <1,000 mg/L TDS ☐ Fresh Surface Water: <1,000 mg/L TDS ☐ Other (please specify):
CONCENTRATE DISPOSAL METHOD:	Deep Well Injection
SOURCE WATER NAME:	Hueco Bolson
IS THE GROUNDWATER UNDER THE INFLUENCE OF SURFACE WATER?	☐ yes ☒ no
CONTACT NAME:	Art Ruiz
CONTACT TELEPHONE NUMBER:	(915) 621-2051
CONTACT EMAIL ADDRESS:	aruiz@epwu.org
WEBSITE:	www.epwu.org
OWNER NAME:	El Paso Water Utilities
OWNER ADDRESS:	1154 Hawkins El Paso, Texas, Blvd, 79925
OWNERSHIP STATUS:	☒ Public Agency (municipality) ☐ Water Authority ☐ Private Agency ☐ Other (please specify):

II. RO/NF MEMBRANE PLANT DESIGN CHARACTERISTICS

PLANT PRODUCTION STATE DATE:	July 23, 2007	
DESIGN HYDRAULIC CAPACITY OF PLANT:	27.5 MGD	
PLANT ORIGINALLY DESIGNED FOR EXPANSION	☒ yes ☐ no	
DESIGN PERCENT RO FEEDWATER RECOVERY:	85	%
DESIGN RO MEMBRANE FLUX:	14	gal/day-ft^2
DESIGN PRESSURE:	185	psi (max)
	125	psi (min)
WHAT IS THE END USE OF THE RO/NF PERMEATE?	☒ Potable Water ☐ Industrial Use ☐ Groundwater recharge (for indirect potable reuse) ☐ Groundwater recharge (seawater intrusion barrier) ☐ Irrigation ☐ Other (please specify):	

III. PLANT SCHEMATIC

PLEASE ATTACH AN OVERALL SCHEMATIC OF THE PLANT SHOWING ANY PRE- AND POST-TREATMENT PROCESSES TO MEMBRANE FILTRATION, INCLUDING THE LOCATION OF CHEMICAL ADDITION:



SAMPLE SCHEMATIC

IV. **POST TREATMENT INFORMATION**

POST TREATMENT TYPE:	☐ Air stripping/desulfurization ☐ Degasification/decarbonation ☐ Caustic chemical addition ☒ Corrosion inhibitor addition ☒ Blending ☐ Treated surface water ☐ Treated groundwater ☐ Other (please specify)
DISINFECTION:	Primary: ☒ Chlorine ☐ Ozone ☐ UV ☐ Chlorine dioxide ☐ Other (please specify) Secondary: ☐ Chlorine ☐ Chloramine ☐ Other (please specify)
NOT TAKING INTO ACCOUNT THE MEMBRANE PROCESS, WHAT ARE YOUR POST-TREATMENT DISINFECTION AND DISINFECTANT RESIDUAL GOALS?	For post treatment disinfection Sodium Hypochlorite is used a free chlorine residual of 1.5 – 1.8 mg/l is maintained.
HAVE YOU EXPERIENCED ANY POST TREATMENT PROBLEMS WITHIN THE PLANT?	☐ Blending limitation like salt concentration or DBP precursors ☐ Scaling of degasification/stripping towers ☐ Biogrowth in degasifaction/stripping towers ☐ Chemical injector plugging ☐ Specific issues with cleaning post treatment equipment ☐ White water formation ☐ Corrosion events ☐ Colored or red water ☐ Other (please specify) **NONE**
ANY DISTRIBUTION SYSTEM IMPACTS NOTED?	☐ Corrosion events (infrastructure) ☐ Lead and Copper Rule impacts ☐ Disinfection By-Products ☐ Taste and odor ☐ Detention time prior to point of entry to distribution system ☐ Detention time after point of entry to distribution system ☐ pH stability ☐ Disinfection residual stability ☐ White water ☐ Color ☐ Red water/black water ☐ Biological regrowth ☐ Other (please specify) **NONE**
PLEASE PROVIDE BLENDED OR BY-PASS DESCRIPTION (IF APPLICABLE):	We have the capability to blend at the beginning or end of the process. We also have the capability to by-pass the operation process and pump directly into the clearwell.

V. TREATMENT INFORMATION

Please complete the following table. Enter the low, high, and average values for the last year, if known. If not, the average value is requested. If data is not available for any particular parameter, enter N/A. If any analytical result was below detection limit, enter “BDL.”

Water Quality Data						
Parameters	**Blend Water (if used)**			**Point of Entry to Distribution System (POE)**		
	Low	**High**	**Average**	**Low**	**High**	**Average**
Temperature (°C)	19.3	26.6	22.9	22.6	25.5	23.9
pH [R]	7.4	8.2	7.6	6.9	7.4	7.1
Alkalinity, mg/L as $CaCO_3$	60	88	73	16	36	21
Turbidity, NTU	.05	.31	.08	.05	.10	.07
Conductivity, umho/cm	1431	1900	1517	593	957	696
Total Dissolved Solids, mg/L	1003	1365	1067	398	836	470
Total Organic Carbon, mg/L	N/A	N/A	N/A	N/A	N/A	N/A

Treated Water Quantity Data (MG/month)			
Month	**2006**	**2007**	**2008**
January			107.272
February			100.768
March			104.655
April			83.484
May			108.792
June			103.829
July		56.567	110.055
August		235.728	104.161
September		201.398	69.782
October		122.964	106.123
November		117.725	105.625
December		108.659	106.722
Annual Total		**843.041**	**1211.268**

VI. **TREATMENT COSTS**

OVERALL OPERATING COST:	1.64	$/1000 gallons
OVERALL CONCENTRATE DISPOSAL:	N/A	$/1000 gallons
LABOR:	N/A	$/1000 gallons
CHEMICALS:	0.058	$/1000 gallons
ENERGY:	0.36	$/1000 gallons
MEMBRANE REPLACEMENT:	N/A	$/1000 gallons
WHAT IS THE TYPICAL LIFE OF A MEMBRANE?	*****See note below	years
NF/RO SYSTEM (IF AVAILABLE):	None	$/1000 gallons
REPLACEMENT PARTS (NOT INCLUDING MEMBRANE):	N/A	$/1000 gallons
CURRENT ENERGY COSTS:	N/A	$/1000 gallons
DOES THIS INCLUDE THE ENERGY COST ASSOCIATED WITH HIGH SERVICE PUMPS USED TO PROVIDE TREATED WATER TO THE DISTRIBUTION SYSTEM? IF SO, PLEASE PROVIDE THE NUMBER OF PUMPS AND TOTAL HORSEPOWER.	Yes, overall cost includes operations, chemical, maintenance and power. We have a total four (4) 300 horsepower high service pumps.	
OTHER (PLEASE SPECIFY):		$/1000 gallons

*We have no typical life expectancy of the membrane module, it all depends on source water quality, pretreatment and proper maintenance & operation of the unit.

VII. **LESSONS LEARNED**

PERMITTING/REGULATION: WHAT OBSTACLES WERE OVERCOME TO OBTAIN PERMITS/CONSENTS?	No obstacles.
OPERATIONS: ARE THERE ISSUES IN THE DISTRIBUTION SYSTEM THAT HAVE BEEN DIRECTLY RELATED BACK TO POST TREATMENT?	No issues.
CONCENTRATE DISPOSAL: WHAT OBSTACLES WERE OVERCOME DURING CONCENTRATE DISPOSAL?	No obstacles were encountered, concentrate deep well injection is working properly.
ADDITIONAL INFORMATION:	

Appendix I

Disposal Cost Models

Table 1.
Deep Well Disposal Capital Costs

Tubing Diameter (in)	Depth (feet)	Cost of Logging, Testing, and Surveying (2008 Dollars)	Cost of Drilling and Reaming (2008 Dollars)	Cost of Installed Casing (2008 Dollars)	Cost of Installed Grouting (2008 Dollars)	Cost of Installed Injection Tube (2008 Dollars)	Cost of Installed Packer (2008 Dollars)	Total Injection Well Cost (2008 Dollars)	Mobilization/ Demobilization Cost (2008 Dollars)	Monitoring Well Cost (2008 Dollars)	Total Cost (2008 Dollars)
5	2,500	$372,456	$568,841	$663,648	$284,421	$284,421	$88,035	$2,261,822	$846,490	$846,490	**$3,954,802**
5	5,000	$453,719	$1,056,420	$1,191,858	$528,210	$541,754	$88,035	$3,859,995	$1,083,507	$1,083,507	**$6,027,010**
5	7,500	$528,210	$1,503,367	$1,652,349	$717,824	$758,455	$88,035	$5,248,239	$1,151,227	$1,151,227	**$7,550,692**
5	10,000	$616,245	$1,997,717	$2,099,296	$920,981	$1,015,788	$88,035	$6,738,062	$1,218,946	$1,218,946	**$9,175,954**
6	2,500	$378,325	$593,220	$691,639	$297,965	$297,965	$96,161	$2,355,274	$846,490	$846,490	**$4,048,255**
6	5,000	$461,394	$1,098,857	$1,243,325	$563,424	$568,841	$96,161	$4,032,002	$1,083,507	$1,083,507	**$6,199,017**
6	7,500	$537,239	$1,566,571	$1,722,325	$769,290	$799,087	$96,161	$5,490,674	$1,151,227	$1,151,227	**$7,793,127**
6	10,000	$626,628	$2,078,980	$2,189,588	$980,574	$1,067,255	$96,161	$7,039,187	$1,218,946	$1,218,946	**$9,477,078**
7	2,500	$384,194	$617,599	$719,630	$311,508	$311,508	$104,288	$2,448,727	$846,490	$846,490	**$4,141,707**
7	5,000	$469,068	$1,141,295	$1,294,791	$598,638	$595,929	$104,288	$4,204,009	$1,083,507	$1,083,507	**$6,371,024**
7	7,500	$546,268	$1,629,776	$1,792,302	$820,757	$839,718	$104,288	$5,733,109	$1,151,227	$1,151,227	**$8,035,562**
7	10,000	$637,012	$2,160,243	$2,279,880	$1,040,167	$1,118,721	$104,288	$7,340,311	$1,218,946	$1,218,946	**$9,778,203**
8	2,500	$390,063	$641,978	$747,620	$325,052	$325,052	$112,414	$2,542,179	$846,490	$846,490	**$4,235,160**
8	5,000	$476,743	$1,183,732	$1,346,258	$633,852	$623,017	$112,414	$4,376,016	$1,083,507	$1,083,507	**$6,543,031**
8	7,500	$555,298	$1,692,980	$1,862,278	$872,223	$880,350	$112,414	$5,975,544	$1,151,227	$1,151,227	**$8,277,997**
8	10,000	$647,396	$2,241,506	$2,370,173	$1,099,760	$1,170,188	$112,414	$7,641,436	$1,218,946	$1,218,946	**$10,079,328**
9	2,500	$395,932	$666,357	$775,611	$338,596	$338,596	$120,540	$2,635,632	$846,490	$846,490	**$4,328,612**
9	5,000	$484,418	$1,226,169	$1,397,725	$669,066	$650,104	$120,540	$4,548,022	$1,083,507	$1,083,507	**$6,715,037**
9	7,500	$564,327	$1,756,185	$1,932,255	$923,690	$920,981	$120,540	$6,217,978	$1,151,227	$1,151,227	**$8,520,432**
9	10,000	$657,779	$2,322,769	$2,460,465	$1,159,353	$1,221,655	$120,540	$7,942,561	$1,218,946	$1,218,946	**$10,380,453**
10	2,500	$401,801	$690,736	$803,601	$352,140	$352,140	$128,667	$2,729,084	$846,490	$846,490	**$4,422,065**
10	5,000	$492,093	$1,268,607	$1,449,191	$704,280	$677,192	$128,667	$4,720,029	$1,083,507	$1,083,507	**$6,887,044**
10	7,500	$573,356	$1,819,390	$2,002,231	$975,157	$961,613	$128,667	$6,460,413	$1,151,227	$1,151,227	**$8,762,866**
10	10,000	$668,163	$2,404,032	$2,550,757	$1,218,946	$1,273,121	$128,667	$8,243,686	$1,218,946	$1,218,946	**$10,681,578**
11	2,500	$407,670	$715,115	$831,592	$398,866	$365,684	$129,150	$2,848,077	$846,490	$846,490	**$4,541,057**
11	5,000	$499,768	$1,311,044	$1,500,658	$782,834	$698,862	$129,150	$4,922,316	$1,083,507	$1,083,507	**$7,089,331**
11	7,500	$582,385	$1,882,594	$2,072,208	$1,082,153	$994,118	$129,150	$6,742,609	$1,151,227	$1,151,227	**$9,045,062**
11	10,000	$678,547	$2,485,295	$2,641,049	$1,361,156	$1,316,462	$129,150	$8,611,659	$1,218,946	$1,218,946	**$11,049,551**
12	2,500	$413,539	$739,494	$859,583	$445,592	$379,228	$129,634	$2,967,069	$846,490	$846,490	**$4,660,049**
12	5,000	$507,443	$1,353,481	$1,552,124	$861,388	$720,532	$129,634	$5,124,603	$1,083,507	$1,083,507	**$7,291,618**
12	7,500	$591,414	$1,945,799	$2,142,184	$1,189,149	$1,026,623	$129,634	$7,024,804	$1,151,227	$1,151,227	**$9,327,258**
12	10,000	$688,930	$2,566,558	$2,731,342	$1,503,367	$1,359,802	$129,634	$8,979,632	$1,218,946	$1,218,946	**$11,417,524**
13	2,500	$419,408	$763,873	$887,573	$492,319	$392,771	$130,118	$3,086,061	$846,490	$846,490	**$4,779,042**
13	5,000	$515,117	$1,395,919	$1,603,591	$939,943	$742,203	$130,118	$5,326,890	$1,083,507	$1,083,507	**$7,493,905**
13	7,500	$600,444	$2,009,003	$2,212,161	$1,296,146	$1,059,129	$130,118	$7,307,000	$1,151,227	$1,151,227	**$9,609,453**
13	10,000	$699,314	$2,647,821	$2,821,634	$1,645,577	$1,403,142	$130,118	$9,347,606	$1,218,946	$1,218,946	**$11,785,497**
14	2,500	$425,277	$788,252	$915,564	$539,045	$406,315	$130,601	$3,205,054	$846,490	$846,490	**$4,898,034**
14	5,000	$522,792	$1,438,356	$1,655,058	$1,018,497	$763,873	$130,601	$5,529,177	$1,083,507	$1,083,507	**$7,696,192**
14	7,500	$609,473	$2,072,208	$2,282,138	$1,403,142	$1,091,634	$130,601	$7,589,196	$1,151,227	$1,151,227	**$9,891,649**

Tubing Diameter (in)	Depth (feet)	Cost of Logging, Testing, and Surveying (2008 Dollars)	Cost of Drilling and Reaming (2008 Dollars)	Cost of Installed Casing (2008 Dollars)	Cost of Installed Grouting (2008 Dollars)	Cost of Installed Injection Tube (2008 Dollars)	Cost of Installed Packer (2008 Dollars)	Total Injection Well Cost (2008 Dollars)	Mobilization/ Demobilization Cost (2008 Dollars)	Monitoring Well Cost (2008 Dollars)	Total Cost (2008 Dollars)
14	10,000	$709,697	$2,729,084	$2,911,926	$1,787,787	$1,446,482	$130,601	$9,715,579	$1,218,946	$1,218,946	**$12,153,471**
15	2,500	$431,146	$812,631	$943,554	$585,771	$419,859	$131,085	$3,324,046	$846,490	$846,490	**$5,017,026**
15	5,000	$530,467	$1,480,794	$1,706,524	$1,097,051	$785,543	$131,085	$5,731,464	$1,083,507	$1,083,507	**$7,898,479**
15	7,500	$618,502	$2,135,413	$2,352,114	$1,510,138	$1,124,139	$131,085	$7,871,391	$1,151,227	$1,151,227	**$10,173,845**
15	10,000	$720,081	$2,810,347	$3,002,219	$1,929,998	$1,489,823	$131,085	$10,083,552	$1,218,946	$1,218,946	**$12,521,444**
16	2,500	$437,015	$837,009	$971,545	$632,497	$433,403	$131,569	$3,443,038	$846,490	$846,490	**$5,136,019**
16	5,000	$538,142	$1,523,231	$1,757,991	$1,175,606	$807,213	$131,569	$5,933,751	$1,083,507	$1,083,507	**$8,100,766**
16	7,500	$627,531	$2,198,617	$2,422,091	$1,617,135	$1,156,644	$131,569	$8,153,587	$1,151,227	$1,151,227	**$10,456,040**
16	10,000	$730,465	$2,891,610	$3,092,511	$2,072,208	$1,533,163	$131,569	$10,451,526	$1,218,946	$1,218,946	**$12,889,417**
17	2,500	$442,884	$861,388	$999,536	$679,224	$446,947	$132,052	$3,562,031	$846,490	$846,490	**$5,255,011**
17	5,000	$545,817	$1,565,668	$1,809,457	$1,254,160	$828,883	$132,052	$6,136,038	$1,083,507	$1,083,507	**$8,303,053**
17	7,500	$636,561	$2,261,822	$2,492,067	$1,724,131	$1,189,149	$132,052	$8,435,783	$1,151,227	$1,151,227	**$10,738,236**
17	10,000	$740,848	$2,972,874	$3,182,803	$2,214,418	$1,576,503	$132,052	$10,819,499	$1,218,946	$1,218,946	**$13,257,391**
18	2,500	$448,753	$885,767	$1,027,526	$725,950	$460,491	$132,536	$3,681,023	$846,490	$846,490	**$5,374,003**
18	5,000	$553,492	$1,608,106	$1,860,924	$1,332,714	$850,553	$132,536	$6,338,325	$1,083,507	$1,083,507	**$8,505,340**
18	7,500	$645,590	$2,325,026	$2,562,044	$1,831,128	$1,221,655	$132,536	$8,717,978	$1,151,227	$1,151,227	**$11,020,432**
18	10,000	$751,232	$3,054,137	$3,273,095	$2,356,629	$1,619,844	$132,536	$11,187,472	$1,218,946	$1,218,946	**$13,625,364**
19	2,500	$454,622	$910,146	$1,055,517	$772,676	$474,035	$133,020	$3,800,015	$846,490	$846,490	**$5,492,996**
19	5,000	$561,167	$1,650,543	$1,912,391	$1,411,268	$872,223	$133,020	$6,540,612	$1,083,507	$1,083,507	**$8,707,627**
19	7,500	$654,619	$2,388,231	$2,632,020	$1,938,124	$1,254,160	$133,020	$9,000,174	$1,151,227	$1,151,227	**$11,302,627**
19	10,000	$761,615	$3,135,400	$3,363,388	$2,498,839	$1,663,184	$133,020	$11,555,446	$1,218,946	$1,218,946	**$13,993,337**
20	2,500	$460,491	$934,525	$1,083,507	$819,403	$487,578	$133,504	$3,919,008	$846,490	$846,490	**$5,611,988**
20	5,000	$568,841	$1,692,980	$1,963,857	$1,489,823	$893,894	$133,504	$6,742,899	$1,083,507	$1,083,507	**$8,909,914**
20	7,500	$663,648	$2,451,436	$2,701,997	$2,045,120	$1,286,665	$133,504	$9,282,370	$1,151,227	$1,151,227	**$11,584,823**
20	10,000	$771,999	$3,216,663	$3,453,680	$2,641,049	$1,706,524	$133,504	$11,923,419	$1,218,946	$1,218,946	**$14,361,311**
21	2,500	$466,360	$958,904	$1,111,498	$866,129	$501,122	$133,987	$4,038,000	$846,490	$846,490	**$5,730,980**
21	5,000	$576,516	$1,735,418	$2,015,324	$1,568,377	$915,564	$133,987	$6,945,186	$1,083,507	$1,083,507	**$9,112,201**
21	7,500	$672,678	$2,514,640	$2,771,973	$2,152,117	$1,319,170	$133,987	$9,564,565	$1,151,227	$1,151,227	**$11,867,018**
21	10,000	$782,383	$3,297,926	$3,543,972	$2,783,260	$1,749,865	$133,987	$12,291,392	$1,218,946	$1,218,946	**$14,729,284**
22	2,500	$472,229	$983,283	$1,139,489	$912,855	$514,666	$134,471	$4,156,992	$846,490	$846,490	**$5,849,973**
22	5,000	$584,191	$1,777,855	$2,066,790	$1,646,931	$937,234	$134,471	$7,147,473	$1,083,507	$1,083,507	**$9,314,488**
22	7,500	$681,707	$2,577,845	$2,841,950	$2,259,113	$1,351,676	$134,471	$9,846,761	$1,151,227	$1,151,227	**$12,149,214**
22	10,000	$792,766	$3,379,189	$3,634,265	$2,925,470	$1,793,205	$134,471	$12,659,366	$1,218,946	$1,218,946	**$15,097,257**
23	2,500	$478,098	$1,007,662	$1,167,479	$959,581	$528,210	$134,955	$4,275,985	$846,490	$846,490	**$5,968,965**
23	5,000	$591,866	$1,820,292	$2,118,257	$1,725,486	$958,904	$134,955	$7,349,760	$1,083,507	$1,083,507	**$9,516,775**
23	7,500	$690,736	$2,641,049	$2,911,926	$2,366,109	$1,384,181	$134,955	$10,128,956	$1,151,227	$1,151,227	**$12,431,410**
23	10,000	$803,150	$3,460,452	$3,724,557	$3,067,680	$1,836,545	$134,955	$13,027,339	$1,218,946	$1,218,946	**$15,465,231**
24	2,500	$483,967	$1,032,041	$1,195,470	$1,006,308	$541,754	$135,438	$4,394,977	$846,490	$846,490	**$6,087,957**
24	5,000	$599,541	$1,862,730	$2,169,724	$1,804,040	$980,574	$135,438	$7,552,047	$1,083,507	$1,083,507	**$9,719,062**
24	7,500	$699,765	$2,704,254	$2,981,903	$2,473,106	$1,416,686	$135,438	$10,411,152	$1,151,227	$1,151,227	**$12,713,605**
24	10,000	$813,534	$3,541,715	$3,814,849	$3,209,891	$1,879,885	$135,438	$13,395,312	$1,218,946	$1,218,946	**$15,833,204**

Table 2.
Evaporation Pond Disposal Capital Costs

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
1	4	60	1.65	1.65	1	$1,354	$10,835	$24,379	$24,379	$12,867	$2,939	$62,374	$102,917	$10,292	$10,292	**$123,501**
1	8	60	2.35	2.35	1	$1,354	$23,702	$17,607	$17,607	$14,898	$2,519	$70,080	$164,689	$16,469	$16,469	**$197,627**
1	12	60	3.1	3.1	1	$1,354	$35,214	$13,544	$13,544	$17,607	$2,167	$79,886	$247,647	$24,765	$24,765	**$297,177**
2	4	60	1.475	2.95	1	$1,354	$9,142	$27,765	$27,765	$10,835	$2,418	$61,514	$181,466	$18,147	$18,147	**$217,760**
2	8	60	2	4	1	$1,354	$20,316	$20,993	$20,993	$12,325	$2,072	$67,060	$268,241	$26,824	$26,824	**$321,889**
2	12	60	2.6	5.2	1	$1,354	$32,505	$16,930	$16,930	$14,356	$1,828	$76,974	$400,266	$40,027	$40,027	**$480,320**
3	4	60	1.3	3.9	1	$1,354	$7,449	$31,151	$31,151	$8,803	$1,896	$60,654	$236,550	$23,655	$23,655	**$283,861**
3	8	60	1.65	4.95	1	$1,354	$16,930	$24,379	$24,379	$9,752	$1,625	$64,040	$316,998	$31,700	$31,700	**$380,397**
3	12	60	2.1	6.3	1	$1,354	$29,796	$20,316	$20,316	$11,106	$1,490	$74,062	$466,593	$46,659	$46,659	**$559,912**
4	4	60	1.275	5.1	1	$1,354	$6,772	$31,828	$31,828	$8,126	$1,693	$59,774	$304,845	$30,485	$30,485	**$365,815**
4	8	60	1.575	6.3	1	$1,354	$15,914	$26,410	$26,410	$8,939	$1,490	$64,108	$403,878	$40,388	$40,388	**$484,654**
4	12	60	1.925	7.7	1	$1,354	$27,088	$21,670	$21,670	$9,955	$1,354	$71,421	$549,944	$54,994	$54,994	**$659,933**
5	4	60	1.25	6.25	1	$1,354	$6,095	$32,505	$32,505	$7,449	$1,490	$58,893	$368,083	$36,808	$36,808	**$441,700**
5	8	60	1.5	7.5	1	$1,354	$14,898	$28,442	$28,442	$8,126	$1,354	$64,175	$481,315	$48,132	$48,132	**$577,578**
5	12	60	1.75	8.75	1	$1,354	$24,379	$23,025	$23,025	$8,803	$1,219	$68,780	$601,827	$60,183	$60,183	**$722,193**
6	4	60	1.24	7.44	1	$1,354	$5,688	$33,047	$33,047	$7,097	$1,409	$58,595	$435,949	$43,595	$43,595	**$523,139**
6	8	60	1.47	8.82	1	$1,354	$14,356	$28,984	$28,984	$7,747	$1,287	$63,728	$562,085	$56,208	$56,208	**$674,502**
6	12	60	1.71	10.26	1	$1,354	$23,702	$23,837	$23,837	$8,343	$1,165	$68,401	$701,795	$70,179	$70,179	**$842,154**
7	4	60	1.23	8.61	1	$1,354	$5,282	$33,589	$33,589	$6,745	$1,327	$58,297	$501,940	$50,194	$50,194	**$602,328**
7	8	60	1.44	10.08	1	$1,354	$13,815	$29,526	$29,526	$7,368	$1,219	$63,281	$637,877	$63,788	$63,788	**$765,453**
7	12	60	1.67	11.69	1	$1,354	$23,025	$24,650	$24,650	$7,883	$1,111	$68,022	$795,175	$79,518	$79,518	**$954,210**
8	4	60	1.22	9.76	1	$1,354	$4,876	$34,130	$34,130	$6,393	$1,246	$57,999	$566,074	$56,607	$56,607	**$679,289**
8	8	60	1.41	11.28	1	$1,354	$13,273	$30,067	$30,067	$6,989	$1,151	$62,835	$708,774	$70,877	$70,877	**$850,528**
8	12	60	1.63	13.04	1	$1,354	$22,347	$25,462	$25,462	$7,422	$1,056	$67,643	$882,059	$88,206	$88,206	**$1,058,471**
9	4	60	1.21	10.89	1	$1,354	$4,469	$34,672	$34,672	$6,041	$1,165	$57,701	$628,368	$62,837	$62,837	**$754,042**
9	8	60	1.38	12.42	1	$1,354	$12,731	$30,609	$30,609	$6,609	$1,084	$62,388	$774,854	$77,485	$77,485	**$929,825**
9	12	60	1.59	14.31	1	$1,354	$21,670	$26,275	$26,275	$6,962	$1,002	$67,263	$962,539	$96,254	$96,254	**$1,155,047**
10	4	60	1.2	12	1	$1,354	$4,063	$35,214	$35,214	$5,688	$1,084	$57,403	$688,841	$68,884	$68,884	**$826,610**
10	8	60	1.35	13.5	1	$1,354	$12,189	$31,151	$31,151	$6,230	$1,016	$61,941	$836,199	$83,620	$83,620	**$1,003,438**
10	12	60	1.55	15.5	1	$1,354	$20,993	$27,088	$27,088	$6,501	$948	$66,884	$1,036,704	$103,670	$103,670	**$1,244,045**
20	4	60	1.16	23.2	1	$1,354	$3,386	$36,568	$36,568	$4,639	$867	$56,814	$1,318,092	$131,809	$131,809	**$1,581,710**
20	8	60	1.275	25.5	1	$1,354	$9,819	$32,844	$32,844	$4,977	$819	$59,814	$1,525,263	$152,526	$152,526	**$1,830,316**
20	12	60	1.42	28.4	1	$1,354	$17,607	$29,796	$29,796	$5,181	$772	$64,710	$1,837,774	$183,777	$183,777	**$2,205,329**
30	4	60	1.12	33.6	1	$1,354	$2,709	$37,923	$37,923	$3,589	$650	$56,225	$1,889,165	$188,916	$188,916	**$2,266,997**
30	8	60	1.2	36	1	$1,354	$7,449	$34,537	$34,537	$3,725	$623	$57,688	$2,076,763	$207,676	$207,676	**$2,492,116**
30	12	60	1.29	38.7	1	$1,354	$14,221	$32,505	$32,505	$3,860	$596	$62,537	$2,420,165	$242,017	$242,017	**$2,904,198**
40	4	60	1.105	44.2	1	$1,354	$2,438	$38,261	$38,261	$3,284	$582	$55,920	$2,471,682	$247,168	$247,168	**$2,966,018**
40	8	60	1.175	47	1	$1,354	$6,772	$35,553	$35,553	$3,386	$562	$57,627	$2,708,465	$270,847	$270,847	**$3,250,159**
40	12	60	1.26	50.4	1	$1,354	$12,867	$33,521	$33,521	$3,488	$542	$61,771	$3,113,276	$311,328	$311,328	**$3,735,931**
50	4	60	1.09	54.5	1	$1,354	$2,167	$38,600	$38,600	$2,980	$515	$55,616	$3,031,054	$303,105	$303,105	**$3,637,264**
50	8	60	1.15	57.5	1	$1,354	$6,095	$36,568	$36,568	$3,047	$501	$57,566	$3,310,044	$331,004	$331,004	**$3,972,052**
50	12	60	1.23	61.5	1	$1,354	$11,512	$34,537	$34,537	$3,115	$488	$61,006	$3,751,876	$375,188	$375,188	**$4,502,251**
60	4	60	1.08	65.04	1	$1,354	$2,004	$38,735	$38,735	$2,817	$485	$55,396	$3,602,972	$360,297	$360,297	**$4,323,567**
60	8	60	1.14	68.64	1	$1,354	$5,824	$36,839	$36,839	$2,877	$473	$57,367	$3,937,663	$393,766	$393,766	**$4,725,195**
60	12	60	1.22	72.96	1	$1,354	$10,889	$34,808	$34,808	$2,936	$460	$60,448	$4,410,294	$441,029	$441,029	**$5,292,353**
70	4	60	1.08	75.46	1	$1,354	$1,842	$38,871	$38,871	$2,655	$455	$55,177	$4,163,645	$416,364	$416,364	**$4,996,373**
70	8	60	1.14	79.66	1	$1,354	$5,553	$37,110	$37,110	$2,706	$444	$57,168	$4,553,986	$455,399	$455,399	**$5,464,783**
70	12	60	1.20	84.14	1	$1,354	$10,266	$35,079	$35,079	$2,758	$433	$59,890	$5,039,153	$503,915	$503,915	**$6,046,984**
80	4	60	1.07	85.76	1	$1,354	$1,679	$39,006	$39,006	$2,492	$425	$54,957	$4,713,149	$471,315	$471,315	**$5,655,779**

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
80	8	60	1.13	90.56	1	$1,354	$5,282	$37,381	$37,381	$2,535	$416	$56,969	$5,159,085	$515,908	$515,908	**$6,190,902**
80	12	60	1.19	95.04	1	$1,354	$9,643	$35,349	$35,349	$2,579	$406	$59,332	$5,638,922	$563,892	$563,892	**$6,766,707**
90	4	60	1.07	95.94	1	$1,354	$1,517	$39,142	$39,142	$2,330	$395	$54,738	$5,251,566	$525,157	$525,157	**$6,301,879**
90	8	60	1.13	101.34	1	$1,354	$5,011	$37,652	$37,652	$2,365	$387	$56,770	$5,753,031	$575,303	$575,303	**$6,903,637**
90	12	60	1.17	105.66	1	$1,354	$9,020	$35,620	$35,620	$2,400	$379	$58,774	$6,210,070	$621,007	$621,007	**$7,452,084**
100	4	60	1.06	106	1	$1,354	$1,354	$39,277	$39,277	$2,167	$366	$54,519	$5,778,973	$577,897	$577,897	**$6,934,767**
100	8	60	1.12	112	1	$1,354	$4,740	$37,923	$37,923	$2,194	$359	$56,571	$6,335,896	$633,590	$633,590	**$7,603,076**
100	12	60	1.16	116	1	$1,354	$8,397	$35,891	$35,891	$2,221	$352	$58,216	$6,753,065	$675,307	$675,307	**$8,103,678**
1	4	60	1.65	1.65	1	$1,354	$10,835	$24,379	$24,379	$12,867	$2,939	$72,374	$119,417	$11,942	$11,942	**$143,301**
1	8	60	2.35	2.35	1	$1,354	$23,702	$17,607	$17,607	$14,898	$2,519	$80,080	$188,189	$18,819	$18,819	**$225,827**
1	12	60	3.1	3.1	1	$1,354	$35,214	$13,544	$13,544	$17,607	$2,167	$89,886	$278,647	$27,865	$27,865	**$334,377**
2	4	60	1.475	2.95	1	$1,354	$9,142	$27,765	$27,765	$10,835	$2,418	$71,514	$210,966	$21,097	$21,097	**$253,160**
2	8	60	2	4	1	$1,354	$20,316	$20,993	$20,993	$12,325	$2,072	$77,060	$308,241	$30,824	$30,824	**$369,889**
2	12	60	2.6	5.2	1	$1,354	$32,505	$16,930	$16,930	$14,356	$1,828	$86,974	$452,266	$45,227	$45,227	**$542,720**
3	4	60	1.3	3.9	1	$1,354	$7,449	$31,151	$31,151	$8,803	$1,896	$70,654	$275,550	$27,555	$27,555	**$330,661**
3	8	60	1.65	4.95	1	$1,354	$16,930	$24,379	$24,379	$9,752	$1,625	$74,040	$366,498	$36,650	$36,650	**$439,797**
3	12	60	2.1	6.3	1	$1,354	$29,796	$20,316	$20,316	$11,106	$1,490	$84,062	$529,593	$52,959	$52,959	**$635,512**
4	4	60	1.275	5.1	1	$1,354	$6,772	$31,828	$31,828	$8,126	$1,693	$69,774	$355,845	$35,585	$35,585	**$427,015**
4	8	60	1.575	6.3	1	$1,354	$15,914	$26,410	$26,410	$8,939	$1,490	$74,108	$466,878	$46,688	$46,688	**$560,254**
4	12	60	1.925	7.7	1	$1,354	$27,088	$21,670	$21,670	$9,955	$1,354	$81,421	$626,944	$62,694	$62,694	**$752,333**
5	4	60	1.25	6.25	1	$1,354	$6,095	$32,505	$32,505	$7,449	$1,490	$68,893	$430,583	$43,058	$43,058	**$516,700**
5	8	60	1.5	7.5	1	$1,354	$14,898	$28,442	$28,442	$8,126	$1,354	$74,175	$556,315	$55,632	$55,632	**$667,578**
5	12	60	1.75	8.75	1	$1,354	$24,379	$23,025	$23,025	$8,803	$1,219	$78,780	$689,327	$68,933	$68,933	**$827,193**
6	4	60	1.24	7.44	1	$1,354	$5,688	$33,047	$33,047	$7,097	$1,409	$68,595	$510,349	$51,035	$51,035	**$612,419**
6	8	60	1.47	8.82	1	$1,354	$14,356	$28,984	$28,984	$7,747	$1,287	$73,728	$650,285	$65,028	$65,028	**$780,342**
6	12	60	1.71	10.26	1	$1,354	$23,702	$23,837	$23,837	$8,343	$1,165	$78,401	$804,395	$80,439	$80,439	**$965,274**
7	4	60	1.23	8.61	1	$1,354	$5,282	$33,589	$33,589	$6,745	$1,327	$68,297	$588,040	$58,804	$58,804	**$705,648**
7	8	60	1.44	10.08	1	$1,354	$13,815	$29,526	$29,526	$7,368	$1,219	$73,281	$738,677	$73,868	$73,868	**$886,413**
7	12	60	1.67	11.69	1	$1,354	$23,025	$24,650	$24,650	$7,883	$1,111	$78,022	$912,075	$91,208	$91,208	**$1,094,490**
8	4	60	1.22	9.76	1	$1,354	$4,876	$34,130	$34,130	$6,393	$1,246	$67,999	$663,674	$66,367	$66,367	**$796,409**
8	8	60	1.41	11.28	1	$1,354	$13,273	$30,067	$30,067	$6,989	$1,151	$72,835	$821,574	$82,157	$82,157	**$985,888**
8	12	60	1.63	13.04	1	$1,354	$22,347	$25,462	$25,462	$7,422	$1,056	$77,643	$1,012,459	$101,246	$101,246	**$1,214,951**
9	4	60	1.21	10.89	1	$1,354	$4,469	$34,672	$34,672	$6,041	$1,165	$67,701	$737,268	$73,727	$73,727	**$884,722**
9	8	60	1.38	12.42	1	$1,354	$12,731	$30,609	$30,609	$6,609	$1,084	$72,388	$899,054	$89,905	$89,905	**$1,078,865**
9	12	60	1.59	14.31	1	$1,354	$21,670	$26,275	$26,275	$6,962	$1,002	$77,263	$1,105,639	$110,564	$110,564	**$1,326,767**
10	4	60	1.2	12	1	$1,354	$4,063	$35,214	$35,214	$5,688	$1,084	$67,403	$808,841	$80,884	$80,884	**$970,610**
10	8	60	1.35	13.5	1	$1,354	$12,189	$31,151	$31,151	$6,230	$1,016	$71,941	$971,199	$97,120	$97,120	**$1,165,438**
10	12	60	1.55	15.5	1	$1,354	$20,993	$27,088	$27,088	$6,501	$948	$76,884	$1,191,704	$119,170	$119,170	**$1,430,045**
20	4	60	1.16	23.2	1	$1,354	$3,386	$36,568	$36,568	$4,639	$867	$66,814	$1,550,092	$155,009	$155,009	**$1,860,110**
20	8	60	1.275	25.5	1	$1,354	$9,819	$32,844	$32,844	$4,977	$819	$69,814	$1,780,263	$178,026	$178,026	**$2,136,316**
20	12	60	1.42	28.4	1	$1,354	$17,607	$29,796	$29,796	$5,181	$772	$74,710	$2,121,774	$212,177	$212,177	**$2,546,129**
30	4	60	1.12	33.6	1	$1,354	$2,709	$37,923	$37,923	$3,589	$650	$66,225	$2,225,165	$222,516	$222,516	**$2,670,197**
30	8	60	1.2	36	1	$1,354	$7,449	$34,537	$34,537	$3,725	$623	$67,688	$2,436,763	$243,676	$243,676	**$2,924,116**
30	12	60	1.29	38.7	1	$1,354	$14,221	$32,505	$32,505	$3,860	$596	$72,537	$2,807,165	$280,717	$280,717	**$3,368,598**
40	4	60	1.105	44.2	1	$1,354	$2,438	$38,261	$38,261	$3,284	$582	$65,920	$2,913,682	$291,368	$291,368	**$3,496,418**
40	8	60	1.175	47	1	$1,354	$6,772	$35,553	$35,553	$3,386	$562	$67,627	$3,178,465	$317,847	$317,847	**$3,814,159**
40	12	60	1.26	50.4	1	$1,354	$12,867	$33,521	$33,521	$3,488	$542	$71,771	$3,617,276	$361,728	$361,728	**$4,340,731**
50	4	60	1.09	54.5	1	$1,354	$2,167	$38,600	$38,600	$2,980	$515	$65,616	$3,576,054	$357,605	$357,605	**$4,291,264**
50	8	60	1.15	57.5	1	$1,354	$6,095	$36,568	$36,568	$3,047	$501	$67,566	$3,885,044	$388,504	$388,504	**$4,662,052**
50	12	60	1.23	61.5	1	$1,354	$11,512	$34,537	$34,537	$3,115	$488	$71,006	$4,366,876	$436,688	$436,688	**$5,240,251**
60	4	60	1.084	65.04	1	$1,354	$2,004	$38,735	$38,735	$2,817	$485	$65,396	$4,253,372	$425,337	$425,337	**$5,104,047**
60	8	60	1.144	68.64	1	$1,354	$5,824	$36,839	$36,839	$2,877	$473	$67,367	$4,624,063	$462,406	$462,406	**$5,548,875**

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
60	12	60	1.216	72.96	1	$1,354	$10,889	$34,808	$34,808	$2,936	$460	$70,448	$5,139,894	$513,989	$513,989	**$6,167,873**
70	4	60	1.078	75.46	1	$1,354	$1,842	$38,871	$38,871	$2,655	$455	$65,177	$4,918,245	$491,824	$491,824	**$5,901,893**
70	8	60	1.138	79.66	1	$1,354	$5,553	$37,110	$37,110	$2,706	$444	$67,168	$5,350,586	$535,059	$535,059	**$6,420,703**
70	12	60	1.202	84.14	1	$1,354	$10,266	$35,079	$35,079	$2,758	$433	$69,890	$5,880,553	$588,055	$588,055	**$7,056,664**
80	4	60	1.072	85.76	1	$1,354	$1,679	$39,006	$39,006	$2,492	$425	$64,957	$5,570,749	$557,075	$557,075	**$6,684,899**
80	8	60	1.132	90.56	1	$1,354	$5,282	$37,381	$37,381	$2,535	$416	$66,969	$6,064,685	$606,468	$606,468	**$7,277,622**
80	12	60	1.188	95.04	1	$1,354	$9,643	$35,349	$35,349	$2,579	$406	$69,332	$6,589,322	$658,932	$658,932	**$7,907,187**
90	4	60	1.066	95.94	1	$1,354	$1,517	$39,142	$39,142	$2,330	$395	$64,738	$6,210,966	$621,097	$621,097	**$7,453,159**
90	8	60	1.126	101.34	1	$1,354	$5,011	$37,652	$37,652	$2,365	$387	$66,770	$6,766,431	$676,643	$676,643	**$8,119,717**
90	12	60	1.174	105.66	1	$1,354	$9,020	$35,620	$35,620	$2,400	$379	$68,774	$7,266,670	$726,667	$726,667	**$8,720,004**
100	4	60	1.06	106	1	$1,354	$1,354	$39,277	$39,277	$2,167	$366	$64,519	$6,838,973	$683,897	$683,897	**$8,206,767**
100	8	60	1.12	112	1	$1,354	$4,740	$37,923	$37,923	$2,194	$359	$66,571	$7,455,896	$745,590	$745,590	**$8,947,076**
100	12	60	1.16	116	1	$1,354	$8,397	$35,891	$35,891	$2,221	$352	$68,216	$7,913,065	$791,307	$791,307	**$9,495,678**
1	4	60	1.65	1.65	2	$2,709	$10,835	$24,379	$24,379	$12,867	$2,939	$63,728	$105,152	$10,515	$10,515	**$126,182**
1	8	60	2.35	2.35	2	$2,709	$23,702	$17,607	$17,607	$14,898	$2,519	$71,435	$167,872	$16,787	$16,787	**$201,446**
1	12	60	3.1	3.1	2	$2,709	$35,214	$13,544	$13,544	$17,607	$2,167	$81,241	$251,846	$25,185	$25,185	**$302,215**
2	4	60	1.475	2.95	2	$2,709	$9,142	$27,765	$27,765	$10,835	$2,418	$62,868	$185,462	$18,546	$18,546	**$222,554**
2	8	60	2	4	2	$2,709	$20,316	$20,993	$20,993	$12,325	$2,072	$68,415	$273,658	$27,366	$27,366	**$328,390**
2	12	60	2.6	5.2	2	$2,709	$32,505	$16,930	$16,930	$14,356	$1,828	$78,329	$407,309	$40,731	$40,731	**$488,771**
3	4	60	1.3	3.9	2	$2,709	$7,449	$31,151	$31,151	$8,803	$1,896	$62,008	$241,833	$24,183	$24,183	**$290,199**
3	8	60	1.65	4.95	2	$2,709	$16,930	$24,379	$24,379	$9,752	$1,625	$65,394	$323,702	$32,370	$32,370	**$388,442**
3	12	60	2.1	6.3	2	$2,709	$29,796	$20,316	$20,316	$11,106	$1,490	$75,417	$475,126	$47,513	$47,513	**$570,151**
4	4	60	1.275	5.1	2	$2,709	$6,772	$31,828	$31,828	$8,126	$1,693	$61,128	$311,753	$31,175	$31,175	**$374,103**
4	8	60	1.575	6.3	2	$2,709	$15,914	$26,410	$26,410	$8,939	$1,490	$65,462	$412,411	$41,241	$41,241	**$494,893**
4	12	60	1.925	7.7	2	$2,709	$27,088	$21,670	$21,670	$9,955	$1,354	$72,776	$560,373	$56,037	$56,037	**$672,448**
5	4	60	1.25	6.25	2	$2,709	$6,095	$32,505	$32,505	$7,449	$1,490	$60,248	$376,548	$37,655	$37,655	**$451,857**
5	8	60	1.5	7.5	2	$2,709	$14,898	$28,442	$28,442	$8,126	$1,354	$65,530	$491,473	$49,147	$49,147	**$589,768**
5	12	60	1.75	8.75	2	$2,709	$24,379	$23,025	$23,025	$8,803	$1,219	$70,135	$613,678	$61,368	$61,368	**$736,414**
6	4	60	1.24	7.44	2	$2,709	$5,688	$33,047	$33,047	$7,097	$1,409	$59,950	$446,026	$44,603	$44,603	**$535,231**
6	8	60	1.47	8.82	2	$2,709	$14,356	$28,984	$28,984	$7,747	$1,287	$65,083	$574,030	$57,403	$57,403	**$688,836**
6	12	60	1.71	10.26	2	$2,709	$23,702	$23,837	$23,837	$8,343	$1,165	$69,755	$715,691	$71,569	$71,569	**$858,829**
7	4	60	1.23	8.61	2	$2,709	$5,282	$33,589	$33,589	$6,745	$1,327	$59,652	$513,601	$51,360	$51,360	**$616,322**
7	8	60	1.44	10.08	2	$2,709	$13,815	$29,526	$29,526	$7,368	$1,219	$64,636	$651,529	$65,153	$65,153	**$781,835**
7	12	60	1.67	11.69	2	$2,709	$23,025	$24,650	$24,650	$7,883	$1,111	$69,376	$811,008	$81,101	$81,101	**$973,209**
8	4	60	1.22	9.76	2	$2,709	$4,876	$34,130	$34,130	$6,393	$1,246	$59,354	$579,293	$57,929	$57,929	**$695,151**
8	8	60	1.41	11.28	2	$2,709	$13,273	$30,067	$30,067	$6,989	$1,151	$64,189	$724,051	$72,405	$72,405	**$868,861**
8	12	60	1.63	13.04	2	$2,709	$22,347	$25,462	$25,462	$7,422	$1,056	$68,997	$899,721	$89,972	$89,972	**$1,079,665**
9	4	60	1.21	10.89	2	$2,709	$4,469	$34,672	$34,672	$6,041	$1,165	$59,056	$643,118	$64,312	$64,312	**$771,741**
9	8	60	1.38	12.42	2	$2,709	$12,731	$30,609	$30,609	$6,609	$1,084	$63,742	$791,675	$79,168	$79,168	**$950,010**
9	12	60	1.59	14.31	2	$2,709	$21,670	$26,275	$26,275	$6,962	$1,002	$68,618	$981,920	$98,192	$98,192	**$1,178,304**
10	4	60	1.2	12	2	$2,709	$4,063	$35,214	$35,214	$5,688	$1,084	$58,758	$705,094	$70,509	$70,509	**$846,113**
10	8	60	1.35	13.5	2	$2,709	$12,189	$31,151	$31,151	$6,230	$1,016	$63,295	$854,483	$85,448	$85,448	**$1,025,379**
10	12	60	1.55	15.5	2	$2,709	$20,993	$27,088	$27,088	$6,501	$948	$68,239	$1,057,697	$105,770	$105,770	**$1,269,237**
20	4	60	1.16	23.2	2	$2,709	$3,386	$36,568	$36,568	$4,639	$867	$58,169	$1,349,513	$134,951	$134,951	**$1,619,416**
20	8	60	1.275	25.5	2	$2,709	$9,819	$32,844	$32,844	$4,977	$819	$61,169	$1,559,800	$155,980	$155,980	**$1,871,760**
20	12	60	1.42	28.4	2	$2,709	$17,607	$29,796	$29,796	$5,181	$772	$66,065	$1,876,239	$187,624	$187,624	**$2,251,486**
30	4	60	1.12	33.6	2	$2,709	$2,709	$37,923	$37,923	$3,589	$650	$57,580	$1,934,672	$193,467	$193,467	**$2,321,606**
30	8	60	1.2	36	2	$2,709	$7,449	$34,537	$34,537	$3,725	$623	$59,042	$2,125,521	$212,552	$212,552	**$2,550,625**
30	12	60	1.29	38.7	2	$2,709	$14,221	$32,505	$32,505	$3,860	$596	$63,891	$2,472,580	$247,258	$247,258	**$2,967,096**
40	4	60	1.105	44.2	2	$2,709	$2,438	$38,261	$38,261	$3,284	$582	$57,275	$2,531,545	$253,155	$253,155	**$3,037,855**
40	8	60	1.175	47	2	$2,709	$6,772	$35,553	$35,553	$3,386	$562	$58,981	$2,772,121	$277,212	$277,212	**$3,326,546**
40	12	60	1.26	50.4	2	$2,709	$12,867	$33,521	$33,521	$3,488	$542	$63,126	$3,181,536	$318,154	$318,154	**$3,817,844**

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
50	4	60	1.09	54.5	2	$2,709	$2,167	$38,600	$38,600	$2,980	$515	$56,970	$3,104,868	$310,487	$310,487	**$3,725,841**
50	8	60	1.15	57.5	2	$2,709	$6,095	$36,568	$36,568	$3,047	$501	$58,920	$3,387,921	$338,792	$338,792	**$4,065,505**
50	12	60	1.23	61.5	2	$2,709	$11,512	$34,537	$34,537	$3,115	$488	$62,360	$3,835,171	$383,517	$383,517	**$4,602,205**
60	4	60	1.084	65.04	2	$2,709	$2,004	$38,735	$38,735	$2,817	$485	$56,751	$3,691,061	$369,106	$369,106	**$4,429,274**
60	8	60	1.144	68.64	2	$2,709	$5,824	$36,839	$36,839	$2,877	$473	$58,721	$4,030,628	$403,063	$403,063	**$4,836,753**
60	12	60	1.216	72.96	2	$2,709	$10,889	$34,808	$34,808	$2,936	$460	$61,802	$4,509,110	$450,911	$450,911	**$5,410,932**
70	4	60	1.078	75.46	2	$2,709	$1,842	$38,871	$38,871	$2,655	$455	$56,531	$4,265,846	$426,585	$426,585	**$5,119,016**
70	8	60	1.138	79.66	2	$2,709	$5,553	$37,110	$37,110	$2,706	$444	$58,522	$4,661,876	$466,188	$466,188	**$5,594,251**
70	12	60	1.202	84.14	2	$2,709	$10,266	$35,079	$35,079	$2,758	$433	$61,244	$5,153,111	$515,311	$515,311	**$6,183,733**
80	4	60	1.072	85.76	2	$2,709	$1,679	$39,006	$39,006	$2,492	$425	$56,312	$4,829,301	$482,930	$482,930	**$5,795,162**
80	8	60	1.132	90.56	2	$2,709	$5,282	$37,381	$37,381	$2,535	$416	$58,323	$5,281,738	$528,174	$528,174	**$6,338,085**
80	12	60	1.188	95.04	2	$2,709	$9,643	$35,349	$35,349	$2,579	$406	$60,686	$5,767,643	$576,764	$576,764	**$6,921,171**
90	4	60	1.066	95.94	2	$2,709	$1,517	$39,142	$39,142	$2,330	$395	$56,092	$5,381,505	$538,151	$538,151	**$6,457,807**
90	8	60	1.126	101.34	2	$2,709	$5,011	$37,652	$37,652	$2,365	$387	$58,124	$5,890,284	$589,028	$589,028	**$7,068,341**
90	12	60	1.174	105.66	2	$2,709	$9,020	$35,620	$35,620	$2,400	$379	$60,128	$6,353,174	$635,317	$635,317	**$7,623,809**
100	4	60	1.06	106	2	$2,709	$1,354	$39,277	$39,277	$2,167	$366	$55,873	$5,922,538	$592,254	$592,254	**$7,107,045**
100	8	60	1.12	112	2	$2,709	$4,740	$37,923	$37,923	$2,194	$359	$57,925	$6,487,588	$648,759	$648,759	**$7,785,105**
100	12	60	1.16	116	2	$2,709	$8,397	$35,891	$35,891	$2,221	$352	$59,570	$6,910,174	$691,017	$691,017	**$8,292,209**
1	4	60	1.65	1.65	2	$2,709	$10,835	$24,379	$24,379	$12,867	$2,939	$73,728	$121,652	$12,165	$12,165	**$145,982**
1	8	60	2.35	2.35	2	$2,709	$23,702	$17,607	$17,607	$14,898	$2,519	$81,435	$191,372	$19,137	$19,137	**$229,646**
1	12	60	3.1	3.1	2	$2,709	$35,214	$13,544	$13,544	$17,607	$2,167	$91,241	$282,846	$28,285	$28,285	**$339,415**
2	4	60	1.475	2.95	2	$2,709	$9,142	$27,765	$27,765	$10,835	$2,418	$72,868	$214,962	$21,496	$21,496	**$257,954**
2	8	60	2	4	2	$2,709	$20,316	$20,993	$20,993	$12,325	$2,072	$78,415	$313,658	$31,366	$31,366	**$376,390**
2	12	60	2.6	5.2	2	$2,709	$32,505	$16,930	$16,930	$14,356	$1,828	$88,329	$459,309	$45,931	$45,931	**$551,171**
3	4	60	1.3	3.9	2	$2,709	$7,449	$31,151	$31,151	$8,803	$1,896	$72,008	$280,833	$28,083	$28,083	**$336,999**
3	8	60	1.65	4.95	2	$2,709	$16,930	$24,379	$24,379	$9,752	$1,625	$75,394	$373,202	$37,320	$37,320	**$447,842**
3	12	60	2.1	6.3	2	$2,709	$29,796	$20,316	$20,316	$11,106	$1,490	$85,417	$538,126	$53,813	$53,813	**$645,751**
4	4	60	1.275	5.1	2	$2,709	$6,772	$31,828	$31,828	$8,126	$1,693	$71,128	$362,753	$36,275	$36,275	**$435,303**
4	8	60	1.575	6.3	2	$2,709	$15,914	$26,410	$26,410	$8,939	$1,490	$75,462	$475,411	$47,541	$47,541	**$570,493**
4	12	60	1.925	7.7	2	$2,709	$27,088	$21,670	$21,670	$9,955	$1,354	$82,776	$637,373	$63,737	$63,737	**$764,848**
5	4	60	1.25	6.25	2	$2,709	$6,095	$32,505	$32,505	$7,449	$1,490	$70,248	$439,048	$43,905	$43,905	**$526,857**
5	8	60	1.5	7.5	2	$2,709	$14,898	$28,442	$28,442	$8,126	$1,354	$75,530	$566,473	$56,647	$56,647	**$679,768**
5	12	60	1.75	8.75	2	$2,709	$24,379	$23,025	$23,025	$8,803	$1,219	$80,135	$701,178	$70,118	$70,118	**$841,414**
6	4	60	1.24	7.44	2	$2,709	$5,688	$33,047	$33,047	$7,097	$1,409	$69,950	$520,426	$52,043	$52,043	**$624,511**
6	8	60	1.47	8.82	2	$2,709	$14,356	$28,984	$28,984	$7,747	$1,287	$75,083	$662,230	$66,223	$66,223	**$794,676**
6	12	60	1.71	10.26	2	$2,709	$23,702	$23,837	$23,837	$8,343	$1,165	$79,755	$818,291	$81,829	$81,829	**$981,949**
7	4	60	1.23	8.61	2	$2,709	$5,282	$33,589	$33,589	$6,745	$1,327	$69,652	$599,701	$59,970	$59,970	**$719,642**
7	8	60	1.44	10.08	2	$2,709	$13,815	$29,526	$29,526	$7,368	$1,219	$74,636	$752,329	$75,233	$75,233	**$902,795**
7	12	60	1.67	11.69	2	$2,709	$23,025	$24,650	$24,650	$7,883	$1,111	$79,376	$927,908	$92,791	$92,791	**$1,113,489**
8	4	60	1.22	9.76	2	$2,709	$4,876	$34,130	$34,130	$6,393	$1,246	$69,354	$676,893	$67,689	$67,689	**$812,271**
8	8	60	1.41	11.28	2	$2,709	$13,273	$30,067	$30,067	$6,989	$1,151	$74,189	$836,851	$83,685	$83,685	**$1,004,221**
8	12	60	1.63	13.04	2	$2,709	$22,347	$25,462	$25,462	$7,422	$1,056	$78,997	$1,030,121	$103,012	$103,012	**$1,236,145**
9	4	60	1.21	10.89	2	$2,709	$4,469	$34,672	$34,672	$6,041	$1,165	$69,056	$752,018	$75,202	$75,202	**$902,421**
9	8	60	1.38	12.42	2	$2,709	$12,731	$30,609	$30,609	$6,609	$1,084	$73,742	$915,875	$91,588	$91,588	**$1,099,050**
9	12	60	1.59	14.31	2	$2,709	$21,670	$26,275	$26,275	$6,962	$1,002	$78,618	$1,125,020	$112,502	$112,502	**$1,350,024**
10	4	60	1.2	12	2	$2,709	$4,063	$35,214	$35,214	$5,688	$1,084	$68,758	$825,094	$82,509	$82,509	**$990,113**
10	8	60	1.35	13.5	2	$2,709	$12,189	$31,151	$31,151	$6,230	$1,016	$73,295	$989,483	$98,948	$98,948	**$1,187,379**
10	12	60	1.55	15.5	2	$2,709	$20,993	$27,088	$27,088	$6,501	$948	$78,239	$1,212,697	$121,270	$121,270	**$1,455,237**
20	4	60	1.16	23.2	2	$2,709	$3,386	$36,568	$36,568	$4,639	$867	$68,169	$1,581,513	$158,151	$158,151	**$1,897,816**
20	8	60	1.275	25.5	2	$2,709	$9,819	$32,844	$32,844	$4,977	$819	$71,169	$1,814,800	$181,480	$181,480	**$2,177,760**
20	12	60	1.42	28.4	2	$2,709	$17,607	$29,796	$29,796	$5,181	$772	$76,065	$2,160,239	$216,024	$216,024	**$2,592,286**
30	4	60	1.12	33.6	2	$2,709	$2,709	$37,923	$37,923	$3,589	$650	$67,580	$2,270,672	$227,067	$227,067	**$2,724,806**

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
30	8	60	1.2	36	2	$2,709	$7,449	$34,537	$34,537	$3,725	$623	$69,042	$2,485,521	$248,552	$248,552	**$2,982,625**
30	12	60	1.29	38.7	2	$2,709	$14,221	$32,505	$32,505	$3,860	$596	$73,891	$2,859,580	$285,958	$285,958	**$3,431,496**
40	4	60	1.105	44.2	2	$2,709	$2,438	$38,261	$38,261	$3,284	$582	$67,275	$2,973,545	$297,355	$297,355	**$3,568,255**
40	8	60	1.175	47	2	$2,709	$6,772	$35,553	$35,553	$3,386	$562	$68,981	$3,242,121	$324,212	$324,212	**$3,890,546**
40	12	60	1.26	50.4	2	$2,709	$12,867	$33,521	$33,521	$3,488	$542	$73,126	$3,685,536	$368,554	$368,554	**$4,422,644**
50	4	60	1.09	54.5	2	$2,709	$2,167	$38,600	$38,600	$2,980	$515	$66,970	$3,649,868	$364,987	$364,987	**$4,379,841**
50	8	60	1.15	57.5	2	$2,709	$6,095	$36,568	$36,568	$3,047	$501	$68,920	$3,962,921	$396,292	$396,292	**$4,755,505**
50	12	60	1.23	61.5	2	$2,709	$11,512	$34,537	$34,537	$3,115	$488	$72,360	$4,450,171	$445,017	$445,017	**$5,340,205**
60	4	60	1.084	65.04	2	$2,709	$2,004	$38,735	$38,735	$2,817	$485	$66,751	$4,341,461	$434,146	$434,146	**$5,209,754**
60	8	60	1.144	68.64	2	$2,709	$5,824	$36,839	$36,839	$2,877	$473	$68,721	$4,717,028	$471,703	$471,703	**$5,660,433**
60	12	60	1.216	72.96	2	$2,709	$10,889	$34,808	$34,808	$2,936	$460	$71,802	$5,238,710	$523,871	$523,871	**$6,286,452**
70	4	60	1.078	75.46	2	$2,709	$1,842	$38,871	$38,871	$2,655	$455	$66,531	$5,020,446	$502,045	$502,045	**$6,024,536**
70	8	60	1.138	79.66	2	$2,709	$5,553	$37,110	$37,110	$2,706	$444	$68,522	$5,458,476	$545,848	$545,848	**$6,550,171**
70	12	60	1.202	84.14	2	$2,709	$10,266	$35,079	$35,079	$2,758	$433	$71,244	$5,994,511	$599,451	$599,451	**$7,193,413**
80	4	60	1.072	85.76	2	$2,709	$1,679	$39,006	$39,006	$2,492	$425	$66,312	$5,686,901	$568,690	$568,690	**$6,824,282**
80	8	60	1.132	90.56	2	$2,709	$5,282	$37,381	$37,381	$2,535	$416	$68,323	$6,187,338	$618,734	$618,734	**$7,424,805**
80	12	60	1.188	95.04	2	$2,709	$9,643	$35,349	$35,349	$2,579	$406	$70,686	$6,718,043	$671,804	$671,804	**$8,061,651**
90	4	60	1.066	95.94	2	$2,709	$1,517	$39,142	$39,142	$2,330	$395	$66,092	$6,340,905	$634,091	$634,091	**$7,609,087**
90	8	60	1.126	101.34	2	$2,709	$5,011	$37,652	$37,652	$2,365	$387	$68,124	$6,903,684	$690,368	$690,368	**$8,284,421**
90	12	60	1.174	105.66	2	$2,709	$9,020	$35,620	$35,620	$2,400	$379	$70,128	$7,409,774	$740,977	$740,977	**$8,891,729**
100	4	60	1.06	106	2	$2,709	$1,354	$39,277	$39,277	$2,167	$366	$65,873	$6,982,538	$698,254	$698,254	**$8,379,045**
100	8	60	1.12	112	2	$2,709	$4,740	$37,923	$37,923	$2,194	$359	$67,925	$7,607,588	$760,759	$760,759	**$9,129,105**
100	12	60	1.16	116	2	$2,709	$8,397	$35,891	$35,891	$2,221	$352	$69,570	$8,070,174	$807,017	$807,017	**$9,684,209**
1	4	60	1.65	1.65	3	$5,418	$10,835	$24,379	$24,379	$12,867	$2,939	$66,437	$109,621	$10,962	$10,962	**$131,546**
1	8	60	2.35	2.35	3	$5,418	$23,702	$17,607	$17,607	$14,898	$2,519	$74,144	$174,238	$17,424	$17,424	**$209,085**
1	12	60	3.1	3.1	3	$5,418	$35,214	$13,544	$13,544	$17,607	$2,167	$83,949	$260,243	$26,024	$26,024	**$312,292**
2	4	60	1.475	2.95	3	$5,418	$9,142	$27,765	$27,765	$10,835	$2,418	$65,577	$193,453	$19,345	$19,345	**$232,143**
2	8	60	2	4	3	$5,418	$20,316	$20,993	$20,993	$12,325	$2,072	$71,123	$284,493	$28,449	$28,449	**$341,392**
2	12	60	2.6	5.2	3	$5,418	$32,505	$16,930	$16,930	$14,356	$1,828	$81,037	$421,395	$42,139	$42,139	**$505,674**
3	4	60	1.3	3.9	3	$5,418	$7,449	$31,151	$31,151	$8,803	$1,896	$64,717	$252,397	$25,240	$25,240	**$302,876**
3	8	60	1.65	4.95	3	$5,418	$16,930	$24,379	$24,379	$9,752	$1,625	$68,103	$337,110	$33,711	$33,711	**$404,532**
3	12	60	2.1	6.3	3	$5,418	$29,796	$20,316	$20,316	$11,106	$1,490	$78,126	$492,191	$49,219	$49,219	**$590,629**
4	4	60	1.275	5.1	3	$5,418	$6,772	$31,828	$31,828	$8,126	$1,693	$63,837	$325,568	$32,557	$32,557	**$390,681**
4	8	60	1.575	6.3	3	$5,418	$15,914	$26,410	$26,410	$8,939	$1,490	$68,171	$429,476	$42,948	$42,948	**$515,371**
4	12	60	1.925	7.7	3	$5,418	$27,088	$21,670	$21,670	$9,955	$1,354	$75,484	$581,231	$58,123	$58,123	**$697,477**
5	4	60	1.25	6.25	3	$5,418	$6,095	$32,505	$32,505	$7,449	$1,490	$62,956	$393,478	$39,348	$39,348	**$472,173**
5	8	60	1.5	7.5	3	$5,418	$14,898	$28,442	$28,442	$8,126	$1,354	$68,239	$511,789	$51,179	$51,179	**$614,147**
5	12	60	1.75	8.75	3	$5,418	$24,379	$23,025	$23,025	$8,803	$1,219	$72,843	$637,380	$63,738	$63,738	**$764,856**
6	4	60	1.24	7.44	3	$5,418	$5,688	$33,047	$33,047	$7,097	$1,409	$62,658	$466,179	$46,618	$46,618	**$559,415**
6	8	60	1.47	8.82	3	$5,418	$14,356	$28,984	$28,984	$7,747	$1,287	$67,792	$597,922	$59,792	$59,792	**$717,506**
6	12	60	1.71	10.26	3	$5,418	$23,702	$23,837	$23,837	$8,343	$1,165	$72,464	$743,483	$74,348	$74,348	**$892,179**
7	4	60	1.23	8.61	3	$5,418	$5,282	$33,589	$33,589	$6,745	$1,327	$62,360	$536,924	$53,692	$53,692	**$644,309**
7	8	60	1.44	10.08	3	$5,418	$13,815	$29,526	$29,526	$7,368	$1,219	$67,345	$678,834	$67,883	$67,883	**$814,601**
7	12	60	1.67	11.69	3	$5,418	$23,025	$24,650	$24,650	$7,883	$1,111	$72,085	$842,673	$84,267	$84,267	**$1,011,208**
8	4	60	1.22	9.76	3	$5,418	$4,876	$34,130	$34,130	$6,393	$1,246	$62,063	$605,730	$60,573	$60,573	**$726,876**
8	8	60	1.41	11.28	3	$5,418	$13,273	$30,067	$30,067	$6,989	$1,151	$66,898	$754,606	$75,461	$75,461	**$905,527**
8	12	60	1.63	13.04	3	$5,418	$22,347	$25,462	$25,462	$7,422	$1,056	$71,706	$935,043	$93,504	$93,504	**$1,122,052**
9	4	60	1.21	10.89	3	$5,418	$4,469	$34,672	$34,672	$6,041	$1,165	$61,765	$672,616	$67,262	$67,262	**$807,139**
9	8	60	1.38	12.42	3	$5,418	$12,731	$30,609	$30,609	$6,609	$1,084	$66,451	$825,318	$82,532	$82,532	**$990,382**
9	12	60	1.59	14.31	3	$5,418	$21,670	$26,275	$26,275	$6,962	$1,002	$71,327	$1,020,683	$102,068	$102,068	**$1,224,819**
10	4	60	1.2	12	3	$5,418	$4,063	$35,214	$35,214	$5,688	$1,084	$61,467	$737,599	$73,760	$73,760	**$885,119**
10	8	60	1.35	13.5	3	$5,418	$12,189	$31,151	$31,151	$6,230	$1,016	$66,004	$891,051	$89,105	$89,105	**$1,069,261**

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
10	12	60	1.55	15.5	3	$5,418	$20,993	$27,088	$27,088	$6,501	$948	$70,947	$1,099,683	$109,968	$109,968	**$1,319,620**
20	4	60	1.16	23.2	3	$5,418	$3,386	$36,568	$36,568	$4,639	$867	$60,877	$1,412,357	$141,236	$141,236	**$1,694,828**
20	8	60	1.275	25.5	3	$5,418	$9,819	$32,844	$32,844	$4,977	$819	$63,877	$1,628,874	$162,887	$162,887	**$1,954,649**
20	12	60	1.42	28.4	3	$5,418	$17,607	$29,796	$29,796	$5,181	$772	$68,774	$1,953,168	$195,317	$195,317	**$2,343,801**
30	4	60	1.12	33.6	3	$5,418	$2,709	$37,923	$37,923	$3,589	$650	$60,288	$2,025,687	$202,569	$202,569	**$2,430,824**
30	8	60	1.2	36	3	$5,418	$7,449	$34,537	$34,537	$3,725	$623	$61,751	$2,223,037	$222,304	$222,304	**$2,667,644**
30	12	60	1.29	38.7	3	$5,418	$14,221	$32,505	$32,505	$3,860	$596	$66,600	$2,577,409	$257,741	$257,741	**$3,092,891**
40	4	60	1.105	44.2	3	$5,418	$2,438	$38,261	$38,261	$3,284	$582	$59,984	$2,651,273	$265,127	$265,127	**$3,181,528**
40	8	60	1.175	47	3	$5,418	$6,772	$35,553	$35,553	$3,386	$562	$61,690	$2,899,434	$289,943	$289,943	**$3,479,320**
40	12	60	1.26	50.4	3	$5,418	$12,867	$33,521	$33,521	$3,488	$542	$65,834	$3,318,058	$331,806	$331,806	**$3,981,670**
50	4	60	1.09	54.5	3	$5,418	$2,167	$38,600	$38,600	$2,980	$515	$59,679	$3,252,495	$325,250	$325,250	**$3,902,995**
50	8	60	1.15	57.5	3	$5,418	$6,095	$36,568	$36,568	$3,047	$501	$61,629	$3,543,675	$354,367	$354,367	**$4,252,410**
50	12	60	1.23	61.5	3	$5,418	$11,512	$34,537	$34,537	$3,115	$488	$65,069	$4,001,760	$400,176	$400,176	**$4,802,112**
60	4	60	1.084	65.04	3	$5,418	$2,004	$38,735	$38,735	$2,817	$485	$59,459	$3,867,240	$386,724	$386,724	**$4,640,688**
60	8	60	1.144	68.64	3	$5,418	$5,824	$36,839	$36,839	$2,877	$473	$61,430	$4,216,558	$421,656	$421,656	**$5,059,869**
60	12	60	1.216	72.96	3	$5,418	$10,889	$34,808	$34,808	$2,936	$460	$64,511	$4,706,741	$470,674	$470,674	**$5,648,090**
70	4	60	1.078	75.46	3	$5,418	$1,842	$38,871	$38,871	$2,655	$455	$59,240	$4,470,250	$447,025	$447,025	**$5,364,300**
70	8	60	1.138	79.66	3	$5,418	$5,553	$37,110	$37,110	$2,706	$444	$61,231	$4,877,657	$487,766	$487,766	**$5,853,188**
70	12	60	1.202	84.14	3	$5,418	$10,266	$35,079	$35,079	$2,758	$433	$63,953	$5,381,027	$538,103	$538,103	**$6,457,232**
80	4	60	1.072	85.76	3	$5,418	$1,679	$39,006	$39,006	$2,492	$425	$59,021	$5,061,605	$506,161	$506,161	**$6,073,926**
80	8	60	1.132	90.56	3	$5,418	$5,282	$37,381	$37,381	$2,535	$416	$61,032	$5,527,044	$552,704	$552,704	**$6,632,453**
80	12	60	1.188	95.04	3	$5,418	$9,643	$35,349	$35,349	$2,579	$406	$63,395	$6,025,084	$602,508	$602,508	**$7,230,101**
90	4	60	1.066	95.94	3	$5,418	$1,517	$39,142	$39,142	$2,330	$395	$58,801	$5,641,385	$564,138	$564,138	**$6,769,662**
90	8	60	1.126	101.34	3	$5,418	$5,011	$37,652	$37,652	$2,365	$387	$60,833	$6,164,791	$616,479	$616,479	**$7,397,749**
90	12	60	1.174	105.66	3	$5,418	$9,020	$35,620	$35,620	$2,400	$379	$62,837	$6,639,383	$663,938	$663,938	**$7,967,259**
100	4	60	1.06	106	3	$5,418	$1,354	$39,277	$39,277	$2,167	$366	$58,582	$6,209,667	$620,967	$620,967	**$7,451,600**
100	8	60	1.12	112	3	$5,418	$4,740	$37,923	$37,923	$2,194	$359	$60,634	$6,790,970	$679,097	$679,097	**$8,149,164**
100	12	60	1.16	116	3	$5,418	$8,397	$35,891	$35,891	$2,221	$352	$62,279	$7,224,391	$722,439	$722,439	**$8,669,269**
1	4	60	1.65	1.65	3	$5,418	$10,835	$24,379	$24,379	$12,867	$2,939	$76,437	$126,121	$12,612	$12,612	**$151,346**
1	8	60	2.35	2.35	3	$5,418	$23,702	$17,607	$17,607	$14,898	$2,519	$84,144	$197,738	$19,774	$19,774	**$237,285**
1	12	60	3.1	3.1	3	$5,418	$35,214	$13,544	$13,544	$17,607	$2,167	$93,949	$291,243	$29,124	$29,124	**$349,492**
2	4	60	1.475	2.95	3	$5,418	$9,142	$27,765	$27,765	$10,835	$2,418	$75,577	$222,953	$22,295	$22,295	**$267,543**
2	8	60	2	4	3	$5,418	$20,316	$20,993	$20,993	$12,325	$2,072	$81,123	$324,493	$32,449	$32,449	**$389,392**
2	12	60	2.6	5.2	3	$5,418	$32,505	$16,930	$16,930	$14,356	$1,828	$91,037	$473,395	$47,339	$47,339	**$568,074**
3	4	60	1.3	3.9	3	$5,418	$7,449	$31,151	$31,151	$8,803	$1,896	$74,717	$291,397	$29,140	$29,140	**$349,676**
3	8	60	1.65	4.95	3	$5,418	$16,930	$24,379	$24,379	$9,752	$1,625	$78,103	$386,610	$38,661	$38,661	**$463,932**
3	12	60	2.1	6.3	3	$5,418	$29,796	$20,316	$20,316	$11,106	$1,490	$88,126	$555,191	$55,519	$55,519	**$666,229**
4	4	60	1.275	5.1	3	$5,418	$6,772	$31,828	$31,828	$8,126	$1,693	$73,837	$376,568	$37,657	$37,657	**$451,881**
4	8	60	1.575	6.3	3	$5,418	$15,914	$26,410	$26,410	$8,939	$1,490	$78,171	$492,476	$49,248	$49,248	**$590,971**
4	12	60	1.925	7.7	3	$5,418	$27,088	$21,670	$21,670	$9,955	$1,354	$85,484	$658,231	$65,823	$65,823	**$789,877**
5	4	60	1.25	6.25	3	$5,418	$6,095	$32,505	$32,505	$7,449	$1,490	$72,956	$455,978	$45,598	$45,598	**$547,173**
5	8	60	1.5	7.5	3	$5,418	$14,898	$28,442	$28,442	$8,126	$1,354	$78,239	$586,789	$58,679	$58,679	**$704,147**
5	12	60	1.75	8.75	3	$5,418	$24,379	$23,025	$23,025	$8,803	$1,219	$82,843	$724,880	$72,488	$72,488	**$869,856**
6	4	60	1.24	7.44	3	$5,418	$5,688	$33,047	$33,047	$7,097	$1,409	$72,658	$540,579	$54,058	$54,058	**$648,695**
6	8	60	1.47	8.82	3	$5,418	$14,356	$28,984	$28,984	$7,747	$1,287	$77,792	$686,122	$68,612	$68,612	**$823,346**
6	12	60	1.71	10.26	3	$5,418	$23,702	$23,837	$23,837	$8,343	$1,165	$82,464	$846,083	$84,608	$84,608	**$1,015,299**
7	4	60	1.23	8.61	3	$5,418	$5,282	$33,589	$33,589	$6,745	$1,327	$72,360	$623,024	$62,302	$62,302	**$747,629**
7	8	60	1.44	10.08	3	$5,418	$13,815	$29,526	$29,526	$7,368	$1,219	$77,345	$779,634	$77,963	$77,963	**$935,561**
7	12	60	1.67	11.69	3	$5,418	$23,025	$24,650	$24,650	$7,883	$1,111	$82,085	$959,573	$95,957	$95,957	**$1,151,488**
8	4	60	1.22	9.76	3	$5,418	$4,876	$34,130	$34,130	$6,393	$1,246	$72,063	$703,330	$70,333	$70,333	**$843,996**
8	8	60	1.41	11.28	3	$5,418	$13,273	$30,067	$30,067	$6,989	$1,151	$76,898	$867,406	$86,741	$86,741	**$1,040,887**
8	12	60	1.63	13.04	3	$5,418	$22,347	$25,462	$25,462	$7,422	$1,056	$81,706	$1,065,443	$106,544	$106,544	**$1,278,532**

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
9	4	60	1.21	10.89	3	$5,418	$4,469	$34,672	$34,672	$6,041	$1,165	$71,765	$781,516	$78,152	$78,152	**$937,819**
9	8	60	1.38	12.42	3	$5,418	$12,731	$30,609	$30,609	$6,609	$1,084	$76,451	$949,518	$94,952	$94,952	**$1,139,422**
9	12	60	1.59	14.31	3	$5,418	$21,670	$26,275	$26,275	$6,962	$1,002	$81,327	$1,163,783	$116,378	$116,378	**$1,396,539**
10	4	60	1.2	12	3	$5,418	$4,063	$35,214	$35,214	$5,688	$1,084	$71,467	$857,599	$85,760	$85,760	**$1,029,119**
10	8	60	1.35	13.5	3	$5,418	$12,189	$31,151	$31,151	$6,230	$1,016	$76,004	$1,026,051	$102,605	$102,605	**$1,231,261**
10	12	60	1.55	15.5	3	$5,418	$20,993	$27,088	$27,088	$6,501	$948	$80,947	$1,254,683	$125,468	$125,468	**$1,505,620**
20	4	60	1.16	23.2	3	$5,418	$3,386	$36,568	$36,568	$4,639	$867	$70,877	$1,644,357	$164,436	$164,436	**$1,973,228**
20	8	60	1.275	25.5	3	$5,418	$9,819	$32,844	$32,844	$4,977	$819	$73,877	$1,883,874	$188,387	$188,387	**$2,260,649**
20	12	60	1.42	28.4	3	$5,418	$17,607	$29,796	$29,796	$5,181	$772	$78,774	$2,237,168	$223,717	$223,717	**$2,684,601**
30	4	60	1.12	33.6	3	$5,418	$2,709	$37,923	$37,923	$3,589	$650	$70,288	$2,361,687	$236,169	$236,169	**$2,834,024**
30	8	60	1.2	36	3	$5,418	$7,449	$34,537	$34,537	$3,725	$623	$71,751	$2,583,037	$258,304	$258,304	**$3,099,644**
30	12	60	1.29	38.7	3	$5,418	$14,221	$32,505	$32,505	$3,860	$596	$76,600	$2,964,409	$296,441	$296,441	**$3,557,291**
40	4	60	1.105	44.2	3	$5,418	$2,438	$38,261	$38,261	$3,284	$582	$69,984	$3,093,273	$309,327	$309,327	**$3,711,928**
40	8	60	1.175	47	3	$5,418	$6,772	$35,553	$35,553	$3,386	$562	$71,690	$3,369,434	$336,943	$336,943	**$4,043,320**
40	12	60	1.26	50.4	3	$5,418	$12,867	$33,521	$33,521	$3,488	$542	$75,834	$3,822,058	$382,206	$382,206	**$4,586,470**
50	4	60	1.09	54.5	3	$5,418	$2,167	$38,600	$38,600	$2,980	$515	$69,679	$3,797,495	$379,750	$379,750	**$4,556,995**
50	8	60	1.15	57.5	3	$5,418	$6,095	$36,568	$36,568	$3,047	$501	$71,629	$4,118,675	$411,867	$411,867	**$4,942,410**
50	12	60	1.23	61.5	3	$5,418	$11,512	$34,537	$34,537	$3,115	$488	$75,069	$4,616,760	$461,676	$461,676	**$5,540,112**
60	4	60	1.084	65.04	3	$5,418	$2,004	$38,735	$38,735	$2,817	$485	$69,459	$4,517,640	$451,764	$451,764	**$5,421,168**
60	8	60	1.144	68.64	3	$5,418	$5,824	$36,839	$36,839	$2,877	$473	$71,430	$4,902,958	$490,296	$490,296	**$5,883,549**
60	12	60	1.216	72.96	3	$5,418	$10,889	$34,808	$34,808	$2,936	$460	$74,511	$5,436,341	$543,634	$543,634	**$6,523,610**
70	4	60	1.078	75.46	3	$5,418	$1,842	$38,871	$38,871	$2,655	$455	$69,240	$5,224,850	$522,485	$522,485	**$6,269,820**
70	8	60	1.138	79.66	3	$5,418	$5,553	$37,110	$37,110	$2,706	$444	$71,231	$5,674,257	$567,426	$567,426	**$6,809,108**
70	12	60	1.202	84.14	3	$5,418	$10,266	$35,079	$35,079	$2,758	$433	$73,953	$6,222,427	$622,243	$622,243	**$7,466,912**
80	4	60	1.072	85.76	3	$5,418	$1,679	$39,006	$39,006	$2,492	$425	$69,021	$5,919,205	$591,921	$591,921	**$7,103,046**
80	8	60	1.132	90.56	3	$5,418	$5,282	$37,381	$37,381	$2,535	$416	$71,032	$6,432,644	$643,264	$643,264	**$7,719,173**
80	12	60	1.188	95.04	3	$5,418	$9,643	$35,349	$35,349	$2,579	$406	$73,395	$6,975,484	$697,548	$697,548	**$8,370,581**
90	4	60	1.066	95.94	3	$5,418	$1,517	$39,142	$39,142	$2,330	$395	$68,801	$6,600,785	$660,078	$660,078	**$7,920,942**
90	8	60	1.126	101.34	3	$5,418	$5,011	$37,652	$37,652	$2,365	$387	$70,833	$7,178,191	$717,819	$717,819	**$8,613,829**
90	12	60	1.174	105.66	3	$5,418	$9,020	$35,620	$35,620	$2,400	$379	$72,837	$7,695,983	$769,598	$769,598	**$9,235,179**
100	4	60	1.06	106	3	$5,418	$1,354	$39,277	$39,277	$2,167	$366	$68,582	$7,269,667	$726,967	$726,967	**$8,723,600**
100	8	60	1.12	112	3	$5,418	$4,740	$37,923	$37,923	$2,194	$359	$70,634	$7,910,970	$791,097	$791,097	**$9,493,164**
100	12	60	1.16	116	3	$5,418	$8,397	$35,891	$35,891	$2,221	$352	$72,279	$8,384,391	$838,439	$838,439	**$10,061,269**
1	4	60	1.65	1.65	4	$9,481	$10,835	$24,379	$24,379	$12,867	$2,939	$70,500	$116,326	$11,633	$11,633	**$139,591**
1	8	60	2.35	2.35	4	$9,481	$23,702	$17,607	$17,607	$14,898	$2,519	$78,207	$183,786	$18,379	$18,379	**$220,543**
1	12	60	3.1	3.1	4	$9,481	$35,214	$13,544	$13,544	$17,607	$2,167	$88,013	$272,839	$27,284	$27,284	**$327,407**
2	4	60	1.475	2.95	4	$9,481	$9,142	$27,765	$27,765	$10,835	$2,418	$69,640	$205,439	$20,544	$20,544	**$246,527**
2	8	60	2	4	4	$9,481	$20,316	$20,993	$20,993	$12,325	$2,072	$75,187	$300,746	$30,075	$30,075	**$360,895**
2	12	60	2.6	5.2	4	$9,481	$32,505	$16,930	$16,930	$14,356	$1,828	$85,101	$442,523	$44,252	$44,252	**$531,028**
3	4	60	1.3	3.9	4	$9,481	$7,449	$31,151	$31,151	$8,803	$1,896	$68,780	$268,243	$26,824	$26,824	**$321,892**
3	8	60	1.65	4.95	4	$9,481	$16,930	$24,379	$24,379	$9,752	$1,625	$72,166	$357,223	$35,722	$35,722	**$428,667**
3	12	60	2.1	6.3	4	$9,481	$29,796	$20,316	$20,316	$11,106	$1,490	$82,189	$517,789	$51,779	$51,779	**$621,346**
4	4	60	1.275	5.1	4	$9,481	$6,772	$31,828	$31,828	$8,126	$1,693	$67,900	$346,290	$34,629	$34,629	**$415,548**
4	8	60	1.575	6.3	4	$9,481	$15,914	$26,410	$26,410	$8,939	$1,490	$72,234	$455,074	$45,507	$45,507	**$546,089**
4	12	60	1.925	7.7	4	$9,481	$27,088	$21,670	$21,670	$9,955	$1,354	$79,548	$612,517	$61,252	$61,252	**$735,020**
5	4	60	1.25	6.25	4	$9,481	$6,095	$32,505	$32,505	$7,449	$1,490	$67,020	$418,872	$41,887	$41,887	**$502,647**
5	8	60	1.5	7.5	4	$9,481	$14,898	$28,442	$28,442	$8,126	$1,354	$72,302	$542,263	$54,226	$54,226	**$650,715**
5	12	60	1.75	8.75	4	$9,481	$24,379	$23,025	$23,025	$8,803	$1,219	$76,907	$672,933	$67,293	$67,293	**$807,519**
6	4	60	1.24	7.44	4	$9,481	$5,688	$33,047	$33,047	$7,097	$1,409	$66,722	$496,409	$49,641	$49,641	**$595,691**
6	8	60	1.47	8.82	4	$9,481	$14,356	$28,984	$28,984	$7,747	$1,287	$71,855	$633,759	$63,376	$63,376	**$760,510**
6	12	60	1.71	10.26	4	$9,481	$23,702	$23,837	$23,837	$8,343	$1,165	$76,527	$785,171	$78,517	$78,517	**$942,205**
7	4	60	1.23	8.61	4	$9,481	$5,282	$33,589	$33,589	$6,745	$1,327	$66,424	$571,908	$57,191	$57,191	**$686,289**

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
7	8	60	1.44	10.08	4	$9,481	$13,815	$29,526	$29,526	$7,368	$1,219	$71,408	$719,790	$71,979	$71,979	**$863,749**
7	12	60	1.67	11.69	4	$9,481	$23,025	$24,650	$24,650	$7,883	$1,111	$76,148	$890,172	$89,017	$89,017	**$1,068,206**
8	4	60	1.22	9.76	4	$9,481	$4,876	$34,130	$34,130	$6,393	$1,246	$66,126	$645,387	$64,539	$64,539	**$774,464**
8	8	60	1.41	11.28	4	$9,481	$13,273	$30,067	$30,067	$6,989	$1,151	$70,961	$800,438	$80,044	$80,044	**$960,526**
8	12	60	1.63	13.04	4	$9,481	$22,347	$25,462	$25,462	$7,422	$1,056	$75,769	$988,026	$98,803	$98,803	**$1,185,632**
9	4	60	1.21	10.89	4	$9,481	$4,469	$34,672	$34,672	$6,041	$1,165	$65,828	$716,864	$71,686	$71,686	**$860,237**
9	8	60	1.38	12.42	4	$9,481	$12,731	$30,609	$30,609	$6,609	$1,084	$70,514	$875,783	$87,578	$87,578	**$1,050,939**
9	12	60	1.59	14.31	4	$9,481	$21,670	$26,275	$26,275	$6,962	$1,002	$75,390	$1,078,826	$107,883	$107,883	**$1,294,591**
10	4	60	1.2	12	4	$9,481	$4,063	$35,214	$35,214	$5,688	$1,084	$65,530	$786,357	$78,636	$78,636	**$943,628**
10	8	60	1.35	13.5	4	$9,481	$12,189	$31,151	$31,151	$6,230	$1,016	$70,067	$945,904	$94,590	$94,590	**$1,135,084**
10	12	60	1.55	15.5	4	$9,481	$20,993	$27,088	$27,088	$6,501	$948	$75,010	$1,162,662	$116,266	$116,266	**$1,395,194**
20	4	60	1.16	23.2	4	$9,481	$3,386	$36,568	$36,568	$4,639	$867	$64,941	$1,506,622	$150,662	$150,662	**$1,807,946**
20	8	60	1.275	25.5	4	$9,481	$9,819	$32,844	$32,844	$4,977	$819	$67,941	$1,732,484	$173,248	$173,248	**$2,078,981**
20	12	60	1.42	28.4	4	$9,481	$17,607	$29,796	$29,796	$5,181	$772	$72,837	$2,068,561	$206,856	$206,856	**$2,482,273**
30	4	60	1.12	33.6	4	$9,481	$2,709	$37,923	$37,923	$3,589	$650	$64,351	$2,162,208	$216,221	$216,221	**$2,594,650**
30	8	60	1.2	36	4	$9,481	$7,449	$34,537	$34,537	$3,725	$623	$65,814	$2,369,310	$236,931	$236,931	**$2,843,172**
30	12	60	1.29	38.7	4	$9,481	$14,221	$32,505	$32,505	$3,860	$596	$70,663	$2,734,653	$273,465	$273,465	**$3,281,584**
40	4	60	1.105	44.2	4	$9,481	$2,438	$38,261	$38,261	$3,284	$582	$64,047	$2,830,864	$283,086	$283,086	**$3,397,037**
40	8	60	1.175	47	4	$9,481	$6,772	$35,553	$35,553	$3,386	$562	$65,753	$3,090,402	$309,040	$309,040	**$3,708,482**
40	12	60	1.26	50.4	4	$9,481	$12,867	$33,521	$33,521	$3,488	$542	$69,898	$3,522,841	$352,284	$352,284	**$4,227,410**
50	4	60	1.09	54.5	4	$9,481	$2,167	$38,600	$38,600	$2,980	$515	$63,742	$3,473,937	$347,394	$347,394	**$4,168,725**
50	8	60	1.15	57.5	4	$9,481	$6,095	$36,568	$36,568	$3,047	$501	$65,692	$3,777,306	$377,731	$377,731	**$4,532,767**
50	12	60	1.23	61.5	4	$9,481	$11,512	$34,537	$34,537	$3,115	$488	$69,132	$4,251,644	$425,164	$425,164	**$5,101,972**
60	4	60	1.084	65.04	4	$9,481	$2,004	$38,735	$38,735	$2,817	$485	$63,523	$4,131,507	$413,151	$413,151	**$4,957,809**
60	8	60	1.144	68.64	4	$9,481	$5,824	$36,839	$36,839	$2,877	$473	$65,493	$4,495,452	$449,545	$449,545	**$5,394,543**
60	12	60	1.216	72.96	4	$9,481	$10,889	$34,808	$34,808	$2,936	$460	$68,574	$5,003,189	$500,319	$500,319	**$6,003,827**
70	4	60	1.078	75.46	4	$9,481	$1,842	$38,871	$38,871	$2,655	$455	$63,303	$4,776,856	$477,686	$477,686	**$5,732,227**
70	8	60	1.138	79.66	4	$9,481	$5,553	$37,110	$37,110	$2,706	$444	$65,294	$5,201,327	$520,133	$520,133	**$6,241,593**
70	12	60	1.202	84.14	4	$9,481	$10,266	$35,079	$35,079	$2,758	$433	$68,016	$5,722,900	$572,290	$572,290	**$6,867,480**
80	4	60	1.072	85.76	4	$9,481	$1,679	$39,006	$39,006	$2,492	$425	$63,084	$5,410,061	$541,006	$541,006	**$6,492,074**
80	8	60	1.132	90.56	4	$9,481	$5,282	$37,381	$37,381	$2,535	$416	$65,095	$5,895,003	$589,500	$589,500	**$7,074,004**
80	12	60	1.188	95.04	4	$9,481	$9,643	$35,349	$35,349	$2,579	$406	$67,458	$6,411,246	$641,125	$641,125	**$7,693,496**
90	4	60	1.066	95.94	4	$9,481	$1,517	$39,142	$39,142	$2,330	$395	$62,864	$6,031,204	$603,120	$603,120	**$7,237,444**
90	8	60	1.126	101.34	4	$9,481	$5,011	$37,652	$37,652	$2,365	$387	$64,896	$6,576,551	$657,655	$657,655	**$7,891,861**
90	12	60	1.174	105.66	4	$9,481	$9,020	$35,620	$35,620	$2,400	$379	$66,900	$7,068,696	$706,870	$706,870	**$8,482,435**
100	4	60	1.06	106	4	$9,481	$1,354	$39,277	$39,277	$2,167	$366	$62,645	$6,640,361	$664,036	$664,036	**$7,968,434**
100	8	60	1.12	112	4	$9,481	$4,740	$37,923	$37,923	$2,194	$359	$64,697	$7,246,043	$724,604	$724,604	**$8,695,251**
100	12	60	1.16	116	4	$9,481	$8,397	$35,891	$35,891	$2,221	$352	$66,342	$7,695,717	$769,572	$769,572	**$9,234,860**
1	4	60	1.65	1.65	4	$9,481	$10,835	$24,379	$24,379	$12,867	$2,939	$80,500	$132,826	$13,283	$13,283	**$159,391**
1	8	60	2.35	2.35	4	$9,481	$23,702	$17,607	$17,607	$14,898	$2,519	$88,207	$207,286	$20,729	$20,729	**$248,743**
1	12	60	3.1	3.1	4	$9,481	$35,214	$13,544	$13,544	$17,607	$2,167	$98,013	$303,839	$30,384	$30,384	**$364,607**
2	4	60	1.475	2.95	4	$9,481	$9,142	$27,765	$27,765	$10,835	$2,418	$79,640	$234,939	$23,494	$23,494	**$281,927**
2	8	60	2	4	4	$9,481	$20,316	$20,993	$20,993	$12,325	$2,072	$85,187	$340,746	$34,075	$34,075	**$408,895**
2	12	60	2.6	5.2	4	$9,481	$32,505	$16,930	$16,930	$14,356	$1,828	$95,101	$494,523	$49,452	$49,452	**$593,428**
3	4	60	1.3	3.9	4	$9,481	$7,449	$31,151	$31,151	$8,803	$1,896	$78,780	$307,243	$30,724	$30,724	**$368,692**
3	8	60	1.65	4.95	4	$9,481	$16,930	$24,379	$24,379	$9,752	$1,625	$82,166	$406,723	$40,672	$40,672	**$488,067**
3	12	60	2.1	6.3	4	$9,481	$29,796	$20,316	$20,316	$11,106	$1,490	$92,189	$580,789	$58,079	$58,079	**$696,946**
4	4	60	1.275	5.1	4	$9,481	$6,772	$31,828	$31,828	$8,126	$1,693	$77,900	$397,290	$39,729	$39,729	**$476,748**
4	8	60	1.575	6.3	4	$9,481	$15,914	$26,410	$26,410	$8,939	$1,490	$82,234	$518,074	$51,807	$51,807	**$621,689**
4	12	60	1.925	7.7	4	$9,481	$27,088	$21,670	$21,670	$9,955	$1,354	$89,548	$689,517	$68,952	$68,952	**$827,420**
5	4	60	1.25	6.25	4	$9,481	$6,095	$32,505	$32,505	$7,449	$1,490	$77,020	$481,372	$48,137	$48,137	**$577,647**
5	8	60	1.5	7.5	4	$9,481	$14,898	$28,442	$28,442	$8,126	$1,354	$82,302	$617,263	$61,726	$61,726	**$740,715**

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
5	12	60	1.75	8.75	4	$9,481	$24,379	$23,025	$23,025	$8,803	$1,219	$86,907	$760,433	$76,043	$76,043	**$912,519**
6	4	60	1.24	7.44	4	$9,481	$5,688	$33,047	$33,047	$7,097	$1,409	$76,722	$570,809	$57,081	$57,081	**$684,971**
6	8	60	1.47	8.82	4	$9,481	$14,356	$28,984	$28,984	$7,747	$1,287	$81,855	$721,959	$72,196	$72,196	**$866,350**
6	12	60	1.71	10.26	4	$9,481	$23,702	$23,837	$23,837	$8,343	$1,165	$86,527	$887,771	$88,777	$88,777	**$1,065,325**
7	4	60	1.23	8.61	4	$9,481	$5,282	$33,589	$33,589	$6,745	$1,327	$76,424	$658,008	$65,801	$65,801	**$789,609**
7	8	60	1.44	10.08	4	$9,481	$13,815	$29,526	$29,526	$7,368	$1,219	$81,408	$820,590	$82,059	$82,059	**$984,709**
7	12	60	1.67	11.69	4	$9,481	$23,025	$24,650	$24,650	$7,883	$1,111	$86,148	$1,007,072	$100,707	$100,707	**$1,208,486**
8	4	60	1.22	9.76	4	$9,481	$4,876	$34,130	$34,130	$6,393	$1,246	$76,126	$742,987	$74,299	$74,299	**$891,584**
8	8	60	1.41	11.28	4	$9,481	$13,273	$30,067	$30,067	$6,989	$1,151	$80,961	$913,238	$91,324	$91,324	**$1,095,886**
8	12	60	1.63	13.04	4	$9,481	$22,347	$25,462	$25,462	$7,422	$1,056	$85,769	$1,118,426	$111,843	$111,843	**$1,342,112**
9	4	60	1.21	10.89	4	$9,481	$4,469	$34,672	$34,672	$6,041	$1,165	$75,828	$825,764	$82,576	$82,576	**$990,917**
9	8	60	1.38	12.42	4	$9,481	$12,731	$30,609	$30,609	$6,609	$1,084	$80,514	$999,983	$99,998	$99,998	**$1,199,979**
9	12	60	1.59	14.31	4	$9,481	$21,670	$26,275	$26,275	$6,962	$1,002	$85,390	$1,221,926	$122,193	$122,193	**$1,466,311**
10	4	60	1.2	12	4	$9,481	$4,063	$35,214	$35,214	$5,688	$1,084	$75,530	$906,357	$90,636	$90,636	**$1,087,628**
10	8	60	1.35	13.5	4	$9,481	$12,189	$31,151	$31,151	$6,230	$1,016	$80,067	$1,080,904	$108,090	$108,090	**$1,297,084**
10	12	60	1.55	15.5	4	$9,481	$20,993	$27,088	$27,088	$6,501	$948	$85,010	$1,317,662	$131,766	$131,766	**$1,581,194**
20	4	60	1.16	23.2	4	$9,481	$3,386	$36,568	$36,568	$4,639	$867	$74,941	$1,738,622	$173,862	$173,862	**$2,086,346**
20	8	60	1.275	25.5	4	$9,481	$9,819	$32,844	$32,844	$4,977	$819	$77,941	$1,987,484	$198,748	$198,748	**$2,384,981**
20	12	60	1.42	28.4	4	$9,481	$17,607	$29,796	$29,796	$5,181	$772	$82,837	$2,352,561	$235,256	$235,256	**$2,823,073**
30	4	60	1.12	33.6	4	$9,481	$2,709	$37,923	$37,923	$3,589	$650	$74,351	$2,498,208	$249,821	$249,821	**$2,997,850**
30	8	60	1.2	36	4	$9,481	$7,449	$34,537	$34,537	$3,725	$623	$75,814	$2,729,310	$272,931	$272,931	**$3,275,172**
30	12	60	1.29	38.7	4	$9,481	$14,221	$32,505	$32,505	$3,860	$596	$80,663	$3,121,653	$312,165	$312,165	**$3,745,984**
40	4	60	1.105	44.2	4	$9,481	$2,438	$38,261	$38,261	$3,284	$582	$74,047	$3,272,864	$327,286	$327,286	**$3,927,437**
40	8	60	1.175	47	4	$9,481	$6,772	$35,553	$35,553	$3,386	$562	$75,753	$3,560,402	$356,040	$356,040	**$4,272,482**
40	12	60	1.26	50.4	4	$9,481	$12,867	$33,521	$33,521	$3,488	$542	$79,898	$4,026,841	$402,684	$402,684	**$4,832,210**
50	4	60	1.09	54.5	4	$9,481	$2,167	$38,600	$38,600	$2,980	$515	$73,742	$4,018,937	$401,894	$401,894	**$4,822,725**
50	8	60	1.15	57.5	4	$9,481	$6,095	$36,568	$36,568	$3,047	$501	$75,692	$4,352,306	$435,231	$435,231	**$5,222,767**
50	12	60	1.23	61.5	4	$9,481	$11,512	$34,537	$34,537	$3,115	$488	$79,132	$4,866,644	$486,664	$486,664	**$5,839,972**
60	4	60	1.084	65.04	4	$9,481	$2,004	$38,735	$38,735	$2,817	$485	$73,523	$4,781,907	$478,191	$478,191	**$5,738,289**
60	8	60	1.144	68.64	4	$9,481	$5,824	$36,839	$36,839	$2,877	$473	$75,493	$5,181,852	$518,185	$518,185	**$6,218,223**
60	12	60	1.216	72.96	4	$9,481	$10,889	$34,808	$34,808	$2,936	$460	$78,574	$5,732,789	$573,279	$573,279	**$6,879,347**
70	4	60	1.078	75.46	4	$9,481	$1,842	$38,871	$38,871	$2,655	$455	$73,303	$5,531,456	$553,146	$553,146	**$6,637,747**
70	8	60	1.138	79.66	4	$9,481	$5,553	$37,110	$37,110	$2,706	$444	$75,294	$5,997,927	$599,793	$599,793	**$7,197,513**
70	12	60	1.202	84.14	4	$9,481	$10,266	$35,079	$35,079	$2,758	$433	$78,016	$6,564,300	$656,430	$656,430	**$7,877,160**
80	4	60	1.072	85.76	4	$9,481	$1,679	$39,006	$39,006	$2,492	$425	$73,084	$6,267,661	$626,766	$626,766	**$7,521,194**
80	8	60	1.132	90.56	4	$9,481	$5,282	$37,381	$37,381	$2,535	$416	$75,095	$6,800,603	$680,060	$680,060	**$8,160,724**
80	12	60	1.188	95.04	4	$9,481	$9,643	$35,349	$35,349	$2,579	$406	$77,458	$7,361,646	$736,165	$736,165	**$8,833,976**
90	4	60	1.066	95.94	4	$9,481	$1,517	$39,142	$39,142	$2,330	$395	$72,864	$6,990,604	$699,060	$699,060	**$8,388,724**
90	8	60	1.126	101.34	4	$9,481	$5,011	$37,652	$37,652	$2,365	$387	$74,896	$7,589,951	$758,995	$758,995	**$9,107,941**
90	12	60	1.174	105.66	4	$9,481	$9,020	$35,620	$35,620	$2,400	$379	$76,900	$8,125,296	$812,530	$812,530	**$9,750,355**
100	4	60	1.06	106	4	$9,481	$1,354	$39,277	$39,277	$2,167	$366	$72,645	$7,700,361	$770,036	$770,036	**$9,240,434**
100	8	60	1.12	112	4	$9,481	$4,740	$37,923	$37,923	$2,194	$359	$74,697	$8,366,043	$836,604	$836,604	**$10,039,251**
100	12	60	1.16	116	4	$9,481	$8,397	$35,891	$35,891	$2,221	$352	$76,342	$8,855,717	$885,572	$885,572	**$10,626,860**
1	4	20	1.65	1.65	1	$1,354	$10,835	$24,379	$8,126	$12,867	$2,939	$46,121	$76,100	$7,610	$7,610	**$91,320**
1	8	20	2.35	2.35	1	$1,354	$23,702	$17,607	$5,869	$14,898	$2,519	$58,342	$137,105	$13,710	$13,710	**$164,526**
1	12	20	3.1	3.1	1	$1,354	$35,214	$13,544	$4,515	$17,607	$2,167	$70,857	$219,657	$21,966	$21,966	**$263,588**
2	4	20	1.475	2.95	1	$1,354	$9,142	$27,765	$9,255	$10,835	$2,418	$43,004	$126,862	$12,686	$12,686	**$152,234**
2	8	20	2	4	1	$1,354	$20,316	$20,993	$6,998	$12,325	$2,072	$53,065	$212,260	$21,226	$21,226	**$254,712**
2	12	20	2.6	5.2	1	$1,354	$32,505	$16,930	$5,643	$14,356	$1,828	$65,688	$341,576	$34,158	$34,158	**$409,892**
3	4	20	1.3	3.9	1	$1,354	$7,449	$31,151	$10,384	$8,803	$1,896	$39,887	$155,558	$15,556	$15,556	**$186,670**
3	8	20	1.65	4.95	1	$1,354	$16,930	$24,379	$8,126	$9,752	$1,625	$47,787	$236,547	$23,655	$23,655	**$283,857**
3	12	20	2.1	6.3	1	$1,354	$29,796	$20,316	$6,772	$11,106	$1,490	$60,519	$381,267	$38,127	$38,127	**$457,520**

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
4	4	20	1.275	5.1	1	$1,354	$6,772	$31,828	$10,609	$8,126	$1,693	$38,555	$196,630	$19,663	$19,663	**$235,956**
4	8	20	1.575	6.3	1	$1,354	$15,914	$26,410	$8,803	$8,939	$1,490	$46,501	$292,954	$29,295	$29,295	**$351,545**
4	12	20	1.925	7.7	1	$1,354	$27,088	$21,670	$7,223	$9,955	$1,354	$56,975	$438,704	$43,870	$43,870	**$526,445**
5	4	20	1.25	6.25	1	$1,354	$6,095	$32,505	$10,835	$7,449	$1,490	$37,223	$232,645	$23,264	$23,264	**$279,173**
5	8	20	1.5	7.5	1	$1,354	$14,898	$28,442	$9,481	$8,126	$1,354	$45,214	$339,105	$33,910	$33,910	**$406,926**
5	12	20	1.75	8.75	1	$1,354	$24,379	$23,025	$7,675	$8,803	$1,219	$53,431	$467,518	$46,752	$46,752	**$561,021**
6	4	20	1.24	7.44	1	$1,354	$5,688	$33,047	$11,016	$7,097	$1,409	$36,564	$272,036	$27,204	$27,204	**$326,443**
6	8	20	1.47	8.82	1	$1,354	$14,356	$28,984	$9,661	$7,747	$1,287	$44,406	$391,660	$39,166	$39,166	**$469,992**
6	12	20	1.71	10.26	1	$1,354	$23,702	$23,837	$7,946	$8,343	$1,165	$52,510	$538,749	$53,875	$53,875	**$646,498**
7	4	20	1.23	8.61	1	$1,354	$5,282	$33,589	$11,196	$6,745	$1,327	$35,905	$309,141	$30,914	$30,914	**$370,969**
7	8	20	1.44	10.08	1	$1,354	$13,815	$29,526	$9,842	$7,368	$1,219	$43,598	$439,465	$43,947	$43,947	**$527,359**
7	12	20	1.67	11.69	1	$1,354	$23,025	$24,650	$8,217	$7,883	$1,111	$51,589	$603,071	$60,307	$60,307	**$723,685**
8	4	20	1.22	9.76	1	$1,354	$4,876	$34,130	$11,377	$6,393	$1,246	$35,246	$343,998	$34,400	$34,400	**$412,798**
8	8	20	1.41	11.28	1	$1,354	$13,273	$30,067	$10,022	$6,989	$1,151	$42,790	$482,667	$48,267	$48,267	**$579,201**
8	12	20	1.63	13.04	1	$1,354	$22,347	$25,462	$8,487	$7,422	$1,056	$50,668	$660,706	$66,071	$66,071	**$792,847**
9	4	20	1.21	10.89	1	$1,354	$4,469	$34,672	$11,557	$6,041	$1,165	$34,587	$376,648	$37,665	$37,665	**$451,978**
9	8	20	1.38	12.42	1	$1,354	$12,731	$30,609	$10,203	$6,609	$1,084	$41,982	$521,411	$52,141	$52,141	**$625,693**
9	12	20	1.59	14.31	1	$1,354	$21,670	$26,275	$8,758	$6,962	$1,002	$49,747	$711,875	$71,187	$71,187	**$854,250**
10	4	20	1.2	12	1	$1,354	$4,063	$35,214	$11,738	$5,688	$1,084	$33,927	$407,129	$40,713	$40,713	**$488,555**
10	8	20	1.35	13.5	1	$1,354	$12,189	$31,151	$10,384	$6,230	$1,016	$41,173	$555,841	$55,584	$55,584	**$667,009**
10	12	20	1.55	15.5	1	$1,354	$20,993	$27,088	$9,029	$6,501	$948	$48,826	$756,798	$75,680	$75,680	**$908,158**
20	4	20	1.16	23.2	1	$1,354	$3,386	$36,568	$12,189	$4,639	$867	$32,435	$752,501	$75,250	$75,250	**$903,001**
20	8	20	1.275	25.5	1	$1,354	$9,819	$32,844	$10,948	$4,977	$819	$37,918	$966,919	$96,692	$96,692	**$1,160,302**
20	12	20	1.42	28.4	1	$1,354	$17,607	$29,796	$9,932	$5,181	$772	$44,846	$1,273,628	$127,363	$127,363	**$1,528,353**
30	4	20	1.12	33.6	1	$1,354	$2,709	$37,923	$12,641	$3,589	$650	$30,943	$1,039,695	$103,969	$103,969	**$1,247,634**
30	8	20	1.2	36	1	$1,354	$7,449	$34,537	$11,512	$3,725	$623	$34,663	$1,247,880	$124,788	$124,788	**$1,497,456**
30	12	20	1.29	38.7	1	$1,354	$14,221	$32,505	$10,835	$3,860	$596	$40,866	$1,581,530	$158,153	$158,153	**$1,897,836**
40	4	20	1.105	44.2	1	$1,354	$2,438	$38,261	$12,754	$3,284	$582	$30,413	$1,344,247	$134,425	$134,425	**$1,613,096**
40	8	20	1.175	47	1	$1,354	$6,772	$35,553	$11,851	$3,386	$562	$33,925	$1,594,484	$159,448	$159,448	**$1,913,381**
40	12	20	1.26	50.4	1	$1,354	$12,867	$33,521	$11,174	$3,488	$542	$39,424	$1,986,970	$198,697	$198,697	**$2,384,363**
50	4	20	1.09	54.5	1	$1,354	$2,167	$38,600	$12,867	$2,980	$515	$29,882	$1,628,589	$162,859	$162,859	**$1,954,306**
50	8	20	1.15	57.5	1	$1,354	$6,095	$36,568	$12,189	$3,047	$501	$33,187	$1,908,256	$190,826	$190,826	**$2,289,907**
50	12	20	1.23	61.5	1	$1,354	$11,512	$34,537	$11,512	$3,115	$488	$37,982	$2,335,867	$233,587	$233,587	**$2,803,041**
60	4	20	1.08	65.04	1	$1,354	$2,004	$38,735	$12,912	$2,817	$485	$29,573	$1,923,406	$192,341	$192,341	**$2,308,087**
60	8	20	1.14	68.64	1	$1,354	$5,824	$36,839	$12,280	$2,877	$473	$32,807	$2,251,899	$225,190	$225,190	**$2,702,278**
60	12	20	1.22	72.96	1	$1,354	$10,889	$34,808	$11,603	$2,936	$460	$37,243	$2,717,248	$271,725	$271,725	**$3,260,698**
70	4	20	1.08	75.46	1	$1,354	$1,842	$38,871	$12,957	$2,655	$455	$29,263	$2,208,183	$220,818	$220,818	**$2,649,819**
70	8	20	1.14	79.66	1	$1,354	$5,553	$37,110	$12,370	$2,706	$444	$32,428	$2,583,191	$258,319	$258,319	**$3,099,829**
70	12	20	1.20	84.14	1	$1,354	$10,266	$35,079	$11,693	$2,758	$433	$36,504	$3,071,480	$307,148	$307,148	**$3,685,776**
80	4	20	1.07	85.76	1	$1,354	$1,679	$39,006	$13,002	$2,492	$425	$28,953	$2,483,031	$248,303	$248,303	**$2,979,637**
80	8	20	1.13	90.56	1	$1,354	$5,282	$37,381	$12,460	$2,535	$416	$32,048	$2,902,269	$290,227	$290,227	**$3,482,723**
80	12	20	1.19	95.04	1	$1,354	$9,643	$35,349	$11,783	$2,579	$406	$35,766	$3,399,182	$339,918	$339,918	**$4,079,019**
90	4	20	1.07	95.94	1	$1,354	$1,517	$39,142	$13,047	$2,330	$395	$28,644	$2,748,062	$274,806	$274,806	**$3,297,675**
90	8	20	1.13	101.34	1	$1,354	$5,011	$37,652	$12,551	$2,365	$387	$31,668	$3,209,270	$320,927	$320,927	**$3,851,124**
90	12	20	1.17	105.66	1	$1,354	$9,020	$35,620	$11,873	$2,400	$379	$35,027	$3,700,976	$370,098	$370,098	**$4,441,171**
100	4	20	1.06	106	1	$1,354	$1,354	$39,277	$13,092	$2,167	$366	$28,334	$3,003,388	$300,339	$300,339	**$3,604,066**
100	8	20	1.12	112	1	$1,354	$4,740	$37,923	$12,641	$2,194	$359	$31,289	$3,504,330	$350,433	$350,433	**$4,205,196**
100	12	20	1.16	116	1	$1,354	$8,397	$35,891	$11,964	$2,221	$352	$34,289	$3,977,481	$397,748	$397,748	**$4,772,977**
1	4	20	1.65	1.65	1	$1,354	$10,835	$24,379	$8,126	$12,867	$2,939	$56,121	$92,600	$9,260	$9,260	**$111,120**
1	8	20	2.35	2.35	1	$1,354	$23,702	$17,607	$5,869	$14,898	$2,519	$68,342	$160,605	$16,060	$16,060	**$192,726**
1	12	20	3.1	3.1	1	$1,354	$35,214	$13,544	$4,515	$17,607	$2,167	$80,857	$250,657	$25,066	$25,066	**$300,788**
2	4	20	1.475	2.95	1	$1,354	$9,142	$27,765	$9,255	$10,835	$2,418	$53,004	$156,362	$15,636	$15,636	**$187,634**

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
2	8	20	2	4	1	$1,354	$20,316	$20,993	$6,998	$12,325	$2,072	$63,065	$252,260	$25,226	$25,226	**$302,712**
2	12	20	2.6	5.2	1	$1,354	$32,505	$16,930	$5,643	$14,356	$1,828	$75,688	$393,576	$39,358	$39,358	**$472,292**
3	4	20	1.3	3.9	1	$1,354	$7,449	$31,151	$10,384	$8,803	$1,896	$49,887	$194,558	$19,456	$19,456	**$233,470**
3	8	20	1.65	4.95	1	$1,354	$16,930	$24,379	$8,126	$9,752	$1,625	$57,787	$286,047	$28,605	$28,605	**$343,257**
3	12	20	2.1	6.3	1	$1,354	$29,796	$20,316	$6,772	$11,106	$1,490	$70,519	$444,267	$44,427	$44,427	**$533,120**
4	4	20	1.275	5.1	1	$1,354	$6,772	$31,828	$10,609	$8,126	$1,693	$48,555	$247,630	$24,763	$24,763	**$297,156**
4	8	20	1.575	6.3	1	$1,354	$15,914	$26,410	$8,803	$8,939	$1,490	$56,501	$355,954	$35,595	$35,595	**$427,145**
4	12	20	1.925	7.7	1	$1,354	$27,088	$21,670	$7,223	$9,955	$1,354	$66,975	$515,704	$51,570	$51,570	**$618,845**
5	4	20	1.25	6.25	1	$1,354	$6,095	$32,505	$10,835	$7,449	$1,490	$47,223	$295,145	$29,514	$29,514	**$354,173**
5	8	20	1.5	7.5	1	$1,354	$14,898	$28,442	$9,481	$8,126	$1,354	$55,214	$414,105	$41,410	$41,410	**$496,926**
5	12	20	1.75	8.75	1	$1,354	$24,379	$23,025	$7,675	$8,803	$1,219	$63,431	$555,018	$55,502	$55,502	**$666,021**
6	4	20	1.24	7.44	1	$1,354	$5,688	$33,047	$11,016	$7,097	$1,409	$46,564	$346,436	$34,644	$34,644	**$415,723**
6	8	20	1.47	8.82	1	$1,354	$14,356	$28,984	$9,661	$7,747	$1,287	$54,406	$479,860	$47,986	$47,986	**$575,832**
6	12	20	1.71	10.26	1	$1,354	$23,702	$23,837	$7,946	$8,343	$1,165	$62,510	$641,349	$64,135	$64,135	**$769,618**
7	4	20	1.23	8.61	1	$1,354	$5,282	$33,589	$11,196	$6,745	$1,327	$45,905	$395,241	$39,524	$39,524	**$474,289**
7	8	20	1.44	10.08	1	$1,354	$13,815	$29,526	$9,842	$7,368	$1,219	$53,598	$540,265	$54,027	$54,027	**$648,319**
7	12	20	1.67	11.69	1	$1,354	$23,025	$24,650	$8,217	$7,883	$1,111	$61,589	$719,971	$71,997	$71,997	**$863,965**
8	4	20	1.22	9.76	1	$1,354	$4,876	$34,130	$11,377	$6,393	$1,246	$45,246	$441,598	$44,160	$44,160	**$529,918**
8	8	20	1.41	11.28	1	$1,354	$13,273	$30,067	$10,022	$6,989	$1,151	$52,790	$595,467	$59,547	$59,547	**$714,561**
8	12	20	1.63	13.04	1	$1,354	$22,347	$25,462	$8,487	$7,422	$1,056	$60,668	$791,106	$79,111	$79,111	**$949,327**
9	4	20	1.21	10.89	1	$1,354	$4,469	$34,672	$11,557	$6,041	$1,165	$44,587	$485,548	$48,555	$48,555	**$582,658**
9	8	20	1.38	12.42	1	$1,354	$12,731	$30,609	$10,203	$6,609	$1,084	$51,982	$645,611	$64,561	$64,561	**$774,733**
9	12	20	1.59	14.31	1	$1,354	$21,670	$26,275	$8,758	$6,962	$1,002	$59,747	$854,975	$85,497	$85,497	**$1,025,970**
10	4	20	1.2	12	1	$1,354	$4,063	$35,214	$11,738	$5,688	$1,084	$43,927	$527,129	$52,713	$52,713	**$632,555**
10	8	20	1.35	13.5	1	$1,354	$12,189	$31,151	$10,384	$6,230	$1,016	$51,173	$690,841	$69,084	$69,084	**$829,009**
10	12	20	1.55	15.5	1	$1,354	$20,993	$27,088	$9,029	$6,501	$948	$58,826	$911,798	$91,180	$91,180	**$1,094,158**
20	4	20	1.16	23.2	1	$1,354	$3,386	$36,568	$12,189	$4,639	$867	$42,435	$984,501	$98,450	$98,450	**$1,181,401**
20	8	20	1.275	25.5	1	$1,354	$9,819	$32,844	$10,948	$4,977	$819	$47,918	$1,221,919	$122,192	$122,192	**$1,466,302**
20	12	20	1.42	28.4	1	$1,354	$17,607	$29,796	$9,932	$5,181	$772	$54,846	$1,557,628	$155,763	$155,763	**$1,869,153**
30	4	20	1.12	33.6	1	$1,354	$2,709	$37,923	$12,641	$3,589	$650	$40,943	$1,375,695	$137,569	$137,569	**$1,650,834**
30	8	20	1.2	36	1	$1,354	$7,449	$34,537	$11,512	$3,725	$623	$44,663	$1,607,880	$160,788	$160,788	**$1,929,456**
30	12	20	1.29	38.7	1	$1,354	$14,221	$32,505	$10,835	$3,860	$596	$50,866	$1,968,530	$196,853	$196,853	**$2,362,236**
40	4	20	1.105	44.2	1	$1,354	$2,438	$38,261	$12,754	$3,284	$582	$40,413	$1,786,247	$178,625	$178,625	**$2,143,496**
40	8	20	1.175	47	1	$1,354	$6,772	$35,553	$11,851	$3,386	$562	$43,925	$2,064,484	$206,448	$206,448	**$2,477,381**
40	12	20	1.26	50.4	1	$1,354	$12,867	$33,521	$11,174	$3,488	$542	$49,424	$2,490,970	$249,097	$249,097	**$2,989,163**
50	4	20	1.09	54.5	1	$1,354	$2,167	$38,600	$12,867	$2,980	$515	$39,882	$2,173,589	$217,359	$217,359	**$2,608,306**
50	8	20	1.15	57.5	1	$1,354	$6,095	$36,568	$12,189	$3,047	$501	$43,187	$2,483,256	$248,326	$248,326	**$2,979,907**
50	12	20	1.23	61.5	1	$1,354	$11,512	$34,537	$11,512	$3,115	$488	$47,982	$2,950,867	$295,087	$295,087	**$3,541,041**
60	4	20	1.084	65.04	1	$1,354	$2,004	$38,735	$12,912	$2,817	$485	$39,573	$2,573,806	$257,381	$257,381	**$3,088,567**
60	8	20	1.144	68.64	1	$1,354	$5,824	$36,839	$12,280	$2,877	$473	$42,807	$2,938,299	$293,830	$293,830	**$3,525,958**
60	12	20	1.216	72.96	1	$1,354	$10,889	$34,808	$11,603	$2,936	$460	$47,243	$3,446,848	$344,685	$344,685	**$4,136,218**
70	4	20	1.078	75.46	1	$1,354	$1,842	$38,871	$12,957	$2,655	$455	$39,263	$2,962,783	$296,278	$296,278	**$3,555,339**
70	8	20	1.138	79.66	1	$1,354	$5,553	$37,110	$12,370	$2,706	$444	$42,428	$3,379,791	$337,979	$337,979	**$4,055,749**
70	12	20	1.202	84.14	1	$1,354	$10,266	$35,079	$11,693	$2,758	$433	$46,504	$3,912,880	$391,288	$391,288	**$4,695,456**
80	4	20	1.072	85.76	1	$1,354	$1,679	$39,006	$13,002	$2,492	$425	$38,953	$3,340,631	$334,063	$334,063	**$4,008,757**
80	8	20	1.132	90.56	1	$1,354	$5,282	$37,381	$12,460	$2,535	$416	$42,048	$3,807,869	$380,787	$380,787	**$4,569,443**
80	12	20	1.188	95.04	1	$1,354	$9,643	$35,349	$11,783	$2,579	$406	$45,766	$4,349,582	$434,958	$434,958	**$5,219,499**
90	4	20	1.066	95.94	1	$1,354	$1,517	$39,142	$13,047	$2,330	$395	$38,644	$3,707,462	$370,746	$370,746	**$4,448,955**
90	8	20	1.126	101.34	1	$1,354	$5,011	$37,652	$12,551	$2,365	$387	$41,668	$4,222,670	$422,267	$422,267	**$5,067,204**
90	12	20	1.174	105.66	1	$1,354	$9,020	$35,620	$11,873	$2,400	$379	$45,027	$4,757,576	$475,758	$475,758	**$5,709,091**
100	4	20	1.06	106	1	$1,354	$1,354	$39,277	$13,092	$2,167	$366	$38,334	$4,063,388	$406,339	$406,339	**$4,876,066**
100	8	20	1.12	112	1	$1,354	$4,740	$37,923	$12,641	$2,194	$359	$41,289	$4,624,330	$462,433	$462,433	**$5,549,196**

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
100	12	20	1.16	116	1	$1,354	$8,397	$35,891	$11,964	$2,221	$352	$44,289	$5,137,481	$513,748	$513,748	**$6,164,977**
1	4	20	1.65	1.65	2	$2,709	$10,835	$24,379	$8,126	$12,867	$2,939	$47,476	$78,335	$7,834	$7,834	**$94,002**
1	8	20	2.35	2.35	2	$2,709	$23,702	$17,607	$5,869	$14,898	$2,519	$59,697	$140,288	$14,029	$14,029	**$168,345**
1	12	20	3.1	3.1	2	$2,709	$35,214	$13,544	$4,515	$17,607	$2,167	$72,211	$223,855	$22,386	$22,386	**$268,626**
2	4	20	1.475	2.95	2	$2,709	$9,142	$27,765	$9,255	$10,835	$2,418	$44,358	$130,857	$13,086	$13,086	**$157,029**
2	8	20	2	4	2	$2,709	$20,316	$20,993	$6,998	$12,325	$2,072	$54,419	$217,677	$21,768	$21,768	**$261,213**
2	12	20	2.6	5.2	2	$2,709	$32,505	$16,930	$5,643	$14,356	$1,828	$67,042	$348,619	$34,862	$34,862	**$418,343**
3	4	20	1.3	3.9	2	$2,709	$7,449	$31,151	$10,384	$8,803	$1,896	$41,241	$160,840	$16,084	$16,084	**$193,008**
3	8	20	1.65	4.95	2	$2,709	$16,930	$24,379	$8,126	$9,752	$1,625	$49,142	$243,251	$24,325	$24,325	**$291,902**
3	12	20	2.1	6.3	2	$2,709	$29,796	$20,316	$6,772	$11,106	$1,490	$61,873	$389,799	$38,980	$38,980	**$467,759**
4	4	20	1.275	5.1	2	$2,709	$6,772	$31,828	$10,609	$8,126	$1,693	$39,909	$203,538	$20,354	$20,354	**$244,245**
4	8	20	1.575	6.3	2	$2,709	$15,914	$26,410	$8,803	$8,939	$1,490	$47,855	$301,487	$30,149	$30,149	**$361,784**
4	12	20	1.925	7.7	2	$2,709	$27,088	$21,670	$7,223	$9,955	$1,354	$58,329	$449,133	$44,913	$44,913	**$538,959**
5	4	20	1.25	6.25	2	$2,709	$6,095	$32,505	$10,835	$7,449	$1,490	$38,578	$241,109	$24,111	$24,111	**$289,331**
5	8	20	1.5	7.5	2	$2,709	$14,898	$28,442	$9,481	$8,126	$1,354	$46,568	$349,263	$34,926	$34,926	**$419,115**
5	12	20	1.75	8.75	2	$2,709	$24,379	$23,025	$7,675	$8,803	$1,219	$54,785	$479,369	$47,937	$47,937	**$575,242**
6	4	20	1.24	7.44	2	$2,709	$5,688	$33,047	$11,016	$7,097	$1,409	$37,918	$282,113	$28,211	$28,211	**$338,535**
6	8	20	1.47	8.82	2	$2,709	$14,356	$28,984	$9,661	$7,747	$1,287	$45,760	$403,605	$40,361	$40,361	**$484,327**
6	12	20	1.71	10.26	2	$2,709	$23,702	$23,837	$7,946	$8,343	$1,165	$53,864	$552,645	$55,264	$55,264	**$663,173**
7	4	20	1.23	8.61	2	$2,709	$5,282	$33,589	$11,196	$6,745	$1,327	$37,259	$320,802	$32,080	$32,080	**$384,962**
7	8	20	1.44	10.08	2	$2,709	$13,815	$29,526	$9,842	$7,368	$1,219	$44,952	$453,118	$45,312	$45,312	**$543,741**
7	12	20	1.67	11.69	2	$2,709	$23,025	$24,650	$8,217	$7,883	$1,111	$52,943	$618,904	$61,890	$61,890	**$742,685**
8	4	20	1.22	9.76	2	$2,709	$4,876	$34,130	$11,377	$6,393	$1,246	$36,600	$357,217	$35,722	$35,722	**$428,660**
8	8	20	1.41	11.28	2	$2,709	$13,273	$30,067	$10,022	$6,989	$1,151	$44,144	$497,945	$49,794	$49,794	**$597,534**
8	12	20	1.63	13.04	2	$2,709	$22,347	$25,462	$8,487	$7,422	$1,056	$52,022	$678,367	$67,837	$67,837	**$814,041**
9	4	20	1.21	10.89	2	$2,709	$4,469	$34,672	$11,557	$6,041	$1,165	$35,941	$391,397	$39,140	$39,140	**$469,677**
9	8	20	1.38	12.42	2	$2,709	$12,731	$30,609	$10,203	$6,609	$1,084	$43,336	$538,232	$53,823	$53,823	**$645,878**
9	12	20	1.59	14.31	2	$2,709	$21,670	$26,275	$8,758	$6,962	$1,002	$51,101	$731,256	$73,126	$73,126	**$877,507**
10	4	20	1.2	12	2	$2,709	$4,063	$35,214	$11,738	$5,688	$1,084	$35,282	$423,382	$42,338	$42,338	**$508,058**
10	8	20	1.35	13.5	2	$2,709	$12,189	$31,151	$10,384	$6,230	$1,016	$42,528	$574,125	$57,413	$57,413	**$688,950**
10	12	20	1.55	15.5	2	$2,709	$20,993	$27,088	$9,029	$6,501	$948	$50,180	$777,791	$77,779	$77,779	**$933,349**
20	4	20	1.16	23.2	2	$2,709	$3,386	$36,568	$12,189	$4,639	$867	$33,790	$783,922	$78,392	$78,392	**$940,707**
20	8	20	1.275	25.5	2	$2,709	$9,819	$32,844	$10,948	$4,977	$819	$39,273	$1,001,455	$100,146	$100,146	**$1,201,746**
20	12	20	1.42	28.4	2	$2,709	$17,607	$29,796	$9,932	$5,181	$772	$46,200	$1,312,092	$131,209	$131,209	**$1,574,511**
30	4	20	1.12	33.6	2	$2,709	$2,709	$37,923	$12,641	$3,589	$650	$32,298	$1,085,202	$108,520	$108,520	**$1,302,242**
30	8	20	1.2	36	2	$2,709	$7,449	$34,537	$11,512	$3,725	$623	$36,018	$1,296,638	$129,664	$129,664	**$1,555,966**
30	12	20	1.29	38.7	2	$2,709	$14,221	$32,505	$10,835	$3,860	$596	$42,221	$1,633,945	$163,395	$163,395	**$1,960,734**
40	4	20	1.105	44.2	2	$2,709	$2,438	$38,261	$12,754	$3,284	$582	$31,767	$1,404,111	$140,411	$140,411	**$1,684,933**
40	8	20	1.175	47	2	$2,709	$6,772	$35,553	$11,851	$3,386	$562	$35,280	$1,658,140	$165,814	$165,814	**$1,989,768**
40	12	20	1.26	50.4	2	$2,709	$12,867	$33,521	$11,174	$3,488	$542	$40,778	$2,055,231	$205,523	$205,523	**$2,466,277**
50	4	20	1.09	54.5	2	$2,709	$2,167	$38,600	$12,867	$2,980	$515	$31,237	$1,702,403	$170,240	$170,240	**$2,042,883**
50	8	20	1.15	57.5	2	$2,709	$6,095	$36,568	$12,189	$3,047	$501	$34,541	$1,986,133	$198,613	$198,613	**$2,383,360**
50	12	20	1.23	61.5	2	$2,709	$11,512	$34,537	$11,512	$3,115	$488	$39,336	$2,419,162	$241,916	$241,916	**$2,902,994**
60	4	20	1.084	65.04	2	$2,709	$2,004	$38,735	$12,912	$2,817	$485	$30,927	$2,011,495	$201,149	$201,149	**$2,413,794**
60	8	20	1.144	68.64	2	$2,709	$5,824	$36,839	$12,280	$2,877	$473	$34,162	$2,344,864	$234,486	$234,486	**$2,813,836**
60	12	20	1.216	72.96	2	$2,709	$10,889	$34,808	$11,603	$2,936	$460	$38,597	$2,816,064	$281,606	$281,606	**$3,379,277**
70	4	20	1.078	75.46	2	$2,709	$1,842	$38,871	$12,957	$2,655	$455	$30,617	$2,310,385	$231,038	$231,038	**$2,772,461**
70	8	20	1.138	79.66	2	$2,709	$5,553	$37,110	$12,370	$2,706	$444	$33,782	$2,691,081	$269,108	$269,108	**$3,229,297**
70	12	20	1.202	84.14	2	$2,709	$10,266	$35,079	$11,693	$2,758	$433	$37,859	$3,185,438	$318,544	$318,544	**$3,822,526**
80	4	20	1.072	85.76	2	$2,709	$1,679	$39,006	$13,002	$2,492	$425	$30,308	$2,599,183	$259,918	$259,918	**$3,119,020**
80	8	20	1.132	90.56	2	$2,709	$5,282	$37,381	$12,460	$2,535	$416	$33,402	$3,024,922	$302,492	$302,492	**$3,629,906**
80	12	20	1.188	95.04	2	$2,709	$9,643	$35,349	$11,783	$2,579	$406	$37,120	$3,527,903	$352,790	$352,790	**$4,233,484**

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
90	4	20	1.066	95.94	2	$2,709	$1,517	$39,142	$13,047	$2,330	$395	$29,998	$2,878,002	$287,800	$287,800	**$3,453,602**
90	8	20	1.126	101.34	2	$2,709	$5,011	$37,652	$12,551	$2,365	$387	$33,023	$3,346,523	$334,652	$334,652	**$4,015,828**
90	12	20	1.174	105.66	2	$2,709	$9,020	$35,620	$11,873	$2,400	$379	$36,382	$3,844,080	$384,408	$384,408	**$4,612,896**
100	4	20	1.06	106	2	$2,709	$1,354	$39,277	$13,092	$2,167	$366	$29,688	$3,146,953	$314,695	$314,695	**$3,776,343**
100	8	20	1.12	112	2	$2,709	$4,740	$37,923	$12,641	$2,194	$359	$32,643	$3,656,021	$365,602	$365,602	**$4,387,226**
100	12	20	1.16	116	2	$2,709	$8,397	$35,891	$11,964	$2,221	$352	$35,643	$4,134,589	$413,459	$413,459	**$4,961,507**
1	4	20	1.65	1.65	2	$2,709	$10,835	$24,379	$8,126	$12,867	$2,939	$57,476	$94,835	$9,484	$9,484	**$113,802**
1	8	20	2.35	2.35	2	$2,709	$23,702	$17,607	$5,869	$14,898	$2,519	$69,697	$163,788	$16,379	$16,379	**$196,545**
1	12	20	3.1	3.1	2	$2,709	$35,214	$13,544	$4,515	$17,607	$2,167	$82,211	$254,855	$25,486	$25,486	**$305,826**
2	4	20	1.475	2.95	2	$2,709	$9,142	$27,765	$9,255	$10,835	$2,418	$54,358	$160,357	$16,036	$16,036	**$192,429**
2	8	20	2	4	2	$2,709	$20,316	$20,993	$6,998	$12,325	$2,072	$64,419	$257,677	$25,768	$25,768	**$309,213**
2	12	20	2.6	5.2	2	$2,709	$32,505	$16,930	$5,643	$14,356	$1,828	$77,042	$400,619	$40,062	$40,062	**$480,743**
3	4	20	1.3	3.9	2	$2,709	$7,449	$31,151	$10,384	$8,803	$1,896	$51,241	$199,840	$19,984	$19,984	**$239,808**
3	8	20	1.65	4.95	2	$2,709	$16,930	$24,379	$8,126	$9,752	$1,625	$59,142	$292,751	$29,275	$29,275	**$351,302**
3	12	20	2.1	6.3	2	$2,709	$29,796	$20,316	$6,772	$11,106	$1,490	$71,873	$452,799	$45,280	$45,280	**$543,359**
4	4	20	1.275	5.1	2	$2,709	$6,772	$31,828	$10,609	$8,126	$1,693	$49,909	$254,538	$25,454	$25,454	**$305,445**
4	8	20	1.575	6.3	2	$2,709	$15,914	$26,410	$8,803	$8,939	$1,490	$57,855	$364,487	$36,449	$36,449	**$437,384**
4	12	20	1.925	7.7	2	$2,709	$27,088	$21,670	$7,223	$9,955	$1,354	$68,329	$526,133	$52,613	$52,613	**$631,359**
5	4	20	1.25	6.25	2	$2,709	$6,095	$32,505	$10,835	$7,449	$1,490	$48,578	$303,609	$30,361	$30,361	**$364,331**
5	8	20	1.5	7.5	2	$2,709	$14,898	$28,442	$9,481	$8,126	$1,354	$56,568	$424,263	$42,426	$42,426	**$509,115**
5	12	20	1.75	8.75	2	$2,709	$24,379	$23,025	$7,675	$8,803	$1,219	$64,785	$566,869	$56,687	$56,687	**$680,242**
6	4	20	1.24	7.44	2	$2,709	$5,688	$33,047	$11,016	$7,097	$1,409	$47,918	$356,513	$35,651	$35,651	**$427,815**
6	8	20	1.47	8.82	2	$2,709	$14,356	$28,984	$9,661	$7,747	$1,287	$55,760	$491,805	$49,181	$49,181	**$590,167**
6	12	20	1.71	10.26	2	$2,709	$23,702	$23,837	$7,946	$8,343	$1,165	$63,864	$655,245	$65,524	$65,524	**$786,293**
7	4	20	1.23	8.61	2	$2,709	$5,282	$33,589	$11,196	$6,745	$1,327	$47,259	$406,902	$40,690	$40,690	**$488,282**
7	8	20	1.44	10.08	2	$2,709	$13,815	$29,526	$9,842	$7,368	$1,219	$54,952	$553,918	$55,392	$55,392	**$664,701**
7	12	20	1.67	11.69	2	$2,709	$23,025	$24,650	$8,217	$7,883	$1,111	$62,943	$735,804	$73,580	$73,580	**$882,965**
8	4	20	1.22	9.76	2	$2,709	$4,876	$34,130	$11,377	$6,393	$1,246	$46,600	$454,817	$45,482	$45,482	**$545,780**
8	8	20	1.41	11.28	2	$2,709	$13,273	$30,067	$10,022	$6,989	$1,151	$54,144	$610,745	$61,074	$61,074	**$732,894**
8	12	20	1.63	13.04	2	$2,709	$22,347	$25,462	$8,487	$7,422	$1,056	$62,022	$808,767	$80,877	$80,877	**$970,521**
9	4	20	1.21	10.89	2	$2,709	$4,469	$34,672	$11,557	$6,041	$1,165	$45,941	$500,297	$50,030	$50,030	**$600,357**
9	8	20	1.38	12.42	2	$2,709	$12,731	$30,609	$10,203	$6,609	$1,084	$53,336	$662,432	$66,243	$66,243	**$794,918**
9	12	20	1.59	14.31	2	$2,709	$21,670	$26,275	$8,758	$6,962	$1,002	$61,101	$874,356	$87,436	$87,436	**$1,049,227**
10	4	20	1.2	12	2	$2,709	$4,063	$35,214	$11,738	$5,688	$1,084	$45,282	$543,382	$54,338	$54,338	**$652,058**
10	8	20	1.35	13.5	2	$2,709	$12,189	$31,151	$10,384	$6,230	$1,016	$52,528	$709,125	$70,913	$70,913	**$850,950**
10	12	20	1.55	15.5	2	$2,709	$20,993	$27,088	$9,029	$6,501	$948	$60,180	$932,791	$93,279	$93,279	**$1,119,349**
20	4	20	1.16	23.2	2	$2,709	$3,386	$36,568	$12,189	$4,639	$867	$43,790	$1,015,922	$101,592	$101,592	**$1,219,107**
20	8	20	1.275	25.5	2	$2,709	$9,819	$32,844	$10,948	$4,977	$819	$49,273	$1,256,455	$125,646	$125,646	**$1,507,746**
20	12	20	1.42	28.4	2	$2,709	$17,607	$29,796	$9,932	$5,181	$772	$56,200	$1,596,092	$159,609	$159,609	**$1,915,311**
30	4	20	1.12	33.6	2	$2,709	$2,709	$37,923	$12,641	$3,589	$650	$42,298	$1,421,202	$142,120	$142,120	**$1,705,442**
30	8	20	1.2	36	2	$2,709	$7,449	$34,537	$11,512	$3,725	$623	$46,018	$1,656,638	$165,664	$165,664	**$1,987,966**
30	12	20	1.29	38.7	2	$2,709	$14,221	$32,505	$10,835	$3,860	$596	$52,221	$2,020,945	$202,095	$202,095	**$2,425,134**
40	4	20	1.105	44.2	2	$2,709	$2,438	$38,261	$12,754	$3,284	$582	$41,767	$1,846,111	$184,611	$184,611	**$2,215,333**
40	8	20	1.175	47	2	$2,709	$6,772	$35,553	$11,851	$3,386	$562	$45,280	$2,128,140	$212,814	$212,814	**$2,553,768**
40	12	20	1.26	50.4	2	$2,709	$12,867	$33,521	$11,174	$3,488	$542	$50,778	$2,559,231	$255,923	$255,923	**$3,071,077**
50	4	20	1.09	54.5	2	$2,709	$2,167	$38,600	$12,867	$2,980	$515	$41,237	$2,247,403	$224,740	$224,740	**$2,696,883**
50	8	20	1.15	57.5	2	$2,709	$6,095	$36,568	$12,189	$3,047	$501	$44,541	$2,561,133	$256,113	$256,113	**$3,073,360**
50	12	20	1.23	61.5	2	$2,709	$11,512	$34,537	$11,512	$3,115	$488	$49,336	$3,034,162	$303,416	$303,416	**$3,640,994**
60	4	20	1.084	65.04	2	$2,709	$2,004	$38,735	$12,912	$2,817	$485	$40,927	$2,661,895	$266,189	$266,189	**$3,194,274**
60	8	20	1.144	68.64	2	$2,709	$5,824	$36,839	$12,280	$2,877	$473	$44,162	$3,031,264	$303,126	$303,126	**$3,637,516**
60	12	20	1.216	72.96	2	$2,709	$10,889	$34,808	$11,603	$2,936	$460	$48,597	$3,545,664	$354,566	$354,566	**$4,254,797**
70	4	20	1.078	75.46	2	$2,709	$1,842	$38,871	$12,957	$2,655	$455	$40,617	$3,064,985	$306,498	$306,498	**$3,677,981**

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
70	8	20	1.138	79.66	2	$2,709	$5,553	$37,110	$12,370	$2,706	$444	$43,782	$3,487,681	$348,768	$348,768	**$4,185,217**
70	12	20	1.202	84.14	2	$2,709	$10,266	$35,079	$11,693	$2,758	$433	$47,859	$4,026,838	$402,684	$402,684	**$4,832,206**
80	4	20	1.072	85.76	2	$2,709	$1,679	$39,006	$13,002	$2,492	$425	$40,308	$3,456,783	$345,678	$345,678	**$4,148,140**
80	8	20	1.132	90.56	2	$2,709	$5,282	$37,381	$12,460	$2,535	$416	$43,402	$3,930,522	$393,052	$393,052	**$4,716,626**
80	12	20	1.188	95.04	2	$2,709	$9,643	$35,349	$11,783	$2,579	$406	$47,120	$4,478,303	$447,830	$447,830	**$5,373,964**
90	4	20	1.066	95.94	2	$2,709	$1,517	$39,142	$13,047	$2,330	$395	$39,998	$3,837,402	$383,740	$383,740	**$4,604,882**
90	8	20	1.126	101.34	2	$2,709	$5,011	$37,652	$12,551	$2,365	$387	$43,023	$4,359,923	$435,992	$435,992	**$5,231,908**
90	12	20	1.174	105.66	2	$2,709	$9,020	$35,620	$11,873	$2,400	$379	$46,382	$4,900,680	$490,068	$490,068	**$5,880,816**
100	4	20	1.06	106	2	$2,709	$1,354	$39,277	$13,092	$2,167	$366	$39,688	$4,206,953	$420,695	$420,695	**$5,048,343**
100	8	20	1.12	112	2	$2,709	$4,740	$37,923	$12,641	$2,194	$359	$42,643	$4,776,021	$477,602	$477,602	**$5,731,226**
100	12	20	1.16	116	2	$2,709	$8,397	$35,891	$11,964	$2,221	$352	$45,643	$5,294,589	$529,459	$529,459	**$6,353,507**
1	4	20	1.65	1.65	3	$5,418	$10,835	$24,379	$8,126	$12,867	$2,939	$50,185	$82,805	$8,280	$8,280	**$99,365**
1	8	20	2.35	2.35	3	$5,418	$23,702	$17,607	$5,869	$14,898	$2,519	$62,406	$146,653	$14,665	$14,665	**$175,984**
1	12	20	3.1	3.1	3	$5,418	$35,214	$13,544	$4,515	$17,607	$2,167	$74,920	$232,252	$23,225	$23,225	**$278,703**
2	4	20	1.475	2.95	3	$5,418	$9,142	$27,765	$9,255	$10,835	$2,418	$47,067	$138,848	$13,885	$13,885	**$166,618**
2	8	20	2	4	3	$5,418	$20,316	$20,993	$6,998	$12,325	$2,072	$57,128	$228,512	$22,851	$22,851	**$274,215**
2	12	20	2.6	5.2	3	$5,418	$32,505	$16,930	$5,643	$14,356	$1,828	$69,751	$362,705	$36,270	$36,270	**$435,246**
3	4	20	1.3	3.9	3	$5,418	$7,449	$31,151	$10,384	$8,803	$1,896	$43,950	$171,405	$17,140	$17,140	**$205,686**
3	8	20	1.65	4.95	3	$5,418	$16,930	$24,379	$8,126	$9,752	$1,625	$51,850	$256,660	$25,666	$25,666	**$307,992**
3	12	20	2.1	6.3	3	$5,418	$29,796	$20,316	$6,772	$11,106	$1,490	$64,582	$406,865	$40,686	$40,686	**$488,238**
4	4	20	1.275	5.1	3	$5,418	$6,772	$31,828	$10,609	$8,126	$1,693	$42,618	$217,352	$21,735	$21,735	**$260,823**
4	8	20	1.575	6.3	3	$5,418	$15,914	$26,410	$8,803	$8,939	$1,490	$50,564	$318,552	$31,855	$31,855	**$382,262**
4	12	20	1.925	7.7	3	$5,418	$27,088	$21,670	$7,223	$9,955	$1,354	$61,038	$469,990	$46,999	$46,999	**$563,988**
5	4	20	1.25	6.25	3	$5,418	$6,095	$32,505	$10,835	$7,449	$1,490	$41,286	$258,039	$25,804	$25,804	**$309,647**
5	8	20	1.5	7.5	3	$5,418	$14,898	$28,442	$9,481	$8,126	$1,354	$49,277	$369,579	$36,958	$36,958	**$443,494**
5	12	20	1.75	8.75	3	$5,418	$24,379	$23,025	$7,675	$8,803	$1,219	$57,494	$503,070	$50,307	$50,307	**$603,684**
6	4	20	1.24	7.44	3	$5,418	$5,688	$33,047	$11,016	$7,097	$1,409	$40,627	$302,266	$30,227	$30,227	**$362,719**
6	8	20	1.47	8.82	3	$5,418	$14,356	$28,984	$9,661	$7,747	$1,287	$48,469	$427,497	$42,750	$42,750	**$512,996**
6	12	20	1.71	10.26	3	$5,418	$23,702	$23,837	$7,946	$8,343	$1,165	$56,573	$580,437	$58,044	$58,044	**$696,524**
7	4	20	1.23	8.61	3	$5,418	$5,282	$33,589	$11,196	$6,745	$1,327	$39,968	$344,125	$34,412	$34,412	**$412,949**
7	8	20	1.44	10.08	3	$5,418	$13,815	$29,526	$9,842	$7,368	$1,219	$47,661	$480,422	$48,042	$48,042	**$576,506**
7	12	20	1.67	11.69	3	$5,418	$23,025	$24,650	$8,217	$7,883	$1,111	$55,652	$650,569	$65,057	$65,057	**$780,683**
8	4	20	1.22	9.76	3	$5,418	$4,876	$34,130	$11,377	$6,393	$1,246	$39,309	$383,655	$38,365	$38,365	**$460,386**
8	8	20	1.41	11.28	3	$5,418	$13,273	$30,067	$10,022	$6,989	$1,151	$46,853	$528,500	$52,850	$52,850	**$634,199**
8	12	20	1.63	13.04	3	$5,418	$22,347	$25,462	$8,487	$7,422	$1,056	$54,731	$713,690	$71,369	$71,369	**$856,428**
9	4	20	1.21	10.89	3	$5,418	$4,469	$34,672	$11,557	$6,041	$1,165	$38,650	$420,896	$42,090	$42,090	**$505,075**
9	8	20	1.38	12.42	3	$5,418	$12,731	$30,609	$10,203	$6,609	$1,084	$46,045	$571,875	$57,187	$57,187	**$686,250**
9	12	20	1.59	14.31	3	$5,418	$21,670	$26,275	$8,758	$6,962	$1,002	$53,810	$770,018	$77,002	$77,002	**$924,022**
10	4	20	1.2	12	3	$5,418	$4,063	$35,214	$11,738	$5,688	$1,084	$37,991	$455,887	$45,589	$45,589	**$547,065**
10	8	20	1.35	13.5	3	$5,418	$12,189	$31,151	$10,384	$6,230	$1,016	$45,237	$610,694	$61,069	$61,069	**$732,832**
10	12	20	1.55	15.5	3	$5,418	$20,993	$27,088	$9,029	$6,501	$948	$52,889	$819,777	$81,978	$81,978	**$983,732**
20	4	20	1.16	23.2	3	$5,418	$3,386	$36,568	$12,189	$4,639	$867	$36,499	$846,766	$84,677	$84,677	**$1,016,119**
20	8	20	1.275	25.5	3	$5,418	$9,819	$32,844	$10,948	$4,977	$819	$41,982	$1,070,529	$107,053	$107,053	**$1,284,635**
20	12	20	1.42	28.4	3	$5,418	$17,607	$29,796	$9,932	$5,181	$772	$48,909	$1,389,021	$138,902	$138,902	**$1,666,826**
30	4	20	1.12	33.6	3	$5,418	$2,709	$37,923	$12,641	$3,589	$650	$35,006	$1,176,217	$117,622	$117,622	**$1,411,460**
30	8	20	1.2	36	3	$5,418	$7,449	$34,537	$11,512	$3,725	$623	$38,726	$1,394,154	$139,415	$139,415	**$1,672,984**
30	12	20	1.29	38.7	3	$5,418	$14,221	$32,505	$10,835	$3,860	$596	$44,930	$1,738,774	$173,877	$173,877	**$2,086,529**
40	4	20	1.105	44.2	3	$5,418	$2,438	$38,261	$12,754	$3,284	$582	$34,476	$1,523,838	$152,384	$152,384	**$1,828,606**
40	8	20	1.175	47	3	$5,418	$6,772	$35,553	$11,851	$3,386	$562	$37,988	$1,785,453	$178,545	$178,545	**$2,142,543**
40	12	20	1.26	50.4	3	$5,418	$12,867	$33,521	$11,174	$3,488	$542	$43,487	$2,191,752	$219,175	$219,175	**$2,630,103**
50	4	20	1.09	54.5	3	$5,418	$2,167	$38,600	$12,867	$2,980	$515	$33,946	$1,850,031	$185,003	$185,003	**$2,220,037**
50	8	20	1.15	57.5	3	$5,418	$6,095	$36,568	$12,189	$3,047	$501	$37,250	$2,141,887	$214,189	$214,189	**$2,570,265**

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
50	12	20	1.23	61.5	3	$5,418	$11,512	$34,537	$11,512	$3,115	$488	$42,045	$2,585,751	$258,575	$258,575	**$3,102,901**
60	4	20	1.084	65.04	3	$5,418	$2,004	$38,735	$12,912	$2,817	$485	$33,636	$2,187,673	$218,767	$218,767	**$2,625,208**
60	8	20	1.144	68.64	3	$5,418	$5,824	$36,839	$12,280	$2,877	$473	$36,871	$2,530,793	$253,079	$253,079	**$3,036,952**
60	12	20	1.216	72.96	3	$5,418	$10,889	$34,808	$11,603	$2,936	$460	$41,306	$3,013,696	$301,370	$301,370	**$3,616,435**
70	4	20	1.078	75.46	3	$5,418	$1,842	$38,871	$12,957	$2,655	$455	$33,326	$2,514,788	$251,479	$251,479	**$3,017,746**
70	8	20	1.138	79.66	3	$5,418	$5,553	$37,110	$12,370	$2,706	$444	$36,491	$2,906,861	$290,686	$290,686	**$3,488,234**
70	12	20	1.202	84.14	3	$5,418	$10,266	$35,079	$11,693	$2,758	$433	$40,568	$3,413,354	$341,335	$341,335	**$4,096,024**
80	4	20	1.072	85.76	3	$5,418	$1,679	$39,006	$13,002	$2,492	$425	$33,016	$2,831,487	$283,149	$283,149	**$3,397,784**
80	8	20	1.132	90.56	3	$5,418	$5,282	$37,381	$12,460	$2,535	$416	$36,111	$3,270,228	$327,023	$327,023	**$3,924,274**
80	12	20	1.188	95.04	3	$5,418	$9,643	$35,349	$11,783	$2,579	$406	$39,829	$3,785,344	$378,534	$378,534	**$4,542,413**
90	4	20	1.066	95.94	3	$5,418	$1,517	$39,142	$13,047	$2,330	$395	$32,707	$3,137,881	$313,788	$313,788	**$3,765,457**
90	8	20	1.126	101.34	3	$5,418	$5,011	$37,652	$12,551	$2,365	$387	$35,731	$3,621,030	$362,103	$362,103	**$4,345,236**
90	12	20	1.174	105.66	3	$5,418	$9,020	$35,620	$11,873	$2,400	$379	$39,090	$4,130,288	$413,029	$413,029	**$4,956,346**
100	4	20	1.06	106	3	$5,418	$1,354	$39,277	$13,092	$2,167	$366	$32,397	$3,434,082	$343,408	$343,408	**$4,120,899**
100	8	20	1.12	112	3	$5,418	$4,740	$37,923	$12,641	$2,194	$359	$35,352	$3,959,403	$395,940	$395,940	**$4,751,284**
100	12	20	1.16	116	3	$5,418	$8,397	$35,891	$11,964	$2,221	$352	$38,352	$4,448,806	$444,881	$444,881	**$5,338,567**
1	4	20	1.65	1.65	3	$5,418	$10,835	$24,379	$8,126	$12,867	$2,939	$60,185	$99,305	$9,930	$9,930	**$119,165**
1	8	20	2.35	2.35	3	$5,418	$23,702	$17,607	$5,869	$14,898	$2,519	$72,406	$170,153	$17,015	$17,015	**$204,184**
1	12	20	3.1	3.1	3	$5,418	$35,214	$13,544	$4,515	$17,607	$2,167	$84,920	$263,252	$26,325	$26,325	**$315,903**
2	4	20	1.475	2.95	3	$5,418	$9,142	$27,765	$9,255	$10,835	$2,418	$57,067	$168,348	$16,835	$16,835	**$202,018**
2	8	20	2	4	3	$5,418	$20,316	$20,993	$6,998	$12,325	$2,072	$67,128	$268,512	$26,851	$26,851	**$322,215**
2	12	20	2.6	5.2	3	$5,418	$32,505	$16,930	$5,643	$14,356	$1,828	$79,751	$414,705	$41,470	$41,470	**$497,646**
3	4	20	1.3	3.9	3	$5,418	$7,449	$31,151	$10,384	$8,803	$1,896	$53,950	$210,405	$21,040	$21,040	**$252,486**
3	8	20	1.65	4.95	3	$5,418	$16,930	$24,379	$8,126	$9,752	$1,625	$61,850	$306,160	$30,616	$30,616	**$367,392**
3	12	20	2.1	6.3	3	$5,418	$29,796	$20,316	$6,772	$11,106	$1,490	$74,582	$469,865	$46,986	$46,986	**$563,838**
4	4	20	1.275	5.1	3	$5,418	$6,772	$31,828	$10,609	$8,126	$1,693	$52,618	$268,352	$26,835	$26,835	**$322,023**
4	8	20	1.575	6.3	3	$5,418	$15,914	$26,410	$8,803	$8,939	$1,490	$60,564	$381,552	$38,155	$38,155	**$457,862**
4	12	20	1.925	7.7	3	$5,418	$27,088	$21,670	$7,223	$9,955	$1,354	$71,038	$546,990	$54,699	$54,699	**$656,388**
5	4	20	1.25	6.25	3	$5,418	$6,095	$32,505	$10,835	$7,449	$1,490	$51,286	$320,539	$32,054	$32,054	**$384,647**
5	8	20	1.5	7.5	3	$5,418	$14,898	$28,442	$9,481	$8,126	$1,354	$59,277	$444,579	$44,458	$44,458	**$533,494**
5	12	20	1.75	8.75	3	$5,418	$24,379	$23,025	$7,675	$8,803	$1,219	$67,494	$590,570	$59,057	$59,057	**$708,684**
6	4	20	1.24	7.44	3	$5,418	$5,688	$33,047	$11,016	$7,097	$1,409	$50,627	$376,666	$37,667	$37,667	**$451,999**
6	8	20	1.47	8.82	3	$5,418	$14,356	$28,984	$9,661	$7,747	$1,287	$58,469	$515,697	$51,570	$51,570	**$618,836**
6	12	20	1.71	10.26	3	$5,418	$23,702	$23,837	$7,946	$8,343	$1,165	$66,573	$683,037	$68,304	$68,304	**$819,644**
7	4	20	1.23	8.61	3	$5,418	$5,282	$33,589	$11,196	$6,745	$1,327	$49,968	$430,225	$43,022	$43,022	**$516,269**
7	8	20	1.44	10.08	3	$5,418	$13,815	$29,526	$9,842	$7,368	$1,219	$57,661	$581,222	$58,122	$58,122	**$697,466**
7	12	20	1.67	11.69	3	$5,418	$23,025	$24,650	$8,217	$7,883	$1,111	$65,652	$767,469	$76,747	$76,747	**$920,963**
8	4	20	1.22	9.76	3	$5,418	$4,876	$34,130	$11,377	$6,393	$1,246	$49,309	$481,255	$48,125	$48,125	**$577,506**
8	8	20	1.41	11.28	3	$5,418	$13,273	$30,067	$10,022	$6,989	$1,151	$56,853	$641,300	$64,130	$64,130	**$769,559**
8	12	20	1.63	13.04	3	$5,418	$22,347	$25,462	$8,487	$7,422	$1,056	$64,731	$844,090	$84,409	$84,409	**$1,012,908**
9	4	20	1.21	10.89	3	$5,418	$4,469	$34,672	$11,557	$6,041	$1,165	$48,650	$529,796	$52,980	$52,980	**$635,755**
9	8	20	1.38	12.42	3	$5,418	$12,731	$30,609	$10,203	$6,609	$1,084	$56,045	$696,075	$69,607	$69,607	**$835,290**
9	12	20	1.59	14.31	3	$5,418	$21,670	$26,275	$8,758	$6,962	$1,002	$63,810	$913,118	$91,312	$91,312	**$1,095,742**
10	4	20	1.2	12	3	$5,418	$4,063	$35,214	$11,738	$5,688	$1,084	$47,991	$575,887	$57,589	$57,589	**$691,065**
10	8	20	1.35	13.5	3	$5,418	$12,189	$31,151	$10,384	$6,230	$1,016	$55,237	$745,694	$74,569	$74,569	**$894,832**
10	12	20	1.55	15.5	3	$5,418	$20,993	$27,088	$9,029	$6,501	$948	$62,889	$974,777	$97,478	$97,478	**$1,169,732**
20	4	20	1.16	23.2	3	$5,418	$3,386	$36,568	$12,189	$4,639	$867	$46,499	$1,078,766	$107,877	$107,877	**$1,294,519**
20	8	20	1.275	25.5	3	$5,418	$9,819	$32,844	$10,948	$4,977	$819	$51,982	$1,325,529	$132,553	$132,553	**$1,590,635**
20	12	20	1.42	28.4	3	$5,418	$17,607	$29,796	$9,932	$5,181	$772	$58,909	$1,673,021	$167,302	$167,302	**$2,007,626**
30	4	20	1.12	33.6	3	$5,418	$2,709	$37,923	$12,641	$3,589	$650	$45,006	$1,512,217	$151,222	$151,222	**$1,814,660**
30	8	20	1.2	36	3	$5,418	$7,449	$34,537	$11,512	$3,725	$623	$48,726	$1,754,154	$175,415	$175,415	**$2,104,984**
30	12	20	1.29	38.7	3	$5,418	$14,221	$32,505	$10,835	$3,860	$596	$54,930	$2,125,774	$212,577	$212,577	**$2,550,929**

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
40	4	20	1.105	44.2	3	$5,418	$2,438	$38,261	$12,754	$3,284	$582	$44,476	$1,965,838	$196,584	$196,584	**$2,359,006**
40	8	20	1.175	47	3	$5,418	$6,772	$35,553	$11,851	$3,386	$562	$47,988	$2,255,453	$225,545	$225,545	**$2,706,543**
40	12	20	1.26	50.4	3	$5,418	$12,867	$33,521	$11,174	$3,488	$542	$53,487	$2,695,752	$269,575	$269,575	**$3,234,903**
50	4	20	1.09	54.5	3	$5,418	$2,167	$38,600	$12,867	$2,980	$515	$43,946	$2,395,031	$239,503	$239,503	**$2,874,037**
50	8	20	1.15	57.5	3	$5,418	$6,095	$36,568	$12,189	$3,047	$501	$47,250	$2,716,887	$271,689	$271,689	**$3,260,265**
50	12	20	1.23	61.5	3	$5,418	$11,512	$34,537	$11,512	$3,115	$488	$52,045	$3,200,751	$320,075	$320,075	**$3,840,901**
60	4	20	1.084	65.04	3	$5,418	$2,004	$38,735	$12,912	$2,817	$485	$43,636	$2,838,073	$283,807	$283,807	**$3,405,688**
60	8	20	1.144	68.64	3	$5,418	$5,824	$36,839	$12,280	$2,877	$473	$46,871	$3,217,193	$321,719	$321,719	**$3,860,632**
60	12	20	1.216	72.96	3	$5,418	$10,889	$34,808	$11,603	$2,936	$460	$51,306	$3,743,296	$374,330	$374,330	**$4,491,955**
70	4	20	1.078	75.46	3	$5,418	$1,842	$38,871	$12,957	$2,655	$455	$43,326	$3,269,388	$326,939	$326,939	**$3,923,266**
70	8	20	1.138	79.66	3	$5,418	$5,553	$37,110	$12,370	$2,706	$444	$46,491	$3,703,461	$370,346	$370,346	**$4,444,154**
70	12	20	1.202	84.14	3	$5,418	$10,266	$35,079	$11,693	$2,758	$433	$50,568	$4,254,754	$425,475	$425,475	**$5,105,704**
80	4	20	1.072	85.76	3	$5,418	$1,679	$39,006	$13,002	$2,492	$425	$43,016	$3,689,087	$368,909	$368,909	**$4,426,904**
80	8	20	1.132	90.56	3	$5,418	$5,282	$37,381	$12,460	$2,535	$416	$46,111	$4,175,828	$417,583	$417,583	**$5,010,994**
80	12	20	1.188	95.04	3	$5,418	$9,643	$35,349	$11,783	$2,579	$406	$49,829	$4,735,744	$473,574	$473,574	**$5,682,893**
90	4	20	1.066	95.94	3	$5,418	$1,517	$39,142	$13,047	$2,330	$395	$42,707	$4,097,281	$409,728	$409,728	**$4,916,737**
90	8	20	1.126	101.34	3	$5,418	$5,011	$37,652	$12,551	$2,365	$387	$45,731	$4,634,430	$463,443	$463,443	**$5,561,316**
90	12	20	1.174	105.66	3	$5,418	$9,020	$35,620	$11,873	$2,400	$379	$49,090	$5,186,888	$518,689	$518,689	**$6,224,266**
100	4	20	1.06	106	3	$5,418	$1,354	$39,277	$13,092	$2,167	$366	$42,397	$4,494,082	$449,408	$449,408	**$5,392,899**
100	8	20	1.12	112	3	$5,418	$4,740	$37,923	$12,641	$2,194	$359	$45,352	$5,079,403	$507,940	$507,940	**$6,095,284**
100	12	20	1.16	116	3	$5,418	$8,397	$35,891	$11,964	$2,221	$352	$48,352	$5,608,806	$560,881	$560,881	**$6,730,567**
1	4	20	1.65	1.65	4	$9,481	$10,835	$24,379	$8,126	$12,867	$2,939	$54,248	$89,509	$8,951	$8,951	**$107,411**
1	8	20	2.35	2.35	4	$9,481	$23,702	$17,607	$5,869	$14,898	$2,519	$66,469	$156,202	$15,620	$15,620	**$187,442**
1	12	20	3.1	3.1	4	$9,481	$35,214	$13,544	$4,515	$17,607	$2,167	$78,983	$244,848	$24,485	$24,485	**$293,818**
2	4	20	1.475	2.95	4	$9,481	$9,142	$27,765	$9,255	$10,835	$2,418	$51,130	$150,835	$15,083	$15,083	**$181,002**
2	8	20	2	4	4	$9,481	$20,316	$20,993	$6,998	$12,325	$2,072	$61,191	$244,765	$24,476	$24,476	**$293,718**
2	12	20	2.6	5.2	4	$9,481	$32,505	$16,930	$5,643	$14,356	$1,828	$73,814	$383,833	$38,383	$38,383	**$460,600**
3	4	20	1.3	3.9	4	$9,481	$7,449	$31,151	$10,384	$8,803	$1,896	$48,013	$187,251	$18,725	$18,725	**$224,701**
3	8	20	1.65	4.95	4	$9,481	$16,930	$24,379	$8,126	$9,752	$1,625	$55,914	$276,772	$27,677	$27,677	**$332,127**
3	12	20	2.1	6.3	4	$9,481	$29,796	$20,316	$6,772	$11,106	$1,490	$68,645	$432,462	$43,246	$43,246	**$518,955**
4	4	20	1.275	5.1	4	$9,481	$6,772	$31,828	$10,609	$8,126	$1,693	$46,681	$238,074	$23,807	$23,807	**$285,689**
4	8	20	1.575	6.3	4	$9,481	$15,914	$26,410	$8,803	$8,939	$1,490	$54,627	$344,150	$34,415	$34,415	**$412,980**
4	12	20	1.925	7.7	4	$9,481	$27,088	$21,670	$7,223	$9,955	$1,354	$65,101	$501,277	$50,128	$50,128	**$601,532**
5	4	20	1.25	6.25	4	$9,481	$6,095	$32,505	$10,835	$7,449	$1,490	$45,349	$283,434	$28,343	$28,343	**$340,121**
5	8	20	1.5	7.5	4	$9,481	$14,898	$28,442	$9,481	$8,126	$1,354	$53,340	$400,052	$40,005	$40,005	**$480,063**
5	12	20	1.75	8.75	4	$9,481	$24,379	$23,025	$7,675	$8,803	$1,219	$61,557	$538,623	$53,862	$53,862	**$646,347**
6	4	20	1.24	7.44	4	$9,481	$5,688	$33,047	$11,016	$7,097	$1,409	$44,690	$332,496	$33,250	$33,250	**$398,995**
6	8	20	1.47	8.82	4	$9,481	$14,356	$28,984	$9,661	$7,747	$1,287	$52,532	$463,334	$46,333	$46,333	**$556,001**
6	12	20	1.71	10.26	4	$9,481	$23,702	$23,837	$7,946	$8,343	$1,165	$60,636	$622,124	$62,212	$62,212	**$746,549**
7	4	20	1.23	8.61	4	$9,481	$5,282	$33,589	$11,196	$6,745	$1,327	$44,031	$379,108	$37,911	$37,911	**$454,930**
7	8	20	1.44	10.08	4	$9,481	$13,815	$29,526	$9,842	$7,368	$1,219	$51,724	$521,379	$52,138	$52,138	**$625,654**
7	12	20	1.67	11.69	4	$9,481	$23,025	$24,650	$8,217	$7,883	$1,111	$59,715	$698,068	$69,807	$69,807	**$837,681**
8	4	20	1.22	9.76	4	$9,481	$4,876	$34,130	$11,377	$6,393	$1,246	$43,372	$423,311	$42,331	$42,331	**$507,973**
8	8	20	1.41	11.28	4	$9,481	$13,273	$30,067	$10,022	$6,989	$1,151	$50,916	$574,332	$57,433	$57,433	**$689,198**
8	12	20	1.63	13.04	4	$9,481	$22,347	$25,462	$8,487	$7,422	$1,056	$58,794	$766,673	$76,667	$76,667	**$920,008**
9	4	20	1.21	10.89	4	$9,481	$4,469	$34,672	$11,557	$6,041	$1,165	$42,713	$465,143	$46,514	$46,514	**$558,172**
9	8	20	1.38	12.42	4	$9,481	$12,731	$30,609	$10,203	$6,609	$1,084	$50,108	$622,339	$62,234	$62,234	**$746,807**
9	12	20	1.59	14.31	4	$9,481	$21,670	$26,275	$8,758	$6,962	$1,002	$57,873	$828,162	$82,816	$82,816	**$993,795**
10	4	20	1.2	12	4	$9,481	$4,063	$35,214	$11,738	$5,688	$1,084	$42,054	$504,645	$50,465	$50,465	**$605,574**
10	8	20	1.35	13.5	4	$9,481	$12,189	$31,151	$10,384	$6,230	$1,016	$49,300	$665,546	$66,555	$66,555	**$798,655**
10	12	20	1.55	15.5	4	$9,481	$20,993	$27,088	$9,029	$6,501	$948	$56,952	$882,756	$88,276	$88,276	**$1,059,307**
20	4	20	1.16	23.2	4	$9,481	$3,386	$36,568	$12,189	$4,639	$867	$40,562	$941,031	$94,103	$94,103	**$1,129,237**

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
20	8	20	1.275	25.5	4	$9,481	$9,819	$32,844	$10,948	$4,977	$819	$46,045	$1,174,139	$117,414	$117,414	**$1,408,967**
20	12	20	1.42	28.4	4	$9,481	$17,607	$29,796	$9,932	$5,181	$772	$52,972	$1,504,415	$150,441	$150,441	**$1,805,298**
30	4	20	1.12	33.6	4	$9,481	$2,709	$37,923	$12,641	$3,589	$650	$39,070	$1,312,739	$131,274	$131,274	**$1,575,286**
30	8	20	1.2	36	4	$9,481	$7,449	$34,537	$11,512	$3,725	$623	$42,790	$1,540,427	$154,043	$154,043	**$1,848,513**
30	12	20	1.29	38.7	4	$9,481	$14,221	$32,505	$10,835	$3,860	$596	$48,993	$1,896,018	$189,602	$189,602	**$2,275,222**
40	4	20	1.105	44.2	4	$9,481	$2,438	$38,261	$12,754	$3,284	$582	$38,539	$1,703,430	$170,343	$170,343	**$2,044,116**
40	8	20	1.175	47	4	$9,481	$6,772	$35,553	$11,851	$3,386	$562	$42,052	$1,976,421	$197,642	$197,642	**$2,371,705**
40	12	20	1.26	50.4	4	$9,481	$12,867	$33,521	$11,174	$3,488	$542	$47,550	$2,396,535	$239,654	$239,654	**$2,875,842**
50	4	20	1.09	54.5	4	$9,481	$2,167	$38,600	$12,867	$2,980	$515	$38,009	$2,071,472	$207,147	$207,147	**$2,485,767**
50	8	20	1.15	57.5	4	$9,481	$6,095	$36,568	$12,189	$3,047	$501	$41,313	$2,375,518	$237,552	$237,552	**$2,850,622**
50	12	20	1.23	61.5	4	$9,481	$11,512	$34,537	$11,512	$3,115	$488	$46,108	$2,835,635	$283,563	$283,563	**$3,402,762**
60	4	20	1.084	65.04	4	$9,481	$2,004	$38,735	$12,912	$2,817	$485	$37,699	$2,451,941	$245,194	$245,194	**$2,942,329**
60	8	20	1.144	68.64	4	$9,481	$5,824	$36,839	$12,280	$2,877	$473	$40,934	$2,809,688	$280,969	$280,969	**$3,371,626**
60	12	20	1.216	72.96	4	$9,481	$10,889	$34,808	$11,603	$2,936	$460	$45,369	$3,310,144	$331,014	$331,014	**$3,972,172**
70	4	20	1.078	75.46	4	$9,481	$1,842	$38,871	$12,957	$2,655	$455	$37,389	$2,821,394	$282,139	$282,139	**$3,385,672**
70	8	20	1.138	79.66	4	$9,481	$5,553	$37,110	$12,370	$2,706	$444	$40,554	$3,230,532	$323,053	$323,053	**$3,876,639**
70	12	20	1.202	84.14	4	$9,481	$10,266	$35,079	$11,693	$2,758	$433	$44,631	$3,755,227	$375,523	$375,523	**$4,506,273**
80	4	20	1.072	85.76	4	$9,481	$1,679	$39,006	$13,002	$2,492	$425	$37,080	$3,179,943	$317,994	$317,994	**$3,815,932**
80	8	20	1.132	90.56	4	$9,481	$5,282	$37,381	$12,460	$2,535	$416	$40,174	$3,638,187	$363,819	$363,819	**$4,365,825**
80	12	20	1.188	95.04	4	$9,481	$9,643	$35,349	$11,783	$2,579	$406	$43,892	$4,171,506	$417,151	$417,151	**$5,005,808**
90	4	20	1.066	95.94	4	$9,481	$1,517	$39,142	$13,047	$2,330	$395	$36,770	$3,527,700	$352,770	$352,770	**$4,233,240**
90	8	20	1.126	101.34	4	$9,481	$5,011	$37,652	$12,551	$2,365	$387	$39,795	$4,032,790	$403,279	$403,279	**$4,839,348**
90	12	20	1.174	105.66	4	$9,481	$9,020	$35,620	$11,873	$2,400	$379	$43,154	$4,559,601	$455,960	$455,960	**$5,471,521**
100	4	20	1.06	106	4	$9,481	$1,354	$39,277	$13,092	$2,167	$366	$36,460	$3,864,776	$386,478	$386,478	**$4,637,732**
100	8	20	1.12	112	4	$9,481	$4,740	$37,923	$12,641	$2,194	$359	$39,415	$4,414,477	$441,448	$441,448	**$5,297,372**
100	12	20	1.16	116	4	$9,481	$8,397	$35,891	$11,964	$2,221	$352	$42,415	$4,920,132	$492,013	$492,013	**$5,904,158**
1	4	20	1.65	1.65	4	$9,481	$10,835	$24,379	$8,126	$12,867	$2,939	$64,248	$106,009	$10,601	$10,601	**$127,211**
1	8	20	2.35	2.35	4	$9,481	$23,702	$17,607	$5,869	$14,898	$2,519	$76,469	$179,702	$17,970	$17,970	**$215,642**
1	12	20	3.1	3.1	4	$9,481	$35,214	$13,544	$4,515	$17,607	$2,167	$88,983	$275,848	$27,585	$27,585	**$331,018**
2	4	20	1.475	2.95	4	$9,481	$9,142	$27,765	$9,255	$10,835	$2,418	$61,130	$180,335	$18,033	$18,033	**$216,402**
2	8	20	2	4	4	$9,481	$20,316	$20,993	$6,998	$12,325	$2,072	$71,191	$284,765	$28,476	$28,476	**$341,718**
2	12	20	2.6	5.2	4	$9,481	$32,505	$16,930	$5,643	$14,356	$1,828	$83,814	$435,833	$43,583	$43,583	**$523,000**
3	4	20	1.3	3.9	4	$9,481	$7,449	$31,151	$10,384	$8,803	$1,896	$58,013	$226,251	$22,625	$22,625	**$271,501**
3	8	20	1.65	4.95	4	$9,481	$16,930	$24,379	$8,126	$9,752	$1,625	$65,914	$326,272	$32,627	$32,627	**$391,527**
3	12	20	2.1	6.3	4	$9,481	$29,796	$20,316	$6,772	$11,106	$1,490	$78,645	$495,462	$49,546	$49,546	**$594,555**
4	4	20	1.275	5.1	4	$9,481	$6,772	$31,828	$10,609	$8,126	$1,693	$56,681	$289,074	$28,907	$28,907	**$346,889**
4	8	20	1.575	6.3	4	$9,481	$15,914	$26,410	$8,803	$8,939	$1,490	$64,627	$407,150	$40,715	$40,715	**$488,580**
4	12	20	1.925	7.7	4	$9,481	$27,088	$21,670	$7,223	$9,955	$1,354	$75,101	$578,277	$57,828	$57,828	**$693,932**
5	4	20	1.25	6.25	4	$9,481	$6,095	$32,505	$10,835	$7,449	$1,490	$55,349	$345,934	$34,593	$34,593	**$415,121**
5	8	20	1.5	7.5	4	$9,481	$14,898	$28,442	$9,481	$8,126	$1,354	$63,340	$475,052	$47,505	$47,505	**$570,063**
5	12	20	1.75	8.75	4	$9,481	$24,379	$23,025	$7,675	$8,803	$1,219	$71,557	$626,123	$62,612	$62,612	**$751,347**
6	4	20	1.24	7.44	4	$9,481	$5,688	$33,047	$11,016	$7,097	$1,409	$54,690	$406,896	$40,690	$40,690	**$488,275**
6	8	20	1.47	8.82	4	$9,481	$14,356	$28,984	$9,661	$7,747	$1,287	$62,532	$551,534	$55,153	$55,153	**$661,841**
6	12	20	1.71	10.26	4	$9,481	$23,702	$23,837	$7,946	$8,343	$1,165	$70,636	$724,724	$72,472	$72,472	**$869,669**
7	4	20	1.23	8.61	4	$9,481	$5,282	$33,589	$11,196	$6,745	$1,327	$54,031	$465,208	$46,521	$46,521	**$558,250**
7	8	20	1.44	10.08	4	$9,481	$13,815	$29,526	$9,842	$7,368	$1,219	$61,724	$622,179	$62,218	$62,218	**$746,614**
7	12	20	1.67	11.69	4	$9,481	$23,025	$24,650	$8,217	$7,883	$1,111	$69,715	$814,968	$81,497	$81,497	**$977,961**
8	4	20	1.22	9.76	4	$9,481	$4,876	$34,130	$11,377	$6,393	$1,246	$53,372	$520,911	$52,091	$52,091	**$625,093**
8	8	20	1.41	11.28	4	$9,481	$13,273	$30,067	$10,022	$6,989	$1,151	$60,916	$687,132	$68,713	$68,713	**$824,558**
8	12	20	1.63	13.04	4	$9,481	$22,347	$25,462	$8,487	$7,422	$1,056	$68,794	$897,073	$89,707	$89,707	**$1,076,488**
9	4	20	1.21	10.89	4	$9,481	$4,469	$34,672	$11,557	$6,041	$1,165	$52,713	$574,043	$57,404	$57,404	**$688,852**
9	8	20	1.38	12.42	4	$9,481	$12,731	$30,609	$10,203	$6,609	$1,084	$60,108	$746,539	$74,654	$74,654	**$895,847**

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
9	12	20	1.59	14.31	4	$9,481	$21,670	$26,275	$8,758	$6,962	$1,002	$67,873	$971,262	$97,126	$97,126	**$1,165,515**
10	4	20	1.2	12	4	$9,481	$4,063	$35,214	$11,738	$5,688	$1,084	$52,054	$624,645	$62,465	$62,465	**$749,574**
10	8	20	1.35	13.5	4	$9,481	$12,189	$31,151	$10,384	$6,230	$1,016	$59,300	$800,546	$80,055	$80,055	**$960,655**
10	12	20	1.55	15.5	4	$9,481	$20,993	$27,088	$9,029	$6,501	$948	$66,952	$1,037,756	$103,776	$103,776	**$1,245,307**
20	4	20	1.16	23.2	4	$9,481	$3,386	$36,568	$12,189	$4,639	$867	$50,562	$1,173,031	$117,303	$117,303	**$1,407,637**
20	8	20	1.275	25.5	4	$9,481	$9,819	$32,844	$10,948	$4,977	$819	$56,045	$1,429,139	$142,914	$142,914	**$1,714,967**
20	12	20	1.42	28.4	4	$9,481	$17,607	$29,796	$9,932	$5,181	$772	$62,972	$1,788,415	$178,841	$178,841	**$2,146,098**
30	4	20	1.12	33.6	4	$9,481	$2,709	$37,923	$12,641	$3,589	$650	$49,070	$1,648,739	$164,874	$164,874	**$1,978,486**
30	8	20	1.2	36	4	$9,481	$7,449	$34,537	$11,512	$3,725	$623	$52,790	$1,900,427	$190,043	$190,043	**$2,280,513**
30	12	20	1.29	38.7	4	$9,481	$14,221	$32,505	$10,835	$3,860	$596	$58,993	$2,283,018	$228,302	$228,302	**$2,739,622**
40	4	20	1.105	44.2	4	$9,481	$2,438	$38,261	$12,754	$3,284	$582	$48,539	$2,145,430	$214,543	$214,543	**$2,574,516**
40	8	20	1.175	47	4	$9,481	$6,772	$35,553	$11,851	$3,386	$562	$52,052	$2,446,421	$244,642	$244,642	**$2,935,705**
40	12	20	1.26	50.4	4	$9,481	$12,867	$33,521	$11,174	$3,488	$542	$57,550	$2,900,535	$290,054	$290,054	**$3,480,642**
50	4	20	1.09	54.5	4	$9,481	$2,167	$38,600	$12,867	$2,980	$515	$48,009	$2,616,472	$261,647	$261,647	**$3,139,767**
50	8	20	1.15	57.5	4	$9,481	$6,095	$36,568	$12,189	$3,047	$501	$51,313	$2,950,518	$295,052	$295,052	**$3,540,622**
50	12	20	1.23	61.5	4	$9,481	$11,512	$34,537	$11,512	$3,115	$488	$56,108	$3,450,635	$345,063	$345,063	**$4,140,762**
60	4	20	1.084	65.04	4	$9,481	$2,004	$38,735	$12,912	$2,817	$485	$47,699	$3,102,341	$310,234	$310,234	**$3,722,809**
60	8	20	1.144	68.64	4	$9,481	$5,824	$36,839	$12,280	$2,877	$473	$50,934	$3,496,088	$349,609	$349,609	**$4,195,306**
60	12	20	1.216	72.96	4	$9,481	$10,889	$34,808	$11,603	$2,936	$460	$55,369	$4,039,744	$403,974	$403,974	**$4,847,692**
70	4	20	1.078	75.46	4	$9,481	$1,842	$38,871	$12,957	$2,655	$455	$47,389	$3,575,994	$357,599	$357,599	**$4,291,192**
70	8	20	1.138	79.66	4	$9,481	$5,553	$37,110	$12,370	$2,706	$444	$50,554	$4,027,132	$402,713	$402,713	**$4,832,559**
70	12	20	1.202	84.14	4	$9,481	$10,266	$35,079	$11,693	$2,758	$433	$54,631	$4,596,627	$459,663	$459,663	**$5,515,953**
80	4	20	1.072	85.76	4	$9,481	$1,679	$39,006	$13,002	$2,492	$425	$47,080	$4,037,543	$403,754	$403,754	**$4,845,052**
80	8	20	1.132	90.56	4	$9,481	$5,282	$37,381	$12,460	$2,535	$416	$50,174	$4,543,787	$454,379	$454,379	**$5,452,545**
80	12	20	1.188	95.04	4	$9,481	$9,643	$35,349	$11,783	$2,579	$406	$53,892	$5,121,906	$512,191	$512,191	**$6,146,288**
90	4	20	1.066	95.94	4	$9,481	$1,517	$39,142	$13,047	$2,330	$395	$46,770	$4,487,100	$448,710	$448,710	**$5,384,520**
90	8	20	1.126	101.34	4	$9,481	$5,011	$37,652	$12,551	$2,365	$387	$49,795	$5,046,190	$504,619	$504,619	**$6,055,428**
90	12	20	1.174	105.66	4	$9,481	$9,020	$35,620	$11,873	$2,400	$379	$53,154	$5,616,201	$561,620	$561,620	**$6,739,441**
100	4	20	1.06	106	4	$9,481	$1,354	$39,277	$13,092	$2,167	$366	$46,460	$4,924,776	$492,478	$492,478	**$5,909,732**
100	8	20	1.12	112	4	$9,481	$4,740	$37,923	$12,641	$2,194	$359	$49,415	$5,534,477	$553,448	$553,448	**$6,641,372**
100	12	20	1.16	116	4	$9,481	$8,397	$35,891	$11,964	$2,221	$352	$52,415	$6,080,132	$608,013	$608,013	**$7,296,158**
1	4	120	1.65	1.65	1	$1,354	$10,835	$24,379	$48,758	$12,867	$2,939	$86,753	$143,142	$14,314	$14,314	**$171,771**
1	8	120	2.35	2.35	1	$1,354	$23,702	$17,607	$35,214	$14,898	$2,519	$87,687	$206,066	$20,607	$20,607	**$247,279**
1	12	120	3.1	3.1	1	$1,354	$35,214	$13,544	$27,088	$17,607	$2,167	$93,430	$289,633	$28,963	$28,963	**$347,560**
2	4	120	1.475	2.95	1	$1,354	$9,142	$27,765	$55,530	$10,835	$2,418	$89,279	$263,373	$26,337	$26,337	**$316,047**
2	8	120	2	4	1	$1,354	$20,316	$20,993	$41,986	$12,325	$2,072	$88,053	$352,213	$35,221	$35,221	**$422,655**
2	12	120	2.6	5.2	1	$1,354	$32,505	$16,930	$33,860	$14,356	$1,828	$93,904	$488,301	$48,830	$48,830	**$585,962**
3	4	120	1.3	3.9	1	$1,354	$7,449	$31,151	$62,302	$8,803	$1,896	$91,805	$358,039	$35,804	$35,804	**$429,647**
3	8	120	1.65	4.95	1	$1,354	$16,930	$24,379	$48,758	$9,752	$1,625	$88,419	$437,673	$43,767	$43,767	**$525,208**
3	12	120	2.1	6.3	1	$1,354	$29,796	$20,316	$40,632	$11,106	$1,490	$94,378	$594,582	$59,458	$59,458	**$713,499**
4	4	120	1.275	5.1	1	$1,354	$6,772	$31,828	$63,656	$8,126	$1,693	$91,602	$467,168	$46,717	$46,717	**$560,602**
4	8	120	1.575	6.3	1	$1,354	$15,914	$26,410	$52,821	$8,939	$1,490	$90,518	$570,264	$57,026	$57,026	**$684,317**
4	12	120	1.925	7.7	1	$1,354	$27,088	$21,670	$43,340	$9,955	$1,354	$93,091	$716,804	$71,680	$71,680	**$860,165**
5	4	120	1.25	6.25	1	$1,354	$6,095	$32,505	$65,010	$7,449	$1,490	$91,398	$571,241	$57,124	$57,124	**$685,489**
5	8	120	1.5	7.5	1	$1,354	$14,898	$28,442	$56,884	$8,126	$1,354	$92,617	$694,631	$69,463	$69,463	**$833,557**
5	12	120	1.75	8.75	1	$1,354	$24,379	$23,025	$46,049	$8,803	$1,219	$91,805	$803,292	$80,329	$80,329	**$963,951**
6	4	120	1.24	7.44	1	$1,354	$5,688	$33,047	$66,094	$7,097	$1,409	$91,642	$681,819	$68,182	$68,182	**$818,182**
6	8	120	1.47	8.82	1	$1,354	$14,356	$28,984	$57,968	$7,747	$1,287	$92,712	$817,722	$81,772	$81,772	**$981,266**
6	12	120	1.71	10.26	1	$1,354	$23,702	$23,837	$47,674	$8,343	$1,165	$92,238	$946,364	$94,636	$94,636	**$1,135,637**
7	4	120	1.23	8.61	1	$1,354	$5,282	$33,589	$67,177	$6,745	$1,327	$91,886	$791,139	$79,114	$79,114	**$949,367**
7	8	120	1.44	10.08	1	$1,354	$13,815	$29,526	$59,051	$7,368	$1,219	$92,807	$935,495	$93,550	$93,550	**$1,122,594**
7	12	120	1.67	11.69	1	$1,354	$23,025	$24,650	$49,300	$7,883	$1,111	$92,672	$1,083,331	$108,333	$108,333	**$1,299,997**

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
8	4	120	1.22	9.76	1	$1,354	$4,876	$34,130	$68,261	$6,393	$1,246	$92,130	$899,187	$89,919	$89,919	**$1,079,025**
8	8	120	1.41	11.28	1	$1,354	$13,273	$30,067	$60,135	$6,989	$1,151	$92,902	$1,047,933	$104,793	$104,793	**$1,257,520**
8	12	120	1.63	13.04	1	$1,354	$22,347	$25,462	$50,925	$7,422	$1,056	$93,105	$1,214,089	$121,409	$121,409	**$1,456,907**
9	4	120	1.21	10.89	1	$1,354	$4,469	$34,672	$69,344	$6,041	$1,165	$92,374	$1,005,949	$100,595	$100,595	**$1,207,139**
9	8	120	1.38	12.42	1	$1,354	$12,731	$30,609	$61,218	$6,609	$1,084	$92,997	$1,155,019	$115,502	$115,502	**$1,386,022**
9	12	120	1.59	14.31	1	$1,354	$21,670	$26,275	$52,550	$6,962	$1,002	$93,538	$1,338,535	$133,853	$133,853	**$1,606,242**
10	4	120	1.2	12	1	$1,354	$4,063	$35,214	$70,428	$5,688	$1,084	$92,617	$1,111,409	$111,141	$111,141	**$1,333,691**
10	8	120	1.35	13.5	1	$1,354	$12,189	$31,151	$62,302	$6,230	$1,016	$93,091	$1,256,735	$125,673	$125,673	**$1,508,082**
10	12	120	1.55	15.5	1	$1,354	$20,993	$27,088	$54,175	$6,501	$948	$93,972	$1,456,563	$145,656	$145,656	**$1,747,876**
20	4	120	1.16	23.2	1	$1,354	$3,386	$36,568	$73,137	$4,639	$867	$93,383	$2,166,478	$216,648	$216,648	**$2,599,774**
20	8	120	1.275	25.5	1	$1,354	$9,819	$32,844	$65,688	$4,977	$819	$92,658	$2,362,781	$236,278	$236,278	**$2,835,337**
20	12	120	1.42	28.4	1	$1,354	$17,607	$29,796	$59,593	$5,181	$772	$94,507	$2,683,993	$268,399	$268,399	**$3,220,792**
30	4	120	1.12	33.6	1	$1,354	$2,709	$37,923	$75,846	$3,589	$650	$94,148	$3,163,369	$316,337	$316,337	**$3,796,043**
30	8	120	1.2	36	1	$1,354	$7,449	$34,537	$69,074	$3,725	$623	$92,225	$3,320,088	$332,009	$332,009	**$3,984,106**
30	12	120	1.29	38.7	1	$1,354	$14,221	$32,505	$65,010	$3,860	$596	$95,042	$3,678,117	$367,812	$367,812	**$4,413,741**
40	4	120	1.105	44.2	1	$1,354	$2,438	$38,261	$76,523	$3,284	$582	$94,182	$4,162,834	$416,283	$416,283	**$4,995,400**
40	8	120	1.175	47	1	$1,354	$6,772	$35,553	$71,105	$3,386	$562	$93,180	$4,379,437	$437,944	$437,944	**$5,255,324**
40	12	120	1.26	50.4	1	$1,354	$12,867	$33,521	$67,042	$3,488	$542	$95,292	$4,802,735	$480,273	$480,273	**$5,763,281**
50	4	120	1.09	54.5	1	$1,354	$2,167	$38,600	$77,200	$2,980	$515	$94,216	$5,134,751	$513,475	$513,475	**$6,161,701**
50	8	120	1.15	57.5	1	$1,354	$6,095	$36,568	$73,137	$3,047	$501	$94,134	$5,412,725	$541,273	$541,273	**$6,495,270**
50	12	120	1.23	61.5	1	$1,354	$11,512	$34,537	$69,074	$3,115	$488	$95,543	$5,875,889	$587,589	$587,589	**$7,051,067**
60	4	120	1.08	65.04	1	$1,354	$2,004	$38,735	$77,471	$2,817	$485	$94,132	$6,122,322	$612,232	$612,232	**$7,346,787**
60	8	120	1.14	68.64	1	$1,354	$5,824	$36,839	$73,679	$2,877	$473	$94,206	$6,466,309	$646,631	$646,631	**$7,759,571**
60	12	120	1.22	72.96	1	$1,354	$10,889	$34,808	$69,615	$2,936	$460	$95,256	$6,949,862	$694,986	$694,986	**$8,339,834**
70	4	120	1.08	75.46	1	$1,354	$1,842	$38,871	$77,742	$2,655	$455	$94,048	$7,096,837	$709,684	$709,684	**$8,516,205**
70	8	120	1.14	79.66	1	$1,354	$5,553	$37,110	$74,220	$2,706	$444	$94,278	$7,510,179	$751,018	$751,018	**$9,012,215**
70	12	120	1.20	84.14	1	$1,354	$10,266	$35,079	$70,157	$2,758	$433	$94,969	$7,990,662	$799,066	$799,066	**$9,588,795**
80	4	120	1.07	85.76	1	$1,354	$1,679	$39,006	$78,013	$2,492	$425	$93,964	$8,058,327	$805,833	$805,833	**$9,669,992**
80	8	120	1.13	90.56	1	$1,354	$5,282	$37,381	$74,762	$2,535	$416	$94,350	$8,544,309	$854,431	$854,431	**$10,253,171**
80	12	120	1.19	95.04	1	$1,354	$9,643	$35,349	$70,699	$2,579	$406	$94,682	$8,998,532	$899,853	$899,853	**$10,798,238**
90	4	120	1.07	95.94	1	$1,354	$1,517	$39,142	$78,283	$2,330	$395	$93,880	$9,006,821	$900,682	$900,682	**$10,808,185**
90	8	120	1.13	101.34	1	$1,354	$5,011	$37,652	$75,304	$2,365	$387	$94,421	$9,568,673	$956,867	$956,867	**$11,482,408**
90	12	120	1.17	105.66	1	$1,354	$9,020	$35,620	$71,241	$2,400	$379	$94,394	$9,973,712	$997,371	$997,371	**$11,968,454**
100	4	120	1.06	106	1	$1,354	$1,354	$39,277	$78,554	$2,167	$366	$93,796	$9,942,350	$994,235	$994,235	**$11,930,820**
100	8	120	1.12	112	1	$1,354	$4,740	$37,923	$75,846	$2,194	$359	$94,493	$10,583,246	$1,058,325	$1,058,325	**$12,699,895**
100	12	120	1.16	116	1	$1,354	$8,397	$35,891	$71,782	$2,221	$352	$94,107	$10,916,443	$1,091,644	$1,091,644	**$13,099,731**
1	4	120	1.65	1.65	1	$1,354	$10,835	$24,379	$48,758	$12,867	$2,939	$96,753	$159,642	$15,964	$15,964	**$191,571**
1	8	120	2.35	2.35	1	$1,354	$23,702	$17,607	$35,214	$14,898	$2,519	$97,687	$229,566	$22,957	$22,957	**$275,479**
1	12	120	3.1	3.1	1	$1,354	$35,214	$13,544	$27,088	$17,607	$2,167	$103,430	$320,633	$32,063	$32,063	**$384,760**
2	4	120	1.475	2.95	1	$1,354	$9,142	$27,765	$55,530	$10,835	$2,418	$99,279	$292,873	$29,287	$29,287	**$351,447**
2	8	120	2	4	1	$1,354	$20,316	$20,993	$41,986	$12,325	$2,072	$98,053	$392,213	$39,221	$39,221	**$470,655**
2	12	120	2.6	5.2	1	$1,354	$32,505	$16,930	$33,860	$14,356	$1,828	$103,904	$540,301	$54,030	$54,030	**$648,362**
3	4	120	1.3	3.9	1	$1,354	$7,449	$31,151	$62,302	$8,803	$1,896	$101,805	$397,039	$39,704	$39,704	**$476,447**
3	8	120	1.65	4.95	1	$1,354	$16,930	$24,379	$48,758	$9,752	$1,625	$98,419	$487,173	$48,717	$48,717	**$584,608**
3	12	120	2.1	6.3	1	$1,354	$29,796	$20,316	$40,632	$11,106	$1,490	$104,378	$657,582	$65,758	$65,758	**$789,099**
4	4	120	1.275	5.1	1	$1,354	$6,772	$31,828	$63,656	$8,126	$1,693	$101,602	$518,168	$51,817	$51,817	**$621,802**
4	8	120	1.575	6.3	1	$1,354	$15,914	$26,410	$52,821	$8,939	$1,490	$100,518	$633,264	$63,326	$63,326	**$759,917**
4	12	120	1.925	7.7	1	$1,354	$27,088	$21,670	$43,340	$9,955	$1,354	$103,091	$793,804	$79,380	$79,380	**$952,565**
5	4	120	1.25	6.25	1	$1,354	$6,095	$32,505	$65,010	$7,449	$1,490	$101,398	$633,741	$63,374	$63,374	**$760,489**
5	8	120	1.5	7.5	1	$1,354	$14,898	$28,442	$56,884	$8,126	$1,354	$102,617	$769,631	$76,963	$76,963	**$923,557**
5	12	120	1.75	8.75	1	$1,354	$24,379	$23,025	$46,049	$8,803	$1,219	$101,805	$890,792	$89,079	$89,079	**$1,068,951**
6	4	120	1.24	7.44	1	$1,354	$5,688	$33,047	$66,094	$7,097	$1,409	$101,642	$756,219	$75,622	$75,622	**$907,462**

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
6	8	120	1.47	8.82	1	$1,354	$14,356	$28,984	$57,968	$7,747	$1,287	$102,712	$905,922	$90,592	$90,592	**$1,087,106**
6	12	120	1.71	10.26	1	$1,354	$23,702	$23,837	$47,674	$8,343	$1,165	$102,238	$1,048,964	$104,896	$104,896	**$1,258,757**
7	4	120	1.23	8.61	1	$1,354	$5,282	$33,589	$67,177	$6,745	$1,327	$101,886	$877,239	$87,724	$87,724	**$1,052,687**
7	8	120	1.44	10.08	1	$1,354	$13,815	$29,526	$59,051	$7,368	$1,219	$102,807	$1,036,295	$103,630	$103,630	**$1,243,554**
7	12	120	1.67	11.69	1	$1,354	$23,025	$24,650	$49,300	$7,883	$1,111	$102,672	$1,200,231	$120,023	$120,023	**$1,440,277**
8	4	120	1.22	9.76	1	$1,354	$4,876	$34,130	$68,261	$6,393	$1,246	$102,130	$996,787	$99,679	$99,679	**$1,196,145**
8	8	120	1.41	11.28	1	$1,354	$13,273	$30,067	$60,135	$6,989	$1,151	$102,902	$1,160,733	$116,073	$116,073	**$1,392,880**
8	12	120	1.63	13.04	1	$1,354	$22,347	$25,462	$50,925	$7,422	$1,056	$103,105	$1,344,489	$134,449	$134,449	**$1,613,387**
9	4	120	1.21	10.89	1	$1,354	$4,469	$34,672	$69,344	$6,041	$1,165	$102,374	$1,114,849	$111,485	$111,485	**$1,337,819**
9	8	120	1.38	12.42	1	$1,354	$12,731	$30,609	$61,218	$6,609	$1,084	$102,997	$1,279,219	$127,922	$127,922	**$1,535,062**
9	12	120	1.59	14.31	1	$1,354	$21,670	$26,275	$52,550	$6,962	$1,002	$103,538	$1,481,635	$148,163	$148,163	**$1,777,962**
10	4	120	1.2	12	1	$1,354	$4,063	$35,214	$70,428	$5,688	$1,084	$102,617	$1,231,409	$123,141	$123,141	**$1,477,691**
10	8	120	1.35	13.5	1	$1,354	$12,189	$31,151	$62,302	$6,230	$1,016	$103,091	$1,391,735	$139,173	$139,173	**$1,670,082**
10	12	120	1.55	15.5	1	$1,354	$20,993	$27,088	$54,175	$6,501	$948	$103,972	$1,611,563	$161,156	$161,156	**$1,933,876**
20	4	120	1.16	23.2	1	$1,354	$3,386	$36,568	$73,137	$4,639	$867	$103,383	$2,398,478	$239,848	$239,848	**$2,878,174**
20	8	120	1.275	25.5	1	$1,354	$9,819	$32,844	$65,688	$4,977	$819	$102,658	$2,617,781	$261,778	$261,778	**$3,141,337**
20	12	120	1.42	28.4	1	$1,354	$17,607	$29,796	$59,593	$5,181	$772	$104,507	$2,967,993	$296,799	$296,799	**$3,561,592**
30	4	120	1.12	33.6	1	$1,354	$2,709	$37,923	$75,846	$3,589	$650	$104,148	$3,499,369	$349,937	$349,937	**$4,199,243**
30	8	120	1.2	36	1	$1,354	$7,449	$34,537	$69,074	$3,725	$623	$102,225	$3,680,088	$368,009	$368,009	**$4,416,106**
30	12	120	1.29	38.7	1	$1,354	$14,221	$32,505	$65,010	$3,860	$596	$105,042	$4,065,117	$406,512	$406,512	**$4,878,141**
40	4	120	1.105	44.2	1	$1,354	$2,438	$38,261	$76,523	$3,284	$582	$104,182	$4,604,834	$460,483	$460,483	**$5,525,800**
40	8	120	1.175	47	1	$1,354	$6,772	$35,553	$71,105	$3,386	$562	$103,180	$4,849,437	$484,944	$484,944	**$5,819,324**
40	12	120	1.26	50.4	1	$1,354	$12,867	$33,521	$67,042	$3,488	$542	$105,292	$5,306,735	$530,673	$530,673	**$6,368,081**
50	4	120	1.09	54.5	1	$1,354	$2,167	$38,600	$77,200	$2,980	$515	$104,216	$5,679,751	$567,975	$567,975	**$6,815,701**
50	8	120	1.15	57.5	1	$1,354	$6,095	$36,568	$73,137	$3,047	$501	$104,134	$5,987,725	$598,773	$598,773	**$7,185,270**
50	12	120	1.23	61.5	1	$1,354	$11,512	$34,537	$69,074	$3,115	$488	$105,543	$6,490,889	$649,089	$649,089	**$7,789,067**
60	4	120	1.084	65.04	1	$1,354	$2,004	$38,735	$77,471	$2,817	$485	$104,132	$6,772,722	$677,272	$677,272	**$8,127,267**
60	8	120	1.144	68.64	1	$1,354	$5,824	$36,839	$73,679	$2,877	$473	$104,206	$7,152,709	$715,271	$715,271	**$8,583,251**
60	12	120	1.216	72.96	1	$1,354	$10,889	$34,808	$69,615	$2,936	$460	$105,256	$7,679,462	$767,946	$767,946	**$9,215,354**
70	4	120	1.078	75.46	1	$1,354	$1,842	$38,871	$77,742	$2,655	$455	$104,048	$7,851,437	$785,144	$785,144	**$9,421,725**
70	8	120	1.138	79.66	1	$1,354	$5,553	$37,110	$74,220	$2,706	$444	$104,278	$8,306,779	$830,678	$830,678	**$9,968,135**
70	12	120	1.202	84.14	1	$1,354	$10,266	$35,079	$70,157	$2,758	$433	$104,969	$8,832,062	$883,206	$883,206	**$10,598,475**
80	4	120	1.072	85.76	1	$1,354	$1,679	$39,006	$78,013	$2,492	$425	$103,964	$8,915,927	$891,593	$891,593	**$10,699,112**
80	8	120	1.132	90.56	1	$1,354	$5,282	$37,381	$74,762	$2,535	$416	$104,350	$9,449,909	$944,991	$944,991	**$11,339,891**
80	12	120	1.188	95.04	1	$1,354	$9,643	$35,349	$70,699	$2,579	$406	$104,682	$9,948,932	$994,893	$994,893	**$11,938,718**
90	4	120	1.066	95.94	1	$1,354	$1,517	$39,142	$78,283	$2,330	$395	$103,880	$9,966,221	$996,622	$996,622	**$11,959,465**
90	8	120	1.126	101.34	1	$1,354	$5,011	$37,652	$75,304	$2,365	$387	$104,421	$10,582,073	$1,058,207	$1,058,207	**$12,698,488**
90	12	120	1.174	105.66	1	$1,354	$9,020	$35,620	$71,241	$2,400	$379	$104,394	$11,030,312	$1,103,031	$1,103,031	**$13,236,374**
100	4	120	1.06	106	1	$1,354	$1,354	$39,277	$78,554	$2,167	$366	$103,796	$11,002,350	$1,100,235	$1,100,235	**$13,202,820**
100	8	120	1.12	112	1	$1,354	$4,740	$37,923	$75,846	$2,194	$359	$104,493	$11,703,246	$1,170,325	$1,170,325	**$14,043,895**
100	12	120	1.16	116	1	$1,354	$8,397	$35,891	$71,782	$2,221	$352	$104,107	$12,076,443	$1,207,644	$1,207,644	**$14,491,731**
1	4	120	1.65	1.65	2	$2,709	$10,835	$24,379	$48,758	$12,867	$2,939	$88,107	$145,377	$14,538	$14,538	**$174,453**
1	8	120	2.35	2.35	2	$2,709	$23,702	$17,607	$35,214	$14,898	$2,519	$89,042	$209,248	$20,925	$20,925	**$251,098**
1	12	120	3.1	3.1	2	$2,709	$35,214	$13,544	$27,088	$17,607	$2,167	$94,784	$293,832	$29,383	$29,383	**$352,598**
2	4	120	1.475	2.95	2	$2,709	$9,142	$27,765	$55,530	$10,835	$2,418	$90,633	$267,368	$26,737	$26,737	**$320,842**
2	8	120	2	4	2	$2,709	$20,316	$20,993	$41,986	$12,325	$2,072	$89,408	$357,630	$35,763	$35,763	**$429,156**
2	12	120	2.6	5.2	2	$2,709	$32,505	$16,930	$33,860	$14,356	$1,828	$95,258	$495,344	$49,534	$49,534	**$594,413**
3	4	120	1.3	3.9	2	$2,709	$7,449	$31,151	$62,302	$8,803	$1,896	$93,159	$363,321	$36,332	$36,332	**$435,985**
3	8	120	1.65	4.95	2	$2,709	$16,930	$24,379	$48,758	$9,752	$1,625	$89,773	$444,378	$44,438	$44,438	**$533,253**
3	12	120	2.1	6.3	2	$2,709	$29,796	$20,316	$40,632	$11,106	$1,490	$95,733	$603,115	$60,311	$60,311	**$723,738**
4	4	120	1.275	5.1	2	$2,709	$6,772	$31,828	$63,656	$8,126	$1,693	$92,956	$474,076	$47,408	$47,408	**$568,891**
4	8	120	1.575	6.3	2	$2,709	$15,914	$26,410	$52,821	$8,939	$1,490	$91,873	$578,797	$57,880	$57,880	**$694,556**

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
4	12	120	1.925	7.7	2	$2,709	$27,088	$21,670	$43,340	$9,955	$1,354	$94,446	$727,233	$72,723	$72,723	**$872,680**
5	4	120	1.25	6.25	2	$2,709	$6,095	$32,505	$65,010	$7,449	$1,490	$92,753	$579,706	$57,971	$57,971	**$695,647**
5	8	120	1.5	7.5	2	$2,709	$14,898	$28,442	$56,884	$8,126	$1,354	$93,972	$704,789	$70,479	$70,479	**$845,746**
5	12	120	1.75	8.75	2	$2,709	$24,379	$23,025	$46,049	$8,803	$1,219	$93,159	$815,143	$81,514	$81,514	**$978,172**
6	4	120	1.24	7.44	2	$2,709	$5,688	$33,047	$66,094	$7,097	$1,409	$92,997	$691,895	$69,190	$69,190	**$830,274**
6	8	120	1.47	8.82	2	$2,709	$14,356	$28,984	$57,968	$7,747	$1,287	$94,067	$829,668	$82,967	$82,967	**$995,601**
6	12	120	1.71	10.26	2	$2,709	$23,702	$23,837	$47,674	$8,343	$1,165	$93,593	$960,260	$96,026	$96,026	**$1,152,312**
7	4	120	1.23	8.61	2	$2,709	$5,282	$33,589	$67,177	$6,745	$1,327	$93,240	$802,800	$80,280	$80,280	**$963,360**
7	8	120	1.44	10.08	2	$2,709	$13,815	$29,526	$59,051	$7,368	$1,219	$94,161	$949,147	$94,915	$94,915	**$1,138,977**
7	12	120	1.67	11.69	2	$2,709	$23,025	$24,650	$49,300	$7,883	$1,111	$94,026	$1,099,164	$109,916	$109,916	**$1,318,997**
8	4	120	1.22	9.76	2	$2,709	$4,876	$34,130	$68,261	$6,393	$1,246	$93,484	$912,406	$91,241	$91,241	**$1,094,888**
8	8	120	1.41	11.28	2	$2,709	$13,273	$30,067	$60,135	$6,989	$1,151	$94,256	$1,063,210	$106,321	$106,321	**$1,275,853**
8	12	120	1.63	13.04	2	$2,709	$22,347	$25,462	$50,925	$7,422	$1,056	$94,459	$1,231,751	$123,175	$123,175	**$1,478,101**
9	4	120	1.21	10.89	2	$2,709	$4,469	$34,672	$69,344	$6,041	$1,165	$93,728	$1,020,698	$102,070	$102,070	**$1,224,838**
9	8	120	1.38	12.42	2	$2,709	$12,731	$30,609	$61,218	$6,609	$1,084	$94,351	$1,171,840	$117,184	$117,184	**$1,406,208**
9	12	120	1.59	14.31	2	$2,709	$21,670	$26,275	$52,550	$6,962	$1,002	$94,893	$1,357,916	$135,792	$135,792	**$1,629,499**
10	4	120	1.2	12	2	$2,709	$4,063	$35,214	$70,428	$5,688	$1,084	$93,972	$1,127,662	$112,766	$112,766	**$1,353,194**
10	8	120	1.35	13.5	2	$2,709	$12,189	$31,151	$62,302	$6,230	$1,016	$94,446	$1,275,019	$127,502	$127,502	**$1,530,023**
10	12	120	1.55	15.5	2	$2,709	$20,993	$27,088	$54,175	$6,501	$948	$95,326	$1,477,556	$147,756	$147,756	**$1,773,068**
20	4	120	1.16	23.2	2	$2,709	$3,386	$36,568	$73,137	$4,639	$867	$94,737	$2,197,900	$219,790	$219,790	**$2,637,480**
20	8	120	1.275	25.5	2	$2,709	$9,819	$32,844	$65,688	$4,977	$819	$94,012	$2,397,318	$239,732	$239,732	**$2,876,781**
20	12	120	1.42	28.4	2	$2,709	$17,607	$29,796	$59,593	$5,181	$772	$95,861	$2,722,458	$272,246	$272,246	**$3,266,949**
30	4	120	1.12	33.6	2	$2,709	$2,709	$37,923	$75,846	$3,589	$650	$95,502	$3,208,877	$320,888	$320,888	**$3,850,652**
30	8	120	1.2	36	2	$2,709	$7,449	$34,537	$69,074	$3,725	$623	$93,579	$3,368,846	$336,885	$336,885	**$4,042,615**
30	12	120	1.29	38.7	2	$2,709	$14,221	$32,505	$65,010	$3,860	$596	$96,396	$3,730,532	$373,053	$373,053	**$4,476,638**
40	4	120	1.105	44.2	2	$2,709	$2,438	$38,261	$76,523	$3,284	$582	$95,536	$4,222,697	$422,270	$422,270	**$5,067,237**
40	8	120	1.175	47	2	$2,709	$6,772	$35,553	$71,105	$3,386	$562	$94,534	$4,443,093	$444,309	$444,309	**$5,331,712**
40	12	120	1.26	50.4	2	$2,709	$12,867	$33,521	$67,042	$3,488	$542	$96,647	$4,870,995	$487,100	$487,100	**$5,845,195**
50	4	120	1.09	54.5	2	$2,709	$2,167	$38,600	$77,200	$2,980	$515	$95,570	$5,208,565	$520,857	$520,857	**$6,250,278**
50	8	120	1.15	57.5	2	$2,709	$6,095	$36,568	$73,137	$3,047	$501	$95,489	$5,490,602	$549,060	$549,060	**$6,588,723**
50	12	120	1.23	61.5	2	$2,709	$11,512	$34,537	$69,074	$3,115	$488	$96,897	$5,959,184	$595,918	$595,918	**$7,151,020**
60	4	120	1.084	65.04	2	$2,709	$2,004	$38,735	$77,471	$2,817	$485	$95,486	$6,210,411	$621,041	$621,041	**$7,452,494**
60	8	120	1.144	68.64	2	$2,709	$5,824	$36,839	$73,679	$2,877	$473	$95,561	$6,559,274	$655,927	$655,927	**$7,871,129**
60	12	120	1.216	72.96	2	$2,709	$10,889	$34,808	$69,615	$2,936	$460	$96,610	$7,048,678	$704,868	$704,868	**$8,458,413**
70	4	120	1.078	75.46	2	$2,709	$1,842	$38,871	$77,742	$2,655	$455	$95,402	$7,199,039	$719,904	$719,904	**$8,638,847**
70	8	120	1.138	79.66	2	$2,709	$5,553	$37,110	$74,220	$2,706	$444	$95,632	$7,618,069	$761,807	$761,807	**$9,141,683**
70	12	120	1.202	84.14	2	$2,709	$10,266	$35,079	$70,157	$2,758	$433	$96,323	$8,104,620	$810,462	$810,462	**$9,725,544**
80	4	120	1.072	85.76	2	$2,709	$1,679	$39,006	$78,013	$2,492	$425	$95,318	$8,174,479	$817,448	$817,448	**$9,809,375**
80	8	120	1.132	90.56	2	$2,709	$5,282	$37,381	$74,762	$2,535	$416	$95,704	$8,666,962	$866,696	$866,696	**$10,400,354**
80	12	120	1.188	95.04	2	$2,709	$9,643	$35,349	$70,699	$2,579	$406	$96,036	$9,127,253	$912,725	$912,725	**$10,952,703**
90	4	120	1.066	95.94	2	$2,709	$1,517	$39,142	$78,283	$2,330	$395	$95,234	$9,136,761	$913,676	$913,676	**$10,964,113**
90	8	120	1.126	101.34	2	$2,709	$5,011	$37,652	$75,304	$2,365	$387	$95,776	$9,705,926	$970,593	$970,593	**$11,647,112**
90	12	120	1.174	105.66	2	$2,709	$9,020	$35,620	$71,241	$2,400	$379	$95,749	$10,116,816	$1,011,682	$1,011,682	**$12,140,179**
100	4	120	1.06	106	2	$2,709	$1,354	$39,277	$78,554	$2,167	$366	$95,150	$10,085,915	$1,008,591	$1,008,591	**$12,103,098**
100	8	120	1.12	112	2	$2,709	$4,740	$37,923	$75,846	$2,194	$359	$95,848	$10,734,937	$1,073,494	$1,073,494	**$12,881,924**
100	12	120	1.16	116	2	$2,709	$8,397	$35,891	$71,782	$2,221	$352	$95,462	$11,073,551	$1,107,355	$1,107,355	**$13,288,262**
1	4	120	1.65	1.65	2	$2,709	$10,835	$24,379	$48,758	$12,867	$2,939	$98,107	$161,877	$16,188	$16,188	**$194,253**
1	8	120	2.35	2.35	2	$2,709	$23,702	$17,607	$35,214	$14,898	$2,519	$99,042	$232,748	$23,275	$23,275	**$279,298**
1	12	120	3.1	3.1	2	$2,709	$35,214	$13,544	$27,088	$17,607	$2,167	$104,784	$324,832	$32,483	$32,483	**$389,798**
2	4	120	1.475	2.95	2	$2,709	$9,142	$27,765	$55,530	$10,835	$2,418	$100,633	$296,868	$29,687	$29,687	**$356,242**
2	8	120	2	4	2	$2,709	$20,316	$20,993	$41,986	$12,325	$2,072	$99,408	$397,630	$39,763	$39,763	**$477,156**
2	12	120	2.6	5.2	2	$2,709	$32,505	$16,930	$33,860	$14,356	$1,828	$105,258	$547,344	$54,734	$54,734	**$656,813**

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
3	4	120	1.3	3.9	2	$2,709	$7,449	$31,151	$62,302	$8,803	$1,896	$103,159	$402,321	$40,232	$40,232	**$482,785**
3	8	120	1.65	4.95	2	$2,709	$16,930	$24,379	$48,758	$9,752	$1,625	$99,773	$493,878	$49,388	$49,388	**$592,653**
3	12	120	2.1	6.3	2	$2,709	$29,796	$20,316	$40,632	$11,106	$1,490	$105,733	$666,115	$66,611	$66,611	**$799,338**
4	4	120	1.275	5.1	2	$2,709	$6,772	$31,828	$63,656	$8,126	$1,693	$102,956	$525,076	$52,508	$52,508	**$630,091**
4	8	120	1.575	6.3	2	$2,709	$15,914	$26,410	$52,821	$8,939	$1,490	$101,873	$641,797	$64,180	$64,180	**$770,156**
4	12	120	1.925	7.7	2	$2,709	$27,088	$21,670	$43,340	$9,955	$1,354	$104,446	$804,233	$80,423	$80,423	**$965,080**
5	4	120	1.25	6.25	2	$2,709	$6,095	$32,505	$65,010	$7,449	$1,490	$102,753	$642,206	$64,221	$64,221	**$770,647**
5	8	120	1.5	7.5	2	$2,709	$14,898	$28,442	$56,884	$8,126	$1,354	$103,972	$779,789	$77,979	$77,979	**$935,746**
5	12	120	1.75	8.75	2	$2,709	$24,379	$23,025	$46,049	$8,803	$1,219	$103,159	$902,643	$90,264	$90,264	**$1,083,172**
6	4	120	1.24	7.44	2	$2,709	$5,688	$33,047	$66,094	$7,097	$1,409	$102,997	$766,295	$76,630	$76,630	**$919,554**
6	8	120	1.47	8.82	2	$2,709	$14,356	$28,984	$57,968	$7,747	$1,287	$104,067	$917,868	$91,787	$91,787	**$1,101,441**
6	12	120	1.71	10.26	2	$2,709	$23,702	$23,837	$47,674	$8,343	$1,165	$103,593	$1,062,860	$106,286	$106,286	**$1,275,432**
7	4	120	1.23	8.61	2	$2,709	$5,282	$33,589	$67,177	$6,745	$1,327	$103,240	$888,900	$88,890	$88,890	**$1,066,680**
7	8	120	1.44	10.08	2	$2,709	$13,815	$29,526	$59,051	$7,368	$1,219	$104,161	$1,049,947	$104,995	$104,995	**$1,259,937**
7	12	120	1.67	11.69	2	$2,709	$23,025	$24,650	$49,300	$7,883	$1,111	$104,026	$1,216,064	$121,606	$121,606	**$1,459,277**
8	4	120	1.22	9.76	2	$2,709	$4,876	$34,130	$68,261	$6,393	$1,246	$103,484	$1,010,006	$101,001	$101,001	**$1,212,008**
8	8	120	1.41	11.28	2	$2,709	$13,273	$30,067	$60,135	$6,989	$1,151	$104,256	$1,176,010	$117,601	$117,601	**$1,411,213**
8	12	120	1.63	13.04	2	$2,709	$22,347	$25,462	$50,925	$7,422	$1,056	$104,459	$1,362,151	$136,215	$136,215	**$1,634,581**
9	4	120	1.21	10.89	2	$2,709	$4,469	$34,672	$69,344	$6,041	$1,165	$103,728	$1,129,598	$112,960	$112,960	**$1,355,518**
9	8	120	1.38	12.42	2	$2,709	$12,731	$30,609	$61,218	$6,609	$1,084	$104,351	$1,296,040	$129,604	$129,604	**$1,555,248**
9	12	120	1.59	14.31	2	$2,709	$21,670	$26,275	$52,550	$6,962	$1,002	$104,893	$1,501,016	$150,102	$150,102	**$1,801,219**
10	4	120	1.2	12	2	$2,709	$4,063	$35,214	$70,428	$5,688	$1,084	$103,972	$1,247,662	$124,766	$124,766	**$1,497,194**
10	8	120	1.35	13.5	2	$2,709	$12,189	$31,151	$62,302	$6,230	$1,016	$104,446	$1,410,019	$141,002	$141,002	**$1,692,023**
10	12	120	1.55	15.5	2	$2,709	$20,993	$27,088	$54,175	$6,501	$948	$105,326	$1,632,556	$163,256	$163,256	**$1,959,068**
20	4	120	1.16	23.2	2	$2,709	$3,386	$36,568	$73,137	$4,639	$867	$104,737	$2,429,900	$242,990	$242,990	**$2,915,880**
20	8	120	1.275	25.5	2	$2,709	$9,819	$32,844	$65,688	$4,977	$819	$104,012	$2,652,318	$265,232	$265,232	**$3,182,781**
20	12	120	1.42	28.4	2	$2,709	$17,607	$29,796	$59,593	$5,181	$772	$105,861	$3,006,458	$300,646	$300,646	**$3,607,749**
30	4	120	1.12	33.6	2	$2,709	$2,709	$37,923	$75,846	$3,589	$650	$105,502	$3,544,877	$354,488	$354,488	**$4,253,852**
30	8	120	1.2	36	2	$2,709	$7,449	$34,537	$69,074	$3,725	$623	$103,579	$3,728,846	$372,885	$372,885	**$4,474,615**
30	12	120	1.29	38.7	2	$2,709	$14,221	$32,505	$65,010	$3,860	$596	$106,396	$4,117,532	$411,753	$411,753	**$4,941,038**
40	4	120	1.105	44.2	2	$2,709	$2,438	$38,261	$76,523	$3,284	$582	$105,536	$4,664,697	$466,470	$466,470	**$5,597,637**
40	8	120	1.175	47	2	$2,709	$6,772	$35,553	$71,105	$3,386	$562	$104,534	$4,913,093	$491,309	$491,309	**$5,895,712**
40	12	120	1.26	50.4	2	$2,709	$12,867	$33,521	$67,042	$3,488	$542	$106,647	$5,374,995	$537,500	$537,500	**$6,449,995**
50	4	120	1.09	54.5	2	$2,709	$2,167	$38,600	$77,200	$2,980	$515	$105,570	$5,753,565	$575,357	$575,357	**$6,904,278**
50	8	120	1.15	57.5	2	$2,709	$6,095	$36,568	$73,137	$3,047	$501	$105,489	$6,065,602	$606,560	$606,560	**$7,278,723**
50	12	120	1.23	61.5	2	$2,709	$11,512	$34,537	$69,074	$3,115	$488	$106,897	$6,574,184	$657,418	$657,418	**$7,889,020**
60	4	120	1.084	65.04	2	$2,709	$2,004	$38,735	$77,471	$2,817	$485	$105,486	$6,860,811	$686,081	$686,081	**$8,232,974**
60	8	120	1.144	68.64	2	$2,709	$5,824	$36,839	$73,679	$2,877	$473	$105,561	$7,245,674	$724,567	$724,567	**$8,694,809**
60	12	120	1.216	72.96	2	$2,709	$10,889	$34,808	$69,615	$2,936	$460	$106,610	$7,778,278	$777,828	$777,828	**$9,333,933**
70	4	120	1.078	75.46	2	$2,709	$1,842	$38,871	$77,742	$2,655	$455	$105,402	$7,953,639	$795,364	$795,364	**$9,544,367**
70	8	120	1.138	79.66	2	$2,709	$5,553	$37,110	$74,220	$2,706	$444	$105,632	$8,414,669	$841,467	$841,467	**$10,097,603**
70	12	120	1.202	84.14	2	$2,709	$10,266	$35,079	$70,157	$2,758	$433	$106,323	$8,946,020	$894,602	$894,602	**$10,735,224**
80	4	120	1.072	85.76	2	$2,709	$1,679	$39,006	$78,013	$2,492	$425	$105,318	$9,032,079	$903,208	$903,208	**$10,838,495**
80	8	120	1.132	90.56	2	$2,709	$5,282	$37,381	$74,762	$2,535	$416	$105,704	$9,572,562	$957,256	$957,256	**$11,487,074**
80	12	120	1.188	95.04	2	$2,709	$9,643	$35,349	$70,699	$2,579	$406	$106,036	$10,077,653	$1,007,765	$1,007,765	**$12,093,183**
90	4	120	1.066	95.94	2	$2,709	$1,517	$39,142	$78,283	$2,330	$395	$105,234	$10,096,161	$1,009,616	$1,009,616	**$12,115,393**
90	8	120	1.126	101.34	2	$2,709	$5,011	$37,652	$75,304	$2,365	$387	$105,776	$10,719,326	$1,071,933	$1,071,933	**$12,863,192**
90	12	120	1.174	105.66	2	$2,709	$9,020	$35,620	$71,241	$2,400	$379	$105,749	$11,173,416	$1,117,342	$1,117,342	**$13,408,099**
100	4	120	1.06	106	2	$2,709	$1,354	$39,277	$78,554	$2,167	$366	$105,150	$11,145,915	$1,114,591	$1,114,591	**$13,375,098**
100	8	120	1.12	112	2	$2,709	$4,740	$37,923	$75,846	$2,194	$359	$105,848	$11,854,937	$1,185,494	$1,185,494	**$14,225,924**
100	12	120	1.16	116	2	$2,709	$8,397	$35,891	$71,782	$2,221	$352	$105,462	$12,233,551	$1,223,355	$1,223,355	**$14,680,262**
1	4	120	1.65	1.65	3	$5,418	$10,835	$24,379	$48,758	$12,867	$2,939	$90,816	$149,847	$14,985	$14,985	**$179,816**

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
1	8	120	2.35	2.35	3	$5,418	$23,702	$17,607	$35,214	$14,898	$2,519	$91,751	$215,614	$21,561	$21,561	**$258,737**
1	12	120	3.1	3.1	3	$5,418	$35,214	$13,544	$27,088	$17,607	$2,167	$97,493	$302,229	$30,223	$30,223	**$362,675**
2	4	120	1.475	2.95	3	$5,418	$9,142	$27,765	$55,530	$10,835	$2,418	$93,342	$275,359	$27,536	$27,536	**$330,431**
2	8	120	2	4	3	$5,418	$20,316	$20,993	$41,986	$12,325	$2,072	$92,116	$368,465	$36,847	$36,847	**$442,158**
2	12	120	2.6	5.2	3	$5,418	$32,505	$16,930	$33,860	$14,356	$1,828	$97,967	$509,430	$50,943	$50,943	**$611,316**
3	4	120	1.3	3.9	3	$5,418	$7,449	$31,151	$62,302	$8,803	$1,896	$95,868	$373,885	$37,389	$37,389	**$448,662**
3	8	120	1.65	4.95	3	$5,418	$16,930	$24,379	$48,758	$9,752	$1,625	$92,482	$457,786	$45,779	$45,779	**$549,343**
3	12	120	2.1	6.3	3	$5,418	$29,796	$20,316	$40,632	$11,106	$1,490	$98,441	$620,180	$62,018	$62,018	**$744,216**
4	4	120	1.275	5.1	3	$5,418	$6,772	$31,828	$63,656	$8,126	$1,693	$95,665	$487,891	$48,789	$48,789	**$585,469**
4	8	120	1.575	6.3	3	$5,418	$15,914	$26,410	$52,821	$8,939	$1,490	$94,581	$595,862	$59,586	$59,586	**$715,035**
4	12	120	1.925	7.7	3	$5,418	$27,088	$21,670	$43,340	$9,955	$1,354	$97,155	$748,091	$74,809	$74,809	**$897,709**
5	4	120	1.25	6.25	3	$5,418	$6,095	$32,505	$65,010	$7,449	$1,490	$95,462	$596,635	$59,664	$59,664	**$715,962**
5	8	120	1.5	7.5	3	$5,418	$14,898	$28,442	$56,884	$8,126	$1,354	$96,681	$725,104	$72,510	$72,510	**$870,125**
5	12	120	1.75	8.75	3	$5,418	$24,379	$23,025	$46,049	$8,803	$1,219	$95,868	$838,845	$83,884	$83,884	**$1,006,614**
6	4	120	1.24	7.44	3	$5,418	$5,688	$33,047	$66,094	$7,097	$1,409	$95,705	$712,048	$71,205	$71,205	**$854,458**
6	8	120	1.47	8.82	3	$5,418	$14,356	$28,984	$57,968	$7,747	$1,287	$96,775	$853,559	$85,356	$85,356	**$1,024,271**
6	12	120	1.71	10.26	3	$5,418	$23,702	$23,837	$47,674	$8,343	$1,165	$96,301	$988,052	$98,805	$98,805	**$1,185,662**
7	4	120	1.23	8.61	3	$5,418	$5,282	$33,589	$67,177	$6,745	$1,327	$95,949	$826,123	$82,612	$82,612	**$991,347**
7	8	120	1.44	10.08	3	$5,418	$13,815	$29,526	$59,051	$7,368	$1,219	$96,870	$976,452	$97,645	$97,645	**$1,171,742**
7	12	120	1.67	11.69	3	$5,418	$23,025	$24,650	$49,300	$7,883	$1,111	$96,735	$1,130,829	$113,083	$113,083	**$1,356,995**
8	4	120	1.22	9.76	3	$5,418	$4,876	$34,130	$68,261	$6,393	$1,246	$96,193	$938,844	$93,884	$93,884	**$1,126,613**
8	8	120	1.41	11.28	3	$5,418	$13,273	$30,067	$60,135	$6,989	$1,151	$96,965	$1,093,765	$109,377	$109,377	**$1,312,518**
8	12	120	1.63	13.04	3	$5,418	$22,347	$25,462	$50,925	$7,422	$1,056	$97,168	$1,267,073	$126,707	$126,707	**$1,520,488**
9	4	120	1.21	10.89	3	$5,418	$4,469	$34,672	$69,344	$6,041	$1,165	$96,437	$1,050,197	$105,020	$105,020	**$1,260,236**
9	8	120	1.38	12.42	3	$5,418	$12,731	$30,609	$61,218	$6,609	$1,084	$97,060	$1,205,483	$120,548	$120,548	**$1,446,580**
9	12	120	1.59	14.31	3	$5,418	$21,670	$26,275	$52,550	$6,962	$1,002	$97,602	$1,396,679	$139,668	$139,668	**$1,676,014**
10	4	120	1.2	12	3	$5,418	$4,063	$35,214	$70,428	$5,688	$1,084	$96,681	$1,160,167	$116,017	$116,017	**$1,392,201**
10	8	120	1.35	13.5	3	$5,418	$12,189	$31,151	$62,302	$6,230	$1,016	$97,155	$1,311,588	$131,159	$131,159	**$1,573,905**
10	12	120	1.55	15.5	3	$5,418	$20,993	$27,088	$54,175	$6,501	$948	$98,035	$1,519,542	$151,954	$151,954	**$1,823,451**
20	4	120	1.16	23.2	3	$5,418	$3,386	$36,568	$73,137	$4,639	$867	$97,446	$2,260,743	$226,074	$226,074	**$2,712,892**
20	8	120	1.275	25.5	3	$5,418	$9,819	$32,844	$65,688	$4,977	$819	$96,721	$2,466,391	$246,639	$246,639	**$2,959,670**
20	12	120	1.42	28.4	3	$5,418	$17,607	$29,796	$59,593	$5,181	$772	$98,570	$2,799,387	$279,939	$279,939	**$3,359,264**
30	4	120	1.12	33.6	3	$5,418	$2,709	$37,923	$75,846	$3,589	$650	$98,211	$3,299,891	$329,989	$329,989	**$3,959,870**
30	8	120	1.2	36	3	$5,418	$7,449	$34,537	$69,074	$3,725	$623	$96,288	$3,466,362	$346,636	$346,636	**$4,159,634**
30	12	120	1.29	38.7	3	$5,418	$14,221	$32,505	$65,010	$3,860	$596	$99,105	$3,835,361	$383,536	$383,536	**$4,602,434**
40	4	120	1.105	44.2	3	$5,418	$2,438	$38,261	$76,523	$3,284	$582	$98,245	$4,342,425	$434,242	$434,242	**$5,210,910**
40	8	120	1.175	47	3	$5,418	$6,772	$35,553	$71,105	$3,386	$562	$97,243	$4,570,405	$457,041	$457,041	**$5,484,486**
40	12	120	1.26	50.4	3	$5,418	$12,867	$33,521	$67,042	$3,488	$542	$99,356	$5,007,517	$500,752	$500,752	**$6,009,021**
50	4	120	1.09	54.5	3	$5,418	$2,167	$38,600	$77,200	$2,980	$515	$98,279	$5,356,193	$535,619	$535,619	**$6,427,431**
50	8	120	1.15	57.5	3	$5,418	$6,095	$36,568	$73,137	$3,047	$501	$98,198	$5,646,357	$564,636	$564,636	**$6,775,628**
50	12	120	1.23	61.5	3	$5,418	$11,512	$34,537	$69,074	$3,115	$488	$99,606	$6,125,773	$612,577	$612,577	**$7,350,928**
60	4	120	1.084	65.04	3	$5,418	$2,004	$38,735	$77,471	$2,817	$485	$98,195	$6,386,590	$638,659	$638,659	**$7,663,907**
60	8	120	1.144	68.64	3	$5,418	$5,824	$36,839	$73,679	$2,877	$473	$98,269	$6,745,204	$674,520	$674,520	**$8,094,245**
60	12	120	1.216	72.96	3	$5,418	$10,889	$34,808	$69,615	$2,936	$460	$99,319	$7,246,310	$724,631	$724,631	**$8,695,571**
70	4	120	1.078	75.46	3	$5,418	$1,842	$38,871	$77,742	$2,655	$455	$98,111	$7,403,443	$740,344	$740,344	**$8,884,131**
70	8	120	1.138	79.66	3	$5,418	$5,553	$37,110	$74,220	$2,706	$444	$98,341	$7,833,850	$783,385	$783,385	**$9,400,620**
70	12	120	1.202	84.14	3	$5,418	$10,266	$35,079	$70,157	$2,758	$433	$99,032	$8,332,536	$833,254	$833,254	**$9,999,043**
80	4	120	1.072	85.76	3	$5,418	$1,679	$39,006	$78,013	$2,492	$425	$98,027	$8,406,783	$840,678	$840,678	**$10,088,140**
80	8	120	1.132	90.56	3	$5,418	$5,282	$37,381	$74,762	$2,535	$416	$98,413	$8,912,268	$891,227	$891,227	**$10,694,722**
80	12	120	1.188	95.04	3	$5,418	$9,643	$35,349	$70,699	$2,579	$406	$98,745	$9,384,694	$938,469	$938,469	**$11,261,633**
90	4	120	1.066	95.94	3	$5,418	$1,517	$39,142	$78,283	$2,330	$395	$97,943	$9,396,640	$939,664	$939,664	**$11,275,968**
90	8	120	1.126	101.34	3	$5,418	$5,011	$37,652	$75,304	$2,365	$387	$98,485	$9,980,433	$998,043	$998,043	**$11,976,519**

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
90	12	120	1.174	105.66	3	$5,418	$9,020	$35,620	$71,241	$2,400	$379	$98,458	$10,403,024	$1,040,302	$1,040,302	**$12,483,629**
100	4	120	1.06	106	3	$5,418	$1,354	$39,277	$78,554	$2,167	$366	$97,859	$10,373,044	$1,037,304	$1,037,304	**$12,447,653**
100	8	120	1.12	112	3	$5,418	$4,740	$37,923	$75,846	$2,194	$359	$98,556	$11,038,319	$1,103,832	$1,103,832	**$13,245,982**
100	12	120	1.16	116	3	$5,418	$8,397	$35,891	$71,782	$2,221	$352	$98,170	$11,387,768	$1,138,777	$1,138,777	**$13,665,322**
1	4	120	1.65	1.65	3	$5,418	$10,835	$24,379	$48,758	$12,867	$2,939	$100,816	$166,347	$16,635	$16,635	**$199,616**
1	8	120	2.35	2.35	3	$5,418	$23,702	$17,607	$35,214	$14,898	$2,519	$101,751	$239,114	$23,911	$23,911	**$286,937**
1	12	120	3.1	3.1	3	$5,418	$35,214	$13,544	$27,088	$17,607	$2,167	$107,493	$333,229	$33,323	$33,323	**$399,875**
2	4	120	1.475	2.95	3	$5,418	$9,142	$27,765	$55,530	$10,835	$2,418	$103,342	$304,859	$30,486	$30,486	**$365,831**
2	8	120	2	4	3	$5,418	$20,316	$20,993	$41,986	$12,325	$2,072	$102,116	$408,465	$40,847	$40,847	**$490,158**
2	12	120	2.6	5.2	3	$5,418	$32,505	$16,930	$33,860	$14,356	$1,828	$107,967	$561,430	$56,143	$56,143	**$673,716**
3	4	120	1.3	3.9	3	$5,418	$7,449	$31,151	$62,302	$8,803	$1,896	$105,868	$412,885	$41,289	$41,289	**$495,462**
3	8	120	1.65	4.95	3	$5,418	$16,930	$24,379	$48,758	$9,752	$1,625	$102,482	$507,286	$50,729	$50,729	**$608,743**
3	12	120	2.1	6.3	3	$5,418	$29,796	$20,316	$40,632	$11,106	$1,490	$108,441	$683,180	$68,318	$68,318	**$819,816**
4	4	120	1.275	5.1	3	$5,418	$6,772	$31,828	$63,656	$8,126	$1,693	$105,665	$538,891	$53,889	$53,889	**$646,669**
4	8	120	1.575	6.3	3	$5,418	$15,914	$26,410	$52,821	$8,939	$1,490	$104,581	$658,862	$65,886	$65,886	**$790,635**
4	12	120	1.925	7.7	3	$5,418	$27,088	$21,670	$43,340	$9,955	$1,354	$107,155	$825,091	$82,509	$82,509	**$990,109**
5	4	120	1.25	6.25	3	$5,418	$6,095	$32,505	$65,010	$7,449	$1,490	$105,462	$659,135	$65,914	$65,914	**$790,962**
5	8	120	1.5	7.5	3	$5,418	$14,898	$28,442	$56,884	$8,126	$1,354	$106,681	$800,104	$80,010	$80,010	**$960,125**
5	12	120	1.75	8.75	3	$5,418	$24,379	$23,025	$46,049	$8,803	$1,219	$105,868	$926,345	$92,634	$92,634	**$1,111,614**
6	4	120	1.24	7.44	3	$5,418	$5,688	$33,047	$66,094	$7,097	$1,409	$105,705	$786,448	$78,645	$78,645	**$943,738**
6	8	120	1.47	8.82	3	$5,418	$14,356	$28,984	$57,968	$7,747	$1,287	$106,775	$941,759	$94,176	$94,176	**$1,130,111**
6	12	120	1.71	10.26	3	$5,418	$23,702	$23,837	$47,674	$8,343	$1,165	$106,301	$1,090,652	$109,065	$109,065	**$1,308,782**
7	4	120	1.23	8.61	3	$5,418	$5,282	$33,589	$67,177	$6,745	$1,327	$105,949	$912,223	$91,222	$91,222	**$1,094,667**
7	8	120	1.44	10.08	3	$5,418	$13,815	$29,526	$59,051	$7,368	$1,219	$106,870	$1,077,252	$107,725	$107,725	**$1,292,702**
7	12	120	1.67	11.69	3	$5,418	$23,025	$24,650	$49,300	$7,883	$1,111	$106,735	$1,247,729	$124,773	$124,773	**$1,497,275**
8	4	120	1.22	9.76	3	$5,418	$4,876	$34,130	$68,261	$6,393	$1,246	$106,193	$1,036,444	$103,644	$103,644	**$1,243,733**
8	8	120	1.41	11.28	3	$5,418	$13,273	$30,067	$60,135	$6,989	$1,151	$106,965	$1,206,565	$120,657	$120,657	**$1,447,878**
8	12	120	1.63	13.04	3	$5,418	$22,347	$25,462	$50,925	$7,422	$1,056	$107,168	$1,397,473	$139,747	$139,747	**$1,676,968**
9	4	120	1.21	10.89	3	$5,418	$4,469	$34,672	$69,344	$6,041	$1,165	$106,437	$1,159,097	$115,910	$115,910	**$1,390,916**
9	8	120	1.38	12.42	3	$5,418	$12,731	$30,609	$61,218	$6,609	$1,084	$107,060	$1,329,683	$132,968	$132,968	**$1,595,620**
9	12	120	1.59	14.31	3	$5,418	$21,670	$26,275	$52,550	$6,962	$1,002	$107,602	$1,539,779	$153,978	$153,978	**$1,847,734**
10	4	120	1.2	12	3	$5,418	$4,063	$35,214	$70,428	$5,688	$1,084	$106,681	$1,280,167	$128,017	$128,017	**$1,536,201**
10	8	120	1.35	13.5	3	$5,418	$12,189	$31,151	$62,302	$6,230	$1,016	$107,155	$1,446,588	$144,659	$144,659	**$1,735,905**
10	12	120	1.55	15.5	3	$5,418	$20,993	$27,088	$54,175	$6,501	$948	$108,035	$1,674,542	$167,454	$167,454	**$2,009,451**
20	4	120	1.16	23.2	3	$5,418	$3,386	$36,568	$73,137	$4,639	$867	$107,446	$2,492,743	$249,274	$249,274	**$2,991,292**
20	8	120	1.275	25.5	3	$5,418	$9,819	$32,844	$65,688	$4,977	$819	$106,721	$2,721,391	$272,139	$272,139	**$3,265,670**
20	12	120	1.42	28.4	3	$5,418	$17,607	$29,796	$59,593	$5,181	$772	$108,570	$3,083,387	$308,339	$308,339	**$3,700,064**
30	4	120	1.12	33.6	3	$5,418	$2,709	$37,923	$75,846	$3,589	$650	$108,211	$3,635,891	$363,589	$363,589	**$4,363,070**
30	8	120	1.2	36	3	$5,418	$7,449	$34,537	$69,074	$3,725	$623	$106,288	$3,826,362	$382,636	$382,636	**$4,591,634**
30	12	120	1.29	38.7	3	$5,418	$14,221	$32,505	$65,010	$3,860	$596	$109,105	$4,222,361	$422,236	$422,236	**$5,066,834**
40	4	120	1.105	44.2	3	$5,418	$2,438	$38,261	$76,523	$3,284	$582	$108,245	$4,784,425	$478,442	$478,442	**$5,741,310**
40	8	120	1.175	47	3	$5,418	$6,772	$35,553	$71,105	$3,386	$562	$107,243	$5,040,405	$504,041	$504,041	**$6,048,486**
40	12	120	1.26	50.4	3	$5,418	$12,867	$33,521	$67,042	$3,488	$542	$109,356	$5,511,517	$551,152	$551,152	**$6,613,821**
50	4	120	1.09	54.5	3	$5,418	$2,167	$38,600	$77,200	$2,980	$515	$108,279	$5,901,193	$590,119	$590,119	**$7,081,431**
50	8	120	1.15	57.5	3	$5,418	$6,095	$36,568	$73,137	$3,047	$501	$108,198	$6,221,357	$622,136	$622,136	**$7,465,628**
50	12	120	1.23	61.5	3	$5,418	$11,512	$34,537	$69,074	$3,115	$488	$109,606	$6,740,773	$674,077	$674,077	**$8,088,928**
60	4	120	1.084	65.04	3	$5,418	$2,004	$38,735	$77,471	$2,817	$485	$108,195	$7,036,990	$703,699	$703,699	**$8,444,387**
60	8	120	1.144	68.64	3	$5,418	$5,824	$36,839	$73,679	$2,877	$473	$108,269	$7,431,604	$743,160	$743,160	**$8,917,925**
60	12	120	1.216	72.96	3	$5,418	$10,889	$34,808	$69,615	$2,936	$460	$109,319	$7,975,910	$797,591	$797,591	**$9,571,091**
70	4	120	1.078	75.46	3	$5,418	$1,842	$38,871	$77,742	$2,655	$455	$108,111	$8,158,043	$815,804	$815,804	**$9,789,651**
70	8	120	1.138	79.66	3	$5,418	$5,553	$37,110	$74,220	$2,706	$444	$108,341	$8,630,450	$863,045	$863,045	**$10,356,540**
70	12	120	1.202	84.14	3	$5,418	$10,266	$35,079	$70,157	$2,758	$433	$109,032	$9,173,936	$917,394	$917,394	**$11,008,723**

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
80	4	120	1.072	85.76	3	$5,418	$1,679	$39,006	$78,013	$2,492	$425	$108,027	$9,264,383	$926,438	$926,438	**$11,117,260**
80	8	120	1.132	90.56	3	$5,418	$5,282	$37,381	$74,762	$2,535	$416	$108,413	$9,817,868	$981,787	$981,787	**$11,781,442**
80	12	120	1.188	95.04	3	$5,418	$9,643	$35,349	$70,699	$2,579	$406	$108,745	$10,335,094	$1,033,509	$1,033,509	**$12,402,113**
90	4	120	1.066	95.94	3	$5,418	$1,517	$39,142	$78,283	$2,330	$395	$107,943	$10,356,040	$1,035,604	$1,035,604	**$12,427,248**
90	8	120	1.126	101.34	3	$5,418	$5,011	$37,652	$75,304	$2,365	$387	$108,485	$10,993,833	$1,099,383	$1,099,383	**$13,192,599**
90	12	120	1.174	105.66	3	$5,418	$9,020	$35,620	$71,241	$2,400	$379	$108,458	$11,459,624	$1,145,962	$1,145,962	**$13,751,549**
100	4	120	1.06	106	3	$5,418	$1,354	$39,277	$78,554	$2,167	$366	$107,859	$11,433,044	$1,143,304	$1,143,304	**$13,719,653**
100	8	120	1.12	112	3	$5,418	$4,740	$37,923	$75,846	$2,194	$359	$108,556	$12,158,319	$1,215,832	$1,215,832	**$14,589,982**
100	12	120	1.16	116	3	$5,418	$8,397	$35,891	$71,782	$2,221	$352	$108,170	$12,547,768	$1,254,777	$1,254,777	**$15,057,322**
1	4	120	1.65	1.65	4	$9,481	$10,835	$24,379	$48,758	$12,867	$2,939	$94,879	$156,551	$15,655	$15,655	**$187,861**
1	8	120	2.35	2.35	4	$9,481	$23,702	$17,607	$35,214	$14,898	$2,519	$95,814	$225,162	$22,516	$22,516	**$270,195**
1	12	120	3.1	3.1	4	$9,481	$35,214	$13,544	$27,088	$17,607	$2,167	$101,556	$314,825	$31,482	$31,482	**$377,790**
2	4	120	1.475	2.95	4	$9,481	$9,142	$27,765	$55,530	$10,835	$2,418	$97,405	$287,345	$28,735	$28,735	**$344,814**
2	8	120	2	4	4	$9,481	$20,316	$20,993	$41,986	$12,325	$2,072	$96,179	$384,718	$38,472	$38,472	**$461,661**
2	12	120	2.6	5.2	4	$9,481	$32,505	$16,930	$33,860	$14,356	$1,828	$102,030	$530,558	$53,056	$53,056	**$636,670**
3	4	120	1.3	3.9	4	$9,481	$7,449	$31,151	$62,302	$8,803	$1,896	$99,931	$389,731	$38,973	$38,973	**$467,678**
3	8	120	1.65	4.95	4	$9,481	$16,930	$24,379	$48,758	$9,752	$1,625	$96,545	$477,899	$47,790	$47,790	**$573,478**
3	12	120	2.1	6.3	4	$9,481	$29,796	$20,316	$40,632	$11,106	$1,490	$102,504	$645,778	$64,578	$64,578	**$774,934**
4	4	120	1.275	5.1	4	$9,481	$6,772	$31,828	$63,656	$8,126	$1,693	$99,728	$508,613	$50,861	$50,861	**$610,335**
4	8	120	1.575	6.3	4	$9,481	$15,914	$26,410	$52,821	$8,939	$1,490	$98,644	$621,460	$62,146	$62,146	**$745,752**
4	12	120	1.925	7.7	4	$9,481	$27,088	$21,670	$43,340	$9,955	$1,354	$101,218	$779,377	$77,938	$77,938	**$935,252**
5	4	120	1.25	6.25	4	$9,481	$6,095	$32,505	$65,010	$7,449	$1,490	$99,525	$622,030	$62,203	$62,203	**$746,436**
5	8	120	1.5	7.5	4	$9,481	$14,898	$28,442	$56,884	$8,126	$1,354	$100,744	$755,578	$75,558	$75,558	**$906,694**
5	12	120	1.75	8.75	4	$9,481	$24,379	$23,025	$46,049	$8,803	$1,219	$99,931	$874,397	$87,440	$87,440	**$1,049,277**
6	4	120	1.24	7.44	4	$9,481	$5,688	$33,047	$66,094	$7,097	$1,409	$99,769	$742,278	$74,228	$74,228	**$890,734**
6	8	120	1.47	8.82	4	$9,481	$14,356	$28,984	$57,968	$7,747	$1,287	$100,839	$889,396	$88,940	$88,940	**$1,067,275**
6	12	120	1.71	10.26	4	$9,481	$23,702	$23,837	$47,674	$8,343	$1,165	$100,365	$1,029,740	$102,974	$102,974	**$1,235,688**
7	4	120	1.23	8.61	4	$9,481	$5,282	$33,589	$67,177	$6,745	$1,327	$100,012	$861,107	$86,111	$86,111	**$1,033,328**
7	8	120	1.44	10.08	4	$9,481	$13,815	$29,526	$59,051	$7,368	$1,219	$100,933	$1,017,408	$101,741	$101,741	**$1,220,890**
7	12	120	1.67	11.69	4	$9,481	$23,025	$24,650	$49,300	$7,883	$1,111	$100,798	$1,178,328	$117,833	$117,833	**$1,413,993**
8	4	120	1.22	9.76	4	$9,481	$4,876	$34,130	$68,261	$6,393	$1,246	$100,256	$978,500	$97,850	$97,850	**$1,174,200**
8	8	120	1.41	11.28	4	$9,481	$13,273	$30,067	$60,135	$6,989	$1,151	$101,028	$1,139,598	$113,960	$113,960	**$1,367,517**
8	12	120	1.63	13.04	4	$9,481	$22,347	$25,462	$50,925	$7,422	$1,056	$101,231	$1,320,056	$132,006	$132,006	**$1,584,068**
9	4	120	1.21	10.89	4	$9,481	$4,469	$34,672	$69,344	$6,041	$1,165	$100,500	$1,094,445	$109,444	$109,444	**$1,313,333**
9	8	120	1.38	12.42	4	$9,481	$12,731	$30,609	$61,218	$6,609	$1,084	$101,123	$1,255,947	$125,595	$125,595	**$1,507,137**
9	12	120	1.59	14.31	4	$9,481	$21,670	$26,275	$52,550	$6,962	$1,002	$101,665	$1,454,822	$145,482	$145,482	**$1,745,787**
10	4	120	1.2	12	4	$9,481	$4,063	$35,214	$70,428	$5,688	$1,084	$100,744	$1,208,925	$120,892	$120,892	**$1,450,710**
10	8	120	1.35	13.5	4	$9,481	$12,189	$31,151	$62,302	$6,230	$1,016	$101,218	$1,366,440	$136,644	$136,644	**$1,639,728**
10	12	120	1.55	15.5	4	$9,481	$20,993	$27,088	$54,175	$6,501	$948	$102,098	$1,582,521	$158,252	$158,252	**$1,899,025**
20	4	120	1.16	23.2	4	$9,481	$3,386	$36,568	$73,137	$4,639	$867	$101,509	$2,355,008	$235,501	$235,501	**$2,826,010**
20	8	120	1.275	25.5	4	$9,481	$9,819	$32,844	$65,688	$4,977	$819	$100,784	$2,570,002	$257,000	$257,000	**$3,084,002**
20	12	120	1.42	28.4	4	$9,481	$17,607	$29,796	$59,593	$5,181	$772	$102,633	$2,914,780	$291,478	$291,478	**$3,497,737**
30	4	120	1.12	33.6	4	$9,481	$2,709	$37,923	$75,846	$3,589	$650	$102,274	$3,436,413	$343,641	$343,641	**$4,123,696**
30	8	120	1.2	36	4	$9,481	$7,449	$34,537	$69,074	$3,725	$623	$100,351	$3,612,635	$361,264	$361,264	**$4,335,162**
30	12	120	1.29	38.7	4	$9,481	$14,221	$32,505	$65,010	$3,860	$596	$103,168	$3,992,605	$399,261	$399,261	**$4,791,126**
40	4	120	1.105	44.2	4	$9,481	$2,438	$38,261	$76,523	$3,284	$582	$102,308	$4,522,016	$452,202	$452,202	**$5,426,420**
40	8	120	1.175	47	4	$9,481	$6,772	$35,553	$71,105	$3,386	$562	$101,306	$4,761,373	$476,137	$476,137	**$5,713,648**
40	12	120	1.26	50.4	4	$9,481	$12,867	$33,521	$67,042	$3,488	$542	$103,419	$5,212,300	$521,230	$521,230	**$6,254,760**
50	4	120	1.09	54.5	4	$9,481	$2,167	$38,600	$77,200	$2,980	$515	$102,342	$5,577,635	$557,763	$557,763	**$6,693,162**
50	8	120	1.15	57.5	4	$9,481	$6,095	$36,568	$73,137	$3,047	$501	$102,261	$5,879,988	$587,999	$587,999	**$7,055,985**
50	12	120	1.23	61.5	4	$9,481	$11,512	$34,537	$69,074	$3,115	$488	$103,669	$6,375,657	$637,566	$637,566	**$7,650,788**
60	4	120	1.084	65.04	4	$9,481	$2,004	$38,735	$77,471	$2,817	$485	$102,258	$6,650,857	$665,086	$665,086	**$7,981,028**

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
60	8	120	1.144	68.64	4	$9,481	$5,824	$36,839	$73,679	$2,877	$473	$102,332	$7,024,099	$702,410	$702,410	**$8,428,918**
60	12	120	1.216	72.96	4	$9,481	$10,889	$34,808	$69,615	$2,936	$460	$103,382	$7,542,757	$754,276	$754,276	**$9,051,309**
70	4	120	1.078	75.46	4	$9,481	$1,842	$38,871	$77,742	$2,655	$455	$102,174	$7,710,048	$771,005	$771,005	**$9,252,058**
70	8	120	1.138	79.66	4	$9,481	$5,553	$37,110	$74,220	$2,706	$444	$102,404	$8,157,520	$815,752	$815,752	**$9,789,025**
70	12	120	1.202	84.14	4	$9,481	$10,266	$35,079	$70,157	$2,758	$433	$103,095	$8,674,410	$867,441	$867,441	**$10,409,292**
80	4	120	1.072	85.76	4	$9,481	$1,679	$39,006	$78,013	$2,492	$425	$102,090	$8,755,239	$875,524	$875,524	**$10,506,287**
80	8	120	1.132	90.56	4	$9,481	$5,282	$37,381	$74,762	$2,535	$416	$102,476	$9,280,227	$928,023	$928,023	**$11,136,272**
80	12	120	1.188	95.04	4	$9,481	$9,643	$35,349	$70,699	$2,579	$406	$102,808	$9,770,856	$977,086	$977,086	**$11,725,027**
90	4	120	1.066	95.94	4	$9,481	$1,517	$39,142	$78,283	$2,330	$395	$102,006	$9,786,459	$978,646	$978,646	**$11,743,751**
90	8	120	1.126	101.34	4	$9,481	$5,011	$37,652	$75,304	$2,365	$387	$102,548	$10,392,193	$1,039,219	$1,039,219	**$12,470,631**
90	12	120	1.174	105.66	4	$9,481	$9,020	$35,620	$71,241	$2,400	$379	$102,521	$10,832,337	$1,083,234	$1,083,234	**$12,998,805**
100	4	120	1.06	106	4	$9,481	$1,354	$39,277	$78,554	$2,167	$366	$101,922	$10,803,739	$1,080,374	$1,080,374	**$12,964,486**
100	8	120	1.12	112	4	$9,481	$4,740	$37,923	$75,846	$2,194	$359	$102,620	$11,493,392	$1,149,339	$1,149,339	**$13,792,070**
100	12	120	1.16	116	4	$9,481	$8,397	$35,891	$71,782	$2,221	$352	$102,234	$11,859,094	$1,185,909	$1,185,909	**$14,230,913**
1	4	120	1.65	1.65	4	$9,481	$10,835	$24,379	$48,758	$12,867	$2,939	$104,879	$173,051	$17,305	$17,305	**$207,661**
1	8	120	2.35	2.35	4	$9,481	$23,702	$17,607	$35,214	$14,898	$2,519	$105,814	$248,662	$24,866	$24,866	**$298,395**
1	12	120	3.1	3.1	4	$9,481	$35,214	$13,544	$27,088	$17,607	$2,167	$111,556	$345,825	$34,582	$34,582	**$414,990**
2	4	120	1.475	2.95	4	$9,481	$9,142	$27,765	$55,530	$10,835	$2,418	$107,405	$316,845	$31,685	$31,685	**$380,214**
2	8	120	2	4	4	$9,481	$20,316	$20,993	$41,986	$12,325	$2,072	$106,179	$424,718	$42,472	$42,472	**$509,661**
2	12	120	2.6	5.2	4	$9,481	$32,505	$16,930	$33,860	$14,356	$1,828	$112,030	$582,558	$58,256	$58,256	**$699,070**
3	4	120	1.3	3.9	4	$9,481	$7,449	$31,151	$62,302	$8,803	$1,896	$109,931	$428,731	$42,873	$42,873	**$514,478**
3	8	120	1.65	4.95	4	$9,481	$16,930	$24,379	$48,758	$9,752	$1,625	$106,545	$527,399	$52,740	$52,740	**$632,878**
3	12	120	2.1	6.3	4	$9,481	$29,796	$20,316	$40,632	$11,106	$1,490	$112,504	$708,778	$70,878	$70,878	**$850,534**
4	4	120	1.275	5.1	4	$9,481	$6,772	$31,828	$63,656	$8,126	$1,693	$109,728	$559,613	$55,961	$55,961	**$671,535**
4	8	120	1.575	6.3	4	$9,481	$15,914	$26,410	$52,821	$8,939	$1,490	$108,644	$684,460	$68,446	$68,446	**$821,352**
4	12	120	1.925	7.7	4	$9,481	$27,088	$21,670	$43,340	$9,955	$1,354	$111,218	$856,377	$85,638	$85,638	**$1,027,652**
5	4	120	1.25	6.25	4	$9,481	$6,095	$32,505	$65,010	$7,449	$1,490	$109,525	$684,530	$68,453	$68,453	**$821,436**
5	8	120	1.5	7.5	4	$9,481	$14,898	$28,442	$56,884	$8,126	$1,354	$110,744	$830,578	$83,058	$83,058	**$996,694**
5	12	120	1.75	8.75	4	$9,481	$24,379	$23,025	$46,049	$8,803	$1,219	$109,931	$961,897	$96,190	$96,190	**$1,154,277**
6	4	120	1.24	7.44	4	$9,481	$5,688	$33,047	$66,094	$7,097	$1,409	$109,769	$816,678	$81,668	$81,668	**$980,014**
6	8	120	1.47	8.82	4	$9,481	$14,356	$28,984	$57,968	$7,747	$1,287	$110,839	$977,596	$97,760	$97,760	**$1,173,115**
6	12	120	1.71	10.26	4	$9,481	$23,702	$23,837	$47,674	$8,343	$1,165	$110,365	$1,132,340	$113,234	$113,234	**$1,358,808**
7	4	120	1.23	8.61	4	$9,481	$5,282	$33,589	$67,177	$6,745	$1,327	$110,012	$947,207	$94,721	$94,721	**$1,136,648**
7	8	120	1.44	10.08	4	$9,481	$13,815	$29,526	$59,051	$7,368	$1,219	$110,933	$1,118,208	$111,821	$111,821	**$1,341,850**
7	12	120	1.67	11.69	4	$9,481	$23,025	$24,650	$49,300	$7,883	$1,111	$110,798	$1,295,228	$129,523	$129,523	**$1,554,273**
8	4	120	1.22	9.76	4	$9,481	$4,876	$34,130	$68,261	$6,393	$1,246	$110,256	$1,076,100	$107,610	$107,610	**$1,291,320**
8	8	120	1.41	11.28	4	$9,481	$13,273	$30,067	$60,135	$6,989	$1,151	$111,028	$1,252,398	$125,240	$125,240	**$1,502,877**
8	12	120	1.63	13.04	4	$9,481	$22,347	$25,462	$50,925	$7,422	$1,056	$111,231	$1,450,456	$145,046	$145,046	**$1,740,548**
9	4	120	1.21	10.89	4	$9,481	$4,469	$34,672	$69,344	$6,041	$1,165	$110,500	$1,203,345	$120,334	$120,334	**$1,444,013**
9	8	120	1.38	12.42	4	$9,481	$12,731	$30,609	$61,218	$6,609	$1,084	$111,123	$1,380,147	$138,015	$138,015	**$1,656,177**
9	12	120	1.59	14.31	4	$9,481	$21,670	$26,275	$52,550	$6,962	$1,002	$111,665	$1,597,922	$159,792	$159,792	**$1,917,507**
10	4	120	1.2	12	4	$9,481	$4,063	$35,214	$70,428	$5,688	$1,084	$110,744	$1,328,925	$132,892	$132,892	**$1,594,710**
10	8	120	1.35	13.5	4	$9,481	$12,189	$31,151	$62,302	$6,230	$1,016	$111,218	$1,501,440	$150,144	$150,144	**$1,801,728**
10	12	120	1.55	15.5	4	$9,481	$20,993	$27,088	$54,175	$6,501	$948	$112,098	$1,737,521	$173,752	$173,752	**$2,085,025**
20	4	120	1.16	23.2	4	$9,481	$3,386	$36,568	$73,137	$4,639	$867	$111,509	$2,587,008	$258,701	$258,701	**$3,104,410**
20	8	120	1.275	25.5	4	$9,481	$9,819	$32,844	$65,688	$4,977	$819	$110,784	$2,825,002	$282,500	$282,500	**$3,390,002**
20	12	120	1.42	28.4	4	$9,481	$17,607	$29,796	$59,593	$5,181	$772	$112,633	$3,198,780	$319,878	$319,878	**$3,838,537**
30	4	120	1.12	33.6	4	$9,481	$2,709	$37,923	$75,846	$3,589	$650	$112,274	$3,772,413	$377,241	$377,241	**$4,526,896**
30	8	120	1.2	36	4	$9,481	$7,449	$34,537	$69,074	$3,725	$623	$110,351	$3,972,635	$397,264	$397,264	**$4,767,162**
30	12	120	1.29	38.7	4	$9,481	$14,221	$32,505	$65,010	$3,860	$596	$113,168	$4,379,605	$437,961	$437,961	**$5,255,526**
40	4	120	1.105	44.2	4	$9,481	$2,438	$38,261	$76,523	$3,284	$582	$112,308	$4,964,016	$496,402	$496,402	**$5,956,820**
40	8	120	1.175	47	4	$9,481	$6,772	$35,553	$71,105	$3,386	$562	$111,306	$5,231,373	$523,137	$523,137	**$6,277,648**

Evaporative Surface (acres)	Dike Height (ft)	Liner Thickness (mils)	Total Acreage to Evaporative Acreage	Total Acreage (acres)	Land Type	Land Clearing (2008 Dollars/acre)	Dike (2008 Dollars/acre)	Nominal Liner (2008 Dollars/acre)	Liner (2008 Dollars/acre)	Fence (2008 Dollars/acre)	Road (2008 Dollars/acre)	Total Unit Cost (2008 Dollars)	TOTAL (2008 Dollars)	Engineering (10%)	Contingency (10%)	Grand Total (2008 Dollars)
40	12	120	1.26	50.4	4	$9,481	$12,867	$33,521	$67,042	$3,488	$542	$113,419	$5,716,300	$571,630	$571,630	**$6,859,560**
50	4	120	1.09	54.5	4	$9,481	$2,167	$38,600	$77,200	$2,980	$515	$112,342	$6,122,635	$612,263	$612,263	**$7,347,162**
50	8	120	1.15	57.5	4	$9,481	$6,095	$36,568	$73,137	$3,047	$501	$112,261	$6,454,988	$645,499	$645,499	**$7,745,985**
50	12	120	1.23	61.5	4	$9,481	$11,512	$34,537	$69,074	$3,115	$488	$113,669	$6,990,657	$699,066	$699,066	**$8,388,788**
60	4	120	1.084	65.04	4	$9,481	$2,004	$38,735	$77,471	$2,817	$485	$112,258	$7,301,257	$730,126	$730,126	**$8,761,508**
60	8	120	1.144	68.64	4	$9,481	$5,824	$36,839	$73,679	$2,877	$473	$112,332	$7,710,499	$771,050	$771,050	**$9,252,598**
60	12	120	1.216	72.96	4	$9,481	$10,889	$34,808	$69,615	$2,936	$460	$113,382	$8,272,357	$827,236	$827,236	**$9,926,829**
70	4	120	1.078	75.46	4	$9,481	$1,842	$38,871	$77,742	$2,655	$455	$112,174	$8,464,648	$846,465	$846,465	**$10,157,578**
70	8	120	1.138	79.66	4	$9,481	$5,553	$37,110	$74,220	$2,706	$444	$112,404	$8,954,120	$895,412	$895,412	**$10,744,945**
70	12	120	1.202	84.14	4	$9,481	$10,266	$35,079	$70,157	$2,758	$433	$113,095	$9,515,810	$951,581	$951,581	**$11,418,972**
80	4	120	1.072	85.76	4	$9,481	$1,679	$39,006	$78,013	$2,492	$425	$112,090	$9,612,839	$961,284	$961,284	**$11,535,407**
80	8	120	1.132	90.56	4	$9,481	$5,282	$37,381	$74,762	$2,535	$416	$112,476	$10,185,827	$1,018,583	$1,018,583	**$12,222,992**
80	12	120	1.188	95.04	4	$9,481	$9,643	$35,349	$70,699	$2,579	$406	$112,808	$10,721,256	$1,072,126	$1,072,126	**$12,865,507**
90	4	120	1.066	95.94	4	$9,481	$1,517	$39,142	$78,283	$2,330	$395	$112,006	$10,745,859	$1,074,586	$1,074,586	**$12,895,031**
90	8	120	1.126	101.34	4	$9,481	$5,011	$37,652	$75,304	$2,365	$387	$112,548	$11,405,593	$1,140,559	$1,140,559	**$13,686,711**
90	12	120	1.174	105.66	4	$9,481	$9,020	$35,620	$71,241	$2,400	$379	$112,521	$11,888,937	$1,188,894	$1,188,894	**$14,266,725**
100	4	120	1.06	106	4	$9,481	$1,354	$39,277	$78,554	$2,167	$366	$111,922	$11,863,739	$1,186,374	$1,186,374	**$14,236,486**
100	8	120	1.12	112	4	$9,481	$4,740	$37,923	$75,846	$2,194	$359	$112,620	$12,613,392	$1,261,339	$1,261,339	**$15,136,070**
100	12	120	1.16	116	4	$9,481	$8,397	$35,891	$71,782	$2,221	$352	$112,234	$13,019,094	$1,301,909	$1,301,909	**$15,622,913**

Table 3.
Spray Irrigation Disposal Capital Costs

Flow Rate (MGD)	Loading (ft/yr)	Land Type	Storage Time (days)	Land Unit Cost (2008 Dollars/acre)	Land Requirements (acres)	Land Clearing Unit Cost (2008 Dollars/acre)	Land Cost (acres * land unit cost) (2008 Dollars)	Land Clearing Cost (acres* unit cost) (2008 Dollars)	Piping Cost (2008 Dollars)	Sprinkler Valves, Control System Cost (2008 Dollars)	Distribution System Material Cost (2008 Dollars)	Installed Distribution System Cost (2008 Dollars)	Pump Cost (1992 Dollars)	Storage Tank Cost (1992 Dollars)	Underdrain Cost (2008 Dollars)	Total (2008 Dollars)
1	5	1	1	$10,000	250	$1,354	$2,500,000	$338,596	$338,596	$148,982	$487,578	$877,641	$34,414	$430,173	$487,578	$4,668,402
1	10	1	1	$10,000	110	$1,354	$1,100,000	$148,982	$148,982	$81,263	$230,245	$414,442	$34,414	$430,173	$214,534	$2,342,545
1	15	1	1	$10,000	75	$1,354	$750,000	$101,579	$101,579	$60,947	$162,526	$292,547	$34,414	$430,173	$146,274	$1,754,986
1	20	1	1	$10,000	55	$1,354	$550,000	$74,491	$67,719	$40,632	$108,351	$195,031	$34,414	$430,173	$97,516	$1,381,625
1	5	2	1	$10,000	250	$2,709	$2,500,000	$677,192	$338,596	$148,982	$487,578	$877,641	$34,414	$430,173	$487,578	$5,006,998
1	10	2	1	$10,000	110	$2,709	$1,100,000	$297,965	$148,982	$81,263	$230,245	$414,442	$34,414	$430,173	$214,534	$2,491,527
1	15	2	1	$10,000	75	$2,709	$750,000	$203,158	$101,579	$60,947	$162,526	$292,547	$34,414	$430,173	$146,274	$1,856,565
1	20	2	1	$10,000	55	$2,709	$550,000	$148,982	$67,719	$40,632	$108,351	$195,031	$34,414	$430,173	$97,516	$1,456,116
1	5	3	1	$10,000	250	$5,418	$2,500,000	$1,354,384	$338,596	$148,982	$487,578	$877,641	$34,414	$430,173	$487,578	$5,684,190
1	10	3	1	$10,000	110	$5,418	$1,100,000	$595,929	$148,982	$81,263	$230,245	$414,442	$34,414	$430,173	$214,534	$2,789,492
1	15	3	1	$10,000	75	$5,418	$750,000	$406,315	$101,579	$60,947	$162,526	$292,547	$34,414	$430,173	$146,274	$2,059,723
1	20	3	1	$10,000	55	$5,418	$550,000	$297,965	$67,719	$40,632	$108,351	$195,031	$34,414	$430,173	$97,516	$1,605,098
1	5	4	1	$10,000	250	$9,481	$2,500,000	$2,370,173	$338,596	$148,982	$487,578	$877,641	$34,414	$430,173	$487,578	$6,699,979
1	10	4	1	$10,000	110	$9,481	$1,100,000	$1,042,876	$148,982	$81,263	$230,245	$414,442	$34,414	$430,173	$214,534	$3,236,439
1	15	4	1	$10,000	75	$9,481	$750,000	$711,052	$101,579	$60,947	$162,526	$292,547	$34,414	$430,173	$146,274	$2,364,459
1	20	4	1	$10,000	55	$9,481	$550,000	$521,438	$67,719	$40,632	$108,351	$195,031	$34,414	$430,173	$97,516	$1,828,572
1	5	1	2	$10,000	250	$1,354	$2,500,000	$338,596	$338,596	$148,982	$487,578	$877,641	$34,414	$430,173	$487,578	$4,668,402
1	10	1	2	$10,000	110	$1,354	$1,100,000	$148,982	$148,982	$81,263	$230,245	$414,442	$34,414	$430,173	$214,534	$2,342,545
1	15	1	2	$10,000	75	$1,354	$750,000	$101,579	$101,579	$60,947	$162,526	$292,547	$34,414	$430,173	$146,274	$1,754,986
1	20	1	2	$10,000	55	$1,354	$550,000	$74,491	$67,719	$40,632	$108,351	$195,031	$34,414	$430,173	$97,516	$1,381,625
1	5	2	2	$10,000	250	$2,709	$2,500,000	$677,192	$338,596	$148,982	$487,578	$877,641	$34,414	$430,173	$487,578	$5,006,998
1	10	2	2	$10,000	110	$2,709	$1,100,000	$297,965	$148,982	$81,263	$230,245	$414,442	$34,414	$430,173	$214,534	$2,491,527
1	15	2	2	$10,000	75	$2,709	$750,000	$203,158	$101,579	$60,947	$162,526	$292,547	$34,414	$430,173	$146,274	$1,856,565
1	20	2	2	$10,000	55	$2,709	$550,000	$148,982	$67,719	$40,632	$108,351	$195,031	$34,414	$430,173	$97,516	$1,456,116
1	5	3	2	$10,000	250	$5,418	$2,500,000	$1,354,384	$338,596	$148,982	$487,578	$877,641	$34,414	$430,173	$487,578	$5,684,190
1	10	3	2	$10,000	110	$5,418	$1,100,000	$595,929	$148,982	$81,263	$230,245	$414,442	$34,414	$430,173	$214,534	$2,789,492
1	15	3	2	$10,000	75	$5,418	$750,000	$406,315	$101,579	$60,947	$162,526	$292,547	$34,414	$430,173	$146,274	$2,059,723
1	20	3	2	$10,000	55	$5,418	$550,000	$297,965	$67,719	$40,632	$108,351	$195,031	$34,414	$430,173	$97,516	$1,605,098
1	5	4	2	$10,000	250	$9,481	$2,500,000	$2,370,173	$338,596	$148,982	$487,578	$877,641	$34,414	$430,173	$487,578	$6,699,979
1	10	4	2	$10,000	110	$9,481	$1,100,000	$1,042,876	$148,982	$81,263	$230,245	$414,442	$34,414	$430,173	$214,534	$3,236,439
1	15	4	2	$10,000	75	$9,481	$750,000	$711,052	$101,579	$60,947	$162,526	$292,547	$34,414	$430,173	$146,274	$2,364,459
1	20	4	2	$10,000	55	$9,481	$550,000	$521,438	$67,719	$40,632	$108,351	$195,031	$34,414	$430,173	$97,516	$1,828,572
1	5	1	1	$20,000	250	$1,354	$5,000,000	$338,596	$338,596	$148,982	$487,578	$877,641	$34,414	$430,173	$487,578	$7,168,402
1	10	1	1	$20,000	110	$1,354	$2,200,000	$148,982	$148,982	$81,263	$230,245	$414,442	$34,414	$430,173	$214,534	$3,442,545
1	15	1	1	$20,000	75	$1,354	$1,500,000	$101,579	$101,579	$60,947	$162,526	$292,547	$34,414	$430,173	$146,274	$2,504,986
1	20	1	1	$20,000	55	$1,354	$1,100,000	$74,491	$67,719	$40,632	$108,351	$195,031	$34,414	$430,173	$97,516	$1,931,625
1	5	2	1	$20,000	250	$2,709	$5,000,000	$677,192	$338,596	$148,982	$487,578	$877,641	$34,414	$430,173	$487,578	$7,506,998
1	10	2	1	$20,000	110	$2,709	$2,200,000	$297,965	$148,982	$81,263	$230,245	$414,442	$34,414	$430,173	$214,534	$3,591,527
1	15	2	1	$20,000	75	$2,709	$1,500,000	$203,158	$101,579	$60,947	$162,526	$292,547	$34,414	$430,173	$146,274	$2,606,565
1	20	2	1	$20,000	55	$2,709	$1,100,000	$148,982	$67,719	$40,632	$108,351	$195,031	$34,414	$430,173	$97,516	$2,006,116
1	5	3	1	$20,000	250	$5,418	$5,000,000	$1,354,384	$338,596	$148,982	$487,578	$877,641	$34,414	$430,173	$487,578	$8,184,190
1	10	3	1	$20,000	110	$5,418	$2,200,000	$595,929	$148,982	$81,263	$230,245	$414,442	$34,414	$430,173	$214,534	$3,889,492
1	15	3	1	$20,000	75	$5,418	$1,500,000	$406,315	$101,579	$60,947	$162,526	$292,547	$34,414	$430,173	$146,274	$2,809,723
1	20	3	1	$20,000	55	$5,418	$1,100,000	$297,965	$67,719	$40,632	$108,351	$195,031	$34,414	$430,173	$97,516	$2,155,098
1	5	4	1	$20,000	250	$9,481	$5,000,000	$2,370,173	$338,596	$148,982	$487,578	$877,641	$34,414	$430,173	$487,578	$9,199,979
1	10	4	1	$20,000	110	$9,481	$2,200,000	$1,042,876	$148,982	$81,263	$230,245	$414,442	$34,414	$430,173	$214,534	$4,336,439
1	15	4	1	$20,000	75	$9,481	$1,500,000	$711,052	$101,579	$60,947	$162,526	$292,547	$34,414	$430,173	$146,274	$3,114,459
1	20	4	1	$20,000	55	$9,481	$1,100,000	$521,438	$67,719	$40,632	$108,351	$195,031	$34,414	$430,173	$97,516	$2,378,572
1	5	1	2	$20,000	250	$1,354	$5,000,000	$338,596	$338,596	$148,982	$487,578	$877,641	$34,414	$430,173	$487,578	$7,168,402
1	10	1	2	$20,000	110	$1,354	$2,200,000	$148,982	$148,982	$81,263	$230,245	$414,442	$34,414	$430,173	$214,534	$3,442,545
1	15	1	2	$20,000	75	$1,354	$1,500,000	$101,579	$101,579	$60,947	$162,526	$292,547	$34,414	$430,173	$146,274	$2,504,986
1	20	1	2	$20,000	55	$1,354	$1,100,000	$74,491	$67,719	$40,632	$108,351	$195,031	$34,414	$430,173	$97,516	$1,931,625
1	5	2	2	$20,000	250	$2,709	$5,000,000	$677,192	$338,596	$148,982	$487,578	$877,641	$34,414	$430,173	$487,578	$7,506,998

Flow Rate (MGD)	Loading (ft/yr)	Land Type	Storage Time (days)	Land Unit Cost (2008 Dollars/acre)	Land Requirements (acres)	Land Clearing Unit Cost (2008 Dollars/acre)	Land Cost (acres * land unit cost) (2008 Dollars)	Land Clearing Cost (acres* unit cost) (2008 Dollars)	Piping Cost (2008 Dollars)	Sprinkler Valves, Control System Cost (2008 Dollars)	Distribution System Material Cost (2008 Dollars)	Installed Distribution System Cost (2008 Dollars)	Pump Cost (1992 Dollars)	Storage Tank Cost (1992 Dollars)	Underdrain Cost (2008 Dollars)	Total (2008 Dollars)
1	10	2	2	$20,000	110	$2,709	$2,200,000	$297,965	$148,982	$81,263	$230,245	$414,442	$34,414	$430,173	$214,534	$3,591,527
1	15	2	2	$20,000	75	$2,709	$1,500,000	$203,158	$101,579	$60,947	$162,526	$292,547	$34,414	$430,173	$146,274	$2,606,565
1	20	2	2	$20,000	55	$2,709	$1,100,000	$148,982	$67,719	$40,632	$108,351	$195,031	$34,414	$430,173	$97,516	$2,006,116
1	5	3	2	$20,000	250	$5,418	$5,000,000	$1,354,384	$338,596	$148,982	$487,578	$877,641	$34,414	$430,173	$487,578	$8,184,190
1	10	3	2	$20,000	110	$5,418	$2,200,000	$595,929	$148,982	$81,263	$230,245	$414,442	$34,414	$430,173	$214,534	$3,889,492
1	15	3	2	$20,000	75	$5,418	$1,500,000	$406,315	$101,579	$60,947	$162,526	$292,547	$34,414	$430,173	$146,274	$2,809,723
1	20	3	2	$20,000	55	$5,418	$1,100,000	$297,965	$67,719	$40,632	$108,351	$195,031	$34,414	$430,173	$97,516	$2,155,098
1	5	4	2	$20,000	250	$9,481	$5,000,000	$2,370,173	$338,596	$148,982	$487,578	$877,641	$34,414	$430,173	$487,578	$9,199,979
1	10	4	2	$20,000	110	$9,481	$2,200,000	$1,042,876	$148,982	$81,263	$230,245	$414,442	$34,414	$430,173	$214,534	$4,336,439
1	15	4	2	$20,000	75	$9,481	$1,500,000	$711,052	$101,579	$60,947	$162,526	$292,547	$34,414	$430,173	$146,274	$3,114,459
1	20	4	2	$20,000	55	$9,481	$1,100,000	$521,438	$67,719	$40,632	$108,351	$195,031	$34,414	$430,173	$97,516	$2,378,572
2	10	1	1	$10,000	250	$1,354	$2,500,000	$338,596	$372,456	$148,982	$521,438	$938,588	$36,995	$860,346	$536,336	$5,210,861
2	15	1	1	$10,000	150	$1,354	$1,500,000	$203,158	$243,789	$101,579	$345,368	$621,662	$36,995	$860,346	$351,056	$3,573,217
2	20	1	1	$10,000	110	$1,354	$1,100,000	$148,982	$203,158	$74,491	$277,649	$499,768	$36,995	$860,346	$292,547	$2,938,638
2	10	2	1	$10,000	250	$2,709	$2,500,000	$677,192	$372,456	$148,982	$521,438	$938,588	$36,995	$860,346	$536,336	$5,549,457
2	15	2	1	$10,000	150	$2,709	$1,500,000	$406,315	$243,789	$101,579	$345,368	$621,662	$36,995	$860,346	$351,056	$3,776,375
2	20	2	1	$10,000	110	$2,709	$1,100,000	$297,965	$203,158	$74,491	$277,649	$499,768	$36,995	$860,346	$292,547	$3,087,620
2	10	3	1	$10,000	250	$5,418	$2,500,000	$1,354,384	$372,456	$148,982	$521,438	$938,588	$36,995	$860,346	$536,336	$6,226,650
2	15	3	1	$10,000	150	$5,418	$1,500,000	$812,631	$243,789	$101,579	$345,368	$621,662	$36,995	$860,346	$351,056	$4,182,690
2	20	3	1	$10,000	110	$5,418	$1,100,000	$595,929	$203,158	$74,491	$277,649	$499,768	$36,995	$860,346	$292,547	$3,385,585
2	10	4	1	$10,000	250	$9,481	$2,500,000	$2,370,173	$372,456	$148,982	$521,438	$938,588	$36,995	$860,346	$536,336	$7,242,438
2	15	4	1	$10,000	150	$9,481	$1,500,000	$1,422,104	$243,789	$101,579	$345,368	$621,662	$36,995	$860,346	$351,056	$4,792,163
2	20	4	1	$10,000	110	$9,481	$1,100,000	$1,042,876	$203,158	$74,491	$277,649	$499,768	$36,995	$860,346	$292,547	$3,832,531
2	10	1	2	$10,000	250	$1,354	$2,500,000	$338,596	$372,456	$148,982	$521,438	$938,588	$36,995	$860,346	$536,336	$5,210,861
2	15	1	2	$10,000	150	$1,354	$1,500,000	$203,158	$243,789	$101,579	$345,368	$621,662	$36,995	$860,346	$351,056	$3,573,217
2	20	1	2	$10,000	110	$1,354	$1,100,000	$148,982	$203,158	$74,491	$277,649	$499,768	$36,995	$860,346	$292,547	$2,938,638
2	10	2	2	$10,000	250	$2,709	$2,500,000	$677,192	$372,456	$148,982	$521,438	$938,588	$36,995	$860,346	$536,336	$5,549,457
2	15	2	2	$10,000	150	$2,709	$1,500,000	$406,315	$243,789	$101,579	$345,368	$621,662	$36,995	$860,346	$351,056	$3,776,375
2	20	2	2	$10,000	110	$2,709	$1,100,000	$297,965	$203,158	$74,491	$277,649	$499,768	$36,995	$860,346	$292,547	$3,087,620
2	10	3	2	$10,000	250	$5,418	$2,500,000	$1,354,384	$372,456	$148,982	$521,438	$938,588	$36,995	$860,346	$536,336	$6,226,650
2	15	3	2	$10,000	150	$5,418	$1,500,000	$812,631	$243,789	$101,579	$345,368	$621,662	$36,995	$860,346	$351,056	$4,182,690
2	20	3	2	$10,000	110	$5,418	$1,100,000	$595,929	$203,158	$74,491	$277,649	$499,768	$36,995	$860,346	$292,547	$3,385,585
2	10	4	2	$10,000	250	$9,481	$2,500,000	$2,370,173	$372,456	$148,982	$521,438	$938,588	$36,995	$860,346	$536,336	$7,242,438
2	15	4	2	$10,000	150	$9,481	$1,500,000	$1,422,104	$243,789	$101,579	$345,368	$621,662	$36,995	$860,346	$351,056	$4,792,163
2	20	4	2	$10,000	110	$9,481	$1,100,000	$1,042,876	$203,158	$74,491	$277,649	$499,768	$36,995	$860,346	$292,547	$3,832,531
2	10	1	1	$20,000	250	$1,354	$5,000,000	$338,596	$372,456	$148,982	$521,438	$938,588	$36,995	$860,346	$536,336	$7,710,861
2	15	1	1	$20,000	150	$1,354	$3,000,000	$203,158	$243,789	$101,579	$345,368	$621,662	$36,995	$860,346	$351,056	$5,073,217
2	20	1	1	$20,000	110	$1,354	$2,200,000	$148,982	$203,158	$74,491	$277,649	$499,768	$36,995	$860,346	$292,547	$4,038,638
2	10	2	1	$20,000	250	$2,709	$5,000,000	$677,192	$372,456	$148,982	$521,438	$938,588	$36,995	$860,346	$536,336	$8,049,457
2	15	2	1	$20,000	150	$2,709	$3,000,000	$406,315	$243,789	$101,579	$345,368	$621,662	$36,995	$860,346	$351,056	$5,276,375
2	20	2	1	$20,000	110	$2,709	$2,200,000	$297,965	$203,158	$74,491	$277,649	$499,768	$36,995	$860,346	$292,547	$4,187,620
2	10	3	1	$20,000	250	$5,418	$5,000,000	$1,354,384	$372,456	$148,982	$521,438	$938,588	$36,995	$860,346	$536,336	$8,726,650
2	15	3	1	$20,000	150	$5,418	$3,000,000	$812,631	$243,789	$101,579	$345,368	$621,662	$36,995	$860,346	$351,056	$5,682,690
2	20	3	1	$20,000	110	$5,418	$2,200,000	$595,929	$203,158	$74,491	$277,649	$499,768	$36,995	$860,346	$292,547	$4,485,585
2	10	4	1	$20,000	250	$9,481	$5,000,000	$2,370,173	$372,456	$148,982	$521,438	$938,588	$36,995	$860,346	$536,336	$9,742,438
2	15	4	1	$20,000	150	$9,481	$3,000,000	$1,422,104	$243,789	$101,579	$345,368	$621,662	$36,995	$860,346	$351,056	$6,292,163
2	20	4	1	$20,000	110	$9,481	$2,200,000	$1,042,876	$203,158	$74,491	$277,649	$499,768	$36,995	$860,346	$292,547	$4,932,531
2	10	1	2	$20,000	250	$1,354	$5,000,000	$338,596	$372,456	$148,982	$521,438	$938,588	$36,995	$860,346	$536,336	$7,710,861
2	15	1	2	$20,000	150	$1,354	$3,000,000	$203,158	$243,789	$101,579	$345,368	$621,662	$36,995	$860,346	$351,056	$5,073,217
2	20	1	2	$20,000	110	$1,354	$2,200,000	$148,982	$203,158	$74,491	$277,649	$499,768	$36,995	$860,346	$292,547	$4,038,638
2	10	2	2	$20,000	250	$2,709	$5,000,000	$677,192	$372,456	$148,982	$521,438	$938,588	$36,995	$860,346	$536,336	$8,049,457
2	15	2	2	$20,000	150	$2,709	$3,000,000	$406,315	$243,789	$101,579	$345,368	$621,662	$36,995	$860,346	$351,056	$5,276,375
2	20	2	2	$20,000	110	$2,709	$2,200,000	$297,965	$203,158	$74,491	$277,649	$499,768	$36,995	$860,346	$292,547	$4,187,620
2	10	3	2	$20,000	250	$5,418	$5,000,000	$1,354,384	$372,456	$148,982	$521,438	$938,588	$36,995	$860,346	$536,336	$8,726,650
2	15	3	2	$20,000	150	$5,418	$3,000,000	$812,631	$243,789	$101,579	$345,368	$621,662	$36,995	$860,346	$351,056	$5,682,690
2	20	3	2	$20,000	110	$5,418	$2,200,000	$595,929	$203,158	$74,491	$277,649	$499,768	$36,995	$860,346	$292,547	$4,485,585

Flow Rate (MGD)	Loading (ft/yr)	Land Type	Storage Time (days)	Land Unit Cost (2008 Dollars/acre)	Land Requirements (acres)	Land Clearing Unit Cost (2008 Dollars/acre)	Land Cost (acres * land unit cost) (2008 Dollars)	Land Clearing Cost (acres* unit cost) (2008 Dollars)	Piping Cost (2008 Dollars)	Sprinkler Valves, Control System Cost (2008 Dollars)	Distribution System Material Cost (2008 Dollars)	Installed Distribution System Cost (2008 Dollars)	Pump Cost (1992 Dollars)	Storage Tank Cost (1992 Dollars)	Underdrain Cost (2008 Dollars)	Total (2008 Dollars)
2	10	4	2	$20,000	250	$9,481	$5,000,000	$2,370,173	$372,456	$148,982	$521,438	$938,588	$36,995	$860,346	$536,336	$9,742,438
2	15	4	2	$20,000	150	$9,481	$3,000,000	$1,422,104	$243,789	$101,579	$345,368	$621,662	$36,995	$860,346	$351,056	$6,292,163
2	20	4	2	$20,000	110	$9,481	$2,200,000	$1,042,876	$203,158	$74,491	$277,649	$499,768	$36,995	$860,346	$292,547	$4,932,531
3	15	1	1	$10,000	225	$1,354	$2,250,000	$304,736	$352,140	$142,210	$494,350	$889,830	$39,576	$1,290,519	$507,081	$5,281,743
3	20	1	1	$10,000	170	$1,354	$1,700,000	$230,245	$331,824	$115,123	$446,947	$804,504	$39,576	$1,290,519	$477,827	$4,542,671
3	15	2	1	$10,000	225	$2,709	$2,250,000	$609,473	$352,140	$142,210	$494,350	$889,830	$39,576	$1,290,519	$507,081	$5,586,480
3	20	2	1	$10,000	170	$2,709	$1,700,000	$460,491	$331,824	$115,123	$446,947	$804,504	$39,576	$1,290,519	$477,827	$4,772,916
3	15	3	1	$10,000	225	$5,418	$2,250,000	$1,218,946	$352,140	$142,210	$494,350	$889,830	$39,576	$1,290,519	$507,081	$6,195,953
3	20	3	1	$10,000	170	$5,418	$1,700,000	$920,981	$331,824	$115,123	$446,947	$804,504	$39,576	$1,290,519	$477,827	$5,233,407
3	15	4	1	$10,000	225	$9,481	$2,250,000	$2,133,155	$352,140	$142,210	$494,350	$889,830	$39,576	$1,290,519	$507,081	$7,110,162
3	20	4	1	$10,000	170	$9,481	$1,700,000	$1,611,717	$331,824	$115,123	$446,947	$804,504	$39,576	$1,290,519	$477,827	$5,924,143
3	15	1	2	$10,000	225	$1,354	$2,250,000	$304,736	$352,140	$142,210	$494,350	$889,830	$39,576	$1,290,519	$507,081	$5,281,743
3	20	1	2	$10,000	170	$1,354	$1,700,000	$230,245	$331,824	$115,123	$446,947	$804,504	$39,576	$1,290,519	$477,827	$4,542,671
3	15	2	2	$10,000	225	$2,709	$2,250,000	$609,473	$352,140	$142,210	$494,350	$889,830	$39,576	$1,290,519	$507,081	$5,586,480
3	20	2	2	$10,000	170	$2,709	$1,700,000	$460,491	$331,824	$115,123	$446,947	$804,504	$39,576	$1,290,519	$477,827	$4,772,916
3	15	3	2	$10,000	225	$5,418	$2,250,000	$1,218,946	$352,140	$142,210	$494,350	$889,830	$39,576	$1,290,519	$507,081	$6,195,953
3	20	3	2	$10,000	170	$5,418	$1,700,000	$920,981	$331,824	$115,123	$446,947	$804,504	$39,576	$1,290,519	$477,827	$5,233,407
3	15	4	2	$10,000	225	$9,481	$2,250,000	$2,133,155	$352,140	$142,210	$494,350	$889,830	$39,576	$1,290,519	$507,081	$7,110,162
3	20	4	2	$10,000	170	$9,481	$1,700,000	$1,611,717	$331,824	$115,123	$446,947	$804,504	$39,576	$1,290,519	$477,827	$5,924,143
3	15	1	1	$20,000	225	$1,354	$4,500,000	$304,736	$352,140	$142,210	$494,350	$889,830	$39,576	$1,290,519	$507,081	$7,531,743
3	20	1	1	$20,000	170	$1,354	$3,400,000	$230,245	$331,824	$115,123	$446,947	$804,504	$39,576	$1,290,519	$477,827	$6,242,671
3	15	2	1	$20,000	225	$2,709	$4,500,000	$609,473	$352,140	$142,210	$494,350	$889,830	$39,576	$1,290,519	$507,081	$7,836,480
3	20	2	1	$20,000	170	$2,709	$3,400,000	$460,491	$331,824	$115,123	$446,947	$804,504	$39,576	$1,290,519	$477,827	$6,472,916
3	15	3	1	$20,000	225	$5,418	$4,500,000	$1,218,946	$352,140	$142,210	$494,350	$889,830	$39,576	$1,290,519	$507,081	$8,445,953
3	20	3	1	$20,000	170	$5,418	$3,400,000	$920,981	$331,824	$115,123	$446,947	$804,504	$39,576	$1,290,519	$477,827	$6,933,407
3	15	4	1	$20,000	225	$9,481	$4,500,000	$2,133,155	$352,140	$142,210	$494,350	$889,830	$39,576	$1,290,519	$507,081	$9,360,162
3	20	4	1	$20,000	170	$9,481	$3,400,000	$1,611,717	$331,824	$115,123	$446,947	$804,504	$39,576	$1,290,519	$477,827	$7,624,143
3	15	1	2	$20,000	225	$1,354	$4,500,000	$304,736	$352,140	$142,210	$494,350	$889,830	$39,576	$1,290,519	$507,081	$7,531,743
3	20	1	2	$20,000	170	$1,354	$3,400,000	$230,245	$331,824	$115,123	$446,947	$804,504	$39,576	$1,290,519	$477,827	$6,242,671
3	15	2	2	$20,000	225	$2,709	$4,500,000	$609,473	$352,140	$142,210	$494,350	$889,830	$39,576	$1,290,519	$507,081	$7,836,480
3	20	2	2	$20,000	170	$2,709	$3,400,000	$460,491	$331,824	$115,123	$446,947	$804,504	$39,576	$1,290,519	$477,827	$6,472,916
3	15	3	2	$20,000	225	$5,418	$4,500,000	$1,218,946	$352,140	$142,210	$494,350	$889,830	$39,576	$1,290,519	$507,081	$8,445,953
3	20	3	2	$20,000	170	$5,418	$3,400,000	$920,981	$331,824	$115,123	$446,947	$804,504	$39,576	$1,290,519	$477,827	$6,933,407
3	15	4	2	$20,000	225	$9,481	$4,500,000	$2,133,155	$352,140	$142,210	$494,350	$889,830	$39,576	$1,290,519	$507,081	$9,360,162
3	20	4	2	$20,000	170	$9,481	$3,400,000	$1,611,717	$331,824	$115,123	$446,947	$804,504	$39,576	$1,290,519	$477,827	$7,624,143

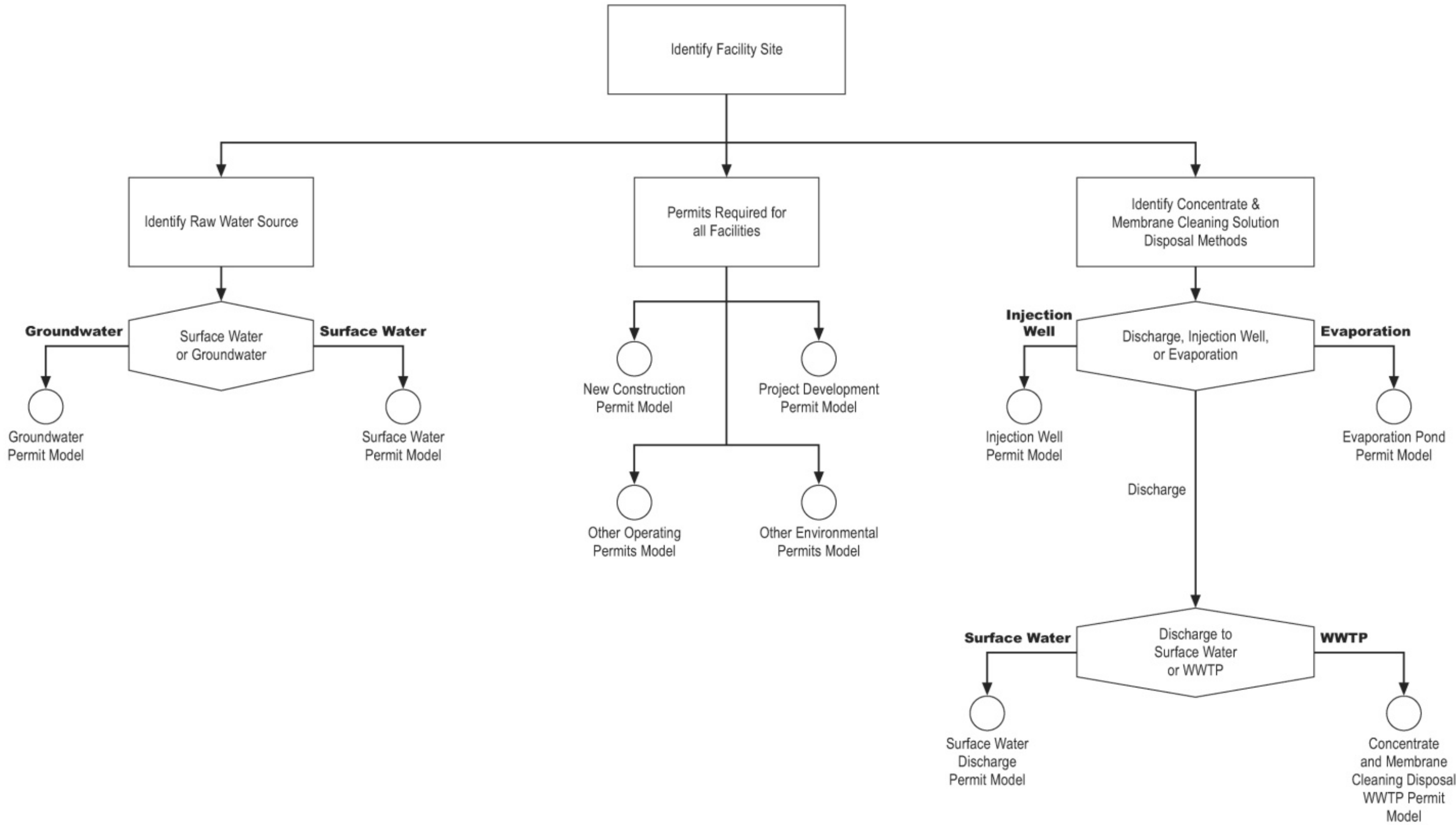
Table 4.
Zero Liquid Disposal Capital and O&M Costs

Flow Rate (MGD)	Reject Level of Unit (%)	Capital Costs: Concentrater Reject/ Feed to Crystallizer (MGD)	Feed to Crystallizer (GPM)	Capital Cost of Installed Concentrator (2008 Dollars)	Capital Cost of Installed Crystallizer (2008 Dollars)	Total Capital Cost (2008 Dollars)	Operation and Maintenance Costs: Energy Usage for Concentrator (kW)	Energy Usage for Crystallizer (kW)	Cost of Electricity (2008 Dollars/kwh)	Annual Energy Cost of Concentrator (2008 Dollars)	Annual Energy Cost of Crystallizer (2008 Dollars)	Total Annual O&M Costs (2008 Dollars)
1	2	0.02	13.88	$9,480,690	$2,302,453	$11,783,143	3700	200	$0.15	$4,861,800	$262,800	$5,124,600
2	2	0.04	27.76	$16,252,612	$3,250,522	$19,503,134	7000	375	$0.15	$9,198,000	$492,750	$9,690,750
3	2	0.06	41.64	$27,764,878	$3,792,276	$31,557,154	10750	550	$0.15	$14,125,500	$722,700	$14,848,200
1	4	0.04	27.76	$9,480,690	$3,250,522	$12,731,212	3700	375	$0.15	$4,861,800	$492,750	$5,354,550
2	4	0.08	55.52	$16,252,612	$4,198,591	$20,451,203	7000	760	$0.15	$9,198,000	$998,640	$10,196,640
1	6	0.06	41.64	$9,480,690	$3,724,557	$13,205,247	3700	550	$0.15	$4,861,800	$722,700	$5,584,500
1	8	0.08	55.52	$9,480,690	$4,198,591	$13,679,281	3700	760	$0.15	$4,861,800	$998,640	$5,860,440

Appendix J

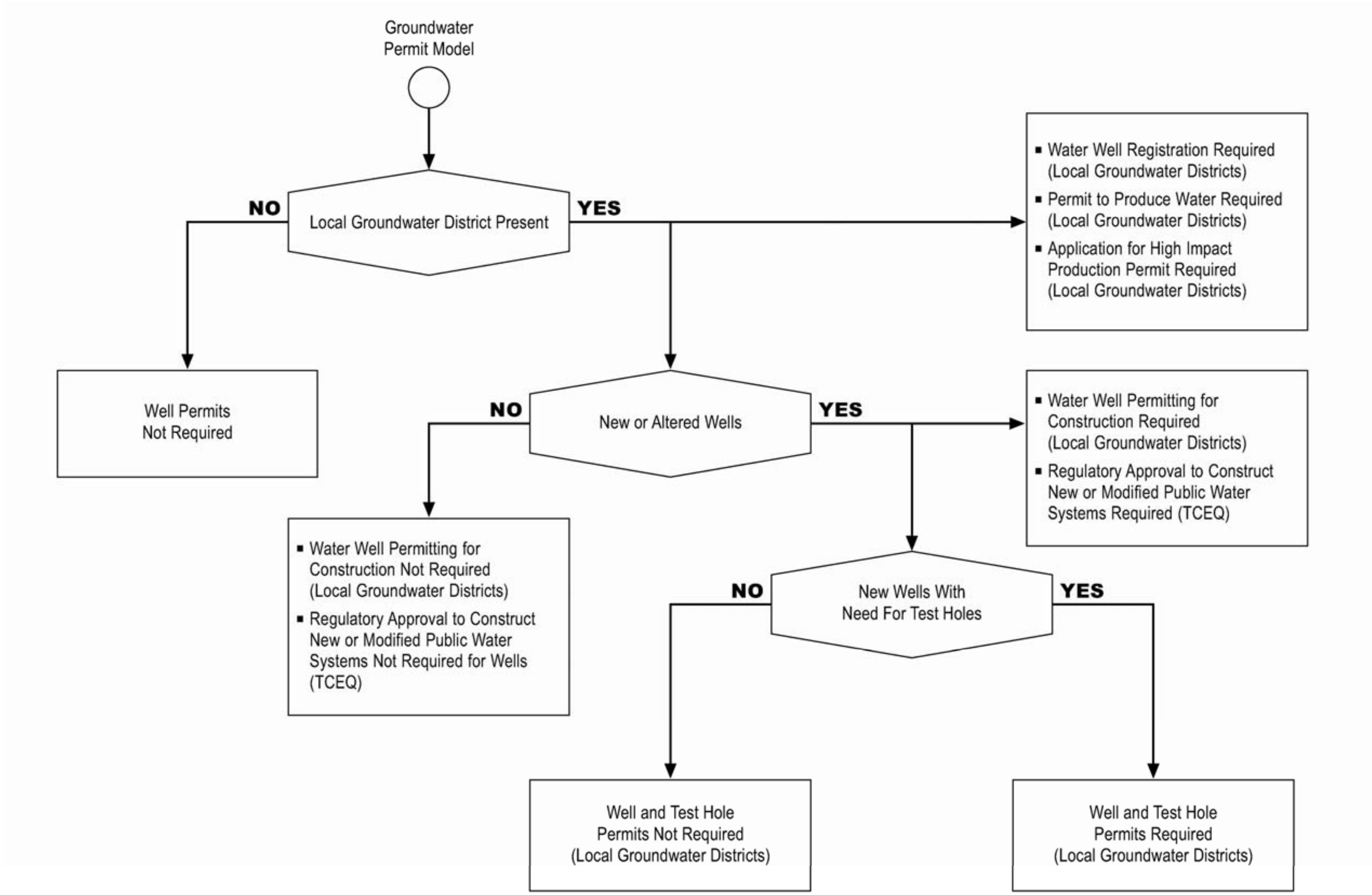
Regulatory Models

Permitting Model Overview for Desalination Facilities in Texas [1]



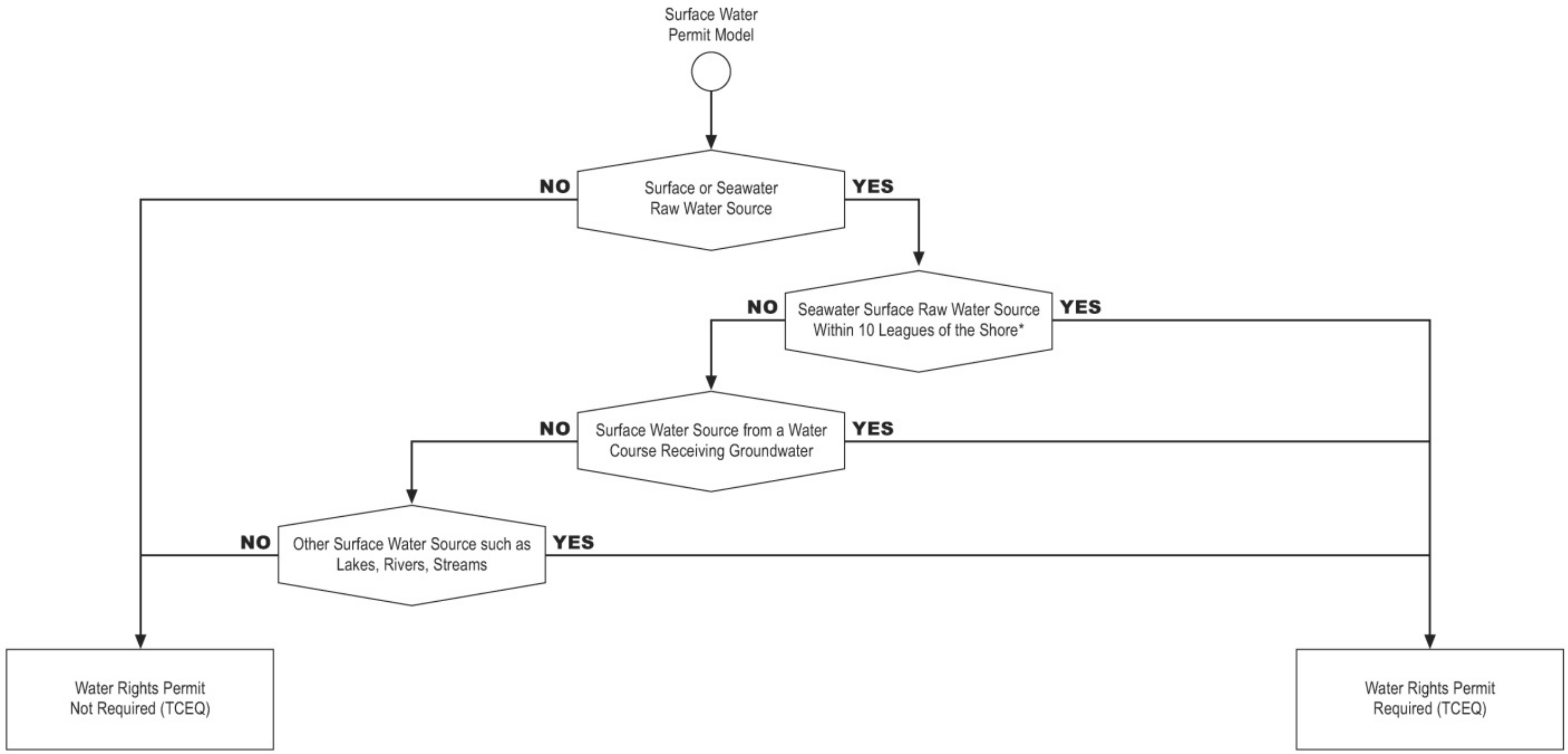
Source: Figure 7-1, Guidance Manual for Permitting Requirements in Texas for Desalination Facilities Using Reverse Osmosis Processes, 2004.

Groundwater Permitting Model (1)



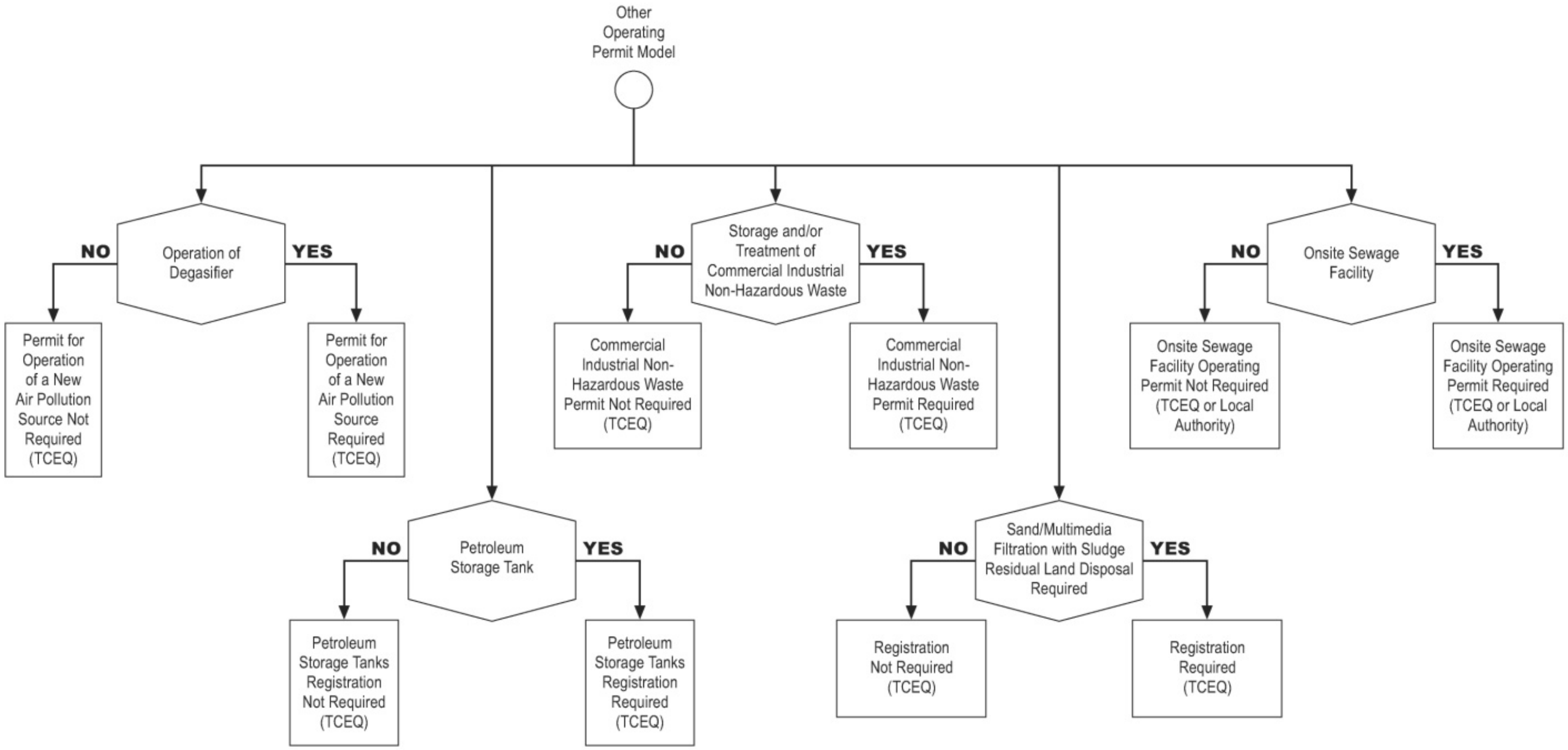
Source: Figure 7-1, Guidance Manual for Permitting Requirements in Texas for Desalination Facilities Using Reverse Osmosis Processes, 2004.

Surface Water Permitting Model [1]



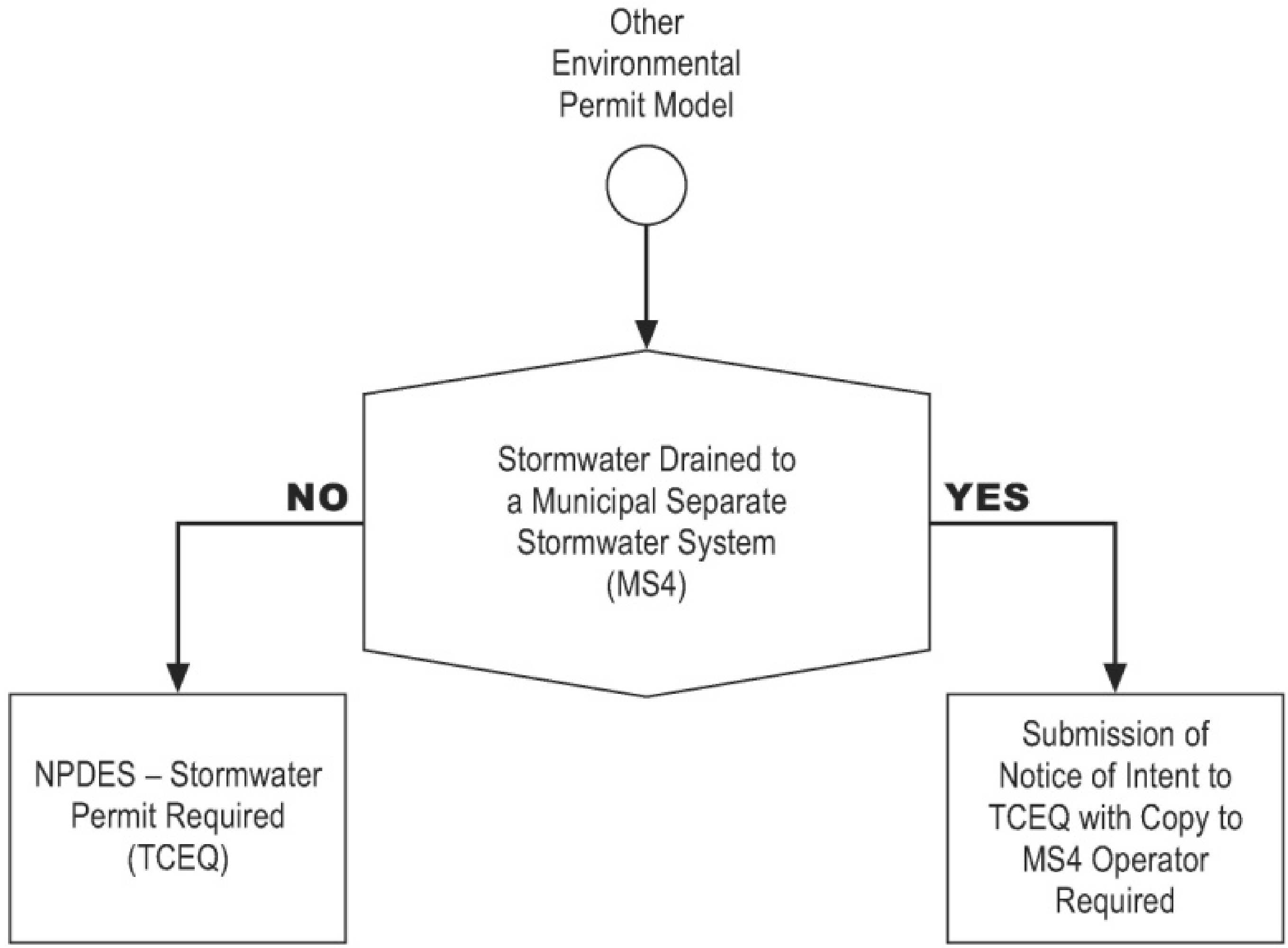
Source: Figure 7-1, Guidance Manual for Permitting Requirements in Texas for Desalination Facilities Using Reverse Osmosis Processes, 2004.

Other Operating Permits Model (1)



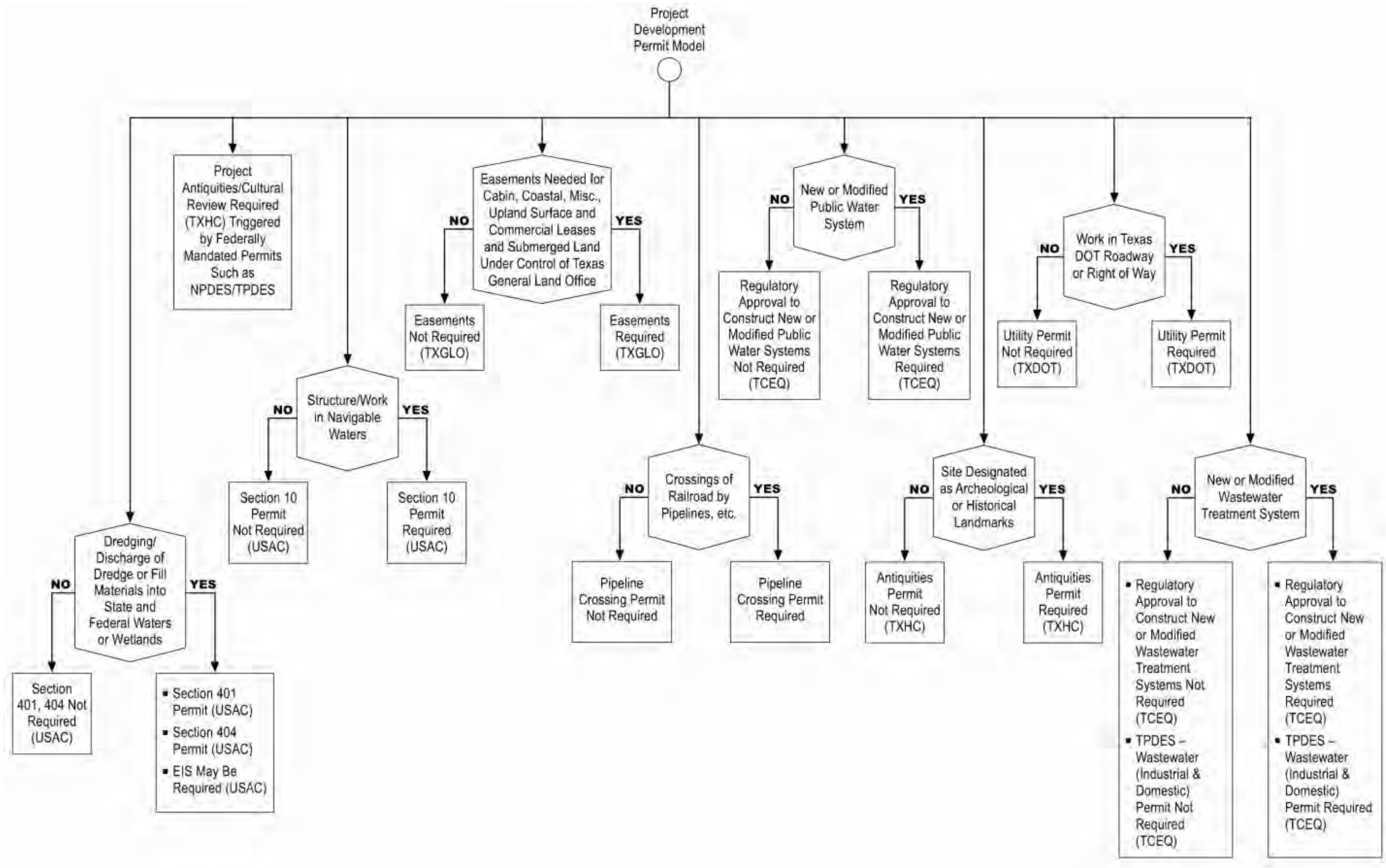
Source: Figure 7-1, Guidance Manual for Permitting Requirements in Texas for Desalination Facilities Using Reverse Osmosis Processes, 2004.

Other Environmental Permits Model [1]



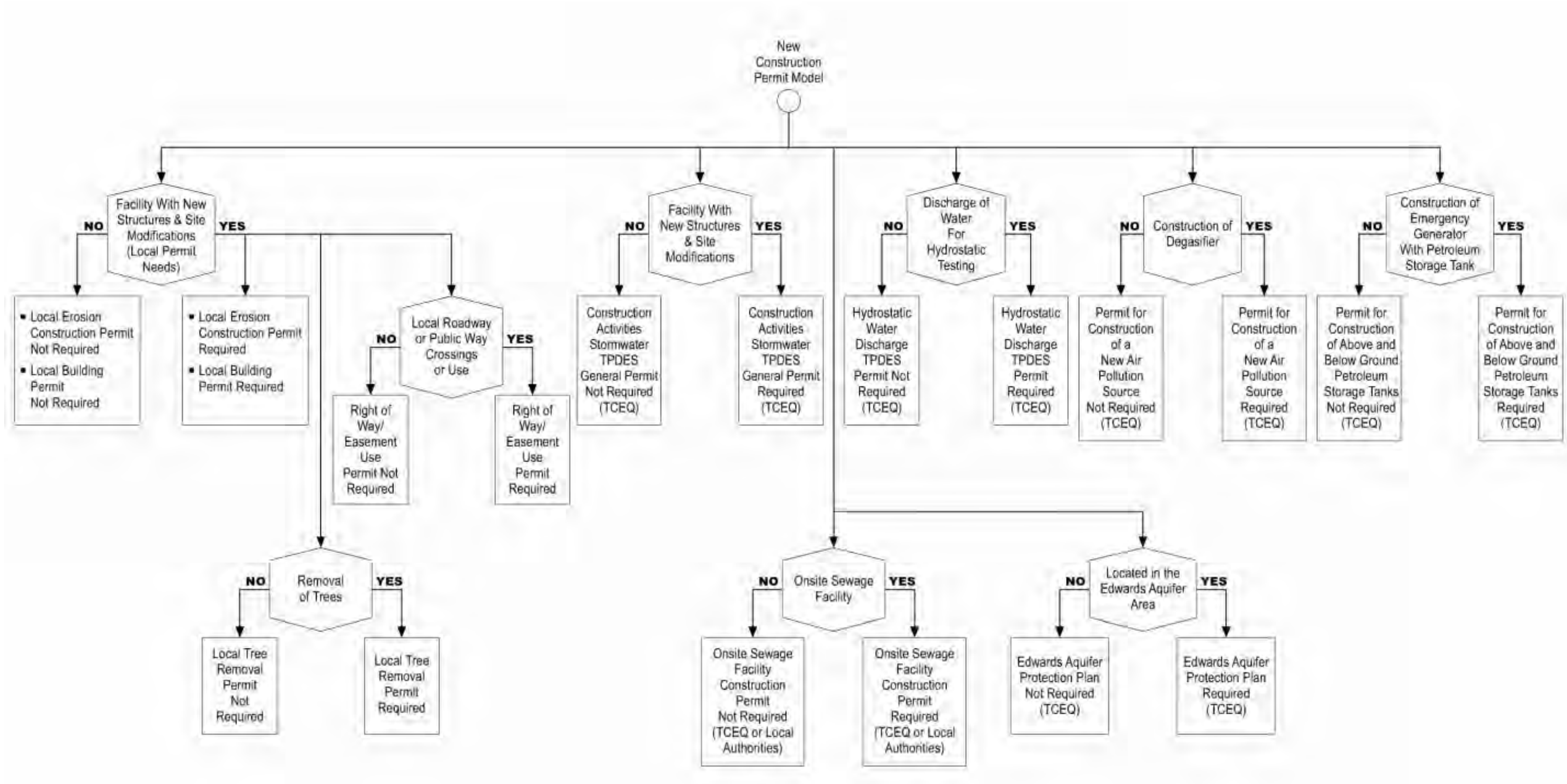
Source: Figure 7-1, Guidance Manual for Permitting Requirements in Texas for Desalination Facilities Using Reverse Osmosis Processes, 2004.

Project Development Permit Model (1)



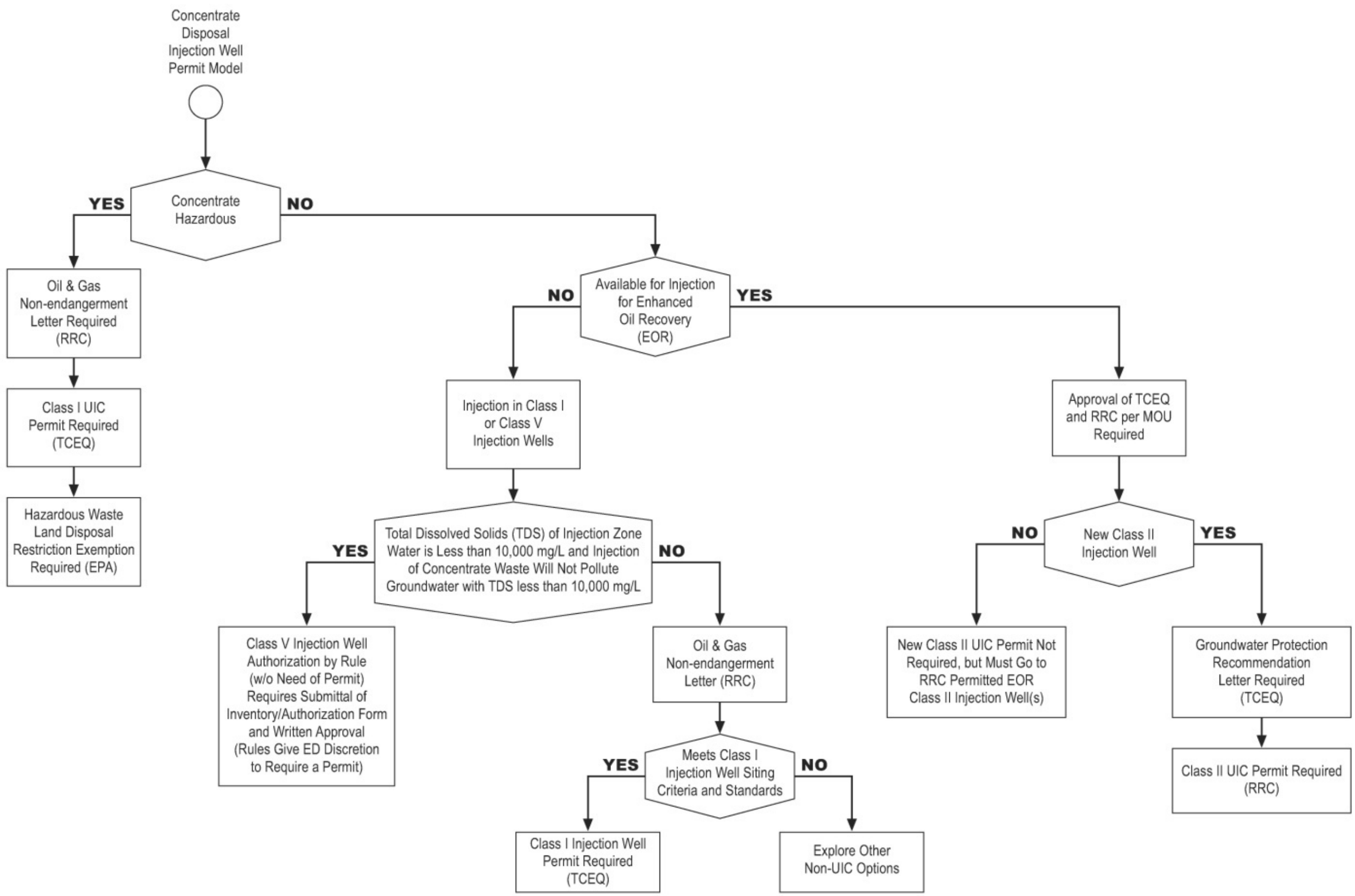
Source: Figure 7-1, Guidance Manual for Permitting Requirements in Texas for Desalination Facilities Using Reverse Osmosis Processes, 2004.

New Construction Permit Model [1]



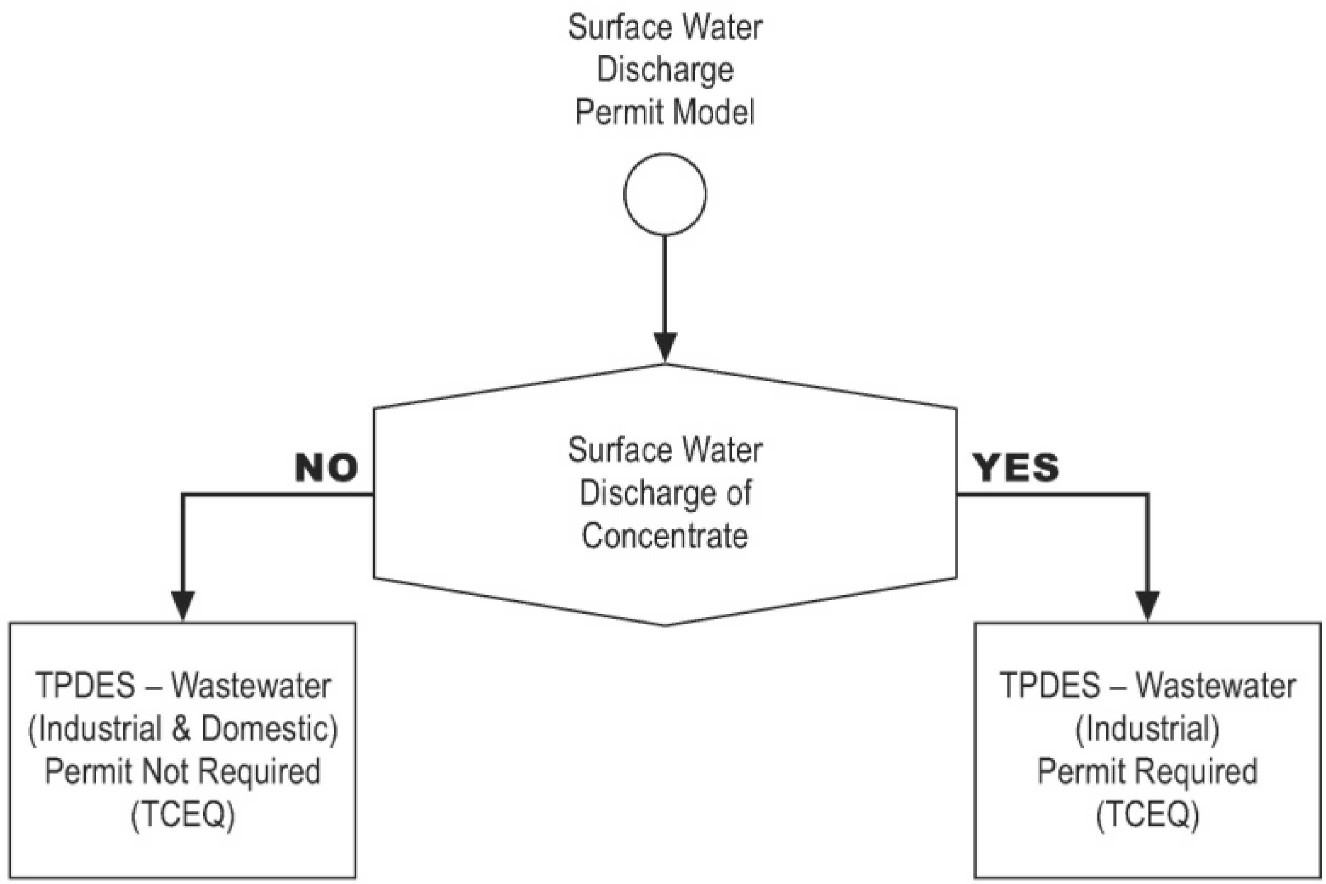
Source: Figure 7-1, Guidance Manual for Permitting Requirements in Texas for Desalination Facilities Using Reverse Osmosis Processes, 2004.

Injection Well Permit Model (1)



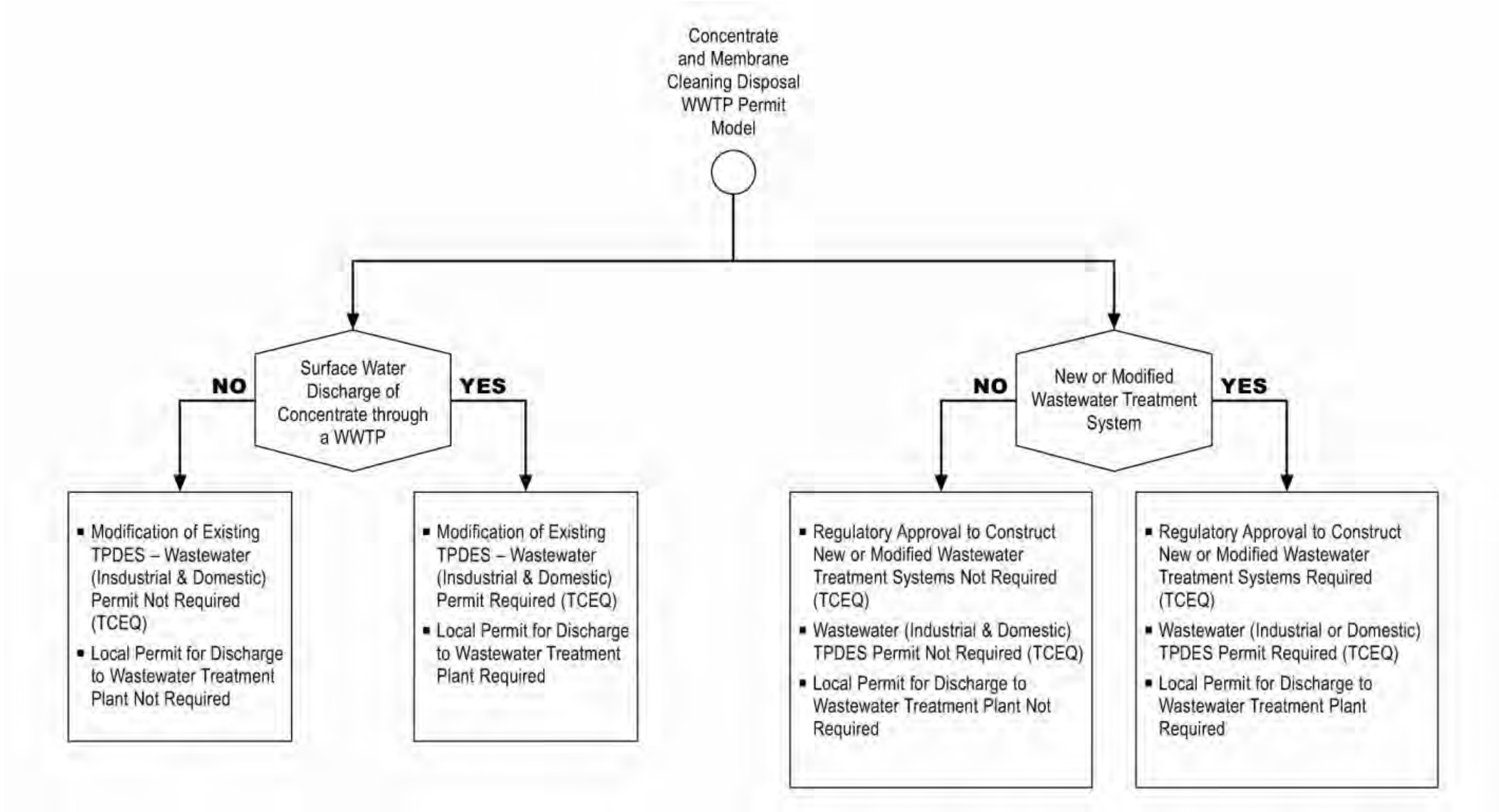
Source: Figure 7-1, Guidance Manual for Permitting Requirements in Texas for Desalination Facilities Using Reverse Osmosis Processes, 2004.

Surface Water Discharge Permit Model [1]



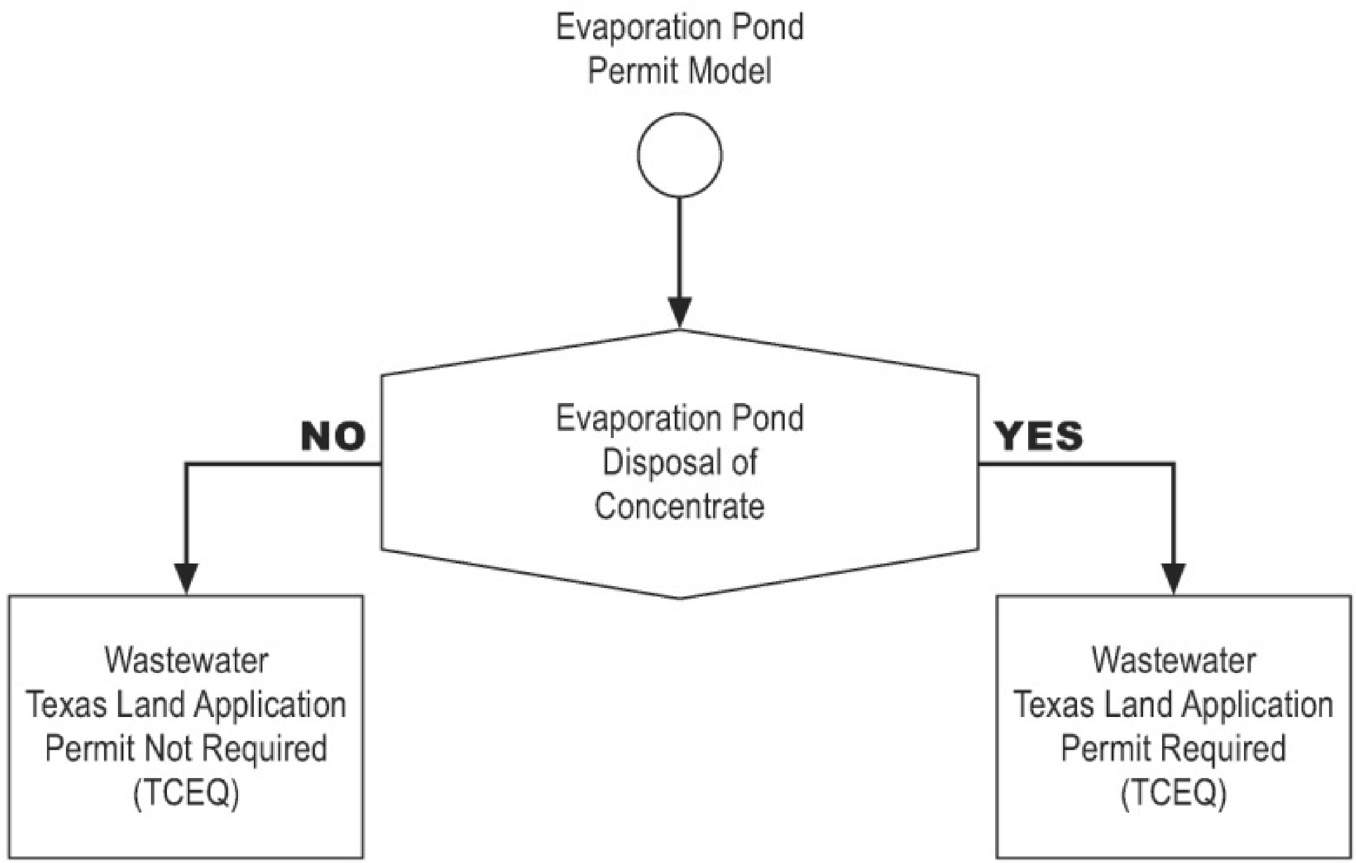
Source: Figure 7-1, Guidance Manual for Permitting Requirements in Texas for Desalination Facilities Using Reverse Osmosis Processes, 2004.

Concentrate and Membrane Cleaning Disposal to a WWTP Permit Model [1]



Source: Figure 7-1, Guidance Manual for Permitting Requirements in Texas for Desalination Facilities Using Reverse Osmosis Processes, 2004.

Evaporation Pond Permit Model (1)



Source: Figure 7-1, Guidance Manual for Permitting Requirements in Texas for Desalination Facilities Using Reverse Osmosis Processes, 2004.

APPENDIX S

COOKE-GRAYSON COUNTY WATER SUPPLY STUDY

Water Supply Study for Cooke and Grayson Counties

September 2010

Prepared for:
Region C Water Planning Group

Prepared by:
Alan Plummer Associates, Inc
Freese and Nichols, Inc.
CP&Y, Inc.

Draft Water Supply Study for Cooke and Grayson Counties
Region C Water Planning Group

TABLE OF CONTENTS

				Page
1.	Executive Summary			ES.1
2.	Introduction			2.1
3.	Population and Demand Projections			3.1
	3.1.	Meetings to Collect Data		3.1
	3.2.	Revisions to Population and Demand Projections		3.2
	3.3.	Recommended Population Projections for WUGs and WWPs		3.4
	3.4.	Recommended Water Demands for WUGs		3.8
4.	Evaluation of Current Supplies			4.1
	4.1	Surface Water		4.1
	4.2	Groundwater		4.2
5	Comparison of Current Supplies to Projected Demand			5.1
6	Revisions to Management Strategies			6.1
	6.1	Cooke County		6.2
		6.1.1	Bolivar WSC	6.2
		6.1.2	Gainesville	6.3
		6.1.3	Kiowa Homeowners WSC	6.5
		6.1.4	Lindsay	6.6
		6.1.5	Muenster	6.7
		6.1.6	Valley View	6.8
		6.1.7	Woodbine WSC	6.9
		6.1.8	Cooke County-Other	6.10
		6.1.9	Cooke County – Non Municipal	6.11
	6.2	Grayson County		6.15
		6.2.1	Bells	6.15
		6.2.2	Collinsville	6.16
		6.2.3	Denison	6.17

6.2.4 Gunter 6.18
6.2.5 Marilee SUD 6.19
6.2.6 Howe 6.20
6.2.7 Luella WSC 6.21
6.2.8 Pottsboro 6.22
6.2.9 Sherman 6.23
6.2.10 South Grayson WSC 6.24
6.2.11 Southmayd 6.25
6.2.12 Southwest Fannin County SUD 6.26
6.2.13 Tioga 6.27
6.2.14 Tom Bean 6.28
6.2.15 Two Way SUD 6.29
6.2.16 Van Alstyne 6.30
6.2.17 Whitesboro 6.31
6.2.18 Whitewright 6.32
6.2.19 Grayson County-Other 6.33
6.2.20 Grayson County – Non Municipal 6.34
7 Estimated Costs for Recommended Water Management Strategies 7.1
8 Implementation Plan for Proposed Water Management Strategies 8.1
9 Alternative Water Management Strategies 9.1
9.1 Cooke County 9.1
9.2 Grayson County 9.1
10 Conclusions 10.1

APPENDICES

Appendix A .... References

Appendix B .... Cost Estimates

Appendix C .... Assumptions for Cost Estimates

Appendix D .... Cost Estimates for Alternative Strategies

Appendix E .... Public Meeting

LIST OF TABLES

		Page
3.1	Meetings with WUGs and WWPs	3.2
3.2	Approved Population Projections in Cooke County	3.5
3.3	Approved Population Projections in Grayson County	3.6
3.4	Approved Population Projections for Cooke County Entities Split by County	3.7
3.5	Approved Population Projections for Grayson County Entities Split by County	3.8
3.6	Approved Cooke County Municipal Per Capita Water Use Projections in Gallons Per Person Per Day	3.9
3.7	Approved Cooke County Municipal Per Capita Water Use Projections in Gallons Per Person Per Day	3.10
3.8	Approved Gainesville Wholesale Water Provider Projections	3.12
3.9	Approved Greater Texoma Utility Authority Wholesale Water Provider Projections	3.13
3.10	Approved Cooke County Demand Projections in Acre-Feet per year	3.14
3.11	Approved Grayson County Demand Projections in Acre-Feet per year	3.14
6.1.1	Bolivar WSC	6.3
6.1.2	Gainesville	6.4
6.1.3	Kiowa Homeowners WSC	6.5
6.1.4	Lindsay	6.6
6.1.5	Muenster	6.7
6.1.6	Valley View	6.8
6.1.7	Woodbine WSC	6.9
6.1.8	Cooke County-Other	6.10
6.1.9	Cooke County – Irrigation	6.11
6.1.10	Cooke County – Livestock	6.12
6.1.11	Cooke County – Manufacturing	6.13
6.1.12	Cooke County – Mining	6.14
6.2.1	Bells	6.15
6.2.2	Collinsville	6.16
6.2.3	Denison	6.17
6.2.4	Gunter	6.18
6.2.5	Marilee SUD	6.19
6.2.6	Howe	6.20
6.2.7	Luella WSC	6.21
6.2.8	Pottsboro	6.22
6.2.9	Sherman	6.23
6.2.10	South Grayson WSC	6.24
6.2.11	Southmayd	6.25
6.2.12	Southwest Fannin County SUD	6.26
6.2.13	Tioga	6.27
6.2.14	Tom Bean	6.28
6.2.15	Two Way SUD	6.29

6.2.16	Van Alstyne	6.30
6.2.17	Whitesboro	6.31
6.2.18	Whitewright	6.32
6.2.19	Grayson County-Other	6.33
6.2.20	Grayson County – Irrigation	6.34
6.2.21	Grayson County – Livestock	6.35
6.2.22	Grayson County – Manufacturing	6.36
6.2.23	Grayson County – Mining	6.37
6.2.24	Grayson County – Steam Electric Power	6.38
7.1	Capital Costs for Recommended Water Management Strategies Not Associated with WWPs	7.1
7.2	Capital Costs for Recommended Water Management Strategies Associated with WWPs	7.2
8.1	Implementation of Recommended Water Management Strategies	8.1

LIST OF FIGURES

		Page
2.1	Cooke and Grayson County Study Area	2.1
3.2	Approved Population Projections for Cooke County	3.5
3.3	Approved Population Projections for Grayson County	3.7
3.4	Approved Demand Projections for Cooke County	3.9
3.5	Approved Demand Projections for Grayson County	3.11
10.1	Total Projected Municipal Water Demand and Supply for Cooke County	10.1
10.2	Total Projected Municipal Water Demand and Supply for Grayson County	10.2

Region C Water Planning Group
Water Supply Study for Cooke and Grayson Counties

1. Executive Summary

As part of the 2011 Region C water planning process, several county studies were included to more closely examine the water management strategies of those counties. Cooke and Grayson Counties are two of the counties included in the studies. The purpose of this study is to provide supplementary information regarding water management strategies and to then analyze the feasibility of developing Cooke and Grayson County Water Supply Systems. Water management strategies (WMSs) were updated based on information obtained from meetings with various water user groups (WUGs) in Cooke and Grayson Counties as well as from surveys mailed to every WUG in Region C. Several WMSs were revised to reflect new demand projections as determined in the *2011 Region C Water Plan* (1). The population projections in the *2011 Region C Water Plan* (1) are lower for Cooke County than the *2006 Region C Water Plan* (2). All demand projections except 2010 are higher for Cooke County in the *2011 Region C Water Plan* (1) than the *2006 Region C Water Plan* (2). The population and demand projections in the *2011 Region C Water Plan* (1) are both lower for Grayson County than the *2006 Region C Water Plan* (2). Cost estimates and an implementation plan for water management strategies are also included in this report.

The majority of WUGs in Cooke and Grayson Counties rely on groundwater from the Trinity and Woodbine Aquifers. The only surface water source is from Moss Lake in Cooke County and Lake Randell and Lake Texoma in Grayson County.

(1) Superscripted numbers in parenthesis match references in Appendix A

COOKE COUNTY


COOKE COUNTY COURTHOUSE

2000 Population: 36,363

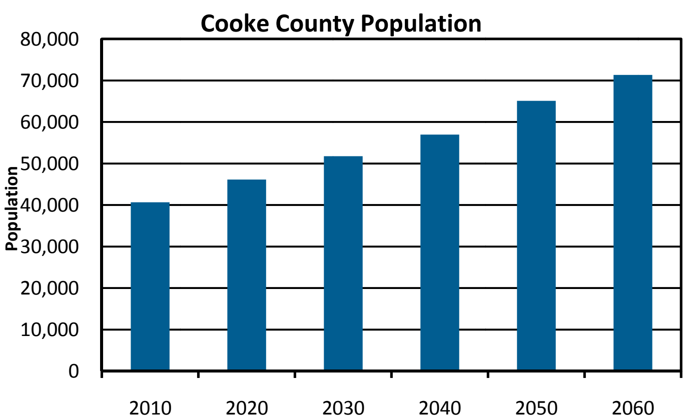
Projected 2060 Population: *71,328*

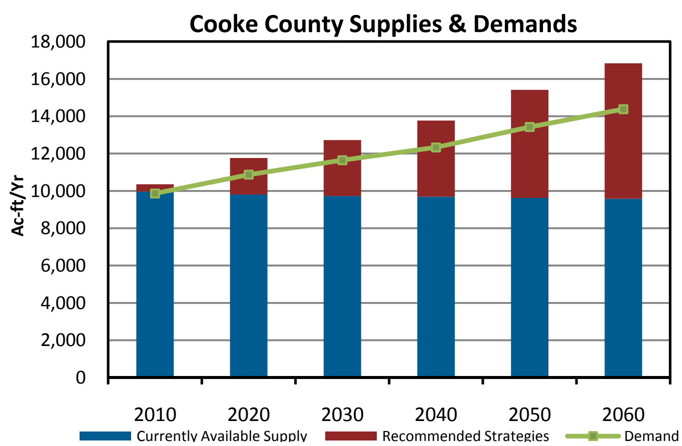
County Seat: Gainesville

Economy: *Oil, agribusiness, tourism, manufacturing*

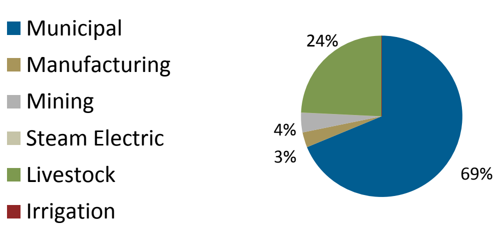
River Basin(s):

– *Trinity (67%), Red (32%)*



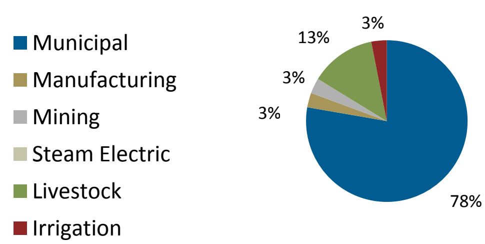


2000 Cooke County Demand
(% of total)



Total=7,270 acre-feet

2060 Cooke County Demand
(% of total)

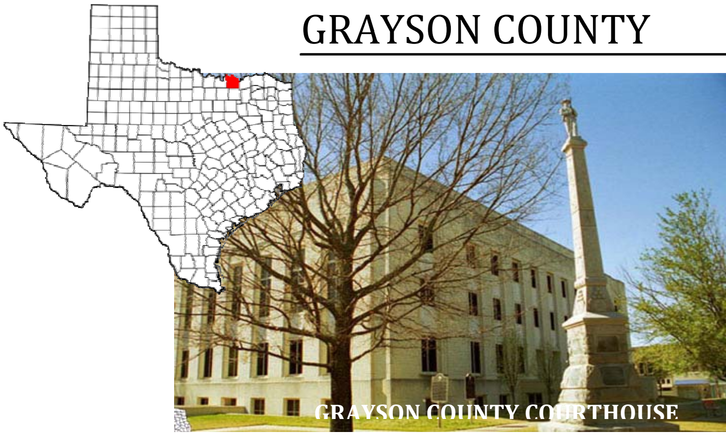


Total= 14,381 acre-feet

COOKE COUNTY

WATER USER GROUP	2060 COOKE CO. DEMAND (AC-FT/YR)	CURRENT SUPPLIES	RECOMMENDED STRATEGIES [b]
Bolivar WSC [a]	285	Trinity Aquifer	Supplemental wells, UTRWD supplies, Cooke County Water Supply Project
Gainesville	5,522	Trinity Aquifer, Moss Lake	Supplemental wells, Overdraft Trinity Aquifer (2010), Cooke County Water Supply Project (raw water delivery and water treatment)
Kiowa Homeowners WSC	947	Trinity Aquifer	Supplemental wells, Cooke County Water Supply Project
Lindsay	160	Trinity Aquifer	Supplemental wells, Cooke County Water Supply Project
Muenster	414	Trinity Aquifer	Supplemental wells, Develop Muenster Lake supply
Two Way SUD [a]	11	Trinity Aquifer	Supplemental wells, Grayson County Water Supply Project
Valley View	1,714	Trinity Aquifer	Supplemental wells, Cooke County Water Supply Project
Woodbine WSC [a]	902	Trinity Aquifer	Supplemental wells, Cooke County Water Supply Project
County-Other	1,222	Trinity, Woodbine, and Other Aquifers	Supplemental wells, Cooke County Water Supply Project
Irrigation	444	Trinity and Other Aquifers, Direct reuse (Gainesville), Local supplies	Supplemental wells, Overdraft of Trinity Aquifer (2010), Cooke County Water Supply Project, Additional reuse
Livestock	1,898	Trinity Aquifer, Local supplies	Supplemental wells
Manufacturing	421	Trinity Aquifer, Gainesville	Supplemental wells, Muenster Lake, Cooke County Water Supply Project
Mining	441	Trinity Aquifer, Local supplies	Supplemental wells, Overdraft Trinity Aquifer (2010), Reuse, Cooke County Water Supply Project
Steam Electric Power	0	None	None

[a] WUG is in multiple counties
[b] Water conservation is a strategy for every municipal user group.



2000 Population: *110,595*

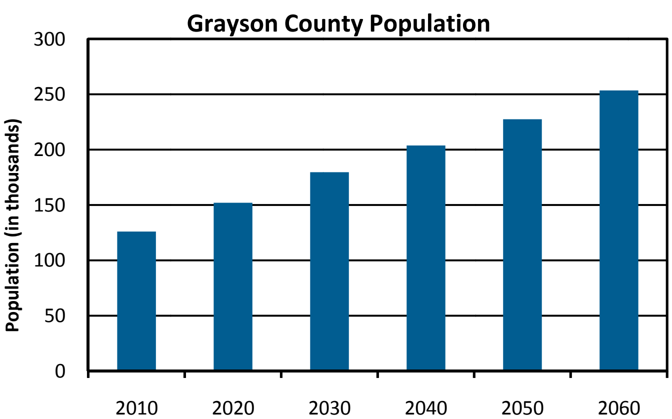
Projected 2060 Population: *253,568*

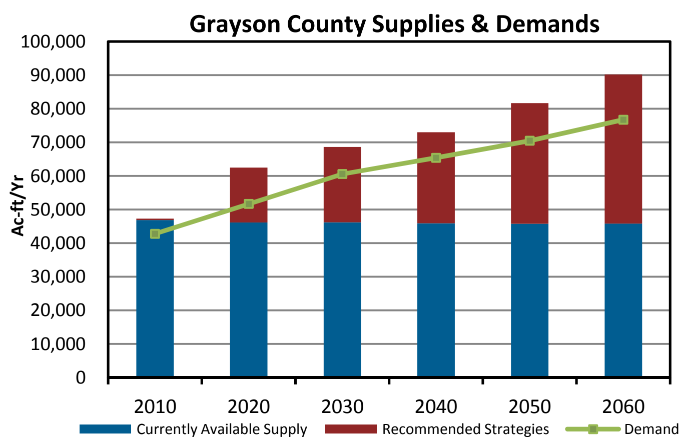
County Seat: *Sherman*

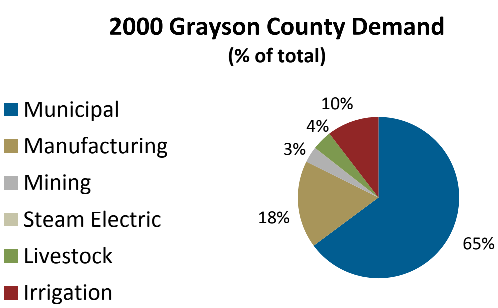
Economy: *Manufacturing, distribution and trade; tourism; mineral production.*

River Basin(s):

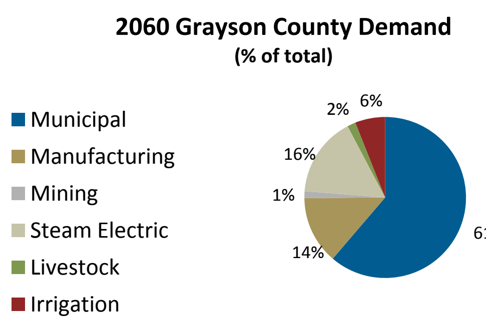
– Trinity (36%), Red (64%)







Total=32,478 acre-feet



Total= 76,742 acre-feet

WATER USER GROUP	2060 GRAYSON CO. DEMAND (AC-FT/YR)	CURRENT SUPPLIES	RECOMMENDED STRATEGIES [b]
Bells	493	Trinity and Woodbine Aquifers	Supplemental wells, Grayson County Water Supply Project
Collinsville	899	Trinity Aquifer	Supplemental wells, Grayson County Water Supply Project
Denison	6,875	Trinity and Woodbine Aquifers, Randell Lake, Lake Texoma	Supplemental wells, Water treatment plant expansion and additional Lake Texoma, infrastructure improvements
Gunter	1,149	Trinity Aquifer	Supplemental wells, Grayson County Water Supply Project
Howe	588	Woodbine Aquifer, Collin-Grayson Municipal Alliance (GTUA & NTMWD)	Supplemental wells, Additional Collin-Grayson Municipal Alliance
Luella WSC	1,365	Woodbine Aquifer	Supplemental wells, Grayson County Water Supply Project
Marilee SUD [a]	672	Trinity Aquifer, Grayson County Water Supply Project	Supplemental wells, Additional Grayson County Water Supply Project
Pottsboro	1,976	Woodbine Aquifer, Denison	Supplemental wells, Grayson County Water Supply Project
Sherman	19,804	Trinity and Woodbine Aquifers, Lake Texoma (GTUA)	Supplemental wells, Grayson County Water Supply Project
South Grayson WSC [a]	672	Trinity and Woodbine Aquifers	Supplemental wells, Grayson County Water Supply Project, Collin-Grayson Municipal Alliance (GTUA & NTMWD)
Southmayd	703	Trinity Aquifer, Monarch Water Company (Woodbine Aquifer)	Supplemental wells, Woodbine Aquifer, Grayson County Water Supply Project
Southwest Fannin County SUD [a]	46	Woodbine Aquifer	Supplemental wells, Fannin County Water Supply Project
Tioga	757	Trinity Aquifer	Supplemental wells, Grayson County Water Supply Project
Tom Bean	448	Woodbine Aquifer	Supplemental wells, Grayson County Water Supply Project
Two Way SUD [a]	1,497	Trinity Aquifer	Supplemental wells, Grayson County Water Supply Project
Van Alstyne	3,549	Trinity and Woodbine Aquifers, Collin-Grayson Municipal Alliance (GTUA & NTMWD)	Supplemental wells, Additional Collin-Grayson Municipal Alliance
Whitesboro	1,635	Trinity Aquifer	Supplemental wells, Grayson County Water Supply Project
Whitewright [a]	1,411	Woodbine Aquifer	Supplemental wells, Grayson County Water Supply Project
Woodbine WSC [a]	13	Trinity Aquifer	Supplemental wells, Cooke County Water Supply Project
County-Other	2,461	Other, Trinity, and Woodbine Aquifers, Sherman, Denison, Red River Authority	Supplemental wells, Grayson County Water Supply Project

WATER USER GROUP	2060 GRAYSON CO. DEMAND (AC-FT/YR)	CURRENT SUPPLIES	RECOMMENDED STRATEGIES [B]
Irrigation	4,616	Woodbine Aquifer, Local supplies, Lake Texoma	Supplemental wells
Livestock	1,297	Woodbine Aquifer, Local supplies	Supplemental wells
Manufacturing	10,444	Woodbine Aquifer, Local supplies, Sherman, Howe (Collin-Grayson Municipal Alliance – GTUA & NTMWD), Denison	Supplemental wells, Grayson County Water Supply Project, Additional Howe, Additional Dension
Mining	1,046	Trinity and Woodbine Aquifers	Supplemental wells
Steam Electric Power	12,326	Sherman [GTUA (Lake Texoma)]	Additional Lake Texoma (GTUA)

[a] WUG is in multiple counties

[b] Water conservation is a strategy for every municipal user group.

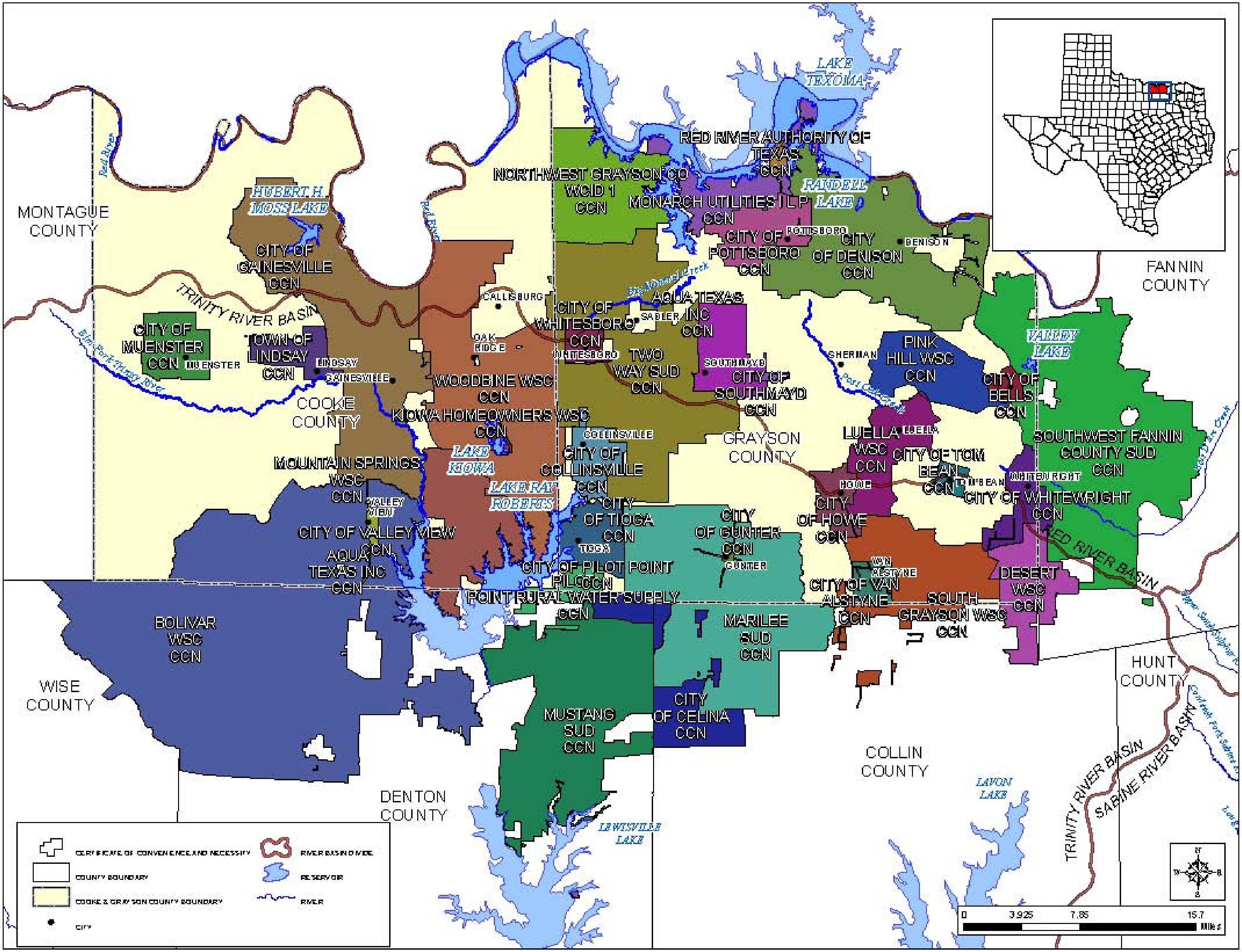
2. Introduction

As part of the 2011 Region C water planning process, several county Studies were included to more closely examine the water management strategies of those counties. Cooke and Grayson Counties are two of the counties included in the Studies. The purpose of this study is to provide supplementary information regarding water management strategies and to then analyze the feasibility of developing Cooke and Grayson County Water Supply Systems.

The Cooke and Grayson County study area is shown in Figure 2.1. Populations by decade through 2060 are projected to be up to 7.1% lower than what was projected in the *2006 Region C Water Plan* (2) , and the water demands over the same period are projected to be between 4.5% and 9.5% lower than what was projected in the *2006 Region C Water Plan* (2) for Grayson County. Water demands over the same period for Cooke County are projected to be 0.8% to 1.9% higher than what was projected in the *2006 Region C Water Plan* (2) despite the decrease in population projections for every planning period except 2010. Increased projected per capita demands account for the higher Cooke County demand. Population, demands and supplies are characterized in more detail in subsequent sections.

This report summarizes the analysis and recommendations for meeting water demand projections for water user groups in the Cooke and Grayson County Study area.

Figure 2.1
Cooke-Grayson County Study



3. Population and Demand Projections

3.1. Meetings to Collect Data

Alan Plummer Associates (APAI) met with water user groups (WUGs) in Cooke and Grayson Counties during September 2009. **Table 3.1** lists the meetings held and the meeting participants. A survey covering existing and projected populations, demands, supplies and strategies as defined in the *2006 Region C Water Plan*(2) was sent to each WUG prior to these meetings. In some cases the WUG revised and resubmitted these values. At each meeting, APAI presented the population and demand projections as shown in the regional water plans and the proposed revisions, if applicable. The current population and water use estimates of the entity and their existing and/or potential future customers were discussed. Many entities provided information related to recent water use, pumping capacity and number of connections.

The current water supply for each entity, the recommended water management strategies as presented in the regional water plans, and any suggested adjustments to those recommendations were discussed. In most cases, the entities plan to implement the recommended strategies, although the amounts of supply may change. In a few cases, the entities are pursuing other options for water supply to meet their future needs.

The information obtained in these meetings was used to develop updated population and demand projections presented in this report. The updated information related to water supply was used to supplement or update proposed management strategies.

APAI met with the North Texas Municipal Water District (NTMWD) and Greater Texoma Utility Authority (GTUA) on August 24, 2009. The purpose of the meeting was to coordinate the special study with the existing wholesale water providers (WWPs) in the area. APAI reviewed the *2006 Region C Water Plan* (2) strategies for Cooke and Grayson County WUGs with NTWMD and GTUA for reference. GTUA is projected to meet future Grayson County demands through the Grayson County Water Supply Project, described in more detail in later sections of this report.

Table 3.1
Meetings with WUGs

Date	Entity	WUG Attendees	Meeting Location
September 2, 2009	City of Gainesville	Ron Sellman, Earl Williams	Gainesville City Hall
September 10, 2009	City of Lindsay	Don Metzler, Danny Nortman	Muenster City Hall
September 10, 2009	City of Muenster	Stan Endres	Muenster City Hall
September 8, 2009	Kiowa Homeowners WSC	Ronny Young	Whitesboro City Hall
September 8, 2009	Two Way Special Utility District	Jeff Bice	Whitesboro City Hall
September 8, 2009	Woodbine WSC	Rickey Kemp	Whitesboro City Hall
September 2, 2009	City of Denison	David Howerton, Dean Rylant	Denison Public Works Department Offices
September 11, 2009	City of Gunter	Mark Millar	Tioga City Hall
September 11, 2009	Marilee SUD	Denny Brackeen, Donna Loiselle	Tioga City Hall
September 14, 2009	City of Howe	Michael Jones	Whitewright City Hall
September 8, 2009	City of Pottsboro	Kevin Farley	Whitesboro City Hall
September 21, 2009	City of Sherman	Mark Gibson	Sherman Public Works Department Offices
September 24, 2009	South Grayson WSC	John Spencer	Telephone Interview
September 11, 2009	City of Southmayd	Jack Ransom, Daniel Pepe	Tioga City Hall
September 11, 2009	City of Tioga	Jim Hale	Tioga City Hall
September 8, 2009	City of Whitesboro	Bill Goodson, CC Beasley	Whitesboro City Hall
September 14, 2009	City of Whitewright	Michael Marter	Whitewright City Hall

3.2. Revisions to Population and Demand Projections

The following section discusses the revisions to population and demand as recommended in this study. Municipal per capita water uses and population are used to determine water demand. Municipal per capita water use is the sum of residential, commercial, and institutional water use divided by the population served. Note that the recommended population and demand projections fall in the middle of a range of projections. It is estimated that the actual population and demand values could be 15 percent higher or lower than the recommended values.

The *2006 Region C Water Plan* [2] population and demand projections were used as base projections for this study. More recent historical trends and demographic information was used, as available, to verify the *2006 Region C Water Plan* [2] projections. Revisions to the *2006 Region C Water Plan* [2] were made as needed and the updated projections were sent to each WUG in Cooke and Grayson Counties for review and comment. Final updated projections were created based on the historical trends, updated demographics and survey responses.

Review of Cooke and Grayson County WUG Status

As part of this special study the water utility providers in Cooke and Grayson Counties were reviewed to determine if any additional entities should be considered for inclusion in future water planning cycles. Municipal demand that is not defined through official WUGs is compiled into a 'County-Other' designation for planning purposes. The TWDB states that a WUG is defined as one of the following:

- Cities and towns with populations of 500 or more
- Non-city utilities providing more than 280 acre-feet per year of water for municipal use

The TCEQ water utility database (WUD) was reviewed for Cooke and Grayson Counties[3]. Based on the WUD there are 80 public water utilities or cities in Cooke and Grayson Counties, of which 23 were included in the 2006 Plan. Of the remaining 57 utilities, 53 are utility districts and 4 are municipalities. There are four utility districts with demands greater than 280 acre-feet per year, all in Grayson County: Kentuckytown WSC, RRA Preston Shores Water System, Sherwood Shores and Tanglewood on Texoma [3]. One municipality, the City of Callisburg in Cooke County, has an estimated existing population of 1650 people. This city and utilities should be reviewed in advance of the next planning cycle for possible inclusion as WUGs. Other entities could experience growth that would place them in WUG status and as such the same planning-level review should occur for future planning periods.

Additional County Aggregated Projections

APAI collected the demand projections developed in the regional water planning process for county-other, manufacturing, mining, irrigation, livestock and steam electric power. No demands were adjusted in this study for manufacturing, mining, irrigation or livestock. Steam electric power demands were updated based on additional data collected on the number and type of plants as well as updated current and projected operational status [(4)]. Strategies for non-municipal water supplies are discussed in more detail in Section 6.

3.3. Recommended Population Projections for WUGs and WWPs

APAI collected available historical and projected population data for each entity through the in-person meetings. Additional historical population data was gathered from the Texas State Data Center [(5)] and the U.S. Census [(6)]. APAI also gathered population projections previously approved by the Texas Water Development Board for regional water planning.

In Cooke County two WUGs had revisions to previous population projections: Gainesville and Muenster. Population projections were decreased based on recent historical data and survey responses. In Grayson County ten WUGs had revisions to previous population projections: Bells, Gunter, Howe, Luella WSC, Marilee SUD, Southmayd, Tom Bean, Van Alstyne, Whitesboro, and Whitewright. Population projections were decreased based on recent historical data and survey responses. Recommended population projections for Cooke and Grayson Counties are shown in **Table 3.2** and **Table 3.3**, respectively. County population data for WUGs in Cooke and Grayson Counties are displayed in **Figure 3.1** and **Figure 3.2,** respectively. Data in these tables and figures includes only population inside of Cooke and Grayson Counties. Three WUGs include service areas outside of Cooke County: Bolivar WSC, Two Way SUD and Woodbine WSC. Six WUGs include service areas outside of Grayson County: Marilee WSC, South Grayson WSC, Southwest Fannin County SUD, Two Way WSC, Whitewright, and Woodbine WSC. Total population for these entities split by county are shown in **Table 3.4** and **Table 3.5** for Cooke and Grayson Counties, respectively.

Table 3.2
Approved Population Projections in Cooke County

Water User Group	2011 Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Bolivar WSC	1,666	1,787	1,849	1,859	1,859	1,858
Gainesville	16,800	19,000	21,400	23,900	26,400	29,000
Kiowa Homeowners WSC	3,324	3,567	3,691	3,711	3,710	3,709
Lindsay	879	943	976	981	981	981
Muenster	1,700	1,800	1,900	2,000	2,100	2,200
Two Way WSC	84	90	93	93	93	93
Valley View	1,500	3,000	5,000	7,000	12,000	15,000
Woodbine WSC	5,234	5,773	6,307	6,839	7,370	7,901
County-Other	9,487	10,181	10,533	10,590	10,586	10,586
County - Total	40,674	46,141	51,749	56,973	65,099	71,328

Figure 3.2

Approved Population Projections in Cooke County

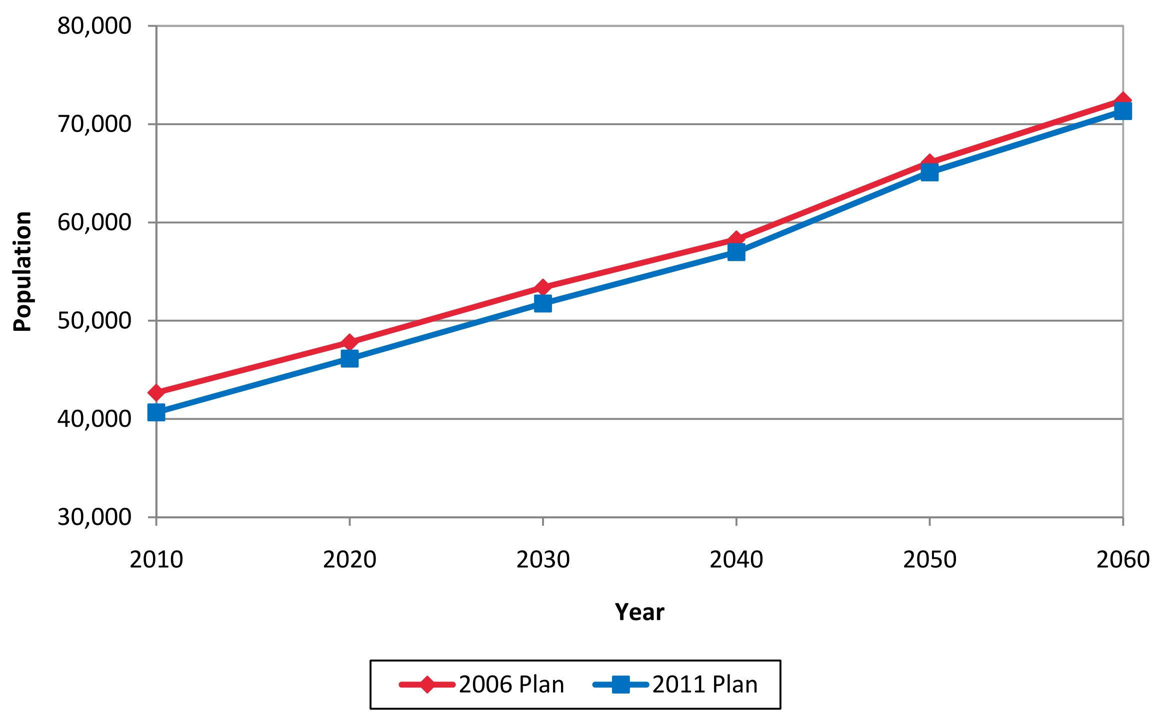


Table 3.3

Approved Population Projections in Grayson County

Water User Group	2011 Projections					
	2010	2020	2030	2040	2050	2060
Bells	1,400	2,100	2,750	3,250	3,700	4,000
Collinsville	2,035	2,835	3,635	4,435	5,235	6,035
Denison	25,000	28,000	30,000	31,000	32,000	33,000
Gunter	2,000	3,500	5,000	6,500	8,000	9,000
Marilee SUD	649	1,067	1,600	2,200	3,500	5,000
Howe	3,000	4,500	6,500	8,500	9,772	10,781
Luella WSC	3,300	3,800	4,300	4,950	5,080	5,770
Pottsboro	3,000	5,000	7,000	9,000	11,000	12,000
Sherman	39,300	44,400	50,600	57,700	67,000	80,000
South Grayson WSC	1,200	1,900	2,500	3,200	4,000	5,000
Southmayd	1,200	1,500	2,000	3,000	4,500	5,600
Southwest Fannin County SUD	391	391	391	391	391	391
Tioga	1,100	2,500	3,500	4,000	4,400	4,600
Tom Bean	1,100	1,300	1,500	1,700	1,900	2,000
Two Way SUD	4,997	6,630	8,158	9,726	11,289	12,852
Van Alstyne	3,000	7,500	13,500	17,000	18,500	19,200
Whitesboro	4,400	5,000	5,700	6,500	7,500	10,000
Whitewright	2,000	3,200	4,500	5,500	6,500	7,500
Woodbine WSC	102	106	109	110	111	112
County-Other	26,925	26,799	26,482	25,160	23,185	20,727
County - Total	126,099	152,028	179,725	203,822	227,563	253,568

Figure 3.3

Approved Population Projections in Grayson County

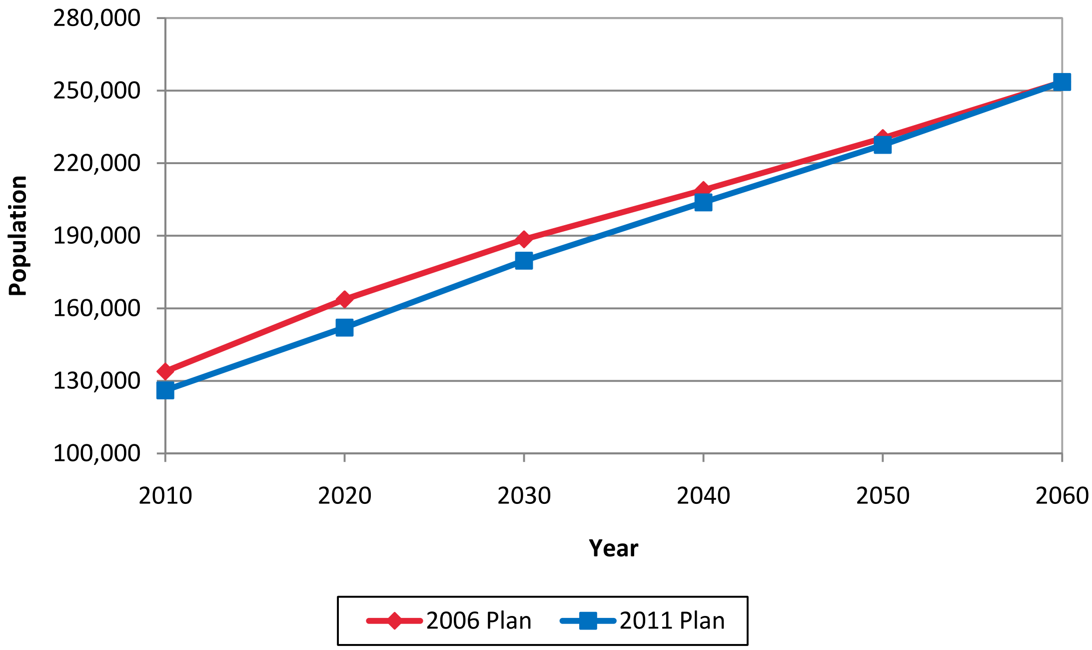


Table 3.4

Approved Population Projections for Cooke County Entities Split by County

Water User Group	2011 Projections					
	2010	2020	2030	2040	2050	2060
Bolivar WSC[(a)]	10,386	12,465	21,806	44,726	70,848	95,836
Two Way SUD[(b)]	5,081	6,720	8,251	9,819	11,382	12,945
Woodbine WSC[(b)]	5,336	5,879	6,416	6,949	7,481	8,013

(a) Cooke, Denton and Wise Counties

(b) Cooke and Grayson Counties

Table 3.5

Approved Population Projections for Grayson County Entities Split by County

Water User Group	Revised Projections					
	2010	2020	2030	2040	2050	2060
Marilee WSC[a]	4,300	6,400	8,653	10,679	13,471	16,560
South Grayson WSC[a]	2,700	3,450	4,100	4,825	5,650	6,675
Southwest Fannin SUD[b]	7,491	8,940	9,947	10,852	11,657	12,463
Two Way WSC[c]	5,081	6,720	8,251	9,819	11,382	12,945
Whitewright[c]	2,022	3,228	4,532	5,535	6,538	7,541
Woodbine WSC[c]	5,336	5,879	6,416	6,949	7,481	8,013

(a) Collin and Grayson Counties

(b) Fannin and Grayson Counties

(c) Cooke and Grayson Counties

3.4. Recommended Water Demands for WUGs and WWPs

Demand projections for each WUG were reviewed and updated as necessary. *2006 Region C Water Plan* [(2)] per capita demands for Cooke County WUGs was reviewed and changes were made to two WUGs: Kiowa Homeowners WSC (increased in *2011 Region C Water Plan* [(1)]) and Two Way SUD (decreased in *2011 Region C Water Plan* [(1)]). *2006 Region C Water Plan* [(2)] per capita demands for Grayson County WUGs was reviewed and changes were made to the following five WUGs: Howe, Sherman, Van Alstyne, and Whitewright (decreased in *2011 Region C Water Plan* [(1)]) and Southmayd (increased in *2011 Region C water Plan* [(1)] based on recent historical data. Per capita demands for the remaining Cooke and Grayson County WUGs were not altered. Recommended per capita data are shown in **Table 3.6** and **Table 3.7** for Cooke and Grayson Counties, respectively. As a result of changes to population and/or per capita demands three Cooke County WUG demands have been updated: Gainesville and Kiowa Homeowners WSC (increased in *2011 Region C Water Plan* [(1)]) and Muenster (decreased in *2011 Region C Water Plan* [(1)]). A total of ten Grayson County WUG demands have been updated (all decreased in *2011 Region C Water Plan* [(1)]): Bells, Gunter, Howe, Luella WSC, Sherman, Southmayd, Tom Bean, Van Alstyne, Whitesboro, and Whitewright.

The City of Gainesville and GTUA are the wholesale water providers projected to supply demands to Cooke and Grayson Counties, respectively. Summary data for Gainesville and GTUA are displayed in **Table 3.8** and **Table 3.9**, respectively. All recommended demand data is shown in **Table 3.10** and **Table 3.11** for Cooke and Grayson Counties, respectively. County demand data for WUGs in Cooke and Grayson Counties are also displayed as **Figure 3.4** and **Figure 3.5,** respectively.

Table 3.6
Approved Cooke County Municipal Per Capita Water Use Projections In Gallons Per Capita Per Day

Water User Group	2011 Projections					
	2010	2020	2030	2040	2050	2060
Bolivar WSC	110	122	138	137	137	137
Gainesville	180	176	174	171	170	170
Kiowa Homeowners WSC	235	233	231	229	228	228
Lindsay	156	152	150	147	146	146
Muenster	178	174	172	169	168	168
Two Way WSC	101	108	106	105	104	104
Valley View	111	108	106	103	102	102
Woodbine WSC	112	108	106	103	102	102
County-Other	101	108	106	104	103	103

Figure 3.4
Approved Demand Projections for Cooke County

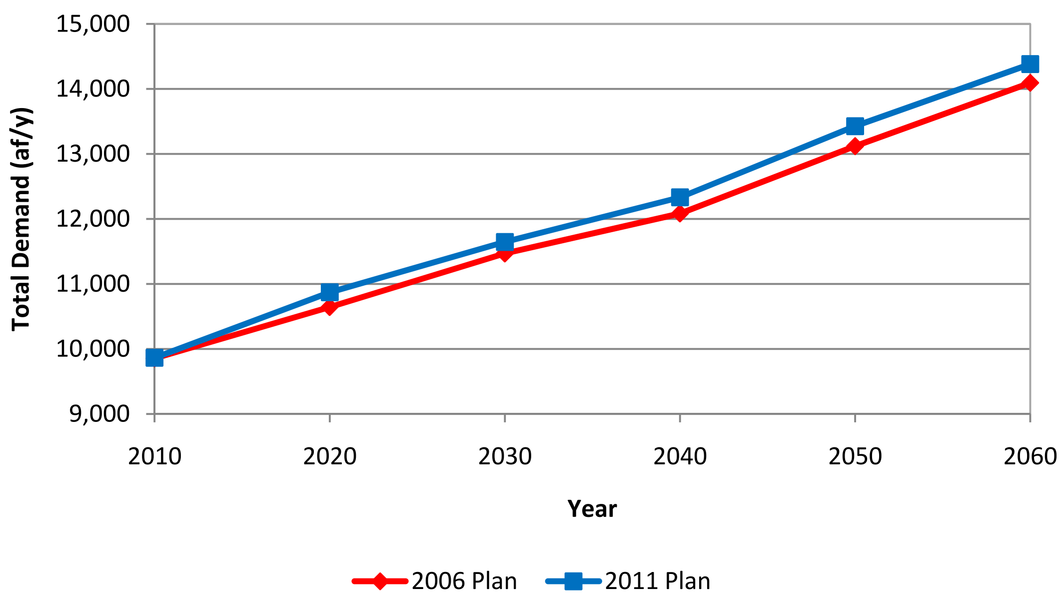


Table 3.7
Approved Grayson County Municipal Per Capita Water Use Projections
In Gallons Per Capita Per Day

Water User Group	2011 Projections					
	2010	2020	2030	2040	2050	2060
Bells	118	115	113	111	110	110
Collinsville	142	139	137	134	133	133
Denison	196	193	190	187	186	186
Gunter	121	119	117	115	114	114
Marilee SUD	110	108	106	105	105	105
Howe	120	117	115	114	113	113
Luella WSC	111	108	106	105	104	104
Pottsboro	150	152	150	148	147	147
Sherman	229	226	224	222	221	221
South Grayson WSC	126	124	122	121	120	120
Southmayd	119	117	115	113	112	112
Southwest Fannin County SUD	87	105	107	105	105	105
Tioga	156	153	150	148	147	147
Tom Bean	210	207	204	201	200	200
Two Way SUD	101	108	106	105	104	104
Van Alstyne	150	168	166	165	165	165
Whitesboro	155	152	150	147	146	146
Whitewright	178	175	172	169	168	168
Woodbine WSC	112	108	106	103	102	102
County-Other	115	113	110	107	106	106

Figure 3.5
Approved Demand Projections for Grayson County

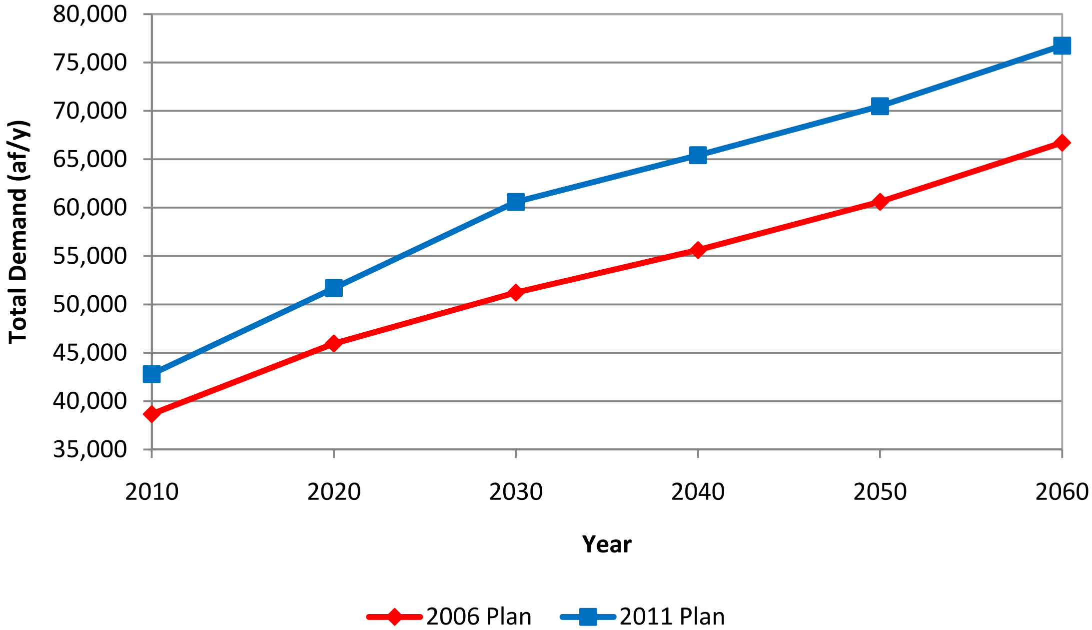


Table 3.8
Approved CCWSP (Gainesville Wholesale Water Provider) Projections

Gainesville Customers	Revised Total Demand (acre-feet/year)						Net Gainesville Demand (acre-feet/year)					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
Gainesville	3,387	3,746	4,171	4,578	5,027	5,522	3,387	3,746	4,171	4,578	5,027	5,522
Bolivar WSC	2,093	3,329	6,101	10,437	15,492	19,921	0	18	83	104	127	149
Sanger	814	1,626	2,730	3,574	4,620	5,214	0	0	0	0	0	0
Cooke County - Irrigation	304	304	304	304	304	304	0	70	70	70	70	70
Cooke County - Manufacturing	273	306	335	364	389	421	223	255	243	265	283	306
Cooke County - Mining	321	334	341	348	355	361	0	99	67	71	74	77
Cooke County - Other	1,074	1,232	1,251	1,234	1,221	1,222	0	125	125	125	125	125
Kiowa Homeowners Association	875	931	955	952	948	947	0	100	100	100	100	100
Lindsay	154	161	164	162	160	160	0	40	50	50	50	50
Valley View	187	363	594	808	1,371	1,714	0	150	400	650	1,200	1,600
Woodbine WSC	669	712	762	802	855	915	0	40	80	120	170	230
Total	**9,337**	**11,418**	**14,978**	**19,989**	**26,122**	**31,487**	**3,610**	**4,643**	**5,389**	**6,133**	**7,226**	**8,229**

Table 3.9: Approved GCWSP (Greater Texoma Utility Authority Wholesale Water Provider) Projections

GTUA Customers in Study Area	Revised Total Demand (acre-feet/year)						Net GTUA Demand (acre-feet/year)					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
Northwest WTP	**2,044**	**3,144**	**3,616**	**4,105**	**4,653**	**5,499**	**0**	**910**	**1,260**	**1,635**	**2,135**	**2,860**
Collinsville	324	441	558	666	780	899	0	100	200	300	400	500
South Grayson WSC	381	479	561	654	760	897	0	0	0	75	175	300
Whitesboro	764	851	958	1,070	1,227	1,635	0	50	150	200	350	700
Two Way SUD	575	813	979	1,155	1,326	1,508	0	200	350	500	650	800
County-Other	0	560	560	560	560	560	0	560	560	560	560	560
North WTP	***664***	***1,248***	***1,734***	***2,272***	***2,876***	***3,279***	***0***	***520***	***1,000***	***1,490***	***2,050***	***2,400***
Collinsville	504	851	1,176	1,492	1,811	1,976	0	280	600	870	1,150	1,275
Southmayd	160	197	258	380	565	703	0	40	100	220	400	525
County-Other	0	200	300	400	500	600	0	200	300	400	500	600
Sherman	**10,081**	**11,240**	**12,696**	**14,348**	**16,586**	**19,804**	**2,535**	**3,694**	**5,150**	**6,802**	**9,040**	**12,258**
Bells	185	271	348	404	456	493	0	80	150	210	260	300
Gunter	271	467	655	837	1,022	1,149	0	180	350	530	700	820
Marilee SUD	530	774	1,027	1,256	1,585	1,948	125	150	400	650	1,000	1,350
Luella WSC	410	460	511	582	592	672	0	38	80	140	150	220
Tioga	192	428	588	663	725	757	0	225	375	425	475	500
Tom Bean	259	301	343	383	426	448	0	10	40	75	120	130
Whitewright	403	632	873	1,048	1,230	1,419	0	200	400	600	750	900
County-Other	3,468	2,633	2,403	2,056	1,693	1,301	75	100	100	200	300	600
County-Steam Electric Power	5,600	5,600	5,600	5,600	5,600	5,600	5,600	5,600	5,600	5,600	5,600	5,600
County-Manufacturing	7,010	7,781	8,453	9,088	9,621	10,444	5,149	5,849	6,478	7,064	7,539	8,280
Total Sherman	***28,409***	***30,587***	***33,497***	***36,265***	***39,536***	***44,035***	***13,484***	***16,126***	***19,123***	***22,296***	***25,934***	***30,958***
Pottsboro	*Through Denison*						*560*	*560*	*560*	*560*	*560*	*560*
Steam Electric	*0*	*3,363*	*6,726*	*6,726*	*6,726*	*6,726*	*0*	*3,363*	*6,726*	*6,726*	*6,726*	*6,726*
Total	**31,117**	**38,342**	**45,573**	**49,368**	**53,791**	**59,539**	**14,044**	**21,479**	**28,669**	**32,707**	**37,405**	**43,504**

Table 3.10
Approved Cooke County Demand Projections in Acre-Feet per Year

Water User Group	2006 Plan						2011 Projections					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
Bolivar WSC	205	244	286	285	285	285	205	244	286	285	285	285
Gainesville	3,750	3,992	4,385	4,693	5,046	5,522	3,387	3,746	4,171	4,578	5,027	5,522
Kiowa Homeowners WSC	503	531	542	536	532	532	875	931	955	952	948	947
Lindsay	154	161	164	162	160	160	154	161	164	162	160	160
Muenster	379	429	468	511	565	621	339	351	366	379	395	414
Two Way WSC	10	11	11	11	11	11	10	11	11	11	11	11
Valley View	187	363	594	808	1,371	1,714	187	363	594	808	1,371	1,714
Woodbine WSC	656	699	749	789	842	902	656	699	749	789	842	902
County-Other	1,074	1,232	1,251	1,234	1,221	1,222	1,074	1,232	1,251	1,234	1,221	1,222

Table 3.11
Approved Grayson County Demand Projections in Acre-Feet per Year

Water User Group	2006 Plan						2011 Projections					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
Bells	238	296	348	404	456	493	185	271	348	404	456	493
Collinsville	324	441	558	666	780	899	324	441	558	666	780	899
Denison	5,489	6,053	6,385	6,493	6,667	6,875	5,489	6,053	6,385	6,493	6,667	6,875
Gunter	407	666	786	902	1,022	1,149	271	467	655	837	1,022	1,149
Marilee SUD	99	145	190	259	412	588	80	129	190	259	412	588
Howe	593	918	1,193	1,355	1,499	1,655	403	590	837	1,085	1,237	1,365
Luella WSC	489	535	565	582	592	672	410	460	511	582	592	672
Pottsboro	504	851	1,176	1,492	1,811	1,976	504	851	1,176	1,492	1,811	1,976
Sherman	10,081	12,135	13,660	15,382	17,787	21,238	10,081	11,240	12,696	14,348	16,586	19,804
South Grayson WSC	169	264	342	434	538	672	169	264	342	434	538	672
Southmayd	199	366	455	529	594	652	160	197	258	380	565	703
Southwest Fannin Co. SUD	38	46	47	46	46	46	38	46	47	46	46	46
Tioga	192	428	588	663	725	757	192	428	588	663	725	757
Tom Bean	311	348	388	405	426	448	259	301	343	383	426	448
Two Way SUD	565	802	968	1,144	1,315	1,497	565	802	968	1,144	1,315	1,497
Van Alstyne	966	2,341	3,159	3,561	3,875	4,022	504	1,411	2,510	3,142	3,419	3,549
Whitesboro	1,042	1,277	1,429	1,524	1,594	1,636	764	851	958	1,070	1,227	1,635
Whitewright	549	757	958	1,152	1,354	1,563	399	627	867	1,041	1,223	1,411
Woodbine WSC	13	13	13	13	13	13	13	13	13	13	13	13
County-Other	3,468	3,393	3,263	3,016	2,753	2,461	3,468	3,393	3,263	3,016	2,753	2,461

4. Evaluation of Current Supplies

Water is supplied to Cooke County WUGs via groundwater from the Trinity and Woodbine Aquifers and via surface water from Moss Lake (Gainesville). Water is supplied to Grayson County WUGs via groundwater from the Trinity and Woodbine Aquifers and via surface water from Lake Randell (Denison) and Lake Texoma (Denison and Sherman). Details of each source are discussed below.

4.1 Surface Water

Cooke County

Gainesville currently treats 1,121 acre feet per year of surface water from Moss Lake. Gainesville is expanding the current plant by 1 million gallon per day (1,121 acre feet per year) in 2010. This supply of surface water is identified as a major source of sustainable supply for expected Cooke County demands for both Gainesville as well as additional WUGs in the county. The Cooke County Water Supply Project consists of a network of water lines to allow Gainesville to serve all included Cooke County WUGs with the exception of Muenster. Indirect reuse is also a strategy identified for Gainesville and Moss Lake, with a 561 acre feet per year supply estimated to be available by 2020. Muenster recently completed construction of Lake Muenster but does not have current treatment capacity.

Grayson County

Denison currently treats 5,400 acre feet per year of surface water from Randell Lake: the Randell Lake supply is blended with an additional 1,900 acre feet per year of surface water from Lake Texoma. Sherman currently treats 11,200 acre feet per year of surface water from Lake Texoma (purchased from GTUA). This Sherman supply of surface water is a major source of sustainable supply for both Sherman and its projected wholesale customers. Future treatment plants will also utilize Lake Texoma water (GTUA) as supplies for wholesale contracts to other WUGs in the county.

4.2 Groundwater

Cooke County

The Trinity Aquifer provides groundwater to every WUG in Cooke County including both Gainesville and Muenster. The long term water demand of WUGs in Cooke County is projected to be above the sustainable yield of the aquifer. Conservation practices and the Cooke County Water Supply project are strategies to lessen the demands placed on the Trinity Aquifer.

Grayson County

The Trinity and Woodbine Aquifers provide groundwater to every WUG in Grayson County. The long term water demand of WUGs in Grayson County is projected to be slightly above the sustainable yield of the Woodbine Aquifer. Conservation practices and the Grayson County Water Supply project are strategies to lessen the aquifer demands.

5. Comparison of Current Supplies to Projected Demand

The revised projected demands in the study area are different from those shown in the *2006 Region C Water Plan* [2] for 13 of the 29 WUGs in the study area (three in Cooke County and eleven in Grayson County). The projected demand for Cooke County is slightly higher than what was projected in the *2006 Region C Water Plan* [2]. The projected demand for Grayson County is lower than what was projected in *2006 Region C Water Plan* [2]. Two WUGs, Kiowa Homeowners WSC and Two Way SUD, have *2011 Region C Water Plan* [1] demands greater than the total of their current supplies plus recommended strategies from the *2006 Region C Water Plan* [2].

Current groundwater supplies have been reallocated throughout the study area for the *2011 Region C Water Plan* [1] based on historical demands and usage rates. After reallocation there are no water user groups in the study area that have revised demands that exceed the total of their current supplies plus the recommended water management strategies in the *2006 Region C Water Plan* [2]. Each water management strategy for all WUGs has been reviewed and updates have been made as necessary. Changes made to previous strategies typically involve timing and type of groundwater resources used. The proposed revisions are discussed in the following section.

6. Proposed Revisions to Water Management Strategies

This report includes revised water management strategies for inclusion in the 2011 Region C Water Plan [1]. This section describes the proposed adjustments for the entities with changed conditions. Most changes apply to 2010 strategies or are changes to the need for a WUG to overdraft using existing pump and well capacity.

Previous Region C Water Plans have referred to both the *Cooke County Water Supply Project* (CCWSP) and the *Grayson County Water Supply Project (GCWSP)*. These projects are actually collections of proposed water transmission lines to bring surface water to WUGs in Cooke and Grayson Counties, respectively, to meet future demands. The CCWSP would provide water from Gainesville to WUGs in Cooke County (except Muenster). The GCWSP would provide water from three different water treatment plants to WUGs in Grayson County (except Denison). The treatment plants include Sherman (existing) and two proposed plants in north and northwest Grayson County near Lake Texoma. Water rights from all plants would be from GTUA. Although costs have been estimated for all of the transmission lines required to provide service to each individual WUG, the costs and quantities are grouped into similar projects. Existing demands from Howe and Van Alstyne are supplied by the Collin-Grayson Municipal Alliance (CGMA) pipeline (NTMWD and GTUA). Future water demands for these WUGs will be met with an expansion of the CGMA pipeline.

The Red River Groundwater Conservation District (RRGCD) was formed in 2009 by Texas Senate Bill 2529 [8]. The District, whose boundary is coterminous with Fannin and Grayson Counties, is charged with managing groundwater by providing for the conservation, preservation, protection, recharging, and prevention of waste of the groundwater resources within its jurisdictions. The North Texas Groundwater Conservation District (NTGCD) was also formed in 2009 by Texas Senate Bill 2497 [9]. The District, whose boundary is coterminous with Cooke, Denton and Collin Counties, is charged with managing groundwater by providing for the conservation, preservation, protection, recharging, and prevention of waste of the groundwater resources within its jurisdictions.

The RRGCD and NTGCD, as with all Texas groundwater conservation districts, is authorized with powers and duties that enable them to manage groundwater resources.

The three primary authorities include: permitting water wells; developing a comprehensive management plan; and adopting the necessary rules to implement a management plan [10]. To date the RRGCD and NTGCD have not yet formally adopted strategies or management plans for Grayson and Cooke County groundwater, respectively. The Region C Water Planning Group will continue to monitor the progress of the RRGCD and NTGCD and will coordinate future strategies with the district.

Supplemental groundwater wells are defined as wells required to maintain the existing groundwater capacity of a WUG. It is assumed that 20% of the existing WUG groundwater well system will be renewed every 10 years as part of the normal renewal program of a WUG. These supplemental wells do not add groundwater capacity to WUGs. Supplemental wells are a water management strategy for every WUG that utilizes groundwater as a water supply. Water conservation is also a strategy for every municipal WUG.

6.1 Cooke County

The WMS for municipal and non-municipal Cooke County WUGs were reviewed. Most changes to strategies involve either the timing of projects (Lindsay, Muenster) or the quantity of CCWSP supply (based on updated, allocated groundwater). Each individual WUG is described in more detail in the following sections.

6.1.1 Gainesville

A summary of water demand and supply information for Gainesville is located in **Table 6.1.1**. The amount of water supplied to other Cooke County WUGs, via the CCWSP, increased in the *2011 Region C Water Plan* [1]. This increase corresponds to more expansions of the WTP at Moss Lake to serve the demands of the Cooke County WUGs. The City of Gainesville has purchased a portion of GTUA's water supply from Lake Texoma and plans to utilize it in the future.

Table 6.1.1
Summary Information for Gainesville

Gainesville	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	16,800	19,000	21,400	23,900	26,400	29,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	3,387	3,746	4,171	4,578	5,027	5,522
Cooke County - Irrigation	9	149	149	149	149	149
Cooke County - Manufacturing	223	255	243	265	283	306
Cooke County - Mining	0	198	135	142	149	155
Wholesale Demand (Cooke County Water Supply Project)	0	473	838	1,149	1,772	2,254
Total Projected Water Demand	**3,619**	**4,821**	**5,536**	**6,283**	**7,380**	**8,386**
Currently Available Water Supplies (ac-ft/yr)						
Hubert H. Moss Lake	1,120	1,120	1,120	1,120	1,120	1,120
Direct Reuse Gainesville WTP	9	9	9	9	9	9
Trinity Aquifer	2,360	2,360	2,360	2,360	2,360	2,360
Total Supply	***3,489***	***3,489***	***3,489***	***3,489***	***3,489***	***3,489***
Need (Demand - Supply) (ac-ft/yr)	***130***	***1,332***	***2,047***	***2,794***	***3,891***	***4,897***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	27	95	225	288	359	441
Water Conservation - Expanded Package	0	0	13	19	20	22
Overdraft Trinity Aquifer (Existing Wells)	103	0	0	0	0	0
Expand Gainesville WTP capacity 4 MGD and Moss Lake Raw Water Supply	0	2,240	2,240	2,240	2,240	2,240
WTP Expansion of 2 MGD	0	0	0	1,120	1,120	1,120
WTP Expansion of 2 MGD	0	0	0	0	1,120	1,120
Expand Direct Reuse	0	169	137	141	144	147
Total Water Management Strategies	**130**	**2,504**	**2,615**	**3,808**	**5,003**	**5,090**
Reserve (ac-ft/yr)	**0**	**1,172**	**568**	**1,014**	**1,112**	**193**

6.1.2 Bolivar WSC

A summary of water demand and supply information for Bolivar WSC is located in **Table 6.1.2**. The amount of water purchased from the Upper Trinity Regional Water

District increased in the *2011 Region C Water Plan* (1). This increase corresponds to a slight decrease in CCWSP demands but did not change timing of the project.

Table 6.1.2
Summary Information for Bolivar WSC

Bolivar WSC	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population [(a)]	10,386	12,465	21,806	44,726	70,848	95,836
Projected Water Demand (ac-ft/yr)						
Municipal Demand [(a)]	1,279	1,703	3,371	6,863	10,872	14,707
Wholesale Demand (Sanger)	814	1,626	2,730	3,574	4,620	5,214
Total Projected Water Demand	***2,093***	***3,329***	***6,101***	***10,437***	***15,492***	***19,921***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer [(b)]	1,548	1,548	1,548	1,548	1,548	1,548
Total Supply	***1,548***	***1,548***	***1,548***	***1,548***	***1,548***	***1,548***
Need (Demand - Supply) (ac-ft/yr)	***545***	***1,781***	***4,553***	***8,889***	***13,944***	***18,373***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	19	70	162	356	601	862
Water Conservation - Expanded Package	10	14	27	55	88	119
Cooke County Water Supply Project	0	18	83	104	127	149
Purchase water from UTRWD [(c)]	814	2,107	4,848	9,293	14,455	18,992
Total Water Management Strategies	***843***	***2,209***	***5,120***	***9,809***	***15,271***	***20,122***
Reserve (ac-ft/yr)	**298**	**428**	**567**	**920**	**1,327**	**1,749**

(a) Includes Cooke, Denton and Wise Counties

(b) From Cooke and Denton County groundwater sources

(c) Existing UTRWD supply to Sanger. UTRWD supply to Bolivar WSC by 2020.

6.1.3 Kiowa Homeowners WSC

A summary of water demand and supply information for Kiowa Homeowners WSC is located in **Table 6.1.3**. The amount of water groundwater available from the Trinity Aquifer increased in the *2011 Region C Water Plan* (1). This increase corresponds to a slight decrease in CCWSP demands but did not change timing of the project.

Table 6.1.3
Summary Information for Kiowa Homeowners WSC

	Revised Projections					
Kiowa Homeowners WSC	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	3,324	3,567	3,691	3,711	3,710	3,709
Projected Water Demand (ac-ft/yr)						
Municipal Demand	875	931	955	952	948	947
Total Projected Water Demand	***875***	***931***	***955***	***952***	***948***	***947***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	887	887	887	887	887	887
Total Supply	***887***	***887***	***887***	***887***	***887***	***887***
Need (Demand - Supply) (ac-ft/yr)	***0***	***44***	***68***	***65***	***61***	***60***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	6	20	28	31	34	38
Cooke County Water Supply Project	0	100	100	100	100	100
Total Water Management Strategies	***6***	***120***	***128***	***131***	***134***	***138***
Reserve (ac-ft/yr)	**18**	**76**	**60**	**66**	**73**	**78**

6.1.4 Lindsay

A summary of water demand and supply information for Lindsay is located in **Table 6.1.4**. The timing of the CCWSP was moved from 2030 to start in 2020 for the *2011 Region C Water Plan* [(1)]. This change was made after meetings with the WUG on the status of water lines installed to connect to Gainesville and meetings with Gainesville on projected timing of water line projects. The City of Lindsay has purchased a portion of GTUA's water supply from Lake Texoma and plans to utilize it in the future.

Table 6.1.4
Summary Information for Lindsay

Lindsay	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	879	943	976	981	981	981
Projected Water Demand (ac-ft/yr)						
Municipal Demand	154	161	164	162	160	160
Total Projected Water Demand	***154***	***161***	***164***	***162***	***160***	***160***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	165	165	165	165	165	165
Total Supply	***165***	***165***	***165***	***165***	***165***	***165***
Need (Demand - Supply) (ac-ft/yr)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	2	5	7	8	8	9
Cooke County Water Supply Project	0	40	50	50	50	50
Total Water Management Strategies	***2***	***45***	***57***	***58***	***58***	***59***
Reserve (ac-ft/yr)	**13**	**49**	**58**	**61**	**63**	**64**

6.1.5 Muenster

A summary of water demand and supply information for Muenster is located in **Table 6.1.5**. The timing of the Muenster WTP was moved from 2010 to start in 2030 for the *2011 Region C Water Plan* (1). This change was made after meetings with the WUG on the status of projected water treatment plant.

Table 6.1.5
Summary Information for Muenster

Muenster	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	1,700	1,800	1,900	2,000	2,100	2,200
Projected Water Demand (ac-ft/yr)						
Municipal Demand	339	351	366	379	395	414
Cooke County - Manufacturing	0	0	60	61	63	65
Total Projected Water Demand	***339***	***351***	***426***	***440***	***458***	***479***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	339	339	339	339	339	339
Total Supply	***339***	***339***	***339***	***339***	***339***	***339***
Need (Demand - Supply) (ac-ft/yr)	***0***	***12***	***87***	***101***	***119***	***140***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	3	9	13	23	27	32
Water Conservation - Expanded Package	0	0	0	2	2	3
New WTP at Muenster Lake	0	280	280	280	280	280
Total Water Management Strategies	***3***	***289***	***293***	***305***	***309***	***314***
Reserve (ac-ft/yr)	**3**	**277**	**206**	**204**	**190**	**174**

6.1.6 Valley View

A summary of water demand and supply information for Valley View is located in **Table 6.1.6**. Since the *2006 Region C Water Plan* (2) the WUG has purchased part of a water system (including groundwater wells) from Bolivar WSC. Purchasing additional water from Bolivar WSC has been removed from the WMS in the *2011 Region C Water Plan* (1). This decrease in available supply corresponds with an increase in CCWSP demands, but does not change timing of the project.

Table 6.1.6
Summary Information for Valley View

Valley View	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	1,500	3,000	5,000	7,000	12,000	15,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	187	363	594	808	1,371	1,714
Total Projected Water Demand	***187***	***363***	***594***	***808***	***1,371***	***1,714***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	363	363	363	363	363	363
Total Supply	***363***	***363***	***363***	***363***	***363***	***363***
Need (Demand - Supply) (ac-ft/yr)	***0***	***0***	***231***	***445***	***1,008***	***1,351***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	3	16	31	46	83	110
Cooke County Water Supply Project	0	150	400	650	1,200	1,600
Total Water Management Strategies	***3***	***166***	***431***	***696***	***1,283***	***1,710***
Reserve (ac-ft/yr)	**179**	**166**	**200**	**251**	**275**	**359**

6.1.7 Woodbine WSC

A summary of water demand and supply information for Woodbine WSC is located in **Table 6.1.7**. The amount of water groundwater available from the Trinity Aquifer increased in the *2011 Region C Water Plan* (1). This increase corresponds to a slight decrease in CCWSP demands but did not change timing of the project.

Woodbine WSC has demands in both Cooke and Grayson Counties.

Table 6.1.7
Summary Information for Woodbine WSC

	Revised Projections					
Woodbine WSC	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population [a]	5,336	5,773	6,307	6,839	7,370	7,901
Projected Water Demand (ac-ft/yr)						
Municipal Demand [a]	669	712	762	802	855	915
Total Projected Water Demand	***669***	***712***	***762***	***802***	***855***	***915***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	661	661	661	661	661	661
Total Supply	***661***	***661***	***661***	***661***	***661***	***661***
Need (Demand - Supply) (ac-ft/yr)	***8***	***51***	***101***	***141***	***194***	***254***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	8	28	39	46	52	59
Cooke County Water Supply Project	0	40	80	120	170	230
Total Water Management Strategies	***8***	***68***	***119***	***166***	***222***	***289***
Reserve (ac-ft/yr)	**0**	**17**	**18**	**25**	**28**	**35**

(a) Includes both Cooke and Grayson Counties

6.1.8 Cooke County - Other

A summary of water demand and supply information for Cooke County - Other is located in **Table 6.1.8**. The amount of water groundwater available from the Trinity, Woodbine and Other Aquifers increased in the *2011 Region C Water Plan* [1]. This increase corresponds to a slight decrease in CCWSP demands but did not change timing of the project.

Table 6.1.8
Summary Information for Cooke County - Other

Cooke County - Other	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	9,487	10,181	10,533	10,590	10,586	10,586
Projected Water Demand (ac-ft/yr)						
Municipal Demand	1,074	1,232	1,251	1,234	1,221	1,222
Total Projected Water Demand	***1,074***	***1,232***	***1,251***	***1,234***	***1,221***	***1,222***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	888	888	888	888	888	888
Woodbine Aquifer	154	154	154	154	154	154
Other Aquifer	137	137	137	137	137	137
Total Supply	***1,179***	***1,179***	***1,179***	***1,179***	***1,179***	***1,179***
Need (Demand - Supply) (ac-ft/yr)	***0***	***53***	***72***	***55***	***42***	***43***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	13	47	65	70	74	78
Cooke County Water Supply Project	0	125	125	125	125	125
Total Water Management Strategies	***13***	***172***	***190***	***195***	***199***	***203***
Reserve (ac-ft/yr)	**118**	**119**	**118**	**140**	**157**	**160**

6.1.9 Cooke County Non Municipal

This section includes all demands and water management strategies for non-municipal water users in Cooke County. **Table 6.1.9** provides summary information for Cooke County Irrigation users. The new WMS for the *2011 Region C Water Plan* (1) include direct reuse from Gainesville and temporary overdrafting the Trinity Aquifer. These new WMS removed the *2006 Region C Water Plan* (2) delayed and reduced the CCWSP for irrigation demands.

Table 6.1.9
Summary Information for Cooke County - Irrigation

	Revised Projections					
Cooke County - Irrigation	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Water Demand (ac-ft/yr)						
Irrigation Demand	444	444	444	444	444	444
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	172	172	172	172	172	172
Other Aquifer	100	100	100	100	100	100
Direct Reuse	9	9	9	9	9	9
Local Supply	23	23	23	23	23	23
Total Supply	***304***	***304***	***304***	***304***	***304***	***304***
Need (Demand - Supply) (ac-ft/yr)	***140***	***140***	***140***	***140***	***140***	***140***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Other Aquifers	0	0	0	0	0	0
Water Conservation - Irrigation General Rebate	0	6	11	15	18	22
Overdraft Trinity Aquifer (Existing Wells)	140	0	0	0	0	0
Direct Reuse	0	70	70	70	70	70
Cooke County Water Supply Project	0	70	70	70	70	70
Total Water Management Strategies	***140***	***146***	***151***	***155***	***158***	***162***
Reserve (ac-ft/yr)	**0**	**6**	**11**	**15**	**18**	**22**

Table 6.1.10 provides summary information for Cooke County Livestock demands. As with the *2006 Region C Water Plan* (1), the *2011 Region C Water Plan* (2) shows no net need for water for this non-municipal WUG.

Table 6.1.10
Summary Information for Cooke County - Livestock

Cooke County - Livestock	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Water Demand (ac-ft/yr)						
Livestock Demand	1,898	1,898	1,898	1,898	1,898	1,898
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	711	711	711	711	711	711
Local Supply	1,187	1,187	1,187	1,187	1,187	1,187
Total Supply	***1,898***	***1,898***	***1,898***	***1,898***	***1,898***	***1,898***
Need (Demand - Supply) (ac-ft/yr)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (ac-ft/yr)	**0**	**0**	**0**	**0**	**0**	**0**

Table 6.1.11 provides summary information for Cooke County Manufacturing demands. The allocated groundwater from the Trinity Aquifer has been reduced in the *2011 Region C Water Plan* (2) for each planning period. This reduction corresponds to a higher supply from Gainesville starting in 2020.

Table 6.1.11
Summary Information for Cooke County - Manufacturing

	Revised Projections					
Cooke County - Manufacturing	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Water Demand (ac-ft/yr)						
Manufacturing Demand	273	306	335	364	389	421
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	50	50	50	50	50	50
Gainesville	223	255	243	265	283	306
Total Supply	***273***	***305***	***293***	***315***	***333***	***356***
Need (Demand - Supply) (ac-ft/yr)	***0***	***1***	***42***	***49***	***56***	***65***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Manufacturing General Rebate	0	1	7	10	11	12
Lake Muenster	0	0	60	61	63	65
Total Water Management Strategies	***0***	***1***	***67***	***71***	***74***	***77***
Reserve (ac-ft/yr)	**0**	**0**	**25**	**22**	**18**	**12**

Table 6.1.12 provides summary information for Cooke County Mining demands. The amount of water available from overdrafting existing wells and production from new wells has been reduced in the *2011 Region C Water Plan* (2) for each planning period. This reduction corresponds to a new supply from the CCWSP and from direct reuse (Gainesville) starting in 2020 and a temporary (2010) overdrafting of the Trinity Aquifer.

Table 6.1.12
Summary Information for Cooke County - Mining

	Revised Projections					
Cooke County - Mining	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Water Demand (ac-ft/yr)						
Mining Demand	361	484	421	428	435	441
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	49	49	49	49	49	49
Local Supply	237	237	237	237	237	237
Total Supply	***286***	***286***	***286***	***286***	***286***	***286***
Need (Demand - Supply) (ac-ft/yr)	***75***	***198***	***135***	***142***	***149***	***155***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Overdraft Trinity Aquifer (Existing Wells)	75	0	0	0	0	0
Direct Reuse	0	99	67	71	74	77
Cooke County Water Supply Project	0	99	68	71	75	78
Total Water Management Strategies	***75***	***198***	***135***	***142***	***149***	***155***
Reserve (ac-ft/yr)	**0**	**0**	**0**	**0**	**0**	**0**

6.2 Grayson County

The WMS for municipal and non-municipal Grayson County WUGs were reviewed. Most changes to strategies involve either the location (new plants or Sherman) or the quantity of GCWSP supply (based on updated, allocated groundwater). Each individual WUG is described in more detail in the following sections. Woodbine WSC is discussed in Cooke County in Section 6.1.

6.2.1 Bells

A summary of water demand and supply information for Bells is located in **Table 6.2.1**. The amount of allocated water available from the Woodbine Aquifer increased in the *2011 Region C Water Plan* (1). This increase corresponds to a slight decrease in GCWSP demands but did not change timing of the project.

Table 6.2.1
Summary Information for Bells

	Revised Projections					
Bells	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	1,400	2,100	2,750	3,250	3,700	4,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	185	271	348	404	456	493
Total Projected Water Demand	***185***	***271***	***348***	***404***	***456***	***493***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	161	161	161	161	161	161
Woodbine Aquifer	43	43	43	43	43	43
Total Supply	***204***	***204***	***204***	***204***	***204***	***204***
Need (Demand - Supply) (ac-ft/yr)	**0**	**67**	**144**	**200**	**252**	**289**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	2	11	17	22	26	30
Water Conservation - Expanded Package	1	2	2	3	3	4
Grayson County Water Supply Project (Sherman WTP)	0	80	150	210	260	300
Total Water Management Strategies	***4***	***93***	***170***	***235***	***290***	***334***
Reserve (ac-ft/yr)	**23**	**26**	**26**	**35**	**38**	**45**

6.2.2 Collinsville

A summary of water demand and supply information for Collinsville is located in **Table 6.2.2**. The amount of allocated water available from the Trinity Aquifer increased in the *2011 Region C Water Plan* (1). This increase corresponds to a slight decrease in GCWSP demands but did not change timing of the project.

Table 6.2.2
Summary Information for Collinsville

Collinsville	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	2,035	2,835	3,635	4,435	5,235	6,035
Projected Water Demand (ac-ft/yr)						
Municipal Demand	324	441	558	666	780	899
Total Projected Water Demand	***324***	***441***	***558***	***666***	***780***	***899***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	356	356	356	356	356	356
Total Supply	***356***	***356***	***356***	***356***	***356***	***356***
Need (Demand - Supply) (ac-ft/yr)	**0**	**85**	**202**	**310**	**424**	**543**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	4	15	24	32	40	49
Water Conservation - Expanded Package	3	4	5	6	7	8
Grayson County Water Supply Project (Northwest WTP)	0	100	200	300	400	500
Total Water Management Strategies	***7***	***119***	***229***	***338***	***447***	***557***
Reserve (ac-ft/yr)	**39**	**34**	**27**	**28**	**23**	**14**

6.2.3 Denison

A summary of water demand and supply information for Denison is located in **Table 6.2.3**. The projected wholesale demands from Pottsboro were reduced (see 6.2.7 for Pottsboro recommended strategy) for the *2011 Region C Water Plan* (1). The remaining WMS have not changed timing or appreciably changed in magnitude from the *2006 Region C Water Plan* (2).

Table 6.2.3
Summary Information for Denison

Denison	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	25,000	28,000	30,000	31,000	32,000	33,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	5,489	6,053	6,385	6,493	6,667	6,875
Wholesale – Pottsboro	561	561	561	561	561	561
Wholesale - County – Other	310	310	310	310	310	310
Total Projected Water Demand	***6,906***	***7,533***	***7,901***	***8,052***	***8,279***	***8,561***
Currently Available Water Supplies (ac-ft/yr)						
Lake Randell	1,400	1,400	1,400	1,400	1,400	1,400
Lake Texoma - to Lake Randell	5,791	5,791	5,791	5,791	5,791	5,791
Trinity Aquifer	157	157	157	157	157	157
Woodbine Aquifer	155	155	155	155	155	155
Total Supply	***7,503***	***7,503***	***7,503***	***7,503***	***7,503***	***7,503***
Need (Demand - Supply) (ac-ft/yr)	***0***	***30***	***398***	***549***	***776***	***1,058***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	43	145	382	496	566	641
Water Conservation - Expanded Package	0	0	27	38	39	40
WTP Expansion	0	0	0	1,121	1,121	1,121
Total Water Management Strategies	***43***	***145***	***409***	***1,656***	***1,726***	***1,802***
Reserve (ac-ft/yr)	**640**	**115**	**11**	**1,107**	**950**	**744**

6.2.4 Gunter

A summary of water demand and supply information for Gunter is located in **Table 6.2.4**. The amount of allocated water available from the Trinity Aquifer increased in the *2011 Region C Water Plan* (1). This increase corresponds to a slight decrease in GCWSP demands but did not change timing of the project.

Table 6.2.4
Summary Information for Gunter

	Revised Projections					
Gunter	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	2,000	3,500	5,000	6,500	8,000	9,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	271	467	655	837	1,022	1,149
Total Projected Water Demand	***271***	***467***	***655***	***837***	***1,022***	***1,149***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	298	298	298	298	298	298
Total Supply	***298***	***298***	***298***	***298***	***298***	***298***
Need (Demand - Supply) (ac-ft/yr)	**0**	**169**	**357**	**539**	**724**	**851**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	3	16	28	39	51	62
Water Conservation - Expanded Package	2	3	4	5	6	6
Grayson County Water Supply Project (Sherman WTP)	0	180	350	530	700	820
Total Water Management Strategies	***5***	***199***	***382***	***574***	***757***	***888***
Reserve (ac-ft/yr)	**32**	**30**	**25**	**35**	**33**	**37**

6.2.5 Marilee SUD

A summary of water demand and supply information for Marilee SUD is located in **Table 6.2.5**. The projected supplies and water management strategies in the *2011 Region C Water Plan* (1) have not changed from the *2006 Region C Water Plan* (2). Small changes in calculated water conservation savings slightly increased supplies from the GCWSP but did not affect timing.

Table 6.2.5
Summary Information for Marilee SUD

Marilee SUD	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population [(a)]	4,300	6,400	8,653	10,679	13,471	16,560
Projected Water Demand (ac-ft/yr)						
Municipal Demand [(a)]	530	774	1,027	1,256	1,585	1,948
Total Projected Water Demand	***530***	***774***	***1,027***	***1,256***	***1,585***	***1,948***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer [(b)]	634	634	634	634	634	634
Total Supply	***634***	***634***	***634***	***634***	***634***	***634***
Need (Demand - Supply) (ac-ft/yr)	**0**	**140**	**393**	**622**	**951**	**1,314**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	1	6	10	13	17	22
Water Conservation - Expanded Package	1	1	1	2	2	3
Grayson County Water Supply Project (Sherman WTP)	0	150	400	650	1,000	1,350
Total Water Management Strategies	***2***	***158***	***411***	***664***	***1,019***	***1,374***
Reserve (ac-ft/yr)	**106**	**18**	**18**	**42**	**68**	**60**

(a) Includes both Collin and Grayson Counties

(b) From Collin and Grayson County groundwater sources

6.2.6 Howe

A summary of water demand and supply information for Howe is located in **Table 6.2.6**. The projected water demands are lower for Howe in the *2011 Region C Water Plan* [(1)]. In addition the supply from the CGMA Pipeline (GTUA/NTMWD supply) is now a currently available strategy. These factors have reduced the projected WMS from the CGMA pipeline to Howe from the *2006 Region C Water Plan* [(2)].

Table 6.2.6
Summary Information for Howe

Howe	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	3,000	4,500	6,500	8,500	9,772	10,781
Projected Water Demand (ac-ft/yr)						
Municipal Demand	403	590	837	1,085	1,237	1,365
Total Projected Water Demand	***403***	***590***	***837***	***1,085***	***1,237***	***1,365***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	117	117	117	117	117	117
CGMA Pipeline	307	391	430	430	430	430
Total Supply	***424***	***508***	***547***	***547***	***547***	***547***
Need (Demand - Supply) (ac-ft/yr)	**0**	**82**	**290**	**538**	**690**	**818**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	5	22	39	54	66	78
Water Conservation - Expanded Package	4	6	8	11	12	14
Expand CGMA Pipeline Capacity: Trunk Line	0	103	311	559	711	839
Total Water Management Strategies	***9***	***130***	***358***	***624***	***790***	***930***
Reserve (ac-ft/yr)	**30**	**48**	**68**	**86**	**100**	**112**

6.2.7 Pottsboro

A summary of water demand and supply information for Pottsboro is located in **Table 6.2.7**. In the *2011 Region C Water Plan* (1) Pottsboro will maintain the current Denison supply but will utilize supplies from a new north treatment plant as a water management strategy for future needs. In the *2006 Region C Water Plan* (2) both current and new supplies were projected to be met by Denison.

Table 6.2.7
Summary Information for Pottsboro

	Revised Projections					
Pottsboro	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	3,000	5,000	7,000	9,000	11,000	12,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	504	851	1,176	1,492	1,811	1,976
Total Projected Water Demand	***504***	***851***	***1,176***	***1,492***	***1,811***	***1,976***
Currently Available Water Supplies (ac-ft/yr)						
Lake Texoma (Denison)	561	561	561	561	561	561
Woodbine Aquifer	123	123	123	123	123	123
Total Supply	***684***	***684***	***684***	***684***	***684***	***684***
Need (Demand - Supply) (ac-ft/yr)	**0**	**167**	**492**	**808**	**1,127**	**1,292**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	6	45	77	112	151	181
Water Conservation - Expanded Package	6	14	20	25	32	35
Grayson County Water Supply Project (North WTP)	0	280	600	870	1,150	1,275
Total Water Management Strategies	***12***	***339***	***697***	***1,007***	***1,332***	***1,491***
Reserve (ac-ft/yr)	**193**	**172**	**206**	**199**	**206**	**200**

6.2.8 Luella WSC

A summary of water demand and supply information for Luella WSC is located in **Table 6.2.8**. The amount of allocated water available from the Woodbine Aquifer increased in the *2011 Region C Water Plan* [1]. This increase corresponded with a decrease in GCWSP demands but did not change timing of the project.

Table 6.2.8
Summary Information for Luella WSC

Luella WSC	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	3,300	3,800	4,300	4,950	5,080	5,770
Projected Water Demand (ac-ft/yr)						
Municipal Demand	410	460	511	582	592	672
Total Projected Water Demand	***410***	***460***	***511***	***582***	***592***	***672***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	450	450	450	450	450	450
Total Supply	***450***	***450***	***450***	***450***	***450***	***450***
Need (Demand - Supply) (ac-ft/yr)	**0**	**10**	**61**	**132**	**142**	**222**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	5	18	27	33	36	43
Grayson County Water Supply Project (Sherman WTP)	0	38	80	140	150	220
Total Water Management Strategies	***5***	***56***	***107***	***173***	***186***	***263***
Reserve (ac-ft/yr)	**45**	**46**	**46**	**41**	**44**	**41**

6.2.9 Sherman

A summary of water demand and supply information for Sherman is located in **Table 6.2.9**. The higher water demand from non-municipal users and GCWSP in the *2011 Region C Water Plan* requires new expansions and a new WTP in the *2011 Region C Water Plan.*

Table 6.2.9
Summary Information for Sherman

Sherman	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	39,300	44,400	50,600	57,700	67,000	80,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	10,081	11,240	12,696	14,348	16,586	19,804
Wholesale Demand - Grayson Co. Supply Project	200	983	1,895	2,830	3,755	4,820
Grayson County - SEP Demand	5,600	5,600	5,600	5,600	5,600	5,600
Grayson County - Manufacturing	5,149	5,849	6,478	7,064	7,539	8,280
Total Projected Water Demand	***21,030***	***23,672***	***26,669***	***29,842***	***33,480***	***38,504***
Currently Available Water Supplies (ac-ft/yr)						
Lake Texoma: GTUA (Steam Electric Power)	5,600	5,600	5,600	5,600	5,600	5,600
Lake Texoma (GTUA)	8,000	8,000	8,000	8,000	8,000	8,000
Trinity Aquifer	4,083	4,083	4,083	4,083	4,083	4,083
Woodbine Aquifer	3,463	3,463	3,463	3,463	3,463	3,463
Total Supply	***21,146***	***21,146***	***21,146***	***21,146***	***21,146***	***21,146***
Need (Demand - Supply) (ac-ft/yr)	***0***	***2,526***	***5,523***	***8,696***	***12,334***	***17,358***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	67	217	333	880	1,411	1,850
Water Conservation - Expanded Package	0	0	0	78	102	119
10 MGD WTP Expansion	0	5,600	5,600	5,600	5,600	5,600
5 MGD WTP Expansion	0	0	2,800	2,800	2,800	2,800
New 10 MGD WTP	0	0	0	0	5,600	5,600
New WTP: 10 MGD WTP Expansion	0	0	0	0	0	5,600
Total Water Management Strategies	***67***	***5,817***	***8,733***	***9,358***	***15,513***	***21,568***
Reserve (ac-ft/yr)	**183**	**3,291**	**3,209**	**662**	**3,178**	**4,210**

6.2.10 South Grayson WSC

A summary of water demand and supply information for South Grayson WSC is located in **Table 6.2.10**. Some WUG demands in Collin County are now met through the GCWSP in the *2011 Region C Water Plan* (1). This change corresponds with an increase in GCWSP demands but did not change timing of the project.

Table 6.2.10
Summary Information for South Grayson WSC

South Grayson WSC	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population [a]	2,700	3,450	4,100	4,825	5,650	6,675
Projected Water Demand (ac-ft/yr)						
Municipal Demand [a]	381	479	561	654	760	897
Total Projected Water Demand	***381***	***479***	***561***	***654***	***760***	***897***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer [b]	360	360	360	360	360	360
Woodbine Aquifer [b]	360	360	360	360	360	360
Total Supply	***720***	***720***	***720***	***720***	***720***	***720***
Need (Demand - Supply) (ac-ft/yr)	**0**	**0**	**0**	**0**	**40**	**177**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	3	12	19	26	34	45
Collin-Grayson Municipal Alliance Project	0	100	100	100	100	100
Grayson County Water Supply Project (Northwest WTP)	0	0	0	75	175	300
Total Water Management Strategies	***3***	***112***	***119***	***201***	***309***	***445***
Reserve (ac-ft/yr)	**342**	**353**	**278**	**267**	**269**	**268**

(a) Includes both Collin and Grayson Counties

(b) From Collin and Grayson County groundwater sources

6.2.11 Southmayd

A summary of water demand and supply information for Southmayd is located in **Table 6.2.11**. The amount of allocated water available from the Woodbine and Trinity Aquifers slightly increased in the *2011 Region C Water Plan* (1). The projected water demands for Southmayd were lower in every planning period except 2060. Southmayd plans to purchase a portion of a current WSC providing service in the city and drill a new well in the Woodbine Aquifer to upgrade the capacity of this new system. These changes correspond to a slight decrease in GCWSP demands but did not change timing of the project.

Table 6.2.11
Summary Information for Southmayd

	Revised Projections					
Southmayd	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	1,200	1,500	2,000	3,000	4,500	5,600
Projected Water Demand (ac-ft/yr)						
Municipal Demand	160	197	258	380	565	703
Total Projected Water Demand	***160***	***197***	***258***	***380***	***565***	***703***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	130	130	130	130	130	130
Woodbine Aquifer (County-Other)	60	0	0	0	0	0
Total Supply	***190***	***130***	***130***	***130***	***130***	***130***
Need (Demand - Supply) (ac-ft/yr)	**0**	**67**	**128**	**250**	**435**	**573**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	2	8	13	21	33	43
Purchase WSC System	0	0	0	0	0	0
New Well (Woodbine Aquifer)	0	60	60	60	60	60
Grayson County Water Supply Project (North WTP)	0	40	100	220	400	525
Total Water Management Strategies	***2***	***108***	***173***	***301***	***493***	***628***
Reserve (ac-ft/yr)	**32**	**41**	**45**	**51**	**58**	**55**

6.2.12 Southwest Fannin County SUD

A summary of water demand and supply information for Southwest Fannin County SUD is located in **Table 6.2.12**. Details of the Fannin County Water Supply Project can be found in the *Fannin County Special Study* (7).

Table 6.2.12
Summary Information for Southwest Fannin County SUD

Southwest Fannin County SUD	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population [a]	7,491	8,940	9,947	10,852	11,657	12,463
Projected Water Demand (ac-ft/yr)						
Municipal Demand [a]	722	1,042	1,192	1,288	1,371	1,466
Total Projected Water Demand	***722***	***1,042***	***1,192***	***1,288***	***1,371***	***1,466***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer [b]	803	803	803	803	803	803
Total Supply	***803***	***803***	***803***	***803***	***803***	***803***
Need (Demand - Supply) (ac-ft/yr)	**0**	**239**	**389**	**485**	**568**	**663**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	15	44	62	72	82	93
Fannin County Water Supply Project	0	399	560	666	756	859
Total Water Management Strategies	***15***	***443***	***622***	***738***	***838***	***952***
Reserve (ac-ft/yr)	**96**	**204**	**233**	**253**	**270**	**289**

(a) Includes both Fannin and Grayson Counties

(b) From Fannin and Grayson County groundwater sources

6.2.13 Tioga

A summary of water demand and supply information for Tioga is located in **Table 6.2.13**. The amount of allocated water available from the Trinity Aquifer increased in the *2011 Region C Water Plan* (1). This increase corresponds to a slight decrease in GCWSP demands but did not change timing of the project.

Table 6.2.13
Summary Information for Tioga

Tioga	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	1,100	2,500	3,500	4,000	4,400	4,600
Projected Water Demand (ac-ft/yr)						
Municipal Demand	192	428	588	663	725	757
Total Projected Water Demand	***192***	***428***	***588***	***663***	***725***	***757***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	211	211	211	211	211	211
Total Supply	***211***	***211***	***211***	***211***	***211***	***211***
Need (Demand - Supply) (ac-ft/yr)	**0**	**217**	**377**	**452**	**514**	**546**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	2	26	48	60	72	81
Water Conservation - Expanded Package	1	4	7	8	9	9
Grayson County Water Supply Project (Sherman WTP)	0	225	375	425	475	500
Total Water Management Strategies	***4***	***256***	***430***	***493***	***555***	***590***
Reserve (ac-ft/yr)	**23**	**39**	**53**	**41**	**41**	**44**

6.2.14 Tom Bean

A summary of water demand and supply information for Tom Bean is located in **Table 6.2.14**. The available supplies and projected water demands have not changed in the *2011 Region C Water Plan* (1). The reserve has been reduced from what was projected in the *2006 Region C Water Plan* (2). This decrease corresponds to a decrease in GCWSP demands but did not change timing of the project.

Table 6.2.14
Summary Information for Tom Bean

Tom Bean	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	1,100	1,300	1,500	1,700	1,900	2,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	259	301	343	383	426	448
Total Projected Water Demand	***259***	***301***	***343***	***383***	***426***	***448***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	288	288	288	288	288	288
Total Supply	***288***	***288***	***288***	***288***	***288***	***288***
Need (Demand - Supply) (ac-ft/yr)	**0**	**13**	**55**	**95**	**138**	**160**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	22	67	81	93	108	117
Water Conservation - Expanded Package	2	4	4	5	5	6
Grayson County Water Supply Project (Sherman WTP)	0	10	40	75	120	130
Total Water Management Strategies	***25***	***81***	***125***	***173***	***233***	***252***
Reserve (ac-ft/yr)	**54**	**68**	**70**	**79**	**95**	**93**

6.2.15 Two Way SUD

A summary of water demand and supply information for Two Way SUD is located in **Table 6.2.15**. The amount of water groundwater available from the Trinity Aquifer increased in the *2011 Region C Water Plan* (1). This increase corresponds to a slight decrease in GCWSP demands but did not change timing of the project.

Two Way SUD has demands in both Cooke and Grayson Counties.

Table 6.2.15
Summary Information for Two Way SUD

Two Way SUD	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population [a]	5,081	6,720	8,251	9,819	11,382	12,945
Projected Water Demand (ac-ft/yr)						
Municipal Demand [a]	575	813	979	1,155	1,326	1,508
Total Projected Water Demand	***575***	***813***	***979***	***1,155***	***1,326***	***1,508***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer [b]	622	622	622	622	622	622
Total Supply	***622***	***622***	***622***	***622***	***622***	***622***
Need (Demand - Supply) (ac-ft/yr)	***0***	***191***	***357***	***533***	***704***	***886***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	9	34	51	65	80	96
Water Conservation - Expanded Package	5	7	8	10	11	13
Grayson County Water Supply Project	0	200	350	500	650	800
Total Water Management Strategies	***13***	***240***	***409***	***575***	***741***	***909***
Reserve (ac-ft/yr)	**60**	**49**	**52**	**42**	**37**	**23**

(a) Includes both Cooke and Grayson Counties

(b) From Grayson County groundwater sources

6.2.16 Van Alstyne

A summary of water demand and supply information for Van Alstyne is located in **Table 6.2.16**. The projected water demands decreased in the *2011 Region C Water Plan* (1). This decrease corresponds to a decrease in GCWSP demands but does not change timing of the project.

Table 6.2.16
Summary Information for Van Alsytne

Van Alstyne	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	3,000	7,500	13,500	17,000	18,500	19,200
Projected Water Demand (ac-ft/yr)						
Municipal Demand	504	1,411	2,510	3,142	3,419	3,549
Total Projected Water Demand	***504***	***1,411***	***2,510***	***3,142***	***3,419***	***3,549***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	235	235	235	235	235	235
Woodbine Aquifer	215	215	215	215	215	215
CGMA Pipeline	58	795	1,291	1,291	1,291	1,291
Total Supply	***508***	***1,245***	***1,741***	***1,741***	***1,741***	***1,741***
Need (Demand - Supply) (ac-ft/yr)	**0**	**166**	**769**	**1,401**	**1,678**	**1,808**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	5	70	152	218	265	305
Water Conservation - Expanded Package	3	12	26	35	41	43
Expand CGMA Pipeline Capacity: Trunk Line	0	170	773	1,405	1,682	1,812
Total Water Management Strategies	***8***	***252***	***951***	***1,658***	***1,988***	***2,160***
Reserve (ac-ft/yr)	**12**	**86**	**182**	**257**	**310**	**352**

6.2.17 Whitesboro

A summary of water demand and supply information for Whitesboro is located in **Table 6.2.17**. The amount of allocated water available from the Trinity Aquifer increased in the *2011 Region C Water Plan* (1). This increase corresponds to a slight decrease in GCWSP demands but did not change timing of the project.

Table 6.2.17
Summary Information for Whitesboro

Whitesboro	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	4,400	5,000	5,700	6,500	7,500	10,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	764	851	958	1,070	1,227	1,635
Total Projected Water Demand	***764***	***851***	***958***	***1,070***	***1,227***	***1,635***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	840	840	840	840	840	840
Total Supply	***840***	***840***	***840***	***840***	***840***	***840***
Need (Demand - Supply) (ac-ft/yr)	**0**	**11**	**118**	**230**	**387**	**795**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	7	42	61	78	100	147
Water Conservation - Expanded Package	0	3	5	6	7	10
Grayson County Water Supply Project (Northwest WTP)	0	50	150	200	350	700
Total Water Management Strategies	***7***	***95***	***216***	***284***	***457***	***857***
Reserve (ac-ft/yr)	**83**	**84**	**98**	**54**	**70**	**62**

6.2.18 Whitewright

A summary of water demand and supply information for Whitewright is located in **Table 6.2.18**. The available supplies, water demands and water management strategies have not changed in the *2011 Region C Water Plan* (1).

Table 6.2.18
Summary Information for Whitewright

Whitewright	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population [a]	2,022	3,228	4,532	5,535	6,538	7,541
Projected Water Demand (ac-ft/yr)						
Municipal Demand [a]	403	632	873	1,048	1,230	1,419
Total Projected Water Demand	***403***	***632***	***873***	***1,048***	***1,230***	***1,419***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	438	438	438	438	438	438
Total Supply	***438***	***438***	***438***	***438***	***438***	***438***
Need (Demand - Supply) (ac-ft/yr)	**0**	**194**	**435**	**610**	**792**	**981**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	3	30	52	71	94	120
Water Conservation - Expanded Package	2	4	5	6	8	9
Grayson County Water Supply Project (Sherman WTP)	0	200	400	600	750	900
Total Water Management Strategies	***5***	***233***	***457***	***678***	***851***	***1,029***
Reserve (ac-ft/yr)	**40**	**39**	**22**	**68**	**59**	**48**

(a) Includes both Fannin and Grayson Counties

6.2.19 Grayson County - Other

A summary of water demand and supply information for Grayson County – Other municipal WUGs is located in **Table 6.2.19**. The available supplies and demands have not changed in the *2011 Region C Water Plan* [(1)]. The water management strategies are broken down into each water treatment plant (existing Sherman and the two proposed plants).

Table 6.2.19
Summary Information for Grayson County – Other

	Revised Projections					
Grayson County – Other	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	26,925	26,799	26,482	25,160	23,185	20,727
Projected Water Demand (ac-ft/yr)						
Municipal Demand	3,468	3,393	3,263	3,016	2,753	2,461
Total Projected Water Demand	***3,468***	***3,393***	***3,263***	***3,016***	***2,753***	***2,461***
Currently Available Water Supplies (ac-ft/yr)						
Lake Randell	60	60	60	60	60	60
Lake Texoma	967	958	942	972	989	1,048
Other Aquifer	35	35	35	35	35	35
Trinity Aquifer	1,170	1,170	1,170	1,170	1,170	1,170
Woodbine Aquifer	1,659	1,659	1,659	1,659	1,659	1,659
Total Supply	***3,891***	***3,882***	***3,866***	***3,896***	***3,913***	***3,972***
Need (Demand – Supply) (ac-ft/yr)	**0**	**0**	**0**	**0**	**0**	**0**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity, Woodbine and Other Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	37	123	165	168	164	155
Grayson County Water Supply Project (Sherman WTP)	75	100	100	200	300	600
Grayson County Water Supply Project (North WTP)	0	200	300	400	500	600
Grayson County Water Supply Project (Northwest WTP)	0	560	560	560	560	560
Total Water Management Strategies	***112***	***983***	***1,125***	***1,328***	***1,524***	***1,915***
Reserve (ac-ft/yr)	**535**	**1,472**	**1,728**	**2,208**	**2,684**	**3,426**

6.2.20 Grayson County Non-Municipal

This section provides detail on all non-municipal water users in Grayson County. **Table 6.2.20** provides information for Grayson County Irrigation demands. There are no changes to demands or strategies in the *2011 Region C Water Plan* [1]. This WUG has no net water needs and as such no specific WMS.

Table 6.2.20
Summary Information for Grayson County - Irrigation

Grayson County - Irrigation	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Water Demand (ac-ft/yr)						
Irrigation Demand	3,561	3,751	3,950	4,158	4,381	4,616
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	2,347	2,347	2,347	2,347	2,347	2,347
Lake Texoma	150	150	150	150	150	150
Local Supply	2,394	2,394	2,394	2,394	2,394	2,394
Total Supply	***4,891***	***4,891***	***4,891***	***4,891***	***4,891***	***4,891***
Need (Demand - Supply) (ac-ft/yr)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (ac-ft/yr)	**1,330**	**1,140**	**941**	**733**	**510**	**275**

Table 6.2.21 provides information for Grayson County Livestock demands. There are no changes to supplies, demands or strategies in the *2011 Region C Water Plan* [1]. This WUG has no net water needs and as such no specific WMS.

Table 6.2.21
Summary Information for Grayson County - Livestock

Grayson County - Livestock	**Revised Projections**					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Water Demand (ac-ft/yr)						
Livestock Demand	1,297	1,297	1,297	1,297	1,297	1,297
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	360	360	360	360	360	360
Local Supply	1,683	1,683	1,683	1,683	1,683	1,683
Total Supply	***2,043***	***2,043***	***2,043***	***2,043***	***2,043***	***2,043***
Need (Demand - Supply) (ac-ft/yr)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (ac-ft/yr)	**746**	**746**	**746**	**746**	**746**	**746**

Table 6.2.22 provides information for Grayson County Mining demands. There are no changes to demands or strategies in the *2011 Region C Water Plan* (1). There is a slight increase in allocated supply to the Trinity Aquifer in the *2011 Region C Water Plan* (1). This WUG has no net water needs and as such no specific WMS.

Table 6.2.22
Summary Information for Grayson County - Mining

Grayson County - Mining	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Water Demand (ac-ft/yr)						
Mining Demand	1,052	1,050	1,049	1,048	1,047	1,046
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	595	595	595	595	595	595
Woodbine Aquifer	559	559	559	559	559	559
Total Supply	***1,154***	***1,154***	***1,154***	***1,154***	***1,154***	***1,154***
Need (Demand - Supply) (ac-ft/yr)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (ac-ft/yr)	**102**	**104**	**105**	**106**	**107**	**108**

Table 6.2.23 provides information for Grayson County Manufacturing demands. Manufacturing demands increased in the *2011 Region C Water Plan* (1). The additional demands are proposed to be met with additional Lake Texoma supply.

Table 6.2.23
Summary Information for Grayson County - Manufacturing

Grayson County - Manufacturing	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Water Demand (ac-ft/yr)						
Manufacturing Demand	7,010	7,781	8,453	9,088	9,621	10,444
Currently Available Water Supplies (ac-ft/yr)						
Lake Texoma (Sherman)	5,149	5,849	6,478	7,064	7,539	8,280
Lake Randell (Denison)	546	609	645	688	741	815
Howe (NTMWD)	70	78	85	91	96	104
Woodbine Aquifer	1,215	1,215	1,215	1,215	1,215	1,215
Local Supply	30	30	30	30	30	30
Total Supply	***7,010***	***7,781***	***8,453***	***9,088***	***9,621***	***10,444***
Need (Demand - Supply) (ac-ft/yr)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies (ac-ft/yr)						
Water Conservation - Manufacturing General Rebate	0	15	175	255	272	291
Total Water Management Strategies	***0***	***15***	***175***	***255***	***272***	***291***
Reserve (ac-ft/yr)	**0**	**15**	**175**	**255**	**272**	**291**

Table 6.2.24 provides information for Grayson County Steam Electric Power demands. There were no steam electric power demands in the *2006 Region C Water Plan* [(1)]. The new demands are proposed to be met through Lake Texoma (via Sherman).

Table 6.2.24
Summary Information for Grayson County – Steam Electric Power

Grayson County - Steam Electric Power	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Water Demand (ac-ft/yr)						
Steam Electric Power Demand	5,600	8,963	12,326	12,326	12,326	12,326
Currently Available Water Supplies (ac-ft/yr)						
Lake Texoma - Sherman	5,600	5,600	5,600	5,600	5,600	5,600
Total Supply	***5,600***	***5,600***	***5,600***	***5,600***	***5,600***	***5,600***
Need (Demand - Supply) (ac-ft/yr)	***0***	***3,363***	***6,726***	***6,726***	***6,726***	***6,726***
Water Management Strategies (ac-ft/yr)						
Additional Lake Texoma	0	3,400	7,000	7,000	7,000	7,000
Total Water Management Strategies	***0***	***3,400***	***7,000***	***7,000***	***7,000***	***7,000***
Reserve (ac-ft/yr)	**0**	**37**	**274**	**274**	**274**	**274**

7. Estimated Costs for Recommended Water Management Strategies

The estimated costs for proposed water management strategies were updated and are included in Appendix B. The capital costs are broken down by category in **Tables 7.1 and 7.2**. Refer to Appendix Q for additional details on cost assumptions. See Sections 4E and 4F of the *2011 Region C Water Plan* for additional cost information for Collin and Grayson Counties and additional WWP cost information.

Capital costs for supplemental groundwater wells are defined as the costs required to maintain the existing groundwater capacity of a WUG. It is assumed that 20% of the existing WUG groundwater well system will be renewed every 10 years as part of the normal capital renewal program of a WUG. These costs do not add groundwater capacity to WUGs. Capital costs for new wells are the costs for new infrastructure to add additional capacity for a WUG.

Table 7.1
Capital Costs for Proposed Water Management Strategies Not Associated With Wholesale Water Providers

Water Management Strategy Category	Cooke County	Grayson County
	Capital Cost During Study Period	
Transmission Facilities	$0	$13,847,000
Additional Groundwater	$0	$366,000
Supplemental Wells	$24,436,000	$108,901,000
Connect to Supplies	$8,217,000	$0
Treatment Capacity	$35,346,000	$7,270,000
Overdraft Groundwater	$269,000	$0
Total Capital Costs for Study Area	$32,920,000	$130,527,000

Table 7.2
Capital Costs for Proposed Water Management Strategies Associated With Wholesale Water Providers

Water Management Strategy Category	Cooke County	Grayson County
	Capital Cost During Study Period	
Cooke County Water Supply Project (Gainesville)	$50,280,000	$0
Grayson County Water Supply Project (Sherman)	$0	$146,071,000
Grayson County Water Supply Project (GTUA)	$0	$136,016,000
Collin-Grayson Municipal Alliance (GTUA)*	$0	$77,366,000
Additional Lake Texoma for SEP (GTUA)	$0	$24,780,000
Direct Reuse (Gainesville)	$1,828,000	
Supplemental Wells (Gainesville)	$5,468,000	
Total Capital Costs for Study Area	$57,576,000	$384,233,000

*Includes the entire CGMA cost, not just the Grayson County portion

8. Implementation Plan for Proposed Water Management Strategies

Implementation of the Cooke County Water Supply Project and Grayson County Water Supply Project includes developing water management strategies for both surface water and groundwater sources. For surface water sources, the implementation plan for water management strategies includes the following components:

- Obtain required environmental and construction permits
- Design and construct required facilities

For groundwater sources, the implementation plan for water management strategies includes the following components:

- Obtain required permits from the North Texas Groundwater Conservation District and Red River Groundwater Conservation District
- Design and construct required facilities

Table 8.1 lists recommended water management strategies with approximate in-service dates.

Table 8.1
Implementation of Recommended Water Management Strategies

Owner	Project	Approximate In-service Year	County
Lindsay	CCWSP	2013	Cooke
Valley View	CCWSP	2016	Cooke
Bolivar WSC	CCWSP	2018	Cooke
Woodbine WSC	CCWSP	2018	Cooke
County – Other	CCWSP	2018	Cooke
Gainesville	WTP Expansions	2020	Cooke
Kiowa Homeowners WSC	CCWSP	2020	Cooke
Muenster	New WTP	2020	Cooke
Gainesville	WTP Expansions	2020	Cooke

Owner	Project	Approximate In-service Year	County
Gainesville	WTP Expansions	2040 and 2050	Cooke
Bells	GCWSP (Sherman WTP)	2015	Grayson
Luella WSC	GCWSP (Sherman WTP)	2015	Grayson
Two Way SUD	GCWSP (Northwest WTP)	2017	Grayson
Southmayd	New GW Wells	2017	Grayson
Whitesboro	GCWSP (Northwest WTP)	2017	Grayson
Gunter	GCWSP (Sherman WTP)	2017	Grayson
Marilee SUD	GCWSP (Sherman WTP)	2017	Grayson
Tom Bean	GCWSP (Sherman WTP)	2017	Grayson
SFWCSUD	FCWSP	2018	Grayson
County-Other	GCWSP	2018	Grayson
Pottsboro	GCWSP (North WTP)	2019	Grayson
Southmayd	GCWSP (North WTP)	2019	Grayson
Collinsville	GCWSP (Northwest WTP)	2019	Grayson
Tioga	GCWSP (Sherman WTP)	2019	Grayson
Whitewright	GCWSP (Sherman WTP)	2019	Grayson
Howe	CGMA	2020	Grayson
Van Alstyne	CGMA	2020	Grayson
South Grayson WSC	GCWSP (Northwest WTP)	2035	Grayson
Denison	WTP Expansion	2040	Grayson
Sherman	WTP Expansions	2020 and 2050	Grayson

9. Alternative Water Management Strategies

In general, most of the water user groups and wholesale water providers in the Cooke and Grayson County study areas indicated that their future water supply plans are in line with the *2006 Region C Water Plan* [2]. However, seven possible alternative water management strategies were identified in this study: two in Cooke County and five in Grayson County.

9.1 Cooke County

Muenster currently plans to build a water treatment plant to treat surface water from Lake Muenster. An alternative strategy is to purchase treated water from Gainesville (through Lindsay) via the CCWSP.

Two Way SUD has a current recommended strategy to purchase water through the GCWSP (Northwest WTP). An alternative strategy is to purchase treated water from Gainesville via the CCWSP.

9.2 Grayson County

Pottsboro has a current recommended strategy to continue the purchase of treated water from a north water treatment plant. Two alternative strategies exist for Pottsboro: purchasing treated water from the GCWSP (Sherman) or from Denison.

Whitewright has a current recommended strategy to purchase water through the GCWSP (Sherman). An alternative strategy is to purchase treated water from Bonham (NTMWD) via the FCWSP. This was also identified in the *Fannin County Special Study* [7].

Howe and Van Alstyne have current recommended strategies to purchase water through the CGMA Pipeline (NTMWD/GTUA). An alternative strategy is to purchase treated water from Sherman via the GCWSP.

Southmayd has a current recommended strategy to purchase water through GTUA (North WTP). An alternative strategy is to purchase treated water from Sherman (Sherman WTP).

Cost estimates for alternative strategies are located in Appendix Q.

10. Conclusions

The water user groups in the Cooke and Grayson Counties are projecting steady growth in the next 50 years. In general, population growth is lower and water demands are higher than what was projected in the *2006 Region C Water Plan* (2) for Cooke County. In general, population growth and water demands are lower than what was projected in the *2006 Region C Water Plan* (2) for Grayson County. To meet the projected water demands, the recommended water management strategies have been revised as discussed in this report. For most of the water user groups, currently planned water management strategies are in line with the strategies presented in the *2006 Region C Water Plan* (2). **Figure 10.1** and **Figure 10.2** show the total projected demands, current water supplies, and recommended water management strategies for the Cooke and Grayson County Study areas, respectively.

Appendix B contains information on the Public Meeting held on February 25, 2010.

Figure 10.1
Total Projected Municipal Water Demand and Supply for Cooke County

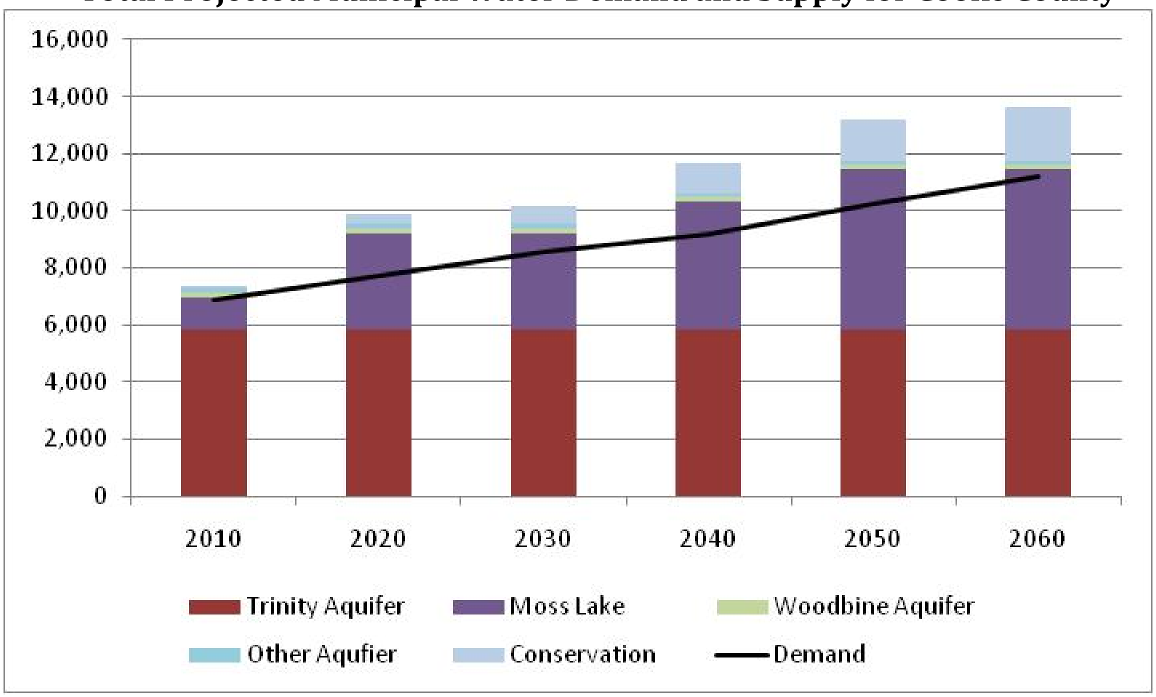
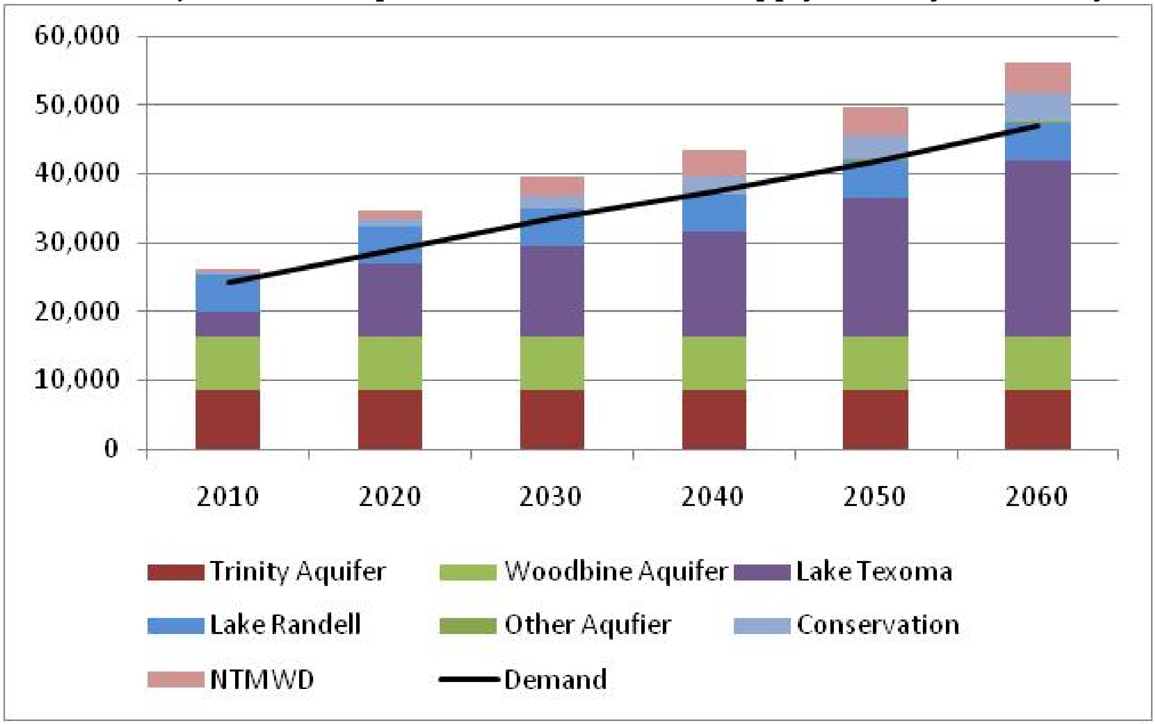


Figure 10.2
Total Projected Municipal Water Demand and Supply for Grayson County



APPENDIX A

REFERENCES

APPENDIX A

REFERENCES

1) Freese and Nichols, Inc., Alan Plummer Associates, Inc., CP&Y, Inc., and Cooksey Communications, Inc.: *2011 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, April 2010.
2) Freese and Nichols, Inc., Alan Plummer Associates, Inc., Chiang, Patel & Yerby, Inc., and Cooksey Communications, Inc.: *2006 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, July 2006.
3) Texas Commission on Environmental Quality: Water Utility Database, [Online], Available URL: http://www10.tceq.state.tx.us/iwud, December 2009.
4) Alan Plummer Associates, Inc.: *Technical Memorandum: Steam Electric Power Demand Projections;* prepared for Region C Water Planning Group, August 2009.
5) Texas State Data Center and Office of the State Demographer: 2007 Population Estimates for Texas Places, [Online], Available URL: http://txsdc.utsa.edu/tpepp/2006_txpopest_place.php, September 2007.
6) United States Census Bureau: Census Data for the State of Texas: Population by County, Population by Place, [Online], Available URL: http://www.census.gov/census2000/states/tx.html, September 2007.
7) Alan Plummer Associates, Inc.: *Fannin County Special Study*; prepared for Region C Water Planning Group, February 2010.
8) Texas Senate Bill 2529: Subtitle H, Title 6, Chapter 8859: Red River Groundwater Conservation District, [Online], Available URL: http://www.sos.state.tx.us/statdoc/bills/sb/SB2529.pdf, June 2009.
9) Texas Senate Bill 2497: Subtitle H, Title 6, Chapter 8856: North Texas Groundwater Conservation District, [Online], Available URL: http://www.legis.state.tx.us/tlodocs/81R/billtext/pdf/SB02497F.pdf

APPENDIX B

PUBLIC MEETING

MEETING MINUTES

Date of Meeting:	February 25, 2010	***Time:***	10:00 AM
Meeting Location:	Whitesboro City Hall, Whitesboro, Texas		

Attendees:

APAI	Two Way SUD
Adam Rose, Preston Dillard	Jeff Bice
City of Gainesville	Marilee SUD
Earl Williams	Donna Loiselle
Woodbine WSC	Kiowa Homeowners WSC
Rickey Kemp	Ronny Young
GTUA, Region C Rep.	City of Howe
Alan Moore	Jeff Stanley, Joe Shepard
City of Whitesboro	City of Valley View
Michael Marter	Mark Patterson
City of Sherman	City of Collinsville
Mark Gibson	Mike Bryant
City of Muenster	City of Southmayd
Stan Endres	Daniel Pepe
CP&Y	
Gil Barnett	

Distribution: File

Project Name: Cooke-Grayson County Special Study, Region C Water Planning Group, 2011 Update

FNI Project No.: NTD08492

CP&Y Project No.: FNI09035

CP&Y Contact Person: Richard Shaffer, 817-392-6821 (rshaffer@cpyi.com)

The following is our understanding of the major discussion items, decisions, and action points of this meeting. If this differs from your understanding, please notify the CP&Y contact person in writing within five (5) days.

DISCUSSION

Preston Dillard, PE, with APAI was the presenter for this meeting.

Introduction: Introductions were made for those persons present at the meeting.

1. Region C Planning Process was reviewed.

a. History of water planning process was covered beginning with 1997 Texas Senate Bill 1.
b. Planning process is "bottom up" with planning on local levels rolled up to regional level.
c. Population in the Region will double by 2060.
d. Region C consists of 16 counties.
e. 50-year planning period for project demand, existing supply, and strategies.
f. Currently working on 2011 Region C Water Plan, which will be incorporated into the (2012) State Water Plan.

2. 5 of the 16 counties in Region C were selected for special studies during this round of water planning. Cooke and Grayson counties were selected to get a closer look with one of these special studies, and it is the results of that study that we are presenting today.

3. Cooke County population growth projections were reviewed. Population is expected to grow from 80,000 to over 140,000 by 2060. Reviewed year 2000 data on Cooke County water demand. Municipal had largest percentage of water use at 69%, and Livestock was second at 24%. By 2060, municipal is expected to be 78% of the county water demand, and Livestock is 13%.

4. Grayson County population growth projections were reviewed. Population is expected to grow from 125,000 to over 250,000 by 2060. Reviewed year 2000 data on Grayson County water demand. Municipal had largest percentage of water use at 65%, and manufacturing was second at 18%. By 2060, municipal is expected to be 61% of the county water demand, and manufacturing is 14%. The most significant change is the increase of Steam Electric use from zero in 2000, to 16% of the county water demand by year 2060.

5. Cooke County Summary: Covered table of the water providers in Cooke County which reviewed the demands for each water provider.

   Detailed data for each water provider in Cooke County was presented with a table for each entity. Those with a representative present were reviewed in some detail, while those with no representative present were passed over without discussion. The water providers were:

   - Bolivar WSC
   - Gainesville
   - Kiowa Homeowners WSC
   - Lindsay
   - Muenster
   - Valley View
   - Woodbine WSC
   - Cooke County – Other

6. Grayson County Summary: Covered table of the water providers in Grayson County, which reviewed the demands for each water provider.

   Detailed data for each water provider in Grayson County was presented with a table for each entity. Those with a representative present were reviewed in some detail, while those with no representative present were passed over without discussion. The water providers were:

   - Bells
   - Collinsville
   - Denison
   - Gunter
   - Howe

- Luella WSC
- Marilee SUD
- Pottsboro
- Sherman
- South Grayson WSC
- Southmayd
- Southwest Fannin County SUD
- Tioga
- Tom Bean
- Two Way SUD
- Van Alstyne
- Whitesboro
- Whitewright
- Grayson County - Other

7. Capital costs for water management strategies were presented and reviewed. Total capital costs from Cooke County are projected to be $115 million. Grayson County capital costs are projected to be $323 million.

8. Total demand and supply for each county was reviewed via a graph for each.

9. Conclusions:

   - WUGs in Cooke and Grayson Counties project steady growth in next 50 years.

   - For Cooke County, projected growth is lower but projected demand is higher in comparison to the projections in the 2006 Region C Water Plan.

   - For Grayson County, projected growth and demand are lower than projections in the 2006 Plan.

10. Next Steps:
    - Region C Board meets March 15, 2010, and will approve the IPP for all Region C.
    - Public hearing on IPP will be May 25, 2010.
    - Final plan adopted October 1, 2010.

11. At 10:45 a.m. the meeting was opened for questions or comments from those present.

    Jerry Chapman was not present at the meeting, but he sent a representative in his stead. Alan Moore from GTUA was present and asked the group to let Jerry know of any changes that might be made to anyone's plans. It is important to ensure that the plan includes any items that a water provider may pursue. If an item is in the plan, funding is possible; but for items not in the plan, funding may not be available.

    The question was asked if Region C is always active. Preston responded that the board is always active. The consultant team working on the Region's water plan may only be active for 1.5 to 2 years of the 5-year cycle. It is important to pass on information to the board at any time, while it may not be during the active period when the plan is being developed.

The question was asked if it was mandatory to implement the conservation packages in order to receive funding, and if entities had to track the effects of the conservation strategies. Preston responded that funding was not tied to mandatory conservation strategies. While it is beneficial to track conservation effectiveness, it can be difficult to do and is not a requirement. Plumbing codes have a significant impact on conservation, and the savings estimate for those codes are built into the plan.

As part of the conservation discussion, Preston pointed out that Region C is a net importer of water. The State needs to see, especially from Regions like ours that import water, a level of conservation efforts.

The question was asked if the population numbers in this plan would be updated by the upcoming census. The census results will not be available for the 2011 plan, but will go into the next plan.

A question was asked about what is considered reuse water. Reuse water can be direct reuse taken from WWTPs and used for irrigation, or indirect, put back into a reservoir for use again later.

The question was asked, if the Capital Costs reviewed earlier in the presentation included funding for supplemental wells and transmission costs. The slide was reviewed again, which had costs for both of those categories identified.

The question was asked, when will the Cooke-Grayson Special Study Report be available on line. Preston replied that it should be on the Region C website early next week.

12. The meeting adjourned at 11:15 a.m.

Water Supply Study
for Cooke and Grayson Counties

Preston Dillard, P.E.
Alan Plummer and Associates

Regional Water Planning Process

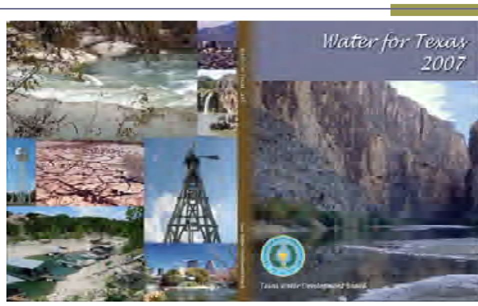
- Senate Bill 1 - Texas Legislature in 1997
- Spurred by 1996 drought
- Population projected to double by 2060
- “Bottom up” water planning process
- Texas Water Development Board
  - Adopted rules
  - Set out 16 regions
  - Named initial planning group members

Regional Water Planning Areas

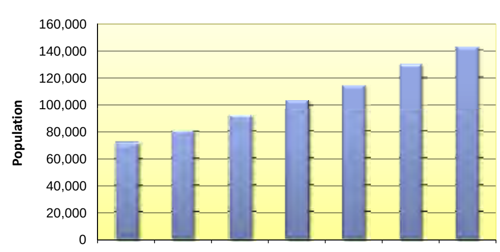
Regional Water Planning Process

- 50-year planning period
- Project population and water demand
- Existing supply
- Evaluate need for additional water
- Recommend strategies
- Water right permitting and TWDB funding use plans

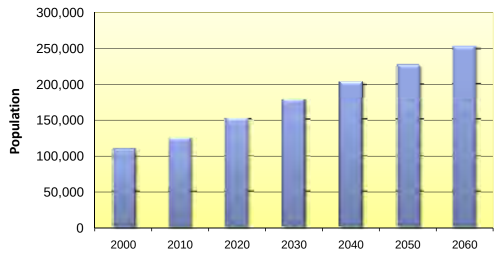
2007 State Water Plan



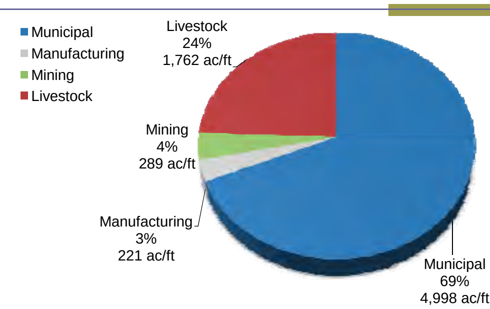
Cooke County Population



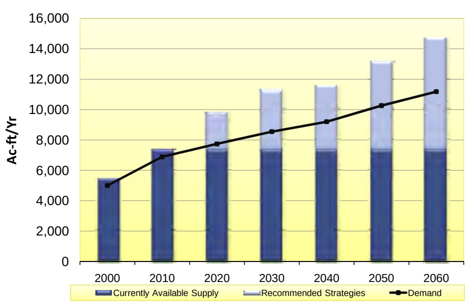
Grayson County Population



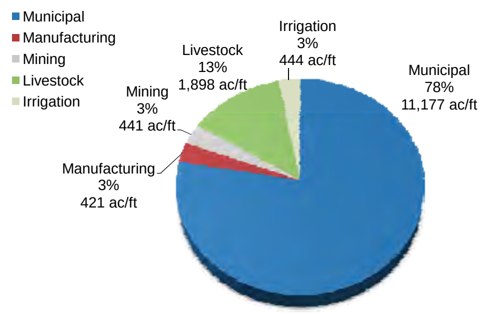
2000 Cooke County Water Use (% of total)



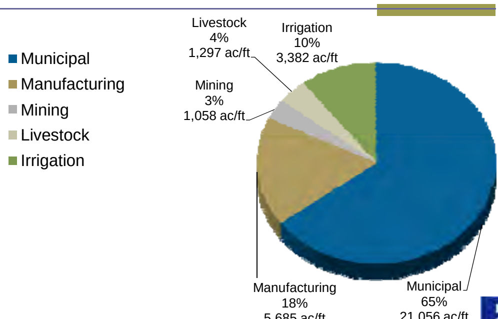
Cooke County Municipal Supplies and Demands



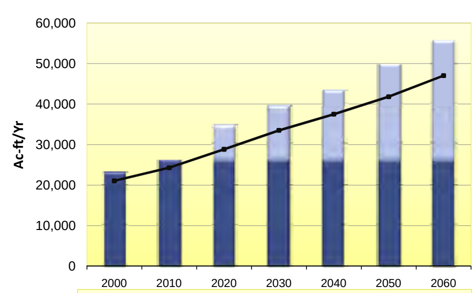
2060 Cooke County Demand (% of total)



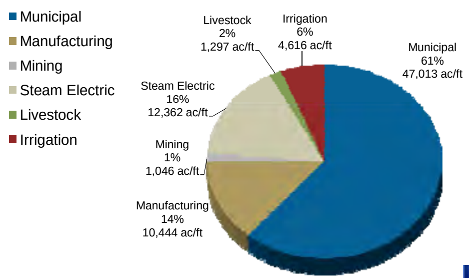
2000 Grayson County Water Use (% of total)



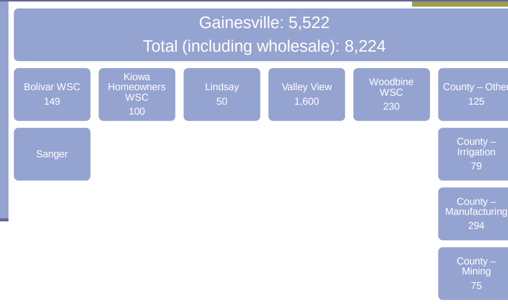
Grayson County Municipal Supplies and Demands



2060 Grayson County Demand (% of total)



2060 Net Cooke County WSP Demands (ac-ft/yr)



Bolivar WSC Summary

Bolivar WSC	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population [(a)]	10,386	12,465	21,806	44,726	70,848	95,836
Projected Water Demand (ac-ft/yr)						
Municipal Demand [(a)]	1,279	1,703	3,371	6,863	10,872	14,707
Wholesale Demand (Sanger)	814	1,626	2,730	3,574	4,620	5,214
Total Projected Water Demand	***2,093***	***3,329***	***6,101***	***10,437***	***15,492***	***19,921***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer [(b)]	1,548	1,548	1,548	1,548	1,548	1,548
Total Supply	***1,548***	***1,548***	***1,548***	***1,548***	***1,548***	***1,548***
Need (Demand - Supply) (ac-ft/yr)	***545***	***1,781***	***4,553***	***8,889***	***13,944***	***18,373***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	19	70	162	356	601	862
Water Conservation - Expanded Package	10	14	27	55	88	119
Cooke County Water Supply Project	0	18	83	104	127	149
Purchase water from UTRWD [(c)]	814	2,107	4,848	9,293	14,455	18,992
Total Water Management Strategies	***843***	***2,209***	***5,120***	***9,809***	***15,271***	***20,122***
Reserve (ac-ft/yr)	**298**	**428**	**567**	**920**	**1,327**	**1,749**

(a) Includes Cooke, Denton and Wise Counties

(b) From Cooke and Denton County groundwater sources

(c) Existing UTRWD supply to Sanger. UTRWD supply to Bolivar WSC by 2020.

Gainesville Summary

Gainesville	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	16,800	19,000	21,400	23,900	26,400	29,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	3,387	3,746	4,171	4,578	5,027	5,522
Cooke County - Irrigation	9	79	79	79	79	79
Cooke County - Manufacturing	49	255	218	243	265	294
Cooke County - Mining	0	48	55	62	69	75
Wholesale Demand (Cooke County Water Supply Project)	0	473	838	1,149	1,772	2,254
Total Projected Water Demand	***3,445***	***4,601***	***5,361***	***6,111***	***7,212***	***8,224***
Currently Available Water Supplies (ac-ft/yr)						
Hubert H. Moss Lake	1,121	1,121	1,121	1,121	1,121	1,121
Direct Reuse Gainesville WTP	9	9	9	9	9	9
Trinity Aquifer	2,360	2,360	2,360	2,360	2,360	2,360
Total Supply	***3,490***	***3,490***	***3,490***	***3,490***	***3,490***	***3,490***
Need (Demand - Supply) (ac-ft/yr)	***0***	***1,111***	***1,871***	***2,621***	***3,722***	***4,734***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	27	95	225	288	359	441
Water Conservation - Expanded Package	0	0	13	19	20	22
Expand Gainesville WTP capacity 4 MGD and Moss Lake Raw Water Supply	0	2,242	2,242	2,242	2,242	2,242
WTP Expansion of 2 MGD	0	0	1,121	1,121	1,121	1,121
WTP Expansion of 2 MGD	0	0	0	0	1,121	1,121
WTP Expansion of 2 MGD	0	0	0	0	0	1,121
Expand Direct Reuse	0	94	97	101	104	107
Total Water Management Strategies	***27***	***2,431***	***3,698***	***3,771***	***4,967***	***6,174***
Reserve (ac-ft/yr)	**72**	**1,320**	**1,827**	**1,150**	**1,245**	**1,440**

Kiowa Homeowners WSC Summary

Kiowa Homeowners WSC	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	3,324	3,567	3,691	3,711	3,710	3,709
Projected Water Demand (ac-ft/yr)						
Municipal Demand	875	931	955	952	948	947
Total Projected Water Demand	***875***	***931***	***955***	***952***	***948***	***947***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	887	887	887	887	887	887
Total Supply	***887***	***887***	***887***	***887***	***887***	***887***
Need (Demand - Supply) (ac-ft/yr)	***0***	***44***	***68***	***65***	***61***	***60***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	6	20	28	31	34	38
Cooke County Water Supply Project	0	100	100	100	100	100
Total Water Management Strategies	***6***	***120***	***128***	***131***	***134***	***138***
Reserve (ac-ft/yr)	**18**	**76**	**60**	**66**	**73**	**78**

Lindsay Summary

Lindsay	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	879	943	976	981	981	981
Projected Water Demand (ac-ft/yr)						
Municipal Demand	154	161	164	162	160	160
Total Projected Water Demand	***154***	***161***	***164***	***162***	***160***	***160***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	165	165	165	165	165	165
Total Supply	***165***	***165***	***165***	***165***	***165***	***165***
Need (Demand - Supply) (ac-ft/yr)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	2	5	7	8	8	9
Cooke County Water Supply Project	0	40	50	50	50	50
Total Water Management Strategies	***2***	***45***	***57***	***58***	***58***	***59***
Reserve (ac-ft/yr)	**13**	**49**	**58**	**61**	**63**	**64**

Muenster Summary

Muenster	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	1,700	1,800	1,900	2,000	2,100	2,200
Projected Water Demand (ac-ft/yr)						
Municipal Demand	339	351	366	379	395	414
Cooke County - Manufacturing	0	0	60	61	63	65
Total Projected Water Demand	***339***	***351***	***426***	***440***	***458***	***479***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	339	339	339	339	339	339
Total Supply	***339***	***339***	***339***	***339***	***339***	***339***
Need (Demand - Supply) (ac-ft/yr)	***0***	***12***	***87***	***101***	***119***	***140***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	3	9	13	23	27	32
Water Conservation - Expanded Package	0	0	0	2	2	3
New WTP at Muenster Lake	0	280	280	280	280	280
Total Water Management Strategies	***3***	***289***	***293***	***305***	***309***	***314***
Reserve (ac-ft/yr)	**3**	**277**	**206**	**204**	**190**	**174**

Valley View Summary

Valley View	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	1,500	3,000	5,000	7,000	12,000	15,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	187	363	594	808	1,371	1,714
Total Projected Water Demand	***187***	***363***	***594***	***808***	***1,371***	***1,714***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	363	363	363	363	363	363
Total Supply	***363***	***363***	***363***	***363***	***363***	***363***
Need (Demand - Supply) (ac-ft/yr)	***0***	***0***	***231***	***445***	***1,008***	***1,351***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	3	16	31	46	83	110
Cooke County Water Supply Project	0	150	400	650	1,200	1,600
Total Water Management Strategies	***3***	***166***	***431***	***696***	***1,283***	***1,710***
Reserve (ac-ft/yr)	**179**	**166**	**200**	**251**	**275**	**359**

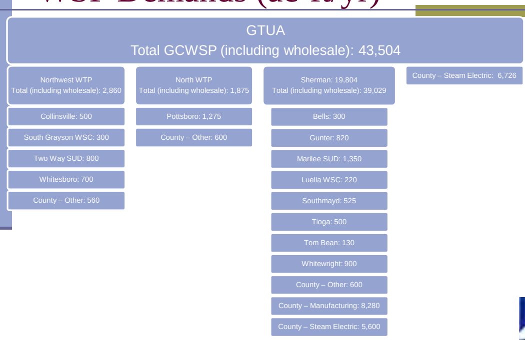
Woodbine WSC Summary

Woodbine WSC	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population [(a)]	5,336	5,773	6,307	6,839	7,370	7,901
Projected Water Demand (ac-ft/yr)						
Municipal Demand [(a)]	669	712	762	802	855	915
Total Projected Water Demand	***669***	***712***	***762***	***802***	***855***	***915***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	661	661	661	661	661	661
Total Supply	***661***	***661***	***661***	***661***	***661***	***661***
Need (Demand - Supply) (ac-ft/yr)	***8***	***51***	***101***	***141***	***194***	***254***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	8	28	39	46	52	59
Cooke County Water Supply Project	0	40	80	120	170	230
Total Water Management Strategies	***8***	***68***	***119***	***166***	***222***	***289***
Reserve (ac-ft/yr)	**0**	**17**	**18**	**25**	**28**	**35**
(a) Includes both Cooke and Grayson Counties						

Cooke County – Other Summary

Cooke County - Other	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	9,487	10,181	10,533	10,590	10,586	10,586
Projected Water Demand (ac-ft/yr)						
Municipal Demand	1,074	1,232	1,251	1,234	1,221	1,222
Total Projected Water Demand	***1,074***	***1,232***	***1,251***	***1,234***	***1,221***	***1,222***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	888	888	888	888	888	888
Woodbine Aquifer	154	154	154	154	154	154
Other Aquifer	137	137	137	137	137	137
Total Supply	***1,179***	***1,179***	***1,179***	***1,179***	***1,179***	***1,179***
Need (Demand - Supply) (ac-ft/yr)	***0***	***53***	***72***	***55***	***42***	***43***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	13	47	65	70	74	78
Cooke County Water Supply Project	0	125	125	125	125	125
Total Water Management Strategies	***13***	***172***	***190***	***195***	***199***	***203***
Reserve (ac-ft/yr)	**118**	**119**	**118**	**140**	**157**	**160**

2060 Net GTUA Grayson County WSP Demands (ac-ft/yr)



Bells Summary

Bells	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	1,400	2,100	2,750	3,250	3,700	4,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	185	271	348	404	456	493
Total Projected Water Demand	***185***	***271***	***348***	***404***	***456***	***493***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	161	161	161	161	161	161
Woodbine Aquifer	43	43	43	43	43	43
Total Supply	***204***	***204***	***204***	***204***	***204***	***204***
Need (Demand - Supply) (ac-ft/yr)	**0**	**67**	**144**	**200**	**252**	**289**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	2	11	17	22	26	30
Water Conservation - Expanded Package	1	2	2	3	3	4
Grayson County Project (Sherman WTP)	0	80	150	210	260	300
Total Water Management Strategies	***4***	***93***	***170***	***235***	***290***	***334***
Reserve (ac-ft/yr)	**23**	**26**	**26**	**35**	**38**	**45**

Collinsville Summary

Collinsville	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	2,035	2,835	3,635	4,435	5,235	6,035
Projected Water Demand (ac-ft/yr)						
Municipal Demand	324	441	558	666	780	899
Total Projected Water Demand	***324***	***441***	***558***	***666***	***780***	***899***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	356	356	356	356	356	356
Total Supply	***356***	***356***	***356***	***356***	***356***	***356***
Need (Demand - Supply) (ac-ft/yr)	**0**	**85**	**202**	**310**	**424**	**543**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	4	15	24	32	40	49
Water Conservation - Expanded Package	3	4	5	6	7	8
Grayson County Project (Northwest WTP)	0	100	200	300	400	500
Total Water Management Strategies	***7***	***119***	***229***	***338***	***447***	***557***
Reserve (ac-ft/yr)	**39**	**34**	**27**	**28**	**23**	**14**

Denison Summary

Denison	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	25,000	28,000	30,000	31,000	32,000	33,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	5,489	6,053	6,385	6,493	6,667	6,875
Wholesale - Pottsboro	561	561	561	561	561	561
Wholesale - County - Other	310	310	310	310	310	310
Total Projected Water Demand	***6,906***	***7,533***	***7,901***	***8,052***	***8,279***	***8,561***
Currently Available Water Supplies (ac-ft/yr)						
Lake Randell	5,400	5,400	5,400	5,400	5,400	5,400
Lake Texoma - to Lake Randell	1,900	1,900	1,900	1,900	1,900	1,900
Trinity Aquifer	157	157	157	157	157	157
Woodbine Aquifer	155	155	155	155	155	155
Total Supply	***7,612***	***7,612***	***7,612***	***7,612***	***7,612***	***7,612***
Need (Demand - Supply) (ac-ft/yr)	**0**	***0***	***289***	***440***	***667***	***949***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	43	145	382	496	566	641
Water Conservation - Expanded Package	0	0	27	38	39	40
WTP Expansion	0	0	0	1,121	1,121	1,121
Total Water Management Strategies	***43***	***145***	***409***	***1,656***	***1,726***	***1,802***
Reserve (ac-ft/yr)	**749**	**224**	**120**	**1,216**	**1,059**	**853**

Gunter Summary

Gunter	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	2,000	3,500	5,000	6,500	8,000	9,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	271	467	655	837	1,022	1,149
Total Projected Water Demand	***271***	***467***	***655***	***837***	***1,022***	***1,149***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	298	298	298	298	298	298
Total Supply	***298***	***298***	***298***	***298***	***298***	***298***
Need (Demand - Supply) (ac-ft/yr)	**0**	**169**	**357**	**539**	**724**	**851**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	3	16	28	39	51	62
Water Conservation - Expanded Package	2	3	4	5	6	6
Grayson County Project (Sherman WTP)	0	180	350	530	700	820
Total Water Management Strategies	***5***	***199***	***382***	***574***	***757***	***888***
Reserve (ac-ft/yr)	**32**	**30**	**25**	**35**	**33**	**37**

Howe Summary

Howe	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	3,000	4,500	6,500	8,500	9,772	10,781
Projected Water Demand (ac-ft/yr)						
Municipal Demand	403	590	837	1,085	1,237	1,365
Grayson County - Manufacturing	70	78	85	91	96	104
Total Projected Water Demand	***473***	***668***	***922***	***1,176***	***1,333***	***1,469***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	301	301	301	301	301	301
CGMA Pipeline	307	391	430	430	430	430
Total Supply	***608***	***692***	***731***	***731***	***731***	***731***
Need (Demand - Supply) (ac-ft/yr)	**0**	**0**	**191**	**445**	**602**	**738**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	5	22	39	54	66	78
Water Conservation - Expanded Package	4	6	8	11	12	14
Expand CGMA Pipeline Capacity: Trunk Line	0	103	311	559	711	839
Total Water Management Strategies	***9***	***130***	***358***	***624***	***790***	***930***
Reserve (ac-ft/yr)	**144**	**154**	**167**	**179**	**188**	**192**

Luella WSC Summary

Luella WSC	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	3,300	3,800	4,300	4,950	5,080	5,770
Projected Water Demand (ac-ft/yr)						
Municipal Demand	410	460	511	582	592	672
Total Projected Water Demand	***410***	***460***	***511***	***582***	***592***	***672***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	450	450	450	450	450	450
Total Supply	***450***	***450***	***450***	***450***	***450***	***450***
Need (Demand - Supply) (ac-ft/yr)	**0**	**10**	**61**	**132**	**142**	**222**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	5	18	27	33	36	43
Grayson County Project (Sherman WTP)	0	38	80	140	150	220
Total Water Management Strategies	***5***	***56***	***107***	***173***	***186***	***263***
Reserve (ac-ft/yr)	**45**	**46**	**46**	**41**	**44**	**41**

Marilee SUD Summary

Marilee SUD	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population [a]	4,300	6,400	8,653	10,679	13,471	16,560
Projected Water Demand (ac-ft/yr)						
Municipal Demand [a]	530	774	1,027	1,256	1,585	1,948
Total Projected Water Demand	***530***	***774***	***1,027***	***1,256***	***1,585***	***1,948***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer [b]	634	634	634	634	634	634
Total Supply	***634***	***634***	***634***	***634***	***634***	***634***
Need (Demand - Supply) (ac-ft/yr)	**0**	**140**	**393**	**622**	**951**	**1,314**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	1	6	10	13	17	22
Water Conservation - Expanded Package	1	1	1	2	2	3
Grayson County Project (Sherman WTP)	0	150	400	650	1,000	1,350
Total Water Management Strategies	***2***	***158***	***411***	***664***	***1,019***	***1,374***
Reserve (ac-ft/yr)	**106**	**18**	**18**	**42**	**68**	**60**
(a) Includes both Collin and Grayson Counties						
(b) From Collin and Grayson County groundwater sources						

Pottsboro Summary

Pottsboro	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	3,000	5,000	7,000	9,000	11,000	12,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	504	851	1,176	1,492	1,811	1,976
Total Projected Water Demand	***504***	***851***	***1,176***	***1,492***	***1,811***	***1,976***
Currently Available Water Supplies (ac-ft/yr)						
Lake Texoma (Denison)	561	561	561	561	561	561
Woodbine Aquifer	123	123	123	123	123	123
Total Supply	***684***	***684***	***684***	***684***	***684***	***684***
Need (Demand - Supply) (ac-ft/yr)	**0**	**167**	**492**	**808**	**1,127**	**1,292**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	6	45	77	112	151	181
Water Conservation - Expanded Package	6	14	20	25	32	35
Grayson County Project (North WTP)	0	280	600	870	1,150	1,275
Total Water Management Strategies	***12***	***339***	***697***	***1,007***	***1,332***	***1,491***
Reserve (ac-ft/yr)	**193**	**172**	**206**	**199**	**206**	**200**
(b) From Collin and Grayson County groundwater sources						

Sherman Summary

Sherman	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	39,300	44,400	50,600	57,700	67,000	80,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	10,081	11,240	12,696	14,348	16,586	19,804
Wholesale Demand - Grayson Co. Supply Project	0	1,023	1,995	3,050	4,155	5,345
Grayson County - SEP Demand	5,600	5,600	5,600	5,600	5,600	5,600
Grayson County - Manufacturing	5,149	5,849	6,478	7,064	7,539	8,280
Total Projected Water Demand	***20,830***	***23,712***	***26,769***	***30,062***	***33,880***	***39,029***
Currently Available Water Supplies (ac-ft/yr)						
Lake Texoma (GTUA – to Steam Electric Power)	5,600	5,600	5,600	5,600	5,600	5,600
Lake Texoma (GTUA)	8,000	8,000	8,000	8,000	8,000	8,000
Trinity Aquifer	4,083	4,083	4,083	4,083	4,083	4,083
Woodbine Aquifer	3,463	3,463	3,463	3,463	3,463	3,463
Total Supply	***21,146***	***21,146***	***21,146***	***21,146***	***21,146***	***21,146***
Need (Demand - Supply) (ac-ft/yr)	***0***	***2,566***	***5,623***	***8,916***	***12,734***	***17,883***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	67	217	333	880	1,411	1,850
Water Conservation - Expanded Package	0	0	0	78	102	119
10 MGD WTP Expansion	0	5,600	5,600	5,600	5,600	5,600
5 MGD WTP Expansion	0	0	2,800	2,800	2,800	2,800
New 10 MGD WTP	0	0	0	0	5,600	5,600
New WTP: 10 MGD WTP Expansion	0	0	0	0	0	5,600
Total Water Management Strategies	***67***	***5,817***	***8,733***	***9,358***	***15,513***	***21,568***
Reserve (ac-ft/yr)	**383**	**3,251**	**3,109**	**442**	**2,778**	**3,685**

South Grayson WSC Summary

South Grayson WSC	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population [(a)]	2,700	3,450	4,100	4,825	5,650	6,675
Projected Water Demand (ac-ft/yr)						
Municipal Demand [(a)]	381	479	561	654	760	897
Total Projected Water Demand	***381***	***479***	***561***	***654***	***760***	***897***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer [(b)]	360	360	360	360	360	360
Woodbine Aquifer [(b)]	360	360	360	360	360	360
Total Supply	***720***	***720***	***720***	***720***	***720***	***720***
Need (Demand - Supply) (ac-ft/yr)	**0**	**0**	**0**	**0**	**40**	**177**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	3	12	19	26	34	45
Collin-Grayson Municipal Alliance Project	0	100	100	100	100	100
Grayson County Water Supply Project (Northwest WTP)	0	0	0	75	175	300
Total Water Management Strategies	***3***	***112***	***119***	***201***	***309***	***445***
Reserve (ac-ft/yr)	**342**	**353**	**278**	**267**	**269**	**268**
(a) Includes both Collin and Grayson Counties						
(b) From Collin and Grayson County groundwater sources						

Southmayd Summary

Southmayd	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	1,200	1,500	2,000	3,000	4,500	5,600
Projected Water Demand (ac-ft/yr)						
Municipal Demand	160	197	258	380	565	703
Total Projected Water Demand	***160***	***197***	***258***	***380***	***565***	***703***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	130	130	130	130	130	130
Woodbine Aquifer	60	60	60	60	60	60
Total Supply	***190***	***190***	***190***	***190***	***190***	***190***
Need (Demand - Supply) (ac-ft/yr)	**0**	**7**	**68**	**190**	**375**	**513**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	2	8	13	21	33	43
Grayson County Project (Sherman WTP)	0	40	100	220	400	525
Total Water Management Strategies	***2***	***48***	***113***	***241***	***433***	***568***
Reserve (ac-ft/yr)	**32**	**41**	**45**	**51**	**58**	**55**

Southwest Fannin County SUD Summary

Southwest Fannin County SUD	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population [(a)]	7,491	8,940	9,947	10,852	11,657	12,463
Projected Water Demand (ac-ft/yr)						
Municipal Demand [(a)]	722	1,042	1,192	1,288	1,371	1,466
Total Projected Water Demand	***722***	***1,042***	***1,192***	***1,288***	***1,371***	***1,466***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer [(b)]	803	803	803	803	803	803
Total Supply	***803***	***803***	***803***	***803***	***803***	***803***
Need (Demand - Supply) (ac-ft/yr)	**0**	**239**	**389**	**485**	**568**	**663**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	15	44	62	72	82	93
Fannin County Water Supply Project	0	399	560	666	756	859
Total Water Management Strategies	***15***	***443***	***622***	***738***	***838***	***952***
Reserve (ac-ft/yr)	**96**	**204**	**233**	**253**	**270**	**289**
(a) Includes both Fannin and Grayson Counties						
(b) From Fannin and Grayson County groundwater sources						

Tioga Summary

Tioga	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	1,100	2,500	3,500	4,000	4,400	4,600
Projected Water Demand (ac-ft/yr)						
Municipal Demand	192	428	588	663	725	757
Total Projected Water Demand	***192***	***428***	***588***	***663***	***725***	***757***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	211	211	211	211	211	211
Total Supply	***211***	***211***	***211***	***211***	***211***	***211***
Need (Demand - Supply) (ac-ft/yr)	**0**	**217**	**377**	**452**	**514**	**546**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	2	26	48	60	72	81
Water Conservation - Expanded Package	1	4	7	8	9	9
Grayson County Project (Sherman WTP)	0	225	375	425	475	500
Total Water Management Strategies	***4***	***256***	***430***	***493***	***555***	***590***
Reserve (ac-ft/yr)	**23**	**39**	**53**	**41**	**41**	**44**

Tom Bean Summary

Tom Bean	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	1,100	1,300	1,500	1,700	1,900	2,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	259	301	343	383	426	448
Total Projected Water Demand	***259***	***301***	***343***	***383***	***426***	***448***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	288	288	288	288	288	288
Total Supply	***288***	***288***	***288***	***288***	***288***	***288***
Need (Demand - Supply) (ac-ft/yr)	**0**	**13**	**55**	**95**	**138**	**160**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	22	67	81	93	108	117
Water Conservation - Expanded Package	2	4	4	5	5	6
Grayson County Project (Sherman WTP)	0	10	40	75	120	130
Total Water Management Strategies	***25***	***81***	***125***	***173***	***233***	***252***
Reserve (ac-ft/yr)	**54**	**68**	**70**	**79**	**95**	**93**

Two Way SUD Summary

Two Way SUD	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population [(a)]	5,081	6,720	8,251	9,819	11,382	12,945
Projected Water Demand (ac-ft/yr)						
Municipal Demand [(a)]	575	813	979	1,155	1,326	1,508
Total Projected Water Demand	***575***	***813***	***979***	***1,155***	***1,326***	***1,508***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer [(b)]	622	622	622	622	622	622
Total Supply	***622***	***622***	***622***	***622***	***622***	***622***
Need (Demand - Supply) (ac-ft/yr)	***0***	***191***	***357***	***533***	***704***	***886***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	9	34	51	65	80	96
Water Conservation - Expanded Package	5	7	8	10	11	13
Grayson County Project (Northwest WTP)	0	200	350	500	650	800
Total Water Management Strategies	***13***	***240***	***409***	***575***	***741***	***909***
Reserve (ac-ft/yr)	**60**	**49**	**52**	**42**	**37**	**23**
(a) Includes both Cooke and Grayson Counties						
(b) From Grayson County groundwater sources						

Van Alstyne Summary

Van Alstyne	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	3,000	7,500	13,500	17,000	18,500	19,200
Projected Water Demand (ac-ft/yr)						
Municipal Demand	504	1,411	2,510	3,142	3,419	3,549
Total Projected Water Demand	***504***	***1,411***	***2,510***	***3,142***	***3,419***	***3,549***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	235	235	235	235	235	235
Woodbine Aquifer	215	215	215	215	215	215
CGMA Pipeline	58	795	1,291	1,291	1,291	1,291
Total Supply	***508***	***1,245***	***1,741***	***1,741***	***1,741***	***1,741***
Need (Demand - Supply) (ac-ft/yr)	**0**	**166**	**769**	**1,401**	**1,678**	**1,808**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	5	70	152	218	265	305
Water Conservation - Expanded Package	3	12	26	35	41	43
Expand CGMA Pipeline Capacity: Trunk Line	0	170	773	1,405	1,682	1,812
Total Water Management Strategies	***8***	***252***	***951***	***1,658***	***1,988***	***2,160***
Reserve (ac-ft/yr)	**12**	**86**	**182**	**257**	**310**	**352**

Whitesboro Summary

Whitesboro	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	4,400	5,000	5,700	6,500	7,500	10,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	764	851	958	1,070	1,227	1,635
Total Projected Water Demand	***764***	***851***	***958***	***1,070***	***1,227***	***1,635***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	840	840	840	840	840	840
Total Supply	***840***	***840***	***840***	***840***	***840***	***840***
Need (Demand - Supply) (ac-ft/yr)	**0**	**11**	**118**	**230**	**387**	**795**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	7	42	61	78	100	147
Water Conservation - Expanded Package	0	3	5	6	7	10
Grayson County Project (Northwest WTP)	0	50	150	200	350	700
Total Water Management Strategies	***7***	***95***	***216***	***284***	***457***	***857***
Reserve (ac-ft/yr)	**83**	**84**	**98**	**54**	**70**	**62**

Whitewright Summary

Whitewright	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population [(a)]	2,022	3,228	4,532	5,535	6,538	7,541
Projected Water Demand (ac-ft/yr)						
Municipal Demand [(a)]	403	632	873	1,048	1,230	1,419
Total Projected Water Demand	***403***	***632***	***873***	***1,048***	***1,230***	***1,419***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	438	438	438	438	438	438
Total Supply	***438***	***438***	***438***	***438***	***438***	***438***
Need (Demand - Supply) (ac-ft/yr)	**0**	**194**	**435**	**610**	**792**	**981**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	3	30	52	71	94	120
Water Conservation - Expanded Package	2	4	5	6	8	9
Grayson County Project (Sherman WTP)	0	200	400	600	750	900
Total Water Management Strategies	***5***	***233***	***457***	***678***	***851***	***1,029***
Reserve (ac-ft/yr)	**40**	**39**	**22**	**68**	**59**	**48**
(a) Includes both Fannin and Grayson Counties						

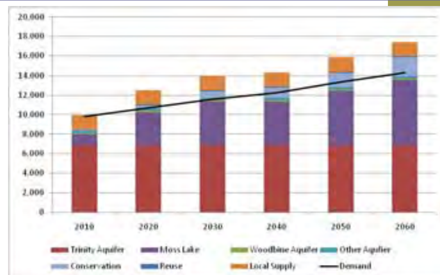
Grayson County – Other Summary

Grayson County – Other	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	26,925	26,799	26,482	25,160	23,185	20,727
Projected Water Demand (ac-ft/yr)						
Municipal Demand	3,468	3,393	3,263	3,016	2,753	2,461
Total Projected Water Demand	***3,468***	***3,393***	***3,263***	***3,016***	***2,753***	***2,461***
Currently Available Water Supplies (ac-ft/yr)						
Lake Randell	60	60	60	60	60	60
Lake Texoma	891	891	891	891	891	891
Other Aquifer	35	35	35	35	35	35
Trinity Aquifer	1,170	1,170	1,170	1,170	1,170	1,170
Woodbine Aquifer	1,659	1,659	1,659	1,659	1,659	1,659
Total Supply	***3,815***	***3,815***	***3,815***	***3,815***	***3,815***	***3,815***
Need (Demand – Supply) (ac-ft/yr)	**0**	**0**	**0**	**0**	**0**	**0**
Water Management Strategies (ac-ft/yr)						
Supplemental Groundwater Wells in Aquifers	0	0	0	0	0	0
Water Conservation – Basic Package	37	123	165	168	164	155
Grayson County Project (Sherman WTP)	0	100	100	200	300	600
Grayson County Project (North WTP)	0	200	300	400	500	600
Grayson County Project (Northwest WTP)	0	560	560	560	560	560
Total Water Management Strategies	***37***	***983***	***1,125***	***1,328***	***1,524***	***1,915***
Reserve (ac-ft/yr)	**383**	**1,405**	**1,676**	**2,127**	**2,585**	**3,268**

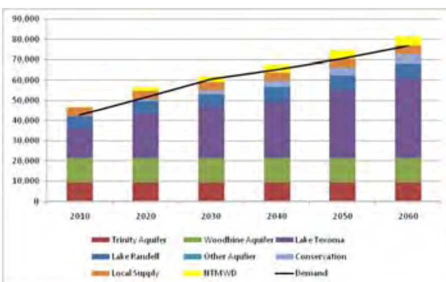
Capital Costs for Proposed Water Management Strategies

Water Management Strategy Category	Capital Cost During Study Period	
	Cooke County	Grayson County
Transmission Facilities	$26,135,000	$38,255,000
Supplemental Wells	$38,780,000	$79,709,000
New Water Treatment Plants	$8,217,000	$74,883,000
Water Treatment Plant Expansions	$41,932,000	$130,266,000
Total Capital Costs for Study Area	**$115,064,000**	**$323,113,000**

Total Demand and Supply for the Cooke County



Total Demand and Supply for the Grayson County



Conclusions

- WUGs in the Cooke and Grayson Counties Study are projecting steady growth in the next 50 years.
- For Cooke County, growth lower but demand higher than what was projected in the *2006 Region C Water Plan*.
- For Grayson County, growth and demand lower than what was projected in the *2006 Region C Water Plan*.
- For most of the WUGs, currently planned water management strategies are in line with the strategies presented in the *2006 Region C Water Plan.*

Next Steps

- Region C Initially Prepared Plan (IPP) to be presented to Region C Board for Approval – 3/15/10
- Public Hearing on IPP – 5/25/10, 7 pm in Arlington at the Bob Duncan Center in Vandergriff Park
- Final plan adopted – 10/1/10

APPENDIX S

COOKE-GRAYSON COUNTY WATER SUPPLY STUDY

Water Supply Study for Cooke and Grayson Counties

September 2010

Prepared for:
Region C Water Planning Group

Prepared by:
Alan Plummer Associates, Inc
Freese and Nichols, Inc.
CP&Y, Inc.

Draft Water Supply Study for Cooke and Grayson Counties
Region C Water Planning Group

TABLE OF CONTENTS

			Page
1.	Executive Summary		ES.1
2.	Introduction		2.1
3.	Population and Demand Projections		3.1
	3.1.	Meetings to Collect Data	3.1
	3.2.	Revisions to Population and Demand Projections	3.2
	3.3.	Recommended Population Projections for WUGs and WWPs	3.4
	3.4.	Recommended Water Demands for WUGs	3.8
4.	Evaluation of Current Supplies		4.1
	4.1	Surface Water	4.1
	4.2	Groundwater	4.2
5	Comparison of Current Supplies to Projected Demand		5.1
6	Revisions to Management Strategies		6.1
	6.1	Cooke County	6.2
		6.1.1 Bolivar WSC	6.2
		6.1.2 Gainesville	6.3
		6.1.3 Kiowa Homeowners WSC	6.5
		6.1.4 Lindsay	6.6
		6.1.5 Muenster	6.7
		6.1.6 Valley View	6.8
		6.1.7 Woodbine WSC	6.9
		6.1.8 Cooke County-Other	6.10
		6.1.9 Cooke County – Non Municipal	6.11
	6.2	Grayson County	6.15
		6.2.1 Bells	6.15
		6.2.2 Collinsville	6.16
		6.2.3 Denison	6.17

6.2.4 Gunter 6.18
6.2.5 Marilee SUD 6.19
6.2.6 Howe 6.20
6.2.7 Luella WSC 6.21
6.2.8 Pottsboro 6.22
6.2.9 Sherman 6.23
6.2.10 South Grayson WSC 6.24
6.2.11 Southmayd 6.25
6.2.12 Southwest Fannin County SUD 6.26
6.2.13 Tioga 6.27
6.2.14 Tom Bean 6.28
6.2.15 Two Way SUD 6.29
6.2.16 Van Alstyne 6.30
6.2.17 Whitesboro 6.31
6.2.18 Whitewright 6.32
6.2.19 Grayson County-Other 6.33
6.2.20 Grayson County – Non Municipal 6.34
7 Estimated Costs for Recommended Water Management Strategies 7.1
8 Implementation Plan for Proposed Water Management Strategies 8.1
9 Alternative Water Management Strategies 9.1
9.1 Cooke County 9.1
9.2 Grayson County 9.1
10 Conclusions 10.1

APPENDICES

Appendix A .... References

Appendix B .... Cost Estimates

Appendix C .... Assumptions for Cost Estimates

Appendix D .... Cost Estimates for Alternative Strategies

Appendix E .... Public Meeting

LIST OF TABLES

		Page
3.1	Meetings with WUGs and WWPs	3.2
3.2	Approved Population Projections in Cooke County	3.5
3.3	Approved Population Projections in Grayson County	3.6
3.4	Approved Population Projections for Cooke County Entities Split by County	3.7
3.5	Approved Population Projections for Grayson County Entities Split by County	3.8
3.6	Approved Cooke County Municipal Per Capita Water Use Projections in Gallons Per Person Per Day	3.9
3.7	Approved Cooke County Municipal Per Capita Water Use Projections in Gallons Per Person Per Day	3.10
3.8	Approved Gainesville Wholesale Water Provider Projections	3.12
3.9	Approved Greater Texoma Utility Authority Wholesale Water Provider Projections	3.13
3.10	Approved Cooke County Demand Projections in Acre-Feet per year	3.14
3.11	Approved Grayson County Demand Projections in Acre-Feet per year	3.14
6.1.1	Bolivar WSC	6.3
6.1.2	Gainesville	6.4
6.1.3	Kiowa Homeowners WSC	6.5
6.1.4	Lindsay	6.6
6.1.5	Muenster	6.7
6.1.6	Valley View	6.8
6.1.7	Woodbine WSC	6.9
6.1.8	Cooke County-Other	6.10
6.1.9	Cooke County – Irrigation	6.11
6.1.10	Cooke County – Livestock	6.12
6.1.11	Cooke County – Manufacturing	6.13
6.1.12	Cooke County – Mining	6.14
6.2.1	Bells	6.15
6.2.2	Collinsville	6.16
6.2.3	Denison	6.17
6.2.4	Gunter	6.18
6.2.5	Marilee SUD	6.19
6.2.6	Howe	6.20
6.2.7	Luella WSC	6.21
6.2.8	Pottsboro	6.22
6.2.9	Sherman	6.23
6.2.10	South Grayson WSC	6.24
6.2.11	Southmayd	6.25
6.2.12	Southwest Fannin County SUD	6.26
6.2.13	Tioga	6.27
6.2.14	Tom Bean	6.28
6.2.15	Two Way SUD	6.29

6.2.16	Van Alstyne	6.30
6.2.17	Whitesboro	6.31
6.2.18	Whitewright	6.32
6.2.19	Grayson County-Other	6.33
6.2.20	Grayson County – Irrigation	6.34
6.2.21	Grayson County – Livestock	6.35
6.2.22	Grayson County – Manufacturing	6.36
6.2.23	Grayson County – Mining	6.37
6.2.24	Grayson County – Steam Electric Power	6.38
7.1	Capital Costs for Recommended Water Management Strategies Not Associated with WWPs	7.1
7.2	Capital Costs for Recommended Water Management Strategies Associated with WWPs	7.2
8.1	Implementation of Recommended Water Management Strategies	8.1

LIST OF FIGURES

		Page
2.1	Cooke and Grayson County Study Area	2.1
3.2	Approved Population Projections for Cooke County	3.5
3.3	Approved Population Projections for Grayson County	3.7
3.4	Approved Demand Projections for Cooke County	3.9
3.5	Approved Demand Projections for Grayson County	3.11
10.1	Total Projected Municipal Water Demand and Supply for Cooke County	10.1
10.2	Total Projected Municipal Water Demand and Supply for Grayson County	10.2

Region C Water Planning Group
Water Supply Study for Cooke and Grayson Counties

1. Executive Summary

As part of the 2011 Region C water planning process, several county studies were included to more closely examine the water management strategies of those counties. Cooke and Grayson Counties are two of the counties included in the studies. The purpose of this study is to provide supplementary information regarding water management strategies and to then analyze the feasibility of developing Cooke and Grayson County Water Supply Systems. Water management strategies (WMSs) were updated based on information obtained from meetings with various water user groups (WUGs) in Cooke and Grayson Counties as well as from surveys mailed to every WUG in Region C. Several WMSs were revised to reflect new demand projections as determined in the *2011 Region C Water Plan* (1). The population projections in the *2011 Region C Water Plan* (1) are lower for Cooke County than the *2006 Region C Water Plan* (2). All demand projections except 2010 are higher for Cooke County in the *2011 Region C Water Plan* (1) than the *2006 Region C Water Plan* (2). The population and demand projections in the *2011 Region C Water Plan* (1) are both lower for Grayson County than the *2006 Region C Water Plan* (2). Cost estimates and an implementation plan for water management strategies are also included in this report.

The majority of WUGs in Cooke and Grayson Counties rely on groundwater from the Trinity and Woodbine Aquifers. The only surface water source is from Moss Lake in Cooke County and Lake Randell and Lake Texoma in Grayson County.

(1) Superscripted numbers in parenthesis match references in Appendix A

2000 Population: 36,363

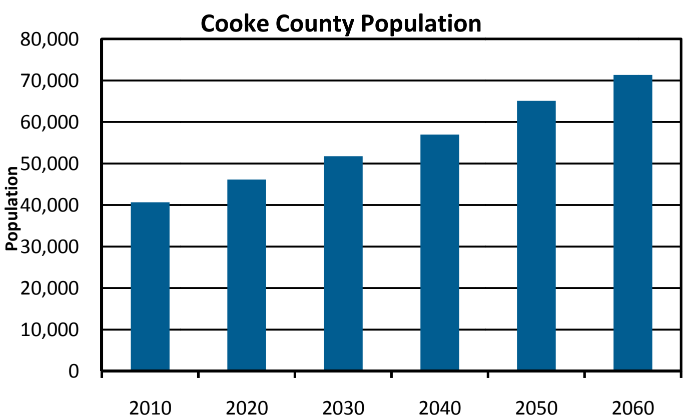
Projected 2060 Population: *71,328*

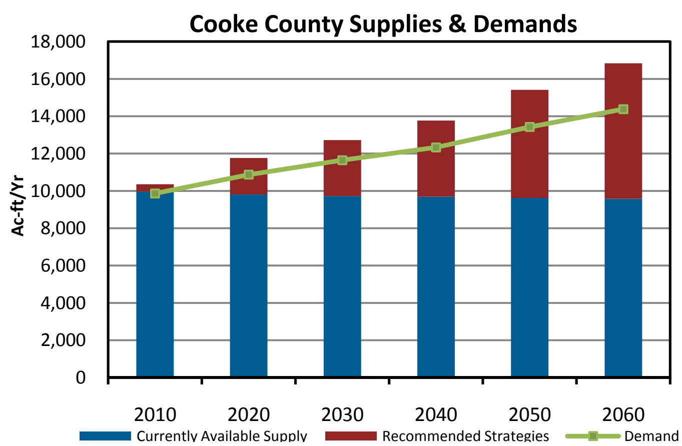
County Seat: Gainesville

Economy: *Oil, agribusiness, tourism, manufacturing*

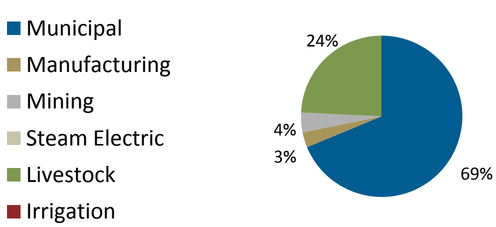
River Basin(s):

- *Trinity (67%), Red (32%)*



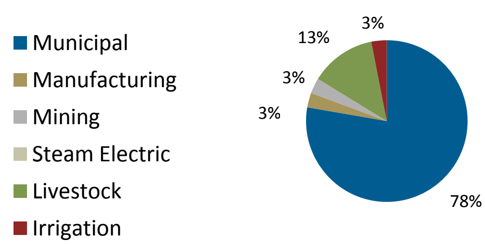


2000 Cooke County Demand
(% of total)



Total=7,270 acre-feet

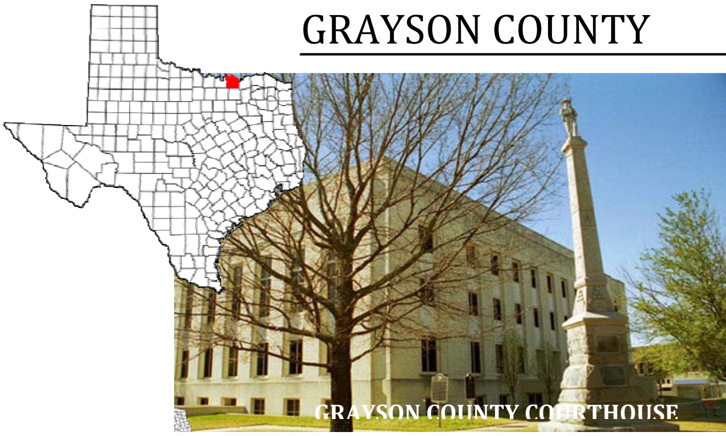
2060 Cooke County Demand
(% of total)



Total= 14,381 acre-feet

WATER USER GROUP	2060 COOKE CO. DEMAND (AC-FT/YR)	CURRENT SUPPLIES	RECOMMENDED STRATEGIES [b]
Bolivar WSC [a]	285	Trinity Aquifer	Supplemental wells, UTRWD supplies, Cooke County Water Supply Project
Gainesville	5,522	Trinity Aquifer, Moss Lake	Supplemental wells, Overdraft Trinity Aquifer (2010), Cooke County Water Supply Project (raw water delivery and water treatment)
Kiowa Homeowners WSC	947	Trinity Aquifer	Supplemental wells, Cooke County Water Supply Project
Lindsay	160	Trinity Aquifer	Supplemental wells, Cooke County Water Supply Project
Muenster	414	Trinity Aquifer	Supplemental wells, Develop Muenster Lake supply
Two Way SUD [a]	11	Trinity Aquifer	Supplemental wells, Grayson County Water Supply Project
Valley View	1,714	Trinity Aquifer	Supplemental wells, Cooke County Water Supply Project
Woodbine WSC [a]	902	Trinity Aquifer	Supplemental wells, Cooke County Water Supply Project
County-Other	1,222	Trinity, Woodbine, and Other Aquifers	Supplemental wells, Cooke County Water Supply Project
Irrigation	444	Trinity and Other Aquifers, Direct reuse (Gainesville), Local supplies	Supplemental wells, Overdraft of Trinity Aquifer (2010), Cooke County Water Supply Project, Additional reuse
Livestock	1,898	Trinity Aquifer, Local supplies	Supplemental wells
Manufacturing	421	Trinity Aquifer, Gainesville	Supplemental wells, Muenster Lake, Cooke County Water Supply Project
Mining	441	Trinity Aquifer, Local supplies	Supplemental wells, Overdraft Trinity Aquifer (2010), Reuse, Cooke County Water Supply Project
Steam Electric Power	0	None	None

[a] WUG is in multiple counties
[b] Water conservation is a strategy for every municipal user group.



2000 Population: *110,595*

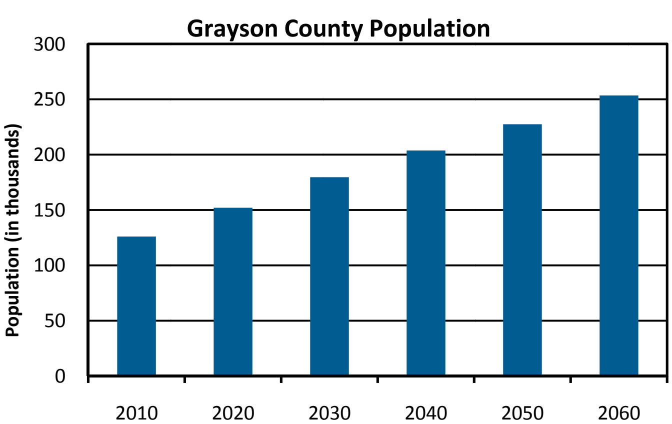
Projected 2060 Population: *253,568*

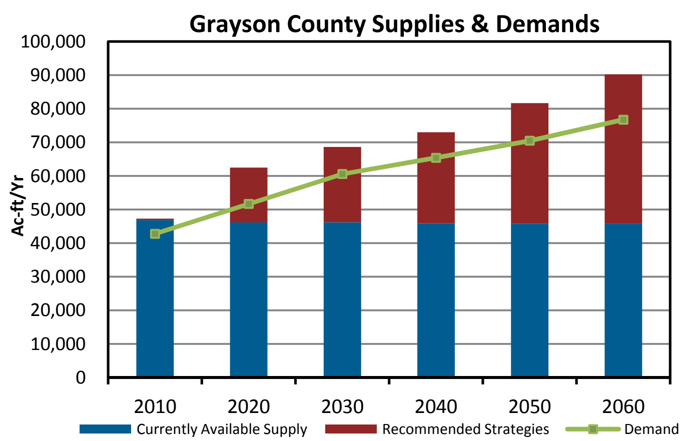
County Seat: *Sherman*

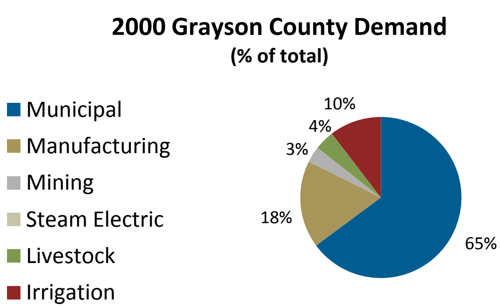
Economy: *Manufacturing, distribution and trade; tourism; mineral production.*

River Basin(s):

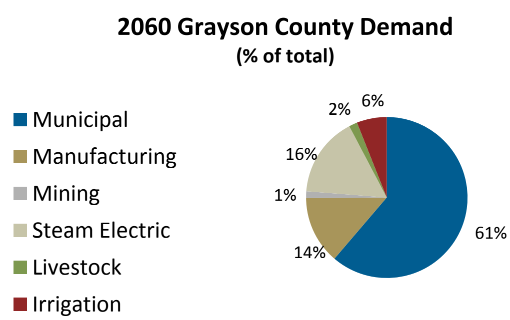
– Trinity (36%), Red (64%)







Total=32,478 acre-feet



Total= 76,742 acre-feet

WATER USER GROUP	2060 GRAYSON CO. DEMAND (AC-FT/YR)	CURRENT SUPPLIES	RECOMMENDED STRATEGIES [b]
Bells	493	Trinity and Woodbine Aquifers	Supplemental wells, Grayson County Water Supply Project
Collinsville	899	Trinity Aquifer	Supplemental wells, Grayson County Water Supply Project
Denison	6,875	Trinity and Woodbine Aquifers, Randell Lake, Lake Texoma	Supplemental wells, Water treatment plant expansion and additional Lake Texoma, infrastructure improvements
Gunter	1,149	Trinity Aquifer	Supplemental wells, Grayson County Water Supply Project
Howe	588	Woodbine Aquifer, Collin-Grayson Municipal Alliance (GTUA & NTMWD)	Supplemental wells, Additional Collin-Grayson Municipal Alliance
Luella WSC	1,365	Woodbine Aquifer	Supplemental wells, Grayson County Water Supply Project
Marilee SUD [a]	672	Trinity Aquifer, Grayson County Water Supply Project	Supplemental wells, Additional Grayson County Water Supply Project
Pottsboro	1,976	Woodbine Aquifer, Denison	Supplemental wells, Grayson County Water Supply Project
Sherman	19,804	Trinity and Woodbine Aquifers, Lake Texoma (GTUA)	Supplemental wells, Grayson County Water Supply Project
South Grayson WSC [a]	672	Trinity and Woodbine Aquifers	Supplemental wells, Grayson County Water Supply Project, Collin-Grayson Municipal Alliance (GTUA & NTMWD)
Southmayd	703	Trinity Aquifer, Monarch Water Company (Woodbine Aquifer)	Supplemental wells, Woodbine Aquifer, Grayson County Water Supply Project
Southwest Fannin County SUD [a]	46	Woodbine Aquifer	Supplemental wells, Fannin County Water Supply Project
Tioga	757	Trinity Aquifer	Supplemental wells, Grayson County Water Supply Project
Tom Bean	448	Woodbine Aquifer	Supplemental wells, Grayson County Water Supply Project
Two Way SUD [a]	1,497	Trinity Aquifer	Supplemental wells, Grayson County Water Supply Project
Van Alstyne	3,549	Trinity and Woodbine Aquifers, Collin-Grayson Municipal Alliance (GTUA & NTMWD)	Supplemental wells, Additional Collin-Grayson Municipal Alliance
Whitesboro	1,635	Trinity Aquifer	Supplemental wells, Grayson County Water Supply Project
Whitewright [a]	1,411	Woodbine Aquifer	Supplemental wells, Grayson County Water Supply Project
Woodbine WSC [a]	13	Trinity Aquifer	Supplemental wells, Cooke County Water Supply Project
County-Other	2,461	Other, Trinity, and Woodbine Aquifers, Sherman, Denison, Red River Authority	Supplemental wells, Grayson County Water Supply Project

WATER USER GROUP	2060 GRAYSON CO. DEMAND (AC-FT/YR)	CURRENT SUPPLIES	RECOMMENDED STRATEGIES [(B)]
Irrigation	4,616	Woodbine Aquifer, Local supplies, Lake Texoma	Supplemental wells
Livestock	1,297	Woodbine Aquifer, Local supplies	Supplemental wells
Manufacturing	10,444	Woodbine Aquifer, Local supplies, Sherman, Howe (Collin-Grayson Municipal Alliance – GTUA & NTMWD), Denison	Supplemental wells, Grayson County Water Supply Project, Additional Howe, Additional Dension
Mining	1,046	Trinity and Woodbine Aquifers	Supplemental wells
Steam Electric Power	12,326	Sherman [GTUA (Lake Texoma)]	Additional Lake Texoma (GTUA)

[(a)] WUG is in multiple counties
[(b)] Water conservation is a strategy for every municipal user group.

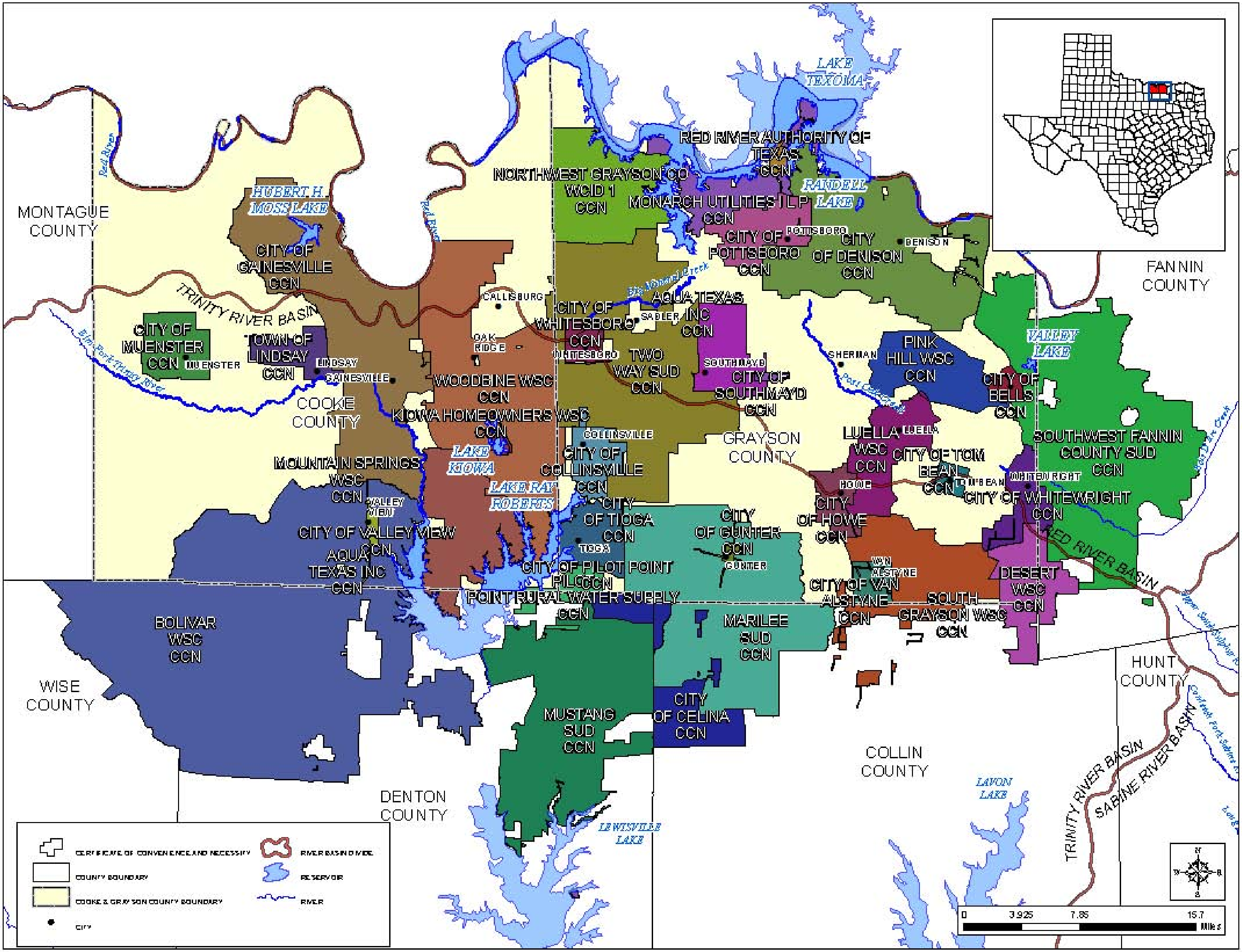
2. Introduction

As part of the 2011 Region C water planning process, several county Studies were included to more closely examine the water management strategies of those counties. Cooke and Grayson Counties are two of the counties included in the Studies. The purpose of this study is to provide supplementary information regarding water management strategies and to then analyze the feasibility of developing Cooke and Grayson County Water Supply Systems.

The Cooke and Grayson County study area is shown in Figure 2.1. Populations by decade through 2060 are projected to be up to 7.1% lower than what was projected in the *2006 Region C Water Plan* (2) , and the water demands over the same period are projected to be between 4.5% and 9.5% lower than what was projected in the *2006 Region C Water Plan* (2) for Grayson County. Water demands over the same period for Cooke County are projected to be 0.8% to 1.9% higher than what was projected in the *2006 Region C Water Plan* (2) despite the decrease in population projections for every planning period except 2010. Increased projected per capita demands account for the higher Cooke County demand. Population, demands and supplies are characterized in more detail in subsequent sections.

This report summarizes the analysis and recommendations for meeting water demand projections for water user groups in the Cooke and Grayson County Study area.

Figure 2.1
Cooke-Grayson County Study



3. Population and Demand Projections

3.1. Meetings to Collect Data

Alan Plummer Associates (APAI) met with water user groups (WUGs) in Cooke and Grayson Counties during September 2009. **Table 3.1** lists the meetings held and the meeting participants. A survey covering existing and projected populations, demands, supplies and strategies as defined in the *2006 Region C Water Plan*(2) was sent to each WUG prior to these meetings. In some cases the WUG revised and resubmitted these values. At each meeting, APAI presented the population and demand projections as shown in the regional water plans and the proposed revisions, if applicable. The current population and water use estimates of the entity and their existing and/or potential future customers were discussed. Many entities provided information related to recent water use, pumping capacity and number of connections.

The current water supply for each entity, the recommended water management strategies as presented in the regional water plans, and any suggested adjustments to those recommendations were discussed. In most cases, the entities plan to implement the recommended strategies, although the amounts of supply may change. In a few cases, the entities are pursuing other options for water supply to meet their future needs.

The information obtained in these meetings was used to develop updated population and demand projections presented in this report. The updated information related to water supply was used to supplement or update proposed management strategies.

APAI met with the North Texas Municipal Water District (NTMWD) and Greater Texoma Utility Authority (GTUA) on August 24, 2009. The purpose of the meeting was to coordinate the special study with the existing wholesale water providers (WWPs) in the area. APAI reviewed the *2006 Region C Water Plan* (2) strategies for Cooke and Grayson County WUGs with NTWMD and GTUA for reference. GTUA is projected to meet future Grayson County demands through the Grayson County Water Supply Project, described in more detail in later sections of this report.

Table 3.1
Meetings with WUGs

Date	Entity	WUG Attendees	Meeting Location
September 2, 2009	City of Gainesville	Ron Sellman, Earl Williams	Gainesville City Hall
September 10, 2009	City of Lindsay	Don Metzler, Danny Nortman	Muenster City Hall
September 10, 2009	City of Muenster	Stan Endres	Muenster City Hall
September 8, 2009	Kiowa Homeowners WSC	Ronny Young	Whitesboro City Hall
September 8, 2009	Two Way Special Utility District	Jeff Bice	Whitesboro City Hall
September 8, 2009	Woodbine WSC	Rickey Kemp	Whitesboro City Hall
September 2, 2009	City of Denison	David Howerton, Dean Rylant	Denison Public Works Department Offices
September 11, 2009	City of Gunter	Mark Millar	Tioga City Hall
September 11, 2009	Marilee SUD	Denny Brackeen, Donna Loiselle	Tioga City Hall
September 14, 2009	City of Howe	Michael Jones	Whitewright City Hall
September 8, 2009	City of Pottsboro	Kevin Farley	Whitesboro City Hall
September 21, 2009	City of Sherman	Mark Gibson	Sherman Public Works Department Offices
September 24, 2009	South Grayson WSC	John Spencer	Telephone Interview
September 11, 2009	City of Southmayd	Jack Ransom, Daniel Pepe	Tioga City Hall
September 11, 2009	City of Tioga	Jim Hale	Tioga City Hall
September 8, 2009	City of Whitesboro	Bill Goodson, CC Beasley	Whitesboro City Hall
September 14, 2009	City of Whitewright	Michael Marter	Whitewright City Hall

3.2. Revisions to Population and Demand Projections

The following section discusses the revisions to population and demand as recommended in this study. Municipal per capita water uses and population are used to determine water demand. Municipal per capita water use is the sum of residential, commercial, and institutional water use divided by the population served. Note that the recommended population and demand projections fall in the middle of a range of projections. It is estimated that the actual population and demand values could be 15 percent higher or lower than the recommended values.

The *2006 Region C Water Plan* [2] population and demand projections were used as base projections for this study. More recent historical trends and demographic information was used, as available, to verify the *2006 Region C Water Plan* [2] projections. Revisions to the *2006 Region C Water Plan* [2] were made as needed and the updated projections were sent to each WUG in Cooke and Grayson Counties for review and comment. Final updated projections were created based on the historical trends, updated demographics and survey responses.

Review of Cooke and Grayson County WUG Status

As part of this special study the water utility providers in Cooke and Grayson Counties were reviewed to determine if any additional entities should be considered for inclusion in future water planning cycles. Municipal demand that is not defined through official WUGs is compiled into a 'County-Other' designation for planning purposes. The TWDB states that a WUG is defined as one of the following:

- Cities and towns with populations of 500 or more
- Non-city utilities providing more than 280 acre-feet per year of water for municipal use

The TCEQ water utility database (WUD) was reviewed for Cooke and Grayson Counties[3]. Based on the WUD there are 80 public water utilities or cities in Cooke and Grayson Counties, of which 23 were included in the 2006 Plan. Of the remaining 57 utilities, 53 are utility districts and 4 are municipalities. There are four utility districts with demands greater than 280 acre-feet per year, all in Grayson County: Kentuckytown WSC, RRA Preston Shores Water System, Sherwood Shores and Tanglewood on Texoma [3]. One municipality, the City of Callisburg in Cooke County, has an estimated existing population of 1650 people. This city and utilities should be reviewed in advance of the next planning cycle for possible inclusion as WUGs. Other entities could experience growth that would place them in WUG status and as such the same planning-level review should occur for future planning periods.

Additional County Aggregated Projections

APAI collected the demand projections developed in the regional water planning process for county-other, manufacturing, mining, irrigation, livestock and steam electric power. No demands were adjusted in this study for manufacturing, mining, irrigation or livestock. Steam electric power demands were updated based on additional data collected on the number and type of plants as well as updated current and projected operational status [(4)]. Strategies for non-municipal water supplies are discussed in more detail in Section 6.

3.3. Recommended Population Projections for WUGs and WWPs

APAI collected available historical and projected population data for each entity through the in-person meetings. Additional historical population data was gathered from the Texas State Data Center [(5)] and the U.S. Census [(6)]. APAI also gathered population projections previously approved by the Texas Water Development Board for regional water planning.

In Cooke County two WUGs had revisions to previous population projections: Gainesville and Muenster. Population projections were decreased based on recent historical data and survey responses. In Grayson County ten WUGs had revisions to previous population projections: Bells, Gunter, Howe, Luella WSC, Marilee SUD, Southmayd, Tom Bean, Van Alstyne, Whitesboro, and Whitewright. Population projections were decreased based on recent historical data and survey responses. Recommended population projections for Cooke and Grayson Counties are shown in **Table 3.2** and **Table 3.3**, respectively. County population data for WUGs in Cooke and Grayson Counties are displayed in **Figure 3.1** and **Figure 3.2,** respectively. Data in these tables and figures includes only population inside of Cooke and Grayson Counties. Three WUGs include service areas outside of Cooke County: Bolivar WSC, Two Way SUD and Woodbine WSC. Six WUGs include service areas outside of Grayson County: Marilee WSC, South Grayson WSC, Southwest Fannin County SUD, Two Way WSC, Whitewright, and Woodbine WSC. Total population for these entities split by county are shown in **Table 3.4** and **Table 3.5** for Cooke and Grayson Counties, respectively.

Table 3.2
Approved Population Projections in Cooke County

Water User Group	2011 Projections					
	2010	2020	2030	2040	2050	2060
Bolivar WSC	1,666	1,787	1,849	1,859	1,859	1,858
Gainesville	16,800	19,000	21,400	23,900	26,400	29,000
Kiowa Homeowners WSC	3,324	3,567	3,691	3,711	3,710	3,709
Lindsay	879	943	976	981	981	981
Muenster	1,700	1,800	1,900	2,000	2,100	2,200
Two Way WSC	84	90	93	93	93	93
Valley View	1,500	3,000	5,000	7,000	12,000	15,000
Woodbine WSC	5,234	5,773	6,307	6,839	7,370	7,901
County-Other	9,487	10,181	10,533	10,590	10,586	10,586
County - Total	40,674	46,141	51,749	56,973	65,099	71,328

Figure 3.2

Approved Population Projections in Cooke County

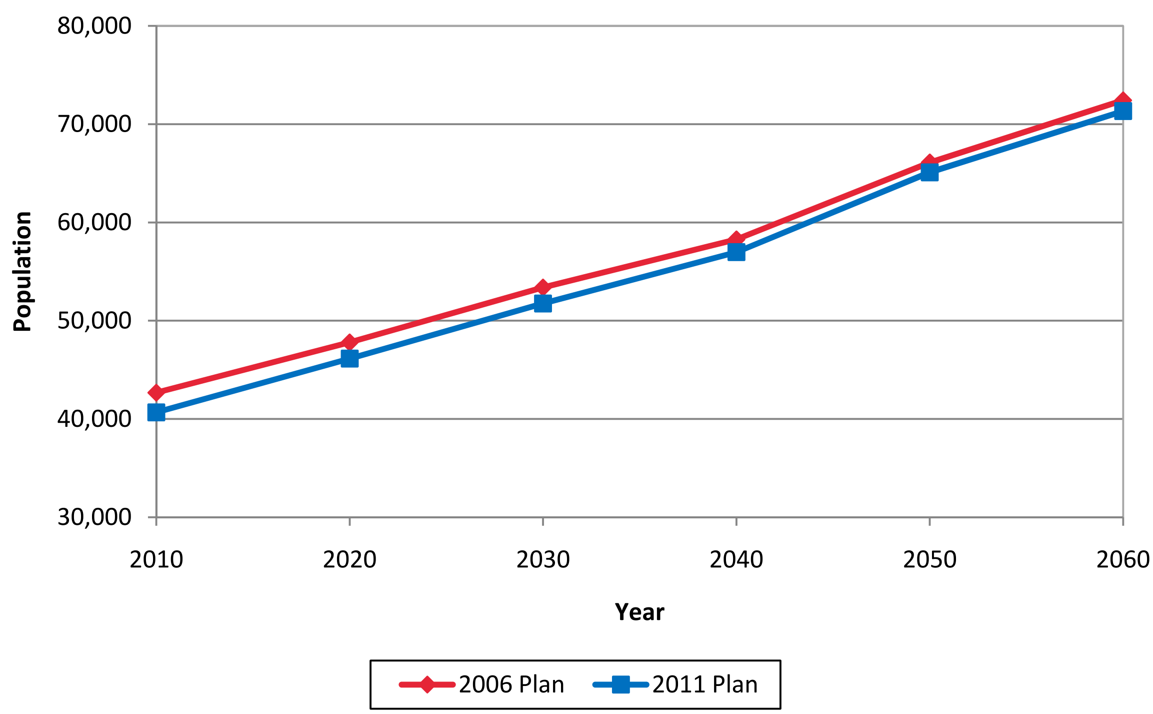


Table 3.3

Approved Population Projections in Grayson County

Water User Group	2011 Projections					
	2010	2020	2030	2040	2050	2060
Bells	1,400	2,100	2,750	3,250	3,700	4,000
Collinsville	2,035	2,835	3,635	4,435	5,235	6,035
Denison	25,000	28,000	30,000	31,000	32,000	33,000
Gunter	2,000	3,500	5,000	6,500	8,000	9,000
Marilee SUD	649	1,067	1,600	2,200	3,500	5,000
Howe	3,000	4,500	6,500	8,500	9,772	10,781
Luella WSC	3,300	3,800	4,300	4,950	5,080	5,770
Pottsboro	3,000	5,000	7,000	9,000	11,000	12,000
Sherman	39,300	44,400	50,600	57,700	67,000	80,000
South Grayson WSC	1,200	1,900	2,500	3,200	4,000	5,000
Southmayd	1,200	1,500	2,000	3,000	4,500	5,600
Southwest Fannin County SUD	391	391	391	391	391	391
Tioga	1,100	2,500	3,500	4,000	4,400	4,600
Tom Bean	1,100	1,300	1,500	1,700	1,900	2,000
Two Way SUD	4,997	6,630	8,158	9,726	11,289	12,852
Van Alstyne	3,000	7,500	13,500	17,000	18,500	19,200
Whitesboro	4,400	5,000	5,700	6,500	7,500	10,000
Whitewright	2,000	3,200	4,500	5,500	6,500	7,500
Woodbine WSC	102	106	109	110	111	112
County-Other	26,925	26,799	26,482	25,160	23,185	20,727
County - Total	126,099	152,028	179,725	203,822	227,563	253,568

Figure 3.3

Approved Population Projections in Grayson County

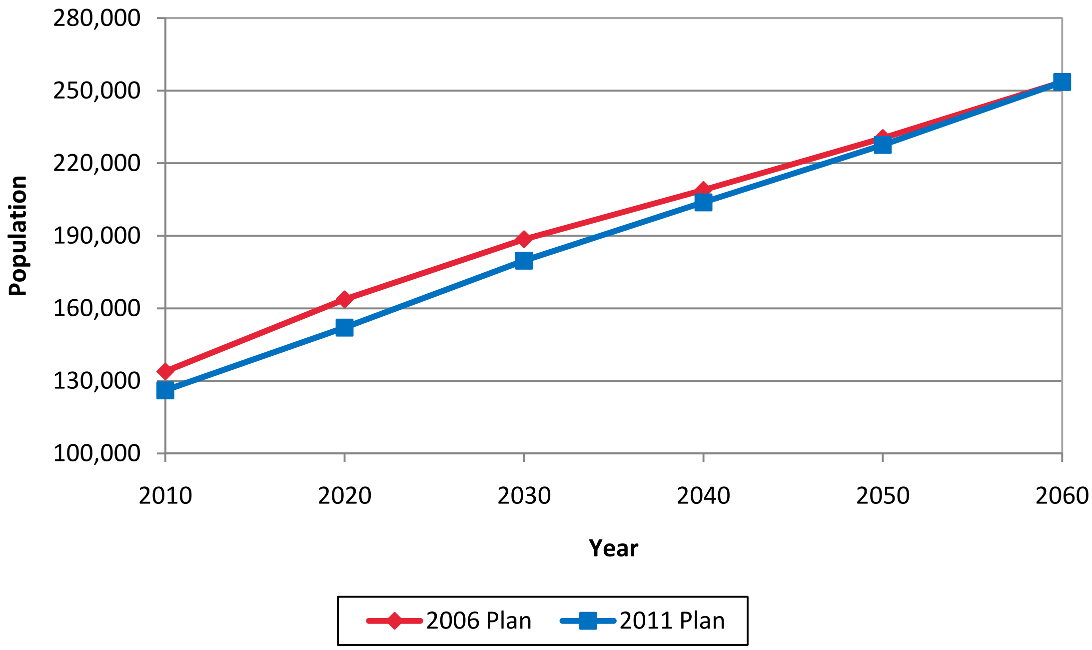


Table 3.4

Approved Population Projections for Cooke County Entities Split by County

Water User Group	2011 Projections					
	2010	2020	2030	2040	2050	2060
Bolivar WSC[(a)]	10,386	12,465	21,806	44,726	70,848	95,836
Two Way SUD[(b)]	5,081	6,720	8,251	9,819	11,382	12,945
Woodbine WSC[(b)]	5,336	5,879	6,416	6,949	7,481	8,013

(a) Cooke, Denton and Wise Counties

(b) Cooke and Grayson Counties

Table 3.5

Approved Population Projections for Grayson County Entities Split by County

Water User Group	Revised Projections					
	2010	2020	2030	2040	2050	2060
Marilee WSC[a]	4,300	6,400	8,653	10,679	13,471	16,560
South Grayson WSC[a]	2,700	3,450	4,100	4,825	5,650	6,675
Southwest Fannin SUD[b]	7,491	8,940	9,947	10,852	11,657	12,463
Two Way WSC[c]	5,081	6,720	8,251	9,819	11,382	12,945
Whitewright[c]	2,022	3,228	4,532	5,535	6,538	7,541
Woodbine WSC[c]	5,336	5,879	6,416	6,949	7,481	8,013

(a) Collin and Grayson Counties

(b) Fannin and Grayson Counties

(c) Cooke and Grayson Counties

3.4. Recommended Water Demands for WUGs and WWPs

Demand projections for each WUG were reviewed and updated as necessary. *2006 Region C Water Plan* (2) per capita demands for Cooke County WUGs was reviewed and changes were made to two WUGs: Kiowa Homeowners WSC (increased in *2011 Region C Water Plan* (1)) and Two Way SUD (decreased in *2011 Region C Water Plan* (1)). *2006 Region C Water Plan* (2) per capita demands for Grayson County WUGs was reviewed and changes were made to the following five WUGs: Howe, Sherman, Van Alstyne, and Whitewright (decreased in *2011 Region C Water Plan* (1)) and Southmayd (increased in *2011 Region C water Plan* (1)) based on recent historical data. Per capita demands for the remaining Cooke and Grayson County WUGs were not altered. Recommended per capita data are shown in **Table 3.6** and **Table 3.7** for Cooke and Grayson Counties, respectively. As a result of changes to population and/or per capita demands three Cooke County WUG demands have been updated: Gainesville and Kiowa Homeowners WSC (increased in *2011 Region C Water Plan* (1)) and Muenster (decreased in *2011 Region C Water Plan* (1)). A total of ten Grayson County WUG demands have been updated (all decreased in *2011 Region C Water Plan* (1)): Bells, Gunter, Howe, Luella WSC, Sherman, Southmayd, Tom Bean, Van Alstyne, Whitesboro, and Whitewright.

The City of Gainesville and GTUA are the wholesale water providers projected to supply demands to Cooke and Grayson Counties, respectively. Summary data for Gainesville and GTUA are displayed in **Table 3.8** and **Table 3.9**, respectively. All recommended demand data is shown in **Table 3.10** and **Table 3.11** for Cooke and Grayson Counties, respectively. County demand data for WUGs in Cooke and Grayson Counties are also displayed as **Figure 3.4** and **Figure 3.5,** respectively.

Table 3.6
Approved Cooke County Municipal Per Capita Water Use Projections
In Gallons Per Capita Per Day

	2011 Projections					
Water User Group	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Bolivar WSC	110	122	138	137	137	137
Gainesville	180	176	174	171	170	170
Kiowa Homeowners WSC	235	233	231	229	228	228
Lindsay	156	152	150	147	146	146
Muenster	178	174	172	169	168	168
Two Way WSC	101	108	106	105	104	104
Valley View	111	108	106	103	102	102
Woodbine WSC	112	108	106	103	102	102
County-Other	101	108	106	104	103	103

Figure 3.4
Approved Demand Projections for Cooke County

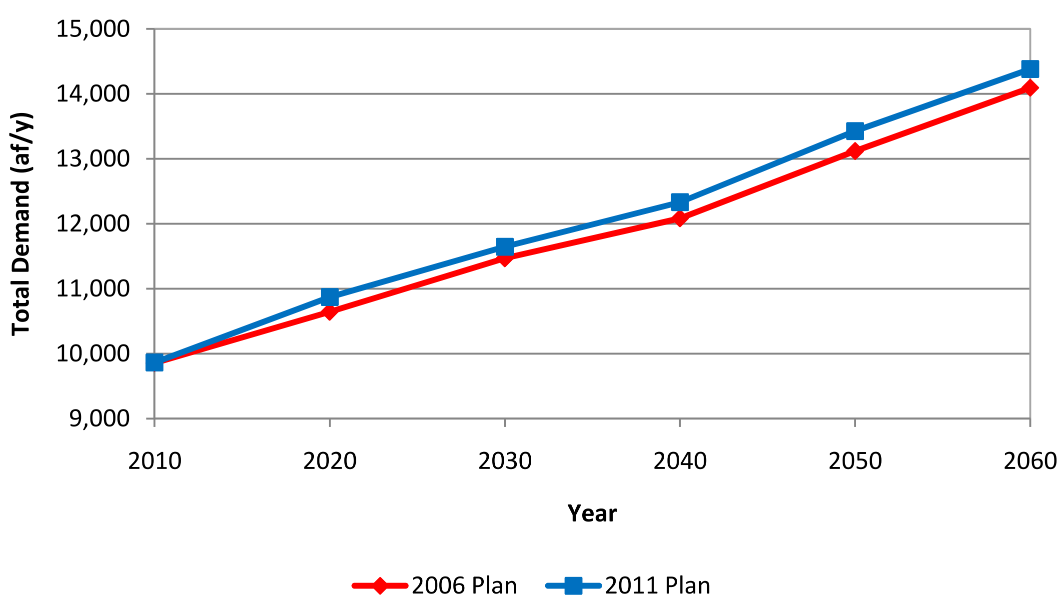


Table 3.7
Approved Grayson County Municipal Per Capita Water Use Projections
In Gallons Per Capita Per Day

Water User Group	2011 Projections					
	2010	2020	2030	2040	2050	2060
Bells	118	115	113	111	110	110
Collinsville	142	139	137	134	133	133
Denison	196	193	190	187	186	186
Gunter	121	119	117	115	114	114
Marilee SUD	110	108	106	105	105	105
Howe	120	117	115	114	113	113
Luella WSC	111	108	106	105	104	104
Pottsboro	150	152	150	148	147	147
Sherman	229	226	224	222	221	221
South Grayson WSC	126	124	122	121	120	120
Southmayd	119	117	115	113	112	112
Southwest Fannin County SUD	87	105	107	105	105	105
Tioga	156	153	150	148	147	147
Tom Bean	210	207	204	201	200	200
Two Way SUD	101	108	106	105	104	104
Van Alstyne	150	168	166	165	165	165
Whitesboro	155	152	150	147	146	146
Whitewright	178	175	172	169	168	168
Woodbine WSC	112	108	106	103	102	102
County-Other	115	113	110	107	106	106

Figure 3.5
Approved Demand Projections for Grayson County

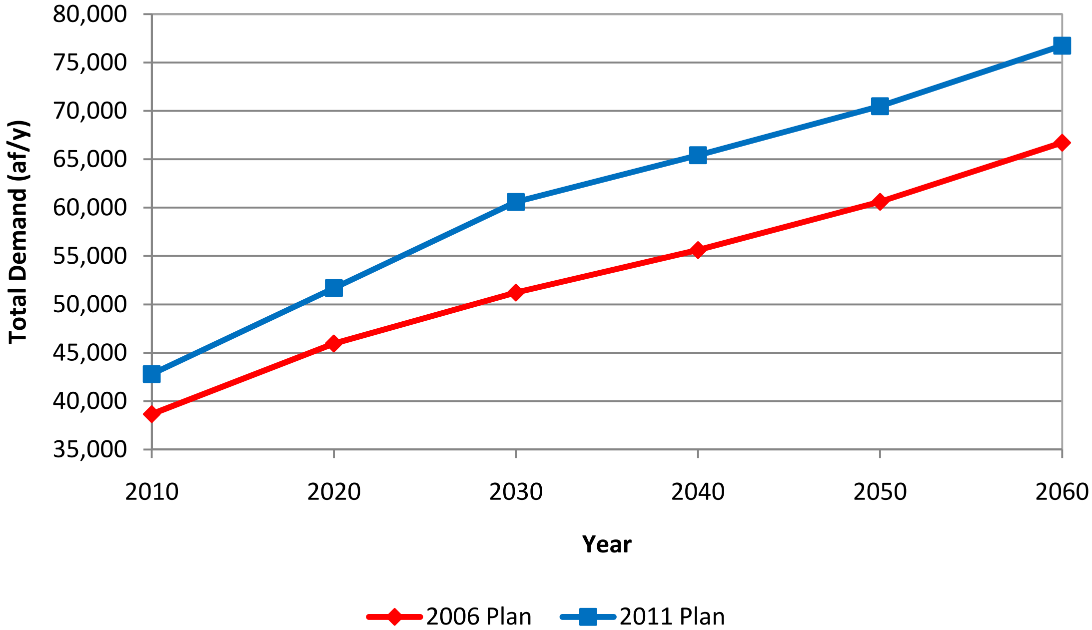


Table 3.8
Approved CCWSP (Gainesville Wholesale Water Provider) Projections

Gainesville Customers	Revised Total Demand (acre-feet/year)						Net Gainesville Demand (acre-feet/year)					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Gainesville	3,387	3,746	4,171	4,578	5,027	5,522	3,387	3,746	4,171	4,578	5,027	5,522
Bolivar WSC	2,093	3,329	6,101	10,437	15,492	19,921	0	18	83	104	127	149
Sanger	814	1,626	2,730	3,574	4,620	5,214	0	0	0	0	0	0
Cooke County - Irrigation	304	304	304	304	304	304	0	70	70	70	70	70
Cooke County - Manufacturing	273	306	335	364	389	421	223	255	243	265	283	306
Cooke County - Mining	321	334	341	348	355	361	0	99	67	71	74	77
Cooke County - Other	1,074	1,232	1,251	1,234	1,221	1,222	0	125	125	125	125	125
Kiowa Homeowners Association	875	931	955	952	948	947	0	100	100	100	100	100
Lindsay	154	161	164	162	160	160	0	40	50	50	50	50
Valley View	187	363	594	808	1,371	1,714	0	150	400	650	1,200	1,600
Woodbine WSC	669	712	762	802	855	915	0	40	80	120	170	230
Total	**9,337**	**11,418**	**14,978**	**19,989**	**26,122**	**31,487**	**3,610**	**4,643**	**5,389**	**6,133**	**7,226**	**8,229**

Table 3.9: Approved GCWSP (Greater Texoma Utility Authority Wholesale Water Provider) Projections

GTUA Customers in Study Area	Revised Total Demand (acre-feet/year)						Net GTUA Demand (acre-feet/year)					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
Northwest WTP	**2,044**	**3,144**	**3,616**	**4,105**	**4,653**	**5,499**	**0**	**910**	**1,260**	**1,635**	**2,135**	**2,860**
Collinsville	324	441	558	666	780	899	0	100	200	300	400	500
South Grayson WSC	381	479	561	654	760	897	0	0	0	75	175	300
Whitesboro	764	851	958	1,070	1,227	1,635	0	50	150	200	350	700
Two Way SUD	575	813	979	1,155	1,326	1,508	0	200	350	500	650	800
County-Other	0	560	560	560	560	560	0	560	560	560	560	560
North WTP	***664***	***1,248***	***1,734***	***2,272***	***2,876***	***3,279***	***0***	***520***	***1,000***	***1,490***	***2,050***	***2,400***
Collinsville	504	851	1,176	1,492	1,811	1,976	0	280	600	870	1,150	1,275
Southmayd	160	197	258	380	565	703	0	40	100	220	400	525
County-Other	0	200	300	400	500	600	0	200	300	400	500	600
Sherman	**10,081**	**11,240**	**12,696**	**14,348**	**16,586**	**19,804**	**2,535**	**3,694**	**5,150**	**6,802**	**9,040**	**12,258**
Bells	185	271	348	404	456	493	0	80	150	210	260	300
Gunter	271	467	655	837	1,022	1,149	0	180	350	530	700	820
Marilee SUD	530	774	1,027	1,256	1,585	1,948	125	150	400	650	1,000	1,350
Luella WSC	410	460	511	582	592	672	0	38	80	140	150	220
Tioga	192	428	588	663	725	757	0	225	375	425	475	500
Tom Bean	259	301	343	383	426	448	0	10	40	75	120	130
Whitewright	403	632	873	1,048	1,230	1,419	0	200	400	600	750	900
County-Other	3,468	2,633	2,403	2,056	1,693	1,301	75	100	100	200	300	600
County-Steam Electric Power	5,600	5,600	5,600	5,600	5,600	5,600	5,600	5,600	5,600	5,600	5,600	5,600
County-Manufacturing	7,010	7,781	8,453	9,088	9,621	10,444	5,149	5,849	6,478	7,064	7,539	8,280
Total Sherman	***28,409***	***30,587***	***33,497***	***36,265***	***39,536***	***44,035***	***13,484***	***16,126***	***19,123***	***22,296***	***25,934***	***30,958***
Pottsboro	*Through Denison*						*560*	*560*	*560*	*560*	*560*	*560*
Steam Electric	*0*	*3,363*	*6,726*	*6,726*	*6,726*	*6,726*	*0*	*3,363*	*6,726*	*6,726*	*6,726*	*6,726*
Total	**31,117**	**38,342**	**45,573**	**49,368**	**53,791**	**59,539**	**14,044**	**21,479**	**28,669**	**32,707**	**37,405**	**43,504**

Table 3.10
Approved Cooke County Demand Projections in Acre-Feet per Year

Water User Group	2006 Plan						2011 Projections					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
Bolivar WSC	205	244	286	285	285	285	205	244	286	285	285	285
Gainesville	3,750	3,992	4,385	4,693	5,046	5,522	3,387	3,746	4,171	4,578	5,027	5,522
Kiowa Homeowners WSC	503	531	542	536	532	532	875	931	955	952	948	947
Lindsay	154	161	164	162	160	160	154	161	164	162	160	160
Muenster	379	429	468	511	565	621	339	351	366	379	395	414
Two Way WSC	10	11	11	11	11	11	10	11	11	11	11	11
Valley View	187	363	594	808	1,371	1,714	187	363	594	808	1,371	1,714
Woodbine WSC	656	699	749	789	842	902	656	699	749	789	842	902
County-Other	1,074	1,232	1,251	1,234	1,221	1,222	1,074	1,232	1,251	1,234	1,221	1,222

Table 3.11
Approved Grayson County Demand Projections in Acre-Feet per Year

Water User Group	2006 Plan						2011 Projections					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
Bells	238	296	348	404	456	493	185	271	348	404	456	493
Collinsville	324	441	558	666	780	899	324	441	558	666	780	899
Denison	5,489	6,053	6,385	6,493	6,667	6,875	5,489	6,053	6,385	6,493	6,667	6,875
Gunter	407	666	786	902	1,022	1,149	271	467	655	837	1,022	1,149
Marilee SUD	99	145	190	259	412	588	80	129	190	259	412	588
Howe	593	918	1,193	1,355	1,499	1,655	403	590	837	1,085	1,237	1,365
Luella WSC	489	535	565	582	592	672	410	460	511	582	592	672
Pottsboro	504	851	1,176	1,492	1,811	1,976	504	851	1,176	1,492	1,811	1,976
Sherman	10,081	12,135	13,660	15,382	17,787	21,238	10,081	11,240	12,696	14,348	16,586	19,804
South Grayson WSC	169	264	342	434	538	672	169	264	342	434	538	672
Southmayd	199	366	455	529	594	652	160	197	258	380	565	703
Southwest Fannin Co. SUD	38	46	47	46	46	46	38	46	47	46	46	46
Tioga	192	428	588	663	725	757	192	428	588	663	725	757
Tom Bean	311	348	388	405	426	448	259	301	343	383	426	448
Two Way SUD	565	802	968	1,144	1,315	1,497	565	802	968	1,144	1,315	1,497
Van Alstyne	966	2,341	3,159	3,561	3,875	4,022	504	1,411	2,510	3,142	3,419	3,549
Whitesboro	1,042	1,277	1,429	1,524	1,594	1,636	764	851	958	1,070	1,227	1,635
Whitewright	549	757	958	1,152	1,354	1,563	399	627	867	1,041	1,223	1,411
Woodbine WSC	13	13	13	13	13	13	13	13	13	13	13	13
County-Other	3,468	3,393	3,263	3,016	2,753	2,461	3,468	3,393	3,263	3,016	2,753	2,461

4. Evaluation of Current Supplies

Water is supplied to Cooke County WUGs via groundwater from the Trinity and Woodbine Aquifers and via surface water from Moss Lake (Gainesville). Water is supplied to Grayson County WUGs via groundwater from the Trinity and Woodbine Aquifers and via surface water from Lake Randell (Denison) and Lake Texoma (Denison and Sherman). Details of each source are discussed below.

4.1 Surface Water

Cooke County

Gainesville currently treats 1,121 acre feet per year of surface water from Moss Lake. Gainesville is expanding the current plant by 1 million gallon per day (1,121 acre feet per year) in 2010. This supply of surface water is identified as a major source of sustainable supply for expected Cooke County demands for both Gainesville as well as additional WUGs in the county. The Cooke County Water Supply Project consists of a network of water lines to allow Gainesville to serve all included Cooke County WUGs with the exception of Muenster. Indirect reuse is also a strategy identified for Gainesville and Moss Lake, with a 561 acre feet per year supply estimated to be available by 2020. Muenster recently completed construction of Lake Muenster but does not have current treatment capacity.

Grayson County

Denison currently treats 5,400 acre feet per year of surface water from Randell Lake: the Randell Lake supply is blended with an additional 1,900 acre feet per year of surface water from Lake Texoma. Sherman currently treats 11,200 acre feet per year of surface water from Lake Texoma (purchased from GTUA). This Sherman supply of surface water is a major source of sustainable supply for both Sherman and its projected wholesale customers. Future treatment plants will also utilize Lake Texoma water (GTUA) as supplies for wholesale contracts to other WUGs in the county.

4.2 Groundwater

Cooke County

The Trinity Aquifer provides groundwater to every WUG in Cooke County including both Gainesville and Muenster. The long term water demand of WUGs in Cooke County is projected to be above the sustainable yield of the aquifer. Conservation practices and the Cooke County Water Supply project are strategies to lessen the demands placed on the Trinity Aquifer.

Grayson County

The Trinity and Woodbine Aquifers provide groundwater to every WUG in Grayson County. The long term water demand of WUGs in Grayson County is projected to be slightly above the sustainable yield of the Woodbine Aquifer. Conservation practices and the Grayson County Water Supply project are strategies to lessen the aquifer demands.

5. Comparison of Current Supplies to Projected Demand

The revised projected demands in the study area are different from those shown in the *2006 Region C Water Plan* (2) for 13 of the 29 WUGs in the study area (three in Cooke County and eleven in Grayson County). The projected demand for Cooke County is slightly higher than what was projected in the *2006 Region C Water Plan* (2). The projected demand for Grayson County is lower than what was projected in *2006 Region C Water Plan* (2). Two WUGs, Kiowa Homeowners WSC and Two Way SUD, have *2011 Region C Water Plan* (1) demands greater than the total of their current supplies plus recommended strategies from the *2006 Region C Water Plan* (2).

Current groundwater supplies have been reallocated throughout the study area for the *2011 Region C Water Plan* (1) based on historical demands and usage rates. After reallocation there are no water user groups in the study area that have revised demands that exceed the total of their current supplies plus the recommended water management strategies in the *2006 Region C Water Plan* (2). Each water management strategy for all WUGs has been reviewed and updates have been made as necessary. Changes made to previous strategies typically involve timing and type of groundwater resources used. The proposed revisions are discussed in the following section.

6. Proposed Revisions to Water Management Strategies

This report includes revised water management strategies for inclusion in the 2011 Region C Water Plan [(1)]. This section describes the proposed adjustments for the entities with changed conditions. Most changes apply to 2010 strategies or are changes to the need for a WUG to overdraft using existing pump and well capacity.

Previous Region C Water Plans have referred to both the *Cooke County Water Supply Project* (CCWSP) and the *Grayson County Water Supply Project (GCWSP)*. These projects are actually collections of proposed water transmission lines to bring surface water to WUGs in Cooke and Grayson Counties, respectively, to meet future demands. The CCWSP would provide water from Gainesville to WUGs in Cooke County (except Muenster). The GCWSP would provide water from three different water treatment plants to WUGs in Grayson County (except Denison). The treatment plants include Sherman (existing) and two proposed plants in north and northwest Grayson County near Lake Texoma. Water rights from all plants would be from GTUA. Although costs have been estimated for all of the transmission lines required to provide service to each individual WUG, the costs and quantities are grouped into similar projects. Existing demands from Howe and Van Alstyne are supplied by the Collin-Grayson Municipal Alliance (CGMA) pipeline (NTMWD and GTUA). Future water demands for these WUGs will be met with an expansion of the CGMA pipeline.

The Red River Groundwater Conservation District (RRGCD) was formed in 2009 by Texas Senate Bill 2529 [(8)]. The District, whose boundary is coterminous with Fannin and Grayson Counties, is charged with managing groundwater by providing for the conservation, preservation, protection, recharging, and prevention of waste of the groundwater resources within its jurisdictions. The North Texas Groundwater Conservation District (NTGCD) was also formed in 2009 by Texas Senate Bill 2497 [(9)]. The District, whose boundary is coterminous with Cooke, Denton and Collin Counties, is charged with managing groundwater by providing for the conservation, preservation, protection, recharging, and prevention of waste of the groundwater resources within its jurisdictions.

The RRGCD and NTGCD, as with all Texas groundwater conservation districts, is authorized with powers and duties that enable them to manage groundwater resources.

The three primary authorities include: permitting water wells; developing a comprehensive management plan; and adopting the necessary rules to implement a management plan [10]. To date the RRGCD and NTGCD have not yet formally adopted strategies or management plans for Grayson and Cooke County groundwater, respectively. The Region C Water Planning Group will continue to monitor the progress of the RRGCD and NTGCD and will coordinate future strategies with the district.

Supplemental groundwater wells are defined as wells required to maintain the existing groundwater capacity of a WUG. It is assumed that 20% of the existing WUG groundwater well system will be renewed every 10 years as part of the normal renewal program of a WUG. These supplemental wells do not add groundwater capacity to WUGs. Supplemental wells are a water management strategy for every WUG that utilizes groundwater as a water supply. Water conservation is also a strategy for every municipal WUG.

6.1 Cooke County

The WMS for municipal and non-municipal Cooke County WUGs were reviewed. Most changes to strategies involve either the timing of projects (Lindsay, Muenster) or the quantity of CCWSP supply (based on updated, allocated groundwater). Each individual WUG is described in more detail in the following sections.

6.1.1 Gainesville

A summary of water demand and supply information for Gainesville is located in **Table 6.1.1**. The amount of water supplied to other Cooke County WUGs, via the CCWSP, increased in the *2011 Region C Water Plan* [1]. This increase corresponds to more expansions of the WTP at Moss Lake to serve the demands of the Cooke County WUGs. The City of Gainesville has purchased a portion of GTUA's water supply from Lake Texoma and plans to utilize it in the future.

Table 6.1.1
Summary Information for Gainesville

Gainesville	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	16,800	19,000	21,400	23,900	26,400	29,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	3,387	3,746	4,171	4,578	5,027	5,522
Cooke County - Irrigation	9	149	149	149	149	149
Cooke County - Manufacturing	223	255	243	265	283	306
Cooke County - Mining	0	198	135	142	149	155
Wholesale Demand (Cooke County Water Supply Project)	0	473	838	1,149	1,772	2,254
Total Projected Water Demand	**3,619**	**4,821**	**5,536**	**6,283**	**7,380**	**8,386**
Currently Available Water Supplies (ac-ft/yr)						
Hubert H. Moss Lake	1,120	1,120	1,120	1,120	1,120	1,120
Direct Reuse Gainesville WTP	9	9	9	9	9	9
Trinity Aquifer	2,360	2,360	2,360	2,360	2,360	2,360
Total Supply	***3,489***	***3,489***	***3,489***	***3,489***	***3,489***	***3,489***
Need (Demand - Supply) (ac-ft/yr)	***130***	***1,332***	***2,047***	***2,794***	***3,891***	***4,897***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	27	95	225	288	359	441
Water Conservation - Expanded Package	0	0	13	19	20	22
Overdraft Trinity Aquifer (Existing Wells)	103	0	0	0	0	0
Expand Gainesville WTP capacity 4 MGD and Moss Lake Raw Water Supply	0	2,240	2,240	2,240	2,240	2,240
WTP Expansion of 2 MGD	0	0	0	1,120	1,120	1,120
WTP Expansion of 2 MGD	0	0	0	0	1,120	1,120
Expand Direct Reuse	0	169	137	141	144	147
Total Water Management Strategies	**130**	**2,504**	**2,615**	**3,808**	**5,003**	**5,090**
Reserve (ac-ft/yr)	**0**	**1,172**	**568**	**1,014**	**1,112**	**193**

6.1.2 Bolivar WSC

A summary of water demand and supply information for Bolivar WSC is located in **Table 6.1.2**. The amount of water purchased from the Upper Trinity Regional Water

District increased in the *2011 Region C Water Plan* (1). This increase corresponds to a slight decrease in CCWSP demands but did not change timing of the project.

Table 6.1.2
Summary Information for Bolivar WSC

Bolivar WSC	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population [a]	10,386	12,465	21,806	44,726	70,848	95,836
Projected Water Demand (ac-ft/yr)						
Municipal Demand [a]	1,279	1,703	3,371	6,863	10,872	14,707
Wholesale Demand (Sanger)	814	1,626	2,730	3,574	4,620	5,214
Total Projected Water Demand	***2,093***	***3,329***	***6,101***	***10,437***	***15,492***	***19,921***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer [b]	1,548	1,548	1,548	1,548	1,548	1,548
Total Supply	***1,548***	***1,548***	***1,548***	***1,548***	***1,548***	***1,548***
Need (Demand - Supply) (ac-ft/yr)	***545***	***1,781***	***4,553***	***8,889***	***13,944***	***18,373***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	19	70	162	356	601	862
Water Conservation - Expanded Package	10	14	27	55	88	119
Cooke County Water Supply Project	0	18	83	104	127	149
Purchase water from UTRWD [c]	814	2,107	4,848	9,293	14,455	18,992
Total Water Management Strategies	***843***	***2,209***	***5,120***	***9,809***	***15,271***	***20,122***
Reserve (ac-ft/yr)	**298**	**428**	**567**	**920**	**1,327**	**1,749**

(a) Includes Cooke, Denton and Wise Counties

(b) From Cooke and Denton County groundwater sources

(c) Existing UTRWD supply to Sanger. UTRWD supply to Bolivar WSC by 2020.

6.1.3 Kiowa Homeowners WSC

A summary of water demand and supply information for Kiowa Homeowners WSC is located in **Table 6.1.3**. The amount of water groundwater available from the Trinity Aquifer increased in the *2011 Region C Water Plan* (1). This increase corresponds to a slight decrease in CCWSP demands but did not change timing of the project.

Table 6.1.3
Summary Information for Kiowa Homeowners WSC

Kiowa Homeowners WSC	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	3,324	3,567	3,691	3,711	3,710	3,709
Projected Water Demand (ac-ft/yr)						
Municipal Demand	875	931	955	952	948	947
Total Projected Water Demand	***875***	***931***	***955***	***952***	***948***	***947***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	887	887	887	887	887	887
Total Supply	***887***	***887***	***887***	***887***	***887***	***887***
Need (Demand - Supply) (ac-ft/yr)	***0***	***44***	***68***	***65***	***61***	***60***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	6	20	28	31	34	38
Cooke County Water Supply Project	0	100	100	100	100	100
Total Water Management Strategies	***6***	***120***	***128***	***131***	***134***	***138***
Reserve (ac-ft/yr)	**18**	**76**	**60**	**66**	**73**	**78**

6.1.4 Lindsay

A summary of water demand and supply information for Lindsay is located in **Table 6.1.4**. The timing of the CCWSP was moved from 2030 to start in 2020 for the *2011 Region C Water Plan* [1]. This change was made after meetings with the WUG on the status of water lines installed to connect to Gainesville and meetings with Gainesville on projected timing of water line projects. The City of Lindsay has purchased a portion of GTUA's water supply from Lake Texoma and plans to utilize it in the future.

Table 6.1.4
Summary Information for Lindsay

Lindsay	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	879	943	976	981	981	981
Projected Water Demand (ac-ft/yr)						
Municipal Demand	154	161	164	162	160	160
Total Projected Water Demand	***154***	***161***	***164***	***162***	***160***	***160***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	165	165	165	165	165	165
Total Supply	***165***	***165***	***165***	***165***	***165***	***165***
Need (Demand - Supply) (ac-ft/yr)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	2	5	7	8	8	9
Cooke County Water Supply Project	0	40	50	50	50	50
Total Water Management Strategies	***2***	***45***	***57***	***58***	***58***	***59***
Reserve (ac-ft/yr)	**13**	**49**	**58**	**61**	**63**	**64**

6.1.5 Muenster

A summary of water demand and supply information for Muenster is located in **Table 6.1.5**. The timing of the Muenster WTP was moved from 2010 to start in 2030 for the *2011 Region C Water Plan* (1). This change was made after meetings with the WUG on the status of projected water treatment plant.

Table 6.1.5
Summary Information for Muenster

Muenster	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	1,700	1,800	1,900	2,000	2,100	2,200
Projected Water Demand (ac-ft/yr)						
Municipal Demand	339	351	366	379	395	414
Cooke County - Manufacturing	0	0	60	61	63	65
Total Projected Water Demand	***339***	***351***	***426***	***440***	***458***	***479***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	339	339	339	339	339	339
Total Supply	***339***	***339***	***339***	***339***	***339***	***339***
Need (Demand - Supply) (ac-ft/yr)	***0***	***12***	***87***	***101***	***119***	***140***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	3	9	13	23	27	32
Water Conservation - Expanded Package	0	0	0	2	2	3
New WTP at Muenster Lake	0	280	280	280	280	280
Total Water Management Strategies	***3***	***289***	***293***	***305***	***309***	***314***
Reserve (ac-ft/yr)	**3**	**277**	**206**	**204**	**190**	**174**

6.1.6 Valley View

A summary of water demand and supply information for Valley View is located in **Table 6.1.6**. Since the *2006 Region C Water Plan* (2) the WUG has purchased part of a water system (including groundwater wells) from Bolivar WSC. Purchasing additional water from Bolivar WSC has been removed from the WMS in the *2011 Region C Water Plan* (1). This decrease in available supply corresponds with an increase in CCWSP demands, but does not change timing of the project.

Table 6.1.6
Summary Information for Valley View

Valley View	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	1,500	3,000	5,000	7,000	12,000	15,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	187	363	594	808	1,371	1,714
Total Projected Water Demand	***187***	***363***	***594***	***808***	***1,371***	***1,714***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	363	363	363	363	363	363
Total Supply	***363***	***363***	***363***	***363***	***363***	***363***
Need (Demand - Supply) (ac-ft/yr)	***0***	***0***	***231***	***445***	***1,008***	***1,351***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	3	16	31	46	83	110
Cooke County Water Supply Project	0	150	400	650	1,200	1,600
Total Water Management Strategies	***3***	***166***	***431***	***696***	***1,283***	***1,710***
Reserve (ac-ft/yr)	**179**	**166**	**200**	**251**	**275**	**359**

6.1.7 Woodbine WSC

A summary of water demand and supply information for Woodbine WSC is located in **Table 6.1.7**. The amount of water groundwater available from the Trinity Aquifer increased in the *2011 Region C Water Plan* (1). This increase corresponds to a slight decrease in CCWSP demands but did not change timing of the project.

Woodbine WSC has demands in both Cooke and Grayson Counties.

Table 6.1.7
Summary Information for Woodbine WSC

Woodbine WSC	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population [a]	5,336	5,773	6,307	6,839	7,370	7,901
Projected Water Demand (ac-ft/yr)						
Municipal Demand [a]	669	712	762	802	855	915
Total Projected Water Demand	***669***	***712***	***762***	***802***	***855***	***915***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	661	661	661	661	661	661
Total Supply	***661***	***661***	***661***	***661***	***661***	***661***
Need (Demand - Supply) (ac-ft/yr)	***8***	***51***	***101***	***141***	***194***	***254***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	8	28	39	46	52	59
Cooke County Water Supply Project	0	40	80	120	170	230
Total Water Management Strategies	***8***	***68***	***119***	***166***	***222***	***289***
Reserve (ac-ft/yr)	**0**	**17**	**18**	**25**	**28**	**35**

(a) Includes both Cooke and Grayson Counties

6.1.8 Cooke County - Other

A summary of water demand and supply information for Cooke County - Other is located in **Table 6.1.8**. The amount of water groundwater available from the Trinity, Woodbine and Other Aquifers increased in the *2011 Region C Water Plan* [(1)]. This increase corresponds to a slight decrease in CCWSP demands but did not change timing of the project.

Table 6.1.8
Summary Information for Cooke County - Other

Cooke County - Other	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	9,487	10,181	10,533	10,590	10,586	10,586
Projected Water Demand (ac-ft/yr)						
Municipal Demand	1,074	1,232	1,251	1,234	1,221	1,222
Total Projected Water Demand	***1,074***	***1,232***	***1,251***	***1,234***	***1,221***	***1,222***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	888	888	888	888	888	888
Woodbine Aquifer	154	154	154	154	154	154
Other Aquifer	137	137	137	137	137	137
Total Supply	***1,179***	***1,179***	***1,179***	***1,179***	***1,179***	***1,179***
Need (Demand - Supply) (ac-ft/yr)	***0***	***53***	***72***	***55***	***42***	***43***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	13	47	65	70	74	78
Cooke County Water Supply Project	0	125	125	125	125	125
Total Water Management Strategies	***13***	***172***	***190***	***195***	***199***	***203***
Reserve (ac-ft/yr)	**118**	**119**	**118**	**140**	**157**	**160**

6.1.9 Cooke County Non Municipal

This section includes all demands and water management strategies for non-municipal water users in Cooke County. **Table 6.1.9** provides summary information for Cooke County Irrigation users. The new WMS for the *2011 Region C Water Plan* (1) include direct reuse from Gainesville and temporary overdrafting the Trinity Aquifer. These new WMS removed the *2006 Region C Water Plan* (2) delayed and reduced the CCWSP for irrigation demands.

Table 6.1.9
Summary Information for Cooke County - Irrigation

	Revised Projections					
Cooke County - Irrigation	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Water Demand (ac-ft/yr)						
Irrigation Demand	444	444	444	444	444	444
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	172	172	172	172	172	172
Other Aquifer	100	100	100	100	100	100
Direct Reuse	9	9	9	9	9	9
Local Supply	23	23	23	23	23	23
Total Supply	***304***	***304***	***304***	***304***	***304***	***304***
Need (Demand - Supply) (ac-ft/yr)	***140***	***140***	***140***	***140***	***140***	***140***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Other Aquifers	0	0	0	0	0	0
Water Conservation - Irrigation General Rebate	0	6	11	15	18	22
Overdraft Trinity Aquifer (Existing Wells)	140	0	0	0	0	0
Direct Reuse	0	70	70	70	70	70
Cooke County Water Supply Project	0	70	70	70	70	70
Total Water Management Strategies	***140***	***146***	***151***	***155***	***158***	***162***
Reserve (ac-ft/yr)	**0**	**6**	**11**	**15**	**18**	**22**

Table 6.1.10 provides summary information for Cooke County Livestock demands. As with the *2006 Region C Water Plan* [1], the *2011 Region C Water Plan* [2] shows no net need for water for this non-municipal WUG.

Table 6.1.10
Summary Information for Cooke County - Livestock

Cooke County - Livestock	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Water Demand (ac-ft/yr)						
Livestock Demand	1,898	1,898	1,898	1,898	1,898	1,898
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	711	711	711	711	711	711
Local Supply	1,187	1,187	1,187	1,187	1,187	1,187
Total Supply	***1,898***	***1,898***	***1,898***	***1,898***	***1,898***	***1,898***
Need (Demand - Supply) (ac-ft/yr)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (ac-ft/yr)	**0**	**0**	**0**	**0**	**0**	**0**

Table 6.1.11 provides summary information for Cooke County Manufacturing demands. The allocated groundwater from the Trinity Aquifer has been reduced in the *2011 Region C Water Plan* (2) for each planning period. This reduction corresponds to a higher supply from Gainesville starting in 2020.

Table 6.1.11
Summary Information for Cooke County - Manufacturing

	Revised Projections					
Cooke County - Manufacturing	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Water Demand (ac-ft/yr)						
Manufacturing Demand	273	306	335	364	389	421
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	50	50	50	50	50	50
Gainesville	223	255	243	265	283	306
Total Supply	***273***	***305***	***293***	***315***	***333***	***356***
Need (Demand - Supply) (ac-ft/yr)	***0***	***1***	***42***	***49***	***56***	***65***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Manufacturing General Rebate	0	1	7	10	11	12
Lake Muenster	0	0	60	61	63	65
Total Water Management Strategies	***0***	***1***	***67***	***71***	***74***	***77***
Reserve (ac-ft/yr)	**0**	**0**	**25**	**22**	**18**	**12**

Table 6.1.12 provides summary information for Cooke County Mining demands. The amount of water available from overdrafting existing wells and production from new wells has been reduced in the *2011 Region C Water Plan* [(2)] for each planning period. This reduction corresponds to a new supply from the CCWSP and from direct reuse (Gainesville) starting in 2020 and a temporary (2010) overdrafting of the Trinity Aquifer.

Table 6.1.12
Summary Information for Cooke County - Mining

	Revised Projections					
Cooke County - Mining	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Water Demand (ac-ft/yr)						
Mining Demand	361	484	421	428	435	441
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	49	49	49	49	49	49
Local Supply	237	237	237	237	237	237
Total Supply	***286***	***286***	***286***	***286***	***286***	***286***
Need (Demand - Supply) (ac-ft/yr)	***75***	***198***	***135***	***142***	***149***	***155***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Overdraft Trinity Aquifer (Existing Wells)	75	0	0	0	0	0
Direct Reuse	0	99	67	71	74	77
Cooke County Water Supply Project	0	99	68	71	75	78
Total Water Management Strategies	***75***	***198***	***135***	***142***	***149***	***155***
Reserve (ac-ft/yr)	**0**	**0**	**0**	**0**	**0**	**0**

6.2 Grayson County

The WMS for municipal and non-municipal Grayson County WUGs were reviewed. Most changes to strategies involve either the location (new plants or Sherman) or the quantity of GCWSP supply (based on updated, allocated groundwater). Each individual WUG is described in more detail in the following sections. Woodbine WSC is discussed in Cooke County in Section 6.1.

6.2.1 Bells

A summary of water demand and supply information for Bells is located in **Table 6.2.1**. The amount of allocated water available from the Woodbine Aquifer increased in the *2011 Region C Water Plan* (1). This increase corresponds to a slight decrease in GCWSP demands but did not change timing of the project.

Table 6.2.1
Summary Information for Bells

Bells	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	1,400	2,100	2,750	3,250	3,700	4,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	185	271	348	404	456	493
Total Projected Water Demand	***185***	***271***	***348***	***404***	***456***	***493***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	161	161	161	161	161	161
Woodbine Aquifer	43	43	43	43	43	43
Total Supply	***204***	***204***	***204***	***204***	***204***	***204***
Need (Demand - Supply) (ac-ft/yr)	**0**	**67**	**144**	**200**	**252**	**289**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	2	11	17	22	26	30
Water Conservation - Expanded Package	1	2	2	3	3	4
Grayson County Water Supply Project (Sherman WTP)	0	80	150	210	260	300
Total Water Management Strategies	***4***	***93***	***170***	***235***	***290***	***334***
Reserve (ac-ft/yr)	**23**	**26**	**26**	**35**	**38**	**45**

6.2.2 Collinsville

A summary of water demand and supply information for Collinsville is located in **Table 6.2.2**. The amount of allocated water available from the Trinity Aquifer increased in the *2011 Region C Water Plan* [(1)]. This increase corresponds to a slight decrease in GCWSP demands but did not change timing of the project.

Table 6.2.2
Summary Information for Collinsville

Collinsville	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	2,035	2,835	3,635	4,435	5,235	6,035
Projected Water Demand (ac-ft/yr)						
Municipal Demand	324	441	558	666	780	899
Total Projected Water Demand	***324***	***441***	***558***	***666***	***780***	***899***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	356	356	356	356	356	356
Total Supply	***356***	***356***	***356***	***356***	***356***	***356***
Need (Demand - Supply) (ac-ft/yr)	**0**	**85**	**202**	**310**	**424**	**543**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	4	15	24	32	40	49
Water Conservation - Expanded Package	3	4	5	6	7	8
Grayson County Water Supply Project (Northwest WTP)	0	100	200	300	400	500
Total Water Management Strategies	***7***	***119***	***229***	***338***	***447***	***557***
Reserve (ac-ft/yr)	**39**	**34**	**27**	**28**	**23**	**14**

6.2.3 Denison

A summary of water demand and supply information for Denison is located in **Table 6.2.3**. The projected wholesale demands from Pottsboro were reduced (see 6.2.7 for Pottsboro recommended strategy) for the *2011 Region C Water Plan* (1). The remaining WMS have not changed timing or appreciably changed in magnitude from the *2006 Region C Water Plan* (2).

Table 6.2.3
Summary Information for Denison

Denison	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	25,000	28,000	30,000	31,000	32,000	33,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	5,489	6,053	6,385	6,493	6,667	6,875
Wholesale – Pottsboro	561	561	561	561	561	561
Wholesale - County – Other	310	310	310	310	310	310
Total Projected Water Demand	***6,906***	***7,533***	***7,901***	***8,052***	***8,279***	***8,561***
Currently Available Water Supplies (ac-ft/yr)						
Lake Randell	1,400	1,400	1,400	1,400	1,400	1,400
Lake Texoma - to Lake Randell	5,791	5,791	5,791	5,791	5,791	5,791
Trinity Aquifer	157	157	157	157	157	157
Woodbine Aquifer	155	155	155	155	155	155
Total Supply	***7,503***	***7,503***	***7,503***	***7,503***	***7,503***	***7,503***
Need (Demand - Supply) (ac-ft/yr)	***0***	***30***	***398***	***549***	***776***	***1,058***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	43	145	382	496	566	641
Water Conservation - Expanded Package	0	0	27	38	39	40
WTP Expansion	0	0	0	1,121	1,121	1,121
Total Water Management Strategies	***43***	***145***	***409***	***1,656***	***1,726***	***1,802***
Reserve (ac-ft/yr)	**640**	**115**	**11**	**1,107**	**950**	**744**

6.2.4 Gunter

A summary of water demand and supply information for Gunter is located in **Table 6.2.4**. The amount of allocated water available from the Trinity Aquifer increased in the *2011 Region C Water Plan* (1). This increase corresponds to a slight decrease in GCWSP demands but did not change timing of the project.

Table 6.2.4
Summary Information for Gunter

Gunter	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	2,000	3,500	5,000	6,500	8,000	9,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	271	467	655	837	1,022	1,149
Total Projected Water Demand	***271***	***467***	***655***	***837***	***1,022***	***1,149***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	298	298	298	298	298	298
Total Supply	***298***	***298***	***298***	***298***	***298***	***298***
Need (Demand - Supply) (ac-ft/yr)	**0**	**169**	**357**	**539**	**724**	**851**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	3	16	28	39	51	62
Water Conservation - Expanded Package	2	3	4	5	6	6
Grayson County Water Supply Project (Sherman WTP)	0	180	350	530	700	820
Total Water Management Strategies	***5***	***199***	***382***	***574***	***757***	***888***
Reserve (ac-ft/yr)	**32**	**30**	**25**	**35**	**33**	**37**

6.2.5 Marilee SUD

A summary of water demand and supply information for Marilee SUD is located in **Table 6.2.5**. The projected supplies and water management strategies in the *2011 Region C Water Plan* (1) have not changed from the *2006 Region C Water Plan* (2). Small changes in calculated water conservation savings slightly increased supplies from the GCWSP but did not affect timing.

Table 6.2.5
Summary Information for Marilee SUD

Marilee SUD	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population [a]	4,300	6,400	8,653	10,679	13,471	16,560
Projected Water Demand (ac-ft/yr)						
Municipal Demand [a]	530	774	1,027	1,256	1,585	1,948
Total Projected Water Demand	***530***	***774***	***1,027***	***1,256***	***1,585***	***1,948***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer [b]	634	634	634	634	634	634
Total Supply	***634***	***634***	***634***	***634***	***634***	***634***
Need (Demand - Supply) (ac-ft/yr)	**0**	**140**	**393**	**622**	**951**	**1,314**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	1	6	10	13	17	22
Water Conservation - Expanded Package	1	1	1	2	2	3
Grayson County Water Supply Project (Sherman WTP)	0	150	400	650	1,000	1,350
Total Water Management Strategies	***2***	***158***	***411***	***664***	***1,019***	***1,374***
Reserve (ac-ft/yr)	**106**	**18**	**18**	**42**	**68**	**60**

(a) Includes both Collin and Grayson Counties

(b) From Collin and Grayson County groundwater sources

6.2.6 Howe

A summary of water demand and supply information for Howe is located in **Table 6.2.6**. The projected water demands are lower for Howe in the *2011 Region C Water Plan* [1]. In addition the supply from the CGMA Pipeline (GTUA/NTMWD supply) is now a currently available strategy. These factors have reduced the projected WMS from the CGMA pipeline to Howe from the *2006 Region C Water Plan* [2].

Table 6.2.6
Summary Information for Howe

Howe	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	3,000	4,500	6,500	8,500	9,772	10,781
Projected Water Demand (ac-ft/yr)						
Municipal Demand	403	590	837	1,085	1,237	1,365
Total Projected Water Demand	***403***	***590***	***837***	***1,085***	***1,237***	***1,365***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	117	117	117	117	117	117
CGMA Pipeline	307	391	430	430	430	430
Total Supply	***424***	***508***	***547***	***547***	***547***	***547***
Need (Demand - Supply) (ac-ft/yr)	**0**	**82**	**290**	**538**	**690**	**818**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	5	22	39	54	66	78
Water Conservation - Expanded Package	4	6	8	11	12	14
Expand CGMA Pipeline Capacity: Trunk Line	0	103	311	559	711	839
Total Water Management Strategies	***9***	***130***	***358***	***624***	***790***	***930***
Reserve (ac-ft/yr)	**30**	**48**	**68**	**86**	**100**	**112**

6.2.7 Pottsboro

A summary of water demand and supply information for Pottsboro is located in **Table 6.2.7**. In the *2011 Region C Water Plan* (1) Pottsboro will maintain the current Denison supply but will utilize supplies from a new north treatment plant as a water management strategy for future needs. In the *2006 Region C Water Plan* (2) both current and new supplies were projected to be met by Denison.

Table 6.2.7
Summary Information for Pottsboro

	Revised Projections					
Pottsboro	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	3,000	5,000	7,000	9,000	11,000	12,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	504	851	1,176	1,492	1,811	1,976
Total Projected Water Demand	***504***	***851***	***1,176***	***1,492***	***1,811***	***1,976***
Currently Available Water Supplies (ac-ft/yr)						
Lake Texoma (Denison)	561	561	561	561	561	561
Woodbine Aquifer	123	123	123	123	123	123
Total Supply	***684***	***684***	***684***	***684***	***684***	***684***
Need (Demand - Supply) (ac-ft/yr)	**0**	**167**	**492**	**808**	**1,127**	**1,292**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	6	45	77	112	151	181
Water Conservation - Expanded Package	6	14	20	25	32	35
Grayson County Water Supply Project (North WTP)	0	280	600	870	1,150	1,275
Total Water Management Strategies	***12***	***339***	***697***	***1,007***	***1,332***	***1,491***
Reserve (ac-ft/yr)	**193**	**172**	**206**	**199**	**206**	**200**

6.2.8 Luella WSC

A summary of water demand and supply information for Luella WSC is located in **Table 6.2.8**. The amount of allocated water available from the Woodbine Aquifer increased in the *2011 Region C Water Plan* (1). This increase corresponded with a decrease in GCWSP demands but did not change timing of the project.

Table 6.2.8
Summary Information for Luella WSC

Luella WSC	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	3,300	3,800	4,300	4,950	5,080	5,770
Projected Water Demand (ac-ft/yr)						
Municipal Demand	410	460	511	582	592	672
Total Projected Water Demand	***410***	***460***	***511***	***582***	***592***	***672***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	450	450	450	450	450	450
Total Supply	***450***	***450***	***450***	***450***	***450***	***450***
Need (Demand - Supply) (ac-ft/yr)	**0**	**10**	**61**	**132**	**142**	**222**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	5	18	27	33	36	43
Grayson County Water Supply Project (Sherman WTP)	0	38	80	140	150	220
Total Water Management Strategies	***5***	***56***	***107***	***173***	***186***	***263***
Reserve (ac-ft/yr)	**45**	**46**	**46**	**41**	**44**	**41**

6.2.9 Sherman

A summary of water demand and supply information for Sherman is located in **Table 6.2.9**. The higher water demand from non-municipal users and GCWSP in the *2011 Region C Water Plan* requires new expansions and a new WTP in the *2011 Region C Water Plan.*

Table 6.2.9
Summary Information for Sherman

Sherman	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	39,300	44,400	50,600	57,700	67,000	80,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	10,081	11,240	12,696	14,348	16,586	19,804
Wholesale Demand - Grayson Co. Supply Project	200	983	1,895	2,830	3,755	4,820
Grayson County - SEP Demand	5,600	5,600	5,600	5,600	5,600	5,600
Grayson County - Manufacturing	5,149	5,849	6,478	7,064	7,539	8,280
Total Projected Water Demand	***21,030***	***23,672***	***26,669***	***29,842***	***33,480***	***38,504***
Currently Available Water Supplies (ac-ft/yr)						
Lake Texoma: GTUA (Steam Electric Power)	5,600	5,600	5,600	5,600	5,600	5,600
Lake Texoma (GTUA)	8,000	8,000	8,000	8,000	8,000	8,000
Trinity Aquifer	4,083	4,083	4,083	4,083	4,083	4,083
Woodbine Aquifer	3,463	3,463	3,463	3,463	3,463	3,463
Total Supply	***21,146***	***21,146***	***21,146***	***21,146***	***21,146***	***21,146***
Need (Demand - Supply) (ac-ft/yr)	***0***	***2,526***	***5,523***	***8,696***	***12,334***	***17,358***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	67	217	333	880	1,411	1,850
Water Conservation - Expanded Package	0	0	0	78	102	119
10 MGD WTP Expansion	0	5,600	5,600	5,600	5,600	5,600
5 MGD WTP Expansion	0	0	2,800	2,800	2,800	2,800
New 10 MGD WTP	0	0	0	0	5,600	5,600
New WTP: 10 MGD WTP Expansion	0	0	0	0	0	5,600
Total Water Management Strategies	***67***	***5,817***	***8,733***	***9,358***	***15,513***	***21,568***
Reserve (ac-ft/yr)	**183**	**3,291**	**3,209**	**662**	**3,178**	**4,210**

6.2.10 South Grayson WSC

A summary of water demand and supply information for South Grayson WSC is located in **Table 6.2.10**. Some WUG demands in Collin County are now met through the GCWSP in the *2011 Region C Water Plan* (1). This change corresponds with an increase in GCWSP demands but did not change timing of the project.

Table 6.2.10
Summary Information for South Grayson WSC

South Grayson WSC	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population [(a)]	2,700	3,450	4,100	4,825	5,650	6,675
Projected Water Demand (ac-ft/yr)						
Municipal Demand [(a)]	381	479	561	654	760	897
Total Projected Water Demand	***381***	***479***	***561***	***654***	***760***	***897***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer [(b)]	360	360	360	360	360	360
Woodbine Aquifer [(b)]	360	360	360	360	360	360
Total Supply	***720***	***720***	***720***	***720***	***720***	***720***
Need (Demand - Supply) (ac-ft/yr)	**0**	**0**	**0**	**0**	**40**	**177**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	3	12	19	26	34	45
Collin-Grayson Municipal Alliance Project	0	100	100	100	100	100
Grayson County Water Supply Project (Northwest WTP)	0	0	0	75	175	300
Total Water Management Strategies	***3***	***112***	***119***	***201***	***309***	***445***
Reserve (ac-ft/yr)	**342**	**353**	**278**	**267**	**269**	**268**

(a) Includes both Collin and Grayson Counties

(b) From Collin and Grayson County groundwater sources

6.2.11 Southmayd

A summary of water demand and supply information for Southmayd is located in **Table 6.2.11**. The amount of allocated water available from the Woodbine and Trinity Aquifers slightly increased in the *2011 Region C Water Plan* (1). The projected water demands for Southmayd were lower in every planning period except 2060. Southmayd plans to purchase a portion of a current WSC providing service in the city and drill a new well in the Woodbine Aquifer to upgrade the capacity of this new system. These changes correspond to a slight decrease in GCWSP demands but did not change timing of the project.

Table 6.2.11
Summary Information for Southmayd

Southmayd	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	1,200	1,500	2,000	3,000	4,500	5,600
Projected Water Demand (ac-ft/yr)						
Municipal Demand	160	197	258	380	565	703
Total Projected Water Demand	***160***	***197***	***258***	***380***	***565***	***703***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	130	130	130	130	130	130
Woodbine Aquifer (County-Other)	60	0	0	0	0	0
Total Supply	***190***	***130***	***130***	***130***	***130***	***130***
Need (Demand - Supply) (ac-ft/yr)	**0**	**67**	**128**	**250**	**435**	**573**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	2	8	13	21	33	43
Purchase WSC System	0	0	0	0	0	0
New Well (Woodbine Aquifer)	0	60	60	60	60	60
Grayson County Water Supply Project (North WTP)	0	40	100	220	400	525
Total Water Management Strategies	***2***	***108***	***173***	***301***	***493***	***628***
Reserve (ac-ft/yr)	**32**	**41**	**45**	**51**	**58**	**55**

6.2.12 Southwest Fannin County SUD

A summary of water demand and supply information for Southwest Fannin County SUD is located in **Table 6.2.12**. Details of the Fannin County Water Supply Project can be found in the *Fannin County Special Study* [7].

Table 6.2.12
Summary Information for Southwest Fannin County SUD

Southwest Fannin County SUD	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population [a]	7,491	8,940	9,947	10,852	11,657	12,463
Projected Water Demand (ac-ft/yr)						
Municipal Demand [a]	722	1,042	1,192	1,288	1,371	1,466
Total Projected Water Demand	***722***	***1,042***	***1,192***	***1,288***	***1,371***	***1,466***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer [b]	803	803	803	803	803	803
Total Supply	***803***	***803***	***803***	***803***	***803***	***803***
Need (Demand - Supply) (ac-ft/yr)	**0**	**239**	**389**	**485**	**568**	**663**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	15	44	62	72	82	93
Fannin County Water Supply Project	0	399	560	666	756	859
Total Water Management Strategies	***15***	***443***	***622***	***738***	***838***	***952***
Reserve (ac-ft/yr)	**96**	**204**	**233**	**253**	**270**	**289**

(a) Includes both Fannin and Grayson Counties

(b) From Fannin and Grayson County groundwater sources

6.2.13 Tioga

A summary of water demand and supply information for Tioga is located in **Table 6.2.13**. The amount of allocated water available from the Trinity Aquifer increased in the *2011 Region C Water Plan* [(1)]. This increase corresponds to a slight decrease in GCWSP demands but did not change timing of the project.

Table 6.2.13
Summary Information for Tioga

Tioga	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	1,100	2,500	3,500	4,000	4,400	4,600
Projected Water Demand (ac-ft/yr)						
Municipal Demand	192	428	588	663	725	757
Total Projected Water Demand	***192***	***428***	***588***	***663***	***725***	***757***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	211	211	211	211	211	211
Total Supply	***211***	***211***	***211***	***211***	***211***	***211***
Need (Demand - Supply) (ac-ft/yr)	**0**	**217**	**377**	**452**	**514**	**546**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	2	26	48	60	72	81
Water Conservation - Expanded Package	1	4	7	8	9	9
Grayson County Water Supply Project (Sherman WTP)	0	225	375	425	475	500
Total Water Management Strategies	***4***	***256***	***430***	***493***	***555***	***590***
Reserve (ac-ft/yr)	**23**	**39**	**53**	**41**	**41**	**44**

6.2.14 Tom Bean

A summary of water demand and supply information for Tom Bean is located in **Table 6.2.14**. The available supplies and projected water demands have not changed in the *2011 Region C Water Plan* (1). The reserve has been reduced from what was projected in the *2006 Region C Water Plan* (2). This decrease corresponds to a decrease in GCWSP demands but did not change timing of the project.

Table 6.2.14
Summary Information for Tom Bean

Tom Bean	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	1,100	1,300	1,500	1,700	1,900	2,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	259	301	343	383	426	448
Total Projected Water Demand	***259***	***301***	***343***	***383***	***426***	***448***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	288	288	288	288	288	288
Total Supply	***288***	***288***	***288***	***288***	***288***	***288***
Need (Demand - Supply) (ac-ft/yr)	**0**	**13**	**55**	**95**	**138**	**160**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	22	67	81	93	108	117
Water Conservation - Expanded Package	2	4	4	5	5	6
Grayson County Water Supply Project (Sherman WTP)	0	10	40	75	120	130
Total Water Management Strategies	***25***	***81***	***125***	***173***	***233***	***252***
Reserve (ac-ft/yr)	**54**	**68**	**70**	**79**	**95**	**93**

6.2.15 Two Way SUD

A summary of water demand and supply information for Two Way SUD is located in **Table 6.2.15**. The amount of water groundwater available from the Trinity Aquifer increased in the *2011 Region C Water Plan* (1). This increase corresponds to a slight decrease in GCWSP demands but did not change timing of the project.

Two Way SUD has demands in both Cooke and Grayson Counties.

Table 6.2.15
Summary Information for Two Way SUD

Two Way SUD	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population [(a)]	5,081	6,720	8,251	9,819	11,382	12,945
Projected Water Demand (ac-ft/yr)						
Municipal Demand [(a)]	575	813	979	1,155	1,326	1,508
Total Projected Water Demand	***575***	***813***	***979***	***1,155***	***1,326***	***1,508***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer [(b)]	622	622	622	622	622	622
Total Supply	***622***	***622***	***622***	***622***	***622***	***622***
Need (Demand - Supply) (ac-ft/yr)	***0***	***191***	***357***	***533***	***704***	***886***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	9	34	51	65	80	96
Water Conservation - Expanded Package	5	7	8	10	11	13
Grayson County Water Supply Project	0	200	350	500	650	800
Total Water Management Strategies	***13***	***240***	***409***	***575***	***741***	***909***
Reserve (ac-ft/yr)	**60**	**49**	**52**	**42**	**37**	**23**

(a) Includes both Cooke and Grayson Counties

(b) From Grayson County groundwater sources

6.2.16 Van Alstyne

A summary of water demand and supply information for Van Alstyne is located in **Table 6.2.16**. The projected water demands decreased in the *2011 Region C Water Plan* [1]. This decrease corresponds to a decrease in GCWSP demands but does not change timing of the project.

Table 6.2.16
Summary Information for Van Alsytne

Van Alstyne	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	3,000	7,500	13,500	17,000	18,500	19,200
Projected Water Demand (ac-ft/yr)						
Municipal Demand	504	1,411	2,510	3,142	3,419	3,549
Total Projected Water Demand	***504***	***1,411***	***2,510***	***3,142***	***3,419***	***3,549***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	235	235	235	235	235	235
Woodbine Aquifer	215	215	215	215	215	215
CGMA Pipeline	58	795	1,291	1,291	1,291	1,291
Total Supply	***508***	***1,245***	***1,741***	***1,741***	***1,741***	***1,741***
Need (Demand - Supply) (ac-ft/yr)	**0**	**166**	**769**	**1,401**	**1,678**	**1,808**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	5	70	152	218	265	305
Water Conservation - Expanded Package	3	12	26	35	41	43
Expand CGMA Pipeline Capacity: Trunk Line	0	170	773	1,405	1,682	1,812
Total Water Management Strategies	***8***	***252***	***951***	***1,658***	***1,988***	***2,160***
Reserve (ac-ft/yr)	**12**	**86**	**182**	**257**	**310**	**352**

6.2.17 Whitesboro

A summary of water demand and supply information for Whitesboro is located in **Table 6.2.17**. The amount of allocated water available from the Trinity Aquifer increased in the *2011 Region C Water Plan* (1). This increase corresponds to a slight decrease in GCWSP demands but did not change timing of the project.

Table 6.2.17
Summary Information for Whitesboro

Whitesboro	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	4,400	5,000	5,700	6,500	7,500	10,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	764	851	958	1,070	1,227	1,635
Total Projected Water Demand	***764***	***851***	***958***	***1,070***	***1,227***	***1,635***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	840	840	840	840	840	840
Total Supply	***840***	***840***	***840***	***840***	***840***	***840***
Need (Demand - Supply) (ac-ft/yr)	**0**	**11**	**118**	**230**	**387**	**795**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	7	42	61	78	100	147
Water Conservation - Expanded Package	0	3	5	6	7	10
Grayson County Water Supply Project (Northwest WTP)	0	50	150	200	350	700
Total Water Management Strategies	***7***	***95***	***216***	***284***	***457***	***857***
Reserve (ac-ft/yr)	**83**	**84**	**98**	**54**	**70**	**62**

6.2.18 Whitewright

A summary of water demand and supply information for Whitewright is located in **Table 6.2.18**. The available supplies, water demands and water management strategies have not changed in the *2011 Region C Water Plan* (1).

Table 6.2.18
Summary Information for Whitewright

Whitewright	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population [a]	2,022	3,228	4,532	5,535	6,538	7,541
Projected Water Demand (ac-ft/yr)						
Municipal Demand [a]	403	632	873	1,048	1,230	1,419
Total Projected Water Demand	***403***	***632***	***873***	***1,048***	***1,230***	***1,419***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	438	438	438	438	438	438
Total Supply	***438***	***438***	***438***	***438***	***438***	***438***
Need (Demand - Supply) (ac-ft/yr)	**0**	**194**	**435**	**610**	**792**	**981**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	3	30	52	71	94	120
Water Conservation - Expanded Package	2	4	5	6	8	9
Grayson County Water Supply Project (Sherman WTP)	0	200	400	600	750	900
Total Water Management Strategies	***5***	***233***	***457***	***678***	***851***	***1,029***
Reserve (ac-ft/yr)	**40**	**39**	**22**	**68**	**59**	**48**

(a) Includes both Fannin and Grayson Counties

6.2.19 Grayson County - Other

A summary of water demand and supply information for Grayson County – Other municipal WUGs is located in **Table 6.2.19**. The available supplies and demands have not changed in the *2011 Region C Water Plan* [1]. The water management strategies are broken down into each water treatment plant (existing Sherman and the two proposed plants).

Table 6.2.19
Summary Information for Grayson County – Other

Grayson County – Other	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	26,925	26,799	26,482	25,160	23,185	20,727
Projected Water Demand (ac-ft/yr)						
Municipal Demand	3,468	3,393	3,263	3,016	2,753	2,461
Total Projected Water Demand	***3,468***	***3,393***	***3,263***	***3,016***	***2,753***	***2,461***
Currently Available Water Supplies (ac-ft/yr)						
Lake Randell	60	60	60	60	60	60
Lake Texoma	967	958	942	972	989	1,048
Other Aquifer	35	35	35	35	35	35
Trinity Aquifer	1,170	1,170	1,170	1,170	1,170	1,170
Woodbine Aquifer	1,659	1,659	1,659	1,659	1,659	1,659
Total Supply	***3,891***	***3,882***	***3,866***	***3,896***	***3,913***	***3,972***
Need (Demand – Supply) (ac-ft/yr)	**0**	**0**	**0**	**0**	**0**	**0**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity, Woodbine and Other Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	37	123	165	168	164	155
Grayson County Water Supply Project (Sherman WTP)	75	100	100	200	300	600
Grayson County Water Supply Project (North WTP)	0	200	300	400	500	600
Grayson County Water Supply Project (Northwest WTP)	0	560	560	560	560	560
Total Water Management Strategies	***112***	***983***	***1,125***	***1,328***	***1,524***	***1,915***
Reserve (ac-ft/yr)	**535**	**1,472**	**1,728**	**2,208**	**2,684**	**3,426**

6.2.20 Grayson County Non-Municipal

This section provides detail on all non-municipal water users in Grayson County. **Table 6.2.20** provides information for Grayson County Irrigation demands. There are no changes to demands or strategies in the *2011 Region C Water Plan* [(1)]. This WUG has no net water needs and as such no specific WMS.

Table 6.2.20
Summary Information for Grayson County - Irrigation

Grayson County - Irrigation	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Water Demand (ac-ft/yr)						
Irrigation Demand	3,561	3,751	3,950	4,158	4,381	4,616
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	2,347	2,347	2,347	2,347	2,347	2,347
Lake Texoma	150	150	150	150	150	150
Local Supply	2,394	2,394	2,394	2,394	2,394	2,394
Total Supply	***4,891***	***4,891***	***4,891***	***4,891***	***4,891***	***4,891***
Need (Demand - Supply) (ac-ft/yr)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (ac-ft/yr)	**1,330**	**1,140**	**941**	**733**	**510**	**275**

Table 6.2.21 provides information for Grayson County Livestock demands. There are no changes to supplies, demands or strategies in the *2011 Region C Water Plan* [1]. This WUG has no net water needs and as such no specific WMS.

Table 6.2.21
Summary Information for Grayson County - Livestock

Grayson County - Livestock	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Water Demand (ac-ft/yr)						
Livestock Demand	1,297	1,297	1,297	1,297	1,297	1,297
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	360	360	360	360	360	360
Local Supply	1,683	1,683	1,683	1,683	1,683	1,683
Total Supply	***2,043***	***2,043***	***2,043***	***2,043***	***2,043***	***2,043***
Need (Demand - Supply) (ac-ft/yr)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (ac-ft/yr)	**746**	**746**	**746**	**746**	**746**	**746**

Table 6.2.22 provides information for Grayson County Mining demands. There are no changes to demands or strategies in the *2011 Region C Water Plan* (1). There is a slight increase in allocated supply to the Trinity Aquifer in the *2011 Region C Water Plan* (1). This WUG has no net water needs and as such no specific WMS.

Table 6.2.22
Summary Information for Grayson County - Mining

Grayson County - Mining	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Water Demand (ac-ft/yr)						
Mining Demand	1,052	1,050	1,049	1,048	1,047	1,046
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	595	595	595	595	595	595
Woodbine Aquifer	559	559	559	559	559	559
Total Supply	***1,154***	***1,154***	***1,154***	***1,154***	***1,154***	***1,154***
Need (Demand - Supply) (ac-ft/yr)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Total Water Management Strategies	***0***	***0***	***0***	***0***	***0***	***0***
Reserve (ac-ft/yr)	**102**	**104**	**105**	**106**	**107**	**108**

Table 6.2.23 provides information for Grayson County Manufacturing demands. Manufacturing demands increased in the *2011 Region C Water Plan* [(1)]. The additional demands are proposed to be met with additional Lake Texoma supply.

Table 6.2.23
Summary Information for Grayson County - Manufacturing

Grayson County - Manufacturing	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Water Demand (ac-ft/yr)						
Manufacturing Demand	7,010	7,781	8,453	9,088	9,621	10,444
Currently Available Water Supplies (ac-ft/yr)						
Lake Texoma (Sherman)	5,149	5,849	6,478	7,064	7,539	8,280
Lake Randell (Denison)	546	609	645	688	741	815
Howe (NTMWD)	70	78	85	91	96	104
Woodbine Aquifer	1,215	1,215	1,215	1,215	1,215	1,215
Local Supply	30	30	30	30	30	30
Total Supply	***7,010***	***7,781***	***8,453***	***9,088***	***9,621***	***10,444***
Need (Demand - Supply) (ac-ft/yr)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies (ac-ft/yr)						
Water Conservation - Manufacturing General Rebate	0	15	175	255	272	291
Total Water Management Strategies	***0***	***15***	***175***	***255***	***272***	***291***
Reserve (ac-ft/yr)	**0**	**15**	**175**	**255**	**272**	**291**

Table 6.2.24 provides information for Grayson County Steam Electric Power demands. There were no steam electric power demands in the *2006 Region C Water Plan* [1]. The new demands are proposed to be met through Lake Texoma (via Sherman).

Table 6.2.24
Summary Information for Grayson County – Steam Electric Power

Grayson County - Steam Electric Power	Revised Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Water Demand (ac-ft/yr)						
Steam Electric Power Demand	5,600	8,963	12,326	12,326	12,326	12,326
Currently Available Water Supplies (ac-ft/yr)						
Lake Texoma - Sherman	5,600	5,600	5,600	5,600	5,600	5,600
Total Supply	***5,600***	***5,600***	***5,600***	***5,600***	***5,600***	***5,600***
Need (Demand - Supply) (ac-ft/yr)	***0***	***3,363***	***6,726***	***6,726***	***6,726***	***6,726***
Water Management Strategies (ac-ft/yr)						
Additional Lake Texoma	0	3,400	7,000	7,000	7,000	7,000
Total Water Management Strategies	***0***	***3,400***	***7,000***	***7,000***	***7,000***	***7,000***
Reserve (ac-ft/yr)	**0**	**37**	**274**	**274**	**274**	**274**

7. Estimated Costs for Recommended Water Management Strategies

The estimated costs for proposed water management strategies were updated and are included in Appendix B. The capital costs are broken down by category in **Tables 7.1 and 7.2**. Refer to Appendix Q for additional details on cost assumptions. See Sections 4E and 4F of the *2011 Region C Water Plan* for additional cost information for Collin and Grayson Counties and additional WWP cost information.

Capital costs for supplemental groundwater wells are defined as the costs required to maintain the existing groundwater capacity of a WUG. It is assumed that 20% of the existing WUG groundwater well system will be renewed every 10 years as part of the normal capital renewal program of a WUG. These costs do not add groundwater capacity to WUGs. Capital costs for new wells are the costs for new infrastructure to add additional capacity for a WUG.

Table 7.1
Capital Costs for Proposed Water Management Strategies Not Associated With Wholesale Water Providers

Water Management Strategy Category	Cooke County	Grayson County
	Capital Cost During Study Period	
Transmission Facilities	$0	$13,847,000
Additional Groundwater	$0	$366,000
Supplemental Wells	$24,436,000	$108,901,000
Connect to Supplies	$8,217,000	$0
Treatment Capacity	$35,346,000	$7,270,000
Overdraft Groundwater	$269,000	$0
Total Capital Costs for Study Area	$32,920,000	$130,527,000

Table 7.2
Capital Costs for Proposed Water Management Strategies Associated With Wholesale Water Providers

Water Management Strategy Category	Cooke County	Grayson County
	Capital Cost During Study Period	
Cooke County Water Supply Project (Gainesville)	$50,280,000	$0
Grayson County Water Supply Project (Sherman)	$0	$146,071,000
Grayson County Water Supply Project (GTUA)	$0	$136,016,000
Collin-Grayson Municipal Alliance (GTUA)*	$0	$77,366,000
Additional Lake Texoma for SEP (GTUA)	$0	$24,780,000
Direct Reuse (Gainesville)	$1,828,000	
Supplemental Wells (Gainesville)	$5,468,000	
Total Capital Costs for Study Area	$57,576,000	$384,233,000

*Includes the entire CGMA cost, not just the Grayson County portion

8. Implementation Plan for Proposed Water Management Strategies

Implementation of the Cooke County Water Supply Project and Grayson County Water Supply Project includes developing water management strategies for both surface water and groundwater sources. For surface water sources, the implementation plan for water management strategies includes the following components:

- Obtain required environmental and construction permits
- Design and construct required facilities

For groundwater sources, the implementation plan for water management strategies includes the following components:

- Obtain required permits from the North Texas Groundwater Conservation District and Red River Groundwater Conservation District
- Design and construct required facilities

Table 8.1 lists recommended water management strategies with approximate in-service dates.

Table 8.1
Implementation of Recommended Water Management Strategies

Owner	Project	Approximate In-service Year	County
Lindsay	CCWSP	2013	Cooke
Valley View	CCWSP	2016	Cooke
Bolivar WSC	CCWSP	2018	Cooke
Woodbine WSC	CCWSP	2018	Cooke
County – Other	CCWSP	2018	Cooke
Gainesville	WTP Expansions	2020	Cooke
Kiowa Homeowners WSC	CCWSP	2020	Cooke
Muenster	New WTP	2020	Cooke
Gainesville	WTP Expansions	2020	Cooke

Owner	Project	Approximate In-service Year	County
Gainesville	WTP Expansions	2040 and 2050	Cooke
Bells	GCWSP (Sherman WTP)	2015	Grayson
Luella WSC	GCWSP (Sherman WTP)	2015	Grayson
Two Way SUD	GCWSP (Northwest WTP)	2017	Grayson
Southmayd	New GW Wells	2017	Grayson
Whitesboro	GCWSP (Northwest WTP)	2017	Grayson
Gunter	GCWSP (Sherman WTP)	2017	Grayson
Marilee SUD	GCWSP (Sherman WTP)	2017	Grayson
Tom Bean	GCWSP (Sherman WTP)	2017	Grayson
SFWCSUD	FCWSP	2018	Grayson
County-Other	GCWSP	2018	Grayson
Pottsboro	GCWSP (North WTP)	2019	Grayson
Southmayd	GCWSP (North WTP)	2019	Grayson
Collinsville	GCWSP (Northwest WTP)	2019	Grayson
Tioga	GCWSP (Sherman WTP)	2019	Grayson
Whitewright	GCWSP (Sherman WTP)	2019	Grayson
Howe	CGMA	2020	Grayson
Van Alstyne	CGMA	2020	Grayson
South Grayson WSC	GCWSP (Northwest WTP)	2035	Grayson
Denison	WTP Expansion	2040	Grayson
Sherman	WTP Expansions	2020 and 2050	Grayson

9. Alternative Water Management Strategies

In general, most of the water user groups and wholesale water providers in the Cooke and Grayson County study areas indicated that their future water supply plans are in line with the *2006 Region C Water Plan* [2]. However, seven possible alternative water management strategies were identified in this study: two in Cooke County and five in Grayson County.

9.1 Cooke County

Muenster currently plans to build a water treatment plant to treat surface water from Lake Muenster. An alternative strategy is to purchase treated water from Gainesville (through Lindsay) via the CCWSP.

Two Way SUD has a current recommended strategy to purchase water through the GCWSP (Northwest WTP). An alternative strategy is to purchase treated water from Gainesville via the CCWSP.

9.2 Grayson County

Pottsboro has a current recommended strategy to continue the purchase of treated water from a north water treatment plant. Two alternative strategies exist for Pottsboro: purchasing treated water from the GCWSP (Sherman) or from Denison.

Whitewright has a current recommended strategy to purchase water through the GCWSP (Sherman). An alternative strategy is to purchase treated water from Bonham (NTMWD) via the FCWSP. This was also identified in the *Fannin County Special Study* [7].

Howe and Van Alstyne have current recommended strategies to purchase water through the CGMA Pipeline (NTMWD/GTUA). An alternative strategy is to purchase treated water from Sherman via the GCWSP.

Southmayd has a current recommended strategy to purchase water through GTUA (North WTP). An alternative strategy is to purchase treated water from Sherman (Sherman WTP).

Cost estimates for alternative strategies are located in Appendix Q.

10. Conclusions

The water user groups in the Cooke and Grayson Counties are projecting steady growth in the next 50 years. In general, population growth is lower and water demands are higher than what was projected in the *2006 Region C Water Plan* (2) for Cooke County. In general, population growth and water demands are lower than what was projected in the *2006 Region C Water Plan* (2) for Grayson County. To meet the projected water demands, the recommended water management strategies have been revised as discussed in this report. For most of the water user groups, currently planned water management strategies are in line with the strategies presented in the *2006 Region C Water Plan* (2). **Figure 10.1** and **Figure 10.2** show the total projected demands, current water supplies, and recommended water management strategies for the Cooke and Grayson County Study areas, respectively.

Appendix B contains information on the Public Meeting held on February 25, 2010.

Figure 10.1
Total Projected Municipal Water Demand and Supply for Cooke County

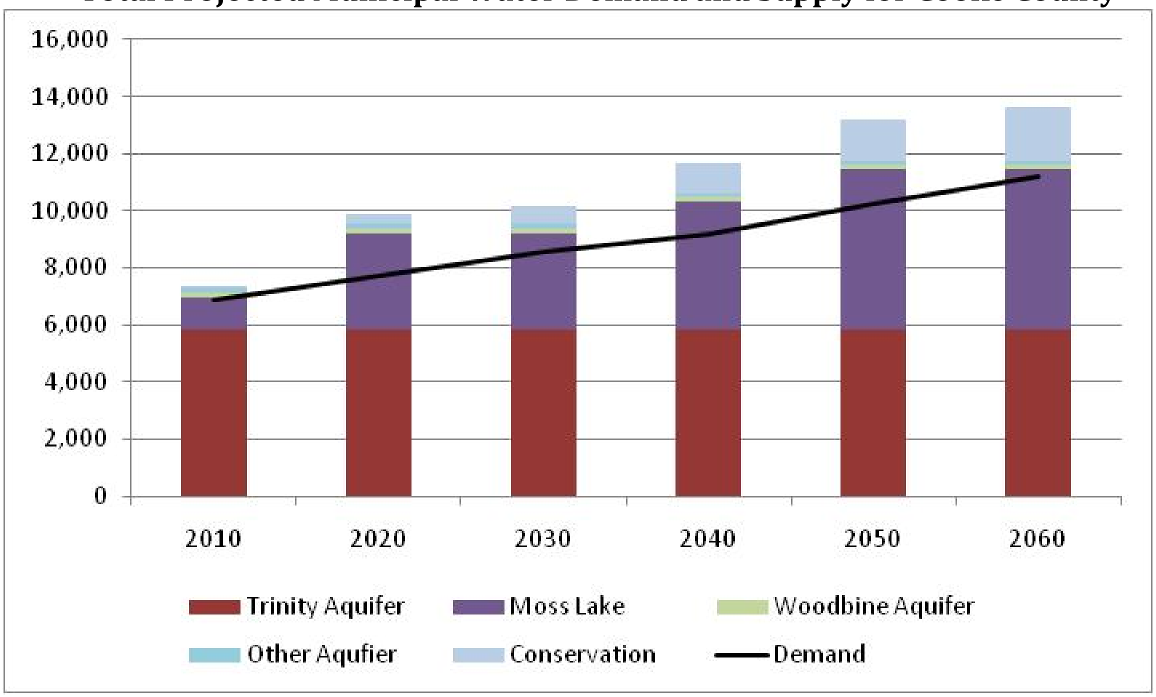
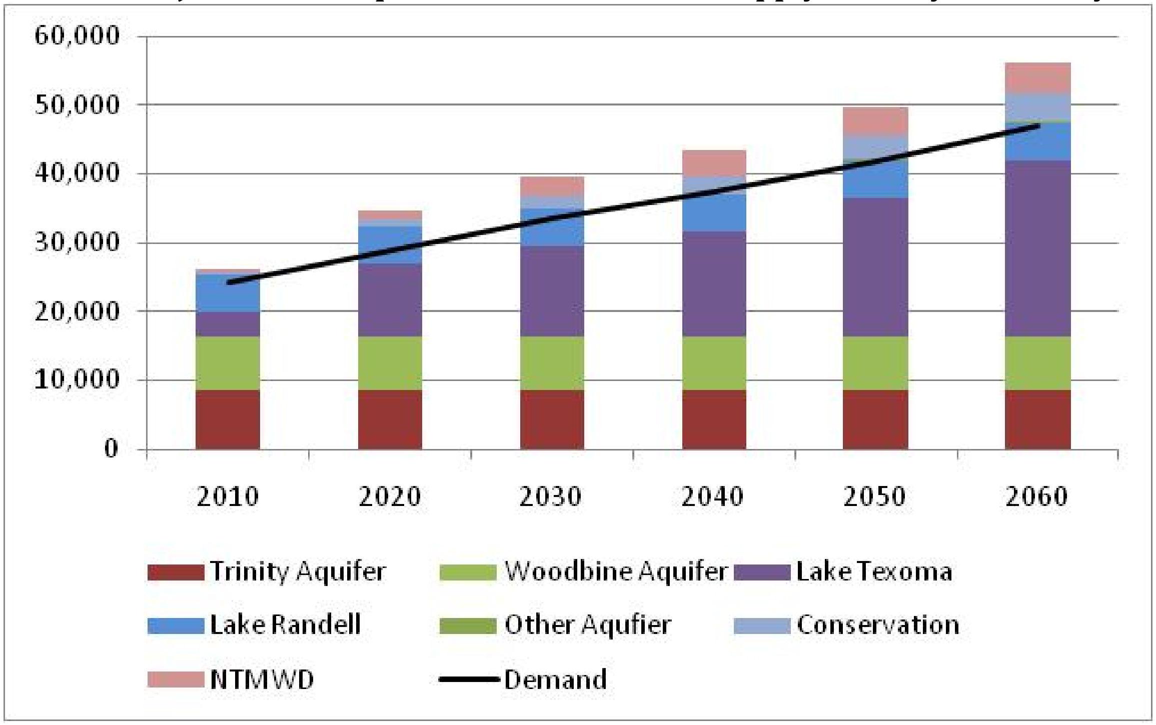


Figure 10.2
Total Projected Municipal Water Demand and Supply for Grayson County



APPENDIX A

REFERENCES

APPENDIX A

REFERENCES

1) Freese and Nichols, Inc., Alan Plummer Associates, Inc., CP&Y, Inc., and Cooksey Communications, Inc.: *2011 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, April 2010.
2) Freese and Nichols, Inc., Alan Plummer Associates, Inc., Chiang, Patel & Yerby, Inc., and Cooksey Communications, Inc.: *2006 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, July 2006.
3) Texas Commission on Environmental Quality: Water Utility Database, [Online], Available URL: http://www10.tceq.state.tx.us/iwud, December 2009.
4) Alan Plummer Associates, Inc.: *Technical Memorandum: Steam Electric Power Demand Projections;* prepared for Region C Water Planning Group, August 2009.
5) Texas State Data Center and Office of the State Demographer: 2007 Population Estimates for Texas Places, [Online], Available URL: http://txsdc.utsa.edu/tpepp/2006_txpopest_place.php, September 2007.
6) United States Census Bureau: Census Data for the State of Texas: Population by County, Population by Place, [Online], Available URL: http://www.census.gov/census2000/states/tx.html, September 2007.
7) Alan Plummer Associates, Inc.: *Fannin County Special Study*; prepared for Region C Water Planning Group, February 2010.
8) Texas Senate Bill 2529: Subtitle H, Title 6, Chapter 8859: Red River Groundwater Conservation District, [Online], Available URL: http://www.sos.state.tx.us/statdoc/bills/sb/SB2529.pdf, June 2009.
9) Texas Senate Bill 2497: Subtitle H, Title 6, Chapter 8856: North Texas Groundwater Conservation District, [Online], Available URL: http://www.legis.state.tx.us/tlodocs/81R/billtext/pdf/SB02497F.pdf

APPENDIX B

PUBLIC MEETING

MEETING MINUTES

Date of Meeting: February 25, 2010 ***Time:*** 10:00 AM

Meeting Location: Whitesboro City Hall, Whitesboro, Texas

Attendees:

APAI
Adam Rose, Preston Dillard

City of Gainesville
Earl Williams

Woodbine WSC
Rickey Kemp

GTUA, Region C Rep.
Alan Moore

City of Whitesboro
Michael Marter

City of Sherman
Mark Gibson

City of Muenster
Stan Endres

CP&Y
Gil Barnett

Two Way SUD
Jeff Bice

Marilee SUD
Donna Loiselle

Kiowa Homeowners WSC
Ronny Young

City of Howe
Jeff Stanley, Joe Shepard

City of Valley View
Mark Patterson

City of Collinsville
Mike Bryant

City of Southmayd
Daniel Pepe

Distribution: File

Project Name: Cooke-Grayson County Special Study, Region C Water Planning Group, 2011 Update

FNI Project No.: NTD08492

CP&Y Project No.: FNI09035

CP&Y Contact Person: Richard Shaffer, 817-392-6821 (rshaffer@cpyi.com)

The following is our understanding of the major discussion items, decisions, and action points of this meeting. If this differs from your understanding, please notify the CP&Y contact person in writing within five (5) days.

DISCUSSION

Preston Dillard, PE, with APAI was the presenter for this meeting.

Introduction: Introductions were made for those persons present at the meeting.

1. Region C Planning Process was reviewed.

a. History of water planning process was covered beginning with 1997 Texas Senate Bill 1.
b. Planning process is "bottom up" with planning on local levels rolled up to regional level.
c. Population in the Region will double by 2060.
d. Region C consists of 16 counties.
e. 50-year planning period for project demand, existing supply, and strategies.
f. Currently working on 2011 Region C Water Plan, which will be incorporated into the (2012) State Water Plan.

2. 5 of the 16 counties in Region C were selected for special studies during this round of water planning. Cooke and Grayson counties were selected to get a closer look with one of these special studies, and it is the results of that study that we are presenting today.

3. Cooke County population growth projections were reviewed. Population is expected to grow from 80,000 to over 140,000 by 2060. Reviewed year 2000 data on Cooke County water demand. Municipal had largest percentage of water use at 69%, and Livestock was second at 24%. By 2060, municipal is expected to be 78% of the county water demand, and Livestock is 13%.

4. Grayson County population growth projections were reviewed. Population is expected to grow from 125,000 to over 250,000 by 2060. Reviewed year 2000 data on Grayson County water demand. Municipal had largest percentage of water use at 65%, and manufacturing was second at 18%. By 2060, municipal is expected to be 61% of the county water demand, and manufacturing is 14%. The most significant change is the increase of Steam Electric use from zero in 2000, to 16% of the county water demand by year 2060.

5. Cooke County Summary: Covered table of the water providers in Cooke County which reviewed the demands for each water provider.

   Detailed data for each water provider in Cooke County was presented with a table for each entity. Those with a representative present were reviewed in some detail, while those with no representative present were passed over without discussion. The water providers were:

   - Bolivar WSC
   - Gainesville
   - Kiowa Homeowners WSC
   - Lindsay
   - Muenster
   - Valley View
   - Woodbine WSC
   - Cooke County – Other

6. Grayson County Summary: Covered table of the water providers in Grayson County, which reviewed the demands for each water provider.

   Detailed data for each water provider in Grayson County was presented with a table for each entity. Those with a representative present were reviewed in some detail, while those with no representative present were passed over without discussion. The water providers were:

   - Bells
   - Collinsville
   - Denison
   - Gunter
   - Howe

- Luella WSC
- Marilee SUD
- Pottsboro
- Sherman
- South Grayson WSC
- Southmayd
- Southwest Fannin County SUD
- Tioga
- Tom Bean
- Two Way SUD
- Van Alstyne
- Whitesboro
- Whitewright
- Grayson County - Other

7. Capital costs for water management strategies were presented and reviewed. Total capital costs from Cooke County are projected to be $115 million. Grayson County capital costs are projected to be $323 million.

8. Total demand and supply for each county was reviewed via a graph for each.

9. Conclusions:

   - WUGs in Cooke and Grayson Counties project steady growth in next 50 years.
   - For Cooke County, projected growth is lower but projected demand is higher in comparison to the projections in the 2006 Region C Water Plan.
   - For Grayson County, projected growth and demand are lower than projections in the 2006 Plan.

10. Next Steps:
    - Region C Board meets March 15, 2010, and will approve the IPP for all Region C.
    - Public hearing on IPP will be May 25, 2010.
    - Final plan adopted October 1, 2010.

11. At 10:45 a.m. the meeting was opened for questions or comments from those present.

    Jerry Chapman was not present at the meeting, but he sent a representative in his stead. Alan Moore from GTUA was present and asked the group to let Jerry know of any changes that might be made to anyone's plans. It is important to ensure that the plan includes any items that a water provider may pursue. If an item is in the plan, funding is possible; but for items not in the plan, funding may not be available.

    The question was asked if Region C is always active. Preston responded that the board is always active. The consultant team working on the Region's water plan may only be active for 1.5 to 2 years of the 5-year cycle. It is important to pass on information to the board at any time, while it may not be during the active period when the plan is being developed.

The question was asked if it was mandatory to implement the conservation packages in order to receive funding, and if entities had to track the effects of the conservation strategies. Preston responded that funding was not tied to mandatory conservation strategies. While it is beneficial to track conservation effectiveness, it can be difficult to do and is not a requirement. Plumbing codes have a significant impact on conservation, and the savings estimate for those codes are built into the plan.

As part of the conservation discussion, Preston pointed out that Region C is a net importer of water. The State needs to see, especially from Regions like ours that import water, a level of conservation efforts.

The question was asked if the population numbers in this plan would be updated by the upcoming census. The census results will not be available for the 2011 plan, but will go into the next plan.

A question was asked about what is considered reuse water. Reuse water can be direct reuse taken from WWTPs and used for irrigation, or indirect, put back into a reservoir for use again later.

The question was asked, if the Capital Costs reviewed earlier in the presentation included funding for supplemental wells and transmission costs. The slide was reviewed again, which had costs for both of those categories identified.

The question was asked, when will the Cooke-Grayson Special Study Report be available on line. Preston replied that it should be on the Region C website early next week.

12. The meeting adjourned at 11:15 a.m.

Water Supply Study
for Cooke and Grayson Counties

Preston Dillard, P.E.
Alan Plummer and Associates

Regional Water Planning Process

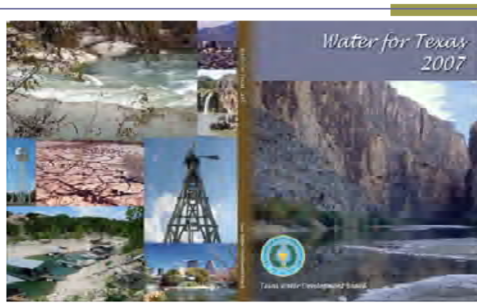
- Senate Bill 1 - Texas Legislature in 1997
- Spurred by 1996 drought
- Population projected to double by 2060
- "Bottom up" water planning process
- Texas Water Development Board
  - Adopted rules
  - Set out 16 regions
  - Named initial planning group members

Regional Water Planning Areas

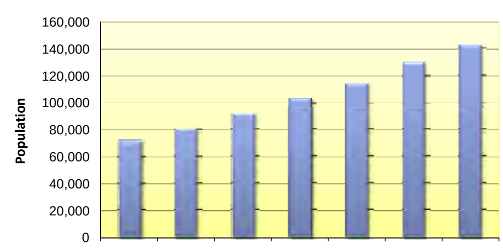
Regional Water Planning Process

- 50-year planning period
- Project population and water demand
- Existing supply
- Evaluate need for additional water
- Recommend strategies
- Water right permitting and TWDB funding use plans

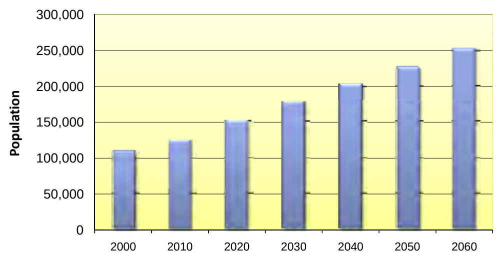
2007 State Water Plan



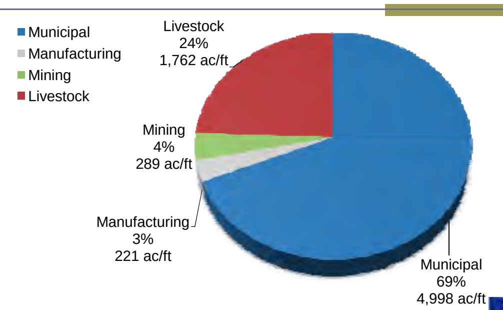
Cooke County Population



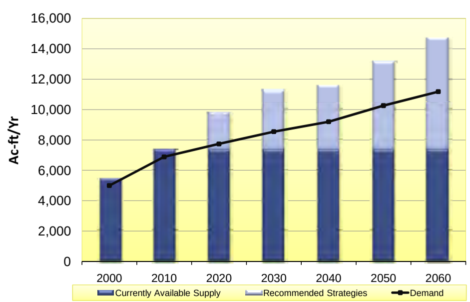
Grayson County Population



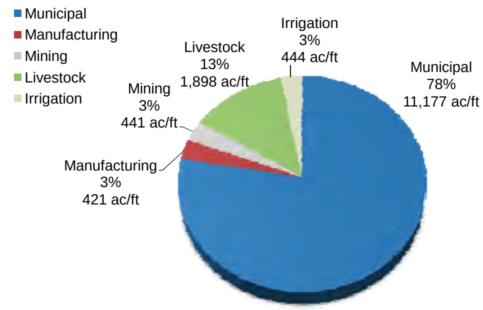
2000 Cooke County Water Use (% of total)



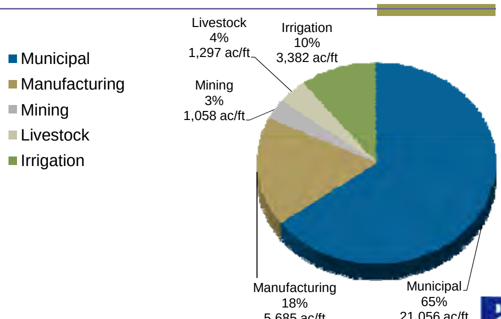
Cooke County Municipal Supplies and Demands



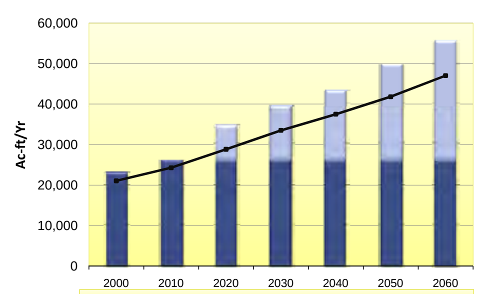
2060 Cooke County Demand (% of total)



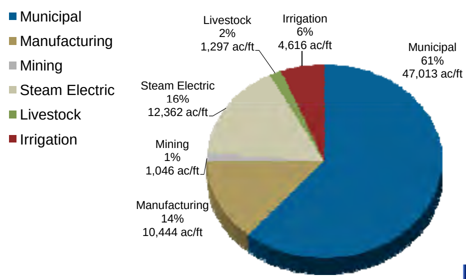
2000 Grayson County Water Use (% of total)



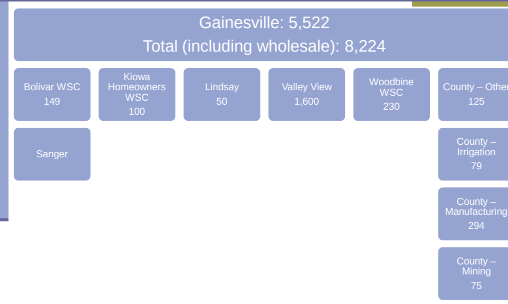
Grayson County Municipal Supplies and Demands



2060 Grayson County Demand (% of total)



2060 Net Cooke County WSP Demands (ac-ft/yr)



Bolivar WSC Summary

Bolivar WSC	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population [(a)]	10,386	12,465	21,806	44,726	70,848	95,836
Projected Water Demand (ac-ft/yr)						
Municipal Demand [(a)]	1,279	1,703	3,371	6,863	10,872	14,707
Wholesale Demand (Sanger)	814	1,626	2,730	3,574	4,620	5,214
Total Projected Water Demand	***2,093***	***3,329***	***6,101***	***10,437***	***15,492***	***19,921***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer [(b)]	1,548	1,548	1,548	1,548	1,548	1,548
Total Supply	***1,548***	***1,548***	***1,548***	***1,548***	***1,548***	***1,548***
Need (Demand - Supply) (ac-ft/yr)	***545***	***1,781***	***4,553***	***8,889***	***13,944***	***18,373***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	19	70	162	356	601	862
Water Conservation - Expanded Package	10	14	27	55	88	119
Cooke County Water Supply Project	0	18	83	104	127	149
Purchase water from UTRWD [(c)]	814	2,107	4,848	9,293	14,455	18,992
Total Water Management Strategies	***843***	***2,209***	***5,120***	***9,809***	***15,271***	***20,122***
Reserve (ac-ft/yr)	**298**	**428**	**567**	**920**	**1,327**	**1,749**

(a) Includes Cooke, Denton and Wise Counties

(b) From Cooke and Denton County groundwater sources

(c) Existing UTRWD supply to Sanger. UTRWD supply to Bolivar WSC by 2020.

Gainesville Summary

Gainesville	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	16,800	19,000	21,400	23,900	26,400	29,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	3,387	3,746	4,171	4,578	5,027	5,522
Cooke County - Irrigation	9	79	79	79	79	79
Cooke County - Manufacturing	49	255	218	243	265	294
Cooke County - Mining	0	48	55	62	69	75
Wholesale Demand (Cooke County Water Supply Project)	0	473	838	1,149	1,772	2,254
Total Projected Water Demand	***3,445***	***4,601***	***5,361***	***6,111***	***7,212***	***8,224***
Currently Available Water Supplies (ac-ft/yr)						
Hubert H. Moss Lake	1,121	1,121	1,121	1,121	1,121	1,121
Direct Reuse Gainesville WTP	9	9	9	9	9	9
Trinity Aquifer	2,360	2,360	2,360	2,360	2,360	2,360
Total Supply	***3,490***	***3,490***	***3,490***	***3,490***	***3,490***	***3,490***
Need (Demand - Supply) (ac-ft/yr)	***0***	***1,111***	***1,871***	***2,621***	***3,722***	***4,734***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	27	95	225	288	359	441
Water Conservation - Expanded Package	0	0	13	19	20	22
Expand Gainesville WTP capacity 4 MGD and Moss Lake Raw Water Supply	0	2,242	2,242	2,242	2,242	2,242
WTP Expansion of 2 MGD	0	0	1,121	1,121	1,121	1,121
WTP Expansion of 2 MGD	0	0	0	0	1,121	1,121
WTP Expansion of 2 MGD	0	0	0	0	0	1,121
Expand Direct Reuse	0	94	97	101	104	107
Total Water Management Strategies	***27***	***2,431***	***3,698***	***3,771***	***4,967***	***6,174***
Reserve (ac-ft/yr)	**72**	**1,320**	**1,827**	**1,150**	**1,245**	**1,440**

Kiowa Homeowners WSC Summary

Kiowa Homeowners WSC	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	3,324	3,567	3,691	3,711	3,710	3,709
Projected Water Demand (ac-ft/yr)						
Municipal Demand	875	931	955	952	948	947
Total Projected Water Demand	***875***	***931***	***955***	***952***	***948***	***947***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	887	887	887	887	887	887
Total Supply	***887***	***887***	***887***	***887***	***887***	***887***
Need (Demand - Supply) (ac-ft/yr)	***0***	***44***	***68***	***65***	***61***	***60***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	6	20	28	31	34	38
Cooke County Water Supply Project	0	100	100	100	100	100
Total Water Management Strategies	***6***	***120***	***128***	***131***	***134***	***138***
Reserve (ac-ft/yr)	**18**	**76**	**60**	**66**	**73**	**78**

Lindsay Summary

Lindsay	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	879	943	976	981	981	981
Projected Water Demand (ac-ft/yr)						
Municipal Demand	154	161	164	162	160	160
Total Projected Water Demand	***154***	***161***	***164***	***162***	***160***	***160***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	165	165	165	165	165	165
Total Supply	***165***	***165***	***165***	***165***	***165***	***165***
Need (Demand - Supply) (ac-ft/yr)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	2	5	7	8	8	9
Cooke County Water Supply Project	0	40	50	50	50	50
Total Water Management Strategies	***2***	***45***	***57***	***58***	***58***	***59***
Reserve (ac-ft/yr)	**13**	**49**	**58**	**61**	**63**	**64**

Muenster Summary

Muenster	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	1,700	1,800	1,900	2,000	2,100	2,200
Projected Water Demand (ac-ft/yr)						
Municipal Demand	339	351	366	379	395	414
Cooke County - Manufacturing	0	0	60	61	63	65
Total Projected Water Demand	***339***	***351***	***426***	***440***	***458***	***479***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	339	339	339	339	339	339
Total Supply	***339***	***339***	***339***	***339***	***339***	***339***
Need (Demand - Supply) (ac-ft/yr)	***0***	***12***	***87***	***101***	***119***	***140***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	3	9	13	23	27	32
Water Conservation - Expanded Package	0	0	0	2	2	3
New WTP at Muenster Lake	0	280	280	280	280	280
Total Water Management Strategies	***3***	***289***	***293***	***305***	***309***	***314***
Reserve (ac-ft/yr)	**3**	**277**	**206**	**204**	**190**	**174**

Valley View Summary

Valley View	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	1,500	3,000	5,000	7,000	12,000	15,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	187	363	594	808	1,371	1,714
Total Projected Water Demand	***187***	***363***	***594***	***808***	***1,371***	***1,714***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	363	363	363	363	363	363
Total Supply	***363***	***363***	***363***	***363***	***363***	***363***
Need (Demand - Supply) (ac-ft/yr)	***0***	***0***	***231***	***445***	***1,008***	***1,351***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	3	16	31	46	83	110
Cooke County Water Supply Project	0	150	400	650	1,200	1,600
Total Water Management Strategies	***3***	***166***	***431***	***696***	***1,283***	***1,710***
Reserve (ac-ft/yr)	**179**	**166**	**200**	**251**	**275**	**359**

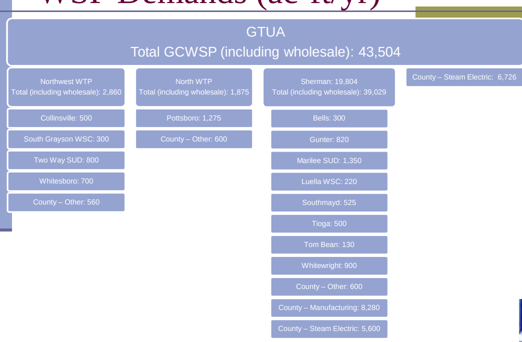
Woodbine WSC Summary

Woodbine WSC	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population [(a)]	5,336	5,773	6,307	6,839	7,370	7,901
Projected Water Demand (ac-ft/yr)						
Municipal Demand [(a)]	669	712	762	802	855	915
Total Projected Water Demand	***669***	***712***	***762***	***802***	***855***	***915***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	661	661	661	661	661	661
Total Supply	***661***	***661***	***661***	***661***	***661***	***661***
Need (Demand - Supply) (ac-ft/yr)	***8***	***51***	***101***	***141***	***194***	***254***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	8	28	39	46	52	59
Cooke County Water Supply Project	0	40	80	120	170	230
Total Water Management Strategies	***8***	***68***	***119***	***166***	***222***	***289***
Reserve (ac-ft/yr)	**0**	**17**	**18**	**25**	**28**	**35**
(a) Includes both Cooke and Grayson Counties						

Cooke County – Other Summary

Cooke County - Other	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	9,487	10,181	10,533	10,590	10,586	10,586
Projected Water Demand (ac-ft/yr)						
Municipal Demand	1,074	1,232	1,251	1,234	1,221	1,222
Total Projected Water Demand	***1,074***	***1,232***	***1,251***	***1,234***	***1,221***	***1,222***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	888	888	888	888	888	888
Woodbine Aquifer	154	154	154	154	154	154
Other Aquifer	137	137	137	137	137	137
Total Supply	***1,179***	***1,179***	***1,179***	***1,179***	***1,179***	***1,179***
Need (Demand - Supply) (ac-ft/yr)	***0***	***53***	***72***	***55***	***42***	***43***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	13	47	65	70	74	78
Cooke County Water Supply Project	0	125	125	125	125	125
Total Water Management Strategies	***13***	***172***	***190***	***195***	***199***	***203***
Reserve (ac-ft/yr)	**118**	**119**	**118**	**140**	**157**	**160**

2060 Net GTUA Grayson County WSP Demands (ac-ft/yr)



Bells Summary

Bells	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	1,400	2,100	2,750	3,250	3,700	4,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	185	271	348	404	456	493
Total Projected Water Demand	***185***	***271***	***348***	***404***	***456***	***493***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	161	161	161	161	161	161
Woodbine Aquifer	43	43	43	43	43	43
Total Supply	***204***	***204***	***204***	***204***	***204***	***204***
Need (Demand - Supply) (ac-ft/yr)	**0**	**67**	**144**	**200**	**252**	**289**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	2	11	17	22	26	30
Water Conservation - Expanded Package	1	2	2	3	3	4
Grayson County Project (Sherman WTP)	0	80	150	210	260	300
Total Water Management Strategies	***4***	***93***	***170***	***235***	***290***	***334***
Reserve (ac-ft/yr)	**23**	**26**	**26**	**35**	**38**	**45**

Collinsville Summary

Collinsville	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	2,035	2,835	3,635	4,435	5,235	6,035
Projected Water Demand (ac-ft/yr)						
Municipal Demand	324	441	558	666	780	899
Total Projected Water Demand	***324***	***441***	***558***	***666***	***780***	***899***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	356	356	356	356	356	356
Total Supply	***356***	***356***	***356***	***356***	***356***	***356***
Need (Demand - Supply) (ac-ft/yr)	**0**	**85**	**202**	**310**	**424**	**543**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	4	15	24	32	40	49
Water Conservation - Expanded Package	3	4	5	6	7	8
Grayson County Project (Northwest WTP)	0	100	200	300	400	500
Total Water Management Strategies	***7***	***119***	***229***	***338***	***447***	***557***
Reserve (ac-ft/yr)	**39**	**34**	**27**	**28**	**23**	**14**

Denison Summary

Denison	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	25,000	28,000	30,000	31,000	32,000	33,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	5,489	6,053	6,385	6,493	6,667	6,875
Wholesale - Pottsboro	561	561	561	561	561	561
Wholesale - County - Other	310	310	310	310	310	310
Total Projected Water Demand	***6,906***	***7,533***	***7,901***	***8,052***	***8,279***	***8,561***
Currently Available Water Supplies (ac-ft/yr)						
Lake Randell	5,400	5,400	5,400	5,400	5,400	5,400
Lake Texoma - to Lake Randell	1,900	1,900	1,900	1,900	1,900	1,900
Trinity Aquifer	157	157	157	157	157	157
Woodbine Aquifer	155	155	155	155	155	155
Total Supply	***7,612***	***7,612***	***7,612***	***7,612***	***7,612***	***7,612***
Need (Demand - Supply) (ac-ft/yr)	**0**	***0***	***289***	***440***	***667***	***949***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	43	145	382	496	566	641
Water Conservation - Expanded Package	0	0	27	38	39	40
WTP Expansion	0	0	0	1,121	1,121	1,121
Total Water Management Strategies	***43***	***145***	***409***	***1,656***	***1,726***	***1,802***
Reserve (ac-ft/yr)	**749**	**224**	**120**	**1,216**	**1,059**	**853**

Gunter Summary

Gunter	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	2,000	3,500	5,000	6,500	8,000	9,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	271	467	655	837	1,022	1,149
Total Projected Water Demand	***271***	***467***	***655***	***837***	***1,022***	***1,149***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	298	298	298	298	298	298
Total Supply	***298***	***298***	***298***	***298***	***298***	***298***
Need (Demand - Supply) (ac-ft/yr)	**0**	**169**	**357**	**539**	**724**	**851**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	3	16	28	39	51	62
Water Conservation - Expanded Package	2	3	4	5	6	6
Grayson County Project (Sherman WTP)	0	180	350	530	700	820
Total Water Management Strategies	***5***	***199***	***382***	***574***	***757***	***888***
Reserve (ac-ft/yr)	**32**	**30**	**25**	**35**	**33**	**37**

Howe Summary

Howe	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	3,000	4,500	6,500	8,500	9,772	10,781
Projected Water Demand (ac-ft/yr)						
Municipal Demand	403	590	837	1,085	1,237	1,365
Grayson County - Manufacturing	70	78	85	91	96	104
Total Projected Water Demand	***473***	***668***	***922***	***1,176***	***1,333***	***1,469***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	301	301	301	301	301	301
CGMA Pipeline	307	391	430	430	430	430
Total Supply	***608***	***692***	***731***	***731***	***731***	***731***
Need (Demand - Supply) (ac-ft/yr)	**0**	**0**	**191**	**445**	**602**	**738**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	5	22	39	54	66	78
Water Conservation - Expanded Package	4	6	8	11	12	14
Expand CGMA Pipeline Capacity: Trunk Line	0	103	311	559	711	839
Total Water Management Strategies	***9***	***130***	***358***	***624***	***790***	***930***
Reserve (ac-ft/yr)	**144**	**154**	**167**	**179**	**188**	**192**

Luella WSC Summary

Luella WSC	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	3,300	3,800	4,300	4,950	5,080	5,770
Projected Water Demand (ac-ft/yr)						
Municipal Demand	410	460	511	582	592	672
Total Projected Water Demand	***410***	***460***	***511***	***582***	***592***	***672***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	450	450	450	450	450	450
Total Supply	***450***	***450***	***450***	***450***	***450***	***450***
Need (Demand - Supply) (ac-ft/yr)	**0**	**10**	**61**	**132**	**142**	**222**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	5	18	27	33	36	43
Grayson County Project (Sherman WTP)	0	38	80	140	150	220
Total Water Management Strategies	***5***	***56***	***107***	***173***	***186***	***263***
Reserve (ac-ft/yr)	**45**	**46**	**46**	**41**	**44**	**41**

Marilee SUD Summary

Marilee SUD	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population [a]	4,300	6,400	8,653	10,679	13,471	16,560
Projected Water Demand (ac-ft/yr)						
Municipal Demand [a]	530	774	1,027	1,256	1,585	1,948
Total Projected Water Demand	***530***	***774***	***1,027***	***1,256***	***1,585***	***1,948***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer [b]	634	634	634	634	634	634
Total Supply	***634***	***634***	***634***	***634***	***634***	***634***
Need (Demand - Supply) (ac-ft/yr)	**0**	**140**	**393**	**622**	**951**	**1,314**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	1	6	10	13	17	22
Water Conservation - Expanded Package	1	1	1	2	2	3
Grayson County Project (Sherman WTP)	0	150	400	650	1,000	1,350
Total Water Management Strategies	***2***	***158***	***411***	***664***	***1,019***	***1,374***
Reserve (ac-ft/yr)	**106**	**18**	**18**	**42**	**68**	**60**
(a) Includes both Collin and Grayson Counties						
(b) From Collin and Grayson County groundwater sources						

Pottsboro Summary

Pottsboro	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	3,000	5,000	7,000	9,000	11,000	12,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	504	851	1,176	1,492	1,811	1,976
Total Projected Water Demand	***504***	***851***	***1,176***	***1,492***	***1,811***	***1,976***
Currently Available Water Supplies (ac-ft/yr)						
Lake Texoma (Denison)	561	561	561	561	561	561
Woodbine Aquifer	123	123	123	123	123	123
Total Supply	***684***	***684***	***684***	***684***	***684***	***684***
Need (Demand - Supply) (ac-ft/yr)	**0**	**167**	**492**	**808**	**1,127**	**1,292**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	6	45	77	112	151	181
Water Conservation - Expanded Package	6	14	20	25	32	35
Grayson County Project (North WTP)	0	280	600	870	1,150	1,275
Total Water Management Strategies	***12***	***339***	***697***	***1,007***	***1,332***	***1,491***
Reserve (ac-ft/yr)	**193**	**172**	**206**	**199**	**206**	**200**
(b) From Collin and Grayson County groundwater sources						

Sherman Summary

Sherman	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	39,300	44,400	50,600	57,700	67,000	80,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	10,081	11,240	12,696	14,348	16,586	19,804
Wholesale Demand - Grayson Co. Supply Project	0	1,023	1,995	3,050	4,155	5,345
Grayson County - SEP Demand	5,600	5,600	5,600	5,600	5,600	5,600
Grayson County - Manufacturing	5,149	5,849	6,478	7,064	7,539	8,280
Total Projected Water Demand	***20,830***	***23,712***	***26,769***	***30,062***	***33,880***	***39,029***
Currently Available Water Supplies (ac-ft/yr)						
Lake Texoma (GTUA – to Steam Electric Power)	5,600	5,600	5,600	5,600	5,600	5,600
Lake Texoma (GTUA)	8,000	8,000	8,000	8,000	8,000	8,000
Trinity Aquifer	4,083	4,083	4,083	4,083	4,083	4,083
Woodbine Aquifer	3,463	3,463	3,463	3,463	3,463	3,463
Total Supply	***21,146***	***21,146***	***21,146***	***21,146***	***21,146***	***21,146***
Need (Demand - Supply) (ac-ft/yr)	***0***	***2,566***	***5,623***	***8,916***	***12,734***	***17,883***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	67	217	333	880	1,411	1,850
Water Conservation - Expanded Package	0	0	0	78	102	119
10 MGD WTP Expansion	0	5,600	5,600	5,600	5,600	5,600
5 MGD WTP Expansion	0	0	2,800	2,800	2,800	2,800
New 10 MGD WTP	0	0	0	0	5,600	5,600
New WTP: 10 MGD WTP Expansion	0	0	0	0	0	5,600
Total Water Management Strategies	***67***	***5,817***	***8,733***	***9,358***	***15,513***	***21,568***
Reserve (ac-ft/yr)	**383**	**3,251**	**3,109**	**442**	**2,778**	**3,685**

South Grayson WSC Summary

South Grayson WSC	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population [(a)]	2,700	3,450	4,100	4,825	5,650	6,675
Projected Water Demand (ac-ft/yr)						
Municipal Demand [(a)]	381	479	561	654	760	897
Total Projected Water Demand	***381***	***479***	***561***	***654***	***760***	***897***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer [(b)]	360	360	360	360	360	360
Woodbine Aquifer [(b)]	360	360	360	360	360	360
Total Supply	***720***	***720***	***720***	***720***	***720***	***720***
Need (Demand - Supply) (ac-ft/yr)	**0**	**0**	**0**	**0**	**40**	**177**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	3	12	19	26	34	45
Collin-Grayson Municipal Alliance Project	0	100	100	100	100	100
Grayson County Water Supply Project (Northwest WTP)	0	0	0	75	175	300
Total Water Management Strategies	***3***	***112***	***119***	***201***	***309***	***445***
Reserve (ac-ft/yr)	**342**	**353**	**278**	**267**	**269**	**268**
(a) Includes both Collin and Grayson Counties						
(b) From Collin and Grayson County groundwater sources						

Southmayd Summary

Southmayd	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	1,200	1,500	2,000	3,000	4,500	5,600
Projected Water Demand (ac-ft/yr)						
Municipal Demand	160	197	258	380	565	703
Total Projected Water Demand	***160***	***197***	***258***	***380***	***565***	***703***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	130	130	130	130	130	130
Woodbine Aquifer	60	60	60	60	60	60
Total Supply	***190***	***190***	***190***	***190***	***190***	***190***
Need (Demand - Supply) (ac-ft/yr)	**0**	**7**	**68**	**190**	**375**	**513**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	2	8	13	21	33	43
Grayson County Project (Sherman WTP)	0	40	100	220	400	525
Total Water Management Strategies	***2***	***48***	***113***	***241***	***433***	***568***
Reserve (ac-ft/yr)	**32**	**41**	**45**	**51**	**58**	**55**

Southwest Fannin County SUD Summary

Southwest Fannin County SUD	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population [(a)]	7,491	8,940	9,947	10,852	11,657	12,463
Projected Water Demand (ac-ft/yr)						
Municipal Demand [(a)]	722	1,042	1,192	1,288	1,371	1,466
Total Projected Water Demand	***722***	***1,042***	***1,192***	***1,288***	***1,371***	***1,466***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer [(b)]	803	803	803	803	803	803
Total Supply	***803***	***803***	***803***	***803***	***803***	***803***
Need (Demand - Supply) (ac-ft/yr)	**0**	**239**	**389**	**485**	**568**	**663**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	15	44	62	72	82	93
Fannin County Water Supply Project	0	399	560	666	756	859
Total Water Management Strategies	***15***	***443***	***622***	***738***	***838***	***952***
Reserve (ac-ft/yr)	**96**	**204**	**233**	**253**	**270**	**289**
(a) Includes both Fannin and Grayson Counties						
(b) From Fannin and Grayson County groundwater sources						

Tioga Summary

Tioga	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	1,100	2,500	3,500	4,000	4,400	4,600
Projected Water Demand (ac-ft/yr)						
Municipal Demand	192	428	588	663	725	757
Total Projected Water Demand	***192***	***428***	***588***	***663***	***725***	***757***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	211	211	211	211	211	211
Total Supply	***211***	***211***	***211***	***211***	***211***	***211***
Need (Demand - Supply) (ac-ft/yr)	**0**	**217**	**377**	**452**	**514**	**546**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	2	26	48	60	72	81
Water Conservation - Expanded Package	1	4	7	8	9	9
Grayson County Project (Sherman WTP)	0	225	375	425	475	500
Total Water Management Strategies	***4***	***256***	***430***	***493***	***555***	***590***
Reserve (ac-ft/yr)	**23**	**39**	**53**	**41**	**41**	**44**

Tom Bean Summary

Tom Bean	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	1,100	1,300	1,500	1,700	1,900	2,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	259	301	343	383	426	448
Total Projected Water Demand	***259***	***301***	***343***	***383***	***426***	***448***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	288	288	288	288	288	288
Total Supply	***288***	***288***	***288***	***288***	***288***	***288***
Need (Demand - Supply) (ac-ft/yr)	**0**	**13**	**55**	**95**	**138**	**160**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	22	67	81	93	108	117
Water Conservation - Expanded Package	2	4	4	5	5	6
Grayson County Project (Sherman WTP)	0	10	40	75	120	130
Total Water Management Strategies	***25***	***81***	***125***	***173***	***233***	***252***
Reserve (ac-ft/yr)	**54**	**68**	**70**	**79**	**95**	**93**

Two Way SUD Summary

Two Way SUD	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population [(a)]	5,081	6,720	8,251	9,819	11,382	12,945
Projected Water Demand (ac-ft/yr)						
Municipal Demand [(a)]	575	813	979	1,155	1,326	1,508
Total Projected Water Demand	***575***	***813***	***979***	***1,155***	***1,326***	***1,508***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer [(b)]	622	622	622	622	622	622
Total Supply	***622***	***622***	***622***	***622***	***622***	***622***
Need (Demand - Supply) (ac-ft/yr)	***0***	***191***	***357***	***533***	***704***	***886***
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	9	34	51	65	80	96
Water Conservation - Expanded Package	5	7	8	10	11	13
Grayson County Project (Northwest WTP)	0	200	350	500	650	800
Total Water Management Strategies	***13***	***240***	***409***	***575***	***741***	***909***
Reserve (ac-ft/yr)	**60**	**49**	**52**	**42**	**37**	**23**
(a) Includes both Cooke and Grayson Counties						
(b) From Grayson County groundwater sources						

Van Alstyne Summary

Van Alstyne	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	3,000	7,500	13,500	17,000	18,500	19,200
Projected Water Demand (ac-ft/yr)						
Municipal Demand	504	1,411	2,510	3,142	3,419	3,549
Total Projected Water Demand	***504***	***1,411***	***2,510***	***3,142***	***3,419***	***3,549***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	235	235	235	235	235	235
Woodbine Aquifer	215	215	215	215	215	215
CGMA Pipeline	58	795	1,291	1,291	1,291	1,291
Total Supply	***508***	***1,245***	***1,741***	***1,741***	***1,741***	***1,741***
Need (Demand - Supply) (ac-ft/yr)	**0**	**166**	**769**	**1,401**	**1,678**	**1,808**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity and Woodbine Aquifers	0	0	0	0	0	0
Water Conservation - Basic Package	5	70	152	218	265	305
Water Conservation - Expanded Package	3	12	26	35	41	43
Expand CGMA Pipeline Capacity: Trunk Line	0	170	773	1,405	1,682	1,812
Total Water Management Strategies	***8***	***252***	***951***	***1,658***	***1,988***	***2,160***
Reserve (ac-ft/yr)	**12**	**86**	**182**	**257**	**310**	**352**

Whitesboro Summary

Whitesboro	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	4,400	5,000	5,700	6,500	7,500	10,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	764	851	958	1,070	1,227	1,635
Total Projected Water Demand	***764***	***851***	***958***	***1,070***	***1,227***	***1,635***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	840	840	840	840	840	840
Total Supply	***840***	***840***	***840***	***840***	***840***	***840***
Need (Demand - Supply) (ac-ft/yr)	**0**	**11**	**118**	**230**	**387**	**795**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Trinity Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	7	42	61	78	100	147
Water Conservation - Expanded Package	0	3	5	6	7	10
Grayson County Project (Northwest WTP)	0	50	150	200	350	700
Total Water Management Strategies	***7***	***95***	***216***	***284***	***457***	***857***
Reserve (ac-ft/yr)	**83**	**84**	**98**	**54**	**70**	**62**

Whitewright Summary

Whitewright	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population [(a)]	2,022	3,228	4,532	5,535	6,538	7,541
Projected Water Demand (ac-ft/yr)						
Municipal Demand [(a)]	403	632	873	1,048	1,230	1,419
Total Projected Water Demand	***403***	***632***	***873***	***1,048***	***1,230***	***1,419***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	438	438	438	438	438	438
Total Supply	***438***	***438***	***438***	***438***	***438***	***438***
Need (Demand - Supply) (ac-ft/yr)	**0**	**194**	**435**	**610**	**792**	**981**
Water Management Strategies (ac-ft/yr)						
Supplemental Wells in Woodbine Aquifer	0	0	0	0	0	0
Water Conservation - Basic Package	3	30	52	71	94	120
Water Conservation - Expanded Package	2	4	5	6	8	9
Grayson County Project (Sherman WTP)	0	200	400	600	750	900
Total Water Management Strategies	***5***	***233***	***457***	***678***	***851***	***1,029***
Reserve (ac-ft/yr)	**40**	**39**	**22**	**68**	**59**	**48**
(a) Includes both Fannin and Grayson Counties						

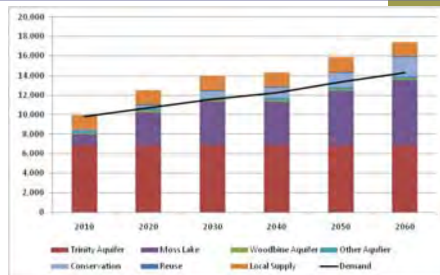
Grayson County – Other Summary

Grayson County – Other	Revised Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	26,925	26,799	26,482	25,160	23,185	20,727
Projected Water Demand (ac-ft/yr)						
Municipal Demand	3,468	3,393	3,263	3,016	2,753	2,461
Total Projected Water Demand	***3,468***	***3,393***	***3,263***	***3,016***	***2,753***	***2,461***
Currently Available Water Supplies (ac-ft/yr)						
Lake Randell	60	60	60	60	60	60
Lake Texoma	891	891	891	891	891	891
Other Aquifer	35	35	35	35	35	35
Trinity Aquifer	1,170	1,170	1,170	1,170	1,170	1,170
Woodbine Aquifer	1,659	1,659	1,659	1,659	1,659	1,659
Total Supply	***3,815***	***3,815***	***3,815***	***3,815***	***3,815***	***3,815***
Need (Demand – Supply) (ac-ft/yr)	**0**	**0**	**0**	**0**	**0**	**0**
Water Management Strategies (ac-ft/yr)						
Supplemental Groundwater Wells in Aquifers	0	0	0	0	0	0
Water Conservation – Basic Package	37	123	165	168	164	155
Grayson County Project (Sherman WTP)	0	100	100	200	300	600
Grayson County Project (North WTP)	0	200	300	400	500	600
Grayson County Project (Northwest WTP)	0	560	560	560	560	560
Total Water Management Strategies	***37***	***983***	***1,125***	***1,328***	***1,524***	***1,915***
Reserve (ac-ft/yr)	**383**	**1,405**	**1,676**	**2,127**	**2,585**	**3,268**

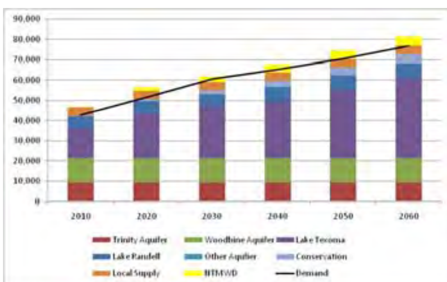
Capital Costs for Proposed Water Management Strategies

Water Management Strategy Category	Capital Cost During Study Period	
	Cooke County	Grayson County
Transmission Facilities	$26,135,000	$38,255,000
Supplemental Wells	$38,780,000	$79,709,000
New Water Treatment Plants	$8,217,000	$74,883,000
Water Treatment Plant Expansions	$41,932,000	$130,266,000
Total Capital Costs for Study Area	**$115,064,000**	**$323,113,000**

Total Demand and Supply for the Cooke County



Total Demand and Supply for the Grayson County



Conclusions

- WUGs in the Cooke and Grayson Counties Study are projecting steady growth in the next 50 years.
- For Cooke County, growth lower but demand higher than what was projected in the *2006 Region C Water Plan*.
- For Grayson County, growth and demand lower than what was projected in the *2006 Region C Water Plan*.
- For most of the WUGs, currently planned water management strategies are in line with the strategies presented in the *2006 Region C Water Plan.*

Next Steps

- Region C Initially Prepared Plan (IPP) to be presented to Region C Board for Approval – 3/15/10
- Public Hearing on IPP – 5/25/10, 7 pm in Arlington at the Bob Duncan Center in Vandergriff Park
- Final plan adopted – 10/1/10

APPENDIX T

FANNIN COUNTY WATER SUPPLY STUDY

Water Supply Study for Fannin County

September 2010

Prepared for:
Region C Water Planning Group

Prepared by:
Alan Plummer Associates, Inc
Freese and Nichols, Inc.
CP&Y, Inc.

Draft Water Supply Study for Fannin County
Region C Water Planning Group

TABLE OF CONTENTS

		Page
1.	Executive Summary	ES.1
2.	Introduction	2.1
3.	Population and Demand Projections	3.1
3.1	Meetings to Collect Data	3.1
3.2	Revisions to Population and Demand Projections	3.3
3.3	Approved Population Projections for Water User Groups	3.4
3.4	Approved Water Demands for Water User Groups	3.7
4.	Evaluation of Current Supplies	4.1
4.1	Surface Water	4.1
4.2	Groundwater	4.1
5.	Comparison of Current Supplies to Projected Demand	5.1
6.	Proposed Revisions to Water Management Strategies	6.1
7.	Estimated Costs for Recommended Water Management Strategies	7.1
8.	Implementation Plan for Proposed Water Management Strategies	8.1
9.	Alternative Water Management Strategies	9.1
10.	Conclusion	10.1

APPENDICES

Appendix A .... References
Appendix B .... Public Meeting

LIST OF TABLES

		Page
Table ES.1	Fannin County Water User Groups	ES.1
Table 3.1	Meetings with WUGs	3.2
Table 3.2	Approved Population Projections in Study Area	3.6
Table 3.3	Approved Population Projections for Entities Split by County	3.7
Table 3.4	Approved Municipal Per Capita Water Use Projections in Gallons Per Person Per Day	3.10
Table 3.5	Approved Demand Projections in Acre-Feet per Year	3.11
Table 6.1	Summary Information for Bonham	6.2
Table 6.2	Summary Information for Ector	6.3
Table 6.3	Summary Information for Honey Grove	6.4
Table 6.4	Summary Information for Ladonia	6.5
Table 6.5	Summary Information for Southwest Fannin County SUD	6.6
Table 6.6	Summary Information for Hickory Creek SUD	6.7
Table 6.7	Summary Information for Leonard	6.7
Table 6.8	Summary Information for North Hunt WSC	6.8
Table 6.9	Summary Information for Savoy	6.8
Table 6.10	Summary Information for Trenton	6.9
Table 6.11	Summary Information for Whitewright	6.9
Table 6.12	Summary Information for Fannin County – Other	6.10
Table 6.13	Summary Information for Fannin County – Irrigation	6.11
Table 6.14	Summary Information for Fannin County – Livestock	6.11
Table 6.15	Summary Information for Fannin County – Manufacturing	6.12
Table 6.16	Summary Information for Fannin County – Mining	6.12
Table 6.17	Summary Information for Fannin County – Steam Electric Power	6.13
Table 7.1	Capital Costs for Recommended WMSs Not Associated with WWPs	7.1
Table 7.2	Capital Costs for Recommended WMSs Associated with WWPs	7.1
Table 8.1	Implementation of Recommended Water Management Strategies	8.1

LIST OF FIGURES

		Page
Figure 2.1	Fannin County Study Area	2.2
Figure 3.1	Approved Population Projections for Fannin County	3.7
Figure 3.2	Approved Demand Projections for Fannin County	3.12
Figure 10.1	Total Projected Municipal Water Demand and Supply for the Study Area	10.1

Region C Water Planning Group
Water Supply Study for Fannin County

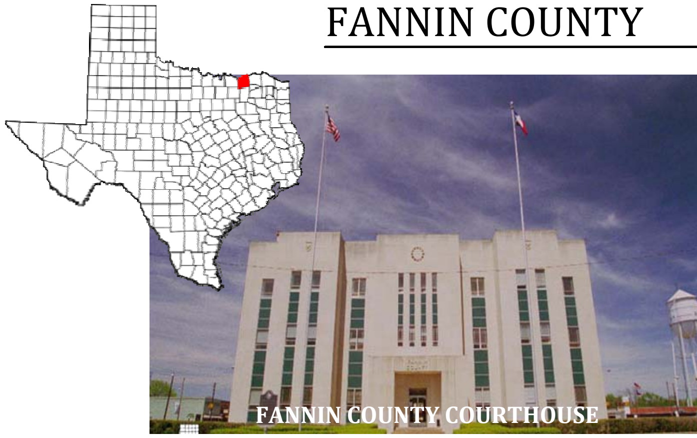
1. Executive Summary

As part of the 2011 Region C water planning process, several individual county studies were included to more closely examine the water management strategies of those counties. Fannin County is one of the counties included in the studies. The purpose of this study is to provide supplementary information regarding water management strategies and to then analyze the feasibility of developing a Fannin County Water Supply Project. Water management strategies (WMSs) were updated based on information obtained from meetings with various water user groups (WUGs) in Fannin County as well as from surveys mailed to every WUG in Region C. Several WMSs were revised to reflect new water demand projections as determined in the *2011 Region C Water Plan* [(1)]. The population projections in the *2011 Region C Water Plan* [(1)] are higher than the *2006 Region C Water Plan* [(2)], while the municipal demand projections in the *2011 Region C Water Plan* [(1)] are lower than the *2006 Region C Water Plan* [(2)]. Changes in WUG per capita water usage estimates account for the lower demand. Cost estimates and an implementation plan for water management strategies are also included in this report.

The majority of WUGs in Fannin County rely on groundwater from the Trinity and Woodbine Aquifers. The only surface water source is from Lake Bonham, currently used only by Bonham.

[(1)] Superscripted numbers in parenthesis match references in Appendix A

FANNIN COUNTY



***2000 Population:** 31,242*

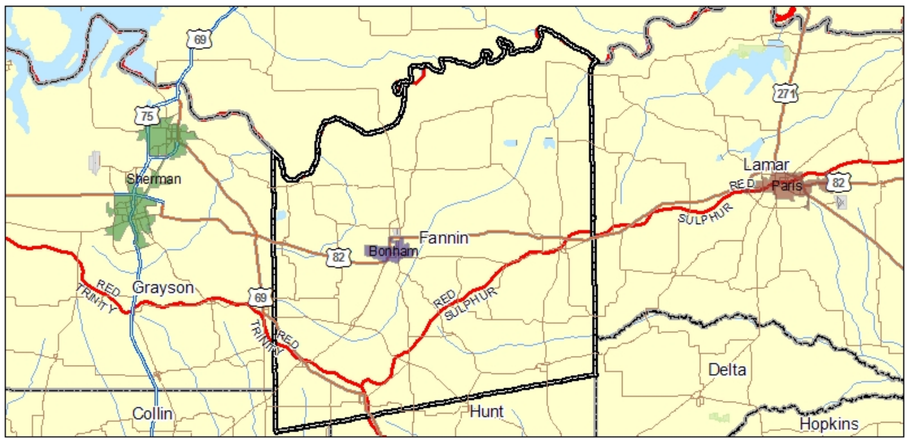
***Projected 2060 Population:** 86,970*

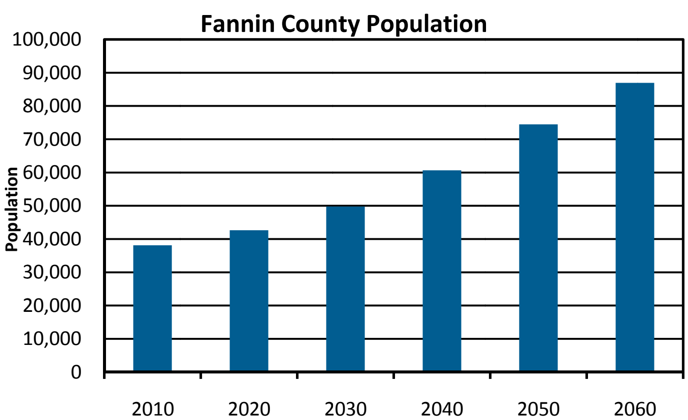
***County Seat:** Bonham*

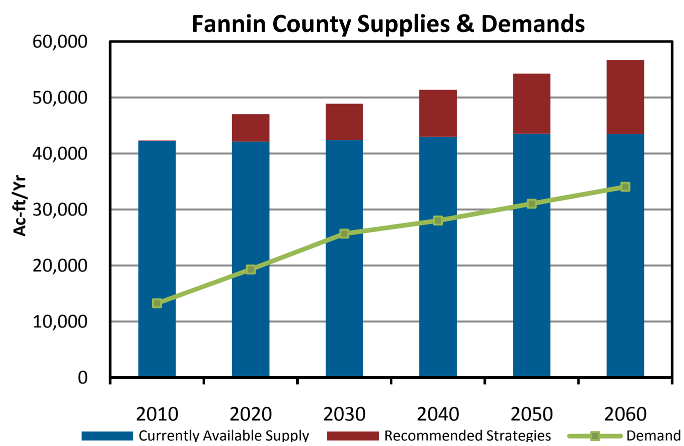
***Economy:** Communications; agriculture; government/services; petroleum distribution; tourism; varied manufacturing*

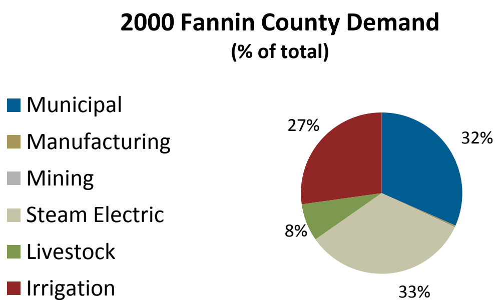
River Basin(s):

– Trinity (5%), Red (71%), Sulphur (23%)

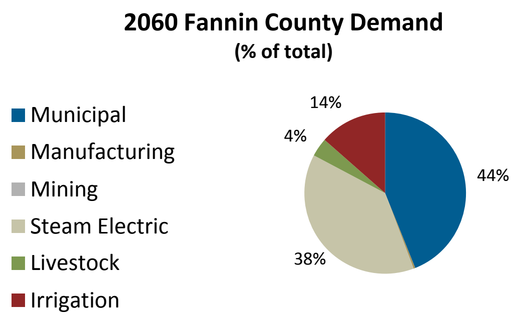








Total=16,935 acre-feet



Total= 34,063 acre-feet

WATER USER GROUP	2060 FANNIN CO. DEMAND (AC-FT/YR)	CURRENT SUPPLIES	RECOMMENDED STRATEGIES [(b)]
Bonham	7,253	Lake Bonham (NTMWD Treatment)	Fannin County Water Supply Project, WTP expansion
Ector	107	Woodbine Aquifer	Supplemental wells, Fannin County Water Supply Project
Hickory Creek SUD [(a)]	38	Woodbine Aquifer (Region D)	None
Honey Grove	856	Woodbine Aquifer	Supplemental wells, Fannin County Water Supply Project
Ladonia	1,055	Trinity Aquifer	Supplemental wells, Lake Ralph Hall
Leonard	1,299	Woodbine Aquifer	Supplemental wells, Fannin County Water Supply Project
North Hunt WSC [(a)]	70	Woodbine Aquifer	Supplemental wells
Savoy	109	Woodbine Aquifer	Supplemental wells, Fannin County Water Supply Project
Southwest Fannin County SUD [(a)]	1,420	Woodbine Aquifer	Supplemental wells, Fannin County Water Supply Project
Trenton	1,550	Woodbine Aquifer	Supplemental wells, Fannin County Water Supply Project
Whitewright [(a)]	8	Woodbine Aquifer	Supplemental wells, Grayson County Water Supply Project
County-Other	1,202	Woodbine and Trinity Aquifers, Run-of-river, Lake Bonham	Supplemental wells, Fannin County Water Supply Project
Irrigation	4,608	Other Aquifer, Red River	Supplemental wells
Livestock	1,270	Woodbine and Trinity Aquifers, Local supplies	Supplemental wells
Manufacturing	114	Lake Bonham	None
Mining	12	Run-of-river	None
Steam Electric Power	13,092	Woodbine Aquifer, Lake Texoma	Supplemental wells

[(a)] WUG is in multiple counties

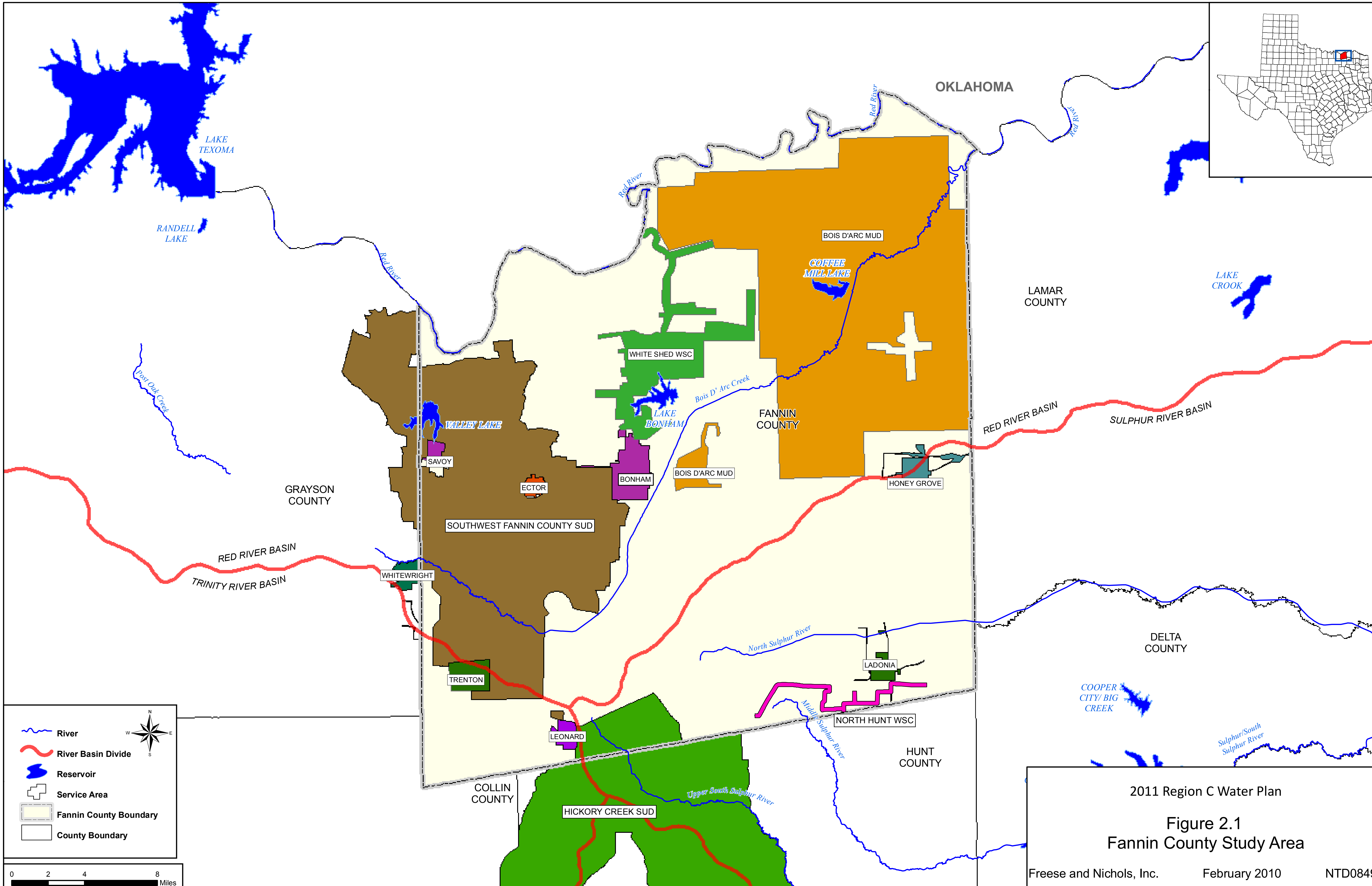
[(b)] Water conservation is a strategy for every municipal user group.

2. Introduction

As part of the 2011 Region C water planning process, several individual county studies were included to more closely examine the water management strategies of those counties. Fannin County is one of the counties included in the studies. The purpose of this study is to provide supplementary information regarding water management strategies and to then analyze the feasibility of developing a Fannin County Water Supply Project.

The Fannin County study area is shown in Figure 2.1. , The County is projecting steady growth over the next 50 years. Populations by decade through 2060 are projected to be between 3% and 5% greater than what was projected in the *2006 Region C Water Plan* (2). Demand over the same period is projected to be between 3% and 7% lower than what was projected in the *2006 Region C Water Plan* (2). Reductions in projected per capita demands account for the lower demand. Population, demands and supplies are characterized in more detail in subsequent sections.

This report summarizes the analysis and recommendations for meeting water demand projections for water user groups in the Fannin County Study area.


OKLAHOMA
LAKE TEXOMA
RANDELL LAKE
Red River
Post Oak Creek
GRAYSON COUNTY
LAMAR COUNTY
LAKE CROOK
FANNIN COUNTY
BOIS D'ARC MUD
COFFEE MILL LAKE
WHITE SHED WSC
LAKE BONHAM
Bois D' Arc Creek
VALLEY LAKE
SAVOY
ECTOR
BONHAM
SOUTHWEST FANNIN COUNTY SUD
HONEY GROVE
RED RIVER BASIN
SULPHUR RIVER BASIN
TRINITY RIVER BASIN
WHITEWRIGHT
TRENTON
LEONARD
North Sulphur River
LADONIA
NORTH HUNT WSC
Middle Sulphur River
DELTA COUNTY
COOPER CITY/ BIG CREEK
Sulphur/South Sulphur River
HUNT COUNTY
COLLIN COUNTY
HICKORY CREEK SUD
Upper South Sulphur River
River
River Basin Divide
Reservoir
Service Area
Fannin County Boundary
County Boundary
0 2 4 8 Miles
2011 Region C Water Plan
Figure 2.1
Fannin County Study Area
Freese and Nichols, Inc.
February 2010
NTD08492

3. Population and Demand Projections

3.1. *Meetings to Collect Data*

Alan Plummer Associates (APAI) met with all eleven water user groups (WUGs) in Fannin County, as defined in the *2006 Region C Water Plan* [(2)], during September 2009. Table 3.1 lists the meetings held and the meeting participants. A survey covering existing and projected populations, demands, supplies and water management strategies from the *2006 Region C Water Plan* [(2)] was sent to each WUG prior to these meetings. In some cases the WUG revised and resubmitted this information. At each meeting, APAI presented the population and demand projections as shown in the *2006 Region C Water Plan* [(2)] and the revised projections, if applicable. The current population and water use estimates of each WUG and existing and/or potential future customers were discussed. Many WUGs provided information related to recent water use, pumping capacity and number of connections.

The current water supply for each WUG, the recommended water management strategies as presented in the *2006 Region C Water Plan* [(2)], and any suggested adjustments to those recommendations were discussed. In most cases, the WUGs plan to implement the recommended strategies, although the amounts of supply may change. In a few cases, the WUGs are pursuing other options for water supply to meet their future needs. The updated information related to water supply was used to supplement or update proposed management strategies.

Two of the WUGs that APAI met with are located in multiple regions. Hickory Creek SUD has only a small portion of its customers in Region C (Fannin County) and does not have any water supply in Region C. Region D will plan for water management strategies for Hickory Creek SUD, and Region C will coordinate with Region D for consistent strategies. North Hunt WSC is also split between Region C and Region D. Both Regions will plan for their respective portions of North Hunt WSC and coordinate strategies for consistency.

APAI met with the North Texas Municipal Water District (NTMWD) on August 24, 2009. The purpose of the meeting was to coordinate the special study with the existing wholesale water providers (WWPs) in the area. APAI reviewed the *2006 Region C Water Plan* [(2)] strategies for the Fannin County WUGs with NTWMD for comment. NTMWD is projected to meet future Fannin County demands through the Fannin County Water Supply Project, described in more detail in later sections of this report.

Table 3.1
Meetings with WUGs

Date	Entity	WUG Attendees	Meeting Location
September 14, 2009	Southwest Fannin SUD	John Keen	Bonham Public Library
September 14, 2009	Ector	Steve Perkins	
September 14, 2009	Savoy	Arthur Ballard	
September 14, 2009	Whitewright	Bill Goodson, CC Beasley	Whitewright City Hall
September 17, 2009	Bonham	Ronald Ford	Bonham Public Works
September 17, 2009	Honey Grove	Billy Stephens, Joey Rickman, Linda Brown, Jaci Garner, Harold Roberts, Scott Hoelzle	Honey Grove City Hall
September 17, 2009	Ladonia	Scott Hoelzle, Jan Cooper, Sherrie Phelps, Michael Davis	
September 17, 2009	Trenton	Charles Earl	Leonard City Hall
September 17, 2009	Leonard	Darvin Nolen, Butch Henderson	
September 17, 2009	Hickory Creek SUD	Quentin Turner	
September 17, 2009	North Hunt WSC	Jason Shive, Jeremy Kinkade	

3.2. *Revisions to Population and Demand Projections*

The following section discusses the revisions to population and demand as recommended in this study. Population and municipal per capita water usage are used to determine total municipal water demand. Municipal per capita water use is the sum of residential, commercial, and institutional water use divided by the population served. These projections are only best estimates of future water use. Actual future water use may be higher or lower than these projections.

The *2006 Region C Water Plan* (2) population and demand projections were used as base projections for this study. More recent historical trends and demographic information was used, as available, to verify the 2006 projections. Revisions were made as needed and the updated projections were sent to each WUG in Fannin County for review and comment. Final updated projections were created based on the historical trends, updated demographics and survey responses.

Review of Fannin County WUG Status

As part of this special study the list of WUGs in Fannin County was reviewed to determine if any additional entities should be considered for inclusion in future water planning cycles. Municipal demand that is not defined through official WUGs is compiled into a "County-Other" designation for planning purposes. The TWDB states that a WUG is defined as one of the following:

- Cities and towns with populations of 500 or more
- Non-city utilities providing more than 280 acre-feet per year (0.25 million gallons per day, average demand) of water for municipal use

The TCEQ water utility database (WUD) was reviewed for Fannin County (3). Based on the WUD there are 30 public water utilities or cities in Fannin County, of which 11 were included in the *2006 Region C Water Plan* (2). Of the remaining 19 utilities, 15 are utility districts and 4 are municipalities. There are no remaining utility districts with demands greater than 280 acre-feet per year. (The largest is Bois d'Arc MUD with estimated demands of 172 acre-feet per year (3).) However, two of the water providers (the City of Dodd City and the City of Wolfe City) both have existing populations greater than 500 people. These two cities should be reviewed in advance of the next planning cycle for possible inclusion as WUGs. Other entities could experience growth that would classify them as WUGs and therefore the same planning-level review should occur for future planning periods.

Additional County Aggregated Projections

APAI collected the demand projections developed in the regional water planning process for county-other, manufacturing, mining, irrigation, livestock and steam electric power. The demands for manufacturing, mining, irrigation and livestock were not changed from the *2006 Region C Water Plan* (2). Steam electric power demands were updated based on additional data collected on the number and type of plants as well as updated current and projected operational status (4).

3.3. Approved Population Projections for Water User Groups

APAI collected available historical and projected population data for each entity through the in-person meetings. Additional historical population data was gathered from the Texas State Data Center (5) and the U.S. Census (6). APAI also gathered population projections previously approved by the Texas Water Development Board for regional water planning.

The population information was used to review growth in the cities. The population in Fannin County as a whole is growing faster than what was projected in the *2006 Region C Water Plan* (2). Most of the WUGs have the same population projections as in the *2006 Region C Water Plan* (2), with the exceptions described in more detail below.

Honey Grove

The City of Honey Grove provided revised population projections, which are higher than the projections presented in the *2006 Region C Water Plan* (2). Revised demand projections were calculated by multiplying the revised population projections by the municipal per capita water use presented in the *2006 Region C Water Plan* (2).

Ladonia

The short term (2010) population of Ladonia was reduced based on recent historical information. Other planning periods (2020-2060) were the same as were presented in the *2006 Region C Water Plan* [2]. Ladonia verified the lower short term (2010) population estimate at the September meeting.

Southwest Fannin County SUD

Southwest Fannin County SUD provided revised population projections, which are higher than the projections presented in the *2006 Region C Water Plan* [2]. Revised demand projections were calculated by multiplying the revised population projections by the municipal per capita water use presented in the *2006 Region C Water Plan* [2]. After review and discussion with Southwest Fannin County SUD the updated, higher projections were utilized.

Trenton

The City of Trenton estimates its current population at approximately 640, 64% of the Region C 2010 population estimate found in the *2006 Region C Water Plan* [2]. After review and discussion with Trenton the projections were not changed. Projections will be reviewed for future planning cycles.

Two Fannin County WUGs also extend into Grayson County: Whitewright and Southwest Fannin County SUD. Strategies for these two WUGs will be for Fannin County water use only unless specified otherwise. Both WUGs extend into Grayson County, which is discussed in more detail in the Cooke/Grayson County Study [7].

Water User Groups Whose Population Projections are Unchanged

Population projections remain unchanged for the following water user groups:

- Bonham
- Ector
- Hickory Creek SUD
- Leonard
- North Hunt WSC
- Savoy

- Trenton
- Whitewright
- Fannin County – Other

Table 3.2 presents approved population projections for each Water User Group in the study area, as well as what was previously projected in the *2006 Region C Water Plan* (2). Figure 3.1 shows the current and *2006 Region C Water Plan* (2) population projections for Fannin County. Table 3.3 provides the total recommended population projections for entities split by county.

Table 3.2
Approved Population Projections for Fannin County

Water User Group	2006 Plan						2011 Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Bonham	11,516	12,603	16,000	22,000	30,000	37,000	11,516	12,603	16,000	22,000	30,000	37,000
Ector	652	691	720	741	763	786	652	691	720	741	763	786
Hickory Creek SUD (a)	173	191	204	213	222	233	173	191	204	213	222	233
Honey Grove	1,858	1,978	2,105	2,241	2,386	2,539	1,858	2,100	2,500	3,000	3,500	4,000
Ladonia	1,500	1,600	2,000	2,200	2,500	3,000	800	1,600	2,000	2,200	2,500	3,000
Leonard	2,149	2,502	3,500	5,500	8,000	10,000	2,149	2,502	3,500	5,500	8,000	10,000
North Hunt WSC (a)	380	427	462	488	514	542	380	427	462	488	514	542
Savoy	869	889	910	930	952	974	869	889	910	930	952	974
Southwest Fannin County SUD (b)	5,113	6,562	7,569	8,474	9,279	10,085	7,100	8,549	9,556	10,461	11,266	12,072
Trenton	1,000	1,500	2,500	4,000	6,000	8,000	1,000	1,500	2,500	4,000	6,000	8,000
Whitewright (b)	22	28	32	35	38	41	22	28	32	35	38	41
County-Other	11,610	11,568	11,391	11,091	10,735	10,322	11,610	11,568	11,391	11,091	10,735	10,322
Total Fannin County	**36,842**	**40,539**	**47,393**	**57,913**	**71,389**	**83,522**	**38,129**	**42,648**	**49,775**	**60,659**	**74,490**	**86,970**

(a) Includes only population inside Fannin County. Does not include Region D population.
(b) Includes only population inside Fannin County. Does not include Grayson County.

Figure 3.1
Approved Population Projections for Fannin County

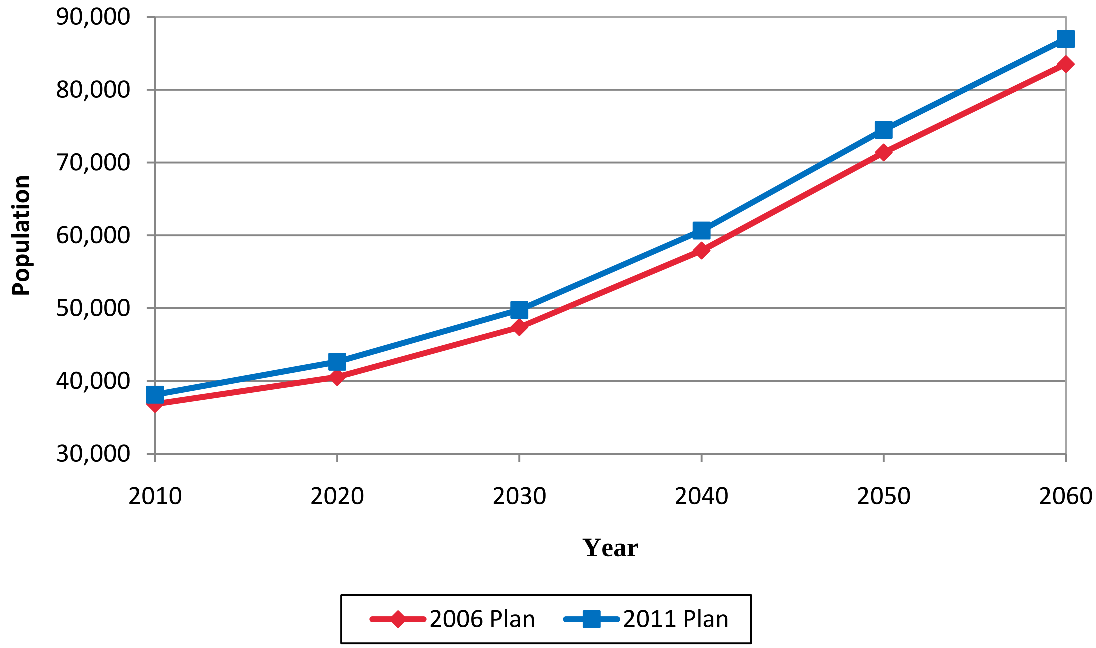


Table 3.3
Approved Population Projections for Entities Split By County

Water User Group	2006 Plan						2011 Projections					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
Hickory Creek SUD[(a)]	2,567	3,156	3,983	5,327	8,290	12,923	2,567	3,156	3,983	5,327	8,290	12,923
North Hunt WSC[(a)]	3,272	3,965	4,922	6,457	9,806	15,043	3,272	3,965	4,922	6,457	9,806	15,043
Southwest Fannin County SUD[(b)]	5,504	6,953	7,960	8,865	9,670	10,476	7,491	8,940	9,947	10,852	11,657	12,463
Whitewright[(b)]	2,522	3,528	4,532	5,535	6,538	7,541	2,022	3,228	4,532	5,535	6,538	7,541

(a) Includes population in Region D.
(b) Includes population in Grayson County.

3.4. Approved Water Demands for Water User Groups

APAI reviewed the historical and projected water demands for each WUG. A number of WUGs provided recent water use data, and some WUGs also provided water demand projections. The demand information was used to review growth in the cities. In general, the water demand in Fannin County is growing slower than what was projected in the *2006*

Region C Water Plan (2). WUGs with updated water demand projections are described in more detail below.

Bonham

The per capita water demand projections for Bonham were reduced based on recent historical data. This decrease translates into a decrease in water demand projections for Bonham even though the population projections for the city have not changed.

Honey Grove

The water demand projections for Honey Grove increased with the corresponding increase in projected population. The per capita water demand projections for Honey Grove did not change.

Ladonia

The 2010 water demand projection for Ladonia decreased with the corresponding decrease in projected population. The per capita water demand projections of Ladonia did not change.

Southwest Fannin County SUD

The water demand projections for Southwest Fannin County SUD increased with the corresponding increase in projected population. The per capita water demand projections of Southwest Fannin County SUD did not change.

Whitewright

The per capita water demands projections for Whitewright were reduced based on recent historical data. This decrease translates into a decrease in overall water demand projections for Whitewright even though the population projections for the city have not changed.

Water User Groups Whose Water Demand Projections are Unchanged

Water demand projections remain unchanged for several water user groups. The water demand projections presented in the *2006 Region C Water Plan* [2] are recommended to remain as previously projected for the following water user groups:

- Ector
- Hickory Creek SUD
- Leonard
- North Hunt WSC
- Savoy
- Trenton
- Fannin County – Other

Table 3.4 summarizes the municipal per capita water use projections for this study. Municipal per capita water use is the sum of residential, commercial, and institutional water use divided by the population served.

Table 3.4
Approved Municipal Per Capita Water Use Projections
-in Gallons per Person per Day-

Water User Group	2006 Plan						2011 Projections					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
Bonham	212	209	207	206	205	205	182	179	177	176	175	175
Ector	131	128	125	123	122	122	131	128	125	123	122	122
Hickory Creek SUD	155	150	149	142	145	146	155	150	149	142	145	146
Honey Grove	202	198	195	192	191	191	202	198	195	192	191	191
Ladonia	325	322	319	316	314	314	325	322	319	316	314	314
Leonard	126	122	119	117	116	116	126	122	119	117	116	116
North Hunt WSC	115	115	116	115	115	115	115	115	116	115	115	115
Savoy	111	108	104	101	100	100	111	108	104	101	100	100
Southwest Fannin County SUD	86	104	107	106	105	105	86	104	107	106	105	105
Trenton	184	180	177	174	173	173	184	180	177	174	173	173
Whitewright	196	193	190	187	186	186	178	175	172	169	168	168
County-Other	115	112	109	106	104	104	115	112	109	106	104	104

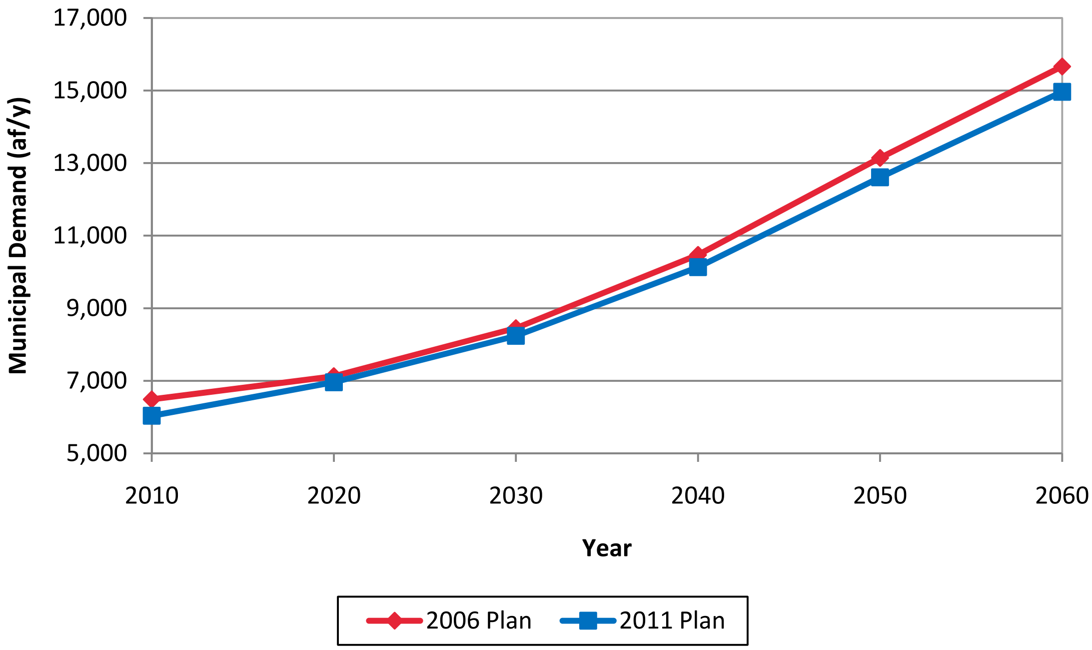
The population projection was multiplied by the projected municipal per capita water use to establish the projected demand for each WUG. For the WUGs who did not provide information, it was assumed the projections developed in the *2006 Region C Water Plan* (2) were still appropriate for use in this study. Table 3.5 lists the recommended water demand projections for this study. Figure 3.2 compares the *2006 Region C Water Plan* (2) and *2011 Region C Water Plan* (1) projected Fannin County municipal demands.

Table 3.5
Approved Demand Projections in Acre-Feet per Year

Water User Group	2006 Plan						2011 Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Bonham	2,735	2,950	3,710	5,076	6,889	8,496	2,348	2,527	3,172	4,337	5,881	7,253
Ector	96	99	101	102	104	107	96	99	101	102	104	107
Hickory Creek SUD [(a)]	30	32	34	34	36	38	30	32	34	34	36	38
Honey Grove	421	438	459	482	511	544	421	466	546	645	749	856
Ladonia	546	577	715	779	879	1,055	291	577	715	779	879	1,055
Leonard	303	342	466	720	1,040	1,299	303	342	466	720	1,040	1,299
North Hunt WSC [(a)]	49	55	60	63	66	70	49	55	60	63	66	70
Savoy	108	108	106	105	107	109	108	108	106	105	107	109
Southwest Fannin County SUD [(a)]	492	764	907	1,006	1,091	1,186	684	996	1,145	1,242	1,325	1,420
Trenton	206	302	496	780	1,163	1,550	206	302	496	780	1,163	1,550
Whitewright [(a)]	5	6	7	7	8	9	4	5	6	7	7	8
County-Other	1,496	1,452	1,390	1,317	1,251	1,202	1,496	1,452	1,390	1,317	1,251	1,202
Total Study Area	**6,487**	**7,125**	**8,451**	**10,471**	**13,145**	**15,665**	**6,036**	**6,961**	**8,237**	**10,131**	**12,608**	**14,967**

[a] Includes only water demand inside Fannin County

Figure 3.2
Approved Municipal Demand Projections for Fannin County



4. Evaluation of Current Supplies

4.1 Surface Water

In the *2006 Region C Water Plan* [2] the City of Bonham operated a water treatment plant at Lake Bonham to serve the needs of Bonham. Lake Bonham is located on Timber Creek in the Red River Basin in Fannin County. The reservoir has conservation storage of 13,000 acre-feet and a yield of 5,340 acre-feet per year. In June 2008 NTMWD began operation of a new 6 million gallon per day (MGD) water treatment plant at the same general location. The City water treatment plant has been abandoned and the water demands of Bonham are now met through the NTMWD plant treating raw water from Lake Bonham.

4.2 Groundwater

The Trinity and/or Woodbine Aquifers provide groundwater to every WUG in Fannin County except Bonham. The long term water demand of WUGs in Fannin County is projected to be above the sustainable yields of the aquifers [8,9]. Conservation practices and the Fannin County Water Supply Project are recommended strategies to lessen the demands placed on the aquifers.

5. Comparison of Current Supplies to Projected Demand

The revised projected water demands in the study area are higher than those shown in the *2006 Region C Water Plan* [2] for two of the eleven WUGs. No WUGs in the study area have revised demands that exceed the total of their current supplies plus the recommended water management strategies in the *2006 Region C Water Plan* [2]. However, each water management strategy was reviewed with each WUG and updates were made as necessary. Changes made to previous strategies typically involve timing and type of groundwater resources used. The proposed revisions are discussed in the following section.

6. Proposed Revisions to Water Management Strategies

This report includes revised water management strategies for inclusion in the *2011 Region C Water Plan* [1]. This section describes the proposed adjustments for the entities with changed conditions. Most changes apply to 2010 strategies or are changes to the ability of a WUG to overdraft using existing pump and well capacity.

Previous Region C Water Plans have referred to the *Fannin County Water Supply Project*. This project is actually a collection of proposed water transmission pipelines to bring surface water to WUGs in Fannin County to meet future demands. Although costs have been estimated for all of the transmission pipelines required to provide service to each individual WUG, the costs and quantities are grouped into similar projects.

The Red River Groundwater Conservation District (RRGCD) was formed in 2009 by Texas Senate Bill 2529 [10]. The District, whose boundary is coterminous with Fannin and Grayson Counties, is charged with managing groundwater by providing for the conservation, preservation, protection, recharge, and prevention of waste of the groundwater resources within its jurisdictions. The RRGCD, as with all Texas groundwater conservation districts, is authorized with powers and duties that enable them to manage groundwater resources. The three primary authorities include: permitting water wells; developing a comprehensive management plan; and adopting the necessary rules to implement a management plan [10]. To date the RRGCD has not yet formally adopted strategies or management plans for Fannin County groundwater. The Region C Water Planning Group will continue to monitor the progress of the RRGCD and will coordinate future strategies with the district.

Supplemental groundwater wells are defined as wells required to maintain the existing groundwater capacity of a WUG. It is assumed that 20% of the existing WUG groundwater well system will be renewed every 10 years as part of the normal renewal program of a WUG. These supplemental wells do not add groundwater capacity to WUGs. Supplemental wells are a water management strategy for every WUG that utilizes groundwater as a water supply.

Bonham

The City of Bonham currently purchases treated water from NTMWD via Lake Bonham, which has a current yield of 5,340 ac-ft/yr. The first phase of the Fannin County Water Supply Project will utilize water from this NTMWD plant, which has a current treatment capacity of 6 MGD. The plant has raw water supply and capacity to meet the water demands of Bonham and the other planned participants of the Fannin County Water Supply Project until approximately 2040. As the projected water demand approaches the yield of Lake Bonham, NTMWD will establish a second delivery point, supplying water from the proposed Lower Bois D'Arc Reservoir into the Bonham distribution system via the second phase of the Fannin County Water Supply Project. Table 6.1 contains summary information for Bonham.

Table 6.1
Summary Information for Bonham

Bonham	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	11,516	12,603	16,000	22,000	30,000	37,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	2,348	2,527	3,172	4,337	5,881	7,253
Fannin County - Manufacturing	73	82	90	98	105	114
Total Projected Water Demand	***2,421***	***2,609***	***3,262***	***4,435***	***5,986***	***7,367***
Currently Available Water Supplies (ac-ft/yr)						
Lake Bonham	2,405	2,124	2,306	2,817	3,438	3,933
Total Supply	***2,405***	***2,124***	***2,306***	***2,817***	***3,438***	***3,933***
Need (Demand - Supply) (ac-ft/yr)	***16***	***485***	***956***	***1,618***	***2,548***	***3,434***
Water Management Strategies (ac-ft/yr)						
Water Conservation - Basic Package	16	99	162	259	401	555
Water Conservation - Expanded Package	0	4	13	23	30	39
Fannin County Water Supply Project	0	378	780	1,336	2,117	2,840
Total Water Management Strategies	***16***	***485***	***956***	***1,618***	***2,548***	***3,434***
Reserve (ac-ft/yr)	**0**	**0**	**0**	**0**	**0**	**0**

Ector

Ector's water management strategies in the *2006 Region C Water Plan* [(2)] included utilizing new wells in the Trinity Aquifer. The City of Ector has existing pump and well capacity to meet the projected water demands through 2060 with currently available groundwater supplies. Additional water supplies after 2010 are still projected from the Fannin County Water Supply Project. Table 6.2 contains summary water management information for Ector.

Table 6.2
Summary Information for Ector

Ector	2010	2020	2030	2040	2050	2060
Projected Population	652	691	720	741	763	786
Projected Water Demand (ac-ft/yr)						
Municipal Demand	96	99	101	102	104	107
Total Projected Water Demand	***96***	***99***	***101***	***102***	***104***	***107***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	113	113	113	113	113	113
Total Supply	***113***	***113***	***113***	***113***	***113***	***113***
Water Management Strategies (ac-ft/yr)						
Water Conservation - Basic Package	1	4	5	6	6	7
Fannin County Water Supply Project	0	2	3	4	6	9
Total Water Management Strategies	***1***	***6***	***8***	***9***	***12***	***15***
Total Supply Less Projected Demand (ac-ft/yr)	**18**	**20**	**20**	**20**	**21**	**21**

Honey Grove

The long term population of Honey Grove has been increased above that in the *2006 Region C Water Plan* [2]. Honey Grove has currently available supply to meet the additional demand from the Woodbine Aquifer. Water demands beyond 2010 are still projected to be met by the Fannin County Water Supply Project. Table 6.3 contains summary water management information for Honey Grove.

Table 6.3
Summary Information for Honey Grove

Honey Grove	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	1,858	2,100	2,500	3,000	3,500	4,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	421	466	546	645	749	856
Total Projected Water Demand	***421***	***466***	***546***	***645***	***749***	***856***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	463	463	463	463	463	463
Total Supply	***463***	***463***	***463***	***463***	***463***	***463***
Water Management Strategies (ac-ft/yr)						
Water Conservation - Basic Package	3	30	67	85	105	127
Water Conservation - Expanded Package	0	1	2	3	3	4
Fannin County Water Supply Project	0	65	123	223	328	433
Total Water Management Strategies	***3***	***96***	***192***	***311***	***436***	***564***
Total Supply Less Projected Demand (ac-ft/yr)	**45**	**93**	**109**	**129**	**150**	**171**

Ladonia

One of Ladonia's water management strategies in the *2006 Region C Water Plan* [2] was utilizing new wells in the Trinity Aquifer. The City of Ladonia has existing pump and well capacity to meet the updated projected 2010 water demands with existing wells. Additional water demands beyond 2010 are still projected to be met by the proposed Lake Ralph Hall. Table 6.4 contains summary water management information for Ladonia.

Table 6.4
Summary Information for Ladonia

Ladonia	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	800	1,600	2,000	2,200	2,500	3,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	291	577	715	779	879	1,055
Total Projected Water Demand	***291***	***577***	***715***	***779***	***879***	***1,055***
Currently Available Water Supplies (ac-ft/yr)						
Trinity Aquifer	320	320	320	320	320	320
Total Supply	***320***	***320***	***320***	***320***	***320***	***320***
Water Management Strategies (ac-ft/yr)						
Water Conservation - Basic Package	2	23	36	46	59	80
Water Conservation - Expanded Package	3	8	10	11	13	15
Ralph Hall Reservoir	0	342	492	558	663	851
Total Water Management Strategies	***5***	***372***	***538***	***615***	***735***	***946***
Total Supply Less Projected Demand (ac-ft/yr)	**34**	**115**	**143**	**156**	**176**	**211**

Southwest Fannin County SUD

One of Southwest Fannin County SUD's water management strategies in the *2006 Region C Water Plan* [(2)] was utilizing new wells in the Woodbine Aquifer. Southwest Fannin County SUD has existing pump and well capacity to meet the updated projected 2010 water demand with existing wells. Additional water demands beyond 2010 are still projected to be met by the Fannin County Water Supply Project. Table 6.5 contains summary water management information for Southwest Fannin County SUD.

Table 6.5
Summary Information for Southwest Fannin County SUD[(a)]

Southwest Fannin County SUD	2010	2020	2030	2040	2050	2060
Projected Population	7,100	8,549	9,556	10,461	11,266	12,072
Projected Water Demand (ac-ft/yr)						
Municipal Demand	684	996	1,145	1,242	1,325	1,420
Total Projected Water Demand	***684***	***996***	***1,145***	***1,242***	***1,325***	***1,420***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	752	752	752	752	752	752
Total Supply	***752***	***752***	***752***	***752***	***752***	***752***
Water Management Strategies (ac-ft/yr)						
Water Conservation - Basic Package	15	44	62	72	82	93
Fannin County Water Supply Project	0	399	560	666	756	859
Total Water Management Strategies	***15***	***443***	***622***	***738***	***838***	***952***
Total Supply Less Projected Demand (ac-ft/yr)	**83**	**199**	**229**	**248**	**265**	**284**

(a) Fannin County portion only

Water User Groups Whose Water Management Strategies are Unchanged

Population and demand projections remain unchanged for the following water user groups:

- Hickory Creek SUD (Region D will coordinate strategies)
- Leonard
- North Hunt WSC
- Savoy
- Trenton
- Whitewright (recommended strategy is Grayson County Water Supply Project, discussed in Cooke/Grayson Study [(7)])

Summary water management information for these WUGs is included in Tables 6.6 through 6.12 for reference.

Table 6.6
Summary Information for Hickory Creek SUD [(a)]

Hickory Creek SUD	2010	2020	2030	2040	2050	2060
Projected Population	173	191	204	213	222	233
Projected Water Demand (ac-ft/yr)						
Municipal Demand	30	32	34	34	36	38
Total Projected Water Demand	***30***	***32***	***34***	***34***	***36***	***38***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	45	45	44	44	44	30
Total Supply	***45***	***45***	***44***	***44***	***44***	***30***
Water Management Strategies (ac-ft/yr)						
Water Conservation - Basic Package	1	3	4	5	6	7
Water Conservation - Expanded Package	0	0	0	1	1	1
Total Water Management Strategies	***2***	***3***	***4***	***5***	***6***	***23***
Total Supply Less Projected Demand (ac-ft/yr)	**17**	**16**	**14**	**15**	**14**	**15**

(a) Fannin County Portion only

Table 6.7
Summary Information for Leonard

Leonard	2010	2020	2030	2040	2050	2060
Projected Population	2,149	2,502	3,500	5,500	8,000	10,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	303	342	466	720	1,040	1,299
Total Projected Water Demand	***303***	***342***	***466***	***720***	***1,040***	***1,299***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	333	333	333	333	333	333
Total Supply	***333***	***333***	***333***	***333***	***333***	***333***
Water Management Strategies (ac-ft/yr)						
Water Conservation - Basic Package	3	12	22	37	58	77
Water Conservation - Expanded Package	3	3	4	6	9	12
Fannin County Water Supply Project	0	62	200	487	848	1,138
Total Water Management Strategies	***6***	***77***	***226***	***531***	***915***	***1,226***
Total Supply Less Projected Demand (ac-ft/yr)	**36**	**68**	**93**	**144**	**208**	**260**

Table 6.8
Summary Information for North Hunt WSC [(a)]

North Hunt WSC	2010	2020	2030	2040	2050	2060
Projected Population	380	427	462	488	514	542
Projected Water Demand (ac-ft/yr)						
Municipal Demand	49	55	60	63	66	70
Total Projected Water Demand	***49***	***55***	***60***	***63***	***66***	***70***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	77	77	77	77	77	77
Total Supply	***77***	***77***	***77***	***77***	***77***	***77***
Water Management Strategies (ac-ft/yr)						
Water Conservation - Basic Package	1	2	3	3	4	4
Total Water Management Strategies	**1**	**2**	**3**	**3**	**4**	***4***
Total Supply Less Projected Demand (ac-ft/yr)	**29**	**24**	**20**	**17**	**15**	**11**

(a) Fannin County Portion only

Table 6.9
Summary Information for Savoy

Savoy	2010	2020	2030	2040	2050	2060
Projected Population	869	889	910	930	952	974
Projected Water Demand (ac-ft/yr)						
Municipal Demand	108	108	106	105	107	109
Total Projected Water Demand	***108***	***108***	***106***	***105***	***107***	***109***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	119	119	119	119	119	119
Total Supply	***119***	***119***	***119***	***119***	***119***	***119***
Water Management Strategies (ac-ft/yr)						
Water Conservation - Basic Package	1	4	5	6	6	7
Fannin County Water Supply Project	0	7	3	1	3	5
Total Water Management Strategies	***1***	***11***	***8***	***7***	***9***	***12***
Total Supply Less Projected Demand (ac-ft/yr)	**12**	**22**	**21**	**21**	**21**	**22**

Table 6.10
Summary Information for Trenton

Trenton	2010	2020	2030	2040	2050	2060
Projected Population	1,000	1,500	2,500	4,000	6,000	8,000
Projected Water Demand (ac-ft/yr)						
Municipal Demand	206	302	496	780	1,163	1,550
Total Projected Water Demand	***206***	***302***	***496***	***780***	***1,163***	***1,550***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	227	227	227	227	227	227
Total Supply	***227***	***227***	***227***	***227***	***227***	***227***
Water Management Strategies (ac-ft/yr)						
Water Conservation - Basic Package	2	22	69	115	181	255
Water Conservation - Expanded Package	2	3	5	8	13	17
Fannin County Water Supply Project	0	110	294	586	975	1,362
Total Water Management Strategies	***4***	***135***	***368***	***709***	***1,169***	***1,633***
Total Supply Less Projected Demand (ac-ft/yr)	**25**	**60**	**99**	**156**	**233**	**310**

Table 6.11
Summary Information for Whitewright[(a)]

Whitewright	2010	2020	2030	2040	2050	2060
Projected Population	22	28	32	35	38	41
Projected Water Demand (ac-ft/yr)						
Municipal Demand	403	632	873	1,048	1,230	1,419
Total Projected Water Demand	***403***	***632***	***873***	***1,048***	***1,230***	***1,419***
Currently Available Water Supplies (ac-ft/yr)						
Woodbine Aquifer	438	438	438	438	438	438
Total Supply	***438***	***438***	***438***	***438***	***438***	***438***
Water Management Strategies (ac-ft/yr)						
Water Conservation - Basic Package	3	30	52	72	95	121
Water Conservation - Expanded Package	2	4	5	7	8	9
Grayson County Water Supply Project [(7)]	0	287	552	741	935	1,135
Total Water Management Strategies	***5***	***320***	***610***	***820***	***1,038***	***1,265***
Total Supply Less Projected Demand (ac-ft/yr)	**40**	**126**	**175**	**210**	**246**	**284**

(a) Fannin County portion only.

Table 6.12
Summary Information for Fannin County – Other

Fannin County - Other	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	11,610	11,568	11,391	11,091	10,735	10,322
Projected Water Demand (ac-ft/yr)						
Municipal Demand	1,496	1,452	1,390	1,317	1,251	1,202
Total Projected Water Demand	***1,496***	***1,452***	***1,390***	***1,317***	***1,251***	***1,202***
Currently Available Water Supplies (ac-ft/yr)						
Lake Bonham	75	73	70	66	63	60
Run-of-river - Red River	20	20	20	20	20	20
Run-of-river - Sulphur River	49	49	49	49	49	49
Trinity Aquifer	308	308	308	308	308	308
Woodbine Aquifer	831	831	831	831	831	831
Total Supply	***1,283***	***1,281***	***1,278***	***1,274***	***1,271***	***1,268***
Water Management Strategies (ac-ft/yr)						
Water Conservation - Basic Package	16	53	70	74	75	76
Fannin County Water Supply Project	0	408	320	233	155	98
Overdraft Woodbine Aquifer (New Wells)	197	0	0	0	0	0
Total Water Management Strategies	***512***	***461***	***390***	***306***	***230***	***174***
Total Supply Less Projected Demand (ac-ft/yr)	**0**	**290**	**278**	**263**	**250**	**240**

Table 6.13
Summary Information for Fannin County – Irrigation

Fannin County - Irrigation	2010	2020	2030	2040	2050	2060
Projected Water Demand (ac-ft/yr)						
Irrigation Demand	4,608	4,608	4,608	4,608	4,608	4,608
Total Projected Water Demand	***4,608***	***4,608***	***4,608***	***4,608***	***4,608***	***4,608***
Currently Available Water Supplies (ac-ft/yr)						
Red River	14,758	14,758	14,758	14,758	14,758	14,758
Local Aquifer	2,620	2,620	2,620	2,620	2,620	2,620
Total Supply	***17,378***	***17,378***	***17,378***	***17,378***	***17,378***	***17,378***
Need (Demand - Supply) (ac-ft/yr)	**0**	**0**	**0**	**0**	**0**	**0**
Reserve (ac-ft/yr)	**12,770**	**12,770**	**12,770**	**12,770**	**12,770**	**12,770**

Table 6.14
Summary Information for Fannin County - Livestock

Fannin County - Livestock	2010	2020	2030	2040	2050	2060
Projected Water Demand (ac-ft/yr)						
Livestock Demand	1,270	1,270	1,270	1,270	1,270	1,270
Total Projected Water Demand	***1,270***	***1,270***	***1,270***	***1,270***	***1,270***	***1,270***
Currently Available Water Supplies (ac-ft/yr)						
Local Supply	1,583	1,583	1,583	1,583	1,583	1,583
Trinity Aquifer	72	72	72	72	72	72
Woodbine Aquifer	302	302	302	302	302	302
Total Supply	***1,957***	***1,957***	***1,957***	***1,957***	***1,957***	***1,957***
Need (Demand - Supply) (ac-ft/yr)	**0**	**0**	**0**	**0**	**0**	**0**
Reserve (ac-ft/yr)	**687**	**687**	**687**	**687**	**687**	**687**

Table 6.15
Summary Information for Fannin County – Manufacturing

Fannin County – Manufacturing	2010	2020	2030	2040	2050	2060
Projected Water Demand (ac-ft/yr)						
Manufacturing Demand	73	82	90	98	105	114
Total Projected Water Demand	***73***	***82***	***90***	***98***	***105***	***114***
Currently Available Water Supplies (ac-ft/yr)						
Lake Bonham	73	82	90	98	105	114
Total Supply	***73***	***82***	***90***	***98***	***105***	***114***
Need (Demand - Supply) (ac-ft/yr)	**0**	**0**	**0**	**0**	**0**	**0**
Reserve (ac-ft/yr)	**0**	**0**	**0**	**0**	**0**	**0**

Table 6.16
Summary Information for Fannin County – Mining

Fannin County - Mining	2010	2020	2030	2040	2050	2060
Projected Water Demand (ac-ft/yr)						
Mining Demand	12	12	12	12	12	12
Total Projected Water Demand	***12***	***12***	***12***	***12***	***12***	***12***
Currently Available Water Supplies (ac-ft/yr)						
Run-Of-River	72	72	72	72	72	72
Total Supply	***72***	***72***	***72***	***72***	***72***	***72***
Need (Demand - Supply) (ac-ft/yr)	**0**	**0**	**0**	**0**	**0**	**0**
Reserve (ac-ft/yr)	**60**	**60**	**60**	**60**	**60**	**60**

Table 6.17
Summary Information for Fannin County – Steam Electric Power

Fannin County - Steam Electric Power	2010	2020	2030	2040	2050	2060
Projected Water Demand (ac-ft/yr)						
Steam Electric Power Demand	1,261	6,363	11,474	11,910	12,443	13,092
Total Projected Water Demand	***1,261***	***6,363***	***11,474***	***11,910***	***12,443***	***13,092***
Currently Available Water Supplies (ac-ft/yr)						
Lake Texoma	16,400	16,400	16,400	16,400	16,400	16,400
Woodbine Aquifer	80	80	80	80	80	80
Total Supply	***16,480***	***16,480***	***16,480***	***16,480***	***16,480***	***16,480***
Need (Demand - Supply) (ac-ft/yr)	**0**	**0**	**0**	**0**	**0**	**0**
Reserve (ac-ft/yr)	**15,219**	**10,117**	**5,006**	**4,570**	**4,037**	**3,388**

7. Estimated Costs for Recommended Water Management Strategies

The estimated costs for proposed water management strategies were updated and are included in Appendix Q of the *2011 Region C Water Plan*. The capital costs are broken down by category in Tables 7.1 and 7.2. Refer to Appendix Q for additional details on cost assumptions. See Sections 4E and 4F of the 2011 Region C Water Plan for additional information on Fannin County and the Fannin County Water Supply Project (see NTMWD).

Capital costs for supplemental groundwater wells are defined as the costs required to maintain the existing groundwater capacity of a WUG. It is assumed that 20% of the existing WUG groundwater well system will be renewed every 10 years as part of the normal capital renewal program of a WUG. These costs do not add groundwater capacity to WUGs. Capital costs for new wells are the costs for new infrastructure to add additional capacity for a WUG.

Table 7.1
Capital Costs for Proposed Water Management Strategies Not Associated with Wholesale Water Providers

Water Management Strategy Category	Capital Cost During Study Period
Purchase from WWP	$12,966,000
Supplemental Wells	$37,229,000
Total Capital Costs for Study Area	$50,220,000

Table 7.2
Capital Costs for Proposed Water Management Strategies Associated with Wholesale Water Providers

Water Management Strategy Category	Capital Cost During Study Period
Fannin County Water Supply Project (NTMWD)	$38,471,000
Total Capital Costs for Study Area	$38,471,000

8. Implementation Plan for Proposed Water Management Strategies

Implementation of the Fannin County Water Supply Project includes developing water management strategies for both surface water and groundwater sources. For surface water sources, the implementation plan for water management strategies includes the following components:

- Obtain water rights and/or develop water supply contracts for Lower Bois d'Arc Creek and Lake Ralph Hall reservoirs
- Obtain required environmental and construction permits
- Design and construct required facilities

For groundwater sources, the implementation plan for water management strategies includes the following components:

- Obtain required permits from Red River Groundwater Conservation District
- Design and construct required facilities

Table 8.1 lists recommended water management strategies with approximate in-service dates.

Table 8.1
Implementation of Recommended Water Management Strategies

Owner	Project	Approximate In-service Year
Bonham	Pipeline from Leonard to Bonham	2040
County-Other	New Groundwater Wells	2010
Ector	Pipeline from Bonham to Ector	2014
Honey Grove	Pipeline from Bonham to Honey Grove	2018
Ladonia	Pipeline from UTRWD[a] to Ladonia	2020
Leonard	Pipeline from NTMWD to Leonard	2020
NTMWD	Expand Lake Bonham WTP	2040
NTMWD	Raw water pipe and pump station	2020
NTMWD	Lower Bois d'Arc WTP	2020
Savoy	Pipeline from SWFCSUD to Savoy	2016
Southwest Fannin County SUD	Pipeline from Ector to SWFCSUD	2014
Trenton	Pipeline from NTMWD to Trenton	2020
UTRWD	Ralph Hall Reservoir and WTP	2020

(a) Upper Trinity Regional Water District

9. Alternative Water Management Strategies

In general, most of the water user groups and wholesale water providers in the study area indicated that their future water supply plans are in line with the *2006 Region C Water Plan* [2]. However, three possible alternative water management strategies were identified in this study:

Bonham

Bonham will be required to supplement its current water supplies to meet projected water demands after the yield of Lake Bonham has been exceeded. The recommended strategy is to meet projected water demands through connection to a second treated water source (NTMWD treatment of Lower Bois d'Arc Reservoir). An alternative strategy is to supplement the yield of Lake Bonham directly by pumping raw water from Lower Bois d'Arc Reservoir into Lake Bonham to be treated at the existing NTMWD water treatment plant. The existing 6 MGD NTMWD plant can be expanded to 9 MGD, which is sufficient to meet the 2060 Bonham projected water demand.

Ladonia

Ladonia currently plans to purchase surface water from the Upper Trinity Regional Water District (UTRWD) out of Lake Ralph Hall. An alternative strategy would be to purchase water from NTMWD out of Lower Bois d'Arc Reservoir as part of the Fannin County Water Supply Project through a water line from Honey Grove.

Whitewright

A majority of the projected water demand of Whitewright is located in Grayson County and is projected to be met through the Grayson County Water Supply Project. An alternative strategy is to receive water from the Fannin County Water Supply Project through a water line from Trenton.

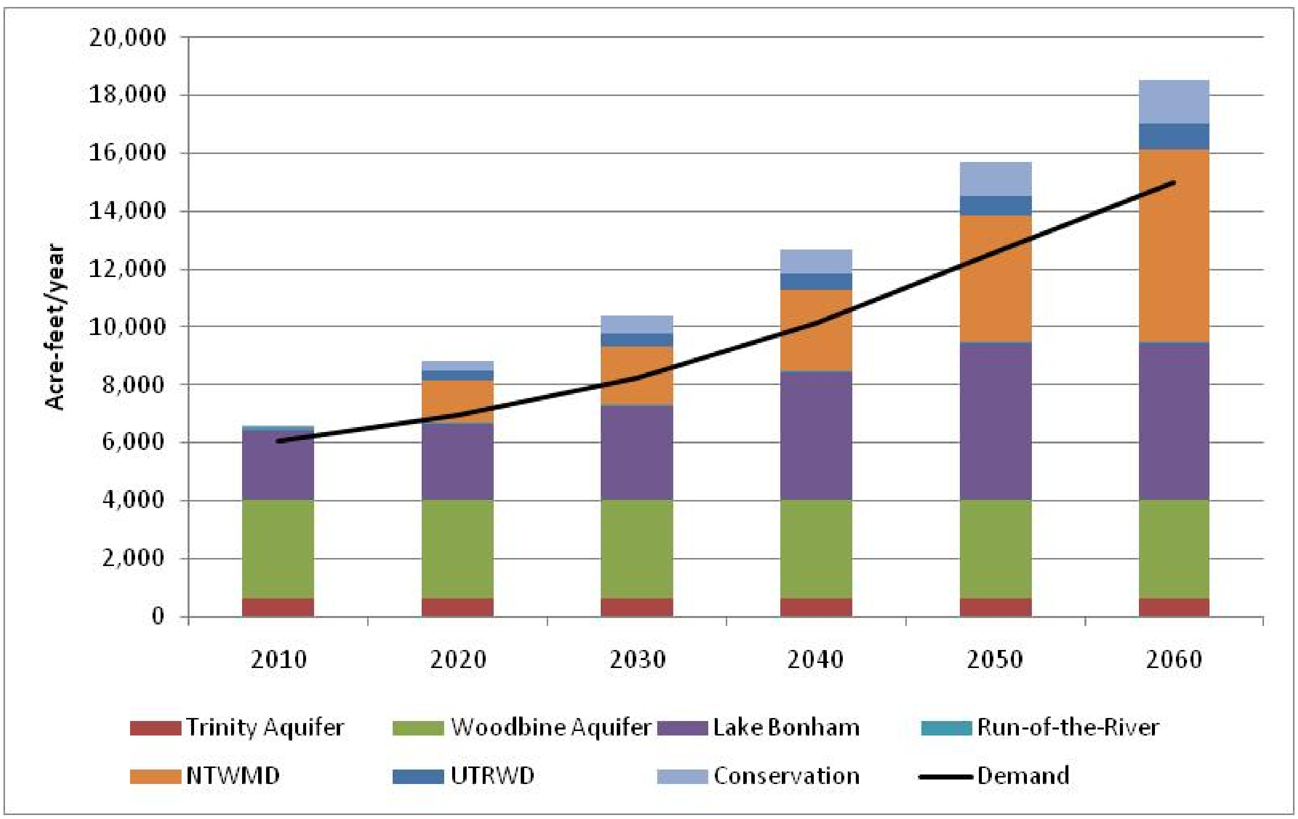
Cost estimates for these alternative strategies are located in Appendix Q.

10. Conclusions

The WUGs in the Fannin County Study are projecting steady growth in the next 50 years. In general, growth appears to be greater but water demand less than what was projected in the *2006 Region C Water Plan* (2). To meet the projected water demands, the recommended water management strategies have been revised as discussed in this report. For most of the WUGs, currently planned water management strategies are in line with the strategies presented in the *2006 Region C Water Plan* (2). Figure 10.1 shows the total projected municipal water demands, current water supplies, and recommended water management strategies for the Fannin County Study area.

Appendix B contains information on the Public Meeting held on February 4, 2010.

Figure 10.1
Total Projected Municipal Water Demand and Supply for the Study Area



APPENDIX A
REFERENCES

APPENDIX A
REFERENCES

1) Freese and Nichols, Inc., Alan Plummer Associates, Inc., Chiang, Patel & Yerby, Inc., and Cooksey Communications, Inc.: *2011 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, April 2010.
2) Freese and Nichols, Inc., Alan Plummer Associates, Inc., Chiang, Patel & Yerby, Inc., and Cooksey Communications, Inc.: *2006 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, July 2006.
3) Texas Commission on Environmental Quality: Water Utility Database, [Online], Available URL: http://www10.tceq.state.tx.us/iwud, December 2009.
4) Alan Plummer Associates, Inc.: *Technical Memorandum: Steam Electric Power Demand Projections;* prepared for Region C Water Planning Group, August 2009.
5) Texas State Data Center and Office of the State Demographer: 2007 Population Estimates for Texas Places, [Online], Available URL: http://txsdc.utsa.edu/tpepp/2006_txpopest_place.php, September 2007.
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7) Alan Plummer Associates, Inc.: *Grayson/Cooke County Special Study*; prepared for Region C Water Planning Group, January 2010.
8) Texas Water Development Board: "GAM Run 08-84mag," Managed available groundwater estimates for the Trinity Aquifer in Groundwater Management Area 8, Austin, March 2009.
9) Texas Water Development Board: "GAM Run 08-14mag," Managed available groundwater estimates for the Woodbine Aquifer in Groundwater Management Area 8, Austin, December 2008.
10) Texas Senate Bill 2529: Subtitle H, Title 6, Chapter 8859: Red River Groundwater Conservation District, [Online], Available URL: http://www.sos.state.tx.us/statdoc/bills/sb/SB2529.pdf, June 2009.

APPENDIX B

PUBLIC MEETING

Water Supply Study for Fannin County

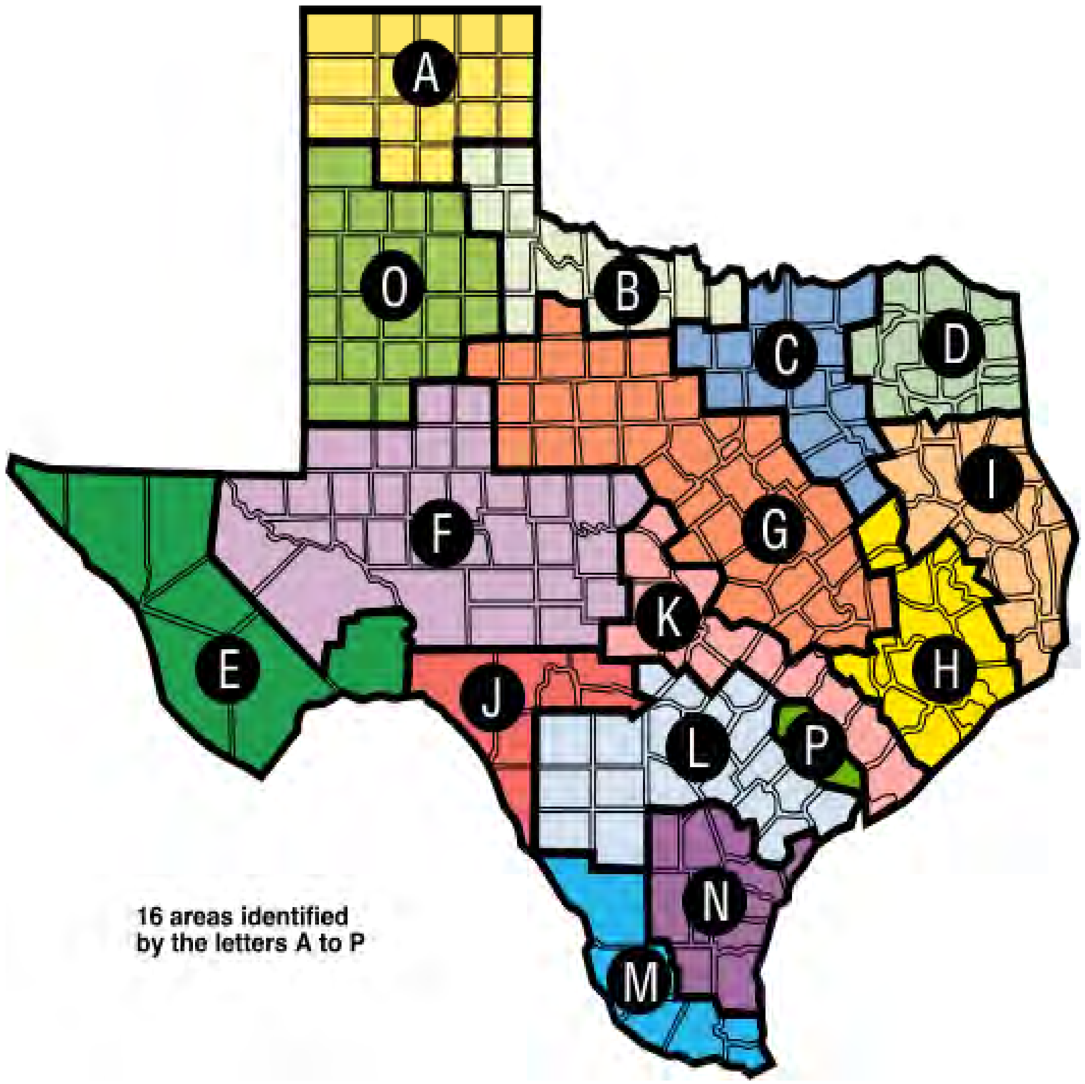
Preston Dillard, P.E.
Alan Plummer and Associates

Regional Water Planning Process

- Senate Bill 1 - Texas Legislature in 1997
- Spurred by 1996 drought
- Population projected to double by 2060
- "Bottom up" water planning process
- Texas Water Development Board
  - Adopted rules
  - Set out 16 regions
  - Named initial planning group members

REGION C

Regional Water Planning Areas

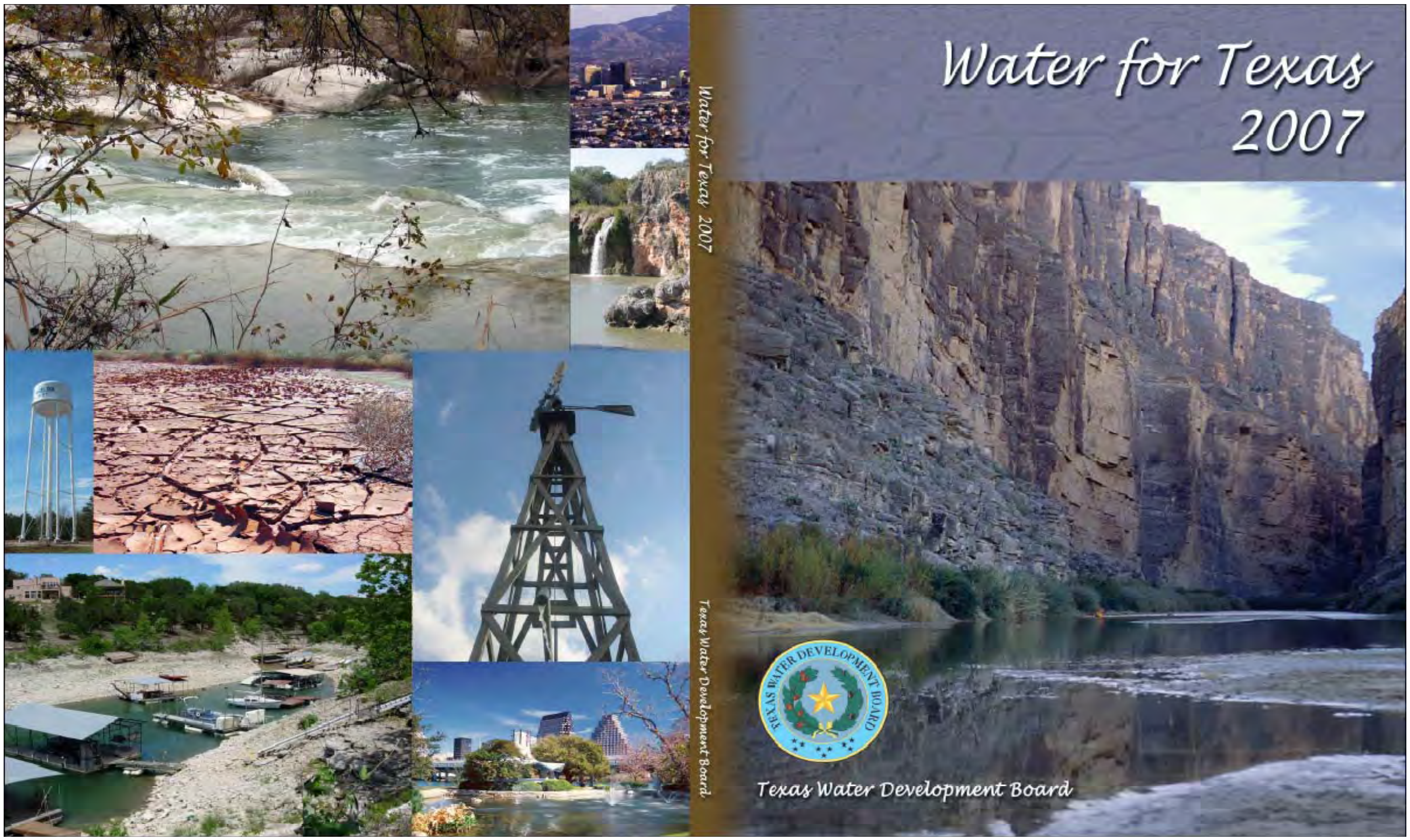


Regional Water Planning Process

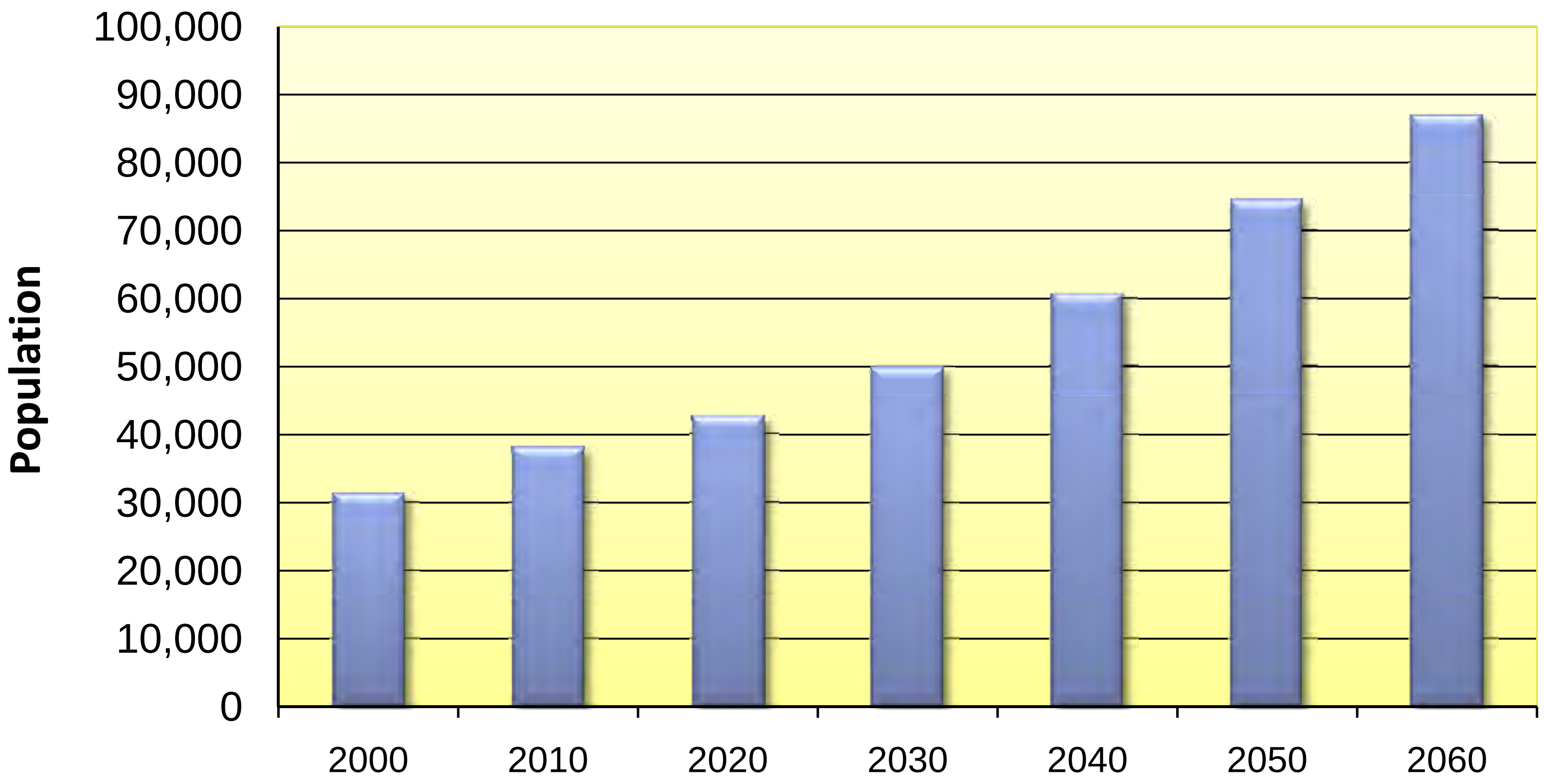
- 50-year planning period
- Project population and water demand
- Existing supply
- Evaluate need for additional water
- Recommend strategies
- Water right permitting and TWDB funding use plans

REGION C

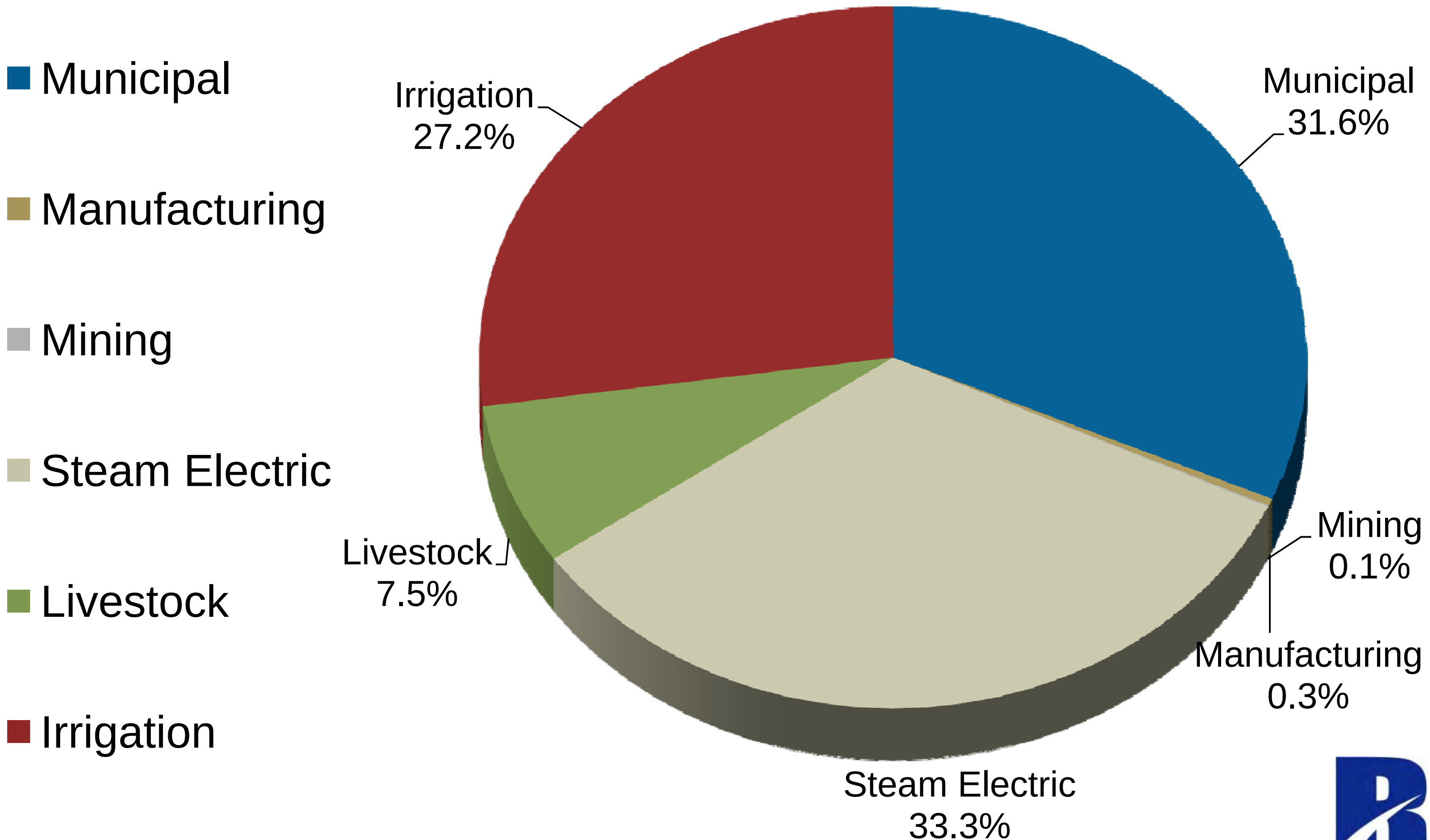
2007 State Water Plan



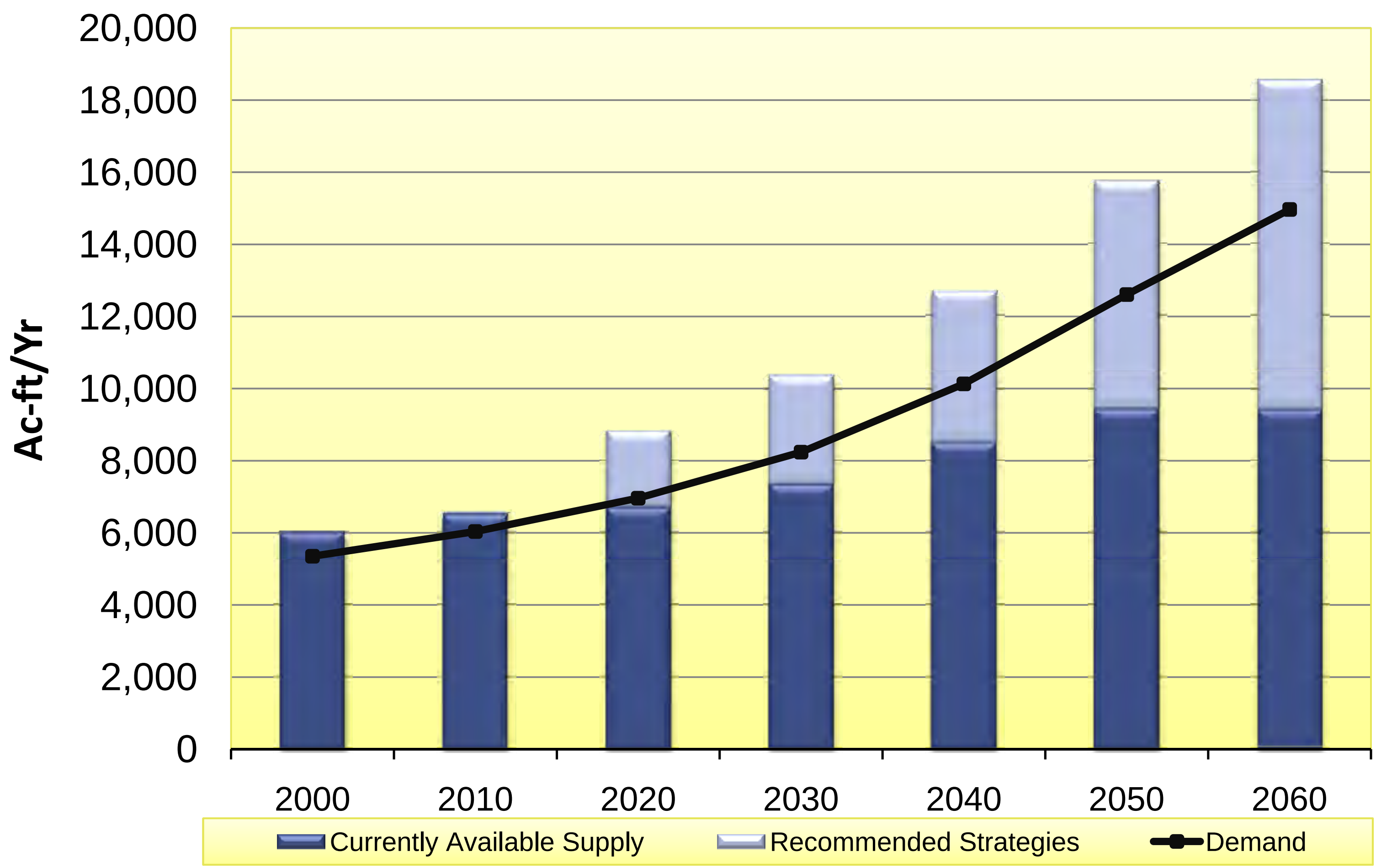
Fannin County Population



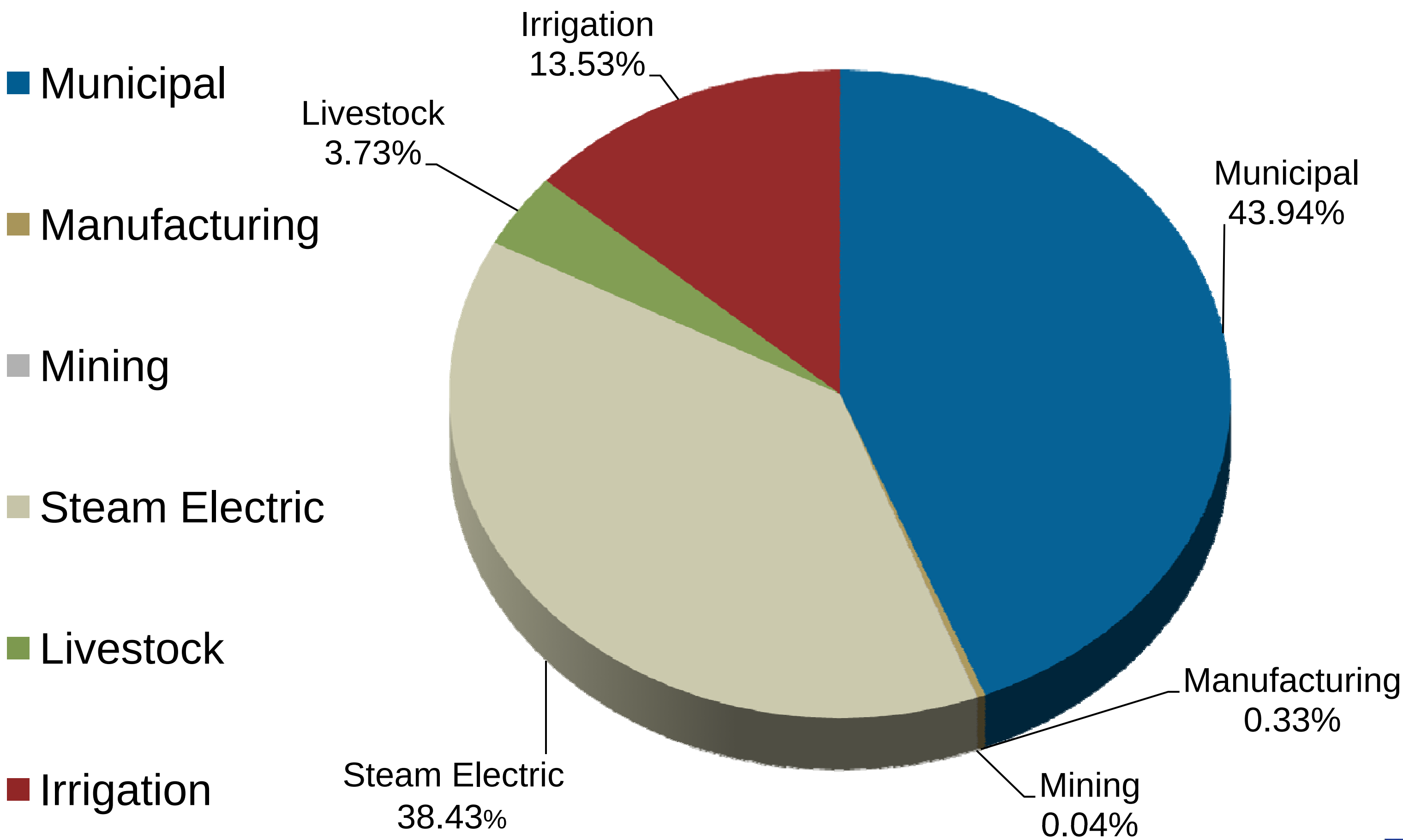
2000 Fannin County Demand (% of total)



Fannin County Supplies and Demands



2060 Fannin County Demand (% of total)



Bonham Summary

Bonham	2010	2020	2030	2040	2050	2060
Projected Population	11,516	12,603	16,000	22,000	30,000	37,000
Projected Water Demand (ac-ft/yr)						
• Municipal Demand	2,348	2,527	3,172	4,337	5,881	7,253
Total Projected Water Demand	***2,348***	***2,527***	***3,172***	***4,337***	***5,881***	***7,253***
Currently Available Water Supplies (ac-ft/yr)						
• Lake Bonham	2,348	2,527	3,172	4,337	5,340	5,340
Total Supply	***2,348***	***2,527***	***3,172***	***4,337***	***5,340***	***5,340***
Water Management Strategies(ac-ft/yr)						
• Water Conservation - Basic Package	16	99	162	259	401	555
• Water Conservation - Expanded Package	0	4	13	23	30	39
• Fannin County Water Supply Project	0	402	459	585	1,286	2,769
Total Water Management Strategies	***16***	***505***	***634***	***867***	***1,717***	***3,364***
Total Supply Less Projected Demand (ac-ft/yr)	**16**	**505**	**634**	**867**	**1,176**	**1,451**

REGION C

Ector Summary

Ector	2010	2020	2030	2040	2050	2060
Projected Population	652	691	720	741	763	786
Projected Water Demand (ac-ft/yr)						
• Municipal Demand	96	99	101	102	104	107
Total Projected Water Demand	***96***	***99***	***101***	***102***	***104***	***107***
Currently Available Water Supplies (ac-ft/yr)						
• Woodbine Aquifer	113	113	113	113	113	113
Total Supply	***113***	***113***	***113***	***113***	***113***	***113***
Water Management Strategies (ac-ft/yr)						
• Water Conservation - Basic Package	1	4	5	6	6	7
• Fannin County Water Supply Project	0	2	3	4	6	9
Total Water Management Strategies	***1***	***6***	***8***	***9***	***12***	***15***
Total Supply Less Projected Demand (ac-ft/yr)	**18**	**20**	**20**	**20**	**21**	**21**

REGION C

Honey Grove Summary

Honey Grove	2010	2020	2030	2040	2050	2060
Projected Population	1,858	2,100	2,500	3,000	3,500	4,000
Projected Water Demand (ac-ft/yr)						
• Municipal Demand	421	466	546	645	749	856
Total Projected Water Demand	***421***	***466***	***546***	***645***	***749***	***856***
Currently Available Water Supplies (ac-ft/yr)						
• Woodbine Aquifer	463	463	463	463	463	463
Total Supply	***463***	***463***	***463***	***463***	***463***	***463***
Water Management Strategies (ac-ft/yr)						
• Water Conservation - Basic Package	3	30	67	85	105	127
• Water Conservation - Expanded Package	0	1	2	3	3	4
• Fannin County Water Supply Project	0	65	123	223	328	433
Total Water Management Strategies	***3***	***96***	***192***	***311***	***436***	***564***
Total Supply Less Projected Demand (ac-ft/yr)	**45**	**93**	**109**	**129**	**150**	**171**

REGION C

Ladonia Summary

Ladonia	2010	2020	2030	2040	2050	2060
Projected Population	800	1,600	2,000	2,200	2,500	3,000
Projected Water Demand (ac-ft/yr)						
• Municipal Demand	291	577	715	779	879	1,055
Total Projected Water Demand	***291***	***577***	***715***	***779***	***879***	***1,055***
Currently Available Water Supplies (ac-ft/yr)						
• Trinity Aquifer	320	320	320	320	320	320
Total Supply	***320***	***320***	***320***	***320***	***320***	***320***
Water Management Strategies (ac-ft/yr)						
• Water Conservation - Basic Package	2	23	36	46	59	80
• Water Conservation - Expanded Package	3	8	10	11	13	15
• Ralph Hall Reservoir	0	342	492	558	663	851
Total Water Management Strategies	***5***	***372***	***538***	***615***	***735***	***946***
Total Supply Less Projected Demand (ac-ft/yr)	**34**	**115**	**143**	**156**	**176**	**211**

REGION C

Southwest Fannin County SUD Summary

Southwest Fannin County SUD	2010	2020	2030	2040	2050	2060
Projected Population	7,100	8,549	9,556	10,461	11,266	12,072
Projected Water Demand (ac-ft/yr)						
• Municipal Demand	684	996	1,145	1,242	1,325	1,420
Total Projected Water Demand	***684***	***996***	***1,145***	***1,242***	***1,325***	***1,420***
Currently Available Water Supplies (ac-ft/yr)						
• Woodbine Aquifer	752	752	752	752	752	752
Total Supply	***752***	***752***	***752***	***752***	***752***	***752***
Water Management Strategies (ac-ft/yr)						
• Water Conservation - Basic Package	15	44	62	72	82	93
• Fannin County Water Supply Project	0	399	560	666	756	859
Total Water Management Strategies	***15***	***443***	***622***	***738***	***838***	***952***
Total Supply Less Projected Demand (ac-ft/yr)	**83**	**199**	**229**	**248**	**265**	**284**

REGION C

Southwest Hickory Creek SUD Summary

Hickory Creek SUD	2010	2020	2030	2040	2050	2060
Projected Population	173	191	204	213	222	233
Projected Water Demand (ac-ft/yr)						
• Municipal Demand	30	32	34	34	36	38
Total Projected Water Demand	***30***	***32***	***34***	***34***	***36***	***38***
Currently Available Water Supplies (ac-ft/yr)						
• Woodbine Aquifer	45	45	44	44	44	30
Total Supply	***45***	***45***	***44***	***44***	***44***	***30***
Water Management Strategies (ac-ft/yr)						
• Water Conservation - Basic Package	1	3	4	5	6	7
• Water Conservation - Expanded Package	0	0	0	1	1	1
Total Water Management Strategies	***2***	***3***	***4***	***5***	***6***	***23***
Total Supply Less Projected Demand (ac-ft/yr)	**17**	**16**	**14**	**15**	**14**	**15**

REGION C

Leonard Summary

Leonard	2010	2020	2030	2040	2050	2060
Projected Population	2,149	2,502	3,500	5,500	8,000	10,000
Projected Water Demand (ac-ft/yr)						
• Municipal Demand	303	342	466	720	1,040	1,299
Total Projected Water Demand	***303***	***342***	***466***	***720***	***1,040***	***1,299***
Currently Available Water Supplies (ac-ft/yr)						
• Woodbine Aquifer	333	333	333	333	333	333
Total Supply	***333***	***333***	***333***	***333***	***333***	***333***
Water Management Strategies (ac-ft/yr)						
• Water Conservation - Basic Package	3	12	22	37	58	77
• Water Conservation - Expanded Package	3	3	4	6	9	12
• Fannin County Water Supply Project	0	62	200	487	848	1,138
Total Water Management Strategies	***6***	***77***	***226***	***531***	***915***	***1,226***
Total Supply Less Projected Demand (ac-ft/yr)	**36**	**68**	**93**	**144**	**208**	**260**

REGION C

North Hunt WSC Summary

North Hunt WSC	2010	2020	2030	2040	2050	2060
Projected Population	380	427	462	488	514	542
Projected Water Demand (ac-ft/yr)						
• Municipal Demand	49	55	60	63	66	70
Total Projected Water Demand	***49***	***55***	***60***	***63***	***66***	***70***
Currently Available Water Supplies (ac-ft/yr)						
• Woodbine Aquifer	77	77	77	77	77	77
Total Supply	***77***	***77***	***77***	***77***	***77***	***77***
Water Management Strategies (ac-ft/yr)						
• Water Conservation - Basic Package	1	2	3	3	4	4
Total Water Management Strategies	**1**	**2**	**3**	**3**	**4**	***4***
Total Supply Less Projected Demand (ac-ft/yr)	**29**	**24**	**20**	**17**	**15**	**11**

Savoy Summary

Savoy	2010	2020	2030	2040	2050	2060
Projected Population	869	889	910	930	952	974
Projected Water Demand (ac-ft/yr)						
• Municipal Demand	108	108	106	105	107	109
Total Projected Water Demand	***108***	***108***	***106***	***105***	***107***	***109***
Currently Available Water Supplies (ac-ft/yr)						
• Woodbine Aquifer	119	119	119	119	119	119
Total Supply	***119***	***119***	***119***	***119***	***119***	***119***
Water Management Strategies (ac-ft/yr)						
• Water Conservation - Basic Package	1	4	5	6	6	7
• Fannin County Water Supply Project	0	7	3	1	3	5
Total Water Management Strategies	***1***	***11***	***8***	***7***	***9***	***12***
Total Supply Less Projected Demand (ac-ft/yr)	**12**	**22**	**21**	**21**	**21**	**22**

Trenton Summary

Trenton	2010	2020	2030	2040	2050	2060
Projected Population	1,000	1,500	2,500	4,000	6,000	8,000
Projected Water Demand (ac-ft/yr)						
• Municipal Demand	206	302	496	780	1,163	1,550
Total Projected Water Demand	***206***	***302***	***496***	***780***	***1,163***	***1,550***
Currently Available Water Supplies (ac-ft/yr)						
• Woodbine Aquifer	227	227	227	227	227	227
Total Supply	***227***	***227***	***227***	***227***	***227***	***227***
Water Management Strategies (ac-ft/yr)						
• Water Conservation - Basic Package	2	22	69	115	181	255
• Water Conservation - Expanded Package	2	3	5	8	13	17
• Fannin County Water Supply Project	0	110	294	586	975	1,362
Total Water Management Strategies	***4***	***135***	***368***	***709***	***1,169***	***1,633***
Total Supply Less Projected Demand (ac-ft/yr)	**25**	**60**	**99**	**156**	**233**	**310**

REGION C

Whitewright Summary

Whitewright	2010	2020	2030	2040	2050	2060
Projected Population	22	28	32	35	38	41
Projected Water Demand (ac-ft/yr)						
• Municipal Demand	403	632	873	1,048	1,230	1,419
Total Projected Water Demand	***403***	***632***	***873***	***1,048***	***1,230***	***1,419***
Currently Available Water Supplies (ac-ft/yr)						
• Woodbine Aquifer	438	438	438	438	438	438
Total Supply	***438***	***438***	***438***	***438***	***438***	***438***
Water Management Strategies (ac-ft/yr)						
• Water Conservation - Basic Package	3	30	52	72	95	121
• Water Conservation - Expanded Package	2	4	5	7	8	9
• Grayson County Water Supply Project	0	287	552	741	935	1,135
Total Water Management Strategies	***5***	***320***	***610***	***820***	***1,038***	***1,265***
Total Supply Less Projected Demand (ac-ft/yr)	**40**	**126**	**175**	**210**	**246**	**284**

REGION C

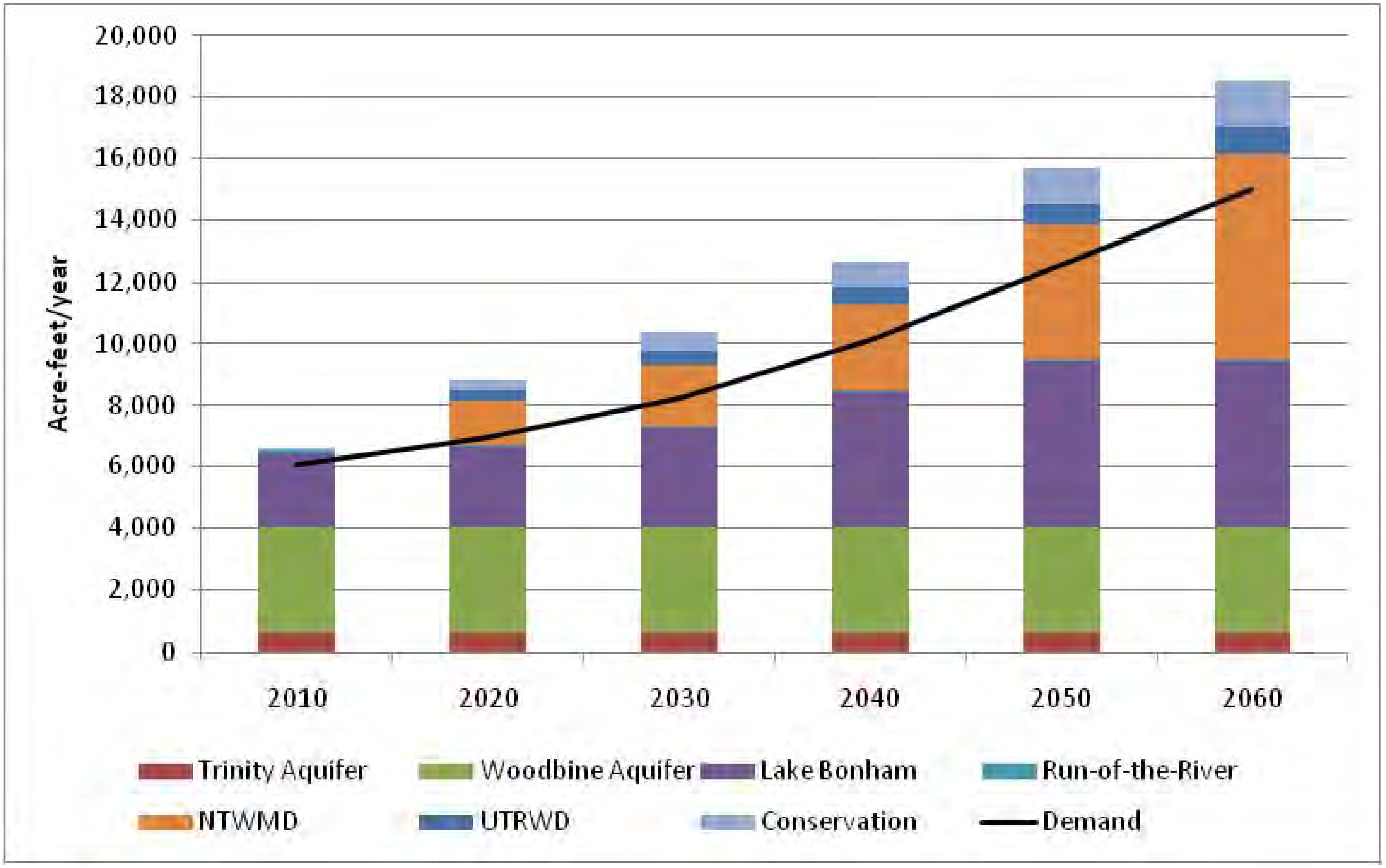
Fannin County – Other Summary

Fannin County - Other	2010	2020	2030	2040	2050	2060
Projected Population	11,610	11,568	11,391	11,091	10,735	10,322
Projected Water Demand (ac-ft/yr)						
• Municipal Demand	1,496	1,452	1,390	1,317	1,251	1,202
Total Projected Water Demand	***1,496***	***1,452***	***1,390***	***1,317***	***1,251***	***1,202***
Currently Available Water Supplies (ac-ft/yr)						
• Lake Bonham	75	73	70	66	63	60
• Run-of-river - Red River	20	20	20	20	20	20
• Run-of-river - Sulphur River	49	49	49	49	49	49
• Trinity Aquifer	308	308	308	308	308	308
• Woodbine Aquifer	831	831	831	831	831	831
Total Supply	***1,283***	***1,281***	***1,278***	***1,274***	***1,271***	***1,268***
Water Management Strategies (ac-ft/yr)						
• Water Conservation - Basic Package	16	53	70	74	75	76
• Fannin County Water Supply Project	0	408	320	233	155	98
• Additional Woodbine Aquifer (New Wells)	496	0	0	0	0	0
Total Water Management Strategies	***512***	***461***	***390***	***306***	***230***	***174***
Total Supply Less Projected Demand (ac-ft/yr)	**299**	**290**	**278**	**263**	**250**	**240**

Capital Costs for Proposed Water Management Strategies

Water Management Strategy Category	Capital Cost During Study Period
Transmission Facilities	$55,539,000
Supplemental Wells	$26,153,000
New Wells	$1,213,000
New Water Treatment Plants	$23,234,000
Water Treatment Plant Expansions	$15,017,000
Total Capital Costs for Study Area	**$121,156,000**

Total Demand and Supply for the Study Area



Conclusions

- WUGs in the Fannin County Study are projecting steady growth in the next 50 years.
- Growth greater but demand less than what was projected in the *2006 Region C Water Plan*.
- For most of the WUGs, currently planned water management strategies are in line with the strategies presented in the *2006 Region C Water Plan.*

Next Steps

- Region C Initially Prepared Plan (IPP) to be presented to Region C Board for Approval – 3/15/10
- Public Hearing on IPP – 5/25/10, 7 pm in Arlington at the Bob Duncan Center in Vandergriff Park
- Final plan adopted – 10/1/10

MEETING MINUTES

Date of Meeting:	February 4, 2010	***Time:***	6:00 PM
Meeting Location:	Bonham Public Library, Bonham, Texas		

Attendees:

APAI
Adam Rose, Preston Dillard

North Hunt WSC
Stacey Nicholson

S.W. Fannin SUD
Kevin Brown

City of Honey Grove
Joey Rickman, Jaci Garner

City of Bonham
Ronald Ford

City of Leonard
Butch Henderson

GTUA, Region C Rep.
Jerry Chapman

NTMWD
Robert McCarthy

CP&Y
Gil Barnett, Dusty Brannum, Richard Shaffer

Distribution: File

Project Name: Fannin County Special Study, Region C Water Planning Group, 2011 Update

FNI Project No.: NTD08492

CP&Y Project No.: FNI09035

CP&Y Contact Person: Richard Shaffer, 817-392-6821 (rshaffer@cpyi.com)

The following is our understanding of the major discussion items, decisions, and action points of this meeting. If this differs from your understanding, please notify the CP&Y contact person in writing within five (5) days.

DISCUSSION

Preston Dillard, PE, with APAI was the presenter for this meeting.

Introductions were made for those persons present at the meeting.

1. Region C Planning Process was reviewed.

    a. History of water planning process was covered beginning with 1997 Texas Senate Bill 1.
    b. Population will double by 2060.
    c. Region C consists of 16 counties, including Fannin County.
    d. 50-year planning period for project demand, existing supply, and strategies.
    e. Currently working on 2011 Region C Water Plan, which will be incorporated into the (2012) State Water Plan.

2. Fannin County population growth projections were reviewed. Population is expected to grow from 30,000 to over 80,000 by 2060. Reviewed year 2000 data on Fannin County water demand. Steam Electric has largest percentage of water rights at 33.3% of total.

Presented Fannin County supplies and demand chart for years 2000 through 2060. Reviewed 2060 demand, which is almost 3 times the 2000 demand.

3. Bonham Summary: Covered table of Bonham city population projections and water demands for 2010 to 2060. Region C is developing water conservation and reuse strategies to help meet the 2060 water needs.

   Other WUGs in Fannin County that were reviewed in this special study include:

   - Ector
   - Honey Grove
   - Ladonia
   - SW Fannin County SUD – Split partially to Region D
   - Leonard
   - North Hunt WSC – Numbers on table are only for Region C population; part of population is in Region D
   - Savoy
   - Trenton
   - Whitewright
   - Fannin County – Other: This category includes parts of the county that are not included in a WUG.
     - Fannin County getting a special study during this round of water planning
     - Water suppliers below certain populations and water usage were not included in the study.
     - For the next study, water suppliers that grow to the WUG threshold will be added as individual entities instead of being included in County – Other.

4. Capital costs for water management strategies were presented and reviewed. Total capital costs from the study area are projected to be $121 million.

5. Total demand and supply for the study area was reviewed via a graph. Groundwater continues to be a significant source of supply through 2060; however, surface water does increase in significance.

6. Conclusions: WUGs in Fannin County project steady growth in next 50 years from demands of near 6,000 AFY to 18,000 AFY by 2060.

7. Next Steps:
   - Region C Board meets March 15, 2010, and will approve the IPP for all Region C.
   - Public hearing on IPP will be May 25, 2010.
   - Final plan adopted October 1, 2010.

8. At 6:30 p.m. the meeting was opened for questions or comments from those present.

   A question was asked regarding the timing on the Ralph Hall Reservoir. The response was that it was uncertain and no new information was available.

The presenter mentioned that groundwater in Fannin County may be a greater focus in the next round of planning.

A question was asked about further details regarding the agricultural and irrigation demands (asked by Jerry Chapman) Preston responded that he will look into this further, but did not have more details at the moment.

Jerry Chapman asked if the Steam Electric portion of the water demand shown in the Fannin County Study was all predicated on TXU's Savoy plant. The Savoy plant has water rights from storage at Texoma, but that could change. Preston mentioned that water rights are not given up even in the case of a power plant shutdown, and the Region needs to look carefully at the status of permits and water rights for steam electric during the 5 year planning cycles. Some water allocated to steam electric and other areas may not be used currently, but should be accounted for in the planning process as long as the rights exist.

Jerry Chapman mentioned that it is important for WUGs to include any possible projects in the information supplied to the Region C Plan. The state is following through with funding so it is important to have your strategies documented in the Plan so they will have the opportunity for funding.

Preston thanked everyone for attending and for their efforts and input.

Rick Shaffer commented that a water infrastructure finance survey will be going out soon and to be watching for it.

9. At 6:50 p.m. the meeting concluded.

APPENDIX U

WATER SUPPLY STUDY FOR FREESTONE COUNTY

Water Supply Study for Freestone County

September 2010

Prepared for:

Region C Water Planning Group

Prepared by:

Freese and Nichols, Inc

Alan Plummer Associates, Inc

CP&Y, Inc

Water Supply Study for Freestone County
Region C Water Planning Group

TABLE OF CONTENTS

Page

1. Executive Summary 1.1
2. Introduction 2.1
3. Population and Demand Projections 3.1
   3.1 Meetings to Collect Data 3.1
   3.2 Revisions to Population and Demand Projections 3.2
   3.3 Recommended Population Projections 3.3
   3.4 Recommended Water Demands for Water User Groups 3.6
   3.5 Recommended Water Demands for Wholesale Water Providers 3.9
4. Evaluation of Current Supplies 4.1
   4.1 Surface Water 4.1
   4.2 Groundwater 4.1
5. Comparison of Current Supplies to Projected Demand 5.1
6. Proposed Revisions to Water Management Strategies 6.1
7. Estimated Costs for Proposed Water Management Strategies 7.1
8. Implementation Plan for Proposed Water Management Strategies 8.1
9. Conclusion 9.1

APPENDICES

Appendix 1 .... References

Appendix 2 .... Mid-East Texas GCD Resolution 2009-01

LIST OF TABLES

Page

Table 3.1 Meetings with WUGs and GCDs ... 3.1

Table 3.2 Recommended Population Projections in Study Area ... 3.5

Table 3.4 Recommended Municipal Per Capita Water Use Projections in Gallons per Person per Day ... 3.7

Table 3.5 Recommended Demand Projections in Acre-Feet per Year ... 3.8

Table 3.6 Demand Projections Expected to be Supplied by WWPs ... 3.10

Table 4.1 Pumping Allocations through 2060 for the Mid-East GCD ... 4.2

Table 6.1 Summary Information for Fairfield ... 6.2

Table 6.2 Summary Information for Teague ... 6.3

Table 6.3 Summary Information for Wortham ... 6.4

Table 6.4 Summary Information for Freestone County Steam Electric Power ... 6.6

Table 7.1 Capital Costs for Proposed Water Management Strategies by Category ... 7.1

Table 7.2 Capital Costs for Proposed Water Management Strategies by WUG ... 7.1

Table 8.1 Implementation of Proposed Water Management Strategies ... 8.1

LIST OF FIGURES

Page

Figure 2.1 Freestone County Study Area 2.2
Figure 3.1 Recommended Population Projections for Freestone County 3.6
Figure 3.2 Recommended Municipal Demand Projections for Freestone County 3.7
Figure 3.3 Recommended Total Demand Projections for Freestone County 3.9
Figure 9.1 Total Demands and Supplies for Freestone County 9.1

Region C Water Planning Group
Water Supply Study for Freestone County

1. Executive Summary

As part of the 2011 Region C water planning process, several individual county studies were included to more closely examine the water management strategies for those counties. Freestone County is one of the counties included in the studies. The purpose of this study is to provide supplementary information regarding water management strategies and to then analyze the feasibility of developing a Freestone County Water Supply System. The impacts of the Mid-East Texas Groundwater Conservation District pumping policies were also evaluated to determine the effects on future supplies for Freestone County. Water management strategies (WMSs) were updated based on information obtained from meetings with various water user groups (WUGs) in Freestone County as well as from surveys mailed to every WUG in Region C. Several WMSs were revised to reflect new demand projections as determined in the *2011 Region C Water Plan* (1). The population and demand projections in the *2011 Region C Water Plan* (1) are lower than the *2006 Region C Water Plan* (2) projections from 2010 to 2030 and higher from 2040 to 2060. Cost estimates and an implementation plan for water management strategies are also included in this report.

The majority of WUGs in Freestone County rely on groundwater from the Carrizo-Wilcox Aquifer. The largest water user in the county is steam electric power which uses mostly surface water.

(1) Superscripted numbers in parenthesis match references in Appendix 1.

2000 Population: *17,867*

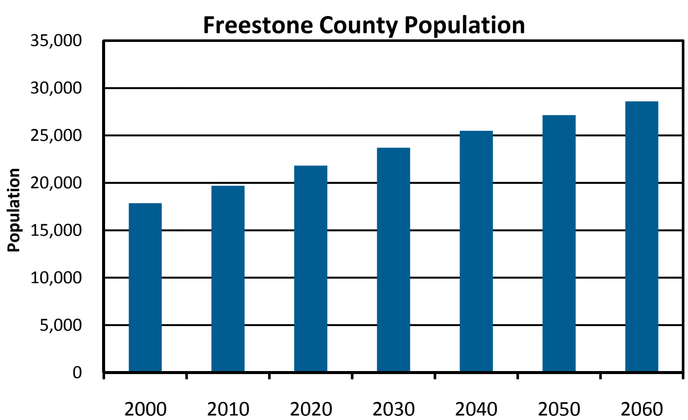
Projected 2060 Population: *28,593*

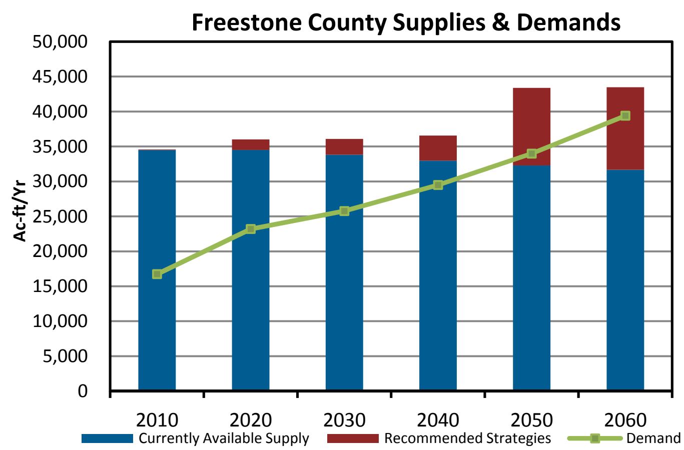
County Seat: *Fairfield*

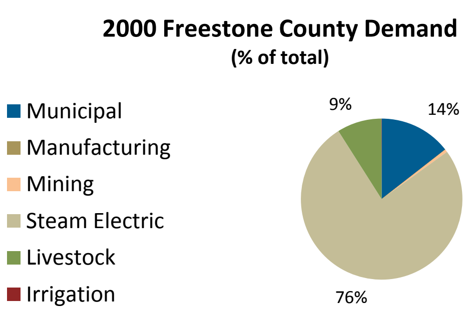
Economy: *Natural gas, mining, electricity generating plants, agriculture.*

River Basin(s):

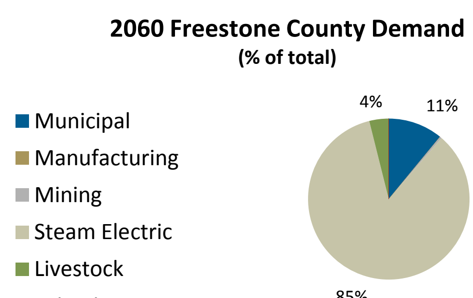
– Trinity (89%), Brazos (11%)







Total= 17,107 acre-feet



Total= 39,396 acre-feet

WATER USER GROUP	2060 FREESTONE CO. DEMAND (AC-FT/YR)	CURRENT SUPPLIES	RECOMMENDED STRATEGIES [b]
Fairfield	1,588	Carrizo-Wilcox Aquifer	New WTP, TRWD, Additional Carrizo-Wilcox Aquifer, Supplemental wells
Flo Community WSC [a]	19	Carrizo-Wilcox Aquifer	Supplemental wells
Freestone County-Irrigation	8	Carrizo-Wilcox Aquifer, Local supplies	Supplemental wells
Freestone County-Livestock	1,528	Carrizo-Wilcox, Other, and Queen City Aquifers, Local supplies	Supplemental wells
Freestone County-Manufacturing	0	None	None
Freestone County-Mining	149	Carrizo-Wilcox Aquifer, Local supplies	Supplemental wells
Freestone County-Other	1,229	Carrizo-Wilcox Aquifer, Run-of-river, TRWD	Additional water from TRWD, Supplemental wells
Freestone County-Steam Electric Power	33,398	Carrizo-Wilcox Aquifer, Lake Fairfield, Lake Livingston (upstream diversion), TRWD	Supplemental wells, Additional water from TRWD through TRA, TRA reuse
Teague	982	Carrizo-Wilcox Aquifer	Supplemental wells, Additional Carrizo-Wilcox Aquifer
Wortham	495	Bistone Municipal Water Supply District (Carrizo-Wilcox Aquifer in Limestone County)	Corsicana, TRWD (through TRA), WTP expansion/rehabilitation

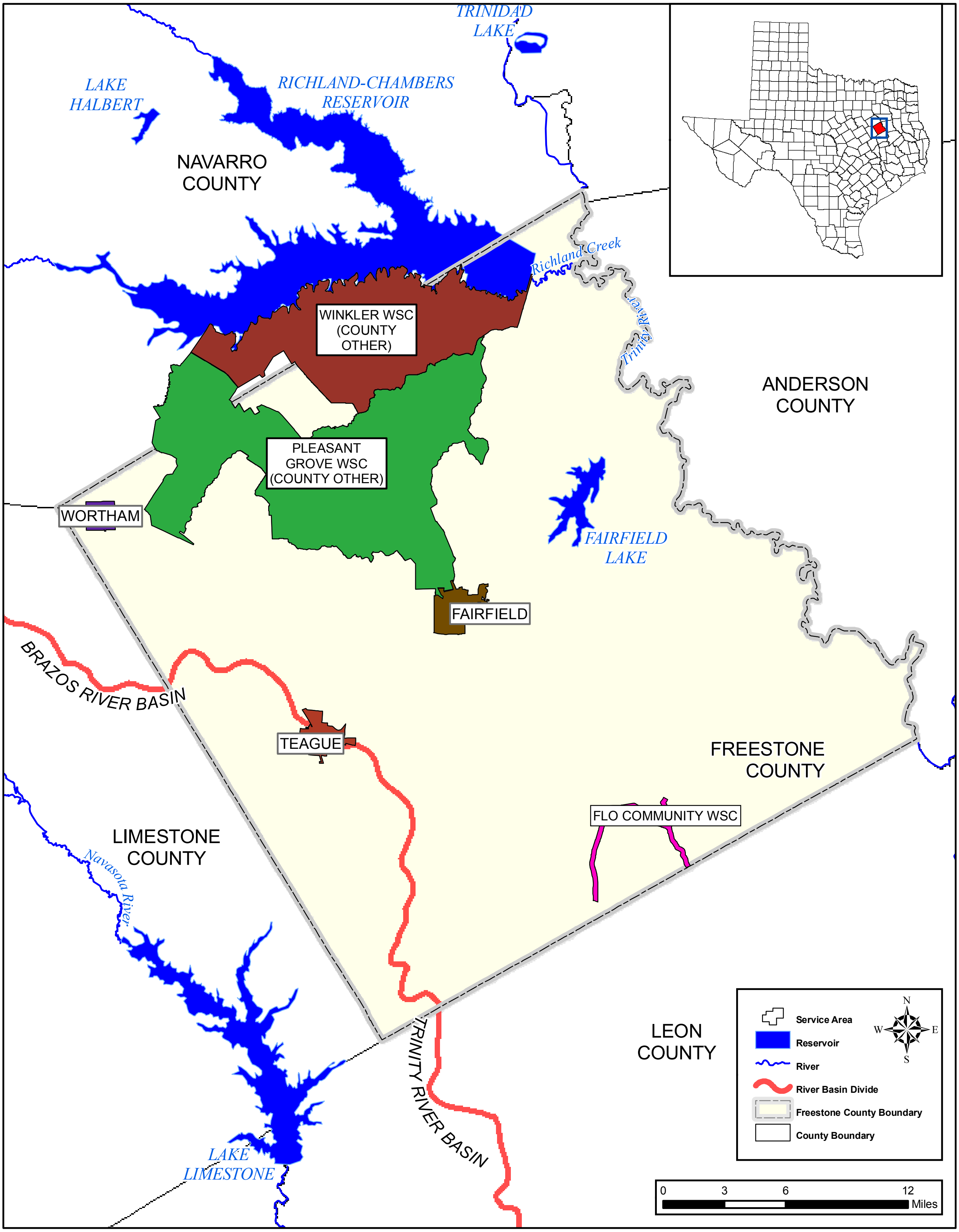
[a] Freestone County portion only
[b] Water conservation is a strategy for every municipal user group

2. Introduction

The *2011 Region C Water Plan* (1) includes special county studies funded by the Texas Water Development Board (TWDB). The consultant team for the *2011 Region C Water Plan* (1) includes Freese and Nichols, Inc. (FNI), Alan Plummer and Associates (APAI), CP&Y, Inc., and Cooksey Communications. The special county studies are aimed at analyzing approaches to developing and implementing the water management strategies for the counties. The Freestone County Study is one of these projects.

Many of the water management strategies developed in this study are in line with the *2006 Region C Water Plan* (2). However, several of the Water User Group (WUG) demands have increased in the long term and those water management strategies have been reevaluated. This report summarizes the analysis and recommendations for meeting water demand projections for WUGs in Freestone County and the feasibility of a regional water supply project. The study area is shown in Figure 2.1.

Figure 2.1
Freestone County Water Supply Service Areas



3. Population and Demand Projections

3.1 Meetings to Collect Data

Freese and Nichols, Inc. (FNI) met with three water user groups (WUGs) in Freestone County and one groundwater conservation district (GCD) in the summer of 2009. Table 3.1 lists the meetings held and the meeting participants. At each meeting, FNI presented the population and demand projections as shown in the *2006 Region C Water Plan* (2) as well as draft projections for the *2011 Region C Water Plan* (1). The current population and water use estimates of the entity and their existing and/or potential future customers were discussed.

Table 3.1
Meetings with WUGs and GCDs

Date	Entity	Meeting Type	Attendees
July 15, 2009	Fairfield	In person	Jeff Looney, Billy Chancellor, Scott Schick, Keeley Brown, Rachel Ickert
July 15, 2009	Mid-East Texas Groundwater Conservation District	In person	Robert Gresham, David Bailey, Keeley Brown, Rachel Ickert
July 1, 2009	Teague	In person	Gus Ramirez, Don Doering, Keeley Brown, Rachel Ickert
July 1, 2009	Wortham	In person	Wayne Gierisch, Cliff Nedsmith, Mayor Ken Gibbs, Albert E. Hall, Butch Davis, Keeley Brown, Rachel Ickert

The current water supply for each entity, the recommended water management strategies as presented in the *2006 Region C Water Plan* (2), and any suggested adjustments to those recommendations were discussed. In most cases, the entities plan to implement the recommended strategies, although the amounts of supply have changed. In a few cases, the entities are pursuing other options for water supply to meet their future needs.

The information obtained in these meetings was used to develop updated population and demand projections. The updated information related to water supply was used to supplement or update proposed management strategies.

3.2 Revisions to Population and Demand Projections

The following section discusses the revisions to the population and demand projections as adopted in the *2011 Region C Water Plan* [1]. Municipal per capita water use (measured in gallons per capita per day) and population projections are used to project future water demand. Municipal per capita water use is the sum of residential, commercial, and institutional water use divided by the population served.

Fairfield

Revised population projections for the City of Fairfield were developed based on historical data. The revised projections are lower than *2006 Region C Water Plan* [2] projections for 2010 through 2050 based on Census, State Demographer, and TWDB data. The 2060 projection remained the same as the number presented in the *2006 Region C Water Plan* [2]. The demand projections were changed based on the decreased population projections. The municipal per capita water use estimates did not change.

Wortham

Revised population projections for the City of Wortham were developed based on input from the City and the TWDB. Population projections were increased for all years. The demand was increased based on the changes to population. The municipal per capita values are the same as those presented in the *2006 Region C Water Plan* [2].

Additional County Aggregated Projections

The Region C consultant team examined the demand projections developed in the *2006 Region C Water Plan* [2] for county-other, manufacturing, mining, irrigation, livestock, and steam electric power. In Freestone County, only the steam electric power demands were adjusted for the *2011 Region C Water Plan* [1].

The steam electric power demands in Freestone County were decreased based on lower recent demands and projections presented by the Bureau of Economic Geology (BEG) in the study *Water Demand Projections for Power Generation in Texas* [3]. The demand projections presented in the *2006 Region C Water Plan* [2] are too high based on historical data from the TCEQ and the TWDB. The BEG demand projections are lower than what the historical trends indicate. The new steam electric demand projections for

Freestone County are lower than those in the 2006 Plan and higher than the BEG projections. The existing power plants located in Freestone County are the Big Brown Power Company LLC (Luminant) and Calpine–Freestone Power Generation LP plants.

Water User Groups Whose Population and Demand Projections are Unchanged

Population and demand projections remain unchanged for several water user groups. The population and demand projections presented in the *2006 Region C Water Plan* (2) are recommended to remain as previously projected for the following water user groups:

- Flo Community WSC
- Freestone County – Irrigation
- Freestone County – Livestock
- Freestone County – Manufacturing
- Freestone County - Mining
- Freestone County - Other
- Teague

Flo Community WSC is located in both Freestone (Region C) and Leon Counties (Region H). Over 90 percent of the population and demand for Flo Community WSC is located in Leon County. The Region C demands are met by groundwater in Freestone County.

3.3 Recommended Population Projections

Freese and Nichols, Inc. (FNI) collected available historical and projected population data for each entity through the in-person meetings. Additional historical population data was gathered from the Texas State Data Center (4), the U.S. Census Bureau (5), and the North Central Texas Council of Governments (NCTCOG) (6). FNI also gathered population projections developed by the NCTCOG and those approved by the Texas Water Development Board for regional water planning. Additional input from entities was obtained through surveys mailed to each WUG in Region C.

The population information was used to review growth in the cities. In general, the population in Freestone County is growing as projected in the *2006 Region C Water Plan* [2]. The revised recommended projections are based on information provided by the entities and on historical population estimates. The total recommended population projections for Freestone County are lower than the *2006 Region C Water Plan* [2] projections from 2010 to 2030 and higher from 2040 to 2060.

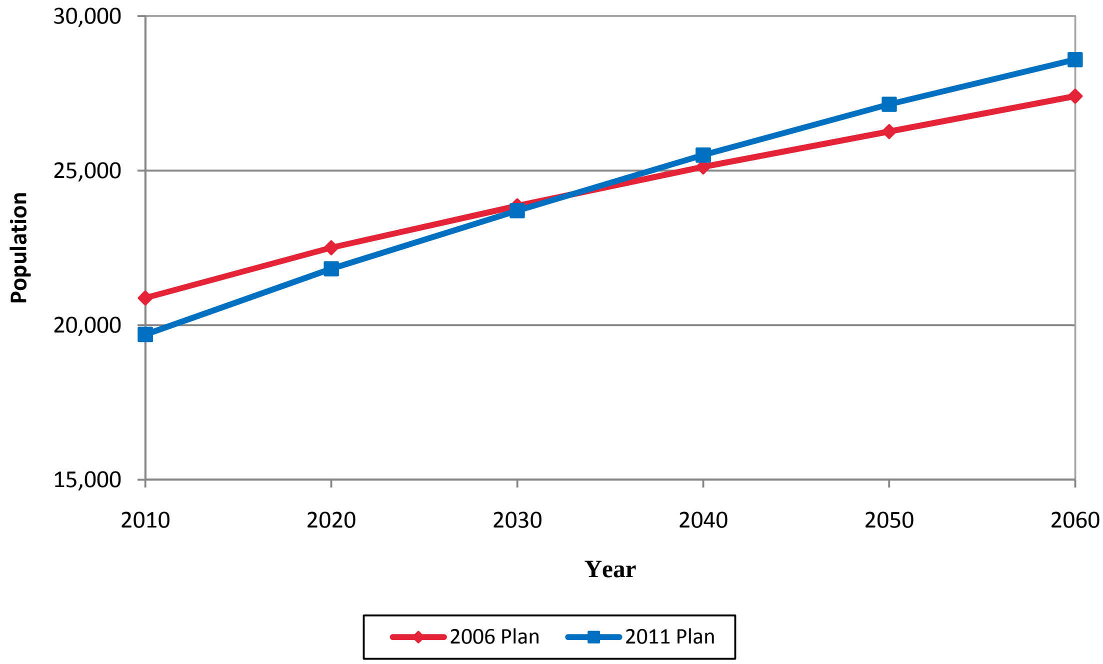
Table 3.2 presents recommended population projections for each water user group in the study area, as well as what was previously projected in the *2006 Region C Water Plan* [2]. Figure 3.1 shows the population projections for Freestone County.

Table 3.2
Recommended Population Projections for Freestone County

Water User Group	2006 Plan Projections						2011 Plan Projections					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
Fairfield	5,000	5,500	6,000	6,500	7,000	7,500	3,700	4,500	5,300	6,100	6,900	7,500
Flo Community WSC [(a)]	252	263	269	271	271	271	252	263	269	271	271	271
Freestone County - Other	9,298	9,717	9,935	9,998	9,998	9,998	9,298	9,717	9,935	9,998	9,998	9,998
Teague	5,201	5,846	6,450	7,135	7,779	8,424	5,201	5,846	6,450	7,135	7,779	8,424
Wortham	1,131	1,182	1,209	1,217	1,217	1,217	1,250	1,500	1,750	2,000	2,200	2,400
Freestone County Total	**20,882**	**22,508**	**23,863**	**25,121**	**26,265**	**27,410**	**19,701**	**21,826**	**23,704**	**25,504**	**27,148**	**28,593**

[(a)] Freestone County Portion Only

Figure 3.1
Recommended Population Projections for Freestone County



3.4 Recommended Water Demands for Water User Groups

The municipal water demand projections presented in this section are based on per capita dry-year water use and the adopted population projections from the previous section. The per capita dry-year water uses presented in this section are based on the per capita water uses from the *2006 Region C Water Plan* (2). No adjustments to the per capita water uses from the *2006 Region C Water Plan* (2) were made for Freestone County.

Municipal demand projections were changed based on changes made to population projections. The population projection was multiplied by the projected municipal per capita water use to establish the projected demand for each entity. Historical and projected water demands, as well as water demands provided by entities, were reviewed and considered. Table 3.4 summarizes the municipal per capita water use projections. These numbers include water savings from plumbing code requirements for low-flow fixtures. Municipal per capita water use is the sum of residential, commercial, and institutional water use divided by the population served. Table 3.5 lists the recommended demand projections for this study. Figure 3.2 shows the municipal demands from the 2006 Plan in relation to the 2011 Plan demand projections.

Table 3.4
Recommended Municipal Per Capita Water Use Projections in Gallons per Person per Day

Water User Group	2010	2020	2030	2040	2050	2060
Fairfield	200	196	193	190	189	189
Flo Community WSC [a]	71	68	66	66	63	63
Freestone County - Other	120	117	114	111	110	110
Teague	92	110	107	105	104	104
Wortham	194	191	188	185	184	184

[a] Freestone County portion only

Figure 3.2
Recommended Municipal Demand Projections for Freestone County

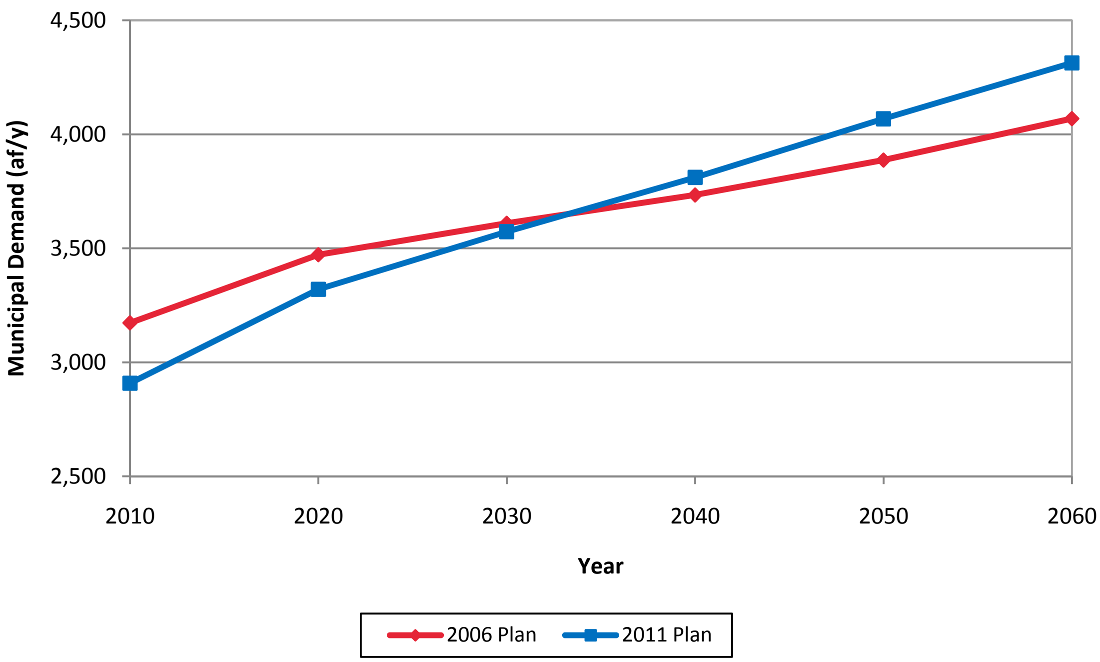


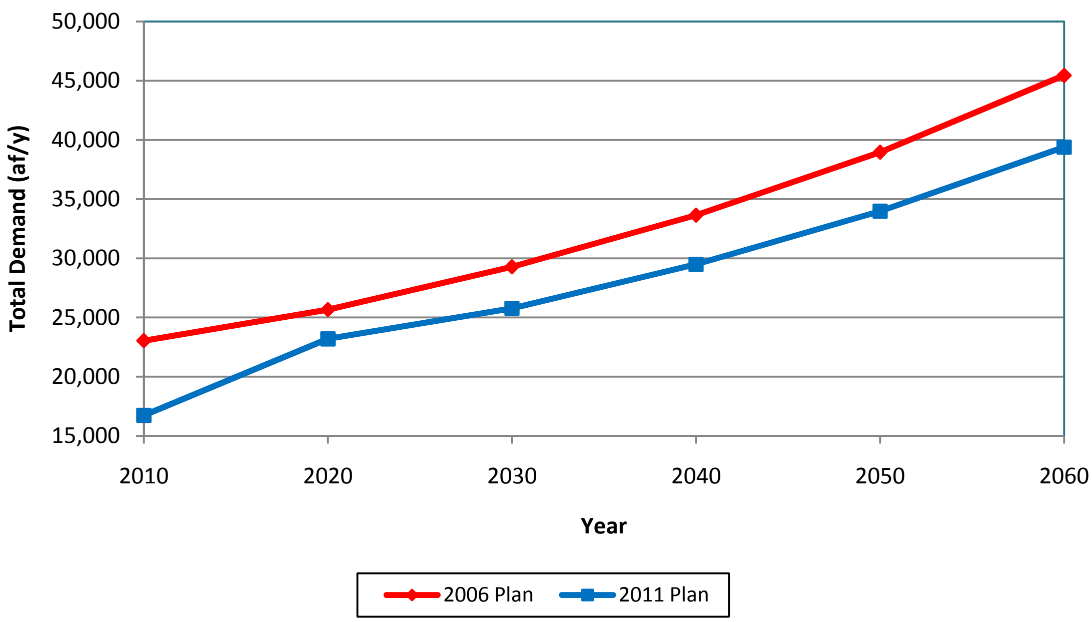
Table 3.5
Recommended Demand Projections in Acre-Feet per Year in Freestone County

Water User Group	2006 Plan Projections						2011 Plan Projections					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
Fairfield	1,120	1,208	1,297	1,383	1,482	1,588	829	988	1,146	1,298	1,461	1,588
Flo Community WSC [a]	20	20	20	20	19	19	20	20	20	20	19	19
Freestone County - Other	1,251	1,271	1,265	1,240	1,229	1,229	1,251	1,271	1,265	1,240	1,229	1,229
Freestone County - Irrigation	8	8	8	8	8	8	8	8	8	8	8	8
Freestone County -Livestock	1,528	1,528	1,528	1,528	1,528	1,528	1,528	1,528	1,528	1,528	1,528	1,528
Freestone County -Manufacturing	0	0	0	0	0	0	0	0	0	0	0	0
Freestone County -Mining	116	126	132	138	144	149	116	126	132	138	144	149
Freestone County -Steam Electric Power	18,210	20,524	23,999	28,234	33,398	39,692	12,173	18,210	20,524	23,999	28,234	33,398
Teague	536	720	773	839	906	982	536	720	773	839	906	982
Wortham	246	253	255	252	251	251	272	321	369	414	453	495
Freestone County Total	**23,035**	**25,658**	**29,277**	**33,642**	**38,965**	**45,446**	**16,733**	**23,192**	**25,765**	**29,484**	**33,982**	**39,396**

[a] Freestone County portion only

Non-municipal water demand projections including manufacturing, steam electric power, irrigation, mining, and livestock are reported on a county-wide basis. Projections of the non-municipal water demands were based on the projections from the *2006 Region C Water Plan* (2). Projections for manufacturing, irrigation, and livestock did not change from the *2006 Region C Water Plan* (2) for any of the counties in Region C. The steam electric power demands were revised based on available new information, which included recent power plant development activity, mothballing of existing plants, and the Bureau of Economic Geology report (3) released in 2008. Table 3.5 shows the projected demands for Freestone County. Figure 3.3 shows the total demands for Freestone County from the 2006 and 2011 Region C Water Plans (1, 2).

Figure 3.3
Recommended Total Demand Projections for Freestone County



3.5 Recommended Water Demands for Wholesale Water Providers

There are currently no wholesale water providers (WWP) in Freestone County. The City of Fairfield may be interested in becoming a WWP at some point. Possible communities that Fairfield would serve include Wortham, Streetman, Butler, Kirvin, Dew, and Oakwood.

Table 3.6
Demand Projections Expected to be Supplied by WWPs

Demand Supplied by WWPs	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Demand Supplied by TRWD						
Fairfield	0	0	0	6	169	296
Freestone County Other	285	344	388	400	400	400
Freestone County Steam Electric Power	6,726	7,726	7,726	7,726	7,726	7,726
Wortham	0	300	300	300	300	300
Demand on TRWD in Study Area	**7,011**	**8,370**	**8,414**	**8,432**	**8,595**	**8,722**
Demand Supplied by Corsicana						
Wortham	0	300	300	300	300	300
Demand Supplied by TRA						
Freestone County Steam Electric Power (Reuse)	0	0	0	0	1,508	6,672
Freestone SEP Power (Livingston to Luminant)	16,643	19,091	20,000	20,000	20,000	20,000
Demand on TRA in Study Area	***16,643***	***19,091***	***20,000***	***20,000***	***21,508***	***26,672***
Demand on WWPs in Study Area	**23,654**	**27,761**	**28,714**	**28,732**	**30,403**	**35,694**

4. Evaluation of Current Supplies

4.1 Surface Water

Surface water is used to meet steam electric demands in Freestone County. Surface water sources including Lake Fairfield, Lake Livingston (TRA – by upstream diversion from the Trinity River), and Tarrant Regional Water District (TRWD) sources are used to meet the steam electric power demands for the two existing power plants in Freestone County. The City of Fairfield is considering surface water as a possible future water supply by either purchasing water from TRWD or building a new reservoir that would be owned by the City.

4.2 Groundwater

All of the water user groups in the study area, with the exception of Wortham, intend to continue using groundwater from the Carrizo-Wilcox aquifer. An updated Managed Available Groundwater (MAG) assessment was not completed for the Carrizo-Wilcox aquifer before the TWDB's deadline for inclusion in this plan. Consequently, the estimated supply from the *2006 Regional Water Plan* (2) was used again for the 2011 Plan. However, the allocation of groundwater was changed to account for changes in projected demands.

In 2001, the Mid-East Texas Groundwater Conservation District (METGCD) was created by the Texas Legislature as part of House Bill 1784. The conservation district includes Madison, Leon, and Freestone counties. The purpose of the District is to promote water conservation, provide public information, prevent the pollution of groundwater resources, and maintain a regulatory permitting system which prevents aquifer drawdown and consequent reductions of groundwater availability to future generations (7).

In accordance with the Texas Water Code, desired future conditions (DFCs) of the groundwater within the District must be established. The DFCs are determined through joint planning by the Groundwater Districts that comprise Groundwater Management Area 12 (GMA 12). Once DFCs are established they will be reported to the Texas Water Development Board (TWDB) who will then calculate the Managed Available

Groundwater (MAG). Each Groundwater Conservation District will use the MAG calculations to determine the available groundwater in that district. The DFCs for GMA 12 have yet to be finalized. However, preliminary DFCs were adopted in June 2009 (see Appendix 2 of this report). Final managed available groundwater values for the aquifers located within the Mid-East Texas Groundwater Conservation District are not yet available. When looking at the groundwater supplies allocated within the METGCD's boundaries (Leon, Madison, and Freestone Counties) the total pumping through 2060 is well below the pumping used to calculate the drawdowns in the DFCs. The drawdowns in the preliminary DFCs, included in Resolution 2009-01, are based on 25,000 acre-feet per year total annual pumping within the District. Resolution 2009-01 is included in Appendix 2. Table 3.6 shows the pumping allocations, as established by the Region C and Region H planning groups, for the counties in the District and the pumping allocations through 2060.

Table 4.1
Pumping Allocations through 2060 for the
Mid-East Texas Groundwater Conservation District

	Pumping Allocations through 2060 (Ac-Ft)			
Aquifer	**Leon County (8)**	**Madison County (8)**	**Freestone County (1)**	**Totals**
Carrizo-Wilcox	4,623	1,372	5,197	11,192
Sparta	1,431	1,010	0	2,441
Queen City	343	96	40	479
Other Aquifer	0	329	50	379
Totals	**6,397**	**2,807**	**5,287**	**14,491**

A number of pumping policies are discussed in the METCGD's District Rules. Several of the rules could possibly affect future groundwater supply within Freestone County, including rules regarding production limits and the renewal of operating permits. For wells requiring an operating permit an annual production limit is set at an amount the District determines does not unreasonable affect existing groundwater and surface water resources. Operating permits are generally renewed at the end of each permit term unless aquifer conditions indicate that a reduction in production is required to prevent aquifer mining. It is unlikely that the above rules will affect the future groundwater supply in Freestone County, but they must be considered in regional water planning. Water Management Strategies to prepare for possible depletions in available groundwater are discussed in Chapter 6.

5. Comparison of Current Supplies to Projected Demand

The revised projected demands in the study area are lower than those shown in the *2006 Region C Water Plan* [2] from 2010 to 2030 and higher for the years 2040 through 2060. Wortham is the only water user group having a revised demand that exceeds the total of their current supplies plus the recommended water management strategies in the *2006 Region C Water Plan* [2]. The water management strategies for Wortham must be revised to meet increased demands. To meet the increased demands of other WUGs, water was reallocated or supplies from existing sources were increased. The proposed revisions are discussed in the following section.

6. Proposed Revisions to Water Management Strategies

This section describes the proposed water management strategies adjustments for the *2011 Region C Water Plan* [1]. Appendix C of the *2011 Region C Water Plan* [1] includes a summary table of demand and supply for each water user group in Freestone County.

Fairfield

The City of Fairfield currently relies on the Carrizo-Wilcox aquifer and plans to continue using groundwater as long as possible. Fairfield will drill new and supplemental wells as needed. Water from the Tarrant Regional Water District (TRWD) is still a future water supply strategy for Fairfield. Fairfield has an agreement with TRWD for 1.5 million gallons per day (1,680 acre-feet per year) from Richland-Chambers Reservoir. Fairfield is not currently utilizing TRWD supplies because the City's current demands can be met with groundwater and there is no infrastructure in place to utilize TRWD supplies. A water treatment plant would have to be built before TRWD supplies could be utilized by the City. The City is also considering building a new reservoir (to be owned by the City) to meet their future water demands.

Fairfield's current water management strategies are in line with the strategies in the *2006 Region C Water Plan* [2]. Water from the Carrizo-Wilcox aquifer was reallocated in the *2011 Region C Water Plan* [2] producing a greater supply for Fairfield than the supply available to the City in the *2006 Region C Water Plan* [2]. Table 6.1 is a summary table for the City of Fairfield.

Table 6.1
Summary Information for Fairfield

Fairfield	2011 Plan Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	3,700	4,500	5,300	6,100	6,900	7,500
Projected Water Demand						
Municipal Demand	829	988	1,146	1,298	1,461	1,588
Total Projected Water Demand	***829***	***988***	***1,146***	***1,298***	***1,461***	***1,588***
Currently Available Water Supplies						
Carrizo-Wilcox Aquifer	1,292	1,292	1,292	1,292	1,292	1,292
Total Supply	***1,292***	***1,292***	***1,292***	***1,292***	***1,292***	***1,292***
Need (Demand - Supply)	***0***	***0***	***0***	***6***	***169***	***296***
Water Management Strategies						
Water Conservation - Basic Package	7	24	37	76	98	120
Purchase water from TRWD	0	0	0	4	100	176
New well in Carrizo-Wilcox Aquifer	0	0	0	282	282	282
Supplemental wells in Carrizo-Wilcox Aquifer	0	0	0	0	0	0
New WTP	0	0	0	0	0	0
Total Water Management Strategies	***7***	***24***	***37***	***362***	***480***	***578***
Reserve or (Shortage)	**470**	**328**	**183**	**356**	**311**	**282**

Teague

The current and planned future water supply for the City of Teague is the Carrizo-Wilcox aquifer. Teague plans to drill a new groundwater well in the near future. The City does not have any surface water supplies and has no plans to add surface water supplies to the system. Teague is not a wholesale water provider and is not interested in becoming a wholesale water provider.

Teague's currently planned water management strategies are in line with the strategies in the *2006 Region C Water Plan* [(2)]. Teague's supply from the Carrizo-Wilcox aquifer has been increased from the *2006 Region C Water Plan* [(2)]. Table 6.2 is a summary table for the City of Teague.

Table 6.2
Summary Information for Teague

Teague	2011 Plan Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	5,201	5,846	6,450	7,135	7,779	8,424
Projected Water Demand						
Municipal Demand	536	720	773	839	906	982
Total Projected Water Demand	***536***	***720***	***773***	***839***	***906***	***982***
Currently Available Water Supplies						
Carrizo-Wilcox Aquifer	994	994	994	994	994	994
Total Supply	***994***	***994***	***994***	***994***	***994***	***994***
Future Need	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation - Basic Package	6	22	32	38	45	52
New wells in Carrizo-Wilcox Aquifer	0	221	221	443	443	443
Supplemental wells in Carrizo-Wilcox Aquifer	0	0	0	0	0	0
Total Water Management Strategies	***6***	***243***	***253***	***481***	***488***	***495***
Reserve or (Shortage)	**464**	**517**	**474**	**636**	**576**	**507**

Wortham

The City of Wortham currently purchases groundwater from the City of Mexia (through Bistone MWSD) in Limestone County. A contract exists between the City of Wortham and the City of Mexia which allows for use of up to 500,000 gallons per day. The contract has 30 years remaining and is not a take-or-pay contract.

Wortham plans to rehabilitate their water treatment plant and use Wortham Lake as an interim supply for four to five years to reduce water costs. There are plans to upgrade the plant and it should be online in 2012. Once the plant is back online Wortham will no longer purchase water from Mexia, but will begin purchasing water from Corsicana or TRWD (Richland-Chambers Reservoir) around 2020. If Wortham begins purchasing water from Corsicana the plant will be taken offline, but if Wortham begins purchasing water from TRWD the plant will remain in operation. Wortham has reached an agreement with Corsicana, and Corsicana passed a resolution to supply Wortham if or when Wortham requests water and constructs the facilities required to transmit water from Corsicana to Wortham. Table 6.3 is a summary table for the City of Wortham.

Table 6.3
Summary Information for Wortham

Wortham	2011 Plan Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	1,250	1,500	1,750	2,000	2,200	2,400
Projected Water Demand						
Municipal Demand	272	321	369	414	453	495
Total Projected Water Demand	***272***	***321***	***369***	***414***	***453***	***495***
Currently Available Water Supplies						
Wortham Lake	0	0	0	0	0	0
Carrizo-Wilcox Aquifer (Limestone County)	560	0	0	0	0	0
Total Supply	***560***	***0***	***0***	***0***	***0***	***0***
Future Need	***0***	***321***	***369***	***414***	***453***	***495***
Water Management Strategies						
Water Conservation - Basic Package	14	38	49	58	68	78
Purchase treated water from Corsicana	0	300	300	300	300	300
Purchase water from TRWD (Richland-Chambers)	0	300	300	300	300	300
WTP expansion/rehabilitation	0	0	0	0	0	0
Total Water Management Strategies	***14***	***638***	***649***	***658***	***668***	***678***
Reserve or (Shortage)	**302**	**317**	**280**	**244**	**215**	**183**

Freestone County Steam Electric Power

The water management strategies for Freestone County Steam Electric Power have been adjusted as shown in Table 6.4 to reflect the changes in projected demands. Steam electric power demands from the *2006 Region C Water Plan* (2) were reevaluated using more recent studies and improved methodologies for determining steam electric power water use. The projected demands for Freestone County steam electric power water use have been reduced since the *2006 Region C Water Plan* (2) based on information from the 2006 Plan and the Bureau of Economic Geology study, *Water Demand Projections for Power Generation in Texas* (3) .

Steam electric demands in Freestone County are currently met through groundwater, Trinity River Authority (TRA) sources, and TRWD sources (through TRA). Luminant holds a water right in Lake Fairfield for 14,150 acre-feet per year, but the 2060 firm yield of the lake is only 870 acre-feet per year. Lake Livingston is located in Region H and water used to meet Freestone County SEP demands is purchased through TRA. Calpine-Freestone Power Generation LP has a contract with TRWD for 6,722 acre-feet per year.

Table 6.4
Summary Information for Freestone County Steam Electric Power

	2011 Plan Projections					
Freestone County Steam Electric Power	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Water Demand						
Steam Electric Power Demand	12,173	18,210	20,524	23,999	28,234	33,398
Total Projected Water Demand	***12,173***	***18,210***	***20,524***	***23,999***	***28,234***	***33,398***
Currently Available Water Supplies						
Carrizo-Wilcox Aquifer	745	745	745	745	745	745
Lake Fairfield	870	870	870	870	870	870
Lake Livingston (Luminant-Fairfield)	20,000	20,000	20,000	20,000	20,000	20,000
TRWD Sources	6,722	6,722	6,026	5,214	4,566	3,981
Total Supply	***28,337***	***28,337***	***27,641***	***26,829***	***26,181***	***25,596***
Future Need	***0***	***0***	***0***	***0***	***2,053***	***7,802***
Water Management Strategies						
Purchase Water from TRWD	4	4	700	1,512	2,160	2,745
Purchase Water from TRWD (above existing contract)	0	1,000	1,000	1,000	1,000	1,000
TRA Reuse	0	0	0	0	6,760	6,760
Total Water Management Strategies	***4***	***1,004***	***1,700***	***2,512***	***9,920***	***10,505***
Reserve or (Shortage)	**16,168**	**11,131**	**8,817**	**5,342**	**7,867**	**2,703**

Water User Groups with No Revisions to Water Management Strategies

The water user groups in Freestone County that have no revisions to water management strategies as presented in the *2006 Region C Water Plan* [2] include the following:

- Flo Community WSC
- Freestone County – Irrigation
- Freestone County – Livestock
- Freestone County – Manufacturing
- Freestone County – Mining
- Freestone County – Other

Summary tables for these water user groups are included in Appendix C of the *2011 Region C Water Plan* [1].

7. Estimated Costs for Proposed Water Management Strategies

The estimated costs for proposed water management strategies were updated and are included in Appendix Q of the *2011 Region C Water Plan* [(1)]. Total capital cost for the Freestone County Study Area through the year 2060 is estimated to be approximately $58 million. The capital costs are broken down by category in Table 7.1 and by water user group (WUG) in Table 7.2. Refer to Appendix Q for additional details.

Table 7.1
Capital Costs for Proposed Water Management Strategies by Category

Water Management Strategy Category	**Capital Cost During Study Period**
Transmission Facilities	$37,316,000
New Wells	$1,475,738
Supplemental Wells	$8,290,000
New Water Treatment Plants	$6,151,000
Water Treatment Plant Expansions	$4,662,000
Total Capital Costs for Study Area	**$57,894,738**

Table 7.2
Capital Costs for Proposed Water Management Strategies by WUG

Water User Group	**Capital Cost During Study Period**
Fairfield	$11,788,338
Flo Community WSC	$2,305,000
Freestone County - Irrigation	$75,000
Freestone County - Livestock	$75,000
Freestone County - Mining	$118,000
Freestone County - Other	$463,000
Freestone County - SEP	$22,438,600
Teague	$3,226,400
Wortham	$17,405,400
Total Capital Costs for Study Area	**$57,894,738**

8. Implementation Plan for Proposed Water Management Strategies

Implementation of the Freestone County Water Supply System includes developing water management strategies for both surface water and groundwater sources. For surface water sources, the implementation plan for water management strategies includes the following components:

- Obtain water rights and/or develop water supply contracts
- Obtain required permits
- Design and construct required facilities

For groundwater sources, the implementation plan for water management strategies includes the following components:

- Obtain required permits
- Design and construct required facilities

Table 8.1 is a list of recommended water management strategies with approximate in-service dates.

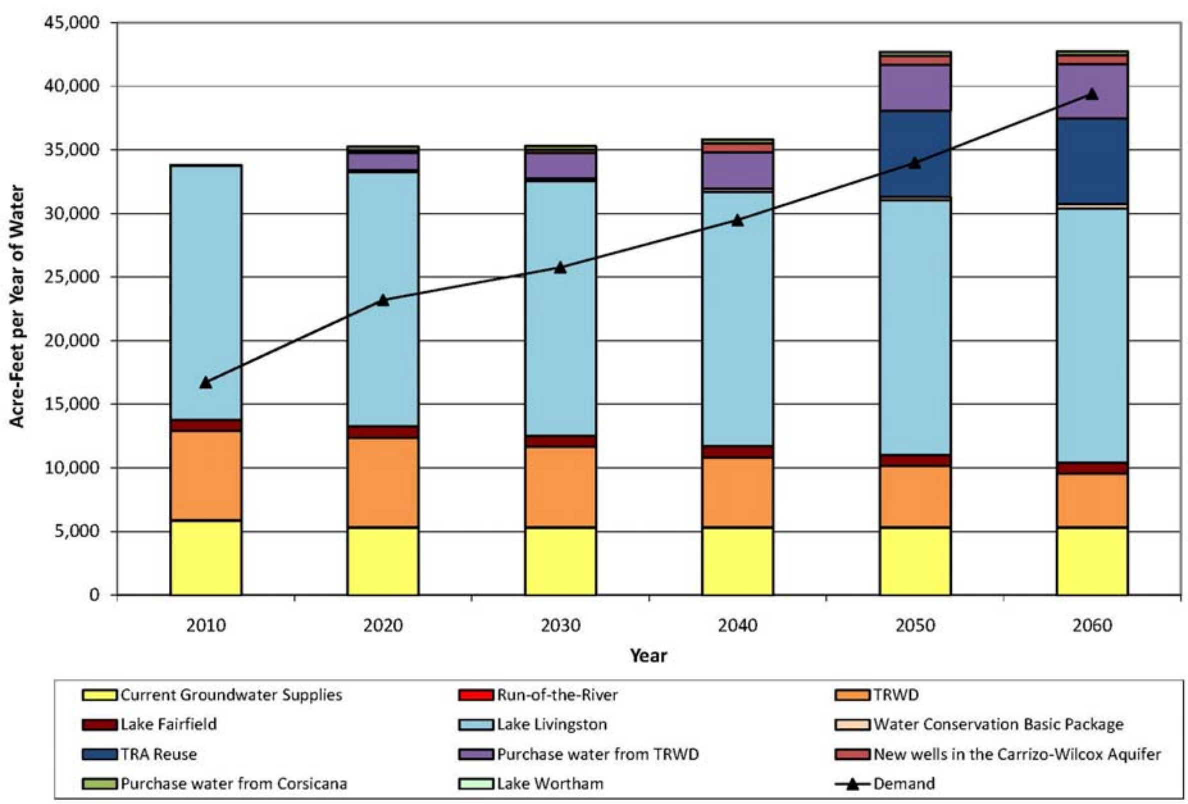
Table 8.1
Implementation of Proposed Water Management Strategies

Owner	Project	Approximate In-service Year
Fairfield	Connection to TRWD (Richland-Chambers)	2040
Fairfield	New Wells in Carrizo-Wilcox Aquifer	2040
Freestone County Other	Purchase water from TRWD	2020
Freestone County SEP	Purchase water from TRWD	2020
Freestone County SEP	TRA Reuse	2050
Teague	New Wells in Carrizo-Wilcox Aquifer	2020
Wortham	Water treatment plant rehabilitation	2012
Wortham	Purchase treated water from Corsicana	2020
Wortham	Purchase and treat raw water from TRWD (Richland-Chambers)	2020

9. Conclusion

In the near term, the projected growth in Freestone County has decreased since the *2006 Region C Water Plan* (2). However, population and demand projections have increased since the 2006 Plan from 2040 through 2060. The water management strategies recommended in the *2006 Region C Water Plan* (2) have been adjusted to account for these changes to projected demands. For most water user groups, their currently planned water management strategies are in line with the strategies presented in the *2006 Region C Water Plan* (2). Figure 9.1 shows the total projected demands, current water supplies, and recommended water management strategies for Freestone County.

Figure 9.1
Total Demands and Supplies for Freestone County



REFERENCES

APPENDIX 1

REFERENCES

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(2) Freese and Nichols, Inc., Alan Plummer Associates, Inc., Chiang, Patel & Yerby, Inc., and Cooksey Communications, Inc.: *2011 Region C Water Plan*, prepared for the Region C Water Planning Group, Fort Worth, September 2010.

(3) Bureau of Economic Geology: *Water Demand Projections for Power Generation in Texas,* prepared for the Texas Water Development Board, Austin, August 2008.

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(5) United States Census Bureau: Census 2000 Data for the State of Texas; Population by County, Population by Place, [Online], Available URL: http://www.census.gov/census2000/states/tx.html, May 2005.

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APPENDIX 2

MID-EAST TEXAS GCD RESOLUTION 2009-01

Resolution 2009-01

Be it resolved that on this date June 23, 2009 the Board of Directors of the Mid-East Texas Groundwater Conservation District met in a duly filed and noticed regular meeting.

An agenda item at this meeting was the adoption of preliminary Desired Future Conditions (DFC) of the aquifers located within the boundaries of the District. After duly considering the information pertaining to the DFC's the Board made its decision.

The desired future conditions for the Mid-East Texas GCD are presented below in the following table. These drawdowns are based on 25,000 acft/yr total annual pumping within the District.

Aquifer Name	Avg. District Drawdowns
Sparta	12 feet
Queen City	25 feet
Carrizo	55 feet
Calvert Bluff	70 feet
Simsboro	115 feet
Hooper	95 feet

These drawdown amounts are applicable to 2060, but may be revised every five (5) years through the Groundwater Management Area 12 revision process.

Attest:

____

William Parten, Secretary

Approved this date June 23, 2009

____

Mike Speer, President
Board of Directors

APPENDIX V

WATER SUPPLY STUDY FOR NAVARRO COUNTY

Water Supply Study for Navarro County

September 2010

Prepared for:

Region C Water Planning Group

Prepared by:

Freese and Nichols, Inc

Alan Plummer Associates, Inc

CP&Y, Inc

Water Supply Study for Navarro County
Region C Water Planning Group

TABLE OF CONTENTS

Page

1. Executive Summary 1.1
2. Introduction 2.1
3. Population and Demand Projections 3.1
   3.1 Meetings to Collect Data 3.1
   3.2 Revisions to Population and Demand Projections 3.2
   Additional County Aggregated Projections 3.4
   3.3 Recommended Population Projections 3.5
   3.4 Recommended Water Demands for Water User Groups 3.9
   3.5 Recommended Water Demands for Wholesale Water Providers 3.13
4. Evaluation of Current Supplies 4.1
   4.1 Surface Water 4.1
   4.2 Groundwater 4.1
5. Evaluation of Future Supplies 5.1
   5.1 Surface Water 5.1
   5.2 Groundwater 5.1
6. Proposed Revisions to Water Management Strategies 6.1
7. Estimated Costs for Water Management Strategies 7.1
8. Implementation Plan for Water Management Strategies 8.1
9. Alternative Water Management Strategies 9.1
10. Conclusion 10.1

APPENDICES

Appendix 1 ..... References

LIST OF TABLES

Page

Table 3.1 Meetings with WUGs and WWPs 3.1

Table 3.2 Recommended Population Projections in Study Area 3.6

Table 3.3 Population Projections for Entities Split by County 3.8

Table 3.4 Recommended Municipal Per Capita Water Use Projections in Gallons per Person per Day 3.9

Table 3.5 Recommended Demand Projections in Acre-Feet per Year 3.12

Table 3.6 Demand Projections Expected to be Supplied by the City of Corsicana 3.13

Table 6.1 Summary Information for Blooming Grove 6.2

Table 6.2 Summary Information for Brandon-Irene WSC 6.3

Table 6.3 Summary Information for Chatfield WSC 6.4

Table 6.4 Summary Information for Corsicana 6.7

Table 6.5 Summary Information for Kerens 6.8

Table 6.6 Summary Information for M E N WSC 6.9

Table 6.7 Summary Information for Navarro County Steam Electric Power 6.10

Table 6.8 Summary Information for Navarro Mills WSC 6.11

Table 7.1 Capital Costs for Water Management Strategies by Category 7.1

Table 7.2 Capital Costs for Water Management Strategies by WUG 7.1

Table 8.1 Implementation of Proposed Water Management Strategies 8.2

Table 9.1 Capital Costs for Alternative Water Management Strategies by Category 9.2

Table 9.2 Capital Costs for Alternative Water Management Strategies by WUG 9.2

LIST OF FIGURES

Page

Figure 2.1 Navarro County Water Supply Service Areas... 2.2

Figure 3.1 Recommended Population Projections for Navarro County 3.7

Figure 3.2 Recommended Municipal Demand Projections for Navarro County..............3.10

Figure 3.3 Recommended Total Demand Projections for Navarro County........................3.11

Figure 10.1 Total Demands and Supplies for Navarro County 10.1

Region C Water Planning Group
Water Supply Study for Navarro County

1. Executive Summary

The *2011 Region C Water Plan* (1) includes special county studies aimed at analyzing approaches to developing water management strategies for a county as well as approaches for implementation of the water management strategies. Countywide water systems are comprised of separate projects that are completed over a period of time by various WUGs. The Navarro County Study is one of the separate county studies included in the *2011 Region C Water Plan* (1).

Navarro County is projecting higher growth in the near term than previously projected. Growth from 2010 to 2040, as projected in the *2011 Region C Water Plan* (1), is greater than the projections in the *2006 Region C Water Plan* (2). Water management strategies (WMSs) have been revised to meet the higher near term demands. WMSs were updated based on information obtained from meetings with various water user groups in Navarro County as well as from surveys mailed to every WUG in Region C. Corsicana is the major water supplier in Navarro County. In most cases, the supply from Corsicana was increased to meet the higher demands.

(1) Superscripted numbers in parenthesis match references in Appendix 1.

2000 Population: *45,124*

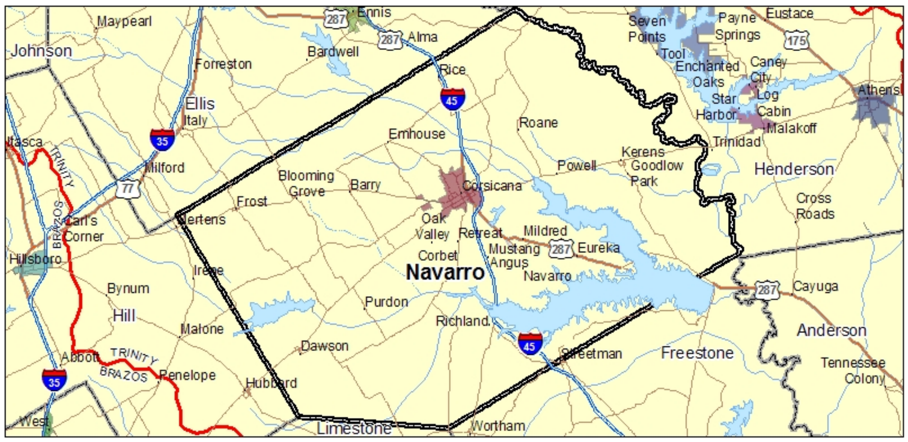
Projected 2060 Population: *89,638*

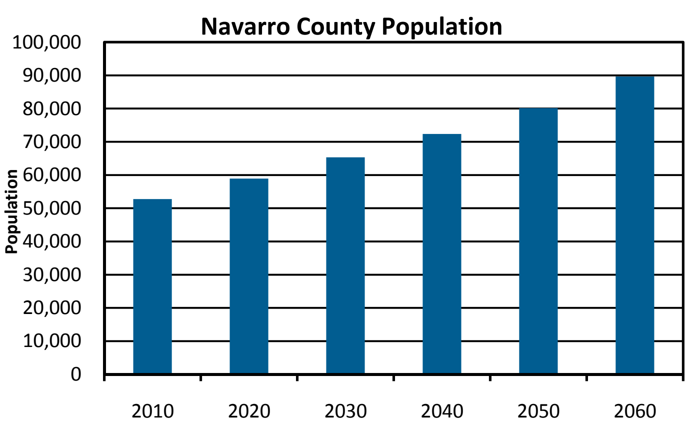
County Seat: *Corsicana*

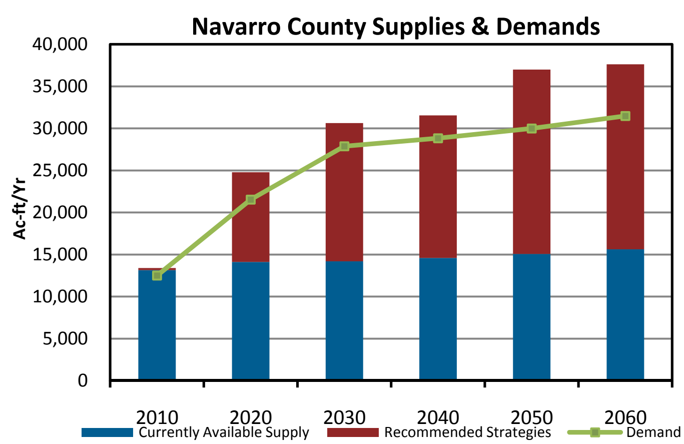
Economy: *Manufacturing; agribusinesses; oil-field operations, distribution.*

River Basin(s):

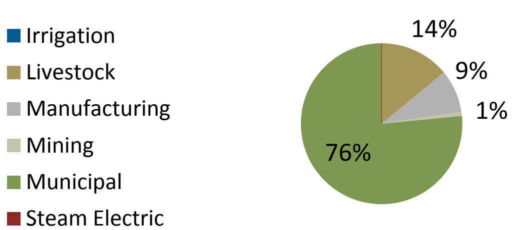
- Trinity (100%)





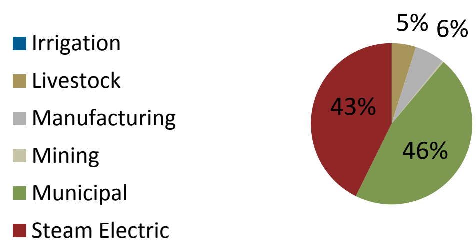


2000 Navarro County Demand
(% of total)



Total=11,007 acre-feet

2060 Navarro County Demand
(% of total)



Total= 31,482 acre-feet

WATER USER GROUP	2060 DEMAND (AC-FT/YR)	CURRENT SUPPLIES	RECOMMENDED STRATEGIES [(b)]
Blooming Grove	150	Corsicana	Additional Corsicana supplies, New well in Trinity Aquifer
Brandon-Irene WSC [(a)]	36	Aquilla WSD (Lake Aquilla, Region G)	None
Chatfield WSC	1,655	Corsicana	Additional Corsicana supplies
Community Water Company (Navarro Co. Only) [(a)]	366	Corsicana	Additional Corsicana supplies
Corsicana	7,518	Navarro Mills Reservoir, Lake Halbert/ Richland-Chambers	New pump station and WTP (Lake Halbert/Richland-Chambers), WTP expansions, TRWD supplies (Richland-Chambers Reservoir), Raw water for SEP
Dawson	238	Corsicana	Additional Corsicana supplies, New Water Treatment Plant
Frost	63	Corsicana, Woodbine Aquifer	Supplemental wells
Kerens	436	Corsicana	Additional Corsicana supplies
M E N WSC	621	Corsicana	Additional Corsicana supplies
Navarro Mills WSC	754	Corsicana	Additional Corsicana supplies, New well in Woodbine Aquifer
Rice	463	Rice WSC (from Ennis and Corsicana)	Additional Rice WSC supplies
Rice WSC [(a)]	2,009	Ennis, Corsicana	Additional Ennis supplies, Additional Corsicana supplies
County-Other	229	Corsicana, TRWD, Woodbine Aquifer	Additional Corsicana supplies, Additional TRWD supplies, supplemental wells
Irrigation	0	Local supplies	None
Livestock	1,543	Carrizo-Wilcox, Nacatoch, and Other Aquifers, Local supplies	Supplemental wells
Manufacturing	1,872	Corsicana, TRWD	Additional Corsicana supplies, Additional TRWD supplies
Mining	89	Carrizo-Wilcox and Nacatoch Aquifers	Supplemental wells
Steam Electric Power	13,440	None	Corsicana supplies

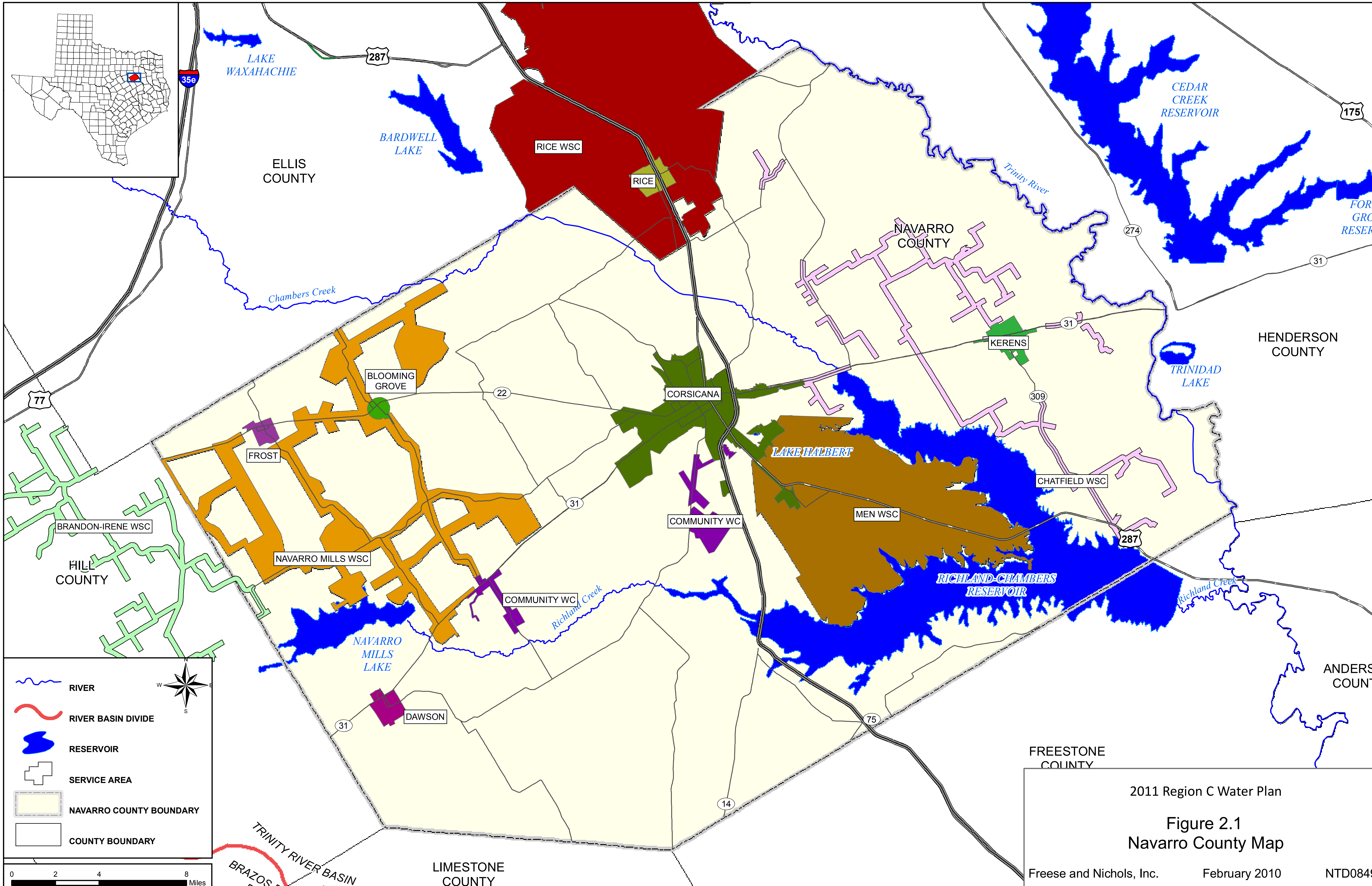
[(a)] WUG is in multiple counties

[(b)] Water conservation is a strategy for every municipal user group.

2. Introduction

The *2011 Region C Water Plan* [1] includes special county studies funded by the Texas Water Development Board (TWDB). The consultant team for the *2011 Region C Water Plan* [1] includes Freese and Nichols, Inc. (FNI), Alan Plummer and Associates (APAI), Chiang, Patel & Yerby, Inc. (CPY), and Cooksey Communications. The special county studies are aimed at analyzing approaches to developing and implementing the water management strategies for the counties. The Navarro County Study is one of these projects. This study also compares the strategies in Corsicana's 2007 Master Plan to the strategies from the *2006 Region C Water Plan* [2].

Many of the water management strategies are in line with the *2006 Region C Water Plan* [2]. However, several of the Water User Group (WUG) demands have increased in the near term and those water management strategies have been reevaluated. In addition, several WUGs are contemplating development of additional supply sources to supplement existing supplies. This report summarizes the analysis and recommendations for meeting water demand projections for WUGs in Navarro County. The study area is shown in Figure 2.1.


LAKE WAXAHACHIE
BARDWELL LAKE
ELLIS COUNTY
RICE WSC
RICE
CEDAR CREEK RESERVOIR
Trinity River
NAVARRO COUNTY
Chambers Creek
BLOOMING GROVE
CORSICANA
KERENS
HENDERSON COUNTY
TRINIDAD LAKE
FROST
LAKE HALBERT
CHATFIELD WSC
MEN WSC
COMMUNITY WC
BRANDON-IRENE WSC
HILL COUNTY
NAVARRO MILLS WSC
COMMUNITY WC
Richland Creek
RICHLAND-CHAMBERS RESERVOIR
NAVARRO MILLS LAKE
DAWSON
ANDERSON COUNTY
FREESTONE COUNTY
LIMESTONE COUNTY
TRINITY RIVER BASIN
RIVER
RIVER BASIN DIVIDE
RESERVOIR
SERVICE AREA
NAVARRO COUNTY BOUNDARY
COUNTY BOUNDARY
0 2 4 8 Miles
2011 Region C Water Plan
Figure 2.1
Navarro County Map
Freese and Nichols, Inc.
February 2010
NTD08492

3. Population and Demand Projections

3.1 Meetings to Collect Data

Freese and Nichols, Inc. (FNI) met with four water user groups (WUGs) and one wholesale water provider (WWP) in Navarro County in the summer of 2009. Table 3.1 lists the meetings held and the meeting participants. At each meeting, FNI presented the population and demand projections as shown in the *2006 Region C Water Plan* [(2)] as well as draft projections for the *2011 Region C Water Plan* [(1)]. Survey responses were also discussed if the WUG or WWP had returned their survey. Each WUG and WWP in Region C was surveyed in early 2009 regarding their population and demand projections. In the survey, each WUG was provided a copy of their population and demand projections from the *2006 Region C Water Plan* [(2)] and asked if they were in agreement with the projections. If the WUG was not in agreement with the projections they were asked to provide alternative projections. The current population and water use estimates of the entity and their existing and/or potential future customers were also discussed at the meetings. Several entities provided information related to recent water use.

Table 3.1
Meetings with WUGs and WWPs

Date	Entity	Meeting Type	Attendees
July 1, 2009	Brandon-Irene WSC	In person	Benny Lamson, Mary Cox, Keeley Brown, Rachel Ickert
July 2, 2009	Corsicana	In person	Connie Standridge, Kyle Pritchett, Tom Gooch, Keeley Brown, Rachel Ickert
July 2, 2009	Corsicana Customers	In person	Connie Standridge (Corsicana), Kyle Pritchett (Corsicana), Mayor Larry Bailey (City of Rice), Carrie Woolridge (Navarro Mills WSC), Dennis Donoho (M E N WSC), Tom Gooch, Keeley Brown, Rachel Ickert

The current water supply for each entity, the recommended water management strategies as presented in the *2006 Region C Water Plan*[(2)], and any suggested adjustments to those recommendations were discussed. In most cases, the entities plan to implement the recommended strategies, although the amounts of supply may change. In a few cases, the entities are pursuing other options for water supply to meet their future needs.

The information obtained in these meetings was used to update population and demand projections presented in the *2006 Region C Water Plan* (2). The updated information related to water supply was used to update proposed management strategies.

3.2 Revisions to Population and Demand Projections

The following section discusses the revisions to the population and demand projections as adopted in the *2011 Region C Water Plan* (1). Population projections and municipal per capita water use (measured in gallons per capita per day) are used to project future water demand. Municipal per capita water use is the sum of residential, commercial, and institutional water use divided by the population served.

Blooming Grove

Revised population projections for the City of Blooming Grove were based on input from the TWDB. The population was increased based on historical data. Revised demand projections were increased and were calculated by multiplying the revised population projections by the municipal per capita water use presented in the *2006 Region C Water Plan* (2).

Chatfield WSC

In their survey response, Chatfield WSC suggested lower population projections than those presented in the *2006 Region C Water Plan* (2). The reduction in population was based on the current population served and historical trends. Demand projections were reduced based on the reduction to population. Revised demand projections were calculated by multiplying the revised population projections by the municipal per capita water use presented in the *2006 Region C Water Plan* (2).

Corsicana

Corsicana supplies water to all municipal water user groups in Navarro County with the exception of Winkler WSC, which uses water from Richland-Chambers Reservoir. Wortham, which is located in Freestone County, is a potential future customer for Corsicana. Draft population revisions were discussed with the City of Corsicana and the City was in agreement with the proposed increases to population and demand projections. The projected increases were based on input from the TWDB. Demand projections were increased based on the revised population projections. The City has historically grown 1 percent to 1.5 percent per year.

Frost

The City of Frost provided revised population projections developed based on economic factors. According to the City's survey response, few jobs are available in the area and the City is currently losing water customers. The City recommended a decrease to the population projections presented in the *2006 Region C Water Plan* [2]. Demand projections were reduced based on the reduction to population.

Kerens

The City of Kerens has seen significant population growth in recent years. From 2004 to 2005 the population increased 6.6 percent. The increase in population from 2005 to 2006 was over 4 percent [4]. The City's population projections were increased based on recommendations by the TWDB. Demand projections were increased to account for the increased population. Revised demand projections were calculated by multiplying the revised population projections by the municipal per capita water use presented in the *2006 Region C Water Plan* [2].

Navarro Mills WSC

Navarro Mills WSC provided revised population projections, which are lower than those presented in the *2006 Region C Water Plan* [2]. The population and demand projections were reduced based on input from Navarro Mills WSC. Revised demand projections were calculated by multiplying the revised population projections by the municipal per capita water use presented in the *2006 Region C Water Plan* [2].

Additional County Aggregated Projections

The Region C consultant team examined the demand projections developed in the *2006 Region C Water Plan* [2] for county-other, manufacturing, mining, irrigation, livestock, and steam electric power. In Navarro County, only the steam electric power demands were adjusted for the *2011 Region C Water Plan* [1]. A study completed by the Bureau of Economic Geology (BEG) entitled *Water Demand Projections for Power Generation in Texas* [3] and the *2006 Region C Water Plan* [2] projected no steam electric demands in Navarro County. The steam electric power demands in Navarro County were increased to account for new plants that are planned in the near term that were not accounted for previously. The new plants include the proposed L.S. Power Plant and the proposed Patten Energy (formerly Babcock and Brown) Plant. A Memorandum of Understanding exists between Corsicana and the power plants that states Corsicana will sell water to them.

Water User Groups Whose Population and Demand Projections are Unchanged

Population and demand projections remain unchanged for several water user groups. The population and demand projections presented in the *2006 Region C Water Plan* [2] remain as previously projected for the following water user groups:

- Brandon-Irene WSC
- Community Water Company
- Dawson
- M E N WSC
- Navarro County – Irrigation
- Navarro County – Livestock
- Navarro County – Manufacturing
- Navarro County – Mining
- Navarro County - Other
- Rice

- Rice WSC

3.3 Recommended Population Projections

Freese and Nichols, Inc. (FNI) collected available historical and projected population data for each entity through the in-person meetings. Additional historical population data was gathered from the Texas State Data Center [(5)], the U.S. Census Bureau [(6)], and the North Central Texas Council of Governments (NCTCOG) [(7)]. FNI also gathered population projections developed by the NCTCOG and suggested changes from the TWDB since the *2006 Region C Water Plan* [(2)].

The population information was used to review growth in the cities. In general, the population in Navarro County is growing at nearly the same rate as projected in the *2006 Region C Water Plan* [(2)]. The total recommended population projections for Navarro County are slightly higher than the *2006 Region C Water Plan* [(2)] projections through 2040 and slightly lower in 2050 and 2060.

Table 3.2 presents recommended population projections for each water user group in the study area, as well as what was previously projected in the *2006 Region C Water Plan* [(2)]. Table 3.3 provides the total recommended population projections for three Navarro County WUGs that also have population in other counties. Figure 3.1 shows the population projections for Navarro County.

Table 3.2
Recommended Population Projections in Navarro County

Water User Group	2006 Plan Projections						2011 Plan Projections					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
Blooming Grove	833	833	833	833	833	833	897	897	897	897	897	897
Brandon-Irene WSC [a]	221	238	256	276	299	328	221	238	256	276	299	328
Chatfield WSC	5,285	6,708	8,190	9,799	11,718	14,075	4,200	6,000	7,800	9,799	11,718	14,075
Community Water Company [a]	1,041	1,301	1,626	2,032	2,541	3,176	1,041	1,301	1,626	2,032	2,541	3,176
Corsicana	25,537	26,674	27,858	29,144	30,678	32,563	27,132	28,340	29,598	30,964	32,594	34,597
County - Other	1,760	1,760	1,760	1,760	1,760	1,760	1,760	1,760	1,760	1,760	1,760	1,760
Dawson	909	971	1,036	1,106	1,190	1,293	909	971	1,036	1,106	1,190	1,293
Frost	694	744	796	852	919	1,002	550	550	550	550	550	550
Kerens	1,681	1,681	1,681	1,681	1,681	1,681	1,937	1,937	1,937	1,937	1,937	1,937
M E N WSC	3,421	3,755	4,137	4,477	4,762	5,180	3,421	3,755	4,137	4,477	4,762	5,180
Navarro Mills WSC	3,213	4,016	5,020	6,274	7,843	9,804	3,090	3,690	4,290	5,000	5,800	6,600
Rice	954	1,123	1,299	1,490	1,718	1,998	954	1,123	1,299	1,490	1,718	1,998
Rice WSC [a]	6,640	8,357	10,145	12,086	14,402	17,247	6,640	8,357	10,145	12,086	14,402	17,247
Navarro County Total	**52,189**	**58,161**	**64,637**	**71,810**	**80,344**	**90,940**	**52,752**	**58,919**	**65,331**	**72,374**	**80,168**	**89,638**

[a] Navarro County portion only

Figure 3.1
Recommended Population Projections for Navarro County

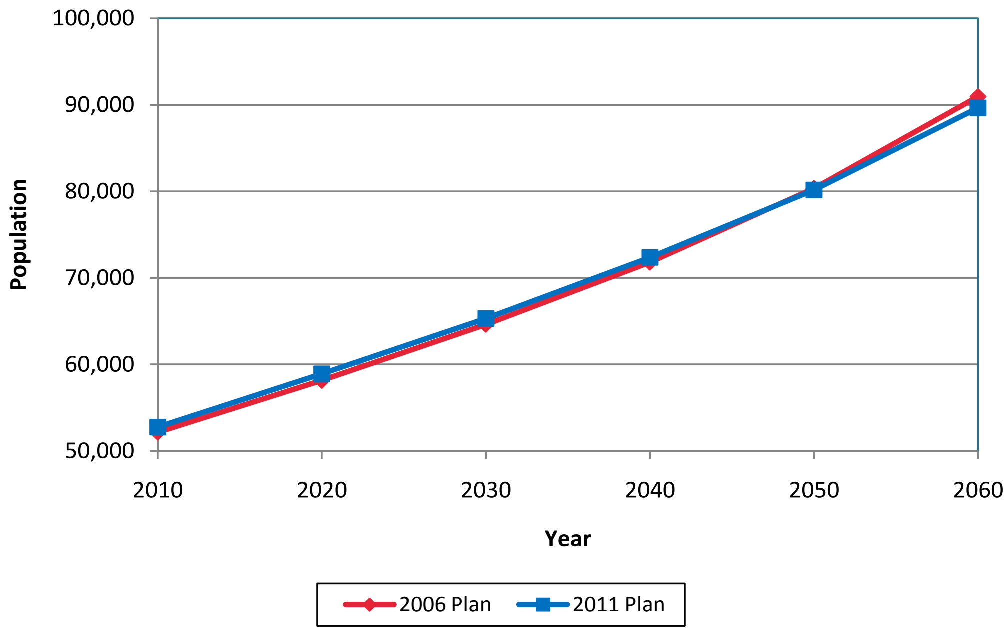


Table 3.3
Population Projections for Entities Split by County [a]

Water User Group	2006 Plan Projections						2011 Plan Projections					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
Brandon-Irene WSC	2,359	2,455	2,562	2,670	2,788	2,922	2,359	2,455	2,562	2,670	2,788	2,922
Community Water Company	4,289	5,046	5,863	6,767	7,955	9,418	4,289	5,046	5,863	6,767	7,955	9,418
Rice WSC	7,667	9,734	11,867	14,161	16,872	20,152	7,667	9,734	11,867	14,161	16,872	20,152

[a] The total shown is for the entire entity, including that portion of the entity located outside of Navarro County.

3.4 Recommended Water Demands for Water User Groups

Freese and Nichols, Inc. (FNI) reviewed the historical and projected water demands. A number of entities provided recent water use data, and some entities provided water demand projections for consideration as well.

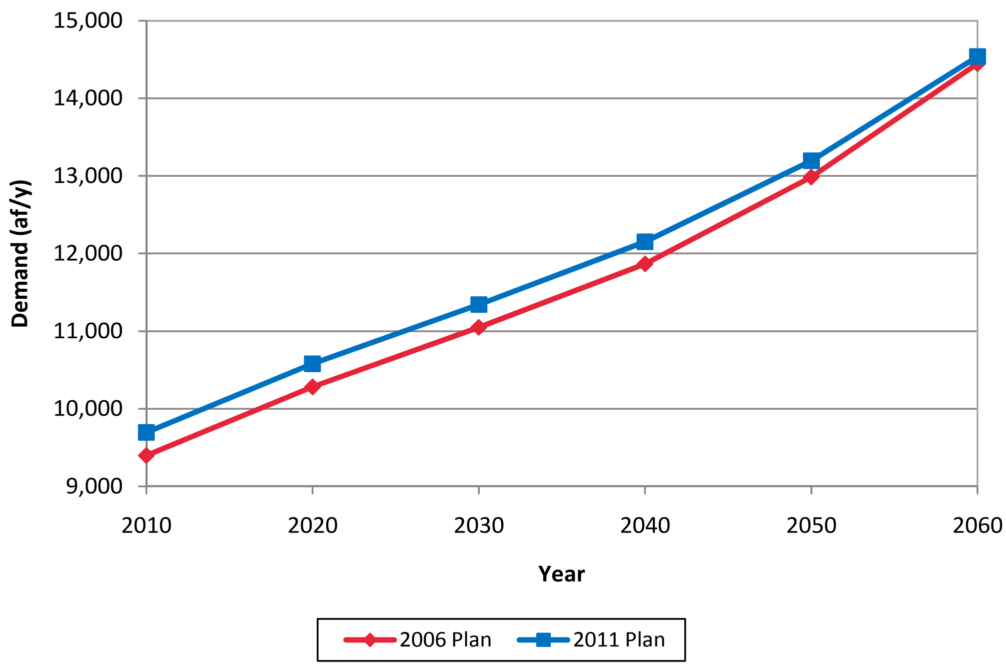
The municipal water demand projections presented in this section are based on per capita dry-year water use and the adopted population projections from the previous section. The per capita dry-year water uses presented in this section are based on the per capita water uses from the *2006 Region C Water Plan* (2), which include water savings from plumbing code requirements for low-flow fixtures. No adjustments to the per capita water uses from the *2006 Region C Water Plan* (2) were made for Navarro County. Table 3.4 summarizes the municipal per capita water use projections for this study. Municipal per capita water use is the sum of residential, commercial, and institutional water use divided by the population served. Figure 3.2 shows the 2006 and 2011 Plan municipal demand projections.

Table 3.4
Recommended Municipal Per Capita Water Use Projections
in Gallons per Person per Day

Water User Group	2010	2020	2030	2040	2050	2060
Blooming Grove	160	156	154	151	149	149
Brandon-Irene WSC	109	105	105	100	99	98
Chatfield WSC	91	108	107	105	105	105
Community Water Company	91	108	106	104	103	103
County - Other	204	201	198	195	194	194
Corsicana	127	124	121	118	116	116
Dawson	174	170	168	165	164	164
Frost	112	109	107	103	102	102
Kerens	212	209	206	203	201	201
M E N WSC	115	112	110	108	107	107
Navarro Mills WSC	95	107	104	103	102	102
Rice	214	211	209	208	207	207
Rice WSC	110	107	106	104	104	104

For each entity the population projection was multiplied by the projected municipal per capita water use to establish the projected demand. Table 3.5 lists the adopted demand projections for this study.

Figure 3.2
Recommended Municipal Demand Projections for Navarro County



Non-municipal water demand projections including manufacturing, steam electric power, irrigation, mining, and livestock are reported on a county-wide basis. Projections of the non-municipal water demands were based on the projections from the *2006 Region C Water Plan* [2]. Projections for manufacturing, irrigation, and livestock did not change from the *2006 Region C Water Plan* [2] for any of the counties in Region C. The steam electric power demands were revised based on available new information, which included recent power plant development activity, mothballing of existing plants, and the Bureau of Economic Geology report [4] released in 2008. Table 3.5 shows the projected demands for Navarro County. Figure 3.3 shows the total demands for Navarro County from the 2006 and 2011 Region C Water Plans [1, 2]. The substantial increase in projected demands is driven primarily by the increase in projected demands for steam electric power.

Figure 3.3
Recommended Total Demand Projections for Navarro County

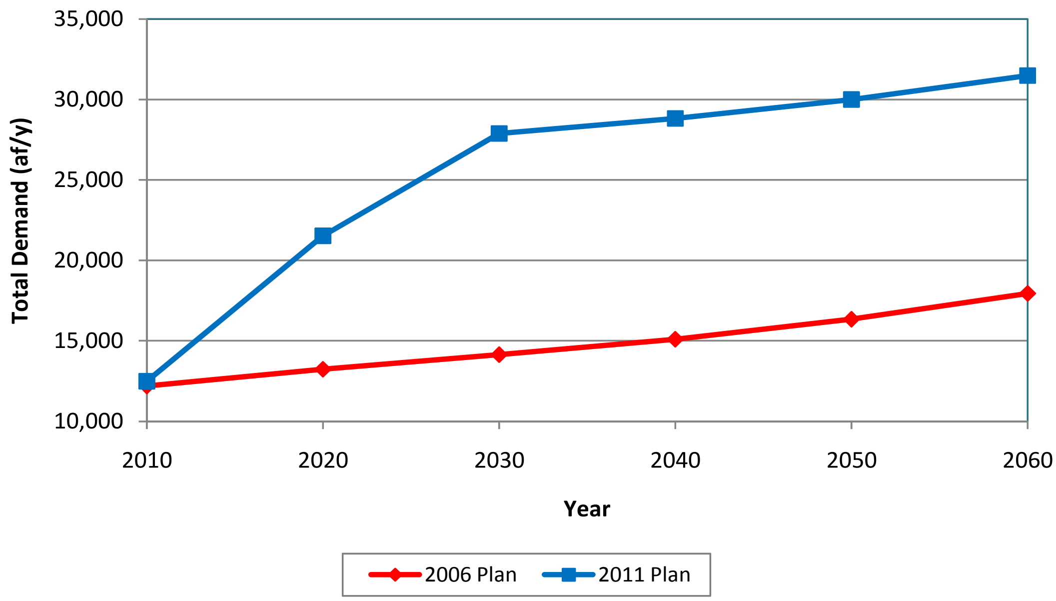


Table 3.5
Recommended Demand Projections in Acre-Feet per Year

Water User Group	2006 Plan Projections						2011 Plan Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Blooming Grove	149	146	144	141	139	139	161	157	155	152	150	150
Brandon-Irene WSC [(a)]	27	28	30	31	33	36	27	28	30	31	33	36
Chatfield WSC	539	812	982	1,153	1,378	1,655	428	726	935	1,153	1,378	1,655
Community Water Company [(a)]	106	157	193	237	293	366	106	157	193	237	293	366
Corsicana	5,835	6,006	6,179	6,366	6,667	7,076	6,200	6,381	6,564	6,763	7,083	7,518
Dawson	177	185	195	204	219	238	177	185	195	204	219	238
Frost	87	91	95	98	105	114	69	67	66	63	63	63
Kerens	399	394	388	382	378	378	460	453	447	440	436	436
M E N WSC	441	471	510	542	571	621	441	471	510	542	571	621
Navarro County - Irrigation	0	0	0	0	0	0	0	0	0	0	0	0
Navarro County - Livestock	1,543	1,543	1,543	1,543	1,543	1,543	1,543	1,543	1,543	1,543	1,543	1,543
Navarro County - Manufacturing	1,172	1,328	1,468	1,607	1,730	1,872	1,172	1,328	1,468	1,607	1,730	1,872
Navarro County - Mining	89	89	89	89	89	89	89	89	89	89	89	89
Navarro County - Other	250	244	239	233	229	229	250	244	239	233	229	229
Navarro County - Steam Electric Power	0	0	0	0	0	0	0	8,000	13,440	13,440	13,440	13,440
Navarro Mills WSC	342	481	585	724	896	1,120	329	442	500	577	663	754
Rice	229	265	304	347	398	463	229	265	304	347	398	463
Rice WSC [(a)]	818	1,002	1,205	1,408	1,678	2,009	818	1,002	1,205	1,408	1,678	2,009
Navarro County Total	**12,203**	**13,242**	**14,149**	**15,105**	**16,346**	**17,948**	**12,499**	**21,538**	**27,883**	**28,829**	**29,996**	**31,482**

[(a)] Navarro County portion only

3.5 Recommended Water Demands for Wholesale Water Providers

The City of Corsicana has contracts in place to provide water service to the majority of the entities in the study area and is considered a regional wholesale water provider. Table 3.6 shows the recommended population and demand projections expected to be supplied by Corsicana in Region C and Region G.

Table 3.6
Demand Projections Expected to be Supplied by the City of Corsicana

Demand Met by Corsicana (ac-ft)/yr	2010	2020	2030	2040	2050	2060
Corsicana Customers						
Corsicana Municipal	6,200	6,381	6,564	6,763	7,083	7,518
Blooming Grove	161	157	155	152	150	150
Chatfield WSC	428	726	935	1,153	1,378	1,655
Community WC (Navarro County)	106	157	193	237	293	366
Coolidge (through Post Oak SUD - Region G)	37	37	37	37	37	37
Dawson	177	185	195	204	219	238
Freestone County Other	0	225	225	225	225	225
Frost	69	67	66	63	63	63
Hill County Other (Region G)	353	353	353	353	353	353
Hubbard (through Post Oak SUD - Region G)	194	188	183	177	173	173
Kerens	460	453	447	440	436	436
MEN WSC	441	471	510	542	571	621
Navarro County Other	150	146	143	140	137	137
Navarro County Manufacturing (50%)	586	664	734	804	865	936
Navarro County Steam Electric	0	8,000	13,440	13,440	13,440	13,440
Navarro Mills WSC	329	442	500	577	663	754
Rice WSC (Ellis and Navarro Counties)	945	1,167	1,409	1,650	1,966	2,347
Rice	229	265	304	347	398	463
Wortham (potential future customer)	0	300	300	300	300	300
Total Demand Supplied By Corsicana	**10,865**	**20,384**	**26,693**	**27,604**	**28,750**	**30,212**

4. Evaluation of Current Supplies

4.1 Surface Water

The surface water sources for water user groups in the study area include Lake Halbert, Navarro Mills Reservoir (through TRA), Richland-Chambers Reservoir, and Lake Bardwell (through Ennis).

The City of Corsicana supplies water to its customers from Lake Halbert, Navarro Mills Reservoir, and Richland-Chambers Reservoir. The supply from Navarro Mills Reservoir is purchased from Trinity River Authority (TRA) and is limited by the 20 million gallon per day peak capacity of the Navarro Mills Water Treatment Plant. The supply from Lake Halbert and Richland-Chambers Reservoir is limited by the four million gallon per day peak capacity of the Halbert Water Treatment Plant.

The supply from Lake Bardwell is purchased from TRA and is limited by the firm yield of the reservoir which is 8,000 acre feet per year in 2060. In Navarro County, Rice WSC and the City of Rice (through Rice WSC) use water from Lake Bardwell purchased from the City of Ennis. Rice WSC is located in both Ellis and Navarro Counties. Community Water Company (WC) is located in Navarro County (Region C), Ellis County (Region C), Smith County (Region I), and Hunt County (Region D). Community WC purchases water from Corsicana in Navarro County, from Ennis in Ellis County, from the Sabine River Authority in Hunt County, and from Tyler in Smith County. Community WC also has groundwater wells in Smith County. It is assumed that Community Water Company's supply in each county is completely independent of the other counties and there is no transfer of water among counties or regions for this entity.

4.2 Groundwater

The only current municipal groundwater use in Navarro County is for County - Other and peaking for the City of Frost. The City of Frost uses a well in the Woodbine Aquifer during periods of high demand. The Navarro County - Other demands are also met using water from the Woodbine Aquifer. The majority of groundwater use in Navarro County is for livestock and mining purposes.

5. Evaluation of Future Supplies

5.1 Surface Water

The surface water sources included in the water management strategies include all of the supplies discussed in Section 4 as well as additional Tarrant Regional Water District (TRWD) sources and sources from the TRA Ellis County Water Supply Project. Navarro County – Other and Navarro County manufacturing currently utilize TRWD sources. Water management strategies for these WUGs include purchasing additional water from TRWD. Corsicana will need to begin purchasing water from TRWD in 2030 to meet their demands.

The TRA Ellis County Water Supply Project will deliver raw water from the TRWD pipelines to water suppliers in Ellis County. Raw water will be diverted from the TRWD pipelines and treated at regional facilities. This project is a water management strategy for Rice WSC.

5.2 Groundwater

The City of Blooming Grove and Navarro Mills WSC are considering groundwater as a future supply. Blooming Grove plans to utilize water from the Trinity Aquifer. Navarro Mills WSC plans to pump from the Woodbine Aquifer.

6. Proposed Revisions to Water Management Strategies

In general, the revised projected demands in the study area are higher than those shown in the *2006 Region C Water Plan* (2). To meet the higher water demands, the water management strategies need to be revised. This section describes the proposed water management strategies developed for the *2011 Region C Water Plan* (1). Appendix C of the *2011 Region C Water Plan* (1) includes a summary table of demand and supply for each water user group in Navarro County. The Navarro County supply is mainly comprised of surface water with limited groundwater supplies.

Blooming Grove

Blooming Grove's currently planned water management strategies are in line with the strategies in the *2006 Region C Water Plan* (2) with the addition of groundwater as a future supply. A well is being considered as a future supply and would be online by 2020 in the Trinity Aquifer with a capacity of 160 acre-feet per year. The amount of supply from Corsicana (TRA sources) is increased to meet increased projected demands. The City's contract with Corsicana allows for use of up to fifteen million gallons per month (552 acre-feet per year). The current capacity of the City's pipeline that transports water from Corsicana is 336 acre-feet per year. This capacity is sufficient to meet Blooming Grove's increased demands. Table 6.1 summarizes the updates to the water management strategies for Blooming Grove.

Table 6.1
Summary Information for Blooming Grove

Blooming Grove	2011 Plan Projections 2010	2020	2030	2040	2050	2060
Projected Population	897	897	897	897	897	897
Projected Water Demand						
Municipal Demand	161	157	155	152	150	150
Total Projected Water Demand	***161***	***157***	***155***	***152***	***150***	***150***
Currently Available Water Supplies						
Navarro Mills Reservoir (through Corsicana)	161	157	146	138	131	124
Total Supply	***161***	***157***	***146***	***138***	***131***	***124***
Need (Demand - Supply)	***0***	***0***	***9***	***14***	***19***	***26***
Water Management Strategies						
Water Conservation - Basic Package	2	5	6	10	11	12
Water Conservation - Expanded Package	0	0	0	1	1	1
Purchase additional water from Corsicana	0	0	3	3	7	13
New Well in Trinity Aquifer	0	160	160	160	160	160
Total Water Management Strategies	***2***	***165***	***169***	***174***	***179***	***186***
Reserve or (Shortage)	**2**	**165**	**160**	**160**	**160**	**160**

Brandon-Irene WSC

Brandon-Irene WSC (BIWSC) is located in Ellis (Region C), Navarro (Region C), and Hill Counties (Region G). Brandon-Irene WSC currently purchases water from Aquilla WSC and plans to continue to do so. Region C customers are served with water purchased from Aquilla WSC. BIWSC also purchases water from Files Valley WSC, but would like to discontinue purchasing water from Files Valley WSC if they can serve those customers with a new groundwater well. The customers served by water purchased from Files Valley WSC are in Region G only. BIWSC currently has two groundwater wells located in Hill County. The drilling of a new 200 gallon per minute groundwater well, to be located in Region G, is planned for the near future. The WSC has applied for federal funding for rural development and are waiting on that funding. Brandon-Irene WSC may also be required to construct a new elevated tank at the new well site. Table 6.2 summarizes Brandon-Irene WSC's future water supply plans.

Table 6.2
Summary Information for Brandon-Irene WSC

Brandon - Irene WSC (Region C only - Ellis and Navarro Counties)	2011 Plan Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	300	327	355	385	419	460
Projected Water Demand						
Municipal Demand	37	39	41	43	46	51
Total Projected Water Demand	***37***	***39***	***41***	***43***	***46***	***51***
Currently Available Water Supplies						
Lake Aquilla (Aquilla WSC)	37	39	41	43	46	51
Total Supply	***37***	***39***	***41***	***43***	***46***	***51***
Need (Demand - Supply)	***0***	***0***	***0***	***0***	***0***	***0***
Water Management Strategies						
Water Conservation - Basic Package	0	2	2	3	3	3
Total Water Management Strategies	***0***	***2***	***2***	***3***	***3***	***3***
Reserve or (Shortage)	**0**	**2**	**2**	**3**	**3**	**3**

Chatfield WSC

Chatfield WSC currently receives water from Richland-Chambers Reservoir and Navarro Mills Reservoir through Corsicana. Chatfield WSC has contracts to supply water on a wholesale basis to Goodlow and Kerens, but Kerens has not purchased any supply in recent years.

The City's currently planned water management strategies are in line with the strategies in the *2006 Region C Water Plan* [(2)], but several new alternative water management strategies have been added. The amount of supply from Corsicana is decreased due to decreased projected demands from 2010 to 2030. Alternative water management strategies for Chatfield WSC consist of groundwater and several possible surface water sources. Alternative WMSs are discussed in Section 9. Table 6.3 summarizes the updates to the water management strategies for Chatfield WSC.

Table 6.3
Summary Information for Chatfield WSC

Chatfield WSC	2011 Plan Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	4,200	6,000	7,800	9,799	11,718	14,075
Projected Water Demand						
Municipal Demand	428	726	935	1,153	1,378	1,655
Total Projected Water Demand	***428***	***726***	***935***	***1,153***	***1,378***	***1,655***
Currently Available Water Supplies						
Corsicana Sources	428	726	878	1,047	1,201	1,372
Total Supply	***428***	***726***	***878***	***1,047***	***1,201***	***1,372***
Need (Demand - Supply)	***0***	***0***	***57***	***106***	***177***	***283***
Water Management Strategies						
Water Conservation - Basic Package	6	30	49	65	83	105
Purchase additional water from Corsicana	0	0	8	41	94	178
Total Water Management Strategies	***6***	***30***	***57***	***106***	***177***	***283***
Reserve or (Shortage)	**6**	**30**	**0**	**0**	**0**	**0**

Corsicana

Several of the *2006 Region C Water Plan* [2] recommended water management strategies have been put into operation or changed since the publication of the 2006 Plan. The City of Corsicana updated their Water System Master Plan [8] in 2007 which lists several additional water management strategies since the *2006 Region C Water Plan* [2]. Corsicana's water management strategies include basic and expanded conservation packages, a new water treatment plant and treatment plant expansions at Lake Halbert, and purchasing water from Tarrant Regional Water District (TRWD).

Corsicana's sources include the Lake Halbert/Richland-Chambers system and Navarro Mills Reservoir. Corsicana owns 1,344 acre-feet per year of water rights in Lake

Halbert and 13,664 acre-feet per year in Richland-Chambers Reservoir for a total of approximately 15,000 acre-feet per year in the two reservoirs. Corsicana's firm yield from Lake Halbert and Richland-Chambers Reservoir ranges from 13,872 in 2010 to 13,830 acre-feet per year in 2060. The currently available supply from this source is limited to 2,242 acre-feet per year by the capacity of the Lake Halbert Water Treatment Plant which treats water from both sources. Corsicana also purchases water from Navarro Mills Reservoir through Trinity River Authority (TRA). The firm yield of Navarro Mills ranges from 19,342 acre-feet per year in 2010 to14,300 acre-feet per year in 2060. The currently available supply from this source is limited by the capacity of the Navarro Mills water treatment plant to 11,210 acre-feet per year.

Since the *2006 Region C Water Plan* [2] the City has constructed a 36-inch pipeline from Richland-Chambers Reservoir to the Lake Halbert Water Treatment Plant. The raw water pipeline was a recommended strategy in the *2006 Region C Water Plan* [2]. An intake pump station is still needed at Richland-Chambers Reservoir and is expected to be online by 2012. The City considers Halbert/Richland-Chambers a reliable supply without the intake pump station because emergency pumps can be used if needed.

Corsicana's Master Plan [8] evaluated three potential sites for new water treatment plants. An expansion of the Navarro Mills treatment plant was the most economical alternative, but during the 2006 drought the Navarro Mills pool elevation dropped from 424.5 mean sea level (msl) to 416 (msl). Because of this, the City felt it was not a reliable supply and determined that any treatment plant capacity expansions should utilize raw water from Lake Halbert and Richland-Chambers Reservoir.

The City's 2007 Master Plan Update [8] includes the addition of a 24 mgd (26,904 acre-feet per year) water treatment plant at Lake Halbert. The new plant is based on a 1982 study [9] evaluating how the city could best use the Richland-Chambers water. The new treatment plant will be completed in eight mgd increments and will replace the existing 4 mgd plant at Lake Halbert. The first eight mgd increment is planned to be online between 2010 and 2020. Corsicana has received Water Infrastructure Fund (WIF) funding for the project and the design process began late in the summer of 2009. The second 8 mgd WTP expansion will need to be online by 2040. The third expansion, for a total water treatment capacity of 24 mgd, will not be needed until after 2060. The water available at the new treatment plant is limited by the firm yield of Corsicana's portion of water rights in the Lake Halbert/Richland Chambers system. In order to utilize the water treatment plant expansions and supply raw water to the two planned power plants, Corsicana is expected to begin purchasing water from Tarrant Regional Water District (TRWD) by 2030. TRWD has water rights for 210,000 acre-feet per year from Richland-Chambers Reservoir.

The existing Navarro Mills Water Treatment Plant has an average capacity of 10 mgd. A 5 mgd expansion to the Navarro Mills Water Treatment Plant was a recommended water management strategy in the *2006 Region C Water Plan* (2). This strategy is included in the *2011 Region C Water Plan* (1) as an alternative water management strategy. The expansion amount published in Corsicana's 2007 Master Plan (8) is 6.75 mgd based on Corsicana's water rights in the lake, but based on consultation with Corsicana's city staff, the recommended capacity will remain at 5 mgd. The City has no immediate plans for this expansion.

The option of a third small new water treatment plant on Richland-Chambers Reservoir was evaluated in Corsicana's Master Plan Update. It was determined that this treatment plant would not be as economical as the treatment plants discussed above and is not included as a water management strategy in the *2011 Region C Water Plan* (1). Table 6.4 summarizes Corsicana's future water supply plans.

Table 6.4
Summary Information for Corsicana

Corsicana	2011 Plan Projections					
	2010	2020	2030	2040	2050	2060
Projected Population	27,132	28,340	29,598	30,964	32,594	34,597
Projected Water Demand						
Municipal Demand	6,200	6,381	6,564	6,763	7,083	7,518
Customer Demand	4,665	14,003	20,129	20,841	21,667	22,694
Total Projected Water Demand	***10,865***	***20,384***	***26,693***	***27,604***	***28,750***	***30,212***
Currently Available Water Supplies						
Lake Halbert/Richland-Chambers	2,242	2,242	2,242	2,242	2,242	2,242
Navarro Mills Reservoir (through TRA)	11,210	11,210	11,210	11,210	11,210	11,210
Total Supply	***13,452***	***13,452***	***13,452***	***13,452***	***13,452***	***13,452***
Need (Demand - Supply)	***0***	***6,932***	***13,241***	***14,152***	***15,298***	***16,760***
Water Management Strategies						
Water Conservation	147	382	531	868	1,105	1,309
Water Treatment Expansions						
Pump station from R-C [(a)] and new Lake Halbert/ R-C WTP (8 MGD) replacing existing 4 MGD plant	0	2,242	2,242	2,242	2,242	2,242
Lake Halbert/R-C WTP expansion (8 MGD)	0	0	0	4,484	4,484	4,484
Raw water for power plant	0	8,000	8,000	8,000	8,000	8,000
Raw water for second power plant	0	0	5,440	5,440	5,440	5,440
Navarro Mills Reservoir WTP expansion (5 mgd) - Alternative Strategy	0	0	0	0	0	0
Purchase water from TRWD [(b)]	0	0	1,097	1,680	2,597	3,863
Total Water Management Strategies	***0***	***8,000***	***13,640***	***14,152***	***15,298***	***16,760***
Planned WMS totals from Halbert/Richland-Chambers Supply (limited by firm yield)	0	10,242	13,855	13,847	13,838	13,830
Reserve or (Shortage)	**492**	**1,450**	**0**	**0**	**0**	**0**

[(a)] R-C is Richland-Chamber Reservoir
[(b)] Amount not included in Total Water Management Strategies to avoid double counting

Dawson

Dawson currently purchases water from Corsicana and plans to continue to do so. The City is also considering building a WTP on Navarro Mills Reservoir to utilize their contracted water out of the reservoir. Dawson has a contract for 112 acre-feet per year with TRA. Table 6.5 summarizes the updates to the water management strategies for Dawson.

Table 6.5
Summary Information for Dawson

Dawson	2011 Plan Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	909	971	1,036	1,106	1,190	1,293
Projected Water Demand						
Municipal Demand	177	185	195	204	219	238
Total Projected Water Demand	***177***	***185***	***195***	***204***	***219***	***238***
Currently Available Water Supplies						
Navarro Mills Reservoir (through Corsicana)	177	185	183	185	191	197
Total Supply	***177***	***185***	***183***	***185***	***191***	***197***
Need (Demand - Supply)	***0***	***0***	***12***	***19***	***28***	***41***
Water Management Strategies						
Water Conservation - Basic Package	2	5	7	13	15	19
Water Conservation – Expanded Package	0	0	0	0	1	1
Purchase additional water from Corsicana	0	0	0	0	14	31
New Water Treatment Plant (0.1 MGD)	0	56	56	56	56	56
Total Water Management Strategies	***2***	***61***	***63***	***69***	***86***	***106***
Reserve or (Shortage)	**2**	**61**	**51**	**50**	**58**	**65**

Kerens

Kerens' currently planned water management strategies are in line with the strategies in the *2006 Region C Water Plan* [2]. The amount of supply from Corsicana is increased to meet increased projected demands. The City's contract with Corsicana allows for use of up to ten million gallons per month (368 acre-feet per year). Kerens must increase their current contract amount with Corsicana for additional Corsicana supplies. Kerens also has a wholesale contract with Chatfield WSC, but has not used this supply in recent years. Table 6.5 summarizes the updates to the water management strategies for Kerens.

Table 6.5
Summary Information for Kerens

Kerens	2011 Plan Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	1,937	1,937	1,937	1,937	1,937	1,937
Projected Water Demand						
Municipal Demand	460	453	447	440	436	436
Total Projected Water Demand	***460***	***453***	***447***	***440***	***436***	***436***
Currently Available Water Supplies						
Navarro Mills Reservoir (through Corsicana)	368	368	368	368	368	361
Total Supply	***368***	***368***	***368***	***368***	***368***	***361***
Need (Demand - Supply)	***92***	***85***	***79***	***72***	***68***	***75***
Water Management Strategies						
Water Conservation - Basic Package	4	10	14	16	17	19
Purchase additional water from Corsicana	88	75	65	56	51	56
Total Water Management Strategies	***92***	***85***	***79***	***72***	***68***	***75***
Reserve or (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

M E N WSC

M E N WSC purchases water from Corsicana which obtains water from Navarro Mills Reservoir. M E N WSC has a contract with Corsicana allowing for a maximum use of 1,473 acre-feet per year. M E N WSC plans to continue to receive water from Corsicana, but is looking into several other sources of supply. These other sources are included as alternative WMSs and additional information is included in Section 9.

M E N WSC plans to upsize their current 6-inch connection at Lake Halbert to a 12-inch connection and to add 0.5 million gallons of elevated storage. New metering facilities will be required for these additions. The upsized connection, new elevated storage tank, and metering facilities are included in the *2011 Region C Water Plan* [1] as water management strategies that were not included in the *2006 Region C Water Plan* (2). Table 6.6 summarizes M E N WSC's future water supply plans.

Table 6.6
Summary Information for M E N WSC

M E N WSC	2011 Plan Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	3,421	3,755	4,137	4,477	4,762	5,180
Projected Water Demand						
Municipal Demand	441	471	510	542	571	621
Total Projected Water Demand	***441***	***471***	***510***	***542***	***571***	***621***
Currently Available Water Supplies						
Navarro Mills Reservoir (through Corsicana)	441	471	479	492	497	515
Total Supply	***441***	***471***	***479***	***492***	***497***	***515***
Need (Demand - Supply)	***0***	***0***	***31***	***50***	***74***	***106***
Water Management Strategies						
Water Conservation - Basic Package	6	18	26	30	34	39
Purchase additional water from Corsicana	0	0	5	20	40	67
Total Water Management Strategies	***6***	***18***	***31***	***50***	***74***	***106***
Reserve or (Shortage)	**6**	**18**	**0**	**0**	**0**	**0**

Navarro County-Steam Electric Power

There were no Navarro County Steam Electric Power (SEP) water management strategies in the *2006 Region C Water Plan* (2) because there were no existing or projected steam electric power demands. However, several new power plants are planned in Navarro County in the near term including the L.S. Power, Patten Energy (formerly Babcock and Brown) and Corsicana Plants. These new SEP demands will be met by the City of Corsicana. Corsicana has indicated that the new pipelines required to deliver water to the power plants will be paid for by the power companies. Table 6.7 summarizes the changes to water management strategies for Navarro County Steam Electric Power.

Table 6.7
Summary Information for Navarro County Steam Electric Power

Navarro County – Steam Electric Power	2011 Plan Projections					
	2010	2020	2030	2040	2050	2060
Projected Water Demand						
Steam Electric Demand	0	8,000	13,440	13,440	13,440	13,440
Total Projected Water Demand	***0***	***8,000***	***13,440***	***13,440***	***13,440***	***13,440***
Currently Available Water Supplies						
Total Supply	***0***	***0***	***0***	***0***	***0***	***0***
Need (Demand - Supply)	***0***	***8,000***	***13,440***	***13,440***	***13,440***	***13,440***
Water Management Strategies						
Purchase water from Corsicana	0	8,000	13,440	13,440	13,440	13,440
Total Water Management Strategies	***0***	***8,000***	***13,440***	***13,440***	***13,440***	***13,440***
Reserve or (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Navarro Mills WSC

Navarro Mills WSC's currently planned water management strategies are in line with the strategies in the *2006 Region C Water Plan* [2]. The amount of supply from Navarro Mills Reservoir (TRA sources) through Corsicana is decreased because of decreased projected demands. The City's contract with Corsicana allows for use of up to 1,473 acre-feet per year. Navarro Mills WSC also plans on using groundwater from the Woodbine Aquifer. Table 6.8 summarizes the changes in supply for Navarro Mills WSC.

Table 6.8
Summary Information for Navarro Mills WSC

Navarro Mills WSC	2011 Plan Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	3,090	3,690	4,290	5,000	5,800	6,600
Projected Water Demand						
Municipal Demand	329	442	500	577	663	754
Total Projected Water Demand	***329***	***442***	***500***	***577***	***663***	***754***
Currently Available Water Supplies						
Navarro Mills Reservoir (through Corsicana)	329	442	470	524	578	625
Total Supply	***329***	***442***	***470***	***524***	***578***	***625***
Need (Demand - Supply)	***0***	***0***	***30***	***53***	***85***	***129***
Water Management Strategies						
Water Conservation - Basic Package	5	18	27	33	41	49
Purchase additional water from Corsicana	0	0	3	20	44	80
New well in the Woodbine Aquifer	0	44	44	44	44	44
Total Water Management Strategies	***5***	***62***	***74***	***97***	***129***	***173***
Reserve or (Shortage)	**5**	**62**	**44**	**44**	**44**	**44**

Water User Groups with No Revisions to Water Management Strategies

The water user groups in Navarro County that have no revisions to water management strategies as presented in the *2006 Region C Water Plan* [(2)] include the following:

- Community Water Company
- Frost
- Navarro County - Irrigation
- Navarro County - Livestock
- Navarro County - Manufacturing
- Navarro County - Mining
- Navarro County - Other

- Rice
- Rice WSC

Summary tables for these water user groups are included in Appendix C.

7. Estimated Costs for Water Management Strategies

The estimated costs for water management strategies were updated and are included in Appendix Q. Total capital cost for the Navarro County Study Area through the year 2060 is estimated to be $88.8 million. The capital costs are broken down by category in Table 7.1 and broken down by WUG in Table 7.2. Costs for alternative water management strategies are included in Section 9 of this report. Refer to Appendix Q for additional details on cost estimates.

Table 7.1
Capital Costs for Water Management Strategies by Category

Water Management Strategy Category	Capital Cost During Study Period
Transmission Facilities	$34,884,300
New Wells	$2,695,400
Supplemental Wells	$1,569,000
New Water Treatment Plants	$29,709,000
Water Treatment Plant Expansions	$19,969,550
Total Capital Costs for Study Area	**$88,827,250**

Table 7.2
Capital Costs for Water Management Strategies by WUG

Water User Group	Capital Cost During Study Period
Blooming Grove	$1,495,400
Corsicana	$52,357,950
Dawson	$1,044,000
Frost	$558,000
M E N WSC	$3,001,800
Navarro County Livestock	$105,000
Navarro County Mining	$348,000
Navarro County Other	$558,000
Navarro County - Steam Electric Power	$28,159,100
Navarro Mills WSC	$1,200,000
Total Capital Costs for Study Area	**$88,827,250**

8. Implementation Plan for Water Management Strategies

Implementation of the Navarro County Water Supply System includes developing water management strategies for surface water. The Navarro County Water Supply System is comprised of separate projects that are completed over a period of time by various WUGs. For surface water sources, the implementation plan for water management strategies includes the following components:

- Obtain water rights and/or develop water supply contracts
- Obtain required permits
- Design and construct required facilities

For groundwater sources, the implementation plan for water management strategies includes the following components:

- Obtain required permits
- Design and construct required facilities

Table 8.1 is a list of recommended water management strategies with approximate in-service dates.

Table 8.1
Implementation of Proposed Water Management Strategies

Owner	Project	Approximate In-service Year
Blooming Grove	New well in Trinity Aquifer	2020
Corsicana	New Water Treatment Plant (8 MGD)	2020
Corsicana	Pump station at Lake Halbert	2020
Corsicana	Water Treatment Plant Expansion (8 MGD)	2040
Dawson	New Water Treatment Plant (0.1 MGD)	2020
Frost	Supplemental Well in Woodbine Aquifer	2010
M E N WSC	Upsizing connection at Lake Halbert	2010
Navarro County - Livestock	Supplemental wells Carrizo-Wilcox Aquifer	2010
Navarro County - Mining	Supplemental wells in Carrizo-Wilcox & Nacatoch Aquifers	2010
Navarro County - Other	Supplemental wells in Woodbine Aquifer	2020
Navarro County - Steam Electric Power	Raw water pipeline	2020
Navarro County - Steam Electric Power	Raw water pipeline	2030
Navarro Mills WSC	New well in Woodbine Aquifer	2020

9. Alternative Water Management Strategies

In general, most of the water user groups and wholesale water providers in the study area indicated that their future water supply plans are in line with the *2006 Region C Water Plan* (2). However, alternative strategies exist for Chatfield WSC, the City of Corsicana, and M E N WSC.

Corsicana

Corsicana's five mgd expansion of the Navarro Mills Water Treatment Plant is listed as an alternative strategy in the *2011 Region C Water Plan* (1). This strategy was included in the *2006 Region C Water Plan* (2) as a recommended water management strategy, but after discussions with the City of Corsicana was listed as an alternative strategy in the 2011 Plan.

Chatfield WSC

New alternative WMSs for Chatfield WSC include a new well in the Trinity River Alluvium (Other Aquifer) and a joint venture project with M E N WSC to obtain water from either Richland-Chambers Reservoir or Cedar Creek Reservoir. All of the water currently available, according to the most recent MAG numbers, in Navarro County from the Other Aquifer has been allocated. This does not mean that water is not available for Chatfield WSC to use, but the Region C Water Plan does not show any Other Aquifer supplies available for allocation to Chatfield WSC.

M E N WSC

New alternative WMSs for M E N WSC not included in the 2006 Plan include groundwater from the Other Aquifer and a joint venture project with Chatfield WSC to obtain water from either Richland-Chambers Reservoir or Cedar Creek Reservoir. All of the water currently available, according to the most recent MAG numbers, in Navarro County from the Other Aquifer has been allocated. This does not mean that water is not available for M E N WSC to use, but the Region C Water Plan does not show any Other Aquifer supplies available for allocation to M E N WSC.

The estimated costs for alternative water management strategies are included in Appendix Q. The total capital cost for the Navarro County Study Area for alternative

WMSs, through the year 2060, is estimated to be $38.5 million. The capital costs are broken down by category in Table 9.1 and broken down by WUG in Table 9.2. Refer to Appendix Q for additional details.

Table 9.1
Capital Costs for Alternative Water Management Strategies by Category

Water Management Strategy Category	Capital Cost During Study Period
Transmission Facilities	$0
New Wells	$7,000,000
Supplemental Wells	$0
New Water Treatment Plants	$17,000,000
Water Treatment Plant Expansions	$14,548,000
Total Capital Costs for Study Area	**$38,548,000**

Table 9.2
Capital Costs for Alternative Water Management Strategies by WUG

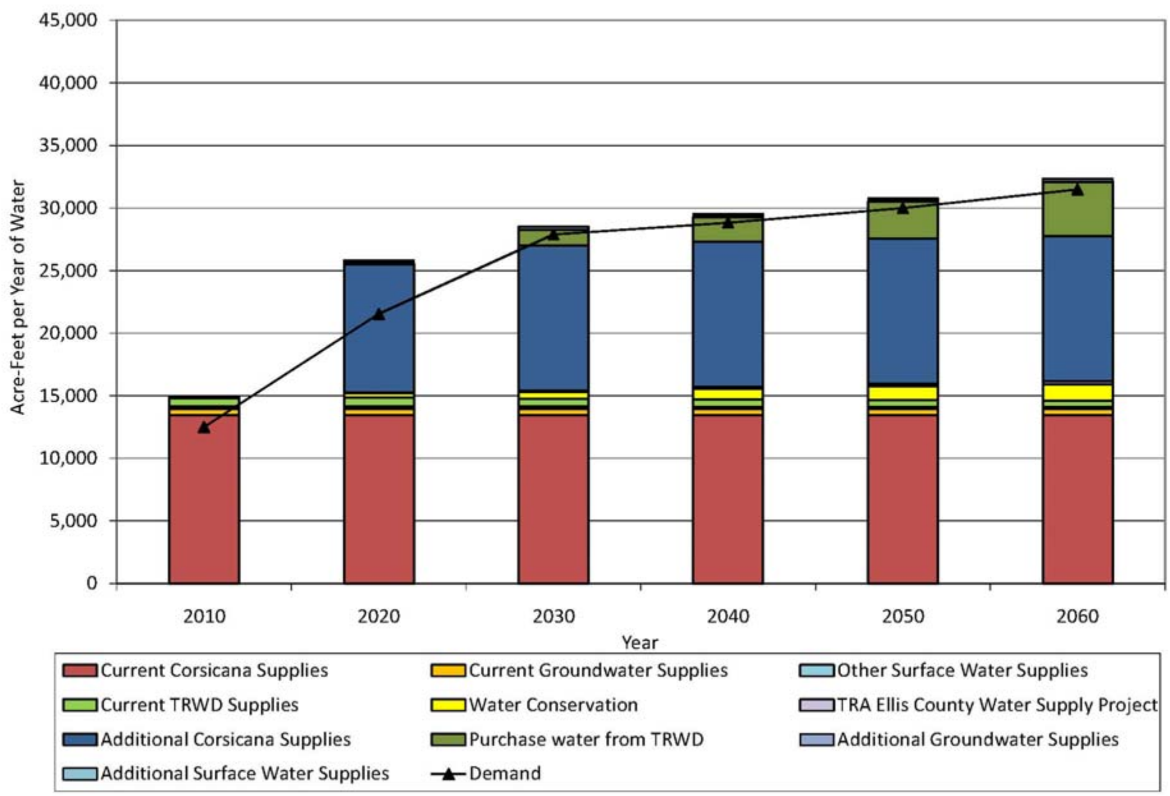
Water User Group	Capital Cost During Study Period
Chatfield WSC	$12,000,000
Corsicana	$14,548,000
M E N WSC	$12,000,000
Total Capital Costs for Study Area	**$38,548,000**

10. Conclusion

The projected growth in Navarro County has increased for the entire study period since the *2006 Region C Water Plan* (2). The water management strategies recommended in the *2006 Region C Water Plan* (2) have been adjusted to account for these changes to future demands. For most water user groups, their currently planned water management strategies are in line with the strategies presented in the *2006 Region C Water Plan* (2). Corsicana, through Navarro Mills Reservoir, Lake Halbert, and Richland-Chambers Reservoir, will meet most of the municipal and steam electric power demands in Navarro County. Figure 10.1 shows the total projected demands, current water supplies, and recommended water management strategies for Navarro County.

Figure 10.1

Total Demands and Supplies for Navarro County



APPENDIX 1

REFERENCES

APPENDIX 1

REFERENCES

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APPENDIX W

WATER SUPPLY STUDY FOR KAUFMAN COUNTY

Water Supply Study for Kaufman County

September 2010

Prepared for:

Region C Water Planning Group

Prepared by:

Freese and Nichols, Inc

Alan Plummer Associates, Inc

CP&Y, Inc.

Water Supply Study for Kaufman County
Region C Water Planning Group

TABLE OF CONTENTS

		Page
1.	Executive Summary	1.1
2.	Introduction	2.1
2.1	Meetings to Collect Data	2.1
3.	Population and Demand Projections	3.1
3.1	Revisions to Population and Demand Projections	3.1
3.2	Recommended Population Projections	3.6
3.3	Recommended Water Demands for Water User Groups	3.10
3.4	Recommended Water Demands for Wholesale Water Providers	3.15
4.	Evaluation of Current Supplies	4.1
4.1	Surface Water	4.1
4.2	Groundwater	4.1
5.	Comparison of Current Supplies to Projected Demand	5.1
6.	Proposed Revisions to Water Management Strategies	6.1
7.	Estimated Costs for Proposed Water Management Strategies	7.1
8.	Implementation Plan for Proposed Water Management Strategies	8.1
9.	Alternative Water Management Strategies	9.1
10.	Conclusion	10.1

APPENDICES

Appendix 1 .... References

LIST OF TABLES

Page

Table 2.1 Meetings with WUGs and WWPs 2.3

Table 3.1 Recommended Population Projections in Study Area 3.8

Table 3.2 Recommended Total Population Projections for Entities in More Than One County 3.9

Table 3.3 Recommended Municipal Per Capita Water Use Projections in Gallons per Person per Day 3.12

Table 3.4 Recommended Demand Projections in Acre-Feet per Year 3.13

Table 3.5 Recommended Population and Demand Projections Expected to be Supplied by Dallas Water Utilities 3.15

Table 3.6 Recommended Population and Demand Projections Expected to be Supplied by North Texas Municipal Water District 3.16

Table 3.7 Recommended Population and Demand Projections Expected to be Supplied by Tarrant Regional Water District 3.17

Table 6.1 Summary Information for Ables Springs WSC 6.1

Table 6.2 Summary Information for College Mound WSC 6.2

Table 6.3 Summary Information for Combine WSC 6.3

Table 6.4 Summary Information for Crandall 6.4

Table 6.5 Summary Information for Forney 6.5

Table 6.6 Summary Information for Kaufman 6.6

Table 6.7 Summary Information for Kaufman County Irrigation 6.7

Table 6.8 Summary Information for Kaufman County Other 6.8

Table 6.9 Summary Information for Kaufman County Steam Electric Power 6.9

Table 6.10 Summary Information for Mabank 6.10

Table 6.11 Summary Information for Post Oak Bend City 6.11

Table 6.12 Summary Information for Scurry 6.12

Table 6.13 Summary Information for Talty 6.13

Table 6.14 Summary Information for Terrell 6.14

Table 7.1 Capital Costs for Proposed Water Management Strategies by Category 7.1

Table 7.2 Capital Costs for Proposed Water Management Strategies by WUG 7.1

Table 8.1 Implementation of Proposed Water Management Strategies 8.1

LIST OF FIGURES

Page

Figure 2.1 Kaufman County Study Area 2.2

Figure 3.1 Recommended Population Projections for Kaufman County 3.7

Figure 3.2 Recommended Municipal Demand Projections for Kaufman County 3.11

Figure 3.3 Recommended Total Demand Projections for Kaufman County 3.11

Figure 10.1 Total Demands and Supplies for Kaufman County 10.1

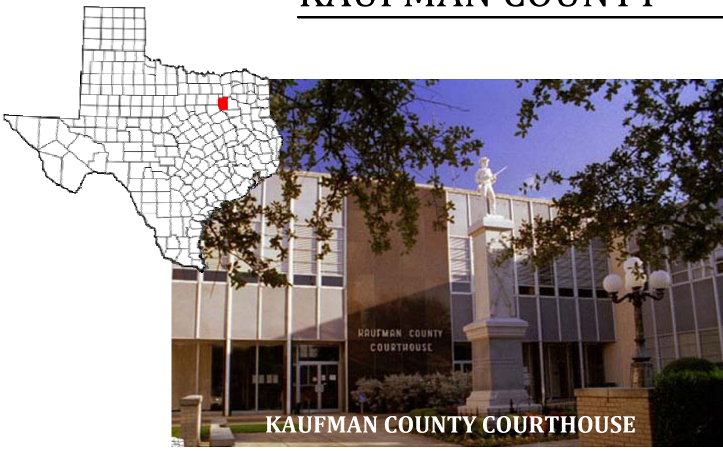
Region C Water Planning Group
Water Supply Study for Kaufman County

1. Executive Summary

As part of the 2011 Region C water planning process, several special county studies were included to more closely examine the water management strategies for those counties. Kaufman County is one of the counties included in the study. The purpose of this study is to analyze alternative approaches to provide water to the northern portion of Kaufman County and analyze alternative potential uses for Lake Terrell. Water management strategies (WMSs) were changed based on information obtained from meetings with various water user groups (WUGs) in Kaufman County as well as from surveys mailed to every WUG in Region C. Several WMSs were revised to reflect new demand projections as determined in the *2011 Region C Water Plan* (1). The population and demand projections in the *2011 Region C Water Plan* (1) are greater than the *2006 Region C Water Plan* (2) projections from 2020 to 2060. A summary of cost estimates and an implementation plan for water management strategies are also included in this report. Detailed cost estimates are included in Appendix Q of the *2011 Region C Water Plan* (1).

The majority of WUGs in Kaufman County rely on surface water provided by North Texas Municipal Water District (NTMWD), Tarrant Regional Water District (TRWD), and Dallas Water Utilities (DWU). Additional sources in the county include Lake Tawakoni (Sabine River Authority), and reuse.

(1) Superscripted numbers in parenthesis match references in Appendix 1.



2000 Population: *71,313*

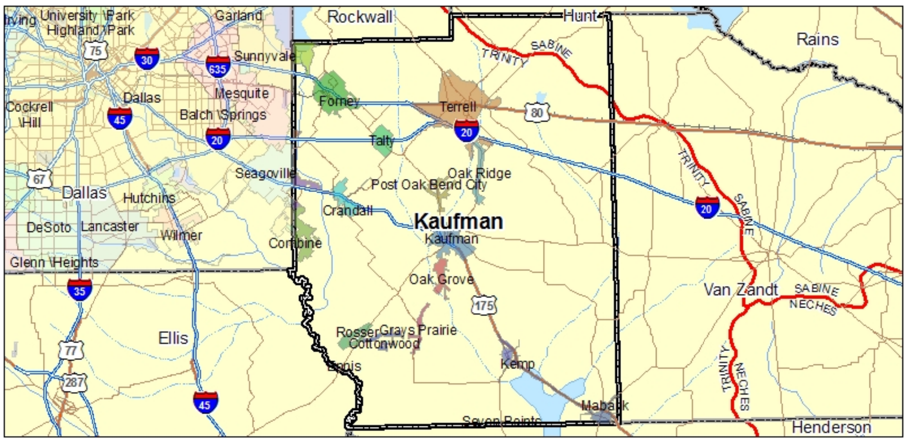
Projected 2060 Population: *349,385*

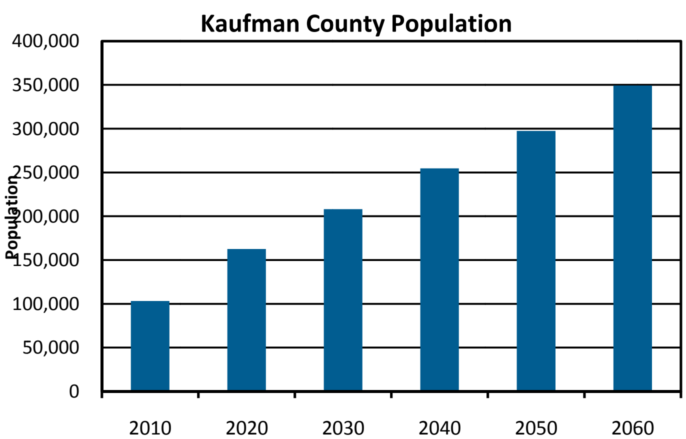
County Seat: *Kaufman*

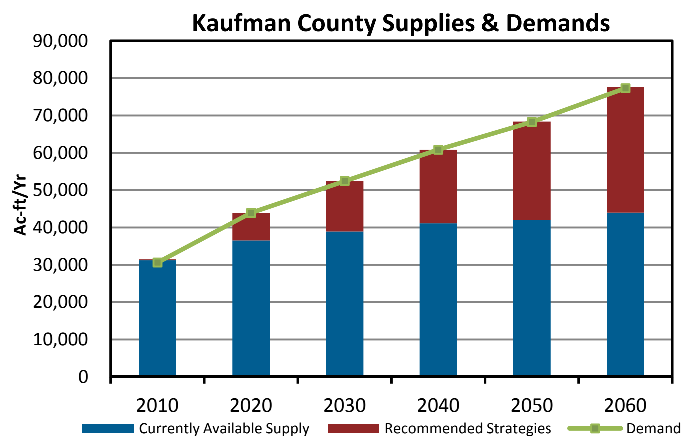
Economy: *Manufacturing; government/services*

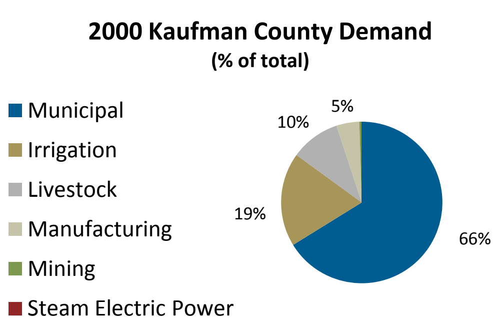
River Basin(s):

– Trinity (95%), Sabine (5%)

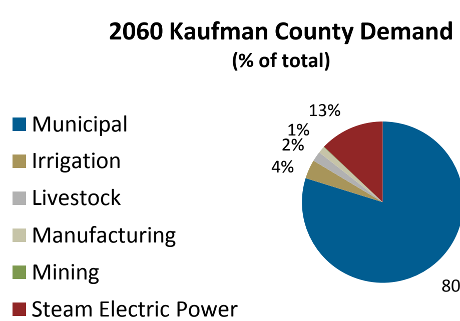








Total=15,523 acre-feet



Total= 77,308 acre-feet

WATER USER GROUP	2060 KAUFMAN CO. DEMAND (AC-FT/YR)	CURRENT SUPPLIES	RECOMMENDED STRATEGIES [b]
Ables Springs WSC [a]	1,828	SRA (through MacBee SUD)	NTMWD supplies (connect to Tawakoni WTP and additional capacity)
College Mound WSC	2,623	NTMWD	Additional NTMWD supplies
Combine [a]	447	Combine WSC (DWU)	Additional Combine WSC (DWU)
Combine WSC [a]	1,189	DWU	Additional DWU supplies
Crandall	2,362	NTMWD	Additional NTMWD supplies, DWU (through Seagoville)
Forney	7,048	NTMWD, Garland reuse (for SEP)	Additional NTMWD supplies
Forney Lake WSC [a]	2,014	NTMWD	Additional NTMWD supplies
Gastonia-Scurry WSC	2,255	NTMWD	Additional NTMWD supplies
High Point WSC [a]	939	Forney and Terrell (NTMWD)	Additional NTMWD supplies (through Forney and Terrell)
Kaufman	3,029	NTMWD	Additional NTMWD supplies
Kemp	296	TRWD	Additional TRWD supplies
Mabank [a]	1,323	TRWD	Additional TRWD supplies, Water Treatment Plant expansion
MacBee WSC [a]	94	SRA	None
Mesquite [a]	2	NTMWD	Additional NTMWD supplies
Oak Grove	283	North Kaufman WSC from NTMWD through Terrell and Kaufman	Additional North Kaufman WSC supplies
Post Oak Bend City	982	Rose Hill SUD (NTMWD)	Additional Rose Hill SUD supplies
Scurry	186	Gastonia-Scurry SUD (NTMWD)	Additional Gastonia-Scurry SUD supplies
Seagoville [a]	11	DWU	Additional DWU supplies
Talty	4,948	NTMWD (through Gastonia-Scurry WSC and Talty WSC [Kaufman County Other])	Additional NTMWD supplies
Terrell	24,643	NTMWD	Additional NTMWD supplies
West Cedar Creek MUD [a]	3,180	TRWD	Additional TRWD supplies, Water Treatment Plant expansions
County-Other	2,020	Nacatoch Aquifer, NTMWD, TRWD	Additional NTMWD supplies, Additional TRWD supplies, Supplemental wells
Irrigation	2,916	Cedar Creek Lake (TRWD), NTMWD, Direct reuse, Local supplies, Nacatoch and Trinity Aquifers	Additional NTMWD supplies, Supplemental wells
Livestock	1,545	Local supplies, Nacatoch and Woodbine Aquifers	Supplemental wells
Manufacturing	1,061	NTMWD (through Terrell, Forney, and Kaufman)	Additional NTMWD supplies
Mining	84	Local supplies	None
Steam Electric Power	10,000	Reuse from Garland (through Forney)	Forney (NTMWD), TRA reuse

[a] WUG is in multiple counties
[b] Water conservation is a strategy for every municipal user group

2. Introduction

The *2011 Region C Water Plan* [1] includes special county studies funded by the Texas Water Development Board (TWDB). The consultant team for the *2011 Region C Water Plan* [1] includes Freese and Nichols, Inc. (FNI), Alan Plummer and Associates (APAI), CP&Y, Inc., and Cooksey Communications. The special county studies are aimed at analyzing approaches to developing and implementing the water management strategies for the counties. The Kaufman County Study is one of these projects.

Many of the water management strategies are consistent with the *2006 Region C Water Plan* [2]. However, several of the Water User Group (WUG) demands have increased in the long term, and water management strategies for those WUGs have been reevaluated. This report summarizes the analysis and recommendations for meeting water demand projections for WUGs in Kaufman County and potential alternative uses for Lake Terrell. The study area is shown in Figure 2.1.

2.1 Meetings to Collect Data

Freese and Nichols, Inc. (FNI) met with six water user groups (WUGs) in Kaufman County in the fall of 2009. An additional seven WUGs were contacted via telephone, but phone calls were not returned by four of the seven WUGs contacted. Table 3.1 lists the meetings held and the meeting participants. At each in-person meeting, FNI presented the finalized population and demand projections for the *2011 Region C Water Plan* [1]. Several of the WUGs, including Forney and Crandall, did not agree with the new projections. These issues will be better addressed in the next round of planning once the 2010 Census has been completed.

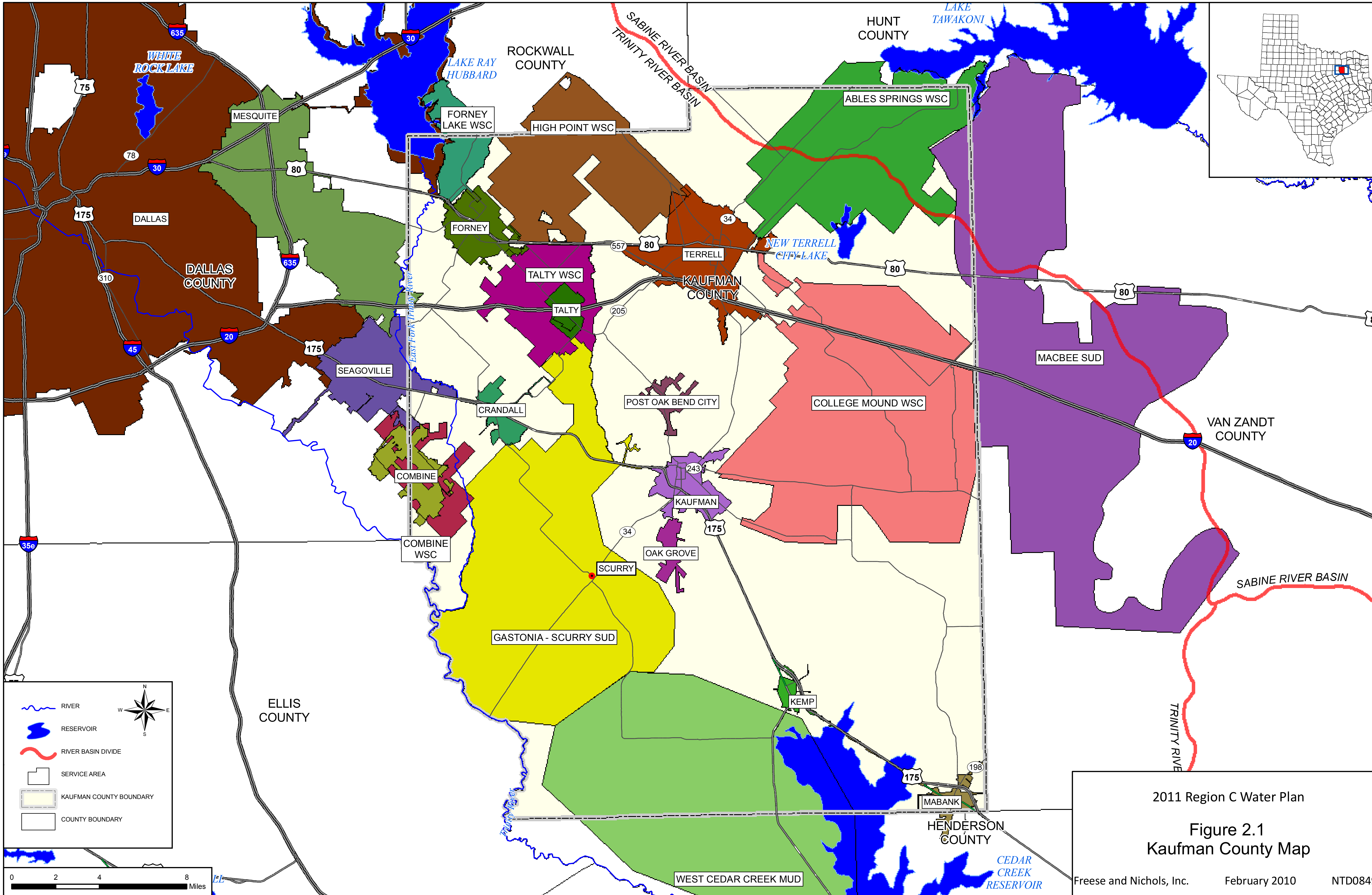
The current water supply for each entity, the recommended water management strategies as presented in the *2006 Region C Water Plan* [2], and any suggested adjustments to those recommendations were discussed. In many cases the entities plan to implement the recommended strategies, although the amounts of supply may change. In several cases the entities are pursuing other water supply options to meet their future needs. Current and future infrastructure projects were also discussed. Several of the

WUGs presented FNI with cost estimates of their near term projects as well as historical water use data.

The information obtained in these meetings was used to supplement or update proposed management strategies. Cost estimate information provided was used to update Appendix Q of the *2011 Region C Water Plan* (1).

Table 2.1
Meetings with WUGs and WWPs

Date	Entity	Meeting Type	Attendees
10/14/2009	Ables Springs WSC	In person	Paula Weber, Richard Simmons, Keeley Brown, Amy Kaarlela, Dusty Brannum
10/14/2009	College Mound WSC	In person	Shirley Blakely, Chad Wilson, Keeley Brown, Amy Kaarlela, Dusty Brannum
11/5/09	Crandall	In person	Heath Kaplan, Keeley Brown, Amy Kaarlela
11/3/2009	Forney	In person	Mike Shook, Richard Dormier, Keeley Brown, Amy Kaarlela
10/8/2009	Forney Lake WSC	Telephone	Alan Smirl, Keeley Brown
11/2/09	Gastonia-Scurry SUD	Telephone	Josh Liles, Dusty Brannum
10/14/2009	Kaufman	In person	Richard Underwood, Keeley Brown, Amy Kaarlela, Dusty Brannum
10/15/2009	Rose Hill SUD	Telephone	Vickie Armstrong, Amy Kaarlela
11/2/09	Talty WSC	Telephone	Kim Langley, Dusty Brannum
9/21/09	Terrell	In person	Sonny Groessel, Steve Rogers, Amy Kaarlela, Tom Gooch
11/23/09	West Cedar Creek MUD	Telephone	Tony Ciardo, Dusty Brannum


ROCKWALL COUNTY
HUNT COUNTY
LAKE TAWAKONI
LAKE RAY HUBBARD
WHITE ROCK LAKE
SABINE RIVER BASIN
TRINITY RIVER BASIN
MESQUITE
FORNEY LAKE WSC
HIGH POINT WSC
ABLES SPRINGS WSC
DALLAS
DALLAS COUNTY
FORNEY
NEW TERRELL CITY LAKE
TERRELL
TALTY WSC
KAUFMAN COUNTY
TALTY
MACBEE SUD
SEAGOVILLE
CRANDALL
POST OAK BEND CITY
COLLEGE MOUND WSC
VAN ZANDT COUNTY
COMBINE
KAUFMAN
COMBINE WSC
OAK GROVE
SCURRY
SABINE RIVER BASIN
GASTONIA - SCURRY SUD
ELLIS COUNTY
KEMP
MABANK
HENDERSON COUNTY
CEDAR CREEK RESERVOIR
WEST CEDAR CREEK MUD
East Fork Trinity River
RIVER
RESERVOIR
RIVER BASIN DIVIDE
SERVICE AREA
KAUFMAN COUNTY BOUNDARY
COUNTY BOUNDARY
0 2 4 8 Miles
2011 Region C Water Plan
Figure 2.1
Kaufman County Map
Freese and Nichols, Inc.
February 2010
NTD08492

3. Population and Demand Projections

3.1 Revisions to Population and Demand Projections

The following section discusses the revisions to the population and demand projections as adopted in the *2011 Region C Water Plan* [(1)]. Municipal per capita water use (measured in gallons per capita per day) and population projections are used to project future water demand. Municipal per capita water use is the sum of residential, commercial, and institutional water use divided by the population served.

The Region C Consultant Team collected available historical and projected population data for each entity through the in-person or phone meetings. Additional historical population data was gathered from the Texas State Data Center [(3)], the U.S. Census Bureau [(4)], and the North Central Texas Council of Governments (NCTCOG) [(5)]. FNI also gathered population projections developed by the NCTCOG and those approved by the Texas Water Development Board for regional water planning. Additional input from entities was obtained through surveys mailed to each WUG in Region C.

Crandall

No revisions to Crandall's population and demand projections were made in the *2011 Region C Water Plan* [(1)]. However, after meeting with Crandall's city staff, it appears the TWDB approved population projections for the City may be low. The City has ample of room for growth and has plans to annex multiple areas around the City. The City also expects increased growth because of easy access to the City of Dallas via major highways. Crandall's growth will be reexamined in the 2016 round of planning. The new projections will likely be more reflective of the City's growth because they will incorporate 2010 Census numbers.

College Mound WSC

The population projections for College Mound WSC were changed based on a meter count provided by College Mound WSC. College Mound WSC recommended using the assumption of three people per meter to estimate their population. The revised projections are lower than *2006 Region C Water Plan* [(2)] projections for the entire planning period. The demand projections were changed based on the decreased population projections.

Forney

The City of Forney's population was increased in 2010 based on recent data. The TWDB recommended an increase from 2010 through 2060, but based on historical data, the projections from the *2006 Region C Water Plan* [(2)] are more in line with Forney's current growth trends. The demand for Forney was increased in 2010 based on the increased population.

Forney Lake WSC

Forney Lake WSC is located in both Kaufman and Rockwall Counties with approximately 50 percent of the population in each county. The population for Forney Lake WSC was significantly decreased for the entire 50 year planning period based on the current population as submitted by Forney Lake WSC to North Texas Municipal Water District (NTMWD). The demand was decreased based on the changes to population.

Gastonia-Scurry SUD

Gastonia-Scurry SUD's population and demand projections were decreased for the entire planning period. Gastonia-Scurry SUD had no disagreement with their population projections in their survey response but their population was decreased because of the addition of Scurry as a separate WUG. The demand projections were decreased based on the decreases in population.

High Point WSC

The population estimate for High Point WSC was decreased based on the current Texas Commission on Environmental Quality (TCEQ) Utilities Database meter count. The current population was determined by assuming three people per meter. This current population estimate was used to revise the future projections by reducing them proportionately. Demands were decreased based on the changes to population estimates. The municipal per capita values are the same as those in the *2006 Region C Water Plan* [(2)].

Kaufman

The City of Kaufman's population projections were not changed from the *2006 Region C Water Plan* (2). The municipal per capita value for 2010 was increased based on recent data. The demand projection for 2010 increased based on the change to municipal per capita.

Kaufman County Other

The County Other population includes any rural population not included in a water user group. Kaufman County Other projections were decreased because of the two new WUGs that were added in Kaufman County. Post Oak Bend City and Scurry are now considered WUGs because their population reached at least 500 people since the 2006 Plan. A portion of the population from County Other is now counted as Post Oak Bend City's population. The demand was decreased based on the changes to population. The municipal per capita values are the same as those presented in the *2006 Region C Water Plan* (2).

Kemp

The population estimate for Kemp was increased based on Texas State Demographer data. The 2007 State Demographer population estimate for Kemp is 1,361. The *2006 Region C Water Plan* (2) projects Kemp's population as 1,133 for the entire 50 year planning period. Demands were increased based on the changes to population estimates. The municipal per capita values are the same as those in the *2006 Region C Water Plan* (2).

Mabank

The City of Mabank's population was increased based on a recommendation by the TWDB. The City's demand increased based on the changes made to the population projections. The municipal per capita values are the same as those in the *2006 Region C Water Plan* (2).

Mesquite

The majority of the City of Mesquite is located in Dallas County, with a very small portion crossing over into Kaufman County. There was no change to the population and demand projections from the *2006 Region C Water Plan* [(2)] for the Kaufman County segment of the City. However, the municipal per capita usage was increased because projected commercial growth in Mesquite is much greater than projected population growth.

Post Oak Bend City

Post Oak Bend City was added as a WUG in the *2011 Region C Water Plan* [(1)]. The City's population reached at least 500 since the *2006 Region C Water Plan* [(2)] which is the criteria a city must meet to be considered a WUG. Population projections for Post Oak Bend City were provided by the TWDB. A municipal per capita usage of 115 gallons per capita per day (gpcd) was assumed as the baseline gpcd for water supply corporations. The demand for the City was calculated based on the population and per capita usage projections.

Scurry

Surry is another WUG that was added to the *2011 Region C Water Plan* [(1)]. Population projections for the City were provided by the TWDB. A municipal per capita usage of 115 gpcd was assumed. The demand for the City of Scurry was calculated based on the population and per capita usage projections.

Talty

The City of Talty's population was reduced in 2010 based on their survey response. The growth of the City has slowed recently, but their survey indicates they feel growth will be back in line with the *2006 Region C Water Plan* [(2)] projections by 2020. Based on recent data, the municipal per capita usage was increased for the 50 year planning period. The demand for 2010 decreased from the *2006 Region C Water Plan* [(2)] projection, but increased from 2020 through 2060 because of the increase to per capita usage.

Terrell

Based on information from Terrell's water provider (NTMWD) and Terrell's Master Plan, the City's population projections were increased for the planning period. The City's demand was increased based on the changes to the population projections.

West Cedar Creek MUD

Based on West Cedar Creek MUD's current meter count from the TCEQ Water Utilities Database and a factor of three persons per meter, FNI estimated their current population. From that estimate FNI revised the future projections proportionately. West Cedar Creek MUD's population was decreased for all years based on the calculation described above. Their demand was decreased based on the changes to the population projections.

Additional County Aggregated Projections

The Region C Consultant Team examined the demand projections developed in the *2006 Region C Water Plan* (2) for county-other, manufacturing, mining, irrigation, livestock, and steam electric power. In Kaufman County, only the steam electric power demands were adjusted for the *2011 Region C Water Plan* (1).

The steam electric power demands in Kaufman County were changed based on projections developed in the *2006 Region C Water Plan* (2) and by the Bureau of Economic Geology (BEG) in the study *Water Demand Projections for Power Generation in Texas* (4). The new steam electric demand projections for Kaufman County are significantly lower than those in the 2006 Plan and higher than the BEG projections. Kaufman County currently has one steam electric power plant owned by FPLE Forney LLP. Kaufman County is designated as a non-attainment area and it is unlikely new plants will be constructed. Areas failing to meet the National Ambient Air Quality Standard (NAAQS) for ozone are designated as non-attainment areas. The 2010 projection did not change from the *2006 Region C Water Plan* (2), but the 2020 through 2060 demand projections were decreased.

Water User Groups Whose Population and Demand Projections are Unchanged

Population and demand projections remain unchanged for several water user groups. The population and demand projections presented in the *2006 Region C Water Plan* (2) remain as previously projected for the following water user groups:

- Ables Springs WSC
- Combine
- Combine WSC
- Crandall
- Kaufman County – Irrigation
- Kaufman County – Livestock
- Kaufman County – Manufacturing
- Kaufman County - Mining
- MacBee SUD
- Mesquite
- Oak Grove
- Seagoville

3.2 Recommended Population Projections

In general, the population in Kaufman County is increasing more than projected in the *2006 Region C Water Plan* [(2)]. The revised recommended projections are based on information provided by the entities and historical population estimates. The total recommended population projections for Kaufman County are lower than the *2006 Region C Water Plan* [(2)] projections for 2010 and higher from 2020 to 2060.

Table 3.1 presents recommended population projections for each water user group in the study area, as well as what was previously projected in the *2006 Region C Water Plan* [(2)]. Figure 3.1 shows the population projections for Kaufman County. Table 3.1 lists the population projections for the WUGs in Kaufman County. The population projections for entities split between counties or regions are shown in Table 3.2. The projections shown are the population projections for the entire entity, not just the Kaufman County portion.

Figure 3.1
Recommended Population Projections for Kaufman County

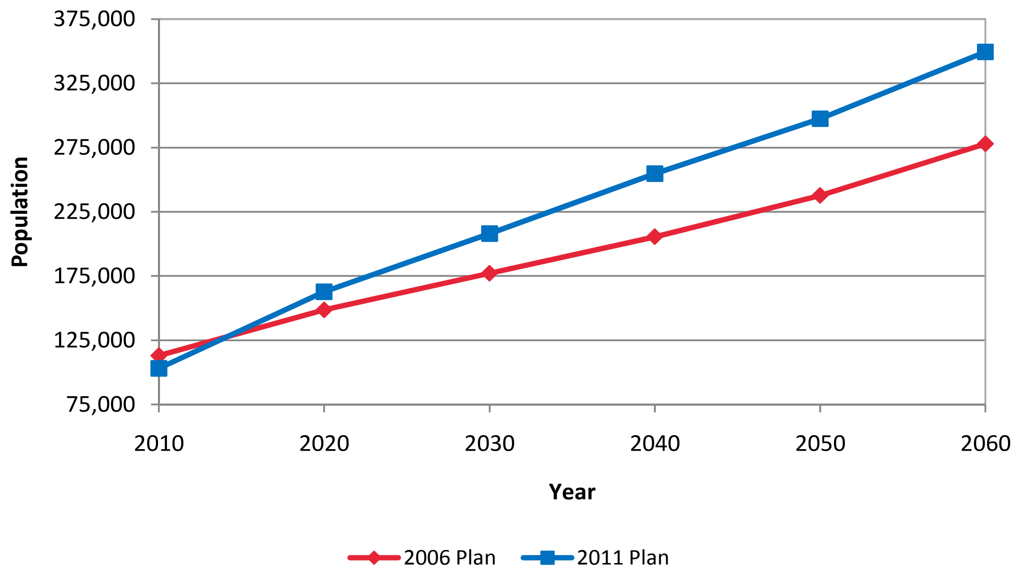


Table 3.1
Recommended Population Projections in Kaufman County

Water User Group	2006 Plan Projections						2011 Plan Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Ables Springs WSC	4,809	6,529	8,297	10,257	12,683	15,693	4,809	6,529	8,297	10,257	12,683	15,693
College Mound WSC	10,530	13,042	15,624	18,485	22,027	26,421	9,150	11,333	13,576	16,062	19,140	22,958
Combine [(a)]	1,547	1,921	2,306	2,732	3,260	3,914	1,547	1,921	2,306	2,732	3,260	3,914
Combine WSC [(a)]	2,730	3,897	5,096	6,425	8,071	10,112	2,730	3,897	5,096	6,425	8,071	10,112
County - Other	14,426	14,426	14,426	14,426	14,426	14,426	13,767	13,767	13,767	13,767	13,767	13,767
Crandall	4,373	5,933	7,537	9,314	11,515	14,245	4,373	5,933	7,537	9,314	11,515	14,245
Forney	12,000	24,000	30,000	35,000	39,000	42,803	13,000	24,000	30,000	35,000	39,000	42,803
Forney Lake WSC [(a)]	10,200	11,000	11,500	12,000	12,500	13,000	3,531	3,938	4,922	6,153	7,691	9,613
Gastonia - Scurry SUD	8,000	10,000	11,648	14,122	17,186	20,986	7,322	9,211	10,730	13,054	15,944	19,541
High Point WSC [(a)]	4,761	5,982	7,237	8,628	10,350	12,486	3,102	3,898	4,715	5,622	6,744	8,136
Kaufman	8,256	10,864	13,020	14,753	16,484	19,883	8,256	10,864	13,020	14,753	16,484	19,883
Kemp	1,133	1,133	1,133	1,133	1,133	1,133	1,400	1,700	2,000	2,000	2,000	2,000
Mabank [(a)]	2,367	2,889	3,425	4,019	4,755	5,667	2,637	3,219	3,816	4,478	5,298	6,314
MacBee SUD [(a)]	277	348	421	502	602	726	277	348	421	502	602	726
Mesquite [(a)]	2	3	4	6	8	10	2	3	4	6	8	10
Oak Grove	928	1,141	1,360	1,602	1,902	2,274	928	1,141	1,360	1,602	1,902	2,274
Post Oak Bend City	Not a WUG in 2006 Plan						659	1,075	1,754	2,862	4,671	7,623
Scurry	Not a WUG in 2006 Plan						678	789	918	1,068	1,242	1,445
Seagoville [(a)]	17	27	37	48	62	79	17	27	37	48	62	79
Talty	2,447	3,832	5,256	6,834	8,788	11,211	1,800	3,832	5,256	6,834	8,788	11,211
Terrell	15,196	18,642	21,664	23,650	25,599	28,445	16,185	45,005	65,000	85,000	97,000	110,000
West Cedar Creek MUD [(a)]	8,972	12,971	17,081	21,635	27,274	34,269	7,079	10,234	13,477	17,070	21,519	27,038
Kaufman County Total	**112,971**	**148,580**	**177,072**	**205,571**	**237,625**	**277,783**	**103,249**	**162,664**	**208,009**	**254,609**	**297,391**	**349,385**

[(a)] Kaufman County portion only

Table 3.2
Recommended Total Population Projections for Entities in More Than One County

Water User Group	2006 Plan Projections						2011 Plan Projections					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
Ables Springs WSC	5,227	7,046	8,956	11,153	14,106	17,943	5,227	7,046	8,956	11,153	14,106	17,943
Combine	2,393	2,969	3,474	4,019	4,702	5,563	2,393	2,969	3,474	4,019	4,702	5,563
Combine WSC	4,122	5,737	7,202	8,795	10,785	13,285	4,122	5,737	7,202	8,795	10,785	13,285
Forney Lake WSC	18,200	22,000	23,000	24,000	25,000	26,000	6,300	7,875	9,844	12,305	15,381	19,226
High Point WSC	5,218	6,619	8,030	9,589	11,509	13,877	3,400	4,313	5,232	6,248	7,499	9,042
Mabank	2,708	3,254	3,814	4,433	5,199	6,149	3,074	3,729	4,401	5,142	6,058	7,194
MacBee WSC	8,496	9,931	11,211	12,326	13,956	16,019	8,496	9,931	11,211	12,326	13,956	16,019
Mesquite	160,002	195,003	225,004	242,006	249,008	250,610	142,002	165,003	180,004	183,168	183,445	183,501
Seagoville	16,668	19,183	21,352	23,699	25,536	27,517	13,017	16,327	19,537	22,848	25,536	27,517
West Cedar Creek MUD	21,673	28,602	35,601	43,119	52,374	63,933	17,100	22,567	28,089	34,021	41,323	50,443

3.3 Recommended Water Demands for Water User Groups

The municipal water demand projections presented in this section are based on per capita dry-year water use and the adopted population projections from the previous section. The per capita dry-year water uses presented in this section are based on the per capita water uses from the *2006 Region C Water Plan* (2), which include water savings from plumbing code requirements for low-flow fixtures. Adjustments to per capita water use from the *2006 Region C Water Plan* (2) were made to Kaufman (2010 only), Mesquite, Seagoville, and Talty. The changes to Kaufman, Seagoville, Talty were made based on recent per capita water use data. Mesquite's per capita use was adjusted because the commercial growth is much greater than the population growth in Mesquite. Table 3.4 summarizes the municipal per capita water use projections for this study. Municipal per capita water use is the sum of residential, commercial, and institutional water use divided by the population served. Figure 3.2 shows the 2006 and 2011 Plan municipal demand projections.

For each entity the population projections was multiplied by the projected municipal per capita water use to establish the projected demand. Table 3.5 lists the adopted demand projections for this study.

Non-municipal water demand projections including manufacturing, steam electric power, irrigation, mining, and livestock are reported on a county-wide basis. Projections of the non-municipal water demands were based on the projections from the *2006 Region C Water Plan* (2). Projections for manufacturing, irrigation, and livestock did not change from the *2006 Region C Water Plan* (2) for any of the counties in Region C. The steam electric power demands were revised based on available new information, which included recent power plant development activity, mothballing of existing plants, and the Bureau of Economic Geology report (6) released in 2008. Table 3.5 shows the projected demands for Kaufman County. Figure 3.3 shows the total demands for Kaufman County from the 2006 and 2011 Region C Water Plans (1, 2).

Figure 3.2
Recommended Municipal Demand Projections for Kaufman County

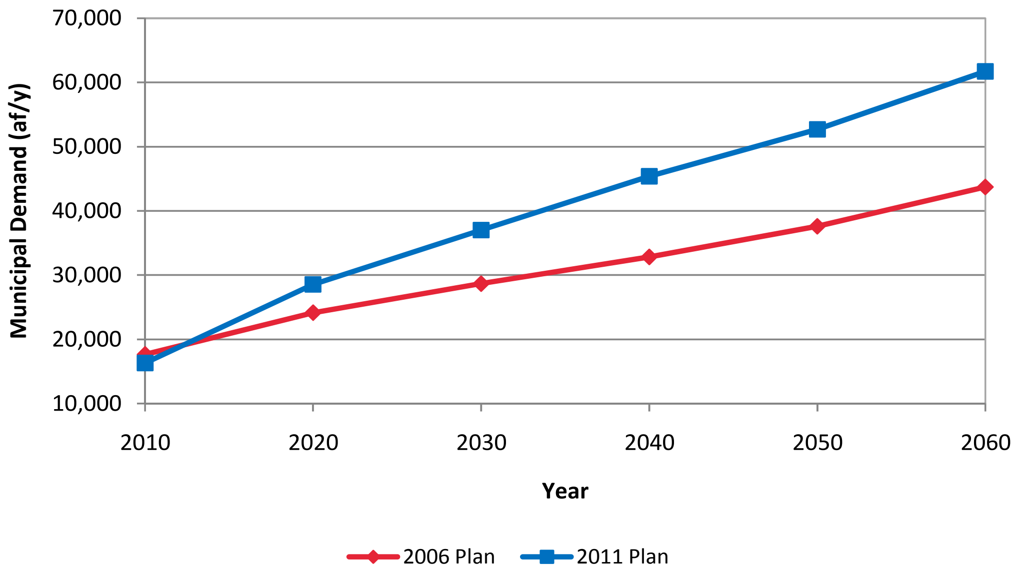


Figure 3.3
Recommended Total Demand Projections for Kaufman County

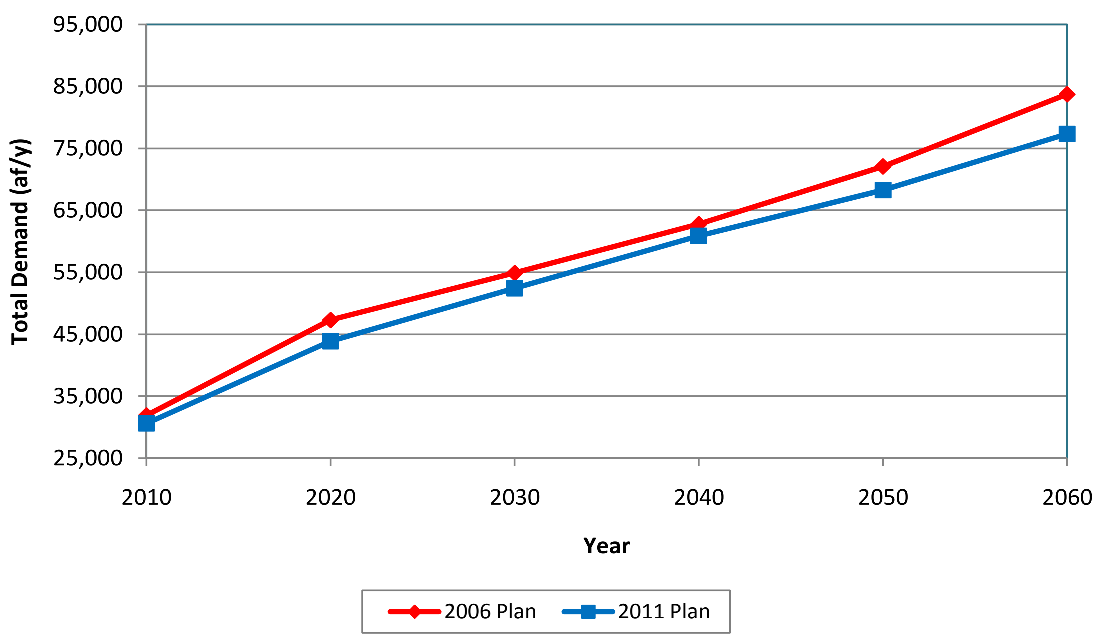


Table 3.3
Recommended Municipal Per Capita Water Use Projections in Gallons per Person per Day

Water User Group	2006 Plan Projections						2011 Plan Projections					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
Ables Springs WSC [a]	95	107	105	104	104	104	95	107	105	104	104	104
College Mound WSC	74	91	104	103	102	102	74	91	104	103	102	102
Combine	105	107	104	103	102	102	106	107	104	103	102	102
Combine WSC	100	107	106	105	105	105	100	107	106	105	105	105
County - Other	135	134	133	132	131	131	135	134	133	132	131	131
Crandall	149	151	149	148	148	148	149	151	149	148	148	148
Forney	144	150	148	147	147	147	144	150	148	147	147	147
Forney Lake WSC	195	192	190	188	187	187	195	192	190	188	187	187
Gastonia - Scurry SUD	94	107	105	103	103	103	94	107	105	103	103	103
High Point WSC	95	107	105	104	103	103	96	107	105	104	103	103
Kaufman	125	141	138	137	136	136	143	141	138	137	136	136
Kemp	143	140	137	134	132	132	143	140	137	134	132	132
Mabank	195	192	189	188	187	187	194	191	188	188	187	187
MacBee SUD	116	115	115	116	116	116	116	115	115	116	116	116
Mesquite	160	157	154	153	152	152	165	164	168	168	168	168
Oak Grove	119	116	113	112	111	111	119	116	113	112	111	111
Post Oak Bend City	Not a WUG in 2006 Plan						115	115	115	115	115	115
Scurry	Not a WUG in 2006 Plan						115	115	115	115	115	115
Seagoville	132	128	127	125	125	125	143	139	138	136	136	136
Talty	315	314	314	314	314	314	403	400	397	395	394	394
Terrell	210	206	203	201	200	200	210	206	203	201	200	200
West Cedar Creek MUD	90	103	106	105	105	105	90	103	106	105	105	105

[a] Region C portion only

Table 3.4
Recommended Demand Projections in Acre-Feet per Year

Water User Group	2006 Plan Projections						2011 Plan Projections					
	2010	2020	2030	2040	2050	2060	2010	2020	2030	2040	2050	2060
Ables Springs WSC	512	783	976	1,195	1,478	1,828	512	783	976	1,195	1,478	1,828
College Mound WSC	873	1,329	1,820	2,133	2,517	3,019	758	1,155	1,582	1,853	2,187	2,623
Combine [a]	182	230	269	315	372	447	182	230	269	315	372	447
Combine WSC [a]	306	467	605	756	949	1,189	306	467	605	756	949	1,189
County - Other	2,182	2,166	2,150	2,133	2,117	2,117	2,082	2,066	2,051	2,036	2,020	2,020
Crandall	730	1,004	1,258	1,544	1,909	2,362	730	1,004	1,258	1,544	1,909	2,362
Forney	1,936	4,033	4,973	5,763	6,422	7,048	2,097	4,033	4,973	5,763	6,422	7,048
Forney Lake WSC [a]	2,228	2,366	2,448	2,527	2,618	2,723	771	847	1,048	1,296	1,611	2,014
Gastonia - Scurry SUD	842	1,199	1,370	1,629	1,983	2,421	771	1,104	1,262	1,506	1,840	2,255
High Point WSC [a]	507	717	851	1,005	1,194	1,441	330	467	555	655	778	939
Kaufman	1,156	1,716	2,013	2,264	2,511	3,029	1,322	1,716	2,013	2,264	2,511	3,029
Kaufman County - Irrigation	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916	2,916
Kaufman County -Livestock	1,545	1,545	1,545	1,545	1,545	1,545	1,545	1,545	1,545	1,545	1,545	1,545
Kaufman County - Manufacturing	760	813	869	928	993	1,061	760	813	869	928	993	1,061
Kaufman County -Mining	79	80	81	82	83	84	79	80	81	82	83	84
Kaufman County -Steam Electric Power	8,979	17,798	20,808	24,478	28,950	34,403	8,979	10,000	10,000	10,000	10,000	10,000
Kemp	181	178	174	170	168	168	224	267	307	300	296	296
Mabank [a]	517	621	725	846	996	1,187	576	692	808	943	1,110	1,323
MacBee SUD [a]	36	45	54	65	78	94	36	45	54	65	78	94
Mesquite [a]	0	1	1	1	1	2	0	1	1	1	1	2

Table 3.4, Continued (Recommended Demand Projections in Acre-Feet per Year)

Oak Grove	124	148	172	201	236	283	124	148	172	201	236	283
Post Oak Bend City	Not a WUG in 2006 Plan						85	138	226	369	602	982
Scurry	Not a WUG in 2006 Plan						87	102	118	138	160	186
Seagoville [(a)]	3	4	5	7	9	11	3	4	5	7	9	11
Talty	863	1,348	1,849	2,404	3,091	3,943	813	1,717	2,337	3,024	3,878	4,948
Terrell	3,575	4,302	4,926	5,325	5,735	6,372	3,807	10,385	14,780	19,138	21,731	24,643
West Cedar Creek MUD [(a)]	904	1,497	2,028	2,545	3,208	4,031	714	1,181	1,600	2,008	2,531	3,180
Kaufman County Total	**31,936**	**47,306**	**54,886**	**62,777**	**72,079**	**83,724**	**30,609**	**43,906**	**52,411**	**60,848**	**68,246**	**77,308**

[(a)] Kaufman County portion only

3.4 Recommended Water Demands for Wholesale Water Providers

A number of regional and local wholesale water providers (WWPs) supply water throughout Kaufman County. Regional wholesale water providers that provide water to Kaufman County include:

- Dallas Water Utilities (DWU)
- North Texas Municipal Water District (NTMWD)
- Tarrant Regional Water District (TRWD)

Local wholesale water provides include:

- Forney
- Seagoville
- Terrell
- West Cedar Creek MUD

Tables 3.5 through 3.7 show the recommended population and demand projections expected to be supplied by DWU, NTMWD, and TRWD.

Table 3.5
Recommended Population and Demand Projections Expected to be Supplied by Dallas Water Utilities

DWU Customers in Study Area	2010	2020	2030	2040	2050	2060
Population Served by DWU						
Seagoville	17	27	37	48	62	79
Combine WSC [a]	4,122	5,737	7,202	8,795	10,785	13,285
Combine [a]	2,393	2,969	3,474	4,019	4,702	5,563
Crandall	0	2,051	3,601	4,054	6,255	8,986
Population served by DWU in Study Area	**6,532**	**10,784**	**14,314**	**16,916**	**21,804**	**27,913**
Demand Supplied by DWU [b] (acre-feet/year)						
Seagoville	3	4	5	7	9	11
Combine WSC [a]	462	688	855	1,035	1,268	1,562
Combine [a]	282	356	405	463	537	635
Crandall	0	347	601	672	1,037	1,490
Demand on DWU in Study Area	**747**	**1,395**	**1,866**	**2,177**	**2,851**	**3,698**

[a] Includes Dallas and Kaufman Counties
[b] Conservation is included in the demand amounts

Table 3.6
Recommended Population and Demand Projections Expected to be Supplied by North Texas Municipal Water District

NTMWD Customers in Study Area	2010	2020	2030	2040	2050	2060
Population Served by NTMWD						
Ables Springs WSC [(a)]	0	7,046	8,956	11,153	14,106	17,943
College Mound WSC	9,150	11,333	13,576	16,062	19,140	22,958
Crandall	4,373	3,882	3,936	5,260	5,260	5,259
Forney	13,000	24,000	30,000	35,000	39,000	42,803
High Point WSC [(b)] (50%)	1,700	2,157	2,616	3,124	3,750	4,521
Talty WSC	2,447	3,832	5,256	6,834	8,788	11,211
Kaufman County Other (10%)	826	1,086	1,302	1,475	1,648	1,988
Forney Lake WSC [(b)]	4,973	7,075	9,174	11,433	14,186	17,720
Gastonia - Scurry SUD	6,300	7,875	9,844	12,305	15,381	19,226
Scurry	7,322	9,211	10,730	13,054	15,944	19,541
Kaufman	8,256	10,864	13,020	14,753	16,484	19,883
Kaufman County Other (20%)	1,651	2,173	2,604	2,951	3,297	3,977
Oak Grove	2	3	4	6	8	10
Mesquite [(c)]	659	1,075	1,754	2,862	4,671	7,623
Post Oak Bend City	678	789	918	1,068	1,242	1,445
Terrell	16,185	45,005	65,000	85,000	97,000	110,000
High Point WSC [(b)] (50%)	3,660	4,533	5,430	6,425	7,656	9,183
Kaufman County Other (40%)	1,700	2,157	2,616	3,124	3,750	4,521
Total Population Served by NTMWD	3,302	4,346	5,208	5,901	6,594	7,953
Demand Supplied by NTMWD [(d)] (acre-feet/year)						
Ables Springs WSC [(a)]	0	845	1,054	1,299	1,644	2,090
College Mound WSC	758	1,155	1,582	1,853	2,187	2,623
Crandall	730	657	657	872	872	872
Forney	2,097	4,033	4,973	5,763	6,422	7,048
High Point WSC [(b)] (50%)	181	259	308	364	433	522
Talty WSC	813	1,717	2,337	3,024	3,878	4,948
Kaufman County Manufacturing (60%)	456	488	521	557	596	637
Kaufman County Other (10%)	208	207	205	204	202	202
Forney Lake WSC [(b)]	1,376	1,694	2,096	2,592	3,222	4,028
Gastonia - Scurry SUD	771	1,104	1,262	1,506	1,840	2,255
Scurry	87	102	118	138	160	186
Kaufman	1,322	1,716	2,013	2,264	2,511	3,029
Kaufman County Other (20%)	416	413	410	407	404	404
Oak Grove	224	267	307	300	296	296
Kaufman County SEP (1 MGD)	0	1,121	1,121	1,121	1,121	1,121

Table 3.6, Continued

Mesquite [(c)]	0	1	1	1	1	2
Post Oak Bend City (through Rose Hill	85	138	226	369	602	982
Terrell	3,807	10,385	14,780	19,138	21,731	24,643
High Point WSC [a] (50%)	181	259	308	364	433	522
Hunt County Other	108	128	157	203	313	485
Kaufman County Manufacturing (40%)	304	325	348	371	397	424
Kaufman County Other (40%)	833	826	820	814	808	808
Demand on NTMWD in Study Area	**14,757**	**27,840**	**35,604**	**43,524**	**50,073**	**58,127**

[(a)] Includes Kaufman and Hunt Counties
[(b)] Includes Kaufman and Rockwall Counties
[(c)] Kaufman County Portion Only
[(d)] Conservation is included in the demand amounts

Table 3.7
Recommended Population and Demand Projections Expected to be Supplied by Tarrant Regional Water District

TRWD Customers in Study Area	2010	2020	2030	2040	2050	2060
Population Served by TRWD						
Kaufman County Other (20%)	2,753	2,753	2,753	2,753	2,753	2,753
Kemp	1,400	1,700	2,000	2,000	2,000	2,000
Mabank [(a)]	3,074	3,729	4,401	5,142	6,058	7,194
West Cedar Creek MUD [(a)]	17,100	22,567	28,089	34,021	41,323	50,443
Seven Points [(b)]	1,402	1,681	1,956	2,238	2,582	3,016
Tool [(b)]	2,618	2,990	3,357	3,733	4,192	4,771
Population Served by TRWD in Study Area	**28,347**	**35,420**	**42,556**	**49,887**	**58,908**	**70,177**
Demand Supplied by TRWD [(c)] (acre-feet/year)						
Kaufman County Irrigation	100	100	100	100	100	100
Kaufman County Other (20%)	416	413	410	407	404	404
Kemp	224	267	307	300	296	296
Mabank [(a)]	671	801	931	1,083	1,269	1,507
West Cedar Creek MUD [(a)]	1,724	2,604	3,335	4,002	4,860	5,933
Seven Points [(b)]	188	222	254	288	330	385
Tool [(b)]	405	452	500	548	610	695
Demand on TRWD in Study Area	**3,728**	**4,859**	**5,837**	**6,728**	**7,869**	**9,320**

[a] Includes Kaufman and Henderson Counties
[b] Located in Henderson County
[c] Conservation is included in the demand amounts

4. Evaluation of Current Supplies

4.1 Surface Water

The surface water sources for water user groups in Kaufman County include NTMWD supplies, TRWD supplies, DWU supplies, Lake Tawakoni (Sabine River Authority supplies), and reuse. All of the municipal WUGs, with the exception of Kaufman County Other, use only surface water supplies.

Lake Terrell is no longer used as a municipal supply and alternative uses for the lake are being considered. Possible alternative uses include building a pipeline to Lake Tawakoni and selling the water to SRA, selling to another local MUD, selling water for irrigation purposes, or building a pipeline to the new NTMWD water treatment plant to supplement Lake Tawakoni sources.

4.2 Groundwater

Groundwater supplies are used to help meet the demands for irrigation, livestock, and county other. Pumping occurs in the Nacatoch, Woodbine, and Trinity Aquifers. The total groundwater availability in Kaufman County is 1,910 acre-feet per year according to the available managed available groundwater (MAG) reports. Of the 1,910 acre-feet per year available, 703 acre-feet per year is allocated to WUGs in Kaufman County.

5. Comparison of Current Supplies to Projected Demand

The revised projected demands in the study area are lower than those shown in the *2006 Region C Water Plan* [(2)] for 2010 and higher from 2020 to 2060. Many of the WUGs plan on continuing to use their current supply source and increase the amount supplied to them. A few of the WUGs plan on pursuing alternative or additional water sources. The water management strategies for several WUGs have been revised to meet increased demands. The proposed revisions are discussed in the following section.

6. Proposed Revisions to Water Management Strategies

This section describes the proposed water management strategy adjustments from the *2011 Region C Water Plan* [(1)]. Appendix C of the *2011 Region C Water Plan* [(1)] includes a summary table of demand and supply for each water user group in Kaufman County. The Kaufman County supply mainly consists of surface water from regional wholesale water providers.

Ables Springs WSC

Ables Springs WSC is currently a customer of MacBee SUD. When the NTMWD Tawakoni Plant is in operation, Ables Springs WSC will become a NTMWD customer and stop taking water from MacBee SUD. Ables Springs WSC plans to get any current and future supply from the NTMWD Tawakoni Plant. Table 6.1 summarizes Ables Springs WSC's future water supply plans.

Table 6.1
Summary Information for Ables Springs WSC

	2011 Plan Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	5,227	7,046	8,956	11,153	14,106	17,943
Projected Water Demand						
Municipal Demand	556	845	1,054	1,299	1,644	2,090
Total Projected Water Demand	***556***	***845***	***1,054***	***1,299***	***1,644***	***2,090***
Currently Available Water Supplies						
SRA sources (through MacBee SUD)	965	0	0	0	0	0
Total Supply	***965***	***0***	***0***	***0***	***0***	***0***
Need (Demand - Supply)	***0***	***845***	***1,054***	***1,299***	***1,644***	***2,090***
Water Management Strategies						
Water Conservation - Basic Package	9	33	52	69	91	118
Water Conservation - Expanded Package	5	7	9	11	13	16
Purchase water from NTMWD & connect to Tawakoni WTP	0	688	745	825	944	1,116
Purchase additional water from NTMWD	0	117	248	394	596	840
Total Water Management Strategies	***13***	***845***	***1,054***	***1,299***	***1,644***	***2,090***
Reserve or (Shortage)	**422**	**0**	**0**	**0**	**0**	**0**

College Mound WSC

College Mound WSC gets all of its water from NTMWD through three separate delivery points. The delivery points include the Kaufman 4-1 line, a direct line from NTMWD, and a supply line from Terrell. The Kaufman 4-1 group includes Gastonia-Scurry SUD, College Mound WSC, Rose Hill SUD, and Crandall. The water from the Terrell supply line is purchased through Terrell, but NTMWD is the original source. College Mound WSC plans to upsize the Terrell supply line, from an eight inch line to a 12-inch line by 2020. The line to be replaced is approximately 3.5 miles long. College Mound WSC's water supply plans are outlined in Table 6.2.

Table 6.2
Summary Information for College Mound WSC

	2011 Plan Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	9,150	11,333	13,576	16,062	19,140	22,958
Projected Water Demand						
Municipal Demand	758	1,155	1,582	1,853	2,187	2,623
Total Projected Water Demand	***758***	***1,155***	***1,582***	***1,853***	***2,187***	***2,623***
Currently Available Water Supplies						
NTMWD Sources	745	940	1,118	1,177	1,256	1,400
Total Supply	***745***	***940***	***1,118***	***1,177***	***1,256***	***1,400***
Need (Demand - Supply)	***13***	***215***	***464***	***676***	***931***	***1,223***
Water Management Strategies						
Water Conservation - Basic Package	13	55	86	108	136	172
Purchase additional water from NTMWD	0	160	378	568	795	1,051
Total Water Management Strategies	***13***	***215***	***464***	***676***	***931***	***1,223***
Reserve or (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Combine WSC

Combine WSC currently purchases DWU water from Seagoville. Residents of the City of Combine are retail customers of Combine WSC. Combine WSC is considering contracting directly with DWU, with supplies to be delivered through Seagoville. This is an alternative strategy in Section 9. Combine WSC's future water supply plans are outlined in Table 6.3.

Table 6.3
Summary Information for Combine WSC

	2011 Plan Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	4,122	5,737	7,202	8,795	10,785	13,285
Projected Water Demand						
Municipal Demand	462	688	855	1,035	1,268	1,562
Customer Demand	282	356	405	463	537	635
Total Projected Water Demand	***744***	***1,044***	***1,260***	***1,498***	***1,805***	***2,197***
Currently Available Water Supplies						
DWU Sources	684	785	904	1,009	1,122	1,201
Total Supply	***684***	***785***	***904***	***1,009***	***1,122***	***1,201***
Need (Demand - Supply)	***60***	***259***	***356***	***489***	***683***	***996***
Water Management Strategies						
Water Conservation - Basic Package	12	45	69	88	111	143
Purchase additional water from Seagoville	48	214	287	401	572	853
Total Water Management Strategies	***60***	***259***	***356***	***489***	***683***	***996***
Reserve or (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Crandall

North Texas Municipal Water District (NTMWD) supplies all of Crandall's water through the Kaufman 4-1 consortium. The Kaufman 4-1 consortium is comprised of Crandall, College Mound WSC, Gastonia-Scurry SUD, and Rose Hill SUD. Crandall owns 26.7 percent of the Kaufman 4-1 facilities. The City currently uses more than their contracted amount. This is possible because Gastonia-Scurry WSC is not using their entire contracted amount.

Crandall approached NTMWD about additional facilities, but NTMWD is not able to put in additional facilities until the Kaufman 4-1 line is used at full capacity. Crandall has sought to purchase additional capacity from the other Kaufman 4-1 users, but none are willing to sell any of their capacity. Crandall is now pursuing purchasing water from

Dallas Water Utilities (DWU) through Seagoville. Crandall is currently seeking an amendment to the *2006 Region C Water Plan* (2) to construct a supply line from Seagoville to Crandall. The agreement for water will be with DWU. The DWU water will be passed through Seagoville and Crandall will pay Seagoville a "facility charge." Table 6.4 shows Crandall's future water supply plans.

Table 6.4
Summary Information for Crandall

	2011 Plan Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	4,373	5,933	7,537	9,314	11,515	14,245
Projected Water Demand						
Municipal Demand	730	1,004	1,258	1,544	1,909	2,362
Total Projected Water Demand	***730***	***1,004***	***1,258***	***1,544***	***1,909***	***2,362***
Currently Available Water Supplies						
NTMWD Sources	715	545	474	426	385	358
Total Supply	***715***	***545***	***474***	***426***	***385***	***358***
Need (Demand - Supply)	***15***	***459***	***784***	***1,118***	***1,524***	***2,004***
Water Management Strategies						
Water Conservation - Basic Package	9	60	103	140	189	253
Water Conservation - Expanded Package	6	12	16	20	26	32
Purchase additional water from NTMWD	0	65	121	356	388	408
Purchase water from DWU (through Seagoville)	0	322	544	602	921	1,310
Total Water Management Strategies	***15***	***459***	***784***	***1,118***	***1,524***	***2,004***
Reserve or (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Forney

The City of Forney's current sources include NTMWD supplies and reuse from the City of Garland. The reuse from Garland is used only for steam electric power purposes. Forney is a member city of NTMWD and has no plans to obtain future supplies from any other entities. The City has two pump stations that deliver treated water from NTMWD. Pump Station 1 has a 13 million gallon per day (mgd) maximum capacity. Pump Station 2 has a current (Phase I) capacity of 13 mgd. A 15 mgd expansion (Phase II) has already been designed and was slated for construction before the current decline in the economy. Another 15 mgd expansion (Phase III) is planned, but will not be constructed until the City needs it. The pump station is already designed for these expansions with a build-out capacity of 43 mgd. Cost estimates for Phases I and II were provided to Freese and Nichols, Inc. by the City's Engineer. It is estimated that each expansion will cost approximately five million dollars.

Forney's current water management strategies are consistent with the strategies in the *2006 Region C Water Plan* (2). The amount of supply from NTMWD is increased in 2010 to meet the increased demands. Table 6.5 summarizes the updates to the water management strategies for Forney.

Table 6.5
Summary Information for Forney

	2011 Plan Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	13,000	24,000	30,000	35,000	39,000	42,803
Projected Water Demand						
Municipal Demand	2,097	4,033	4,973	5,763	6,422	7,048
Customer Demand	10,546	11,452	12,146	12,916	13,868	15,060
Total Projected Water Demand	***12,643***	***15,485***	***17,119***	***18,679***	***20,290***	***22,108***
Currently Available Water Supplies						
NTMWD Sources	3,717	6,367	6,692	7,007	7,265	7,729
Garland Reuse	8,979	8,979	8,979	8,979	8,979	8,979
Total Supply	***12,696***	***15,346***	***15,671***	***15,986***	***16,244***	***16,708***
Need (Demand - Supply)	***38***	***1,358***	***2,673***	***3,926***	***5,287***	***6,649***
Water Management Strategies						
Water Conservation - Basic Package	38	294	465	630	819	1,045
Water Conservation - Expanded Package	0	22	33	41	48	55
Purchase additional water from NTMWD	0	1,042	2,175	3,255	4,420	5,549
Total Water Management Strategies	***38***	***1,358***	***2,673***	***3,926***	***5,287***	***6,649***
Reserve or (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Kaufman

Kaufman purchases water from NTMWD and plans to continue to do so. Kaufman receives NTMWD water via a single 20-inch pipeline with a capacity of 7.5 MGD. Kaufman's existing pipeline will carry them well into the future if growth continues as projected. NTMWD water from the Tawakoni Plant is an alternative strategy included in Section 9. Kaufman's future water supply plans are outlined in Table 6.6.

Table 6.6
Summary Information for Kaufman

	2011 Plan Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	8,256	10,864	13,020	14,753	16,484	19,883
Projected Water Demand						
Municipal Demand	1,322	1,716	2,013	2,264	2,511	3,029
Customer Demand	124	148	172	201	236	283
Total Projected Water Demand	***1,446***	***1,864***	***2,185***	***2,465***	***2,747***	***3,312***
Currently Available Water Supplies						
NTMWD Sources	1,419	1,517	1,545	1,566	1,578	1,768
Total Supply	***1,419***	***1,517***	***1,545***	***1,566***	***1,578***	***1,768***
Need (Demand - Supply)	***27***	***347***	***640***	***899***	***1,169***	***1,544***
Water Management Strategies						
Water Conservation - Basic Package	23	122	110	138	166	213
Water Conservation - Expanded Package	12	16	18	20	23	27
Purchase additional water from NTMWD	0	209	512	741	980	1,304
Total Water Management Strategies	***35***	***347***	***640***	***899***	***1,169***	***1,544***
Reserve or (Shortage)	**8**	**0**	**0**	**0**	**0**	**0**

Kaufman County Irrigation

In the *2006 Region C Water Plan* [(2)] purchasing additional water from TRWD was a water management strategy (WMS). This is not included as a WMS in the 2011 Plan. Purchasing water from NTMWD was also listed as a WMS in the 2006 Plan. This strategy is now a current supply for Kaufman County Irrigation. Water management strategies for Kaufman County Irrigation include conservation, additional water from NTMWD, and supplemental wells in the Nacatoch and Trinity Aquifers. Table 6.7 summarizes Kaufman County Irrigation's water supply plans.

Table 6.7
Summary Information for Kaufman County Irrigation

	2011 Plan Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Water Demand						
Irrigation Demand	2,916	2,916	2,916	2,916	2,916	2,916
Total Projected Water Demand	***2,916***	***2,916***	***2,916***	***2,916***	***2,916***	***2,916***
Currently Available Water Supplies						
Cedar Creek Lake (TRWD)	100	92	78	67	59	52
Direct Reuse	576	758	758	758	758	758
NTMWD Sources	1,984	1,469	1,276	1,146	1,037	963
Irrigation Local Supply	64	64	64	64	64	64
Nacatoch Aquifer	4	4	4	4	4	4
Trinity Aquifer	185	185	185	185	185	185
Total Supply	***2,913***	***2,572***	***2,365***	***2,224***	***2,107***	***2,026***
Need (Demand - Supply)	***3***	***344***	***551***	***692***	***809***	***890***
Water Management Strategies						
Water Conservation	4	72	140	177	212	247
Purchase additional water from NTMWD	0	272	411	515	597	643
Supplemental wells in Nacatoch & Trinity Aquifers	0	0	0	0	0	0
Total Water Management Strategies	***4***	***344***	***551***	***692***	***809***	***890***
Reserve or (Shortage)	**1**	**0**	**0**	**0**	**0**	**0**

Kaufman County Other

Rose Hill SUD is not considered a WUG in the *2011 Region C Water Plan* (1), but based on information obtained from the SUD, it is recommended Rose Hill SUD be included as a WUG in the next round of planning. Rose Hill SUD has 1,396 connections and the average day use in 2008 was 0.257 mgd which qualifies it as a WUG. Rose Hill SUD currently has three sources of supply including Terrell, Kaufman 4-1 line, and the Old

Kaufman line. The Terrell supply was discontinued in November 2009. The other two lines are supplied by NTMWD. In place of the supply from Terrell, Rose Hill SUD will get water directly from NTMWD via the Terrell Line. Rose Hill SUD has a tap on this line and a storage tank at the tap location. A new pipeline will be built to access this water in the very near future. The new infrastructure will consist of a one mile 12-inch pipeline, a meter, and chlorine treatment. The estimated cost of this project is $1.1 million. The current contract with NTMWD allows Rose Hill SUD to take up to 100 million gallons per year from this line. Table 6.8 summarizes the water supply plans for Kaufman County Other.

Table 6.8
Summary Information for Kaufman County Other

	2011 Plan Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	13,767	13,767	13,767	13,767	13,767	13,767
Projected Water Demand						
Municipal Demand	2,082	2,066	2,051	2,036	2,020	2,020
Total Projected Water Demand	***2,082***	***2,066***	***2,051***	***2,036***	***2,020***	***2,020***
Currently Available Water Supplies						
Nacatoch Aquifer	241	241	241	241	241	241
NTMWD Sources	1,437	1,177	1,015	905	812	755
TRWD Sources (part through Mabank)	411	379	320	275	239	208
Total Supply	***2,089***	***1,797***	***1,576***	***1,421***	***1,292***	***1,204***
Need (Demand - Supply)	***0***	***269***	***475***	***615***	***728***	***816***
Water Management Strategies						
Water Conservation - Basic Package	25	68	91	99	105	112
Purchase additional water from NTMWD	0	152	293	396	481	552
Purchase additional water from TRWD	0	49	91	120	142	152
Supplemental wells in Nacatoch Aquifer	0	0	0	0	0	0
Total Water Management Strategies	***25***	***269***	***475***	***615***	***728***	***816***
Reserve or (Shortage)	**32**	**0**	**0**	**0**	**0**	**0**

Kaufman County Steam Electric Power

The water management strategies for Kaufman County Steam Electric Power have been adjusted as shown in Table 6.9 to reflect the changes in projected demands. Steam electric power demands from the *2006 Region C Water Plan* [(2)] were reevaluated using more recent studies and improved methodologies for determining steam electric power water use. The projected demands for Kaufman County steam electric power water use have been significantly reduced since the *2006 Region C Water Plan* [(2)]. Steam electric power demands in Kaufman County are currently met using reuse from Garland (through Forney). Water management strategies for additional steam electric power supplies include treated water from Forney (from NTMWD) and reuse from the Trinity River Authority (TRA).

Table 6.9
Summary Information for Kaufman County Steam Electric Power

	2011 Plan Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Water Demand						
Steam Electric Power Demand	8,979	10,000	10,000	10,000	10,000	10,000
Total Projected Water Demand	***8,979***	***10,000***	***10,000***	***10,000***	***10,000***	***10,000***
Currently Available Water Supplies						
Reuse from Garland (through Forney)	8,979	8,979	8,979	8,979	8,979	8,979
Total Supply	***8,979***	***8,979***	***8,979***	***8,979***	***8,979***	***8,979***
Need (Demand - Supply)	***0***	***1,021***	***1,021***	***1,021***	***1,021***	***1,021***
Water Management Strategies						
Purchase water from Forney (NTMWD)	0	1,121	1,121	1,121	1,121	1,121
TRA reuse	0	1,000	1,000	1,000	1,000	1,000
Total Water Management Strategies	***0***	***2,121***	***2,121***	***2,121***	***2,121***	***2,121***
Reserve or (Shortage)	**0**	**1,100**	**1,100**	**1,100**	**1,100**	**1,100**

Mabank

The City of Mabank currently purchases water from TRWD. According to Mabank's survey response, the City has a 20-year contract with TRWD that allocates between

1,140 and 1,870 acre-feet per year. This contract amount is greater than the projected 2060 demand for Mabank in Kaufman and Henderson Counties, but Mabank also supplies some use outside the City. The City will purchase additional water from TRWD as needed to meet their increased demands and will need a water treatment plant expansion to meet all of the City's future demands. Table 6.10 summarizes Mabank's water supply plans.

Table 6.10
Summary Information for Mabank

Mabank (Henderson and Kaufman County)	2011 Plan Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	3,074	3,729	4,401	5,142	6,058	7,194
Projected Water Demand						
Municipal Demand	671	801	931	1,083	1,269	1,507
Total Projected Water Demand	***671***	***801***	***931***	***1,083***	***1,269***	***1,507***
Currently Available Water Supplies						
TRWD Sources	665	735	726	730	750	777
Total Supply	***665***	***735***	***726***	***730***	***750***	***777***
Need (Demand - Supply)	***6***	***66***	***205***	***353***	***519***	***730***
Water Management Strategies						
Water Conservation - Basic Package	6	69	169	206	253	313
Water Conservation - Expanded Package	0	2	3	4	4	5
Purchase additional water from TRWD	0	0	32	143	262	412
Water Treatment Plant Expansions						
Water treatment plant expansion (1 MGD) [a]	560	560	560	560	560	560
Total Water Management Strategies	***6***	***71***	***205***	***353***	***519***	***730***
Reserve or (Shortage)	**0**	**5**	**0**	**0**	**0**	**0**

[a] Not included in total to avoid double counting

Post Oak Bend City

Post Oak Bend City was not large enough to be considered a WUG in the 2006 Plan. However, since the 2006 Plan, the City's population has reached at least 500 and the City is now a WUG. The City's residents are retail customers of Rose Hill SUD, which is supplied by NTMWD sources. Post Oak Bend City's water supply plans are outlined in Table 6.11.

Table 6.11
Summary Information for Post Oak Bend City

	2011 Plan Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	659	1,075	1,754	2,862	4,671	7,623
Projected Water Demand						
Municipal Demand	85	138	226	369	602	982
Total Projected Water Demand	***85***	***138***	***226***	***369***	***602***	***982***
Currently Available Water Supplies						
NTMWD supplies (through Rose Hill SUD)	83	112	160	234	346	524
Total Supply	***83***	***112***	***160***	***234***	***346***	***524***
Need (Demand - Supply)	***2***	***26***	***66***	***135***	***256***	***458***
Water Management Strategies						
Water Conservation - Basic Package	2	6	12	20	35	61
Additional NTMWD supplies (through Rose Hill SUD)	0	20	54	115	221	397
Total Water Management Strategies	***2***	***26***	***66***	***135***	***256***	***458***
Reserve or (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Scurry

Since the 2006 Plan the City of Scurry's population has reached at least 500 and Scurry is now considered to be a WUG. The City's customers are retail customers of Gastonia-Scurry SUD, which is supplied by NTMWD sources. Table 6.12 summarizes Scurry's future water supply plans.

Table 6.12
Summary Information for Scurry

	2011 Plan Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	678	789	918	1,068	1,242	1,445
Projected Water Demand						
Municipal Demand	87	102	118	138	160	186
Total Projected Water Demand	***87***	***102***	***118***	***138***	***160***	***186***
Currently Available Water Supplies						
NTMWD supplies (through Gastonia-Scurry SUD)	85	83	83	88	92	99
Total Supply	***85***	***83***	***83***	***88***	***92***	***99***
Need (Demand - Supply)	***2***	***19***	***35***	***50***	***68***	***87***
Water Management Strategies						
Water Conservation - Basic Package	2	4	6	8	9	11
Additional NTMWD supplies (through Gastonia-Scurry SUD)	0	15	29	42	59	76
Total Water Management Strategies	***2***	***19***	***35***	***50***	***68***	***87***
Reserve or (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Talty

Residents of the City of Talty are retail customers of Gastonia-Scurry WSC and Talty WSC, which purchases NTMWD water through Forney. Because of Talty's increase in per capita usage, the additional demands will be supplied through Forney with NTMWD sources. Water supply plans for Talty are summarized in Table 6.13.

Table 6.13
Summary Information for Talty

	2011 Plan Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	1,800	3,832	5,256	6,834	8,788	11,211
Projected Water Demand						
Municipal Demand	813	1,717	2,337	3,024	3,878	4,948
Total Projected Water Demand	***813***	***1,717***	***2,337***	***3,024***	***3,878***	***4,948***
Currently Available Water Supplies						
NTMWD Sources	808	1,397	1,652	1,921	2,227	2,641
Total Supply	***808***	***1,397***	***1,652***	***1,921***	***2,227***	***2,641***
Need (Demand - Supply)	***5***	***320***	***685***	***1,103***	***1,651***	***2,307***
Water Management Strategies						
Water Conservation - Basic Package	5	60	104	160	238	345
Water Conservation - Expanded Package	0	6	9	12	16	20
Additional NTMWD supplies through Gastonia-Scurry WSC and Talty WSC through Forney	0	254	571	931	1,397	1,942
Total Water Management Strategies	***5***	***320***	***685***	***1,103***	***1,651***	***2,307***
Reserve or (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Terrell

Terrell purchases water from NTMWD and plans to continue to do so. The City has several plans for new pipelines, new metering facilities, and ground storage and pump station expansions. These additions are included in Appendix Q – Cost Estimates. The City also plans to develop a second treated water delivery point from NTMWD. Terrell's Master Plan discusses plans for a pipeline from NTMWD's Tawakoni WTP to the Terrell Pipeline. New ground storage, a new pump station, and new pipelines to the City's distribution system are all part of the planned second point of delivery.

Lake Terrell is no longer used as a municipal supply and alternative uses for the lake are being considered. Terrell has filed an application for planning grant assistance with the Texas Water Development Board. The grant will be used as funding for a study to determine the best use of Lake Terrell and facilities needed to comply with Texas

Commission on Environmental Quality (TCEQ) dam safety regulations. Possible alternative uses include building a pipeline to Lake Tawakoni and selling the water to SRA, selling to another local MUD, selling water for irrigation purposes, or building a pipeline to the new NTMWD water treatment plant to supplement Lake Tawakoni sources. Terrell's water supply plans are outlined in Table 6.14.

Table 6.14
Summary Information for Terrell

	2011 Plan Projections					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	16,185	45,005	65,000	85,000	97,000	110,000
Projected Water Demand						
Municipal Demand	3,807	10,385	14,780	19,138	21,731	24,643
Customer Demand	1,729	2,000	2,266	2,494	2,826	3,289
Total Projected Water Demand	***5,536***	***12,385***	***17,046***	***21,632***	***24,557***	***27,932***
Currently Available Water Supplies						
NTMWD Sources	5,490	10,081	12,050	13,739	14,103	14,910
Total Supply	***5,490***	***10,081***	***12,050***	***13,739***	***14,103***	***14,910***
Need (Demand - Supply)	***46***	***2,304***	***4,996***	***7,892***	***10,454***	***13,021***
Water Management Strategies						
Water Conservation - Basic Package	46	600	1,123	1,609	2,013	2,496
Water Conservation - Expanded Package	0	20	61	102	125	143
Purchase additional water from NTMWD	0	1,684	3,812	6,181	8,316	10,382
Total Water Management Strategies	***46***	***2,304***	***4,996***	***7,892***	***10,454***	***13,021***
Reserve or (Shortage)	**0**	**0**	**0**	**0**	**0**	**0**

Water User Groups with No Revisions to Water Management Strategies

The water user groups in Kaufman County that have no revisions to water management strategies as presented in the *2006 Region C Water Plan* [(2)] include the following:

- Combine
- Combine WSC

- Forney Lake WSC
- Gastonia – Scurry SUD
- High Point WSC
- Kaufman County – Irrigation
- Kaufman County – Livestock
- Kaufman County – Manufacturing
- Kaufman County - Mining
- Kaufman County – Other
- MacBee SUD
- Mesquite
- Oak Grove
- Seagoville
- West Cedar Creek MUD

Summary tables for these water user groups are included in Appendix C of the *2011 Region C Water Plan* (1).

7. Estimated Costs for Proposed Water Management Strategies

The estimated costs for water management strategies were updated and are included in Appendix Q of the *2011 Region C Water Plan* (1). Total capital costs for the Kaufman County Study Area through the year 2060 are estimated to be $116.3 million. The capital costs are broken down by category in Table 7.1 and by WUG in Table 7.2. Costs for alternative water management strategies are not included in the tables below. Refer to Appendix Q for additional cost details.

Table 7.1
Capital Costs for Water Management Strategies by Category

Water Management Strategy Category	Capital Cost During Study Period
Transmission Facilities	$79,644,000
Supplemental Wells	$516,000
New Water Treatment Plants	$0
Water Treatment Plant Expansions	$40,020,000
Total Capital Costs for Study Area	**$120,180,000**

Table 7.2
Capital Costs for Water Management Strategies by WUG

Water User Group	Capital Cost During Study Period
Ables Springs WSC	$3,566,000
College Mound WSC	$2,569,000
Crandall	$6,104,000
Forney	$10,000,000
Kaufman County Livestock	$56,000
Kaufman County Other	$404,000
Kaufman County Steam Electric Power	$19,903,000
Mabank	$4,094,000
MacBee SUD	$7,270,000
Terrell	$32,551,000
West Cedar Creek MUD	$28,656,000
Total Capital Costs for Study Area	**$120,180,000**

8. Implementation Plan for Proposed Water Management Strategies

Implementation of the Kaufman County Water Supply System includes developing water management strategies for surface water sources. For surface water sources, the implementation plan for water management strategies includes the following components:

- Obtain water rights and/or develop water supply contracts
- Obtain required permits
- Design and construct required facilities

Table 8.1 is a list of recommended water management strategies with approximate in-service dates.

Table 8.1
Implementation of Proposed Water Management Strategies

Owner	Project	Approximate In-service Year
Ables Springs WSC	Connect to NTMWD Tawakoni Water Treatment Plant	2014
Crandall	Pipeline to Seagoville (DWU)	2016
Kaufman	Connect to NTMWD Tawakoni Water Treatment Plant (alternative strategy)	2016
Kaufman County - Steam Electric Power	TRA reuse	2020
Kaufman County - Steam Electric Power	Purchase water from NTMWD (through Forney)	2012
Kaufman County - Steam Electric Power	Additional Garland Reuse	2020
Mabank	Water Treatment Plant Expansion of 1 MGD	2030
MacBee SUD	Water Treatment Plant Expansion of 2 MGD	2020
Terrell	Water system expansions and upgrades	2010-2020
Terrell	Second connection to NTMWD Tawakoni Water Treatment Plant	2012
West Cedar Creek MUD	Water Treatment Plant Expansion of 5 MGD	2030

9. Alternative Water Management Strategies

In general, most of the water user groups in the study area indicated that their future water supply plans are in line with the *2006 Region C Water Plan* (2). However, two alternative strategies were identified for Combine WSC and the City of Kaufman. Tables summarizing the future water supply plans for all WUGs in Kaufman County can be found in Appendix C of the *2011 Region C Water Plan* (1).

Combine WSC

Combine WSC has expressed an interest in contracting directly from DWU for water and has talked with DWU about this. Combine WSC would continue to use its existing infrastructure, but would have a direct contract with DWU rather than a contract with Seagoville. Water would still be delivered through Seagoville.

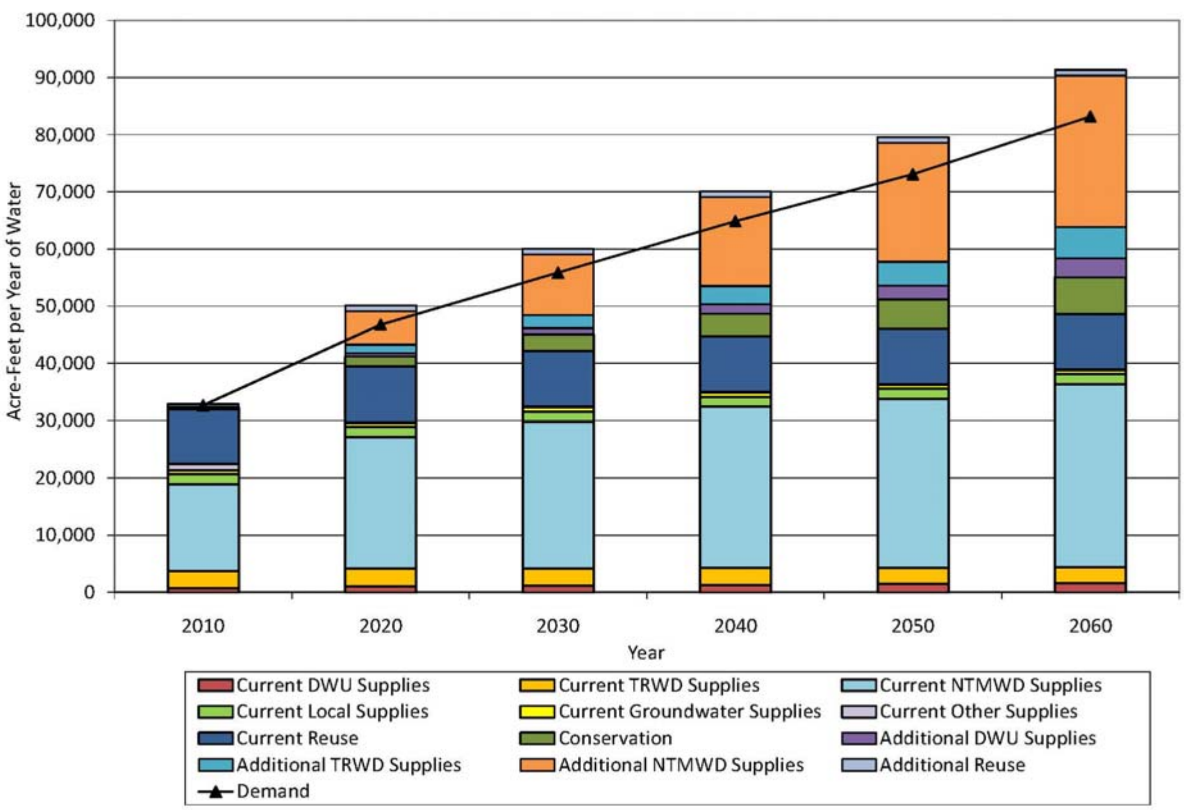
Kaufman

NTMWD water from the Tawakoni Plant is an alternative future strategy for Kaufman. Kaufman would be interested in the possibility of a shared pipeline with other entities to deliver water from the plant. The estimated cost of this alternative strategy is $21.3 million. Additional information on cost estimates can be found in Appendix Q of the *2011 Region C Water Plan* (1).

10. Conclusion

In the near term, the projected growth in Kaufman County has decreased since the *2006 Region C Water Plan* (2). However, population and demand projections have increased since the 2006 Plan for 2020 through 2060. The water management strategies recommended in the *2006 Region C Water Plan* (2) have been adjusted to account for these changes to projected demands. For most water management groups, their currently planned water management strategies are in line with the strategies presented in the *2006 Region C Water Plan* (2). Figure 10.1 shows the total projected demands, current water supplies, and recommended water management strategies for Kaufman County.

Table 10.1
Total Demands and Supplies for Kaufman County



APPENDIX 1

REFERENCES

APPENDIX 1

REFERENCES

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APPENDIX X

INFRASTRUCTURE FINANCING INFORMATION

APPENDIX X
INFRASTRUCTURE FINANCING INFORMATION

This appendix includes information related to infrastructure financing. The topics included in this appendix are as follows:

- Description of funding programs available to water suppliers
- Questionnaires on infrastructure financing of recommended water management strategies, including information on the TWDB's state participation programs
- Summary of survey responses to questionnaires

The Infrastructure Financing Request (IFR) survey/questionnaire, developed by the TWDB, requested information from water suppliers regarding the amount of desired funding from five specific TWDB financial assistance programs. In addition to these five programs, there are numerous financial assistance programs sponsored by various federal, state and local agencies. These additional programs were not included in the TWDB's IFR survey of water suppliers, but are none the less available to water suppliers in Region C for water supply infrastructure projects, and are therefore being including in this appendix for reference.

For each program discussed below, the purpose of the program, eligible applicants, restrictions on the use of funds, the loan maturity, the interest rate, and the total available funding are reported where available. Water users that are interested in one of these programs should contact the program manager to determine whether additional restrictions apply.

1.0 Market Financing

Market financing through local bank loans and municipal bonds that are repaid through increased fees and revenues are the primary mechanisms for funding municipal infrastructure projects. This funding mechanism places the burden of paying for the capital improvements on the beneficiaries of the project. It also provides for local control in the implementation and timing of the needed improvements. Private and local financing (both taxable and tax-exempt) will continue to be an integral component for financing water infrastructure, especially for non-municipal users. This is because most non-municipal water users are involved in for-profit activities, and most public water supply infrastructure funding programs are available only to non-profit entities. It will be necessary for many non-municipal users to locate private financing sources.

Service providers have historically used various debt instruments to fund costs that were not covered by governmental assistance. The conventional debt instruments that public entities have used for long-term financing include General Obligation Bonds, Revenue Bonds, Double-Barreled Bonds and Certificates of Obligation. A fifth option is the use of t*ax-exempt Private Activity Bonds for public-private partnerships.*

General Obligation Bonds

General Obligation Bonds (GOs) are secured by the full faith and credit of the city or the issuing taxing authority entity and used for a specific purpose. GOs are secured by the pledge of a city's ad valorem taxing power. One disadvantage of GO bonds is that the approval process usually takes a longer amount of time. The public must authorize the issuance of this bond through an election. In addition, the governmental issuer may have a practical or legal debt limit that they must adhere to. The positive aspects of GOs are that they are considered the most secure type of debt obligation and the issuance process tends to be simpler and less costly.

Revenue Bonds

Revenue Bonds are completely paid for by the revenue received from the provision of a service. Thus, repayment of Revenue Bonds used in the financing of water and wastewater facility improvements is made through the revenue collected from the designated revenue source, i.e. water sales and wastewater treatment. The Service Provider must/should conduct a cost of service and rate design study in which the revenue requirements include not only the operation and maintenance costs for the system, but also the debt service payments and reserve fund deposits for this debt. Revenue Bonds may have any number of reserve fund requirements including debt service reserve fund, construction fund, renewal and replacement fund, operating fund, insurance fund, and/or arbitrage rebate fund. The Service Provider must also be aware of any coverage requirements required for the issuance of the Revenue Bond. The issuance of Revenue Bonds is limited to the amount of rate increase that the Service Provider is willing to implement.

Double-Barreled Bonds

Double-Barreled Bonds are revenue bonds that are additionally guaranteed by a larger municipal entity. It is considered a hybrid of a Revenue Bond and a General Obligation Bond. The first source of funds for the principal and interest is derived from the designated revenue source, i.e. water sales. If the revenue source does not match the revenue requirement during a specific period of time, then the tax revenue of the larger municipal entity is used to cover the principal and interest requirement. Double-Barreled Bonds have similar advantages and disadvantages to General Obligation Bonds.

Certificates of Obligation

Certificates of Obligation (COs) have different issuance requirements than the General Obligation Bonds but can be used for the same purpose. Certificates of Obligation can either be a tax pledge or a combination of tax and revenue pledges (Combination Tax and Revenue COs). If CO bonds are only backed by tax revenue then they can only be used for limited purposes. However, if it is a Combination Tax and Revenue Bond then it can be used for any lawful purpose.

Tax-exempt Private Activity Bonds for Public-Private Partnerships

Tax-exempt Private Activity Bonds (PAB's) are a financing tool which allows private sector investment in public projects—the benefits of which are interest rates lower than conventional taxable financing, lower delivered cost of service, and a readily available money supply. PAB's have historically been used by public authorities when several criteria are triggered involving private participation in the activity being financed (long-term operations, industrial water supply, private ownership, etc). Currently, federal tax law imposes state bond caps which limit the ability of local governments to use PAB's as a funding alternative for water and wastewater infrastructure development.

Generally, to access tax-exempt financing for water and wastewater projects for entities other than political subdivisions, the Texas Water Development Board (TWDB), or the public entity itself, must submit an application to the Texas Bond Review Board to reserve a portion of the state's private activity volume cap. Use of tax-exempt bonds as a means of financing water and wastewater projects allows the TWDB to offer more affordable interest rates to borrowers.

Because a municipality's rating on its tax exempt municipal bonds is determined in part by the amount of such bonds outstanding, many municipalities cannot issue an unlimited number of these bonds without risking having their debt rating lowered, which would cause a rise in the interest rates they must pay on the debt they issue. With investments rising, utilities must issue more and more debt. To reduce the risk of having their debt rating lowered, municipalities can use PABs in lieu of government bonds, because on PABs the payback risk is with the private entity that issues the bond, not the municipality. Consequently, municipalities' bond ratings will not be adversely affected. This will give the municipality more flexibility to use its municipal bonds on other important projects.

One way a municipality can use the private sector is through a public-private partnership. A typical model can be for a municipality to sign a contract with a private company to build and/or manage and operate a water utility. All involved with such partnerships want to ensure the lowest costs for the customer, including project financing costs. This has usually meant that traditional tax-exempt municipal bonds are used so that customers benefit from the lower interest rates. However, such government bonds come with certain government imposed limitations. Financing public-private partnerships with PABs will free them from these limitations.

2.0 Texas Water Development Board Programs

Texas Water Development Board (TWDB) programs are targeted towards political subdivisions and non-profit water supply corporations and districts. Two programs, the Economically Distressed Areas Program (EDAP) and the Colonia Self-Help Program (CSHP), benefit *colonias* and state-designated economically distressed areas. Since Region C does not have any *colonias* or economically distressed counties[1,2], these programs would appear to not be applicable. Other programs available to political subdivisions and non-profit water suppliers in Region C include the Drinking Water State Revolving Loan Fund (DWSRF), Clean Water State Revolving Fund Program (CWSRF), Texas Water Development Fund II (DFund), Rural Water Assistance Fund Program (RWAF), State Participation Program (SPP), the Water Infrastructure Fund (WIF), and the Agricultural Water Conservation Grants and Loan Program.

Five of these TWDB programs that may provide benefits to non-municipal users are the CWSRF, SPP, Agriculture Water Conservation Loans, the RWAF, and the WIF programs. The CWSRF and the SPP provide assistance for development of wastewater recycling and reuse projects. With the exception of livestock water use, the non-municipal water uses are well suited for wastewater reuse projects. Each of these TWDB programs is discussed below.

Drinking Water State Revolving Loan Fund Program[3]

The Drinking Water State Revolving Loan Fund (DWSRF) provides low interest loans to finance projects for public drinking water systems. Additional subsidies are available for disadvantaged communities. The purpose of this program is to assist applicants in providing water that meets drinking water regulations or otherwise significantly further the health protection objectives of the Federal Safe Drinking Water Act. Applicants may be a political subdivision of the state, non-profit water supply corporation, privately owned water system or state agency.

The loans can be used for planning, design and construction of projects to upgrade or replace water infrastructure, purchase additional capacity, and/or purchase land integral to the project. This land could be for the construction of the project or to protect the source water from potential contamination, such as nitrate contamination of a municipal well field.

Applicants to the DWSRF program must submit an information form to the TWDB each year for inclusion in the TWDB's intended use plan for the year. The TCEQ prioritizes potential DWSRF projects and funding is distributed based on the priority rating and applicant's readiness to proceed. Depending on the source of funds, interest rates for mainstream loans vary from 1.2 percent to 1.5 percent below market interest rates and the maximum repayment period is 20 years after completion of construction.

Clean Water State Revolving Fund [4]

The Clean Water State Revolving Fund Program (CWSRF) provides low-interest loans for planning, design, and construction of wastewater treatment facilities, wastewater recycling and reuse facilities, collection systems, storm water pollution control projects, and implementation of nonpoint source pollution control projects. The applicant for assistance from the CWSRF program must be a political subdivision. Therefore, any reuse project to provide reclaimed water for non-municipal users must also benefit a political subdivision, and the political subdivision must plan, design, and construct the project. A water quality based priority system is used to rank potential applicants and fund projects with the greatest environmental benefits. However, nonprofit water supply corporations are not eligible to receive assistance from the CWSRF, even though they are considered political subdivisions for other TWDB programs.

Applicants to the CWSRF program must submit an information form to the TWDB each year for inclusion in the TWDB's intended use plan for the year. The TWDB identifies priority projects and requests funding applications for these projects. Depending on the source of funds, fixed interest rates vary from 0.70 percent to 1.95 percent below market interest rates, however there is an additional cost-recovery loan origination fee of 1.85 percent which can be financed into the loan. An additional source of funding, the Disadvantaged Communities fund offers a fixed interest rate of 0.0 percent or 1.0 percent to eligible communities.

The maximum repayment period is 30 years after completion of construction. Total loan amounts are limited to $75 million for the first nine months of the fiscal year.

State Participation Program[5]

Deferred interest loans from the TWDB's State Participation Program may be used for regional systems where the project sponsors are unable to assume debt for an optimally sized facility. The program is intended to promote the "Right Sizing" of projects in consideration of future growth. In return for state participation, the TWDB may acquire ownership interest in the project. The benefits of assistance from the State Participation Program include deferred payments until the customer base grows into the project capacity and no interest on the deferred payments. TWDB will fund up to 80% of costs for new water supply projects and up to 50% of costs for other projects. Remaining costs may be eligible for funding from other TWDB programs.

Applicants must be political subdivisions or water supply corporations that are sponsoring construction of a regional water or wastewater project. Applications are accepted on a first-come, first-served basis. An application must consist of an engineering feasibility report and environmental information, as well as general, fiscal, and legal information. There is also a requirement that the project cannot be reasonably financed without state participation assistance, and that the optimum regional development of the project cannot be reasonably financed without the State participation.

The maximum repayment term for assistance from the State Participation Program is 34 years. While the assistance is not a loan, the purchase requirement is certain as to terms of payment and does include a component of the repurchase cost that includes the interest costs of the TWDB's funds in financing the project. The repayment schedule may be obtained from the TWDB. State Participation Program funding will vary depending on funds received from ongoing participation projects.

Texas Water Development Fund II[6]

The Development Fund II (DFund) is a pure state loan fund (does not receive federal subsidies) used for financing water supply, water quality enhancement, flood control and municipal solid waste. DFund is the more streamlined of the TWDB funding programs. This program provides financing for water supply infrastructure as well as acquisition of water rights. The applicants can be political subdivisions of the state and non-profit water supply corporations with applicable projects.

Interest rates for the loans will vary depending on market conditions. The lending rate scales are set at 0.35 percent above the TWDB's borrowing cost. Repayment periods generally range from 20 to 25 years. System revenues and/or tax pledges are typically required to secure the loans.

Agriculture Water Conservation Grant and Loan Program [7]

As a result of Senate Bill 1053, passed by the 78th Texas Legislature, the Texas Water Development Board's (TWDB) agricultural water conservation program has been expanded to provide three methods of assistance. The program provides agricultural water conservation loans to political subdivisions and state agencies. The program provides agricultural water conservation loans to individuals. And the program provides agricultural water conservation grants to state agencies and political subdivisions.

Grants may be made available for demonstrations, education, research, technical assistance, and technology transfer. Grants may also be made to political subdivisions for agricultural water conservation projects for purchasing and installing, on either public or private property, metering devices to measure irrigation water use to quantify effects of different water conservation strategies. Any political subdivision such as a city, county, soil and water conservation district, underground water conservation district, or irrigation district can apply.

Under the loan program, the TWDB loans money to borrower and lender districts, such as soil and water conservation districts, irrigation districts and underground water conservation districts. In turn, these districts make loans to individual borrowers to purchase and install more efficient irrigation equipment on private property for agricultural water conservation purposes. Eligible applicants include soil and water conservation districts, underground water conservation districts or districts authorized to supply water for irrigation. Although only these public entities may apply for funding under this program, the purpose is to encourage lending to individual borrowers. Therefore, non-municipal water users may indirectly benefit from this funding program.

Funds may be used for conservation programs or conservation projects. "A conservation program is: an agricultural water conservation technical assistance program; a research, demonstration, technology transfer, or educational program relation to agricultural water use and conservation; a precipitation enhancement program in an area of the state where the program, in the TWDB's judgment, would be most effective; or other state agency or political subdivision administered conservation programs that provide loans to a person for a conservation project. A conservation project: improves efficiency of water delivery and application on existing irrigation systems; prepares irrigated land for conversion to dry land conditions; prepares dry land for more efficient use of natural precipitation; purchases and installs on public or private property devices designed to indicate the amount of water withdrawn for irrigation purposes; or prepares and maintains land to be used for brush control activities in areas of the state where those activities, in the TWDB's judgment, would be most effective."

The interest rate to the political subdivision shall be equal to the asking yield for a U.S. Treasury Note with a 12-month maturity on the date rates are set.

Water Infrastructure Fund[8]

Using the Water Infrastructure Fund, the TWDB will provide funding at 2 percent below the TWDB's cost of funds for water management strategies recommended in the state or regional water plans. Only political subdivisions are eligible to apply. Therefore, to use funds from this program to implement a recommended water management strategy for non-municipal users, a political subdivision must lead the project. Repayment periods are a maximum of 20 years. The applicant may defer all interest and principal payments for up to 10 years, or until the end of construction of the project, whichever is sooner. Interest is not accrued during the deferral period and the loan is amortized over the final 10 years.

Funds may be used for eligible projects and for planning and design costs, permitting costs, and other costs associated with state or federal regulatory activities with respect to a project. An eligible project is "any undertaking or work, including planning and design activities and work to obtain regulatory authority, to conserve, mitigate, convey, and develop water resources of the state, including any undertaking or work done outside the state that the board determines will result in water being available for use in or for the benefit of the state."

The 80th Texas Legislature (2007) appropriated funding to enable issuance of $440 million in bonds for WIF to fund water plan projects through the biennium. This amount is estimated to meet a portion of the water supply needs identified in the 2007 State Water Plan through 2020. Additional funds will be needed to meet the additional water supply needs through the 2060 planning horizon.

Rural Water Assistance Fund[9]

The Rural Water Assistance Fund (RWAF) provides small rural water utilities with low-cost financing for water and wastewater construction projects. The TWDB offers attractive interest rate loans with short- and long-term finance options at tax exempt rates. Funding through this program gives an added benefit to nonprofit water supply corporations, as construction costs qualify for sales tax exemption.

Eligible applicants include rural political subdivisions which include nonprofit water supply or sewer service corporations, water districts or municipalities serving a population of up to 10,000 persons, municipalities serving a population of up to 10,000 persons, and counties in which no urban area has a population exceeding 50,000 persons. Generally, the program targets Non-profit

Water Supply Corporations with eligible water supply projects and wastewater projects.

The RWAF loans may be used to fund water and wastewater construction projects including, but not limited to line extensions, overhead storage, the purchase of well fields, the purchase or lease of rights to produce groundwater, and wastewater collection. Costs of planning, design, and construction are all eligible for funding. The fund may also be used to enable a rural water utility to obtain water or wastewater service supplied by a larger utility or to finance the consolidation or regionalization of a neighboring utility.

Loans for planning, design, and construction can be funded through the WIF, and are offered at a subsidized interest rate which is 2 percent below the TWDB's cost of funds. Repayment periods are a maximum of 20 years. An applicant may defer all interest and principal payments for up to 10 years, or until the end of construction of the project, whichever is sooner. Interest is not accrued during the deferral period and the loan is amortized over the final 10 years.

3.0 U.S. Department of Agriculture Programs

The U.S. Department of Agriculture administers the Farm Ownership program (through its Farm Service Agency), the Rural Utilities Service, and the Watershed Protection and Flood Prevention Program. Each of these is discussed below.

Farm Ownership Program[10]

The Farm Service Agency (FSA) makes direct and guaranteed farm ownership and operating loans to family-size farmers and ranchers who cannot obtain commercial credit from a bank, Farm Credit System institution, or other lender. FSA loans can be used to purchase land, livestock, equipment, feed, seed, and supplies. These loans can also be used to construct buildings or make farm improvements.

Eligible applicants must be U.S. citizens; must have sufficient education, training, or experience in managing or operating a farm or ranch; must be unable to get credit elsewhere; must not have received debt forgiveness from the Farm Service Agency (with some exceptions); must not be delinquent on any federal debt; and must be the owner or tenant operator of a family farm after the loan closes.

FSA can guarantee loans up to $1,112,000. The maximum loan guarantee is 95 percent of the loan amount, and the maximum term of the loan is 40 years. The interest rate is negotiated with the lender and must not exceed the rate charged to the lender's average farm customer. Under the Interest Assistance program, the FSA may subsidize 4 percent of the interest rate.

Rural Utilities Service Water and Waste Disposal Loans and Grants[11]

The Rural Utilities Service Water and Environmental Programs division provides loans, grants, and loan guarantees for drinking water, sanitary sewer, solid waste, and storm drainage facilities in rural areas or in cities of 10,000 people or less. Eligible applicants are public bodies, non-profit organizations, and recognized Native American tribes. Non-municipal water users are not eligible for this program, but these users may be able to work with eligible public bodies, non-profit organizations, or recognized Native American tribes to obtain funding for water supply infrastructure projects.

Direct loans and grants have been set aside for communities along the U.S.-Mexico border designated as "*colonias*;" areas designated Empowerment Zones/Enterprise Communities and Rural Economic Area Partnership Zones; certain projects where at least 50 percent of the users of the facility/project are Native Americans; rural Alaskan villages; and water emergencies and disaster relief.

Loans and grants may be used to construct, repair, modify, expand, or otherwise improve water supply and distribution systems and waste collection and treatment systems, including storm drainage and solid waste disposal facilities; acquire needed land, water sources, and water rights; and pay costs such as legal and engineering fees when necessary to develop the facilities.

Grants may be made for up to 75 percent of eligible project costs. The maximum term of a loan is the lesser of 40 years or the useful life of the facilities being financed. The interest rate may be a poverty rate of 4.5 percent, a market rate, or an intermediate rate, depending on the project.

The Water and Waste Disposal Loan Program had $790 million available for direct loans and grants in fiscal year 2009. Overall, the Rural Utility Service invested $2.5 billion in direct and guaranteed loans and grants to rural communities. Additionally, the Rural Utility Service was tasked with deploying $1.3 billion in of funds by the American Recovery and Reinvestment Act of 2009 (ARRA).

Watershed Protection and Flood Prevention Program[12]

The Watershed Protection and Flood Prevention Program, also known as the Small Watershed Program or the PL566 Program, is operated by the Natural Resources Conservation Service (NRCS). This program provides grants and technical assistance to local sponsoring organizations, state, and other public agencies to voluntarily plan and install watershed-based projects on private lands. Eligible watershed projects include watershed protection; flood prevention; water quality improvements; soil erosion reduction; rural, municipal and industrial water supply; irrigation water management; sedimentation control; fish and wildlife habitat enhancement; creation and restoration of wetlands and wetland functions; groundwater recharge; easements; wetland and floodplain conservation easements; hydropower; and watershed dam rehabilitation.

Eligible applicants include state or local agencies, counties, municipalities, towns or townships, soil and water conservation districts, flood prevention/flood control districts, Native American tribes or tribal organizations, or other governmental subunits. Projects are limited to watersheds containing no more than 250,000 acres. No structure providing more than 12,500 acre-feet of floodwater detention capacity or more than 25,000 acre-feet of total capacity may be included in the plan.

Although only governmental subunits may apply for funding, projects funded under this program are targeted at private land and can be used for rural and industrial water supply. Therefore, this program is indirectly applicable to non-municipal users.

Projects involving more than $5,000,000 of federal assistance or involving a single structure having a storage capacity of more than 2,500 acre-feet require approval from Congress. Other plans are approved administratively. Typical projects entail $3.5 million to $5 million in federal assistance.

4.0 Texas Department of Agriculture Programs

The Texas Department of Agriculture administers the Texas Capital Fund Infrastructure Development Program. Funding from this source may be used for water supply infrastructure improvements. In addition, the Texas Agricultural Finance Authority (TAFA), a public authority within the Texas Department of Agriculture, administers the following finance programs: the Interest Rate Reduction Program, the Agricultural Loan Guarantee Program, the Young Farmer Interest Rate Reduction Program, and the Young Farmer Grant Program. The TAFA provides financial assistance through eligible lending institutions to creditworthy individuals and businesses, and encourages private commercial lending at below market rates, to eligible applicants for eligible projects.

The Texas Capital Fund Infrastructure Development Program, the Interest Rate Reduction Program, and the Agricultural Loan Guarantee Program specifically mention use of funds for water supply infrastructure projects. The Young Farmer Interest Rate Reduction Program and the Young Farmer Grant Program do not specifically mention water supply infrastructure projects, but the rules are very general, and this use of funds may be acceptable. At the very least, funding from these programs may allow non-municipal water users to shift funds from other uses to water supply infrastructure projects. Each of these programs is reviewed below.

Texas Capital Fund Infrastructure Development Program[13]

The Texas Capital Fund Infrastructure Development Program is an economic development tool designed to provide financial resources to non-entitlement communities. Funds from this program can be utilized for the public infrastructure needed to assist a business that commits to create and/or retain permanent jobs, primarily for low and moderate-income persons. This program encourages new business development and expansions.

Funds may be used for public infrastructure such as water and sewer lines/facilities, road/street improvements, natural gas lines, electric, telephone, and fiber optic lines, harbor/channel dredging, purchase of real estate related to infrastructure, drainage channels and ponds, pre-treatment facilities, traffic signals and signs, and railroad spurs

The program is only available to non-entitlement city or county governments. Non-entitlement cities/counties do not receive Community Development funding from the U.S. Department of Housing and Urban Development and typically include cities with a population of less than 50,000 and counties of less than 200,000. There are over 1,200 eligible cities and counties in the state. Awarded cities and counties receive funds to make public infrastructure and/or real estate improvements to support a specific business that is expanding or beginning operations in the applicant's jurisdiction. Businesses or individuals may not directly submit applications. Projects must demonstrate project feasibility and financial capability. Projects are evaluated by using a scoring system based on community need, jobs, and economic impact.

The minimum award is $50,000 and the maximum is $1,000,000 inclusive of administration costs. Awards of more than $750,000 require a greater level of job creation/retention and matching funds, and are limited to two (2) per year. The award may not exceed fifty percent (50%) of the total project cost. A minimum equity injection of ten percent (10%) of the total project cost by the business is required.

Interest Rate Reduction Program[14]

The TAFA provides financial assistance through eligible lending institutions to creditworthy individuals and businesses by encouraging private commercial lending at below market rates, to eligible applicants for eligible projects. An eligible applicant is a person who proposes to use the proceeds of a loan in a manner that will help accomplish the state's goal of fostering the creation and expansion of enterprises based on agriculture in this state. An eligible lender must be a financial institution that makes commercial loans, is a depository of state funds and agrees to comply with the requirements of the Interest Rate Reduction (IRR) Program.

Loan proceeds under the program may be used for any agriculture-related operating expense, including the purchase or lease of land or fixed asset acquisition or improvement, or for any enterprise based on agriculture as identified in the application. A loan under this program may also be applied to existing debt only when required by the lender to finance the expansion of an eligible project. Eligible water conservation equipment includes: underground pipe; in-line valves; pipe increasers/reducers; gate valves; fittings and bushings; flow meters and accessories; complete circular watering systems; drip irrigation systems complete with installation; and any other equipment which can be identified and verified as water conservation equipment for use within the state. Eligible water conservation projects include: brush control projects, stock tank renovation or construction; dam renovation or construction; or any other project that can be identified as a water conservation project.

The maximum amount of a loan under this program is $500,000. Typically, IRR loans offer interest rates lower than current market rates. The Comptroller of Public Accounts sets the deposit interest rate but such rate may not drop below the floor rate of 1.5%. The IRR Program is an interest rate buy down and not a guaranteed loan program.

Agricultural Loan Guarantee Program[15]

The TAFA provides financial assistance through loan guarantees to lenders for eligible applicants who wish to establish or enhance their farm and/or ranch operation or establish an agriculture-related business. An applicant must provide evidence that the applicant's farm, ranch or agriculture-related business to be financed is or will be located within the State of Texas, provide evidence they are a United States citizen and a resident of the State of Texas, and provide a plan to the lender for the proposed operation that includes a budget for the proposed operation indicating how the loan proceeds will be used.

Financing received under this program may be used to provide working capital for operating a farm, ranch, or agriculture related business, including the lease of facilities, the purchase of machinery and equipment, or for any other agriculture-related business purpose, including the purchase of real estate, as identified in the plan. The TAFA may provide a guarantee to an eligible applicant based on a tiered structure. A guarantee shall not exceed:

1) $250,000 or 90%, whichever is less
2) $500,000 or 80%, whichever is less
3) $750,000 or 70%, whichever is less

The guarantee shall not exceed a maximum of 10 years or the useful life of the assets being financed. Interest rates are determined by the lender and approved by the TAFA. An applicant may be eligible for an interest rebate, which reimburses the applicant. The rate reduction per eligible borrower shall not exceed three percentage points or cause the rate to go below a 5% floor, or a maximum of $5,000 in any one calendar year.

Young Farmer Interest Rate Reduction Program[16]

An eligible applicant is a person who is 18 years of age but younger than 46 years of age and proposes to use the proceeds of a loan in a manner that will help accomplish the state's goal of fostering the creation and expansion of enterprises based on agriculture in this state. An eligible lender must be a financial institution that makes commercial loans, is a depository of state funds and agrees to comply with the requirements of the Young Farmer Interest Rate Reduction (YFIRR) Program.

Loan proceeds under the program may be used for any agriculture-related operating expense, including the purchase or lease of land or fixed asset acquisition or improvement, or for any enterprise based on agriculture as identified in the application. A loan under this program may also be applied to existing debt only when required by the lender to finance the expansion of an eligible project.

The maximum amount of a loan under this program is $500,000. Typically, YFIRR loans offer interest rates lower than current market rates. The Comptroller of Public Accounts sets the deposit interest rate but such rate may not drop below the floor rate of .5%. The YFIRR Program is an interest rate buy down and not a guaranteed loan program.

Young Farmer Grant Program[17]

The purpose of the Young Farmer Grant program is to provide financial assistance in the form of dollar-for-dollar matching grant funds between $5,000 and $10,000, to those persons 18 years or older but younger than 46 years of age that are engaged or will be engaged in creating or expanding an agricultural business in Texas.

Financing received under this program may be used to provide operating expenses such as seed, fertilizer and fuel. It can also be used to purchase livestock, feed, and associated costs which may include lease of land and any other costs associated with an agriculture operation. Capital purchases that exceed $5,000 will not be eligible.

The TAFA Young Farmer Grant is a competitive grant, and recipients are selected by the TAFA Board of Directors after a review of all applications.

5.0 U.S. Department of Commerce Economic Development Administration Public Works Program[18]

The United States Economic Development Administration (EDA) Public Works Program "empowers distressed communities to revitalize, expand, and upgrade their physical infrastructure to attract new industry, encourage business expansion, diversify local economies, and generate or retain long-term, private sector jobs and investment." In particular, water and sewer systems for industrial use are eligible for funding. Eligible applicants include units of state and local government, Native American tribes, economic development districts, public and private non-profit organizations, universities, and other institutions of higher learning.

Although non-municipal water users are not strictly eligible for funding, projects funded under this program are targeted at industrial and commercial development and can be used for public works facilities to support this development. Therefore, this program is indirectly applicable to non-municipal users.

Projects must be consistent with the Comprehensive Economic Development Strategy (CEDS) approved by the EDA for the project area. Applicants must develop a pre-application for review by the EDA that shows how the project will address economic development needs and objectives outlined in the CEDS. Upon approval of the pre-application, applicants will be invited to submit a full application.

Public Works Program grants generally require a 50 percent match from applicant contributions, state and local grants and loans, general obligation bonds, and other public and private contributions.

6.0 U.S. Small Business Administration Programs

Among other programs, the U.S. Small Business Administration (SBA) offers the 7a Loan Guaranty Program and the Certified Development Company (504) Program. The 7a Loan Guaranty Program does not specifically mention financing for water supply infrastructure projects, but the rules are very general, and this use may be acceptable. At the very least, funding from the 7a Loan Guaranty Program may allow non-municipal water users to shift funds from other uses to water supply infrastructure projects.

7a Loan Guaranty Program[19]

The 7(a) Loan Program is SBA's primary program to help start-up and existing small businesses obtain financing when they might not be eligible for business loans through normal lending channels. SBA itself does not make loans, but rather guarantees a portion of loans made and administered by commercial lending institutions.

7(a) loans are the most basic and most commonly used type of loans. They are also the most flexible, since financing can be guaranteed for a variety of general business purposes, including working capital, machinery and equipment, furniture and fixtures, land and building (including purchase, renovation and new construction), lease-hold improvements, and debt refinancing (under special conditions). Loan maturity is up to 10 years for working capital and generally up to 25 years for fixed assets.

SBA offers several different types of 7(a) loans. One program that may be helpful to small communities is the Small/Rural Lender Advantage (S/RLA) initiative, which is designed to accommodate the unique loan processing needs of small community/rural-based lenders by simplifying and streamlining loan application process and procedures, particularly for smaller SBA loans. It is part of a broader SBA initiative to promote the economic development of local communities, particularly those facing the challenges of population loss, economic dislocation, and high unemployment.

SBA can guarantee as much as 85 percent on loans of up to $150,000 and 75 percent on loans of more than $150,000. 7(a) loans have a maximum loan amount of $2 million. SBA's maximum exposure is $1.5 million. Thus, if a business receives an SBA-guaranteed loan for $2 million, the maximum guaranty to the lender will be $1.5 million or 75 percent. SBAExpress loans have a maximum guaranty set at 50 percent. The American Recovery and Reinvestment Act signed into law February 17, 2009, authorized a temporary increase in SBA's guaranty percentage to up to 90% on guaranty loans, except those processed under SBAExpress, through the end of calendar year 2009, or until the funds appropriated for this provision are exhausted, whichever comes first.

Maximum loan maturities have been established: 25 years for real estate and equipment, and terms for a working capital or inventory loan should be appropriate to the borrower's ability to repay up to 10 years.

The maximum maturity of loans used to finance fixed assets other than real estate will be limited to the economic life of those assets, in no instance to exceed 25 years. The 25-year maximum will generally apply to the acquisition of land and buildings or the refinancing of debt incurred in their acquisition. Where business premises are to be constructed or significantly renovated, the 25-year maximum would be in addition to the time needed to complete construction.

Certified Development Company (504) Program[20]

The Certified Development Company (CDC) Program offers businesses long-term, fixed-rate financing for major fixed assets, such as land and buildings. A CDC is a non-profit corporation formed for the purpose of economic development. There are approximately 270 CDCs nationwide, each covering a specific geographic area. CDCs that serve portions of Region C include the Central Texas Certified Development Company, the Dallas Business Finance Corporation, the East Texas Regional Development Company, Inc., Alliance Lending Corporation in Fort Worth, the Greater East Texas Certified Development Company, and the North Texas Certified Development Corporation[21].

Proceeds from loans may be used for the following purposes: purchasing land and improvements, including existing buildings; grading, street improvements, utilities, parking lots and landscaping; construction of new facilities, or modernizing, renovating or converting existing facilities; or purchasing long-term machinery and equipment. Eligible businesses must have a tangible net worth of less than $7.5

million and an average net income of less than $2.5 million after taxes for the preceding two years. In general, the business must also create or retain one job for every $65,000 provided by the SBA—except for small manufacturers, which must create or retain one job for every $100,000 provided by the SBA.

A typical project includes "a loan secured with a senior lien from a private-sector lender covering up to 50 percent of the project cost, a loan secured with a junior lien from the CDC (backed by a 100 percent SBA-guaranteed debenture) covering up to 40 percent of the cost, and a contribution of at least 10 percent equity from the small business being helped." Loan maturities of 10 and 20 years are available. Interest rates are pegged to an increment above the current market rate for 5-year and 10-year U.S. Treasury issues.

7.0 Texas Department of Economic Development Programs

The Texas Department of Economic Development offers several financing programs, including the Industry Development Loan Program, Texas Industrial Revenue Bond Program, and the Texas Leverage Fund. Other programs are also available, but these appear to be the most general in scope. None of these programs specifically target water supply infrastructure projects, but each could allow non-municipal water users to shift other funds to water supply infrastructure projects. Each of the above programs is reviewed below.

Texas Industry Development Loan Program[22]

The main objective of Texas Industry Development (TID) Loan Program is to support projects that will stimulate the creation of jobs, and can be used for a variety of purposes including community infrastructure/economic development. The TID program provides variable rate, low-cost loans for loans above $5,000,000. The term of the loan cannot extend beyond the useful life of the assets, or bond maturity in 2025.

Texas Industrial Revenue Bond Program[23]

The Texas Industrial Revenue Bond Program provides tax-exempt bond financing for land and depreciable property for industrial and manufacturing projects. Cities, counties, and conservation and reclamation districts may form non-profit industrial development corporations or authorities to issue taxable and tax-exempt bonds for eligible projects in their jurisdictions.

Texas Leverage Fund[24]

The Texas Leverage Fund offers additional financing to communities that have passed the economic development sales tax. Eligible applicants must be Industrial Development Corporations and may serve municipalities, businesses, or nonprofit entities. The fund does not specifically mention financing for water or wastewater projects, but the rules are very general, and this use may be acceptable. At the very least, this fund may allow municipalities to shift funds from other uses to water or wastewater projects. The maximum loan amount is no more than $5 million, and interest rates are given as the Wall Street Journal prime floating rate. Maximum life on the loans is 15 years.

Texas Enterprise Zone Program[25]

The Texas Enterprise Zone Program encourages job creation and capital investment in areas of economic distress using state and local incentives. With the exception of Wise County, enterprise zones have been created in every county in Region C. Qualified businesses must be nominated for the program by a city or county that governs the enterprise zone. A qualified business must be active within an enterprise zone, and 25 percent of its new employees must live in the jurisdiction of the governing body or be economically disadvantaged. State incentives may include refunds of state sales taxes or use taxes, franchise tax benefits, or franchise tax economic development credits. The Enterprise Zone program also requires that the governing body offer at least one local financial incentive.

8.0 United States Army Corps of Engineers Assistance

The United States Army Corps of Engineers (USACE) has traditionally been involved in large-scale flood damage reduction projects through the construction of reservoirs. In Region C, there are nine USACE-operated reservoirs. The USACE offers federal financing opportunities through partnering and constructing projects with a federal purpose. Examples of such projects include new reservoir construction and wastewater reuse projects. The USACE can participate in multipurpose reservoir projects through their existing flood damage reduction, ecosystem restoration and water supply authorities. The cost sharing agreements for reservoir projects may vary with the local sponsor and ability to pay. Generally, under current policies the total non-federal interest should be a minimum of 35 percent of the project for flood control, 35 percent for the ecosystem restoration portion of the project and 100 percent for water supply. Reservoir projects that are primarily for water supply will require Congressional authorization to benefit from Corps assistance.

Water supply through reuse could be sponsored with the USACE through the ecosystem restoration authority. The purpose of this authority is to improve ecosystem functions to produce environmental benefits. The proposed reuse projects in Region C that utilize constructed wetlands could potentially qualify under this authority. For ecosystem restoration projects, the federal contribution is 65 percent for that portion of the project.

9.0 Local Economic Development Incentives

More than 30 local economic development agencies in Region C[26] offer incentives for businesses to locate in certain areas. Incentives may include tax abatements, electric rate discounts, economic development grants, sales tax rebates, permit/development fee waivers, and infrastructure cost participation. The level of the incentives is generally predicated on the number of jobs that the business will create, the average wage and the gross payroll generated, the amount of capital investment, and the new taxes generated by the project. Economic development incentives that are not specifically targeted toward water supply infrastructure projects may still allow a potential water user to shift other funds to water supply infrastructure projects.

10.0 Bureau of Reclamation Programs[27]

WaterSMART is the Bureau of Reclamation's program for working to achieve a sustainable water strategy to meet the Nation's water needs. WaterSMART grants and Title XVI funding are available under the WaterSMART program to help fund water conservation and water reuse projects.

In 2010, the Bureau of Reclamation issued Grants that will use $12.8 million in federal funding to construct projects that seek to save water, increase energy efficiency and improve environmental conditions while addressing water demands. Through these new WaterSMART Water and Energy Efficiency Grant projects, federal funding will be leveraged to complete more than $54 million in water management and delivery improvements. Proposals were received from water districts, municipalities and native American Tribes.

The Title XVI program is focused on identifying and investigating opportunities to reclaim and reuse wastewaters and naturally impaired ground and surface water in the 17 Western States and Hawaii. Title XVI is budgeted for by the Bureau of Reclamation's regional offices and includes funding for planning studies and the construction of water recycling projects, on a project specific basis, in partnership with local governmental entities. The Bureau of Reclamation is currently developing funding criteria for a fiscal year 2011 Title XVI funding opportunity.

11.0 Texas Department of Rural Affairs

Small Town Environment Program (STEP)[28]

The Texas Department of Rural Affairs (TDRA) administers the Small Towns Environment Program (STEP). Communities may apply for STEP by invitation from TDRA only. The STEP program promotes using local resources to solve water and wastewater problems. Funds are provided through the Community Development

Block Grant program and are generally available to rural counties with a non-metropolitan population under 200,000 and and cities with less than 50,000 people that are not eligible to participate in the entitlement portion of the federal Community Block Grant Program. Water and wastewater projects are eligible under the national program's objectives to a) benefit low- and moderate-income persons and b) meet community needs that represent an immediate threat to the health and safety of the residents of the community. The maximum grant available is $350,000.

Renewable Energy Demonstration Pilot Program[29]

The TDRA designates Community Development Block Grant funds for its Renewable Energy Demonstration Pilot Program (REDPP). Individual grants are limited to $500,000. These grants can be used to help eligible rural communities install their own renewable energy projects, such as using wind turbines or solar panels to power water and/or wastewater treatment facilities. Eligible applicants include rural city or counties that can demonstrate that 51 percent or more of the residents benefitting from these projects meet low- to moderate-income limits set by the U.S. Department of Housing and Urban Development.

Desalination Fund[30]

The TDRA designates grant funds for its Desalination Fund program. Individual grants are limited to $750,000, although the TDRA reserves the option to award up to $1,500,000 to applicants demonstrating additional merit and need. These grants can be used to help eligible rural communities utilize wind turbines to help provide electricity for desalination of brackish groundwater.

[1] "Economically Distressed Area Program," Texas Water Development Board, available online at http://www.twdb.state.tx.us/publications/shells/EDAP.pdf, August 2010.

[2] "County-Level Unemployment and Median Household Income for Texas," 2008, Economic Research Service, U.S. Department of Agriculture, available online at http://www.ers.usda.gov/data/unemployment/RDList2.asp?ST=TX, August 2010.

[3] "Drinking Water State Revolving Fund Program," Texas Water Development Board, available online at http://www.twdb.state.tx.us/assistance/financial/fin_infrastructure/dwsrf.asp, August 2010.

[4] "Clean Water State Revolving Fund Program," Texas Water Development Board, available online at http://www.twdb.state.tx.us/assistance/financial/fin_infrastructure/cwsrffund.asp, August 2010.

[5] "State Participation Program," Texas Water Development Board, available online at http://www.twdb.state.tx.us/assistance/financial/fin_infrastructure/StateParticipation.asp, August 2010.

[6] "Texas Water Development Fund II," Texas Water Development Board, available online at http://www.twdb.state.tx.us/assistance/financial/fin_infrastructure/DfundII.asp, August 2010

[7] "Agricultural Water Conservation Loan Program," Texas Water Development Board, available online at http://www.twdb.state.tx.us/assistance/financial/fin_infrastructure/awcfund.asp, August 2010.

[8] "Water Infrastructure Fund," Texas Water Development Board, available online at http://www.twdb.state.tx.us/assistance/financial/fin_infrastructure/WIF.asp August 2010.

[9] "Rural Water Assistance Fund," Texas Water Development Board, available online at http://www.twdb.state.tx.us/assistance/financial/fin_infrastructure/RWAF.asp, August 2010.

[10] "Farm Loan Programs," Farm Service Agency, U.S. Department of Agriculture, available online at http://www.fsa.usda.gov/dafl/default.htm, August 2010.

[11] "Fiscal Year 2009: Water and Environmental Programs," Rural Utilities Service, U.S. Department of Agriculture, available online at http://www.usda.gov/rus/water/docs/FY%202009%20Annual%20Report.pdf August 2010.

[12] "NRCS Watershed Program," Natural Resources Conservation Service, U.S. Department of Agriculture, available online at http://www.nrcs.usda.gov/programs/watershed/index.html, August 2010.

[13] "Texas Capital Fund Infrastructure Development Program," Texas Department of Agriculture, available online at http://www.agr.state.tx.us/agr/program_render/0,1987,1848_6054_0_0,00.html?channelId=6054 August 2010.

[14] "Interest Rate Reduction Program," Texas Department of Agriculture, available online at http://www.agr.state.tx.us/agr/program_render/0,1987,1848_6057_0_0,00.html?channelId=6057 August 2010.

[15] "Agricultural Loan Guarantee Program," Texas Department of Agriculture, available online at http://www.agr.state.tx.us/agr/program_render/0,1987,1848_6058_0_0,00.html?channelId=6058 August 2010.

[16] "Young Farmer Interest Rate Reduction Program," Texas Department of Agriculture, available online at http://www.agr.state.tx.us/agr/program_render/0,1987,1848_34684_0_0,00.html?channelId=34684 August 2010.

[17] "Young Farmer Grant Program," Texas Department of Agriculture, available online at http://www.agr.state.tx.us/agr/program_render/0,1987,1848_6059_0_0,00.html?channelId=6059 August 2010.

[18] "Investment Programs," Economic Development Administration, U.S. Department of Commerce, available online at http://www.eda.gov/AboutEDA/Programs.xml, August 2010.

[19] "Basic 7(a) Loan Program," U.S. Small Business Association, available online at http://www.sba.gov/financialassistance/borrowers/guaranteed/7alp/index.html August 2010.

[20] "Certified Development Company (504) Loan Program," U.S. Small Business Administration, available online at http://www.sba.gov/financialassistance/borrowers/guaranteed/CDC504lp/index.html August 2010.

[21] "Certified Development Companies for SBA 504 Program – TX," U.S. Small Business Administration, available online at http://www.sba.gov/idc/groups/public/documents/tx_san_antonio/tx_sa_certdevcomp-tx.pdf August 2010.

[22] "Industry Development Loan Program," Texas Department of Economic Development, available online at http://governor.state.tx.us/ecodev/financial_resources/loan_assistance/ August 2010.

[23] "Industrial Revenue Bonds," Texas Department of Economic Development, available online at http://governor.state.tx.us/ecodev/financial_resources/loan_assistance/ August 2010.

[24] "Texas Leverage Fund," Texas Department of Economic Development, available online at http://governor.state.tx.us/ecodev/financial_resources/loan_assistance/ August 2010.

[25] "Texas Enterprise Zone Program," Window on State Government, Comptroller of Public Accounts, Available online at http://www.window.state.tx.us/taxinfo/enterprise_zone/ez_program.html August 2010.

[26] "Texas Economic Development Directory", available online at http://www.ecodevdirectory.com/texas.htm, August 2010.

[27] "WaterSMART," United States Bureau of Reclamation, Department of the Interior, available online at http://www.usbr.gov/WaterSMART/index.html, August 2010.

[28] "Small Towns Environment Program (STEP)," Texas Department of Rural Affairs, available online at http://www.orca.state.tx.us/index.php/Community+Development/Grant+Fact+Sheets/Texas+Small+Towns+Environment+Program+(STEP)+Fund August 2010.

[29] "Renewable Energy Demonstration Pilot Program (REDPP)," Texas Department of Rural Affairs, available online at http://www.orca.state.tx.us/index.php/Community+Development/Grant+Fact+Sheets/Renewable+Energy+Demonstration+Pilot+Program+(REDPP), September 2010.

[30] "Desalination Fund," Texas Department of Rural Affairs, available online at http://www.tdra.state.tx.us/index.php/Community+Development/Grant+Fact+Sheets/Desalination+Fund, September 2010.

Infrastructure Financing Survey Report

24: CEDAR HILL

As part of the regional and state water planning process, regional water planning groups recommend water supply projects for each of their respective regions. The purpose of this survey is gather information from your organization regarding how you plan to finance water supply projects recommended for the 2012 state water plan, and determine whether you intend to use financial assistance programs offered by the State of Texas and administered by the Texas Water Development Board (TWDB).

The TWDB has several funding programs for water projects identified in the 2012 state water plan. Funds are targeted toward: 1) construction of water supply projects, 2) planning and design and permitting for projects that have long development time frames meaning that construction would require 5-10 years of planning, design and permitting, and 3) projects that would be built with excess capacity intended to meet future water needs. These programs offer various attractive financing options such as subsidized interest rates, deferral of principal and interest during planning, design and permitting phase, partial deferral of interest and principal for those portions of the project which are optimally sized for future needs. Additionally, grant funding is available for those service areas which qualify as rural or economically disadvantaged. More information on these financial assistance programs (i.e., the Water Infrastructure Fund, the State Participation Fund, and the Economically Disadvantaged Areas Program) can be found at the TWDB website at:

http://www.twdb.state.tx.us/assistance/financial/financial_main.asp

Your cooperation and responses to these questions are crucial in helping the state in ensuring that our communities and our citizens have adequate water supplies. If you have any questions related to the financial programs offered by the TWDB or about the survey questions, please contact Rick Shaffer by phone at (817)354-0189 or by email at rshaffer@cpyi.com. If you have any computer or technology related problems with the survey, please contact Wendy Barron by phone at (512) 936-0886 or by email at wendy.barron@twdb.state.tx.us.

Section 1: Project Financing Information

For project(s) identified in the State Water Plan, the TWDB has funding available for different aspects of a project. The different programs available are:

- WIF-Deferred offers subsidized interest and deferral of principal and interest for up to 10 years for planning, design and permitting costs.

- WIF-Construction offers subsidized interest for all construction costs, including planning, acquisition, design, and construction.

- State Participation funding offers partial interest and principal deferral for the incremental cost of project elements which are designed and built to serve needs beyond 10 years.

- Rural areas funding offers grants and 0% interest loans for service areas which are not in a Metropolitan Statistical Area (MSA) and in which the population does not exceed 5,000. The service area must also meet the EDAP eligibility criteria.

- Economically Distressed Areas Program (EDAP) offers funding through grants and loans for service areas within a project which meet the EDAP eligibility criteria. Eligibility for the TWDB's EDAP requires that the median household income of the area to be served by the proposed project be less than 75 percent of the Texas median household income ($39,927), as shown in the 2000 Census. EDAP eligibility also requires adoption of Model Subdivision rules by the appropriate planning entities.

- State Participation funding offers partial interest and principal deferral for the incremental cost of project elements which are designed and built to serve needs beyond 10 years.

If you are interested in receiving funds from the above programs, please complete the remainder of the survey.

Please enter only the amounts you wish to receive from TWDB program in the Project Costs fields and do not enter a specific project cost more than once.

Section 2: Projects

For each of the project(s) listed below, please enter only the amounts you wish to receive from TWDB programs in the 'Cost' field and the earliest date you wish to receive these amounts. In addition, the total amount entered into all five categories cannot exceed the total cost of the project. Each of the five categories corresponds to a funding program available at the TWDB. Each of the funding programs and categories are described below.

- Planning, design, permitting: Enter costs into the 'Planning, design, permitting' category if you want to participate in the WIF-Deferred program. The WIF-Deferred program offers subsidized interest and deferral of principal and interest for up to 10 years for planning, design and permitting costs.

- Acquisition and construction: Enter costs into the 'Acquisition and construction' category if you want to participate in the WIF-Construction program. The WIF-Construction program offers subsidized interest for all construction costs, including planning, acquisition, design, and construction.

- Excess Capacity: Enter costs into the 'Excess capacity' category if you want to participate in the State Participation program. State Participating funding offers partial interest and principal deferral for the incremental cost of project elements which are designed and built to serve needs beyond 10 years.

- Rural: Enter costs into the 'Rural' category if you want to participate in the Rural areas funding program. Rural areas funding offers grants and 0% interest loans for service areas which are not in a Metropolitan Statistical Area (MSA) and in which the population does not exceed 5,000. The service area must also meet the EDAP eligibility criteria.

- Disadvantaged: Enter costs into the 'Disadvantaged' category if you want to participate in the Economically Distressed Areas Program (EDAP). EDAP offers funding through grants and loans for service areas within a project which meet the EDAP eligibility criteria. Eligibility for the TWDB's EDAP requires that the median household income of the area to be served by the proposed project be less than 75 percent of the Texas median household income ($39,927), as shown in the 2000 Census. EDAP eligibility also requires adoption of Model Subdivision rules by the appropriate planning entities.

137 - MUNICIPAL CONSERVATION-BASIC $31,256.00

Planning, design, permitting	Cost:		Year:	
Acquisition and contruction	Cost:		Year:	
Excess Capacity	Cost:		Year:	

Rural	Cost:	Year:
Disadvantaged	Cost:	Year:
	Total:	

177 - MUNICIPAL CONSERVATION-EXPANDED $31,256.00

Planning, design, permitting	Cost:	Year:
Acquisition and contruction	Cost:	Year:
Excess Capacity	Cost:	Year:
Rural	Cost:	Year:
Disadvantaged	Cost:	Year:
	Total:	

307 - SUPPLEMENTAL WELLS $2,336,000.00

Planning, design, permitting	Cost:	Year:
Acquisition and contruction	Cost:	Year:
Excess Capacity	Cost:	Year:
Rural	Cost:	Year:
Disadvantaged	Cost:	Year:
	Total:	

Section 3: Contact Information

1. Name: ____________________

2. Phone Number: ____________________

3. Email: ____________________

4. Comments

Table X-1
Summary of Infrastructure Financing Survey Results

Entity Name	WWP?	County	Estimate of Total Funds Requested from TWDB	WIF- Deferred	WIF- Construction	Excess Capacity	Rural	Dis-advantaged
ALEDO		PARKER	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
ALLEN		COLLIN	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
ANNA		COLLIN	$ 1,381,000	$ 0	$ 1,381,000	$ 0	$ 0	$ 0
ARGYLE WSC	Yes	DENTON	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
ARLINGTON	Yes	TARRANT	$ 38,500,000	$ 4,500,000	$ 34,000,000	$ 0	$ 0	$ 0
ATHENS		HENDERSON	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
AUBREY		DENTON	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
AURORA		WISE	$ 1,512,000	$ 250,000	$ 750,000	$ 250,000	$ 250,000	$ 12,000
AZLE		TARRANT	$ 20,892,000	$ 2,000,000	$ 18,892,000	$ 0	$ 0	$ 0
BARTONVILLE WSC	Yes	DENTON	$ 6,016,000	$ 616,000	$ 5,000,000	$ 400,000	$ 0	$ 0
BEDFORD		TARRANT	$ 1,200,000	$ 100,000	$ 1,100,000	$ 0	$ 0	$ 0
BENBROOK		TARRANT	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
BOLIVAR WSC	Yes	DENTON	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
BONHAM		FANNIN	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
CARROLLTON		DENTON	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
CELINA		COLLIN	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
COMBINE WSC		KAUFMAN	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
CORSICANA	Yes	NAVARRO	$ 24,450,000	$ 350,000	$ 24,100,000	$ 0	$ 0	$ 0
CRANDALL		KAUFMAN	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
DALLAS	Yes	DALLAS	$ 2,707,686,615	$ 194,095,980	$ 2,513,590,635	$ 0	$ 0	$ 0
DENISON		GRAYSON	$ 20,686,000	$ 486,000	$ 20,200,000	$ 0	$ 0	$ 0
DENTON	Yes	DENTON	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
EAST CEDAR CREEK FWSD	Yes	HENDERSON	$ 26,116,000	$ 18,846,000	$ 7,270,000	$ 0	$ 0	$ 0
ENNIS	Yes	ELLIS	$ 45,011,642	$ 2,555,642	$ 42,456,000	$ 0	$ 0	$ 0
EULESS		TARRANT	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
EUSTACE		HENDERSON	$ 1,048,559	$ 43,000	$ 500,000	$ 235,559	$ 270,000	$ 0
EVERMAN		TARRANT	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
FARMERS BRANCH		DALLAS	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
FORT WORTH	Yes	TARRANT	$ 254,000,000	$ 24,000,000	$ 230,000,000	$ 0	$ 0	$ 0
FRISCO		COLLIN	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
GAINESVILLE	Yes	COOKE	$ 55,046,000	$ 1,546,000	$ 14,000,000	$ 19,500,000	$ 20,000,000	$ 0
GARLAND	Yes	DALLAS	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
GRAND PRAIRIE	Yes	DALLAS	$ 42,013,751	$ 4,199,375	$ 37,814,376	$ 0	$ 0	$ 0
GRAPEVINE		TARRANT	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0

Table X-1 Continued

Entity Name	WWP?	County	Estimate of Total Funds Requested from TWDB	WIF- Deferred	WIF- Construction	Excess Capacity	Rural	Dis-advantaged
GREATER TEXOMA UTILITY AUTHORITY	Yes	N/A	$ 190,292,250	$ 8,292,250	$ 0	$ 182,000,000	$ 0	$ 0
HOWE		GRAYSON	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
HUDSON OAKS		PARKER	$ 7,523,000	$ 205,000	$ 4,000,000	$ 1,318,000	$ 0	$ 2,000,000
IRVING		DALLAS	$ 194,825,000	$ 20,000,000	$ 174,825,000	$ 0	$ 0	$ 0
KELLER		TARRANT	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
KENNEDALE		TARRANT	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
LAKE WORTH		TARRANT	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
LEONARD		FANNIN	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
LEWISVILLE		DENTON	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
LINDSAY		COOKE	$ 1,380,000	$ 280,000	$ 1,100,000	$ 0	$ 0	$ 0
LITTLE ELM		DENTON	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
MABANK		KAUFMAN	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
MANSFIELD	Yes	TARRANT	$ 10,000	$ 10,000	$ 0	$ 0	$ 0	$ 0
MARILEE SUD		COLLIN	$ 1,500,000	$ 250,000	$ 1,250,000	$ 0	$ 0	$ 0
MCKINNEY		COLLIN	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
MELISSA		COLLIN	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
MESQUITE		DALLAS	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
MIDLOTHIAN	Yes	ELLIS	$ 50,489,000	$ 4,075,000	$ 40,414,000	$ 6,000,000	$ 0	$ 0
MT. PEAK SUD		ELLIS	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
MUENSTER		COOKE	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
MUSTANG SUD	Yes	DENTON	$ 3,500,000	$ 500,000	$ 3,000,000	$ 0	$ 0	$ 0
NORTH RICHLAND HILLS	Yes	TARRANT	$ 24,216,058	$ 6,750,000	$ 14,550,658	$ 2,915,400	$ 0	$ 0
NORTH TEXAS MUNICIPAL WATER DISTRICT	Yes	N/A	$ 4,981,088,500	$ 537,730,620	$ 4,200,771,800	$ 242,586,080	$ 0	$ 0
NORTHLAKE		DENTON	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
OAK POINT		DENTON	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
OVILLA		ELLIS	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
PILOT POINT		DENTON	$ 4,002,000	$ 102,000	$ 3,900,000	$ 0	$ 0	$ 0
RICHLAND HILLS		TARRANT	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
ROANOKE		DENTON	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
ROCKETT SUD	Yes	ELLIS	$ 38,460,000	$ 2,000,000	$ 36,460,000	$ 0	$ 0	$ 0
RUNAWAY BAY		WISE	$ 2,735,000	$ 250,000	$ 1,585,000	$ 900,000	$ 0	$ 0

Table X-1 Continued

Entity Name	WWP?	County	Estimate of Total Funds Requested from TWDB	WIF- Deferred	WIF- Construction	Excess Capacity	Rural	Dis-advantaged
SARDIS-LONE ELM WSC		ELLIS	$ 4,992,000	$ 1,000,000	$ 3,992,000	$ 0	$ 0	$ 0
SAVOY		FANNIN	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
SHERMAN	Yes	GRAYSON	$ 179,952,000	$ 7,382,000	$ 101,285,000	$ 71,285,000	$ 0	$ 0
SOUTH GRAYSON WSC		GRAYSON	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
SOUTHMAYD		GRAYSON	$ 2,108,316	$ 212,000	$ 96,316	$ 400,000	$ 0	$ 1,400,000
SW FANNIN CO. SUD		FANNIN	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
TARRANT REGIONAL WATER DISTRICT	Yes	N/A	$ 914,424,000	$ 0	$ 914,424,000	$ 0	$ 0	$ 0
TEAGUE		FREESTONE	$ 2,992,800	$ 250,000	$ 320,000	$ 0	$ 1,024,000	$ 1,398,800
TERRELL	Yes	KAUFMAN	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
TOM BEAN		GRAYSON	$ 600,000	$ 50,000	$ 550,000	$ 0	$ 0	$ 0
TRINITY RIVER AUTH.	Yes	N/A	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
TROPHY CLUB		DENTON	$ 3,094,000	$ 774,000	$ 1,548,000	$ 772,000	$ 0	$ 0
TWO WAY SUD		GRAYSON	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
UPPER TRINITY REGIONAL WATER DISTRICT	Yes	N/A	$ 1,284,167,000	$ 141,832,000	$ 434,882,000	$ 707,453,000	$ 0	$ 0
VIRGINIA HILL WSC		HENDERSON	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
WALNUT CREEK SUD	Yes	PARKER	$ 1,100,000	$ 1,100,000	$ 0	$ 0	$ 0	$ 0
WAXAHACHIE	Yes	ELLIS	$ 58,134,000	$ 2,000,000	$ 28,226,000	$ 27,908,000	$ 0	$ 0
WEATHERFORD	Yes	PARKER	$ 47,622,000	$ 350,000	$ 47,272,000	$ 0	$ 0	$ 0
WHITESBORO		GRAYSON	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
WILMER		DALLAS	$ 2,977,000	$ 50,000	$ 2,927,000	$ 0	$ 0	$ 0
WISE COUNTY WSD	Yes	N/A	$ 14,540,000	$ 1,750,000	$ 12,790,000	$ 0	$ 0	$ 0
WOODBINE WSC		COOKE	$ 900,000	$ 150,000	$ 350,000	$ 100,000	$ 100,000	$ 200,000
Total			$ 11,263,183,491	$ 990,932,867	$ 8,981,572,785	$ 1,264,023,039	$ 21,644,000	$ 5,010,800

APPENDIX Y
REGION C NEWSLETTERS

Collin
Cooke
Dallas
Denton
Ellis
Fannin
Freestone
Grayson
Henderson
Jack
Kaufman
Navarro
Parker
Rockwall
Tarrant
Wise

REGION C

Water Planning for North Texas

Fall 2007 Newsletter

Region C Water Planning Group Invites Public to Attend Public Meetings

Public attendance is welcome at all Region C Water Planning Group Meetings, and attending members of the public have an opportunity for comment on the Planning Group's activities during each meeting.

Next Meeting (tentative):

Monday, December 10, 2007, 1:00 p.m.

Meeting Location:

Trinity River Authority
Central Wastewater Treatment Plant
6500 W. Singleton Blvd.
Grand Prairie, TX 75212
(972) 263-2251

*Please Note: Persons with disabilities who plan to attend the Region C Water Planning Group meeting – and who may need auxiliary aids or services such as mobility assistance, interpreters for persons who are deaf or hearing-impaired, readers, large print, or Braille – are requested to contact Lee Shaffer in the TRA Central Wastewater Treatment Plant at (972) 263-2251 at least (5) work days prior to the meeting so that appropriate arrangements can be made.

For more information about the Region C Water Planning Group, contact:
James (Jim) M. Parks, RCWPG Chair
North Texas Municipal Water District
P.O. Box 2408
Wylie, TX 75098
Phone: 972.442.5405
E-mail: jparks@ntmwd.com

To be added to the RCWPG newsletter mailing list, send your name and mailing address to Colby Walton via e-mail, colby@cookseypr.com, or via fax to 972-580-0852.

Visit www.regioncwater.org for the latest updates on RCWPG activities, meetings and other water planning news.

Planning Group Undertakes Special Studies for 2007-2009

As regional water planning efforts enter a third round of planning – after two five-year planning periods that commenced in 1997 – Regional Water Planning Groups such as the Region C Water Planning Group (RCWPG) have been directed by the Texas Water Development Board (TWDB) to take a different approach from that employed in previous planning periods.

For the third round of regional water planning, each Regional Water Planning Group statewide will primarily focus on conducting special studies that advance proposed water management strategies towards implementation, update information due to changed conditions, address problems realized during the previous planning cycle, make refinements for small communities and rural county populations, or provide for interregional cooperation.

Prior to the start of this third round of planning, the RCWPG submitted a request to the TWDB for funding for the first two years' worth of studies. Subsequently, the TWDB approved funding for four types of studies in Region C, as well as administrative and public participation activities to support the Planning Group's efforts. The following is a brief description of the studies that the RCWPG will undertake over the next two years:

Study 1 *Further Implementation of Water Conservation and Reuse Strategies*

–Total Cost $298,800

This study will examine the initial performance of water conservation and reuse strategies that have already been implemented within Region C. The RCWPG and its consultants will gather information on these projects and assess their performance, enhance coordination among Water User Groups and encourage a consistent approach to water conservation across Region C. In addition, this study will update the recommendations for implementation of water conservation and reuse strategies.

The study will include four critical tasks, with a final report expected to be completed by Sept. 2008:

(1) Survey of water providers in Region C, to identify which of the Water Conservation Implementation Task Force water conservation Best Management Practices (BMPs) have been implemented within Region C, see how effective these BMPs have been, assess public reaction to the BMPs implemented, determine future water conservation plans, gather information on the cost of BMP implementation and gather information on reuse projects and supplies.

(2) *Information and data gathering,* to identify changed conditions that may affect conservation and reuse strategies in Region C, assess water quantities used before and after implementation of the BMPs, gather additional cost information on BMP implementation, review public education and information approaches implemented by various entities and review the procedures used to address water loss, leakage and leak detection issues by selected water suppliers within the region.

(3) *Assessment of performance,* including detailed analysis of water data and reuse data, comparison of actual BMP performance versus the proposed performance indicated in the Water Conservation Implementation Task Force report and the 2006 Region C Water Plan, cost analysis relative to the proposed costs anticipated by the committee report and Regional Water Plan, assessment of the probability of achieving Region C water conservation and reuse goals and various other assessments.

(4) *Update implementation plan,* based on the information developed above, including development of new implementation recommendations, coordination with Region H on environmental flow considerations, assessment of regional development patterns that could impact future population densities, projection of future return flows from Region C, review of the instream flow model in coordination with Region H and delivery of a report describing this study.

Study 2 *Interregional Study of Toledo Bend Reservoir –Total Cost $40,500*

Region I will lead this study, with input from Regions C and D, to analyze the water supply available in the Toledo Bend Reservoir for delivery to the northern area of Texas. This study is a cooperative effort designed to examine inter-regional coordination, potential pipeline routes, importation of species, potential impacts to bays, estuaries and instream flows, and updated cost estimates.

Region C will coordinate with Region I on demand refinement and the potential for supplying raw water to smaller entities along the proposed pipeline route, and Region C will also review routing studies, the impacts on receiving reservoirs, impacts to bays and estuaries, and updated cost estimates.

A final memorandum for this project is anticipated to be presented in mid-2008.

Study 3 *Further Implementation of Direct Reuse and Indirect Reuse Pilot Projects –Total Cost $139,900*

This study includes the City of Fort Worth's direct reuse project, which will serve a developing area in the southwest portion of the city, and the Athens Municipal Water Authority/City of Athens indirect reuse project, which is designed to augment their water supply. To further the implementation of these water reuse projects, the RCWPG will develop information to establish appropriate barriers for protecting the safety and health of water users, to confirm the financial feasibility of the projects and to further develop design and operational considerations.

Final reports relating to each reuse pilot project are anticipated to be presented to the RCWPG and TWDB in early 2009.

Study 4 *Regional System Implementation Plans –Total Cost $435,600*

This study will develop implementation plans for regional water supply systems in rapidly urbanizing and rural areas in Region C. Groundwater will be insufficient to meet the growing demands in these areas, so an immediate shift from groundwater to surface water supplies is necessary. This study will coordinate various approaches and develop specific implementation strategies for regional systems.

Three critical tasks will be undertaken as part of this study, to address the specific regional system needs of areas within Region C:

(1) *Water supply study for Ellis County, Southwest Dallas County, Southeast Tarrant County and Johnson County.* This area in the southern part of the Metroplex is undergoing rapid growth, so the creation of a regional water supply system to meet future needs may be desirable. Region C work items will be related to Dallas, Ellis and Tarrant County participants, and work efforts will be coordinated with the Brazos G Region for those water users in Johnson County. Activities anticipated as part of this task will include initial meetings and data gathering, review of population and demand projections through 2030 in the study area, water supply plan development, final coordination and production of a report in conjunction with the Brazos G Planning Group.

(2) *Parker and Wise Counties.*

The City of Weatherford and Walnut Creek Special Utility District (SUD) are wholesale water providers that supply treated water to several of the water user groups in Parker County. The Trinity Aquifer also serves as a primary water supply source for Parker County. Water user groups in Wise County also obtain a considerable amount of water from the Walnut Creek SUD. This task anticipates meetings with various water user groups in both Parker and Wise Counties to discuss population and demand projections, planned water management strategies, other water issues and strategies, and possible roles for the City of Weatherford and Walnut Creek SUD as regional providers. The RCWPG will develop a specific implementation plan with water management strategy recommendations.

(3) *Other county meetings, with Cooke, Grayson, Fannin, Freestone, North Kaufman and Navarro Counties.*

RCWPG consultants will meet with water user groups in each of these counties to discuss their population and demand projections and seek input on other water issues and management strategies.

Final reports on the Dallas-Ellis-Johnson-Tarrant County Area plans and Parker-Wise County plans are anticipated in late 2008, and a memorandum summarizing input from other studies counties will also be prepared in 2008.

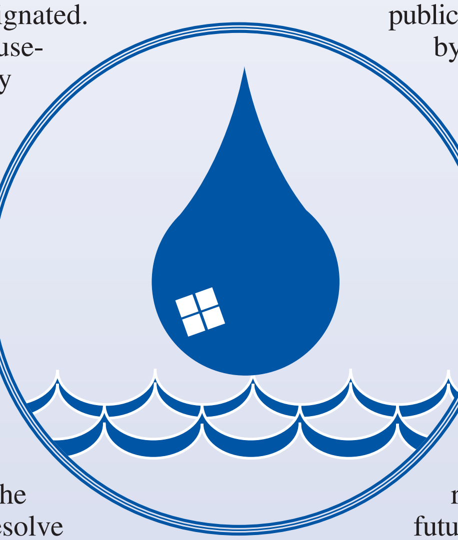
New Legislation Supports Proposed Region C Reservoirs, Conservation Activities, Groundwater Regulation

During the 80th Regular Session of the Texas Legislature, the state's elected representatives made water planning one of their key priorities and passed an omnibus water bill, SB 3, along with other critical legislation that, taken together, gauges the flow of rivers, promotes conservation and identifies new reservoir sites.

The new **reservoir site designations** were the most controversial element of the proposed legislation. As approved, the final version of SB 3, authored by Sen. Kip Averitt and sponsored by Rep. Robert Puente, does not explicitly contain any reservoir designations, but the bill does stipulate that if the Texas Water Development Board's (TWDB) State Water Plan recommends those sites for designation, then they are so designated. The compromise worked out by the House-Senate Conference Committee effectively restores the proposed Marvin Nichols and Fastrill reservoirs included in the 2006 Region C Water Plan, which had previously been omitted from SB 3. As a protection to rural property owners, the bill sunsets reservoir designations on Sept. 1, 2015, unless the project sponsor votes prior to that deadline to pay for the filing of permit applications.

SB 3 also creates a **Study Commission on Region C Water Supply**, to review water supply alternatives for the region. The special study approach was designed to resolve differences between the Region C and Region D (Northeast Texas) Water Planning Groups. The commission will consist of three members selected by the RCWPG and three members selected by the RDWPG. On Oct. 1, 2007 the RCWPG designated State Senator Florence Shapiro, State Representative Jodie Laubenberg and RCWPG Chairman Jim Parks as its appointees to the joint study commission. The commission's efforts are expected to begin in late 2007 and conclude with the delivery of a report to the TWDB by Dec. 1, 2010.

SB 3 protects the state's rivers, bays and estuaries by creating an **Environmental Flows Advisory Group** to oversee regional, consensus-based Bay and Basin Stakeholders Committees, which would be responsible for developing environmental flow standard recommendations for consideration by the Texas Commission on Environmental Quality. Similarly, HB 3, authored by Rep. Puente and sponsored by Sen. Averitt, contains certain provisions protecting environmental flows and requiring the involvement of a TWDB member on the Environmental Flows Advisory Group.



SB 3 and HB 4, authored by Rep. Puente and sponsored by Sen. Averitt, together promote water conservation through the establishment of a **Water Conservation Advisory Council**, whose 23 members representing various federal and state agencies and water interest groups will report annually on the best conservation practices being implemented around the state. On Aug. 27, 2007, the TWDB appointed RCWPG Chairman Jim Parks to represent River Authorities on the council, with a term expiring in 2009.

The new legislation also authorizes **a statewide awareness program to educate citizens about water conservation**. Private businesses, nonprofits and members of the public are encouraged to support the campaign by contacting the TWDB's Carla Dawes at carla.dawes@twdb.state.tx.us, as legislators did not provide funding for the campaign as part of the authorizing legislation.

However, the Texas Legislature did pass a critical appropriations measure, HB 1, which provides total project funding from bond proceeds of $762.4 million, for **implementation of water management strategies** included in the 2007 State Water Plan. These funds represent a critical investment in the future water supply, distribution and delivery systems that serve communities statewide, including those in Region C.

In other measures, the Legislature passed bills establishing the **Northern Trinity Groundwater Conservation District** (GCD) – located in Tarrant County – and providing for the formation of the **Upper Trinity Groundwater Conservation District**, which consists of Hood, Montague, Parker and Wise Counties. These bills were initiated in response to local concerns about the impact of Barnett Shale natural gas exploration and rapid population growth on groundwater supplies, in areas where groundwater forms a significant percentage of currently available water supplies.

The Northern Trinity GCD has no taxing or bond-issuing authority and requires no confirmation election to be established. The Upper Trinity GCD has no taxing power but may impose specified fees and may require exempt wells to comply with spacing regulations. The district must be confirmed by a local election before Sept. 1, 2009.

REGION C
Water Planning
for North Texas
5525 N MacArthur Blvd.
Suite 530
Irving, TX 75038

Planning Group Elects New Members and Officers, Appoints Regional Liaisons

Since the conclusion of the second round of Regional Water Planning, the Region C Water Planning Group (RCWPG) elected new members to replace members with expiring terms in late 2006. The following members have been newly elected, or re-elected, to the RCWPG, for the term Nov. 2006 through Nov. 2011 (with interest group representation noted after each name):

Steve Berry (new member) **– Environment**
Jerry Chapman (re-elected) **– Water Districts**
Frank Crumb (new member) **– Municipalities**
Bill Lewis (new member) **– Small Business**
Jim McCarter (re-elected) **– Water Utilities**
Jim Parks (re-elected) **– Water Districts**
Paul Phillips (re-elected) **– Municipalities**
Jody Puckett (new member) **– Municipalities**
Mary Vogelson (re-elected) **– Public**
Dr. Tom Woodward (new member) **– Agriculture**

Additionally, the following officers have been elected to serve as leaders of the RCWPG through the end of 2007:

Jim Parks, **Chairman**
Jody Puckett, **Vice Chair**
Secretary – currently vacant

The RCWPG also recently re-appointed the following individuals as liaisons to neighboring water planning regions:

Region B – ***Jerry Chapman***
Region D – ***Mike Rickman***
Region G – ***currently vacant***
Region H – ***Danny Vance***
Region I – ***Connie Standridge***

We salute the individuals listed above, as well as all members of the RCWPG, for their commitment to the regional water planning effort and for their dedication of a significant amount of time and attention to regional water issues.

Collin
Cooke
Dallas
Denton
Ellis
Fannin
Freestone
Grayson
Henderson
Jack
Kaufman
Navarro
Parker
Rockwall
Tarrant
Wise

REGION C

Water Planning for North Texas

Summer 2008 Newsletter

Region C Water Planning Group Invites Public to Attend Public Meetings

Public attendance is welcome at all Region C Water Planning Group Meetings, and attending members of the public have an opportunity for comment on the Planning Group's activities during each meeting.

Next Meeting:

Monday, September 22, 2008, 1:00 p.m.

Meeting Location:

Trinity River Authority
Central Wastewater Treatment Plant
6500 W. Singleton Blvd.
Grand Prairie, TX 75212
(972) 263-2251

*Please Note: Persons with disabilities who plan to attend the Region C Water Planning Group meeting – and who may need auxiliary aids or services such as mobility assistance, interpreters for deaf or hearing-impaired persons, readers, large print, or Braille – are requested to contact Lee Shaffer in the TRA Central Wastewater Treatment Plant at (972) 263-2251 at least (5) work days prior to the meeting so that appropriate arrangements can be made.

For more information about the Region C Water Planning Group, contact:
James (Jim) M. Parks, RCWPG Chair
North Texas Municipal Water District
P.O. Box 2408
Wylie, TX 75098
Phone: (972) 442-5405
E-mail: jparks@ntmwd.com

To be added to the RCWPG newsletter mailing list, send your name and mailing address to Colby Walton via e-mail to colby@cookseypr.com, or via fax to (972) 580-0852.

Visit www.regioncwater.org for the latest updates on RCWPG activities, meetings and other water planning news, or contact Stephanie Griffin with Freese & Nichols at swg@freese.com.

A Decade of Regional Water Planning

Since the regional water planning process first got underway in 1997, the North Texas region comprising Region C has made significant progress in planning for a long-term water supply and in implementing high-priority water management strategies to address the region's critical needs.

To date, two five-year rounds of regional water planning have been completed, and we are now in the midst of the third five-year planning cycle to update and improve the Regional Water Plan.

Most critically, the RCWPG has contributed over the last decade to the implementation of the following major water management strategies by wholesale water suppliers, municipalities and other entities, facilitating the addition of nearly **2 million acre/feet per year** of new supply:

1. Reuse projects

a. *Total reuse of more than 730,000 acre-feet/year.*
b. *Completed* supplies include Garland/Forney reuse for power plant, North Texas Municipal Wilson Creek reuse expansion, Grapevine/Dallas County Park Cities Municipal Utility District (MUD), Upper Trinity Regional Water District (UTRWD) reuse of Lake Chapman water.
c. *Under-construction* supplies include NTMWD East Fork Raw Water Supply Project, Tarrant Regional Water District (TRWD) wetlands (phased).
d. *In-progress* supplies include Dallas' contract for return flows.
e. *Other supplies now permitted* include Athens MWA, Trinity River Authority, Dallas' Lake Ray Hubbard & Lake Lewisville, Irving.

2. Connection to existing supplies

a. Several entities (including TRWD, NTMWD and UTRWD) are currently seeking Oklahoma water.
b. Many completed projects and under-construction projects.
c. *Total from connection to existing supplies is more than 1,070,000 acre-feet/year.*

3. New reservoirs/supply sources

a. Muenster Lake completed, at 500 acre-feet/year.
b. Permit applications have been submitted for Lower Bois d'Arc Creek Reservoir and Lake Ralph Hall *(totaling 168,000 acre feet/year).*

4. Large-scale conservation initiatives

Conservation programs to reduce water consumption and increase public awareness about conservation strategies have been undertaken by the following entities:

a. Dallas
b. NTMWD
c. Arlington
d. Fort Worth
e. TRWD
f. Many other cities and suppliers throughout the region.

5. Significant amount of regional cooperation

Where previous water planning efforts often were fragmented and lacked coordination, today the major water suppliers and Water User Groups (WUGs) in Region C work more closely together to coordinate water management strategies that will address the region's needs.

6. Significant amount of public participation

Throughout the five-year planning cycles, the RCWPG has invited members of the public to attend regular public meetings, to provide frequent input on water planning activities, and in particular to attend public hearings and offer feedback on the Planning Group's Initially Prepared Plans at the conclusion of each cycle. Additionally, the Planning Group has published frequent newsletters, provided updated information through the Region C website (www.regioncwater.org), and worked consistently with the media to ensure maximum awareness of the planning process and opportunities for public participation.

The RCWPG is pleased to be proactive in addressing the region's long-term water supply needs, and we welcome the public's continued input and involvement in this vital effort. With this careful planning, we will ensure an abundant water supply to fuel the continued growth, prosperity, and quality of life that are all so important to the region.

TRWD Continues to Pursue Oklahoma Water in Federal Lawsuit

A federal judge ruled late last year that the Tarrant Regional Water District's (TRWD) lawsuit challenging an Oklahoma moratorium on out-of-state water sales should be heard in federal court, and the 10th U.S. Circuit Court of Appeals is expected to weigh in soon on this ruling. Most recently, the Oklahoma Legislature passed a resolution asking Congress to intercede in the matter.

As of the time of publication of this newsletter, the Appeals Court's ruling had not yet been issued, and no action had been taken by Congress.

The TRWD is pursuing surplus, Gulf-bound water that would be used to meet future water supply needs in North Texas.

The TRWD has filed permit applications with Oklahoma to secure water from the Beaver, Cache, and Kiamichi Rivers just before it flows into the Red River, where it becomes less suitable for municipal water supply due to salinity and requires expensive treatment. The District hopes to obtain approximately seven percent of the water destined for the Gulf, and would not seek any water from Oklahoma reservoirs.

Oklahoma water is included as a recommended strategy in the 2006 Region C Water Plan and was anticipated at the time of the Plan's completion to supply 115,000 acre-feet of water per year to the North Texas region – although TRWD, the North Texas Municipal Water District (NTMWD), and the Upper Trinity Regional Water District (UTRWD) are seeking additional amounts of Oklahoma water currently.

The 2006 Plan also includes Oklahoma water as an alternative strategy for Dallas Water Utilities and the City of Irving.

If a successful, collaborative resolution of this dispute can be reached, North Texas residents and Oklahoma residents will both be the beneficiaries. Due to explosive population growth and unforeseen issues that may arise with implementation of other water management strategies, the North Texas region needs to plan on obtaining future water supplies from as many available sources as possible.

Oklahoma water offers a potentially significant supply of water to meet these critical needs, and this water also offers a potential benefit to Oklahoma residents through the revenues that future sales would generate.

Water Conservation Corner: Water Less While Preserving Outdoor Aesthetics

As summertime approaches and as our regional water supply becomes stressed, it is even more imperative that North Texans consider adopting water-efficient methods to keep their landscaping attractive. Conservation and reuse are a big part of the Region C Water Plan, and we all need to do our part to adopt these strategies where feasible.

Many Texas resources offer helpful information about easy-to-adopt, water-efficient landscaping practices, including the following landscaping principles that can lead to significant water savings:

- Planning and design
- Soil analysis
- Practical turf areas
- Appropriate plant selection
- Efficient irrigation
- Use of mulches
- Appropriate maintenance

For more information about the best water-efficient landscaping strategies for your home or business, see the Earth Kind website at EarthKind.tamu.edu, or visit one of the following informative sites:

- www.txsmartscape.com
- http://urbanlandscapeguide.tamu.edu/waterwise.html
- www.wateriq.org.

About the Region C Water Planning Group

Region C is made up of all or part of 16 counties in North Texas: Collin, Cooke, Dallas, Denton, Ellis, Fannin, Freestone, Grayson, Henderson, Jack, Kaufman, Navarro, Parker, Rockwall, Tarrant, and Wise.

The Region C Water Planning Group (RCWPG) is one of 16 regional water planning groups selected by the Texas Water Development Board (TWDB) to help develop and revise a comprehensive state water plan for Texas through 2060. Each water planning group is responsible for preparing and adopting a regional water plan for its area. The RCWPG is made up of 19 members representing 11 different interest groups.

Name	Title	Representing
Jim Parks	Chair	Water Districts
Jody Puckett	Vice Chair	Municipalities
Russell Laughlin	Secretary	Industry
Steve Berry	Member	Environment
Jerry Chapman	Member	Water Districts
Frank Crumb	Member	Municipalities
Jerry Johnson	Member	Electric Generating Utilities
Bill Lewis	Member	Small Business
G. K. Maenius	Member	Counties
Howard Martin	Member	Municipalities
Jim McCarter	Member	Water Utilities
Paul Phillips	Member	Municipalities
Marsh Rice	Member	Public
Bob Scott	Member	Environment
Connie Standridge	Member	Water Utilities
Jack Stevens	Member	Water Districts
Danny Vance	Member	River Authority
Mary Vogelson	Member	Public
Dr. Tom Woodward	Member	Agriculture
David Brock	Non-Voting Member	Region I
Curtis Campbell	Non-Voting Member	Region B
Terry Kelley	Non-Voting Member	Brazos G RWPG
Angela Masloff	Non-Voting Member	Texas Water Development Board
David Weidman	Non-Voting Member	Region D
E.W. Wesley	Non-Voting Member	Texas Dept. of Agriculture
Adam Whisenant	Non-Voting Member	Texas Parks & Wildlife Dept.

Study Commission on Region C Water Supply Kicks Off Efforts

The 80th Texas Legislature's SB 3 authorized the creation of a Study Commission on Region C Water Supply to review water supply alternatives for the region and to help resolve differences between the Region C and Region D (Northeast Texas) Water Planning Groups.

The commission, consisting of three representatives each from Region C and Region D, held its first meeting at The University of Texas at Dallas on February 13, 2008, and commission representatives subsequently reported on their progress at a recent hearing of the Senate Committee on Natural Resources. As of the publication of this newsletter, the Study Commission was still defining its proposed scope of work to address the tasks laid out in SB 3, and it had not yet set a date or a specific location for its next meeting.

The commission's efforts are expected to conclude with the delivery of a report to the Texas Water Development Board by December 1, 2010.

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5525 N MacArthur Blvd.
Suite 530
Irving, TX 75038

Planning Group Elects New Member and Officer

With the resignation of former Region C Water Planning Group member and Secretary Paul Zweiacker, who has been a member of the RCWPG since its inception in 1997, the planning group recently elected a new member and a new secretary.

Russell Laughlin, a member of the planning group representing industry and a senior vice president with Hillwood Properties, has been elected to serve as secretary of the RCWPG.

Jerry Johnson, generation environmental manager with Luminant Power, has been elected as a member of the RCWPG to fill Paul Zweiacker's vacant position representing electric generating utilities.

We salute these individuals, as well as all members of the RCWPG, for their commitment to the regional water planning effort and for their dedication of a significant amount of time and attention to regional water issues.

Collin
Cooke
Dallas
Denton
Ellis
Fannin
Freestone
Grayson
Henderson
Jack
Kaufman
Navarro
Parker
Rockwall
Tarrant
Wise

REGION C

Water Planning for North Texas

Fall 2008 Newsletter

Region C Water Planning Group Invites Public to Attend Public Meetings

Public attendance is welcome at all Region C Water Planning Group Meetings, and attending members of the public have an opportunity for comment on the Planning Group's activities during each meeting.

Next Meeting:

Monday, March 23, 2009, 1:00 p.m.

Meeting Location:

Trinity River Authority
Central Wastewater Treatment Plant
6500 W. Singleton Blvd.
Grand Prairie, TX 75212
(972) 263-2251

*Please Note: Persons with disabilities who plan to attend the Region C Water Planning Group meeting – and who may need auxiliary aids or services such as mobility assistance, interpreters for deaf or hearing-impaired persons, readers, large print, or Braille – are requested to contact Lee Shaffer in the TRA Central Wastewater Treatment Plant at (972) 263-2251 at least (5) work days prior to the meeting so that appropriate arrangements can be made.

For more information about the Region C Water Planning Group, contact:
James (Jim) M. Parks, RCWPG Chair
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P.O. Box 2408
Wylie, TX 75098
Phone: (972) 442-5405
E-mail: jparks@ntmwd.com

To be added to the RCWPG newsletter mailing list, send your name and mailing address to Colby Walton via e-mail to colby@cookseypr.com, or via fax to (972) 580-0852.

Visit www.regioncwater.org for the latest updates on RCWPG activities, meetings and other water planning news, or contact Tom Gooch with Freese & Nichols at tcg@freese.com.

Region C Undertakes Significant Reuse and Conservation Projects

Region C has been a state leader in developing reuse and conservation projects to use water wisely. Here's a look at some of the major Region C reuse and conservation projects that are currently underway or coming soon.

The **City of Dallas** is in the process of designing its Cedar Crest Pipeline Extension Project, which is expected to support an average supply of 1.75 million gallons of water per day (MGD), or 1,961 acre-feet per year. The project would extend an existing reuse pipeline to serve the Dallas Zoo and Rock–Tenn area in Dallas.

The **City of Fort Worth** is working on several reuse projects.

The city is on track to complete a feasibility study of a separate satellite treatment facility serving the southern area of town by the end of the year. The facility would supplement the Village Creek Wastewater Treatment Plant, which was designed to supply the central and southern parts of Fort Worth with reclaimed water. The project, with a service area that includes the Trinity River Vision Project, several golf courses, parks and an industrial area, would support an annual average demand of 2.2 MGD, or 2,466 acre-feet per year.

Fort Worth is conducting a follow-up study, slated for completion in 2009, to select a site for a satellite treatment facility in the Mary's Creek watershed. This project, which would serve new developments in western Fort Worth, would provide water for irrigation of a golf course, green space areas and residential developments using dual distribution systems, and would support an annual average demand of 3.8 MGD or 4,259 acre-feet per year.

City officials are moving forward with design and developing customer commitments for a project that would use treated effluent – or outflow – from the Village Creek Wastewater Treatment Plant for non-drinking water service. Construction on the project, which would serve customers in far eastern Fort Worth, Dallas/Fort Worth International Airport, as well as the cities of Arlington, Euless and Grand Prairie, is slated for completion by 2010. Demand stemming from natural gas well development has caused Fort Worth city officials to update their demand projections for the project, which was originally envisioned to support an average annual demand of 2.8 MGD, or 3,138 acre-feet per year.

The **City of Denton** collaborated with Robson Communities Inc. to build a 0.25 MGD water reclamation facility to serve its residential development. Robson Communities agreed to fund the construction of the city-owned facility in exchange for 25 years of effluent for irrigation. The facility is being expanded to provide a capacity of 0.8 MGD; future expansions could increase capacity to 1.6 MGD. The distribution system is currently being designed and would provide wastewater to the community's golf course and other public areas.

The **City of Frisco** completed the first phase of modifications to its reuse system, which included expanding the existing reuse pump station at Stewart Creek Wastewater Treatment Plant and installing a back pressure sustaining valve in a pipeline. The modification was part of a plan laid out in the city's 2006 Reuse Water Master Plan. Two additional phases will follow. In the future, the Panther Creek Wastewater Treatment Plant will become the primary source of reuse water and will have an average daily capacity of up to 20 MGD, or 22,418 acre-feet per year.

The **Tarrant Regional Water District's** (TRWD) George W. Shannon Wetlands Water Recycling Facility, which is adjacent to the Richland-Chambers Reservoir, will soon begin a 200-acre expansion that will add 15,750 acre-feet per year of water supply. The project, which will be completed in 2010, will enable the wetlands to transition from being used for research to providing an estimated 63,000 acre-feet of water supply each year.

The project uses constructed wetlands to treat Trinity River water prior to its introduction into the Richland-Chambers and Cedar Creek reservoirs.

The district's Cedar Creek Reservoir Wetland Project, which will produce 52,500 acre-feet per year of water, is currently under design.

The TRWD's conservation program enabled the district to experience only a 0.59 percent increase in water consumption during two similarly wet years – 2004 and 2007 – while population grew 5.9 percent over the period. This year, the district created a new conservation committee to share ideas and discuss strategies. The TRWD partnered with NTMWD and Dallas Water Utilities (DWU) for a regional conservation symposium focusing on best practices for programs including toilet replacement programs, irrigation audits and water conservation pricing.

The **North Texas Municipal Water District (NTMWD)** recently approved $1 million in funding for the fiscal year that began October 1 to continue its Water IQ program, which encourages consumers to consider how their lifestyle may impact water consumption and communicate the role conservation may play in ensuring water supplies for the future. The district estimates the program has helped conserve about 200 MGD during peak summer months, or 10 to 12 percent of annual water savings between June 2006 and June 2007. The program has been in place since 2006.

Under the **DWU's** 5-year water conservation plan, the goal is to reduce per capita use by 1 percent each year by reducing seasonal peak demand, reducing water loss and waste, and decreasing water use by individual users on a daily basis. As of 2007, the program had reduced consumption by an average of 2.8 percent annually.

The **Trinity River Authority's (TRA)** public campaign promoting water conservation continues to pay off. The authority planned to expand its 87 MGD water treatment plant serving Bedford, Colleyville, Euless, Grapevine, and North Richland Hills this year. However, as a result of the conservation campaign that started in late 2006 encouraging residents to refrain from watering between 10 a.m. and 6 p.m., the peak demand for water declined enough to allow TRA to delay the expansion project. TRA's latest forecasts now call for expansion in 2014 or 2015.

Update on State Water Plan Funding Project Prioritization

The Water Infrastructure Fund (WIF) provides low-interest loans for the planning, design and construction of State Water Plan projects. The fund was created by the 80th Texas Legislature in 2007 and is authorized to issue up to $440 million in projects through the current biennium. Qualified projects must be recommended water management strategies in the most recent Texas Water Development Board (TWDB)-approved Regional Water Plan or in the State Water Plan.

Projects were recently prioritized for WIF monies by the TWDB based on a series of factors, including whether the project would create a new, usable supply of water, how urgently the project was needed and whether the project would achieve significant water conservation savings.

Region C projects in the running to receive WIF monies during this year's second round of applications include:

- City of Dallas (East Side water treatment plant expansion)
  WIF funds requested: $94,720,000
- North Texas Municipal Water District (Tawakoni-Terrell/Lawrence pipeline)
  WIF funds requested: $26,155,000
- North Texas Municipal Water District (Lower Bois d'Arc permitting and mitigation)
  WIF funds requested $23,350,000
- North Texas Municipal Water District (Pipeline from Wylie water treatment plant)
  WIF funds requested: $17,825,000
- Greater Texoma Utility Authority (Northwest Grayson Co. WCID 1 storage, pump station and transmission)
  WIF funds requested: $10,005,000
- City of Corsicana (Lake Halbert Water Treatment Plant)
  WIF funds requested: $2,000,000

The TWDB is scheduled to take action on funding for the projects later this year.

North Texas Water Providers Agree to Jointly Pursue Oklahoma Water

The Tarrant Regional Water District (TRWD), the City of Dallas and the North Texas Municipal Water District have agreed to work together to negotiate a deal to pump water from Oklahoma.

The proposal to pump water from the Kiamichi River, Cache Creek and Beaver Creek basins would help the North Central Texas region better weather drought conditions as its population grows over the coming decades. The groundbreaking agreement would mean the three water providers would share water brought from Oklahoma.

The TRWD will take the lead role in the negotiations with Oklahoma, which implemented a moratorium on out-of-state water sales in 2001. TRWD has challenged the state's moratorium with a lawsuit, and the case is now pending before a federal court in Oklahoma. In October, the 10th Circuit U.S. Court of Appeals in Denver ruled that the TRWD's suit could proceed in the lower court.

In August 2008, the City of Irving signed an agreement to purchase water from Hugo Lake in Oklahoma. As part of the agreement, Irving is assisting Hugo officials with a pending legal challenge against Oklahoma's moratorium.

The Upper Trinity Regional Water District (UTRWD) previously filed two separate water rights applications for 115,000 acre-feet of water each from the Kiamichi River and Muddy Boggy Creek Basins. These applications are still pending technical review by the Oklahoma Water Resources Board. The UTRWD is not part of the pending lawsuits.

New Water Supply Projects Coming Online

Here are some of the major new water supply projects that have recently come online or are about to be completed in Region C.

The **Upper Trinity Regional Water District's** Tom Harpool Water Treatment Plant was activated in December 2007 with "membrane filtration" technology that uses high-grade plastic material with microscopic pores to purify water of pollutants and other health risks such as Giardia and Cryptosporidium. Tom Harpool WTP has an initial treatment capacity of 20 million gallons per day and will serve customers in the areas north and east of Lewisville Lake. The site's master plan will allow the treatment capacity to expand to 240 MGD of treatment capacity.

The **North Texas Municipal Water District's** $246 million East Fork Raw Water Supply Project will naturally filter raw water from the Trinity River near Crandall to be sent 40 miles to the north end of Lavon Lake. Construction on the 1,840-acre man-made wetland is undergoing testing and will be online later this year. The conservation and reuse project, which is among the largest man-made wetlands in the nation, helps the district in its effort to produce the equivalent of a Lavon Lake, or 100,000 acre-feet per year. The district's Upper Sabine Basin River Water Supply Project, which is expected to augment raw water supplies by 50,000 acre-feet per year, went online in July 2008.

The **City of Dallas'** Lake Fork Pipeline and Pump Station Project is scheduled to come online by the end of 2008. The project will pump water 29 miles from Lake Fork and connect to the discharge pipe at the Iron Bridge pump station at Lake Tawakoni. The $200 million project, which began in 1997, will allow the pump station to supply 107 MGD, or 117,165 acre-feet of water per year. At its maximum capacity, the station would be able to supply as much as 240 MGD or 262,800 acre-feet per year.

The **Tarrant Regional Water District's** (TRWD) Eagle Mountain Pipeline Connection was completed in March of 2008 and began testing in May. It will be available to pump water if necessary during Winter and Spring 2009. The pipeline will allow TRWD to pump water from its two East Texas reservoirs, Richland-Chambers and Cedar Creek, so that Eagle Mountain Lake is as close to conservation level as possible by June 1 in order to meet high summer demands. By using imported water from East Texas, the city hopes to meet increased water demands in rapidly growing northwest Tarrant County without exclusively using water from the watershed of the West Fork of the Trinity River.

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Conservation Corner

The Region C Water Planning Group has recently undertaken a special study on Best Management Practices for water conservation.

The Planning Group's consultants surveyed water user groups in Region C and asked them to report what water conservation measures they have implemented, how much those programs cost and what savings they experienced. The team's findings are available for review in a series of memoranda on the RCWPG Web site (www.regioncwater.org) and have been compiled into a draft report.

The consultants found that there wasn't sufficient hard data to precisely evaluate the water conservation programs. While the cost of low-flow toilets or shower heads may be easy to quantify, other costs, such as staff time spent on a project, are harder to itemize.

Another challenge was accounting for one of the most significant factors in water use – the weather. A public education program may be making strides, but hotter weather from one year to the next could still translate into higher consumption levels.

Additionally, while a water user group may be experiencing overall water use savings, it's difficult to determine how effective each program is when several programs may be in place at the same time.

While the Planning Group has not made any official recommendations regarding documentation of conservation savings and reporting of results in a consistent manner, it's definitely something we are considering for the future.

Collin
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Denton
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Henderson
Jack
Kaufman
Navarro
Parker
Rockwall
Tarrant
Wise

REGION C

Water Planning for North Texas

Spring 2009 Newsletter

Region C Water Planning Group Invites Public to Attend Public Meetings

Public attendance is welcome at all Region C Water Planning Group meetings, and attending members of the public have an opportunity for comment on the Planning Group's activities during each meeting.

Next Meeting:

Monday, June 8, 2009, 1:00 p.m.

Meeting Location:

Trinity River Authority
Central Wastewater Treatment Plant
6500 W. Singleton Blvd.
Grand Prairie, TX 75212
(972) 263-2251

*Please Note: Persons with disabilities who plan to attend the Region C Water Planning Group meeting – and who may need auxiliary aids or services such as mobility assistance, interpreters for deaf or hearing-impaired persons, readers, large print, or Braille – are requested to contact Lee Shaffer in the TRA Central Wastewater Treatment Plant at (972) 263-2251 at least (5) work days prior to the meeting so that appropriate arrangements can be made.

For more information about the Region C Water Planning Group, contact:
James (Jim) M. Parks, RCWPG Chair
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P.O. Box 2408
Wylie, TX 75098
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E-mail: jparks@ntmwd.com

To be added to the RCWPG newsletter mailing list, send your name and mailing address to Colby Walton via e-mail to colby@cookseypr.com, or via fax to (972) 580-0852.

Visit www.regioncwater.org for the latest updates on RCWPG activities, meetings and other water planning news, or contact Amy Kaarlela with Freese & Nichols at adk@freese.com.

Planning Group Concludes 2007-2008 Special Studies

As part of a statewide effort to examine emerging water supply issues, the Region C Water Planning Group (RCWPG) recently concluded two years of special studies that will be critical in helping the group develop an updated Regional Water Plan by 2011.

The studies looked at issues of particular importance to North Central Texas, including water conservation and reuse practices, the availability of water from the Toledo Bend Reservoir in East Texas, direct and indirect water reuse case studies and potential water management strategies to address rapid population growth and other changing conditions in localized areas of the region.

Short summaries of each RCWPG special study are provided below, and the full draft reports from the studies may be read in their entirety at www.regioncwater.org.

Water Conservation and Reuse Study

The Water Conservation and Reuse Study examined an issue of considerable consequence for Region C. Conservation and reuse are major recommended strategies in the existing 2006 Region C Water Plan, representing 1.3 million acre-feet per year of the water supply available to the region by 2060.

Encouragingly, the study found that the water user groups and water providers in Region C are on-target or ahead of schedule for implementing the 2006 plan's recommended conservation strategies, and that many conservation measures have been implemented in the region.

The conservation initiatives currently showing increasing adoption rates by water providers include public and school education programs, water waste prohibitions and residential audits. Region C water providers are also committing significant dollars to water conservation programs, and some entities are considering joining together to promote conservation programs and share implementation costs.

Implementation of rebate programs and programs targeting industrial, commercial and institutional water users has been slower, perhaps due to institutional challenges with administering these programs.

Water reuse also continues to be a significant component of the region's conservation efforts. Since adoption of the 2006 plan, one planned reuse project has been implemented, and seven new reuse projects have been identified for development. Taking into account all current and planned projects, Region C has by far the largest reuse program in Texas. Although water providers continue to express their commitment to reuse projects, the study found that implementation issues continue to be a concern.

Ultimately, the study's conservation and reuse-related recommendations for the 2011 Region C Water Plan are fivefold:

1. Consider other strategies currently being used in the region for possible inclusion in the expanded conservation package;
2. Encourage regional coordination of public education efforts;
3. Develop, in cooperation with the Texas Water Development Board (TWDB) and Texas Commission on Environmental Quality (TCEQ), a program to gather more data and information about water savings and costs associated with conservation strategies, and perform a quantitative assessment of water savings and costs per strategy;
4. Monitor water conservation technology developments and review new strategies for possible inclusion in plan updates; and
5. Monitor findings and recommendations of the statewide Water Conservation Advisory Council for possible inclusion in plan updates.

Region I's Toledo Bend Study

This study was led by the Region I Water Planning Group. The Region C consultant team reviewed the study, titled ***East Texas Region Special Study No. 1: Inter-Regional Coordination on the Toledo Bend Project,*** and provided input. Due to projected water demands in Region C, the 2007 State Water Plan recommended moving water from the Toledo Bend Reservoir in East Texas to water providers in North Texas via a pipeline project. Region I conducted this study to better understand the developments that have occurred since 2007.

The Toledo Bend Pipeline Project is considered viable, but it is not expected to be developed until 2060. Due to this extended timeframe, additional analysis will likely be needed, which may have significant implications on the project's preliminary design and cost. The study indicates that the major participants are currently pursuing other water supply projects and recommends that the East Texas region should continue to monitor the demand for water from sources in its region and coordinate with adjoining regions to best utilize its resources.

Direct and Indirect Reuse Study

This study examined direct and indirect reuse in Region C, in order to develop guidance documents for future reuse projects. The reuse of treated water effluent, also known as reclaimed or recycled water, is increasingly important statewide and in Region C. The 2006 Region C Water Plan projects that water reuse will address over 26 percent of regional water demand by the year 2060.

Direct reuse occurs when treated wastewater is delivered from a wastewater treatment plan to an end user, with no intervening discharge to waters of the state. Direct reuse requires a notification to the Texas Commission on Environmental Quality (TCEQ), which is routinely accepted so long as requirements to protect public health are met. Direct reuse is most commonly used to supply water for landscape irrigation (especially golf courses) and industrial uses (especially cooling for steam electric power plants).

The **Direct, Non-Potable Reuse Guidance Document** developed as part of the study is designed to provide guidance for implementation of future direct water reuse projects, including the identification of technical and regulatory issues that must be addressed in the planning and design of such projects.

As a case study for the guidance document, the RCWPG refined the implementation plans for two City of Fort Worth direct reuse projects: a Central System to serve potential customers between the Village Creek Wastewater Treatment Plant and the Central Business District, and a Southern System to serve potential customers in the industrial area near the intersection of I-20 and I-35W.

The Region C guidance document recommends that the City pursue further discussions with potential customers to finalize their commitment to reclaimed water use, and recommends phased construction of both projects over the next decade.

The RCWPG also developed an **Indirect Reuse Guidance Document,** which provides general guidance and a case study implementation plan for the Athens Municipal Water Authority and City of Athens to transport reclaimed water from the Athens wastewater treatment plants to Lake Athens to augment its raw water supply.

Indirect reuse occurs when treated wastewater is discharged to a stream or reservoir and is then diverted for reuse. The discharged water mixes with ambient water in the stream or reservoir as it travels to the point of diversion. Indirect reuse can provide water supplies for municipal use, as well as irrigation and industrial supplies.

The state does not have specific regulations for indirect use, since planned augmentation of raw water supplies with reclaimed water is relatively new in Texas. Rather, indirect reuse is regulated by other state permits and standards.

The document's recommendations for indirect reuse in Texas include a multi-barrier approach to manage the uncertainties associated with augmentation of raw water supplies with reclaimed water.

Studies Pertaining to Localized Areas

The remaining special studies conducted by the RCWPG during the 2007-2008 period looked at changing conditions in localized areas.

The first of these, the **Draft Water Supply Study for Ellis, Johnson, southern Dallas and southern Tarrant counties,** was commissioned to review recent population growth in the four-county area, make adjustments to projects as a result of the growth and update the current and future water plans of the water user groups and wholesale water providers in the study area based on revised projections.

This study was needed because the TWDB-approved population projections for Ellis and Johnson Counties that were used by the RCWPG in developing the 2006 Region C Water Plan did not take into account subsequent population projections developed by the North Central Texas Council of Governments (NCTCOG), which were significantly higher than those of the TWDB. More recent population estimates have shown that growth in the area falls between the two sets of projections.

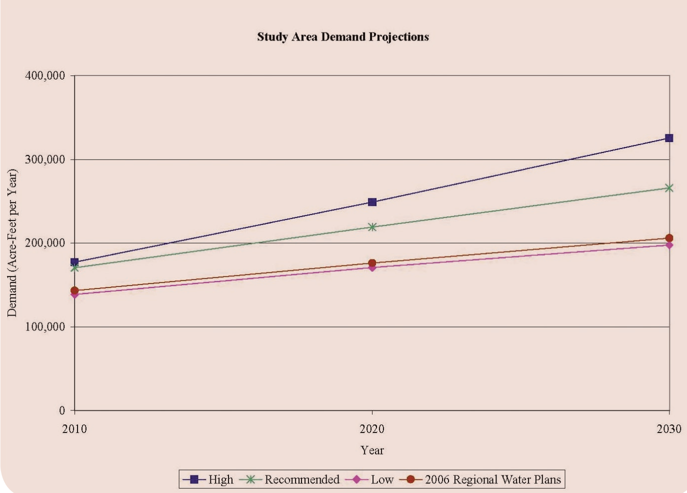
The study provided the opportunity to revise water management strategies to reflect new demand projections and current planning by area water suppliers.

The study concluded that significant changes in water supply should be expected in the coming decade, including:

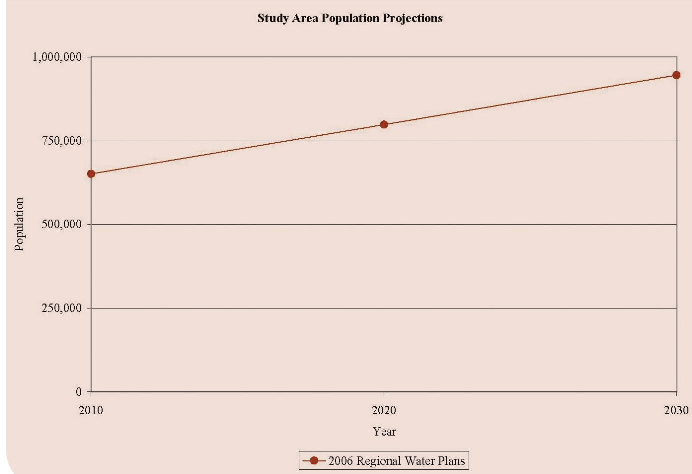
- Increased reliance on surface water supplies, instead of groundwater.
- Substantial additional supplies from the Sokoll water treatment plant currently under construction in Ellis County.
- Additional supplies from Midlothian's proposed water treatment plant.
- More treated water supplies from the Tarrant Regional Water District's (TRWD) primary customers.
- Cleburne's development of additional reuse supplies for manufacturing and mining use and development of a desalination plant for Lake Whitney water.
- Increased supply from Dallas with the growth of current customers and the completion of the Red Oak connection.

The study also recommended a variety of additional water management strategies to ensure an adequate future supply in the rapidly growing area.

Four-County Study — Total Study Area Demand

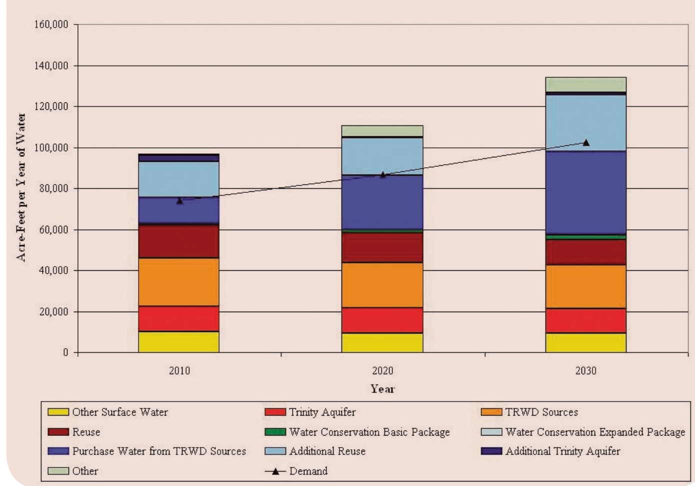


Four-County Study — Total Study Area Population

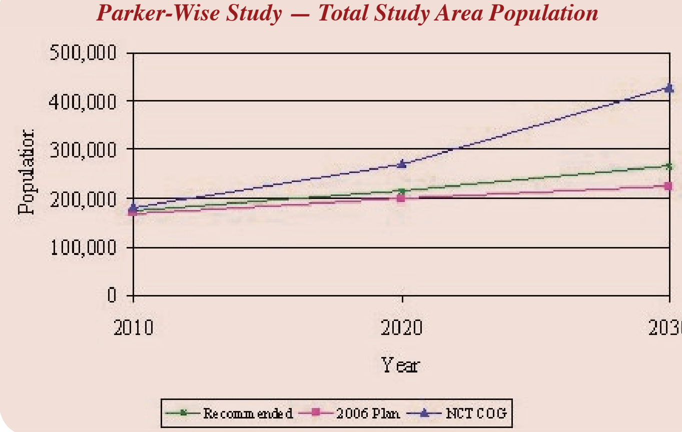


Another localized study, the **Water Supply Study for Parker and Wise counties,** focused on the years 2010 through 2030, detailing revisions and updates to the Region C Water Plan that will be needed to account for steadily increasing population growth projections. The resulting report concluded that, for most water user groups in the area, increasing the amount of supply from TRWD sources was the only change necessary to meet higher projected demands.

Parker-Wise Study — Study Area Supply Sources



Parker-Wise Study — Total Study Area Population



In addition to the localized studies, the RCWPG conducted meetings in six additional counties — Cooke, Fannin, Freestone, Grayson, Kaufman and Navarro — to identify changed conditions with the potential to impact the 2011 Region C

Water Plan. The RCWPG will take all of the input provided at these meetings into consideration while developing the 2011 plan over the coming year.

Planning Group Monitors Drought, Legislative Proposals

The Region C Water Planning Group (RCWPG) is closely watching two issues with significant implications for the North Central Texas water supply, both for the near term and over the long term.

Texas is currently experiencing a drought, with regional conditions ranging from abnormally dry to exceptional (the most severe level), and unless rainfall conditions improve, many reservoirs and groundwater supplies will be well below optimal levels over the coming spring and summer months. Consequently, water suppliers and municipalities in the region may have to implement watering restrictions and other conservation measures.

The RCWPG strongly urges residents and businesses to be wise users of our scarce water resources, to help the region proactively address supply shortages.

The drought also illustrates the critical importance of long-term regional water planning, and North Central Texas' future growth projections further underscore the urgency of proactive planning to identify the best water management strategies for our region.

Additionally, the RCWPG is following a number of proposals currently under consideration by the Texas Legislature. Most critically, the Legislature needs to identify funding sources for water management strategies included in the State Water Plan, to ensure an ample long-term supply of water for North Central Texas and the entire state.

Many of the recommended strategies in the plan require significant time for planning, development and implementation — including effective conservation and reuse programs, as well as the construction of new reservoirs — so the time is now to dedicate the appropriate resources to these strategies. The RCWPG salutes Gov. Perry and Sen. Averitt for their leadership in identifying financing streams for the water plan.

The RCWPG will also closely monitor the Legislature's actions over the coming months with respect to groundwater conservation, eminent domain, environmental protection and other relevant issues affecting water supplies in our region.

Conservation Corner: Adopt Small Steps for Significant Savings

It's springtime once again, and the warmer weather has arrived. Since Texas is already experiencing a drought that is also affecting our region, it is imperative that North Texans take proactive measures to help conserve our most precious resource. If we join together in adopting a few, simple tips now, we can – and will – make a significant impact on our water supply.

Consider the following hints from the Texas Water Development Board when developing your conservation program:

- Plant drought tolerant grass and native plants
- Only water early in the morning or late in the evening
- Conserve soil moisture by using 1 to 3 inches of mulch
- Mulch or compost grass clippings
- Check automatic sprinkler heads and remove dirt and debris
- Sweep debris off of sidewalks and driveways instead of using water for removal
- Cover pools and spas to reduce evaporation

For additional conservation tips and more information, visit:

- http://www.twdb.state.tx.us/assistance/conservation/education.asp
- http://www.waterwisetexas.org/

About the Regional Water Planning Group

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Kaufman
Navarro
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Rockwall
Tarrant
Wise

REGION C

Water Planning for North Texas

Summer 2009 Newsletter

Region C Water Planning Group Invites Public to Attend Public Meetings

Public attendance is welcome at all Region C Water Planning Group meetings, and attending members of the public have an opportunity for comment on the Planning Group's activities during each meeting.

Next Meeting:

Monday, September 28, 2009, 1:00 p.m.

Meeting Location:

Trinity River Authority
Central Wastewater Treatment Plant
6500 W. Singleton Blvd.
Grand Prairie, TX 75212
(972) 263-2251

*Please Note: Persons with disabilities who plan to attend the Region C Water Planning Group meeting – and who may need auxiliary aids or services such as mobility assistance, interpreters for deaf or hearing-impaired persons, readers, large print, or Braille – are requested to contact Lee Shaffer in the TRA Central Wastewater Treatment Plant at (972) 263-2251 at least (5) work days prior to the meeting so that appropriate arrangements can be made.

For more information about the Region C Water Planning Group, contact:

James (Jim) M. Parks, RCWPG Chair
North Texas Municipal Water District
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Wylie, TX 75098
Phone: (972) 442-5405
E-mail: jparks@ntmwd.com

To be added to the RCWPG newsletter mailing list, send your name and mailing address to Colby Walton via e-mail to colby@cookseypr.com, or via fax to (972) 580-0852.

Visit www.regioncwater.org for the latest updates on RCWPG activities, meetings and other water planning news, or contact Amy Kaarlela with Freese & Nichols at adk@freese.com.

Water Plan Revisions Underway; Public Participation Encouraged

Water is a critical resource, to preserve Texans' way of life, to enable continued prosperity and to protect the region's ecology and wildlife. Without additional water supply, the region's 2060 employment could be reduced by nearly 700,000 jobs, and the region's income could be reduced by $58.8 billion.

The state's propensity to experience serious, prolonged droughts has taught us that being unprepared is simply not an option. That is why thoughtful, statewide planning for a long-term water supply is so important, and why it is equally important for the public to monitor and participate in the water planning process.

This article provides background information on regional water planning in Texas, notes milestone dates for the development of the 2011 Region C Water Plan and outlines opportunities for the public to stay aware and become involved throughout the planning process.

Public awareness and public participation are key elements of regional water planning throughout Texas, and this is particularly true in North Central Texas, where planners seek to take into consideration the needs of a rapidly growing population, tremendous business growth and a long-term desire to allocate scarce natural resources as intelligently as possible.

The Region C Water Planning Group (RCWPG) strongly encourages the public to closely follow the regional water issues and to weigh in on the long-term Water Management Strategies currently under consideration for our region.

Regional Water Planning in Texas

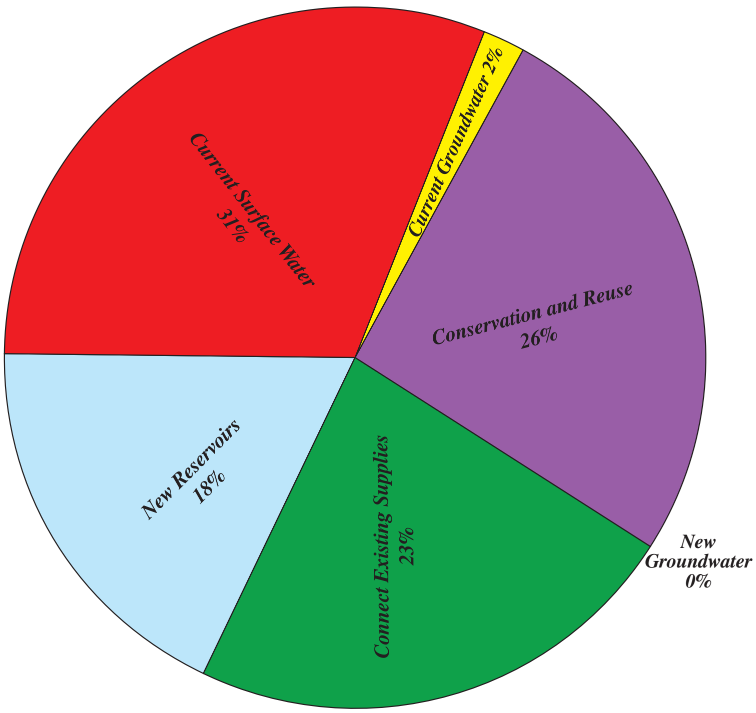
In 1997, the Texas Legislature enacted Senate Bill 1 (SB 1), comprehensive water legislation that called for the development of a State Water Plan in response to increased awareness of limited water supplies in Texas. The Water Plan seeks to provide water for the next five decades.

SB 1 created 16 Regional Water Planning Groups (RWPGs) around the state to prepare Regional Water Plans in 2001, which were then incorporated into a comprehensive State Water Plan in 2002. The bill also stipulated that RWPGs should update their plans every five years in response to changing climate, environmental, socioeconomic and demographic conditions. The 2001 Region C Water Plan was updated in 2006, during the second phase of regional water planning, and that plan will be updated again in this third phase of planning.

The *2006 Region C Water Plan* called for the development of a wide variety of Water Management Strategies over the next 50 years, including the implementation of significant water conservation and reuse strategies.

Under the existing plan, Region C's 2060 water demand would be met as follows:

- **Approximately *one-third* would come from currently available, connected supplies (both surface water and groundwater)**
- **Slightly more than *one-quarter* would come from new water conservation and water reuse projects**
- **Slightly less than *one-quarter* would come from the connection of existing water sources**
- **Slightly less than *one-fifth* would come from new reservoirs**
- ***Additional supply* would be accounted for through the development of regional systems, system operation of reservoirs and use of groundwater.**



Sources of Water Available to Region C as of 2060

The full *2006 Region C Water Plan* may be accessed at www.regioncwater.org.

Today, the RCWPG is in the midst of its third five-year cycle of regional water planning. Over the last two years, the RCWPG conducted special studies that examined issues of particular importance to North Central Texas, including water conservation and reuse practices, the availability of water from the Toledo Bend Reservoir in East Texas, direct and indirect water reuse case studies and potential water management strategies to address rapid population growth and other changing conditions in localized areas of the region.

For the remaining portion of this planning cycle, the RCWPG will take the results of those special studies and, in conjunction with a review of updated population and demand projections, develop an updated Region C Water Plan for submission to the Texas Water Development Board next year.

Water Planning Schedule of Activities

The current schedule for development of the updated 2011 Region C Water Plan is as follows:

- **Today:** Plan development is underway
- **September 28, 2009:** Public meeting of the RCWPG
- **November 9, 2009:** Public meeting of the RCWPG
- **January 2010 (date TBD):** Public meeting of the RCWPG
- **March 2010 (date TBD):** Public meeting of the RCWPG
- **April 1, 2010:** Initially Prepared Plan (IPP) due to the Texas Water Development Board (TWDB)
- **Summer 2010 (dates TBD):** RCWPG to hold public hearings on IPP
- **August 1, 2010:** TWDB comments on IPP due to RCWPG
- **September 2010:** Public meeting of the RCWPG to adopt Region C Water Plan
- **October 1, 2010:** RCWPG to submit final Region C Water Plan to the TWDB
- **December 31, 2010:** TWDB to complete review of all Regional Plans and prepare summary for Texas Legislature
- **January 5, 2012:** State Water Plan published by TWDB

Public Awareness and Participation

All public meetings of the RCWPG provide an opportunity for observation and public comment on the activities of the Planning Group. Members of the public are invited to speak about proposed action items during the course of the meeting, as well as to offer general comments at the conclusion of each RCWPG meeting.

The public can get an advance look at the agenda for each RCWPG meeting on the Region C Water Planning website, www.regioncwater.org. Agendas are posted one week prior to each meeting. Media advisories announcing each public meeting are also distributed to publications throughout North Central Texas at least one week in advance of each meeting. The *2006 Region C Water Plan* and a variety of other water planning documents may also be viewed on the Region C website.

Beyond the opportunity to provide input during regular, public meetings of the RCWPG, the public will also have access to the draft version of the updated Region C Water Plan, known technically as the Initially Prepared Plan (or IPP), once it is submitted to the Texas Water Development Board on April 1, 2010. Once the IPP is prepared for public review, a notice will be published in publications of record throughout the region, and copies of the IPP will be made available in at least one major, public library in each of the 16 North Central

Texas counties that make up Region C. The IPP will also be published on the Region C website, www.regioncwater.org, at this time.

Subsequent to the publication of the IPP for review, the RCWPG will hold one or more public hearings to accept public comments on the draft plan update. After this hearing or hearings, the Planning Group will review all public comments, take them into account in modifying the draft plan, and submit an updated version of the plan to the Texas Water Development Board.

Once the TWDB provides its feedback on Region C's IPP, the Planning Group will consider changes to the draft plan and, after appropriate modifications, approve a final version of the Region C Water Plan for submission to the TWDB by October 1, 2010. Any such action will be taken at a public meeting of the RCWPG, and again, public comments at the meeting are encouraged.

The public can stay informed about these and other Region C Water Planning activities by visiting the Region C website (noted above), signing up to receive the RCWPG newsletter and watching for stories and notices in regional media. To sign up for the Region C Water Planning newsletter, which will be published semi-annually over the remainder of this planning cycle, please send your name and mailing address to colby@cookseypr.com, or you may fax your contact information to 972-580-0852.

The RCWPG also encourages members of the public to learn about Texas water supply and conservation issues at the following websites:

- **Region C Water Planning:** www.regioncwater.org
- **Dallas Water Utilities:** www.dallascityhall.com/dwu/water_utilities.html
- **North Texas Municipal Water District:** www.ntmwd.com
- **Texas Water Development Board:** www.twdb.state.tx.us
- **Texas Commission on Environmental Quality:** www.tceq.state.tx.us/nav/main/water_main.html
- **Texas Parks & Wildlife:** www.tpwd.state.tx.us/landwater/
- **Tarrant Regional Water District:** www.trwd.com
- **Water IQ (conservation public awareness program):** www.wateriq.org

Region C Participates in Texas Water Conservation Day

Thursday, May 21, 2009 marked a significant day for promotion of water conservation throughout the state. Both the Texas House and Senate passed resolutions declaring the date as "Water Conservation Day," and several major water suppliers from North Central Texas participated in activities in Austin to heighten awareness of local conservation efforts and the need for continued Legislative support.

This event, which was hosted by the Texas Water Foundation, served as a significant step towards gaining the Texas Legislature's attention in supporting water conservation efforts and providing long-term funding for all of the recommended water management strategies in the State Water Plan.

Texas regions represented at the event included those with the most active water conservation awareness campaigns, such as the ones underway in Region C. Participating Region C entities included Dallas Water Utilities (DWU), the North Texas Municipal Water District (NTMWD), the Tarrant Regional Water District (TRWD) and the City of Frisco.

Event displays featured water conservation efforts across the state, as well as interactive exhibitions, including one that showcased the Water IQ program, in which the NTMWD is an active participant. This statewide public awareness program, created by the Texas Water Development Board, aims to educate Texans about effective water conservation and the importance of conserving water, both in times of drought and when the reservoirs are full.

WATER IQ℠
Know your water.

The NTMWD estimates that, since its implementation of Water IQ in 2006, the district has achieved a reduction in water deliveries of 200 million gallons per day during the peak summer months, and an annualized reduction in water deliveries between 10-12 percent.

At the May 21st event, Dallas Water Utilities and the Tarrant Regional Water District also highlighted their joint water conservation and education campaign, titled "Save Water, Nothing Can Replace It." DWU's Carole Davis and TRWD's Linda Christie pointed out to attendees that this collaboration demonstrates how major water suppliers in a region can work together to reach a common objective, and ultimately to help reduce per capita municipal water use across a region.

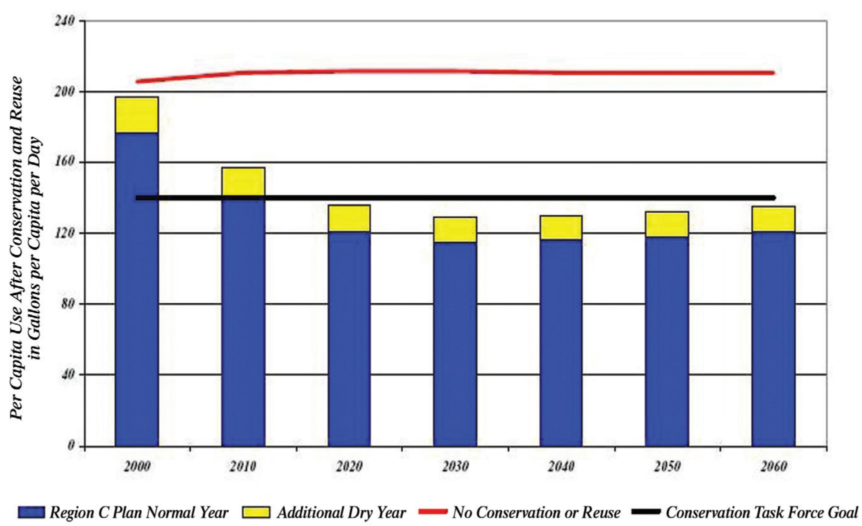
Since 2002, DWU estimates that its conservation efforts have saved 71 billion gallons of water. The TRWD estimates that the year-round daytime outdoor watering restrictions adopted by its customers are reducing water demand by about 10 billion gallons annually.

Although this was the first Water Conservation Day, it proved to be a resounding success. A number of Texas lawmakers or their legislative staff members attended the day's activities, learning more about key water conservation initiatives and ongoing needs.

SAVE WATER.
Nothing can replace it.

As the Region C Water Planning Group works on updating the 16-county region's long-term water plan, the group intends to continue its focus on enhanced water conservation education and awareness. This includes encouraging elected officials to support and fully fund water conservation programs that produce desired results.

Although a wide variety of water management strategies will be necessary to meet the needs of a rapidly growing Region C, water conservation initiatives are one of the most essential, to ensure that scarce resources are being used as wisely as possible.



Projected per Capita Municipal Use in Region C with Full Implementation of Planned Conservation & Reuse

Conservation Corner: Planning Group Identifies Best Practices for Water Providers

With the temperature continuing to rise and the hot weather already well upon us, identifying effective conservation strategies continues to be a focus of the Region C Water Planning Group. Over the last two years, the Planning Group was able to identify a range of conservation best management practices through a survey of water providers in the region. The survey sought to determine the effectiveness of the conservation and reuse strategies that have been implemented, or are being considered for future implementation, by various water providers. Read on to learn how these practices are measuring up.

The most commonly implemented best management practices reported by wholesale water providers and water user groups include public and school education, low-flow plumbing fixtures, price increases, water system audits and leak detection and repair programs. Additionally, the reuse of water to augment existing supplies continues to gain popularity and is becoming more widely implemented.

Documenting the amount of water saved and the costs associated with some of the practices currently underway proved to be a challenge. For instance, it is clear that leak detection and repair programs save water, and increasing water prices may reduce use, but it is difficult to quantify or measure those savings. Even if overall water savings can be quantified, it is difficult to know how to attribute the saving to each of the conservation measure that is practiced.

Encouragingly, the majority of survey respondents who implemented some of the best management practices indicated that they have seen a reduction in per capita water usage, and they plan to continue with the implemented practices. The survey concluded that water conservation best management practices are valuable as part of a broader conservation strategy, as water conservation and reuse are projected to provide 17 percent of year 2010 municipal water demand in Region C — and will grow to provide over 25 percent of Region C's 2060 water supply.

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www.regioncwater.org

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REGION C
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Fall 2009 Newsletter

Region C Water Planning Group Invites Public to Attend Public Meetings

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Next Meeting:

Monday, January 11, 2010, 1:00 p.m.

Meeting Location:

Trinity River Authority
Central Wastewater Treatment Plant
6500 W. Singleton Blvd.
Grand Prairie, TX 75212
(972) 263-2251

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Phone: (972) 442-5405
E-mail: jparks@ntmwd.com

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Residential Water Use Comparison Yields Favorable Results

Cities and water users in Region C have received criticism in recent years for purportedly being "water hogs," with critics pointing to Gallons Per Capita Per Day (GPCD) municipal water use figures as evidence of this charge. The mostly frequently cited statistic notes that the City of Dallas averages over 200 GPCD annually for municipal water use.

In comparison, various media outlets and critics have observed that the City of San Antonio reports an average of 150 GPCD annually for its municipal water use, with the obvious conclusion being that the City of San Antonio and its residents are more wisely using scarce water resources.

But is such a comparison fair or statistically valid?

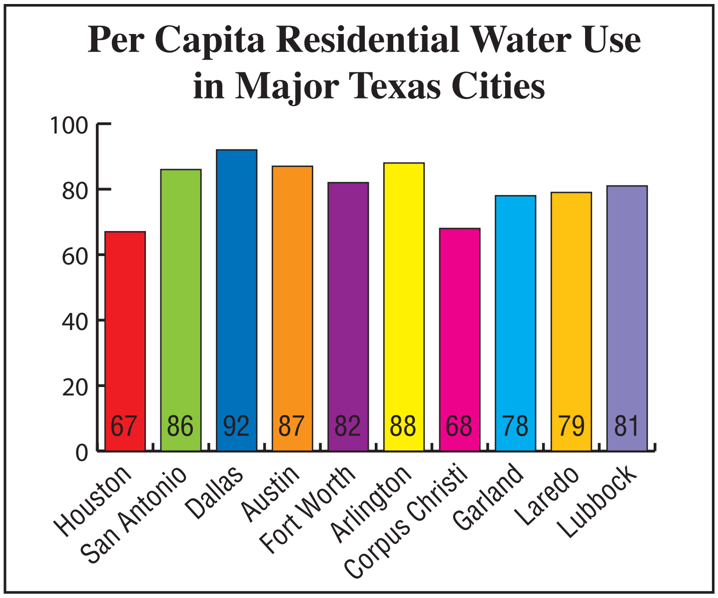
In fact, there are numerous difficulties with making city-to-city or region-to-region comparisons using municipal GPCD figures.

First, as the Texas Water Conservation Advisory Council noted in its Dec. 2008 report to the Legislature, there is no standard methodology used by water suppliers for calculating GPCD. On top of the difference in calculation methods, water data reporting methods vary widely, and in some cases, municipal boundaries may not match up with water supplier boundaries – making per capita calculations imperfect, at best. It is therefore improper to use municipal GPCD figures for rigid comparisons of personal water use.

Second, municipal water use is a broad water use category, and it encompasses both residential and commercial water use. Commercial water use can be an intensive use of water. Thus, for cities with relatively high levels of commercial activity, GPCD municipal water use figures will skew more highly than in cities with lower levels of commercial activity – even though residential customers may be using comparable amounts of water.

A better, though still imperfect, comparison would be between purely residential per capita water use figures in cities or regions. Even a residential comparison can be problematic, however, as different cities account for multi-family residential usage, and other types of residential water usage, in different ways.

These shortcomings notwithstanding, how do Region C cities fare when compared to other cities statewide, looking only at residential GPCD water use calculations?



**Source: Texas Water Development Board – 2007 Water Use Survey Summary Estimates*
***Note: The residential GPCD figure for El Paso was not included in the summary estimates developed by the TWDB because of reporting variations. The residential GPCD figure for Fort Worth, which was not available from the TWDB, was provided by the City of Fort Worth. The Fort Worth number reflects Fiscal Year 2007 (October 1, 2006 – September 30, 2007), and the TWDB numbers reflect Calendar Year 2007.*

As it turns out, Dallas and other major cities in Region C turn out to be remarkably similar to their counterparts in other Texas cities, when only residential GPCD figures are considered.

This stands to reason, as there is no cause to think that residents of North Texas use water differently from how residents of other Texas regions use water. In fact, with North Texas water providers engaged in major water conservation education programs, and with future water supplies expected to be strained by a rapidly growing population, North Texas water users are becoming increasingly sensitive to resource preservation.

Variations in residential water use should also be assessed in light of Texas cities' different climates. For example, Houston and Corpus Christi report lower residential water usage GPCD figures, but this should not be surprising, given those cities' significantly higher average rainfall totals.

None of this suggests that Region C should place less emphasis on water conservation and reuse, and in fact, Region C is a national leader in developing innovative conservation and reuse strategies. In the 2006 Region C Water Plan, new conservation and reuse strategies account for 26 percent of Region C's future water supply.

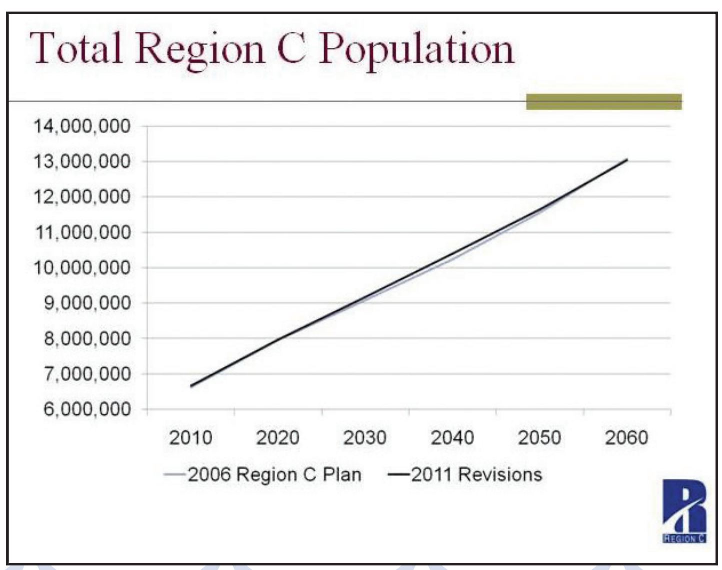
This fresh look at the data does suggest, however, that perhaps Region C water users aren't quite the "water hogs" that some would make them out to be, and that Region C water users are making significant strides in carefully using a valuable, scarce resource.

Population and Water Demand Projections Remain Similar to 2006 Plan Projections

The Region C Water Planning Group (RCWPG) recently approved population and water demand projections for the *2011 Region C Water Plan*. Projections were completed for all cities with a population of more than 500 and for non-city water suppliers with more than 0.25 Million Gallons Daily of supply. Rural populations were accounted for in a separate category.

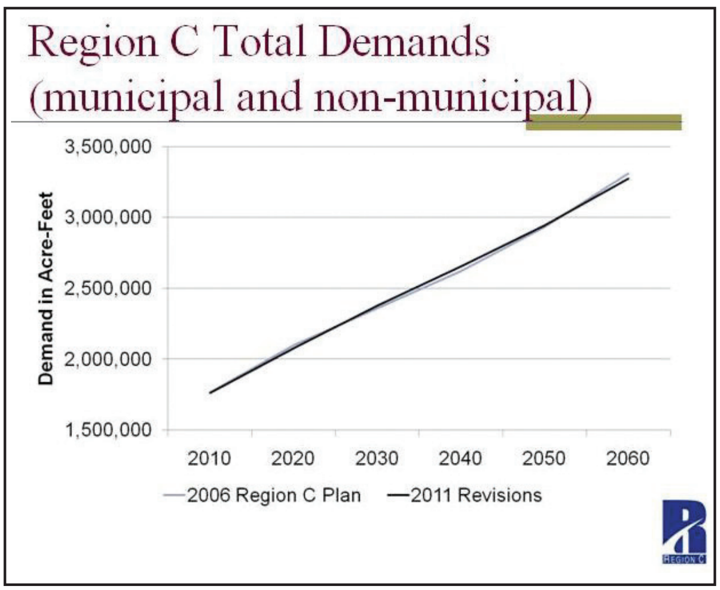
The Texas Water Development Board (TWDB) provided suggested population revisions for a number of water user groups based on the 2007 population estimates by the State Demographer. Overall the State Demographer's population estimates were in line with previous projections. Additional revisions were made as a result of input from water user groups and wholesale water providers, information from the North Central Texas Council of Governments, and data from the Texas Commission on Environment Quality's water utility database.

After taking into account all of the feedback and recommendations, the Region C total population should remain nearly the same as the projections in the *2006 Region C Water Plan*. Slight revisions to the population projections include an increase in years 2000 through 2050, a slight decrease in 2060, and a more accurate distribution of population among water user groups.



Similarly, adjustments to the municipal water demand projections, which are based on the population projections and per capita dry-year water usages, were made based on suggestions from the TWDB and input from water user groups and wholesale water providers. Based on feedback from these entities and from analyzing historical per capita usage for cities and available non-cities, the Planning Group made slight revisions. Non-municipal demand projections remained the same for irrigation, manufacturing, and livestock use, while the projections for steam electric power and mining were revised.

Some of the reasons for the revisions include recent power plant development activity, exploration in the Barnett Shale and changes suggested by the Bureau of Economic Geology's 2008 report. Taking all of the revisions into account, the total water demand projections are slightly lower than the projections in the *2006 Region C Water Plan*.



Several Groundwater Conservation Districts Located in Region C

The state of Texas currently has 95 confirmed groundwater conservation districts (GCDs), seven of which cover areas located in Region C. GCDs provide the authority to regulate the spacing and production of water wells. The districts in Region C are:

- the *Mid-East Texas GCD*, which covers Freestone County and several counties outside of Region C;
- the *Neches & Trinity Valleys GCD*, which covers Henderson County and several counties outside of Region C;
- the *North Texas GCD*, which covers Collin, Cooke and Denton counties;
- the *Northern Trinity GCD*, which covers Tarrant County;
- the *Prairielands GCD*, which covers Ellis County and several counties outside of Region C;
- the *Red River GCD*, which covers Grayson and Fannin counties; and
- the *Upper Trinity GCD*, which covers Parker and Wise counties and several counties outside of Region C.

New GCDs may be created by the Texas Legislature, via a local petition process or by the Texas Commission on Environmental Quality. Currently, three new GCDs are being considered statewide and are pending election results. None of the pending GCDs is located in Region C.

GCDs must develop a groundwater management plan that addresses various goals, including how to provide the most efficient use of groundwater, control land subsidence and prevent waste of groundwater. The plan must also provide information, performance standards and management objectives, as well as descriptions and estimates for achieving the identified goals. The completed groundwater management plan is then sent to the Texas Water Development Board (TWDB) for approval. All new districts must submit their groundwater management plans to the TWDB within three years of creation.

For more information about Groundwater Conservation Districts in Texas, visit http://www.twdb.state.tx.us/GwRD/GCD/gcdhome.htm.

Planning Group Adopts Resolution Honoring Marsh Rice

It is with great sadness that the Region C Water Planning Group (RCWPG) notes the recent passing of Irvin Marshall (Marsh) Rice, a founding member of the RCWPG and a distinguished public servant. During his many years of service to the Planning Group, Marsh dedicated his efforts to ensuring that North Central Texas residents and businesses would have a safe, plentiful water supply for many decades to come.

Over the course of his career, Marsh served as director of Dallas Water Utilities, as executive secretary of the Trinity Improvement Association, as a life board member of the Texas Water Conservation Association and as a member of the Greater Dallas Planning Committee.

Marsh was also a servant of his country, including service in both World War II, where he was part of the D-Day landing team on Omaha Beach, and in the Korean War, in addition to many years of post-war service in the U.S. Army and U.S. Army Corps of Engineers. The U.S. Army recognized Marsh's 30 years of military service with two Legion of Merit and three Bronze Star medals for meritorious service.

At its September 28, 2009 meeting, the Region C Water Planning Group adopted a resolution that commemorated Marsh's selfless service to the community and noted that his legacy will live on in the Region C Water Plan and countless other public projects benefiting the entire region.

Study Commission on Region C Water Supply Examines Alternatives to Marvin Nichols Reservoir

In 2008, the Study Commission on Region C Water Supply was formed as a result of Senate Bill 3 to study potential alternative strategies to the Marvin Nichols Reservoir, a large reservoir planned for Northeast Texas. The Study Commission is composed of six members. Three of the members represent Region C, and the other three members represent Region D:

- Thomas Duckert, Environmental Health & Safety Manager, International Paper;
- State Rep. Stephen Frost;
- State Rep. Jodie Laubenberg;
- Region D Water Planning Group Chairman Richard LeTourneau;
- Region C Water Planning Group Chairman Jim Parks; and
- State Sen. Florence Shapiro.

The group was charged with several tasks, including reviewing water supply alternatives available to Region C, analyzing the socioeconomic effect on the area where the water supply is located and determining whether water demand in Region C may be reduced through additional conservation and reuse measures, among other items.

Phase I of the Study Commission's efforts focused on an examination of existing studies and data gaps, with respect to five alternative water sources: Lake O' the Pines, Lake Texoma, Marvin Nichols Reservoir, Toledo Bend Reservoir and Lake Wright Patman. A draft report summarizing existing data, socioeconomic studies and data gaps related to the alternative water sources was presented in September to the Commission. The Commission is working now to finalize the Phase I report and to lay out its scope of work for Phase II.

Phase II of the Commission's efforts will continue the work of Phase I and more closely examine the potential alternative water supply strategies, with a deadline of October 2010 for completion of the Commission's work. For more information about the Commission's ongoing efforts, visit http://www.twdb.state.tx.us/wrpi/rwp/committee/rgc/rgc.htm.

About the Regional Water Planning Group

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Jody Puckett	Vice Chair	Municipalities
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Jerry Chapman	Member	Water Districts
S. Frank Crumb	Member	Municipalities
Bill Lewis	Member	Small Business
G. K. Maenius	Member	Counties
Howard Martin	Member	Municipalities
Jim McCarter	Member	Water Utilities
Paul Phillips	Member	Municipalities
Bob Scott	Member	Environment
Gary Spicer	Member	Electric Generating Utilities
Connie Standridge	Member	Water Utilities
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Danny Vance	Member	River Authority
Mary Vogelson	Member	Public
Dr. Tom Woodward	Member	Agriculture
Curtis Campbell	Non-Voting Member	Region B
Mike Harbordt	Non-Voting Member	Region I
Terry Kelley	Non-Voting Member	Brazos G RWPG
Angela Masloff	Non-Voting Member	Texas Water Development Board
David Weidman	Non-Voting Member	Region D
E.W. Wesley	Non-Voting Member	Texas Dept. of Agriculture
Adam Whisenant	Non-Voting Member	Texas Parks & Wildlife Dept.

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Suite 530
Irving, TX 75038

Collin
Cooke
Dallas
Denton
Ellis
Fannin
Freestone
Grayson
Henderson
Jack
Kaufman
Navarro
Parker
Rockwall
Tarrant
Wise

REGION C

Water Planning for North Texas

Spring 2010 Newsletter

Planning Group Hosts Public Hearing, Accepts Comments on the Initially Prepared Plan

The next Region C meeting will be a public hearing to present the Initially Prepared Plan and to solicit public feedback on the draft plan. Comments may be submitted verbally or in writing at the public hearing. Members of the public may also submit comments in writing, no later than August 1, 2010, through the Region C website, ***www.regioncwater.org***, or by sending an e-mail or mailed comments to Amy Kaarlela with Freese & Nichols at the address below.

Public Hearing:

Tuesday, May 25, 2010, 7:00 p.m.

Hearing Location:

The Bob Duncan Center
2800 S. Center Street
Arlington, TX 76014
(817) 465-6661

To provide written comments on the Initially Prepared Plan, or for public hearing questions, contact:

Amy Kaarlela
Freese & Nichols
4055 International Plaza, Suite 200
Fort Worth, Texas 76109-4895
Phone: 817-735-7438
E-mail: RegionCcomments@freese.com

*Please Note: Persons with disabilities who plan to attend the Region C Water Planning Group hearing – and who may need auxiliary aids or services such as mobility assistance, interpreters for deaf or hearing-impaired persons, readers, large print, or Braille – are requested to contact Melisa Fuller with the North Texas Municipal Water District at (972) 442-5405 at least (5) work days prior to the meeting so that appropriate arrangements can be made.

To be added to the RCWPG newsletter mailing list, send your name and mailing address to Colby Walton via e-mail to colby@cookseypr.com, or via fax to (972) 580-0852.

Visit www.regioncwater.org for the latest updates on RCWPG activities, meetings and other water planning news, or contact Amy Kaarlela with Freese & Nichols at adk@freese.com.

Region C Unveils Initially Prepared Plan, Announces Public Hearing

With the third round of the statewide water planning process nearing an end, and after extensive research and evaluation of potential water management strategies, the Region C Water Planning Group unveiled a revised, draft Regional Water Plan (known formally as the Initially Prepared Plan, or IPP) on April 1, 2010. The IPP is currently available for public review on the Region C Web site, ***www.regioncwater.org***, and the plan is also available in each county clerk's office and at least one public library in each of Region C's 16 counties (see the Region C Web site, or the public notice appearing in major newspapers, for a full list of locations).

On Tuesday, May 25, 2010, at 7:00 p.m., the Region C Water Planning Group will host a public hearing at The Bob Duncan Center in Arlington at which public comments on the draft plan will be accepted (see sidebar article about public hearing).

The following article provides an overview of the IPP, to assist the public with navigating its voluminous contents.

The first section of the IPP is an Executive Summary, providing a succinct overview of the 10 chapters in the draft plan. For many readers, this summary – at fewer than 30 pages – will be a good way to see the big picture of the overall plan.

Chapter One of the IPP provides a *description of Region C*. Included in this description are the following sections:

- Economic activity in Region C
- Water-related physical features in Region C
- Current water uses and demand centers in Region C
- Current sources of water supply
- Water providers in Region C
- Pre-existing plans for water supply development
- Agricultural and natural resources in Region C
- Summary of threats and constraints to water supply in Region C
- Water-related threats to agricultural and natural resources in Region C

Chapter Two includes *population and water demand projections* for the next 50 years, including a historical perspective on the projections. A detailed explanation of the basis for population and water demand projections is described in this chapter.

Chapter Three features an analysis of the *water supply that is currently available* to Region C. Among this chapter's sections are the following:

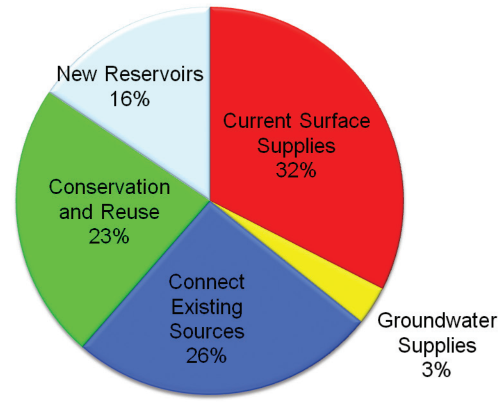
- Overall water supply availability (surface water and groundwater)
- Water availability by Wholesale Water Provider
- Current water supplies available to Regional Wholesale Water Providers
- Current water supplies available to the Local Wholesale Water Providers
- Water availability by Water User Group
- Summary of current water supply in Region C

In Chapter Four, the Planning Group *identifies, evaluates and selects particular water management strategies.* Section A of this chapter includes a *comparison of the current water supply to projected water demand* to identify projected water shortages and the timing of these shortages. In the final report, Section A will also measure the potential economic impact if projected needs are not met through the development of new supplies.

In Section B of Chapter Four, the Planning Group considers *water conservation and reuse* as a major water management strategy. This section defines water conservation, lists the goals of conservation, and recommends particular water management strategies for each Wholesale Water Provider and Water User Group with a projected shortage.

Section C of Chapter Four describes the methodology for evaluating and selecting water management strategies. Water management strategies considered for inclusion in the plan are:

- Expanded use of existing supplies, through:
  - » Reservoir system operation
  - » Conjunctive use of ground and surface water
  - » Connecting existing sources
  - » Reallocation of reservoir storage
  - » Enhancement of yields of existing sources
- Development of new supplies, including:
  - » Surface water
  - » Groundwater
  - » Desalination
  - » Aquifer storage and recovery
- Interbasin transfers
- Other measures



Major strategies evaluated in Chapter Four, Section C of the draft plan, and either *recommended*, identified as an *alternative strategy* or *not recommended* in Section D include:

Major Strategies Recommended:

- New Conservation and Reuse
  - » Full Development of Tarrant Regional Water District's (TRWD) Trinity River Diversions
  - » Main Stem Trinity River Pump Station – Dallas Water Utilities (DWU) and North Texas Municipal Water District (NTMWD)
  - » Multiple Reuse Projects for Steam Electric Power, Irrigation, etc.
- Connect to Existing Supplies Currently Unconnected or Only Partly Connected
  - » Lake Fork
  - » Lake Palestine
  - » Toledo Bend Reservoir
  - » Lake Texoma (blending – NTMWD)
  - » Lake Texoma (desalination – Greater Texoma Utility Authority/Sherman)
  - » Lake Wright Patman
  - » Oklahoma Water
  - » TRWD/DWU Integrated Pipeline
- New Supplies
  - » Lower Bois d'Arc Creek Reservoir
  - » Lake Ralph Hall
  - » Marvin Nichols Reservoir

Major Strategies Identified as Alternative Strategies:

- Connect to Existing Supplies
  - Lake Livingston
  - Additional Lake Texoma (not authorized for water supply)
  - Carrizo-Wilcox Groundwater
  - Roberts County Groundwater
  - Brazos River
- New Supplies
  - George Parkhouse North Reservoir
  - George Parkhouse South Reservoir
  - Lake Tehuacana
  - Lake Columbia
  - Neches River Diversions

Major Strategies Not Recommended:

- Connect to Existing Supplies
  - Gulf of Mexico with Desalination
- New Supplies
  - Lake Fastrill

Sections E and F outline the Planning Group's *recommended water management strategies* for Wholesale Water Providers and for Water User Groups by county.

Section G of Chapter Four will eventually include tables produced by the Texas Water Development Board. Section H highlights the special studies conducted by the Planning Group from 2007-2008, focusing on water supply issues of particular importance to North Central Texas. The special studies examined water conservation and reuse practices, the availability of water from the Toledo Bend Reservoir in East Texas, direct and indirect water reuse case studies and potential water management strategies to address rapid population growth and other changing conditions in localized areas of the region. Section H also includes a summary of special studies conducted by the Planning Group during the latter stage of the current planning period. These studies include a saline study and individual county studies for six of the Region C counties.

Chapter Five considers the *impacts* of the recommended water management strategies, particularly the impact on key water quality parameters, the impact of moving water from rural and agricultural areas and the impact on third parties.

Chapter Six provides recommendations on *water conservation and drought management*, including a look at model conservation plans.

Chapter Seven evaluates the *consistency of the plan's recommendations with the long-term protection of resources* such as water, agricultural and natural resources.

Chapter Eight provides *recommendations related to ecologically unique river and stream segments, unique sites for reservoir construction and legislative recommendations.*

Chapter Nine of the final plan will summarize *infrastructure funding recommendations*. The survey of Wholesale Water Providers and Water User Groups will be conducted in June. The results will be included in the final report.

Finally, Chapter Ten describes the *plan approval process* and options that have been provided, or will be provided, for *public participation* in the planning process. A number of appendices are also attached to the draft plan, providing background on how figures were compiled and how water management strategies were evaluated during the third round of regional water planning in Region C.

Key dates in the water planning process include:

April 1, 2010: Initially Prepared Plans due to TWDB and made available to the public to review.

May 25, 2010: Public hearing on Region C's Initially Prepared Plan.

August 1, 2010: Public comments, TWDB comments and other public agency comments on IPP due to the RCWPG.

September 2010: Public meeting of the RCWPG to adopt Region C Water Plan.

October 1, 2010: Deadline for RCWPG to submit final Region C Water Plan to the TWDB.

December 31, 2010: TWDB to complete review of all Regional Plans and prepare summary for Texas Legislature.

January 5, 2012: State Water Plan published by the TWDB.

Region C Continues Commitment to Reuse Projects

Region C continues to lead the way with its commitment to conservation and reuse projects. Read on for an update on a few of the projects that are currently in use, underway or coming online shortly.

On June 12, 2009, the Tarrant Regional Water District (TRWD) officially designated its wetland project the "George W. Shannon Wetlands Water Recycling Facility." TRWD Board President Vic Henderson unveiled a plaque bearing Shannon's name, and Mary Shannon and other members of the Shannon family were in attendance at the ceremony. The TRWD initiated the first phase of construction on the facility in 2000, and the TRWD completed the second phase of construction in 2009. The final phase of construction is expected to begin in late 2010. When construction is complete, the facility will include more than 1,600 acres of quality wetland habitat and is projected to supply over 100,000 acre-feet of water annually to the Fort Worth area.

TRWD's George W. Shannon Wetlands Water Recycling Facility

The North Texas Municipal Water District's (NTMWD) East Fork Raw Water Supply Project came online in 2009, after initial work began in 2004. The 1,840 acre wetland project provides additional raw water supply to help meet the increasing population of Collin, Dallas, Denton, Hunt, Kaufman and Rockwall counties. Water from the Trinity River's East Fork is pumped into the wetland, and aquatic plants polish the water. Then, the cleansed water is piped to Lavon Lake for storage and blending with other NTMWD raw water sources and becomes part of the available water supply. The project, the largest in Texas using reclaimed water supply to augment a surface water supply source, can provide the NTMWD with 102,000 acre-feet of water per year. The additional supply provided by the wetlands is almost equivalent to the quantity provided annually by Lavon Lake, 104,000 acre-feet.

NTMWD's East Fork Raw Water Supply Project

The City of Fort Worth is proceeding with the Village Creek Eastern Reclaimed Water Delivery System. In December, the Fort Worth City Council approved contracts with three wholesale water customers, awarded the construction contracts for the pump station and all four sections of the pipeline and accepted a loan from the Texas Water Development Board.

The loan to support construction is funded by the Drinking Water State Revolving Fund Appropriation from the American Recovery and Reinvestment Act of 2009 (ARRA). This funding mechanism is estimated to save more than $8.6 million over the 20-year term of the loan. Construction began on all segments in February. Currently, the estimated annual demand for the project in 2011 is over 1,300 acre-feet of water. This estimated annual demand dramatically increases to more than 3,000 acre-feet of water by 2022.

The three wholesale customers for the reclaimed water system are the City of Arlington, the City of Euless and the Dallas/Fort Worth International Airport. All three must complete associated projects to be able to connect and use the reclaimed water. These projects are on track for completion by February 2011. Fort Worth's projects are scheduled for completion in December 2010.

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APPENDIX Z
TABLES REQUIRED BY TWDB ON ALL WATER MANAGEMENT STRATEGIES

APPENDIX Z
TABLES REQUIRED BY TWDB

The Texas Water Development Board Regional Planning Guidelines require specific summary tables to be included in the Regional Plans. This appendix contains these tables which are:

Table Z.1: List of Potentially Feasible Water Management Strategies, Region C

Table Z.2: Summary of Recommended Strategies, Region C WUGs and WWPs

Table Z.3: Summary of Alternate Strategies, Region C WUGs and WWPs

These tables are based on information from the Texas Water Development Board online planning database (DB12) and reflect the most current information in the database at the time of the printing of this report. Subsequent adjustments may be made to the database and an update to these tables may be made through an errata to this report. There may be slight numerical differences between the TWDB online planning database and this printed regional water plan due to rounding associated with the regional water plan preparation and online data entry. In any and all instances where numbers in the regional water plan and the online planning database do not match, the data in the online planning database (DB12) shall take precedence over the associated number in the regional water plan for the purpose of development of the State Water Plan.

Table Z.1
List of Potentially Feasible Water Management Strategies
Region C

WMS Project ID	Project Name
C70	ADDITIONAL DRY YEAR SUPPLY
C15LF	ADDITIONAL PIPELINE FROM LAKE TAWAKONI (MORE LAKE FORK SUPPLY)
C02.1TRIN	ADDITIONAL TRINITY AQUIFER - EXISTING WELLS
C03.1WB	ADDITIONAL WOODBINE AQUIFER - EXISTING WELLS
C54	BED AND BANKS PERMIT
C29	BRAZOS GROUNDWATER PROJECT TO DWU
C29.1	BRAZOS GROUNDWATER PROJECT TO NTMWD
C29.2	BRAZOS GROUNDWATER PROJECT TO TRWD
C36	COLLIN-GRAYSON MUNICIPAL ALLIANCE SYSTEM
C38	CONVEYANCE AND TREATMENT PROJECT
C37	CONVEYANCE PROJECT
C46	COOKE COUNTY PROJECT
C55	DIRECT REUSE
C19	DWU REUSE
C51	ENNIS REUSE
C42	FACILITY IMPROVEMENTS
C47	FANNIN COUNTY PROJECT
C900	FASTRILL REPLACEMENT
C01CONSIRR	GOLF COURSE CONSERVATION
C48	GRAYSON COUNTY PROJECT
C28	GULF OF MEXICO DESALINATION
C56	INDIRECT REUSE
C32	LAKE COLUMBIA TO DWU
C23.1	LAKE GEORGE PARKHOUSE NORTH FOR DWU
C23	LAKE GEORGE PARKHOUSE NORTH FOR NTMWD
C24	LAKE GEORGE PARKHOUSE SOUTH FOR NTMWD
C25	LAKE LIVINGSTON TO DWU
C25.1	LAKE LIVINGSTON TO NTMWD
C25.2	LAKE LIVINGSTON TO TRWD
C30	LAKE O THE PINES TO DWU
C30.1	LAKE O THE PINES TO NTMWD
C30.2	LAKE O THE PINES TO TRWD
C16LP	LAKE PALESTINE CONNECTION (INTEGRATED PIPELINE WITH TRWD)
C14RH	LAKE RALPH HALL
C22	LAKE TEHUACANA
C10TEX	LAKE TEXOMA - AUTHORIZED (BLEND)
C10.1TEX	LAKE TEXOMA - AUTHORIZED (DESALINATE)
C10.4TEX	LAKE TEXOMA - INTERIM PURCHASE FROM GTUA
C10.2TEX	LAKE TEXOMA - NOT AUTHORIZED (BLEND)
C10.3TEX	LAKE TEXOMA - NOT AUTHORIZED (DESALINATE)
C33	LAKE TEXOMA TO DWU (BLEND)
C13LBC	LOWER BOIS D ARC CREEK RESERVOIR
C72	MAIN STEM PS (ADDITIONAL EAST FORK) NTMWD
C71	MAIN STEM TRINITY PUMP STATION (LAKE RAY HUBBARD INDIRECT REUSE - DWU)

Table Z.1
List of Potentially Feasible Water Management Strategies
Region C

WMS Project ID	Project Name
C01CONSMFG	MANUFACTURING CONSERVATION
C08MN	MARVIN NICHOLS 1A RESERVOIR
C08.1MN	MARVIN NICHOLS 1A RESERVOIR WITH DWU
C01CONSBAS	MUNICIPAL CONSERVATION-BASIC
C01CONSEXP	MUNICIPAL CONSERVATION-EXPANDED
C04CW	NEW WELLS - CARRIZO WILCOX AQUIFER
C05OTH	NEW WELLS - OTHER AQUIFER
C02TRIN	NEW WELLS - TRINITY AQUIFER
C03WB	NEW WELLS - WOODBINE AQUIFER
C34	NTMWD INTERIM PURCHASE FROM DWU
C20	NTMWD WILSON CREEK REUSE
C12.1OK	OKLAHOMA WATER TO DWU
C59	OKLAHOMA WATER TO IRVING
C12.2OK	OKLAHOMA WATER TO NTMWD
C12OK	OKLAHOMA WATER TO NTMWD, TRWD, UTRWD
C12.3OK	OKLAHOMA WATER TO TRWD
C12.4OK	OKLAHOMA WATER TO UTRWD AND IRVING
C02.3TRIN	OVERDRAFT TRINITY AQUIFER - EXISTING WELLS
C02.2TRIN	OVERDRAFT TRINITY AQUIFER - NEW WELLS
C03.3WB	OVERDRAFT WOODBINE AQUIFER - EXISTING WELLS
C03.2WB	OVERDRAFT WOODBINE AQUIFER - NEW WELLS
C50	PURCHASE FROM WATER PROVIDER
C60	REALLOCATION OF FLOOD STORAGE
C58	RED RIVER DIVERSION
C100	REDISTRIBUTION OF SUPPLIES
C27	ROBERTS COUNTY PROJECT TO DWU
C27.1	ROBERTS COUNTY PROJECT TO NTMWD
C27.2	ROBERTS COUNTY PROJECT TO TRWD
C26	SAM RAYBURN TO DWU
C26.1	SAM RAYBURN TO NTMWD
C26.2	SAM RAYBURN TO TRWD
C57	SUBORDINATION AGREEMENT
C06SUPWELL	SUPPLEMENTAL WELLS
C07TB	TOLEDO BEND PROJECT (500,000)
C07.2TB	TOLEDO BEND PROJECT (700,000)
C21.1	TRA DALLAS COUNTY REUSE
C21.5	TRA DENTON CREEK WWTP REUSE
C21.2	TRA ELLIS COUNTY REUSE
C21.3	TRA FREESTONE COUNTY REUSE
C21.4	TRA KAUFMAN COUNTY REUSE
C21	TRA LAS COLINAS REUSE
C40	TRA TARRANT COUNTY PROJECT
C11	TRWD THIRD PIPELINE AND REUSE
C53.1	WATER TREATMENT PLANT - EXPANSION

Table Z.1
List of Potentially Feasible Water Management Strategies
Region C

WMS Project ID	Project Name
C53	WATER TREATMENT PLANT - NEW
C01CONWWP	WHOLESALE WATER PROVIDER CUSTOMER CONSERVATION
C9.4WP	WRIGHT PATMAN - REALLOCATION OF FLOOD POOL (112K)
C9.5WP	WRIGHT PATMAN - REALLOCATION OF FLOOD POOL DWU (180K)
C9.6WP	WRIGHT PATMAN - REALLOCATION OF FLOOD POOL NTMWD (180K)
C9.7WP	WRIGHT PATMAN - REALLOCATION OF FLOOD POOL TRWD (180K)
C9.1WP	WRIGHT PATMAN - TEXARKANA SALE TO DWU
C9.2WP	WRIGHT PATMAN - TEXARKANA SALE TO NTMWD
C9.3WP	WRIGHT PATMAN - TEXARKANA SALE TO TRWD
C09WP	WRIGHT PATMAN SYSTEM OPERATION

Table Z.2
Summary of Recommended Strategies
Region C WUGs and WWPs

Strategy Name	Capital Cost	2010 Annual Costs ($/AF)	SS2010	SS2020	SS2030	SS2040	SS2050	SS2060	2010 Annual Costs ($/AF)
ADDITIONAL DRY YEAR SUPPLY	$0	$0	25,000	0	0	0	0	0	$0
ADDITIONAL PIPELINE FROM LAKE TAWAKONI (MORE LAKE FORK SUPPLY)	$496,243,000	$0	0	77,999	75,777	73,563	71,346	69,128	$108
BED AND BANKS PERMIT	$0	$0	0	18	83	104	127	149	$0
COLLIN-GRAYSON MUNICIPAL ALLIANCE SYSTEM**	$77,366,000	$0	0	3,255	8,614	14,192	20,604	27,412	$1,307
CONVEYANCE AND TREATMENT PROJECT	$5,478,000	NA	0	0	0	0	0	0	NA
CONVEYANCE PROJECT	$358,148,000	$6,648	4,128	27,903	50,566	57,879	76,647	79,453	$571
COOKE COUNTY PROJECT	$40,604,000	$0	0	2,240	2,240	3,360	4,480	4,480	$372
DIRECT REUSE	$199,553,000	$429	3,263	18,577	38,791	52,056	55,442	58,603	$73
DWU REUSE	$225,487,000	$0	0	52,070	56,330	59,917	60,702	61,667	$69
ENNIS REUSE	$31,779,000	$0	0	0	0	333	2,521	3,696	$1,328
FACILITY IMPROVEMENTS	$2,944,509,000	NA	0	0	0	0	0	0	NA
FANNIN COUNTY PROJECT**	$94,361,000	$0	0	1,455	1,962	2,790	4,357	6,684	$226
FASTRILL REPLACEMENT	NA	$0	0	0	0	0	0	112,100	NA
GOLF COURSE CONSERVATION	$0	$214	56	942	1,808	2,261	2,690	3,121	$211
GRAYSON COUNTY PROJECT	$428,158,000	$0	0	7,560	10,920	13,440	19,040	24,640	$550
INDIRECT REUSE	$0	$0	0	6,050	11,984	18,170	21,020	22,340	$0
LAKE PALESTINE CONNECTION (INTEGRATED PIPELINE WITH TRWD)	$887,954,000	$0	0	111,776	110,670	109,563	108,455	107,347	$204
LAKE RALPH HALL	$286,401,000	$0	0	34,050	34,050	34,050	34,050	34,050	$116
LAKE TEXOMA - AUTHORIZED (BLEND)	$336,356,000	$0	0	0	69,200	68,500	113,000	113,000	$87
LAKE TEXOMA - INTERIM PURCHASE FROM GTUA	$0	$0	0	21,900	21,900	21,900	0	0	$0
LOWER BOIS D ARC CREEK RESERVOIR	$615,498,000	$0	0	56,050	120,200	118,000	115,800	113,600	$75
MAIN STEM PS (ADDITIONAL EAST FORK) NTMWD	$0	$0	0	34,900	15,100	0	0	0	$0
MANUFACTURING CONSERVATION	$0	$0	1	146	1,530	2,259	2,457	2,618	$211
MARVIN NICHOLS 1A RESERVOIR	$3,427,638,000	$0	0	0	227,400	227,400	472,300	472,300	$96
MUNICIPAL CONSERVATION-BASIC	$1,125,975	$200	42,027	97,242	138,043	176,314	217,505	265,111	$84
MUNICIPAL CONSERVATION-EXPANDED	$1,097,572	$167	4,801	9,984	14,067	17,099	19,040	20,797	$391
NEW WELLS - CARRIZO WILCOX AQUIFER	$1,081,100	$341	154	154	154	436	436	436	$134
NEW WELLS - TRINITY AQUIFER	$4,160,000	$382	1,298	1,458	1,722	1,722	1,722	1,722	$112
NEW WELLS - WOODBINE AQUIFER	$6,993,000	$726	963	2,132	2,132	2,132	2,132	2,132	$119
OKLAHOMA WATER TO IRVING	$194,825,000	$0	0	0	25,000	25,000	25,000	25,000	$244
OKLAHOMA WATER TO NTMWD, TRWD, UTRWD	$756,045,000	$0	0	0	0	0	0	115,000	$494
OVERDRAFT TRINITY AQUIFER - EXISTING WELLS	$0	$43	572	0	0	0	0	0	$0
OVERDRAFT TRINITY AQUIFER - NEW WELLS	$1,690,900	$203	1,774	0	0	0	0	0	$0
PURCHASE FROM WATER PROVIDER	$0	NA	53,303	521,030	868,391	1,181,758	1,584,716	2,026,761	NA
REDISTRIBUTION OF SUPPLIES	$0	$0	1,441	-12,073	-16,348	-21,478	-31,096	-54,203	$0
SUBORDINATION AGREEMENT	$0	$0	0	280	220	219	217	215	$0
SUPPLEMENTAL WELLS	$483,608,065	NA	0	0	0	0	0	0	NA
TOLEDO BEND PROJECT (500,000) Phase I***	$1,930,588,000	$0	0	0	0	0	200,000	200,000	$1,029
TRA DALLAS COUNTY REUSE	$14,895,000	$0	0	0	6,760	6,760	6,760	6,760	$99
TRA DENTON CREEK WWTP REUSE	$9,506,000	$0	0	3,750	3,750	3,750	3,750	3,750	$229

Table Z.2
Summary of Recommended Strategies
Region C WUGs and WWPs

Strategy Name	Capital Cost	2010 Annual Costs ($/AF)	SS2010	SS2020	SS2030	SS2040	SS2050	SS2060	2010 Annual Costs ($/AF)
TRA ELLIS COUNTY REUSE	$10,384,000	$0	0	0	0	0	0	2,200	$505
TRA FREESTONE COUNTY REUSE	$17,266,000	$0	0	0	0	0	6,760	6,760	$323
TRA KAUFMAN COUNTY REUSE	$9,760,000	$0	0	2,000	2,000	2,000	2,000	2,000	$96
TRA LAS COLINAS REUSE	$14,530,000	$0	0	7,000	7,000	7,000	7,000	7,000	$134
TRA TARRANT COUNTY PROJECT**	$59,008,000	$0	0	1,627	7,841	12,949	17,108	20,949	$239
TRWD THIRD PIPELINE AND REUSE	$914,424,000	$0	0	105,500	105,500	105,500	105,500	105,500	$263
WATER TREATMENT PLANT - EXPANSION	$3,948,023,000	$0	0	2,723	3,069	9,007	9,272	9,343	$0
WATER TREATMENT PLANT - NEW	$595,147,400	$0	0	191	912	1,201	1,565	1,732	$0
WHOLESALE WATER PROVIDER CUSTOMER CONSERVATION*	$0	$0	60,620	145,754	213,347	273,900	339,148	414,244	$0
WRIGHT PATMAN - REALLOCATION OF FLOOD POOL (112K)	$896,478,000	$0	0	0	0	112,100	112,100	112,100	$0

* Wholesale water provider customer conservation is the compilation of the conservation of water saved by customers. It does not represent additional water saved.
** This does not represent new water supply. Quantity is shown as "0" in DB12.
*** Costs and supply amounts are only reported for WWPs located in Region C.

Table Z.3
Summary of Alternate Strategies
Region C WUGs and WWPs

Aternate Strategy	Capital Cost	2010 Annual Costs ($/AF)	SS2010	SS2020	SS2030	SS2040	SS2050	SS2060	2060 Annual Cost ($/AF)
BRAZOS GROUNDWATER PROJECT TO DWU	$801,451,000	$0	0	0	0	100,000	100,000	100,000	$1,222
BRAZOS GROUNDWATER PROJECT TO NTMWD	$913,344,000	$0	0	0	0	100,000	100,000	100,000	$1,417
LAKE COLUMBIA TO DWU	$179,945,000	$0	0	0	35,800	35,800	35,800	35,800	$169
LAKE GEORGE PARKHOUSE NORTH FOR DWU	$521,281,000	$0	0	0	0	112,000	112,000	112,000	$459
LAKE GEORGE PARKHOUSE NORTH FOR NTMWD	$516,585,000	$0	0	0	0	118,960	118,960	118,960	$427
LAKE GEORGE PARKHOUSE NORTH FOR UTRWD	$151,988,000	$0	0	0	0	0	35,000	35,000	$459
LAKE GEORGE PARKHOUSE SOUTH FOR UTRWD	$208,364,000	$1	0	0	0	0	35,000	35,000	$590
LAKE GEORGE PARKHOUSE SOUTH FOR NTMWD	$645,810,000	$0	0	0	0	108,480	108,480	108,480	$557
LAKE GEORGE PARKHOUSE SOUTH FOR DWU	$692,921,000	$0	0	0	0	115,260	115,260	115,260	$567
LAKE LIVINGSTON TO DWU	$1,855,538,000	$0	0	0	0	0	200,000	200,000	$981
LAKE LIVINGSTON TO NTMWD	$2,115,111,000	$0	0	0	0	0	200,000	200,000	$1,101
LAKE LIVINGSTON TO TRWD	$2,084,210,000	$0	0	0	0	0	200,000	200,000	$1,121
LAKE O THE PINES TO DWU	$541,534,000	$0	0	0	0	89,600	89,600	89,600	$704
LAKE O THE PINES TO NTMWD	$402,431,000	$0	0	87,900	87,900	87,900	87,900	87,900	$244
LAKE TEHUACANA	$746,345,000	$0	0	0	0	56,800	56,800	56,800	$1,118
LAKE TEXOMA - AUTHORIZED (DESALINATE)	$796,532,000	$0	0	0	105,000	105,000	105,000	105,000	$443
LAKE TEXOMA - NOT AUTHORIZED (BLEND)	$531,378,300	$0	0	0	0	113,000	113,000	113,000	$446
LAKE TEXOMA - NOT AUTHORIZED (DESALINATE)	$925,918,000	$0	0	0	0	105,000	105,000	105,000	$1,098
LAKE TEXOMA TO DWU (BLEND)	$56,334,000	$0	0	0	20,000	20,000	20,000	20,000	$101
MARVIN NICHOLS 1A RESERVOIR WITH DWU	$634,154,000	$0	0	0	95,931	95,931	95,931	95,931	$179
NECHES RUN-OF-RIVER FOR DWU	$1,980,278,000	$0	0	0	0	0	0	112,100	$1,437
NTMWD INTERIM PURCHASE FROM DWU	$1,777,000	$0	0	11,200	11,200	0	0	0	$0
OKLAHOMA WATER TO DWU	$343,934,000	$0	0	0	0	0	0	50,000	$701
ROBERTS COUNTY PROJECT TO DWU	$2,435,534,000	$0	0	0	0	0	200,000	200,000	$1,108
ROBERTS COUNTY PROJECT TO NTMWD	$2,434,529,000	$0	0	0	0	0	200,000	200,000	$1,127
ACCELERATED TOLEDO BEND (500,000)	$1,246,595,000	$0	0	0	0	0	0	200,000	$849
TOLEDO BEND PROJECT (700,000) - DWU	$1,433,774,000	$0	0	0	0	0	200,000	200,000	$815
TOLEDO BEND PROJECT (700,000) - UTRWD	$297,543,000	$0	0	0	0	0	48,000	48,000	$762
WRIGHT PATMAN - REALLOCATION OF FLOOD POOL NTMWD (180K)	$905,929,000	$0	0	0	0	180,000	180,000	180,000	$544
WRIGHT PATMAN - REALLOCATION OF FLOOD POOL TRWD (180K)	$1,694,140,000	$0	0	0	0	180,000	180,000	180,000	$955
WRIGHT PATMAN - TEXARKANA SALE TO NTMWD	$684,966,000	$0	0	0	0	100,000	100,000	100,000	$811
WRIGHT PATMAN - TEXARKANA SALE TO TRWD	$1,081,475,000	$0	0	0	0	100,000	100,000	100,000	$1,167
WRIGHT PATMAN SYSTEM OPERATION									
UTRWD	$890,872,000	$0	0	0	0	38,000	38,000	38,000	$808
NTMWD	$781,741,000	$0	0	0	0	130,000	130,000	130,000	$648
TRWD	$1,282,327,000	$0	0	0	0	130,000	130,000	130,000	$1,066
Water Treatment Expansion - Navarro Mills	$19,669,000	$0	0	0	0				
CONVEYANCE PROJECT									
- Athens MUA purchase from DWU	$15,343,000	$0	0	0	0	4,000	4,000	4,000	$391
- Athens MUA purchase from TRWD	$33,000,000	$0	0	0	0	4,480	4,480	4,480	$1,056
- Walnut Creek connection to Bridgeport	$48,972,000	$0	0	0	0	6,726	6,726	6,726	$1,206
- Muenster Cooke County Project	$3,253,833	$0	0	0	200	200	200	200	$929
REUSE									
- Athens MUA	$20,075,000	$0	0	0	0	1,938	1,938	1,938	$922
INFRASTRUCTURE IMPROVEMENTS		$0	0	0	0				
- Athens MUA - More Lake Athens	$7,409,000	$0	0	0	0	840	840	840	$916

APPENDIX AA

COMMENTS ON THE INITIALLY PREPARED PLAN

Comments Received on the Initially Prepared 2011 Region C Water Plan

(Letters / Emails Received by the Region C Water Planning Group)

Count*	Name	Representing
1	Carolyn Brittin	Texas Water Development Board
2	Ross Melinchuck	Texas Parks and Wildlife
3	Julie Hunt	City of Arlington
4	Julie Hunt	City of Arlington
5	Robert Stanley	City of Arlington
6	Mark Newhouse	Bois D' Arc MUD on Fannin Co Report
7	Jason Gray	City of Celina
8	James Rice	City of Copeville SUD
9	Tyler N. Hendrickson	Velvin & Weeks Consulting Engineers Inc. (representing City of Crandall)
10	Donald Cureton	Self
11	Christie Bell	Dallas Regional Chamber
12	David Howerton	City of Denison
13	Robert Bolen	City of Ennis
14	Ron McCuller	City of Grand Prairie
15	Carlyle Greenfield	Self
16	Jerry Chapman	GTUA
17	Douglas Hawes	Self
18	Doug Franklin	City of Ladonia
19	Jeffrey Hogan	BWR (representing City of Melissa)
20	Dan Petty	North Texas Commission
21	Mike Adams	City of Midlothian
22	Shirlene Perryman	Self
23	Ken Kramer	Sierra Club
24	Larry Patterson	UTRWD
25	Larry Patterson	UTRWD
26	Transcript of May 25, 2010 Public Hearing	

*After initial comments by TWDB & TPWD, comments are listed alphabetically according to entities represented (or last name of commenter if representing self).

July 26, 2010

Mr. Jim Parks
Chairman, Region C Regional Water Planning Group
c/o North Texas Municipal Water District
P.O. Box 2408
Wylie, TX 75098

Re: Texas Water Development Board Comments for the Region C Regional Water Planning Group Initially Prepared Plan, Contract No. 0904830862

Dear ~~Mr. Parks~~: Jim

Texas Water Development Board (TWDB) staff completed a review of the Initially Prepared Plan (IPP) submitted by March 1, 2010 on behalf of the Region C Regional Water Planning Group. The attached comments (Attachments A and B) follow this format:

- Level 1: Comments, questions, and online planning database revisions that must be satisfactorily addressed in order to meet statutory, agency rule, and/or contract requirements; and
- Level 2: Comments and suggestions for consideration that may improve the readability and overall understanding of the regional plan.

Based on the information provided to date by regional water planning groups, TWDB has identified potential interregional conflicts that are summarized in Attachment B. The TWDB's statutory requirement for review of potential interregional conflicts under Title 31, Texas Administrative Code (TAC) §357.14 will not be completed until submittal and review of adopted regional water plans.

In addition, the TWDB reserves the right to submit additional Level 1 comments after a TWDB staff review of the online database (DB12) versus the Region C Initially Prepared Plan is completed.

Title 31, TAC, §357.11(b) requires the regional water planning group to consider timely agency and public comment. Section 357.10(a)(3) of the TAC requires the final adopted plan include summaries of all timely written and oral comments received, along with a response explaining any resulting revisions or why changes are not warranted. Copies of TWDB's Level 1 and 2 written comments and the region's responses must be included in the final, adopted regional water plan.

If you have any questions, please do not hesitate to contact Mr. David Meesey of my staff at (512) 936-0852.

Sincerely,

C L Brittin

Carolyn L. Brittin
Deputy Executive Administrator
Water Resources Planning and Information

Attachments (2)

c w/att: Mr. Tom Gooch, Freese and Nichols, Inc.

ATTACHMENT A

TWDB Comments on Initially Prepared 2011 Region C Regional Water Plan

LEVEL 1. Comments and questions must be satisfactorily addressed in order to meet statutory, agency rule, and/or contract requirements.

General Comments

1. Please confirm that the hydrologic and climate data was updated in the plan and whether the data used (2006-2007) is the most recently available. *[Contract Exhibit "A", Task 1.b]*

Chapter 2

2. Please include categories of water use by river basin for water user groups and wholesale water providers. *[Title 31 Texas Administrative Code (TAC) §357.7(a)(2)(A)(iv) and §357.7(a)(2)(B)]*

3. Page 2.13, Table 2.4: The total of 501,886 acft/yr in 2060 appears to incorrectly total the data contained within the table for Collin County. Livestock demand has apparently been excluded from all totals. Please revise table to show correct totals in each decade (e.g. 502,770 acft/yr in 2060).

Chapter 3

4. Please provide a statement regarding any water availability requirements promulgated by a county commissioners court pursuant to TWC §35.019, which in Region C applies to the Northern Trinity and Woodbine Aquifers Priority Groundwater Management Area. *[31 TAC §357.5(k)(1)(H)]*

5. Page 3.8, paragraph 5; page 3.12, paragraph 1 and others: The text indicates that the Sparta Aquifer supplies water to users in Region C, but the aquifer does not actually occur in the region. Please correct or remove references to the Sparta Aquifer.

Chapter 4

6. Please explain how the region considered emergency transfers of non-municipal use surface water without causing unreasonable damage to the property of the non-municipal water rights holder pursuant to Texas Water Code §11.139. *[31 TAC §357.5(i)]*

7. Please describe how third party impacts from voluntary redistributions of water and moving water including from rural and agricultural areas were considered, if applicable. *[31 TAC §357.7(a)(8)(G)]*

8. Please include in the final plan quantitative reporting of impacts of potentially feasible water management strategies on agricultural resources, as appropriate. *[31 TAC §357.7(a)(8)(A)(iii)]*

Chapter 6

9. Please include a summary of information regarding water loss audits specific to Region C. *[31 TAC§357.7 (a)(1)(M)]*

Chapter 7

10. Please clarify in the plan whether or not water management strategies were adjusted for potential impacts to threatened or endangered species and those instances when mitigation of potential effects was selected instead. *[31 TAC §357.5(e)(1)]*

Appendix Q

11. Page Q.14: Please revise cost estimates or justify why a 30-year debt service period rather than the TWDB-recommended 20-year debt service period was used for evaluating water management strategies other than reservoirs. *[Contract Exhibit "C" Section 4.1.2]*

12. *(Attachment B)* Based on the information provided to date by the regional water planning groups, TWDB has also attached a summary, in spreadsheet format, of potential interregional conflicts, apparent water source over allocations, and apparent unmet water needs that were identified during the review of the online planning database and Initially Prepared Regional Water Plan. *[Additional TWDB comments regarding the general conformance of the online planning database (DB12) format and content to the Guidelines for Regional Water Planning Data Deliverables (Contract Exhibit D) are being provided by TWDB staff under separate cover as 'Exception Reports']*

LEVEL 2. Comments and suggestions that might be considered to clarify or enhance the plan.

Chapter 1

1. Page 1.96, paragraph 2: Please consider referencing Appendix M for baseline water quality conditions used to evaluate water management strategies.

REGION C

POTENTIALLY OVER ALLOCATED SOURCES

Source Name	Source Region	Source County	Source Basin	Comments	Over allocated by WUG or WWP?	Interregional?
BARDWELL LAKE/RESERVOIR	C	RESERVOIR	TRINITY	Possible issue with WMS Flags.	WUG	No
DIRECT REUSE	C	COOKE	TRINITY	Possible issue with WMS Flags.	BOTH	No
DIRECT REUSE	C	DALLAS	TRINITY	Possible issue with WMS Flags.	BOTH	No
DIRECT REUSE	C	DENTON	TRINITY	Possible issue with WMS Flags.	WUG	No
DIRECT REUSE	C	ELLIS	TRINITY	Over allocated by current supplies.	BOTH	No
DIRECT REUSE	C	TARRANT	TRINITY	Over allocated by current supplies.	BOTH	No
DIRECT REUSE	C	WISE	TRINITY	Possible issue with WMS Flags.	BOTH	No
HUBERT H MOSS LAKE/RESERVOIR	C	RESERVOIR	RED	Possible issue with WMS Flags.	WUG	No
INDIRECT REUSE	C	DALLAS	TRINITY	Possible issue with WMS Flags.	BOTH	No
INDIRECT REUSE	C	DENTON	TRINITY	Possible issue with WMS Flags.	WUG	No
INDIRECT REUSE	C	ELLIS	TRINITY	Possible issue with WMS Flags.	WUG	No
INDIRECT REUSE	C	NAVARRO	TRINITY	Possible issue with WMS Flags.	BOTH	Yes - C/G
INDIRECT REUSE	C	TARRANT	TRINITY	Possible issue with WMS Flags.	WUG	No
LEWISVILLE LAKE/RESERVOIR NON-SYSTEM PORTION	C	RESERVOIR	TRINITY	Over allocated by current supplies.	WUG	No
OTHER AQUIFER	C	COLLIN	TRINITY	Over allocated by current supplies.	WUG	No
OTHER AQUIFER	C	ELLIS	TRINITY	Over allocated by current supplies.	WUG	No
OTHER AQUIFER	C	JACK	TRINITY	Over allocated by current supplies.	WUG	No
RAY HUBBARD LAKE/RESERVOIR	C	RESERVOIR	TRINITY	Over allocated by current supplies.	BOTH	No
RAY ROBERTS LAKE/RESERVOIR NON-SYSTEM PORTION	C	RESERVOIR	TRINITY	Over allocated by current supplies.	BOTH	No
RAY ROBERTS-LEWISVILLE-GRAPEVINE LAKE/RESERVOIR SYSTEM	C	RESERVOIR	TRINITY	Over allocated by current supplies.	BOTH	No
RICHLAND CHAMBERS LAKE/RESERVOIR NON-SYSTEM PORTION	C	RESERVOIR	TRINITY	Possible issue with WMS Flags.	BOTH	Yes - C/G
TAWAKONI LAKE/RESERVOIR	D	RESERVOIR	SABINE	Over allocated by current supplies.	WUG	yes - C/D
TEXOMA LAKE/RESERVOIR NON-SYSTEM PORTION	C	RESERVOIR	RED	Possible issue with WMS Flags.	BOTH	yes - C/D
TRINITY AQUIFER	C	COOKE	TRINITY	Over allocated by current supplies.	WUG	No
TRINITY AQUIFER	C	ELLIS	TRINITY	OK - Overdraft	WUG	No
TRINITY AQUIFER	C	FANNIN	RED	OK - Overdraft	WUG	No
TRINITY AQUIFER	C	GRAYSON	TRINITY	Over allocated by current supplies.	WUG	No
TRINITY AQUIFER	G	JOHNSON	TRINITY	Over allocated by current supplies.	WUG	Yes - C/G
TRINITY AQUIFER	C	PARKER	TRINITY	Possible issue with WMS Flags.	WUG	No
TRWD LAKE/RESERVOIR SYSTEM	C	RESERVOIR	TRINITY	Possible issue with WMS Flags.	BOTH	Yes - C/G
WAXAHACHIE LAKE/RESERVOIR	C	RESERVOIR	TRINITY	Over allocated by current supplies.	WUG	No
WEATHERFORD LAKE/RESERVOIR	C	RESERVOIR	TRINITY	Over allocated by current supplies.	WUG	No
WOODBINE AQUIFER	C	COLLIN	TRINITY	Over allocated by current supplies.	WUG	No
WOODBINE AQUIFER	C	ELLIS	TRINITY	Over allocated by WMS. Project name does not include 'Overdraft'	WUG	No
WOODBINE AQUIFER	C	FANNIN	RED	Over allocated by current supplies.	WUG	No
WOODBINE AQUIFER	C	FANNIN	SULPHUR	Over allocated by current supplies.	WUG	yes - C/D
WOODBINE AQUIFER	C	FANNIN	TRINITY	OK - Overdraft	WUG	yes - C/D
WOODBINE AQUIFER	C	GRAYSON	RED	Over allocated by current supplies.	WUG	No

WATER USER GROUPS WITH APPARENT UNMET NEEDS

WUG Name	WUG Region	WUG County	WUG Basin	2010	2020	2030	2040	2050	2060
MANUFACTURING	C	DENTON	TRINITY	0	-51	-211	-335	-381	-576
ARGYLE	C	DENTON	TRINITY	0	0	0	-32	-107	0
ARGYLE WSC	C	DENTON	TRINITY	0	-133	-11	0	0	0
ATHENS	C	HENDERSON	TRINITY	0	-1,320	-1,568	-1,947	-2,492	-3,216
BARDWELL	C	ELLIS	TRINITY	0	-10	-33	-57	-86	-117
BONHAM	C	FANNIN	RED	0	-69	-404	-192	-1,363	-1,324
BUENA VISTA - BETHEL SUD	C	ELLIS	TRINITY	0	-539	-913	-1,336	-1,647	-2,084
CEDAR HILL	C	ELLIS	TRINITY	-1	0	0	0	0	0
CELINA	C	COLLIN	TRINITY	0	0	-6	-103	-105	-96
CELINA	C	DENTON	TRINITY	0	-331	-771	-1,510	-2,705	-3,212
COMMUNITY WATER COMPANY	C	ELLIS	TRINITY	-14	0	0	0	0	0
COUNTY-OTHER	C	FANNIN	RED	-152	-30	0	0	0	0
COUNTY-OTHER	C	FANNIN	TRINITY	-44	-35	-25	-16	-8	-2
FERRIS	C	ELLIS	TRINITY	-113	-147	-221	-277	-342	-404
GRAPEVINE	C	TARRANT	TRINITY	0	-33	-1,261	-2,372	-1,769	-2,732
HICKORY CREEK	C	DENTON	TRINITY	0	0	0	-26	0	0
HIGH POINT WSC	C	ROCKWALL	TRINITY	0	-1	0	-1	0	0
HOWE	C	GRAYSON	RED	-16	-28	-32	-38	-37	-35
HOWE	C	GRAYSON	TRINITY	0	0	-76	-177	-209	-230
IRVING	C	DALLAS	TRINITY	0	-1,477	-17,493	-19,771	-21,126	-22,368
ITALY	C	ELLIS	TRINITY	0	-30	-56	-87	-76	-101
JOHNSON COUNTY SUD	C	TARRANT	TRINITY	-179	-29	0	0	0	0
LUCAS	C	COLLIN	TRINITY	0	-1	0	0	0	0
MIDLOTHIAN	C	ELLIS	TRINITY	-83	-3,408	-5,054	-6,465	-5,341	-6,382
MUENSTER	C	COOKE	TRINITY	0	-3	-14	-15	-27	-40
OVILLA	C	DALLAS	TRINITY	-3	-4	-4	-6	-7	-11
OVILLA	C	ELLIS	TRINITY	-51	-53	-52	-50	-48	-45
PILOT POINT	C	DENTON	TRINITY	0	-118	-460	-498	-418	-595
SACHSE	C	COLLIN	TRINITY	-1	0	0	0	0	0
SANGER	C	DENTON	TRINITY	-718	-1,448	-2,184	-2,657	-2,986	-3,101
SARDIS-LONE ELM WSC	C	ELLIS	TRINITY	0	-1,944	-2,622	-2,545	-2,103	-1,980
WILLOW PARK	C	PARKER	TRINITY	0	-118	-423	-540	-569	-566
WORTHAM	C	FREESTONE	TRINITY	-258	0	0	0	0	-34
STEAM ELECTRIC POWER	C	ELLIS	TRINITY	0	0	0	-1,796	-3,766	-3,671

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July 20, 2010

Mr. James M. Parks
RCWPG Chairman/Administrator
c/o NTMWD
P.O. Box 2408
Wylie, Texas 75098-2408

Re: 2010 Region C Initially Prepared Regional Water Plan

Dear Mr. Parks:

Thank you for seeking review and comment from the Texas Parks and Wildlife Department ("TPWD") on the 2010 Initially Prepared Regional Water Plan for Region C (IPP).

As you may know, the Texas Parks and Wildlife Commission recently issued a new and updated Land and Water Resources Conservation and Recreation Plan. One of the cornerstones of the Land and Water Plan calls for TPWD to promote and protect healthy aquatic ecosystems, including the establishment of cooperative strategies to incorporate long-term plant, fish and wildlife needs in all statewide, regional and local watershed planning, management and permitting processes. As you will see in this letter, TPWD has some serious questions about the IPP and in particular, new reservoirs that are under active consideration.

TPWD understands that regional water planning groups are required by TAC §357.7(a)(8)(A) to perform quantitative reporting of environmental factors including effects on environmental water needs, wildlife habitat, cultural resources, and effects of upstream development on bays, estuaries and arms of the Gulf of Mexico when evaluating water management strategies. TPWD believes this quantification is a critical step in the process of attempting to plan for future water needs while at the same time, providing adequate protection of environmental resources, including fresh water inflows to current reservoirs and to the Gulf of Mexico. Accordingly, TPWD staff reviewed the IPP with a focus on the following questions:

- Does the IPP include a quantitative reporting of environmental factors including the effects on environmental water needs and habitat?
- Does the IPP include a description of natural resources and threats to natural resources due to water quantity or quality problems?
- Does the IPP discuss how these threats will be addressed?
- Does the IPP describe how it is consistent with long-term protection of natural resources?
- Does the IPP include water conservation as a water management strategy? Reuse?
- Does the IPP recommend any stream segments be nominated as ecologically unique?
- If the IPP includes strategies identified in the 2006 regional water plan, does it address concerns raised by TPWD in connection with the 2006 Water Plan.

Some amount of quantitative reporting of impacts to environmental factors for the major water management strategies is included in the plan. However, it appears the quantitative reporting has changed little from the 2006 plan. TPWD recognizes that this is likely due to different priorities and funding allocations during this planning cycle. Nevertheless, in the future, there is a need to update the quantitative reporting in the plan by incorporating available environmental data for each water management strategy. The Ralph Hall Reservoir and the Lower Bois d'Arc Creek Reservoir are both in the permitting phase of development. When environmental data becomes available for these projects it should be included in the quantitative analysis. This may include detailed biological and habitat information, as well as changes to water quantity and water quality.

The plan describes the natural resources in the region and briefly discusses threats to those resources from water management strategies in Chapters 1, 5, and 7. No detailed information is provided on how these threats will be addressed. Even though many of the threats will likely not be addressed until the permitting processes. However, there is a need to understand the threats to natural resources prior to the permitting process in order to better evaluate which water management strategies to include in the plan.

The transport of invasive species and toxic algae through interbasin transfers is not included as a threat to natural resources. Golden alga (*Prymnesium parvum*) and zebra mussels (*Dreissana polymorpha*) are both found in Lake Texoma. Zebra mussels have already been identified in West Prong Sister Grove Creek upstream of Lake Lavon due to an interbasin transfer from Lake Texoma. Fish kills from golden alga toxin are increasing throughout the Brazos River Basin and portions of Lake Texoma in the Red River Basin. For this reason, the importation of invasive species and toxic algae through interbasin transfers should be included as threats to natural resources. There is also a need to develop strategies for minimizing the impacts associated with transporting water from areas that are known to have invasive species or toxic algal species.

Marvin Nichols Reservoir is a recommended Water Management Strategy, but it covers a slightly different footprint than in the 2006 Regional Water Plan. This new footprint is qualitatively described as causing fewer impacts to bottomland hardwoods (page 4D.8). However, the new footprint does not appear to be reflected in the map (Figure 4D.1) or the quantification of inundated acreage on page 4D.8 (both of which are identical to the 2006 plan). TPWD supports the avoidance of bottomland hardwoods, but, pending additional details on the new footprint, continues to have significant concerns regarding the impacts to fish and wildlife posed by Marvin Nichols Reservoir.

Much of this planning cycle was devoted to advancing water conservation in Region C. TPWD is pleased to see Region C play an active role in the Water Conservation Advisory Council, funding water conservation awareness campaigns, and implementing the water conservation strategies in the 2006 plan. It is even more encouraging to see that the basic and expanded water conservation packages have been enhanced for the 2011 plan and the region continues to plan to meet the 140 gpcd goal (with reuse) by 2020.

With Region C projected to have 29% of the state's population by 2060 and the majority of water being used is for municipal supply, the region has a great opportunity to conserve water beyond the planned 135 gpcd by 2060. TPWD staff encourages the region to continue to pursue advanced strategies to conserve water.

Tables 4B.3 and 6.7 project the total Region C demands at 2,924,157 acre-feet per year in 2060 which differs from the total demand of 3,273,461 acre-feet per year listed in Chapter 2. The 2,924,157 acre-feet per year appears to only be the 2060 municipal demand as shown in Table 2.3. You may wish to rectify this discrepancy in the final water plan.

TPWD staff appreciates the time the planning group gave to evaluating whether to recommend stream segments as ecologically unique. Although TPWD would have preferred to see stream segments be recommended as unique segments, it supports the planning group's legislative recommendation to form a working group comprised of representatives of TWDB, TPWD, TCEQ, and the sixteen water planning regions to bring clarity, purpose, and direction to designating streams as ecologically unique.

The plan calls for an approximate 25% surplus of water supply above the projected demand of 3.3 million acre-feet per year for 2060. This amount of surplus (about 840,000 acre-feet per year) represents significant potential oversupply with corresponding significant potential impacts to natural resources.

TPWD hopes the Region C Regional Water Planning Group will consider and address our questions and concerns before finalizing the IPP. While we value and appreciate the need to meet future water supply demands, we must do so in a thoughtful and sound manner that ensures the ecological health of our state's aquatic and natural resources. We look forward to hearing from you. If you have any questions, or if we can be of any assistance, please feel to contact Cindy Loeffler at 512-389-8715. Thank you.

Sincerely,

Ross Melinchuk
Deputy Executive Director, Natural Resources

RM:CL:ch

Enclosure

Richard Roca

From: Julie Hunt [Julie.Hunt@arlingtontx.gov]
Sent: Friday, May 28, 2010 8:51 AM
To: Region C Comments
Cc: Darryl Westbrook; Dustan Compton
Subject: comments on State Water Plan

As mentioned at the Public meeting on May 25, Arlington recommends modifying the model water conservation plan, Appendix L of the State Water Plan to use the year round 10am -6pm restriction for outdoor irrigation.

Julia J. Hunt, P.E.
Director of Water Utilities
Arlington Water Utilities
817.459.6600

Richard Roca

From: Julie Hunt [Julie.Hunt@arlingtontx.gov]
Sent: Thursday, April 22, 2010 6:54 PM
To: Amy Kaarlela
Cc: Tom Gooch
Subject: FW: Region C Plan for Arlington
Attachments: Arlington.pdf; Arlington Appendix H.pdf

Amy,
Thank you for sending to me. I had a chance to review the text in the Arlington document. Will you make these corrections? The water in Lake Arlington is from TRWD so we pay them for this water withdrawal from Lake Arlington (even though we own the Lake). Please use John F. Kubala Treatment Plant for the name of the plant (instead of Kubala). Thank you.

From: Amy Kaarlela [mailto:adk@freese.com]
Sent: Tuesday, April 20, 2010 3:05 PM
To: Julie Hunt
Cc: Tom Gooch
Subject: Region C Plan for Arlington

Ms. Hunt,

Attached is a portion of Chapter 4E ("Recommended Strategies for Wholesale Providers") from the *2011 Initially Prepared Region C Water Plan*. These pages contain our understanding of your demands, supplies, and future strategies. Also attached is an excerpt from Appendix H, which details your customers' demand on your system. There will be a Public Hearing on May 25, 2010 at which time the public is encouraged to provide comment and/or ask questions about the Plan. The public comment period runs through July 26, 2010. As a Wholesale Water Provider, we welcome your input at any time before July 26th, and would be glad to discuss these plans with you. Thank you for your participation in the Region C planning process.
Amy

Amy D. Kaarlela
Water Resources Planning
Freese and Nichols, Inc.
817-735-7438
adk@freese.com
www.freese.com

Richard Roca

From: Robert D. Stanley [Robert.Stanley@arlingtontx.gov]
Sent: Wednesday, April 28, 2010 11:15 AM
To: Amy Kaarlela
Subject: Region C Plan for Arlington Review

Amy,
Julie ask me to review the documents you send from the 2011 Initially Prepared Region C Water Plan (via email April 20, 2010). I have a few questions I hope you can help me with:

1. Where did the wholesale supply estimates come from? I believe the Pantego supply estimate should be closer to 1.0 MGD instead of 0.1 MGD?
2. Table 4E.27 under "Current Supply" why does the TRWD volumes decrease (from 68,006 ac-ft to 48,949 ac-ft)? In the previous Demand vs Supply table we reviewed, under "Supplies" the TRWD volume increased from 70,336 ac-ft to 95,627 ac-ft?
3. Table 4E.27 under "Water Management Strategies" what does "Additional TRWD (to Current Plan Capacity)" mean? It looks like part of the TRWD supply was moved from "Supplies" to "Strategies", why?

Please feel free to email me your responses (preferred) or give me a call this afternoon.

Thank you,

Robert D. Stanley, PE
Water/Wastewater Modeling Engineer

City of Arlington Water Utilities
Mail Stop 01-0200
P.O. Box 90231
Arlington, TX 76004-3231

Phone: (817) 459-6824
Fax: (817) 459-6626
Email: robert.stanley@arlingtontx.gov

Mistakes made on the Water Supply Study for Fannin County prepared by Alan Plumber and Associates:

1. Page 5 shows the Fannin County map with water systems and their service areas. Bois D' Arc MUD and White Shed WSC serves more than 25% of the County and we were not invited to any meetings or had any input in this study.

Response: As defined by TWDB and described in Water Supply Study for Fannin County on page 8, non-city utilities are defined as water user groups (WUGs) based on annual average demands of at least 280 ac-ft/year, not service area size or service area population. The two water providers mentioned, as well as 17 other water providers not individually identified in the report, do not meet the TWDB water use requirements for WUGs. Water providers that do not meet these requirements are aggregated into the "County-Other" category for planning purposes.

2. Page 6, 3.1 Population Demands. This report states that surveys were sent to the WUGs (Water User Group) prior to the meetings. The city of Honey Grove attendees told me that they (did not) receive any survey and that the information provided by APAI (Alan Plumber and Associates Inc.) was inaccurate and that APAI would not listen to them and would not change any figures.

Response: Surveys were sent to each of the 11 defined municipal WUGs in Fannin County and were completed and returned by 8 WUGs. The survey response received on March 12, 2009 from Honey Grove indicated that population would increase more than the proposed projections showed. The population was adjusted based on the survey comments and the new projections were subsequently approved by TWDB in September 2009. Meeting minutes published from September 19, 2009 meeting indicate no disagreement with the approved projections.

3. Page 6 3rd paragraph states that APAI met with Hickory Creek SUD and North Hunt WSC, small providers in Fannin County, and did not meet with Bois D' Arc MUD or White Shed WSC, providers of over 25% of the County.

Response: See response to comment #1.

4. Page 7 Table 3.1 Where is Bois D' Arc Mud?

Response: See response to comment #1.

5. Page 8 Last paragraph finally mentioned us as using 172 acre feet of water / year when we really use 212 acre feet of water / year. Where are they getting these figures?

Response: As referenced in the report the pumping information was accessed from TCEQ records, which are collected from data supplied by public water systems to the state. TWDB website currently lists Bois D' Arc MUD usage at 172 acre feet of water per year.

6. Page 9 3.3 It states that APAI collected information from Honey Grove. Honey Grove never was asked to provide any information and told APAI that the information was wrong and they still did not correct it.

Response: See response to comment #2.

7. Page 11 Table 3.2 Honey Grove is projected to grow from 1838 for 2010 to 4000 in 2060. I have lived in the Honey Grove area for 58 years and I have seen the population go from 2100 to 1838. With the high city tax rate and the economy, it will do good to stay the same. Many of the residents are moving to the country or dying off. The city of Ladonia is shown to have a population of 1500 for 2010. At the present the population is 667. Somebody didn't do their research.

Response: See response to comment #2.

8. Page 15 Table 3.4 The table shows Ladonia per capita water use is 325 which is not correct. Several years ago the Supreme Meat Packing plant could have used enough water to show that high of a per capita. It has been closed down and will never be opened again. After speaking with a Ladonia official, they met at Honey Grove with APAI with their records but were told that they would not need them. I WONDER WHY!

Response: The survey response received on April 1, 2009 from Ladonia indicates no significant disagreement with projected population and demand estimates. Meeting minutes published from September 19, 2009 meeting also indicate no disagreement.

9. Page 16 Table 3.5 This table shows Ladonia's water demand to be 546 acre feet per year. That is over 177,000,000 gallons/ year for a population of 667 people. Bois D' Arc Mud's population is a little over 2600 and our usage is 70,000,000 / year. There is something wrong with this report.

Response: The figure of 546 acre-feet per year is from the 2006 Plan as indicated in Table 3.5. The updated 2011 projection for Ladonia for 2010 demand is 291 acre-feet per year as indicated in the same table. Differences in per capita consumption produce differences in total consumption for different utilities and municipalities.

10. Page 18, 4.2 Who determines sustainable yields of an aquifer? They need to talk to Dr. Collier from Erath County.

Response: As referenced in the report the sustainable aquifer yields are provided by the Groundwater Availability Model for the Trinity and Woodbine Aquifers for Groundwater Management Area 8 as defined by the Texas Water Development Board. Use of these Groundwater Availability Models is required by TWDB for Regional Planning.

11. Page 23 Table 6.3 Honey Grove's projected population is inaccurate. APAI has taken the growth in the southwestern part of the county and is applying it to the northeastern part of the county and that just doesn't work!

Response: See response to comment #2.

12. Page 24 Ladonia's projected population growth is over-estimated to grow over three times its present size. It will not happen. In 1972 when Ladonia voted to go wet (sale of alcohol), all kind of predictions were made and it only caused the town to diminish in size and quality of people.

Response: See response to comment #8.

13. Page 30 Fannin County's irrigation figures are based on the permits issued to farmers in the 1980's. Most do not irrigate any more and none of them meter their water. How can they have amounts charted when none of the water is metered.

Response: Irrigation usage varies greatly based on climate condition: the irrigation demand displayed in Table 6.13 is based on historical peak Texas Water Development Board records to ensure adequate supply for dry weather conditions. Future projections do not show any increase from the historical peak.

14. North Texas Municipal Water District is controlling what is done on the Region C level. They are trying to scare everyone into believing that the ground water is diminishing and that the county will have to go to surface water. Could that be that they will be the only surface water provider in northeast Texas? Is that a " Monopoly"? Didn't the government break up the "Phone company" because they didn't want one company in control. I predict and can prove that ground water (in this area) will continue to be the main source of water for the next 50 years, only if the TCEQ will ignore NTMWD and their ploy to bash ground water users so that they will be the "only" game in town. Most people in the entities that have been on

ground water all their life want to continue to be on ground water. They hear complaints from the surface water customers on how bad the water is since NTMWD took over the water treatment plant for the city of Bonham. (bad taste, tea colored bath water, stained laundry)

Response: Comment acknowledged.

15. This small amount of information is proof that the report was not done accurately. If all of the Fannin County WUGs were accurately surveyed, This report would look somewhat different. If this many mistakes were made on this report, all of the other counties reports will be bogus too.

Response: Comment acknowledged.

Richard Roca

From: Jason Gray [Celina] [jgray@celina-tx.gov]
Sent: Tuesday, May 04, 2010 2:37 PM
To: Region C Comments
Cc: jjohnson@celina-tx.gov; 'Gary Hendricks'; lpatterson@utrwd.com
Subject: FW: 2011 Region C Water IPP for City of Celina

Region C Water Planning Team-

The only comment from the City of Celina is that we may need access to NTMWD water prior to the 2020 date shown in the draft. We would prefer to be shown as receiving up to 1.5mgd from NTMWD in the 2010-2020 timeframe.

Thank you-

Jason Gray
City Manager

142 North Ohio
Celina, Texas 75009
972-382-3617 (O)
469-396-9640 (M)
jgray@celina-tx.gov
www.celina-tx.gov

From: Gil Barnett [mailto:gbarnett@cpyi.com]
Sent: Monday, May 03, 2010 4:09 PM
To: jgray@celina-tx.gov
Subject: 2011 Region C Water IPP for City of Celina

Dear Mr. Jason Gray,

This email is being sent to you to inform you that the *2011 Initially Prepared Region C Water Plan* was submitted to the Texas Water Development Board on April 1st, 2010. Copies of the plan have been sent to County Clerk offices in all counties and to one library in each county to be available for the public to review. A list of the locations where copies have been sent can be found on the Region C web site at www.regioncwater.org. An electronic copy of the *2011 Initially Prepared Region C Water Plan* can also be downloaded from the Region C web site.

A summary of the population and water demand projections, existing water supplies, and proposed water management strategies for City of Celina is included in the table below. The public has until July 26th, 2010 to comment on the *2011 Initially Prepared Region C Water Plan*.

Also, on Tuesday May 25th, 2010 at 7:00 PM, there will be a public hearing held at the Bob Duncan Community Center. The purpose of this public hearing is to receive comments from the public regarding the Water Plan. The address is:

Bob Duncan Community Center
2800 S. Center Street
Arlington, TX 76014

To provide written comments on the *2011 Initially Prepared Region C Water Plan*, or for public hearing questions, please contact:

Amy Kaarlela

Freese & Nichols
4055 International Plaza, Suite 200
Fort Worth, TX 76109-7438
Phone: 817-735-7438

Email: RegionCcomments@freese.com

Table C-41
Celina

(Values in Ac-Ft/Yr)	Projected Population and Demand					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Projected Population	**5,000**	**25,414**	**53,798**	**95,267**	**145,702**	**168,118**
Projected Water Demand						
Municipal Demand	1,238	6,234	13,076	23,050	35,253	40,677
Total Projected Water Demand	***1,238***	***6,234***	***13,076***	***23,050***	***35,253***	***40,677***
Currently Available Water Supplies						
Trinity Aquifer	317	317	317	317	317	317
Woodbine Aquifer	236	236	236	236	236	236
Upper Trinity Regional Water District	723	1,517	2,338	2,800	2,800	2,800
Total Current Supplies	***1,276***	***2,070***	***2,891***	***3,353***	***3,353***	***3,353***
Need (Demand - Current Supply)	***0***	***4,164***	***10,185***	***19,697***	***31,900***	***37,324***
Water Management Strategies						
Water Conservation	37	317	791	1,593	2,732	3,497
Additional Water from UTRWD	0	2,403	6,500	13,259	24,373	29,082
Connection to NTMWD and Supply	0	1,500	3,000	5,000	5,000	5,000
Supplemental Wells	0	0	0	0	0	0
Total Water Management Strategies	***37***	***4,220***	***10,291***	***19,852***	***32,105***	***37,579***
Reserve (Shortage)	**75**	**56**	**106**	**155**	**205**	**255**

Gil Barnett
CP&Y, Inc.
gbarnett@cpyi.com

Richard Roca

From: Tom Gooch
Sent: Friday, April 09, 2010 2:47 PM
To: Marilyn Rice
Cc: 'tcg'; Amy Kaarlela
Subject: RE: Region C Water

Dear Mr. Rice:

The demands for Copeville SUD are included under Collin County Other. The Texas Water Development Board definition for water user groups includes cities with over 500 people and other suppliers (WSCs, SUDs, private companies and other districts) supplying more than 0.25 mgd on an average day basis. Copeville SUD supplies very near 0.25 mgd on an average basis and may be included as a separate water user group in the next round of planning.

The "County Other" category is where the demands and supplies for the suppliers that aren't covered as individual WUGs are included. We have included demands for Copeville SUD (as part of Collin County Other) in the plans of North Texas MWD.

We appreciate your reviewing the Region C Plan. Please let us know if you have other comments or questions.

Yours truly,

Tom Gooch
Vice President
Freese and Nichols
4055 International Plaza, Suite 200
Fort Worth, Texas 76109-4895
Phone: (817)735-7314
Cell: (817) 602-0492
FAX: (817)735-7492
tcg@freese.com

From: Marilyn Rice [mailto:mrice@consultrice.com]
Sent: Friday, April 09, 2010 11:27 AM
To: Tom Gooch
Subject: Region C Water

My name is James Rice, president of the Copeville SUD. I reviewed the Region C initial plan and did not see any mention of Copeville SUD in the Collin County detail of the executive summary. Are our numbers included in the County number or are they not included?

Thanks for your attention to this,

James Rice
214-793-4161

Richard Roca

From: Tyler N. Hendrickson [then@velvin-weeks.com]
Sent: Wednesday, March 03, 2010 1:47 PM
To: Keeley Brown
Subject: Re: Region C water supply projections for Crandall
Attachments: city of crandall - projected capacities.pdf

Keeley - Crandall's current contractual capacity is 1.17 mgd or 522 acre-feet/yr (allowable peaking factor is 2.5). The allotment from 4/1 can not be reduced at this time. Once the 4/1 system is upgraded to the maximum pumping capacity of 5,000 gpm, Crandall's capacity will be: 1.94 mgd or 870 acre-feet/yr.

I've got a spreadsheet of the projected demands through 2060. After meeting with TCEQ and Crandall today I need to make some updates. I've attached a preliminary copy for you to look over.

Tyler

On 3/3/2010 1:23 PM, Keeley Brown wrote:
Tyler,

After meeting with Heath several months ago, it was our understanding that once Crandall had access to water from DWU they were going to reduce what they were currently taking from the Kaufman 4-1 line—reduce it to the portion they actually own (27.7% of the line). Our records show that the peak capacity of the Kaufman 4-1 line is 3000 gpm. Using a peaking factor of 2, Crandall's portion of the average capacity of the line is 670 ac-ft/yr. Therefore, the decrease is due to the fact that once Crandall can begin taking water from DWU (sometime before 2020), they will only take their portion of the 4-1 line (670 ac-ft/yr) and their remaining needs will be met with DWU supplies. Please let me know if any of the above is incorrect or is not what Crandall plans on doing.

Keeley Brown, EIT
Freese and Nichols, Inc.
(817) 735-7476

From: Tyler N. Hendrickson [mailto:then@velvin-weeks.com]
Sent: Wednesday, March 03, 2010 1:08 PM
To: Keeley Brown
Subject: Region C water supply projections for Crandall

Keeley - I've attached a section of the Crandall water projections from your Table A2-1. I'm not clear on why the available supply from NTMWD decreases so significantly.

Thanks - Tyler

VELVIN & WEEKS
CONSULTING ENGINEERS, INC.

Tyler N. Hendrickson, P.E.
President

930 East Corsicana Street • Athens, Texas 75751
phone: 903-675-3903 • *fax:* 903-675-8345
mobile phone: 903-676-6138 • *email:* then@velvin-weeks.com

RCWPG MEETING
MAY 25, 2010

PUBLIC HEARING WRITTEN COMMENT FORM

Name: Donald W. Curston

Representing: Citizens Opposing Mary's Creek Sewage Plant in Our Neighborhood

Mailing Address: 10129 Chapel ~~Creek~~ Glen Terrace, Ft Worth TX 76116

E-mail Address: doncurst@tarrantcounty.com

Comment: This wastewater Treatment Plant is in the wrong place. It would destroy established homes, increase the flooding and erosion of Mary's Creek, and change the ecological balance in the basin. The proposed areas are near schools and churches. Children, pets, and wild animals use the creek freely; the gray water output of this plant would pose a serious health risk. More thought and emphasis on Wetlands are needed - not just cessation of dumping unclean water and creating pollution, but refocus on creating clean, reusable, and ecologically helpful means of expanding and reusing the water we turn into wastewater.

Mary's Creek already floods 10 to 28 feet, one to four times each year, just from normal rainfall. The increased water flow from both the plant and from planned new construction of communities can only make this worse. Further, the growth projected to require this plant is much farther west - the plan should include placement of new water or reuse sources closer to where they will be needed.

The plan needs to be revised with more direction and better recommendations.

Richard Roca

From: cbell@dallaschamber.org
Sent: Tuesday, May 18, 2010 2:57 PM
To: Region C Comments
Subject: Region C Water Plan

Please reply to cbell@dallaschamber.org

Mr. Jim Parks
RCWPG Chairman/Administrator
c/o North Texas Municipal Water District
P.O. Box 2408
Wylie, Texas 75098-2408

Mr. Parks:

As you know, the Initially Prepared 2011 Region C Water Plan, which covers all or part of 16 North Central Texas counties was adopted by the Region C Water Planning Group on March 15, 2010. As a member of the Dallas Regional Chamber, I believe the Water Plan represents a feasible plan for fulfilling the water needs for the 16-county region through 2060.

In my opinion, water is a critical and essential factor in the economic and social development of North Central Texas. Without a viable and definitive plan for addressing the future water needs of our part of the state, the prospect for citizens and businesses to achieve success, growth and a sustainable quality of life is jeopardized.

Along with my colleagues at the Dallas Regional Chamber, I urge you to support final adoption of the proposed Region C Water Plan which is scheduled for a public hearing on May 25, 2010 in Arlington and set to be finalized in September of 2010. Your support of the Water Plan will enable us to collectively and effectively address our long-term, important region-wide water needs.

Thank you!

Regards,

Mrs. Christie Bell
525 W. Westchester Pkwy
Apt 712
Grand Prairie TX 75052
Email: cbell@dallaschamber.org

GREATER TEXOMA UTILITY AUTHORITY

5100 AIRPORT DRIVE
DENISON, TEXAS 75020-8448
903/786-4433
FAX: 903/786-8211
www.gtua.org

MEMO

TO: Tom Gooch, Freese and Nichols, Inc.

FROM: Jerry W. Chapman, General Manager

DATE: August 13, 2010

RE: Comments on Region C 2011 Initially Prepared Plan

I had recently provided you with comments on the Initially Prepared Plan for Region C as it relates to retail water providers in the Texoma area. In addition to comments already provided, I would like to pass on comments received from the City of Denison in a meeting with Denison representatives earlier today. I met with City Engineer David Howerton and the Water Plant Superintendent Dean Rylant. They advised me they would like to make sure any water plant improvements they need to make to their water treatment plant would be identified in the plan for 2011 as well as dam and spillway repairs, raw water line, intake and raw water pump station replacement at Lake Randell. Thank you very much for your consideration of these matters.

JWC:cc

cc: David Howerton, City of Denison

Amy Kaarlela

From: Howerton, David [DHowerton@cityofdenison.com]
Sent: Wednesday, September 01, 2010 1:29 PM
To: Jerry Chapman (jerryc@gtua.org)
Cc: Carmen Catterson; Amy Kaarlela; Tom Gooch
Subject: RE: Initially Prepared Plan Comments - City of Denison

Jerry,

Here is the info I understand that is needed for the Initially Prepared Plan:

1. No additional treatment capacity planned via these improvements or for the foreseeable future.
2. New two million gallon clearwell and misc. repairs $1,850,000
2. New raw water line from Lake Texoma to Lake Randell $ 400,000
3. New Lake Randell raw water pump station and intake $3,500,000
4. Lake Randell spillway and dam improvements $3,000,000
5. Randell WTP flocculation/mixing/clarifier repairs $1,025,000

Thanks for your assistance. Please let me know if you have any questions.
David Howerton
Denison Public Works

-----Original Message-----
From: Tom Gooch [mailto:TCG@freese.com]
Sent: Friday, August 13, 2010 4:54 PM
To: Carmen Catterson
Cc: Howerton, David; Jerry Chapman (jerryc@gtua.org); Amy Kaarlela
Subject: RE: Initially Prepared Plan Comments - City of Denison

Do they have cost estimates for any of these? Will the 2011 WTP improvements increase plant capacity? By how much? Should we call Mr. Howerton on these questions?

Tom

From: Carmen Catterson [carmenc@gtua.org]
Sent: Friday, August 13, 2010 4:33 PM
To: Tom Gooch
Cc: David Howerton
Subject: Initially Prepared Plan Comments - City of Denison

Attached is a memo regarding comments on the Initally Prepared Plan.

Carmen Catterson, Secretary
Greater Texoma Utility Authority
5100 Airport Drive
Denison, TX 75020
Phone: (903) 786-4433
Fax: (903) 786-8211
carmenc@gtua.org

Richard Roca

From: Robert Bolen [rbolen@ennis-texas.com]
Sent: Monday, April 26, 2010 10:16 AM
To: Amy Kaarlela
Cc: 'Steve Howerton'
Subject: RE: Region C Plan for Ennis

Ms Kaarlela,

Please note the following changes that should be made to projections and demands for the City of Ennis.

Current available supplies should be 8,810 ac/ft not 5,512 ac/ft as shown
We currently own water rights in Lake Bardwell of 5,200 ac/ft and there is no reason to show a reduction of those water rights over the projection period. We also have available water rights from TRWD of 2.810 ac/ft. This water is available now not in 2060 as shown.

Ellis County Steam Electric Power should be changed to reflect the actual name of the power company which is Suez, N.A. Electric Power.

The City of Bardwell should be removed from our system demands since no agreement exists between the City of Ennis and the City of Bardwell.

Community Water Company cannot by contract exceed 266 ac/ft per year

Please make the required changes to the charts and graphs and return them to me for approval.

Thank you

Robert Bolen

From: Amy Kaarlela [mailto:adk@freese.com]
Sent: Wednesday, April 21, 2010 9:45 AM
To: rbolen@ennis-texas.com
Cc: Tom Gooch
Subject: Region C Plan for Ennis

Mr. Bolen,

Attached is a portion of Chapter 4E ("Recommended Strategies for Wholesale Providers") from the *2011 Initially Prepared Region C Water Plan*. These pages contain our understanding of your demands, supplies, and future strategies. Also attached is an excerpt from Appendix H, which details your customers' demand on your system. There will be a Public Hearing on May 25, 2010 at which time the public is encouraged to provide comment and/or ask questions about the Plan. The public comment period runs through July 26, 2010. As a Wholesale Water Provider, we welcome your input at any time before July 26th, and would be glad to discuss these plans with you. Thank you for your participation in the Region C planning process.
Amy

Amy D. Kaarlela
Water Resources Planning
Freese and Nichols, Inc.

817-735-7438
adk@freese.com
www.freese.com

Richard Roca

From: Ron McCuller [Rmcculle@GPTX.org]
Sent: Monday, July 12, 2010 11:47 AM
To: Amy Kaarlela
Cc: Tom Gooch; Doug Cuny
Subject: RE: Region C Plan for Grand Prairie

Ms Kaarlela:

Thank you for the opportunity to comment on the Region C Water Plan for Grand Prairie. The document looks good with the following excerptions:

1. On page 4E.83 the statement in the middle of the page should be revised to read "Grand Prairie has entered into contracts to obtain supplies from Midlothian, Mansfield and ~~Arlington~~ is investigating an Arlington Supply, all of which will be implemented before 2020".
2. Table 4E.52-The Grand Prairie share of capital costs on the Arlington Project is currently estimated at $2.5 million. IN this same table, I expect the more reasonable dates to be developed are as follows:
    a. Midlothian – 2015
    b. Mansfield – 2012
    c. Arlington – 2013
    d. Additional DWU – incrementally adding abt. 1-2 MGD per year 2011 thru 2060.
    e. Supplemental Wells – in place, rehab costs anticipate to be abt. $3 million over the 50 yr. period (I don't know where the $13,265,000 figure comes from)

Hope this helps. Call me if you have questions.

Thanks.

Ronald E. McCuller
Public Works Director
206 W. Church St.
P.O. Box 534045
Grand Prairie, Texas 75053-4075
Office 972-237-8066
Fax 972-237-8116
rmcculle@gptx.org

From: Amy Kaarlela [mailto:adk@freese.com]
Sent: Wednesday, April 21, 2010 9:54 AM
To: Ron McCuller
Cc: Tom Gooch
Subject: Region C Plan for Grand Prairie

Mr. McCuller,

Attached is a portion of Chapter 4E ("Recommended Strategies for Wholesale Providers") from the *2011 Initially Prepared Region C Water Plan*. These pages contain our understanding of your demands, supplies, and future strategies. There will be a Public Hearing on May 25, 2010 at which time the public is encouraged to provide comment and/or ask questions about the Plan. The public comment period runs through July 26, 2010. As a Wholesale Water Provider, we welcome your input at any time before July 26th, and would be glad to discuss these plans with you. Thank you for your participation in the Region C planning process.
Amy

Amy D. Kaarlela
Water Resources Planning

Freese and Nichols, Inc.
817-735-7438
adk@freese.com
www.freese.com

June 19, 2010

Dear Region C Water District,

I believe that the Region C Water Plan relies too heavily on spending billions of taxpayer dollars for new reservoirs and pipelines, rather than conserving the water that we do have. The average rainfall for Dallas is 38 inches a year. That is a lot of water. Conservation is much cheaper than lawsuits, pipelines, building reservoirs and paying other states for their water

Here in Dallas, we have a Water Conservation Ordinance that is essentially unenforced because of the design of the program. I continue to see many, many sprinkler systems watering lawns during and immediately after a 3-4 inch rain in Dallas. This is a pure waste of water. I see people watering the lawn at 1:00 in the afternoon, and many broken sprinkler systems with missing heads/broken pipes. This lack of enforcement has been obvious for the past 3 years. The Code Compliance officers are afraid to give a notice of violation to the property owner.

At a time when we are considering building a $500,000,000.00 pipeline to Oklahoma, and considering building reservoirs in East Texas which will condemn tens of thousands of acres of farm land, it seems as though we first should do a much better job of implementing water conservation throughout Region C. I have lived in an arid region of Colorado before and experienced first hand what constitutes effective and substantial water conservation. Here in Dallas, we are far, far away from any type of meaningful water conservation.

There are many conservation measures yet to be implemented and enforced before we begin spending $8,000,000,000.00 to build pipelines and reservoirs. We should strengthen existing conservation measures and begin using alternate day watering, drip irrigation, water conserving MP rotator sprinkler heads, drought tolerant landscaping, and rainwater harvesting. I believe that Austin gives a $500 rebate for anyone who installs a rain harvesting system at their home. In San Antonio, they are allowed to water the grass one day a week, as compared to seven days a week in Dallas. At a time when municipal, state, and federal budgets all have deficits, water conservation is much less expensive than building pipelines, reservoirs, and buying water from other states.

As noted, I believe that the 2011 Region C Water Plan substantially lacks measures to ensure compliance with adequate water conservation regulations, and instead relies too heavily on simply making up the difference by unnecessarily spending huge amounts of taxpayer money to import vast quantities of water from other areas. All so that we can keep the lawns looking perfect and the pools overflowing and the country clubs green.

It is my strong recommendation that the plan be amended to increase the conservation of water in Region C, and decrease frivolous spending of taxpayer money on new water.

Sincerely,

Carlyle Greenfield, M.D.
Dallas, TX

MEMO

TO: Tom Gooch, Freese & Nichols, Inc.

FROM: Jerry W. Chapman, General Manager

DATE: August 11, 2010

RE: Comments on 2011 Initially Prepared Region C Plan

Outlined below are comments I am offering after reviewing the 2011 Initially Prepared Region C Plan. My comments are identified by the page of items as they are found in the report.

- Page ES.19 – Cooke County Water User Groups
  - City of Gainesville - It might be worthwhile to consider mentioning under the City of Gainesville Recommended Strategies expansion of the Water Treatment Plant. The Authority currently has an application for the TWDB Water Infrastructure Fund to expand that plant.
  - City of Muenster - Under the City of Muenster Recommended Strategies include supplemental wells and developing Lake Muenster supply. It might be worthwhile to add Cooke County Water Supply project. I spoke with the City Administrator and he agrees this would be good to list as a possible strategy so Muenster would be able to participate in the future, if desired.
  - Manufacturing - Under Manufacturing Recommended Strategies, supplemental wells and Lake Muenster are listed. I was wondering why Lake Muenster would be listed for Manufacturing sources in Cooke County. The supply from Lake Muenster is limited and remote from most manufacturing activities

- Page ES.30 – Fannin County Water User Groups
  - Steam Electric Power - Under the Steam Electric Power for 2060 identifying 13,092 acre-feet of water, the current supplies are listed as Woodbine Aquifer and Lake Texoma (for TXU) and recommended strategies include supplemental wells. Since we have already received one inquiry from a merchant power plant to utilize water from Lake Texoma I wondered if it would be possible to consider leaving that option open for future steam electric users in Fannin County.

- Page 2.12 – Table 2.2 – Adopted Cooke County Water Demand Projections for Region C
  - I am curious as to why Cooke County's water demand projections are so low when compared with counties of similar size. For example, Fannin County begins with a 2006 demand of 12,198 acre-feet and grows to a demand of 34,063 acre-feet in 2060. Cooke County begins at 8,324 acre-feet of demand in 2006 and only grows to 14,381 by 2060. The populations of the two counties are similar and I am uncertain as to why Cooke County's demand less than doubles over a 50-year period.

- Page 3.11 – Table 3.5 – Groundwater Supplies in Region C
  - Groundwater supplies in this table reflect the Woodbine and Trinity Aquifers. Other areas in the report, specifically Table 1.5 on groundwater availability in Appendix I show "other" aquifers in Fannin County of 2,919 acre-feet. I understand this may be the Red River Alluvian and I understand this may have been derived from TWDB historical reports. The members of the Red River Groundwater Conservation District are concerned about having that amount of water appear in their available supplies, when that water would not be available to a typical water provider in Fannin County.

- Page 3.14 – Table 3.7 – Currently Available Supplies by County
  - What are the sources of Fannin County's water supply?

- Page 3.18 – Table 3.5
  - Greater Texoma Utility Authority – It might be worthwhile to reflect the increase in water supply available from 25,000 acre-feet per year to add the newly secured 56,500 acre-feet approved earlier this year.

- Page 4C.7 – Table 4C.2
  - This page does reflect the 56,500 acre-feet of additional water storage, which would seem to support my recommendation that the previous table be modified to reflect this water.

- Page 4D.11 – 4D.5 Lake Texoma
  - The second paragraph should be modified to reflect the reallocated 150,000 acre-feet of water storage purchased by GTUA and the North Texas Municipal Water District.

- Page 4F.3
  - In the fourth bullet, the information suggests that Marilee SUD and South Grayson WSC will continue using water from the Trinity Aquifer and will be supplied by the Grayson County Water Supply Project. The City of Gunter should be added since they, too will be supplied by the Grayson County Water Supply Project.

- Page 4F.5
  - South Grayson Water Supply Corporation – Perhaps the CGMA source should be further clarified. South Grayson WSC already has the approval of the cities involved to receive water if they desire.

- Page 4F.8
  - City of Melissa – The City is listed as a possible candidate for expansion to $1,330,000 for additional wells. It is unlikely Melissa will ever drill another well since they are now supplied by the CGMA project and a line from NTMWD.

- Page 4F.12
  - The second paragraph mentions the Gainesville Water Treatment Plant Expansion. I would like this to be consistent with the previous mention of this project on ES.19.

- Page 4F.14 – Table 4F.4
  - With regard to this table, Muenster is listed as having three strategies - conservation, supplemental wells and Muenster Lake. I discussed this matter with the City Administrator and agrees it might be worthwhile to mention the Cooke County Water Supply Project as an option for Muenster.

- Page 4F.75
  - South Grayson WSC is mentioned as purchasing water from the NTMWD. Although that will be the origin of the water supply, the purchase will be through GTUA and the CGMA project.

- Page 4F.77
  - City of Pottsboro recommended strategies include conservation, supplemental wells and additional Denison supplies. In a conversation with the City Manager of Pottsboro, he requested an option for surface supplies involving the City of Pottsboro and other retail water providers in the Preston Peninsula area as a potential option. This would probably be the development of a small reverse osmosis plant that might be developed to serve Pottsboro, Red River Authority of Texas and Southwest Water Co. System around Lake Texoma. Southwest Water Co. has recently requested a contract from Pottsboro to supply wholesale water to their systems.

- As we have already discussed, the expansion of the Lake Texoma Pump Station should be included as a strategy.

JWC:cc

An Unsolicited Review of the 2011 Region C Proposed Water Plan

By Douglas T. Hawes, retired Agronomist
Plano, TX May, 2010

I first became aware of the Region C's proposed water plan when reading an April 12, 2010 editorial in The Dallas Morning News. For various reasons I had trouble down loading it off the internet and obtained a CD version from Amy D. Kaarlela of Freese and Nichols, Inc. This allowed me to review it a little each day for three weeks. There is a tremendous amount of material on the CD and I skimmed most of it. I did not even skim the County studies of: Cooke-Graham, Fannin, Freestone, Kaufman, and Navarro.

I looked at the Plan as both a long time citizen of Plano, TX and a retired agronomist who had made a living assisting golf courses with their maintenance problems. I did the latter both as a traveling consultant and as a technical college instructor both here at Grayson County College, Denison, TX and at a similar position at the Institute of Applied Agriculture(IAA), College Park, MD. I earned a Ph. D. in agronomy at the University of Maryland while teaching in the IAA.

On the East Coast too much water, usually as rainfall, made turf diseases a very high priority maintenance problem. In the many state region where I worked north and west of Texas as a consultant, low water quantity and poor water quality were both primary maintenance concerns on many golf courses.

This latter extensive experience left me with a strong interest in water quality and quantity which I have continued to stay abreast of at both the local North Texas level but also the world level. On the world level, Region C looks to be in good condition with ample water for all. At least much more than ample if we consider what the 1/3 of the world's population that lives in China and India have to get by on. But before we get too cocky, is the energy of the food (meat, fruit and vegetables) raised in Region C equal to that consumed by the population in the Region?

I will propose in this review a few minor additions to the Region C proposed water plan; and a fair number of comments.

Suggested additions: 1. I would like to see a conversion of rainfall on Region C to acre-feet of water. 2. I would also like to see a conversion of the runoff on Region C to acre-feet of water. The latter would theoretically be the maximum available surface water in the Region.

Comments : 1. I can see the wisdom of desalination of river water such as the Red and Trinity if total dissolved solids are too high for municipal water use. However, the desalination of the groundwater aquifers underlying Region C appears to be a poor investment of taxpayer dollars. These aquifers have an almost unknown volume which would tend to get saltier the more they were pumped and they have very questionable recharge. I would expect recharge to go down as the Region attempts to capture as much of the low rainfall received in the area as possible.

2. Page 16 of the Saline Water Study Draft, second line, first sentence: I assume that the Red River in addition to chloride and sulfate anions has a nearly equal amount of sodium and calcium cations? Which brings up a point that I as an agronomist found to be common among those involved in municipal water production: the anions were of more interest to them than the cations, although calcium and magnesium did get their attention because they cause hard water conditions. Those of us trying to find good water for crop/turf irrigation look hard at the water's sodium level, best expressed as Sodium Absorption Ratio. This was the parameter of most interest to us.

3. Page 19 of the Saline Water Study Draft, the table whose sub-title "Monthly Unappropriated flows (Acre-feet/year)" needs explaining, at least to me. I have a problem understanding Acre-feet/year for a monthly flow.

4. Appendix P: In looking through this appendix's table I decided not to comment on anything specific but as a retired agronomist who has traveled widely in the U.S. of A. and some in other countries I find it hard to believe that the Impacts of Strategy on Environmental Factors, Agricultural Resources/Rural Areas, Other Natural Resources, Possible Third Party, and Key Water Quality Parameters were so often evaluated as **low.** The score: 293 low impacts for 470 strategies. It would appear that you were either awful careful in choosing your strategies or you have under estimated their impact.

5. Section 4C – Methodology for Evaluation and Selection of Water Management Strategies. Pg. 10 Brush control: I am strongly in favor of leaving the brush. It helps prevent erosion of banks from cattle traffic and should stabilize banks and reduce erosion during flooding..

6. Section 4E - It would appear wise to me for Region C to advocate slowing of population growth in the Region until additional water resources are in place. Depending upon conservation and reuse before they have proven themselves for 35% of the Dallas 2060 water supply seems shaky, when another 18% of that water supply for Dallas is listed currently as unknown. Figure 4E.3

A similar statement can be made for Tarrant RWD where 31% will be from conservation and reuse, and 41% from new reservoir. Figure 4E.6. Or for the NTMWD where 22% will be from conservation and reuse and 41% from new reservoir. Figure 4E.9.

Projected demand greatly exceeds current available supplies for most of the Region. The Region currently is operating with little, if any, reserve water resources. Now it may well be that this recession we are in, with its slowing of new home production will result in lower population figures for the future and thus lower water demand. Nevertheless having made your predictions, you need to be sure that you are ready for the worst-case scenario.

7. Chapter 5, pg. 2 Perhaps you should add to the “Parameters considered for TCEQ Water Quality Inventory in evaluation of whether water body use supported, not supported, or have quality concerns.” These parameter should also include an irrigation use parameter centered on amount of sodium. I’m not sure that Total Dissolved Solids is sufficiently descriptive.

8. Chapter 5, pg. 9 Comments here indicate that some agriculture might be removed by inundation from new reservoirs. The overall tone of the whole report seems to appreciate the value of agriculture, however, agriculture is not represented by a lot of voters and tends, in this day and age to get neglected. Most voters don’t think about their stomachs till it is a little too late to grow the food they need to eat. Don’t neglect agriculture on your shift.

9. On page 5 of Chapter 6: Water Conservation and Drought Management Recommendations it is noted that 16% of 2060 water supply is to be Reuse. Yet I did not find anything in the Plan addressing the problem of insuring or controlling the quality of the effluent. Now, I might well have missed it but, let me address the concern of golf courses using Reuse water.

Golf course maintenance operations have had some concerns over pathogens, and amounts of organic matter in Reuse water, particularly if the later led to odor problems in storage ponds on the golf course. But, these two problems were usually minor compared to the amount of sodium in the water. The main cause of high sodium in Reuse water was water softeners, although sometimes the municipal water itself started out with high sodium levels.

I, therefore, would think it wise for you to strongly advocate restrictions in the use of water softeners in homes and businesses. Water softners certainly are desirable when trying to wash clothes or ones body when the tap water is of a certain hardness. However the sodium added to drinking water or to outside faucets is harmful to humans, plants, and particularly to soils. Restricting water softeners to hot water lines only in homes would help to reduce their destruction of Reuse water quality without greatly reducing their benefit in softening hard water, in my opinion. Perhaps only allowing their use where the tap water has a particularly high hardness.

A city ordinance which states that the city will not accept in its sewer system effluent with more than a certain % increase in sodium level might be an interesting approach to control of water softeners.

Summary: I have only commented on areas where I had a particular interest or some expertise. I understand the need to prepare for water needs in the future. This is particularly important in a region such as this, that has relatively low water availability and is experiencing a relatively high growth rate. Now the Region needs to act on their Plan.

Respectfully submitted,

Douglas T. Hawes, retired agronomist
3517 Deep Valley Trail
Plano, TX 75023
madhawes@verizon.net
Ph. 972-596-1023
May 20, 2010

Cc: Freese and Nichols, Inc; The Dallas Morning News; Collin County, and Region C

City of Ladonia, Texas
Est. 1848
Small Town Big Future

Doug Franklin's Comments to the Region C Water Planning Group

Public Hearing on the 2011 Initially Prepared Region C Water Plan

May 25, 2010

DOUG FRANKLIN'S COMMENTS TO REGION C WATER PLANNING GROUP

MAY 25, 2010

A. I am Doug Franklin. I am member of the Ladonia City Council. Ladonia is in Fannin County, and our city limits cross the North Sulphur River.

- I am a lifelong resident of Ladonia, have been mayor of the town, and served as president of the local school board.
- I am a retired environmental manager from Raytheon, and in retirement I am a Realtor with Century 21 First Group serving the Ladonia area.

B. The City of Ladonia is a partner with Upper Trinity Regional Water District in the planning of Lake Ralph Hall on the North Sulphur River.

- The City of Ladonia and its people support creation of Lake Ralph Hall.
- Positive impacts include solving our need for water, the economic benefits, its compatibility with Caddo National Grasslands, and the environmental assets of the project.

C. Ladonia will need a dependable source for future water.

- Our current water is from two wells, three-thousand feet into the Paluxy Sands of the Trinity Aquifer.
- In 1971, we were pumping from 250 feet; today we pump from 2000 feet. The water table is dropping.
- Water users of that aquifer are withdrawing 180,000 ac-ft/year. Recharge rate is 100,000 ac-ft/year.
- The quality of the well water is marginal: high dissolved solids, sodium phosphate, and sodium carbonate.
- Our wells are on the edge of potable water. 12 miles southeast, the aquifer is salty. As drawdown continues our supply will become salty.

D. The economic impact of Lake Ralph Hall to us is big.

- The lake is projected to bring $148M to Fannin County.
- Yes, the lake will take some 11 to 12 thousand acres - - about half of it being farm land in production. In our area such land yields about $100 per acre of productivity. It would take over 200 years of continued farming to equal the beneficial impact of the lake.

E. The lake will create synergy with Caddo National Grasslands.

- 2,800 acres of Caddo National Grasslands is located two miles west of Ladonia and adjoins the lake site.

- The Grasslands exist in several fragments. The lake will help tie those into a contiguous unit.
- Wildlife in the Grasslands will benefit from the adjoining water habitat.

F. Beyond the Grasslands, the lake will bring positive benefits to our environment.

- Fannin County has lost 28 million tons of topsoil due to erosion since channelization of the North Sulphur River 80 years ago, and the erosion continues, making the giant channel both wider and deeper each year - - with no end in sight.
- Lake Ralph Hall will be a blessing.

G. In summary, the City of Ladonia supports Lake Ralph Hall and the *2011 Initially Prepared Region C Water Plan* - - and we urge its adoption.

Amy Kaarlela

From: Richard Shaffer [RSHAFFER@cpyi.com]
Sent: Monday, August 30, 2010 10:28 PM
To: Amy Kaarlela
Subject: FW: TWDB Infrastructure Financial Assistance - 2011 Region C Water Plan - Melissa

Amy,

Below is an email from the City of Melissa regarding a project connecting to NTMWD. I'm not familiar with their system though – does NTMWD supply raw water to Melissa or treated water? If it's treated water, then wouldn't this be considered a distribution system project, and therefore not counted? But if it's raw water, then they may want to make sure that it is included since it sounds like its coming up pretty soon.

Richard L. Shaffer, P.E.
CP&Y, Inc.
817.319.2151 Cell
rshaffer@cpyi.com | www.cpyi.com

From: Gil Barnett
Sent: Friday, August 20, 2010 4:25 PM
To: Richard Shaffer
Subject: FW: TWDB Infrastructure Financial Assistance - 2011 Region C Water Plan

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From: Jeffery A. Hogan [mailto:jhogan@bwrcorp.com]
Sent: Friday, August 20, 2010 4:22 PM
To: Gil Barnett
Cc: Bob Helmberger; jlittle@cityofmelissa.com
Subject: RE: TWDB Infrastructure Financial Assistance - 2011 Region C Water Plan

Gil:

As I mentioned on the phone, the City of Melissa does not anticipate on using TWDB funding for the projects currently listed in the IFR survey (the $5,000 for municipal-conservation, or, the $1,330,000 for additional wells). However, the City may have applied/may apply for funding for the South Water Take Point Project, also know as the Melissa Road Water Take Point Project. This project carries a total project cost of $1,838,540 and it serves to add a new ground storage reservoir, yard piping, pump house and associated work to the existing water take point in Melissa (receiving NTMWD water). The breakdown of the $1,838,540 estimate is as follows:

- Estimated Construction cost of $1,500,000;
- Estimated Engineering cost of $297,250;
- Estimated Subcontractors (easements, surveying and legal) costs of $5,240;
- Estimated Design Phase Program Management costs of $18,025; and,
- Estimated Construction Phase Program Management costs of $18,025;

Please let me know if you have any questions. Thanks.

Jeffery A. Hogan, P.E., CFM | Project Manager, Municipal Services | **BWR**
2620 County Road 1106, Anna, TX 75409 | P 972.924.2757 | F 214.765.1763 | C 214.250.0070

From: Gil Barnett [mailto:gbarnett@cpyi.com]
Sent: Tuesday, August 03, 2010 3:06 PM

To: Jeffery A. Hogan
Subject: TWDB Infrastructure Financial Assistance - 2011 Region C Water Plan

Dear Mr. Hogan:

As part of the regional water planning process, the Region C Water Planning Group (RCWPG) and the Texas Water Development Board (TWDB) have been charged with evaluating the financial assistance, if any, that will be needed to implement the water management strategies recommended in the regional water plans. We are addressing this issue by a survey of water providers that show capital costs associated with the projects proposed to meet water needs during the 50-year planning period.

Below is a web link that you can use to access the online TWDB survey for City of Melissa.
Web link:
http://www.twdb.state.tx.us/apps/ifr/ifrsurvey.aspx?entityid=1824

Your response to the online survey is very important to the water planning process and to ensuring that financial programs are adequately funded in the future. Even if you intend to finance these strategies without TWDB assistance, we are still requesting that you complete the online survey. The results of this survey will be included in the *2011 Region C Water Plan*, and thus we would appreciate your response by August 17, 2010. If you have any questions, please contact either Rick Shaffer or Gil Barnett at (817) 354-0189.

Please let us know if you have trouble accessing the online survey, or would prefer a printed copy of the survey by either fax or regular mail.

Thank you.

Gil Barnett

CP&Y

115 West 7th Street, Suite 1500
Fort Worth, Texas 76102
817-354-0189 ext 215
gbarnett@cpyi.com | www.cpyi.com

Amy Kaarlela

From: Mike Adams [Mike.Adams@Midlothian.tx.us]
Sent: Thursday, April 29, 2010 8:34 AM
To: Amy Kaarlela
Cc: Tom Gooch; Dan Sefko; Ben Wilson; Ray Cason; Theodore Chan; Caswell, Bryant
Subject: RE: Region C Plan for Midlothian

Amy,

Thanks for this information. I've had a chance to review and have asked Theo to coordinate with you regarding our current supplies and future WTP plans. F&N and SRA have just recently completed a Preliminary Design Report for our new water treatment plant that you can use to help make our information in the Region C plan more current and accurate (e.g., we currently have a contract with TRA for 9.33 MGD of TRWD water, a part of our new plant is under construction and/or design at the present time). Also, I noticed that the plan intends for Midlothian to provide additional water to Mt. Peak SUD; however, Mt. Peak has never indicated any interest in additional water from us at this time. Finally, our Rockett SUD contract is for an average daily take volume of 2 MGD vs. the 1.5 that's included in the plan.

Thanks,
Mike

Mike Adams, P.E.
Exec. Director of Engineering and Utilities
City of Midlothian
972-775-7105
972-775-7171 (fax)

From: Amy Kaarlela [mailto:adk@freese.com]
Sent: Wednesday, April 21, 2010 10:09 AM
To: Mike Adams
Cc: Tom Gooch; Dan Sefko
Subject: RE: Region C Plan for Midlothian

I'm so sorry! Here you go. On this first file, you'll need to scroll down about half a page to get to the Midlothian section of the report. Thanks.

Amy D. Kaarlela
Water Resources Planning
Freese and Nichols, Inc.
817-735-7438
adk@freese.com
www.freese.com

From: Mike Adams [mailto:Mike.Adams@Midlothian.tx.us]
Sent: Wednesday, April 21, 2010 10:06 AM
To: Amy Kaarlela
Cc: Tom Gooch; Dan Sefko
Subject: RE: Region C Plan for Midlothian

Hey Amy,

You accidently sent me the information for the City of Mansfield and not Midlothian – if you'll resend, I'll review and forward my comments to you (if any).

Thanks,

Mike Adams, P.E.
Exec. Director of Engineering and Utilities
City of Midlothian
972-775-7105
972-775-7171 (fax)

From: Amy Kaarlela [mailto:adk@freese.com]
Sent: Wednesday, April 21, 2010 9:59 AM
To: Mike Adams
Cc: Tom Gooch; Dan Sefko
Subject: Region C Plan for Midlothian

Mr. Adams,

Attached is a portion of Chapter 4E ("Recommended Strategies for Wholesale Providers") from the *2011 Initially Prepared Region C Water Plan*. These pages contain our understanding of your demands, supplies, and future strategies. Also attached is an excerpt from Appendix H, which details your customers' demand on your system. There will be a Public Hearing on May 25, 2010 at which time the public is encouraged to provide comments and/or ask questions about the Plan. The public comment period runs through July 26, 2010. As a Wholesale Water Provider, we welcome your input at any time before July 26th, and would be glad to discuss these plans with you. Thank you for your participation in the Region C planning process.
Amy

Amy D. Kaarlela
Water Resources Planning
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NORTH
TEXAS
COMMISSION

June 29, 2010

To the Region C Water Planning Group:

As the one and only public-private regional organization committed to enhancing the overall economic vitality and quality of life of North Texas, the North Texas Commission is keenly interested in long-term natural resource and infrastructure issues affecting our region.

Developing a plentiful long-term water supply, and maintaining an adequate reserve to guard against unforeseen droughts or other future challenges, is one of the most pressing issues deserving of our attention. Simply put, having a safe and adequate supply of water is absolutely vital in order to keep North Texas strong.

As we look towards the future and see North Texas' tremendous growth projected to continue over the coming decades, we know how important it is to plan now for our region's future water needs. This is true especially in light of the long lead time required for planning and implementation of most major water management strategies.

The Dallas-Fort Worth has the highest numerical population growth annually of any U.S. region. This is a plus in many regards, as it means we are attracting talented workers and many of the world's leading businesses to North Texas. With this growth, however, come formidable challenges – including not only strains on the long-term water supply, but also challenges related to transportation and air quality.

The draft 2011 Region C Water Plan recently developed by the Region C Water Planning Group is a powerful, strategic roadmap for addressing the water supply issue over the next 50 years.

The North Texas Commission is very pleased by the balanced mix of water management strategies recommended in the draft plan – including a significant focus on water conservation, some of the nation's most innovative and ambitious water reuse strategies, greater reliance on existing water supply sources and selective development of new reservoirs. This balanced approach ensures both that our future water supply will be sufficient to meet our growing needs, and that this valuable natural resource will be wisely allocated.

BUILDING THE REGION OF CHOICE JUL 02 2010
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METRO: 972.621.0400 FACSIMILE: 972.929.0916
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NORTH
TEXAS
COMMISSION

Each of these supply source types is important, and we urge the Planning Group – as well as the Texas Legislature – to do everything within their power to preserve the ability of the region to implement this balanced approach to water supply management. We simply cannot afford to take any category of water supply sources off the table, as our projected growth requires that we keep every tool in our water planning toolbox.

We also commend the Region C Water Planning Group for conducting special studies during the current planning period on emerging issues such as water conservation and reuse, regional coordination on the Toledo Bend project, and rapidly changing conditions in certain localized areas within the North Texas region. Those special emphases have resulted in a plan that is smartly crafted and deserving of adoption.

For all of the reasons cited above, the North Texas Commission strongly supports the draft 2011 Region C Water Plan, and we urge the Planning Group to adopt it formally later this year.

Sincerely,

Dan S. Petty
CEO and President
North Texas Commission

To, Ms. Kaarlela,

I have lived in and around Dallas since 1984 and I have a question.

Why does all the water taste so bad and will the TWDB fix this problem?

I moved to Gainesville a year ago and the water tastes so bad that I buy bottled water to drink.

Hopefully something can be done to fix this problem.

Thank you,

Shirlene Perryman

Shirlene Perryman
Lot 96
1400 Old Sivells Bend Rd.
Gainesville, TX 76240

FORT WORTH TX 760

USA FIRST-CLASS FOREVER

Attention:
Amy Kaarlela

Freese & Nichols
4055 International Plaza
Suite 200
Ft. Worth, Tx.
76109-4895

310344814

KEN KRAMER, SIERRA CLUB
LONE STAR CHAPTER

Some Observations on the Region C Water Plan

Region C is making progress on water conservation and should be recognized for moving in the right direction in regard to more efficient use of existing water supplies – example: North Texas Municipal Water District's adoption of the "Water IQ" program to advance their customer's understanding of the sources of their water and the importance of using that water wisely and efficiently

However, Region C is still over-estimating and over-planning its water supplies for the next 50 years. Even by its own projections for water supply demands, Region C is proposing water management strategies that would provide ***about 25% <u>more</u> water in 2060 than the projected <u>demand</u> for water***. [See the Executive Summary, page ES.9.] Region C asserts that this amount of water is a "reasonable reserve to provide for difficulties in developing strategies in a timely manner, droughts worse than the drought of record, greater than expected growth, and supply for needs beyond this planning horizon." Even if one accepts the concept that some amount of water over projected demands should be planned for, a 25% figure is not justified, given the additional costs, environmental impacts, and impacts on rural and other communities from many of the proposed strategies. This approach also totally ignores the implementation of drought contingency plans that at the very least should be part of the scenario for managing extreme droughts as well as more periodic droughts.

Moreover, Region C is still over projecting demand in the first place. Region C is still projecting a "need" for water to meet <u>all</u> the levels of use that people would exercise for water during normal times even during a drought as bad as the historic "drought of record" in the 1950s. In other words the Region C plan would envision that people's demands for outdoor watering to keep their landscaping and lawns green should be met even while the region would be experiencing a drought as bad as the drought of the 1950s.

Region C still refuses to incorporate the impacts of the implementation of drought contingency plans in evaluating demands during drought periods despite the fact that more water suppliers than ever before are now required by state law to have drought contingency plans, that most of those drought contingency plans envision reasonable and staged reductions in non-essential water use during drought periods, and despite the fact that those water suppliers or other entities that have implemented drought contingency plans during dry periods have seen significant reductions in water use for those periods (primarily through reduction of outside watering).

The result of Region C's refusal to use implementation of drought contingency plans as a water management strategy means that the Region is over-projecting the amount of water demands and thus proposing the building of more water projects than necessary to meet that inflated demand. Some other regional planning groups, such as those for Regions K and L, have started to use drought management as a water management strategy in their currently proposed plans. These first efforts are still too limited, but at least other regions are beginning to understand that drought management is an important part of managing future water demands. Region C is still ignoring that fact.

While Region C is making strides in water conservation, it should be pointed out that its claims of progress and its goals in terms of per capita water use are somewhat misleading because the proposed regional plan gives credit for water reuse in calculating the per capita numbers. While water reuse is a legitimate water supply strategy and in general Region C should be commended for pursuing more water reuse, giving credit for water reuse in calculating per capita water use figures makes its appear that the region is being much more efficient in its use of water than it actually is.

For example, if a water service area is being provided 20,000 acre-feet of water through reuse, and you count that amount of water as part of the total water used before dividing by population to get your per capita water use, your per capita figure is going to be much ***higher*** than if you credit yourself for the reuse by subtracting that amount of reuse water from your supply before you calculate per capita water use. If water reuse is not credited in the calculation of per capita municipal water use in Region C, the projected 2060 per capita figure is 178 gallons per capita per day rather than 135 gpcd (see page 6.37 in Chapter 6 of the plan). Region C needs to recommend water conservation management strategies that get their per capita municipal water use figures down to 140 or below without crediting reuse to achieve that figure. That will further reduce the need for water supply projects in the region and is in line with what other cities in other regions are accomplishing.

RCWPG MEETING
MAY 25, 2010

PUBLIC HEARING WRITTEN COMMENT FORM

Name: Larry N. Patterson

Representing: Upper Trinity Regional Water District

Mailing Address: P. O. Drawer 305
Lewisville, Tx 75067

E-mail Address: lpatterson@utrwd.com

Comment: Please see written comments provided to Chairman Jim Parks letter dated May 20, 2010.

UPPER TRINITY
REGIONAL WATER DISTRICT

P.O. Drawer 305 • Lewisville, TX 75067
(972) 219-1228 • Fax: (972) 221-9896

May 20, 2010

Mr. Jim Parks, RCWPG Chairman / Administrator
c/o North Texas Municipal Water District
PO Box 2408
Wylie, TX 75098-2408

Re: Support for the 2011 Initially Prepared Region C Water Plan

Dear Chairman Parks:

As the regional water provider for Denton County and portions of Collin, Cooke and Wise Counties, Upper Trinity Regional Water District takes its water supply planning responsibility very seriously. Accordingly, we have reviewed in detail the proposed water management strategies for the 16-county region, especially those strategies listed for Upper Trinity included in the **2011 Initially Prepared Region C Water Plan**.

The population and water demand projections prepared by the RCWPG consultant for the Upper Trinity service area are reasonable and consistent with our expectations. Upper Trinity fully supports the **Initially Prepared Plan** and urges its adoption. Prior to submission to the Texas Water Development Board, we request a few minor corrections related to Upper Trinity (see enclosures).

Please feel free to contact me at 972-219-1228 should you have any questions or need additional information.

Sincerely,

Larry N. Patterson

Larry N. Patterson, P.E.
Director – Operations & Water Resources

RE/jkh

Enclosures: (2)

C: Thomas E. Taylor, Executive Director
Tom Gooch, P.E., Freese and Nichols, Inc.
Region C File

MAY 24 2010

Upper Trinity Regional Water District

The Upper Trinity Regional Water District (UTRWD) currently supplies treated water to users in Denton County and Collin County. The UTRWD also provides direct reuse for irrigation in Denton County. The currently available supplies for UTRWD include water purchased from Sulphur River Water District and Commerce out of Lake Chapman, purchased raw water from Denton and Dallas Water Utilities (DWU) and reuse. UTRWD's currently available supplies range between 33,158 and 63,463 acre-feet per year from 2010 to 2060. (The changes in supply over time are due primarily to changes in water availability from DWU.) Considering losses associated with treatment and distribution, UTRWD needs to develop an additional 100,520 acre-feet per year by 2060. UTRWD will also need to develop additional treatment and distribution capacity to serve the growing demands of its current and future customers. The recommended water management strategies for UTRWD include the following:

- Conservation
- Additional supplies from DWU under current contracts
- Lake Ralph Hall
- Indirect reuse of return flows from Lake Ralph Hall
- Marvin Nichols Reservoir
- Additional DWU supplies
- Oklahoma water
- Water treatment plant and distribution system improvements.

Marvin Nichols Reservoir and water from Oklahoma are multi-provider strategies and are discussed on pages 4E.2 to 4E.4. The other strategies identified for UTRWD are discussed individually below:

Conservation. Conservation is the projected conservation savings for UTRWD's existing and potential customers, based on the Region C recommended water conservation program. Not including savings from low-flow plumbing fixtures and not including reuse, conservation by UTRWD customers is projected to reach 13,202 acre-feet per year by 2060.

Additional Supplies from DWU under Current Contracts. UTRWD's current contracts with DWU indicate that DWU will supply (1) water needed for several specific water suppliers in Denton County plus an additional 10 mgd and (2) an additional amount equal to 40 percent of UTRWD's supplies from Lake Chapman. Based on projected demands, the contracts would provide up to 61,638 acre-feet per year in 2060. UTRWD is currently using less than the amount in this contract (due to the availability of other interim water supplies) but plans to eventually use the full contracted amount.

Lake Ralph Hall. UTRWD has applied for a water right permit to develop the proposed Lake Ralph Hall on the North Sulphur River in Fannin County. The project would yield 34,050 acre-feet per year, up to 90 percent of which would be delivered to Denton County. Water would be pumped from the lake to the existing balancing reservoir on the pipeline from Lake Chapman to UTRWD's Harpool Water Treatment Plant and Lewisville Lake. From there, it would be delivered through existing facilities to the Harpool plant and the lake. (The existing facilities have sufficient capacity for the supply.)

Indirect Reuse of Return Flows from Lake Ralph Hall. UTRWD plans to apply for the right to reuse return flows from the Lake Ralph Hall project, which are assumed to be 60 percent of the supply delivered to Denton County from the project, or 18,387 acre-feet per year.

Additional Direct Reuse. UTRWD plans to develop up to an additional 2,240 acre-feet per year of direct reuse in Denton County. The specific location of this supply is uncertain and will depend on demands in UTRWD's service area.

Additional Water from Dallas Water Utilities. In addition to the water supplied by DWU under the existing contract between UTRWD and DWU and the additional supplies associated with Lake Chapman reuse, UTRWD plans to contract for additional surface water supplies from DWU. This supply is expected to amount to 11,200 acre-feet per year by 2060.

Water Treatment and Distribution Improvements. UTRWD will need to make improvements to its water treatment and distribution system to meet the demands of its customers. UTRWD has developed a capital improvement plan with specific projects through 2029, and estimated costs for improvements after 2029 are also included.

Table 4E.15 and Figure 4E.11 show the recommended plan for water supply development for UTRWD. Based on the recommended plan, 26 percent of the projected 2060 supply for UTRWD will be from conservation and reuse. Table 4E.16 gives information on the capital and unit costs for the recommended water management strategies.

If any of the projects identified in the recommended plan are not implemented, the UTRWD may wish to pursue alternative strategies. The following alternative water management strategies are recommended for UTRWD:

- Toledo Bend Reservoir
- Wright Patman Lake
- George Parkhouse Reservoir (North)
- George Parkhouse Reservoir (South)
- Lake Texoma
- Additional reuse.

Information on the alternative strategies is shown on Table 4E.17.

Table 4E.15
Summary of Recommended Water Management Strategies for Upper Trinity Regional Water District

Planned Supplies by Source (Acre-Feet per Year)	2010	2020	2030	2040	2050	2060
Projected Demands	**34,902**	**58,104**	**85,674**	**110,308**	**137,411**	**156,545**
Existing Supplies						
*DWU**	*8,290*	*36,549*	*42,664*	*41,267*	*39,087*	*35,226*
Denton	*4,069*	*0*	*0*	*0*	*0*	*0*
Chapman	*13,268*	*13,268*	*13,268*	*13,268*	*13,268*	*13,268*
Chapman Reuse	*6,634*	*6,634*	*6,634*	*6,634*	*6,634*	*6,634*
Direct Reuse	*897*	*897*	*897*	*897*	*897*	*897*
Total Existing Supplies	***33,158***	***57,348***	***63,463***	***62,066***	***59,886***	***56,025***
Need (Demand - Supply)	**1,744**	**756**	**22,211**	**48,242**	**77,525**	**100,520**
Contracted Amount from DWU*	**38,815**	**46,290**	**56,656**	**58,438**	**60,066**	**61,638**
New Supplies						
Conservation (wholesale customers)	1,211	3,549	6,062	8,308	10,922	13,202
Additional Supplies from DWU (Up to Current Contracts)*	710	9,741	13,992	17,171	20,979	26,412
Lake Ralph Hall		34,050	34,050	34,050	34,050	34,050
Lake Ralph Hall Indirect Reuse		6,129	12,258	18,387	18,387	18,387
Additional Direct Reuse			560	1,121	2,240	2,240
Marvin Nichols**					17,500	17,500
Additional DWU (New Contract)						11,200
Oklahoma						15,000
Supplies from Strategies	**1,921**	**53,469**	**66,923**	**79,037**	**104,078**	**137,990**
Total Supplies	**35,079**	**110,817**	**130,386**	**141,103**	**163,964**	**194,015**
Reserve or (Shortage)	**177**	**52,713**	**44,712**	**30,795**	**26,553**	**37,470**

* Under the existing contracts, UTRWD is entitled to 38,835 acre-feet per year from Dallas in 2010. However, given limited Dallas supplies in 2010 and other supplies available to UTRWD, a supply of 13,000 acre-feet per year from Dallas to UTRWD is assumed for 2010.

** UTRWD intends to secure a supply of 35,000 acre-feet per year from the Marvin Nichols project, but the full amount will not be connected until beyond this planning period.

match above 38,815

9,000=8,290+710

Figure 4E.11
Recommended Water Management Strategies for the Upper Trinity Regional Water District

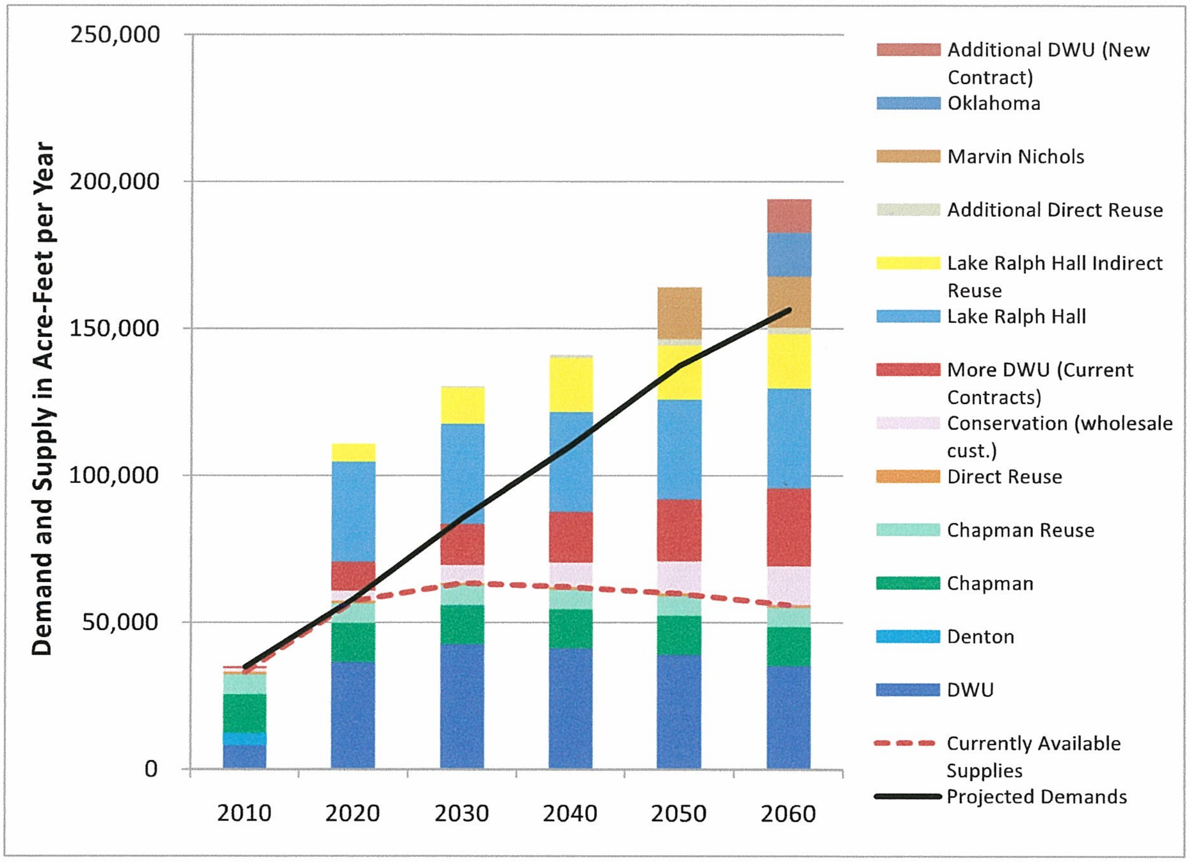


Table 4E.16
Summary of Costs for UTRWD Recommended Strategies

Strategy	Date to be Developed	Quantity for UTRWD (Ac-Ft/Yr)	UTRWD Share of Capital Costs	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table for Details
Conservation	2010-2060	13,202	Included under County Summaries in Section 4F.			
Additional Supplies from DWU (to Current Contracts)	2010-2060	26,412	$0	$0.4971	$0.4971	None
Lake Ralph Hall and Indirect Reuse	2020	52,437	$316,756,000	$1.58	$0.23	Q-67
Additional Direct Reuse	2030	2,240	$11,313,000	$1.62	$0.50	Q-93
Marvin Nichols	2050	17,500	$143,542,000	$2.41	$0.56	Q-21
Oklahoma	2060	15,000	$96,083,000	$2.04	$0.61	Q-48
Additional DWU (New Contract)	2060	11,200	$0	$0.4791	$0.4971	None
Treatment and Distribution System Improvements	2020	0	$488,368,000	N/A	N/A	Q-94
Total UTRWD Capital Costs			**$1,056,062,000**			

$0.4971

Table 4E.17
Summary of Costs for UTRWD Alternative Strategies

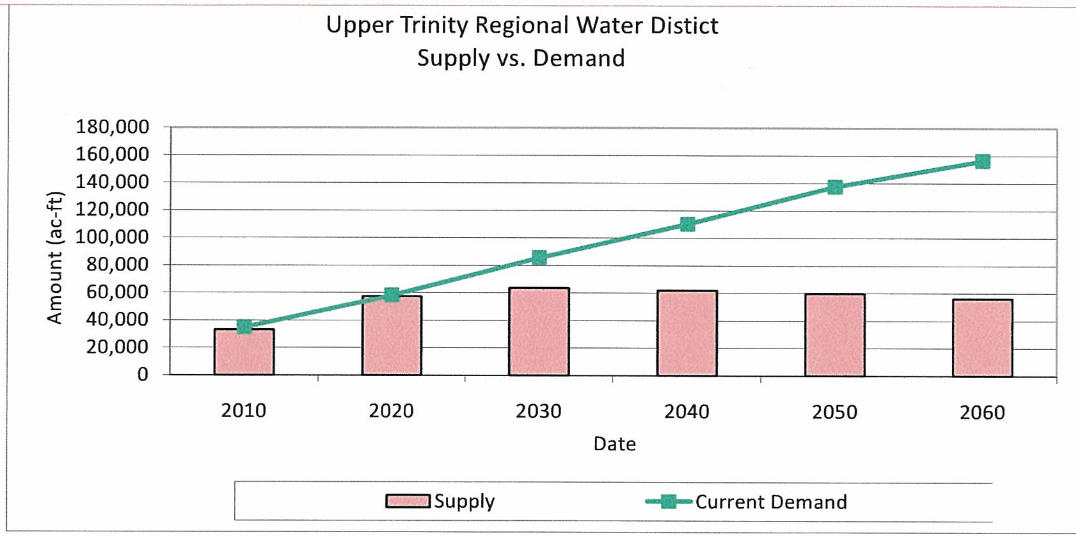
Strategy	Date to be Developed	Quantity for UTRWD (Ac-Ft/Yr)	UTRWD Share of Capital Costs	Unit Cost ($/1000 gal) With Debt Service	Unit Cost ($/1000 gal) After Debt Service	Table for Details
Toledo Bend Reservoir	2050	48,000	$351,400,000	$2.56	$0.93	Q-95
Wright Patman Lake	2035	38,000	$890,872,000	$2.48	$0.74	Q-95
Lake Texoma	Unknown	25,000	$117,562,000	$1.37	$0.32	Q-95
George Parkhouse Reservoir (North)	Unknown	35,000	$151,988,000	$1.41	$0.44	Q-95
George Parkhouse Reservoir (South)	Unknown	35,000	$208,364,000	$1.81	$0.49	Q-95
Additional Reuse	Unknown	15,000	$1,000,000	$0.01	$0.00	Q-95

Upper Trinity Regional Water District
-Values in Acre-Feet per Year-

Current Supply	2010	2020	2030	2040	2050	2060
DWU*	8,290	36,549	42,664	41,267	39,087	35,226
Denton	4,069	0	0	0	0	0
Chapman	13,268	13,268	13,268	13,268	13,268	13,268
Chapman Reuse	6,634	6,634	6,634	6,634	6,634	6,634
Direct Reuse	897	897	897	897	897	897
Total	**33,158**	**57,348**	**63,463**	**62,066**	**59,886**	**56,025**

Supplies Less Demands	**-1,744**	**-756**	**-22,211**	**-48,242**	**-77,525**	**-100,520**

****Under the existing contracts, UTRWD is entitled to 38,815 acre-feet per year from Dallas in 2010. However, given limited Dallas supplies in 2010 and other supplies available to UTRWD, a supply of 9,000 acre-feet per year from Dallas to UTRWD is assumed for 2010.***



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PUBLIC HEARING ON

2011 INITIALLY PREPARED

REGION C WATER PLAN

****

MAY 25, 2010

ORIGINAL

CARREN DURAN

CERTIFIED SHORTHAND REPORTER

A P P E A R A N C E S

REGIONAL WATER PLANNING GROUP:

MR. JAMES M. (JIM) PARKS, CHAIR
MR. MIKE RICKMAN, (ALTERNATE FOR JIM PARKS)
MS. JODY PUCKETT, VICE CHAIR
MR. BILL CEVERHA, MEMBER
MR. BILL LEWIS, MEMBER
MR. TIM FISH, MEMBER
MR. JACK STEVENS, MEMBER
MS. CONNIE STANDRIDGE, MEMBER
MR. DANNY VANCE, MEMBER
DR. TOM WOODWARD, MEMBER

FREESE AND NICHOLS, INC:

MR. THOMAS C. GOOCH
MS. AMY KAARLELA

ALLAN PLUMMER ASSOCIATES, INC:

MR. PRESTON DILLARD

COOKSEY COMMUNICATIONS:

MS. GAIL COOKSEY
MS. ELYSA NELSON
MR. COLBY WALTON

CHIANG, PATEL AND YERBY:

MR. RICHARD SHAFFER

TEXAS WATER DEVELOPMENT BOARD:

MS. ANGELA KENNEDY
MR. DAVID MEESEY

MR. PARKS: On behalf of the Region C Water Planning Group, I want to open the public hearing of 2011 Region C Initially Prepared Plan. You'll hear me also refer to that as the IPP just for brevity. My name is James Parks. I'm the current Chairman of the Region C Water Planning Group, and I'd like to welcome everyone that's come out tonight and thank you for taking the time out of your schedule to show up to give us input, your comments, on the Initially Prepared Plan. We're here tonight to receive your comments either verbally or in writing or both concerning the IPP. After tonight, we'll continue to receive your comments in a written form until August the 1st of this year.

Later in the meeting, I think Tom Gooch will give you some more details about how to go about doing that if you would like to file written comments with the planning group. Before we receive your comments though tonight, and this is a public hearing, I want to introduce the members that are here tonight with us from the Region C Water Planning Group. First, I want to start with -- and just raise your hand and identify where you're sitting. Bill Ceverha, is our Public Interest Representative. Bill Lewis, is a Small Business Representative. Tim Fish, here I think -- Tim, you could have sat on the front row, Tim. Tim is an alternate to Howard Martin who is representing Municipal Interest on the planning group. Mike Rickman, is my alternate on the planning group standing to my right. Jack Stevens, Jack's right to my left representing Water Districts. Connie Standridge, to my right representing Water Utilities. Danny Vance, representing River Authorities. Dr. Tom Woodward, on the very end representing Agricultural Interest.

MEMBER: I think you missed Jody. She came in at the last minute.

MR. PARKS: I did miss Jody.

MS. PUCKETT: Hi Jim.

MR. PARKS: Jody is the Vice Chair. She's the director of Dallas Water Utilities and also represents Municipal Interest. Thanks. I apologize for missing you.

MS. PUCKETT: I apologize for being tardy.

MR. PARKS: Other representatives that are here that work with the planning group include Angela Kennedy, who is with the Texas Water Development Board and David Meesey, also from the Texas Water Development Board and Adam Whisenant, who is with Texas Parks & Wildlife on the very end. Also, I think Mr. Bill Fickle, with the U.S. Army Corp of Engineers, Fort Worth District is with us tonight. So, thank you for coming out.

Also, I want to introduce our consulting team that has worked with us, some of them for the last 14 years, on the water plan. Of course, this cycle is actually the third cycle. So, we're in the fourth year of the third cycle. Our primary consultant is Freese and Nichols. Mr. Tom Gooch, is leading the primary consulting team. Amy Kaarlela, right in front of me, is also with Freese and Nichols. Representing a sub-consultant to Freese and Nichols is Allen Plummer & Associates and that would be Preston Dillard. Representing CPY is Rick Shaffer. Rick is in the far back standing behind that table. Then our Public Participation Coordinators are from Cooksey Communication and we have Gail Cooksey. Gail is sitting by herself over to the right. Colby Walton in the far back and Elysa Nelson beside Colby.

Again, I want to thank you for your attendance here tonight and assure you that we are very much interested in your comments. As I said, this is the third five-year planning cycle of the Water Planning Group. The Region C water plan is a living dynamic document that is under constant review, revision, and improvement. It's really the blueprint for how each Public Water Agency plans to provide for its water --

projected water needs over the next 50 years and that's a rolling 50 years. The plan only looks at the water need and the source of water to meet that need. It only considers infrastructure from the standpoint of trying to estimate cost to move developed water into the Region C water planning period. The planning group has no regulatory or enforcement authority. Later this year, the final version of the Region C water plan will be submitted to the Texas Water Development Board for their review and approval.

David, do you want to -- or Angela to speak to kind of how the role of the Development Board and how your -- that power plan fits with compiling the State plan?

MR. MEESEY: If you want me to I'll be glad to.

MR. PARKS: Yes, if you would. That way you can be heard a little easier.

MR. MEESEY: Thank you. Good to see everybody here. The way this works is we have 16 of these planning regions in the state. Region C is one of the 16, Dallas/Fort Worth Metroplex. Each region produces its own unique Regional Water Plan that is appropriate for its area and its part of the state. It has recommend strategies to meet any water needs for the

50 year planning period. At the end of the five-year cycle, when these plans are produced we have a public hearing as we're doing tonight. We listen to public comments. We revise the plan. It is finalized and submitted to our agency the Water Development Board for approval. We take it to our board in an open meeting of the Water Development Board for approval. We do that for all 16. The following year we spend that year taking the data, consolidating it for all the regional plans, rolling it up and making the State Water Plan that's produced every five years also. But tonight, we are just here to listen to you and understand and listen to your comments and that is our sole purpose for Angela and I being here tonight. We thank you very much for coming and we're anxious to hear anything that you have to say. I'll turn it back to you.

MR. PARKS: Thanks, David. Before we take, again, public comments, I'm going to ask Tom Gooch with Freese and Nichols to come up and to run through just a very short power point and slide presentation to kind of review for you what the planning group has been doing from a planning prospective over the last four years and what the group has been engaged in as far as developing the draft plan. So, Tom if you're ready.

MR. GOOCH: Thank you, Jim. I'll probably be more audible if I just hold the mic. I'm going to run through some slides and kind of show some of the stuff we've been doing. The Regional Water Planning -- I'm going to talk about the Regional Water Planning process for Region C and summarize the 2011 plan and talk briefly about the plans for three of the major providers in the area. Regional Water Planning Process started out -- this is now constituted in Texas. It started out in 1997 with the Senate Bill 1 passed by the State Legislator. The law was spurred by the 1996 drought and then established a new Water Planning Process in Texas. There have been plans done in Texas since the early '60s late '50s, State Water Plans, but they were done from Austin on a central basis, and this new process established regions around the state that would develop regional plans and those were incorporated into a state plan. The Texas Water Development Board has the role in this process of setting up rules that govern how planning is done, setting out the 16 regions, naming the initial planning group members, and as Jim mentioned earlier, reviewing and approving state plans and then making -- excuse me, regional plans and then making it a state plan out of them.

Plans are done every five years so that we can react to changing conditions. We're now just finishing up the third round of plan. The state has 16 regional water planning areas. Region C is right here. It's the most populace of the regions. It includes the Dallas/Fort Worth metropolitan area. It includes 15 whole counties and about half of Henderson County. It goes from the Red River in the north to Freestone County in the south. The regional planning process emphasizes local and regional decision making. All our meetings are open to the public. We meet maybe on average once every two months through the planning process, sometimes more frequently, sometimes less.

By law there are 11 different interest groups representing on the Regional Water Planning Group which oversees the process and they're listed here. There are I believe 19 members in Region C. So, there's more than one representative of some of these interest. The plan that we're going to talk about today covers a 50 year period from 2010 to 2060. Our steps are to project the population water demand over that 50 years, determine what the existing supplies are, evaluate where we need additional water, and then come up with strategies to supply that additional water. The 2011 Region C Initially Prepared Plan is out for public comment. It's available on the web, in the public libraries, and in the region, and in County Courthouses.

The comment period break is through August 1st, and our final plan after responding to comments, revising the plan and final approval, is due to the Development Board by October 1st. Region C, I described really early when we looked at the map. That's about a quarter of the state's population. In Region C, we use about a 12th of the state's water. It's a lot less in the water use than it is in the population, and the primary reason for that is we do not have heavy manufacturing use as some of the regions do. We don't have a lot of manufacturing use and we don't have very much irrigation which is, a large water user in some other parts of the state. This is another map that shows the region showing some of the major aquifers and the urban area. In our area, 90 percent of the water supply we use is surface water.

The plan covers 41, what are called wholesale water providers. Wholesale water providers are entities that supply a thousand acre-feet per year or more of water on a wholesale basis. They sell it to someone else who sells it to customers and it includes 357 water user groups. Water user groups are towns with a population of over 500. Other water suppliers supply over a quarter of an MGD on average. And then county wide aggregations of non-municipal demands, including irrigation, mining, steam electric power, manufacturing, and livestock. Looking at Region C, our population has grown fairly steadily since 1900. There was a few hundred thousand people here in 1900. By 2000 there were 5.3 million people, and estimated population now is well over 6 million. Projecting approximate doubling of the population between now and 2060 to right around 13 million people. Our water demands pretty much grow in line with that population growth. On these bars the blue is municipal water demand. That's water for use by people in their residence, by commercial establishments, stores, malls, et cetera. Yellow, is manufacturing use. Red, steam electric power, irrigation, mining and livestock. And what that shows is that only a small fraction of our use in Region C is for other purposes than municipal. Municipal is probably our biggest use. Now, that's not true for the State as a whole. For the State as a whole, irrigation use is about 60 percent. So, again, we're a little different here. We're a very urban area in terms of our water use. If you look in the region, this shows our currently available water supplies. Again, bars mean different things. The blue bar at the bottom is Region C reservoirs. Reservoirs, surface water reservoirs here in Region C. The yellow bar is surface water importation. Red bar is where the river supplies. Light blue bar is groundwater and the green is reuse supplies. One of the interesting things, five years ago when we did the plan, this was our supply in the region. So, in the last five years we developed almost half a million acre-feet a year of additional supply, projects that have been implemented in that period. Now, if you take that supply and you compare it to demand you can see that you've got enough water supply if you can perfectly distribute it in the region to meet our needs in 2010 and 2020. That doesn't mean everybody in the region has enough supply because some cities have more, some have less, some people have to do something quicker than 2020, but from 2030 on we have an overall shortage in the region and we have to develop new supplies to meet these goals and demands.

If I could kind of briefly talk about what the big picture is in Region C. In our plan we seek to maintain reserve supplies. To maintain a supply that's greater than the projected demand, and that's intended to cover against possible problems that might develop if your supply is too close to demand. If your growth is faster than projected you need to have some supply to cover that. If you get a new severe drought that's more severe than anything you've had before, your supply might be less than believed based on the previous droughts. You have to be ready for that. And you also have to be prepared for -- to take longer to complete strategies than planned or even for some strange reason become impossible as they're implemented. Another thing in the big picture of the Region C plan, we have increased surface water supply. That's especially true in the growing counties. You have some counties that have a lower demand where a large percentage of the current supplies is for groundwater. But as the population and the demand for water grows the groundwater supply is not going to be able to keep up. There's just not enough groundwater available in this area for that to be the major supply. Another aspect of the plan is that there's a heavy reliance on the major providers, major water providers in the plan, and there's focus on conservation and reuse. Conservation and reuse of supplies is going to provide a quarter of the supply in 2060 and well over a third of the new supply that's developed during the plan and this kind of shows that. If you look at 2060, the plans, the supplies we have to have in 2060. This is what we have now in the way of surface supplies. This is what we have now in the way of groundwater supplies. We're going to get about a quarter of our 2060 supplies from increasing -- from connecting existing water resources currently built and ready for these that aren't yet being used. You're going to get about another quarter from conservation and reuse projects and about 15 percent of our supplies in 2060 will be from new reservoirs that are contemplated in the plan. The total cost of all these water supply strategies and basically that's the cost to get a new water supply, bring it to where it's needed, and provide water treatment for it. Capital cost is $18.3 billion in current money. So, inflation is not included in that. About $13.5 billion of that is from the three largest suppliers in the area. Now, there are other costs associated with water supply, water distribution systems. Those are not included with this. Those are internal distribution issues. This plan doesn't address them. Now, the total new supply of almost $2.4 million acre-feet a year and about three quarters of that will be from the three largest suppliers.

The largest suppliers in the region supply about 85 percent of the water, and they are Tarrant Regional Water District, Dallas Water Utilities, and North Texas Municipal Water District. Dallas supplies a whole lot of other communities with water. The current supplies are a number of lakes in the area and some reuse. Plan supplies include conservation, additional reuse, new connecting and existing lakes, Palestine, Lake Fork, and Wright Patman, and a strategy that will replace what was a contemplated supply from Lake Fastrill, which was a proposed lake which is no longer a feasible project. This is Dallas' planned supplies. I'm not going to go through all the details on the chart, but this shows the supply having handy now, projecting into the future and the bars show exactly what the sources are. Then these are the additional supplies, slightly bigger line, this is the projected demand, and you can see the supply keeps ahead of the demand through the planning period. Tarrant Regional Water District supplies a lot of water to Fort Worth and Arlington and many other communities. Current supplies include Lake Bridgeport, Eagle Mountain Lake, Cedar Creek Lake, Richland-Chambers Lake and reuse. Planned supplies are conservation, additional reuse, connecting existing supplies from Toledo Bend Lake in East Texas and from Oklahoma and participating in the Marvin Nichols Reservoir project in East Texas. And, again, the red bar -- red line is the existing supplies. The black line is the projected demand and the bar is showing existing planned supplies to meet these projected things. North Texas Municipal Water District supplies communities north and east of Dallas with treated water. Current supply are Lakes Lavon, Chapman, and Texoma and reuse. Planned supplies include conservation, more reuse, connecting with existing Toledo Bend supply, getting additional water from Lake Texoma, getting water from Oklahoma and participating in Marvin Nichols reservoir and developing the Lower Bois d'Arc Creek reservoir in Fannin County. Again, this shows the overall picture and the individual plan supplies for North Texas Municipal Water District. One of the things that we emphasize in this round of planning, it's been emphasized in Region C in recent years, it's increased conservation and reuse. Dallas Water Utilities, Tarrant Regional Water District and North Texas Municipal Water District all have major conservation awareness campaigns. Estimated savings in 2006 for these campaigns was 32 billion gallons of water. There are currently in progress or already developed reuse projects that are going to have over 600,000 acre-feet a year of supply for the area and I've got a list here. Some of the largest ones involve the construction of wetlands, which water is put into those wetlands and put through those wetlands for natural treatment processes and then usually take it from there into lakes and diverted eventually and used. If you look at Region C compared to other regions in the state conservation and reuse standout. Our efforts standout.

The blue bar here is the existing reuse supplies, estimated to be available is 26 -- by 2060 from existing projects in Region C verses the other 15 regions in the state. The yellow bar is planned additional reuse projects. See our total plans for reuse is over 600,000 acre-feet a year, and the green bar on top is Municipal Water Conservation. And, again, our plan for conservation far exceeds that of any other region.

Just some closing thoughts, the details on any individual Water User Group that you're interested in or in the Initially Prepared Plan which is available for public view on our web site www.RegionCwater.org. In all county clerk offices in the Region 16 Counties and at least one major public library in each county. Public comment deadline is August 1st. You can submit written comments to RegionCcomments@freese.com or you can present them by mail and the address is on the poster outside the room here. And that finishes my presentation and open floor now for public comments.

MR. PARKS: Thanks, Tom. We are ready to begin receiving public comments. I've got something less than 20 speakers right now to speak to us. If you would like to speak to the Water Planning Group tonight you need to go back and fill out one of the speaker forms, so I can make sure that I get to you tonight. In order to give everyone a chance to speak -- and we posted a hearing from 7 o'clock to 9:00. I'm going to ask you to -- or each of the speakers to hold your comments to about five minutes. You can go a little longer than that if you're making valid points and not just repeating the same comments over and over. So, I'll base my judgement on that fact, but we should be able to give you ample time to speak to the planning group. So, with that, I'm going to ask the first speaker to come up and restate your name and who you represent and then make your comments to us. And this is just to receive comments tonight. It's not a dialogue. If you have questions that you'd like to ask the planning group to -- or the consultants to look at and address, then you can do that in the form of your written comments, and that's part of what the consultants will be doing will be looking at your comments and any questions that you might have with regard to our planning effort and our responsibility.

So, first public speaker would be Julie Hunt.

(Open session.)

MS. HUNT: Thank you. I appreciate the opportunity to appear before you this evening and welcome members of the Region C Water Planning Group to the City of Arlington. I'm the director of Water Utilities for the City of Arlington. And the City of Arlington continues to thrive largely because of our ability to provide water and wastewater services to our residential and commercial customers. Our population is around 368,000. We currently have more than 100,000 retail water accounts. We're committed in Arlington to the principals of water conservation, and we support conservation as one of the water supply strategies. Arlington has set an example with year round 10:00 a.m. to 6:00 p.m. irrigation restrictions, and we recommend that the model water conservation plan that's included in the document Appendix L of the state water plan be modified to use the year round 10:00 a.m. to 6:00 p.m. restriction. The City of Arlington also benefits from the planning of its wholesale water supplier, Tarrant Regional Water District.

We have supported the regional partnership water conservation messages between Tarrant Regional Water District and the City of Dallas. We also would like to recognize our partnership with the City of Fort Worth. We have recently entered into a partnership to directly use reclaimed water from Fort Worth's Village Creek Wastewater Treatment Plan for irrigation facilities in North Arlington. The pipeline for this is currently under construction. Arlington has also benefitted from the State Revolving Funds from the Texas Water Development Board for one of our recent treatment plan expansions.

So, again I want to thank you for coming to Arlington to share the progress of this plan.

MR. PARKS: Thank you, Ms. Hunt. The next speaker card I have is Kathleen Darling. The comment on the card was unsure whether or not if you want to speak. Thank you.

MS. DARLING: My name is Kathleen Darling, and I'm speaking on behalf of citizens. I'm a resident of Arlington, and I just wanted to comment on what I read, and I hope I read it correctly on the 11 percent reduction through conservation. I noted in your slide it was 23 percent for conservation and reuse. It seemed to me that 11 percent reduction via conservation doesn't seem aggressive enough, and I just have to give you a little context. I obviously don't have a Texas accent. I'm from Ohio and when I moved here from Ohio, I was familiar with a system where we had odd and even day restrictions for watering and Ohio -- where I came from in Ohio, we received a whole lot more rain than we do -- 30 to 35 inches or so that we get in this part of the country. So, when I came here and at that time

Arlington didn't have its restrictions, I was appalled just absolutely appalled that people watered as much as they did with much less rainfall here when a place which received a greater generosity of rainfall was already restricting their water usage.

So, that's sort of the basis of my comments here, my observations of water use, especially landscape water use here. So, my request is that the planning committee evaluate the conservation goal. I think 11 percent is a little light. I think what we're looking for is some sort of cultural change, and while the pricing may influence -- the pricing conservation strategies may influence some people, I don't believe it will influence the average citizen.

So, thank you also for a very thorough plan. It seems very well put together.

MR. PARKS: Thank you for your comments. The next speaker is Wayne Owen.

MR. OWEN: Good evening. My name is Wayne Owen. I'm director of planning for the Tarrant Regional Water District, which is the wholesale water supply provider for the western third of the metroplex. We have an 11 county service area and we serve approximately 1.8 million people and the population is expected to double by 2030. And I appreciate the

Development Board's continued support of Regional Water Supply planning in this third cycle of the Region C plan. Also, I appreciate that the Texas Water Development Board has proposed to the Texas legislature water infrastructure financing, special financing for the implementation of state water -- state and regional water plan, water supply projects and programs. And that water infrastructure financing is helping Tarrant Regional right now pursue strategies developed by the Region C plan, and we're very much appreciated of that financing which is an initial loan amount of approximately 100 million dollars. I would say the Tarrant Regional Water District and its customers, approximately 20 million dollars are in the life of that loan -- that financing.

Also, I appreciate the Development Boards continued focus on water conservation especially incumbent in the regional water plans. The Dallas/Fort Worth region has made aggressive steps over the last 10 years and has seen peek to average water use ratios drop, approximately 10 percent due to the aggressive outdoor watering restrictions and that has -- was very evident in water supply operations over the last -- since those irrigation restrictions were deployed. I also want to say that the Dallas/Fort Worth region and the primary water supply providers are working very closely on the regional supply projects that are recommended in this plan, TRWD, City of Dallas, Upper Trinity Regional Water District, North Texas Municipal Water District, as well as the Trinity River Authority of Texas. And it's largely a product of this regional planning program, which is now in its fifth cycle. The water supply projects for Tarrant Regional Water District reuse through constructed artificial wetlands, is one of several projects proposed for meeting Tarrant Regional Water District and Tarrant Counties long time -- long term water supply needs along with additional reservoirs which are urgently needed. The Dallas/Fort Worth region is fourth in the nation in gross metropolitan product reported with Wikipedia. Some people question those statistics, but none the less, fourth in the United States and tenth in gross metropolitan product in the world and to the scale of this regional planning, I just wanted to mention that Tarrant Regional Water District's current service area 1.8 million people is a population greater than 13 states right now. So, it's a very large initiative that requires a great deal of effective planning. And, also the biggest question facing us as we move forward with this regional plan, is how to pay for and how to permit these projects and urge the Texas Water Development Board and the Region C planning group to continue to focus on implementing these projects, additional funding for water infrastructure financing, and the protection of unique reservoir sites that have been designated by the legislature, and additional emphasis with regards to Texas Water Development Board supporting regional wholesale water providers, water utility groups and permitting regional water supply projects that are addressed in this plan. And we're very encouraged by the Initially Prepared Plan and congratulate the Regional Planning Group on its role out here. Thank you.

MR. PARKS: Thank you, Mr. Owen. Next speaker is Kenneth Brown.

MR. BROWN: My name is Kenneth Brown, and I just wanted to come tonight to see this plan and to talk about a little bit of some of the implications that are coming about with this plan. It appears that these reuse facilities are, you know, sewer plants that are going to be used as reuse facilities. I wanted to know if Region C had any opinion on whether or not they should be put in the middle of established neighborhoods. It appears in one instance, we're fighting the Mary's Creek Recycling Center that's being put in the middle of an older residential community that was built in the '60s and '70s. They're wanting to put the recycling center in our area to favor Walsh Ranch, which is supposed to be 15,000 homes that's further west that right now is basically vacant land.

So, I just didn't know if y'all studied anything about the flooding implications with all these new reservoirs and those types of things with the reuse because, for instance the Mary's Creek site recycling center that the Tarrant Regional Water District of Fort Worth wants to put in right by our house, it says that you only have an inch to two inches of water rising, but if you look at -- if you go to weather.com you can find that in the last six years, Mary's Creek has flooded at least three times and been over three foot of the average flood level. So, is this plan in other areas, is it going to cause -- especially now that FEMA has redrawn the maps. Is this going to have flooding issues where the citizens of Texas are now going to have to pay more for flooding insurance? Are we doing enough to push more reservoirs and those types of things is one of the concerns. I understand that we need to do the reuse and be conservative, but I think the locations of these centers should be reconsidered and put -- since we are so far ahead of the game and we're planning 50 years out, I think there's a lot of time to find areas where nobody lives to put these recycling centers. Thank you for your time.

MR. PARKS: Thank you, Mr. Brown. The next speaker is Julie Burgen.

MS. BURGEN: Thank you very much. I thought you might be interested in comments from a 76-year-old Native Texan who's seen quite a lot, and obviously I want to comment on our basic need for water. I've lived in the metroplex since 1949 and have been active on environmental issues, essentials of water, and air and open space since the late 1960s. In the 1990s, just so you'll know I'm not a fly on the wall, I did receive three statewide awards for my efforts for conservation of our basic resources. I have commented numerous times on water issues. I want to commend my own Arlington Water Utilities Department, Julie Hunt who's already spoken, for the recognitions which they have received for quality and distribution, attention to alternative property lawn management, and general efforts at conservation, efficient appliances and so on. They are really working at it.

For the global view, I would like beyond Region C, I would recommend reading, For Want of a Drink, in the May 22nd to 28th current edition of the economist. It's a global view, but we are part the global. A quote from there, "Unless some breakthrough occurs in getting the salt out of seawater, the best hope of a happy marriage between supply and demand comes from much greater restraint among water users." Which I will go along with the previous speaker in saying that 11 percent for conservation is not enough. And for starters this example, the notion that everyone or at least those who can afford the high cost, deserves a big house and lawn in the suburbs, are now exurbs. That notion has got to go. It's unfortunate that the metroplex did not have urban gross boundaries as some other places have.

By example, just a few days ago I had to drive for the first time in 20 plus years up 35W to Argyle, Flower Mound, Rowan Oak area to take my sister to her annual summer camp. It was a unique experience far from cities back then when she first started going. It is now surrounded by large houses with larger lawns. That was a conversion of large acreage to huge water use as will happen with Walsh Ranch and all other similar developments, has happened, and will. Things have got to change to denser living just like the older cities have with neighborhood parks and community gardens to their green outdoor relief. As reported in

Star-Telegram on March the 5th, I side with the National Wildlife Federation and the Sierra Club in saying that area -- and they were referring to the Region C plan, area cities are making more effort to conserve but more can be done, and I will add must be done. A recent Star-Telegram editorial this month opined that there's plenty of water available for North Texas. There are enough ifs for that statement to render it copy talk. A savenorthtexaswater.com ad says, "I don't drink until after 6:00 p.m. your yard." Well, at least we have gotten to the after 6:00 p.m. part, but that still allows for daily watering which is a big no, no.

I am a water user and I do have a yard, but I'm saying that water costs should increase greatly for outdoor use once a certain threshold of amount is used for those in existing properties. Builders, planners, city permitters, everybody that has a hand in this should stop building for sale properties with grandiose lawns even if they absolutely insist on putting them in far North Tarrant County, Denton County. We are waisting and seriously depleting numerous resources with this sprawl. We are waisting and serious depleting numerous resources with grass lawns. Out with Saint Augustine, figure out someway to get the growers and the nurseries to convert to native plants and providing mulch and filch on fertilizers please. You don't need to make it grow. For example, if a homeowner has major -- just an idea -- people always say, "Well, what ideas do you have? Well, here's one. If a homeowner has major pruning or tree removal instead of picking up their stuff and turning it to a landfill require or provide onsite mulching and require them to return the mulch to the property as ground cover instead of grass. Get this dialogue going seriously and with some teeth through ordinances and through efforts with the purveyors and the providers of those kinds of things which are feeding the water frenzy. Otherwise the sprawl and building norms will just continue to consume many precious resources.

I personally do not want my water needs to be met by taking water from other areas out of state or in East Texas and especially by drowning forest which are critical as the lungs of this planet. We have already drown enough floodplain forest. We must learn to live frugally and hence truly conserve. Remember it is water needs and not water wants that you must plan for. Thank you.

MR. PARKS: Thank you, Ms. Burgen. The next speaker is Richard Huckaby.

MR. HUCKABY: My name is Richard Huckaby.

I'm here representing the Upper Trinity Regional Water District. I serve on the board of directors. I'm a past president of that board, and I currently serve as the chairman of the water supply committee. I'm also a retired military, a former city manager, and I'm now working as a college instructor teaching government. I'm still seeking something that I will do when I grow up. The opportunity serves a rapidly growing area on the north side of the metroplex primarily located in Denton County, not limited to that but essentially Denton County. Working with the region who developed our strategies for water conservation and reuse and for new sources of water to provide adequately for the future needs of that growing area. We believe it's wise to have a diversified water supply portfolio.

Our existing water strategies include water from Chapman Lake, from Lake Lewisville, Ray Roberts Lake, a very robust water conservation and water reuse strategies are included, but to further diversify our water supply portfolio the Upper Trinity is planning a new reservoir Lake Ralph Hall in Fannin County near the City of Ladonia. Our present supplies we believe are adequate until about 2025, but additional sources are going to be critical to us to provide water for future generations and Lake Ralph Hall included in the IPP is an important element of the Upper Trinity's portfolio. It's a sound project and we believe it should be built. The proposed plan to provide for the long term water supply needs of Region C, we believe is responsible and should be adopted and we enthusiastically support it. The region has worked hard to develop a consensus. There are reasonable management strategies and alternatives. We know that Region C is not a regulatory body and some of these proposed strategies may not make it through the process. That makes it doubly important and necessary to include alternatives in contingencies in the plan which you have done. The people in future generations are depending upon what we do for future adequate water supplies. We believe the Region C plan includes the strategies that are practical, reliable, and implement -- doable. Therefore, we support this plan put fourth by the Region C Planning Group. The Upper Trinity strategies are sound and we are depending on them for our future water supply.

So, Region C strategies are comprehensive and responsible. We support them and we thank you for ensuring the Upper Trinity and the region will have enough water in our future. Thank you.

MR. PARKS: Thank you, Mr. Huckaby. The next speaker is Judy Williams.

MS. WILLIAMS: Good evening, I'm Judy Williams. I'm a Fort Worth resident, and I wanted to compliment Mr. Parks on the editorial that was in this week's paper. "A cathedral of pipes filled with life sustaining liquid takes vision." At the top it says, "Miracles don't explain the clean water flowing from North Texas taps, good planning does." And I want to say that I realize a lot of work went into this plan and I thank you for that. I'm very much in favor of planning -- good planning and a regional plan is a very good thing. I'm very interested in protecting our water resources, a very precious resource. It will become even more so in the future and it's life sustaining. We need to protect it and do all that we can to conserve. I do have a concern, in talking with one of my neighbors a registered nurse, she has done some research that she shared with me about the hazards of endocrine disrupters, and I wanted to quote from something that she -- excuse me. I've had a bad cold. "When these substances endocrine disrupters seep into the environment as wastewater affluent in agricultural and urban runoff they mix and form a toxic soup of chemicals that sickens at risk wildlife, decimates riparian ecosystems, and contaminates drinking water." So, my concern is what will Region C do if anything to guard against this? I'm also part of a group that Kenneth spoke of called, Citizens opposing Mary's Creek Sewage Plant in our Neighborhood. I'm concerned that the Fort Worth Water Department wants to put a sewage plant in West Fort Worth in existing neighborhoods with homes, churches and four nearby schools. I live on the creek itself in a riparian area or zone. I oppose the plan that they have proposed, and I'm wondering what advise you have to help us as a citizen's group to get this plant moved to a more suitable area, farther west and out of our existing neighborhood.

We do live in a pristine area and we want to keep Mary's Creek undisturbed. We as a group are very concerned about possible severe flooding and erosion problems if this sewage plant is built in the Mary's Creek Basin. We already have flooding issues with heavy rainfall. How will Region C help us with this flooding and erosion problem that goes with it should this happen? One question I have is, couldn't this recycling of wastewater treatment plant be placed in another body of water? Start over with the study that was done. This plan we think had many flaws in it. It's superficial, and one of the things that was a problem is that we had no representation from our neighborhood and we stated that before probably. Two of the three preferred sites are very near us as close as 12 yards up to half a block or so for many of us. Another concern that we have is that a plan for a wetland was not included in this plan. Another concern was the proximity of these two preferred sites to near by schools. What will happen with the school children should there ever be a spill of the chlorine that would be stored there. Our citizen's group has other concerns that we'd like to share with Region C planning at your earliest convenience. We have done much research on this since February when we found out about this proposed plan and we'd like to have a visit with you. Thank you very much for your time. I appreciate your listening. Thank you.

MR. PARKS: Thank you, Ms. Williams. The next speaker is Doug Franklin.

MR. FRANKLIN: Thank you, Mr. Chairman, I am Doug Franklin. I'm a member of the Ladonia City Council. Ladonia is in Fannin County at the far northeast corner of Region C, and our city limits crosses the North Sulphur River. I'm a lifelong resident of Ladonia. I've been mayor of the town. I've served as president of our local school board. I'm a retired environmental manager from Raytheon and in retirement, I'm a realtor with Century 21st group that serves Ladonia. The City of Ladonia is a partner with Upper Trinity Regional Water District in planning of Lake Ralph Hall on the North Sulphur River. The City of Ladonia and its people supports the creation of Lake Ralph Hall. The positive impacts in solving our need for water, the economic benefits, its compatibility with Caddo National Grasslands and the environmental assets of the project are the reasons that we support it.

Ladonia will need a dependable source of future water. Our current water is provided from two wells drilled 3,000 feet into the Biloxi sands of the Trinity Aquifer. In 1971, we were pumping from 250 feet down. Today, we're pumping from 2,000 feet down. The water table is dropping. Water users of that aquifer are withdrawing 180,000 acre-feet per year. The recharge rate of that aquifer is 100,000 acre-feet per year. The quality of well water is marginal. It's high in dissolved solids. It's high in sodium phosphate and it's high in sodium carbonate. Our wells are on the edge of potable water, 12 miles southeast of those wells the aquifer is salty. As drawdown continues in that aquifer our supply will become salty. The economic impact of Lake Ralph Hall to us is big. The lake is projected to bring 148 million dollars to Fannin County. And yes, the lake is going to take 11 to 12,000 acres of land about half of it being farmland that is in production.

Now, in our area such land yields about $100 per acre of productivity every year. So, if we calculate that it would take over 200 years of continued farming to equal the beneficial impact of the lake. The lake will create synergy with Caddo National Grasslands. There are 2,800 acres of Caddo National Grasslands located two miles west of Ladonia and that adjoins the lake site. The grasslands presently exist in several fragments. The lake will help tie those into a contiguous unit. Wildlife and the grasslands will benefit from the adjoining water habitat, and beyond the grasslands the lake will provide positive benefits to our environment. Fannin County has lost 28 million tons of tox soil due to erosion since generalization of the North Sulphur River 80 years ago, and that erosion continues today. The giant channel is getting wider and deeper every year. We're all familiar with the size of the Panama Canal and you can place two Panama Canals side by side in the channel of the North Sulphur River. Lake Ralph Hall will be a blessing to us.

In summary, the City of Ladonia supports Lake Ralph Hall and the 2011 Initially Prepared Region C Water Plan and we urge its adoption. Thank you, Mr. Chairman.

MR. PARKS: Thank you, Mr. Franklin, the next speaker is Rita Beving.

MS. BEVING: My name is Rita Beving. I'm on the executive committee of the Loan Star Chapter of the Sierra Club. Within the State we have 21,000 members. Within the Region C area we have over 7,000 members. So, we're about a third of that membership. Tonight I'm here to deliver comments on behalf of our Loan Star executive director Ken Kramer who is long worked on water issues for more than two decades. So, with that I'd like to go ahead and give his comments of which I'll submit at the end. As far as Region C's plan, Region C is making progress on water conservation and should be recognized for moving in the right direction in regard to more efficient use of water supply. For example, the water IQ program to advance their customers understanding of the sources of their water and the importance of using that water wisely and efficiently. Likewise, I'll compliment the City of Dallas on that.

However, Region C is still over estimating and over planning its water supply for the next 50 years. Even by its own projections for water supply demand, Region C is proposing water management strategies that would provide about 25 percent more water in 2060 than the projected demand for water. See in the executive summary page ES-9. Region C asserts that this amount of water is a reasonable reserve to provide for difficulties in developing strategies in a timely manner, droughts worse than the drought of record, greater than expected growth and supply for needs beyond this planning horizon. Even if one accepts the concept that some amount of water over projected demands should be planned for a 25 percent figure is not justified. Given the additional cost the environmental impacts and the impacts on rural and other communities for many of the proposed strategies.

This approach also totally ignores the implementation of drought contingency plans that at the very least should be part of the scenario for managing extreme droughts as well as more periodic droughts. Moreover, Region C is still over projecting demand in the first place. Region C is still projecting a need for water to meet all the levels of use that people would exercise for water during normal times, even during a drought as bad as this historic drought of record in the 1950s. In other words, the Region C plan would envision that people's demand for outdoor watering to keep their landscaping and lawns green should be met even when their region is experiencing a drought as bad as the drought of the 1950s. Region C, still refuses to incorporate the impact of the implementation of drought contingency plans and evaluating demands during drought periods despite the fact that more water suppliers than ever before are now required by state law to have drought contingency plans. That most of those drought contingency plans envision reasonable and stage reductions in nonessential water use during those drought periods and despite the fact that those water supplies or other entities that have implemented drought contingency plans during dry periods have seen significant reductions in water use for those periods, primarily through the reduction of outside watering. The result of Region C's refusal to use implementation of drought contingency plans as a water management strategy means that the region is over projecting the amount of water depends and thus proposing the building of more water projects such as Marvin Nichols and others, that they feel is necessary to meet the inflated demand. Some other regional planning groups such as those for Region K and Region L have started to use drought management as a water management strategy in their currently proposed plans. These first efforts are still too limited but at least other regions are beginning to understand that drought management is an important fact, an important part of managing future water demands. Region C is still ignoring that fact. While Region C is making strides in water conservation as I mentioned earlier, it should be pointed out that its claims of progress and its goals in terms of per capita water use are somewhat misleading because the proposed regional plan gives credit for water reuse in calculating the per capita numbers.

While water reuse is a legitimate water supply strategy and in general Region C should be commended for pursuing more water reuse. Giving credit for water reuse and calculating per water capita use figures, makes it appear that the region is much more efficient in its use of water than it actually is. For example, if a water service area is being provided 20 thousand acre-feet of water through reuse and you count that amount of water as part of the total water use before dividing by population to get your per capita water use, your per capita figure is going to be much higher than if you credit yourself for the reuse by subtracting that amount of reuse water from your supply before you calculate the per capita water use. If water reuse is not credited in the calculation of per capita municipal water use from Region C, the projected 2060 per capita figure is 178 gallons per capita per day rather than 135 gallons per capita per day. See page 6.37 in chapter six of the plan. In essence, Region C needs to recommend water conservation management strategies that gets their per capital -- per capita municipal water use figures down to 140 or below without crediting reuse to achieve that figure. That will further reduce the need for water supply projects in the region and is in line with what other cities in the other regions are accomplishing.

Those are Ken Kramer's comments and as some of you know from seeing me around water planning in the past, I just want to on a personal note assure you that the Sierra Club stands together with National Wildlife Federation, with the Texas Conservation Alliance to find better means in finding water for not only our region but through other regions without throwing Texans off their lands. And for those of you who know I work personally on Marvin Nichols. That alliance that I have with working with those East Texans, ranchers, international paper, oil, timber and many still city officials and county officials. I still stand with them and I will continue to work to get a more reasonable water plan for this area.

MR. PARKS: Thank you, Ms. Beving. Next

speaker is Donald Cureton.

MR. CURETON: Good evening. My name is Don Cureton, and I represent Chapel Creek Church and I'm also a member of the Citizen's opposed to the Mary's Creek Sewage Plant in our Neighborhood Group.

MR. PARKS: Could you speak a little closer to the -- I'm having a hard time --

MR. CURETON: Sorry. Better?

MR. PARKS: That's good, thanks.

MR. CURETON: Okay. I would like to say that I think that the Region C water planning needs to be thought out a little more carefully. I agree with everything that's been said about conservation. I disagree with the results of the Region C planning, and I say that in a sense that -- of what other entities, other political entities, have taken from your plan and decided they needed to do with it. I don't believe that in terms of reuse water that dumping gray water into populated areas -- especially when you combine it with the runoff with the new construction that many of these plants are being built to serve is going to help at all. It's going to create more runoff. It's going to create more exposure to contaminants because gray water is not cleaned up water. It's just got some of the stuff removed. I think that there is a better way to do it.

We need to do more thinking about how we reuse and we do need to do more reuse planning. But we need to think about reuse in terms of not just taking dirty water and finding something to do with it that is legally allowable because legally is not necessarily best, but we need to find a way to return the water to the land in a useful and safe fashion that will improve the land and the ecology and dumping used water that we've messed up into a creek which is not messed up at all, really. At least not yet. It's just not a smart way to do business. We've already ruined the Trinity River that way. We really don't need to ruin all the rest of our waterways that way.

We need to think, I think more in terms of things such as wetlands and we can move them further west. I think everybody knows that the farther west you go in this state the dryer you get, and they have a greater need for something like that than we do, and if the expansion in the population here -- the regrowth here is predicted to be towards the west -- this is what I've been hearing, than that's where we need to move them closer to. We don't need to move them right to the edge of the already existing and already served areas. We need to move them where they're going to be needed. We need to improve that land further west. It can be made better than it is. And I think over the long haul that the people out towards our west will appreciate that more than they will having to now create new pipelines to get water back to the east where it already was.

Also, I'd like to talk about the demographics. I realize that water planning is going to be kind of a long term thing, but in 50 years -- I'm 49. So, I've lived about 50 years and I've seen at least three of the places I've lived shift tremendously in their demographics from highly packed areas to places that are almost empty. So, I know that in 50 years your demographics can change so drastically that it just doesn't make sense to plan it in such a way that you feel you have to build huge plants to serve huge populations. It makes more sense and provides more flexibility to build it in a more dispersed fashion unless you are going to build a wetland, because that is really a permanent and useful and helpful thing. It will tend to stabilize your population especially in Texas which is so dry. We need to have your plants smaller and more dispersed and build them a little bit closer to the time when you really think you're going to need them, because then if the demographics don't quite shift where you thought they were you won't have a plant up in the middle of somewhere and you have to lay miles of pipe to get the water to where it really needs to go or come from as the case may be. I also think that that kind of planning would tend to prevent less waist of money, and just honestly it would just help us to not destroy so much of what already exists. If we're going to grow westward and if we're actually going to continue to grow the way that has been projected, you're going to need more out west. And you don't -- let's be honest we don't really know exactly where it's going to be. We may have some idea. We know what we think but if you concentrate it in one place you're going to end up with the same situation we have here in Fort Worth already. Which is we've got one big plant in the middle of Arlington out there and that's nice for Arlington and Fort Worth, but it now puts us in the position of we have to go west with this thing and we can't lay the pipe. It's just too much to do that. Well, let's not make the same mistake here on Mary's Creek along with all the other mistakes we've been making with Mary's Creek and the people who live there. Let's move this thing further west.

If we're not going to make it into something that's really good for the ecology out there like the wetlands then let's make it a little smaller.

Build what you need not what you think you're going to need and just find out you did it the wrong place at the wrong time and spent a lot of money you didn't even have to spend to do it. Thank you.

MR. PARKS: Thank you, Mr. Cureton. Cindi Creswell.

MS. CRESWELL: Hello, my name is Cindi Creswell, and I'm representing two parts of the Mary's Creek opposition, but I'm also stating that we have a lot of people here that represent companies, CEOs and very few of our fellow citizens that this is really impacting and I find it very disheartening because -- when I came in I made the comment that when I called my library they didn't know what the heck I was talking about when I said Region C. And it seems to be when you ask anybody on the street, what's Region C? They give you this very, you know, deer caught in the headlights. If this is such a profound issue is our water which is, he who has the most water wins, then why is it that the education of the public isn't more aware of that? I don't feel that there was enough information out there for people, and I feel that if they understood the necessity of this that maybe we should be putting up the red flags. There is a rapid growth all over the metroplex. I understand that. I came from a state that did have a lot of rapid growth, and they're suffering for it too. And I would hate to see that in this area because it would be so easy to do. And I mean by rapid growth I mean the unbridle growth. I mean something that's forced upon. It's not natural. It's something that happens quickly, and I understand that you need to project this and you need to have plans in place and everything else, but always it comes back to being very simplistic with life. If water is so important to us why aren't we letting people know about that? So, they can be more conservation minded. We try to teach this to our children which comes from the very bottom to work its way up, but still everybody else doesn't seem to get the idea.

I understand that in the section here of 6123 and what have you talking about the reuse. Well, reuse is all well and good but you know, I think we now need to look at what are we reusing this water for? If water is so precious and it's going to be that way for so long why are we waisting it? I'm sorry but you know, we have millions of gallons going out a day that cannot be reused or they're not being reused with our gas wells, with everything else that goes on in the city. Why is that? If there is such a need for reuse then why is it not going toward where it belongs? To the people.

I am -- I'm trying to understand the issue, and I don't feel there was enough information out for people to make a good judgement on this. More people have been informed and more people are more up to date on it but you know when we ask the average person, they don't. They have no clue, and I really worry about that. And each time I read something I keep getting different projections, different growths, different studies that dealers have done and different studies that everybody has done, how they keep changing the numbers around to match. What is the real truth here that we're looking at? I hope Region C can do a better job of educating our communities and the state about what really is going on and how important our conservation is because it's our next generation, because half of us here are not going to be around when the projections are out there. So, what we leave is a legacy. I hope it's in our good name. Thank you.

MR. PARKS: Thank you. Beverly Branham.

MS. BRANHAM: I have to find this microphone to see where I'm supposed to talk. Hi, my name is Beverly Branham. I live in West Fort Worth to Camp Wellington. Oh goody. And the reason I got into this, because I'm a grandmother, the Trinity River flows along our neighborhood Ridglea Hills, and when Mary's

Creek was going to put gray water, according to my City Councilman Zim Zimmerman, into the Trinity River I knew that you guys did not know that we have little ponds with little dams. So, I started calling everybody in the water department and I said, "Yes, we do." And they said, "Does the water ever drought?" And I said, "No, it doesn't." And then I explained that if stuff grows in nurseries, in the ponds, it swings around down by Mayfest -- and the mommies take the little children down and pat in the water, then it goes around Trinity River Vision and is housed behind closed floodgates and you have people in the water you will end up with sick people. So, I want you to know that because I've registered my observation. I did some homework. I would like to share with you my homework. I'm here about the Mary's Creek placement sewer plant. I notice that the head of our water department Frank Crumb is not here, and I notice that G.K. -- I don't know how to say her name, Maenius who is Region C representing counties is not here. Frank Crumb, who is the head of our water department, he was concerned that the Mary's Creek people disagreed, took a Fort Worth Water Department car with photographs out to the homes and photographed those homes with the signs in them in the Mary's Creek neighborhood and in Benbrook. I want you to be aware this is not about the placement of the Mary's Creek Sewer. The Initially Prepared Plan is reasonable but the charge does not go far enough. Reclaim and reuse does not include discharged clean water in a lake where it can refreshed and used for drinking before it moves on. Benbrook Lake goes to Eagle Mountain Lake for drinking water. A sewer plant is not an economic development project. It can ruin homes and lives when Mary's Creek discharges and flows around to the little ponds, as I said which goes down to Trinity Vision.

The City of Fort Worth budget shows that the land purchase for the Mary's Creek wastewater treatment is listed as Mary's Creek wastewater treatment land purchase and it's already been purchased or that's what this piece of paper shows. That's a city budget from 2006-2007. So, it's not about the placement of the creek -- the sewer plant. In the City Water Plan, the city does not have money in the budget, City of Fort Worth, to use recommended electric driven lift pumps for the recommended sewer plant location which is 10. The city has a 70 million dollar shortfall. Houses and condos don't sale. The city wants to cut policies, close libraries, cut police, close swimming pools, and have discussed adding a $6 a month fee for street repair onto the water bill invoice. The Tarrant Regional Water

Board has just transferred 200 million of gas bonus money to the economic development project Trinity River Vision because it was out of construction money. If a regional sewer plant is built the Water Board will need to sale more bonds and raise property taxes to redeem them.

Research of Parker County shows three towns that want to begin planning sewer plants but one has already applied. The other two have turned against that town because Tarrant Regional Water Authority wants to build a regional sewer plant. That is stopping economic growth. Sure it helps people with money but there is another issue. Walsh Ranch is working just fine on the special annexation water and sewer services approved by Fort Worth. Now, where's that paperwork? This is about Fort Worth wanting to sale water to Walsh Ranch. This is an economic development agreement, and it shows Fort Worth will earn $298,000 per million gallons a day. That is some millions a month. It's 107 million a year. Here's that paperwork. And just for fun I looked up how much acre-feet it is to drill a well about 3 million gallons. If you drill a well for three million gallons and you fracture it and you got 3,000 wells you're looking at 60,000 acre-feet. You-all that doesn't balance right. If they don't have to reuse their water -- which they can do, because in Decatur they've got ways to do it. If they don't have to reuse their water, they're taking it out of the water supply, and we are struggling to live. They're struggling to make money, but you know what? If enough rudely people get dry and parched -- well, I don't want to think about that. So, that's all I've got to say. I'm sorry to burden you with me but I'm a grandmother. I'm here because I care. I drove from West Fort Worth. Google put it out wrong and I drove all over town before I found you. You-all do a good job. You're reasonable people, but I think you don't put on your jeans and your tennis shoes and I think you don't go investigate, and you need to put on your Sherlock Holmes hat and go out and look at what's happening. And have a think on it before you make things so hard that we can't figure it out. Thanks a lot.

MR. PARKS: Thank you, Ms. Branham. Is there anybody else that signed up to speak that I have missed somewhere in the process? Okay. If not then it is almost 8:30. I'm going to close the public hearing and thank you for all attending and providing your verbal comments. I would encourage those that have spoken if you want to -- I mean we videotaped the proceedings. I've taken notes as well as Tom. I would encourage you to send us any questions in written form that you would like us to try to address as best we can, and we'll be happy to do that, and I don't know if that information is up here. It's in several different place. Tom, if you want to show that before we close. And again I appreciate you showing up and taking the time tonight to talk to us. If you didn't write this down before you need to write it down now, so that you can send that information to us. But again thank you for coming tonight we appreciate it.

(End of open session.)

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PUBLIC HEARING ON

2011 INITIALLY PREPARED

REGION C WATER PLAN

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REPORTER'S CERTIFICATION

I, Carren Duran, Certified Shorthand Reporter in and for the State of Texas, do hereby certify that the above and foregoing contains a true and correct transcription of all portions of evidence and other proceedings in the above-styled and numbered cause, all of which occurred and were reported by me.

I further certify that this transcription of the proceedings truly and correctly reflects the exhibits, if any, admitted by the respective parties.

WITNESS MY OFFICIAL HAND this the 14th day of June, 2010.

Carren Duran

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APPENDIX BB

RESPONSE TO COMMENTS

APPENDIX BB
RESPONSE TO COMMENTS

This appendix includes responses to written comments on the *Initially Prepared 2011 Region C Water Plan* (IPP) that were received by the Region C Water Planning Group (RCWPG). This appendix also includes summaries of public comments provided at the May 25, 2010 Region C Water Planning Group Public Hearing on the Initially Prepared Plan and responses to those comments. Comments from state agencies (Texas Water Development Board and Texas Parks and Wildlife Department) are presented in full. Other comments are summarized. The full version of all comments is included in Appendix AA. A full transcript of the comments from the public meeting may be found at the end of Appendix AA and on the Region C web site.

TWDB Comments on Initially Prepared 2011 Region C Regional Water Plan

LEVEL 1:	**Comments and questions must be satisfactorily addressed in order to meet statutory, agency rule, and/or contract requirements**.

General Comments

1. Please confirm that the hydrologic and climate data was updated in the plan and whether the data used (2006-2007) is the most recently available. *[Contract Exhibit "A", Task 1.b]*

   Response: The precipitation data was updated in Figure 1.2 and the data used for Figures 1.5 and 1.6 were updated. The average annual runoff and average annual gross evaporation data for Figures 1.3 and 1.4 were not readily available and thus were not updated.

Chapter 2

2. Please include categories of water use by river basin for water user groups and wholesale water providers. *[Title 31 Texas Administrative Code (TAC) §357.7(a)(2)(A)(iv) and §357.7(a)(2)(B)]*

   Response: Summary tables of demand split by county and basin were added to the end of Appendix G (for WUGs) and Appendix H (for WWPs).

3. Page 2.13, Table 2.4: The total of 501,886 acft/yr in 2060 appears to incorrectly total the data contained within the table for Collin County. Livestock demand has apparently

been excluded from all totals. Please revise table to show correct totals in each decade (e.g. 502,770 acft/yr in 2060).

Response: Totals in Table 2.4 were corrected.

Chapter 3

4. Please provide a statement regarding any water availability requirements promulgated by a county commissioners court pursuant to TWC §35.019, which in Region C applies to the Northern Trinity and Woodbine Aquifers Priority Groundwater Management Area. *[31 TAC §357.5(k)(1)(H)]*

   Response: Statement has been added in the "Groundwater Availability" section of Chapter 3

5. Page 3.8, paragraph 5; page 3.12, paragraph 1 and others: The text indicates that the Sparta Aquifer supplies water to users in Region C, but the aquifer does not actually occur in the region. Please correct or remove references to the Sparta Aquifer.

   Response: References to the Sparta Aquifer have been removed from Chapter 3 and Appendix I.

Chapter 4

6. Please explain how the region considered emergency transfers of non-municipal use surface water without causing unreasonable damage to the property of the non-municipal water rights holder pursuant to Texas Water Code §11.139. *[31 TAC §357.5(i)]*

   Response: Clarification was added on page 4C.9, paragraph 3.

7. Please describe how third party impacts from voluntary redistributions of water and moving water including from rural and agricultural areas were considered, if applicable. *[31 TAC §357.7(a)(8)(G)]*

   Response: Clarification was added on page 4C.9, paragraph 3.

8. Please include in the final plan quantitative reporting of impacts of potentially feasible water management strategies on agricultural resources, as appropriate. *[31 TAC §357.7(a)(8)(A)(iii)]*

   Response: Clarification was added on page 4C.5, paragraph 1.

Chapter 6

9. Please include a summary of information regarding water loss audits specific to Region C. *[31 TAC§357.7 (a)(1)(M)]*

Response: Added Section 6.12 "Water Loss and Water Audit"

Chapter 7

10. Please clarify in the plan whether or not water management strategies were adjusted for potential impacts to threatened or endangered species and those instances when mitigation of potential effects was selected instead. *[31 TAC §357.5(e)(1)]*

Response: Page 7.5 of the plan states, "All recommended strategies in Region C have been chosen with the possible effects on these threatened and endangered species in mind. For example, strategies that are likely to disturb threatened or endangered species habitat include mitigation allowances that set aside additional land for that habitat." Additional information on the impacts of water management strategies can be found in Appendix P.

Appendix Q

11. Page Q.14: Please revise cost estimates or justify why a 30-year debt service period rather than the TWDB-recommended 20-year debt service period was used for evaluating water management strategies other than reservoirs. *[Contract Exhibit "C" Section 4.1.2]*

Response: Justification has been added in Section Q-3, first bullet item.

12. *(Attachment B)* Based on the information provided to date by the regional water planning groups, TWDB has also attached a summary, in spreadsheet format, of potential interregional conflicts, apparent water source over allocations, and apparent unmet water needs that were identified during the review of the online planning database and Initially Prepared Regional Water Plan. *[Additional TWDB comments regarding the general conformance of the online planning database (DB12) format and content to the Guidelines for Regional Water Planning Data Deliverables (Contract Exhibit D) are being provided by TWDB staff under separate cover as 'Exception Reports']*

Response: Initial Level 1 database comments have been resolved. Additional comments will continue to be addressed after this report is published.

LEVEL 2: Comments and suggestions that might be considered to clarify or enhance the plan.

Chapter 1

1. Page 1.96, paragraph 2: Please consider referencing Appendix M for baseline water quality conditions used to evaluate water management strategies.

   Response: A reference to Appendix M has been added to page 1.98, paragraph 2.

Texas Parks & Wildlife Comments on Initially Prepared 2011 Region C Regional Water Plan

1. Does the IPP include a quantitative reporting of environmental factors including the effects on environmental water needs and habitat?

   Response: Qualitative impacts of strategies on environmental factors are presented in Appendix P. Where available, quantitative data was used to determine those qualitative impacts listed.

2. Does the IPP include a description of natural resources and threats to natural resources due to water quantity or quality problems?

   Response: Yes. Section 1.8 is a Summary of Threats and Constraints to Water Supply, and Section 1.9 is a summary of Water-Related Threats to Agricultural and Natural Resources.

3. Does the IPP discuss how these threats will be addressed?

   Response: Chapter 7 presents, in general terms, a description of how the Plan is consistent with long-term protection of natural resources.

4. Does the IPP describe how it is consistent with long-term protection of natural resources?

   Response: Chapter 7 presents, in general terms, a description of how the Plan is consistent with long-term protection of natural resources.

5. Does the IPP include water conservation as a water management strategy? Reuse?

Response: Conservation and Reuse strategies account for 28% of the future water demand in Region C. Water conservation strategies were recommended for every municipal water user and for many of the non-municipal users. Reuse strategies are outlined in Table 6.6.

6. Does the IPP recommend any stream segments be nominated as ecologically unique?

Response: No. Region C recommends the formation of a Work Group to further clarify unresolved issues surrounding unique stream segments.

7. If the IPP includes strategies identified in the 2006 regional water plan, does it address concerns raised by TPWD in connection with the 2006 Water Plan.

Response: This appendix of the Final *2011 Region C Water Plan* only addresses specific comments made on the *2011 Initially Prepared Region C Water Plan*, not comments on any previous reports.

8. Some amount of quantitative report of impacts to environmental factors for the major water management strategies is included in the plan. However, it appears the quantitative reporting has changed little from the 2006 plan. TPWD recognizes that this is likely due to different priorities and funding allocations during this planning cycle. Nevertheless, in the future, there is a need to update the quantitative reporting in the plan by incorporating available environmental data for each water management strategy. The Ralph Hall Reservoir and the Lower Bois d'Arc Creek Reservoir are both in the permitting phase of development. When environmental data becomes available for these projects it should be included in the quantitative analysis. This may include detailed biological and habitat information, as well as changes to water quantity and water quality.

Response: To the extent that information was available, Appendix P was updated to show qualitative information for Ralph Hall and Lower Bois D' Arc Reservoir.

9. The plan describes the natural resources in the region and briefly discusses threats to those resources from water management strategies in Chapters 1, 5 and 7. No detailed information is provided on how these threats will be addressed. Even though many of the threats will likely not be addressed until the permitting processes. However, there is

a need to understand the threats to natural resources prior to the permitting process in order to better evaluate which water management strategies to include in the plan.

Response: The information presented in the plan fulfills the requirements of the planning regulations and is sufficient to provide understanding of the threats to natural resources for the evaluation of strategies. More detailed analysis will be developed during the permitting process, and the cost of developing such information is included in cost estimates.

10. The transport of invasive species and toxic algae through interbasin transfers is not included as a threat to natural resources. Golden alga (*Prymnesium parvum*) and zebra mussels (*Dreissana polymorpha*) are both found in Lake Texoma. Zebra mussels have already been identified in West Prong Sister Grove Creek upstream of Lake Lavon due to an interbasin transfer from Lake Texoma. Fish kills from golden alga toxin are increasing throughout the Brazos River Basin and portion of Lake Texoma in the Red River Basin. For this reason, the importation of invasive species and toxic algae through interbasin transfers should be included as threats to natural resources. There is also a need to develop strategies for minimizing the impacts associated with transporting water from areas that are known to have invasive species or toxic algal species.

    Response: A discussion of invasive species has been added on page 1.86

11. Marvin Nichols Reservoir is a recommended Water Management Strategy, but it covers a slightly different footprint than in the 2006 Regional Water Plan. This new footprint is qualitatively described as causing fewer impacts to bottomland hardwoods (page 4D.8). However, the new footprint does not appear to be reflected in the map (Figure 4D.1) or the quantification of inundated acreage on page 4D.8 (both of which are identical to the 2006 plan). TPWD supports the avoidance of bottomland hardwoods, but, pending additional details on the new footprint, continues to have significant concerns regarding the impacts to fish and wildlife posted by Marvin Nichols Reservoir.

    Response: The IPP was in error when it stated that the footprint of Marvin Nichols Reservoir had changed since the last plan. That statement was inadvertently left in from the text of the 2006 Region C Plan. To clarify, Marvin Nichols Reservoir footprint did change between the 2001 Region C Plan and the 2006 Region C Plan, but has not changed since the 2006 Region C Plan. We apologize for this error and the confusion it caused, and we appreciate TPWD for pointing this out so it could be corrected in the final 2011 Region C Plan.

12. Much of this planning cycle was devoted to advancing water conservation in Region C. TPWD is pleased to see Region C play an active role in the Water Conservation Advisory

council, funding water conservation awareness campaigns and implementing the water conservation strategies in the 2006 plan. It is even more encouraging to see that the basic and expanded water conservation packages have been enhanced for the 2011 plan and the region continues to plan to meet the 140 gpcd goal (with reuse) by 2020.

Response: Comment acknowledged.

13. With Region C projected to have 29% of the state's population by 2060 and the majority of water being used is for municipal supply, the region has a great opportunity to conserve water beyond the planned 135 gpcd by 2060. TPWD staff encourages the region to continue to pursue advanced strategies to conserve water.

    Response: Comment acknowledged.

14. Tables 4B.3 and 6.7 project the total Region C demands at 2,924,157 acre-feet per year in 2060 which differs from the total demand of 3,273,461 acre-feet per year listed in Chapter 2. The 2,924,157 acre-feet per year appears to only be the 2060 municipal demand as shown in Table 2.3. You may wish to rectify this discrepancy in the final water plan.

    Response: Tables 4B.3 and 6.7 were clarified to state that the demands are municipal demands not total demands.

15. TPWD staff appreciates the time the planning group gave to evaluating whether to recommend stream segments as ecologically unique. Although TPWD would have preferred to see stream segments be recommended as unique segments, it supports the planning group's legislative recommendation to form a working group comprised of representatives of TWDB, TPWD, TCEQ and the sixteen water planning regions to bring clarity, purpose, and direction to designating streams as ecologically unique.

    Response: Comment acknowledged

16. The plan calls for an approximate 25% surplus of water supply above the projected demand of 3.3 million acre-feet per year for 2060. This amount of surplus (about 840,000 acre-feet per year) represents significant potential oversupply with corresponding significant potential impacts to natural resources.

    Response: The plan calls for a 21.7% surplus of water supply. These surplus supplies in the plan are intended to give a reserve to protect against reduced supplies from droughts worse than the drought of record, projects that cannot be developed or that are delayed, faster than projected growth, and needs beyond the planning period.

Summary of and Responses to Other Comments

Sierra Club

- Surplus supplies are not justified. **Response**: The surplus supplies in the plan are intended to give a reserve to protect against reduced supplies from droughts worse than the drought of record, projects that cannot be developed or that are delayed, faster than projected growth, and needs beyond the planning period.
- Approach ignores drought contingency plans. **Response**: Drought contingency plans are discussed on 4B.9 in Section 4B.
- Region C should not credit reuse as a conservation measure in considering the goal of 140 gallons per capita per day water use. **Response:** The goal of 140 gallons per capita per day water use was set in 2004 by the state's Water Implementation Task Force. In their report, it was clearly stated that the 140 gallons per capita per day was intended to include credit for indirect reuse.

Other Comments

- North Texas Commission
  - Support for plan. **Response**: Comments noted.
- Dallas Regional Chamber
  - Support for plan. **Response**: Comments noted.
- Arlington
  - Numerous questions and suggestions
  - Editorial changes regarding Lake Arlington supply and John F. Kubala Treatment Plant. **Response**: Changes incorporated throughout report.
  - Suggest adding 10 am – 6 pm watering restrictions to the model plan. **Response**: Added option of year round watering restrictions to Section 5.4 of the Model Conservation Plan in Appendix L.
- Athens MWA
  - Move new groundwater well strategy from City of Athens to Athens MWA. **Response**: Changes made to both Athens and Athens MWA to reflect this.
- Bois D' Arc MUD
  - Various comments on Fannin County Water Supply Study. **Response**: See responses incorporated directly with comments in Appendix AA.

- Celina
  - Show timing of supply from NTMWD to be between 2010 and 2020 rather than 2020. **Response**: In the plan, all projects listed for 2020 are assumed to be developed between 2010 and 2020.
- Copeville SUD
  - No mention of Copeville SUD in the plan. **Response**: Responded to Copeville SUD that they are included in Collin County Other.
- Crandall
  - Adjustments to the amount needed from NTMWD and from Dallas Water Utilities (through Seagoville) **Response**: Unable to change approved overall demand projections. Incorporated demand distribution from Crandall's engineer. This WUG has been noted for further refinement in next planning round update (See Table 2.20).
- Dallas Water Utilities
  - Lake Fastrill Replacement omitted from list of recommended strategies for DWU **Response**: Lake Fastrill Replacement has been added to the list of recommended strategies for DWU.
- Danville WCS
  - Population projections too high (comments made via phone). **Response**: Unable to change approved demand projections. This WUG has been noted for further refinement in next planning round update (See Table 2.20).
- Denison
  - Provided cost estimates for various planned water supply infrastructure projects. **Response**: Incorporated these costs into the Plan.
- East Cedar Creek FWSD
  - Population projections adjustment (comments made via phone). **Response**: Unable to change approved demand projections. This WUG has been noted for further refinement in next planning round update (See Table 2.20).
- Ennis
  - Numerous comments – **Response**: After discussions with City staff, comments were addressed through footnotes to Table 4E.42.
- Garland
  - Questions reuse as a supply for Garland (comments made via phone) – **Response**: After discussions with City staff, comments were addressed through changes made to Table 4E.49.
- Grand Prairie
  - Provided information on timing and cost of strategies – **Response**: After discussions with City staff, comments were addressed by incorporating

suggested text changes and cost of groundwater wells. The cost of the Arlington project was incorporated as a footnote to Table 4E.52. Grand Prairie staff concurred that the additional Dallas supply originally suggested was not needed due to additional supplies from Midlothian, Mansfield, and Arlington. Dates of project development were not changed because in the plan, all projects listed for 2020 are assumed to be developed between 2010 and 2020.

- Greater Texas Utility Authority
    - Include new Lake Texoma water right. **Response**: This new water right has been included throughout the plan.
    - Include Lake Texoma pump station expansion as a water management strategy for GTUA and NTNWD. **Response**: This strategy has been included for both GTUA and NTMWD in Section 4E.
    - Various other questions and comments specific to individual entities in Cooke and Fannin Counties. **Response**: Melissa – Costs mentioned are for supplemental wells to replace existing wells as necessary, not for expansion of groundwater use; Muenster – Cooke County Water Supply Project has been added as an Alternate Strategy; Fannin County Steam Electric – Lake Texoma has been added as an alternative strategy; Gainesville and Lindsay – Comment was added regarding their purchase of Texoma water from GTUA for future use.
- Haltom City
    - Demand projections should be lower (comments made via phone). **Response**: Unable to change approved demand projections. This WUG has been noted for further refinement in next planning round update (See Table 2.20).
- Irving (comments made via multiple phone conversations)
    - Include Chapman Booster Pump Station as a strategy for Irving as well as NTMWD – **Response**: This strategy has been included for Irving in Section 4F and NTMWD in Section 4E (as well as other sections throughout the report).
    - Include alternative strategies for Irving (Marvin Nichols Reservoir, George Parkhouse North, George Parkhouse South, Ralph Hall, Wright Patman, and indirect reuse) **Response**: These strategies have been included for Irving in Section 4F as well as other sections throughout the report.
    - Listed sponsors for Oklahoma water in Tables 4C.3 and 4C.5 do not match. Irving is a sponsor. **Response**: These tables have been reconciled to show Irving as a sponsor for Oklahoma water.
- Ladonia
    - Supports creation of Lake Ralph Hall and adoption of *2011 Initially Prepared Region C Water Plan*; City of Ladonia needs dependable source of future water supply; Lake Ralph Hall will have positive economic impact, unify currently

fragmented Caddo National Grasslands, and prevent further erosion and channelization of North Sulphur River. **Response**: Comments noted.

- Melissa
  - Provided information on new water supply connection to North Texas Municipal Water District. **Response**: Incorporated this project and cost estimate into the Plan.
- Midlothian
  - Comments on current and potential wholesale supplies from the city. **Response**: Adjusted the amount of supply from Midlothian to Rockett SUD throughout the report.
- Runaway Bay
  - Questions about planning process (via phone) – **Response**: Consultants contact city and answered general questions. No change to the report necessary.
- Upper Trinity Regional WD
  - Support for plan. **Response**: Comment noted.
  - Suggested wording changes – **Response**: Incorporated suggested changes.
  - Comments on cost estimates – **Response**: Updated cost estimate for Lake Ralph Hall.
- Written comments from individuals not representing public entities:
  - Concern over water taste. **Response**: Forwarded comments to supplier.
  - Need for more conservation and opposition to reservoirs. **Response**: Comments noted.
  - Concern over placement of wastewater treatment plant on Mary's Creek. **Response**: RCWPD does not make recommendations regarding placement of wastewater treatment plants. No change made to report.
  - Suggested changes to rainfall and runoff measurement units; Desalination of groundwater not cost effective; specific comments regarding water quality; support of brush control as water management strategy; advocate population control. **Response**: Comments noted.
  - Need more conservation and less wasting of water; no need to spend taxpayer money on new reservoirs. **Response**: Comments noted.
  - Several specific comments and advocacy for slowing population growth until additional water resources are in place. **Response**: Considered individual comments. RCWPG does not control population growth.

Other Changes to the IPP

- Rewrite of Section 4F to include a separate discussion for each supplier.
- Addition of Socio-Economic Analysis by TWDB

- Addition of Infrastructure Funding report generated from Survey of Water Suppliers
- Addition of newly acquired water right (56,500 acre-feet per year from Lake Texoma) by the Greater Texoma Utility Authority.
- Year 2060 total existing reuse from Chapter 6 of Initially Prepared Plan was not carried through in all calculations in Chapter 3 and Executive Summary of Initially Prepared Plan. This error was corrected.
- Editorial changes
- Addition of Tables required by Texas Water Development Board.
- Revision of some cost estimates.