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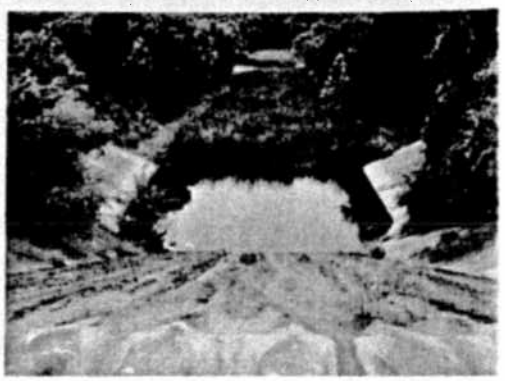

WATER SUPPLY FACILITY PLANNING
NEW TERRELL CITY LAKE

Prepared for:

City Of Terrell

In conjunction with:

Texas Water Development Board

FNI Project Number: TER10197
City of Terrell Project Number: 09-11
TWDB Contract Number: 1004831081

1004831081_Final Report

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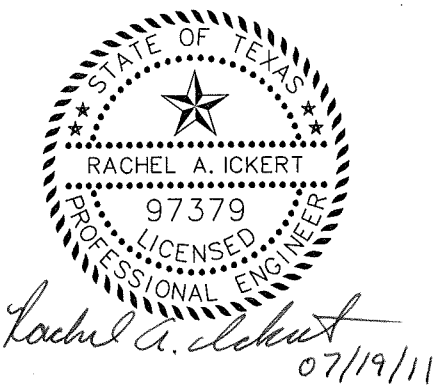

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TABLE OF CONTENTS

EXECUTIVE SUMMARY 1
1.0 Introduction 1-1
1.1 Assessment of Needs 1-2
2.0 Water Supply Evaluation 2-1
2.1 New Terrell City Lake Water Availability with Normal Pool Elevation of 504 Feet 2-1
2.2 New Terrell City Lake Water Availability with Raised Normal Pool Elevation 2-5
2.3 Meetings with Potential Users of Water from New Terrell City Lake 2-6
3.0 Determination of Transmission Facilities, Costs, and Recommendations 3-1
3.1 Methodology for Transmission Facility Cost Estimates 3-1
3.2 Transmission Facilities for Potential Users of New Terrell City Lake 3-4
3.2.1 City of Canton 3-10
3.2.2 Dallas Water Utilities (DWU) 3-10
3.2.3 North Texas Municipal Water District (NTMWD) 3-12
3.2.4 Sabine River Authority (SRA) 3-13
3.3 Results 3-14
3.4 Possible Funding Source for Transmission Facilities 3-16
4.0 Dam Condition Assessment 4-1
4.1 Description of Dam 4-1
4.2 Applicable Regulations 4-4
4.2.1 Size Classification 4-5
4.2.2 Hazard Classification 4-5
4.2.3 Hydraulic Requirements 4-6
4.3 Operation and Maintenance Issues 4-6
4.4 Review of Available Studies 4-8
4.5 Alternatives Review 4-9
4.5.1 NRCS Study 4-9
4.5.2 Current Study 4-14
4.6 Possible Funding Source for Dam Rehabilitation 4-19
5.0 Water Conservation and Drought Contingency Plans 5-1
5.1 Water Conservation Plans 5-1
5.2 Drought Contingency Plans 5-2
6.0 Post Draft Report Actions 6-1
6.1 Presentation To Terrell City Council 6-1

6.2 Texas Water Development Board Comments 6-1
7.0 Meetings 7-1
7.1 Public Meetings 7-1
7.2 Meeting With Raw Water Users 7-1
7.3 Meetings With Canton, DWU, and NTMWD 7-1
8.0 Conclusions/Recommendations 8-1

LIST OF TABLES

Table ES-1 Summary of Cost Estimates for Feasible Water Supply Alternatives ES-3
Table 1-1 Potential Users of New Terrell City Lake and Their Projected Water Needs 1-3
Table 2-1 Water Availability Analysis for New Terrell City Lake 2-5
Table 3-1 Existing Pumps at New Terrell City Lake 3-1
Table 3-2 Current Value of Existing Pump Station Facilities at New Terrell City Lake 3-3
Table 3-3 Project Costs for New Terrell City Lake Water Supply to Canton 3-10
Table 3-4 Project Costs for New Terrell City Lake Water Supply to DWU 3-12
Table 3-5 Project Costs for New Terrell City Lake Water Supply to NTMWD 3-13
Table 3-6 Project Costs for New Terrell City Lake Water Supply to SRA 3-13
Table 3-7 Summary of Costs 3-15
Table 4-1 Maintenance Reparis Cost Estimates 4-8
Table 4-2 Summary of Dam Modifications 4-21
Table 4-3 Summary of Cost Estimates 4-22

LIST OF FIGURES

Figure ES-1 Study Area ES-2
Figure 2-1 New Terrell City Lake Storage, Firm Yield = 2,400 ac-ft/yr 2-2
Figure 2-2 New Terrell City Lake Storage, Target Diversion = 6,000 ac-ft/yr 2-3
Figure 2-3 New Terrell City Lake Annual Diversions, Target Diversion = 6,000 ac-ft/yr 2-3
Figure 2-4 New Terrell City Lake Storage, Target Diversion = 6,000 ac-ft/yr When Storage Is >50%, Target Diversion = 1,800 ac-ft/yr When Storage Is <50% 2-4
Figure 2-5 New Terrell City Lake Annual Diversions, Target Diversion = 6,000 ac-ft/yr When Storage Is >50%, Target Diversion = 1,800 ac-ft/yr When Storage Is <50% 2-5
Figure 3-1 Schematic of New Terrell City Lake Water Supply to Canton 3-6
Figure 3-2 Schematic of New Terrell City Lake Water Supply to DWU 3-7
Figure 3-3 Schematic of New Terrell City Lake Water Supply to NTMWD 3-8
Figure 3-4 Schematic of New Terrell City Lake Water Supply to SRA 3-9
Figure 4-1 Aerial View of Dam 4-2
Figure 4-2 Embankment Modifications Alternatives 1 and 2 4-12
Figure 4-3 New Principal Spillway Alternatives 1 and 2 4-13
Figure 4-4 Embankment Modification Alternatives 3 and 4 4-16
Figure 4-5 Summary of Modifications 4-18

APPENDICES

Appendix A References
Appendix B Cost Estimates
Appendix C Public Meetings & Meeting With Raw Water Suppliers
Appendix D New Terrell City Lake Water Right Permit
Appendix E Water Availability Analysis – New Terrell City Lake
Appendix F Hydraulics
Appendix G Memorandums and Meeting Items for Interested Parties
Appendix H Presentation to Terrell City Council
Appendix I Texas Water Development Board Comments on Draft Report

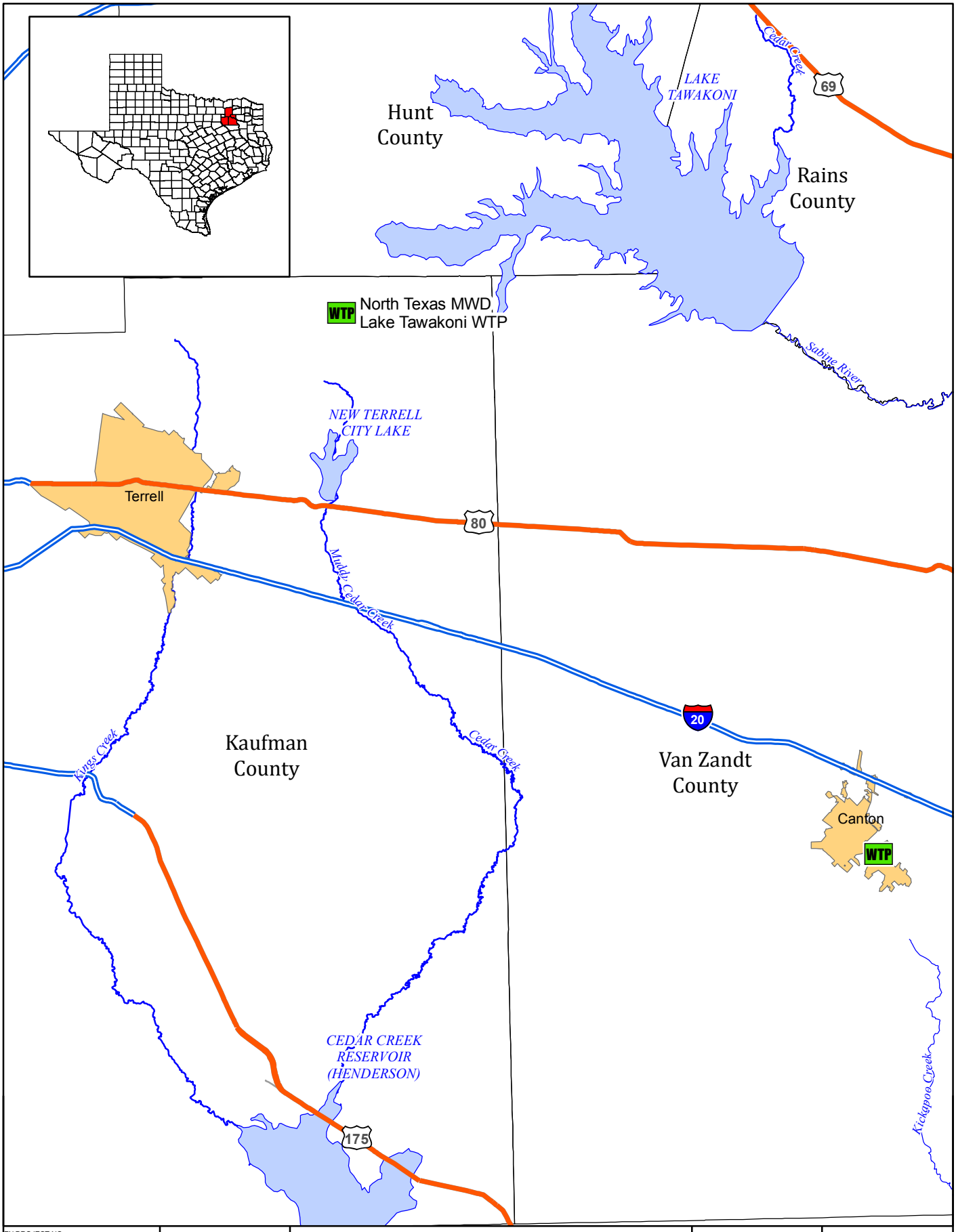
EXECUTIVE SUMMARY

In May of 2010, Freese and Nichols (FNI) was retained by the City of Terrell, Texas, in cooperation with the Texas Water Development Board (TWDB) to assess alternative uses of New Terrell City Lake (City Lake) and perform a dam condition assessment. An alternative for modifying the dam to raise the conservation pool of the reservoir two feet to increase reservoir yield was also evaluated.

The City of Terrell no longer uses the water supply from New Terrell City Lake and would like to find alternative uses for this supply. Figure ES-1 is a map of the study area. The City of Terrell owns Certificate of Adjudication 4972 which allows the city to divert 6,000 acre-feet per year (5.35 mgd) from New Terrell City Lake on Muddy Cedar Creek in the Trinity River Basin. The water right allows for the storage of up to 8,712 acre-feet. The firm yield of the New Terrell City Lake is 2,400 acre-feet per year (2.14 mgd), and the average annual diversion from the lake with a demand of 6,000 acre-feet per year is 5,250 acre-feet per year (4.68 mgd). The firm yield of a reservoir is the amount of water that the reservoir could have produced annually if it had been in place during the worst drought of record or, in practical terms, the diversion that results in zero storage.

Water suppliers in the New Terrell City Lake area with a need for additional supplies were contacted (see Table 1-1), and a public meeting was held to determine which entities might be interested in the New Terrell City Lake supply. Entities that expressed interest in using water from New Terrell City Lake were the City of Canton, Dallas Water Utilities (DWU), North Texas Municipal Water District (NTMWD) and the Sabine River Authority (SRA). For each of these four entities, alternative transmission facilities were evaluated, and cost estimates were developed. See Table E-1 for a summary of the estimated costs.

The report includes feasible water supply alternatives from New Terrell City Lake for four entities: Canton, NTMWD, DWU, and SRA. Further discussions between the City of Terrell and potential raw water customers will be required. Therefore, this report does not recommend one specific user of the New Terrell City Lake water supply.



FN PROJECT NO.	TER10197
FILE NAME	Canton_final.mxd
DATUM & COORDINATE SYSTEM	NAD83 STATE PLANE TX NORTH CENTRAL (FT)
DATE CREATED	SEPTEMBER 2010
PREPARED BY	KEK

FREESE NICHOLS
4055 International Plaza, Suite 200
Fort Worth, TX 76109-4895
817-735-7300

0 12,000 24,000 48,000 Feet

Terrell Water Supply Study

Study Area

N

FIGURE

ES-1

Table ES-1 Summary of Costs for Feasible Water Supply Alternatives

Potential Customer	Alternative	Supply (peak, mgd)	Cost of New Construction	Cost of Existing Facilities	Unit Costs (per 1,000 gallons)			
					Average Annual Yield (5,250 Ac-ft/yr)		Firm Yield (2,400 ac-ft/yr)	
					Pre-Amortization	Post-Amortization	Pre-Amortization	Post-Amortization
Canton	Supply from New Terrell City Lake to Canton's WTP	12.96	$35,745,000	$1,150,000	$2.33	$0.77	$4.52	$1.09
DWU	Pass-through using no New Terrell City Lake Water (Option 1)	72	$51,809,100	$2,292,593	$0.37*	$0.11*	N/A	N/A
DWU	Pass-through with Purchase of New Terrell City Lake Water (Option 2)	72	$50,995,200	$2,292,593	$0.37*	$0.14*	N/A	N/A
NTMWD	Supply from New Terrell City Lake to Tawakoni WTP	12.96	$9,001,000	$1,150,000	$1.09	$0.66	$1.78	$0.84
NTMWD	Supply from New Terrell City Lake to Tawakoni WTP as a Backup Supply (new pump station)	30	$20,056,000	$0	$1.54	$0.69	$2.78	$0.92
NTMWD	Supply from New Terrell City Lake to Tawakoni WTP as a Backup Supply (existing pump station)	30	$13,397,000	$1,150,000	$1.31	$0.70	$2.26	$0.91
SRA	New Terrell City Lake Water to Lake Tawakoni	10.9	$2,966,000	$2,949,000	$0.92	$0.67	$1.40	$0.85

*Unit costs are based on an average annual supply of 50 mgd from Lake Tawakoni.

In addition to providing water supply, New Terrell City Lake Dam provides flood control and is part of the Cedar Creek Watershed Plan developed by the Natural Resource Conservation Service (NRCS). A separate study was performed by the NRCS to assess the dam's hydraulic adequacy against NRCS requirements. The NRCS study found, and this study confirmed, the dam does not meet current NRCS dam safety requirements. The study identified several maintenance items that need to be addressed, and these totaled approximately $450,000. Four alternatives were developed to rehabilitate the dam to meet NRCS hydraulic requirements. Two alternatives were developed in the NRCS study, and cost estimates ranged from $3,400,000 to $3,750,000. Two additional rehabilitation alternatives were developed as part of this study, and these cost estimates ranged from $2,436,000 to $4,511,000. A fifth alternative was developed that would increase water supply by raising the normal pool as well as rehabilitate the dam to meet dam safety criteria. The cost estimate for this alternative was $2,899,000. There is the potential to partner with NRCS through the Small Watershed Rehabilitation Amendments (Public Law 106-472) for rehabilitation of the dam in which eligible costs are shared 35 percent by the local sponsor and 65 percent by the NRCS.

The dam spillway can be modified to raise the normal pool elevation of the reservoir two feet. Raising the normal pool elevation two feet results in increasing the firm yield from 2,400 acre-feet per year (2.14 mgd) to 2,700 acre-feet per year (2.41 mgd).

1.0 INTRODUCTION

In May of 2010, Freese and Nichols (FNI) was retained by the City of Terrell, Texas in cooperation with the Texas Water Development Board (TWDB) to assess alternative uses of New Terrell City Lake (City Lake) and perform a dam condition assessment. The City of Terrell no longer uses the water supply from New Terrell City Lake and would like to find alternative uses for this supply.

The methodology of the study was to:

1. Review the Senate Bill One 2011 Region C and Region D water plans (Terrell is located in Region C) to determine the water suppliers in the area with projected water needs who could potentially benefit from supplies from the City Lake, and develop up to three water supply alternatives for entities with needs.
2. Determine the facilities needed to make use of supplies from the City Lake and use the Trinity Water Availability Model (WAM) to determine the annual water availability and the reliable supply from the lake.
3. Perform a dam condition assessment and determine the facilities needed to provide for additional water supply from the City Lake and to meet Texas Dam Safety Regulations. Develop up to two alternatives to increase the spillway capacities or modify the dam to allow the dam to meet dam safety criteria and provide for additional water supply for the considered water supply alternatives.
4. Develop preliminary costs of the facilities for each alternative use of the supply and preliminary cost estimates for the recommended improvements or studies for the dam.
5. Review the consistency of the alternative uses of the City Lake with the Region C and Region D Water Plans and recommend changes Terrell should seek in the plans, if any.

6. Review water conservation and drought contingency plans for Terrell and the potential customers for water from City Lake and recommend changes, if any, to the plans needed to meet TWDB requirements.
7. Hold at least three public meetings with the participants, consultants, local entities, the Texas Commission on Environmental Quality (TCEQ), the Texas Water Development Board (TWDB), and any interested parties.

1.1 Assessment of Needs

The Region C and Region D water plans were reviewed to obtain information on the water suppliers in the planning area that need additional water and would benefit from the supply from New Terrell City Lake. Table 1-1 shows the entities in the area that were considered as potential users of the supply and their respective needs as presented in the Regional Water Plans.

Table 1-1 Potential Users of New Terrell City Lake and Their Projected Water Needs

Water Suppliers	Needs According to Regional Water Plans (Ac-Ft/Yr)					
	2010	**2020**	**2030**	**2040**	**2050**	**2060**
Ables Springs WSC	0	845	1,054	1,299	1,644	2,090
Canton [a]	0	0	29	57	104	161
College Mound WSC [e]	13	215	464	676	931	1,223
Dallas Water Utilities [b] [e]	48,797	171,126	206,488	256,215	325,741	444,098
Elmo WSC	Need included in Kaufman Co. Other					
High Point WSC [e]	4	97	180	266	369	486
Kaufman County Other	0	269	475	615	728	816
Kaufman County WCID No. 1	Need included in Kaufman Co. Other					
Las Lomas MUD No. 3	Need included in Kaufman Co. Other					
Las Lomas MUD No. 4 of Kaufman County	Need included in Kaufman Co. Other					
Lawrence WSC	Need included in Kaufman Co. Other					
MacBee SUD [d]	0	0	0	0	0	0
North Kaufman WSC	Need included in Kaufman Co. Other					
North Texas Municipal Water District	0	91,666	170,196	243,839	313,530	368,271
Poetry WSC	0	0	0	1	14	46
Rose Hill SUD	Need included in Kaufman Co. Other					
Sabine River Authority [c]	22,488	25,417	28,345	31,273	34,202	37,130
South Tawakoni WSC [d]	0	0	0	0	0	0
Talty WSC	Need included in Kaufman Co. Other					
Tarrant Regional Water District	0	49,680	147,533	244,544	351,389	477,251
Terrell Hunt Realty Corporation	Need included in Kaufman Co. Other					
Wills Point [d]	0	0	0	0	0	0
Total	**71,302**	**313,683**	**525,955**	**746,835**	**993,505**	**1,293,173**

[a] Canton disagrees with the TWDB population projections, and believes their 2060 service population may be as high as 34,000. The needs above are based on a 2060 population of 4,613.

[b] Does not include needs for projected customer demands.

[c] Region D shows no shortage for SRA. This amount is SRA's supplies less current demands for Region C. (Does not include projected future customer demands.) SRA's sources are fully contracted, and SRA has requests for additional water.

[d] Entities with no needs are able to meet their projected demands with their existing supplies, but it was determined these entities may potentially be interested in the City Lake supply.

[e] Shortages in 2010 are met with conservation and, for DWU, additional dry year supply.

2.0 WATER SUPPLY EVALUATION

2.1 New Terrell City Lake Water Availability with Normal Pool Elevation of 504 Feet

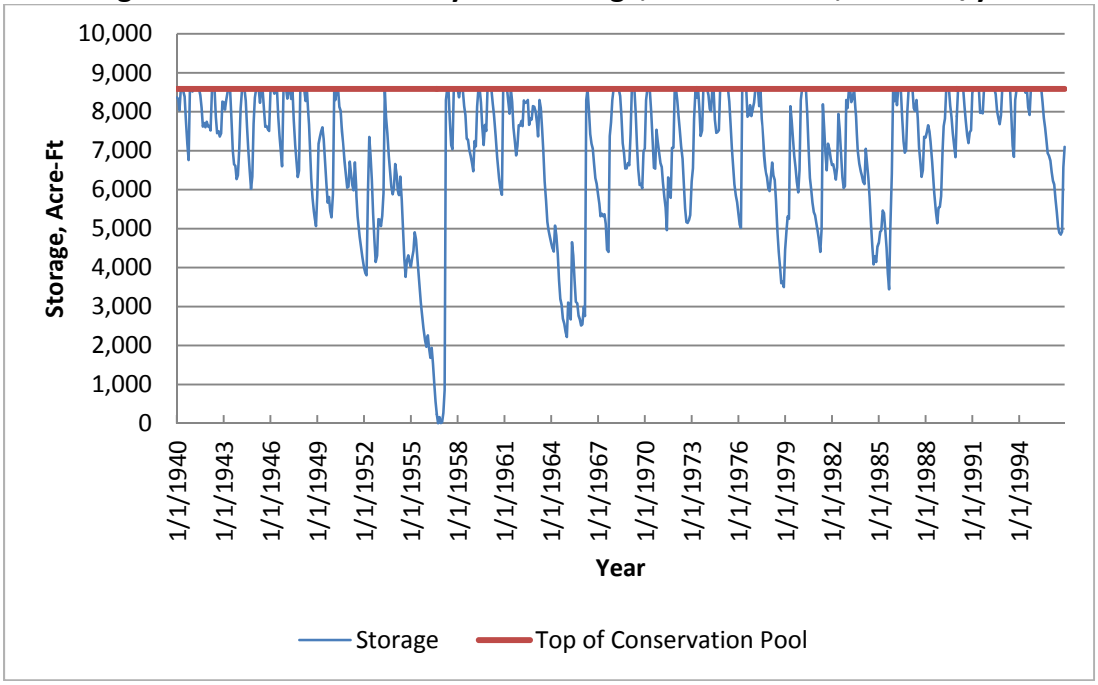
The City of Terrell owns the Certificate of Adjudication 4972, which allows the city to impound 8,712 acre-feet in New Terrell City Lake on Muddy Cedar Creek in the Trinity River Basin and to divert 6,000 acre-feet per year. The priority date for the full diversion amount and 8,300 acre-feet of the storage is February 23, 1954. The additional 412 acre-feet of storage has a priority date of February 17, 1969. [(1)] A priority date is the date the water right was recognized. The priority date controls who gets water when there is insufficient water to meet all the rights to a water source. The most recent volumetric survey report by the Texas Water Development Board (March 2003) shows that the capacity of the conservation pool is 8,594 acre-feet. [(2)] The diversion authorization and most of the storage authorization are senior to Cedar Creek Reservoir, which is located downstream from New Terrell City Lake and has a priority date of May 28, 1956. Appendix D includes a copy of the water right for City Lake.

The TCEQ Water Availability Models (WAMs) are used to determine if water is available from a lake, river, or stream, the amount of water available, and how reliable the water would be under various conditions. The WAMs include the area and capacity of reservoirs based on their original permits. The TCEQ models do not account for sedimentation (reduced capacity) over time. FNI used the March 2003 volumetric survey for New Terrell City Lake to estimate a sedimentation rate and to project reservoir capacities in the year 2000 and the year 2060. This is the approach used for the *2011 Region C Water Plan.* [(3)] The TCEQ Water Availability Model for the Trinity Basin [(4)] was prepared in the late 1990s. The hydrologic data has not been extended since that time. However, the drought of the 1950's remains the drought of record and will likely still control the results of the water availability analysis. The period of record for the model simulations is 1940 to 1997.

[(1)] Numbers in parentheses match references listed in Appendix A.

Using the latest TCEQ Trinity WAM with New Terrell City Lake modified to Year 2000 conditions, the firm yield of New Terrell City Lake was determined to be 2,400 acre-feet per year. Figure 2-1 is the resulting storage trace from the firm yield analysis. The firm yield of New Terrell City Lake is 2,300 acre-feet per year under Year 2060 conditions, which assumes reduced storage capacity based on sedimentation. Year 2000 and 2060 area and capacity conditions for New Terrell City Lake were developed for the *2011 Region C Water Plan.* [3]

Figure 2-1 New Terrell City Lake Storage, Firm Yield = 2,400 ac-ft/yr



To determine the water available for diversion on a regular basis, the Trinity WAM was first run with a target diversion rate (or demand) of the permitted 6,000 acre-feet per year. The results indicated that in 16% of the months, the actual diversion would be less than the target diversion. The average annual diversion over the time period is 5,250 acre-feet, and the minimum annual diversion is 1,060 acre-feet. Figure 2-2 shows the storage trace, and Figure 2-3 shows the annual diversions from New Terrell City Lake with a target diversion of 6,000 acre-feet per year.

Figure 2-2 New Terrell City Lake Storage, Target Diversion = 6,000 ac-ft/yr

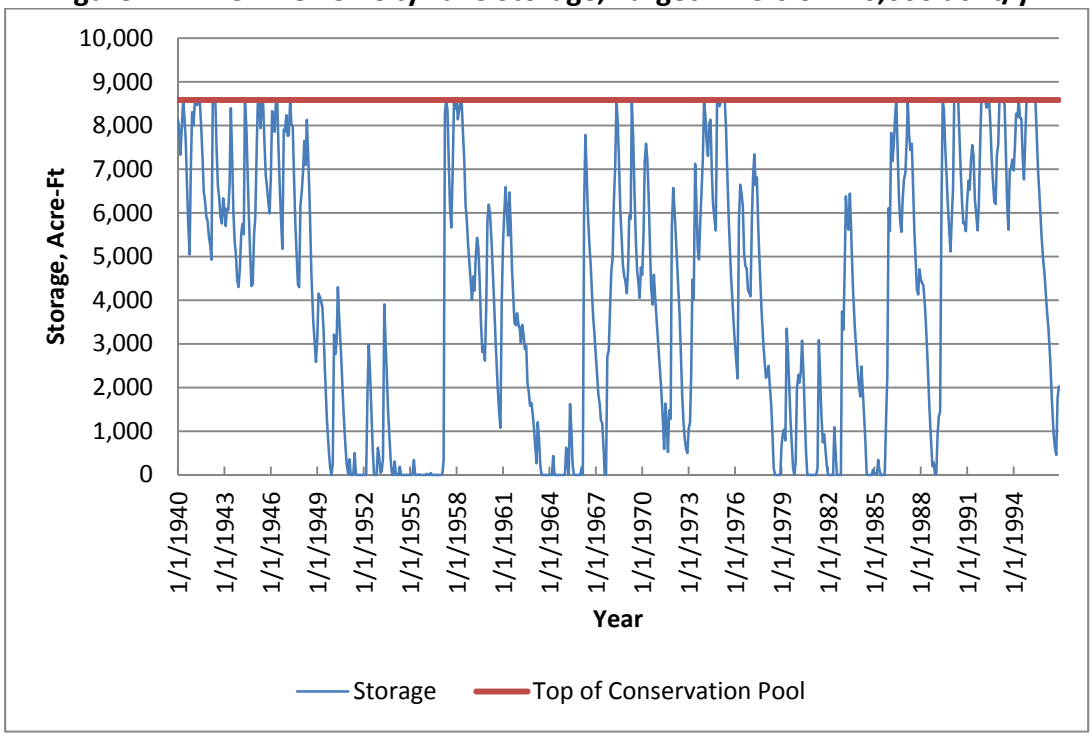
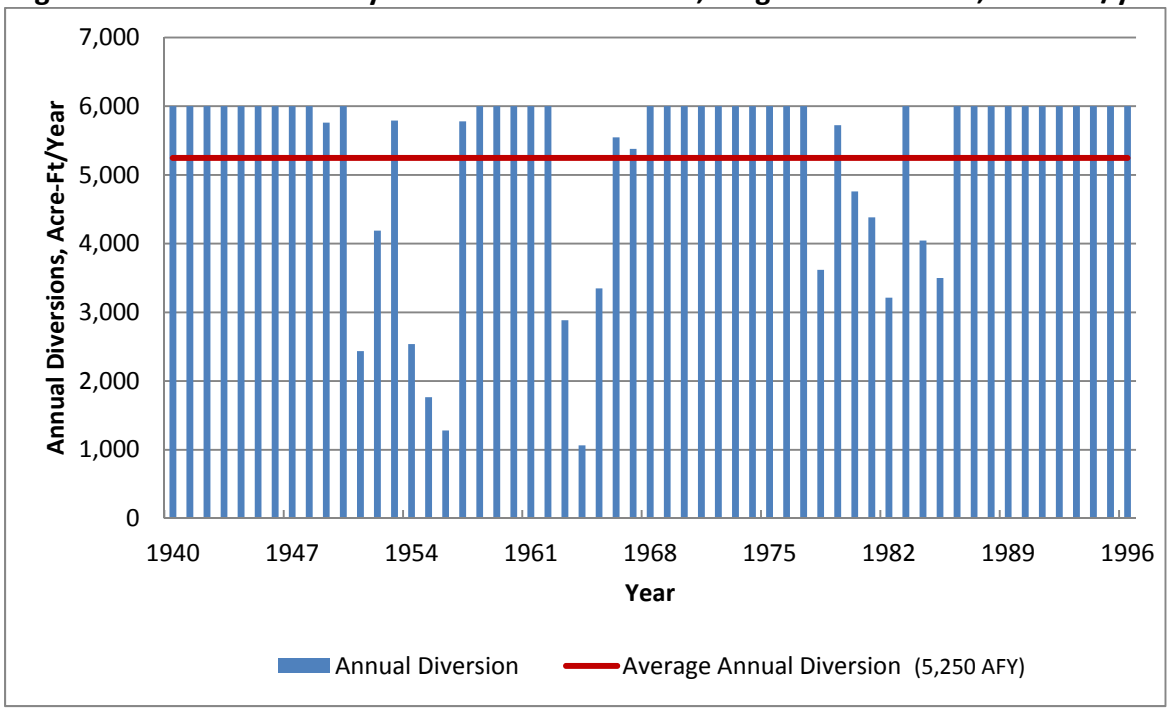


Figure 2-3 New Terrell City Lake Annual Diversions, Target Diversion = 6,000 ac-ft/yr



Running the WAM with a target diversion rate of 4,000 acre-feet per year from New Terrell City Lake results in an actual diversion less than the target diversion in only 4% of the months. The average annual diversion over the simulated time period is 3,870 acre-feet with a minimum annual diversion of 1,230 acre-feet.

A target diversion of 6,000 acre-feet per year when the reservoir storage is greater than 50% and a target diversion of 1,800 acre-feet per year (30% of 6,000) when the reservoir storage is less than 50% was also analyzed. This resulted in no shortages and an average annual diversion of 4,540 acre-feet per year over the simulation period. Figure 2-4 shows the storage trace, and Figure 2-5 shows the annual diversions from New Terrell City Lake for this scenario. The results discussed above are summarized in Table 2-1. A memorandum summarizing the information above was sent to Canton, DWU, NTMWD, and SRA. A copy of this memorandum is included in Appendix E.

Figure 2-4 New Terrell City Lake Storage, Target Diversion = 6,000 ac-ft/yr When Storage Is >50%, Target Diversion = 1,800 ac-ft/yr When Storage Is <50%

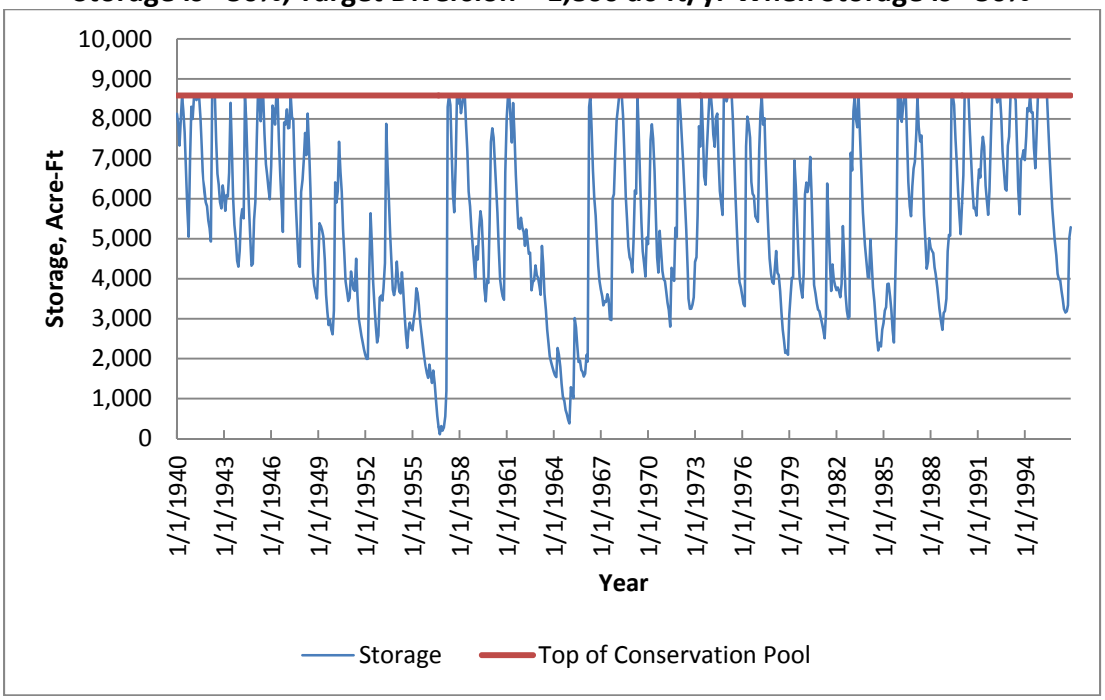


Figure 2-5 New Terrell City Lake Annual Diversions, Target Diversion = 6,000 ac-ft/yr When Storage Is >50%, Target Diversion = 1,800 ac-ft/yr When Storage Is <50%

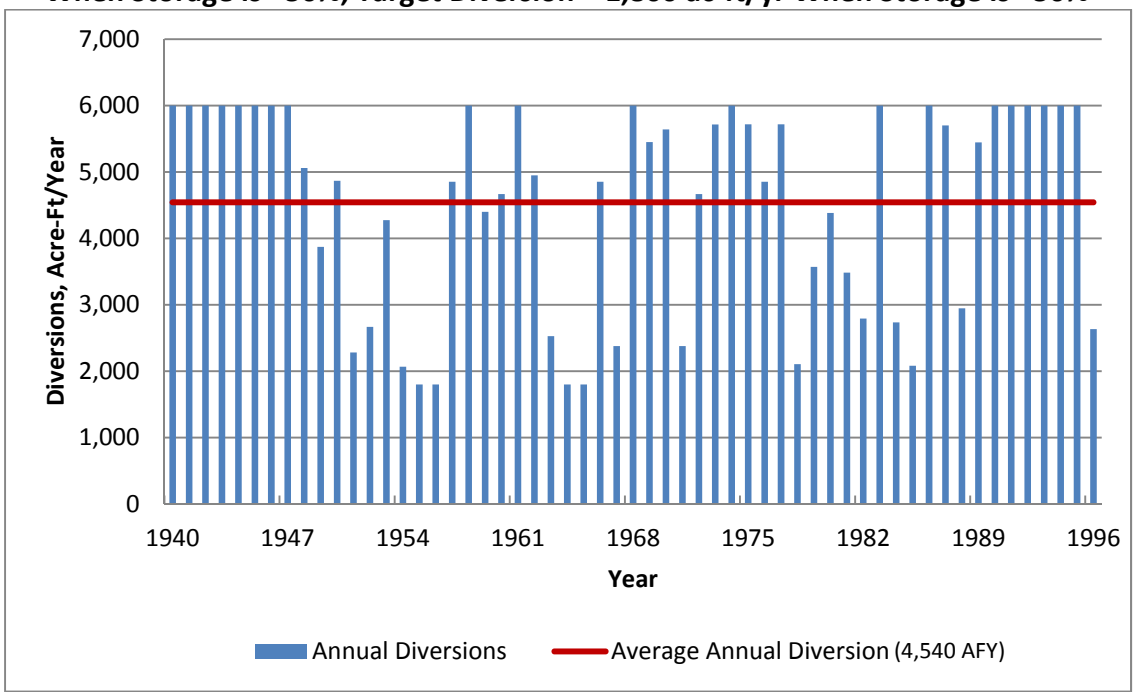


Table 2-1 Water Availability Analysis for New Terrell City Lake

Target Diversion Rate (Ac-Ft/Year)	% of Months with Shortage	Average Annual Diversion (Ac-Ft/Year)	Minimum Annual Diversion (Ac-Ft/Year)
2,400 (Firm Yield)	0%	2,400	2,400
6,000 (Permitted Amount)	16%	5,250	1,060
4,000	4%	3,870	1,230
6,000 when storage >50% 1,800 when storage <50%	0%	4,540	1,800

2.2 New Terrell City Lake Water Availability with Raised Normal Pool Elevation

It is possible to increase the firm yield of the New Terrell City Lake by raising the normal pool elevation, which is currently 504.0 ft-msl. The dam's service spillway can be modified to raise the normal pool two feet. (See Section 4.5 for a more detailed discussion on the required modification.) The Trinity WAM, as described in Section 2.1, was modified to determine the impact on the firm yield if the normal pool is raised two feet (to elevation 506.0 ft-msl) and five feet (to 509.0 ft-msl). In the model, the

additional storage above 504.0 ft-msl was assigned a priority date of January 27, 2011, which is junior to the existing water rights in the model.

The WAM analysis indicated that raising the normal pool elevation two feet from elevation 504.0 ft-msl to 506.0 ft-msl increases the firm yield from 2,400 acre-feet per year to 2,700 acre-feet per year. Raising the normal pool an additional three feet to elevation 509.0 ft-msl did not increase the firm yield any further.

After determining the firm yield with a normal pool elevation of 506.0 ft-msl, the model was run with a target diversion rate (or demand) of 6,000 acre-feet per year. The results indicated that in 15% of the months, the actual diversion would be less than the target diversion. The average annual diversion over the time period is 5,290 acre-feet, and the minimum annual diversion is 1,060 acre-feet. Therefore, raising the normal pool does not have a significant impact to the average annual diversion when imposing a target diversion rate of 6,000 acre-feet per year.

2.3 Meetings with Potential Users of Water from New Terrell City Lake

The water suppliers with needs in the New Terrell City Lake area (see Table 1-1) were assessed, and several entities were contacted and invited to a meeting to determine their interest in using water from City Lake. The meeting was held at the City of Terrell Public Works Service Center on July 7, 2010. See Section 7 for additional information on this meeting. Entities were later contacted based on interest expressed at this meeting. Those interested in using water from New Terrell City Lake were the City of Canton, Dallas Water Utilities (DWU), North Texas Municipal Water District (NTMWD) and the Sabine River Authority (SRA). Below are summaries of the alternatives considered for each of the water suppliers. Schematics of each of the alternatives are shown in Figures 3-1 through 3-4. A detailed description and cost estimate for each alternative is included in Section 3.

Canton is potentially interested in purchasing water from New Terrell City Lake and treating the water at the City of Canton's water treatment plant (WTP). A pipeline would be required to transport New Terrell City Lake water to the City's WTP.

DWU is potentially interested in using New Terrell City Lake as a pass-through from Lake Tawakoni to Cedar Creek Reservoir. In this option DWU may or may not purchase water from New Terrell City Lake. The existing 24-inch pipeline from Lake Tawakoni to New Terrell City Lake would need to be replaced with a larger diameter pipe. The water would be released from the lake into the existing Cedar Creek channel and flow to Cedar Creek Reservoir. This would require a bed and banks permit and an agreement with Tarrant Regional Water District (TRWD) to allow the water to be passed through Cedar Creek Reservoir to the joint TRWD/DWU Integrated Pipeline, which will deliver water to the Metroplex area.

NTMWD is potentially interested in purchasing water from New Terrell City Lake and treating the water at their Tawakoni WTP, either as a primary or backup supply. To use the water as a primary or backup supply, a pipeline would be required to transport New Terrell City Lake Water to the Tawakoni WTP. To use City Lake as a backup supply, a new pump station and new intake structure can be constructed, or the existing intake structure and several of the existing pumps can be used with two new additional pumps.

SRA is potentially interested in purchasing water from City Lake and transporting the water to Lake Tawakoni. A new pipeline is required to connect to the existing 24-inch pipeline from New Terrell City Lake to Lake Tawakoni. The construction of an outlet structure at Lake Tawakoni would be required.

3.0 DETERMINATION OF TRANSMISSION FACILITIES, COSTS, AND RECOMMENDATIONS

3.1 Methodology for Transmission Facility Cost Estimates

Alternative uses of New Terrell City Lake were considered for Canton, DWU, NTMWD, and SRA. The preliminary costs of the transmission facilities were developed using the same methodology used to develop costs in the *2011 Region C Water Plan.* This was done to allow the potential users of the City Lake to make a direct cost comparison with water management strategies listed in the *2011 Region C Water Plan*.

Terrell owns existing facilities (pump station, outlet structure, pipeline, pipeline easement, etc.) related to the New Terrell City Lake supply. Terrell will consider selling these facilities if they are needed for any of the proposed alternatives. Terrell owns a pump station with five pumps, a variable frequency drive (VFD), and a gated intake structure with a 30-inch concrete outlet pipe that runs under the dam at New Terrell City Lake. The City also has a 24-inch pipeline from Lake Tawakoni to New Terrell City Lake that includes a 30-foot-wide easement.

The costs of the existing pumps were calculated by determining the current cost of a new similar pump and using a straight line depreciation to determine the current value. This calculation assumed the useful life of the pumps is 20 years. Based on this assumption, Pumps 2 and 4 have no current value, but a salvage value of $1,000 was assigned to both pumps. Table 3-1 shows the existing pumps, their corresponding horsepower amounts, and their depreciated (current) value. All of the pumps are located in the same building, and costs assume that in agreeing to purchase one of the pumps, the buyer agrees to purchase all five pumps and the building in which they are housed.

Table 3-1 Existing Pumps at New Terrell City Lake

Pump	HP	Date Purchased	Current Value
1	60	1998	$17,400
2	40	1989	$1,000
3	200	1995	$19,800
4	200	1972	$1,000
5 (and VFD)	200	2001	$79,400

The original building in which Pumps 1 and 2 are housed and the intake structure were constructed in 1960. The pump station building was expanded in the 1970s to add three new pumps. The current value of the intake was calculated by depreciating the cost of a new intake structure of the same size. The pipeline from the existing intake to the pump station is a 30-inch line.

New electrical and chemical buildings were added onto the original pump station building in 2001. Pump 5 and a Variable Frequency Drive (VFD) were also installed at this time. The current value of the original building and the portion of the building added in the 1970's was calculated by determining the current cost of construction of a pump station and using straight line depreciation based on the age of the buildings. The current value of the new electrical and chemical buildings was determined based on the construction contract amount provided by the City of Terrell and the same straight line depreciation method used to determine the other current costs. The useful life of the buildings was assumed to be 50 years. "Current cost" refers to the cost in January 2009 dollars. Costs were determined in January 2009 dollars to be comparable to the costs presented in the *2011 Region C Water Plan*, which are September 2008 dollars. Based on a review of construction cost indices, September 2008 and January 2009 costs were determined to be essentially the same. Table 3-2 shows the current value of the existing pump station facilities at City Lake.

Table 3-2 Current Value of Existing Pump Station Facilities at New Terrell City Lake

Facility	Date of Construction	Current Value
Original building (100 hp)	1960	$0
New Building (600 hp)	1972	$444,000
New Electrical and Chemical Facilities	2001	$417,200
Intake Structure	1960	$170,400

The unit costs used for pipelines, pump stations, and discharge structures are based on historical bid data and are shown in Appendix B. Developing costs for treatment facilities and distribution systems needed, if any, are outside the scope of this study and are not included in the cost estimates. To determine whether the existing pumps at New Terrell City Lake could be used, ground profiles and hydraulic grade lines were calculated to develop system curves. These system curves were then compared with the pump performance test curves of the existing pumps. The pump and system curves can be seen in Appendix F. Assumptions for the cost estimates include the following:

- Pipeline length was assumed to be the straight-line distance plus 10% to account for slope distances and routing around obstacles.
- Permitting and mitigation of pipelines was assumed to be 1% of the construction cost.
- Significant permitting may be required to construct an outlet structure in Lake Tawakoni for the SRA alternative. Because of this, the permitting and mitigation for the new outlet structure was estimated at 3% rather than 1%.
- Significant permitting may be required to replace the existing intake at New Terrell City Lake for the NTMWD option as a backup supply. Because of this, permitting and mitigation for the new intake was estimated at 5% rather than 1%.
- The cost of raw water, as determined by Terrell, is $0.45 per 1,000 gallons.

- The electricity costs are based on $0.09 per kilowatt hour.
- Operation and maintenance (O & M) costs for new facilities was assumed to be 1% of the construction cost for pipelines and 2.5% of the construction cost for pump stations. O&M costs for existing facilities were assumed to be 2.5% of the pump station cost in new condition.
- Debt service was assumed to be 6% for 30 years.
- Debt service for replacement of pumps was assumed to be 6% for 15 years.

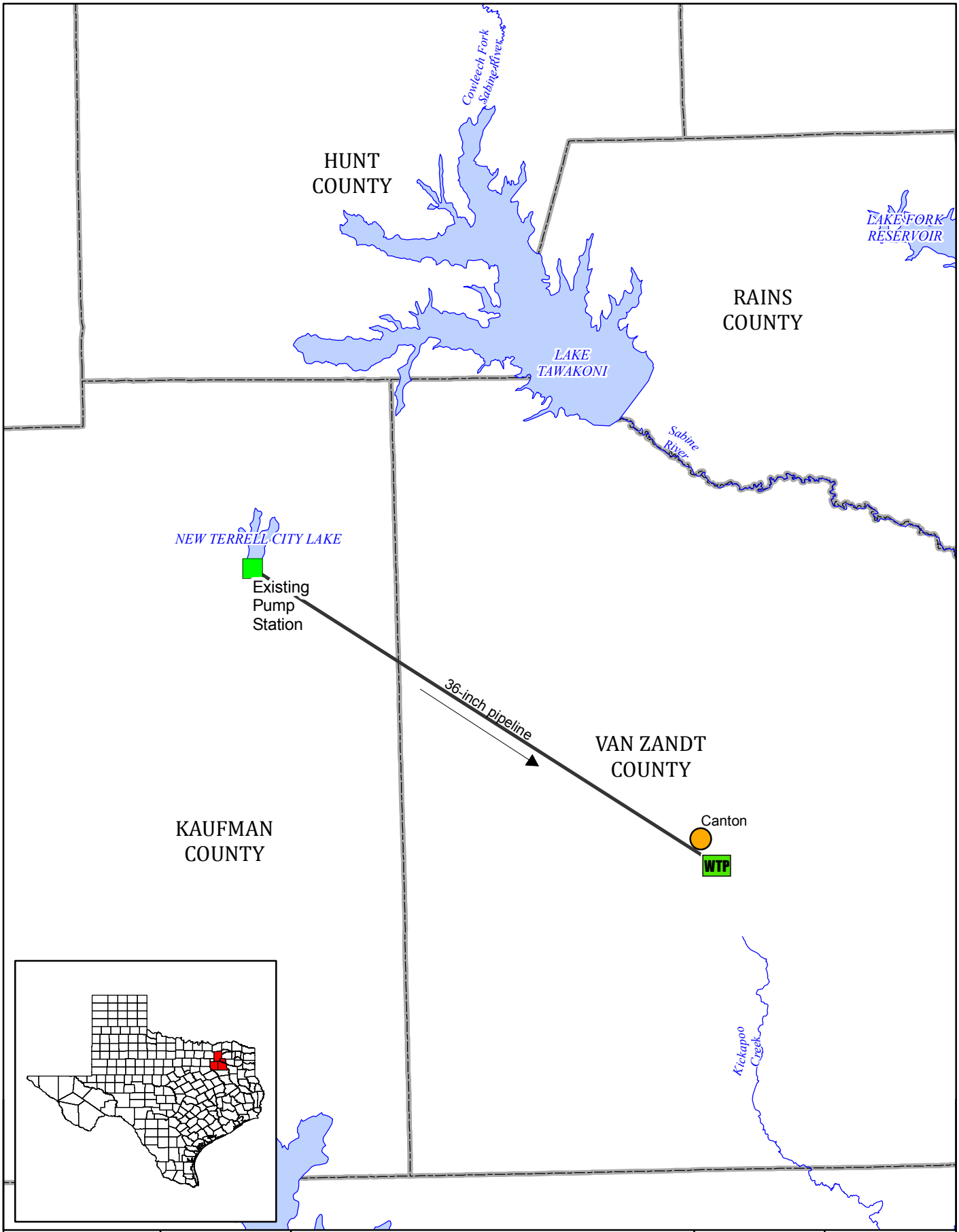
Annual and unit costs were determined using 5,250 acre-feet per year (the average annual diversion of New Terrell City Lake with a target diversion of 6,000 acre-feet per year) and 2,400 acre-feet per year (the firm yield of New Terrell City Lake) for the convenience of the potential buyer (see Section 2.1 for a detailed description of the determination of the yield from New Terrell City Lake). The annual and unit costs will vary depending on how the buyer decides to operate the reservoir, which is why costs were presented for both the average annual yield and the firm yield of the reservoir.

A summary of the preliminary costs for each of the alternatives is listed in Tables 3-3, 3-4, 3-5, and 3-6. Detailed cost estimates are included in Appendix B. Note that the cost estimates in this section do not include any dam modifications. Dam safety requirements and potential modifications are discussed in Section 4.

3.2 Transmission Facilities for Potential Users of New Terrell City Lake

The required transmission facilities for each alternative were determined based on the amount of water the potential buyer was interested in using and the desired operation of City Lake for each potential customer. The existing Terrell facilities were used when feasible. Terrell's existing water right will need to be amended for each of the alternatives. The current water right allows for the diversion of approximately five mgd whereas the alternatives look at diverting 13 mgd or more. Diversion rate modifications have historically been relatively easy to obtain. Schematics of each of the

alternatives are included in Figures 3-1 through 3-4. The hydraulics used to develop the potential alternatives for each customer are included in Appendix F.



FN PROJECT NO.	TER10197
FILE NAME	Canton_final.mxd
DATUM & COORDINATE SYSTEM	NAD83 STATE PLANE TX NORTH CENTRAL (FT)
DATE CREATED	SEPTEMBER 2010
PREPARED BY	KEK

FREESE NICHOLS
4055 International Plaza, Suite 200
Fort Worth, TX 76109-4895
817-735-7300

0 15,000 30,000 60,000 Feet

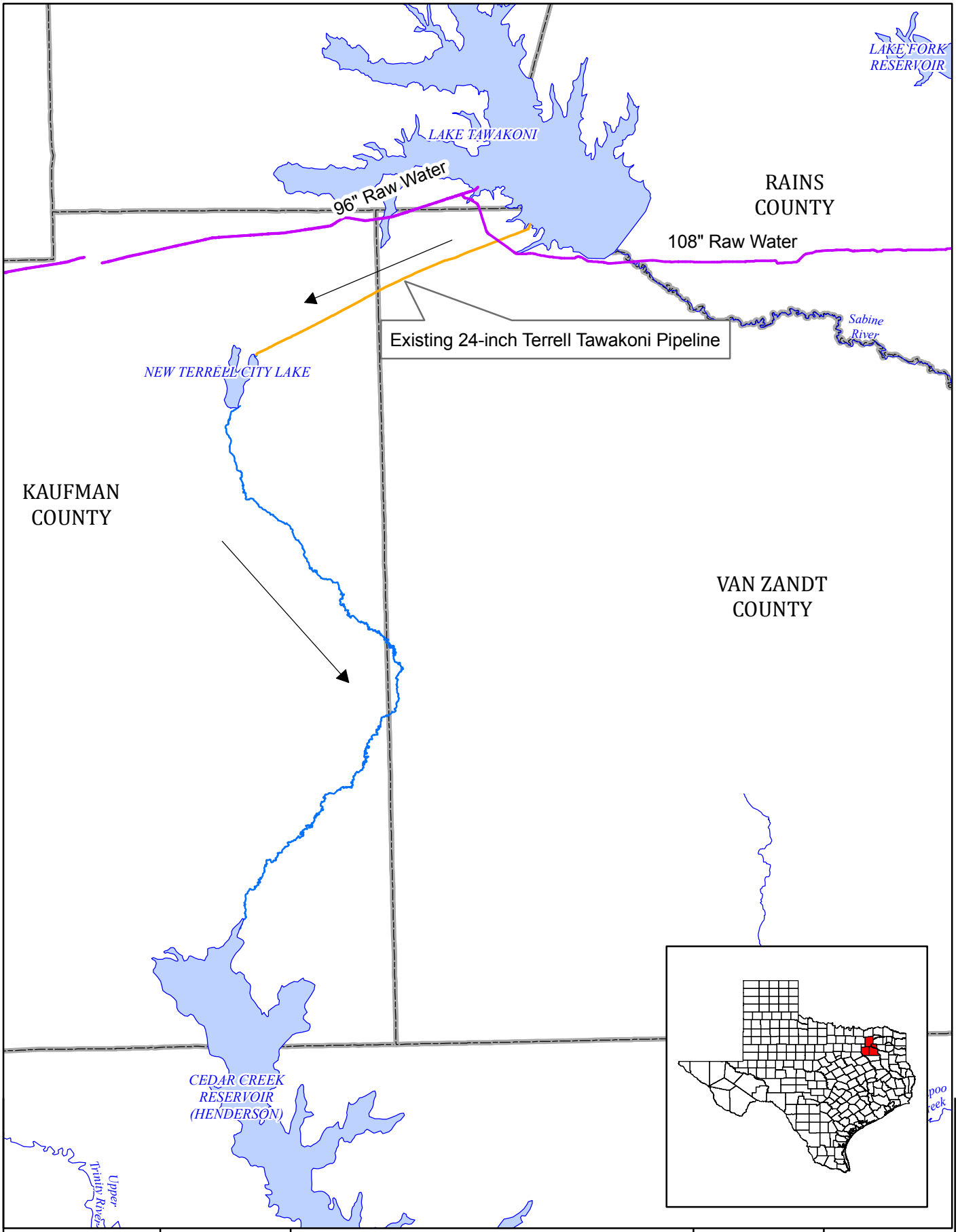
N

Terrell Water Supply Study

Water Supply to Canton

FIGURE

3-1



FN PROJECT NO.	TER10197
FILE NAME	DWU_final.mxd
DATUM & COORDINATE SYSTEM	NAD83 STATE PLANE TX NORTH CENTRAL (FT)
DATE CREATED	SEPTEMBER 2010
PREPARED BY	KEK

FREESE NICHOLS
4055 International Plaza, Suite 200
Fort Worth, TX 76109-4895
817-735-7300

0 19,000 38,000 76,000 Feet

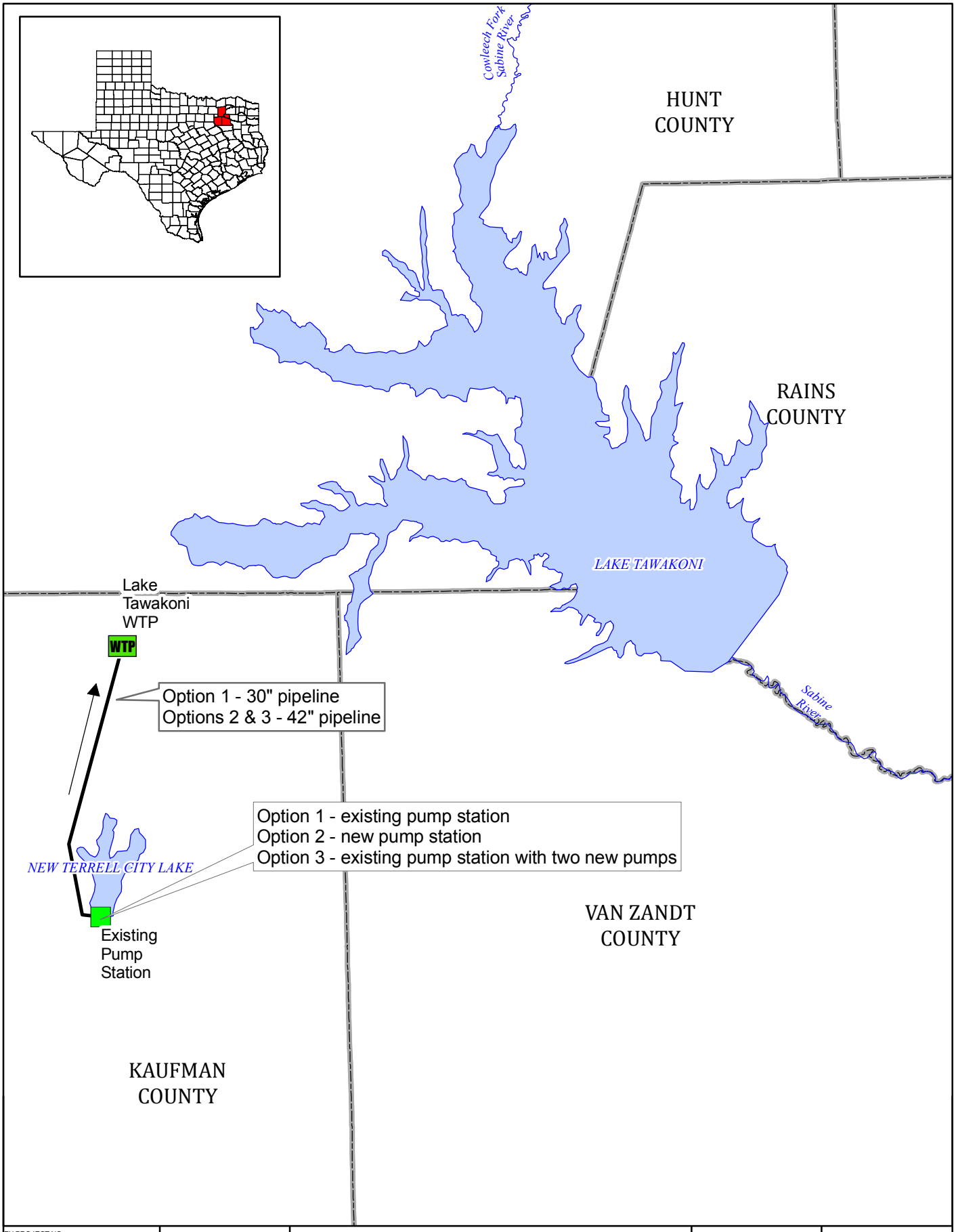
N

Terrell Water Supply Study

Water Supply for DWU

FIGURE

3-2



FN PROJECT NO.	TER10197
FILE NAME	NTMWD_final.mxd
DATUM & COORDINATE SYSTEM	NAD83 STATE PLANE TX NORTH CENTRAL (FT)
DATE CREATED	SEPTEMBER 2010
PREPARED BY	KEK

FREESE NICHOLS
4055 International Plaza, Suite 200
Fort Worth, TX 76109-4895
817-735-7300

0 8,750 17,500 35,000 Feet

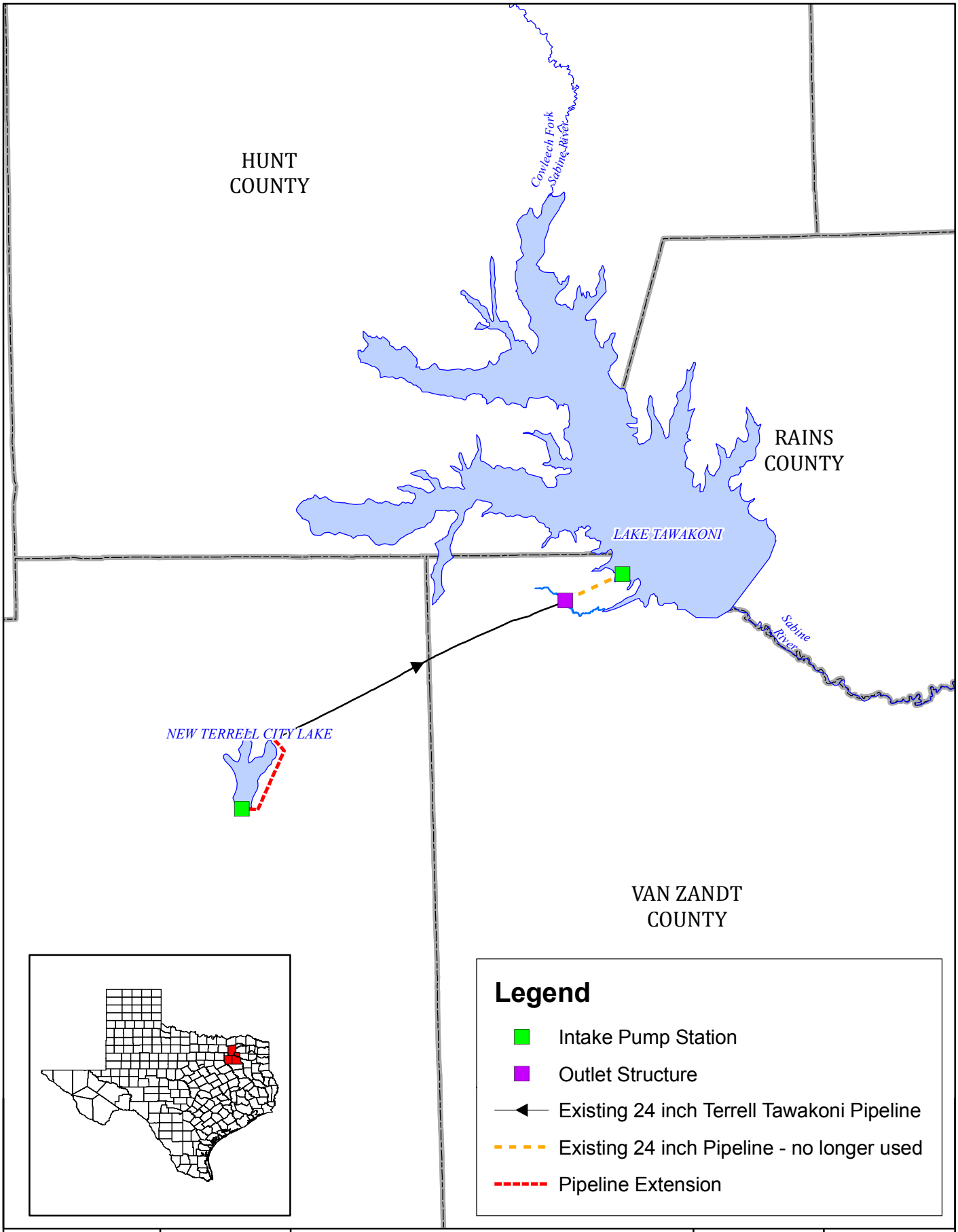
Terrell Water Supply Study

NTMWD Alternatives

N

FIGURE

3-3



FN PROJECT NO.	TER10197
FILE NAME	Canton_final.mxd
DATUM & COORDINATE SYSTEM	NAD83 STATE PLANE TX NORTH CENTRAL (FT)
DATE CREATED	SEPTEMBER 2010
PREPARED BY	KEK

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4055 International Plaza, Suite 200
Fort Worth, TX 76109-4895
817-735-7300

0 11,500 23,000 46,000 Feet

Terrell Water Supply Study

Water Supply for SRA

N

FIGURE

3-4

3.2.1 City of Canton

Canton is potentially interested in purchasing water from New Terrell City Lake and treating the water at the City of Canton's water treatment plant (WTP). A 25-mile long, 36-inch diameter pipeline is required to transport 13 mgd (peak) to the City's WTP. Terrell's existing pumps can be used to transport water from the City Lake to the WTP. Any WTP expansions needed to treat 13 mgd are beyond the scope of this project and were not considered. An interbasin transfer (IBT) permit will be required for Canton to use New Terrell City Lake water. Table 3-3 displays the project costs for water supply to Canton. The cost of new construction includes the 25-mile long, 36-inch pipeline. The cost of the existing facilities includes the cost of pumps 1 through 5, the VFD, the pump building, and pump intake. A detailed cost estimate is included in Appendix B.

Table 3-3 Project Costs for New Terrell City Lake Water Supply to Canton

Alternative	Supply (peak, mgd)	Cost of New Construction	Cost of Existing Facilities	Unit Costs (per 1,000 gallons)			
				Average Annual Yield		Firm Yield	
				Pre-Amortization	Post-Amortization	Pre-Amortization	Post-Amortization
Supply from New Terrell City Lake to Canton's WTP	12.96	$35,745,000	$1,150,000	$2.33	$0.77	$4.52	$1.09

3.2.2 Dallas Water Utilities (DWU)

DWU is potentially interested in using New Terrell City Lake as a pass-through facility to transport water from Lake Tawakoni to Cedar Creek Reservoir (Option 1). In this option DWU would transport water at an average rate of 50 mgd and a peak rate of 75 mgd. DWU may also choose to purchase water from New Terrell City Lake along with using the lake as a pass-through (Option 2). In which case, DWU would purchase 4.7 mgd from City Lake and transport water from Lake Tawakoni at a peak rate of 67.3 mgd.

To use New Terrell City Lake as a pass-through (Option 1) the existing 24-inch pipeline from Lake Tawakoni to New Terrell City Lake would need to be replaced with a 66-inch pipeline. The 66-inch pipeline could transport up to 72 mgd and the existing 30-foot easement can be used. The existing outlet structure capacity at City Lake is 72 mgd

and is controlled by the 30-inch concrete culvert that runs under the dam. A new 4,100 horsepower intake pump station would be required at Lake Tawakoni to transport 72 mgd to City Lake. At the request of DWU, annual and unit costs for this option were calculated for the transport of 72 mgd and 50 mgd from Lake Tawakoni to New Terrell City Lake. It is important to note that if DWU chooses to only use City Lake as a pass-through the water supply options for Canton, NTMWD, or SRA can still be pursued and can be done in conjunction with the pass-through option.

If DWU chooses to purchase water from New Terrell City Lake as water from Lake Tawakoni is passed through (Option 2), 67.3 mgd would be transported from Lake Tawakoni to City Lake. The remaining 4.7 mgd would come from New Terrell City Lake for a peak discharge into Cedar Creek of 72 mgd. The existing 24-inch pipeline from Lake Tawakoni to the City Lake would need to be replaced with a 66-inch pipeline for this option. A new 3,700 horsepower intake pump station would be required at Lake Tawakoni to transport 67.3 mgd to New Terrell City Lake. The electricity costs for this option were based on transporting 50 mgd from Lake Tawakoni.

No pumps would be required at City Lake for either of the options discussed above. The water would be released from the lake into the existing Cedar Creek channel, which would require a bed and banks permit, and flow to Cedar Creek Reservoir. Bed and bank permits are obtained through the Texas Commission on Environmental Quality (TCEQ) and require a water right permit or water right amendment. An agreement with Tarrant Regional Water District (TRWD) is also required to allow the water to be passed through Cedar Creek Reservoir to the joint TRWD/DWU Integrated Pipeline, which will deliver water to the Metroplex area.

It should be noted that the condition of the outlet structure is unknown. Additionally, it is unknown as to whether the downstream channel can handle a peak flow of 72 mgd. The assessment of the outlet structure and the downstream channel are beyond the scope of this project, and it is assumed that both are capable of handling peak flows of 72 mgd. Table 3-4 displays the project costs for water supply to DWU. Detailed cost estimates are included in Appendix B.

Table 3-4 Project Costs for New Terrell City Lake Water Supply to DWU

Alternative	Supply (peak, mgd)	Cost of New Construction	Cost of Existing Facilities	Unit Costs (per 1,000 gallons)	
				Pre-Amortization	Post-Amortization
Option 1	72	$51,809,100	$2,292,593	$0.37*	$0.11*
Option 2	72	$50,995,200	$2,292,593	$0.37	$0.14

*Unit costs are based on an average annual supply of 50 mgd from Lake Tawakoni.

3.2.3 North Texas Municipal Water District (NTMWD)

NTMWD is potentially interested in purchasing water from New Terrell City Lake and treating the water at their Tawakoni WTP, either as a primary or backup supply. As a backup supply, water from New Terrell City Lake would be used to provide 25 to 30 mgd if other sources in the vicinity of NTMWD's Tawakoni WTP were not available. The diversion rate in the water right would need to be amended from 6,000 acre-feet per year (5.4 mgd) to 33,630 acre-feet per year (30 mgd) for NTMWD to operate City Lake as a backup supply. If the water right is amended to allow a diversion rate of 30 mgd, NTMWD can withdraw from the lake at a rate of 13 mgd for about five months out of the year, or a rate of 30 mgd for about 2 months in order to operate within the diversion limits of the water right. To use the water as a primary supply (Option 1), an eight-mile long, 30-inch pipeline is required to transport 13 mgd (peak) to the Tawakoni WTP. The existing Terrell pumps can be used to transport water from City Lake to the Tawakoni WTP for this option. To use New Terrell City Lake as a backup supply, an eight-mile long, 42-inch pipeline is required to transport 30 mgd (peak) to the WTP. A new 1,500 horsepower pump station and new intake structure can be constructed (Option 2), or the existing intake structure and several of the existing pumps can be used with two new additional pumps (Option 3). Table 3-5 displays the project costs for water supply to NTMWD. Detailed cost estimates are presented in Appendix B.

Table 3-5 Project Costs for New Terrell City Lake Water Supply to NTMWD

Alternative	Supply (peak, mgd)	Cost of New Construction	Cost of Existing Facilities	Unit Costs (per 1,000 gallons)			
				Average Annual Yield		Firm Yield	
				Pre-Amortization	Post-Amortization	Pre-Amortization	Post-Amortization
Option 1	12.96	$9,001,000	$1,150,000	$1.09	$0.66	$1.78	$0.84
Option 2	30.00	$20,056,000	$0	$1.54	$0.69	$2.78	$0.92
Option 3	30.00	$13,397,000	$1,150,000	$1.31	$0.70	$2.26	$0.91

3.2.4 Sabine River Authority (SRA)

SRA is potentially interested in purchasing water from City Lake and transmitting the water to Lake Tawakoni. A three-mile long, 24-inch pipeline is required to connect to the existing 24-inch pipeline from New Terrell City Lake to Lake Tawakoni. The existing 24-inch pipeline was used to transport water from Lake Tawakoni to New Terrell City Lake and has a capacity of 12.5 mgd. The capacity of the existing 24-inch pipeline transporting water in reverse, from New Terrell City Lake to Lake Tawakoni, is 10.9 mgd. The construction of an outlet structure at Lake Tawakoni would be required, and the existing Terrell pumps could be used to transport the water to Lake Tawakoni. An interbasin transfer (IBT) permit will be required for SRA to use New Terrell City Lake water. Table 3-6 displays the project costs for water supply to SRA. The cost of new construction includes the cost of the outlet structure at Lake Tawakoni and the three miles of 24-inch pipeline. The cost for the existing facilities includes the existing 12 miles of 24-inch pipeline to Lake Tawakoni, pumps 1 through 5, the VFD, the pump building, and the pump intake. A detailed cost estimate is included in Appendix B.

Table 3-6 Project Costs for New Terrell City Lake Water Supply to SRA

Alternative	Supply (peak, mgd)	Cost of New Construction	Cost of Existing Facilities	Unit Costs (per 1,000 gallons)			
				Average Annual Yield		Firm Yield	
				Pre-Amortization	Post-Amortization	Pre-Amortization	Post-Amortization
Terrell water to Lake Tawakoni	10.9	$2,966,000	$2,949,000	$0.92	$0.67	$1.40	$0.85

3.3 Results

Memorandums were sent to Canton, DWU, NTMWD, and SRA summarizing the considered alternatives for each entity and the related costs. Meetings were held with Canton, DWU, and NTMWD to discuss their respective alternatives in detail. Appendix G includes the memorandums sent to each entity and the meeting materials for each meeting. Based on the overall estimated cost of the New Terrell City Lake supply presented in the memorandum to SRA, SRA was not interested in pursuing the supply any further. Therefore, a follow-up meeting with SRA was not scheduled.

The water supply alternatives presented in this report were reviewed for consistency with the Region C and Region D Water Plans. Region C and Region D are two of the 16 regions that were developed by the Texas Water Development Board (TWDB) to aid in long-term statewide water supply planning. Terrell, DWU, NTMWD, and part of SRA are located in Region C. Canton and a portion of SRA are located in Region D. Water supply from New Terrell City Lake is not included as a recommended or alternative water management strategy in the Region C or Region D Water Plans for any of the potential users of the lake. The *2011 Region C Water Plan* acknowledges that Terrell is pursuing alternative uses of the lake but makes no recommendations. If Canton, DWU, or NTMWD decide to pursue the use of New Terrell City Lake, the *2011 Region C Water Plan* and/or the *North East Texas (Region D) Regional Water Plan* [5] may need to be amended for the projects to be eligible for state funding.

Table 3-7 summarizes the costs for each of the water supply alternatives. It is recommended that the City of Terrell continue to discuss feasible alternative uses of New Terrell City Lake with potential customers.

Terrell may also consider selling the dam, water rights, and all associated facilities at New Terrell City Lake. This alternative was not studied in detail but can be discussed further if a potential water user is interested.

Table 3-7 Summary of Costs

Potential Customer	Alternative	Supply (peak, mgd)	Cost of New Construction	Cost of Existing Facilities	Unit Costs (per 1,000 gallons)			
					Average Annual Yield (5,250 Ac-ft/yr)		Firm Yield (2,400 ac-ft/yr)	
					Pre-Amortization	Post-Amortization	Pre-Amortization	Post-Amortization
Canton	Supply from New Terrell City Lake to Canton's WTP	12.96	$35,745,000	$1,150,000	$2.33	$0.77	$4.52	$1.09
DWU	Pass-through using no New Terrell City Lake Water (Option 1)	72	$51,809,100	$2,292,593	$0.37*	$0.11*	N/A	N/A
DWU	Pass-through with Purchase of New Terrell City Lake Water (Option 2)	72	$50,995,200	$2,292,593	$0.37*	$0.14*	N/A	N/A
NTMWD	Supply from New Terrell City Lake to Tawakoni WTP	12.96	$9,001,000	$1,150,000	$1.09	$0.66	$1.78	$0.84
NTMWD	Supply from New Terrell City Lake to Tawakoni WTP as a Backup Supply (new pump station)	30	$20,056,000	$0	$1.54	$0.69	$2.78	$0.92
NTMWD	Supply from New Terrell City Lake to Tawakoni WTP as a Backup Supply (existing pump station)	30	$13,397,000	$1,150,000	$1.31	$0.70	$2.26	$0.91
SRA	New Terrell City Lake Water to Lake Tawakoni	10.9	$2,966,000	$2,949,000	$0.92	$0.67	$1.40	$0.85

*Unit costs are based on an average annual supply of 50 mgd from Lake Tawakoni.

3.4 Possible Funding Source for Transmission Facilities

The Texas Water Development Board has financial assistance available for water supply projects. The water supply alternatives in this report could potentially be eligible for the following funds:

- Water Infrastructure Fund (WIF)
- Drinking Water State Revolving Fund (SRF)
- Texas Water Development Fund
- Rural Water Assistance Fund
- State Participation Fund

Information and criteria for these funds are included on the TWDB website: http://www.twdb.state.tx.us/financial/programs/. Each fund listed is a low-interest loan from the TWDB. The WIF and SRF funds require the water supply projects to be consistent with the current State Water Plan (or Regional Water Plan). Therefore, an amendment to the applicable regional water plan would be required for the Terrell City Lake water supply alternatives to be eligible for WIF or SRF funding.

4.0 DAM CONDITION ASSESSMENT

4.1 Description of Dam

New Terrell City Lake Dam was originally constructed by the City of Terrell in 1955 and was modified by the Natural Resource Conservation Service (NRCS) in 1967. As part of that modification project, the dam was given a second name: Floodwater Retarding Structure No. 87A in the Cedar Creek Watershed. For the purposes of this report, the dam will be referred to as New Terrell City Lake Dam.

New Terrell City Lake Dam is a 4,800-foot long earthen embankment dam with a maximum height of 43 feet above the original streambed and a crest elevation of 513.4 ft-msl. Figure 4-1 shows an aerial view of the dam. The embankment consists of a center impervious fill core and foundation cut-off trench with semi-pervious fill outer shells on either side of the core. The upstream slope is 3 horizontal to 1 vertical (3H:1V) and protected by a 12-inch layer of rock riprap underlain by a 6-inch layer of gravel bedding. The rock riprap extends between elevations 493.0 ft-msl and 507.0 ft-msl; above the 507.0 ft-msl the upstream slope is grassed. The downstream slope is 2.5H:1V with grass slope protection. The embankment crest width varies from 14 to 20 feet. There is no internal drainage system for the embankment. The 1967 modifications to the embankment consisted of raising the original crest from elevation 512.0 ft-msl. The crest was raised with compacted fill placed within the original crest width. The 1967 modifications did not affect the embankment's upstream or downstream slopes.

The service spillway, located near the left abutment, consists of a 40-foot wide concrete overflow structure with 2H:1V side slopes and a crest elevation of 508.8 ft-msl. A series of nine 24-inch concrete pipes are located beneath the crest of the overflow spillway. These concrete pipes, each with an invert elevation of 504.0 ft-msl, establish the normal pool elevation. The service spillway slab slopes at 2.5 horizontal to 1.0 vertical (2.5H:1V) from the crest to a 50-foot long stilling basin at elevation 466.0 ft-msl. The service spillway slab and side slopes consist of an 8-inch thick reinforced concrete slab with transverse key walls into the foundations spaced at approximately 30.5 feet.

FNI PROJECT NO. TER10197

FILE H:\WR_DESIGN\FIGURES\New Terrell City Lake.mxd

DATUM & COORDINATE SYSTEM NAD83 STATE PLANE TX NORTH CENTRAL (FEET)

DATE JUNE 2010

PREPARED BY DLB

N

TERRELL WATER SUPPLY STUDY

AERIAL VIEW OF DAM

4055 International Plaza, Suite 200
Fort Worth, Texas 76109-4895
817-735-7300

FIGURE
4-1

The end sill of the stilling basin is at elevation 470.0 ft-msl, thus the stilling basin impounds 4 feet of water during normal conditions. The 1967 modifications to the service spillway consisted of raising the original crest from elevation 503.0 ft-msl and installing the 9 low-flow pipes mentioned previously. The remainder of the spillway and stilling basin was unchanged.

A 500-foot wide earthen emergency spillway is located at the right abutment. The crest of the emergency spillway is 509.8 ft-msl and the spillway includes a center splitter dike which has a top width of 14 feet, a dike height of 3.6 feet, and 3H:1V side slopes. At its base, the splitter dike is 35.6 feet wide, thus reducing the effective spillway width. The 1967 modifications to the emergency spillway consisted of raising the original crest from elevation 507.0 ft-msl and adding the center splitter dike.

The service outlet structure consists of a 31-foot tall, 6-foot by 6-foot concrete intake tower. The tower walls are 12 inches thick, leaving interior tower dimensions of 4-foot by 4-foot. The intake tower includes three 30-inch by 30-inch inlet gates with flowline elevations of 481.0, 488.0, and 495.0 ft-msl. All gates use a seating head design and are mounted to the exterior of the tower. The original drawings show a 42-inch by 42-inch metal trash rack was also mounted to the exterior of the tower. The inlet gates are manually operated from the deck of the intake structure. A four-foot wide timber walkway bridge connects the crest of the embankment to the deck of the intake structure. The walkway is supported by four timber piles spaced 16 to 18 feet apart.

Flow is passed through the dam via a 30-inch concrete pipe through the embankment. The concrete pipe is encased in a square concrete section which provides a minimum of 6 inches of cover from the outside wall of the pipe. The outlet pipe includes two anti-seepage concrete collars at the center of the embankment, with each collar being located 25 feet upstream and downstream of the dam centerline. The total length of the outlet pipe is 224 feet, with 192 feet being encased in concrete through the template (i.e. footprint) of the embankment and the final 32 feet of pipe not being encased. The upstream invert of the outlet pipe is 478.5 ft-msl and the downstream invert is 474.0 ft-msl, for a slope of 2.0 percent. The outlet pipe terminates at a 30-inch by 20-inch tee located downstream of the embankment toe.

A 20-inch gate valve directs flows into the raw water pump station and a 30-inch gate valve directs flow via a 32-foot section of concrete pipe into the downstream channel. The original design intent of the service outlet was to provide water from the lake to the adjacent raw water pump station. There is no discharge structure at the end of this pipe to dissipate flows entering the channel. The 1967 modifications did not alter the intake tower, walkway, outlet pipe or valves.

4.2 Applicable Regulations

New Terrell City Lake Dam was originally constructed by the City of Terrell in 1955 to serve as the city's primary water supply source. In 1967, the dam was modified by the NRCS as part of a rehabilitation project for the dam to serve a dual flood control purpose. For NRCS flood control projects, the federal government partners with a local sponsor to design, construct, and maintain the improvements. The federal government provides funds for technical assistance and construction of the improvements. The local sponsor is also responsible for obtaining funding for the project, as well as other administrative functions such as permitting and land rights. After construction is complete, the local sponsor assumes responsibility for operation and maintenance of the project. For the Cedar Creek Watershed Plan, of which New Terrell City Lake Dam/Cedar Creek FRS No. 87A is part of, the following organizations are listed as local sponsors:

- City of Terrell
- City of Kaufman
- Kaufman-Van Zandt Soil and Water Conservation District
- Trinity-Neches Soil and Water Conservation District
- Henderson County Commissioners Court
- Kaufman County Commissioners Court
- Van Zandt County Commissioners Court
- Rockwall County Commissioners Court
- Texas Parks and Wildlife

The City of Terrell has assumed all operation and maintenance responsibilities for the dam.

In Texas, the Texas Commission on Environmental Quality (TCEQ) is the regulatory agency responsible for the administration of state dam safety laws, which are contained in the Texas Administrative Code, Title 30 – Environmental Quality, Chapter 299 – Dams and Reservoirs. Section 299.15.a.1.C makes a provision that modifications to a dam using hydrologic procedures of the NRCS are acceptable, provided that the procedures are shown to be equal to or more conservative than TCEQ hydrologic procedures. NRCS requirements and methodologies are addressed through the publication titled Technical Release Number 60 – Earth Dams and Reservoirs.

4.2.1 Size Classification

The TCEQ size classification of small, intermediate, or large is based on the storage in the reservoir and the height of the dam. Intermediate-sized dams are those with maximum storage between 1,000 and 50,000 acre-feet and/or a height between 40 and 100 feet. New Terrell City Lake Dam is classified as an intermediate-sized dam based on its maximum storage capacity of 20,147 acre-feet and maximum height of 43 feet. The NRCS does not assign a size classification for dams.

4.2.2 Hazard Classification

TCEQ's dam hazard classification can be low, significant, or high based on the downstream risks in the event of a failure. A high hazard dam is usually located where failure can cause serious damage to homes, agricultural, industrial and commercial facilities, important public utilities, main highways, and railroads or possible loss of more than a few lives. TCEQ criteria define a high hazard structure as one which could potentially impact seven or more lives, or three or more habitable structures.

NRCS criteria define a high hazard dam as one where failure may cause loss of life (i.e. minimum of one life), serious damage to homes, industrial and commercial buildings, important public utilities, main highways, or railroads. New Terrell City Lake Dam is classified as a high hazard dam by both TCEQ and NRCS criteria.

4.2.3 Hydraulic Requirements

Section 299.15.a.c.3.a of the Texas Administrative Code states that an existing high hazard, intermediate-sized dam is required to safely pass at least 75 percent of the Probable Maximum Flood (PMF). The PMF event is defined by and methodologies for calculation of are addressed in the TCEQ publication titled Hydrologic and Hydraulic Guidelines for Dams in Texas. The 75 percent PMF standard is allowed based on the following conditions being met by the owner: having an emergency action plan (EAP), having an operation and maintenance (O&M) manual, having an inspection program, and submitting annual reports to the TCEQ documenting compliance with these requirements.

The NRCS evaluates a dam's hydraulic adequacy based on three separate flood events. The first criterion requires the dam to pass the 100-year flood event entirely through the principal spillway without engaging the emergency spillway; this event is also referred to as the principal spillway hydrograph. The principal spillway must also be able to discharge 85 percent of the stored volume from the 100-year event within 10 days. This requirement is referred to the 10-day drawdown. The second criterion requires the dam pass the stability design hydrograph without sustaining substantial damage to the emergency spillway. The third criterion requires the dam to pass the freeboard hydrograph without overtopping the dam. The freeboard hydrograph results from the Probable Maximum Precipitation (PMP) event.
The most direct comparison between TCEQ and NRCS hydraulic requirements is that the TCEQ requires minimally passing 75 percent of the PMF versus the NRCS requiring passing 100 percent of the PMF. The methodologies in developing the hydrology for the respective PMF events differ, however the NRCS requirement for the freeboard hydrograph is generally more conservative than the TCEQ 75 percent PMF requirement.

4.3 Operation and Maintenance Issues

A dam safety inspection was performed by NRCS staff in May 2008. During that inspection, the operation and maintenance activities were classified as adequate. The primary deficiencies noted in the inspection report included trees growing on the upstream slope, scattered trees on the crest and downstream slope, and vegetation growing in joints of the

concrete service spillway. The inspection also identified a seepage area on the downstream slope that was overgrown with vegetation because the area was too wet to mow.

As part of the 2010 NRCS assessment study, a similar site inspection was performed. This report basically confirmed the conditions observed in the 2008 inspection, but noted that the seepage area had deteriorated in a series of sloughs of the embankment. It was also noted that the extents of the seepage area had increased.

As part of this study, a separate dam safety inspection was performed in May 2010. The findings of this inspection were provided in a separate memorandum. The major points are highlighted as follows:

- Trees and brush needed to be removed from the upstream slope. Vegetation generally was heaviest on the right half of the dam.
- Multiple areas of erosion and benching in the upstream slope rock riprap were observed. The tree and brush vegetation obscured inspection of the slope in areas. It was recommended that the slope be reinspected after removal of the trees to identify more eroded areas and then rock riprap be added in these areas.
- The downstream slope was well maintained and in good condition, with one significant exception. The seepage area identified in previous inspections had further deteriorated to include several sloughs and seepage exiting the vertical faces of the sloughs. Inspection of the entire area was difficult due to heavy vegetation growth. Given the location within the embankment and the amount of exiting seepage, it was recommended the slough area be repaired and an internal drainage system be included as part of the repairs. Several small areas of erosion gullies were also identified for repair on the downstream slope.
- Longitudinal cracking was noted in the crest of the dam. Monitoring was recommended to observe whether the cracking sealed itself or worsened.
- Visible portions of the service outlet were in good condition. One of the three slide gates was inoperable due to a disengaged stem nut. The timber walkway from the crest of the dam to the outlet structure was in fair condition, with deterioration of the piles noted at the waterline. An underwater inspection was recommended to assess

the condition of the outlet structure. Since the 30-inch discharge pipe remains under full headwater pressure through the embankment, it was recommended the interior of the pipe also be evaluated for settlement, leakage, discontinuities, etc.

- The emergency spillway was in good condition. Removal of small trees and brush was recommended.
- The service spillway was in good condition. Removal of vegetation from joints and cracks in the concrete was recommended, as well as the removal of trees and brush from behind the side slope paving.

Table 4-1 presents cost estimates for operation and maintenance improvements that may have to be contracted out by the City. Cost estimates were not developed for routine maintenance activities such as mowing, minor brush removal, etc. that can be performed by City crews.

Table 4-1 Maintenance Repairs Cost Estimates

Repair Item	Cost	Notes
Upstream slope: tree/brush removal	$25,000	
Upstream slope: Addition of supplemental rock riprap to eroded areas	$50,000	Preliminary estimate only. Will need to evaluate after tree removal.
Service outlet: removal and replacement of timber walkway with concrete walkway	$150,000	Estimate assumed complete replacement. Engineering (10%) and contingency (25%) included.
Service outlet: underwater inspection of tower and 30-inch conduit	$10,000	
Service outlet: slide gate operator repair	$5,000	
Downstream slope: slough repair	$208,000	Engineering (10%) and contingency (25%) included. See Appendix B for details.

4.4 Review of Available Studies

In 2010, the NRCS began an assessment study of approximately 175 high hazard dams across the State of Texas. These dams were originally constructed or modified by NRCS under the Flood Control Act of 1944 (Public Law 534). New Terrell City Lake Dam was one of the

selected dams for the study. The scope of the assessment study included the following elements:

- dam safety inspection
- evaluation of operation and maintenance activities
- development of a breach analysis and inundation mapping
- estimates of failure index, risk index, and population-at-risk from a breach
- determination for eligibility for assistance under the NRCS' Watershed Rehabilitation Program
- development of alternatives and cost estimates to rehabilitate the dam to meet NRCS hydraulic criteria.

This study was performed by M&E Consultants under contract to the NRCS. Deliverables from the study included a safety inspection report, breach inundation maps, and a dam assessment report.

The current study made an independent review of the hydrologic model and alternatives developed in the NRCS study. The NRCS' Water Resource Site Analysis Computer Program (SITES) was used to analyze both the hydrologic and hydraulic capacity of the dam. The current study developed a separate SITES model for New Terrell City Lake Dam and compared results to the NRCS study. Several differences were noted, however overall the model results were in close agreement. It should be noted that the NRCS study did not account for discharge capacities through the existing low flow outlet works when evaluating various flood events. Given that the outlet works have been used in the past only for water supply purposes, this assumption is reasonable. This same assumption of ignoring discharge capacities through the low flow outlet was also applied in the current study in order to provide consistent comparisons.

4.5 Alternatives Review

4.5.1 NRCS Study

The NRCS study identified five alternatives for modifying the dam to meet NRCS criteria for the principal spillway hydrograph and the freeboard hydrograph events. Only two of these

alternatives will be discussed in this report, as the remaining three alternatives looked at decommissioning the dam through controlled breaches and downgrading the dam to a low hazard structure by removing downstream risks. These three alternatives were not considered pertinent to evaluating water supply options under the current study.

In its existing condition, the dam does not satisfy either the principal spillway hydrograph or freeboard hydrograph requirements. For the principal spillway hydrograph, the emergency spillway is engaged. As referenced, the peak 100-year discharge was calculated as 805 cubic feet per second (cfs). During the freeboard hydrograph, the dam would be overtopped by 2.89 feet.

Alternative 1 modified the dam by raising the dam 2.3 feet and widening the emergency spillway 275 feet. The existing service spillway would be completely replaced by constructing a new principal spillway intake structure with a 36-inch conduit and a new overflow weir similar to the original design. Installation of the new principal spillway would be completed using the "cut-and-cover" method, which involves draining the lake and having an open excavation of the embankment in order to install the 36-inch conduit, intake structure, and downstream impact basin in the dry. Because the lake is drained in the cut-and-cover option, this would temporarily disrupt water and likely incur additional permitting requirements. The dam raise consisted of adding compacted fill to the crest and flattening the downstream slope from 2.5H:1V to 3H:1V. A sand chimney drain was included between the existing slope and additional fill on the downstream slope. The total project cost estimate for Alternative 1 was $4,125,000, including a 25% contingency for direct construction costs. (It should be noted that all cost estimates related to dam modifications include costs for engineering, permitting, land rights, project administration, and construction inspection. Refer to Appendix B for a summary of the total project cost estimates for each alternative.) Figure 4-2 shows a schematic of the embankment modification for raising the dam and flattening the downstream slope. Figure 4-3 shows a schematic of embankment modifications for installing a new principal spillway structure using the cut-and-cover method.

Alternative 2 modified the dam by raising the dam 2.5 feet, widening the emergency spillway 275 feet and raising its crest by 0.6 feet, and constructing a new principal spillway

intake structure and 54-inch conduit. The new principal spillway system was also assumed to be constructed by the cut-and-cover method. The existing service spillway would be abandoned. As with Alternative 1, the dam raise consisted of adding compacted fill to the crest and flattening the downstream slope from 2.5H:1V to 3H:1V and including a sand chimney drain in the new downstream slope fill. The total project cost estimate for Alternative 2 was $3,793,000, including a 25% contingency for direct construction costs.

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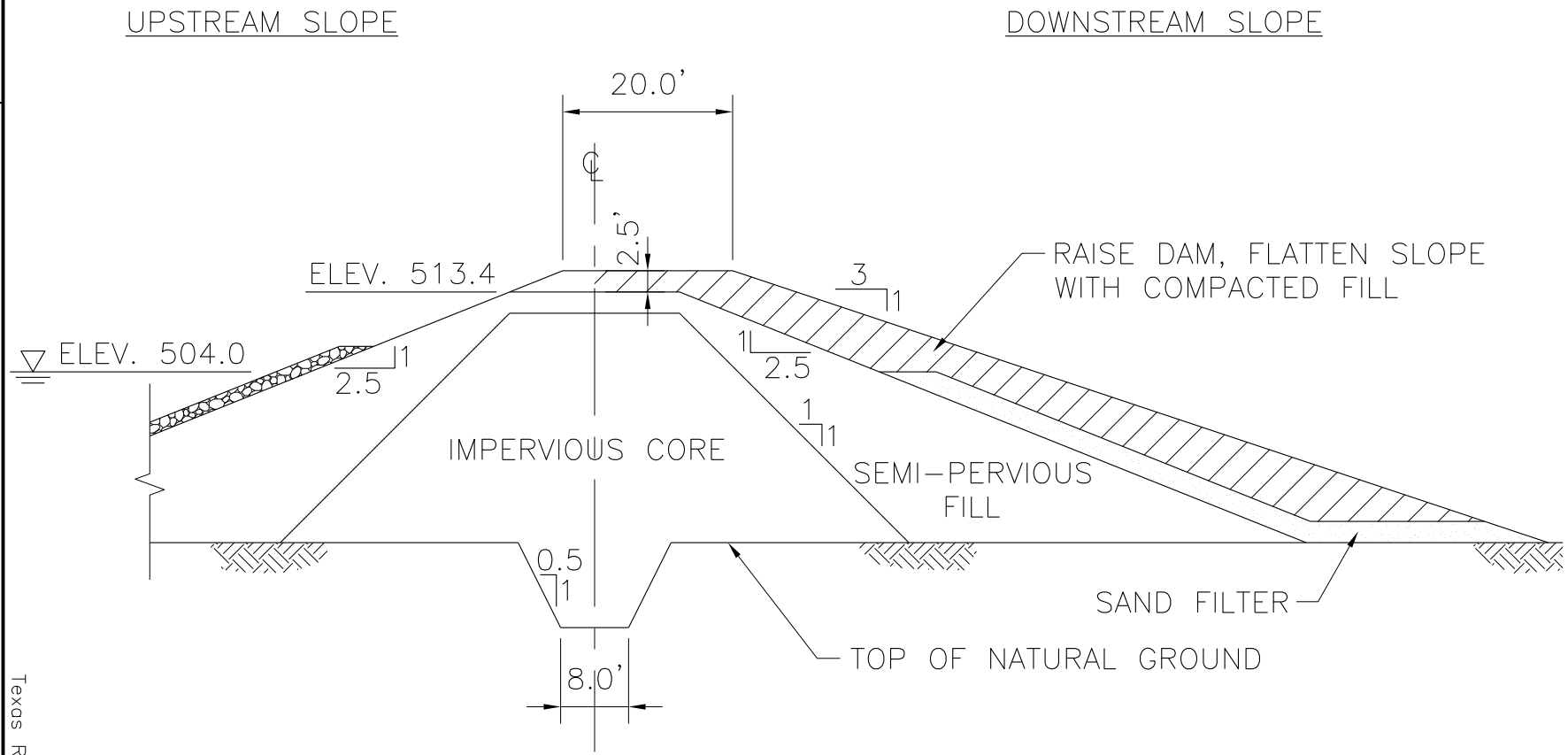
CITY OF TERRELL, TEXAS

TERRELL WATER SUPPLY STUDY

EMBANKMENT MODIFICATIONS
ALTERNATIVES 1 AND 2



EMBANKMENT MODIFICATIONS
ALTERNATIVES 1 AND 2

1"=20'

Freese and Nichols, Inc.
Texas Registered Engineering Firm F-2144

F&N JOB NO.	TER10197
DATE	FEB. 2011
SCALE	AS SHOWN
DESIGNED	MHP
DRAFTED	MLP
FILE	ALT-1&2.dwg

FIGURE 4-2

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REFERENCES: N:\Standard\8PREPORTBDR.dwg

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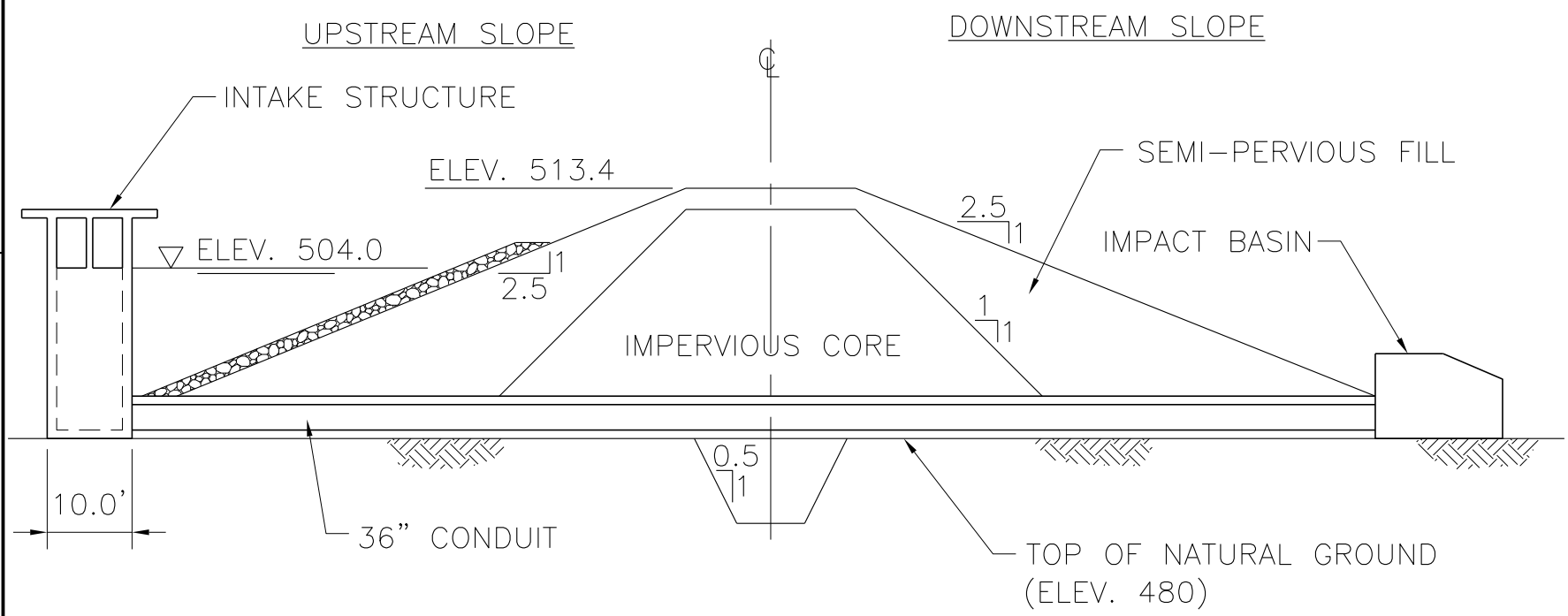
CITY OF TERRELL, TEXAS

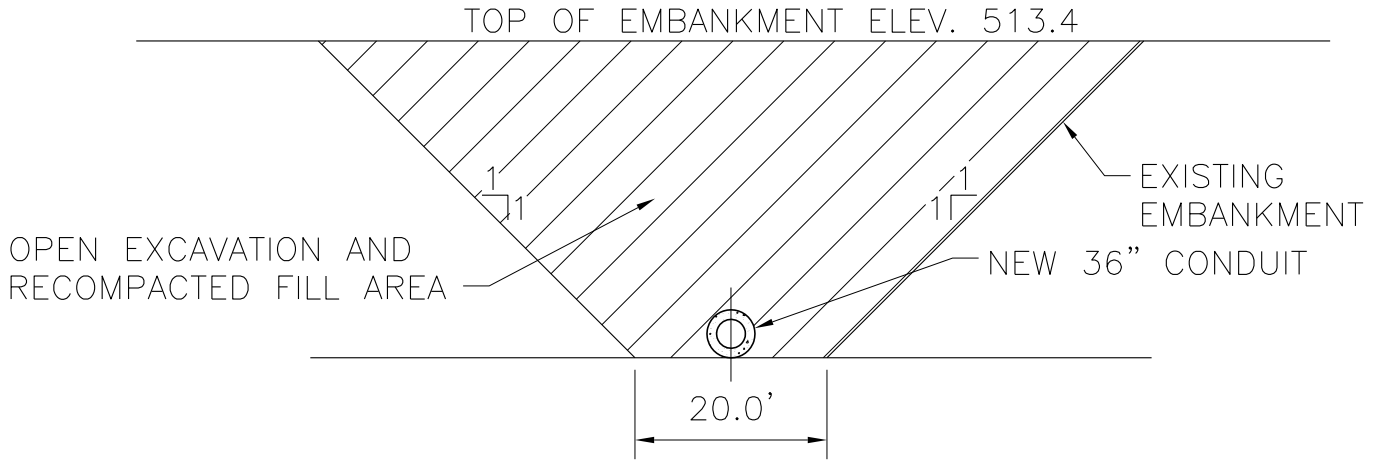
TERRELL WATER SUPPLY STUDY

NEW PRINCIPAL SPILLWAY ALTERNATIVES 1 AND 2



TYPICAL SECTION-NEW PRINCIPAL SPILLWAY

1"=20'



CUT-AND-COVER TYPICAL SECTION

NOT TO SCALE

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F&N JOB NO.	TER10197
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FIGURE 4-3

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4.5.2 Current Study

The current study used the SITES model to independently compare existing conditions as well as develop additional alternatives to modify the dam to meet NRCS dam safety criteria. A core component of the NRCS alternatives was the construction of a new principal spillway that was either combined with or completely replaced the existing service spillway. To provide a contrast to this approach, the current study focused on rehabilitation alternatives which did not include constructing a new, separate principal spillway system and did not require draining the lake.

Alternative 3 would modify the dam by raising the dam 2.6 feet with a reinforced concrete parapet wall along the upstream shoulder of the crest. The service spillway would be modified by creating a 20-foot wide notch in the center of the spillway and the flowline of the notch would be set at elevation 504.0 ft-msl. The flowline of the remaining culverts and the crest elevation of the remaining section of spillway would remain at elevations 504.0 ft-msl and 508.8 ft-msl, respectively.

Given that the original service spillway is over 50 years old, it was assumed that rehabilitation of the spillway would be required to meet current design standards and extend its service life. The selected rehabilitation method was a 12-inch reinforced concrete overlay of the existing spillway slabs, extension of the side slope paving, and the addition of a 75-foot long rock riprap transition section downstream of the stilling basin. This spillway rehabilitation option was consistent with the NRCS' Alternative 1 in which the spillway was completely rebuilt. The feasibility of the complete replacement versus overlay option would need to be evaluated in further detail.

Since the existing service spillway was modified to pass the principal spillway hydrograph criterion, Alternative 3 did not include a new principal spillway structure as in Alternatives 1 and 2. As discussed previously, a potential use of New Terrell City Lake would be as a pass-through reservoir. Under this scenario, the service outlet works would be used to discharge flows into the downstream channel on a continual basis. To account for this potential use, a reinforced concrete impact basin was included at the outlet of the 30-inch discharge pipe. Under Alternative 3, the emergency spillway configuration did not change. The total

project cost estimate for Alternative 3 was $2,829,000, including a 25% contingency for direct construction costs. See Appendix B for a detailed construction cost estimate. Figure 4-4 shows a schematic of raising the dam with a reinforced concrete parapet wall.

It should be noted that Alternative 3 results in a peak discharge at the 100-year event of 993 cfs. This was less than the 1,242 cfs peak discharge predicted with the current study's SITES model, but more than the 805 cfs calculated by the NRCS' study for existing conditions. A detailed study of flood impacts downstream would be necessary to evaluate impacts of one alternative versus another.

Alternative 4 was developed to evaluate what spillway modifications would be necessary so that the crest of the dam was not raised. Alternative 4 assumed the existing 40-foot wide service spillway would be widened to a total width of 185 feet. The widening was assumed to occur to the east side of the existing spillway, thus requiring excavation into the hillside and widening and extending the discharge channel to adjoin the downstream creek channel. The spillway crest would be lowered to elevation 504.0 ft-msl and the existing culverts and stepped weir would be removed. The new portion of the spillway would be constructed of reinforced concrete and the original portion would be overlaid as discussed in Alternative 3. Alternative 4 also included widening the emergency spillway 275 feet and maintaining the existing crest elevation of 509.8 ft-msl. Similar to Alternative 3, a concrete impact basin was assumed for the 30-inch low flow outlet pipe. The total project cost estimate for Alternative 4 was $5,255,000, including a 25% contingency for direct construction costs. Appendix B includes a detailed construction cost estimate.

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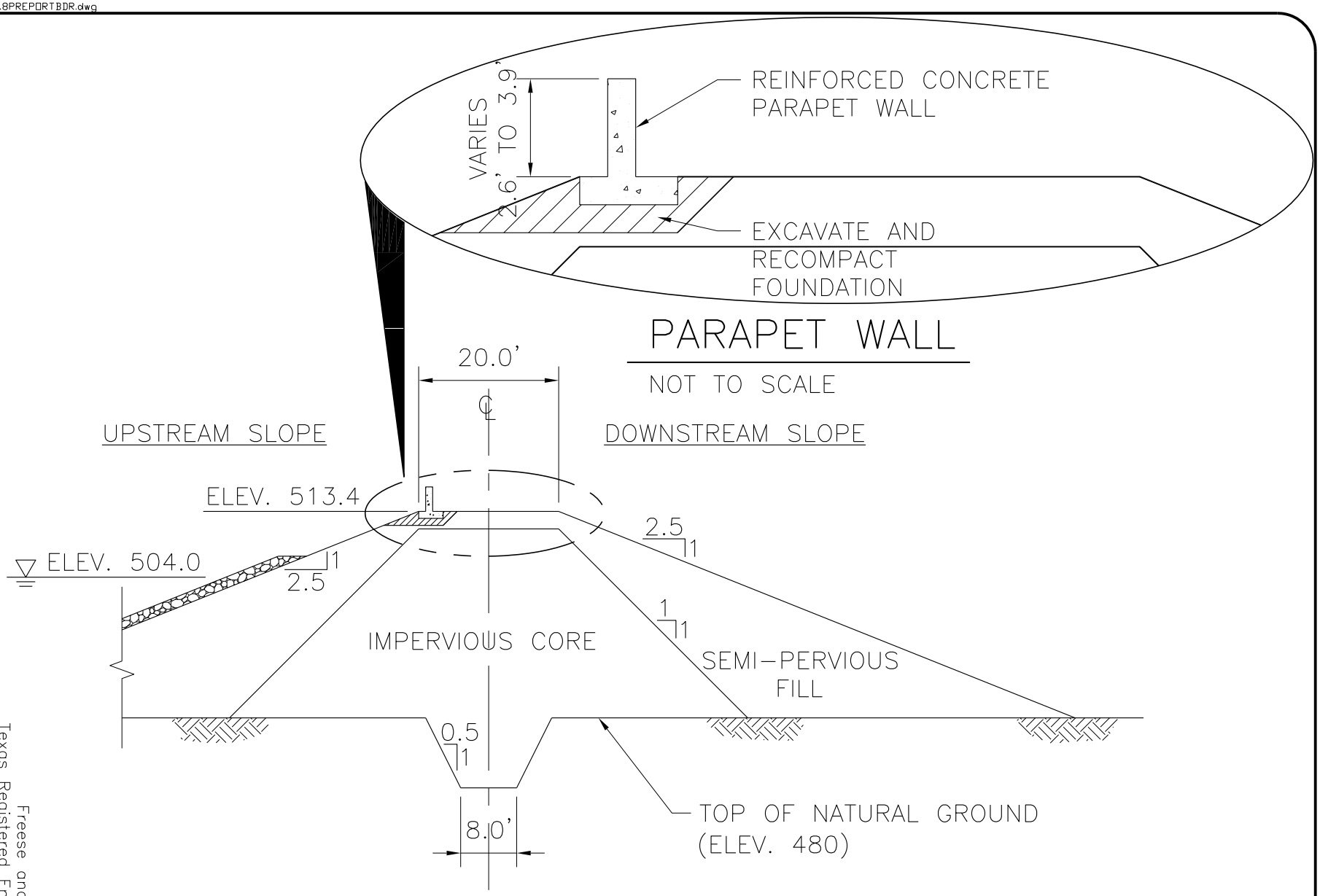
TERRELL WATER SUPPLY STUDY

EMBANKMENT MODIFICATIONS
ALTERNATIVES 3 and 4



EMBANKMENT MODIFICATIONS
ALTERNATIVES 3AND 5

1"=20'

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DATE	FEB. 2011
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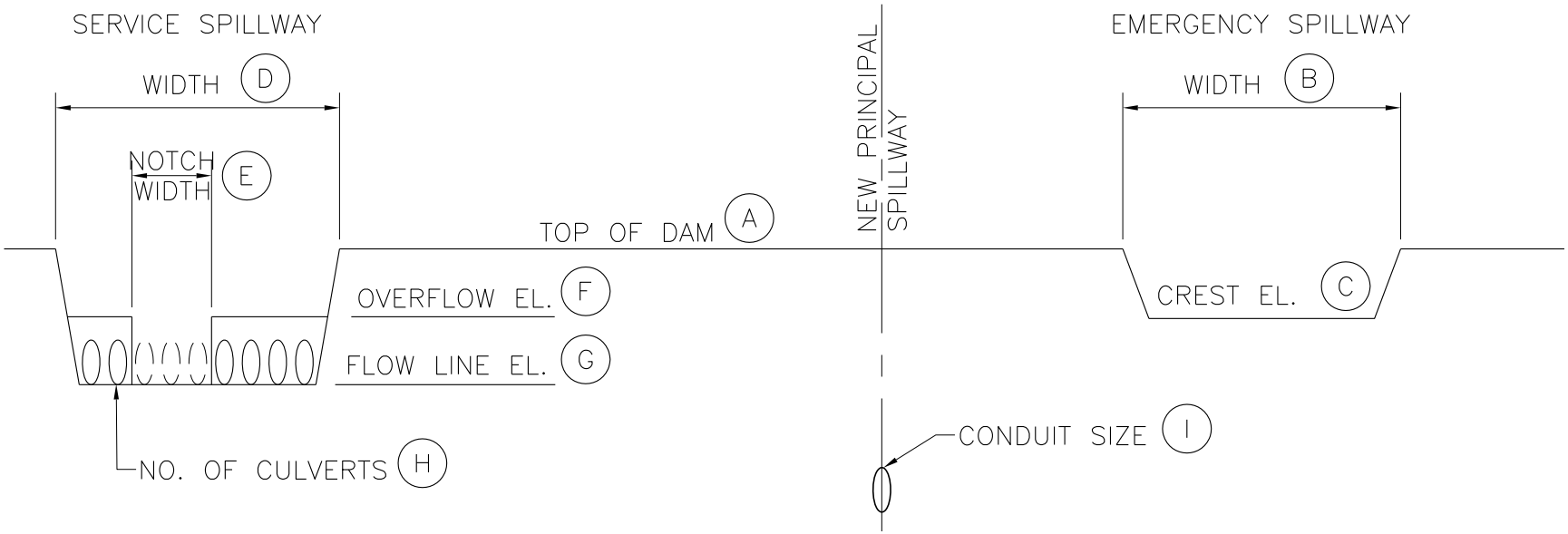
FIGURE 4-4

As mentioned in Section 2.2, an additional dam rehabilitation alternative was developed to evaluate the creation of additional water supply. Alternative 5 assumed the normal pool elevation was raised two feet from 504.0 ft-msl to 506.0 ft-msl. The normal pool level would be raised by altering the crest of the existing service spillway. The nine low flow pipes would be removed and a 25-foot notch would be created with a flowline of 506.0 ft-msl. The remainder of the existing spillway crest would remain at elevation 508.8 ft-msl. Similar to Alternative 3, it was assumed the service spillway structure would be overlaid and extended. To offset the decrease in available flood storage by raising the normal pool, the crest of the emergency spillway was raised one foot from 509.8 ft-msl to 510.8 ft-msl. The width of the emergency spillway remained unchanged. The crest of the dam would have to be raised 3.9 feet. A reinforced concrete parapet wall was assumed in the cost estimate. All modifications were modeled in order to satisfy NRCS criteria for the principal spillway hydrograph and freeboard hydrograph conditions. Other than including an impact basin for the service outlet 30-inch discharge pipe, no other modifications to the service outlet were assumed. The total project cost estimate for Alternative 5 was $3,347,000, including a 25% contingency for direct construction costs. It should be noted that this alternative considered only the dam modifications that would be required and did not evaluate other impacts such as changes in inundation levels, water rights impacts, etc. See Appendix B for a detailed construction cost estimate. Figure 4-5 shows a schematic summarizing the modifications to the dam for Alternatives 1 through 5.



ELEVATION VIEW OF DAM (LOOKING DOWNSTREAM)

NOT TO SCALE

NOTES:
1. EXISTING SERVICE OUTLET AND 30-INCH CONDUIT NOT SHOWN.

CONDITION	A (FT-MSL)	B (FT)	C (FT-MSL)	D (FT)	E (FT)	F (FT-MSL)	G (FT-MSL)	H (NO.)	I (INCH)
EXISTING	513.4	500	509.8	40	NA	508.8	504.0	9 – 24"	NA
ALTERNATIVE 1	515.7	775	509.8	40	NA	508.8	504.0	9 – 24"	36
ALTERNATIVE 2	515.9	775	510.4	REMOVE	NA	REMOVE	REMOVE	REMOVE	54
ALTERNATIVE 3	516.0	500	509.8	40	20	508.8	504.0	4 – 24"	NA
ALTERNATIVE 4	513.0	775	509.8	185	NA	NA	504.0	REMOVE	NA
ALTERNATIVE 5	517.3	500	510.8	40	25	508.8	506.0	REMOVE	NA

SUMMARY OF MODIFICATIONS

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CITY OF TERRELL, TEXAS

TERRELL WATER SUPPLY STUDY

SUMMARY OF MODIFICATIONS

Freese and Nichols, Inc.
Texas Registered Engineering Firm F-2144

F&N JOB NO. TER10197
DATE FEB. 2011
SCALE AS SHOWN
DESIGNED MHP
DRAFTED MDC
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FIGURE 4-5

4.6 Possible Funding Source for Dam Rehabilitation

The 1967 modification to New Terrell City Lake Dam by the NRCS was performed under the authority of Public Law 534 to provide flood control benefits as part of the Cedar Creek Watershed Plan. In 2000, the "Small Watershed Rehabilitation Amendments" (Public Law 106-472) were signed into law which authorize the NRCS to assist local sponsors with the rehabilitation of aging dams. The Small Watershed Program is a cost-share program in which the local sponsor provides 35 percent of project costs and the NRCS provides the remaining 65 percent. New Terrell City Lake Dam is eligible under this program since it is classified as a high hazard dam, was modified under Public Law 534, and operation and maintenance activities are considered adequate.

To be considered for the program, an application must be made using the Standard Form 424 – Application for Federal Assistance. Applications are reviewed by NRCS and funds are allocated based on funding availability and priority of the project. Following is a list of conditions related to this possible funding source:

- The SF-424 application deadline is April 1, 2011.
- All local sponsors of the watershed plan must sign the application, whether or not each local sponsor will be contributing financially to the project.
- The local sponsor is responsible for obtaining land rights, if applicable, for the project.
- The local sponsor is responsible for all costs related to obtaining necessary permits for the project.
- The local sponsor must enter into an operation and maintenance agreement with the NRCS and provide continual funds for performing operation and maintenance activities.
- The local sponsor is responsible for leading the project at the local level and coordinating with various stakeholders.
- The local sponsor must execute a memorandum of understanding with the NRCS before being credited with the value of any in-kind contributions.

To apply for the Small Watershed Rehabilitation grant, it is not required to designate a specific alternative from the list of alternatives discussed previously. If the project is granted funding, the NRCS will conduct a detailed planning study to identify feasible alternatives before proceeding to final design. Based on discussions with NRCS, it is recommended that a total project cost of $4,125,000 be assumed for budgeting purposes and inclusion in the Small Watershed Rehabilitation grant application. While this budgetary number coincides with the total project cost for Alternative 1, it is emphasized that this does not imply that Alternative 1 is necessarily the recommended final configuration of the dam.

Finally, it is important to understand the timing of the SF-424 application review and reward process. The following is an overview of the typical planning-design-construction process:

- Year 1
    - April: Applications due
    - June: NRCS reviews applications and makes funding requests for upcoming federal budget
    - December: Funding status is communicated to NRCS
- Year 2
    - April to June: If funding is available, a detailed planning study is performed to develop more detailed design constraints and construction cost estimates.
    - June: NRCS makes request for construction funding for upcoming federal budget
    - December: Funding status is communicated to NRCS
- Year 3
    - January to October: If funding is available, final design and bidding occurs
    - October: Construction of improvements begins

Another potential funding source for the dam rehabilitation is Texas Water Development Board financial assistant programs. Refer to Section 3.4 for details.

Table 4-2 Summary of Dam Modifications

Dam Element	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Service Outlet (Intake and 30" pipe)	No change	No change	Add impact basin for pass-through capability	Add impact basin for pass-through capability	Add impact basin for pass-through capability
New Principal Spillway	New tower, 36" pipe, and stilling basin	New tower, 54" pipe, and stilling basin	No new principal spillway	No new principal spillway	No new principal spillway
Service Spillway	Rebuild, combine with new principal spillway structure	Abandon	Modify with 20-foot low flow notch, maintain existing 40-foot spillway width	Lower crest 4.8 feet and widen to total width of 185 feet	Raise crest 2.0 feet, modify with 25-foot notch, maintain existing 40-foot spillway width
Emergency Spillway	Widen 275 feet, maintain existing crest elevation	Widen 275 feet, raise crest 0.6 feet	No change	Widen 275 feet, maintain existig crest elevation	Raise crest 1.0 feet, main existing width
Raise Dam	Raise 2.3 feet with compacted fill, flatten d/s slope to 3:1	Raise 2.5 feet with compacted fill, flatten d/s slope to 3:1	Raise 2.6 feet with concrete parapet wall	No dam raise	Raise 3.9 feet with concrete parapet wall

Table 4-3 Summary of Cost Estimates

Cost Item	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Construction Cost Estimate	$2,595,000	$2,375,000	$1,804,000	$3,342,000	$2,147,000
Construction Contingency (25%)	$649,000	$594,000	$451,000	$836,000	$537,000
Construction Subtotal	$3,244,000	$2,969,000	$2,255,000	$4,178,000	$2,684,000
Engineering (10%)	$324,000	$297,000	$226,000	$418,000	$268,000
Permitting	$100,000	$100,000	$100,000	$100,000	$100,000
Land Rights and Acquisition	$100,000	$100,000	$0	$100,000	$0
Project Administration (4%)	$130,000	$119,000	$90,000	$167,000	$107,000
Construction Inspection (7%)	$227,000	$208,000	$158,000	$292,000	$188,000
Total Project Costs	$4,125,000	$3,793,000	$2,829,000	$5,255,000	$3,347,000

5.0 WATER CONSERVATION AND DROUGHT CONTINGENCY PLANS

5.1 Water Conservation Plans

Several changes may need to be made to Terrell's Water Conservation Plan [6] if any of the alternatives discussed above are pursued. If Terrell decides to sell the dam and/or water right, Section 7.1 (Water Sources and NTMWD System Operation Plan) of Terrell's Water Conservation Plan [6] will need to be updated. Section III of the Texas Commission on Environmental Quality (TCEQ) Water Utility Profile in Appendix C of Terrell's Water Conservation Plan [6] will also need to be updated if Terrell decides to sell the dam and/or water right.

Changes may need to be made to Canton's, DWU's, or NTMWD's Water Conservation Plan depending on which entity decides to move forward with the alternatives discussed in previous portions of this report.

Several sections of Canton's Water Conservation Plan [7] will need to be updated if they choose to purchase water from New Terrell City Lake. Sections that may need to be modified include Section II (Utility Profile, Water Supply System Data) and Section XV (Drought Contingency Plan). Within Exhibit 1, which is the Utility Profile, Section III may need to be revised. Section III of Exhibit 1 includes sub-exhibits that may need to be revised: Exhibit 4 - Water System Inventory and Exhibit 5 - Water System Layout.

Section 4 of DWU's Water Conservation Plan [8] regarding DWU's water supply sources may need to be updated if DWU purchases water from City Lake. The section concerning DWU's water supply system data in Appendix B will also need to be updated if DWU purchases water from City Lake. If DWU chooses to only use City Lake as a pass-through, no changes will be needed to DWU's Water Conservation Plan.

If NTMWD purchases water from City Lake, Section 3 (Description of Service Area) and Section 6.2 regarding NTMWD's permitted water supply may need to be updated. Appendix C, which includes the Water Utility Profile, may also need to be updated.

5.2 Drought Contingency Plans

If NTMWD is the entity to pursue the use of New Terrell City Lake, Section 2 (Drought Contingency and Water Management Response Plan) of Terrell's Drought Contingency and Water Emergency Response Plan [9] may need to be updated based on any changes NTMWD might make to Section 11 (Drought Contingency and Water Management Response Plan) of their Water Conservation and Drought Contingency and Water Emergency Response Plan [10]. In other words, if NTMWD purchases water from New Terrell City Lake and changes their drought triggers in Section 11 of their drought plan, Terrell will need to modify Section 2 of their drought plan. Section 1 (Introduction and Objectives) of Terrell's Drought Contingency and Water Emergency Response Plan [9] will need to be updated if Terrell sells the water right to New Terrell City Lake.

Several sections of the drought contingency plans for potential users of New Terrell City Lake may need to be changed. Section VIII of Canton's Drought Contingency Plan [11] regarding the criteria for initiation and termination of drought response stages will likely need to be updated. No changes will be needed for DWU's Drought Contingency Plan [12], and Section 11 (Drought Contingency and Water Management Response Plan) of NTMWD's Drought Contingency Plan [10] may need to be modified.

6.0 POST DRAFT REPORT ACTIONS

6.1 Presentation to Terrell City Council

On April 28, 2011 a presentation was given to the Terrell City Council summarizing the findings of the Regional Water Study. The presentation is included in Appendix H.

6.2 Texas Water Development Board Comments

Comments on the draft report from the Texas Water Development Board were sent to the City of Terrell on June 27, 2011. The original letter received from TWDB is included in Appendix I. Below is a list of the comments received and the response to each comment.

1. Please consider including a map of the entire study area centered on the New Terrell City Lake and showing some of the facility alternatives in the report.

   Figure ES-1 was added to the executive summary showing the study area. Detailed figures of the facilities associated with each feasible alternative are included in Section 3.2.

2. The Executive Summary covers the dam evaluation thoroughly but is brief on summarizing the water supply alternatives. Suggest including more information about the alternatives in the executive summary.

   Table ES-1 was added to the executive summary which includes a summary of each alternative and the associated costs.

3. Page 4-19, Section 4.6 describes potential NRCS funding programs that could help finance necessary dam rehabilitation. Please consider expanding this funding discussion to include relevant TWDB financial assistance programs that could help fund other required infrastructure improvements in order to implement chosen alternatives.

   Section 3.4 was added to discuss relevant TWDB financial assistance. A sentence was also added to the end of Section 4, which is specific to the Terrell City Lake dam rehabilitation.

4. Contract scope of work Task 4(d) states "review the consistency of the alternatives(s)...with the Region C Water Plan and recommend changes Terrell should seek..." Please include the consistency analysis in the report and clarify if the alternatives are consistent with the plan of if any plan amendments appear necessary.

   See Section 3.3 on page 3-14, paragraph 2.

5. On page 4-10, third paragraph, lines three and four describing the "cut-and-cover" method of spillway intake structure construction are awkward and somewhat confusing. Please revise this section in order to clarify the intended meaning.

   The wording of this section was revised to read more clearly.

7.0 MEETINGS

7.1 Public Meetings

Three public meetings were held throughout the study with the participants, consultants, local entities, the Texas Water Development Board, and any interested parties. The first public meeting was held on May 17, 2010, and the scope and schedule of the study were presented and discussed. The second public meeting was held on July 7, 2010, and the items discussed included the scope and schedule of the study, the available supply from City Lake, and the potential alternatives being considered for Canton, DWU, NTMWD, and SRA. The third public meeting was held on February 17, 2011, and the items discussed included the scope and schedule of the study, the water available from New Terrell City Lake, and the potential alternatives and associated costs for Canton, DWU, NTMWD, and SRA. Agendas, meeting notes, presentations, and sign-in sheets from these meetings are included in Appendix C.

7.2 Meeting With Raw Water Users

A meeting with raw water users was held on July 7, 2010 at the City of Terrell Public Works Service Center. The purpose of the meeting was to provide background on the study and determine potential water users of the New Terrell City Lake supply. Information provided at the meeting included the purpose of the study, the water availability from New Terrell City Lake, the water needs for potential users according to the Regional Water Plans, and descriptions of the existing facilities.

7.3 Meetings With Canton, DWU, and NTMWD

On January 26, 2011 a meeting was held with NTMWD to discuss the City Lake water supply alternatives considered for NTMWD. NTMWD expressed their continued interest in the City Lake supply at the meeting.

A meeting was held with the City of Canton on February 8, 2011 to discuss the City Lake water supply alternative considered for Canton. Canton expressed continued

interested in the City Lake supply at the meeting, and is also considering other water supply options.

The DWU alternatives summarized in the memorandum sent to DWU were discussed at a meeting held on February 17, 2011. DWU plans to further explore the feasibility of the New Terrell Lake supply in their long-range water supply plan. The New Terrell City Lake supply may allow DWU to move water around in their supply area and possibly delay other construction projects.

The memorandums sent to the interested parties, along with the meeting materials, are included in Appendix G.

8.0 CONCLUSIONS/RECOMMENDATIONS

It is recommended that the City of Terrell continue to discuss feasible alternative uses of New Terrell City Lake with potential customers. This study includes feasible water supply alternatives for four entities: Canton, NTMWD, DWU, and SRA. Further discussions between the City of Terrell and potential raw water customers will be required. Therefore, this report does not recommend one specific user of the New Terrell City Lake water supply.

New Terrell City Lake Dam's current condition is considered fair to good. Several maintenance activities are need, including the repair of the existing slough on the downstream slope. With these maintenance items addressed, the dam would be considered in good condition.

A separate NRCS study showed the dam does not meet current NRCS dam safety criteria and this study confirmed this finding. Two rehabilitation alternatives were developed in the NRCS study to upgrade the dam. Rehabilitation work included raising the dam, widening the emergency spillway, and replacing or modifying the existing service spillway with a new principal spillway structure. These two alternatives ranged from $3,792,000 to $4,125,000. A significant drawback to these alternatives is that the construction methodology would require the lake to be drained and open excavation of the dam embankment in order for the new principal spillway improvements to be constructed. This approach would eliminate the lake's water supply during construction. In addition, the environmental permitting associated with the lake lowering would likely be more intensive.

Two additional alternatives were developed in this study to rehabilitate the dam. These alternatives also considered raising the dam and widening the emergency spillway. Instead of constructing a new principal spillway, these alternatives considered modifications to the existing service spillway above the current normal pool elevation so that the lake would not have to be drained. These two alternatives costs ranged from $2,823,00 to $5,255,000. A fifth alternative looked at raising the normal pool elevation

to provide additional water supply, as well as modify the dam to meet dam safety criteria. The cost estimate for this alternative was $2,829,000.

Recommendations

1. Perform recommended maintenance activities. The downstream slope slough repairs should be considered highest priority.
2. Evaluate downstream flooding impacts that would result from proposed changes to the dam's configuration. These impacts would need to be compared against discharges from dam under existing conditions.
3. Submit an application to participate in the NRCS' Small Watershed Rehabilitation Program. A total project cost of $4,125,000 should be assumed for budgeting purposes and inclusion in the Small Watershed Rehabilitation grant application. While this budgetary number coincides with the total project cost for Alternative 1, it is emphasized that this does not imply that Alternative 1 is necessarily the recommended final configuration of the dam.

APPENDIX A
REFERENCES

References

1. **Texas Commission on Environmental Quality.** *Water Right Permits and Certificates of Adjudication.* Austin : s.n., various dates.

2. **Texas Water Development Board.** *Volumetric Survey of New Terrell City Lake.* Austin : Prepared for the City of Terrell, March 2003.

3. **Freese and Nichols, Inc., Alan Plummer Associates, Inc., CP&Y, Inc., and Cooksey Communications, Inc.** *2011 Region C Water Plan.* Fort Worth : prepared for the Region C Water Planning Group, October 2010.

4. **Espey Consultants, Inc., Brown and Root, Inc., Freese and Nichols, Inc., GSG Inc., Crespo Consulting Services, Inc.** *Final Water Availability Models for the Trinity, Trinity-San Jacinto, and Neches-Trinity Basins.* Austin : prepared for the Texas Natural Resource Conservation Commission, March 2002.

5. **Bucher Willis & Ratliff Corp., Hayter Engineering, Inc., Hayes Engineering Company, Bob Bowman Associates, LBG/Guyton Associates.** *North East Texas Regional Water Plan.* Texas : Prepared for Region D - North East Texas Regional Water Planning Group, September 2010.

6. **Freese and Nichols, Inc.** *Water Conservation Plan.* Fort Worth : Prepared for the City of Terrell, May 2009.

7. **Gary Burton Engineering, Inc.** *Water Conservation Plan.* Tyler : Prepared for the City of Canton, April 2009.

8. **Dallas Water Utilities.** *Water Conservation Plan.* Dallas : Prepared for the City of Dallas, 2010.

9. **Freese and Nichols, Inc.** *Drought Contingency and Water Emergency Response Plan.* Fort Worth : Prepared for the City of Terrell, May 2009.

10. **Freese and Nichols, Inc.** *Water Conservation and Drought Contingency and Water Emergency Response Plan.* Fort Worth : Prepared for North Texas Municipal Water District, March 2008.

11. **Gary Burton Engineering, Inc.** *Drought Contingency Plan.* Tyler, Texas : Prepared for the City of Canton, March 2009.

12. **Dallas Water Utilities.** *Drought Contingency Plan.* Dallas, Texas : City of Dallas, 2010.

APPENDIX B
COST ESTIMATES

Appendix B – Cost Estimates

Standard pipeline costs used for the cost estimates are shown in Table B-1. Pump station costs based on required horsepower capacity are listed in Table B-2. Discharge structure costs are shown in Table B-3.

Table B-1 Pipeline Costs (does not include ROW)

Diameter	Base Installed Cost	Rural Cost with Appurtenances	Urban Cost with Appurtenances	Assumed Easement 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

FNI Assumptions:

1. Unit Prices include road crossings and appurtenances
2. Unit Prices do not include real estate costs
3. Urban Pipeline cost equals rural cost plus 50%
4. Engineering, Administration, Surveying, Construction Inspection, Testing Cost equals 30% of construction costs.

Table B-2 Pump Station Costs for Transmission Systems

Pump Station	Booster PS	Intake PS
Max Running HP	Construction Cost	Construction Cost
5	$516,000	
10	$538,000	$717,333
20	$564,000	$752,000
25	$591,000	$788,000
50	$645,000	$860,000
100	$742,000	$989,333
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

FNI Assumptions:

1. Use 35% for Engineering, Administration, Construction Inspection, Surveying, Testing, and Contingencies
2. For intake pump station, use 133% of booster pump station cost.
3. Cost of booster pump stations does not include storage tanks
4. Cost of pump stations does not include substations or power lines.

Table B-3 Discharge Structures

Capacity (MGD)	Cost
0.5	$32,000
1	$33,000
2	$37,000
5	$43,000
10	$54,000
13	$59,160
60	$140,000
80	$160,000
120	$240,000

APPENDIX C
PUBLIC MEETINGS
&
MEETING WITH RAW WATER SUPPLIERS

Freese and Nichols

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Vision: *Be the firm of choice for clients and employees*

PURPOSE
The overall objective of the meeting should be clear and noted on the agenda.

AGENDA
The agenda should include what is to be covered, who is responsible and how long each item will require.

CODE OF CONDUCT
Meeting participants should respect each other by honoring the Code of Conduct.

EXPECTATIONS
The expectations of the participants should be discussed, noted and reviewed for closure.

ROLES
The roles of leader, scribe, minute taker, time keeper and facilitator should be clarified at the beginning of the meeting.

City of Terrell
Water and Wastewater Regional Studies – Public Meeting No. 1
May 17, 2010
Cit of Terrell City Hall – Council Chambers
10:00 to 11:00 am

AGENDA

Topic	Who	Time
1. Wastewater Study Scope	GB	10:00 AM
2. Wastewater Flow Projections	GB	10:10 AM
3. TCEQ Discharge Permit Requirements	GB	10:20 AM
4. Wastewater Study Schedule	GB	10:25 AM
5. Water Study Scope	RAI	10:30 AM
6. Water Study Schedule	RAI	10:40 AM
7. Questions/Discussions	All	10:45 AM
CLOSE/ADJOURN		**11:00 AM**

CODE OF CONDUCT
1. Publish an agenda and maintain minutes.
2. Challenge ideas and processes, not people.
3. Share responsibility and ownership.
4. Maintain an open, honest environment.
5. Question and participate.
6. Listen constructively.
7. Begin and end on time unless participants agree to an extension.
8. Come prepared and with action items completed.
9. Base decisions on factual data.
10. Keep confidences.

FREESE NICHOLS

Terrell Regional Water and Wastewater Studies

PUBLIC MEETING NO. 1

Monday, May 17, 2010

Wastewater Study Scope

1. Condition Assessment
   - What equipment needs replacement?
   - When does equipment need to be replaced?
2. Process Modeling
   - How much flow can we process at different effluent limits?
3. Improvement Recommendations
   - Based on modeling and assessment
   - What improvements are needed to continue meeting treatment requirements?

Wastewater Schedule

- Major Milestones
  1. Public Meeting No. 1 – May 17, 2010
  2. Condition Assessment Report – June 14, 2010
  3. Improvement Recommendations – Aug. 4, 2010
  4. Public Meeting No. 2 – Aug. 5, 2010
  5. Draft Improvements Report – Sept. 23, 2010
  6. Texas Water Development Board Review – Nov. 7, 2010
  7. Develop Final Report – Nov. 21, 2010
  8. Public Meeting No. 3 – Nov. 22, 2010

Water Study Scope

1. Water Supply – New Terrell City Lake
   - Determine available supply from the lake
   - Determine who might use the water
   - Estimate costs and recommend facilities required to make use of the available supply
2. Dam Safety Regulations
   - Inspect the dam to assess its condition
   - Estimate the Probable Maximum Flood (PMF) for the dam
   - Recommend improvements to the dam
   - Develop a breach analysis and emergency action plan for the dam

Water Study Schedule

- Major Milestones
  1. Public Meeting No. 1 – May 17, 2010
  2. Condition Assessment Site Visit – May 21, 2010
  3. Facility Recommendations – Jul. 25, 2010
  4. Public Meeting No. 2 – Aug. 5, 2010
  5. Draft Water Supply Study Report – Sept. 27, 2010
  6. Emergency Action Plan – Oct. 29, 2010
  7. TWDB Review of Report – Nov. 8, 2010
  8. Develop Final Report – Nov. 21, 2010
  9. Public Meeting No. 3 – Nov. 22, 2010

MEETING MINUTES

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PROJECT: City of Terrell Water and Wastewater Studies
NAME OF MEETING: Public Meeting Number 1
RECORDED BY: Rachel Ickert
DATE: May 17, 2010
LOCATION: City of Terrell
ATTENDEES:

Name	Company
Angela Kennedy	Texas Water Development Board
Steve Rogers	City of Terrell
Sonny Groessel	City of Terrell
Dick Boyd	City of Terrell
John Rickman	City of Terrell
Torry Edward	City of Terrell
John Rounsavall	City of Terrell
Brian Dench	Pate Engineers
Bob Wright	Pate Engineers
Robert McCarthy	North Texas Municipal Water District
Yanbo Li	North Texas Municipal Water District
Scott Norris	Land Advisors LTD
Todd Watson	Hunt Realty
Adam Conway	Petitt Barraza
Ron Perkins	North Kaufman WSC
Ryan Estes	Rose Hill SUD
Michael Shook	City of Forney
Frank Nuchereno	Anthony Properties
David Hinds	Markout WSC, Van Tone Flavorings
Vickie Armstrong	Rose Hill SUD
Shirley Blakely	College Mound WSC
Gennady Boksiner	Freese and Nichols
Rachel Ickert	Freese and Nichols

The following reflects our understanding of the items discussed during the subject meeting. If you do not notify us within five working days, we will assume that you are in agreement with our understanding.

ITEM	DESCRIPTION
1	Introductions • Steve Rogers welcomed everyone and facilitated introductions. The sign in sheets for the meeting are attached.

ITEM	DESCRIPTION
2	Presentation • Gennady Boksiner presented the scope and schedule for the wastewater study. • Rachel Ickert presented the scope and schedule for the water study.
3	Questions/Discussion • Frank Nuchereno (Anthony Properties) asked if the wastewater study would be a continuation of previous studies, or if we are starting from scratch. Steve Rogers indicated that the permit allows two more years, and flows into the wastewater treatment plant have decreased significantly. The plant is currently treating an average of 1.5 MGD and is permitted for 4.5 MGD. For these reasons, Terrell may be able to use the existing plant longer and buy some time in making improvements. This study is going to look at what is needed to continue using the existing plant, or if it makes more sense to build a new WW treatment plant or build a lift station to send wastewater to NTMWD. This study will not look at specific locations for a new plant or improvements to the collection system. • Las Lomas MUD No. 4 and all other potential customers need to revise their flow projections to better reflect current conditions. It is anticipated that everyone will have lower projections that what was shown in the last wastewater study. **Steve Rogers and FNI requested that updated projections be provided within 30 days in order to be considered in the study.** • David Hinds with Van Tone Flavorings asked if the same trickling filter technology will be used when assessing keeping the existing plant. Gennady Boksiner indicated that trickling filter technology is outdated and has limited options for improvements. However, certain process improvements to the existing plant are possible, and will be studied, to prolong existing plant's life. • It was asked if there is room at this existing plant to retrofit while keeping the plant in use. Terrell believes there is enough room. • Scott Norris with Land Advisors LTD asked if this study will be looking at future treatment requirements and trying to stay one step ahead of the TCEQ regulations, or if Terrell is just trying to meet current permit requirements. Steve Rogers indicated that right now, Terrell is trying to meet the permit, which presents a significant challenge. Gennady Boksiner pointed out that the most logical anticipated TCEQ requirements, such as phosphorus, will be considered.
4	End Public Meeting
5	TWDB/Terrell/FNI Discussion Following the Public Meeting • The timing of the public meetings needs to be adjusted. The 2nd Public Meeting should occur sometime in the middle of the study. The 3rd Public Meeting needs to be after the draft report is prepared but before TWDB reviews the draft report. **FNI will adjust the schedules and send to Terrell and TWDB for review.** • For both the water study and the wastewater study, the scope in the contract between Terrell and FNI should be revised to better follow the contract between Terrell and the TWDB. Angela Kennedy indicated that we need to add a list of deliverables, requirements for meetings and meeting documentation, specific scenarios to be studied, etc. **Angela has already looked at rewording the scope and will send Rachel Ickert what she has drafted to this point. Rachel, Gennady, and Angela will work together to**

ITEM	DESCRIPTION
	develop a revised scope. • **Terrell and FNI will develop a list of potential users of the Terrell raw water supply and will provide the list to Angela.** This list will be included in the scope. **Terrell will discuss internally and then contact Rachel to discuss further.** • **Per TWDB requirements, FNI will send Terrell monthly progress reports with billings.** Terrell will need separate reports for the water and wastewater studies.

ACTION ITEMS			
WHAT	**WHO**	**WHEN**	**STATUS**
1. Provide revised wastewater flow projections to Terrell and FNI.	All Participating Entities	June 17, 2010	
2. Revise project schedules.	GB/RAI	May 27, 2010	
3. Send suggested scope revisions to FNI.	Angela Kennedy	May 27, 2010	
4. Develop list of potential customers for Terrell water supply and discuss with Rachel Ickert.	Sonny Groessel/ Steve Rogers	May 24, 2010	
5. Prepare separate progress reports for the water and wastewater studies.	GB/RAI	On-going	

Terrell Regional Wastewater Plan

Public Meeting No. 1
May 17, 2010

Name	Company	Address	Phone	E-mail	Signature
Angela Kennedy	TWDB	Austin TX	512-463-1437	angela.kennedy@twdb.state.tx.us	[illegible]
Brian Dench	Pate Engineers	8150 Brookriver Dr. Suite S-700	214 357 2981	bdench@pateeng.com	BAD
Bob Wright	Pate Engineers	Dallas, Texas 75247	"	bwright@pateeng.com	BW
Robert McCarthy	NTMWD	505 E Brown Wylie TX 75098	972-442-5405	RMCCARTHY@NTMWD.com	RM
Yanbo Li	"	"	"	yli@ntmwd.com	[illegible]
Scott Norris	Land Advisors Ltd	4265 Kellway Cir Addison TX 7500[illegible]	972 239-0707	SNORRIS@[illegible]	[illegible]
Todd Watson	Hunt Realty	1900 N Akard Dallas	214 978 8761		Todd Watson
Adam Conway	Petitt Barraza	300 Municipal Dr. Richardson	214 2219955	aconway@petittbarraza.com	[illegible]
Roy Perkins	North Kaufman WSC	P.O. Box 870 Kaufman TX 75080	972-962-7644	ROY_NKWSC@Yahoo.com	Roy Perkins
Ryan Estes	Rose Hill SUD	P.O. Box 190 Kaufman, 75142	972 932 3077	ryan@rhsud.com	Ryan Estes
MICHAEL Shook	City of Forney	P.O. BOX 826 Forney TX 75126	972-564-7300	mShook@cityofForney.org	[illegible]
Frank Nichols	Anthony	6127 Colt Road Dallas 75234	214 [illegible]	frank@AnthonyProperties.com	[illegible]
Gennady Boksiner	FNI	1701 N. Market St, Dallas	214-217-2224	gb@freese.com	Gennady Boksiner
Torry Edwards	City of Terrell		972-551-6604		[illegible]
DAVID HINDS	VTCF	200 METRO DR	214-244-1944	david_hinds@airmail.net	D Hinds

Terrell Regional Water Plan

Public Meeting No. 1
May 17, 2010

Name	Company	Address	Phone	E-mail	Signature
Brian Dench	Pate Engineers	8150 Brookriver Dr. Dallas, TX 75247	214 357 2981	bdench@pateeng.com	Brian A Dench
Bob Wright	" "	" "	214 357 2981	bwrigh@pateeng.com	BW
Angela Kennedy	TWDB	Austin, TX	512-463-1437	angela.kennedy@twdb.state.tx.us	AK
Robert McCarthy	NTMWD	505 E Brown Wylie TX 75098	972-442-5405	RMCCARTHY@NTMWD.COM	Robert McCarthy
Yanbo Li	"	"	"	YLi@ntmwd.com	Yanbo Li
Scott Norris	Land Advisors	4265 Kellway Cir. Addison TX 75001	972-239-0707	SNORRIS@TOMLINVEST	Scott Norris
Rachel Ickert	Freese + Nichols	4055 International Plaza, Suite 200	817-735-7296	rai@freese.com	Rachel Ickert
Dick L. Boyd	City of Terrell	P.O. Box 310, Terrell	972-551-6635	dboyd@cityofterrell.org	Dick L Boyd
Todd Water	Hunt Realty	1900 N Akard Dallas	214 978 8761		Todd Water
Vickie Armstrong	Rose Hill SUD	PO Box 190 Kaufman	972 932 3077	RHWSC@AOL.com	Vickie Armstrong
Shirley Blakely	College Mound WSC	12731 FM 429 Terrell	972-563-1355	SBlakely.CMWS@Arcma.net	Shirley Blakely

Freese and Nichols

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PURPOSE
The overall objective of the meeting should be clear and noted on the agenda.

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City of Terrell
Regional Facility Planning Study – New Terrell City Lake
Meeting with Potential Raw Water Customers
July 7, 2010
City of Terrell Public Works Service Center – Training Room
10:00 am

AGENDA

Topic	Who	Time
1. Welcome and Introductions	S. Rogers	10:00 AM
2. Background Information	R. Ickert	10:10 AM
3. Purpose of the Study	R. Ickert	10:15 AM
4. Water Availability	R. Ickert	10:20 AM
5. Water Needs of Potential Customers	R. Ickert	10:25 AM
6. Existing Facilities	R. Ickert	10:30 AM
7. Interest in Purchasing Raw Water	S. Rogers	10:40 AM
8. Questions/Discussions	All	10:45 AM
CLOSE/ADJOURN		**11:00 AM**

CODE OF CONDUCT
1. Publish an agenda and maintain minutes.
2. Challenge ideas and processes, not people.
3. Share responsibility and ownership.
4. Maintain an open, honest environment.
5. Question and participate.
6. Listen constructively.
7. Begin and end on time unless participants agree to an extension.
8. Come prepared and with action items completed.
9. Base decisions on factual data.
10. Keep confidences.

Regional Facility Plan for New Terrell City Lake

Meeting with Potential Raw Water Customers

Wednesday, July 7, 2010

1

Background

- Study is partially funded by TWDB Regional Facility Planning Grant
- Supply from Terrell City Lake is no longer used, and the raw water is available for purchase
- Terrell plans to maintain ownership of the dam and sell raw water

2

Purpose of Study

Water Supply – New Terrell City Lake

- Determine available supply from the lake
- Determine who might use the water
- Estimate costs and recommend facilities required to make use of the available supply

3

Water Availability

- Terrell's Water Right (CA 4972)
  - Authorized impoundment = 8,712 acre-feet
  - Authorized diversion = 6,000 acre-feet/year (5.4 MGD)
  - Maximum diversion rate = 10 cfs
  - Diversion from anywhere on perimeter of reservoir
  - 1954 priority

4

Water Availability

- Yield of New Terrell City Lake
  - TCEQ Trinity Water Availability Model used to determine firm yield
  - 1997 Volumetric Survey used to update WAM (accounts for sediment accumulation in the lake)
  - Firm yield in 2000 = 2,400 ac-ft/yr (2.1 MGD)
  - Firm yield in 2060 = 2,300 ac-ft/yr (2.05 MGD)
  - Amount of water for sale = 6,000 ac-ft/yr (5.4 MGD) when available

5

Water Availability

- Permit Requirements
  - Inter-basin Transfer Permit may be required
  - Entities requiring IBT (MacBee SUD, Canton, SRA, South Tawakoni WSC)
  - Van Zandt, Kaufman, Hunt and Collin Counties are partially in Trinity basin (easier to get an IBT)

6

Water Needs

Water Suppliers	Needs According to Regional Water Plans (Ac-Ft/Yr)					
	2010	2020	2030	2040	2050	2060
Wills Point	0	0	0	0	0	0
Poetry WSC	0	0	0	1	14	46
Ables Springs WSC	0	722	931	1,177	1,522	1,969
High Point WSC	4	97	180	266	369	486
South Tawakoni WSC	0	0	0	0	0	0
College Mound WSC	13	215	464	676	931	1,223
Sabine River Authority	22,488	25,417	28,345	31,273	34,202	37,130
MacBee SUD	0	0	0	0	0	0
North Texas MWD	0	91,679	170,209	243,628	313,320	368,061
Kaufman County Other	0	269	475	615	728	816
Canton	0	0	29	57	104	161
Dallas Water Utilities	48,797	171,126	206,488	256,215	325,741	444,098
Tarrant Regional Water District	0	49,680	147,533	244,544	351,389	477,251
Total	**71,302**	**339,205**	**554,654**	**778,452**	**1,028,320**	**1,331,241**

7

Water Needs

- Needs included as part of County Other
  - Elmo WSC
  - Kaufman Co. Water Control and Improvement District No. 1
  - Las Lomas MUD No. 3
  - Las Lomas MUD No. 4
  - Lawrence WSC
  - North Kaufman WSC
  - Rose Hill SUD
  - Talty WSC
  - Terrell Hunt Realty Corporation

8

Existing Facilities

- New Terrell City Lake Facilities
  - Dam constructed in 1955 and modified in 1967
  - 21-inch pipeline to WTP (off-line in 2006)
  - Intake pump station (off-line in 2006)
    - RWP #1 – Replaced in 1998
    - RWP #2 – Replaced in 1989
    - RWP #3 – Replaced in 1995
    - RWP #4 – Installed in 1972
    - RWP #5 – Installed in 2001
    - Pump station electrical replaced; added a VFD, polymer chemical feed system, and SCADA – Installed in 2001
    - Since taking the pump station off-line, Terrell has typically exercised one pump per month.

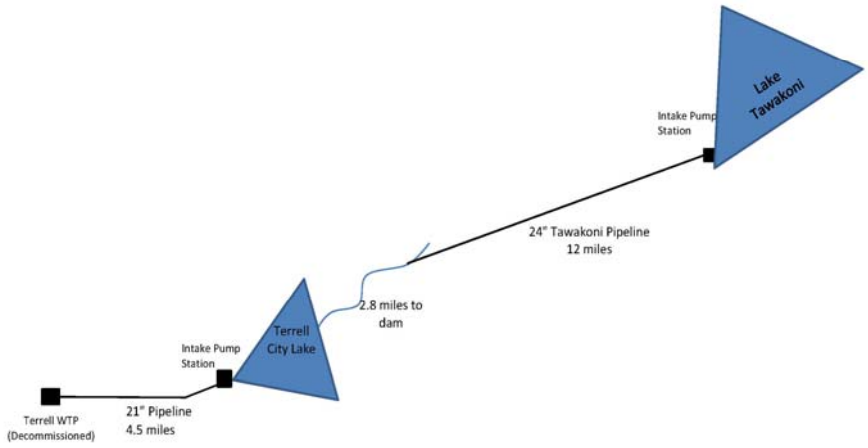
9

Existing Facilities

- Transmission Facilities from Lake Tawakoni
  - 24-inch pipeline from Lake Tawakoni to New Terrell City Lake
  - Pipeline taken off-line in 2006
  - 11 MGD pipeline capacity from Tawakoni to New Terrell City Lake
  - Will determine the capacity of the pipeline going from New Terrell City Lake to Tawakoni
  - Terrell Tawakoni Pump Station and Intake transferred to NTMWD in 2006

10

Schematic of Existing Facilities



11

Closing Points

- If interested in purchasing water from New Terrell City Lake, please let us know
  - Determines how we proceed with the study

12

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CITY OF TERRELL, TEXAS

Questions?
Comments?

13

MEETING MINUTES

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PROJECT: Water Supply Facility Planning – New Terrell City Lake
NAME OF MEETING: Meeting with Potential Raw Water Customers
RECORDED BY: Rachel Ickert
DATE: July 7, 2010
LOCATION: City of Terrell
ATTENDEES:

Name	Company
Steve Rogers	City of Terrell
Sonny Groessel	City of Terrell
Dick Boyd	City of Terrell
David Wilson	City of Terrell
Jason Stovall	Sabine River Authority
Randy Traylor	Sabine River Authority
Denis Qualls	Dallas Water Utilities
Billy Wynn	Elmo WSC
Yanbo Li	North Texas Municipal Water District
Tina Ptak	Tarrant Regional Water District
Roy Perkins	North Kaufman WSC
Vickie Armstrong	Rose Hill SUD
Shirley Blakely	College Mound WSC
Tom Gooch	Freese and Nichols
Rachel Ickert	Freese and Nichols

The following reflects our understanding of the items discussed during the subject meeting. If you do not notify us within five working days, we will assume that you are in agreement with our understanding.

ITEM	DESCRIPTION
1	Introductions • Steve Rogers welcomed everyone and facilitated introductions. The sign in sheet for the meeting is attached.
2	Presentation • Rachel Ickert presented information on the Water Supply Facility Planning Study for New Terrell City Lake. The presentation is attached.
3	Questions/Discussion • Denis Qualls asked some questions regarding the existing facilities. The outlet through the dam is a 30-inch pipe, and water can be passed through the dam. The pipeline from Tawakoni to New Terrell City Lake is in a 30-ft easement. The hydraulic capacity of the stream from the Tawakoni pipeline to New Terrell City Lake is unknown. The existing intake at Lake Tawakoni is used by North Texas Municipal Water District and MacBee SUD and does not have any

ITEM	DESCRIPTION
	additional capacity. If someone were to pump water from Lake Tawakoni, it may be feasible to construct an expansion to the existing intake, or a completely new intake structure may be required. • Tina Ptak asked about the uses authorized by Terrell's water right. The water right authorizes municipal and recreational use. An amendment would be required for industrial use of the supply.
4	End Meeting with Potential Raw Water Customers
5	Terrell/FNI Discussion Following the Public Meeting • Terrell would like to study the following three scenarios as part of this study: 1. Reverse flow from New Terrell City Lake to the Sabine Basin. 2. Route Tawakoni or Lake Fork water through New Terrell City Lake; release the water to Cedar Creek Reservoir to be accessed through the new TRWD/Dallas integrated pipeline 3. Pipe the water directly from New Terrell City Lake to NTMWD's water treatment plant. **Tom Gooch will talk to NTMWD to see if they are interested in this arrangement. If not, another alternative will be studied.** • **FNI will begin the analysis to determine how much water is available from New Terrell City Lake on a regular basis.** • **Tom Gooch will follow up with Gary Burton to see if Canton would be interested in purchasing Terrell's raw water.** • **Terrell will send Denis Qualls the plans for the Tawakoni to New Terrell City Lake pipeline.** • **Tom Gooch will contact SRA and NTMWD to discuss their interest. Rachel or Tom will send them the presentation from this meeting for their review.** • **Rachel Ickert will follow up with Tina Ptak to see if TRWD is interested in purchasing Terrell's raw water.**

ACTION ITEMS			
WHAT	**WHO**	**WHEN**	**STATUS**
1. FNI will begin the analysis to determine how much water is available from New Terrell City Lake on a regular basis.	RAI	July 30, 2010	
2. Tom Gooch will follow up with Gary Burton to see if Canton would be interested in purchasing Terrell's raw water.	TCG	July 16, 2010	
3. Terrell will send Denis Qualls the plans for the Tawakoni to New Terrell City Lake pipeline.	Sonny Groessel/ Steve Rogers	July 16, 2010	
4. Tom Gooch will contact SRA and NTMWD to discuss their interest. Rachel or Tom will send them the presentation from this meeting for their review.	TCG/RAI	July 16, 2010	
5. Rachel Ickert will follow up with Tina Ptak to see if TRWD is interested in purchasing Terrell's raw water.	RAI	July 16, 2010	

Terrell Potential Raw Water Use
Meeting No. 1
July 7, 2010

Name	Company	Address	Phone	E-mail	Signature
Steve Rogers	City of Terrell	P.O. Box 310	972-551-6607	srogers@cityofterrell.org	
SONNY GROESSEL	City of Terrell	PO BOX 310 Terrell 75160	9725516609	sgroessel@cityofterrell.org	
DAVID WILSON	CITY OF TERRELL	400 INDUSTRIAL TERRELL	972-551-5001	dwilson@CITY OF TERRELL.ORG	
Dick L Boyd	City of Terrell	PO Box 310	972-551-6635	dboyd@cityofterrell.org	
Tom Gooch	Freese & Nichols	4055 International Plaza Fort Worth Tx 76109	817/735-7300	tcg@freese.com	
Rachel Ickert	" "	" " "	"	rai@freese.com	
Vickie Armstrong	Rose Hill SUD	PO Box 190 Kaufman TX 75142	9729323077	RHSUD@AOL.COM	
Roy PERKINS	NORTH KAUFMAN WSC	P.O. Box 870 KAUFMAN TX 75142	972-962-7614	Roy_NKWSC@YAHOO.COM	
JASON STOVALL	Sabine River Authority	PO BOX 310 POINT TX 75472	903-598-2216	jstovall@SRATX.org	
Randy Traylor	Sabine River Authority	P.O. Box 310 Point Tx 75472	903-598-2216	rtraylor@sratx.org	
DENIS QUALLS	DALLAS	1500 MARILLA 4AN DALLAS TX 75201	214 670-3943	DENIS.QUALLS@DALLASCITYHALL.COM	
Billy Wynn	ELMO WSC	P.O. Box 10 Elmo, Tx 75118	972 670-9392	elmowsc.bill@etex.com	
Yanbo Li	NTMWD	505 E. Brown St. Wylie, TX 75098	972-442-5405	yli@ntmwd.com	
Tina Ptak	TRWD	800 E North Side Dr, FW 76102	817.372.4611	tina.ptak@trwd.com	
Shirley Blakely	CMWSC	12731 FM 429 Terrell TX 75161	9725631355	SBLAKELY.CMWSC@AIRMAIL.NET	

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PURPOSE
The overall objective of the meeting should be clear and noted on the agenda.

AGENDA
The agenda should include what is to be covered, who is responsible and how long each item will require.

CODE OF CONDUCT
Meeting participants should respect each other by honoring the Code of Conduct.

EXPECTATIONS
The expectations of the participants should be discussed, noted and reviewed for closure.

ROLES
The roles of leader, scribe, minute taker, time keeper and facilitator should be clarified at the beginning of the meeting.

City of Terrell
Water and Wastewater Regional Studies – Public Meeting No. 2
August 5, 2010
Cit of Terrell City Hall – Council Chambers
10:00 to 11:00 am

AGENDA

Topic	Who	Time
1. Wastewater Study Scope	GB	10:00 AM
2. Condition Assessment Summary	GB	10:05 AM
3. Process Evaluation Summary	GB	10:10 AM
4. Planning Development (Next Steps)	GB	10:15 AM
5. Wastewater Study Schedule	GB	10:20 AM
6. Water Study Scope	RAI	10:25 AM
7. Available Raw Water Supply	RAI	10:30 AM
8. Water Supply Alternatives	RAI	10:35 AM
9. Water Study Schedule	RAI	10:40 AM
10. Questions/Discussions	All	10:45 AM
CLOSE/ADJOURN		**11:00 AM**

CODE OF CONDUCT
1. Publish an agenda and maintain minutes.
2. Challenge ideas and processes, not people.
3. Share responsibility and ownership.
4. Maintain an open, honest environment.
5. Question and participate.
6. Listen constructively.
7. Begin and end on time unless participants agree to an extension.
8. Come prepared and with action items completed.
9. Base decisions on factual data.
10. Keep confidences.

Terrell Regional Water and Wastewater Studies

Public Meeting No. 2

Thursday, August 5, 2010

1

Wastewater Study Scope

1. Condition Assessment
   - What is the current mechanical condition of the King's Creek WWTP?
2. Process Modeling
   - What is the process capacity for the King's Creek WWTP?
3. Wastewater Treatment Planning Development
   - Consensus on population projections to be used
   - Projected flow impact alternatives evaluation

2

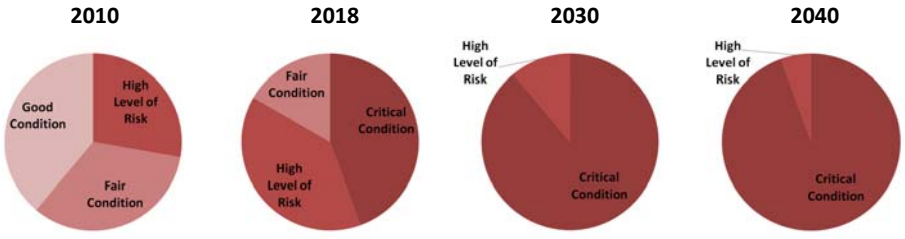
Condition Assessment

- Conducted on May 27 and June 3 of 2010
- Standardized evaluation of unit processes for risk of failure
- Used to determine functional life of existing facilities
- Four categories
  - Good Condition: No immediate repairs required
  - Fair Condition: Repairs likely in next 5-10 years
  - High Level of Risk: Near term repairs required
  - Critical Condition: Immediate repairs required

3

Condition Assessment

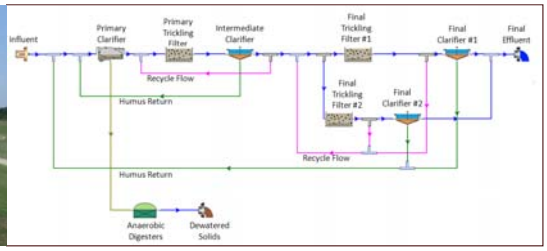
- 8 of 18 unit processes will be in critical condition in 2018
- 16 of 18 unit processes will be in critical condition in 2030
- Significant mechanical upgrades required before 2018 to maintain treatment capabilities



4

Process Evaluation

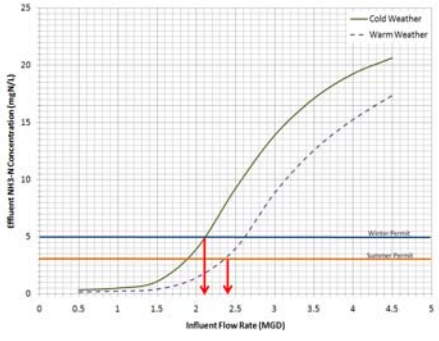
- Computer model developed to simulate King's Creek WWTP
- Calibrated to process performance sampling of individual unit processes
- Validated with 3 years of historic performance data
- Performance projections made for increasing flows

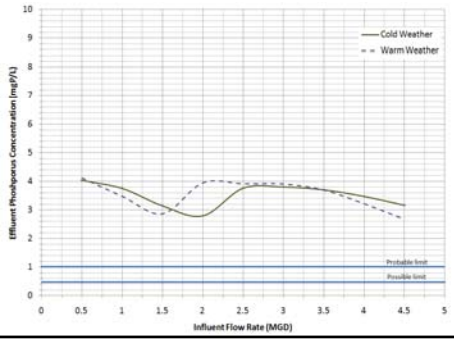


5

Process Evaluation

- Calibrated, validated model used to simulate performance
- Existing critical parameter: ammonia (NH_3-N) removal
- Future critical parameters: ammonia and phosphorus removal
- Capacity for ammonia removal: 2.1 MGD (Cold Weather)
- Capacity for phosphorus removal: current processes do not meet future permit levels





Wastewater Treatment Planning Development

- Next step: develop treatment alternatives
- Reconciled population and flow projections
  - Provide agreed upon flows to be treated
  - Impact treatment expansion timeline
- Three sources of population information
  1. Population projections for City of Terrell and surrounding developments – City of Terrell CIP November 2009 (FNI – 2009).
  2. FNI projected populations for NTMWD for water demand – DRAFT 2010 NTMWD CIP (FNI – 2010).
  3. Texas Water Development Board (TWDB) projected populations for North Texas Municipal Water District (NTMWD) proposed populations for water demand – DRAFT 2010 NTMWD CIP (TWDB – 2010).

7

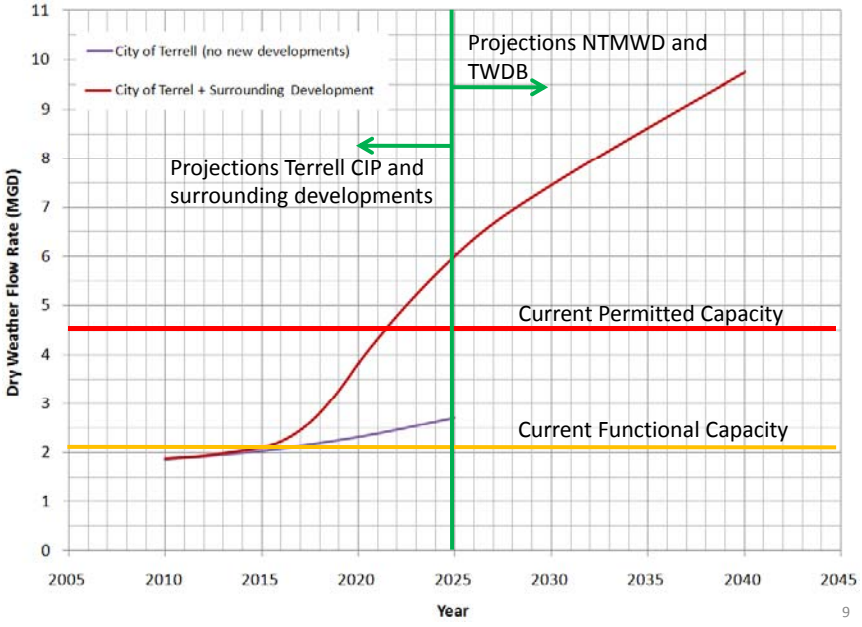
Population and Flow Projections

	Population					
	City of Terrell	Fairfield	Whitt Ranch	Las Lomas	RIO	Total
2010	16,185	0	0	0	0	16,185
2015	17,694	0	612	0	0	18,306
2020	20,018	300	2,487	6,183	81	33,219
2025	23,546	3,900	5,019	15,183	1,090	52,788
2030	-	-	-	-	-	65,000
2040	-	-	-	-	-	85,000

•Populations through 2025 provided July 2010
•2040 Total Population from North Texas Municipal Water District water supply projections, based on Texas Water Development Board projections

8

Population and Flow Projections



9

Wastewater Treatment Planning Development

- Two critical components of alternatives analysis
  1. Facility upgrades to treat current permitted flow capacity
  2. Timeline for expansion beyond current permitted flow capacity
- Alternative being evaluated
  1. Upgrade existing King's Creek WWTP unit processes to meet flows and permit requirements through 2040
  2. Construct a new WWTP on the existing King's Creek WWTP site
  3. Construction of infrastructure to convey all flows to a NTMWD regional wastewater treatment facility

10

Wastewater Schedule

- Major Milestones
  - Mid October, 2010 – Draft Improvements Report
  - October 21, 2010 – Public Meeting No. 3
  - Mid November, 2010 – Texas Water Development Board Review
  - Mid January, 2011 – Develop Final Report

11

Water Study Scope

Completed Scope Items

- Determined available supply from the lake
- Identified potential alternative uses of the lake
- Completed dam site inspection

12

Water Study Scope

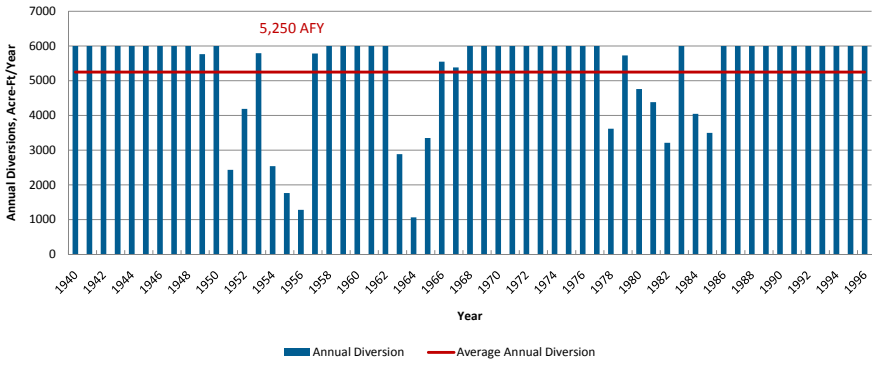
Remaining Scope Items

- Estimate costs and recommend facilities required to make use of the available supply
- Complete Dam Condition Assessment
- Review Water Conservation and Drought Contingency Plans
- Prepare report

13

Available Supply From Lake

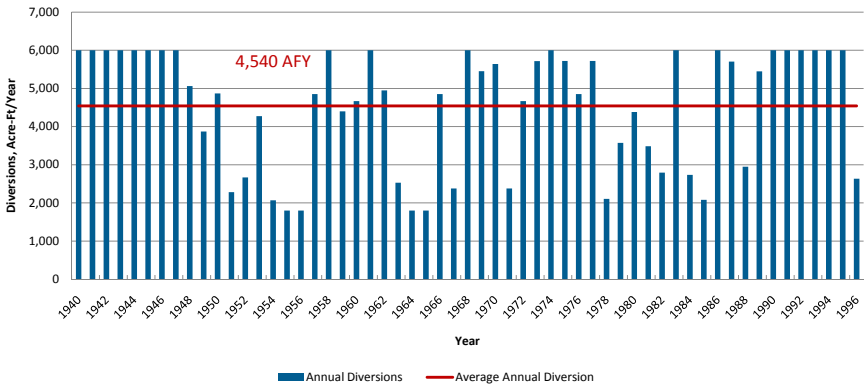
- Analysis completed using the TCEQ Trinity WAM
- Firm Yield = 2,300 ac-ft/yr for 2060 conditions
- Water Availability Analysis
  - Target diversion of 6,000 ac-ft/yr – in 12% of the months, the actual diversion is less than the target diversion. Average annual diversion = 5,250 acre-feet



14

Available Supply From Lake

- Water Availability Analysis
  - Target diversion of 6,000 ac-ft/yr when reservoir storage is > 50% and target diversion of 1,800 ac-ft/yr when reservoir storage is < 50%
    - Results in no shortages
    - Average annual diversion = 4,540 ac-ft



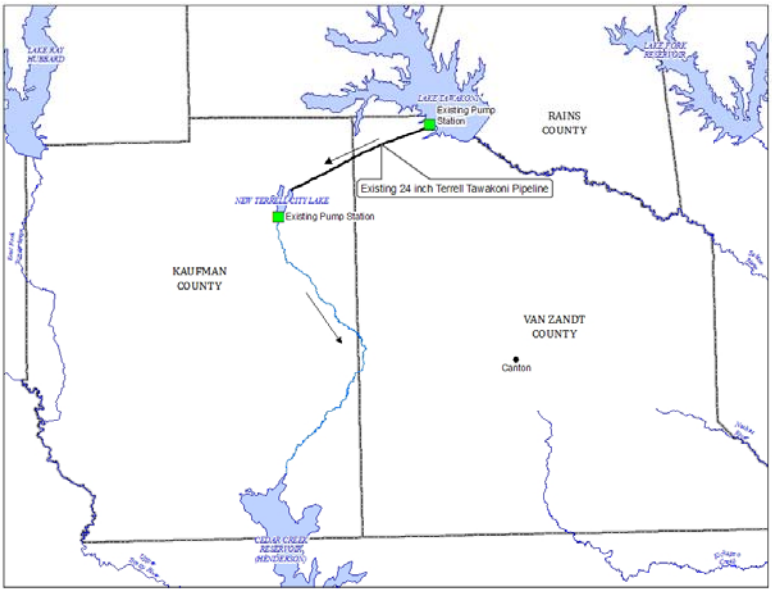
15

Possible Alternatives

- Dallas Water Utilities (DWU) - Interested in taking water through New Terrell City Lake to Cedar Creek Reservoir.
- North Texas Municipal Water District (NTMWD) - Interested in delivering water from New Terrell City Lake to their Tawakoni WTP
- Sabine River Authority (SRA) - Interested in taking New Terrell City Lake water back to Lake Tawakoni or supplying customers closer to Terrell
- City of Canton – Interested in delivering water from New Terrell City Lake to their WTP

16

Possible Alternatives - DWU



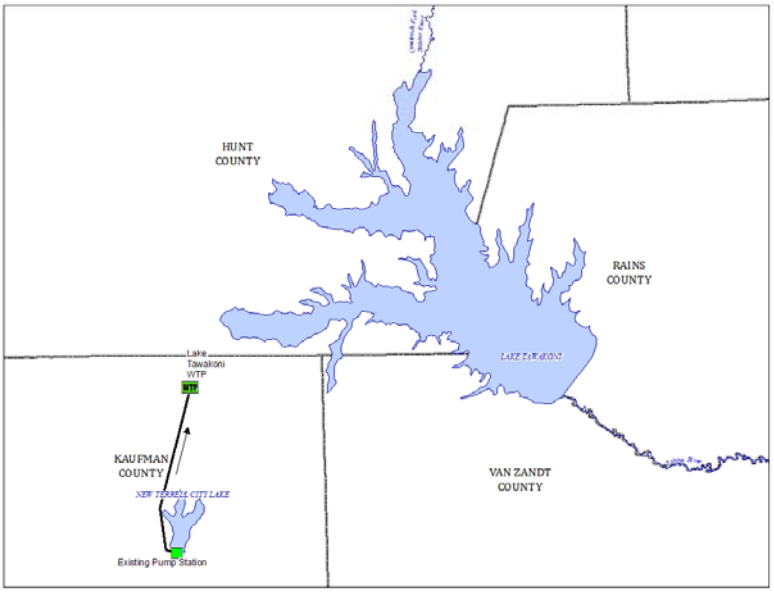
17

Possible Alternatives

- Dallas Water Utilities (DWU)
  - Interested in taking water through New Terrell City Lake to Cedar Creek Reservoir. Study will determine:
    - Amount of water that can be transported through the existing Terrell Tawakoni pipeline.
      - Existing 24" Tawakoni pipeline capacity = 12.5 mgd
    - Capacity of outlet works at Terrell City Lake.
      - Approximately 20 to 58 MGD (depending on lake level)
    - If an additional pipeline can be constructed in the existing 30-ft easement from Tawakoni to New Terrell City Lake.
    - Identify where DWU's Lake Fork pipeline crosses the Terrell Tawakoni pipeline.

18

Possible Alternatives - NTMWD



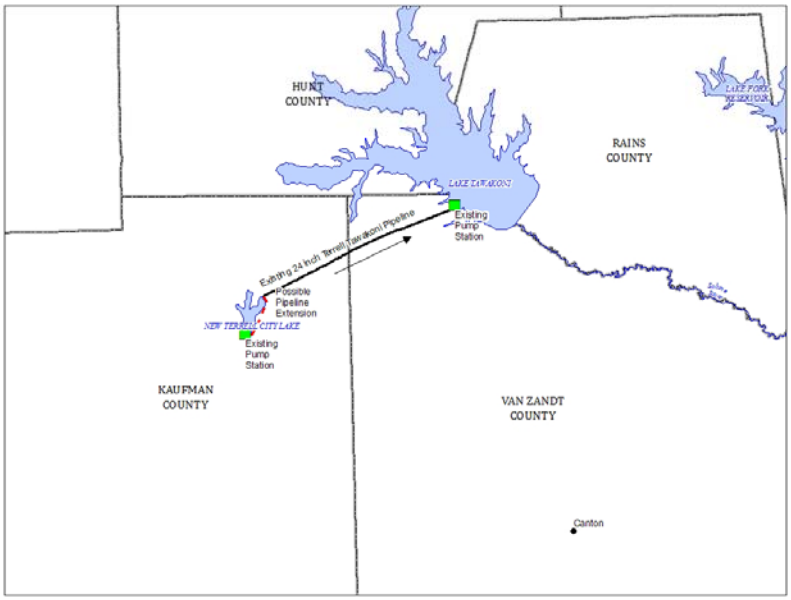
19

Possible Alternatives

- North Texas Municipal Water District (NTMWD)
  - Interested in delivering water from New Terrell City Lake to their Tawakoni WTP. Study will determine:
    - Pipe size required
    - If existing Terrell lake pumps can be used
    - Pipe size needed to utilize Terrell water as an emergency back-up supply for NTMWD Tawakoni WTP

20

Possible Alternatives - SRA



21

Possible Alternatives

- Sabine River Authority
  - Interested in taking New Terrell City Lake water back to Lake Tawakoni. Study will determine:
    - Capacity of existing pipeline in reverse
    - Additional water transmission facilities required
    - If Terrell pumps can be used
  - Interested in supplying customers closer to Terrell. Study will determine:
    - Which customers could be supplied and their demands
    - The required facilities

22

Possible Alternatives (SRA)

- Capacity of existing pipeline in reverse
  - 12,000 ac-ft/yr (11 mgd)
  - Based on pipe diameter, pipe pressure classes, and ground profile
  - Pipeline will need to be extended approximately 3 miles to New Terrell City Lake Dam, and an outlet structure will need to be added at Lake Tawakoni.

23

Possible Alternatives (SRA)

- Existing and potential customers near Terrell
  - Customers with WTPs
    - Cash SUD
    - MacBee SUD
  - Customers with no WTPs
    - Ables Springs WSC
    - Elmo WSC
    - Poetry WSC
    - College Mound WSC
    - North Kaufman WSC

24

Possible Alternatives (SRA)

– Demands of SRA Customers near Terrell

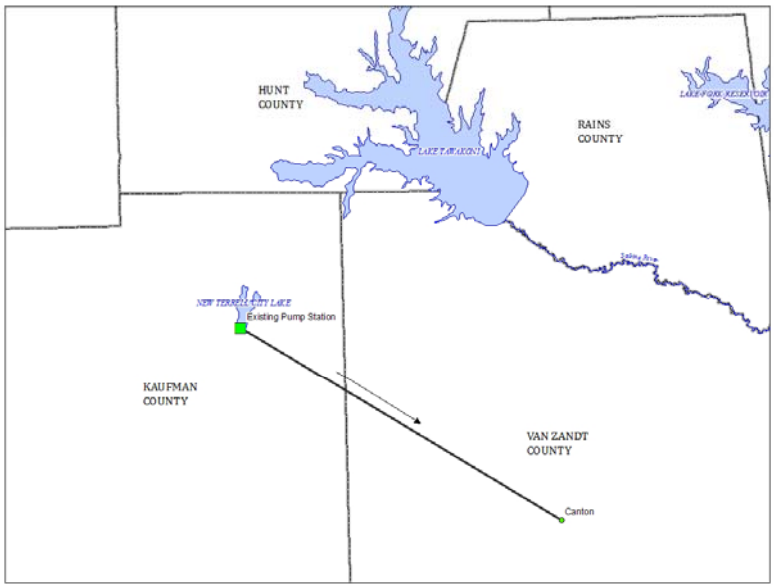
	Demands* (ac-ft/yr)					
SRA Customers	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Ables Springs WSC	1,120	1,120	1,120	1,120	1,120	1,120
NTMWD (formerly Terrell)	10,081	10,081	10,081	10,081	10,081	10,081
Cash SUD	5,803	5,803	5,803	5,803	5,803	5,803
MacBee SUD	2,240	2,240	2,240	2,240	2,240	2,240
Subtotal Existing Customers	19,244	19,244	19,244	19,244	19,244	19,244

Potential Future Customers	**2010**	**2020**	**2030**	**2040**	**2050**	**2060**
Elmo WSC	4,484	4,484	4,484	4,484	4,484	4,484
Poetry WSC	2,242	2,242	2,242	2,242	2,242	2,242
College Mound WSC	5,605	5,605	5,605	5,605	5,605	5,605
North Kaufman WSC	1,233	1,233	1,233	1,233	1,233	1,233
Subtotal Potential Customers	13,564	13,564	13,564	13,564	13,564	13,564
Total	**32,808**	**32,808**	**32,808**	**32,808**	**32,808**	**32,808**

* Based on 2011 Region C Water Plan

25

Possible Alternatives - Canton



26

Possible Alternatives

- City of Canton
  - Interested in delivering New Terrell City Lake water to their WTP. Study will determine:
    - Pipe size needed to deliver water from New Terrell City Lake to Canton's WTP
    - If Terrell pumps can be used

27

Water Schedule

- Major Milestones
  - Late August – Complete determination of costs and recommendations
  - Mid September – Complete review of Water Conservation and Drought Contingency Plans
  - Early October – Complete dam condition assessment
  - Mid October – Develop Draft Report
  - October 21st – Hold Public Meeting Number 3
  - Mid November – Develop Final Report
  - Mid January – Submit Final Report with the incorporation of TWDB comments

28

MEETING MINUTES

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PROJECT: City of Terrell Water and Wastewater Studies
NAME OF MEETING: Public Meeting Number 2
RECORDED BY: Keeley Kirksey
DATE: August 5, 2010
LOCATION: City of Terrell
ATTENDEES:

Name	Company
Steve Rogers	City of Terrell
Sonny Groessel	City of Terrell
Dick Boyd	City of Terrell
John Rickman	City of Terrell
Mike Sims	City of Terrell
Gary Burton	Gary Burton Engineering, Inc. (Representing the City of Canton)
Michael Dowdey	Dowdey, Anderson
Mark Edgren	Hillwood
Michael Shook	City of Forney
Linda Stewart	High Point WSC
Vickie Armstrong	Rose Hill SUD
Shirley Blakely	College Mound WSC
Gennady Boksiner	Freese and Nichols
Rachel Ickert	Freese and Nichols
Keeley Kirksey	Freese and Nichols

The following reflects our understanding of the items discussed during the subject meeting. If you do not notify us within five working days, we will assume that you are in agreement with our understanding.

ITEM	DESCRIPTION
1	Introductions • Steve Rogers welcomed everyone and facilitated introductions. The sign in sheets for the meeting are attached.
2	Presentation • Gennady Boksiner presented the scope, progress made, and the schedule for the wastewater study. • Rachel Ickert presented the scope, progress made, and schedule for the water study.
3	Questions/Discussion • Gary Burton (Canton's Engineer) inquired about the drainage area of New Terrell City Lake and the volume of New Terrell City Lake based on the most recent volumetric survey. Rachel Ickert will provide this information to Gary.

ITEM	DESCRIPTION
	• Gary Burton also asked if there was a site for a regional North Texas MWD WWTP. Gennady Boksiner informed him that a pump station and pipeline would be built to convey flows to NTMWD's existing WWTP. • Vickie Armstrong (Rose Hill SUD) asked what Planning Region Canton is located in. Rachel informed her it is in Region D. Rachel Ickert went on to say that the Canton and SRA alternatives would require IBTs. • Gary Burton asked how the presented population projections match up with the Texas Water Development Board Projections. Gennady Boksiner informed him that the actual population numbers used were scaled back to reflect the more recent growth trends and the economy. • Rachel Ickert explained that the firm yield of New Terrell City Lake is based on the TCEQ WAM and matches the firm yield presented in the 2011 Region C Water Plan. Upon Terrell's review and approval, Rachel will send Gary Burton a memorandum on the yield analysis. • Mike Shook (City of Forney) asked why the SRA demands presented do not change over time. Rachel Ickert explained that the demands shown are demands on SRA (not total demands for each customer), and the amounts shown are the contract amounts. • Gary Burton asked if the cost of the raw water will be determined in this study. Steve Rogers (City of Terrell) replied that the raw water cost will be determined in this study and will likely be presented at the next public meeting. Gary mentioned that Canton is interested in the water, but cannot win a bidding war. Rachel Ickert mentioned that the DWU option may be possible without DWU purchasing the raw water from Terrell Lake. • Gary Burton asked about the existing 24" pipeline from Lake Tawakoni to New Terrell City Lake. Rachel informed him that it was included in the presentation because it may be used for some of the possible alternative uses of New Terrell City Lake, but a condition assessment will likely need to be performed at some point.
4	End Public Meeting
5	Terrell/FNI Discussion Following the Public Meeting • Steve asked that cost estimates and summaries for each alternative be prepared and sent to the potential customers for their review and comment and that meetings be held with the potential customers as needed. • Steve asked that a meeting between FNI and Terrell be held to discuss the options for water and wastewater studies separately.

ACTION ITEMS			
WHAT	WHO	WHEN	STATUS
1. Provide drainage area, volume of New Terrell City Lake based on most recent volumetric survey, and memo on New Terrell City Lake yield to Gary Burton.	RAI		
2. Schedule a meeting with Terrell and FNI.	RAI		

Terrell Regional Water Plan

Public Meeting No. 2
August 5, 2010

Name	Company	Address	Phone	E-mail	Signature
Sonny Groessel	City of Terrell	PO Box 310 Terrell Tx 75160	9725516609	sgroessel@cityofterrell.org	
Dick L. Boyd	City of Terrell	PO Box 310 Terrell Tx 75160	972 551-6635	dboyd@cityofterrel.org	
Steve Rogers	City of Terrell	P.O. Box 310 Terrell, TX 75160	972-551-6607	Srogers@cityofterrell.org	
Gennedy Boksiner	Freese & Nichols	1701 N. Market St. Suite 500, Dallas TX	214-217-2224	gb@freese.com	Gennedy Boksiner
Keeley Kirksey	" "	~~4000~~ 4055 International Plaza, FW TX Suite 200	817-735-7476	kek@freese.com	Keeley Kirksey
Gary Burton	City of Canton	14531 SH 155 S. Tyler 75703	903-561-6984	gburton@gbei-tx.com	
Rachel Ickert	Freese & Nichols	4055 International Plaza, Suit 200	817-735-7286	rai@freese.com	
Shirley Blakely	College Mound	12731 FM 429	9725631355	SBlakely.cmws@Aicmail.Net	SBlakely
Vickie Armstrong	Rose Hill SUD	PO Box 190 Kaufman TX 75142	9729323077	RHWSC@AOL.COM	
LINDA STEWART	HIGH POINT	16986 VALLEY VIEW RD	972-564-3801	HIGHPOINTWSC@AOL.COM	
MIKE SHOOK	City of Forney	P.O. BOX 826, Forney 75126	972-564-3148	MSHOOK@cityofforney.org	
Mike Sims	City of Terrell				
MARK EDGREN	HILLWOOD	5430 LBJ STE 800 DALLAS 75240	972 201-2956	mark.edgren@hillwood.com	

Terrell Regional Wastewater Plan

Public Meeting No. 2
August 5, 2010

Name	Company	Address	Phone	E-mail	Signature
Sonny Groessel	City of Terrell	PO Box 310 Terrell TX 75160	972-551-6609	sgroessel@cityofterrell.org	
Dick L. Boyd	City of Terrell	P.O. Box 310 Terrell TX 75160	972-551-6635	dboyd@cityofterrell.org	
Steve Rogers	City of Terrell	P.O. Box 310 Terrell, TX 75160	972-551-6607	srogers@cityofterrell.org	
Gennady Boksiner	Freese & Nichols	1701 N. Market St, Suite 500, Dallas TX	214-217-2224	gb@freese.com	Gennady Boksiner
Gary Burton	City of Canton	14531 SH 155 S. Tyler, TX	903-561-6984	gburton@gbei-tx.com	Gary L Burton
Rachel Ickert	FNI	4055 International Plaza, Suite	817-735-7286	rai@freese.com	Rachel A Ickert
Keeley Kirksey	FNI	Fort Worth, TX 76109 200	817-735-7476	kek@freese.com	
Michael Dowdey	Dowdey, Anderson	5225 Village Creek Dr. Ste 200 Plano 75093	972-931-0694	mdowdey@daa-civil.com	
Mike Sims	City of Terrell				
John Rickman	City of Terrell	P.O. Box 310, Terrell, Tx 75160	972-551-6620	jrickman@cityofterrell.org	

APPENDIX D
WATER RIGHT PERMIT

CERTIFICATE OF ADJUDICATION

CERTIFICATE OF ADJUDICATION: 08-4972

OWNER: City of Terrell
P. O. Box 310
Terrell, Texas 75160

COUNTY: Kaufman

PRIORITY DATES: February 23, 1954 and February 17, 1969

WATERCOURSE: Muddy Cedar Creek, tributary of Cedar Creek, tributary of the Trinity River

BASIN: Trinity River

WHEREAS, by final decree of the 66th Judicial District Court of Hill County, in Cause No. 28,952 In Re: The Adjudication of Water Rights in the Middle Trinity River Segment of the Trinity River Basin dated September 4, 1986 a right was recognized under Permit 1700A authorizing the City of Terrell to appropriate waters of the State of Texas as set forth below;

NOW, THEREFORE, this certificate of adjudication to appropriate waters of the State of Texas in the Trinity River Basin is issued to the City of Terrell, subject to the following terms and conditions:

1. IMPOUNDMENT

Owner is authorized to maintain an existing dam and reservoir on Muddy Cedar Creek (New Terrell City Lake) and impound therein not to exceed 8712 acre-feet of water. The dam is located in the Robert A. Cartwright Survey, Abstract 76, Kaufman County, Texas.

2. USE

A. Owner is authorized to divert and use not to exceed 6000 acre-feet of water per annum from the aforesaid reservoir for municipal purposes.

B. Owner is also authorized to use the water impounded in the aforesaid reservoir for recreation purposes.

3. DIVERSION

A. Location
At the perimeter of the aforesaid reservoir

B. Maximum rate: 10.00 cfs (4500 gpm).

4. PRIORITY

A. The time priority of owner's right is February 23, 1954 for the impoundment of 8300 acre-feet of water, the use of the water for recreation purposes and the diversion and use of water for municipal purposes.

B. The time priority of owner's right is February 17, 1969 for the impoundment of an additional 412 acre-feet of water.

5. SPECIAL CONDITIONS

A. Owner shall maintain a suitable outlet in the aforesaid dam authorized herein to allow the free passage of water that owner is not entitled to divert or impound.

B. Owner will make daily determinations of water surface elevations in the reservoir by means of a gage set to U. S. Geological Survey or U. S. Coast and Geodetic Survey datum. The Texas Water Commission will be furnished with complete records of such determinations.

The locations of pertinent features related to this certificate are shown on Page 4 of the Middle Trinity River Segment Certificates of Adjudication Maps, copies of which are located in the office of the Texas Water Commission, Austin, Texas.

This certificate of adjudication is issued subject to all terms, conditions and provisions in the final decree of the 66th Judicial District Court of Hill County, Texas, in Cause No. 28,952 In Re: The Adjudication of Water Rights in the Middle Trinity River Segment of the Trinity River Basin dated September 4, 1986 and supersedes all rights of the owner asserted in that cause.

This certificate of adjudication is issued subject to senior and superior water rights in the Trinity River Basin.

APPENDIX E
WATER AVAILABLILTY ANALYSIS – NEW TERRELL CITY LAKE

DRAFT MEMORANDUM

FREESE AND NICHOLS

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Practical results
Outstanding service

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DRAFT

THIS DOCUMENT IS RELEASED FOR THE PURPOSE OF INTERIM REVIEW UNDER THE AUTHORITY OF RACHEL A. ICKERT, P.E., TEXAS NO. 97379 ON 07/15/2010. IT IS NOT TO BE USED FOR CONSTRUCTION, BIDDING OR PERMIT PURPOSES.

FREESE AND NICHOLS, INC.

TEXAS REGISTERED ENGINEERING FIRM F- 2144

TO: File

CC: TCG, JSA

FROM: RAI

SUBJECT: Water Availability Analysis – New Terrell City Lake

DATE: July 15, 2010

The City of Terrell owns the Certificate of Adjudication 4972 to divert 6,000 acre-feet per year from the Muddy Cedar Creek in the Trinity River Basin. CA 4972 authorizes impoundment of 8,712 acre-feet in the New Terrell City Lake. The priority date for the diversion of the full permit and storage of 8,300 acre-feet is February 23, 1954. The additional 412 acre-feet of storage has a priority date of February 17, 1969. The most recent volumetric survey report by the Texas Water Development Board (March, 2003) shows that the capacity of the conservation pool is 8,594 acre-feet. The diversion authorization and most of the storage authorization are senior to Cedar Creek Reservoir, which is located downstream from New Terrell City Lake and has a priority date of May 28, 1956.

The TCEQ Water Availability Models (WAMs) are used to determine if water is available from a lake, river, or stream, the amount of water available, and how often the water would be available under various conditions. The WAMs include the area and capacity of reservoirs based on their original permits. The TCEQ models do not account for sedimentation (reduced capacity) over time. FNI used the March 2003 volumetric survey for New Terrell City Lake to determine the sedimentation rate and project reservoir capacities in the year 2000 and the year 2060. This approach adds some conservatism to the analysis and is the approach used for the *Region C Water Plan*. The TCEQ Water Availability Model for the Trinity Basin was prepared in the late 1990's. The hydrologic data has not been extended since that time. Extending the hydrology for the entire model is a very large undertaking. It is our opinion that extending the hydrology beyond 1996 would not change our results because the drought of the 50's will likely still control the results of the water availability analysis.

Using the latest TCEQ Trinity WAM with Lake Terrell modified to Year 2000 conditions, the firm yield of New Terrell City Lake was determined to be 2,400 acre-feet per year. Figure 1 is the resulting storage trace from the firm yield analysis. The firm yield of New Terrell City Lake is 2,300 acre-feet per year under Year 2060 conditions, which assume reduced storage capacity based on sedimentation. Year 2000 and 2060 conditions for New Terrell City Lake were developed for the 2011 Region C plan.

To determine the water available for diversion on a regular basis, the Trinity WAM was first run with a target diversion rate (or demand) of 6,000 acre-feet per year. The results indicated that in 16% of the months, the actual diversion is less than the target diversion. The average annual diversion over the time period is 5,250 acre-feet, and the minimum diversion is 1,060 acre-feet per year. Figure 2 shows the storage trace, and Figure 3 shows the annual diversions from New Terrell City Lake with a target diversion of 6,000 acre-feet per year.

Running the WAM with a target diversion rate of 4,000 acre-feet per year from New Terrell City Lake results in an actual diversion less than the target diversion in 4% of the months. The average annual diversion over the simulated time period is 3,870 acre-feet with a minimum diversion of 1,230 acre-feet per year. Figure 4 shows the storage trace, and Figure 5 shows the annual diversions from New Terrell City Lake with a target diversion of 4,000 acre-feet per year.

I then looked at a target diversion of 6,000 acre-feet per year when the reservoir storage is greater than 50% and a target diversion of 1,800 acre-feet per year (30% of 6,000) when the reservoir storage is less than 50%. This resulted in no shortages and an average annual diversion of 4,540 acre-feet per year over the simulation period. Figure 6 shows the storage trace, and Figure 7 shows the annual diversions from New Terrell City Lake for this scenario.

The results discussed above are summarized in Table 1.

Table 1
Water Availability Analysis for New Terrell City Lake

Target Diversion Rate (Ac-Ft/Year)	% of Months with Shortage	Average Annual Diversion (Ac-Ft/Year)	Minimum Annual Diversion (Ac-Ft/Year)
2,400 (Firm Yield)	0%	2,400	2,400
6,000	16%	5,250	1,060
4,000	4%	3,870	1,230
6,000 when storage >50% 1,800 when storage <50%	0%	4,540	1,800

Figure 1

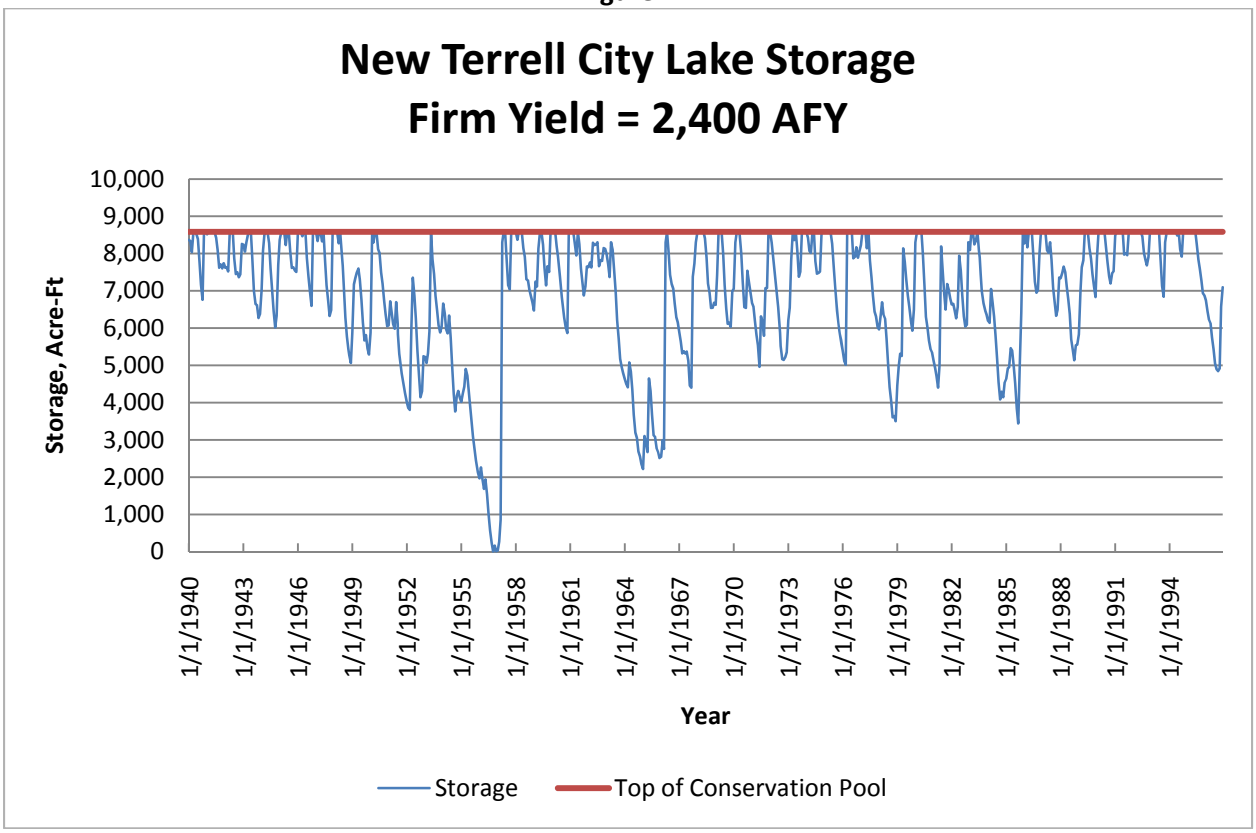


Figure 2

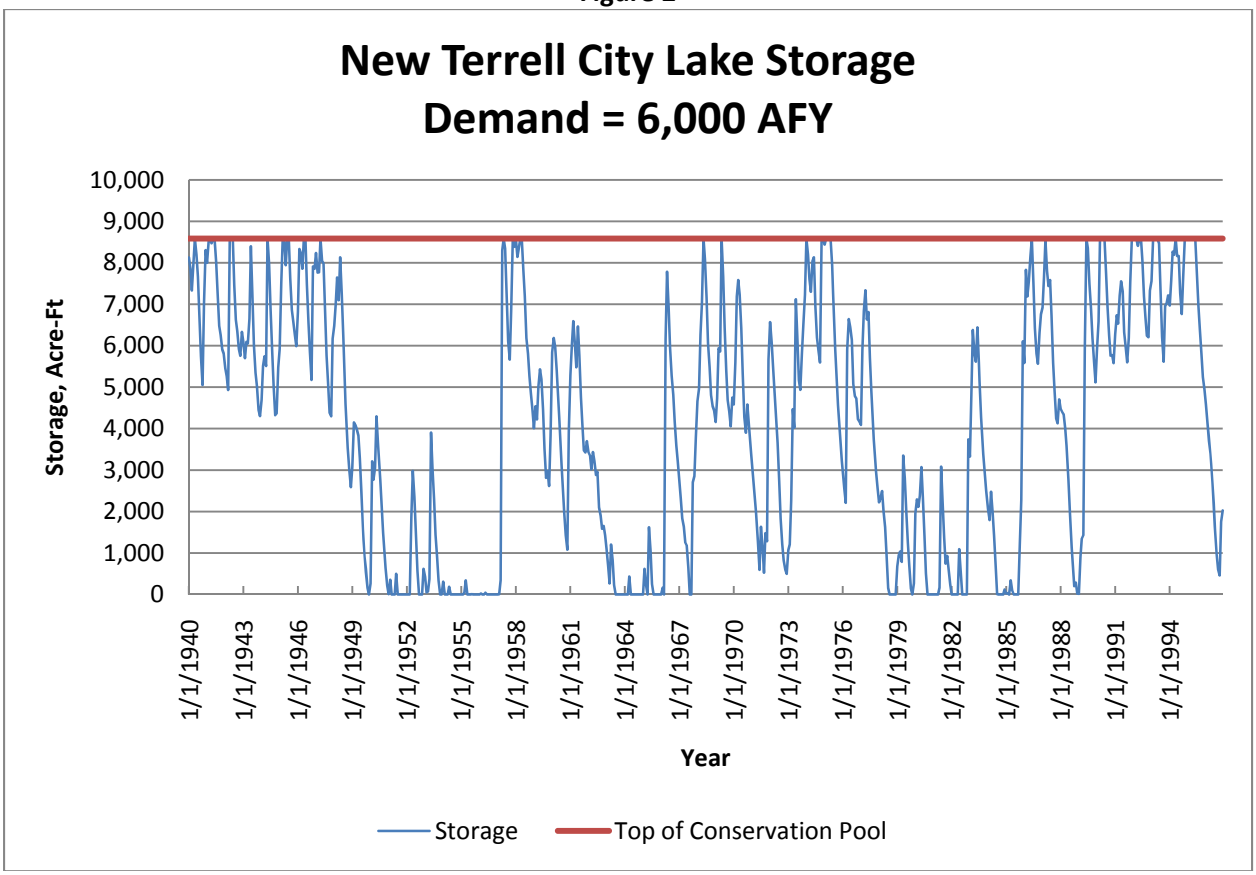


Figure 3

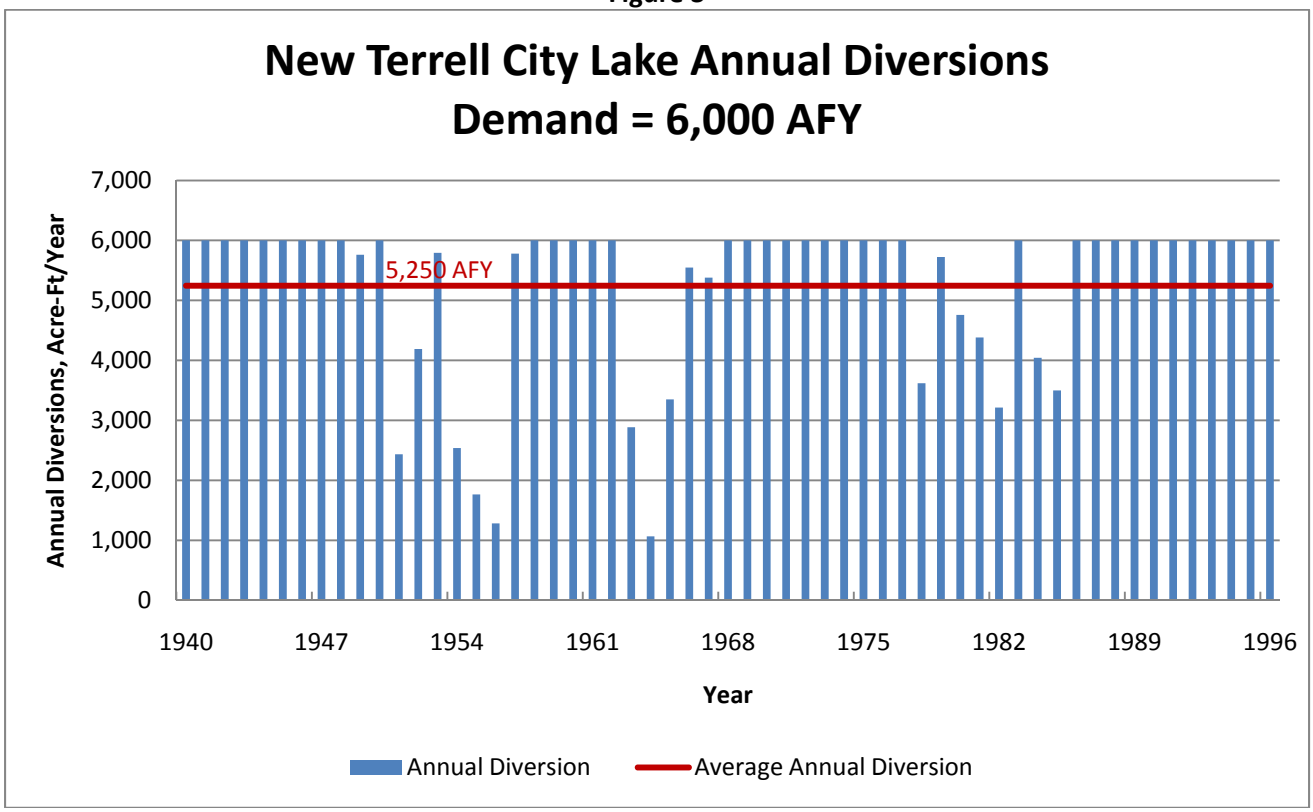


Figure 4

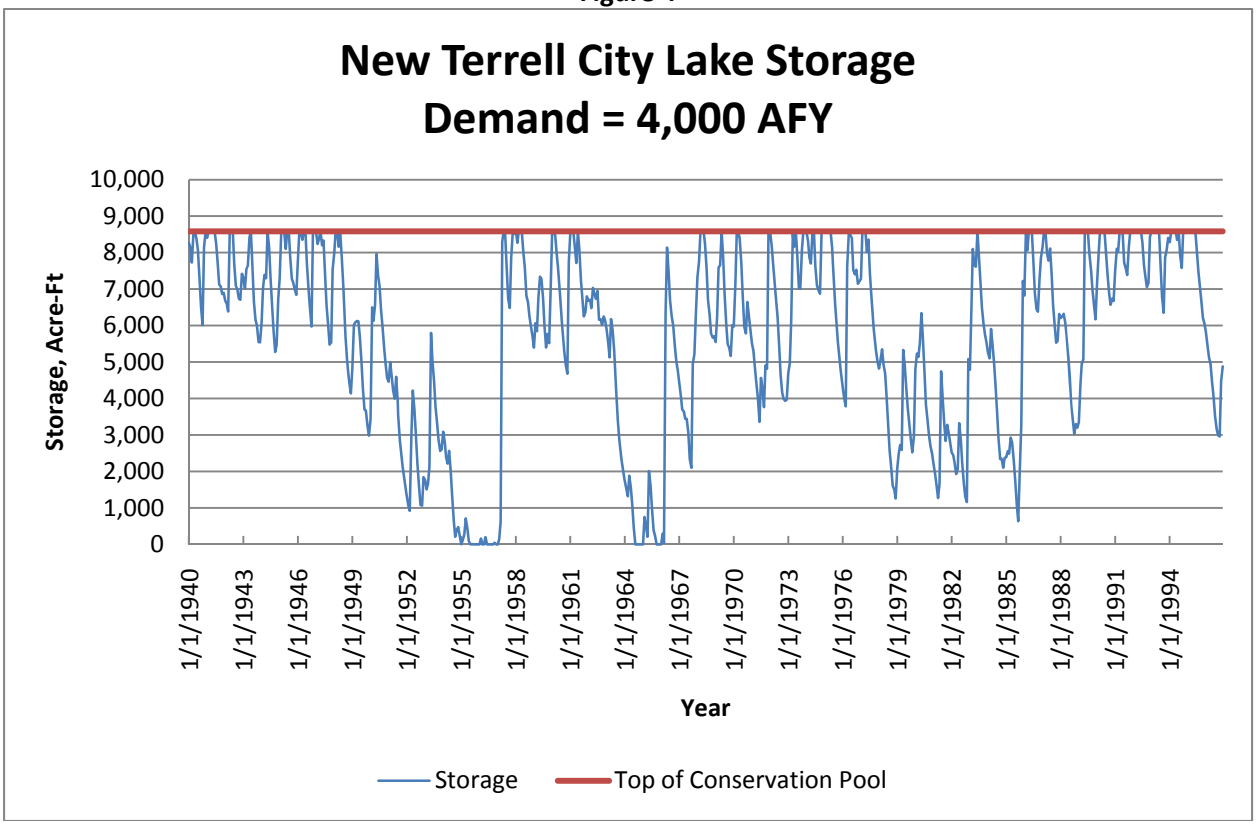


Figure 5

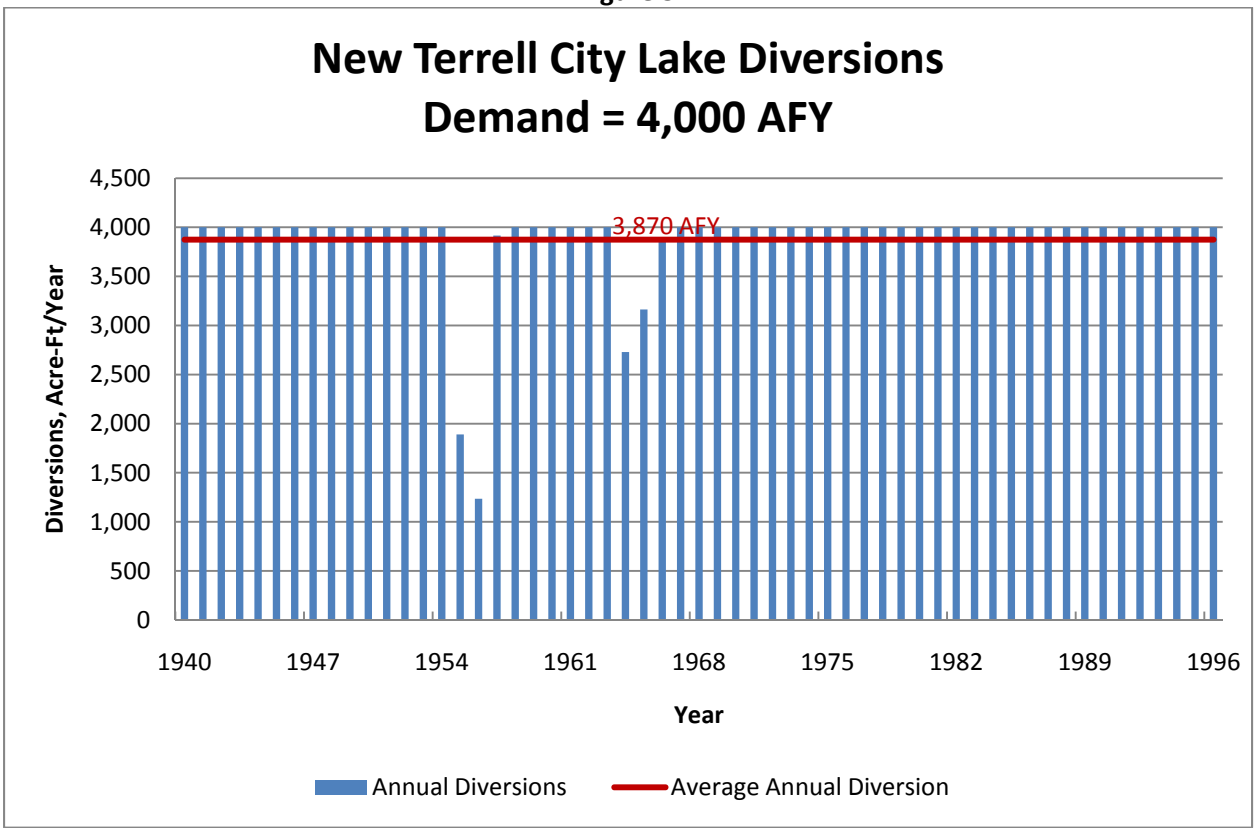


Figure 6

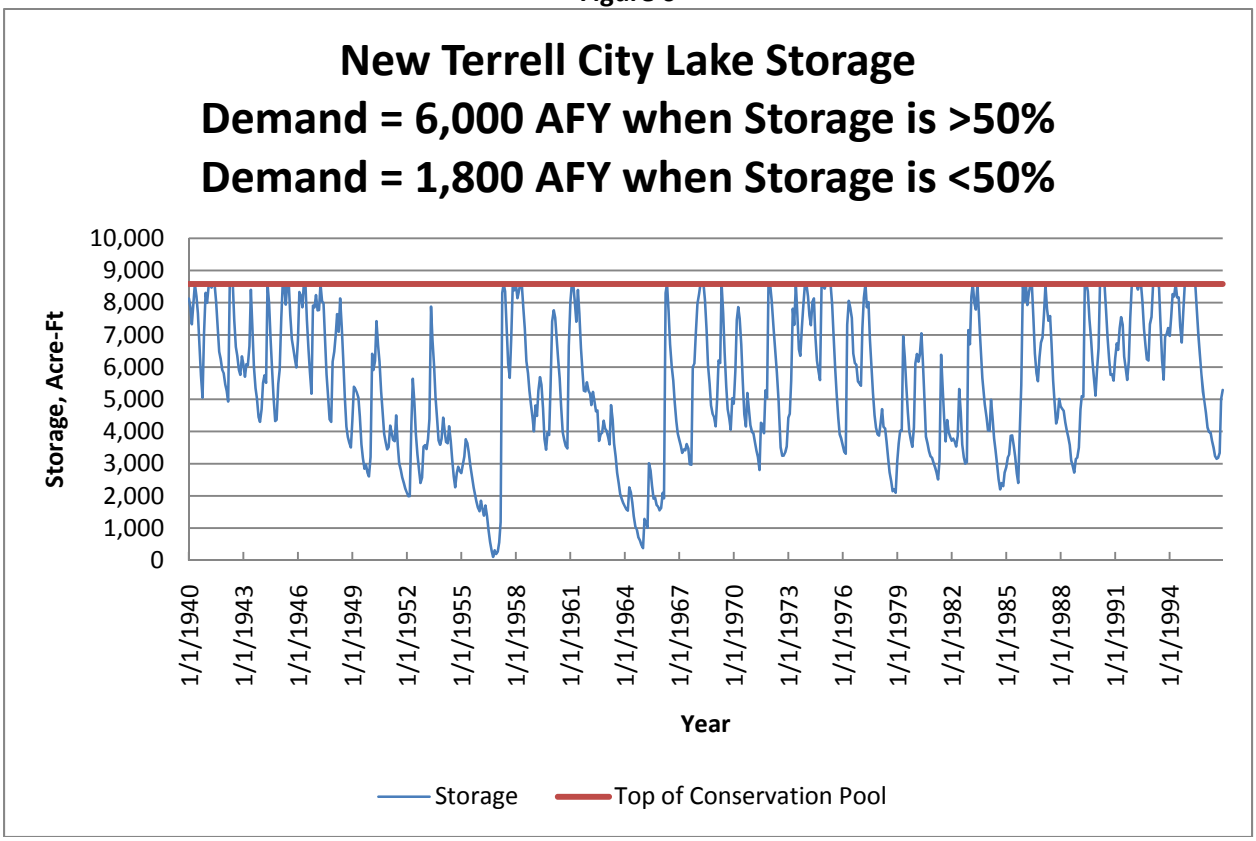
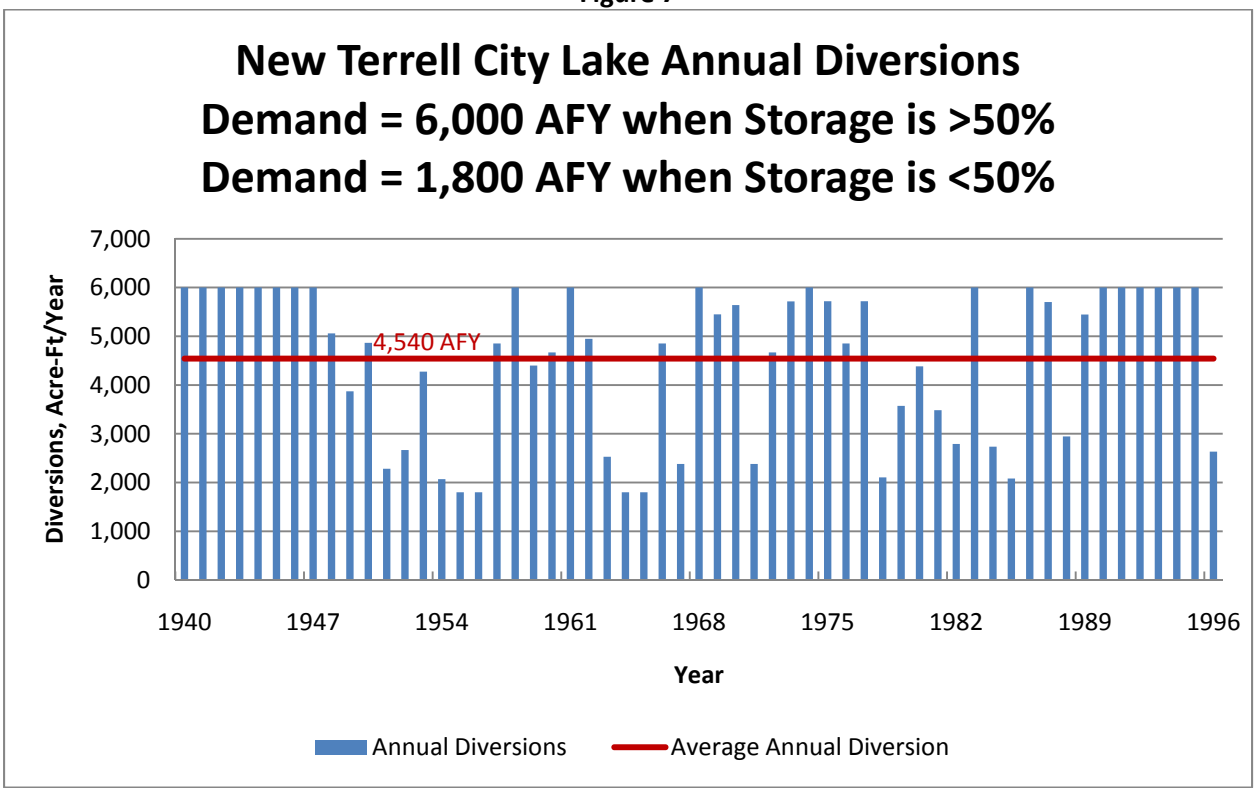
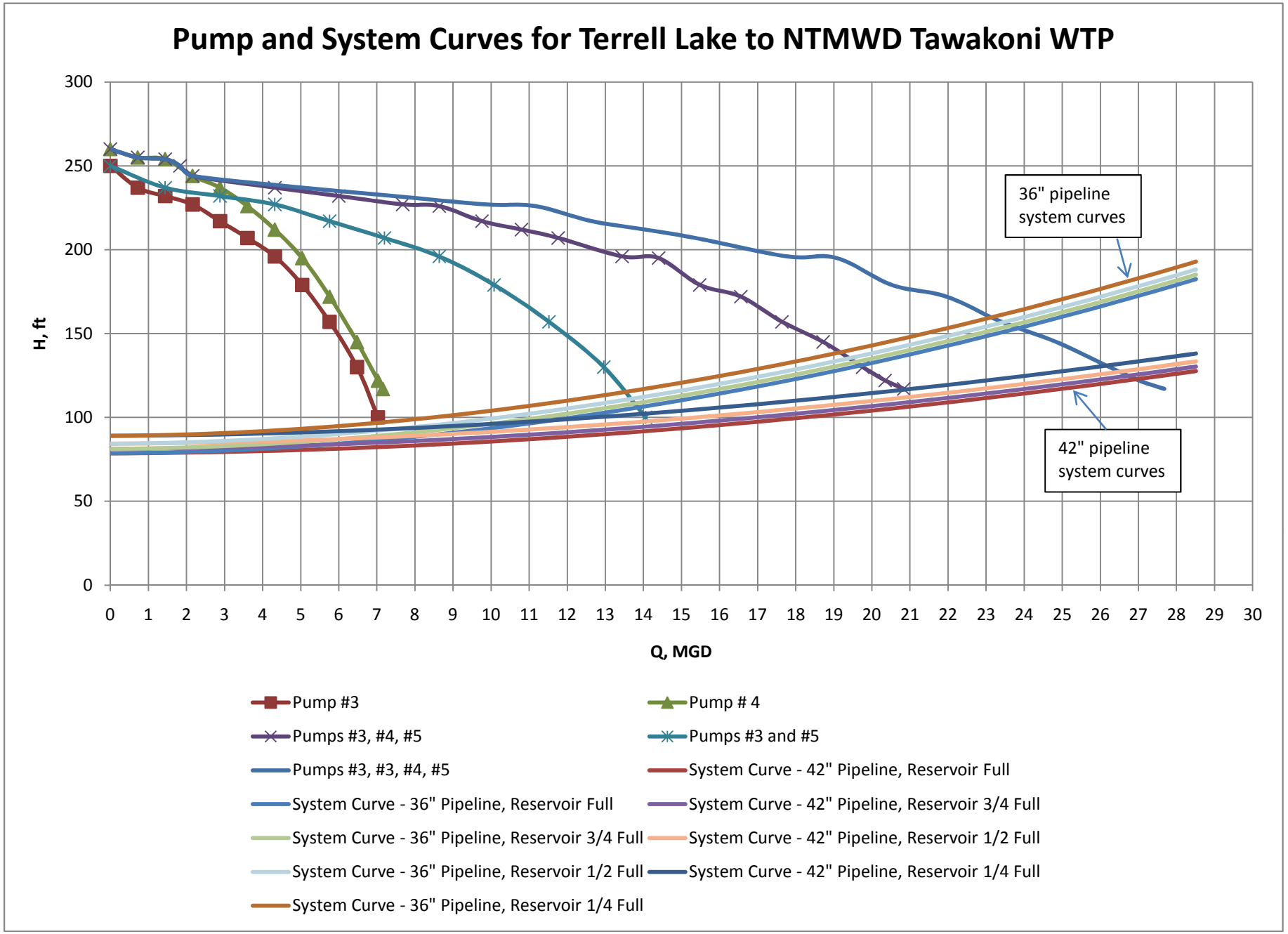
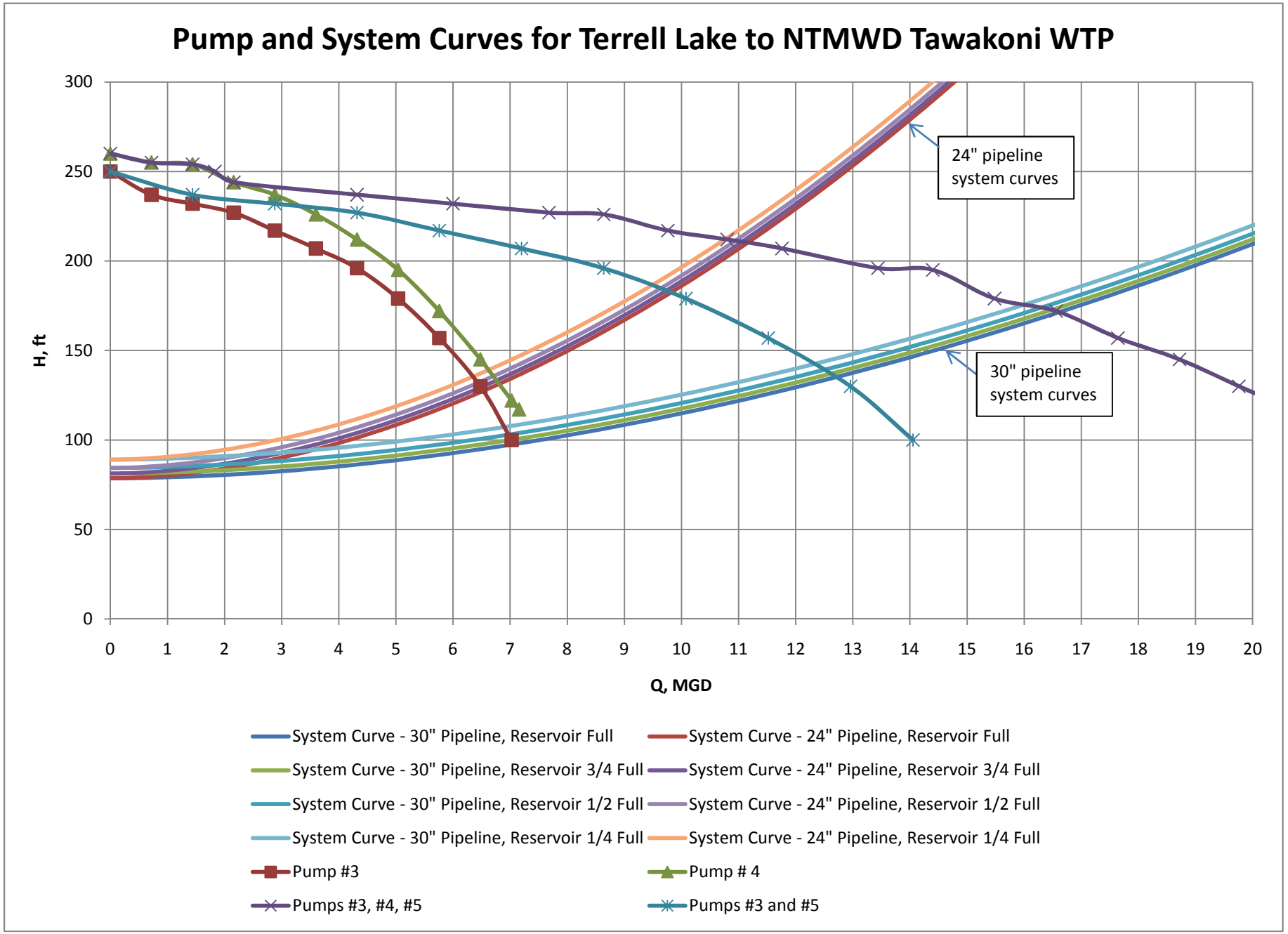


Figure 7

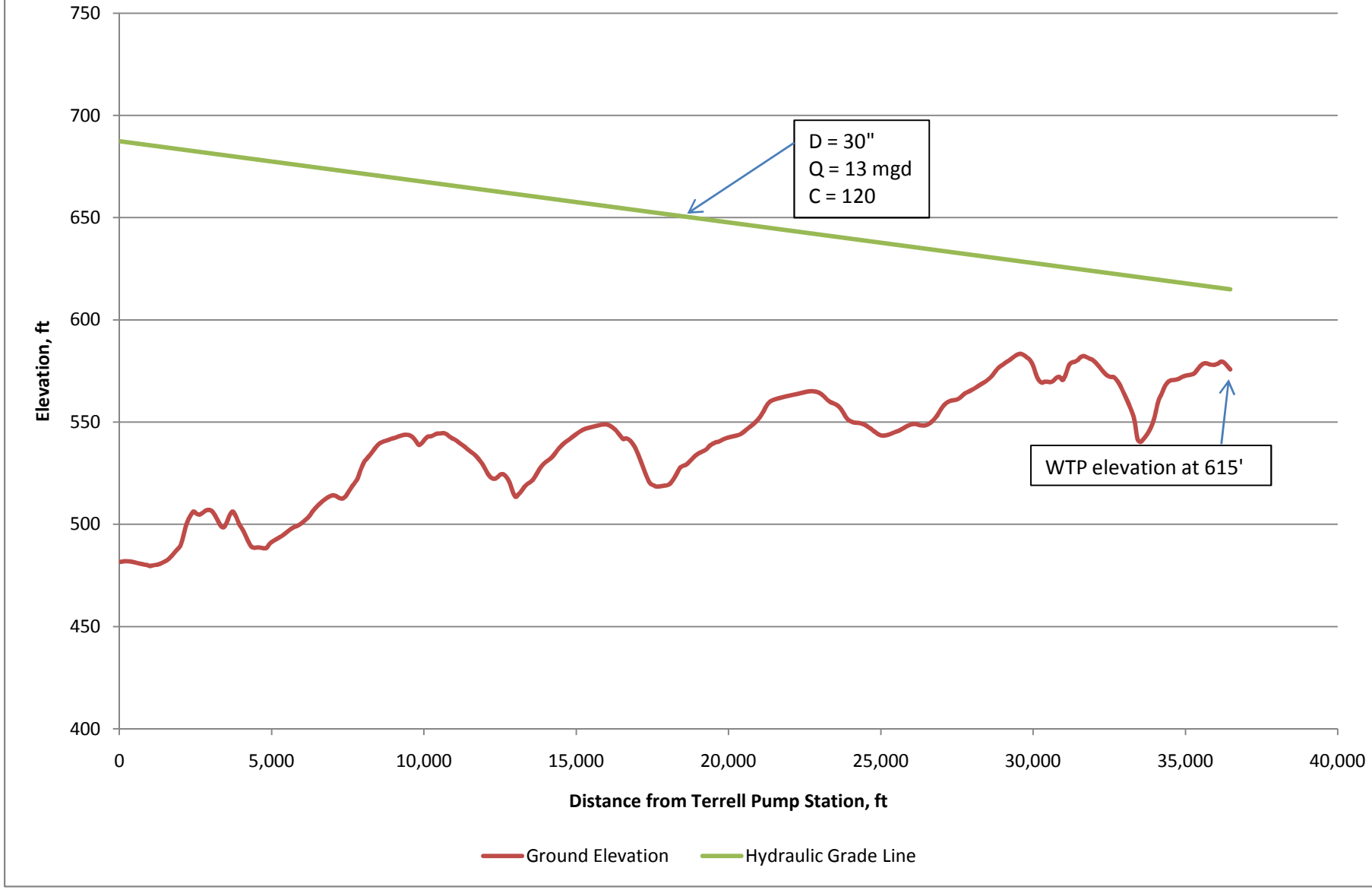


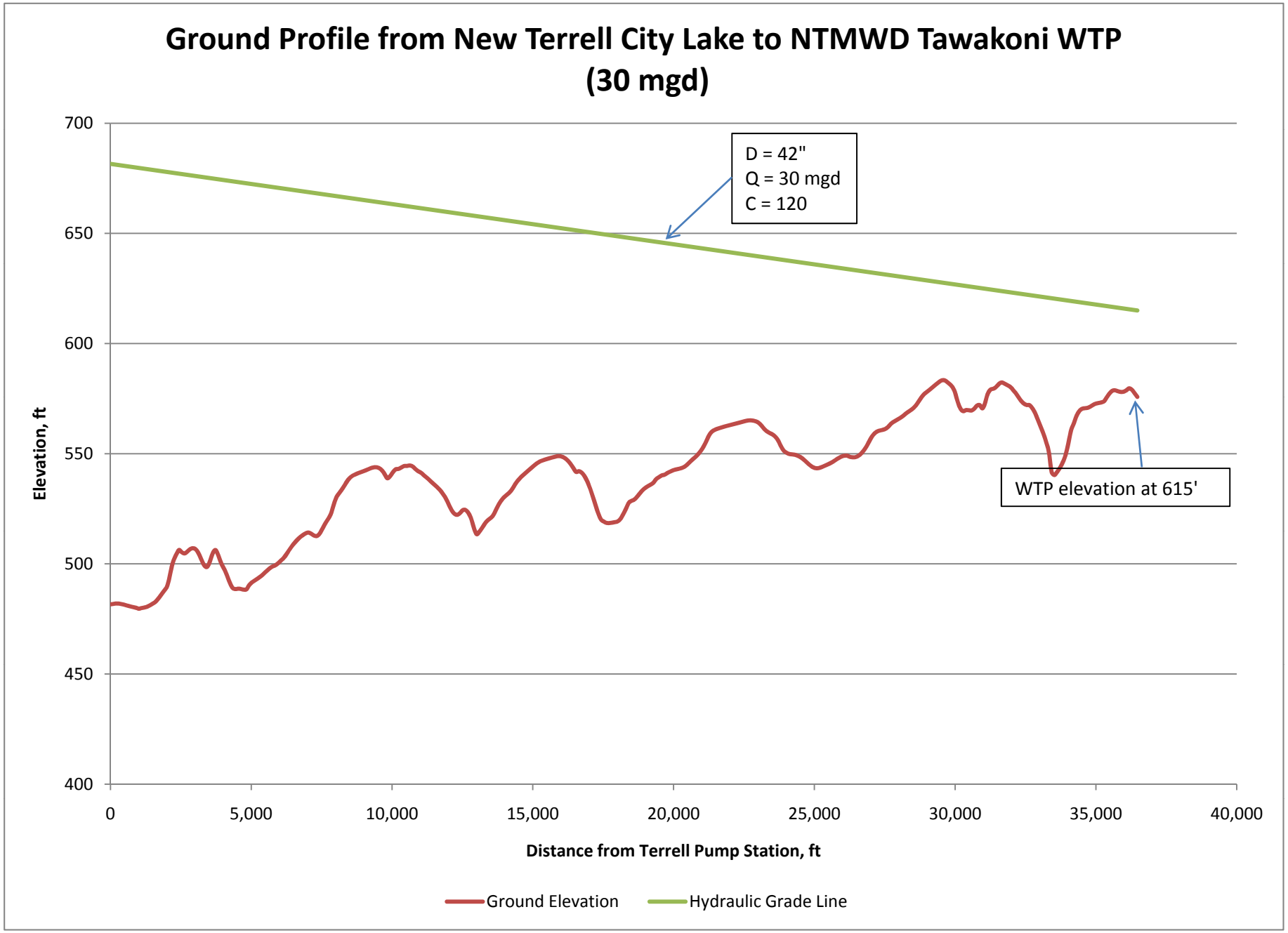
APPENDIX F
HYDRAULICS

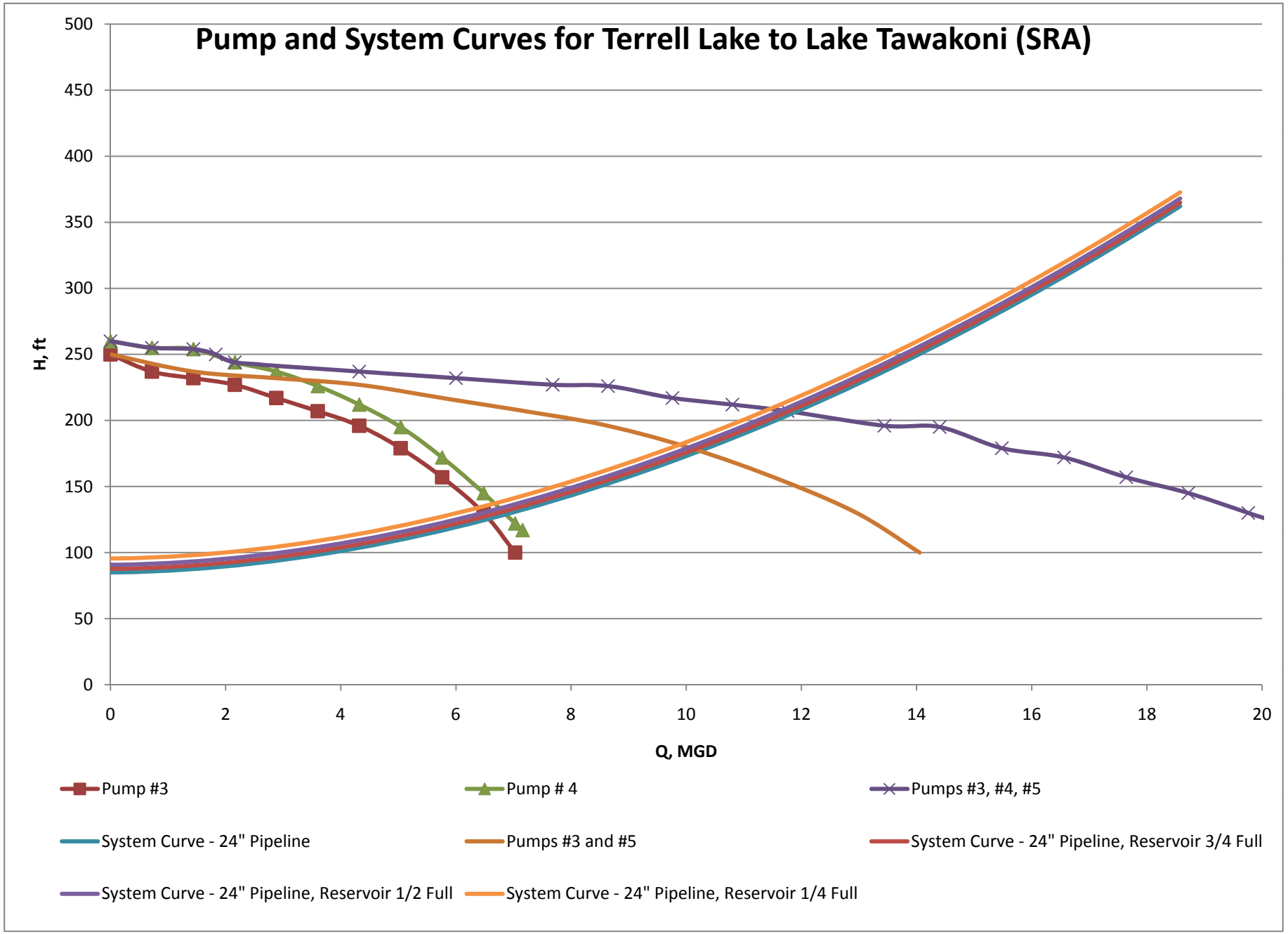

Pump and System Curves for Terrell Lake to NTMWD Tawakoni WTP
H, ft
Q, MGD
36" pipeline system curves
42" pipeline system curves
Pump #3
Pump # 4
Pumps #3, #4, #5
Pumps #3 and #5
Pumps #3, #3, #4, #5
System Curve - 42" Pipeline, Reservoir Full
System Curve - 36" Pipeline, Reservoir Full
System Curve - 42" Pipeline, Reservoir 3/4 Full
System Curve - 36" Pipeline, Reservoir 3/4 Full
System Curve - 42" Pipeline, Reservoir 1/2 Full
System Curve - 36" Pipeline, Reservoir 1/2 Full
System Curve - 42" Pipeline, Reservoir 1/4 Full
System Curve - 36" Pipeline, Reservoir 1/4 Full


Pump and System Curves for Terrell Lake to NTMWD Tawakoni WTP
H, ft
Q, MGD
24" pipeline system curves
30" pipeline system curves
System Curve - 30" Pipeline, Reservoir Full
System Curve - 24" Pipeline, Reservoir Full
System Curve - 30" Pipeline, Reservoir 3/4 Full
System Curve - 24" Pipeline, Reservoir 3/4 Full
System Curve - 30" Pipeline, Reservoir 1/2 Full
System Curve - 24" Pipeline, Reservoir 1/2 Full
System Curve - 30" Pipeline, Reservoir 1/4 Full
System Curve - 24" Pipeline, Reservoir 1/4 Full
Pump #3
Pump # 4
Pumps #3, #4, #5
Pumps #3 and #5

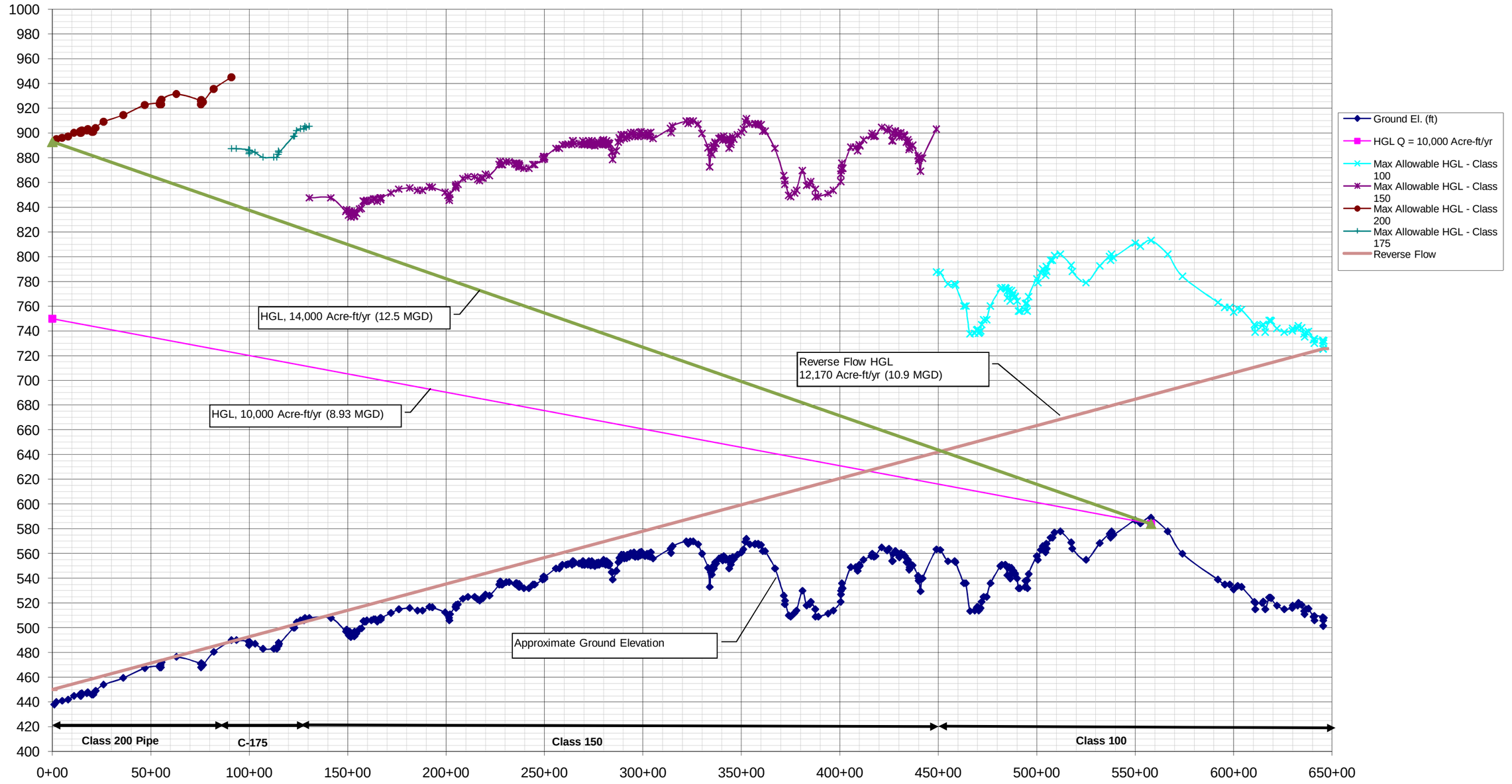
Ground Profile from New Terrell City Lake to NTMWD Tawakoni WTP (13 mgd)



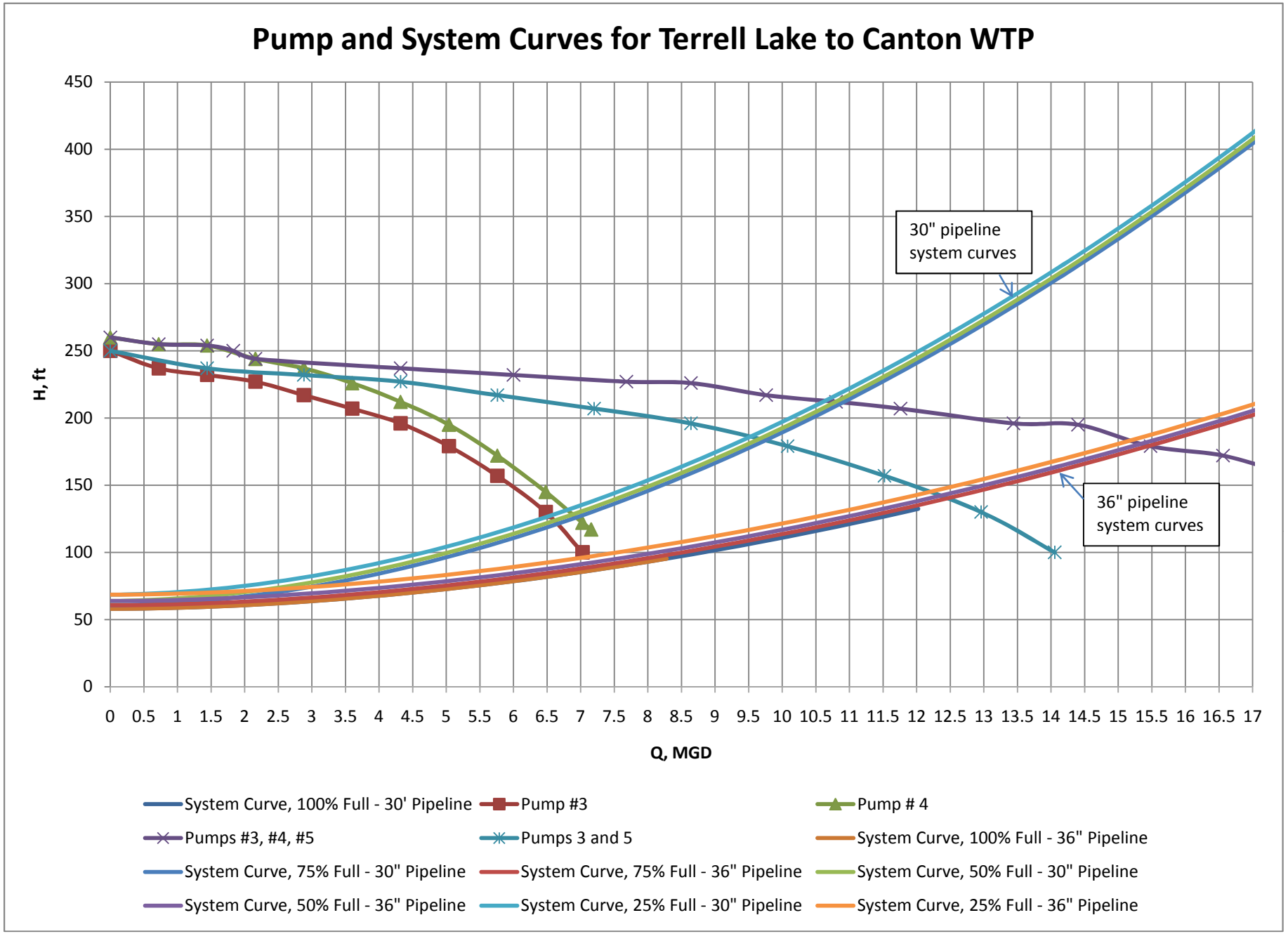

Ground Profile from New Terrell City Lake to NTMWD Tawakoni WTP
(30 mgd)
700
650
600
550
500
450
400
Elevation, ft
D = 42"
Q = 30 mgd
C = 120
WTP elevation at 615'
0
5,000
10,000
15,000
20,000
25,000
30,000
35,000
40,000
Distance from Terrell Pump Station, ft
Ground Elevation
Hydraulic Grade Line

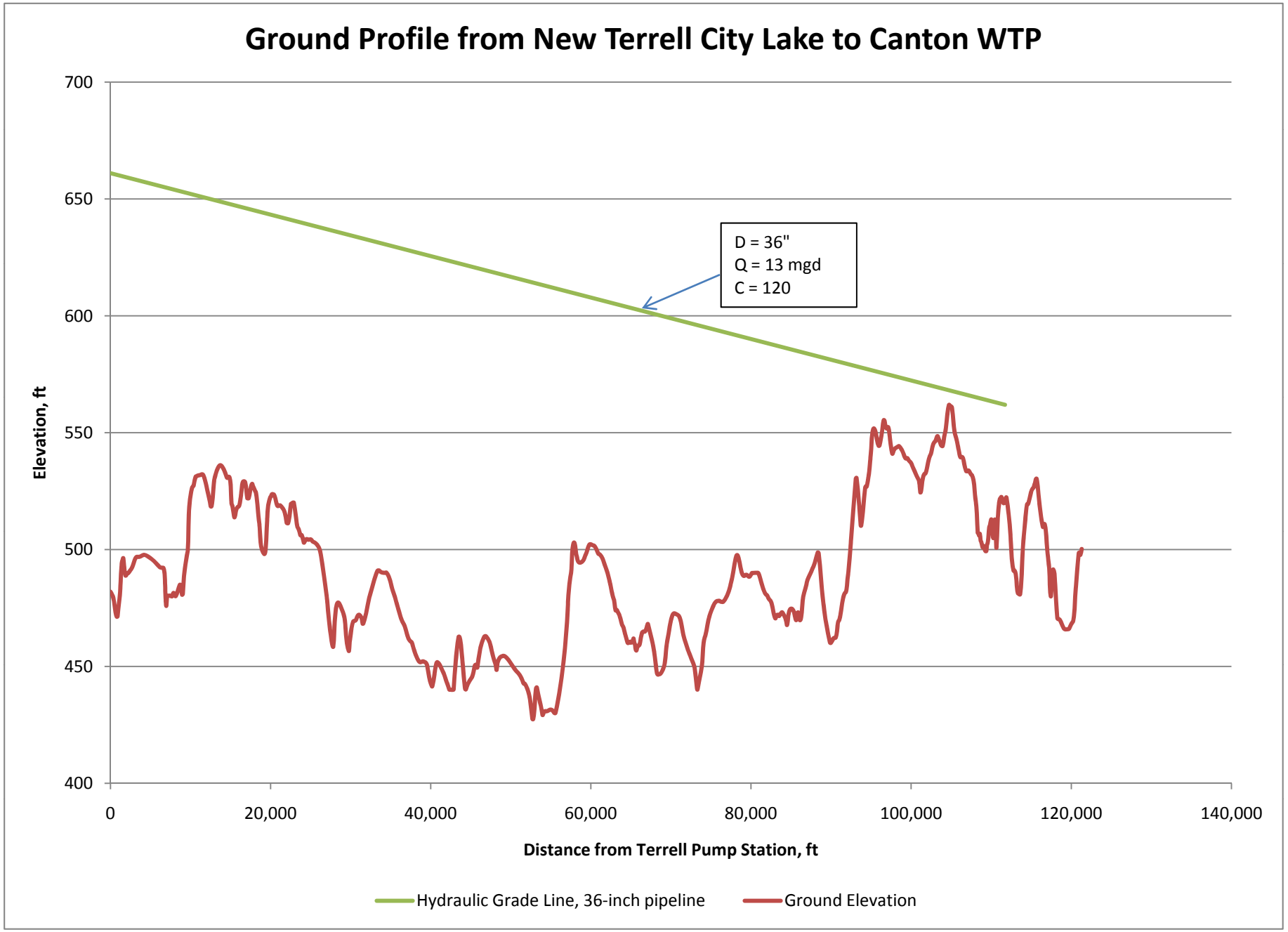

Pump and System Curves for Terrell Lake to Lake Tawakoni (SRA)
H, ft
500
450
400
350
300
250
200
150
100
50
0
0
2
4
6
8
10
12
14
16
18
20
Q, MGD
Pump #3
Pump # 4
Pumps #3, #4, #5
System Curve - 24" Pipeline
Pumps #3 and #5
System Curve - 24" Pipeline, Reservoir 3/4 Full
System Curve - 24" Pipeline, Reservoir 1/2 Full
System Curve - 24" Pipeline, Reservoir 1/4 Full

Profile - Lake Tawakoni to Terrell (with reverse flow from Terrell to Lake Tawakoni)



Profile - Lake Tawakoni to Terrell (DWU Option)


Pump and System Curves for Terrell Lake to Canton WTP
H, ft
Q, MGD
30" pipeline system curves
36" pipeline system curves
System Curve, 100% Full - 30' Pipeline
Pump #3
Pump # 4
Pumps #3, #4, #5
Pumps 3 and 5
System Curve, 100% Full - 36" Pipeline
System Curve, 75% Full - 30" Pipeline
System Curve, 75% Full - 36" Pipeline
System Curve, 50% Full - 30" Pipeline
System Curve, 50% Full - 36" Pipeline
System Curve, 25% Full - 30" Pipeline
System Curve, 25% Full - 36" Pipeline


Ground Profile from New Terrell City Lake to Canton WTP
700
650
600
550
500
450
400
Elevation, ft
D = 36"
Q = 13 mgd
C = 120
0
20,000
40,000
60,000
80,000
100,000
120,000
140,000
Distance from Terrell Pump Station, ft
Hydraulic Grade Line, 36-inch pipeline
Ground Elevation

APPENDIX G
MEMORANDUMS AND MEETING ITEMS FOR INTERTESED PARTIES

MEMORANDUM

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TO: **Gary Burton, III, P.E., Andy McCuistion**

CC: **Steve Rogers P.E. (City of Terrell), Sonny Groessel (City of Terrell)**

FROM: **Rachel Ickert, P.E. and Keeley Kirksey, EIT**

SUBJECT: **Terrell Water Supply Study**

DATE: **November 16, 2010**

The City of Terrell owns New Terrell City Lake and is interested in selling raw water from the lake. Terrell is potentially interested in selling some of the existing facilities associated with this supply. Texas Water Development Board (TWDB) funds have been obtained by Terrell to study potential uses of the New Terrell City Lake Supply.

The City of Terrell has a water right to divert 6,000 acre-feet per year (5.4 MGD) from the lake. The firm yield of the lake, as determined using the Texas Commission on Environmental Quality (TCEQ) Water Availability Model, is 2,400 acre-feet per year (2.1 MGD), and the average annual diversion available is 5,250 acre-feet per year (4.7 MGD).

It is our understanding that the City of Canton is potentially interested in purchasing water from New Terrell City Lake and treating the water at the City's Water Treatment Plant (WTP). Below is a summary of our findings regarding Canton's possible use of the New Terrell City Lake supply:

- A twenty-five-mile long, 36-inch pipeline is required to transport 13 mgd (peak) to the City of Canton WTP.
- The existing Terrell pumps could be used to transport water from New Terrell City Lake to the WTP.

To obtain 13 mgd the water right will need to be amended. The current maximum diversion rate, as listed in the water right, is 6.5 mgd.

Attached are conceptual cost estimates for the construction costs and the cost of purchasing the existing facilities from Terrell for the above-mentioned alternative. A schematic map is also included.

The costs of the existing pumps were calculated by determining the current cost of a new similar pump and using a straight line depreciation to determine the current value. This calculation assumed the useful life of the pumps is 20 years. Based on this assumption, Pumps 2 and 4 have no current value, but a salvage value of $1,000 was assigned to both pumps. All of the pumps are located in the same building, and costs assume that in agreeing to purchase one of the pumps, the buyer agrees to purchase all five pumps and the building they are housed in.

The original building Pumps 1 and 2 are housed in and the intake structure were constructed in 1960. The pump station building was expanded in the 1970's to add three new pumps. The current value of the intake was

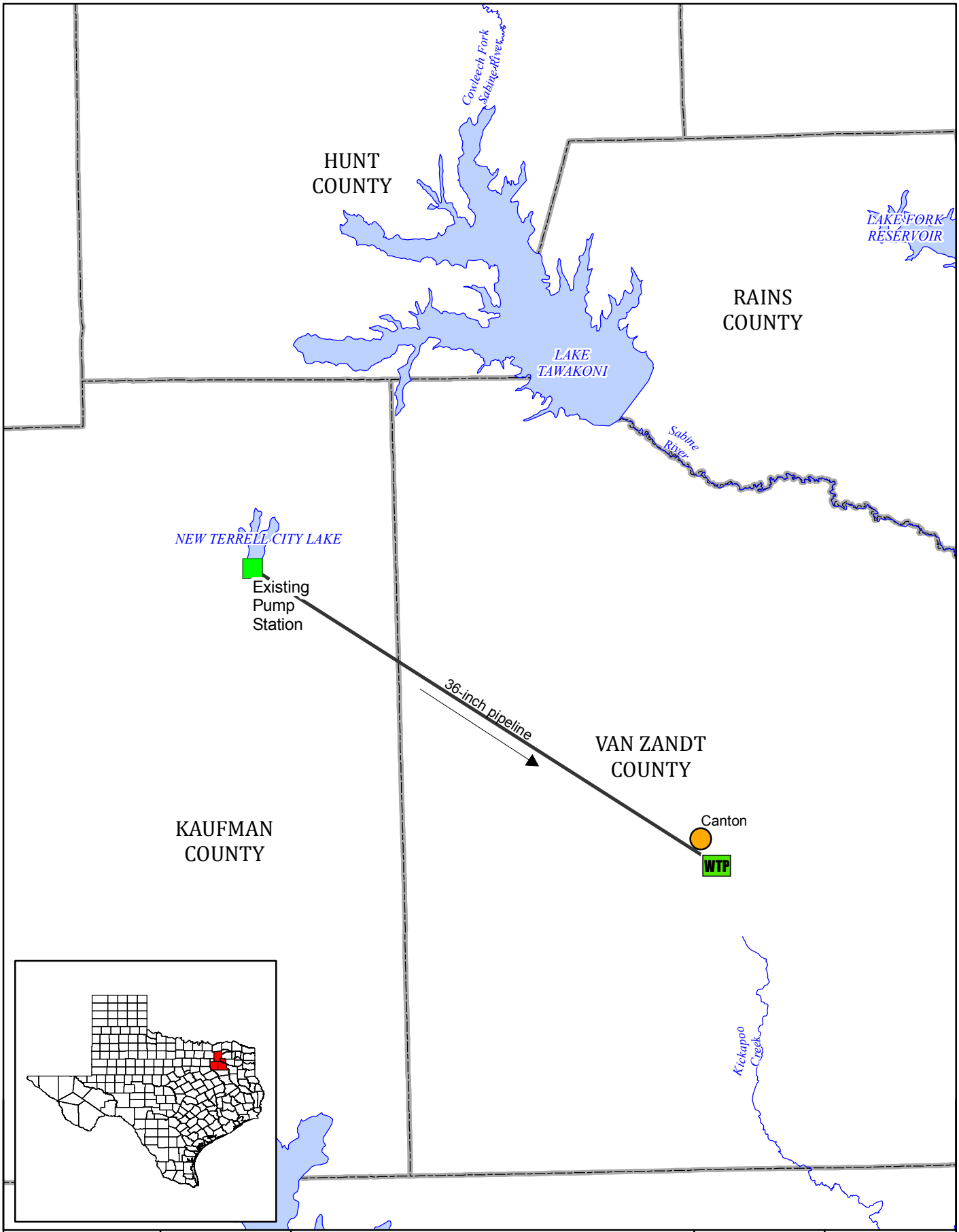
calculated by depreciating the cost of a new intake structure of the same size. The pipeline from the existing intake to the pump station is a 30-inch line.

New electrical and chemical buildings were added onto the original pump station building in 2001. Pump 5 and a Variable Frequency Drive (VFD) were also installed at this time. The current value of the original building and the portion of the building added in the 1970's was calculated by determining the current cost of construction of a pump station and using straight line depreciation based on the age of the buildings. The current value of the new electrical and chemical buildings was determined based on the construction contract amount provided by the City of Terrell and the same straight line depreciation method used to determine the other current costs. The useful life of the buildings was assumed to be 50 years. "Current cost" refers to the cost in January 2009 dollars. Costs were determined in January 2009 dollars to be consistent with the costs presented in the *2011 Region C Water Plan*. The table below displays the project costs for water supply to Canton.

Alternative	Supply (peak, mgd)	Cost of New Construction	Cost of Existing Facilities	Unit Costs (per 1,000 gallons)			
				Average Annual Yield		Firm Yield	
				Pre-Amortization	Post-Amortization	Pre-Amortization	Post-Amortization
Supply from New Terrell City Lake to Canton's WTP	12.96	$35,745,000	$1,150,000	$2.33	$0.77	$4.52	$1.09

The cost of raw water at New Terrell City Lake was assumed to be $0.45 per thousand gallons.

Another option that is open for consideration includes purchasing the dam, water rights, and all associated existing facilities at New Terrell City Lake.



FN PROJECT NO.	TER10197
FILE NAME	Canton_final.mxd
DATUM & COORDINATE SYSTEM	NAD83 STATE PLANE TX NORTH CENTRAL (FT)
DATE CREATED	SEPTEMBER 2010
PREPARED BY	KEK

FREESE NICHOLS
4055 International Plaza, Suite 200
Fort Worth, TX 76109-4895
817-735-7300

0 15,000 30,000 60,000 Feet

N

Terrell Water Supply Study

Water Supply to Canton

FIGURE 1

City of Canton - Supply from Terrell Lake to Canton's WTP

Terrell Water Supply Facility Planning

Conceptual Cost Estimate for Supply from Terrell Lake to Canton's WTP

13 mgd (peak)

ACCOUNT NO.	ESTIMATOR	CHECKED	DATE
TER10197	KEK	RAI, SFK	August 4, 2010

ITEM	DESCRIPTION	QNTY	UNIT	UNIT PRICE	TOTAL
COST FOR TRANSMISSION FACILITY CONSTRUCTION					
	PIPELINES				
	36-inch Pipeline from Lake Terrell to Canton's WTP	133,442	LF	$184	$24,530,000
	Right of Way Easements (ROW)	133,442	LF	$11.50	$1,535,000
	Engineering and Contingencies (30%)				$7,359,000
	Permitting and Mitigation				$245,000
	Total of Pipeline				**$33,669,000**
	CONSTRUCTION TOTAL				**$33,669,000**
	Interest During Construction (18 months)				$2,076,000
	TOTAL COST				**$35,745,000**
COST FOR PURCHASING EXISTING TRANSMISSION FACILITIES					
	PUMP STATIONS (Depreciated Costs)				
	Pump #1	1	LS	$17,446	$17,446
	Pump #2	1	LS	$1,000	$1,000
	Pump #3	1	LS	$19,825	$19,825
	Pump #4	1	LS	$1,000	$1,000
	Pump #5 & VFD	1	LS	$79,414	$79,414
	Pump Building	1	LS	$861,222	$861,222
	Pump Intake	1	LS	$170,400	$170,400
	Total of Pump Stations				**$1,150,000**
	TOTAL PROJECT COST				**$36,895,000**
ANNUAL COSTS (5,250 AC-FT/YR)					
	Debt Service (6% for 30 years)				$2,680,000
	Debt Service for Replacement of pumps (6% for 15 years)				$44,000
	Electricity ($0.09 kWh)				$67,000
	Raw Water Cost ($0.45/1,000 gal)				$770,000
	Operation & Maintenance				$433,000
	Total Annual Costs				**$3,994,000**
ANNUAL COSTS (2,400 AC-FT/YR)					
	Debt Service (6% for 30 years)				$2,680,000
	Debt Service for Replacement of pumps (6% for 15 years)				$44,000
	Electricity ($0.09 kWh)				$27,000
	Raw Water Cost ($0.45/1,000 gal)				$352,000
	Operation & Maintenance				$433,000
	Total Annual Costs				**$3,536,000**
UNIT COSTS FOR AVERAGE ANNUAL SUPPLY (5,250 AC-FT/YR)					
	UNIT COSTS (Pre Amort.)				
	Per MGD				$852,814
	Per Acre-Foot				$761
	Per 1,000 Gallons				$2.33
	UNIT COSTS (Post Amort.)				
	Per MGD				$280,570
	Per Acre-Foot				$250
	Per 1,000 Gallons				$0.77
UNIT COSTS FOR FIRM YIELD SUPPLY (2,400 AC-FT/YR)					
	UNIT COSTS (Pre Amort.)				
	Per MGD				$1,651,607
	Per Acre-Foot				$1,473
	Per 1,000 Gallons				$4.52
	UNIT COSTS (Post Amort.)				
	Per MGD				$399,823
	Per Acre-Foot				$357
	Per 1,000 Gallons				$1.09

MEETING AGENDA

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MEETING: Raw Water Supply – New Terrell City Lake
DATE: February 1, 2011
LOCATION: Terrell
TIME: 1:30pm

PURPOSE

The overall objective of the meeting should be clear and noted on the agenda.

AGENDA

The agenda should include what is to be covered, who is responsible and how long each item will require.

CODE OF CONDUCT

Meeting participants should respect each other by honoring the Code of Conduct.

EXPECTATIONS

The expectations of the participants should be discussed, noted and reviewed for closure.

ROLES

The roles of leader, scribe, minute taker, time keeper and facilitator should be clarified at the beginning of the meeting.

AGENDA

TOPIC

1. Background and Purpose of the Study
2. New Terrell City Lake Water Availability
3. Results of Study – Canton Alternatives
4. Discussion
5. Follow-up and Action Items

CODE OF CONDUCT

1. Publish an agenda and maintain minutes.
2. Challenge ideas and processes, not people.
3. Share responsibility and ownership.
4. Maintain an open, honest environment.
5. Question and participate.
6. Listen constructively.
7. Begin and end on time unless participants agree to an extension.
8. Come prepared and with action items completed.
9. Base decisions on factual data.
10. Keep confidences.

MEETING MINUTES

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PROJECT: Water Supply Facility Planning – New Terrell City Lake
NAME OF MEETING: Meeting with the City of Canton
RECORDED BY: Keeley Kirksey
DATE: February 8, 2011
LOCATION: Terrell Offices
ATTENDEES:

Name	Company
Steve Rogers	City of Terrell
Sonny Groessel	City of Terrell
Mike Sims	City of Terrell
Gary Burton	Gary Burton Engineering
Andy McCuistion	City of Canton
Rachel Ickert	Freese and Nichols
Keeley Kirksey	Freese and Nichols

The following reflects our understanding of the items discussed during the subject meeting. If you do not notify us within five working days, we will assume that you are in agreement with our understanding.

ITEM	DESCRIPTION
1	Background and Purpose of the Study • Steve Rogers started the meeting by discussing the status and purpose of the study. The study is partially funded by a TWDB grant, and the purpose is to determine how much water is available in New Terrell City Lake, who can use the water, and how much it will cost.
2	New Terrell City Lake Water Availability • Rachel Ickert presented information on the New Terrell City Lake water availability analysis. The results have been summarized in a memorandum (attached) that was distributed at the meeting.
3	Results of the Study – Canton Alternatives • Rachel Ickert presented the results as summarized in the memorandum to Canton dated November 16, 2010 (attached). Gary Burton mentioned the pipeline to Canton's WTP may be sized for more water than Canton needs and that a 24-inch pipeline would be sufficient. Steve Rogers explained that the current study is looking at the maximum amount of water available for purchase from New Terrell City Lake.
4	Discussion • Gary Burton said Canton's City Council has been investigating new water supplies for three years. Canton conducted a study to assess various options including purchasing treated water from Tyler, building a reservoir, or purchasing water from the DWU/TRWD Integrated Pipeline (IPL). When the study was performed the assumed alignment of the IPL was closer to Canton than the current alignment; therefore, the costs presented in that study are lower than they would be with the current IPL alignment. The study found

ITEM	DESCRIPTION
	building a reservoir to be the most cost effective option. • Canton's City Council has asked Gary Burton and Andy McCuistion to look into the Terrell water supply. • Canton's current supply consists of Lake Canton and 2 wells. A 3rd well is in the process of being drilled. Groundwater is not a long-term supply for Canton because of the quality and limited amount of supply. • Canton also has a permit pending for reuse supplies. • Mike Sims asked if Canton's City Council has a time horizon for a new water supply alternative. Gary Burton replied that there is no time horizon. They are still in the process of investigating options. • Canton serves about 200 customers outside of the city and has approximately 400,000 visitors that come to Canton for 1st Monday Trade Days. Canton's current population is approximately 5,000. • The 2060 projected population for Canton is 35,000 with an annual average demand of 5.78 mgd and a maximum month demand of 7.23 mgd. • Gary Burton asked if Terrell was using the pipeline between Lake Tawakoni and New Terrell City Lake. Steve Rogers explained that the pipeline from Lake Tawakoni was not in use and that NTMWD took over Terrell's intake and pump station at Lake Tawakoni when Terrell became a NTMWD treated water customer. • Gary Burton inquired about the cost of raw water presented in the cost estimates ($0.45/1,000 gallons). Steve Rogers replied that it is a starting point and is negotiable. • In Canton's study to look at water supply alternatives, the cost of water from Lake Palestine was approximately $0.33/1,000 gallons. • Gary Burton asked if Terrell was going to keep the water right for New Terrell City Lake. Steve Rogers explained that that is Terrell's plan but is negotiable. If Terrell retains their water right they also have to maintain the dam.

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TO: **Denis Qualls, P.E.**

CC: **Steve Rogers P.E. (City of Terrell), Sonny Groessel (City of Terrell)**

FROM: **Rachel Ickert, P.E. and Keeley Kirksey, EIT**

SUBJECT: **Terrell Water Supply Study**

DATE: **November 16, 2010**

The City of Terrell owns New Terrell City Lake and is interested in selling raw water from the lake. Terrell is potentially interested in selling some of the existing facilities associated with this supply. Texas Water Development Board (TWDB) funds have been obtained by Terrell to study potential uses of the New Terrell City Lake Supply.

The City of Terrell has a water right to divert 6,000 acre-feet per year (5.4 MGD) from the lake. The firm yield of the lake, as determined using the Texas Commission on Environmental Quality (TCEQ) Water Availability Model, is 2,400 acre-feet per year (2.1 MGD), and the average annual diversion available is 5,250 acre-feet per year (4.7 MGD).

It is our understanding that DWU is potentially interested in purchasing water from New Terrell City Lake and/or using the lake as a pass through from Lake Tawakoni to Cedar Creek Lake. Below is a summary of our findings regarding DWU's possible use of the New Terrell City Lake supply:

<u>Pass-through using no New Terrell City Lake Water (Option 1)</u>

- The existing 24-inch pipeline from Lake Tawakoni to New Terrell City Lake can transport 12.5 mgd.
- A 66-inch pipeline could replace the existing 24-inch pipeline, in the existing 30-foot right of way, to transport 72 mgd (peak).
- The existing outlet structure capacity at New Terrell City Lake is 72 mgd and is controlled by the 30-inch concrete culvert that runs under the dam.
- A new 4,100 HP intake pump station would be required at Lake Tawakoni.
- No pumps would be required at New Terrell City Lake. The water would be released from the lake into the existing Cedar Creek channel which would require a bed and banks permit.
- Annual and unit costs were calculated for the transport of 72 mgd and 50 mgd from Lake Tawakoni to New Terrell City Lake.

<u>Pass-through with purchase of New Terrell City Lake Water (Option 2)</u>

- On average, 4.7 mgd could be obtained from New Terrell City Lake. If discharging 72 mgd through the New Terrell City Lake outlet structure, an average of 4.7 mgd could be from New Terrell City Lake, and the remaining water would be transported from Lake Tawakoni (67.3 mgd, for a total out of New Terrell City Lake of 72 mgd).
- A 66-inch pipeline could replace the existing 24-inch pipeline, in the existing 30-foot right of way, to transport 67 mgd.

- A new 3,700 HP intake pump station would be required at Lake Tawakoni to transport 67.3 mgd to New Terrell City Lake.
- The electricity calculations were based on transporting 50 mgd from Lake Tawakoni.
- The cost of raw water at New Terrell City Lake was assumed to be $0.45 per thousand gallons.

Significant permitting will be required to construct a new intake structure at Lake Tawakoni. Because of this, the permitting and mitigation for the new intake pump station was estimated at 5 percent.

Attached are conceptual cost estimates for the construction costs and the cost of purchasing the existing facilities from Terrell for each of the above-mentioned alternatives. A schematic map is also included.

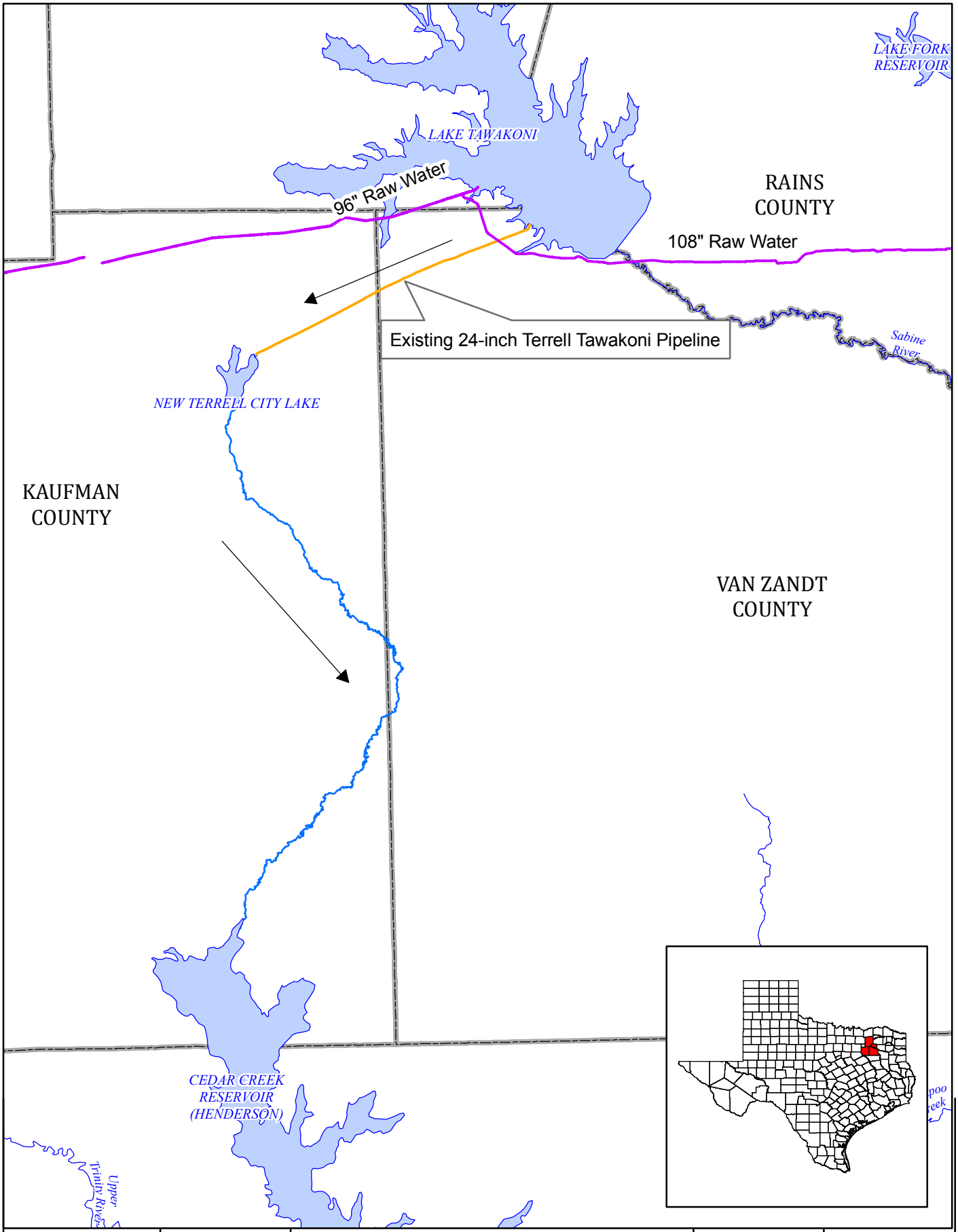
The outlet structure at New Terrell City Lake was constructed in 1960. The current value of the outlet was calculated by depreciating the cost of a new outlet structure of the same size. "Current value" refers to the cost in January 2009 dollars. Costs were determined in January 2009 dollars to be consistent with the costs presented in the *2011 Region C Water Plan*. It should be noted that the condition of the outlet structure is unknown. Additionally, it is unknown as to whether the downstream channel can handle a peak flow of 72 mgd. The assessment of the outlet structure and the downstream channel was beyond the scope of this project, and it is assumed that both are capable of handling peak flows of 72 mgd.

The table below displays the project costs for each of the above-mentioned supply options.

Alternative	Supply (peak, mgd)	Cost of New Construction	Cost of Existing Facilities	Unit Costs (per 1,000 gallons)	
				Pre-Amortization	Post-Amortization
Option 1	72	$51,809,100	$2,292,593	$0.37*	$0.11*
Option 2	72	$50,995,200	$2,292,593	$0.37	$0.14

*Unit costs are based on an average annual supply of 50 mgd from Lake Tawakoni.

Another option that is open for consideration includes purchasing the dam, water rights, and all associated existing facilities at New Terrell City Lake.



FN PROJECT NO.	TER10197
FILE NAME	DWU_final.mxd
DATUM & COORDINATE SYSTEM	NAD83 STATE PLANE TX NORTH CENTRAL (FT)
DATE CREATED	SEPTEMBER 2010
PREPARED BY	KEK

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N

Terrell Water Supply Study

Water Supply for DWU

FIGURE 1

Dallas Water Utilities - Supply from Lake Tawakoni to New Terrell City Lake

Terrell Water Supply Facility Planning

Conceptual Cost Estimate for Pass Through Option Using Terrell Lake (Option 1)

72 mgd (peak)

ACCOUNT NO.	ESTIMATOR	CHECKED	DATE
TER10197	KEK	RAI, SFK	August 4, 2010

ITEM	DESCRIPTION	QNTY	UNIT	UNIT PRICE	TOTAL
	PUMP STATIONS				
	4100 HP Intake Pump Station at Lake Tawakoni	1	LS	$8,225,600	$8,225,600
	Engineering and Contingencies (35%)				$2,879,000
	Permitting and Mitigation				$411,000
	Total of Intake Pump Structure				**$11,515,600**
	PIPELINES				
	66-inch Pipeline in Existing Right of Way (to replace existing 24-inch pipeline)	64,575	LF	$441	$28,461,000
	Engineering and Contingencies (30%)				$8,538,000
	Permitting and Mitigation				$285,000
	Total of Parallel Pipeline				**$37,284,000**
	CONSTRUCTION TOTAL				**$48,799,600**
	Interest During Construction (18 months)				$3,009,500
	TOTAL COST				**$51,809,100**
COST FOR PURCHASING EXISTING TRANSMISSION FACILITIES/RIGHT OF WAY AND OUTLET STRUCTURE					
	PIPELINES (Depreciated Costs)				
	24" Pipeline to New Terrell City Lake	64,575	LF	$27.86	$1,799,318
	Right of Way	64,575	LF	$5.00	$322,875
	Total of Pipeline				**$2,122,193**
	OUTLET STRUCTURE				
	Existing Outlet Structure at New Terrell City Lake	1	LS	$170,400	$170,400
	Total of Outlet Structure				**$170,400**
	EXISTING FACILITIES TOTAL				**$2,292,593**
	TOTAL PROJECT COST				**$54,101,693**
ANNUAL COSTS (72 MGD)					
	Debt Service (6% for 30 years)				$3,930,000
	Debt Service for Replacement of pumps (6% for 15 years)				$681,000
	Electricity ($0.09 kWh)				$2,405,000
	Operation & Maintenance				$611,000
	Total Annual Costs				**$7,627,000**
ANNUAL COSTS (50 MGD)					
	Debt Service (6% for 30 years)				$3,930,000
	Debt Service for Replacement of pumps (6% for 15 years)				$681,000
	Electricity ($0.09 kWh)				$1,446,000
	Operation & Maintenance				$611,000
	Total Annual Costs				**$6,668,000**
UNIT COSTS FOR SUPPLY OF 72 MGD					
	UNIT COSTS (Pre Amort.)				
	Per MGD				$105,931
	Per Acre-Foot				$94
	Per 1,000 Gallons				$0.29
	UNIT COSTS (Post Amort.)				
	Per MGD				$41,889
	Per Acre-Foot				$37
	Per 1,000 Gallons				$0.11
UNIT COSTS FOR SUPPLY OF 50 MGD					
	UNIT COSTS (Pre Amort.)				
	Per MGD				$133,360
	Per Acre-Foot				$119
	Per 1,000 Gallons				$0.37
	UNIT COSTS (Post Amort.)				
	Per MGD				$41,140
	Per Acre-Foot				$37
	Per 1,000 Gallons				$0.11

Dallas Water Utilities - Supply from Lake Tawakoni to New Terrell City Lake

Terrell Water Supply Facility Planning

Conceptual Cost Estimate for Pass Through Option Using New Terrell City Lake Water (Option 2)

72 mgd (peak) from New Terrell City Lake - 67 MGD from Lake Tawakoni, 4.7 MGD from New Terrell City Lake

ACCOUNT NO.	ESTIMATOR	CHECKED	DATE
TER10197	KEK	RAI, SFK	August 4, 2010

ITEM	DESCRIPTION	QNTY	UNIT	UNIT PRICE	TOTAL
	PUMP STATIONS				
	3700 HP Intake Pump Station at Lake Tawakoni	1	LS	$7,678,000	$7,678,000
	Engineering and Contingencies (35%)				$2,687,000
	Permitting and Mitigation				$384,000
	Total of Intake Pump Structure				**$10,749,000**
	PIPELINES				
	66-inch Pipeline in Existing Right of Way (to replace existing 24-inch pipeline)	64,575	LF	$441	$28,461,000
	Engineering and Contingencies (30%)				$8,538,000
	Permitting and Mitigation				$285,000
	Total of Parallel Pipeline				**$37,284,000**
	CONSTRUCTION TOTAL				**$48,033,000**
	Interest During Construction (18 months)				$2,962,200
	TOTAL COST				**$50,995,200**
COST FOR PURCHASING EXISTING TRANSMISSION FACILITIES/RIGHT OF WAY					
	PIPELINES (Depreciated Costs)				
	24" Pipeline to New Terrell City Lake	64,575	LF	$27.86	$1,799,318
	Right of Way	64,575	LF	$5.00	$322,875
	Total of Pipeline				**$2,122,193**
	OUTLET STRUCTURE				
	Exiting Outlet Structure at New Terrell City Lake	1	LS	$170,400	$170,400
	Total of Outlet Structure				**$170,400**
	EXISTING FACILITIES TOTAL				**$2,292,593**
	TOTAL PROJECT COST				**$53,287,793**
ANNUAL COSTS (4.7 MGD from Terrell)					
	Debt Service (6% for 30 years)				$3,871,000
	Debt Service for Replacement of pumps (6% for 15 years)				$700,000
	Electricity ($0.09 kWh) (calculated based on 50 mgd from Lake Tawakoni)				$1,446,000
	Raw Water Cost ($0.45/1,000 gal)				$770,000
	Operation & Maintenance				$594,000
	Total Annual Costs				**$7,381,000**
ANNUAL COSTS (2.1 MGD from Terrell)					
	Debt Service (6% for 30 years)				$3,871,000
	Debt Service for Replacement of pumps (6% for 15 years)				$700,000
	Electricity ($0.09 kWh) (calculated based on 50 mgd from Lake Tawakoni)				$1,446,000
	Raw Water Cost ($0.45/1,000 gal)				$352,000
	Operation & Maintenance				$594,000
	Total Annual Costs				**$6,963,000**
UNIT COSTS FOR AVERAGE ANNUAL SUPPLY (4.7 MGD) + SUPPLY FROM LAKE TAWAKONI (67.3 MGD)					
	UNIT COSTS (Pre Amort.)				
	Per MGD				$134,977
	Per Acre-Foot				$120
	Per 1,000 Gallons				$0.37
	UNIT COSTS (Post Amort.)				
	Per MGD				$51,387
	Per Acre-Foot				$46
	Per 1,000 Gallons				$0.14
UNIT COSTS FOR FIRM YIELD SUPPLY (2.1 MGD) + SUPPLY FROM LAKE TAWAKONI (67.3 MGD)					
	UNIT COSTS (Pre Amort.)				
	Per MGD				$133,542
	Per Acre-Foot				$119
	Per 1,000 Gallons				$0.37
	UNIT COSTS (Post Amort.)				
	Per MGD				$53,892
	Per Acre-Foot				$48
	Per 1,000 Gallons				$0.15

MEETING AGENDA

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MEETING: Raw Water Supply – New Terrell City Lake
DATE: February 17, 2011
LOCATION: Terrell
TIME: 9:30am

PURPOSE

The overall objective of the meeting should be clear and noted on the agenda.

AGENDA

The agenda should include what is to be covered, who is responsible and how long each item will require.

CODE OF CONDUCT

Meeting participants should respect each other by honoring the Code of Conduct.

EXPECTATIONS

The expectations of the participants should be discussed, noted and reviewed for closure.

ROLES

The roles of leader, scribe, minute taker, time keeper and facilitator should be clarified at the beginning of the meeting.

AGENDA

TOPIC

1. Background and Purpose of the Study
2. New Terrell City Lake Water Availability
3. Results of Study – DWU Alternatives
4. Discussion
5. Follow-up and Action Items

CODE OF CONDUCT

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PROJECT: Water Supply Facility Planning – New Terrell City Lake
NAME OF MEETING: Meeting with Dallas Water Utilities (DWU)
RECORDED BY: Keeley Kirksey
DATE: February 17, 2011
LOCATION: City of Terrell Offices
ATTENDEES:

Name	Company
Steve Rogers	City of Terrell
Sonny Groessel	City of Terrell
Mike Simms	City of Terrell
Denis Qualls	Dallas Water Utilities
Varghese Abraham	Dallas Water Utilities
Rachel Ickert	Freese and Nichols
Keeley Kirksey	Freese and Nichols

The following reflects our understanding of the items discussed during the subject meeting. If you do not notify us within five working days, we will assume that you are in agreement with our understanding.

ITEM	DESCRIPTION
1	Background and Purpose of the Study • Steve Rogers started the meeting by discussing the status and purpose of the study. The study is partially funded by a TWDB grant, and the purpose is to determine how much water is available in New Terrell City Lake, who can use the water, and how much it will cost. Another aspect of the study is a dam condition assessment.
2	New Terrell City Lake Water Availability • Rachel Ickert presented information on the New Terrell City Lake water availability analysis. The results have been summarized in a memorandum (attached) that was distributed at the meeting.
3	Discussion • Denis Qualls commented that DWU is interested in the Terrell supply because it can help them move water from the eastern portion of their service region to the western side and may allow DWU to delay a portion of the Integrated Pipeline (IPL). Using the Terrell pass-through option, some of DWU's East Texas water sources could be operated in conjunction with the Joe Pool supply. The pass-through option would allow for more operational flexibility and would allow DWU to move water around and possibly delay other construction projects. • Denis plans to discuss DWU's long-range water supply plan with Tom Gooch, and Denis would like to further explore the Terrell supply in DWU's plan. • Denis said he would be interested in seeing the costs of purchasing the New Terrell City Lake dam and water right in relation to the costs presented to DWU for Options 1 and 2 of the study.

ITEM	DESCRIPTION
	• Denis noted that a study of the downstream channel is needed to determine water losses and if the channel can handle flows of 72 mgd. A study is also needed to assess potential water losses from the end of the Tawakoni pipeline to New Terrell City Lake. • Denis asked if the options presented in the report for SRA, NTMWD, Canton and DWU were mutually exclusive. Steve and Rachel explained that multiple options can be pursued if DWU decides to only use the lake as a pass-through. (i.e. NTMWD could use the Terrell supply at their Tawakoni WTP, and Canton could transmit the water to their WTP. Denis mentioned that DWU could move water through Terrell Lake, and SRA and DWU could work out an accounting system for SRA to use the "Terrell" supply at Lake Tawakoni.) • Steve commented that his initial inclination was to sell Terrell Lake water for an annual revenue stream, but now believes selling the dam and water right could also be an option for consideration. • Denis commented that DWU is interested in the Terrell supply, but there are a lot of unknowns at this point. Steve replied that the goal of this study is to provide enough background for interested parties to decide if it is worthwhile for them to perform their own feasibility studies regarding New Terrell City Lake. • Denis commented that the real value for DWU is the right of way for the pipeline from Lake Tawakoni. • Denis asked about Terrell's existing intake at Lake Tawakoni. Steve explained that NTMWD took over that intake when Terrell became a customer of NTMWD. Denis asked if the existing intake was expandable and if it is something they could team with NTMWD on, or if DWU would have to construct a new intake. Brian Coltharp (Freese and Nichols) will know the capacity of the intake and if it is expandable. • Denis asked about the condition of the existing pipeline from Lake Tawakoni to Terrell Lake, and Steve explained that the pipeline was disconnected from Lake Tawakoni when Terrell became a customer of NTMWD. The pipe has not been pressurized and checked since 2007. Steve mentioned that there are taps on the line, and people were told they could take water when there was water in the pipeline. Denis asked if that was part of the right of way agreement. Steve did not know, but it is something that would need to be investigated. • DWU asked about Terrell's land ownership around the lake, and Terrell presented a map showing the area Terrell owns (approx. 1,100 acres) and where they have flood easements. A handful of people live around the lake, but there are no agreements for water use or rights to use the lake. • Denis asked about the alternatives for the New Terrell City Lake Dam. Rachel indicated that overall, the dam is in good structural condition but needs some modifications to meet NRCS criteria and needs some O&M-type work (approximately $0.5 million worth). The costs of alternatives presented in the report range from $3-million to $5-million worth of work to meet NRCS criteria. • Denis is interested in seeing which of the options discussed in the report can be done together through water accounting or through partnerships. He thinks we should add a discussion on this to the report. • Steve Rogers closed the discussion by saying if DWU has additional questions, they can contact any of us at Terrell or FNI.

ACTION ITEMS			
WHAT	**WHO**	**WHEN**	**STATUS**
1. Find out capacity of NTMWD's intake on Lake Tawakoni and if it is expandable	FNI		
2.			
3.			
4.			
5.			

MEMORANDUM

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TO: **Jim Parks, Mike Rickman**

CC: **Steve Rogers P.E. (City of Terrell), Sonny Groessel (City of Terrell)**

FROM: **Rachel Ickert, P.E. and Keeley Kirksey, EIT**

SUBJECT: **Terrell Water Supply Study**

DATE: **November 3, 2010**

The City of Terrell owns New Terrell City Lake and is interested in selling raw water from the lake. Terrell is potentially interested in selling some of the existing facilities associated with this supply. Terrell has obtained Texas Water Development Board (TWDB) funds to study potential uses of the New Terrell City Lake Supply.

The City of Terrell has a water right to divert 6,000 acre-feet per year (5.4 MGD) from the lake. The firm yield of the lake, as determined using the Texas Commission on Environmental Quality (TCEQ) Water Availability Model, is 2,400 acre-feet per year (2.1 MGD), and the average annual diversion available is 5,250 acre-feet per year (4.7 MGD).

It is our understanding that NTMWD is potentially interested in purchasing water from New Terrell City Lake and treating the water at the Tawakoni Water Treatment Plant (WTP), either as a primary or backup supply. Below is a summary of our findings regarding possible NTMWD use of the New Terrell City Lake supply:

Primary Supply (Option 1)

- An eight-mile long, 30-inch pipeline is required to transport 13 mgd (peak) to the Tawakoni WTP.
- The existing Terrell pumps could be used to transport water from New Terrell City Lake to the Tawakoni WTP.

Backup Supply (Options 2 and 3)

- An eight-mile long, 42-inch pipeline is required to transport 30 mgd (peak) to the Tawakoni WTP.
- Two pump station configurations are possible.
    - A new 1,500 horsepower pump station and new intake structure could be constructed (Option 2), or
    - The existing intake structure and existing Pumps 3, 4, and 5 could be used with two additional pumps of a similar size. Using the existing pumps and expanding the pump station to include two new pumps would also require new yard piping and pump station piping (Option 3).

To obtain 13 mgd or 30 mgd, as discussed above, the water right will need to be amended. The current maximum diversion rate, as listed in the water right, is 6.5 mgd.

For Option 2, significant permitting will be required to replace the existing intake structure. Because of this, the permitting and mitigation for the new intake pump station was estimated at 5 percent rather than the 1 percent used for Options 1 and 3. Depending on the condition of the existing intake, it may be possible to use the existing intake with the new pump station facility to avoid costly permitting issues.

Another option that is open for consideration includes purchasing the dam, water rights, and all associated existing facilities at New Terrell City Lake.

Attached are conceptual cost estimates for the construction costs and the cost of purchasing the existing facilities from Terrell for each of the above-mentioned alternatives. A schematic map is also included.

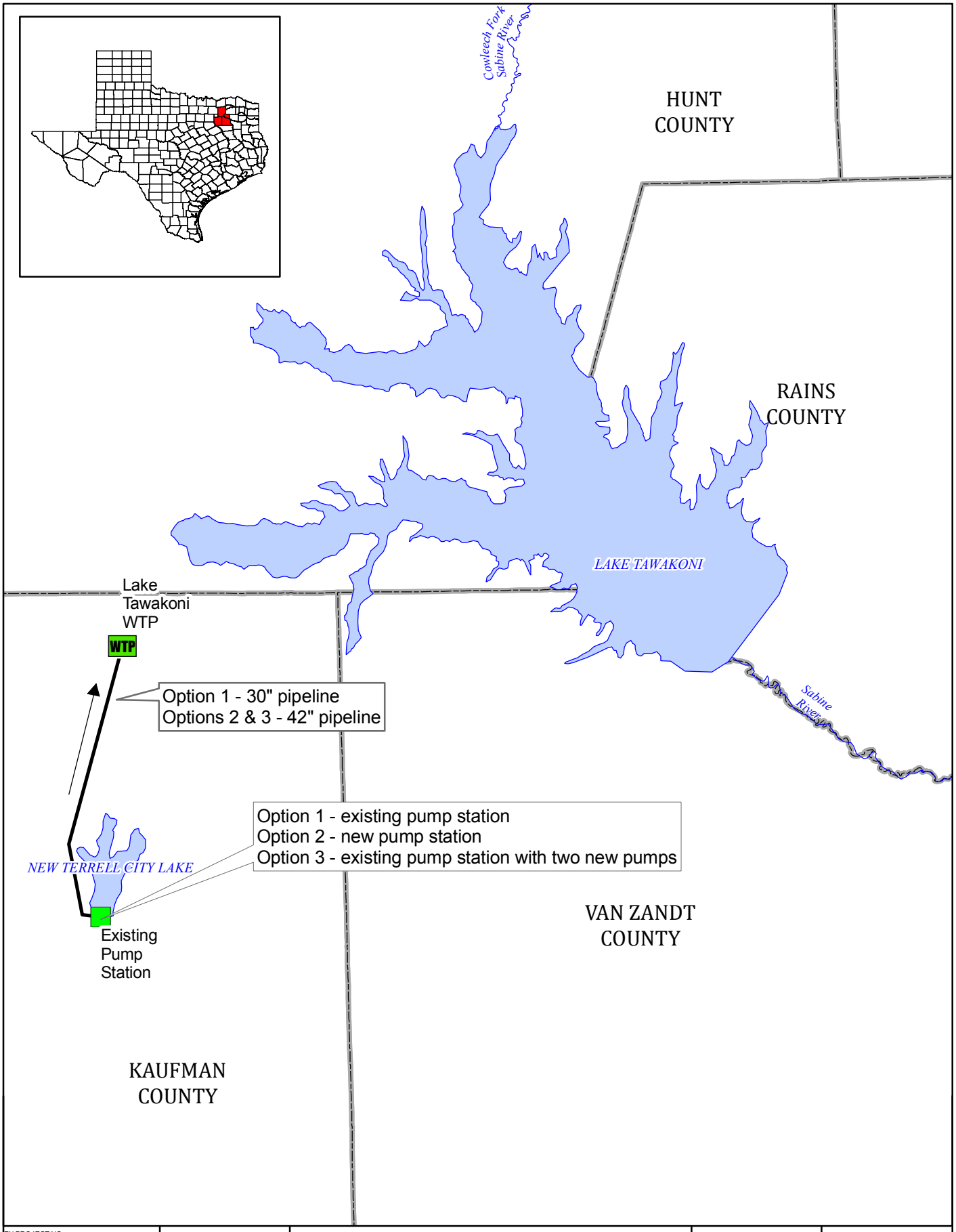
The costs of the existing pumps were calculated by determining the current cost of a new similar pump and using a straight line depreciation to determine the current value. This calculation assumed the useful life of the pumps is 20 years. Based on this assumption, Pumps 2 and 4 have no current value, but a salvage value of $1,000 was assigned to both pumps. All of the pumps are located in the same building, and costs assume that in agreeing to purchase one of the pumps, the buyer agrees to purchase all five pumps and the building they are housed in.

The original building Pumps 1 and 2 are housed in and the intake structure were constructed in 1960. The pump station building was expanded in the 1970's to add three new pumps. The current value of the intake was calculated by depreciating the cost of a new intake structure of the same size. The pipeline from the existing intake to the pump station is a 30-inch line. The velocity in this line for the options transporting 30 mgd is nearly 9.5 feet per second. Depending on the condition of the pipe, this may or may not cause problems with the pipe lining. However, this pipeline can be replaced or paralleled if needed.

New electrical and chemical buildings were added onto the original pump station building in 2001. Pump 5 and a Variable Frequency Drive (VFD) were also installed at this time. The current value of the original building and the portion of the building added in the 1970's was calculated by determining the current cost of construction of a pump station and using straight line depreciation based on the age of the buildings. The current value of the new electrical and chemical buildings was determined based on the construction contract amount provided by the City of Terrell and the same straight line depreciation method used to determine the other current costs. The useful life of the buildings was assumed to be 50 years. "Current cost" refers to the cost in January 2009 dollars. Costs were determined in January 2009 dollars to be consistent with the costs presented in the *2011 Region C Water Plan*. The table below displays the project costs for each of the above-mentioned supply options.

Alternative	Supply (peak, mgd)	Cost of New Construction	Cost of Existing Facilities	Unit Costs (per 1,000 gallons)			
				Average Annual Yield		Firm Yield	
				Pre-Amortization	Post-Amortization	Pre-Amortization	Post-Amortization
Option 1	12.96	$9,001,000	$1,150,000	$1.09	$0.66	$1.78	$0.84
Option 2	30.00	$20,056,000	$0	$1.54	$0.69	$2.78	$0.92
Option 3	30.00	$13,397,000	$1,150,000	$1.31	$0.70	$2.26	$0.91

The cost of raw water at New Terrell City Lake was assumed to be $0.45 per thousand gallons.



FN PROJECT NO.	TER10197
FILE NAME	NTMWD_final.mxd
DATUM & COORDINATE SYSTEM	NAD83 STATE PLANE TX NORTH CENTRAL (FT)
DATE CREATED	SEPTEMBER 2010
PREPARED BY	KEK

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0 8,750 17,500 35,000 Feet

Terrell Water Supply Study

NTMWD Alternatives

N

FIGURE 1

North Texas Municipal Water District - Supply from Terrell Lake to Tawakoni WTP

Terrell Water Supply Facility Planning

Conceptual Cost Estimate for Supply from Terrell Lake to Tawakoni WTP (Option 1)

13 mgd (peak)

ACCOUNT NO.	ESTIMATOR	CHECKED	DATE
TER10197	KEK	RAI, SFK	August 4, 2010

ITEM	DESCRIPTION	QNTY	UNIT	UNIT PRICE	TOTAL
COST FOR TRANSMISSION FACILITY CONSTRUCTION					
	PIPELINES				
	30-inch Pipeline from Lake Terrell to Tawakoni WTP	42,049	LF	$145	$6,102,000
	Right of Way Easements (ROW)	42,049	LF	$11.50	$484,000
	Engineering and Contingencies (30%)				$1,831,000
	Permitting and Mitigation (1%)				$61,000
	Total of Pipeline				**$8,478,000**
	CONSTRUCTION TOTAL				**$8,478,000**
	Interest During Construction (18 months)				$522,800
	TOTAL COST				**$9,001,000**
COST FOR PURCHASING EXISTING TRANSMISSION FACILITIES					
	PUMP STATIONS (Depreciated Costs)				
	Pump #1	1	LS	$17,446	$17,446
	Pump #2	1	LS	$1,000	$1,000
	Pump #3	1	LS	$19,825	$19,825
	Pump #4	1	LS	$1,000	$1,000
	Pump #5 & VFD	1	LS	$79,414	$79,414
	Pump Building	1	LS	$861,222	$861,222
	Pump Intake	1	LS	$170,400	$170,400
	Total of Pump Stations				**$1,150,000**
	TOTAL PROJECT COST				**$10,151,000**
ANNUAL COSTS (5,250 AC-FT/YR)					
	Debt Service (6% for 30 years)				$737,000
	Debt Service for Replacement of Pumps (6% for 15 years)				$52,000
	Electricity ($0.09 kWh)				$99,000
	Raw Water Cost ($0.45/1,000 gal)				$770,000
	Operation & Maintenance				$212,000
	Total Annual Costs				**$1,870,000**
ANNUAL COSTS (2,400 AC-FT/YR)					
	Debt Service (6% for 30 years)				$737,000
	Debt Service for Replacement of Pumps (6% for 15 years)				$52,000
	Electricity ($0.09 kWh)				$42,000
	Raw Water Cost ($0.45/1,000 gal)				$352,000
	Operation & Maintenance				$212,000
	Total Annual Costs				**$1,395,000**
UNIT COSTS FOR AVERAGE ANNUAL SUPPLY (5,250 AC-FT/YR)					
	UNIT COSTS (Pre Amort.)				
	Per MGD				$399,290
	Per Acre-Foot				$356
	Per 1,000 Gallons				$1.09
	UNIT COSTS (Post Amort.)				
	Per MGD				$241,922
	Per Acre-Foot				$216
	Per 1,000 Gallons				$0.66
UNIT COSTS FOR FIRM YIELD SUPPLY (2,400 AC-FT/YR)					
	UNIT COSTS (Pre Amort.)				
	Per MGD				$651,581
	Per Acre-Foot				$581
	Per 1,000 Gallons				$1.78
	UNIT COSTS (Post Amort.)				
	Per MGD				$307,341
	Per Acre-Foot				$274
	Per 1,000 Gallons				$0.84

North Texas Municipal Water District - Pipeline from Terrell Lake to Tawakoni WTP - Backup Supply

Terrell Water Supply Facility Planning

Conceptual Cost Estimate for Pipeline from Terrell Lake to Tawakoni WTP as a Backup Supply (Option 2)

30 mgd (peak)

ACCOUNT NO.	ESTIMATOR	CHECKED	DATE
TER10197	KEK	RAI, SFK	August 4, 2010

ITEM	DESCRIPTION	QNTY	UNIT	UNIT PRICE	TOTAL
COST FOR TRANSMISSION FACILITY CONSTRUCTION					
	PIPELINES				
	42-inch Pipeline from Lake Terrell to Tawakoni WTP	42,049	LF	$215	$9,040,000
	Right of Way Easements (ROW)	42,049	LF	$11.50	$484,000
	Engineering and Contingencies (30%)				$2,712,000
	Permitting and Mitigation (1%)				$90,000
	Total of Pipeline				**$12,326,000**
	PUMP STATIONS				
	1500 HP Intake Pump Station at New Terrell City Lake	1	LS	$4,689,500	$4,689,500
	Engineering and Contingencies (35%)				$1,641,000
	Permitting and Mitigation (5%)				$234,000
	Total of Pump Stations				**$6,564,500**
	CONSTRUCTION TOTAL				**$18,890,500**
	Interest During Construction (18 months)				$1,165,000
	TOTAL COST				**$20,055,500**
ANNUAL COSTS (5,250 AC-FT/YR)					
	Debt Service (6% for 30 years)				$1,457,000
	Debt Service for Replacement of Pumps (6% for 15 years)				$74,133
	Electricity ($0.09 kWh)				$92,000
	Raw Water Cost ($0.45/1,000 gal)				$770,000
	Operation & Maintenance				$249,000
	Total Annual Costs				**$2,642,133**
ANNUAL COSTS (2,400 AC-FT/YR)					
	Debt Service (6% for 30 years)				$1,457,000
	Debt Service for Replacement of Pumps (6% for 15 years)				$74,133
	Electricity ($0.09 kWh)				$42,000
	Raw Water Cost ($0.45/1,000 gal)				$352,000
	Operation & Maintenance				$249,000
	Total Annual Costs				**$2,174,133**
UNIT COSTS FOR AVERAGE ANNUAL SUPPLY (5,250 AC-FT/YR)					
	UNIT COSTS (Pre Amort.)				
	Per MGD				$564,158
	Per Acre-Foot				$503
	Per 1,000 Gallons				$1.54
	UNIT COSTS (Post Amort.)				
	Per MGD				$253,054
	Per Acre-Foot				$226
	Per 1,000 Gallons				$0.69
UNIT COSTS FOR FIRM YIELD SUPPLY (2,400 AC-FT/YR)					
	UNIT COSTS (Pre Amort.)				
	Per MGD				$1,015,501
	Per Acre-Foot				$906
	Per 1,000 Gallons				$2.78
	UNIT COSTS (Post Amort.)				
	Per MGD				$334,961
	Per Acre-Foot				$299
	Per 1,000 Gallons				$0.92

North Texas Municipal Water District - Supply from Terrell Lake to Tawakoni WTP

Terrell Water Supply Facility Planning

Conceptual Cost Estimate for Supply from Terrell Lake to Tawakoni WTP (Option 3)

30 mgd (peak)

ACCOUNT NO.	ESTIMATOR	CHECKED	DATE
TER10197	KEK	RAI, SFK	August 4, 2010

ITEM	DESCRIPTION	QNTY	UNIT	UNIT PRICE	TOTAL
COST FOR TRANSMISSION FACILITY CONSTRUCTION					
	PIPELINES				
	42-inch Pipeline from Lake Terrell to Tawakoni WTP	42,049	LF	$215	$9,040,000
	Right of Way Easements (ROW)	42,049	LF	$11.50	$484,000
	Engineering and Contingencies (30%)				$2,712,000
	Permitting and Mitigation (1%)				$90,000
	Total of Pipeline				**$12,326,000**
	PUMPS				
	New pumps with same pump curve as existing Pump #4	2	LS	$79,300	$158,600
	Pump Station and Yard Piping	1	LS	$58,000	$58,000
	Engineering and Contingencies (35%)				$76,000
	Total of Pumps				**$292,600**
	CONSTRUCTION TOTAL				**$12,619,000**
	Interest During Construction (18 months)				$778,000
	TOTAL COST				**$13,397,000**
COST FOR PURCHASING EXISTING TRANSMISSION FACILITIES					
	PUMP STATIONS (Depreciated Costs)				
	Pump #1	1	LS	$17,446	$17,446
	Pump #2	1	LS	$1,000	$1,000
	Pump #3	1	LS	$19,825	$19,825
	Pump #4	1	LS	$1,000	$1,000
	Pump #5 & VFD	1	LS	$79,414	$79,414
	Pump Building	1	LS	$861,222	$861,222
	Pump Intake	1	LS	$170,400	$170,400
	Total of Pump Stations				**$1,150,000**
	TOTAL PROJECT COST				**$14,547,000**
ANNUAL COSTS (5,250 AC-FT/YR)					
	Debt Service (6% for 30 years)				$1,057,000
	Debt Service for Replacement of Pumps (6% for 15 years)				$64,000
	Electricity ($0.09 kWh)				$105,000
	Raw Water Cost ($0.45/1,000 gal)				$770,000
	Operation & Maintenance				$253,000
	Total Annual Costs				**$2,249,000**
ANNUAL COSTS (2,400 AC-FT/YR)					
	Debt Service (6% for 30 years)				$1,057,000
	Debt Service for Replacement of Pumps (6% for 15 years)				$64,000
	Electricity ($0.09 kWh)				$42,000
	Raw Water Cost ($0.45/1,000 gal)				$352,000
	Operation & Maintenance				$253,000
	Total Annual Costs				**$1,768,000**
UNIT COSTS FOR AVERAGE ANNUAL SUPPLY (5,250 AC-FT/YR)					
	UNIT COSTS (Pre Amort.)				
	Per MGD				$480,215
	Per Acre-Foot				$428
	Per 1,000 Gallons				$1.31
	UNIT COSTS (Post Amort.)				
	Per MGD				$254,520
	Per Acre-Foot				$227
	Per 1,000 Gallons				$0.70
UNIT COSTS FOR FIRM YIELD SUPPLY (2,400 AC-FT/YR)					
	UNIT COSTS (Pre Amort.)				
	Per MGD				$825,803
	Per Acre-Foot				$737
	Per 1,000 Gallons				$2.26
	UNIT COSTS (Post Amort.)				
	Per MGD				$332,096
	Per Acre-Foot				$296
	Per 1,000 Gallons				$0.91

MEETING AGENDA

FREESE AND NICHOLS

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MEETING: Raw Water Supply – New Terrell City Lake
DATE: January 26, 2011
LOCATION: NTMWD
TIME: 1:00pm

PURPOSE

The overall objective of the meeting should be clear and noted on the agenda.

AGENDA

The agenda should include what is to be covered, who is responsible and how long each item will require.

CODE OF CONDUCT

Meeting participants should respect each other by honoring the Code of Conduct.

EXPECTATIONS

The expectations of the participants should be discussed, noted and reviewed for closure.

ROLES

The roles of leader, scribe, minute taker, time keeper and facilitator should be clarified at the beginning of the meeting.

AGENDA

TOPIC

1. Background and Purpose of the Study
2. New Terrell City Lake Water Availability
3. Results of Study – NTMWD Alternatives
4. Discussion
5. Follow-up and Action Items

CODE OF CONDUCT

1. Publish an agenda and maintain minutes.
2. Challenge ideas and processes, not people.
3. Share responsibility and ownership.
4. Maintain an open, honest environment.
5. Question and participate.
6. Listen constructively.
7. Begin and end on time unless participants agree to an extension.
8. Come prepared and with action items completed.
9. Base decisions on factual data.
10. Keep confidences.

MEETING MINUTES

FREESE AND NICHOLS
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PROJECT: Water Supply Facility Planning – New Terrell City Lake
NAME OF MEETING: Meeting with North Texas Municipal Water District (NTMWD)
RECORDED BY: Rachel Ickert
DATE: January 26, 2011
LOCATION: NTMWD Offices
ATTENDEES:

Name	Company
Steve Rogers	City of Terrell
Sonny Groessel	City of Terrell
Mike Rickman	North Texas Municipal Water District
Ted Kilpatrick	North Texas Municipal Water District
Robert McCarthy	North Texas Municipal Water District
Yanbo Li	North Texas Municipal Water District
Tom Gooch	Freese and Nichols
Brian Coltharp	Freese and Nichols
Rachel Ickert	Freese and Nichols

The following reflects our understanding of the items discussed during the subject meeting. If you do not notify us within five working days, we will assume that you are in agreement with our understanding.

ITEM	DESCRIPTION
1	Background and Purpose of the Study • Steve Rogers started the meeting by discussing the status and purpose of the study. The study is partially funded by a TWDB grant, and the purpose is to determine how much water is available in New Terrell City Lake, who can use the water, and how much it will cost. Another aspect of the study is a dam condition assessment. • Brian Coltharp discussed the background on Terrell's water supply system.
2	New Terrell City Lake Water Availability • Rachel Ickert presented information on the New Terrell City Lake water availability analysis. The results have been summarized in a memorandum (attached) that was distributed at the meeting.
3	Results of the Study – NTMWD Alternatives • Rachel Ickert presented the results as summarized in the memorandum to NTMWD dated November 3, 2010 (attached). Three options for transporting water from the New Terrell City Lake to NTMWD's Tawakoni WTP were evaluated as part of the study.
4	Discussion • NTMWD asked about Terrell's land ownership around the lake, and Terrell presented a map showing the area Terrell owns and where they have flood easements. A handful of people live around the lake, but there are no agreements for water use or rights to use the lake. The City of Terrell has the

ITEM	DESCRIPTION
	only permits for using the water in the lake. There are no permitted irrigation systems around the lake. • Rachel Ickert indicated that the water right would have to be amended to increase the diversion rate to 13 mgd or 30 mgd as presented in the memorandum on supply alternatives. Tom Gooch said that diversion rate modifications have historically been relatively easy to obtain. • Robert McCarthy asked Ted Kilpatrick if he thought there would be any concerns with blending the water from New Terrell City Lake with water from Lake Tawakoni. Ted indicated that he did not think so. Sonny Groessel said he could provide water quality data. • NTMWD asked if the water level in New Terrell City Lake could be drawn down, and Steve Rogers said yes. • Tom Gooch indicated that NTMWD could use the Terrell supply more in the summer and maybe not at all in the winter. NTMWD could withdraw at a rate of 13 mgd for about 5 to 6 months out of the year, or a rate of 30 mgd for about 2 months. The 30 mgd rate would not be a standard operation, more for an emergency supply. • NTMWD indicated that they would have someone at the February 17th public meeting for the study. • Mike Rickman asked if Terrell has considered selling the water right. Steve Rogers said yes, but that needs further study and discussion. • There was some discussion on Terrell's wastewater study and how NTMWD may be involved in one alternative being studied. • Mike Rickman asked about the condition of the New Terrell City Lake Dam. Tom Gooch indicated that overall, the dam is in good condition but needs some modifications to meet NRCS criteria and needs some O&M-type work. Based on preliminary estimates, the dam needs between $2-million to $3-million worth of work but is structurally sound. • Steve Rogers closed the discussion by saying if NTMWD has additional questions, they can contact any of us at Terrell or FNI.

ACTION ITEMS			
WHAT	**WHO**	**WHEN**	**STATUS**
1. Attend Public Meeting Number 3 for the study.	Terrell, FNI, NTMWD	02/17/2011	
2.			
3.			
4.			
5.			

MEMORANDUM

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TO: **Jerry Clark and David Montagne**

CC: **Steve Rogers P.E. (City of Terrell), Sonny Groessel (City of Terrell)**

FROM: **Rachel Ickert, P.E. and Keeley Kirksey, EIT**

SUBJECT: **Terrell Water Supply Study**

DATE: **November 16, 2010**

The City of Terrell owns New Terrell City Lake and is interested in selling raw water from the lake. Terrell is potentially interested in selling some of the existing facilities associated with this supply. Texas Water Development Board (TWDB) funds have been obtained by Terrell to study potential uses of the New Terrell City Lake Supply.

The City of Terrell has a water right to divert 6,000 acre-feet per year (5.4 MGD) from the lake. The firm yield of the lake, as determined using the Texas Commission on Environmental Quality (TCEQ) Water Availability Model, is 2,400 acre-feet per year (2.1 MGD), and the average annual diversion available is 5,250 acre-feet per year (4.7 MGD).

It is our understanding that SRA is potentially interested in purchasing water from New Terrell City Lake and transmitting the water to Lake Tawakoni. Below is a summary of our findings regarding SRA's possible use of the New Terrell City Lake supply:

<u>New Terrell City Lake Water to Lake Tawakoni</u>

- A three-mile long, 24-inch pipeline is required to connect to the existing 24-inch pipeline from New Terrell City Lake to Lake Tawakoni.
- The capacity of the existing 24-inch pipeline to Lake Tawakoni is 10.9 mgd.
- The construction of an outlet structure at Lake Tawakoni would be required.
- The existing Terrell pumps could be used to transport water from New Terrell City Lake to Lake Tawakoni.

To obtain 10.9 mgd, as discussed above, the water right will need to be amended. The current maximum diversion rate, as listed in the water right, is 6.5 mgd.

Significant permitting may be required to construct an outlet structure in Lake Tawakoni. Because of this, the permitting and mitigation for the new outlet structure was estimated at 3 percent.

Attached are conceptual cost estimates for the construction costs and the cost of purchasing the existing facilities from Terrell for the above-mentioned alternative. A schematic map is also included.

The costs of the existing pumps were calculated by determining the current cost of a new similar pump and using a straight line depreciation to determine the current value. This calculation assumed the useful life of the pumps is 20 years. Based on this assumption, Pumps 2 and 4 have no current value, but a salvage value of $1,000 was assigned to both pumps. All of the pumps are located in the same building, and costs assume that in

agreeing to purchase one of the pumps, the buyer agrees to purchase all five pumps and the building they are housed in.

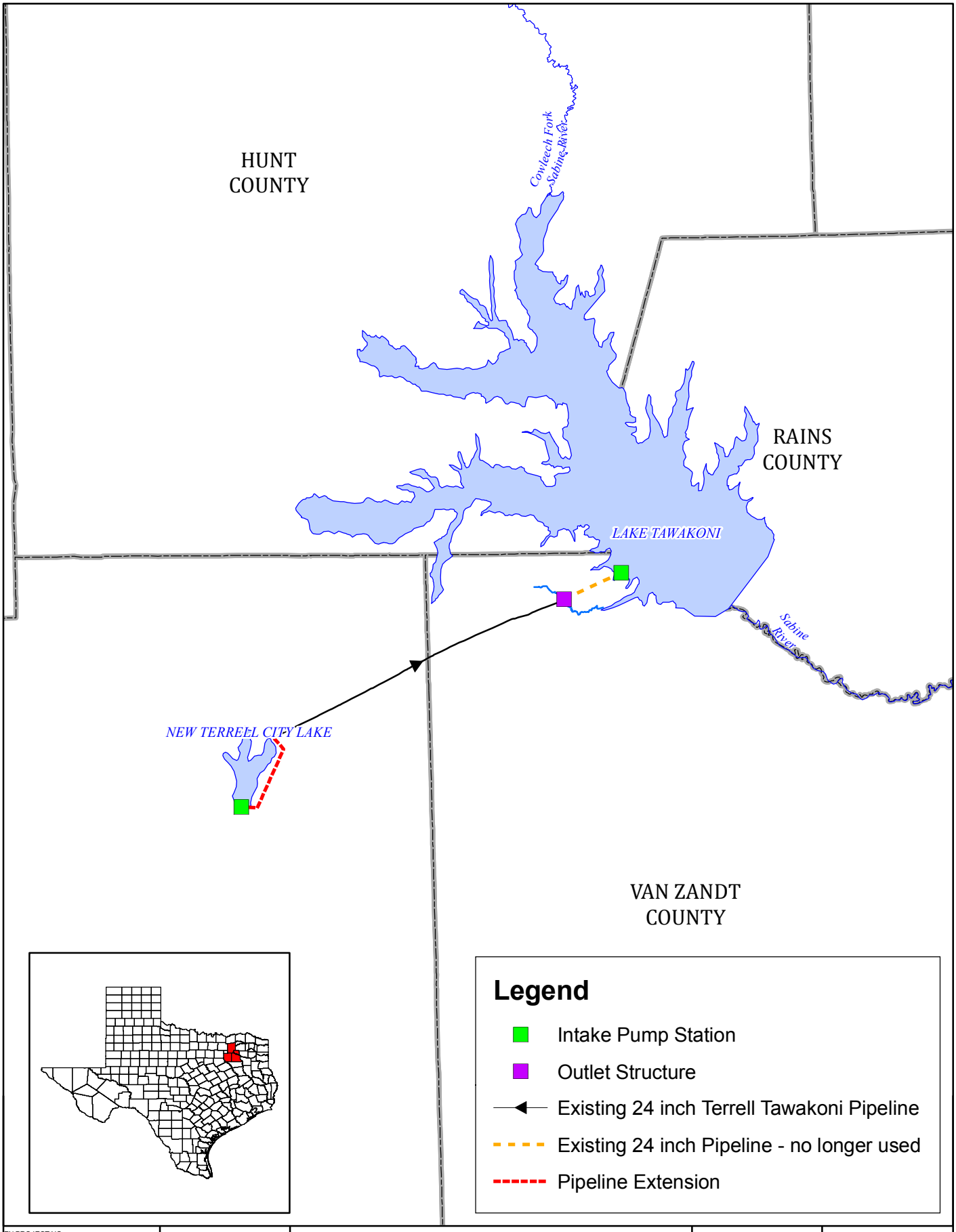
The original building Pumps 1 and 2 are housed in and the intake structure were constructed in 1960. The pump station building was expanded in the 1970's to add three new pumps. The current value of the intake was calculated by depreciating the cost of a new intake structure of the same size. The pipeline from the existing intake to the pump station is a 30-inch line.

New electrical and chemical buildings were added onto the original pump station building in 2001. Pump 5 and a Variable Frequency Drive (VFD) were also installed at this time. The current value of the original building and the portion of the building added in the 1970's was calculated by determining the current cost of construction of a pump station and using straight line depreciation based on the age of the buildings. The current value of the new electrical and chemical buildings was determined based on the construction contract amount provided by the City of Terrell and the same straight line depreciation method used to determine the other current costs. The useful life of the buildings was assumed to be 50 years. "Current cost" refers to the cost in January 2009 dollars. Costs were determined in January 2009 dollars to be consistent with the costs presented in the *2011 Region C Water Plan*. The table below displays the project costs for water supply to Lake Tawakoni for SRA's use.

Alternative	Supply (peak, mgd)	Cost of New Construction	Cost of Existing Facilities	Unit Costs (per 1,000 gallons)			
				Average Annual Yield		Firm Yield	
				Pre-Amortization	Post-Amortization	Pre-Amortization	Post-Amortization
Terrell water to Lake Tawakoni	10.9	$2,966,000	$2,949,000	$0.92	$0.67	$1.40	$0.85

The cost of raw water at New Terrell City Lake was assumed to be $0.45 per thousand gallons.

Another option that is open for consideration includes purchasing the dam, water rights, and all associated existing facilities at New Terrell City Lake.



FN PROJECT NO.	TER10197
FILE NAME	Canton_final.mxd
DATUM & COORDINATE SYSTEM	NAD83 STATE PLANE TX NORTH CENTRAL (FT)
DATE CREATED	SEPTEMBER 2010
PREPARED BY	KEK

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0 11,500 23,000 46,000 Feet

Terrell Water Supply Study

Water Supply for SRA

N

FIGURE

1

Sabine River Authority - Supply from Terrell Lake to Lake Tawakoni

Terrell Water Supply Facility Planning

Conceptual Cost Estimate for Supply from Terrell Lake to Lake Tawakoni

10.9 mgd (peak)

ACCOUNT NO.	ESTIMATOR	CHECKED	DATE
TER10197	KEK	RAI, SFK	August 4, 2010

ITEM	DESCRIPTION	QNTY	UNIT	UNIT PRICE	TOTAL
	COST FOR TRANSMISSION FACILITY CONSTRUCTION				
	PIPELINES				
	24-inch Pipeline from Lake Terrell Intake to Existing Lake Tawakoni Pipeline	16,946	LF	$116	$1,967,000
	Right of Way Easements (ROW)	16,946	LF	$11.50	$195,000
	Engineering and Contingencies (30%)				$590,000
	Permitting and Mitigation (1%)				$20,000
	Total of Pipeline				**$2,772,000**
	OUTLET STRUCTURE				
	Discharge Structure at Lake Tawakoni	1	LS	$54,000	$54,000
	Engineering and Contingencies (35%)				$19,000
	Permitting and Mitigation (3%)				$2,000
	Total of Outlet Structure				**$75,000**
	CONSTRUCTION TOTAL				**$2,847,000**
	Interest During Construction (12 months)				$119,000
	TOTAL COST				**$2,966,000**
	COST FOR PURCHASING EXISTING TRANSMISSION FACILITIES				
	PIPELINES (Depreciated Costs)				
	24" Pipeline to Tawakoni Lake	64,575	LF	$27.86	$1,799,000
	Total of Pipelines				**$1,799,000**
	PUMP STATIONS (Depreciated Costs)				
	Pump #1	1	LS	$17,446	$17,446
	Pump #2	1	LS	$1,000	$1,000
	Pump #3	1	LS	$19,825	$19,825
	Pump #4	1	LS	$1,000	$1,000
	Pump #5 & VFD	1	LS	$79,414	$79,414
	Pump Building	1	LS	$861,222	$861,222
	Pump Intake	1	LS	$170,400	$170,400
	Total of Pump Stations				**$1,150,000**
	EXISTING FACILITIES TOTAL				**$2,949,000**
	TOTAL PROJECT COST				**$5,915,000**
	ANNUAL COSTS (5,250 AC-FT/YR)				
	Debt Service (6% for 30 years)				$430,000
	Debt Service for Replacement of Pumps (6% for 15 years)				$35,000
	Electricity ($0.09 kWh)				$91,000
	Raw Water Cost ($0.45/1,000 gal)				$770,000
	Operation & Maintenance				$255,000
	Total Annual Costs				**$1,581,000**
	ANNUAL COSTS (2,400 AC-FT/YR)				
	Debt Service (6% for 30 years)				$430,000
	Debt Service for Replacement of Pumps (6% for 15 years)				$35,000
	Electricity ($0.09 kWh)				$25,000
	Raw Water Cost ($0.45/1,000 gal)				$352,000
	Operation & Maintenance				$255,000
	Total Annual Costs				**$1,097,000**
	UNIT COSTS FOR AVERAGE ANNUAL SUPPLY (5,250 AC-FT/YR)				
	UNIT COSTS (Pre Amort.)				
	Per MGD				$337,581
	Per Acre-Foot				$301
	Per 1,000 Gallons				$0.92
	UNIT COSTS (Post Amort.)				
	Per MGD				$245,766
	Per Acre-Foot				$219
	Per 1,000 Gallons				$0.67
	UNIT COSTS FOR FIRM YIELD SUPPLY (2,400 AC-FT/YR)				
	UNIT COSTS (Pre Amort.)				
	Per MGD				$512,390
	Per Acre-Foot				$457
	Per 1,000 Gallons				$1.40
	UNIT COSTS (Post Amort.)				
	Per MGD				$311,545
	Per Acre-Foot				$278
	Per 1,000 Gallons				$0.85

APPENDIX H
PRESENTATION TO TERRELL CITY COUNCIL

Terrell Regional Water Study

Council Workshop

April 28, 2011

City of Terrell Project No. 09-11
TWDB Contract No. 1004831081

1

RESOLUTION NO. 644

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF TERRELL, TEXAS, AUTHORIZING THE CITY OF TERRELL TO APPLY FOR A GRANT FROM THE TEXAS WATER DEVELOPMENT BOARD FOR REGIONAL WATER PLANNING

WHEREAS, the City of Terrell, Texas, represented by its City Manager, Terry Edwards or his designee, is authorized to apply for a grant from the Texas Water Development Board;

WHEREAS, the City of Terrell, Texas, has the authority to plan, implement, and operate a water supply facility within the planning area of the application;

WHEREAS, the City Council grants authority to enter into a contract with the Texas Water Development Board if a grant is awarded;

WHEREAS, the City of Terrell, intends to commit $50,000.00 in local matching funds in cash and/or in kind services.

NOW, THEREFORE BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF TERRELL, TEXAS, that the City of Terrell or its designee hereby agrees to perform a regional water planning study that is partially funded by the Texas Water Development Board.

That this Resolution shall become effective immediately upon its passage and approval.

Passed and adopted this the 1st day of December, 2009.

Hal Richards, Mayor

Attest:

John Roumasvall, City Secretary

Approved as to Form:

Mary Gayle Ramsey, City Attorney

2

Brief History of New Terrell City Lake

- New Terrell City Lake Dam built in 1955
- New Water Treatment Plant began operation 1960
- Raw Water Pump Station and Water Treatment Plant was expanded to 6.2 MGD in 1972
- Agreement to Receive Treated Water from North Texas Municipal Water District (NTMWD) in April 2004
- Began receiving treated water from NTMWD In March 2007
- Closed the Water Treatment Plant in June 2007

3

Water Study

- Determine available supply from the lake
- Perform needs assessment for water suppliers who may be interested in the Terrell supply
- Identify potential alternative uses of the lake and associated costs
- Review Region C and Region D Water Plans for potential changes needed

4

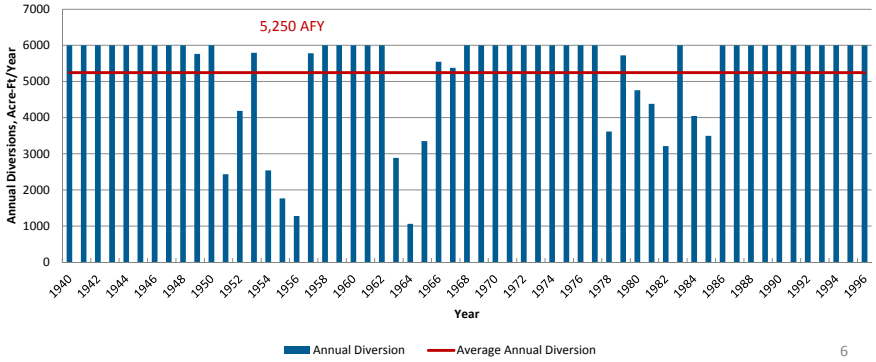
Water Study, Continued

- Complete dam site inspection
- Develop dam improvement alternatives and associated costs
- Develop Emergency Action Plan (EAP) for dam
- Review water conservation and drought contingency plans for Terrell and potential customers

5

Available Supply From Lake

- Analysis with the TCEQ Trinity Water Availability Model (WAM)
- Permitted Amount = 6,000 ac-ft/yr (5.4 mgd)
- Firm Yield = 2,300 ac-ft/yr (2.05 mgd) for 2060 conditions
- Water Availability Analysis
  - Target diversion of 6,000 ac-ft/yr – in 16% of the months, the actual diversion is less than the target diversion. Average annual diversion = 5,250 acre-feet (4.7 mgd)



6

Available Supply From Lake

- Permitted Amount = 5.4 mgd
- Firm Yield = 2.1 mgd (1940-1996)
- Average Annual Diversion = 4.7 mgd (1940-1996)
- Average Use = 1.7 mgd

7

Potential Alternatives

- Dallas Water Utilities (DWU) – Transmit water through Terrell City Lake to Cedar Creek Reservoir.
- North Texas Municipal Water District (NTMWD) - Transmit water from New Terrell City Lake to NTMWD Tawakoni WTP
- Sabine River Authority (SRA) – Transmit New Terrell City Lake water to Lake Tawakoni
- City of Canton – Transmit water from Terrell to Canton City Lake

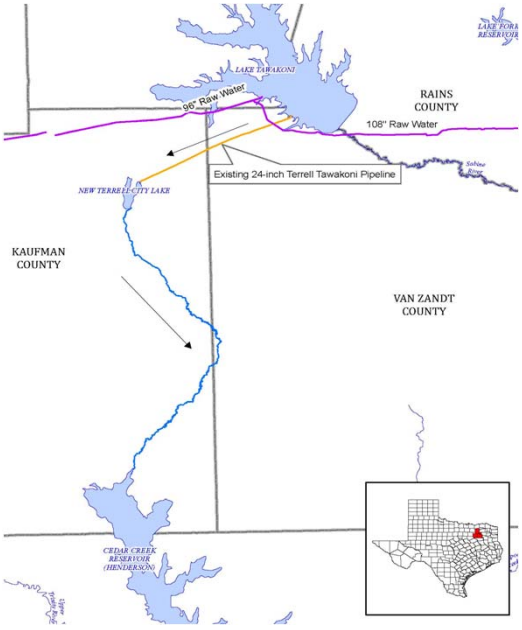
8

Raw Water Cost Assumptions for Alternatives

- Study Assumes $0.45 per 1,000 gallons
- Raw Water Rates in Region C
  - DWU Uninterruptible: $0.50
  - DWU Interruptible: $0.23
  - NTMWD: $0.69
  - TRWD in District: $0.69
  - TRWD out of District: $0.72

9

Potential Alternatives - DWU



10

Potential Alternatives

- Dallas Water Utilities (DWU)
  - Interested in taking water through New Terrell City Lake to Cedar Creek Reservoir
  - Pass-through without purchase of New Terrell City Lake water (Option 1)
    - Transport 75 mgd (peak) from Lake Tawakoni to New Terrell City Lake (based on outlet capacity at Terrell Lake).
    - Replace the existing 24-inch pipeline from Lake Tawakoni with a 66-inch pipeline.
    - New 4,100 HP intake pump station at Lake Tawakoni.
    - Option is not mutually exclusive. If DWU does not purchase Terrell water, the water is available for one of the other potential alternatives.

11

Potential Alternatives

- Dallas Water Utilities (DWU)
  - Pass-through with purchase of New Terrell City Lake water (Option 2)
    - Transport 67.3 mgd from Lake Tawakoni and purchase 4.7 mgd from Lake Terrell
    - Replace the existing 24-inch pipeline from Lake Tawakoni with a 66-inch pipeline.
    - New 3,700 HP intake pump station at Lake Tawakoni.

12

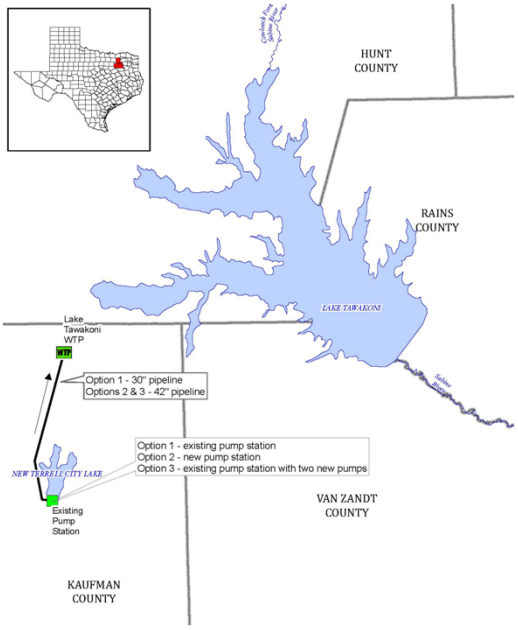
DWU - Costs

Alternative	Supply (peak, mgd)	Cost of New Construction	Cost of Existing Facilities	Unit Costs (per 1,000 gallons)	
				Pre-Amortization	Post-Amortization
Option 1	72	$51,809,100	$2,292,593	$0.37*	$0.11*
Option 2	72	$50,995,200	$2,292,593	$0.37	$0.14

*Unit costs are based on an average annual supply of 50 mgd from Lake Tawakoni
Pre-amortization is prior to the debt being repaid
Post-amortization is after the debt is repaid

13

Potential Alternatives - NTMWD



14

Potential Alternatives

- North Texas Municipal Water District (NTMWD)
  - Interested in delivering water from New Terrell City Lake to their Tawakoni WTP as a primary or backup supply.
    - Primary supply (Option 1)
      - 8-mile long, 30-inch pipeline is required to transport 13 mgd
      - Existing Terrell pumps can be used
    - Backup supply (Options 2 & 3)
      - 8-mile long, 42-inch pipeline is required to transport 30 mgd
      - New 1,500 HP pump station and a new intake at Lake Terrell required (Option 2) or
      - Existing intake structure and several existing pumps with 2 new pumps can be used (Option 3)

15

NTMWD - Costs

Alternative	Supply (peak, mgd)	Cost of New Construction	Cost of Existing Facilities	Unit Costs (per 1,000 gallons)		Unit Costs (per 1,000 gallons)	
				Average Annual Yield		Firm Yield	
				Pre-Amortization	Post-Amortization	Pre-Amortization	Post-Amortization
Option 1	12.96	$9,001,000	$1,150,000	$1.09	$0.66	$1.78	$0.84
Option 2	30	$20,056,000	$0	$1.54	$0.69	$2.78	$0.92
Option 3	30	$13,397,000	$1,150,000	$1.31	$0.70	$2.26	$0.91

Pre-amortization is prior to the debt being repaid
Post-amortization is after the debt is repaid

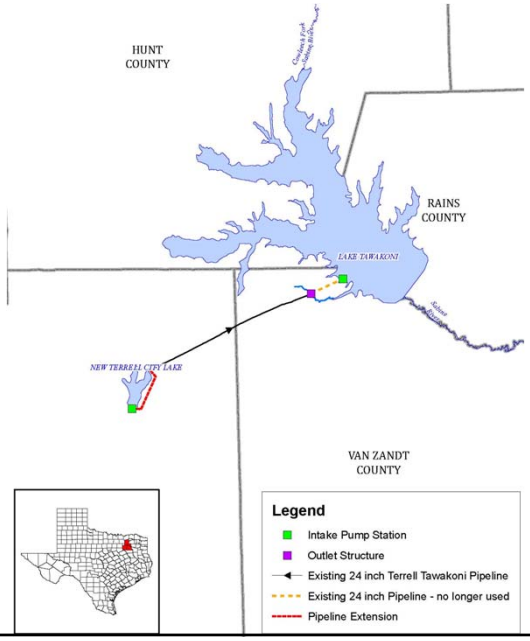
16

NTMWD – Compare Unit Costs for Terrell Supply to Region C Strategies

NTMWD Potential Water Management Strategies	Unit Costs (per 1,000 gallons)	
	Average Annual Yield	
	Pre-Amortization	Post-Amortization
Additional Lake Texoma	$0.93	$0.27
Terrell Lake to Tawakoni WTP	$1.09	$0.66
Terrell Lake - Backup (existing pump station)	$1.31	$0.70
Lower Bois d'Arc Creek	$1.33	$0.21
Oklahoma	$1.43	$0.49
Marvin Nichols	$1.45	$0.39
Terrell Lake - Backup (new pump station)	$1.54	$0.69
Fannin County Water Supply System	$2.19	$0.92
Toledo Bend Phase 1	$2.93	$0.86

17

Potential Alternatives - SRA



18

Potential Alternatives

- Sabine River Authority
  - Transmit New Terrell City Lake water to Lake Tawakoni.
    - Existing 24-inch pipeline to be extended approximately 3 miles to New Terrell City Lake.
    - New outlet structure needed at Lake Tawakoni.
  - Based on the overall estimated cost, SRA is not interested in pursuing the Terrell supply at this time.

19

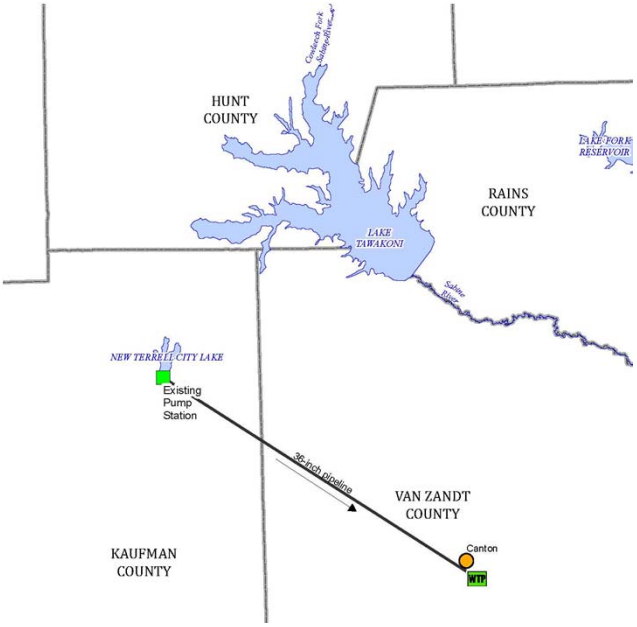
SRA - Costs

Alternative	Supply (peak, mgd)	Cost of New Construction	Cost of Existing Facilities	Unit Costs (per 1,000 gallons)		Unit Costs (per 1,000 gallons)	
				Average Annual Yield		Firm Yield	
				Pre-Amortization	Post-Amortization	Pre-Amortization	Post-Amortization
Terrell water to Lake Tawakoni	10.9	$2,966,000	$2,949,000	$0.92	$0.67	$1.40	$0.85

Pre-amortization is prior to the debt being repaid
Post-amortization is after the debt is repaid

20

Potential Alternatives - Canton



21

Potential Alternatives

- City of Canton
  - Interested in delivering Terrell water to their lake.
    - 25-mile long, 36-inch pipeline required to transport 13 mgd (peak) to Canton's WTP.
    - Interbasin transfer permit is required.
    - Existing Terrell pumps can be used.

Alternative	Supply (peak, mgd)	Cost of New Construction	Cost of Existing Facilities	Unit Costs (per 1,000 gallons)		Unit Costs (per 1,000 gallons)	
				Average Annual Yield		Firm Yield	
				Pre-Amortization	Post-Amortization	Pre-Amortization	Post-Amortization
New Terrell City Lake to Canton's WTP	12.96	$35,745,000	$1,150,000	$2.33	$0.77	$4.52	$1.09

Pre-amortization is prior to the debt being repaid
Post-amortization is after the debt is repaid

22

Benefits to Terrell

- Revenue from sale of existing pipelines, pumps, intake/discharge structures, pipeline right-of-way, etc.
- Revenue stream from raw water sales.
- Potential revenue associated with selling the permitted water rights and dam.

23

Regional Water Plans

- The Terrell water supply is not included as a recommended or alternative water management strategy in the State Water Plan for any of the potential users.
- If Canton, DWU, or NTMWD pursue the Terrell Lake supply, the *2011 Region C Water Plan* and/or the *North East Texas Regional Water Plan* (Region D) will need to be amended for the projects to be eligible for state funding.

24

Dam Site Assessment

- A separate study was performed by NRCS to assess the dam's hydraulic capacity against NRCS requirements.
- The NRCS study found that the dam does not meet current NRCS hydraulic capacity requirements.
- Four alternatives were developed to rehabilitate the dam to meet NRCS requirements.
- Terrell has applied for NRCS funding for the dam rehabilitation.

25

Dam Condition Assessment - Background

- Dam constructed by Terrell in 1955 (water supply)
- Dam rehabilitated by Natural Resources Conservation Service (NRCS) in 1967.
  - Provided flood control
  - Part of Cedar Creek Watershed plan
  - Authorized under PL-534

26

Recent Work

- NRCS study (2010)
- Condition assessment (2010) – TWDB study
- Develop Emergency Action Plan (in progress)

27

Findings

- Dam does not meet NRCS hydraulic criteria.
- Alternatives developed to upgrade dam.
  - Raise crest of dam
    - Compacted fill or concrete wall
  - Enlarge emergency spillway
  - Enlarge principal spillway
    - Modify existing overflow weir
    - Install new system (cut-and-cover method)
    - Leave existing raw water intake as-is
  - Combinations of these
- Costs ranged from $2.8 to $5.3 Million

28

NRCS Small Watershed Rehabilitation Grant

- 65% NRCS of eligible project costs
  - NRCS cost share cannot exceed 100% of construction costs.
- 35% Terrell of eligible project costs
  - City portion can be cost-share or in-kind services

Note: Funding is function of federal budgeting process. Funding is <u>not</u> guaranteed at any stage of project.

29

NRCS Grant - Eligible Project Costs

- Engineering (design, survey, geotech, etc.)
  - Must use NRCS design standards
- Contract Administration
- Land Rights
- Construction
- Construction Inspection

Note: Permitting costs are <u>not</u> eligible costs under grant, must be procured separately by City.

30

NRCS Grant - Key Dates

- Year 1
  - April 1, 2011: Grant application due to NRCS
  - June 2011: NRCS selects projects for funding request
  - December 2011: Funding status determined
- Year 2
  - Detailed planning study and construction funding request *(if funding is granted)*
- Years 3 & 4
  - Final design, construction of improvements *(if funding is granted)*

31

Next Steps

- Major Milestones
  - No formal action required by City Council to complete the study
  - Continue to discuss options with water suppliers
  - Receive comments on Draft Report from TWDB
  - Progress the Dam Improvement Project
  - Submit EAP to TCEQ, June deadline
  - Finalize Report

32

APPENDIX I
TEXAS WATER DEVELOPMENT BOARD
COMMENTS ON DRAFT REPORT

Texas Water Development Board

P.O. Box 13231, 1700 N. Congress Ave.
Austin, TX 78711-3231, www.twdb.state.tx.us
Phone (512) 463-7847, Fax (512) 475-2053

June 27, 2011

Steve Rogers
City Engineer
City of Terrell
210 E. Nash
Terrell, Texas 75160

RE: Regional Water Supply Facility Planning Grant Contract between the Texas Water Development Board (TWDB) and the City of Terrell (City); TWDB Contract No. 1004831081, Draft Report Comments

Dear Mr. Rogers:

Staff members of the TWDB have completed a review of the draft report prepared under the above-referenced contract. ATTACHMENT I provides the comments resulting from this review. As stated in the TWDB contract, the City will consider incorporating draft report comments from the EXECUTIVE ADMINISTRATOR as well as other reviewers into the final report. In addition, the City will include a copy of the EXECUTIVE ADMINISTRATOR'S draft report comments in the Final Report.

The TWDB looks forward to receiving one (1) electronic copy of the entire Final Report in Portable Document Format (PDF) and six (6) bound double-sided copies. The City shall also submit one (1) electronic copy of any computer programs or models, and, if applicable, an operations manual developed under the terms of this Contract.

If you have any questions concerning the contract, please contact Angela Kennedy, the TWDB's designated Contract Manager for this project at (512) 463-1437.

Sincerely,

Dan Hardin

for Carolyn L. Brittin
Deputy Executive Administrator
Water Resources Planning and Information

Enclosures

c: Angela Kennedy, TWDB

Attachment I

Terrell Regional Water Study Draft Report Review Comments
Contract No. 1004831081

1. Please consider including a map of the entire study area centered on the New Terrell City Lake and showing some of the facility alternatives in the report.

2. The Executive Summary covers the dam evaluation thoroughly but is brief on summarizing the water supply alternatives. Suggest including more information about the alternatives in the executive summary.

3. Page 4-19, section 4.6 describes potential NRCS funding programs that could help finance necessary dam rehabilitation. Please consider expanding this funding discussion to include relevant TWDB financial assistance programs that could help fund other required infrastructure improvements in order to implement chosen alternatives.

4. Contract scope of work Task 4(d) states "review the consistency of the alternative(s)...with the Region C Water Plan and recommend changes Terrell should seek..." Please include the consistency analysis in the report and clarify if the alternatives are consistent with the plan or if any plan amendments appear necessary.

5. On page 4-10, third paragraph, lines three and four describing the "cut-and-cover" method of spillway intake structure construction are awkward and somewhat confusing. Please revise this section in order to clarify the intended meaning.