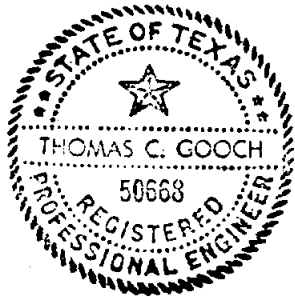
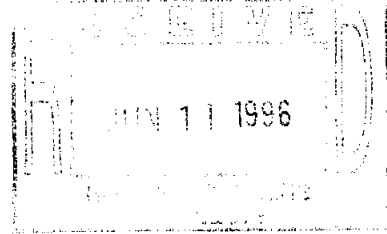


**Memorandum Report  
Updated Water Project Opinions of Cost**

Prepared for the  
Texas Water Development Board

Freese and Nichols, Inc.  
TWD95236

June 3, 1996



6/4/96

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## Introduction

1. In July of 1995, the Texas Water Development Board contracted with Freese and Nichols to update the opinions of cost for a group of future major water supply projects and water conveyance projects. This memorandum report is a brief review of the updated opinions of cost. Table 1 is a summary of the updated costs for the water supply projects, and Table 2 has the same information for the conveyance projects. Appendix A lists the primary and secondary sources of information. The primary source documents are the most recent available to Freese and Nichols. Appendix B contains the updated water supply project opinions of cost, and Appendix C contains the updated conveyance project opinions of cost.

**Table 1**  
**Water Supply Projects**

Project	Primary Source Document		1995 Updated Cost
	Date	Author	
1 Lindenau	Feb. 1986	Espey Huston*	\$267,190,000
2 Paluxy	Sept. 1991	Freese & Nichols	\$74,640,000
3 Allens Creek	July 1995	Freese & Nichols	\$143,250,000
4 Cuero	Feb. 1986	Espey Huston*	\$358,830,000
5 Eastex	Aug. 1991	Lockwood, Andrews & Newnam	\$122,320,000
6 Post	June 1979	Freese & Nichols	\$35,510,000
7 Goliad	Feb. 1986	Espey Huston*	\$248,380,000
8 Brownsville Weir	Aug. 1994	Horizon Environmental	\$35,000,000
9 Tehuacana	Oct. 1990	Freese & Nichols	\$156,060,000
10 Big Sandy	Oct. 1988	Bureau of Reclamation	\$70,947,000
11 Parkhouse I	Oct. 1990	Freese & Nichols	\$163,420,000
12 Parkhouse II	Oct. 1990	Freese & Nichols	\$120,520,000
13 Marvin Nichols I	Oct. 1990	Freese & Nichols	\$317,980,000
14 Marvin Nichols II	Oct. 1990	Freese & Nichols	\$240,120,000
15 Shaws Bend	July 1985	Bureau of Reclamation*	\$256,633,000
16 South Bend	July 1987	Freese & Nichols	\$264,960,000
17 Cibolo	Feb. 1986	Espey Huston*	\$215,830,000
18 Neches Salt Barrier	July 1994	COE - Galveston	\$78,000,000

\* See paragraph 9

**Table 2**  
**Water Transmission Projects**

	Project	Primary Source Document		1995 Updated Cost
		Date	Author	
1	Moss Lake to Gainesville			\$3,824,200
2	Sam Rayburn to Lufkin	Sept. 1994	Freese & Nichols	\$10,214,000
3	Eastex to Customers	Aug. 1991	Lockwood, Andrews & Newnam	\$41,644,800
4	Paluxy System	Sept. 1991	Freese & Nichols	\$15,683,400
5	Stillhouse Hollow to Georgetown	Dec. 1988	HDR	\$21,218,200
6	Alan Henry to Lubbock	April 1983	Freese & Nichols	\$57,924,400
7	Palo Duro to Gruver	May 1985	Freese & Nichols	\$41,144,300
8	Livingston to Houston (Luce Bayou)	Jan. 1979	Brown & Root	\$38,983,820
9	Ivie to Abilene	Dec. 1991	Freese & Nichols	\$44,881,600
10	Toledo Bend to Houston	Nov. 1989	Freese & Nichols	\$176,610,000
11	Palestine to Dallas	Dec. 1989	Turner, Collie & Braden	\$195,377,700
12	Post to Lubbock	Oct. 1991	Freese & Nichols	\$35,307,600
13	Lake Fork to Dallas	Dec. 1989	Turner, Collie & Braden	\$194,574,000
14	Tehuacana/Richland to Ft Worth	Oct. 1990	Freese & Nichols	\$343,728,200
15	Shaws Bend to San Antonio	May 1994	HDR	\$221,344,200
16	Parkhouse to Dallas	Dec. 1989	Turner, Collie & Braden	\$192,760,000

2. Appendices B and C are provided on disks with this report. The appendices are in two QuattroPro 5 for Windows spreadsheet files: RES\_COST.WB1 and PIPECOST.WB1. Each spreadsheet is divided into several pages. The first page contains general information about each project. The second page is a comparison of (a) the original estimates, (b) the costs from *Water for Texas Today and Tomorrow, 1990* and (c) the current opinions of cost. Following the first two pages are the detailed calculations, with each project on its own page. The formulas used in the calculations may be inspected by opening the files. Information that appears more than once in a file is referenced to a single cell. For example, if you change the pipe price for a project, the updated prices will appear both on the detail page and on the summary page. Each page has a macro button to print the page. The printouts are formatted for an HP Laserjet IIISi printer.
  
3. Also included with this report are two notebooks of information copied from the source documents. The detailed tables in the appendices and spreadsheets refer to information found in this notebook.

4. There are inherent inconsistencies in the costs given in this report due to the wide variety of sources and variations in the quality of the original estimates. Some sources are only a conceptual presentation with a rough estimate of the costs, while some are based on detailed studies. Some source documents include detailed tables with construction quantities, while others present only a brief summary of costs. In some cases the original estimates are simply out of date. For this project we have tried to make the opinions of cost as consistent as possible, but it is beyond the scope of this project to make a detailed study of each project. If the original opinion of cost seemed to be consistent with our experience, we accepted it as valid.
5. The source documents vary widely in what is included in the estimate. We have identified standard items that may be included in each estimate, additional facilities that may be needed for some projects, and facilities that are specifically excluded from our estimates. Table 3 contains a summary of these items. For water supply projects we included the cost to build the dam itself, to acquire and use the reservoir land area, and to permit the project. Some reservoir projects require supplemental pumping or flood protection for facilities within the flood pool that cannot be moved. Recreational facilities and interest accrued during construction were excluded at the request of the TWDB. For conveyance projects we included the cost to install the pipe, to build pumping facilities and inlet structures, to acquire and use the right-of-way, and to permit the project. Some conveyance projects require outlet structures if water is delivered to an existing lake or river, and some projects require terminal storage facilities. Treatment facilities and interest accrued during construction were excluded at the request of the TWDB. The costs of facilities to deliver treated water to customers were excluded unless a regional treatment plant is part of the original concept, as in the Palo Duro, Eastex and Paluxy systems.

### **Cost Multipliers**

6. Opinions of cost usually include a contingency factor varying from 10 to 35 percent as an allowance for unforeseen circumstances, engineering design and representation during construction, mobilization of construction crews, overhead and profit for the contractor, and the relative confidence level of the estimator. In this report, we used the markups in the original estimates for water supply projects unless we revised the original estimate. If we made a new water supply estimate, we used 25 percent for engineering and contingencies. For conveyance projects, we used a 20 percent engineering and contingencies multiplier for installed pipe and a 25 percent multiplier for other items. We also used a 15 percent multiplier for overhead and profit for the contractor rather than including this factor in the unit prices.

**Table 3**  
**Elements for Opinions of cost**

<b>Standard Facilities</b>	
<b>Water Supply Projects</b>	<b>Conveyance Projects</b>
Embankment	Installed pipe
Spillway	Intake structures
Outlet works	Pump stations
Site work	Right of way
Land	Conflicts
Conflicts	Environmental & archeological studies
Administrative facilities	Engineering & contingencies
Environmental & archeological studies	Construction management
Permitting	
Terrestrial mitigation tracts	
Engineering & contingencies	
Construction management	
<b>Other Facilities</b>	
<b>Water Supply Projects</b>	<b>Conveyance Projects</b>
Supplemental pumping facilities	Terminal storage
Flood protection	Outlet structures
<b>Excluded Elements</b>	
<b>Water Supply Projects</b>	<b>Conveyance Projects</b>
Public use areas	Treatment facilities
Interest accrued during construction	Distribution facilities for treated water
	Interest accrued during construction

**Water Supply Projects**

- In most cases the original estimates were updated by multiplying by the appropriate Engineering News Record construction cost index (CCI). In some cases the original opinion of cost was recomputed using current construction prices. Table 3 is a list of the elements included in and excluded from the opinions of cost. Excluded from the water supply opinions of cost were interest accrued during construction and public use facilities.

8. Elements of the original reservoir opinions of cost were divided into the following categories:
  - **Construction** - the costs associated with the dam, spillway and outlet structure, including on-site administrative facilities.
  - **Land and Conflicts** - the cost to buy and clear the land in the reservoir's flood pool and the cost to relocate highways, utilities, oil and gas wells, and other facilities affected by the reservoir.
  - **Permitting and Studies** - the costs associated with permitting, including environmental and archeological surveys and water rights applications. It is likely that this total was underestimated in the older estimates for some projects.
  - **Other**- the costs of facilities that are not part of a typical reservoir. Examples are pumping facilities for augmented yield and levee systems to protect facilities that cannot be relocated.
  - **Terrestrial Mitigation** - the costs associated with the purchase of mitigation property. We assumed that terrestrial mitigation would be 15 percent of the reservoir's total cost unless this cost was included in the original report.
9. Opinions of cost for the Shaws Bend, Lindenau, Cuero, Goliad and Cibolo reservoirs were updated in 1994 for the *Trans-Texas West Central Study Area Phase I Interim Report*. However, the opinions of cost in the Interim Report are presented only as a summary and were not detailed enough to separate the projects into water supply, transmission and treatment components, or to exclude the elements indicated in table 3. The costs in the Interim Report for Shaws Bend were based on a 1985 cost estimate by the Bureau of Reclamation, and the costs of the remaining reservoirs were based on the 1985 report *Water Availability Study for the Guadalupe and San Antonio River Basins* by Espey Huston and Associates. Those reports have more detailed opinions of cost and were used in this report. To update those costs we excluded the elements listed in Table 3 and multiplied by the appropriate CCI.
10. The two channel dam structures - the Brownsville Weir (Site A Channel Dam) and the Neches Salt Barrier - do not have individual spreadsheet pages, since the total costs were simply multiplied by the CCI. The calculations are in the spreadsheet cost summary page.
11. For the South Bend Reservoir, we used the option with the top of the dam at elevation 1090.0 msl. For the reservoir yield, we assumed that South Bend would be operated in coordination with Possum Kingdom and Lake Granbury.

**Conveyance Systems**

12. With a few exceptions, we made new calculations for the cost of installed pipe. If the cost of the right-of-way was not specified in the report, we assumed a cost of \$5 per foot. Most other costs are the original source document figures multiplied by the CCI. Table 3 is a summary of included and excluded elements. Interest during construction and water treatment facilities were not included in the opinions of cost.
13. Table 4 is a list of average prices for installed pipe of mixed class, using standard open cut construction in a rural area. The price of installed pipe may increase if the pipe is installed in an urban area, in hard rock or under unusual or adverse conditions. With the exception of the Stillhouse Hollow to Georgetown project, we found no information in the source documents about conditions that would increase the installation cost of the pipe. These costs were derived using a spreadsheet developed in-house by Freese and Nichols. The unit cost of the pipe includes the cost of pipe material, trench excavation and safety, installation, select fill (embedding), backfill, compaction and other miscellaneous costs. Costs for overhead and profit for the contractor, engineering, contingencies, right-of-way or conflicts are not included in the unit prices. Our pipe unit costs are less conservative than the costs originally used by the TWDB in 1990. However, they are consistent with our experience.

**Table 4**  
**Average Unit Costs for Installed Pipe**

Pipe Size in Inches	A Base Cost per Foot	B Cost per Foot with Overhead & Profit	C Cost per Foot with Overhead, Profit, Engineering & Contingencies	D 1990 TWDB Pipe Cost Updated to 1995 (1.20 CCI)
		A x 1.15	B x 1.20	
10"	\$22	\$25	\$30	
12"	\$27	\$31	\$37	
14"	\$32	\$37	\$44	
21"	\$47	\$54	\$65	
24"	\$54	\$62	\$75	\$120
27"	\$61	\$70	\$84	
33"	\$75	\$86	\$104	
36"	\$81	\$93	\$112	\$186
42"	\$100	\$115	\$138	
48"	\$125	\$144	\$173	\$198
66"	\$198	\$228	\$273	\$288
72"	\$216	\$248	\$298	
84"	\$252	\$290	\$348	\$396
96"	\$288	\$331	\$397	\$492
102"	\$305	\$351	\$421	

14. Opinions of cost for conveyance facilities were divided into the following categories:

- **Conveyance** - the cost for pipe or canal system, including the cost of installed pipe, right-of-way and conflicts. In most cases we made a new opinion of cost for the pipe and multiplied other costs by the CCI.
- **Pump Station and Inlet** - the cost of the pump station and inlet works at the water supply source, including inlet structures, buildings, equipment and permitting. This may also include the cost of a residence for the operator or other facilities as required.
- **Booster Pump Stations** - the cost of booster pump facilities along the transmission line, including buildings, equipment, storage tanks and permitting. This may also include the cost of a residence for the operator or other facilities as required.
- **Other** - the costs of outlet works and terminal storage reservoirs or tanks.
- **Environmental and Archeological** - the costs associated with environmental and archeological studies required for the permitting process. This was assumed to be \$1,000 per mile.

15. In most cases the cost of pumping facilities was based on the original price multiplied by the CCI factor. If a pump station cost was unavailable or the cost did not seem to be appropriate, we estimated a cost based on our recent experience.

16. In many cases a conveyance system was part of a water supply scenario that was difficult to separate into individual components. Sometimes there were different options for the same project with variations in pipe sizes, capacities, routes and delivery points. Examples of projects with these difficulties are Lake Livingston to Houston, Toledo Bend to Houston, Lake Fork to Dallas, Alan Henry to Lubbock, and Post to Lubbock. For these projects we made the following assumptions:

- The primary conveyance system from Lake Livingston to Houston was assumed to be the Luce Bayou project. Conveyance from Toledo Bend was assumed to be the system recommended in the *Preliminary Feasibility Study Interbasin Water Transfer from the Sabine River to the San Jacinto River Authority Service Area* (Freese and Nichols, 1989), which uses the existing CWA canal system. Other conceptual designs (Wayne Smith and Associates, 1988; Metcalf and Eddy, 1986; Turner, Collie and Braden, 1974) have presented different alternatives for conveyance from these sources.
- We used the Lake Fork to Dallas system found in Appendix F of the 1989 *Long Range Water Supply Plan 1990-2050* by Turner, Collie and Braden. This system uses 84-inch pipe for the entire project. Other scenarios for this project were presented elsewhere in the same report.



- We were unable to locate a conceptual design for conveyance solely from the Post Reservoir. Post has been included in a system with Alan Henry (Justiceburg), and it was generally assumed that Post would be built before Alan Henry. This is not the case. For this report, we assumed that both systems were built independently.
17. In some cases we were unable to locate a design report, or the information that we found was insufficient to make an adequate opinion of cost. For these projects we made the following assumptions:
- We used the Parkhouse to Dallas system found in Alternative 5 in the 1989 Turner, Collie and Braden plan. We assumed this system would be 100 miles long.
  - For Moss Reservoir to Gainesville we used information provided by the TWDB.
  - For the Sam Rayburn to Lufkin project we used a rough opinion of cost found in the 1989 *Memorandum Report on Long-Range Water Supply Study* prepared by Freese and Nichols for Champion International Corporation. Champion is an industrial concern in the Lufkin area and a possible customer of Sam Rayburn water.
  - For the Shaws Bend conveyance project we used the system in the 1994 *Trans-Texas West Central Study Area Phase I Interim Report*. We assumed the system was 104 miles long and would require four pump stations.
18. Other assumptions concerning conveyance projects are as follows:
- At the TWDB's request, we only updated the cost of the Eastex northern system as described in the *Lake Eastex Regional Water Supply Planning Study*. We did not update costs for the other systems in that report.
  - For the Paluxy system, we included the cost to deliver water to Stephenville, Glen Rose and parts of rural Somervell County.
  - A definite route and delivery point for the O.H. Ivie to Abilene project have not been chosen. We used the option recommended by Freese and Nichols in the 1991 West Central Texas Municipal Water District *Regional Water Supply Plan*.

### **Recommendations for Additional Studies**

19. Based on recent experience with Lake Alan Henry and Richland-Chambers Reservoir, we recommend that subordination of mineral rights be reevaluated for all potential reservoir sites. This issue is still being contested in the legal system and has not been resolved, but it is our opinion that all of the reservoir studies should be re-examined with regard to this problem.

20. We recommend that all reservoir projects that have not been studied in detail since 1990 be reevaluated in light of current permitting and mitigation requirements. These projects are the Post, Big Sandy and South Bend reservoirs.
  
21. For transmission systems we recommend that the projects which did not have a detailed conceptual design be studied. (It is possible that in some cases a detailed conceptual design exists but was unavailable for this report.) These projects are Moss Reservoir to Gainesville, Sam Rayburn to Lufkin, O.H. Ivie to Abilene, Shaws Bend to San Antonio, and Parkhouse to Dallas. We also recommend reevaluations of the Post and Alan Henry transmission systems.

## **Appendix A**

### **References**

## Appendix A

### Primary References

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Espey, Huston and Associates, Inc., *Water Availability Study for the Guadalupe and San Antonio River Basins* (two volumes), prepared for the San Antonio River Authority, Guadalupe-Blanco River Authority, and the City of San Antonio, February, 1986.

Freese and Nichols, Inc., *Draft Memorandum Report on Operation Studies and Opinions of Cost for Allens Creek Reservoir*, prepared for the Trans-Texas Water Program Southeast Area, July 1995.

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Freese and Nichols, Inc., *Memorandum to the Palo Duro River Authority: Cost Estimate for Palo Duro Reservoir and Transmission System*, December 1984 (updated May 1985).

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U.S. Army Corps of Engineers, Galveston, *Cost Estimate, Neches River Salt Water Barrier Modified Site 1 Plan Beaumont, Texas*, October 1994 (price level July 1994).

U.S. Department of the Interior, Bureau of Reclamation, Great Plains Region, Billings, Montana, *Report on the Texas Big Sandy Study*, April 1991 (price level October 1988).

## Secondary References

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Freese and Nichols, Inc., *Economic Analysis of Surface Water Treatment*, prepared for the City of Stephenville, October 1988.

Freese and Nichols, Inc., *Engineering Report on Paluxy Reservoir*, prepared for the City of Stephenville, March 1985.

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**Appendix B**  
**Water Supply Projects**  
**Cost Estimates**





### Water Supply Project Information

	Project Name	Basin	Dammed Stream	Dam Height (feet)	Area (acres)	Storage (ac-ft)	Annual Yield (ac-ft/yr)	Primary Source Used for Opinion of Cost		
								Date	Author	Source Document
1	Lindenau	Guadalupe	Sandies Cr	101.0	26,875	606,280	45,800	Feb, 1986	Espey Huston*	Water Availability Study for The Guadalupe & San Antonio River Basins
2	Paluxy	Brazos	Paluxy R	124.0	3,848	99,674	16,300	Sept, 1991	Freese & Nichols	Memorandum Rept - Prelim. Opinion of Costs for a Paluxy Res. Water Supply System
3	Allens Creek	Brazos	Allens Cr	55.5	7,060	143,571	70,000	July, 1995	Freese & Nichols	Draft Memorandum Rept. Operation Studies & Opinion of Cost for Allens Cr Res
4	Cuero	Guadalupe	Guadalupe R	111.0	41,500	1,167,000	168,000	Feb, 1986	Espey Huston*	Water Availability Study for The Guadalupe & San Antonio River Basins
5	Eastex	Neches	Mud Cr	65.0	10,000	187,839	85,507	Aug, 1991	Lockwood, Andrews & Newnam	Lake Eastex Regional Water Supply Planning Study - ANRA
6	Post	Brazos	N Fk Dbl Mtn Fk	94.0	2,283	57,420	10,765	June, 1979	Freese & Nichols	Memorandum Rept. Post-Justiceburg Surface Water Supply System
7	Goliad	San Antonio	San Antonio R	119.5	27,810	707,500	115,500	Feb, 1986	Espey Huston*	Water Availability Study for The Guadalupe & San Antonio River Basins
8	Brownsville Weir	Rio Grande	Rio Grande				40,000	Aug, 1994	Horizon Environmental	Environmental Assessment Brownsville Wier and Reservoir Project
9	Tehuacana	Trinity	Tehuacana Cr	85.5	14,938	337,947	68,300	Oct, 1990	Freese & Nichols	Regional Water Supply Plan - TCWCID#1 Vol. 2
10	Big Sandy	Sabine	Big Sandy Cr	54	4,405	67,200	46,600	Oct, 1988	Bureau of Reclamation	Report on the Texas Big Sandy Study
11	Parkhouse I	Sulphur	S Sulphur R	75	29,740	685,706	123,000	Oct, 1990	Freese & Nichols	Regional Water Supply Plan - TCWCID#1 Vol. 2
12	Parkhouse II	Sulphur	N Sulphur R	70	12,250	243,613	136,700	Oct, 1990	Freese & Nichols	Regional Water Supply Plan - TCWCID#1 Vol. 2
13	Marvin Nichols I	Sulphur	Sulphur R	74	62,128	1,369,717	624,400	Oct, 1990	Freese & Nichols	Regional Water Supply Plan - TCWCID#1 Vol. 2
14	Marvin Nichols II	Sulphur	White Oak Cr	68	35,919	771,631	294,800	Oct, 1990	Freese & Nichols	Regional Water Supply Plan - TCWCID#1 Vol. 2
15	Shaws Bend	Colorado	Colorado R	67	12,400	132,220	100,000	July, 1985	Bureau of Reclamation*	Project Cost Estimate
16	South Bend	Brazos	Brazos R	101.5	28,951	745,790	120,100	July, 1987	Freese & Nichols	TCG Letter to BRA "Estimated Costs for Items on the Time Line"
17	Cibolo	San Antonio	Cibolo Cr	123	16,700	409,700	32,300	Feb, 1986	Espey Huston*	Water Availability Study for The Guadalupe & San Antonio River Basins
18	Neches SW Barrier	Neches	Neches R	53	--	--	--	July, 1994	COE - Galveston	Cost Estimate Neches River Salt Water Barrier Modified Site 1 Plan

\* Used instead of the more recent HDR TTWP report because of more detailed cost estimates



Water Supply Project Opinion of Cost

Project Name	1990 Water Plan Opinion of Cost	Original Estimate					1995 Updated Opinion of Cost						Comments	
		Construction	Land & Conflicts	Permitting & Studies	Other	Total	Cost Index	Updated Cost	Additional		Mitigation			Total Cost
									Costs	Item(s)	Cost	Source		
1 Lindenau	\$315,000,000	\$40,210,000	\$109,590,000	\$1,580,000	\$45,910,000	\$197,290,000	1.29	\$254,500,000			\$12,690,000	Original estimate	\$267,190,000	Includes diversions from the Guadalupe River (EH design)
2 Paluxy	\$61,000,000	\$30,830,000	\$23,100,000	\$2,020,000		\$55,950,000	1.16	\$64,900,000			\$9,740,000	15% of Total	\$74,640,000	Detailed estimate in 1985
3 Allens Creek	\$158,000,000	\$52,040,000	\$28,790,000	\$2,880,000	\$47,010,000	\$130,720,000	1.00	\$131,000,000			\$12,250,000	Original estimate	\$143,250,000	Alternative project - excludes wetland
4 Cuero	\$346,000,000	\$111,790,000	\$148,000,000	\$2,410,000		\$262,200,000	1.29	\$338,240,000			\$20,590,000	Original estimate	\$358,830,000	
5 Eastex	\$91,000,000	\$20,990,000	\$66,880,000			\$87,870,000	1.16	\$101,930,000	\$2,000,000	404 Permit	\$18,390,000	Original estimate	\$122,320,000	Water right permit granted in 1985
6 Post	\$28,000,000	\$12,640,000	\$2,890,000			\$15,530,000	1.85	\$28,700,000	\$2,500,000	Permits	\$4,310,000	15% of Total	\$35,510,000	
7 Goliad	\$296,000,000	\$80,450,000	\$84,910,000	\$2,060,000		\$167,420,000	1.29	\$215,980,000			\$32,400,000	15% of Total	\$248,380,000	No mitigation in EH estimate
8 Brownsville Weir	\$28,000,000	\$31,462,798				\$31,462,798	1.01	\$32,000,000	\$3,000,000	Permits			\$35,000,000	
9 Tehuacana	\$113,000,000	\$31,160,000	\$79,432,000	\$2,529,000		\$113,121,000	1.20	\$135,700,000			\$20,380,000	15% of Total	\$156,080,000	
10 Big Sandy	\$84,000,000	\$23,700,000	\$30,800,000	\$900,000		\$55,400,000	1.21	\$67,100,000			\$3,847,000	Original estimate	\$70,947,000	Report published in April 1991, price level 1988
11 Parkhouse I	\$60,000,000	\$71,114,000	\$42,826,000	\$4,519,000		\$118,459,000	1.20	\$142,100,000			\$21,320,000	15% of Total	\$163,420,000	
12 Parkhouse II	\$59,000,000	\$69,501,000	\$15,333,000	\$2,519,000		\$87,353,000	1.20	\$104,800,000			\$15,720,000	15% of Total	\$120,520,000	
13 Marvin Nichols I		\$132,110,000	\$90,390,000	\$7,943,000		\$230,443,000	1.20	\$276,500,000			\$41,480,000	15% of Total	\$317,980,000	
14 Marvin Nichols II		\$84,168,000	\$84,918,000	\$4,876,000		\$173,962,000	1.20	\$208,800,000			\$31,320,000	15% of Total	\$240,120,000	
15 Shaws Bend	\$257,000,000	\$86,060,000	\$88,050,000	\$2,500,000		\$176,610,000	1.32	\$232,420,000			\$24,213,000	Original estimate	\$256,633,000	
16 South Bend	\$208,000,000	\$73,720,000	\$107,790,000	\$2,810,000		\$184,320,000	1.25	\$230,400,000			\$34,560,000	15% of Total	\$264,960,000	Cons pool at 1090, yield for 3 reservoir system
17 Cibolo	\$226,000,000	\$79,610,000	\$72,920,000	\$2,040,000	\$9,530,000	\$164,100,000	1.29	\$211,690,000			\$4,140,000	Original estimate	\$215,830,000	Includes flood protection system
18 Neches SW Barrier	\$450,000,000	\$74,778,944				\$74,778,944	1.015	\$76,000,000	\$2,000,000	Permits			\$78,000,000	Does not include cost to relocate Temple-Inland outfall

## Lindenau Reservoir

Source: Espey Huston , February 1986  
Table 8.3-6

		1986 Cost	1986 Total	1995 Total
<b>Construction Cost</b>				
Earthen Embankment		\$19,648,800		
Spillway & Outlet Works		\$13,489,100		
Administration Facilities		\$370,000		
		\$33,507,900		
Engineering & Contingencies:	20%	\$6,701,580		
1986 Total		\$40,209,480	\$40,210,000	
CCI	1.29	\$51,870,900		\$51,870,000
<b>Land &amp; Conflicts</b>				
Lands & ROW		\$60,089,895		
Roads & Bridges		\$24,319,265		
Utilities & Pipeline		\$2,826,259		
		\$87,235,419		
Engineering & Contingencies:	20%	\$17,447,084		
		\$104,682,503		
ROW Acquisition		\$4,910,750		
1986 Total		\$109,593,253	\$109,590,000	
CCI	1.29	\$141,371,100		\$141,370,000
<b>Permitting &amp; Studies</b>				
Permitting		\$483,000		
Engineering & Contingencies:	20%	\$96,600		
		\$579,600		
Permitting (Legal)		\$1,000,000		
1986 Total		\$1,579,600	\$1,580,000	
CCI	1.29	\$2,038,200		\$2,040,000

**Other**

Supplemental Pumping			
Intake		\$5,017,400	
Pump Station		\$18,992,093	
Pipeline		\$8,424,000	
Outlet		\$311,400	
Land & ROW		\$65,909	
Flood Protection			
Levee		\$450,000	
Pump Station		\$5,000,000	
		\$38,260,802	
Engineering & Contingencies:	20%	\$7,652,160	
1986 Total		\$45,912,962	\$45,910,000
CCI	1.29	\$59,223,900	\$59,220,000
<b>Grand Total</b>			<b>\$197,290,000 \$254,500,000</b>

## Paluxy Reservoir

### Construction Cost

Source: Freese and Nichols, September 1991

Table 1

		1991 Cost	1991 Total	1995 Total (1.16 CCI)
Design and Construction		\$24,513,500		
Contingencies	20%	\$4,902,700		
		\$29,416,200		
Engineering	4.8%	\$1,412,000		
		\$30,828,200	\$30,830,000	\$35,760,000

### Land & Conflicts

Source: Freese and Nichols, September 1991

Table 1

		1991 Costs		
FM Roads		\$7,711,200		
County Roads		\$1,928,100		
Land		\$5,455,200		
Severance @ 10%		\$545,500		
Easement		\$468,600		
Cemetery Relocation		\$166,100		
Reservoir Clearing		\$2,206,800		
		\$18,481,500		
Engineering & contingency	25%	\$4,620,400		
		\$23,101,900	\$23,100,000	\$26,800,000

### Permitting & Studies

Permits		\$2,019,900	\$2,020,000	\$2,340,000
<b>Grand Total</b>			\$55,950,000	\$64,900,000

## Allens Creek Reservoir

Source: Freese and Nichols, 1995

Opinion of Probable Cost to Develop the Proposed Allens Creek Reservoir (draft)

Table 5

		Cost	Total
<b>Construction Cost</b>			
Earthen Embankment		\$29,311,000	
Spillway		\$9,886,000	
Outlet Works		\$210,000	
Site Work		\$514,000	
		\$39,921,000	
Engineering & Contengencies	25%	\$9,980,250	
		\$49,901,250	
Construction Monitoring		\$2,139,000	
		\$52,040,250	\$52,040,000
<b>Land &amp; Conflicts</b>			
Reservoir Land		\$16,021,000	
Flood Easement		\$600,000	
Subordination of Mineral Rights		\$500,000	
Conflict Resolution		\$11,415,000	
Lake Office		\$250,000	
Subtotal		\$28,786,000	\$28,790,000
<b>Permitting &amp; Studies</b>			
Permitting		\$2,875,000	\$2,880,000
<b>Other</b>			
<b>Pump Station &amp; Related Facilities</b>			
Intake & Forebay		\$2,281,000	
Structure & Equipment		\$28,673,000	
Discharge Facilities		\$3,600,000	
		\$34,554,000	
Engineering & Contengencies	25%	\$8,638,500	
		\$43,192,500	
Electrical Facilities		\$2,796,000	
Construction Monitoring		\$1,021,000	
		\$47,009,500	\$47,010,000
<b>Grand Total</b>			<b>\$130,720,000</b>

## Cuero Reservoir

Source: Espey Huston , February 1986  
Table 8.3-3

		1986 Cost	1986 Total	1995 Total
<b>Construction Cost</b>				
Earthen Embankment		\$42,396,975		
Spillway & Outlet Works		\$50,393,925		
Administration Facilities		\$370,000		
		\$93,160,900		
Engineering & Contingencies	20%	\$18,632,180		
1986 Total		\$111,793,080	\$111,790,000	
CCI	1.29	\$144,213,073		\$144,210,000
<b>Land &amp; Conflicts</b>				
Lands & ROW		\$81,411,185		
Roads & Bridges		\$30,087,960		
Utilities & Pipeline		\$3,377,000		
Rail Roads		\$3,402,000		
Cemetaries		\$600,000		
		\$118,878,145		
Engineering & Contingencies	20%	\$23,775,629		
		\$142,653,774		
ROW Acquisition		\$5,350,850		
1986 Total		\$148,004,624	\$148,000,000	
CCI	1.29	\$190,925,965		\$190,930,000
<b>Permitting &amp; Studies</b>				
Permitting		\$1,005,000		
Engineering & Contingencies	20%	\$201,000		
		\$1,206,000		
Permitting (Legal)		\$1,200,000		
1986 Total		\$2,406,000	\$2,410,000	
CCI	1.29	\$3,103,740		\$3,100,000
<b>Other</b>				
<b>Grand Total</b>			\$262,200,000	\$338,240,000

## Lake Eastex

Source: Lockwood, Andrews & Newnam, August 1991  
 Tables IV.3, IV.4, IV.5, VI.1

		1991 Cost	1991 Total	1995 Total (1.16 CCI)
<b>Construction Cost</b>				
Embankment		\$10,707,000		
Spillway		\$4,222,000		
Outlet Works		\$400,000		
Outfall Channel		\$813,000		
Site Work		\$650,000		
		\$16,792,000		
Engineering & Contengencies	25%	\$4,198,000		
		\$20,990,000	\$20,990,000	
CCI	1.16	\$24,348,400		\$24,350,000
<b>Land &amp; Conflicts</b>				
ANRA Program Management		\$219,000		
Title Search & Insurance		\$424,000		
Surveyor		\$743,000		
Appraisal		\$500,000		
Negotiations		\$312,000		
Condemnation		\$377,000		
Land		\$11,207,000		
		\$13,782,000		
Engineering & Contengencies	20%	\$2,756,400		
		\$16,538,400		
CCI	1.16	\$19,184,544		
Highways		\$26,595,000		
County Roads		\$1,478,000		
Railroad		\$4,905,000		
Power Lines		\$4,532,000		
Oil & Gas		\$2,103,000		
Telephone		\$550,000		
ROW Acquisition		\$111,000		
		\$40,274,000		
Engineering & Contengencies	25%	\$10,068,500		
		\$50,342,500	\$66,880,000	
CCI	1.16	\$58,397,300		\$77,580,000



**Permitting & Studies**

**Other**

**Grand Total**

**\$87,870,000 \$101,930,000**

## Post Reservoir

Source: Freese and Nichols, June 1979  
Table 6

### Construction Cost

	Unit	Quantity	Unit Cost	1979 Cost	1995 Cost (1.85 CCI)
Care of Water	L.S.			\$212,000	
Clear & Grub	Acre	66	\$1,272.00	\$84,000	
Excavation	C.Y.	866,600	\$1.06	\$918,600	
Borrow Excav.	C.Y.	3,090,300	\$0.95	\$2,935,800	
Care Trench	C.Y.	93,600	\$1.06	\$99,200	
Embankment, Selected	C.Y.	1,515,000	\$0.72	\$1,090,800	
Embankment, Random	C.Y.	2,277,900	\$0.53	\$1,207,300	
Waste	C.Y.	257,600	\$0.11	\$28,300	
Filter	C.Y.	174,000	\$5.30	\$922,200	
Riprap	C.Y.	126,300	\$10.60	\$1,338,800	
Blanket	C.Y.	31,600	\$5.30	\$167,500	
Seeding	Ac	33	\$2,120.00	\$70,000	
Stabilized base roadway	Sta	140	\$1,272.00	\$178,100	
Bituminous coatings	L.S.			\$14,000	
Spillway	L.S.			\$816,000	
Guard posts	Ea	900	\$4.24	\$3,800	
Irrigation system	L.S.			\$26,500	
				\$10,112,900	
Engineering & contingencies			25%	\$2,528,200	
<b>Total</b>				\$12,641,100	\$12,640,000
					\$23,400,000
<b>Land &amp; Conflicts</b>					
Raise Hwy. 361 bridge				\$804,000	
Engineering & contingencies			25%	\$201,000	
Land	Ac	3,302	\$320	\$1,056,600	
Severance (10%)		10%		\$105,700	
Easement	Ac	1,380	\$210	\$289,800	
Clearing	Ac	2,200	\$55	\$121,000	
				\$1,573,100	
Contingency			20%	\$314,600	
<b>Total</b>				\$2,892,700	\$2,890,000
					\$5,300,000
					\$0
					\$0
<b>Permitting &amp; Studies</b>					
					\$0
					\$0
<b>Grand Total</b>				\$15,530,000	\$28,700,000

## Goliad Reservoir

Source: Espey Huston , February 1986  
Table 8.3-11

		1986 Cost	1986 Total	1995 Total
<b>Construction Cost</b>				
Earthen Embankment		\$17,504,750		
Spillway & Outlet Works		\$49,168,250		
Administration Facilities		\$370,000		
		\$67,043,000		
Engineering & Contingencies	20%	\$13,408,600		
1986 Total		\$80,451,600	\$80,450,000	
CCI	1.29	\$103,782,564		\$103,780,000
<b>Land &amp; Conflicts</b>				
Lands & ROW		\$54,600,000		
Roads & Bridges		\$10,152,825		
Utilities & Pipeline		\$2,315,751		
		\$67,068,576		
Engineering & Contingencies	20%	\$13,413,715		
		\$80,482,291		
ROW Acquisition		\$4,431,000		
1986 Total		\$84,913,291	\$84,910,000	
CCI	1.29	\$109,538,146		\$109,540,000
<b>Permitting &amp; Studies</b>				
Permitting		\$882,500		
Engineering & Contingencies	20%	\$176,500		
		\$1,059,000		
Permitting (Legal)		\$1,000,000		
1986 Total		\$2,059,000	\$2,060,000	
CCI	1.29	\$2,656,110		\$2,660,000
<b>Other</b>				
<b>Grand Total</b>			\$167,420,000	\$215,980,000

## Tehuacana Reservoir

Source: Freese and Nichols, October 1990  
Table I-16 (1989 prices)

### Construction Cost

Item	Description	1989 cost	1989 total	1995 total (1.20 CCI)
14	Construction	\$29,742,000		
13	Advertising	\$5,000		
4	Engineering pre-design	\$100,000		
5	Geotech	\$457,000		
10	Final Design	\$856,000		
	Subtotal	\$31,160,000	\$31,160,000	\$37,400,000

### Land & Conflicts

11	Land Acquisition	\$35,234,000		
12	Conflicts	\$44,198,000		
	Subtotal	\$79,432,000	\$79,432,000	\$95,300,000

### Permitting & Studies

1	Water Rights	\$800,000		
2	Environmental	\$200,000		
3	Archeological	\$176,000		
7	404 application	\$20,000		
8	404 related work	\$827,000		
9	Contingencies	\$506,000		
	Subtotal	\$2,529,000	\$2,529,000	\$3,000,000

**Grand Total** \$113,121,000 \$135,700,000

## Big Sandy Reservoir

Source: Bureau of Reclamation, April 1991  
Table II-7 (1988 prices)

### Estimation of BofR markup

Total field costs	\$53,966,000
Non-contract costs	\$10,364,000
Percentage	19.20% Round to 20%

### Construction Cost

	1988 cost	1988 total	1995 total (1.21 CCI)
Dam, spillway, outlet works	\$18,946,000		
Reservoir clearing	\$782,000		
Subtotal	\$19,728,000		
20% contingency	\$3,945,600		
	\$23,673,600	\$23,700,000	\$28,700,000

### Land & Conflicts

Relocations	\$18,627,000		
Land & Rights	\$6,030,000		
General Property	\$1,001,000		
Subtotal	\$25,658,000		
20% contingency	\$5,131,600		
	\$30,789,600	\$30,800,000	\$37,300,000

### Permitting & Studies

Archeological	\$768,000		
20% contingency	\$153,600		
	\$921,600	\$900,000	\$1,100,000

<b>Grand Total</b>		\$55,400,000	\$67,100,000
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# George Parkhouse Reservoir I

Source: Freese and Nichols, October 1990  
Table I-19 (1989 prices)

## Construction Cost

Item	Description	1989 cost	1989 total	1995 total (1.20 CCI)
14	Construction	\$67,873,000		
13	Advertising	\$5,000		
4	Engineering pre-design	\$140,000		
5	Geotech	\$1,042,000		
6	Hydraulic model study	\$100,000		
10	Final Design	\$1,954,000		
	Subtotal	\$71,114,000	\$71,114,000	\$85,300,000

## Land & Conflicts

11	Land Acquisition	\$24,995,000		
12	Conflicts	\$17,831,000		
	Subtotal	\$42,826,000	\$42,826,000	\$51,400,000

## Permitting & Studies

1	Water Rights	\$1,400,000		
2	Environmental	\$300,000		
3	Archeological	\$361,000		
7	404 application	\$30,000		
8	404 related work	\$1,524,000		
9	Contingency	\$904,000		
	Subtotal	\$4,519,000	\$4,519,000	\$5,400,000

**Grand Total** \$118,459,000 \$142,100,000

## George Parkhouse Reservoir II

Source: Freese and Nichols, October 1990  
Table I-22 (1989 prices)

### Construction Cost

Item	Description	1989 cost	1989 total	1995 total (1.20 CCI)
14	Construction	\$66,366,000		
13	Advertising	\$5,000		
4	Engineering pre-design	\$100,000		
5	Geotech	\$1,019,000		
6	Hydraulic model study	\$100,000		
10	Final Design	\$1,911,000		
	Subtotal	\$69,501,000	\$69,501,000	\$83,400,000

### Land & Conflicts

11	Land Acquisition	\$10,724,000		
12	Conflicts	\$4,609,000		
	Subtotal	\$15,333,000	\$15,333,000	\$18,400,000

### Permitting & Studies

1	Water Rights	\$800,000		
2	Environmental	\$200,000		
3	Archeological	\$174,000		
7	404 application	\$20,000		
8	404 related work	\$821,000		
9	Contingency	\$504,000		
	Subtotal	\$2,519,000	\$2,519,000	\$3,000,000

**Grand Total** \$87,353,000 \$104,800,000

## Marvin Nichols Reservoir I

Source: Freese and Nichols, October 1990  
Table I-25 (1989 prices)

### Construction Cost

Item	Description	1989 cost	1989 total	1995 total (1.20 CCI)
14	Construction	\$126,213,000		
13	Advertising	\$5,000		
4	Engineering pre-design	\$200,000		
5	Geotech	\$1,938,000		
6	Hydraulic model study	\$120,000		
10	Final Design	\$3,634,000		
	Subtotal	\$132,110,000	\$132,110,000	\$158,500,000

### Land & Conflicts

11	Land Acquisition	\$57,626,000		
12	Conflicts	\$32,764,000		
	Subtotal	\$90,390,000	\$90,390,000	\$108,500,000

### Permitting & Studies

1	Water Rights	\$2,000,000		
2	Environmental	\$500,000		
3	Archeological	\$776,000		
7	404 application	\$50,000		
8	404 related work	\$3,028,000		
9	Contingency	\$1,589,000		
	Subtotal	\$7,943,000	\$7,943,000	\$9,500,000

**Grand Total** \$230,443,000 \$276,500,000



## Marvin Nichols Reservoir II

Source: Freese and Nichols, October 1990  
Table I-28 (1989 prices)

### Construction Cost

Item	Description	1989 cost	1989 total	1995 total (1.20 CCI)
14	Construction	\$80,375,000		
13	Advertising	\$5,000		
4	Engineering pre-design	\$140,000		
5	Geotech	\$1,234,000		
6	Hydraulic model study	\$100,000		
10	Final Design	\$2,314,000		
	Subtotal	\$84,168,000	\$84,168,000	\$101,000,000

### Land & Conflicts

11	Land Acquisition	\$31,545,000		
12	Conflicts	\$53,373,000		
	Subtotal	\$84,918,000	\$84,918,000	\$101,900,000

### Permitting & Studies

1	Water Rights	\$1,400,000		
2	Environmental	\$300,000		
3	Archeological	\$433,000		
7	404 application	\$30,000		
8	404 related work	\$1,738,000		
9	Contingency	\$975,000		
	Subtotal	\$4,876,000	\$4,876,000	\$5,900,000

<b>Grand Total</b>			\$173,962,000	\$208,800,000
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# Shaws Bend Reservoir

Source: Bureau of Reclamation, July 1985  
Project Cost Estimate

## Construction Cost

Acct. No.	Description		1985 Cost	1985 Total	1995 Total
151	Dam		\$13,920,000		
	Spillway		\$49,440,000		
	Outlet Works		\$3,264,000		
	Subtotal		\$66,624,000		
	Engineering & Contingencies	25%	\$16,656,000		
			\$83,280,000		
130	Operating Facilities		\$785,000		
	Engineering & Contingencies	25%	\$197,000		
			\$982,000		
120	Reservoir clearing		\$1,500,000		
	Contingencies	20%	\$300,000		
			\$1,800,000		
	1985 Total		\$86,062,000	\$86,060,000	
	CCI	1.316	\$113,257,592		\$113,260,000

## Land & Conflicts

100	Land and Rights		\$75,000,000		
	Contingencies	15%	\$11,250,000		
			\$86,250,000		
110	Relocations		\$1,500,000		
	Contingencies	20%	\$300,000		
			\$1,800,000		
	1985 Total		\$88,050,000	\$88,050,000	
	CCI	1.316	\$115,873,800		\$115,870,000

**Permitting & Studies**

120 Archeology		\$2,000,000		
Contingencies	25%	\$500,000		
1985 Total		\$2,500,000	\$2,500,000	
CCI	1.316	\$3,290,000		\$3,290,000
<b>Grand Total</b>			<b>\$176,610,000</b>	<b>\$232,420,000</b>

## South Bend

Source: Freese and Nichols, July 1987

Note: Conservation pool at 1090

### Construction Cost

Item	Description	1987 cost	1987 total	1995 total (1.25 CCI)
13	Construction	\$70,007,400		
4	Engineering pre-design	\$50,000		
5	Geotech	\$775,000		
6	Hydraulic model study	\$120,000		
9	Final Design	\$2,767,600		
	Subtotal	\$73,720,000	\$73,720,000	\$92,200,000

### Land & Conflicts

10	Land Acquisition	\$66,478,800		
11	Conflicts	\$41,312,500		
	Subtotal	\$107,791,300	\$107,790,000	\$134,700,000

### Permitting & Studies

1	Water Rights	\$900,000		
2	Environmental	\$200,000		
3	Archeological	\$316,000		
7	404 application	\$10,000		
8	404 related work	\$1,380,000		
	Subtotal	\$2,806,000	\$2,810,000	\$3,500,000

<b>Grand Total</b>			\$184,320,000	\$230,400,000
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## Cibolo Reservoir

Source: Espey Huston , February 1986  
Table 8.3-11

		1986 Cost	1986 Total	1995 Total
<b>Construction Cost</b>				
Earthen Embankment		\$32,112,200		
Spillway & Outlet Works		\$33,857,000		
Administration Facilities		\$370,000		
		\$66,339,200		
Engineering & Contingencies	20%	\$13,267,840		
1986 Total		\$79,607,040	\$79,610,000	
CCI	1.29	\$102,693,082		\$102,690,000
<b>Land &amp; Conflicts</b>				
Lands & ROW		\$33,301,629		
Roads & Bridges		\$22,460,910		
Utilities & Pipeline		\$1,456,331		
		\$57,218,870		
Engineering & Contingencies	20%	\$11,443,774		
		\$68,662,644		
ROW Acquisition		\$4,261,500		
1986 Total		\$72,924,144	\$72,920,000	
CCI	1.29	\$94,072,146		\$94,070,000
<b>Permitting &amp; Studies</b>				
Permitting		\$865,000		
Engineering & Contingencies	20%	\$173,000		
		\$1,038,000		
Permitting (Legal)		\$1,000,000		
1986 Total		\$2,038,000	\$2,040,000	
CCI	1.29	\$2,629,020		\$2,630,000

**Other**

Flood Protection			
Levee		\$2,945,000	
Pump Station		\$5,000,000	
		\$7,945,000	
Engineering & Contingencies	20%	\$1,589,000	
1986 Total		\$9,534,000	\$9,530,000
CCI	1.29	\$12,298,860	\$12,300,000
<b>Grand Total</b>			\$164,100,000 \$211,690,000

**Appendix C**  
**Conveyance Systems**  
**Cost Estimates**



Conveyance Systems Information

	Project Name	Source	Destination	Length in Feet	Flow in MGD	Peaking Factor	Design Flow in MGD	Pipe Size in Inches	C Factor	Hf	Friction Loss	Elevation Change in Feet	Total LIR in Feet	Pump Stations
1	Moss Reservoir to Gainesville	Moss Reservoir	Gainesville	22,000	4.91	2	9.82	24	120	3.50	77	37	114	1
2	Sam Rayburn to Lufkin	Sam Rayburn	Champion International	73,920			20	36	130	1.56	116	136	252	1
3	Eastex to Customers	Lake Eastex	WTP	2,640	16.48	1.85	30.51	42	120	1.87	5	85	90	1
		WTP	New Summerfield WSC	6,600	9.4	1.85	17.39	30	120	3.40	22	70	92	1
		New Summerfield WSC	Henderson	110,880	3.87	1.85	7.16	20	120	4.74	526	30	556	1
		New Summerfield WSC	Blackjack WSC	23,760	5.36	1.85	9.92	24	120	3.57	85	-30	55	
		Blackjack WSC	Leo Childs	10,560	0.08	1.85	0.15	4	120	9.42	100	-40	60	
		Blackjack WSC	Troup	34,320	5.16	1.85	9.55	24	120	3.33	114	10	124	1
		Troup	Walnut Grove WSC	47,520	1.3	1.85	2.41	12	120	7.61	362	30	392	
		Troup	Wright City WSC	31,680	0.73	1.85	1.35	10	120	6.33	201		201	
		Troup	Arp	34,320	2.54	1.85	4.7	16	120	6.45	222	50	272	1
		Arp	Jackson WSC	47,520	0.81	1.85	1.5	10	120	7.70	388	40	406	
		Jackson WSC	Star Mountain WSC	26,400	0.36	1.85	0.87	8	120	5.14	136	-70	86	
		Arp	Overton	34,320	1.36	1.85	2.52	12	120	8.27	284		284	
		Overton	New London	15,840	0.66	1.85	1.22	10	120	5.25	83	70	153	
		WTP	Split	31,680	7.09	1.85	13.12	30	120	2.02	64	80	144	
		Split	Jacksonville	18,480	5.38	1.85	9.95	24	120	3.59	66	50	116	
		Split	Craft-Turney WSC	18,480	1.71	1.85	3.16	16	120	3.10	57	-30	27	
		Craft-Turney WSC	Pump Station	7,920	1.07	1.85	1.96	16	120	1.30	10	-110	(100)	1
		Pump Station	Rusk	44,880	1	1.85	1.85	10	120	11.34	509	210	719	1
		Pump Station	Recklaw WSC	58,080	0.07	1.85	0.13	4	120	7.23	420	-10	410	
				605,860										7
4	Pakuxy to Customers	Pakuxy	WTP	3,300	10	2	20	36	120	1.81	6	130	136	1
		WTP	Stephenville	94,150	3	2	6	24	120	1.41	133	570	703	2
		WTP	Glen Rose, NE & SE Zones	26,000	1.10	2	2.21	14	120	3.06	80		80	1
		WTP	Takeoff	15,300	0.45	2	0.90	12	120	1.23	19		19	
		Takeoff	SW Tank	9,700	0.24	2	0.49	10	120	0.96	9		9	
		Takeoff	NW Zone	28,000	0.21	2	0.41	10	120	0.70	20		20	
				176,450										
5	Stillhouse Hollow to Georgetown	Stillhouse Hollow	Lk Georgetown	149,000	21.3	1.09	23.22	33	120	3.65	544	170	714	1
6	Alan Henry to Lubbock	Alan Henry	Term Stor & WTP	287,200	26.5	1.43	38	42	130	2.42	895	1060	1,755	4
7	Palo Duro to Customers	Palo Duro	WTP	55,800	7.81	1.5	11.72	27	120	2.74	153	208	361	1
		WTP	Spearman	10,600	1.11	1.5	1.67	12	120	3.86	41		41	
		WTP	Pump Station 1	18,000	6.70	1.5	10.05	27	120	2.06	37	35	72	1
		Pump Station 1	Gruver	53,300	1.48	1.5	2.22	14	120	3.09	165	40	205	
		Pump Station 1	Pump Station 2	110,100	5.22	1.5	7.83	24	120	2.30	254	100	354	1
		Pump Station 2	Stinnett	83,350	0.54	1.5	0.81	10	120	2.46	205	-35	170	
		Pump Station 2	Pump Station 3	64,800	4.68	1.5	7.02	21	120	3.61	234	235	469	1
		Pump Station 3	Sunny	28,000	0.69	1.5	1.04	10	120	3.91	109	40	149	
		Pump Station 3	Dumas	58,450	3.99	1.5	5.98	21	120	2.68	157	185	342	
		Dumas	Cactus	68,200	0.91	1.5	1.37	10	120	6.51	444	-35	409	1
				550,600										
8	Livingston to Houston (Luce Bayou)	Trinity River	Lake Houston	19,000			400	2 x 96 canal	120	1.08	10	72	82	1
				12,900				stream bed						
				42,700										
				74,800										
9	Ive to Abilene	Ive Reservoir	Grimes WTP	325,000	13.33	1.5	20	36	120	1.81	589	169	758	2
10	Toledo Bend to Houston	Sabine River	Lk Houston, Highlands Res	580,800			300	canal						9
11	Palestine to Dallas	Palestine	SE WTP	463,100	100	1.2	120	84	120	0.80	373	125	498	2
12	Post to Lubbock	Post Reservoir	New WTP & Term Stor	198,528	10	1.5	15	36	120	1.06	211	750	961	2
13	Lake Fork to Dallas	Lake Fork	SE WTP (via Lake Tawakoni)	390,888	100	1.2	120	84	120	0.80	315	67	382	3
14	Tehuacana/Richland to Ft Worth	Richland	Ennis	157,264	192.8	1.25	241	102	130	0.98	154	167	350	1
		Ennis	Balancing Reservoir	223,650			244	102	130	1.00	224	251	557	2
		Balancing Reservoir	Rolling Hills WTP	31,875			244	102	130	1.00	32	-44		
				412,789										
15	Shaws Bend to San Antonio	Shaws Bend	North WTP	550,000	89	1.30	116	72	130	1.38	760	820	1,580	
16	Parkhouse to Dallas	Parkhouse I	Ray Roberts (via Cooper)	528,000			60	66	120	0.72	382		381.54	4





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Conveyance Systems Information

	Project Name	Design Report		
		Date	Author	Source Document
1	Moss Reservoir to Gainesville			TWDB Spreadsheet
2	Sam Rayburn to Lufkin	Sept, 1994	Freese & Nichols	Champion International Corporation Memorandum Report on Long-Range Water Supply Study
3	Eastex to Customers	Aug, 1991	Lockwood, Andrews & Newnam	Lake Eastex Regional Water Supply Planning Study
4	Paluxy to Customers	Sept. 1991	Freese & Nichols	Memorandum Rpt: Prelim. Opinion of Costs for a Paluxy Res. Water Supply System
5	Stillhouse Hollow to Georgetown	Dec. 1988	HDR	Williamson Co Raw Water Line Preliminary Eng Rpt
6	Alan Henry to Lubbock	April, 1983	Freese & Nichols	Cost estimates from file
7	Palo Duro to Customers	May 1985	Freese & Nichols	Cost estimates from file
8	Livingston to Houston (Luce Bayou)	Jan 1979	Brown & Root	Environmental Report The City of Houston's Luce Bayou Project
9	Ivie to Abilene	Dec. 1991	Freese & Nichols	WCTMWD Regional Water Supply Plan
10	Toledo Bend to Houston	Nov 1989	Freese & Nichols	Preliminary Feasibility Study Interbasin Water Transfer from the Sabine River to the San Jacinto River Authority Serv
11	Palestine to Dallas	Dec, 1989	Turner, Collie & Braden	Dallas Long-Range Water Supply Plan 1990-2050
12	Post to Lubbock	June 1979	Freese & Nichols	Memorandum Report on Post-Justiceberg Surface Water Supply System
13	Lake Fork to Dallas	Dec, 1989	Turner, Collie & Braden	Dallas Long-Range Water Supply Plan 1990-2050
14	Tehuacana/Richland to Ft Worth	Nov, 1989	Freese & Nichols	File for TCWCID#1 Regional Water Supply Plan
15	Shaws Bend to San Antonio	May, 1994	HDR	Trans-Texas Water Program West Central Study Area Phase I Interim Rpt
16	Parkhouse to Dallas	Dec, 1989	Turner, Collie & Braden	Dallas Long-Range Water Supply Plan 1990-2050



Conveyance Systems Opinions of Cost

Project Name	1990 Water Plan Opinion of Cost	Original Estimate					1995 Updated Opinion of Cost						Source	Comments
		Conveyance (Pipe or Canal)	Pump Station & Inlet	Booster Pump Stations	Other	Total Opinion of Cost	Conveyance (Pipe or Canal)	Pump Station & Inlet	Booster Pump Stations	Other	Environmental and Archeological	Total Opinion of Cost		
Moss Reservoir to Gainesville	\$4,000,000						\$1,660,000	\$2,160,000			\$4,200	\$3,824,200	New estimate	
Sam Rayburn to Lufkin	\$44,000,000	\$8,000,000	\$2,045,000			\$10,045,000	\$8,120,000	\$2,080,000			\$14,000	\$10,214,000	Update	
Eastex to Customers	\$27,000,000	\$28,300,000		\$7,496,250		\$35,796,250	\$32,830,000		\$8,700,000		\$114,800	\$41,644,800	Update	Lake pump station not separated from others
Pakuxy to Customers	\$26,000,000	\$8,597,719	\$1,313,456	\$2,324,401	\$1,330,116	\$13,568,000	\$10,420,000	\$1,430,000	\$2,530,000	\$1,270,000	\$33,400	\$15,683,400	Update*	Does not include Hood County or Distribution
Stillhouse Hollow to Georgetown	\$19,000,000	\$12,487,100	\$2,796,400		\$351,800	\$16,000,000	\$19,980,000	\$3,380,000			\$26,200	\$23,818,200	Update*	
Alan Henry to Lubbock	\$84,000,000	\$31,371,900	\$4,847,800	\$9,398,700	\$4,048,300	\$49,668,700	\$40,870,000	\$5,000,000	\$12,000,000		\$54,400	\$57,924,400	Update*	
Palo Duro to Customers	\$25,000,000	\$18,467,000	\$2,419,000	\$3,869,000		\$24,755,000	\$31,040,000	\$2,500,000	\$7,500,000		\$104,300	\$41,144,300	Update*	Based on total system ( without Perryton)
Livingston to Houston (Luca Bayou)	\$84,000,000	\$17,300,000	\$6,500,000			\$23,800,000	\$26,489,720	\$12,480,000			\$14,100	\$38,983,820	Update*	
Ivie to Abilene	\$45,000,000	\$23,790,000	\$3,270,000	\$2,110,000		\$29,170,000	\$36,280,000	\$3,970,000	\$2,570,000		\$81,600	\$44,881,600	Update*	
Toledo Bend to Houston	\$399,000,000	\$104,610,000	\$3,750,000	\$41,210,000		\$149,570,000	\$123,440,000	\$4,430,000	\$48,630,000		\$110,000	\$176,610,000	Update	Drop under Trinity alternative
Palestine to Dallas	\$215,000,000	\$122,721,500	\$21,289,000	\$5,600,000		\$149,610,500	\$163,830,000	\$24,910,000	\$8,550,000		\$87,700	\$195,377,700	Update*	
Post to Lubbock	\$42,000,000	\$23,509,400	\$3,745,000	\$2,487,500	\$3,362,100	\$33,104,000	\$22,270,000	\$5,000,000	\$8,000,000		\$37,800	\$35,307,600	New estimate	
Lake Fork to Dallas	\$196,000,000	\$98,423,928	\$41,000,000	\$4,725,000	\$2,955,500	\$147,104,428	\$137,540,000	\$47,970,000	\$5,530,000	\$3,460,000	\$74,000	\$194,574,000	Update*	
Tehuacana/Richland to Ft Worth	\$278,000,000	\$245,480,000	\$12,975,000	\$22,988,000		\$281,443,000	\$300,480,000	\$15,580,000	\$27,590,000		\$78,200	\$343,728,200	Update*	Includes additional Richland yield and Trinity River diversion
Shaws Bend to San Antonio						\$210,600,000	\$167,240,000	\$15,000,000	\$39,000,000		\$104,200	\$221,344,200	New estimate	
Parkhouse to Dallas	\$313,000,000					\$133,500,000	\$147,440,000	\$13,300,000	\$31,920,000		\$100,000	\$192,760,000	Update*	From table 9-8H

\*New cost estimate for pipe, other facilities updated from original estimate

## Moss Reservoir to Gainesville

### Pipe

F&N 1995 Update (based on TWDB figures)

	Length	Unit Price	1995 Cost	
24 inch pipe	22,000	\$54	\$1,188,000	
Mobilization, overhead & pro		15%	\$178,200	
			\$1,366,200	
ROW	22,000	\$5	\$110,000	
			\$1,476,200	
Engineering & contingencies		20%	\$295,240	
			\$1,661,440	\$1,660,000

### Pump Station

Lake PS			\$1,500,000	
Overhead & profit		15%	\$225,000	
			\$1,725,000	
Engineering & contingencies		25%	\$431,250	
			\$2,156,250	\$2,160,000
				\$3,820,000

## Sam Rayburn to Lufkin (Champion International)

Freese and Nichols, September 1994

Appendix G

20 MGD option

### Pipe

	1994 Cost	CCI	1995 Cost
36" pipe	\$8,000,000	1.015	\$8,120,000

### Pump Station

3 pump stations	\$1,645,000		
Other equipment	\$400,000		
	\$2,045,000	1.015	\$2,080,000
			\$10,200,000

## Eastex to Customers

Lockwood, Andrews & Newnam, August 1991  
Table IV.7

			1995 Cost
<b>Pipe</b>			
1991 Estimate		\$22,640,000	
Engineering & contingencies	25%	\$5,660,000	
		\$28,300,000	
CCI	1.16	\$32,828,000	\$32,830,000
<b>Intake &amp; Pumping</b>			
not broken out in 1991 report			
Phase I		\$5,324,000	
Phase II		\$673,000	
		\$5,997,000	
Engineering & contingencies	25%	\$1,499,250	
		\$7,496,250	
CCI	1.16	\$8,695,650	\$8,700,000
<b>Total</b>			\$41,530,000

## Paluxy

Freese and Nichols, September 1991

### Pipeline

1995 update based on Tables 1,2,4

	Size	Length	Unit price	Total	1995 Total
WTP	36	3,300	\$81	\$267,300	
Stephenville	24	94,150	\$54	\$5,084,100	
Glen Rose, NE & SE Zones	14	26,000	\$32	\$832,000	
Takeoff	12	15,300	\$27	\$413,100	
SW Tank	10	9,700	\$22	\$213,400	
NW Zone	10	28,000	\$22	\$616,000	
				\$7,425,900	
Mobilization, overhead & profit			15%	\$1,113,885	
				\$8,539,785	
ROW		176,450	\$5	\$882,250	
				\$9,422,035	
Engineering & Contingencies			20%	\$1,884,407	
				\$10,424,192	\$10,420,000

### Pump Stations

Table 1

Lake				\$1,020,200	
Engineering & Contingencies			25%	\$255,050	
				\$1,275,250	
CCI			1.12	\$1,428,280	\$1,430,000

Table 2, Table 6

WTP to Stephenville				\$686,400	
Stephenville Booster				\$777,900	
WTP to Somervell*				\$341,000	
				\$1,805,300	
Engineering & Contingencies			25%	\$451,325	
				\$2,256,625	
CCI			1.12	\$2,527,420	
				\$2,527,420	\$2,530,000

\*Adjusted to remove E&C

**Storage Tanks**

Table 2, Table 5

2-MG ground (Stephenville)		\$574,000	
1.5-MG (Glen Rose)		\$332,400	
		\$906,400	
Engineering & Contingencies	25%	\$226,600	
		\$1,133,000	
CCI	1.12	\$1,268,960	\$1,270,000
			\$15,650,000

## Stillhouse Hollow to Georgetown

### Pipe Cost

1995 Pipe cost update

Class	Length		Unit price*	Cost	Subtotal	1995 Total
33" 300		35,000	\$95.70	\$3,349,500		
33" 250		19,000	\$92.40	\$1,755,600		
33" 200		21,000	\$89.10	\$1,871,100		
33" 150		63,000	\$85.80	\$5,405,400		
33" 100		11,000	\$82.50	\$907,500		
					\$13,289,100	
Mobilization, overhead & profit			15%	\$1,993,365		
					\$15,282,465	
Engineering & Contingency			20%	\$3,056,493		
					\$16,345,593	\$16,345,593

\*Unit price includes allowance for pipe class and rock trenching

HDR, December 1988

Table 5-2

Stream Crossing		\$170,000				
Road Bores		\$315,000				
Appurtenances		\$162,500				
Surveying		\$103,600				
Appraisal		\$475,000				
Easements		\$506,000				
Assignment from Table 5-4*		\$673,375				
				\$2,405,475		
Engineering & Contingency		25%	\$601,369			
				\$3,006,844		
CCI		1.21	\$3,638,281	\$3,638,281	\$19,980,000	

### Pump Stations

Table 5-3

Intake & P.S.		\$1,735,100				
Assignment from Table 5.4*		\$502,050				
				\$2,237,150		
Engineering & Contingency		25%	\$559,288			
				\$2,796,438		
CCI		1.21	\$3,383,689		\$3,380,000	



**Outlet Works**

Outlet		\$55,000	
Assignment from Table 5.4*		\$226,475	
		\$281,475	
Contingency	25%	\$70,369	
		\$351,844	
CCI	1.21	\$425,731	\$430,000
<b>Total</b>			<b>\$23,790,000</b>

\*Table 5-4

	Adjustment		Assignment		
			0% 37.5%	75% 37.5%	25% 25%
			Pipeline	P.S.	Outlet
Permits	\$102,000	\$102,000		\$76,500	\$25,500
Geotechnical	\$52,000	\$52,000		\$39,000	\$13,000
Surveying	\$382,500	\$103,600	\$278,900	\$209,175	\$69,725
Design	\$675,000	\$675,000	\$0		
Appraisal	\$475,000	\$475,000	\$0		
Permanent Easement	\$506,000	\$506,000	\$0		
Construction Easement	\$496,000	\$496,000	\$496,000		
Testing	\$360,000	\$360,000	\$135,000	\$135,000	\$90,000
Construction Admin	\$113,000	\$113,000	\$42,375	\$42,375	\$28,250
	<b>\$3,161,500</b>	<b>\$1,401,900</b>	<b>\$673,375</b>	<b>\$502,050</b>	<b>\$226,475</b>

## Alan Henry to Lubbock

### Pipe

#### 1995 Update

	L.F.	Unit price	Cost	Subtotal	1995 Total
42-inch	287,200	\$100	\$28,720,000		
RR crossing	200	\$480	\$96,000		
Creek crossing	200	\$480	\$96,000		
			\$28,912,000		
Mobilization, overhead & profit		15%	\$4,336,800		
			\$33,248,800		
Engineering & Contingencies		20%	\$6,649,760		
			\$39,898,560	\$39,900,000	

#### Freese and Nichols, April 1983

#### Estimated pipeline costs for the Justiceberg Project

US highway crossing	2	\$52,000	\$104,000		
State highway crossing	6	\$39,000	\$234,000		
FM highway crossing	1	\$19,500	\$19,500		
Minor road crossing	6	\$9,800	\$58,800		
Right-of-Way	750	\$198	\$148,500		
			\$564,800		
CCI		1.37	\$773,776		
Engineering & Contingencies		25%	\$193,444		
			\$967,220	\$970,000	\$40,870,000

### Pump Stations

#### 1995 Update

Lake PS	1	\$4,000,000	\$4,000,000		
Engineering & Contingencies		25%	\$1,000,000		
			\$5,000,000		\$5,000,000
Booster PS	3	\$3,200,000	\$9,600,000		
Engineering & Contingencies		25%	\$2,400,000		
			\$12,000,000		\$12,000,000
<b>Total</b>					<b>\$57,870,000</b>

**Palo Duro to Customers**

**Pipe**

1995 Update

		Length	Size	Unit Cost	Cost	
Palo Duro	WTP	55,800	27	\$61	\$3,403,800	
WTP	Spearman	10,600	12	\$27	\$286,200	
WTP	Pump Station 1	18,000	27	\$61	\$1,098,000	
Pump Station 1	Gruver	53,300	14	\$32	\$1,705,600	
Pump Station 1	Pump Station 2	110,100	24	\$54	\$5,945,400	
Pump Station 2	Stinnett	83,350	10	\$22	\$1,833,700	
Pump Station 2	Pump Station 3	64,800	21	\$47	\$3,045,600	
Pump Station 3	Sunray	28,000	10	\$22	\$616,000	
Pump Station 3	Dumas	58,450	21	\$47	\$2,747,150	
Dumas	Cactus	68,200	10	\$22	\$1,500,400	
					\$22,181,850	
	Mobilization, overhead & profit			15%	\$3,327,278	
					\$25,509,128	
	Engineering & Contingency			20%	\$5,101,826	
					\$30,610,953	\$30,610,000

Freese and Nichols, May 1985  
Table 3

Land, Conflicts, ROW, etc.			\$330,000		
CCI	1.316	\$434,280	\$430,000	\$31,040,000	

**Pump Stations**

1995 Update

Lake	1	\$2,000,000	\$2,000,000		
Engineering & Contingency		25%	\$500,000		
			\$2,500,000		\$2,500,000
Booster	4	\$1,500,000	\$6,000,000		
Engineering & Contingency		25%	\$1,500,000		
			\$7,500,000		\$7,500,000
					\$41,040,000

**Livingston to Houston (Luce Bayou)**

**Conveyance**

Brown and Root, January 1979

Page 6

		1979 Cost	Subtotal	1995 Cost
Canal		\$1,000,000		
Stream		\$350,000		
ROW & Contingencies		\$4,550,000		
		\$5,900,000		
CCI	1.92	\$11,328,000	\$11,330,000	

**1995 Update**

	Length	Unit Price			
2 x 96 in pipe	19,000	\$576	\$10,944,000		
Mobilization, overhead & profit		15%	\$1,641,600		
			\$12,585,600		
ROW	9,500	\$5	\$47,500		
			\$12,633,100		
Engineering & contingencies		20%	\$2,526,620		
			\$15,159,720	\$15,159,720	\$26,489,720

**Pump Station**

Brown and Root, January 1979

Page 6

		1979 Cost		
		\$6,500,000		
CCI	1.92	\$12,480,000		\$12,480,000
<b>Total</b>				<b>\$38,969,720</b>

**Ivie to Abilene**

**Pipe**

1995 Update

Pipe	Length	Unit price	Cost	1995 Total
36" variable class	325,000	\$81	\$26,325,000	
Mobilization, overhead & profit		15%	\$3,948,750	
			\$30,273,750	
ROW	325,000	\$5	\$1,625,000	
			\$31,898,750	
Engineering & Contingencies		20%	\$6,379,750	
			\$38,278,500	\$38,280,000

**Pump Stations**

Freese and Nichols, December 1991  
Table 10.3

		1991 Cost	
Lake		\$2,837,000	
CCI	1.12	\$3,177,440	
Engineering & contingency	25%	\$794,360	
		\$3,971,800	\$3,970,000
Booster		\$1,833,000	
CCI	1.12	\$2,052,960	
Engineering & contingency	25%	\$513,240	
		\$2,566,200	\$2,570,000
			\$44,820,000

## Toledo Bend to Houston

300 MGD option

### Transmission

Freese and Nichols, November 1989  
Tables C-4, C-12, C-16, C-24

	1989 Cost	1989 Total	1995 Cost (1.18 CCI)
SRA to Neches	\$23,775,343		
LNVA to Trinity PS	\$19,168,968		
Pipeline under Trinity	\$37,746,250		
Trinity to Lake Houston	\$23,924,371		
	\$104,614,932	\$104,610,000	\$123,440,000

### Pump Stations

Sabine River PS Enlargement	\$3,750,000	\$3,750,000	\$4,430,000
SRA canal PS#2	\$9,660,000		
LNVA to Trinity PS#1	\$10,296,250		
Pipe under Trinity PS#1	\$12,076,250		
Trinity to L. Houston PS#2	\$9,178,750		
	\$41,211,250	\$41,210,000	\$48,630,000
		\$149,570,000	\$176,500,000

## Palestine to Dallas

### Pipeline

1995 Update

	length	unit price	cost	
84-inch pipe	463,100	\$252	\$116,701,200	
Mobilization, overhead & profit		15%	\$17,505,180	
			\$134,206,380	
ROW	463,100	\$5	\$2,315,500	
			\$136,521,880	
Engineering & contingencies		20%	\$27,304,376	
			\$163,826,256	
			\$163,830,000	

### Pump Stations

Turner, Collie and Braden, December 1989

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Lake PS			\$21,289,000	
CCI		1.17	\$24,908,130	\$24,910,000
Booster PS			\$5,600,000	
CCI		1.17	\$6,552,000	\$6,550,000

### Other

**Total** **\$195,290,000**

**Post to Lubbock**

**Pipe**

1995 Update

	Size	Length	Unit Cost	Cost	Subtotal	1995 Total
Post Reservoir New WTP & Term Stor	36	198,528	\$81	\$16,080,768		
Mobilization, overhead & profit			15%	\$2,412,115		
				\$18,492,883		
Engineering & contingencies			20%	\$3,698,577		
				\$22,191,460	\$22,190,000	

Freese and Nichols, June 1979  
Table 8

Right of way	Post to booster			\$16,100		
	Booster to WTP			\$25,000		
				\$41,100		
	CCI		1.85	\$76,035	\$80,000	\$22,270,000

**Pump Stations**

1995 Update

Lake		1	\$5,000,000	\$5,000,000		\$5,000,000
Booster		2	\$4,000,000	\$8,000,000		\$8,000,000
						\$35,270,000



## Lake Fork to Dallas

### Pipeline

#### 1995 Update

	length	unit cost	cost	1995 cost
84" With ROW	267,336	\$252	\$67,368,672	
84" Without ROW	123,552	\$252	\$31,135,104	
			\$98,503,776	
Mobilization, overhead & profit		15%	\$14,775,566	
			\$113,279,342	
ROW	267,336	\$5	\$1,336,680	
			\$114,616,022	
Engineering & contingencies		20%	\$22,923,204	
			\$137,539,226	\$137,540,000

### Pump Stations

Turner, Collie and Braden, December 1989  
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Lake Fork PS			\$20,500,000	
Tawakoni PS			\$20,500,000	
			\$41,000,000	
CCI		1.17	\$47,970,000	\$47,970,000
Booster PS			\$4,725,000	
CCI		1.17	\$5,528,250	\$5,530,000
<b>Other</b>				
Tawakoni outlet			\$1,647,000	
Balancing reservoir			\$1,308,500	
			\$2,955,500	
CCI		1.17	\$3,457,935	\$3,460,000
<b>Total</b>				<b>\$194,500,000</b>

## Tehuacana/Richland to Ft. Worth

### Pipe

Freese and Nichols, November 1989  
from file for TCWCID#1 Water Supply Plan

	Pipe size	Length	Unit Cost	Cost	1995 Cost
Richland to Ennis	102" 250	1,632	\$523	\$853,536	
	102" 200	54,239	\$504	\$27,336,456	
	102" 150	98,857	\$478	\$47,253,646	
	102" 100	2,536	\$469	\$1,189,384	
				\$76,633,022	
Engineering & Contingencies			25%	\$19,158,256	
				\$95,791,278	\$95,790,000
CCI			1.20	\$114,948,000	\$114,950,000
Ennis to Bal Res	102" 250	4,952	\$523	\$2,589,896	
	102" 200	75,139	\$504	\$37,870,056	
	102" 150	105,039	\$478	\$50,208,642	
	102" 100	38,520	\$469	\$18,065,880	
				\$108,734,474	
Engineering & Contingencies			25%	\$27,183,619	
				\$135,918,093	\$135,920,000
CCI			1.20	\$163,104,000	\$163,100,000
Bal Res to Rolling Hil	102" 100	31,875	\$469	\$14,949,375	
Engineering & Contingencies			25%	\$3,737,344	
				\$18,686,719	\$18,690,000
CCI			1.20	\$22,428,000	\$22,430,000
					\$300,480,000
<b>Pump Stations</b>					
Lake PS				\$12,975,000	\$12,980,000
CCI			1.2	\$15,576,000	\$15,580,000
Ennis booster				\$11,625,000	
Waxahachie booster				\$11,363,000	
				\$22,988,000	\$22,990,000
CCI			1.2	\$27,588,000	\$27,590,000
<b>Total</b>				\$286,370,000	\$343,650,000

## Shaws Bend to San Antonio

### Pipe

1995 Update  
Based on HDR , May 1994

	Length	Unit Cost	Cost	1995 Cost
72-inch pipe	550,000	\$216	\$118,800,000	
Mobilization, overhead & profit		15%	\$17,820,000	
			\$136,620,000	
ROW	550,000	\$5	\$2,750,000	
			\$139,370,000	
Engineering & Contingencies		20%	\$27,874,000	
			\$167,244,000	\$167,240,000
<b>Pump Stations</b>				
Lake PS	1	\$15,000,000	\$15,000,000	\$15,000,000
Booster Stations	3	\$13,000,000	\$39,000,000	\$39,000,000
<b>Total</b>				<b>\$221,240,000</b>

## Parkhouse to Dallas

### Pipe

1995 Update

	Length	Unit Cost		
66-inch pipe	528,000	\$198	\$104,544,000	
Mobilization, overhead & profit		15%	\$15,681,600	
			\$120,225,600	
ROW	528,000	\$5	\$2,640,000	
			\$122,865,600	
Engineering & Contingencies		20%	\$24,573,120	
			\$147,438,720	\$147,440,000

### Pump Stations

Lake PS	1	\$13,300,000	\$13,300,000	\$13,300,000
Booster Stations	3	\$10,640,000	\$31,920,000	\$31,920,000
<b>Total</b>				\$192,660,000