CENTRAL TEXAS WATER TREATMENT PLANT TO SERVE AUSTIN AND SAN ANTONIO WATER SYSTEM

SPONSOR:

TEXAS WATER DEVELOPMENT BOARD

STUDY PARTICIPANTS:

LCRA
ENERGY • WATER • COMMUNITY SERVICES

CITY OF AUSTIN
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San Antonio Water System

SAN ANTONIO RIVER AUTHORITY
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PREPARED BY:

K FRIESE & ASSOCIATES, INC.

OCTOBER 2005

CENTRAL TEXAS WATER TREATMENT PLANT

TO SERVE CITY OF AUSTIN AND SAN ANTONIO WATER SYSTEM

Prepared for:

Lower Colorado River Authority
P.O. Box 220
Austin, Texas 78767-0220
(512) 327-3200

Prepared by:

K Friese & Associates, Inc.
7600 Burnet Road, Ste. 290
Austin, Texas 78757
(512) 338-1704

OCTOBER 2005

Central Texas Regional Water Treatment Plant
to serve City of Austin and San Antonio Water System

Executive Summary

The Lower Colorado River Authority contracted with K Friese & Associates, Inc. to conduct a feasibility study of a Central Texas water treatment plant to serve Austin and San Antonio. Texas Water Development Board and study participants funded the study. Participants include LCRA, the Guadalupe-Blanco River Authority, the San Antonio River Authority, the City of Austin and the San Antonio Water System. The source of Texas Water Development funding is a 50% matching funds grant to conduct regional water facility planning.

The purpose of this engineering study was to evaluate the feasibility and comparative costs of developing a large regional water treatment facility to provide potable water for both the cities of Austin and San Antonio, instead of the two separate facilities currently under consideration in the Texas Water Development Board Region L and K plans. Most water utility managers recognize the compelling economies of scale offered by large regional water treatment facilities, which offer lower construction, operation and maintenance costs, while typically delivering higher quality water. This study developed the information necessary to examine the feasibility and economics of this proposed single large plant alternative versus the currently planned separate facilities, one in Austin and one in San Antonio.

The City of Austin and the San Antonio Water System are planning to develop large surface water transfer and treatment facilities using Colorado River water to meet future water demand. The City of Austin has a site under evaluation for Water Treatment Plant No. 4, which would treat water drawn from Lake Travis. However, the intake site and route for the raw water transmission main has not yet been decided. In addition, the city is considering decommissioning the Green Water Treatment plant on Town Lake.

SAWS is working with LCRA to develop surface water supplies. The LCRA-SAWS Water Project is in the study phase and will involve the development of off-channel storage in Colorado, Wharton or Matagorda counties near the Colorado River. The water captured in this storage would be transferred via pipeline to a location near San Antonio where a new or expanded water treatment plant would be located. The specific location of these facilities has not yet been determined.

This feasibility study examined the idea of developing a single water treatment plant located between the cities of Austin and San Antonio that could provide additional capacity to meet the demands of these two cities.

In addition to studying a source of future treated water for Austin and San Antonio, the study also determined the water demands of the other study participants that could be satisfied by this facility.

The study was not prepared in the traditional way studies of this type are normally done. This study was accomplished using an interactive format in which all of the study participants were actively involved in the actual development of the parameters of the scope, the assumptions, analysis and findings of the investigation. This was accomplished by frequent meetings with the participants in which technical memorandums describing the results to date of the investigation were presented and

discussed. Based on these interactive meetings the study team made refinements in the original scope to adjust the emphasis and detail that were needed to better answer the basic feasibility question that the study was to address.

By performing the study in this manner, participants were able to steer the investigations in a way that would produce the most beneficial findings and allow each of them to evaluate the feasibility of their participation in a regional facility. As the study progressed more alternatives were identified and analyzed than was anticipated in the original scope. The end results included findings that addressed the feasibility question of a regional facility.

Technical Memorandums were drafted as the study progressed and were assembled at the end of the study to form the completed report. Each of the memorandums generally addressed one or more of the tasks identified in the original scope. By performing the study in this manner the final report is not as readable as it might be if the study had been performed in a more traditional manner. However, the analysis and findings are presented in much greater detail and are more useable to the study participants.

The study determined at the end of the planning period in year 2065, there would be a total average day demand of 271 million gallons a day (mgd) of water, which could be met by the proposed regional facility. Both average annual and maximum day demands estimated by the participants are summarized below:

Projected Average Day Demand
(acre-feet/year)

Year	***2015***	***2020***	***2030***	***2040***	***2050***	***2060***	***2065***
City of Austin	0	0	16,802	22,403	33,604	33,604	33,604
SAWS	73,000	205,000	205,000	205,000	205,000	205,000	205,000
GBRA	0	0	6,000	8,000	10,000	12,300	12,300
SARA	20,550	23,406	28,433	31,393	34,411	37,530	41,128
LCRA	0	0	5,600	11,200	11,200	11,200	11,200
Total	**93,550**	**228,406**	**261,835**	**277,996**	**294,215**	**299,634**	**303,232**

Projected Maximum Delivery Rate
(MGD)

Year	*2015*	*2020*	*2030*	*2040*	*2050*	*2060*	*2065*
City of Austin	0	0	25	35	50	50	50
SAWS	85	238	238	238	238	238	238
GBRA	0	0	11	14	18	22	22
SARA	24	27	33	36	40	44	48
LCRA	0	0	10	20	20	20	20
Total	**109**	**265**	**317**	**344**	**366**	**373**	**378**

SAWS also provided a second, "delayed demand scenario." The first scenario uses the full amount of water supply available with phasing based on an estimation of when the necessary infrastructure can be in place. The second scenario delays 66,000 acre-feet/year of demand from 2020 to 2030.

Projected Average Day Demand
"Delayed Demand Scenario"
(acre-feet/year)

Year	*2015*	*2020*	*2030*	*2040*	*2050*	*2060*	*2065*
City of Austin	0	0	16,802	22,403	33,604	33,604	33,604
SAWS	73,000	139,000	205,000	205,000	205,000	205,000	205,000
GBRA	0	0	6,000	8,000	10,000	12,300	12,300
SARA	20,550	23,406	28,433	31,393	34,411	37,530	41,128
LCRA	0	0	5,600	11,200	11,200	11,200	11,200
Total	**93,550**	**162,406**	**261,835**	**277,996**	**294,215**	**299,634**	**303,232**

Projected Maximum Delivery Rate
"Delayed Demand Scenario"
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Year	*2015*	*2020*	*2030*	*2040*	*2050*	*2060*	*2065*
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SAWS	85	161	238	238	238	238	238
GBRA	0	0	11	14	18	22	22
SARA	24	27	33	36	40	44	48
LCRA	0	0	10	20	20	20	20
Total	**109**	**188**	**317**	**344**	**366**	**373**	**378**

Several potential alternative diversion points for raw water were identified. One location consisted of a series of intakes located in Matagorda, Wharton, and/or Colorado counties along the lower reaches of the Colorado River. A second location considered for an intake was in the segment of the Colorado River from the City of Austin (Town Lake) downstream of the City of Bastrop. Groundwater from the Simsboro Aquifer was also considered. Three general sites for the location of the regional facility were identified and included in the analysis. The three sites considered were: one east of San Antonio near Interstate 10, one east of San Marcos and one in the northern corner of

Caldwell County. The treatment plant evaluated for the facility consisted of a split process water treatment plant. This process approach recognizes that some of the participants require soft water and some do not. In this approach raw water is split at a distribution box and routed through separate processes. Part of the water would be softened using lime. Part of the water would be treated using a so-called conventional water treatment process. Both waters would be filtered separately through microfiltration membranes. This split process would accommodate separate disinfection approaches to better match the existing practices of the participant to avoid compatibility problems. Points for connecting treated water from a regional facility were identified by each participant.

The initial analysis of the first three alternatives of varying the location of the plant indicated a rather small percentage difference in the cost, the least costly being the location east of San Marcos. Four additional alternatives were developed and analyzed for a more complete understanding of the potential regional scenarios. The results showed a greater reduction in the present value of these four new alternatives compared to the lowest present value of the first three alternatives. However, it was determined that the lower costs were either not comparable or that the changes to the basic scenario included in the alternative scenario were not realistic and could not be implemented. The alternatives considered are summarized below:

Alternative	Description	Total NPV in Millions of Dollars
1A	WTP located east of San Antonio.	$3,896
2A	WTP located east of San Marcos.	$3,852
3A	WTP located in northern corner of Caldwell County.	$3,895
1B	Similar to 1A, with the WTP located 10 miles closer to San Antonio.	$3,790
1C	Similar to Alt 1B, with Simsboro gravity line alternative.	$3,758
3B	Similar to Alt 3A, uses the “Delayed Demands”.	$3,379
1D	Similar to Alt 1A, with no Bastrop intake and groundwater treatment plant near Elgin.	$3,580

One final alternative was evaluated. In this alternative, the plant was changed to a base load plant for San Antonio, SARA and GBRA, thereby reducing the size of the plant and treated water transmission mains. Other adjustments were made to help make the regional facility comparable to the other separate alternatives available to the participants. These adjustments included resizing the raw water intake in Matagorda County per the LCRA-SAWS Water Project Viability Assessment. In addition, an assumption was made that scalping withdrawals would not be required for the Bastrop raw water facilities. Next, for comparison purposes, the present value cost was converted to a cost per acre-foot. This was done by dividing the total cost of the project by the acre-foot capacity. The resulting cost was $794 per acre-foot for treated water at the water treatment plant, without consideration of the potable water transmission mains. When the potable water transmission mains are considered, the average cost would be $1,039 per acre-foot delivered to the participant’s delivery points. The latter figure is in the upper range of costs that have been developed for the LCRA-SAWS Water Project. Those costs range from $970 to $1,103.

Alternative	Description	Total NPV in Millions of Dollars
2A - Special	Similar to 2A, with plant and lines sized for SAWS, SARA, and GBRA average day demands	$3,451 *$ per ac-ft = $1,039*

While the cost per acre-foot for a regional facility may be at least marginally reasonable for San Antonio and SARA, it is not for the other participants because of the cost of transmission facilities the other participants would have to build compared to their separate alternatives.

An alternative that was not included in the scope of this study but would appear to be worthy of additional analysis is a sub-regional facility located between Austin and Bastrop on or near the Colorado River. That facility could meet the demands of Austin, LCRA and possibly GBRA in a more cost effective manner. A very preliminary cost estimate for such a facility using similar costing data in this study appears to be in the $741 per acre-foot range not including potable water transmission mains and $848 per acre-foot including transmission mains to the participant's delivery points.

K FRIESE
& ASSOCIATES, INC.

TECHNICAL MEMORANDUM

PROJECT: Central Texas Regional Water Treatment Plant
SUBJECT: Task 1 – Data Collection
DATE: February 8, 2005

Works Consulted

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K FRIESE & ASSOCIATES, INC.

TECHNICAL MEMORANDUM

PROJECT: Central Texas Regional Water Treatment Plant
SUBJECT: Task 2 - Demand Projections
DATE: February 8, 2005

The purpose of this study is to evaluate the feasibility and comparative costs of developing a large regional water treatment facility to provide potable water for both the Cities of Austin and San Antonio. Although various raw water sources have been included in the analysis (specifically the LCRA-SAWS Water Project, groundwater from the Simsboro Aquifer, and the Bastrop/Colorado River diversion point), no attempt has been made to evaluate these sources. The sole focus is defining the benefits of regional treatment – not defining the issues surrounding sources of raw water.

The purpose of this task is to establish the projected demands for the potential service area and to develop the projected size of the water treatment plant over the planning horizon. A 50-year planning horizon is used, beginning in 2015 and continuing to 2065. Projected average day demands and maximum delivery rate peaking factors were obtained from each study participant. The projected size of the water treatment plant is based on the maximum delivery rate and is more fully discussed in the technical memorandum for Task 8 – Facility Phasing.

The methodology used by each participant in establishing projected average day demands for the study period is summarized below:

1. City of Austin – The City of Austin maintains a system model for use in determining future needs and planning improvements. The demands in the model were developed in coordination with the TWDB for consistency with the State Water Plan and the City's demands for the Central Texas Regional Water Treatment Plant (CTRWTP) project were derived from the model.

2. SAWS –SAWS is evaluating several potential sources of water including surface water from the Colorado River diverted from the Bastrop area (18,000 acre-feet/year) and from the Matagorda/Wharton County area (132,000 acre-feet/year) as part of the LCRA-SAWS Water Project, and Simsboro groundwater from the Aluminum Company of America and the City Public Service Board of San Antonio (ALCOA/CPS) sites in Milam, Lee, and Bastrop Counties (55,000 acre-feet/year) near the Bastrop surface water diversion point. The projected SAWS demands are based on these available water sources.

3. GBRA – GBRA demands were developed by subtracting available water supply from the TWDB projected demands for the GBRA service area.

4. SARA – SARA demands were developed by subtracting the CTRWTP SAWS demands from the TWDB projected water supply deficit for Bexar County.

5. LCRA – LCRA demands are based on potential water supply to an area in south east Travis County currently known as the Creedmore Maha Water Supply Corporation and the Winfield Municipal Utility District. Demands are based on residential and commercial utility service to approximately 2,400 acres of currently undeveloped land. Maximum day demands were calculated based on a projection of approximately 6,900 connections in 2030 and 13,900 connections in 2040. Next, an average day demand factor of two was applied to the maximum day demands to obtain the projected average day demand.

Table 2-1
Projected Average Day Demand
(acre-feet/year)

Year	*2015*	*2020*	*2030*	*2040*	*2050*	*2060*	*2065*
City of Austin	0	0	16,802	22,403	33,604	33,604	33,604
SAWS	73,000	205,000	205,000	205,000	205,000	205,000	205,000
GBRA	0	0	6,000	8,000	10,000	12,300	12,300
SARA	20,550	23,406	28,433	31,393	34,411	37,530	41,128
LCRA	0	0	5,600	11,200	11,200	11,200	11,200
Total	**93,550**	**228,406**	**261,835**	**277,996**	**294,215**	**299,634**	**303,232**

The maximum projected delivery rate is derived by applying standard peaking factors used in long-range planning by each participant to the average day demand. These factors are:

1. City of Austin = 1.67 x average day demand
2. SAWS = 1.3 x average day demand
3. GBRA = 2.0 x average day demand
4. SARA = 1.3 x average day demand
5. LCRA = 2.0 x average day demand

Table 2-2
Projected Maximum Delivery Rate
(MGD)

Year	*2015*	*2020*	*2030*	*2040*	*2050*	*2060*	*2065*
City of Austin	0	0	25	35	50	50	50
SAWS	85	238	238	238	238	238	238
GBRA	0	0	11	14	18	22	22
SARA	24	27	33	36	40	44	48
LCRA	0	0	10	20	20	20	20
Total	**109**	**265**	**317**	**344**	**366**	**373**	**378**

SAWS also provided a second, "delayed demand scenario". The first scenario uses the full amount of water supply available with phasing based on an estimation of when the necessary infrastructure can be in place. The second scenario delays 66,000 acre-feet/year of demand from 2020 to 2030. The second scenario is to be considered if delaying the raw water transmission main from the Matagorda/Wharton County intake location results in a more economically feasible project. SAWS will temporarily obtain the 66,000 acre-feet/year supply from another source until the Matagorda/Wharton County intake is in place. The following tables summarize the "delayed demand scenario".

Table 2-3
Projected Average Day Demand
"Delayed Demand Scenario"
(acre-feet/year)

Year	***2015***	***2020***	***2030***	***2040***	***2050***	***2060***	***2065***
City of Austin	0	0	16,802	22,403	33,604	33,604	33,604
SAWS	73,000	139,000	205,000	205,000	205,000	205,000	205,000
GBRA	0	0	6,000	8,000	10,000	12,300	12,300
SARA	20,550	23,406	28,433	31,393	34,411	37,530	41,128
LCRA	0	0	5,600	11,200	11,200	11,200	11,200
Total	**93,550**	**162,406**	**261,835**	**277,996**	**294,215**	**299,634**	**303,232**

Table 2-4
Projected Maximum Delivery Rate
"Delayed Demand Scenario"
(MGD)

Year	***2015***	***2020***	***2030***	***2040***	***2050***	***2060***	***2065***
City of Austin	0	0	25	35	50	50	50
SAWS	85	161	238	238	238	238	238
GBRA	0	0	11	14	18	22	22
SARA	24	27	33	36	40	44	48
LCRA	0	0	10	20	20	20	20
Total	**109**	**188**	**317**	**344**	**366**	**373**	**378**

K FRIESE
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TECHNICAL MEMORANDUM

PROJECT: Central Texas Regional Water Treatment Plant
SUBJECT: Task 4 - Water Treatment Process
DATE: February 8, 2005

Background

The Central Texas Regional Water Treatment Plant would be one of the largest water treatment facilities in the State of Texas. As such, it is expected that this facility would take advantage of state of the art technology in order to produce a high quality potable water.

The selection of a water treatment process is dependent upon three issues. The first is the source water quality, both surface and groundwater. The second is the State and Federal regulations known currently and anticipated to be in place during the life of the treatment works, and third the finished water quality desired by the customers.

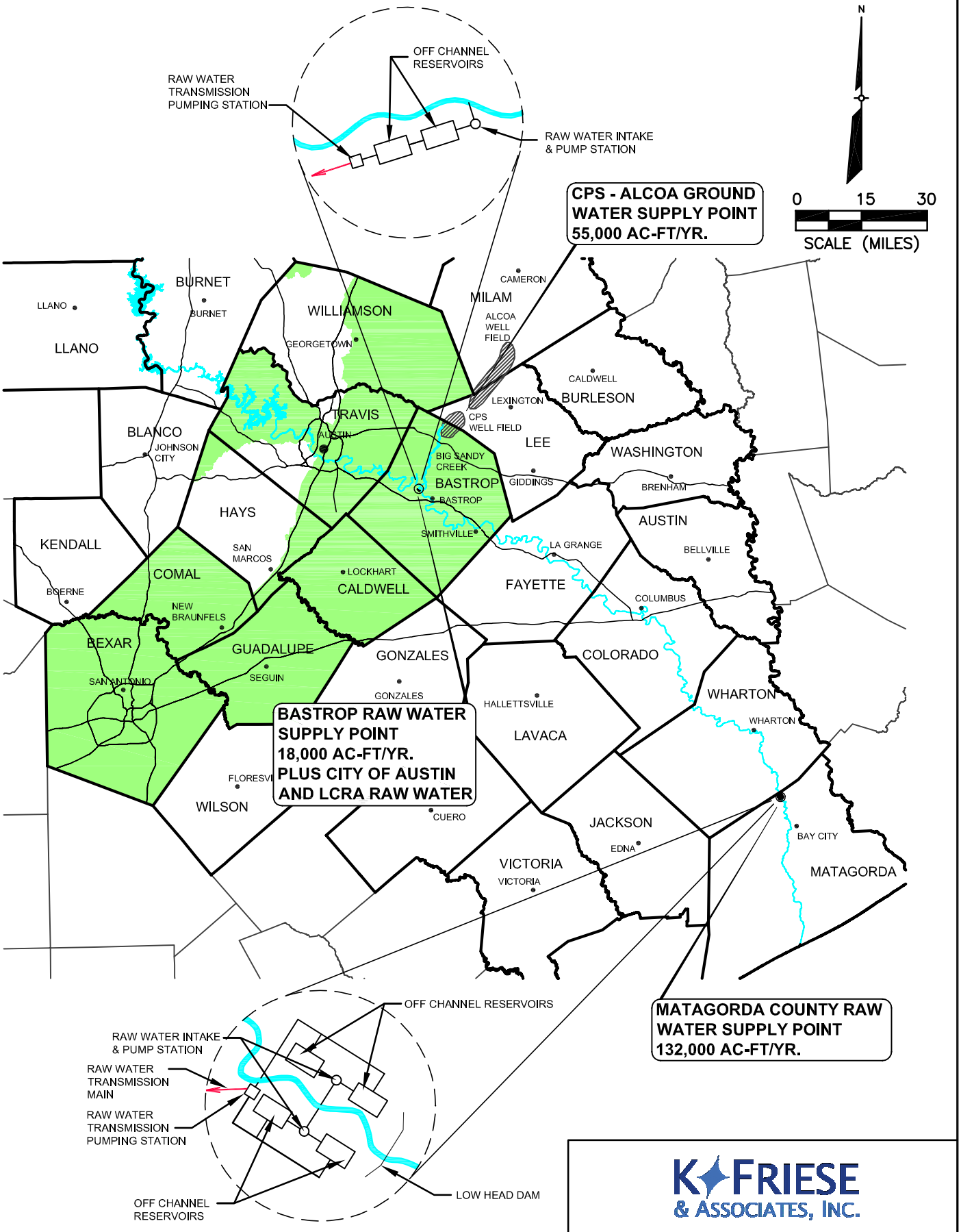
The purpose of this study is to evaluate the feasibility and comparative costs of developing a large regional water treatment facility to provide potable water for both the Cities of Austin and San Antonio.

Although various raw water sources have been included in the analysis (specifically the LCRA-SAWS Water Project, groundwater from the Simsboro Aquifer, and the Bastrop/Colorado River diversion point), no attempt has been made to evaluate these sources. The sole focus is defining the benefits of regional treatment – not defining the issues surrounding sources of raw water.

It is anticipated that the raw water would be derived from at least three sources (See Figure 4.1). As of this writing it is not known where raw water for GBRA and SARA would come from. The largest of the three would be from the Colorado River in the vicinity of Matagorda County near the Gulf of Mexico, the diversion point for the LCRA-SAWS Water Project. It is expected that 132,000 acre-feet/year of surface water would be diverted from this segment of the Colorado River. Another source would be the Colorado River further upstream near the City of Bastrop. It is expected that approximately 18,000 acre-feet/year would be diverted at this location. Also, it is likely that raw water for the City of Austin and LCRA would be withdrawn from the Bastrop location. It is also expected that 55,000 acre-feet/year of groundwater from well fields in Milam, Lee and Bastrop Counties will be introduced into the regional water system at some point during the transmission/treatment system.

As a Public Water System, these facilities must comply with both the State of Texas and Federal drinking water regulations. The State rules are administered by the Texas Commission on Environmental Quality (TCEQ) and are codified in Title 30 Texas Administrative Code Chapter 290 Subchapters D and F. Current and anticipated Federal rules are described later in this section.

Our review of water treatment processes is preliminary based on existing water quality data about the Colorado River and the ALCOA/CPS groundwater and discussions with the various participants as to their individual finished water requirements. Our purpose is not to absolutely establish a water treatment process but to establish a level of appropriate technology that can be used as the basis of cost estimating. We all realize that very involved and detailed water treatability studies will be necessary before the final process is established. Recognize that this study is a comparative analysis of several regional treatment and piping arrangements to see which is more cost effective to implement.



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CENTRAL TEXAS REGIONAL
WATER TREATMENT PLANT
TO SERVE AUSTIN AND SAN ANTONIO
RAW WATER / GROUNDWATER SUPPLY POINTS

FIGURE 4.1

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ALCOA/CPS Groundwater

SAWS has entered into agreements with the ALCOA/CPS for the use of groundwater in Milam, Lee and Bastrop Counties (see Figure 4.2). Preliminary water availability studies of the ALCOA/CPS proposed well field areas indicate that the following quantities of groundwater, shown in Table 4-1, are available on a long-term basis.

Table 4-1
Available Groundwater
(acre-feet/year)

Source	***Quantity***
CPS Property	15,000
ALCOA	40,000
Total	55,000

The quality of the water from the ALCOA/CPS property is considered suitable for public water supplies recognizing that treatment and/or blending with other water to reduce elevated concentrations of iron and manganese will be required (see Table 4-2). It is also reported that certain wells in the Simsboro formation produce high temperature water. The following table generally describes the water quality of the Wilcox Group of the Carrizo-Wilcox Aquifer System which underlie the ALCOA/CPS properties and from where the groundwater would be derived. The Wilcox Group consists of the Hooper, Simsboro and Calvert Bluff formations.

Table 4-2
Statistical Summary of Water Quality Data for Hooper, Simsboro and Calvert Bluff Formations
Source – HDR, Assessment of Groundwater Availability on CPS Property in Bastrop and Lee Counties, Texas, SAWS, July 1999

	Hooper			***Simsboro***			***Calvert Bluff***		
Water Quality	***Median***	***Range***		***Median***	***Range***		***Median***	***Range***	
Temperature (°C)	23	21	25	26	21	76	23	21	27
Silica (mg/l)	35.0	12.0	53.0	30.0	5.0	62.0	29.0	14.0	69.0
Calcium (mg/l)	70.4	4.4	222.0	66.0	2.4	130.0	72.5	12.0	474.0
Magnesium (mg/l)	12.3	6.8	68.0	11.0	1.9	43.0	17.0	2.2	103.0
Sodium (mg/l)	62.0	24.0	258.0	33.0	18.0	258.0	65.5	27.0	1670.0
Potassium (mg/l)	2.70	-	-	3.70	1.50	10.00	4.90	4.00	6.00
Iron (mg/l)	-	-	-	0.47	0.00	13.00	-	-	-
Manganese (mg/l)	-	-	-	0.18	0.00	0.72	-	-	-
Carbonate (mg/l)	0.0	0.0	7.2	0.0	0.0	0.0	0.0	0.0	0.0
Bicarbonate (mg/l)	237	120	422	226	7	568	218	46	804
Sulfate (mg/l)	28	15	213	61	10	199	133	23	879
Chloride (mg/l)	74	42	550	53	19	205	52	18	3480
Fluoride (mg/l)	0.20	0.10	0.50	0.20	0.00	1.10	0.30	0.00	0.70
Nitrate (mg/l as N)	0.18	0.00	21.00	0.20	0.00	20.40	0.40	0.00	70.00
pH	7.40	6.40	8.50	7.20	5.50	8.50	7.40	6.2	8.30
Total Alkalinity (mg/l)	194	98	346	162	6	256	179	38	659
Total Hardness as CaCO3	226	72	726	223	14	488	255	39	1606
TDS (mg/l)	361	271	1411	369	121	850	436	227	2187
Specific Conductance	556	462	2470	586	192	1400	776	370	11200

SAWS has had numerous studies prepared by other consulting engineers to evaluate the quality and quantity of this specific groundwater source as well as several delivery schemes. The most promising of the delivery schemes calls for transmission piping from the well field over a 107 mile route through Caldwell and Guadalupe Counties terminating at a water treatment plant in eastern Bexar County. This option has a total project cost in excess of $400,000,000.00. When you examine annual costs and project yield, the cost of this water is calculated at $864 per acre-feet or $2.65 per 1000 gallons. This includes the cost of the raw water, well field, transmission facilities including a 107 mile transmission line to a point in eastern Bexar County, and a water treatment plant (51.6 MGD) to remove iron and manganese. Costs do not include integration into the SAWS distribution system.

Water Quality

Let us first understand the source of the surface water considered in this study - The Colorado River. LCRA built several dams on the Colorado River from 1935 to 1951 to create Lakes Buchanan, Inks, Marble Falls, Travis, and Austin. They operate the dams and regulate water releases from the lakes to manage floods and provide water for municipal and industrial water supply, irrigation, mining, hydropower generation, and recreation. Town Lake is impounded by Longhorn Dam which is owned and operated by the City of Austin.

The headwaters of the Colorado River occur in eastern New Mexico and flow to the southeast across Texas approximately 600 miles, discharging into Matagorda Bay and the Gulf of Mexico. According to the "Texas Commission on Environmental Quality's 2002 The State of Texas Water Quality Inventory", the Colorado River has good water quality and fully supports public water supply use for the reaches of the river where water intake facilities are being considered in this study.

Water quality data for three locations in the Colorado River Basin (Figure 4.3) are summarized in Table 4-3. This data describes water that is relatively consistent and typical of the Colorado River. The water is hard with high alkalinity. It is expected that turbidity levels will fluctuate when storm events occur within the river's watershed. It is reported that concentrations of aluminum, iron and manganese may occasionally exceed the secondary contaminant limits. All of these constituents are quite manageable by a modern water treatment facility.

Table 4-3
Colorado River Water Quality

	Town Lake		***Wharton***		***Bay City***	
	Median	***Range***	***Median***	***Range***	***Median***	***Range***
Alkalinity (mg/L as CaCO3)	174	117-235	182	73-286	200	69-256
Total Organic Carbon (mg/L)	3	1-5.1	4	2.0-16.0	5	1.0-11.0
Nitrate/Nitrite N (mg/L)	0.26	0.02-0.72	1.12	0.02-3.8	0.02	.01-.099
TKN (mg/L as N)	0.447	0.03-2.68	0.873	0.02-5.6	0.72	.08-3.45
pH (mg/L)	7.8	7.2-8.3	8.11	6.94-9.4	8.11	6.76-8.8
Total Phosphorous (mg/L)	0.04	0.01-0.269	0.374	0.07-2.16	0.26	.005-1.04
Sulfate (mg/L)	38	14.8-99	40.2	12-220	39.5	0.42-220
Temp (Degrees Centigrade)	21.5	10.7-31.15	22.4	7.2-33.7	22.3	6.5-32.9
Calcium	50.6	48.8-50.6	59.8	59.8	44.6	44.6
Hardness, Total (mg/L CaCO3)	209	188-213	235	220-238	200	134-243
Chlorophyll-A, Phytoplanktonug (L)	2	.2-73.3	4	.2-136	.8-83.4	5.9
Magnesium, Dissolved (mg/L)	21	21-21.2	21.6	21.6	21.5	21.5

Notes: Town Lake near City of Austin, Wharton and Bay City near Gulf of Mexico approximately 100 miles down river of Austin

Surface Water Treatability

Information on treating the water in the Colorado River near the City of Austin has been largely derived from the City of Austin's own treatment experience. The City of Austin operates three water treatment plants, two on Lake Austin and one on Town Lake. Table 4-4 identifies the three water treatment facilities.

Table 4-4
City of Austin Treatment Process
(MGD)

Water Treatment Plant	***Process***	***Capacity***	***Disinfection***	***Source***
Davis	Lime Softening	118	Chlorine/Chloramines	Lake Austin / Colorado River
Ullrich	Lime Softening	100	Chlorine/Chloramines	Lake Austin / Colorado River
Green	Lime Softening	42	Chlorine/Chloramines	Town Lake / Colorado River

The City of Austin has more experience in treating the waters of the Colorado than anyone else. It is important to examine their historical experience in developing our proposed process selections.

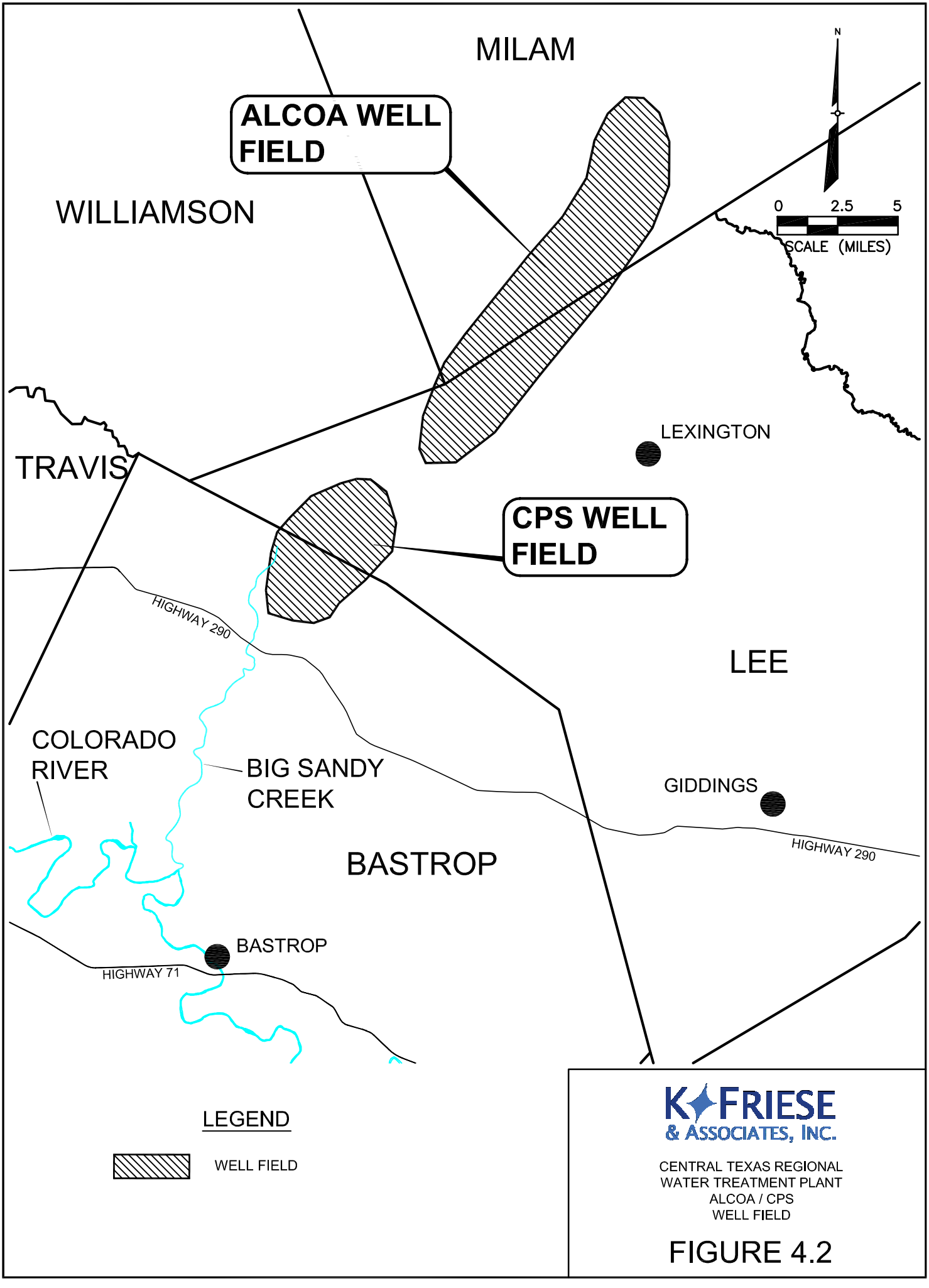
The Green, Davis and Ullrich Water Treatment Plants are lime-softening plants. The Green and Davis WTPs are conventional lime softening plants with rapid mix basins, flocculation, sedimentation and filtration. The softening process at the Ullrich WTP is performed in upflow solids contact basins. As a result of the lime softening process the pH of the water is increased from approximately 8 to 10 or greater.

Currently gaseous chlorine is used for primary disinfection. After an appropriate contact time ammonia is added to form chloramines.

Ferric sulfate is used at all three plants as a coagulant. Fluoride is added to the water to promote dental health. Powdered activated carbon (PAC) is used as needed for taste and odor control.

In recent years Davis and Ullrich began recarbonation to reduce the pH and scaling potential in the filters and distribution system.

It is important that we examine this approach for possible consideration for a new water treatment plant.



K FRIESE & ASSOCIATES, INC.

CENTRAL TEXAS REGIONAL
WATER TREATMENT PLANT
ALCOA / CPS
WELL FIELD

FIGURE 4.2

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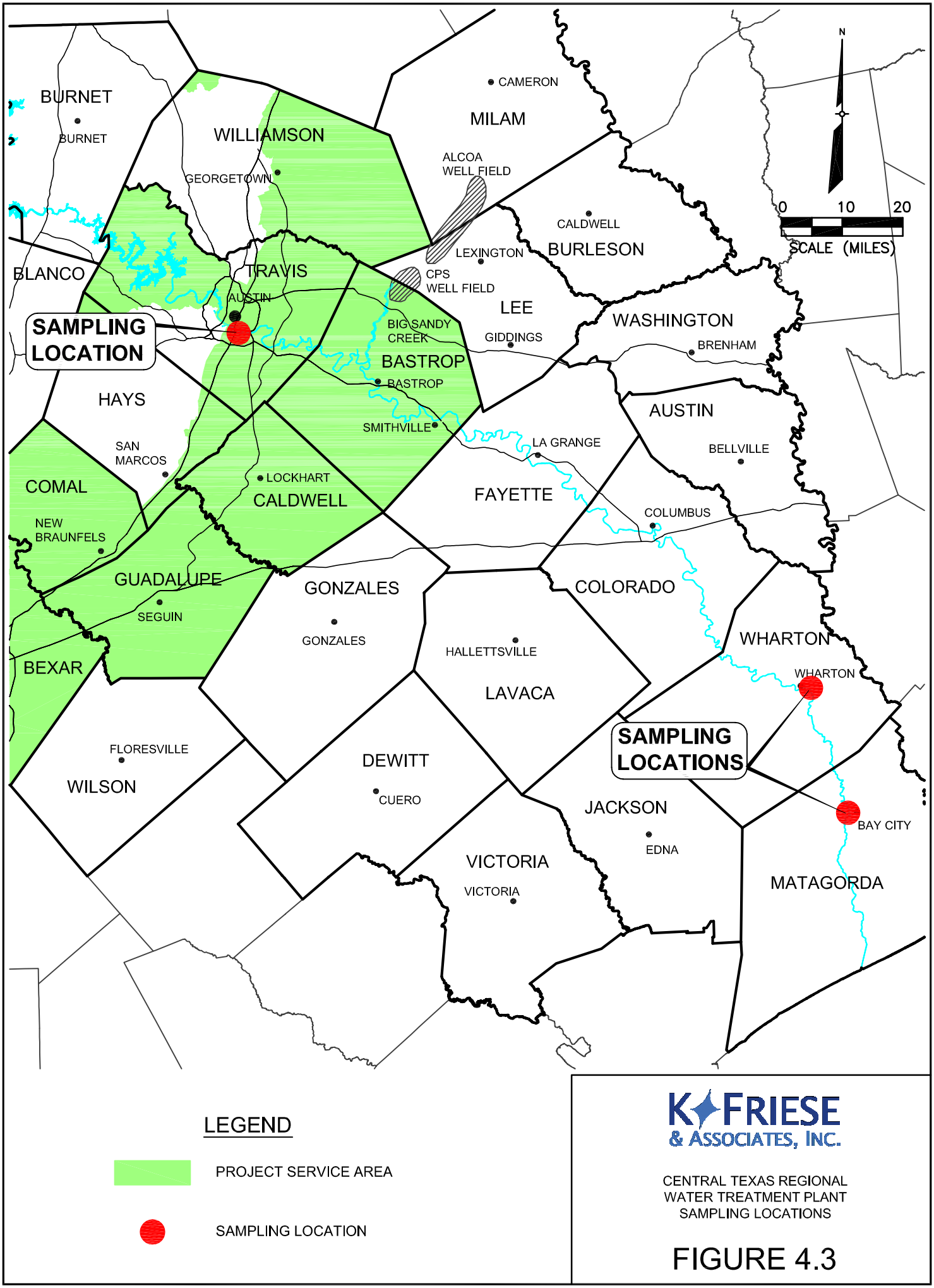
BURNET
BURNET
WILLIAMSON
GEORGETOWN
CAMERON
MILAM
ALCOA
WELL FIELD
CALDWELL
BURLESON
LEXINGTON
CPS
WELL FIELD
BLANCO
TRAVIS
AUSTIN
SAMPLING
LOCATION
LEE
WASHINGTON
BIG SANDY
CREEK
GIDDINGS
BRENHAM
BASTROP
BASTROP
HAYS
SMITHVILLE
AUSTIN
LA GRANGE
BELLVILLE
SAN
MARCOS
COMAL
LOCKHART
CALDWELL
FAYETTE
NEW
BRAUNFELS
COLUMBUS
GUADALUPE
GONZALES
COLORADO
SEGUIN
GONZALES
HALLETTSVILLE
WHARTON
WHARTON
BEXAR
LAVACA
SAMPLING
LOCATIONS
FLORESVILLE
DEWITT
WILSON
CUERO
JACKSON
BAY CITY
EDNA
VICTORIA
MATAGORDA
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0
10
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SCALE (MILES)
LEGEND
PROJECT SERVICE AREA
SAMPLING LOCATION
K FRIESE
& ASSOCIATES, INC.
CENTRAL TEXAS REGIONAL
WATER TREATMENT PLANT
SAMPLING LOCATIONS
FIGURE 4.3
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Regulatory Framework

Water treatment regulations have evolved significantly since the advent of the Safe Drinking Water Act in 1974. A major challenge for water suppliers is how to balance the risks from microbial pathogens and disinfection byproducts. It is important to provide protection from these microbial pathogens while simultaneously ensuring decreasing health risks to the population from disinfection byproducts (DBPs). The Federal regulations that need to be considered include the following:

1. Safe Drinking Water Act (Primary Drinking Water Standards)
2. Surface Water Treatment Rule
3. Lead and Copper Rule
4. Total Coliform Rule
5. Stage 1 Disinfectants/Disinfection By-Products (D/DBP) Rule
6. Interim Enhanced Surface Water Treatment Rule (IESWTR)
7. Long-Term Enhanced Surface Water Treatment Rule (LT1ESWTR)
8. Filter Backwash Rule
9. Arsenic Rule
10. Radionuclides Rule
11. Unregulated Contaminant Monitoring Rule (UCMR)
12. Pharmaceutical and Personal Care Products (PPCPs) (Future)
13. Secondary Drinking Water Regulation
14. Total Coliform Rule and Distribution System Rule (Future)

The U.S. Environmental Protection Agency (EPA) is in the process of issuing two additional regulations, the Long-Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) and the Stage 2 D/DBPR.

The LT2ESWTR includes the following provisions:

1. Source water monitoring for Cryptosporidium
2. Additional Cryptosporidium treatment techniques for filtered systems based on source water Cryptosporidium concentrations
3. Inactivation of Cryptosporidium for all unfiltered systems
4. Disinfection profiling and benchmarking to assure continued levels of microbial protection while PWs take the necessary steps to comply with new DBP standards
5. Covering, treating or implementing a risk management plan for uncovered finished water reservoirs

The expected requirements for the Stage 2 D/DBPR are:

-80 ug/L TTHM (Total Trihalomethanes)

-60 ug/L HAA5 (Haloacetic Acid)

It will be required that each system conduct an Initial Distribution System Evaluation (IDSE) and compliance with each MCL will be determined based on a Locational Running Annual Average.

It is expected that Federal Regulations will continue to put emphasis on better filter performance and control of disinfection byproducts.

Softening

Hard water can cause scaling problems in water heaters as well as other appliances where the temperature of the

water is increased and soap does not lather well in hard water. "Hardness" in water is primarily the result of concentrations of naturally occurring calcium and magnesium ions that are dissolved in the water. Because of these issues some water utilities choose to soften water during the treatment process.

Hardness in water is derived from contact with soil and rock formations, which in the case of Central Texas is contact with limestone formations. The water in the Colorado River is relatively hard with calcium carbonate hardness in the range of 220 mg/L. In general the degree of hardness is classified as follows:

Table 4-5
Hardness Classification
(mg/L)

Hardness	***$CaCO_3$***
Soft	0 to 75
Moderate	75 to 150
Hard	150 to 300
Very Hard	Above 300

Source: Water Treatment Plant Design, 1998.

For most applications, total hardness of 80-120 mg/L appears to be a typical design target for softening facilities.

In the lime softening process, the soluble hardness constituents are converted to insoluble precipitates that are removed by settling and filtration. Softening is usually accomplished by adding chemical lime (CaO) to the water to increase its pH. Elevating the pH of the water to about 10.3 precipitates the ferrous, manganous, and calcium ions out of the water. Raising the pH further begins to precipitate magnesium ions as well. Softening to remove only the calcium hardness is called lime softening, while softening to remove calcium and magnesium hardness is called excess lime softening.

Finished water quality data for both the City of Austin and the City of San Antonio are presented in Tables 4-6 and 4-7. It is evident from this information that the characteristics of the drinking water in these two communities is somewhat different. First San Antonio is used to a relatively hard water which is softened using home softeners at the individual customer's location. Austin Water Utility provides softened water.

Also the disinfection practice of these two communities is different with San Antonio using free chlorine and Austin using a combination of chlorine and chloramine disinfection. Both communities fluoridate.

Table 4-6
Finished Water Quality Data – City of Austin

CITY OF AUSTIN
WATER QUALITY SUMMARY
1st Quarter Averages (January 1, 2004 to March 31, 2004)
Preface

CONSTITUENT (mg/L)	DWTP Raw	GWTP Raw	UWTP Raw	DWTP Tap	GWTP Tap	UWTP Tap	SDWA Tap MCL/[SMCL]
Total Ammonia (as N)	0.05	0.05	0.05	0.49	0.49	0.51	
Free Ammonia (as N)	---	---	---	0.10	0.12	0.13	
Calcium	46	54	46	12	16	14	
Chlorine Residual	---	---	---	2.27	2.20	2.23	
Fluoride	0.22	0.23	0.22	0.92	0.81	0.88	4/[2]
Magnesium	20	20	20	18	18	16	
Sulfate	30.5	32.6	31.1	37.0	37.4	35.9	[250]
Total Phosphate	0.03	0.04	0.03	0.91	1.11	1.01	
Total Hardness (as $CaCO_3$)	198	220	199	104	114	100	
pH (units)	8.2	8.0	8.2	9.8	9.8	9.6	[>7.0]
Conductivity (umhos/cm)	484	516	484	328	344	325	
Total Alkalinity (as $CaCO_3$)	168	184	168	68	77	65	
Phenol Alkalinity (as $CaCO_3$)	0	0	0	20	23	16	
Total Solids	298	319	294	198	208	199	[500]
Threshold Odor (TON)	4	4	4	0	0	0	[3]
Total Organic Carbon	3.16	2.77	3.10	2.23	2.09	2.11	
Turbidity (NTU)	4.09	2.91	3.81	0.06	0.06	0.04	0.3
Silica	8.0	8.1	7.9	7.6	8.3	7.6	
UV254 (cm^{-1})	0.060	0.050	0.060	0.050	0.040	0.040	
Total Coliform (Col/100ml)	106	586	158	<1	<1	<1	
E.Coli (Col/100ml)	13	114	14	<1	<1	<1	

Parameters listed below were analyzed by the Texas Department of Health for compliance with the Safe Drinking Water Act.

CONSTITUENT (mg/L)	DWTP Raw	GWTP Raw	UWTP Raw	DWTP Tap	GWTP Tap	UWTP Tap	SDWA Tap MCL/[SMCL]
Nitrate (as N)	&	&	&	0.0133	0.218	<0.0100	10
Chloride	&	&	&	36.9	37.1	36.6	[250]
Trihalomethane	&	&	&	0.0219	0.0236	0.0168	0.080
Sodium	&	&	&	18.9	19.0	19.1	---
Aluminum	&	&	&	0.017	0.020	0.008	[0.05 - 0.2]
Arsenic	&	&	&	<0.002	<0.002	<0.002	0.01
Barium	&	&	&	0.007	0.006	0.010	2
Cadmium	&	&	&	<0.001	<0.001	<0.001	0.005
Chromium	&	&	&	<0.001	<0.001	<0.001	0.1
Copper	&	&	&	<0.001	0.003	<0.001	1.3 **
Iron	&	&	&	<0.05	<0.05	<0.05	[0.3]
Lead	&	&	&	<0.001	<0.001	<0.001	0.015 **
Manganese	&	&	&	<0.001	<0.001	<0.001	[0.05]
Mercury	&	&	&	<0.0002	<0.0002	<0.0002	0.002
Nickel	&	&	&	<0.001	<0.001	<0.001	[0.10]
Selenium	&	&	&	<0.004	<0.004	<0.004	0.05
Silver	&	&	&	<0.001	<0.001	<0.001	0.1
Antimony	&	&	&	<0.001	<0.001	<0.001	0.006
Beryllium	&	&	&	<0.001	<0.001	<0.001	0.004
Thallium	&	&	&	<0.001	<0.001	<0.001	0.002
Zinc	&	&	&	<0.004	<0.004	<0.004	[5.0]
Endrin	&	&	&	<0.0002	<0.0002	<0.0002	0.002
Lindane	&	&	&	<0.0002	<0.0002	<0.0002	0.0002
Methoxychlor	&	&	&	<0.0002	<0.0002	<0.0002	0.04

SDWA MCL = Safe Drinking Water Act Maximum Contaminant Level
SMCL = Secondary Maximum Contaminant Level standard recommended by TCEQ for aesthetic quality
** = Action Levels

< = Symbol indicates levels are below detection limits of the instrumentation or method

& = No data available

Table 4-7
Finished Water Quality Data – City of San Antonio

Regulated Substances

Substance	Highest Concentration found in Water	Concentration Range found in Water	MCL	MCLG	Possible Source
Nitrate (ppm) 2003	2.12	.06– 2.12	10	10	Erosion of natural deposits; Runoff from fertilizer use; Leaching from septic tanks, sewage.
Barium (ppm) 2003	0.0516	0.0487– 0.0516	2	2	Erosion of natural deposits; Discharge of drilling wastes; Discharge from metal refineries.
Fluoride* (ppm) 2003	1.1	0.5 – 1.1	4	4	Erosion of natural deposits; Discharge from fertilizer and aluminum factories.
Nitrite (ppm) 2003	0.01	ND– 0.01	10	10	Erosion of natural deposits; Runoff from fertilizer use; Leaching from septic tanks, sewage.
Tetrachloroethylene (ppb) 2003	0.9	ND – 0.9	5	0	Leaching by PVC pipes; discharge from factories and dry cleaners.
Di-(2-ethyllhexyl) phthalate (ppb)**	4.19	ND - 4.19	6	0	Discharge from rubber and chemical factories.
Gross alpha adjusted (pCi/l) 2003	4.7	ND - 4.7	15	0	Erosion of natural deposits

** Fluoride in the form of hydrofluorosilic acid (H2SiF6) was added to SAWS drinking water as of August 2002.*
*** Phthalate contamination was unavoidable in the process of analyzing the sample for this substance, therefore this concentration may not have been reliable.*

Other Substances (2003)

Substance	Concentration Range (ppm)	Avg. Concentration (ppm)	MCL (ppm)
Calcium	71 - 91	81	Not regulated
Chloride	20	20	250
Copper	0.005 - 0.007	0.006	1
Magnesium	16 - 29	23	Not regulated
Sodium	6 - 9	8	Not regulated
Sulfate	17 - 20	19	250
Total Hardness [a]	240 - 343	292	Not regulated
Total Alkalinity [a]	209 - 319	264	Not regulated
Total Dissolved Solids	283 - 358	321	500
Zinc	0.0336 - 0.129	0.08	5

[a] As Calcium Carbonate

Required Monitoring - No MCLs [d] (2003)
these values are from points-of-entry

Substance [e]	Range Detected (ppb)	Average Concentration (ppb)	Reasons for Monitoring
Chloroform	ND	ND	[d] These values are from points of entry. [e] Unregulated contaminants monitored helps EPA to determine where certain contaminants occur and whether EPA needs to regulate those contaminants.
Bromodichloromethane	ND – 2.4	1.1	
Dibromochloromethane	ND – 2.9	1.6	
Bromoform	ND – 1.3	1.1	

Lead and Copper Results [f] (2001)

Substance	90th Percentile	Action Level	Number of residences exceeding Action Level	Possible Source
Lead (ppb)	4.9	15	0	Corrosion of household plumbing
Copper (ppm)	0.215	1.3	0	

f: These two metals get into the water because of corrosion of household plumbing. Many older homes have copper pipes that were put together with lead-based solder. The 90th percentile means that 90 percent of the homes measured had less than that.
A total of 50 residences were monitored.

Microbiological Contaminants Monitoring (2003)

Substance	MCL	Amount Found	Source
Total Coliform (presence)	*	Highest monthly % of positive samples was 3.24%	Naturally present in the environment
Fecal Coliform (presence)	**	0	Human and animal waste

*presence of coliform bacteria in 5% or more of the monthly samples
**A routine sample and a repeat sample are total coliform positive and one is also fecal coliform or E. coli positive

Process Alternatives

Selection of the water treatment process is made to accomplish the following objectives;

1. Produce water safe for human consumption meeting all regulations
2. Achieve consumer satisfaction
3. Produce water at a reasonable capital and operating cost

The water treatment plant will be designed to remove and/or deactivate certain characteristics such as turbidity, color, taste, odor as well as microbial and bacteriological contaminants and other chemical constituents. The typical processes utilized to accomplish this include the addition of coagulation chemicals to the raw water, clarification, filtration and disinfection.

Presented in Figure 4.4 is a proposed conventional lime softening water treatment facility with granular filtration. This is fairly similar to what the City of Austin currently utilizes with the exception that we have substituted Ultraviolet light for disinfection. We present this level of technology for costing purposes if we were to consider the current state of drinking water regulations.

Figure 4.5 presents more advanced technology utilizing lime softening. In this case the granular media filtration system is replaced with filtration membranes. This technology anticipates more stringent regulations which are sure to develop over the life of this water treatment facility and develops the multiple barrier approach that is considered very desirable to minimize the penetration of microbial pathogens.

Figure 4.6 presents a split process water treatment facility. This process approach recognizes that some of the participants require soft water and some do not. In this approach raw water is split at a distribution box and routed through separate processes. Part of the water would be lime softened. Part of the water would be treated using a so-called conventional water treatment process. Both waters would be filtered separately through microfiltration membranes. This split process would accommodate separate disinfection approaches to better match the existing practices of the participant to avoid compatibility problems.

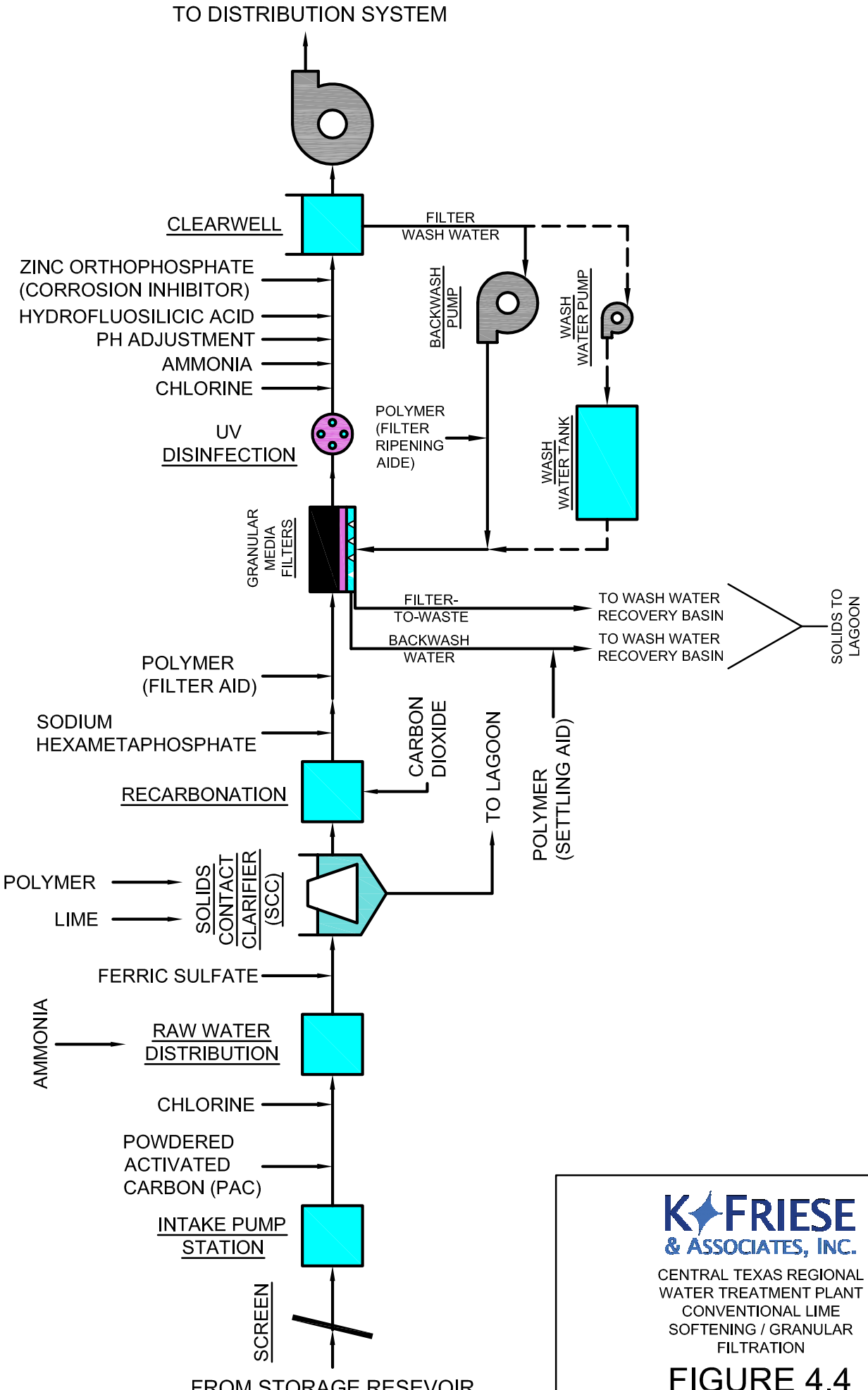
For purposes of this study we will develop costing around the concept of the split process.

Compatibility Issues

Finished water from this water treatment facility will be distributed to five retail water systems, who in some cases already receive groundwater or surface water from another source, for distribution to their customers. Blending of waters from different sources and treatment plants can have a significant impact on pH stability and distribution system water quality. It will be important to examine these compatibility issues in the process selection. In some cases polishing facilities will be necessary to match the outgoing finished water to the existing water quality. The following compatibility issues should be examined in the future.

Water pH is a major factor in the solubility of pipe materials and films that form from corrosion by-products. Mixing waters with different pH's can result in distribution system instability, colored water and aesthetic water quality issues.

There is also a concern relative to blending waters that have different chlorine-based disinfectants, which can happen when water that is disinfected with chloramines is mixed with water that is disinfected with free chlorine. The concern here is the breakpoint reaction that results in residual depletion. Taste and odor problems develop in the blending zone where conditions might allow the formation of di- and tri-chloramines.



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CENTRAL TEXAS REGIONAL WATER TREATMENT PLANT CONVENTIONAL LIME SOFTENING / GRANULAR FILTRATION

FIGURE 4.4

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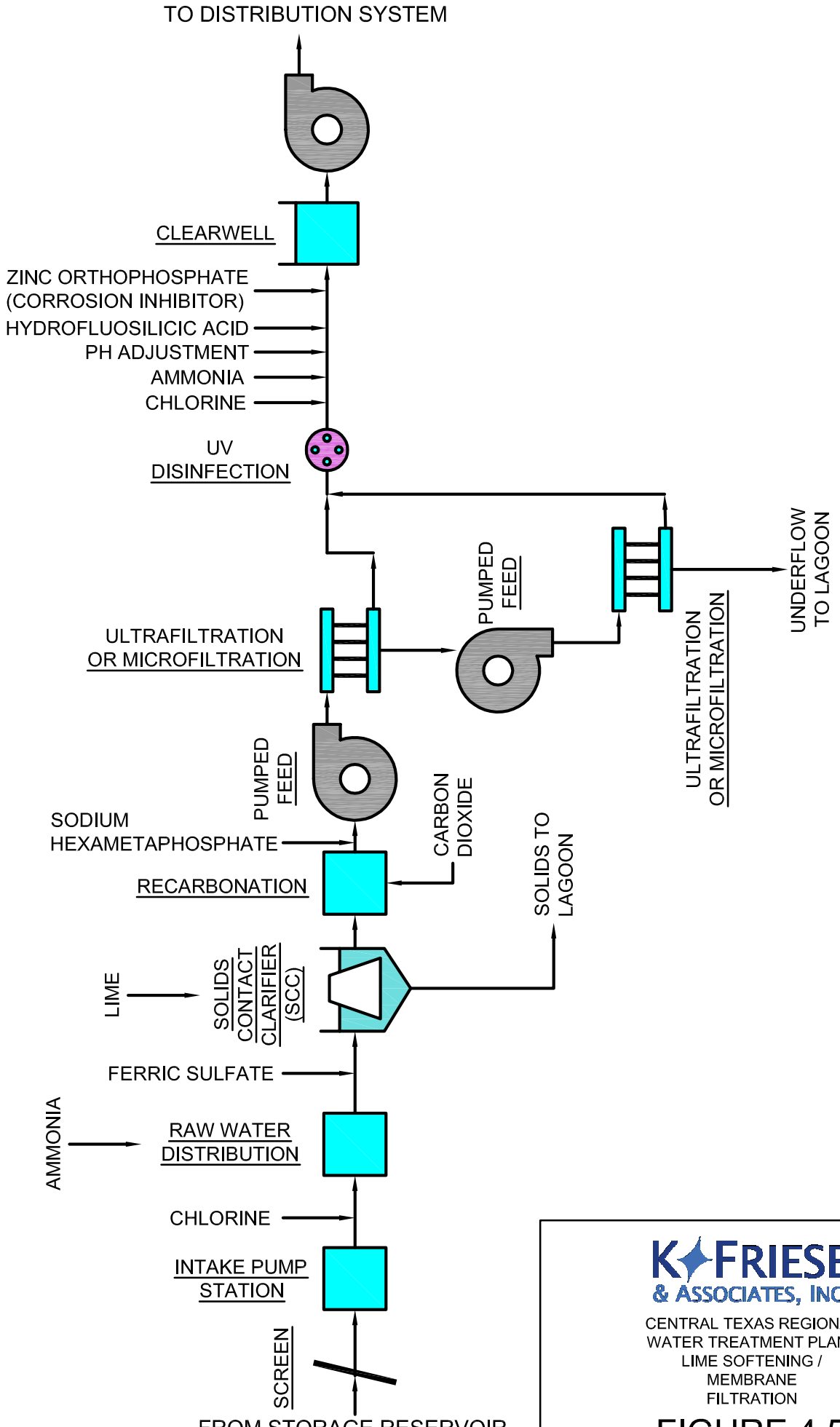

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CENTRAL TEXAS REGIONAL
WATER TREATMENT PLANT
LIME SOFTENING /
MEMBRANE
FILTRATION

FIGURE 4.5

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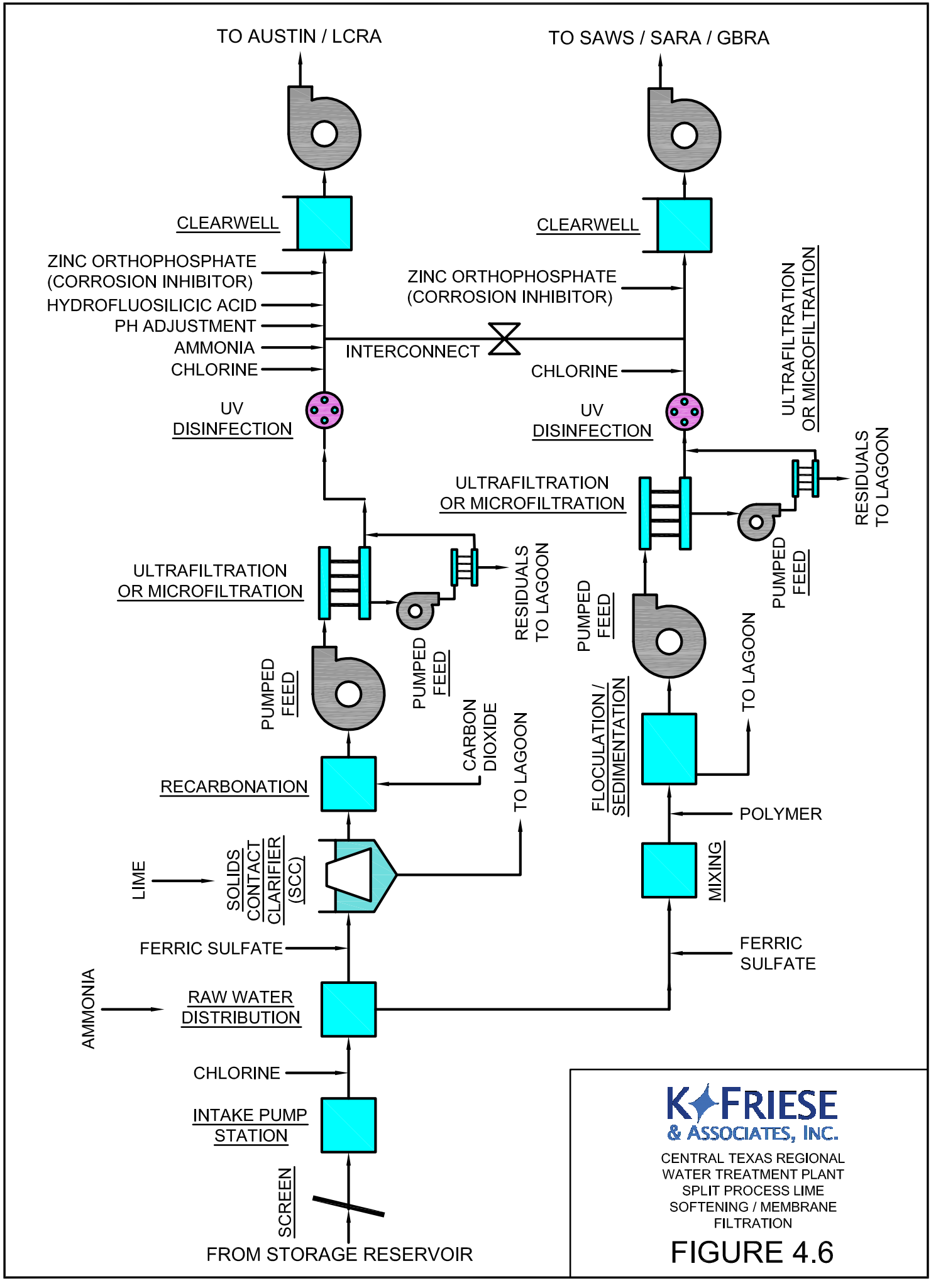

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CENTRAL TEXAS REGIONAL WATER TREATMENT PLANT
SPLIT PROCESS LIME SOFTENING / MEMBRANE FILTRATION

FIGURE 4.6

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Using a split process approach will help in minimizing many of the compatibility issues and allow the treatment facility to better match the participant's existing water.

Residuals Disposal

Residuals management will be an important part of the water treatment facility. This section of the report will describe what will be done with those constituents that are removed from the water during the treatment process. This can include the sludge from a conventional water treatment process, the lime sludge produced during the softening process as well as the concentrate from a membrane facility.

For purposes of this study we have assumed that the location of the water treatment plant will be such that we have sufficient land available so we can fully develop lagoons for disposal of residuals. The residuals that need to be considered include the disposal of settled solids from the chemical coagulation process as well as the lime softening sludge. Other options include various thickening and dewatering techniques where adequate land is not available, although these are typically more expensive and maintenance intensive.

The concentrate from a microfiltration or ultrafiltration plant consists only of particulates which were removed from the water. We propose that this also be placed into the lagoon system. This also can be disposed of in a sanitary sewer if one is available nearby, but this is more expensive.

Raw Water Storage

Since the raw water delivery facilities will be designed for average demands, it will be necessary to store raw water at the treatment plant site to allow the facility to meet peak day requirements. Given the extended periods of dry/hot weather that can be experienced in Central Texas, there is a tendency to experience several peak days in succession.

We recommend that the water treatment plant be designed to have the capacity for 30 peak days in succession and that the raw water storage reservoir be sized for the greater of peak requirement less the average day requirement over a continuous 30-day period and 15 days at average day demand.

Cost Estimates

It is recognized in the water industry that the unit capital cost of a water treatment plant varies inversely to the size of the plant, in other words the bigger the plant the smaller the per gallon unit price is. This is one of the reasons that many communities look to participate in larger regional water treatment facilities.

The following cost information for water treatment plants has been developed based on cost experience throughout the region adjusted for current Engineering News Record (ENR) indices to the 3rd Quarter of 2004. For purposes of this study we have selected the split process using both conventional water treatment as well as lime softening as shown in Figure 4.6. We will treat each section of the split process as a separate plant for costing purposes. The cost tables are presented in graphical form in Figure 4.7.

Operation and maintenance (O&M) costs were developed as a percentage of capital cost. Cost curves for O&M costs are presented as Figure 4.8. The O&M costs include labor, materials, replacement of equipment, process energy, building energy, chemicals, and pumping energy.

The Capital and O&M costs associated with groundwater treatment facilities has been derived from a letter report developed by HDR Engineering dated August 24, 2004 entitled "Work Item #9 SAWS Simsboro Project: Updates of Delivery Options 1 and 2".

Figure 4.7
Water Treatment Plant Unit Costs
Capital Costs

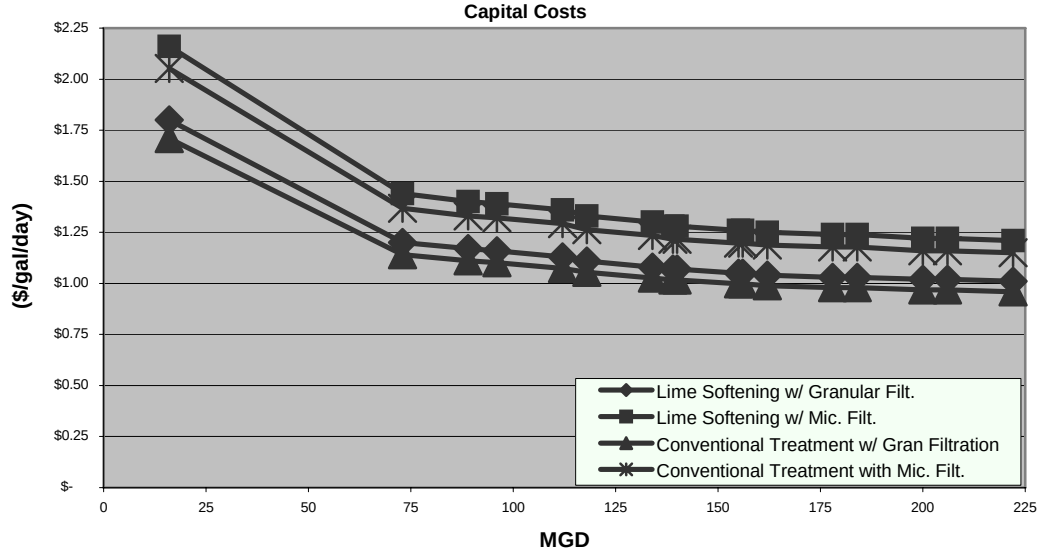
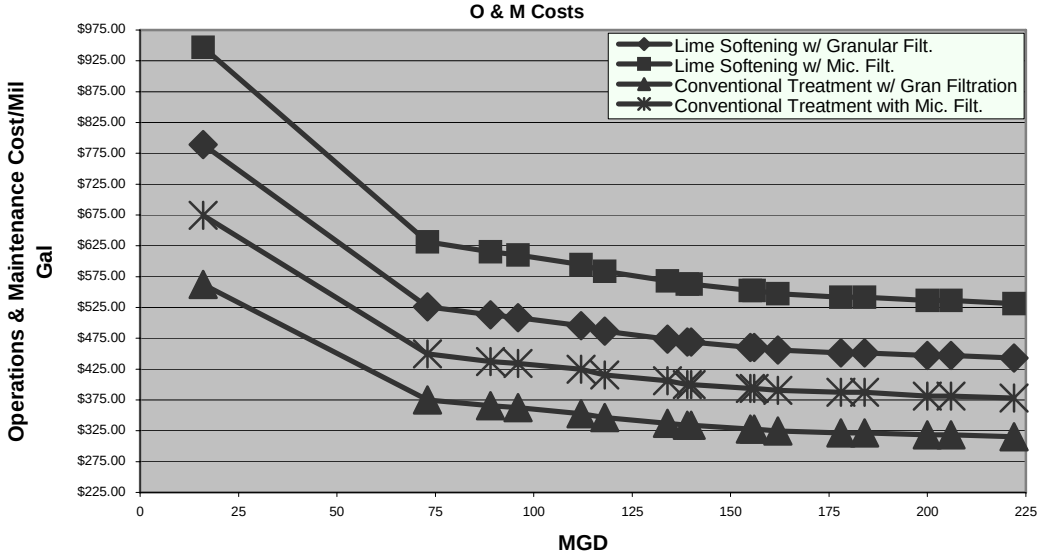


Figure 4.8
Water Treatment Plant Unit Costs
O & M Costs



K FRIESE & ASSOCIATES, INC.

TECHNICAL MEMORANDUM

PROJECT: Central Texas Regional Water Treatment Plant
SUBJECT: Task 5 – Establish Potential Take Points (Diversions of Raw Water)
DATE: February 8, 2005

Background

The purpose of this study is to evaluate the feasibility and comparative costs of developing a large regional water treatment facility to provide potable water for both the Cities of Austin and San Antonio. Although various raw water sources have been included in the analysis (specifically the LCRA-SAWS Water Project, groundwater from the Simsboro Aquifer, and the Bastrop/Colorado River diversion point), no attempt has been made to evaluate these sources. The sole focus is defining the benefits of regional treatment – not defining the issues surrounding sources of raw water.

The purpose of this task is to establish potential take points and delivery routes for raw water. In addition to potential sites in Colorado, Wharton and Matagorda Counties, consideration is given to additional surface water diversions in Bastrop County and in Travis County, and to groundwater from the Simsboro Aquifer.

Raw Water Intake Locations

Two general locations were considered for the regional system's raw water intakes. The first location would consist of a series of intakes located in Matagorda, Wharton, and/or Colorado Counties along the lower reaches of the Colorado River. The second general location for an intake or intakes was in the segment of the Colorado River from the City of Austin (Town Lake) downstream to the City of Bastrop.

The lower Colorado intakes would be in the same locations as the intakes contemplated for the LCRA-SAWS Water Project that is currently in the planning phase. It is beyond the scope of this study to select the best specific location for these intakes. The specific siting of these intakes is being done as part of the LCRA-SAWS Water Project planning study. Unfortunately, the LCRA-SAWS Water Project planning study has not yet identified the best location for these intakes. For the purpose of this study, it was assumed that the location of the lower Colorado intakes would be in Matagorda County (just downstream of the Wharton/Matagorda county line) and this location was used for all alternatives considered. This location was chosen as the most conservative in terms of both water rights and cost. That is, it is a location that is most likely to have the available water rights needed for the project and is the farthest from the service area. If the lower Colorado intakes can be located further upstream, overall transmission main costs will be reduced but it is assumed that all alternatives would be affected almost equally.

For the river segment between Austin and Bastrop, the alternative analysis considered intakes on Town Lake at Austin and just upstream of Bastrop. The Town Lake intake was considered because the City of Austin has rights to withdraw water at this location. Furthermore, raw water pumped from this location would have lower energy costs associated with it compared with allowing this water to flow down to Matagorda County and having to pump it to the water treatment plant and then back to Austin.

An intake at Bastrop was considered initially because of diversion of 18,000 acre-feet/year at Bastrop is contemplated in the State Water Plan. As the alternative analysis process developed, it also became apparent that a Bastrop intake and raw water transmission main to the water treatment plant might also be used to reduce costs to

deliver ground water from the ALCOA/CPS well fields to San Antonio.

While it is conceivable that all the raw water available to SAWS, LCRA, and the City of Austin could be diverted at the lower Colorado intake(s) in Matagorda County, it was considered that a second intake up-river might lower the overall project costs. Having an intake upriver could reduce the overall operational costs, since during high river flow periods, raw water that would have been diverted downstream, could be diverted upriver through the Town Lake or Bastrop intakes. This would reduce the overall pumping costs for both intakes without significantly affecting Colorado River flows.

A sole intake at Town Lake or Bastrop is not feasible because there are not sufficient water rights available in the Colorado River to meet the participant's demands. Thus, the Matagorda intakes are necessary under all scenarios.

While up-river intakes at both Town Lake and Bastrop are possible from technical and water rights points of view, the economics do not appear viable. The cost of two intakes and two raw water transmission mains increase the overall project costs over alternatives that have only one intake. An intake at Town Lake the advantage of the existing Longhorn Dam facilitating the diversion

However, the Town Lake intake could not be used to withdraw the 18,000 acre-feet of Colorado River water that may be available at Bastrop, nor could the Town Lake intake offer synergies with the transmission of ALCOA/CPS groundwater to the water treatment plant. The initial screening of the alternatives also indicated that a water treatment plant location southeast of Austin and an intake near Bastrop would offer a lower overall project cost compared with an intake on Town Lake.

For these reasons, the alternatives evaluated in this study considered intakes in Matagorda County and just upstream of Bastrop. Because of the general nature of the intake, off-channel reservoir, and treatment plant sites; delivery routes for raw water were taken to be a straight line between the assumed location of each of these facilities.

Matagorda County Raw Water Intake Facilities and Off-Channel Reservoirs (RWI-A)

In accordance with the planning for the LCRA-SAWS Water Project, the lower Colorado River intake system in Matagorda County will involve a low head dam across the river and four to six intake structures that would pump river water to four to six large off-channel reservoirs near the Colorado River. Depending on the location of the intakes, the low head dam may or may not be necessary. For the purpose of this study, it has been assumed that there would be four low head dams of the inflatable type, four raw water intakes, and four reservoirs (except for alternatives 1D and 2A - Special).

According to the Project Viability Assessment (PVA) for the LCRA-SAWS Water Project, the lower Colorado intakes would be designed to withdraw 4000 to 6000 cfs from the river during peak flow events. A peak withdrawal of 4,000 cfs has been assumed in this analysis. The average withdrawal would be 132,000 acre-feet/year (equivalent to 182 cfs). Thus, each of the four intakes would be sized to "scalp" up to 1000 cfs during periods of high river flow.

Each intake would pump raw water through a raw water main to an off-channel reservoir. Thus, there would be a total of four raw water mains, each designed for a peak flow of 1,000 cfs and having a length of one mile and a diameter of 120 inches. Each of the four off-channel reservoirs would have a storage capacity of 25,000 acre feet and a surface area of 1,340 acres.

Raw Water Transmission Main and Pump Stations (RWTM-A)

The raw water stored in the four off-channel reservoirs in Matagorda County would be pumped via a high head pumping station(s) into a raw water transmission main (RWTM) that would deliver the raw water to the water treatment plant. Although the distances between the off-channel reservoirs may, and probably would, dictate the need for more than one high head pumping station at the upstream end of the RWTM, this alternative analysis has assumed all four off-channel reservoirs would feed to a single high head pumping station.

In all of the alternatives, RWTM-A would be over 120 miles in length. Due to this length and the elevation difference between Matagorda County and the alternative WTP sites, at least two additional booster pumping stations would be necessary along the route to avoid pipeline pressures above 150 psi. Each of the booster stations would also include a balancing reservoir with a capacity of about 5 million gallons, which would represent about 60 minutes of storage at the design pumping rate of about 82,000 gpm. The purpose of the balancing reservoirs along the RWTM would be to facilitate operation of the booster pumps, which would take suction from the balancing tank. The balancing tanks are not intended to provide maximum demand versus average demand balancing.

ALCOA/CPS Groundwater

As mentioned in an earlier chapter, SAWS has agreements to obtain as much as 55,000 acre-feet of groundwater from well fields in the Simsboro Aquifer in Bastrop, Lee and Milam Counties. SAWS is considering a separate pipeline to transport this groundwater to San Antonio. However, since this pipeline would cross and parallel the raw water transmission main for a regional facility, the transportation of this groundwater to San Antonio has been considered in the alternatives analyzed in this project. Of particular interest is whether or not this groundwater, together with limited water rights in the Colorado River at Bastrop, could be used to delay the construction of the lower Colorado intakes, off-channel reservoirs and RWTM-A.

Several possibilities were identified for integrating the ALCOA/CPS groundwater into a regional water supply plan. These are as follows:

1. Groundwater could be piped to the off-channel reservoir near the Bastrop intake and combined with surface water, then pumped to the water treatment plant in a common raw water transmission main (RWTM-B).
2. The groundwater could be discharged to Big Sandy Creek at Hwy 290 and allowed to flow to the Colorado River where it would mix with surface water. This would allow the diversion of an equal amount of raw water from the Colorado River either at the Bastrop intake (RWI-B) or at the Matagorda intake downstream (RWI-A). This additional raw water would then be pumped into the off-channel reservoirs near RWI-A or RWI-B and then pumped to the WTP via RWTM-A or RWTM-B.
3. The groundwater from the well fields could be treated separately (for iron and manganese removal). The treated water would then be pumped into the potable water transmission system downstream of the WTP that would treat the raw water from the Colorado River.

Option 3 takes advantage of the quality of the groundwater and would result in lower treatment costs for the 55,000 acre-feet/year available from the ALCOA/CPS well fields. However, overall transmission costs could be higher since a separate groundwater transmission main (GWTM) would be required from the well fields and the groundwater treatment plant to the interconnection with the potable water transmission main.

Transmission main costs would be lower in Option 1 but the groundwater would be treated in the surface water treatment system along with the surface water from the Colorado River. Part of the additional treatment costs could be offset by constructing wells as "non-potable" wells; savings of about $17 million for the 120 wells anticipated. (San Antonio Water System Preliminary Feasibility of Options to Deliver ALCOA/CPS Ground Water to Bexar County, HDR, Jan 2000; and HDR Update Memo of August 24, 2004).

Transmission costs could be reduced even lower using Option 2, since there would be no need for a GWTM from the well fields to the Colorado River. Since Big Sandy Creek discharges to the Colorado River just upstream of the proposed Bastrop intake (RWI-B), there would be no impact on water rights if an additional 55,000 acre-feet were diverted just downstream at the Bastrop intake.

In the alternative analysis that follows, each of these options is considered in order to estimate the relative savings that could be realized from one option to the next. This information could then be used to judge whether each option should be pursued in more detail in the event a regional system is attractive to the participants.

Bastrop Raw Water Intake Facilities and Off-Channel Reservoir (RWI-B)

As with the Matagorda intakes, the Bastrop intake system will involve low head dams across the river, intake structures with low head pump stations, and off-channel reservoirs near the Colorado River. However, since the diversion at this point would be less, it has been assumed that there would be two low head dams, two raw water intakes, and four reservoirs.

The average yearly withdrawal would be 18,000 acre-feet /year for SAWS plus the withdrawals to meet the LCRA and COA demands (11,200 acre-feet/year and 33604 acre-feet/year in 2065, respectively). In 2065, the total average withdrawal would be 62,804 acre-feet/year, which is equivalent to 87 cfs. The Bastrop intake would be designed to withdraw up to 2000 cfs from the river during peak flow events. The peak withdrawal rate is based on the same ratio of peak withdrawal rate to average withdrawal rate that was determined by LCRA for the Matagorda intake. LCRA would need to undertake a similar analysis to verify this assumed peak withdrawal rate in the event a regional system is pursued.

If the ALCOA/CPS groundwater is discharged to Big Sandy Creek (see Option 2 above under ALCOA/CPS Groundwater section of this memorandum) then RWI-B would be sized to withdraw an additional 55,000 acre-feet/year from the Colorado River. Since the groundwater would be discharged to Big Sandy Creek at an average rate of 55,000 acre-feet/year, the additional withdrawal rate at RWI-B would also be 55,000 acre-feet/year. Thus, no peak withdrawal factor would need to be applied to this volume.

The Bastrop intakes would pump raw water through four raw water mains to four 15,000 acre-foot off-channel reservoirs. Each raw water main would be designed for a peak flow of 224,000 gpm and would have a diameter of 120 inches and a length of two miles. It was assumed that the off channel reservoirs would need to be smaller and possibly farther away from the river near Bastrop (when compared to Matagorda County). Thus, 15,000 acre-foot reservoirs were assumed (instead of 25,000 acre-feet) and two mile raw water mains were used (instead of one mile mains as assumed for the intakes in Matagorda County).

Raw Water Transmission Main and Pump Stations (RWTM-B)

The raw water stored in the off-channel reservoir near the Bastrop intake (RWI-B) would be pumped via a high head pumping station(s) into a raw water transmission main that would deliver the water to the water treatment plant.

As in the case of RWTM-A, additional booster pumping stations may be necessary along the RWTM-B route to avoid pipeline pressures above 150 psi. Each of the booster stations would also include a balancing reservoir which would have a capacity equivalent to about 60 minutes of storage at the design pumping rate for the raw water transmission main. The balancing tanks would be used to facilitate operation of the booster pumps and are not intended to impact the design basis of RWTM-B, which is the average demand for raw water from the Bastrop intake system.

K FRIESE & ASSOCIATES, INC.

TECHNICAL MEMORANDUM

PROJECT: Central Texas Regional Water Treatment Plant
SUBJECT: Task 6 – Potential Plant Sites and Potable Water Transmission Main Routes
DATE: February 8, 2005

Background

The purpose of this study is to evaluate the feasibility and comparative costs of developing a large regional water treatment facility to provide potable water for both the Cities of Austin and San Antonio. Although various raw water sources have been included in the analysis (specifically the LCRA-SAWS Water Project, groundwater from the Simsboro Aquifer, and the Bastrop/Colorado River diversion point), no attempt has been made to evaluate these sources. The sole focus is defining the benefits of regional treatment – not defining the issues surrounding sources of raw water.

The purpose of this task is to examine potential plant sites and treated water pipeline corridors between Austin and San Antonio.

Regional Water Treatment Plant Alternative Sites

The selection of the treatment process and the factors used in that evaluation are discussed in detail in other sections. This section only discusses the potential sites.

It was anticipated that the siting of the regional water treatment plant would have a major impact on the raw water and finished water transmission routes and pipeline lengths and thus, on both capital and operating costs. In the initial analysis, three sites were considered:

1. Alternative 1A: East of San Antonio (just south of I-10 approximately 5 miles east of I-410 Loop)
2. Alternative 2A: East of San Marcos (approximately 1 mile northeast of Martindale)
3. Alternative 3A: In the northern corner of Caldwell County about 2 miles east of the intersection of Hwys 183 and 21

The selection of specific sites for each of these alternatives was beyond the scope of this study but the sites described above are generally rural and were defined for the purpose of estimating transmission main lengths and for estimating the elevation of the water treatment plant facilities. The objective in choosing these water treatment plant locations roughly parallel to the I-35 corridor was to identify the general location that resulted in the lowest present value. Then, adjustments to that location could be analyzed to find the location with the least overall cost. The results of the evaluation and the adjustments made to the initially selected alternatives are discussed in the technical memorandum for Tasks 3 and 10 (a combined memorandum). Because of the general nature of the treatment plant sites and the additional economical analyses performed under Tasks 3 and 10, treated water pipeline corridors were taken to be a straight line between the assumed location of the plant and each delivery point.

Potable Water Transmission Mains (PWTMs)

Each of the participants provided descriptions of the points where they wanted the deliveries of finished water to their distribution system, flow to each connection point, and the hydraulic grade elevation (HGL) at each connection point. This information is used in the alternatives analysis for transmission main length and sizing.

Connection point information coordinated with the participants is summarized below:

1. City of Austin – The City of Austin has specified the Pilot Knob Reservoir as the connection point. The Pilot Knob Reservoir has an overflow elevation of 720 and 100% of the City's maximum delivery rate will be delivered to this location.

2. SAWS – SAWS has specified two connection points:
    a. Northeastern connection point of the Green Mountain Pump Station. The Green Mountain Pump Station has an HGL of 1125 and 40% of the SAWS maximum delivery rate will be delivered to this location.
    b. The remaining 60% of the SAWS maximum delivery rate will be delivered to the northwestern delivery point, the Culebra Pump Station. The Culebra Pump Station has an HGL of 1080.

3. GBRA – GBRA connection point is assumed to be located approximately 5 miles south of San Marcos along Highway 123. Based on area topography, an HGL of 740 is used.

4. SARA – SARA will be using the SAWS Northeastern connection point, the Green Mountain Pump Station, as the delivery point.

5. LCRA – LCRA connection point is assumed to be located approximately 7 miles south of the City of Austin's Pilot Knob Pump Station. Based on area topography, an HGL of 790 is used.

Connection point HGL and flow data is summarized below in Table 6-1. It should be noted that for each SAWS connection point there are two delivery rates tabulated. SAWS provided two demand scenarios for analysis. These scenarios are further detailed in Task 7 – Connection Points.

Table 6-1
Connection Point Data

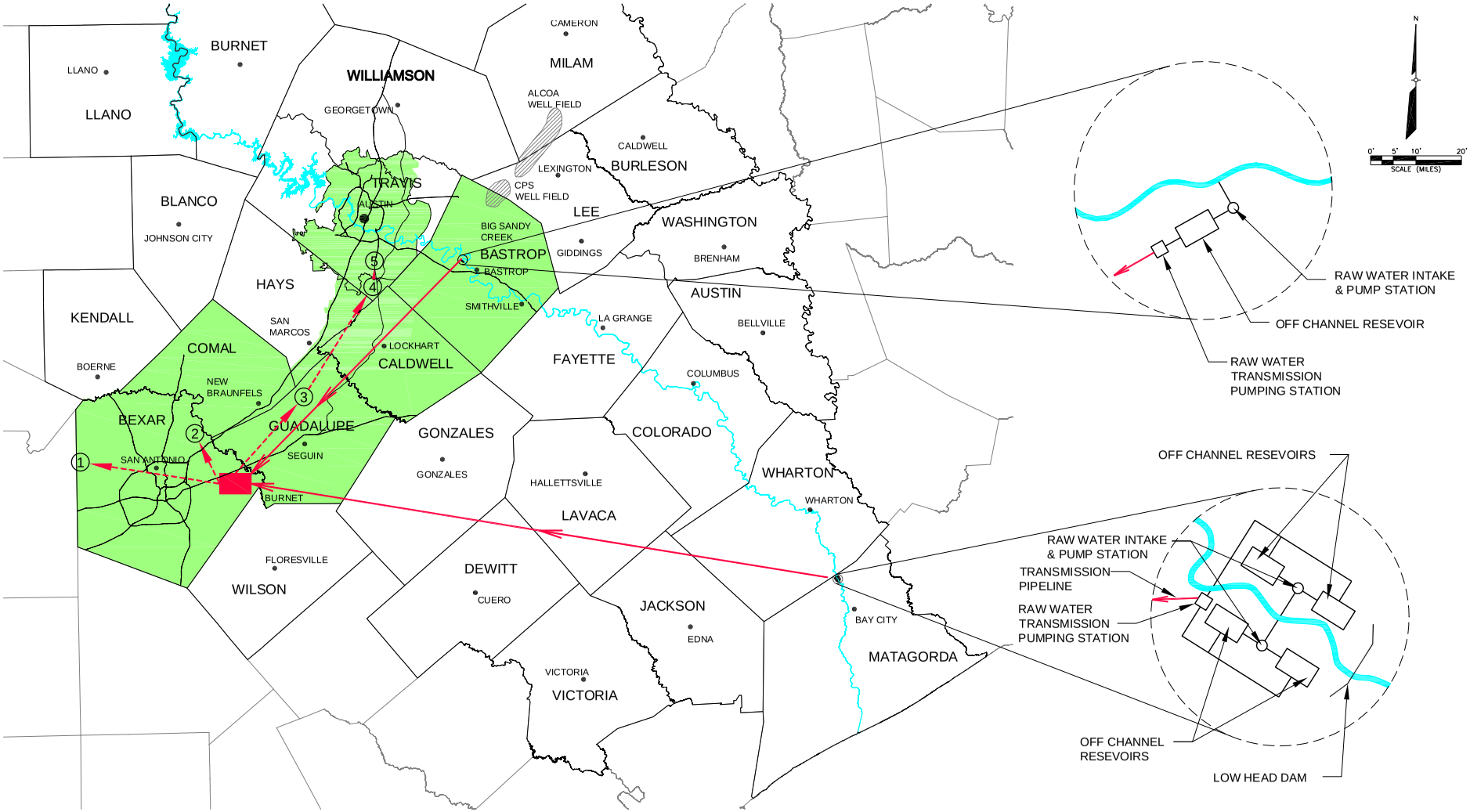
	HGL (feet)	***2015 Flow (MGD)***	***2020 Flow (MGD)***	***2030 Flow (MGD)***	***2040 Flow (MGD)***	***2050 Flow (MGD)***	***2060 Flow (MGD)***	***2065 Flow (MGD)***
City of Austin Pilot Knob Reservoir	720	0	0	25	35	50	50	50
SAWS Green Mtn. Pump Station	1125	34	95.2	95.2	95.2	95.2	95.2	95.2
		34	*64.4*	*95.2*	*95.2*	*95.2*	*95.2*	*95.2*
SAWS Culebra Pump Station	1080	51	142.8	142.8	142.8	142.8	142.8	142.8
		51	*96.6*	*142.8*	*142.8*	*142.8*	*142.8*	*142.8*
GBRA	740	0	0	11	14	18	22	22
SARA Green Mtn. Pump Station	1125	24	27	33	36	40	44	48
LCRA	790	0	0	10	20	20	20	20

Each system component was then sized based on the assumptions provided in Table 6-2. Based on the participants' delivery points and the water treatment plant locations in each alternative, general routes for the PWTMs were selected. The routes also had to take into account that SAWS, SARA and GBRA required un-softened water while LCRA and the COA required softened water.

Schematics of the PWTM layouts are shown in Figures 6-1, 6-2, and 6-3.

Table 6-2
Summary of Design Basis for Each Facility

Facility	***Design Basis***
RWI-A	Peak withdrawal rate from Colorado River at Matagorda
RWTM-A	Average delivery rate to WTP
ALCOA/CPS Well Fields	Average groundwater extraction rate of 55,000 acre-feet/year
RWI-B	Peak withdrawal rate from Colorado River at Bastrop
RWTM-B	Average delivery rate to WTP
WTP	Sum of Maximum Day Demands of Participants
PWTM‘s	Sum of Connection Point Maximum Day Demands



LEGEND

- PROJECT SERVICE AREA
- RAW WATER SUPPLY
- FINISHED WATER SUPPLY

FINISHED WATER DELIVERY LOCATION

1. SAWS
2. SARA / SAWS
3. GBRA
4. LCRA
5. COA

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CENTRAL TEXAS REGIONAL
WATER TREATMENT PLANT
TO SERVE AUSTIN AND SAN ANTONIO
ALTERNATIVE 1

OCTOBER, 2004

FIGURE 6-1

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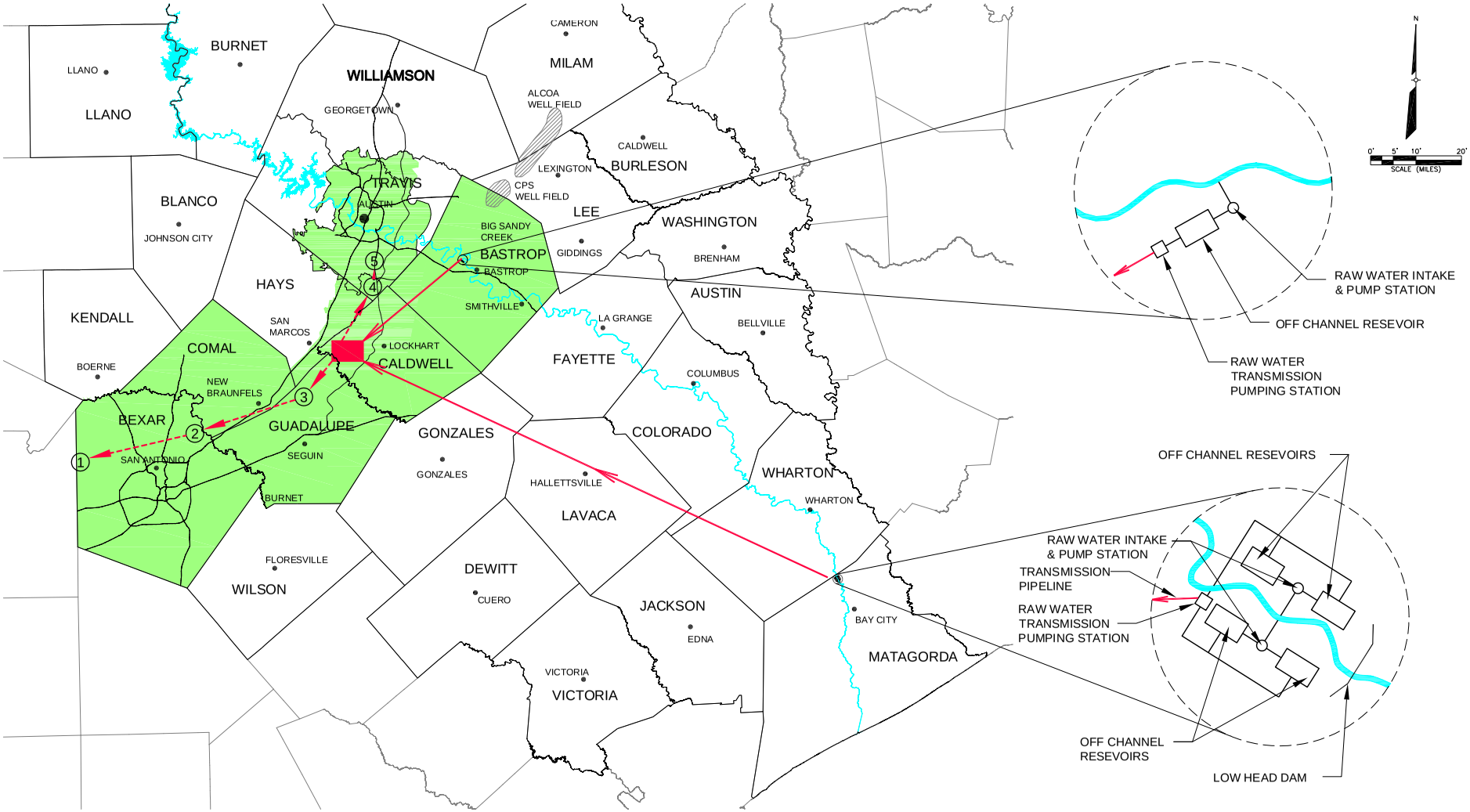

LEGEND

- PROJECT SERVICE AREA
- RAW WATER SUPPLY
- FINISHED WATER SUPPLY

FINISHED WATER DELIVERY LOCATION

1. SAWS
2. SARA / SAWS
3. GBRA
4. LCRA
5. COA

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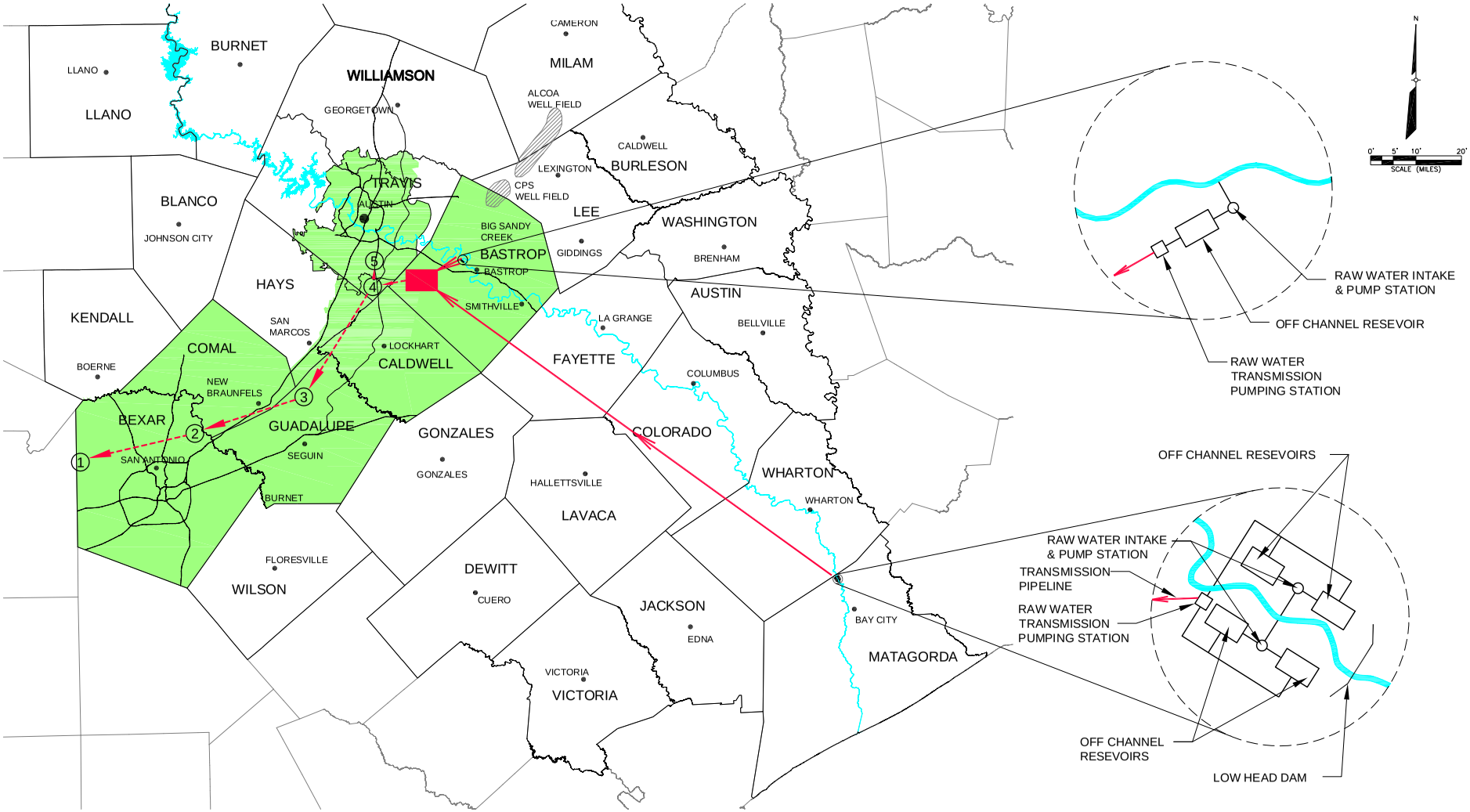
CENTRAL TEXAS REGIONAL
WATER TREATMENT PLANT
TO SERVE AUSTIN AND SAN ANTONIO
ALTERNATIVE 2

OCTOBER, 2004

FIGURE 6-2



LEGEND

- PROJECT SERVICE AREA
- RAW WATER SUPPLY
- FINISHED WATER SUPPLY

FINISHED WATER DELIVERY LOCATION

1. SAWS
2. SARA / SAWS
3. GBRA
4. LCRA
5. COA

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CENTRAL TEXAS REGIONAL
WATER TREATMENT PLANT
TO SERVE AUSTIN AND SAN ANTONIO
ALTERNATIVE 3

OCTOBER, 2004

FIGURE 6-3

K FRIESE & ASSOCIATES, INC.

TECHNICAL MEMORANDUM

PROJECT: Central Texas Regional Water Treatment Plant
SUBJECT: Task 7 - Connection Points
DATE: February 8, 2005

Although the purpose of this task is to present the connection points to the study participant's distribution system, flow to each connection point, and the hydraulic grade elevation (HGL) at each connection point; this information was used in the alternatives analysis for transmission main length and sizing which was presented in Task 6. The following text then focuses on connection points, but reiterates much of the information presented in Task 6.

Connection point information coordinated with the participants is summarized below:

1. City of Austin – The City of Austin has specified the Pilot Knob Reservoir as the connection point. The Pilot Knob Reservoir has an overflow elevation of 720 and 100% of the City's maximum delivery rate will be delivered to this location.

2. SAWS – SAWS has specified two connection points:
    a. Northeastern connection point of the Green Mountain Pump Station. The Green Mountain Pump Station has an HGL of 1125 and 40% of the SAWS maximum delivery rate will be delivered to this location.
    b. The remaining 60% of the SAWS maximum delivery rate will be delivered to the northwestern delivery point, the Culebra Pump Station. The Culebra Pump Station has an HGL of 1080.

3. GBRA – GBRA connection point is assumed to be located approximately 5 miles south of San Marcos along Highway 123. Based on area topography, an HGL of 740 is used.

4. SARA – SARA will be using the SAWS Northeastern connection point, the Green Mountain Pump Station, as the delivery point.

5. LCRA – LCRA connection point is assumed to be located approximately 7 miles south of the City of Austin's Pilot Knob Reservoir. Based on area topography, an HGL of 790 is used.

Connection point HGL and flow data is summarized in Table 7-1. SAWS also provided a second, "delayed demand scenario". The first scenario uses the full amount of water supply available with phasing based on an estimation of when the necessary infrastructure can be in place. The second scenario delays 66,000 acre-feet/year of demand from 2020 to 2030. The second scenario is to be considered if delaying the raw water transmission main from the Matagorda/Wharton County intake location results in a more economically feasible project. SAWS will temporarily obtain the 66,000 acre-feet/year supply from another source until the Matagorda/Wharton County intake is in place. Table 7-2 summarizes the "delayed demand scenario".

Table 7-1
Connection Point Data

	HGL (feet)	***2015 Flow (MGD)***	***2020 Flow (MGD)***	***2030 Flow (MGD)***	***2040 Flow (MGD)***	***2050 Flow (MGD)***	***2060 Flow (MGD)***	***2065 Flow (MGD)***
City of Austin Pilot Knob Reservoir	720	0	0	25	35	50	50	50
SAWS Green Mtn. Pump Station	1125	34	95.2	95.2	95.2	95.2	95.2	95.2
SAWS Culebra Pump Station	1080	51	142.8	142.8	142.8	142.8	142.8	142.8
GBRA	740	0	0	11	14	18	22	22
SARA Green Mtn. Pump Station	1125	24	27	33	36	40	44	48
LCRA	790	0	0	10	20	20	20	20

Table 7-2
Connection Point Data
Delayed Demand Scenario

	HGL (feet)	***2015 Flow (MGD)***	***2020 Flow (MGD)***	***2030 Flow (MGD)***	***2040 Flow (MGD)***	***2050 Flow (MGD)***	***2060 Flow (MGD)***	***2065 Flow (MGD)***
City of Austin Pilot Knob Reservoir	720	0	0	25	35	50	50	50
SAWS Green Mtn. Pump Station	1125	34	64.4	95.2	95.2	95.2	95.2	95.2
SAWS Culebra Pump Station	1080	51	96.6	142.8	142.8	142.8	142.8	142.8
GBRA	740	0	0	11	14	18	22	22
SARA Green Mtn. Pump Station	1125	24	27	33	36	40	44	48
LCRA	790	0	0	10	20	20	20	20

K FRIESE & ASSOCIATES, INC.

TECHNICAL MEMORANDUM

PROJECT: Central Texas Regional Water Treatment Plant
SUBJECT: Task 8 - Phasing Potential
DATE: May 7, 2005

Background

The purpose of this task is to examine the phasing potential of the facilities and the effect of phasing on unit costs. Since a key economic incentive for a regional treatment plant is to realize the economies of scale associated with a larger plant, the construction phasing has to be carefully considered. Building the plant in numerous phases will minimize unused capacity but erode the economies of scale advantage.

Phasing Potential

Facility phasing is determined by two primary factors, capacity required and least cost net present value (NPV). Table 8-1 is a schedule of the projected maximum delivery rate for each participant categorized as softened or non-softened demand.

Table 8-1
Projected Maximum Delivery Rate
(MGD)

Year	***2015***	***2020***	***2030***	***2040***	***2050***	***2060***	***2065***
Softened Demand							
City of Austin	0	0	25	35	50	50	50
LCRA	0	0	10	20	20	20	20
Sub-Total	0	0	35	55	70	70	70
Non-Softened Demand							
SAWS	85	238	238	238	238	238	238
GBRA	0	0	11	14	18	22	22
SARA	24	27	33	36	40	44	48
Sub-Total	109	265	282	288	296	304	308
Total	**109**	**265**	**317**	**343**	**366**	**374**	**378**

SAWS also provided a second, "delayed demand scenario". The first scenario uses the full amount of water supply available with phasing based on an estimation of when the necessary infrastructure can be in place. The second scenario delays 66,000 acre-feet/year of SAWS demand from 2020 to 2030 and delays all of the SARA demand until 2030. The second scenario is to be considered if delaying the raw water transmission main from the Matagorda/Wharton County intake location results in a more economically feasible project. SAWS will temporarily obtain the 66,000 acre-feet/year supply from another source until the Matagorda/Wharton County intake is in place. The following table summarizes the "delayed demand scenario".

Table 8-2
Projected Maximum Delivery Rate
"Delayed Demand Scenario"
(MGD)

Year	***2015***	***2020***	***2030***	***2040***	***2050***	***2060***	***2065***
Softened Demand							
City of Austin	0	0	25	35	50	50	50
LCRA	0	0	10	20	20	20	20
Sub-Total	0	0	35	55	70	70	70
Non-Softened Demand							
SAWS	85	161	238	238	238	238	238
GBRA	0	0	11	14	18	22	22
SARA	0	0	33	36	40	44	48
Sub-Total	85	161	282	288	296	304	308
Total	**109**	**161**	**317**	**343**	**366**	**374**	**378**

Seven alternative regional systems were evaluated. The seven alternatives are more fully described under Tasks 3 and 10, Economic Analysis. The main variables in the alternatives analysis are treatment plant location, treatment plant phasing, and raw water facilities phasing. The following Table 8-3 shows the location and timing of these variables. The results of the economic analysis are discussed in the Technical Memorandum for Tasks 3 and 10.

Table 8-3
Facilities Phasing

Case	WTP Location	Phasing Scenario	Facility	2015	2020	2030	2040	2050	2060	2065
1A	East of San Antonio	RWTM B & ALCOA/CPS built by 2015; RWTM A Built in 2020	RWI & TM	RWI B	RWI A					
			Softened WTP (MGD)			50	20			
			Non-Softened WTP (MGD)	200	100					
			Total WTP (MGD)	200	300	350	370	370	370	370
2A	East of San Marcos	RWTM B & ALCOA/CPS built by 2015; RWTM A Built in 2020	RWI & TM	RWI B	RWI A					
			Softened WTP (MGD)			50	20			
			Non-Softened WTP (MGD)	200	100					
			Total WTP (MGD)	200	300	350	370	370	370	370
3A	Northern Corner of Caldwell County	RWTM B & ALCOA/CPS built by 2015; RWTM A Built in 2020	RWI & TM	RWI B	RWI A					
			Softened WTP (MGD)			50	20			
			Non-Softened WTP (MGD)	200	100					
			Total WTP (MGD)	200	300	350	370	370	370	370
1B	East of San Antonio	RWTM B & ALCOA/CPS built by 2015; RWTM A Built in 2020	RWI & RWTM	RWI B	RWI A					
			Softened WTP (MGD)			50	20			
			Non-Softened WTP (MGD)	200	100					
			Total WTP (MGD)	200	300	350	370	370	370	370
1C	East of San Antonio	RWTM B & ALCOA/CPS built by 2015; RWTM A Built in 2020	RWI & TM	RWI B	RWI A					
			Softened WTP (MGD)			50	20			
			Non-Softened WTP (MGD)	200	100					
			Total WTP (MGD)	200	300	350	370	370	370	370
3B	Northern Corner of Caldwell County	RWTM B & ALCOA/CPS built by 2015; RWTM A Built in 2030, Reduced Demand Scenario	RWI & TM	RWI B		RWI A				
			Softened WTP (MGD)			50	20			
			Non-Softened WTP (MGD)	100	100	100				
			Total WTP (MGD)	100	200	350	370	370	370	370
1D	WTP for ALCOA/CPS East of Elgin; Main Surface WTP East of San Antonio	2015 – Build ALCOA/CPS System with PWTM's to San Antonio; 2020 – Build RWI A and Surface WTP	RWI & TM		RWI A					
			Softened WTP (MGD)							
			Non-Softened WTP (MGD)	200	100					
			Total WTP (MGD)	200	300	300	300	300	300	300

K FRIESE & ASSOCIATES, INC.

TECHNICAL MEMORANDUM

PROJECT: Central Texas Regional Water Treatment Plant
SUBJECT: Task 9 – Develop Treatment Plant Layout
DATE: May 9, 2005

Background

The purpose of this task is to determine the land area requirements for a regional facility of this size and to identify the phasing of the units so that adequate space is available for future expansion. This task is also to identify any additional treatment units and land needs required by future changes in drinking water regulations. This information was used to estimate the cost of the plant site and to determine general areas where the facility could be located. The identification of a definitive size and location of specific plant sites is beyond the scope of this task.

Area required for Plant Site

In Task 2 – Demand Projections, the average day ultimate capacity for this facility was determined to be 303,232 acre-feet/year or 271 MGD. A peak or maximum day rate of 378 MGD was also determined based on peaking factors established by each of the participants. Alternatives were developed for each of these plant sizes. In Task 4 – Water Treatment Process, a split process consisting of two treatment trains was proposed. One of the trains would use a conventional process and the other would be lime softened. Both trains would use microfiltration membranes for filtration. Task 4 also proposed a raw water storage reservoir at or near the plant site. The reservoir would be used to provide raw water in the event that maintenance was required on the raw water transmission main or pump stations. The reservoir was sized at 12,000 acre-feet and would provide approximately 15 days of storage at average flow. At this planning level, a nominal 100 acre plant site is proposed for both plant sizes. An additional 528 acres is proposed for the raw water reservoir based on an assumed depth of 25 feet.

Phasing

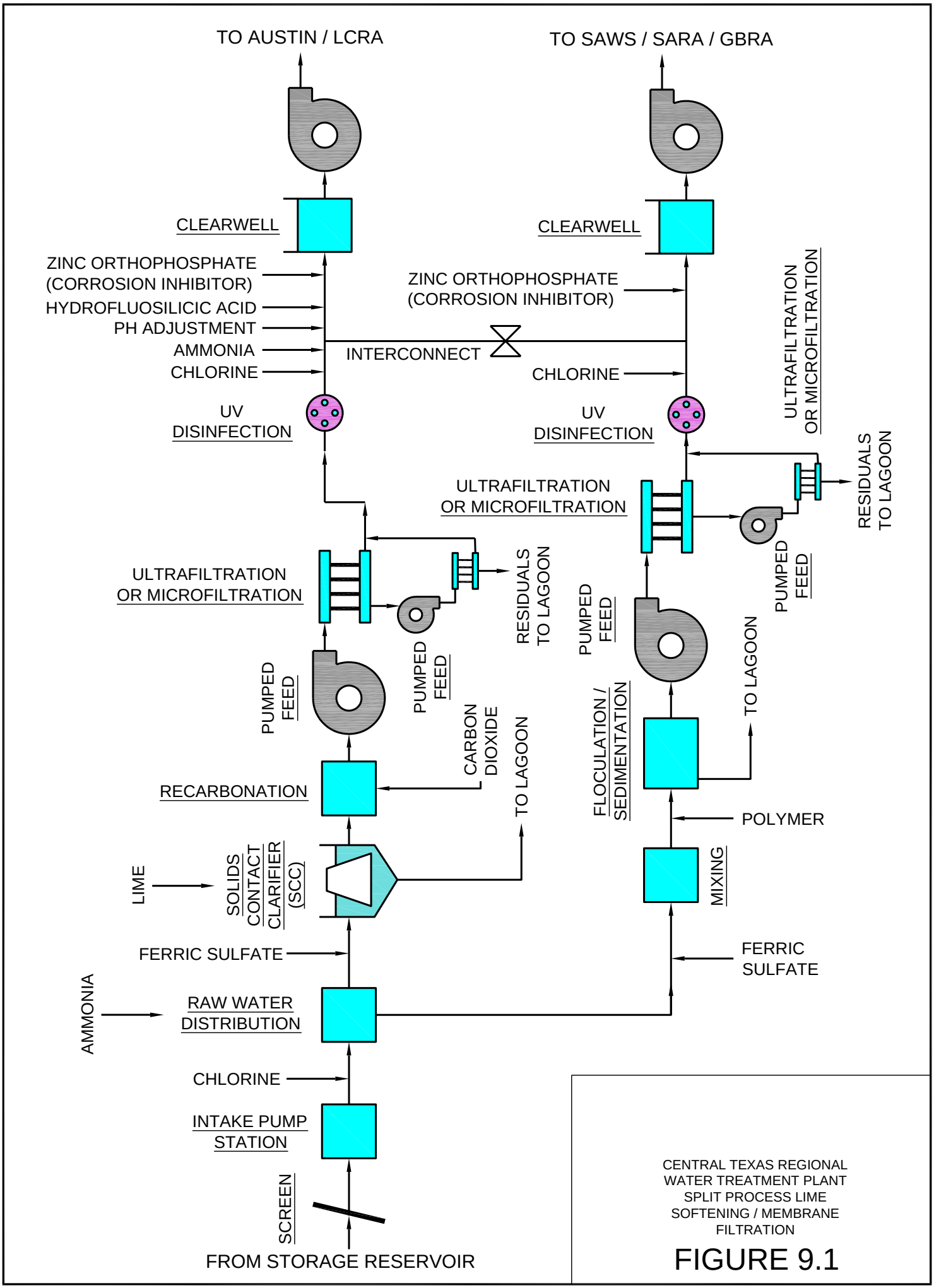
Various options for phasing of the facilities were considered based on when capacity was needed, economy of scale in building larger units and the time value of money. Because the SAWS demand comes on so quickly it was determined that the ultimate size facility of 220 MGD for the non-soften train should be constructed initially with no phasing. For the soften train an initial size of 50 MGD should be constructed in 2030 with a 20 MGD expansion in 2040. Both of these expansions were considered to be fairly normal in their space requirements so no additional area was required for this factor. It should be noted that the total soften capacity of 70 MGD is a maximum day capacity while the 220 MGD for the non-soften capacity is an average day capacity.

Future Regulations

Since membranes were proposed for filtration on both treatment trains, it was assumed that no major additional treatment units that could effect the size requirements of the plant site would be needed in the future. Hence no additional land was proposed for this factor.

Conclusions

A plant site of 100 acres is proposed for the regional facility. An additional 528 acre site adjacent to or near the plant site for a raw water storage reservoir is also proposed. A process flow diagram for the proposed facility is shown in Figure 9.1. The required treatments units are identified for both treatment trains. A more detailed plant layout is dependent on the specifics of the actual plant site selected.



CENTRAL TEXAS REGIONAL WATER TREATMENT PLANT
SPLIT PROCESS LIME SOFTENING / MEMBRANE FILTRATION

FIGURE 9.1

K FRIESE & ASSOCIATES, INC.

TECHNICAL MEMORANDUM

PROJECT: Central Texas Regional Water Treatment Plant
SUBJECT: Tasks 3 and 10 – Economic Analysis
DATE: February 8, 2005

Background

The purpose of this study is to evaluate the feasibility and comparative costs of developing a large regional water treatment facility to provide potable water for both the Cities of Austin and San Antonio. Although various raw water sources have been included in the analysis (specifically the LCRA-SAWS Water Project, groundwater from the Simsboro Aquifer, and the Bastrop/Colorado River diversion point), no attempt has been made to evaluate these sources. The sole focus is defining the benefits of regional treatment – not defining the issues surrounding sources of raw water.

Methodology

The economic analysis was undertaken in two steps: first, an initial analysis of three regional system configurations with the main difference being the location of the water treatment plant, and second, the development and analysis of additional alternatives based on the results of the initial analysis.

Initial Analysis of Alternatives

The purpose of the initial analysis was two-fold: First, to identify the principal factors that are likely to affect the costs of the regional system and, second, to screen alternative regional systems in order to determine which water treatment plant locations are most likely to result in the lowest overall cost. The steps taken to accomplish this task were as follows:

1. Estimate the size of the intakes, pumping stations, reservoirs, and water treatment plants and assign unit construction costs to each cost item, then calculate capital costs including contingencies; engineering, legal and administrative costs; environmental and surveying costs; land or easement acquisition costs; and other miscellaneous costs
2. Prepare operation and maintenance cost estimates
3. Calculate present values using a discount rate of 5% for both capital cost expenditures and operation and maintenance costs over the 50 year planning period
4. Compare the present values for each alternative and identify the most economical alternatives

Unit Costs

The unit costs used in the analysis were gathered from the LCRA-SAWS Water Project PVA, 2004. The unit costs from the PVA were used because the facilities in both projects were of a similar nature and their use added a sense of consistency between the two projects.

The unit costs in the 2004 PVA were presented in a series of tables and these are included in Appendix 1. Each of

the unit cost tables was graphed, and using the trendline feature of Excel, a best-fit equation was determined. The best-fit equation was then used in the alternative analysis spreadsheets to estimate costs.

After most of the analysis was complete and the results had been presented to the project participants, the LCRA-SAWS Water Project PVA was revised. One alternative presented in this report (Alternative 2A – Special) was updated to the revised PVA assumptions and costs. This final alternative was based on the revised PVA assumptions and costs, so the reader may note some inconsistencies between Alternative 2A - Special and the others.

Initial Analysis Results

As mentioned previously, the initial analysis evaluated three alternative water treatment plant sites, which were as follows:

1. Alternative 1A: East of San Antonio
2. Alternative 2A: East of San Marcos
3. Alternative 3A: In the northern corner of Caldwell County

The results of the initial analysis are shown in Table 10-1. Although the location of the water treatment plant had a major impact on the orientation of the raw water and potable water transmission mains, there was only a 1.1% difference in the present values between the highest and lowest. Alternative 2A, with the water treatment plant located east of San Marcos, had the least present value. A review of the capital and O&M estimates indicated that while locating the water treatment plant closer to the Bastrop intake and the ALCOA/CPS well fields lowered the cost of the raw water transmission mains, the cost of the potable water transmission mains were increased. In particular, the power costs associated with the potable water transmission mains increased. This result can be explained by the fact that the largest demands are at the southernmost delivery points (those for SAWS and SARA), and by the fact that potable water transmission mains must be designed for maximum daily demands while raw water transmission mains are designed for average daily demands. As the water treatment plant is moved to the northeast, more potable water must be pumped south through the potable water transmission main running parallel to I-35. The potable water transmission main segments between the water treatment plant and the SAWS delivery points must be sized for these large flows.

For Alternatives 1A, 2A, and 3A, the PWTMs represent a sizable percentage of the overall costs of the project over the 50-year analysis period: 20% to 31% of the present value of both capital and O&M costs. The size of the PWTMs range from 54 inches in diameter, for the mains serving the City of Austin on the north end of the project, to 120 inches in diameter for the line serving GBRA, SAWS and SARA on the south end in Alternative 3A.

Since SAWS' maximum daily demand accounts for almost 63% of the total, the PWTMs serving the SAWS delivery points require the largest investments.

Based on the analysis of Alternatives 1A, 2A and 3A, the following observations were made:

1. The location of the water treatment plant had a lower impact than expected on overall present values. In fact, although a 1.1% difference represents over $40 million, a 1.1% difference is not significant given the accuracy of these feasibility level cost estimates.

2. The least cost alternative was Alternative 2A, which located the water treatment plant east of San Marcos. The cost of Alternative 1A and Alternative 3A were essentially the same.

Table 10-1

Summary of Alternatives 1A, 2A and 3A (Initial Alternatives)

WTP Location	Case	Phasing Scenario	Total NPVs in Millions of $	RWI A & OCRs (Matagorda County)	RWTM A (Including Pump Stations)	ALCOA/CPS	RWI B & OCR (just upstream of Bastrop)	RWTM B (Including Pump Station)	WTP & RW Storage at Plant	PWTMs (Including Pump Stations)
East of San Antonio	1A	RWTM B & ALCOA/CPS built by 2015; RWTM A built in 2020.		Sized for 4000 cfs to scalp water; 4 intakes, 4 miles of 120-inch raw water mains & 4 OCRs at 25,000 ac-ft each	150 miles of 96-inch diameter pipe sized to deliver 132,000 ac-ft/year on a continuous basis; includes 3 pumping stations w/ balancing reservoirs along route	Non-Public wells; Transmission of 55,000 ac-ft/year to the OCR at RWI B via 15 miles of 54" gravity pipeline from Hwy 290 east of Elgin	Sized for 2000 cfs to scalp water; 2 intakes; 8 miles of 120-inch raw water mains and 4 OCRs at 15,000 ac-ft/each	Sized for 117,804 ac-ft/yr; 77 miles of 84" pipeline with two pumping stations and balancing reservoirs	Raw water reservoir w/ 11,000 ac-ft capacity; Conventional settling with membrane filtration for SAWS, SARA & GBRA; Lime softening with membrane filtration for COA & LCRA water	Each PWTM sized for maximum daily demand (See PWTM Summary Sheet in the Appendices)
		NPV of Capital Costs	$ 2,366	$ 191	$ 534	$ 135	$ 204	$ 297	$ 585	$ 420
		NPV of O&M Costs	$ 1,530	$ 49	$ 288	$ 142	$ 40	$ 160	$ 499	$ 352
		Total NPV of Capital & O&M	**$ 3,896**	$ 240	$ 822	$ 277	$ 244	$ 457	$ 1,084	$ 772
East of San Marcos	2A	RWTM B & ALCOA/CPS built by 2015; RWTM A built in 2020.		Sized for 4000 cfs to scalp water; 4 intakes, 4 miles of 120-inch raw water mains & 4 OCRs at 25,000 ac-ft each	126 miles of 96-inch diameter pipe sized to deliver 132,000 ac-ft/year on a continuous basis; includes 3 pumping stations w/ balancing reservoirs along route	Non-Public wells; Transmission of 55,000 ac-ft/year to the OCR at RWI B via 15 miles of 54" gravity pipeline from Hwy 290 east of Elgin	Sized for 2000 cfs to scalp water; 2 intakes; 8 miles of 120-inch raw water mains and 4 OCRs at 15,000 ac-ft/each	Sized for 117,804 ac-ft/yr; 36 miles of 96" pipeline with one pumping station and balancing reservoir	Raw water reservoir w/ 11,000 ac-ft capacity; Conventional settling with membrane filtration for SAWS, SARA & GBRA; Lime softening with membrane filtration for COA & LCRA water	Each PWTM sized for maximum daily demand (See PWTM Summary Sheet in the Appendices)
		NPV of Capital Costs	$ 2,306	$ 191	$ 451	$ 135	$ 204	$ 168	$ 572	$ 585
		NPV of O&M Costs	$ 1,546	$ 49	$ 250	$ 142	$ 40	$ 93	$ 502	$ 470
		Total NPV of Capital & O&M	**$ 3,852**	$ 240	$ 701	$ 277	$ 244	$ 261	$ 1,074	$ 1,055
Northern Corner of Caldwell County	3A	RWTM B & ALCOA/CPS built by 2015; RWTM A built in 2020.		Sized for 4000 cfs to scalp water; 4 intakes, 4 miles of 120-inch raw water mains & 4 OCRs at 25,000 ac-ft each	126 miles of 96-inch diameter pipe sized to deliver 132,000 ac-ft/year on a continuous basis; includes 3 pumping stations w/ balancing reservoirs along route	Non-Public wells; Transmission of 55,000 ac-ft/year to the OCR at RWI B via 15 miles of 54" gravity pipeline from Hwy 290 east of Elgin	Sized for 2000 cfs to scalp water; 2 intakes; 8 miles of 120-inch raw water mains and 4 OCRs at 15,000 ac-ft/each	Sized for 117,804 ac-ft/yr; 20 miles of 84" pipeline with one pumping station and balancing reservoir	Raw water reservoir w/ 11,000 ac-ft capacity; Conventional settling with membrane filtration for SAWS, SARA & GBRA; Lime softening with membrane filtration for COA & LCRA water	Each PWTM sized for maximum daily demand (See PWTM Summary Sheet in the Appendices)
		NPV of Capital Costs	$ 2,333	$ 191	$ 451	$ 135	$ 204	$ 86	$ 572	$ 694
		NPV of O&M Costs	$ 1,562	$ 49	$ 250	$ 142	$ 40	$ 83	$ 502	$ 496
		Total NPV of Capital & O&M	**$ 3,895**	$ 240	$ 701	$ 277	$ 244	$ 169	$ 1,074	$ 1,190

3. The raw water transmission mains, potable water transmission mains and the water treatment plant were the principal cost drivers.

Analysis Results for Alternates 1B, 1C, 1D, and 3B

Taking these observations into account, four additional alternatives were developed and analyzed for a more complete understanding of the potential regional scenarios (see Table 10-2).

In Alternative 1B, the water treatment plant was located about 10 miles northwest of the location shown in Alternative 1A. This alternative was developed to test if a plant site in the San Antonio area, even closer to the SAWS & SARA delivery points, could yield a present value for the San Antonio plant site lower than the San Marcos site. The water treatment plant is still about 8 miles east of Delivery Point #2, but finding a site for the water treatment plant west of this point may be difficult. Otherwise, no other changes were made compared to Alternative 1A. This change lowered the present value by about $106 million (about 2.7%). Alternative 1B represents the least cost alternative of the four alternate water treatment plant locations considered, and it is about $62 million lower than the San Marcos location represented by Alternative 2A.

Given that the water treatment plant location did not have a major impact on present values, changes to the basic scenario were tested to determine if other adjustments could be made to lower the overall cost.

In Alternative 1C, the financial impact of discharging the ALCOA/CPS groundwater to Big Sandy Creek was analyzed. Alternative 1B was used as the base case and the ALCOA/CPS costs were revised to show the elimination of a ground water transmission main from the well fields to the Off-Channel Reservoir (OCR) near the Bastrop intake (RWI-B). However, the O&M costs for this intake were increased to account for the withdrawal of an additional 55,000 acre-feet/year. The overall present value for Alternative 1C was about $32 million less than Alternative 1B.

Alternate 3B analyzes the impact of delaying a portion of SAWS's 2020 demand to 2030. It also assumes that all of SARA's demands would be delayed until 2030. This alternative is also predicated on the negotiation of an agreement for SAWS to temporarily withdraw LCRA's raw water (11,200 acre-feet/year), the City of Austin's raw water (33,604 acre-feet/year), and an additional 21,196 acre-feet/year of raw water at the Bastrop intake (RWI-A), in addition to the 18,000 acre-feet/year that has been used in the previous alternatives. This agreement would not be necessary after 2030.

Alternative 3B seeks to determine the impact of delaying the costly RWTM-A and the Matagorda intake. Its present value has been estimated at about $516 million (about 13 %) less than Alternative 3A, to which it is equivalent in all other respects. Had Alternatives 1A or 2A been used as the comparison basis, the savings would have been similar. However, in this case, using present values as the basis for comparison is misleading, since over the project's 50 year life, approximately 9.6% less treated water is delivered to the participants in Alternative 3B compared to 3A as well as all of the other alternatives. Taking this into account, Alternative 3B offers a 3.7% reduction in overall costs compared to 3A.

Alternative 1D represents a more significant change in the basic scenario used in all of the alternatives thus far described. In 1D, the Bastrop intake (RWI-B) and its raw water transmission main (RWTM-B) are eliminated. The ALCOA/CPS well fields would be developed in 2015 and a groundwater treatment plant would be built near Elgin. Treated ground water would be pumped to the SAWS delivery points via a potable water transmission main, but this main would be routed to pass close to the City of Austin, LCRA and GBRA delivery points.

Table 10-2

Summary of Additional Alternatives Analyzed

WTP Location	Case	Phasing Scenario	Total NPVs in Millions of $	RWI A & OCRs (Matagorda County)	RWTM A (Including Pump Stations)	ALCOA/CPS	RWI B & OCR (just upstream of Bastrop)	RWTM B (Including Pump Station)	WTP & RW Storage at Plant	PWTMs (Including Pump Stations)
East of San Antonio	1B	RWTM B & ALCOA/CPS built by 2015; RWTM A built in 2020.		Sized for 4000 cfs to scalp water; 4 intakes, 4 miles of 120-inch raw water mains & 4 OCRs at 25,000 ac-ft each	142 miles of 96-inch diameter pipe sized to deliver 132,000 ac-ft/year on a continuous basis; includes 3 pumping stations w/ balancing reservoirs along route	Non-public wells; Transmission of 55,000 ac-ft/year to the OCR at RWI B via 15 miles of 54" gravity pipeline from Hwy 290 east of Elgin	Sized for 2000 cfs to scalp water; 2 intakes; 8 miles of 120-inch raw water mains and 4 OCRs at 15,000 ac-ft/each	Sized for 117,804 ac-ft/yr; 68 miles of 84" pipeline with two pumping stations and balancing reservoirs	Raw water reservoir w/ 11,000 ac-ft capacity; Conventional settling with membrane filtration for SAWS, SARA & GBRA; Lime softening with membrane filtration for COA & LCRA water	Each PWTM sized for maximum daily demand (See PWTM Summary Sheet in the Appendices)
		NPV of Capital Costs	$ 2,286	$ 191	$ 507	$ 135	$ 204	$ 265	$ 572	$ 412
		NPV of O&M Costs	$ 1,504	$ 49	$ 280	$ 142	$ 40	$ 148	$ 502	$ 343
		Total NPV of Capital & O&M	**$ 3,790**	$ 240	$ 787	$ 277	$ 244	$ 413	$ 1,074	$ 755
East of San Antonio	1C	RWTM B & ALCOA/CPS built by 2015; RWTM A built in 2020.		Sized for 4000 cfs to scalp water; 4 intakes, 4 miles of 120-inch raw water mains & 4 OCRs at 25,000 ac-ft each	142 miles of 96-inch diameter pipe sized to deliver 132,000 ac-ft/year on a continuous basis; includes 3 pumping stations w/ balancing reservoirs along route	Non-public wells; Discharge of 55,000 ac-ft/year to Big Sandy Creek near Hwy 290 east of Elgin with flow to Colorado River just upstream of RWI-B	Sized for 2000 cfs (2 intakes) to scalp surface water plus an additional 76 cfs (55,000 ac-ft/yr) equivalent to groundwater released to Big Sandy Creek; 8 miles of 120-inch pipe; 4 OCRs at 15,000 ac-ft/each	Sized for 117,804 ac-ft/yr; 68 miles of 84" pipeline with two pumping stations and balancing reservoirs	Raw water reservoir w/ 11,000 ac-ft capacity; Conventional settling with membrane filtration for SAWS, SARA & GBRA; Lime softening with membrane filtration for COA & LCRA water	Each PWTM sized for maximum daily demand (See PWTM Summary Sheet in the Appendices)
		NPV of Capital Costs	$ 2,249	$ 191	$ 507	$ 98	$ 204	$ 265	$ 572	$ 412
		NPV of O&M Costs	$ 1,509	$ 49	$ 280	$ 138	$ 49	$ 148	$ 502	$ 343
		Total NPV of Capital & O&M	**$ 3,758**	$ 240	$ 787	$ 236	$ 253	$ 413	$ 1,074	$ 755
Northern Corner of Caldwell County	3B	Reduced SAWS demand in 2020 by 66,000 ac-ft/yr (& SARA to 0 demand); RWTM B & ALCOA/CPS built by 2015; RWTM A built in 2030.	Note: This Alternative delivers 9.6% less water to participants over 50 years than the other Alternatives	Sized for 4000 cfs to scalp water; 4 intakes, 4 miles of 120-inch raw water mains & 4 OCRs at 25,000 ac-ft each	126 miles of 96-inch diameter pipe sized to deliver 132,000 ac-ft/year on a continuous basis; includes 3 pumping stations w/ balancing reservoirs along route	Non-Public wells; Transmission of 55,000 ac-ft/year to the OCR at RWI B via 15 miles of 54" gravity pipeline from Hwy 290 east of Elgin	Sized for 2000 cfs to scalp water; 2 intakes; 8 miles of 120-inch raw water mains and 4 OCRs at 15,000 ac-ft/each	Sized for 117,804 ac-ft/yr; 20 miles of 84" pipeline with one pumping station and balancing reservoir	Raw water reservoir w/ 11,000 ac-ft capacity; Conventional settling with membrane filtration for SAWS, SARA & GBRA; Lime softening with membrane filtration for COA & LCRA water	Each PWTM sized for maximum daily demand (See PWTM Summary Sheet in the Appendices)
		NPV of Capital Costs	$ 2,039	$ 170	$ 277	$ 135	$ 204	$ 86	$ 524	$ 643
		NPV of O&M Costs	$ 1,340	$ 39	$ 142	$ 142	$ 40	$ 87	$ 427	$ 463
		Total NPV of Capital & O&M	**$ 3,379**	$ 209	$ 419	$ 277	$ 244	$ 173	$ 951	$ 1,106
WTP for ALCOA/CPS groundwater east of Elgin; Main suface WTP east of San Antonio.	1D	2015: Construct ALCOA/CPS system with PWTM's to San Antonio; 2020: Construct RWI & RWTM A with main suface WTP east of San Antonio.		Sized for 6000 cfs to scalp water; 6 intakes & 6 OCRs at 25,000 ac-ft each	142 miles of 108-inch diameter pipe sized to deliver an ultimate average flow of 194,800 ac-ft/year; includes 3 pumping stations w/ balancing reservoirs along route	Public wells; Treat 55,000 ac-ft/year in iron/manganese removal WTP near Hwy 290 east of Elgin	None req'd	None req'd	Raw water reservoir w/ 12,000 ac-ft capacity; Conventional settling with membrane filtration for SAWS, SARA & GBRA	Each PWTM sized for maximum daily demand (See PWTM Summary Sheet in the Appendices)
		NPV of Capital Costs	$ 2,074	$ 284	$ 610	$ 143			$ 496	$ 541
		NPV of O&M Costs	$ 1,506	$ 65	$ 421	$ 196			$ 445	$ 379
		Total NPV of Capital & O&M	**$ 3,580**	$ 349	$ 1,031	$ 339	$ -	$ -	$ 941	$ 920

The Matagorda intake (RWI-A) and RWTM-A would be built in 2020 and would be sized to withdraw, store and transport up to 194,804 acre-feet/year to a water treatment plant located just northeast of San Antonio. Beginning in
2030, potable water from the Elgin groundwater treatment plant would be diverted to the City of Austin, LCRA and GBRA while more and more of SAWS's potable water would come from the surface water treatment plant.

The present value for Alternative 1D is about $210 million (about 5.5%) less than the present value of Alternative 1B, the least cost alternative of the first 4 alternatives evaluated. However, by including a separate treatment plant for the ALCOA/CPS groundwater, Alternative 1D takes advantage of the lower treatment costs for this water. This alternative offers SAWS a way of avoiding a long groundwater transmission main from the ALCOA/CPS fields and the potential for sharing in the cost of the potable water transmission main. As in the other alternatives, this regional potable water transmission main (at least 60-inches in diameter) running parallel to IH-35 could be used to service the anticipated growth along the I-35 corridor and to provide an emergency connection between the large public water systems at either end.

However, implementation of Alternative 1D would be predicated on the following:

1. The City of Austin would need to verify that treated groundwater from the ALCOA/CPS well fields would be compatible with its treated water from other sources, and that its treatment would be less expensive than the treatment of surface water from the Colorado River in its own treatment plant.

2. The City of Austin, LCRA, and SAWS would need to negotiate a water rights transfer that would give SAWS access to 44,804 acre-feet/year (11,200 from LCRA and 33604 from the City of Austin) of Colorado River water in return for the same amount from the ALCOA/CPS well fields.

3. SARA would have to meet its water demands from 2015 to 2020 using treated water from some other source and treatment plant since there would be no water treatment plant near San Antonio until after 2020.

Final Alternative Analysis (Alternative 2A – Special)

After the presentation of the aforementioned results to the participants in a meeting held on March 7, 2005, the project team was requested to analyze one more alternative (Alternative 2A – Special). This alternative was to be similar to Alternative 2A (WTP located east of San Marcos) with the following exceptions:

1. The non-softening side of the water treatment plant would be sized to meet the average day demands of SAWS, SARA and GBRA. Demands exceeding the average day demands would have to be met by using water from other sources. For SAWS, it was anticipated that wells in the Edwards Aquifer could be used to make up the difference.

2. Potable water transmission mains, leading to the demand points for SAWS, SARA and GBRA would also be sized for average day demands rather than for maximum day demands.

3. The raw water facilities in Matagorda County (RWI-A) would be sized in accordance with the latest information in the LCRA-SAWS Water Project PVA, that is, for a maximum withdrawal of 6000 cfs.

4. The raw water facilities at the Bastrop intake (RWI-B) would be sized for 90 cfs, which is based on the assumption that “scalping” withdrawals would not be required.

5. Unit costs used were to be in accordance with the latest unit costs used in the LCRA-SAWS Water Project PVA.

The net present value of capital costs and O&M for this Alternative 2A-Special was about 10% less than the cost for Alternative 2A, but a direct comparison is misleading since some unit costs and design assumptions were changed. The purpose of Alternative 2A–Special was not to compare against the previously mentioned alternatives, but to compare against other water supply alternatives the participants are considering. For this reason, additional calculations were prepared for this special alternative and these are shown in Table 10-3.

Using the same methodology that was used in the LCRA-SAWS Water Project PVA, potable water would cost about $794 per acre-foot produced at the water treatment plant site (based on 2050 production and expressed in 2005 dollars). If the capital and operating costs of the potable water transmission mains are included, the average cost would be $1039 per acre-foot delivered to each customer's delivery point.

Table 10-3

CTRWTP - Alternate 2A Special - WTP East of San Marcos

WTP Location	Alter-nate	Phasing Scenario	Total NPVs in Millions of $	RWI A & OCRs	RWTM A (Including Pump Stations)	ALCOA/CPS	RWI B & OCR	RWTM B (Including Pump Stations)	WTP & RW Storage at Plant	PWT Pur
East of San Marcos	2A - Special	RWTM B & ALCOA/CPS built by 2015; RWTM A built in 2020; Assumes base loaded non-softening plant and PWTMs for SAWS, SARA and GBRA; max day demand softening plant and PWTMs for LCRA and COA		Sized for 6000 cfs to scalp water; 1 low head dam; 6 intakes, 6 miles of 120-inch raw water mains & 4 OCRs at 33,000 ac-ft each (Total of 132,000 acre feet)	126 miles of 96-inch diameter pipe sized to deliver 132,000 ac-ft/year on a continuous basis; includes 3 pumping stations w/ balancing reservoirs along route	Non-Public wells; Transmission of 55,000 ac-ft/year to the balancing tank at RWI B via 15 miles of 54" gravity pipeline from Hwy 290 east of Elgin	Sized for 90 cfs (no scalping capability req'd); 1 intakes; 2 miles of 60-inch raw water main, 1 balancing reservoir at 30 ac-ft (10 mg)	Sized for 117,804 ac-ft/yr; 36 miles of 96" pipeline with one pumping station and balancing reservoir	Raw water reservoir w/ 11,000 ac-ft capacity; Conventional settling with membrane filtration for SAWS, SARA and GBRA; Lime softening with membrane filtration for COA and LCRA	PWTM SARA sized f daily d loaded PWTM LCRA day de PWTM Sheet Appen
		Construction Costs	$ 1,624	$ 169	$ 408	$ 83	$ 7	$ 119	$ 462	$
		Capital Costs	$ 2,246	$ 261	$ 552	$ 131	$ 10	$ 161	$ 627	$
		NPV of Capital Costs	$ 1,938	$ 205	$ 432	$ 131	$ 10	$ 161	$ 526	$
		NPV of O&M Costs	$ 1,513	$ 56	$ 253	$ 142	$ 9	$ 94	$ 497	$
		Total NPV of Capital & O&M	**$ 3,451**	$ 260	$ 685	$ 273	$ 19	$ 255	$ 1,023	$
		Year 2050 O&M Costs in 2005 $	$ 104	$ 3.86	$ 17.18	$ 7.78	$ 0.77	$ 6.14	$ 37.66	$

Unit Cost Calculations:

	Millions of $	
	Not including PWTMs	Including PWTMs
Capital cost	$ 1,741.2	$ 2,246.2
Interest accrued during construction	$ 309.4	$ 399.1
Interest earned during construc.	$ (74.4)	$ (95.9)
Total project cost	$ 1,976.2	$ 2,549.3
Annual Costs:		
Debt service - principal and interest	$ 143.6	$ 185.2
Adjustment for "Committed Purchase Fee"	$ 8.8	$ 8.8
Subtotal	$ 152.4	$ 194.0
O&M and Power	$ 73.4	$ 103.9
Total annual cost	$ 225.8	$ 298.0
Ag and Gw	$ 7.8	$ 7.8
Total	233.56	305.76
Acre-feet produced (annual average)	294,215	294,215
$ per acre feet produced	$ 794	$ 1,039

Interest rate	6%
Total loan period (years)	30
Number of years for construction	3

Interest earned during construction	4%
Number of years for construction	3

Interest rate on loan	6%
Number of payments	30

Basis = Year 2050

Basis = Year 2050

K FRIESE & ASSOCIATES, INC.

TECHNICAL MEMORANDUM

PROJECT: Central Texas Regional Water Treatment Plant
SUBJECT: Task 11 – Identify Other Potential Customers and Participants
DATE: May 9, 2005

Background

The purpose of this task is to identify other potential water customers or participants, at a conceptual level, that may be benefited by this facility. In Task 2 – Demand Projections, the water demand for each of the study participants was determined. A total average day demand of 303,232 acre-feet/year was projected for the study area. It is believed that amount represents the total demand of the study area. The five study participants are expected to serve all of the potential customers within this area either as wholesale or retail customers. Because of the high level nature of this study, those entities within the service area but not participating in the study will be identified and contacted by the individual study participants expected to serve the entity and thus will not be further discussed in this study.

Other Potential Customers

No potential customers outside of the study area have been identified. If additional customers are identified in the future, additional water sources will also have to be identified before they can be served.

K FRIESE & ASSOCIATES, INC.

TECHNICAL MEMORANDUM

PROJECT: Central Texas Regional Water Treatment Plant
SUBJECT: Task 12 - Institutional Considerations
DATE: May 7, 2005

Background

The purpose of this task is to investigate several potential institutional approaches to develop the proposed water treatment plant. These could include the creation of a development corporation, a regional water authority or other corporate entity to own and operate the facilities. This task also includes examining various procurement tools to facilitate the development of the water treatment plant.

Institutional Considerations

Tasks 3 and 10 – Economic Analysis, discusses the various alternatives evaluated and the resulting net present value of the facilities. For the final alternative considered, the plant was changed to a base load plant for San Antonio, SARA and GBRA thereby reducing the size of the plant and treated water transmission main. Other adjustments were made to help make the regional facility comparable to the other separate alternatives available to the participants. The present value cost was converted to a cost per acre-foot also for comparison purposes. This was done by dividing the total cost by the acre-foot capacity and would be the same for all participants. That cost was $794 per acre-foot for treated water at the water treatment plant. When the potable water transmission mains are considered, the average cost would be $1039 per acre-foot delivered to the participants delivery points. The latter figure is in the upper range of costs that have been developed for the LCRA-SAWS Water Project. While the cost per acre-foot for a regional facility appear to be somewhat reasonable for San Antonio and SARA it is not for the other participants because of the cost of transmission facilities that the other participants would not have compared to their separate alternatives. The conclusion appears fairly clear that a regional facility is not feasible based on the alternatives and demand included in this analysis.

Institutional considerations and procurement tools were not further evaluated since it appears from this analysis that a regional facility is not feasible.

K FRIESE & ASSOCIATES, INC.

TECHNICAL MEMORANDUM

PROJECT: Central Texas Regional Water Treatment Plant
SUBJECT: Task 13 - Identify Necessary Permits
DATE: May 7, 2005

Background

The purpose of this task is to review the project components and locations and to identify the permitting entities and permits that will be required to implement a regional water treatment plant. The permitting requirements for a similar sized facility were analyzed in the recently completed LCRA-SAWS Water Project PVA. It was determined the following primary permits may be required:

Name	Granting Agency
Section 404 Permit	United States Army Corps of Engineers
Section 10 Permit	United States Army Corps of Engineers
Water Rights	Texas Commission on Environmental Quality
Public Drinking Water Supplies	Texas Commission on Environmental Quality
Safe Drinking Water Act	Texas Commission on Environmental Quality
Section 401 Water Quality Certification	Texas Commission on Environmental Quality
TPDES Industrial Storm Water Permits	Texas Commission on Environmental Quality
Dam and Reservoir Safety	Texas Commission on Environmental Quality
Cultural Resources	Texas Historical Commission

Approvals, Consultations, and Permits

The following is the complete List of Possibly Required Local, State, and Federal Permits and Approvals from the LCRA-SAWS Water Project PVA. This detailed list has been included since the LCRA-SAWS Water Project is of similar scope, scale, and geographical location as the CTRWTP facilities evaluated herein.

POSSIBLE FEDERAL APPROVALS, CONSULTATIONS, AND PERMITS NECESSARY FOR THE LCRA-SAWS WATER PROJECT

Name	Granting Agency
Agricultural Issues Consultation	U.S. Department of Agriculture (USDA)
Bridge Permit (Section 8 Review	U.S. Coast Guard
Conditional Letter of map Revision (CLOMR)/Letter of Map Revision (LOMR)	Federal Emergency Management Agency (FEMA)
Environmental Justice	U.S. Environmental Protection Agency
Federal Endangered or Threatened Species (Section 7 or 10 Review)	U.S. Fish and Wildlife Service (USFWS)
Fishery Impacts	National Marine Fisheries Service (NMFS)
Prime Farmlands	Natural Resources Conservation Service (NRCS)
Section 4(f) Review	Bureau of Reclamation and U.S. Fish and Wildlife Service
Section 404 Permit	United States Army Corps of Engineers (USACE) (Fort Worth and Galveston Districts)
Section 10 Permit	United States Army Corps of Engineers (USACE) (Fort Worth and Galveston Districts)
Section 10 of the Rivers and Harbors Act of 1899	U.S. EPA
Wildlife Management Areas	USFWS

POSSIBLE STATE AND DISTRICT APPROVALS, CONSULTATIONS, AND PERMITS NECESSARY FOR THE LCRA-SAWS WATER PROJECT

Name	Granting Agency
Coastal Management Zone (Dredging Permits)	Texas General Land Office (GLO)
Coastal Natural Resources Area	TGLO, Coastal Coordination Council (CCC)
Agricultural Issues	TX Department of Agriculture
Cultural Resources (SHPO/Section 106 Review)	Texas Historical Commission (THC)
Dam and Reservoir Safety (Chapter 299)	Texas Commission on Environmental Quality (TCEQ)
Edwards Aquifer Regulations	Edwards Aquifer Conservation District and TCEQ
State Endangered or Threatened Species and Species of Concern (sometimes referred to as Section 7 Review	TPWD
Groundwater Protection	Groundwater Conservation Districts
Water Rights (Water Code Chapter 11, Tex. Admin. Code Chapters 228, 295, 297)	TCEQ And Various Agencies
LCRA Act Section 28	LCRA
Public Drinking Water Supplies (Chapter 290)	TCEQ
Right of Way and Transportation Access	Texas Department of Transportation (TxDOT)
Regional Water Planning Coordination	Water Development Board
Safe Drinking Water Act	TCEQ
Sand and Gravel Permit	TPWD
Section 10 of the Rivers and Harbors Act of 1899	TCEQ and U.S. EPA
Section 4(f) Review	Varies, Bureau of Reclamation , U.S. Fish and Wildlife Service, TPWD
Section 401 Water Quality Certification	TCEQ
Section 404 Permit	USACE (Fort Worth and Galveston Districts)
TPDES Industrial Storm Water Permits	TCEQ
TPDES Storm Water Permits for Activities Associated with Construction	TCEQ
Water Quality (Chapter 307) and TPDES For Other Discharges	TCEQ
Wildlife Management Areas	TPWD

POSSIBLE LOCAL APPROVALS, CONSULTATIONS, AND PERMITS NECESSARY FOR THE LCRA-SAWS WATER PROJECT

Name	Granting Agency
Local Regulatory Floodplain	Affected Municipalities
Local Zoning	Affected Municipalities

K FRIESE & ASSOCIATES, INC.

TECHNICAL MEMORANDUM

PROJECT: Central Texas Regional Water Treatment Plant
SUBJECT: Task 14 – Conclusions and Major Project Issues
DATE: May 9, 2005

Background

The Technical Memorandums for Tasks 1 through 13 present the body of the study. Each of Technical Memoranda discusses a specific aspect of the study; which together address the scope of work contained in the funding grant from the Texas Water Development Board to the Lower Colorado River Authority. The purpose of the study was to evaluate the feasibility and comparative costs of developing a regional water treatment facility to provide potable water for the Cities of Austin and San Antonio.

The study determined that at the end of the planning period, 2065, there was a total average day demand of 271 MGD that could be met by a regional facility. The treatment plant evaluated for the facility consisted of a split process water treatment plant. Part of the water would be lime softened. The other part would use a conventional water treatment process. Both waters would be filtered separately through microfiltration membranes. This split process would accommodate separate disinfection approaches to better match the existing practices of the participant to avoid compatibility problems.

Several potential alternative diversion points for raw water were identified. One location consisted of a series of intakes located in Matagorda, Wharton, and/or Colorado Counties along the lower reaches of the Colorado River. A second location considered for an intake was in the segment of the Colorado River from the City of Austin (Town Lake) downstream to the City of Bastrop. Ground water from the Simsboro Aquifer was also considered.

Three general sites for the location of the regional facility were identified and included in the analysis. The three sites considered were: one east of San Antonio near I-10, one east of San Marcos and one in the northern corner of Caldwell County. Points for connecting treated water from a regional facility were identified by each participant.

Pipelines and pump stations were sized and located to tie the alternative intake and plant locations to the connection points. A series of alternatives were developed and construction cost estimates were prepared for each. Both construction cost and O&M cost were identified for each alternative.

The initial analysis of the first three alternatives of varying the location of the plant indicated a rather small percentage difference in the cost, the least costly being the location east of San Marcos. Four additional alternatives were developed and analyzed for a more complete understanding of the potential regional scenarios. In one of these alternatives a fourth plant location closer to San Antonio was analyzed. The other three alternatives tested changes to the basic scenario to determine if other adjustments could be made to lower the overall costs.

The results showed a greater reduction in the present value of these four new alternatives compared to the lowest present value of the first three alternatives. However, it was determined that the lower costs were either not comparable or that the changes to the basic scenario included in the alternative scenario were not realistic and/or could not be implemented.

One final alternative was evaluated. In this alternative, the plant was changed to a base load plant for San Antonio, SARA and GBRA thereby reducing the size of the plant and treated water transmission main. Other adjustments were made to help make the regional facility comparable to the other separate alternatives available to the participants. The present value cost was converted to a cost per acre-foot also for comparison purposes. This was done by dividing the total cost by the acre-foot capacity and would be the same for all participants. That cost was $794 per acre-foot for treated water at the water treatment plant. When the potable water transmission mains are considered, the average cost would be $1039 per acre-foot delivered to the participant's delivery points. The latter figure is in the upper range of costs that have been developed for the LCRA-SAWS Water Project. Those costs range from $970 to $1,103.

Conclusions

While the cost per acre-foot for a regional facility appear to be somewhat reasonable for San Antonio and SARA it is not for the other participants because of the cost of transmission facilities that the other participants would not have compared to their separate alternatives. The conclusion appears fairly clear that a regional facility is not feasible based on the alternatives and demand included in this analysis.

An alternative that was not included in the scope of this study but would appear to be worthy of additional analysis is a sub-regional facility located between Austin and Bastrop on or near the Colorado River. That facility could meet the demands of Austin, LCRA and possibly GBRA in a more cost effective manner. A very preliminary cost estimate for such a facility using similar costing data in this study appears to be in the $741 per acre-foot range (not including PWTMs) and $848 per acre-foot (including PWTMs to the delivery points).

APPENDIX 1

CENTRAL TEXAS REGIONAL WATER TREATMENT PLANT TO SERVE AUSTIN AND SAN ANTONIO WATER SYSTEM

ECONOMIC ANALYSIS AND UNIT PRICES

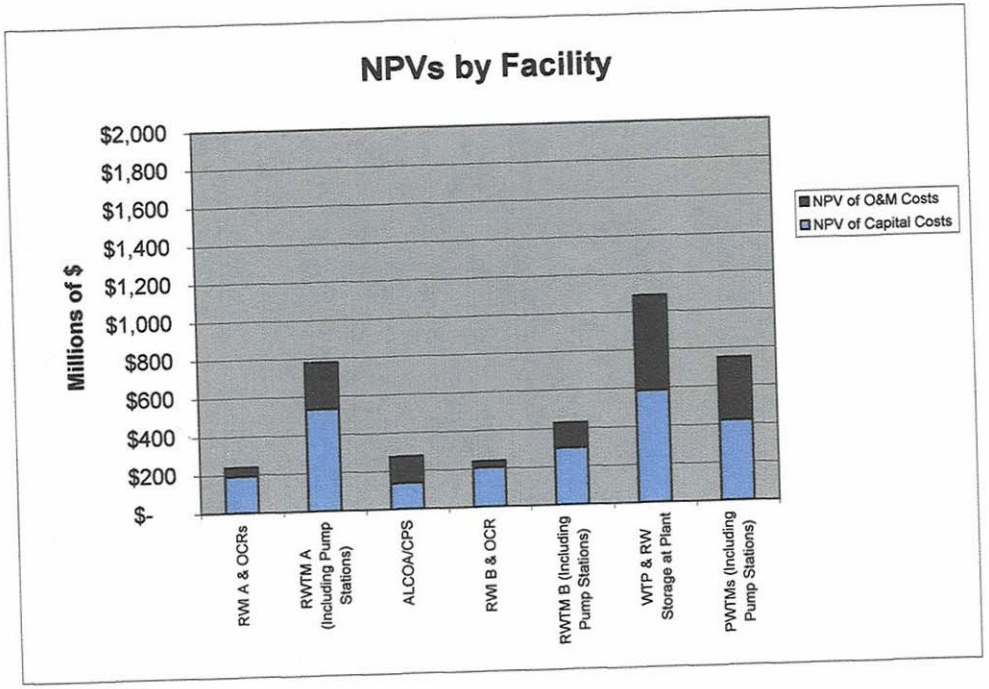
APPENDIX 1

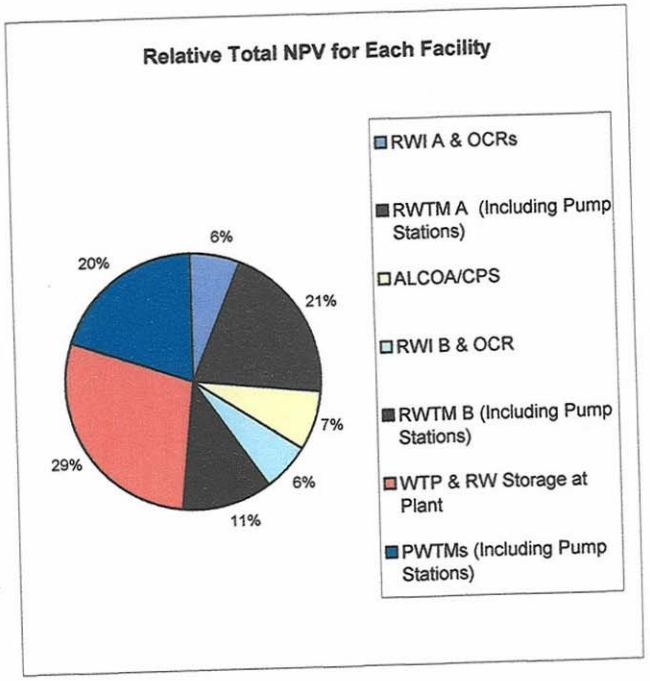
CENTRAL TEXAS REGIONAL WATER TREATMENT PLANT TO SERVE AUSTIN AND SAN ANTONIO WATER SYSTEM

ECONOMIC ANALYSIS AND UNIT PRICES

CTRWTP - Alternate 1A - WTP East of San Antonio

WTP Location	Alter-nate	Phasing Scenario	Total NPVs in Millions of $	RWI A & OCRs	RWTM A (Including Pump Stations)	ALCOA/CPS	RWI B & OCR	RWTM B (Including Pump Stations)	WTP & RW Storage at Plant	PWTMs (Including Pump Stations)
East of San Antonio	1A	RWTM B & ALCOA/CPS built by 2015; RWTM A built in 2020.		Sized for 4000 cfs to scalp water; 4 intakes, 4 miles of 120-inch raw water mains & 4 OCRs at 25,000 ac-ft each	150 miles of 96-inch diameter pipe sized to deliver 132,000 ac-ft/year on a continuous basis; includes 3 pumping stations w/ balancing reservoirs along route	Non-Public wells; Transmission of 55,000 ac-ft/year to the OCR at RWI B via 15 miles of 54" gravity pipeline from Hwy 290 east of Elgin	Sized for 2000 cfs to scalp water; 2 intakes; 8 miles of 120-inch raw water mains and 4 OCRs at 15,000 ac-ft/each	Sized for 117,804 ac-ft/yr; 77 miles of 84" pipeline with two pumping stations and balancing reservoirs	Raw water reservoir w/ 11,000 ac-ft capacity; Conventional settling with membrane filtration for SAWS, SARA & GBRA; Lime softening with membrane filtration for COA & LCRA water	Each PWTM sized for maximum daily demand (See PWTM Summary Sheet in the Appendices)
		NPV of Capital Costs	$ 2,366	$ 191	$ 534	$ 135	$ 204	$ 297	$ 585	$ 420
		NPV of O&M Costs	$ 1,423	$ 47	$ 244	$ 141	$ 34	$ 130	$ 499	$ 329
		Total NPV of Capital & O&M	**$ 3,789**	$ 238	$ 778	$ 276	$ 238	$ 428	$ 1,084	$ 748





O&M Cost Calculations
RWI A - Matagorda Co. River Intakes, and Storage
CTRWTP - Alternate 1A - WTP East of San Antonio

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile
			or =	$ 5,000	per acre

Inflatable Rubber Low Head Dam

	Quantity	Units	Size	Unit Constr. Cost (millions)	Total Estimated Constr. Cost (millions)	Contigency, Eng., etc. (millions)	Total Capital Cost (millions)
Inflatable Rubber Low Head Dam	4	each	10 ft high	$ 2.25	$ 9.00	$ 3.42	$ 12.42

Estimated inflatable dam cost as % of total	50%		
Value of inflatable dam	$ 4.50	million	
Assumed life of inflatable dam	10	years	
Estimated maintenance/replacement cost	$ 0.45	million/year	
Year built	2020		
NPV of O&M Costs	$6.27	million	
NPV of Capital Costs	$ 9.73	million	
Total NPV of Capital and O&M Costs	$16.00	million	

Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)

Average withdrawal	132,000	ac-ft/year			
	182	cfs			
Total intake design withdrawal rate (for scalping high flows	4,000	cfs	21.9	Ratio of design withdrawal rate to Total intake design withdrawal rate	
	1,795,200	gpm			
No. of Intakes	4				
Design withdrawal rate per intake	1,000	cfs			
	448,800	gpm			
No. of reservoirs	4				
Design flow to each reservoir	448,800	gpm			
Inside diameter of each RWTM	120	in.			
Area	78.54	sf			
Average length of each RWTM	1	miles	4.0	miles for all RWTMs	
	5,280	feet	21,120	feet	
Estimated construction cost for RWTM	$ 793	per LF		$ 1,254	
Total construction cost in millions	$ 16.8				
Contingencies	$ 3.4				
Subtotal	$ 20.1				
Engineering, Legal & Administrative	$ 3.0				
Subtotal	$ 23.1				
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 0.4				
Total Capital Cost for PWTM in millions	$ 23.5	million			
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.040	Million $/year (all RWTMs to Reservoirs)	

Note: Assume each intake has two RWTMs pumping out of it, one to each reservoir.

Design flow rate for each RWTM (from above)	448,800	gpm			
Pumping rate (one pump)	50,000	gpm			
No. of pumps (not counting spare) pumping into each RW	9				
Peak flow rate into each RWTM (all pumps except spare)	450,000	gpm			
Velocity at peak flow rate	12.77	fps			
C factor	120				
Head loss per foot	0.00327	ft/ft	$h_f = \frac{\lvert 3.552*Q \rvert^{1.85}}{\lvert C*(d)^{2.63} \rvert}$		
	17.25	ft/mile			
Head loss at peak flow rate	17	ft			
Allowance for minor losses	30% 5	ft	90	Elev of discharge at reservoir	
Total estimated losses	22	ft	50	Water surface elev in river	
Average static head	40	ft	40	ft	
Total estimated dynamic head	62	ft			
	27	psi			
Assumed pump efficiency	85%				
Assumed motor efficiency	90%				
Estimated Hp required per pump	1,030	hp/pump			
	769	kw/pump			
Total hp pumping into each RWTM (not counting spare)	9,272	hp/RWTM			
Total hp at each intake (not counting spare)	9,272	hp/intake			
Total hp all intakes (not counting spares)	37,089	hp			
Total kw all intakes (not counting spares)	27,668	kw			
Unit construction cost for each pump station (from cost cu	$ 889	per firm hp of pump station		$ 1,180	
Construction cost per intake/pump station	8.2	million			
No. of intakes from above	4	each			
Total construction cost in millions	$ 33.0	million			
Contigency, Eng., etc. in millions	$ 12.53	million			
Total capital cost in millions	$ 45.5	million			
Total construction cost for pump stations	$ 33.0	million			
Value of equipment	$ 13.2	million	40%	Estimated equip cost as % of total constr cost	
Assumed life of equipment	20	years			
Estimated maintenance/replacement cost	$ 0.66	million/year			

O&M Costs:

Year	Flow pumped by year		No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	-	-	-	-	$ -	$ -			$ -	$ -
2016	-	-	-	-	$ -	$ -			$ -	$ -
2017	-	-	-	-	$ -	$ -			$ -	$ -
2018	-	-	-	-	$ -	$ -			$ -	$ -
2019	-	-	-	-	$ -	$ -			$ -	$ -
2020	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 1.15
2021	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 1.10
2022	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 1.05
2023	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 1.00
2024	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.95
2025	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.90
2026	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.86
2027	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.82
2028	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.78
2029	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.74
2030	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.71
2031	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.67
2032	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.64
2033	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.61
2034	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.58
2035	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.55
2036	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.53
2037	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.50
2038	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.48
2039	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.46
2040	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.43
2041	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.41
2042	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.39
2043	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.38
2044	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.36
2045	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.34
2046	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.32
2047	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.31
2048	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.29
2049	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.28
2050	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.27
2051	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.25
2052	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.24
2053	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.23
2054	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.22
2055	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.21
2056	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.20
2057	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.19
2058	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.18
2059	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.17
2060	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.16
2061	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.16
2062	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.15
2063	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.14
2064	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.13
2065	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.13
								Total NPV of O&M Costs		$ 21.6

Capital Costs in million $:		Yr built		
RWTM to Reservoirs	$ 23.5	2020		$ 18.4
Intake/Pumping Stations	$ 45.5	2020		$ 35.6
			Total NPV of Capital Costs	$ 54.1
			Total NPV of Capital and O&M Costs in millions	$ 75.7

Reservoirs

	Quantity	Units	Volume/each (acre-feet)	Unit Cost ($/ac-ft))	Total Construction Cost in millions	Contigency, Eng., etc.	Total in millions
Reservoirs	4	each	25000	$ 974	$ 97.4	$ 37.0	$ 134.4
				$ 909			

Estimated average depth of reservoir	20	ft		
Surface area of reservoir	5000	acres		
Ratio of total land area reqd to surface area of reservoir	1.1			
Total land area reqd for reservoirs	5500	acres	Envir & Archaeology, Surv, and Land Acq =	27.5
			Total capital cost in millions =	$ 161.9
Assumed life of reservoir	100	years		
Estimated replacement cost	$ 0.97	million/year		
Estimated maintenance	0.4	million/year	Mowing, maintaining fences, etc.	
Total	$ 1.37	million/year		
Year built	2020			
NPV of O&M costs	$ 19.1	million		
NPV of Capital costs	$ 126.8	million		
Total NPV of Capital and O&M Costs	$ 145.9	million		

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Inflatable Rubber Low Head Dam	$ 9.7	$ 6.3	$ 16.0
Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)	$ 54.1	$ 21.6	$ 75.7
Reservoirs	$ 126.8	$ 19.1	$ 145.9
Total for RWI A	$ 190.6	$ 47.0	$ 237.6

O&M Cost Calculations
RWTM A - Matagorda Co. to WTP
CTRWTP - Alternate 1A - WTP East of San Antonio

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

Raw Water Transmission Main - A

Inside diameter of pipe		96	in.			
Area		50.27	sf			
Length of RWTM		150	miles			
		792,000	feet			
Estimated unit construction cost for RWTM		$ 567	per LF		$ 865	
Total construction cost in millions		$ 449				
Contingencies		$ 90				
Subtotal		$ 539				
Engineering, Legal & Administrative		$ 81				
Subtotal		$ 620				
Envir & Arch Studies & Mitigation, Surveying, & Land Acq		$ 15				
Total Capital Cost for PWTM in millions		$ 635	million			
Unit maintenance cost/year-mile		$ 10,000	$/year-mile	$ 1.500	Million $/year	
Design flow rate (after 100% buildout)		132,000	ac-ft/year			
		118	mgd			
		81,829	gpm			
Pumping rate (one pump)		16,400	gpm			
No. of pumps (not counting spare)		5				
Peak flow rate (all pumps except spare)		82,000	gpm			
Velocity at peak flow rate		3.63	fps			
C factor		120				
Head loss per foot		0.00041	ft/ft	$h_f = \left\| \frac{3.552*Q}{C*(d)^{2.63}} \right\|^{1.85}$		
		2.19	ft/mile			
Head loss at peak flow rate		328	ft			
Allowance for minor losses	10%	33	ft	600	Elev. At San Antonio East WTP	
Total estimated losses		361	ft	90	Elev. At Matagorda OCRs	
Average static head		510	ft	510	ft	
Total estimated dynamic head		871	ft			
		378	psi			
No of pumping stations req'd along route		2.52		150	psi (assumed max pressure	
No. of pumping stations used in cost estimate		3.0			in pipe)	
Average head per pump station		290	ft			
Assumed pump efficiency		85%				
Assumed motor efficiency		90%				
Estimated Hp required per pump		1,572	hp/pump			
		1,173	kw/pump			
Total hp per pump station (not counting spare)		7,861	hp/station			
Total kw per pump set (set=pumps in series along route)		4,717	kw/pump set	(one pump at each station)		
Unit constr. cost for each pump station (from cost curve)		$ 1,315	per firm hp of pump station		$ 890	
Construction cost per pump station		$ 10.33	million			
Balancing reservoir		$ 0.75	million	60	min. of storage at avg pumping rate	
Total construction cost per pump station		$ 11.08	million	5.0	mg	
				$ 0.15	per gal for open top reservoir	
No. of pump stations from above		3.0	each			
Total construction cost in millions		$ 33.3	million			
Contigency, Eng., etc. in millions		$ 12.64	million			
Total capital cost in millions		$ 45.9	million			
Total construction cost for pump stations		$ 33.3	million			
Value of equipment		$ 13.3	million	40%	Estimated equipment cost as % of total	
Assumed life of equipment		20	years			
Estimated maintenance/replacement cost		$ 0.67	million/year			

O&M Costs

Year	Flow pumped by year		No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	-	-	-	-	$ -	$ -			$ -	$ -
2016	-	-	-	-	$ -	$ -			$ -	$ -
2017	-	-	-	-	$ -	$ -			$ -	$ -
2018	-	-	-	-	$ -	$ -			$ -	$ -
2019	-	-	-	-	$ -	$ -			$ -	$ -
2020	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 13.00
2021	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 12.38
2022	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 11.79
2023	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 11.23
2024	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 10.70
2025	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 10.19
2026	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 9.70
2027	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 9.24
2028	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 8.80
2029	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 8.38
2030	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 7.98
2031	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 7.60
2032	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 7.24
2033	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 6.90
2034	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 6.57
2035	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 6.25
2036	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 5.96
2037	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 5.67
2038	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 5.40
2039	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 5.15
2040	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 4.90
2041	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 4.67
2042	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 4.45
2043	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 4.23
2044	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 4.03
2045	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 3.84
2046	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 3.66
2047	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 3.48
2048	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 3.32
2049	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 3.16
2050	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 3.01
2051	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 2.87
2052	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 2.73
2053	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 2.60
2054	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 2.48
2055	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 2.36
2056	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 2.25
2057	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 2.14
2058	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 2.04
2059	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 1.94
2060	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 1.85
2061	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 1.76
2062	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 1.68
2063	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 1.60
2064	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 1.52
2065	132,000	118	4.99	564,822	$ 39,538	$ 14.43	$ 0.67	$ 1.500	$ 16.60	$ 1.45
								Total NPV of O&M Costs		**$ 244**

Capital Costs in million $:		Yr built		
RWTM	$ 635	2020		$ 498
Pumping Stations	$ 46	2020		$ 36
			Total NPV of Capital Costs	**$ 534**

Total NPV of Capital and O&M Costs in millions $ 778

NPV CALCULATIONS
ALCOA / CPS GROUNDWATER
CTRWTP - Alternate 1A - WTP East of San Antonio

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

Well Fields and Collection Lines

	ALCOA	CPS	Total
Year built	2015	2015	
Estimated Construction Cost in Millions			
Wells (Based on Non-Public Water Supply Wells)	20.92	7.94	28.86
Pipeline	13.03	5.94	18.97
Pump Stations & Storage	8.51	0	8.51
Subtotal	42.46	13.88	56.34
Contingency	8.49	2.78	11.27
Subtotal	50.95	16.66	67.61
Engineering, Legal & Administrative	6.37	2.08	8.45
Subtotal	57.32	18.74	76.06
Environmental & Archaeology Studies & Mitigation	0.63	0.2	0.83
Land Acquisition & Surveying	0	0	0.00
Groundwater Purchase	0	5.64	5.64
ALCOA Construction Program Management Fee	5.45	0	5.45
Interest During Construction (2 years, 6% int., 4% ret.)	5.89	2.44	8.33
Total Capital Cost	**69.29**	**27.02**	**96.31**
Estimated Annual O&M Costs			
O&M	0.67	0.18	0.85
Pumping Energy	2.41	0.52	2.93
ALCOA Project Management Fees	0.35	0.00	0.35
Purchase of Groundwater	2.00	0.00	2.00
Groundwater District Fees	0.65	0.25	0.90
Mitigation Reserves	0.28	0.11	0.39
Total Annual Cost	**6.36**	**1.06**	**7.42**

NPV of O&M Costs	$ 116	$ 19	$ 135	million
NPV of Capital Costs	$ 69	$ 27	$ 96	million
Total NPV of Capital and O&M Costs for Well Fields	**$ 185**	**$ 46**	**$ 232**	**million**

Cooling of Well Water

Total number of wells in both fields	120	wells	Approximate capacity per wel	300 gpm
Percentage of wells with temperatures > than ___ degrees	5%			36,000 gpm
Estimated number of wells with temperature > ____ degrees	6.0		Rough check	58,072 ac-ft/year

Estimated Capital Costs

Year built	2015	
Number of Packaged Cooling Towers (300 gpm capacity/each)	6.0	
Equipment cost (cooling towers and fans)	$ 60,000	
Installation and contractors mark-up	$ 50,000	
Structural slab	$ 30,000	
Electrical	$ 50,000	
Estimated Unit Construction Cost	$ 190,000	Each
Total construction cost	$ 1.14	million
Contingencies	$ 0.23	
Subtotal	$ 1.37	
Engineering, Legal and Admin	$ 0.21	
Total Estimated Capital Cost	$ 1.57	
NPV of Capital Costs	$ 1.57	million

Estimated O&M Costs

Value of equipment	$ 0.4	million
Assumed life of equipment	10	years
Estimated maintenance/replacement cost	$ 0.04	million/year
Blower Hp per cooling tower	10	Hp
	7	kw
Hours of operation	24	hours
Power consumption per cooling tower	179	kwh per day
	65,350	kwh per year
Power cost per cooling tower	$ 4,574	per year
Total power cost for all cooling towers in millions	$ 0.03	million per year
Regular operational checks and routine maintenance	$ 6,000	per month for all cooling towers
	$ 0.07	per year
Estimated O&M Cost	$ 0.14	million $ per year
NPV of O&M costs	$ 2.47	million $

Ground Water Transmission Main and Pump Station (Hwy 290 to Bastrop Intake)

Inside diameter of transmission pipe	54	in.

Area		15.90	sf			
Length of Ground Water TM		15	miles			
		79,200	feet			
Estimated construction cost for GWTM		$ 327	per LF			
Total construction cost in millions		$ 25.9				
Contingencies		$ 5.2				
Subtotal		$ 31.1				
Engineering, Legal & Administrative		$ 4.7				
Subtotal		$ 35.8				
Envir & Arch Studies & Mitigation, Surveying, & Land Acq		$ 1.5				
Total Capital Cost for PWTM in millions		$ 37.3	million			
Unit maintenance cost/year-mile		$ 10,000	$/year-mile	$ 0.150	Million $/year	
Design flow rate		55,000	ac-ft/year			
		49	mgd			
		34,095	gpm			
Velocity at peak flow rate		4.78	fps			
C factor		120				
Head loss per foot		0.00134	ft/ft	$h_f = \lvert 3.552*Q \rvert^{1.85} / \lvert C*(d)^{2.63} \rvert$		
		7.10	ft/mile			
Head loss at peak flow rate		106	ft			
Allowance for minor losses	10%	11	ft	400	Elev. At RWI-B	
Total estimated losses		117	ft	550	minus Elev. - Storage Tank at Hwy 290	
Average static head		-150	ft	-150	ft	
Total estimated dynamic head		-33	ft	(intake is lower than tank at Hwy 290)		
		-14	psi			

Negative indicates gravity flow from Hwy 290 to Bastrop Intake; no pumping necessary.

				Million $
Annual O&M Cost in million $:		Yr built		
GWTM	$ 0.150	2015		
			Total NPV of O&M Costs	$ 2.7
Capital Costs in million $:		Yr built		
GWTM	$ 37.3	2015		$ 37.3
			Total NPV of Capital Costs	$ 37.3

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Well Fields and Collection Lines (including tank and pump station at Hwy 290)	$ 96.3	$ 135.5	$ 231.8
Cooling Towers for Selected High Temperature Wells	$ 1.6	$ 2.5	$ 4.0
Ground Water Transmission Main and Pumping Station	$ 37.3	$ 2.7	$ 40.0
Total for ALCOA-CPS	$ 135.1	$ 140.7	$ 275.8

O&M Cost Calculations
RWI B - Colorado River Intake at Bastrop and Off Channel Reservoir
CTRWTP - Alternate 1A - WTP East of San Antonio

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	40	years			
Unit cost of energy	$ 0.07	per kwh	Environmental & Archaeology Studies & Mitigation, Surveying, and Land Acquisition =	$ 100,000	per mile
			or =	$ 5,000	per acre

Inflatable Rubber Low Head Dam

	Quantity	Units	Size	Unit Constr. Cost (millions)	Total Estimated Constr. Cost (millions)	Contigency, Eng., etc. (millions)	Total Capital Cost (millions)
Inflatable Rubber Low Head Dam	2	each	10 ft high	$ 2.25	$ 4.50	$ 1.71	$ 6.21

Estimated inflatable dam cost as % of total	50%		
Value of inflatable dam	$ 2.25	million	
Assumed life of inflatable dam	10	years	
Estimated maintenance/replacement cost	$ 0.23	million/year	
Year built	2015		
NPV of O&M Costs	$ 3.86	million	
NPV of Capital Costs	$ 6.21	million	
Total NPV of Capital and O&M Costs	**$ 10.07**	**million**	

Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)

Summary of withdrawals in acre-feet/year:

Year	2015	2020	2030	2040	2050	2060	2065
For SAWS	18000	18000	18000	18000	18000	18000	18000
LCRA			5600	11200	11200	11200	11200
COA			16802	22403	33604	33604	33604
Total	18000	18000	40402	51603	62804	62804	62804

Ultimate (Y2065) average design withdrawal rate	62,804	ac-ft/year		
	87	cfs		
			23.1	Ratio of design withdrawal rate to Total intake design withdrawal rate
Total intake design withdrawal rate (for scalping high flows)	2,000	cfs		
	897,600	gpm		
No. of Intakes	2			
Design withdrawal rate per intake	1,000	cfs		
	448,800	gpm		
No. of reservoirs	4			
Design flow to each reservoir	224,400	gpm		
Inside diameter of each RWTM	120	in.		
Area	78.54	sf		
Average length of each RWTM	2	miles	8.0	miles for all RWTMs
	10,560	feet	42,240	feet
Estimated construction cost for RWTMs	$ 793	per LF	$ 1,254	
Total construction cost in millions	$ 33.5			
Contingencies	$ 6.7			
Subtotal	$ 40.2			
Engineering, Legal & Administrative	$ 6.0			
Subtotal	$ 46.2			
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 0.8			
Total Capital Cost for PWTM in millions	$ 47.0			
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.080	Million $/year (all RWTMs to Reservoirs)

Note: Assume intake has one RWTM pumping to the reservoir.

Design flow rate for each RWTM (from above)	224,400	gpm		
Pumping rate (one pump)	40,000	gpm		
No. of pumps (not counting spare) pumping into each RWT	6			
Peak flow rate into each RWTM (all pumps except spare)	240,000	gpm		
Velocity at peak flow rate	6.81	fps		
C factor	120			
Head loss per foot	0.00102	ft/ft	$h_f = \lvert \frac{3.552*Q}{C*(d)^{2.63}} \rvert^{1.85}$	
	5.39	ft/mile		
Head loss at peak flow rate	11	ft		
Allowance for minor losses 30%	3	ft	400	Discharge at reservoir
Total estimated losses	14	ft	320	Water surface elev in river
Average static head	80	ft	80	ft
Total estimated dynamic head	94	ft		
	41	psi		
Assumed pump efficiency	85%			
Assumed motor efficiency	90%			
Estimated Hp required per pump	1,241	hp/pump		
	926	kw/pump		

Total hp pumping into each RWTM (not counting spare)		7,448	hp/RWTM		
Total hp at each intake (not counting spare)		14,897	hp/intake		
Total hp all intakes (not counting spares)		29,793	hp		
Total kw all intakes (not counting spares)		22,226	kw		
Unit construction cost for each pump station (from cost cur	$	889	per firm hp of pump station	$	830
Construction cost per intake/pump station		13.2	million		
No. of intakes from above		2	each		
Total construction cost in millions	$	26.5	million		
Contigency, Eng., etc. in millions	$	10.06	million		
Total capital cost in millions	$	36.6	million		
Total construction cost for pump stations	$	26.5	million	40%	Estimated equipment cost as % of total
Value of equipment	$	10.6	million		
Assumed life of equipment		20	years		
Estimated maintenance/replacement cost	$	0.53	million/year		

O&M Costs:

Year	Flow pumped by year		No. of pump "sets" operating	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd	/day	(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.77
2016	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.73
2017	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.70
2018	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.66
2019	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.63
2020	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.60
2021	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.57
2022	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.55
2023	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.52
2024	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.50
2025	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.47
2026	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.45
2027	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.43
2028	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.41
2029	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.39
2030	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.46
2031	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.44
2032	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.42
2033	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.40
2034	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.38
2035	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.36
2036	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.35
2037	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.33
2038	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.31
2039	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.30
2040	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.31
2041	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.30
2042	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.28
2043	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.27
2044	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.26
2045	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.25
2046	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.23
2047	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.22
2048	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.21
2049	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.20
2050	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.21
2051	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.20
2052	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.19
2053	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.18
2054	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.17
2055	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.17
2056	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.16
2057	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.15
2058	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.14
2059	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.14
2060	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.13
2061	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.12
2062	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.12
2063	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.11
2064	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.11
2065	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.10
								Total NPV of O&M Costs		$ 17.1

Capital Costs in million $:			Yr built		
RWTM to Reservoir	$	47.0	2015		$ 47.0
Intake/Pumping Stations	$	36.6	2015		$ 36.6
				Total NPV of Capital Costs	$ 83.6
				Total NPV of Capital and O&M Costs in millions	$ 100.7

Reservoirs

	Quantity	Units	Volume/each (acre-feet)	Unit Cost ($/ac-ft)	Total Construction Cost in millions	Contigency, Eng., etc.	Total in millions
Reservoirs	4	each	15000	$ 1,180	$ 70.8	$ 26.9	$ 97.7
				$ 0.004	per gallon		
Estimated average depth of reservoir		20	ft				

Surface area of reservoir	3000	acres		
Ratio of total land area reqd to surface area of reservoir	1.1			
Total land area reqd for reservoirs	3300	acres	Envir & Archaeology, Surv, and Land Acq =	16.5
			Total capital cost in millions =	$ 114.2
Assumed life of reservoir	100	years		
Estimated replacement cost	$ 0.71	million/year		
Estimated maintenance	$ 0.04	million/year	Mowing, maintaining fences, etc.	
Total	$ 0.75	million/year		
Year built	2015			
NPV of O&M costs	$ 12.8	million		
NPV of Capital costs	$ 114.2	million		
Total NPV of Capital and O&M Costs	**$ 127.0**	**million**		

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Inflatable Rubber Low Head Dam	$ 6.2	$ 3.9	$ 10.1
Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)	$ 83.6	$ 17.1	$ 100.7
Off Channel Reservoir	$ 114.2	$ 12.8	$ 127.0
Total for RWI A	$ 204.0	$ 33.8	$ 237.8

O&M Cost Calculations
RWTM B - RWI B near Bastrop to WTP
CTRWTP - Alternate 1A - WTP East of San Antonio

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	40	years	Environmental & Archaeology Studies & Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile
Unit cost of energy	$ 0.07	per kwh			

Summary of average pumping rates in acre-feet/year:

Surface Water Year	2015	2020	2030	2040	2050	2060	2065
For SAWS	18000	18000	18000	18000	18000	18000	18000
LCRA			5600	11200	11200	11200	11200
COA			16802	22403	33604	33604	33604
Subtotal	18000	18000	40402	51603	62804	62804	62804

Groundwater Year	2015	2020	2030	2040	2050	2060	2065
For SAWS	55000	55000	55000	55000	55000	55000	55000
Suface & groun	73000	73000	95402	106603	117804	117804	117804

Ultimate (Y2065) average design pumping rate 117,804 ac-ft/year

Sizing of Raw Water Transmission Main B & Pump Stations

Inside diameter of RWTM		84	in.		
Area		38.48	sf		
Length of RWTM		77	miles		
		406,560	feet		
Estimated unit construction cost for RWTM		$ 467	per LF	$ 417	
Total construction cost in millions		$ 190.0			
Contingencies		$ 38.0			
Subtotal		$ 228.0			
Engineering, Legal & Administrative		$ 34.2			
Subtotal		$ 262.2			
Envir & Arch Studies & Mitigation, Surveying, & Land Acq		$ 7.7			
Total Capital Cost for PWTM in millions		$ 269.9	million		
Unit maintenance cost/year-mile		$ 5,000	$/year-mile	$ 0.385	Million $/year
Design flow rate (from table above)		117,804	ac-ft/year		
		105	mgd		
		73,029	gpm		
Pumping rate (one pump)		15,000	gpm		
No. of pumps (not counting spare)		5			
Peak flow rate (all pumps except spare)		75,000	gpm		
Velocity at peak flow rate		4.34	fps		
C factor		120			
Head loss per foot		0.00067	ft/ft	$h_f = \frac{\lvert 3.552*Q \rvert^{1.85}}{\lvert C*(d)^{2.63} \rvert}$	
		3.55	ft/mile		
Head loss at peak flow rate		274	ft		
Allowance for minor losses	10%	27	ft	650	Elev. At WTP
Total estimated losses		301	ft	400	Elev of WSE in Bastrop reservoir
Average static head		250	ft	250	ft
Total estimated dynamic head		551	ft		
		239	psi		
No of recommended pumping stations along route		1.59		150	psi (assumed max pressure
No. of pumping stations used in cost estimate		2.0			in pipe)
Average head per pump station		276	ft		
Assumed pump efficiency		85%			
Assumed motor efficiency		90%			
Estimated Hp required per pump		1,364	hp/pump		
		1,018	kw/pump		
Total hp per pump station (not counting spare)		6,822	hp/station		
Total kw per pump set (set=pumps in series along route)		2,729	kw/pump set	(one pump at each station)	
Unit construc cost for each pump station (from cost curve)		$ 1,349	per firm hp of pump station		
Construction cost per pump station		9.2	million		
Balancing reservoir		$ 0.75	million	60	min. of storage at avg pumping rate
Total construction cost per pump station		$ 9.95	million	5.0	mg
				$ 0.15	per gal for open top reservoir
No. of pump stations from above		2.0	each		
Total construction cost in millions		$ 19.9	million		
Contingency, Eng., etc. in millions		$ 7.57	million		
Total capital cost in millions		$ 27.5	million		
Total construction cost for pump stations		$ 19.9	million		
Value of equipment		$ 8.0	million	40%	Estimated equipment cost as % of total
Assumed life of equipment		20	years		
Estimated maintenance/replacement cost		$ 0.40	million/year		

O&M Costs

Year	Flow pumped by year		No. of pump "sets" operating	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd	/day	(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	73,000	65	3.02	197,574	$ 13,830	$ 5.05	$ 0.40	$ 0.385	$ 5.83	$ 5.83
2016	73,000	65	3.02	197,574	$ 13,830	$ 5.05	$ 0.40	$ 0.385	$ 5.83	$ 5.55
2017	73,000	65	3.02	197,574	$ 13,830	$ 5.05	$ 0.40	$ 0.385	$ 5.83	$ 5.29
2018	73,000	65	3.02	197,574	$ 13,830	$ 5.05	$ 0.40	$ 0.385	$ 5.83	$ 5.04
2019	73,000	65	3.02	197,574	$ 13,830	$ 5.05	$ 0.40	$ 0.385	$ 5.83	$ 4.80
2020	73,000	65	3.02	197,574	$ 13,830	$ 5.05	$ 0.40	$ 0.385	$ 5.83	$ 4.57
2021	73,000	65	3.02	197,574	$ 13,830	$ 5.05	$ 0.40	$ 0.385	$ 5.83	$ 4.35
2022	73,000	65	3.02	197,574	$ 13,830	$ 5.05	$ 0.40	$ 0.385	$ 5.83	$ 4.14
2023	73,000	65	3.02	197,574	$ 13,830	$ 5.05	$ 0.40	$ 0.385	$ 5.83	$ 3.95
2024	73,000	65	3.02	197,574	$ 13,830	$ 5.05	$ 0.40	$ 0.385	$ 5.83	$ 3.76
2025	73,000	65	3.02	197,574	$ 13,830	$ 5.05	$ 0.40	$ 0.385	$ 5.83	$ 3.58
2026	73,000	65	3.02	197,574	$ 13,830	$ 5.05	$ 0.40	$ 0.385	$ 5.83	$ 3.41
2027	73,000	65	3.02	197,574	$ 13,830	$ 5.05	$ 0.40	$ 0.385	$ 5.83	$ 3.25
2028	73,000	65	3.02	197,574	$ 13,830	$ 5.05	$ 0.40	$ 0.385	$ 5.83	$ 3.09
2029	73,000	65	3.02	197,574	$ 13,830	$ 5.05	$ 0.40	$ 0.385	$ 5.83	$ 2.95
2030	95,402	85	3.94	258,205	$ 18,074	$ 6.60	$ 0.40	$ 0.385	$ 7.38	$ 3.55
2031	95,402	85	3.94	258,205	$ 18,074	$ 6.60	$ 0.40	$ 0.385	$ 7.38	$ 3.38
2032	95,402	85	3.94	258,205	$ 18,074	$ 6.60	$ 0.40	$ 0.385	$ 7.38	$ 3.22
2033	95,402	85	3.94	258,205	$ 18,074	$ 6.60	$ 0.40	$ 0.385	$ 7.38	$ 3.07
2034	95,402	85	3.94	258,205	$ 18,074	$ 6.60	$ 0.40	$ 0.385	$ 7.38	$ 2.92
2035	95,402	85	3.94	258,205	$ 18,074	$ 6.60	$ 0.40	$ 0.385	$ 7.38	$ 2.78
2036	95,402	85	3.94	258,205	$ 18,074	$ 6.60	$ 0.40	$ 0.385	$ 7.38	$ 2.65
2037	95,402	85	3.94	258,205	$ 18,074	$ 6.60	$ 0.40	$ 0.385	$ 7.38	$ 2.52
2038	95,402	85	3.94	258,205	$ 18,074	$ 6.60	$ 0.40	$ 0.385	$ 7.38	$ 2.40
2039	95,402	85	3.94	258,205	$ 18,074	$ 6.60	$ 0.40	$ 0.385	$ 7.38	$ 2.29
2040	106,603	95	4.41	288,521	$ 20,196	$ 7.37	$ 0.40	$ 0.385	$ 8.15	$ 2.41
2041	106,603	95	4.41	288,521	$ 20,196	$ 7.37	$ 0.40	$ 0.385	$ 8.15	$ 2.29
2042	106,603	95	4.41	288,521	$ 20,196	$ 7.37	$ 0.40	$ 0.385	$ 8.15	$ 2.18
2043	106,603	95	4.41	288,521	$ 20,196	$ 7.37	$ 0.40	$ 0.385	$ 8.15	$ 2.08
2044	106,603	95	4.41	288,521	$ 20,196	$ 7.37	$ 0.40	$ 0.385	$ 8.15	$ 1.98
2045	106,603	95	4.41	288,521	$ 20,196	$ 7.37	$ 0.40	$ 0.385	$ 8.15	$ 1.89
2046	106,603	95	4.41	288,521	$ 20,196	$ 7.37	$ 0.40	$ 0.385	$ 8.15	$ 1.80
2047	106,603	95	4.41	288,521	$ 20,196	$ 7.37	$ 0.40	$ 0.385	$ 8.15	$ 1.71
2048	106,603	95	4.41	288,521	$ 20,196	$ 7.37	$ 0.40	$ 0.385	$ 8.15	$ 1.63
2049	106,603	95	4.41	288,521	$ 20,196	$ 7.37	$ 0.40	$ 0.385	$ 8.15	$ 1.55
2050	117,804	105	4.87	318,836	$ 22,319	$ 8.15	$ 0.40	$ 0.385	$ 8.93	$ 1.62
2051	117,804	105	4.87	318,836	$ 22,319	$ 8.15	$ 0.40	$ 0.385	$ 8.93	$ 1.54
2052	117,804	105	4.87	318,836	$ 22,319	$ 8.15	$ 0.40	$ 0.385	$ 8.93	$ 1.47
2053	117,804	105	4.87	318,836	$ 22,319	$ 8.15	$ 0.40	$ 0.385	$ 8.93	$ 1.40
2054	117,804	105	4.87	318,836	$ 22,319	$ 8.15	$ 0.40	$ 0.385	$ 8.93	$ 1.33
2055	117,804	105	4.87	318,836	$ 22,319	$ 8.15	$ 0.40	$ 0.385	$ 8.93	$ 1.27
2056	117,804	105	4.87	318,836	$ 22,319	$ 8.15	$ 0.40	$ 0.385	$ 8.93	$ 1.21
2057	117,804	105	4.87	318,836	$ 22,319	$ 8.15	$ 0.40	$ 0.385	$ 8.93	$ 1.15
2058	117,804	105	4.87	318,836	$ 22,319	$ 8.15	$ 0.40	$ 0.385	$ 8.93	$ 1.10
2059	117,804	105	4.87	318,836	$ 22,319	$ 8.15	$ 0.40	$ 0.385	$ 8.93	$ 1.04
2060	117,804	105	4.87	318,836	$ 22,319	$ 8.15	$ 0.40	$ 0.385	$ 8.93	$ 0.99
2061	117,804	105	4.87	318,836	$ 22,319	$ 8.15	$ 0.40	$ 0.385	$ 8.93	$ 0.95
2062	117,804	105	4.87	318,836	$ 22,319	$ 8.15	$ 0.40	$ 0.385	$ 8.93	$ 0.90
2063	117,804	105	4.87	318,836	$ 22,319	$ 8.15	$ 0.40	$ 0.385	$ 8.93	$ 0.86
2064	117,804	105	4.87	318,836	$ 22,319	$ 8.15	$ 0.40	$ 0.385	$ 8.93	$ 0.82
2065	117,804	105	4.87	318,836	$ 22,319	$ 8.15	$ 0.40	$ 0.385	$ 8.93	$ 0.78
								Total NPV of O&M Costs		$ 130.3

Capital Costs in million $:		Yr built		
RWTM	$ 269.9	2015		$ 269.9
Pumping Stations	$ 27.5	2015		$ 27.5
			Total NPV of Capital Costs	$ 297.4

Total NPV of Capital and O&M Costs in millions $ 427.7

O&M Cost Calculations
WTP and Raw Water Storage Reservoir at WTP
CTRWTP - Alternate 1A - WTP East of San Antonio

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition =	$ 25,000	per acre

Treated Water Production by Treatment Type (from Demand Chart - BE SURE TO CHECK)

	Year =	2015	2020	2030	2040	2050	2060	2065
Softened water demand:	Units							
Average yearly demands:								
City of Austin	ac-ft/yr	0	0	16802	22403	33604	33604	33604
LCRA	ac-ft/yr	0	0	5600	11200	11200	11200	11200
Totals	ac-ft/yr	0	0	22402	33603	44804	44804	44804
Totals	mgd	0	0	20	30	40	40	40
Max day demands:								
City of Austin	mgd	0	0	25	35	50	50	50
LCRA	mgd	0	0	10	20	20	20	20
Totals	mgd	0	0	35	55	70	70	70

	Year =	2015	2020	2030	2040	2050	2060	2065
Non-softened water demands:	Units							
Average yearly demands:								
SAWS	ac-ft/yr	73000	205000	205000	205000	205000	205000	205000
SARA	ac-ft/yr	20550	23406	28433	31393	34411	37530	41128
GBRA	ac-ft/yr	0	0	6000	8000	10000	12300	12300
Totals		93550	228406	239433	244393	249411	254830	258428
Totals	mgd	84	204	214	218	223	227	231
Max day demands:								
SAWS	mgd	85	238	238	238	238	238	238
SARA	mgd	24	27	33	36	40	44	48
GBRA	mgd	0	0	11	14	18	22	22
Totals	mgd	109	265	282	288	296	304	308
Total: softened and non-softened water demands								
Average yearly demand	ac-ft/yr	93550	228406	261835	277996	294215	299634	303232
	mgd	84	204	234	248	263	267	271
Max day demand	mgd	109	265	317	343	366	374	378

Raw Water Reservoir

Sizing for ultimate conditions:

Assumed number of days of consecutive Max Day demands	30	days	
Design (Max. Day) treated water production req'd in mgd	378	mgd	
Average treated water production in mgd	271	mgd	(which is also equal to sum of ground and raw water that can be pumped to the WTP)
Difference (shortfall of raw water)	107	mgd	
Required storage reservoir for raw water	3,219	mg	
	9,880	ac-ft	
Add safety factor 25%	2,470	ac-ft	
Total storage required	12,350	ac-ft	
Total storage recommended	12,000	ac-ft	Note: No. of days at average day demand (for example, for repair of RWTM A) = 33 days

	Quantity	Units	Volume/each (acre-feet)	Unit Cost ($/ac-ft))	Total Construction Cost	Contigency, Eng., etc.	Total Capital Cost
Reservoirs	1	each	12,000	$ 1,283	$ 15.4	$ 5.9	$ 21.3

Estimated average depth of reservoir	25	ft	
Surface area of reservoir	480	acres	
Ratio of total land area reqd to surface area of reservoir	1.10		
Total land area reqd for reservoirs	528	acres	Envir & Archaeology, Surv, and Land Acq = 13.2
			Total capital cost in millions = $ 34.5
Assumed life of reservoir	100	years	
Estimated replacement cost	$ 0.15	million/year	
Estimated maintenance	$ 0.04	million/year	Mowing, maintaining fences, etc.
Total	$ 0.19	million/year	
Year built	2015		
NPV of O&M costs	$ 3.5	million	
NPV of Capital costs	$ 34.5	million	
Total NPV of Capital and O&M Costs	$ 38.0	million	

WTP

Plant Phasing and Capital Costs:

Softening Treatment Trains

Year =	2015	2020	2030	2040	2050	2060	2065
Average treated water production in mgd	0	0	20	30	40	40	40
Design (Max. Day) treated water production req'd in mgd	0	0	35	55	70	70	70
Initial/additional Max day capacity built (mgd)			50	20			
Total capacity on line (must exceed Design Max Day Req'd)	0	0	50	70	70	70	70
Unit cost for max day treatment capacity ($/gpd of capacity)			$ 1.78	$ 2.14			
Estimated construction cost of expansion in $millions	$ -	$ -	$ 89.0	$ 42.8	$ -	$ -	$ -

Non-softening Treatment Trains

Year =	2015	2020	2030	2040	2050	2060	2065
Average treated water production in mgd	84	204	214	218	223	227	231
Design (Max. Day) treated water production req'd in mgd	109	265	282	288	296	304	308
Additional Max day capacity built (mgd)	210	100					
Total capacity on line (must exceed Design Max Day Req'd)	210	310	310	310	310	310	310
Unit cost for max day treatment capacity ($/gpd of capacity)	$ 1.14	$ 1.32					
Estimated construction cost of expansion in $millions	$ 238.7	$ 131.5	$ -	$ -	$ -	$ -	$ -

Totals (Softening + Non-softening Trains)

Year =	2015	2020	2030	2040	2050	2060	2065
Total construction cost for both trains	$ 238.7	$ 131.5	$ 89.0	$ 42.8	$ -	$ -	$ -
Contingencies	47.7	26.3	17.8	8.6	-	-	-
Subtotal	$ 286.5	$ 157.8	$ 106.8	$ 51.3	$ -	$ -	$ -
Engineering, Legal, & Administrative	43.0	23.7	16.0	7.7	-	-	-
Subtotal	329.4	181.5	122.8	59.0	-	-	-
Environmental & Archaeology Studies and Mitigation & Land Acquisition and Surveying (see Note below)	2.5						
Total estimated capital cost	$ 331.9	$ 181.5	$ 122.8	$ 59.0	$ -	$ -	$ -
NPV of capital cost	$ 331.9	$ 142.2	$ 59.1	$ 17.4	$ -	$ -	$ -

Total NPV of WTP initial construction & expansions $ 551

Note: Assumed land requirement for WTP (not including reservoir 100 acres

O&M Costs for Softening Trains:

Year	Plant Capacity in service	Estimated treated water production	Estimated O&M cost from unit cost curve		Net present value
	mgd of capacity	mgd produced	$ per mg treated	$million /year	($)
2015	-	-		$ -	$ -
2016	-	-		$ -	$ -
2017	-	-		$ -	$ -
2018	-	-		$ -	$ -
2019	-	-		$ -	$ -
2020	-	-		$ -	$ -
2021	-	-		$ -	$ -
2022	-	-		$ -	$ -
2023	-	-		$ -	$ -
2024	-	-		$ -	$ -
2025	-	-		$ -	$ -
2026	-	-		$ -	$ -
2027	-	-		$ -	$ -
2028	-	-		$ -	$ -
2029	-	-		$ -	$ -
2030	50	20	$ 712	$ 5.20	$ 2.50
2031	50	20	$ 712	$ 5.20	$ 2.38
2032	50	20	$ 712	$ 5.20	$ 2.27
2033	50	20	$ 712	$ 5.20	$ 2.16
2034	50	20	$ 712	$ 5.20	$ 2.06
2035	50	20	$ 712	$ 5.20	$ 1.96
2036	50	20	$ 712	$ 5.20	$ 1.87
2037	50	20	$ 712	$ 5.20	$ 1.78
2038	50	20	$ 712	$ 5.20	$ 1.69
2039	50	20	$ 712	$ 5.20	$ 1.61
2040	70	30	$ 661	$ 7.24	$ 2.14
2041	70	30	$ 661	$ 7.24	$ 2.04
2042	70	30	$ 661	$ 7.24	$ 1.94
2043	70	30	$ 661	$ 7.24	$ 1.85
2044	70	30	$ 661	$ 7.24	$ 1.76
2045	70	30	$ 661	$ 7.24	$ 1.68
2046	70	30	$ 661	$ 7.24	$ 1.60
2047	70	30	$ 661	$ 7.24	$ 1.52
2048	70	30	$ 661	$ 7.24	$ 1.45
2049	70	30	$ 661	$ 7.24	$ 1.38
2050	70	40	$ 661	$ 9.65	$ 1.75
2051	70	40	$ 661	$ 9.65	$ 1.67
2052	70	40	$ 661	$ 9.65	$ 1.59
2053	70	40	$ 661	$ 9.65	$ 1.51
2054	70	40	$ 661	$ 9.65	$ 1.44
2055	70	40	$ 661	$ 9.65	$ 1.37
2056	70	40	$ 661	$ 9.65	$ 1.31
2057	70	40	$ 661	$ 9.65	$ 1.24
2058	70	40	$ 661	$ 9.65	$ 1.18
2059	70	40	$ 661	$ 9.65	$ 1.13
2060	70	40	$ 661	$ 9.65	$ 1.07
2061	70	40	$ 661	$ 9.65	$ 1.02
2062	70	40	$ 661	$ 9.65	$ 0.97
2063	70	40	$ 661	$ 9.65	$ 0.93
2064	70	40	$ 661	$ 9.65	$ 0.88
2065	70	40	$ 661	$ 9.65	$ 0.84
			Total NPV of O&M Costs		$ 58

O&M Costs for Non-Softening Trains:

Year	Plant Capacity in service	Estimated treated water production	Estimated O&M cost from unit cost curve		Net present value
	mgd of capacity	mgd produced	$ per mg treated	$million /year	($)
2015	210	84	$ 370	$ 11.29	$ 11.29
2016	210	84	$ 370	$ 11.29	$ 10.75
2017	210	84	$ 370	$ 11.29	$ 10.24
2018	210	84	$ 370	$ 11.29	$ 9.75
2019	210	84	$ 370	$ 11.29	$ 9.29
2020	310	204	$ 340	$ 25.32	$ 19.84
2021	310	204	$ 340	$ 25.32	$ 18.89
2022	310	204	$ 340	$ 25.32	$ 17.99
2023	310	204	$ 340	$ 25.32	$ 17.13
2024	310	204	$ 340	$ 25.32	$ 16.32
2025	310	204	$ 340	$ 25.32	$ 15.54
2026	310	204	$ 340	$ 25.32	$ 14.80
2027	310	204	$ 340	$ 25.32	$ 14.10
2028	310	204	$ 340	$ 25.32	$ 13.43
2029	310	204	$ 340	$ 25.32	$ 12.79
2030	310	214	$ 340	$ 26.54	$ 12.77
2031	310	214	$ 340	$ 26.54	$ 12.16
2032	310	214	$ 340	$ 26.54	$ 11.58
2033	310	214	$ 340	$ 26.54	$ 11.03
2034	310	214	$ 340	$ 26.54	$ 10.50
2035	310	214	$ 340	$ 26.54	$ 10.00
2036	310	214	$ 340	$ 26.54	$ 9.53
2037	310	214	$ 340	$ 26.54	$ 9.07
2038	310	214	$ 340	$ 26.54	$ 8.64
2039	310	214	$ 340	$ 26.54	$ 8.23
2040	310	218	$ 340	$ 27.09	$ 8.00
2041	310	218	$ 340	$ 27.09	$ 7.62
2042	310	218	$ 340	$ 27.09	$ 7.26
2043	310	218	$ 340	$ 27.09	$ 6.91
2044	310	218	$ 340	$ 27.09	$ 6.58
2045	310	218	$ 340	$ 27.09	$ 6.27
2046	310	218	$ 340	$ 27.09	$ 5.97
2047	310	218	$ 340	$ 27.09	$ 5.68
2048	310	218	$ 340	$ 27.09	$ 5.41
2049	310	218	$ 340	$ 27.09	$ 5.16
2050	310	223	$ 340	$ 27.64	$ 5.01
2051	310	223	$ 340	$ 27.64	$ 4.77
2052	310	223	$ 340	$ 27.64	$ 4.55
2053	310	223	$ 340	$ 27.64	$ 4.33
2054	310	223	$ 340	$ 27.64	$ 4.12
2055	310	223	$ 340	$ 27.64	$ 3.93
2056	310	223	$ 340	$ 27.64	$ 3.74
2057	310	223	$ 340	$ 27.64	$ 3.56
2058	310	223	$ 340	$ 27.64	$ 3.39
2059	310	223	$ 340	$ 27.64	$ 3.23
2060	310	227	$ 340	$ 28.24	$ 3.14
2061	310	227	$ 340	$ 28.24	$ 2.99
2062	310	227	$ 340	$ 28.24	$ 2.85
2063	310	227	$ 340	$ 28.24	$ 2.72
2064	310	227	$ 340	$ 28.24	$ 2.59
2065	310	231	$ 340	$ 28.64	$ 2.50
				Total NPV of O&M Costs	$ 438

NPV Totals for O&M:

Softening trains	$ 58
Non-softening Trains	$ 438
	$ 495

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Raw Water Reservoir	$ 34	$ 3.5	$ 38
Water Treatment Plant	$ 551	$ 495	$ 1,046
Totals	$ 585	$ 499	$ 1,084

Capital and O&M Cost Calculations
Potable Water Transmission Mains
CTRWTP - Alternate 1A - WTP East of San Antonio

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

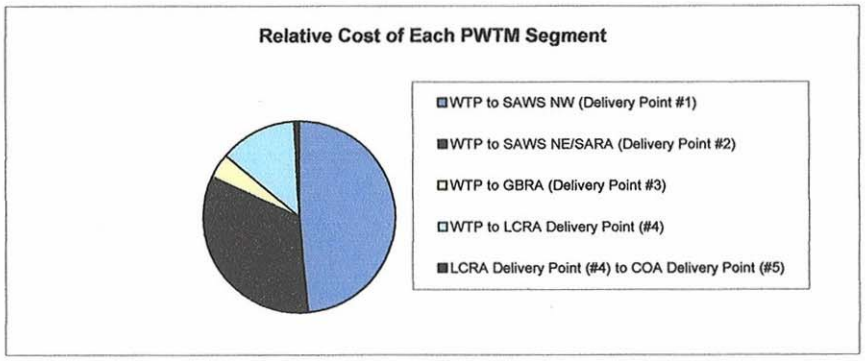
Summary of Demands

Average demands to be delivered in each segment in acre-feet/year

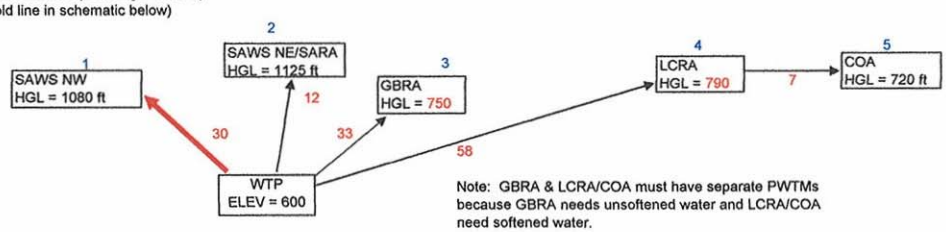
Year	2015	2020	2030	2040	2050	2060	2065
SAWS NW	43800	123000	123000	123000	123000	123000	123000
SAWS NE	29200	82000	82000	82000	82000	82000	82000
Subtotal	73000	205000	205000	205000	205000	205000	205000
SARA	20550	23406	28433	31393	34411	37530	41128
GBRA			6000	8000	10000	12300	12300
LCRA			5600	11200	11200	11200	11200
COA			16802	22403	33604	33604	33604
Total	93550	228406	261835	277996	294215	299634	303232

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
WTP to SAWS NW (Delivery Point #1)	$ 200	$ 164	$ 365
WTP to SAWS NE/SARA (Delivery Point #2)	$ 108	$ 141	$ 249
WTP to GBRA (Delivery Point #3)	$ 24	$ 6	$ 30
WTP to LCRA Delivery Point (#4)	$ 82	$ 16	$ 98
LCRA Delivery Point (#4) to COA Delivery Point (#5)	$ 6	$ 1	$ 7
Total for PWTMs	$ 420	$ 329	$ 748



WTP to SAWS NW (Delivery Point #1)
(Bold line in schematic below)



Note: GBRA & LCRA/COA must have separate PWTMs because GBRA needs unsoftened water and LCRA/COA need softened water.

Demands for this pipe segment

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
SAWS NW	39	110	110	110	110	110	110	1.3
Total	39	110	110	110	110	110	110	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
SAWS NW	51	143	143	143	143	143	143
Total	51	143	143	143	143	143	143

PWTM and Pump Station Costs

Design flow rate - year 2065	143	mgd	
	99,125	gpm	
Pumping capacity of one pump	16,500	gpm	
No. of pumps (not counting spare)	6		
Peak flow rate (all pumps except spare)	99,000	gpm	
Inside diameter of PWTM	96	in.	
Area	50.27	sf	
Length of PWTM	30	miles	(linked to mileage in schematic above)
	158,400	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	25%	39,600	$ 557	$ 22.1	million
Rural - rock	25%	39,600	$ 750	$ 29.7	
Urban - rock	50%	79,200	$ 843	$ 66.7	
		158,400		$ 118.5	million
Average estimated unit construction cost for PWTM			$ 748	per LF	

Total construction cost in millions	$	118.5	million	
Contingencies	$	23.7		
Subtotal	$	142.2		
Engineering, Legal & Administrative	$	21.3		
Subtotal	$	163.5		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$	3.0		
Total Capital Cost for PWTM in millions	$	166.5		
Unit maintenance cost/year-mile	$	10,000	$/year-mile	$ 0.300 Million $/year
Velocity at peak flow rate		4.39	fps	
C factor		120		
Head loss per foot		0.00059	ft/ft	$h_f = \left\| \frac{3.552*Q}{C*(d)^{2.63}} \right\|^{1.85}$
		3.10	ft/mile	
Head loss at peak flow rate		93	ft	
Allowance for minor losses 20%		19	ft	1080 Desired HGL At Delivery Point
Total estimated losses		112	ft	600 Elev. At WTP
Average static head		480	ft	480 ft
Total estimated dynamic head		592	ft	
		256	psi	
No of recommended pumping stations along route		1.71		150 psi (assumed max pressure
No. of pumping stations used in cost estimate		2		in pipe)
Average head per pump station		296	ft	
Assumed pump efficiency		85%		
Assumed motor efficiency		90%		
Estimated Hp required per pump		1,611	hp/pump	
		1,202	kw/pump	
Total hp per pump station (not counting spare)		9,668	hp/station	
Total kw per pump set (set=pumps in series along route)		3,223	kw/pump set	(one pump at each station)
Unit capital cost for each pump station (from cost curve)	$	1,264	per firm hp of pump station	
Construction cost per pump station		12.2	million	
Total construction cost for pump stations		24.4		for 2 pump stations
Contingencies	$	4.9		
Subtotal	$	29.3		
Engineering, Legal & Administrative	$	4.4		

Total capital cost for pump stations	$	33.7	million
		40%	Estimated equipment cost as % of total
Value of equipment	$	10	million
Assumed life of equipment		20	years
Estimated maintenance/replacement cost	$	0.49	million/year

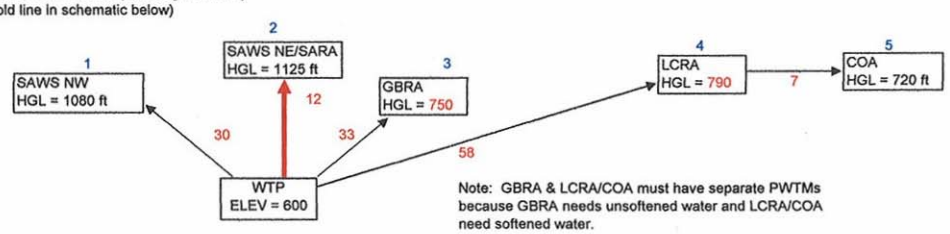
O&M Costs

Year	Flow pumped by year (average flows from Table above)	No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - PWTM	Total O&M cost	Net present value
	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	39	1.65	127,279	$ 8,910	$ 3.25	$ 0.49	$ 0.300	$ 4.04	$ 4.04
2016	39	1.65	127,279	$ 8,910	$ 3.25	$ 0.49	$ 0.300	$ 4.04	$ 3.85
2017	39	1.65	127,279	$ 8,910	$ 3.25	$ 0.49	$ 0.300	$ 4.04	$ 3.67
2018	39	1.65	127,279	$ 8,910	$ 3.25	$ 0.49	$ 0.300	$ 4.04	$ 3.49
2019	39	1.65	127,279	$ 8,910	$ 3.25	$ 0.49	$ 0.300	$ 4.04	$ 3.32
2020	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 7.77
2021	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 7.40
2022	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 7.05
2023	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 6.72
2024	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 6.40
2025	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 6.09
2026	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 5.80
2027	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 5.52
2028	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 5.26
2029	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 5.01
2030	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 4.77
2031	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 4.54
2032	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 4.33
2033	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 4.12
2034	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 3.93
2035	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 3.74
2036	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 3.56
2037	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 3.39
2038	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 3.23
2039	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 3.08
2040	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 2.93
2041	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 2.79
2042	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 2.66
2043	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 2.53
2044	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 2.41
2045	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 2.30
2046	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 2.19
2047	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 2.08
2048	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 1.98
2049	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 1.89
2050	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 1.80
2051	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 1.71
2052	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 1.63
2053	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 1.55
2054	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 1.48
2055	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 1.41
2056	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 1.34
2057	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 1.28
2058	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 1.22
2059	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 1.16
2060	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 1.10
2061	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 1.05
2062	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 1.00
2063	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 0.95
2064	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 0.91
2065	110	4.62	357,427	$ 25,020	$ 9.13	$ 0.49	$ 0.300	$ 9.92	$ 0.87
							Total NPV of O&M Costs		$ 164

Capital Costs in million $:			Yr built		
PWTM	$	167	2015		$ 167
Pumping Stations	$	34	2015		$ 34
				Total NPV of Capital Costs	$ 200

Total NPV of Capital and O&M Costs in millions $ 365
WTP to SAWS NW (Delivery Point #1)

WTP to SAWS NE/SARA (Delivery Point #2)
(Bold line in schematic below)



Note: GBRA & LCRA/COA must have separate PWTMs because GBRA needs unsoftened water and LCRA/COA need softened water.

Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
SAWS NE	26	73	73	73	73	73	73	1.3
SARA	18	21	25	28	31	34	37	1.3
Total	44	94	99	101	104	107	110	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
SAWS NE	34	95	95	95	95	95	95
SARA	24	27	33	36	40	44	48
Total	58	122	128	132	135	139	143

PWTM and Pump Station Costs

Design flow rate - year 2065	143	mgd	
	99,228	gpm	
Pumping capacity of one pump	19,000	gpm	
No. of pumps (not counting spare)	6		
Peak flow rate (all pumps except spare)	114,000	gpm	
Inside diameter of PWTM	108	in.	
Area	63.62	sf	
Length of PWTM	12	miles	(linked to mileage in schematic above)
	63,360	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	50%	31,680	$ 666	$ 21.1	million
Rural - rock	25%	15,840	$ 894	$ 14.2	
Urban - rock	25%	15,840	$ 1,007	$ 16.0	
		63,360		$ 51.2	million
Average estimated unit construction cost for PWTM			$ 808	per LF	

Total construction cost in millions	$	51.2		
Contingencies	$	10.2		
Subtotal	$	61.4		
Engineering, Legal & Administrative	$	9.2		
Subtotal	$	70.7		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$	1.2		
Total Capital Cost for PWTM in millions	$	71.9		
Unit maintenance cost/year-mile	$	10,000	$/year-mile	$ 0.120 Million $/year
Velocity at peak flow rate		3.99	fps	
C factor		120		
Head loss per foot		0.00043	ft/ft	$h_f = \left\| \frac{3.552*Q}{C*(d)^{2.63}} \right\|^{1.85}$
		2.27	ft/mile	
Head loss at peak flow rate		27	ft	
Allowance for minor losses 20%		5	ft	1125 Desired HGL At Delivery Point
Total estimated losses		33	ft	600 Elev. At WTP
Average static head		525	ft	525 ft
Total estimated dynamic head		558	ft	
		242	psi	
No of recommended pumping stations along route		1.61		150 psi (assumed max pressure
No. of pumping stations used in cost estimate		2		in pipe)
Average head per pump station		279	ft	
Assumed pump efficiency		85%		
Assumed motor efficiency		90%		
Estimated Hp required per pump		1,749	hp/pump	
		1,305	kw/pump	
Total hp per pump station (not counting spare)		10,493	firm hp/station	
Total kw per pump set (set=pumps in series along route)		3,498	kw/pump set	(one pump at each station)
Unit construction cost for each pump station (from cost curve)	$	1,244	per firm hp of pump station	
Construction cost per pump station		13.1	million	
Total construction cost for pump stations		26.1		for 2 pump stations
Contingencies	$	5.2		
Subtotal	$	31.3		

Engineering, Legal & Administrative	$	4.7	
Total capital cost for pump stations in millions	$	36.0	million
			40% Equip cost as % of constr cost
Value of equipment	$	10	million
Assumed life of equipment		20	years
Estimated maintenance/replacement cost	$	0.52	million/year

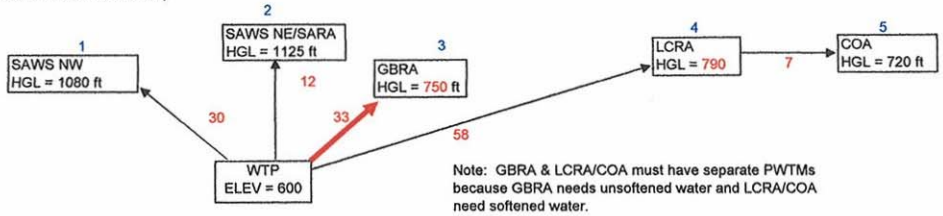
O&M Costs

Year	Flow pumped by year (average flows from Table above)	No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - PWTM	Total O&M cost	Net present value
	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	44	1.62	136,264	$ 9,538	$ 3.48	$ 0.52	$ 0.120	$ 4.12	$ 4.12
2016	44	1.62	136,264	$ 9,538	$ 3.48	$ 0.52	$ 0.120	$ 4.12	$ 3.93
2017	44	1.62	136,264	$ 9,538	$ 3.48	$ 0.52	$ 0.120	$ 4.12	$ 3.74
2018	44	1.62	136,264	$ 9,538	$ 3.48	$ 0.52	$ 0.120	$ 4.12	$ 3.56
2019	44	1.62	136,264	$ 9,538	$ 3.48	$ 0.52	$ 0.120	$ 4.12	$ 3.39
2020	94	3.44	288,705	$ 20,209	$ 7.38	$ 0.52	$ 0.120	$ 8.02	$ 6.28
2021	94	3.44	288,705	$ 20,209	$ 7.38	$ 0.52	$ 0.120	$ 8.02	$ 5.98
2022	94	3.44	288,705	$ 20,209	$ 7.38	$ 0.52	$ 0.120	$ 8.02	$ 5.70
2023	94	3.44	288,705	$ 20,209	$ 7.38	$ 0.52	$ 0.120	$ 8.02	$ 5.43
2024	94	3.44	288,705	$ 20,209	$ 7.38	$ 0.52	$ 0.120	$ 8.02	$ 5.17
2025	94	3.44	288,705	$ 20,209	$ 7.38	$ 0.52	$ 0.120	$ 8.02	$ 4.92
2026	94	3.44	288,705	$ 20,209	$ 7.38	$ 0.52	$ 0.120	$ 8.02	$ 4.69
2027	94	3.44	288,705	$ 20,209	$ 7.38	$ 0.52	$ 0.120	$ 8.02	$ 4.47
2028	94	3.44	288,705	$ 20,209	$ 7.38	$ 0.52	$ 0.120	$ 8.02	$ 4.25
2029	94	3.44	288,705	$ 20,209	$ 7.38	$ 0.52	$ 0.120	$ 8.02	$ 4.05
2030	99	3.60	302,474	$ 21,173	$ 7.73	$ 0.52	$ 0.120	$ 8.37	$ 4.03
2031	99	3.60	302,474	$ 21,173	$ 7.73	$ 0.52	$ 0.120	$ 8.37	$ 3.83
2032	99	3.60	302,474	$ 21,173	$ 7.73	$ 0.52	$ 0.120	$ 8.37	$ 3.65
2033	99	3.60	302,474	$ 21,173	$ 7.73	$ 0.52	$ 0.120	$ 8.37	$ 3.48
2034	99	3.60	302,474	$ 21,173	$ 7.73	$ 0.52	$ 0.120	$ 8.37	$ 3.31
2035	99	3.60	302,474	$ 21,173	$ 7.73	$ 0.52	$ 0.120	$ 8.37	$ 3.15
2036	99	3.60	302,474	$ 21,173	$ 7.73	$ 0.52	$ 0.120	$ 8.37	$ 3.00
2037	99	3.60	302,474	$ 21,173	$ 7.73	$ 0.52	$ 0.120	$ 8.37	$ 2.86
2038	99	3.60	302,474	$ 21,173	$ 7.73	$ 0.52	$ 0.120	$ 8.37	$ 2.73
2039	99	3.60	302,474	$ 21,173	$ 7.73	$ 0.52	$ 0.120	$ 8.37	$ 2.60
2040	101	3.70	310,581	$ 21,741	$ 7.94	$ 0.52	$ 0.120	$ 8.58	$ 2.53
2041	101	3.70	310,581	$ 21,741	$ 7.94	$ 0.52	$ 0.120	$ 8.58	$ 2.41
2042	101	3.70	310,581	$ 21,741	$ 7.94	$ 0.52	$ 0.120	$ 8.58	$ 2.30
2043	101	3.70	310,581	$ 21,741	$ 7.94	$ 0.52	$ 0.120	$ 8.58	$ 2.19
2044	101	3.70	310,581	$ 21,741	$ 7.94	$ 0.52	$ 0.120	$ 8.58	$ 2.08
2045	101	3.70	310,581	$ 21,741	$ 7.94	$ 0.52	$ 0.120	$ 8.58	$ 1.98
2046	101	3.70	310,581	$ 21,741	$ 7.94	$ 0.52	$ 0.120	$ 8.58	$ 1.89
2047	101	3.70	310,581	$ 21,741	$ 7.94	$ 0.52	$ 0.120	$ 8.58	$ 1.80
2048	101	3.70	310,581	$ 21,741	$ 7.94	$ 0.52	$ 0.120	$ 8.58	$ 1.71
2049	101	3.70	310,581	$ 21,741	$ 7.94	$ 0.52	$ 0.120	$ 8.58	$ 1.63
2050	104	3.80	318,847	$ 22,319	$ 8.15	$ 0.52	$ 0.120	$ 8.79	$ 1.59
2051	104	3.80	318,847	$ 22,319	$ 8.15	$ 0.52	$ 0.120	$ 8.79	$ 1.52
2052	104	3.80	318,847	$ 22,319	$ 8.15	$ 0.52	$ 0.120	$ 8.79	$ 1.45
2053	104	3.80	318,847	$ 22,319	$ 8.15	$ 0.52	$ 0.120	$ 8.79	$ 1.38
2054	104	3.80	318,847	$ 22,319	$ 8.15	$ 0.52	$ 0.120	$ 8.79	$ 1.31
2055	104	3.80	318,847	$ 22,319	$ 8.15	$ 0.52	$ 0.120	$ 8.79	$ 1.25
2056	104	3.80	318,847	$ 22,319	$ 8.15	$ 0.52	$ 0.120	$ 8.79	$ 1.19
2057	104	3.80	318,847	$ 22,319	$ 8.15	$ 0.52	$ 0.120	$ 8.79	$ 1.13
2058	104	3.80	318,847	$ 22,319	$ 8.15	$ 0.52	$ 0.120	$ 8.79	$ 1.08
2059	104	3.80	318,847	$ 22,319	$ 8.15	$ 0.52	$ 0.120	$ 8.79	$ 1.03
2060	107	3.90	327,390	$ 22,917	$ 8.36	$ 0.52	$ 0.120	$ 9.01	$ 1.00
2061	107	3.90	327,390	$ 22,917	$ 8.36	$ 0.52	$ 0.120	$ 9.01	$ 0.95
2062	107	3.90	327,390	$ 22,917	$ 8.36	$ 0.52	$ 0.120	$ 9.01	$ 0.91
2063	107	3.90	327,390	$ 22,917	$ 8.36	$ 0.52	$ 0.120	$ 9.01	$ 0.87
2064	107	3.90	327,390	$ 22,917	$ 8.36	$ 0.52	$ 0.120	$ 9.01	$ 0.82
2065	110	4.02	337,245	$ 23,607	$ 8.62	$ 0.52	$ 0.120	$ 9.26	$ 0.81
								Total NPV of O&M Costs	$ 141.2

Capital Costs in million $:		Yr built		
PWTM	$ 71.9	2015		$ 71.9
Pumping Stations	$ 36.0	2015		$ 36.0
			Total NPV of Capital Costs	$ 107.9

Total NPV of Capital and O&M Costs in millions $ 249
WTP to SAWS NE/SARA (Delivery Point #2)

WTP to GBRA (Delivery Point #3)
(Bold line in schematic below)



Note: GBRA & LCRA/COA must have separate PWTMs because GBRA needs unsoftened water and LCRA/COA need softened water.

Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
GBRA	0	0	5	7	9	11	11	2.0
Total	0	0	5	7	9	11	11	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
GBRA	0	0	11	14	18	22	22
Total	0	0	11	14	18	22	22

PWTM and Pump Station Costs

Design flow rate - year 2065	22	mgd	
	15,250	gpm	
Pumping capacity of one pump	5,100	gpm	
No. of pumps (not counting spare)	3		
Peak flow rate (all pumps except spare)	15,300	gpm	
Inside diameter of PWTM	42	in.	
Area	9.62	sf	
Length of RWTM	33	miles	(linked to mileage in schematic above)
	174,240	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	100%	174,240	$ 174	$ 30.3	million
Rural - rock	0%	-	$ 244	$ -	
Urban - rock	0%	-	$ 263	$ -	
		174,240		$ 30.3	million

Average estimated unit construction cost for PWTM $ 174 per LF

Total construction cost in millions	$ 30.3			
Contingencies	$ 6.1			
Subtotal	$ 36.3			
Engineering, Legal & Administrative	$ 5.4			
Subtotal	$ 41.8			
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 3.3			
Total Capital Cost for PWTM in millions	$ 45.1			
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.330	Million $/year

Velocity at peak flow rate	3.54	fps		
C factor	120			
Head loss per foot	0.00104	ft/ft	$h_f = \lvert \frac{3.552*Q}{C*(d)^{2.63}} \rvert^{1.85}$	
	5.47	ft/mile		
Head loss at peak flow rate	181	ft		
Allowance for minor losses 20%	36	ft	740	Desired HGL At Delivery Point
Total estimated losses	217	ft	600	Elev. At WTP
Average static head	140	ft	140	ft
Total estimated dynamic head	357	ft		
	155	psi		
No of recommended pumping stations along route	1.03		150	psi (assumed max pressure
No. of pumping stations used in cost estimate	1			in pipe)
Average head per pump station	357	ft		
Assumed pump efficiency	85%			
Assumed motor efficiency	90%			
Estimated Hp required per pump	601	hp/pump		
	448	kw/pump		
Total hp per pump station (not counting spare)	1,802	hp/station		
Total kw per pump set (set=pumps in series along route)	601	kw/pump set	(one pump at each station)	
Unit construction cost for each pump station (from cost curve)	$ 1,674	per firm hp of pump station		
Construction cost per pump station	3.0	million		
Total construction cost for pump stations	3.0		for 1	pump stations
Contingencies	$ 0.6			
Subtotal	$ 3.6			
Engineering, Legal & Administrative	$ 0.5			

Total capital cost for pump stations	$	4.2	million
		40%	Equip cost as % of constr cost
Value of equipment	$	1.2	million
Assumed life of equipment		20	years
Estimated maintenance/replacement cost	$	0.06	million/year

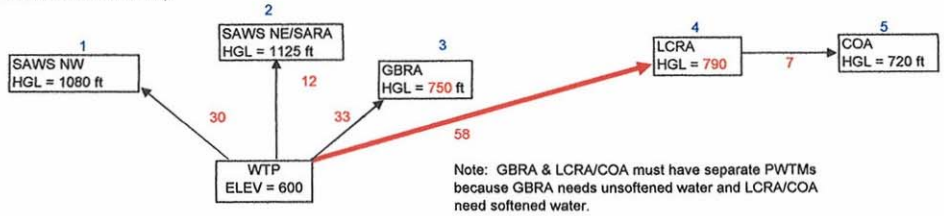
O&M Costs

Year	Flow pumped by year (average flows from Table above)	No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - PWTM	Total O&M cost	Net present value
	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	-							$ -	$ -
2016	-							$ -	$ -
2017	-							$ -	$ -
2018	-							$ -	$ -
2019	-							$ -	$ -
2020	-							$ -	$ -
2021	-							$ -	$ -
2022	-							$ -	$ -
2023	-							$ -	$ -
2024	-							$ -	$ -
2025	-							$ -	$ -
2026	-							$ -	$ -
2027	-							$ -	$ -
2028	-							$ -	$ -
2029	-							$ -	$ -
2030	5	0.73	10,513	$ 736	$ 0.27	$ 0.06	$ 0.330	$ 0.66	$ 0.32
2031	5	0.73	10,513	$ 736	$ 0.27	$ 0.06	$ 0.330	$ 0.66	$ 0.30
2032	5	0.73	10,513	$ 736	$ 0.27	$ 0.06	$ 0.330	$ 0.66	$ 0.29
2033	5	0.73	10,513	$ 736	$ 0.27	$ 0.06	$ 0.330	$ 0.66	$ 0.27
2034	5	0.73	10,513	$ 736	$ 0.27	$ 0.06	$ 0.330	$ 0.66	$ 0.26
2035	5	0.73	10,513	$ 736	$ 0.27	$ 0.06	$ 0.330	$ 0.66	$ 0.25
2036	5	0.73	10,513	$ 736	$ 0.27	$ 0.06	$ 0.330	$ 0.66	$ 0.24
2037	5	0.73	10,513	$ 736	$ 0.27	$ 0.06	$ 0.330	$ 0.66	$ 0.23
2038	5	0.73	10,513	$ 736	$ 0.27	$ 0.06	$ 0.330	$ 0.66	$ 0.21
2039	5	0.73	10,513	$ 736	$ 0.27	$ 0.06	$ 0.330	$ 0.66	$ 0.20
2040	7	0.97	14,017	$ 981	$ 0.36	$ 0.06	$ 0.330	$ 0.75	$ 0.22
2041	7	0.97	14,017	$ 981	$ 0.36	$ 0.06	$ 0.330	$ 0.75	$ 0.21
2042	7	0.97	14,017	$ 981	$ 0.36	$ 0.06	$ 0.330	$ 0.75	$ 0.20
2043	7	0.97	14,017	$ 981	$ 0.36	$ 0.06	$ 0.330	$ 0.75	$ 0.19
2044	7	0.97	14,017	$ 981	$ 0.36	$ 0.06	$ 0.330	$ 0.75	$ 0.18
2045	7	0.97	14,017	$ 981	$ 0.36	$ 0.06	$ 0.330	$ 0.75	$ 0.17
2046	7	0.97	14,017	$ 981	$ 0.36	$ 0.06	$ 0.330	$ 0.75	$ 0.16
2047	7	0.97	14,017	$ 981	$ 0.36	$ 0.06	$ 0.330	$ 0.75	$ 0.16
2048	7	0.97	14,017	$ 981	$ 0.36	$ 0.06	$ 0.330	$ 0.75	$ 0.15
2049	7	0.97	14,017	$ 981	$ 0.36	$ 0.06	$ 0.330	$ 0.75	$ 0.14
2050	9	1.22	17,521	$ 1,226	$ 0.45	$ 0.06	$ 0.330	$ 0.84	$ 0.15
2051	9	1.22	17,521	$ 1,226	$ 0.45	$ 0.06	$ 0.330	$ 0.84	$ 0.14
2052	9	1.22	17,521	$ 1,226	$ 0.45	$ 0.06	$ 0.330	$ 0.84	$ 0.14
2053	9	1.22	17,521	$ 1,226	$ 0.45	$ 0.06	$ 0.330	$ 0.84	$ 0.13
2054	9	1.22	17,521	$ 1,226	$ 0.45	$ 0.06	$ 0.330	$ 0.84	$ 0.12
2055	9	1.22	17,521	$ 1,226	$ 0.45	$ 0.06	$ 0.330	$ 0.84	$ 0.12
2056	9	1.22	17,521	$ 1,226	$ 0.45	$ 0.06	$ 0.330	$ 0.84	$ 0.11
2057	9	1.22	17,521	$ 1,226	$ 0.45	$ 0.06	$ 0.330	$ 0.84	$ 0.11
2058	9	1.22	17,521	$ 1,226	$ 0.45	$ 0.06	$ 0.330	$ 0.84	$ 0.10
2059	9	1.22	17,521	$ 1,226	$ 0.45	$ 0.06	$ 0.330	$ 0.84	$ 0.10
2060	11	1.50	21,551	$ 1,509	$ 0.55	$ 0.06	$ 0.330	$ 0.94	$ 0.10
2061	11	1.50	21,551	$ 1,509	$ 0.55	$ 0.06	$ 0.330	$ 0.94	$ 0.10
2062	11	1.50	21,551	$ 1,509	$ 0.55	$ 0.06	$ 0.330	$ 0.94	$ 0.09
2063	11	1.50	21,551	$ 1,509	$ 0.55	$ 0.06	$ 0.330	$ 0.94	$ 0.09
2064	11	1.50	21,551	$ 1,509	$ 0.55	$ 0.06	$ 0.330	$ 0.94	$ 0.09
2065	11	1.50	21,551	$ 1,509	$ 0.55	$ 0.06	$ 0.330	$ 0.94	$ 0.08
								Total NPV of O&M Costs	$ 6.2

Capital Costs in million $:			Yr built		
PWTM	$	45	2030	$	21.7
Pumping Stations	$	4	2030	$	2.0
			Total NPV of Capital Costs	$	23.7

Total NPV of Capital and O&M Costs in millions $ 29.8
WTP to GBRA (Delivery Point #3)

WTP to LCRA Delivery Point (#4)
(Bold line in schematic below)



Note: GBRA & LCRA/COA must have separate PWTMs because GBRA needs unsoftened water and LCRA/COA need softened water.

Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
LCRA	0	0	5	10	10	10	10	2.0
COA	0	0	15	20	30	30	30	1.68
Total	0	0	20	30	40	40	40	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
LCRA	0	0	10	20	20	20	20
COA	0	0	25	34	50	50	50
Total	0	0	35	54	70	70	70

PWTM and Pump Station Costs

Design flow rate - year 2065	70	mgd	
	48,883	gpm	
Pumping capacity of one pump	10,000	gpm	
No. of pumps (not counting spare)	5		
Peak flow rate (all pumps except spare)	50,000	gpm	
Inside diameter of PWTM	72	in.	
Area	28.27	sf	
Length of RWTM	58	miles	(linked to mileage in schematic above)
	306,240	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	100%	306,240	$ 365	$ 111.9	million
Rural - rock	0%	-	$ 498	$ -	
Urban - rock	0%	-	$ 552	$ -	
		306,240		$ 111.9	million

Average estimated unit construction cost for PWTM $ 365 per LF

Total construction cost in millions	$	111.9		
Contingencies	$	22.4		
Subtotal	$	134.3		
Engineering, Legal & Administrative	$	20.1		
Subtotal	$	154.4		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$	5.8		
Total Capital Cost for PWTM in millions	$	160.2		
Unit maintenance cost/year-mile	$	10,000	$/year-mile	$ 0.580 Million $/year

Velocity at peak flow rate	3.94	fps	
C factor	120		
Head loss per foot	0.00067	ft/ft	$h_f = \lvert \frac{3.552*Q}{C*(d)^{2.63}} \rvert^{1.85}$
	3.55	ft/mile	
Head loss at peak flow rate	206	ft	
Allowance for minor losses 20%	41	ft	790 Desired HGL At Delivery Point
Total estimated losses	247	ft	720 Elev. At Delivery Point 3
Average static head	70	ft	70 ft
Total estimated dynamic head	317	ft	
	138	psi	
No of recommended pumping stations along route	0.92		150 psi (assumed max pressure in pipe)
No. of pumping stations used in cost estimate	1		
Average head per pump station	317	ft	
Assumed pump efficiency	85%		
Assumed motor efficiency	90%		
Estimated Hp required per pump	1,048	hp/pump	
	782	kw/pump	
Total hp per pump station (not counting spare)	5,238	firm hp/station	
Total kw per pump set (set=pumps in series along route)	1,048	kw/pump set	(one pump at each station)
Unit construction cost for each pump station (from cost curve)	$ 1,414	per firm hp of pump station	
Construction cost per pump station	7.4	million	
Total construction cost for pump stations	7.4	for 1	pump stations
Contingencies	$ 1.5		
Subtotal	$ 8.9		
Engineering, Legal & Administrative	$ 1.3		

Total capital cost for pump stations	$	10.2	million
		40%	Equip cost as % of constr cost
Value of equipment	$	3.0	million
Assumed life of equipment		20	years
Estimated maintenance/replacement cost	$	0.15	million/year

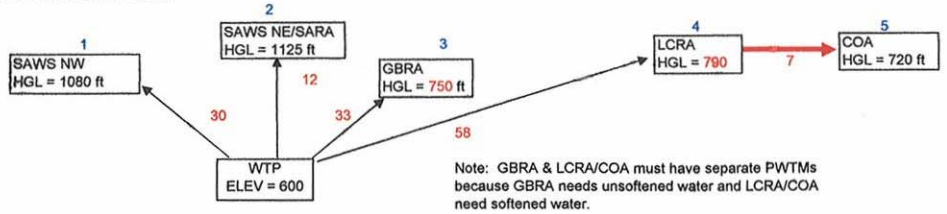
O&M Costs

Year	Flow pumped by year (average flows from Table above)	No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations		Maintenance costs - PWTM		Total O&M cost		Net present value	
	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)		(Million $ /year)		(Million $ /year)		($)	
2015										$	-	$	-
2016										$	-	$	-
2017										$	-	$	-
2018										$	-	$	-
2019										$	-	$	-
2020										$	-	$	-
2021										$	-	$	-
2022										$	-	$	-
2023										$	-	$	-
2024										$	-	$	-
2025										$	-	$	-
2026										$	-	$	-
2027										$	-	$	-
2028										$	-	$	-
2029										$	-	$	-
2030	20	1.39	34,919	$ 2,444	$ 0.89	$ 0.15	$	0.580	$	1.62	$	0.78	
2031	20	1.39	34,919	$ 2,444	$ 0.89	$ 0.15	$	0.580	$	1.62	$	0.74	
2032	20	1.39	34,919	$ 2,444	$ 0.89	$ 0.15	$	0.580	$	1.62	$	0.71	
2033	20	1.39	34,919	$ 2,444	$ 0.89	$ 0.15	$	0.580	$	1.62	$	0.67	
2034	20	1.39	34,919	$ 2,444	$ 0.89	$ 0.15	$	0.580	$	1.62	$	0.64	
2035	20	1.39	34,919	$ 2,444	$ 0.89	$ 0.15	$	0.580	$	1.62	$	0.61	
2036	20	1.39	34,919	$ 2,444	$ 0.89	$ 0.15	$	0.580	$	1.62	$	0.58	
2037	20	1.39	34,919	$ 2,444	$ 0.89	$ 0.15	$	0.580	$	1.62	$	0.55	
2038	20	1.39	34,919	$ 2,444	$ 0.89	$ 0.15	$	0.580	$	1.62	$	0.53	
2039	20	1.39	34,919	$ 2,444	$ 0.89	$ 0.15	$	0.580	$	1.62	$	0.50	
2040	30	2.08	52,379	$ 3,667	$ 1.34	$ 0.15	$	0.580	$	2.07	$	0.61	
2041	30	2.08	52,379	$ 3,667	$ 1.34	$ 0.15	$	0.580	$	2.07	$	0.58	
2042	30	2.08	52,379	$ 3,667	$ 1.34	$ 0.15	$	0.580	$	2.07	$	0.55	
2043	30	2.08	52,379	$ 3,667	$ 1.34	$ 0.15	$	0.580	$	2.07	$	0.53	
2044	30	2.08	52,379	$ 3,667	$ 1.34	$ 0.15	$	0.580	$	2.07	$	0.50	
2045	30	2.08	52,379	$ 3,667	$ 1.34	$ 0.15	$	0.580	$	2.07	$	0.48	
2046	30	2.08	52,379	$ 3,667	$ 1.34	$ 0.15	$	0.580	$	2.07	$	0.46	
2047	30	2.08	52,379	$ 3,667	$ 1.34	$ 0.15	$	0.580	$	2.07	$	0.43	
2048	30	2.08	52,379	$ 3,667	$ 1.34	$ 0.15	$	0.580	$	2.07	$	0.41	
2049	30	2.08	52,379	$ 3,667	$ 1.34	$ 0.15	$	0.580	$	2.07	$	0.39	
2050	40	2.78	69,838	$ 4,889	$ 1.78	$ 0.15	$	0.580	$	2.51	$	0.46	
2051	40	2.78	69,838	$ 4,889	$ 1.78	$ 0.15	$	0.580	$	2.51	$	0.43	
2052	40	2.78	69,838	$ 4,889	$ 1.78	$ 0.15	$	0.580	$	2.51	$	0.41	
2053	40	2.78	69,838	$ 4,889	$ 1.78	$ 0.15	$	0.580	$	2.51	$	0.39	
2054	40	2.78	69,838	$ 4,889	$ 1.78	$ 0.15	$	0.580	$	2.51	$	0.37	
2055	40	2.78	69,838	$ 4,889	$ 1.78	$ 0.15	$	0.580	$	2.51	$	0.36	
2056	40	2.78	69,838	$ 4,889	$ 1.78	$ 0.15	$	0.580	$	2.51	$	0.34	
2057	40	2.78	69,838	$ 4,889	$ 1.78	$ 0.15	$	0.580	$	2.51	$	0.32	
2058	40	2.78	69,838	$ 4,889	$ 1.78	$ 0.15	$	0.580	$	2.51	$	0.31	
2059	40	2.78	69,838	$ 4,889	$ 1.78	$ 0.15	$	0.580	$	2.51	$	0.29	
2060	40	2.78	69,838	$ 4,889	$ 1.78	$ 0.15	$	0.580	$	2.51	$	0.28	
2061	40	2.78	69,838	$ 4,889	$ 1.78	$ 0.15	$	0.580	$	2.51	$	0.27	
2062	40	2.78	69,838	$ 4,889	$ 1.78	$ 0.15	$	0.580	$	2.51	$	0.25	
2063	40	2.78	69,838	$ 4,889	$ 1.78	$ 0.15	$	0.580	$	2.51	$	0.24	
2064	40	2.78	69,838	$ 4,889	$ 1.78	$ 0.15	$	0.580	$	2.51	$	0.23	
2065	40	2.78	69,838	$ 4,889	$ 1.78	$ 0.15	$	0.580	$	2.51	$	0.22	
									Total NPV of O&M Costs		$	16.4	

Capital Costs in million $:			Yr built		
PWTM	$	160.2	2030	$	77.1
Pumping Stations	$	10.2	2030	$	4.9
			Total NPV of Capital Costs	$	82.0

Total NPV of Capital and O&M Costs in millions $ 98
WTP to LCRA Delivery Point (#4)

LCRA Delivery Point (#4) to COA Delivery Point (#5)
(Bold line in schematic below)



Note: GBRA & LCRA/COA must have separate PWTMs because GBRA needs unsoftened water and LCRA/COA need softened water.

Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
COA	0	0	15	20	30	30	30	1.68
Total	0	0	15	20	30	30	30	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
COA	0	0	25	34	50	50	50
Total	0	0	25	34	50	50	50

PWTM and Pump Station Costs

Design flow rate - year 2065	50	mgd	
	34,997	gpm	
Inside diameter of PWTM	54	in.	
Area	15.90	sf	
Length of PWTM	7	miles	(linked to mileage in schematic above)
	36,960	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	100%	36,960	$ 244	$ 9.0	million
Rural - rock	0%	-	$ 337	$ -	
Urban - rock	0%	-	$ 369	$ -	
		36,960		$ 9.0	million
Average estimated unit construction cost for PWTM			$ 244	per LF	

Total construction cost in millions	$ 9.0		
Contingencies	$ 1.8		
Subtotal	$ 10.8		
Engineering, Legal & Administrative	$ 1.6		
Subtotal	$ 12.4		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 0.0		
Total Capital Cost for PWTM in millions	$ 12.4		
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.070 Million $/year

Velocity at peak flow rate	4.90	fps	
C factor	120		
Head loss per foot	0.00141	ft/ft	$h_f = \frac{3.552 * Q^{1.85}}{C^{2.63} * d^{2.63}}$
	7.45	ft/mile	

Head loss at peak flow rate	52	ft	
Allowance for minor losses	20%	10	ft
Total estimated losses		63	ft
Average static head		-70	ft
Total estimated dynamic head		-7	ft
		-3	psi

720	Desired HGL At Delivery Point
790	Elev. At Delivery Point 4
-70	ft

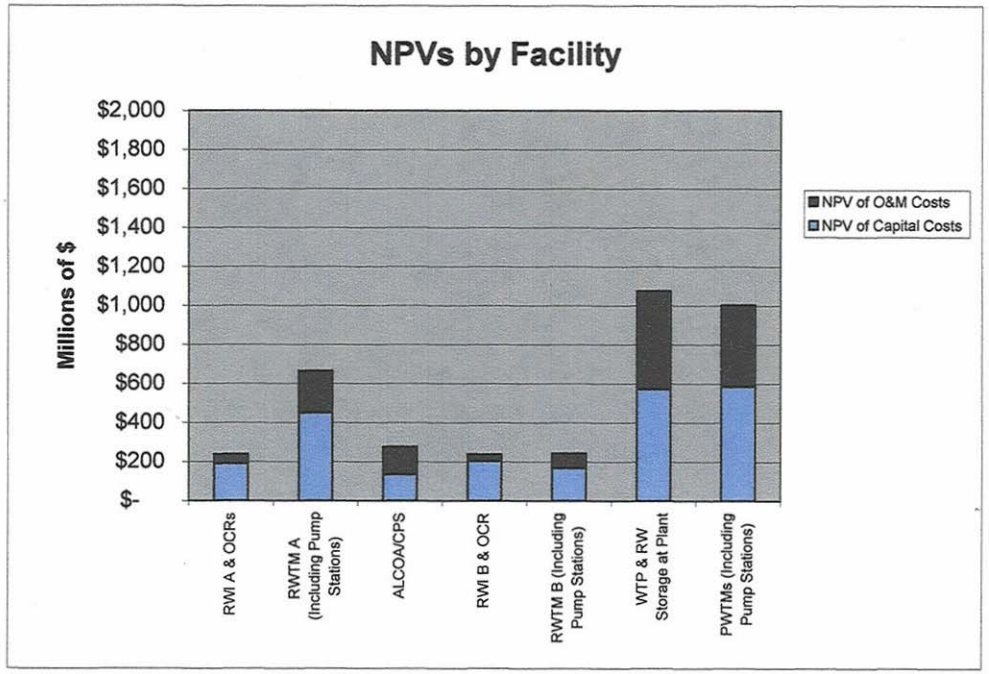
Negative indicates gravity flow from #4 to #5; no pumping necessary.

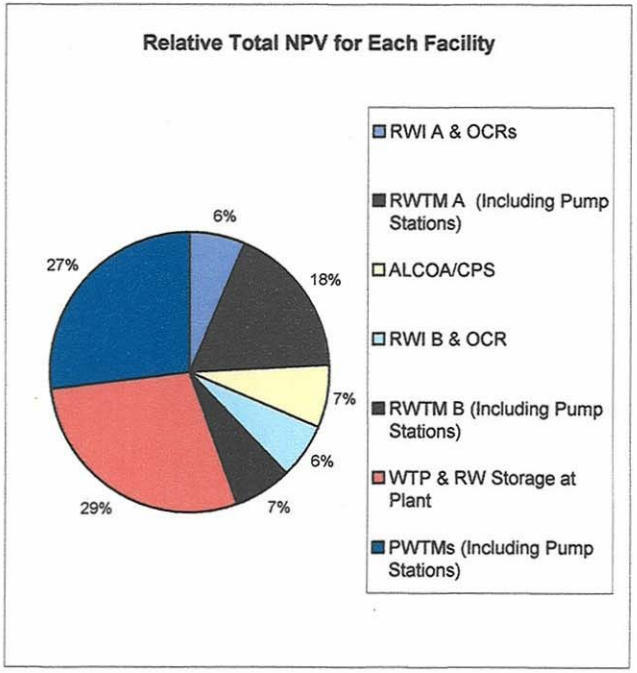
			Million $
Annual O&M Cost in million $:		Yr built	
PWTM	$ 0.070	2030	
Total NPV of O&M Costs			$0.55
Capital Costs in million $:		Yr built	
PWTM	$ 12.4	2030	$ 6.0
Total NPV of Capital Costs			$ 6.0

Total NPV of Capital and O&M Costs in millions $ 6.5
LCRA Delivery Point (#4) to COA Delivery Point (#5)

CTRWTP - Alternate 2A - WTP East of San Marcos

WTP Location	Alter-nate	Phasing Scenario	Total NPVs in Millions of $	RWI A & OCRs	RWTM A (Including Pump Stations)	ALCOA/CPS	RWI B & OCR	RWTM B (Including Pump Stations)	WTP & RW Storage at Plant	PWTMs (Including Pump Stations)
East of San Marcos	2A	RWTM B & ALCOA/CPS built by 2015; RWTM A built in 2020.		Sized for 4000 cfs to scalp water; 4 intakes, 4 miles of 120-inch raw water mains & 4 OCRs at 25,000 ac-ft each	126 miles of 96-inch diameter pipe sized to deliver 132,000 ac-ft/year on a continuous basis; includes 3 pumping stations w/ balancing reservoirs along route	Non-Public wells; Transmission of 55,000 ac-ft/year to the OCR at RWI B via 15 miles of 54" gravity pipeline from Hwy 290 east of Elgin	Sized for 2000 cfs to scalp water; 2 intakes; 8 miles of 120-inch raw water mains and 4 OCRs at 15,000 ac-ft/each	Sized for 117,804 ac-ft/yr; 36 miles of 96" pipeline with one pumping station and balancing reservoir	Raw water reservoir w/ 11,000 ac-ft capacity; Conventional settling with membrane filtration for SAWS, SARA & GBRA; Lime softening with membrane filtration for COA & LCRA water	Each PWTM sized for maximum daily demand (See PWTM Summary Sheet in the Appendices)
		NPV of Capital Costs	$ 2,306	$ 191	$ 451	$ 135	$ 204	$ 168	$ 572	$ 585
		NPV of O&M Costs	$ 1,432	$ 47	$ 213	$ 141	$ 34	$ 75	$ 502	$ 419
		Total NPV of Capital & O&M	**$ 3,737**	$ 238	$ 664	$ 276	$ 238	$ 243	$ 1,075	$ 1,004





O&M Cost Calculations
RWI A - Matagorda Co. River Intakes, and Storage
CTRWTP - Alternate 2A - WTP East of San Marcos

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile
			or =	$ 5,000	per acre

Inflatable Rubber Low Head Dam

	Quantity	Units	Size	Unit Constr. Cost (millions)	Total Estimated Constr. Cost (millions)	Contigency, Eng., etc. (millions)	Total Capital Cost (millions)
Inflatable Rubber Low Head Dam	4	each	10 ft high	$ 2.25	$ 9.00	$ 3.42	$ 12.42

Estimated inflatable dam cost as % of total	50%		
Value of inflatable dam	$ 4.50	million	
Assumed life of inflatable dam	10	years	
Estimated maintenance/replacement cost	$ 0.45	million/year	
Year built	2020		
NPV of O&M Costs	$6.27	million	
NPV of Capital Costs	$ 9.73	million	
Total NPV of Capital and O&M Costs	$16.00	million	

Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)

Average withdrawal	132,000	ac-ft/year			
	182	cfs			
Total intake design withdrawal rate (for scalping high flows	4,000	cfs	21.9	Ratio of design withdrawal rate to Total intake design withdrawal rate	
	1,795,200	gpm			
No. of Intakes	4				
Design withdrawal rate per intake	1,000	cfs			
	448,800	gpm			
No. of reservoirs	4				
Design flow to each reservoir	448,800	gpm			
Inside diameter of each RWTM	120	in.			
Area	78.54	sf			
Average length of each RWTM	1	miles	4.0	miles for all RWTMs	
	5,280	feet	21,120	feet	
Estimated construction cost for RWTM	$ 793	per LF			
Total construction cost in millions	$ 16.8				
Contingencies	$ 3.4				
Subtotal	$ 20.1				
Engineering, Legal & Administrative	$ 3.0				
Subtotal	$ 23.1				
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 0.4				
Total Capital Cost for PWTM in millions	$ 23.5	million			
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.040	Million $/year (all RWTMs to Reservoirs)	

Note: Assume each intake has two RWTMs pumping out of it, one to each reservoir.

Design flow rate for each RWTM (from above)	448,800	gpm		
Pumping rate (one pump)	50,000	gpm		
No. of pumps (not counting spare) pumping into each RW	9			
Peak flow rate into each RWTM (all pumps except spare)	450,000	gpm		
Velocity at peak flow rate	12.77	fps		
C factor	120			
Head loss per foot	0.00327	ft/ft	$h_f = \lvert 3.552*Q \rvert^{1.85} / \lvert C*(d)^{2.63} \rvert$	
	17.25	ft/mile		
Head loss at peak flow rate	17	ft		
Allowance for minor losses 30%	5	ft	90	Elev of discharge at reservoir
Total estimated losses	22	ft	50	Water surface elev in river
Average static head	40	ft	40	ft
Total estimated dynamic head	62	ft		
	27	psi		
Assumed pump efficiency	85%			
Assumed motor efficiency	90%			
Estimated Hp required per pump	1,030	hp/pump		
	769	kw/pump		
Total hp pumping into each RWTM (not counting spare)	9,272	hp/RWTM		
Total hp at each intake (not counting spare)	9,272	hp/intake		
Total hp all intakes (not counting spares)	37,089	hp		
Total kw all intakes (not counting spares)	27,668	kw		
Unit construction cost for each pump station (from cost cu	$ 889	per firm hp of pump station		
Construction cost per intake/pump station	8.2	million		
No. of intakes from above	4	each		
Total construction cost in millions	$ 33.0	million		
Contigency, Eng., etc. in millions	$ 12.53	million		
Total capital cost in millions	$ 45.5	million		
Total construction cost for pump stations	$ 33.0	million		
Value of equipment	$ 13.2	million	40%	Estimated equip cost as % of total constr cost
Assumed life of equipment	20	years		
Estimated maintenance/replacement cost	$ 0.66	million/year		

O&M Costs:

Year	Flow pumped by year		No. of pump "sets" operating	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd	/day	(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	-	-	-	-	$ -	$ -			$ -	$ -
2016	-	-	-	-	$ -	$ -			$ -	$ -
2017	-	-	-	-	$ -	$ -			$ -	$ -
2018	-	-	-	-	$ -	$ -			$ -	$ -
2019	-	-	-	-	$ -	$ -			$ -	$ -
2020	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 1.15
2021	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 1.10
2022	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 1.05
2023	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 1.00
2024	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.95
2025	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.90
2026	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.86
2027	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.82
2028	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.78
2029	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.74
2030	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.71
2031	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.67
2032	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.64
2033	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.61
2034	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.58
2035	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.55
2036	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.53
2037	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.50
2038	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.48
2039	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.46
2040	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.43
2041	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.41
2042	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.39
2043	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.38
2044	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.36
2045	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.34
2046	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.32
2047	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.31
2048	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.29
2049	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.28
2050	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.27
2051	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.25
2052	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.24
2053	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.23
2054	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.22
2055	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.21
2056	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.20
2057	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.19
2058	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.18
2059	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.17
2060	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.16
2061	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.16
2062	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.15
2063	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.14
2064	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.13
2065	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.13
								Total NPV of O&M Costs		$ 21.6

Capital Costs in million $:		Yr built		
RWTM to Reservoirs	$ 23.5	2020		$ 18.4
Intake/Pumping Stations	$ 45.5	2020		$ 35.6
			Total NPV of Capital Costs	$ 54.1

Total NPV of Capital and O&M Costs in millions $ 75.7

Reservoirs

	Quantity	Units	Volume/each (acre-feet)	Unit Cost ($/ac-ft))	Total Construction Cost in millions	Contigency, Eng., etc.	Total in millions
Reservoirs	4	each	25000	$ 974	$ 97.4	$ 37.0	$ 134.4

Estimated average depth of reservoir	20	ft		
Surface area of reservoir	5000	acres		
Ratio of total land area reqd to surface area of reservoir	1.1		Envir & Archaeology, Surv, and Land Acq =	27.5
Total land area reqd for reservoirs	5500	acres	Total capital cost in millions =	$ 161.9
Assumed life of reservoir	100	years		
Estimated replacement cost	$ 0.97	million/year		
Estimated maintenance	0.4	million/year	Mowing, maintaining fences, etc.	
Total	$ 1.37	million/year		
Year built	2020			
NPV of O&M costs	$ 19.1	million		
NPV of Capital costs	$ 126.8	million		
Total NPV of Capital and O&M Costs	$ 145.9	million		

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Inflatable Rubber Low Head Dam	$ 9.7	$ 6.3	$ 16.0
Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)	$ 54.1	$ 21.6	$ 75.7
Reservoirs	$ 126.8	$ 19.1	$ 145.9
Total for RWI A	$ 190.6	$ 47.0	$ 237.6

O&M Cost Calculations
RWTM A - Matagorda Co. to WTP
CTRWTP - Alternate 2A - WTP East of San Marcos

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

Raw Water Transmission Main - A

Inside diameter of pipe		96	in.			
Area		50.27	sf			
Length of RWTM		126	miles			
		665,280	feet			
Estimated unit construction cost for RWTM	$	567	per LF			
Total construction cost in millions	$	378				
Contingencies	$	76				
Subtotal	$	453				
Engineering, Legal & Administrative	$	68				
Subtotal	$	521				
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$	13				
Total Capital Cost for PWTM in millions	$	534	million			
Unit maintenance cost/year-mile	$	10,000	$/year-mile	$	1.260	Million $/year
Design flow rate (after 100% buildout)		132,000	ac-ft/year			
		118	mgd			
		81,829	gpm			
Pumping rate (one pump)		16,400	gpm			
No. of pumps (not counting spare)		5				
Peak flow rate (all pumps except spare)		82,000	gpm			
Velocity at peak flow rate		3.63	fps			
C factor		120				
Head loss per foot		0.00041	ft/ft	$h_f = \left\| \frac{3.552*Q}{C*(d)^{2.63}} \right\|^{1.85}$		
		2.19	ft/mile			
Head loss at peak flow rate		276	ft			
Allowance for minor losses	10%	28	ft	550	Elev. At San Antonio East WTP	
Total estimated losses		303	ft	90	Elev. At Matagorda OCRs	
Average static head		460	ft	460	ft	
Total estimated dynamic head		763	ft			
		331	psi			
No of pumping stations req'd along route		2.21		150	psi (assumed max pressure	
No. of pumping stations used in cost estimate		3.0			in pipe)	
Average head per pump station		254	ft			
Assumed pump efficiency		85%				
Assumed motor efficiency		90%				
Estimated Hp required per pump		1,378	hp/pump			
		1,028	kw/pump			
Total hp per pump station (not counting spare)		6,888	hp/station			
Total kw per pump set (set=pumps in series along route)		4,133	kw/pump set	(one pump at each station)		
Unit construction cost for each pump station (from cost curv	$	1,347	per firm hp of pump station			
Construction cost per pump station		9.3	million			
Balancing reservoir	$	0.75	million	60	min. of storage at avg pumping rate	
Total construction cost per pump station	$	10.03	million	5.0	mg	
				$ 0.15	per gal for open top reservoir	
No. of pump stations from above		3.0	each			
Total construction cost in millions	$	30.1	million			
Contigency, Eng., etc. in millions	$	11.43	million			
Total capital cost in millions	$	41.5	million			
Total construction cost for pump stations	$	30.1	million			
Value of equipment	$	12.0	million	40%	Estimated equipment cost as % of total	
Assumed life of equipment		20	years			
Estimated maintenance/replacement cost	$	0.60	million/year			

O&M Costs

Year	Flow pumped by year		No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	-	-	-	-	$ -	$ -			$ -	$ -
2016	-	-	-	-	$ -	$ -			$ -	$ -
2017	-	-	-	-	$ -	$ -			$ -	$ -
2018	-	-	-	-	$ -	$ -			$ -	$ -
2019	-	-	-	-	$ -	$ -			$ -	$ -
2020	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 11.37
2021	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 10.83
2022	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 10.31
2023	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 9.82
2024	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 9.35
2025	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 8.91
2026	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 8.48
2027	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 8.08
2028	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 7.69
2029	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 7.33
2030	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 6.98
2031	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 6.65
2032	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 6.33
2033	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 6.03
2034	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 5.74
2035	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 5.47
2036	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 5.21
2037	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 4.96
2038	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 4.72
2039	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 4.50
2040	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 4.28
2041	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 4.08
2042	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 3.89
2043	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 3.70
2044	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 3.52
2045	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 3.36
2046	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 3.20
2047	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 3.04
2048	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.90
2049	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.76
2050	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.63
2051	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.50
2052	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.39
2053	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.27
2054	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.16
2055	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.06
2056	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.96
2057	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.87
2058	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.78
2059	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.70
2060	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.61
2061	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.54
2062	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.46
2063	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.39
2064	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.33
2065	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.27
								Total NPV of O&M Costs		**$ 213**

Capital Costs in million $:		Yr built		
RWTM	$ 534	2020		$ 418
Pumping Stations	$ 42	2020		$ 33
			Total NPV of Capital Costs	**$ 451**
			Total NPV of Capital and O&M Costs in millions	**$ 664**

NPV CALCULATIONS
ALCOA / CPS GROUNDWATER
CTRWTP - Alternate 2A - WTP East of San Marcos

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

Well Fields and Collection Lines

	ALCOA	CPS	Total
Year built	2015	2015	
Estimated Construction Cost in Millions			
Wells (Based on Non-Public Water Supply Wells)	20.92	7.94	28.86
Pipeline	13.03	5.94	18.97
Pump Stations & Storage	8.51	0	8.51
Subtotal	42.46	13.88	56.34
Contingency	8.49	2.78	11.27
Subtotal	50.95	16.66	67.61
Engineering, Legal & Administrative	6.37	2.08	8.45
Subtotal	57.32	18.74	76.06
Environmental & Archaeology Studies & Mitigation	0.63	0.2	0.83
Land Acquisition & Surveying	0	0	0.00
Groundwater Purchase	0	5.64	5.64
ALCOA Construction Program Management Fee	5.45	0	5.45
Interest During Construction (2 years, 6% int., 4% ret.)	5.89	2.44	8.33
Total Capital Cost	**69.29**	**27.02**	**96.31**
Estimated Annual O&M Costs			
O&M	0.67	0.18	0.85
Pumping Energy	2.41	0.52	2.93
ALCOA Project Management Fees	0.35	0.00	0.35
Purchase of Groundwater	2.00	0.00	2.00
Groundwater District Fees	0.65	0.25	0.90
Mitigation Reserves	0.28	0.11	0.39
Total Annual Cost	**6.36**	**1.06**	**7.42**

NPV of O&M Costs	$ 116	$ 19	$ 135	million
NPV of Capital Costs	$ 69	$ 27	$ 96	million
Total NPV of Capital and O&M Costs for Well Fields	**$ 185**	**$ 46**	**$ 232**	**million**

Cooling of Well Water

Total number of wells in both fields	120	wells	Approximate capacity per wel	300 gpm
Percentage of wells with temperatures > than ___ degrees	5%			36,000 gpm
Estimated number of wells with temperature > ____ degrees	6.0		Rough check	58,072 ac-ft/year

Estimated Capital Costs

Year built	2015		
Number of Packaged Cooling Towers (300 gpm capacity/each)	6.0		
Equipment cost (cooling towers and fans)	$ 60,000		
Installation and contractors mark-up	$ 50,000		
Structural slab	$ 30,000		
Electrical	$ 50,000		
Estimated Unit Construction Cost	$ 190,000	Each	
Total construction cost	$ 1.14	million	
Contingencies	$ 0.23		
Subtotal	$ 1.37		
Engineering, Legal and Admin	$ 0.21		
Total Estimated Capital Cost	$ 1.57		
NPV of Capital Costs	$ 1.57	million	

Estimated O&M Costs

Value of equipment	$ 0.4	million	
Assumed life of equipment	10	years	
Estimated maintenance/replacement cost	$ 0.04	million/year	
Blower Hp per cooling tower	10	Hp	
	7	kw	
Hours of operation	24	hours	
Power consumption per cooling tower	179	kwh per day	
	65,350	kwh per year	
Power cost per cooling tower	$ 4,574		
Total power cost for all cooling towers in millions	$ 0.03	million per year	
Regular operational checks and routine maintenance	$ 6,000	per month for all cooling towers	
	$ 0.07	per year	
Estimated O&M Cost	$ 0.14	million $ per year	
NPV of O&M costs	$ 2.47	million $	

Ground Water Transmission Main and Pump Station (Hwy 290 to Bastrop Intake)

Inside diameter of transmission pipe	54	in.

Area			15.90	sf		
Length of Ground Water TM			15	miles		
			79,200	feet		
Estimated construction cost for GWTM		$	327	per LF		
Total construction cost in millions		$	25.9			
Contingencies		$	5.2			
Subtotal		$	31.1			
Engineering, Legal & Administrative		$	4.7			
Subtotal		$	35.8			
Envir & Arch Studies & Mitigation, Surveying, & Land Acq		$	1.5			
Total Capital Cost for PWTM in millions		$	37.3	million		
Unit maintenance cost/year-mile		$	10,000	$/year-mile	$ 0.150	Million $/year
Design flow rate			55,000	ac-ft/year		
			49	mgd		
			34,095	gpm		
Velocity at peak flow rate			4.78	fps		
C factor			120			
Head loss per foot			0.00134	ft/ft	$h_f = \lvert 3.552*Q\rvert^{1.85} / \lvert C*(d)^{2.63}\rvert$	
			7.10	ft/mile		
Head loss at peak flow rate			106	ft		
Allowance for minor losses	10%		11	ft	400	Elev. At RWI-B
Total estimated losses			117	ft	550	minus Elev. - Storage Tank at Hwy 290
Average static head			-150	ft	-150	ft
Total estimated dynamic head			-33	ft	(intake is lower than tank at Hwy 290)	
			-14	psi		

Negative indicates gravity flow from Hwy 290 to Bastrop Intake; no pumping necessary.

				Million $
Annual O&M Cost in million $:		Yr built		
GWTM	$ 0.150	2015		
			Total NPV of O&M Costs	$ 2.7
Capital Costs in million $:		Yr built		
GWTM	$ 37.3	2015		$ 37.3
			Total NPV of Capital Costs	$ 37.3

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Well Fields and Collection Lines (including tank and pump station at Hwy 290)	$ 96.3	$ 135.5	$ 231.8
Cooling Towers for Selected High Temperature Wells	$ 1.6	$ 2.5	$ 4.0
Ground Water Transmission Main and Pumping Station	$ 37.3	$ 2.7	$ 40.0
Total for ALCOA-CPS	$ 135.1	$ 140.7	$ 275.8

O&M Cost Calculations
RWI B - Colorado River Intake at Bastrop and Off Channel Reservoir
CTRWTP - Alternate 2A - WTP East of San Marcos

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	40	years			
Unit cost of energy	$ 0.07	per kwh	Environmental & Archaeology Studies & Mitigation, Surveying, and Land Acquisition =	$ 100,000	per mile
			or =	$ 5,000	per acre

Inflatable Rubber Low Head Dam

	Quantity	Units	Size	Unit Constr. Cost (millions)	Total Estimated Constr. Cost (millions)	Contigency, Eng., etc. (millions)	Total Capital Cost (millions)
Inflatable Rubber Low Head Dam	2	each	10 ft high	$ 2.25	$ 4.50	$ 1.71	$ 6.21

Estimated inflatable dam cost as % of total	50%		
Value of inflatable dam	$ 2.25	million	
Assumed life of inflatable dam	10	years	
Estimated maintenance/replacement cost	$ 0.23	million/year	
Year built	2015		
NPV of O&M Costs	$ 3.86	million	
NPV of Capital Costs	$ 6.21	million	
Total NPV of Capital and O&M Costs	**$ 10.07**	**million**	

Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)

Summary of withdrawals in acre-feet/year:

Year	2015	2020	2030	2040	2050	2060	2065
For SAWS	18000	18000	18000	18000	18000	18000	18000
LCRA			5600	11200	11200	11200	11200
COA			16802	22403	33604	33604	33604
Total	18000	18000	40402	51603	62804	62804	62804

Ultimate (Y2065) average design withdrawal rate	62,804	ac-ft/year		
	87	cfs		
			23.1	Ratio of design withdrawal rate to Total intake design withdrawal rate
Total intake design withdrawal rate (for scalping high flows)	2,000	cfs		
	897,600	gpm		
No. of Intakes	2			
Design withdrawal rate per intake	1,000	cfs		
	448,800	gpm		
No. of reservoirs	4			
Design flow to each reservoir	224,400	gpm		
Inside diameter of each RWTM	120	in.		
Area	78.54	sf		
Average length of each RWTM	2	miles	8.0	miles for all RWTMs
	10,560	feet	42,240	feet

Estimated construction cost for RWTMs	$ 793	per LF		
Total construction cost in millions	$ 33.5			
Contingencies	$ 6.7			
Subtotal	$ 40.2			
Engineering, Legal & Administrative	$ 6.0			
Subtotal	$ 46.2			
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 0.8			
Total Capital Cost for PWTM in millions	$ 47.0			
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.080	Million $/year (all RWTMs to Reservoirs)

Note: Assume intake has one RWTM pumping to the reservoir.

Design flow rate for each RWTM (from above)	224,400	gpm		
Pumping rate (one pump)	40,000	gpm		
No. of pumps (not counting spare) pumping into each RWT	6			
Peak flow rate into each RWTM (all pumps except spare)	240,000	gpm		
Velocity at peak flow rate	6.81	fps		
C factor	120			
Head loss per foot	0.00102	ft/ft	$h_f = \left\lvert \frac{3.552 \cdot Q}{C \cdot (d)^{2.63}} \right\rvert^{1.85}$	
	5.39	ft/mile		
Head loss at peak flow rate	11	ft		
Allowance for minor losses 30%	3	ft	400	Discharge at reservoir
Total estimated losses	14	ft	320	Water surface elev in river
Average static head	80	ft	80	ft
Total estimated dynamic head	94	ft		
	41	psi		
Assumed pump efficiency	85%			
Assumed motor efficiency	90%			
Estimated Hp required per pump	1,241	hp/pump		
	926	kw/pump		

Total hp pumping into each RWTM (not counting spare)	7,448	hp/RWTM
Total hp at each intake (not counting spare)	14,897	hp/intake
Total hp all intakes (not counting spares)	29,793	hp
Total kw all intakes (not counting spares)	22,226	kw

Unit construction cost for each pump station (from cost cur	$ 889	per firm hp of pump station
Construction cost per intake/pump station	13.2	million
No. of intakes from above	2	each

Total construction cost in millions	$ 26.5	million
Contigency, Eng., etc. in millions	$ 10.06	million
Total capital cost in millions	$ 36.6	million

Total construction cost for pump stations	$ 26.5	million	40% Estimated equipment cost as % of total
Value of equipment	$ 10.6	million	
Assumed life of equipment	20	years	
Estimated maintenance/replacement cost	$ 0.53	million/year	

O&M Costs:

Year	Flow pumped by year		No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.77
2016	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.73
2017	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.70
2018	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.66
2019	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.63
2020	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.60
2021	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.57
2022	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.55
2023	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.52
2024	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.50
2025	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.47
2026	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.45
2027	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.43
2028	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.41
2029	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.39
2030	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.46
2031	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.44
2032	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.42
2033	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.40
2034	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.38
2035	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.36
2036	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.35
2037	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.33
2038	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.31
2039	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.30
2040	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.31
2041	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.30
2042	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.28
2043	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.27
2044	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.26
2045	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.25
2046	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.23
2047	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.22
2048	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.21
2049	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.20
2050	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.21
2051	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.20
2052	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.19
2053	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.18
2054	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.17
2055	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.17
2056	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.16
2057	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.15
2058	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.14
2059	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.14
2060	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.13
2061	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.12
2062	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.12
2063	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.11
2064	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.11
2065	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.10
								Total NPV of O&M Costs		$ 17.1

Capital Costs in million $:		Yr built		
RWTM to Reservoir	$ 47.0	2015		$ 47.0
Intake/Pumping Stations	$ 36.6	2015		$ 36.6
			Total NPV of Capital Costs	$ 83.6
			Total NPV of Capital and O&M Costs in millions	$ 100.7

Reservoirs

	Quantity	Units	Volume/each (acre-feet)	Unit Cost ($/ac-ft))	Total Construction Cost in millions	Contigency, Eng., etc.	Total in millions
Reservoirs	4	each	15000	$ 1,180	$ 70.8	$ 26.9	$ 97.7
				$ 0.004	per gallon		
Estimated average depth of reservoir		20	ft				

Surface area of reservoir	3000	acres		
Ratio of total land area reqd to surface area of reservoir	1.1			
Total land area reqd for reservoirs	3300	acres	Envir & Archaeology, Surv, and Land Acq =	16.5
			Total capital cost in millions =	$ 114.2
Assumed life of reservoir	100	years		
Estimated replacement cost	$ 0.71	million/year		
Estimated maintenance	$ 0.04	million/year	Mowing, maintaining fences, etc.	
Total	$ 0.75	million/year		
Year built	2015			
NPV of O&M costs	$ 12.8	million		
NPV of Capital costs	$ 114.2	million		
Total NPV of Capital and O&M Costs	**$ 127.0**	**million**		

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Inflatable Rubber Low Head Dam	$ 6.2	$ 3.9	$ 10.1
Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)	$ 83.6	$ 17.1	$ 100.7
Off Channel Reservoir	$ 114.2	$ 12.8	$ 127.0
Total for RWI A	$ 204.0	$ 33.8	$ 237.8

O&M Cost Calculations
RWTM B - RWI B near Bastrop to WTP
CTRWTP - Alternate 2A - WTP East of San Marcos

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	40	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

Summary of average pumping rates in acre-feet/year:

Suface Water

Year	2015	2020	2030	2040	2050	2060	2065
For SAWS	18000	18000	18000	18000	18000	18000	18000
LCRA			5600	11200	11200	11200	11200
COA			16802	22403	33604	33604	33604
Subtotal	18000	18000	40402	51603	62804	62804	62804

Groundwater

Year	2015	2020	2030	2040	2050	2060	2065
For SAWS	55000	55000	55000	55000	55000	55000	55000
Suface & grour	73000	73000	95402	106603	117804	117804	117804

Ultimate (Y2065) average design pumping rate 117,804 ac-ft/year

Sizing of Raw Water Transmission Main B & Pump Stations

Inside diameter of RWTM		96	in.			
Area		50.27	sf			
Length of RWTM		36	miles			
		190,080	feet			
Estimated unit construction cost for RWTM	$	567	per LF			
Total construction cost in millions	$	107.9				
Contingencies	$	21.6				
Subtotal	$	129.4				
Engineering, Legal & Administrative	$	19.4				
Subtotal	$	148.9				
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$	3.6				
Total Capital Cost for PWTM in millions	$	152.5	million			
Unit maintenance cost/year-mile	$	5,000	$/year-mile	$	0.180	Million $/year
Design flow rate (after 100% buildout)		117,804	ac-ft/year			
		105	mgd			
		73,029	gpm			
Pumping rate (one pump)		15,000	gpm			
No. of pumps (not counting spare)		5				
Peak flow rate (all pumps except spare)		75,000	gpm			
Velocity at peak flow rate		3.32	fps			
C factor		120				
Head loss per foot		0.00035	ft/ft	$h_f = \lvert 3.552*Q \rvert^{1.85} / \lvert C*(d)^{2.63} \rvert$		
		1.86	ft/mile			
Head loss at peak flow rate		67	ft			
Allowance for minor losses	10%	7	ft	650	Elev. At WTP	
Total estimated losses		74	ft	400	Elev of WSE in Bastrop reservoir	
Average static head		250	ft	250	ft	
Total estimated dynamic head		324	ft			
		140	psi			
No of recommended pumping stations along route		0.93		150	psi (assumed max pressure	
No. of pumping stations used in cost estimate		1.0			in pipe)	
Average head per pump station		324	ft			
Assumed pump efficiency		85%				
Assumed motor efficiency		90%				
Estimated Hp required per pump		1,602	hp/pump			
		1,195	kw/pump			
Total hp per pump station (not counting spare)		8,009	hp/station			
Total kw per pump set (set=pumps in series along route)		1,602	kw/pump set	(one pump at each station)		
Unit construction cost for each pump station (from cost cur	$	1,310	per firm hp of pump station			
Construction cost per pump station		10.5	million			
Balancing reservoir	$	0.75	million	60	min. of storage at avg pumping rate	
Total construction cost per pump station	$	11.24	million	5.0	mg	
				$ 0.15	per gal for open top reservoir	
No. of pump stations from above		1.0	each			
Total construction cost in millions	$	11.2	million			
Contingency, Eng., etc. in millions	$	4.27	million			
Total capital cost in millions	$	15.5	million			
Total construction cost for pump stations	$	11.2	million			
Value of equipment	$	4.5	million	40%	Estimated equipment cost as % of total	
Assumed life of equipment		20	years			
Estimated maintenance/replacement cost	$	0.22	million/year			

O&M Costs

Year	Flow pumped by year		No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 3.37
2016	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 3.21
2017	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 3.06
2018	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 2.91
2019	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 2.77
2020	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 2.64
2021	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 2.51
2022	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 2.39
2023	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 2.28
2024	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 2.17
2025	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 2.07
2026	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 1.97
2027	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 1.88
2028	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 1.79
2029	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 1.70
2030	95,402	85	3.94	151,577	$ 10,610	$ 3.87	$ 0.22	$ 0.180	$ 4.28	$ 2.06
2031	95,402	85	3.94	151,577	$ 10,610	$ 3.87	$ 0.22	$ 0.180	$ 4.28	$ 1.96
2032	95,402	85	3.94	151,577	$ 10,610	$ 3.87	$ 0.22	$ 0.180	$ 4.28	$ 1.87
2033	95,402	85	3.94	151,577	$ 10,610	$ 3.87	$ 0.22	$ 0.180	$ 4.28	$ 1.78
2034	95,402	85	3.94	151,577	$ 10,610	$ 3.87	$ 0.22	$ 0.180	$ 4.28	$ 1.69
2035	95,402	85	3.94	151,577	$ 10,610	$ 3.87	$ 0.22	$ 0.180	$ 4.28	$ 1.61
2036	95,402	85	3.94	151,577	$ 10,610	$ 3.87	$ 0.22	$ 0.180	$ 4.28	$ 1.54
2037	95,402	85	3.94	151,577	$ 10,610	$ 3.87	$ 0.22	$ 0.180	$ 4.28	$ 1.46
2038	95,402	85	3.94	151,577	$ 10,610	$ 3.87	$ 0.22	$ 0.180	$ 4.28	$ 1.39
2039	95,402	85	3.94	151,577	$ 10,610	$ 3.87	$ 0.22	$ 0.180	$ 4.28	$ 1.33
2040	106,603	95	4.41	169,373	$ 11,856	$ 4.33	$ 0.22	$ 0.180	$ 4.73	$ 1.40
2041	106,603	95	4.41	169,373	$ 11,856	$ 4.33	$ 0.22	$ 0.180	$ 4.73	$ 1.33
2042	106,603	95	4.41	169,373	$ 11,856	$ 4.33	$ 0.22	$ 0.180	$ 4.73	$ 1.27
2043	106,603	95	4.41	169,373	$ 11,856	$ 4.33	$ 0.22	$ 0.180	$ 4.73	$ 1.21
2044	106,603	95	4.41	169,373	$ 11,856	$ 4.33	$ 0.22	$ 0.180	$ 4.73	$ 1.15
2045	106,603	95	4.41	169,373	$ 11,856	$ 4.33	$ 0.22	$ 0.180	$ 4.73	$ 1.09
2046	106,603	95	4.41	169,373	$ 11,856	$ 4.33	$ 0.22	$ 0.180	$ 4.73	$ 1.04
2047	106,603	95	4.41	169,373	$ 11,856	$ 4.33	$ 0.22	$ 0.180	$ 4.73	$ 0.99
2048	106,603	95	4.41	169,373	$ 11,856	$ 4.33	$ 0.22	$ 0.180	$ 4.73	$ 0.95
2049	106,603	95	4.41	169,373	$ 11,856	$ 4.33	$ 0.22	$ 0.180	$ 4.73	$ 0.90
2050	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.94
2051	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.90
2052	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.85
2053	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.81
2054	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.77
2055	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.74
2056	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.70
2057	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.67
2058	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.64
2059	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.61
2060	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.58
2061	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.55
2062	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.52
2063	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.50
2064	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.47
2065	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.45
								Total NPV of O&M Costs		$ 75.4

Capital Costs in million $:		Yr built		
RWTM	$ 152.5	2015		$ 152.5
Pumping Stations	$ 15.5	2015		$ 15.5
			Total NPV of Capital Costs	$ 168.0

Total NPV of Capital and O&M Costs in millions $ 243.4

O&M Cost Calculations
WTP and Raw Water Storage Reservoir at WTP
CTRWTP - Alternate 2A - WTP East of San Marcos

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition =	$ 25,000	per acre

Treated Water Production by Treatment Type (from Demand Chart)

	Year =	2015	2020	2030	2040	2050	2060	2065
Softened water demand:	Units							
Average yearly demands:								
City of Austin	ac-ft/yr	0	0	16802	22403	33604	33604	33604
LCRA	ac-ft/yr	0	0	5600	11200	11200	11200	11200
Totals	ac-ft/yr	0	0	22402	33603	44804	44804	44804
Totals	mgd	0	0	20	30	40	40	40
Max day demands:								
City of Austin	mgd	0	0	25	35	50	50	50
LCRA	mgd	0	0	10	20	20	20	20
Totals	mgd	0	0	35	55	70	70	70

	Year =	2015	2020	2030	2040	2050	2060	2065
Non-softened water demands:	Units							
Average yearly demands:								
SAWS	ac-ft/yr	73000	205000	205000	205000	205000	205000	205000
SARA	ac-ft/yr	20550	23406	28433	31393	34411	37530	41128
GBRA	ac-ft/yr	0	0	6000	8000	10000	12300	12300
Totals		93550	228406	239433	244393	249411	254830	258428
Totals	mgd	84	204	214	218	223	227	231
Max day demands:								
SAWS	mgd	85	238	238	238	238	238	238
SARA	mgd	24	27	33	36	40	44	48
GBRA	mgd	0	0	5	7	9	11	11
Totals	mgd	109	265	276	281	287	293	297
Total: softened and non-softened water demands								
Average yearly demand	ac-ft/yr	93550	228406	261835	277996	294215	299634	303232
	mgd	84	204	234	248	263	267	271
Max day demand	mgd	109	265	311	336	357	363	367

Raw Water Reservoir

Sizing for ultimate conditions:

Assumed number of days of consecutive Max Day demands	30	days	
Design (Max. Day) treated water production req'd in mgd	367	mgd	
Average treated water production in mgd	271	mgd	(which is also equal to sum of ground and raw water that can be pumped to the WTP)
Difference (shortfall of raw water)	96	mgd	
Required storage reservoir for raw water	2,889	mg	
	8,868	ac-ft	
Add safety factor 25%	2,217	ac-ft	
Total storage required	11,084	ac-ft	
Total storage recommended	12,000	ac-ft	

Note: No. of days at average day demand (for example, for repair of RWTM A) = 33 days

	Quantity	Units	Volume/each (acre-feet)	Unit Cost ($/ac-ft))	Total Construction Cost	Contigency, Eng., etc.	Total Capital Cost
Reservoirs	1	each	12,000	$ 1,283	$ 15.4	$ 5.9	$ 21.3

Estimated average depth of reservoir	25	ft	
Surface area of reservoir	480	acres	
Ratio of total land area reqd to surface area of reservoir	1.10		
Total land area reqd for reservoirs	528	acres	
		Envir & Archaeology, Surv, and Land Acq =	13.2
		Total capital cost in millions =	$ 34.5
Assumed life of reservoir	100	years	

Estimated replacement cost	$ 0.15	million/year	
Estimated maintenance	$ 0.04	million/year	Mowing, maintaining fences, etc.
Total	$ 0.19	million/year	
Year built	2015		
NPV of O&M costs	$ 3.5	million	
NPV of Capital costs	$ 34.5	million	
Total NPV of Capital and O&M Costs	$ 38.0	million	

WTP

Plant Phasing and Capital Costs:

Softening Treatment Trains

Year =	2015	2020	2030	2040	2050	2060	2065
Average treated water production in mgd	0	0	20	30	40	40	40
Design (Max. Day) treated water production req'd in mgd	0	0	35	55	70	70	70
Initial/additional Max day capacity built (mgd)			50	20			
Total capacity on line (must exceed Design Max Day Req'd)	0	0	50	70	70	70	70
Unit cost for max day treatment capacity ($/gpd of capacity)			$ 1.78	$ 2.14			
Estimated construction cost of expansion in $millions	$ -	$ -	$ 89.0	$ 42.8	$ -	$ -	$ -

Non-softening Treatment Trains

Year =	2015	2020	2030	2040	2050	2060	2065
Average treated water production in mgd	84	204	214	218	223	227	231
Design (Max. Day) treated water production req'd in mgd	109	265	276	281	287	293	297
Additional Max day capacity built (mgd)	200	100					
Total capacity on line (must exceed Design Max Day Req'd)	200	300	300	300	300	300	300
Unit cost for max day treatment capacity ($/gpd of capacity)	$ 1.15	$ 1.32					
Estimated construction cost of expansion in $millions	$ 229.6	$ 131.5	$ -	$ -	$ -	$ -	$ -

Totals (Softening + Non-softening Trains)

Year =	2015	2020	2030	2040	2050	2060	2065
Total construction cost for both trains	$ 229.6	$ 131.5	$ 89.0	$ 42.8	$ -	$ -	$ -
Contingencies	45.9	26.3	17.8	8.6	-	-	-
Subtotal	$ 275.5	$ 157.8	$ 106.8	$ 51.3	$ -	$ -	$ -
Engineering, Legal, & Administrative	41.3	23.7	16.0	7.7	-	-	-
Subtotal	316.8	181.5	122.8	59.0	-	-	-
Environmental & Archaelogy Studies and Mitigation & Land Acquisition and Surveying (see Note below)	2.5						
Total estimated capital cost	$ 319.3	$ 181.5	$ 122.8	$ 59.0	$ -	$ -	$ -
NPV of capital cost	$ 319.3	$ 142.2	$ 59.1	$ 17.4	$ -	$ -	$ -

Total NPV of WTP initial construction & expansions $ 538

Note: Assumed land requirement for WTP (not including reserv 100 acres

O&M Costs for Softening Trains:

Year	Plant Capacity in service	Estimated treated water production	Estimated O&M cost from unit cost curve		Net present value
	mgd of capacity	mgd produced	$ per mg treated	$million /year	($)
2015	-	-		$ -	$ -
2016	-	-		$ -	$ -
2017	-	-		$ -	$ -
2018	-	-		$ -	$ -
2019	-	-		$ -	$ -
2020	-	-		$ -	$ -
2021	-	-		$ -	$ -
2022	-	-		$ -	$ -
2023	-	-		$ -	$ -
2024	-	-		$ -	$ -
2025	-	-		$ -	$ -
2026	-	-		$ -	$ -
2027	-	-		$ -	$ -
2028	-	-		$ -	$ -
2029	-	-		$ -	$ -
2030	50	20	$ 712	$ 5.20	$ 2.50
2031	50	20	$ 712	$ 5.20	$ 2.38
2032	50	20	$ 712	$ 5.20	$ 2.27
2033	50	20	$ 712	$ 5.20	$ 2.16
2034	50	20	$ 712	$ 5.20	$ 2.06
2035	50	20	$ 712	$ 5.20	$ 1.96
2036	50	20	$ 712	$ 5.20	$ 1.87
2037	50	20	$ 712	$ 5.20	$ 1.78
2038	50	20	$ 712	$ 5.20	$ 1.69
2039	50	20	$ 712	$ 5.20	$ 1.61
2040	70	30	$ 661	$ 7.24	$ 2.14
2041	70	30	$ 661	$ 7.24	$ 2.04
2042	70	30	$ 661	$ 7.24	$ 1.94
2043	70	30	$ 661	$ 7.24	$ 1.85
2044	70	30	$ 661	$ 7.24	$ 1.76
2045	70	30	$ 661	$ 7.24	$ 1.68
2046	70	30	$ 661	$ 7.24	$ 1.60
2047	70	30	$ 661	$ 7.24	$ 1.52
2048	70	30	$ 661	$ 7.24	$ 1.45
2049	70	30	$ 661	$ 7.24	$ 1.38
2050	70	40	$ 661	$ 9.65	$ 1.75
2051	70	40	$ 661	$ 9.65	$ 1.67
2052	70	40	$ 661	$ 9.65	$ 1.59
2053	70	40	$ 661	$ 9.65	$ 1.51
2054	70	40	$ 661	$ 9.65	$ 1.44
2055	70	40	$ 661	$ 9.65	$ 1.37
2056	70	40	$ 661	$ 9.65	$ 1.31
2057	70	40	$ 661	$ 9.65	$ 1.24
2058	70	40	$ 661	$ 9.65	$ 1.18
2059	70	40	$ 661	$ 9.65	$ 1.13
2060	70	40	$ 661	$ 9.65	$ 1.07
2061	70	40	$ 661	$ 9.65	$ 1.02
2062	70	40	$ 661	$ 9.65	$ 0.97
2063	70	40	$ 661	$ 9.65	$ 0.93
2064	70	40	$ 661	$ 9.65	$ 0.88
2065	70	40	$ 661	$ 9.65	$ 0.84
			Total NPV of O&M Costs		$ 58

O&M Costs for Non-Softening Trains:

Year	Plant Capacity in service	Estimated treated water production	Estimated O&M cost from unit cost curve		Net present value
	mgd of capacity	mgd produced	$ per mg treated	$million /year	($)
2015	200	84	$ 374	$ 11.41	$ 11.41
2016	200	84	$ 374	$ 11.41	$ 10.87
2017	200	84	$ 374	$ 11.41	$ 10.35
2018	200	84	$ 374	$ 11.41	$ 9.86
2019	200	84	$ 374	$ 11.41	$ 9.39
2020	300	204	$ 343	$ 25.50	$ 19.98
2021	300	204	$ 343	$ 25.50	$ 19.03
2022	300	204	$ 343	$ 25.50	$ 18.12
2023	300	204	$ 343	$ 25.50	$ 17.26
2024	300	204	$ 343	$ 25.50	$ 16.44
2025	300	204	$ 343	$ 25.50	$ 15.65
2026	300	204	$ 343	$ 25.50	$ 14.91
2027	300	204	$ 343	$ 25.50	$ 14.20
2028	300	204	$ 343	$ 25.50	$ 13.52
2029	300	204	$ 343	$ 25.50	$ 12.88
2030	300	214	$ 343	$ 26.73	$ 12.86
2031	300	214	$ 343	$ 26.73	$ 12.24
2032	300	214	$ 343	$ 26.73	$ 11.66
2033	300	214	$ 343	$ 26.73	$ 11.11
2034	300	214	$ 343	$ 26.73	$ 10.58
2035	300	214	$ 343	$ 26.73	$ 10.07
2036	300	214	$ 343	$ 26.73	$ 9.59
2037	300	214	$ 343	$ 26.73	$ 9.14
2038	300	214	$ 343	$ 26.73	$ 8.70
2039	300	214	$ 343	$ 26.73	$ 8.29
2040	300	218	$ 343	$ 27.28	$ 8.06
2041	300	218	$ 343	$ 27.28	$ 7.67
2042	300	218	$ 343	$ 27.28	$ 7.31
2043	300	218	$ 343	$ 27.28	$ 6.96
2044	300	218	$ 343	$ 27.28	$ 6.63
2045	300	218	$ 343	$ 27.28	$ 6.31
2046	300	218	$ 343	$ 27.28	$ 6.01
2047	300	218	$ 343	$ 27.28	$ 5.73
2048	300	218	$ 343	$ 27.28	$ 5.45
2049	300	218	$ 343	$ 27.28	$ 5.19
2050	300	223	$ 343	$ 27.84	$ 5.05
2051	300	223	$ 343	$ 27.84	$ 4.81
2052	300	223	$ 343	$ 27.84	$ 4.58
2053	300	223	$ 343	$ 27.84	$ 4.36
2054	300	223	$ 343	$ 27.84	$ 4.15
2055	300	223	$ 343	$ 27.84	$ 3.95
2056	300	223	$ 343	$ 27.84	$ 3.77
2057	300	223	$ 343	$ 27.84	$ 3.59
2058	300	223	$ 343	$ 27.84	$ 3.42
2059	300	223	$ 343	$ 27.84	$ 3.25
2060	300	227	$ 343	$ 28.45	$ 3.17
2061	300	227	$ 343	$ 28.45	$ 3.02
2062	300	227	$ 343	$ 28.45	$ 2.87
2063	300	227	$ 343	$ 28.45	$ 2.74
2064	300	227	$ 343	$ 28.45	$ 2.60
2065	300	231	$ 343	$ 28.85	$ 2.52
				Total NPV of O&M Costs	$ 441

NPV Totals for O&M:

Softening trains	$ 58
Non-softening Trains	$ 441
	$ 499

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Raw Water Reservoir	**$ 34**	**$ 3.5**	**$ 38**
Water Treatment Plant	**$ 538**	**$ 499**	**$ 1,037**
Totals	**$ 572**	**$ 502**	**$ 1,075**

CTRWTP - Alternate 2A - WTP East of San Marcos
Potable Water Transmission Mains
CTRWTP - Alternate 2 - WTP Midway Between Austin & San Antonio

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

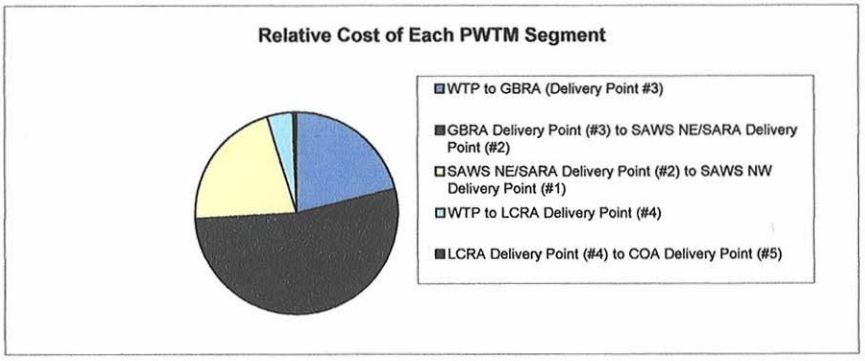
Summary of Demands

Average demands to be delivered in each segment in acre-feet/year

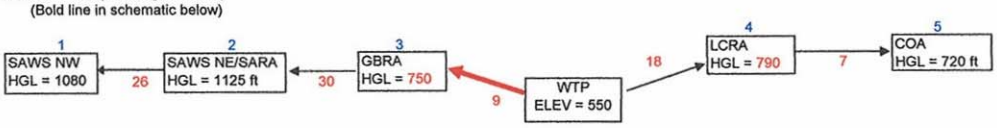
Year	2015	2020	2030	2040	2050	2060	2065
SAWS NW	43800	123000	123000	123000	123000	123000	123000
SAWS NE	29200	82000	82000	82000	82000	82000	82000
Subtotal	73000	205000	205000	205000	205000	205000	205000
SARA	20550	23406	28433	31393	34411	37530	41128
GBRA			6000	8000	10000	12300	12300
LCRA			5600	11200	11200	11200	11200
COA			16802	22403	33604	33604	33604
Total	93550	228406	261835	277996	294215	299634	303232

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
WTP to GBRA (Delivery Point #3)	$ 80	$ 132	$ 212
GBRA Delivery Point (#3) to SAWS NE/SARA Delivery Point (#2)	$ 263	$ 268	$ 532
SAWS NE/SARA Delivery Point (#2) to SAWS NW Delivery Point (#1)	$ 207	$ 5	$ 211
WTP to LCRA Delivery Point (#4)	$ 29	$ 13	$ 42
LCRA Delivery Point (#4) to COA Delivery Point (#5)	$ 6	$ 1	$ 7
Total for PWTMs	$ 585	$ 419	$ 1,004



WTP to GBRA (Delivery Point #3)
(Bold line in schematic below)



Demands for this pipe segment

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
GBRA	0	0	5	7	9	11	11	2.0
SAWS NE	26	73	73	73	73	73	73	1.3
SARA	18	21	25	28	31	34	37	1.3
SAWS NW	39	110	110	110	110	110	110	1.3
Total	84	204	214	218	223	227	231	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
GBRA	0	0	11	14	18	22	22
SAWS NE	34	95	95	95	95	95	95
SARA	24	27	33	36	40	44	48
SAWS NW	51	143	143	143	143	143	143
Total	109	265	282	289	296	303	308

PWTM and Pump Station Costs

Design flow rate - year 2065	308	mgd	
	213,603	gpm	
Pumping capacity of one pump	22,000	gpm	
No. of pumps (not counting spare)	10		
Peak flow rate (all pumps except spare)	220,000	gpm	
Inside diameter of PWTM	120	in.	
Area	78.54	sf	
Length of PWTM	9	miles	(linked to mileage in schematic above)
	47,520	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	100%	47,520	$ 783	$ 37.2	million
Rural - rock	0%	-	$ 1,048	$ -	
Urban - rock	0%	-	$ 1,186	$ -	
		47,520		$ 37.2	million

Average estimated unit construction cost for PWTM	$ 783	per LF	
Total construction cost in millions	$ 37.2		
Contingencies	$ 7.4		
Subtotal	$ 44.6		
Engineering, Legal & Administrative	$ 6.7		
Subtotal	$ 51.3		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 0.9		
Total Capital Cost for PWTM in millions	$ 52.2		
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.090 Million $/year
Velocity at peak flow rate	6.24	fps	
C factor	120		
Head loss per foot	0.00087	ft/ft	$h_f = \frac{3.552 * Q^{1.85}}{C^{*}(d)^{2.63}}$
	4.59	ft/mile	
Head loss at peak flow rate	41	ft	
Allowance for minor losses 20%	8	ft	750 Desired HGL At Delivery Point
Total estimated losses	50	ft	550 Elev. At WTP
Average static head	200	ft	200 ft
Total estimated dynamic head	250	ft	
	108	psi	
No of recommended pumping stations along route	0.72		150 psi (assumed max pressure
No. of pumping stations used in cost estimate	1		in pipe)
Average head per pump station	250	ft	
Assumed pump efficiency	85%		
Assumed motor efficiency	90%		
Estimated Hp required per pump	1,812	hp/pump	
	1,352	kw/pump	
Total hp per pump station (not counting spare)	18,124	firm hp/station	
Total kw per pump set (set=pumps in series along route)	1,812	kw/pump set	(one pump at each station)
Unit capital cost for each pump station (from cost curve)	$ 1,111	per firm hp of pump station	
Construction cost per pump station	20.1	million	
Total construction cost for pump stations	20.1		for 1 pump stations
Contingencies	$ 4.0		
Subtotal	$ 24.2		

Engineering, Legal & Administrative	$ 3.6	
Total capital cost for pump stations	$ 27.8	million

40% Estimated equipment cost as % of total

Value of equipment	$ 8	million
Assumed life of equipment	20	years
Estimated maintenance/replacement cost	$ 0.40	million/year

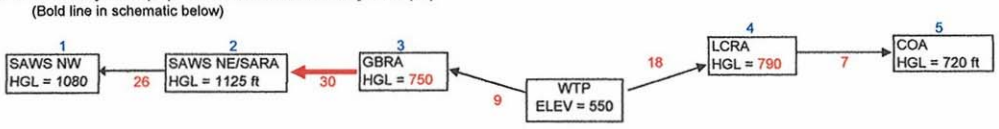
O&M Costs

Year	Flow pumped by year (average flows from Table above)	No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - PWTM	Total O&M cost	Net present value
	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	84	2.64	114,661	$ 8,026	$ 2.93	$ 0.40	$ 0.090	$ 3.42	$ 3.42
2016	84	2.64	114,661	$ 8,026	$ 2.93	$ 0.40	$ 0.090	$ 3.42	$ 3.26
2017	84	2.64	114,661	$ 8,026	$ 2.93	$ 0.40	$ 0.090	$ 3.42	$ 3.10
2018	84	2.64	114,661	$ 8,026	$ 2.93	$ 0.40	$ 0.090	$ 3.42	$ 2.96
2019	84	2.64	114,661	$ 8,026	$ 2.93	$ 0.40	$ 0.090	$ 3.42	$ 2.82
2020	204	6.44	279,949	$ 19,596	$ 7.15	$ 0.40	$ 0.090	$ 7.65	$ 5.99
2021	204	6.44	279,949	$ 19,596	$ 7.15	$ 0.40	$ 0.090	$ 7.65	$ 5.71
2022	204	6.44	279,949	$ 19,596	$ 7.15	$ 0.40	$ 0.090	$ 7.65	$ 5.43
2023	204	6.44	279,949	$ 19,596	$ 7.15	$ 0.40	$ 0.090	$ 7.65	$ 5.17
2024	204	6.44	279,949	$ 19,596	$ 7.15	$ 0.40	$ 0.090	$ 7.65	$ 4.93
2025	204	6.44	279,949	$ 19,596	$ 7.15	$ 0.40	$ 0.090	$ 7.65	$ 4.69
2026	204	6.44	279,949	$ 19,596	$ 7.15	$ 0.40	$ 0.090	$ 7.65	$ 4.47
2027	204	6.44	279,949	$ 19,596	$ 7.15	$ 0.40	$ 0.090	$ 7.65	$ 4.26
2028	204	6.44	279,949	$ 19,596	$ 7.15	$ 0.40	$ 0.090	$ 7.65	$ 4.05
2029	204	6.44	279,949	$ 19,596	$ 7.15	$ 0.40	$ 0.090	$ 7.65	$ 3.86
2030	214	6.75	293,465	$ 20,543	$ 7.50	$ 0.40	$ 0.090	$ 7.99	$ 3.84
2031	214	6.75	293,465	$ 20,543	$ 7.50	$ 0.40	$ 0.090	$ 7.99	$ 3.66
2032	214	6.75	293,465	$ 20,543	$ 7.50	$ 0.40	$ 0.090	$ 7.99	$ 3.49
2033	214	6.75	293,465	$ 20,543	$ 7.50	$ 0.40	$ 0.090	$ 7.99	$ 3.32
2034	214	6.75	293,465	$ 20,543	$ 7.50	$ 0.40	$ 0.090	$ 7.99	$ 3.16
2035	214	6.75	293,465	$ 20,543	$ 7.50	$ 0.40	$ 0.090	$ 7.99	$ 3.01
2036	214	6.75	293,465	$ 20,543	$ 7.50	$ 0.40	$ 0.090	$ 7.99	$ 2.87
2037	214	6.75	293,465	$ 20,543	$ 7.50	$ 0.40	$ 0.090	$ 7.99	$ 2.73
2038	214	6.75	293,465	$ 20,543	$ 7.50	$ 0.40	$ 0.090	$ 7.99	$ 2.60
2039	214	6.75	293,465	$ 20,543	$ 7.50	$ 0.40	$ 0.090	$ 7.99	$ 2.48
2040	218	6.89	299,544	$ 20,968	$ 7.65	$ 0.40	$ 0.090	$ 8.15	$ 2.41
2041	218	6.89	299,544	$ 20,968	$ 7.65	$ 0.40	$ 0.090	$ 8.15	$ 2.29
2042	218	6.89	299,544	$ 20,968	$ 7.65	$ 0.40	$ 0.090	$ 8.15	$ 2.18
2043	218	6.89	299,544	$ 20,968	$ 7.65	$ 0.40	$ 0.090	$ 8.15	$ 2.08
2044	218	6.89	299,544	$ 20,968	$ 7.65	$ 0.40	$ 0.090	$ 8.15	$ 1.98
2045	218	6.89	299,544	$ 20,968	$ 7.65	$ 0.40	$ 0.090	$ 8.15	$ 1.88
2046	218	6.89	299,544	$ 20,968	$ 7.65	$ 0.40	$ 0.090	$ 8.15	$ 1.80
2047	218	6.89	299,544	$ 20,968	$ 7.65	$ 0.40	$ 0.090	$ 8.15	$ 1.71
2048	218	6.89	299,544	$ 20,968	$ 7.65	$ 0.40	$ 0.090	$ 8.15	$ 1.63
2049	218	6.89	299,544	$ 20,968	$ 7.65	$ 0.40	$ 0.090	$ 8.15	$ 1.55
2050	223	7.03	305,694	$ 21,399	$ 7.81	$ 0.40	$ 0.090	$ 8.30	$ 1.51
2051	223	7.03	305,694	$ 21,399	$ 7.81	$ 0.40	$ 0.090	$ 8.30	$ 1.43
2052	223	7.03	305,694	$ 21,399	$ 7.81	$ 0.40	$ 0.090	$ 8.30	$ 1.37
2053	223	7.03	305,694	$ 21,399	$ 7.81	$ 0.40	$ 0.090	$ 8.30	$ 1.30
2054	223	7.03	305,694	$ 21,399	$ 7.81	$ 0.40	$ 0.090	$ 8.30	$ 1.24
2055	223	7.03	305,694	$ 21,399	$ 7.81	$ 0.40	$ 0.090	$ 8.30	$ 1.18
2056	223	7.03	305,694	$ 21,399	$ 7.81	$ 0.40	$ 0.090	$ 8.30	$ 1.12
2057	223	7.03	305,694	$ 21,399	$ 7.81	$ 0.40	$ 0.090	$ 8.30	$ 1.07
2058	223	7.03	305,694	$ 21,399	$ 7.81	$ 0.40	$ 0.090	$ 8.30	$ 1.02
2059	223	7.03	305,694	$ 21,399	$ 7.81	$ 0.40	$ 0.090	$ 8.30	$ 0.97
2060	227	7.18	312,336	$ 21,864	$ 7.98	$ 0.40	$ 0.090	$ 8.47	$ 0.94
2061	227	7.18	312,336	$ 21,864	$ 7.98	$ 0.40	$ 0.090	$ 8.47	$ 0.90
2062	227	7.18	312,336	$ 21,864	$ 7.98	$ 0.40	$ 0.090	$ 8.47	$ 0.86
2063	227	7.18	312,336	$ 21,864	$ 7.98	$ 0.40	$ 0.090	$ 8.47	$ 0.81
2064	227	7.18	312,336	$ 21,864	$ 7.98	$ 0.40	$ 0.090	$ 8.47	$ 0.78
2065	231	7.28	316,746	$ 22,172	$ 8.09	$ 0.40	$ 0.090	$ 8.59	$ 0.75
								Total NPV of O&M Costs	$ 132

Capital Costs in million $:		Yr built		
PWTM	$ 52	2015		$ 52
Pumping Stations	$ 28	2015		$ 28
			Total NPV of Capital Costs	$ 80

Total NPV of Capital and O&M Costs in millions $ 212
WTP to GBRA (Delivery Point #3)

GBRA Delivery Point (#3) to SAWS NE/SARA Delivery Point (#2)
(Bold line in schematic below)



Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
SAWS NE	26	73	73	73	73	73	73	1.3
SARA	18	21	25	28	31	34	37	1.3
SAWS NW	39	110	110	110	110	110	110	1.3
Total	84	204	208	211	214	217	220	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
SAWS NE	34	95	95	95	95	95	95
SARA	24	27	33	36	40	44	48
SAWS NW	51	143	143	143	143	143	143
Total	109	265	271	274	278	281	286

PWTM and Pump Station Costs

Design flow rate - year 2065	286	mgd	
	198,353	gpm	
Pumping capacity of one pump	20,000	gpm	
No. of pumps (not counting spare)	10		
Peak flow rate (all pumps except spare)	200,000	gpm	
Inside diameter of PWTM	120	in.	
Area	78.54	sf	
Length of PWTM	30	miles	(linked to mileage in schematic above)
	158,400	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	50%	79,200	$ 783	$ 62.0	million
Rural - rock	25%	39,600	$ 1,048	$ 41.5	
Urban - rock	25%	39,600	$ 1,186	$ 46.9	
		158,400		$ 150.5	million

Average estimated unit construction cost for PWTM	$ 950	per LF	
Total construction cost in millions	$ 150.5		
Contingencies	$ 30.1		
Subtotal	$ 180.6		
Engineering, Legal & Administrative	$ 27.1		
Subtotal	$ 207.6		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 3.0		
Total Capital Cost for PWTM in millions	$ 210.6		
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.300 Million $/year
Velocity at peak flow rate	5.67	fps	
C factor	120		
Head loss per foot	0.00073	ft/ft	$h_f = \frac{3.552*Q^{1.85}}{C^{*}(d)^{2.63}}$
	3.85	ft/mile	
Head loss at peak flow rate	115	ft	
Allowance for minor losses 20%	23	ft	1125 Desired HGL At Delivery Point
Total estimated losses	139	ft	750 HGL At Delivery Point 3
Average static head	375	ft	375 ft
Total estimated dynamic head	514	ft	
	223	psi	
No of recommended pumping stations along route	1.48		150 psi (assumed max pressure
No. of pumping stations used in cost estimate	2		in pipe)
Average head per pump station	257	ft	
Assumed pump efficiency	85%		
Assumed motor efficiency	90%		
Estimated Hp required per pump	1,695	hp/pump	
	1,265	kw/pump	
Total hp per pump station (not counting spare)	16,951	firm hp/station	
Total kw per pump set (set=pumps in series along route)	3,390	kw/pump set	(one pump at each station)
Unit construction cost for each pump station (from cost curve)	$ 1,127	per firm hp of pump station	
Construction cost per pump station	19.1	million	
Total construction cost for pump stations	38.2		for 2 pump stations
Contingencies	$ 7.6		
Subtotal	$ 45.9		

Engineering, Legal & Administrative	$	6.9	
Total capital cost for pump stations in millions	$	52.7	million
			40% Equip cost as % of constr cost
Value of equipment	$	15	million
Assumed life of equipment		20	years
Estimated maintenance/replacement cost	$	0.76	million/year

O&M Costs

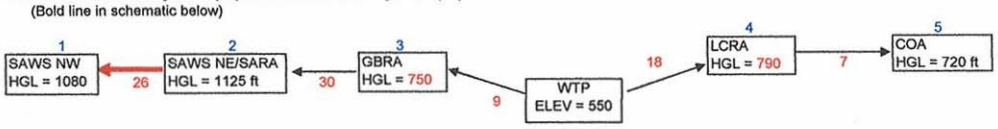
Year	Flow pumped by year (average flows from Table above)	No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - PWTM	Total O&M cost	Net present value
	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	84	2.90	235,928	$ 16,515	$ 6.03	$ 0.76	$ 0.300	$ 7.09	$ 7.09
2016	84	2.90	235,928	$ 16,515	$ 6.03	$ 0.76	$ 0.300	$ 7.09	$ 6.75
2017	84	2.90	235,928	$ 16,515	$ 6.03	$ 0.76	$ 0.300	$ 7.09	$ 6.43
2018	84	2.90	235,928	$ 16,515	$ 6.03	$ 0.76	$ 0.300	$ 7.09	$ 6.13
2019	84	2.90	235,928	$ 16,515	$ 6.03	$ 0.76	$ 0.300	$ 7.09	$ 5.83
2020	204	7.08	576,028	$ 40,322	$ 14.72	$ 0.76	$ 0.300	$ 15.78	$ 12.37
2021	204	7.08	576,028	$ 40,322	$ 14.72	$ 0.76	$ 0.300	$ 15.78	$ 11.78
2022	204	7.08	576,028	$ 40,322	$ 14.72	$ 0.76	$ 0.300	$ 15.78	$ 11.22
2023	204	7.08	576,028	$ 40,322	$ 14.72	$ 0.76	$ 0.300	$ 15.78	$ 10.68
2024	204	7.08	576,028	$ 40,322	$ 14.72	$ 0.76	$ 0.300	$ 15.78	$ 10.17
2025	204	7.08	576,028	$ 40,322	$ 14.72	$ 0.76	$ 0.300	$ 15.78	$ 9.69
2026	204	7.08	576,028	$ 40,322	$ 14.72	$ 0.76	$ 0.300	$ 15.78	$ 9.23
2027	204	7.08	576,028	$ 40,322	$ 14.72	$ 0.76	$ 0.300	$ 15.78	$ 8.79
2028	204	7.08	576,028	$ 40,322	$ 14.72	$ 0.76	$ 0.300	$ 15.78	$ 8.37
2029	204	7.08	576,028	$ 40,322	$ 14.72	$ 0.76	$ 0.300	$ 15.78	$ 7.97
2030	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 7.75
2031	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 7.38
2032	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 7.03
2033	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 6.69
2034	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 6.37
2035	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 6.07
2036	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 5.78
2037	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 5.51
2038	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 5.24
2039	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 4.99
2040	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 4.81
2041	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 4.58
2042	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 4.36
2043	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 4.16
2044	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 3.96
2045	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 3.77
2046	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 3.59
2047	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 3.42
2048	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 3.26
2049	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 3.10
2050	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.99
2051	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.85
2052	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.71
2053	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.58
2054	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.46
2055	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.34
2056	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.23
2057	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.12
2058	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.02
2059	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 1.93
2060	217	7.52	611,648	$ 42,815	$ 15.63	$ 0.76	$ 0.300	$ 16.69	$ 1.86
2061	217	7.52	611,648	$ 42,815	$ 15.63	$ 0.76	$ 0.300	$ 16.69	$ 1.77
2062	217	7.52	611,648	$ 42,815	$ 15.63	$ 0.76	$ 0.300	$ 16.69	$ 1.69
2063	217	7.52	611,648	$ 42,815	$ 15.63	$ 0.76	$ 0.300	$ 16.69	$ 1.60
2064	217	7.52	611,648	$ 42,815	$ 15.63	$ 0.76	$ 0.300	$ 16.69	$ 1.53
2065	220	7.63	620,722	$ 43,451	$ 15.86	$ 0.76	$ 0.300	$ 16.92	$ 1.48
								Total NPV of O&M Costs	$ 268.5

Capital Costs in million $:			Yr built	
PWTM	$	210.6	2015	$ 210.6
Pumping Stations	$	52.7	2015	$ 52.7
			Total NPV of Capital Costs	$ 263.4

Total NPV of Capital and O&M Costs in millions $ 532

GBRA Delivery Point (#3) to SAWS NE/SARA Delivery Point (#2)

SAWS NE/SARA Delivery Point (#2) to SAWS NW Delivery Point (#1)
(Bold line in schematic below)



Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
SAWS NW	39	110	110	110	110	110	110	1.3
Total	39	110	110	110	110	110	110	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
SAWS NW	51	143	143	143	143	143	143
Total	51	143	143	143	143	143	143

PWTM and Pump Station Costs

Design flow rate - year 2065	143	mgd	
	99,125	gpm	
Pumping capacity of one pump	17,000	gpm	
No. of pumps (not counting spare)	6		
Peak flow rate (all pumps except spare)	102,000	gpm	
Inside diameter of PWTM	120	in.	
Area	78.54	sf	
Length of RWTM	26	miles	(linked to mileage in schematic above)
	137,280	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	15%	20,592	$ 783	$ 16.1	million
Rural - rock	35%	48,048	$ 1,048	$ 50.4	
Urban - rock	50%	68,640	$ 1,186	$ 81.4	
		137,280		$ 147.9	million

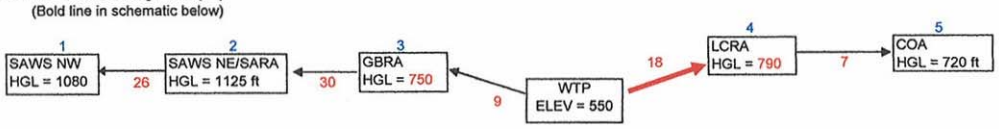
Average estimated unit construction cost for PWTM	$ 1,077	per LF	
Total construction cost in millions	$ 147.9		
Contingencies	$ 29.6		
Subtotal	$ 177.4		
Engineering, Legal & Administrative	$ 26.6		
Subtotal	$ 204.1		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 2.6		
Total Capital Cost for PWTM in millions	$ 206.7		
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.260 Million $/year
Velocity at peak flow rate	2.89	fps	
C factor	120		
Head loss per foot	0.00021	ft/ft	$h_f = \left\| \frac{3.552*Q}{C*(d)^{2.63}} \right\|^{1.85}$
	1.11	ft/mile	
Head loss at peak flow rate	29	ft	
Allowance for minor losses 20%	6	ft	1080 Desired HGL At Delivery Point
Total estimated losses	35	ft	1125 HGL At Delivery Point 2
Average static head	-45	ft	-45 ft
Total estimated dynamic head	-10	ft	
	-5	psi	

Negative indicates gravity flow from #2 to #1; no pumping necessary.

			Million $
Annual O&M Cost in million $:		Yr built	
PWTM	$ 0.260	2015	
Total NPV of O&M Costs			$4.7
Capital Costs in million $:		Yr built	
PWTM	$ 206.7	2015	$ 206.7
Total NPV of Capital Costs			$ 206.7

Total NPV of Capital and O&M Costs in millions $ 211.4
SAWS NE/SARA Delivery Point (#2) to SAWS NW Delivery Point (#1)

WTP to LCRA Delivery Point (#4)
(Bold line in schematic below)



Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
LCRA	0	0	5	10	10	10	10	2.0
COA	0	0	15	20	30	30	30	1.68
Total	0	0	20	30	40	40	40	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
LCRA	0	0	10	20	20	20	20
COA	0	0	25	34	50	50	50
Total	0	0	35	54	70	70	70

PWTM and Pump Station Costs

Design flow rate - year 2065: 70 mgd; 48,883 gpm

Pumping capacity of one pump: 10,000 gpm
No. of pumps (not counting spare): 5
Peak flow rate (all pumps except spare): 50,000 gpm

Inside diameter of PWTM: 72 in.
Area: 28.27 sf
Length of RWTM: 18 miles (linked to mileage in schematic above); 95,040 feet

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	100%	95,040	$ 365	$ 34.7	million
Rural - rock	0%	-	$ 498	$ -	
Urban - rock	0%	-	$ 552	$ -	
		95,040		$ 34.7	million

Average estimated unit construction cost for PWTM: $ 365 per LF

Total construction cost in millions	$	34.7
Contingencies	$	6.9
Subtotal	$	41.7
Engineering, Legal & Administrative	$	6.3
Subtotal	$	47.9
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$	1.8
Total Capital Cost for PWTM in millions	$	49.7

Unit maintenance cost/year-mile: $ 10,000 $/year-mile; $ 0.180 Million $/year

Velocity at peak flow rate: 3.94 fps
C factor: 120
Head loss per foot: 0.00067 ft/ft; 3.55 ft/mile

$$h_f = \left| \frac{3.552 * Q}{C * (d)^{2.63}} \right|^{1.85}$$

Head loss at peak flow rate: 64 ft
Allowance for minor losses: 20%; 13 ft
Total estimated losses: 77 ft
Average static head: 240 ft
Total estimated dynamic head: 317 ft; 137 psi

790 Desired HGL At Delivery Point
550 Elev. At WTP
240 ft

No of recommended pumping stations along route: 0.92
No. of pumping stations used in cost estimate: 1
Average head per pump station: 317 ft

150 psi (assumed max pressure in pipe)

Assumed pump efficiency: 85%
Assumed motor efficiency: 90%
Estimated Hp required per pump: 1,046 hp/pump; 780 kw/pump
Total hp per pump station (not counting spare): 5,228 firm hp/station
Total kw per pump set (set=pumps in series along route): 1,046 kw/pump set (one pump at each station)

Unit construction cost for each pump station (from cost curve): $ 1,414 per firm hp of pump station
Construction cost per pump station: 7.4 million

Total construction cost for pump stations: 7.4 for 1 pump stations

Contingencies	$	1.5
Subtotal	$	8.9
Engineering, Legal & Administrative	$	1.3
Total capital cost for pump stations	$	10.2 million

40% Equip cost as % of constr cost

Value of equipment	$	3.0	million
Assumed life of equipment		20	years
Estimated maintenance/replacement cost	$	0.15	million/year

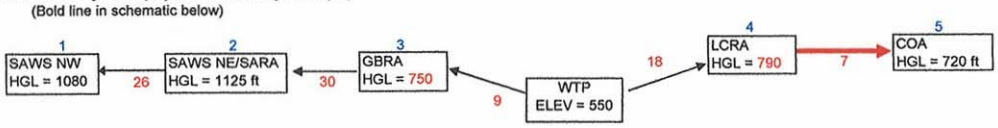
O&M Costs

Year	Flow pumped by year (average flows from Table above)	No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - PWTM	Total O&M cost	Net present value
	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015								$ -	$ -
2016								$ -	$ -
2017								$ -	$ -
2018								$ -	$ -
2019								$ -	$ -
2020								$ -	$ -
2021								$ -	$ -
2022								$ -	$ -
2023								$ -	$ -
2024								$ -	$ -
2025								$ -	$ -
2026								$ -	$ -
2027								$ -	$ -
2028								$ -	$ -
2029								$ -	$ -
2030	20	1.39	34,852	$ 2,440	$ 0.89	$ 0.15	$ 0.180	$ 1.22	$ 0.59
2031	20	1.39	34,852	$ 2,440	$ 0.89	$ 0.15	$ 0.180	$ 1.22	$ 0.56
2032	20	1.39	34,852	$ 2,440	$ 0.89	$ 0.15	$ 0.180	$ 1.22	$ 0.53
2033	20	1.39	34,852	$ 2,440	$ 0.89	$ 0.15	$ 0.180	$ 1.22	$ 0.51
2034	20	1.39	34,852	$ 2,440	$ 0.89	$ 0.15	$ 0.180	$ 1.22	$ 0.48
2035	20	1.39	34,852	$ 2,440	$ 0.89	$ 0.15	$ 0.180	$ 1.22	$ 0.46
2036	20	1.39	34,852	$ 2,440	$ 0.89	$ 0.15	$ 0.180	$ 1.22	$ 0.44
2037	20	1.39	34,852	$ 2,440	$ 0.89	$ 0.15	$ 0.180	$ 1.22	$ 0.42
2038	20	1.39	34,852	$ 2,440	$ 0.89	$ 0.15	$ 0.180	$ 1.22	$ 0.40
2039	20	1.39	34,852	$ 2,440	$ 0.89	$ 0.15	$ 0.180	$ 1.22	$ 0.38
2040	30	2.08	52,278	$ 3,659	$ 1.34	$ 0.15	$ 0.180	$ 1.66	$ 0.49
2041	30	2.08	52,278	$ 3,659	$ 1.34	$ 0.15	$ 0.180	$ 1.66	$ 0.47
2042	30	2.08	52,278	$ 3,659	$ 1.34	$ 0.15	$ 0.180	$ 1.66	$ 0.45
2043	30	2.08	52,278	$ 3,659	$ 1.34	$ 0.15	$ 0.180	$ 1.66	$ 0.42
2044	30	2.08	52,278	$ 3,659	$ 1.34	$ 0.15	$ 0.180	$ 1.66	$ 0.40
2045	30	2.08	52,278	$ 3,659	$ 1.34	$ 0.15	$ 0.180	$ 1.66	$ 0.38
2046	30	2.08	52,278	$ 3,659	$ 1.34	$ 0.15	$ 0.180	$ 1.66	$ 0.37
2047	30	2.08	52,278	$ 3,659	$ 1.34	$ 0.15	$ 0.180	$ 1.66	$ 0.35
2048	30	2.08	52,278	$ 3,659	$ 1.34	$ 0.15	$ 0.180	$ 1.66	$ 0.33
2049	30	2.08	52,278	$ 3,659	$ 1.34	$ 0.15	$ 0.180	$ 1.66	$ 0.32
2050	40	2.78	69,704	$ 4,879	$ 1.78	$ 0.15	$ 0.180	$ 2.11	$ 0.38
2051	40	2.78	69,704	$ 4,879	$ 1.78	$ 0.15	$ 0.180	$ 2.11	$ 0.36
2052	40	2.78	69,704	$ 4,879	$ 1.78	$ 0.15	$ 0.180	$ 2.11	$ 0.35
2053	40	2.78	69,704	$ 4,879	$ 1.78	$ 0.15	$ 0.180	$ 2.11	$ 0.33
2054	40	2.78	69,704	$ 4,879	$ 1.78	$ 0.15	$ 0.180	$ 2.11	$ 0.31
2055	40	2.78	69,704	$ 4,879	$ 1.78	$ 0.15	$ 0.180	$ 2.11	$ 0.30
2056	40	2.78	69,704	$ 4,879	$ 1.78	$ 0.15	$ 0.180	$ 2.11	$ 0.29
2057	40	2.78	69,704	$ 4,879	$ 1.78	$ 0.15	$ 0.180	$ 2.11	$ 0.27
2058	40	2.78	69,704	$ 4,879	$ 1.78	$ 0.15	$ 0.180	$ 2.11	$ 0.26
2059	40	2.78	69,704	$ 4,879	$ 1.78	$ 0.15	$ 0.180	$ 2.11	$ 0.25
2060	40	2.78	69,704	$ 4,879	$ 1.78	$ 0.15	$ 0.180	$ 2.11	$ 0.23
2061	40	2.78	69,704	$ 4,879	$ 1.78	$ 0.15	$ 0.180	$ 2.11	$ 0.22
2062	40	2.78	69,704	$ 4,879	$ 1.78	$ 0.15	$ 0.180	$ 2.11	$ 0.21
2063	40	2.78	69,704	$ 4,879	$ 1.78	$ 0.15	$ 0.180	$ 2.11	$ 0.20
2064	40	2.78	69,704	$ 4,879	$ 1.78	$ 0.15	$ 0.180	$ 2.11	$ 0.19
2065	40	2.78	69,704	$ 4,879	$ 1.78	$ 0.15	$ 0.180	$ 2.11	$ 0.18
							Total NPV of O&M Costs		$ 13.1

Capital Costs in million $:			Yr built		
PWTM	$	49.7	2030		$ 23.9
Pumping Stations	$	10.2	2030		$ 4.9
				Total NPV of Capital Costs	$ 28.8

Total NPV of Capital and O&M Costs in millions $ 42
WTP to LCRA Delivery Point (#4)

LCRA Delivery Point (#4) to COA Delivery Point (#5)
(Bold line in schematic below)



Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
COA	0	0	15	20	30	30	30	1.68
Total	0	0	15	20	30	30	30	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
COA	0	0	25	34	50	50	50
Total	0	0	25	34	50	50	50

PWTM and Pump Station Costs

Design flow rate - year 2065	50	mgd	
	34,997	gpm	
Inside diameter of PWTM	54	in.	
Area	15.90	sf	
Length of PWTM	7	miles	(linked to mileage in schematic above)
	36,960	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	100%	36,960	$ 244	$ 9.0	million
Rural - rock	0%	-	$ 337	$ -	
Urban - rock	0%	-	$ 369	$ -	
		36,960		$ 9.0	million

Average estimated unit construction cost for PWTM	$ 244	per LF
Total construction cost in millions	$ 9.0	
Contingencies	$ 1.8	
Subtotal	$ 10.8	
Engineering, Legal & Administrative	$ 1.6	
Subtotal	$ 12.4	
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 0.0	
Total Capital Cost for PWTM in millions	$ 12.4	

Unit maintenance cost/year-mile $ 10,000 $/year-mile $ 0.070 Million $/year

Velocity at peak flow rate	4.90	fps	
C factor	120		
Head loss per foot	0.00141	ft/ft	$h_f = \left\| \frac{3.552 * Q}{C * (d)^{2.63}} \right\|^{1.85}$
	7.45	ft/mile	

Head loss at peak flow rate	52	ft	
Allowance for minor losses 20%	10	ft	720 Desired HGL At Delivery Point
Total estimated losses	63	ft	790 Elev. At Delivery Point 4
Average static head	-70	ft	-70 ft
Total estimated dynamic head	-7	ft	
	-3	psi	

Negative indicates gravity flow from #4 to #5; no pumping necessary.

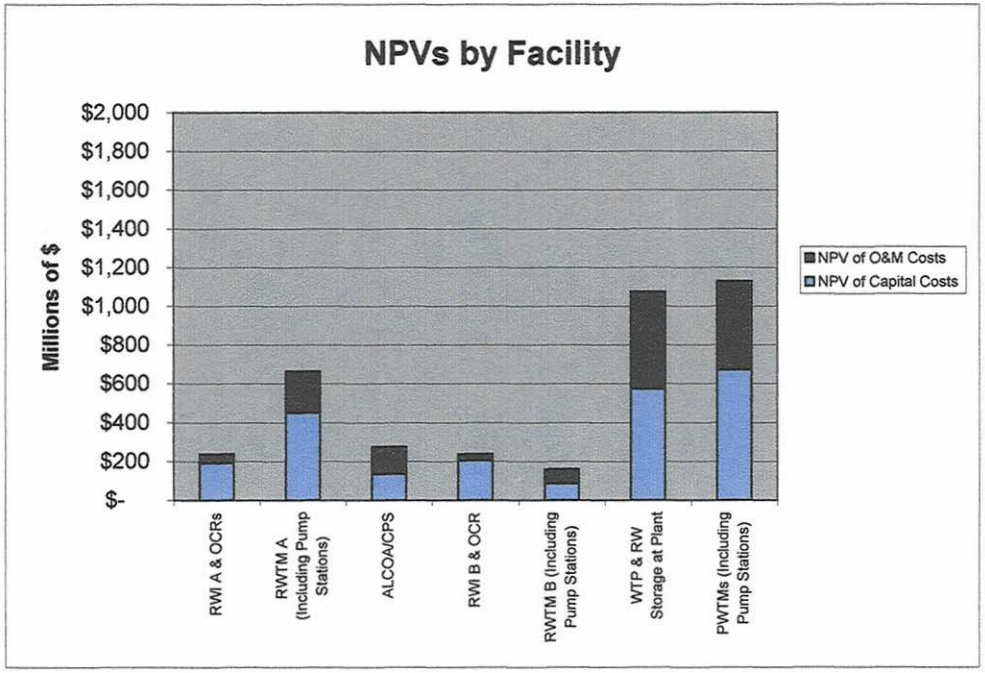
			Million $
Annual O&M Cost in million $:		Yr built	
PWTM	$ 0.070	2030	
		Total NPV of O&M Costs	$0.55
Capital Costs in million $:		Yr built	
PWTM	$ 12.4	2030	$ 5.99
		Total NPV of Capital Costs	$ 6.0

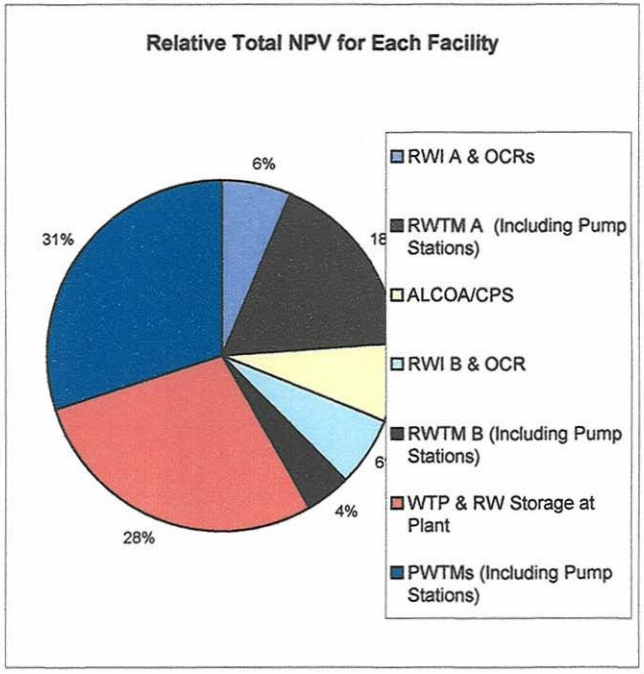
Total NPV of Capital and O&M Costs in millions $ 6.5
LCRA Delivery Point (#4) to COA Delivery Point (#5)

CTRWTP - Alternate 3A - WTP in Northern Corner of Caldwell County

WTP Location	Alter-nate	Phasing Scenario	Total NPVs in Millions of $	RWI A & OCRs	RWTM A (Including Pump Stations)	ALCOA/CPS	RWI B & OCR	RWTM B (Including Pump Stations)	WTP & RW Storage at Plant	PWTMs (Including Pump Stations)
Northern Corner of Caldwell County	3A	RWTM B & ALCOA/CPS built by 2015; RWTM A built in 2020.		Sized for 4000 cfs to scalp water; 4 intakes, 4 miles of 120-inch raw water mains & 4 OCRs at 25,000 ac-ft each	126 miles of 96-inch diameter pipe sized to deliver 132,000 ac-ft/year on a continuous basis; includes 3 pumping stations w/ balancing reservoirs along route	Non-Public wells; Transmission of 55,000 ac-ft/year to the OCR at RWI B via 15 miles of 54" gravity pipeline from Hwy 290 east of Elgin	Sized for 2000 cfs to scalp water; 2 intakes; 8 miles of 120-inch raw water mains and 4 OCRs at 15,000 ac-ft/each	Sized for 117,804 ac-ft/yr; 20 miles of 84" pipeline with one pumping station and balancing reservoir	Raw water reservoir w/ 11,000 ac-ft capacity; Conventional settling with membrane filtration for SAWS, SARA & GBRA; Lime softening with membrane filtration for COA & LCRA water	Each PWTM sized for maximum daily demand (See PWTM Summary Sheet in the Appendices)
		NPV of Capital Costs	$ 2,310	$ 191	$ 451	$ 135	$ 204	$ 86	$ 572	$ 671
		NPV of O&M Costs	$ 1,470	$ 47	$ 213	$ 141	$ 34	$ 75	$ 502	$ 458
		Total NPV of Capital & O&M	**$ 3,780**	$ 238	$ 664	$ 276	$ 238	$ 161	$ 1,075	$ 1,129

0.92





Flow Schematic
CTRWTP - Alternate 3A - WTP in Northern Corner of Caldwell County

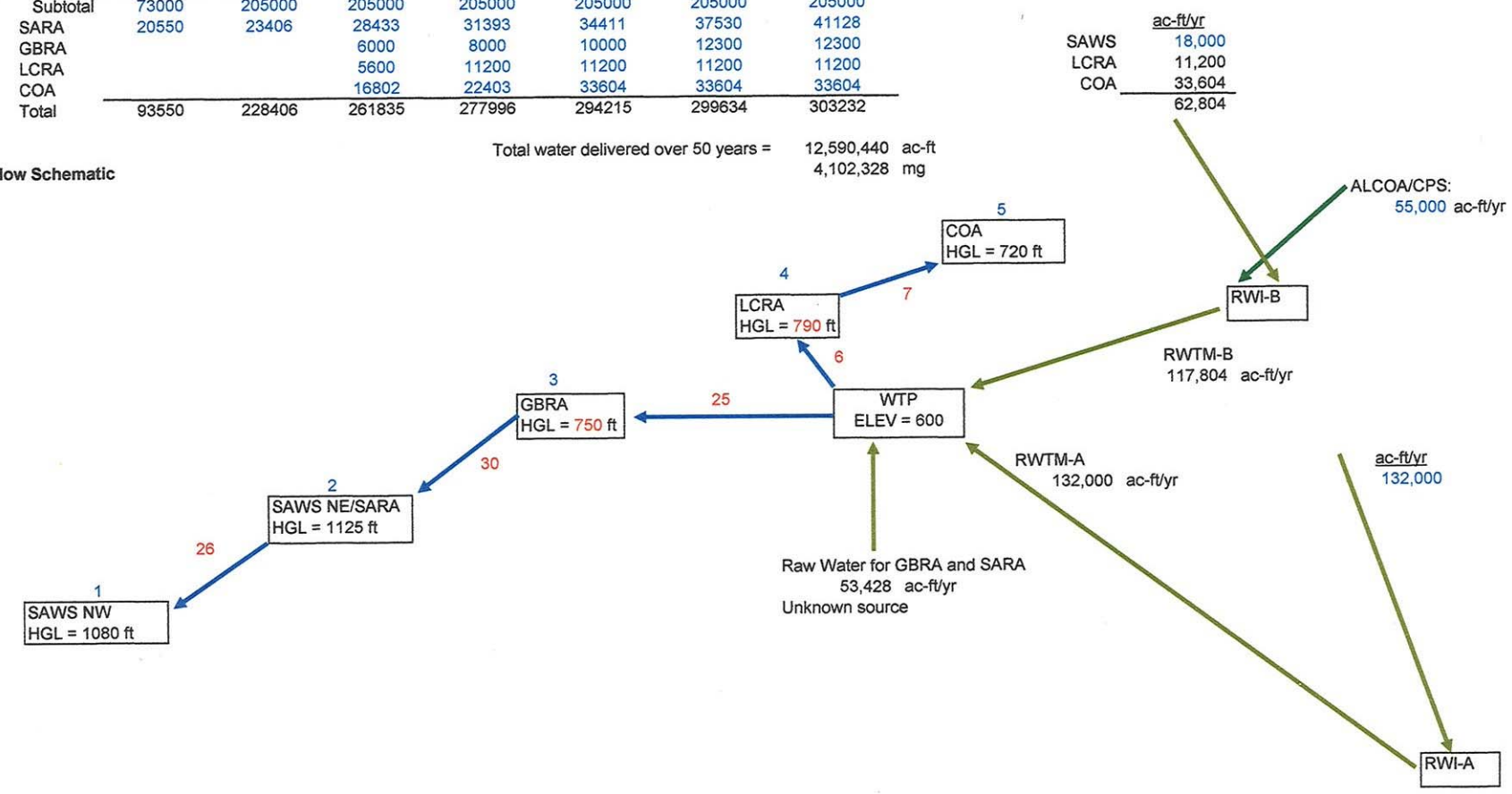
Summary of Demands

Average demands to be delivered in each segment in acre-feet/year

Year	2015	2020	2030	2040	2050	2060	2065
SAWS NW	43800	123000	123000	123000	123000	123000	123000
SAWS NE	29200	82000	82000	82000	82000	82000	82000
Subtotal	73000	205000	205000	205000	205000	205000	205000
SARA	20550	23406	28433	31393	34411	37530	41128
GBRA			6000	8000	10000	12300	12300
LCRA			5600	11200	11200	11200	11200
COA			16802	22403	33604	33604	33604
Total	93550	228406	261835	277996	294215	299634	303232

Total water delivered over 50 years = 12,590,440 ac-ft
4,102,328 mg

Flow Schematic



Check = 303,232

O&M Cost Calculations
RWI A - Matagorda Co. River Intakes, and Storage
CTRWTP - Alternate 3A - WTP in Northern Corner of Caldwell County

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile
			or =	$ 5,000	per acre

Inflatable Rubber Low Head Dam

	Quantity	Units	Size	Unit Constr. Cost (millions)	Total Estimated Constr. Cost (millions)	Contigency, Eng., etc. (millions)	Total Capital Cost (millions)
Inflatable Rubber Low Head Dam	4	each	10 ft high	$ 2.25	$ 9.00	$ 3.42	$ 12.42

Estimated inflatable dam cost as % of total	50%		
Value of inflatable dam	$ 4.50	million	
Assumed life of inflatable dam	10	years	
Estimated maintenance/replacement cost	$ 0.45	million/year	
Year built	2020		
NPV of O&M Costs	$6.27	million	
NPV of Capital Costs	$ 9.73	million	
Total NPV of Capital and O&M Costs	$16.00	million	

Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)

Average withdrawal	132,000	ac-ft/year			
	182	cfs			
			21.9	Ratio of design withdrawal rate	
Total intake design withdrawal rate (for scalping high flows	4,000	cfs		to Total intake design withdrawal rate	
	1,795,200	gpm			
No. of Intakes	4				
Design withdrawal rate per intake	1,000	cfs			
	448,800	gpm			
No. of reservoirs	4				
Design flow to each reservoir	448,800	gpm			
Inside diameter of each RWTM	120	in.			
Area	78.54	sf			
Average length of each RWTM	1	miles	4.0	miles for all RWTMs	
	5,280	feet	21,120	feet	
Estimated construction cost for RWTM	$ 793	per LF		$ 1,254	
Total construction cost in millions	$ 16.8				
Contingencies	$ 3.4				
Subtotal	$ 20.1				
Engineering, Legal & Administrative	$ 3.0				
Subtotal	$ 23.1				
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 0.4				
Total Capital Cost for PWTM in millions	$ 23.5	million			
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.040	Million $/year (all RWTMs to Reservoirs)	

Note: Assume each intake has two RWTMs pumping out of it, one to each reservoir.

Design flow rate for each RWTM (from above)	448,800	gpm		
Pumping rate (one pump)	50,000	gpm		
No. of pumps (not counting spare) pumping into each RW	9			
Peak flow rate into each RWTM (all pumps except spare)	450,000	gpm		
Velocity at peak flow rate	12.77	fps		
C factor	120			
Head loss per foot	0.00327	ft/ft	$h_f = \lvert 3.552*Q \rvert^{1.85} / \lvert C*(d)^{2.63} \rvert$	
	17.25	ft/mile		
Head loss at peak flow rate	17	ft		
Allowance for minor losses 30%	5	ft	90	Elev of discharge at reservoir
Total estimated losses	22	ft	50	Water surface elev in river
Average static head	40	ft	40	ft
Total estimated dynamic head	62	ft		
	27	psi		
Assumed pump efficiency	85%			
Assumed motor efficiency	90%			
Estimated Hp required per pump	1,030	hp/pump		
	769	kw/pump		
Total hp pumping into each RWTM (not counting spare)	9,272	hp/RWTM		
Total hp at each intake (not counting spare)	9,272	hp/intake		
Total hp all intakes (not counting spares)	37,089	hp		
Total kw all intakes (not counting spares)	27,668	kw		
Unit construction cost for each pump station (from cost cui	$ 889	per firm hp of pump station		$ 1,190
Construction cost per intake/pump station	8.2	million		
No. of intakes from above	4	each		
Total construction cost in millions	$ 33.0	million		
Contigency, Eng., etc. in millions	$ 12.53	million		
Total capital cost in millions	$ 45.5	million		
Total construction cost for pump stations	$ 33.0	million		
Value of equipment	$ 13.2	million	40%	Estimated equip cost as % of total constr cost
Assumed life of equipment	20	years		
Estimated maintenance/replacement cost	$ 0.66	million/year		

O&M Costs:

Year	Flow pumped by year		No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	-	-	-	-	$ -	$ -			$ -	$ -
2016	-	-	-	-	$ -	$ -			$ -	$ -
2017	-	-	-	-	$ -	$ -			$ -	$ -
2018	-	-	-	-	$ -	$ -			$ -	$ -
2019	-	-	-	-	$ -	$ -			$ -	$ -
2020	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 1.15
2021	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 1.10
2022	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 1.05
2023	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 1.00
2024	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.95
2025	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.90
2026	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.86
2027	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.82
2028	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.78
2029	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.74
2030	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.71
2031	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.67
2032	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.64
2033	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.61
2034	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.58
2035	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.55
2036	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.53
2037	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.50
2038	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.48
2039	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.46
2040	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.43
2041	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.41
2042	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.39
2043	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.38
2044	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.36
2045	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.34
2046	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.32
2047	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.31
2048	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.29
2049	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.28
2050	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.27
2051	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.25
2052	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.24
2053	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.23
2054	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.22
2055	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.21
2056	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.20
2057	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.19
2058	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.18
2059	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.17
2060	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.16
2061	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.16
2062	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.15
2063	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.14
2064	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.13
2065	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.13
								Total NPV of O&M Costs		$ 21.6

Capital Costs in million $:		Yr built		
RWTM to Reservoirs	$ 23.5	2020		$ 18.4
Intake/Pumping Stations	$ 45.5	2020		$ 35.6
			Total NPV of Capital Costs	$ 54.1
			Total NPV of Capital and O&M Costs in millions	$ 75.7

Reservoirs

	Quantity	Units	Volume/each (acre-feet)	Unit Cost ($/ac-ft))	Total Construction Cost in millions	Contigency, Eng., etc.	Total in millions
Reservoirs	4	each	25000	$ 974	$ 97.4	$ 37.0	$ 134.4
				909			

Estimated average depth of reservoir	20	ft		
Surface area of reservoir	5000	acres		
Ratio of total land area reqd to surface area of reservoir	1.1			
Total land area reqd for reservoirs	5500	acres	Envir & Archaeology, Surv, and Land Acq =	27.5
			Total capital cost in millions =	$ 161.9
Assumed life of reservoir	100	years		
Estimated replacement cost	$ 0.97	million/year		
Estimated maintenance	0.4	million/year	Mowing, maintaining fences, etc.	
Total	$ 1.37	million/year		
Year built	2020			
NPV of O&M costs	$ 19.1	million		
NPV of Capital costs	$ 126.8	million		
Total NPV of Capital and O&M Costs	$ 145.9	million		

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Inflatable Rubber Low Head Dam	$ 9.7	$ 6.3	$ 16.0
Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)	$ 54.1	$ 21.6	$ 75.7
Reservoirs	$ 126.8	$ 19.1	$ 145.9
Total for RWI A	$ 190.6	$ 47.0	$ 237.6

O&M Cost Calculations
RWTM A - Matagorda Co. to WTP
CTRWTP - Alternate 3A - WTP in Northern Corner of Caldwell County

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

Raw Water Transmission Main - A

Inside diameter of pipe		96	in.			
Area		50.27	sf			
Length of RWTM		126	miles			
		665,280	feet			
Estimated unit construction cost for RWTM		$ 567	per LF		$ 865	
Total construction cost in millions		$ 378				
Contingencies		$ 76				
Subtotal		$ 453				
Engineering, Legal & Administrative		$ 68				
Subtotal		$ 521				
Envir & Arch Studies & Mitigation, Surveying, & Land Acq		$ 13				
Total Capital Cost for PWTM in millions		$ 534	million			
Unit maintenance cost/year-mile		$ 10,000	$/year-mile	$ 1.260	Million $/year	
Design flow rate (after 100% buildout)		132,000	ac-ft/year			
		118	mgd			
		81,829	gpm			
Pumping rate (one pump)		16,400	gpm			
No. of pumps (not counting spare)		5				
Peak flow rate (all pumps except spare)		82,000	gpm			
Velocity at peak flow rate		3.63	fps			
C factor		120				
Head loss per foot		0.00041	ft/ft	$h_f = \frac{3.552*Q^{1.85}}{C^*(d)^{2.63}}$		
		2.19	ft/mile			
Head loss at peak flow rate		276	ft			
Allowance for minor losses	10%	28	ft	550	Elev. At San Antonio East WTP	
Total estimated losses		303	ft	90	Elev. At Matagorda OCRs	
Average static head		460	ft	460	ft	
Total estimated dynamic head		763	ft			
		331	psi			
No of pumping stations req'd along route		2.21		150	psi (assumed max pressure	
No. of pumping stations used in cost estimate		3.0			in pipe)	
Average head per pump station		254	ft			
Assumed pump efficiency		85%				
Assumed motor efficiency		90%				
Estimated Hp required per pump		1,378	hp/pump			
		1,028	kw/pump			
Total hp per pump station (not counting spare)		6,888	hp/station			
Total kw per pump set (set=pumps in series along route)		4,133	kw/pump set	(one pump at each station)		
Unit construction cost for each pump station (from cost curv		$ 1,347	per firm hp of pump station	$ 950		
Construction cost per pump station		9.3	million			
Balancing reservoir		$ 0.75	million	60	min. of storage at avg pumping rate	
Total construction cost per pump station		$ 10.03	million	5.0	mg	
				$ 0.15	per gal for open top reservoir	
No. of pump stations from above		3.0	each			
Total construction cost in millions		$ 30.1	million			
Contigency, Eng., etc. in millions		$ 11.43	million			
Total capital cost in millions		$ 41.5	million			
Total construction cost for pump stations		$ 30.1	million			
Value of equipment		$ 12.0	million	40%	Estimated equipment cost as % of total	
Assumed life of equipment		20	years			
Estimated maintenance/replacement cost		$ 0.60	million/year			

O&M Costs

Year	Flow pumped by year		No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	-	-	-	-	$ -	$ -			$ -	$ -
2016	-	-	-	-	$ -	$ -			$ -	$ -
2017	-	-	-	-	$ -	$ -			$ -	$ -
2018	-	-	-	-	$ -	$ -			$ -	$ -
2019	-	-	-	-	$ -	$ -			$ -	$ -
2020	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 11.37
2021	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 10.83
2022	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 10.31
2023	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 9.82
2024	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 9.35
2025	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 8.91
2026	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 8.48
2027	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 8.08
2028	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 7.69
2029	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 7.33
2030	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 6.98
2031	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 6.65
2032	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 6.33
2033	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 6.03
2034	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 5.74
2035	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 5.47
2036	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 5.21
2037	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 4.96
2038	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 4.72
2039	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 4.50
2040	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 4.28
2041	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 4.08
2042	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 3.89
2043	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 3.70
2044	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 3.52
2045	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 3.36
2046	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 3.20
2047	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 3.04
2048	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.90
2049	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.76
2050	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.63
2051	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.50
2052	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.39
2053	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.27
2054	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.16
2055	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.06
2056	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.96
2057	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.87
2058	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.78
2059	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.70
2060	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.61
2061	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.54
2062	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.46
2063	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.39
2064	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.33
2065	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.27
								Total NPV of O&M Costs		**$ 213**

Capital Costs in million $:		Yr built		
RWTM	$ 534	2020		$ 418
Pumping Stations	$ 42	2020		$ 33
			Total NPV of Capital Costs	**$ 451**

Total NPV of Capital and O&M Costs in millions $ 664

NPV CALCULATIONS
ALCOA / CPS GROUNDWATER
CTRWTP - Alternate 3A - WTP in Northern Corner of Caldwell County

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

Well Fields and Collection Lines

	ALCOA	CPS	Total
Year built	2015	2015	
Estimated Construction Cost in Millions			
Wells (Based on Non-Public Water Supply Wells)	20.92	7.94	28.86
Pipeline	13.03	5.94	18.97
Pump Stations & Storage	8.51	0	8.51
Subtotal	42.46	13.88	56.34
Contingency	8.49	2.78	11.27
Subtotal	50.95	16.66	67.61
Engineering, Legal & Administrative	6.37	2.08	8.45
Subtotal	57.32	18.74	76.06
Environmental & Archaeology Studies & Mitigation	0.63	0.2	0.83
Land Acquisition & Surveying	0	0	0.00
Groundwater Purchase	0	5.64	5.64
ALCOA Construction Program Management Fee	5.45	0	5.45
Interest During Construction (2 years, 6% int., 4% ret.)	5.89	2.44	8.33
Total Capital Cost	**69.29**	**27.02**	**96.31**
Estimated Annual O&M Costs			
O&M	0.67	0.18	0.85
Pumping Energy	2.41	0.52	2.93
ALCOA Project Management Fees	0.35	0.00	0.35
Purchase of Groundwater	2.00	0.00	2.00
Groundwater District Fees	0.65	0.25	0.90
Mitigation Reserves	0.28	0.11	0.39
Total Annual Cost	**6.36**	**1.06**	**7.42**

NPV of O&M Costs	$ 116	$ 19	$ 135	million
NPV of Capital Costs	$ 69	$ 27	$ 96	million
Total NPV of Capital and O&M Costs for Well Fields	**$ 185**	**$ 46**	**$ 232**	**million**

Cooling of Well Water

Total number of wells in both fields	120	wells	Approximate capacity per wel	300 gpm
Percentage of wells with temperatures > than ___ degrees	5%			36,000 gpm
Estimated number of wells with temperature > ____ degrees	6.0		Rough check	58,072 ac-ft/year

Estimated Capital Costs

Year built	2015		
Number of Packaged Cooling Towers (300 gpm capacity/each)	6.0		
Equipment cost (cooling towers and fans)	$ 60,000		
Installation and contractors mark-up	$ 50,000		
Structural slab	$ 30,000		
Electrical	$ 50,000		
Estimated Unit Construction Cost	$ 190,000	Each	
Total construction cost	$ 1.14	million	
Contingencies	$ 0.23		
Subtotal	$ 1.37		
Engineering, Legal and Admin	$ 0.21		
Total Estimated Capital Cost	$ 1.57		
NPV of Capital Costs	$ 1.57	million	

Estimated O&M Costs

Value of equipment	$ 0.4	million	
Assumed life of equipment	10	years	
Estimated maintenance/replacement cost	$ 0.04	million/year	
Blower Hp per cooling tower	10	Hp	
	7	kw	
Hours of operation	24	hours	
Power consumption per cooling tower	179	kwh per day	
	65,350	kwh per year	
Power cost per cooling tower	$ 4,574		
Total power cost for all cooling towers in millions	$ 0.03	million per year	
Regular operational checks and routine maintenance	$ 6,000	per month for all cooling towers	
	$ 0.07	per year	
Estimated O&M Cost	$ 0.14	million $ per year	
NPV of O&M costs	$ 2.47	million $	

Ground Water Transmission Main and Pump Station (Hwy 290 to Bastrop Intake)

Inside diameter of transmission pipe	54	in.

Area			15.90	sf		
Length of Ground Water TM			15	miles		
			79,200	feet		
Estimated construction cost for GWTM		$	327	per LF		
Total construction cost in millions		$	25.9			
Contingencies		$	5.2			
Subtotal		$	31.1			
Engineering, Legal & Administrative		$	4.7			
Subtotal		$	35.8			
Envir & Arch Studies & Mitigation, Surveying, & Land Acq		$	1.5			
Total Capital Cost for PWTM in millions		$	37.3	million		
Unit maintenance cost/year-mile		$	10,000	$/year-mile	$ 0.150	Million $/year
Design flow rate			55,000	ac-ft/year		
			49	mgd		
			34,095	gpm		
Velocity at peak flow rate			4.78	fps		
C factor			120			
Head loss per foot			0.00134	ft/ft	$h_f = \lvert 3.552*Q \rvert^{1.85} / \lvert C*(d)^{2.63} \rvert$	
			7.10	ft/mile		
Head loss at peak flow rate			106	ft		
Allowance for minor losses	10%		11	ft	400	Elev. At RWI-B
Total estimated losses			117	ft	550	minus Elev. - Storage Tank at Hwy 290
Average static head			-150	ft	-150	ft
Total estimated dynamic head			-33	ft	(intake is lower than tank at Hwy 290)	
			-14	psi		

Negative indicates gravity flow from Hwy 290 to Bastrop Intake; no pumping necessary.

				Million $
Annual O&M Cost in million $:		Yr built		
GWTM	$ 0.150	2015		
			Total NPV of O&M Costs	$ 2.7
Capital Costs in million $:		Yr built		
GWTM	$ 37.3	2015		$ 37.3
			Total NPV of Capital Costs	$ 37.3

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Well Fields and Collection Lines (including tank and pump station at Hwy 290)	**$ 96.3**	**$ 135.5**	**$ 231.8**
Cooling Towers for Selected High Temperature Wells	**$ 1.6**	**$ 2.5**	**$ 4.0**
Ground Water Transmission Main and Pumping Station	**$ 37.3**	**$ 2.7**	**$ 40.0**
Total for ALCOA-CPS	**$ 135.1**	**$ 140.7**	**$ 275.8**

O&M Cost Calculations
RWI B - Colorado River Intake at Bastrop and Off Channel Reservoir
CTRWTP - Alternate 3A - WTP in Northern Corner of Caldwell County

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	40	years			
Unit cost of energy	$ 0.07	per kwh	Environmental & Archaeology Studies & Mitigation, Surveying, and Land Acquisition =	$ 100,000	per mile
			or =	$ 5,000	per acre

Inflatable Rubber Low Head Dam

	Quantity	Units	Size	Unit Constr. Cost (millions)	Total Estimated Constr. Cost (millions)	Contigency, Eng., etc. (millions)	Total Capital Cost (millions)
Inflatable Rubber Low Head Dam	2	each	10 ft high	$ 2.25	$ 4.50	$ 1.71	$ 6.21

Estimated inflatable dam cost as % of total	50%		
Value of inflatable dam	$ 2.25	million	
Assumed life of inflatable dam	10	years	
Estimated maintenance/replacement cost	$ 0.23	million/year	
Year built	2015		
NPV of O&M Costs	$ 3.86	million	
NPV of Capital Costs	$ 6.21	million	
Total NPV of Capital and O&M Costs	**$ 10.07**	**million**	

Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)

Summary of withdrawals in acre-feet/year:

Year	2015	2020	2030	2040	2050	2060	2065
For SAWS	18000	18000	18000	18000	18000	18000	18000
LCRA			5600	11200	11200	11200	11200
COA			16802	22403	33604	33604	33604
Total	18000	18000	40402	51603	62804	62804	62804

Ultimate (Y2065) average design withdrawal rate	62,804	ac-ft/year		
	87	cfs		
			23.1	Ratio of design withdrawal rate to Total intake design withdrawal rate
Total intake design withdrawal rate (for scalping high flows)	2,000	cfs		
	897,600	gpm		
No. of Intakes	2			
Design withdrawal rate per intake	1,000	cfs		
	448,800	gpm		
No. of reservoirs	4			
Design flow to each reservoir	224,400	gpm		
Inside diameter of each RWTM	120	in.		
Area	78.54	sf		
Average length of each RWTM	2	miles	8.0	miles for all RWTMs
	10,560	feet	42,240	feet

Estimated construction cost for RWTMs	$ 793	per LF		
Total construction cost in millions	$ 33.5			
Contingencies	$ 6.7			
Subtotal	$ 40.2			
Engineering, Legal & Administrative	$ 6.0			
Subtotal	$ 46.2			
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 0.8			
Total Capital Cost for PWTM in millions	$ 47.0			
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.080	Million $/year (all RWTMs to Reservoirs)

Note: Assume intake has one RWTM pumping to the reservoir.

Design flow rate for each RWTM (from above)	224,400	gpm		
Pumping rate (one pump)	40,000	gpm		
No. of pumps (not counting spare) pumping into each RWT	6			
Peak flow rate into each RWTM (all pumps except spare)	240,000	gpm		
Velocity at peak flow rate	6.81	fps		
C factor	120			
Head loss per foot	0.00102	ft/ft	$h_f = \lvert 3.552*Q \rvert^{1.85} / \lvert C*(d)^{2.63} \rvert$	
	5.39	ft/mile		
Head loss at peak flow rate	11	ft		
Allowance for minor losses 30%	3	ft	400	Discharge at reservoir
Total estimated losses	14	ft	320	Water surface elev in river
Average static head	80	ft	80	ft
Total estimated dynamic head	94	ft		
	41	psi		
Assumed pump efficiency	85%			
Assumed motor efficiency	90%			
Estimated Hp required per pump	1,241	hp/pump		
	926	kw/pump		

Total hp pumping into each RWTM (not counting spare)		7,448	hp/RWTM		
Total hp at each intake (not counting spare)		14,897	hp/intake		
Total hp all intakes (not counting spares)		29,793	hp		
Total kw all intakes (not counting spares)		22,226	kw		
Unit construction cost for each pump station (from cost cun	$	889	per firm hp of pump station	$ 830	
Construction cost per intake/pump station		13.2	million		
No. of intakes from above		2	each		
Total construction cost in millions	$	26.5	million		
Contigency, Eng., etc. in millions	$	10.06	million		
Total capital cost in millions	$	36.6	million		
Total construction cost for pump stations	$	26.5	million	40%	Estimated equipment cost as % of total
Value of equipment	$	10.6	million		
Assumed life of equipment		20	years		
Estimated maintenance/replacement cost	$	0.53	million/year		

O&M Costs:

Year	Flow pumped by year		No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.77
2016	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.73
2017	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.70
2018	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.66
2019	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.63
2020	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.60
2021	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.57
2022	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.55
2023	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.52
2024	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.50
2025	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.47
2026	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.45
2027	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.43
2028	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.41
2029	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.39
2030	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.46
2031	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.44
2032	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.42
2033	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.40
2034	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.38
2035	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.36
2036	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.35
2037	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.33
2038	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.31
2039	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.30
2040	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.31
2041	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.30
2042	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.28
2043	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.27
2044	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.26
2045	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.25
2046	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.23
2047	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.22
2048	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.21
2049	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.20
2050	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.21
2051	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.20
2052	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.19
2053	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.18
2054	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.17
2055	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.17
2056	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.16
2057	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.15
2058	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.14
2059	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.14
2060	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.13
2061	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.12
2062	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.12
2063	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.11
2064	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.11
2065	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.10
								Total NPV of O&M Costs		$ 17.1

Capital Costs in million $:		Yr built		
RWTM to Reservoir	$ 47.0	2015		$ 47.0
Intake/Pumping Stations	$ 36.6	2015		$ 36.6
			Total NPV of Capital Costs	$ 83.6
			Total NPV of Capital and O&M Costs in millions	$ 100.7

Reservoirs

	Quantity	Units	Volume/each (acre-feet)	Unit Cost ($/ac-ft))	Total Construction Cost in millions	Contigency, Eng., etc.	Total in millions
Reservoirs	4	each	15000	$ 1,180	$ 70.8	$ 26.9	$ 97.7
				$ 0.004	per gallon		
Estimated average depth of reservoir		20	ft	$ 1,096			

Surface area of reservoir	3000	acres		
Ratio of total land area reqd to surface area of reservoir	1.1		Envir & Archaeology, Surv, and Land Acq =	16.5
Total land area reqd for reservoirs	3300	acres	Total capital cost in millions =	$ 114.2
Assumed life of reservoir	100	years		
Estimated replacement cost	$ 0.71	million/year		
Estimated maintenance	$ 0.04	million/year	Mowing, maintaining fences, etc.	
Total	$ 0.75	million/year		
Year built	2015			
NPV of O&M costs	$ 12.8	million		
NPV of Capital costs	$ 114.2	million		
Total NPV of Capital and O&M Costs	**$ 127.0**	**million**		

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Inflatable Rubber Low Head Dam	$ 6.2	$ 3.9	$ 10.1
Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)	$ 83.6	$ 17.1	$ 100.7
Off Channel Reservoir	$ 114.2	$ 12.8	$ 127.0
Total for RWI A	$ 204.0	$ 33.8	$ 237.8

O&M Cost Calculations
RWTM B - RWI B near Bastrop to WTP
CTRWTP - Alternate 3A - WTP in Northern Corner of Caldwell County

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	40	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

Summary of average pumping rates in acre-feet/year:

Surface Water

Year	2015	2020	2030	2040	2050	2060	2065
For SAWS	18000	18000	18000	18000	18000	18000	18000
LCRA			5600	11200	11200	11200	11200
COA			16802	22403	33604	33604	33604
Subtotal	18000	18000	40402	51603	62804	62804	62804

Groundwater

Year	2015	2020	2030	2040	2050	2060	2065
For SAWS	55000	55000	55000	55000	55000	55000	55000
Suface & grour	73000	73000	95402	106603	117804	117804	117804

Ultimate (Y2065) average design pumping rate 117,804 ac-ft/year

Sizing of Raw Water Transmission Main B & Pump Stations

Inside diameter of RWTM		84	in.		
Area		38.48	sf		
Length of RWTM		20	miles		
		105,600	feet		
Estimated unit construction cost for RWTM	$	467	per LF	$ 550	
Total construction cost in millions	$	49.4			
Contingencies	$	9.9			
Subtotal	$	59.2			
Engineering, Legal & Administrative	$	8.9			
Subtotal	$	68.1			
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$	2.0			
Total Capital Cost for PWTM in millions	$	70.1	million		
Unit maintenance cost/year-mile	$	5,000	$/year-mile	$ 0.100	Million $/year
Design flow rate (after 100% buildout)		117,804	ac-ft/year		
		105	mgd		
		73,029	gpm		
Pumping rate (one pump)		15,000	gpm		
No. of pumps (not counting spare)		5			
Peak flow rate (all pumps except spare)		75,000	gpm		
Velocity at peak flow rate		4.34	fps		
C factor		120			
Head loss per foot		0.00067	ft/ft	$h_f = \frac{3.552*Q}{C*(d)^{2.63}}^{1.85}$	
		3.55	ft/mile		
Head loss at peak flow rate		71	ft		
Allowance for minor losses	10%	7	ft	650	Elev. At WTP
Total estimated losses		78	ft	400	Elev of WSE in Bastrop reservoir
Average static head		250	ft	250	ft
Total estimated dynamic head		328	ft		
		142	psi		
No of recommended pumping stations along route		0.95		150	psi (assumed max pressure
No. of pumping stations used in cost estimate		1.0			in pipe)
Average head per pump station		328	ft		
Assumed pump efficiency		85%			
Assumed motor efficiency		90%			
Estimated Hp required per pump		1,625	hp/pump		
		1,212	kw/pump		
Total hp per pump station (not counting spare)		8,125	hp/station		
Total kw per pump set (set=pumps in series along route)		1,625	kw/pump set	(one pump at each station)	
Unit construction cost for each pump station (from cost cur	$	1,307	per firm hp of pump station		
Construction cost per pump station		10.6	million		
Balancing reservoir	$	0.75	million	60	min. of storage at avg pumping rate
Total construction cost per pump station	$	11.37	million	5.0	mg
				$ 0.15	per gal for open top reservoir
No. of pump stations from above		1.0	each		
Total construction cost in millions	$	11.4	million		
Contingency, Eng., etc. in millions	$	4.32	million		
Total capital cost in millions	$	15.7	million		
Total construction cost for pump stations	$	11.4	million		
Value of equipment	$	4.5	million	40%	Estimated equipment cost as % of total
Assumed life of equipment		20	years		
Estimated maintenance/replacement cost	$	0.23	million/year		

O&M Costs

Year	Flow pumped by year		No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	73,000	65	3.02	117,667	$ 8,237	$ 3.01	$ 0.23	$ 0.100	$ 3.33	$ 3.33
2016	73,000	65	3.02	117,667	$ 8,237	$ 3.01	$ 0.23	$ 0.100	$ 3.33	$ 3.17
2017	73,000	65	3.02	117,667	$ 8,237	$ 3.01	$ 0.23	$ 0.100	$ 3.33	$ 3.02
2018	73,000	65	3.02	117,667	$ 8,237	$ 3.01	$ 0.23	$ 0.100	$ 3.33	$ 2.88
2019	73,000	65	3.02	117,667	$ 8,237	$ 3.01	$ 0.23	$ 0.100	$ 3.33	$ 2.74
2020	73,000	65	3.02	117,667	$ 8,237	$ 3.01	$ 0.23	$ 0.100	$ 3.33	$ 2.61
2021	73,000	65	3.02	117,667	$ 8,237	$ 3.01	$ 0.23	$ 0.100	$ 3.33	$ 2.49
2022	73,000	65	3.02	117,667	$ 8,237	$ 3.01	$ 0.23	$ 0.100	$ 3.33	$ 2.37
2023	73,000	65	3.02	117,667	$ 8,237	$ 3.01	$ 0.23	$ 0.100	$ 3.33	$ 2.26
2024	73,000	65	3.02	117,667	$ 8,237	$ 3.01	$ 0.23	$ 0.100	$ 3.33	$ 2.15
2025	73,000	65	3.02	117,667	$ 8,237	$ 3.01	$ 0.23	$ 0.100	$ 3.33	$ 2.05
2026	73,000	65	3.02	117,667	$ 8,237	$ 3.01	$ 0.23	$ 0.100	$ 3.33	$ 1.95
2027	73,000	65	3.02	117,667	$ 8,237	$ 3.01	$ 0.23	$ 0.100	$ 3.33	$ 1.86
2028	73,000	65	3.02	117,667	$ 8,237	$ 3.01	$ 0.23	$ 0.100	$ 3.33	$ 1.77
2029	73,000	65	3.02	117,667	$ 8,237	$ 3.01	$ 0.23	$ 0.100	$ 3.33	$ 1.68
2030	95,402	85	3.94	153,777	$ 10,764	$ 3.93	$ 0.23	$ 0.100	$ 4.26	$ 2.05
2031	95,402	85	3.94	153,777	$ 10,764	$ 3.93	$ 0.23	$ 0.100	$ 4.26	$ 1.95
2032	95,402	85	3.94	153,777	$ 10,764	$ 3.93	$ 0.23	$ 0.100	$ 4.26	$ 1.86
2033	95,402	85	3.94	153,777	$ 10,764	$ 3.93	$ 0.23	$ 0.100	$ 4.26	$ 1.77
2034	95,402	85	3.94	153,777	$ 10,764	$ 3.93	$ 0.23	$ 0.100	$ 4.26	$ 1.68
2035	95,402	85	3.94	153,777	$ 10,764	$ 3.93	$ 0.23	$ 0.100	$ 4.26	$ 1.60
2036	95,402	85	3.94	153,777	$ 10,764	$ 3.93	$ 0.23	$ 0.100	$ 4.26	$ 1.53
2037	95,402	85	3.94	153,777	$ 10,764	$ 3.93	$ 0.23	$ 0.100	$ 4.26	$ 1.46
2038	95,402	85	3.94	153,777	$ 10,764	$ 3.93	$ 0.23	$ 0.100	$ 4.26	$ 1.39
2039	95,402	85	3.94	153,777	$ 10,764	$ 3.93	$ 0.23	$ 0.100	$ 4.26	$ 1.32
2040	106,603	95	4.41	171,831	$ 12,028	$ 4.39	$ 0.23	$ 0.100	$ 4.72	$ 1.39
2041	106,603	95	4.41	171,831	$ 12,028	$ 4.39	$ 0.23	$ 0.100	$ 4.72	$ 1.33
2042	106,603	95	4.41	171,831	$ 12,028	$ 4.39	$ 0.23	$ 0.100	$ 4.72	$ 1.26
2043	106,603	95	4.41	171,831	$ 12,028	$ 4.39	$ 0.23	$ 0.100	$ 4.72	$ 1.20
2044	106,603	95	4.41	171,831	$ 12,028	$ 4.39	$ 0.23	$ 0.100	$ 4.72	$ 1.15
2045	106,603	95	4.41	171,831	$ 12,028	$ 4.39	$ 0.23	$ 0.100	$ 4.72	$ 1.09
2046	106,603	95	4.41	171,831	$ 12,028	$ 4.39	$ 0.23	$ 0.100	$ 4.72	$ 1.04
2047	106,603	95	4.41	171,831	$ 12,028	$ 4.39	$ 0.23	$ 0.100	$ 4.72	$ 0.99
2048	106,603	95	4.41	171,831	$ 12,028	$ 4.39	$ 0.23	$ 0.100	$ 4.72	$ 0.94
2049	106,603	95	4.41	171,831	$ 12,028	$ 4.39	$ 0.23	$ 0.100	$ 4.72	$ 0.90
2050	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.94
2051	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.89
2052	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.85
2053	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.81
2054	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.77
2055	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.74
2056	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.70
2057	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.67
2058	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.64
2059	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.61
2060	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.58
2061	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.55
2062	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.52
2063	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.50
2064	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.47
2065	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.45
								Total NPV of O&M Costs		$ 74.9

Capital Costs in million $:		Yr built		
RWTM	$ 70.1	2015		$ 70.1
Pumping Stations	$ 15.7	2015		$ 15.7
			Total NPV of Capital Costs	$ 85.8

Total NPV of Capital and O&M Costs in millions $ 160.7

O&M Cost Calculations
WTP and Raw Water Storage Reservoir at WTP
CTRWTP - Alternate 3A - WTP in Northern Corner of Caldwell County

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition =	$ 25,000	per acre

Treated Water Production by Treatment Type (from Demand Chart - BE SURE TO CHECK)

Year =		2015	2020	2030	2040	2050	2060	2065
Softened water demand:	Units							
Average yearly demands:								
City of Austin	ac-ft/yr	0	0	16802	22403	33604	33604	33604
LCRA	ac-ft/yr	0	0	5600	11200	11200	11200	11200
Totals	ac-ft/yr	0	0	22402	33603	44804	44804	44804
Totals	mgd	0	0	20	30	40	40	40
Max day demands:								
City of Austin	mgd	0	0	25	35	50	50	50
LCRA	mgd	0	0	10	20	20	20	20
Totals	mgd	0	0	35	55	70	70	70

Year =		2015	2020	2030	2040	2050	2060	2065
Non-softened water demands:	Units							
Average yearly demands:								
SAWS	ac-ft/yr	73000	205000	205000	205000	205000	205000	205000
SARA	ac-ft/yr	20550	23406	28433	31393	34411	37530	41128
GBRA	ac-ft/yr	0	0	6000	8000	10000	12300	12300
Totals		93550	228406	239433	244393	249411	254830	258428
Totals	mgd	84	204	214	218	223	227	231
Max day demands:								
SAWS	mgd	85	238	238	238	238	238	238
SARA	mgd	24	27	33	36	40	44	48
GBRA	mgd	0	0	5	7	9	11	11
Totals	mgd	109	265	276	281	287	293	297

Total: softened and non-softened water demands								
Average yearly demand	ac-ft/yr	93550	228406	261835	277996	294215	299634	303232
	mgd	84	204	234	248	263	267	271
Max day demand	mgd	109	265	311	336	357	363	367

Raw Water Reservoir

Sizing for ultimate conditions:

Assumed number of days of consecutive Max Day demands		30	days	
Design (Max. Day) treated water production req'd in mgd		367	mgd	
Average treated water production in mgd		271	mgd	(which is also equal to sum of ground and raw water that can be pumped to the WTP)
Difference (shortfall of raw water)		96	mgd	
Required storage reservoir for raw water		2,889	mg	
		8,868	ac-ft	
Add safety factor	25%	2,217	ac-ft	
Total storage required		11,084	ac-ft	
Total storage recommended		12,000	ac-ft	

Note: No. of days at average day demand (for example, for repair of RWTM A) = 33 days

	Quantity	Units	Volume/each (acre-feet)	Unit Cost ($/ac-ft))	Total Construction Cost	Contigency, Eng., etc.	Total Capital Cost
Reservoirs	1	each	12,000	$ 1,283	$ 15.4	$ 5.9	$ 21.3

Estimated average depth of reservoir	25	ft	
Surface area of reservoir	480	acres	
Ratio of total land area reqd to surface area of reservoir	1.10		
Total land area reqd for reservoirs	528	acres	
Envir & Archaeology, Surv, and Land Acq =			13.2
Total capital cost in millions =			$ 34.5
Assumed life of reservoir	100	years	

Estimated replacement cost	$ 0.15	million/year	
Estimated maintenance	$ 0.04	million/year	Mowing, maintaining fences, etc.
Total	$ 0.19	million/year	
Year built	2015		
NPV of O&M costs	$ 3.5	million	
NPV of Capital costs	$ 34.5	million	
Total NPV of Capital and O&M Costs	$ 38.0	million	

WTP

Plant Phasing and Capital Costs:

Softening Treatment Trains

Year =	2015	2020	2030	2040	2050	2060	2065
Average treated water production in mgd	0	0	20	30	40	40	40
Design (Max. Day) treated water production req'd in mgd	0	0	35	55	70	70	70
Initial/additional Max day capacity built (mgd)			50	20			
Total capacity on line (must exceed Design Max Day Req'd)	0	0	50	70	70	70	70
Unit cost for max day treatment capacity ($/gpd of capacity)			$ 1.78	$ 2.14			
Estimated construction cost of expansion in $millions	$ -	$ -	$ 89.0	$ 42.8	$ -	$ -	$ -

Non-softening Treatment Trains

Year =	2015	2020	2030	2040	2050	2060	2065
Average treated water production in mgd	84	204	214	218	223	227	231
Design (Max. Day) treated water production req'd in mgd	109	265	276	281	287	293	297
Additional Max day capacity built (mgd)	200	100					
Total capacity on line (must exceed Design Max Day Req'd)	200	300	300	300	300	300	300
Unit cost for max day treatment capacity ($/gpd of capacity)	$ 1.15	$ 1.32					
Estimated construction cost of expansion in $millions	$ 229.6	$ 131.5	$ -	$ -	$ -	$ -	$ -

Totals (Softening + Non-softening Trains)

Year =	2015	2020	2030	2040	2050	2060	2065
Total construction cost for both trains	$ 229.6	$ 131.5	$ 89.0	$ 42.8	$ -	$ -	$ -
Contingencies	45.9	26.3	17.8	8.6	-	-	-
Subtotal	$ 275.5	$ 157.8	$ 106.8	$ 51.3	$ -	$ -	$ -
Engineering, Legal, & Administrative	41.3	23.7	16.0	7.7	-	-	-
Subtotal	316.8	181.5	122.8	59.0	-	-	-
Environmental & Archaeology Studies and Mitigation & Land Acquisition and Surveying (see Note below)	2.5						
Total estimated capital cost	$ 319.3	$ 181.5	$ 122.8	$ 59.0	$ -	$ -	$ -
NPV of capital cost	$ 319.3	$ 142.2	$ 59.1	$ 17.4	$ -	$ -	$ -

Total NPV of WTP initial construction & expansions $ 538

Note: Assumed land requirement for WTP (not including reserv 100 acres

O&M Costs for Softening Trains:

Year	Plant Capacity in service	Estimated treated water production	Estimated O&M cost from unit cost curve		Net present value
	mgd of capacity	mgd produced	$ per mg treated	$million /year	($)
2015	-	-		$ -	$ -
2016	-	-		$ -	$ -
2017	-	-		$ -	$ -
2018	-	-		$ -	$ -
2019	-	-		$ -	$ -
2020	-	-		$ -	$ -
2021	-	-		$ -	$ -
2022	-	-		$ -	$ -
2023	-	-		$ -	$ -
2024	-	-		$ -	$ -
2025	-	-		$ -	$ -
2026	-	-		$ -	$ -
2027	-	-		$ -	$ -
2028	-	-		$ -	$ -
2029	-	-		$ -	$ -
2030	50	20	$ 712	$ 5.20	$ 2.50
2031	50	20	$ 712	$ 5.20	$ 2.38
2032	50	20	$ 712	$ 5.20	$ 2.27
2033	50	20	$ 712	$ 5.20	$ 2.16
2034	50	20	$ 712	$ 5.20	$ 2.06
2035	50	20	$ 712	$ 5.20	$ 1.96
2036	50	20	$ 712	$ 5.20	$ 1.87
2037	50	20	$ 712	$ 5.20	$ 1.78
2038	50	20	$ 712	$ 5.20	$ 1.69
2039	50	20	$ 712	$ 5.20	$ 1.61
2040	70	30	$ 661	$ 7.24	$ 2.14
2041	70	30	$ 661	$ 7.24	$ 2.04
2042	70	30	$ 661	$ 7.24	$ 1.94
2043	70	30	$ 661	$ 7.24	$ 1.85
2044	70	30	$ 661	$ 7.24	$ 1.76
2045	70	30	$ 661	$ 7.24	$ 1.68
2046	70	30	$ 661	$ 7.24	$ 1.60
2047	70	30	$ 661	$ 7.24	$ 1.52
2048	70	30	$ 661	$ 7.24	$ 1.45
2049	70	30	$ 661	$ 7.24	$ 1.38
2050	70	40	$ 661	$ 9.65	$ 1.75
2051	70	40	$ 661	$ 9.65	$ 1.67
2052	70	40	$ 661	$ 9.65	$ 1.59
2053	70	40	$ 661	$ 9.65	$ 1.51
2054	70	40	$ 661	$ 9.65	$ 1.44
2055	70	40	$ 661	$ 9.65	$ 1.37
2056	70	40	$ 661	$ 9.65	$ 1.31
2057	70	40	$ 661	$ 9.65	$ 1.24
2058	70	40	$ 661	$ 9.65	$ 1.18
2059	70	40	$ 661	$ 9.65	$ 1.13
2060	70	40	$ 661	$ 9.65	$ 1.07
2061	70	40	$ 661	$ 9.65	$ 1.02
2062	70	40	$ 661	$ 9.65	$ 0.97
2063	70	40	$ 661	$ 9.65	$ 0.93
2064	70	40	$ 661	$ 9.65	$ 0.88
2065	70	40	$ 661	$ 9.65	$ 0.84
			Total NPV of O&M Costs		$ 58

O&M Costs for Non-Softening Trains:

Year	Plant Capacity in service	Estimated treated water production	Estimated O&M cost from unit cost curve		Net present value
	mgd of capacity	mgd produced	$ per mg treated	$million /year	($)
2015	200	84	$ 374	$ 11.41	$ 11.41
2016	200	84	$ 374	$ 11.41	$ 10.87
2017	200	84	$ 374	$ 11.41	$ 10.35
2018	200	84	$ 374	$ 11.41	$ 9.86
2019	200	84	$ 374	$ 11.41	$ 9.39
2020	300	204	$ 343	$ 25.50	$ 19.98
2021	300	204	$ 343	$ 25.50	$ 19.03
2022	300	204	$ 343	$ 25.50	$ 18.12
2023	300	204	$ 343	$ 25.50	$ 17.26
2024	300	204	$ 343	$ 25.50	$ 16.44
2025	300	204	$ 343	$ 25.50	$ 15.65
2026	300	204	$ 343	$ 25.50	$ 14.91
2027	300	204	$ 343	$ 25.50	$ 14.20
2028	300	204	$ 343	$ 25.50	$ 13.52
2029	300	204	$ 343	$ 25.50	$ 12.88
2030	300	214	$ 343	$ 26.73	$ 12.86
2031	300	214	$ 343	$ 26.73	$ 12.24
2032	300	214	$ 343	$ 26.73	$ 11.66
2033	300	214	$ 343	$ 26.73	$ 11.11
2034	300	214	$ 343	$ 26.73	$ 10.58
2035	300	214	$ 343	$ 26.73	$ 10.07
2036	300	214	$ 343	$ 26.73	$ 9.59
2037	300	214	$ 343	$ 26.73	$ 9.14
2038	300	214	$ 343	$ 26.73	$ 8.70
2039	300	214	$ 343	$ 26.73	$ 8.29
2040	300	218	$ 343	$ 27.28	$ 8.06
2041	300	218	$ 343	$ 27.28	$ 7.67
2042	300	218	$ 343	$ 27.28	$ 7.31
2043	300	218	$ 343	$ 27.28	$ 6.96
2044	300	218	$ 343	$ 27.28	$ 6.63
2045	300	218	$ 343	$ 27.28	$ 6.31
2046	300	218	$ 343	$ 27.28	$ 6.01
2047	300	218	$ 343	$ 27.28	$ 5.73
2048	300	218	$ 343	$ 27.28	$ 5.45
2049	300	218	$ 343	$ 27.28	$ 5.19
2050	300	223	$ 343	$ 27.84	$ 5.05
2051	300	223	$ 343	$ 27.84	$ 4.81
2052	300	223	$ 343	$ 27.84	$ 4.58
2053	300	223	$ 343	$ 27.84	$ 4.36
2054	300	223	$ 343	$ 27.84	$ 4.15
2055	300	223	$ 343	$ 27.84	$ 3.95
2056	300	223	$ 343	$ 27.84	$ 3.77
2057	300	223	$ 343	$ 27.84	$ 3.59
2058	300	223	$ 343	$ 27.84	$ 3.42
2059	300	223	$ 343	$ 27.84	$ 3.25
2060	300	227	$ 343	$ 28.45	$ 3.17
2061	300	227	$ 343	$ 28.45	$ 3.02
2062	300	227	$ 343	$ 28.45	$ 2.87
2063	300	227	$ 343	$ 28.45	$ 2.74
2064	300	227	$ 343	$ 28.45	$ 2.60
2065	300	231	$ 343	$ 28.85	$ 2.52
				Total NPV of O&M Costs	$ 441

NPV Totals for O&M:

Softening trains	$ 58
Non-softening Trains	$ 441
	$ 499

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Raw Water Reservoir	**$ 34**	**$ 3.5**	**$ 38**
Water Treatment Plant	**$ 538**	**$ 499**	**$ 1,037**
Totals	**$ 572**	**$ 502**	**$ 1,075**

Capital and O&M Cost Calculations
Potable Water Transmission Mains
CTRWTP - Alternate 3A - WTP in Northern Corner of Caldwell County

Initial year of analysis period	2015		Contingency =	20%
Interest rate	5%		Engineering, Legal, Admin. =	15%
Evaluation period	50	years	Environmental & Archaeology Studies &	
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000 per mile

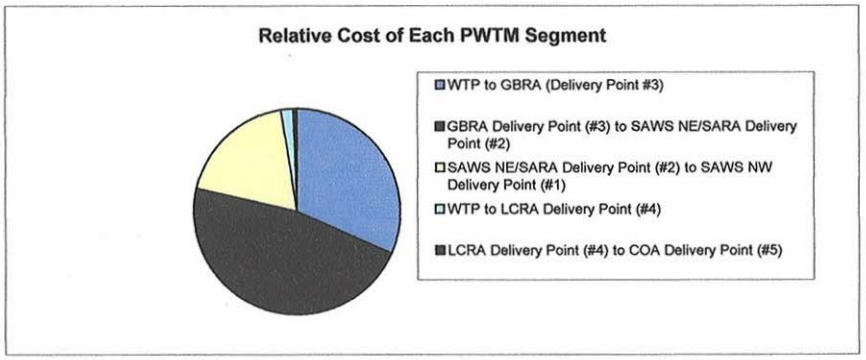
Summary of Demands

Average demands to be delivered in each segment in acre-feet/year

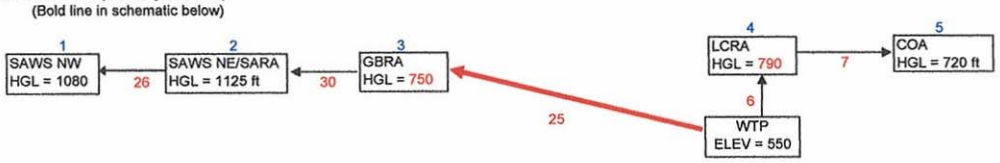
Year	2015	2020	2030	2040	2050	2060	2065
SAWS NW	43800	123000	123000	123000	123000	123000	123000
SAWS NE	29200	82000	82000	82000	82000	82000	82000
Subtotal	73000	205000	205000	205000	205000	205000	205000
SARA	20550	23406	28433	31393	34411	37530	41128
GBRA			6000	8000	10000	12300	12300
LCRA			5600	11200	11200	11200	11200
COA			16802	22403	33604	33604	33604
Total	93550	228406	261835	277996	294215	299634	303232

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
WTP to GBRA (Delivery Point #3)	$ 179	$ 177	$ 356
GBRA Delivery Point (#3) to SAWS NE/SARA Delivery Point (#2)	$ 268	$ 263	$ 532
SAWS NE/SARA Delivery Point (#2) to SAWS NW Delivery Point (#1)	$ 207	$ 5	$ 211
WTP to LCRA Delivery Point (#4)	$ 11	$ 12	$ 23
LCRA Delivery Point (#4) to COA Delivery Point (#5)	$ 6	$ 1	$ 7
Total for PWTMs	$ 671	$ 458	$ 1,129



WTP to GBRA (Delivery Point #3)
(Bold line in schematic below)



Note: GBRA & LCRA/COA must have separate PWTMs because GBRA needs unsoftened water and LCRA/COA need softened water.

Demands for this pipe segment

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
GBRA	0	0	5	7	9	11	11	2.0
SAWS NE	26	73	73	73	73	73	73	1.3
SARA	18	21	25	28	31	34	37	1.3
SAWS NW	39	110	110	110	110	110	110	1.3
Total	84	204	214	218	223	227	231	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
GBRA	0	0	11	14	18	22	22
SAWS NE	34	95	95	95	95	95	95
SARA	24	27	33	36	40	44	48
SAWS NW	51	143	143	143	143	143	143
Total	109	265	282	289	296	303	308

PWTM and Pump Station Costs

Design flow rate - year 2065	308	mgd	
	213,603	gpm	
Pumping capacity of one pump	21,500	gpm	
No. of pumps (not counting spare)	10		
Peak flow rate (all pumps except spare)	215,000	gpm	
Inside diameter of PWTM	120	in.	
Area	78.54	sf	
Length of PWTM	25	miles	(linked to mileage in schematic above)
	132,000	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	100%	132,000	$ 783	$ 103.3	million
Rural - rock	0%	-	$ 1,048	$ -	
Urban - rock	0%	-	$ 1,186	$ -	
		132,000		$ 103.3	million
Average estimated unit construction cost for PWTM			$ 783	per LF	

Total construction cost in millions	$	103.3	
Contingencies	$	20.7	
Subtotal	$	124.0	
Engineering, Legal & Administrative	$	18.6	
Subtotal	$	142.6	
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$	2.5	
Total Capital Cost for PWTM in millions	$	145.1	

Unit maintenance cost/year-mile	$	10,000	$/year-mile	$ 0.250	Million $/year

Velocity at peak flow rate	6.10	fps		
C factor	120			
Head loss per foot	0.00083	ft/ft	$h_f = \frac{3.552*Q}{C*(d)^{2.63}}^{1.85}$	
	4.40	ft/mile		
Head loss at peak flow rate	110	ft		
Allowance for minor losses 20%	22	ft	750	Desired HGL At Delivery Point
Total estimated losses	132	ft	550	Elev. At WTP
Average static head	200	ft	200	ft
Total estimated dynamic head	332	ft		
	144	psi		
No of recommended pumping stations along route	0.96		150	psi (assumed max pressure
No. of pumping stations used in cost estimate	1			in pipe)
Average head per pump station	332	ft		
Assumed pump efficiency	85%			
Assumed motor efficiency	90%			
Estimated Hp required per pump	2,356	hp/pump		
	1,757	kw/pump		
Total hp per pump station (not counting spare)	23,559	firm hp/station		
Total kw per pump set (set=pumps in series along route)	2,356	kw/pump set	(one pump at each station)	
Unit capital cost for each pump station (from cost curve)	$ 1,047	per firm hp of pump station		
Construction cost per pump station	24.7	million		
Total construction cost for pump stations	24.7	for 1	pump stations	

Contingencies	$ 4.9	
Subtotal	$ 29.6	
Engineering, Legal & Administrative	$ 4.4	
Total capital cost for pump stations	$ 34.0	million

40% Estimated equipment cost as % of total

Value of equipment	$ 10	million
Assumed life of equipment	20	years
Estimated maintenance/replacement cost	$ 0.49	million/year

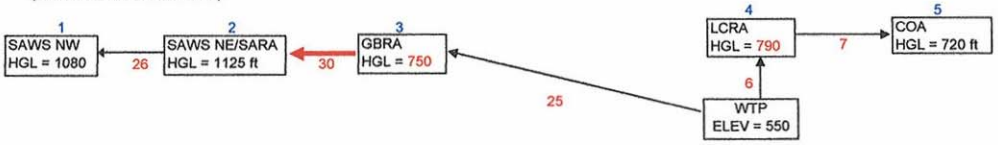
O&M Costs

Year	Flow pumped by year (average flows from Table above)	No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - PWTM	Total O&M cost	Net present value
	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	84	2.70	152,511	$ 10,676	$ 3.90	$ 0.49	$ 0.250	$ 4.64	$ 4.64
2016	84	2.70	152,511	$ 10,676	$ 3.90	$ 0.49	$ 0.250	$ 4.64	$ 4.42
2017	84	2.70	152,511	$ 10,676	$ 3.90	$ 0.49	$ 0.250	$ 4.64	$ 4.21
2018	84	2.70	152,511	$ 10,676	$ 3.90	$ 0.49	$ 0.250	$ 4.64	$ 4.01
2019	84	2.70	152,511	$ 10,676	$ 3.90	$ 0.49	$ 0.250	$ 4.64	$ 3.82
2020	204	6.59	372,362	$ 26,065	$ 9.51	$ 0.49	$ 0.250	$ 10.26	$ 8.04
2021	204	6.59	372,362	$ 26,065	$ 9.51	$ 0.49	$ 0.250	$ 10.26	$ 7.65
2022	204	6.59	372,362	$ 26,065	$ 9.51	$ 0.49	$ 0.250	$ 10.26	$ 7.29
2023	204	6.59	372,362	$ 26,065	$ 9.51	$ 0.49	$ 0.250	$ 10.26	$ 6.94
2024	204	6.59	372,362	$ 26,065	$ 9.51	$ 0.49	$ 0.250	$ 10.26	$ 6.61
2025	204	6.59	372,362	$ 26,065	$ 9.51	$ 0.49	$ 0.250	$ 10.26	$ 6.30
2026	204	6.59	372,362	$ 26,065	$ 9.51	$ 0.49	$ 0.250	$ 10.26	$ 6.00
2027	204	6.59	372,362	$ 26,065	$ 9.51	$ 0.49	$ 0.250	$ 10.26	$ 5.71
2028	204	6.59	372,362	$ 26,065	$ 9.51	$ 0.49	$ 0.250	$ 10.26	$ 5.44
2029	204	6.59	372,362	$ 26,065	$ 9.51	$ 0.49	$ 0.250	$ 10.26	$ 5.18
2030	214	6.90	390,339	$ 27,324	$ 9.97	$ 0.49	$ 0.250	$ 10.72	$ 5.15
2031	214	6.90	390,339	$ 27,324	$ 9.97	$ 0.49	$ 0.250	$ 10.72	$ 4.91
2032	214	6.90	390,339	$ 27,324	$ 9.97	$ 0.49	$ 0.250	$ 10.72	$ 4.68
2033	214	6.90	390,339	$ 27,324	$ 9.97	$ 0.49	$ 0.250	$ 10.72	$ 4.45
2034	214	6.90	390,339	$ 27,324	$ 9.97	$ 0.49	$ 0.250	$ 10.72	$ 4.24
2035	214	6.90	390,339	$ 27,324	$ 9.97	$ 0.49	$ 0.250	$ 10.72	$ 4.04
2036	214	6.90	390,339	$ 27,324	$ 9.97	$ 0.49	$ 0.250	$ 10.72	$ 3.85
2037	214	6.90	390,339	$ 27,324	$ 9.97	$ 0.49	$ 0.250	$ 10.72	$ 3.66
2038	214	6.90	390,339	$ 27,324	$ 9.97	$ 0.49	$ 0.250	$ 10.72	$ 3.49
2039	214	6.90	390,339	$ 27,324	$ 9.97	$ 0.49	$ 0.250	$ 10.72	$ 3.32
2040	218	7.05	398,425	$ 27,890	$ 10.18	$ 0.49	$ 0.250	$ 10.92	$ 3.23
2041	218	7.05	398,425	$ 27,890	$ 10.18	$ 0.49	$ 0.250	$ 10.92	$ 3.07
2042	218	7.05	398,425	$ 27,890	$ 10.18	$ 0.49	$ 0.250	$ 10.92	$ 2.93
2043	218	7.05	398,425	$ 27,890	$ 10.18	$ 0.49	$ 0.250	$ 10.92	$ 2.79
2044	218	7.05	398,425	$ 27,890	$ 10.18	$ 0.49	$ 0.250	$ 10.92	$ 2.65
2045	218	7.05	398,425	$ 27,890	$ 10.18	$ 0.49	$ 0.250	$ 10.92	$ 2.53
2046	218	7.05	398,425	$ 27,890	$ 10.18	$ 0.49	$ 0.250	$ 10.92	$ 2.41
2047	218	7.05	398,425	$ 27,890	$ 10.18	$ 0.49	$ 0.250	$ 10.92	$ 2.29
2048	218	7.05	398,425	$ 27,890	$ 10.18	$ 0.49	$ 0.250	$ 10.92	$ 2.18
2049	218	7.05	398,425	$ 27,890	$ 10.18	$ 0.49	$ 0.250	$ 10.92	$ 2.08
2050	223	7.19	406,605	$ 28,462	$ 10.39	$ 0.49	$ 0.250	$ 11.13	$ 2.02
2051	223	7.19	406,605	$ 28,462	$ 10.39	$ 0.49	$ 0.250	$ 11.13	$ 1.92
2052	223	7.19	406,605	$ 28,462	$ 10.39	$ 0.49	$ 0.250	$ 11.13	$ 1.83
2053	223	7.19	406,605	$ 28,462	$ 10.39	$ 0.49	$ 0.250	$ 11.13	$ 1.74
2054	223	7.19	406,605	$ 28,462	$ 10.39	$ 0.49	$ 0.250	$ 11.13	$ 1.66
2055	223	7.19	406,605	$ 28,462	$ 10.39	$ 0.49	$ 0.250	$ 11.13	$ 1.58
2056	223	7.19	406,605	$ 28,462	$ 10.39	$ 0.49	$ 0.250	$ 11.13	$ 1.51
2057	223	7.19	406,605	$ 28,462	$ 10.39	$ 0.49	$ 0.250	$ 11.13	$ 1.43
2058	223	7.19	406,605	$ 28,462	$ 10.39	$ 0.49	$ 0.250	$ 11.13	$ 1.37
2059	223	7.19	406,605	$ 28,462	$ 10.39	$ 0.49	$ 0.250	$ 11.13	$ 1.30
2060	227	7.35	415,440	$ 29,081	$ 10.61	$ 0.49	$ 0.250	$ 11.36	$ 1.26
2061	227	7.35	415,440	$ 29,081	$ 10.61	$ 0.49	$ 0.250	$ 11.36	$ 1.20
2062	227	7.35	415,440	$ 29,081	$ 10.61	$ 0.49	$ 0.250	$ 11.36	$ 1.15
2063	227	7.35	415,440	$ 29,081	$ 10.61	$ 0.49	$ 0.250	$ 11.36	$ 1.09
2064	227	7.35	415,440	$ 29,081	$ 10.61	$ 0.49	$ 0.250	$ 11.36	$ 1.04
2065	231	7.45	421,305	$ 29,491	$ 10.76	$ 0.49	$ 0.250	$ 11.51	$ 1.00
								Total NPV of O&M Costs	$ 177

Capital Costs in million $:		Yr built		
PWTM	$ 145	2015		$ 145
Pumping Stations	$ 34	2015		$ 34
			Total NPV of Capital Costs	$ 179

Total NPV of Capital and O&M Costs in millions $ 356
WTP to GBRA (Delivery Point #3)

GBRA Delivery Point (#3) to SAWS NE/SARA Delivery Point (#2)
(Bold line in schematic below)



Note: GBRA & LCRA/COA must have separate PWTMs because GBRA needs unsoftened water and LCRA/COA need softened water.

Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
SAWS NE	26	73	73	73	73	73	73	1.3
SARA	18	21	25	28	31	34	37	1.3
SAWS NW	39	110	110	110	110	110	110	1.3
Total	84	204	208	211	214	217	220	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
SAWS NE	34	95	95	95	95	95	95
SARA	24	27	33	36	40	44	48
SAWS NW	51	143	143	143	143	143	143
Total	109	265	271	274	278	281	286

PWTM and Pump Station Costs

Design flow rate - year 2065	286	mgd	
	198,353	gpm	
Pumping capacity of one pump	20,000	gpm	
No. of pumps (not counting spare)	10		
Peak flow rate (all pumps except spare)	200,000	gpm	
Inside diameter of PWTM	120	in.	
Area	78.54	sf	
Length of PWTM	30	miles	(linked to mileage in schematic above)
	158,400	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	50%	79,200	$ 783	$ 62.0	million
Rural - rock	25%	39,600	$ 1,048	$ 41.5	
Urban - rock	25%	39,600	$ 1,186	$ 46.9	
		158,400		$ 150.5	million
Average estimated unit construction cost for PWTM			$ 950	per LF	

Total construction cost in millions		$ 150.5			
Contingencies		$ 30.1			
Subtotal		$ 180.6			
Engineering, Legal & Administrative		$ 27.1			
Subtotal		$ 207.6			
Envir & Arch Studies & Mitigation, Surveying, & Land Acq		$ 3.0			
Total Capital Cost for PWTM in millions		$ 210.6			
Unit maintenance cost/year-mile		$ 10,000	$/year-mile	$ 0.300	Million $/year
Velocity at peak flow rate		5.67	fps		
C factor		120			
Head loss per foot		0.00073	ft/ft	$h_f = \lvert 3.552*Q \rvert^{1.85} / \lvert C*(d)^{2.63} \rvert$	
		3.85	ft/mile		
Head loss at peak flow rate		115	ft		
Allowance for minor losses	20%	23	ft	1125	Desired HGL At Delivery Point
Total estimated losses		139	ft	750	HGL At Delivery Point 3
Average static head		375	ft	375	ft
Total estimated dynamic head		514	ft		
		223	psi		
No of recommended pumping stations along route		1.48		150	psi (assumed max pressure in pipe)
No. of pumping stations used in cost estimate		2			
Average head per pump station		257	ft		
Assumed pump efficiency		85%			
Assumed motor efficiency		90%			
Estimated Hp required per pump		1,695	hp/pump		
		1,265	kw/pump		
Total hp per pump station (not counting spare)		16,951	firm hp/station		
Total kw per pump set (set=pumps in series along route)		3,390	kw/pump set	(one pump at each station)	
Unit construction cost for each pump station (from cost curve)		$ 1,127	per firm hp of pump station		
Construction cost per pump station		19.1	million		
Total construction cost for pump stations		38.2	for 2 pump stations		

Contingencies	$	7.6	
Subtotal	$	45.9	
Engineering, Legal & Administrative	$	6.9	
Total capital cost for pump stations in millions	$	52.7	million
			40% Equip cost as % of constr cost
Value of equipment	$	15	million
Assumed life of equipment		20	years
Estimated maintenance/replacement cost	$	0.76	million/year

O&M Costs

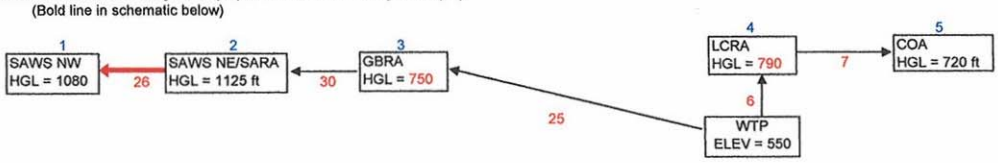
Year	Flow pumped by year (average flows from Table above)	No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - PWTM	Total O&M cost	Net present value
	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	84	2.90	235,928	$ 16,515	$ 6.03	$ 0.76	$ 0.300	$ 7.09	$ 7.09
2016	84	2.90	235,928	$ 16,515	$ 6.03	$ 0.76	$ 0.300	$ 7.09	$ 6.75
2017	84	2.90	235,928	$ 16,515	$ 6.03	$ 0.76	$ 0.300	$ 7.09	$ 6.43
2018	84	2.90	235,928	$ 16,515	$ 6.03	$ 0.76	$ 0.300	$ 7.09	$ 6.13
2019	84	2.90	235,928	$ 16,515	$ 6.03	$ 0.76	$ 0.300	$ 7.09	$ 5.83
2020	204	7.08	576,028	$ 40,322	$ 14.72	$ 0.76	$ 0.300	$ 15.78	$ 12.37
2021	204	7.08	576,028	$ 40,322	$ 14.72	$ 0.76	$ 0.300	$ 15.78	$ 11.78
2022	204	7.08	576,028	$ 40,322	$ 14.72	$ 0.76	$ 0.300	$ 15.78	$ 11.22
2023	204	7.08	576,028	$ 40,322	$ 14.72	$ 0.76	$ 0.300	$ 15.78	$ 10.68
2024	204	7.08	576,028	$ 40,322	$ 14.72	$ 0.76	$ 0.300	$ 15.78	$ 10.17
2025	204	7.08	576,028	$ 40,322	$ 14.72	$ 0.76	$ 0.300	$ 15.78	$ 9.69
2026	204	7.08	576,028	$ 40,322	$ 14.72	$ 0.76	$ 0.300	$ 15.78	$ 9.23
2027	204	7.08	576,028	$ 40,322	$ 14.72	$ 0.76	$ 0.300	$ 15.78	$ 8.79
2028	204	7.08	576,028	$ 40,322	$ 14.72	$ 0.76	$ 0.300	$ 15.78	$ 8.37
2029	204	7.08	576,028	$ 40,322	$ 14.72	$ 0.76	$ 0.300	$ 15.78	$ 7.97
2030	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 7.75
2031	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 7.38
2032	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 7.03
2033	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 6.69
2034	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 6.37
2035	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 6.07
2036	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 5.78
2037	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 5.51
2038	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 5.24
2039	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 4.99
2040	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 4.81
2041	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 4.58
2042	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 4.36
2043	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 4.16
2044	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 3.96
2045	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 3.77
2046	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 3.59
2047	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 3.42
2048	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 3.26
2049	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 3.10
2050	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.99
2051	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.85
2052	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.71
2053	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.58
2054	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.46
2055	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.34
2056	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.23
2057	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.12
2058	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.02
2059	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 1.93
2060	217	7.52	611,648	$ 42,815	$ 15.63	$ 0.76	$ 0.300	$ 16.69	$ 1.86
2061	217	7.52	611,648	$ 42,815	$ 15.63	$ 0.76	$ 0.300	$ 16.69	$ 1.77
2062	217	7.52	611,648	$ 42,815	$ 15.63	$ 0.76	$ 0.300	$ 16.69	$ 1.69
2063	217	7.52	611,648	$ 42,815	$ 15.63	$ 0.76	$ 0.300	$ 16.69	$ 1.60
2064	217	7.52	611,648	$ 42,815	$ 15.63	$ 0.76	$ 0.300	$ 16.69	$ 1.53
2065	220	7.63	620,722	$ 43,451	$ 15.86	$ 0.76	$ 0.300	$ 16.92	$ 1.48
							Total NPV of O&M Costs		$ 268.5

Capital Costs in million $:		Yr built		
PWTM	$ 210.6	2015		$ 210.6
Pumping Stations	$ 52.7	2015		$ 52.7
			Total NPV of Capital Costs	$ 263.4

Total NPV of Capital and O&M Costs in millions $ 532

GBRA Delivery Point (#3) to SAWS NE/SARA Delivery Point (#2)

SAWS NE/SARA Delivery Point (#2) to SAWS NW Delivery Point (#1)
(Bold line in schematic below)



Note: GBRA & LCRA/COA must have separate PWTMs because GBRA needs unsoftened water and LCRA/COA need softened water.

Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
SAWS NW	39	110	110	110	110	110	110	1.3
Total	39	110	110	110	110	110	110	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
SAWS NW	51	143	143	143	143	143	143
Total	51	143	143	143	143	143	143

PWTM and Pump Station Costs

Design flow rate - year 2065	143	mgd	
	99,125	gpm	
Pumping capacity of one pump	20,000	gpm	
No. of pumps (not counting spare)	5		
Peak flow rate (all pumps except spare)	100,000	gpm	
Inside diameter of PWTM	120	in.	
Area	78.54	sf	
Length of RWTM	26	miles	(linked to mileage in schematic above)
	137,280	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	15%	20,592	$ 783	$ 16.1	million
Rural - rock	35%	48,048	$ 1,048	$ 50.4	
Urban - rock	50%	68,640	$ 1,186	$ 81.4	
		137,280		$ 147.9	million
Average estimated unit construction cost for PWTM			$ 1,077	per LF	

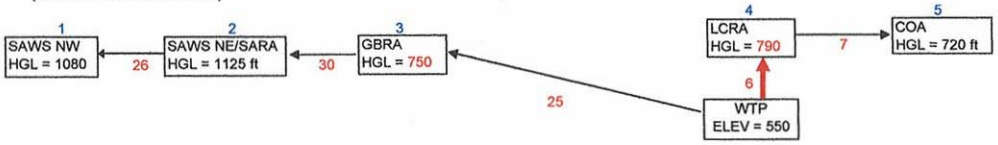
Total construction cost in millions	$	147.9		
Contingencies	$	29.6		
Subtotal	$	177.4		
Engineering, Legal & Administrative	$	26.6		
Subtotal	$	204.1		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$	2.6		
Total Capital Cost for PWTM in millions	$	206.7		
Unit maintenance cost/year-mile	$	10,000	$/year-mile	$ 0.260 Million $/year
Velocity at peak flow rate		2.84	fps	
C factor		120		
Head loss per foot		0.00020	ft/ft	$h_f = \left\| \frac{3.552*Q}{C*(d)^{2.63}} \right\|^{1.85}$
		1.07	ft/mile	
Head loss at peak flow rate		28	ft	
Allowance for minor losses	20%	6	ft	1080 Desired HGL At Delivery Point
Total estimated losses		33	ft	1125 HGL At Delivery Point 2
Average static head		-45	ft	-45 ft
Total estimated dynamic head		-12	ft	
		-5	psi	

Negative indicates gravity flow from #2 to #1; no pumping necessary.

			Million $
Annual O&M Cost in million $:		Yr built	
PWTM	$ 0.260	2015	
Total NPV of O&M Costs			$4.7
Capital Costs in million $:		Yr built	
PWTM	$ 206.7	2015	$ 206.7
Total NPV of Capital Costs			$ 206.7

Total NPV of Capital and O&M Costs in millions $ 211.4
SAWS NE/SARA Delivery Point (#2) to SAWS NW Delivery Point (#1)

WTP to LCRA Delivery Point (#4)
(Bold line in schematic below)



Note: GBRA & LCRA/COA must have separate PWTMs because GBRA needs unsoftened water and LCRA/COA need softened water.

Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
LCRA	0	0	5	10	10	10	10	2.0
COA	0	0	15	20	30	30	30	1.68
Total	0	0	20	30	40	40	40	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
LCRA	0	0	10	20	20	20	20
COA	0	0	25	34	50	50	50
Total	0	0	35	54	70	70	70

PWTM and Pump Station Costs

Design flow rate - year 2065	70	mgd	
	48,883	gpm	
Pumping capacity of one pump	10,000	gpm	
No. of pumps (not counting spare)	5		
Peak flow rate (all pumps except spare)	50,000	gpm	
Inside diameter of PWTM	60	in.	
Area	19.64	sf	
Length of RWTM	6	miles	(linked to mileage in schematic above)
	31,680	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	100%	31,680	$ 282	$ 8.9	million
Rural - rock	0%	-	$ 388	$ -	
Urban - rock	0%	-	$ 427	$ -	
		31,680		$ 8.9	million
Average estimated unit construction cost for PWTM			$ 282	per LF	

Total construction cost in millions	$ 8.9		
Contingencies	$ 1.8		
Subtotal	$ 10.7		
Engineering, Legal & Administrative	$ 1.6		
Subtotal	$ 12.3		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 0.6		
Total Capital Cost for PWTM in millions	$ 12.9		
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.060 Million $/year
Velocity at peak flow rate	5.67	fps	
C factor	120		
Head loss per foot	0.00163	ft/ft	$h_f = \frac{3.552*Q^{1.85}}{C*(d)^{2.63}}$
	8.63	ft/mile	
Head loss at peak flow rate	52	ft	
Allowance for minor losses 20%	10	ft	790 Desired HGL At Delivery Point
Total estimated losses	62	ft	550 Elev. At WTP
Average static head	240	ft	240 ft
Total estimated dynamic head	302	ft	
	131	psi	
No of recommended pumping stations along route	0.87		150 psi (assumed max pressure in pipe)
No. of pumping stations used in cost estimate	1		
Average head per pump station	302	ft	
Assumed pump efficiency	85%		
Assumed motor efficiency	90%		
Estimated Hp required per pump	997	hp/pump	
	744	kw/pump	
Total hp per pump station (not counting spare)	4,987	firm hp/station	
Total kw per pump set (set=pumps in series along route)	997	kw/pump set	(one pump at each station)
Unit construction cost for each pump station (from cost curve)	$ 1,426	per firm hp of pump station	
Construction cost per pump station	7.1	million	
Total construction cost for pump stations	7.1		for 1 pump stations
Contingencies	$ 1.4		
Subtotal	$ 8.5		
Engineering, Legal & Administrative	$ 1.3		

Total capital cost for pump stations	$	9.8	million
		40%	Equip cost as % of constr cost
Value of equipment	$	2.8	million
Assumed life of equipment		20	years
Estimated maintenance/replacement cost	$	0.14	million/year

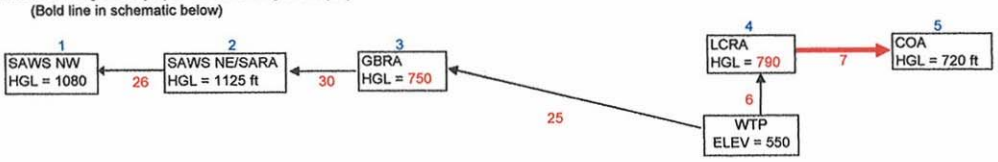
O&M Costs

Year	Flow pumped by year (average flows from Table above)	No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - PWTM	Total O&M cost	Net present value
	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015								$ -	$ -
2016								$ -	$ -
2017								$ -	$ -
2018								$ -	$ -
2019								$ -	$ -
2020								$ -	$ -
2021								$ -	$ -
2022								$ -	$ -
2023								$ -	$ -
2024								$ -	$ -
2025								$ -	$ -
2026								$ -	$ -
2027								$ -	$ -
2028								$ -	$ -
2029								$ -	$ -
2030	20	1.39	33,241	$ 2,327	$ 0.85	$ 0.14	$ 0.060	$ 1.05	$ 0.51
2031	20	1.39	33,241	$ 2,327	$ 0.85	$ 0.14	$ 0.060	$ 1.05	$ 0.48
2032	20	1.39	33,241	$ 2,327	$ 0.85	$ 0.14	$ 0.060	$ 1.05	$ 0.46
2033	20	1.39	33,241	$ 2,327	$ 0.85	$ 0.14	$ 0.060	$ 1.05	$ 0.44
2034	20	1.39	33,241	$ 2,327	$ 0.85	$ 0.14	$ 0.060	$ 1.05	$ 0.42
2035	20	1.39	33,241	$ 2,327	$ 0.85	$ 0.14	$ 0.060	$ 1.05	$ 0.40
2036	20	1.39	33,241	$ 2,327	$ 0.85	$ 0.14	$ 0.060	$ 1.05	$ 0.38
2037	20	1.39	33,241	$ 2,327	$ 0.85	$ 0.14	$ 0.060	$ 1.05	$ 0.36
2038	20	1.39	33,241	$ 2,327	$ 0.85	$ 0.14	$ 0.060	$ 1.05	$ 0.34
2039	20	1.39	33,241	$ 2,327	$ 0.85	$ 0.14	$ 0.060	$ 1.05	$ 0.33
2040	30	2.08	49,862	$ 3,490	$ 1.27	$ 0.14	$ 0.060	$ 1.48	$ 0.44
2041	30	2.08	49,862	$ 3,490	$ 1.27	$ 0.14	$ 0.060	$ 1.48	$ 0.42
2042	30	2.08	49,862	$ 3,490	$ 1.27	$ 0.14	$ 0.060	$ 1.48	$ 0.40
2043	30	2.08	49,862	$ 3,490	$ 1.27	$ 0.14	$ 0.060	$ 1.48	$ 0.38
2044	30	2.08	49,862	$ 3,490	$ 1.27	$ 0.14	$ 0.060	$ 1.48	$ 0.36
2045	30	2.08	49,862	$ 3,490	$ 1.27	$ 0.14	$ 0.060	$ 1.48	$ 0.34
2046	30	2.08	49,862	$ 3,490	$ 1.27	$ 0.14	$ 0.060	$ 1.48	$ 0.33
2047	30	2.08	49,862	$ 3,490	$ 1.27	$ 0.14	$ 0.060	$ 1.48	$ 0.31
2048	30	2.08	49,862	$ 3,490	$ 1.27	$ 0.14	$ 0.060	$ 1.48	$ 0.30
2049	30	2.08	49,862	$ 3,490	$ 1.27	$ 0.14	$ 0.060	$ 1.48	$ 0.28
2050	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.34
2051	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.33
2052	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.31
2053	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.30
2054	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.28
2055	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.27
2056	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.26
2057	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.24
2058	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.23
2059	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.22
2060	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.21
2061	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.20
2062	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.19
2063	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.18
2064	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.17
2065	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.17
								Total NPV of O&M Costs	$ 11.6

Capital Costs in million $:			Yr built		
PWTM	$	12.9	2030		$ 6.2
Pumping Stations	$	9.8	2030		$ 4.7
				Total NPV of Capital Costs	$ 10.9

Total NPV of Capital and O&M Costs in millions $ 23
WTP to LCRA Delivery Point (#4)

LCRA Delivery Point (#4) to COA Delivery Point (#5)
(Bold line in schematic below)



Note: GBRA & LCRA/COA must have separate PWTMs because GBRA needs unsoftened water and LCRA/COA need softened water.

Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
COA	0	0	15	20	30	30	30	1.68
Total	0	0	15	20	30	30	30	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
COA	0	0	25	34	50	50	50
Total	0	0	25	34	50	50	50

PWTM and Pump Station Costs

Design flow rate - year 2065	50	mgd	
	34,997	gpm	
Inside diameter of PWTM	54	in.	
Area	15.90	sf	
Length of PWTM	7	miles	(linked to mileage in schematic above)
	36,960	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	100%	36,960	$ 244	$ 9.0	million
Rural - rock	0%	-	$ 337	$ -	
Urban - rock	0%	-	$ 369	$ -	
		36,960		$ 9.0	million
Average estimated unit construction cost for PWTM			$ 244	per LF	

Total construction cost in millions	$	9.0		
Contingencies	$	1.8		
Subtotal	$	10.8		
Engineering, Legal & Administrative	$	1.6		
Subtotal	$	12.4		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$	0.0		
Total Capital Cost for PWTM in millions	$	12.4		
Unit maintenance cost/year-mile	$	10,000	$/year-mile	$ 0.070 Million $/year
Velocity at peak flow rate		4.90	fps	
C factor		120		
Head loss per foot		0.00141	ft/ft	$h_f = \left\| \frac{3.552*Q}{C*(d)^{2.63}} \right\|^{1.85}$
		7.45	ft/mile	
Head loss at peak flow rate		52	ft	
Allowance for minor losses	20%	10	ft	720 Desired HGL At Delivery Point
Total estimated losses		63	ft	790 Elev. At Delivery Point 4
Average static head		-70	ft	-70 ft
Total estimated dynamic head		-7	ft	
		-3	psi	

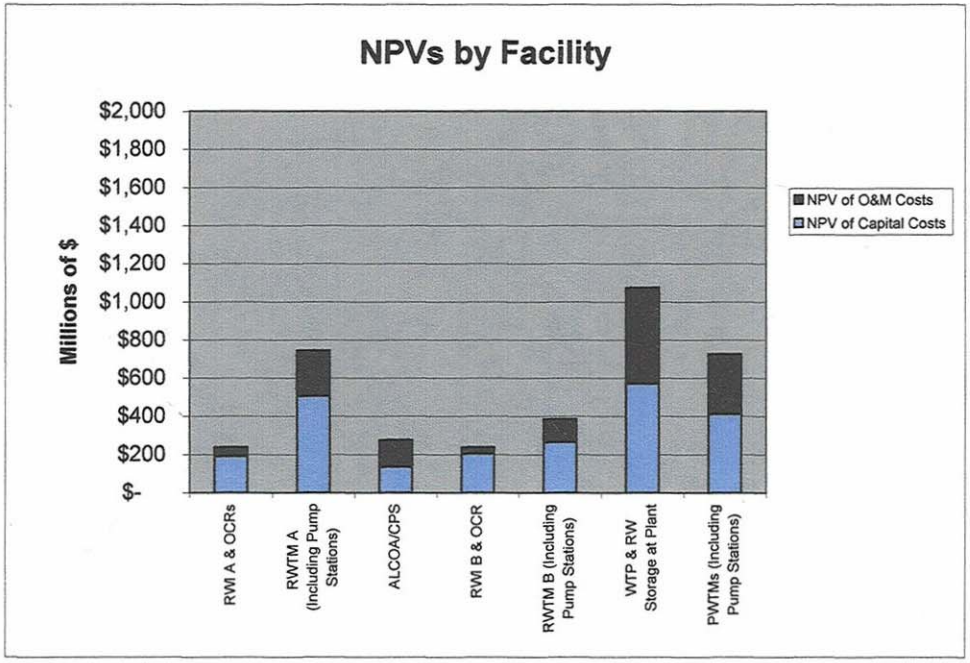
Negative indicates gravity flow from #4 to #5; no pumping necessary.

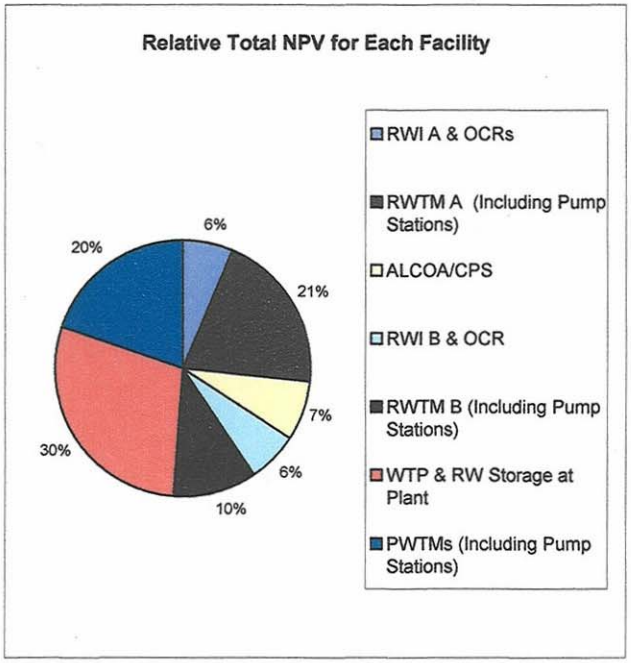
			Million $
Annual O&M Cost in million $:		Yr built	
PWTM	$ 0.070	2030	
Total NPV of O&M Costs			$0.6
Capital Costs in million $:		Yr built	
PWTM	$ 12.4	2030	
			$ 6.0
Total NPV of Capital Costs			$ 6.0
Total NPV of Capital and O&M Costs in millions			**$ 6.5**

LCRA Delivery Point (#4) to COA Delivery Point (#5)

CTRWTP - Alternate 1B - WTP East of San Antonio

WTP Location	Alter-nate	Phasing Scenario	Total NPVs in Millions of $	RWI A & OCRs	RWTM A (Including Pump Stations)	ALCOA/CPS	RWI B & OCR	RWTM B (Including Pump Stations)	WTP & RW Storage at Plant	PWTMs (Including Pump Stations)
East of San Antonio	1B	RWTM B & ALCOA/CPS built by 2015; RWTM A built in 2020.		Sized for 4000 cfs to scalp water; 4 intakes, 4 miles of 120-inch raw water mains & 4 OCRs at 25,000 ac-ft each	142 miles of 96-inch diameter pipe sized to deliver 132,000 ac-ft/year on a continuous basis; includes 3 pumping stations w/ balancing reservoirs along route	Non-public wells; Transmission of 55,000 ac-ft/year to the OCR at RWI B via 15 miles of 54" gravity pipeline from Hwy 290 east of Elgin	Sized for 2000 cfs to scalp water; 2 intakes; 8 miles of 120-inch raw water mains and 4 OCRs at 15,000 ac-ft/each	Sized for 117,804 ac-ft/yr; 68 miles of 84" pipeline with two pumping stations and balancing reservoirs	Raw water reservoir w/ 11,000 ac-ft capacity; Conventional settling with membrane filtration for SAWS, SARA & GBRA; Lime softening with membrane filtration for COA & LCRA water	Each PWTM sized for maximum daily demand (See PWTM Summary Sheet in the Appendices)
		NPV of Capital Costs	$ 2,286	$ 191	$ 507	$ 135	$ 204	$ 265	$ 572	$ 412
		NPV of O&M Costs	$ 1,397	$ 47	$ 238	$ 141	$ 34	$ 122	$ 502	$ 313
		Total NPV of Capital & O&M	$ **3,682**	$ 238	$ 745	$ 276	$ 238	$ 386	$ 1,075	$ 726





O&M Cost Calculations
RWI A - Matagorda Co. River Intakes, and Storage
CTRWTP

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile
			or =	$ 5,000	per acre

Inflatable Rubber Low Head Dam

	Quantity	Units	Size	Unit Constr. Cost (millions)	Total Estimated Constr. Cost (millions)	Contigency, Eng., etc. (millions)	Total Capital Cost (millions)
Inflatable Rubber Low Head Dam	4	each	10 ft high	$ 2.25	$ 9.00	$ 3.42	$ 12.42

Estimated inflatable dam cost as % of total	50%		
Value of inflatable dam	$ 4.50	million	
Assumed life of inflatable dam	10	years	
Estimated maintenance/replacement cost	$ 0.45	million/year	
Year built	2020		
NPV of O&M Costs	$6.27	million	
NPV of Capital Costs	$ 9.73	million	
Total NPV of Capital and O&M Costs	$16.00	million	

Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)

Average withdrawal	132,000	ac-ft/year			
	182	cfs			
			21.9	Ratio of design withdrawal rate to Total intake design withdrawal rate	
Total intake design withdrawal rate (for scalping high flows	4,000	cfs			
	1,795,200	gpm			
No. of intakes	4				
Design withdrawal rate per intake	1,000	cfs			
	448,800	gpm			
No. of reservoirs	4				
Design flow to each reservoir	448,800	gpm			
Inside diameter of each RWTM	120	in.			
Area	78.54	sf			
Average length of each RWTM	1	miles	4.0	miles for all RWTMs	
	5,280	feet	21,120	feet	
Estimated construction cost for RWTM	$ 793	per LF		$ 1,254	
Total construction cost in millions	$ 16.8				
Contingencies	$ 3.4				
Subtotal	$ 20.1				
Engineering, Legal & Administrative	$ 3.0				
Subtotal	$ 23.1				
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 0.4				
Total Capital Cost for PWTM in millions	$ 23.5	million			
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.040	Million $/year (all RWTMs to Reservoirs)	

Note: Assume each intake has two RWTMs pumping out of it, one to each reservoir.

Design flow rate for each RWTM (from above)	448,800	gpm			
Pumping rate (one pump)	50,000	gpm			
No. of pumps (not counting spare) pumping into each RW	9				
Peak flow rate into each RWTM (all pumps except spare)	450,000	gpm			
Velocity at peak flow rate	12.77	fps			
C factor	120				
Head loss per foot	0.00327	ft/ft	$h_f = \lvert \frac{3.552 * Q \rvert^{1.85}}{\lvert C * (d)^{2.63} \rvert}$		
	17.25	ft/mile			
Head loss at peak flow rate	17	ft			
Allowance for minor losses 30%	5	ft	90	Elev of discharge at reservoir	
Total estimated losses	22	ft	50	Water surface elev in river	
Average static head	40	ft	40	ft	
Total estimated dynamic head	62	ft			
	27	psi			
Assumed pump efficiency	85%				
Assumed motor efficiency	90%				
Estimated Hp required per pump	1,030	hp/pump			
	769	kw/pump			
Total hp pumping into each RWTM (not counting spare)	9,272	hp/RWTM			
Total hp at each intake (not counting spare)	9,272	hp/intake			
Total hp all intakes (not counting spares)	37,089	hp			
Total kw all intakes (not counting spares)	27,668	kw			
Unit construction cost for each pump station (from cost cur	$ 889	per firm hp of pump station		$ 1,180	
Construction cost per intake/pump station	8.2	million			
No. of intakes from above	4	each			
Total construction cost in millions	$ 33.0	million			
Contigency, Eng., etc. in millions	$ 12.53	million			
Total capital cost in millions	$ 45.5	million			
Total construction cost for pump stations	$ 33.0	million			
Value of equipment	$ 13.2	million	40%	Estimated equip cost as % of total constr cost	
Assumed life of equipment	20	years			
Estimated maintenance/replacement cost	$ 0.66	million/year			

O&M Costs:

Year	Flow pumped by year		No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	-	-	-	-	$ -	$ -			$ -	$ -
2016	-	-	-	-	$ -	$ -			$ -	$ -
2017	-	-	-	-	$ -	$ -			$ -	$ -
2018	-	-	-	-	$ -	$ -			$ -	$ -
2019	-	-	-	-	$ -	$ -			$ -	$ -
2020	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 1.15
2021	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 1.10
2022	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 1.05
2023	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 1.00
2024	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.95
2025	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.90
2026	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.86
2027	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.82
2028	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.78
2029	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.74
2030	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.71
2031	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.67
2032	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.64
2033	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.61
2034	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.58
2035	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.55
2036	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.53
2037	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.50
2038	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.48
2039	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.46
2040	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.43
2041	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.41
2042	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.39
2043	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.38
2044	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.36
2045	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.34
2046	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.32
2047	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.31
2048	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.29
2049	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.28
2050	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.27
2051	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.25
2052	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.24
2053	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.23
2054	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.22
2055	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.21
2056	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.20
2057	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.19
2058	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.18
2059	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.17
2060	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.16
2061	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.16
2062	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.15
2063	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.14
2064	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.13
2065	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.13
								Total NPV of O&M Costs		$ 21.6

Capital Costs in million $:		Yr built		
RWTM to Reservoirs	$ 23.5	2020		$ 18.4
Intake/Pumping Stations	$ 45.5	2020		$ 35.6
			Total NPV of Capital Costs	$ 54.1

Total NPV of Capital and O&M Costs in millions $ 75.7

Reservoirs

	Quantity	Units	Volume/each (acre-feet)	Unit Cost ($/ac-ft))	Total Construction Cost in millions	Contigency, Eng., etc.	Total in millions
Reservoirs	4	each	25000	$ 974	$ 97.4	$ 37.0	$ 134.4
				$ 909			

Estimated average depth of reservoir	20	ft	
Surface area of reservoir	5000	acres	
Ratio of total land area reqd to surface area of reservoir	1.1		
Total land area reqd for reservoirs	5500	acres	
		Envir & Archaeology, Surv, and Land Acq =	27.5
		Total capital cost in millions =	$ 161.9
Assumed life of reservoir	100	years	
Estimated replacement cost	$ 0.97	million/year	
Estimated maintenance	0.4	million/year	Mowing, maintaining fences, etc.
Total	$ 1.37	million/year	
Year built	2020		
NPV of O&M costs	$ 19.1	million	
NPV of Capital costs	$ 126.8	million	
Total NPV of Capital and O&M Costs	$ 145.9	million	

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Inflatable Rubber Low Head Dam	$ 9.7	$ 6.3	$ 16.0
Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)	$ 54.1	$ 21.6	$ 75.7
Reservoirs	$ 126.8	$ 19.1	$ 145.9
Total for RWI A	$ 190.6	$ 47.0	$ 237.6

O&M Cost Calculations
RWTM A - Matagorda Co. to WTP
CTRWTP - Alternate 1B - WTP East of San Antonio

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

Raw Water Transmission Main - A

Inside diameter of pipe		96	in.			
Area		50.27	sf			
Length of RWTM		142	miles			
		749,760	feet			
Estimated unit construction cost for RWTM	$	567	per LF			
Total construction cost in millions	$	425				
Contingencies	$	85				
Subtotal	$	511				
Engineering, Legal & Administrative	$	77				
Subtotal	$	587				
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$	14				
Total Capital Cost for PWTM in millions	$	601	million			
Unit maintenance cost/year-mile	$	10,000	$/year-mile	$	1.420	Million $/year
Design flow rate (after 100% buildout)		132,000	ac-ft/year			
		118	mgd			
		81,829	gpm			
Pumping rate (one pump)		16,400	gpm			
No. of pumps (not counting spare)		5				
Peak flow rate (all pumps except spare)		82,000	gpm			
Velocity at peak flow rate		3.63	fps			
C factor		120				
Head loss per foot		0.00041	ft/ft	$h_f = \lvert 3.552*Q \rvert^{1.85} / \lvert C*(d)^{2.63} \rvert$		
		2.19	ft/mile			
Head loss at peak flow rate		311	ft			
Allowance for minor losses	10%	31	ft	600	Elev. At San Antonio East WTP	
Total estimated losses		342	ft	90	Elev. At Matagorda OCRs	
Average static head		510	ft	510	ft	
Total estimated dynamic head		852	ft			
		369	psi			
No of pumping stations req'd along route		2.46		150	psi (assumed max pressure	
No. of pumping stations used in cost estimate		3.0			in pipe)	
Average head per pump station		284	ft			
Assumed pump efficiency		85%				
Assumed motor efficiency		90%				
Estimated Hp required per pump		1,537	hp/pump			
		1,147	kw/pump			
Total hp per pump station (not counting spare)		7,687	hp/station			
Total kw per pump set (set=pumps in series along route)		4,612	kw/pump set	(one pump at each station)		
Unit constr. cost for each pump station (from cost curve)	$	1,320	per firm hp of pump station			
Construction cost per pump station	$	10.15	million			
Balancing reservoir	$	0.75	million	60	min. of storage at avg pumping rate	
Total construction cost per pump station	$	10.90	million	5.0	mg	
				$ 0.15	per gal for open top reservoir	
No. of pump stations from above		3.0	each			
Total construction cost in millions	$	32.7	million			
Contigency, Eng., etc. in millions	$	12.42	million			
Total capital cost in millions	$	45.1	million			
Total construction cost for pump stations	$	32.7	million			
Value of equipment	$	13.1	million	40%	Estimated equipment cost as % of total	
Assumed life of equipment		20	years			
Estimated maintenance/replacement cost	$	0.65	million/year			

O&M Costs

Year	Flow pumped by year		No. of pump "sets" operating	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd	/day	(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	-	-	-	-	$ -	$ -			$ -	$ -
2016	-	-	-	-	$ -	$ -			$ -	$ -
2017	-	-	-	-	$ -	$ -			$ -	$ -
2018	-	-	-	-	$ -	$ -			$ -	$ -
2019	-	-	-	-	$ -	$ -			$ -	$ -
2020	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 12.68
2021	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 12.08
2022	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 11.50
2023	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 10.96
2024	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 10.43
2025	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 9.94
2026	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 9.46
2027	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 9.01
2028	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 8.58
2029	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 8.18
2030	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 7.79
2031	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 7.41
2032	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 7.06
2033	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 6.73
2034	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 6.41
2035	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 6.10
2036	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 5.81
2037	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 5.53
2038	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 5.27
2039	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 5.02
2040	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 4.78
2041	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 4.55
2042	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 4.34
2043	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 4.13
2044	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 3.93
2045	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 3.75
2046	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 3.57
2047	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 3.40
2048	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 3.24
2049	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 3.08
2050	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 2.93
2051	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 2.79
2052	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 2.66
2053	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 2.53
2054	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 2.41
2055	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 2.30
2056	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 2.19
2057	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 2.09
2058	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 1.99
2059	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 1.89
2060	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 1.80
2061	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 1.72
2062	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 1.63
2063	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 1.56
2064	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 1.48
2065	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 1.41
								Total NPV of O&M Costs		**$ 238**

Capital Costs in million $:		Yr built		
RWTM	$ 601	2020		$ 471
Pumping Stations	$ 45	2020		$ 35
			Total NPV of Capital Costs	**$ 507**
			Total NPV of Capital and O&M Costs in millions	**$ 745**

NPV CALCULATIONS
ALCOA / CPS GROUNDWATER
###

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

Well Fields and Collection Lines

	ALCOA	CPS	Total
Year built	2015	2015	
Estimated Construction Cost in Millions			
Wells (Based on Non-Public Water Supply Wells)	20.92	7.94	28.86
Pipeline	13.03	5.94	18.97
Pump Stations & Storage	8.51	0	8.51
Subtotal	42.46	13.88	56.34
Contingency	8.49	2.78	11.27
Subtotal	50.95	16.66	67.61
Engineering, Legal & Administrative	6.37	2.08	8.45
Subtotal	57.32	18.74	76.06
Environmental & Archaeology Studies & Mitigation	0.63	0.2	0.83
Land Acquisition & Surveying	0	0	0.00
Groundwater Purchase	0	5.64	5.64
ALCOA Construction Program Management Fee	5.45	0	5.45
Interest During Construction (2 years, 6% int., 4% ret.)	5.89	2.44	8.33
Total Capital Cost	**69.29**	**27.02**	**96.31**
Estimated Annual O&M Costs			
O&M	0.67	0.18	0.85
Pumping Energy	2.41	0.52	2.93
ALCOA Project Management Fees	0.35	0.00	0.35
Purchase of Groundwater	2.00	0.00	2.00
Groundwater District Fees	0.65	0.25	0.90
Mitigation Reserves	0.28	0.11	0.39
Total Annual Cost	**6.36**	**1.06**	**7.42**

NPV of O&M Costs	$ 116	$ 19	$ 135	million
NPV of Capital Costs	$ 69	$ 27	$ 96	million
Total NPV of Capital and O&M Costs for Well Fields	**$ 185**	**$ 46**	**$ 232**	**million**

Cooling of Well Water

Total number of wells in both fields	120	wells	Approximate capacity per wel	300 gpm
Percentage of wells with temperatures > than ___ degrees	5%			36,000 gpm
Estimated number of wells with temperature > ____ degrees	6.0		Rough check	58,072 ac-ft/year

Estimated Capital Costs

Year built	2015		
Number of Packaged Cooling Towers (300 gpm capacity/each)	6.0		
Equipment cost (cooling towers and fans)	$ 60,000		
Installation and contractors mark-up	$ 50,000		
Structural slab	$ 30,000		
Electrical	$ 50,000		
Estimated Unit Construction Cost	$ 190,000	Each	
Total construction cost	$ 1.14	million	
Contingencies	$ 0.23		
Subtotal	$ 1.37		
Engineering, Legal and Admin	$ 0.21		
Total Estimated Capital Cost	$ 1.57		
NPV of Capital Costs	$ 1.57	million	

Estimated O&M Costs

Value of equipment	$ 0.4	million	
Assumed life of equipment	10	years	
Estimated maintenance/replacement cost	$ 0.04	million/year	
Blower Hp per cooling tower	10	Hp	
	7	kw	
Hours of operation	24	hours	
Power consumption per cooling tower	179	kwh per day	
	65,350	kwh per year	
Power cost per cooling tower	$ 4,574	per year	
Total power cost for all cooling towers in millions	$ 0.03	million per year	
Regular operational checks and routine maintenance	$ 6,000	per month for all cooling towers	
	$ 0.07	per year	
Estimated O&M Cost	$ 0.14	million $ per year	
NPV of O&M costs	$ 2.47	million $	

Ground Water Transmission Main and Pump Station (Hwy 290 to Bastrop Intake)

Inside diameter of transmission pipe	54	in.

Area			15.90	sf		
Length of Ground Water TM			15	miles		
			79,200	feet		
Estimated construction cost for GWTM		$	327	per LF		
Total construction cost in millions		$	25.9			
Contingencies		$	5.2			
Subtotal		$	31.1			
Engineering, Legal & Administrative		$	4.7			
Subtotal		$	35.8			
Envir & Arch Studies & Mitigation, Surveying, & Land Acq		$	1.5			
Total Capital Cost for PWTM in millions		$	37.3	million		
Unit maintenance cost/year-mile		$	10,000	$/year-mile	$ 0.150	Million $/year
Design flow rate			55,000	ac-ft/year		
			49	mgd		
			34,095	gpm		
Velocity at peak flow rate			4.78	fps		
C factor			120			
Head loss per foot			0.00134	ft/ft	$h_f = \lvert 3.552*Q \rvert^{1.85} / \lvert C*(d)^{2.63} \rvert$	
			7.10	ft/mile		
Head loss at peak flow rate			106	ft		
Allowance for minor losses	10%		11	ft	400	Elev. At RWI-B
Total estimated losses			117	ft	550	minus Elev. - Storage Tank at Hwy 290
Average static head			-150	ft	-150	ft
Total estimated dynamic head			-33	ft	(intake is lower than tank at Hwy 290)	
			-14	psi		

Negative indicates gravity flow from Hwy 290 to Bastrop Intake; no pumping necessary.

				Million $
Annual O&M Cost in million $:		Yr built		
GWTM	$ 0.150	2015		
			Total NPV of O&M Costs	$ 2.7
Capital Costs in million $:		Yr built		
GWTM	$ 37.3	2015		$ 37.3
			Total NPV of Capital Costs	$ 37.3

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Well Fields and Collection Lines (including tank and pump station at Hwy 290)	**$ 96.3**	**$ 135.5**	**$ 231.8**
Cooling Towers for Selected High Temperature Wells	**$ 1.6**	**$ 2.5**	**$ 4.0**
Ground Water Transmission Main and Pumping Station	**$ 37.3**	**$ 2.7**	**$ 40.0**
Total for ALCOA-CPS	**$ 135.1**	**$ 140.7**	**$ 275.8**

O&M Cost Calculations
RWI B - Colorado River Intake at Bastrop and Off Channel Reservoir
CTRWTP - Alternate 1B - WTP East of San Antonio

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	40	years			
Unit cost of energy	$ 0.07	per kwh	Environmental & Archaeology Studies & Mitigation, Surveying, and Land Acquisition =	$ 100,000	per mile
			or =	$ 5,000	per acre

Inflatable Rubber Low Head Dam

	Quantity	Units	Size	Unit Constr. Cost (millions)	Total Estimated Constr. Cost (millions)	Contigency, Eng., etc. (millions)	Total Capital Cost (millions)
Inflatable Rubber Low Head Dam	2	each	10 ft high	$ 2.25	$ 4.50	$ 1.71	$ 6.21

Estimated inflatable dam cost as % of total	50%		
Value of inflatable dam	$ 2.25	million	
Assumed life of inflatable dam	10	years	
Estimated maintenance/replacement cost	$ 0.23	million/year	
Year built	2015		
NPV of O&M Costs	$ 3.86	million	
NPV of Capital Costs	$ 6.21	million	
Total NPV of Capital and O&M Costs	**$ 10.07**	**million**	

Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)

Summary of withdrawals in acre-feet/year:

Year	2015	2020	2030	2040	2050	2060	2065
For SAWS	18000	18000	18000	18000	18000	18000	18000
LCRA			5600	11200	11200	11200	11200
COA			16802	22403	33604	33604	33604
Total	18000	18000	40402	51603	62804	62804	62804

Ultimate (Y2065) average design withdrawal rate	62,804	ac-ft/year		
	87	cfs		
			23.1	Ratio of design withdrawal rate to Total intake design withdrawal rate
Total intake design withdrawal rate (for scalping high flows)	2,000	cfs		
	897,600	gpm		
No. of Intakes	2			
Design withdrawal rate per intake	1,000	cfs		
	448,800	gpm		
No. of reservoirs	4			
Design flow to each reservoir	224,400	gpm		
Inside diameter of each RWTM	120	in.		
Area	78.54	sf		
Average length of each RWTM	2	miles	8.0	miles for all RWTMs
	10,560	feet	42,240	feet
Estimated construction cost for RWTMs	$ 793	per LF	$ 1,254	
Total construction cost in millions	$ 33.5			
Contingencies	$ 6.7			
Subtotal	$ 40.2			
Engineering, Legal & Administrative	$ 6.0			
Subtotal	$ 46.2			
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 0.8			
Total Capital Cost for PWTM in millions	$ 47.0			
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.080	Million $/year (all RWTMs to Reservoirs)

Note: Assume intake has one RWTM pumping to the reservoir.

Design flow rate for each RWTM (from above)	224,400	gpm		
Pumping rate (one pump)	40,000	gpm		
No. of pumps (not counting spare) pumping into each RWT	6			
Peak flow rate into each RWTM (all pumps except spare)	240,000	gpm		
Velocity at peak flow rate	6.81	fps		
C factor	120			
Head loss per foot	0.00102	ft/ft	$h_f = \left\| \frac{3.552*Q}{C*(d)^{2.63}} \right\|^{1.85}$	
	5.39	ft/mile		
Head loss at peak flow rate	11	ft		
Allowance for minor losses	30%	3 ft	400	Discharge at reservoir
Total estimated losses		14 ft	320	Water surface elev in river
Average static head		80 ft	80	ft
Total estimated dynamic head		94 ft		
		41 psi		
Assumed pump efficiency	85%			
Assumed motor efficiency	90%			
Estimated Hp required per pump	1,241	hp/pump		
	926	kw/pump		

Total hp pumping into each RWTM (not counting spare)	7,448	hp/RWTM	
Total hp at each intake (not counting spare)	14,897	hp/intake	
Total hp all intakes (not counting spares)	29,793	hp	
Total kw all intakes (not counting spares)	22,226	kw	
Unit construction cost for each pump station (from cost cur	$ 889	per firm hp of pump station	$ 830
Construction cost per intake/pump station	13.2	million	
No. of intakes from above	2	each	
Total construction cost in millions	$ 26.5	million	
Contigency, Eng., etc. in millions	$ 10.06	million	
Total capital cost in millions	$ 36.6	million	
Total construction cost for pump stations	$ 26.5	million	40% Estimated equipment cost as % of total
Value of equipment	$ 10.6	million	
Assumed life of equipment	20	years	
Estimated maintenance/replacement cost	$ 0.53	million/year	

O&M Costs:

Year	Flow pumped by year		No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.77
2016	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.73
2017	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.70
2018	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.66
2019	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.63
2020	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.60
2021	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.57
2022	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.55
2023	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.52
2024	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.50
2025	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.47
2026	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.45
2027	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.43
2028	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.41
2029	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.39
2030	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.46
2031	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.44
2032	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.42
2033	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.40
2034	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.38
2035	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.36
2036	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.35
2037	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.33
2038	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.31
2039	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.30
2040	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.31
2041	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.30
2042	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.28
2043	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.27
2044	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.26
2045	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.25
2046	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.23
2047	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.22
2048	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.21
2049	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.20
2050	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.21
2051	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.20
2052	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.19
2053	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.18
2054	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.17
2055	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.17
2056	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.16
2057	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.15
2058	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.14
2059	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.14
2060	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.13
2061	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.12
2062	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.12
2063	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.11
2064	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.11
2065	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.10
								Total NPV of O&M Costs		$ 17.1

Capital Costs in million $:		Yr built	
RWTM to Reservoir	$ 47.0	2015	$ 47.0
Intake/Pumping Stations	$ 36.6	2015	$ 36.6
		Total NPV of Capital Costs	$ 83.6
		Total NPV of Capital and O&M Costs in millions	$ 100.7

Reservoirs

	Quantity	Units	Volume/each (acre-feet)	Unit Cost ($/ac-ft)	Total Construction Cost in millions	Contigency, Eng., etc.	Total in millions
Reservoirs	4	each	15000	$ 1,180	$ 70.8	$ 26.9	$ 97.7
				$ 0.004	per gallon		
Estimated average depth of reservoir		20	ft				

Surface area of reservoir	3000	acres		
Ratio of total land area reqd to surface area of reservoir	1.1		Envir & Archaeology, Surv, and Land Acq =	16.5
Total land area reqd for reservoirs	3300	acres	Total capital cost in millions =	$ 114.2
Assumed life of reservoir	100	years		
Estimated replacement cost	$ 0.71	million/year		
Estimated maintenance	$ 0.04	million/year	Mowing, maintaining fences, etc.	
Total	$ 0.75	million/year		
Year built	2015			
NPV of O&M costs	$ 12.8	million		
NPV of Capital costs	$ 114.2	million		
Total NPV of Capital and O&M Costs	**$ 127.0**	**million**		

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Inflatable Rubber Low Head Dam	$ 6.2	$ 3.9	$ 10.1
Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)	$ 83.6	$ 17.1	$ 100.7
Off Channel Reservoir	$ 114.2	$ 12.8	$ 127.0
Total for RWI A	$ 204.0	$ 33.8	$ 237.8

O&M Cost Calculations
RWTM B - RWI B near Bastrop to WTP
CTRWTP - Alternate 1B - WTP East of San Antonio

Initial year of analysis period	2015			Contingency =	20%
Interest rate	5%			Engineering, Legal, Admin. =	15%
Evaluation period	40	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

Summary of average pumping rates in acre-feet/year:

Surface Water

Year	2015	2020	2030	2040	2050	2060	2065
For SAWS	18000	18000	18000	18000	18000	18000	18000
LCRA			5600	11200	11200	11200	11200
COA			16802	22403	33604	33604	33604
Subtotal	18000	18000	40402	51603	62804	62804	62804

Groundwater

Year	2015	2020	2030	2040	2050	2060	2065
For SAWS	55000	55000	55000	55000	55000	55000	55000
Suface & groun	73000	73000	95402	106603	117804	117804	117804

Ultimate (Y2065) average design pumping rate 117,804 ac-ft/year

Sizing of Raw Water Transmission Main B & Pump Stations

Inside diameter of RWTM			84	in.	
Area			38.48	sf	
Length of RWTM			68	miles	
			359,040	feet	
Estimated unit construction cost for RWTM		$	467	per LF	
Total construction cost in millions		$	167.8		
Contingencies		$	33.6		
Subtotal		$	201.4		
Engineering, Legal & Administrative		$	30.2		
Subtotal		$	231.6		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq		$	6.8		
Total Capital Cost for PWTM in millions		$	238.4	million	
Unit maintenance cost/year-mile		$	5,000	$/year-mile	$ 0.340 Million $/year
Design flow rate (from table above)			117,804	ac-ft/year	
			105	mgd	
			73,029	gpm	
Pumping rate (one pump)			15,000	gpm	
No. of pumps (not counting spare)			5		
Peak flow rate (all pumps except spare)			75,000	gpm	
Velocity at peak flow rate			4.34	fps	
C factor			120		
Head loss per foot			0.00067	ft/ft	$h_f = \lvert 3.552*Q\rvert^{1.85} / \lvert C*(d)^{2.63}\rvert$
			3.55	ft/mile	
Head loss at peak flow rate			242	ft	
Allowance for minor losses	10%		24	ft	650 Elev. At WTP
Total estimated losses			266	ft	400 Elev of WSE in Bastrop reservoir
Average static head			250	ft	250 ft
Total estimated dynamic head			516	ft	
			224	psi	
No of recommended pumping stations along route			1.49		150 psi (assumed max pressure
No. of pumping stations used in cost estimate			2.0		in pipe)
Average head per pump station			258	ft	
Assumed pump efficiency			85%		
Assumed motor efficiency			90%		
Estimated Hp required per pump			1,277	hp/pump	
			953	kw/pump	
Total hp per pump station (not counting spare)			6,386	hp/station	
Total kw per pump set (set=pumps in series along route)			2,554	kw/pump set	(one pump at each station)
Unit construc cost for each pump station (from cost curve)		$	1,365	per firm hp of pump station	
Construction cost per pump station			8.7	million	
Balancing reservoir		$	0.75	million	60 min. of storage at avg pumping rate
Total construction cost per pump station		$	9.47	million	5.0 mg
					$ 0.15 per gal for open top reservoir
No. of pump stations from above			2.0	each	
Total construction cost in millions		$	18.9	million	
Contingency, Eng., etc. in millions		$	7.20	million	
Total capital cost in millions		$	26.1	million	
Total construction cost for pump stations		$	18.9	million	
Value of equipment		$	7.6	million	40% Estimated equipment cost as % of total
Assumed life of equipment			20	years	
Estimated maintenance/replacement cost		$	0.38	million/year	

O&M Costs

Year	Flow pumped by year		No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 5.44
2016	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 5.19
2017	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 4.94
2018	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 4.70
2019	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 4.48
2020	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 4.27
2021	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 4.06
2022	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 3.87
2023	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 3.69
2024	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 3.51
2025	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 3.34
2026	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 3.18
2027	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 3.03
2028	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 2.89
2029	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 2.75
2030	95,402	85	3.94	241,716	$ 16,920	$ 6.18	$ 0.38	$ 0.340	$ 6.89	$ 3.32
2031	95,402	85	3.94	241,716	$ 16,920	$ 6.18	$ 0.38	$ 0.340	$ 6.89	$ 3.16
2032	95,402	85	3.94	241,716	$ 16,920	$ 6.18	$ 0.38	$ 0.340	$ 6.89	$ 3.01
2033	95,402	85	3.94	241,716	$ 16,920	$ 6.18	$ 0.38	$ 0.340	$ 6.89	$ 2.86
2034	95,402	85	3.94	241,716	$ 16,920	$ 6.18	$ 0.38	$ 0.340	$ 6.89	$ 2.73
2035	95,402	85	3.94	241,716	$ 16,920	$ 6.18	$ 0.38	$ 0.340	$ 6.89	$ 2.60
2036	95,402	85	3.94	241,716	$ 16,920	$ 6.18	$ 0.38	$ 0.340	$ 6.89	$ 2.47
2037	95,402	85	3.94	241,716	$ 16,920	$ 6.18	$ 0.38	$ 0.340	$ 6.89	$ 2.36
2038	95,402	85	3.94	241,716	$ 16,920	$ 6.18	$ 0.38	$ 0.340	$ 6.89	$ 2.24
2039	95,402	85	3.94	241,716	$ 16,920	$ 6.18	$ 0.38	$ 0.340	$ 6.89	$ 2.14
2040	106,603	95	4.41	270,096	$ 18,907	$ 6.90	$ 0.38	$ 0.340	$ 7.62	$ 2.25
2041	106,603	95	4.41	270,096	$ 18,907	$ 6.90	$ 0.38	$ 0.340	$ 7.62	$ 2.14
2042	106,603	95	4.41	270,096	$ 18,907	$ 6.90	$ 0.38	$ 0.340	$ 7.62	$ 2.04
2043	106,603	95	4.41	270,096	$ 18,907	$ 6.90	$ 0.38	$ 0.340	$ 7.62	$ 1.94
2044	106,603	95	4.41	270,096	$ 18,907	$ 6.90	$ 0.38	$ 0.340	$ 7.62	$ 1.85
2045	106,603	95	4.41	270,096	$ 18,907	$ 6.90	$ 0.38	$ 0.340	$ 7.62	$ 1.76
2046	106,603	95	4.41	270,096	$ 18,907	$ 6.90	$ 0.38	$ 0.340	$ 7.62	$ 1.68
2047	106,603	95	4.41	270,096	$ 18,907	$ 6.90	$ 0.38	$ 0.340	$ 7.62	$ 1.60
2048	106,603	95	4.41	270,096	$ 18,907	$ 6.90	$ 0.38	$ 0.340	$ 7.62	$ 1.52
2049	106,603	95	4.41	270,096	$ 18,907	$ 6.90	$ 0.38	$ 0.340	$ 7.62	$ 1.45
2050	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 1.51
2051	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 1.44
2052	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 1.37
2053	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 1.31
2054	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 1.24
2055	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 1.19
2056	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 1.13
2057	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 1.08
2058	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 1.02
2059	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 0.98
2060	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 0.93
2061	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 0.88
2062	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 0.84
2063	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 0.80
2064	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 0.76
2065	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 0.73
								Total NPV of O&M Costs		$ 121.7

Capital Costs in million $:		Yr built		
RWTM	$ 238.4	2015		$ 238.4
Pumping Stations	$ 26.1	2015		$ 26.1
			Total NPV of Capital Costs	$ 264.5
			Total NPV of Capital and O&M Costs in millions	**$ 386.2**

O&M Cost Calculations
WTP and Raw Water Storage Reservoir at WTP
CTRWTP - Alternate 1B - WTP East of San Antonio

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition =	$ 25,000	per acre

Treated Water Production by Treatment Type (from Demand Chart - BE SURE TO CHECK)

	Year =	2015	2020	2030	2040	2050	2060	2065
Softened water demand:	Units							
Average yearly demands:								
City of Austin	ac-ft/yr	0	0	16802	22403	33604	33604	33604
LCRA	ac-ft/yr	0	0	5600	11200	11200	11200	11200
Totals	ac-ft/yr	0	0	22402	33603	44804	44804	44804
Totals	mgd	0	0	20	30	40	40	40
Max day demands:								
City of Austin	mgd	0	0	25	35	50	50	50
LCRA	mgd	0	0	10	20	20	20	20
Totals	mgd	0	0	35	55	70	70	70

	Year =	2015	2020	2030	2040	2050	2060	2065
Non-softened water demands:	Units							
Average yearly demands:								
SAWS	ac-ft/yr	73000	205000	205000	205000	205000	205000	205000
SARA	ac-ft/yr	20550	23406	28433	31393	34411	37530	41128
GBRA	ac-ft/yr	0	0	6000	8000	10000	12300	12300
Totals		93550	228406	239433	244393	249411	254830	258428
Totals	mgd	84	204	214	218	223	227	231
Max day demands:								
SAWS	mgd	85	238	238	238	238	238	238
SARA	mgd	24	27	33	36	40	44	48
GBRA	mgd	0	0	5	7	9	11	11
Totals	mgd	109	265	276	281	287	293	297
Total: softened and non-softened water demands								
Average yearly demand	ac-ft/yr	93550	228406	261835	277996	294215	299634	303232
	mgd	84	204	234	248	263	267	271
Max day demand	mgd	109	265	311	336	357	363	367

Raw Water Reservoir

Sizing for ultimate conditions:

Assumed number of days of consecutive Max Day demands	30	days	
Design (Max. Day) treated water production req'd in mgd	367	mgd	
Average treated water production in mgd	271	mgd	(which is also equal to sum of ground and raw water that can be pumped to the WTP)
Difference (shortfall of raw water)	96	mgd	
Required storage reservoir for raw water	2,889	mg	
	8,868	ac-ft	
Add safety factor 25%	2,217	ac-ft	
Total storage required	11,084	ac-ft	
Total storage recommended	12,000	ac-ft	

Note: No. of days at average day demand (for example, for repair of RWTM A) = 33 days

	Quantity	Units	Volume/each (acre-feet)	Unit Cost ($/ac-ft))	Total Construction Cost	Contigency, Eng., etc.	Total Capital Cost
Reservoirs	1	each	12,000	$ 1,283	$ 15.4	$ 5.9	$ 21.3

Estimated average depth of reservoir	25	ft	
Surface area of reservoir	480	acres	
Ratio of total land area reqd to surface area of reservoir	1.10		
Total land area reqd for reservoirs	528	acres	

Envir & Archaeology, Surv, and Land Acq = 13.2
Total capital cost in millions = $ 34.5

Assumed life of reservoir	100	years	
Estimated replacement cost	$ 0.15	million/year	
Estimated maintenance	$ 0.04	million/year	Mowing, maintaining fences, etc.
Total	$ 0.19	million/year	
Year built	2015		
NPV of O&M costs	$ 3.5	million	
NPV of Capital costs	$ 34.5	million	
Total NPV of Capital and O&M Costs	$ 38.0	million	

WTP

Plant Phasing and Capital Costs:

Softening Treatment Trains

Year =	2015	2020	2030	2040	2050	2060	2065
Average treated water production in mgd	0	0	20	30	40	40	40
Design (Max. Day) treated water production req'd in mgd	0	0	35	55	70	70	70
Initial/additional Max day capacity built (mgd)			50	20			
Total capacity on line (must exceed Design Max Day Req'd)	0	0	50	70	70	70	70
Unit cost for max day treatment capacity ($/gpd of capacity)			$ 1.78	$ 2.14			
Estimated construction cost of expansion in $millions	$ -	$ -	$ 89.0	$ 42.8	$ -	$ -	$ -

Non-softening Treatment Trains

Year =	2015	2020	2030	2040	2050	2060	2065
Average treated water production in mgd	84	204	214	218	223	227	231
Design (Max. Day) treated water production req'd in mgd	109	265	276	281	287	293	297
Additional Max day capacity built (mgd)	200	100					
Total capacity on line (must exceed Design Max Day Req'd)	200	300	300	300	300	300	300
Unit cost for max day treatment capacity ($/gpd of capacity)	$ 1.15	$ 1.32					
Estimated construction cost of expansion in $millions	$ 229.6	$ 131.5	$ -	$ -	$ -	$ -	$ -

Totals (Softening + Non-softening Trains)

Year =	2015	2020	2030	2040	2050	2060	2065
Total construction cost for both trains	$ 229.6	$ 131.5	$ 89.0	$ 42.8	$ -	$ -	$ -
Contingencies	45.9	26.3	17.8	8.6	-	-	-
Subtotal	$ 275.5	$ 157.8	$ 106.8	$ 51.3	$ -	$ -	$ -
Engineering, Legal, & Administrative	41.3	23.7	16.0	7.7	-	-	-
Subtotal	316.8	181.5	122.8	59.0	-	-	-
Environmental & Archaelogy Studies and Mitigation & Land Acquisition and Surveying (see Note below)	2.5						
Total estimated capital cost	$ 319.3	$ 181.5	$ 122.8	$ 59.0	$ -	$ -	$ -
NPV of capital cost	$ 319.3	$ 142.2	$ 59.1	$ 17.4	$ -	$ -	$ -

Total NPV of WTP initial construction & expansions $ 538

Note: Assumed land requirement for WTP (not including reservoir 100 acres

O&M Costs for Softening Trains:

Year	Plant Capacity in service	Estimated treated water production	Estimated O&M cost from unit cost curve		Net present value
	mgd of capacity	mgd produced	$ per mg treated	$million /year	($)
2015	-	-		$ -	$ -
2016	-	-		$ -	$ -
2017	-	-		$ -	$ -
2018	-	-		$ -	$ -
2019	-	-		$ -	$ -
2020	-	-		$ -	$ -
2021	-	-		$ -	$ -
2022	-	-		$ -	$ -
2023	-	-		$ -	$ -
2024	-	-		$ -	$ -
2025	-	-		$ -	$ -
2026	-	-		$ -	$ -
2027	-	-		$ -	$ -
2028	-	-		$ -	$ -
2029	-	-		$ -	$ -
2030	50	20	$ 712	$ 5.20	$ 2.50
2031	50	20	$ 712	$ 5.20	$ 2.38
2032	50	20	$ 712	$ 5.20	$ 2.27
2033	50	20	$ 712	$ 5.20	$ 2.16
2034	50	20	$ 712	$ 5.20	$ 2.06
2035	50	20	$ 712	$ 5.20	$ 1.96
2036	50	20	$ 712	$ 5.20	$ 1.87
2037	50	20	$ 712	$ 5.20	$ 1.78
2038	50	20	$ 712	$ 5.20	$ 1.69
2039	50	20	$ 712	$ 5.20	$ 1.61
2040	70	30	$ 661	$ 7.24	$ 2.14
2041	70	30	$ 661	$ 7.24	$ 2.04
2042	70	30	$ 661	$ 7.24	$ 1.94
2043	70	30	$ 661	$ 7.24	$ 1.85
2044	70	30	$ 661	$ 7.24	$ 1.76
2045	70	30	$ 661	$ 7.24	$ 1.68
2046	70	30	$ 661	$ 7.24	$ 1.60
2047	70	30	$ 661	$ 7.24	$ 1.52
2048	70	30	$ 661	$ 7.24	$ 1.45
2049	70	30	$ 661	$ 7.24	$ 1.38
2050	70	40	$ 661	$ 9.65	$ 1.75
2051	70	40	$ 661	$ 9.65	$ 1.67
2052	70	40	$ 661	$ 9.65	$ 1.59
2053	70	40	$ 661	$ 9.65	$ 1.51
2054	70	40	$ 661	$ 9.65	$ 1.44
2055	70	40	$ 661	$ 9.65	$ 1.37
2056	70	40	$ 661	$ 9.65	$ 1.31
2057	70	40	$ 661	$ 9.65	$ 1.24
2058	70	40	$ 661	$ 9.65	$ 1.18
2059	70	40	$ 661	$ 9.65	$ 1.13
2060	70	40	$ 661	$ 9.65	$ 1.07
2061	70	40	$ 661	$ 9.65	$ 1.02
2062	70	40	$ 661	$ 9.65	$ 0.97
2063	70	40	$ 661	$ 9.65	$ 0.93
2064	70	40	$ 661	$ 9.65	$ 0.88
2065	70	40	$ 661	$ 9.65	$ 0.84
			Total NPV of O&M Costs		$ 58

O&M Costs for Non-Softening Trains:

Year	Plant Capacity in service	Estimated treated water production	Estimated O&M cost from unit cost curve		Net present value
	mgd of capacity	mgd produced	$ per mg treated	$million /year	($)
2015	200	84	$ 374	$ 11.41	$ 11.41
2016	200	84	$ 374	$ 11.41	$ 10.87
2017	200	84	$ 374	$ 11.41	$ 10.35
2018	200	84	$ 374	$ 11.41	$ 9.86
2019	200	84	$ 374	$ 11.41	$ 9.39
2020	300	204	$ 343	$ 25.50	$ 19.98
2021	300	204	$ 343	$ 25.50	$ 19.03
2022	300	204	$ 343	$ 25.50	$ 18.12
2023	300	204	$ 343	$ 25.50	$ 17.26
2024	300	204	$ 343	$ 25.50	$ 16.44
2025	300	204	$ 343	$ 25.50	$ 15.65
2026	300	204	$ 343	$ 25.50	$ 14.91
2027	300	204	$ 343	$ 25.50	$ 14.20
2028	300	204	$ 343	$ 25.50	$ 13.52
2029	300	204	$ 343	$ 25.50	$ 12.88
2030	300	214	$ 343	$ 26.73	$ 12.86
2031	300	214	$ 343	$ 26.73	$ 12.24
2032	300	214	$ 343	$ 26.73	$ 11.66
2033	300	214	$ 343	$ 26.73	$ 11.11
2034	300	214	$ 343	$ 26.73	$ 10.58
2035	300	214	$ 343	$ 26.73	$ 10.07
2036	300	214	$ 343	$ 26.73	$ 9.59
2037	300	214	$ 343	$ 26.73	$ 9.14
2038	300	214	$ 343	$ 26.73	$ 8.70
2039	300	214	$ 343	$ 26.73	$ 8.29
2040	300	218	$ 343	$ 27.28	$ 8.06
2041	300	218	$ 343	$ 27.28	$ 7.67
2042	300	218	$ 343	$ 27.28	$ 7.31
2043	300	218	$ 343	$ 27.28	$ 6.96
2044	300	218	$ 343	$ 27.28	$ 6.63
2045	300	218	$ 343	$ 27.28	$ 6.31
2046	300	218	$ 343	$ 27.28	$ 6.01
2047	300	218	$ 343	$ 27.28	$ 5.73
2048	300	218	$ 343	$ 27.28	$ 5.45
2049	300	218	$ 343	$ 27.28	$ 5.19
2050	300	223	$ 343	$ 27.84	$ 5.05
2051	300	223	$ 343	$ 27.84	$ 4.81
2052	300	223	$ 343	$ 27.84	$ 4.58
2053	300	223	$ 343	$ 27.84	$ 4.36
2054	300	223	$ 343	$ 27.84	$ 4.15
2055	300	223	$ 343	$ 27.84	$ 3.95
2056	300	223	$ 343	$ 27.84	$ 3.77
2057	300	223	$ 343	$ 27.84	$ 3.59
2058	300	223	$ 343	$ 27.84	$ 3.42
2059	300	223	$ 343	$ 27.84	$ 3.25
2060	300	227	$ 343	$ 28.45	$ 3.17
2061	300	227	$ 343	$ 28.45	$ 3.02
2062	300	227	$ 343	$ 28.45	$ 2.87
2063	300	227	$ 343	$ 28.45	$ 2.74
2064	300	227	$ 343	$ 28.45	$ 2.60
2065	300	231	$ 343	$ 28.85	$ 2.52
				Total NPV of O&M Costs	$ 441

NPV Totals for O&M:

Softening trains	$ 58
Non-softening Trains	$ 441
	$ 499

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Raw Water Reservoir	**$ 34**	**$ 3.5**	**$ 38**
Water Treatment Plant	**$ 538**	**$ 499**	**$ 1,037**
Totals	**$ 572**	**$ 502**	**$ 1,075**

Capital and O&M Cost Calculations
Potable Water Transmission Mains
CTRWTP - Alternate 1B - WTP East of San Antonio

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

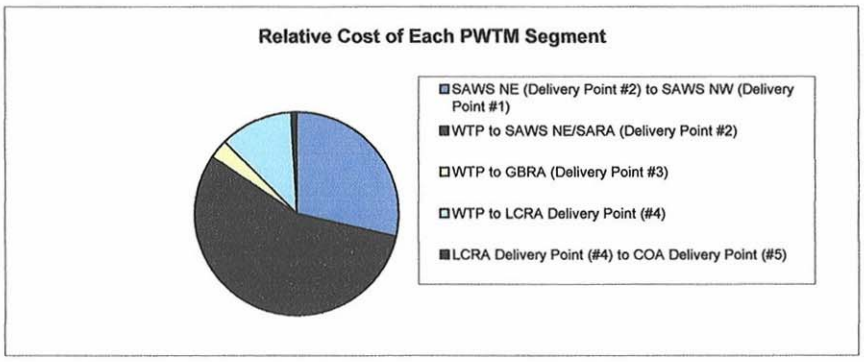
Summary of Demands

Average demands to be delivered in each segment in acre-feet/year

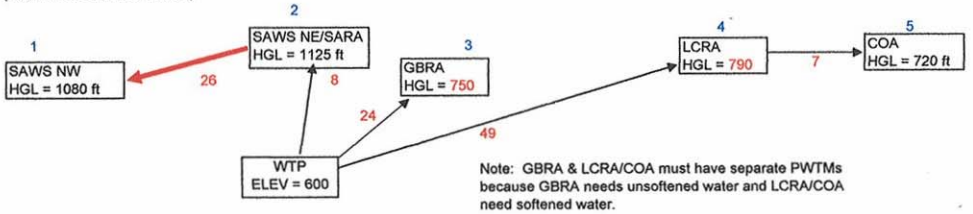
Year	2015	2020	2030	2040	2050	2060	2065
SAWS NW	43800	123000	123000	123000	123000	123000	123000
SAWS NE	29200	82000	82000	82000	82000	82000	82000
Subtotal	73000	205000	205000	205000	205000	205000	205000
SARA	20550	23406	28433	31393	34411	37530	41128
GBRA			6000	8000	10000	12300	12300
LCRA			5600	11200	11200	11200	11200
COA			16802	22403	33604	33604	33604
Total	93550	228406	261835	277996	294215	299634	303232

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
SAWS NE (Delivery Point #2) to SAWS NW (Delivery Point #1)	$ 203	$ 5	$ 207
WTP to SAWS NE/SARA (Delivery Point #2)	$ 117	$ 289	$ 405
WTP to GBRA (Delivery Point #3)	$ 17	$ 5	$ 22
WTP to LCRA Delivery Point (#4)	$ 70	$ 14	$ 84
LCRA Delivery Point (#4) to COA Delivery Point (#5)	$ 6	$ 1	$ 7
Total for PWTMs	$ 412	$ 313	$ 726



SAWS NE (Delivery Point #2) to SAWS NW (Delivery Point #1)
(Bold line in schematic below)



Note: GBRA & LCRA/COA must have separate PWTMs because GBRA needs unsoftened water and LCRA/COA need softened water.

Demands for this pipe segment

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
SAWS NW	39	110	110	110	110	110	110	1.3
Total	39	110	110	110	110	110	110	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
SAWS NW	51	143	143	143	143	143	143
Total	51	143	143	143	143	143	143

PWTM and Pump Station Costs

Design flow rate - year 2065	143	mgd	
	99,125	gpm	
Pumping capacity of one pump	20,000	gpm	
No. of pumps (not counting spare)	5		
Peak flow rate (all pumps except spare)	100,000	gpm	
Inside diameter of PWTM	120	in.	
Area	78.54	sf	
Length of RWTM	26	miles	(linked to mileage in schematic above)
	137,280	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	15%	20,592	$ 783	$ 16.1	million
Rural - rock	50%	68,640	$ 1,048	$ 72.0	
Urban - rock	35%	48,048	$ 1,186	$ 57.0	
		137,280		$ 145.0	million
Average estimated unit construction cost for PWTM			$ 1,057	per LF	

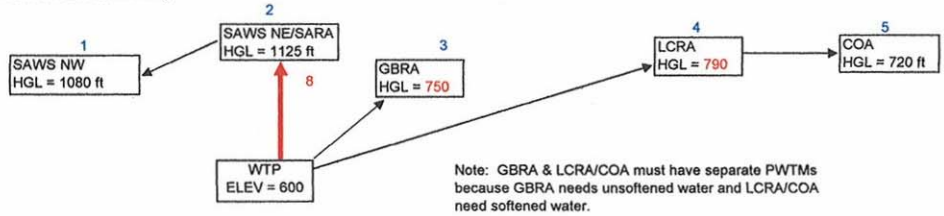
Total construction cost in millions	$	145.0		
Contingencies	$	29.0		
Subtotal	$	174.0		
Engineering, Legal & Administrative	$	26.1		
Subtotal	$	200.2		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$	2.6		
Total Capital Cost for PWTM in millions	$	202.8		
Unit maintenance cost/year-mile	$	10,000	$/year-mile	$ 0.260 Million $/year
Velocity at peak flow rate		2.84	fps	
C factor		120		
Head loss per foot		0.00020	ft/ft	$h_f = \frac{3.552*Q}{C*(d)^{2.63}}^{1.85}$
		1.07	ft/mile	
Head loss at peak flow rate		28	ft	
Allowance for minor losses	20%	6	ft	1080 Desired HGL At Delivery Point
Total estimated losses		33	ft	1125 HGL At Delivery Point 2
Average static head		-45	ft	-45 ft
Total estimated dynamic head		-12	ft	
		-5	psi	

Negative indicates gravity flow from #2 to #1; no pumping necessary.

			Million $
Annual O&M Cost in million $:		Yr built	
PWTM	$ 0.260	2015	
Total NPV of O&M Costs			$4.7
Capital Costs in million $:		Yr built	
PWTM	$ 202.8	2015	$ 202.8
Total NPV of Capital Costs			$ 202.8

Total NPV of Capital and O&M Costs in millions $ 207.5
SAWS NE (Delivery Point #2) to SAWS NW (Delivery Point #1)

WTP to SAWS NE/SARA (Delivery Point #2)
(Bold line in schematic below)



Note: GBRA & LCRA/COA must have separate PWTMs because GBRA needs unsoftened water and LCRA/COA need softened water.

Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
SAWS NW	39	110	110	110	110	110	110	1.3
SAWS NE	26	73	73	73	73	73	73	1.3
SARA	18	21	25	28	31	34	37	1.3
Total	84	204	208	211	214	217	220	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
SAWS NW	51	143	143	143	143	143	143
SAWS NE	34	95	95	95	95	95	95
SARA	24	27	33	36	40	44	48
Total	109	265	271	274	278	281	286

PWTM and Pump Station Costs

Design flow rate - year 2065	286	mgd
	198,353	gpm
Pumping capacity of one pump	20,000	gpm
No. of pumps (not counting spare)	10	
Peak flow rate (all pumps except spare)	200,000	gpm
Inside diameter of PWTM	120	in.
Area	78.54	sf
Length of PWTM	8	miles (linked to mileage in schematic above)
	42,240	feet

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	25%	10,560	$ 783	$ 8.3	million
Rural - rock	50%	21,120	$ 1,048	$ 22.1	
Urban - rock	25%	10,560	$ 1,186	$ 12.5	
		42,240		$ 42.9	million
Average estimated unit construction cost for PWTM			$ 1,016	per LF	

Total construction cost in millions	$	42.9
Contingencies	$	8.6
Subtotal	$	51.5
Engineering, Legal & Administrative	$	7.7
Subtotal	$	59.2
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$	0.8
Total Capital Cost for PWTM in millions	$	60.0

Unit maintenance cost/year-mile: $ 10,000 $/year-mile | $ 0.080 Million $/year

Velocity at peak flow rate	5.67	fps	
C factor	120		
Head loss per foot	0.00073	ft/ft	$h_f = \left\| \frac{3.552 * Q}{C * (d)^{2.63}} \right\|^{1.85}$
	3.85	ft/mile	
Head loss at peak flow rate	31	ft	
Allowance for minor losses 20%	6	ft	1125 Desired HGL At Delivery Point
Total estimated losses	37	ft	600 Elev. At WTP
Average static head	525	ft	525 ft
Total estimated dynamic head	562	ft	
	244	psi	
No of recommended pumping stations along route	1.62		150 psi (assumed max pressure
No. of pumping stations used in cost estimate	2		in pipe)
Average head per pump station	281	ft	
Assumed pump efficiency	85%		
Assumed motor efficiency	90%		
Estimated Hp required per pump	1,855	hp/pump	
	1,384	kw/pump	
Total hp per pump station (not counting spare)	18,549	firm hp/station	
Total kw per pump set (set=pumps in series along route)	3,710	kw/pump set (one pump at each station)	
Unit construction cost for each pump station (from cost curve)	$ 1,105	per firm hp of pump station	
Construction cost per pump station	20.5	million	
Total construction cost for pump stations	41.0	for 2 pump stations	

Contingencies	$	8.2	
Subtotal	$	49.2	
Engineering, Legal & Administrative	$	7.4	
Total capital cost for pump stations in millions	$	56.6	million

40% Equip cost as % of constr cost

Value of equipment	$	16	million
Assumed life of equipment		20	years
Estimated maintenance/replacement cost	$	0.82	million/year

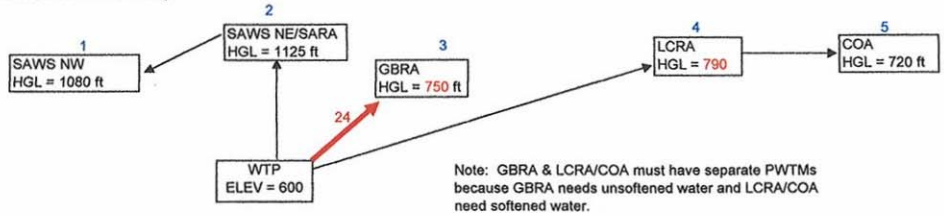
O&M Costs

Year	Flow pumped by year (average flows from Table above)	No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - PWTM	Total O&M cost	Net present value
	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	84	2.90	258,178	$ 18,072	$ 6.60	$ 0.82	$ 0.080	$ 7.50	$ 7.50
2016	84	2.90	258,178	$ 18,072	$ 6.60	$ 0.82	$ 0.080	$ 7.50	$ 7.14
2017	84	2.90	258,178	$ 18,072	$ 6.60	$ 0.82	$ 0.080	$ 7.50	$ 6.80
2018	84	2.90	258,178	$ 18,072	$ 6.60	$ 0.82	$ 0.080	$ 7.50	$ 6.48
2019	84	2.90	258,178	$ 18,072	$ 6.60	$ 0.82	$ 0.080	$ 7.50	$ 6.17
2020	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 13.32
2021	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 12.69
2022	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 12.09
2023	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 11.51
2024	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 10.96
2025	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 10.44
2026	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 9.94
2027	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 9.47
2028	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 9.02
2029	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 8.59
2030	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 8.35
2031	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 7.95
2032	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 7.57
2033	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 7.21
2034	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 6.87
2035	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 6.54
2036	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 6.23
2037	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 5.93
2038	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 5.65
2039	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 5.38
2040	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 5.19
2041	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 4.94
2042	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 4.71
2043	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 4.48
2044	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 4.27
2045	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 4.06
2046	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 3.87
2047	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 3.69
2048	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 3.51
2049	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 3.34
2050	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 3.22
2051	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 3.07
2052	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 2.92
2053	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 2.78
2054	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 2.65
2055	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 2.53
2056	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 2.41
2057	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 2.29
2058	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 2.18
2059	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 2.08
2060	217	7.52	669,331	$ 46,853	$ 17.10	$ 0.82	$ 0.080	$ 18.00	$ 2.00
2061	217	7.52	669,331	$ 46,853	$ 17.10	$ 0.82	$ 0.080	$ 18.00	$ 1.91
2062	217	7.52	669,331	$ 46,853	$ 17.10	$ 0.82	$ 0.080	$ 18.00	$ 1.82
2063	217	7.52	669,331	$ 46,853	$ 17.10	$ 0.82	$ 0.080	$ 18.00	$ 1.73
2064	217	7.52	669,331	$ 46,853	$ 17.10	$ 0.82	$ 0.080	$ 18.00	$ 1.65
2065	220	7.63	679,260	$ 47,548	$ 17.36	$ 0.82	$ 0.080	$ 18.26	$ 1.59
								Total NPV of O&M Costs	$ 288.7

Capital Costs in million $:			Yr built		
PWTM	$	60.0	2015		$ 60.0
Pumping Stations	$	56.6	2015		$ 56.6
				Total NPV of Capital Costs	$ 116.6

Total NPV of Capital and O&M Costs in millions $ 405
WTP to SAWS NE/SARA (Delivery Point #2)

WTP to GBRA (Delivery Point #3)
(Bold line in schematic below)



Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
GBRA	0	0	5	7	9	11	11	2.0
Total	0	0	5	7	9	11	11	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
GBRA	0	0	11	14	18	22	22
Total	0	0	11	14	18	22	22

PWTM and Pump Station Costs

Design flow rate - year 2065	22	mgd	
	15,250	gpm	
Pumping capacity of one pump	5,100	gpm	
No. of pumps (not counting spare)	3		
Peak flow rate (all pumps except spare)	15,300	gpm	
Inside diameter of PWTM	42	in.	
Area	9.62	sf	
Length of RWTM	24	miles	(linked to mileage in schematic above)
	126,720	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	100%	126,720	$ 174	$ 22.0	million
Rural - rock	0%	-	$ 244	$ -	
Urban - rock	0%	-	$ 263	$ -	
		126,720		$ 22.0	million
Average estimated unit construction cost for PWTM			$ 174	per LF	

Total construction cost in millions	$ 22.0			
Contingencies	$ 4.4			
Subtotal	$ 26.4			
Engineering, Legal & Administrative	$ 4.0			
Subtotal	$ 30.4			
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 2.4			
Total Capital Cost for PWTM in millions	$ 32.8			
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.240	Million $/year
Velocity at peak flow rate	3.54	fps		
C factor	120			
Head loss per foot	0.00104	ft/ft	$h_f = \lvert 3.552*Q \rvert^{1.85} / \lvert C*(d)^{2.63} \rvert$	
	5.47	ft/mile		
Head loss at peak flow rate	131	ft		
Allowance for minor losses 20%	26	ft	740	Desired HGL At Delivery Point
Total estimated losses	158	ft	600	Elev. At WTP
Average static head	140	ft	140	ft
Total estimated dynamic head	298	ft		
	129	psi		
No of recommended pumping stations along route	0.86		150	psi (assumed max pressure
No. of pumping stations used in cost estimate	1			in pipe)
Average head per pump station	298	ft		
Assumed pump efficiency	85%			
Assumed motor efficiency	90%			
Estimated Hp required per pump	501	hp/pump		
	374	kw/pump		
Total hp per pump station (not counting spare)	1,503	hp/station		
Total kw per pump set (set=pumps in series along route)	501	kw/pump set	(one pump at each station)	
Unit construction cost for each pump station (from cost curve)	$ 1,718	per firm hp of pump station		
Construction cost per pump station	2.6	million		
Total construction cost for pump stations	2.6		for 1	pump stations
Contingencies	$ 0.5			
Subtotal	$ 3.1			
Engineering, Legal & Administrative	$ 0.5			

Total capital cost for pump stations	$	3.6	million
Value of equipment	$	1.0	million
Assumed life of equipment		20	years
Estimated maintenance/replacement cost	$	0.05	million/year

40% Equip cost as % of constr cost

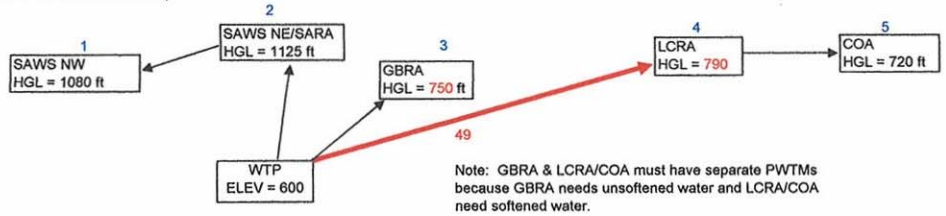
O&M Costs

Year	Flow pumped by year (average flows from Table above)	No. of pump "sets" operating /day	Energy used	Energy cost	Other O&M costs - Pump Stations	Maintenance costs - PWTM	Total O&M cost	Net present value
	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	-						$ -	$ -
2016	-						$ -	$ -
2017	-						$ -	$ -
2018	-						$ -	$ -
2019	-						$ -	$ -
2020	-						$ -	$ -
2021	-						$ -	$ -
2022	-						$ -	$ -
2023	-						$ -	$ -
2024	-						$ -	$ -
2025	-						$ -	$ -
2026	-						$ -	$ -
2027	-						$ -	$ -
2028	-						$ -	$ -
2029	-						$ -	$ -
2030	5	0.73	8,771	$ 614	$ 0.22	$ 0.05	$ 0.240	$ 0.52	$ 0.25
2031	5	0.73	8,771	$ 614	$ 0.22	$ 0.05	$ 0.240	$ 0.52	$ 0.24
2032	5	0.73	8,771	$ 614	$ 0.22	$ 0.05	$ 0.240	$ 0.52	$ 0.23
2033	5	0.73	8,771	$ 614	$ 0.22	$ 0.05	$ 0.240	$ 0.52	$ 0.21
2034	5	0.73	8,771	$ 614	$ 0.22	$ 0.05	$ 0.240	$ 0.52	$ 0.20
2035	5	0.73	8,771	$ 614	$ 0.22	$ 0.05	$ 0.240	$ 0.52	$ 0.19
2036	5	0.73	8,771	$ 614	$ 0.22	$ 0.05	$ 0.240	$ 0.52	$ 0.19
2037	5	0.73	8,771	$ 614	$ 0.22	$ 0.05	$ 0.240	$ 0.52	$ 0.18
2038	5	0.73	8,771	$ 614	$ 0.22	$ 0.05	$ 0.240	$ 0.52	$ 0.17
2039	5	0.73	8,771	$ 614	$ 0.22	$ 0.05	$ 0.240	$ 0.52	$ 0.16
2040	7	0.97	11,694	$ 819	$ 0.30	$ 0.05	$ 0.240	$ 0.59	$ 0.17
2041	7	0.97	11,694	$ 819	$ 0.30	$ 0.05	$ 0.240	$ 0.59	$ 0.17
2042	7	0.97	11,694	$ 819	$ 0.30	$ 0.05	$ 0.240	$ 0.59	$ 0.16
2043	7	0.97	11,694	$ 819	$ 0.30	$ 0.05	$ 0.240	$ 0.59	$ 0.15
2044	7	0.97	11,694	$ 819	$ 0.30	$ 0.05	$ 0.240	$ 0.59	$ 0.14
2045	7	0.97	11,694	$ 819	$ 0.30	$ 0.05	$ 0.240	$ 0.59	$ 0.14
2046	7	0.97	11,694	$ 819	$ 0.30	$ 0.05	$ 0.240	$ 0.59	$ 0.13
2047	7	0.97	11,694	$ 819	$ 0.30	$ 0.05	$ 0.240	$ 0.59	$ 0.12
2048	7	0.97	11,694	$ 819	$ 0.30	$ 0.05	$ 0.240	$ 0.59	$ 0.12
2049	7	0.97	11,694	$ 819	$ 0.30	$ 0.05	$ 0.240	$ 0.59	$ 0.11
2050	9	1.22	14,618	$ 1,023	$ 0.37	$ 0.05	$ 0.240	$ 0.67	$ 0.12
2051	9	1.22	14,618	$ 1,023	$ 0.37	$ 0.05	$ 0.240	$ 0.67	$ 0.11
2052	9	1.22	14,618	$ 1,023	$ 0.37	$ 0.05	$ 0.240	$ 0.67	$ 0.11
2053	9	1.22	14,618	$ 1,023	$ 0.37	$ 0.05	$ 0.240	$ 0.67	$ 0.10
2054	9	1.22	14,618	$ 1,023	$ 0.37	$ 0.05	$ 0.240	$ 0.67	$ 0.10
2055	9	1.22	14,618	$ 1,023	$ 0.37	$ 0.05	$ 0.240	$ 0.67	$ 0.09
2056	9	1.22	14,618	$ 1,023	$ 0.37	$ 0.05	$ 0.240	$ 0.67	$ 0.09
2057	9	1.22	14,618	$ 1,023	$ 0.37	$ 0.05	$ 0.240	$ 0.67	$ 0.09
2058	9	1.22	14,618	$ 1,023	$ 0.37	$ 0.05	$ 0.240	$ 0.67	$ 0.08
2059	9	1.22	14,618	$ 1,023	$ 0.37	$ 0.05	$ 0.240	$ 0.67	$ 0.08
2060	11	1.50	17,980	$ 1,259	$ 0.46	$ 0.05	$ 0.240	$ 0.75	$ 0.08
2061	11	1.50	17,980	$ 1,259	$ 0.46	$ 0.05	$ 0.240	$ 0.75	$ 0.08
2062	11	1.50	17,980	$ 1,259	$ 0.46	$ 0.05	$ 0.240	$ 0.75	$ 0.08
2063	11	1.50	17,980	$ 1,259	$ 0.46	$ 0.05	$ 0.240	$ 0.75	$ 0.07
2064	11	1.50	17,980	$ 1,259	$ 0.46	$ 0.05	$ 0.240	$ 0.75	$ 0.07
2065	11	1.50	17,980	$ 1,259	$ 0.46	$ 0.05	$ 0.240	$ 0.75	$ 0.07
							Total NPV of O&M Costs	$ 4.8

Capital Costs in million $:			Yr built		
PWTM	$	33	2030	$	15.8
Pumping Stations	$	4	2030	$	1.7
			Total NPV of Capital Costs	$	17.5

Total NPV of Capital and O&M Costs in millions $ 22.3
WTP to GBRA (Delivery Point #3)

WTP to LCRA Delivery Point (#4)
(Bold line in schematic below)



Note: GBRA & LCRA/COA must have separate PWTMs because GBRA needs unsoftened water and LCRA/COA need softened water.

Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
LCRA	0	0	5	10	10	10	10	2.0
COA	0	0	15	20	30	30	30	1.68
Total	0	0	20	30	40	40	40	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
LCRA	0	0	10	20	20	20	20
COA	0	0	25	34	50	50	50
Total	0	0	35	54	70	70	70

PWTM and Pump Station Costs

Design flow rate - year 2065	70	mgd	
	48,883	gpm	
Pumping capacity of one pump	10,000	gpm	
No. of pumps (not counting spare)	5		
Peak flow rate (all pumps except spare)	50,000	gpm	
Inside diameter of PWTM	72	in.	
Area	28.27	sf	
Length of RWTM	49	miles	(linked to mileage in schematic above)
	258,720	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	100%	258,720	$ 365	$ 94.5	million
Rural - rock	0%	-	$ 498	$ -	
Urban - rock	0%	-	$ 552	$ -	
		258,720		$ 94.5	million

Average estimated unit construction cost for PWTM $ 365 per LF

Total construction cost in millions	$ 94.5		
Contingencies	$ 18.9		
Subtotal	$ 113.4		
Engineering, Legal & Administrative	$ 17.0		
Subtotal	$ 130.4		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 4.9		
Total Capital Cost for PWTM in millions	$ 135.3		
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.490 Million $/year
Velocity at peak flow rate	3.94	fps	
C factor	120		
Head loss per foot	0.00067	ft/ft	$h_f = \left\| \frac{3.552*Q}{C*(d)^{2.63}} \right\|^{1.85}$
	3.55	ft/mile	
Head loss at peak flow rate	174	ft	
Allowance for minor losses 20%	35	ft	790 Desired HGL At Delivery Point
Total estimated losses	209	ft	720 Elev. At Delivery Point 3
Average static head	70	ft	70 ft
Total estimated dynamic head	279	ft	
	121	psi	
No of recommended pumping stations along route	0.81		150 psi (assumed max pressure
No. of pumping stations used in cost estimate	1		in pipe)
Average head per pump station	279	ft	
Assumed pump efficiency	85%		
Assumed motor efficiency	90%		
Estimated Hp required per pump	921	hp/pump	
	687	kw/pump	
Total hp per pump station (not counting spare)	4,605	firm hp/station	
Total kw per pump set (set=pumps in series along route)	921	kw/pump set	(one pump at each station)
Unit construction cost for each pump station (from cost curve)	$ 1,445	per firm hp of pump station	
Construction cost per pump station	6.7	million	
Total construction cost for pump stations	6.7		for 1 pump stations
Contingencies	$ 1.3		
Subtotal	$ 8.0		
Engineering, Legal & Administrative	$ 1.2		

Total capital cost for pump stations	$	9.2	million
		40%	Equip cost as % of constr cost
Value of equipment	$	2.7	million
Assumed life of equipment		20	years
Estimated maintenance/replacement cost	$	0.13	million/year

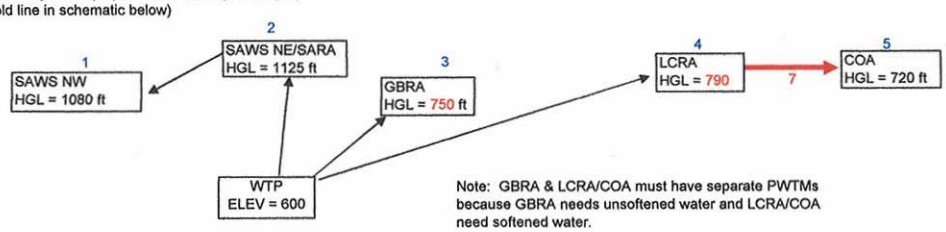
O&M Costs

Year	Flow pumped by year (average flows from Table above)	No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - PWTM	Total O&M cost	Net present value
	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015								$ -	$ -
2016								$ -	$ -
2017								$ -	$ -
2018								$ -	$ -
2019								$ -	$ -
2020								$ -	$ -
2021								$ -	$ -
2022								$ -	$ -
2023								$ -	$ -
2024								$ -	$ -
2025								$ -	$ -
2026								$ -	$ -
2027								$ -	$ -
2028								$ -	$ -
2029								$ -	$ -
2030	20	1.39	30,696	$ 2,149	$ 0.78	$ 0.13	$ 0.490	$ 1.41	$ 0.68
2031	20	1.39	30,696	$ 2,149	$ 0.78	$ 0.13	$ 0.490	$ 1.41	$ 0.64
2032	20	1.39	30,696	$ 2,149	$ 0.78	$ 0.13	$ 0.490	$ 1.41	$ 0.61
2033	20	1.39	30,696	$ 2,149	$ 0.78	$ 0.13	$ 0.490	$ 1.41	$ 0.58
2034	20	1.39	30,696	$ 2,149	$ 0.78	$ 0.13	$ 0.490	$ 1.41	$ 0.56
2035	20	1.39	30,696	$ 2,149	$ 0.78	$ 0.13	$ 0.490	$ 1.41	$ 0.53
2036	20	1.39	30,696	$ 2,149	$ 0.78	$ 0.13	$ 0.490	$ 1.41	$ 0.51
2037	20	1.39	30,696	$ 2,149	$ 0.78	$ 0.13	$ 0.490	$ 1.41	$ 0.48
2038	20	1.39	30,696	$ 2,149	$ 0.78	$ 0.13	$ 0.490	$ 1.41	$ 0.46
2039	20	1.39	30,696	$ 2,149	$ 0.78	$ 0.13	$ 0.490	$ 1.41	$ 0.44
2040	30	2.08	46,044	$ 3,223	$ 1.18	$ 0.13	$ 0.490	$ 1.80	$ 0.53
2041	30	2.08	46,044	$ 3,223	$ 1.18	$ 0.13	$ 0.490	$ 1.80	$ 0.51
2042	30	2.08	46,044	$ 3,223	$ 1.18	$ 0.13	$ 0.490	$ 1.80	$ 0.48
2043	30	2.08	46,044	$ 3,223	$ 1.18	$ 0.13	$ 0.490	$ 1.80	$ 0.46
2044	30	2.08	46,044	$ 3,223	$ 1.18	$ 0.13	$ 0.490	$ 1.80	$ 0.44
2045	30	2.08	46,044	$ 3,223	$ 1.18	$ 0.13	$ 0.490	$ 1.80	$ 0.42
2046	30	2.08	46,044	$ 3,223	$ 1.18	$ 0.13	$ 0.490	$ 1.80	$ 0.40
2047	30	2.08	46,044	$ 3,223	$ 1.18	$ 0.13	$ 0.490	$ 1.80	$ 0.38
2048	30	2.08	46,044	$ 3,223	$ 1.18	$ 0.13	$ 0.490	$ 1.80	$ 0.36
2049	30	2.08	46,044	$ 3,223	$ 1.18	$ 0.13	$ 0.490	$ 1.80	$ 0.34
2050	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.40
2051	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.38
2052	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.36
2053	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.34
2054	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.33
2055	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.31
2056	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.30
2057	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.28
2058	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.27
2059	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.26
2060	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.24
2061	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.23
2062	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.22
2063	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.21
2064	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.20
2065	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.19
								Total NPV of O&M Costs	$ 14.3

Capital Costs in million $:			Yr built		
PWTM	$	135.3	2030	$	65.1
Pumping Stations	$	9.2	2030	$	4.4
			Total NPV of Capital Costs	$	69.5

Total NPV of Capital and O&M Costs in millions $ 84
WTP to LCRA Delivery Point (#4)

LCRA Delivery Point (#4) to COA Delivery Point (#5)
(Bold line in schematic below)



Note: GBRA & LCRA/COA must have separate PWTMs because GBRA needs unsoftened water and LCRA/COA need softened water.

Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
COA	0	0	15	20	30	30	30	1.68
Total	0	0	15	20	30	30	30	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
COA	0	0	25	34	50	50	50
Total	0	0	25	34	50	50	50

PWTM and Pump Station Costs

Design flow rate - year 2065	50	mgd	
	34,997	gpm	
Inside diameter of PWTM	54	in.	
Area	15.90	sf	
Length of PWTM	7	miles	(linked to mileage in schematic above)
	36,960	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	100%	36,960	$ 244	$ 9.0	million
Rural - rock	0%	-	$ 337	$ -	
Urban - rock	0%	-	$ 369	$ -	
		36,960		$ 9.0	million
Average estimated unit construction cost for PWTM			$ 244	per LF	

Total construction cost in millions	$ 9.0			
Contingencies	$ 1.8			
Subtotal	$ 10.8			
Engineering, Legal & Administrative	$ 1.6			
Subtotal	$ 12.4			
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 0.0			
Total Capital Cost for PWTM in millions	$ 12.4			
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.070	Million $/year
Velocity at peak flow rate	4.90	fps		
C factor	120			
Head loss per foot	0.00141	ft/ft	$h_f = \frac{\lvert 3.552*Q \rvert^{1.85}}{\lvert C*(d)^{2.63} \rvert}$	
	7.45	ft/mile		
Head loss at peak flow rate	52	ft		
Allowance for minor losses 20%	10	ft	720	Desired HGL At Delivery Point
Total estimated losses	63	ft	790	Elev. At Delivery Point 4
Average static head	-70	ft	-70	ft
Total estimated dynamic head	-7	ft		
	-3	psi		

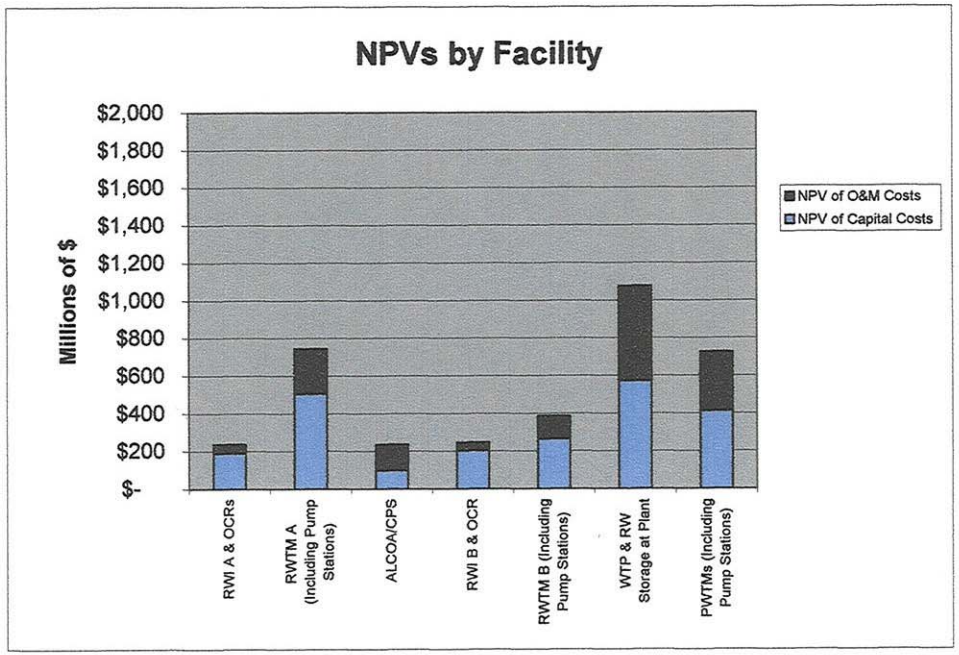
Negative indicates gravity flow from #4 to #5; no pumping necessary.

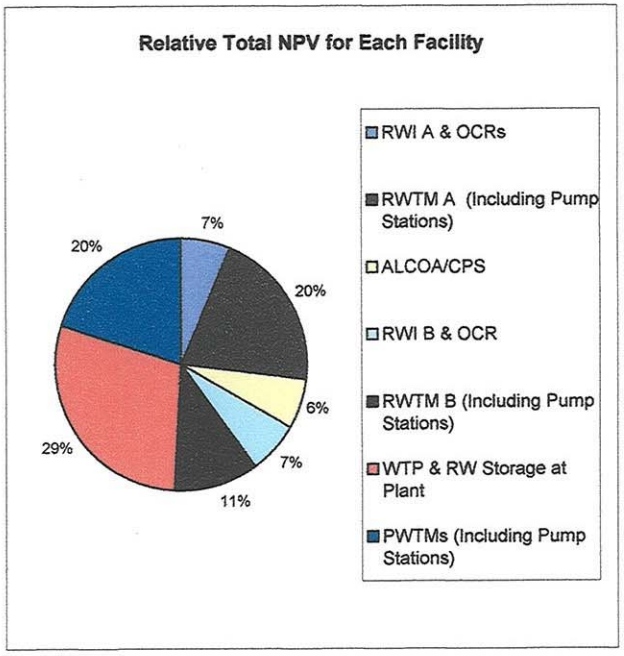
			Million $
Annual O&M Cost in million $:		Yr built	
PWTM	$ 0.070	2030	
Total NPV of O&M Costs			$0.55
Capital Costs in million $:		Yr built	
PWTM	$ 12.4	2030	
			$ 6.0
Total NPV of Capital Costs			$ 6.0

Total NPV of Capital and O&M Costs in millions $ 6.5
LCRA Delivery Point (#4) to COA Delivery Point (#5)

CTRWTP - Alternate 1C - WTP East of San Antonio (Discharge ALCOA/CPS groundwater to Big Sandy Creek)

WTP Location	Alter-nate	Phasing Scenario	Total NPVs in Millions of $	RWI A & OCRs	RWTM A (Including Pump Stations)	ALCOA/CPS	RWI B & OCR	RWTM B (Including Pump Stations)	WTP & RW Storage at Plant	PWTMs (Including Pump Stations)
East of San Antonio	1C	RWTM B & ALCOA/CPS built by 2015; RWTM A built in 2020.		Sized for 4000 cfs to scalp water; 4 intakes, 4 miles of 120-inch raw water mains & 4 OCRs at 25,000 ac-ft each	142 miles of 96-inch diameter pipe sized to deliver 132,000 ac-ft/year on a continuous basis; includes 3 pumping stations w/ balancing reservoirs along route	Non-public wells; Discharge of 55,000 ac-ft/year to Big Sandy Creek near Hwy 290 east of Elgin with flow to Colorado River just upstream of RWI-B	Sized for 2000 cfs (2 intakes) to scalp surface water plus an additional 76 cfs (55,000 ac-ft/yr) equivalent to groundwater released to Big Sandy Creek; 8 miles of 120-inch pipe; 4 OCRs at 15,000 ac-ft/each	Sized for 117,804 ac-ft/yr; 68 miles of 84" pipeline with two pumping stations and balancing reservoirs	Raw water reservoir w/ 11,000 ac-ft capacity; Conventional settling with membrane filtration for SAWS, SARA & GBRA; Lime softening with membrane filtration for COA & LCRA water	Each PWTM sized for maximum daily demand (See PWTM Summary Sheet in the Appendices)
		NPV of Capital Costs	$ 2,248	$ 191	$ 507	$ 98	$ 204	$ 265	$ 572	$ 412
		NPV of O&M Costs	$ 1,403	$ 47	$ 238	$ 138	$ 43	$ 122	$ 502	$ 313
		Total NPV of Capital & O&M	**$ 3,652**	$ 238	$ 745	$ 236	$ 247	$ 386	$ 1,075	$ 726





O&M Cost Calculations
RWI A - Matagorda Co. River Intakes, and Storage
CTRWTP - Alternate 1C - WTP East of San Antonio (Discharge ALCOA/CPS groundwater to Big Sandy Creek)

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile
			or =	$ 5,000	per acre

Inflatable Rubber Low Head Dam

	Quantity	Units	Size	Unit Constr. Cost (millions)	Total Estimated Constr. Cost (millions)	Contigency, Eng., etc. (millions)	Total Capital Cost (millions)
Inflatable Rubber Low Head Dam	4	each	10 ft high	$ 2.25	$ 9.00	$ 3.42	$ 12.42

Estimated inflatable dam cost as % of total	50%		
Value of inflatable dam	$ 4.50	million	
Assumed life of inflatable dam	10	years	
Estimated maintenance/replacement cost	$ 0.45	million/year	
Year built	2020		
NPV of O&M Costs	$6.27	million	
NPV of Capital Costs	$ 9.73	million	
Total NPV of Capital and O&M Costs	$16.00	million	

Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)

Average withdrawal	132,000	ac-ft/year			
	182	cfs			
			21.9	Ratio of design withdrawal rate to Total intake design withdrawal rate	
Total intake design withdrawal rate (for scalping high flows	4,000	cfs			
	1,795,200	gpm			
No. of Intakes	4				
Design withdrawal rate per intake	1,000	cfs			
	448,800	gpm			
No. of reservoirs	4				
Design flow to each reservoir	448,800	gpm			
Inside diameter of each RWTM	120	in.			
Area	78.54	sf			
Average length of each RWTM	1	miles	4.0	miles for all RWTMs	
	5,280	feet	21,120	feet	
Estimated construction cost for RWTM	$ 793	per LF		$ 1,254	
Total construction cost in millions	$ 16.8				
Contingencies	$ 3.4				
Subtotal	$ 20.1				
Engineering, Legal & Administrative	$ 3.0				
Subtotal	$ 23.1				
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 0.4				
Total Capital Cost for PWTM in millions	$ 23.5	million			
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.040	Million $/year (all RWTMs to Reservoirs)	

Note: Assume each intake has two RWTMs pumping out of it, one to each reservoir.

Design flow rate for each RWTM (from above)	448,800	gpm		
Pumping rate (one pump)	50,000	gpm		
No. of pumps (not counting spare) pumping into each RW	9			
Peak flow rate into each RWTM (all pumps except spare)	450,000	gpm		
Velocity at peak flow rate	12.77	fps		
C factor	120			
Head loss per foot	0.00327	ft/ft	$h_f = \frac{3.552*Q^{1.85}}{C^*(d)^{2.63}}$	
	17.25	ft/mile		
Head loss at peak flow rate	17	ft		
Allowance for minor losses 30%	5	ft	90	Elev of discharge at reservoir
Total estimated losses	22	ft	50	Water surface elev in river
Average static head	40	ft	40	ft
Total estimated dynamic head	62	ft		
	27	psi		
Assumed pump efficiency	85%			
Assumed motor efficiency	90%			
Estimated Hp required per pump	1,030	hp/pump		
	769	kw/pump		
Total hp pumping into each RWTM (not counting spare)	9,272	hp/RWTM		
Total hp at each intake (not counting spare)	9,272	hp/intake		
Total hp all intakes (not counting spares)	37,089	hp		
Total kw all intakes (not counting spares)	27,668	kw		
Unit construction cost for each pump station (from cost cur	$ 889	per firm hp of pump station		$ 1,180
Construction cost per intake/pump station	8.2	million		
No. of intakes from above	4	each		
Total construction cost in millions	$ 33.0	million		
Contigency, Eng., etc. in millions	$ 12.53	million		
Total capital cost in millions	$ 45.5	million		
Total construction cost for pump stations	$ 33.0	million		
Value of equipment	$ 13.2	million	40%	Estimated equip cost as % of total constr cost
Assumed life of equipment	20	years		
Estimated maintenance/replacement cost	$ 0.66	million/year		

O&M Costs:

Year	Flow pumped by year		No. of pump "sets" operating	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd	/day	(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	-	-	-	-	$ -	$ -			$ -	$ -
2016	-	-	-	-	$ -	$ -			$ -	$ -
2017	-	-	-	-	$ -	$ -			$ -	$ -
2018	-	-	-	-	$ -	$ -			$ -	$ -
2019	-	-	-	-	$ -	$ -			$ -	$ -
2020	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 1.15
2021	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 1.10
2022	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 1.05
2023	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 1.00
2024	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.95
2025	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.90
2026	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.86
2027	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.82
2028	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.78
2029	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.74
2030	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.71
2031	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.67
2032	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.64
2033	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.61
2034	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.58
2035	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.55
2036	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.53
2037	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.50
2038	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.48
2039	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.46
2040	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.43
2041	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.41
2042	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.39
2043	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.38
2044	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.36
2045	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.34
2046	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.32
2047	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.31
2048	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.29
2049	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.28
2050	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.27
2051	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.25
2052	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.24
2053	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.23
2054	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.22
2055	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.21
2056	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.20
2057	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.19
2058	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.18
2059	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.17
2060	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.16
2061	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.16
2062	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.15
2063	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.14
2064	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.13
2065	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.13
								Total NPV of O&M Costs		$ 21.6

Capital Costs in million $:		Yr built		
RWTM to Reservoirs	$ 23.5	2020		$ 18.4
Intake/Pumping Stations	$ 45.5	2020		$ 35.6
			Total NPV of Capital Costs	$ 54.1
			Total NPV of Capital and O&M Costs in millions	$ 75.7

Reservoirs

	Quantity	Units	Volume/each (acre-feet)	Unit Cost ($/ac-ft))	Total Construction Cost in millions	Contigency, Eng., etc.	Total in millions
Reservoirs	4	each	25000	$ 974	$ 97.4	$ 37.0	$ 134.4
				$ 909			

Estimated average depth of reservoir	20	ft	
Surface area of reservoir	5000	acres	
Ratio of total land area reqd to surface area of reservoir	1.1		
Total land area reqd for reservoirs	5500	acres	Envir & Archaeology, Surv, and Land Acq = 27.5
			Total capital cost in millions = $ 161.9
Assumed life of reservoir	100	years	
Estimated replacement cost	$ 0.97	million/year	
Estimated maintenance	0.4	million/year	Mowing, maintaining fences, etc.
Total	$ 1.37	million/year	
Year built	2020		
NPV of O&M costs	$ 19.1	million	
NPV of Capital costs	$ 126.8	million	
Total NPV of Capital and O&M Costs	$ 145.9	million	

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Inflatable Rubber Low Head Dam	$ 9.7	$ 6.3	$ 16.0
Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)	$ 54.1	$ 21.6	$ 75.7
Reservoirs	$ 126.8	$ 19.1	$ 145.9
Total for RWI A	$ 190.6	$ 47.0	$ 237.6

O&M Cost Calculations
RWTM A - Matagorda Co. to WTP
CTRWTP - Alternate 1C - WTP East of San Antonio (Discharge ALCOA/CPS groundwater to Big Sandy Creek)

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

Raw Water Transmission Main - A

Inside diameter of pipe		96	in.		
Area		50.27	sf		
Length of RWTM		142	miles		
		749,760	feet		
Estimated unit construction cost for RWTM		$ 567	per LF		
Total construction cost in millions		$ 425			
Contingencies		$ 85			
Subtotal		$ 511			
Engineering, Legal & Administrative		$ 77			
Subtotal		$ 587			
Envir & Arch Studies & Mitigation, Surveying, & Land Acq		$ 14			
Total Capital Cost for PWTM in millions		$ 601	million		
Unit maintenance cost/year-mile		$ 10,000	$/year-mile	$ 1.420	Million $/year
Design flow rate (after 100% buildout)		132,000	ac-ft/year		
		118	mgd		
		81,829	gpm		
Pumping rate (one pump)		16,400	gpm		
No. of pumps (not counting spare)		5			
Peak flow rate (all pumps except spare)		82,000	gpm		
Velocity at peak flow rate		3.63	fps		
C factor		120			
Head loss per foot		0.00041	ft/ft	$h_f = \left\| \frac{3.552*Q}{C*(d)^{2.63}} \right\|^{1.85}$	
		2.19	ft/mile		
Head loss at peak flow rate		311	ft		
Allowance for minor losses	10%	31	ft	600	Elev. At San Antonio East WTP
Total estimated losses		342	ft	90	Elev. At Matagorda OCRs
Average static head		510	ft	510	ft
Total estimated dynamic head		852	ft		
		369	psi		
No of pumping stations req'd along route		2.46		150	psi (assumed max pressure
No. of pumping stations used in cost estimate		3.0			in pipe)
Average head per pump station		284	ft		
Assumed pump efficiency		85%			
Assumed motor efficiency		90%			
Estimated Hp required per pump		1,537	hp/pump		
		1,147	kw/pump		
Total hp per pump station (not counting spare)		7,687	hp/station		
Total kw per pump set (set=pumps in series along route)		4,612	kw/pump set	(one pump at each station)	
Unit constr. cost for each pump station (from cost curve)		$ 1,320	per firm hp of pump station		
Construction cost per pump station		$ 10.15	million		
Balancing reservoir		$ 0.75	million	60	min. of storage at avg pumping rate
Total construction cost per pump station		$ 10.90	million	5.0	mg
				$ 0.15	per gal for open top reservoir
No. of pump stations from above		3.0	each		
Total construction cost in millions		$ 32.7	million		
Contigency, Eng., etc. in millions		$ 12.42	million		
Total capital cost in millions		$ 45.1	million		
Total construction cost for pump stations		$ 32.7	million		
Value of equipment		$ 13.1	million	40%	Estimated equipment cost as % of total
Assumed life of equipment		20	years		
Estimated maintenance/replacement cost		$ 0.65	million/year		

O&M Costs

Year	Flow pumped by year		No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	-	-	-	-	$ -	$ -			$ -	$ -
2016	-	-	-	-	$ -	$ -			$ -	$ -
2017	-	-	-	-	$ -	$ -			$ -	$ -
2018	-	-	-	-	$ -	$ -			$ -	$ -
2019	-	-	-	-	$ -	$ -			$ -	$ -
2020	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 12.68
2021	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 12.08
2022	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 11.50
2023	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 10.96
2024	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 10.43
2025	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 9.94
2026	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 9.46
2027	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 9.01
2028	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 8.58
2029	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 8.18
2030	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 7.79
2031	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 7.41
2032	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 7.06
2033	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 6.73
2034	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 6.41
2035	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 6.10
2036	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 5.81
2037	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 5.53
2038	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 5.27
2039	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 5.02
2040	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 4.78
2041	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 4.55
2042	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 4.34
2043	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 4.13
2044	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 3.93
2045	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 3.75
2046	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 3.57
2047	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 3.40
2048	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 3.24
2049	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 3.08
2050	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 2.93
2051	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 2.79
2052	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 2.66
2053	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 2.53
2054	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 2.41
2055	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 2.30
2056	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 2.19
2057	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 2.09
2058	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 1.99
2059	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 1.89
2060	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 1.80
2061	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 1.72
2062	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 1.63
2063	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 1.56
2064	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 1.48
2065	132,000	118	4.99	552,331	$ 38,663	$ 14.11	$ 0.65	$ 1.420	$ 16.19	$ 1.41
								Total NPV of O&M Costs		**$ 238**

Capital Costs in million $:		Yr built		
RWTM	$ 601	2020		$ 471
Pumping Stations	$ 45	2020		$ 35
			Total NPV of Capital Costs	**$ 507**
			Total NPV of Capital and O&M Costs in millions	**$ 745**

NPV CALCULATIONS
ALCOA / CPS GROUNDWATER
CTRWTP - Alternate 1C - WTP East of San Antonio (Discharge ALCOA/CPS groundwater to Big Sandy Creek)

Initial year of analysis period	2015			Contingency =	20%
Interest rate	5%			Engineering, Legal, Admin. =	15%
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

Well Fields and Collection Lines

	ALCOA	CPS	Total
Year built	2015	2015	
Estimated Construction Cost in Millions			
Wells (Based on Non-Public Water Supply Wells)	20.92	7.94	28.86
Pipeline	13.03	5.94	18.97
Pump Stations & Storage	8.51	0	8.51
Subtotal	42.46	13.88	56.34
Contingency	8.49	2.78	11.27
Subtotal	50.95	16.66	67.61
Engineering, Legal & Administrative	6.37	2.08	8.45
Subtotal	57.32	18.74	76.06
Environmental & Archaeology Studies & Mitigation	0.63	0.2	0.83
Land Acquisition & Surveying	0	0	0.00
Groundwater Purchase	0	5.64	5.64
ALCOA Construction Program Management Fee	5.45	0	5.45
Interest During Construction (2 years, 6% int., 4% ret.)	5.89	2.44	8.33
Total Capital Cost	**69.29**	**27.02**	**96.31**
Estimated Annual O&M Costs			
O&M	0.67	0.18	0.85
Pumping Energy	2.41	0.52	2.93
ALCOA Project Management Fees	0.35	0.00	0.35
Purchase of Groundwater	2.00	0.00	2.00
Groundwater District Fees	0.65	0.25	0.90
Mitigation Reserves	0.28	0.11	0.39
Total Annual Cost	**6.36**	**1.06**	**7.42**

NPV of O&M Costs	$ 116	$ 19	$ 135	million
NPV of Capital Costs	$ 69	$ 27	$ 96	million
Total NPV of Capital and O&M Costs for Well Fields	**$ 185**	**$ 46**	**$ 232**	**million**

Cooling of Well Water

Total number of wells in both fields	120	wells	Approximate capacity per wel	300 gpm
Percentage of wells with temperatures > than ___ degrees	5%			36,000 gpm
Estimated number of wells with temperature > ____ degrees	6.0		Rough check	58,072 ac-ft/year

Estimated Capital Costs

Year built	2015		
Number of Packaged Cooling Towers (300 gpm capacity/each)	6.0		
Equipment cost (cooling towers and fans)	$ 60,000		
Installation and contractors mark-up	$ 50,000		
Structural slab	$ 30,000		
Electrical	$ 50,000		
Estimated Unit Construction Cost	$ 190,000	Each	
Total construction cost	$ 1.14	million	
Contingencies	$ 0.23		
Subtotal	$ 1.37		
Engineering, Legal and Admin	$ 0.21		
Total Estimated Capital Cost	$ 1.57		
NPV of Capital Costs	$ 1.57	million	

Estimated O&M Costs

Value of equipment	$ 0.4	million	
Assumed life of equipment	10	years	
Estimated maintenance/replacement cost	$ 0.04	million/year	
Blower Hp per cooling tower	10	Hp	
	7	kw	
Hours of operation	24	hours	
Power consumption per cooling tower	179	kwh per day	
	65,350	kwh per year	
Power cost per cooling tower	$ 4,574	per year	
Total power cost for all cooling towers in millions	$ 0.03	million per year	
Regular operational checks and routine maintenance	$ 6,000	per month for all cooling towers	
	$ 0.07	per year	
Estimated O&M Cost	$ 0.14	million $ per year	
NPV of O&M costs	$ 2.47	million $	

Ground Water Transmission Main and Pump Station (Hwy 290 to Bastrop Intake)

None Req'd - flow in Big Sandy Creek

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Well Fields and Collection Lines (including tank and pump station at Hwy 290)	$ 96.3	$ 135.5	$ 231.8
Cooling Towers for Selected High Temperature Wells	$ 1.6	$ 2.5	$ 4.0
Ground Water Transmission Main and Pumping Station	$ -	$ -	$ -
Total for ALCOA-CPS	$ 97.9	$ 137.9	$ 235.8

O&M Cost Calculations
RWI B - Colorado River Intake at Bastrop and Off Channel Reservoir
CTRWTP - Alternate 1C - WTP East of San Antonio (Discharge ALCOA/CPS groundwater to Big Sandy Creek)

Initial year of analysis period	2015		Contingency =	20%
Interest rate	5%		Engineering, Legal, Admin. =	15%
Evaluation period	40	years		
Unit cost of energy	$ 0.07	per kwh	Environmental & Archaeology Studies & Mitigation, Surveying, and Land Acquisition =	$ 100,000 per mile
			or =	$ 5,000 per acre

Inflatable Rubber Low Head Dam

	Quantity	Units	Size	Unit Constr. Cost (millions)	Total Estimated Constr. Cost (millions)	Contigency, Eng., etc. (millions)	Total Capital Cost (millions)
Inflatable Rubber Low Head Dam	2	each	10 ft high	$ 2.25	$ 4.50	$ 1.71	$ 6.21

Estimated inflatable dam cost as % of total	50%		
Value of inflatable dam	$ 2.25	million	
Assumed life of inflatable dam	10	years	
Estimated maintenance/replacement cost	$ 0.23	million/year	
Year built	2015		
NPV of O&M Costs	$ 3.86	million	
NPV of Capital Costs	$ 6.21	million	
Total NPV of Capital and O&M Costs	**$ 10.07**	**million**	

Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)

Summary of withdrawals in acre-feet/year:

Year	2015	2020	2030	2040	2050	2060	2065
For SAWS	18000	18000	18000	18000	18000	18000	18000
LCRA			5600	11200	11200	11200	11200
COA			16802	22403	33604	33604	33604
Subtotals	18000	18000	40402	51603	62804	62804	62804
ALCOA/CPS	55000	55000	55000	55000	55000	55000	55000
Totals	73000	73000	95402	106603	117804	117804	117804

Ultimate (Y2065) average design surface water withdrawal ra	62,804	ac-ft/year		
	87	cfs		
			23.1	Ratio of design withdrawal rate to Total intake design withdrawal rate
Surface water withdrawal rate (for scalping high flows)	2,000	cfs		
	897,600	gpm		
Plus additional withdrawal of groundwater on constant basis	55,000	ac-ft/yr		
	76	cfs		
	34,095	gpm		
Total design withdrawal rate	931,695	gpm		
No. of Intakes	2			
Design withdrawal rate per intake	465,848	gpm		
No. of reservoirs	4			
Design flow to each reservoir	232,924	gpm		
Inside diameter of each RWTM	120	in.		
Area	78.54	sf		
Average length of each RWTM	2	miles	8.0	miles for all RWTMs
	10,560	feet	42,240	feet
Estimated construction cost for RWTMs	$ 793	per LF	$ 1,254	
Total construction cost in millions	$ 33.5			
Contingencies	$ 6.7			
Subtotal	$ 40.2			
Engineering, Legal & Administrative	$ 6.0			
Subtotal	$ 46.2			
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 0.8			
Total Capital Cost for PWTM in millions	$ 47.0			
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.080	Million $/year (all RWTMs to Reservoirs)

Note: Assume intake has one RWTM pumping to the reservoir.

Design flow rate for each RWTM (from above)	232,924	gpm		
Pumping rate (one pump)	40,000	gpm		
No. of pumps (not counting spare) pumping into each RWTM	6			
Peak flow rate into each RWTM (all pumps except spare)	240,000	gpm		
Velocity at peak flow rate	6.81	fps		
C factor	120			
Head loss per foot	0.00102	ft/ft	$h_f = \lvert 3.552*Q\rvert^{1.85} / \lvert C*(d)^{2.63}\rvert$	
	5.39	ft/mile		
Head loss at peak flow rate	11	ft		
Allowance for minor losses 30%	3	ft	400	Discharge at reservoir
Total estimated losses	14	ft	320	Water surface elev in river
Average static head	80	ft	80	ft

Total estimated dynamic head		94	ft		
		41	psi		
Assumed pump efficiency		85%			
Assumed motor efficiency		90%			
Estimated Hp required per pump		1,241	hp/pump		
		926	kw/pump		
Total hp pumping into each RWTM (not counting spare)		7,448	hp/RWTM		
Total hp at each intake (not counting spare)		14,897	hp/intake		
Total hp all intakes (not counting spares)		29,793	hp		
Total kw all intakes (not counting spares)		22,226	kw		
Unit construction cost for each pump station (from cost curve	$	889	per firm hp of pump station	$ 830	
Construction cost per intake/pump station		13.2	million		
No. of intakes from above		2	each		
Total construction cost in millions	$	26.5	million		
Contigency, Eng., etc. in millions	$	10.06	million		
Total capital cost in millions	$	36.6	million		
Total construction cost for pump stations	$	26.5	million	40% Estimated equipment cost as % of total	
Value of equipment	$	10.6	million		
Assumed life of equipment		20	years		
Estimated maintenance/replacement cost	$	0.53	million/year		

O&M Costs:

Year	Flow pumped by year		No. of pump "sets" operating	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd	/day	(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	73,000	65	1.13	25,145	$ 1,760	$ 0.64	$ 0.53	$ 0.080	$ 1.25	$ 1.25
2016	73,000	65	1.13	25,145	$ 1,760	$ 0.64	$ 0.53	$ 0.080	$ 1.25	$ 1.19
2017	73,000	65	1.13	25,145	$ 1,760	$ 0.64	$ 0.53	$ 0.080	$ 1.25	$ 1.14
2018	73,000	65	1.13	25,145	$ 1,760	$ 0.64	$ 0.53	$ 0.080	$ 1.25	$ 1.08
2019	73,000	65	1.13	25,145	$ 1,760	$ 0.64	$ 0.53	$ 0.080	$ 1.25	$ 1.03
2020	73,000	65	1.13	25,145	$ 1,760	$ 0.64	$ 0.53	$ 0.080	$ 1.25	$ 0.98
2021	73,000	65	1.13	25,145	$ 1,760	$ 0.64	$ 0.53	$ 0.080	$ 1.25	$ 0.93
2022	73,000	65	1.13	25,145	$ 1,760	$ 0.64	$ 0.53	$ 0.080	$ 1.25	$ 0.89
2023	73,000	65	1.13	25,145	$ 1,760	$ 0.64	$ 0.53	$ 0.080	$ 1.25	$ 0.85
2024	73,000	65	1.13	25,145	$ 1,760	$ 0.64	$ 0.53	$ 0.080	$ 1.25	$ 0.81
2025	73,000	65	1.13	25,145	$ 1,760	$ 0.64	$ 0.53	$ 0.080	$ 1.25	$ 0.77
2026	73,000	65	1.13	25,145	$ 1,760	$ 0.64	$ 0.53	$ 0.080	$ 1.25	$ 0.73
2027	73,000	65	1.13	25,145	$ 1,760	$ 0.64	$ 0.53	$ 0.080	$ 1.25	$ 0.70
2028	73,000	65	1.13	25,145	$ 1,760	$ 0.64	$ 0.53	$ 0.080	$ 1.25	$ 0.66
2029	73,000	65	1.13	25,145	$ 1,760	$ 0.64	$ 0.53	$ 0.080	$ 1.25	$ 0.63
2030	95,402	85	1.48	32,862	$ 2,300	$ 0.84	$ 0.53	$ 0.080	$ 1.45	$ 0.70
2031	95,402	85	1.48	32,862	$ 2,300	$ 0.84	$ 0.53	$ 0.080	$ 1.45	$ 0.66
2032	95,402	85	1.48	32,862	$ 2,300	$ 0.84	$ 0.53	$ 0.080	$ 1.45	$ 0.63
2033	95,402	85	1.48	32,862	$ 2,300	$ 0.84	$ 0.53	$ 0.080	$ 1.45	$ 0.60
2034	95,402	85	1.48	32,862	$ 2,300	$ 0.84	$ 0.53	$ 0.080	$ 1.45	$ 0.57
2035	95,402	85	1.48	32,862	$ 2,300	$ 0.84	$ 0.53	$ 0.080	$ 1.45	$ 0.55
2036	95,402	85	1.48	32,862	$ 2,300	$ 0.84	$ 0.53	$ 0.080	$ 1.45	$ 0.52
2037	95,402	85	1.48	32,862	$ 2,300	$ 0.84	$ 0.53	$ 0.080	$ 1.45	$ 0.50
2038	95,402	85	1.48	32,862	$ 2,300	$ 0.84	$ 0.53	$ 0.080	$ 1.45	$ 0.47
2039	95,402	85	1.48	32,862	$ 2,300	$ 0.84	$ 0.53	$ 0.080	$ 1.45	$ 0.45
2040	106,603	95	1.65	36,720	$ 2,570	$ 0.94	$ 0.53	$ 0.080	$ 1.55	$ 0.46
2041	106,603	95	1.65	36,720	$ 2,570	$ 0.94	$ 0.53	$ 0.080	$ 1.55	$ 0.44
2042	106,603	95	1.65	36,720	$ 2,570	$ 0.94	$ 0.53	$ 0.080	$ 1.55	$ 0.41
2043	106,603	95	1.65	36,720	$ 2,570	$ 0.94	$ 0.53	$ 0.080	$ 1.55	$ 0.39
2044	106,603	95	1.65	36,720	$ 2,570	$ 0.94	$ 0.53	$ 0.080	$ 1.55	$ 0.38
2045	106,603	95	1.65	36,720	$ 2,570	$ 0.94	$ 0.53	$ 0.080	$ 1.55	$ 0.36
2046	106,603	95	1.65	36,720	$ 2,570	$ 0.94	$ 0.53	$ 0.080	$ 1.55	$ 0.34
2047	106,603	95	1.65	36,720	$ 2,570	$ 0.94	$ 0.53	$ 0.080	$ 1.55	$ 0.32
2048	106,603	95	1.65	36,720	$ 2,570	$ 0.94	$ 0.53	$ 0.080	$ 1.55	$ 0.31
2049	106,603	95	1.65	36,720	$ 2,570	$ 0.94	$ 0.53	$ 0.080	$ 1.55	$ 0.29
2050	117,804	105	1.83	40,578	$ 2,840	$ 1.04	$ 0.53	$ 0.080	$ 1.65	$ 0.30
2051	117,804	105	1.83	40,578	$ 2,840	$ 1.04	$ 0.53	$ 0.080	$ 1.65	$ 0.28
2052	117,804	105	1.83	40,578	$ 2,840	$ 1.04	$ 0.53	$ 0.080	$ 1.65	$ 0.27
2053	117,804	105	1.83	40,578	$ 2,840	$ 1.04	$ 0.53	$ 0.080	$ 1.65	$ 0.26
2054	117,804	105	1.83	40,578	$ 2,840	$ 1.04	$ 0.53	$ 0.080	$ 1.65	$ 0.25
2055	117,804	105	1.83	40,578	$ 2,840	$ 1.04	$ 0.53	$ 0.080	$ 1.65	$ 0.23
2056	117,804	105	1.83	40,578	$ 2,840	$ 1.04	$ 0.53	$ 0.080	$ 1.65	$ 0.22
2057	117,804	105	1.83	40,578	$ 2,840	$ 1.04	$ 0.53	$ 0.080	$ 1.65	$ 0.21
2058	117,804	105	1.83	40,578	$ 2,840	$ 1.04	$ 0.53	$ 0.080	$ 1.65	$ 0.20
2059	117,804	105	1.83	40,578	$ 2,840	$ 1.04	$ 0.53	$ 0.080	$ 1.65	$ 0.19
2060	117,804	105	1.83	40,578	$ 2,840	$ 1.04	$ 0.53	$ 0.080	$ 1.65	$ 0.18
2061	117,804	105	1.83	40,578	$ 2,840	$ 1.04	$ 0.53	$ 0.080	$ 1.65	$ 0.17
2062	117,804	105	1.83	40,578	$ 2,840	$ 1.04	$ 0.53	$ 0.080	$ 1.65	$ 0.17
2063	117,804	105	1.83	40,578	$ 2,840	$ 1.04	$ 0.53	$ 0.080	$ 1.65	$ 0.16
2064	117,804	105	1.83	40,578	$ 2,840	$ 1.04	$ 0.53	$ 0.080	$ 1.65	$ 0.15
2065	117,804	105	1.83	40,578	$ 2,840	$ 1.04	$ 0.53	$ 0.080	$ 1.65	$ 0.14
								Total NPV of O&M Costs		$ 26.4

Capital Costs in million $:			Yr built		
RWTM to Reservoir	$	47.0	2015		$ 47.0
Intake/Pumping Stations	$	36.6	2015		$ 36.6
				Total NPV of Capital Costs	$ 83.6
				Total NPV of Capital and O&M Costs in millions	$ 110.0

Reservoirs

	Quantity	Units	Volume/each (acre-feet)	Unit Cost ($/ac-ft)	Total Construction Cost in millions	Contigency, Eng., etc.	Total in millions
Reservoirs	4	each	15000	$ 1,180	$ 70.8	$ 26.9	$ 97.7

Estimated average depth of reservoir	20	ft		
Surface area of reservoir	3000	acres		
Ratio of total land area reqd to surface area of reservoir	1.1			
Total land area reqd for reservoirs	3300	acres	Envir & Archaeology, Surv, and Land Acq =	16.5
			Total capital cost in millions =	$ 114.2
Assumed life of reservoir	100	years		
Estimated replacement cost	$ 0.71	million/year		
Estimated maintenance	$ 0.04	million/year	Mowing, maintaining fences, etc.	
Total	$ 0.75	million/year		
Year built	2015			
NPV of O&M costs	$ 12.8	million		
NPV of Capital costs	$ 114.2	million		
Total NPV of Capital and O&M Costs	**$ 127.0**	**million**		

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Inflatable Rubber Low Head Dam	**$ 6.2**	**$ 3.9**	**$ 10.1**
Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)	**$ 83.6**	**$ 26.4**	**$ 110.0**
Off Channel Reservoir	**$ 114.2**	**$ 12.8**	**$ 127.0**
Total for RWI A	**$ 204.0**	**$ 43.1**	**$ 247.1**

O&M Cost Calculations
RWTM B - RWI B near Bastrop to WTP
CTRWTP - Alternate 1C - WTP East of San Antonio (Discharge ALCOA/CPS groundwater to Big Sandy Creek)

Initial year of analysis period	2015			Contingency =	20%
Interest rate	5%			Engineering, Legal, Admin. =	15%
Evaluation period	40	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

Summary of average pumping rates in acre-feet/year:

Surface Water

Year	2015	2020	2030	2040	2050	2060	2065
For SAWS	18000	18000	18000	18000	18000	18000	18000
LCRA			5600	11200	11200	11200	11200
COA			16802	22403	33604	33604	33604
Subtotal	18000	18000	40402	51603	62804	62804	62804

Groundwater

Year	2015	2020	2030	2040	2050	2060	2065
For SAWS	55000	55000	55000	55000	55000	55000	55000
Suface & groun	73000	73000	95402	106603	117804	117804	117804

Ultimate (Y2065) average design pumping rate 117,804 ac-ft/year

Sizing of Raw Water Transmission Main B & Pump Stations

Inside diameter of RWTM			84	in.	
Area			38.48	sf	
Length of RWTM			68	miles	
			359,040	feet	
Estimated unit construction cost for RWTM		$	467	per LF	
Total construction cost in millions		$	167.8		
Contingencies		$	33.6		
Subtotal		$	201.4		
Engineering, Legal & Administrative		$	30.2		
Subtotal		$	231.6		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq		$	6.8		
Total Capital Cost for PWTM in millions		$	238.4	million	
Unit maintenance cost/year-mile		$	5,000	$/year-mile	$ 0.340 Million $/year
Design flow rate (from table above)			117,804	ac-ft/year	
			105	mgd	
			73,029	gpm	
Pumping rate (one pump)			15,000	gpm	
No. of pumps (not counting spare)			5		
Peak flow rate (all pumps except spare)			75,000	gpm	
Velocity at peak flow rate			4.34	fps	
C factor			120		
Head loss per foot			0.00067	ft/ft	$h_f = \left\| \frac{3.552*Q}{C*(d)^{2.63}} \right\|^{1.85}$
			3.55	ft/mile	
Head loss at peak flow rate			242	ft	
Allowance for minor losses	10%		24	ft	650 Elev. At WTP
Total estimated losses			266	ft	400 Elev of WSE in Bastrop reservoir
Average static head			250	ft	250 ft
Total estimated dynamic head			516	ft	
			224	psi	
No of recommended pumping stations along route			1.49		150 psi (assumed max pressure
No. of pumping stations used in cost estimate			2.0		in pipe)
Average head per pump station			258	ft	
Assumed pump efficiency			85%		
Assumed motor efficiency			90%		
Estimated Hp required per pump			1,277	hp/pump	
			953	kw/pump	
Total hp per pump station (not counting spare)			6,386	hp/station	
Total kw per pump set (set=pumps in series along route)			2,554	kw/pump set	(one pump at each station)
Unit construc cost for each pump station (from cost curve)		$	1,365	per firm hp of pump station	
Construction cost per pump station			8.7	million	
Balancing reservoir		$	0.75	million	60 min. of storage at avg pumping rate
Total construction cost per pump station		$	9.47	million	5.0 mg
					$ 0.15 per gal for open top reservoir
No. of pump stations from above			2.0	each	
Total construction cost in millions		$	18.9	million	
Contingency, Eng., etc. in millions		$	7.20	million	
Total capital cost in millions		$	26.1	million	
Total construction cost for pump stations		$	18.9	million	
Value of equipment		$	7.6	million	40% Estimated equipment cost as % of total
Assumed life of equipment			20	years	
Estimated maintenance/replacement cost		$	0.38	million/year	

O&M Costs

Year	Flow pumped by year		No. of pump "sets" operating	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd	/day	(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 5.44
2016	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 5.19
2017	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 4.94
2018	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 4.70
2019	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 4.48
2020	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 4.27
2021	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 4.06
2022	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 3.87
2023	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 3.69
2024	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 3.51
2025	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 3.34
2026	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 3.18
2027	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 3.03
2028	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 2.89
2029	73,000	65	3.02	184,957	$ 12,947	$ 4.73	$ 0.38	$ 0.340	$ 5.44	$ 2.75
2030	95,402	85	3.94	241,716	$ 16,920	$ 6.18	$ 0.38	$ 0.340	$ 6.89	$ 3.32
2031	95,402	85	3.94	241,716	$ 16,920	$ 6.18	$ 0.38	$ 0.340	$ 6.89	$ 3.16
2032	95,402	85	3.94	241,716	$ 16,920	$ 6.18	$ 0.38	$ 0.340	$ 6.89	$ 3.01
2033	95,402	85	3.94	241,716	$ 16,920	$ 6.18	$ 0.38	$ 0.340	$ 6.89	$ 2.86
2034	95,402	85	3.94	241,716	$ 16,920	$ 6.18	$ 0.38	$ 0.340	$ 6.89	$ 2.73
2035	95,402	85	3.94	241,716	$ 16,920	$ 6.18	$ 0.38	$ 0.340	$ 6.89	$ 2.60
2036	95,402	85	3.94	241,716	$ 16,920	$ 6.18	$ 0.38	$ 0.340	$ 6.89	$ 2.47
2037	95,402	85	3.94	241,716	$ 16,920	$ 6.18	$ 0.38	$ 0.340	$ 6.89	$ 2.36
2038	95,402	85	3.94	241,716	$ 16,920	$ 6.18	$ 0.38	$ 0.340	$ 6.89	$ 2.24
2039	95,402	85	3.94	241,716	$ 16,920	$ 6.18	$ 0.38	$ 0.340	$ 6.89	$ 2.14
2040	106,603	95	4.41	270,096	$ 18,907	$ 6.90	$ 0.38	$ 0.340	$ 7.62	$ 2.25
2041	106,603	95	4.41	270,096	$ 18,907	$ 6.90	$ 0.38	$ 0.340	$ 7.62	$ 2.14
2042	106,603	95	4.41	270,096	$ 18,907	$ 6.90	$ 0.38	$ 0.340	$ 7.62	$ 2.04
2043	106,603	95	4.41	270,096	$ 18,907	$ 6.90	$ 0.38	$ 0.340	$ 7.62	$ 1.94
2044	106,603	95	4.41	270,096	$ 18,907	$ 6.90	$ 0.38	$ 0.340	$ 7.62	$ 1.85
2045	106,603	95	4.41	270,096	$ 18,907	$ 6.90	$ 0.38	$ 0.340	$ 7.62	$ 1.76
2046	106,603	95	4.41	270,096	$ 18,907	$ 6.90	$ 0.38	$ 0.340	$ 7.62	$ 1.68
2047	106,603	95	4.41	270,096	$ 18,907	$ 6.90	$ 0.38	$ 0.340	$ 7.62	$ 1.60
2048	106,603	95	4.41	270,096	$ 18,907	$ 6.90	$ 0.38	$ 0.340	$ 7.62	$ 1.52
2049	106,603	95	4.41	270,096	$ 18,907	$ 6.90	$ 0.38	$ 0.340	$ 7.62	$ 1.45
2050	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 1.51
2051	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 1.44
2052	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 1.37
2053	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 1.31
2054	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 1.24
2055	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 1.19
2056	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 1.13
2057	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 1.08
2058	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 1.02
2059	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 0.98
2060	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 0.93
2061	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 0.88
2062	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 0.84
2063	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 0.80
2064	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 0.76
2065	117,804	105	4.87	298,476	$ 20,893	$ 7.63	$ 0.38	$ 0.340	$ 8.34	$ 0.73
								Total NPV of O&M Costs		$ 121.7

Capital Costs in million $:		Yr built		
RWTM	$ 238.4	2015		$ 238.4
Pumping Stations	$ 26.1	2015		$ 26.1
			Total NPV of Capital Costs	$ 264.5

Total NPV of Capital and O&M Costs in millions $ 386.2

O&M Cost Calculations
WTP and Raw Water Storage Reservoir at WTP
CTRWTP - Alternate 1C - WTP East of San Antonio (Discharge ALCOA/CPS groundwater to Big Sandy Creek)

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition =	$ 25,000	per acre

Treated Water Production by Treatment Type (from Demand Chart - BE SURE TO CHECK)

	Year =	2015	2020	2030	2040	2050	2060	2065
Softened water demand:	Units							
Average yearly demands:								
City of Austin	ac-ft/yr	0	0	16802	22403	33604	33604	33604
LCRA	ac-ft/yr	0	0	5600	11200	11200	11200	11200
Totals	ac-ft/yr	0	0	22402	33603	44804	44804	44804
Totals	mgd	0	0	20	30	40	40	40
Max day demands:								
City of Austin	mgd	0	0	25	35	50	50	50
LCRA	mgd	0	0	10	20	20	20	20
Totals	mgd	0	0	35	55	70	70	70

	Year =	2015	2020	2030	2040	2050	2060	2065
Non-softened water demands:	Units							
Average yearly demands:								
SAWS	ac-ft/yr	73000	205000	205000	205000	205000	205000	205000
SARA	ac-ft/yr	20550	23406	28433	31393	34411	37530	41128
GBRA	ac-ft/yr	0	0	6000	8000	10000	12300	12300
Totals		93550	228406	239433	244393	249411	254830	258428
Totals	mgd	84	204	214	218	223	227	231
Max day demands:								
SAWS	mgd	85	238	238	238	238	238	238
SARA	mgd	24	27	33	36	40	44	48
GBRA	mgd	0	0	5	7	9	11	11
Totals	mgd	109	265	276	281	287	293	297
Total; softened and non-softened water demands								
Average yearly demand	ac-ft/yr	93550	228406	261835	277996	294215	299634	303232
	mgd	84	204	234	248	263	267	271
Max day demand	mgd	109	265	311	336	357	363	367

Raw Water Reservoir

Sizing for ultimate conditions:

Assumed number of days of consecutive Max Day demands	30	days	
Design (Max. Day) treated water production req'd in mgd	367	mgd	
Average treated water production in mgd	271	mgd	(which is also equal to sum of ground and raw water that can be pumped to the WTP)
Difference (shortfall of raw water)	96	mgd	
Required storage reservoir for raw water	2,889	mg	
	8,868	ac-ft	
Add safety factor 25%	2,217	ac-ft	
Total storage required	11,084	ac-ft	
Total storage recommended	12,000	ac-ft	Note: No. of days at average day demand (for example, for repair of RWTM A) = 33 days

	Quantity	Units	Volume/each (acre-feet)	Unit Cost ($/ac-ft))	Total Construction Cost	Contigency, Eng., etc.	Total Capital Cost
Reservoirs	1	each	12,000	$ 1,283	$ 15.4	$ 5.9	$ 21.3

Estimated average depth of reservoir	25	ft	
Surface area of reservoir	480	acres	
Ratio of total land area reqd to surface area of reservoir	1.10		
Total land area reqd for reservoirs	528	acres	Envir & Archaeology, Surv, and Land Acq = 13.2
			Total capital cost in millions = $ 34.5
Assumed life of reservoir	100	years	
Estimated replacement cost	$ 0.15	million/year	
Estimated maintenance	$ 0.04	million/year	Mowing, maintaining fences, etc.
Total	$ 0.19	million/year	
Year built	2015		
NPV of O&M costs	$ 3.5	million	
NPV of Capital costs	$ 34.5	million	
Total NPV of Capital and O&M Costs	$ 38.0	million	

WTP

Plant Phasing and Capital Costs:

Softening Treatment Trains

Year =	2015	2020	2030	2040	2050	2060	2065
Average treated water production in mgd	0	0	20	30	40	40	40
Design (Max. Day) treated water production req'd in mgd	0	0	35	55	70	70	70
Initial/additional Max day capacity built (mgd)			50	20			
Total capacity on line (must exceed Design Max Day Req'd)	0	0	50	70	70	70	70
Unit cost for max day treatment capacity ($/gpd of capacity)			$ 1.78	$ 2.14			
Estimated construction cost of expansion in $millions	$ -	$ -	$ 89.0	$ 42.8	$ -	$ -	$ -

Non-softening Treatment Trains

Year =	2015	2020	2030	2040	2050	2060	2065
Average treated water production in mgd	84	204	214	218	223	227	231
Design (Max. Day) treated water production req'd in mgd	109	265	276	281	287	293	297
Additional Max day capacity built (mgd)	200	100					
Total capacity on line (must exceed Design Max Day Req'd)	200	300	300	300	300	300	300
Unit cost for max day treatment capacity ($/gpd of capacity)	$ 1.15	$ 1.32					
Estimated construction cost of expansion in $millions	$ 229.6	$ 131.5	$ -	$ -	$ -	$ -	$ -

Totals (Softening + Non-softening Trains)

Year =	2015	2020	2030	2040	2050	2060	2065
Total construction cost for both trains	$ 229.6	$ 131.5	$ 89.0	$ 42.8	$ -	$ -	$ -
Contingencies	45.9	26.3	17.8	8.6	-	-	-
Subtotal	$ 275.5	$ 157.8	$ 106.8	$ 51.3	$ -	$ -	$ -
Engineering, Legal, & Administrative	41.3	23.7	16.0	7.7	-	-	-
Subtotal	316.8	181.5	122.8	59.0	-	-	-
Environmental & Archaeology Studies and Mitigation & Land Acquisition and Surveying (see Note below)	2.5						
Total estimated capital cost	$ 319.3	$ 181.5	$ 122.8	$ 59.0	$ -	$ -	$ -
NPV of capital cost	$ 319.3	$ 142.2	$ 59.1	$ 17.4	$ -	$ -	$ -
Total NPV of WTP initial construction & expansions	$ 538						

Note: Assumed land requirement for WTP (not including reservoir 100 acres

O&M Costs for Softening Trains:

Year	Plant Capacity in service	Estimated treated water production	Estimated O&M cost from unit cost curve		Net present value
	mgd of capacity	mgd produced	$ per mg treated	$million /year	($)
2015	-	-		$ -	$ -
2016	-	-		$ -	$ -
2017	-	-		$ -	$ -
2018	-	-		$ -	$ -
2019	-	-		$ -	$ -
2020	-	-		$ -	$ -
2021	-	-		$ -	$ -
2022	-	-		$ -	$ -
2023	-	-		$ -	$ -
2024	-	-		$ -	$ -
2025	-	-		$ -	$ -
2026	-	-		$ -	$ -
2027	-	-		$ -	$ -
2028	-	-		$ -	$ -
2029	-	-		$ -	$ -
2030	50	20	$ 712	$ 5.20	$ 2.50
2031	50	20	$ 712	$ 5.20	$ 2.38
2032	50	20	$ 712	$ 5.20	$ 2.27
2033	50	20	$ 712	$ 5.20	$ 2.16
2034	50	20	$ 712	$ 5.20	$ 2.06
2035	50	20	$ 712	$ 5.20	$ 1.96
2036	50	20	$ 712	$ 5.20	$ 1.87
2037	50	20	$ 712	$ 5.20	$ 1.78
2038	50	20	$ 712	$ 5.20	$ 1.69
2039	50	20	$ 712	$ 5.20	$ 1.61
2040	70	30	$ 661	$ 7.24	$ 2.14
2041	70	30	$ 661	$ 7.24	$ 2.04
2042	70	30	$ 661	$ 7.24	$ 1.94
2043	70	30	$ 661	$ 7.24	$ 1.85
2044	70	30	$ 661	$ 7.24	$ 1.76
2045	70	30	$ 661	$ 7.24	$ 1.68
2046	70	30	$ 661	$ 7.24	$ 1.60
2047	70	30	$ 661	$ 7.24	$ 1.52
2048	70	30	$ 661	$ 7.24	$ 1.45
2049	70	30	$ 661	$ 7.24	$ 1.38
2050	70	40	$ 661	$ 9.65	$ 1.75
2051	70	40	$ 661	$ 9.65	$ 1.67
2052	70	40	$ 661	$ 9.65	$ 1.59
2053	70	40	$ 661	$ 9.65	$ 1.51
2054	70	40	$ 661	$ 9.65	$ 1.44
2055	70	40	$ 661	$ 9.65	$ 1.37
2056	70	40	$ 661	$ 9.65	$ 1.31
2057	70	40	$ 661	$ 9.65	$ 1.24
2058	70	40	$ 661	$ 9.65	$ 1.18
2059	70	40	$ 661	$ 9.65	$ 1.13
2060	70	40	$ 661	$ 9.65	$ 1.07
2061	70	40	$ 661	$ 9.65	$ 1.02
2062	70	40	$ 661	$ 9.65	$ 0.97
2063	70	40	$ 661	$ 9.65	$ 0.93
2064	70	40	$ 661	$ 9.65	$ 0.88
2065	70	40	$ 661	$ 9.65	$ 0.84
			Total NPV of O&M Costs		$ 58

O&M Costs for Non-Softening Trains:

Year	Plant Capacity in service	Estimated treated water production	Estimated O&M cost from unit cost curve		Net present value
	mgd of capacity	mgd produced	$ per mg treated	$million /year	($)
2015	200	84	$ 374	$ 11.41	$ 11.41
2016	200	84	$ 374	$ 11.41	$ 10.87
2017	200	84	$ 374	$ 11.41	$ 10.35
2018	200	84	$ 374	$ 11.41	$ 9.86
2019	200	84	$ 374	$ 11.41	$ 9.39
2020	300	204	$ 343	$ 25.50	$ 19.98
2021	300	204	$ 343	$ 25.50	$ 19.03
2022	300	204	$ 343	$ 25.50	$ 18.12
2023	300	204	$ 343	$ 25.50	$ 17.26
2024	300	204	$ 343	$ 25.50	$ 16.44
2025	300	204	$ 343	$ 25.50	$ 15.65
2026	300	204	$ 343	$ 25.50	$ 14.91
2027	300	204	$ 343	$ 25.50	$ 14.20
2028	300	204	$ 343	$ 25.50	$ 13.52
2029	300	204	$ 343	$ 25.50	$ 12.88
2030	300	214	$ 343	$ 26.73	$ 12.86
2031	300	214	$ 343	$ 26.73	$ 12.24
2032	300	214	$ 343	$ 26.73	$ 11.66
2033	300	214	$ 343	$ 26.73	$ 11.11
2034	300	214	$ 343	$ 26.73	$ 10.58
2035	300	214	$ 343	$ 26.73	$ 10.07
2036	300	214	$ 343	$ 26.73	$ 9.59
2037	300	214	$ 343	$ 26.73	$ 9.14
2038	300	214	$ 343	$ 26.73	$ 8.70
2039	300	214	$ 343	$ 26.73	$ 8.29
2040	300	218	$ 343	$ 27.28	$ 8.06
2041	300	218	$ 343	$ 27.28	$ 7.67
2042	300	218	$ 343	$ 27.28	$ 7.31
2043	300	218	$ 343	$ 27.28	$ 6.96
2044	300	218	$ 343	$ 27.28	$ 6.63
2045	300	218	$ 343	$ 27.28	$ 6.31
2046	300	218	$ 343	$ 27.28	$ 6.01
2047	300	218	$ 343	$ 27.28	$ 5.73
2048	300	218	$ 343	$ 27.28	$ 5.45
2049	300	218	$ 343	$ 27.28	$ 5.19
2050	300	223	$ 343	$ 27.84	$ 5.05
2051	300	223	$ 343	$ 27.84	$ 4.81
2052	300	223	$ 343	$ 27.84	$ 4.58
2053	300	223	$ 343	$ 27.84	$ 4.36
2054	300	223	$ 343	$ 27.84	$ 4.15
2055	300	223	$ 343	$ 27.84	$ 3.95
2056	300	223	$ 343	$ 27.84	$ 3.77
2057	300	223	$ 343	$ 27.84	$ 3.59
2058	300	223	$ 343	$ 27.84	$ 3.42
2059	300	223	$ 343	$ 27.84	$ 3.25
2060	300	227	$ 343	$ 28.45	$ 3.17
2061	300	227	$ 343	$ 28.45	$ 3.02
2062	300	227	$ 343	$ 28.45	$ 2.87
2063	300	227	$ 343	$ 28.45	$ 2.74
2064	300	227	$ 343	$ 28.45	$ 2.60
2065	300	231	$ 343	$ 28.85	$ 2.52
				Total NPV of O&M Costs	$ 441

NPV Totals for O&M:

Softening trains	$ 58
Non-softening Trains	$ 441
	$ 499

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Raw Water Reservoir	$ 34	$ 3.5	$ 38
Water Treatment Plant	$ 538	$ 499	$ 1,037
Totals	$ 572	$ 502	$ 1,075

Capital and O&M Cost Calculations
Potable Water Transmission Mains
CTRWTP - Alternate 1C - WTP East of San Antonio (Discharge ALCOA/CPS groundwater to Big Sandy Creek)

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

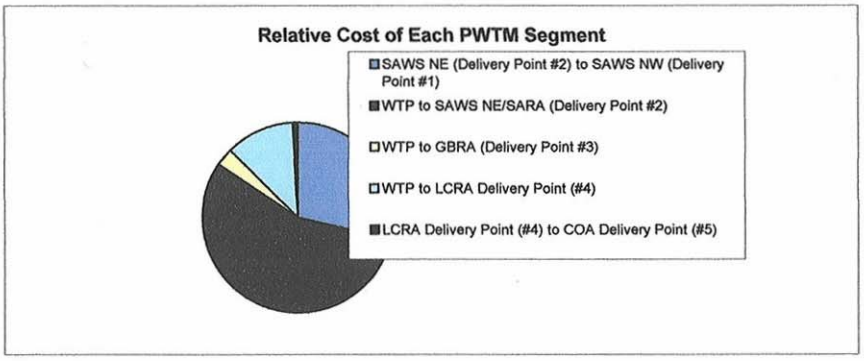
Summary of Demands

Average demands to be delivered in each segment in acre-feet/year

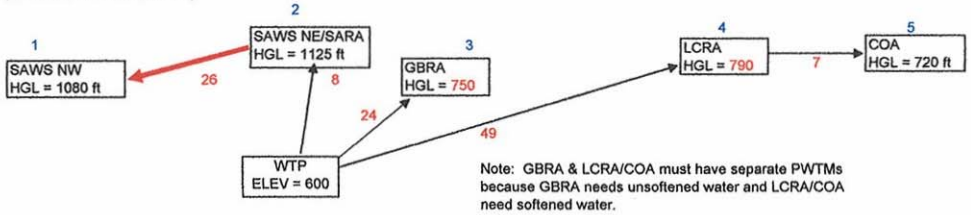
Year	2015	2020	2030	2040	2050	2060	2065
SAWS NW	43800	123000	123000	123000	123000	123000	123000
SAWS NE	29200	82000	82000	82000	82000	82000	82000
Subtotal	73000	205000	205000	205000	205000	205000	205000
SARA	20550	23406	28433	31393	34411	37530	41128
GBRA			6000	8000	10000	12300	12300
LCRA			5600	11200	11200	11200	11200
COA			16802	22403	33604	33604	33604
Total	93550	228406	261835	277996	294215	299634	303232

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
SAWS NE (Delivery Point #2) to SAWS NW (Delivery Point #1)	$ 203	$ 5	$ 207
WTP to SAWS NE/SARA (Delivery Point #2)	$ 117	$ 289	$ 405
WTP to GBRA (Delivery Point #3)	$ 17	$ 5	$ 22
WTP to LCRA Delivery Point (#4)	$ 70	$ 14	$ 84
LCRA Delivery Point (#4) to COA Delivery Point (#5)	$ 6	$ 1	$ 7
Total for PWTMs	$ 412	$ 313	$ 726



SAWS NE (Delivery Point #2) to SAWS NW (Delivery Point #1)
(Bold line in schematic below)



Note: GBRA & LCRA/COA must have separate PWTMs because GBRA needs unsoftened water and LCRA/COA need softened water.

Demands for this pipe segment

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
SAWS NW	39	110	110	110	110	110	110	1.3
Total	39	110	110	110	110	110	110	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
SAWS NW	51	143	143	143	143	143	143
Total	51	143	143	143	143	143	143

PWTM and Pump Station Costs

Design flow rate - year 2065	143	mgd	
	99,125	gpm	
Pumping capacity of one pump	20,000	gpm	
No. of pumps (not counting spare)	5		
Peak flow rate (all pumps except spare)	100,000	gpm	
Inside diameter of PWTM	120	in.	
Area	78.54	sf	
Length of RWTM	26	miles	(linked to mileage in schematic above)
	137,280	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	15%	20,592	$ 783	$ 16.1	million
Rural - rock	50%	68,640	$ 1,048	$ 72.0	
Urban - rock	35%	48,048	$ 1,186	$ 57.0	
		137,280		$ 145.0	million
Average estimated unit construction cost for PWTM			$ 1,057	per LF	

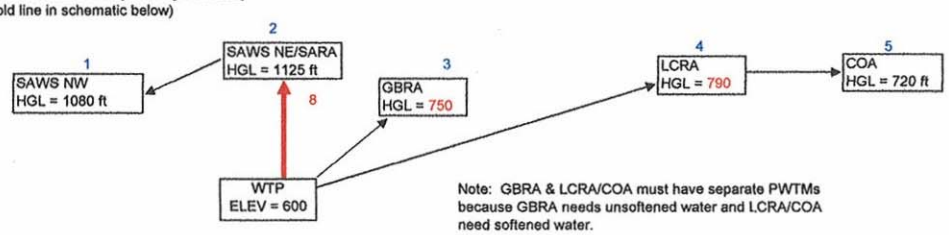
Total construction cost in millions	$ 145.0			
Contingencies	$ 29.0			
Subtotal	$ 174.0			
Engineering, Legal & Administrative	$ 26.1			
Subtotal	$ 200.2			
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 2.6			
Total Capital Cost for PWTM in millions	$ 202.8			
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.260	Million $/year
Velocity at peak flow rate	2.84	fps		
C factor	120			
Head loss per foot	0.00020	ft/ft	$h_f = \frac{3.552*Q^{1.85}}{C*(d)^{2.63}}$	
	1.07	ft/mile		
Head loss at peak flow rate	28	ft		
Allowance for minor losses 20%	6	ft	1080	Desired HGL At Delivery Point
Total estimated losses	33	ft	1125	HGL At Delivery Point 2
Average static head	-45	ft	-45	ft
Total estimated dynamic head	-12	ft		
	-5	psi		

Negative indicates gravity flow from #2 to #1; no pumping necessary.

			Million $
Annual O&M Cost in million $:		Yr built	
PWTM	$ 0.260	2015	
Total NPV of O&M Costs			$4.7
Capital Costs in million $:		Yr built	
PWTM	$ 202.8	2015	$ 202.8
Total NPV of Capital Costs			$ 202.8

Total NPV of Capital and O&M Costs in millions $ 207.5
SAWS NE (Delivery Point #2) to SAWS NW (Delivery Point #1)

WTP to SAWS NE/SARA (Delivery Point #2)
(Bold line in schematic below)



Note: GBRA & LCRA/COA must have separate PWTMs because GBRA needs unsoftened water and LCRA/COA need softened water.

Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
SAWS NW	39	110	110	110	110	110	110	1.3
SAWS NE	26	73	73	73	73	73	73	1.3
SARA	18	21	25	28	31	34	37	1.3
Total	84	204	208	211	214	217	220	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
SAWS NW	51	143	143	143	143	143	143
SAWS NE	34	95	95	95	95	95	95
SARA	24	27	33	36	40	44	48
Total	109	265	271	274	278	281	286

PWTM and Pump Station Costs

Design flow rate - year 2065	286	mgd	
	198,353	gpm	
Pumping capacity of one pump	20,000	gpm	
No. of pumps (not counting spare)	10		
Peak flow rate (all pumps except spare)	200,000	gpm	
Inside diameter of PWTM	120	in.	
Area	78.54	sf	
Length of PWTM	8	miles	(linked to mileage in schematic above)
	42,240	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	25%	10,560	$ 783	$ 8.3	million
Rural - rock	50%	21,120	$ 1,048	$ 22.1	
Urban - rock	25%	10,560	$ 1,186	$ 12.5	
		42,240		$ 42.9	million
Average estimated unit construction cost for PWTM			$ 1,016	per LF	

Total construction cost in millions	$	42.9		
Contingencies	$	8.6		
Subtotal	$	51.5		
Engineering, Legal & Administrative	$	7.7		
Subtotal	$	59.2		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$	0.8		
Total Capital Cost for PWTM in millions	$	60.0		
Unit maintenance cost/year-mile	$	10,000	$/year-mile	$ 0.080 Million $/year
Velocity at peak flow rate		5.67	fps	
C factor		120		
Head loss per foot		0.00073	ft/ft	$h_f = \frac{3.552 * Q^{1.85}}{C^{1.85} * d^{4.87}}$
		3.85	ft/mile	
Head loss at peak flow rate		31	ft	
Allowance for minor losses 20%		6	ft	1125 Desired HGL At Delivery Point
Total estimated losses		37	ft	600 Elev. At WTP
Average static head		525	ft	525 ft
Total estimated dynamic head		562	ft	
		244	psi	
No of recommended pumping stations along route		1.62		150 psi (assumed max pressure
No. of pumping stations used in cost estimate		2		in pipe)
Average head per pump station		281	ft	
Assumed pump efficiency		85%		
Assumed motor efficiency		90%		
Estimated Hp required per pump		1,855	hp/pump	
		1,384	kw/pump	
Total hp per pump station (not counting spare)		18,549	firm hp/station	
Total kw per pump set (set=pumps in series along route)		3,710	kw/pump set	(one pump at each station)
Unit construction cost for each pump station (from cost curve)	$	1,105	per firm hp of pump station	
Construction cost per pump station		20.5	million	
Total construction cost for pump stations		41.0	for 2	pump stations

Contingencies	$	8.2	
Subtotal	$	49.2	
Engineering, Legal & Administrative	$	7.4	
Total capital cost for pump stations in millions	$	56.6	million
			40% Equip cost as % of constr cost
Value of equipment	$	16	million
Assumed life of equipment		20	years
Estimated maintenance/replacement cost	$	0.82	million/year

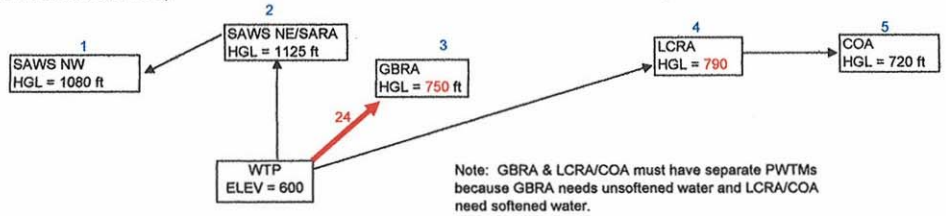
O&M Costs

Year	Flow pumped by year (average flows from Table above)	No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - PWTM	Total O&M cost	Net present value
	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	84	2.90	258,178	$ 18,072	$ 6.60	$ 0.82	$ 0.080	$ 7.50	$ 7.50
2016	84	2.90	258,178	$ 18,072	$ 6.60	$ 0.82	$ 0.080	$ 7.50	$ 7.14
2017	84	2.90	258,178	$ 18,072	$ 6.60	$ 0.82	$ 0.080	$ 7.50	$ 6.80
2018	84	2.90	258,178	$ 18,072	$ 6.60	$ 0.82	$ 0.080	$ 7.50	$ 6.48
2019	84	2.90	258,178	$ 18,072	$ 6.60	$ 0.82	$ 0.080	$ 7.50	$ 6.17
2020	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 13.32
2021	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 12.69
2022	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 12.09
2023	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 11.51
2024	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 10.96
2025	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 10.44
2026	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 9.94
2027	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 9.47
2028	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 9.02
2029	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 8.59
2030	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 8.35
2031	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 7.95
2032	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 7.57
2033	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 7.21
2034	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 6.87
2035	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 6.54
2036	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 6.23
2037	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 5.93
2038	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 5.65
2039	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 5.38
2040	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 5.19
2041	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 4.94
2042	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 4.71
2043	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 4.48
2044	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 4.27
2045	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 4.06
2046	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 3.87
2047	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 3.69
2048	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 3.51
2049	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 3.34
2050	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 3.22
2051	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 3.07
2052	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 2.92
2053	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 2.78
2054	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 2.65
2055	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 2.53
2056	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 2.41
2057	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 2.29
2058	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 2.18
2059	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 2.08
2060	217	7.52	669,331	$ 46,853	$ 17.10	$ 0.82	$ 0.080	$ 18.00	$ 2.00
2061	217	7.52	669,331	$ 46,853	$ 17.10	$ 0.82	$ 0.080	$ 18.00	$ 1.91
2062	217	7.52	669,331	$ 46,853	$ 17.10	$ 0.82	$ 0.080	$ 18.00	$ 1.82
2063	217	7.52	669,331	$ 46,853	$ 17.10	$ 0.82	$ 0.080	$ 18.00	$ 1.73
2064	217	7.52	669,331	$ 46,853	$ 17.10	$ 0.82	$ 0.080	$ 18.00	$ 1.65
2065	220	7.63	679,260	$ 47,548	$ 17.36	$ 0.82	$ 0.080	$ 18.26	$ 1.59
								Total NPV of O&M Costs	$ 288.7

Capital Costs in million $:			Yr built		
PWTM	$	60.0	2015		$ 60.0
Pumping Stations	$	56.6	2015		$ 56.6
				Total NPV of Capital Costs	$ 116.6

Total NPV of Capital and O&M Costs in millions $ 405
WTP to SAWS NE/SARA (Delivery Point #2)

WTP to GBRA (Delivery Point #3)
(Bold line in schematic below)



Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
GBRA	0	0	5	7	9	11	11	2.0
Total	0	0	5	7	9	11	11	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
GBRA	0	0	11	14	18	22	22
Total	0	0	11	14	18	22	22

PWTM and Pump Station Costs

Design flow rate - year 2065	22	mgd	
	15,250	gpm	
Pumping capacity of one pump	5,100	gpm	
No. of pumps (not counting spare)	3		
Peak flow rate (all pumps except spare)	15,300	gpm	
Inside diameter of PWTM	42	in.	
Area	9.62	sf	
Length of RWTM	24	miles	(linked to mileage in schematic above)
	126,720	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	100%	126,720	$ 174	$ 22.0	million
Rural - rock	0%	-	$ 244	$ -	
Urban - rock	0%	-	$ 263	$ -	
		126,720		$ 22.0	million

Average estimated unit construction cost for PWTM $ 174 per LF

Total construction cost in millions	$ 22.0		
Contingencies	$ 4.4		
Subtotal	$ 26.4		
Engineering, Legal & Administrative	$ 4.0		
Subtotal	$ 30.4		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 2.4		
Total Capital Cost for PWTM in millions	$ 32.8		
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.240 Million $/year

Velocity at peak flow rate	3.54	fps	
C factor	120		
Head loss per foot	0.00104	ft/ft	$h_f = \left\| \frac{3.552*Q\|^{1.85}}{\|C*(d)^{2.63}\|} \right.$
	5.47	ft/mile	
Head loss at peak flow rate	131	ft	
Allowance for minor losses 20%	26	ft	740 Desired HGL At Delivery Point
Total estimated losses	158	ft	600 Elev. At WTP
Average static head	140	ft	140 ft
Total estimated dynamic head	298	ft	
	129	psi	
No of recommended pumping stations along route	0.86		150 psi (assumed max pressure in pipe)
No. of pumping stations used in cost estimate	1		
Average head per pump station	298	ft	
Assumed pump efficiency	85%		
Assumed motor efficiency	90%		
Estimated Hp required per pump	501	hp/pump	
	374	kw/pump	
Total hp per pump station (not counting spare)	1,503	hp/station	
Total kw per pump set (set=pumps in series along route)	501	kw/pump set	(one pump at each station)
Unit construction cost for each pump station (from cost curve)	$ 1,718	per firm hp of pump station	
Construction cost per pump station	2.6	million	
Total construction cost for pump stations	2.6	for 1	pump stations
Contingencies	$ 0.5		
Subtotal	$ 3.1		
Engineering, Legal & Administrative	$ 0.5		

Total capital cost for pump stations	$	3.6	million
			40% Equip cost as % of constr cost
Value of equipment	$	1.0	million
Assumed life of equipment		20	years
Estimated maintenance/replacement cost	$	0.05	million/year

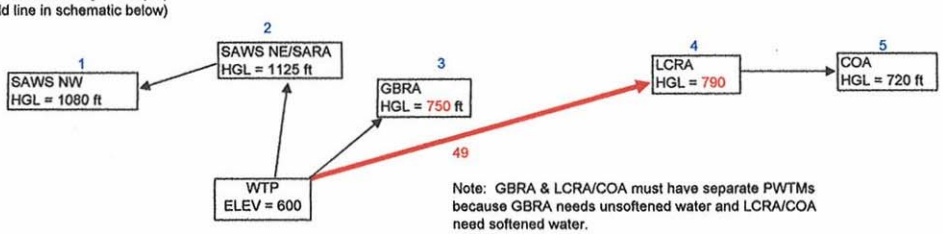
O&M Costs

Year	Flow pumped by year (average flows from Table above)	No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - PWTM	Total O&M cost	Net present value
	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	-							$ -	$ -
2016	-							$ -	$ -
2017	-							$ -	$ -
2018	-							$ -	$ -
2019	-							$ -	$ -
2020	-							$ -	$ -
2021	-							$ -	$ -
2022	-							$ -	$ -
2023	-							$ -	$ -
2024	-							$ -	$ -
2025	-							$ -	$ -
2026	-							$ -	$ -
2027	-							$ -	$ -
2028	-							$ -	$ -
2029	-							$ -	$ -
2030	5	0.73	8,771	$ 614	$ 0.22	$ 0.05	$ 0.240	$ 0.52	$ 0.25
2031	5	0.73	8,771	$ 614	$ 0.22	$ 0.05	$ 0.240	$ 0.52	$ 0.24
2032	5	0.73	8,771	$ 614	$ 0.22	$ 0.05	$ 0.240	$ 0.52	$ 0.23
2033	5	0.73	8,771	$ 614	$ 0.22	$ 0.05	$ 0.240	$ 0.52	$ 0.21
2034	5	0.73	8,771	$ 614	$ 0.22	$ 0.05	$ 0.240	$ 0.52	$ 0.20
2035	5	0.73	8,771	$ 614	$ 0.22	$ 0.05	$ 0.240	$ 0.52	$ 0.19
2036	5	0.73	8,771	$ 614	$ 0.22	$ 0.05	$ 0.240	$ 0.52	$ 0.19
2037	5	0.73	8,771	$ 614	$ 0.22	$ 0.05	$ 0.240	$ 0.52	$ 0.18
2038	5	0.73	8,771	$ 614	$ 0.22	$ 0.05	$ 0.240	$ 0.52	$ 0.17
2039	5	0.73	8,771	$ 614	$ 0.22	$ 0.05	$ 0.240	$ 0.52	$ 0.16
2040	7	0.97	11,694	$ 819	$ 0.30	$ 0.05	$ 0.240	$ 0.59	$ 0.17
2041	7	0.97	11,694	$ 819	$ 0.30	$ 0.05	$ 0.240	$ 0.59	$ 0.17
2042	7	0.97	11,694	$ 819	$ 0.30	$ 0.05	$ 0.240	$ 0.59	$ 0.16
2043	7	0.97	11,694	$ 819	$ 0.30	$ 0.05	$ 0.240	$ 0.59	$ 0.15
2044	7	0.97	11,694	$ 819	$ 0.30	$ 0.05	$ 0.240	$ 0.59	$ 0.14
2045	7	0.97	11,694	$ 819	$ 0.30	$ 0.05	$ 0.240	$ 0.59	$ 0.14
2046	7	0.97	11,694	$ 819	$ 0.30	$ 0.05	$ 0.240	$ 0.59	$ 0.13
2047	7	0.97	11,694	$ 819	$ 0.30	$ 0.05	$ 0.240	$ 0.59	$ 0.12
2048	7	0.97	11,694	$ 819	$ 0.30	$ 0.05	$ 0.240	$ 0.59	$ 0.12
2049	7	0.97	11,694	$ 819	$ 0.30	$ 0.05	$ 0.240	$ 0.59	$ 0.11
2050	9	1.22	14,618	$ 1,023	$ 0.37	$ 0.05	$ 0.240	$ 0.67	$ 0.12
2051	9	1.22	14,618	$ 1,023	$ 0.37	$ 0.05	$ 0.240	$ 0.67	$ 0.11
2052	9	1.22	14,618	$ 1,023	$ 0.37	$ 0.05	$ 0.240	$ 0.67	$ 0.11
2053	9	1.22	14,618	$ 1,023	$ 0.37	$ 0.05	$ 0.240	$ 0.67	$ 0.10
2054	9	1.22	14,618	$ 1,023	$ 0.37	$ 0.05	$ 0.240	$ 0.67	$ 0.10
2055	9	1.22	14,618	$ 1,023	$ 0.37	$ 0.05	$ 0.240	$ 0.67	$ 0.09
2056	9	1.22	14,618	$ 1,023	$ 0.37	$ 0.05	$ 0.240	$ 0.67	$ 0.09
2057	9	1.22	14,618	$ 1,023	$ 0.37	$ 0.05	$ 0.240	$ 0.67	$ 0.09
2058	9	1.22	14,618	$ 1,023	$ 0.37	$ 0.05	$ 0.240	$ 0.67	$ 0.08
2059	9	1.22	14,618	$ 1,023	$ 0.37	$ 0.05	$ 0.240	$ 0.67	$ 0.08
2060	11	1.50	17,980	$ 1,259	$ 0.46	$ 0.05	$ 0.240	$ 0.75	$ 0.08
2061	11	1.50	17,980	$ 1,259	$ 0.46	$ 0.05	$ 0.240	$ 0.75	$ 0.08
2062	11	1.50	17,980	$ 1,259	$ 0.46	$ 0.05	$ 0.240	$ 0.75	$ 0.08
2063	11	1.50	17,980	$ 1,259	$ 0.46	$ 0.05	$ 0.240	$ 0.75	$ 0.07
2064	11	1.50	17,980	$ 1,259	$ 0.46	$ 0.05	$ 0.240	$ 0.75	$ 0.07
2065	11	1.50	17,980	$ 1,259	$ 0.46	$ 0.05	$ 0.240	$ 0.75	$ 0.07
							Total NPV of O&M Costs		$ 4.8

Capital Costs in million $:			Yr built		
PWTM	$	33	2030		$ 15.8
Pumping Stations	$	4	2030		$ 1.7
				Total NPV of Capital Costs	$ 17.5

Total NPV of Capital and O&M Costs in millions $ 22.3
WTP to GBRA (Delivery Point #3)

WTP to LCRA Delivery Point (#4)
(Bold line in schematic below)



Note: GBRA & LCRA/COA must have separate PWTMs because GBRA needs unsoftened water and LCRA/COA need softened water.

Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
LCRA	0	0	5	10	10	10	10	2.0
COA	0	0	15	20	30	30	30	1.68
Total	0	0	20	30	40	40	40	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
LCRA	0	0	10	20	20	20	20
COA	0	0	25	34	50	50	50
Total	0	0	35	54	70	70	70

PWTM and Pump Station Costs

Design flow rate - year 2065	70	mgd	
	48,883	gpm	
Pumping capacity of one pump	10,000	gpm	
No. of pumps (not counting spare)	5		
Peak flow rate (all pumps except spare)	50,000	gpm	
Inside diameter of PWTM	72	in.	
Area	28.27	sf	
Length of RWTM	49	miles	(linked to mileage in schematic above)
	258,720	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	100%	258,720	$ 365	$ 94.5	million
Rural - rock	0%	-	$ 498	$ -	
Urban - rock	0%	-	$ 552	$ -	
		258,720		$ 94.5	million

Average estimated unit construction cost for PWTM $ 365 per LF

Total construction cost in millions	$ 94.5		
Contingencies	$ 18.9		
Subtotal	$ 113.4		
Engineering, Legal & Administrative	$ 17.0		
Subtotal	$ 130.4		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 4.9		
Total Capital Cost for PWTM in millions	$ 135.3		

Unit maintenance cost/year-mile $ 10,000 $/year-mile $ 0.490 Million $/year

Velocity at peak flow rate	3.94	fps	
C factor	120		
Head loss per foot	0.00067	ft/ft	$h_f = \left\| \frac{3.552*Q}{C*(d)^{2.63}} \right\|^{1.85}$
	3.55	ft/mile	
Head loss at peak flow rate	174	ft	
Allowance for minor losses 20%	35	ft	790 Desired HGL At Delivery Point
Total estimated losses	209	ft	720 Elev. At Delivery Point 3
Average static head	70	ft	70 ft
Total estimated dynamic head	279	ft	
	121	psi	
No of recommended pumping stations along route	0.81		150 psi (assumed max pressure
No. of pumping stations used in cost estimate	1		in pipe)
Average head per pump station	279	ft	
Assumed pump efficiency	85%		
Assumed motor efficiency	90%		
Estimated Hp required per pump	921	hp/pump	
	687	kw/pump	
Total hp per pump station (not counting spare)	4,605	firm hp/station	
Total kw per pump set (set=pumps in series along route)	921	kw/pump set	(one pump at each station)
Unit construction cost for each pump station (from cost curve)	$ 1,445	per firm hp of pump station	
Construction cost per pump station	6.7	million	
Total construction cost for pump stations	6.7	for 1	pump stations
Contingencies	$ 1.3		
Subtotal	$ 8.0		
Engineering, Legal & Administrative	$ 1.2		

Total capital cost for pump stations	$	9.2	million	
				40% Equip cost as % of constr cost
Value of equipment	$	2.7	million	
Assumed life of equipment		20	years	
Estimated maintenance/replacement cost	$	0.13	million/year	

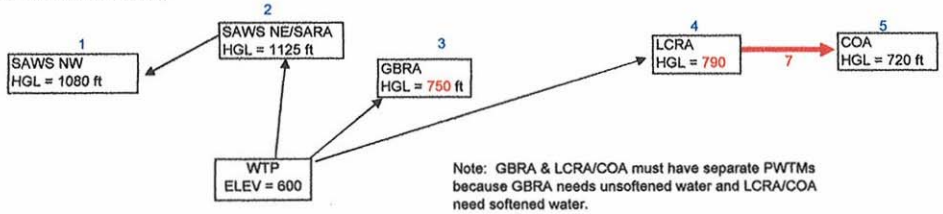
O&M Costs

Year	Flow pumped by year (average flows from Table above)	No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - PWTM	Total O&M cost	Net present value
	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015								$ -	$ -
2016								$ -	$ -
2017								$ -	$ -
2018								$ -	$ -
2019								$ -	$ -
2020								$ -	$ -
2021								$ -	$ -
2022								$ -	$ -
2023								$ -	$ -
2024								$ -	$ -
2025								$ -	$ -
2026								$ -	$ -
2027								$ -	$ -
2028								$ -	$ -
2029								$ -	$ -
2030	20	1.39	30,696	$ 2,149	$ 0.78	$ 0.13	$ 0.490	$ 1.41	$ 0.68
2031	20	1.39	30,696	$ 2,149	$ 0.78	$ 0.13	$ 0.490	$ 1.41	$ 0.64
2032	20	1.39	30,696	$ 2,149	$ 0.78	$ 0.13	$ 0.490	$ 1.41	$ 0.61
2033	20	1.39	30,696	$ 2,149	$ 0.78	$ 0.13	$ 0.490	$ 1.41	$ 0.58
2034	20	1.39	30,696	$ 2,149	$ 0.78	$ 0.13	$ 0.490	$ 1.41	$ 0.56
2035	20	1.39	30,696	$ 2,149	$ 0.78	$ 0.13	$ 0.490	$ 1.41	$ 0.53
2036	20	1.39	30,696	$ 2,149	$ 0.78	$ 0.13	$ 0.490	$ 1.41	$ 0.51
2037	20	1.39	30,696	$ 2,149	$ 0.78	$ 0.13	$ 0.490	$ 1.41	$ 0.48
2038	20	1.39	30,696	$ 2,149	$ 0.78	$ 0.13	$ 0.490	$ 1.41	$ 0.46
2039	20	1.39	30,696	$ 2,149	$ 0.78	$ 0.13	$ 0.490	$ 1.41	$ 0.44
2040	30	2.08	46,044	$ 3,223	$ 1.18	$ 0.13	$ 0.490	$ 1.80	$ 0.53
2041	30	2.08	46,044	$ 3,223	$ 1.18	$ 0.13	$ 0.490	$ 1.80	$ 0.51
2042	30	2.08	46,044	$ 3,223	$ 1.18	$ 0.13	$ 0.490	$ 1.80	$ 0.48
2043	30	2.08	46,044	$ 3,223	$ 1.18	$ 0.13	$ 0.490	$ 1.80	$ 0.46
2044	30	2.08	46,044	$ 3,223	$ 1.18	$ 0.13	$ 0.490	$ 1.80	$ 0.44
2045	30	2.08	46,044	$ 3,223	$ 1.18	$ 0.13	$ 0.490	$ 1.80	$ 0.42
2046	30	2.08	46,044	$ 3,223	$ 1.18	$ 0.13	$ 0.490	$ 1.80	$ 0.40
2047	30	2.08	46,044	$ 3,223	$ 1.18	$ 0.13	$ 0.490	$ 1.80	$ 0.38
2048	30	2.08	46,044	$ 3,223	$ 1.18	$ 0.13	$ 0.490	$ 1.80	$ 0.36
2049	30	2.08	46,044	$ 3,223	$ 1.18	$ 0.13	$ 0.490	$ 1.80	$ 0.34
2050	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.40
2051	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.38
2052	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.36
2053	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.34
2054	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.33
2055	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.31
2056	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.30
2057	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.28
2058	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.27
2059	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.26
2060	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.24
2061	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.23
2062	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.22
2063	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.21
2064	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.20
2065	40	2.78	61,391	$ 4,297	$ 1.57	$ 0.13	$ 0.490	$ 2.19	$ 0.19
							Total NPV of O&M Costs		$ 14.3

Capital Costs in million $:			Yr built	
PWTM	$	135.3	2030	$ 65.1
Pumping Stations	$	9.2	2030	$ 4.4
			Total NPV of Capital Costs	$ 69.5

Total NPV of Capital and O&M Costs in millions $ 84
WTP to LCRA Delivery Point (#4)

LCRA Delivery Point (#4) to COA Delivery Point (#5)
(Bold line in schematic below)



Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
COA	0	0	15	20	30	30	30	1.68
Total	0	0	15	20	30	30	30	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
COA	0	0	25	34	50	50	50
Total	0	0	25	34	50	50	50

PWTM and Pump Station Costs

Design flow rate - year 2065	50	mgd	
	34,997	gpm	
Inside diameter of PWTM	54	in.	
Area	15.90	sf	
Length of PWTM	7	miles	(linked to mileage in schematic above)
	36,960	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	100%	36,960	$ 244	$ 9.0	million
Rural - rock	0%	-	$ 337	$ -	
Urban - rock	0%	-	$ 369	$ -	
		36,960		$ 9.0	million
Average estimated unit construction cost for PWTM			$ 244	per LF	

Total construction cost in millions	$	9.0
Contingencies	$	1.8
Subtotal	$	10.8
Engineering, Legal & Administrative	$	1.6
Subtotal	$	12.4
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$	0.0
Total Capital Cost for PWTM in millions	$	12.4

Unit maintenance cost/year-mile: $ 10,000 $/year-mile | $ 0.070 Million $/year

Velocity at peak flow rate	4.90	fps	
C factor	120		
Head loss per foot	0.00141	ft/ft	$h_f = \left\| \frac{3.552 * Q}{C * (d)^{2.63}} \right\|^{1.85}$
	7.45	ft/mile	

Head loss at peak flow rate		52	ft	
Allowance for minor losses	20%	10	ft	720 Desired HGL At Delivery Point
Total estimated losses		63	ft	790 Elev. At Delivery Point 4
Average static head		-70	ft	-70 ft
Total estimated dynamic head		-7	ft	
		-3	psi	

Negative indicates gravity flow from #4 to #5; no pumping necessary.

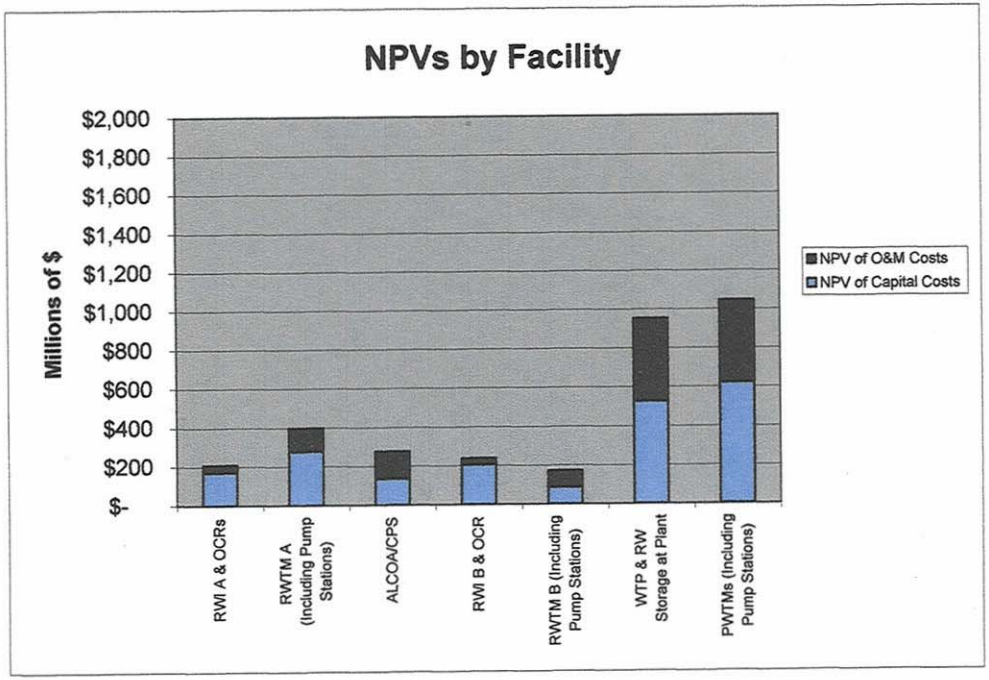
			Million $
Annual O&M Cost in million $:		Yr built	
PWTM	$ 0.070	2030	
Total NPV of O&M Costs			$0.55
Capital Costs in million $:		Yr built	
PWTM	$ 12.4	2030	
			$ 6.0
Total NPV of Capital Costs			$ 6.0

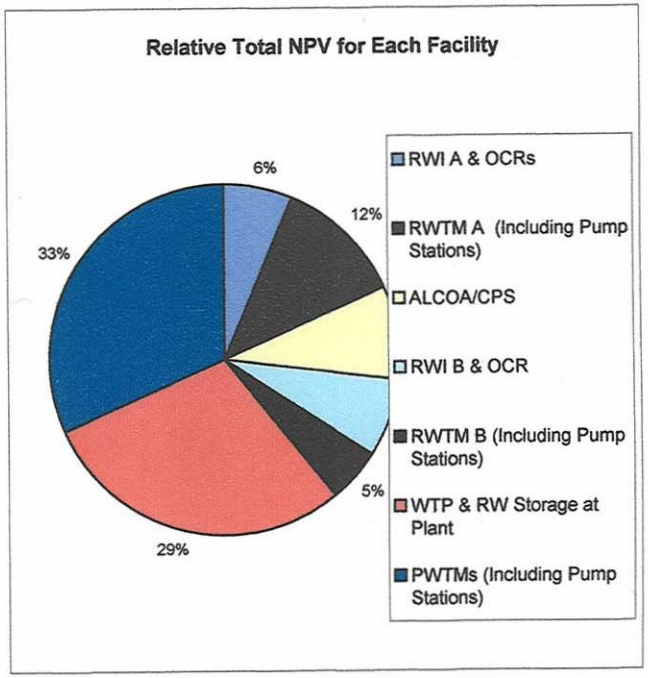
Total NPV of Capital and O&M Costs in millions $ 6.5
LCRA Delivery Point (#4) to COA Delivery Point (#5)

CTRWTP - Alternate 3B - WTP in Northern Corner of Caldwell County - Delayed SAWS and SARA Demands

WTP Location	Alter-nate	Phasing Scenario	Total NPVs in Millions of $	RWI A & OCRs	RWTM A (Including Pump Stations)	ALCOA/CPS	RWI B & OCR	RWTM B (Including Pump Stations)	WTP & RW Storage at Plant	PWTMs (Including Pump Stations)
Northern Corner of Caldwell County	3B	Reduced SAWS demand in 2020 by 66,000 ac-ft/yr (& SARA to 0 demand); RWTM B & ALCOA/CPS built by 2015; RWTM A built in 2030.		Sized for 4000 cfs to scalp water; 4 intakes, 4 miles of 120-inch raw water mains & 4 OCRs at 25,000 ac-ft each	126 miles of 96-inch diameter pipe sized to deliver 132,000 ac-ft/year on a continuous basis; includes 3 pumping stations w/ balancing reservoirs along route	Non-Public wells; Transmission of 55,000 ac-ft/year to the OCR at RWI B via 15 miles of 54" gravity pipeline from Hwy 290 east of Elgin	Sized for 2000 cfs to scalp water; 2 intakes; 8 miles of 120-inch raw water mains and 4 OCRs at 15,000 ac-ft/each	Sized for 117,804 ac-ft/yr; 20 miles of 84" pipeline with one pumping station and balancing reservoir	Raw water reservoir w/ 11,000 ac-ft capacity; Conventional settling with membrane filtration for SAWS, SARA & GBRA; Lime softening with membrane filtration for COA & LCRA water	Each PWTM sized for maximum daily demand (See PWTM Summary Sheet in the Appendices)
		NPV of Capital Costs	$ 2,016	$ 170	$ 277	$ 135	$ 204	$ 86	$ 524	$ 620
		NPV of O&M Costs	$ 1,271	$ 38	$ 121	$ 141	$ 34	$ 87	$ 427	$ 424
		Total NPV of Capital & O&M	**$ 3,287**	$ 207	$ 398	$ 276	$ 238	$ 172	$ 951	$ 1,044

0.89





Flow Schematic
CTRWTP - Alternate 3B - WTP in Northern Corner of Caldwell County - Delayed SAWS and SARA Demands

Summary of Demands

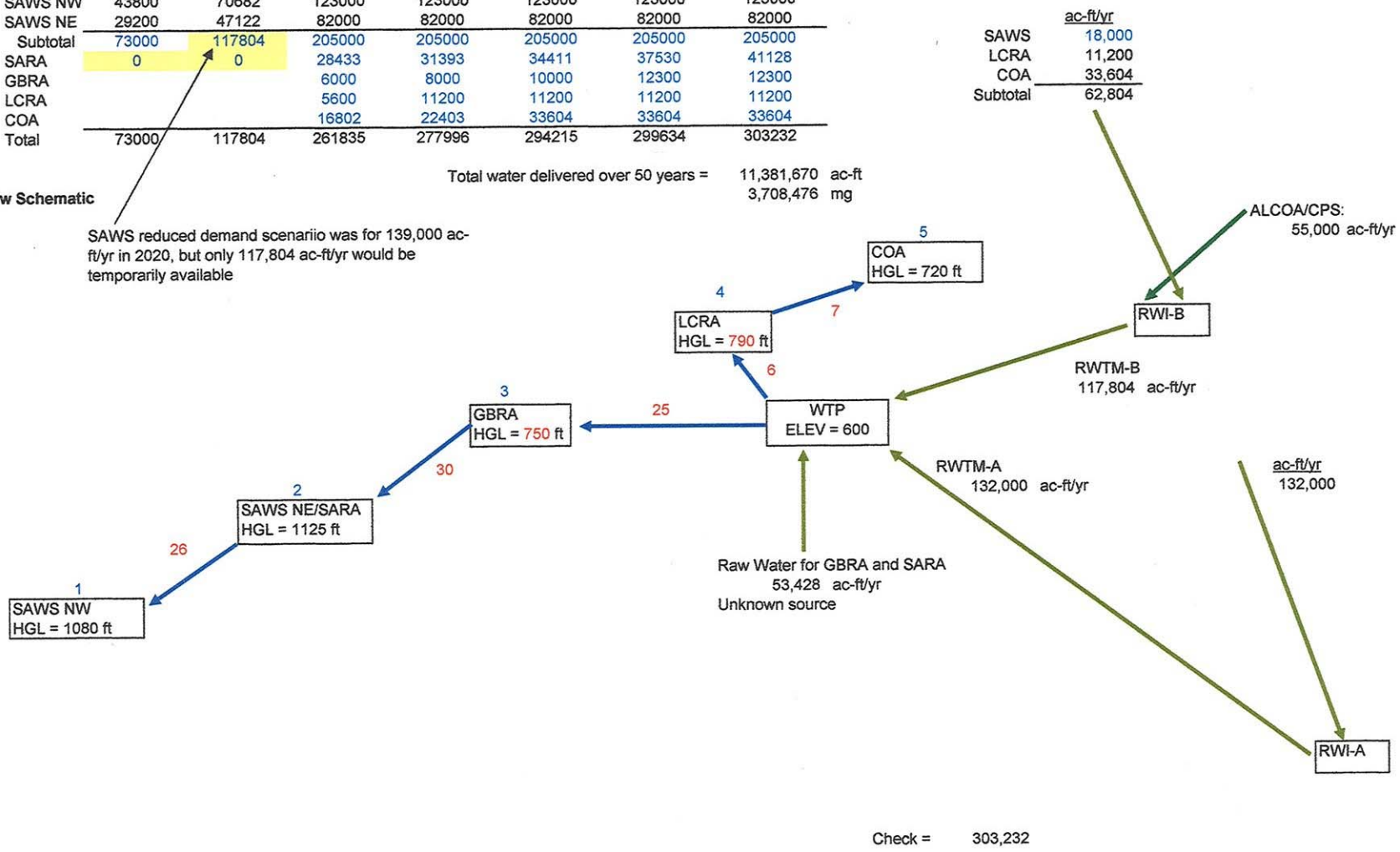
Average demands to be delivered in each segment in acre-feet/year

Year	2015	2020	2030	2040	2050	2060	2065
SAWS NW	43800	70682	123000	123000	123000	123000	123000
SAWS NE	29200	47122	82000	82000	82000	82000	82000
Subtotal	73000	117804	205000	205000	205000	205000	205000
SARA	0	0	28433	31393	34411	37530	41128
GBRA			6000	8000	10000	12300	12300
LCRA			5600	11200	11200	11200	11200
COA			16802	22403	33604	33604	33604
Total	73000	117804	261835	277996	294215	299634	303232

Total water delivered over 50 years = 11,381,670 ac-ft
3,708,476 mg

Flow Schematic

SAWS reduced demand scenariio was for 139,000 ac-ft/yr in 2020, but only 117,804 ac-ft/yr would be temporarily available



Check = 303,232

O&M Cost Calculations
RWI A - Matagorda Co. River Intakes, and Storage
CTRWTP - Alternate 3B - WTP in Northern Corner of Caldwell County - Delayed SAWS and SARA Demands

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile
			or =	$ 5,000	per acre

Inflatable Rubber Low Head Dam

	Quantity	Units	Size	Unit Constr. Cost (millions)	Total Estimated Constr. Cost (millions)	Contigency, Eng., etc. (millions)	Total Capital Cost (millions)
Inflatable Rubber Low Head Dam	4	each	10 ft high	$ 2.25	$ 9.00	$ 3.42	$ 12.42

Estimated inflatable dam cost as % of total	50%	
Value of inflatable dam	$ 4.50	million
Assumed life of inflatable dam	10	years
Estimated maintenance/replacement cost	$ 0.45	million/year
Year built	2020	
NPV of O&M Costs	$6.27	million
NPV of Capital Costs	$ 9.73	million
Total NPV of Capital and O&M Costs	$16.00	million

Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)

Average withdrawal	132,000	ac-ft/year		
	182	cfs		
Total intake design withdrawal rate (for scalping high flows	4,000	cfs	21.9	Ratio of design withdrawal rate to Total intake design withdrawal rate
	1,795,200	gpm		
No. of intakes	4			
Design withdrawal rate per intake	1,000	cfs		
	448,800	gpm		
No. of reservoirs	4			
Design flow to each reservoir	448,800	gpm		
Inside diameter of each RWTM	120	in.		
Area	78.54	sf		
Average length of each RWTM	1	miles	4.0	miles for all RWTMs
	5,280	feet	21,120	feet
Estimated construction cost for RWTM	$ 793	per LF		
Total construction cost in millions	$ 16.8			
Contingencies	$ 3.4			
Subtotal	$ 20.1			
Engineering, Legal & Administrative	$ 3.0			
Subtotal	$ 23.1			
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 0.4			
Total Capital Cost for PWTM in millions	$ 23.5	million		
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.040	Million $/year (all RWTMs to Reservoirs)

Note: Assume each intake has two RWTMs pumping out of it, one to each reservoir.

Design flow rate for each RWTM (from above)	448,800	gpm		
Pumping rate (one pump)	50,000	gpm		
No. of pumps (not counting spare) pumping into each RW	9			
Peak flow rate into each RWTM (all pumps except spare)	450,000	gpm		
Velocity at peak flow rate	12.77	fps		
C factor	120			
Head loss per foot	0.00327	ft/ft	$h_f = \frac{3.552 * Q^{1.85}}{C^{1.85} * d^{4.87}}$	
	17.25	ft/mile		
Head loss at peak flow rate	17	ft		
Allowance for minor losses	30% 5	ft	90	Elev of discharge at reservoir
Total estimated losses	22	ft	50	Water surface elev in river
Average static head	40	ft	40	ft
Total estimated dynamic head	62	ft		
	27	psi		
Assumed pump efficiency	85%			
Assumed motor efficiency	90%			
Estimated Hp required per pump	1,030	hp/pump		
	769	kw/pump		
Total hp pumping into each RWTM (not counting spare)	9,272	hp/RWTM		
Total hp at each intake (not counting spare)	9,272	hp/intake		
Total hp all intakes (not counting spares)	37,089	hp		
Total kw all intakes (not counting spares)	27,668	kw		
Unit construction cost for each pump station (from cost cur	$ 889	per firm hp of pump station		
Construction cost per intake/pump station	8.2	million		
No. of intakes from above	4	each		
Total construction cost in millions	$ 33.0	million		
Contigency, Eng., etc. in millions	$ 12.53	million		
Total capital cost in millions	$ 45.5	million		
Total construction cost for pump stations	$ 33.0	million		
Value of equipment	$ 13.2	million	40%	Estimated equip cost as % of total constr cost
Assumed life of equipment	20	years		
Estimated maintenance/replacement cost	$ 0.66	million/year		

O&M Costs:

Year	Flow pumped by year		No. of pump "sets" operating	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd	/day	(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	-	-	-	-	$ -	$ -			$ -	$ -
2016	-	-	-	-	$ -	$ -			$ -	$ -
2017	-	-	-	-	$ -	$ -			$ -	$ -
2018	-	-	-	-	$ -	$ -			$ -	$ -
2019	-	-	-	-	$ -	$ -			$ -	$ -
2020	-	-	-	-	$ -	$ -			$ -	$ -
2021	-	-	-	-	$ -	$ -			$ -	$ -
2022	-	-	-	-	$ -	$ -			$ -	$ -
2023	-	-	-	-	$ -	$ -			$ -	$ -
2024	-	-	-	-	$ -	$ -			$ -	$ -
2025	-	-	-	-	$ -	$ -			$ -	$ -
2026	-	-	-	-	$ -	$ -			$ -	$ -
2027	-	-	-	-	$ -	$ -			$ -	$ -
2028	-	-	-	-	$ -	$ -			$ -	$ -
2029	-	-	-	-	$ -	$ -			$ -	$ -
2030	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.71
2031	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.67
2032	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.64
2033	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.61
2034	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.58
2035	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.55
2036	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.53
2037	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.50
2038	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.48
2039	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.46
2040	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.43
2041	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.41
2042	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.39
2043	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.38
2044	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.36
2045	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.34
2046	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.32
2047	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.31
2048	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.29
2049	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.28
2050	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.27
2051	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.25
2052	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.24
2053	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.23
2054	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.22
2055	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.21
2056	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.20
2057	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.19
2058	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.18
2059	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.17
2060	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.16
2061	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.16
2062	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.15
2063	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.14
2064	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.13
2065	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.13
								Total NPV of O&M Costs		$ 12.3

Capital Costs in million $:		Yr built		
RWTM to Reservoirs	$ 23.5	2030		$ 11.3
Intake/Pumping Stations	$ 45.5	2030		$ 21.9
			Total NPV of Capital Costs	$ 33.2
			Total NPV of Capital and O&M Costs in millions	$ 45.5

Reservoirs

	Quantity	Units	Volume/each (acre-feet)	Unit Cost ($/ac-ft))	Total Construction Cost in millions	Contigency, Eng., etc.	Total in millions
Reservoirs	4	each	25000	$ 974	$ 97.4	$ 37.0	$ 134.4

Estimated average depth of reservoir	20	ft		
Surface area of reservoir	5000	acres		
Ratio of total land area reqd to surface area of reservoir	1.1		Envir & Archaeology, Surv,	
Total land area reqd for reservoirs	5500	acres	and Land Acq =	27.5
			Total capital cost in millions =	$ 161.9
Assumed life of reservoir	100	years		
Estimated replacement cost	$ 0.97	million/year		
Estimated maintenance	0.4	million/year	Mowing, maintaining fences, etc.	
Total	$ 1.37	million/year		
Year built	2020			
NPV of O&M costs	$ 19.1	million		
NPV of Capital costs	$ 126.8	million		
Total NPV of Capital and O&M Costs	$ 145.9	million		

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Inflatable Rubber Low Head Dam	$ 9.7	$ 6.3	$ 16.0
Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)	$ 33.2	$ 12.3	$ 45.5
Reservoirs	$ 126.8	$ 19.1	$ 145.9
Total for RWI A	$ 169.7	$ 37.7	$ 207.4

O&M Cost Calculations
RWTM A - Matagorda Co. to WTP
CTRWTP - Alternate 3B - WTP in Northern Corner of Caldwell County - Delayed SAWS and SARA Demands

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

Raw Water Transmission Main - A

Inside diameter of pipe		96	in.			
Area		50.27	sf			
Length of RWTM		126	miles			
		665,280	feet			
Estimated unit construction cost for RWTM	$	567	per LF			
Total construction cost in millions	$	378				
Contingencies	$	76				
Subtotal	$	453				
Engineering, Legal & Administrative	$	68				
Subtotal	$	521				
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$	13				
Total Capital Cost for PWTM in millions	$	534	million			
Unit maintenance cost/year-mile	$	10,000	$/year-mile	$	1.260	Million $/year
Design flow rate (after 100% buildout)		132,000	ac-ft/year			
		118	mgd			
		81,829	gpm			
Pumping rate (one pump)		16,400	gpm			
No. of pumps (not counting spare)		5				
Peak flow rate (all pumps except spare)		82,000	gpm			
Velocity at peak flow rate		3.63	fps			
C factor		120				
Head loss per foot		0.00041	ft/ft	$h_f = \lvert 3.552*Q \rvert^{1.85} / \lvert C*(d)^{2.63} \rvert$		
		2.19	ft/mile			
Head loss at peak flow rate		276	ft			
Allowance for minor losses	10%	28	ft	550	Elev. At San Antonio East WTP	
Total estimated losses		303	ft	90	Elev. At Matagorda OCRs	
Average static head		460	ft	460	ft	
Total estimated dynamic head		763	ft			
		331	psi			
No of pumping stations req'd along route		2.21		150	psi (assumed max pressure	
No. of pumping stations used in cost estimate		3.0			in pipe)	
Average head per pump station		254	ft			
Assumed pump efficiency		85%				
Assumed motor efficiency		90%				
Estimated Hp required per pump		1,378	hp/pump			
		1,028	kw/pump			
Total hp per pump station (not counting spare)		6,888	hp/station			
Total kw per pump set (set=pumps in series along route)		4,133	kw/pump set	(one pump at each station)		
Unit construction cost for each pump station (from cost curv	$	1,347	per firm hp of pump station			
Construction cost per pump station		9.3	million			
Balancing reservoir	$	0.75	million	60	min. of storage at avg pumping rate	
Total construction cost per pump station	$	10.03	million	5.0	mg	
				$ 0.15	per gal for open top reservoir	
No. of pump stations from above		3.0	each			
Total construction cost in millions	$	30.1	million			
Contigency, Eng., etc. in millions	$	11.43	million			
Total capital cost in millions	$	41.5	million			
Total construction cost for pump stations	$	30.1	million			
Value of equipment	$	12.0	million	40%	Estimated equipment cost as % of total	
Assumed life of equipment		20	years			
Estimated maintenance/replacement cost	$	0.60	million/year			

O&M Costs

Year	Flow pumped by year		No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	-	-	-	-	$ -	$ -			$ -	$ -
2016	-	-	-	-	$ -	$ -			$ -	$ -
2017	-	-	-	-	$ -	$ -			$ -	$ -
2018	-	-	-	-	$ -	$ -			$ -	$ -
2019	-	-	-	-	$ -	$ -			$ -	$ -
2020	-	-	-	-	$ -	$ -			$ -	$ -
2021	-	-	-	-	$ -	$ -			$ -	$ -
2022	-	-	-	-	$ -	$ -			$ -	$ -
2023	-	-	-	-	$ -	$ -			$ -	$ -
2024	-	-	-	-	$ -	$ -			$ -	$ -
2025	-	-	-	-	$ -	$ -			$ -	$ -
2026	-	-	-	-	$ -	$ -			$ -	$ -
2027	-	-	-	-	$ -	$ -			$ -	$ -
2028	-	-	-	-	$ -	$ -			$ -	$ -
2029	-	-	-	-	$ -	$ -			$ -	$ -
2030	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 6.98
2031	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 6.65
2032	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 6.33
2033	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 6.03
2034	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 5.74
2035	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 5.47
2036	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 5.21
2037	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 4.96
2038	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 4.72
2039	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 4.50
2040	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 4.28
2041	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 4.08
2042	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 3.89
2043	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 3.70
2044	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 3.52
2045	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 3.36
2046	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 3.20
2047	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 3.04
2048	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.90
2049	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.76
2050	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.63
2051	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.50
2052	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.39
2053	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.27
2054	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.16
2055	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.06
2056	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.96
2057	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.87
2058	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.78
2059	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.70
2060	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.61
2061	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.54
2062	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.46
2063	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.39
2064	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.33
2065	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.27
								Total NPV of O&M Costs		**$ 121**

Capital Costs in million $:		Yr built		
RWTM	$ 534	2030		$ 257
Pumping Stations	$ 42	2030		$ 20
			Total NPV of Capital Costs	**$ 277**

Total NPV of Capital and O&M Costs in millions $ 398

NPV CALCULATIONS
ALCOA / CPS GROUNDWATER
CTRWTP - Alternate 3B - WTP in Northern Corner of Caldwell County - Delayed SAWS and SARA Demands

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

Well Fields and Collection Lines

	ALCOA	CPS	Total
Year built	2015	2015	
Estimated Construction Cost in Millions			
Wells (Based on Non-Public Water Supply Wells)	20.92	7.94	28.86
Pipeline	13.03	5.94	18.97
Pump Stations & Storage	8.51	0	8.51
Subtotal	42.46	13.88	56.34
Contingency	8.49	2.78	11.27
Subtotal	50.95	16.66	67.61
Engineering, Legal & Administrative	6.37	2.08	8.45
Subtotal	57.32	18.74	76.06
Environmental & Archaeology Studies & Mitigation	0.63	0.2	0.83
Land Acquisition & Surveying	0	0	0.00
Groundwater Purchase	0	5.64	5.64
ALCOA Construction Program Management Fee	5.45	0	5.45
Interest During Construction (2 years, 6% int., 4% ret.)	5.89	2.44	8.33
Total Capital Cost	**69.29**	**27.02**	**96.31**
Estimated Annual O&M Costs			
O&M	0.67	0.18	0.85
Pumping Energy	2.41	0.52	2.93
ALCOA Project Management Fees	0.35	0.00	0.35
Purchase of Groundwater	2.00	0.00	2.00
Groundwater District Fees	0.65	0.25	0.90
Mitigation Reserves	0.28	0.11	0.39
Total Annual Cost	**6.36**	**1.06**	**7.42**

NPV of O&M Costs	$ 116	$ 19	$ 135	million
NPV of Capital Costs	$ 69	$ 27	$ 96	million
Total NPV of Capital and O&M Costs for Well Fields	**$ 185**	**$ 46**	**$ 232**	**million**

Cooling of Well Water

Total number of wells in both fields	120	wells	Approximate capacity per wel	300 gpm
Percentage of wells with temperatures > than ___ degrees	5%			36,000 gpm
Estimated number of wells with temperature > ____ degrees	6.0		Rough check	58,072 ac-ft/year

Estimated Capital Costs

Year built	2015		
Number of Packaged Cooling Towers (300 gpm capacity/each)	6.0		
Equipment cost (cooling towers and fans)	$ 60,000		
Installation and contractors mark-up	$ 50,000		
Structural slab	$ 30,000		
Electrical	$ 50,000		
Estimated Unit Construction Cost	$ 190,000	Each	
Total construction cost	$ 1.14	million	
Contingencies	$ 0.23		
Subtotal	$ 1.37		
Engineering, Legal and Admin	$ 0.21		
Total Estimated Capital Cost	$ 1.57		
NPV of Capital Costs	$ 1.57	million	

Estimated O&M Costs

Value of equipment	$ 0.4	million	
Assumed life of equipment	10	years	
Estimated maintenance/replacement cost	$ 0.04	million/year	
Blower Hp per cooling tower	10	Hp	
	7	kw	
Hours of operation	24	hours	
Power consumption per cooling tower	179	kwh per day	
	65,350	kwh per year	
Power cost per cooling tower	$ 4,574		
Total power cost for all cooling towers in millions	$ 0.03	million per year	
Regular operational checks and routine maintenance	$ 6,000	per month for all cooling towers	
	$ 0.07	per year	
Estimated O&M Cost	$ 0.14	million $ per year	
NPV of O&M costs	$ 2.47	million $	

Ground Water Transmission Main and Pump Station (Hwy 290 to Bastrop Intake)

Inside diameter of transmission pipe	54	in.

Area			15.90	sf		
Length of Ground Water TM			15	miles		
			79,200	feet		
Estimated construction cost for GWTM		$	327	per LF		
Total construction cost in millions		$	25.9			
Contingencies		$	5.2			
Subtotal		$	31.1			
Engineering, Legal & Administrative		$	4.7			
Subtotal		$	35.8			
Envir & Arch Studies & Mitigation, Surveying, & Land Acq		$	1.5			
Total Capital Cost for PWTM in millions		$	37.3	million		
Unit maintenance cost/year-mile		$	10,000	$/year-mile	$ 0.150	Million $/year
Design flow rate			55,000	ac-ft/year		
			49	mgd		
			34,095	gpm		
Velocity at peak flow rate			4.78	fps		
C factor			120			
Head loss per foot			0.00134	ft/ft	$h_f = \lvert 3.552*Q \rvert^{1.85} / \lvert C*(d)^{2.63} \rvert$	
			7.10	ft/mile		
Head loss at peak flow rate			106	ft		
Allowance for minor losses	10%		11	ft	400	Elev. At RWI-B
Total estimated losses			117	ft	550	minus Elev. - Storage Tank at Hwy 290
Average static head			-150	ft	-150	ft
Total estimated dynamic head			-33	ft	(intake is lower than tank at Hwy 290)	
			-14	psi		

Negative indicates gravity flow from Hwy 290 to Bastrop Intake; no pumping necessary.

				Million $
Annual O&M Cost in million $:		Yr built		
GWTM	$ 0.150	2015		
			Total NPV of O&M Costs	$ 2.7
Capital Costs in million $:		Yr built		
GWTM	$ 37.3	2015		$ 37.3
			Total NPV of Capital Costs	$ 37.3

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Well Fields and Collection Lines (including tank and pump station at Hwy 290)	**$ 96.3**	**$ 135.5**	**$ 231.8**
Cooling Towers for Selected High Temperature Wells	**$ 1.6**	**$ 2.5**	**$ 4.0**
Ground Water Transmission Main and Pumping Station	**$ 37.3**	**$ 2.7**	**$ 40.0**
Total for ALCOA-CPS	**$ 135.1**	**$ 140.7**	**$ 275.8**

O&M Cost Calculations
RWI B - Colorado River Intake at Bastrop and Off Channel Reservoir
CTRWTP - Alternate 3B - WTP in Northern Corner of Caldwell County - Delayed SAWS and SARA Demands

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	40	years			
Unit cost of energy	$ 0.07	per kwh	Environmental & Archaeology Studies & Mitigation, Surveying, and Land Acquisition =	$ 100,000	per mile
			or =	$ 5,000	per acre

Inflatable Rubber Low Head Dam

	Quantity	Units	Size	Unit Constr. Cost (millions)	Total Estimated Constr. Cost (millions)	Contigency, Eng., etc. (millions)	Total Capital Cost (millions)
Inflatable Rubber Low Head Dam	2	each	10 ft high	$ 2.25	$ 4.50	$ 1.71	$ 6.21

Estimated inflatable dam cost as % of total	50%	
Value of inflatable dam	$ 2.25	million
Assumed life of inflatable dam	10	years
Estimated maintenance/replacement cost	$ 0.23	million/year
Year built	2015	
NPV of O&M Costs	$ 3.86	million
NPV of Capital Costs	$ 6.21	million
Total NPV of Capital and O&M Costs	**$ 10.07**	**million**

Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)

Summary of withdrawals in acre-feet/year:

Includes 18k + 11.2k of LCRA's + 33.6k of COA's

Year	2015	2020	2030	2040	2050	2060	2065
For SAWS	18000	62804	18000	18000	18000	18000	18000
LCRA			5600	11200	11200	11200	11200
COA			16802	22403	33604	33604	33604
Total	18000	62804	40402	51603	62804	62804	62804

Ultimate (Y2065) average design withdrawal rate	62,804	ac-ft/year		
	87	cfs		
			23.1	Ratio of design withdrawal rate to Total intake design withdrawal rate
Total intake design withdrawal rate (for scalping high flows)	2,000	cfs		
	897,600	gpm		
No. of Intakes	2			
Design withdrawal rate per intake	1,000	cfs		
	448,800	gpm		
No. of reservoirs	4			
Design flow to each reservoir	224,400	gpm		
Inside diameter of each RWTM	120	in.		
Area	78.54	sf		
Average length of each RWTM	2	miles	8.0	miles for all RWTMs
	10,560	feet	42,240	feet
Estimated construction cost for RWTMs	$ 793	per LF		
Total construction cost in millions	$ 33.5			
Contingencies	$ 6.7			
Subtotal	$ 40.2			
Engineering, Legal & Administrative	$ 6.0			
Subtotal	$ 46.2			
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 0.8			
Total Capital Cost for PWTM in millions	$ 47.0			
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.080	Million $/year (all RWTMs to Reservoirs)

Note: Assume intake has one RWTM pumping to the reservoir.

Design flow rate for each RWTM (from above)	224,400	gpm		
Pumping rate (one pump)	40,000	gpm		
No. of pumps (not counting spare) pumping into each RWT	6			
Peak flow rate into each RWTM (all pumps except spare)	240,000	gpm		
Velocity at peak flow rate	6.81	fps		
C factor	120			
Head loss per foot	0.00102	ft/ft	$h_f = \lvert 3.552*Q \rvert^{1.85} / \lvert C*(d)^{2.63} \rvert$	
	5.39	ft/mile		
Head loss at peak flow rate	11	ft		
Allowance for minor losses 30%	3	ft		
Total estimated losses	14	ft	400	Discharge at reservoir
Average static head	80	ft	320	Water surface elev in river
Total estimated dynamic head	94	ft	80	ft
	41	psi		
Assumed pump efficiency	85%			
Assumed motor efficiency	90%			
Estimated Hp required per pump	1,241	hp/pump		
	926	kw/pump		

Total hp pumping into each RWTM (not counting spare)	7,448	hp/RWTM	
Total hp at each intake (not counting spare)	14,897	hp/intake	
Total hp all intakes (not counting spares)	29,793	hp	
Total kw all intakes (not counting spares)	22,226	kw	
Unit construction cost for each pump station (from cost cur	$ 889	per firm hp of pump station	
Construction cost per intake/pump station	13.2	million	
No. of intakes from above	2	each	
Total construction cost in millions	$ 26.5	million	
Contigency, Eng., etc. in millions	$ 10.06	million	
Total capital cost in millions	$ 36.6	million	
Total construction cost for pump stations	$ 26.5	million	40% Estimated equipment cost as % of total
Value of equipment	$ 10.6	million	
Assumed life of equipment	20	years	
Estimated maintenance/replacement cost	$ 0.53	million/year	

O&M Costs:

Year	Flow pumped by year		No. of pump "sets" operating	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd	/day	(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.77
2016	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.73
2017	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.70
2018	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.66
2019	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.63
2020	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.60
2021	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.57
2022	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.55
2023	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.52
2024	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.50
2025	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.47
2026	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.45
2027	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.43
2028	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.41
2029	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.39
2030	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.46
2031	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.44
2032	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.42
2033	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.40
2034	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.38
2035	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.36
2036	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.35
2037	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.33
2038	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.31
2039	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.30
2040	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.31
2041	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.30
2042	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.28
2043	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.27
2044	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.26
2045	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.25
2046	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.23
2047	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.22
2048	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.21
2049	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.20
2050	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.21
2051	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.20
2052	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.19
2053	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.18
2054	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.17
2055	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.17
2056	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.16
2057	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.15
2058	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.14
2059	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.14
2060	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.13
2061	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.12
2062	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.12
2063	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.11
2064	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.11
2065	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.10
								Total NPV of O&M Costs		$ 17.1

Capital Costs in million $:		Yr built		
RWTM to Reservoir	$ 47.0	2015		$ 47.0
Intake/Pumping Stations	$ 36.6	2015		$ 36.6
			Total NPV of Capital Costs	$ 83.6
			Total NPV of Capital and O&M Costs in millions	$ 100.7

Reservoirs

	Quantity	Units	Volume/each (acre-feet)	Unit Cost ($/ac-ft))	Total Construction Cost in millions	Contigency, Eng., etc.	Total in millions
Reservoirs	4	each	15000	$ 1,180	$ 70.8	$ 26.9	$ 97.7

Estimated average depth of reservoir 20 ft

Surface area of reservoir	3000	acres		
Ratio of total land area reqd to surface area of reservoir	1.1		Envir & Archaeology, Surv, and Land Acq =	16.5
Total land area reqd for reservoirs	3300	acres	Total capital cost in millions =	$ 114.2
Assumed life of reservoir	100	years		
Estimated replacement cost	$ 0.71	million/year		
Estimated maintenance	$ 0.04	million/year	Mowing, maintaining fences, etc.	
Total	$ 0.75	million/year		
Year built	2015			
NPV of O&M costs	$ 12.8	million		
NPV of Capital costs	$ 114.2	million		
Total NPV of Capital and O&M Costs	**$ 127.0**	**million**		

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Inflatable Rubber Low Head Dam	$ 6.2	$ 3.9	$ 10.1
Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)	$ 83.6	$ 17.1	$ 100.7
Off Channel Reservoir	$ 114.2	$ 12.8	$ 127.0
Total for RWI A	$ 204.0	$ 33.8	$ 237.8

O&M Cost Calculations
RWTM B - RWI B near Bastrop to WTP
CTRWTP - Alternate 3B - WTP in Northern Corner of Caldwell County - Delayed SAWS and SARA Demands

Initial year of analysis period	2015	Contingency =	20%
Interest rate	5%	Engineering, Legal, Admin. =	15%
Evaluation period	40 years	Environmental & Archaeology Studies &	
Unit cost of energy	$ 0.07 per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000 per mile

Summary of average pumping rates in acre-feet/year:

Includes 18k + 11.2k of LCRA's + 33.6k of COA's

Surface Water Year	2015	2020	2030	2040	2050	2060	2065
For SAWS	18000	62804	18000	18000	18000	18000	18000
LCRA			5600	11200	11200	11200	11200
COA			16802	22403	33604	33604	33604
Subtotal	18000	62804	40402	51603	62804	62804	62804
Groundwater Year	**2015**	**2020**	**2030**	**2040**	**2050**	**2060**	**2065**
For SAWS	55000	55000	55000	55000	55000	55000	55000
Suface & grour	73000	117804	95402	106603	117804	117804	117804

Ultimate (Y2065) average design pumping rate 117,804 ac-ft/year

Sizing of Raw Water Transmission Main B & Pump Stations

Inside diameter of RWTM		84	in.		
Area		38.48	sf		
Length of RWTM		20	miles		
		105,600	feet		
Estimated unit construction cost for RWTM		$ 467	per LF		
Total construction cost in millions		$ 49.4			
Contingencies		$ 9.9			
Subtotal		$ 59.2			
Engineering, Legal & Administrative		$ 8.9			
Subtotal		$ 68.1			
Envir & Arch Studies & Mitigation, Surveying, & Land Acq		$ 2.0			
Total Capital Cost for PWTM in millions		$ 70.1	million		
Unit maintenance cost/year-mile		$ 5,000	$/year-mile	$ 0.100	Million $/year
Design flow rate (after 100% buildout)		117,804	ac-ft/year		
		105	mgd		
		73,029	gpm		
Pumping rate (one pump)		15,000	gpm		
No. of pumps (not counting spare)		5			
Peak flow rate (all pumps except spare)		75,000	gpm		
Velocity at peak flow rate		4.34	fps		
C factor		120			
Head loss per foot		0.00067	ft/ft	$h_f = \lvert 3.552*Q \rvert^{1.85} / \lvert C*(d)^{2.63} \rvert$	
		3.55	ft/mile		
Head loss at peak flow rate		71	ft		
Allowance for minor losses	10%	7	ft	650	Elev. At WTP
Total estimated losses		78	ft	400	Elev of WSE in Bastrop reservoir
Average static head		250	ft	250	ft
Total estimated dynamic head		328	ft		
		142	psi		
No of recommended pumping stations along route		0.95		150	psi (assumed max pressure
No. of pumping stations used in cost estimate		1.0			in pipe)
Average head per pump station		328	ft		
Assumed pump efficiency		85%			
Assumed motor efficiency		90%			
Estimated Hp required per pump		1,625	hp/pump		
		1,212	kw/pump		
Total hp per pump station (not counting spare)		8,125	hp/station		
Total kw per pump set (set=pumps in series along route)		1,625	kw/pump set	(one pump at each station)	
Unit construction cost for each pump station (from cost cu		$ 1,307	per firm hp of pump station		
Construction cost per pump station		10.6	million		
Balancing reservoir		$ 0.75	million	60	min. of storage at avg pumping rate
Total construction cost per pump station		$ 11.37	million	5.0	mg
				$ 0.15	per gal for open top reservoir
No. of pump stations from above		1.0	each		
Total construction cost in millions		$ 11.4	million		
Contingency, Eng., etc. in millions		$ 4.32	million		
Total capital cost in millions		$ 15.7	million		
Total construction cost for pump stations		$ 11.4	million		
Value of equipment		$ 4.5	million	40%	Estimated equipment cost as % of total
Assumed life of equipment		20	years		
Estimated maintenance/replacement cost		$ 0.23	million/year		

O&M Costs

Year	Flow pumped by year		No. of pump "sets" operating	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd	/day	(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	73,000	65	3.02	117,667	$ 8,237	$ 3.01	$ 0.23	$ 0.100	$ 3.33	$ 3.33
2016	73,000	65	3.02	117,667	$ 8,237	$ 3.01	$ 0.23	$ 0.100	$ 3.33	$ 3.17
2017	73,000	65	3.02	117,667	$ 8,237	$ 3.01	$ 0.23	$ 0.100	$ 3.33	$ 3.02
2018	73,000	65	3.02	117,667	$ 8,237	$ 3.01	$ 0.23	$ 0.100	$ 3.33	$ 2.88
2019	73,000	65	3.02	117,667	$ 8,237	$ 3.01	$ 0.23	$ 0.100	$ 3.33	$ 2.74
2020	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 4.06
2021	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 3.86
2022	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 3.68
2023	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 3.51
2024	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 3.34
2025	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 3.18
2026	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 3.03
2027	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 2.88
2028	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 2.75
2029	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 2.62
2030	95,402	85	3.94	153,777	$ 10,764	$ 3.93	$ 0.23	$ 0.100	$ 4.26	$ 2.05
2031	95,402	85	3.94	153,777	$ 10,764	$ 3.93	$ 0.23	$ 0.100	$ 4.26	$ 1.95
2032	95,402	85	3.94	153,777	$ 10,764	$ 3.93	$ 0.23	$ 0.100	$ 4.26	$ 1.86
2033	95,402	85	3.94	153,777	$ 10,764	$ 3.93	$ 0.23	$ 0.100	$ 4.26	$ 1.77
2034	95,402	85	3.94	153,777	$ 10,764	$ 3.93	$ 0.23	$ 0.100	$ 4.26	$ 1.68
2035	95,402	85	3.94	153,777	$ 10,764	$ 3.93	$ 0.23	$ 0.100	$ 4.26	$ 1.60
2036	95,402	85	3.94	153,777	$ 10,764	$ 3.93	$ 0.23	$ 0.100	$ 4.26	$ 1.53
2037	95,402	85	3.94	153,777	$ 10,764	$ 3.93	$ 0.23	$ 0.100	$ 4.26	$ 1.46
2038	95,402	85	3.94	153,777	$ 10,764	$ 3.93	$ 0.23	$ 0.100	$ 4.26	$ 1.39
2039	95,402	85	3.94	153,777	$ 10,764	$ 3.93	$ 0.23	$ 0.100	$ 4.26	$ 1.32
2040	106,603	95	4.41	171,831	$ 12,028	$ 4.39	$ 0.23	$ 0.100	$ 4.72	$ 1.39
2041	106,603	95	4.41	171,831	$ 12,028	$ 4.39	$ 0.23	$ 0.100	$ 4.72	$ 1.33
2042	106,603	95	4.41	171,831	$ 12,028	$ 4.39	$ 0.23	$ 0.100	$ 4.72	$ 1.26
2043	106,603	95	4.41	171,831	$ 12,028	$ 4.39	$ 0.23	$ 0.100	$ 4.72	$ 1.20
2044	106,603	95	4.41	171,831	$ 12,028	$ 4.39	$ 0.23	$ 0.100	$ 4.72	$ 1.15
2045	106,603	95	4.41	171,831	$ 12,028	$ 4.39	$ 0.23	$ 0.100	$ 4.72	$ 1.09
2046	106,603	95	4.41	171,831	$ 12,028	$ 4.39	$ 0.23	$ 0.100	$ 4.72	$ 1.04
2047	106,603	95	4.41	171,831	$ 12,028	$ 4.39	$ 0.23	$ 0.100	$ 4.72	$ 0.99
2048	106,603	95	4.41	171,831	$ 12,028	$ 4.39	$ 0.23	$ 0.100	$ 4.72	$ 0.94
2049	106,603	95	4.41	171,831	$ 12,028	$ 4.39	$ 0.23	$ 0.100	$ 4.72	$ 0.90
2050	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.94
2051	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.89
2052	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.85
2053	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.81
2054	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.77
2055	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.74
2056	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.70
2057	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.67
2058	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.64
2059	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.61
2060	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.58
2061	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.55
2062	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.52
2063	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.50
2064	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.47
2065	117,804	105	4.87	189,886	$ 13,292	$ 4.85	$ 0.23	$ 0.100	$ 5.18	$ 0.45
								Total NPV of O&M Costs		$ 86.6

Capital Costs in million $:		Yr built		
RWTM	$ 70.1	2015		$ 70.1
Pumping Stations	$ 15.7	2015		$ 15.7
			Total NPV of Capital Costs	$ 85.8

Total NPV of Capital and O&M Costs in millions $ 172.4

O&M Cost Calculations
WTP and Raw Water Storage Reservoir at WTP
CTRWTP - Alternate 3B - WTP in Northern Corner of Caldwell County - Delayed SAWS and SARA Demands

Initial year of analysis period	2015	Contingency =	20%
Interest rate	5%	Engineering, Legal, Admin. =	15%
Evaluation period	50 years	Environmental & Archaeology Studies &	
Unit cost of energy	$ 0.07 per kwh	Mitigation, Surveying, and Land Acquisition =	$ 25,000 per acre

Treated Water Production by Treatment Type (from Demand Chart - BE SURE TO CHECK)

	Year =	2015	2020	2030	2040	2050	2060	2065
Softened water demand:	Units							
Average yearly demands:								
City of Austin	ac-ft/yr	0	0	16802	22403	33604	33604	33604
LCRA	ac-ft/yr	0	0	5600	11200	11200	11200	11200
Totals	ac-ft/yr	0	0	22402	33603	44804	44804	44804
Totals	mgd	0	0	20	30	40	40	40
Max day demands:								
City of Austin	mgd	0	0	25	35	50	50	50
LCRA	mgd	0	0	10	20	20	20	20
Totals	mgd	0	0	35	55	70	70	70

SAWS reduced demand scenario was for 139,000 ac-ft/yr in 2020, but only 117,804 ac-ft/yr would be temporarily available

	Year =	2015	2020	2030	2040	2050	2060	2065
Non-softened water demands:	Units							
Average yearly demands:								
SAWS	ac-ft/yr	73000	117804	205000	205000	205000	205000	205000
SARA	ac-ft/yr	0	0	28433	31393	34411	37530	41128
GBRA	ac-ft/yr	0	0	6000	8000	10000	12300	12300
Totals		73000	117804	239433	244393	249411	254830	258428
Totals	mgd	65	105	214	218	223	227	231
Max day demands:								
SAWS	mgd	85	137	238	238	238	238	238
SARA	mgd	0	0	33	36	40	44	48
GBRA	mgd	0	0	5	7	9	11	11
Totals	mgd	85	137	276	281	287	293	297
Total: softened and non-softened water demands								
Average yearly demand	ac-ft/yr	73000	117804	261835	277996	294215	299634	303232
	mgd	65	105	234	248	263	267	271
Max day demand	mgd	85	137	311	336	357	363	367

Raw Water Reservoir

Sizing for ultimate conditions:

Assumed number of days of consecutive Max Day demands	30	days	
Design (Max. Day) treated water production req'd in mgd	367	mgd	
Average treated water production in mgd	271	mgd	(which is also equal to sum of ground and raw water that can be pumped to the WTP)
Difference (shortfall of raw water)	96	mgd	
Required storage reservoir for raw water	2,889	mg	
	8,868	ac-ft	
Add safety factor 25%	2,217	ac-ft	
Total storage required	11,084	ac-ft	
Total storage recommended	12,000	ac-ft	

Note: No. of days at average day demand (for example, for repair of RWTM A) = 33 days

	Quantity	Units	Volume/each (acre-feet)	Unit Cost ($/ac-ft))	Total Construction Cost	Contigency, Eng., etc.	Total Capital Cost
Reservoirs	1	each	12,000	$ 1,283	$ 15.4	$ 5.9	$ 21.3

Estimated average depth of reservoir	25	ft	
Surface area of reservoir	480	acres	
Ratio of total land area reqd to surface area of reservoir	1.10		
Total land area reqd for reservoirs	528	acres	
		Envir & Archaeology, Surv, and Land Acq =	13.2
		Total capital cost in millions =	$ 34.5
Assumed life of reservoir	100	years	
Estimated replacement cost	$ 0.15	million/year	
Estimated maintenance	$ 0.04	million/year	Mowing, maintaining fences, etc.
Total	$ 0.19	million/year	
Year built	2015		
NPV of O&M costs	$ 3.5	million	
NPV of Capital costs	$ 34.5	million	
Total NPV of Capital and O&M Costs	$ 38.0	million	

WTP

Plant Phasing and Capital Costs:

Softening Treatment Trains

Year =	2015	2020	2030	2040	2050	2060	2065
Average treated water production in mgd	0	0	20	30	40	40	40
Design (Max. Day) treated water production req'd in mgd	0	0	35	55	70	70	70
Initial/additional Max day capacity built (mgd)			50	20			
Total capacity on line (must exceed Design Max Day Req'd)	0	0	50	70	70	70	70
Unit cost for max day treatment capacity ($/gpd of capacity)			$ 1.78	$ 2.14			
Estimated construction cost of expansion in $millions	$ -	$ -	$ 89.0	$ 42.8	$ -	$ -	$ -

Non-softening Treatment Trains

Year =	2015	2020	2030	2040	2050	2060	2065
Average treated water production in mgd	65	105	214	218	223	227	231
Design (Max. Day) treated water production req'd in mgd	85	137	276	281	287	293	297
Additional Max day capacity built (mgd)	100	100	100				
Total capacity on line (must exceed Design Max Day Req'd)	100	200	300	300	300	300	300
Unit cost for max day treatment capacity ($/gpd of capacity)	$ 1.32	$ 1.32	$ 1.32				
Estimated construction cost of expansion in $millions	$ 131.5	$ 131.5	$ 131.5	$ -	$ -	$ -	$ -

Totals (Softening + Non-softening Trains)

Year =	2015	2020	2030	2040	2050	2060	2065
Total construction cost for both trains	$ 131.5	$ 131.5	$ 220.5	$ 42.8	$ -	$ -	$ -
Contingencies	26.3	26.3	44.1	8.6	-	-	-
Subtotal	$ 157.8	$ 157.8	$ 264.7	$ 51.3	$ -	$ -	$ -
Engineering, Legal, & Administrative	23.7	23.7	39.7	7.7	-	-	-
Subtotal	181.5	181.5	304.4	59.0	-	-	-
Environmental & Archaeology Studies and Mitigation & Land Acquisition and Surveying (see Note below)	2.5						
Total estimated capital cost	$ 184.0	$ 181.5	$ 304.4	$ 59.0	$ -	$ -	$ -
NPV of capital cost	$ 184.0	$ 142.2	$ 146.4	$ 17.4	$ -	$ -	$ -

Total NPV of WTP initial construction & expansions $ 490

Note: Assumed land requirement for WTP (not including reserv 100 acres

O&M Costs for Softening Trains:

Year	Plant Capacity in service	Estimated treated water production	Estimated O&M cost from unit cost curve		Net present value
	mgd of capacity	mgd produced	$ per mg treated	$million /year	($)
2015	-	-		$ -	$ -
2016	-	-		$ -	$ -
2017	-	-		$ -	$ -
2018	-	-		$ -	$ -
2019	-	-		$ -	$ -
2020	-	-		$ -	$ -
2021	-	-		$ -	$ -
2022	-	-		$ -	$ -
2023	-	-		$ -	$ -
2024	-	-		$ -	$ -
2025	-	-		$ -	$ -
2026	-	-		$ -	$ -
2027	-	-		$ -	$ -
2028	-	-		$ -	$ -
2029	-	-		$ -	$ -
2030	50	20	$ 712	$ 5.20	$ 2.50
2031	50	20	$ 712	$ 5.20	$ 2.38
2032	50	20	$ 712	$ 5.20	$ 2.27
2033	50	20	$ 712	$ 5.20	$ 2.16
2034	50	20	$ 712	$ 5.20	$ 2.06
2035	50	20	$ 712	$ 5.20	$ 1.96
2036	50	20	$ 712	$ 5.20	$ 1.87
2037	50	20	$ 712	$ 5.20	$ 1.78
2038	50	20	$ 712	$ 5.20	$ 1.69
2039	50	20	$ 712	$ 5.20	$ 1.61
2040	70	30	$ 661	$ 7.24	$ 2.14
2041	70	30	$ 661	$ 7.24	$ 2.04
2042	70	30	$ 661	$ 7.24	$ 1.94
2043	70	30	$ 661	$ 7.24	$ 1.85
2044	70	30	$ 661	$ 7.24	$ 1.76
2045	70	30	$ 661	$ 7.24	$ 1.68
2046	70	30	$ 661	$ 7.24	$ 1.60
2047	70	30	$ 661	$ 7.24	$ 1.52
2048	70	30	$ 661	$ 7.24	$ 1.45
2049	70	30	$ 661	$ 7.24	$ 1.38
2050	70	40	$ 661	$ 9.65	$ 1.75
2051	70	40	$ 661	$ 9.65	$ 1.67
2052	70	40	$ 661	$ 9.65	$ 1.59
2053	70	40	$ 661	$ 9.65	$ 1.51
2054	70	40	$ 661	$ 9.65	$ 1.44
2055	70	40	$ 661	$ 9.65	$ 1.37
2056	70	40	$ 661	$ 9.65	$ 1.31
2057	70	40	$ 661	$ 9.65	$ 1.24
2058	70	40	$ 661	$ 9.65	$ 1.18
2059	70	40	$ 661	$ 9.65	$ 1.13
2060	70	40	$ 661	$ 9.65	$ 1.07
2061	70	40	$ 661	$ 9.65	$ 1.02
2062	70	40	$ 661	$ 9.65	$ 0.97
2063	70	40	$ 661	$ 9.65	$ 0.93
2064	70	40	$ 661	$ 9.65	$ 0.88
2065	70	40	$ 661	$ 9.65	$ 0.84
			Total NPV of O&M Costs		$ 58

O&M Costs for Non-Softening Trains:

Year	Plant Capacity in service	Estimated treated water production	Estimated O&M cost from unit cost curve		Net present value
	mgd of capacity	mgd produced	$ per mg treated	$million /year	($)
2015	100	65	$ 436	$ 10.37	$ 10.37
2016	100	65	$ 436	$ 10.37	$ 9.87
2017	100	65	$ 436	$ 10.37	$ 9.40
2018	100	65	$ 436	$ 10.37	$ 8.96
2019	100	65	$ 436	$ 10.37	$ 8.53
2020	200	105	$ 374	$ 14.37	$ 11.26
2021	200	105	$ 374	$ 14.37	$ 10.73
2022	200	105	$ 374	$ 14.37	$ 10.21
2023	200	105	$ 374	$ 14.37	$ 9.73
2024	200	105	$ 374	$ 14.37	$ 9.26
2025	200	105	$ 374	$ 14.37	$ 8.82
2026	200	105	$ 374	$ 14.37	$ 8.40
2027	200	105	$ 374	$ 14.37	$ 8.00
2028	200	105	$ 374	$ 14.37	$ 7.62
2029	200	105	$ 374	$ 14.37	$ 7.26
2030	300	214	$ 343	$ 26.73	$ 12.86
2031	300	214	$ 343	$ 26.73	$ 12.24
2032	300	214	$ 343	$ 26.73	$ 11.66
2033	300	214	$ 343	$ 26.73	$ 11.11
2034	300	214	$ 343	$ 26.73	$ 10.58
2035	300	214	$ 343	$ 26.73	$ 10.07
2036	300	214	$ 343	$ 26.73	$ 9.59
2037	300	214	$ 343	$ 26.73	$ 9.14
2038	300	214	$ 343	$ 26.73	$ 8.70
2039	300	214	$ 343	$ 26.73	$ 8.29
2040	300	218	$ 343	$ 27.28	$ 8.06
2041	300	218	$ 343	$ 27.28	$ 7.67
2042	300	218	$ 343	$ 27.28	$ 7.31
2043	300	218	$ 343	$ 27.28	$ 6.96
2044	300	218	$ 343	$ 27.28	$ 6.63
2045	300	218	$ 343	$ 27.28	$ 6.31
2046	300	218	$ 343	$ 27.28	$ 6.01
2047	300	218	$ 343	$ 27.28	$ 5.73
2048	300	218	$ 343	$ 27.28	$ 5.45
2049	300	218	$ 343	$ 27.28	$ 5.19
2050	300	223	$ 343	$ 27.84	$ 5.05
2051	300	223	$ 343	$ 27.84	$ 4.81
2052	300	223	$ 343	$ 27.84	$ 4.58
2053	300	223	$ 343	$ 27.84	$ 4.36
2054	300	223	$ 343	$ 27.84	$ 4.15
2055	300	223	$ 343	$ 27.84	$ 3.95
2056	300	223	$ 343	$ 27.84	$ 3.77
2057	300	223	$ 343	$ 27.84	$ 3.59
2058	300	223	$ 343	$ 27.84	$ 3.42
2059	300	223	$ 343	$ 27.84	$ 3.25
2060	300	227	$ 343	$ 28.45	$ 3.17
2061	300	227	$ 343	$ 28.45	$ 3.02
2062	300	227	$ 343	$ 28.45	$ 2.87
2063	300	227	$ 343	$ 28.45	$ 2.74
2064	300	227	$ 343	$ 28.45	$ 2.60
2065	300	231	$ 343	$ 28.85	$ 2.52
				Total NPV of O&M Costs	$ 366

NPV Totals for O&M:

Softening trains	$ 58
Non-softening Trains	$ 366
	$ 423

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Raw Water Reservoir	$ 34	$ 3.5	$ 38
Water Treatment Plant	$ 490	$ 423	$ 913
Totals	$ 524	$ 427	$ 951

Capital and O&M Cost Calculations
Potable Water Transmission Mains
CTRWTP - Alternate 3B - WTP in Northern Corner of Caldwell County - Delayed SAWS and SARA Demands

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

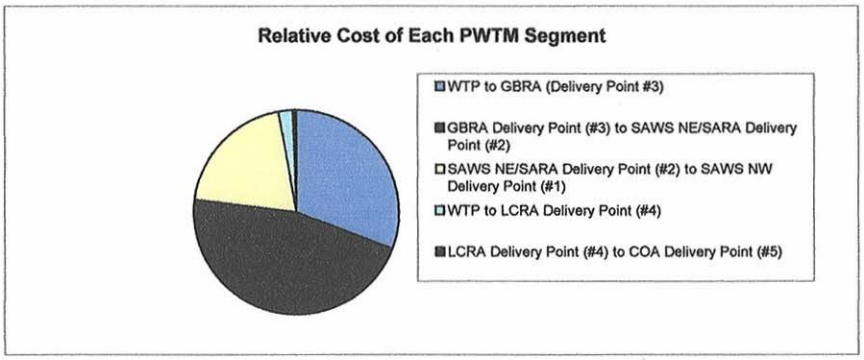
Summary of Demands

Average demands to be delivered in each segment in acre-feet/year

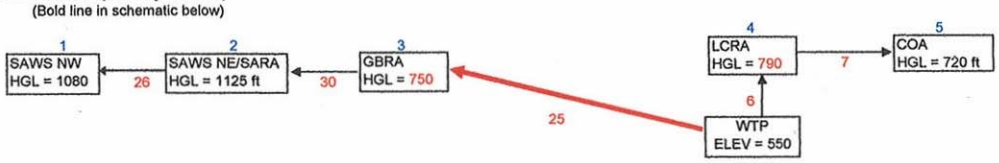
Year	2015	2020	2030	2040	2050	2060	2065
SAWS NW	43800	70682	123000	123000	123000	123000	123000
SAWS NE	29200	47122	82000	82000	82000	82000	82000
Subtotal	73000	117804	205000	205000	205000	205000	205000
SARA	0	0	28433	31393	34411	37530	41128
GBRA			6000	8000	10000	12300	12300
LCRA			5600	11200	11200	11200	11200
COA			16802	22403	33604	33604	33604
Total	73000	117804	261835	277996	294215	299634	303232

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
WTP to GBRA (Delivery Point #3)	$ 179	$ 144	$ 323
GBRA Delivery Point (#3) to SAWS NE/SARA Delivery Point (#2)	$ 217	$ 263	$ 481
SAWS NE/SARA Delivery Point (#2) to SAWS NW Delivery Point (#1)	$ 207	$ 5	$ 211
WTP to LCRA Delivery Point (#4)	$ 11	$ 12	$ 23
LCRA Delivery Point (#4) to COA Delivery Point (#5)	$ 6	$ 1	$ 7
Total for PWTMs	$ 620	$ 424	$ 1,044



WTP to GBRA (Delivery Point #3)
(Bold line in schematic below)



Note: GBRA & LCRA/COA must have separate PWTMs because GBRA needs unsoftened water and LCRA/COA need softened water.

Demands for this pipe segment

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
GBRA	0	0	5	7	9	11	11	2.0
SAWS NE	26	42	73	73	73	73	73	1.3
SARA	0	0	25	28	31	34	37	1.3
SAWS NW	39	63	110	110	110	110	110	1.3
Total	65	105	214	218	223	227	231	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
GBRA	0	0	11	14	18	22	22
SAWS NE	34	55	95	95	95	95	95
SARA	0	0	33	36	40	44	48
SAWS NW	51	82	143	143	143	143	143
Total	85	137	282	289	296	303	308

PWTM and Pump Station Costs

Design flow rate - year 2065	308	mgd	
	213,603	gpm	
Pumping capacity of one pump	21,500	gpm	
No. of pumps (not counting spare)	10		
Peak flow rate (all pumps except spare)	215,000	gpm	
Inside diameter of PWTM	120	in.	
Area	78.54	sf	
Length of PWTM	25	miles	(linked to mileage in schematic above)
	132,000	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	100%	132,000	$ 783	$ 103.3	million
Rural - rock	0%	-	$ 1,048	$ -	
Urban - rock	0%	-	$ 1,186	$ -	
		132,000		$ 103.3	million

Average estimated unit construction cost for PWTM	$ 783	per LF	
Total construction cost in millions	$ 103.3		
Contingencies	$ 20.7		
Subtotal	$ 124.0		
Engineering, Legal & Administrative	$ 18.6		
Subtotal	$ 142.6		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 2.5		
Total Capital Cost for PWTM in millions	$ 145.1		
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.250 Million $/year
Velocity at peak flow rate	6.10	fps	
C factor	120		
Head loss per foot	0.00083	ft/ft	$h_f = \left\| \frac{3.552*Q}{C*(d)^{2.63}} \right\|^{1.85}$
	4.40	ft/mile	
Head loss at peak flow rate	110	ft	
Allowance for minor losses 20%	22	ft	750 Desired HGL At Delivery Point
Total estimated losses	132	ft	550 Elev. At WTP
Average static head	200	ft	200 ft
Total estimated dynamic head	332	ft	
	144	psi	
No of recommended pumping stations along route	0.96		150 psi (assumed max pressure in pipe)
No. of pumping stations used in cost estimate	1		
Average head per pump station	332	ft	
Assumed pump efficiency	85%		
Assumed motor efficiency	90%		
Estimated Hp required per pump	2,356	hp/pump	
	1,757	kw/pump	
Total hp per pump station (not counting spare)	23,559	firm hp/station	
Total kw per pump set (set=pumps in series along route)	2,356	kw/pump set	(one pump at each station)
Unit capital cost for each pump station (from cost curve)	$ 1,047	per firm hp of pump station	
Construction cost per pump station	24.7	million	
Total construction cost for pump stations	24.7	for 1	pump stations

Contingencies	$	4.9	
Subtotal	$	29.6	
Engineering, Legal & Administrative	$	4.4	
Total capital cost for pump stations	$	34.0	million

40% Estimated equipment cost as % of total

Value of equipment	$	10	million
Assumed life of equipment		20	years
Estimated maintenance/replacement cost	$	0.49	million/year

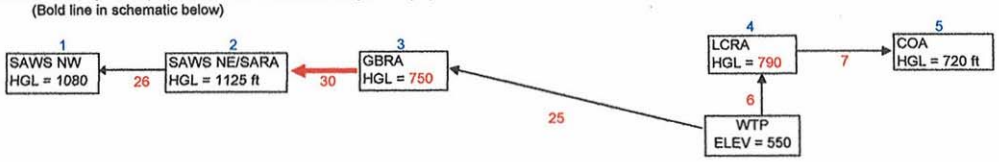
O&M Costs

Year	Flow pumped by year (average flows from Table above)	No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - PWTM	Total O&M cost	Net present value
	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	65	2.10	119,009	$ 8,331	$ 3.04	$ 0.49	$ 0.250	$ 3.78	$ 3.78
2016	65	2.10	119,009	$ 8,331	$ 3.04	$ 0.49	$ 0.250	$ 3.78	$ 3.60
2017	65	2.10	119,009	$ 8,331	$ 3.04	$ 0.49	$ 0.250	$ 3.78	$ 3.43
2018	65	2.10	119,009	$ 8,331	$ 3.04	$ 0.49	$ 0.250	$ 3.78	$ 3.27
2019	65	2.10	119,009	$ 8,331	$ 3.04	$ 0.49	$ 0.250	$ 3.78	$ 3.11
2020	105	3.40	192,051	$ 13,444	$ 4.91	$ 0.49	$ 0.250	$ 5.65	$ 4.43
2021	105	3.40	192,051	$ 13,444	$ 4.91	$ 0.49	$ 0.250	$ 5.65	$ 4.22
2022	105	3.40	192,051	$ 13,444	$ 4.91	$ 0.49	$ 0.250	$ 5.65	$ 4.02
2023	105	3.40	192,051	$ 13,444	$ 4.91	$ 0.49	$ 0.250	$ 5.65	$ 3.82
2024	105	3.40	192,051	$ 13,444	$ 4.91	$ 0.49	$ 0.250	$ 5.65	$ 3.64
2025	105	3.40	192,051	$ 13,444	$ 4.91	$ 0.49	$ 0.250	$ 5.65	$ 3.47
2026	105	3.40	192,051	$ 13,444	$ 4.91	$ 0.49	$ 0.250	$ 5.65	$ 3.30
2027	105	3.40	192,051	$ 13,444	$ 4.91	$ 0.49	$ 0.250	$ 5.65	$ 3.15
2028	105	3.40	192,051	$ 13,444	$ 4.91	$ 0.49	$ 0.250	$ 5.65	$ 3.00
2029	105	3.40	192,051	$ 13,444	$ 4.91	$ 0.49	$ 0.250	$ 5.65	$ 2.85
2030	214	6.90	390,339	$ 27,324	$ 9.97	$ 0.49	$ 0.250	$ 10.72	$ 5.15
2031	214	6.90	390,339	$ 27,324	$ 9.97	$ 0.49	$ 0.250	$ 10.72	$ 4.91
2032	214	6.90	390,339	$ 27,324	$ 9.97	$ 0.49	$ 0.250	$ 10.72	$ 4.68
2033	214	6.90	390,339	$ 27,324	$ 9.97	$ 0.49	$ 0.250	$ 10.72	$ 4.45
2034	214	6.90	390,339	$ 27,324	$ 9.97	$ 0.49	$ 0.250	$ 10.72	$ 4.24
2035	214	6.90	390,339	$ 27,324	$ 9.97	$ 0.49	$ 0.250	$ 10.72	$ 4.04
2036	214	6.90	390,339	$ 27,324	$ 9.97	$ 0.49	$ 0.250	$ 10.72	$ 3.85
2037	214	6.90	390,339	$ 27,324	$ 9.97	$ 0.49	$ 0.250	$ 10.72	$ 3.66
2038	214	6.90	390,339	$ 27,324	$ 9.97	$ 0.49	$ 0.250	$ 10.72	$ 3.49
2039	214	6.90	390,339	$ 27,324	$ 9.97	$ 0.49	$ 0.250	$ 10.72	$ 3.32
2040	218	7.05	398,425	$ 27,890	$ 10.18	$ 0.49	$ 0.250	$ 10.92	$ 3.23
2041	218	7.05	398,425	$ 27,890	$ 10.18	$ 0.49	$ 0.250	$ 10.92	$ 3.07
2042	218	7.05	398,425	$ 27,890	$ 10.18	$ 0.49	$ 0.250	$ 10.92	$ 2.93
2043	218	7.05	398,425	$ 27,890	$ 10.18	$ 0.49	$ 0.250	$ 10.92	$ 2.79
2044	218	7.05	398,425	$ 27,890	$ 10.18	$ 0.49	$ 0.250	$ 10.92	$ 2.65
2045	218	7.05	398,425	$ 27,890	$ 10.18	$ 0.49	$ 0.250	$ 10.92	$ 2.53
2046	218	7.05	398,425	$ 27,890	$ 10.18	$ 0.49	$ 0.250	$ 10.92	$ 2.41
2047	218	7.05	398,425	$ 27,890	$ 10.18	$ 0.49	$ 0.250	$ 10.92	$ 2.29
2048	218	7.05	398,425	$ 27,890	$ 10.18	$ 0.49	$ 0.250	$ 10.92	$ 2.18
2049	218	7.05	398,425	$ 27,890	$ 10.18	$ 0.49	$ 0.250	$ 10.92	$ 2.08
2050	223	7.19	406,605	$ 28,462	$ 10.39	$ 0.49	$ 0.250	$ 11.13	$ 2.02
2051	223	7.19	406,605	$ 28,462	$ 10.39	$ 0.49	$ 0.250	$ 11.13	$ 1.92
2052	223	7.19	406,605	$ 28,462	$ 10.39	$ 0.49	$ 0.250	$ 11.13	$ 1.83
2053	223	7.19	406,605	$ 28,462	$ 10.39	$ 0.49	$ 0.250	$ 11.13	$ 1.74
2054	223	7.19	406,605	$ 28,462	$ 10.39	$ 0.49	$ 0.250	$ 11.13	$ 1.66
2055	223	7.19	406,605	$ 28,462	$ 10.39	$ 0.49	$ 0.250	$ 11.13	$ 1.58
2056	223	7.19	406,605	$ 28,462	$ 10.39	$ 0.49	$ 0.250	$ 11.13	$ 1.51
2057	223	7.19	406,605	$ 28,462	$ 10.39	$ 0.49	$ 0.250	$ 11.13	$ 1.43
2058	223	7.19	406,605	$ 28,462	$ 10.39	$ 0.49	$ 0.250	$ 11.13	$ 1.37
2059	223	7.19	406,605	$ 28,462	$ 10.39	$ 0.49	$ 0.250	$ 11.13	$ 1.30
2060	227	7.35	415,440	$ 29,081	$ 10.61	$ 0.49	$ 0.250	$ 11.36	$ 1.26
2061	227	7.35	415,440	$ 29,081	$ 10.61	$ 0.49	$ 0.250	$ 11.36	$ 1.20
2062	227	7.35	415,440	$ 29,081	$ 10.61	$ 0.49	$ 0.250	$ 11.36	$ 1.15
2063	227	7.35	415,440	$ 29,081	$ 10.61	$ 0.49	$ 0.250	$ 11.36	$ 1.09
2064	227	7.35	415,440	$ 29,081	$ 10.61	$ 0.49	$ 0.250	$ 11.36	$ 1.04
2065	231	7.45	421,305	$ 29,491	$ 10.76	$ 0.49	$ 0.250	$ 11.51	$ 1.00
								Total NPV of O&M Costs	$ 144

Capital Costs in million $:			Yr built		
PWTM	$	145	2015		$ 145
Pumping Stations	$	34	2015		$ 34
				Total NPV of Capital Costs	$ 179

Total NPV of Capital and O&M Costs in millions $ 323
WTP to GBRA (Delivery Point #3)

GBRA Delivery Point (#3) to SAWS NE/SARA Delivery Point (#2)
(Bold line in schematic below)



Note: GBRA & LCRA/COA must have separate PWTMs because GBRA needs unsoftened water and LCRA/COA need softened water.

Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
SAWS NE	26	42	73	73	73	73	73	1.3
SARA	0	0	25	28	31	34	37	1.3
SAWS NW	39	63	110	110	110	110	110	1.3
Total	65	105	208	211	214	217	220	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
SAWS NE	34	55	95	95	95	95	95
SARA	0	0	33	36	40	44	48
SAWS NW	51	82	143	143	143	143	143
Total	85	137	271	274	278	281	286

PWTM and Pump Station Costs

Design flow rate - year 2065	286	mgd	
	198,353	gpm	
Pumping capacity of one pump	20,000	gpm	
No. of pumps (not counting spare)	10		
Peak flow rate (all pumps except spare)	200,000	gpm	
Inside diameter of PWTM	120	in.	
Area	78.54	sf	
Length of PWTM	30	miles	(linked to mileage in schematic above)
	158,400	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	50%	79,200	$ 783	$ 62.0	million
Rural - rock	25%	39,600	$ 1,048	$ 41.5	
Urban - rock	25%	39,600	$ 1,186	$ 46.9	
		158,400		$ 150.5	million

Average estimated unit construction cost for PWTM	$ 950	per LF	
Total construction cost in millions	$ 150.5		
Contingencies	$ 30.1		
Subtotal	$ 180.6		
Engineering, Legal & Administrative	$ 27.1		
Subtotal	$ 207.6		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 3.0		
Total Capital Cost for PWTM in millions	$ 210.6		
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.300 Million $/year
Velocity at peak flow rate	5.67	fps	
C factor	120		
Head loss per foot	0.00073	ft/ft	$h_f = \left\| \frac{3.552*Q}{C*(d)^{2.63}} \right\|^{1.85}$
	3.85	ft/mile	
Head loss at peak flow rate	115	ft	
Allowance for minor losses 20%	23	ft	1125 Desired HGL At Delivery Point
Total estimated losses	139	ft	750 HGL At Delivery Point 3
Average static head	375	ft	375 ft
Total estimated dynamic head	514	ft	
	223	psi	
No of recommended pumping stations along route	1.48		150 psi (assumed max pressure
No. of pumping stations used in cost estimate	2		in pipe)
Average head per pump station	257	ft	
Assumed pump efficiency	85%		
Assumed motor efficiency	90%		
Estimated Hp required per pump	1,695	hp/pump	
	1,265	kw/pump	
Total hp per pump station (not counting spare)	16,951	firm hp/station	
Total kw per pump set (set=pumps in series along route)	3,390	kw/pump set	(one pump at each station)
Unit construction cost for each pump station (from cost curve)	$ 1,127	per firm hp of pump station	
Construction cost per pump station	19.1	million	
Total construction cost for pump stations	38.2	for 2	pump stations

Contingencies	$	7.6	
Subtotal	$	45.9	
Engineering, Legal & Administrative	$	6.9	
Total capital cost for pump stations in millions	$	52.7	million

40% Equip cost as % of constr cost

Value of equipment	$	15	million
Assumed life of equipment		20	years
Estimated maintenance/replacement cost	$	0.76	million/year

O&M Costs

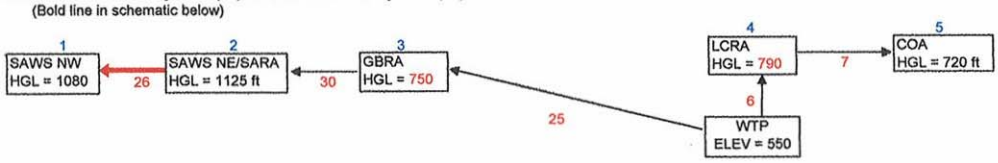
Year	Flow pumped by year (average flows from Table above)	No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - PWTM	Total O&M cost	Net present value
	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	65	2.26	184,102	$ 12,887	$ 4.70	$ 0.76	$ 0.300	$ 5.77	$ 5.77
2016	65	2.26	184,102	$ 12,887	$ 4.70	$ 0.76	$ 0.300	$ 5.77	$ 5.49
2017	65	2.26	184,102	$ 12,887	$ 4.70	$ 0.76	$ 0.300	$ 5.77	$ 5.23
2018	65	2.26	184,102	$ 12,887	$ 4.70	$ 0.76	$ 0.300	$ 5.77	$ 4.98
2019	65	2.26	184,102	$ 12,887	$ 4.70	$ 0.76	$ 0.300	$ 5.77	$ 4.75
2020	105	3.65	297,096	$ 20,797	$ 7.59	$ 0.76	$ 0.300	$ 8.66	$ 6.78
2021	105	3.65	297,096	$ 20,797	$ 7.59	$ 0.76	$ 0.300	$ 8.66	$ 6.46
2022	105	3.65	297,096	$ 20,797	$ 7.59	$ 0.76	$ 0.300	$ 8.66	$ 6.15
2023	105	3.65	297,096	$ 20,797	$ 7.59	$ 0.76	$ 0.300	$ 8.66	$ 5.86
2024	105	3.65	297,096	$ 20,797	$ 7.59	$ 0.76	$ 0.300	$ 8.66	$ 5.58
2025	105	3.65	297,096	$ 20,797	$ 7.59	$ 0.76	$ 0.300	$ 8.66	$ 5.31
2026	105	3.65	297,096	$ 20,797	$ 7.59	$ 0.76	$ 0.300	$ 8.66	$ 5.06
2027	105	3.65	297,096	$ 20,797	$ 7.59	$ 0.76	$ 0.300	$ 8.66	$ 4.82
2028	105	3.65	297,096	$ 20,797	$ 7.59	$ 0.76	$ 0.300	$ 8.66	$ 4.59
2029	105	3.65	297,096	$ 20,797	$ 7.59	$ 0.76	$ 0.300	$ 8.66	$ 4.37
2030	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 7.75
2031	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 7.38
2032	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 7.03
2033	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 6.69
2034	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 6.37
2035	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 6.07
2036	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 5.78
2037	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 5.51
2038	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 5.24
2039	208	7.24	588,706	$ 41,209	$ 15.04	$ 0.76	$ 0.300	$ 16.11	$ 4.99
2040	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 4.81
2041	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 4.58
2042	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 4.36
2043	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 4.16
2044	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 3.96
2045	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 3.77
2046	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 3.59
2047	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 3.42
2048	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 3.26
2049	211	7.33	596,171	$ 41,732	$ 15.23	$ 0.76	$ 0.300	$ 16.30	$ 3.10
2050	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.99
2051	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.85
2052	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.71
2053	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.58
2054	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.46
2055	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.34
2056	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.23
2057	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.12
2058	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 2.02
2059	214	7.42	603,782	$ 42,265	$ 15.43	$ 0.76	$ 0.300	$ 16.49	$ 1.93
2060	217	7.52	611,648	$ 42,815	$ 15.63	$ 0.76	$ 0.300	$ 16.69	$ 1.86
2061	217	7.52	611,648	$ 42,815	$ 15.63	$ 0.76	$ 0.300	$ 16.69	$ 1.77
2062	217	7.52	611,648	$ 42,815	$ 15.63	$ 0.76	$ 0.300	$ 16.69	$ 1.69
2063	217	7.52	611,648	$ 42,815	$ 15.63	$ 0.76	$ 0.300	$ 16.69	$ 1.60
2064	217	7.52	611,648	$ 42,815	$ 15.63	$ 0.76	$ 0.300	$ 16.69	$ 1.53
2065	220	7.63	620,722	$ 43,451	$ 15.86	$ 0.76	$ 0.300	$ 16.92	$ 1.48
								Total NPV of O&M Costs	$ 217.2

Capital Costs in million $:			Yr built		
PWTM	$	210.6	2015		$ 210.6
Pumping Stations	$	52.7	2015		$ 52.7
				Total NPV of Capital Costs	$ 263.4

Total NPV of Capital and O&M Costs in millions $ 481

GBRA Delivery Point (#3) to SAWS NE/SARA Delivery Point (#2)

SAWS NE/SARA Delivery Point (#2) to SAWS NW Delivery Point (#1)
(Bold line in schematic below)



Note: GBRA & LCRA/COA must have separate PWTMs because GBRA needs unsoftened water and LCRA/COA need softened water.

Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
SAWS NW	39	63	110	110	110	110	110	1.3
Total	39	63	110	110	110	110	110	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
SAWS NW	51	82	143	143	143	143	143
Total	51	82	143	143	143	143	143

PWTM and Pump Station Costs

Design flow rate - year 2065	143	mgd	
	99,125	gpm	
Pumping capacity of one pump	20,000	gpm	
No. of pumps (not counting spare)	5		
Peak flow rate (all pumps except spare)	100,000	gpm	
Inside diameter of PWTM	120	in.	
Area	78.54	sf	
Length of RWTM	26	miles	(linked to mileage in schematic above)
	137,280	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	15%	20,592	$ 783	$ 16.1	million
Rural - rock	35%	48,048	$ 1,048	$ 50.4	
Urban - rock	50%	68,640	$ 1,186	$ 81.4	
		137,280		$ 147.9	million

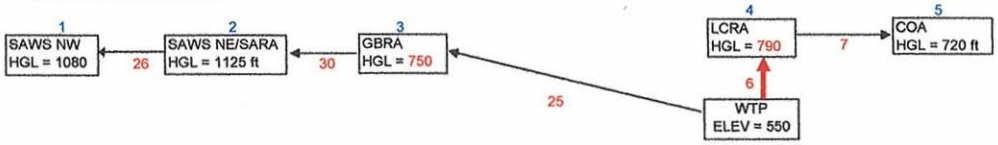
Average estimated unit construction cost for PWTM	$ 1,077	per LF	
Total construction cost in millions	$ 147.9		
Contingencies	$ 29.6		
Subtotal	$ 177.4		
Engineering, Legal & Administrative	$ 26.6		
Subtotal	$ 204.1		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 2.6		
Total Capital Cost for PWTM in millions	$ 206.7		
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.260 Million $/year
Velocity at peak flow rate	2.84	fps	
C factor	120		
Head loss per foot	0.00020	ft/ft	$h_f = \left\| \frac{3.552*Q}{C*(d)^{2.63}} \right\|^{1.85}$
	1.07	ft/mile	
Head loss at peak flow rate	28	ft	
Allowance for minor losses 20%	6	ft	1080 Desired HGL At Delivery Point
Total estimated losses	33	ft	1125 HGL At Delivery Point 2
Average static head	-45	ft	-45 ft
Total estimated dynamic head	-12	ft	
	-5	psi	

Negative indicates gravity flow from #2 to #1; no pumping necessary.

			Million $
Annual O&M Cost in million $:		Yr built	
PWTM	$ 0.260	2015	
		Total NPV of O&M Costs	$4.7
Capital Costs in million $:		Yr built	
PWTM	$ 206.7	2015	$ 206.7
		Total NPV of Capital Costs	$ 206.7

Total NPV of Capital and O&M Costs in millions $ 211.4
SAWS NE/SARA Delivery Point (#2) to SAWS NW Delivery Point (#1)

WTP to LCRA Delivery Point (#4)
(Bold line in schematic below)



Note: GBRA & LCRA/COA must have separate PWTMs because GBRA needs unsoftened water and LCRA/COA need softened water.

Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
LCRA	0	0	5	10	10	10	10	2.0
COA	0	0	15	20	30	30	30	1.68
Total	0	0	20	30	40	40	40	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
LCRA	0	0	10	20	20	20	20
COA	0	0	25	34	50	50	50
Total	0	0	35	54	70	70	70

PWTM and Pump Station Costs

Design flow rate - year 2065	70	mgd	
	48,883	gpm	
Pumping capacity of one pump	10,000	gpm	
No. of pumps (not counting spare)	5		
Peak flow rate (all pumps except spare)	50,000	gpm	
Inside diameter of PWTM	60	in.	
Area	19.64	sf	
Length of RWTM	6	miles	(linked to mileage in schematic above)
	31,680	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	100%	31,680	$ 282	$ 8.9	million
Rural - rock	0%	-	$ 388	$ -	
Urban - rock	0%	-	$ 427	$ -	
		31,680		$ 8.9	million

Average estimated unit construction cost for PWTM	$ 282	per LF	
Total construction cost in millions	$ 8.9		
Contingencies	$ 1.8		
Subtotal	$ 10.7		
Engineering, Legal & Administrative	$ 1.6		
Subtotal	$ 12.3		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 0.6		
Total Capital Cost for PWTM in millions	$ 12.9		
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.060 Million $/year
Velocity at peak flow rate	5.67	fps	
C factor	120		
Head loss per foot	0.00163	ft/ft	$h_f = \frac{3.552*Q}{C*(d)^{2.63}}^{1.85}$
	8.63	ft/mile	
Head loss at peak flow rate	52	ft	
Allowance for minor losses 20%	10	ft	790 Desired HGL At Delivery Point
Total estimated losses	62	ft	550 Elev. At WTP
Average static head	240	ft	240 ft
Total estimated dynamic head	302	ft	
	131	psi	
No of recommended pumping stations along route	0.87		150 psi (assumed max pressure
No. of pumping stations used in cost estimate	1		in pipe)
Average head per pump station	302	ft	
Assumed pump efficiency	85%		
Assumed motor efficiency	90%		
Estimated Hp required per pump	997	hp/pump	
	744	kw/pump	
Total hp per pump station (not counting spare)	4,987	firm hp/station	
Total kw per pump set (set=pumps in series along route)	997	kw/pump set	(one pump at each station)
Unit construction cost for each pump station (from cost curve)	$ 1,426	per firm hp of pump station	
Construction cost per pump station	7.1	million	
Total construction cost for pump stations	7.1		for 1 pump stations
Contingencies	$ 1.4		
Subtotal	$ 8.5		
Engineering, Legal & Administrative	$ 1.3		

Total capital cost for pump stations	$	9.8	million
		40%	Equip cost as % of constr cost
Value of equipment	$	2.8	million
Assumed life of equipment		20	years
Estimated maintenance/replacement cost	$	0.14	million/year

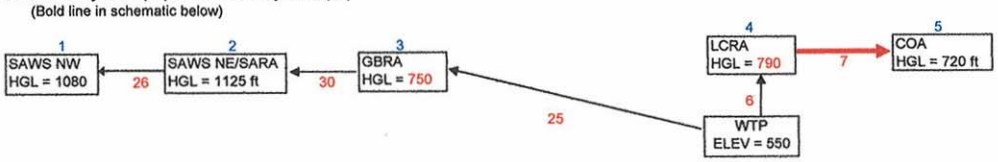
O&M Costs

Year	Flow pumped by year (average flows from Table above)	No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - PWTM	Total O&M cost	Net present value
	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015								$ -	$ -
2016								$ -	$ -
2017								$ -	$ -
2018								$ -	$ -
2019								$ -	$ -
2020								$ -	$ -
2021								$ -	$ -
2022								$ -	$ -
2023								$ -	$ -
2024								$ -	$ -
2025								$ -	$ -
2026								$ -	$ -
2027								$ -	$ -
2028								$ -	$ -
2029								$ -	$ -
2030	20	1.39	33,241	$ 2,327	$ 0.85	$ 0.14	$ 0.060	$ 1.05	$ 0.51
2031	20	1.39	33,241	$ 2,327	$ 0.85	$ 0.14	$ 0.060	$ 1.05	$ 0.48
2032	20	1.39	33,241	$ 2,327	$ 0.85	$ 0.14	$ 0.060	$ 1.05	$ 0.46
2033	20	1.39	33,241	$ 2,327	$ 0.85	$ 0.14	$ 0.060	$ 1.05	$ 0.44
2034	20	1.39	33,241	$ 2,327	$ 0.85	$ 0.14	$ 0.060	$ 1.05	$ 0.42
2035	20	1.39	33,241	$ 2,327	$ 0.85	$ 0.14	$ 0.060	$ 1.05	$ 0.40
2036	20	1.39	33,241	$ 2,327	$ 0.85	$ 0.14	$ 0.060	$ 1.05	$ 0.38
2037	20	1.39	33,241	$ 2,327	$ 0.85	$ 0.14	$ 0.060	$ 1.05	$ 0.36
2038	20	1.39	33,241	$ 2,327	$ 0.85	$ 0.14	$ 0.060	$ 1.05	$ 0.34
2039	20	1.39	33,241	$ 2,327	$ 0.85	$ 0.14	$ 0.060	$ 1.05	$ 0.33
2040	30	2.08	49,862	$ 3,490	$ 1.27	$ 0.14	$ 0.060	$ 1.48	$ 0.44
2041	30	2.08	49,862	$ 3,490	$ 1.27	$ 0.14	$ 0.060	$ 1.48	$ 0.42
2042	30	2.08	49,862	$ 3,490	$ 1.27	$ 0.14	$ 0.060	$ 1.48	$ 0.40
2043	30	2.08	49,862	$ 3,490	$ 1.27	$ 0.14	$ 0.060	$ 1.48	$ 0.38
2044	30	2.08	49,862	$ 3,490	$ 1.27	$ 0.14	$ 0.060	$ 1.48	$ 0.36
2045	30	2.08	49,862	$ 3,490	$ 1.27	$ 0.14	$ 0.060	$ 1.48	$ 0.34
2046	30	2.08	49,862	$ 3,490	$ 1.27	$ 0.14	$ 0.060	$ 1.48	$ 0.33
2047	30	2.08	49,862	$ 3,490	$ 1.27	$ 0.14	$ 0.060	$ 1.48	$ 0.31
2048	30	2.08	49,862	$ 3,490	$ 1.27	$ 0.14	$ 0.060	$ 1.48	$ 0.30
2049	30	2.08	49,862	$ 3,490	$ 1.27	$ 0.14	$ 0.060	$ 1.48	$ 0.28
2050	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.34
2051	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.33
2052	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.31
2053	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.30
2054	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.28
2055	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.27
2056	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.26
2057	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.24
2058	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.23
2059	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.22
2060	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.21
2061	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.20
2062	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.19
2063	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.18
2064	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.17
2065	40	2.78	66,483	$ 4,654	$ 1.70	$ 0.14	$ 0.060	$ 1.90	$ 0.17
							Total NPV of O&M Costs		$ 11.6

Capital Costs in million $:			Yr built		
PWTM	$	12.9	2030		$ 6.2
Pumping Stations	$	9.8	2030		$ 4.7
				Total NPV of Capital Costs	$ 10.9

Total NPV of Capital and O&M Costs in millions $ 23
WTP to LCRA Delivery Point (#4)

LCRA Delivery Point (#4) to COA Delivery Point (#5)
(Bold line in schematic below)



Note: GBRA & LCRA/COA must have separate PWTMs because GBRA needs unsoftened water and LCRA/COA need softened water.

Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
COA	0	0	15	20	30	30	30	1.68
Total	0	0	15	20	30	30	30	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
COA	0	0	25	34	50	50	50
Total	0	0	25	34	50	50	50

PWTM and Pump Station Costs

Design flow rate - year 2065	50	mgd	
	34,997	gpm	
Inside diameter of PWTM	54	in.	
Area	15.90	sf	
Length of PWTM	7	miles	(linked to mileage in schematic above)
	36,960	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	100%	36,960	$ 244	$ 9.0	million
Rural - rock	0%	-	$ 337	$ -	
Urban - rock	0%	-	$ 369	$ -	
		36,960		$ 9.0	million

Average estimated unit construction cost for PWTM	$ 244	per LF	
Total construction cost in millions	$ 9.0		
Contingencies	$ 1.8		
Subtotal	$ 10.8		
Engineering, Legal & Administrative	$ 1.6		
Subtotal	$ 12.4		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 0.0		
Total Capital Cost for PWTM in millions	$ 12.4		
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.070 Million $/year
Velocity at peak flow rate	4.90	fps	
C factor	120		
Head loss per foot	0.00141	ft/ft	$h_f = \left\| \frac{3.552*Q}{C*(d)^{2.63}} \right\|^{1.85}$
	7.45	ft/mile	
Head loss at peak flow rate	52	ft	
Allowance for minor losses 20%	10	ft	720 Desired HGL At Delivery Point
Total estimated losses	63	ft	790 Elev. At Delivery Point 4
Average static head	-70	ft	-70 ft
Total estimated dynamic head	-7	ft	
	-3	psi	

Negative indicates gravity flow from #4 to #5; no pumping necessary.

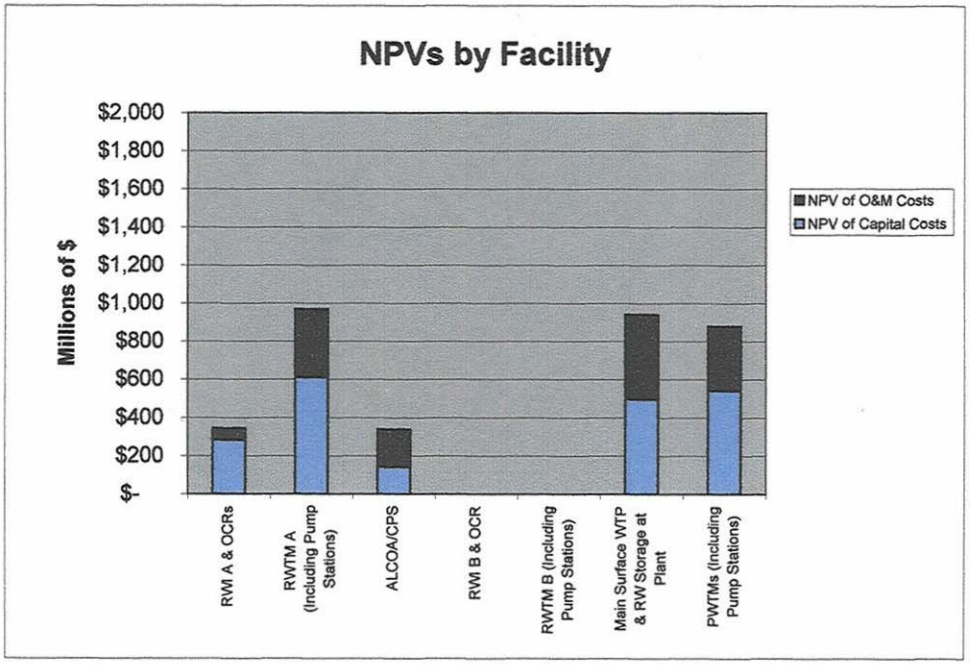
			Million $
Annual O&M Cost in million $:		Yr built	
PWTM	$ 0.070	2030	
		Total NPV of O&M Costs	$0.6
Capital Costs in million $:		Yr built	
PWTM	$ 12.4	2030	
			$ 6.0
		Total NPV of Capital Costs	$ 6.0

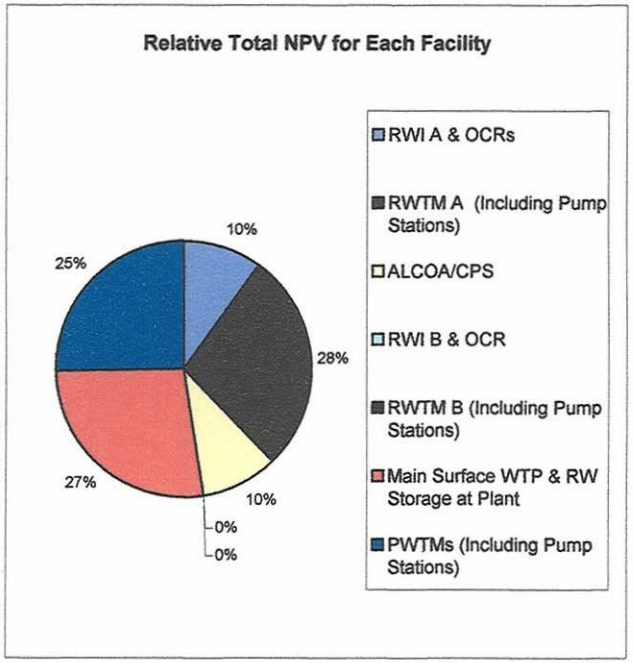
Total NPV of Capital and O&M Costs in millions $ 6.5
LCRA Delivery Point (#4) to COA Delivery Point (#5)

CTRWTP - Alternate 1D - WTP East of San Antonio & ALCOA/CPS Water Ultimately to COA & LCRA

WTP Location	Alter-nate	Phasing Scenario	Total NPVs in Millions of $	RWI A & OCRs	RWTM A (Including Pump Stations)	ALCOA/CPS	RWI B & OCR	RWTM B (Including Pump Stations)	Main Surface WTP & RW Storage at Plant	PWTMs (Including Pump Stations)
WTP for ALCOA/CPS groundwater east of Elgin; Main suface WTP east of San Antonio.	1D	2015: Construct ALCOA/CPS system with PWTM's to San Antonio; 2020: Construct RWI & RWTM A with main suface WTP east of San Antonio.		Sized for 6000 cfs to scalp water; 6 intakes & 6 OCRs at 25,000 ac-ft each	142 miles of 108-inch diameter pipe sized to deliver an ultimate average flow of 194,800 ac-ft/year; includes 3 pumping stations w/ balancing reservoirs along route	Public wells; Treat 55,000 ac-ft/year in iron/manganese removal WTP near Hwy 290 east of Elgin	None req'd	None req'd	Raw water reservoir w/ 12,000 ac-ft capacity; Conventional settling with membrane filtration for SAWS, SARA & GBRA	Each PWTM sized for maximum daily demand (See PWTM Summary Sheet in the Appendices)
		NPV of Capital Costs	$ 2,074	$ 284	$ 610	$ 143	$ -	$ -	$ 496	$ 541
		NPV of O&M Costs	$ 1,399	$ 61	$ 358	$ 196	$ -	$ -	$ 445	$ 338
		Total NPV of Capital & O&M	$ 3,472	$ 344	$ 968	$ 339	$ -	$ -	$ 941	$ 880

0.85





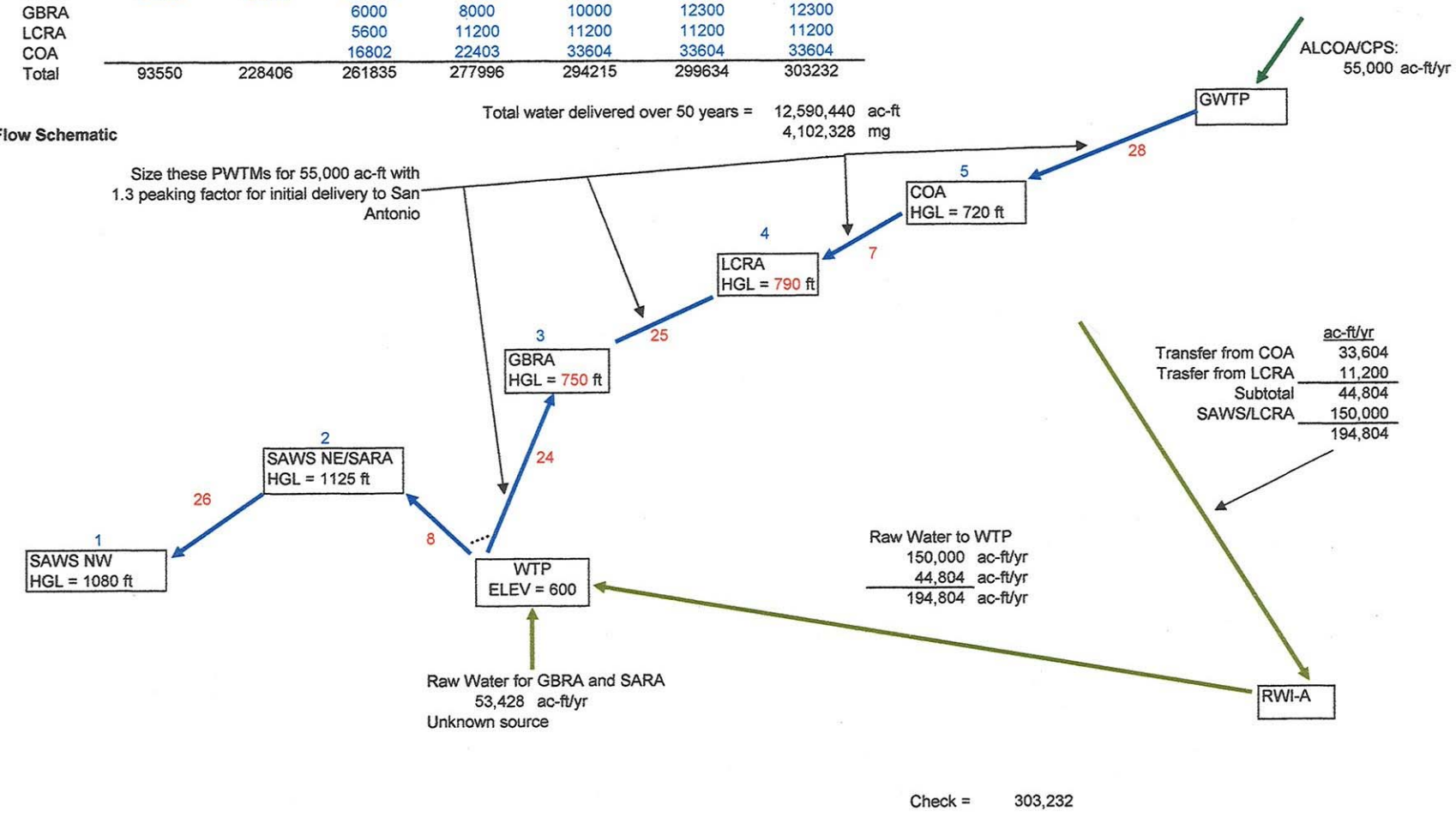
Flow Schematic
CTRWTP - Alternate 1D - WTP East of San Antonio & ALCOA/CPS Water Ultimately to COA & LCRA

Summary of Demands

Average demands to be delivered in each segment in acre-feet/year

Year	2015	2020	2030	2040	2050	2060	2065
SAWS NW	43800	123000	123000	123000	123000	123000	123000
SAWS NE	29200	82000	82000	82000	82000	82000	82000
Subtotal	73000	205000	205000	205000	205000	205000	205000
SARA	20550	23406	28433	31393	34411	37530	41128
GBRA			6000	8000	10000	12300	12300
LCRA			5600	11200	11200	11200	11200
COA			16802	22403	33604	33604	33604
Total	93550	228406	261835	277996	294215	299634	303232

Flow Schematic



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O&M Cost Calculations
RWI A - Matagorda Co. River Intakes, and Storage
CTRWTP - Alternate 1D - WTP East of San Antonio & ALCOA/CPS Water Ultimately to COA & LCRA

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile
			or =	$ 5,000	per acre

Inflatable Rubber Low Head Dam

	Quantity	Units	Size	Unit Constr. Cost (millions)	Total Estimated Constr. Cost (millions)	Contigency, Eng., etc. (millions)	Total Capital Cost (millions)
Inflatable Rubber Low Head Dam	6	each	10 ft high	$ 2.25	$ 13.50	$ 5.13	$ 18.63

Estimated inflatable dam cost as % of total	50%		
Value of inflatable dam	$ 6.75	million	
Assumed life of inflatable dam	10	years	
Estimated maintenance/replacement cost	$ 0.68	million/year	
Year built	2020		
NPV of O&M Costs	$9.40	million	
NPV of Capital Costs	$ 14.60	million	
Total NPV of Capital and O&M Costs	$24.00	million	

Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)

Average withdrawal	194,804	ac-ft/year			
	269	cfs			
Total intake design withdrawal rate (for scalping high flows	6,000	cfs	22.3	Ratio of design withdrawal rate to Total intake design withdrawal rate	
	2,692,800	gpm			
No. of Intakes	6				
Design withdrawal rate per intake	1,000	cfs			
	448,800	gpm			
No. of reservoirs	6				
Design flow to each reservoir	448,800	gpm			
Inside diameter of each RWTM	144	in.			
Area	113.10	sf			
Average length of each RWTM	1	miles	6.0	miles for all RWTMs	
	5,280	feet	31,680	feet	
Estimated construction cost for RWTM	$ 1,053	per LF			
Total construction cost in millions	$ 33.4				
Contingencies	$ 6.7				
Subtotal	$ 40.0				
Engineering, Legal & Administrative	$ 6.0				
Subtotal	$ 46.0				
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 0.6				
Total Capital Cost for PWTM in millions	$ 46.6	million			
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.060	Million $/year (all RWTMs to Reservoirs)	

Note: Assume each intake has two RWTMs pumping out of it, one to each reservoir.

Design flow rate for each RWTM (from above)	448,800	gpm		
Pumping rate (one pump)	50,000	gpm		
No. of pumps (not counting spare) pumping into each RW	9			
Peak flow rate into each RWTM (all pumps except spare)	450,000	gpm		
Velocity at peak flow rate	8.87	fps		
C factor	120			
Head loss per foot	0.00135	ft/ft	$h_f = \frac{3.552*Q^{1.85}}{C^*(d)^{2.63}}$	
	7.10	ft/mile		
Head loss at peak flow rate	7	ft		
Allowance for minor losses 30%	2	ft	90	Elev of discharge at reservoir
Total estimated losses	9	ft	50	Water surface elev in river
Average static head	40	ft	40	ft
Total estimated dynamic head	49	ft		
	21	psi		
Assumed pump efficiency	85%			
Assumed motor efficiency	90%			
Estimated Hp required per pump	813	hp/pump		
	606	kw/pump		
Total hp pumping into each RWTM (not counting spare)	7,313	hp/RWTM		
Total hp at each intake (not counting spare)	7,313	hp/intake		
Total hp all intakes (not counting spares)	43,881	hp		
Total kw all intakes (not counting spares)	32,735	kw		
Unit construction cost for each pump station (from cost cur	$ 889	per firm hp of pump station		
Construction cost per intake/pump station	6.5	million		
No. of intakes from above	6	each		
Total construction cost in millions	$ 39.0	million		
Contigency, Eng., etc. in millions	$ 14.62	million		
Total capital cost in millions	$ 53.8	million		
Total construction cost for pump stations	$ 39.0	million		
Value of equipment	$ 15.6	million	40%	Estimated equip cost as % of total constr cost
Assumed life of equipment	20	years		
Estimated maintenance/replacement cost	$ 0.78	million/year		

O&M Costs:

Year	Flow pumped by year		No. of pump "sets" operating	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd	/day	(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	-	-	-	-	$ -	$ -			$ -	$ -
2016	-	-	-	-	$ -	$ -			$ -	$ -
2017	-	-	-	-	$ -	$ -			$ -	$ -
2018	-	-	-	-	$ -	$ -			$ -	$ -
2019	-	-	-	-	$ -	$ -			$ -	$ -
2020	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 1.36
2021	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 1.30
2022	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 1.23
2023	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 1.18
2024	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 1.12
2025	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 1.07
2026	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 1.02
2027	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.97
2028	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.92
2029	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.88
2030	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.84
2031	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.80
2032	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.76
2033	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.72
2034	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.69
2035	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.65
2036	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.62
2037	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.59
2038	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.57
2039	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.54
2040	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.51
2041	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.49
2042	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.47
2043	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.44
2044	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.42
2045	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.40
2046	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.38
2047	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.36
2048	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.35
2049	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.33
2050	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.32
2051	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.30
2052	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.29
2053	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.27
2054	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.26
2055	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.25
2056	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.24
2057	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.22
2058	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.21
2059	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.20
2060	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.19
2061	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.18
2062	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.18
2063	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.17
2064	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.16
2065	194,804	174	2.42	35,139	$ 2,460	$ 0.90	$ 0.78	$ 0.060	$ 1.74	$ 0.15
								Total NPV of O&M Costs		$ 25.6

Capital Costs in million $:		Yr built		
RWTM to Reservoirs	$ 46.6	2020		$ 36.5
Intake/Pumping Stations	$ 53.8	2020		$ 42.2
			Total NPV of Capital Costs	$ 78.7
			Total NPV of Capital and O&M Costs in millions	$ 104.3

Reservoirs

	Quantity	Units	Volume/each (acre-feet)	Unit Cost ($/ac-ft))	Total Construction Cost in millions	Contigency, Eng., etc.	Total in millions
Reservoirs	6	each	25000	$ 974	$ 146.0	$ 55.5	$ 201.5

Estimated average depth of reservoir	20	ft		
Surface area of reservoir	7500	acres		
Ratio of total land area reqd to surface area of reservoir	1.1			
Total land area reqd for reservoirs	8250	acres	Envir & Archaeology, Surv, and Land Acq =	41.3
			Total capital cost in millions =	$ 242.8
Assumed life of reservoir	100	years		
Estimated replacement cost	$ 1.46	million/year		
Estimated maintenance	0.4	million/year	Mowing, maintaining fences, etc.	
Total	$ 1.86	million/year		
Year built	2020			
NPV of O&M costs	$ 25.9	million		
NPV of Capital costs	$ 190.2	million		
Total NPV of Capital and O&M Costs	$ 216.1	million		

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Inflatable Rubber Low Head Dam	$ 14.6	$ 9.4	$ 24.0
Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)	$ 78.7	$ 25.6	$ 104.3
Reservoirs	$ 190.2	$ 25.9	$ 216.1
Total for RWI A	$ 283.5	$ 60.9	$ 344.4

O&M Cost Calculations
RWTM A - Matagorda Co. to WTP
CTRWTP - Alternate 1D - WTP East of San Antonio & ALCOA/CPS Water Ultimately to COA & LCRA

Initial year of analysis period	2015		Contingency =	20%
Interest rate	5%		Engineering, Legal, Admin. =	15%
Evaluation period	50 years		Environmental & Archaeology Studies &	
Unit cost of energy	$ 0.07 per kwh		Mitigation, Surveying, and Land Acquisition	$ 100,000 per mile

Raw Water Transmission Main - A

Inside diameter of pipe		108	in.		
Area		63.62	sf		
Length of RWTM		142	miles		
		749,760	feet		
Estimated unit construction cost for RWTM		$ 676	per LF		
Total construction cost in millions		$ 507			
Contingencies		$ 101			
Subtotal		$ 608			
Engineering, Legal & Administrative		$ 91			
Subtotal		$ 700			
Envir & Arch Studies & Mitigation, Surveying, & Land Acq		$ 14			
Total Capital Cost for PWTM in millions		$ 714	million		
Unit maintenance cost/year-mile		$ 10,000	$/year-mile	$ 1.420	Million $/year
Design flow rate (after 100% buildout)		194,804	ac-ft/year		
		174	mgd		
		120,762	gpm		
Pumping rate (one pump)		20,000	gpm		
No. of pumps (not counting spare)		6			
Peak flow rate (all pumps except spare)		120,000	gpm		
Velocity at peak flow rate		4.20	fps		
C factor		120			
Head loss per foot		0.00047	ft/ft	$h_f = \lvert 3.552*Q\rvert^{1.85} / \lvert C*(d)^{2.63}\rvert$	
		2.50	ft/mile		
Head loss at peak flow rate		355	ft		
Allowance for minor losses	10%	35	ft	600	Elev. At San Antonio East WTP
Total estimated losses		390	ft	90	Elev. At Matagorda OCRs
Average static head		510	ft	510	ft
Total estimated dynamic head		900	ft		
		390	psi		
No of pumping stations req'd along route		2.60		150	psi (assumed max pressure
No. of pumping stations used in cost estimate		3.0			in pipe)
Average head per pump station		300	ft		
Assumed pump efficiency		85%			
Assumed motor efficiency		90%			
Estimated Hp required per pump		1,981	hp/pump		
		1,478	kw/pump		
Total hp per pump station (not counting spare)		11,884	hp/station		
Total kw per pump set (set=pumps in series along route)		5,942	kw/pump set	(one pump at each station)	
Unit constr. cost for each pump station (from cost curve)		$ 1,214	per firm hp of pump station		
Construction cost per pump station		$ 14.42	million		
Balancing reservoir		$ 1.20	million	60	min. of storage at avg pumping rate
Total construction cost per pump station		$ 15.62	million	8.0	mg
				$ 0.15	per gal for open top reservoir
No. of pump stations from above		3.0	each		
Total construction cost in millions		$ 46.9	million		
Contigency, Eng., etc. in millions		$ 17.81	million		
Total capital cost in millions		$ 64.7	million		
Total construction cost for pump stations		$ 46.9	million		
Value of equipment		$ 18.7	million	40%	Estimated equipment cost as % of total
Assumed life of equipment		20	years		
Estimated maintenance/replacement cost		$ 0.94	million/year		

O&M Costs

Year	Flow pumped by year		No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	-	-	-	-	$ -	$ -			$ -	$ -
2016	-	-	-	-	$ -	$ -			$ -	$ -
2017	-	-	-	-	$ -	$ -			$ -	$ -
2018	-	-	-	-	$ -	$ -			$ -	$ -
2019	-	-	-	-	$ -	$ -			$ -	$ -
2020	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 19.08
2021	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 18.18
2022	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 17.31
2023	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 16.49
2024	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 15.70
2025	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 14.95
2026	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 14.24
2027	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 13.56
2028	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 12.92
2029	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 12.30
2030	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 11.72
2031	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 11.16
2032	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 10.63
2033	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 10.12
2034	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 9.64
2035	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 9.18
2036	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 8.74
2037	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 8.33
2038	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 7.93
2039	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 7.55
2040	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 7.19
2041	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 6.85
2042	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 6.52
2043	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 6.21
2044	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 5.92
2045	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 5.64
2046	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 5.37
2047	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 5.11
2048	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 4.87
2049	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 4.64
2050	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 4.42
2051	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 4.21
2052	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 4.01
2053	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 3.81
2054	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 3.63
2055	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 3.46
2056	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 3.30
2057	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 3.14
2058	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 2.99
2059	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 2.85
2060	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 2.71
2061	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 2.58
2062	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 2.46
2063	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 2.34
2064	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 2.23
2065	194,800	174	6.04	861,036	$ 60,272	$ 22.00	$ 0.94	$ 1.420	$ 24.36	$ 2.12
								Total NPV of O&M Costs		**$ 358**

Capital Costs in million $:		Yr built		
RWTM	$ 714	2020		$ 559
Pumping Stations	$ 65	2020		$ 51
			Total NPV of Capital Costs	**$ 610**

Total NPV of Capital and O&M Costs in millions $ 968

NPV CALCULATIONS
ALCOA / CPS GROUNDWATER
CTRWTP - Alternate 1D - WTP East of San Antonio & ALCOA/CPS Water Ultimately to COA & LCRA

Initial year of analysis period	2015			Contingency =	20%
Interest rate	5%			Engineering, Legal, Admin. =	15%
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

Well Fields and Collection Lines

	ALCOA	CPS	Total
Year built	2015	2015	
Estimated Construction Cost in Millions			
Wells (Based on Non-Public Water Supply Wells)	32.97	12.51	45.48
Pipeline	13.03	5.94	18.97
Pump Stations & Storage	8.51	0	8.51
Subtotal	54.51	18.45	72.96
Contingency	10.90	3.69	14.59
Subtotal	65.41	22.14	87.55
Engineering, Legal & Administrative	8.18	2.77	10.94
Subtotal	73.59	24.91	98.50
Environmental & Archaeology Studies & Mitigation	0.63	0.2	0.83
Land Acquisition & Surveying	0	0	0.00
Groundwater Purchase	0	5.64	5.64
ALCOA Construction Program Management Fee	5.45	0	5.45
Interest During Construction (2 years, 6% int., 4% ret.)	5.89	2.44	8.33
Total Capital Cost	**85.56**	**33.19**	**118.75**
Estimated Annual O&M Costs			
O&M	0.67	0.18	0.85
Pumping Energy	2.41	0.52	2.93
ALCOA Project Management Fees	0.35	0.00	0.35
Purchase of Groundwater	2.00	0.00	2.00
Groundwater District Fees	0.65	0.25	0.90
Mitigation Reserves	0.28	0.11	0.39
Total Annual Cost	**6.36**	**1.06**	**7.42**

NPV of O&M Costs	$ 116	$ 19	$ 135	million
NPV of Capital Costs	$ 86	$ 33	$ 119	million
Total NPV of Capital and O&M Costs for Well Fields	**$ 202**	**$ 53**	**$ 254**	**million**

Cooling of Well Water

Total number of wells in both fields	120	wells	Approximate capacity per wel	300 gpm
Percentage of wells with temperatures > than ___ degrees	5%			36,000 gpm
Estimated number of wells with temperature > ____ degrees	6.0		Rough check	58,072 ac-ft/year

Estimated Capital Costs

Year built	2015	
Number of Packaged Cooling Towers (300 gpm capacity/each)	6.0	
Equipment cost (cooling towers and fans)	$ 60,000	
Installation and contractors mark-up	$ 50,000	
Structural slab	$ 30,000	
Electrical	$ 50,000	
Estimated Unit Construction Cost	$ 190,000	Each
Total construction cost	$ 1.14	million
Contingencies	$ 0.23	
Subtotal	$ 1.37	
Engineering, Legal and Admin	$ 0.21	
Total Estimated Capital Cost	$ 1.57	
NPV of Capital Costs	$ 1.57	million

Estimated O&M Costs

Value of equipment	$ 0.4	million
Assumed life of equipment	10	years
Estimated maintenance/replacement cost	$ 0.04	million/year
Blower Hp per cooling tower	10	Hp
	7	kw
Hours of operation	24	hours
Power consumption per cooling tower	179	kwh per day
	65,350	kwh per year
Power cost per cooling tower	$ 4,574	per year
Total power cost for all cooling towers in millions	$ 0.03	million per year
Regular operational checks and routine maintenance	$ 6,000	per month for all cooling towers
	$ 0.07	per year
Estimated O&M Cost	$ 0.14	million $ per year
NPV of O&M costs	$2.47	million $

Ground Water Transmission Main and Pump Station (Hwy 290 to Bastrop Intake)

None Req'd - flow in Big Sandy Creek

Water Treatment Plant (Iron & manganese removal)

Estimated capital cost	$	22.6	million	(From HDR 2004 update)
Year built		2015		
NPV of capital cost	$	22.6	million	
Estimated annual O&M costs	$	3.19	million	(From HDR 2004 update; 1/2 of O&M estimate; Table 2)
NPV of O&M costs		$58.2	million	

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Well Fields and Collection Lines (including tank and pump station at Hwy 290)	$ 118.7	$ 135.5	$ 254.2
Cooling Towers for Selected High Temperature Wells	$ 1.6	$ 2.5	$ 4.0
Ground Water Transmission Main and Pumping Station	$ -	$ -	$ -
Water Treatment Plant (Iron & manganese removal)	$ 22.6	$ 58.2	$ 80.8
Total for ALCOA-CPS	$ 142.9	$ 196.1	$ 339.1

Check only

49 mgd average production					
64 mgd peak	$	0.35	per gpd of capacity	$ 22.34	milion
17885 mg per year	$	200	per mg treated	3.58	milllion

O&M Cost Calculations
Surface WTP and Raw Water Storage Reservoir at WTP
CTRWTP - Alternate 1D - WTP East of San Antonio & ALCOA/CPS Water Ultimately to COA & LCRA

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition =	$ 25,000	per acre

Treated Water Production by Treatment Type (from Demand Chart - BE SURE TO CHECK)

	Year =	2015	2020	2030	2040	2050	2060	2065
Softened water demand:	Units							
None req'd		0	0	0	0	0	0	0
Non-softened water demands:	Year =	2015	2020	2030	2040	2050	2060	2065
	Units							
Average yearly demands:								
SAWS	ac-ft/yr	73000	205000	205000	205000	205000	205000	205000
SARA	ac-ft/yr	20550	23406	28433	31393	34411	37530	41128
GBRA	ac-ft/yr	0	0	6000	8000	10000	12300	12300
Totals		93550	228406	239433	244393	249411	254830	258428
Totals	mgd	84	204	214	218	223	227	231
Max day demands:								
SAWS	mgd	85	238	238	238	238	238	238
SARA	mgd	24	27	33	36	40	44	48
GBRA	mgd	0	0	5	7	9	11	11
Totals	mgd	109	265	276	281	287	293	297
Total: softened and non-softened water demands								
Average yearly demand	ac-ft/yr	93550	228406	239433	244393	249411	254830	258428
	mgd	84	204	214	218	223	227	231
Max day demand	mgd	109	265	276	281	287	293	297

Raw Water Reservoir

Sizing for ultimate conditions:

Assumed number of days of consecutive Max Day demands	30	days	
Design (Max. Day) treated water production req'd in mgd	297	mgd	
Average treated water production in mgd	231	mgd	(which is also equal to sum of ground and raw water that can be pumped to the WTP)
Difference (shortfall of raw water)	66	mgd	
Required storage reservoir for raw water	1,989	mg	
	6,105	ac-ft	
Add safety factor 25%	1,526	ac-ft	
Total storage required	7,631	ac-ft	
Total storage recommended	12,000	ac-ft	

Note: No. of days at average day demand (for example, for repair of RWTM A) = 33 days

	Quantity	Units	Volume/each (acre-feet)	Unit Cost ($/ac-ft))	Total Construction Cost	Contigency, Eng., etc.	Total Capital Cost
Reservoirs	1	each	12,000	$ 1,283	$ 15.4	$ 5.9	$ 21.3

Estimated average depth of reservoir	25	ft	
Surface area of reservoir	480	acres	
Ratio of total land area reqd to surface area of reservoir	1.10		
Total land area reqd for reservoirs	528	acres	

Envir & Archaeology, Surv, and Land Acq = 13.2
Total capital cost in millions = $ 34.5

Assumed life of reservoir	100	years	
Estimated replacement cost	$ 0.15	million/year	
Estimated maintenance	$ 0.04	million/year	Mowing, maintaining fences, etc.
Total	$ 0.19	million/year	
Year built	2015		
NPV of O&M costs	$ 3.5	million	
NPV of Capital costs	$ 34.5	million	
Total NPV of Capital and O&M Costs	$ 38.0	million	

WTP

Plant Phasing and Capital Costs:

Softening Treatment Trains

Year =	2015	2020	2030	2040	2050	2060	2065
Average treated water production in mgd	0	0	0	0	0	0	0
Design (Max. Day) treated water production req'd in mgd	0	0	0	0	0	0	0
Initial/additional Max day capacity built (mgd)							
Total capacity on line (must exceed Design Max Day Req'd)	0	0	0	0	0	0	0
Unit cost for max day treatment capacity ($/gpd of capacity)							
Estimated construction cost of expansion in $millions	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Non-softening Treatment Trains

Year =	2015	2020	2030	2040	2050	2060	2065
Average treated water production in mgd	84	204	214	218	223	227	231
Design (Max. Day) treated water production req'd in mgd	109	265	276	281	287	293	297
Additional Max day capacity built (mgd)	200	100					
Total capacity on line (must exceed Design Max Day Req'd)	200	300	300	300	300	300	300
Unit cost for max day treatment capacity ($/gpd of capacity)	$ 1.15	$ 1.32					
Estimated construction cost of expansion in $millions	$ 229.6	$ 131.5	$ -	$ -	$ -	$ -	$ -

Totals (Softening + Non-softening Trains)

Year =	2015	2020	2030	2040	2050	2060	2065
Total construction cost for both trains	$ 229.6	$ 131.5	$ -	$ -	$ -	$ -	$ -
Contingencies	45.9	26.3	-	-	-	-	-
Subtotal	$ 275.5	$ 157.8	$ -	$ -	$ -	$ -	$ -
Engineering, Legal, & Administrative	41.3	23.7	-	-	-	-	-
Subtotal	316.8	181.5	-	-	-	-	-
Environmental & Archaelogy Studies and Mitigation & Land Acquisition and Surveying (see Note below)	2.5						
Total estimated capital cost	$ 319.3	$ 181.5	$ -	$ -	$ -	$ -	$ -
NPV of capital cost	$ 319.3	$ 142.2	$ -	$ -	$ -	$ -	$ -
Total NPV of WTP initial construction & expansions	$ 461						

Note: Assumed land requirement for WTP (not including reservoir 100 acres

O&M Costs for Softening Trains:

Year	Plant Capacity in service	Estimated treated water production	Estimated O&M cost from unit cost curve		Net present value
	mgd of capacity	mgd produced	$ per mg treated	$million /year	($)
2015	-	-		$ -	$ -
2016	-	-		$ -	$ -
2017	-	-		$ -	$ -
2018	-	-		$ -	$ -
2019	-	-		$ -	$ -
2020	-	-		$ -	$ -
2021	-	-		$ -	$ -
2022	-	-		$ -	$ -
2023	-	-		$ -	$ -
2024	-	-		$ -	$ -
2025	-	-		$ -	$ -
2026	-	-		$ -	$ -
2027	-	-		$ -	$ -
2028	-	-		$ -	$ -
2029	-	-		$ -	$ -
2030	-	-		$ -	$ -
2031	-	-		$ -	$ -
2032	-	-		$ -	$ -
2033	-	-		$ -	$ -
2034	-	-		$ -	$ -
2035	-	-		$ -	$ -
2036	-	-		$ -	$ -
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2040	-	-		$ -	$ -
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2051	-	-		$ -	$ -
2052	-	-		$ -	$ -
2053	-	-		$ -	$ -
2054	-	-		$ -	$ -
2055	-	-		$ -	$ -
2056	-	-		$ -	$ -
2057	-	-		$ -	$ -
2058	-	-		$ -	$ -
2059	-	-		$ -	$ -
2060	-	-		$ -	$ -
2061	-	-		$ -	$ -
2062	-	-		$ -	$ -
2063	-	-		$ -	$ -
2064	-	-		$ -	$ -
2065	-	-		$ -	$ -
			Total NPV of O&M Costs		$ -

O&M Costs for Non-Softening Trains:

Year	Plant Capacity in service	Estimated treated water production	Estimated O&M cost from unit cost curve		Net present value
	mgd of capacity	mgd produced	$ per mg treated	$million /year	($)
2015	200	84	$ 374	$ 11.41	$ 11.41
2016	200	84	$ 374	$ 11.41	$ 10.87
2017	200	84	$ 374	$ 11.41	$ 10.35
2018	200	84	$ 374	$ 11.41	$ 9.86
2019	200	84	$ 374	$ 11.41	$ 9.39
2020	300	204	$ 343	$ 25.50	$ 19.98
2021	300	204	$ 343	$ 25.50	$ 19.03
2022	300	204	$ 343	$ 25.50	$ 18.12
2023	300	204	$ 343	$ 25.50	$ 17.26
2024	300	204	$ 343	$ 25.50	$ 16.44
2025	300	204	$ 343	$ 25.50	$ 15.65
2026	300	204	$ 343	$ 25.50	$ 14.91
2027	300	204	$ 343	$ 25.50	$ 14.20
2028	300	204	$ 343	$ 25.50	$ 13.52
2029	300	204	$ 343	$ 25.50	$ 12.88
2030	300	214	$ 343	$ 26.73	$ 12.86
2031	300	214	$ 343	$ 26.73	$ 12.24
2032	300	214	$ 343	$ 26.73	$ 11.66
2033	300	214	$ 343	$ 26.73	$ 11.11
2034	300	214	$ 343	$ 26.73	$ 10.58
2035	300	214	$ 343	$ 26.73	$ 10.07
2036	300	214	$ 343	$ 26.73	$ 9.59
2037	300	214	$ 343	$ 26.73	$ 9.14
2038	300	214	$ 343	$ 26.73	$ 8.70
2039	300	214	$ 343	$ 26.73	$ 8.29
2040	300	218	$ 343	$ 27.28	$ 8.06
2041	300	218	$ 343	$ 27.28	$ 7.67
2042	300	218	$ 343	$ 27.28	$ 7.31
2043	300	218	$ 343	$ 27.28	$ 6.96
2044	300	218	$ 343	$ 27.28	$ 6.63
2045	300	218	$ 343	$ 27.28	$ 6.31
2046	300	218	$ 343	$ 27.28	$ 6.01
2047	300	218	$ 343	$ 27.28	$ 5.73
2048	300	218	$ 343	$ 27.28	$ 5.45
2049	300	218	$ 343	$ 27.28	$ 5.19
2050	300	223	$ 343	$ 27.84	$ 5.05
2051	300	223	$ 343	$ 27.84	$ 4.81
2052	300	223	$ 343	$ 27.84	$ 4.58
2053	300	223	$ 343	$ 27.84	$ 4.36
2054	300	223	$ 343	$ 27.84	$ 4.15
2055	300	223	$ 343	$ 27.84	$ 3.95
2056	300	223	$ 343	$ 27.84	$ 3.77
2057	300	223	$ 343	$ 27.84	$ 3.59
2058	300	223	$ 343	$ 27.84	$ 3.42
2059	300	223	$ 343	$ 27.84	$ 3.25
2060	300	227	$ 343	$ 28.45	$ 3.17
2061	300	227	$ 343	$ 28.45	$ 3.02
2062	300	227	$ 343	$ 28.45	$ 2.87
2063	300	227	$ 343	$ 28.45	$ 2.74
2064	300	227	$ 343	$ 28.45	$ 2.60
2065	300	231	$ 343	$ 28.85	$ 2.52
				Total NPV of O&M Costs	$ 441

NPV Totals for O&M:

Softening trains	$ -
Non-softening Trains	$ 441
	$ 441

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Raw Water Reservoir	$ 34	$ 3.5	$ 38
Water Treatment Plant	$ 461	$ 441	$ 903
Totals	$ 496	$ 445	$ 941

Capital and O&M Cost Calculations
Potable Water Transmission Mains
CTRWTP - Alternate 1D - WTP East of San Antonio & ALCOA/CPS Water Ultimately to COA & LCRA

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

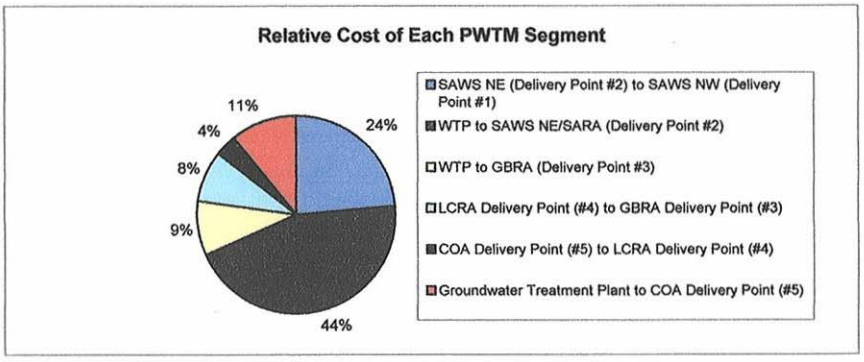
Summary of Demands

Average demands to be delivered in each segment in acre-feet/year

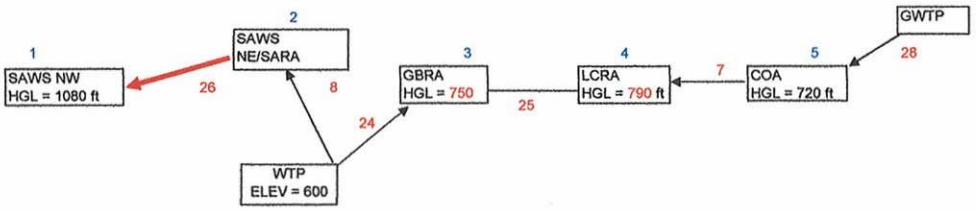
Year	2015	2020	2030	2040	2050	2060	2065
SAWS NW	33000	123000	123000	123000	123000	123000	123000
SAWS NE	22000	82000	82000	82000	82000	82000	82000
Subtotal	55000	205000	205000	205000	205000	205000	205000
SARA	0	23406	28433	31393	34411	37530	41128
GBRA			6000	8000	10000	12300	12300
LCRA			5600	11200	11200	11200	11200
COA			16802	22403	33604	33604	33604
Total	55000	228406	261835	277996	294215	299634	303232

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
SAWS NE (Delivery Point #2) to SAWS NW (Delivery Point #1)	$ 203	$ 5	$ 207
WTP to SAWS NE/SARA (Delivery Point #2)	$ 117	$ 276	$ 393
WTP to GBRA (Delivery Point #3)	$ 74	$ 5	$ 78
LCRA Delivery Point (#4) to GBRA Delivery Point (#3)	$ 60	$ 15	$ 75
COA Delivery Point (#5) to LCRA Delivery Point (#4)	$ 14	$ 17	$ 31
Groundwater Treatment Plant to COA Delivery Point (#5)	$ 75	$ 21	$ 95
Total for PWTMs	$ 541	$ 338	$ 880



SAWS NE (Delivery Point #2) to SAWS NW (Delivery Point #1)
(Bold line in schematic below)



Demands for this pipe segment

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
SAWS NW	29	110	110	110	110	110	110	1.3
Total	29	110	110	110	110	110	110	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
SAWS NW	38	143	143	143	143	143	143
Total	38	143	143	143	143	143	143

PWTM and Pump Station Costs

Design flow rate - year 2065	143	mgd	
	99,125	gpm	
Pumping capacity of one pump	20,000	gpm	
No. of pumps (not counting spare)	5		
Peak flow rate (all pumps except spare)	100,000	gpm	
Inside diameter of PWTM	120	in.	
Area	78.54	sf	
Length of RWTM	26	miles	(linked to mileage in schematic above)
	137,280	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	15%	20,592	$ 783	$ 16.1	million
Rural - rock	50%	68,640	$ 1,048	$ 72.0	
Urban - rock	35%	48,048	$ 1,186	$ 57.0	
		137,280		$ 145.0	million
Average estimated unit construction cost for PWTM			$ 1,057	per LF	

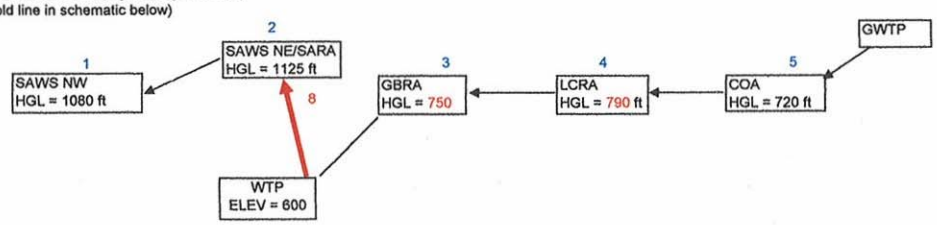
Total construction cost in millions		$ 145.0		
Contingencies		$ 29.0		
Subtotal		$ 174.0		
Engineering, Legal & Administrative		$ 26.1		
Subtotal		$ 200.2		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq		$ 2.6		
Total Capital Cost for PWTM in millions		$ 202.8		
Unit maintenance cost/year-mile		$ 10,000	$/year-mile	$ 0.260 Million $/year
Velocity at peak flow rate		2.84	fps	
C factor		120		
Head loss per foot		0.00020	ft/ft	$h_f = \frac{3.552*Q}{C*(d)^{2.63}}^{1.85}$
		1.07	ft/mile	
Head loss at peak flow rate		28	ft	
Allowance for minor losses	20%	6	ft	1080 Desired HGL At Delivery Point
Total estimated losses		33	ft	1125 HGL At Delivery Point 2
Average static head		-45	ft	-45 ft
Total estimated dynamic head		-12	ft	
		-5	psi	

Negative indicates gravity flow from #2 to #1; no pumping necessary.

			Million $
Annual O&M Cost in million $:		Yr built	
PWTM	$ 0.260	2015	
Total NPV of O&M Costs			$4.7
Capital Costs in million $:		Yr built	
PWTM	$ 202.8	2015	
			$ 202.8
Total NPV of Capital Costs			$ 202.8
Total NPV of Capital and O&M Costs in millions			**$ 207.5**

SAWS NE (Delivery Point #2) to SAWS NW (Delivery Point #1)

WTP to SAWS NE/SARA (Delivery Point #2)
(Bold line in schematic below)



Demands for this pipe segment

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
SAWS NW	29	110	110	110	110	110	110	1.3
SAWS NE	20	73	73	73	73	73	73	1.3
SARA	0	21	25	28	31	34	37	1.3
Total	49	204	208	211	214	217	220	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
SAWS NW	38	143	143	143	143	143	143
SAWS NE	26	95	95	95	95	95	95
SARA	0	27	33	36	40	44	48
Total	64	265	271	274	278	281	286

PWTM and Pump Station Costs

Design flow rate - year 2065	286	mgd	
	198,353	gpm	
Pumping capacity of one pump	20,000	gpm	
No. of pumps (not counting spare)	10		
Peak flow rate (all pumps except spare)	200,000	gpm	
Inside diameter of PWTM	120	in.	
Area	78.54	sf	
Length of PWTM	8	miles	(linked to mileage in schematic above)
	42,240	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	25%	10,560	$ 783	$ 8.3	million
Rural - rock	50%	21,120	$ 1,048	$ 22.1	
Urban - rock	25%	10,560	$ 1,186	$ 12.5	
		42,240		$ 42.9	million
Average estimated unit construction cost for PWTM			$ 1,016	per LF	

Total construction cost in millions	$	42.9		
Contingencies	$	8.6		
Subtotal	$	51.5		
Engineering, Legal & Administrative	$	7.7		
Subtotal	$	59.2		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$	0.8		
Total Capital Cost for PWTM in millions	$	60.0		
Unit maintenance cost/year-mile	$	10,000	$/year-mile	$ 0.080 Million $/year

Velocity at peak flow rate		5.67	fps	
C factor		120		
Head loss per foot		0.00073	ft/ft	$h_f = \frac{3.552 * Q^{1.85}}{C^{*}(d)^{2.63}}$
		3.85	ft/mile	
Head loss at peak flow rate		31	ft	
Allowance for minor losses	20%	6	ft	1125 Desired HGL At Delivery Point
Total estimated losses		37	ft	600 Elev. At WTP
Average static head		525	ft	525 ft
Total estimated dynamic head		562	ft	
		244	psi	
No of recommended pumping stations along route		1.62		150 psi (assumed max pressure
No. of pumping stations used in cost estimate		2		in pipe)
Average head per pump station		281	ft	
Assumed pump efficiency		85%		
Assumed motor efficiency		90%		
Estimated Hp required per pump		1,855	hp/pump	
		1,384	kw/pump	
Total hp per pump station (not counting spare)		18,549	firm hp/station	
Total kw per pump set (set=pumps in series along route)		3,710	kw/pump set	(one pump at each station)
Unit construction cost for each pump station (from cost curve)	$	1,105	per firm hp of pump station	
Construction cost per pump station		20.5	million	
Total construction cost for pump stations		41.0	for 2	pump stations

Contingencies	$	8.2	
Subtotal	$	49.2	
Engineering, Legal & Administrative	$	7.4	
Total capital cost for pump stations in millions	$	56.6	million
			40% Equip cost as % of constr cost
Value of equipment	$	16	million
Assumed life of equipment		20	years
Estimated maintenance/replacement cost	$	0.82	million/year

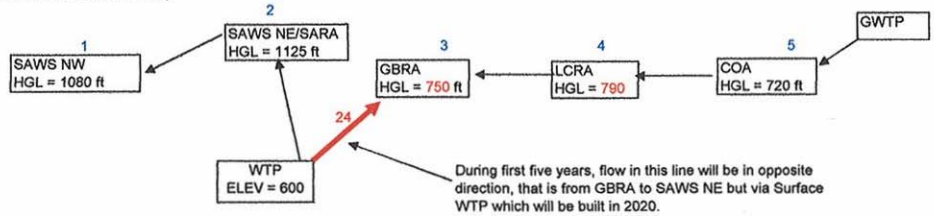
O&M Costs

Year	Flow pumped by year (average flows from Table above)	No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - PWTM	Total O&M cost	Net present value
	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	49	1.70	151,788	$ 10,625	$ 3.88	$ 0.82	$ 0.080	$ 4.78	$ 4.78
2016	49	1.70	151,788	$ 10,625	$ 3.88	$ 0.82	$ 0.080	$ 4.78	$ 4.55
2017	49	1.70	151,788	$ 10,625	$ 3.88	$ 0.82	$ 0.080	$ 4.78	$ 4.33
2018	49	1.70	151,788	$ 10,625	$ 3.88	$ 0.82	$ 0.080	$ 4.78	$ 4.13
2019	49	1.70	151,788	$ 10,625	$ 3.88	$ 0.82	$ 0.080	$ 4.78	$ 3.93
2020	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 13.32
2021	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 12.69
2022	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 12.09
2023	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 11.51
2024	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 10.96
2025	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 10.44
2026	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 9.94
2027	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 9.47
2028	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 9.02
2029	204	7.08	630,351	$ 44,125	$ 16.11	$ 0.82	$ 0.080	$ 17.01	$ 8.59
2030	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 8.35
2031	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 7.95
2032	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 7.57
2033	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 7.21
2034	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 6.87
2035	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 6.54
2036	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 6.23
2037	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 5.93
2038	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 5.65
2039	208	7.24	644,225	$ 45,096	$ 16.46	$ 0.82	$ 0.080	$ 17.36	$ 5.38
2040	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 5.19
2041	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 4.94
2042	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 4.71
2043	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 4.48
2044	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 4.27
2045	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 4.06
2046	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 3.87
2047	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 3.69
2048	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 3.51
2049	211	7.33	652,394	$ 45,668	$ 16.67	$ 0.82	$ 0.080	$ 17.57	$ 3.34
2050	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 3.22
2051	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 3.07
2052	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 2.92
2053	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 2.78
2054	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 2.65
2055	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 2.53
2056	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 2.41
2057	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 2.29
2058	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 2.18
2059	214	7.42	660,723	$ 46,251	$ 16.88	$ 0.82	$ 0.080	$ 17.78	$ 2.08
2060	217	7.52	669,331	$ 46,853	$ 17.10	$ 0.82	$ 0.080	$ 18.00	$ 2.00
2061	217	7.52	669,331	$ 46,853	$ 17.10	$ 0.82	$ 0.080	$ 18.00	$ 1.91
2062	217	7.52	669,331	$ 46,853	$ 17.10	$ 0.82	$ 0.080	$ 18.00	$ 1.82
2063	217	7.52	669,331	$ 46,853	$ 17.10	$ 0.82	$ 0.080	$ 18.00	$ 1.73
2064	217	7.52	669,331	$ 46,853	$ 17.10	$ 0.82	$ 0.080	$ 18.00	$ 1.65
2065	220	7.63	679,260	$ 47,548	$ 17.36	$ 0.82	$ 0.080	$ 18.26	$ 1.59
								Total NPV of O&M Costs	$ 276.4

Capital Costs in million $:			Yr built		
PWTM	$	60.0	2015		$ 60.0
Pumping Stations	$	56.6	2015		$ 56.6
				Total NPV of Capital Costs	$ 116.6

Total NPV of Capital and O&M Costs in millions $ 393
WTP to SAWS NE/SARA (Delivery Point #2)

WTP to GBRA (Delivery Point #3)
(Bold line in schematic below)



Ultimate demands for this pipe segment

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
GBRA	0	0	5	7	9	11	11	2.0
Total	0	0	5	7	9	11	11	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
GBRA	0	0	11	14	18	22	22
Total	0	0	11	14	18	22	22

However, during first 5 years, average demand will be 55,000 acre feet or = 49 mgd
Peak demand will be 1.3 times 64 mgd

PWTM and Pump Station Costs

Design flow rate - year 2015 flow is greater than 2065 flow	64	mgd	
	44,324	gpm	
Pumping capacity of one pump	9,000	gpm	
No. of pumps (not counting spare)	5		
Peak flow rate (all pumps except spare)	45,000	gpm	
Inside diameter of PWTM	72	in.	
Area	28.27	sf	
Length of RWTM	24	miles	(linked to mileage in schematic above)
	126,720	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	100%	126,720	$ 365	$ 46.3	million
Rural - rock	0%	-	$ 498	$ -	
Urban - rock	0%	-	$ 552	$ -	
		126,720		$ 46.3	million
Average estimated unit construction cost for PWTM			$ 365	per LF	

Total construction cost in millions	$ 46.3		
Contingencies	$ 9.3		
Subtotal	$ 55.6		
Engineering, Legal & Administrative	$ 8.3		
Subtotal	$ 63.9		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 2.4		
Total Capital Cost for PWTM in millions	$ 66.3		
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.240 Million $/year
Velocity at peak flow rate	3.55	fps	
C factor	120		
Head loss per foot	0.00055	ft/ft	$h_f = \frac{3.552*Q}{C*(d)^{2.63}}^{1.85}$
	2.92	ft/mile	
Head loss at peak flow rate	70	ft	
Allowance for minor losses 20%	14	ft	750 Desired HGL At Delivery Point
Total estimated losses	84	ft	600 Elev. At WTP
Average static head	150	ft	150 ft
Total estimated dynamic head	234	ft	
	102	psi	
No of recommended pumping stations along route	0.68		150 psi (assumed max pressure
No. of pumping stations used in cost estimate	1		in pipe)
Average head per pump station	234	ft	
Assumed pump efficiency	85%		
Assumed motor efficiency	90%		
Estimated Hp required per pump	696	hp/pump	
	519	kw/pump	
Total hp per pump station (not counting spare)	3,479	hp/station	
Total kw per pump set (set=pumps in series along route)	696	kw/pump set	(one pump at each station)
Unit construction cost for each pump station (from cost curve)	$ 1,514	per firm hp of pump station	
Construction cost per pump station	5.3	million	
Total construction cost for pump stations	5.3	for 1	pump stations
Contingencies	$ 1.1		

Subtotal	$	6.3	
Engineering, Legal & Administrative	$	0.9	
Total capital cost for pump stations	$	7.3	million
			40% Equip cost as % of constr cost
Value of equipment	$	2.1	million
Assumed life of equipment		20	years
Estimated maintenance/replacement cost	$	0.11	million/year

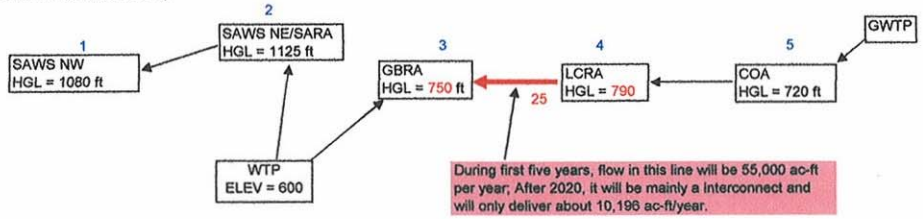
O&M Costs

Year	Flow pumped by year (average flows from Table above)	No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - PWTM	Total O&M cost	Net present value
	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015							$ 0.240	$ 0.24	$ 0.24
2016							$ 0.240	$ 0.24	$ 0.23
2017							$ 0.240	$ 0.24	$ 0.22
2018							$ 0.240	$ 0.24	$ 0.21
2019							$ 0.240	$ 0.24	$ 0.20
2020							$ 0.240	$ 0.24	$ 0.19
2021							$ 0.240	$ 0.24	$ 0.18
2022							$ 0.240	$ 0.24	$ 0.17
2023							$ 0.240	$ 0.24	$ 0.16
2024							$ 0.240	$ 0.24	$ 0.15
2025							$ 0.240	$ 0.24	$ 0.15
2026							$ 0.240	$ 0.24	$ 0.14
2027							$ 0.240	$ 0.24	$ 0.13
2028							$ 0.240	$ 0.24	$ 0.13
2029							$ 0.240	$ 0.24	$ 0.12
2030							$ 0.240	$ 0.24	$ 0.12
2031		Flow is by gravity in opposite direction					$ 0.240	$ 0.24	$ 0.11
2032							$ 0.240	$ 0.24	$ 0.10
2033							$ 0.240	$ 0.24	$ 0.10
2034							$ 0.240	$ 0.24	$ 0.09
2035							$ 0.240	$ 0.24	$ 0.09
2036							$ 0.240	$ 0.24	$ 0.09
2037							$ 0.240	$ 0.24	$ 0.08
2038							$ 0.240	$ 0.24	$ 0.08
2039							$ 0.240	$ 0.24	$ 0.07
2040							$ 0.240	$ 0.24	$ 0.07
2041							$ 0.240	$ 0.24	$ 0.07
2042							$ 0.240	$ 0.24	$ 0.06
2043							$ 0.240	$ 0.24	$ 0.06
2044							$ 0.240	$ 0.24	$ 0.06
2045							$ 0.240	$ 0.24	$ 0.06
2046							$ 0.240	$ 0.24	$ 0.05
2047							$ 0.240	$ 0.24	$ 0.05
2048							$ 0.240	$ 0.24	$ 0.05
2049							$ 0.240	$ 0.24	$ 0.05
2050							$ 0.240	$ 0.24	$ 0.04
2051							$ 0.240	$ 0.24	$ 0.04
2052							$ 0.240	$ 0.24	$ 0.04
2053							$ 0.240	$ 0.24	$ 0.04
2054							$ 0.240	$ 0.24	$ 0.04
2055							$ 0.240	$ 0.24	$ 0.03
2056							$ 0.240	$ 0.24	$ 0.03
2057							$ 0.240	$ 0.24	$ 0.03
2058							$ 0.240	$ 0.24	$ 0.03
2059							$ 0.240	$ 0.24	$ 0.03
2060	11	0.85	14,150	$ 990	$ 0.36	$ 0.11	$ 0.240	$ 0.71	$ 0.08
2061	11	0.85	14,150	$ 990	$ 0.36	$ 0.11	$ 0.240	$ 0.71	$ 0.07
2062	11	0.85	14,150	$ 990	$ 0.36	$ 0.11	$ 0.240	$ 0.71	$ 0.07
2063	11	0.85	14,150	$ 990	$ 0.36	$ 0.11	$ 0.240	$ 0.71	$ 0.07
2064	11	0.85	14,150	$ 990	$ 0.36	$ 0.11	$ 0.240	$ 0.71	$ 0.06
2065	11	0.85	14,150	$ 990	$ 0.36	$ 0.11	$ 0.240	$ 0.71	$ 0.06
								Total NPV of O&M Costs	$ 4.9

Capital Costs in million $:			Yr built		
PWTM	$	66	2015		$ 66.3
Pumping Stations	$	7	2015		$ 7.3
				Total NPV of Capital Costs	$ 73.6

Total NPV of Capital and O&M Costs in millions $ 78.5
WTP to GBRA (Delivery Point #3)

LCRA Delivery Point (#4) to GBRA Delivery Point (#3)
(Bold line in schematic below)



Ultimate demands for this pipe segment

55000 ac-ft = 49 mgd
10196 ac-ft = 9 mgd

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
To SAWS	49	9	9	9	9	9	9	1.3
Total	49	9	9	9	9	9	9	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
To SAWS	64	12	12	12	12	12	12
Total	64	12	12	12	12	12	12

PWTM and Pump Station Costs

Design flow rate - year 2015 flow is greater than 2065 flow: 64 mgd; 44,324 gpm

Pumping capacity of one pump: 9,000 gpm
No. of pumps (not counting spare): 5
Peak flow rate (all pumps except spare): 45,000 gpm

Inside diameter of PWTM: 60 in.
Area: 19.64 sf
Length of RWTM: 25 miles (linked to mileage in schematic above); 132,000 feet

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	100%	132,000	$ 282	$ 37.3	million
Rural - rock	0%	-	$ 388	$ -	
Urban - rock	0%	-	$ 427	$ -	
		132,000		$ 37.3	million

Average estimated unit construction cost for PWTM: $ 282 per LF

Total construction cost in millions	$	37.3
Contingencies	$	7.5
Subtotal	$	44.7
Engineering, Legal & Administrative	$	6.7
Subtotal	$	51.4
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$	2.5
Total Capital Cost for PWTM in millions	$	53.9

Unit maintenance cost/year-mile: $ 10,000 $/year-mile; $ 0.250 Million $/year

Velocity at peak flow rate: 5.11 fps
C factor: 120
Head loss per foot: 0.00135 ft/ft; 7.10 ft/mile

$$h_f = \left| \frac{3.552 * Q}{C * (d)^{2.63}} \right|^{1.85}$$

Head loss at peak flow rate: 178 ft
Allowance for minor losses: 20%; 36 ft
Total estimated losses: 213 ft
Average static head: -40 ft
Total estimated dynamic head: 173 ft; 75 psi

750 Elev. At Delivery Point 3
790 Elev. At Delivery Point 4
-40 ft

No of recommended pumping stations along route: 0.50
No. of pumping stations used in cost estimate: 1
Average head per pump station: 173 ft

150 psi (assumed max pressure in pipe)

Assumed pump efficiency: 85%
Assumed motor efficiency: 90%
Estimated Hp required per pump: 514 hp/pump; 384 kw/pump
Total hp per pump station (not counting spare): 2,571 firm hp/station
Total kw per pump set (set=pumps in series along route): 514 kw/pump set (one pump at each station)

Unit construction cost for each pump station (from cost curve): $ 1,588 per firm hp of pump station
Construction cost per pump station: 4.1 million

Total construction cost for pump stations: 4.1 for 1 pump stations

Contingencies	$	0.8
Subtotal	$	4.9
Engineering, Legal & Administrative	$	0.7

Total capital cost for pump stations	$	5.6	million
		40%	Equip cost as % of constr cost
Value of equipment	$	1.6	million
Assumed life of equipment		20	years
Estimated maintenance/replacement cost	$	0.08	million/year

O&M Costs

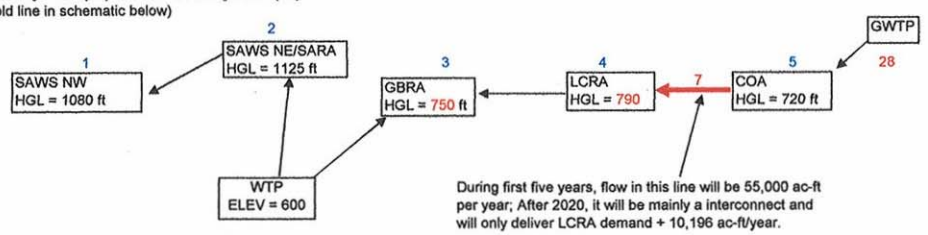
Year	Flow pumped by year (average flows from Table above)	No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - PWTM	Total O&M cost	Net present value
	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	49	3.79	46,745	$ 3,272	$ 1.19	$ 0.08	$ 0.250	$ 1.53	$ 1.53
2016	49	3.79	46,745	$ 3,272	$ 1.19	$ 0.08	$ 0.250	$ 1.53	$ 1.45
2017	49	3.79	46,745	$ 3,272	$ 1.19	$ 0.08	$ 0.250	$ 1.53	$ 1.38
2018	49	3.79	46,745	$ 3,272	$ 1.19	$ 0.08	$ 0.250	$ 1.53	$ 1.32
2019	49	3.79	46,745	$ 3,272	$ 1.19	$ 0.08	$ 0.250	$ 1.53	$ 1.26
2020	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.43
2021	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.41
2022	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.39
2023	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.37
2024	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.36
2025	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.34
2026	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.32
2027	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.31
2028	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.29
2029	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.28
2030	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.27
2031	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.25
2032	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.24
2033	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.23
2034	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.22
2035	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.21
2036	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.20
2037	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.19
2038	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.18
2039	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.17
2040	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.16
2041	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.16
2042	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.15
2043	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.14
2044	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.13
2045	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.13
2046	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.12
2047	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.12
2048	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.11
2049	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.11
2050	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.10
2051	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.10
2052	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.09
2053	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.09
2054	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.08
2055	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.08
2056	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.07
2057	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.07
2058	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.07
2059	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.06
2060	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.06
2061	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.06
2062	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.06
2063	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.05
2064	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.05
2065	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.05
							Total NPV of O&M Costs		$ 15.1

Capital Costs in million $:		Yr built		
PWTM	$ 53.9	2015		$ 53.9
Pumping Stations	$ 5.6	2015		$ 5.6
			Total NPV of Capital Costs	$ 59.6

Total NPV of Capital and O&M Costs in millions $ 75

LCRA Delivery Point (#4) to GBRA Delivery Point (#3)

COA Delivery Point (#5) to LCRA Delivery Point (#4)
(Bold line in schematic below)



Demands for this pipe segment

55000	ac-ft =	49	mgd
10196	ac-ft =	9	mgd

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
LCRA	0	0	5	10	10	10	10	2.0
To SAWS	49	9	9	9	9	9	9	1.3
Total	49	9	14	19	19	19	19	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
LCRA	0	0	10	20	20	20	20
To SAWS	64	12	12	12	12	12	12
Total	64	12	22	32	32	32	32

To SAWS

PWTM and Pump Station Costs

Design flow rate - year 2015 flow is greater than 2065 flow	64	mgd	
	44,324	gpm	
Pumping capacity of one pump	9,000	gpm	
No. of pumps (not counting spare)	5		
Peak flow rate (all pumps except spare)	45,000	gpm	
Inside diameter of PWTM	60	in.	
Area	19.64	sf	
Length of PWTM	7	miles	(linked to mileage in schematic above)
	36,960	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	100%	36,960	$ 282	$ 10.4	million
Rural - rock	0%	-	$ 388	$ -	
Urban - rock	0%	-	$ 427	$ -	
		36,960		$ 10.4	million

Average estimated unit construction cost for PWTM $ 282 per LF

Total construction cost in millions	$	10.4
Contingencies	$	2.1
Subtotal	$	12.5
Engineering, Legal & Administrative	$	1.9
Subtotal	$	14.4
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$	0.0
Total Capital Cost for PWTM in millions	$	14.4

Unit maintenance cost/year-mile $ 10,000 $/year-mile $ 0.070 Million $/year

Velocity at peak flow rate	5.03	fps	
C factor	120		
Head loss per foot	0.00131	ft/ft	$h_f = \frac{3.552*Q}{C*(d)^{2.63}}^{1.85}$
	6.91	ft/mile	

Head loss at peak flow rate		48	ft	
Allowance for minor losses	20%	10	ft	790 Elev. At Delivery Point 4
Total estimated losses		58	ft	720 Elev. At Delivery Point 5
Average static head		70	ft	70 ft
Total estimated dynamic head		128	ft	
		55	psi	

No of recommended pumping stations along route	0.37		150 psi (assumed max pressure
No. of pumping stations used in cost estimate	1		in pipe)
Average head per pump station	128	ft	
Assumed pump efficiency	85%		
Assumed motor efficiency	90%		
Estimated Hp required per pump	380	hp/pump	
	284	kw/pump	
Total hp per pump station (not counting spare)	1,901	firm hp/station	
Total kw per pump set (set=pumps in series along route)	380	kw/pump set	(one pump at each station)

Unit construction cost for each pump station (from cost curve)	$ 1,661	per firm hp of pump station	
Construction cost per pump station	3.2	million	
Total construction cost for pump stations	3.2	for 1	pump stations
Contingencies	$ 0.6		
Subtotal	$ 3.8		
Engineering, Legal & Administrative	$ 0.6		

Total capital cost for pump stations	$	4.4	million
		40%	Equip cost as % of constr cost
Value of equipment	$	1.3	million
Assumed life of equipment		20	years
Estimated maintenance/replacement cost	$	0.06	million/year

O&M Costs

Year	Flow pumped by year (average flows from Table above)	No. of pump "sets" operating /day	Energy used	Energy cost	Other O&M costs - Pump Stations	Maintenance costs - PWTM	Total O&M cost	Net present value
	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	49	3.79	46,745	$ 3,272	$ 1.19	$ 0.08	$ 0.250	$ 1.53	$ 1.53
2016	49	3.79	46,745	$ 3,272	$ 1.19	$ 0.08	$ 0.250	$ 1.53	$ 1.45
2017	49	3.79	46,745	$ 3,272	$ 1.19	$ 0.08	$ 0.250	$ 1.53	$ 1.38
2018	49	3.79	46,745	$ 3,272	$ 1.19	$ 0.08	$ 0.250	$ 1.53	$ 1.32
2019	49	3.79	46,745	$ 3,272	$ 1.19	$ 0.08	$ 0.250	$ 1.53	$ 1.26
2020	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.43
2021	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.41
2022	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.39
2023	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.37
2024	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.36
2025	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.34
2026	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.32
2027	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.31
2028	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.29
2029	9	0.70	8,666	$ 607	$ 0.22	$ 0.08	$ 0.250	$ 0.55	$ 0.28
2030	14	1.09	13,425	$ 940	$ 0.34	$ 0.08	$ 0.250	$ 0.67	$ 0.32
2031	14	1.09	13,425	$ 940	$ 0.34	$ 0.08	$ 0.250	$ 0.67	$ 0.31
2032	14	1.09	13,425	$ 940	$ 0.34	$ 0.08	$ 0.250	$ 0.67	$ 0.29
2033	14	1.09	13,425	$ 940	$ 0.34	$ 0.08	$ 0.250	$ 0.67	$ 0.28
2034	14	1.09	13,425	$ 940	$ 0.34	$ 0.08	$ 0.250	$ 0.67	$ 0.27
2035	14	1.09	13,425	$ 940	$ 0.34	$ 0.08	$ 0.250	$ 0.67	$ 0.25
2036	14	1.09	13,425	$ 940	$ 0.34	$ 0.08	$ 0.250	$ 0.67	$ 0.24
2037	14	1.09	13,425	$ 940	$ 0.34	$ 0.08	$ 0.250	$ 0.67	$ 0.23
2038	14	1.09	13,425	$ 940	$ 0.34	$ 0.08	$ 0.250	$ 0.67	$ 0.22
2039	14	1.09	13,425	$ 940	$ 0.34	$ 0.08	$ 0.250	$ 0.67	$ 0.21
2040	19	1.47	18,185	$ 1,273	$ 0.46	$ 0.08	$ 0.250	$ 0.80	$ 0.24
2041	19	1.47	18,185	$ 1,273	$ 0.46	$ 0.08	$ 0.250	$ 0.80	$ 0.22
2042	19	1.47	18,185	$ 1,273	$ 0.46	$ 0.08	$ 0.250	$ 0.80	$ 0.21
2043	19	1.47	18,185	$ 1,273	$ 0.46	$ 0.08	$ 0.250	$ 0.80	$ 0.20
2044	19	1.47	18,185	$ 1,273	$ 0.46	$ 0.08	$ 0.250	$ 0.80	$ 0.19
2045	19	1.47	18,185	$ 1,273	$ 0.46	$ 0.08	$ 0.250	$ 0.80	$ 0.18
2046	19	1.47	18,185	$ 1,273	$ 0.46	$ 0.08	$ 0.250	$ 0.80	$ 0.18
2047	19	1.47	18,185	$ 1,273	$ 0.46	$ 0.08	$ 0.250	$ 0.80	$ 0.17
2048	19	1.47	18,185	$ 1,273	$ 0.46	$ 0.08	$ 0.250	$ 0.80	$ 0.16
2049	19	1.47	18,185	$ 1,273	$ 0.46	$ 0.08	$ 0.250	$ 0.80	$ 0.15
2050	19	1.47	18,185	$ 1,273	$ 0.46	$ 0.08	$ 0.250	$ 0.80	$ 0.14
2051	19	1.47	18,185	$ 1,273	$ 0.46	$ 0.08	$ 0.250	$ 0.80	$ 0.14
2052	19	1.47	18,185	$ 1,273	$ 0.46	$ 0.08	$ 0.250	$ 0.80	$ 0.13
2053	19	1.47	18,185	$ 1,273	$ 0.46	$ 0.08	$ 0.250	$ 0.80	$ 0.12
2054	19	1.47	18,185	$ 1,273	$ 0.46	$ 0.08	$ 0.250	$ 0.80	$ 0.12
2055	19	1.47	18,185	$ 1,273	$ 0.46	$ 0.08	$ 0.250	$ 0.80	$ 0.11
2056	19	1.47	18,185	$ 1,273	$ 0.46	$ 0.08	$ 0.250	$ 0.80	$ 0.11
2057	19	1.47	18,185	$ 1,273	$ 0.46	$ 0.08	$ 0.250	$ 0.80	$ 0.10
2058	19	1.47	18,185	$ 1,273	$ 0.46	$ 0.08	$ 0.250	$ 0.80	$ 0.10
2059	19	1.47	18,185	$ 1,273	$ 0.46	$ 0.08	$ 0.250	$ 0.80	$ 0.09
2060	19	1.47	18,185	$ 1,273	$ 0.46	$ 0.08	$ 0.250	$ 0.80	$ 0.09
2061	19	1.47	18,185	$ 1,273	$ 0.46	$ 0.08	$ 0.250	$ 0.80	$ 0.08
2062	19	1.47	18,185	$ 1,273	$ 0.46	$ 0.08	$ 0.250	$ 0.80	$ 0.08
2063	19	1.47	18,185	$ 1,273	$ 0.46	$ 0.08	$ 0.250	$ 0.80	$ 0.08
2064	19	1.47	18,185	$ 1,273	$ 0.46	$ 0.08	$ 0.250	$ 0.80	$ 0.07
2065	19	1.47	18,185	$ 1,273	$ 0.46	$ 0.08	$ 0.250	$ 0.80	$ 0.07
							Total NPV of O&M Costs	$ 16.6

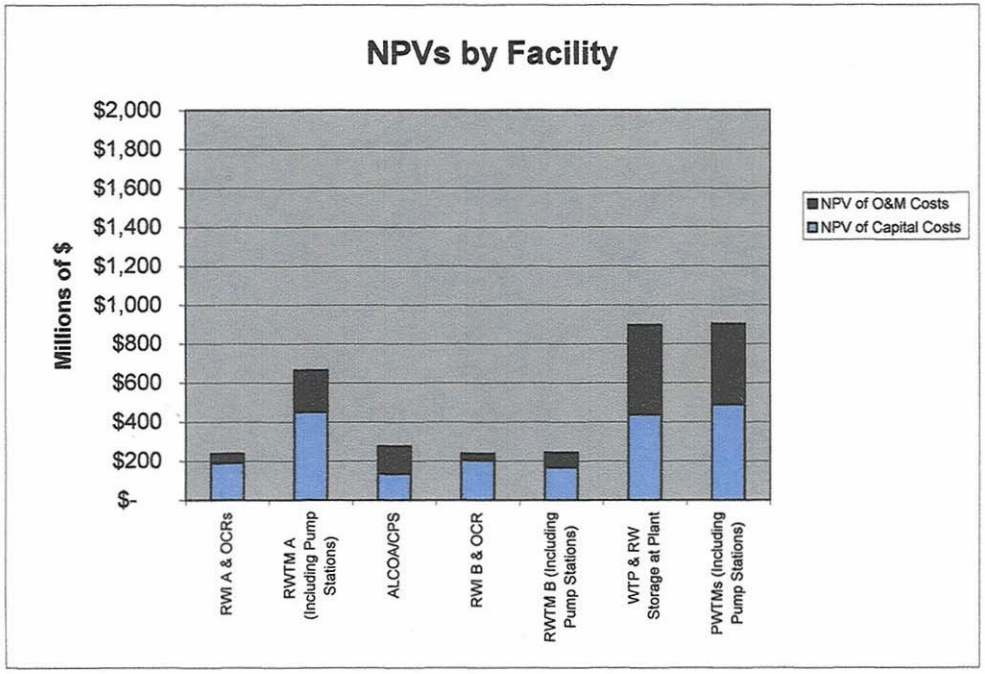
Capital Costs in million $:			Yr built		
PWTM	$	14.4	2015		$ 14.4
Pumping Stations	$	4.4	2015		$ 4.4
				Total NPV of Capital Costs	$ 14.4

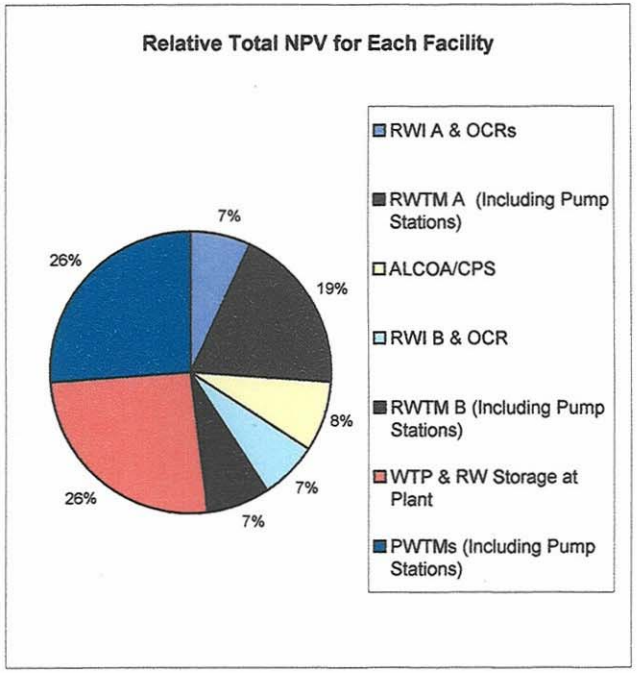
Total NPV of Capital and O&M Costs in millions $ 31.0

COA Delivery Point (#5) to LCRA Delivery Point (#4)

CTRWTP - Alternate 2A - WTP East of San Marcos

WTP Location	Alter-nate	Phasing Scenario	Total NPVs in Millions of $	RWI A & OCRs	RWTM A (Including Pump Stations)	ALCOA/CPS	RWI B & OCR	RWTM B (Including Pump Stations)	WTP & RW Storage at Plant	PWTMs (Including Pump Stations)
East of San Marcos	2A	RWTM B & ALCOA/CPS built by 2015; RWTM A built in 2020.		Sized for 4000 cfs to scalp water; 4 intakes, 4 miles of 120-inch raw water mains & 4 OCRs at 25,000 ac-ft each	126 miles of 96-inch diameter pipe sized to deliver 132,000 ac-ft/year on a continuous basis; includes 3 pumping stations w/ balancing reservoirs along route	Non-Public wells; Transmission of 55,000 ac-ft/year to the OCR at RWI B via 15 miles of 54" gravity pipeline from Hwy 290 east of Elgin	Sized for 2000 cfs to scalp water; 2 intakes; 8 miles of 120-inch raw water main, 4 OCRs at 15,000 ac-ft/each	Sized for 117,804 ac-ft/yr; 36 miles of 96" pipeline with one pumping station and balancing reservoir	Raw water reservoir w/ 11,000 ac-ft capacity; Conventional settling with membrane filtration for all participants (NO SOFTENING PROVIDED)	Each PWTM sized for BASE DEMAND (average daily demand) (See PWTM Summary Sheet in the Appendices)
		NPV of Capital Costs	$ 2,076	$ 191	$ 451	$ 135	$ 204	$ 168	$ 439	$ 489
		NPV of O&M Costs	$ 1,381	$ 47	$ 213	$ 141	$ 34	$ 75	$ 457	$ 413
		Total NPV of Capital & O&M	**$ 3,457**	$ 238	$ 664	$ 276	$ 238	$ 243	$ 896	$ 902





O&M Cost Calculations
RWI A - Matagorda Co. River Intakes, and Storage
CTRWTP - Alternate 2A - WTP East of San Marcos

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile
			or =	$ 5,000	per acre

Inflatable Rubber Low Head Dam

	Quantity	Units	Size	Unit Constr. Cost (millions)	Total Estimated Constr. Cost (millions)	Contigency, Eng., etc. (millions)	Total Capital Cost (millions)
Inflatable Rubber Low Head Dam	4	each	10 ft high	$ 2.25	$ 9.00	$ 3.42	$ 12.42

Estimated inflatable dam cost as % of total	50%	
Value of inflatable dam	$ 4.50	million
Assumed life of inflatable dam	10	years
Estimated maintenance/replacement cost	$ 0.45	million/year
Year built	2020	
NPV of O&M Costs	$6.27	million
NPV of Capital Costs	$ 9.73	million
Total NPV of Capital and O&M Costs	$16.00	million

Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)

Average withdrawal	132,000	ac-ft/year		
	182	cfs		
Total intake design withdrawal rate (for scalping high flows	4,000	cfs	21.9	Ratio of design withdrawal rate to Total intake design withdrawal rate
	1,795,200	gpm		
No. of Intakes	4			
Design withdrawal rate per intake	1,000	cfs		
	448,800	gpm		
No. of reservoirs	4			
Design flow to each reservoir	448,800	gpm		
Inside diameter of each RWTM	120	in.		
Area	78.54	sf		
Average length of each RWTM	1	miles	4.0	miles for all RWTMs
	5,280	feet	21,120	feet
Estimated construction cost for RWTM	$ 793	per LF		
Total construction cost in millions	$ 16.8			
Contingencies	$ 3.4			
Subtotal	$ 20.1			
Engineering, Legal & Administrative	$ 3.0			
Subtotal	$ 23.1			
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 0.4			
Total Capital Cost for PWTM in millions	$ 23.5	million		
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.040	Million $/year (all RWTMs to Reservoirs)

Note: Assume each intake has two RWTMs pumping out of it, one to each reservoir.

Design flow rate for each RWTM (from above)	448,800	gpm		
Pumping rate (one pump)	50,000	gpm		
No. of pumps (not counting spare) pumping into each RW	9			
Peak flow rate into each RWTM (all pumps except spare)	450,000	gpm		
Velocity at peak flow rate	12.77	fps		
C factor	120			
Head loss per foot	0.00327	ft/ft	$h_f = \lvert 3.552*Q\rvert^{1.85} / \lvert C*(d)^{2.63}\rvert$	
	17.25	ft/mile		
Head loss at peak flow rate	17	ft		
Allowance for minor losses 30%	5	ft	90	Elev of discharge at reservoir
Total estimated losses	22	ft	50	Water surface elev in river
Average static head	40	ft	40	ft
Total estimated dynamic head	62	ft		
	27	psi		
Assumed pump efficiency	85%			
Assumed motor efficiency	90%			
Estimated Hp required per pump	1,030	hp/pump		
	769	kw/pump		
Total hp pumping into each RWTM (not counting spare)	9,272	hp/RWTM		
Total hp at each intake (not counting spare)	9,272	hp/intake		
Total hp all intakes (not counting spares)	37,089	hp		
Total kw all intakes (not counting spares)	27,668	kw		
Unit construction cost for each pump station (from cost cur	$ 889	per firm hp of pump station		
Construction cost per intake/pump station	8.2	million		
No. of intakes from above	4	each		
Total construction cost in millions	$ 33.0	million		
Contigency, Eng., etc. in millions	$ 12.53	million		
Total capital cost in millions	$ 45.5	million		
Total construction cost for pump stations	$ 33.0	million		
Value of equipment	$ 13.2	million	40%	Estimated equip cost as % of total constr cost
Assumed life of equipment	20	years		
Estimated maintenance/replacement cost	$ 0.66	million/year		

O&M Costs:

Year	Flow pumped by year		No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	-	-	-	-	$ -	$ -			$ -	$ -
2016	-	-	-	-	$ -	$ -			$ -	$ -
2017	-	-	-	-	$ -	$ -			$ -	$ -
2018	-	-	-	-	$ -	$ -			$ -	$ -
2019	-	-	-	-	$ -	$ -			$ -	$ -
2020	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 1.15
2021	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 1.10
2022	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 1.05
2023	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 1.00
2024	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.95
2025	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.90
2026	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.86
2027	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.82
2028	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.78
2029	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.74
2030	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.71
2031	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.67
2032	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.64
2033	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.61
2034	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.58
2035	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.55
2036	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.53
2037	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.50
2038	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.48
2039	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.46
2040	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.43
2041	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.41
2042	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.39
2043	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.38
2044	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.36
2045	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.34
2046	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.32
2047	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.31
2048	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.29
2049	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.28
2050	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.27
2051	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.25
2052	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.24
2053	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.23
2054	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.22
2055	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.21
2056	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.20
2057	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.19
2058	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.18
2059	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.17
2060	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.16
2061	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.16
2062	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.15
2063	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.14
2064	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.13
2065	132,000	118	1.64	30,188	$ 2,113	$ 0.77	$ 0.66	$ 0.040	$ 1.47	$ 0.13
								Total NPV of O&M Costs		$ 21.6

Capital Costs in million $:		Yr built		
RWTM to Reservoirs	$ 23.5	2020		$ 18.4
Intake/Pumping Stations	$ 45.5	2020		$ 35.6
			Total NPV of Capital Costs	$ 54.1
			Total NPV of Capital and O&M Costs in millions	$ 75.7

Reservoirs

	Quantity	Units	Volume/each (acre-feet)	Unit Cost ($/ac-ft))	Total Construction Cost in millions	Contigency, Eng., etc.	Total in millions
Reservoirs	4	each	25000	$ 974	$ 97.4	$ 37.0	$ 134.4

Estimated average depth of reservoir	20	ft	
Surface area of reservoir	5000	acres	
Ratio of total land area reqd to surface area of reservoir	1.1		
Total land area reqd for reservoirs	5500	acres	
		Envir & Archaeology, Surv, and Land Acq =	27.5
		Total capital cost in millions =	$ 161.9
Assumed life of reservoir	100	years	
Estimated replacement cost	$ 0.97	million/year	
Estimated maintenance	0.4	million/year	Mowing, maintaining fences, etc.
Total	$ 1.37	million/year	
Year built	2020		
NPV of O&M costs	$ 19.1	million	
NPV of Capital costs	$ 126.8	million	
Total NPV of Capital and O&M Costs	$ 145.9	million	

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Inflatable Rubber Low Head Dam	$ 9.7	$ 6.3	$ 16.0
Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)	$ 54.1	$ 21.6	$ 75.7
Reservoirs	$ 126.8	$ 19.1	$ 145.9
Total for RWI A	$ 190.6	$ 47.0	$ 237.6

O&M Cost Calculations
RWTM A - Matagorda Co. to WTP
CTRWTP - Alternate 2A - WTP East of San Marcos

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

Raw Water Transmission Main - A

Inside diameter of pipe		96	in.			
Area		50.27	sf			
Length of RWTM		126	miles			
		665,280	feet			
Estimated unit construction cost for RWTM	$	567	per LF			
Total construction cost in millions	$	378				
Contingencies	$	76				
Subtotal	$	453				
Engineering, Legal & Administrative	$	68				
Subtotal	$	521				
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$	13				
Total Capital Cost for PWTM in millions	$	534	million			
Unit maintenance cost/year-mile	$	10,000	$/year-mile	$	1.260	Million $/year
Design flow rate (after 100% buildout)		132,000	ac-ft/year			
		118	mgd			
		81,829	gpm			
Pumping rate (one pump)		16,400	gpm			
No. of pumps (not counting spare)		5				
Peak flow rate (all pumps except spare)		82,000	gpm			
Velocity at peak flow rate		3.63	fps			
C factor		120				
Head loss per foot		0.00041	ft/ft	$h_f = \frac{3.552*Q^{1.85}}{C^{*}(d)^{2.63}}$		
		2.19	ft/mile			
Head loss at peak flow rate		276	ft			
Allowance for minor losses	10%	28	ft	550	Elev. At San Antonio East WTP	
Total estimated losses		303	ft	90	Elev. At Matagorda OCRs	
Average static head		460	ft	460	ft	
Total estimated dynamic head		763	ft			
		331	psi			
No of pumping stations req'd along route		2.21		150	psi (assumed max pressure	
No. of pumping stations used in cost estimate		3.0			in pipe)	
Average head per pump station		254	ft			
Assumed pump efficiency		85%				
Assumed motor efficiency		90%				
Estimated Hp required per pump		1,378	hp/pump			
		1,028	kw/pump			
Total hp per pump station (not counting spare)		6,888	hp/station			
Total kw per pump set (set=pumps in series along route)		4,133	kw/pump set	(one pump at each station)		
Unit construction cost for each pump station (from cost curv	$	1,347	per firm hp of pump station			
Construction cost per pump station		9.3	million			
Balancing reservoir	$	0.75	million	60	min. of storage at avg pumping rate	
Total construction cost per pump station	$	10.03	million	5.0	mg	
				$ 0.15	per gal for open top reservoir	
No. of pump stations from above		3.0	each			
Total construction cost in millions	$	30.1	million			
Contigency, Eng., etc. in millions	$	11.43	million			
Total capital cost in millions	$	41.5	million			
Total construction cost for pump stations	$	30.1	million			
Value of equipment	$	12.0	million	40%	Estimated equipment cost as % of total	
Assumed life of equipment		20	years			
Estimated maintenance/replacement cost	$	0.60	million/year			

O&M Costs

Year	Flow pumped by year		No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	-	-	-	-	$ -	$ -			$ -	$ -
2016	-	-	-	-	$ -	$ -			$ -	$ -
2017	-	-	-	-	$ -	$ -			$ -	$ -
2018	-	-	-	-	$ -	$ -			$ -	$ -
2019	-	-	-	-	$ -	$ -			$ -	$ -
2020	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 11.37
2021	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 10.83
2022	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 10.31
2023	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 9.82
2024	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 9.35
2025	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 8.91
2026	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 8.48
2027	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 8.08
2028	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 7.69
2029	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 7.33
2030	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 6.98
2031	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 6.65
2032	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 6.33
2033	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 6.03
2034	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 5.74
2035	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 5.47
2036	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 5.21
2037	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 4.96
2038	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 4.72
2039	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 4.50
2040	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 4.28
2041	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 4.08
2042	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 3.89
2043	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 3.70
2044	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 3.52
2045	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 3.36
2046	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 3.20
2047	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 3.04
2048	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.90
2049	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.76
2050	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.63
2051	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.50
2052	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.39
2053	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.27
2054	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.16
2055	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 2.06
2056	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.96
2057	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.87
2058	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.78
2059	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.70
2060	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.61
2061	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.54
2062	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.46
2063	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.39
2064	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.33
2065	132,000	118	4.99	494,936	$ 34,646	$ 12.65	$ 0.60	$ 1.260	$ 14.51	$ 1.27
								Total NPV of O&M Costs		**$ 213**

Capital Costs in million $:		Yr built		
RWTM	$ 534	2020		$ 418
Pumping Stations	$ 42	2020		$ 33
			Total NPV of Capital Costs	**$ 451**

Total NPV of Capital and O&M Costs in millions $ 664

NPV CALCULATIONS
ALCOA / CPS GROUNDWATER
CTRWTP - Alternate 2A - WTP East of San Marcos

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

Well Fields and Collection Lines

	ALCOA	CPS	Total
Year built	2015	2015	
Estimated Construction Cost in Millions			
Wells (Based on Non-Public Water Supply Wells)	20.92	7.94	28.86
Pipeline	13.03	5.94	18.97
Pump Stations & Storage	8.51	0	8.51
Subtotal	42.46	13.88	56.34
Contingency	8.49	2.78	11.27
Subtotal	50.95	16.66	67.61
Engineering, Legal & Administrative	6.37	2.08	8.45
Subtotal	57.32	18.74	76.06
Environmental & Archaeology Studies & Mitigation	0.63	0.2	0.83
Land Acquisition & Surveying	0	0	0.00
Groundwater Purchase	0	5.64	5.64
ALCOA Construction Program Management Fee	5.45	0	5.45
Interest During Construction (2 years, 6% int., 4% ret.)	5.89	2.44	8.33
Total Capital Cost	**69.29**	**27.02**	**96.31**
Estimated Annual O&M Costs			
O&M	0.67	0.18	0.85
Pumping Energy	2.41	0.52	2.93
ALCOA Project Management Fees	0.35	0.00	0.35
Purchase of Groundwater	2.00	0.00	2.00
Groundwater District Fees	0.65	0.25	0.90
Mitigation Reserves	0.28	0.11	0.39
Total Annual Cost	**6.36**	**1.06**	**7.42**

NPV of O&M Costs	$ 116	$ 19	$ 135	million
NPV of Capital Costs	$ 69	$ 27	$ 96	million
Total NPV of Capital and O&M Costs for Well Fields	**$ 185**	**$ 46**	**$ 232**	**million**

Cooling of Well Water

Total number of wells in both fields	120	wells	Approximate capacity per wel	300 gpm
Percentage of wells with temperatures > than ___ degrees	5%			36,000 gpm
Estimated number of wells with temperature > ____ degrees	6.0		Rough check	58,072 ac-ft/year

Estimated Capital Costs

Year built	2015		
Number of Packaged Cooling Towers (300 gpm capacity/each)	6.0		
Equipment cost (cooling towers and fans)	$ 60,000		
Installation and contractors mark-up	$ 50,000		
Structural slab	$ 30,000		
Electrical	$ 50,000		
Estimated Unit Construction Cost	$ 190,000	Each	
Total construction cost	$ 1.14	million	
Contingencies	$ 0.23		
Subtotal	$ 1.37		
Engineering, Legal and Admin	$ 0.21		
Total Estimated Capital Cost	$ 1.57		
NPV of Capital Costs	$ 1.57	million	

Estimated O&M Costs

Value of equipment	$ 0.4	million	
Assumed life of equipment	10	years	
Estimated maintenance/replacement cost	$ 0.04	million/year	
Blower Hp per cooling tower	10	Hp	
	7	kw	
Hours of operation	24	hours	
Power consumption per cooling tower	179	kwh per day	
	65,350	kwh per year	
Power cost per cooling tower	$ 4,574		
Total power cost for all cooling towers in millions	$ 0.03	million per year	
Regular operational checks and routine maintenance	$ 6,000	per month for all cooling towers	
	$ 0.07	per year	
Estimated O&M Cost	$ 0.14	million $ per year	
NPV of O&M costs	$ 2.47	million $	

Ground Water Transmission Main and Pump Station (Hwy 290 to Bastrop Intake)

Inside diameter of transmission pipe	54	in.

Area		15.90	sf			
Length of Ground Water TM		15	miles			
		79,200	feet			
Estimated construction cost for GWTM		$ 327	per LF			
Total construction cost in millions		$ 25.9				
Contingencies		$ 5.2				
Subtotal		$ 31.1				
Engineering, Legal & Administrative		$ 4.7				
Subtotal		$ 35.8				
Envir & Arch Studies & Mitigation, Surveying, & Land Acq		$ 1.5				
Total Capital Cost for PWTM in millions		$ 37.3	million			
Unit maintenance cost/year-mile		$ 10,000	$/year-mile	$ 0.150	Million $/year	
Design flow rate		55,000	ac-ft/year			
		49	mgd			
		34,095	gpm			
Velocity at peak flow rate		4.78	fps			
C factor		120				
Head loss per foot		0.00134	ft/ft	$h_f = \lvert 3.552*Q \rvert^{1.85} / \lvert C*(d)^{2.63} \rvert$		
		7.10	ft/mile			
Head loss at peak flow rate		106	ft			
Allowance for minor losses	10%	11	ft	400	Elev. At RWI-B	
Total estimated losses		117	ft	550	minus Elev. - Storage Tank at Hwy 290	
Average static head		-150	ft	-150	ft	
Total estimated dynamic head		-33	ft	(intake is lower than tank at Hwy 290)		
		-14	psi			

Negative indicates gravity flow from Hwy 290 to Bastrop Intake; no pumping necessary.

				Million $
Annual O&M Cost in million $:		Yr built		
GWTM	$ 0.150	2015		
			Total NPV of O&M Costs	$ 2.7
Capital Costs in million $:		Yr built		
GWTM	$ 37.3	2015		$ 37.3
			Total NPV of Capital Costs	$ 37.3

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Well Fields and Collection Lines (including tank and pump station at Hwy 290)	**$ 96.3**	**$ 135.5**	**$ 231.8**
Cooling Towers for Selected High Temperature Wells	**$ 1.6**	**$ 2.5**	**$ 4.0**
Ground Water Transmission Main and Pumping Station	**$ 37.3**	**$ 2.7**	**$ 40.0**
Total for ALCOA-CPS	**$ 135.1**	**$ 140.7**	**$ 275.8**

O&M Cost Calculations
RWI B - Colorado River Intake at Bastrop and Off Channel Reservoir
CTRWTP - Alternate 2A - WTP East of San Marcos

Initial year of analysis period	2015			Contingency =	20%
Interest rate	5%			Engineering, Legal, Admin. =	15%
Evaluation period	40	years			
Unit cost of energy	$ 0.07	per kwh	Environmental & Archaeology Studies & Mitigation, Surveying, and Land Acquisition =	$ 100,000	per mile
			or =	$ 5,000	per acre

Inflatable Rubber Low Head Dam

	Quantity	Units	Size	Unit Constr. Cost (millions)	Total Estimated Constr. Cost (millions)	Contigency, Eng., etc. (millions)	Total Capital Cost (millions)
Inflatable Rubber Low Head Dam	2	each	10 ft high	$ 2.25	$ 4.50	$ 1.71	$ 6.21

Estimated inflatable dam cost as % of total	50%		
Value of inflatable dam	$ 2.25	million	
Assumed life of inflatable dam	10	years	
Estimated maintenance/replacement cost	$ 0.23	million/year	
Year built	2015		
NPV of O&M Costs	$ 3.86	million	
NPV of Capital Costs	$ 6.21	million	
Total NPV of Capital and O&M Costs	**$ 10.07**	**million**	

Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)

Summary of withdrawals in acre-feet/year:

Year	2015	2020	2030	2040	2050	2060	2065
For SAWS	18000	18000	18000	18000	18000	18000	18000
LCRA			5600	11200	11200	11200	11200
COA			16802	22403	33604	33604	33604
Total	18000	18000	40402	51603	62804	62804	62804

Ultimate (Y2065) average design withdrawal rate	62,804	ac-ft/year		
	87	cfs		
			23.1	Ratio of design withdrawal rate to Total intake design withdrawal rate
Total intake design withdrawal rate (for scalping high flows)	2,000	cfs		
	897,600	gpm		
No. of Intakes	2			
Design withdrawal rate per intake	1,000	cfs		
	448,800	gpm		
No. of reservoirs	4			
Design flow to each reservoir	224,400	gpm		
Inside diameter of each RWTM	120	in.		
Area	78.54	sf		
Average length of each RWTM	2	miles	8.0	miles for all RWTMs
	10,560	feet	42,240	feet

Estimated construction cost for RWTMs	$ 793	per LF			
Total construction cost in millions	$ 33.5				
Contingencies	$ 6.7				
Subtotal	$ 40.2				
Engineering, Legal & Administrative	$ 6.0				
Subtotal	$ 46.2				
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 0.8				
Total Capital Cost for PWTM in millions	$ 47.0				
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.080	Million $/year (all RWTMs to Reservoirs)	

Note: Assume intake has one RWTM pumping to the reservoir.

Design flow rate for each RWTM (from above)	224,400	gpm		
Pumping rate (one pump)	40,000	gpm		
No. of pumps (not counting spare) pumping into each RWT	6			
Peak flow rate into each RWTM (all pumps except spare)	240,000	gpm		
Velocity at peak flow rate	6.81	fps		
C factor	120			
Head loss per foot	0.00102	ft/ft	$h_f = \lvert 3.552*Q \rvert^{1.85} / \lvert C*(d)^{2.63} \rvert$	
	5.39	ft/mile		
Head loss at peak flow rate	11	ft		
Allowance for minor losses 30%	3	ft	400	Discharge at reservoir
Total estimated losses	14	ft	320	Water surface elev in river
Average static head	80	ft	80	ft
Total estimated dynamic head	94	ft		
	41	psi		
Assumed pump efficiency	85%			
Assumed motor efficiency	90%			
Estimated Hp required per pump	1,241	hp/pump		
	926	kw/pump		

Total hp pumping into each RWTM (not counting spare)	7,448	hp/RWTM
Total hp at each intake (not counting spare)	14,897	hp/intake
Total hp all intakes (not counting spares)	29,793	hp
Total kw all intakes (not counting spares)	22,226	kw

Unit construction cost for each pump station (from cost cur	$ 889	per firm hp of pump station
Construction cost per intake/pump station	13.2	million
No. of intakes from above	2	each

Total construction cost in millions	$ 26.5	million
Contigency, Eng., etc. in millions	$ 10.06	million
Total capital cost in millions	$ 36.6	million

Total construction cost for pump stations	$ 26.5	million	40% Estimated equipment cost as % of total
Value of equipment	$ 10.6	million	
Assumed life of equipment	20	years	
Estimated maintenance/replacement cost	$ 0.53	million/year	

O&M Costs:

Year	Flow pumped by year		No. of pump "sets" operating	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd	/day	(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.77
2016	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.73
2017	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.70
2018	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.66
2019	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.63
2020	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.60
2021	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.57
2022	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.55
2023	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.52
2024	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.50
2025	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.47
2026	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.45
2027	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.43
2028	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.41
2029	18,000	16	0.28	6,200	$ 434	$ 0.16	$ 0.53	$ 0.080	$ 0.77	$ 0.39
2030	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.46
2031	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.44
2032	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.42
2033	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.40
2034	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.38
2035	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.36
2036	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.35
2037	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.33
2038	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.31
2039	40,402	36	0.63	13,917	$ 974	$ 0.36	$ 0.53	$ 0.080	$ 0.97	$ 0.30
2040	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.31
2041	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.30
2042	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.28
2043	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.27
2044	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.26
2045	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.25
2046	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.23
2047	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.22
2048	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.21
2049	51,603	46	0.80	17,775	$ 1,244	$ 0.45	$ 0.53	$ 0.080	$ 1.06	$ 0.20
2050	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.21
2051	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.20
2052	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.19
2053	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.18
2054	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.17
2055	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.17
2056	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.16
2057	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.15
2058	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.14
2059	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.14
2060	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.13
2061	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.12
2062	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.12
2063	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.11
2064	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.11
2065	62,804	56	0.97	21,633	$ 1,514	$ 0.55	$ 0.53	$ 0.080	$ 1.16	$ 0.10
								Total NPV of O&M Costs		$ 17.1

Capital Costs in million $:		Yr built		
RWTM to Reservoir	$ 47.0	2015		$ 47.0
Intake/Pumping Stations	$ 36.6	2015		$ 36.6
			Total NPV of Capital Costs	$ 83.6

Total NPV of Capital and O&M Costs in millions $ 100.7

Reservoirs

	Quantity	Units	Volume/each (acre-feet)	Unit Cost ($/ac-ft))	Total Construction Cost in millions	Contigency, Eng., etc.	Total in millions
Reservoirs	4	each	15000	$ 1,180	$ 70.8	$ 26.9	$ 97.7
				$ 0.004	per gallon		
Estimated average depth of reservoir		20	ft				

Surface area of reservoir	3000	acres		
Ratio of total land area reqd to surface area of reservoir	1.1			
Total land area reqd for reservoirs	3300	acres	Envir & Archaeology, Surv, and Land Acq =	16.5
			Total capital cost in millions =	$ 114.2
Assumed life of reservoir	100	years		
Estimated replacement cost	$ 0.71	million/year		
Estimated maintenance	$ 0.04	million/year	Mowing, maintaining fences, etc.	
Total	$ 0.75	million/year		
Year built	2015			
NPV of O&M costs	$ 12.8	million		
NPV of Capital costs	$ 114.2	million		
Total NPV of Capital and O&M Costs	**$ 127.0**	**million**		

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Inflatable Rubber Low Head Dam	$ 6.2	$ 3.9	$ 10.1
Raw Water Intake, Pumping Station, and RWTM (Intake to Reservoir)	$ 83.6	$ 17.1	$ 100.7
Off Channel Reservoir	$ 114.2	$ 12.8	$ 127.0
Total for RWI A	$ 204.0	$ 33.8	$ 237.8

O&M Cost Calculations
RWTM B - RWI B near Bastrop to WTP
CTRWTP - Alternate 2A - WTP East of San Marcos

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	40	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

Summary of average pumping rates in acre-feet/year:

Suface Water

Year	2015	2020	2030	2040	2050	2060	2065
For SAWS	18000	18000	18000	18000	18000	18000	18000
LCRA			5600	11200	11200	11200	11200
COA			16802	22403	33604	33604	33604
Subtotal	18000	18000	40402	51603	62804	62804	62804

Groundwater

Year	2015	2020	2030	2040	2050	2060	2065
For SAWS	55000	55000	55000	55000	55000	55000	55000
Suface & grour	73000	73000	95402	106603	117804	117804	117804

Ultimate (Y2065) average design pumping rate 117,804 ac-ft/year

Sizing of Raw Water Transmission Main B & Pump Stations

Inside diameter of RWTM			96	in.		
Area			50.27	sf		
Length of RWTM			36	miles		
			190,080	feet		
Estimated unit construction cost for RWTM		$	567	per LF		
Total construction cost in millions		$	107.9			
Contingencies		$	21.6			
Subtotal		$	129.4			
Engineering, Legal & Administrative		$	19.4			
Subtotal		$	148.9			
Envir & Arch Studies & Mitigation, Surveying, & Land Acq		$	3.6			
Total Capital Cost for PWTM in millions		$	152.5	million		
Unit maintenance cost/year-mile		$	5,000	$/year-mile	$ 0.180	Million $/year
Design flow rate (after 100% buildout)			117,804	ac-ft/year		
			105	mgd		
			73,029	gpm		
Pumping rate (one pump)			15,000	gpm		
No. of pumps (not counting spare)			5			
Peak flow rate (all pumps except spare)			75,000	gpm		
Velocity at peak flow rate			3.32	fps		
C factor			120			
Head loss per foot			0.00035	ft/ft	$h_f = \left\| \frac{3.552*Q}{C*(d)^{2.63}} \right\|^{1.85}$	
			1.86	ft/mile		
Head loss at peak flow rate			67	ft		
Allowance for minor losses	10%		7	ft	650	Elev. At WTP
Total estimated losses			74	ft	400	Elev of WSE in Bastrop reservoir
Average static head			250	ft	250	ft
Total estimated dynamic head			324	ft		
			140	psi		
No of recommended pumping stations along route			0.93		150	psi (assumed max pressure
No. of pumping stations used in cost estimate			1.0			in pipe)
Average head per pump station			324	ft		
Assumed pump efficiency			85%			
Assumed motor efficiency			90%			
Estimated Hp required per pump			1,602	hp/pump		
			1,195	kw/pump		
Total hp per pump station (not counting spare)			8,009	hp/station		
Total kw per pump set (set=pumps in series along route)			1,602	kw/pump set	(one pump at each station)	
Unit construction cost for each pump station (from cost cur		$	1,310	per firm hp of pump station		
Construction cost per pump station			10.5	million		
Balancing reservoir		$	0.75	million	60	min. of storage at avg pumping rate
Total construction cost per pump station		$	11.24	million	5.0	mg
					$ 0.15	per gal for open top reservoir
No. of pump stations from above			1.0	each		
Total construction cost in millions		$	11.2	million		
Contingency, Eng., etc. in millions		$	4.27	million		
Total capital cost in millions		$	15.5	million		
Total construction cost for pump stations		$	11.2	million		
Value of equipment		$	4.5	million	40%	Estimated equipment cost as % of total
Assumed life of equipment			20	years		
Estimated maintenance/replacement cost		$	0.22	million/year		

O&M Costs

Year	Flow pumped by year		No. of pump "sets" operating	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - RWTM	Total O&M cost	Net present value
	ac-ft/yr	mgd	/day	(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 3.37
2016	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 3.21
2017	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 3.06
2018	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 2.91
2019	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 2.77
2020	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 2.64
2021	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 2.51
2022	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 2.39
2023	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 2.28
2024	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 2.17
2025	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 2.07
2026	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 1.97
2027	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 1.88
2028	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 1.79
2029	73,000	65	3.02	115,984	$ 8,119	$ 2.96	$ 0.22	$ 0.180	$ 3.37	$ 1.70
2030	95,402	85	3.94	151,577	$ 10,610	$ 3.87	$ 0.22	$ 0.180	$ 4.28	$ 2.06
2031	95,402	85	3.94	151,577	$ 10,610	$ 3.87	$ 0.22	$ 0.180	$ 4.28	$ 1.96
2032	95,402	85	3.94	151,577	$ 10,610	$ 3.87	$ 0.22	$ 0.180	$ 4.28	$ 1.87
2033	95,402	85	3.94	151,577	$ 10,610	$ 3.87	$ 0.22	$ 0.180	$ 4.28	$ 1.78
2034	95,402	85	3.94	151,577	$ 10,610	$ 3.87	$ 0.22	$ 0.180	$ 4.28	$ 1.69
2035	95,402	85	3.94	151,577	$ 10,610	$ 3.87	$ 0.22	$ 0.180	$ 4.28	$ 1.61
2036	95,402	85	3.94	151,577	$ 10,610	$ 3.87	$ 0.22	$ 0.180	$ 4.28	$ 1.54
2037	95,402	85	3.94	151,577	$ 10,610	$ 3.87	$ 0.22	$ 0.180	$ 4.28	$ 1.46
2038	95,402	85	3.94	151,577	$ 10,610	$ 3.87	$ 0.22	$ 0.180	$ 4.28	$ 1.39
2039	95,402	85	3.94	151,577	$ 10,610	$ 3.87	$ 0.22	$ 0.180	$ 4.28	$ 1.33
2040	106,603	95	4.41	169,373	$ 11,856	$ 4.33	$ 0.22	$ 0.180	$ 4.73	$ 1.40
2041	106,603	95	4.41	169,373	$ 11,856	$ 4.33	$ 0.22	$ 0.180	$ 4.73	$ 1.33
2042	106,603	95	4.41	169,373	$ 11,856	$ 4.33	$ 0.22	$ 0.180	$ 4.73	$ 1.27
2043	106,603	95	4.41	169,373	$ 11,856	$ 4.33	$ 0.22	$ 0.180	$ 4.73	$ 1.21
2044	106,603	95	4.41	169,373	$ 11,856	$ 4.33	$ 0.22	$ 0.180	$ 4.73	$ 1.15
2045	106,603	95	4.41	169,373	$ 11,856	$ 4.33	$ 0.22	$ 0.180	$ 4.73	$ 1.09
2046	106,603	95	4.41	169,373	$ 11,856	$ 4.33	$ 0.22	$ 0.180	$ 4.73	$ 1.04
2047	106,603	95	4.41	169,373	$ 11,856	$ 4.33	$ 0.22	$ 0.180	$ 4.73	$ 0.99
2048	106,603	95	4.41	169,373	$ 11,856	$ 4.33	$ 0.22	$ 0.180	$ 4.73	$ 0.95
2049	106,603	95	4.41	169,373	$ 11,856	$ 4.33	$ 0.22	$ 0.180	$ 4.73	$ 0.90
2050	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.94
2051	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.90
2052	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.85
2053	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.81
2054	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.77
2055	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.74
2056	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.70
2057	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.67
2058	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.64
2059	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.61
2060	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.58
2061	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.55
2062	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.52
2063	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.50
2064	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.47
2065	117,804	105	4.87	187,170	$ 13,102	$ 4.78	$ 0.22	$ 0.180	$ 5.19	$ 0.45
								Total NPV of O&M Costs		$ 75.4

Capital Costs in million $:		Yr built		
RWTM	$ 152.5	2015		$ 152.5
Pumping Stations	$ 15.5	2015		$ 15.5
			Total NPV of Capital Costs	$ 168.0

Total NPV of Capital and O&M Costs in millions $ 243.4

O&M Cost Calculations
WTP and Raw Water Storage Reservoir at WTP
CTRWTP - Alternate 2A - WTP East of San Marcos

Special case for using plant as a base loaded plant only; no peaking factor; AND ALL NON-SOFTENED WATER PRODUCTION

Initial year of analysis period	2015	Contingency =	20%
Interest rate	5%	Engineering, Legal, Admin. =	15%
Evaluation period	50 years	Environmental & Archaeology Studies &	
Unit cost of energy	$ 0.07 per kwh	Mitigation, Surveying, and Land Acquisition =	$ 25,000 per acre

Treated Water Production by Treatment Type (from Demand Chart)

Year =	Units	2015	2020	2030	2040	2050	2060	2065
NON-Softened water demand:								
Average yearly demands:								
City of Austin	ac-ft/yr	0	0	16802	22403	33604	33604	33604
LCRA	ac-ft/yr	0	0	5600	11200	11200	11200	11200
Totals	ac-ft/yr	0	0	22402	33603	44804	44804	44804
Totals	mgd	0	0	20	30	40	40	40
Max day demands:								
City of Austin	mgd							
LCRA	mgd							
Totals	mgd	0	0	20	30	40	40	40

Year =	Units	2015	2020	2030	2040	2050	2060	2065
Non-softened water demands:								
Average yearly demands:								
SAWS	ac-ft/yr	73000	205000	205000	205000	205000	205000	205000
SARA	ac-ft/yr	20550	23406	28433	31393	34411	37530	41128
GBRA	ac-ft/yr	0	0	6000	8000	10000	12300	12300
Totals		93550	228406	239433	244393	249411	254830	258428
Totals	mgd	84	204	214	218	223	227	231
Max day demands:								
SAWS	mgd							
SARA	mgd							
GBRA	mgd							
Totals	mgd	84	204	214	218	223	227	231

Total: ALL non-softened water demands								
Average yearly demand	ac-ft/yr	93550	228406	261835	277996	294215	299634	303232
	mgd	84	204	234	248	263	267	271
Max day demand	mgd	84	204	234	248	263	267	271

Raw Water Reservoir

Sizing for ultimate conditions:

Assumed number of days of consecutive Max Day demands		30	days
Design (Max. Day) treated water production req'd in mgd		271	mgd
Average treated water production in mgd		271	mgd
Difference (shortfall of raw water)		0	mgd
Required storage reservoir for raw water		-	mg
		-	ac-ft
Add safety factor	25%	-	ac-ft
Total storage required		-	ac-ft
Total storage recommended		6,000	ac-ft

(which is also equal to sum of ground and raw water that can be pumped to the WTP)

Note: No. of days at average day demand (for example, for repair of RWTM A) = 17 days

	Quantity	Units	Volume/each (acre-feet)	Unit Cost ($/ac-ft))	Total Construction Cost	Contigency, Eng., etc.	Total Capital Cost
Reservoirs	1	each	6,000	$ 1,666	$ 10.0	$ 3.8	$ 13.8

Estimated average depth of reservoir	25	ft	
Surface area of reservoir	240	acres	
Ratio of total land area reqd to surface area of reservoir	1.10		
Total land area reqd for reservoirs	264	acres	
		Envir & Archaeology, Surv, and Land Acq =	6.6
		Total capital cost in millions =	$ 20.4
Assumed life of reservoir	100	years	

Estimated replacement cost	$ 0.10	million/year	
Estimated maintenance	$ 0.04	million/year	Mowing, maintaining fences, etc.
Total	$ 0.14	million/year	
Year built	2015		
NPV of O&M costs	$ 2.6	million	
NPV of Capital costs	$ 20.4	million	
Total NPV of Capital and O&M Costs	$ 22.9	million	

WTP

Plant Phasing and Capital Costs:

NON - Softening Treatment Trains

Year =	2015	2020	2030	2040	2050	2060	2065
Average treated water production in mgd	0	0	20	30	40	40	40
Design (Max. Day) treated water production req'd in mgd	0	0	20	30	40	40	40
Initial/additional Max day capacity built (mgd)							
Total capacity on line (must exceed Design Max Day Req'd)	0	0	0	0	0	0	0
Unit cost for max day treatment capacity ($/gpd of capacity)							
Estimated construction cost of expansion in $millions	$ -	$ -	$ -	$ -	$ -	$ -	$ -

Non-softening Treatment Trains

Year =	2015	2020	2030	2040	2050	2060	2065	
Average treated water production in mgd	84	204	214	218	223	227	231	
Design (Max. Day) treated water production req'd in mgd	84	204	234	248	263	267	271	For special case, this includes demands from rows above
Additional Max day capacity built (mgd)	200	50		25				
Total capacity on line (must exceed Design Max Day Req'd)	200	250	250	275	275	275	275	
Unit cost for max day treatment capacity ($/gpd of capacity)	$ 1.15	$ 1.51		$ 1.73				
Estimated construction cost of expansion in $millions	$ 229.6	$ 75.4	$ -	$ 43.2	$ -	$ -	$ -	

Totals (ALL Non-softening Trains)

Year =	2015	2020	2030	2040	2050	2060	2065
Total construction cost for both trains	$ 229.6	$ 75.4	$ -	$ 43.2	$ -	$ -	$ -
Contingencies	45.9	15.1	-	8.6	-	-	-
Subtotal	$ 275.5	$ 90.4	$ -	$ 51.8	$ -	$ -	$ -
Engineering, Legal, & Administrative	41.3	13.6	-	7.8	-	-	-
Subtotal	316.8	104.0	-	59.6	-	-	-
Environmental & Archaeology Studies and Mitigation & Land Acquisition and Surveying (see Note below)	2.5						
Total estimated capital cost	$ 319.3	$ 104.0	$ -	$ 59.6	$ -	$ -	$ -
NPV of capital cost	$ 319.3	$ 81.5	$ -	$ 17.6	$ -	$ -	$ -
Total NPV of WTP initial construction & expansions	$ 418						

Note: Assumed land requirement for WTP (not including reserv 100 acres

O&M Costs for Softening Trains:

Year	Plant Capacity in service	Estimated treated water production	Estimated O&M cost from unit cost curve		Net present value
	mgd of capacity	mgd produced	$ per mg treated	$million /year	($)
2015	-	-		$ -	$ -
2016	-	-		$ -	$ -
2017	-	-		$ -	$ -
2018	-	-		$ -	$ -
2019	-	-		$ -	$ -
2020	-	-		$ -	$ -
2021	-	-		$ -	$ -
2022	-	-		$ -	$ -
2023	-	-		$ -	$ -
2024	-	-		$ -	$ -
2025	-	-		$ -	$ -
2026	-	-		$ -	$ -
2027	-	-		$ -	$ -
2028	-	-		$ -	$ -
2029	-	-		$ -	$ -
2030	-	-		$ -	$ -
2031	-	-		$ -	$ -
2032	-	-		$ -	$ -
2033	-	-		$ -	$ -
2034	-	-		$ -	$ -
2035	-	-		$ -	$ -
2036	-	-		$ -	$ -
2037	-	-		$ -	$ -
2038	-	-		$ -	$ -
2039	-	-		$ -	$ -
2040	-	-		$ -	$ -
2041	-	-		$ -	$ -
2042	-	-		$ -	$ -
2043	-	-		$ -	$ -
2044	-	-		$ -	$ -
2045	-	-		$ -	$ -
2046	-	-		$ -	$ -
2047	-	-		$ -	$ -
2048	-	-		$ -	$ -
2049	-	-		$ -	$ -
2050	-	-		$ -	$ -
2051	-	-		$ -	$ -
2052	-	-		$ -	$ -
2053	-	-		$ -	$ -
2054	-	-		$ -	$ -
2055	-	-		$ -	$ -
2056	-	-		$ -	$ -
2057	-	-		$ -	$ -
2058	-	-		$ -	$ -
2059	-	-		$ -	$ -
2060	-	-		$ -	$ -
2061	-	-		$ -	$ -
2062	-	-		$ -	$ -
2063	-	-		$ -	$ -
2064	-	-		$ -	$ -
2065	-	-		$ -	$ -
		Total NPV of O&M Costs			$ -

O&M Costs for Non-Softening Trains:

Year	Plant Capacity in service	Estimated treated water production	Estimated O&M cost from unit cost curve		Net present value
	mgd of capacity	mgd produced	$ per mg treated	$million /year	($)
2015	200	84	$ 374	$ 11.41	$ 11.41
2016	200	84	$ 374	$ 11.41	$ 10.87
2017	200	84	$ 374	$ 11.41	$ 10.35
2018	200	84	$ 374	$ 11.41	$ 9.86
2019	200	84	$ 374	$ 11.41	$ 9.39
2020	250	204	$ 357	$ 26.54	$ 20.79
2021	250	204	$ 357	$ 26.54	$ 19.80
2022	250	204	$ 357	$ 26.54	$ 18.86
2023	250	204	$ 357	$ 26.54	$ 17.96
2024	250	204	$ 357	$ 26.54	$ 17.11
2025	250	204	$ 357	$ 26.54	$ 16.29
2026	250	204	$ 357	$ 26.54	$ 15.52
2027	250	204	$ 357	$ 26.54	$ 14.78
2028	250	204	$ 357	$ 26.54	$ 14.07
2029	250	204	$ 357	$ 26.54	$ 13.40
2030	250	214	$ 357	$ 27.82	$ 13.38
2031	250	214	$ 357	$ 27.82	$ 12.74
2032	250	214	$ 357	$ 27.82	$ 12.14
2033	250	214	$ 357	$ 27.82	$ 11.56
2034	250	214	$ 357	$ 27.82	$ 11.01
2035	250	214	$ 357	$ 27.82	$ 10.48
2036	250	214	$ 357	$ 27.82	$ 9.99
2037	250	214	$ 357	$ 27.82	$ 9.51
2038	250	214	$ 357	$ 27.82	$ 9.06
2039	250	214	$ 357	$ 27.82	$ 8.63
2040	275	218	$ 349	$ 27.81	$ 8.21
2041	275	218	$ 349	$ 27.81	$ 7.82
2042	275	218	$ 349	$ 27.81	$ 7.45
2043	275	218	$ 349	$ 27.81	$ 7.09
2044	275	218	$ 349	$ 27.81	$ 6.76
2045	275	218	$ 349	$ 27.81	$ 6.43
2046	275	218	$ 349	$ 27.81	$ 6.13
2047	275	218	$ 349	$ 27.81	$ 5.84
2048	275	218	$ 349	$ 27.81	$ 5.56
2049	275	218	$ 349	$ 27.81	$ 5.29
2050	275	223	$ 349	$ 28.38	$ 5.14
2051	275	223	$ 349	$ 28.38	$ 4.90
2052	275	223	$ 349	$ 28.38	$ 4.67
2053	275	223	$ 349	$ 28.38	$ 4.44
2054	275	223	$ 349	$ 28.38	$ 4.23
2055	275	223	$ 349	$ 28.38	$ 4.03
2056	275	223	$ 349	$ 28.38	$ 3.84
2057	275	223	$ 349	$ 28.38	$ 3.66
2058	275	223	$ 349	$ 28.38	$ 3.48
2059	275	223	$ 349	$ 28.38	$ 3.32
2060	275	227	$ 349	$ 29.00	$ 3.23
2061	275	227	$ 349	$ 29.00	$ 3.07
2062	275	227	$ 349	$ 29.00	$ 2.93
2063	275	227	$ 349	$ 29.00	$ 2.79
2064	275	227	$ 349	$ 29.00	$ 2.65
2065	275	231	$ 349	$ 29.40	$ 2.56
			Total NPV of O&M Costs		$ 454

NPV Totals for O&M:

Softening trains	$ -
Non-softening Trains	$ 454
	$ 454

Summary	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
Raw Water Reservoir	$ 20	$ 2.6	$ 23
Water Treatment Plant	$ 418	$ 454	$ 873
Totals	$ 439	$ 457	$ 896

CTRWTP - Alternate 2A - WTP East of San Marcos
Potable Water Transmission Mains
CTRWTP - Alternate 2 - WTP Midway Between Austin & San Antonio

Initial year of analysis period	2015		Contingency =	20%	
Interest rate	5%		Engineering, Legal, Admin. =	15%	
Evaluation period	50	years	Environmental & Archaeology Studies &		
Unit cost of energy	$ 0.07	per kwh	Mitigation, Surveying, and Land Acquisition	$ 100,000	per mile

Special case for using plant as a base loaded plant only; no peaking factor

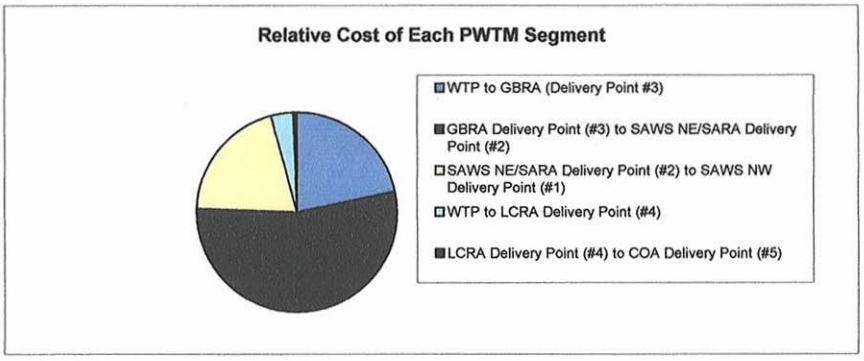
Summary of Demands

Average demands to be delivered in each segment in acre-feet/year

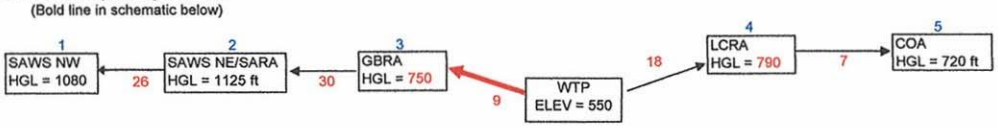
Year	2015	2020	2030	2040	2050	2060	2065
SAWS NW	43800	123000	123000	123000	123000	123000	123000
SAWS NE	29200	82000	82000	82000	82000	82000	82000
Subtotal	73000	205000	205000	205000	205000	205000	205000
SARA	20550	23406	28433	31393	34411	37530	41128
GBRA			6000	8000	10000	12300	12300
LCRA			5600	11200	11200	11200	11200
COA			16802	22403	33604	33604	33604
Total	93550	228406	261835	277996	294215	299634	303232

Summary

	NPV of Capital Costs	NPV of O&M Costs	Total NPV of Capital and O&M Costs
WTP to GBRA (Delivery Point #3)	$ 66	$ 128	$ 194
GBRA Delivery Point (#3) to SAWS NE/SARA Delivery Point (#2)	$ 222	$ 266	$ 488
SAWS NE/SARA Delivery Point (#2) to SAWS NW Delivery Point (#1)	$ 176	$ 5	$ 181
WTP to LCRA Delivery Point (#4)	$ 20	$ 14	$ 33
LCRA Delivery Point (#4) to COA Delivery Point (#5)	$ 5	$ 1	$ 6
Total for PWTMs	$ 489	$ 413	$ 902



WTP to GBRA (Delivery Point #3)
(Bold line in schematic below)



Demands for this pipe segment

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
GBRA	0	0	5	7	9	11	11	1.0
SAWS NE	26	73	73	73	73	73	73	1.0
SARA	18	21	25	28	31	34	37	1.0
SAWS NW	39	110	110	110	110	110	110	1.0
Total	84	204	214	218	223	227	231	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
GBRA	0	0	5	7	9	11	11
SAWS NE	26	73	73	73	73	73	73
SARA	18	21	25	28	31	34	37
SAWS NW	39	110	110	110	110	110	110
Total	84	204	214	218	223	227	231

PWTM and Pump Station Costs

Design flow rate - year 2065	231	mgd	
	160,204	gpm	
Pumping capacity of one pump	20,000	gpm	
No. of pumps (not counting spare)	8		
Peak flow rate (all pumps except spare)	160,000	gpm	
Inside diameter of PWTM	108	in.	
Area	63.62	sf	
Length of PWTM	9	miles	(linked to mileage in schematic above)
	47,520	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	100%	47,520	$ 666	$ 31.6	million
Rural - rock	0%	-	$ 894	$ -	
Urban - rock	0%	-	$ 1,007	$ -	
		47,520		$ 31.6	million

Average estimated unit construction cost for PWTM	$ 666	per LF	
Total construction cost in millions	$ 31.6		
Contingencies	$ 6.3		
Subtotal	$ 38.0		
Engineering, Legal & Administrative	$ 5.7		
Subtotal	$ 43.7		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 0.9		
Total Capital Cost for PWTM in millions	$ 44.6		
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.090 Million $/year
Velocity at peak flow rate	5.60	fps	
C factor	120		
Head loss per foot	0.00081	ft/ft	$h_f = \left\| \frac{3.552 * Q}{C * (d)^{2.63}} \right\|^{1.85}$
	4.25	ft/mile	
Head loss at peak flow rate	38	ft	
Allowance for minor losses 20%	8	ft	750 Desired HGL At Delivery Point
Total estimated losses	46	ft	550 Elev. At WTP
Average static head	200	ft	200 ft
Total estimated dynamic head	246	ft	
	107	psi	
No of recommended pumping stations along route	0.71		150 psi (assumed max pressure
No. of pumping stations used in cost estimate	1		in pipe)
Average head per pump station	246	ft	
Assumed pump efficiency	85%		
Assumed motor efficiency	90%		
Estimated Hp required per pump	1,624	hp/pump	
	1,211	kw/pump	
Total hp per pump station (not counting spare)	12,988	firm hp/station	
Total kw per pump set (set=pumps in series along route)	1,624	kw/pump set	(one pump at each station)
Unit capital cost for each pump station (from cost curve)	$ 1,192	per firm hp of pump station	
Construction cost per pump station	15.5	million	
Total construction cost for pump stations	15.5		for 1 pump stations
Contingencies	$ 3.1		
Subtotal	$ 18.6		

Engineering, Legal & Administrative	$ 2.8	
Total capital cost for pump stations	$ 21.4	million

40% Estimated equipment cost as % of total

Value of equipment	$ 6	million
Assumed life of equipment	20	years
Estimated maintenance/replacement cost	$ 0.31	million/year

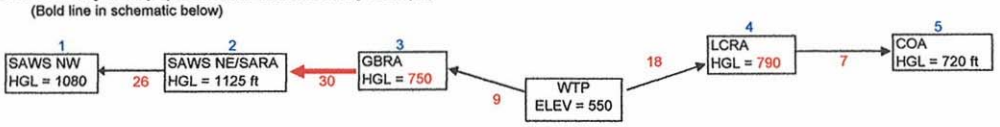
O&M Costs

Year	Flow pumped by year (average flows from Table above)	No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - PWTM	Total O&M cost	Net present value
	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	84	2.90	112,984	$ 7,909	$ 2.89	$ 0.31	$ 0.090	$ 3.29	$ 3.29
2016	84	2.90	112,984	$ 7,909	$ 2.89	$ 0.31	$ 0.090	$ 3.29	$ 3.13
2017	84	2.90	112,984	$ 7,909	$ 2.89	$ 0.31	$ 0.090	$ 3.29	$ 2.98
2018	84	2.90	112,984	$ 7,909	$ 2.89	$ 0.31	$ 0.090	$ 3.29	$ 2.84
2019	84	2.90	112,984	$ 7,909	$ 2.89	$ 0.31	$ 0.090	$ 3.29	$ 2.70
2020	204	7.08	275,854	$ 19,310	$ 7.05	$ 0.31	$ 0.090	$ 7.45	$ 5.84
2021	204	7.08	275,854	$ 19,310	$ 7.05	$ 0.31	$ 0.090	$ 7.45	$ 5.56
2022	204	7.08	275,854	$ 19,310	$ 7.05	$ 0.31	$ 0.090	$ 7.45	$ 5.29
2023	204	7.08	275,854	$ 19,310	$ 7.05	$ 0.31	$ 0.090	$ 7.45	$ 5.04
2024	204	7.08	275,854	$ 19,310	$ 7.05	$ 0.31	$ 0.090	$ 7.45	$ 4.80
2025	204	7.08	275,854	$ 19,310	$ 7.05	$ 0.31	$ 0.090	$ 7.45	$ 4.57
2026	204	7.08	275,854	$ 19,310	$ 7.05	$ 0.31	$ 0.090	$ 7.45	$ 4.35
2027	204	7.08	275,854	$ 19,310	$ 7.05	$ 0.31	$ 0.090	$ 7.45	$ 4.15
2028	204	7.08	275,854	$ 19,310	$ 7.05	$ 0.31	$ 0.090	$ 7.45	$ 3.95
2029	204	7.08	275,854	$ 19,310	$ 7.05	$ 0.31	$ 0.090	$ 7.45	$ 3.76
2030	214	7.42	289,172	$ 20,242	$ 7.39	$ 0.31	$ 0.090	$ 7.79	$ 3.75
2031	214	7.42	289,172	$ 20,242	$ 7.39	$ 0.31	$ 0.090	$ 7.79	$ 3.57
2032	214	7.42	289,172	$ 20,242	$ 7.39	$ 0.31	$ 0.090	$ 7.79	$ 3.40
2033	214	7.42	289,172	$ 20,242	$ 7.39	$ 0.31	$ 0.090	$ 7.79	$ 3.24
2034	214	7.42	289,172	$ 20,242	$ 7.39	$ 0.31	$ 0.090	$ 7.79	$ 3.08
2035	214	7.42	289,172	$ 20,242	$ 7.39	$ 0.31	$ 0.090	$ 7.79	$ 2.94
2036	214	7.42	289,172	$ 20,242	$ 7.39	$ 0.31	$ 0.090	$ 7.79	$ 2.80
2037	214	7.42	289,172	$ 20,242	$ 7.39	$ 0.31	$ 0.090	$ 7.79	$ 2.66
2038	214	7.42	289,172	$ 20,242	$ 7.39	$ 0.31	$ 0.090	$ 7.79	$ 2.54
2039	214	7.42	289,172	$ 20,242	$ 7.39	$ 0.31	$ 0.090	$ 7.79	$ 2.41
2040	218	7.58	295,162	$ 20,661	$ 7.54	$ 0.31	$ 0.090	$ 7.94	$ 2.35
2041	218	7.58	295,162	$ 20,661	$ 7.54	$ 0.31	$ 0.090	$ 7.94	$ 2.23
2042	218	7.58	295,162	$ 20,661	$ 7.54	$ 0.31	$ 0.090	$ 7.94	$ 2.13
2043	218	7.58	295,162	$ 20,661	$ 7.54	$ 0.31	$ 0.090	$ 7.94	$ 2.03
2044	218	7.58	295,162	$ 20,661	$ 7.54	$ 0.31	$ 0.090	$ 7.94	$ 1.93
2045	218	7.58	295,162	$ 20,661	$ 7.54	$ 0.31	$ 0.090	$ 7.94	$ 1.84
2046	218	7.58	295,162	$ 20,661	$ 7.54	$ 0.31	$ 0.090	$ 7.94	$ 1.75
2047	218	7.58	295,162	$ 20,661	$ 7.54	$ 0.31	$ 0.090	$ 7.94	$ 1.67
2048	218	7.58	295,162	$ 20,661	$ 7.54	$ 0.31	$ 0.090	$ 7.94	$ 1.59
2049	218	7.58	295,162	$ 20,661	$ 7.54	$ 0.31	$ 0.090	$ 7.94	$ 1.51
2050	223	7.73	301,223	$ 21,086	$ 7.70	$ 0.31	$ 0.090	$ 8.10	$ 1.47
2051	223	7.73	301,223	$ 21,086	$ 7.70	$ 0.31	$ 0.090	$ 8.10	$ 1.40
2052	223	7.73	301,223	$ 21,086	$ 7.70	$ 0.31	$ 0.090	$ 8.10	$ 1.33
2053	223	7.73	301,223	$ 21,086	$ 7.70	$ 0.31	$ 0.090	$ 8.10	$ 1.27
2054	223	7.73	301,223	$ 21,086	$ 7.70	$ 0.31	$ 0.090	$ 8.10	$ 1.21
2055	223	7.73	301,223	$ 21,086	$ 7.70	$ 0.31	$ 0.090	$ 8.10	$ 1.15
2056	223	7.73	301,223	$ 21,086	$ 7.70	$ 0.31	$ 0.090	$ 8.10	$ 1.10
2057	223	7.73	301,223	$ 21,086	$ 7.70	$ 0.31	$ 0.090	$ 8.10	$ 1.04
2058	223	7.73	301,223	$ 21,086	$ 7.70	$ 0.31	$ 0.090	$ 8.10	$ 0.99
2059	223	7.73	301,223	$ 21,086	$ 7.70	$ 0.31	$ 0.090	$ 8.10	$ 0.95
2060	227	7.90	307,767	$ 21,544	$ 7.86	$ 0.31	$ 0.090	$ 8.26	$ 0.92
2061	227	7.90	307,767	$ 21,544	$ 7.86	$ 0.31	$ 0.090	$ 8.26	$ 0.88
2062	227	7.90	307,767	$ 21,544	$ 7.86	$ 0.31	$ 0.090	$ 8.26	$ 0.83
2063	227	7.90	307,767	$ 21,544	$ 7.86	$ 0.31	$ 0.090	$ 8.26	$ 0.79
2064	227	7.90	307,767	$ 21,544	$ 7.86	$ 0.31	$ 0.090	$ 8.26	$ 0.76
2065	231	8.01	312,113	$ 21,848	$ 7.97	$ 0.31	$ 0.090	$ 8.37	$ 0.73
								Total NPV of O&M Costs	$ 128

Capital Costs in million $:		Yr built		
PWTM	$ 45	2015		$ 45
Pumping Stations	$ 21	2015		$ 21
			Total NPV of Capital Costs	$ 66

Total NPV of Capital and O&M Costs in millions $ 194
WTP to GBRA (Delivery Point #3)

GBRA Delivery Point (#3) to SAWS NE/SARA Delivery Point (#2)
(Bold line in schematic below)



Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
SAWS NE	26	73	73	73	73	73	73	1.0
SARA	18	21	25	28	31	34	37	1.0
SAWS NW	39	110	110	110	110	110	110	1.0
Total	84	204	208	211	214	217	220	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
SAWS NE	26	73	73	73	73	73	73
SARA	18	21	25	28	31	34	37
SAWS NW	39	110	110	110	110	110	110
Total	84	204	208	211	214	217	220

PWTM and Pump Station Costs

Design flow rate - year 2065	220	mgd	
	152,579	gpm	
Pumping capacity of one pump	19,000	gpm	
No. of pumps (not counting spare)	8		
Peak flow rate (all pumps except spare)	152,000	gpm	
Inside diameter of PWTM	108	in.	
Area	63.62	sf	
Length of PWTM	30	miles	(linked to mileage in schematic above)
	158,400	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	50%	79,200	$ 666	$ 52.7	million
Rural - rock	25%	39,600	$ 894	$ 35.4	
Urban - rock	25%	39,600	$ 1,007	$ 39.9	
		158,400		$ 128.0	million

Average estimated unit construction cost for PWTM	$ 808	per LF	
Total construction cost in millions	$ 128.0		
Contingencies	$ 25.6		
Subtotal	$ 153.6		
Engineering, Legal & Administrative	$ 23.0		
Subtotal	$ 176.7		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 3.0		
Total Capital Cost for PWTM in millions	$ 179.7		
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.300 Million $/year
Velocity at peak flow rate	5.32	fps	
C factor	120		
Head loss per foot	0.00073	ft/ft	$h_f = \frac{3.552*Q}{C*(d)^{2.63}}^{1.85}$
	3.87	ft/mile	
Head loss at peak flow rate	116	ft	
Allowance for minor losses 20%	23	ft	1125 Desired HGL At Delivery Point
Total estimated losses	139	ft	750 HGL At Delivery Point 3
Average static head	375	ft	375 ft
Total estimated dynamic head	514	ft	
	223	psi	
No of recommended pumping stations along route	1.49		150 psi (assumed max pressure
No. of pumping stations used in cost estimate	2		in pipe)
Average head per pump station	257	ft	
Assumed pump efficiency	85%		
Assumed motor efficiency	90%		
Estimated Hp required per pump	1,612	hp/pump	
	1,203	kw/pump	
Total hp per pump station (not counting spare)	12,900	firm hp/station	
Total kw per pump set (set=pumps in series along route)	3,225	kw/pump set	(one pump at each station)
Unit construction cost for each pump station (from cost curve)	$ 1,194	per firm hp of pump station	
Construction cost per pump station	15.4	million	
Total construction cost for pump stations	30.8	for 2	pump stations
Contingencies	$ 6.2		
Subtotal	$ 37.0		

Engineering, Legal & Administrative	$	5.5	
Total capital cost for pump stations in millions	$	42.5	million
			40% Equip cost as % of constr cost
Value of equipment	$	12	million
Assumed life of equipment		20	years
Estimated maintenance/replacement cost	$	0.62	million/year

O&M Costs

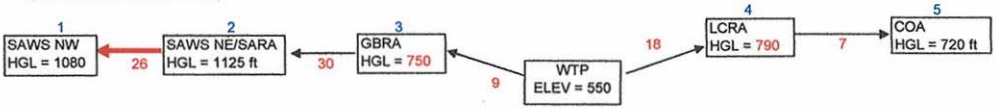
Year	Flow pumped by year (average flows from Table above)	No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - PWTM	Total O&M cost	Net present value
	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015	84	3.05	236,242	$ 16,537	$ 6.04	$ 0.62	$ 0.300	$ 6.95	$ 6.95
2016	84	3.05	236,242	$ 16,537	$ 6.04	$ 0.62	$ 0.300	$ 6.95	$ 6.62
2017	84	3.05	236,242	$ 16,537	$ 6.04	$ 0.62	$ 0.300	$ 6.95	$ 6.31
2018	84	3.05	236,242	$ 16,537	$ 6.04	$ 0.62	$ 0.300	$ 6.95	$ 6.01
2019	84	3.05	236,242	$ 16,537	$ 6.04	$ 0.62	$ 0.300	$ 6.95	$ 5.72
2020	204	7.45	576,795	$ 40,376	$ 14.74	$ 0.62	$ 0.300	$ 15.65	$ 12.26
2021	204	7.45	576,795	$ 40,376	$ 14.74	$ 0.62	$ 0.300	$ 15.65	$ 11.68
2022	204	7.45	576,795	$ 40,376	$ 14.74	$ 0.62	$ 0.300	$ 15.65	$ 11.12
2023	204	7.45	576,795	$ 40,376	$ 14.74	$ 0.62	$ 0.300	$ 15.65	$ 10.59
2024	204	7.45	576,795	$ 40,376	$ 14.74	$ 0.62	$ 0.300	$ 15.65	$ 10.09
2025	204	7.45	576,795	$ 40,376	$ 14.74	$ 0.62	$ 0.300	$ 15.65	$ 9.61
2026	204	7.45	576,795	$ 40,376	$ 14.74	$ 0.62	$ 0.300	$ 15.65	$ 9.15
2027	204	7.45	576,795	$ 40,376	$ 14.74	$ 0.62	$ 0.300	$ 15.65	$ 8.72
2028	204	7.45	576,795	$ 40,376	$ 14.74	$ 0.62	$ 0.300	$ 15.65	$ 8.30
2029	204	7.45	576,795	$ 40,376	$ 14.74	$ 0.62	$ 0.300	$ 15.65	$ 7.91
2030	208	7.62	589,490	$ 41,264	$ 15.06	$ 0.62	$ 0.300	$ 15.98	$ 7.69
2031	208	7.62	589,490	$ 41,264	$ 15.06	$ 0.62	$ 0.300	$ 15.98	$ 7.32
2032	208	7.62	589,490	$ 41,264	$ 15.06	$ 0.62	$ 0.300	$ 15.98	$ 6.97
2033	208	7.62	589,490	$ 41,264	$ 15.06	$ 0.62	$ 0.300	$ 15.98	$ 6.64
2034	208	7.62	589,490	$ 41,264	$ 15.06	$ 0.62	$ 0.300	$ 15.98	$ 6.32
2035	208	7.62	589,490	$ 41,264	$ 15.06	$ 0.62	$ 0.300	$ 15.98	$ 6.02
2036	208	7.62	589,490	$ 41,264	$ 15.06	$ 0.62	$ 0.300	$ 15.98	$ 5.73
2037	208	7.62	589,490	$ 41,264	$ 15.06	$ 0.62	$ 0.300	$ 15.98	$ 5.46
2038	208	7.62	589,490	$ 41,264	$ 15.06	$ 0.62	$ 0.300	$ 15.98	$ 5.20
2039	208	7.62	589,490	$ 41,264	$ 15.06	$ 0.62	$ 0.300	$ 15.98	$ 4.95
2040	211	7.71	596,964	$ 41,788	$ 15.25	$ 0.62	$ 0.300	$ 16.17	$ 4.77
2041	211	7.71	596,964	$ 41,788	$ 15.25	$ 0.62	$ 0.300	$ 16.17	$ 4.55
2042	211	7.71	596,964	$ 41,788	$ 15.25	$ 0.62	$ 0.300	$ 16.17	$ 4.33
2043	211	7.71	596,964	$ 41,788	$ 15.25	$ 0.62	$ 0.300	$ 16.17	$ 4.12
2044	211	7.71	596,964	$ 41,788	$ 15.25	$ 0.62	$ 0.300	$ 16.17	$ 3.93
2045	211	7.71	596,964	$ 41,788	$ 15.25	$ 0.62	$ 0.300	$ 16.17	$ 3.74
2046	211	7.71	596,964	$ 41,788	$ 15.25	$ 0.62	$ 0.300	$ 16.17	$ 3.56
2047	211	7.71	596,964	$ 41,788	$ 15.25	$ 0.62	$ 0.300	$ 16.17	$ 3.39
2048	211	7.71	596,964	$ 41,788	$ 15.25	$ 0.62	$ 0.300	$ 16.17	$ 3.23
2049	211	7.71	596,964	$ 41,788	$ 15.25	$ 0.62	$ 0.300	$ 16.17	$ 3.08
2050	214	7.81	604,586	$ 42,321	$ 15.45	$ 0.62	$ 0.300	$ 16.36	$ 2.97
2051	214	7.81	604,586	$ 42,321	$ 15.45	$ 0.62	$ 0.300	$ 16.36	$ 2.83
2052	214	7.81	604,586	$ 42,321	$ 15.45	$ 0.62	$ 0.300	$ 16.36	$ 2.69
2053	214	7.81	604,586	$ 42,321	$ 15.45	$ 0.62	$ 0.300	$ 16.36	$ 2.56
2054	214	7.81	604,586	$ 42,321	$ 15.45	$ 0.62	$ 0.300	$ 16.36	$ 2.44
2055	214	7.81	604,586	$ 42,321	$ 15.45	$ 0.62	$ 0.300	$ 16.36	$ 2.32
2056	214	7.81	604,586	$ 42,321	$ 15.45	$ 0.62	$ 0.300	$ 16.36	$ 2.21
2057	214	7.81	604,586	$ 42,321	$ 15.45	$ 0.62	$ 0.300	$ 16.36	$ 2.11
2058	214	7.81	604,586	$ 42,321	$ 15.45	$ 0.62	$ 0.300	$ 16.36	$ 2.01
2059	214	7.81	604,586	$ 42,321	$ 15.45	$ 0.62	$ 0.300	$ 16.36	$ 1.91
2060	217	7.91	612,462	$ 42,872	$ 15.65	$ 0.62	$ 0.300	$ 16.56	$ 1.84
2061	217	7.91	612,462	$ 42,872	$ 15.65	$ 0.62	$ 0.300	$ 16.56	$ 1.76
2062	217	7.91	612,462	$ 42,872	$ 15.65	$ 0.62	$ 0.300	$ 16.56	$ 1.67
2063	217	7.91	612,462	$ 42,872	$ 15.65	$ 0.62	$ 0.300	$ 16.56	$ 1.59
2064	217	7.91	612,462	$ 42,872	$ 15.65	$ 0.62	$ 0.300	$ 16.56	$ 1.52
2065	220	8.03	621,548	$ 43,508	$ 15.88	$ 0.62	$ 0.300	$ 16.80	$ 1.46
								Total NPV of O&M Costs	$ 266.0

Capital Costs in million $:		Yr built		
PWTM	$ 179.7	2015		$ 179.7
Pumping Stations	$ 42.5	2015		$ 42.5
			Total NPV of Capital Costs	$ 222.2

Total NPV of Capital and O&M Costs in millions $ 488

GBRA Delivery Point (#3) to SAWS NE/SARA Delivery Point (#2)

SAWS NE/SARA Delivery Point (#2) to SAWS NW Delivery Point (#1)
(Bold line in schematic below)



Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
SAWS NW	39	110	110	110	110	110	110	1.0
Total	39	110	110	110	110	110	110	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
SAWS NW	39	110	110	110	110	110	110
Total	39	110	110	110	110	110	110

PWTM and Pump Station Costs

Design flow rate - year 2065	110	mgd
	76,250	gpm
Pumping capacity of one pump	13,000	gpm
No. of pumps (not counting spare)	6	
Peak flow rate (all pumps except spare)	78,000	gpm
Inside diameter of PWTM	108	in.
Area	63.62	sf
Length of RWTM	26	miles (linked to mileage in schematic above)
	137,280	feet

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	15%	20,592	$ 666	$ 13.7	million
Rural - rock	35%	48,048	$ 894	$ 42.9	
Urban - rock	50%	68,640	$ 1,007	$ 69.2	
		137,280		$ 125.8	million

Average estimated unit construction cost for PWTM	$ 916	per LF
Total construction cost in millions	$ 125.8	
Contingencies	$ 25.2	
Subtotal	$ 151.0	
Engineering, Legal & Administrative	$ 22.6	
Subtotal	$ 173.6	
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 2.6	
Total Capital Cost for PWTM in millions	$ 176.2	
Unit maintenance cost/year-mile	$ 10,000	$/year-mile $ 0.260 Million $/year
Velocity at peak flow rate	2.73	fps
C factor	120	
Head loss per foot	0.00021	ft/ft
	1.13	ft/mile

$$h_f = \left| \frac{3.552 * Q}{C * (d)^{2.63}} \right|^{1.85}$$

Head loss at peak flow rate	29	ft	
Allowance for minor losses	20%	6	ft
Total estimated losses		35	ft
Average static head		-45	ft
Total estimated dynamic head		-10	ft
		-4	psi

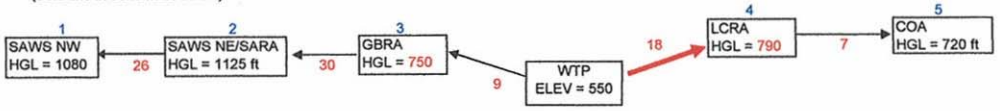
1080 Desired HGL At Delivery Point
1125 HGL At Delivery Point 2
-45 ft

Negative indicates gravity flow from #2 to #1; no pumping necessary.

			Million $
Annual O&M Cost in million $:		Yr built	
PWTM	$ 0.260	2015	
		Total NPV of O&M Costs	$4.7
Capital Costs in million $:		Yr built	
PWTM	$ 176.2	2015	$ 176.2
		Total NPV of Capital Costs	$ 176.2

Total NPV of Capital and O&M Costs in millions $ 181.0
SAWS NE/SARA Delivery Point (#2) to SAWS NW Delivery Point (#1)

WTP to LCRA Delivery Point (#4)
(Bold line in schematic below)



Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
LCRA	0	0	5	10	10	10	10	1.0
COA	0	0	15	20	30	30	30	1.0
Total	0	0	20	30	40	40	40	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
LCRA	0	0	5	10	10	10	10
COA	0	0	15	20	30	30	30
Total	0	0	20	30	40	40	40

PWTM and Pump Station Costs

Design flow rate - year 2065	40	mgd	
	27,775	gpm	
Pumping capacity of one pump	7,000	gpm	
No. of pumps (not counting spare)	4		
Peak flow rate (all pumps except spare)	28,000	gpm	
Inside diameter of PWTM	54	in.	
Area	15.90	sf	
Length of RWTM	18	miles	(linked to mileage in schematic above)
	95,040	feet	

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	100%	95,040	$ 244	$ 23.2	million
Rural - rock	0%	-	$ 337	$ -	
Urban - rock	0%	-	$ 369	$ -	
		95,040		$ 23.2	million

Average estimated unit construction cost for PWTM	$ 244	per LF	
Total construction cost in millions	$ 23.2		
Contingencies	$ 4.6		
Subtotal	$ 27.8		
Engineering, Legal & Administrative	$ 4.2		
Subtotal	$ 32.0		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 1.8		
Total Capital Cost for PWTM in millions	$ 33.8		
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.180 Million $/year
Velocity at peak flow rate	3.92	fps	
C factor	120		
Head loss per foot	0.00093	ft/ft	$h_f = \left\| \frac{3.552*Q}{C*(d)^{2.63}} \right\|^{1.85}$
	4.93	ft/mile	
Head loss at peak flow rate	89	ft	
Allowance for minor losses 20%	18	ft	790 Desired HGL At Delivery Point
Total estimated losses	106	ft	550 Elev. At WTP
Average static head	240	ft	240 ft
Total estimated dynamic head	346	ft	
	150	psi	
No of recommended pumping stations along route	1.00		150 psi (assumed max pressure
No. of pumping stations used in cost estimate	1		in pipe)
Average head per pump station	346	ft	
Assumed pump efficiency	85%		
Assumed motor efficiency	90%		
Estimated Hp required per pump	801	hp/pump	
	597	kw/pump	
Total hp per pump station (not counting spare)	3,202	firm hp/station	
Total kw per pump set (set=pumps in series along route)	801	kw/pump set	(one pump at each station)
Unit construction cost for each pump station (from cost curve)	$ 1,534	per firm hp of pump station	
Construction cost per pump station	4.9	million	
Total construction cost for pump stations	4.9		for 1 pump stations
Contingencies	$ 1.0		
Subtotal	$ 5.9		
Engineering, Legal & Administrative	$ 0.9		
Total capital cost for pump stations	$ 6.8	million	

40% Equip cost as % of constr cost

Value of equipment	$	2.0	million
Assumed life of equipment		20	years
Estimated maintenance/replacement cost	$	0.10	million/year

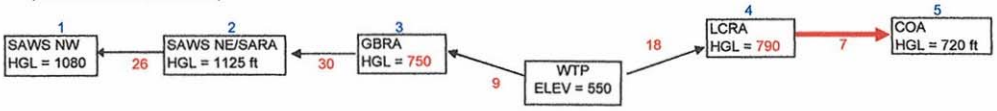
O&M Costs

Year	Flow pumped by year (average flows from Table above)	No. of pump "sets" operating /day	Energy used	Energy cost		Other O&M costs - Pump Stations	Maintenance costs - PWTM	Total O&M cost	Net present value
	mgd		(kwh/day)	($/day)	(Million $ /year)	(Million $ /year)	(Million $ /year)	(Million $ /year)	($)
2015								$ -	$ -
2016								$ -	$ -
2017								$ -	$ -
2018								$ -	$ -
2019								$ -	$ -
2020								$ -	$ -
2021								$ -	$ -
2022								$ -	$ -
2023								$ -	$ -
2024								$ -	$ -
2025								$ -	$ -
2026								$ -	$ -
2027								$ -	$ -
2028								$ -	$ -
2029								$ -	$ -
2030	20	1.98	38,120	$ 2,668	$ 0.97	$ 0.10	$ 0.180	$ 1.25	$ 0.60
2031	20	1.98	38,120	$ 2,668	$ 0.97	$ 0.10	$ 0.180	$ 1.25	$ 0.57
2032	20	1.98	38,120	$ 2,668	$ 0.97	$ 0.10	$ 0.180	$ 1.25	$ 0.55
2033	20	1.98	38,120	$ 2,668	$ 0.97	$ 0.10	$ 0.180	$ 1.25	$ 0.52
2034	20	1.98	38,120	$ 2,668	$ 0.97	$ 0.10	$ 0.180	$ 1.25	$ 0.50
2035	20	1.98	38,120	$ 2,668	$ 0.97	$ 0.10	$ 0.180	$ 1.25	$ 0.47
2036	20	1.98	38,120	$ 2,668	$ 0.97	$ 0.10	$ 0.180	$ 1.25	$ 0.45
2037	20	1.98	38,120	$ 2,668	$ 0.97	$ 0.10	$ 0.180	$ 1.25	$ 0.43
2038	20	1.98	38,120	$ 2,668	$ 0.97	$ 0.10	$ 0.180	$ 1.25	$ 0.41
2039	20	1.98	38,120	$ 2,668	$ 0.97	$ 0.10	$ 0.180	$ 1.25	$ 0.39
2040	30	2.98	57,180	$ 4,003	$ 1.46	$ 0.10	$ 0.180	$ 1.74	$ 0.51
2041	30	2.98	57,180	$ 4,003	$ 1.46	$ 0.10	$ 0.180	$ 1.74	$ 0.49
2042	30	2.98	57,180	$ 4,003	$ 1.46	$ 0.10	$ 0.180	$ 1.74	$ 0.47
2043	30	2.98	57,180	$ 4,003	$ 1.46	$ 0.10	$ 0.180	$ 1.74	$ 0.44
2044	30	2.98	57,180	$ 4,003	$ 1.46	$ 0.10	$ 0.180	$ 1.74	$ 0.42
2045	30	2.98	57,180	$ 4,003	$ 1.46	$ 0.10	$ 0.180	$ 1.74	$ 0.40
2046	30	2.98	57,180	$ 4,003	$ 1.46	$ 0.10	$ 0.180	$ 1.74	$ 0.38
2047	30	2.98	57,180	$ 4,003	$ 1.46	$ 0.10	$ 0.180	$ 1.74	$ 0.36
2048	30	2.98	57,180	$ 4,003	$ 1.46	$ 0.10	$ 0.180	$ 1.74	$ 0.35
2049	30	2.98	57,180	$ 4,003	$ 1.46	$ 0.10	$ 0.180	$ 1.74	$ 0.33
2050	40	3.97	76,240	$ 5,337	$ 1.95	$ 0.10	$ 0.180	$ 2.23	$ 0.40
2051	40	3.97	76,240	$ 5,337	$ 1.95	$ 0.10	$ 0.180	$ 2.23	$ 0.38
2052	40	3.97	76,240	$ 5,337	$ 1.95	$ 0.10	$ 0.180	$ 2.23	$ 0.37
2053	40	3.97	76,240	$ 5,337	$ 1.95	$ 0.10	$ 0.180	$ 2.23	$ 0.35
2054	40	3.97	76,240	$ 5,337	$ 1.95	$ 0.10	$ 0.180	$ 2.23	$ 0.33
2055	40	3.97	76,240	$ 5,337	$ 1.95	$ 0.10	$ 0.180	$ 2.23	$ 0.32
2056	40	3.97	76,240	$ 5,337	$ 1.95	$ 0.10	$ 0.180	$ 2.23	$ 0.30
2057	40	3.97	76,240	$ 5,337	$ 1.95	$ 0.10	$ 0.180	$ 2.23	$ 0.29
2058	40	3.97	76,240	$ 5,337	$ 1.95	$ 0.10	$ 0.180	$ 2.23	$ 0.27
2059	40	3.97	76,240	$ 5,337	$ 1.95	$ 0.10	$ 0.180	$ 2.23	$ 0.26
2060	40	3.97	76,240	$ 5,337	$ 1.95	$ 0.10	$ 0.180	$ 2.23	$ 0.25
2061	40	3.97	76,240	$ 5,337	$ 1.95	$ 0.10	$ 0.180	$ 2.23	$ 0.24
2062	40	3.97	76,240	$ 5,337	$ 1.95	$ 0.10	$ 0.180	$ 2.23	$ 0.22
2063	40	3.97	76,240	$ 5,337	$ 1.95	$ 0.10	$ 0.180	$ 2.23	$ 0.21
2064	40	3.97	76,240	$ 5,337	$ 1.95	$ 0.10	$ 0.180	$ 2.23	$ 0.20
2065	40	3.97	76,240	$ 5,337	$ 1.95	$ 0.10	$ 0.180	$ 2.23	$ 0.19
								Total NPV of O&M Costs	$ 13.6

Capital Costs in million $:			Yr built		
PWTM	$	33.8	2030	$	16.3
Pumping Stations	$	6.8	2030	$	3.3
			Total NPV of Capital Costs	$	19.5

Total NPV of Capital and O&M Costs in millions $ 33
WTP to LCRA Delivery Point (#4)

LCRA Delivery Point (#4) to COA Delivery Point (#5)
(Bold line in schematic below)



Demands for this pipe segment
Demands

Average demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065	Max d/Avg d
COA	0	0	15	20	30	30	30	1.0
Total	0	0	15	20	30	30	30	

Max day demands to be delivered in each segment in mgd

Year	2015	2020	2030	2040	2050	2060	2065
COA	0	0	15	20	30	30	30
Total	0	0	15	20	30	30	30

PWTM and Pump Station Costs

Design flow rate - year 2065	30	mgd		
	20,832	gpm		
Inside diameter of PWTM	48	in.		
Area	12.57	sf		
Length of PWTM	7	miles	(linked to mileage in schematic above)	
	36,960	feet		

Estimated unit cost by condition:	% of length	LF	Unit cost	Cost	
Rural - soil	100%	36,960	$ 208	$ 7.7	million
Rural - rock	0%	-	$ 289	$ -	
Urban - rock	0%	-	$ 314	$ -	
		36,960		$ 7.7	million

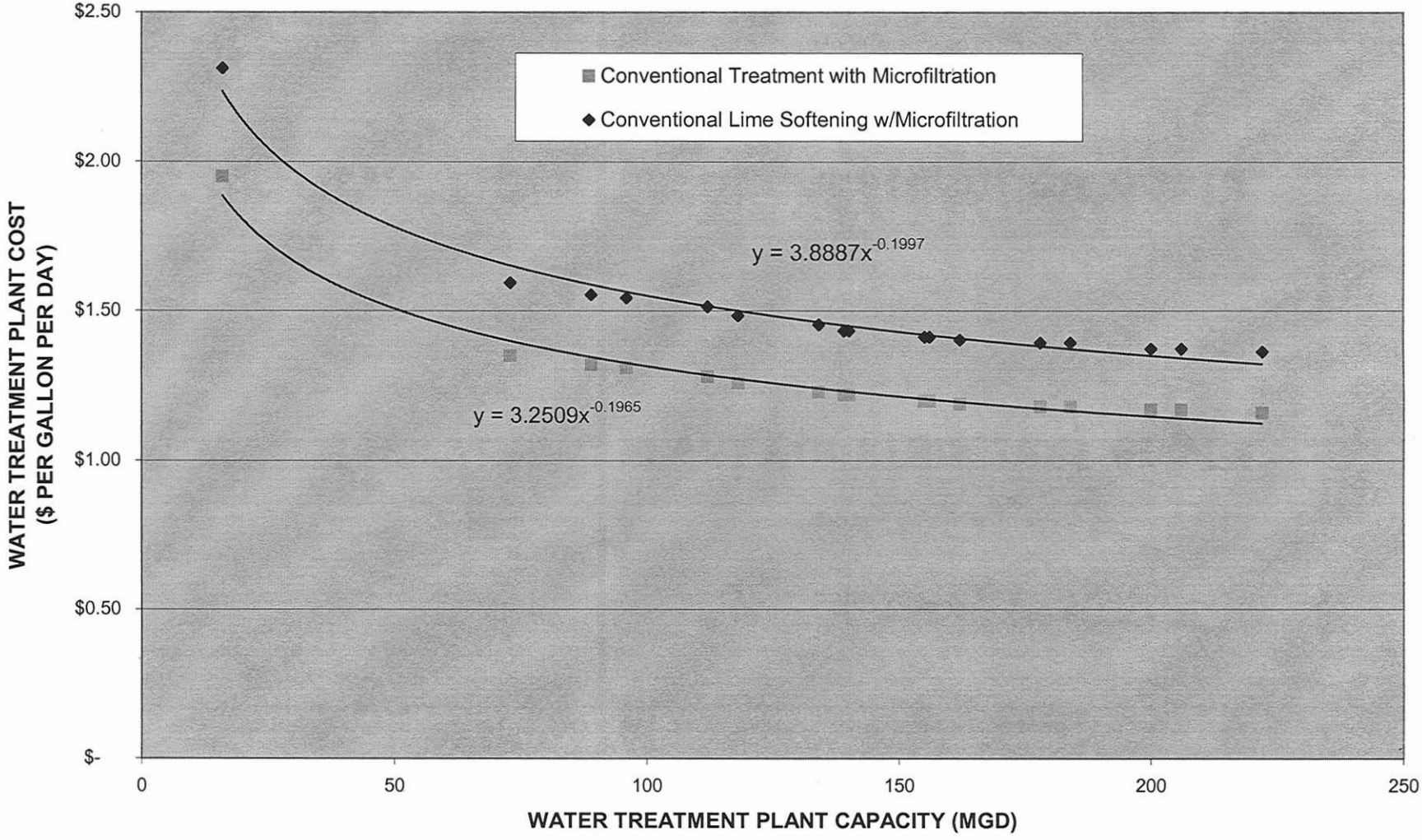
Average estimated unit construction cost for PWTM	$ 208	per LF	
Total construction cost in millions	$ 7.7		
Contingencies	$ 1.5		
Subtotal	$ 9.2		
Engineering, Legal & Administrative	$ 1.4		
Subtotal	$ 10.6		
Envir & Arch Studies & Mitigation, Surveying, & Land Acq	$ 0.0		
Total Capital Cost for PWTM in millions	$ 10.6		
Unit maintenance cost/year-mile	$ 10,000	$/year-mile	$ 0.070 Million $/year
Velocity at peak flow rate	3.69	fps	
C factor	120		
Head loss per foot	0.00096	ft/ft	$h_f = \left\| \frac{3.552*Q}{C*(d)^{2.63}} \right\|^{1.85}$
	5.06	ft/mile	
Head loss at peak flow rate	35	ft	
Allowance for minor losses 20%	7	ft	720 Desired HGL At Delivery Point
Total estimated losses	42	ft	790 Elev. At Delivery Point 4
Average static head	-70	ft	-70 ft
Total estimated dynamic head	-28	ft	
	-12	psi	

Negative indicates gravity flow from #4 to #5; no pumping necessary.

			Million $
Annual O&M Cost in million $:		Yr built	
PWTM	$ 0.070	2030	
		Total NPV of O&M Costs	$0.55
Capital Costs in million $:		Yr built	
PWTM	$ 10.6	2030	$ 5.10
		Total NPV of Capital Costs	$ 5.1
		Total NPV of Capital and O&M Costs in millions	**$ 5.6**

LCRA Delivery Point (#4) to COA Delivery Point (#5)

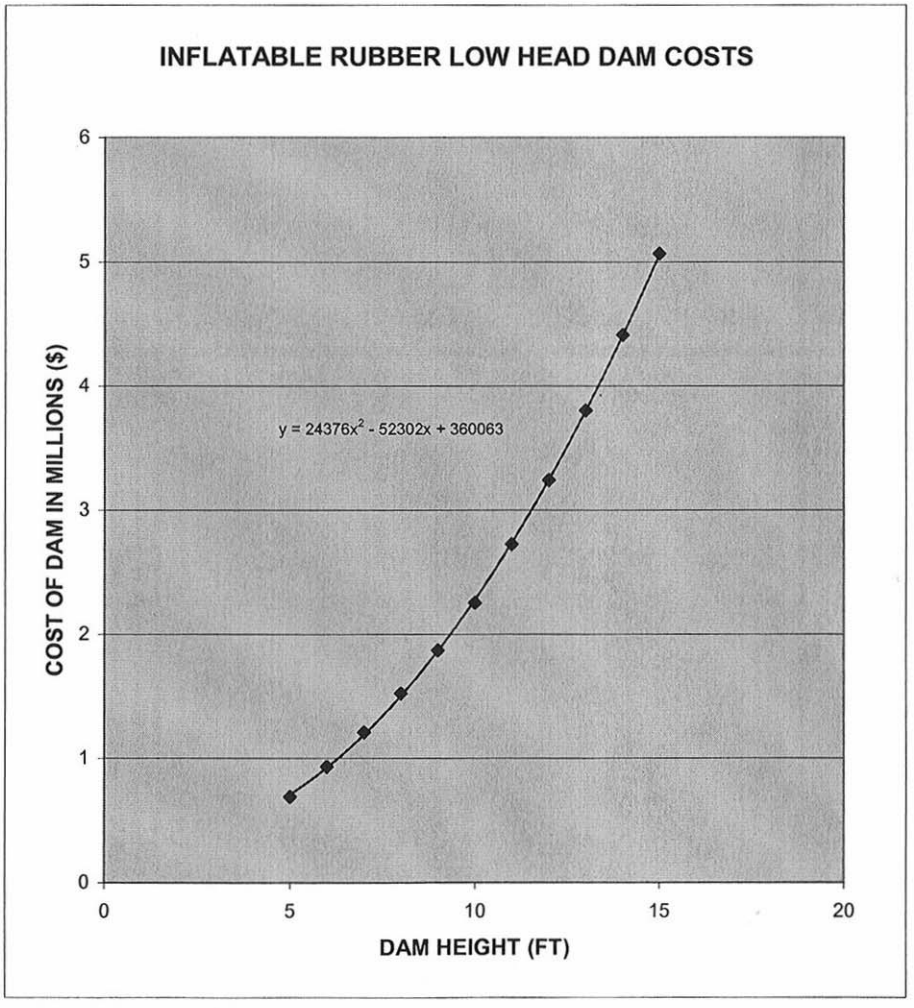
WATER TREATMENT PLANT CONSTRUCTION COSTS



INFLATABLE RUBBER LOW HEAD DAM COST

Dam Height (ft)	Total Cost ($)	Cost Per Height ($)
5	688,000	137,600
6	930,000	155,000
7	1,208,000	172,571
8	1,520,000	190,000
9	1,868,000	207,556
10	2,250,000	225,000
11	2,723,000	247,545
12	3,240,000	270,000
13	3,803,000	292,538
14	4,410,000	315,000
15	5,063,000	337,533

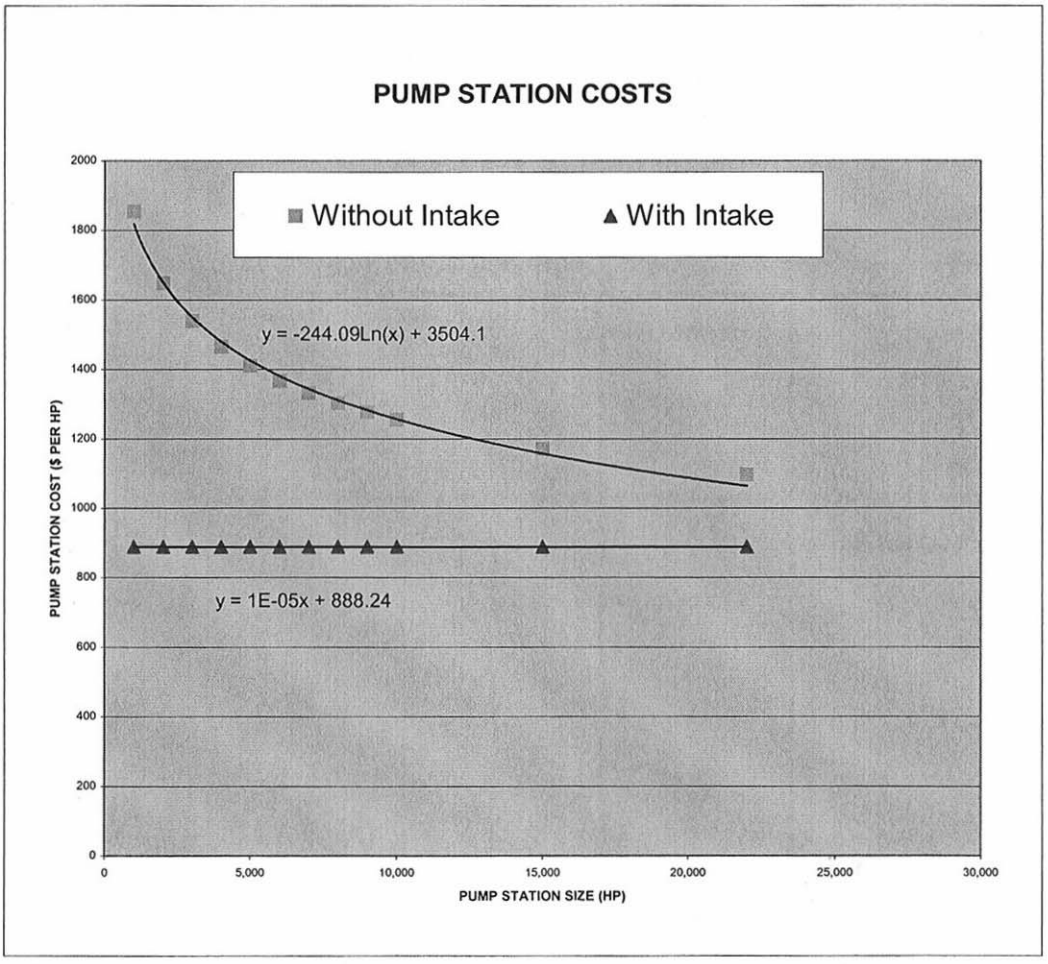
* Costs based on the LCRA-SAWS Water Project (LSWP), 2004.



PUMP STATION COSTS
WITH & WITHOUT INTAKE STRUCTURES

Pump Station (HP)	Pump Station Cost Without Intake Structure ($)	Cost Per HP ($)	Pump Station Cost With Intake Structure ($)	Cost Per HP ($)
1,000	1,854,000	1854	888,000	888
2,000	3,296,000	1648	1,776,800	888
3,000	4,615,000	1538	2,664,000	888
4,000	5,860,000	1465	3,553,600	888
5,000	7,052,000	1410	4,442,000	888
6,000	8,204,000	1367	5,330,400	888
7,000	9,324,000	1332	6,218,800	888
8,000	10,416,000	1302	7,107,200	888
9,000	11,486,000	1276	7,995,600	888
10,000	12,536,000	1254	8,884,000	888
15,000	17,551,000	1170	13,326,000	888
22,000	24,119,000	1096	19,544,800	888

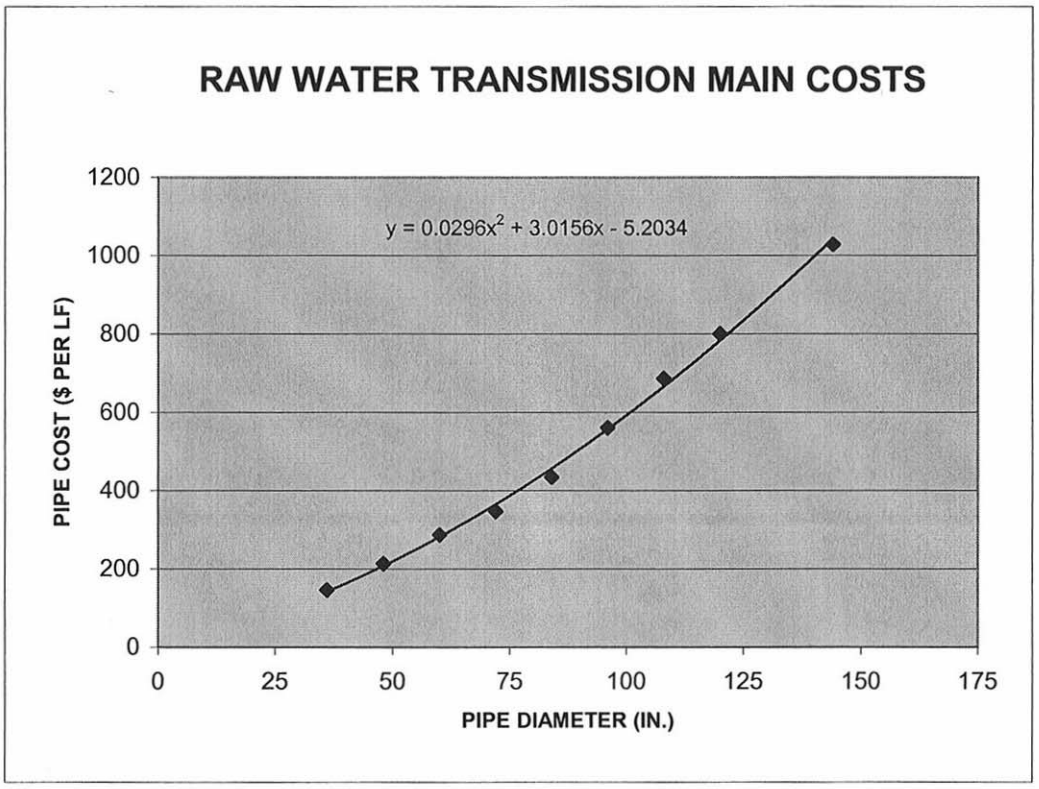
* Costs based on the LCRA-SAWS Water Project (LSWP), 2004.



RAW WATER TRANSMISSION MAIN COSTS

(in.)	($ / LF)
36	146
48	213
60	287
72	347
84	434
96	560
108	686
120	800
144	1028

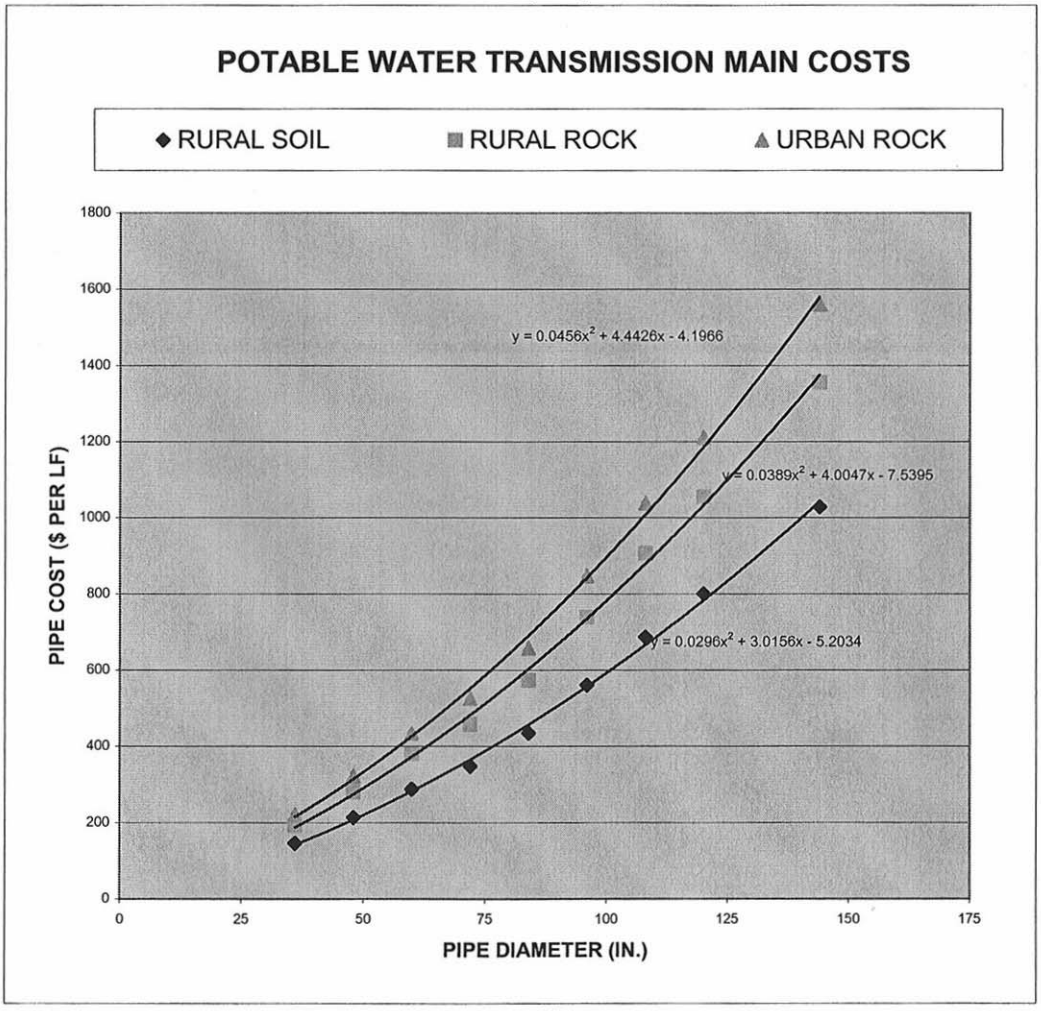
* Costs based on the LCRA-SAWS Water Project (LSWP), 2004.



POTABLE WATER TRANSMISSION MAIN COSTS

Diameter (in.)	RURAL SOIL Cost ($ / LF)	RURAL ROCK Cost ($ / LF)	URBAN ROCK Cost ($ / LF)
36	146	193	221
48	213	281	322
60	287	379	434
72	347	458	525
84	434	573	657
96	560	739	847
108	686	906	1038
120	800	1056	1211
144	1028	1356	1560

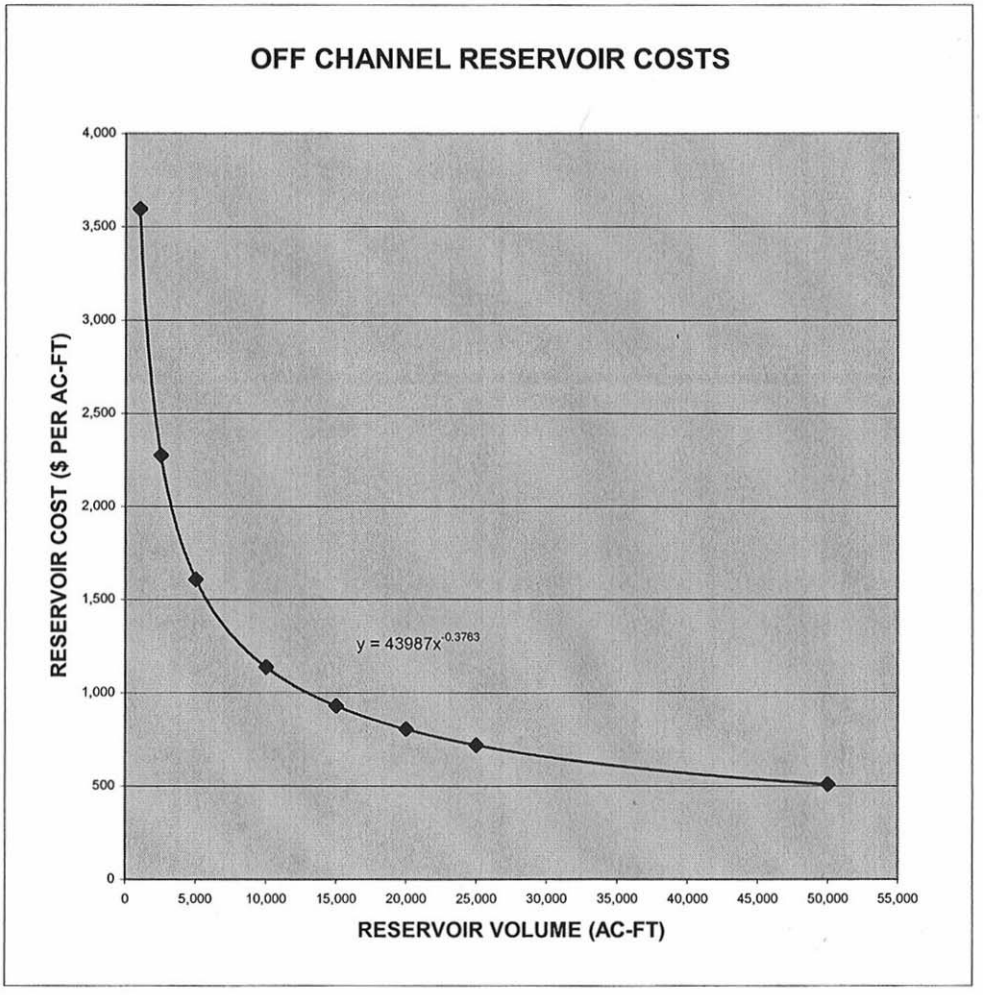
* Costs based on the LCRA-SAWS Water Project (LSWP), 2004.



OFF CHANNEL RESERVOIR COSTS

Volume (ac-ft)	Total Cost ($)	Cost Per Ac-Ft ($)
1,000	3,595,061	3,595
2,500	5,684,290	2,274
5,000	8,038,800	1,608
10,000	11,368,580	1,137
15,000	13,923,610	928
20,000	16,077,600	804
25,000	17,975,000	719
50,000	25,420,918	508

* Costs based on the LCRA-SAWS Water Project (LSWP), 2004.



APPENDIX 2

CENTRAL TEXAS REGIONAL WATER TREATMENT PLANT TO SERVE AUSTIN AND SAN ANTONIO WATER SYSTEM

MEETING MINUTES AND PARTICIPANT COMMENTS

TEXAS WATER DEVELOPMENT BOARD

July 28, 2005

Mr. Scott Ahlstrom, P.E.
Lower Colorado River Authority
P. O. Box 220
Austin, Texas 78767-0220

RE: Regional Water Supply Facility Planning Grant Contract between the Lower Colorado River Authority (LCRA) and the Texas Water Development Board (BOARD), TWDB Contract No. 2004-483-522, Draft Report Comments

Dear Mr. Ahlstrom:

Staff members of the Texas Water Development Board have completed a review of the draft report under TWDB Contract No. 2004-483-522. As stated in the above-referenced contract, the CONTRACTOR (S) will consider incorporating comments from the EXECUTIVE ADMINISTRATOR as shown in Attachment 1 and other commentors on the draft final report into a final report. The CONTRACTOR (S) will include a copy of the EXECUTIVE ADMINISTRATOR's comments in the final report.

The Board looks forward to receiving one (1) electronic copy, one (1) unbound single-sided camera-ready original, and nine (9) bound double-sided copies of the final report on this study.

If you have any questions concerning this contract, please contact Mr. David Meesey, the Board's designated Contract Manager for this study, at (512) 936-0852.

Sincerely,

William F. Mullican, III
Deputy Executive Administrator
Office of Planning

c: David Meesey, TWDB

Attachment 1
Board Contract No. 2004-483-522
Central Texas Regional Water Treatment Plant Study Comments

General Comments

1. The draft report consists of a series of technical memos that represent work performed under specific tasks in the contract scope of work. However, the memos are somewhat difficult to follow and would be improved through the addition of an executive summary that lays out the purpose of the study, introduction, conclusions and recommendations.

2. The tasks in the report do not follow the task sequence in the scope of work, which leads to confusion. In some instances, it is unclear whether or not particular scope of work tasks (i.e. 3, 10, and 11) are addressed in the report.

3. Better documentation of the participants, study area, comments received, and changes in emphasis made during the study could prove useful for reference in future years as this region grows and centralized water treatment becomes an even bigger issue than it is today.

Specific Comments from the Contract Scope of Work

1. Task 3 – Develop a Diagrammatic Trial Design of a Consolidated System Featuring a Single Water Treatment Plant Along with Necessary Raw Water and Finished Water Piping, does not include the raw and finished water piping components.

2. Task 6 – Establish Potential Plant Sites and Treated Water Pipeline Corridors, is only partly addressed, in that the discussion in the technical memorandum is limited primarily to connection points and does not address pipeline corridors. A corridor is defined as a narrow passageway or route. Typically existing right-of-ways for highways, railroads, power lines and possibly other utilities would be considered as possible corridors for water pipelines.

3. Task 8 – Examine Phasing Potential and the Effect of Phasing on Unit Costs, is only partly addressed, as no unit or other costs are demonstrated in the analysis of phasing.

Suggestions for Improving the Report (Listed By Technical Memorandum Subject)

1. Task 2 – Demand Projections

Bullet 1 under methodology refers to a City of Austin system model for determining future needs and planning improvements. Additional explanation would be helpful as to the type of model and how the model results were coordinated.

Bullet 2 under methodology states that SAWS is developing several potential sources of water. For the ones listed, it might be more accurate to state that SAWS is evaluating several potential sources.

Bullet 5 under methodology refers to LCRA demands but does not describe the basis for or how the LCRA demands were computed.

2. Task 4 – Water Treatment Process

Page 16, under Raw Water Storage, second paragraph. The technical memorandum recommends sizing the raw water storage reservoir to hold the differential between peak and average demand for a 30-day period. Please provide the reference for the 30-day period, such as water delivery data or engineering guidance document. Also the Task 9 technical memorandum was based on a raw water storage reservoir sized for 15 days of storage at average flow. The technical memorandum might clarify that both criteria provide similar reservoir sizes, if that is the case, or the same criterion should be used for both technical memoranda.

3. Task 8 – Phasing Potential

Table 8-3, Facilities Phasing, is unclear. For example three of the rows are identical. Additional explanation needs to be added to distinguish between Alternatives 1A, 1B, and 1C.

4. Tasks 3 and 10 – Economic Analysis

On page 1, under Unit Costs, second paragraph, Appendix 1 was not included.

The tables are difficult to read. Suggest either enlarging to 11 x 17 or revising to utilize larger fonts and/or decrease the amount of descriptive information inside table columns.

5. Task 14 – Conclusions and Major Project Issues

The last sentence on page 1 states that the lower costs for the four new alternatives were not comparable or that the changes to the basic scenario were not realistic and/or could not be implemented. Additional explanation and supporting information should be provided to support this conclusion, as it is not obvious from the information presented in this and the other technical memoranda.

6. Costs – The cost analysis appears to be cursory, and documentation for the basis of cost estimates is not included.

K FRIESE & ASSOCIATES, INC.

MEETING MINUTES

Date:	August 24, 2004
Time:	2:00 PM
Subject:	Central Texas Regional Water Treatment Plant to Serve Austin and San Antonio Water System
Location:	Aquarena Springs, San Marcos, Texas
Present:	See Attached List

The following items are believed to have been discussed at the above dated meeting. Unless adjustments are requested, these minutes will be filed as official documentation for this project.

The purpose of the meeting was to provide an update on project progress and receive participant input on project assumptions and demands. Agenda items are shown in italics and the related discussion summarized below.

I. Review Response to Requested Information

- A handout was distributed listing the status of specific information which had previously been requested from each participant. Participants were asked to review the list and provide outstanding items at their earliest convenience.

II. Review Study Area Map

- A handout was distributed showing the proposed study area. It was agreed that the study area in Williamson County will be shown as that area within Austin's service area only and that the service boundary for Bexar County will remain shown as the Bexar County line. Participants agreed to review and provide comment, if any.

III. Discuss Study Assumptions (reference August 2 letter)

- A peaking factor of 1.3 was discussed for the SAWS demand. SAWS typically uses a 1.3 peaking factor for planning purposes. The City of Austin will be including a peaking factor of 1.65. A general discussion of peaking factors concluded that the peaking factor will be unique for each participant and will be reflected in requested capacity and ultimate plant component sizing.
- A discussion of groundwater centered on the point that the intent of the study is to determine the feasibility of a regional water treatment plant and it is not intended to be a water supply study. Although groundwater may impact phasing or other aspects of the facilities, the study will concentrate on surface water treatment.
- The selection of conventional lime softening was questioned with regards to the hardness of water taken from near the delta as compared to water upstream. Water properties will be further considered in process assumptions.
- The best available cost data will be used for the study. This may include data from the Lower Guadalupe study (pending authorization and acceptance of assumptions) or data from TWDB regional plans. Currently, updated costs from Appendix A of the Region L Water Plan are being considered.

IV. *Review Response to Request for Water Demand Data*

- A table showing each study participant and incremental years for the study period (2015 to 2065) was displayed for recording demands. Draft demands for GBRA, LCRA, and the City of Austin were discussed. The participants will further consider demand needs and forward the information.

V. *Discuss Delivery Points and HGLs*

- It was acknowledged that SAWS and the City of Austin provided delivery points. The GBRA delivery point will be directly from the plant. Participants will further consider delivery points and HGLs and forward the information.

VI. *Discuss News Release*

- The possibility of a news release was discussed. It was determined that a one page project description would be developed and kept on-hand for press purposes. LCRA will initiate the effort and provide a draft to participants for input.

VII. *Information Required Prior to Next Meeting*

a. *Potential Plant Sites*
b. *Finalized Demands and Delivery Points*

- If participants have previously considered plant sites within the study area the information will be forwarded to the project team (particularly the City of Austin and SAWS). Otherwise the team will select conceptual plant locations.
- Participants will finalize demands, delivery point locations and delivery HGLs and forward the information no later than September 3rd.

VIII. *Set Next Meeting Date and Discuss Next Meeting Agenda*

a. *Discuss Treatment Process*
b. *Review Diagrammatic Trial Design*

- The next meeting was set for Wednesday, September 22, 2004 at 2:00 PM, at Aquarena Springs.

ACTION	RESPONSIBLE PARTY	DEADLINE
Outstanding Requested Information	All Participants	September 3rd
Finalize Demands	All Participants	September 3rd
Finalize Delivery Points and HGLs	All Participants	September 3rd
Upstream and Downstream Water Quality and Hardness Data	LCRA	September 3rd
One Page Project Summary	LCRA	September 3rd

CENTRAL TEXAS REGIONAL WATER TREATMENT PLANT
TO SERVE AUSTIN AND SAN ANTONIO
August 24, 2004

Name	Organization	Phone No.	E-Mail Address
Chris Lippe	Austin Water Utility	(512) 972-0108	chris.lippe@ci.austin.tx.us
Teresa Lutes	Austin Water Utility	(512) 972-0179	teresa.lutes@ci.austin.tx.us
Fred Blumberg	GBRA	(830) 379-5822	fblumberg@gbra.org
Thomas D. Hill	GBRA	(830) 379-5822	thill@gbra.org
Everett Owen	K Friese & Associates, Inc.	(512) 338-1704	eowen@kfriese.com
Karen Friese	K Friese & Associates, Inc.	(512) 338-1704	kfriese@kfriese.com
Tom Owens	K Friese & Associates, Inc.	(512) 338-1704	towens@kfriese.com
Bill Leisering	LCRA	(512) 473-3588	bleisering@lcra.org
Jason Eichler	LCRA	(512) 473-3200 x7782	jeichler@lcra.org
Randy Goss	LCRA	(512) 473-3589	rgoss@lcra.org
Scott Ahlstrom	LCRA	(512) 473-3367	sahlstrom@lcra.org
Melissa Bryant	SARA	(210) 302-3611	mbryant@sara-tx.org
Kevin Morrision	SAWS	(210) 704-7253	kmorrison@saws.org
Meg Conner	SAWS	(210) 704-7613	mconner@saws.org
David Meesey	TWDB	(512) 936-0852	david.meesey@twdb.state.tx.us

K FRIESE & ASSOCIATES, INC.

MEETING MINUTES

Date:	October 6, 2004
Time:	2:00 PM
Subject:	Central Texas Regional Water Treatment Plant to Serve Austin and San Antonio Water System
Location:	Aquarena Springs, San Marcos, Texas
Present:	See Attached List

The following items are believed to have been discussed at the above dated meeting. Unless adjustments are requested, these minutes will be filed as official documentation for this project.

The purpose of the meeting was to provide an update on project progress and receive participant input on project demands, alternative scenarios, Simsboro water use potential, and upcoming actions. Agenda items are shown in italics and the related discussion summarized below.

I. Review demand calculations

- A table showing average day demand, maximum delivery rate, and delivery points with HGLs was distributed and reviewed.
- The City of Austin and LCRA may each be including demands for the Heep Ranch area in the reported numbers. Jason and Teresa will resolve any discrepancy.
- Demands for Bastrop County/Aqua will not be included in the study at this time.
- The maximum delivery rate for GBRA will include a peaking factor of two (2).
- Delivery points were reviewed and agreed to. GBRA's delivery point is assumed to be at the plant site.
- The Blanco River Basin will be added to the study area.

II. Review ALCOA/CPS groundwater availability assumptions.

- Selected pages from "Preliminary Feasibility of Options to Deliver ALCOA/CPS Groundwater to Bexar County", HDR, January 2000, were distributed.
- The CTRWTP study is assuming Scenario A from the HDR report – 40,000 acft/yr from ALCOA and 15,000 acft/yr from CPS. SAWS is comfortable with this assumption.
- TSAWS reported that the "Direct Pipeline" delivery option for ALCOA/CPS groundwater is the most probable option at this point in time. SAWS will provide updated cost estimates.
- ALCOA/CPS groundwater quality was reviewed. Iron and manganese content may require treatment or blending. High temperatures may be the primary item of concern.

III. Review anticipated raw water quality in the Lower Colorado vs. Town Lake.

- A Water Quality Summary Table with selected Town Lake, Wharton, and Bay City parameters from the Waterquality.LCRA.org website was distributed and reviewed.
- A list of regulations and treated water quality objectives was distributed and discussed.

IV. Review water treatment technology issues and options.

- A chart showing water treatment plant unit costs vs. capacity was distributed and reviewed.
- It was pointed out that based on maximum delivery rates a 367 MGD plant is currently being considered. This size plant is in the $1.00/gal range on the chart.
- Conventional lime softening is being assumed for the plant. The question of what if SAWS and/or SARA do not want softened water was raised. Two options are available (1) deliver softened water and blend with unsoftened water or (2) have separate treatment trains.
- The relative cost of conventional lime softening with membrane treatment would add approximately $0.25/gal as compared to conventional lime softening with granular filtration (typical for City of Austin plants). Since each scenario examined for the CTRWTP project will use the same treatment process the treatment method selected will not impact the outcome.

V. Review three preliminary intake/treatment/transmission system layouts with cost estimates.

- Maps showing each system layout were distributed. Three treatment plant location alternatives were examined for preliminary screening. Each scenario includes an intake near Bastrop and an intake at the north Matagorda County line. The treatment plant locations include one on the northeast side of San Antonio, one near San Marcos, and one on the southeast side of Austin. Each scenario delivers water to each participant's identified delivery point.
- Capital cost estimates for the scenarios were reviewed and Alternative 2, treatment plant located near San Marcos, is the least cost alternative.
- Options for blending groundwater into the raw surface water were discussed. The most economical option is to transport the groundwater to the river/Bastrop intake via Big Sandy Creek. It was noted that environmental and other factors must be considered to ensure feasibility of this transport means.
- Although the preliminary analysis is intended to be an alternatives screening process to narrow the options for further consideration, "cost drivers" and their effect on each alternative should be identified before eliminating any options. For example, diverting all of the raw water from Matagorda and deleting the Bastrop intake could impact the location of the least cost alternative.
- LCRA noted that the identified demand is greater than the available supply from the Colorado River (by 53,428 acft/yr in year 2065) and questioned the source of supply water for SARA and GBRA demands. Reducing the plant size by the overage amount will not significantly impact the plant unit cost per gallon and it was decided to take the demand out of the raw water lines but to leave it in the finished water lines for cost estimating purposes.
- The City of Austin's options of interim water sale (depending on Austin's needs) and timing of future treatment plant projects relative to the CTRWTP may have a significant impact on project phasing.

VI. Proposed project schedule for next 3 months.

- Deliver Technical Memorandums for tasks one through five by November 15.
- Schedule next meeting for early December (actual meeting date to be determined).
- Deliver technical memorandums for tasks six through nine by January 15.

VII. Information or assistance needed from participants

- Comments, concerns, and questions on the project from the participants will be forwarded to Jason Eichler by October 20th.

VIII. Discuss Project Description (news release)

- Comments on the project description will be forwarded to Jason Eichler by October 20th.
- It was noted that the project description is not intended as a press release but will be kept on-hand in case information is requested by the press.

ACTION ITEMS

ACTION	RESPONSIBLE PARTY	DEADLINE
Project comments/concerns/questions	All Participants	October 20th
Project Description comments	All Participants	October 20th
Task 1 thru 5 Tech. Memos	KFA	November 15th
Task 6 thru 9 Tech Memos	KFA	January 15th

CENTRAL TEXAS REGIONAL WATER TREATMENT PLANT
TO SERVE AUSTIN AND SAN ANTONIO
October 6, 2004

Name	Organization	Phone No.	E-Mail Address
Teresa Lutes	Austin Water Utility	(512) 972-0179	teresa.lutes@ci.austin.tx.us
Thomas D. Hill	GBRA	(830) 379-5822	thill@gbra.org
Everett Owen	K Friese & Associates, Inc.	(512) 338-1704	eowen@kfriese.com
Karen Friese	K Friese & Associates, Inc.	(512) 338-1704	kfriese@kfriese.com
Tom Owens	K Friese & Associates, Inc.	(512) 338-1704	towens@kfriese.com
Breck Plauche	K Friese & Associates, Inc.	(512) 338-1704	Breck@realtime.net
Bill Moriarty	EarthTech	(512) 479-1609	bill.moriarty@earthtech.com
Karen Bondy	LCRA	(512) 473-4019	bleisering@lcra.org
Jason Eichler	LCRA	(512) 473-3200 x7782	kbondy@lcra.org
Randy Goss	LCRA	(512) 473-3589	rgoss@lcra.org
Scott Ahlstrom	LCRA	(512) 473-3367	sahlstrom@lcra.org
Phil Weynand	SARA	(210) 302-3629	pweynand@sara-tx.org
Kevin Morrision	SAWS	(210) 704-7253	kmorrison@saws.org
Meg Conner	SAWS	(210) 704-7613	mconner@saws.org
David Meesey	TWDB	(512) 936-0852	david.meesey@twdb.state.tx.us

K FRIESE & ASSOCIATES, INC.

MEETING MINUTES

Date:	March 7, 2005
Time:	9:30 AM
Subject:	Central Texas Regional Water Treatment Plant to Serve Austin and San Antonio Water System
Location:	Aquarena Springs, San Marcos, Texas
Present:	See Attached List

The following items are believed to have been discussed at the above dated meeting. Unless adjustments are requested, these minutes will be filed as official documentation for this project.

The purpose of the meeting was to review the Draft Technical Memorandums and discuss the direction of the remainder of the study. Agenda items are shown in italics and the related discussion summarized below.

I. Brief Presentations of Technical Memorandums

- Each Technical Memorandum was briefly presented.
- Written comments on the memorandums will be submitted by the Participants within two weeks.

II. Discussion

- The original purpose of the study was summarized as determining if a regional facility to serve Austin and San Antonio Water System would be less expensive than individual projects. It was discussed that the conclusion of the study could go beyond providing a net present value of a regional facility and may include items such as:
    - Should two sub-regional facilities be considered (south Austin and San Antonio)?
    - A regional alternative which involves two plants (Alt. 1D).
    - Identification of specific next step(s) which could be taken after completion of the study.

- Various scenarios for possible economic analysis were discussed. These scenarios included:
    - Not applying a peaking factor to the SAWS demand since other sources may be available to supply the peak;
    - Splitting the sources such that supply from the Bastrop area would be used in the south Austin sub-region and supply from the Matagorda area would be used in the San Antonio sub-region. Austin expressed concern with source compatibility and requested more information if the supply split is further pursued.

III. Future Milestones

- The project team will evaluate study findings and discussions to date and propose a methodology for completing the work.

ACTION ITEMS

ACTION	RESPONSIBLE PARTY	DEADLINE
Technical Memorandum Comments	All Participants	March 21, 2005
Project Methodology	Study Team	March 21, 2005

Regional Treatment Plant Comments & Questions

- Is the planned Bastrop Diversion capable of diverting more than the 18,000 AF/yr? Any additional water that could be diverted at Bastrop could reduce the costs associated with the transmission line between Matagorda County and the Regional Treatment Plant. This could provide significant cost savings for all parties. This may also assist with phasing opportunities.

- Finished water quality remains a major issue as we move through the remainder of this study. Since San Antonio would be taking the majority of water from this treatment plant, it would seem reasonable to match San Antonio's water quality. This needs to be further discussed.

    - Treatment with Chloramines is a major issue for the SAWS system and will need to be thoroughly investigated. Chlorine injection is utilized throughout the entire SAWS system.

- What is the elevation of the Treatment Plant in Caldwell County?

- Is water from the Simsboro Project considered in all of the alternatives or only the composite?

- Demand numbers for the LCRA-SAWS Water Project can be phased in to reduce the production requirements.

	Simsboro	**Bastrop**	**LCRA-SAWS**	**Total**
Year 2020	55,000	18,000	66,000	139,000
Year 2030	55,000	18,000	132,000	205,000

- For Simsboro water conveyed directly to the treatment plant by pipeline should reflect costs for public supply wells (in the Alcoa & CPS wellfields). If the water is dropped in the Colorado River, then non-public well costs should be utilized.

CENTRAL TEXAS REGIONAL WATER TREATMENT PLANT
TO SERVE AUSTIN AND SAN ANTONIO
March 7, 2005

Name	Organization	Phone No.	E-Mail Address
Teresa Lutes	Austin Water Utility	(512) 972-0179	teresa.lutes@ci.austin.tx.us
Bill Moriarty	EarthTech	(512) 479-1609	bill.moriarty@earthtech.com
Fred Blumberg	GBRA	(830) 379-5822	fblumberg@gbra.org
Thomas D. Hill	GBRA	(830) 379-5822	thill@gbra.org
Breck Plauche	KFA	(512) 338-1704	Breck@realtime.net
Everett Owen	KFA	(512) 338-1704	eowen@kfriese.com
Karen Friese	KFA	(512) 338-1704	kfriese@kfriese.com
Tom Owens	KFA	(512) 338-1704	towens@kfriese.com
Jason Eichler	LCRA	(512) 473-3200 x7782	jeichler@lcra.org
Scott Ahlstrom	LCRA	(512) 473-3367	sahlstrom@lcra.org
Melissa Bryant	SARA	(210) 302-3611	mbryant@sara-tx.org
Phil Weynand	SARA	(210) 302-3629	pweynand@sara-tx.org
Kevin Morrision	SAWS	(210) 704-7253	kmorrison@saws.org
David Meesey	TWDB	(512) 936-0852	david.meesey@twdb.state.tx.us
Gilbert Ward	TWDB		gilbert.ward@twdb.state.tx.us

Austin Water Utility
4/12/2005

Central Texas Water Treatment Plant to Serve Austin and San Antonio

Comments on Cover Letter

We offer the following comments on the Cover Letter (February 11, 2005):

On page 2, in the section discussing potentially reconsidering initial assumptions:

a. Peaking vs. base load assumption: Due to the large number of associated initial assumptions and uncertainties and for consistent comparison purposes, we recommend keeping the assumption that the projected maximum delivery rate should be based on a projected peaking factor for Austin's portion of the projected plant demand. Austin's portion of the demand projection includes using an average day to peak day demand multiplier of 1.67.
b. Treatment Process assumption: the letter suggests that the second assumption reconsideration would be for the proposed treatment facility to have only one un-softened treatment process. With this assumption, the water from the proposed plant would not be compatible with the current or future City of Austin water provided to Austin customers and thus would not meet Austin's needs. For the results of the study to remain applicable Austin, as set forth in the original scope, the study should continue to evaluate the feasibility of a single facility to meet both Austin and San Antonio needs. To meet water compatibility requirements, the study should continue to assume the plant's treatment process for Austin's portion will produce softened water compatible with Austin's water.

Comments on Draft Technical Memorandums

We offer the following comments on the Draft Technical Memorandums on the above Project:

1. Task 4 Background Section, end of the first sentence of Paragraph 7: Suggest changing the word "preferences" to "requirements".
2. Task 4 Background Section, Figure 4.1 and the other project maps: As previously suggested, consider changing "project service area" to indicate the service areas of Austin and San Antonio, as originally shown in the project scope materials. As currently depicted, the project service area indicates considerable portions of outside of the project service areas as discussed over the course of the project, including large areas of Williamson and Bastrop County.
3. Task 4, first line of text under Table 4-1: Suggest changing "downstream of the City of Austin" to "in the Lower Colorado River Basin", since one of the points is Town Lake.
4. Task 4, Notes under Table 4-3: In the Note at the bottom of the table there is a reference to "100 miles down river". It is unclear what is being referred to.
5. Table 4-4 states the City of Austin utilizes only Chloramine for disinfection. This is incorrect. The City of Austin utilizes a combination of chlorine and chloramine disinfection. Also, suggest changing heading "size" to "capacity".
6. Task 4, end of second paragraph from the end of the "Softening" section: Suggest changing "Clearly Austin is used to soft water" to "Austin Water Utility provides softened water."
7. Task 4, last paragraph in "Softening" section: Suggest changing "…Austin using chloramines" to "Austin utilizes a combination of chlorine and chloramine disinfection."
8. Task 4, in the second sentence of the Paragraph 5 in the "Process Alternatives" section: Suggest changing the word "prefer" to "require".

9. Task 4, in the section just above “Residuals Disposal”, approximately 3 paragraphs are duplicated from the text immediately above.
10. Task 4, “Raw Water Storage” section: An assumption of 30 successive peak days seems very conservative. It may be worthwhile to examine this assumption to determine if a shorter duration of successive peak days would significantly impact the sizing and costs of the raw water storage facilities.
11. Task 4, Figure 4.7, is unit cost information available that would range high enough to cover the largest plant size contemplated by the project?
12. Task 5, Page 2 of 5, third paragraph: Not sure as to the validity of the listed advantages numbered 2 and 3 (i.e., downstream water quality and public perceptions items), particularly the water quality item. Recommend reducing the list down to one advantage (item #1 on list), that being the presence of the dam with its associated lake.
13. Task 5, Page 4 of 5, Bastrop Raw Water Intake Facilities section: In this section it is unclear if the project contemplates two or four 15,000 acre-foot off-channel reservoirs at the Bastrop location. The first paragraph mentions two and the fourth paragraph mentions four. Are the two extra off-channel reservoirs only needed if the system is sized for both Colorado River water and ALCOA water? Also in the same portion of the report, suggest that it should be noted that any required off-channel reservoirs near Bastrop would need to be constructed on land from willing sellers and would address all applicable environmental concerns.
14. Task 6, Table 6-2, last item in “Design Basis” column: What is definition of “downstream” in this table? Is that downstream of the treatment process? Would the term “participants” work there instead?
15. Tasks 3 and 10, Page 1 of 4 and tables 3-10-1 and 2: Add an item #5 to the list, prepare a total unit cost for each alternative, in $/af or $/MGD. In Tables 3-10-1 and 2, add plant capacity and the unit cost figure for each alterative.
16. Tasks 3 and 10, Page 3 of 4: In the second paragraph from the bottom of the page the report states that Alternative 3B would require an agreement, including the City of Austin and others, for SAWS to temporarily withdrawal water at the Bastrop intake in excess of 18,000 af-ft/yr. While the concept details are unclear, there are a number of potential issues with this alternative including water rights and water supply issues and its inconsistency with the adopted Lower Colorado Regional Water Planning Group (Region K) water plan.
17. Tasks 3 and 10, Page 4 of 4: The draft states "The COA would need to verify that treated groundwater from the ALCOA/CPS well fields would be compatible with its treated water from other sources, and that its treatment would be less expensive than treatment of surface water from the Colorado River in its own treatment plant". It is expected that the treated groundwater would not be compatible with Austin’s treated water.
18. Tasks 3 and 10, Page 4 of 4 states "The COA, LCRA, and SAWS would need to negotiate a water rights transfer that would give SAWS access to 44,804 af/yr (...33,604 from COA) of Colorado River water in return for the same amount from the ALCOA/CPS well fields." Austin has concerns/issues with this Alterative related to comparative reliability, particularly during drought conditions, long-term water supply availability, and water compatibility. Additionally, Alternative 1D is problematic in that it is not consistent with the study’s approach of examining a single facility. It also does not result in significant cost savings.

We appreciate the opportunity to comment on the draft technical memos. We look forward to the opportunity to further comment as the report nears completion.

Should you have any questions please contact Chris Lippe (512-972-0108) or Teresa Lutes (512-972-0179)

San Antonio Water System

August 16, 2004

Jason Eichler, P. E.
LCRA Water & Wastewater Utility Services
P.O. Box 220
Austin, TX 78767-0220

Re: Central Texas Water Treatment Plant Study

Dear Mr. Eichler:

Thank you for your letter of August 2, 2004 addressing project-engineering assumptions. The SAWS staff and I have reviewed the assumptions and offer the following comments and suggestions:

- **Assumption Item 2:** While service from such a distance is likely to be designed at constant rate, we need to evaluate the cost of oversizing for potential future volumes or some moderate peaking vs. the cost of local storage to meet summer peaking requirements. We have typically selected a 1.3 peaking factor in other water supply projects to reduce the size of terminal storage required. Additionally, we need to refine the withdrawal rates from the Lower Colorado River and look at the diversion from Bastop area with LCRA. It is possible that we could consider the use of the diversion rate identified in the Region L plan.

- **Assumption Items 3 & 4:** It is important that the water derived from the Simsboro project remain as input source of water for this project. One of the potential future uses of the Simsboro project may be to meet regional needs. If the project were to be utilized in this capacity, treatment at the source would be more important than if Bexar County users were the primary users. The potential to co-locate groundwater treatment facilities was key to our involvement in the study.

- **Assumption Item 5:** We may need additional detail regarding the selection of appropriate treatment/softening process assessment of the quality of the receiving waters in our system.

- **First paragraph after the assumptions:** Because this is a high level regional study, we recommend that the river authorities provide the expected water demands within their service areas. It is probable that the River Authorities have more detailed information on some of the communities that may need water along the pipeline route. The table with County demand projections should also be broken down by city, so that work on potential pipeline alignments can be more easily accomplished.

- **Specific Request #1 (page 2):** Please use the Region L planning forecast and break out by city.

- **Specific Request #2 (page 2):** Potential demand along the pipeline alignment is an expected outcome of the study rather than an input from the study participants.

- **Specific Request #3 (page 2):** SAWS' total water demand in 2050 as projected in the Region L plan is approximately 291,858 AF/yr. SAW water supply is derived from a number of sources, of which this could potentially be one.

Water Delivery Points:
For the purposes of this study, our infrastructure planning staff has requested that water be delivered at two potential locations. Approximately 60% of the water would be delivered to a point on the west side of San Antonio and the remaining 40% would be dropped at the northeast location. Detailed maps will be forwarded.

- Western Delivery Point:
  Highway 211 and FM 471 (Culebra Property)

- Northeast Delivery Point:
  Green Mountain Rd and Loop 1604 (Green Mountain Pump Sta.)

System Water Quality
I have included the most recent water quality report that characterizes the overall system water quality to assist with determination of appropriate water treatment and system compatibility issues.

Again, thank you for the opportunity to comment on the assumption for the project. If you should require additional information please contact me at (210) 704-7375 or Kevin Morrison at (210) 704-7253.

Sincerely,

Susan Butler
Director – Water Resources

Cc: Karen Friese, P.E.
Steve Raabe, P.E. - SARA
Fred Blumberg – GBRA
Chris Lippe – City of Austin
File

Types Of Contaminants

Sources for drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs and wells. As water travels over the surface of the land or through the ground, it dissolves naturally occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activity. Contaminants that may be present in source water include:

- Microbiological contaminants, such as viruses and bacteria which may come from sewage treatment plants, septic systems, agricultural livestock operations and wildlife. Cryptosporidium is an example of a microbiological contaminant affecting surface water sources. Since SAWS uses underground aquifers as water sources, Cryptosporidium is not a tested contaminant.
- Inorganic contaminants, such as salts and metals which can be naturally-occurring or result from urban stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining or farming;
- Pesticides and herbicides, which may have a variety of sources such as agriculture, urban stormwater runoff and residential uses;
- Organic chemical contaminants which are by-products of industrial processes and petroleum production and can also come from gas stations, urban stormwater runoff and septic systems and;
- Radioactive contaminants, which can be naturally occurring or the result of oil and gas production and mining activities.

Contaminants may be found in drinking water and may cause taste, color or odor problems. These types of problems are not necessarily causes for health concerns. For more information on taste, odor or color of drinking water, contact SAWS Customer Service Department at (210)704-SAWS (7297).

Understanding The Charts

Maximum Contaminant Level Goal (MCLG): The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for margin of safety.

Maximum Contaminant Level (MCL): The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLGs as feasible using the best available treatment technology.

Action Level: The concentration of a contaminant which, if exceeded, triggers treatment or other requirements which a water system must follow.

Not regulated: The contaminant is not currently regulated by the Environmental Protection Agency.

pCi/l: Picocuries per liter. A measure of radioactivity in water.

ppm: Parts per million. One part per million equals one teaspoon in 1,302 gallons, which is enough water to fill a typical bathtub more than 40 times.

ppb: Parts per billion. One part per billion is equal to one teaspoon in 1,302,000 gallons – enough to fill a typical bathtub more than 40,000 times.

N/A: Not applicable

ND: Not detected

Points-of-entry: Entry point to the distribution system which is representative of each well after disinfection.

Remember that these substances are shown in parts per million or parts per billion. As you will see in these charts, water delivered by SAWS is of excellent quality.

Substance	Test Year	Concentration Range Found	Highest Concentration Found	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Goal (MCLG)	Possible Source
Nitrate (ppm)	2003	0.6 - 2.12	2.12	10	10	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits.
Barium (ppm)	2003	0.0487 - 0.0516	0.0516	2	2	Discharge from drilling wastes; discharge from metal refineries; erosion of natural deposits.
Fluoride (ppm)*	2003	0.5 - 1.1	1.1	4	4	Erosion of natural deposits; Discharge from fertilizer and aluminum factories.
Nitrite (ppm)	2003	ND - 0.01	0.01	1	1	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits.
Tetrachloroethylene (ppb)	2003	ND - 0.9	0.9	5	0	Leaching from PVC pipes; discharge from factories and dry cleaners.
Di-(2-ethylhexyl) phthalate (ppb)**	2003	ND-4.19	4.19	6	0	Discharge from rubber and chemical factories.
Gross alpha adjusted (pCi/l)	2003	ND - 3.4	3.4	15	0	Erosion of natural deposits.

* Fluoride in the form of hydrofluorosilic acid (H_2SiF_6) was added to SAWS drinking water as of August 2002.

**Phthalate contamination was unavoidable in the process of analyzing the sample for this substance, therefore this concentration may not have been reliable.

Other Substances (2003)

Substance	Concentration Range (ppm)	Average Concentration Found (ppm)	MCL (ppm)
Calcium	71-91	81	Not Regulated
Chloride	20	20	250
Copper	0.005 - 0.007	0.006	1
Magnesium	16 - 29	23	Not Regulated
Sodium	6 - 9	8	Not Regulated
Sulfate	17 - 20	19	250
Total Hardness[a]	240 - 343	292	Not Regulated
Total Alkalinity[a]	209 - 319	264	Not Regulated
Total Dissolved Solids	283 - 358	321	500
Zinc	0.0336 - 0.129	0.08	5

[a] as Calcium Carbonate

Microbiological Contaminants Monitoring (2003)

Substance	MCL	Amount Found	Source
Total Coliform (presence)	[b]	Highest Monthly % of positive samples 3.24%	Naturally present in the environment
Fecal Coliform (presence)	[c]	0	Human and animal fecal waste

[b] Presence of coliform bacteria in 5% or more of the monthly samples.

[c] A routine sample and a repeat sample are total coliform positive, and one is also fecal coliform or E. coli positive

What Are Coliforms?

Total coliform bacteria are used as indicators of microbial contamination of drinking water because testing for them is easy. While not disease-causing organisms themselves, they are often found in association with other microbes that are capable of causing disease. Coliform bacteria are more hardy than many disease-causing organisms; therefore, their absence from water is a good indication that the water is microbiologically safe for human consumption.

Fecal coliform bacteria and in particular, E. coli are members of the coliform bacteria group originating in the intestinal tract of warm-blooded animals and are passed into the environment through feces. The presence of fecal coliform bacteria (E. coli) in drinking water may indicate recent contamination of the drinking water with fecal material. The table above indicates whether total or fecal coliform bacteria were found in the monthly drinking water samples submitted for testing last year.

Required Monitoring - No MCL's [d] (2003)

Substance [e]	Range Detected (ppb)	Average Concentration (ppb)	Reason for monitoring
Chloroform	ND	ND	
Bromodichlormethane	ND - 2.4	1.1	
Dibromochloromethane	ND - 2.9	1.6	
Bromoform	ND - 1.3	1.1	

[d] These values are from points-of-entry

[e] Unregulated contaminants are those for which EPA has not established drinking water standards. The purpose of unregulated contaminant monitoring is to assist EPA in determining the occurrence of unregulated contaminants in drinking water and whether future regulation is warranted.

Lead and Copper Results [f] (2001)

Substance	90th Percentile	Action Level	Number of residences exceeding Action Level	Possible Source
Lead (ppb)	4.9	15	0	Corrosion of household plumbing
Copper (ppm)	0.215	1.3	0	

[f] These two metals enter the water because of corrosion of household plumbing. Many older homes have copper pipes that were put together with lead-based solder. The 90th percentile means that 90 percent of the homes measured had less than that. A total of 50 residences were monitored.

I tend to agree with the comment that one of the outcomes should be discussions among GBRA, LCRA and City of Austin related to northern Hays County. That should be included in the conclusions/recommendations section of the final report.

thnaks. fmb

-----Original Message-----
From: Jason Eichler [mailto:jason.eichler@lcra.org]
Sent: Monday, March 28, 2005 1:47 PM
To: Fred Blumberg
Subject: Re: FW: In-kind services documentation

Thanks Fred. I seemed to recall you had a comment to list all the financial assumptions such as interest rates so each entity could make their own comparisons. Let me know if there is anything else you would like to discuss/revise.

Jason

MEMORANDUM

LCRA ENERGY • WATER • COMMUNITY SERVICES
Water Services

November 24, 2004

TO: Karen Friese, Tom Owens

FROM: Jason Eichler

CC: Scott Ahlstrom, Bill Leisering, Ron Anderson, Ken Hall

SUBJECT: Comments on draft report.

I have completed a preliminary review of the Central Texas study and prepared comments below. I appreciate the effort that has gone into producing this draft, and look forward to helping with development of the report. I understand that work is continuing on this draft, so some of the comments mentioned below may already be in progress.

I also anticipate it will be difficult to collect comments from the other project participants in a timely manner given the volume of the draft and material covered. And consequently, I would like to have the opportunity to perform an additional review with LCRA staff based on the comments below prior to issuing to the other participants. I believe this will help expedite the review process.

Comments by Jason Eichler

1. General: It appears the draft submitted addresses most of the items in Tasks 1 – 10 in the scope. Please complete the Table of Contents, and Purpose & Scope to allow project participants to compare the progress of this draft with the scope and budget. This will also help in prioritizing future efforts that may be needed in some sections as we collect comments from the participants.

2. General: Please complete any sections of the draft that have not been completed (Unit Cost Section). In addition, please provide references to tables and figures in the appropriate locations, and include all figures referenced in the text.

3. General: The Project Viability Assessment has been finalized and is available on the LCRA website. Please ensure that costing data is consistent with this report.

4. See attached for additional comments.

San Antonio Water System

March 24, 2005

Mr. Jason Eichler, P.E.
Lower Colorado River Authority
P.O. Box 220
Austin, TX 78767

RE: Comments on the Regional Treatment Plant Draft Technical Memorandums provided by K Friese & Associates

Dear Mr. Eichler:

Thank you for the opportunity to review and comment on the draft technical memorandums for the Central Texas Water Treatment Plant Study. From a general perspective, SAWS primary concerns with the concept of the Regional Treatment Plant center around the overall costs and water compatibility issues. SAWS offers the following comments for your review and consideration.

Sincerely,

Susan Butler
Director, Water Resources

Regional Treatment Plant
Draft Technical Memo Comments
San Antonio Water System

Task 1 Memo

- **Page 1 of 2** - Add date to HDR Engineering, Inc. "Concept Delivery Study" – Groundwater Quality, SAWS, June 2004.

Task 2 Memo

- **General Comment** - Consider identifying additional potential customers and participants along the IH-35 corridor (as mentioned in the Detailed Scope of Services, 1st page, last paragraph).

Task 4 Memo

- **Page 1 of 19** - Consider adding language to clarify the 18,000 AF/yr diversion at Bastrop. Any water that can be diverted at Bastrop will serve to reduce the water that is taken at Matagorda and thus will reduce the size and ultimate cost of the transmission line portion of the project from the lower part of the basin.
- **Page 4 of 19, 3rd paragraph** – Consider removing sentence referring to SAWS Simsboro project. It makes it appear as if the additional water supply from the Simsboro was an after thought. The possibility of treatment of water from the Simsboro project was one of the primary reasons SAWS decided to participate in the study and included in the original scope.
- **Page 4 of 19, 3rd paragraph** – Consider additional language to clarify that the $ 864 per AF/yr is the cost for the entire project. This includes the cost of the raw water, well field, transmission facilities including a 107-mile transmission line to a point in eastern Bexar County, and a water treatment plant (51.6 MGD) to remove iron & manganese. Costs do not include integration into SAWS distribution system.
- **Page 6 of 19, Table 4-2** – Add reference to cite the source of the data.
- **Page 9 of 19** – Consider adding a listing of all abbreviations for water treatment. Did not see anything for HAA5.
- **Page 10 of 19** – Possibly provide additional detail regarding the statement addressing "acceptable" total hardness. Not sure if it is relevant since each system receiving water would determine the level of softening to match their distribution system.
- **Page 11 of 19, first full sentence** – Consider citing the source regarding San Antonio's use of individual softener systems. The percentage of households utilizing softeners may not be very high when you consider San Antonio's population.
- **Page 13 of 19, Table 4-7** – Consider enlarging the table – possibly breaking it into two parts.
- **Page 18 of 19** – Consider additional discussion for the "30 peak days in succession". Possibly need additional discussion if the users require 30 peak days in a row from this plant or have additional water resources from their system

available. Discuss whether building additional peak capacity into the treatment plant is cost effective.

- **Page 18 of 19, Cost Estimates –** Please add language to indicate the cost basis – are the costs presented 4th Qtr. 2004?
- **Page 19 of 19 –** Is Debt Service included in the O&M costs?
- **Page 19 of 19, Figure 4.**7 – In the capital costs illustrated in the figure, do these costs include interest during the construction period?

Task 5 Memo

- **Page 2 of 5, 2nd Paragraph** – It is suggested that water availability data be provided to clarify why the diversion at Bastrop and Town Lake are not appropriate for all withdrawals.
- **Page 3 of 5, Alcoa/CPS Groundwater** – It is suggested that additional language be included about the actual quantity of water entering the treatment plant from this source (how did you account for channel and evaporative losses), or was that taken into account at this level of study?

Task 6 Memo

- **General Comment** – Throughout this memo text and tables, please change the SAWS Culebra Reservoir and Green Mountain Reservoir to Culebra Pump Station and Green Mountain Pump Station respectively.

Task 7 Memo

- **General Comment** – please change the word "Reservoir" to "Pump Station" throughout the SAWS connection point write up.

Task 3 & 10 Memo

- It is suggested that the memo title "Economic Analysis" be changed to "Financial Analysis".
- **Page 3 of 4** – Add language to state what discount rate was utilized.
- **Page 3 of 4, alternative 1C**, - Are the costs of a TPDES permit included?