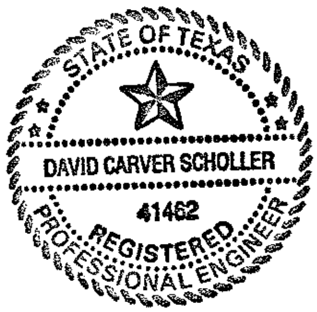
San Jacinto River Authority

Joint Water Resources Assessment Plan
Alternative Analysis

Montgomery County
Alternative Water Supply Program



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Executive Summary

Introduction and Background

In 2001, the Texas Legislature created the Lone Star Groundwater Conservation District (LSGCD) to conserve, protect, and enhance the groundwater resources of Montgomery County. It has become evident that the existing groundwater supply cannot meet the growing water demands of Montgomery County and that the use of groundwater cannot continue to be allowed to exceed the sustainable yield of the Northern Gulf Coast Aquifer system.

A preliminary estimate of 64,000 acre feet per year (afpy) as the sustainable yield for the aquifers in Montgomery County was developed by the LSGCD, and in 2003, the LSGCD adopted the 64,000 afpy estimate for the purposes of its Groundwater Management Plan (GMP).

To begin reducing groundwater demand and encourage the conjunctive use of surface water with groundwater supplies, the LSGCD has adopted regulations that require certain groundwater users to conduct long-term planning. The result of that planning, a Water Resources Assessment Plan (WRAP), assesses future water needs and describes how alternative water supplies may be acquired to meet future demands and groundwater reduction requirements established by the LSGCD. The LSGCD DRP Phase II (A) requires large volume groundwater users (LVGU) to submit WRAPs that are composed of two major parts. LVGUs are groundwater well permittees that currently produce 10 million gallons or more of groundwater annually. Part I of the WRAP includes information about current and projected water demands; identification of current water supplies; and description of current well capacities. Part II includes identification of new water supply sources to meet projected water demands; description of infrastructure needed to deliver new supplies; timeline and cost estimate to develop new supplies; and a letter from the supplier confirming the availability of the new supplies.

Purpose and Approach

The purpose of this Alternative Analysis study is to recommend a surface water treatment and transmission system including its points of delivery to Joint WRAP Participants that will supply enough treated surface water to meet the regulatory requirement of the LSGCD to reduce groundwater use to less than 64,000 afpy. This study has investigated many major areas that include:

- Future Water Demand
- The Conversion Strategy to achieve regulatory compliance
- Potential Water Supply Sources
- Infrastructure Requirements

- Facility Costs
- Economic Analysis

Although this study provides information regarding capacity of surface water treatment infrastructure, it does not address the treatment process or the cost of treatment in significant detail.

Finally, this Alternative Analysis builds on and advances previous efforts on behalf of the LSGCD and the Joint WRAP Participants. Whereas previous investigations may be compared to a 100,000 foot level 'fly-over', this study decreases the altitude and improves the clarity of features in the emerging plan by looking more closely at alternatives related to potential surface water sources and the transmission system and its costs to convey treated surface water to Joint WRAP Participants. However, further studies beyond this Joint WRAP study will be required before the final plan can be developed.

This Alternative Analysis addresses water demand, water sources, and the strategy to convert to surface water in order to meet the LSGCD's requirements to reduce the use of groundwater.

Total Demand

Water demand for Participants in the SJRA Joint WRAP is primarily for municipal purposes along with significant industrial demand for power generation. For the purposes of this Joint WRAP II, the Region H/TWDB projections of population and water demand are used. **Table ES.1** shows the Region H/TWDB projection of future population and water demand.

Table ES.1
Region H/TWDB
Montgomery County Population and Water Demand Projections

	2015	2025	2035	2045
Population	479,872	617,300	775,479	967,800
Demand (afpy)	89,543	113,716	137,435	166,175

SJRA's efforts in preparing the Joint WRAP I secured the participation of 198 of 201 large volume groundwater users (LVGU) in Montgomery County. The three LVGUs that will develop their own WRAPs and therefore are not included in the Joint WRAP are Conroe Country Club, Wedgewood Golf Course, and the City of Houston. The 198 LVGUs that joined this Joint WRAP are listed in **Appendix C**.

Table ES.2 summarizes water demand for the 198 Participants in SJRA's Joint WRAP as well as future Regulated Users that are assumed will join this Joint WRAP. This demand is based on the Region H/TWDB demands for Montgomery County minus the Regulated Users not participating in this Joint WRAP. **Exhibit 1** shows the location of Participants in this Joint WRAP as well as the three Regulated Users that are not participating.

Table ES.2
Total Water Demand (afpy) for SJRA Joint WRAP Participants

	2007	2015	2025	2035	2045
Total County Demand	70,633	89,543	113,716	137,435	166,175
City of Houston	136.0	221.5	314.0	445.5	610.0
Conroe Country Club	22.4	22.4	22.4	22.4	22.4
Wedgewood Golf Course	89.6	89.6	89.6	89.6	89.6
Subtotal	248.0	333.5	426.0	557.5	722.0
Existing and Future Participant Demand	70,385	89,209	113,290	136,877	165,453

As can be seen from **Table ES.2** the projected water demand for existing and future Joint WRAP Participants exceeds 99% of the total county water demand throughout the planning period.

Individual Participant Demands

The total water demand for SJRA Joint WRAP Participants is based on Region H/TWDB projections. Further analysis was conducted to estimate the individual contributions to the demand by each of the 198 Joint WRAP Participants. The Region H/TWDB data included water demand projections for approximately 30 water user groups (WUGs) that are among the Joint WRAP Participants. The remaining approximately 170 Joint WRAP Participants are not part of a WUG defined by Region H/TWDB and are therefore included in "County-Other" by Region H/TWDB. Water demand for these Participants was estimated based on the best information available, including utilizing HGAC projections of population. HGAC's projection of where future population is expected to occur was used as the best estimate available of where future water demand is expected to occur. This assumption essentially allocates or distributes the Region H 'County-Other' population to individual Joint WRAP Participants.

Potential to Reduce Treated Surface Water Infrastructure Requirements

Reducing water demand and providing sources of water other than surface water will extend the surface water available for municipal potable water supply and potentially reduce the infrastructure required thus reducing costs. Reducing water demand may be achieved through conservation and drought contingency methods. Conservation efforts implement water saving devices and practices to accomplish long-term savings and reduction in water demand. In contrast, drought contingency measures seek to reduce water demand in the early stages of drought in order to reduce long-term affects of drought and extend the life of water supplies during the drought.

For the purposes of the development of the SJRA Joint WRAP, reducing demand through conservation and/or utilizing alternatives to treated surface water are assumed not to impact the size and location of the treated surface water infrastructure. The greatest obstacle to implementing any of these strategies is their cost relative to the cost of existing water supplies. As the cost of compliance with existing regulations increases, the incentive to conserve water will increase as will the cost-effectiveness of alternative water supplies. The potential benefits of these strategies include:

- May reduce the capacity and, therefore, cost of the surface water conveyance system that is required.
- May postpone when future expansions of capacity are required and, therefore, delay future expenditures.
- May extend the available supply of surface water.

Use of Reclaimed Wastewater

Numerous potential users of reclaimed wastewater have been identified among the 198 Participants in the Joint WRAP. Possible users of reclaimed water that provide the greatest potential include golf courses, property owners associations, MUDs that currently use groundwater for amenity lake maintenance and/or irrigation, and other irrigated areas such as school athletic fields, and public and commercial landscaping. All wastewater treatment plants were identified as potential sources of reclaimed water based on information for wastewater discharges permitted by the Texas Commission on Environmental Quality (TCEQ).

Use of Raw Water

Existing development near Lake Conroe was investigated to identify potential uses of untreated surface water for irrigation purposes. Thirty-six potential users of raw water for irrigation were identified on the shore of Lake Conroe. The thirty-six include five that currently purchase raw water from SJRA. A detailed evaluation of the infrastructure requirements and costs to supply raw surface water to any of these entities is needed to determine the viability of supplying raw surface water and will be evaluated in greater detail in future planning efforts.

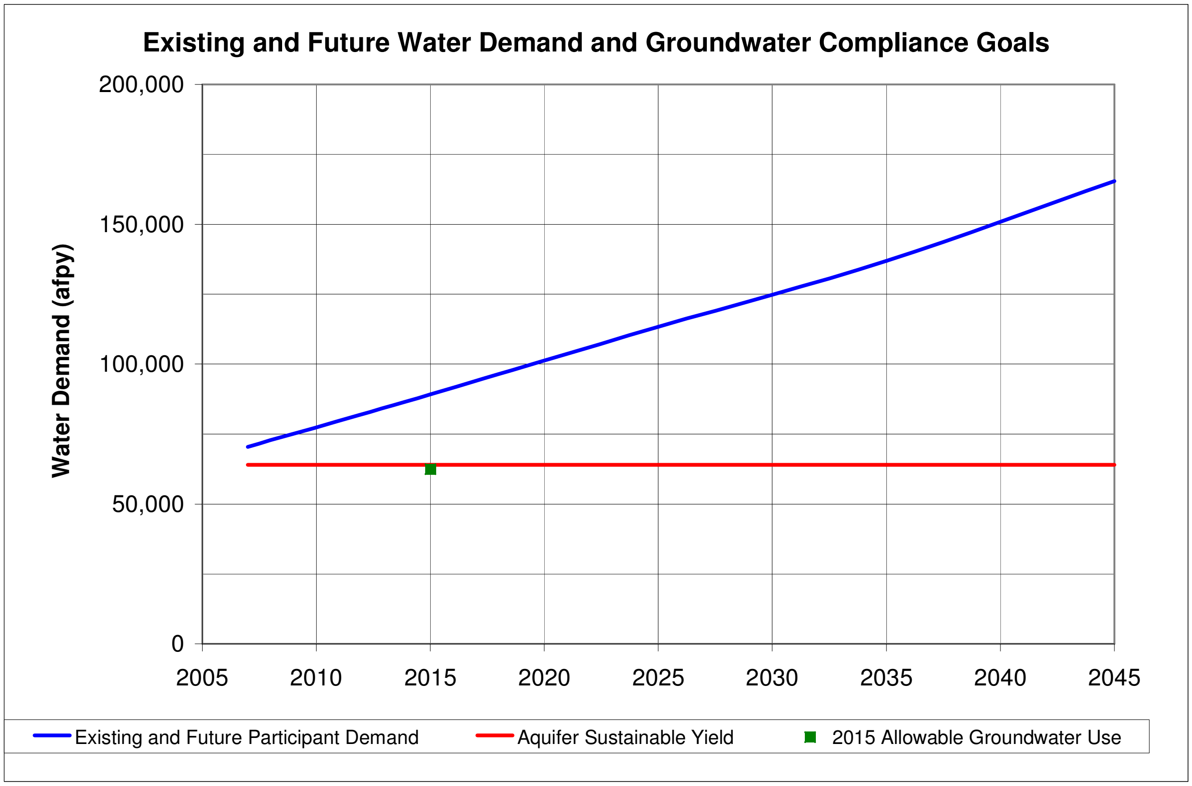
Drought Management Strategies

Many drought contingency or drought management plans consist of “trigger conditions” or stages of severity of the drought as indicated by an appropriate means of measurement. Stages are typically expressed as “Mild”, “Moderate”, “Severe”, and “Critical” or other similar descriptions. The key point for the purposes of the Joint WRAP is that all Joint WRAP Participants are encouraged to adopt drought management plans so that the water resources of all Joint WRAP Participants are used prudently and preserved for as long as possible during emergency conditions.

Conversion Strategy

Figure ES.1 illustrates the total demand for the Joint WRAP Participants and their allowable groundwater use in 2015 in relation to the 64,000 afpy (57.1 mgd) allowable average groundwater use from 2015 to 2045.

Figure ES.1
Existing and Future Water Demand and Groundwater Compliance Goals



To achieve compliance with LSGCD, Joint WRAP Participants must use a quantity of alternative water (assumed to be entirely or mostly surface water) equal to the difference between the total Joint WRAP Participants' water demand and the allowable groundwater use of 62,446 afpy (55.7 mgd). Therefore, based on LSGCD's current regulation and implementation schedule in 2015, surface water use must equal at least 26,765 afpy (23.9 mgd). For the planning period from 2025 through 2045, compliance is measured by supplying alternative water in sufficient quantity that the average groundwater use during the planning period is less than or equal to 62,446 afpy (55.7 mgd).

Compliance Assurance Factor

A critical factor to correctly size elements of the surface water delivery system is the daily and seasonal variation of demand throughout the year. Due to these variations the water treatment and transmission system must be sized for 125% of the average daily demand rate required by the groundwater reduction regulations.

Conversion Strategy

198 Joint WRAP Participants joined together because a joint approach:

- Allows Participants to develop the most cost effective solution to meet regulatory goals.

- Takes advantage of the economy of scale that can be realized by building larger treatment and transmission facilities at lower cost per unit of capacity.

The most cost effective solution is based on over-converting large concentrations of groundwater use for the benefit of all Participants, especially small, remote, users to which it would be cost prohibitive to convey surface water. Based on providing and using a proposed average volume of surface water annually, **Table ES.4** illustrates the proposed groundwater reduction strategy.

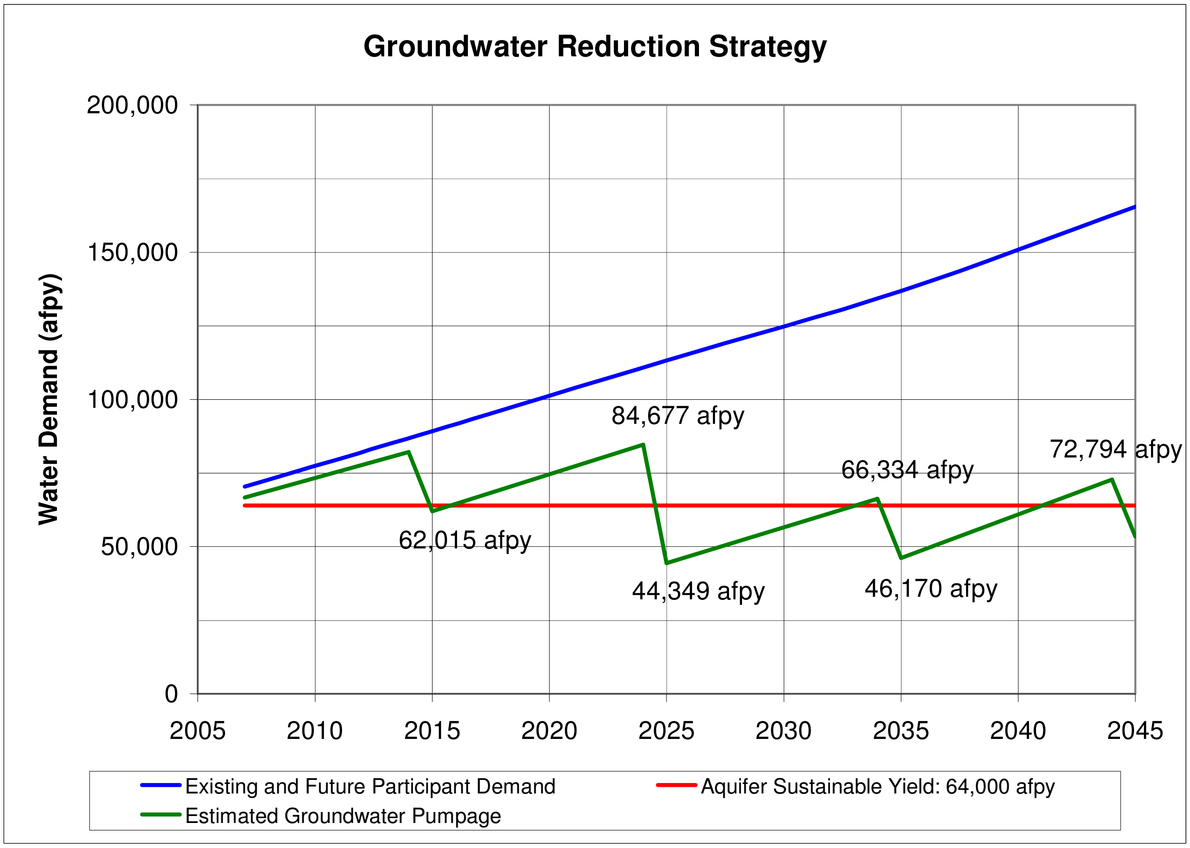
The water supply system must be designed to convey 125% of the average daily surface water to be delivered to meet the groundwater reduction regulations. In 2015, 20,164 afpy is equivalent to 18 mgd. Assuming two treatment modules are constructed to provide the total capacity, then 125% of 9 mgd requires treatment modules of 11.25 mgd capacity. For the purposes of this study, 12 mgd treatment modules were assumed that will provide 6 to 7 percent additional capacity. This surplus capacity provides a buffer to ensure that the desired water quality is attained and can be used to generate over-conversion credits if LSGCD adopts a policy regarding credits. The values for 'Proposed Surface Water Treatment Capacity' in **Table ES.4** reflect the assumption that capacity will be constructed in increments of 12 mgd (13,443 afpy) modules.

Table ES.4
Groundwater Reduction Strategy (afpy)

	2015	2025	2035	2045
Existing and Future Participant Demand	89,209	113,290	136,877	165,453
Power Generation Estimated Surface Water Demand	7,033	8,452	10,054	12,007
Proposed Surface Water Treatment Capacity	20,164	60,492	80,656	100,000
Groundwater Use BEFORE Add'l SW Capacity	82,176	84,674	66,331	72,790
Groundwater Use AFTER Add'l SW Capacity	62,012	44,346	46,167	53,446

Figure ES.2 also graphically illustrates the groundwater reduction strategy with the graph showing the total groundwater pumpage on an annual basis.

Figure ES.2
Joint WRAP Groundwater Reduction Strategy



The conversion strategy also addressed identifying Participant facilities to which to deliver surface water. For the initial 2015 conversion, facilities were added to each alternative until 80% of their average water demand equaled the required conversion of 30% of total demand for all Participants including The regional electric power generator's use of untreated surface water. In the selection of Participant facilities, consideration was given to:

- minimizing the length of water line,
- avoiding the additional cost associated with crossing Interstate Highway 45 (IH 45),
- delivering surface water to all of a Participants groundwater storage facilities (not wells pumping directly to the distribution system or to elevated storage),
- delivering surface water to groups of Participants in relatively close proximity to one another.

For conversions after 2015, projected 2045 water demands were considered in the determination of facilities to add to the ultimate conversion strategy.

Potential Source Study

The SJRA conducted a "Potential Source Study" that investigated nine alternative water supply sources. The purpose of the study is to identify potential alternative water sources available to Montgomery County to reduce groundwater use and meet projected water demands, evaluate those potential sources, and select a source to be used as the basis for the SJRA Joint WRAP Part II study. Based on the present worth of the alternatives, SJRA's Potential Source Study concluded that the most cost-effective water supply alternative is to use SJRA's water rights in Lake Conroe plus the City of Houston's water in Lake Conroe via a long-term water supply contract.

Water Treatment Facilities

Treatment processes will be evaluated in greater detail in the Joint WRAP II Report as will their costs. The cost of treatment infrastructure does not affect the selection of the recommended transmission system because the preferred treatment facilities can be combined with any of the transmission alternatives. **Table ES.5** summarizes information regarding required surface water, average surface water treatment rate, and proposed surface water treatment capacity.

Table ES.5
Surface Water Treatment Capacity (afpy)

	2015	2025	2035	2045
Estimated Treated Surface Water Required	19,730	40,838	62,823	89,446
Average Surface Water Treatment Rate	20,164	60,492	80,656	100,000
Proposed Surface Water Treatment Capacity	26,885	80,656	107,541	134,426

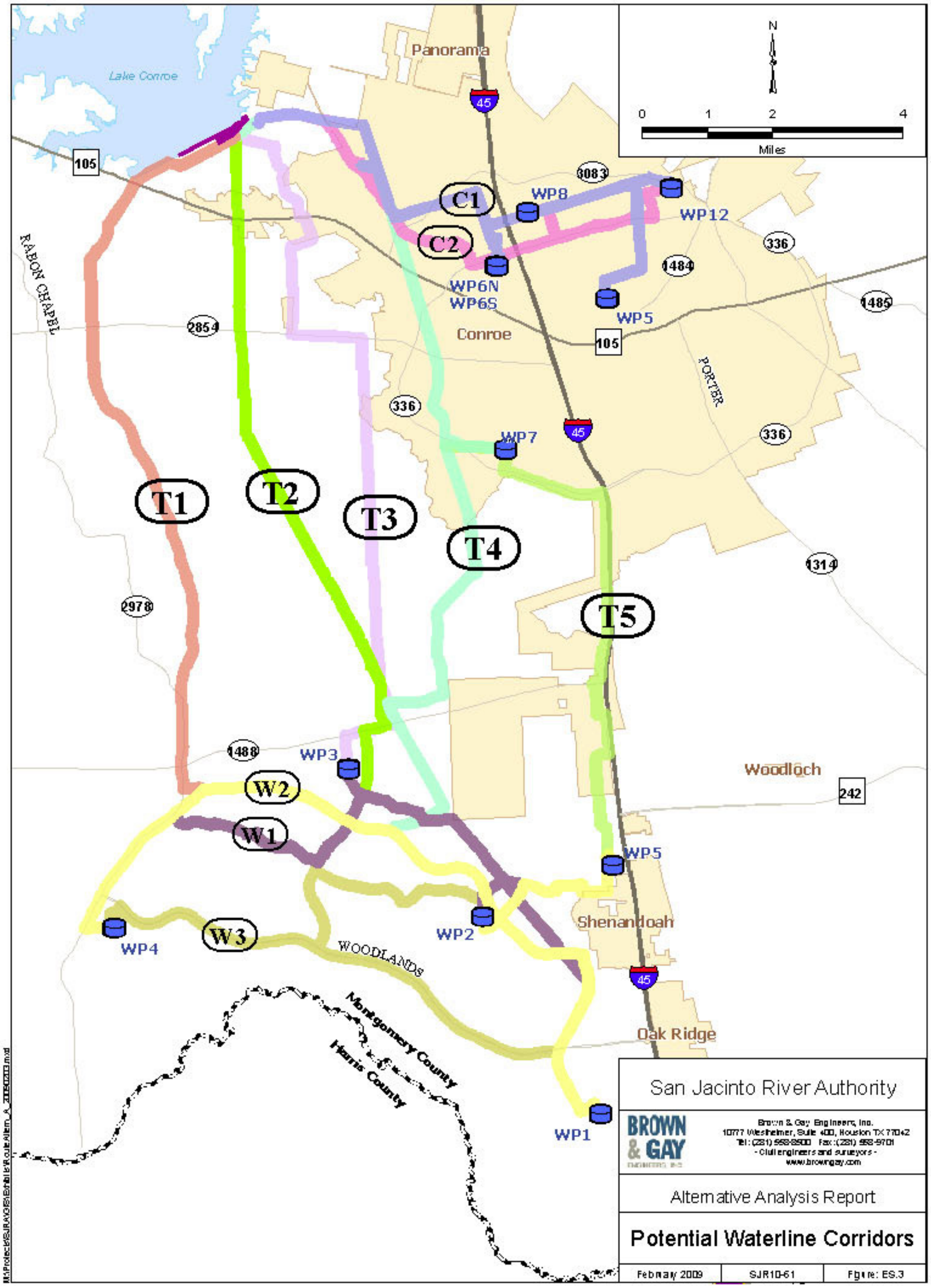
For the purpose of the alternative analysis, a single plant site was assumed to be located downstream of the Lake Conroe dam. This location was assumed for all alternative alignments, so that any potential change in the water plant site would affect all transmission line alternatives equally.

Water Transmission System

The alternative analysis of the transmission mains was performed at two levels. The initial analysis identified three primary transmission corridor groups, shown in **Figure ES.3**:

- North-South - five corridors from the Lake Conroe water treatment plant to a distribution point on the north side of The Woodlands.
- City of Conroe – two west–east corridors from the Lake Conroe water treatment plant to distribution points in the City of Conroe.
- The Woodlands – three west-east corridors from the terminus of the North-South corridor to distribution points in The Woodlands.

Figure ES.3
Potential Waterline Corridors



The investigation for each of the alternative corridors included numerous engineering, construction cost, and environmental factors. The engineering analysis investigated the construction environment for each of the alternative corridors (urban vs. rural), potential underground conflicts (hydrocarbon pipelines, municipal water and sewer lines, communication, and power conduit and cable), overhead conflicts (power lines, etc.), water crossings, major transportation crossings (State highways and railroads), local roadway and driveway crossings and other surface impacts (i.e., traffic patterns near schools or commercial areas). A separate environmental review was performed that investigated the corridors described above.

In the collection of data for the investigation, information was sought from federal, state and local agencies in the form of topographic maps, historic and current aerial photography, soil surveys, physiographic and geologic maps, descriptions of the plants and animals of the region, and historic atlases.

Following the evaluation of the primary corridors, alternative transmission alignments were developed by combining elements of the primary corridors to route potential transmission pipes to each of the distribution points in Conroe and The Woodlands. In addition, there were 24 routing combinations evaluated with hydraulic modeling, estimates of construction cost, and environmental considerations.

Facility Costs

Cost of Water Treatment Facilities

This Alternative Analysis study provides information regarding capacity of surface water treatment infrastructure and does not attempt to address matters related to treatment processes nor their costs. The cost of treatment infrastructure does not affect the selection of the recommended transmission system because the preferred treatment facilities can be combined with any of the transmission alternatives.

Capital Costs

The development of unit costs for the construction of large diameter water transmission mains was based on analysis of bidding information provided by the North Harris County Regional Water Authority, West Harris County Regional Water Authority, and the City of Houston. Bid tabulations for 35 water line construction projects including pipe from less than 12 inches to 60 inches in diameter and bid between 2001 and 2008 were compiled and analyzed to develop transmission main unit costs.

Projects were categorized as “Urban” or “Rural” construction based on quantities of pavement, curb, construction exits, clearing & grubbing, fence replacement, inlet protection, use of sod to restore residential areas, utility relocations, and traffic control.

The Engineering News Record Construction Cost Index (ENR CCI) was used to adjust the bid tab data for each project to October 2008 dollars based on when the projects were bid. The calculated unit costs were compared to cost data developed by the Texas Water Development Board Region H (Region H).

For alternatives evaluated in this study, aerial photography and GIS mapping were used to determine the level of development along transmission main corridors. Sections of pipe in developed areas were considered to have higher costs associated with construction in urban areas. Conversely, pipelines in minimally developed areas were assumed to have lower costs associated with simpler construction in rural areas. The appropriate cost was applied to each pipe section in the various alternatives.

Permanent easement widths for transmission mains adjacent to existing rights-of-way or other easements are assumed to be 20 feet for pipe up to 36 inches in diameter and 30 feet for larger pipe. Permanent easement widths for all transmission mains not adjacent to existing rights-of-way or other easements are assumed to be 30 feet. An additional 10 to 20 feet of temporary construction easement may be acquired where beneficial.

Annual Costs

Annual Operation and Maintenance (O&M) costs include items such as debt service, program management, engineering support to treatment plant and water system operators, etc.; chemical, power, and other treatment plant costs; and transmission main maintenance and repair costs.

An economic spreadsheet was developed to compare alternatives based on the present worth of their costs from 2010 through the planning period to 2045. Costs include debt service payments due to capital costs, annual operations and maintenance (O&M) costs, raw water costs, reservation fees, reserves, etc. On the basis of present worth, the alternative with the lowest present worth of costs is the preferred alternative compared to other alternatives with a higher present worth of costs.

Variables that are constant across all alternatives are classified as global alternatives. Alternative-specific variables are variables or factors that are unique to an individual alternative.

All costs have been inflated by 5% annually based on the historic rate of inflation. For each year from 2010 to 2045, the inflated costs for capital and operations and maintenance were summed and then discounted to a present worth cost using a current bond return rate of 5%. Those present worth costs for each year were summed to calculate a total present worth cost for each alternative. The results of that analysis are presented in **Table ES.6** below.

Table ES.6
Summary of Analysis Results for All Alternatives
Summary of Project Costs and Present Worth of Project Alternatives
($ in millions)

Alternative	Total Project Costs	Total Average Annual Cost	PW of Annual Costs	Rank Based on PW	Sum of Capital and Annual Costs Capital 2010 - 2015	Sum of Capital and Annual Costs Annual 2010 - 2015	Rank Based on Capital 2010 - 2015
T2C1W1	$2,509	$169	$1,781	1	$480	$126	1
T2C1W2	$2,514	$169	$1,787	2	$485	$128	3
T3C1W1	$2,519	$169	$1,790	3	$486	$128	4
T3C1W2	$2,521	$169	$1,794	4	$492	$129	7
T1C1W1	$2,503	$169	$1,798	5	$504	$131	13
T4C1W1	$2,528	$170	$1,800	6	$497	$130	9
T2C2W1	$2,551	$172	$1,810	7	$484	$127	2
T4C1W2	$2,540	$171	$1,813	8	$510	$132	17
T3C2W1	$2,558	$172	$1,816	9	$488	$128	5
T2C2W2	$2,557	$172	$1,816	10	$491	$129	6
T1C1W2	$2,521	$171	$1,816	11	$522	$135	22
T4C1W3	$2,549	$172	$1,819	12	$514	$133	19
T3C2W2	$2,565	$172	$1,824	13	$498	$130	10
T5C1W2	$2,556	$172	$1,825	14	$520	$134	20
T1C2W1	$2,545	$172	$1,826	15	$509	$132	16
T5C1W1	$2,556	$172	$1,827	16	$522	$135	21
T4C2W1	$2,569	$173	$1,827	17	$500	$130	11
T4C2W2	$2,575	$173	$1,834	18	$507	$132	14
T5C2W1	$2,583	$173	$1,838	19	$509	$132	15
L51-2045	$2,657	$175	$1,839	20	$496	$130	8
T4C2W3	$2,584	$173	$1,840	21	$512	$133	18
L41-2045	$2,656	$175	$1,842	22	$500	$130	12
T1C2W2	$2,563	$173	$1,845	23	$527	$136	24
T5C2W2	$2,601	$175	$1,856	24	$525	$135	23

The difference in present worth between all the competing alternatives is less than 5% due to so many of the underlying costs being common to or at least similar in all alternatives. Results are similar for the capital costs of the first, 2015, phase of conversion. Alternative T2C1W1 ranks first by both measures of cost effectiveness.

Because the difference in present worth between Alternative T2C1W1 and competing alternatives is relatively small, other alternative routes and parts of the overall treatment and conveyance system will continue to be considered in future planning. Continued planning will be essential as this phase concludes due to regulatory requirements being developed by the LSGCD, the results of on-going study of the sustainable yield of the Gulf Coast aquifer system, and possible changes in Participants that will be a part of the plan.

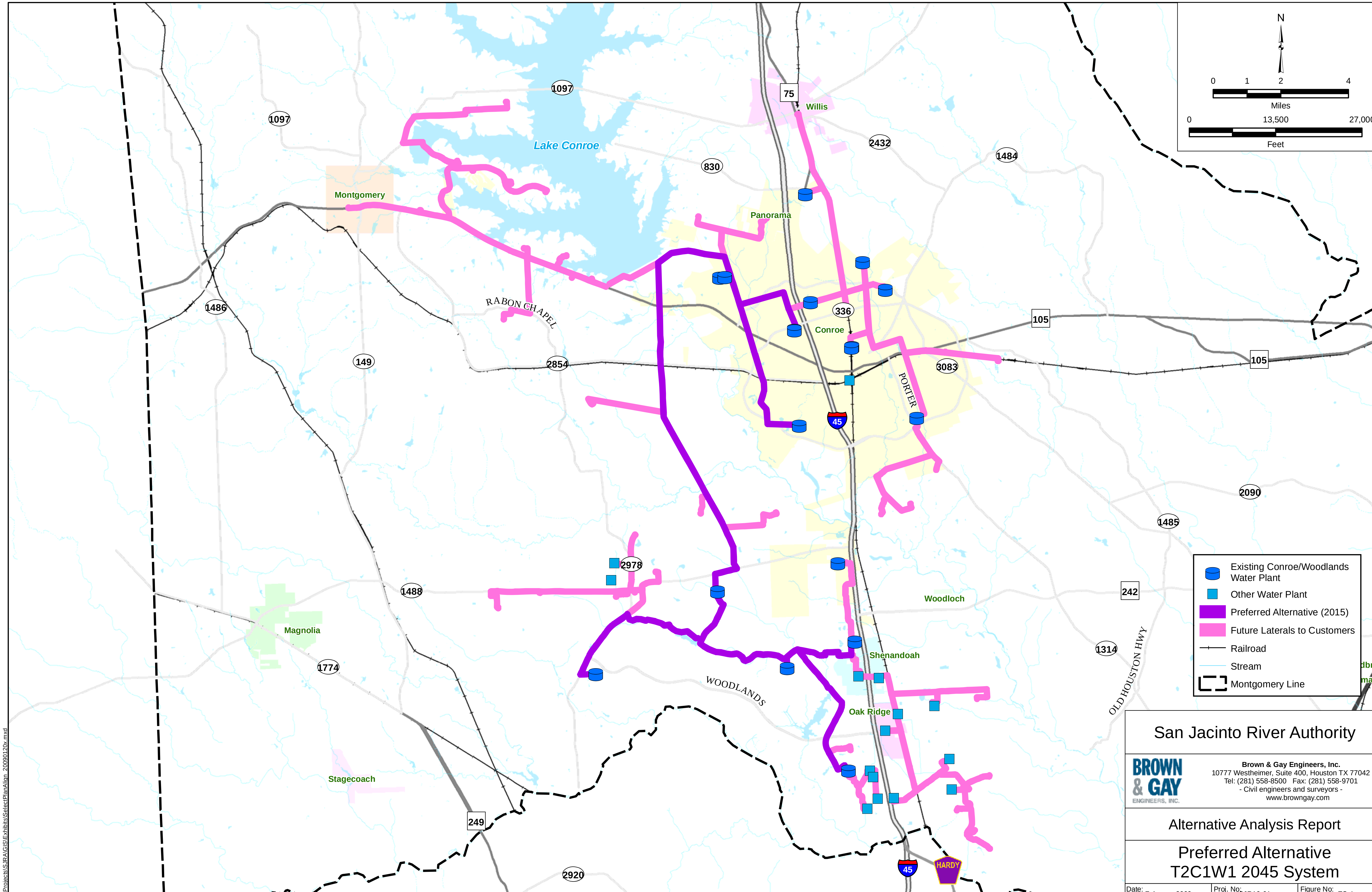
Description of Preferred Alternative

Alternative T2C1W1 was selected as the preferred alternative based on the economic analysis that included preliminary sizing of water lines and estimates of construction, operation and maintenance costs.

In this alternative, there will ultimately be three primary surface water transmission lines –

- To the east, serving the City of Conroe and other adjacent or nearby Participants to the north, south, and east of Conroe.
- To the south, serving The Woodlands and other adjacent or nearby Participants to the north, east, south, and west of The Woodlands.
- To the west, serving Participants on the west side of Lake Conroe, including the City of Montgomery.

Figure ES.4 shows the preferred route T2W1C1.



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Section 1
Introduction

1.1 Background

In 2001, the Texas Legislature created the Lone Star Groundwater Conservation District (LSGCD) to conserve, protect, and enhance the groundwater resources of Montgomery County. Studies conducted by the LSGCD have since confirmed the reports of many water suppliers in Montgomery County that water levels are declining at an alarming rate. Results of computer modeling of future reliance on groundwater showed continued water-level declines and new problem areas for water suppliers in other parts of Montgomery County where water levels are not currently of concern. It is evident that the existing groundwater supply cannot meet the growing water demands of Montgomery County and that the use of groundwater cannot continue to be allowed to exceed the sustainable yield of the Northern Gulf Coast Aquifer system.

A preliminary estimate of 64,000 acre feet per year (afpy) as the sustainable yield in Montgomery County for the aquifer has been developed based on an assumed recharge rate of approximately 1.1 inches per year over the 697,600 acre area of the county. In 2003, the LSGCD adopted the 64,000 afpy estimate for the purposes of its Groundwater Management Plan (GMP).

The Texas Water Development Board (TWDB) is using the Northern Gulf Coast Aquifer Groundwater Availability Model (GAM) to study the aquifer and recently released preliminary results indicating the recharge rate could be considerably less than 64,000 afpy. The LSGCD has chosen not to adopt the TWDB GAM data at this time. Instead, the LSGCD is waiting for the results of a three year US Geological Survey (USGS) study (under contract to the LSGCD) of the recharge rate. Preliminary results of that study will most likely not be available until 2010.

In the interim, to begin reducing groundwater demand and encourage the conjunctive use of surface water with groundwater supplies, the LSGCD has adopted regulations that require certain groundwater users to conduct long-term planning. The result of that planning, a Water Resources Assessment Plan (WRAP), assesses future water needs and describes how alternative water supplies may be acquired to meet future demands and groundwater reduction requirements established by the LSGCD. Requirements for the WRAP are set forth in the LSGCD's District Regulatory Plan (DRP) Phase II (A) and are based on the DRP Phase I regulatory target to reduce groundwater withdrawals in Montgomery County to 64,000 acre-feet per year by January 2015.

The LSGCD DRP Phase II (A) requires large volume groundwater users (LVGU) to submit WRAPs that are composed of two major parts. LVGUs are groundwater well permittees that currently produce 10 million gallons or more of groundwater annually. Part I of the WRAP includes information about current and projected water demands; identification of current water supplies; and description of current well capacities. Part II includes identification of new water supply sources to meet projected water demands; description of infrastructure needed to deliver new supplies; timeline and cost estimate to develop new supplies; and a letter from the supplier confirming the availability of the new supplies.

The LSGCD DRP allows multiple LVGUs to submit a Joint WRAP addressing plans to meet LSGCD requirements on behalf of all LVGUs that are part of the Joint WRAP. After much hard work, the SJRA initially enlisted 198 of the 201 LVGUs in Montgomery County and submitted a Joint WRAP Part I to the LSGCD in August 2008. The 198 LVGUs that joined this Joint WRAP are listed in **Appendix C**.

1.2 Purpose and Approach

The purpose of this study is to recommend a surface water treatment and transmission system including its points of delivery to Joint WRAP Participants that will supply enough treated surface water to meet the regulatory requirement of the LSGCD to reduce groundwater use to less than 64,000 afpy. **Exhibit 1** shows where Participants are located in Montgomery County as well as the three Regulated Users that are not participating in this Joint WRAP.

This study fulfills a significant part of the LSGCD's requirements for WRAP Part II that is to be completed by March 2, 2009. The selection of a preferred alternative primarily provides a feasible system to establish a basis for future costs and financing needs to meet the requirements of the LSGCD for a Joint WRAP Part II. After submission of this Alternative Analysis or the Joint WRAP Part II, possible changes in number of Participants in the plan, LSGCD regulations, and future planning may necessitate changes to the preferred alternative and to the overall plan to implement surface water use among Participants in the plan.

In pursuit of the purpose stated above, this study has investigated many areas that are documented in the sections that follow. Major areas investigated include:

- Future Water Demand (Section 2)
- The Conversion Strategy to achieve regulatory compliance (Section 3)
- Potential Water Supply Sources (Section 4)
- Infrastructure Requirements (Section 5)
- Facility Costs (Section 6)
- Economic Analysis (Section 7)

Although this study provides information regarding capacity of surface water treatment infrastructure, it does not address the treatment process or the cost of treatment in significant detail. The treatment process will be evaluated in greater detail in the Joint WRAP II Report as will the cost of treatment. The cost of treatment infrastructure does not affect the selection of the recommended transmission system because the preferred treatment facilities can be combined with any of the transmission alternatives.

Finally, this Alternative Analysis builds on and advances previous efforts on behalf of the LSGCD and the Joint WRAP Participants. Whereas previous investigations may be compared to a 100,000 foot level 'fly-over', this study decreases the altitude and improves the clarity of features in the emerging plan by looking more closely at alternatives related to potential surface water sources and the transmission system and its costs to convey treated surface water to Joint WRAP Participants. However, further studies beyond this Joint WRAP study will be required before the final plan can be developed.

Section 2
Water Demand

2.1 Total Demand

Water demand for Participants in the SJRA Joint WRAP is primarily for municipal purposes along with significant industrial demand for power generation. Municipal demand is characterized by residential use with a significant seasonal irrigation component and commercial uses. The seasonal irrigation includes lawn watering and golf course irrigation. In addition, the City of Conroe has a large industrial water use component.

SJRA's Joint WRAP Part I submitted to the LSGCD on August 28, 2008 projected water demands based on population. The Joint WRAP Part I compared two projections of future population, one developed by the Houston-Galveston Area Council (HGAC) and one by the Region H Water Planning Group (Region H) based on Texas Water Development Board (TWDB) projections. On average, the HGAC projection is approximately 8% greater than the Region H projection. Based on a history of actual population growth exceeding past projections for Montgomery County, the Joint WRAP Part I proposed to use the higher HGAC projections for planning. However, to use the higher HGAC projections, the Region H projections would have to be modified by adjusting the underlying assumptions regarding rates of migration, birth rates, mortality rates, etc. and providing detailed documentation for these adjustments.

The TWDB recognizes a need to adjust the short-term projection for 2010 upward by approximately 8% to account for recent rapid growth in Montgomery County. How that adjustment may extend to projections beyond 2010 is to be determined by the TWDB. LSGCD and TWDB require that planning efforts use TWDB projections of future water demand. Therefore, for the purposes of this Joint WRAP II the Region H/TWDB projections of population and water demand are used. **Table 2.1** shows the Region H/TWDB projection of future population and water demand in acre-feet per year (afpy).

Table 2.1
Region H/TWDB
Montgomery County Population and Water Demand Projections

	2015	2025	2035	2045
Population	479,872	617,300	775,479	967,800
Demand (afpy)	89,543	113,716	137,435	166,175

SJRA's efforts in preparing the Joint WRAP I secured the participation of 198 of 201 large volume groundwater users (LVGU) in Montgomery County. The three LVGUs that will develop their own WRAPs and therefore are not included in the Joint WRAP are Conroe Country Club, Wedgewood Golf Course, and the City of Houston. Conroe Country Club and Wedgewood Golf Course are both golf course irrigation users, and no permanent residential population is served. The City of Houston water production from wells in Montgomery County in 2007 is disproportionate in comparison to the City's population in the County because the City's wells supply a larger population in adjacent Harris County.

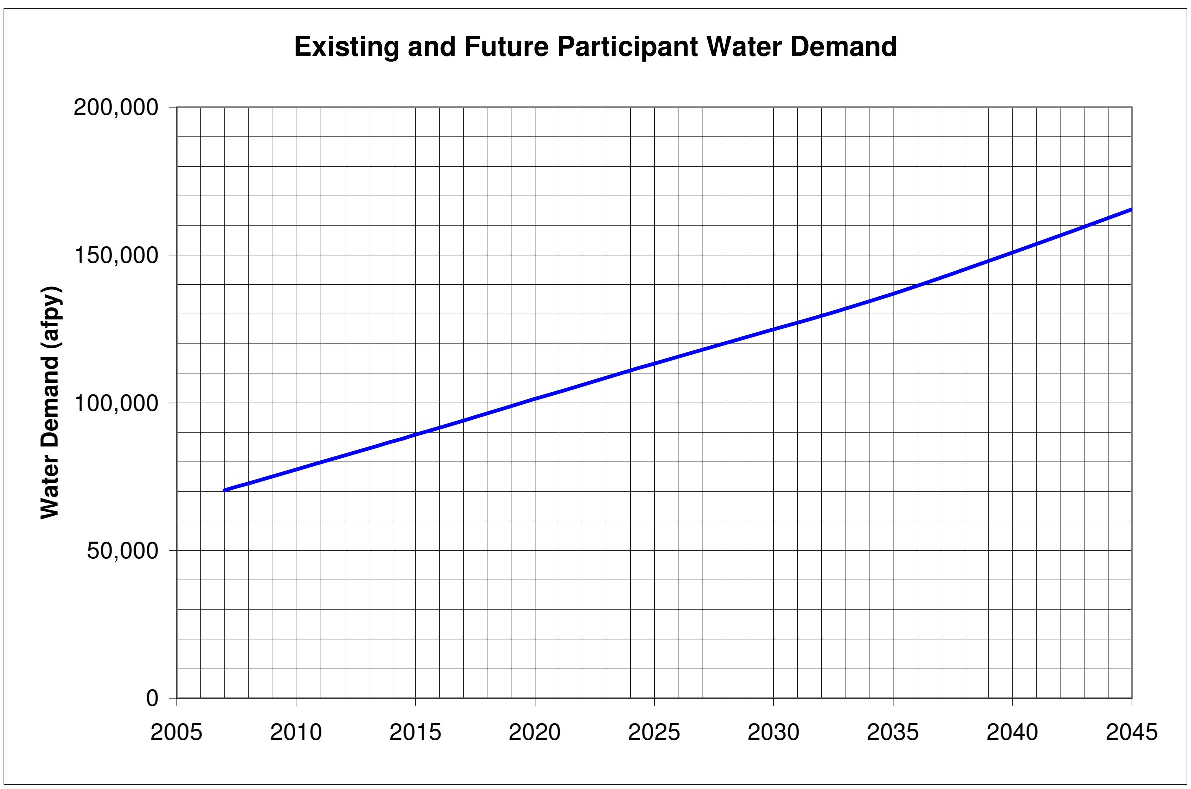
Table 2.2 summarizes water demand for the 198 Participants in SJRA's Joint WRAP as well as future Regulated Users that are assumed will join this Joint WRAP in the future. This demand is based on the Region H/TWDB demands for Montgomery County minus the demand of the Regulated Users that are not participating in the plan. The water demand for Conroe Country Club and Wedgewood Golf Course are based on their average production in recent years for which data was available. The water demand for the City of Houston in Montgomery County over the planning period is based on Region H/TWDB projections.

Table 2.2
Total Water Demand (afpy) for SJRA Joint WRAP Participants

	2007	2015	2025	2035	2045
Total County Demand	70,633	89,543	113,716	137,435	166,175
City of Houston	136.0	221.5	314.0	445.5	610.0
Conroe Country Club	22.4	22.4	22.4	22.4	22.4
Wedgewood Golf Course	89.6	89.6	89.6	89.6	89.6
Subtotal	248.0	333.5	426.0	557.5	722.0
Existing and Future Participant Demand	70,385	89,209	113,290	136,877	165,453

As can be seen from **Table 2.2** the projected water demand for existing and future Joint WRAP Participants exceeds 99% of the total county water demand throughout the planning period. **Figure 2.1** graphically illustrates future water demand for Joint WRAP Participants.

Figure 2.1
Existing and Future Joint WRAP Participant Water Demand



2.2 Individual Participant Demands

To meet the surface water conversion requirement, the existing and future surface water demands need to be located within the county. The evaluations and analyses described in this section were conducted to achieve these objectives.

The total water demand for SJRA Joint WRAP Participants presented in **Table 2.2** is based on Region H/TWDB projections. Further analysis was conducted to estimate the individual contributions to the demand by each of the 198 Joint WRAP Participants. The Region H/TWDB data included water demand projections for approximately 30 water user groups (WUGs) that are among the Joint WRAP Participants. A water user group is defined by the TWDB as a city with a population of 500 or more, a utility providing 280 afpy of water for municipal use, or a group of utilities with a common association.

Among the WUGs, the City of Conroe is notable because approximately 50% of the City's water demand is for commercial and industrial accounts. Commercial/industrial water demand is very specific to the nature of the business or industry and its particular water needs. In addition, while the City of Conroe works to attract business and industry, there is little ability to predict the future success of those efforts with any certainty. For these reasons, it is difficult to forecast industrial water demand very far into the future. Conroe's existing unit demand is approximately 200 gpcd due to its relatively large commercial / industrial component of total water demand. While the commercial / industrial demand will grow, water demand associated with the supporting residential population base is expected to grow more quickly. The result is that unit demand is expected to decrease from the current 200 gpcd to approximately 160 gpcd by 2045. Future planning work will continue to evaluate commercial and industrial water demand in the City.

In addition, four WUGs are private utilities that operate numerous utilities serving Joint WRAP Participants. The total demand for these four WUGs was allocated to the individual Participants within them in proportion to their 2007 groundwater pumpage.

The remaining 170 Joint WRAP Participants are not part of a WUG defined by Region H/TWDB and are therefore included in "County-Other" by Region H/TWDB. Water demand for these Participants was estimated based on the best information available, including utilizing HGAC projections of population. During the Joint WRAP Part I effort, HGAC population projections were used to develop projections of water demand for individual Joint WRAP Participants. The HGAC projections for Montgomery County are based on a land use model that utilizes a 1,000-foot by 1,000-foot grid. GIS tools were utilized to overlay the grid with the boundaries for Joint WRAP Participants in order to develop projections of future population for each of the Joint WRAP Participants. These projections of where future population is expected to occur were used as the best estimate available of where future water demand is expected to occur and potentially be supplied with surface water. This assumption essentially allocates or distributes the Region H 'County-Other' population to individual Joint WRAP Participants.

To estimate Participant's future water demands based on the best information available required an analysis of the many potential combinations of information from various sources as shown in **Table 2.3**. There were five types of information including:

1. The 'character' of the demand and whether the Participant supplies water primarily to a residential population or the water demand is based on land use (LU). All Participants were characterized as either "Muni" for municipal (i.e. the demand is based primarily on the population served) or "LU" for land use (e.g. industry, golf courses, etc.) in column 2 of **Table 2.3**.
2. Number of connections based on responses to questionnaires returned by Participants characterized as "Muni". Questionnaires were sent to all Joint WRAP Participants and requested projections of future population and water demand in addition to other data. A sample of the questionnaire is provided in Appendix B. The information of greatest interest is actual connections in 2007 to determine current unit water demand (gallons per capita per day, gpcd). If a population was not provided in the questionnaire response, a population of three people per connection was assumed. Whether connection information was available or not from the questionnaire was indicated by "Y" for yes or "N" for no in column 3 of **Table 2.3**.
3. Projected water demand in 2045 based on Participants' responses to questionnaires. Whether information was available for projected 2045 water demand based on the Participant's questionnaire was indicated by "Y" or "N" in column 4 of **Table 2.3**.
4. Projected water demand in 2045 based on TWDB projections of future water demand for WUGs. Whether information was available for projected 2045 water demand based on TWDB projections was indicated by "Y" or "N" in column 5 of **Table 2.3**.
5. Groundwater pumpage based on LSGCD records for 2005, 2006 and 2007 was used to determine current unit water demand (gpcd). Groundwater pumpage for 2005 through 2007 was available for most Participants. Whether 2005 through 2007 pumpage was available was indicated by "Y" or "N" in column 6 of **Table 2.3**.

For the five types of information, there are thirty-two possible combinations of "Muni"/"LU" and "Y"/"N" indicators, however, only fifteen of the combinations actually occur for Participants' information. **Table 2.3** categorizes these combinations of information and provides a count of the Participants that fall within each category as shown in column 1. Column 7 provides the number of Joint WRAP Participants that are included in each Category. Column 8, "Key to Future Demand" describes the method used to estimate the Participants' projected water demand. A complete table containing the specific information for each Joint WRAP Participant is included in **Appendix C** – Participant Water Demand Analysis.

Table 2.3
Analysis of Joint WRAP Participant Water Demand

		Questionnaire					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Category	Demand Basis	2007 Connect's	2045 Demand	TWDB WUG	LSGCD 2005 - 2007 Pumpage	Count of Particip's	Key to Future Demand
1	Muni	Y	Y	N	Y	62	1
2	Muni	Y	Y	Y	Y	25	2
3	Muni	N	N	N	Y	25	3
4	Muni	Y	N	N	Y	20	3
5	Muni	N	N	Y	Y	15	2
6	Muni	Y	N	Y	Y	8	2
7	Muni	N	Y	N	Y	4	1
8	Muni	N	N	N	N	2	4
9	Muni	N	Y	N	N	2	5
10	LU	N	N	N	Y	12	6
11	LU	Y	Y	N	Y	11	1
12	LU	Y	N	N	Y	6	6
13	LU	N	N	N	N	3	7
14	LU	N	Y	N	Y	2	1
15	LU	N	N	Y	Y	1	8
					Total Participant Count	198	

The following numbered descriptions correspond to the "Key to Future Demand" in **Table 2.3** to explain how future demand is estimated in each category.

1. Demand is interpolated between 2005 - 2007 average pumpage and 2045 demand from questionnaire or 2005 - 2007 average pumpage, whichever is larger. Using the larger value corrects a few cases where 2005 - 2007 average pumpage exceeds projected 2045 demand.
2. Demand is interpolated between 2005 - 2007 average pumpage and 2045 WUG demand or 2005 - 2007 average pumpage, whichever is larger. Using the larger value corrects a few cases where 2005 - 2007 average pumpage exceeds projected 2045 demand.
3. Demand is interpolated between 2005 - 2007 average pumpage reported to LSGCD and Unit Demand (UD) x HGAC population in 2045 (UD equals to 2005 - 2007 Average Pumpage divided by estimated 2005 - 2007 average population) or 2005 - 2007 average pumpage, whichever is larger. Using the larger value corrects a few cases where 2005 - 2007 average pumpage exceeds projected 2045 demand.
4. Demand equals 128 gpcd times HGAC population for all years.
5. Demand equals 128 gpcd times HGAC population in 2015, then interpolated between 2015 and 2045 demand from questionnaire.
6. Demand equals 2005 - 2007 average pumpage for all future years.

7. Demand is based on use by similar entities.
8. Demand is based on input from The regional electric power generator indicating increased demand to current contract amount of 7 mgd. Water demand from 2025 to 2045 equals TWDB projection.

Potential to Reduce Treated Surface Water Infrastructure Requirements

Reducing water demand and providing sources of water other than surface water will extend the surface water available for municipal potable water supply and potentially reduce the infrastructure required thus reducing costs. Reducing water demand may be achieved through conservation and drought contingency methods. Conservation efforts implement water saving devices and practices to accomplish long-term savings and reduction in water demand. In contrast, drought contingency measures seek to reduce water demand in the early stages of drought in order to reduce long-term affects of drought and extend the life of water supplies during the drought. Other sources of water include wastewater reuse and raw surface water for irrigation and industrial process applications.

For the purposes of the development of the SJRA Joint WRAP, reducing demand through conservation and/or utilizing alternatives to treated surface water are assumed not to impact the size and location of the treated surface water infrastructure. The greatest obstacle to implementing any of these strategies is their cost relative to the cost of existing water supplies. As the cost of compliance with existing regulations increases, the incentive to conserve water will increase as will the cost-effectiveness of alternative water supplies. Before the potential impacts of these strategies can be adequately quantified to include them in development of plans for future infrastructure, the following must be considered:

- Customer behavior – how retail water Customers will react to and accept various water conservation and drought contingency measures.
- Public acceptance – how the public will accept water reuse as a water management strategy.
- Customer’s interest to pursue potential projects and their ability or willingness to share in the cost of those projects.
- Cost sharing – should all Joint WRAP Customers share in project costs because the project is part of an overall strategy that achieves regulatory compliance for all Customers?
- What will happen to existing wastewater treatment plants that are the supply for a reuse project that may be abandoned when that utility is annexed?

Despite these current uncertainties, all these strategies may play some role in future plans. The potential benefits of these strategies include:

- May reduce the capacity and, therefore, cost of the surface water conveyance system that is required.
- May postpone when future expansions of capacity are required and, therefore, delay future expenditures.
- May extend the available supply of surface water.

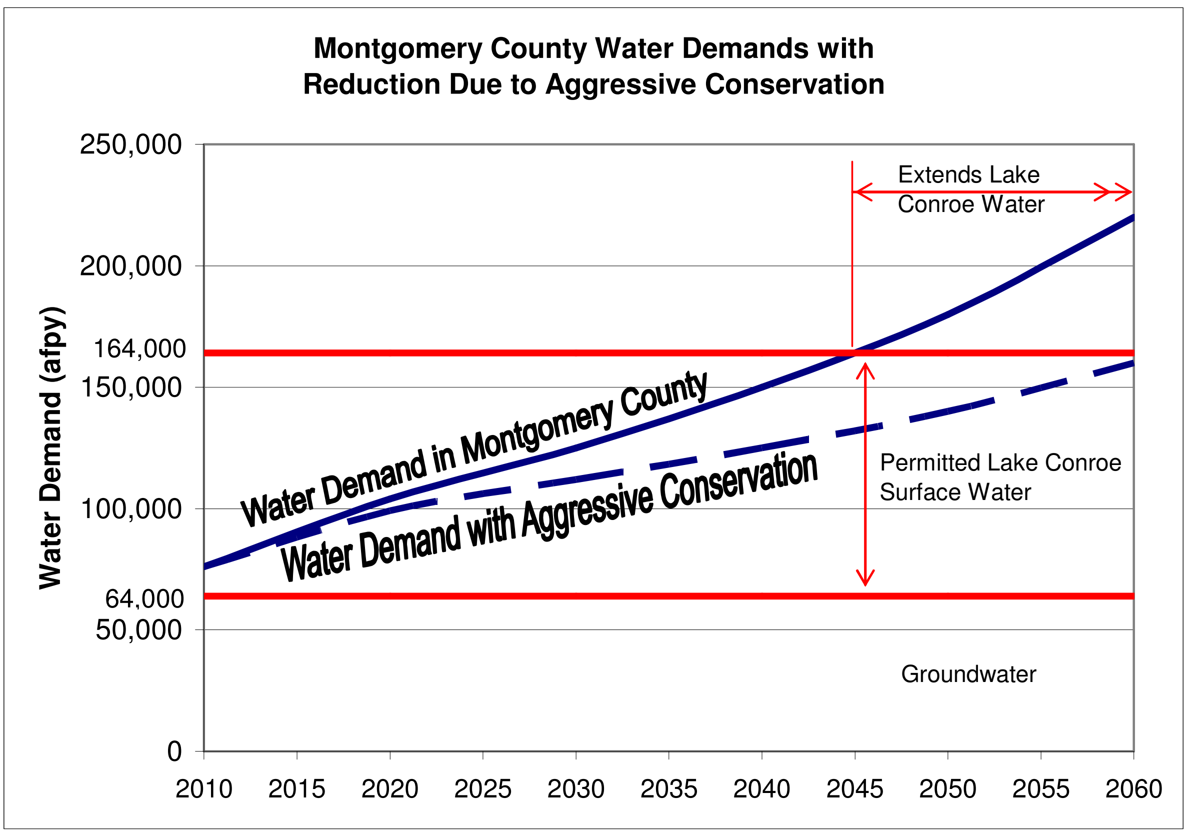
Water Conservation and Drought Contingency Management

The potential benefits of water conservation and drought contingency management include:

- Cost savings to Joint WRAP Participants due to deferred construction of treatment and conveyance infrastructure.
- Savings to Participants in pumpage fees, chemical, power, and maintenance costs of groundwater wells.
- Savings to end users (retail Customers) in both water bills and possibly wastewater charges.
- Potential reduction in capacity of surface water treatment and conveyance infrastructure.
- Reduction in peak water demand, which reduces the least utilized portion of capacity.

Figure 2.2 illustrates some of the changes to future plans that may occur depending on the degree of conservation realized.

Figure 2.2
Montgomery County Water Demands with Reduction to Aggressive Conservation



The potential benefits will not be realized unless all parties diligently pursue plans to ensure the success of water conservation and drought contingency efforts. Many Joint WRAP Participants may already have a water conservation plan in place but the degree of success in reducing water demand varies widely. The elements of water conservation plans typically address two major areas: 1) goals, and 2) methods of conservation.

Conservation goals may include, but are not limited to:

- Goals to reduce unit demand (gallons per person per day);
- Goals to minimize inefficiencies and losses, especially unaccounted-for water;
- Goals to improve or maximize the efficiency of the transmission and/or distribution systems.

Methods to encourage and help achieve these conservation goals include, but are not limited to:

- Water Rate Structure;
- Public Information and Education;
- Metering and Record Management Practices;
- Meter Testing, Repair and Replacement Practices;
- Leak Detection and Line Repair to Minimize Conveyance Losses;
- Placing Contractual Requirements on Customers;
- Fixture Retrofit Efforts;

Many Participants have a drought contingency plan. The elements of drought contingency plans typically address two major areas: 1) stage trigger points, and 2) target water demand reduction for each stage.

While the SJRA will continue to encourage aggressive conservation, assess the viability of conservation projects, and evaluate the success of conservation efforts, as stated previously, for the purpose of developing this Joint WRAP, water conservation is assumed to have no impact on planning for proposed facilities to meet the requirements for groundwater reduction. The possible success of current or future efforts is too uncertain to rely on those efforts. Instead, their impacts are more certain to increase and become significant as the cost of water increases in the future. The impact of reduced demand will be to delay the need for new infrastructure and/or to reduce the size of future infrastructure.

Use of Reclaimed Wastewater

Numerous potential users of reclaimed wastewater have been identified among the 198 Participants in the Joint WRAP. Possible users of reclaimed water that provide the greatest potential include golf courses, property owners associations, MUDs that currently use groundwater for amenity lake maintenance and/or irrigation, and other irrigated areas such as school athletic fields, and public and commercial landscaping. In addition to simply reusing water, Joint WRAP Participants are encouraged to implement water conserving landscaping practices. The identified potential users are shown on **Exhibit 2**.

All wastewater treatment plants were identified as potential sources of reclaimed water based on information for wastewater discharges permitted by the Texas Commission on Environmental Quality (TCEQ). The identified potential sources are also shown on **Exhibit 2.**

Factors affecting the viability of connecting a potential user with a potential source were investigated including distance and whether the quantity of reclaimed water at the source is adequate to meet the demands of the potential user. Based on this analysis, 25 potential users are highlighted on **Exhibit 2.** To be included in a future, more comprehensive, overall groundwater reduction plan, the use of reclaimed wastewater should be technically feasible, cost competitive and dependable. For these reasons, further analysis is recommended before specific projects are incorporated in future groundwater reduction plans. Use of reclaimed water is a realistic alternative to providing additional infrastructure included in plans for future transmission mains.

Use of Raw Water

Existing development near Lake Conroe was investigated to identify potential uses of untreated surface water for irrigation purposes. Thirty-six potential users of raw water for irrigation were identified on the shore of Lake Conroe. The thirty-six include five that currently purchase raw water from SJRA. Those five are: April Sound, Bentwater, Del Lago, Walden, and West Palm Villas. These users are shown on **Exhibit 3**.

It is estimated that more than two to as much as five mgd is used to satisfy the irrigation needs of these five entities. A detailed evaluation of the infrastructure requirements and costs to supply raw surface water to any of these entities is needed to determine the viability of supplying raw surface water and will be evaluated in greater detail in future planning efforts.

Drought Management Strategies

Many drought contingency or drought management plans consist of two major parts. The first major part is "trigger conditions" or stages of severity of the drought as indicated by an appropriate means of measurement. Stages are typically expressed as "Mild", "Moderate", "Severe", and "Critical" or other similar descriptions. Means of measuring drought conditions may consist of comparison of recent rainfall to "normal" rainfall for similar periods, lake levels, the volume of water pumped in comparison to pump or system capacity, and other measures.

The second part is the steps to be taken when each of the trigger conditions are met. Steps typically begin with voluntary action on the part of consumers and increased monitoring on the part of the water supplier. As drought conditions worsen and additional trigger conditions are met, steps typically increase to mandatory reductions in water use, increased efforts to identify and eliminate leaks, operating at reduced pressure, restrictions and potentially prohibitions on certain water using activities, and similar steps.

In addition to these parts, drought management plans may have other elements such as the means of notification of parties that are to act and of the general public, public information and education components, procedures for granting variances, enforcement and penalties, and requirements for updating the plan.

The key point for the purposes of the Joint WRAP is that all Joint WRAP Participants are encouraged to adopt drought management plans so that the water resources of all Joint WRAP Participants are used prudently and preserved for as long as possible during emergency conditions.

Section 3
Conversion Strategy

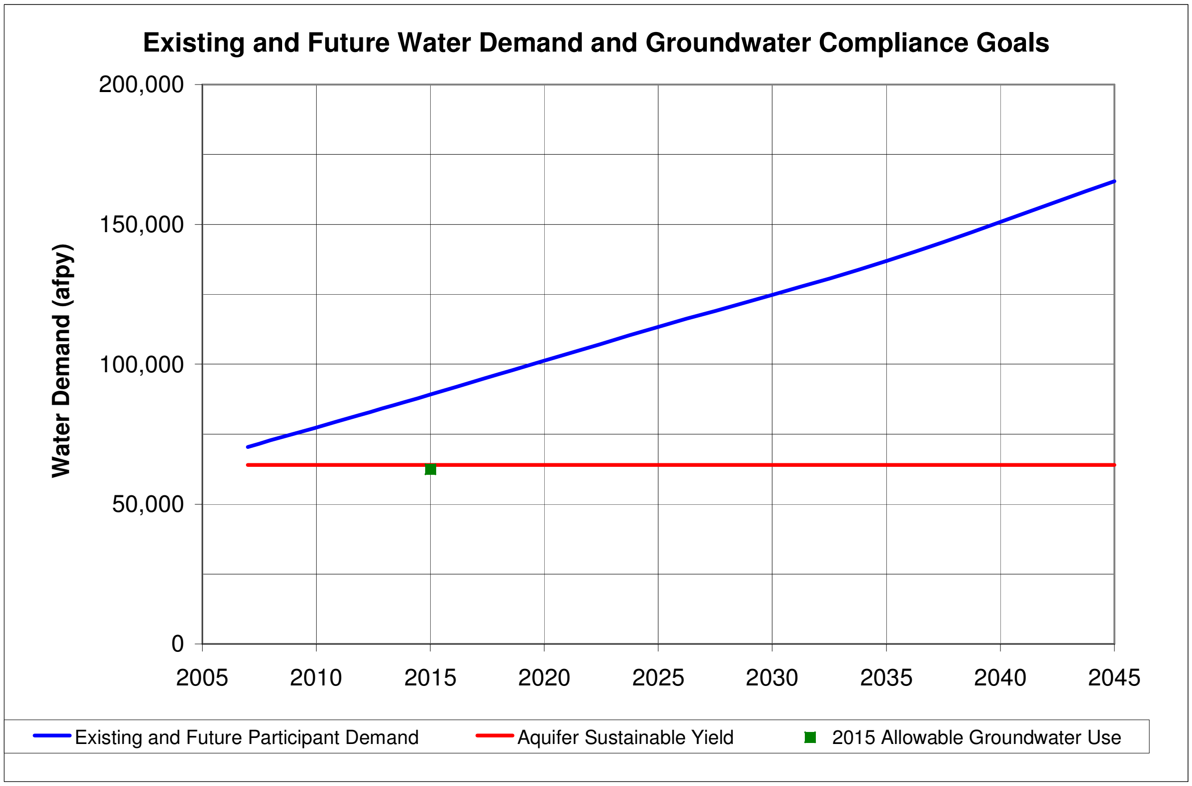
3.1 LSGCD Regulations

The key goal of the LSGCD District Regulatory Plan (DRP) is to reduce withdrawal of groundwater in Montgomery County to less than the sustainable yield of the aquifer. Phase II (A) of the DRP adopted February 12, 2008 requires that groundwater production authorized under permits issued by the District be reduced to no more than 70 percent of total water demand on January 1, 2015. Therefore, based on this regulation, in 2015 the maximum allowable groundwater use by Joint WRAP Participants is 62,446 afpy (55.7 mgd) (89,209 x 70% = 62,446). Under subsection B.4(b) of the Regulatory Plan, WRAPs with multiple groundwater to alternative water conversion projects may provide for growth (of demand) on groundwater between conversions if the Joint WRAP timely meets the initial 70/30 percent conversion requirement in 2015 and the overall average groundwater use for the planning period from 2015 to 2045 is equal to or less than 64,000 acre-feet/year (afpy) (57.1 mgd).

The LSGCD Groundwater Management Plan (GMP), adopted in 2003, assumed the sustainable groundwater yield for Montgomery County is 64,000 afpy based on an annual deep recharge to the Northern Gulf Coast Aquifer System of approximately 1.1 inches per year applied to the area of the county in acres (697,600 acres). The Texas Water Development Board (TWDB) has recently released preliminary results of the Northern Gulf Coast Aquifer Groundwater Availability Model (GAM) which indicate the recharge rate could be considerably less than 64,000 afpy. The LSGCD has contracted with the US Geological Survey (USGS) to conduct a three-year study of the recharge rate. Preliminary results of that study will not be available until 2010. The LSGCD has chosen not to adopt the TWDB GAM data at this time, but rather wait until the USGS study results are available. For the purposes of this Joint WRAP, the value of 64,000 afpy will be used.

Figure 3.1 illustrates the total demand for the Joint WRAP Participants and their allowable groundwater use in 2015 in relation to the 64,000 afpy (57.1 mgd) allowable average groundwater use from 2015 to 2045. In addition, the area between the total water demand and allowable groundwater use (64,000 afpy) lines represents the ‘goal’ for surface water use.

Figure 3.1
Existing and Future Water Demand and Groundwater Compliance Goals



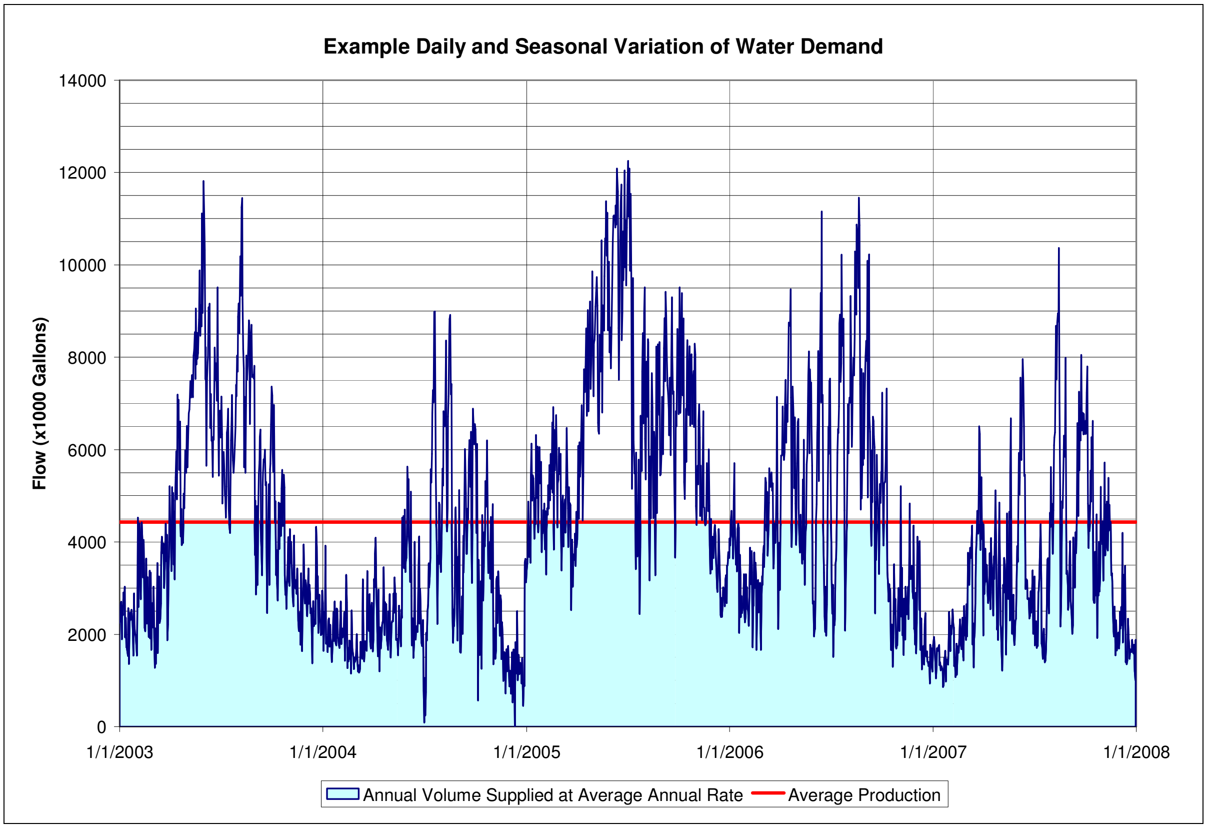
To achieve compliance with the LSGCD, Joint WRAP Participants must supply a quantity of alternative water (assumed to be entirely or mostly surface water) equal to the difference between the total Joint WRAP Participants' water demand (blue line in **Figure 3.1**) of 89,209 afpy (79.6 mgd) and the allowable groundwater use (green dot) of 62,446 afpy (55.7 mgd). Therefore, based on LSGCD's current regulation and implementation schedule in 2015, surface water use must equal at least 26,765 afpy (23.9 mgd). For the planning period from 2025 through 2045, compliance is measured by supplying alternative water in sufficient quantity that the average groundwater use during the planning period is less than or equal to 64,000 afpy (57.1 mgd). The strategy to accomplish this is described in Section 3.3 Conversion Strategy.

3.2 Compliance Assurance Factor

A critical factor to correctly size elements of the surface water delivery system is the daily and seasonal variation of demand throughout the year. It is essential to understand the relationship between daily and seasonal demand and annual volume of water in order to correctly size facilities to deliver surface water at a rate that provides the volume necessary on an annual basis to meet the regulatory goal.

As an example, **Figure 3.2** illustrates daily groundwater pumpage data for 10 wells in Montgomery County for 2002 through 2006. **Figure 3.2** illustrates that there are periods of time when water use is low. During these times, demand may be less than the average rate at which surface water must be delivered to meet the goal for groundwater reduction on an annual basis.

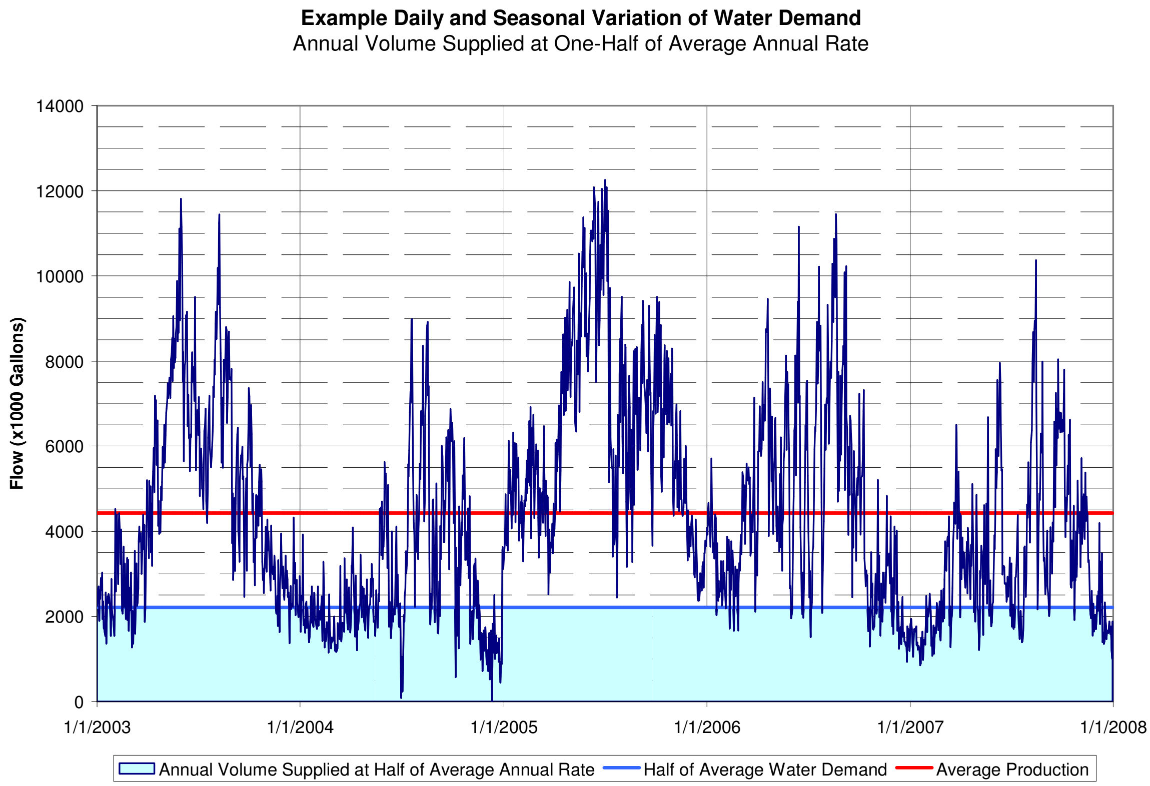
Figure 3.2
Example Daily and Seasonal Variation of Water Demand
Annual Volume Supplied at Average Annual Rate



As seen from **Figure 3.2** the average flow is 4.4 mgd but the daily flows vary from less than 1.0 mgd in the winter months to as high as 12.0 mgd during the summer months. If the treatment and transmission facilities were designed to provide an average flow of 4.4 mgd there are significant periods of time during the year, especially in the summer, where the facilities could not meet the demand. Similarly, there are periods of time during the year, especially during the winter, where the amount of surface water available is greater than the demand. Therefore in order to deliver 100% of the annual demand the treatment and transmission facilities would have to be sized for 12.0 mgd which is 2.7 times the average. This would be cost prohibitive.

Understanding the relationship between the variation in a user's daily demand and the fraction of the user's annual volume of water used is necessary to develop a plan that assures sufficient surface water is utilized to meet the regulatory conversion requirements without unnecessarily over sizing infrastructure. For comparison, **Figure 3.3** illustrates the volume of average demand supplied if surface water is delivered at a rate equal to one-half of the average day water demand.

Figure 3.3
Example Daily and Seasonal Variation of Water Demand
Annual Volume Supplied at One-Half of Average Annual Rate



The complete relationship between the rate at which flow is delivered and the percentage of annual volume defines a curve. Figures of daily pumpage and CAF curves developed in this analysis are included in an Appendix A to this report. For simplicity, the variation in daily demand is expressed in terms of the average day demand (i.e., average day = 1.0). The term 'compliance assurance factor' (CAF) is used to describe the maximum rate at which surface water must be provided to entities receiving surface water. Based on review of all the CAF figures included in Appendix A, a CAF of 1.0 typically provides approximately 70% to 90% of the annual water demand volume as surface water. Therefore, an 80% conversion was assumed for existing and future Participants based on supplying surface water at a maximum rate equal to the Participants average daily water demand.

The CAF is not a peaking rate, rather it expresses the relationship between the maximum rate that surface water is supplied as a factor of average day demand and the percent of the annual volume that occurs and could be supplied at and below that rate or factor. Therefore, when water demand exceeds average daily demand, Participant's groundwater wells will be required to supply that 'peak' water demand that exceeds average demand.

In addition, it is important to understand that introducing surface water as a new source of supply will not change a utility's requirements for storage nor will it adversely affect current storage and pumping operations. Also, receiving surface water will not adversely impact a utility's ability to meet fire flow requirements assuming the utility currently has adequate storage and booster pump capacity.

Adequate storage will be maintained at the surface water treatment plant only for temporary events that force a short-term shut down of a portion or all of the production capacity. Storage at the surface water plant will be sized to provide a cost-effective amount of storage, and if an event should last longer than the amount of storage available, then Participants' wells must be placed in service to provide an uninterrupted supply of water.

3.3 Conversion Strategy

198 Joint WRAP Participants joined together, as allowed by LSGCD's Regulatory Plan, to develop a Joint WRAP because a joint approach provides the following benefits:

- Removes the burden of compliance from 'small' entities not equipped to meet the regulatory requirements on their own.
- Allows Participants to develop the most cost-effective solution to meet regulatory goals.
- Takes advantage of the economy of scale that can be realized by building larger treatment and transmission facilities at lower cost per unit of capacity.

The most cost-effective solution is based on over-converting large concentrations of groundwater use for the benefit of all Participants, especially small, remote, users to which it would be cost prohibitive to convey surface water. An important key to this approach is replacing a large portion of the groundwater used by The Woodlands and the City of Conroe; the two largest groundwater producers in Montgomery County.

To determine new surface water treatment capacity that must be built and in service by the initial conversion date, this Joint WRAP takes advantage of the fact that The regional electric power generator already uses surface water in the process of generating electric power. The regional electric power generator currently has a contract with SJRA for approximately 7 mgd of surface water. A portion of that is captured as runoff before reaching Lake Conroe and the remaining amount is pumped from Lake Conroe to Lewis Creek Reservoir just east of Lake Conroe. The regional electric power generator has not requested an increase in water supply for its operations. However use of surface water to support power generation in Montgomery County is expected to increase through the planning period as indicated in the Region H Water Plan. The regional electric power generator made information available to the SJRA regarding its existing groundwater wells and their typical use. **Table 3.1** shows projected total water demand and typical groundwater use to estimate future untreated surface water needs for power generation.

Table 3.1
Power Generation Water Demand (afpy)

	2015	2025	2035	2045
Total Water Demand (Region H)	7,840	9,259	10,861	12,814
Typical Groundwater Use	807	807	807	807
Estimated Future Surface Water Demand	7,033	8,452	10,054	12,007

The alternative water supply strategy proposed for this Joint WRAP uses the "Estimated Future Surface Water Demand" above to reduce the capacity of future surface water treatment facilities by an equal amount. Based on this and the allowable groundwater use of

62,446 afpy (55.7 mgd) in 2015 and an average of 64,000 afpy (57.1 mgd) in years after 2015, the estimated treated surface water capacity required is shown in **Table 3.2**.

Table 3.2
Surface Water Capacity (afpy)

	2015	2025	2035	2045
Existing and Future Participant Demand	89,209	113,290	136,877	165,453
Power Generation Estimated Surface Water Demand	7,033	8,452	10,054	12,007
Allowable Groundwater Use	62,446	64,000	64,000	64,000
Estimated Treated Surface Water Required	19,730	40,838	62,823	89,446

The actual groundwater use will vary depending on the surface water treatment capacity provided. For the purposes of the Joint WRAP, the average surface water to be delivered at 10 year milestones is: 18 mgd in 2015, 54 mgd in 2025, 72 mgd in 2035, and 89 mgd in 2045. The above treatment capacities in mgd are equal to 20,164 afpy in 2015, 60,492 afpy in 2025, 80,656 afpy in 2035, and 100,000 afpy in 2045. These capacities coincide with the assumed 80% conversion of annual volume described earlier. To meet the groundwater reduction requirement, the surface water treatment and conveyance systems must have a capacity equal to 125% percent of the average surface water to be delivered. Based on delivering the above average volume of surface water annually, **Table 3.3** illustrates the proposed groundwater reduction strategy.

Table 3.3
Groundwater Reduction Strategy

	2015	2025	2035	2045
Existing and Future Participant Demand	89,209	113,290	136,877	165,453
Power Generation Estimated Surface Water Demand	7,033	8,452	10,054	12,007
Average Treated Surface Water Delivered	20,164	60,492	80,656	100,000
Groundwater Use BEFORE Add'l SW Capacity	82,176	84,674	66,331	72,790
Groundwater Use AFTER Add'l SW Capacity	62,012	44,346	46,167	53,446

Figure 3.4 also graphically illustrates the groundwater reduction strategy with the graph showing the total groundwater pumpage on an annual basis.

Figure 3.4
Joint WRAP Groundwater Reduction Strategy

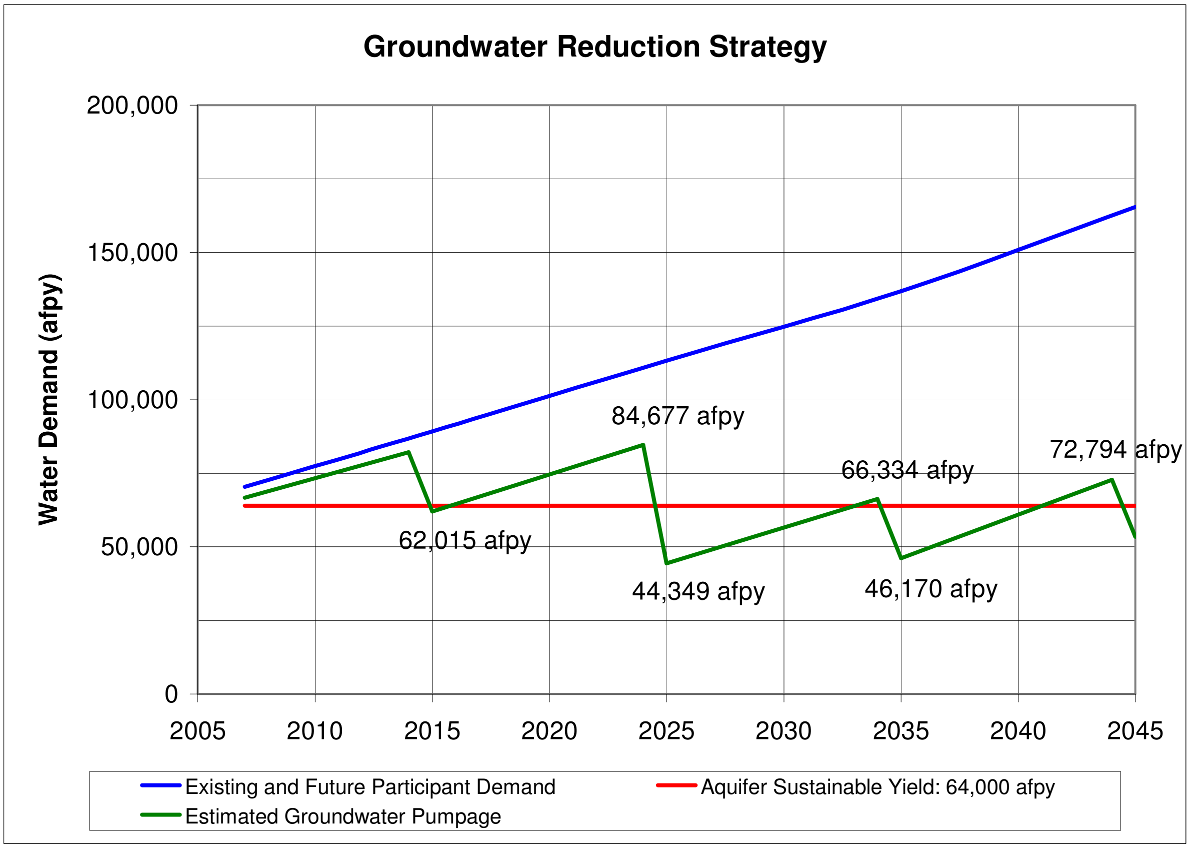


Figure 3.4 shows the maximum and minimum groundwater use prior to and following major expansions of surface water treatment capacity upon which the groundwater reduction strategy is based. These values provide the foundation for Table 3.4 demonstrating that average groundwater use over the planning period is less than 64,000 afpy as required by the LSGCD. The calculated average for the 30-year planning period (2015 through 2044) is less than 64,000 afpy, as required. Adding the groundwater used in 2045 only decreases the average because additional surface water capacity is utilized in 2045 and groundwater use will be less than 64,000 afpy.

Table 3.4
Confirmation that Proposed Groundwater is Less Than 64,000 afpy

Year	Groundwater Used (afpy)	Year	Groundwater Used (afpy)
2015	62,015	2030	56,563
2016	64,533	2031	59,006
2017	67,051	2032	61,449
2018	69,569	2033	63,892
2019	72,087	2034	66,334
2020	74,605	2035	46,170
2021	77,123	2036	49,128
2022	79,641	2037	52,087
2023	82,159	2038	55,045
2024	84,677	2039	58,003
2025	44,349	2040	60,961
2026	46,792	2041	63,919
2027	49,235	2042	66,877
2028	51,678	2043	69,836
2029	54,120	2044	72,794
		Total	1,881,702
		Average	62,723

The conversion strategy also addressed identifying Participant facilities to which to deliver surface water. As stated previously, the approach pursued in this Joint WRAP is to develop the most cost-effective solution to meet regulatory goals. A major tactic in developing the most cost-effective solution is to over-convert large concentrations of groundwater use. Therefore, The Woodlands is converted to approximately 80% surface water by delivering surface water to all five existing water plants in The Woodlands. In addition, the majority of the City of Conroe's water demand west of Interstate Highway 45 is converted to surface water by delivering enough surface water to replace approximately 80% of the annual water production of the City's water plants west of Interstate Highway 45. For the initial 2015 conversion, water plants were added to each alternative until 80% of their average water demand equaled the required conversion of 30% of total demand for all Participants including power generation use of untreated surface water. In the selection of Participant water plants, consideration was given to:

- minimizing the length of water line,
- avoiding the additional cost associated with crossing Interstate Highway 45,
- delivering surface water to all of a Participant's groundwater storage facilities (not wells pumping directly to the distribution system or to elevated storage),
- delivering surface water to groups of Participants in relatively close proximity to one another.

For conversions after 2015, projected 2045 water demands were considered in the determination of facilities to add to the ultimate conversion strategy. Again, facilities were added to each alternative until 80% of their average water demand equaled the required conversion amount indicated as "Proposed Surface Water Treatment Capacity" in **Table 3.3**, above. The same considerations apply to future phases except that it becomes necessary to cross Interstate Highway 45.

Section 4
Water Supply Sources

4.1 Potential Source Study

The LSGCD DRP Phase II (A) requires that each Water Resources Assessment Plan (WRAP) include identification of new water supply sources to meet projected water demands. To satisfy this requirement, the SJRA conducted a "Potential Source Study" that investigated nine alternative water supply sources. The purpose of the study is to identify potential alternative water sources available to Montgomery County to reduce groundwater use and meet projected water demands, evaluate those potential sources, and select a source to be used as the basis for the SJRA Joint WRAP Part II study.

4.2 Alternative Sources

Alternatives evaluated as part of SJRA's Study include the following.

- SJRA trades their Trinity River water rights for the City of Houston's Lake Conroe water rights.
- SJRA trades their San Jacinto Basin water rights for the City of Houston's Lake Conroe water rights.
- SJRA purchases the City of Houston's Lake Conroe water rights.
- SJRA participates in Luce Bayou in exchange for use of the City of Houston's Lake Conroe water rights.
- SJRA enters into a Long-Term Water Supply Contract with NHCRWA for treated surface water.
- SJRA enters into a Long-Term Water Supply Contract with City of Houston for Lake Conroe raw surface water.
- SJRA enters into a Long-Term Water Supply Contract with Trinity River Authority for raw surface water diverted from Trinity River near Huntsville.
- SJRA enters into a Long-Term Water Supply Contract with City of Houston for Lake Conroe raw surface water plus Long-Term Water Supply Contract with Trinity River Authority for raw surface "replacement" water diverted from Trinity River near Huntsville.
- SJRA enters into a Long-Term Water Supply Contract for imported groundwater.

4.3 Evaluation of Alternatives

Through a preliminary screening process, four alternatives were identified for further evaluation. The four alternatives are:

- SJRA enters into a Long-Term Water Supply Contract with City of Houston for Lake Conroe raw surface water.

- SJRA enters into a Long-Term Water Supply Contract with Trinity River Authority for raw surface water diverted from Trinity River near Huntsville.
- SJRA enters into a Long-Term Water Supply Contract with City of Houston for Lake Conroe raw surface water plus Long-Term Water Supply Contract with Trinity River Authority for raw surface "replacement" water diverted from Trinity River near Huntsville.
- SJRA enters into a Long-Term Water Supply Contract for imported groundwater.

To compare alternative water sources, preliminary diversion locations, water treatment, finished water storage and pumping, and transmission size and routing were identified. Costs to implement each alternative were developed and are shown in **Table 4.1**.

Table 4.1 Costs of Alternative Sources

Current SJRA Conroe Rights (Beginning 2015) + Contract COH Water In Conroe (Beginning 2025)+ SJRA's Trinity River Rights Via Luce Bayou (2055)	Current SJRA Conroe Rights (Beginning 2015) + Contract TRA Water From Trinty U/S of Livingston (Beginning 2025) + SJRA's Trinity River Rights Via Luce Bayou (2055)	Current SJRA Conroe Rights (Beginning 2015) + Contract COH Water In Lake Conroe and TRA Water From Trinty U/S of Livingston (Beginning 2025) + SJRA's Trinity River Rights Via Luce Bayou (2055)	Contract Imported Groundwater (Beginning 2015) + Current SJRA Conroe Rights (Beginning 2045) + SJRA's Trinity River Rights Via Luce Bayou (2055)
Capital Costs (2008 Dollars)	**Capital Costs (2008 Dollars)**	**Capital Costs (2008 Dollars)**	**Capital Costs (2008 Dollars)**
$100,088,000	$100,088,000	$100,088,000	$80,510,000
$313,002,000	$313,002,000	$313,002,000	$246,547,000
$63,690,900	$321,172,950	$346,192,350	$68,652,150
$252,913,500	$252,913,500	$252,913,500	$269,415,300
$154,747,950	$154,747,950	$154,747,950	$209,321,700
$594,922,650	$594,922,650	$594,922,650	$594,922,650
$1,479,365,000	$1,736,847,050	$1,761,866,450	$1,469,368,800
Capital Costs (Dollars in Year Constructed)	**Capital Costs (Dollars in Year Constructed)**	**Capital Costs (Dollars in Year Constructed)**	**Capital Costs (Dollars in Year Constructed)**
$110,347,000	$110,347,000	$110,347,000	$88,762,000
$399,479,000	$399,479,000	$399,479,000	$314,664,000
$132,409,000	$667,696,000	$719,709,000	$142,723,000
$856,455,000	$856,455,000	$856,455,000	$912,336,000
$853,592,000	$853,592,000	$853,592,000	$1,154,622,000
$5,345,385,000	$5,345,385,000	$5,345,385,000	$5,345,385,000
Present Worth Value (2015 thru 2060) (2008 Dollars)	**Present Worth Value (2015 thru 2060) (2008 Dollars)**	**Present Worth Value (2015 thru 2060) (2008 Dollars)**	**Present Worth Value (2015 thru 2060) (2007 Dollars)**
$2,996,691,827	$3,461,237,563	$3,900,374,038	$5,481,265,502

4.4 Evaluation Results

Based on the present worth of the alternatives, SJRA's Potential Source Study concluded that the most cost-effective water supply alternative is to use SJRA's water rights in Lake Conroe plus the City of Houston's water in Lake Conroe via a long-term water supply contract. The study recommended that the permitted yield of Lake Conroe be utilized to supply surface water in Montgomery County prior to the conveyance of water from additional sources into the county and that a long-term water supply contract with the City of Houston be executed in a timely manner.

Section 5
Infrastructure Requirements

5.1 Water Treatment Facilities

This Alternative Analysis study provides information regarding capacity of surface water treatment infrastructure and does not attempt to address matters related to treatment processes nor their costs. Treatment processes will be evaluated in greater detail in the Joint WRAP II Report as will their costs. For the purpose of this alternative analysis, it is assumed that the water treatment plant is located at the Lake Conroe dam for all the alternatives evaluated. A previous study for the LSGCD, "Planning Level Study for Alternative Surface Water Pipeline routing in Montgomery County," investigated whether a single or potentially multiple water treatment plant alternative was most cost effective. The conclusion of that study was that a single water treatment plant located at Lake Conroe was most cost effective. Therefore, for the purpose of the alternative analysis, a single plant site was assumed to be located downstream of the Lake Conroe dam. This location was assumed for all alternative alignments, so that any potential change in the water plant site would affect all transmission line alternatives equally.

Section 3 – Conversion Strategy provided the regulatory requirements for surface water treatment capacity to be provided. The conversion strategy went a step further to provide estimates of future groundwater use based on the average rate at which surface water must be treated and delivered. Section 3 also introduced the concept of the Compliance Assurance Factor that addresses the relationship between the rate of demand (expressed as a fraction of average day demand) and the percent of annual water volume that occurs at or below that rate. It was found that by supplying surface water at a rate equal to a Participant's average day demand (CAF = 1.0), surface water would be approximately 80% of the volume of the Participant's annual water demand.

In other words, due to the daily and seasonal variation in water demand, the water supply system must be designed to convey 125% of the average daily demand rate required by the groundwater reduction regulations. The system capacity in excess of the average annual water demand is not used to supply additional treated surface water to individual water users as a peaking factor for daily or seasonal peaks. Each water user will continue to use groundwater to meet daily and seasonal peak demands in excess of the average annual water demand rate. Instead, more water plants would receive treated surface water in order to ensure that the regulatory requirements are met.

Table 5.1 summarizes information regarding required surface water, average surface water treatment rate, and proposed surface water treatment capacity. For the purpose of estimating costs for this alternative analysis, no standby treatment modules or capacity were assumed. Treatment plant costs are based on the capacity constructed and not on the capacity of individual treatment modules or trains. The values for 'Proposed Surface Water Treatment Capacity' in **Table 5.1** reflect the assumption that capacity will be constructed in increments of 12 mgd (13,443 afpy) modules.

Above it was stated that the water supply system must be designed to convey 125% of the average daily surface water to be delivered to meet the groundwater reduction regulations. In 2015, 20,164 afpy is equivalent to 18 mgd. Assuming two treatment modules are constructed to provide the total capacity, then 125% of 9 mgd requires treatment modules of 11.25 mgd capacity. For the purposes of this study, 12 mgd treatment modules were assumed that will provide 6 to 7 percent additional capacity. This surplus capacity provides a buffer to ensure that the desired water quality is attained and can be used to generate over-conversion credits if LSGCD adopts a policy regarding credits. The values for ‘Proposed Surface Water Treatment Capacity’ in **Table 5.1** reflect the assumption that capacity will be constructed in increments of 12 mgd (13,443 afpy) modules.

Table 5.1
Surface Water Treatment Capacity (afpy)

	2015	2025	2035	2045
Estimated Treated Surface Water Required	19,730	40,838	62,823	89,446
Average Treated Surface Water Delivered	20,164	60,492	80,656	100,000
Proposed Surface Water Treatment Capacity (12 mgd modules)	26,885	80,656	107,541	134,426

5.2 Water Transmission System

Water demands for Joint WRAP Participants were identified in Section 2 – Water Demand. Based on those water demands, alternative pipeline systems layouts were developed and hydraulic modeling was used to further quantify infrastructure requirements by determining the sizes of proposed transmission mains. EPANET (version 2) software was used to size pipes to meet common hydraulic design considerations including:

- Pipes were sized so that maximum velocities were in the range of 4 to 6 feet per second (fps)
- The target pressure at delivery points is 25 pounds per square inch (psi). The reference elevation is ground elevation, so 25 psi allows for height of ground storage tanks plus energy losses through control valves. These assumptions typically leave approximately 5 to 10 psi of residual pressure as a margin of safety.
- Pipes are modeled with a flow coefficient (C) value of 120. C = 120 also accounts for minor losses that are not specifically modeled.
- The discharge pressure assumed at the water treatment plant high service pump station is 100 psi for all alternatives.

These considerations expedited the hydraulic modeling of the numerous alternatives. In addition, they ensured that alternatives were developed using consistent conditions and were comparable for purposes of economic analysis to determine the preferred alternative. A specific area for study in the next phase of plan development is whether a different operating pressure at the high service pump station, with appropriate adjustment of proposed pipe sizes, is more economical.

5.3 Transmission Main Alternatives

The alternative analysis for the transmission main pipelines was performed at two levels. The initial analysis distinguished three primary transmission corridor groups, shown in **Exhibit 4**:

- North-South - five corridors from the Lake Conroe water treatment plant to a distribution point on the north side of The Woodlands.
- City of Conroe – two west–east corridors from the Lake Conroe water treatment plant to distribution points in the City of Conroe.
- The Woodlands – three west-east corridors from the terminus of the North-South corridor to distribution points in The Woodlands.

For all routing combinations, a single surface water treatment plant near Lake Conroe was assumed.

5.3.1 Corridors

In the initial phase of the transmission main alternative analysis, three groupings of corridors were identified to convey treated surface water from a treatment plant adjacent to Lake Conroe to the main distribution points in the City of Conroe and The Woodlands. The different alternative alignments for each of three corridor groupings are discussed in the following sections. A map showing each of the corridors is provided in **Exhibit 4**.

The investigation for each of the alternative corridors included numerous engineering, construction cost, and environmental factors. The engineering analysis investigated the construction environment for each of the alternative corridors (urban vs. rural), potential underground conflicts (hydrocarbon pipelines, municipal water and sewer lines, communication, and power conduit and cable), overhead conflicts (power lines, etc.), water crossings, major transportation crossings (State highways and railroads), local roadway and driveway crossings and other surface impacts (i.e., traffic patterns near schools or commercial areas). The evaluation of the infrastructure costs and economic analysis are described in Sections 6 and 7, respectively.

A separate environmental review was performed that investigated nine of the ten corridors described above. The tenth corridor, the fifth of the north-south alignments, was identified after the environmental review was essentially completed. The additional north-south corridor is primarily parallel to Interstate Highway 45 and will be fully review in future studies if it ranks highly enough among the alternatives evaluated in this study. Because it is along Interstate Highway 45, any environmental impacts associated with this corridor are expected to be minimal.

In the collection of data for the investigation information was sought from federal, state and local agencies in the form of topographic maps, historic and current aerial photography, soil surveys, physiographic and geologic maps, descriptions of the plants and animals of the region, and historic atlases. In addition, field reconnaissance surveys of the identified pipeline corridors were performed and the following were identified and/or described for each of the corridors:

- the soils, with particular attention to hydric soils – an indicator of wetland areas, and prime farmland soils,
- six major vegetation communities,
- whether there exists potential suitable habitat for any of seventeen threatened or endangered species (only four are known or anticipated to be present not counting migrating species), and several other "species of concern",
- aquatic resources including floodplains and potential waters of the United States,
- cultural resources including both historic and archeological sites,
- the potential to encounter hazardous materials,
- existing land uses such as public and private rights-of-way (roadway, railroad, power and pipeline utility corridors), and public lands (parks, schools, cemeteries), and
- number of affected parcels.

Following the evaluation of the primary corridors, alternative transmission alignments were developed by combining elements of the primary corridors to route potential transmission pipes to each of the distribution points in Conroe and The Woodlands. In addition, there were 24 routing combinations evaluated with hydraulic modeling, estimates of construction cost, and environmental considerations.

5.3.2 North – South Corridors

The North-South Corridors identify five potential alternative alignments for water pipelines from a treatment plant near Lake Conroe to the north side of The Woodlands. In the initial stages of the alternative evaluation, four corridors were identified and subsequently numbered from west to east. A fifth alternative alignment was identified during the alternative evaluation. Each of the five corridors generally follows an existing roadway or utility infrastructure alignment.

To estimate costs, the conservative assumption is made that parallel easements are purchased rather than being within the public or private right-of-way. The possibility of locating proposed water lines within the existing corridor (i.e., gas/petrochemical pipeline, overhead electric power transmission, etc.), is unlikely because there is typically insufficient space to construct a large diameter water main in the corridor. In addition, the existing easement holder may anticipate the need to expand the capacity of their utility in the future and would not allow a water line to be constructed in their easement.

T1 – Fish Creek Parkway

North-South alignment T1 generally parallels the alignment for Fish Creek Parkway, which is partially constructed and partially under construction at the current time. A water transmission pipeline in this alignment runs from the water treatment plant southwest downstream of the Lake Conroe Dam embankment, crosses SH 105, and meets the Fish Creek Parkway corridor. The southern terminus of alignment T1 is located approximately 2,000 feet south of SH 1488. The transmission pipeline is assumed to parallel, and be located outside of the roadway right-of-way.

T2 – Pipeline Corridor

North-South alignment T2 generally parallels an underground hydrocarbon pipeline corridor, occupied by ConocoPhillips and Magellan. A water transmission line in this alignment would initially run from the water treatment plant straight south, generally along property lines, to the pipeline corridor. The southern end of the alignment would then briefly follow SH 1488 and the future Kuykendahl Road to the Panther Branch riparian corridor.

T3 – Overhead Electric Corridor

North-South alignment T3 generally parallels an overhead electric power corridor. A water transmission line in the alignment would initially run southerly parallel to LaSalle Avenue to SH 105, then south along property lines to the overhead electric corridor to SH 1488. The southern terminus of alignment T3 is The Woodlands Water Plant 3.

T4 – Pipeline Corridor / Carriage Hills

North-South alignment T4 generally parallels an energy utility corridor through the western portion of the City of Conroe, occupied by Copano (natural gas) and overhead electric lines. A water line in this alignment would initially run easterly to the utility corridor, then south through the City of Conroe. South of the crossing of the San Jacinto River, the alignment parallels Carriage Hills Drive and converges with the alignment T2 pipeline corridor. The southern terminus of alignment T4 is near the intersection of SH 242 (College Park Drive) with Greenbridge Drive.

T5 – Pipeline Corridor / Interstate Highway 45

North-South alignment T5 is coincident with alignment T4 through the western portion of the City of Conroe. The southern portion of this alignment parallels an existing City of Conroe water line that runs parallel to SH 336 and Interstate Highway 45. The southern terminus of alignment T5 is The Woodlands Water Plant 5.

5.3.3 Conroe Corridors

The Conroe Corridors identify two potential alternative alignments for water pipelines from a treatment plant near Lake Conroe to distribution points on the north side of the City of Conroe.

C1 – Northerly Alignment

The first three miles of Conroe alignment C1 coincide with the T4 and T5 alignments. From a point near the intersection of SH 3083 and Longmire Road, the alignment turns east, and generally follows parcel boundaries one-half mile north of SH 336 on the north side of the City of Conroe. Conroe alignment C1 runs directly past existing City of Conroe Water Plants 8, 12 and 14. This alignment is the more rural of the two, with the majority of the alignment located just north of the commercial and residential developments that front SH 336 (north Loop).

C2 – Southerly Alignment

The first mile of Conroe alignment C2 coincides with the T4, T5 and C1 alignments. At the intersection with Longmire Road, the alignment turns south and parallels the roadway. At the intersection with SH 336 (north Loop), the alignment turns east and run parallel to the highway. Conroe alignment C2 runs directly past three existing City of Conroe Water Plants 6, 12 and 14. This alignment is almost exclusively in an urban environment. Along the portion of the alignment that is parallel to SH 336 (north Loop), the pipeline will likely run through existing commercial parking lots and across access driveways from the highway.

Conroe Extremities

The Conroe transmission main alternatives run directly by six existing water plants in the City of Conroe system. Common extremity lines were assumed to bring treated surface water to an additional four water plants in the future.

- Conroe Water Plant 5 – near the eastern end of the C1/C2 alignments, a lateral main runs south parallel to an overhead electric and pipeline corridor, turns west and runs along Semands Street, and turns south and runs along 1st Street to the Conroe Water Plant 5.
- Conroe Water Plant 6 – a lateral main runs from the C1 alignment south along Westview Blvd. to Conroe Water Plant 6.
- Conroe Water Plant 7 – a lateral main runs along the T4 and T5 alignments south to SH 336 (south Loop), and then east parallel to an existing hydrocarbon pipeline corridor to Conroe Water Plant 7.
- Conroe Water Plant 8 – a lateral main runs north from the C2 alignment along SH 75 one-half mile and turns west along the existing access road to Conroe Water Plant 8.
- Conroe Water Plant 15 – a lateral main runs north from the C1/C2 alignments north, parallel to either the Union Pacific Railroad or SH 75 approximately three miles to Silver Springs Road, along which Conroe Water Plant 15 is located.
- Conroe Water Plant 18 – the northern portion of this alignment is coincident with the alignment to Conroe Water Plant 5, parallel to an existing overhead electric and pipeline corridor. The alignment would continue south along that corridor approximately four miles to Conroe Water Plant 18.
- Conroe Water Plant 19 – the existing plant is located south of the San Jacinto River, west of Interstate Highway 45. The plant can be served directly from the T5 alignment. For any of the other North-South alignments, treated surface water can be delivered most directly from Woodlands Water Plant 5 along an alignment parallel to Windsor Lakes Blvd., approximately ¼ mile west of Interstate Highway 45.
- Conroe Water Plant 20 - near the eastern end of the C1/C2 alignments, a lateral main runs north parallel to an overhead electric and pipeline corridor (the same corridor referenced for lateral mains to Conroe Water Plants 5 and 18) to Conroe Water Plant 20.

5.3.4 The Woodlands Corridors

The Woodlands Corridors identify three potential alternative alignments for water pipelines to be routed from the North-South alignment terminus to each of the five water plants located in The Woodlands. The Woodlands Development Corporation has expressed the preference that water transmission lines that follow roadway corridors be constructed in the right-of-way, rather than clearing trees to construct a water line parallel to the right-of-way. Thus for all Woodlands corridors located along roadways, it was assumed that the water transmission line would be constructed under the existing roadway.

W1 – Bear and Panther Branch

The Woodlands alignment W1 is the most rural of the three alternative alignments. The majority of the length runs parallel to the Bear Branch and Panther Branch stream channels, located in the floodplain flowage easement. Connecting between the channel corridors, the alignment parallels Kuykendahl Road, which is only constructed with half of the ultimate width. On the west end of The Woodlands, alignment W1 parallels SH 2978 to reach The Woodlands Water Plant 4. On the east, the alignment parallels the hydrocarbon pipeline corridor discussed for the T2 alignment, with laterals to the south to The Woodlands Water Plant 1 (along Grogans Mill Road) and to the east to The Woodlands Water Plant 5.

W2 – Research Forest Drive

The Woodlands alignment W2 is the most urbanized of the three alternative alignments. The majority of the length runs in the right-of-way of Research Forest Drive. On the west end of The Woodlands, alignment W2 parallels SH 2978 to reach Woodlands Water Plant 4. On the east, the alignment would have laterals to the south to Woodlands Water Plant 1 (along Grogans Mill Road) and to the east to The Woodlands Water Plant 5.

W3 – Southerly Alignment

The Woodlands alignment W3 is a mixture of urban and rural construction environments. The spine of the alignment is parallel to Kuykendahl Road, for which only half of the ultimate roadway section has been constructed. A lateral runs east in the Bear Branch flowage easement to The Woodlands Water Plant 2 and continues east to Woodlands Water Plant 5. Two laterals run in The Woodlands Parkway right-of-way, one west to The Woodlands Water Plant 4, and one east to Grogans Mill Road, continuing south to The Woodlands Water Plant 1.

5.3.5 Alternatives

For the hydraulic analysis and conceptual design of the water transmission system, referred to in Section 6.2, 24 alternatives were compiled, combining elements of the North-South, Conroe, and The Woodlands corridors as shown in **Exhibit 4**. In general, the alternatives combine one of the North-South corridors with one Conroe and one Woodlands corridor. However, two of the alternatives investigated the use of a looped system, using two of the North-South corridors.

The hydraulic analysis for each of the alternatives was performed assuming flow rates consistent with the projected demand in the year 2045. In addition to supplying treated surface water to the fifteen delivery points in the City of Conroe and The Woodlands, hydraulic models included connections to approximately 50 existing users along ten lateral main extremities. A discussion regarding assumptions for the lateral main extremities is in Section 5.3.6.

Naming Convention

Most of the combined alternatives utilize one each of the North-South, Conroe, and Woodlands corridors. The alternatives were named, based on a combination of those corridor names. For example, the alternative using North-South alignment T1, Conroe alignment C1, and The Woodlands alignment W1 was named T1C1W1.

Two looped systems were evaluated, assuming that one of the eastern North-South corridors would be constructed and in operation in 2015, and a western North-South corridor would be constructed and in operation in 2035. These looped alternatives used the T4 or T5 corridor in conjunction with the T1 corridor. For both of these looped systems, Conroe alignment C1 and The Woodlands alignment W1 were assumed. These two loop-system alternatives are named Loop41 and Loop51.

Hybrid W1 Alignment

For the analysis of the three Woodlands alignments, a simplification was made combining some of the elements of the W1 and W3 corridors into a hybrid W1 corridor. Instead of using both Bear Branch and Panther Branch for the W1 corridor, the primary east-west water line is assumed to be parallel to Bear Branch in the existing flowage easement. This hybrid alternative corridor has a shorter total length than either of the initial W1 or W3 corridors, and remains primarily in a non-urban construction environment, consistent with the initial W1 corridor.

Modified W3 Alignment

In observations of The Woodlands alignment W3, it was noted that the primary spine of the system is the north-south alignment parallel to Kuykendahl Road, but the existing water plants are distributed further on the east-west axis. The initial alternative included two parallel east-west lateral mains running to the east along Bear Branch and Woodlands Parkway. It was noted that the distance to The Woodlands Water Plant 1 is significantly shorter from The Woodlands Water Plant 2 than from the intersection of Kuykendahl Road and Woodlands Parkway. Consequently, the lateral main to The Woodlands Water Plant 1 was assumed to run in the Grogans Mill Road right-of-way, rather than in the Woodlands Parkway right-of-way. Because of the similar natures of the W3 and W1 alignments, the W3 alignment was only analyzed in conjunction with the North-South T4 alignment.

Figures

The following six figures illustrate how the corridors described above were combined into specific water transmission system alternatives. These figures only show the main corridors and not the additional pipe common to all alternatives that is necessary to deliver surface water to other water plants in future phases.

Figure 5.1, North-South Alignment T1.

- T1C1W1
- T1C2W1
- T1C1W2
- T1C2W2

Figure 5.2, North-South Alignment T2.

- T2C1W1
- T2C2W1
- T2C1W2
- T2C2W2

Figure 5.3, North-South Alignment T3.

- T3C1W1
- T3C2W1
- T3C1W2
- T3C2W2

Figure 5.4, North-South Alignment T4.

- T4C1W1
- T4C2W1
- T4C1W2
- T4C2W2
- T4C1W3
- T4C2W3

Figure 5.5, North-South Alignment T5.

- T5C1W1
- T5C2W1
- T5C1W2
- T5C2W2

Figure 5.6, Looped North-South Alignments.

- Loop41
- Loop51

5.3.6 Extremities

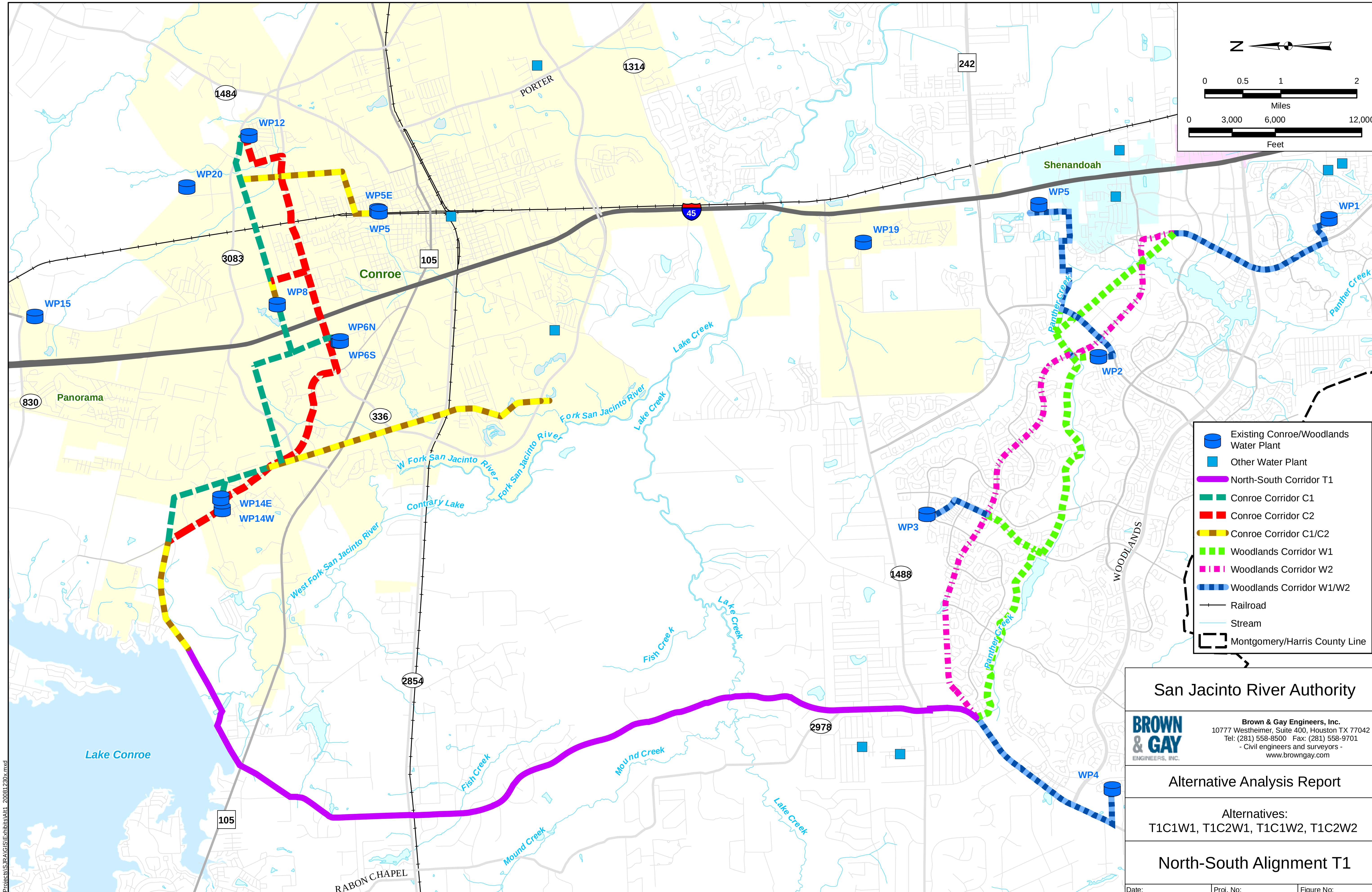
As described in Section 3, the groundwater reduction strategy in 2015 involves converting large portions of the Woodlands and the City of Conroe to meet the 30% alternative water requirement. However, a significant number of smaller outlying water users must ultimately be converted to treated surface water by 2045. Based on their proximity to one another, Participants were grouped for potential conversion to treated surface water by the year 2045.

These regional groups of users were modeled in the hydraulic analysis as demand points. The purposes of this modeling are to ensure that planned transmission mains have adequate capacity to deliver the projected 2045 demand at adequate pressure to anticipated users and to estimate the construction cost for the economic analysis of the alternatives. The length of each lateral transmission main was estimated using an aerial photograph base map, using pipeline, major roadway, or railroad corridors for assumed alignments.

The regional groups are anticipated to be served by extensions of the transmission mains beyond the City of Conroe, The Woodlands, or as individual transmission mains from the surface water treatment plant at Lake Conroe. The regional groups are summarized in **Table 5.2**.

Table 5.2
Regional Groups of Joint WRAP Participants

Regional Group	Served Through	Participants Proposed to Receive Surface Water	Anticipated Service Date
Panorama	Conroe / T4	3	2025
Willis	Conroe	1	2025
Cut and Shoot	Conroe	2	2025
South Conroe	Conroe	3	2025
Carriage Hills	Woodlands / T4	1	2025
Woodlands NW	Woodlands / T1	7	2025
Woodlands SW	Woodlands	2	2025
Shenandoah	Woodlands	1	2025
Woodlands SE	Woodlands	10	2025
Fish Creek	T1	1	2035
W. Lake Conroe	West Main	4	2035
Montgomery	West Main	8	2045



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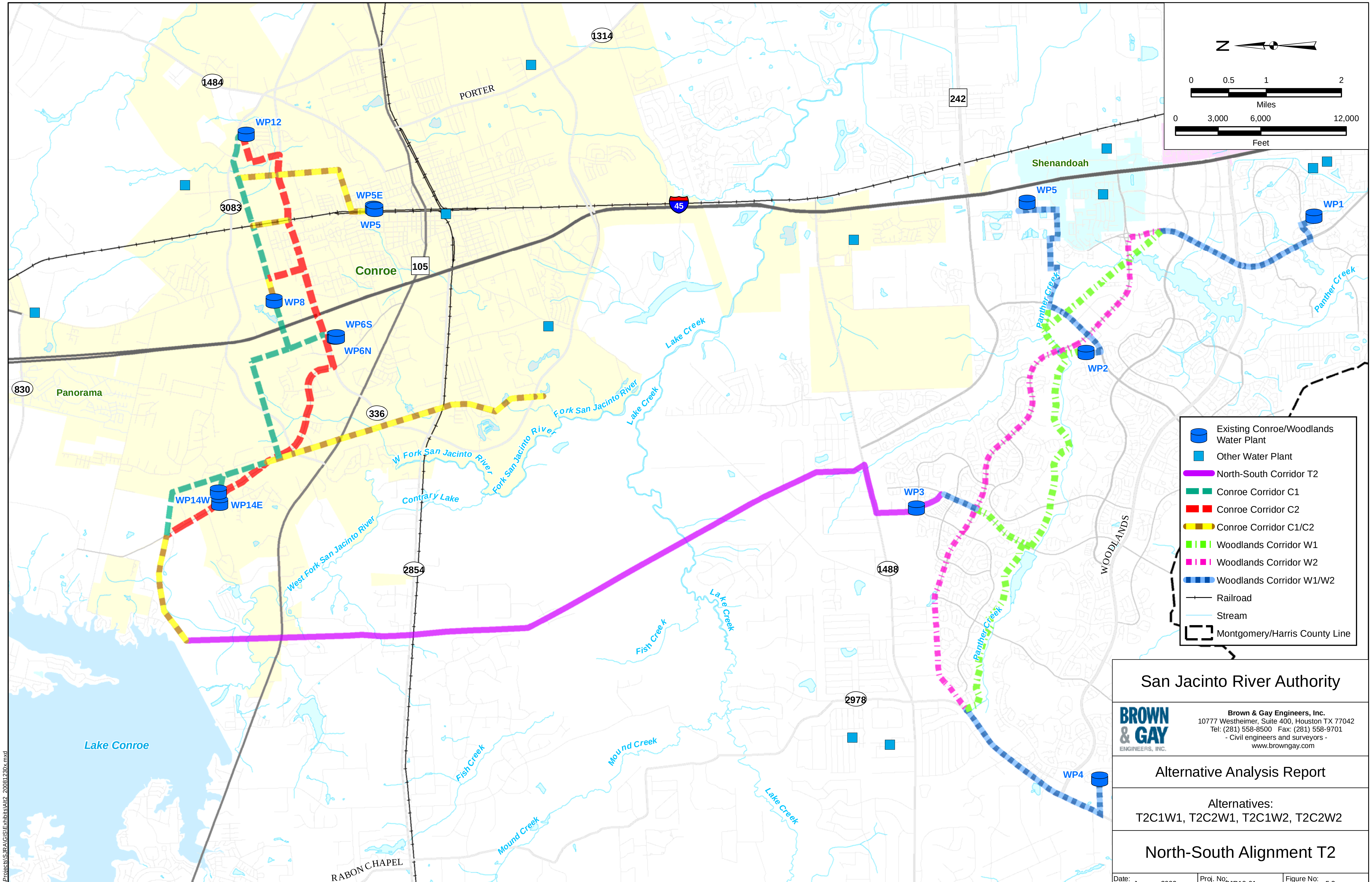
Alternative Analysis Report
Alternatives:
T1C1W1, T1C2W1, T1C1W2, T1C2W2
North-South Alignment T1
Date: January 2009
Proj. No: SJR10-61
Figure No: 5.1
Existing Conroe/Woodlands Water Plant
Other Water Plant
North-South Corridor T1
Conroe Corridor C1
Conroe Corridor C2
Conroe Corridor C1/C2
Woodlands Corridor W1
Woodlands Corridor W2
Woodlands Corridor W1/W2
Railroad
Stream
Montgomery/Harris County Line
Miles
0 0.5 1 2
Feet
0 3,000 6,000 12,000
Conroe
Shenandoah
Panorama
Lake Conroe
WP12
WP20
WP5E
WP5
WP8
WP15
WP6N
WP6S
WP14E
WP14W
WP19
WP1
WP2
WP3
WP4
Lake Creek
Fish Creek
Mound Creek
Panther Creek
Contrary Lake
West Fork San Jacinto River
W Fork San Jacinto River
Fork San Jacinto River
Fork San Jacinto River
PORTER
WOODLANDS
RABON CHAPEL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Alternative Analysis Report
Alternatives:
T2C1W1, T2C2W1, T2C1W2, T2C2W2
North-South Alignment T2
Date: January 2009
Proj. No: SJR10-61
Figure No: 5.2
Existing Conroe/Woodlands Water Plant
Other Water Plant
North-South Corridor T2
Conroe Corridor C1
Conroe Corridor C2
Conroe Corridor C1/C2
Woodlands Corridor W1
Woodlands Corridor W2
Woodlands Corridor W1/W2
Railroad
Stream
Montgomery/Harris County Line
Miles
0 0.5 1 2
Feet
0 3,000 6,000 12,000
N
WP12
WP5E
WP5
WP8
WP6S
WP6N
WP14W
WP14E
WP5
WP1
WP2
WP3
WP4
Conroe
Panorama
Shenandoah
PORTER
RABON CHAPEL
WOODLANDS
Lake Conroe
Lake Creek
Fish Creek
Mound Creek
Panther Creek
Contrary Lake
W Fork San Jacinto River
West Fork San Jacinto River
Fork San Jacinto River
1484
1314
242
3083
105
45
830
336
2854
1488
2978
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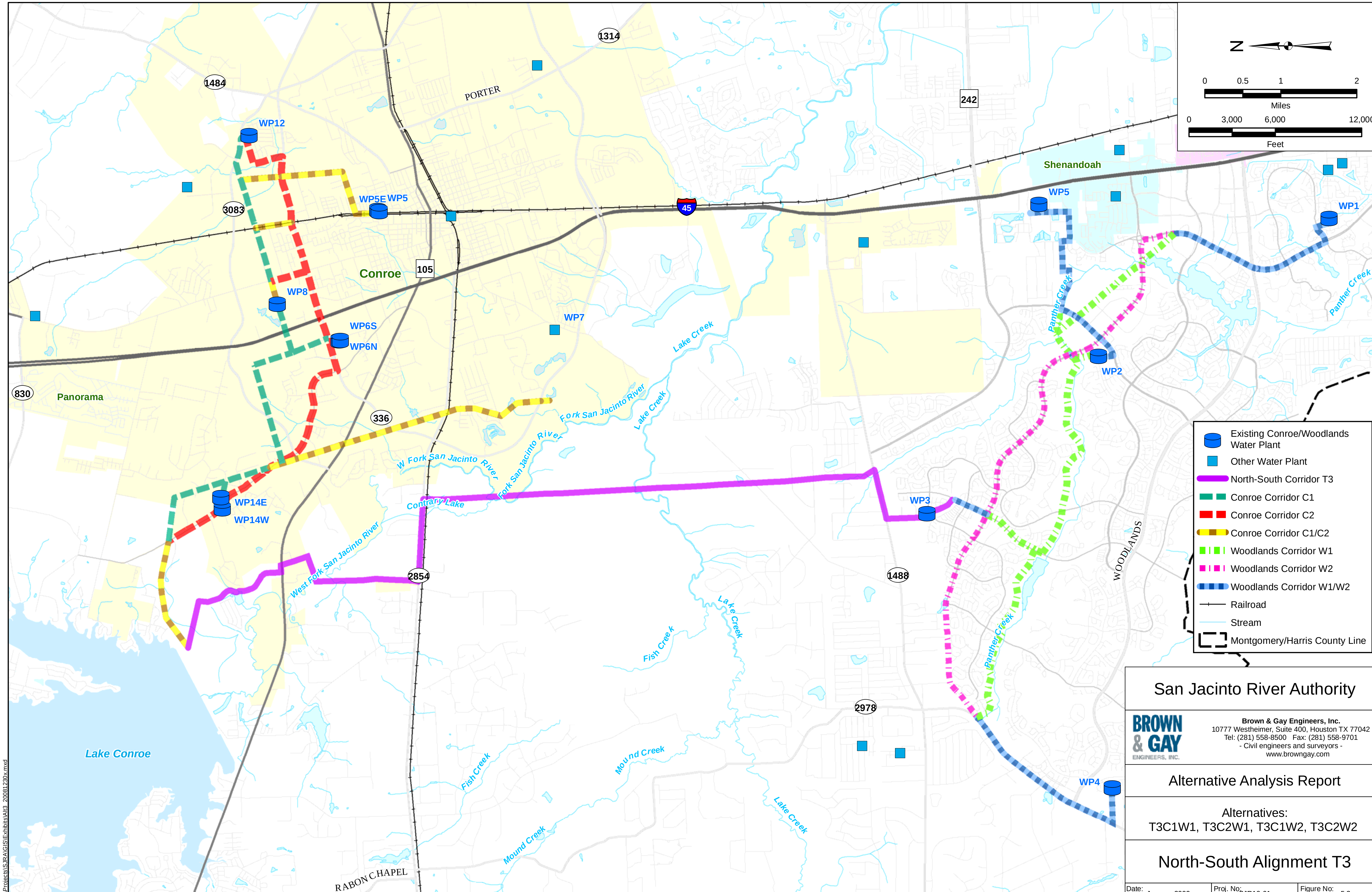

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Alternative Analysis Report
Alternatives:
T3C1W1, T3C2W1, T3C1W2, T3C2W2
North-South Alignment T3
Date: January 2009
Proj. No: SJR10-61
Figure No: 5.3
Existing Conroe/Woodlands Water Plant
Other Water Plant
North-South Corridor T3
Conroe Corridor C1
Conroe Corridor C2
Conroe Corridor C1/C2
Woodlands Corridor W1
Woodlands Corridor W2
Woodlands Corridor W1/W2
Railroad
Stream
Montgomery/Harris County Line
N
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Miles
0 3,000 6,000 12,000
Feet
WP12
WP5E WP5
WP8
WP6S
WP6N
WP7
WP14E
WP14W
WP5
WP1
WP2
WP3
WP4
Conroe
Panorama
Shenandoah
PORTER
WOODLANDS
RABON CHAPEL
Lake Conroe
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Lake Creek
Fork San Jacinto River
W Fork San Jacinto River
West Fork San Jacinto River
Contrary Lake
Panther Creek
Fish Creek
Mound Creek
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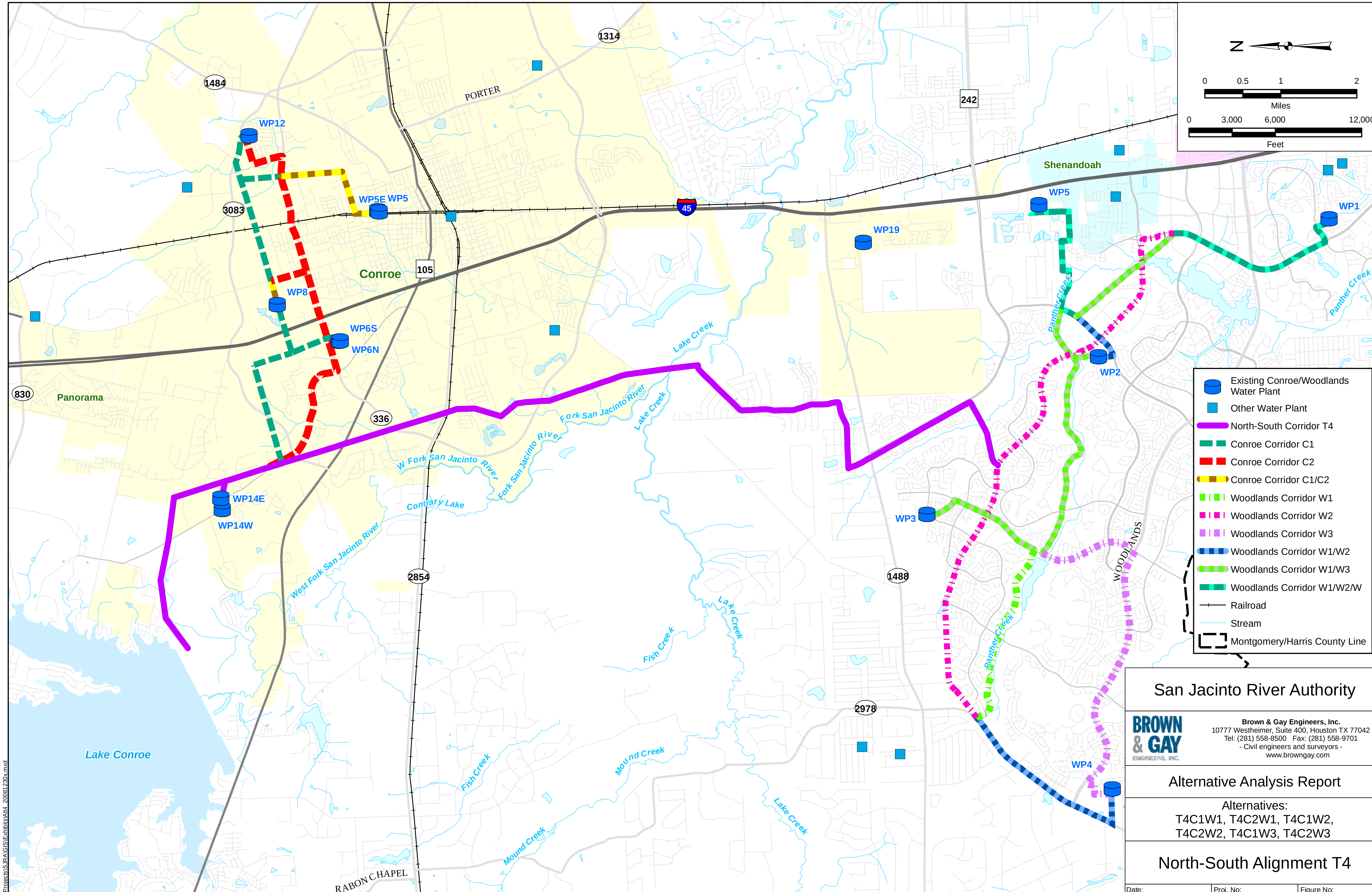

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Alternative Analysis Report

Alternatives:
T4C1W1, T4C2W1, T4C1W2,
T4C2W2, T4C1W3, T4C2W3

North-South Alignment T4

Date: January 2009 | Proj. No: SJR10-61 | Figure No: 5.4

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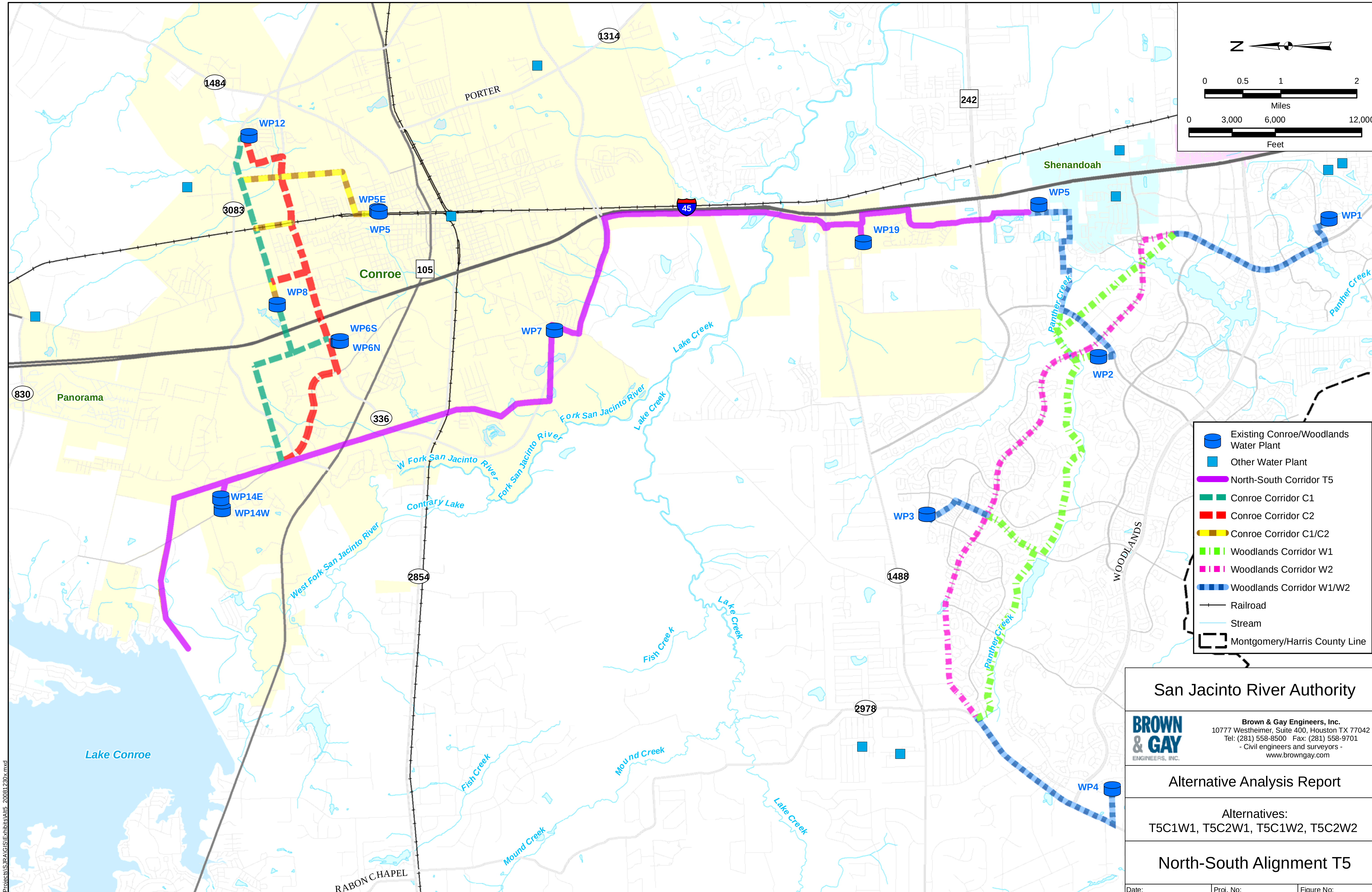

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Alternative Analysis Report

Alternatives:
T5C1W1, T5C2W1, T5C1W2, T5C2W2

North-South Alignment T5

Date: January 2009 | Proj. No: SJR10-61 | Figure No: 5.5

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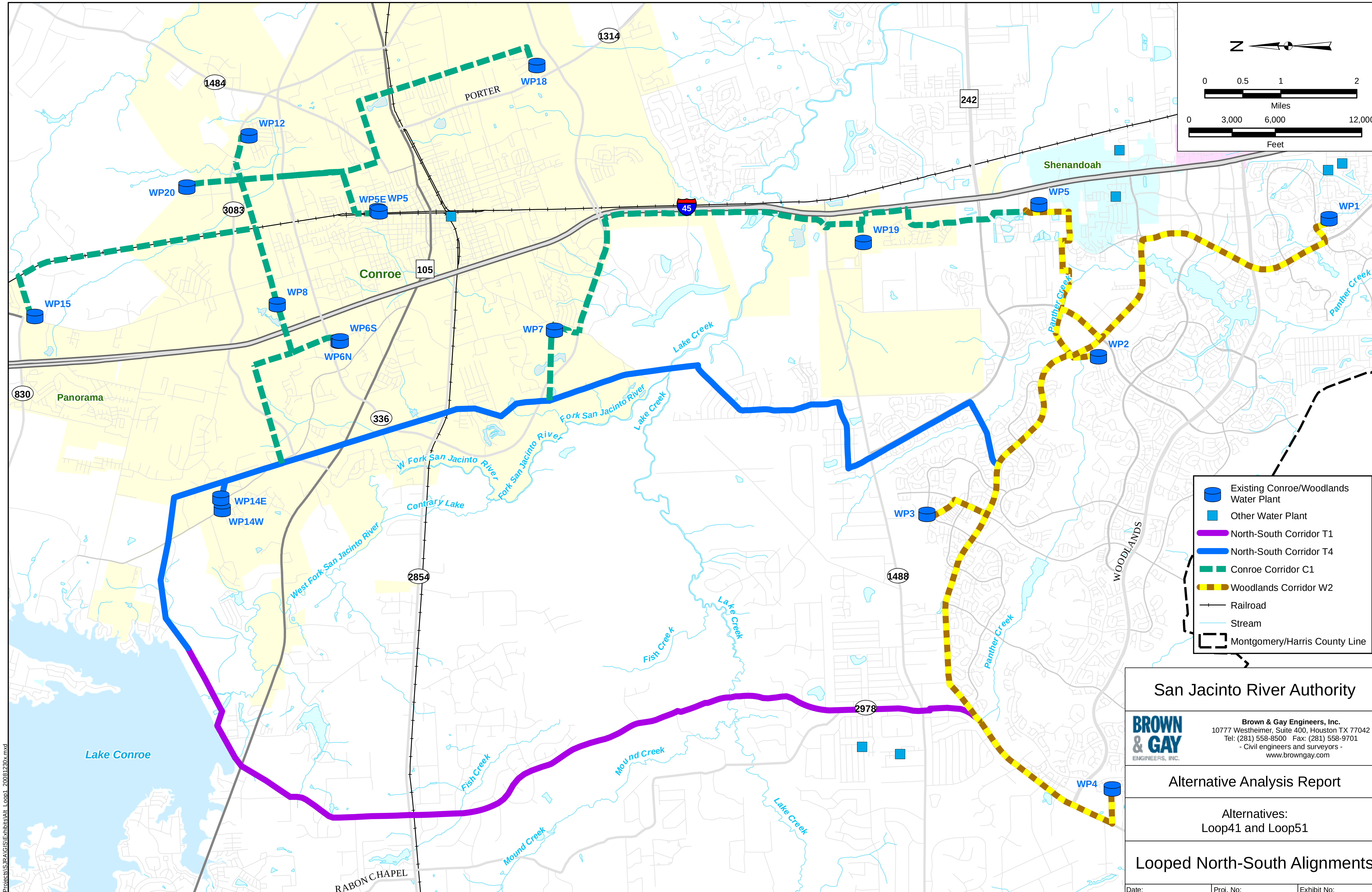

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Alternative Analysis Report

Alternatives:
Loop41 and Loop51

Looped North-South Alignments

Date: January 2009 | Proj. No: SJR10-61 | Exhibit No: 5.6

Section 6
Facility Costs

6.1 Cost of Purchased Water and Water Treatment Facilities

This Alternative Analysis study provides information regarding capacity of surface water treatment infrastructure and does not attempt to address matters related to treatment processes nor their costs. Treatment processes including the use of advanced filtration will be evaluated in greater detail in the Joint WRAP II Report as will their costs. The cost of treatment infrastructure does not affect the selection of the recommended transmission system because the preferred treatment facilities can be combined with any of the transmission alternatives.

6.2 Water Transmission System

6.2.1 Capital Costs

Transmission Mains

The development of unit costs for the construction of large diameter water transmission mains was based on analysis of bidding information provided by the North Harris County Regional Water Authority, West Harris County Regional Water Authority, and the City of Houston. Bid tabulations for 35 water line construction projects including pipe from less than 12 inches to 60 inches in diameter and bid between 2001 and 2008 were compiled and analyzed to develop transmission main unit costs.

Projects were categorized as "Urban" or "Rural" construction based on quantities of pavement, curb, construction exits, clearing & grubbing, fence replacement, inlet protection, use of sod to restore residential areas, utility relocations, and traffic control. None of the projects reviewed replaced pavement for the entire length of water main construction, which may be the case in The Woodlands for corridor W2 and portions of W3. The additional cost of pavement replacement and disruption to the public generally encourage use of trenchless construction methods or use of another alignment if a lower cost alternative is an option, which will favor corridor W1 in The Woodlands.

The approach of categorizing projects as "Urban" or "Rural" provided the additional benefit of allowing the costs developed to be compared with the unit costs developed by Region H. After categorizing projects as "Urban" or "Rural", the process of analyzing bid tab data included the following major steps:

- Extract quantities for pipe only and determine type of construction based on the description for the item and project category (i.e., open-cut rural, trenchless (with or without casing or tunnel liner, etc.). Appurtenances, non-pipe items, cash allowances, mobilization, etc. become embedded in the final unit costs determined.
- Extract the average of the low three bids for each pipe item.

- Determine average bid for pipe items and total project and convert both to present-day dollars based on bid date using ENR's Construction Cost Index (CCI).
- Calculate 'Adjusted' total project costs by removing costs for District connections, 'Extra Work Items', and 'Cash Allowance Items' for each project.
- Determine costs for appurtenances and miscellaneous features by creating a 'weighting' factor based on a ratio of non-pipe items to total project cost. Based on the percentage of LF of each type of pipe construction create a 'weighting' factor for each pipe construction type for each project.
- Calculate 'adjusted' bid prices by adding the actual average bid cost for each item to the average bid cost multiplied by the 'weighting' factor to predict bid costs for pipe items that include the appropriate proportion of the cost of non-pipe items.
- Use linear regression analysis to predict bid costs for each construction type and create a best-fit line for each construction type. Compare the best-fit line to the predicted bid costs. Remove 'outlier' cost data that skew the data.
- Compile a summary table of unit cost based on best-fit values for each construction type and pipe diameter calculated above.

The Engineering News Record Construction Cost Index (ENR CCI) was used to adjust the bid tab data for each project to October 2008 dollars based on when the projects were bid. The calculated unit costs were compared to cost data developed by the Texas Water Development Board Region H (Region H).

Pipe unit costs do not include 'soft' costs associated with planning, design, bidding and financing projects such as program management, engineering, surveying, geotechnical studies, construction management, materials testing and contingency, financial, and legal costs. Soft costs related to planning and construction are estimated as a percentage of construction costs. Financial and legal costs are estimated as a percentage of estimated bond sales.

A contingency of 35% is placed on costs associated with WTP planning and construction. The construction related soft costs are 30% and this value is added to the cost of intake structure and treatment plant construction including ground storage.

For transmission mains, the contingency is reduced to 25% because water line projects are less complex and have less uncertainty associated with them than WTP construction. Again, 30% of the estimated construction is added to account for the soft costs associated with their planning and construction.

Unit costs for rural and urban construction are summarized in **Table 6.1**. In addition, **Table 6.1** provides estimated costs for trenchless construction. As with the rural and urban construction methods, costs for trenchless construction were determined from existing bid tabs and applied to the crossings (see Section 6.2.2) for each alternative.

Table 6.1
Unit Costs for Water Line Construction

Pipe Diameter Inches	Cost/LF ($)		
	Open Cut		Trenchless
	Rural	Urban	
8	95	95	225
10	115	125	290
12	130	155	350
16	165	210	475
20	200	270	595
24	240	330	720
30	290	415	905
36	345	500	1,095
42	400	590	1,280
48	450	675	1,465
54	505	765	1,650
60	560	850	1,835
66	615	940	2,025

For alternatives evaluated in this study, aerial photography and GIS mapping were used to determine the level of development along transmission main corridors. Sections of pipe in developed areas were considered to have higher costs associated with construction in urban areas. Conversely, pipelines in minimally developed areas were assumed to have lower costs associated with simpler construction in rural areas. The appropriate cost was applied to each pipe section in the various alternatives.

Water Line Easements

Permanent easement widths for transmission mains adjacent to existing rights-of-way or other easements are assumed to be 20 feet for pipe up to 36 inches in diameter and 30 feet for larger pipe. Permanent easement widths for all transmission mains not adjacent to existing rights-of-way or other easements are assumed to be 30 feet. Twenty feet for easements is adequate for the majority of locations where the proposed water lines will be adjacent either to public right-of-way or to other corridors such as gas/petrochemical or electric power transmission facilities. Where proposed water lines will be isolated in currently undeveloped areas, the next phase of planning will determine whether a thirty feet wide easement is required to ensure adequate access in the future as the area develops.

An additional 10 to 20 feet of temporary construction easement may be acquired where beneficial. Easement costs were estimated based on available land values from the Montgomery County Appraisal District (MCAD) and by using GIS to identify potentially affected parcels along each corridor. To be conservative because the parcel data is incomplete and to allow for acquisition of temporary construction easements, the weighted average value was increased by 25% and rounded to the nearest $0.05 per square foot ($/sf). In addition, if the estimate was less than $0.25 per square foot ($10,900/acre), then a minimum value of $0.25/sf was used. A special exception was made in the case of corridor T1 along Fishcreek Parkway. Discussion with a property acquisition consultant indicated that recent appraisals are exceeding MCAD property values. Values are expected to continue to increase as this corridor develops, so a minimum value of $0.50/sf was used for T1. In addition to the value of the land, there is significant cost associated with the acquisition process to acquire title, provide engineering and legal support, perform boundary surveys, offer and negotiation activities, recording fees, and, on occasion, the condemnation process. The typical cost for property acquisition, excluding condemnation, is expected to be in the range of $7,000 to $9,000 per parcel therefore a value of $8,000/parcel was adopted for the purpose of this study. The estimated number of parcels is different for each alternative, but varies between approximately 400 and 600 parcels within the 1,000 feet buffer. The number of parcels should be considered very preliminary because the number of parcels in a 1,000 feet buffer is expected to overestimate the number of parcels, however, the incomplete nature of the MCAD parcel data is expected to underestimate the number of parcels. Overall, the total cost of easements (land and acquisition) for transmission mains is potentially in the range of $5,000,000 to $10,000,000.

Water Plant Sites

Where future water lines reach existing water plants, two additional costs apply. First, a cost of $250,000 was added as the estimated cost of meter and control valve facilities at each water plant. These are facilities that will be owned, operated, and maintained by the SJRA. This cost applies at each water plant and is applied in the economic analysis in the appropriate year.

The second cost is for work including conversion of disinfection systems from chlorine to chloramine, yard piping, and storage tank modifications at the point of connection. These water plant costs may be incurred by the water plant owner and potentially reimbursed by the SJRA or incurred by the SJRA directly depending on policy decisions yet to be made. These additional costs are estimated to average approximately $250,000 dollars per water plant site. Therefore, the total cost associated with delivering surface water to existing and future water plants for meter/control valve station and site improvements and modifications is estimated to be approximately $500,000 per water plant.

6.2.2 Consideration of Special Pipe Segments

Crossings of many existing facilities and natural features will likely require trenchless construction methods at additional cost. Locations where transmission corridors intersect these facilities and features were identified using GIS. Trenchless construction is generally assumed at crossings of pipelines, railroads, state-maintained rights-of-way, major thoroughfares, and potentially at wetlands depending on the length of the crossing and other variables. Depending on the size of the proposed pipe, local agency requirements, and other factors, trenchless construction may provide a viable alternative in developed/congested areas to open cut construction with pavement replacement.

6.2.3 Annual Costs

Annual Operation and Maintenance (O&M) costs include:

- Debt service,
- Reserve funds (e.g., debt service reserve, operating reserve)

- Operating costs for the treatment plant (e.g., chemicals, power), and an operator to oversee daily operations,
- Maintenance of water treatment plant and transmission mains and their repair,
- Purchased water (including reservation fees)
- Program management
- Engineering, legal, and financial support

Debt service is determined based on the amount of the bond sale(s) (including legal, financial advisor and other fees) required to fund the total project cost including construction and soft costs. For the purpose of this Alternative Analysis, it is assumed that 25-year bonds are sold at 5%. Despite current market conditions in which the rate on bonds sold publicly may exceed 7%, there is no requirement to assume that this will persist over the long-term. Therefore, the economic analysis uses 5% as the assumed rate on bonds. Future planning may adopt a higher rate, if appropriate, as the time for the first sale of bonds approaches.

The cost of water treatment plant operations are based on Region H estimates adjusted to current, 2008 dollars.

Transmission mains were assumed to require an annual O&M expenditure of 1% of the total construction cost of the pipelines. This assumption is based on Region H planning information.

Section 7
Economic Analysis

7.1 Alternative Analysis

An economic spreadsheet was developed to compare alternatives based on the present worth of their costs from 2010 through the planning period to 2045. Costs include debt service payments due to capital costs, annual operations and maintenance (O&M) costs, raw water costs, reservation fees, reserves, etc. On the basis of present worth, the alternative with the lowest present worth of costs is the preferred alternative compared to other alternatives with a higher present worth of costs.

7.1.1 Global Variables

Variables that are constant across all alternatives are classified as global alternatives. Examples of the Global Variables used in the analysis include:

- Inflation rate of 5%. While current economic conditions have slowed or reversed inflation in some sectors of the economy, the long-term historic rate of inflation is less than 5%. Therefore, the use of 5% for the rate of inflation is assumed to be conservative in the current analysis.
- Bond interest rate of 5% and a bond life of 25 years. As stated previously, although in current market conditions the rate on bonds sold publicly may exceed 7%, there is no requirement to assume that this will persist over the long-term.
- Bond preparation and issuance costs were estimated at 2.5%.
- Bond sales occur no more often than every 3 years.
- Soft costs including construction management, engineering, surveying, environmental and archeological studies, permitting, and mitigation, geotechnical, construction management, testing and contingencies were set at 30% for pipelines and WTP.
- Contingencies were set at 35% of WTP and 25% of water line construction costs.

7.1.2 Alternative Specific Variables

Alternative specific variables are variables or factors that are unique to an individual alternative. In addition to other variables, the alternative specific variables include:

- length of transmission pipelines,
- size and unit cost of transmission pipelines,
- amount of land required for easements and the cost of those easements,
- the number of Participant water plants and the cost to connect to them,
- the number of crossings, length and cost of trenchless construction required.

7.2 Results of Analysis

All costs have been inflated by 5% annually based on the historic rate of inflation. For each year from 2010 to 2045, the inflated costs for capital and operations and maintenance were summed and then discounted to a present worth cost using a current bond return rate of 5%. Those present worth costs for each year were summed to calculate a total present worth cost for each alternative. The results of that analysis are presented in **Table 7.1** below.

Table 7.1
Summary of Analysis Results for All Alternatives
Summary of Project Costs and Present Worth of Project Alternatives

Alternative	Total Project Costs	Total Average Annual Cost	PW of Annual Costs	Rank Based on PW	Sum of Capital and Annual Costs: Capital 2010 - 2015	Sum of Capital and Annual Costs: Annual 2010 - 2015	Rank Based on Capital 2010 - 2015
T2C1W1	$2,509	$169	$1,781	1	$480	$126	1
T2C1W2	$2,514	$169	$1,787	2	$485	$128	3
T3C1W1	$2,519	$169	$1,790	3	$486	$128	4
T3C1W2	$2,521	$169	$1,794	4	$492	$129	7
T1C1W1	$2,503	$169	$1,798	5	$504	$131	13
T4C1W1	$2,528	$170	$1,800	6	$497	$130	9
T2C2W1	$2,551	$172	$1,810	7	$484	$127	2
T4C1W2	$2,540	$171	$1,813	8	$510	$132	17
T3C2W1	$2,558	$172	$1,816	9	$488	$128	5
T2C2W2	$2,557	$172	$1,816	10	$491	$129	6
T1C1W2	$2,521	$171	$1,816	11	$522	$135	22
T4C1W3	$2,549	$172	$1,819	12	$514	$133	19
T3C2W2	$2,565	$172	$1,824	13	$498	$130	10
T5C1W2	$2,556	$172	$1,825	14	$520	$134	20
T1C2W1	$2,545	$172	$1,826	15	$509	$132	16
T5C1W1	$2,556	$172	$1,827	16	$522	$135	21
T4C2W1	$2,569	$173	$1,827	17	$500	$130	11
T4C2W2	$2,575	$173	$1,834	18	$507	$132	14
T5C2W1	$2,583	$173	$1,838	19	$509	$132	15
L51-2045	$2,657	$175	$1,839	20	$496	$130	8
T4C2W3	$2,584	$173	$1,840	21	$512	$133	18
L41-2045	$2,656	$175	$1,842	22	$500	$130	12
T1C2W2	$2,563	$173	$1,845	23	$527	$136	24
T5C2W2	$2,601	$175	$1,856	24	$525	$135	23

The difference in present worth between all the competing alternatives is less than 5% due to so many of the underlying costs being common to or at least similar in all alternatives. Results are similar for the capital costs of the first, 2015, phase of conversion. Alternative T2C1W1 ranks first by both measures of cost effectiveness.

Because costs for alternatives are similar, no alternative should be entirely removed from future consideration. Therefore, other alternative routes and parts of the overall treatment and conveyance system will continue to be considered in future planning. Alternative T2C1W1 may be used as the basis for the Joint WRAP Part II to meet the regulatory requirements of the LSGCD.

7.3 Description of Preferred Alternative

Alternative T2C1W1 was selected as the preferred alternative based on the economic analysis that included preliminary sizing of water lines and estimates of construction, operation and maintenance costs. **Figure 7.1** shows preferred Alternative T2C1W1 with future lateral pipes to serve additional Joint WRAP Participants through 2045.

In this alternative, there will ultimately be three primary surface water transmission lines –

- To the east, serving the City of Conroe and other adjacent or nearby Participants to the north, south, and east of Conroe.
- To the south, serving The Woodlands and other adjacent or nearby Participants to the north, east, south, and west of The Woodlands.
- To the west, serving Participants on the west side of Lake Conroe, including the City of Montgomery.

East Transmission line
The east transmission line of the preferred alternative follows the C1 corridor, which proceeds east from the water treatment plant, and then turns in a southerly direction, parallel to an energy corridor occupied by Copano (natural gas) and overhead electric power lines. From a point near the intersection of SH 3083 and Longmire Road the corridor turns east and generally follows parcels one-half mile north of Loop 336 on the north side of the City of Conroe. Corridor C1 runs directly past existing City of Conroe Water Plants 8, 12 and 14. Lateral pipelines will later deliver treated surface water to existing City of Conroe Water Plants 5, 6, 7, 15, 18, and 20.

Treated surface water will also be delivered to other Participants via other lateral pipelines or extension of the lateral pipelines serving the City of Conroe Water Plants.

- Participants in the area east of Lake Conroe, including the City of Panorama Village, would be served by a network of lateral pipelines that initially run in a northerly direction parallel to the energy corridor occupied by Copano (natural gas) and overhead electric power lines.
- Participants to the north of the City of Conroe, including the City of Willis would be served by a network of lateral pipelines that initially run in a northerly direction from the lateral line which will serve Conroe Water Plant 15.
- Participants to the south of the City of Conroe, including the River Plantation MUD would be served by a network of lateral pipelines that initially run in a southerly direction from the lateral line which will serve Conroe Water Plant 18.

Based on estimated Participant water demands and preliminary sizing of the system, the East transmission line system:

- conveys more than 20 MGD of treated surface water (average annual demand)
- serves 15 Participants
- delivers surface water to more than 20 existing water plants (8 locations in Conroe)

South Transmission line

The south transmission line of the preferred alternative follows the North-South T2 corridor. A water transmission line in this corridor would initially run south from the water treatment plant generally along property lines to and then parallel with an underground hydrocarbon pipeline corridor occupied by ConocoPhillips and Magellan. The southern end of the corridor briefly follows SH 1488 and the future Kuykendahl Road (or the parallel Buck Shot Lane) to The Woodlands Water Plant 3.

Distribution to the other four water plants within The Woodlands and other nearby Participants would follow the hybrid W1 corridor, described earlier, which combines elements of the W1 and W3 corridors. From The Woodlands Water Plant 3, the transmission line initially runs in a southerly direction along Kuykendahl Road to the Bear Branch corridor. From that point, lateral pipelines would run both westerly and easterly along the existing flowage easement for Bear Branch. Within The Woodlands, the western lateral would serve Water Plant 4, and the eastern lateral would serve Water Plants 1, 2, and 5.

Treated surface water would also be delivered to other nearby Participants via additional lateral pipelines.

- A lateral pipeline would serve Participants in the Carriage Hills area north of SH 1488 directly from the T2 pipeline.
- Participants in the area to the northwest of The Woodlands (near the intersection of SH 1488 and SH 2978) would be served by a lateral from the western Bear Branch pipeline.
- Participants in the area east and southeast of The Woodlands, including the City of Shenandoah and eleven other Participants east of Interstate Highway 45 would be served from a lateral pipeline near the eastern end of the W1 corridor. There are two likely locations for the crossing, where existing water plants are located both west and east of the Interstate within one mile of each other:
    - North of the Research Forest Drive interchange, between the western and eastern Shenandoah water plants
    - North of the Rayford Road / Sawdust Road interchange, between the Montgomery County MUD 19 and South Montgomery County MUD water plants
- Participants in the area south of The Woodlands, west of Interstate Highway 45, and east of Spring Creek, served by an extension of the lateral pipeline to The Woodlands Water Plant 1.

Based on estimated Participant water demands and preliminary sizing of the system, the South transmission line system:

- conveys approximately 55 MGD of treated surface water (average annual demand)
- serves 26 Participants
- delivers surface water to more than 30 existing water plants

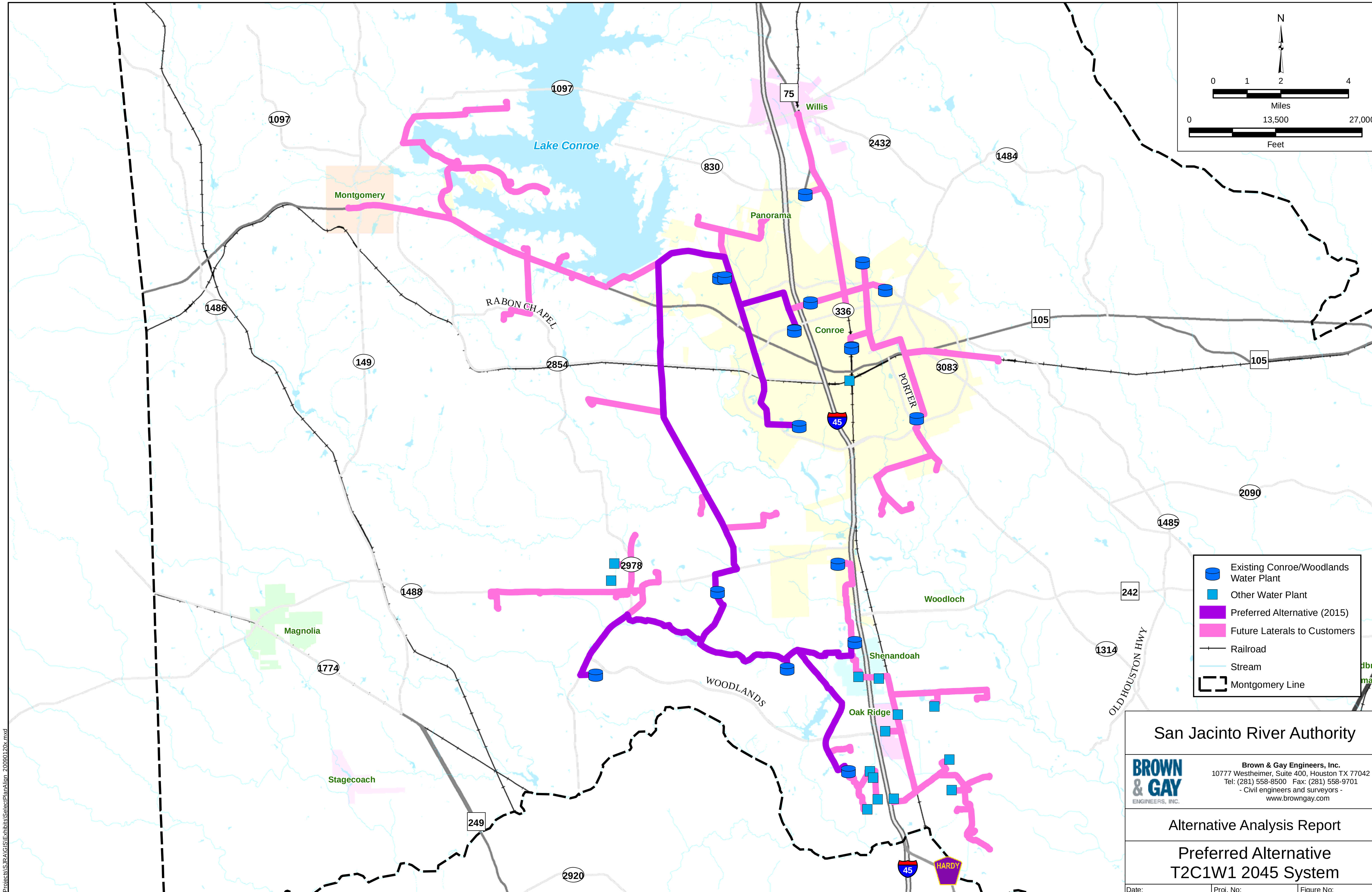
West Transmission line

The future pipeline proceeds in a westerly direction parallel to SH 105 from the water treatment plant at the Lake Conroe dam. Participants include the City of Montgomery and 14 other water users located on the west side of Lake Conroe that will be served by laterals from the west transmission line.

Based on estimated Participant water demands and preliminary sizing of the system, the West transmission line system:

- conveys approximately 16 MGD of treated surface water (average annual demand)
- serves 15 Participants by delivering surface water to 15 existing water plants

Figure 7.1 shows preferred Alternative T2C1W1 with future lateral pipes to serve additional Joint WRAP Participants through 2045.



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Alternative Analysis Report

Preferred Alternative
T2C1W1 2045 System

Date: February 2009 | Proj. No: SJR10-61 | Figure No: 7.1

Section 8
Conclusions and Recommendations

8.1 General

Numerous factors have been considered as part of this investigation including:

- Participant water demand,
- Groundwater reduction strategy and plan to implement surface water use,
- Most economical long-term supply of surface water for Montgomery County,
- Infrastructure to treat and convey surface water to widespread Participants,
- Capital, soft costs, debt service and O&M costs of the infrastructure required, and
- Economic analysis of the costs.

Based on these factors, Alternative T2C1W1 has been identified as the preferred alternative.

Because the difference in present worth between Alternative T2C1W1 and competing alternatives is relatively small, other alternative routes and parts of the overall treatment and conveyance system will continue to be considered in future planning. Continued planning will be essential as this phase concludes due to regulatory requirements being developed by the LSGCD, the results of on-going study of the sustainable yield of the Gulf Coast aquifer system, and possible changes in Participants that will be a part of the plan.

At this time, it is recommended that Alternative T2C1W1 be used as the basis for the Joint WRAP Part II to meet the regulatory requirements of the LSGCD.

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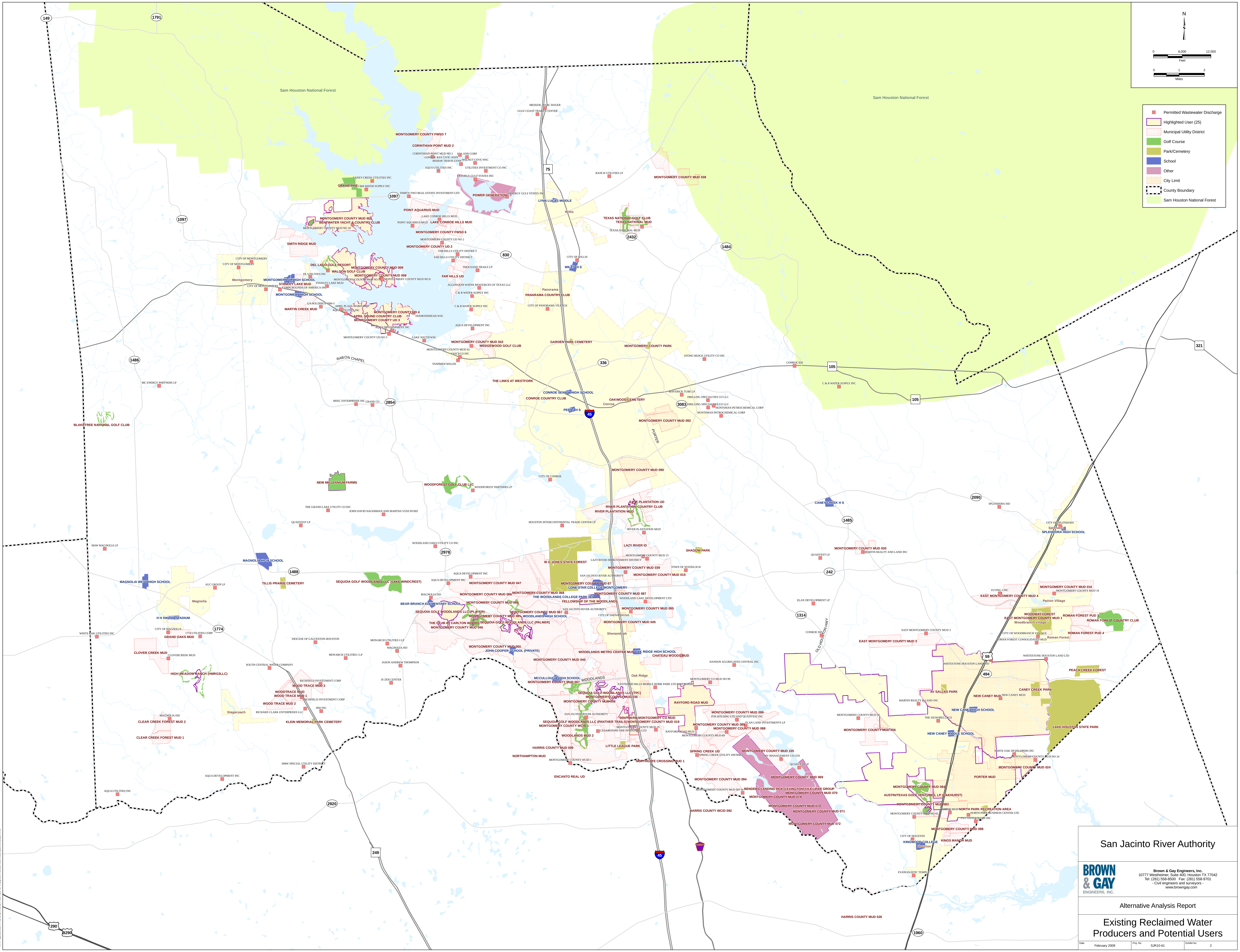
Alternative Analysis Report

Joint WRAP Participants

Date:	Proj. No.	Exhibit No.
February 2009	SJR10-01	1



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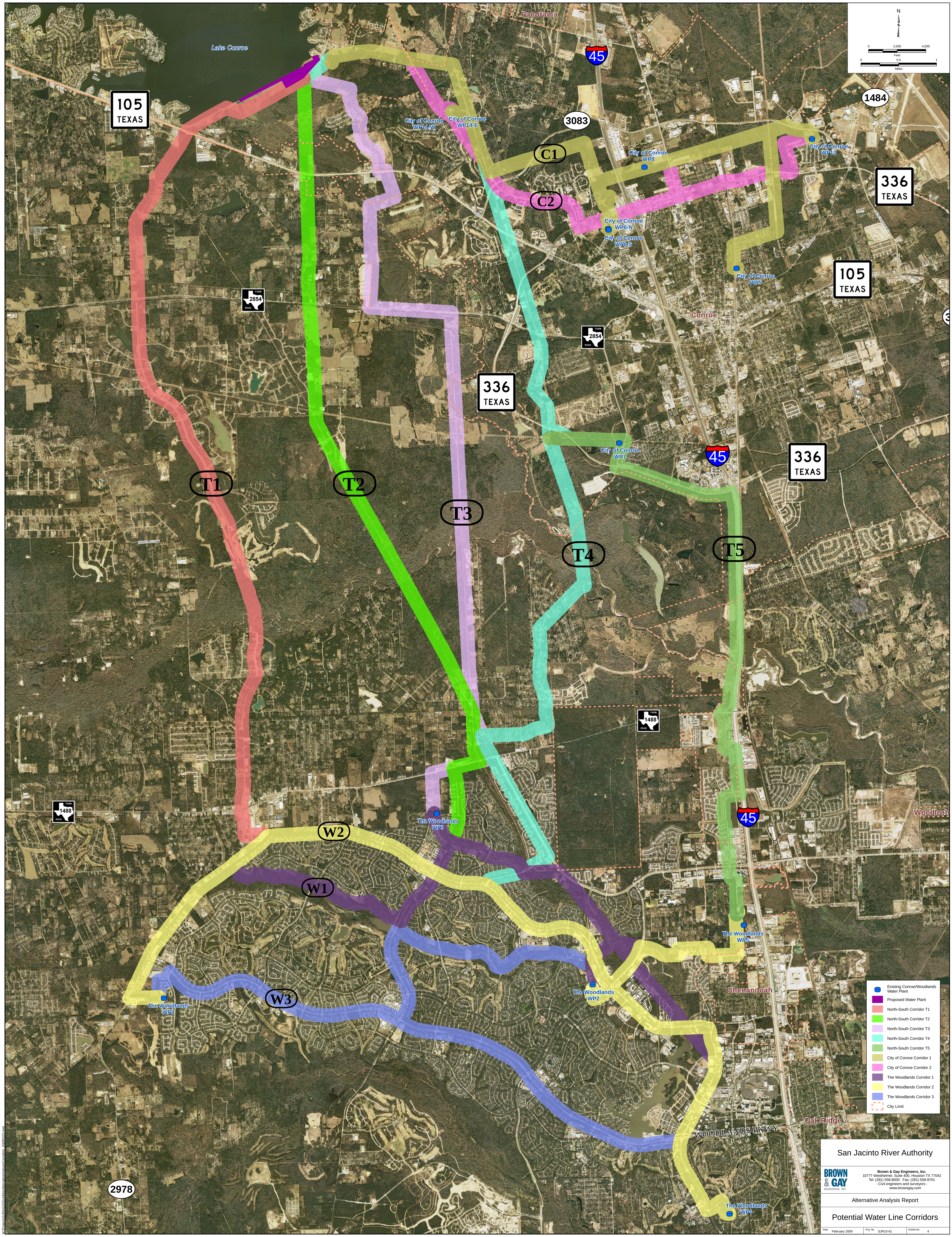
Alternative Analysis Report

Existing Reclaimed Water Producers and Potential Users

Date:	Proj. No:	Exhibit No:
February 2009	SJR10-61	2


Sam Houston National Forest
Sam Houston National Forest
Texas American Water (fka Southwest Utilites, Inc. (Hidden Forest)
C & R Water Supply Inc (Mount Pleasant) fka Wagner Services
C & R Water Supply Inc (Clear Water Cove) fka Wagner Services
Cape Malibu Water Supply Inc.
Corinthian Point MUD No.2
Walnut Cove Water Supply Corp
Texas American Water (fka Southwest Utilities, Inc. (Frontier, Arrowhead)
San Jo Utilities
Aqua Texas, Inc. (Shadow Bay)
Lakewood Estates POA
C & R Water Supply Inc (Rogers Road WS) fka Wagner Services
Entergy Gulf States / Lewis Creek Plant
C & R Water Supply Inc (Bridgepoint Water System) fka Wagner Services
City of Willis
Point Aquarius MUD
Monarch Utilities, Inc (Hulon Lake/Woodcreek Valley)
Bentwater Yacht & Country Club #3 GMC
Montgomery County MUD 18
Bentwater Yacht & Country Club
Lake Conroe Hills MUD
Montgomery County Fresh Water Supply Dist #6
Lake Conroe
Montgomery County UD 2
T & W Water Service (Grand Habor/Gemstone)
Crystal Springs Water (Live Oak Estates)
Conroe Resort Utilities LLC (fka DL Uilities)
Del Lago Golf Resort
Dobbin-Plantersville WSC
T & W Water Service (Harborside)
Waldon Golf Club
Far Hills Utility District
Del Lago Estates WSC
Montgomery County MUD 9
Montgomery County MUD 8
Montgomery County MUD 8
Montgomery I S D (Montgomery High School, Irrg)
City of Montgomery
Stanley Lake MUD
Piney Shores Utility (Algonquin Water Resources)
City of Panorama Village
City of Panorama Village (Country Club) fka Panorama Village Country Club
Panarama Country Club
C & R Water Supply Inc (Pebble Glen) fka Wagner Services
Aqua Texas, Inc. (Lake Conroe Forest & Tejas Creek)
Montgomery County UD 3
April Sound Country Club
Montgomery County UD 4
C & R Water Supply Inc (Longmire) fka Wagner Services
Diamondhead Water & Sewer
Diamondhead Water & Sewer
April Sound Country Club
Aqua Texas, Inc. (Lake Conroe Village)
Lake South Water Supply Corp
Wedgewood Golf Club
Lake Bonanza Water Supply Corp.
Westmont Mobile Home Park
MSEC Enterprises (Highland Ranch/Lake Forest/Shoreline)
MSEC Enterprises (Montgomery Trace/Crown Oaks)
Lake Forest Falls
Mound Creek
Mound Creek
Liberty
Liberty
Rabon Chapel
Davis
149
149
1097
1097
1097
105
105
2854
2854
830
2432
75
75
45
45
N
0 2,500 5,000
Feet
0 0.5 1
Miles
Golf Courses
Existing User of Raw Surface Water
Potential User of Raw Surface Water
San Jacinto River Authority
BROWN & GAY ENGINEERS, INC.
Brown & Gay Engineers, Inc.
10777 Westheimer, Suite 400, Houston TX 77042
Tel: (281) 558-8500 Fax: (281) 558-9701
- Civil engineers and surveyors -
www.browngay.com
Alternative Analysis Report
Potential Users of
Raw Surface Water
Date: February 2009
Proj. No: SJR10-61
Exhibit No: 2.2



San Jacinto River Authority

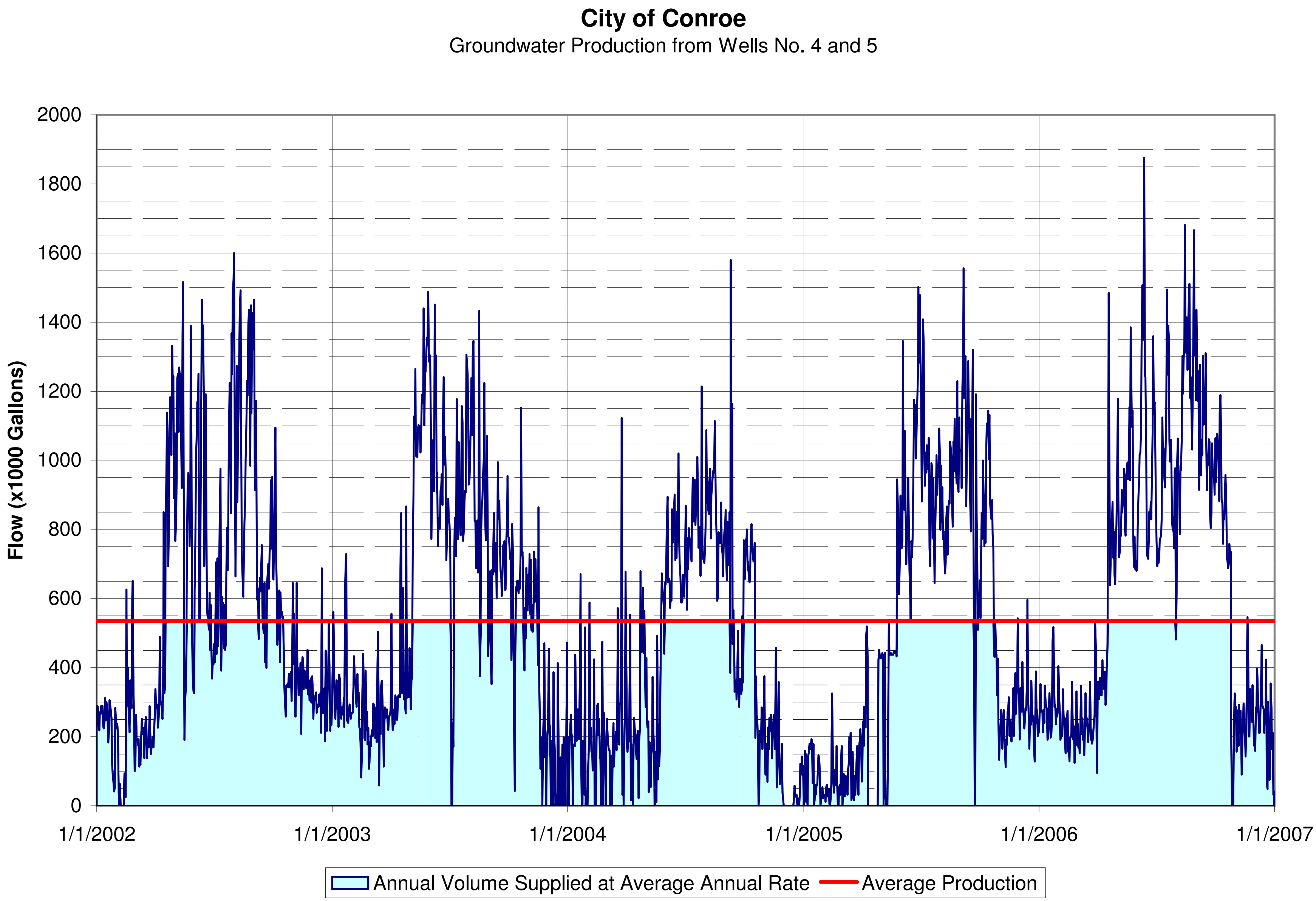
BROWN & GAY ENGINEERS, INC.

Brown & Gay Engineers, Inc.
10777 Westheimer, Suite 400, Houston TX 77042
Tel: (281) 558-8500 Fax: (281) 558-9701
- Civil engineers and surveyors -
www.browngay.com

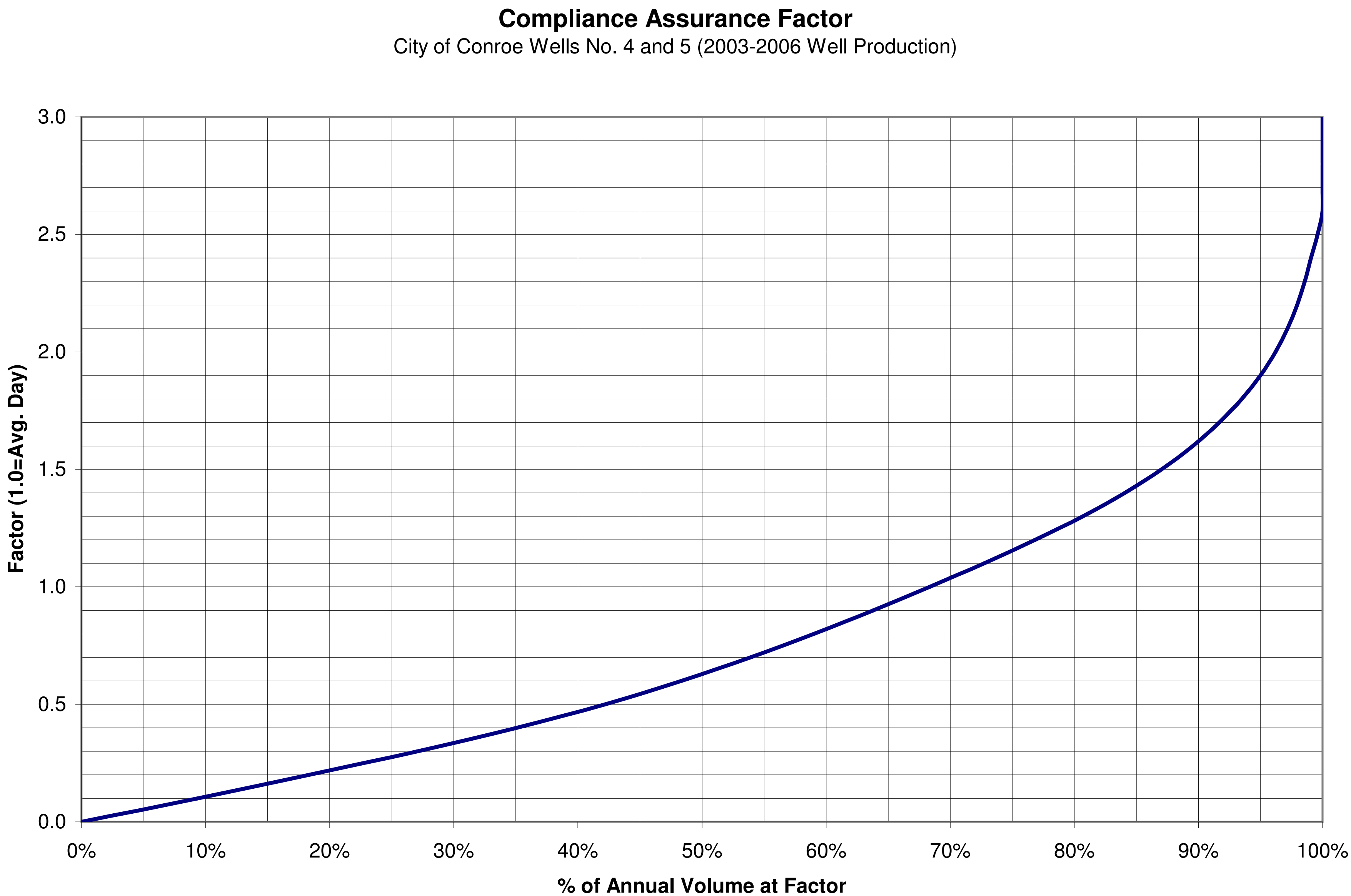
Alternative Analysis Report

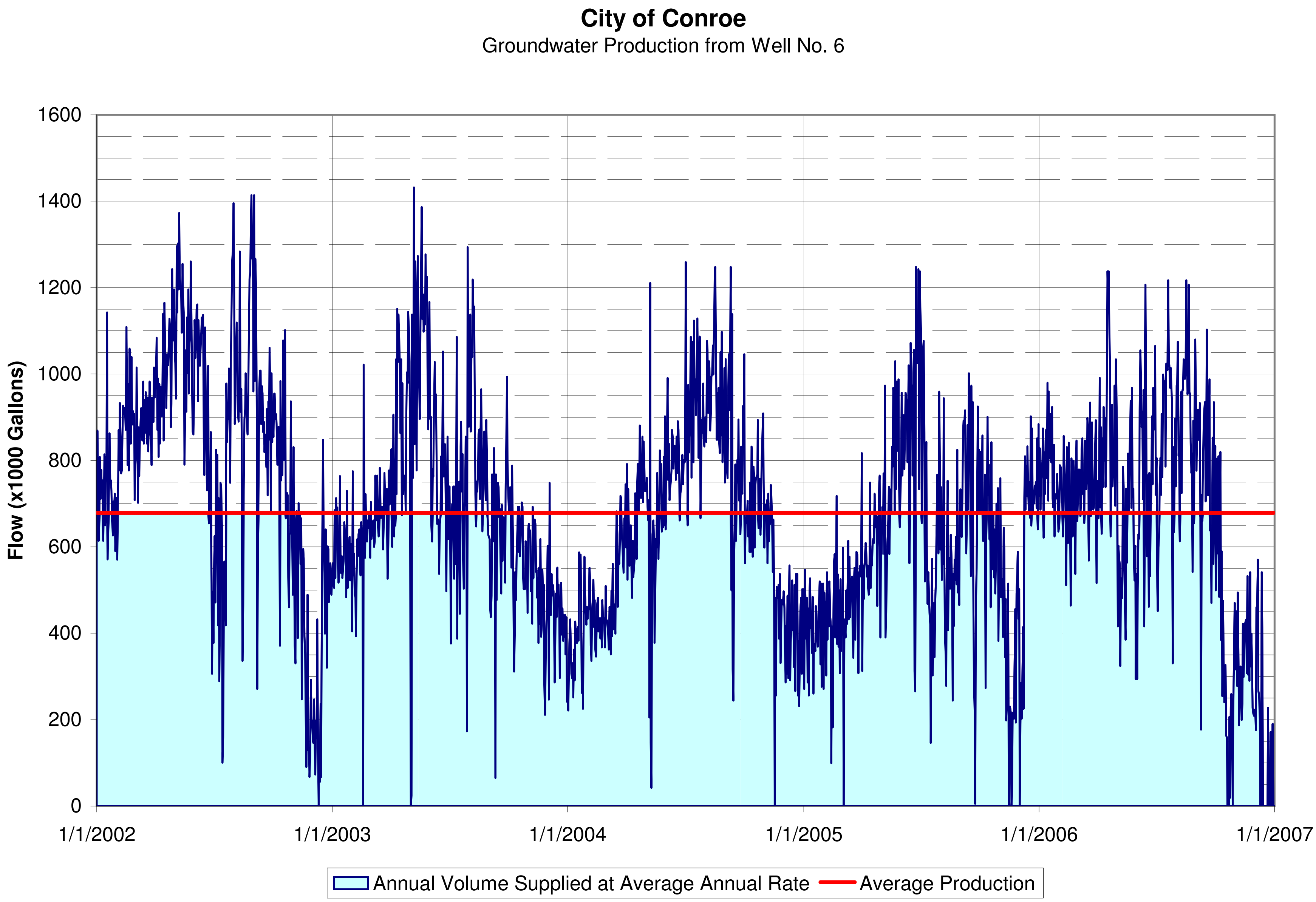
Potential Water Line Corridors

Date: February 2009	Proj. No: SJR10-61	Exhibit No: 4

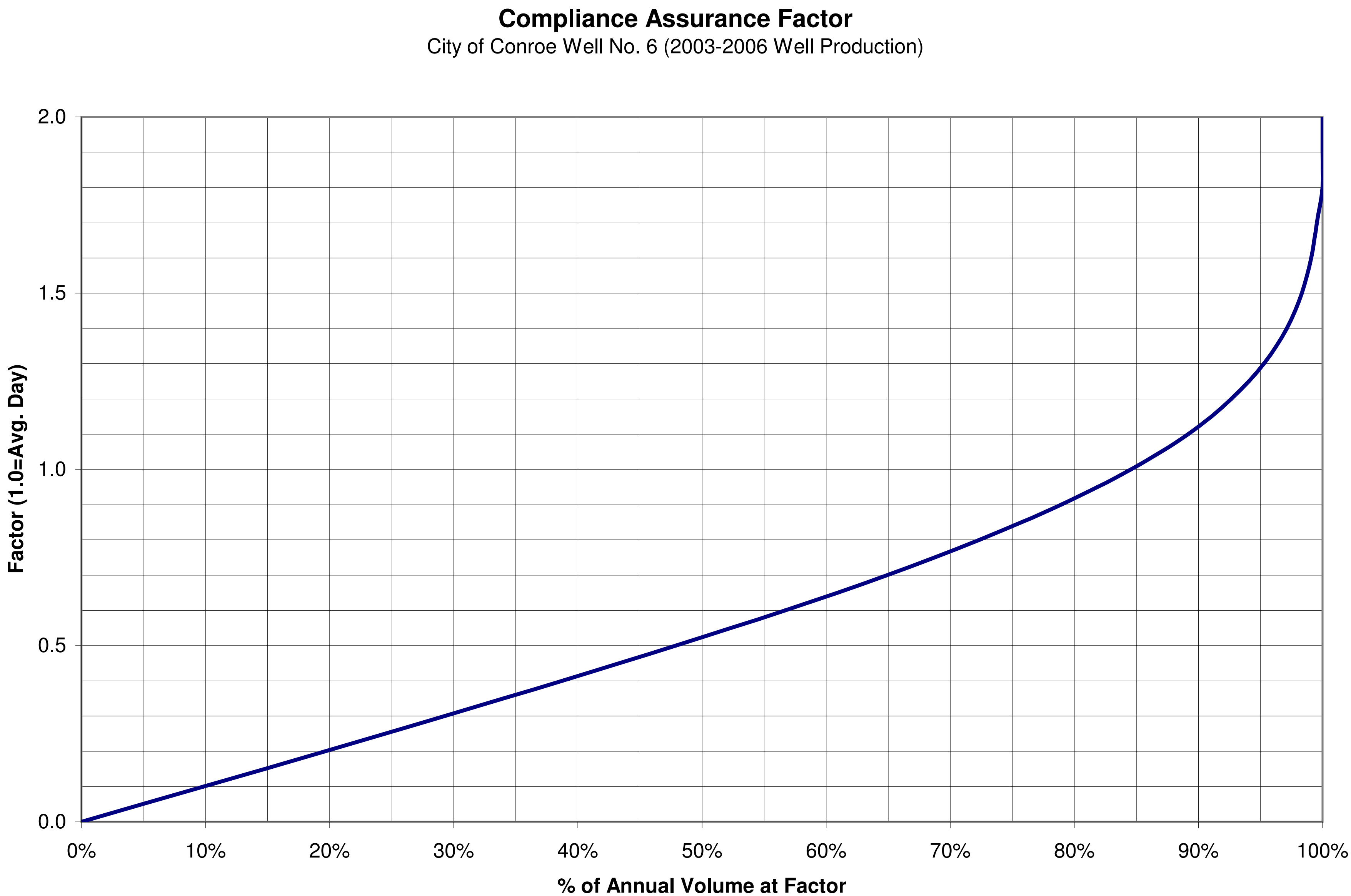


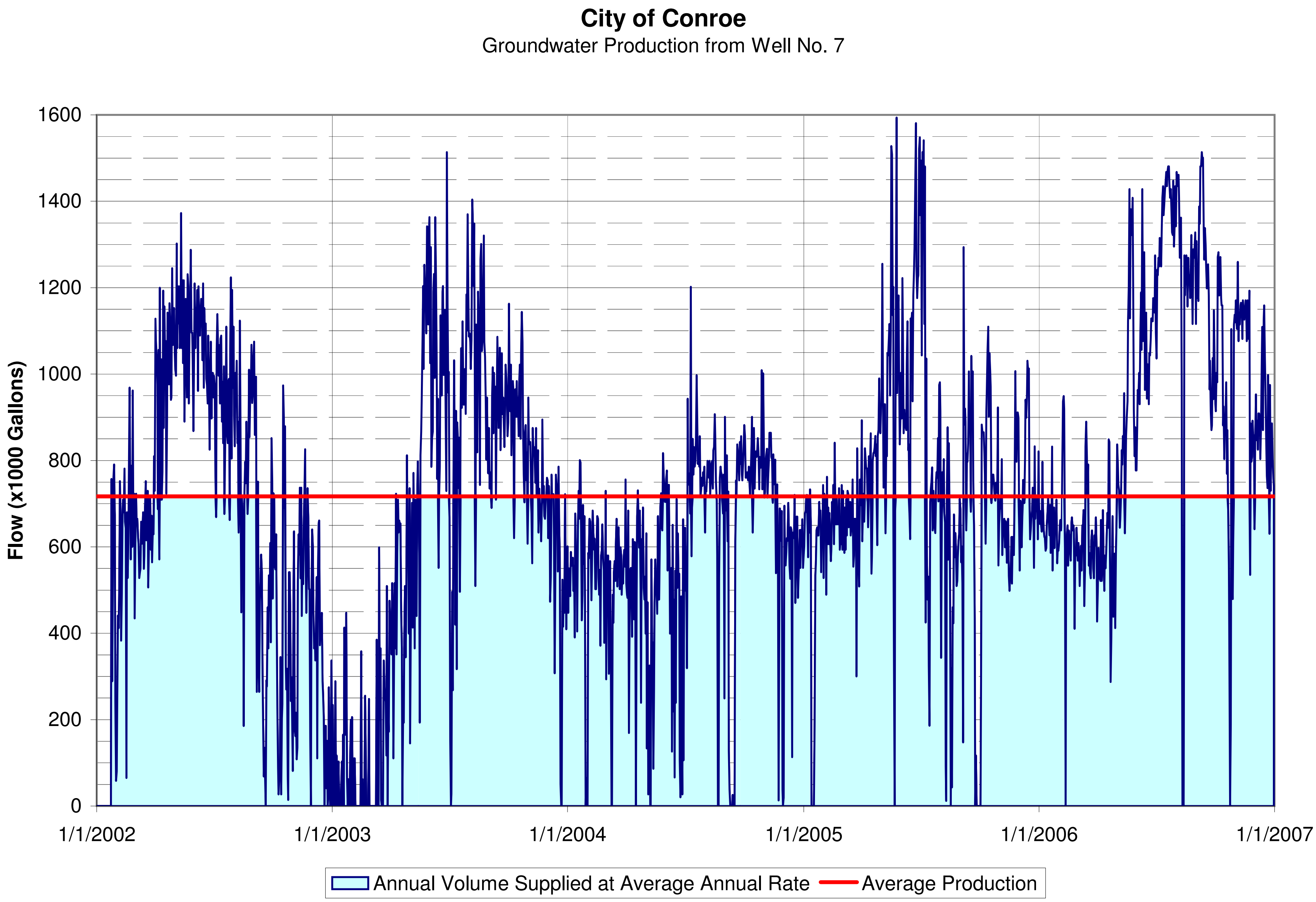
City of Conroe
Groundwater Production from Wells No. 4 and 5
Flow (x1000 Gallons)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
1/1/2002
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
Annual Volume Supplied at Average Annual Rate
Average Production

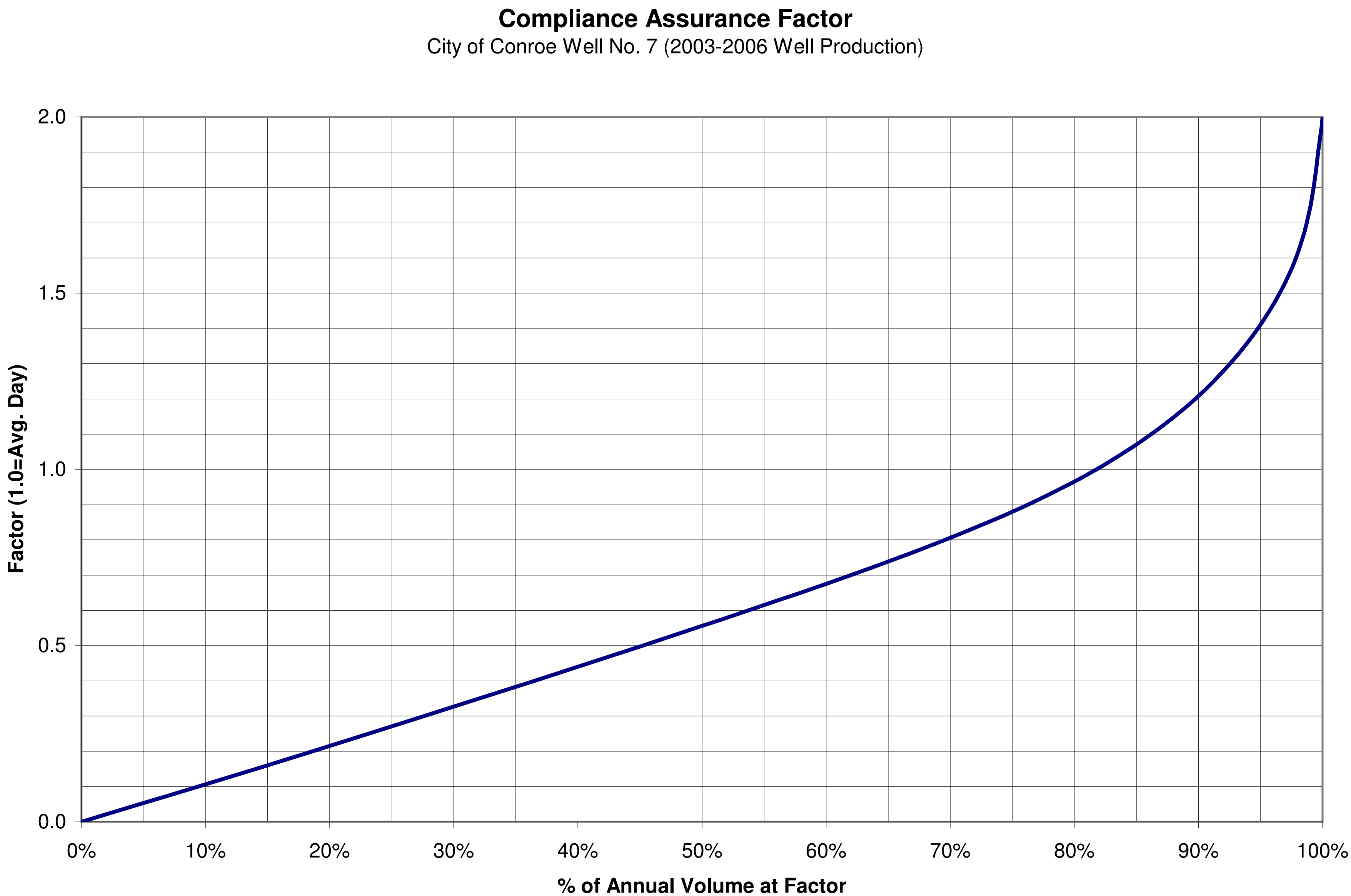

Compliance Assurance Factor
City of Conroe Wells No. 4 and 5 (2003-2006 Well Production)
Factor (1.0=Avg. Day)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
% of Annual Volume at Factor



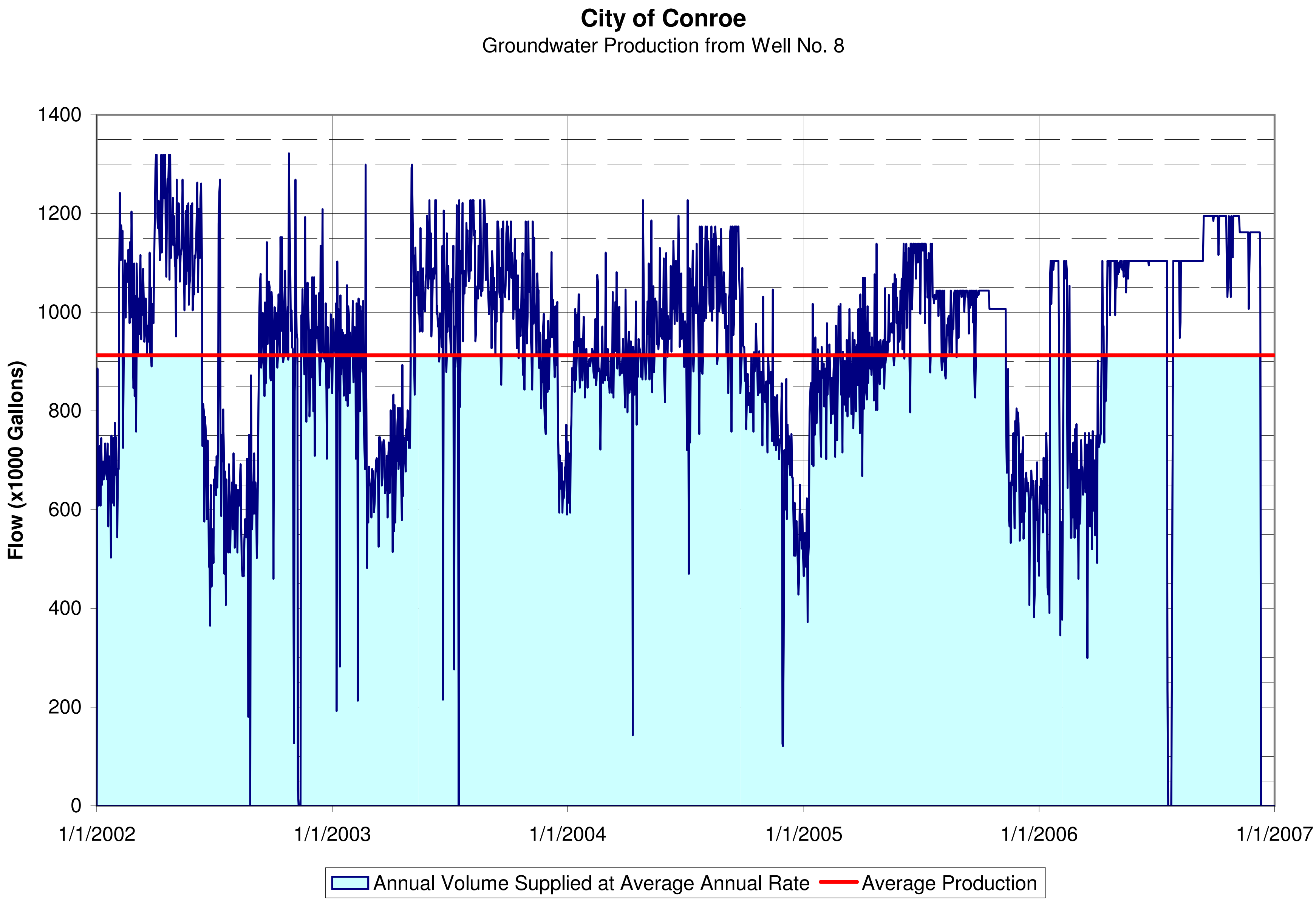
City of Conroe
Groundwater Production from Well No. 6
Flow (x1000 Gallons)
0
200
400
600
800
1000
1200
1400
1600
1/1/2002
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
Annual Volume Supplied at Average Annual Rate
Average Production


Compliance Assurance Factor
City of Conroe Well No. 6 (2003-2006 Well Production)
2.0
1.5
1.0
0.5
0.0
Factor (1.0=Avg. Day)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
% of Annual Volume at Factor

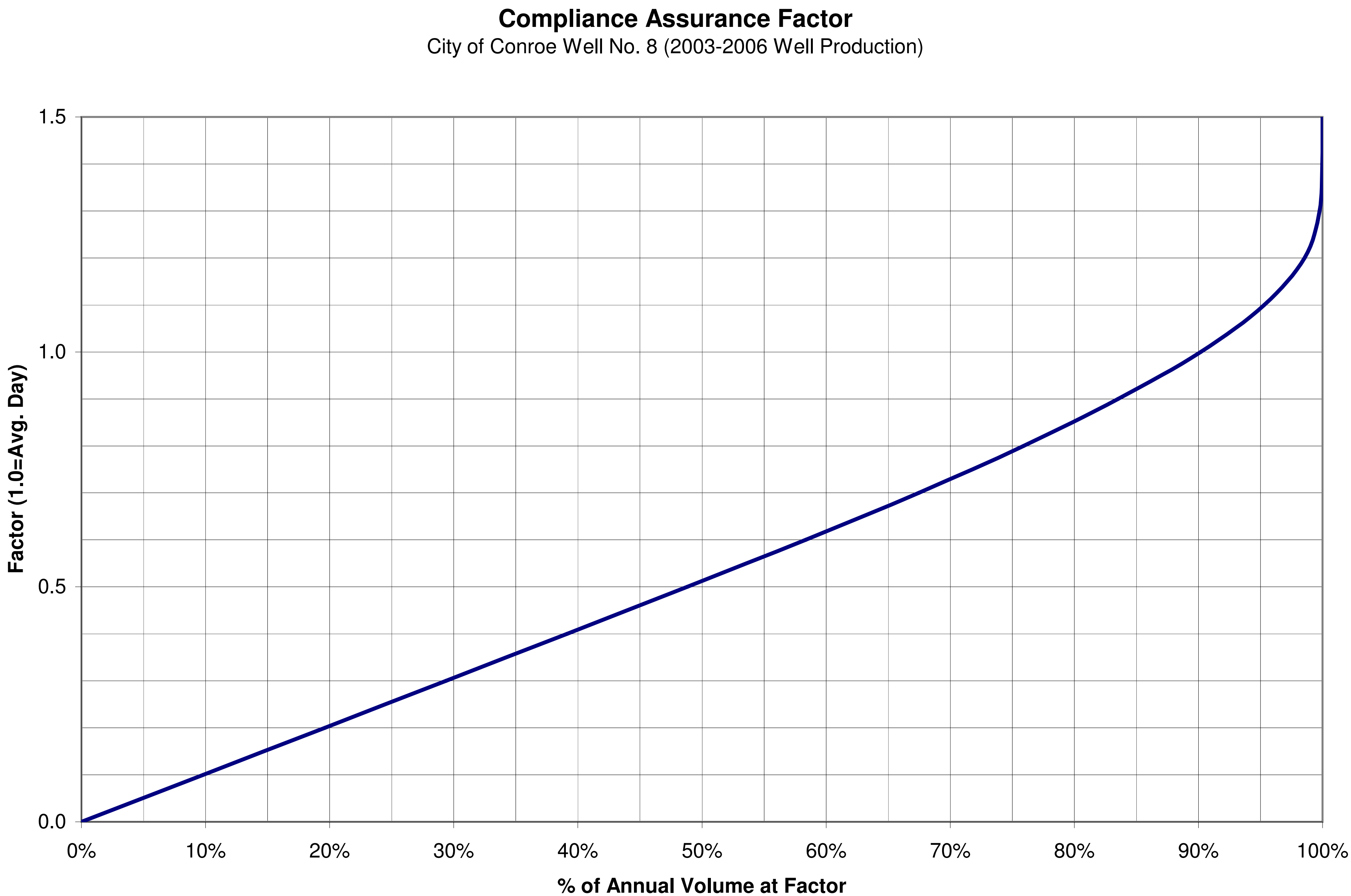

City of Conroe
Groundwater Production from Well No. 7
Flow (x1000 Gallons)
1600
1400
1200
1000
800
600
400
200
0
1/1/2002
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
Annual Volume Supplied at Average Annual Rate
Average Production

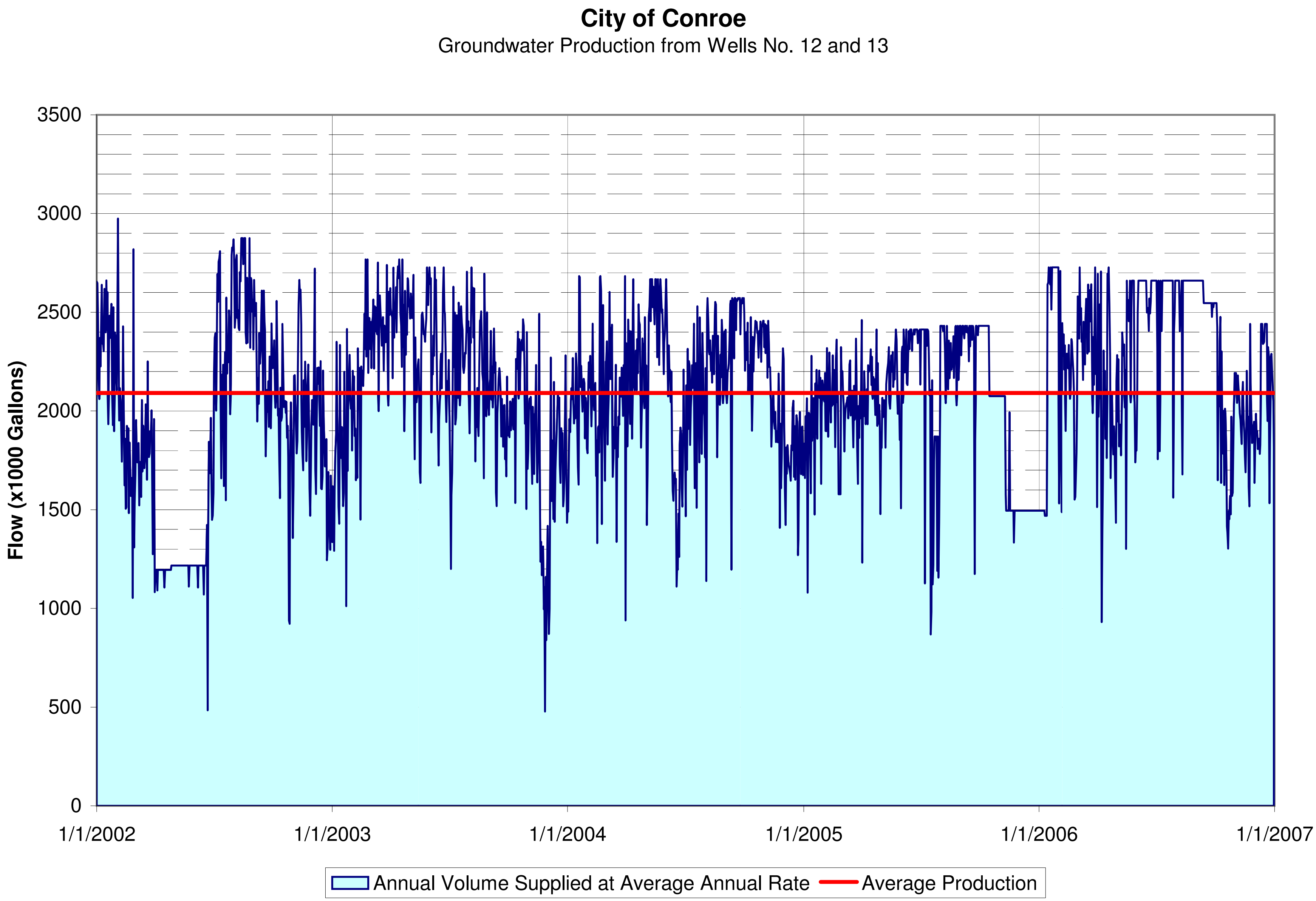


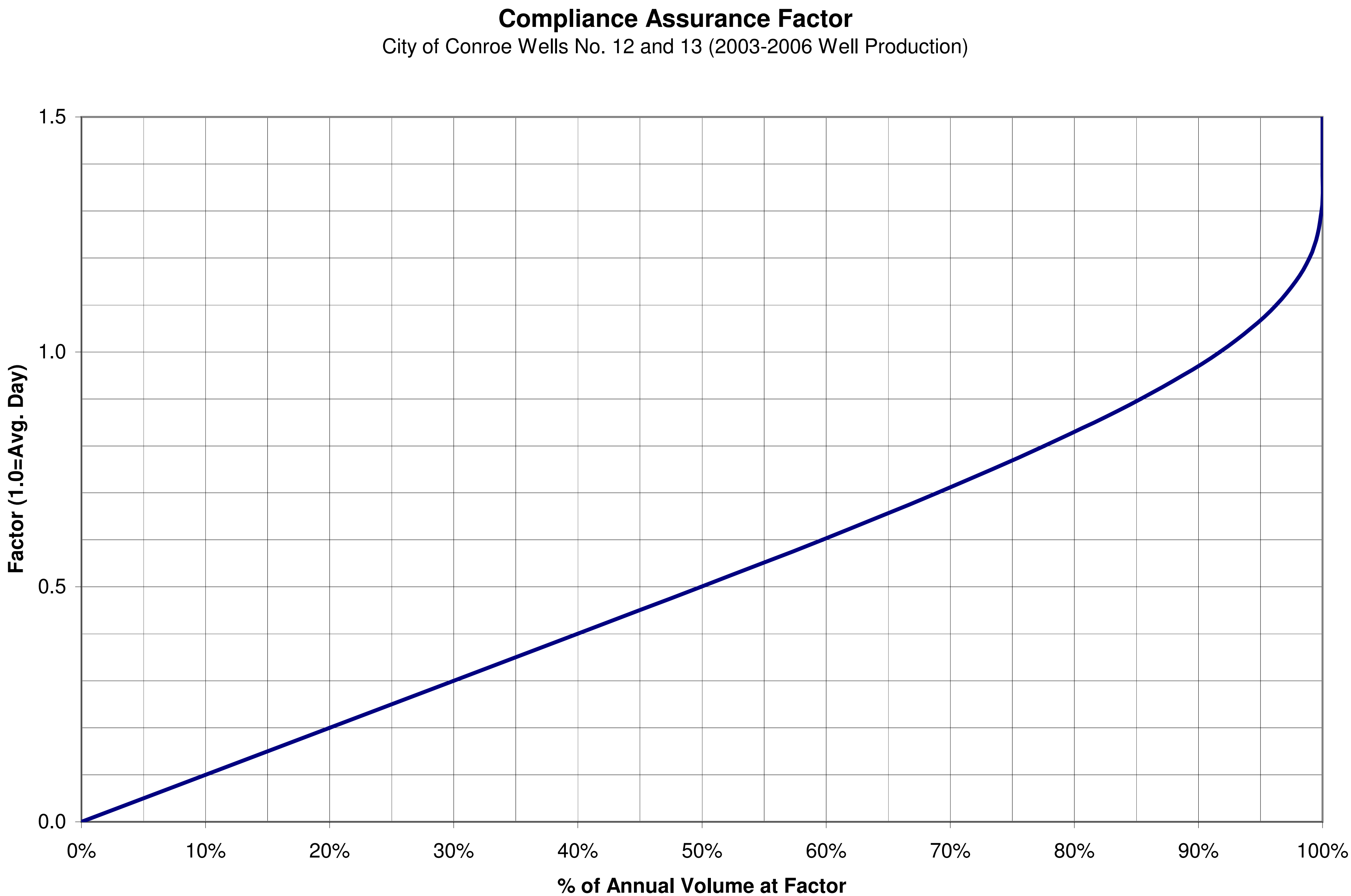
Compliance Assurance Factor
City of Conroe Well No. 7 (2003-2006 Well Production)
Factor (1.0=Avg. Day)
2.0
1.5
1.0
0.5
0.0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
% of Annual Volume at Factor

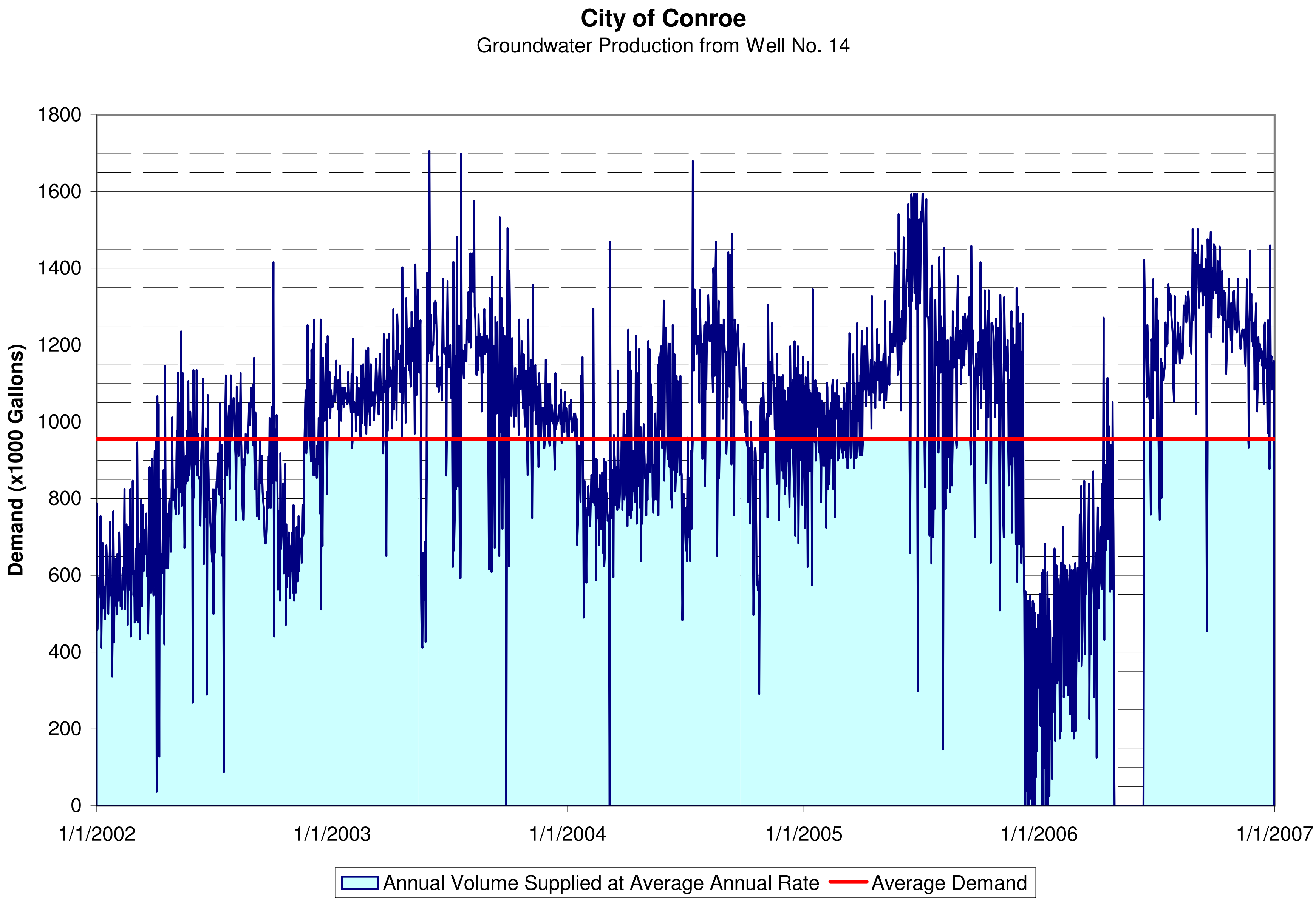


City of Conroe
Groundwater Production from Well No. 8
Flow (x1000 Gallons)
0
200
400
600
800
1000
1200
1400
1/1/2002
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
Annual Volume Supplied at Average Annual Rate
Average Production

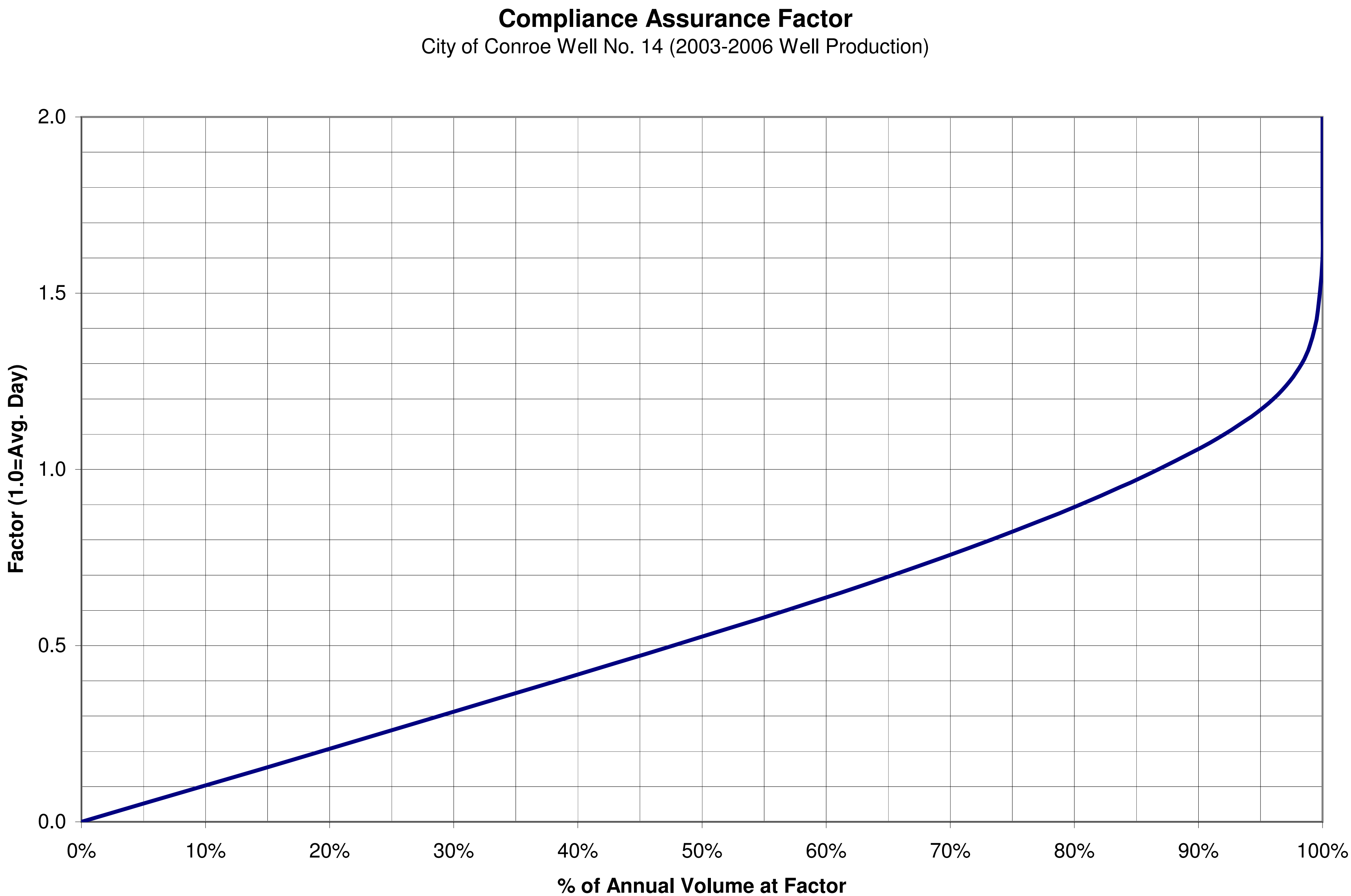

Compliance Assurance Factor
City of Conroe Well No. 8 (2003-2006 Well Production)
1.5
1.0
0.5
0.0
Factor (1.0=Avg. Day)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
% of Annual Volume at Factor

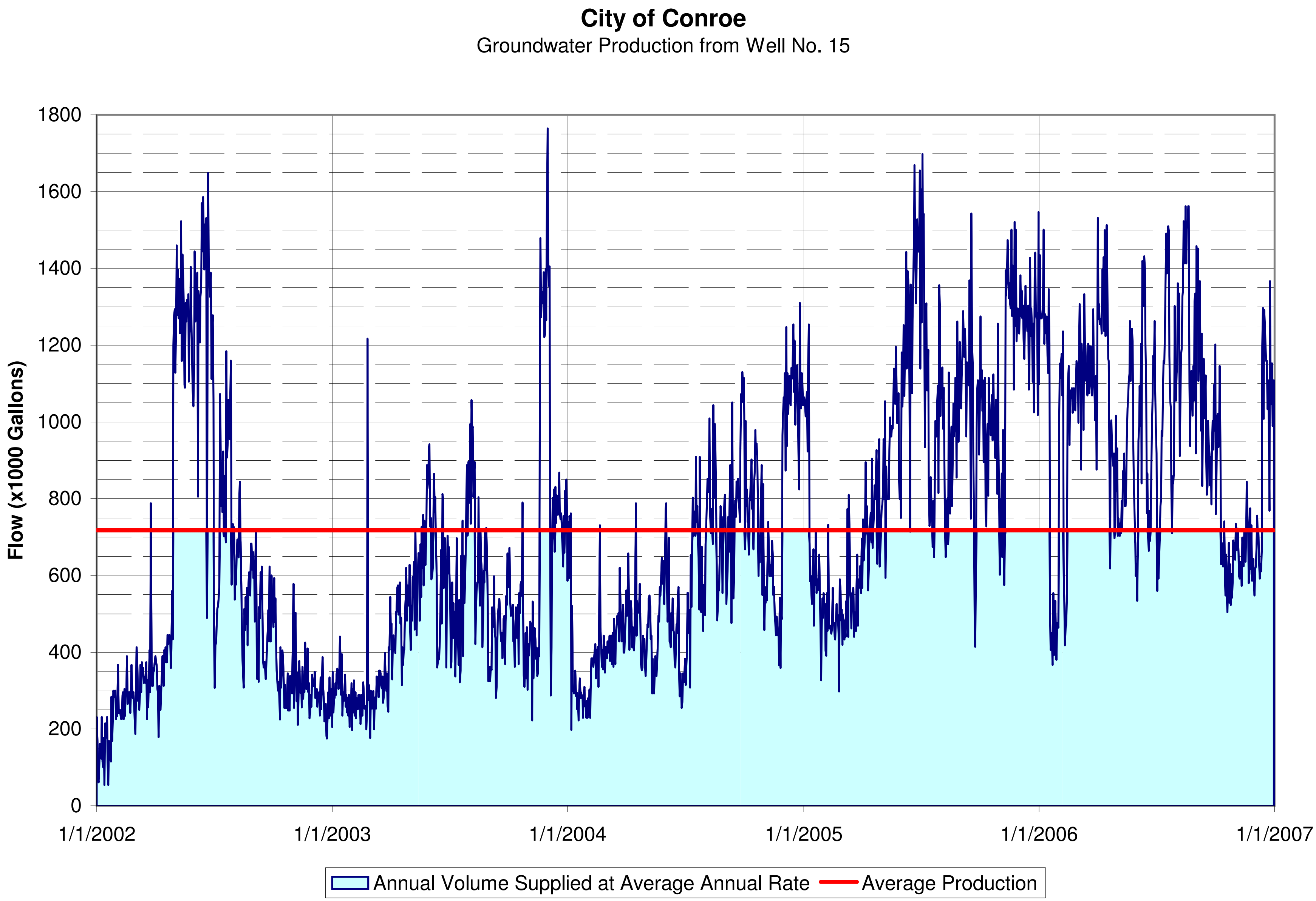

City of Conroe
Groundwater Production from Wells No. 12 and 13
Flow (x1000 Gallons)
3500
3000
2500
2000
1500
1000
500
0
1/1/2002
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
Annual Volume Supplied at Average Annual Rate
Average Production


Compliance Assurance Factor
City of Conroe Wells No. 12 and 13 (2003-2006 Well Production)
1.5
1.0
0.5
0.0
Factor (1.0=Avg. Day)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
% of Annual Volume at Factor

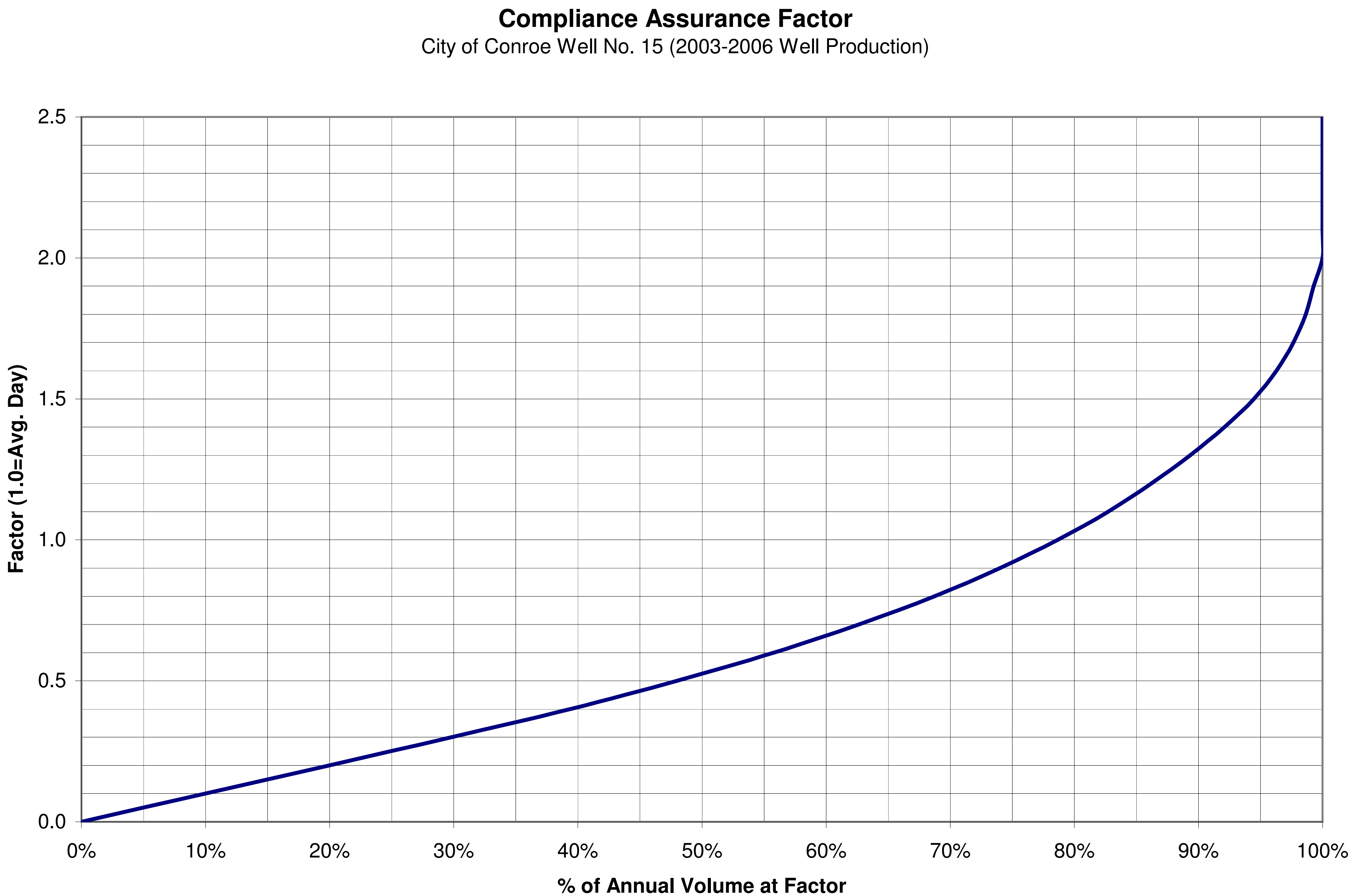


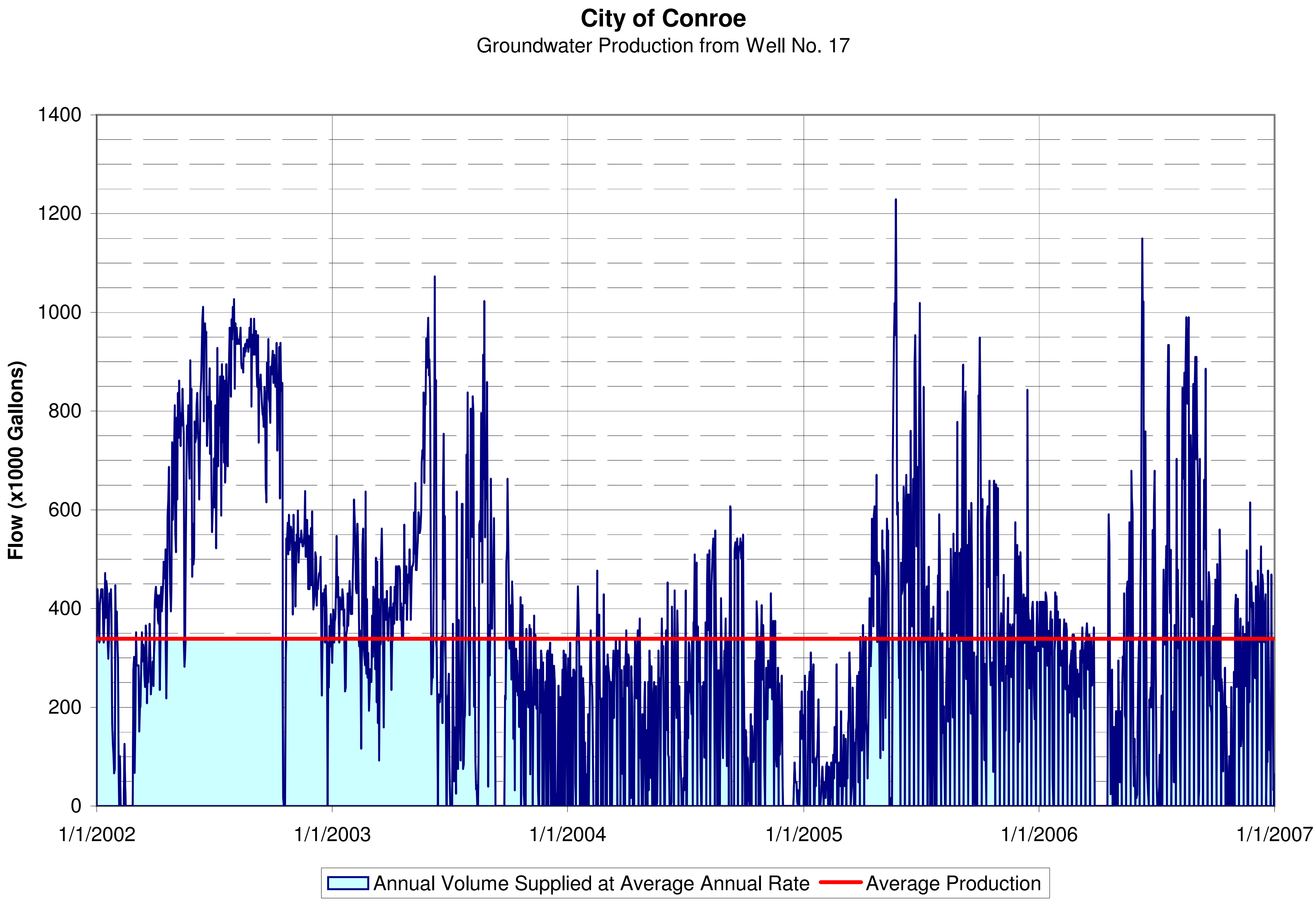
City of Conroe
Groundwater Production from Well No. 14
Demand (x1000 Gallons)
0
200
400
600
800
1000
1200
1400
1600
1800
1/1/2002
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
Annual Volume Supplied at Average Annual Rate
Average Demand


Compliance Assurance Factor
City of Conroe Well No. 14 (2003-2006 Well Production)
2.0
1.5
1.0
0.5
0.0
Factor (1.0=Avg. Day)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
% of Annual Volume at Factor

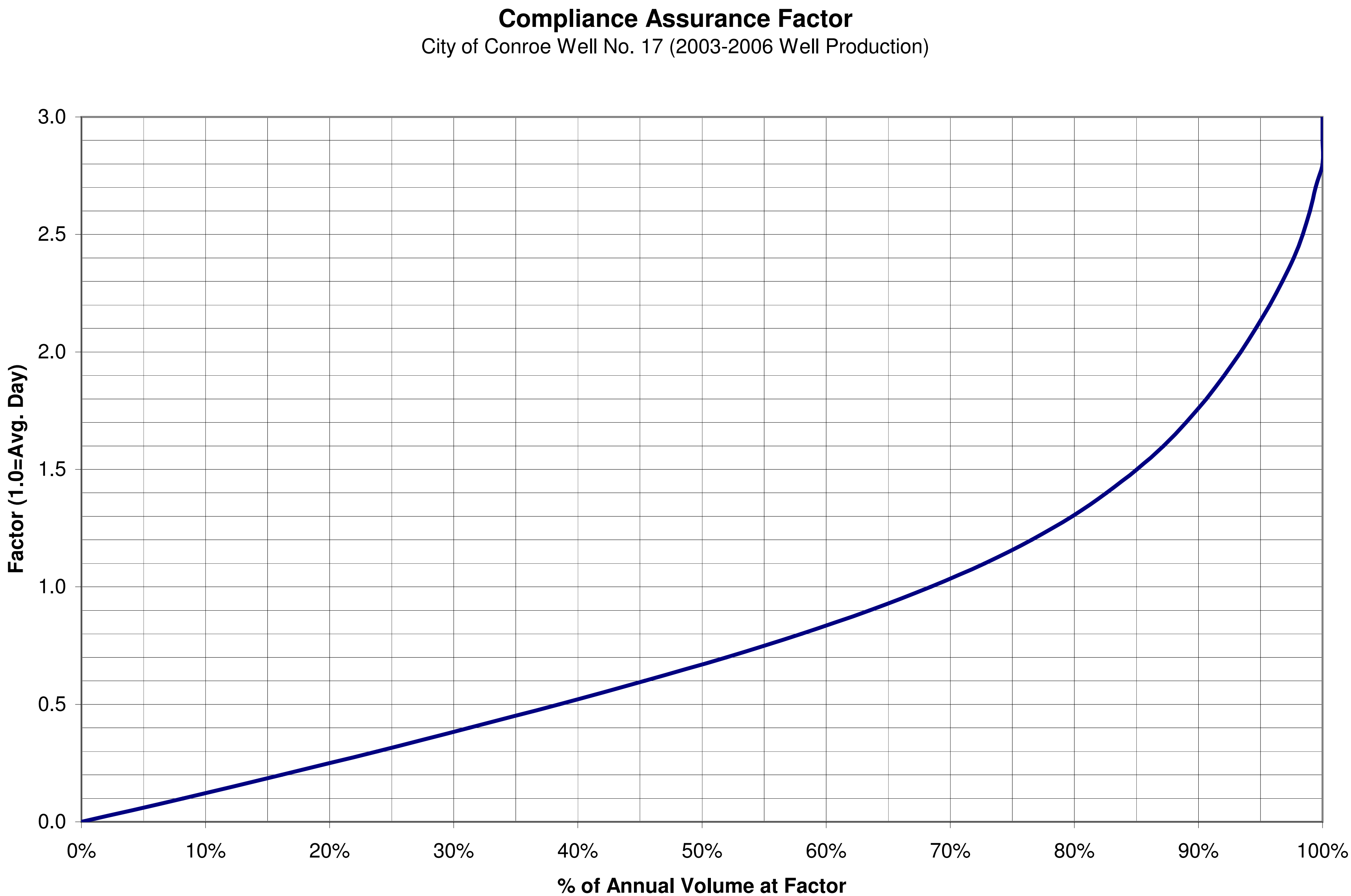


City of Conroe
Groundwater Production from Well No. 15
Flow (x1000 Gallons)
0
200
400
600
800
1000
1200
1400
1600
1800
1/1/2002
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
Annual Volume Supplied at Average Annual Rate
Average Production

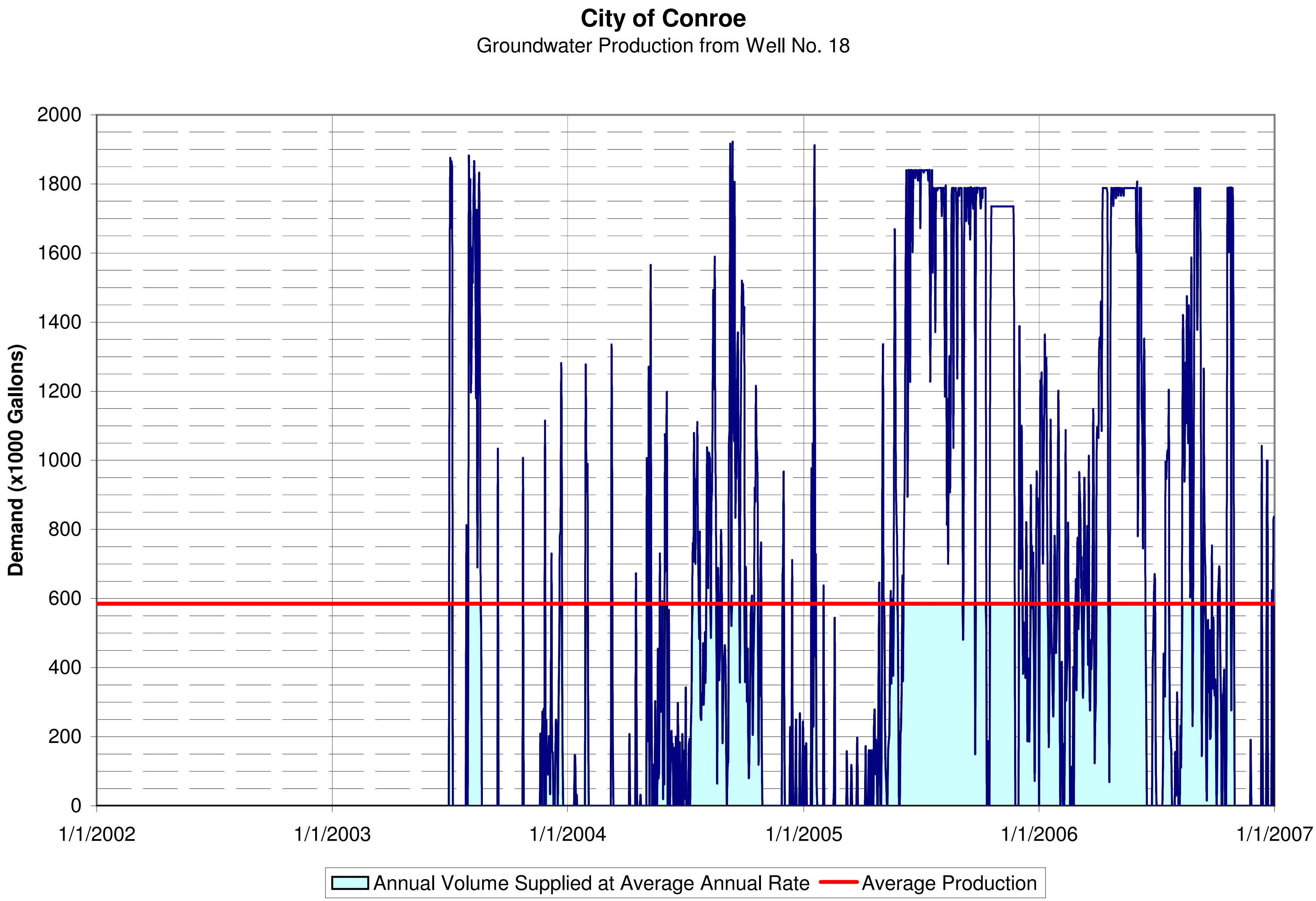

Compliance Assurance Factor
City of Conroe Well No. 15 (2003-2006 Well Production)
Factor (1.0=Avg. Day)
2.5
2.0
1.5
1.0
0.5
0.0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
% of Annual Volume at Factor

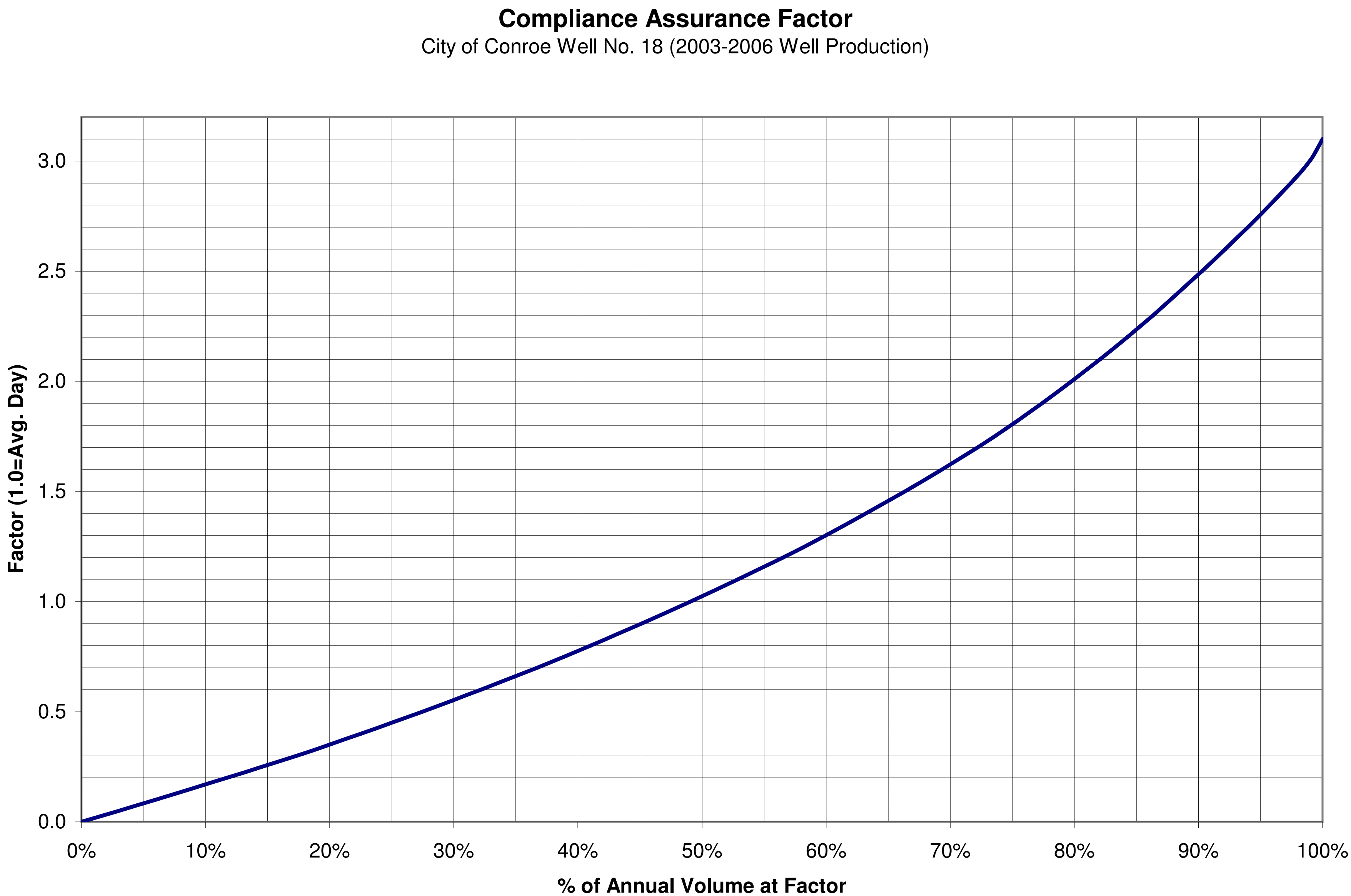


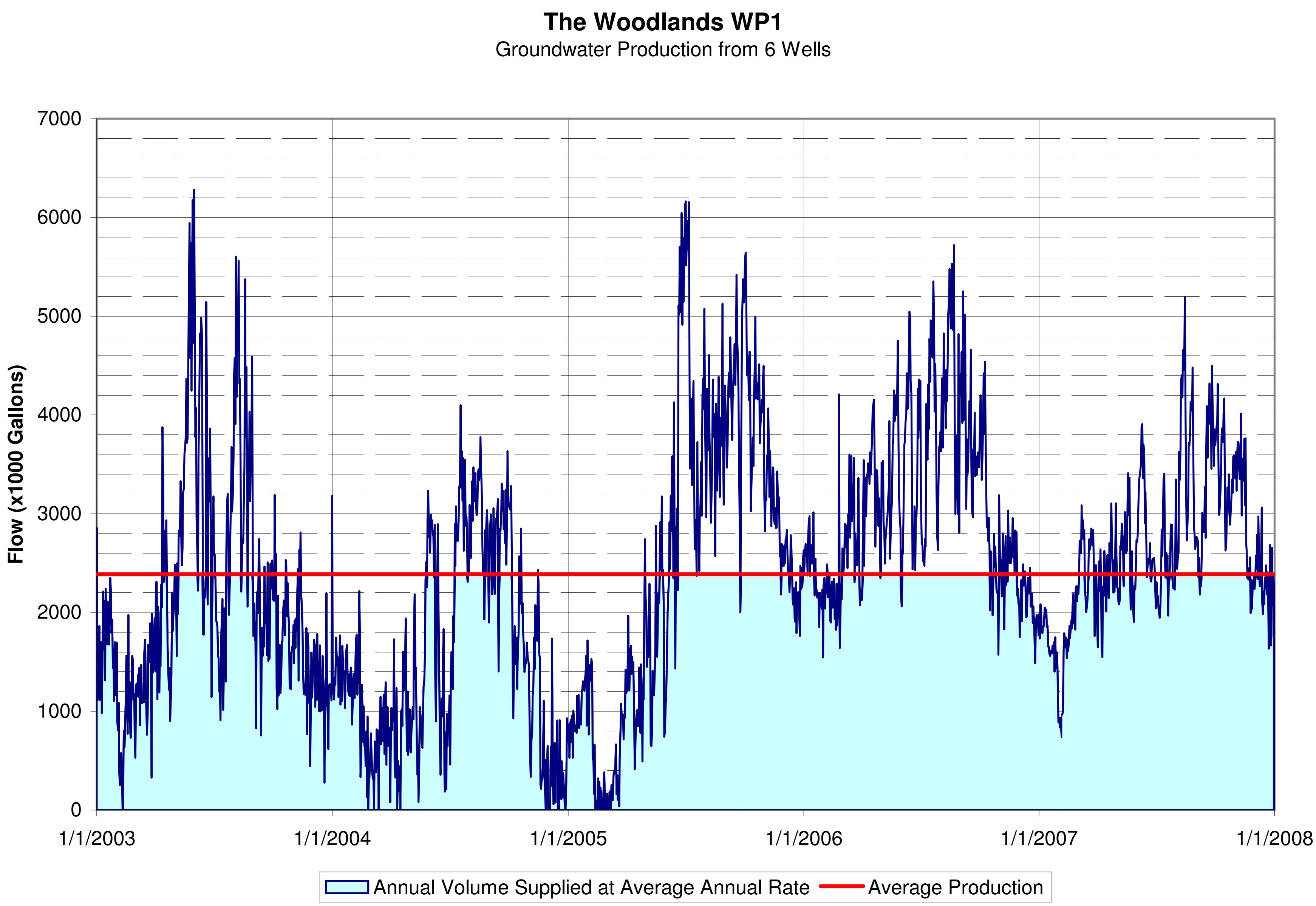
City of Conroe
Groundwater Production from Well No. 17
Flow (x1000 Gallons)
1400
1200
1000
800
600
400
200
0
1/1/2002
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
Annual Volume Supplied at Average Annual Rate
Average Production

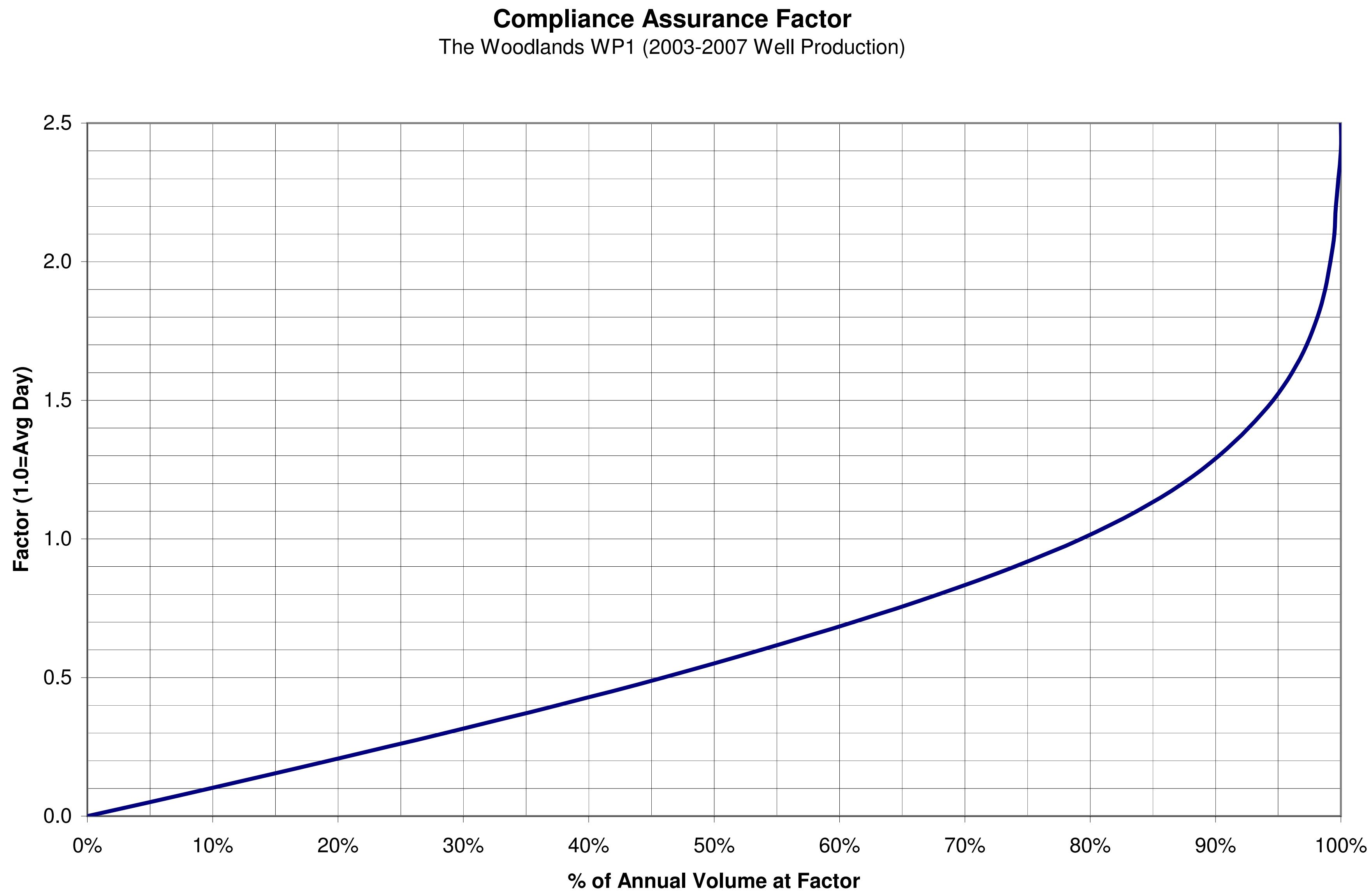


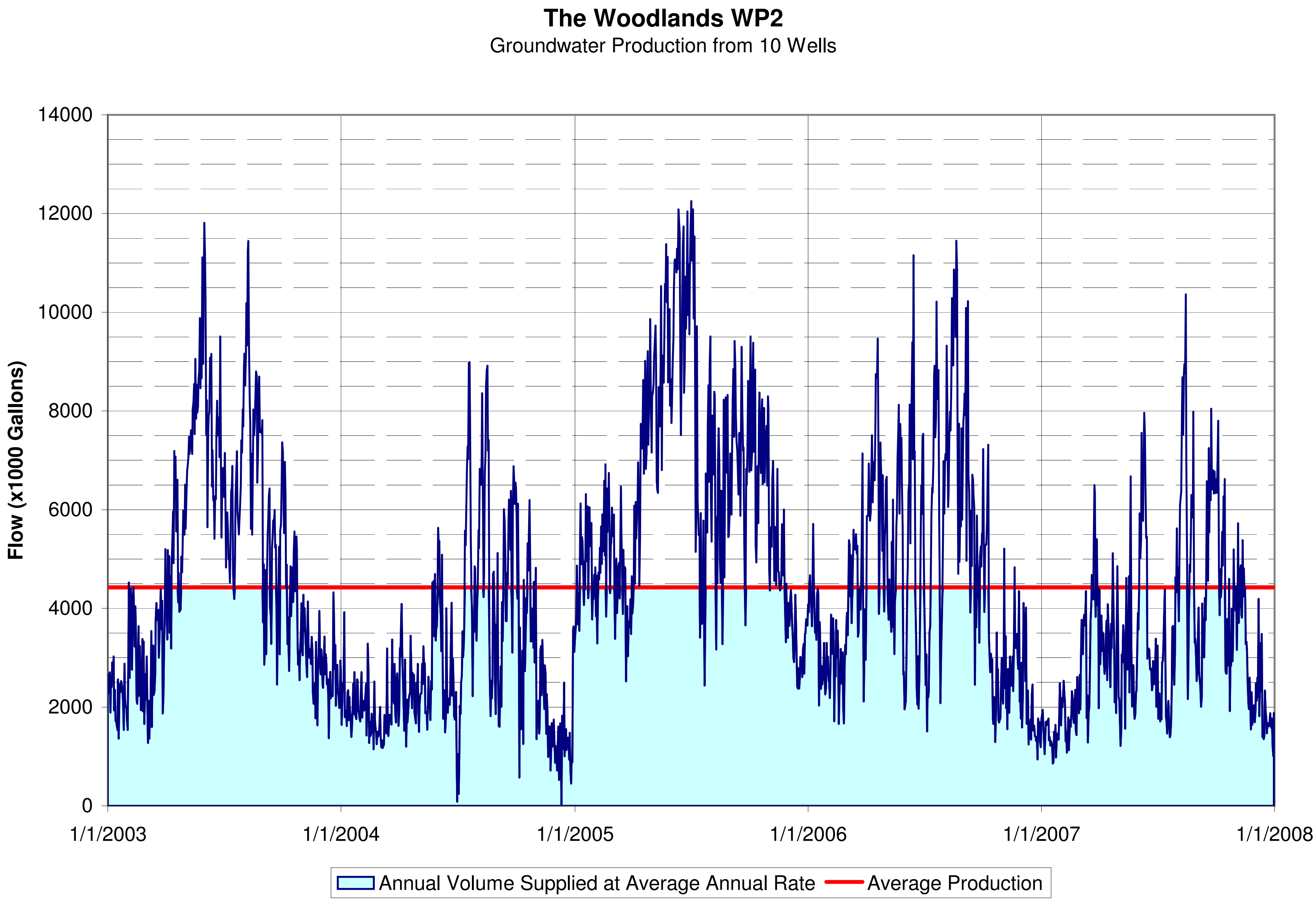
Compliance Assurance Factor
City of Conroe Well No. 17 (2003-2006 Well Production)
Factor (1.0=Avg. Day)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
% of Annual Volume at Factor


City of Conroe
Groundwater Production from Well No. 18
Demand (x1000 Gallons)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
1/1/2002
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
Annual Volume Supplied at Average Annual Rate
Average Production

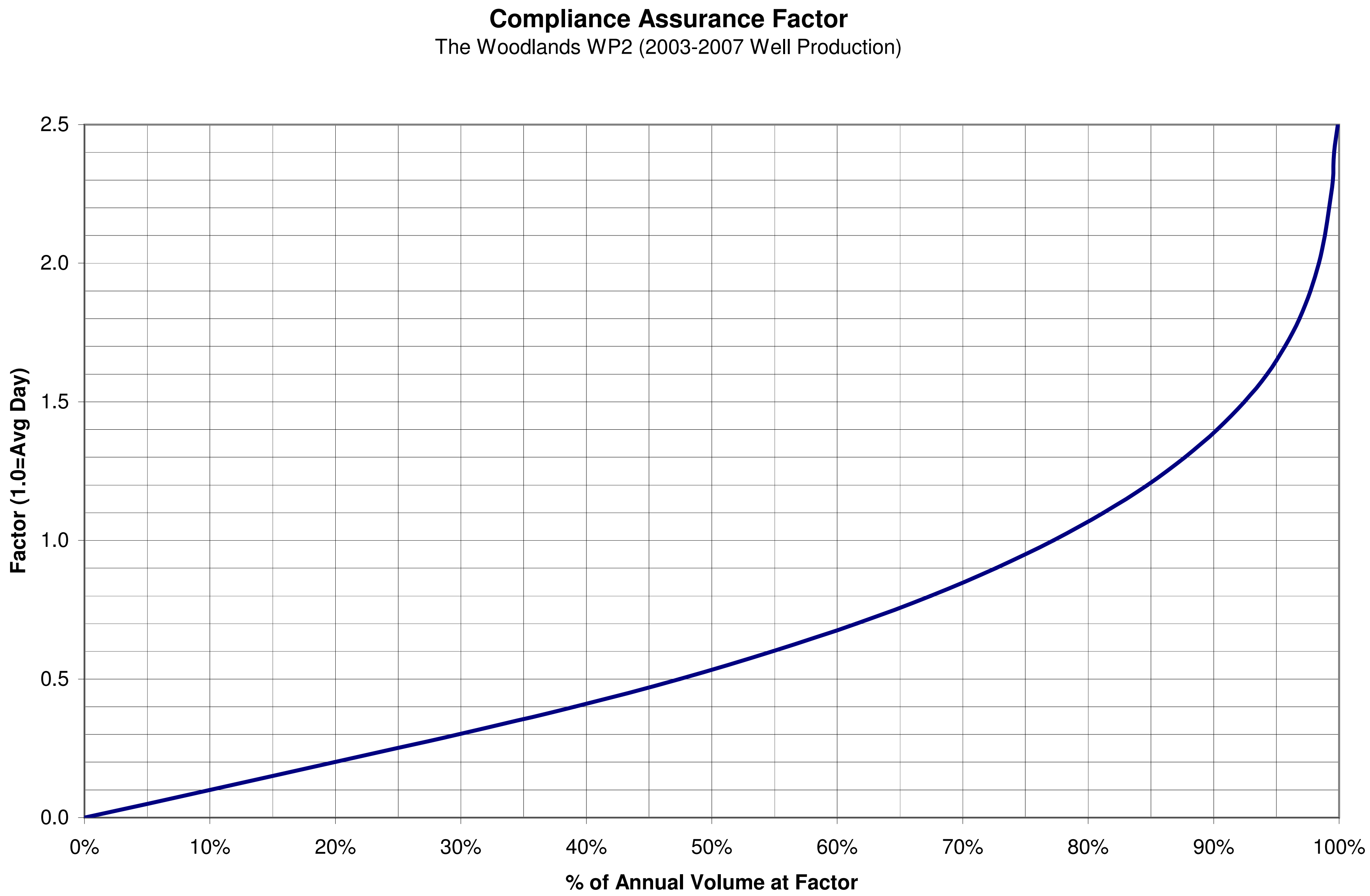

Compliance Assurance Factor
City of Conroe Well No. 18 (2003-2006 Well Production)
Factor (1.0=Avg. Day)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
% of Annual Volume at Factor

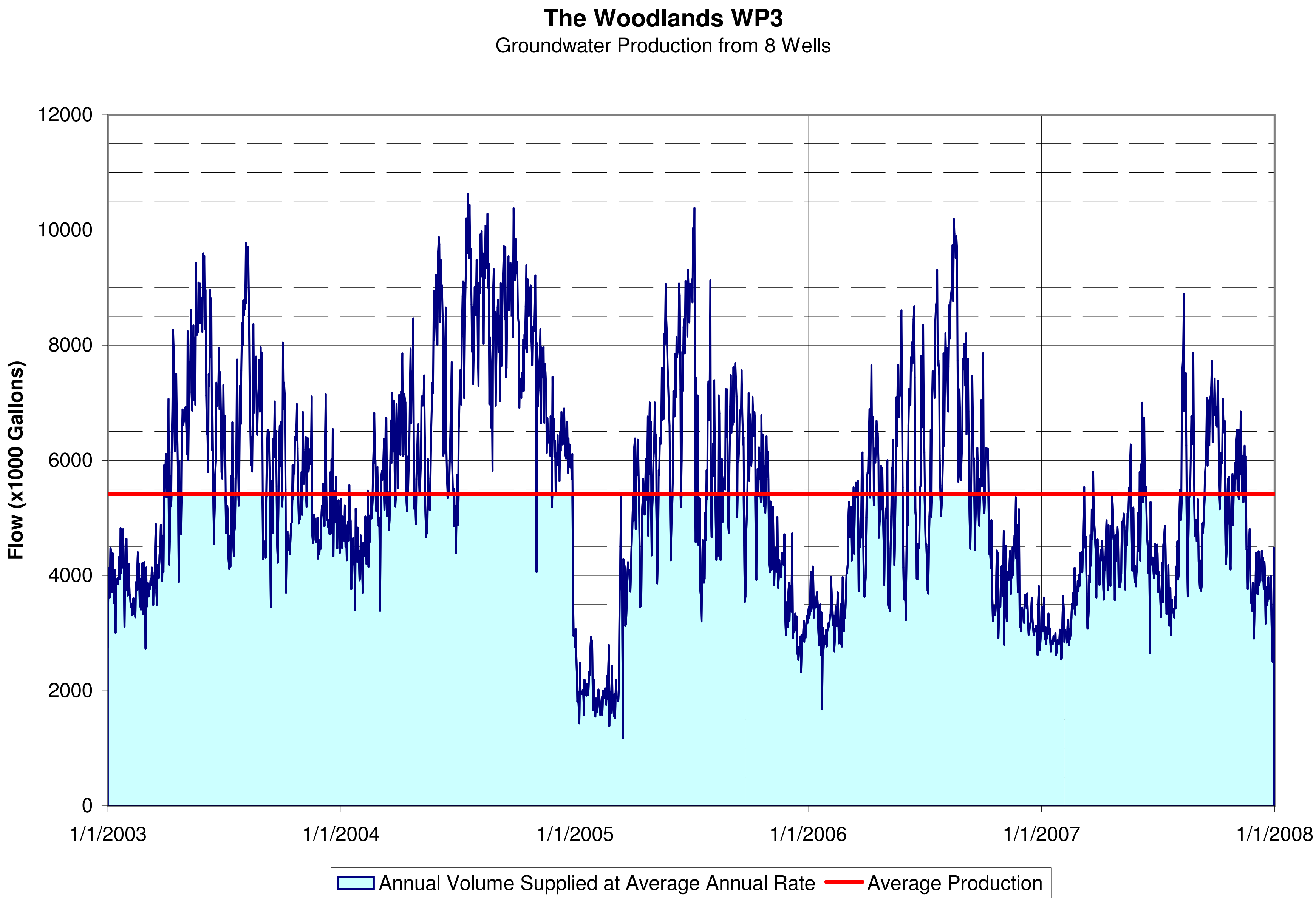

The Woodlands WP1
Groundwater Production from 6 Wells
Flow (x1000 Gallons)
7000
6000
5000
4000
3000
2000
1000
0
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
1/1/2008
Annual Volume Supplied at Average Annual Rate
Average Production


Compliance Assurance Factor
The Woodlands WP1 (2003-2007 Well Production)
Factor (1.0=Avg Day)
2.5
2.0
1.5
1.0
0.5
0.0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
% of Annual Volume at Factor

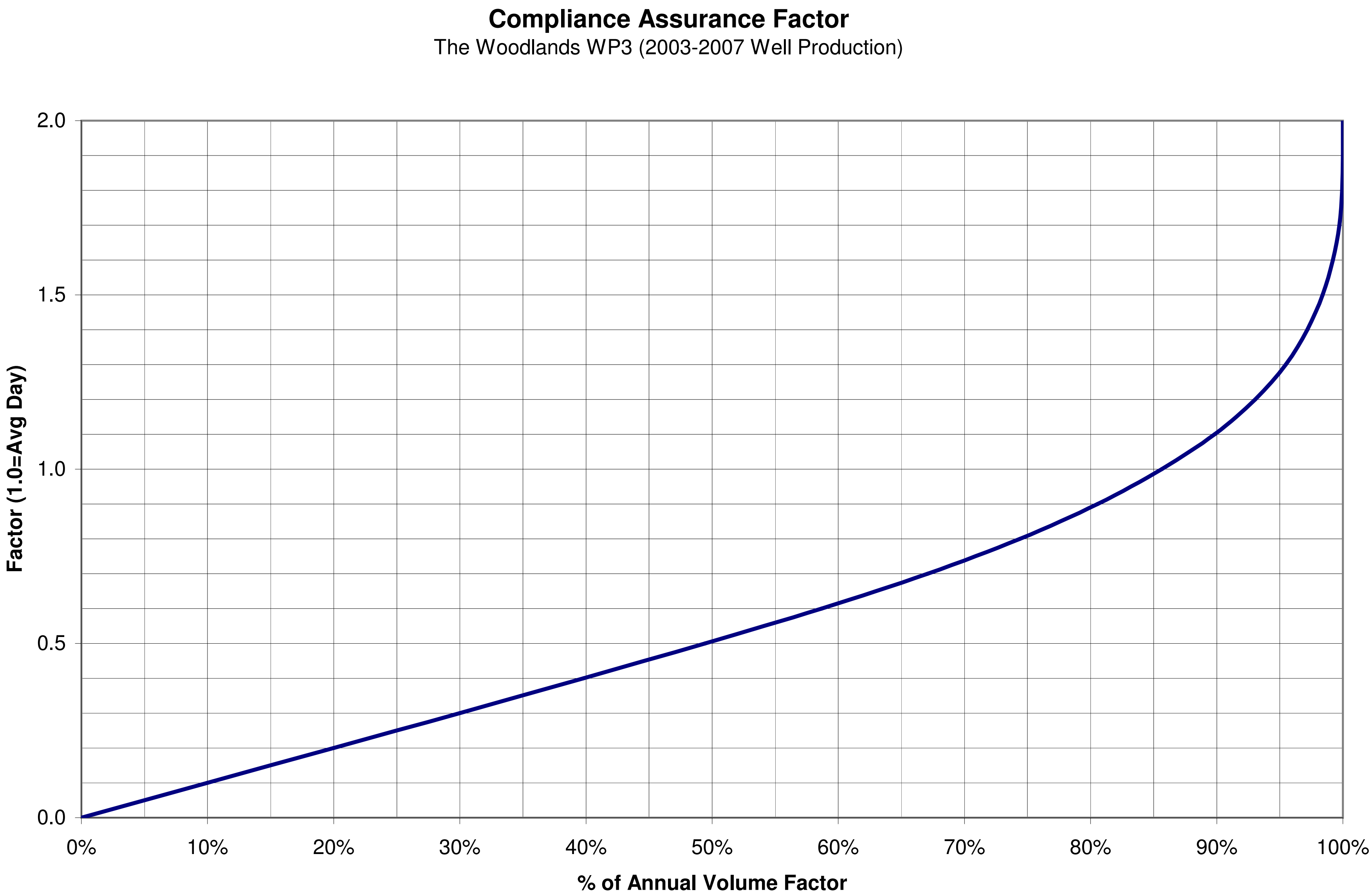


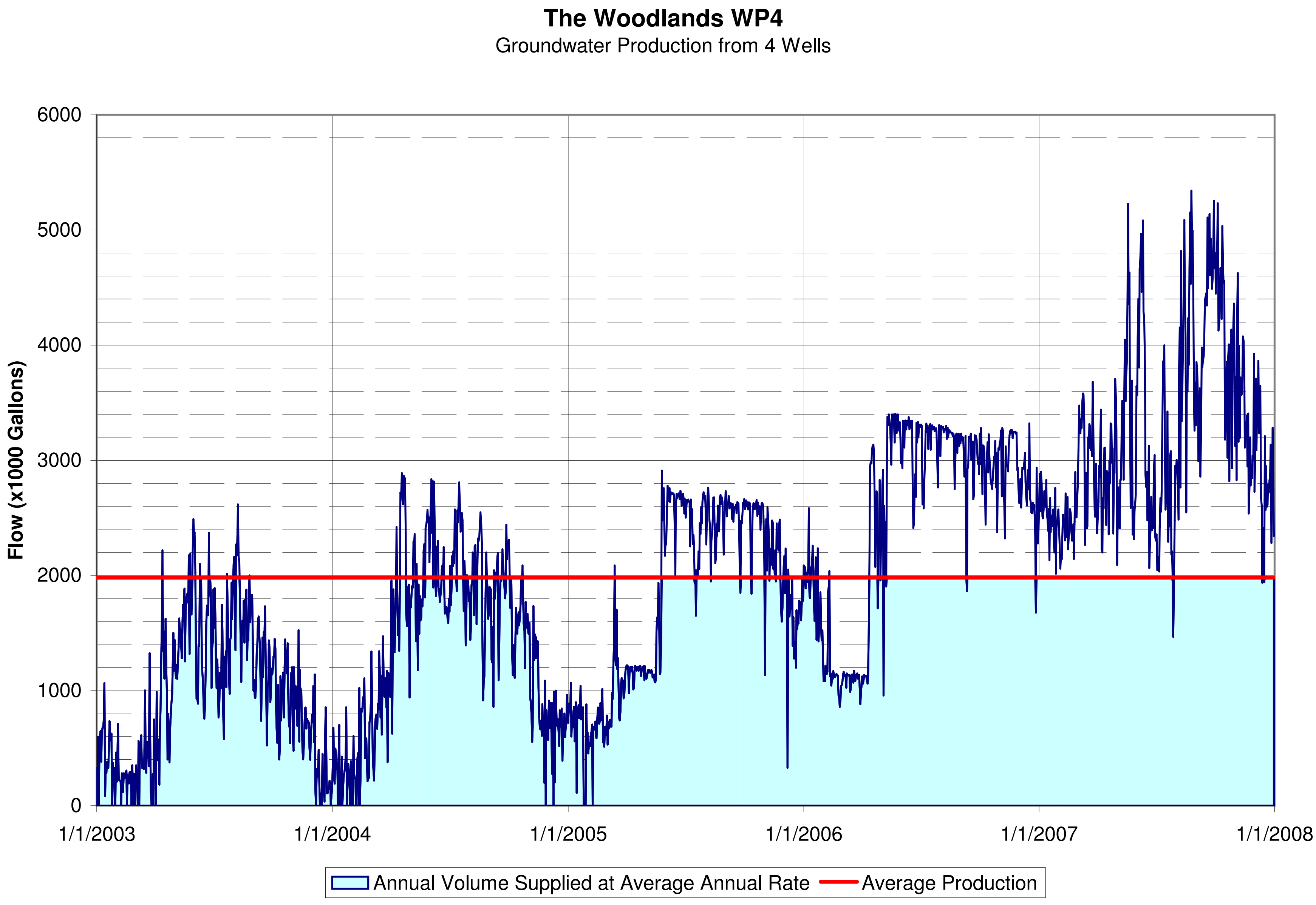
The Woodlands WP2
Groundwater Production from 10 Wells
Flow (x1000 Gallons)
14000
12000
10000
8000
6000
4000
2000
0
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
1/1/2008
Annual Volume Supplied at Average Annual Rate
Average Production


Compliance Assurance Factor
The Woodlands WP2 (2003-2007 Well Production)
Factor (1.0=Avg Day)
2.5
2.0
1.5
1.0
0.5
0.0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
% of Annual Volume at Factor

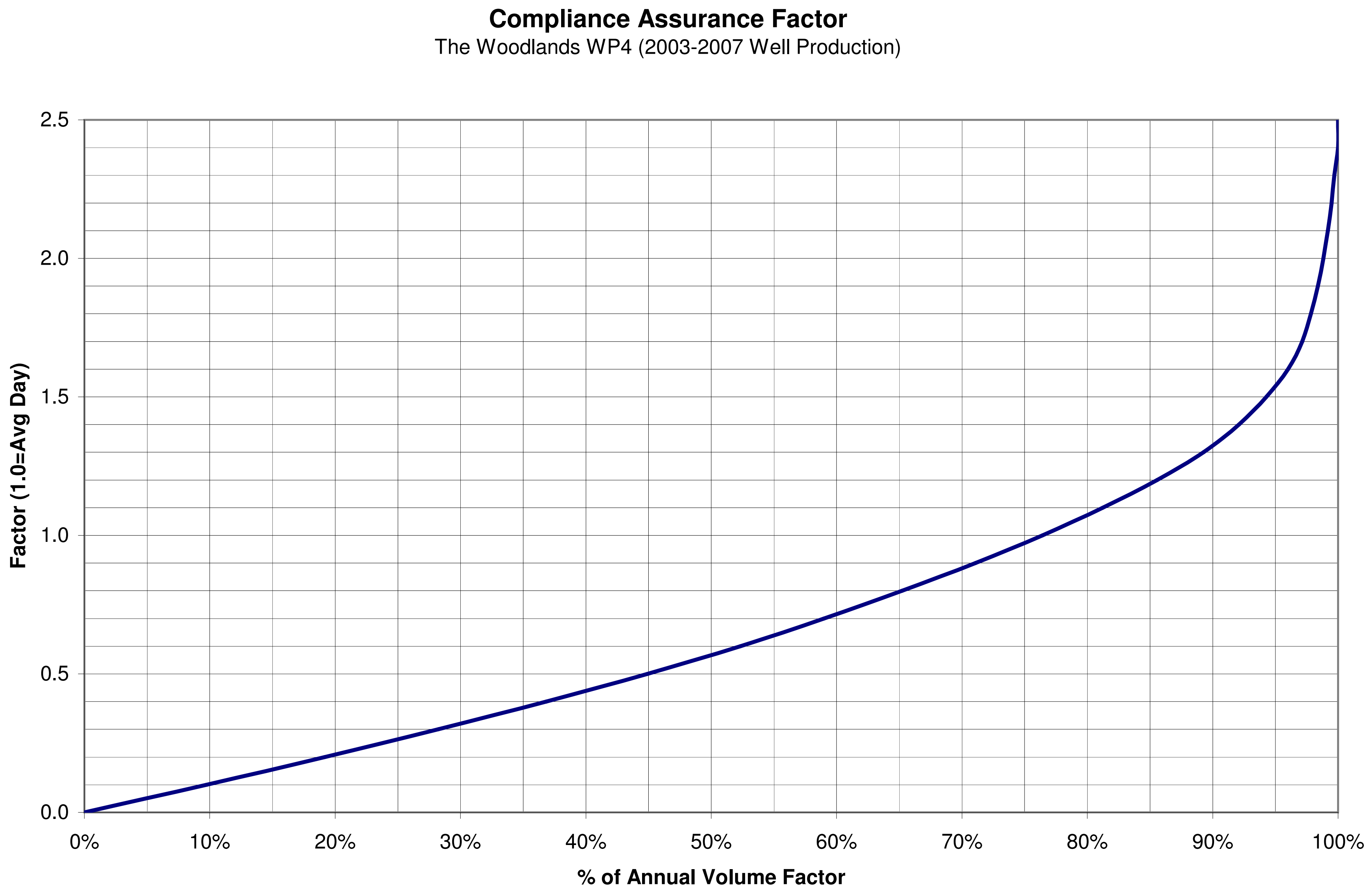


The Woodlands WP3
Groundwater Production from 8 Wells
Flow (x1000 Gallons)
12000
10000
8000
6000
4000
2000
0
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
1/1/2008
Annual Volume Supplied at Average Annual Rate
Average Production


Compliance Assurance Factor
The Woodlands WP3 (2003-2007 Well Production)
Factor (1.0=Avg Day)
2.0
1.5
1.0
0.5
0.0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
% of Annual Volume Factor

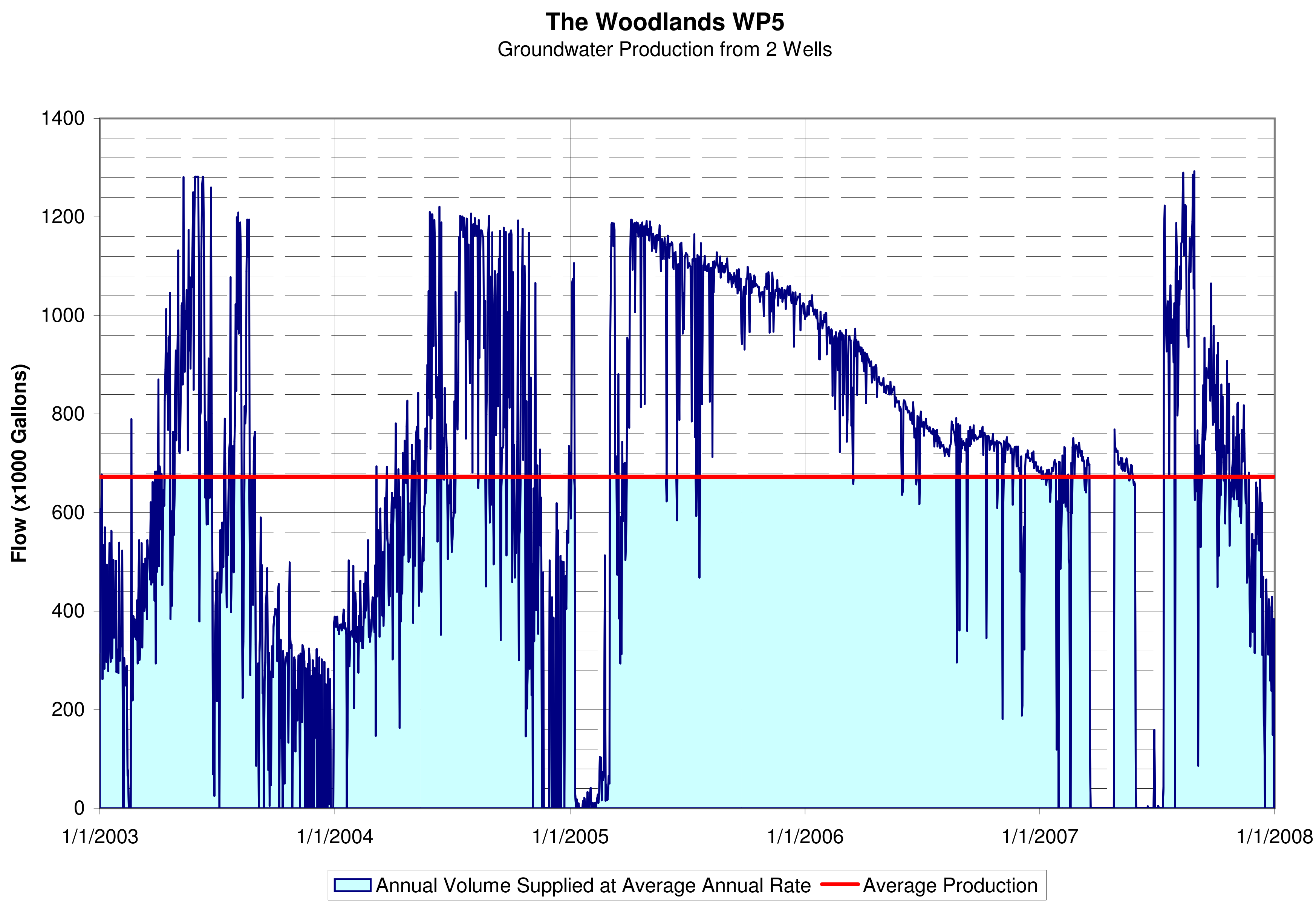


The Woodlands WP4
Groundwater Production from 4 Wells
Flow (x1000 Gallons)
6000
5000
4000
3000
2000
1000
0
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
1/1/2008
Annual Volume Supplied at Average Annual Rate
Average Production

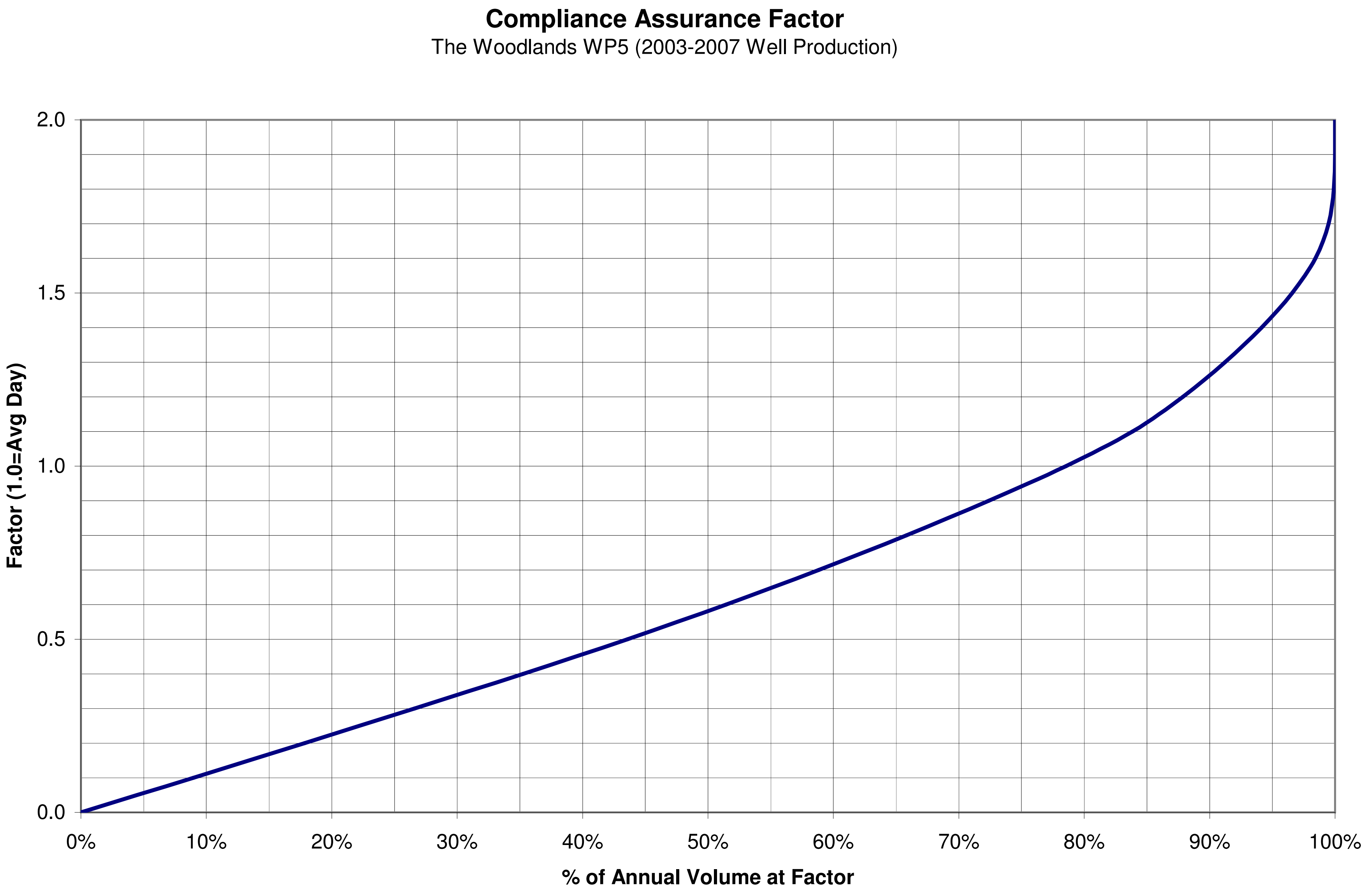


*Well 37 and 38 added from 2007 data

2/4/2009



The Woodlands WP5
Groundwater Production from 2 Wells
Flow (x1000 Gallons)
0
200
400
600
800
1000
1200
1400
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
1/1/2008
Annual Volume Supplied at Average Annual Rate
Average Production


Compliance Assurance Factor
The Woodlands WP5 (2003-2007 Well Production)
Factor (1.0=Avg Day)
2.0
1.5
1.0
0.5
0.0
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
% of Annual Volume at Factor

SAN JACINTO RIVER AUTHORITY
JOINT WRAP QUESTIONNAIRE

April 23, 2008

TO: Large Volume Water Users (LVWU) (more than 10 million gallons per year)

FROM: San Jacinto River Authority

RE: Planning Questionnaire

The SJRA needs the data requested in this Questionnaire in order to effectively plan for regional surface water needs and prepare a Joint Water Resources Assessment Plan ("WRAP") to comply with the Lone Star Groundwater Conservation District Phase IIA regulations. The Questionnaire generally requests from each municipality, district, and private well owner the following information:

1) Contact information for persons knowledgeable about your entity.
2) Existing connections and water use
3) Water conservation and drought contingency
4) Water rates
5) Water quality
6) System interconnections
7) Existing water well information.
8) Existing storage tank information
9) Existing booster pump information
10) Projected demands
11) Existing wastewater facilities
12) Water distribution delivery points

In addition to the following questionnaire, **please provide information regarding the boundaries of your utility**. If information is available regarding planned annexations and/or future service area, please clearly distinguish the various areas and anticipated dates of service. In order of preference, please provide one of the following formats:

- an ESRI compatible coverage or shapefile, or
- an AutoCAD drawing file, and
- metes and bounds description.

Please complete and return the Questionnaire by May 23, 2008.

Thank you for your time, attention, and assistance in this matter.

SAN JACINTO RIVER AUTHORITY
JOINT WRAP QUESTIONNAIRE

QUESTIONNAIRE INSTRUCTIONS

Format of Questionnaire

The questionnaire is divided into two parts. Sections 1 thru 5 contain questions related to your utility's points of contact, historic water use, conservation, water rates, and water quality. Sections 6 through 9 contain questions regarding interconnections, well(s), storage tanks, and booster pumps. Please complete Sections 6 thru 9 for each individual interconnect, well, storage tank, and pump station owned by the utility. Sections 10 through 12 contain questions regarding future water use, wastewater treatment plant information, and potential point(s)-of-delivery, respectively. Please copy pages of this form as needed.

Abbreviations used in the questionnaire include:

Mgal/yr	Millions of gallons per year	ft	Feet
Mgal/day	Millions of gallons per day	in	Inches
gal/mo	Gallons per month	Lat	Latitude (in degrees, minutes, seconds)
gal/day	Gallons per day	Long	Longitude (in degrees, minutes, seconds)
gal	Gallons	TCL	Top of Capacity Level (i.e., Overflow) of EST
gpm	Gallons per minute	BCL	Bottom of Capacity Level of EST

Contact Information for Questionnaire Clarification

If you have questions regarding the data requested, how to return the questionnaire/documents, or if you need clarification on any questions or instructions, please call Mr. Charles Shumate of Brown & Gay Engineers, Inc., at (281) 558-8700 or email him at cshumate@browngay.com.

How to Fill Out Questionnaire

1. **Please type (preferred) or print. If printed, please ensure that all information is legible.**

2. Please respond to this questionnaire as completely as possible with the most recent data available. **Please do not leave any blanks in the forms.** Avoiding blanks reduces uncertainty about whether an item was overlooked, does not apply, etc. Please use the following if no data is provided:

   NA Not Applicable - Data requested does not apply to your current situation.
   X Not Available - Data is not collected by the entity.

3. It is recommended that the most qualified / knowledgeable person complete these forms, drawing on personal knowledge and information from others (engineer, etc.) to complete all questions.

4. Note that the use information requested in Section 2 should include effluent reuse, if any.

5. Please complete all data for each individual interconnect, well, storage tank, and booster pump. Please copy pages of this form as needed.

6. **Please return** the completed questionnaire by e-mail (preferred), regular mail, or fax to Charles Shumate at cshumate@browngay.com, Brown & Gay Engineers, Inc., 10777 Westheimer, Houston, Texas 77042, or fax to 713-488-8250, **by May 23, 2008**.

SAN JACINTO RIVER AUTHORITY
JOINT WRAP QUESTIONNAIRE

Entity Name:	**Date Completed:**
Fiscal Year begins (month/day) :____________	**Fiscal Year ends (month/day) :_____________**

SECTION 1 - Contact Information				
Name of Person Completing This Form:				**Phone:**
Title:				**Email:**
Operator:	**Name:**			**Title:**
	Address:			**Fax:**
	City:	**St:**	**Zip:**	**Phone** (Business)**:**
	Email:			**Phone** (Mobile)**:**
Engineer:	**Name:**			**Title:**
	Address:			**Fax:**
	City:	**St:**	**Zip:**	**Phone** (Business)**:**
	Email:			**Phone** (Mobile)**:**
Attorney:	**Name:**			**Title:**
	Address:			**Fax:**
	City:	**St:**	**Zip:**	**Phone** (Business)**:**
	Email:			**Phone** (Mobile)**:**
Bookkeeper/	**Name:**			**Title:**
Utility Billings:	**Address:**			**Fax:**
	City:	**St:**	**Zip:**	**Phone** (Business)**:**
	Email:			**Phone** (Mobile)**:**
Other:	**Name:**			**Title:**
	Address:			**Fax:**
	City:	**St:**	**Zip:**	**Phone** (Business)**:**
	Email:			**Phone** (Mobile)**:**
Other:	**Name:**			**Title:**
	Address:			**Fax:**
	City:	**St:**	**Zip:**	**Phone** (Business)**:**
	Email:			**Phone** (Mobile)**:**
Other:	**Name:**			**Title:**
	Address:			**Fax:**
	City:	**St:**	**Zip:**	**Phone** (Business)**:**
	Email:			**Phone** (Mobile)**:**

SECTION 2 – Historical Connections and Water Use Summary															
Attach Complete Daily Water Usage Data															
IN LVWU DATA	**2003**			**2004**			**2005**			**2006**			**2007**		
Annual Water Use:	Conn's *	Acres	Mgal/yr	Conn's*	Acres	Mgal/yr	Conn's*	Acres	Mgal/yr	Conn's*	Acres	Mgal/yr	Conn's*	Acres	Mgal/yr
Single Family Residential															
Single Family Irrigation															
Multi-family Residential															
Multi-family Irrigation															
Other Irrigation Including Amenity Lakes POTABLE															
Other Irrigation Including Amenity Lakes RECLAIMED / REUSE															
Commercial															
Industrial															
Total															
Peak Month Water Use:	Month -			Month -			Month -			Month -			Month -		
	Conn's*	Acres	gal/mo	Conn's*	Acres	gal/mo	Conn's*	Acres	gal/mo	Conn's*	Acres	gal/mo	Conn's*	Acres	gal/mo
Single Family Residential															
Single Family Irrigation															
Multi-family Residential															
Multi-family Irrigation															
Other Irrigation including Amenity Lakes POTABLE															

IN LVWU DATA	2003			2004			2005			2006			2007		
Peak Month Water Use:	Conn's*	Acres	gal/mo	Conn's*	Acres	gal/mo	Conn's*	Acres	gal/mo	Conn's*	Acres	gal/mo	Conn's*	Acres	gal/mo
Other Irrigation including Amenity Lakes RECLAIMED / REUSE															
Commercial															
Industrial															
Total															
Peak Day Water Use:	Month/Day -			Month/Day -			Month/Day -			Month/Day -			Month/Day -		
	Conn's	Acres	gal/day	Conn's	Acres	gal/day	Conn's	Acres	gal/day	Conn's	Acres	gal/day	Conn's	Acres	gal/day
Total															
Peak Hour Water Use:	Month/Day -			Month/Day -			Month/Day -			Month/Day -			Month/Day -		
	Conn's	Acres	gal/hr	Conn's	Acres	gal/hr	Conn's	Acres	gal/hr	Conn's	Acres	gal/hr	Conn's	Acres	gal/hr
Total															

* Number of connections.

OUT OF LVWU DATA

If your LVWU serves users outside the LVWU, what other users are served? ______________________

Complete one sheet for each User served.

OUT OF LVWU DATA	2003			2004			2005			2006			2007		
Annual Water Use:	Conn's *	Acres	Mgal/yr	Conn's*	Acres	Mgal/yr	Conn's*	Acres	Mgal/yr	Conn's*	Acres	Mgal/yr	Conn's*	Acres	Mgal/yr
Single Family Residential															
Single Family Irrigation															
Multi-family Residential															
Multi-family Irrigation															
Other Irrigation Including Amenity Lakes POTABLE															

OUT OF LVWU DATA	2003			2004			2005			2006			2007		
Annual Water Use:	Conn's *	Acres	Mgal/yr	Conn's*	Acres	Mgal/yr	Conn's*	Acres	Mgal/yr	Conn's*	Acres	Mgal/yr	Conn's*	Acres	Mgal/yr
Other Irrigation Including Amenity Lakes RECLAIMED / REUSE															
Commercial															
Industrial															
Total															
Peak Month Water Use:	Month -			Month -			Month -			Month -			Month -		
	Conn's	Acres	gal/mo	Conn's	Acres	gal/mo	Conn's	Acres	gal/mo	Conn's	Acres	gal/mo	Conn's	Acres	gal/mo
Single Family Residential															
Single Family Irrigation															
Multi-family Residential															
Multi-family Irrigation															
Other Irrigation including Amenity Lakes POTABLE															
Other Irrigation including Amenity Lakes RECLAIMED / REUSE															
Commercial															
Industrial															
Total															

OUT OF LVWU DATA	2003			2004			2005			2006			2007		
Peak Day Water Use:	Month/Day -			Month/Day -			Month/Day -			Month/Day -			Month/Day -		
	Conn's	Acres	gal/day	Conn's	Acres	gal/day	Conn's	Acres	gal/day	Conn's	Acres	gal/day	Conn's	Acres	gal/day
Total															
Peak Hour Water Use:	Month/Day -			Month/Day -			Month/Day -			Month/Day -			Month/Day -		
	Conn's	Acres	gal/hr	Conn's	Acres	gal/hr	Conn's	Acres	gal/hr	Conn's	Acres	gal/hr	Conn's	Acres	gal/hr
Total															
* Number of connections.															

SECTION 3 - Water Conservation and Drought Contingency	
Has the LVWU developed a Water Conservation Plan and received approval from TCEQ?	☐ Yes ☐ No
If yes, please attach a copy.	
Has the LVWU developed a Drought Contingency Plan and received approval from TCEQ?	☐ Yes ☐ No
If yes, please attach a copy.	
Has LVWU submitted Survey Data to TWDB for all years 1999 thru 2007?	☐ Yes ☐ No
Average Per Capita Usage for three year period 1999 thru 2001 included on Survey Data submitted to TWDB _____________ gpcd	
Average Per Capita Usage for three year period 2003 thru 2005 included on Survey Data submitted to TWDB ______________gpcd	
Have Out of LVWU Users developed a Water Conservation Plan and received approval from TCEQ?	☐ Yes ☐ No
If yes, please attach a copy of each.	
Have Out of LVWU Users developed a Drought Contingency Plan and received approval from TCEQ?	☐ Yes ☐ No
If yes, please attach a copy of each.	
Have Out of LVWU Users submitted Survey Data to TWDB for all years 1999 thru 2007?	☐ Yes ☐ No
Average Per Capita Usage for three year period 1999 thru 2001 included on Survey Data submitted to TWDB for each Out of LVWU User _____________ gpcd	
Average Per Capita Usage for three year period 2003 thru 2005 included on Survey Data submitted to TWDB for each Out of LVWU User ______________gpcd	
SECTION 4 - Water Rates	
Attach Copy of Water Rate Structure for all Customer Classes	
SECTION 5 - Water Quality	
Attach Copy of Water Quality Sampling and Testing Results for 2005, 2006 and 2007	

SECTION 6 - System Interconnections

Complete information for each system interconnection

System Interconnect	Entity Connected:		
Type of Interconnect:	☐ Emergency ☐ Normally Open	Size of Interconnect	in.
One-way Flow, or Two-way Flow	☐ 1-way ☐ 2-way	If 1-way flow, from which entity to which entity?	Metered ☐ Yes ☐ No
Location of Interconnect:	Key Map grid:		
Nearest Street Address:			
Nearest Cross Street:			
Coordinates:	Lat.:	Long.:	
System Interconnect	Entity Connected:		
Type of Interconnect:	☐ Emergency ☐ Normally Open	Size of Interconnect	in.
One-way Flow, or Two-way Flow	☐ 1-way ☐ 2-way	If 1-way flow, from which entity to which entity?	Metered ☐ Yes ☐ No
Location of Interconnect:	Key Map grid:		
Nearest Street Address:			
Nearest Cross Street:			
Coordinates:	Lat.:	Long.:	
System Interconnect	Entity Connected:		
Type of Interconnect:	☐ Emergency ☐ Normally Open	Size of Interconnect	in.
One-way Flow, or Two-way Flow	☐ 1-way ☐ 2-way	If 1-way flow, from which entity to which entity?	Metered ☐ Yes ☐ No
Location of Interconnect:	Key Map grid:		
Nearest Street Address:			
Nearest Cross Street:			
Coordinates:	Lat.:	Long.:	
System Interconnect	Entity Connected:		
Type of Interconnect:	☐ Emergency ☐ Normally Open	Size of Interconnect	in.
One-way Flow, or Two-way Flow	☐ 1-way ☐ 2-way	If 1-way flow, from which entity to which entity?	Metered ☐ Yes ☐ No
Location of Interconnect:	Key Map grid:		
Nearest Street Address:			
Nearest Cross Street:			
Coordinates:	Lat.:	Long.:	

SECTION 7 - Existing Water Well Data

Complete a separate sheet for each groundwater well.

Well Address and Lone Star Groundwater Conservation District Permit Number:

Coordinates: Lat.: Long.:

Approximate date of well construction:

Does this well serve more than the LVWU? ☐ Yes ☐ No

If Yes, please list Out of LVWU Users served by this well:

Well diameter: in.

Well Discharge Pipe Size In.

Well Discharge Pipe Elevation ft., MSL

Current setting of well pump: ft. below ground surface

Current submergence of well pump: ft.

Well capacity: Design Flow: GPM. Test Flow: GPM

Well capacity: Design Head: ft. Test Head: Ft.

Motor Size: Hp

Attach Pump System Head Curve

Annual pumpage:	2003	2004	2005	2006	2007
	Mgal/yr	Mgal/yr	Mgal/yr	Mgal/yr	Mgal/yr

Has the well been expanded, improved or renovated? ☐ Yes ☐ No
If so, what expansion, improvement or renovation and when were they completed?

Do you have any well expansion, improvement or renovation planned? ☐ Yes ☐ No
If so, what expansions, improvements or renovations and when?

Do you think your well will need to be rehabilitated in: ☐ 2-5 years ☐ 5-10 years ☐ 10+ years

Do you think your well will need to be replaced in: ☐ 2-5 years ☐ 5-10 years ☐ 10+ years

Do you think your well will need to be abandoned in: ☐ 2-5 years ☐ 5-10 years ☐ 10+ years

Does this well produce sand? ☐ Yes ☐ No

Does this well produce gas? ☐ Yes ☐ No

Does this well have a known radon or radium problem? ☐ Yes ☐ No

Does this well have water supply or water quality problems? ☐ Yes ☐ No

Other information regarding performance, condition and remaining service life of well and equipment.

SECTION 8 - Existing Storage Tank Data			
Complete a separate sheet for each storage tank.			
Storage Tank Name or ID		Key Map grid:	
Street Address:	Nearest Cross Street		
Coordinates: Lat.:		Long.:	
Type of Storage Tank? ☐ Ground ☐ Elevated			
Materials of Construction:			
Ground Storage Tanks			
Tank Capacity	Gal	Tank Diameter	feet
		Tank Height above Natural Ground	feet
		Natural Ground Elevation	Feet, MSL
		Discharge Pipe Height above Natural Ground	feet
Elevated Storage Tanks			
Type and Shape			
Tank Capacity	Gallons	Tank Max Dia.	feet
		TCL Elevation or Height above ground	ft. ☐ El. ☐ Ht.
		BCL Elevation or Height above ground	ft. ☐ El. ☐ Ht.
		Natural Ground Elevation	Feet, MSL

SECTION 9 - Existing Booster Pump Data					
Complete a separate sheet for each booster pump station.					
Pump station address:					
Approximate date of pump station construction:					
Does this well serve more than the LVWU? ☐ Yes ☐ No					
If Yes, please list Out of LVWU Users served by this well:					
Number and Type of pumps					
Discharge Pipe Size In.					
Discharge Pipe Elevation ft., MSL					
Pump capacity: Design Flow: GPM. Test Flow: GPM					
Pump capacity: Design Head: ft. Test Head: Ft.					
Motor Size: Hp					
Attach System Head Curve of Each Pump					
Annual pumpage:	2003	2004	2005	2006	2007
	Mgal/yr	Mgal/yr	Mgal/yr	Mgal/yr	Mgal/yr
Have the pumps been expanded, improved or renovated? ☐ Yes ☐ No If so, what expansion, improvement or renovation and when were they completed?					
Do you have any pump station expansion, improvement or renovation planned? ☐ Yes ☐ No If so, what expansions, improvements or renovations and when?					
Do you think your pumps will need to be rehabilitated in: ☐ 2-5 years ☐ 5-10 years ☐ 10+ years					
Do you think your pumps will need to be replaced in: ☐ 2-5 years ☐ 5-10 years ☐ 10+ years					
Do you think your pumps will need to be abandoned in: ☐ 2-5 years ☐ 5-10 years ☐ 10+ years					
Other information regarding performance, condition and remaining service life of well and equipment.					

SECTION 10 – Projected Connections and Water Demands															
Please attach information describing the methodology used to forecast the water demands provided below.															
IN LVWU DATA	**2015**			**2017**			**2025**			**2035**			**2045**		
Annual Water Use:	Conn's *	Acres	Mgal/yr	Conn's*	Acres	Mgal/yr	Conn's*	Acres	Mgal/yr	Conn's*	Acres	Mgal/yr	Conn's*	Acres	Mgal/yr
Single Family Residential															
Single Family Irrigation															
Multi-family Residential															
Multi-family Irrigation															
Other Irrigation Including Amenity Lakes POTABLE															
Other Irrigation Including Amenity Lakes RECLAIMED / REUSE															
Commercial															
Industrial															
Total															
Peak Month Water Use:	Month -			Month -			Month -			Month -			Month -		
	Conn's	Acres	gal/mo	Conn's	Acres	gal/mo	Conn's	Acres	gal/mo	Conn's	Acres	gal/mo	Conn's	Acres	gal/mo
Single Family Residential															
Single Family Irrigation															
Multi-family Residential															
Multi-family Irrigation															
Other Irrigation including Amenity Lakes POTABLE															

IN LVWU DATA	2015			2017			2025			2035			2045		
Peak Month Water Use:	Conn's*	Acres	gal/mo	Conn's*	Acres	gal/mo	Conn's*	Acres	gal/mo	Conn's*	Acres	gal/mo	Conn's*	Acres	gal/mo
Other Irrigation including Amenity Lakes RECLAIMED / REUSE															
Commercial															
Industrial															
Total															
Peak Day Water Use:	Month/Day -			Month/Day -			Month/Day -			Month/Day -			Month/Day -		
	Conn's	Acres	gal/day	Conn's	Acres	gal/day	Conn's	Acres	gal/day	Conn's	Acres	gal/day	Conn's	Acres	gal/day
Total															
Peak Hour Water Use:	Month/Day -			Month/Day -			Month/Day -			Month/Day -			Month/Day -		
	Conn's	Acres	gal/hr	Conn's	Acres	gal/hr	Conn's	Acres	gal/hr	Conn's	Acres	gal/hr	Conn's	Acres	gal/hr
Total															

* Number of connections.

OUT OF LVWU DATA

If your LVWU serves users outside the LVWU, what other users are served? ______________________

Complete one sheet for each User served.

OUT OF LVWU DATA	2015			2017			2025			2035			2045		
Annual Water Use:	Conn's *	Acres	Mgal/yr	Conn's*	Acres	Mgal/yr	Conn's*	Acres	Mgal/yr	Conn's*	Acres	Mgal/yr	Conn's*	Acres	Mgal/yr
Single Family Residential															
Single Family Irrigation															
Multi-family Residential															
Multi-family Irrigation															
Other Irrigation Including Amenity Lakes POTABLE															

OUT OF LVWU DATA	2015			2017			2025			2035			2045		
Annual Water Use:	Conn's *	Acres	Mgal/yr	Conn's*	Acres	Mgal/yr	Conn's*	Acres	Mgal/yr	Conn's*	Acres	Mgal/yr	Conn's*	Acres	Mgal/yr
Other Irrigation Including Amenity Lakes RECLAIMED / REUSE															
Commercial															
Industrial															
Total															
Peak Month Water Use:	Month -			Month -			Month -			Month -			Month -		
	Conn's*	Acres	gal/mo	Conn's*	Acres	gal/mo	Conn's*	Acres	gal/mo	Conn's*	Acres	gal/mo	Conn's*	Acres	gal/mo
Single Family Residential															
Single Family Irrigation															
Multi-family Residential															
Multi-family Irrigation															
Other Irrigation including Amenity Lakes POTABLE															
Other Irrigation including Amenity Lakes RECLAIMED / REUSE															
Commercial															
Industrial															
Total															

OUT OF LVWU DATA	2015			2017			2025			2035			2045		
Peak Day Water Use:	Month/Day -			Month/Day -			Month/Day -			Month/Day -			Month/Day -		
	Conn's	Acres	gal/day	Conn's	Acres	gal/day	Conn's	Acres	gal/day	Conn's	Acres	gal/day	Conn's	Acres	gal/day
Total															
Peak Hour Water Use:	Month/Day -			Month/Day -			Month/Day -			Month/Day -			Month/Day -		
	Conn's	Acres	gal/hr	Conn's	Acres	gal/hr	Conn's	Acres	gal/hr	Conn's	Acres	gal/hr	Conn's	Acres	gal/hr
Total															
* Number of connections.															

SECTION 11 - Wastewater Treatment Data

Complete a separate sheet for each Wastewater Treatment Plant Name or ID. If your utility's WW is treated by another utility, indicate which utility.	Key Map grid:
TPDES Permit No.	Permit Expiration Date
Street Address:	Nearest Cross Street

Discharge Pipe Coordinates: Lat.: Long.:

List all LVWUs served by this wastewater facility: ______________________ ______________________

______________________ ______________________ ______________________

Please provide a service area map for the LVWUs listed above.

Capacity		2008	2010	2015	2017	2020	2025	2035	2045
Annual Average Daily Flow	MGD								
Monthly Max Flow	MGD								
Peak 2 Hour Flow	GPM								
Minimum Daily Flow	GPM								

Daily Average Permit Parameters

BOD	TSS
NH3	Other

Provide Copy of 2007 TCEQ Monthly Reports

Are you reusing treated wastewater effluent for nonpotable uses? ☐ Yes ☐ No

If Yes, please describe the applications for which you are using treated effluent.

If No, are you interested in wastewater effluent reuse for nonpotable uses?

☐ Yes ☐ No If Yes, what use and estimated quantity?

SECTION 12 – Water Distribution System Delivery Points

Provide data regarding potential points of delivery of surface water to existing distribution system.

Category	Customer	Demand Basis	Available Information: Questionnaire 2007 Connect's	Available Information: Questionnaire 2045 Demand (mgd)	Available Information: TWDB WUG 2045 Demand (mgd)	Available Information: LSGCD 2005 - 2007 Average Pumpage (gallons)	Summary of Available Information: Questionnaire 2007 Connect's	Summary of Available Information: Questionnaire 2045 Demand	Summary of Available Information: TWDB WUG	Summary of Available Information: LSGCD 2007 Pumpage	Key to Future Demand Calculation	Projected Water Demand (mgd) 2015	Projected Water Demand (mgd) 2025	Projected Water Demand (mgd) 2035	Projected Water Demand (mgd) 2045
12	1404 Blaketree, LP	LU	2			300,000	Y	N	N	Y	6	0.00	0.00	0.00	0.00
11	April Sound Country Club	LU	1	0.12		47,641,233	Y	Y	N	Y	1	0.13	0.13	0.13	0.13
1	Aqua Texas Inc (Lake Conroe Forest and Tejas Creek)	Muni	364	0.10		34,480,907	Y	Y	N	Y	1	0.10	0.10	0.10	0.10
1	Aqua Texas Inc (Shadow Bay)	Muni	319	0.08		18,020,000	Y	Y	N	Y	1	0.06	0.07	0.07	0.08
1	Aqua Texas Inc. (Carriage Hills)	Muni	582	0.21		77,342,667	Y	Y	N	Y	1	0.21	0.21	0.21	0.21
1	Aqua Texas Inc. (Lake Conroe Village)	Muni	276	0.23		12,292,000	Y	Y	N	Y	1	0.07	0.12	0.18	0.23
1	Aqua Texas, Inc. (Brushy Creek)	Muni	134	0.06		13,076,000	Y	Y	N	Y	1	0.04	0.05	0.05	0.06
1	Aqua Texas, Inc. (Cimarron Country)	Muni	256	0.14		31,202,333	Y	Y	N	Y	1	0.10	0.11	0.13	0.14
1	Aqua Texas, Inc. (Clear Creek Forest)	Muni	494	0.14		38,906,000	Y	Y	N	Y	1	0.11	0.12	0.13	0.14
1	Aqua Texas, Inc. (Crighton Ridge)	Muni	423	0.19		94,007,333	Y	Y	N	Y	1	0.26	0.26	0.26	0.26
1	Aqua Texas, Inc. (Crystal Forest)	Muni	197	0.09		14,254,467	Y	Y	N	Y	1	0.05	0.06	0.07	0.09
1	Aqua Texas, Inc. (Decker Woods)	Muni	248	0.08		24,980,667	Y	Y	N	Y	1	0.07	0.07	0.07	0.08
1	Aqua Texas, Inc. (Deerwood Sub.)	Muni	407	0.22		35,859,667	Y	Y	N	Y	1	0.12	0.16	0.19	0.22
1	Aqua Texas, Inc. (Dogwood Hills)	Muni	337	0.11		26,787,333	Y	Y	N	Y	1	0.08	0.09	0.10	0.11
1	Aqua Texas, Inc. (Huntington Estates)	Muni	149	0.04		12,323,667	Y	Y	N	Y	1	0.04	0.04	0.04	0.04
7	Aqua Texas, Inc. (Indigo Ranch)	Muni		0.05		11,866,667	N	Y	N	Y	1	0.04	0.04	0.05	0.05
1	Aqua Texas, Inc. (Lake Creek Forest)	Muni	238	0.10		25,479,000	Y	Y	N	Y	1	0.08	0.08	0.09	0.10
1	Aqua Texas, Inc. (Legends Ranch Estates)	Muni	193	0.11		30,619,667	Y	Y	N	Y	1	0.09	0.09	0.10	0.11
1	Aqua Texas, Inc. (Timberloch Estates)	Muni	224	0.07		16,679,333	Y	Y	N	Y	1	0.05	0.05	0.06	0.07
1	Aqua Texas, Inc. (Turtle Creek)	Muni	184	0.05		15,391,000	Y	Y	N	Y	1	0.04	0.05	0.05	0.05
1	Aqua Texas, Inc. (Walnut Springs)	Muni	201	0.09		18,472,333	Y	Y	N	Y	1	0.06	0.07	0.08	0.09
1	Aqua Texas, Inc. (Westwood 1&2/Old Egypt)	Muni	597	0.17		70,193,667	Y	Y	N	Y	1	0.19	0.19	0.19	0.19
10	Archdiocese of Galveston - Houston (Retreat Center)	LU				11,401,523	N	N	N	Y	6	0.03	0.03	0.03	0.03
11	Austin/Texas Golf Ventures, LP (Oakhurst)	LU	3	0.17		26,400,000	Y	Y	N	Y	1	0.09	0.12	0.14	0.17
10	Benders Landing POA (Lexington)	LU				14,606,940	N	N	N	Y	6	0.04	0.04	0.04	0.04
10	Bentwater Yacht & Country Club #3 GMC	LU				58,916,333	N	N	N	Y	6	0.16	0.16	0.16	0.16
4	C & R Water Supply (Bridgepoint Water System)	Muni	75			9,701,600	Y	N	N	Y	3	0.03	0.03	0.03	0.03
3	C & R Water Supply Inc (Clear Water Cove)	Muni				8,880,600	N	N	N	Y	3	0.03	0.04	0.04	0.05
4	C & R Water Supply Inc (Emerson Estates)	Muni	260			62,300,300	Y	N	N	Y	3	0.17	0.17	0.17	0.17
3	C & R Water Supply Inc (Longmire)	Muni				21,418,000	N	N	N	Y	3	0.06	0.06	0.06	0.06
3	C & R Water Supply Inc (Mount Pleasant)	Muni				5,448,000	N	N	N	Y	3	0.02	0.02	0.02	0.02
8	C & R Water Supply Inc (Timberline Estates)	Muni				3,518,500	N	N	N	Y	4	0.00	0.00	0.00	0.01
3	C & R Water Supply Inc. (Rogers Road WS)	Muni				14,991,580	N	N	N	Y	3	0.06	0.09	0.12	0.14
3	C& R Water Supply Co (Pebble Glen)	Muni				4,859,800	N	N	N	Y	3	0.01	0.01	0.01	0.01
1	Cape Malibu Water Supply Inc.	Muni	118	0.06		11,850,600	Y	Y	N	Y	1	0.04	0.05	0.05	0.06
1	Chateau Woods MUD	Muni	725	0.24		60,298,333	Y	Y	N	Y	1	0.18	0.20	0.22	0.24
6	City of Conroe	Muni	13,503		16.40	3,056,905,667	Y	N	Y	Y	2	10.22	12.52	14.82	17.12
6	City of Magnolia	Muni	950		0.45	120,154,667	Y	N	Y	Y	2	0.35	0.39	0.42	0.45
3	City of Montgomery	Muni				48,654,667	N	N	N	Y	3	0.22	0.33	0.43	0.54
2	City of Panorama Village	Muni	1,069	0.67	1.03	157,920,667	Y	Y	Y	Y	2	0.56	0.71	0.87	1.03
11	City of Panorama Village (Country Club)	LU	1	0.05		14,614,300	Y	Y	N	Y	1	0.04	0.05	0.05	0.05
5	City of Shenandoah	Muni			0.44	253,124,333	N	N	Y	Y	2	0.69	0.69	0.69	0.69
5	City of Splendora	Muni			0.40	167,622,000	N	N	Y	Y	2	0.46	0.46	0.46	0.46
2	City of Willis	Muni	2,191	1.43	1.04	130,211,867	Y	Y	Y	Y	2	0.50	0.68	0.86	1.04
6	City of Woodbranch Village	Muni	349		0.12	38,341,667	Y	N	Y	Y	2	0.11	0.11	0.12	0.12
4	Clover Creek MUD	Muni	182			19,530,333	Y	N	N	Y	3	0.05	0.05	0.05	0.05
11	Conroe ISD (Moorehead JH/ Caney Creek HS / Ben Milar	LU	4	0.06		16,780,000	Y	Y	N	Y	1	0.05	0.05	0.05	0.06
3	Conroe Resort Utilities LLC	Muni				80,138,667	N	N	N	Y	3	0.22	0.22	0.22	0.22
2	Consumers Water Company (Pioneer Trails)	Muni	120	0.05	0.10	14,785,333	Y	Y	Y	Y	2	0.05	0.07	0.08	0.10
2	Consumers Water Company (Porter Terrace)	Muni	97	0.03	0.08	10,431,000	Y	Y	Y	Y	2	0.04	0.05	0.07	0.08

Category	Customer	Demand Basis	Available Information: Questionnaire 2007 Connect's	Available Information: Questionnaire 2045 Demand (mgd)	Available Information: TWDB WUG 2045 Demand (mgd)	Available Information: LSGCD 2005 - 2007 Average Pumpage (gallons)	Summary of Available Information: Questionnaire 2007 Connect's	Summary of Available Information: Questionnaire 2045 Demand	Summary of Available Information: TWDB WUG	Summary of Available Information: LSGCD 2007 Pumpage	Key to Future Demand Calculation	Projected Water Demand (mgd) 2015	Projected Water Demand (mgd) 2025	Projected Water Demand (mgd) 2035	Projected Water Demand (mgd) 2045
2	Consumers Water Company (Spring Forest)	Muni	245	0.10	0.19	30,029,333	Y	Y	Y	Y	2	0.10	0.13	0.16	0.19
1	Corinthian Point MUD 2	Muni	273	0.14		43,518,000	Y	Y	N	Y	1	0.12	0.13	0.14	0.14
10	Crown Oaks POA, Inc	LU				5,437,989	N	N	N	Y	6	0.01	0.01	0.01	0.01
5	Crystal Springs Water (Bennett Woods)	Muni			0.07	7,480,800	N	N	Y	Y	2	0.03	0.04	0.05	0.07
5	Crystal Springs Water (Country West/Western Hills)	Muni			0.18	20,655,200	N	N	Y	Y	2	0.08	0.11	0.15	0.18
5	Crystal Springs Water (Deer Glen)	Muni			0.41	46,701,600	N	N	Y	Y	2	0.19	0.26	0.33	0.41
5	Crystal Springs Water (Live Oak Estates)	Muni			0.17	20,070,100	N	N	Y	Y	2	0.08	0.11	0.14	0.17
5	Crystal Springs Water (Timberland Estates)	Muni			0.17	19,652,000	N	N	Y	Y	2	0.08	0.11	0.14	0.17
5	Crystal Springs Water (Western Hills)	Muni			0.14	16,019,100	N	N	Y	Y	2	0.06	0.09	0.11	0.14
5	Crystal Springs Water (Whispering Pines)	Muni			0.09	10,786,400	N	N	Y	Y	2	0.04	0.06	0.08	0.09
2	Cut and Shoot	Muni	1,085	2.20	0.35	78,494,667	Y	Y	Y	Y	2	0.24	0.28	0.31	0.35
3	Cypresswood Estates Water System	Muni				20,190,540	N	N	N	Y	3	0.06	0.06	0.06	0.06
1	Del Lago Estates WSC	Muni	49	0.06		17,051,500	Y	Y	N	Y	1	0.05	0.05	0.06	0.06
4	Diamondhead Water & Sewer	Muni	156			15,796,833	Y	N	N	Y	3	0.04	0.04	0.04	0.04
3	Dobbin-Plantersville WSC	Muni				73,389,767	N	N	N	Y	3	0.54	0.96	1.39	1.81
3	Domestic Water Company	Muni				30,439,000	N	N	N	Y	3	0.11	0.13	0.16	0.19
13	E.B.J.V., Inc. (FM 1488)	LU				0	N	N	N	N	7	0.03	0.03	0.04	0.04
13	E.B.J.V., Inc. (JFP Yard)	LU				0	N	N	N	N	7	0.03	0.03	0.04	0.04
1	East Montgomery County MUD 3	Muni	11	0.90		21,583,333	Y	Y	N	Y	1	0.24	0.46	0.68	0.90
7	East Montgomery County MUD 4	Muni		0.91		8,006,580	N	Y	N	Y	1	0.21	0.44	0.68	0.91
5	East Plantation UD	Muni			1.12	47,944,533	N	N	Y	Y	2	0.34	0.60	0.86	1.12
15	Entergy Gulf States/Lewis Creek District	LU			11.44	190,388,823	N	N	Y	Y	8	7.00	8.27	9.70	11.44
1	Everett Square Inc. (Windcrest, Honea Egypt)	Muni	74	0.04		11,620,633	Y	Y	N	Y	1	0.03	0.03	0.03	0.04
1	Everett Square, Inc. (Shady Oaks)	Muni	191	0.04		12,143,943	Y	Y	N	Y	1	0.03	0.04	0.04	0.04
1	Far Hills Utility District	Muni	399	0.52		55,045,667	Y	Y	N	Y	1	0.23	0.32	0.42	0.52
10	Fellowship of the Woodlands	LU				7,135,500	N	N	N	Y	6	0.02	0.02	0.02	0.02
4	H.H.J., Inc. / Decker Utilities	Muni	545			31,654,027	Y	N	N	Y	3	0.09	0.09	0.09	0.09
12	HMRG3 LLC	LU	1			100,000,000	Y	N	N	Y	6	0.27	0.27	0.27	0.27
2	HMW Special Utility District (Allenwood)	Muni	110	0.04	0.13	15,173,000	Y	Y	Y	Y	2	0.06	0.09	0.11	0.13
2	HMW Special Utility District (Armadillo Woods)	Muni	208	0.05	0.17	14,940,333	Y	Y	Y	Y	2	0.07	0.10	0.13	0.17
2	HMW Special Utility District (Coe Country)	Muni	589	0.18	0.69	65,008,000	Y	Y	Y	Y	2	0.29	0.42	0.56	0.69
6	HMW Special Utility District (Hunters Retreat)	Muni	356		0.34	33,309,000	Y	N	Y	Y	2	0.14	0.21	0.27	0.34
2	HMW Special Utility District (Kipling Oaks #1)	Muni	374	0.09	0.31	30,390,333	Y	Y	Y	Y	2	0.13	0.19	0.25	0.31
2	HMW Special Utility District (Kipling Oaks #2)	Muni	352	0.19	0.50	53,324,000	Y	Y	Y	Y	2	0.22	0.31	0.41	0.50
5	HMW Special Utility District (Rimwick Forest)	Muni			0.06	5,359,333	N	N	Y	Y	2	0.02	0.03	0.04	0.06
2	HMW Special Utility District (Sendera)	Muni	144	0.06	0.22	24,068,333	Y	Y	Y	Y	2	0.10	0.14	0.18	0.22
2	HMW Special Utility District (Towering Oaks)	Muni	245	0.10	0.33	27,828,667	Y	Y	Y	Y	2	0.13	0.20	0.26	0.33
11	Huntsman Petrochemical Corp.	LU	3	0.63		187,919,469	Y	Y	N	Y	1	0.54	0.57	0.60	0.63
1	Johnston's Utilities, Inc.	Muni	510	0.67		91,339,333	Y	Y	N	Y	1	0.34	0.45	0.56	0.67
4	Keenan Water Supply Corp.	Muni	274			23,133,967	Y	N	N	Y	3	0.06	0.06	0.06	0.06
1	Kings Manor MUD	Muni	1655	0.37		120,345,333	Y	Y	N	Y	1	0.34	0.35	0.36	0.37
4	Lake Bonanza Water Supply Corp.	Muni	621			41,251,133	Y	N	N	Y	3	0.11	0.11	0.11	0.11
3	Lake Conroe Hills MUD	Muni				43,625,033	N	N	N	Y	3	0.12	0.12	0.13	0.13
3	Lake Forest Falls	Muni				15,110,193	N	N	N	Y	3	0.04	0.05	0.05	0.06
3	Lake South Water Supply Corp.	Muni				22,905,633	N	N	N	Y	3	0.09	0.12	0.14	0.17
10	Lake Windcrest POA, Inc	LU				3,270,000	N	N	N	Y	6	0.01	0.01	0.01	0.01
10	Lakeland Section 4 Civic Club	LU				13,753,333	N	N	N	Y	6	0.04	0.04	0.04	0.04
13	Lakewood Estates POA	LU				0	N	N	N	N	7	0.03	0.03	0.04	0.04
3	Lazy River Improvement District	Muni				36,729,333	N	N	N	Y	3	0.11	0.11	0.12	0.12
12	Magnolia ISD (Magnolia High School)	LU	4			13,131,133	Y	N	N	Y	6	0.04	0.04	0.04	0.04

		Available Information					Summary of Available Information								
			Questionnaire		TWDB WUG	LSGCD	Questionnaire					Projected Water Demand (mgd)			
Category	Customer	Demand Basis	2007 Connect's	2045 Demand (mgd)	2045 Demand (mgd)	2005 - 2007 Average Pumpage (gallons)	2007 Connect's	2045 Demand	TWDB WUG	LSGCD 2007 Pumpage	Key to Future Demand Calculation	2015	2025	2035	2045
12	Magnolia ISD (West High School)	LU	4			11,212,667	Y	N	N	Y	6	0.03	0.03	0.03	0.03
12	Maverick Tube, LLC dba Tenaris Conroe	LU	2			28,609,821	Y	N	N	Y	6	0.08	0.08	0.08	0.08
1	Monarch Utilities, Inc (Hulon Lake/Woodcreek Valley)	Muni	246	0.04		18,344,667	Y	Y	N	Y	1	0.05	0.05	0.05	0.05
1	Monarch Utilities, Inc. (Decker Hills/Park Place)	Muni	1,089	0.25		75,645,667	Y	Y	N	Y	1	0.22	0.23	0.24	0.25
1	Monarch Utilities, Inc. (Serenity Woods, Pine)	Muni	135	0.03		11,546,333	Y	Y	N	Y	1	0.03	0.03	0.03	0.03
3	Montgomery County Fresh Wtr Sply Dist 6	Muni				11,067,810	N	N	N	Y	3	0.04	0.06	0.07	0.09
1	Montgomery County MUD 112	Muni	45	0.46		5,300,000	Y	Y	N	Y	1	0.11	0.23	0.34	0.46
7	Montgomery County MUD 119	Muni		0.63		12,100,000	N	Y	N	Y	1	0.16	0.32	0.47	0.63
8	Montgomery County MUD 127	Muni				0	N	N	N	N	4	0.01	0.02	0.07	0.09
4	Montgomery County MUD 15	Muni	702			62,713,333	Y	N	N	Y	3	0.17	0.17	0.17	0.17
1	Montgomery County MUD 16	Muni	186	0.57		18,819,667	Y	Y	N	Y	1	0.16	0.30	0.43	0.57
5	Montgomery County MUD 18	Muni			5.99	357,184,067	N	N	Y	Y	2	2.03	3.35	4.67	5.99
2	Montgomery County MUD 19	Muni	231	0.52	0.40	144,792,667	Y	Y	Y	Y	2	0.40	0.40	0.40	0.40
4	Montgomery County MUD 24	Muni	216			19,582,667	Y	N	N	Y	3	0.05	0.05	0.05	0.05
4	Montgomery County MUD 56	Muni	306			26,495,000	Y	N	N	Y	3	0.07	0.07	0.07	0.07
5	Montgomery County MUD 8	Muni			2.09	235,471,400	N	N	Y	Y	2	0.95	1.33	1.71	2.09
4	Montgomery County MUD 83	Muni	613			80,019,033	Y	N	N	Y	3	0.22	0.22	0.22	0.22
8	Montgomery County MUD 84	Muni				0	N	N	N	N	4	0.03	0.04	0.06	0.08
1	Montgomery County MUD 88 and 89	Muni	2462	0.79		166,938,333	Y	Y	N	Y	1	0.53	0.61	0.70	0.79
6	Montgomery County MUD 9	Muni	1,335		2.31	197,791,033	Y	N	Y	Y	2	0.91	1.38	1.84	2.31
1	Montgomery County MUD 94	Muni	1049	0.84		85,983,667	Y	Y	N	Y	1	0.36	0.52	0.68	0.84
9	Montgomery County MUD 99	Muni		0.71		0	N	Y	N	N	5	0.08	0.29	0.50	0.71
2	Montgomery County UD 2	Muni	1,119	0.61	0.45	119,216,333	Y	Y	Y	Y	2	0.35	0.39	0.42	0.45
6	Montgomery County UD 3	Muni	1,210		0.60	148,684,667	Y	N	Y	Y	2	0.45	0.50	0.55	0.60
2	Montgomery County UD 4	Muni	1,399	1.00	0.80	202,281,333	Y	Y	Y	Y	2	0.61	0.67	0.73	0.80
5	Montgomery County WC & ID 1 (Well 4)	Muni			0.62	104,560,667	N	N	Y	Y	2	0.36	0.44	0.53	0.62
12	Montgomery ISD (Montgomery High School, Irrg)	LU	1			5,759,000	Y	N	N	Y	6	0.02	0.02	0.02	0.02
1	Montgomery Place Water System	Muni	59	0.02		7,147,800	Y	Y	N	Y	1	0.02	0.02	0.02	0.02
14	Montgomery Trace POA	LU		0.07		6,277,000	N	Y	N	Y	1	0.03	0.04	0.05	0.07
9	MSEC (Crown Ranch)	Muni		1.99		0	N	Y	N	N	5	0.00	0.67	1.33	1.99
1	MSEC Enterprises (Highland Ranch/Lake Forest/Shorelin	Muni	159	0.19		16,530,000	Y	Y	N	Y	1	0.08	0.12	0.16	0.19
1	MSEC Enterprises (Montgomery Trace/Crown Oaks)	Muni	1,026	5.54		142,854,867	Y	Y	N	Y	1	1.48	2.83	4.18	5.54
2	New Caney MUD	Muni	3441	1.93	2.74	316,068,000	Y	Y	Y	Y	2	1.26	1.75	2.25	2.74
10	New Millennium Farms	LU				75,000,000	N	N	N	Y	6	0.21	0.21	0.21	0.21
3	North Woods Water Supply Corp.	Muni				12,454,333	N	N	N	Y	3	0.04	0.05	0.06	0.07
4	Northwest Water Systems (Hazy Hallow East Estates)	Muni	662			44,823,133	Y	N	N	Y	3	0.12	0.12	0.12	0.12
4	Northwest Water Systems (White Oak Valley)	Muni	195			12,824,833	Y	N	N	Y	3	0.04	0.04	0.04	0.04
2	Oak Ridge North	Muni	1,149	0.43	1.06	154,798,667	Y	Y	Y	Y	2	0.56	0.72	0.89	1.06
2	Patton Village Water Co., Inc. (East)	Muni	170	0.07	0.07	17,918,333	Y	Y	Y	Y	2	0.05	0.06	0.06	0.07
1	Patton Village Water Co., Inc. (West)	Muni	163	0.04		16,180,333	Y	Y	N	Y	1	0.04	0.04	0.04	0.04
3	Pinedale Mobile Home Community	Muni				15,051,000	N	N	N	Y	3	0.04	0.05	0.05	0.06
4	Pinehurst Decker Prairie (WSC)	Muni	346			29,594,933	Y	N	N	Y	3	0.08	0.08	0.08	0.08
1	Piney Shores Utility	Muni	186	0.06		18,379,667	Y	Y	N	Y	1	0.05	0.06	0.06	0.06
5	Point Aquarius MUD	Muni			1.82	130,193,667	N	N	Y	Y	2	0.67	1.05	1.44	1.82
6	Porter Special Utility District	Muni	3390		2.94	444,287,530	Y	N	Y	Y	2	1.58	2.03	2.49	2.94
1	Quadvest, LP. (Benders Landing)	Muni	627	0.98		97,910,667	Y	Y	N	Y	1	0.42	0.61	0.79	0.98
1	Quadvest, LP. (Creekside Village)	Muni	347	0.11		16,173,333	Y	Y	N	Y	1	0.06	0.08	0.09	0.11
4	Quadvest, LP. (Indigo Lakes)	Muni	759			100,953,000	Y	N	N	Y	3	0.28	0.28	0.28	0.28
1	Quadvest, LP. (Lakes of Magnolia)	Muni	126	0.00		4,366,333	Y	Y	N	Y	1	0.01	0.01	0.01	0.01
1	Quadvest, LP. (McCall Sound)	Muni	15	0.03		587,000	Y	Y	N	Y	1	0.01	0.02	0.02	0.03

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Category	Customer	Demand Basis	2007 Connect's	2045 Demand (mgd)	2045 Demand (mgd)	2005 - 2007 Average Pumpage (gallons)	2007 Connect's	2045 Demand	TWDB WUG	LSGCD 2007 Pumpage	Key to Future Demand Calculation	2015	2025	2035	2045
1	Quadvest, LP. 1 (Lake Windcrest WS)	Muni	843	0.45		222,658,333	Y	Y	N	Y	1	0.61	0.61	0.61	0.61
1	Quadvest, LP. 1 (Mostyn Manor)	Muni	116	0.16		16,685,000	Y	Y	N	Y	1	0.07	0.10	0.13	0.16
1	Quadvest, LP. 1 (Red Oak Ranch WS)	Muni	107	0.06		15,164,000	Y	Y	N	Y	1	0.05	0.05	0.06	0.06
1	Quadvest, LP. 1 (Sendara Ranch)	Muni	331	0.23		36,038,000	Y	Y	N	Y	1	0.13	0.16	0.19	0.23
1	Quadvest, LP. 2 (Lonestar Ranch)	Muni	842	0.16		88,861,667	Y	Y	N	Y	1	0.24	0.24	0.24	0.24
1	Quadvest, LP. 2 (Northcrest Ranch 1, 2, & 3)	Muni	352	0.20		28,554,000	Y	Y	N	Y	1	0.10	0.14	0.17	0.20
1	Quadvest, LP. 2 (Stonecrest Ranch)	Muni	71	0.06		9,310,000	Y	Y	N	Y	1	0.03	0.04	0.05	0.06
1	Ranch Utilities (Caddo Village)	Muni	339	0.18		15,937,333	Y	Y	N	Y	1	0.07	0.11	0.15	0.18
2	Rayford Road MUD	Muni	3714	1.69	1.84	408,134,333	Y	Y	Y	Y	2	1.27	1.46	1.65	1.84
14	Ridge Lake Shores POA	LU		0.05		61,665,046	N	Y	N	Y	1	0.17	0.17	0.17	0.17
10	River Plantation Country Club	LU				13,490,000	N	N	N	Y	6	0.04	0.04	0.04	0.04
2	River Plantation MUD	Muni	949	0.62	0.71	176,279,167	Y	Y	Y	Y	2	0.53	0.59	0.65	0.71
6	Roman Forest Consolidated MUD	Muni	691		0.31	89,342,000	Y	N	Y	Y	2	0.26	0.28	0.29	0.31
4	San Jo Utilties	Muni	201			11,639,000	Y	N	N	Y	3	0.03	0.03	0.03	0.03
11	Sequoia Golf Woodlands LLC (Lake Windcrest)	LU	1	0.21		69,000,000	Y	Y	N	Y	1	0.19	0.20	0.20	0.21
11	Sequoia Golf Woodlands LLC (Palmer)	LU	2	0.30		84,274,667	Y	Y	N	Y	1	0.25	0.26	0.28	0.30
11	Sequoia Golf Woodlands LLC (Panther)	LU	2	0.18		20,360,667	Y	Y	N	Y	1	0.08	0.11	0.15	0.18
11	Sequoia Golf Woodlands LLC (Player)	LU	1	0.14		34,810,267	Y	Y	N	Y	1	0.10	0.12	0.13	0.14
11	Sequoia Golf Woodlands LLC (TPC)	LU	1	0.41		114,153,000	Y	Y	N	Y	1	0.33	0.36	0.39	0.41
2	Southern Montgomery County MUD	Muni	1671	1.64	1.88	393,470,667	Y	Y	Y	Y	2	1.25	1.46	1.67	1.88
2	Spring Creek UD	Muni	2453	0.59	1.04	133,456,667	Y	Y	Y	Y	2	0.51	0.69	0.86	1.04
2	Stanley Lake MUD	Muni	1,138	1.09	0.77	148,077,000	Y	Y	Y	Y	2	0.48	0.58	0.67	0.77
3	T & I Taylor, Inc. (River Club/River Ridge)	Muni				9,976,567	N	N	N	Y	3	0.04	0.05	0.06	0.07
1	T & W Water Service (Deer Run)	Muni	134	0.03		10,100,000	Y	Y	N	Y	1	0.03	0.03	0.03	0.03
1	T & W Water Service (Grand Harbor/Gemstone)	Muni	433	0.38		75,800,000	Y	Y	N	Y	1	0.24	0.29	0.33	0.38
1	T & W Water Service (Harbor Side)	Muni	96	0.06		15,600,000	Y	Y	N	Y	1	0.05	0.05	0.06	0.06
1	T & W Water Service (Old Mill Lake)	Muni	105	0.08		22,900,000	Y	Y	N	Y	1	0.07	0.07	0.07	0.08
1	T & W Water Service (Riverwalk)	Muni	492	0.26		176,188,000	Y	Y	N	Y	1	0.48	0.48	0.48	0.48
1	T & W Water Service (Southwind Ridge)	Muni	127	0.03		10,396,000	Y	Y	N	Y	1	0.03	0.03	0.03	0.03
1	T & W Water Service (Thousand Oaks)	Muni	378	0.26		57,300,000	Y	Y	N	Y	1	0.18	0.20	0.23	0.26
3	Texaba Water Systems	Muni				12,686,667	N	N	N	Y	3	0.03	0.03	0.03	0.03
3	Texas American Water (Frontier, Arrowhead)	Muni				23,510,333	N	N	N	Y	3	0.09	0.11	0.14	0.17
3	Texas American Water (Hidden Forest)	Muni				7,473,000	N	N	N	Y	3	0.02	0.02	0.02	0.02
10	Texas National Golf Club	LU				11,000,000	N	N	N	Y	6	0.03	0.03	0.03	0.03
1	Texas National MUD	Muni	112	0.41		23,409,000	Y	Y	N	Y	1	0.14	0.23	0.32	0.41
2	The Woodlands (San Jacinto River Authority)	Muni	29,000	22.14	25.11	5,722,800,000	Y	Y	Y	Y	2	17.66	20.15	22.63	25.11
10	The Woodlands Development Company	LU				151,358,000	N	N	N	Y	6	0.41	0.41	0.41	0.41
3	Town of Woodloch	Muni				26,168,000	N	N	N	Y	3	0.07	0.07	0.07	0.07
4	Walnut Cove Water Supply Corp	Muni	536			27,717,400	Y	N	N	Y	3	0.08	0.08	0.08	0.08
11	Washington County Railroad	LU	196	0.04		14,756,413	Y	Y	N	Y	1	0.04	0.04	0.04	0.04
4	Westmont Mobile Home Park	Muni	103			7,961,400	Y	N	N	Y	3	0.02	0.02	0.02	0.02
4	Westwood North Water Supply	Muni	812			77,603,667	Y	N	N	Y	3	0.21	0.21	0.21	0.21
1	White Oak Utilities, Inc.	Muni	259	0.14		20,882,333	Y	Y	N	Y	1	0.08	0.10	0.12	0.14
4	White Oak Water Supply Corporation	Muni	209			24,528,100	Y	N	N	Y	3	0.07	0.07	0.07	0.07
3	Wood Trace MUD 1	Muni				1,574,000	N	N	N	Y	3	0.01	0.01	0.01	0.02
10	Woodforest Golf Club LLC	LU				102,761,000	N	N	N	Y	6	0.28	0.28	0.28	0.28
3	Woodland Lakes WSC	Muni				9,239,967	N	N	N	Y	3	0.03	0.03	0.04	0.04
7	Woodland Oaks Utility Co. Inc.	Muni		1.27		43,217,033	N	Y	N	Y	1	0.36	0.66	0.96	1.27