SOUTHEAST WISE COUNTY REGIONAL WASTEWATER STUDY

for

Trinity River Authority of Texas

TWDB REGIONAL FACILITY PLANNING GRANT (Project Contract No. 0804830844)

FINAL REPORT

June 30, 2010

Prepared by:

SUSAN K. ROTH, P.E., PMP

WATER AND WASTEWATER CONSULTING

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TRINITY RIVER AUTHORITY
SOUTHEAST WISE COUNTY REGIONAL WASTEWATER STUDY

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1.0 EXECUTIVE SUMMARY

In December 2007, Trinity River Authority (TRA) and Tarrant Regional Water District (TRWD) submitted an application to the Texas Water Development Board (TWDB) to receive funding assistance to conduct a regional wastewater planning study for Southeast Wise County. TWDB awarded TRA, as the primary applicant, the planning grant in April 2008. As a result, TRA and TRWD, in conjunction with the Cities of Aurora, New Fairview, Newark, Boyd, and Rhome, participated in this study to evaluate the feasibility of developing regional wastewater facilities to serve existing and future populations in Southeast Wise County.

Susan K. Roth Consulting and her team, Plauché International, Inc. and Espey Consultants, Inc., performed the evaluation of the development of several options for regional wastewater collection and treatment facilities in Southeast Wise County; this report summarizes the findings of this evaluation. Seven alternatives were initially identified, along with a base case scenario that would consist of stand-alone community wastewater systems or on-site sewage facilities (OSSFs) for each entity. These alternatives were presented to the participants during a working session held at the second project team meeting. As a result of the working session, the following alternatives were selected for a detailed final evaluation:

- ***Modified Base Case*** – each entity would construct their own WWTP and no regionalization would occur;
- ***Option B*** – Rolling V Ranch and the Cities of Newark and Rhome would participate in a regional system; the City of Boyd would serve Ivy Hills and the Boyette Tract; and,
- ***Option C*** – all five cities and major planned developments would eventually be served by a regional system.

In addition, water quality modeling was conducted to define effluent discharge parameters that would likely be included in the discharge permit for each proposed treatment plant location. Based on the water quality modeling, results indicated that ammonia nitrogen (NH_3-N) and total phosphorus (TP) limits would be relatively strict for new treatment plants constructed in the study area. Capital and operation and maintenance (O&M) cost estimates were developed for each of the final options along with present worth calculations for the time period from 2010 to 2034.

As a result of the detailed evaluation, Option B is the most promising alternative for the project participants to initiate a regional wastewater system. Option B represents partial regionalization with Rolling V Ranch and the Cities of Newark and Rhome and could enable more comprehensive regionalization in the future. Based on the results of the water quality modeling activities, the location recommended for constructing a new facility is the Unnamed Tributary Regional WWTP Site. The proposed effluent limits for discharges reaching Eagle Mountain Lake from this site are 5-mg/L $CBOD_5$, 5-mg/L TSS, 1.3-mg/L NH_3-N and 0.5-mg/L TP.

The least expensive solution for the City of Aurora would be to develop their own stand-alone wastewater system, provided it serves developments with higher densities. Otherwise, OSSFs will continue to be Aurora's most cost-effective alternative. For the City of New Fairview, OSSFs also appear to be the least expensive wastewater alternative unless denser and larger developments are encouraged.

The results of the study also indicated that it would be advantageous for the City of Boyd, Ivy Hills and Boyette Tract to cooperate in a joint wastewater system. Treatment would be provided by the existing City of Boyd Wastewater Treatment Plant (WWTP), which currently has excess capacity and could be expanded and updated as needed to accommodate future flows. The cost of additional treatment processes, such as chemical treatment and filtration to meet stringent nutrient limits, were included in the analysis. A joint system is estimated to be about 25 percent lower on a total project cost basis and about 34 percent lower on a present worth basis (Y2010 to Y2034) when compared to the costs if each entity developed their own system.

From a total project cost standpoint, the evaluation results indicate Option B would be slightly more expensive (approximately 5%) when compared to individual treatment systems for Rolling V Ranch and the Cities of Newark and Rhome. Both cities' share of the project capital costs for Option B and the Modified Base Case would be about the same, approximately $10.7 million. Rolling V Ranch's share of the costs would be about 10% more compared to constructing their own treatment plant. However, when the long term costs of O&M are considered, Option B looks more favorable. From 2010 to 2034, the present worth of the O&M costs for the regional system in Option B is 19% lower than the O&M costs associated with each entity having their own stand-alone system.

Due to the long-term cost advantages and other advantages related to permit and land acquisition, the project team recommends that the Cities of Newark and Rhome work together with Rolling V Ranch to pursue a regional wastewater system. A regional system serving all five cities will most likely become a reality after Year 2030 due to the high cost of transporting wastewater from the Cities of Boyd and New Fairview.

2.0 INTRODUCTION

In December 2007, Trinity River Authority (TRA) and Tarrant Regional Water District (TRWD) submitted an application to the Texas Water Development Board (TWDB) to receive funding assistance to conduct a regional wastewater planning study for Southeast Wise County. TWDB awarded TRA, as the primary applicant, the planning grant in April 2008. As a result, TRA and TRWD, in conjunction with the Cities of Aurora, New Fairview, Newark, Boyd, and Rhome, have promoted this study to evaluate the feasibility of developing regional wastewater facilities to serve existing and future populations in Southeast Wise County.

Susan K. Roth Consulting and her team, Plauché International, Inc. and Espey Consultants, Inc., performed the evaluation of the development of several options for regional wastewater collection and treatment facilities in Southeast Wise County; this report summarizes the findings of this evaluation. Information regarding the study area, projected population and wastewater flows, description of collection and treatment alternatives, water quality modeling results for proposed effluent standards, cost estimates and funding options are also included in this study.

2.1 Project Background

Service Area Description

The study area is generally located along the Interstate 81/U.S. Highway 287 corridor and near FM 114; it aligns with the drainage sub-basins which flow into the West Fork of the Trinity River, Derrett Creek and other smaller tributaries into Eagle Mountain Lake. A map of the study area is shown in Figure 2.1. The study area includes the incorporated limits and extraterritorial jurisdictions (ETJ) of the Cities of Aurora, Boyd, Newark, New Fairview, and Rhome and the surrounding unincorporated areas. The majority of the service area is located in Southeast Wise County with a small portion of the contributing drainage area extending into Northwest Tarrant County.

Basis for the Study

The Cities of Newark and Boyd operate wastewater treatment plants that discharge into Eagle Mountain Lake and the West Fork of the Trinity River, respectively. The City of Rhome operates one WWTP that discharges into Grapevine Lake and another WWTP that discharges into the West Fork of the Trinity River above Eagle Mountain Lake. The Cities of Aurora and New Fairview are served exclusively with on-site sewage facilities (OSSFs). The proposed Southeast Wise County Regional Wastewater System could incorporate the complete collection and treatment systems for these five communities.

Planning for regional wastewater collection and treatment facilities is important at this time for prevention of problems due to aging infrastructure, the size of several planned developments in the area, and the evidence of water quality problems in Eagle Mountain Lake. The population in the study area has increased significantly in the past 10 years and is projected to double over the next 10 years. This planning study for Southeast Wise County considers several regional solutions for wastewater disposal, while addressing the regional objective of protecting the water quality of Eagle Mountain Lake. A regional wastewater system would be designed in conformance with the flow and effluent limits of the State Water Quality Management Plan and would be committed to water conservation.

2.2 Scope of Study

The scope of work for this study involved evaluating the feasibility of developing regional wastewater collection and treatment facilities to serve existing and future development in Southeast Wise

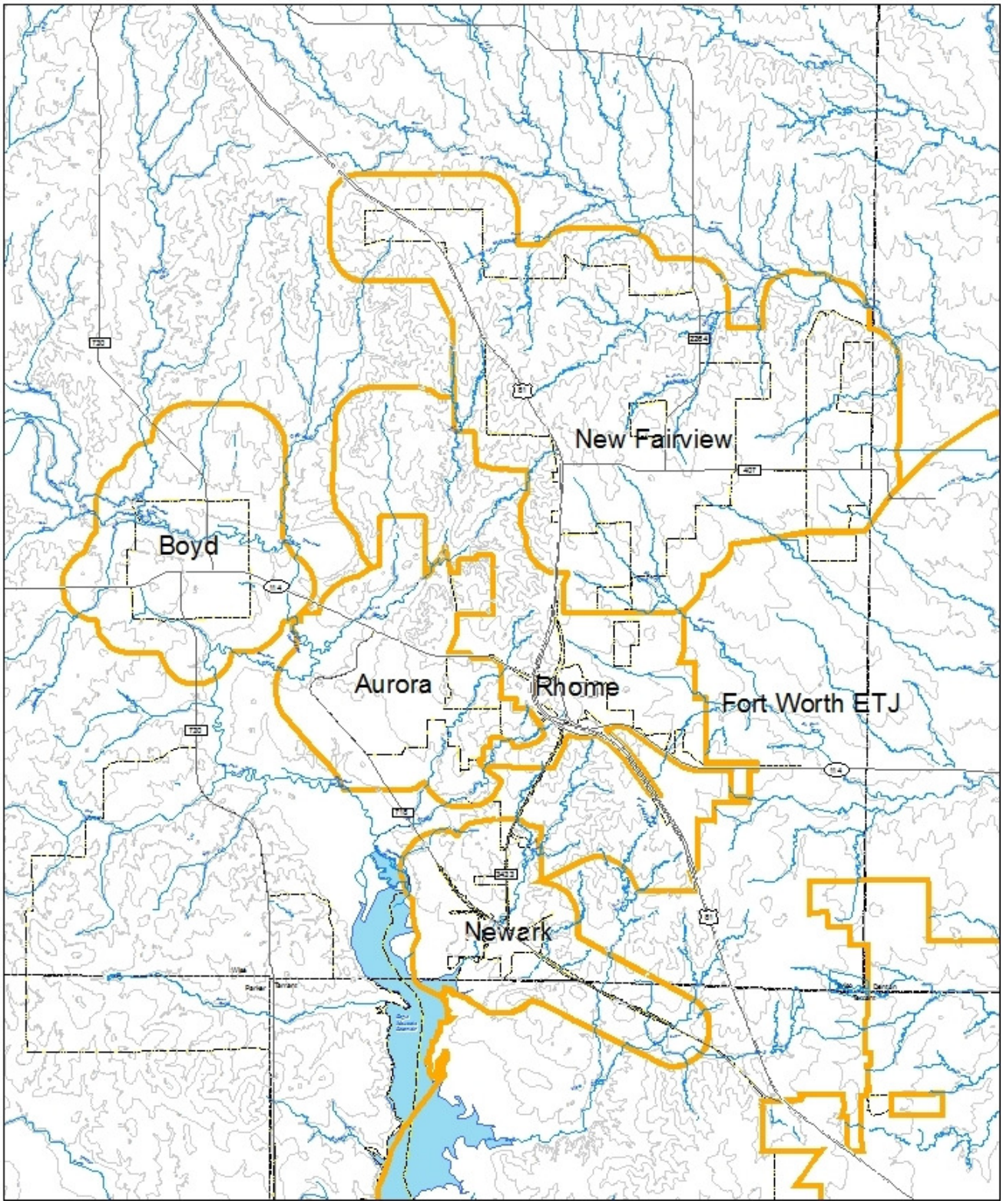


Figure 2.1: Map of Study Area

County. The following items were included in the study from an engineering standpoint, as well as to satisfy the requirements of the TWDB grant program:

- ***Population and Wastewater Flow Projections*** – Population projections and wastewater system information were collected from each of the entities. This data was used to develop population and wastewater flow projections for each city in five year increments through a 2030 planning horizon.
- ***Collection System Alternatives*** – Alternatives were developed for connecting existing collection lines into an overall regional wastewater collection system within the study area. The study also considered the feasibility of developing community or regional wastewater systems in areas of the county that have traditionally been developed with OSSFs.
- ***Treatment Alternatives*** – An evaluation of each existing treatment facility was made for the possibility of expansion and potential for regional operation. The quality or level of treatment required for a regional plant to discharge into Eagle Mountain Lake was evaluated with stream and reservoir computer modeling.
- ***Operation and Reuse Alternatives*** – Potential operation alternatives were examined for each of the cities, including the operation of individual facilities, as well as a regional system. The potential distribution of effluent from existing and proposed treatment facilities was examined in conjunction with an inventory of possible application sites.
- ***Implementation Schedule*** – An implementation plan was developed for the phased construction of collection and treatment facilities for the study area through 2030. This plan takes into consideration the existing collection and treatment capacities, water quality issues, future developments, anticipated growth and cost effectiveness.
- ***Cost Estimates and Recommendations*** – Estimates of the capital and O&M costs for each identified entity for the various alternatives were determined. The capital and O&M costs for the final regional collection and treatment system alternatives were estimated separately and then combined by using a present worth analysis.
- ***Funding Options*** – Potential funding sources and traditional financing vehicles for the construction of the Southeast Wise County Regional Wastewater Systems were provided.
- ***Water Conservation and Drought Contingency Plans*** – TWDB requires project participants receiving grant funding through the Regional Water/Wastewater Facilities Planning Grant Program to prepare and implement water conservation and drought contingency plans. TRA and TRWD already have water conservation and drought contingency plans in place.

Information about each of the items listed in the scope of work is detailed in the following sections of the report.

3.0 GROWTH PROJECTIONS

3.1 Population Projections

The population in the study area has increased significantly over the past 10 years and is projected to double over the next 10 years. In order to accurately capture the population growth of the study area, the following information was collected from each participant early on in the study:

- Current population and growth projections;
- Wastewater system information;

- Utility development agreements for planned developments; and
- Build-out schedules and conceptual plans of planned developments.

This information, along with population and growth projection data obtained from the *TWDB Region C Regional Water Plan (2006),* was used to develop population projections for each entity in five year increments through a 2030 planning horizon, including ultimate build-out of planned developments.

Based on the data collected, an aerial map was created to visually present the development densities in the study area. As shown in Figure 3.1, the following density categories are color-coded and hatched to represent the magnitude and location of existing and future population densities:

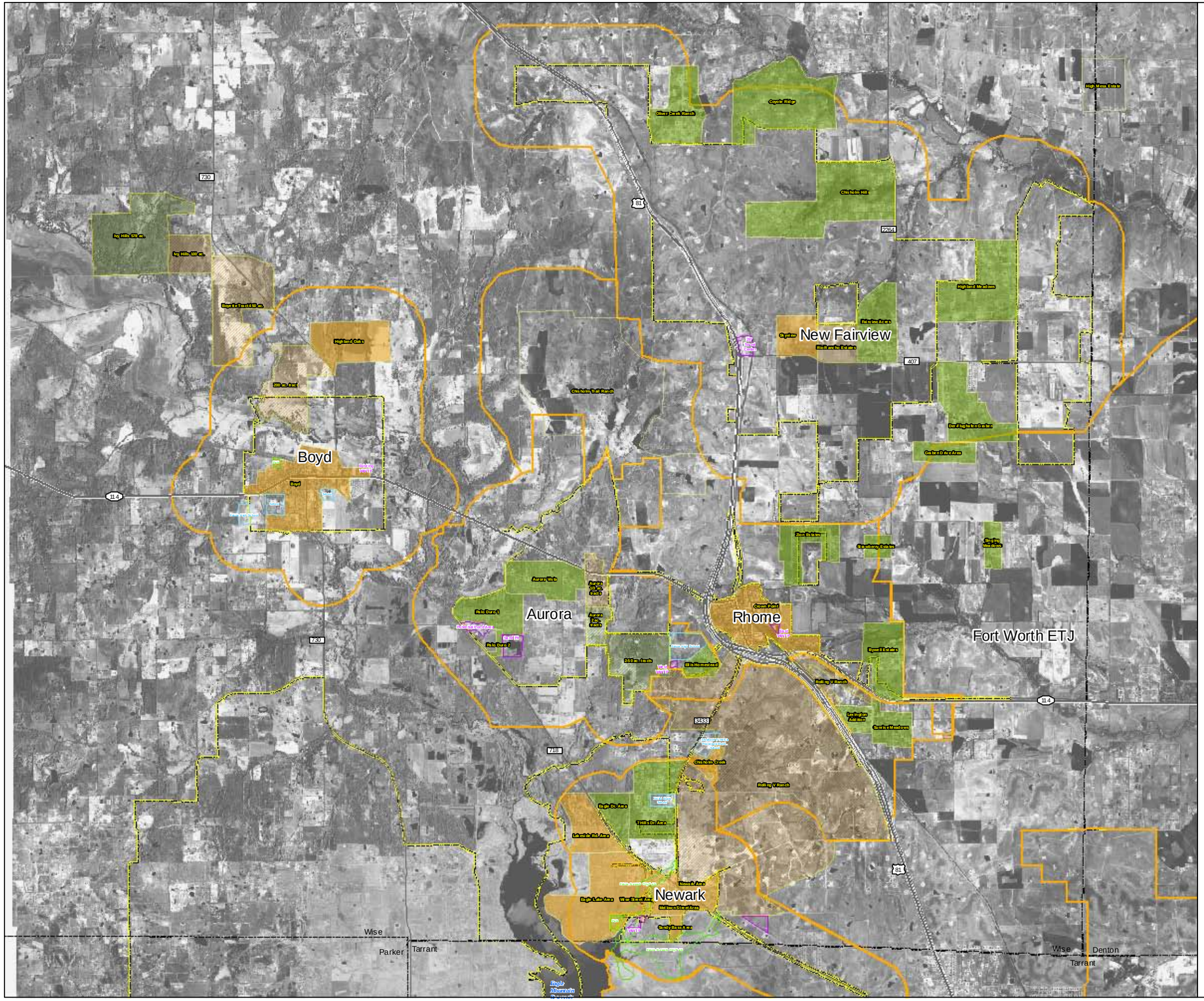
- Solid green – areas of existing developments that have lots greater than an acre;
- Hatched green – areas of future development anticipated to have lots greater than an acre;
- Solid orange – areas of existing development that have lots less than an acre; and,
- Hatched orange – areas of future development anticipated to have lots less than an acre.

Based on these density categories, population projections were then developed for each city according to the service area within the city limits, proposed developments identified inside the ETJ, and proposed developments directly outside of the ETJ. The projected populations were compared to the TWDB population projections in the *2006 Region C Regional Water Plan*. Table 3.1 summarizes the total population projections for each city and includes TWDB projections for comparison purposes.

Table 3.1: TWDB and Cities' Population Projections

City	Annual Growth Projected	2008	2010	2015	2020	2025	2030	2030 + Ultimate Build-out of Development
AURORA								
City Limits	4.0%	1,383	1,496	1,820	2,214	2,694	3,278	3,278
Proposed Developments within ETJ		0	0	0	60	360	1,550	5,000
Total	**5.8%**	**1,383**	**1,496**	**1,820**	**2,274**	**3,054**	**4,828**	**8,278**
TWDB Projections (City Limits)	**1.5%**		**1,096**	**1,196**	**1,295**	**1,392**	**1,489**	
BOYD								
City Limits	2%	1,250	1,301	1,436	1,585	1,750	1,932	1,932
Proposed Developments within ETJ		0	0	0	20	120	220	1,250
Proposed Developments outside ETJ		0	0	35	260	685	1,073	5,445
Total	**4.4%**	**1,250**	**1,301**	**1,471**	**1,865**	**2,555**	**3,225**	**8,627**
TWDB Projections (City Limits)	**1.9%**		**1,500**	**1,750**	**2,000**	**2,100**	**2,200**	
NEWARK								
City Limits	2.0%	1,100	1,144	1,264	1,395	1,540	1,701	1,701
Proposed Developments within ETJ		0	0	150	913	2,038	3,663	7,406
Total	**7.5%**	**1,100**	**1,144**	**1,414**	**2,308**	**3,578**	**5,364**	**9,107**
TWDB Projections (City Limits)	**3.7%**		**1,137**	**1,455**	**1,772**	**2,056**	**2,339**	
NEW FAIRVIEW								
City Limits	3.0%	1,445	1,533	1,777	2,060	2,388	2,769	2,769
Proposed Developments within ETJ		0	0	0	0	0	0	0
Proposed Developments outside ETJ		0	0	0	0	0	0	0
Total	**3.0%**	**1,445**	**1,533**	**1,777**	**2,060**	**2,388**	**2,769**	**2,769**
TWDB Projections (City Limits)	**2.8%**		**1,587**	**1,877**	**2,167**	**2,450**	**2,732**	
RHOME								
City Limits	3.0%	1,500	1,591	1,845	2,139	2,479	2,874	2,874
Proposed Developments within ETJ		0	0	150	1,138	3,113	5,238	11,375
Total	**8.0%**	**1,500**	**1,591**	**1,995**	**3,277**	**5,592**	**8,112**	**14,249**
TWDB Projections (City Limits)	**5.3%**		**2,300**	**3,410**	**4,519**	**5,485**	**6,451**	
Total for Five Cities		**6,678**	**7,065**	**8,477**	**11,784**	**17,167**	**24,298**	**43,030**

Figure 3.1
Density Developments of Study Area



3.2 Wastewater Flow Projections

Wastewater flow projections for each of the cities were calculated using the population projections listed above in Table 3.1 and an average unit flow rate of 80 gallons per capita per day (gpcd). The assumption for the average per capita flow rate is based on the advances made in water conservation along with the increase of high-efficiency appliances on the market these days. Average wastewater flow projections for each of the cities are shown in Table 3.2.

Table 3.2: Average Wastewater Flow Projections

City	Wastewater Flows (MGD)						
	2008	2010	2015	2020	2025	2030	2030 + Ultimate Build-out of Development
AURORA							
Projections for Existing City Limits	0.111	0.120	0.146	0.177	0.216	0.262	0.262
Proposed Developments within ETJ	0	0	0	0.005	0.029	0.124	0.400
Total	0.111	0.120	0.146	0.182	0.244	0.386	0.662
Flows within City Limits for WWTP	0	0	0	0.002	0.014	0.060	0.060
Total Wastewater Served by WWTP	**0**	**0**	**0**	**0.007**	**0.043**	**0.184**	**0.460**
BOYD							
Projections for Existing City Limits	0.100	0.104	0.115	0.127	0.140	0.155	0.155
Proposed Developments within ETJ	0	0	0	0.002	0.010	0.018	0.100
Proposed Developments outside ETJ	0	0	0.003	0.021	0.055	0.086	0.436
Total	**0.100**	**0.104**	**0.118**	**0.149**	**0.204**	**0.258**	**0.690**
NEWARK							
Projections for Existing City Limits	0.088	0.092	0.101	0.112	0.123	0.136	0.136
Proposed Developments within ETJ	0	0	0.012	0.073	0.163	0.293	0.593
Total	**0.088**	**0.092**	**0.113**	**0.185**	**0.286**	**0.429**	**0.729**
NEW FAIRVIEW							
Projections for Existing City Limits	0.116	0.123	0.142	0.165	0.191	0.222	0.222
Proposed Developments within ETJ	0	0	0	0	0	0	0
Proposed Developments outside ETJ	0	0	0	0	0	0	0
Total	0.116	0.123	0.142	0.165	0.191	0.222	0.222
Flows within City Limits for WWTP	0	0	0.032	0.052	0.072	0.091	0.091
Total Wastewater Served by WWTP	**0**	**0**	**0.032**	**0.052**	**0.072**	**0.091**	**0.091**
RHOME							
Projections for Existing City Limits	0.120	0.127	0.148	0.171	0.198	0.230	0.230
Proposed Developments within ETJ	0	0	0.012	0.091	0.249	0.419	0.910
Total	**0.120**	**0.127**	**0.160**	**0.262**	**0.447**	**0.649**	**1.140**
Total for Five Cities	**0.308**	**0.323**	**0.391**	**0.604**	**0.982**	**1.521**	**3.110**

4.0 EXISTING WASTEWATER FACILITIES

The Cities of Boyd, Newark and Rhome have existing wastewater collection systems and treatment plants, while the Cities of Aurora and New Fairview are currently served exclusively by on-site sewage facilities (OSSFs). There are currently no wastewater treatment plants (WWTPs) in the study area that are operated by developers participating in this study. However, the proposed Ivy Hills development recently obtained a discharge permit from TCEQ to build a 0.300 MGD WWTP northwest of Boyd. The Rolling V Ranch development is in the process of preparing a discharge permit application to submit to TCEQ for a package plant on the property.

In addition to the treatment facilities listed above, two wastewater treatment facilities exist outside of the study area and/or are not participants in the regional study. The first WWTP facility is located in Chisholm Springs, just south of the Wise and Tarrant County line in Tarrant County; it is operated by Aqua Development, Inc. The second WWTP facility is located in Newark on the property of the Kenneth Copeland Ministries. This facility has a zero discharge permit. These two WWTP facilities are not included in the overall regional system at this time; however, the wastewater flows discharged by the Chisholm Springs WWTP were factored into the water quality modeling activities and evaluation.

A description of the existing wastewater facilities owned and operated by the Cities of Boyd, Newark and Rhome is provided in the sections below. Refer to Figure 4.1 for the location of the existing and planned treatment facilities; the existing WWTPs are shown in green and the planned WWTPs are shown in red.

4.1 City of Boyd

The City of Boyd provides wastewater service to about 550 connections, most of which are located in the central city area. Approximately 10 connections are in Highland Oaks, a new subdivision by Larry Cole Communities and located north of the city. The system includes primarily 6 and 8-inch gravity lines, nine lift stations of the submersible type (all but one with Flygt pumps and control systems), force mains, and a treatment plant on the eastern edge of the city.

Highland Oaks is served via a 12-inch gravity sewer that runs south from Highland Oaks along FM 730 to the West Fork of the Trinity River, a lift station on the north bank of the river (with two 10 Hp Meyers grinder pumps), and a force main that crosses the river and discharges into the City's sewer system south of the West Fork and about 1500 feet upstream of their WWTP. This system is reported to have cost about $1.24 million and was designed to serve Highland Oaks and lots adjacent to FM 730 and north of the West Fork of the Trinity River.

The existing wastewater treatment plant includes an influent micro-strainer and a flow equalization basin at the influent end of the plant. A lift station then pumps the wastewater to two parallel treatment "trains" each capable of treating 0.120 MGD. Each train consists of a concentric type wastewater treatment plant that includes an aeration tank, clarifier, sludge holding basin, chlorine contact tank, and flow meter (V-notch weir). The plant also includes two sets of sludge drying beds. Treated effluent is discharged into the West Fork of the Trinity River. Both plants were constructed with steel tanks. The second train, constructed in 2008, was recently brought online. A photo of the City of Boyd -- Phase II concentric circle type package WWTP (0.12 MGD design capacity) is shown below in Figure 4.2.

The plant is permitted for a daily average flow of 0.24 MGD and the 2-hour peak flow shall not exceed 500 gpm, which is equivalent to a flow rate of 0.72 MGD. The daily average limits for BOD (5-day) and TSS are each 20 mg/L (40 lbs/day on a load basis). There is no limit for ammonia nitrogen in the permit. Average daily flows typically range between 0.07 and 0.09 MGD during dry periods, but reached a daily flow of about 0.210 MGD during and following a 2.2-inch rain in March 2008. Other rain events have typically produced daily flows of 0.120 to 0.160 MGD. Thus, during dry periods the plant is typically operating at about 25% to 33% of its permitted capacity, and peak daily flows during wet periods can reach about 3 times the average daily dry weather flow.

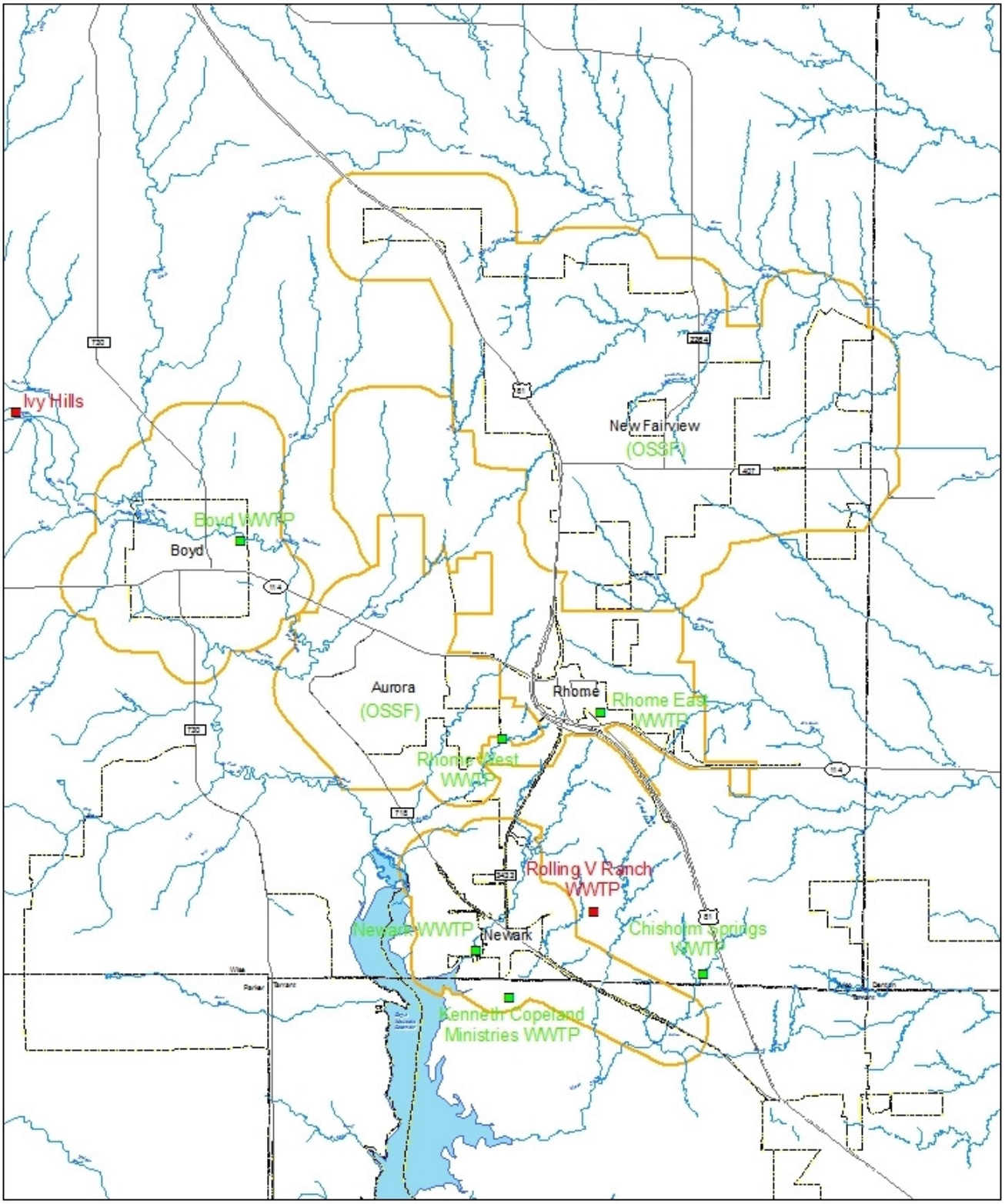


Figure 4.1: Existing and Planned Wastewater Treatment Plants

Figure 4.2: City of Boyd – Phase II Concentric Circle Type WWTP

Several problems with the newer treatment train have been reported including problems with the blowers and that the tankage was "out-of-round". As with the other plants, sludge drying can be a problem during rainy periods. A hydraulic problem related to a recently constructed gravity line, relative to the equalization basin, has also been reported.

The treatment plant is located on a 10-acre site that is owned by the City of Boyd. The City reports that there is easily enough room for two additional treatment trains of 0.12 MGD each, for a total plant capacity of almost 0.5 MGD. The project team has determined that the site could accommodate a treatment plant of 2 or even 3 MGD if the additional trains were built with higher capacities.

The City has a total of five staff with duties related to the wastewater system, including the Public Works Director, who estimates that these staff members spend about 50% of their time on the operation and maintenance of the wastewater collection system, lift stations, and the treatment plant. Their other duties include water supply and distributions, streets and drainage, and animal control.

4.2 City of Newark

The City of Newark provides wastewater service to its central area, to several schools and to the Chisholm Creek development north of the City. Currently, there are about 285 connections to the system. An additional 70 homes, located within the city limits, are served by OSSFs. Areas west and north of the City have been typically developed at about one lot per acre and most are not connected to the City's sewer system; although, there has been some interest expressed by some of the homeowners over the past few years. The City does not have any current plans to extend service into these areas.

Newark's wastewater system includes primarily 8-inch and 10-inch gravity lines, six lift stations of the submersible type, force mains, and a treatment plant on the southern edge of the city. The lift station serving the Chisholm Creek development and nearby schools is located east of FM 3433 and pumps through a force main which runs west along a private road to the east ROW of FM 3433 and

then south. The force main discharges into an 8-inch gravity sewer that continues south along FM 3433 towards central Newark.

The existing wastewater treatment plant consists of influent bar screens, an oxidation ditch aeration tank, two clarifiers, four sludge drying beds, a chlorine contact basin, a flow monitoring structure, and a flow equalization/de-chlorination basin. After de-chlorination, treated effluent flows through a series of wetland ponds prior to being pumped to a discharge into the Derrett Creek arm of Eagle Mountain Reservoir. The original plant was built in about 1978 and the wetlands were added in 1997. A photo of the aeration basin (foreground) and sludge drying beds (background) at the Newark WWTP is shown below in Figure 4.3.

Figure 4.3: Aeration basin and sludge drying beds at the Newark WWTP

The existing plant is permitted for a daily average flow of 0.10 MGD and the 2-hour peak flow shall not exceed 174 gpm, which is equivalent to a flow rate of 0.25 MGD. The daily average limits for CBOD (5-day), TSS, and ammonia nitrogen are 7, 15, and 2 mg/L, respectively (5.8, 13 and 1.7 lbs/day on a load basis).

Daily flows typically range between 0.045 and 0.055 MGD during dry periods, but the data provided by the City indicates that flows increase to 0.075 MGD during and following rain events. Thus, the plant is typically operating at about 45 to 55% of its permitted capacity during dry weather periods.

Several operating problems were reported by the City's staff. These included the difficulty of cleaning and maintaining the wetland ponds, inadequate sludge drying area for the weather often encountered, and low dissolved oxygen levels in the Derrett Creek arm of the lake. It was also observed that the original fixed aerators on the oxidation ditch had been replaced by floating aerators with horizontal shafts. The operators also report that the plant has had problems meeting the effluent limits, although with the new metering and sampling location, fewer violations have occurred.

The oxidation ditch, clarifiers, sludge drying beds, and chlorine contact basin are located on a 2-acre site that is owned by the City of Newark. The flow monitoring structure, flow equalization/de-chlorination basin and wetland ponds are located on property owned by Tarrant County WCID No. 1.

The usable portion of this property (above the 100 year flood plain) is about 7 acres in size. Tarrant County WCID No. 1 also owns additional land south of the existing treatment plant and wetlands.

Three City employees are responsible for operating and maintaining both the water and wastewater systems of Newark. The Public Works Director estimates that about 60% of their time is spent on wastewater collection and treatment.

4.3 City of Rhome

Rhome provides wastewater service to its central area and to the Ellis Homestead development west of Interstate 81/U.S. Highway 287. Currently, there are about 534 connections to the system. The system includes about 12-miles of 6, 8, 10 and 12-inch gravity lines (mostly PVC pipe but also some older sections of clay pipe), approximately 130 manholes, one lift station, and two treatment plants that are known as the East and West WWTPs. The lift station is located at the West WWTP and pumps directly into the plant. This lift station is equipped with two 7.5 Hp/325 gpm pumps.

The East WWTP is over 40 years old and consists of a small bar screen, an Imhoff tank, and two lagoons in series. The primary lagoon has a small floating aerator in it. The plant is equipped with sludge drying beds and with a gravity dewatering container, since the sludge drying beds have proved to be inadequate. The East WWTP is permitted for a daily average flow of 0.08 MGD and no 2-hour peak flow limit is noted in the permit. The daily average limits for BOD (5-day), and TSS are 30 mg/L and 90 mg/L respectively (or 20 and 60 lbs/day on a load basis). The effluent must contain at least 4.0 mg/L of dissolved oxygen. Effluent is discharged into Elizabeth Creek, which flows into Grapevine Lake. A photo of the Rhome East WWTP is shown below in Figure 4.4. Vegetation was recently removed from the lagoons at the time of the photo, and the City intended to remove additional vegetation surrounding the area. A floating aerator had been added recently to improve the performance of the pond.

Figure 4.4: Lagoons at the Rhome East WWTP

The West WWTP was built in 1997 and includes an influent lift station, a concentric circle type package plant, and additional structures. The unit processes include an influent bar screen,

aeration tank, clarifier, sand filters, a filtered water storage tank, a chlorine contact tank, and flow monitoring prior to discharge. Sludge processing includes an aerated sludge holding tank and sludge drying beds. Treated effluent is discharged into Oates Branch, which flows to the West Fork of the Trinity River just north of the upstream end of Eagle Mountain Reservoir. The West WWTP is permitted for a daily average flow of 0.15 MGD and the 2-hour peak flow shall not exceed 313 gpm, which is equivalent to a flow rate of 0.45 MGD. The daily average limits for CBOD (5-day), TSS, and ammonia nitrogen are 10, 15, and 3 mg/L, respectively (13, 19 and 3.8 lbs/day on a load basis). A photo of the Rhome West WWTP is shown below in Figure 4.5; it consists of a concentric circle type package WWTP (0.15 MGD design capacity). Filters and sludge drying beds are located behind the circular tank.

Figure 4.5: Rhome West WWTP – Concentric Circle Type WWTP

At the East WWTP, average daily flows, as measured by the effluent meter, are highly variable, but typically below 0.03 MGD during dry months, or about 40% of the permitted capacity of the plant. However, during a rainy period in March of 2008, flows reached 0.28 MGD (peak daily basis) and flows were above 0.20 MGD for several days during this period (equivalent to 6.7 to 9.3 times the typical average daily flow into the plant). The average daily flow during this rainy month of March 2008 was about 0.13 mgd, or about 160% of its permitted average daily flow limit of 0.08 MGD.

At the West WWTP, average daily flows are typically between 0.035 and 0.055 MGD during dry periods, or about 25% to 40% of the permitted capacity of the plant. This plant also experiences high peak flows during and after rain events. In March of 2008, flows reached 0.50 MGD (peak daily basis), which is equivalent to about 9 to 14 times the typical range of average daily flows into the plant as noted above. The average daily flow during this rainy month of March 2008 was about 0.20 MGD, or about 133% of its permitted average daily flow limit of 0.15 MGD.

From the flow information summarized above, infiltration/inflow (I/I) is quite high and has resulted in permit violations at both plants. The City has recently purchased smoke detection equipment and plans to conduct a study to identify the major sources of I/I. Since the initial system was installed in the late 1950s and early 1960s with clay pipe, it is anticipated that numerous sources of I/I will be discovered. Some of the clay pipe segments were replaced in the 1990s with PVC pipe, and the

high I/I indicates that additional replacements will probably be required. It is suspected that a wastewater line located under a stock pond may have been damaged when the pond was rebuilt and could be contributing a substantial amount of I/I.

The City reported that the West WWTP is operating fairly well except that the clarifier arm was scraping on one side of the clarifier, the site is subject to local flooding, and sludge drying is a problem. The City recently had to rent a portable belt press to dewater the accumulated sludge, and the purchase of a dewatering container is being considered.

On the other hand, the East WWTP relies on an outdated technology and pond maintenance is difficult and time consuming. It has been reported that the ponds have not been dredged over their 40-year life, and that although they were originally clay-lined, it is suspected that the clay liner has been compromised. Other operating problems include difficulties in keeping the gas vents open on the Imhoff tank due to the amount of grease and scum that float into these vent areas, and the difficulty of dewatering the anaerobic sludge produced by the plant. Complaints about odors in the vicinity of the East WWTP are common. An open-top Imhoff tank with anaerobic treatment and settling processes at the Rhome East WWTP are shown below in Figure 4.6. Lagoons with vegetation that has been removed recently are shown in the background.

Figure 4.6: An Open-Top Imhoff Tank at the Rhome East WWTP

The East WWTP is located on a 3-acre site on the southeast side of the city, and the two lagoons are located on about 10 acres of parkland adjacent to the WWTP. The West WWTP is located on a site adjacent to the Ellis Homestead development. Its 10-acre site could accommodate expansions up to a total capacity of approximately 0.45 MGD. In fact, the City reports that it is evaluating projects to expand the plant by either 0.15 MGD or 0.30 MGD. This expansion would allow for the closure of the East WWTP, which the City is anxious to accomplish due to the operating problems cited above. Wastewater flowing to the East WWTP would be diverted to a lift station, and then through approximately 3000 LF of force main, 3000 LF of gravity line, and eventually to the West WWTP. The City has estimated the cost of the lift station, force main and gravity sewer will be about $1.5 million. The City hopes to undertake this project by the year 2013.

Rhome's wastewater system is operated and maintained by the Director of Public Works and one assistant. The Director of Public Works estimates that they spend about 40% of their time on wastewater related activities, with the rest of their time devoted to water supply, streets, drainage, and miscellaneous activities.

In summary, the Cities of Boyd, Newark and Rhome have wastewater (WW) collection systems and treatment plants, while Aurora and New Fairview have only OSSFs. All three cities with WW systems have trouble with I/I and sludge drying. Newark's WWTP plant has little excess capacity and its age makes it difficult to operate. Cleaning and maintaining lagoons and wetlands is a problem for both Newark and Rhome (East WWTP). The City of Boyd is the only one with significant excess capacity.

5.0 DEVELOPMENT OF ALTERNATIVES

Prior to the development of the alternatives, each city's existing wastewater system and development patterns were investigated. In addition, the following factors were also considered:

- *Topography of the study area:* The distance between the cities, as well as the direction of the drainage flows in the area impact the planning of a regional system. A ridgeline runs north to the south, parallel to US Highway 81 (reference Figure 5.1). As a result, gravity sewers in the New Fairview area and eastern part of Rhome would flow to the east; gravity sewers in Aurora, Newark and the western part of Rhome would flow to the southwest (towards Newark);
- *Physical barriers to regionalization:* The West Fork of the Trinity River may present an obstacle to Boyd physically joining a regional system;
- *Number of sub-basins:* The greater the number of lift stations required to pump flows across the sub-basins increases the overall cost (construction and O&M) for each city; and,
- *Existing and anticipated development densities:* If denser developments are encouraged by the cities, the viability of developing or expanding a centralized wastewater system will be improved.

5.1 Impact of Development Densities on Cost of Wastewater Systems

The planning of wastewater facilities is often driven by future development rather than existing development. For areas served by a centralized wastewater system, the density of developments typically range from 2 to 3.5 lots per acre. Centralized wastewater service is more expensive than OSSFs for lot sizes greater than an acre.

As shown in Figure 3.1, a majority of the existing developments in the study area have average densities of less than one lot per acre. Development densities have a considerable impact on the sizing of wastewater collection facilities. In order for centralized wastewater treatment to become more cost effective, the cities would need to promote and encourage higher density developments, targeting 2 to 3.5 lots per acre. Figure 5.2 below depicts the relationship of the lot size versus the cost of implementing septic or centralized wastewater treatment. Note that Wise County requires a minimum lot size of one acre for conventional septic tank/drainfield systems; Figure 5.2 does not present a cost for these types of systems below a lot size of one acre.

As shown, the cost for implementing centralized wastewater treatment is more cost-effective for lot sizes of one acre and less. This information established the basis for classifying the existing and

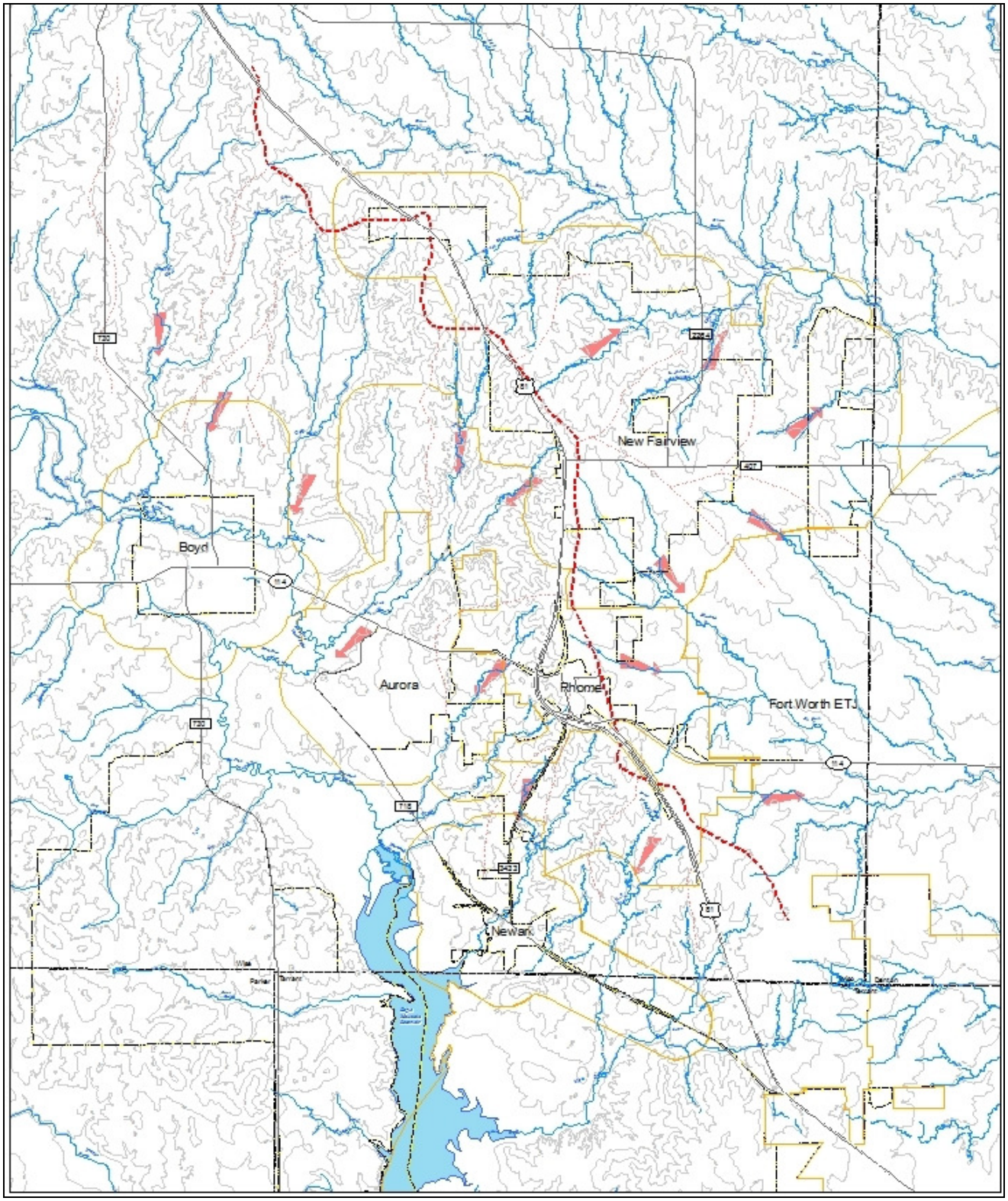
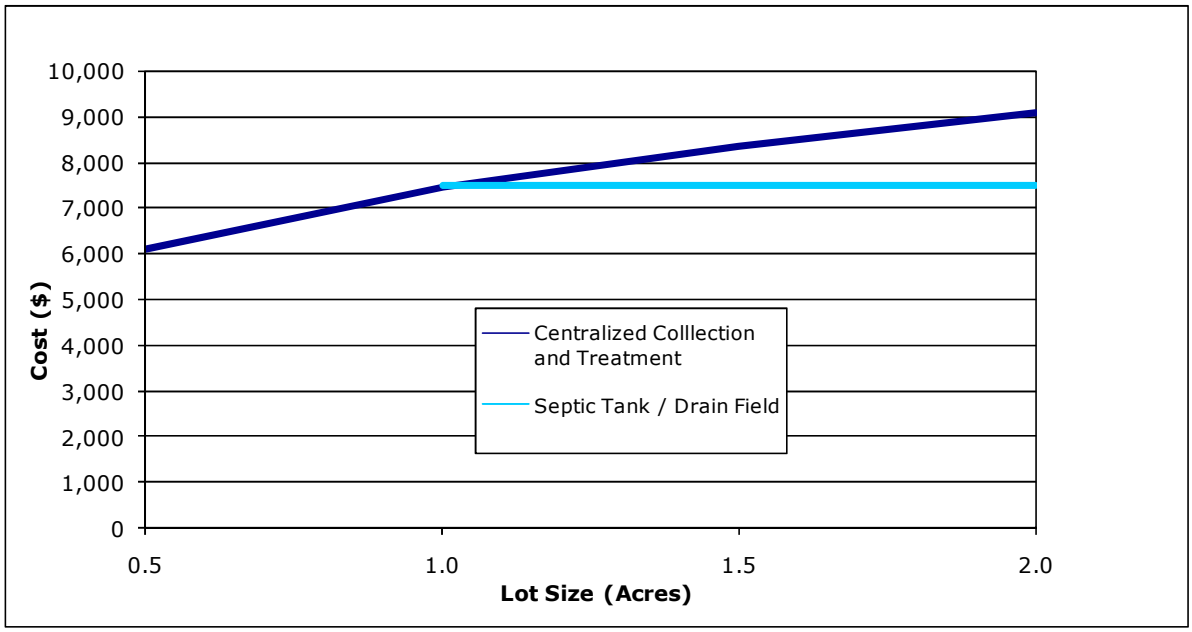


Figure 5.1: Topographic Map of Study Area

future developments within each of the cities. The source of the data in Figure 5.2 is based on bid prices from recent projects of varying capacities.

Since an aerobic-type OSSF system is typical for the rocky terrain, located north of FM 114 in the City of Aurora, the cost estimate for this type of system was estimated at $7,500 and used for cost comparison purposes in Figure 5.2.

Figure 5.2: Cost Trend for Centralized Service vs. Lot Size



5.2 General Observations

A description of each city's existing wastewater system has already been presented in the previous section. Important observations regarding development patterns for each city are noted below.

City of Aurora

Although the City of Aurora is served entirely by septic systems, they have a strong desire to provide wastewater service to commercial developments along the Highway 114 corridor. Previous developments constructed in the City of Aurora have been low density subdivisions with an average of less than one lot per acre. In addition, future development proposed for the area also appears to be planned for low density; however, property along Highway 114 may be developed at a higher density with 1/3 acre lots.

During the data collection activities, the City identified the following areas as potential sites for receiving reuse water:

- Aurora City Park (40 acres)
- Aurora Sand Mining Pit (40 acres)
- Aurora Vista Storage Pond Site (20 acres)

City of Boyd

A majority of the City of Boyd's development is connected to their centralized wastewater system, including the Highland Oaks subdivision. The City's WWTP is relatively new and has been recently

expanded to double its treatment design capacity. The City's WWTP will be able to serve a portion of the developments by Larry Cole Communities proposed for the area northwest of Boyd. These developments (Ivy Hills and Boyette Tract) will require doubling the capacity of the existing WWTP again in order to serve their entire build-out of projected equivalent dwelling units (EDUs).

City of Newark

A majority of the City of Newark's development is connected to their centralized wastewater system. However, developments located to the west and north of the City have been typically constructed at one lot per acre and these areas are primarily not connected to the City's wastewater system. Most of the undeveloped property within Newark's ETJ is either within the Rolling V Ranch or borders Highway 718 southeast of the City.

City of New Fairview

Developments to date in the City of New Fairview have been low density since the City is served entirely by septic systems. The City's website indicates there is a one-acre minimum lot size requirement currently in effect. As shown in Figure 3.1, residential developments are fairly dispersed as a result. The 287 Travel Center, Skyview Ranch, and Rio Rancho Estates are the only developments with population densities and potential wastewater flows that might justify the construction of a wastewater system.

A review of New Fairview's future land use plan indicates a continuation of "very low density" residential development. The plan notes that higher densities will "not (be) prohibited but (they would be) expected to be unique in development design". The plan shows that an industrial / commercial strip is proposed along US Highway 287/State Highway 81; approximately nine commercial "nodes" or areas of development are also planned throughout the City's ETJ.

City of Rhome

A majority of the City of Rhome's developments are connected to their centralized wastewater system. Developments in the City have been higher density, except those located in the outlying areas. Since the Rhome East WWTP has outdated technology, the City plans to abandon it in the near future. The Rhome West WWTP is relatively new, but experiences I/I problems which have resulted in WWTP capacity issues. However, the City has plans to conduct an I/I reduction program. The City currently plans to either double or triple the treatment capacity of the Rhome West WWTP. Unless regionalization occurs, the City will abandon the Rhome East WWTP and expand the Rhome West WWTP.

5.3 Development and Description of Initial Alternatives

Based on the extent of the existing wastewater systems and on the development patterns and other factors presented in the previous section, a total of eight initial alternatives were developed. These alternatives are described in the following paragraphs and are shown schematically in the referenced figures in Appendix A. A summary of the advantages and disadvantages is presented in the following section along with the results of the screening of the initial alternatives.

Base Case: No Regionalization

A Base Case alternative was developed to serve as a benchmark against which the alternatives could be compared. The Base Case assumes that the typical development patterns for each city would continue and that large new developments would pursue their own wastewater systems. Refer to Figure A.1 in Appendix A for a schematic of this alternative. The Base Case is further described as follows:

- Newark renovates/expands its WWTP and serves smaller new developments;
- Boyd serves some new developments, up to the capacity of its existing WWTP;
- Rhome abandons the Rhome East WWTP and expands the Rhome West WWTP;
- Aurora and New Fairview continue to be served by on-site septic systems;
- The proposed Ivy Hills development builds a 0.300 MGD WWTP northwest of Boyd; and,
- The proposed Rolling V Ranch obtains a wastewater discharge permit and constructs a WWTP east of Newark.

Option A: Cities Remain Independent

In Option A, each of the cities remains independent and continues with their current type of wastewater system. The Cities of Aurora and New Fairview remain on septic systems. However, the Cities of Boyd, Newark and Rhome expand their WWTPs to serve developers nearby and new growth. Refer to Figure A.2 in Appendix A for a schematic of this alternative. Details of Option A are presented below:

- Newark renovates & expands its existing WWTP or constructs a new WWTP on a different site; Newark serves Rolling V Ranch and other new developments;
- Boyd serves Ivy Hills and other new developments, expanding the capacity of its existing WWTP by approximately two-fold;
- Rhome abandons the Rhome East WWTP and expands the Rhome West WWTP as needed to serve new developments; and,
- Aurora and New Fairview continue to be served by on-site septic systems.

Option A-1: Cities Remain Independent (WWTPs for Aurora & New Fairview)

In Option A-1, each of the cities remains independent and continues with their current type of wastewater system; however, the Cities of Aurora and New Fairview construct their own package WWTPs to serve commercial areas and/or denser residential developments. The Cities of Boyd, Newark and Rhome expand their WWTPs to serve developers nearby and new growth. Refer to Figure A.3 in Appendix A for a schematic of this alternative. Details of Option A-1 are presented below:

- Newark renovates & expands its existing WWTP or constructs a new WWTP on a different site; Newark serves Rolling V Ranch and other new developments;
- Boyd serves Ivy Hills and other new developments, expanding the capacity of its existing WWTP by approximately two-fold;
- Rhome abandons the Rhome East WWTP and expands the Rhome West WWTP as needed to serve new developments; and,
- Aurora and New Fairview build small package WWTPs for commercial areas and/or denser residential developments; however, the City mostly relies on individual on-site septic systems.

Option B: Partial Regionalization (Newark, Rhome & Rolling V Ranch)

In Option B, regionalization would begin with the cooperation of the Cities of Newark and Rhome. A new regional WWTP would be constructed to serve both cities, as well as Rolling V Ranch. The Cities of Aurora and New Fairview remain on septic systems. The City of Boyd remains independent from the regional system and eventually expands their WWTP to serve other new developments in the area. Refer to Figure A.4 in Appendix A for a schematic of this alternative. Option B is further described below:

- Rhome abandons the Rhome East WWTP and pumps to the Rhome West WWTP; flows in excess of the capacity of the West WWTP are routed through Rolling V Ranch to the Regional WWTP; the Rhome West WWTP is eventually abandoned;

- Boyd serves Ivy Hills and other new developments, expanding the capacity of its existing WWTP by approximately two-fold; and,
- Aurora and New Fairview continue to be served by on-site septic systems.

Option B-1: Partial Regionalization (including Aurora)

In Option B-1, regionalization would begin with the cooperation of the Cities of Newark and Rhome; service is extended to the City of Aurora to include them in the regional system. A new regional WWTP would be constructed to serve both cities, as well as Rolling V Ranch. The City of New Fairview would remain on septic systems. The City of Boyd remains independent from the regional system and eventually expands their WWTP to serve other new developments in the area. Refer to Figure A.5 in Appendix A for a schematic of this alternative. Option B-1 is further described below:

- Regional entity includes Newark, Rhome, Rolling V Ranch and parts of Aurora;
- As in Option B, Rhome abandons the Rhome East WWTP and pumps to the Rhome West WWTP; flows in excess of the capacity of the West WWTP are routed through Rolling V to the Regional WWTP; eventually the Rhome West WWTP is abandoned;
- Aurora remains primarily on septic systems, but wastewater flows from commercial and denser residential areas are routed through Rolling V Ranch to the Regional WWTP;
- Boyd serves Ivy Hills and other new developments, expanding the capacity of its existing WWTP by approximately two-fold; and,
- New Fairview continues to be served by on-site septic systems.

Option B-2: Partial Regionalization (including Aurora & New Fairview)

In Option B-2, regionalization is initiated with the cooperation of Rolling V Ranch and the Cities of Newark and Rhome; service is extended to the City of Aurora and New Fairview to include them in the regional system. The City of Boyd remains independent from the regional system and eventually expands their WWTP to serve other new developments in the area. Refer to Figure A.6 in Appendix A for a schematic of this alternative. Option B-2 is further described below:

- Regional entity renovates & expands Newark's existing WWTP or constructs a new WWTP on a different site; serves Rolling V Ranch, Rhome and parts of Aurora and New Fairview;
- As in Option B, Rhome abandons the Rhome East WWTP and pumps to the Rhome West WWTP; flows in excess of the capacity of the Rhome West WWTP are routed through Rolling V Ranch to the Regional WWTP; eventually the Rhome West WWTP is abandoned;
- Aurora and New Fairview remain primarily on septic systems, but wastewater flows from commercial and denser residential areas are routed to the Regional WWTP; and,
- Boyd serves Ivy Hills and other new developments, expanding the capacity of its existing WWTP by approximately two-fold.

Option C: Partial Regionalization (including Aurora & Boyd)

In Option C, regionalization would begin with the cooperation of Rolling V Ranch and the Cities of Newark and Rhome; service is extended to the Cities of Aurora and Boyd to include them in the regional system. A new regional WWTP would be constructed to serve the entities. The City of New Fairview would remain on septic systems. Refer to Figure A.7 in Appendix A for a schematic of this alternative. Option C is further described below:

- As in Option B-1, the regional entity renovates & expands Newark's existing WWTP or constructs a new WWTP on a different site; serves Rolling V Ranch, Rhome, parts of Aurora and Boyd;
- Rhome abandons the Rhome East WWTP and pumps to the Rhome West WWTP; flows in excess of the capacity of the Rhome West WWTP are routed through Rolling V Ranch to the Regional WWTP; eventually the Rhome West WWTP is abandoned;

- Aurora remains primarily on septic systems, but wastewater flows from commercial and denser residential areas are routed through Rolling V Ranch to the Regional WWTP;
- Boyd serves Ivy Hills and other new developments, but does not expand the capacity of its existing WWTP. Wastewater flows in excess of its capacity are routed through Aurora to the Regional WWTP; eventually, the Boyd WWTP is abandoned; and,
- New Fairview continues to be served by on-site septic systems.

Option C-1: Complete Regionalization

In Option C-1, complete regionalization is achieved by starting with the cooperation of Rolling V Ranch and the Cities of Newark and Rhome; service is extended to the Cities of Aurora, Boyd and New Fairview to include them in the regional system. A new regional WWTP would be constructed to serve the entities. Refer to Figure A.8 in Appendix A for a schematic of this alternative. Option C-1 is further described below:

- Regional entity renovates & expands Newark's existing WWTP or constructs a new WWTP on a different site; serves the entire area, except for those areas served by septic systems;
- As in Option C, Rhome abandons the Rhome East WWTP and pumps to the Rhome West WWTP; flows in excess of the capacity of the Rhome West WWTP are routed through Rolling V Ranch to the Regional WWTP; eventually the Rhome West WWTP is abandoned; and,
- As in Option C, Aurora remains primarily on septic systems, but wastewater flows from commercial and denser residential areas are routed through Rolling V Ranch to the Regional WWTP;
- As in Option C, Boyd serves Ivy Hills and other new developments, but does not expand the capacity of its existing WWTP. Wastewater flows in excess of its capacity are routed through Aurora to the Regional WWTP; eventually, the Boyd WWTP is abandoned; and,
- New Fairview remains primarily on septic systems, but wastewater flows from commercial and denser residential areas are routed to the Regional WWTP.

In summary, the Base Case assumes that no regionalization will occur and there would essentially be "no change" in the development patterns for each city. The large developers would each develop their own wastewater collection and treatment systems. The Cities of Aurora and New Fairview would continue their reliance on OSSFs. Options A and A-1 are minor variations of the "Base Case" with the Cities of Aurora and New Fairview constructing their own WWTPs. Cities of Boyd and Newark extend wastewater service to nearby developments.

The "B" options all assume that regionalization would begin with the cooperation of Newark, Rhome and Rolling V Ranch. Options B-1 and B-2 consider variations for extending service to Aurora and New Fairview. The City of Boyd remains independent in all of the "B" options. Options C and C-1 show a regional system including Newark, Rhome, Rolling V Ranch and Aurora. Both options eventually add Boyd to the overall regional system. In Option C-1, New Fairview is also included into the regional system.

5.4 Advantages and Disadvantages of Initial Alternatives

In order to assess the eight initial alternatives previously listed, a matrix was developed to summarize the advantage and disadvantage view points for each alternative. This matrix, presented below in Table 5.1, was used as a tool during the screening process to reduce the total number of alternatives down to three final alternatives for further evaluation.

Table 5.1: Evaluation of Initial Alternatives

Alternatives	Advantages	Disadvantages
Base Case	• No cooperation required between parties. Each entity can plan, finance, construct and operate their system independently.	• Potentially five or more WWTPs operating in the area. • No economies of scale achieved for construction, operation or management of systems. • Greater risk of WWTP upset or inability to meet effluent limits.
Option A	• No cooperation required between parties. Each entity can plan, finance, construct and operate their system independently. • WWTPs owned and operated by developers are avoided.	• Few economies of scale achieved for construction, operation or management of systems. • Greater risk of WWTP upset or inability to meet effluent limits.
Option A-1	• No cooperation required between parties. Each entity can plan, finance, construct and operate their system independently. • WWTPs owned and operated by developers are avoided. • Aurora and New Fairview construct centralized wastewater systems to serve portions of commercial and denser residential developments.	• Few economies of scale achieved for construction, operation or management of systems. • Greater risk of WWTP upset or inability to meet effluent limits.
Option B	• Minimal cooperation required between the entities to initiate regional system. • Regionalization initiated in areas of denser development with existing collection systems. • Utilizes infrastructure constructed for planned developments (i.e. Rolling V Ranch wastewater lines). • WWTPs owned and operated by developers are avoided. • Regional system initiated with the potential for future expansions. • Economies of scale achieved for construction, operation or management of system.	• Aurora and New Fairview are without centralized wastewater systems to serve portions of commercial and denser residential developments. • Boyd is not part of the regional system.
Option B-1	• Minimal cooperation required between the entities to initiate regional system. • Regionalization initiated in areas of denser development with existing collection systems. • Utilizes infrastructure constructed for planned developments (i.e. Rolling V Ranch wastewater lines). • WWTPs owned and operated by developers are avoided. • Regional system initiated with the potential for future expansions. • Economies of scale achieved for construction, operation or management of system. • Aurora included in regional system to serve portions of commercial and denser residential developments.	• New Fairview is without centralized wastewater systems to serve portions of commercial and denser residential developments. • Boyd is not part of the regional system.

Alternatives	Advantages	Disadvantages
Option B-2	• Minimal cooperation required between the entities to initiate regional system. • Regionalization initiated in areas of denser development with existing collection systems. • Utilizes infrastructure constructed for planned developments (i.e. Rolling V Ranch wastewater lines). • WWTPs owned and operated by developers are avoided. • Regional system initiated with the potential for future expansions. • Economies of scale achieved for construction, operation or management of system. • Aurora and New Fairview included in regional system to serve portions of commercial and denser residential developments.	• Boyd is not part of the regional system.
Option C	• Almost all of the wastewater in area is treated at one WWTP. • Regionalization occurring in areas of denser development with existing collection systems. • Utilizes infrastructure constructed for planned developments (i.e. Rolling V Ranch wastewater lines). • WWTP expansions for Boyd and Rhome may be avoided. • Maximum economies of scale achieved for construction, operation or management of system.	• New Fairview is without a centralized wastewater system to serve portions of commercial and denser residential developments.
Option C-1	• All wastewater in area is treated at one WWTP, which results in one discharge to be received at Eagle Mountain Lake. • Regionalization occurring in areas of denser development with existing collection systems. • Utilizes infrastructure constructed for planned developments (i.e. Rolling V Ranch wastewater lines). • WWTP expansions for Boyd and Rhome may be avoided. • Maximum economies of scale achieved for construction, operation or management of system.	

As a follow-up to the matrix above, the viability of a regional system for the study area will depend on whether the development plans for future subdivisions will be based on large lots served by individual septic systems or smaller lots with centralized wastewater collection and treatment. Due to the physical location and build-out plans of the Rolling V Ranch development, it will serve as the determinant for a regional system that could initially include the Cities of Newark and Rhome.

5.5 Screening of Initial Alternatives

The screening of the initial alternatives was accomplished during the second project meeting on January 26, 2009. The objective of the screening process was to reduce the total number of alternatives from eight down to three final alternatives for further evaluation. For the project meeting, a presentation was given that outlined all eight of the initial alternatives, including the advantages and disadvantages of each. The presentation also included general observations of each alternative that were relevant to the screening process.

The primary observations that were presented addressed the fact that the viability of a regional system will depend on the development density plans for future subdivisions, which influences whether OSSF systems or centralized wastewater collection/treatment systems are constructed. Another key factor involves the willingness of the Cities of Newark and Rhome to work together with the Rolling V Ranch development to achieve economies of scale of a regional wastewater system.

Additional important observations that were presented included the following:

- Beneficial results could be achieved by the City of Boyd and Ivy Hills working together, even if Boyd does not participate in the overall regional system;
- Aurora's participation is not essential to the viability of the initial regionalization, but it would facilitate the inclusion of Boyd into the regional system; and,
- Viability of the regional system is not dependent on New Fairview's participation.

Following the presentation, the participants were divided into three groups for a "working session" to discuss the eight initial alternatives, as well as the observations of the consulting team about the study area. The first group was comprised of the Cities of Aurora and New Fairview since they both were served completely by OSSF systems. The second group was made up of the City of Boyd and Larry Cole Communities because of their close proximity to each other and potential regional opportunities between the two parties. Rolling V Ranch and the Cities of Newark and Rhome met together in the third group since they could most likely be the initial players to form the regional system.

Facilitated discussions were held with each of the three groups as part of the process to gather feedback and narrow down the list of alternatives. During the working session, the following comments were emphasized by the participants about the initial alternatives and the perceived impact on their respective cities:

- The Base Case should be included as one of the final alternatives to evaluate in order to establish a base line for comparison purposes against the regional alternatives;
- Aurora and New Fairview wanted to explore the possibility of constructing centralized wastewater systems in parts of their cities and small package WWTPs to serve these areas in the Base Case alternative;
- Option B, B-1 or B-2 needed to be evaluated because they were expected to compare favorably to the Base Case. Furthermore, all of the "Option B" alternatives could be implemented initially with Newark, Rhome and Rolling V Ranch; however, the regional system could be expanded at a later date to include Aurora, Boyd and New Fairview; and,

- Option C-1 should be selected as one of the final alternatives for evaluation in order to assess the impact of complete regionalization.

As a result, the working session was a successful exercise, and all three groups were able to reach consensus on three final alternatives for further evaluation in the study.

5.6 Regional Alternatives Selected for Detailed Evaluation

Based on the feedback received during the working session, three final regional alternatives were selected for evaluation:

- Modified Base Case
- Option B
- Option C (previously referred to as Option C-1)

These three final alternatives are described in further detail in the paragraphs below.

Base Case (Modified)

The modified version of the Base Case includes all of the aspects of the original Base Case Option, but also involves the Cities of Aurora and New Fairview constructing centralized wastewater collection systems with package WWTPs to serve areas of commercial and higher-density residential developments. A summary of this revised alternative is provided below:

- Each party works independently from the others; no regionalization occurs;
- Newark renovates/expands its WWTP and serves smaller new developments (not including Rolling V Ranch);
- Boyd serves some new developments, up to the capacity of its existing WWTP;
- Rhome abandons its East WWTP, expands the West WWTP and serves smaller new development (not including Rolling V Ranch);
- The proposed Ivy Hills development builds a 0.300 MGD WWTP northwest of Boyd;
- The proposed Rolling V Ranch obtains a permit and builds a WWTP east of Newark; and,
- Aurora and New Fairview construct package WWTPs to serve commercial and high- density residential developments.

Regarding the City of Boyd, some new developments located in close proximity to the City would be served by the City's existing WWTP up to its capacity, but developments located outside of the ETJ would be served by WWTPs constructed by developers. As a result, wastewater flows from Highland Oaks and the 200-Acre Tract would be treated by the City of Boyd WWTP, and wastewater flows from the Boyette Tract would be pumped to the Ivy Hills WWTP for treatment. This would probably mean that the discharge permit for the Ivy Hills WWTP would need to be renewed for a higher flow amount.

Option B: Partial Regionalization

As a result of the working session, the participants agreed that Option B seemed the most promising alternative for implementing the regional system. The consulting team identified the existing Newark WWTP site, as well as two other possible sites located within Newark's ETJ for a regional system. A brief description of these plant sites is presented in Section 6.2. Details summarized for this alternative are noted below:

- Regionalization initiated between Rolling V Ranch and the Cities of Newark and Rhome;
- Newark WWTP either expanded or Regional WWTP constructed on a new site to serve Newark, Rolling V Ranch and Rhome;

- Rhome abandons its East WWTP and eventually its West WWTP; flows are routed through Rolling V Ranch to the Regional WWTP;
- Rhome eventually abandons its West WWTP;
- Boyd serves Ivy Hills and other new developments; and,
- Aurora and New Fairview continue to be served by on-site septic systems.

Option C: Complete Regionalization

During the working session, the participants also agreed that Option C should be included in the final evaluation of the project in order to understand the entire plan for a regional wastewater system to serve all cities and developments in the study area. In addition to the existing Newark WWTP site, the consulting team determined that the two other possible sites considered in Option B should also be considered for Option C. A brief description of these plant sites is presented in Section 6.3. Details summarized for this alternative are noted below:

- Wastewater for entire area treated at one WWTP;
- Newark WWTP either expanded or Regional WWTP constructed on a new site to serve the entire study area, except those homes currently on septic systems;
- Rhome abandons its East WWTP; flows are routed through Rolling V Ranch to the Regional WWTP;
- Rhome eventually abandons its West WWTP;
- Aurora remains primarily on septic; flows from commercial/denser residential areas are routed through Rolling V Ranch to the Regional WWTP;
- Boyd serves Ivy Hills and other new developments, but does not expand the capacity of its existing WWTP; flows in excess of the Boyd WWTP capacity are routed through Aurora to the Regional WWTP;
- Boyd eventually abandons its WWTP; and,
- New Fairview remains primarily on septic systems; flows from commercial/denser residential areas routed to the Regional WWTP.

Although the City of Boyd is physically separated from the other cities by the West Fork of the Trinity River, Boyd expressed an interest in knowing what infrastructure would be necessary, along with projected cost estimates, for them to eventually join the regional system in the future.

5.7 Effluent Reuse Evaluation

The evaluation also included assessments of how effluent reuse might be incorporated into each alternative. The assessment indicated that there were few existing opportunities for the reuse of substantial quantities of effluent, and the sites that were identified were dispersed. With the assistance of the participants and the aerial maps, the following existing sites were identified:

- Aurora City Park (40 acres)
- Aurora Sand Mining Pit (40 acres)
- Aurora Vista Storage Pond Site (20 acres)
- Boyd City Park (5 acres)

In addition to the existing sites, the proposed Newark City Park (approximately 15 acres) would be available as a potential reuse site. However, the best potential for reuse would be a golf course on the Rolling V Ranch development. At this point in time, the developer has not decided if a golf course will be included in the development plans for Rolling V Ranch, but it is being considered.

If a golf course were included as part of the Rolling V Ranch development, then a reuse water distribution system (sometimes referred to as a “purple pipe system”) could be considered for

making reuse water available to individual homeowners and business owners, especially those that would be located between the golf course and the treatment plant.

Without the golf course, it is doubtful that a reuse water system would be economically feasible at this point in time. It is important to note that implementing a reuse system will generally require additional capital upfront from the developer to install the purple pipe reuse distribution system.

The majority of existing potential reuse sites is not large enough to justify the installation of a reuse system and most are located too far away from the regional WWTP sites in Options B and C. However, they could be considered in the Modified Base Case since some of these sites are relatively close to the WWTPs of the individual entities.

5.8 Water Conservation and Drought Contingency Plans

Senate Bill 1 (SB-1), passed by the Texas Legislature in 1997, increased the number of entities required to submit water conservation and drought contingency plans. As part of a regionalization strategy, all involved entities would need to draft and adopt Water Conservation and Drought Contingency Plans under the conditions of SB-1. In addition, the TWDB requires project participants receiving grant funding through the Regional Water/Wastewater Facilities Planning Grant Program to prepare and implement water conservation and drought contingency plans. These plans must meet all minimum requirements outlined by the Texas Commission on Environmental Quality (TCEQ).

The source of water for the study area is primarily groundwater; however, a number of the cities purchase treated water from Walnut Creek Special Utility District. TRA and TRWD already have water conservation and drought contingency plans in place. Sample templates for preparing water conservation and drought contingency plans are provided in Appendix F and G for reference. These templates were provided by the Texas Water Development Board and have been used by previous participants of TWDB planning studies as a guide.

6.0 WATER QUALITY MODELING

As part of the study, a water quality evaluation was conducted to evaluate the impact of the proposed regional and local wastewater treatment plant sites on the future water quality in Eagle Mountain Lake. Modified Base Case, Option B and Option C were evaluated utilizing a CSTR spreadsheet and QUAL-TX models, both developed by TCEQ, to quantify effluent limitations DO, $CBOD_5$, and NH_3-N for each of the three scenarios. The evaluation was based on flows representing the ultimate build-out of planned developments and population projections for the cities through 2030. The results and recommendations of potential options for regional wastewater treatment facilities in Southeast Wise County are presented below. These findings also include proposed water quality effluent standards for differing regional wastewater treatment alternatives.

6.1 Modified Base Case

This scenario represents the existing WWTPs of City of Boyd, City of Rhome, City of Newark and proposed Aurora, Rolling V Ranch and Ivy Hills WWTPs acting independently from the others with no regionalization. Currently Aurora is served exclusively with septic system; however for Modified Base Case, Aurora will have a WWTP that discharges into Blue Creek; thence to Eagle Mountain Lake. Wastewater flows from City of Rhome East WWTP have been combined with and modeled at City of Rhome West WWTP location and will discharge into Oates Branch thence to Eagle Mountain Lake. Rolling V Ranch WWTP has been modeled as a WWTP at the Unnamed Tributary south of Derrett Creek. Figure 4.1 illustrates the locations of all existing and future WWTPs. Table 6.1

provides a summary of proposed wastewater flows for each entity in the Modified Base Case for year 2030 with ultimate build-out of developments.

Table 6.1: Modified Base Case – Summary of Proposed Wastewater Flows

Entity	Treatment Facility	Discharge Stream	Wastewater Flows (MGD)*
Aurora	Individual	Blue Creek	0.460
Boyd	Individual	W. Fork Trinity River (Segment 0810)	0.255
Ivy Hills & Boyette Tract	Individual	W. Fork Trinity River (Segment 0810)	0.436
Newark	Individual	Derrett Creek Arm of Eagle Mountain Lake	0.136
Rhome (West & East WWTPs)	Individual	Oates Branch	0.230
Rolling V Ranch	Individual	Unnamed Tributary, South of Derrett Creek	1.503

* Wastewater flows are based on Year 2030 population projections and ultimate build-out of developments.

6.2 Option B: Partial Regionalization

In Option B, the City of Boyd WWTP will serve Ivy Hills and the Boyette Tract. Regionalization is initiated between the City of Newark, the City of Rhome, and Rolling V Ranch. Wastewater flows from City of Rhome (East & West), City of Newark and Rolling V Ranch would be treated at one of three different potential regional plant sites. The three potential regional plant sites include the Newark Regional Plant, Unnamed Tributary Regional Plant and the Moss Branch Regional Plant Site. Note that there are two possible effluent discharge locations for the Moss Branch Regional Plant Site, either Moss Branch or Indian Creek. A brief description of each regional plant site is noted in the following sections. Table 6.2 summarizes the proposed wastewater flows for Option B.

Table 6.2: Option B – Summary of Proposed Wastewater Flows

Entity	Treatment Facility	Wastewater Flows (MGD)*	Discharge Stream	Total Wastewater Flows (MGD)
Boyd	Boyd WWTP	0.255	W. Fork Trinity River (Segment 0810)	0.690
Ivy Hills & Boyette Tract	Boyd WWTP	0.436		
Newark	Regional	0.136	Derrett Creek, Unnamed Tributary, Moss Branch, Indian Creek	1.869
Rhome (West & East WWTPs)	Regional	0.230		
Rolling V Ranch	Regional	1.503		

* Wastewater flows are based on Year 2030 population projections and ultimate build-out of developments.

6.2.1 Newark Regional Plant Site

The City of Newark operates one WWTP that discharges into a wetlands facility prior to discharging into Derrett Creek Cove of Eagle Mountain Lake (reference Figure 6.1). This existing facility is modeled as a regional plant for Option B with accumulated flows from City of Rhome (East & West), Rolling V Ranch and City of Newark for year 2030.

6.2.2 Unnamed Tributary Regional Plant Site

Figure 6.2 illustrates the location of Unnamed Tributary Regional Plant that discharges into Unnamed Tributary just south of Derrett Creek. This regional facility was modeled for accumulated flows as mentioned above.

6.2.3 Moss Branch Regional Plant Site (Discharge to Moss Branch)

The proposed Moss Branch Regional Plant will be located south of US Highway 718. Figure 6.3 illustrates the location of Moss Branch regional plant that discharges to Moss Branch; thence to Indian Creek Cove of Eagle Mountain Lake.

6.2.4 Moss Branch Regional Plant Site (Discharge to Indian Creek)

As shown in Figure 6.3, the proposed regional plant site is located upstream of the confluence of Moss Branch with Indian Creek and just south of US Highway 718. In this case, the Moss Branch Regional Plant will discharge into Indian Creek; thence to Indian Creek Cove of Eagle Mountain Lake.

6.3 Option C: Complete Regionalization

Option C represents complete regionalization where the wastewater for the entire area including Ivy Hills, Rolling V Ranch and Cities of Aurora, Boyd, Newark, New Fairview and Rhome (East & West) will be treated at one of four different potential regional plant sites. The locations of regional plants are the same as described in Option B. The City of New Fairview operates one WWTP that discharges into Lake Grapevine; however, for Option C the wastewater flows from New Fairview will be part of the regional plant scenarios and will discharge into Eagle Mountain Lake. Figure 6.4, Figure 6.5 and Figure 6.6 illustrate the locations of Newark Regional Plant, Unnamed Tributary Regional Plant, Moss Branch Regional Plant and Indian Creek Regional Plant. Table 6.3 summarizes the proposed wastewater flows for Option C.

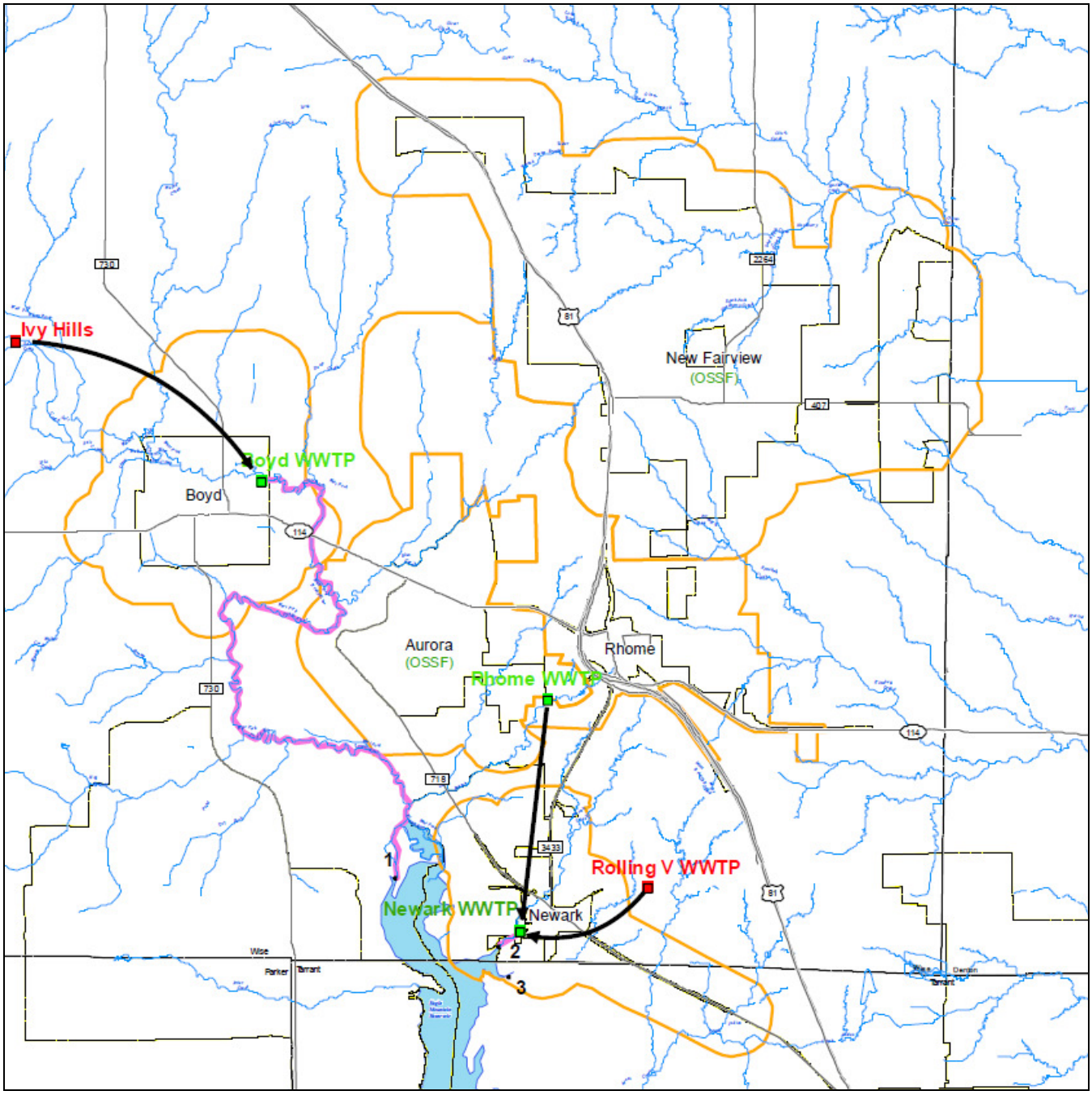


Figure 6.1: Option B – Discharge into Derrett Creek

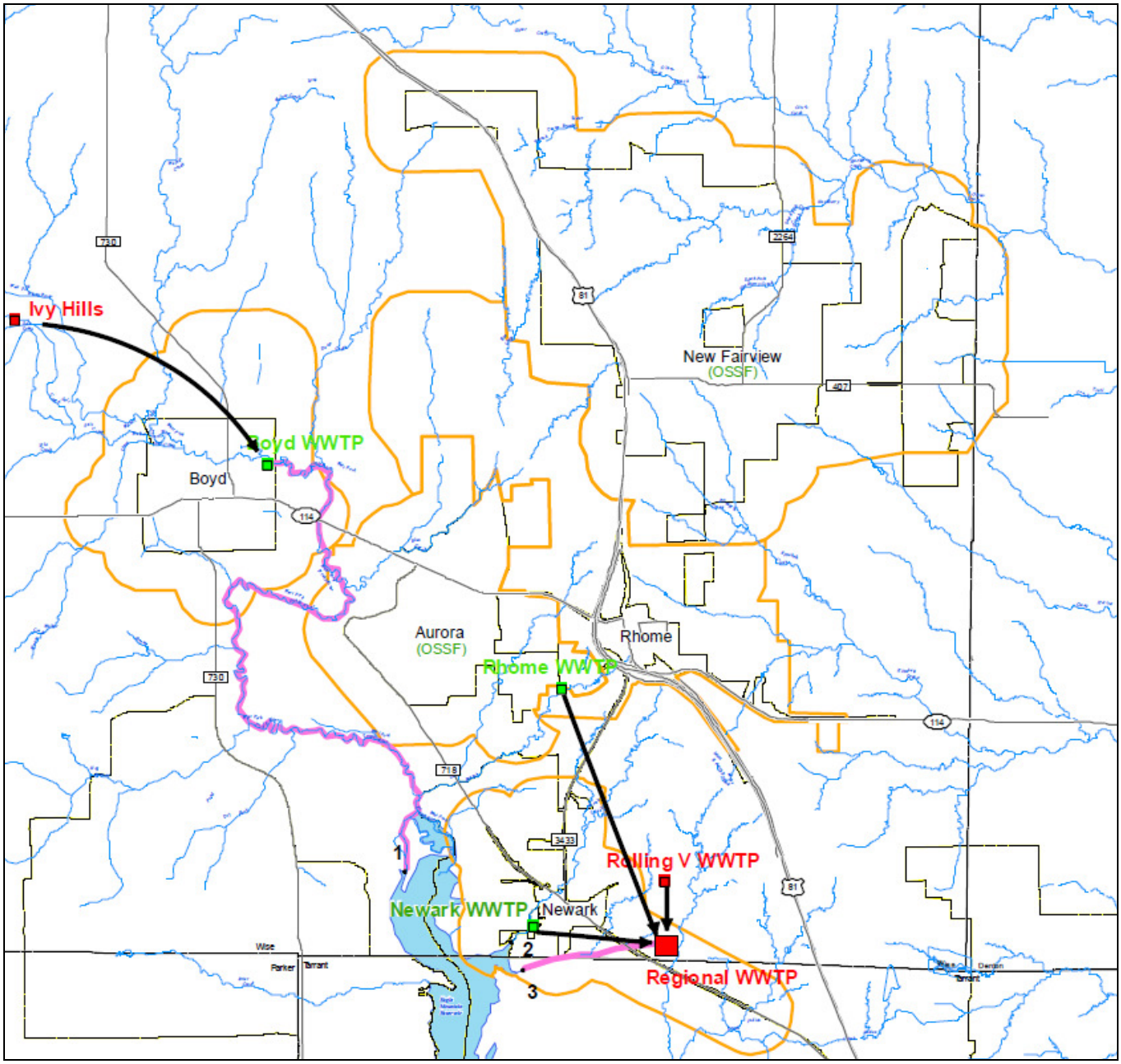


Figure 6.2: Option B – Discharge into Unnamed Tributary

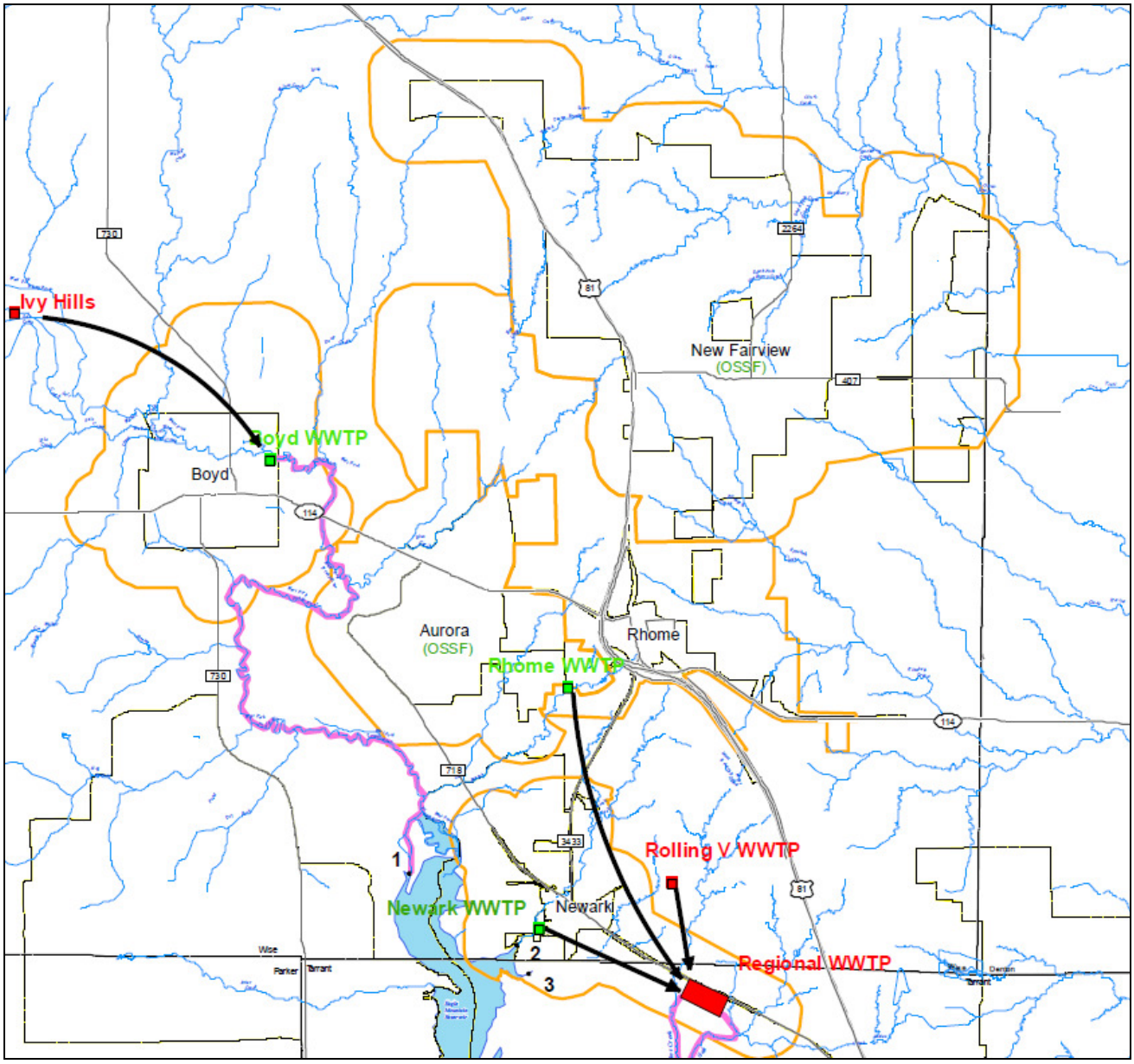


Figure 6.3: Option B – Discharge into Moss Branch and Indian Creek

Table 6.3: Option C – Summary of Proposed Wastewater Flows

Entity	Wastewater Flows (MGD)*	Treatment Facility	Discharge Stream	Total Wastewater Flows (MGD)
Aurora	0.460	Regional	Derrett Creek, Unnamed Tributary, Moss Branch, Indian Creek	3.110
Boyd	0.255			
Ivy Hills & Boyette Tract	0.436			
Newark	0.136			
New Fairview	0.091			
Rhome (West & East WWTPs)	0.230			
Rolling V Ranch	1.503			

* Wastewater flows are based on Year 2030 population projections and ultimate build-out of developments

6.4 Proposed Effluent Standards

Using the CSTR and QUAL-TX models from TCEQ, the Modified Base Case, Option B, and Option C scenarios were modeled, and proposed effluent limits were calculated by systematically adjusting the effluent limits in the model until compliance with the dissolved oxygen (DO) criteria was achieved. A copy of this water quality modeling technical memorandum is included in Appendix B for reference.

Eagle Mountain Lake and the West Fork Trinity River from Eagle Mountain Lake to Bridgeport Reservoir are classified stream segments 0809 and 0810, respectively. Both segments have a DO criterion of 5.0 mg/L. All other streams in this study are unclassified. Unclassified perennial streams have a DO criterion of 5.0 mg/L. Unclassified intermittent streams with perennial pools have a 3.0 mg/L DO criterion while intermittent streams without perennial pools have a 2.0 mg/L DO criterion.

In addition, a TCEQ moratorium affecting discharges from wastewater treatment plants into Eagle Mountain Lake has been in effect since 1986. This moratorium specifically states that the construction of new wastewater treatment plants is prohibited from discharging within one stream mile or directly into Eagle Mountain Lake. TCEQ also states in Chapter 311 for Watershed Protection that all wastewater treatment plants within five stream miles upstream of Eagle Mountain Lake are required to provide tertiary treatment in order to satisfy effluent parameters for domestic wastewater discharges.

Models at existing permitted WWTP sites were first evaluated at permitted effluent values DO, $CBOD_5$, and NH_3-N and then adjusted as necessary until the DO criterion was met. Table 6.4 contains the effluent treatment levels needed to maintain the appropriate DO criteria for the Modified Base Case.

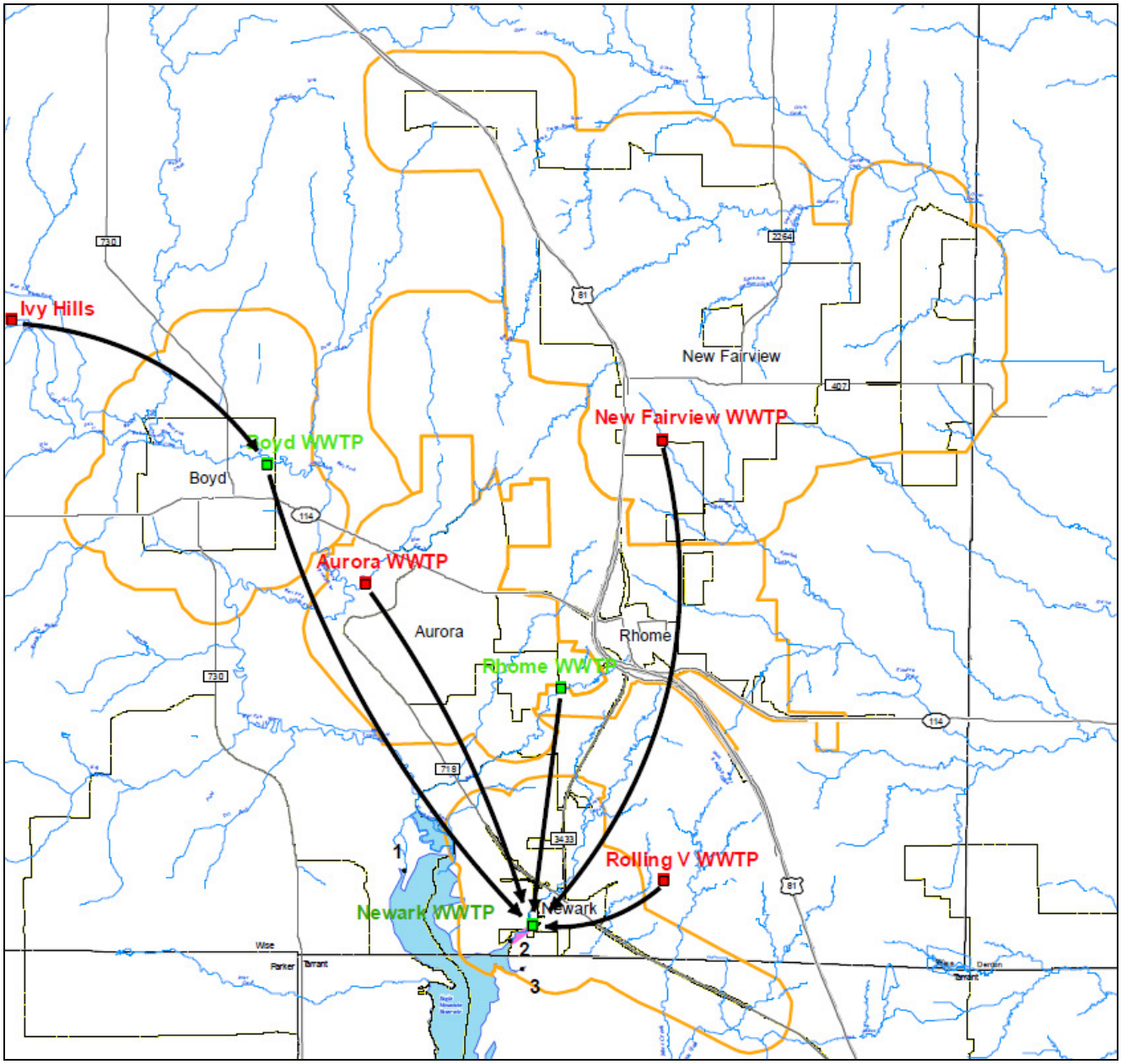


Figure 6.4: Option C – Discharge into Derrett Creek

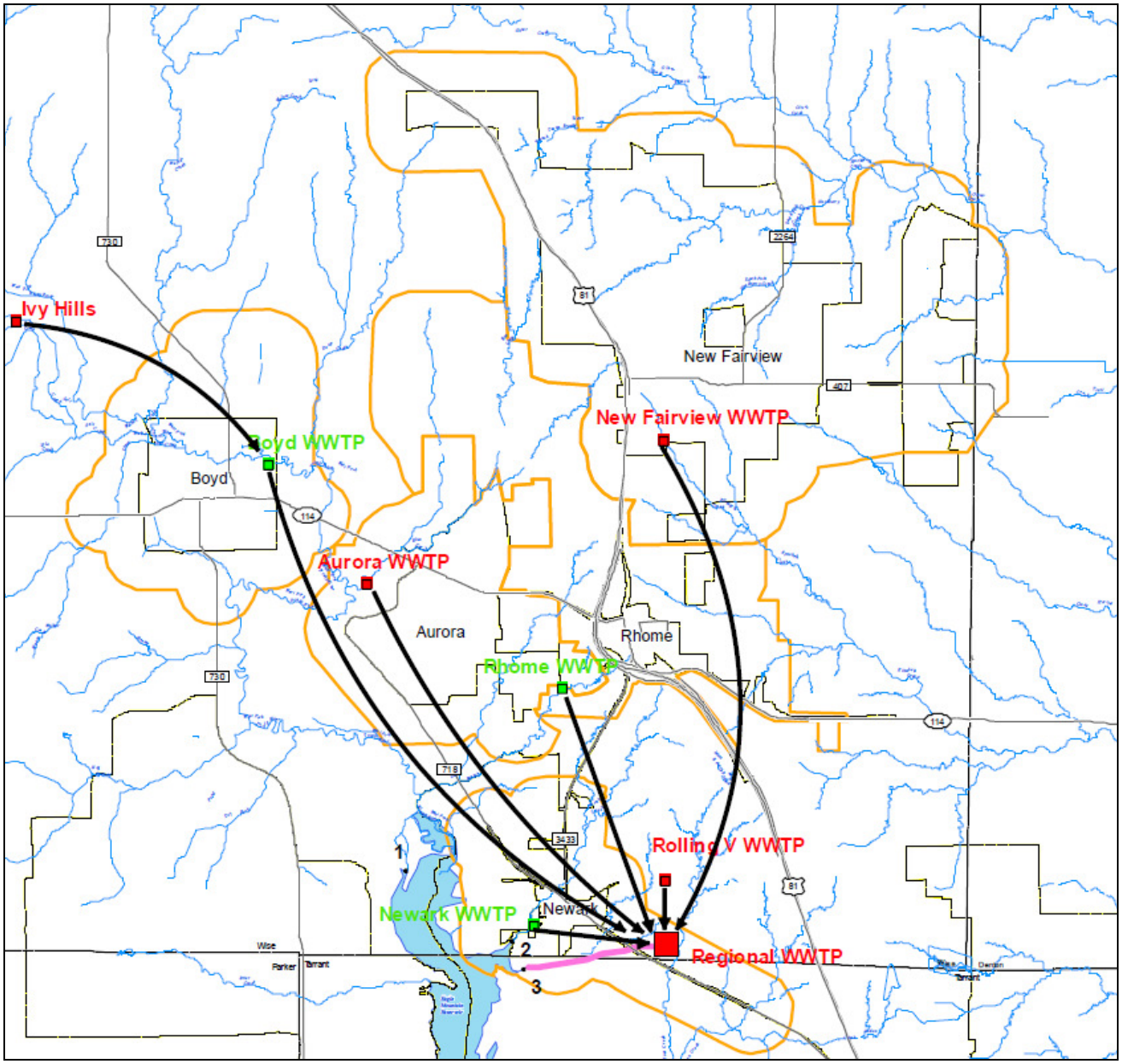


Figure 6.5: Option C – Discharge into Unnamed Tributary

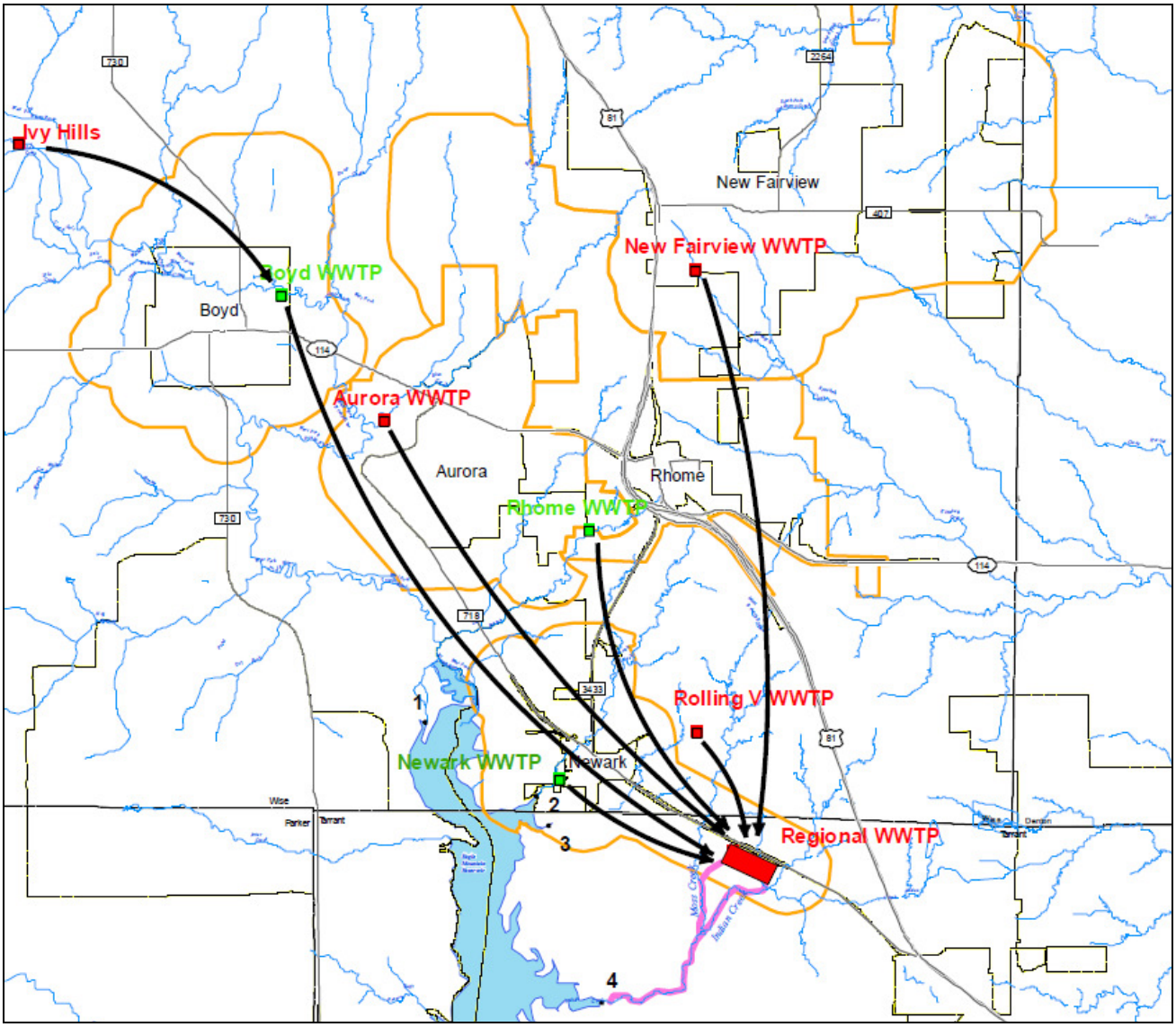


Figure 6.6: Option C – Discharge into Moss Branch and Indian Creek

Table 6.4: Modified Base Case – Summary of Proposed Effluent Limits

Treatment Plant	Discharge (MGD)	DO (mg/L)	$CBOD_5$ (mg/L)	TSS (mg/L)*	NH_3-N (mg/L)	TP (mg/L)
Aurora WWTP	0.46	5.0	10.0	15.0	2.0	1.0**
Boyd WWTP	0.26	2.0	20.0	20.0	12.0	1.0**
Ivy Hills WWTP	0.44	5.0	10.0	15.0	2.0	1.0**
Newark WWTP	0.14	---	---	---	---	---
Rhome WWTP (West)	0.23	4.0	10.0	15.0	3.0	1.0**
Rolling V Ranch WWTP	1.50	6.0	5.0	5.0	1.5	0.5 – 1.0

* TSS values assumed based on water quality modeling results for $CBOD_5$.
** Anticipated future limits from TCEQ if City renewing permit for WWTP expansion.

The Ivy Hills WWTP, the Boyd WWTP, and the Rhome WWTP sites each maintained the same permitted effluent limits for DO, $CBOD_5$, and NH_3-N even under the larger discharge volume for Modified Base Case. The Aurora WWTP site can discharge 5.0 mg/L DO, 10.0 mg/L $CBOD_5$ and 2.0 mg/L NH_3-N at Modified Base Case flows and meet the minimum DO requirements of 5.0 mg/L in Blue Creek and the West Fork Trinity River. Rolling V Ranch, modeled at the Unnamed Tributary Regional Plant Site, meet the minimum DO criteria with discharge limits of 6.0 mg/L DO, 5.0 mg/L $CBOD_5$ and 1.5 mg/L NH_3-N.

For Options B and C, three potential regional plant sites were evaluated. These sites included: Newark Regional WWTP, Unnamed Tributary Regional Plant and Moss Branch Regional Plant (two scenarios – discharging into either Moss Branch or Indian Creek). Initially, the existing Newark WWTP site was considered as a possible location for the new regional system; however, the Newark WWTP does not meet the minimum DO requirement of 5.0 mg/L in Derrett Creek Cove even with an effluent limit of 6.0 mg/L DO, 5.0 mg/L $CBOD_5$ and 1.0 mg/L NH_3-N.

Currently, the City of Newark has a temporary variance to the Water Quality Standards that allows a three year period to develop a site-specific DO criterion for the Derrett Creek arm of Eagle Mountain Lake. Based on the modeling results and minimum DO requirements for Derrett Creek Cove, TCEQ indicated that further permitted development of this plant would be unlikely. As a result, the two other potential treatment plant sites located near Unnamed Tributary and Moss Branch (discharging into either Moss Branch or Indian Creek) were considered.

In Option B, which represents initial regionalization, the Unnamed Tributary Regional Plant and the Moss Branch Regional Plant (discharging into either Moss Branch or Indian Creek) were all capable of meeting applicable DO criteria at stringent WWTP effluent standards. The least stringent effluent standard for Option B occurs at the Moss Branch Regional Plant site with a proposed effluent standard of 6.0 mg/L DO, 5 mg/L $CBOD_5$ and 1.9 mg/L NH_3-N. Table 6.5 contains the effluent treatment levels needed to maintain the appropriate DO criteria for Option B.

Table 6.5: Option B – Summary of Proposed Effluent Limits

Treatment Plant	Discharge (MGD)	DO (mg/L)	$CBOD_5$ (mg/L)	TSS (mg/L)*	NH_3-N (mg/L)	TP (mg/L)
Boyd WWTP (Ivy Hills + Boyd)	0.69	2.0	20.0	20.0	12.0	1.0**
Newark Regional WWTP	1.87	---	---	---	---	---
Unnamed Tributary Regional WWTP	1.87	6.0	5.0	5.0	1.3	0.5 – 1.0
Moss Branch Regional WWTP (discharge to Moss Branch)	1.87	6.0	5.0	5.0	1.9	0.5 – 1.0
Moss Branch Regional WWTP (discharge to Indian Creek)	1.87	6.0	5.0	5.0	1.9	0.5 – 1.0

* TSS values assumed based on water quality modeling results for $CBOD_5$.
** Anticipated future limits from TCEQ if City renewing permit for WWTP expansion.

In Option C, which represents complete regionalization, only the Unnamed Tributary Regional Plant Site and the Moss Branch Regional Plant site (discharging into only Moss Branch) were capable of meeting applicable DO criteria at the stringent WWTP effluent standards. Table 6.6 contains the effluent treatment levels needed to maintain the appropriate DO criteria for Option C.

Table 6.6: Option C – Summary of Proposed Effluent Limits

Treatment Plant	Discharge (MGD)	DO (mg/L)	$CBOD_5$ (mg/L)	TSS (mg/L)*	NH_3-N (mg/L)	TP (mg/L)
Newark Regional WWTP	3.11	---	---	---	---	---
Unnamed Tributary Regional WWTP	3.11	6.0	5.0	5.0	1.0	0.5 – 1.0
Moss Branch Regional WWTP (discharge to Moss Branch)	3.11	6.0	5.0	5.0	1.0	0.5 – 1.0
Moss Branch Regional WWTP (discharge to Indian Creek)	3.11	---	---	---	---	---

* TSS values assumed based on water quality modeling results for $CBOD_5$.

Both regional plant sites, discharging into the Unnamed Tributary south of Derrett Creek and Moss Branch, narrowly met the most stringent effluent standards normally adopted by TCEQ. As a result, the following potential options for improving the model predicted DO and improving the attainability of DO criteria are recommended for this option: use of additional DO enhancement (i.e. diffusers), model refinement and a cove DO study.

Utilizing draft nutrient guidelines developed by TCEQ, the proposed regional plants listed in Options B and C will have a Total Phosphorus (TP) effluent limit of either 0.5 mg/L or 1.0 mg/L, depending

on the size of the treatment facility. Typical effluent limits for Total Phosphorus (TP), as a daily average concentration, generally fall into the following ranges:

- Permitted flow < 0.5 MGD: *TP = 1.0 mg/L*
- Permitted flow ranging between 0.5 – 3.0 MGD: *TP ranges between 0.5 – 1.0 mg/L*
- Permitted flow > 3.0 MGD: *TP = 0.5 mg/L*

As a result, the potential TP limit is shown ranging from 0.5 to 1.0 mg/L in Tables 6.5 and 6.6 for both options. It should be noted that TCEQ is still developing nutrient criteria and at this time and at this stage in the development, it uncertain what the actual TP limit would be but it is more certain that there will be a TP limit required at the regional plant sites.

TCEQ has proposed a screening model for TP to be used to assess the impact of wastewater on the main pool of large reservoirs. At this time, the procedures have been established, but the application of results is still in draft form. The TP Screening Model estimates the increase in TP in the main pool of the reservoir due to the wastewater loadings. This increase is then evaluated one of two ways, both of which are not yet approved:

1) The first method was proposed by TCEQ in January 2009. The increase in TP as a result of the wastewater is compared to the TP assimilation capacity of the reservoir. Assimilation capacity is defined as the difference between the mean TP and the screening level for the reservoir. For Eagle Mountain Lake, the assimilation capacity is 0.017 mg/L. TP increases due to wastewater that are greater than 1 percent of the assimilation capacity may require TP limits.
2) The second method was proposed in April 27, 2009. This method also estimates the increase in TP due to the wastewater; however, this method compares the TP increase to the mean of the reservoir instead of an assimilation capacity. The mean TP concentration for Eagle Mountain Lake is 0.049 mg/L. TP increases due to wastewater that are greater than 10 percent of the mean may require TP limits.

Tarrant Regional Water District (TRWD) compared the two methods listed above as it related to this study and found that the January 2009 methodology is much more stringent that the April 2009 approach and suggests that all effluent limits do not meet the criteria of 1.0% of the assimilation capacity. As shown in Table 6.4 through Table 6.6, the April 2009 methodology suggests TP limits of at least 1.0 mg/L and sometimes as low as 0.5 mg/L. Assessment of WWTP nutrients on reservoirs is a new venture for TCEQ.

While the TCEQ TP Screening Model provides a quick estimate of the effect a WWTP discharge has on the reservoir, it lacks temporal and spatial sophistication, as well as a fundamental link to the effect that the TP increase will have on the algae growth in the reservoir. As a result, TRWD calibrated a 13 month, 17 segment Water Analysis Simulation Program (WASP) model for Eagle Mountain Lake for the period of October 2000 through October 2001. The WASP modeling, which TCEQ would consider a more robust technique, suggests a TP limit of 1.0 to 0.5 mg/L. A copy of TRWD's technical memorandum which details their analysis is included in Appendix C for reference. Both the April 2009 methodology and the TRWD WASP modeling point to the necessity of including TP controls in the design of new plants.

7.0 COST ESTIMATING PROCESS

In Chapter 5, three regional alternatives were narrowed down for a complete evaluation. In Chapter 6, the consideration of water quality impacts dictated that two regional treatment plant locations, each with its own set of effluent discharge limits, were to be considered under Options B and C. Cost will be a significant criterion for judging one regionalization option against the others, and this

chapter explains the process that was used to size the major components of each regional system and to estimate both the capital cost and operation and maintenance (O&M) costs for each option.

7.1 Layout and Sizing of Facilities

With the final alternatives selected, each of these alternatives was then developed in sufficient detail to prepare cost estimates for their construction, operation and maintenance.

The first step in this process was to select the routes for the gravity lines and to determine where lift stations would be needed. The routes for the gravity lines were selected taking into account topography, natural drainage, existing wastewater facilities, property lines, and rights-of-way. A principal objective in preparing the layouts was to minimize the need for lift stations. Another important objective was to minimize the need for easements, or to have wastewater lines run along property lines wherever possible. However, the topography and natural drainage paths often dictated the need to cross private property in order to minimize the need for lift stations. For example, the principal wastewater interceptor in all three final alternatives runs through the Rolling V Ranch tract, parallel and adjacent to Derrett Creek.

Next, lift station sites were selected and force main routes were determined. Lift stations are almost always located in lower areas since this is where they need to be in order to maximize the use of gravity flow in the pipes upstream of the lift station. Thus, they are often located in or near flood plains. The lift station locations shown in the exhibits for each final alternative must be considered approximate, as there was insufficient data at this planning stage to ensure that the site could be protected from floodwaters. Thus, additional investigations would be required to select the final site for the lift station. With the lift stations and gravity lines located, the connecting force main routes were selected.

Potential treatment plant locations have been previously discussed and their locations have been based on maximizing gravity flow in the overall system, and on water quality considerations.

After the facilities were located for each final alternative, the size of each facility was determined. Gravity lines were sized to carry peak wet weather wastewater flows. To calculate peak wet weather flows, average flows were first calculated using the population estimates for areas upstream of each gravity line and an average unit flow of 80 gallons per capita per day. Peak wet weather flows are typically estimated by multiplying average flows by a dry weather peak flow factor, and by then adding an allowance for infiltration and inflow (I/I) during and after a rain event. Dry weather peak flow factors are typically based on the population upstream of each pipe and the factors vary between 4.4 for small service areas, to about 2.7 for large areas such as the entire planning study area for this project. Allowances for I/I are usually based on the area served upstream of each pipe. Allowances in the range of 750 GPD per acre to 1000 GPD per acre are common using today's piping systems and manholes.

This method of calculation requires determining the population and area along the pipeline being sized. At this feasibility phase, this information is not readily available. Instead, peak wet weather flows were estimated assuming a peak wet weather flow factor of between 5 and 6, which was multiplied by the average flow to approximate the impact of the peak dry weather flow factor plus the I/I allowance.

Next, the topographic information available was used to determine the slopes that would be available along the gravity line routes. Gravity pipe diameters were then selected based on the peak wet weather flows and available slopes.

Peak wet weather flows were also used to determine the capacities of lift stations and force mains in accordance with TCEQ requirements.

7.2 Phasing Considerations

Since wastewater flows will increase gradually over the planning period, phasing of the wastewater facilities was considered. Gravity lines are normally installed to serve the long-term anticipated flows. The additional cost to install a large initial line is normally not significant compared to the cost of trenching, backfilling and installing a line with less than the ultimate capacity needed. On the other hand, installing a parallel line at some point in the future can be more expensive than the original line due to the additional easements required and the difficulty involved with installing a second pipe in close proximity to a pipe already in service. There are also operational and maintenance issues that arise with parallel piping systems.

Phasing of lift stations and force mains is common and can simultaneously lower initial costs and improve operation in the short term. Installing the ultimate size wet well and force main often results in odor problems due to the long detention times in the oversized facilities. Installing a smaller diameter force main initially makes it easier to meet the TCEQ minimum velocity requirements in a force main, and thus avoid solids deposition and related odor control problems. As shown in the exhibits for each final alternative, phased lift stations and force mains are shown for all of the larger lift stations.

Larger treatment plants also lend themselves to phasing for similar reasons: to lower initial costs and to improve operation at lower flow rates. A design engineer will typically estimate the required ultimate capacity of the plant, and then divide that number by a reasonable number of parallel treatment “trains”, usually between 3 and 5. The resulting capacity will then be used as the design capacity of the first treatment train. Additional trains will be added as flows increase over time. Some components of the plant can incorporate features for the additional trains. Although plants can and often do have treatment trains with varying capacities, plants with trains of equal capacity are usually easier to operate, so this strategy has been used in the phasing of the treatment plants at this project feasibility stage.

The flow projections were used to determine when each phase of the lift stations, force mains and treatment plants would be needed. Given that the flow projections are based on general population projections, the implementation period for each phase of the facility was associated with a five-year interval rather than a specific year. This approximation is appropriate for a study of this type.

7.3 Capital Cost Estimates

The determination of estimated costs for the study area was provided in two categories: capital costs and annual costs. The strategy used to estimate the capital costs is covered in this section.

Capital costs consist of construction costs, easement and land acquisition costs, and soft costs. Soft costs include engineering design, surveying services, environmental/archeological services, legal services and project management during design and construction. Each of these categories of capital cost is discussed in more detail below.

7.3.1 Pipeline Construction

The final alternatives include two types of pipeline construction: sewage gravity flow pipe (not under pressure), and force mains (pressurized pipe). It is anticipated that gravity pipe through 15-inches in diameter would be ASTM D 3034 PVC pipe and that pipe 18-inches through 27-inches would be

ASTM F 679 PVC pipe. The force mains 12-inches in diameter and smaller would most likely be AWWA C-900 PVC pressure pipe with ductile iron fittings. Force mains 16-inches and larger would be AWWA C-905 PVC pressure pipe.

Unit cost tables were prepared for each type and diameter of pipe based on cost information that was available at both the state and local level See Table D.6 in Appendix D. Inclusive in the unit cost per linear foot for gravity pipe were mobilization, erosion control, tree protection, excavation, bedding, backfill, trench safety, re-vegetation, and pavement repair. Manholes were also included in the unit cost per linear foot by assuming that manholes would be located every 400 feet and would be an average of 10 to 12 feet deep. The unit cost for force mains included all fittings as well as mobilization, erosion control, tree protection, excavation, bedding, backfill, trench safety, re-vegetation, and pavement repair.

7.3.2 Lift Stations

The unit costs for lift stations shown in Table D.6 were based on the peak flow capacity required. It was assumed that lift stations would be of the submersible type and would be equipped with at least two pumps (one as a stand-by), an on-site generator, and telecommunication capabilities.

For the larger lift stations that would be constructed in phases, it was assumed that there would be two wet wells, two sets of controls, two sets of pumps and two force mains. From a cost estimating standpoint, there would be two parallel lift station/force mains, although in practice, these lift stations would be interconnected to improve reliability and operational flexibility.

7.3.3 Treatment Plants

Unit construction costs for several levels of wastewater treatment were developed in accordance with the findings of the water quality studies previously discussed. The treatment levels were defined according to the effluent limits that are likely to be included in the plant's discharge permit. For example, a 5-5-2-1 treatment level corresponds to effluent limits of five milligrams per liter (mg/L) of carbonaceous biochemical oxygen demand ($CBOD_5$); 5 mg/L of total suspended solids (TSS); 2 mg/L of ammonia nitrogen (NH_3-N); and 1 mg/L of total phosphorus (TP).

The type of wastewater received and treated is assumed to be consistent with wastewater generated from typical residential discharges. Treatment plants that would have 20-20 effluent limits (CBOD and TSS; no limits on ammonia nitrogen and total phosphorus) were assumed to include the following processes: preliminary screening, conventional activated sludge (aeration tank followed by clarifier), disinfection using chlorine, de-chlorination, sludge holding basin and sludge drying beds. Plants larger than 1.0 mgd would be equipped with grit removal systems and with aerobic digesters and a belt press in lieu of a sludge holding basin and drying beds. It is assumed that the dewatered sludge would be disposed of at a landfill.

Plants having 10-15-3 (or 10-15-2) effluent limits (no limit on total phosphorus) would be similar to 20-20 plants except aerations systems and blowers would have additional capacity to ensure more complete removal of CBOD and to provide nitrification, or the conversion of ammonia nitrogen to nitrite and nitrate. Some engineers will add tertiary filters between the clarifier and the chlorine contact tank, especially if the effluent is to be used for irrigation, but filters are not necessary and have not been included in the cost estimates for existing plants with 10-15-3 (or 10-15-2) effluent limits or those plants that have already received TCEQ discharge permits (new construction and/or plant expansion).

Treatment plants with capacities less than 1.0 MGD and with total phosphorus effluent limits of less than 2.0 mg/L would include the following processes: preliminary screening, activated sludge with

nitrification, chemical addition to precipitate phosphorus, tertiary filters, disinfection using chlorine, de-chlorination, a sludge holding basin, and sludge drying beds. These plants would be capable of meeting the following effluent limit combinations: 5-5-1.9-1.0, 5-5-1.5-1.0 and 5-5-1.0-0.5. To obtain the lower effluent limits for CBOD and ammonia nitrogen, longer sludge retention times (SRTs) would be incorporated in the design, thus increasing the cost of aeration basins. The tertiary filters would ensure that the TSS limit of 5 mg/L would not be exceeded and the filters would also assist in the removal of CBOD and phosphorus that might be associated with any carry-over flocculant from the clarifier. For phosphorus removal, chemical addition is assumed for small plants since biological nutrient removal (BNR) systems are more difficult to operate and smaller plants typically do not have the personnel to attend to these plants.

Treatment plants with capacities equal to or greater than 1.0 MGD and with total phosphorus effluent limits of less than 2.0 mg/L would include the following processes: preliminary screening, grit removal, activated sludge with BNR, tertiary filters, disinfection using chlorine, de-chlorination, aerobic digesters and a belt press for sludge dewatering. Estimated costs also include a back-up chemical addition system for phosphorus precipitation when the BNR system fails to reach the required effluent limit.

The assumptions related to phosphorus removal are based on total phosphorus levels of about 7 to 9 mg/L in the influent wastewater, removal rates of about 2 mg/L for conventional activated sludge, and removals down to about 1 mg/L for the BNR process. As noted above, chemical addition can be used in lieu of BNR in small plants and should be incorporated into the design as a backup to BNR when the total phosphorus effluent limit is greater than 1.0 mg/L. For limits below 1.0 mg/L, chemical addition is recommended in addition to BNR due to the problem of consistently removing total phosphorus to levels of 1.0 mg/L and lower.

According to the *Draft Nutrient Guidelines* from TCEQ, existing plants that are expanded will likely have total phosphorus limits included in their new discharge permits. As an example, an existing 10-15-2 plant may receive a 10-15-2-1 permit. While filters may not be required for TSS removal they would be recommended for total phosphorus removal.

Unit construction costs (reference Table D.6 in Appendix D) were developed for each level of treatment described above. The tables were developed using actual cost information from plants that were constructed in the last 5 years and updated for 2009 conditions. Cost information was also obtained from equipment suppliers in order to interpolate between the actual construction cost information that was available for specific plants. Unit construction costs show considerable economies of scale once the size of the plant (or the size associated with a phase of the plant) reaches about 1.0 MGD, as can be seen in Table D.6.

Generally, unit costs for treatment plants with capacities of less than 0.5 MGD are based on "package plants", which are plants that are primarily fabricated offsite and then assembled on site. However, treatment plants over 0.5 MGD are primarily constructed on site with reinforced concrete tankage. Package plants can be used as permanent or temporary facilities for providing wastewater service. Smaller package plants can be specifically designed for relocation to another site later on in a project.

7.3.4 On-Site Sewage Facilities

Since Option B assumes that Aurora and New Fairview would continue to develop without a wastewater collection system, it was necessary to develop costs for on-site sewage facilities (OSSFs) in order to compare this alternative with the other alternatives.

There are a number of OSSFs available in today's market, including evapotranspiration, aerobic with spray irrigation, aerobic with drip irrigation, low pressure dosing systems and conventional septic tanks with drain fields. Mr. Gary Grubbs, a local installer of septic systems, stated that the total cost for permitting, site evaluation, design, materials and installation of an aerobic-type system is approximately $7,500. This system is typical for the rocky terrain, located north of FM 114 in the City of Aurora. The total cost of a conventional septic system was quoted as $4,500 for the study area. For the purpose of this study, quotes for conventional septic tanks with drain fields were used to estimate the cost of serving developments in Aurora and New Fairview with OSSFs in the future.

7.3.5 Easements and Land Acquisition

Wherever pipelines would cross undeveloped land, such as through Rolling V Ranch, it was assumed that easements would be granted free-of-charge since these areas would be served by the wastewater lines being constructed. It was also assumed that the Texas Department of Transportation (TxDOT) would not allow wastewater lines to be constructed in its right-of-way so easements from adjacent property owners would be required. It was assumed that the typical easement would be 15-feet wide with a temporary work easement providing another 35-feet of width.

For lift stations and treatment plants, land is typically purchased outright. For small lift stations, a site of 0.1 acres was assumed. Larger lift stations would require approximately 0.25 acres each. Land requirements for treatment plants ranged from 4 acres for a 0.2 mgd plant (ultimate capacity), to 15 acres for a plant with an ultimate capacity of 3.0 MGD. These land requirements include allowances for a 150-foot buffer zone around all treatment units.

Based on discussions with local private developers, current land prices in the area are in the range of $20,000 to $30,000 per acre. To estimate land costs for lift stations and force mains, a land acquisition cost of $20,000 per acre was used.

For easements for pipelines, it was assumed that permanent easements could be obtained for $5,300 per acre, and that temporary easements could be obtained for $1,300 per acre. Thus, for the typical easement widths described above, easements would cost approximately $2,900 per 1,000 linear foot of pipeline. Legal costs associated with land acquisition were included in the "soft" costs which are discussed below.

7.3.6 Construction Contingencies

In accordance with projects in the planning stage, a 20 percent contingency was added to the construction and land acquisition cost estimates to account for unforeseen costs ranging from revised regulations governing construction to revised design elements or construction methods.

7.3.7 Soft Costs

In addition to construction costs and land acquisition costs, project capital costs also include an allowance for the cost of engineering design and surveying services (20% of the total construction and land acquisition costs), environmental/archeological services (5%), and legal/project management (5%).

7.4 Operation and Maintenance Costs

Operation and maintenance (O&M) costs are more difficult to estimate because they vary significantly depending on the size of the system and the entity that operates the system. There are large economies of scale that can be realized and this is a major driving force for regionalization.

O&M costs are usually divided into two categories: fixed costs and variable costs. Fixed costs include labor, equipment (parts and maintenance), building maintenance, grounds, security, communications, lab fees, etc. Variable O&M costs are those that tend to be directly related to the average wastewater flow. These include energy costs, chemical costs, and the costs associated with sludge hauling and disposal. A summary of the O&M costs for each of the alternatives is presented in Appendix E.

For collection system facilities, the annual fixed O&M costs have been estimated at 1.0% of the collection system asset value for those systems with total average flows of less than 0.4 MGD. For systems with average flows greater than or equal to 0.4 MGD, fixed costs have been estimated at 0.5% of the collection system asset value. O&M activities related to collection system facilities include pipeline cleaning, CCTV inspections, smoke testing, flow monitoring, pipeline repair or replacement, and manhole rehabilitation. Maintenance of air release valves would also be included on force mains. For lift stations, the fixed O&M costs would include pump maintenance and repairs, wet well cleaning and building and site maintenance. Variable costs associated with pipelines are generally considered negligible, and variable costs for lift stations are normally limited to energy costs, which vary according to the volume pumped and the total dynamic head (static lift plus friction losses). Chemicals are sometimes used at lift stations and their use is usually dependent on flow, so they can be considered as part of the variable costs. Variable costs for the collection system have been estimated at $0.10 per 1,000 gallons.

Typical O&M costs associated with OSSFs include pumping the septic tanks periodically to remove accumulated non-biodegradable substances, such as grease and soap. Mr. Gary Grubbs, a local installer of septic systems, stated that the cost for pumping an average size septic tank is approximately $300. He recommended that the time frame for pumping septic tanks should be based on the number of people living in a residence. If two people occupy a home, he recommends pumping the septic tank every five years; however, if four or more people reside in a home, he recommends pumping at least every four years.

Fixed O&M costs for wastewater treatment facilities have been assumed to be in the range of 2.0% to 3.0% of the total asset value of these facilities, with the higher percentage related to plants with capacities less than 0.4 MGD. Variable costs include costs for pumping energy, process energy (blowers), chemicals, and sludge hauling and disposal. The chemical costs associated with phosphorus removal can be a significant portion of the variable costs for plants where the effluent limits for total phosphorus are strict, and especially for small plants that are not operated as biological nutrient removal (BNR) plants. In general, approximately 20 mg/L of alum is required to precipitate each 1 mg/L of total phosphorus that must be removed to meet the effluent limit. Variable costs have been estimated to range from $0.50 to $0.65 per 1,000 gallons depending on the level of treatment.

The O&M cost assumptions described above were verified against the operational budgets for several plants that TRA operates, and adjustments were made as required.

8.0 EVALUATION OF FINAL ALTERNATIVES

As noted in Chapter 5, three final options were selected for a complete evaluation based on a preliminary assessment and feedback received on the initial regional alternatives during the working session of the second project meeting on January 26, 2009. Based on the feedback received during the working session, three final regional alternatives were selected for evaluation:

- ***Modified Base Case:*** each entity would construct their own WWTP and no regionalization would occur;

- ***Option B:*** Rolling V Ranch and the Cities of Newark and Rhome would participate in a regional system; the City of Boyd would serve Ivy Hills and the Boyette Tract; and,
- ***Option C (previously referred to as Option C-1):*** all five cities and major planned developments would eventually be served by a regional system.

For Option B, two different wastewater treatment plant locations were considered in accordance with the results of the water quality findings discussed in Chapter 6. Otherwise, the Option B cases were the same.

8.1 Evaluation Strategy

To compare the three alternatives selected for the final evaluation, the following strategy was used:

- A preliminary layout for the major components of the collection system was prepared taking into account topography, existing facilities, areas to be served in each alternative, and property boundaries that could be discerned from the aerial photographs available. This included determining where lift stations and force mains would be required.
- Average and peak wastewater flows were then estimated along each component of the collection system and these were used together with the topographic information to determine the size of each wastewater pipe segment. Year 2030 population projections for the cities plus full build-out of the developments were used to calculate the flows used to select each pipe.
- Peak wastewater flows were also used to determine the ultimate required capacity of the lift stations and force mains.
- Average wastewater flows were used to determine the ultimate required capacity of the treatment plants.
- Five-year population and flow projections were then used to determine the phasing of lift stations, force mains and treatment plants. Small lift stations were not phased but it was assumed that large lift stations would be constructed in two phases with a corresponding force main for each phase. Except in the case of very small plants (capacities less than 0.20 MGD), treatment plants were also to be built in phases. In some cases, as many as five phases were assumed.
- Constructions costs were then prepared for each alternative and the timing of the investment was assigned according to the flow projections for each 5 year interval.
- Soft costs were added to the construction costs and present values were then calculated for the schedule of investments over the planning horizon (years 2010 to 2034).
- Annual operation and maintenance (O&M) costs were then estimated for each alternative over the planning horizon and these were also reduced to present values.
- Finally, present value capital costs and O&M costs were added to obtain total present values for each alternative.

Summaries of the key infrastructure features of each alternative are given in the sections which follow. These descriptions follow the layouts for these alternatives shown in Figures H.1, H.2 and H.3 in Appendix H.

8.2 Modified Base Case

In the Modified Base Case, each public entity and most of the large private entities would construct and expand their wastewater systems independently of the other entities. Thus, no regionalization would occur in this alternative. Figure H.1 shows the location and the size of each pipeline. Additional details, including the phasing of each component, are given in Table D.1 in Appendix D. The key infrastructure features for each entity are summarized as follows:

City of Boyd

- A lift station and 6-inch FM would be constructed on FM 730 just north of the West Fork of the Trinity River in order to pump wastewater flows from the '200-Acre Tract' to the Boyd WWTP (since this tract is within Boyd's ETJ).
- The City of Boyd's existing two WWTPs have sufficient capacity to serve the growth anticipated in the city's ETJ throughout the planning period. An expansion of the Boyd WWTP would not be needed until after 2034. The ultimate capacity of the plant would be about 0.36 MGD with the addition of a third 0.12 MGD plant after the year 2034.

Ivy Hills & Boyette Tract

- A lift station and 8-inch FM would be constructed to pump flows from the Boyette Tract to the proposed Ivy Hills WWTP, assuming that there were agreements between the developers of Ivy Hills and the Boyette Tract.
- Phase I of the proposed Ivy Hills WWTP (0.25 MGD) would have sufficient capacity through Y2028.
- Phase II of the Ivy Hills WWTP would be built during the period from years 2025-2029 for an ultimate treatment plant capacity of 0.50 MGD.

City of Aurora

- The City would construct 8-inch & 12-inch gravity sewers along Hwy 114.
- A lift station and 8-inch FM would be constructed to pump flows from the eastern side of Aurora to the west (along Hwy 114).
- The Aurora WWTP would be located near Blue Creek and Phase I would be built during the period of years 2020 to 2024 and would have a capacity of about 0.24 MGD, which would be sufficient to serve new developments in Aurora throughout the planning period.
- Phase II of the plant would be built after 2034 and the ultimate treatment capacity would be 0.48 MGD.

City of New Fairview

- 8-inch gravity sewers would be constructed along Hwy 407 and then south to the proposed New Fairview WWTP (located southeast of 287 Travel Center).
- The New Fairview WWTP would be constructed in one phase with a capacity of 0.10 MGD, which would be sufficient capacity to serve developments in the western portion of New Fairview.
- It is assumed that the above described system would be constructed between years 2020 and 2024.

City of Rhome

- Flows from Rhome's East WWTP would be diverted to the West Plant by 2014 in order to eliminate the operational costs and problems associated with the East plant.
- A Phase II expansion of the West WWTP (0.15 MGD) would be constructed prior to Y2014, thereby increasing the total treatment capacity to 0.30 MGD. This capacity would be sufficient to serve anticipated developments in Rhome's ETJ (with the exception of those portions of the Rolling V Ranch Development within Rhome's ETJ) throughout the planning period.
- To serve the northwest side of Rhome, a small lift station and 4-inch FM would be constructed just south of Hwy 114 to pump flow to the West WWTP.

City of Newark

- To serve anticipated developments (with the exception of Rolling V Ranch), additional capacity will be required at the existing Newark WWTP. Due to the condition of this plant, it is assumed that the existing plant would be replaced with a new plant with a capacity of 0.15 MGD. Growth projections indicate that the new plant is needed by year 2013.

Rolling V Ranch

- The main interceptor to serve the large Rolling V Ranch would be located along Derrett Creek, running north to south and parallel and east of FM 3433. This interceptor would be 8-inches in diameter at the north end and 18-inches in diameter at its south end.
- The Derrett Creek LS would be constructed at the south end of the aforementioned interceptor. This lift station will pump flows through 10-inch and 12-inch force mains to the Rolling V Ranch WWTP. Phase I of the LS and the 10-inch FM would be constructed in 2015. Phase II and the second 10-inch FM would be built sometime after 2034.
- To serve the eastern portion of the development, Rolling V Ranch would construct the Moss Branch LS to pump flows from areas within the Moss Branch drainage area to the Rolling V Ranch WWTP. Phase I of the LS and the 6-inch FM would be constructed in 2020. Phase II and the 16-inch FM would be built sometime after year 2034.
- It is assumed that the Rolling V Ranch WWTP would be constructed in 3 (or 4) phases and that the first phase would have a capacity of about 0.40 MGD, which would serve the anticipated development until sometime between 2025 and 2029, when Phase II would be built.
- The ultimate capacity of the Rolling V Ranch WWTP would be about 1.6 MGD.

The total capital cost associated with all the collection and treatment components shown in Figure H.1 for the Modified Base Case have been estimated at $58.5 million (see Table D.1). This is the sum of the costs for all the entities and for constructing all the components for the ultimate anticipated wastewater flows.

Note that this cost does not represent the total cost for the wastewater systems as the smaller collection lines that would feed into the main lines shown in Figure H.1 are not included. These lines would be common to all three options and their location, length and size will be dependent on the detailed development plans for each area. Since these development plans are not available and they are common to all options, their cost is not included and would not affect the relative cost between the three options being evaluated.

Since the Rolling V Ranch site is quite large, the developer may find that the construction of one or more small package treatment plants would be attractive from a cash-flow standpoint, instead of constructing the infrastructure described above during the initial phases of the Rolling V Ranch development.

8.3 Option B: Partial Regionalization

Four different WWTP effluent discharge locations were considered for the regional plant sites considered in Option B. However, in accordance with the water quality investigation described in Chapter 6, the existing Newark WWTP site was eliminated as a potential site for a regional treatment facility. This left two potential WWTP sites and three effluent discharge routes as described below:

- ***Unnamed Tributary Regional Plant Site*****:** Construct a new Regional WWTP on a site located south of Rolling V Ranch, north of FM 718 and within Newark's ETJ. This plant would discharge into an unnamed tributary that flows to Eagle Mountain Lake.

- ***Moss Branch Regional Plant Site (Discharge to Moss Branch):*** Construct a new Regional WWTP on a site located about 4,500 feet to the east of the Unnamed Tributary Regional Plant Site. This plant would discharge into Moss Branch.
- ***Moss Branch Regional Plant Site (Discharge to Indian Creek):*** Construct a new Regional WWTP on the same Moss Branch site, but this plant would discharge into Indian Creek.

Except for the location of the regional WWTP and the length of the force mains to the plant, the three Option B cases are the same.

Refer to Figure H.2 and Table D.3 for detailed information on the infrastructure components and phasing. The key infrastructure features for all three Option B cases are summarized as follows:

City of Boyd Together With Ivy Hills and Boyette Tract

- A lift station (labeled the "Ivy Hills LS" on Figure H.2) and a 6-inch FM would be constructed on the southern edge of the Ivy Hills tract in lieu of constructing a WWTP at that location. This pump station would pump wastewater from Ivy Hills to a wastewater interceptor in the Boyette tract. Future topographic studies may indicate that it would be possible to install a gravity line along the West Fork of the Trinity River in a southeasterly direction to avoid the necessity of building a lift station, but the current assessment is that this solution would be difficult to implement.
- An interceptor to transport Ivy Hills' wastewater flows and to collect flows from the Boyette Tract and the 200 Acre Tract would be constructed running in a southeasterly direction through the Boyette Tract, then through the 200 Acre Tract, and finally to FM 730. This interceptor would be 8-inches in diameter at the north end and 15-inches in diameter from the 200 Acre Tract to FM 730.
- A lift station (labeled the "FM 730 LS" on Figure H.2) would pump wastewater flows through a 10-inch FM across the West Fork of the Trinity River into a 15-inch gravity interceptor that would flow in an easterly direction into the existing Boyd WWTP site.
- Boyd's two existing WWTPs have sufficient capacity to serve the anticipated growth to about year 2023. The plant would be expanded by 0.24 MGD in the period from 2020 to 2024. The final expansion of another 0.24 MGD) would not be needed until after 2034. Thus, the ultimate capacity of the plant would be about 0.72 MGD.

City of Aurora

- During the working session held at the second project meeting (January 26th), it was decided that the Option B cases would not include centralized wastewater collection or treatment in Aurora, and that future developments would be served by OSSFs. However, centralized collection and treatment were included during the evaluation process of the Option B cases (see footnote on Table 8.1).

City of New Fairview

- During the working session held at the second project meeting (January 26th), it was decided that the Option B cases would not include centralized wastewater collection or treatment in New Fairview, and that future developments would be served by OSSFs. However, centralized collection and treatment were included during the evaluation process of the Option B cases (see footnote on Table 8.1).

Rhome / Newark / Rolling V Ranch Regional System

- To avoid having to divert flows from Rhome's East WWTP to Rhome's West Plant, the East plant would be kept on line until the main interceptor through Rolling V Ranch was

constructed. Then, the flows into Rhome's East plant would be diverted into that gravity interceptor. Initial indications are that a gravity connection between the East Plant and the upper end of the Derrett Creek interceptor would be feasible, but this will have to be confirmed by more detailed topographic information.

- As in the Modified Base Case, a main interceptor to serve the large Rolling V Ranch development would be located along Derrett Creek, but in Option B, it would also be sized to handle the flows from Rhome. This interceptor would be 12-inches in diameter at the north end and 21-inches in diameter at its south end.
- To serve the northwest side of Rhome, a small lift station and 4-inch FM would be constructed just south of Hwy 114 to pump flow towards the West WWTP.
- The anticipated flow calculations indicate that Rhome's West Plant has sufficient capacity to serve the western side of Rhome, assuming that the East Plant flows are not diverted to the West Plant. When Rhome's West WWTP reaches the end of its useful life, flows would be diverted into a 12-inch gravity sewer that would flow to the proposed Oates Branch East LS. After this diversion, the West WWTP could be abandoned. It has been assumed that Rhome's West WWTP would be abandoned between the years 2020 and 2024. However, growth in Rhome could dictate the need for an expansion prior to the construction of the infrastructure needed to transport flows from Rhome to the Regional WWTP.
- The Oates Branch East LS would be constructed on the northwestern edge of the Rolling V Ranch development. It would pump wastewater flows diverted from Rhome's West WWTP and from the northwestern sections of Rolling V Ranch through an 8-inch FM over a ridge and into a 12-inch gravity sewer that would run in a southeasterly direction to join the main Derrett Creek interceptor just south of the existing Chisholm Creek development.
- As in the Modified Base Case, the Derrett Creek LS would be constructed at the south end of the Derrett Creek interceptor. However, in Option B, this lift station would be larger and will pump flows through two 12-inch force mains to the Regional WWTP. Phase I of the LS and the first 12-inch FM would be constructed in 2015. Phase II and the second 12-inch FM would be built between the years 2030 and 2034.
- To receive flows from the eastern portion of the Rolling V Ranch development, as well as to collect wastewater from areas between that development and Hwy 718, a 12-inch and 15-inch gravity sewer would be built along Moss Branch.
- A proposed Moss Branch LS would be constructed at the southern end of the aforementioned 12/15-inch sewer. This LS would be built in two phases and would pump flows from areas within the Moss Branch drainage area to the Regional WWTP. Phase I of the LS and the 8-inch FM would be constructed in years 2020 to 2024. Phase II and the second 8-inch FM would be built sometime beyond 2034.
- Due to the condition of Newark's plant, it is assumed that the existing plant would be abandoned by about Y2014, and that the proposed Newark Diversion LS would be constructed. This LS would pump Newark's wastewater through a 6-inch FM to the Regional WWTP.
- It is assumed that the Regional WWTP would be constructed in three to four phases and that the first phase would have a capacity of about 0.50 MGD. Phases II and III, each with a capacity of 0.50 MGD each, would be constructed 5 years and 10 years later, respectively.
- The ultimate capacity of the Regional WWTP would be about 2.0 MGD.

The total capital cost of constructing the system as shown in Figure H.2, with the Regional WWTP located on the Unnamed Tributary of Option B, was estimated at $44.5 million. Note that this cost does not include either OSSFs or stand-alone community wastewater systems for Aurora or New Fairview; Section 8.5 on cost comparisons addresses this issue.

Constructing the Regional WWTP at the Moss Branch Site and discharging into either Moss Branch or Indian Creek would require extensions of the force mains from the proposed Derrett Creek Lift

Station and the Newark Diversion Lift Station. It would also require an extension of a 15-inch gravity main down Moss Branch, but the 8-inch force mains from the Moss Branch Lift Station would be shorter. The locations of these facilities are shown in Figures 8.1 and 8.2. The Moss Branch Regional Plant Site would add approximately $1.3 million to the total capital cost of Option B, compared to the cost for the plant at the Unnamed Tributary Site. According to Table 6.5, the ammonia nitrogen limit would be slightly higher for the Moss Branch Site (1.9 mg/L vs. 1.3 mg/L for the Unnamed Tributary Site); however, this difference would not result in significant capital or O&M cost savings.

Since the Moss Branch Regional Plant Site is $1.3 million more expensive, there is little benefit to considering this site. Thus, the evaluations and comparison with the other alternatives, as described below, assume the plant site will be on the Unnamed Tributary as shown in Figure H.2 of Appendix H.

8.4 Option C: Complete Regionalization

In Option C, Newark, Rhome and Rolling V Ranch would form the initial core of a regional collection and treatment system and complete regionalization would be achieved by eventually extending the system to include Aurora, Boyd and New Fairview.

Many of the key infrastructure features for Option C would be the same as for Option B, except that the size of these facilities would be larger due to the increased wastewater flows (reference Figure H.3). Another difference is that there are only two potential effluent discharge locations based on the results of the water quality modeling (see Table 6.6). However, the collection system costs will be higher for this WWTP site as noted above for Option B. Thus, only the Unnamed Tributary Regional WWTP Site has been evaluated for Option C.

The details and phasing of Option C is provided in Figure H.3 and Table D.4. Starting with the initial core of the regional system, the key infrastructure is summarized below:

Rhome / Newark / Rolling V Ranch Regional System

- The diversion of flows from Rhome's East WWTP into the main interceptor through Rolling V Ranch would be the same as for Option B.
- The Derrett Creek interceptor would follow the same route as in Option B, but the southern portions would be larger to carry the additional flows for complete regionalization. This interceptor would be as large as 27-inches in diameter at its southern end.
- Just as in Option B, it is assumed that Rhome's West WWTP would be abandoned between the years of 2020 and 2024 and that flows would be diverted into a 12-inch gravity sewer that would flow to the proposed Oates Branch East LS.
- The Oates Branch East LS would have to be substantially larger since this lift station would eventually receive flows from Boyd, Aurora and New Fairview, in addition to the flows diverted from Rhome's West WWTP and from the northwestern sections of Rolling V Ranch. This LS would be built in two phases and would pump flows through a 12-inch and 16-inch force mains. Phase I of the LS and the 16-inch FM would be constructed between the years of 2020 and 2024. Phase II and the 12-inch FM would be built between the years of 2030 and 2034.
- The interceptor receiving flow from the two force mains mentioned above would need to be about 21-inches in diameter and would flow by gravity in a southeasterly direction to join the main Derrett Creek interceptor just south of the existing Chisholm Creek development.

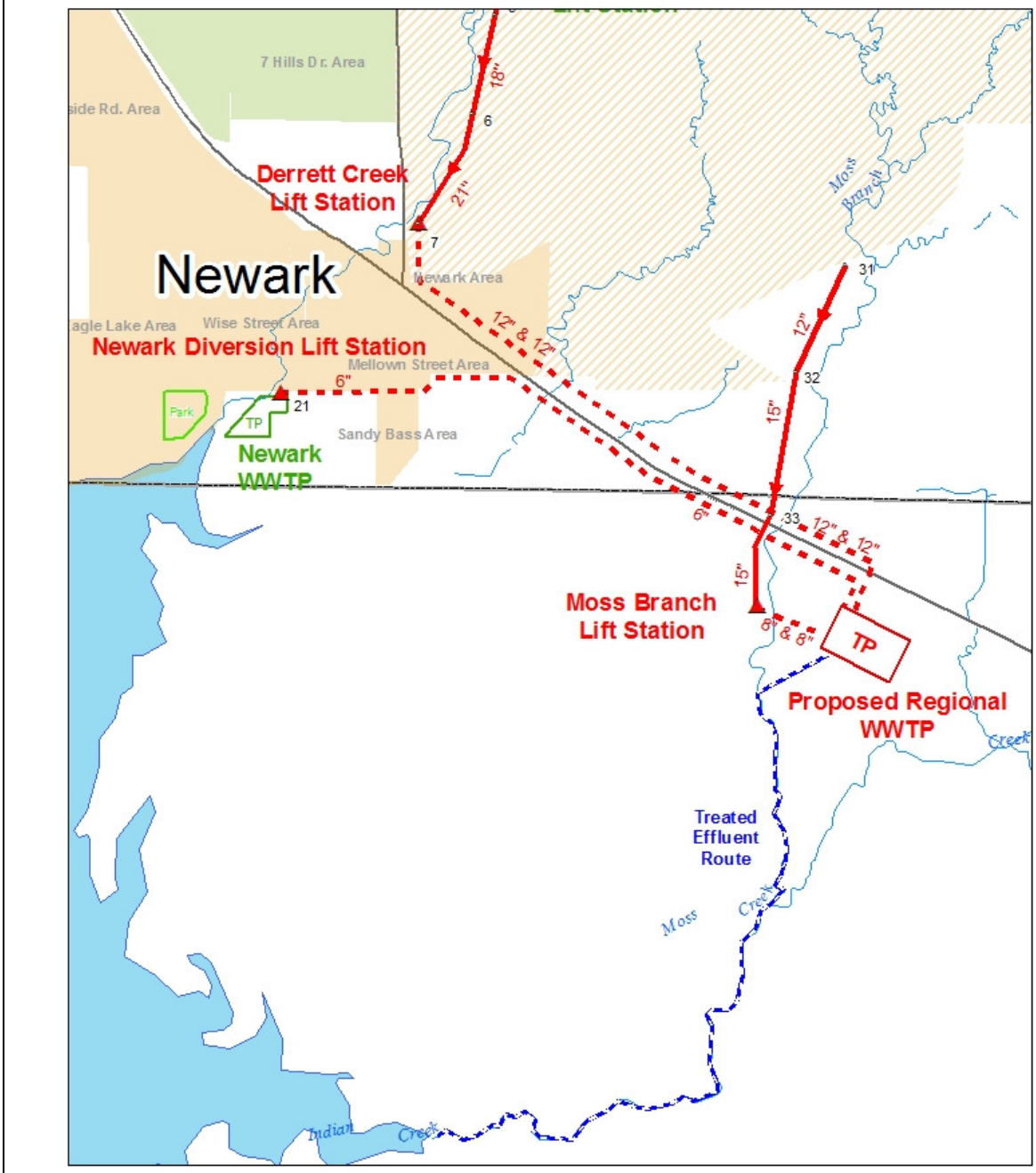


Figure 8.1: Moss Branch Regional WWTP Site (Discharge to Moss Branch)

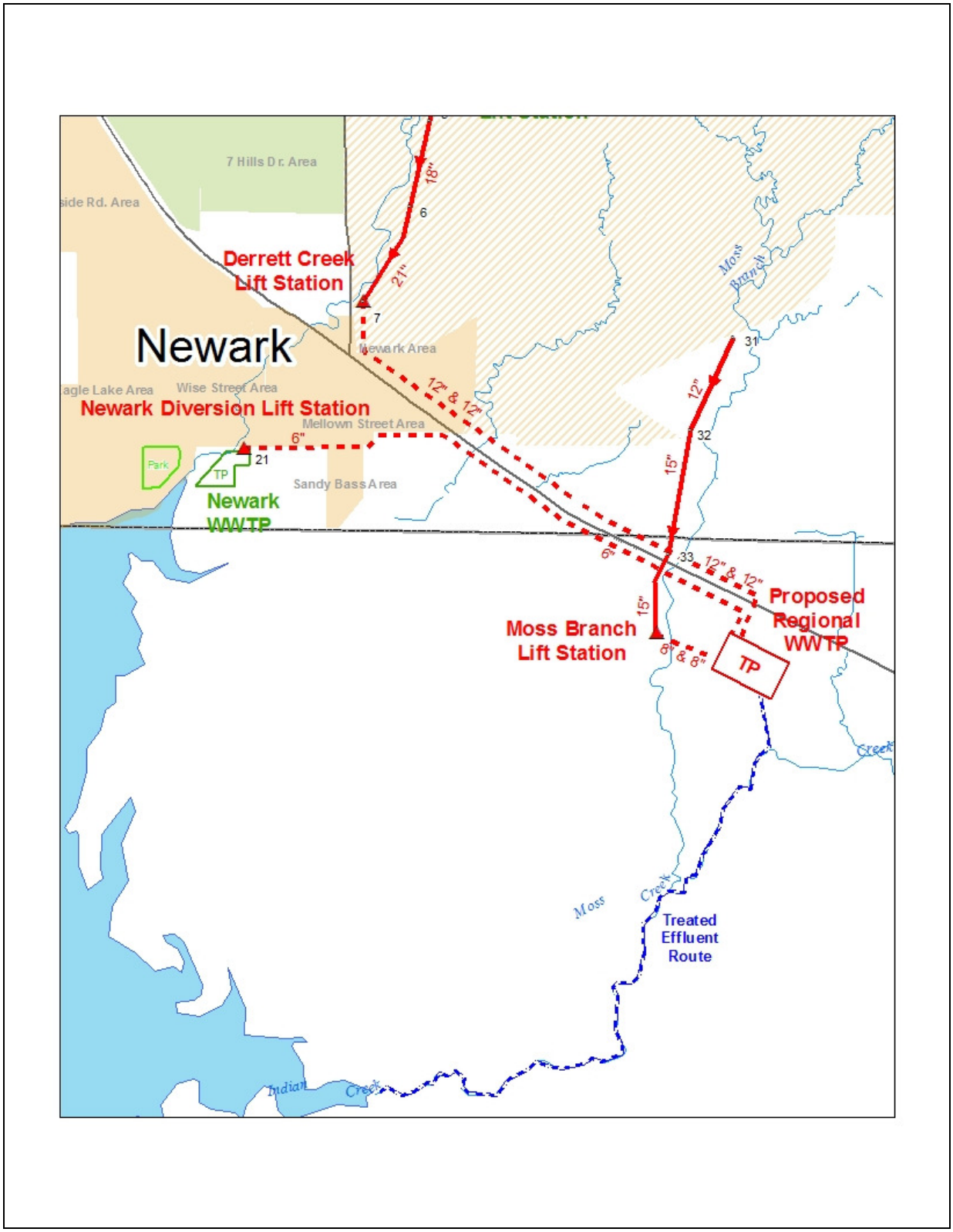


Figure 8.2: Moss Branch Regional WWTP Site (Discharge to Indian Creek)

- The proposed Derrett Creek LS, to be constructed at the south end of the Derrett Creek interceptor, would be built in at least two phases, along with 12-inch and 20-inch force mains which would discharge at the regional WWTP. Phase I of the LS and the 12-inch FM would be constructed between the years of 2015 and 2019. Phase II and the 20-inch FM would be built between the years of 2025 and 2029.
- The system serving the eastern Moss Branch drainage area would be the same as in Option B.
- Newark's existing WWTP would be abandoned by about 2014, and the proposed Newark Diversion LS would pump Newark's wastewater through a 6-inch FM to the regional WWTP.

City of Boyd, Ivy Hills and Boyette Tract

- The system serving Ivy Hills, Boyette Tract and the 200 Acre Tract would be exactly the same as in Option B.
- Boyd's two existing WWTPs have sufficient capacity to serve the anticipated growth to about year 2023. Between years 2020 and 2024, instead of expanding the Boyd WWTP, it would be abandoned after the construction of a diversion system that would consist of an 18-inch interceptor from Boyd's existing WWTP to the west bank of the West Fork of the Trinity River. It is assumed that an inverted siphon could be constructed to cross the river and deliver the wastewater into a continuation of the 18" interceptor. This interceptor would continue to run in a southeasterly direction towards the proposed Blue Creek LS.

City of Aurora

- As in the Modified Base Case, the City of Aurora would construct 8-inch and 12-inch gravity sewers along Hwy 114 and these would flow to the west and then southwest and then into the proposed Blue Creek LS.
- The Blue Creek LS would receive flows from Aurora and eventually all the flow from Boyd, Ivy Hills and the Boyette Tract. This LS would be built in two phases. Phase I of the LS and a 12-inch FM would be constructed between the years of 2020 and 2024. Phase II and the 10-inch FM would be built between 2025 and 2030.
- The eastern end of the two FMs would discharge into an 18-inch interceptor that would run east along Hwy 114, collecting wastewater from developments on the eastern edge of Aurora, and then south to a proposed Oates Branch West LS.
- The proposed Oates Branch West LS would receive wastewater from the Boyd and Aurora areas, as well as from New Fairview as described below. This LS would also be built in two phases. Phase I of the LS and a 10-inch FM would be constructed in between the years of 2020 and 2024. Phase II and a 10-inch FM would be built during the period of years 2030 and 2034.

City of New Fairview

- The sewer system in New Fairview would be the same as in the Modified Base Case, but the sewers would terminate at the proposed Upper Elizabeth Creek LS, which would pump wastewater from New Fairview west and then south along Hwy 287/81 through a 6-inch FM.
- The 6-inch FM would discharge into a gravity sewer that would collect wastewater from the northwest side of Rhome. This gravity sewer would be 8-inch north of Hwy 114 and 12-inch south of the highway. The 12-inch would run in a southwesterly direction until it joined the 18-inch interceptor on the eastern side of Aurora.
- As in the Modified Base Case, it was assumed that the New Fairview System would be built during the period of years 2020 and 2024.

Regional WWTP

- It is assumed that the Regional WWTP would be constructed in four or five phases and that the first phase would be built between the years of 2015 and 2019 and have a capacity of about 0.675 MGD. Phases II and III would be constructed during the periods of 2020 to 2024 and 2025 to 2029, respectively.
- The ultimate capacity of the Option C Regional WWTP would be about 3.4 MGD.

As shown in Table D.4, the total capital cost to construct Option C would be about $65.4 million.

8.5 Cost Comparisons

8.5.1 Overall Cost Comparison

In this section the Options are compared on the basis of costs that are presented in two ways for each Option. Option B has been modified to include centralized collection and treatment systems for Aurora and New Fairview so that Option B can be more accurately compared to the Modified Base Case and Option C. The centralized systems for Aurora and New Fairview would be exactly the same as in the Modified Base Case. All costs are presented in equivalent Y2009 dollars. Appendix D contains tables showing the detailed cost calculations that were used to prepare the summaries in the tables that follow in this section.

Table 8.1 shows the estimated total project capital costs for wastewater systems that would accommodate flow projections in 2030 for the cities and the build-out flows for each of the major developments. Option B was estimated to have the lowest total project capital cost at $56.7 million, closely followed by the Modified Base Case at $58.5 million.

Table 8.1 shows the capital costs that would be incurred during each five year interval. Note that the total collection system costs for the Modified Base Case and Option B were relatively close at $16.6 million and $18.7 million, respectively. The collection system costs for Option C were substantially higher at $31 million reflecting the extensive system of interceptors and force mains needed to transport wastewater from Boyd, Aurora, and New Fairview to the regional plant southeast of Newark.

When the treatment plant costs are compared, Option C had the lowest total project cost at $33 million followed by Option B at $38 million and the Modified Base Case at $42 million. This reflects economies of scale that would be expected. However, changes in the effluent limits at each site work against the economies of scale effect, since the effluent limits are generally stricter for the larger plants, at least in the initial years. For example, the City of Boyd's plant has a 20/20 permit while the regional plant for Option C is anticipated to have a 5/5/1/0.5 permit. Thus, while the economies of scale reduce the unit cost of a plant, these reductions are partially offset by the higher cost for more treatment.

The options have also been compared using the present worth of both capital and O&M costs over the period Y2010 to Y2034, as summarized in Table 8.2. Note that some capital expenditures will occur after Y2034. These are reflected in the total project capital costs but not in the present worth values, which only uses the costs incurred out to Y2034.

The extensive piping and lift station infrastructure that must be built to connect all five cities drives the estimated present worth cost of Option C higher than the other options. The present worth of the Modified Base Case is about $36 million and the present worth of Option B is about $34 million, but note that the present worth of the O&M costs for Option B are about 19% lower than for the

Table 8.1: Summary of Capital Costs (5-Year Increments and Full Development Build-out)

Treatment Facility	Estimated Costs in 5-Year Increments (Y2009 $)						
	2010-2014	2015-2019	2020-2024	2025-2029	2030-2034	After 2034	Totals
COLLECTION SYSTEM							
Modified Base Case							
City of Boyd	$ ---	$ 27,405	$ 984,000	$ 606,600	$ ---	$ ---	$ 1,618,005
Ivy Hills/Boyette Tract	$ ---	$ 454,500	$ 859,050	$ ---	$ ---	$ ---	$ 1,313,550
City of Aurora	$ ---	$ 70,035	$ 2,278,800	$ ---	$ ---	$ ---	$ 2,348,835
City of New Fairview	$ ---	$ 78,735	$ 1,900,500	$ ---	$ ---	$ ---	$ 1,979,235
City of Rhome	$ 796,710	$ ---	$ ---	$ 1,630,200	$ ---	$ ---	$ 2,426,910
Rolling V Ranch	$ ---	$ 4,473,750	$ 705,150	$ ---	$ ---	$ 1,788,900	$ 6,967,800
City of Newark	$ ---	$ ---	$ ---	$ ---	$ ---	$ ---	$ ---
Total Capital Costs	**$ 796,710**	**$ 5,104,425**	**$ 6,727,500**	**$ 2,236,800**	**$ ---**	**$ 1,788,900**	**$ 16,654,335**
Option B*							
Boyd/Ivy Hills/Boyette	$ 39,150	$ 2,434,200	$ 951,750	$ ---	$ ---	$ ---	$ 3,425,100
City of Aurora	$ ---	$ 70,035	$ 2,278,800	$ ---	$ ---	$ ---	$ 2,348,835
City of New Fairview	$ ---	$ 78,735	$ 1,900,500	$ ---	$ ---	$ ---	$ 1,979,235
Rhome/Newark/Rolling V	$ ---	$ 6,285,720	$ 1,203,150	$ 1,630,200	$ 1,350,000	$ 534,150	$ 11,003,220
Total Capital Costs	**$ 39,150**	**$ 8,868,690**	**$ 6,334,200**	**$ 1,630,200**	**$ 1,350,000**	**$ 534,150**	**$ 18,756,390**
Option C							
Five City Regionalization	**$ 70,470**	**$ 8,155,755**	**$ 18,342,462**	**$ ---**	**$ 4,701,750**	**$ ---**	**$ 31,270,437**
WASTEWATER TREATMENT PLANTS							
Modified Base Case							
City of Boyd	$ ---	$ ---	$ ---	$ 2,070,000	$ ---	$ 1,530,000	$ 3,600,000
Ivy Hills/Boyette Tract	$ 112,500	$ 2,887,500	$ ---	$ 4,312,500	$ ---	$ ---	$ 7,312,500
City of Aurora	$ ---	$ 157,500	$ 3,060,000	$ ---	$ ---	$ 3,060,000	$ 6,277,500
City of New Fairview	$ ---	$ 120,000	$ 1,545,000	$ ---	$ ---	$ ---	$ 1,665,000
City of Rhome	$ 1,807,500	$ ---	$ ---	$ 2,587,500	$ ---	$ ---	$ 4,395,000
Rolling V Ranch	$ 240,000	$ 4,200,000	$ ---	$ 4,200,000	$ ---	$ 8,040,000	$ 16,680,000
City of Newark	$ 1,987,500	$ ---	$ ---	$ ---	$ ---	$ ---	$ 1,987,500
Total Capital Costs	**$ 4,147,500**	**$ 7,365,000**	**$ 4,605,000**	**$ 13,170,000**	**$ ---**	**$ 12,630,000**	**$41,917,500**

Treatment Facility	Estimated Costs in 5-Year Increments (Y2009 $)						
	2010-2014	2015-2019	2020-2024	2025-2029	2030-2034	After 2034	Totals
WASTEWATER TREATMENT PLANTS (CONT.)							
Option B*							
Boyd/Ivy Hills/Boyette	$ ---	$ ---	$ 3,780,000	$ ---	$ ---	$ 3,060,000	$ 6,840,000
City of Aurora	$ ---	$ 157,500	$ 3,060,000	$ ---	$ ---	$ 3,060,000	$ 6,277,500
City of New Fairview	$ ---	$ 120,000	$ 1,545,000	$ ---	$ ---	$ ---	$ 1,665,000
Rhome/Newark/Rolling V	$ ---	$ 5,853,000	$ 5,827,500	$ 5,775,000	$ ---	$ 5,775,000	$ 23,230,500
Total Capital Costs	**$ ---**	**$ 6,130,500**	**$ 14,212,500**	**$ 5,775,000**	**$ ---**	**$ 11,895,000**	**$ 38,013,000**
Option C							
Five City Regionalization	**$ ---**	**$ 6,779,250**	**$ 6,836,250**	**$ 6,888,750**	**$ ---**	**$ 12,757,500**	**$ 33,261,750**
COLLECTION SYSTEMS PLUS TREATMENT PLANTS							
Modified Base Case	**$ 4,944,210**	**$12,469,425**	**$ 11,332,500**	**$ 15,406,800**	**$ ---**	**$ 14,418,900**	**$ 58,571,835**
Option B	**$ 39,150**	**$14,999,190**	**$ 20,546,700**	**$ 7,405,200**	**$ 1,350,000**	**$ 12,429,150**	**$ 56,769,390**
Option C	**$ 70,470**	**$14,935,005**	**$ 25,178,712**	**$ 6,888,750**	**$ 4,701,750**	**$ 12,757,500**	**$ 64,532,187**

* In Option B, Aurora and New Fairview are shown developing their own centralized wastewater systems (instead of continuing with OSSFs) in order to accurately compare Option B with the Modified Base Case and Option C.

Table 8.2: Summary of Present Worth Calculations (Y2010 to Y2034)

Alternative	Present Worth of Project Capital Costs (million $)	Present Worth of O&M Costs (million $)	Total Present Worth (million $)
Modified Base Case			
Boyd	$2.00	$0.65	$2.65
Ivy Hills/Boyette Tract	$5.07	$1.53	$6.61
Aurora	$3.29	$0.94	$4.23
New Fairview	$2.24	$0.44	$2.68
Rhome	$3.87	$1.43	$5.30
Rolling V Ranch	$9.04	$3.07	$12.11
Newark	$1.48	$0.90	$2.39
Total Present Worth	**$27.01**	**$8.96**	**$35.97**
Option B: (Discharge to Unnamed Tributary)			
Boyd/Ivy Hills/Boyette Tract	$4.62	$1.48	$6.10
Aurora	$3.29	$0.94	$4.23
New Fairview	$2.24	$0.44	$2.68
Rhome/Newark/Rolling V Ranch	$17.04	$4.38	$21.42
Total Present Worth	**$27.19**	**$7.25**	**$34.44**
Option C			
Five City Regional System	**$30.77**	**$6.06**	**$36.83**

Modified Base Case. If a longer time period was evaluated, Option B would become even more attractive of an alternative compared to the Modified Base Case. The present worth value for Option C was calculated at about $37 million, but it has the lowest O&M present worth amount, reflecting the economies of scale in O&M.

8.5.2 Cost Comparisons by Entity

The preceding section compared the overall costs for each Option. However, the least cost option overall was not necessarily the best option for some of the cities and developments. In this section, the options are compared from the vantage point of each of the entities. Table 8.3 provides a comparison of the project capital costs that would be assigned to each entity for each option.

City of Boyd

The City would benefit from the economies of scale that would be realized in Option B compared to the Modified Base Case. Table 8.3 shows that Boyd's share of the total project costs in Option B ($1.8 million) is significantly lower than their cost if they do not incorporate Ivy Hills/Boyette in their long term plans ($5.2 million). Only a portion of this advantage would be offered by Option C due to the extensive infrastructure that would be required to transport wastewater from Boyd to the regional plant northeast of Newark. Thus, regionalizing with Ivy Hills and the Boyette Tract would be the most desirable alternative from the City of Boyd's perspective.

Ivy Hills & Boyette Tract

From a capital cost standpoint, there is little incentive for Ivy Hills and the Boyette Tract to regionalize with the City of Boyd as their share of the total capital costs are almost the same at about $8.6 million for the Modified Base Case and about $8.5 million for Option B. It is clear that Option C (Complete Regionalization) would not benefit either the City of Boyd or Ivy Hills and the Boyette Tract.

From Table 8.2, the present worth of the O&M costs for the Boyd/Ivy Hills/ Boyette system in Option B ($6.1 million) is lower than the sum of the O&M costs for the separate City of Boyd and the Ivy Hills/Boyette systems in the Modified Base Case ($9.3 million) by over $3.0 million. Taking into account O&M costs, this makes Option B become desirable from the perspective of both the City of Boyd and the Ivy Hills/Boyette Tract.

City of Aurora

Aurora's options are to build their own wastewater system, remain dependent on OSSFs, or become part of the Option C regional system. However, Table 8.3 indicates that Aurora could develop its own system for less capital cost than it would cost to join the Option C regional system due to low density and the distance from the regional plant site.

Developing its own wastewater system would involve capital costs in the order of approximately $3,750 per new EDU that would be served by the system. To arrive at a total cost per EDU, the costs associated with the local infrastructure required within each development would have to be added to this amount. The local infrastructure costs were about $3,000 per EDU for lots of about 0.4 acres each. Thus, the total cost for developing its own infrastructure would cost approximately $6,750 per new EDU for densities of about 2 EDUs per acre.

The cost of an OSSF has been estimated between $4,500 per EDU for a conventional septic tank and drain field and $7,500 per EDU for an aerobic system with drip irrigation. At densities of about 2 EDUs per acre, a centralized wastewater system would be more expensive than OSSFs if most OSSFs were developed with conventional septic tanks and drain fields; however, OSSF developments would be limited to densities of 1 EDU per acre or less. Therefore, if Aurora desires to develop an economic alternative to OSSFs, the City will need to allow and even encourage development densities of at least two EDUs per acre.

City of New Fairview

The City of New Fairview's situation is similar to that of the City of Aurora's, except that the difference between the estimated costs of OSSFs for the new EDUs and the unit cost to develop a centralized wastewater system are even greater. Developing their own wastewater system would involve capital costs in the order of $9,700 per new EDU that would be served by the system. Adding the local infrastructure costs ($3,000 per EDU) to that would mean that the total cost for developing its own infrastructure would cost approximately $12,700 per new EDU, compared to $4,500 to $7,500 for installing an OSSF. A centralized system appears not to be viable unless denser developments are encouraged and unless there were more of these denser developments and they were located relatively close to one another.

Table 8.3: Summary of Estimate Project Capital Costs by Option and Entity*

Entity	Total EDUs	New EDUs (thru 2034)	Modified Base Case		Option B		Option C	
City of Boyd	1,273	752	$5,218,005	9%	$1,755,522	3%	$4,354,584	7%
City of Aurora	2,300	2,300	$8,626,335	15%	$8,626,335	15%	$11,000,880	17%
City of New Fairview	455	455	$3,614,235	6%	$3,614,235	6%	$4,418,930	7%
City of Rhome	1,150		$6,821,910	12%	$5,965,953	11%	$3,600,882	6%
City of Newark	680		$1,987,500	3%	$2,346,445	4%	$2,085,134	3%
Ivy Hills/Boyette Tract	2,178	2,178	$8,626,050	15%	$8,509,578	15%	$16,037,179	25%
Rolling V Ranch	7,512	7,512	$23,647,800	40%	$25,921,321	46%	$23,034,598	36%
TOTAL	**15,548**		**$58,541,835**	**100%**	**$56,739,390**	**100%**	**$64,532,187**	**100%**

* Assumes the cost of the regional systems is paid by each entity according to their percentage of capacity of each primary segment of the system.

LEGEND

Two City Regionalization with Rolling V Ranch

Boyd Serving Ivy Hills/Boyette Tract

Five City Regionalization with Rolling V Ranch & Ivy Hills/Boyette Tract

City of Rhome

Rhome would benefit the most from Option C, as their small number of new EDUs, compared to the total EDUs that would be served by Option C, diminishes their share of the capital cost. Essentially, Rhome would benefit from the involvement of Boyd, Aurora and New Fairview as the infrastructure from these cities would pass through or close to Rhome. While Option C does offer advantages over the other options for the City of Rhome, it is doubtful that Option C would be pursued due to its higher cost for most of the other entities.

Rhome's share of the capital costs for Option B ($6.0 million) make Option B more attractive than the Modified Base Case in which Rhome's share of the capital costs are $6.8 million. As noted earlier, the present worth of the O&M costs for Option B are 19% lower than the sum of the O&M costs for each entity if each operate their own system. In the long term it will be even more advantageous for Rhome to work with Rolling V Ranch, especially if the decommissioning of the Rhome-East WWTP can be delayed until the construction of gravity lines in Rolling V Ranch.

City of Newark

The capital costs for Newark are about the same for all three options (between $2.0 million and $2.3 million). As with Rhome, the primary reason for Newark to participate in a regional option will be the lower O&M costs over the long term.

Rolling V Ranch

The capital cost for Rolling V Ranch is about the same under the Modified Base Case and Option C at approximately $23.6 million and $23.0 million, respectively. Their cost under Option B would be about 10% more (about $2.3 million). However, in addition to the long term benefits regarding lower O&M costs, Rolling V Ranch could potentially achieve the following benefits by participating in the regional system outlined in Option B:

- The WWTP site could be provided by Newark and not located within the Rolling V Ranch development
- The cities of Rhome and Newark, and perhaps a regional authority, could be a party to the discharge permit, thereby making it potentially easier to obtain the TCEQ permit.
- Rolling V Ranch could avoid operating a WWTP on a long term basis, and perhaps even on a short term basis.

9.0 POTENTIAL FUNDING SOURCES

Funding sources for the Southeast Wise County Regional Wastewater System are dependent on the selected alternative and financial viability of each political entity within the study area. Also, the type of funding source selected to finance the engineering design and construction costs will depend on the organizational structure of the entity that owns and operates the regional system.

A number of potential funding sources exist for rural utilities, which typically provide service to less than 50,000 people. Both state and federal agencies offer grant and loan programs to assist rural communities in meeting their infrastructure needs. Most are available to "political subdivisions" such as counties, municipalities, school districts, special districts, or authorities of the state with some programs providing access to private individuals.

Grant funds are typically available to those entities that demonstrate financial need based on a median household income (MHI) value below 75 to 80 percent of the State's MHI value. The funds may be used for planning, design, and construction of wastewater construction projects. Some funds

may be used to finance the consolidation or regionalization of neighboring wastewater utilities. Three Texas agencies that offer financial assistance for wastewater infrastructure are:

- **Texas Water Development Board (TWDB)** has several programs that offer loans at interest rates lower than the market offers to finance projects for public wastewater systems that facilitate compliance with wastewater regulations. Additional subsidies may be available for disadvantaged communities. Low interest rate loans with short and long-term finance options at tax exempt rates for wastewater projects give an added benefit by making construction purchases qualify for a sales tax exemption. Generally, the program targets customers with eligible wastewater projects for all political subdivisions of the state (at tax exempt rates).
- **Office of Rural Community Affairs (ORCA)** is a Texas state agency with a focus on rural Texas by making state and federal resources accessible to rural communities. Funds from the U.S. Department of Housing and Urban Development Community Development Block Grants (CDBG) are administered by ORCA for small, rural communities with populations less than 50,000 that cannot directly receive federal grants. These communities are known as non-entitlement areas. One of the program objectives is to meet a need having a particular urgency, which represents an immediate threat to the health and safety of residents, principally for low- and moderate-income persons.
- **U.S. Department of Agriculture Rural Development Texas (Texas Rural Development)** coordinates federal assistance to rural Texas to help rural Americans improve their quality of life. The Rural Utilities Service (RUS) programs provide funding for water and wastewater disposal systems. The application process, eligibility requirements, and funding structure vary for each of these programs. There are many conditions that must be considered by each agency to determine eligibility and ranking of projects. The principal factors that affect this choice are population, percent of the population under the State MHI, health concerns, compliance with standards, Colonia status, and compatibility with regional and state plans.

In addition to Federal and State water/wastewater programs, funding sources may also originate from revenue bonds and developer participation towards the regional infrastructure of the system. An overview of all of these financing mechanisms is presented below.

9.1 Federal and State Infrastructure Programs

There are a variety of funding programs available to entities through Federal and State infrastructure programs. Depending on the type of organization that owns the proposed Southeast Wise County Regional Wastewater System, funding is most likely to be obtained from programs administered by the TWDB, ORCA and/or Rural Development. Information required by these agencies for initial applications may include financial analyses, records demonstrating health concerns, failing infrastructure, and financial need.

9.1.1 TWDB Funding Options

The programs offered by the TWDB include the Clean Water State Revolving Fund (CWSRF), State Loan Program (Development Fund II) and Economically Distressed Areas Program (EDAP).

Clean Water State Revolving Fund

The Clean Water State Revolving Fund (CWSRF) provides loans (Tier II) at interest rates lower than the market to political subdivisions with the authority to own and operate a wastewater system. The CWSRF also includes Federal (Tier III) and Disadvantaged Communities funds that provide even lower interest rates for those meeting the respective criteria.

The CWSRF offers fixed and variable rate loans at subsidized interest rates. The maximum repayment period for a CWSRF loan is 20 years from the completion of project construction. A cost-recovery loan origination charge of 1.85% is imposed to cover administrative costs of operating the CWSRF; however, an additional interest rate subsidy is offered to those financing the origination charge.

TWDB accepts Information Forms from prospective loan applicants to be included on the CWSRF Intended Use Plan (IUP) during the early part of each year. The Information Form describes the applicant's existing wastewater facilities, facility needs, the nature of the project being considered and project cost estimates. This information is used to rate each proposed project and place them in priority order on the IUP. Applicants eligible for funding through the CWSRF program are notified in June to attend a pre-application meeting and submit an application for financial assistance. Funds would be available the following year, typically in early February, after previously submitting the Information Form.

State Loan Program (Development Fund II)

The State Loan Program is a diverse lending program directly from state funding sources. As it does not receive federal subsidies, it is more streamlined. The loans can incorporate more than one project under the umbrella of one loan. Political subdivisions of the state are eligible for tax exempt rates. Projects can include purchase of treatment plants, pumping facilities, lift stations, collection lines, and acquisitions. The loan requires that the applicant pledge revenue or taxes. The maximum financing life is 50 years, and the average financing period is approximately 20 years. The lending rate scale varies according to several factors, but is set by the TWDB based on cost of funds to the board, risk factors of managing the board loan portfolio, and market rate scales.

The application materials must include an engineering feasibility report, environmental information, rates and customer base, operating budgets, financial statements, and project information. The TWDB considers the needs of the area; benefits of the project; the relationship of the project to the overall state water needs and the State Water Plan; and the availability of all sources of revenue to the rural utility for the ultimate repayment of the loan. The board considers applications on a monthly basis.

Economically Distressed Areas Program

The EDAP Program was originally designed to assist areas along the U.S./Mexico border in areas that were economically distressed. In 2008, this program was extended to apply to the entire state so long as requirements are met. This program provides financial assistance through the provision of grants and loans to communities where present facilities are inadequate to meet resident's minimal needs. Eligible communities are those that have median household income less than 75 percent of the state household income.
The county where the project is located must adopt model rules for the regulation of subdivisions prior to application for financial assistance. If the applicant is a city, the city must also adopt Model Subdivision Rules of TWDB (31 TAC Chapter 364). The program funds design, construction, improvements, and acquisition, and includes measures to prevent future substandard development. The TWDB works with the applicant to find ways to leverage other state and federal financial resources. The loan requires that the applicant pledge revenue or taxes. The maximum financing life is 50 years, and the average financing period is approximately 20 years. The lending rate scale varies according to several factors, but it is set by the TWDB based on cost of funds to the board, risk factors of managing the board loan portfolio, and market rate scales. The TWDB seeks to make reasonable loans with minimal loss to the state. Most projects have a financial package with the majority of the project financed with grants; many recipients have received 100 percent grant funds.

9.1.2 ORCA Funding Options

Created in 2001, ORCA seeks to strengthen rural communities and assist them with community and economic development and healthcare by providing a variety of rural programs, services, and activities. Of their many programs and funds, the most appropriate programs related to drinking water are the Community Development (CD) Fund and Texas Small Towns Environment Program (STEP). These programs offer attractive funding packages to help make improvements to wastewater systems to mitigate potential health concerns.

Community Development Fund

The CD Fund is a competitive grant program for water and wastewater system improvements. Funds are distributed between 24 state planning regions where funds are allocated to address each region's utility priorities. Funds can be used for various types of public works projects, including wastewater system improvements. Cities with a population of less than 50,000 that are not eligible for direct CDBG funding from the U.S. Department of Housing and Urban Development are eligible. Funds are awarded on a competitive basis decided twice a year by regional review committees. Awards are no less than $75,000 and cannot exceed $800,000.

Texas Small Towns Environment Program

Under special occasions some communities are invited to participate in grant programs when self-help is a feasible method for completing a wastewater project, the community is committed to self-help, and the community has the capacity to complete the project. The purpose is to significantly reduce the cost of the project by using the communities' own human, material, and financial capital. Projects typically are repair, rehabilitation, improvements, service connections, and yard services. Reasonable associated administration and engineering cost can be funded. A letter of interest is first submitted, and after CDBG staff determines eligibility, an application may be submitted. Awards are only given twice per year on a priority basis so long as the project can be fully funded ($350,000 maximum award). Ranking criteria are project impact, local effort, past performance, percent of savings, and benefit to low to medium-income persons.

9.1.3 Rural Development Funding Options

The RUS agency of Rural Development established a Revolving Fund Program (RFP) administered by the staff of the Water and Environment Program (WEP) to assist communities with water and wastewater systems. The purpose is to fund technical assistance and projects to help communities bring safe drinking water and sanitary, environmentally sound, waste disposal facilities to rural Americans in greatest need. WEP provides loans, grants, and loan guarantees for drinking water, sanitary sewer, solid waste, and storm drainage facilities in rural areas and cities and towns with a population of 10,000 or less. Recipients must be public entities such as municipalities, counties, special purpose districts, Indian tribes, and corporations not operated for profit. Projects include all forms of infrastructure improvement, acquisition of land and water rights, and design fees. A request for a combination of grants and loans vary on a case by case basis, and some communities may have to wait though several funding cycles until funds become available.

Water and Wastewater Disposal Program

The major components of the RFP are loan, loan guarantees, and grant funding for water and waste disposal systems. Entities must demonstrate that they cannot obtain reasonable loans at market rates, but have the capacity to repay loans, pledge security, and operate the facilities. Grants can be up to 75 percent of the project costs, and loan guarantees can be up to 90 percent of eligible loss. Loans are not to exceed a 40-year repayment period, require tax or revenue pledges, and are offered at three rates:

- ***Poverty Rate*** - The lowest rate is the poverty interest rate of 4.5 percent. Loans must be used to upgrade or construct new facilities to meet health standards, and the MHI in the service area must be below the poverty line for a family of four or below 80 percent of the statewide MHI for non-metropolitan communities.
- ***Market Rate*** – Where the MHI in the service exceeds the state MHI, the rate is based on the average of the "Bond Buyer" 11-Bond Index over a four week period.
- ***Intermediate Rate*** – the average of the Poverty Rate and the Market Rate, but not to exceed seven percent.

9.2 Revenue Bonds

In addition to Federal and State wastewater programs, a wastewater utility may pledge future earnings to fund improvements to the wastewater system through the issuance of revenue bonds. A revenue bond is a special type of municipal bond, and the income generated by the improvement or expansion of the wastewater project would be used for repayment. Unlike general obligation bonds, only the revenues specified in the legal contract between the bond holder and bond issuer are required to be used for repayment of the principal and interest of the revenue bonds. Since the pledge of security is not as great as that of general obligation (G.O.) bonds, revenue bonds may carry a slightly higher interest rate than G.O. bonds.

9.3 Developer Participation

Developer participation typically occurs through two means: upfront capital contributions or payment of impact fees for a water/wastewater infrastructure project. Under a regional system where several political subdivisions are participating, a single independent organization or entity is recommended to manage and/or operate the regional system, such as a river authority or regional utility authority. River authorities, a regional utility authority, or other similar entities may require a developer to completely finance the entire cost of an infrastructure project and then turn it over to the utility to own and operate on their behalf. A utility may also require a developer to pledge capital towards an infrastructure project through an upfront cash payment or a letter of credit for the utility to drawdown on if needed to reduce the level of risk on the project.

The utility may also require that developers contribute toward the cost of new water/wastewater infrastructure through the payment of impact fees. The intent of this funding source is that the cost of new infrastructure serving new utility customers will not be subsidized by the existing utility rate payers. In essence, growth pays for growth.

10.0 CONCLUSIONS AND RECOMMENDATIONS

In conclusion, the results of this study indicate that Option B is the most promising alternative for the project participants to initiate a regional wastewater system. Option B represents partial regionalization with Rolling V Ranch and the Cities of Newark and Rhome and could enable more comprehensive regionalization in the future. Based on the results of the water quality modeling activities, the location recommended for constructing a new facility is the Unnamed Tributary Regional WWTP Site. The proposed effluent limits for discharges reaching Eagle Mountain Lake from this site are 5-mg/L $CBOD_5$, 5-mg/L TSS, 1.3-mg/L NH_3-N and 0.5-mg/L TP.

The least expensive solution for the City of Aurora would be to develop their own stand-alone wastewater system, provided it serves developments with higher densities. If the City did develop its own stand-alone wastewater system, and if Rhome, Newark and Rolling V did pursue a regional approach, then the City of Aurora might at some future point in time reconsider participating in a

regional system. The proximity of Aurora to Rhome and Rolling V Ranch give it an advantage over Boyd and New Fairview in that regard. Otherwise, OSSFs will continue to be Aurora's most cost-effective alternative. For the City of New Fairview, OSSFs also appear to be the least expensive wastewater alternative unless denser and larger developments are encouraged.

The results of the study also indicated that it would be advantageous for the City of Boyd, Ivy Hills and Boyette Tract to cooperate in a joint wastewater system. Treatment would be provided by the existing City of Boyd Wastewater Treatment Plant (WWTP), which currently has excess capacity and could be expanded and updated as needed to accommodate future flows. The cost of additional treatment processes, such as chemical treatment and filtration to meet stringent nutrient limits, were included in the analysis. A joint system is estimated to be about 25 percent lower on a total project cost basis and about 34 percent lower on a present worth basis (Y2010 to Y2034) when compared to the costs if each entity developed their own system.

From a total project cost standpoint, the evaluation results indicate Option B would be slightly more expensive (approximately 5%) when compared to individual treatment systems for Rolling V Ranch and the Cities of Newark and Rhome. Both cities' share of the project capital costs for Option B and the Modified Base Case would be about the same, approximately $10.7 million. Rolling V Ranch's share of the costs would be about 10% more compared to constructing their own treatment plant. However, when the long term costs of O&M are considered, Option B looks more favorable. From 2010 to 2034, the present worth of the O&M costs for the regional system in Option B is 19% lower than the O&M costs associated with each entity having their own stand-alone system.

Due to the long-term cost advantages and other advantages related to permit and land acquisition, the project team recommends that the Cities of Newark and Rhome work together with Rolling V Ranch to pursue a regional wastewater system. A regional system serving all five cities will most likely become a reality after Year 2030 due to the high cost of transporting wastewater from the Cities of Boyd and New Fairview.

For additional information regarding this study, please reference Appendix I for a copy of the draft memorandum that addresses the development of the collection and treatment system alternatives. Appendix J includes a copy of the draft memorandum that outlines the findings and recommendations for this study. In Appendix K, public meeting documentation, which includes the meeting notice, agenda and sign-in sheet, is provided for each of the four project team meetings held throughout the duration of the study. TWDB draft report review comments and the consultant team's responses are attached in Appendix L.

APPENDIX A

Figure A.1: Base Case

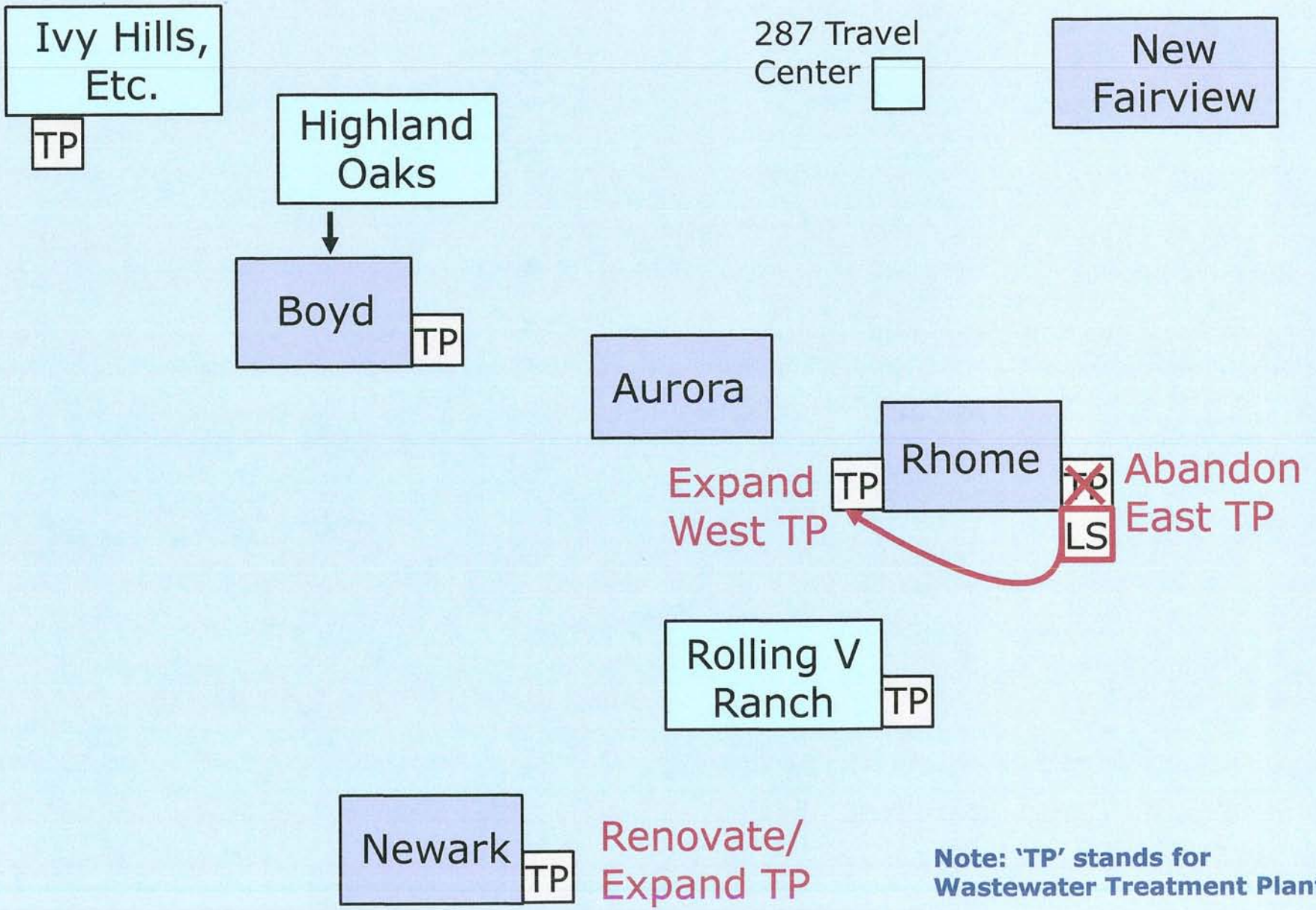


Figure A.2: Option A

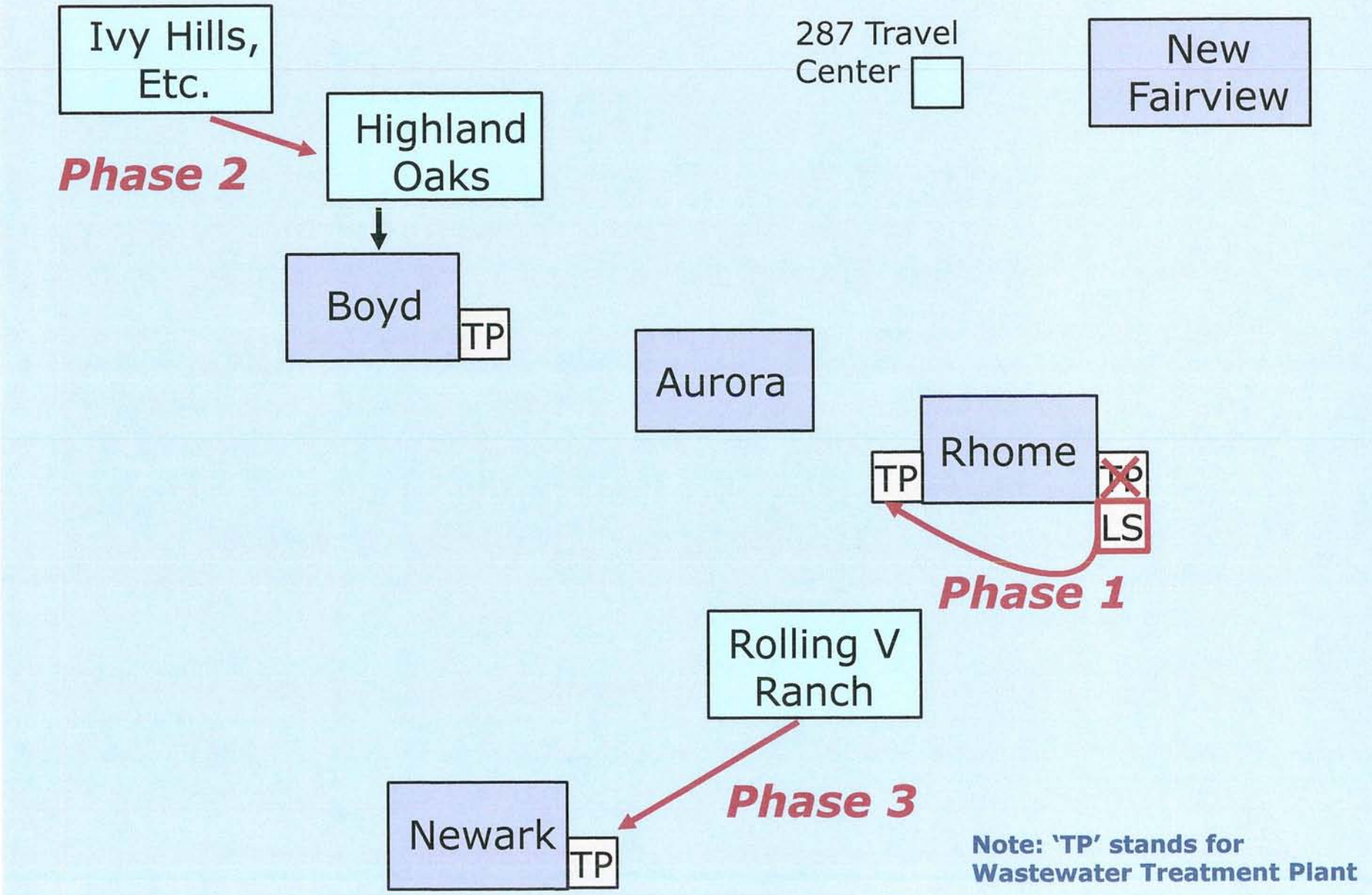


Figure A.3: Option A-1

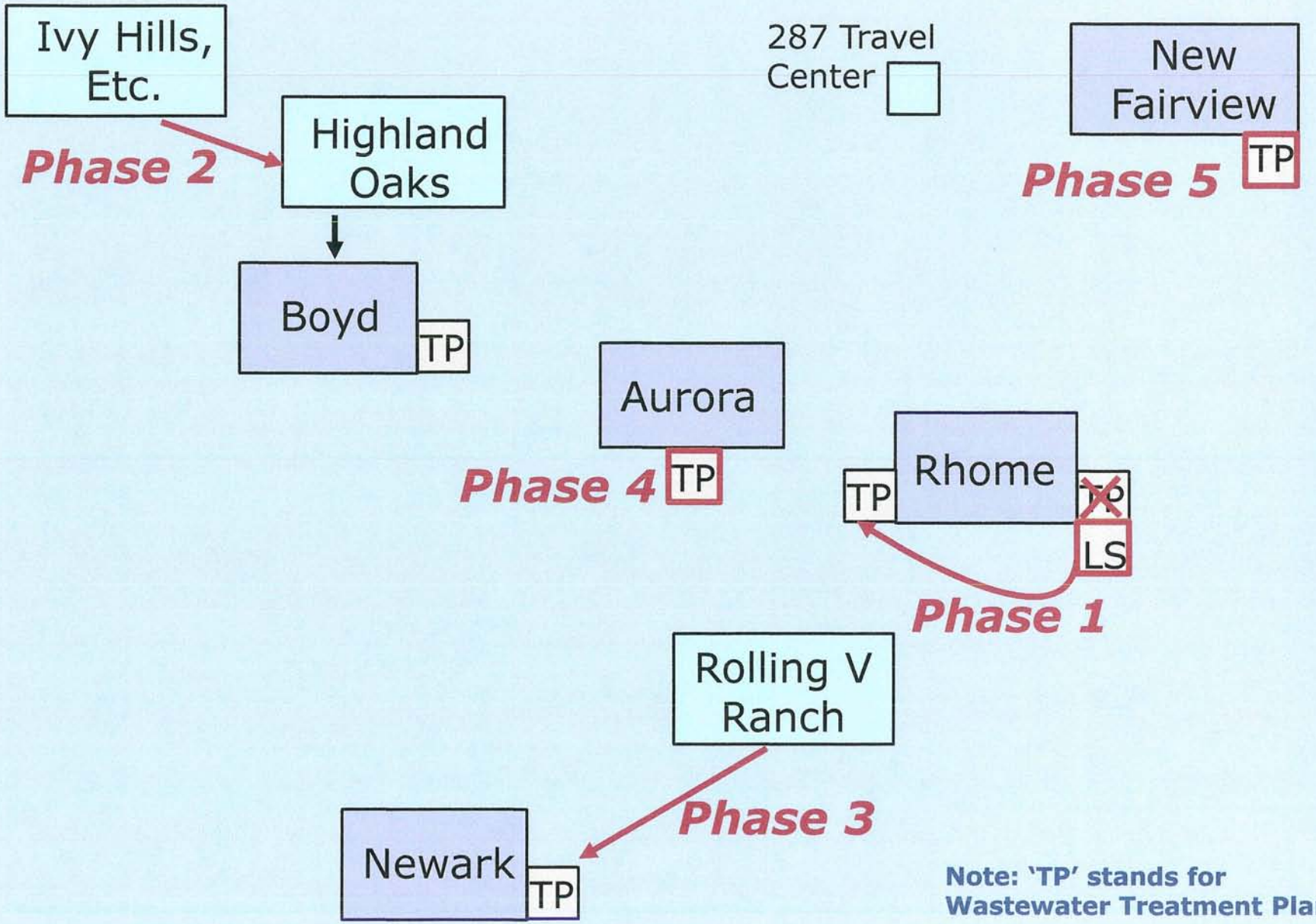


Figure A.4: Option B

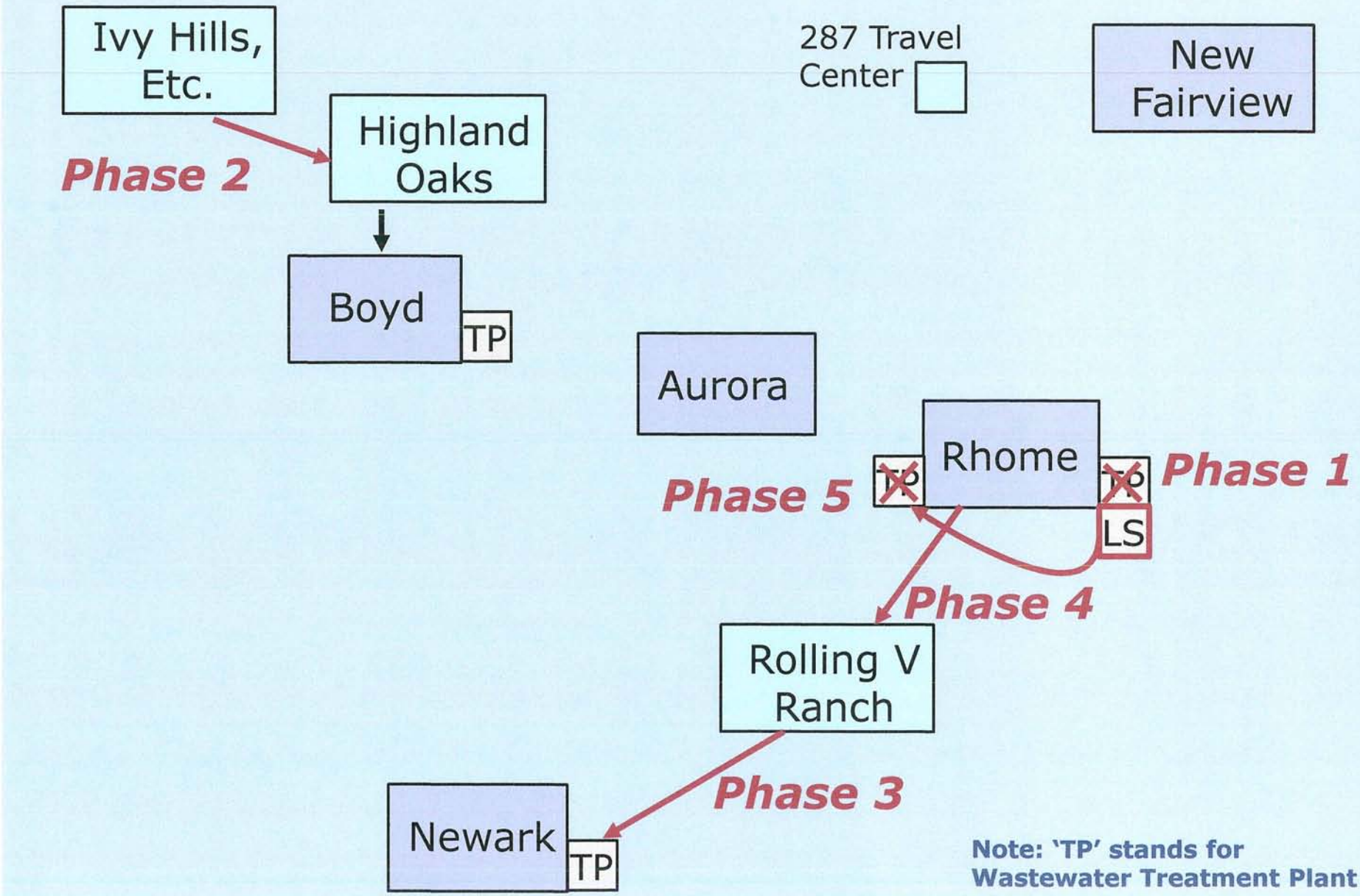


Figure A.5: Option B-1

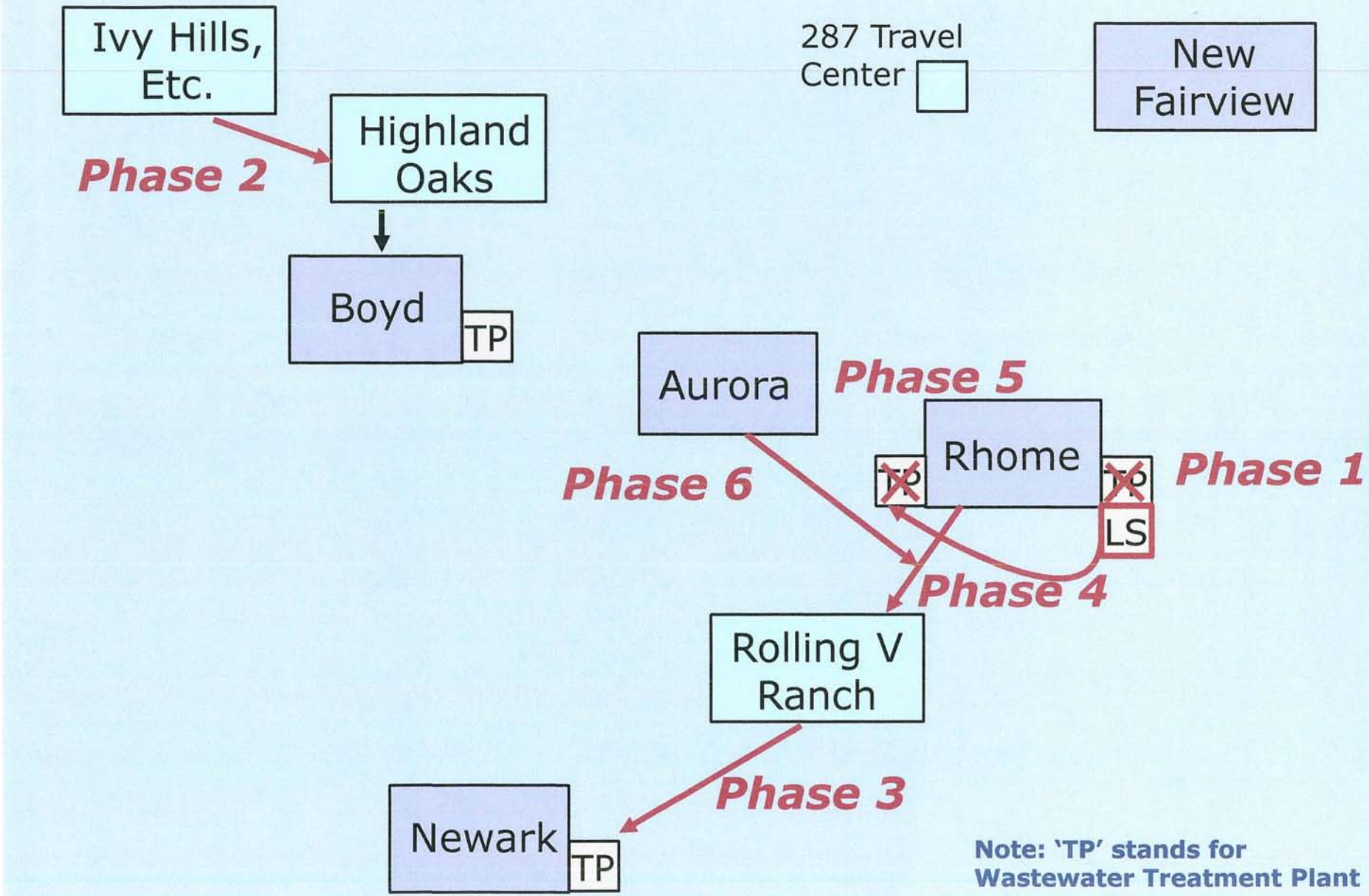


Figure A.6: Option B-2

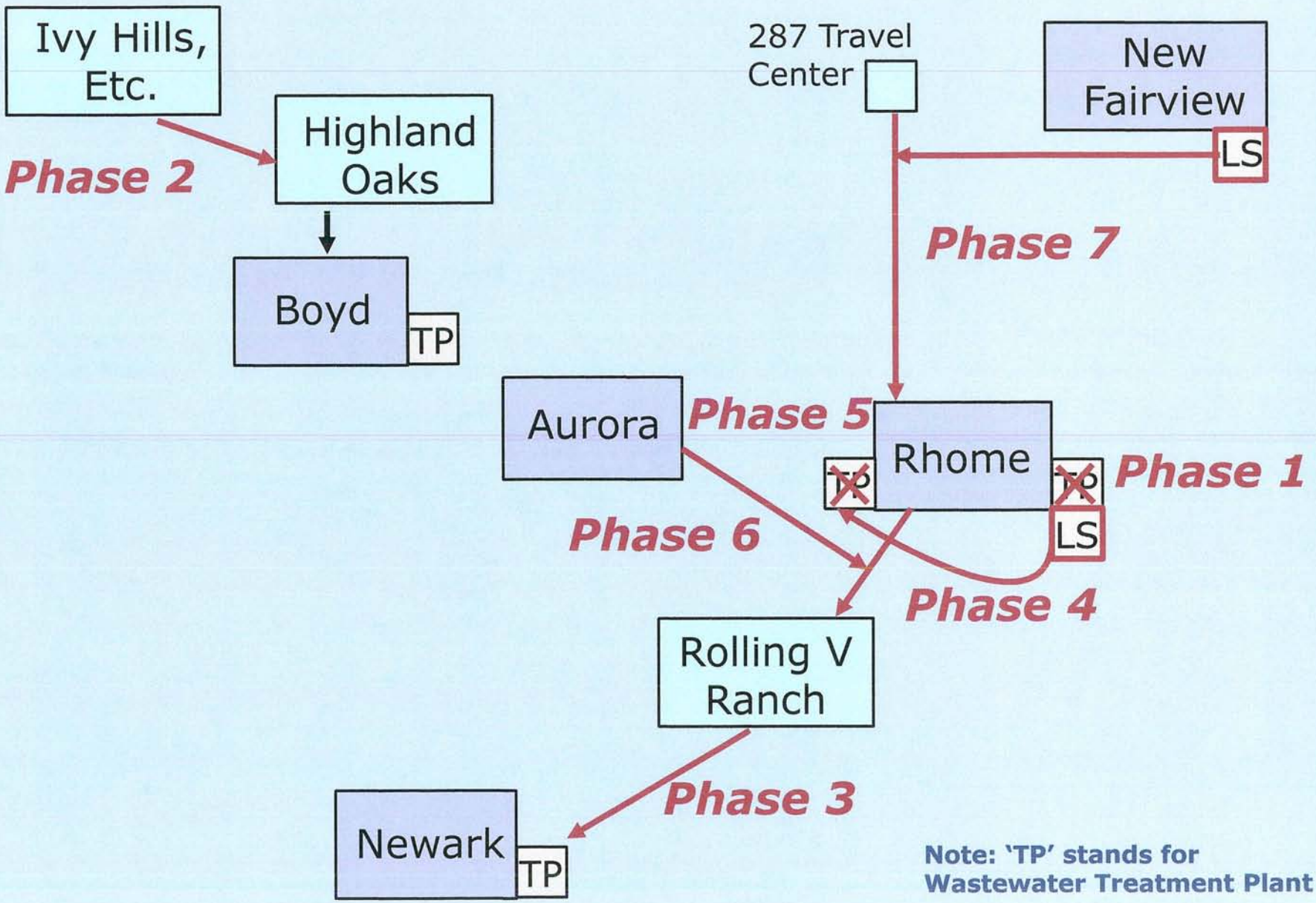


Figure A.7: Option C

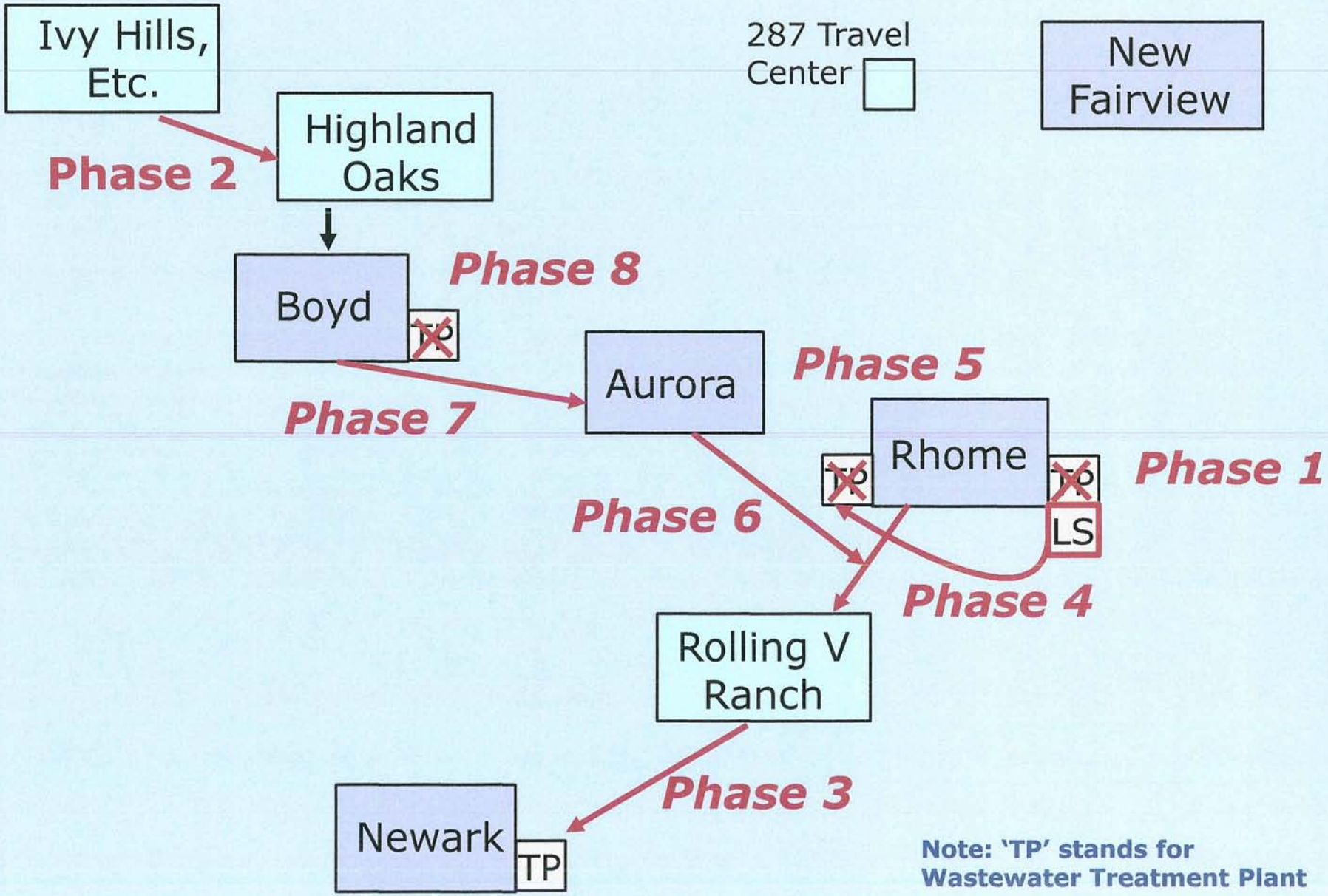
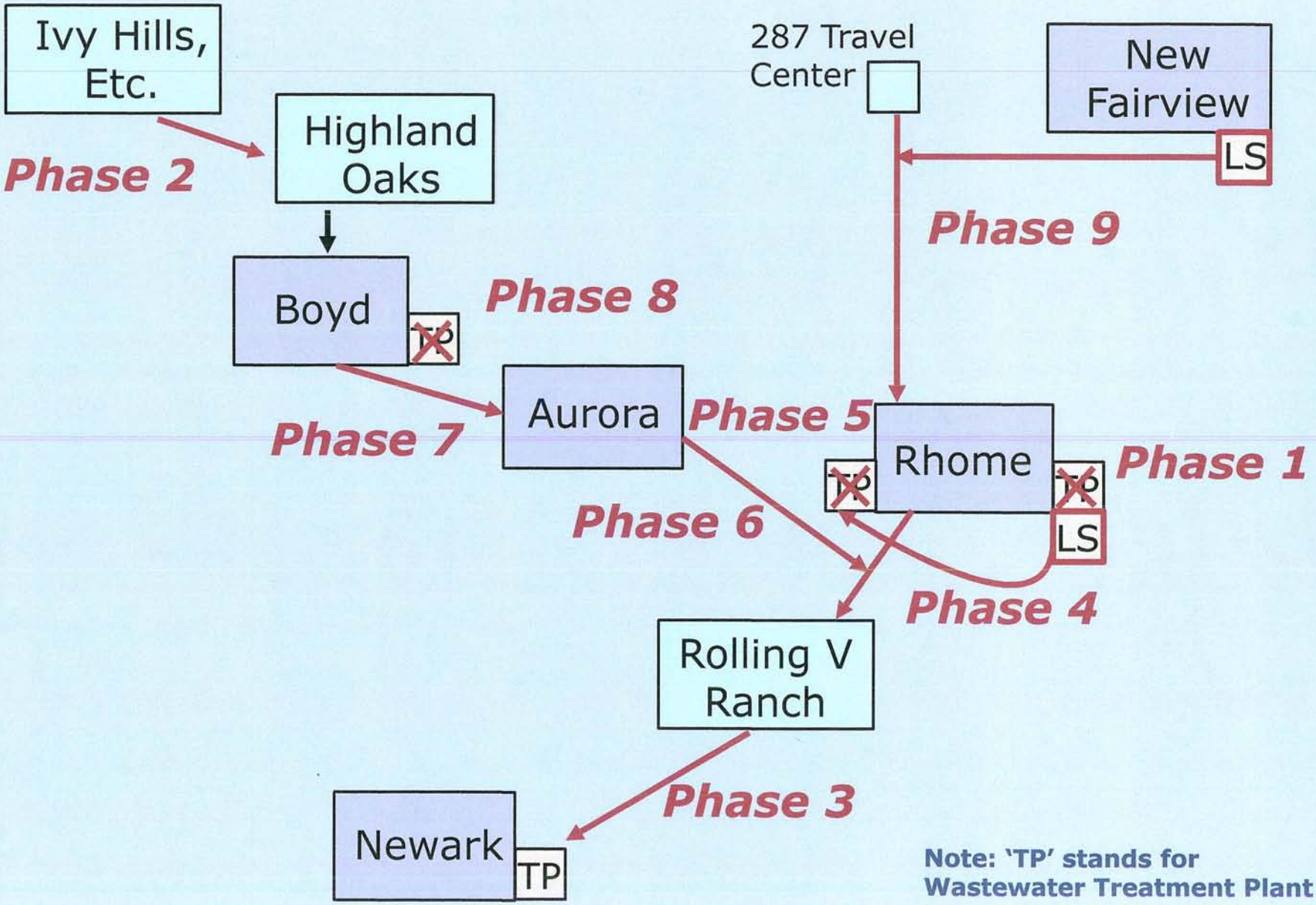


Figure A.8: Option C-1



APPENDIX B

Espey Consultants, Inc.
Environmental & Engineering Services

MEMORANDUM

DATE: May 5, 2009

TO: Susan Roth, P.E., PMP

FROM: David Harkins, Ph.D., P.E., Alisa Patterson, P.E., Sandeep Chaudhari, E.I.T.

RE: Wise County Regional Wastewater Treatment Alternatives Analysis

1.0 INTRODUCTION

This memorandum summarizes the results and recommendation of potential options for regional wastewater treatment facilities, in Southeast Wise County. This memorandum contains information regarding the Wise County study area, projected wastewater flows, description of regional wastewater treatment plant (WWTP) modeling scenarios, model development, application and results, and proposed water quality effluent standards for differing regional wastewater treatment alternatives.

1.1 STUDY AREA

The study area for this project includes the incorporated limits and extraterritorial jurisdictions of the Cities of Aurora, Boyd, Newark, New Fairview, and Rhome and the surrounding unincorporated areas. The majority of service area is located in southeast Wise County with a small portion of the contributing drainage area extending into northwest Tarrant County.

The City of Boyd and Ivy Valley Utilities, L.P. operates WWTPs that discharges into the West Fork Trinity River above Eagle Mountain Lake. The City of Rhome operates one WWTP that discharges into Grapevine Lake and another WWTP that discharges into Oates Branch a tributary to the West Fork Trinity River above Eagle Mountain Reservoir. The City of Newark operates a WWTP that discharges into wetlands prior to discharging into the Derrett Creek arm of Eagle Mountain Lake. The Cities of Aurora and New Fairview are currently served exclusively with septic systems. The proposed Southeast Wise County Regional Wastewater System would incorporate the complete collection and treatment systems for these six communities. The existing and proposed WWTP locations considered in this study are illustrated in Exhibit 1 of Attachment A.

2.0 EXISTING WASTEWATER TREATMENT PLANTS

Ivy Valley Utilities, LP
Permit No. WQ0014841-001
Ivy Hills Wastewater Treatment Facility is located on the north bank of the West Fork Trinity River, approximately 4,200 feet southwest of the intersection of State Highway 730 and County Road 4481 in Wise County, Texas. The currently permitted facility can treat 0.3 MGD of

wastewater with the effluent characteristics of 10 mg/L of 5-day Carbonaceous Biochemical Oxygen Demand ($CBOD_5$), 2 mg/L of Ammonia Nitrogen (NH_3-N) and 5 mg/L of Dissolved Oxygen (DO) and discharges into West Fork Trinity River below Bridgeport Reservoir in Segment No. 0810 of the Trinity River Basin.

City of Boyd
Permit No. WQ0010131-001
City of Boyd Wastewater Treatment Facility is located on the north side of State Highway 114, approximately 1,000 feet east-northeast of the intersection of Farm-to-Market Road 730 and State Highway 114 in Wise County, Texas to the West Fork Trinity River below Bridgeport Reservoir in Segment No. 0810 of the Trinity River Basin. The currently permitted facility can treat 0.24 MGD of wastewater with the effluent characteristics of 20 mg/L of $CBOD_5$ and 2 mg/L of DO and discharges into West Fork Trinity River below Bridgeport Reservoir in Segment No. 0810 of the Trinity River Basin.

City of Rhome:
Permit No. WQ0010701-002
City of Rhome is authorized to treat and discharge wastes from the Westside Wastewater Treatment Facility located approximately 150 feet east of the intersection of County Road 4651 and Oates Branch in Wise County, Texas. The current facility treats 0.15 MGD of wastewater everyday with the effluent characteristics of 10 mg/L of $CBOD_5$, 3 mg/L of NH_3-N and 4 mg/L of DO and discharges into Oates Branch; thence to West Fork Trinity River below Bridgeport Reservoir in Segment No. 0810 of the Trinity River Basin.

City of Newark
Permit No. WQ0011626-001
City of Newark is authorized to treat and dispose of wastes from the wastewater treatment facility located on the east bank of Derrett Creek immediately south of the Newark Beach Road Bridge, about 850 feet west of the intersection of Roger Road and Berke Street in Wise County, Texas. The WWTP facility treats 0.1 MGD of wastewater everyday with the effluent characteristics of 7 mg/L of $CBOD_5$, 2 mg/L of NH_3-N and 5 mg/L of DO and discharges into a series of wetland ponds; thence to the Derrett Creek arm of the Eagle Mountain Reservoir in Segment No. 0809 of the Trinity River Basin.

Aqua Development, Inc.
Permit No. WQ0014129-001
Aqua Development, Inc. is authorized to treat and dispose of wastes from the Chisholm Springs wastewater treatment facility located on the east bank of an unnamed tributary to Indian Creek, approximately 2,200 feet west of the US Highway 287 and just south of Wise and Tarrant County line in Tarrant County, Texas. The WWTP facility treats 0.5 MGD of wastewater everyday with the effluent characteristics of 5 mg/L of $CBOD_5$, 2 mg/L of NH_3-N and 5 mg/L of DO and discharges into Unnamed Tributary; thence to the Indian Creek arm of the Eagle Mountain Lake Segment No. 0809 of the Trinity River Basin.

Table 1 provides a summary of the effluent characteristics for existing permitted WWTPs within the study area for Eagle Mountain Lake.

Table 1 - Summary of Existing WWTP Effluent Characteristics

WWTP Operator	Permit No.	Discharge Stream	Permitted Effluent Characteristics (Daily Average)			
			Flow (MGD)	$CBOD_5$ (mg/L)	NH_3-N (mg/L)	DO (mg/L)
Ivy Valley Utilities, LP	14841-001	W. Fork Trinity River (Seg. 0810)	0.30	10.0	2.0	5.0
City of Boyd	10131-001	W. Fork Trinity River (Seg. 0810)	0.24	20.0	----	2.0
City of Rhome	10701-002	Oates Branch	0.15	10.0	3.0	4.0
City of Newark	11626-001	Derrett Creek Arm of Eagle Mountain	0.10	7.0	2.0	6.0
Aqua Develop., Inc.	14129-001	Unnamed Trib to Indian Creek	0.45	5.0	2.0	5.0

3.0 SCENARIO DESCRIPTION

The population in the study area has increased significantly in the past 10 years, and the population is projected to double over the next 10 years. As a result of the anticipated growth in this area, Trinity River Authority (TRA) and Tarrant Regional Water District (TRWD) intend to develop a regional wastewater plan to identify the best possible means to provide wastewater service. The study would provide a regional solution to serve the rapid growth in the area, while considering regional objectives such as beneficial reuse of effluent and protection of water quality. As part of the study EC conducted a water quality evaluation of regional wastewater treatment plant site alternatives for flows based on ultimate build-out of proposed developments and population projections for the year 2030. Projected wastewater flows were provided by Susan Roth Consulting. Several scenarios were evaluated including a Modified Base Case, an Option B, and an Option C Scenario.

3.1 MODIFIED BASE CASE

This scenario represents the existing WWTPs of Ivy Hills, City of Boyd, City of Rhome, City of Newark and proposed Aurora and Rolling V Ranch WWTPs acting independently from the others with no regionalization. Currently Aurora is served exclusively with septic system; however for Modified Base Case, Aurora will have a WWTP that discharges into Blue Creek thence to Eagle Mountain Lake. Wastewater flows from City of Rhome east WWTP have been combined with and modeled at City of Rhome west WWTP location and will discharge into Oates Branch thence to Eagle Mountain Lake. Rolling V Ranch WWTP has been modeled as a regional plant at Unnamed Tributary south of Derrett Creek. Exhibit 1 in Attachment A illustrates the locations of all WWTPs. Table 2 provides a summary of proposed wastewater flows for each City in the modified base case for year 2030 with ultimate build-out of developments.

Table 2 – Modified Base Case: Summary of Proposed Wastewater Flows, Year 2030

Entity	Treatment Facility	Discharge Stream	Wastewater Flows Y2030 Pop. Proj. + Ultimate Buildout of Developments (GPD)
Aurora	Individual	Blue Creek	460,000
Boyd	Individual	W. Fork Trinity River (Segment 0810)	254,598
Ivy Hills & Boyette Tract	Individual	W. Fork Trinity River (Segment 0810)	435,600
Newark	Individual	Derrett Creek Arm of Eagle Mountain	136,046
Rhome (West & East WWTPs)	Individual	Oates Branch	229,932
Rolling V Ranch	Individual	Unnamed Trib. South of Derrett Creek	1,502,480

3.2 OPTION B: INITIAL REGIONALIZATION

The City of Boyd WWTP will serve Ivy Hills and the Boyette Tract. Regionalization is initiated between the City of Newark, the City of Rhome, and Rolling V Ranch. Wastewater flows from City of Rhome (East & West), City of Newark and Rolling V Ranch will have been accumulated and treated at four (4) different potential regional plants. The four (4) regional plants include the Newark Regional Plant, Unnamed Tributary Regional Plant, Moss Branch Regional Plant and Indian Creek Regional Plant. Following is the brief description of each regional plant.

3.2.1 Newark Regional Plant

The City of Newark operates one WWTP that discharges into a wetlands facility prior to discharging into Derrett Creek Cove of Eagle Mountain Lake. This existing facility is modeled as a regional plant for Option B with accumulated flows from City of Rhome (East & West), Rolling V Ranch and City of Newark for year 2030.

3.2.2 Unnamed Tributary Regional Plant

Exhibit 2 in Attachment A illustrates the location of Unnamed Tributary Regional Plant that discharges into Unnamed Tributary just south of Derrett Creek. This regional facility was modeled for accumulated flows as mentioned under section 3.2. Table 3 summarizes the proposed wastewater flows for Option B.

3.2.3 Moss Branch Regional Plant

The proposed Moss Branch Regional Plant will be located south of US Highway 718. Exhibit 3 in Attachment A illustrates the location of Moss Branch regional plant that discharges to Moss Branch; thence to Indian Creek Cove of Eagle Mountain Lake.

3.2.4 Indian Creek Regional Plant

As illustrated in Exhibit 3 in Attachment A the proposed regional plant site is located upstream of confluence of Moss Branch with Indian Creek and just south of US Highway 718. The Moss Branch Regional Plant and the Indian Creek Regional Plant are at the same location; however the Moss Branch Regional Plant will discharge into Moss Branch whereas the Indian Creek Regional Plant will discharge into Indian Creek; thence to Indian creek Cove of Eagle Mountain Lake.

Table 3 summarizes the proposed wastewater flows for Option B.

Table 3 – Option B: Summary of Proposed Wastewater Flows, Year 2030

Entity	Wastewater Flows for City Y2030 Pop. Proj. + Ultimate Buildout of Developments (GPD)	Total Wastewater Flows (GPD)	Treatment Facility	Discharge Streams
Boyd	254,598	690,198	Boyd WWTP	West Fork Trinity River
Ivy Hills & Boyette Tract	435,600			
Newark	136,046	1,868,458	Regional	Derrett Creek, Unnamed Trib., Moss Branch, Indian Creek
Rhome (West & East WWTPs)	229,932			
Rolling V Ranch	1,502,480			

3.3 OPTION C: COMPLETE REGIONALIZATION

Option C represents complete regionalization where the wastewater for the entire area including Aurora, Ivy Valley, New Fairview, Rolling V Ranch and Cities of Boyd, Newark, Rhome (East & West) will be treated at four (4) different potential regional plants. The locations of regional plants are same as described in Option B. The City of New Fairview operates one WWTP that discharges in to Lake Grapevine, however for Option C the wastewater flows from New Fairview will be part of the regional plant scenarios and will discharge into Eagle Mountain Lake. Exhibit 2 and Exhibit 3 in Attachment A illustrate the locations of Newark Regional Plant, Unnamed Tributary Regional Plant, Moss Branch Regional Plant and Indian Creek Regional Plant. Table 4 summarizes the proposed wastewater flows for Option C.

Table 4 – Option C: Summary of Proposed Wastewater Flows, Year 2030

Entity	Wastewater Flows for City Y2030 Pop. Proj. + Ultimate Buildout of Developments (GPD)	Total Wastewater Flows (GPD)	Treatment Facility	Discharge Stream
Aurora	460,000	3,109,697	Regional	Derrett Creek, Unnamed Trib., Moss Branch, Indian Creek
Boyd	254,598			
Ivy Valley & Boyette Tract	435,600			
New Fairview	91,040			
Newark	136,046			
Rolling V Ranch	1,502,480			
Rhome (West & East WWTPs)	229,932			

4.0 QUAL-TX MODEL DEVELOPMENT AND RESULTS

This section summarizes the development of the models utilized to evaluate the water quality impacts of the regionalization as well as a description of the results and recommendations of proposed effluent discharge locations. Espey Consultants, Inc. (EC) utilized a CSTR spreadsheet model and the QUAL-TX, both developed by the Texas Commission on Environmental Quality (TCEQ), to quantify effluent limitations DO, $CBOD_5$, and NH_3-N for each of the scenarios based on the year 2030 population projections and ultimate build-out conditions detailed in Section 3.0.

4.1 Model Development

All modeling done as part of this study was developed in accordance with TCEQ's 'Evaluating TPDES Permit Applications Using a Continuously Stirred Tank Reactor (CSTR) Model' and 'Methods for Analyzing Dissolved Oxygen in Freshwater Streams Using an Uncalibrated QUAL-TX Model' both dated June 24, 2008. EC obtained the TCEQ's developed QUAL-TX and CSTR models for Ivy Valley Utilities, LP (Permit No. WQ0014841-001), City of Boyd (Permit No. WQ0010131-001), City of Rhome (Permit No. WQ0010701-002), City of Newark (Permit No. WQ0011626-001) and Aqua Development, Inc. (Permit No. WQ0014129-001) and used these models as a basis for the models created as part of this study. EC developed models for each of the WWTPs evaluated in this study utilizing the TCEQ WWTP models when available. Models were developed independent of upstream wastewater treatment plants if the DO level had returned to background conditions prior to the location of the plant. The following sections describe the model development for each of the plant sites and Attachment B contains the QUAL-TX and CSTR input files for the different scenarios.

Ivy Valley Utilities, LP Ivy Hills Plant
EC utilized the Ivy Hills Wastewater Plant QUAL-TX model developed by TCEQ for Permit No. WQ0014841-001 and modified the discharge volume accordingly. The TCEQ modeled this plant independent of other wastewater treatment plants.

City of Boyd
EC utilized the City of Boyd Wastewater Plant QUAL-TX model developed by TCEQ for Permit No. WQ0010131-001 and modified the discharge volume accordingly. Modeling at this site was performed independent of the upstream Ivy Hills Plant because the Ivy Hills model did not show an impact to water quality in the West Fork Trinity River at the City of Boyd's Plant.

Aurora Wastewater Plant
EC developed a QUAL-TX model for the proposed Aurora plant on Blue Creek approximately 0.8 km upstream of the confluence with the West Fork Trinity River using standard TCEQ default values given in the 'Methods for Analyzing Dissolved Oxygen in Freshwater Streams Using an Uncalibrated QUAL-TX Model' dated June 24, 2008. Modeling at this site was performed independent of the upstream City of Boyd Plant and Ivy Hills Plant because the plants did not show an impact at the confluence of Blue Creek with the West Fork Trinity River.

City of Rhome West Wastewater Plant
EC utilized the City of Rhome's Wastewater Plant QUAL-TX model developed by TCEQ for Permit No. WQ0010701-002 and modified the discharge volume accordingly. Modeling of this

plant on Oates Branch was performed independent of the upstream Ivy Hills Plant, the City of Boyd Plant, and Aurora Plant because the upstream plants did not show an impact at the confluence of Oates Branch with the West Fork Trinity River. This model showed no impact to Eagle Mountain Lake; the DO had returned to background model conditions prior to entering Eagle Mountain Lake.

City of Newark/ Regional Plant Site
EC utilized the CSTR and calibrated QUAL-TX model developed by TCEQ for the City of Newark's Permit No. WQ0011626-001 and modified the discharge volume accordingly. The CSTR model developed by TCEQ models the discharge to the wetlands prior to discharging into Derrett Creek Cove of Eagle Mountain Lake.

Unnamed Tributary Regional Plant Site
EC developed a QUAL-TX model for the regional plant site located on the Unnamed Tributary just south of Derrett Creek entering Unnamed Creek cove of Eagle Mountain Lake. The developed model is from the discharge site approximately 2.4 km upstream of Eagle Mountain Lake and includes the Eagle Mountain Lake cove that the Unnamed Tributary enters. The cove is modeled with a constant width and depth approach. Per discussions with Mark Rudolph of the TCEQ Water Quality Assessment Team, the cove is modeled with similar dispersion coefficients as the calibrated TCEQ Newark model. Default stream and boundary conditions were utilized as given in the TCEQ's 'Methods for Analyzing Dissolved Oxygen in Freshwater Streams Using an Uncalibrated QUAL_TX Model' dated June 24, 2008. Initialization runs were completed for each scenario prior to effluent limit determination runs.

Moss Branch Regional Plant Site
EC developed a QUAL-TX model for the regional plant site discharging into Moss Branch approximately 5.0 km upstream of Indian Creek Cove of Eagle Mountain Lake. The developed model reaches from the discharge site on Moss Branch and includes Indian Creek Cove of Eagle Mountain Lake. The Chisholm Springs WWTP, operated by Aqua Development, Inc., is located upstream of the confluence of Indian Creek with Moss Branch is included in this model. EC acquired the TCEQ Chisholm Springs QUAL-TX model which showed an impact to Indian Creek past the confluence with Moss Branch. Indian Creek Cove is modeled with a constant width and depth approach. Per discussions with Mark Rudolph of the TCEQ Water Quality Assessment Team, the cove is modeled with similar dispersion coefficients as the calibrated TCEQ Newark model. Default stream and boundary conditions were utilized as given in the TCEQ's 'Methods for Analyzing Dissolved Oxygen in Freshwater Streams Using an Uncalibrated QUAL_TX Model' dated June 24, 2008. Initialization runs were completed for each scenario prior to effluent limit determination runs.

Indian Creek Regional Plant Site
EC developed a QUAL-TX model for the regional plant site discharging into Indian Creek approximately 5.2 km upstream of Indian Creek Cove of Eagle Mountain Lake. The developed model reaches from the upstream discharge of the Chisholm Springs WWTP down to and including the Indian Creek Cove of Eagle Mountain Lake. The TCEQ Chisholm Springs QUAL-TX model shows an impact to Indian Creek past Indian Creek Regional Plant site. Indian Creek Cove is modeled the same in the Indian Creek Regional Plant Site model as in the Moss

Creek Regional Plant Site model. Default stream and boundary conditions were utilized as given in the TCEQ's 'Methods for Analyzing Dissolved Oxygen in Freshwater Streams Using an Uncalibrated QUAL_TX Model' dated June 24, 2008. Initialization runs were completed for each scenario prior to effluent limit determination runs.

4.2 MODELING RESULTS

Using the models described in the Section 4.1, the Modified Base Case, Option B, and Option C scenarios were modeled and proposed effluent limits were calculated by systematically adjusting the effluent limits in the model until the model predicted compliance with DO criteria. Eagle Mountain Lake and the West Fork Trinity River from Eagle Mountain Lake to Bridgeport Reservoir are classified stream segments 0809 and 0810, respectively. Both segments have a DO criterion of 5.0 mg/L. All other streams in this study are unclassified. Unclassified perennial streams have a DO criterion of 5.0 mg/L. Unclassified intermittent streams with perennial pools have a 3.0 mg/L DO criterion while intermittent streams without perennial pools have a 2.0 mg/L DO criterion. Table 5 provides a summary of the DO criteria per wastewater treatment plant site.

Table 5 - Summary of DO Criteria

Plant Site	Stream	Flow Type	DO Criteria (mg/L)
Ivy Valley	West Flork Trinity River (Segment No. 0810)	Perennial	5.0
Boyd	West Flork Trinity River (Segment No. 0810)	Perennial	5.0
Aurora	Blue Creek	Perennial	5.0
	West Flork Trinity River (Segment No. 0810)	Perennial	5.0
Rhome	Oates Branch	Intermittent	3.0 / 2.0
Regional Plant - Newark Plant	Newark WWTP Wetlands	Wetland	3.0
	Derrett Creek Cove (Segment No. 0809)	Reservoir	5.0
Regional Plant - Unnamed Tributary	Unnamed Tributary	Intermittent	3.0 / 2.0
	Unnamed Tributary Cove (Segment No. 0809)	Reservoir	5.0
Regional Plant - Moss Branch	Moss Branch	Intermittent	3.0 / 2.0
	Moss Branch	Perennial	5.0
	Indian Creek	Perennial	5.0
	Indian Creek Cove (Segment No. 0809)	Reservoir	5.0
Regional Plant - Indian Creek	Indian Creek	Perennial	5.0
	Indian Creek Cove (Segment No. 0809)	Reservoir	5.0

The QUAL-TX and CSTR models are set up to simulate low base flow conditions with the discharge at full flow and effluent concentrations. While this combination of conditions is possible, it is highly unlikely to occur simultaneously. Therefore, actual stream DO is likely to be higher than what the CSTR and QUAL-TX models predict. As a result, the TCEQ considers a model predicted DO that is up to a 0.20 mg/L below the criterion as being consistent with the criterion.

Models at existing permitted sites were first evaluated at permitted effluent values DO,$CBOD_5$, and NH_3-N and then adjusted as necessary until the DO criterion was met. Table 6 contains the effluent treatment levels needed to maintain the appropriate DO criteria for the Modified Base Case.

Table 6 – Modified Base Case Summary of Proposed Effluent Limits

Plant Site	Discharge (MGD)	Proposed Effluent Limits		
		DO (mg/L)	$CBOD_5$ (mg/L)	NH_3-N (mg/L)
Ivy Hills WWTP	0.44	5	10	2
Boyd WWTP	0.26	2	20	12
Rhome WWTP (East + West)	0.23	4	10	3
Newark WWTP	0.14	---	---	---
Aurora WWTP	0.46	5	10	2
Unnamed Trib Regional Plant Site - Rolling V Ranch	1.50	6	5	1.5

The Ivy Hills WWTP, the Boyd WWTP, and the Rhome WWTP sites each maintained the same permitted effluent limits for DO,$CBOD_5$, and NH_3-N even under the larger discharge volume for Modified Base Case. The Aurora WWTP site can discharge 5.0 mg/L DO, 10 mg/L $CBOD_5$ and 2 mg/L NH_3-N at Modified Base Case flows and meet the minimum DO requirements of 5.0 mg/L in Blue Creek and the West Fork Trinity River. Rolling V Ranch, modeled at the Unnamed Tributary Regional Plant Site, meet the minimum DO criteria with discharge limits of 6.0 mg/L DO, 5 mg/L $CBOD_5$ and 1.5 mg/L NH_3-N.

The Newark WWTP site does not meet the minimum DO requirement of 5.0 mg/L in Derrett Creek Cove even with an effluent limit of 6.0 mg/L DO, 5 mg/L $CBOD_5$ and 1 mg/L NH_3-N. Currently the City of Newark has a temporary variance to the Water Quality Standards that allows a three-year period to develop a site-specific DO criterion for the Derrett Creek arm of Eagle Mountain Lake for Permit No. WQ0011626-001. Through multiple discussions with Mark Rudolph of the TCEQ Water Quality Assessment Team, EC learned that that the TCEQ calibrated QUAL-TX model of the Derrett Creek arm of Eagle Mountain Lake indicates that the current DO criterion of 5.0 mg/L is not predicted to be maintained, even in the absence of the Newark Plant. With the absence of site-specific DO criterion to be developed from Permit No. WQ0011626-001, Mark Rudolph indicated that further permitted development of this plant would be unlikely. Utilizing an effluent limit of 6.0 mg/L DO, 5 mg/L $CBOD_5$ and 1 mg/L NH_3-N for the Newark Plant under Modified Base Case flows, the minimum DO in Derrett Creek Cove is 1.9 mg/L. Table 7 contains the effluent treatment levels needed to maintain the appropriate DO criteria for Option B.

Table 7 - Option B Summary of Proposed Effluent Limits

Plant Site	Discharge (MGD)	Proposed Effluent Limits		
		DO (mg/L)	$CBOD_5$ (mg/L)	NH3-N (mg/L)
Boyd (Ivy Hills + Boyd)	0.69	2	20	12
Regional Plant - Newark WWTP	1.87	---	---	---
Regional Plant - Unnamed Trib	1.87	6	5	1.3
Regional Plant - Moss Branch	1.87	6	5	1.9
Regional Plant - Indian Creek	1.87	6	5	1.9

Under Option B flows, the Boyd WWTP site maintained the ability to meet the DO criterion with the same effluent limits permitted for the site for DO,$CBOD_5$, and NH_3-N. The Newark Regional WWTP Site was unable to meet the DO criterion of 5.0 mg/L. Utilizing an effluent limit of 6.0 mg/L DO, 5 mg/L $CBOD_5$ and 1 mg/L NH_3-N and Option B flows, the minimum DO in Derrett Creek Cove is 1.8 mg/L. The other regional plant sites discharging into the Unnamed Tributary, Moss Branch, and Indian Creek, were all able to meet DO criterion at the effluent limits given in Table 7. For each of these plant sites the minimum DO concentration is found in the corresponding cove. The proposed effluent limits for the Regional Plant on the Unnamed Tributary results in a minimum DO in the cove of 4.85 mg/L. The proposed effluent limits for the Regional Plant discharging into Moss Branch results in a minimum DO in Indian Creek Cove of 4.8 mg/L. The proposed effluent limits for the Regional Plant discharging into Indian Creek results in a minimum DO in Indian Creek Cove of 4.8 mg/L. Table 8 contains the effluent treatment levels needed to maintain the appropriate DO criteria for Option C.

Table 8 - Option C Summary of Proposed Effluent Limits

Plant Site	Discharge (MGD)	Proposed Effluent Limits		
		DO (mg/L)	BOD_5 (mg/L)	NH3-N (mg/L)
Regional Plant - Newark WWTP	3.11	---	---	---
Regional Plant - Unnamed Trib	3.11	6	5	1
Regional Plant - Moss Branch	3.11	6	5	1
Regional Plant - Indian Creek	3.11	---	---	---

Under Option C flows, the Newark Regional WWTP Site was unable to meet the DO criterion of 5.0 mg/L. Utilizing an effluent limit of 6.0 mg/L DO, 5 mg/L $CBOD_5$ and 1 mg/L NH_3-N and Option C flows, the minimum DO in Derrett Creek Cove is 1.8 mg/L. The Regional Plant discharging into Indian Creek was unable to meet the DO criterion of 5.0 mg/L in Indian Creek Cove. Utilizing an effluent limit of 6.0 mg/L DO, 5 mg/L $CBOD_5$ and 1 mg/L NH_3-N and Option C flows, the minimum DO in Indian Creek Cove is 4.69 mg/L.

Both the regional plant sites discharging into the Unnamed Tributary and Moss Branch were able to meet DO criterion at the effluent limits given in Table 8. The proposed effluent limits for the Regional Plant on the Unnamed Tributary results in a minimum DO 4.82 mg/L occurring in the cove and the proposed effluent limits for the Regional Plant discharging into Moss Branch results in a minimum DO of 4.81 mg/L occurring in Indian Creek Cove. While both the Regional Plant on the Unnamed Tributary and Regional Plant on Moss Branch meet the DO criteria with a strict effluent limit of 6.0 mg/L DO, 5 mg/L $CBOD_5$ and 1 mg/L NH_3-N, it should be noted that each plant narrowly meets the DO criteria in the coves of 5.0 mg/L (with a maximum variance of 0.20 mg/L).

EC evaluated the potential for a Total Phosphorus permit limit on the regional plant sites for Option C. After careful review of the 'Draft Procedures to Implement the Texas Surface Water Quality Standards' dated January 9, 2009 and the 'Draft Nutrient Screening' document dated April 27, 2009, the regional plant sites under Option C would be assigned a Total Phosphorus Limit of 0.5 mg/L. Both Mark Rudolph and Karen Holligan, of the TCEQ Water Quality Assessment Team, stressed that these two documents are in draft form and will most likely change prior to finalization. Both the screening criteria and typical effluent limits referenced for

particular flow ranges provided in these documents will likely change in the future. At this time and at this stage in the development of the nutrient criteria, it uncertain what the ultimate Total Phosphorus Limit will be but it is more certain that there will be a Total Phosphorus limit required at the regional plant sites.

5.0 OPTIONS FOR IMPROVING MODEL PREDICTED DO

Given that under Option C only the regional plant sites discharging into the Unnamed Tributary south of Derrett Creek and Moss Branch narrowly meet the most stringent effluent standards normally adopted by TCEQ it is prudent to note potential options for improving the model predicted DO and improving the attainability of DO criteria. Options include the use of added DO enhancement (diffusers), the inclusion of wetland facilities, and model refinement. Each of these alternatives has certain drawbacks. Wetland facilities can provide a polishing effect on the wastewater discharge therefore improving the water quality prior to discharge into the stream. The polishing effect of the wetlands would result in previously unattainable DO concentrations in the coves therefore allowing the possibility of less stringent effluent standards. However, large discharges can require a large surface area for the wetland footprint. Water discharged from the wetland facilities can also be highly variable, most instances the water leaving the wetland system has lower levels of nutrients; however, there can be times when the water has higher levels of nutrients and organic material. Another option includes installing diffusers at the end of a discharge pipe into Eagle Mountain. This option improves the ability to meet DO criteria not attainable in the restrictive cove environments. However, diffusers require the installation of a discharge pipe into Eagle Mountain Lake. There have been significant discussions on the installation of such discharge pipes in Eagle Mountain Lake and these pipes are currently not recommended by TRWD. Finally, model refinements (such as new field data, stream geometries, etc.) may be able to provide additional information in the modeling to allow for better representation of the DO in these areas. A cove study may also be useful to determine if the 5.0 mg/L DO criterion for Eagle Mountain Lake is appropriate for that cove.

6.0 CONCLUSION

In the incorporated limits and extraterritorial jurisdictions of the Cities of Aurora, Boyd, Newark, New Fairview, and Rhome and the surrounding unincorporated areas, the population has increased significantly in the past 10 years, and the population is projected to double over the next 10 years. As a result of the anticipated growth in this area, TRA and TRWD intend to develop a regional wastewater plan to identify the best possible means to provide wastewater service. As part of this plan EC conducted a water quality evaluation of regional wastewater treatment plant site alternatives for flows based on ultimate build-out of proposed developments and population projections for the year 2030. Three different modeling scenarios were developed to model a Modified Base Case, an Option B scenario representing initial regionalization, and an Option C scenario representing complete regionalization. The TCEQ's QUAL-TX and CSTR model were utilized and models were developed for each wastewater treatment plant sites for the different scenarios. For Option B and Option C four (4) different potential regional plants were evaluated. The four (4) regional plants include the Newark Regional Plant, Unnamed Tributary Regional Plant, Moss Branch Regional Plant and Indian Creek Regional Plant.

The Newark Regional Plant site is not able to meet the minimum DO requirement of 5.0 mg/L in Derrett Creek Cove for any scenario. According to TCEQ, the calibrated QUAL-TX model for Derrettt Creek Cove indicates that the current DO criterion of 5.0 mg/L is not predicted to be maintained, even in the absence of the Newark Plant. Under Option B representing initial regionalization the Unnamed Tributary Regional Plant, the Moss Branch Regional Plant, and the Indian Creek Regional Plant were all capable of meeting applicable DO criteria at stringent WWTP effluent standards. The least stringent effluent standard for Option B occurs at the Moss Branch Regional Plant and the Indian Creek Regional Plant with a proposed effluent standard of 6.0 mg/L DO, 5 mg/L $CBOD_5$ and 1.9 mg/L NH_3-N.

Under Option C which represents complete regionalization, only the Unnamed Tributary Regional Plant Site and the Moss Branch Regional Plant site were capable of meeting applicable DO criteria at the stringent WWTP effluent standards of 6.0 mg/L DO, 5 mg/L $CBOD_5$ and 1.0 mg/L NH_3-N. Utilizing draft criteria developed by TCEQ, the Option C regional plants will have a Total Phosphorus effluent limit of 0.5 mg/L. It should be noted that TCEQ is still developing nutrient criteria and at this time and at this stage in the development, it uncertain what the actual Total Phosphorus Limit would be but it is more certain that there will be a Total Phosphorus limit required at the regional plant sites.

Given that under Option C only the regional plant sites discharging into the Unnamed Tributary south of Derrett Creek and Moss Branch narrowly meet the most stringent effluent standards normally adopted by TCEQ, it is prudent to note potential options for improving the model predicted DO and improving the attainability of DO criteria. These options include the use of added DO enhancement (diffusers), the inclusion of wetland facilities, model refinement, and a cove DO study but each offers certain drawbacks that should be considered.

ATTACHMENT A
Exhibits

Exhibit 1 – Existing & Proposed Wastewater Treatment Plant Locations
Exhibit 2 – Regional Plant Sites – Derrett Creek & Unnamed Tributary
Exhibit 3 – Regional Plant Site – Moss Branch & Indian Creek

Espey Consultants, Inc.

Environmental & Engineering Services

REGIS. No. F-293

EXHIBIT 1

EXISTING & PROPOSED WASTEWATER TREATMENT PLANT LOCATIONS

SOUTHEAST WISE COUNTY REGIONAL WASTEWATER STUDY

DATE: APRIL 22, 2009

PROJ. # 8078.00

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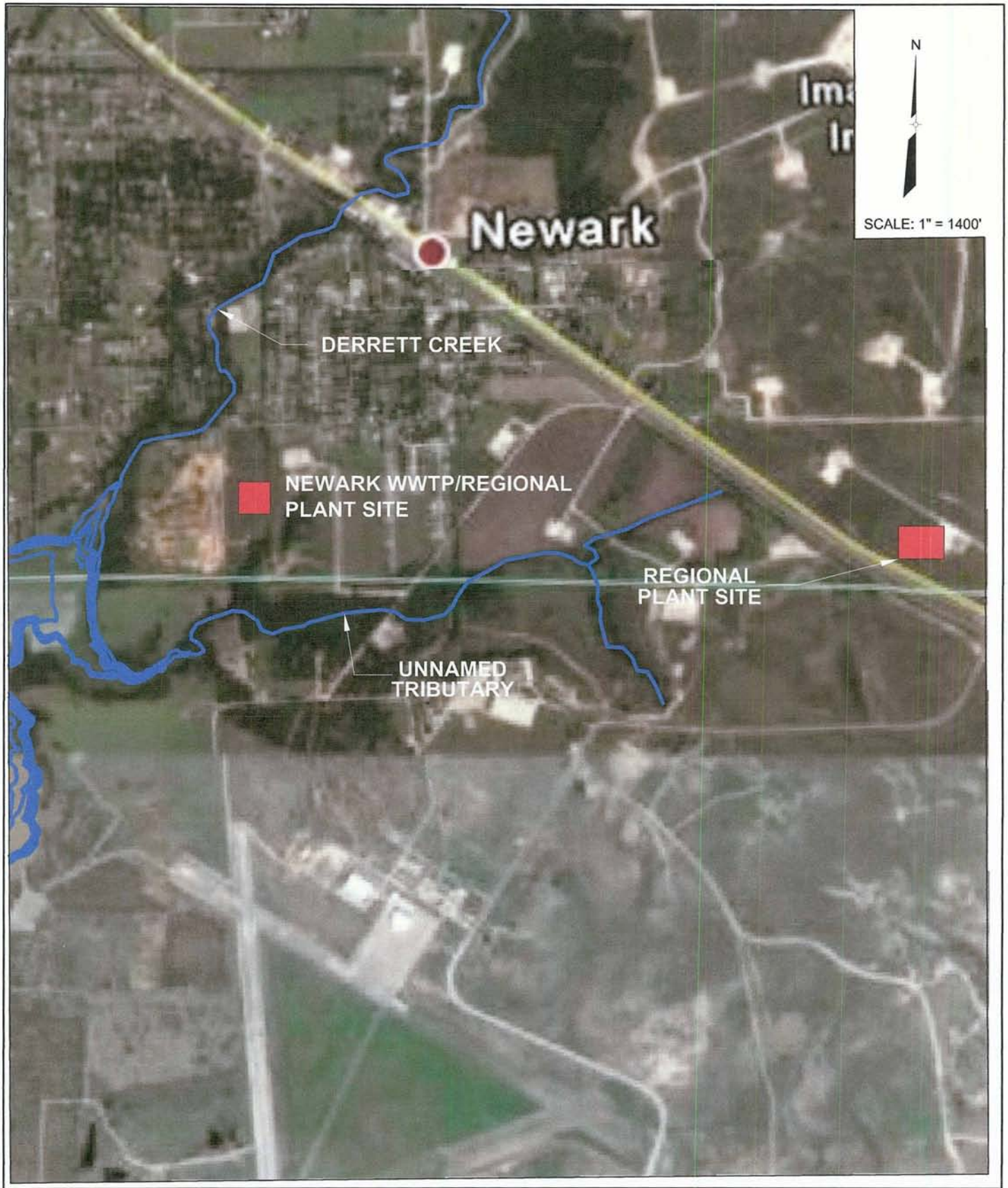

Espey Consultants, Inc.

Environmental & Engineering Services

REGIS. No. F-293

EXHIBIT 2

REGIONAL PLANT SITES - DERRETT CREEK & UNNAMED TRIBUTARY

SOUTHEAST WISE COUNTY

REGIONAL WASTEWATER STUDY

DATE: APRIL 22, 2009

PROJ. # 8078.00

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Espey Consultants, Inc.
Environmental & Engineering Services
REGIS. No. F-293

EXHIBIT 3

REGIONAL PLANT SITE - MOSS BRANCH & INDIAN CREEK
SOUTHEAST WISE COUNTY
REGIONAL WASTEWATER STUDY

DATE: APRIL 22, 2009

PROJ. # 8078.00

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APPENDIX C

Southeast Wise County Regional Wastewater Study

July 2, 2009

TCEQ TP Screening Model

TCEQ has proposed a screening model for total phosphorus to be used to assess the impact of wastewater on the main pool of large reservoirs. As of this time the procedure seems set but the application of results is still in draft form. The screening model is in the Implementation Procedures. Basically, the screening model estimates the increase in TP in the main pool of the reservoir as a result of the wastewater load. This increase is then evaluated one of two ways, both of which are not yet approved:

1. The first method was proposed by TCEQ in Jan 2009. The increase in TP as a result of the wastewater is compared to the TP assimilation capacity of the reservoir. Assimilation capacity is defined as the difference between the mean TP and the Screening level for the reservoir. For Eagle Mountain the assimilation capacity is 0.017 mg/L. TP increases due to wastewater that are greater than 1% of the assimilation capacity may require TP limits.
2. The second method was proposed in April 2009. This method also estimates the increase in TP due to the wastewater but instead of comparing this increase to an assimilation capacity, it compares it to the mean of the reservoir. The mean TP concentration for Eagle Mountain is 0.049 mg/L[1]. TP increases due to wastewater that are greater than 10% of the mean may require TP limits.

Table 1 applied both evaluations to the maximum wastewater discharge during Year 2030 (3.1 mgd from Option C-1) and the minimum wastewater discharge during year 2025 (.94 mgd from Option B) and the most probable wastewater discharge based on engineering and cost (2.558 mgd from Option B) at three different TP concentrations: 3 mg/L, 1 mg/L and 0.5 mg/L. The 3 mg/L concentration is typical for secondary treated wastewater in WWTPs around Eagle Mountain Lake. TCEQ assumes 3.5 mg/L when no data is available. The 1 mg/L and 0.5 mg/L concentrations are often discussed permit limits. Under the maximum flow scenario, a 0.5 mg/L TP effluent limit is suggested using the April 2009 methodology. Under the minimum flow scenario a 1 mg/L effluent concentration would work under the April 2009 methodology. Under the most probable scenario, a 1 TP limit is suggested by a narrow margin for error that would probably be realized by any attenuation of TP. The January 2009 methodology is much more stringent than the April approach and suggests that all effluent limits do not meet the criteria of 1% of the assimilation capacity.

[1] *The mean TP concentration reported in the April 2009 TCEQ Implementation Procedures is 0.022 mg/L. Personal communication with TCEQ (copy at end of report) notes that this was an error and the correct mean TP concentration is 0.049 mg/L.*

No attenuation of nutrients for distance from reservoir included in analysis

Scenario EM Regional WWTP	Criteria 10 % April 2009 method % Increase in Mean TP	Criteria 1% Jan 2009 method % TP Assim Capacity
Maximum flow		
Option C-1 Y2030 Ultimate		
3.109 mgd @ 3 mg/L TP	37.85%	109.09%
3.109 mgd @ 1 mg/L TP	12.62%	36.36%
3.109 mgd @ 0.5 mg/L TP	6.31%	18.18%
Probable flow		
Option B Y2030 Ultimate		
2.558 mgd @ 3 mg/L TP	31.14%	89.76%
2.558 mgd @ 1 mg/L TP	10.38%	29.92%
2.558 mgd @ 0.5 mg/L TP	5.19%	14.96%
Minimum flow		
Option B 2025		
0.938 mgd @ 3 mg/L TP	11.42%	32.91%
0.938 mgd @ 1 mg/L TP	3.81%	10.97%
0.938 mgd @ 0.5 mg/L TP	1.90%	5.49%

Table 1: TP effect from wwtp loading under three flow scenarios with three effluent limits. Highlighted cells exceed the screening level criteria for an increase in TP..

This analysis did not consider attenuation of TP from plants located up the tributaries. This analysis also does not consider plants separately such as is suggested in Option B where there is a Boyd regional plant and a second plant serving Rhome, Newark and Rolling V Ranch. The single cell, completely stirred reactor model is not sensitive to different locations of loading. If attenuation and segregation were applied, the impact on the lake might be lessened but the legitimacy of the analysis would be questionable. TP is very conservative in nature and will eventually get to Eagle Mountain Lake and the two plants in Option B are part of a simultaneous regional effort.

WASP Modeling

Water Analysis Simulation Program (WASP) is a mechanistic eutrophication model supported by the EPA. While the TCEQ TP Screening Model provides a quick estimate of the effect a WWTP discharge has on the reservoir, it lacks temporal and spatial sophistication as well as a fundamental link to the effect the increase TP will have on the algae growth in the reservoir. Tarrant Regional Water District calibrated a 13 month, 17 segment WASP model for Eagle Mountain Lake for the period Oct 2000 through Oct 2001. The segmentation is shown in Figure 1. From this figure it can be seen that any WWTP flows entering from the West Fork of the Trinity, Blue Ck or Oats Branch will enter Segment 6 of the WASP model. Derrett and Noname Creek will enter Segment 5

and Moss and Indian Creek will enter Segment 17. Figures 2 and 3 show the WASP model's fit to observed TP and Chlorophyll 'a' (Chl'a') data, respectively.

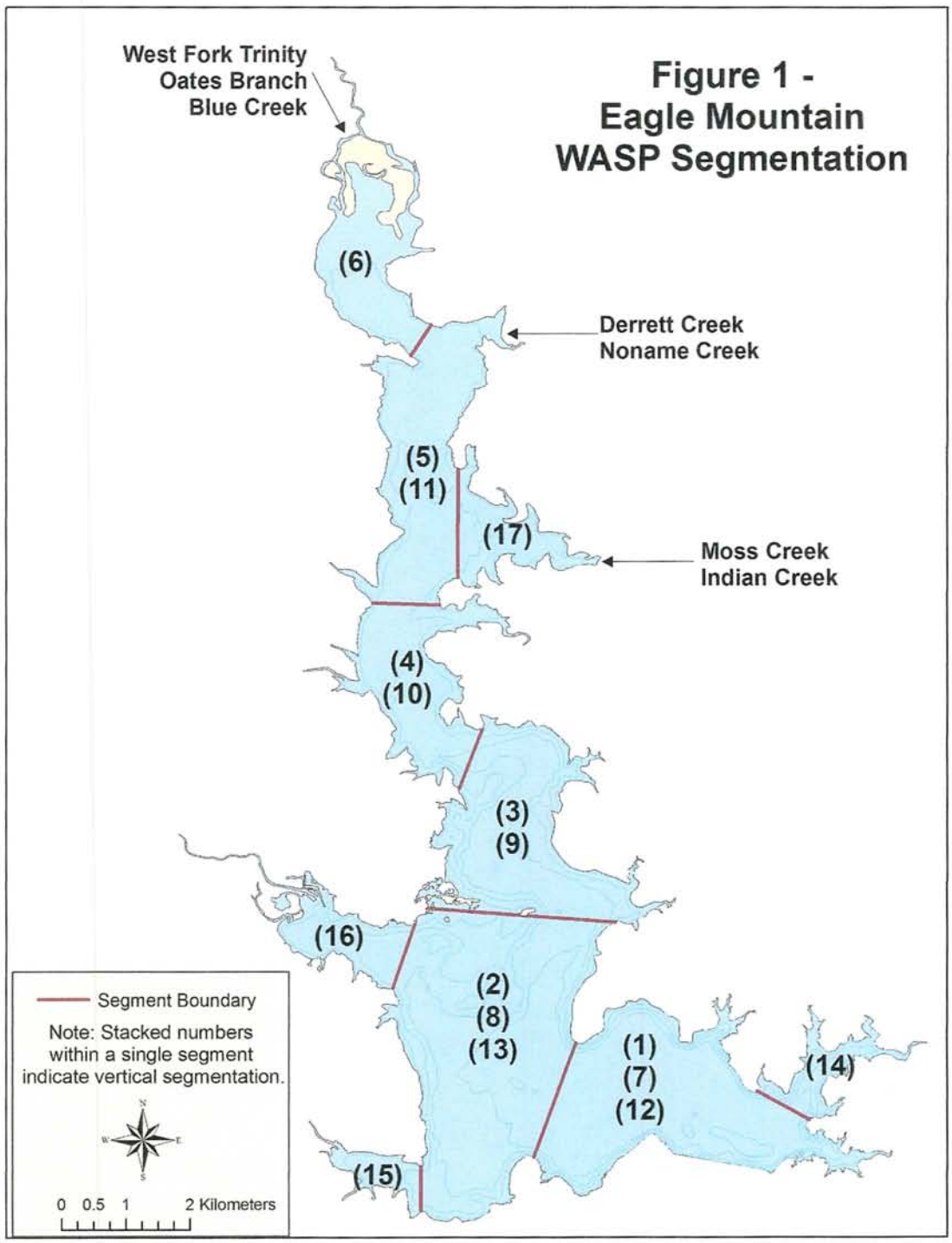


Table 2 presents the flows, concentrations and loads used for each scenario. Median flows for WWTP's at Boyd, Rhome and Newark that were existing when the model was calibrated (2000-2001) totaled 154,550 gallons and they were subtracted from the Y2030 Ultimate flows and Y2025 flows that were modeled because they were already incorporated in the loading from the tributary data used to calibrate the WASP model. This approach accounts for the existing wastewater entering the reservoir and only assesses the additional load. TP concentrations were the same as used in the TCEQ TP Screening Modeling: 3, 1 and 0.5 mg/L. Total Nitrogen concentrations were held constant at 10 mg/L. WASP requires the total nutrients to be speciated into organic and inorganic fractions. We utilized observed data from Rhome's WWTP to develop the fractions to speciate the effluent limits modeled (Table 2).

Since the WASP model only sees loading at the point where the cove segment reaches the conservation pool level, discharge location above that point is not considered in the modeling. For example a scenario that discharges to Moss Creek is no different than one that discharges to Indian Creek because they both end up loading Segment 17 of the WASP model. And as in the TCEQ TP Screening Model, we did not account for any nutrient attenuation. For this reason the various WWTP scenarios could be simplified to 5 Scenarios, at Y2030 Ultimate flow and with three TP concentrations for each:

1. Modified Base Case
2. Option B with a Boyd Regional and NoName Creek Regional WWTP
3. Option B with a Boyd Regional and Moss/Indian Regional WWTP
4. Option C with NoName Regional
5. Option C with Moss/Indian Regional.

The results of the WASP runs were analyzed at each of the receiving segments (6, 5, 17) and at Eagle Mountain Lake dam site (Segment 1). Table 3 displays the mean annual TP concentration for each scenario at each segment. Table 4 calculates the percent increase in the mean TP concentration for each scenario. Keeping in mind the 10% increase in the mean criteria that was proposed at the April 2009 TCEQ Standards meeting, the highlighted cells provide an indication of what effluent limits exceed the proposed criteria. These results indicate that TP effluent limits will be necessary to prevent the receiving cove segments from exceeding a 10% increase in their mean concentration. The affect at the dam site is much less than the TCEQ Screening Model suggested, indicating substantial settling of the TP down the length of the reservoir. Because engineering and cost benefits favor Option B, we looked further at this scenario with reduced flows estimated for year 2025 (Table 4, bottom). The results indicate that even with the reduced flows there are still some concerns with elevated TP in the receiving segments unless the effluent is limited to a TP of 1.0 mg/L.

While TP is an excellent parameter to model because of its well understood cycle and the extent of observed data, changes in Chl'a' are more meaningful to assess the impact to the uses of the reservoir such as recreation or water supply. For that reason, the mean Chl'a' results are presented in Table 5 and percent change in the mean is presented in Table 6. Again using a 10% increase in the mean as was done with TP, the Chl'a data in

Table 6 suggests that nutrient limits need to be included. In light of the engineering and cost analysis that shows Option B to have the most promise, the modeling results suggest that Scenario A with a Boyd Regional - Noname Creek Regional configuration has slightly less impact than the Boyd Regional - Moss/Indian Creek Regional. It appears that Segment 17 of the WASP model, known as Indian Creek Cove, is quite sensitive to the additional nutrients and grows more algae than Segment 5.

Conclusion

Assessment of WWTP nutrient impacts on reservoirs is a new venture for TCEQ. Their most recent methodology suggests TP limits of at least 1 mg/L and sometimes as low as 0.5 mg/L. WASP modeling, which TCEQ would consider a more robust technique, also suggests TP limits of 1 to 0.5 mg/L for most scenarios. Chl'a' modeling may be the most important methodology to consider but interpretation of the model output has not been adequately presented by TCEQ. The 10% criteria used in this report is speculative. However if the criteria was increased to let's say 20%, the results presented in Table 6 still recommend at least a 1 mg/L TP limit. In addition to the modeling suggesting a TP permit limit, a precedent has been set on Eagle Mountain Lake: Chisholm Springs WWTP (Permit No. WQ0014910001) has a TP limit of 1.0 mg/L.

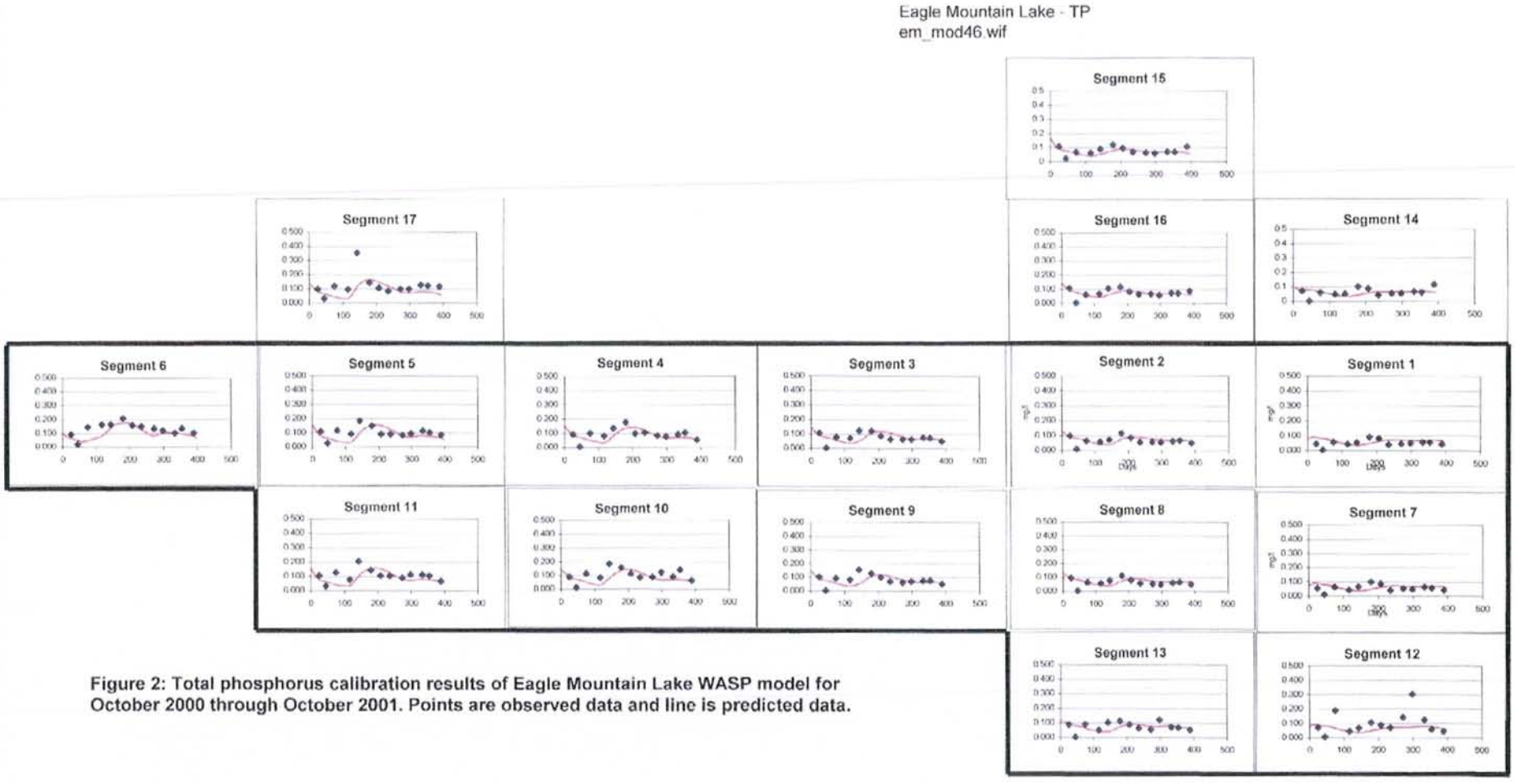


Figure 2: Total phosphorus calibration results of Eagle Mountain Lake WASP model for October 2000 through October 2001. Points are observed data and line is predicted data.

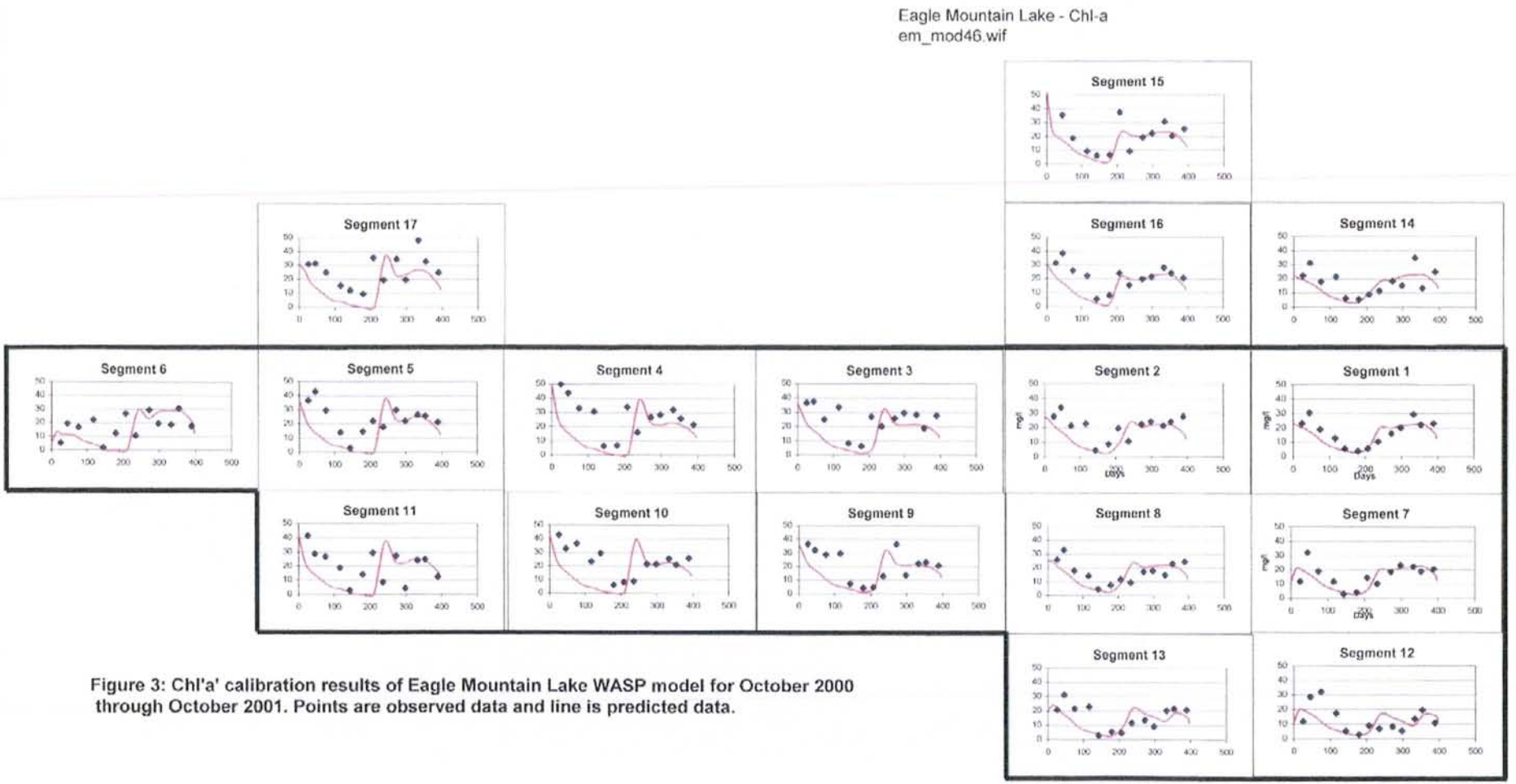


Figure 3: Chl'a' calibration results of Eagle Mountain Lake WASP model for October 2000 through October 2001. Points are observed data and line is predicted data.

Table 2: Eagle Mountain Eutrophication Impact
Calculation of Flows, Nutrients, and Loads

Facility	Existing Median Flow (GPD)
Boyd	83100
Newark	39300
Rhome	32150
Total:	**154550**

	Rhome Frac of Total Nutrient
NH3	**0.19**
NOX	**0.64**
Org N	**0.17**
OPO4	**0.70**
OrgP	**0.30**

Modified Base Case

Projected Additional WWTP Flows

Entity	Discharge Stream	WASP Segment	Y2030 Ultimate GPD
Aurora	Blue Ck	6	460,000
Boyd	West Fork Trinity	6	171,498
Ivy Hills&Boyette	West Fork Trinity	6	435,600
Rhome	Oats	6	197,782
Newark	Derrett Ck	5	96,746
Rolling V Ranch	Unnamed Ck	5	1,502,480
		Total:	**2,864,106**
	Existing + Additional Total:		**3,018,656**

Modified Base Case - WASP Loads

TN: 10 mg/L

			Fraction of Total --->	**0.19**	**0.64**	**0.17**	**0.70**	**0.30**	
TP Scenario	Segment	Flow GPD		NH3 kg/day	NOX kg/day	Org N kg/day	OPO4 kg/day	OrgP kg/day	TP kg/day
3	6	1264880		9.16	30.81	7.91	10.06	4.30	14.36
1	6	1264880		9.16	30.81	7.91	3.35	1.43	4.79
0.5	6	1264880		9.16	30.81	7.91	1.68	0.72	2.39
3	5	1599226		11.58	38.95	10.00	12.72	5.44	18.16
1	5	1599226		11.58	38.95	10.00	4.24	1.81	6.05
0.5	5	1599226		11.58	38.95	10.00	2.12	0.91	3.03

Option B

Entity	Discharge Stream	WASP Segment	Y2030 Ultimate GPD
Boyd	West Fork Trinity	6	171,498
Ivy Hills&Boyette	West Fork Trinity	6	435,600
Newark	Derrett/Unnamed/Moss/Indian	5 or 17	96,746
Rhome	Derrett/Unnamed/Moss/Indian	5 or 17	197,782
Rolling V Ranch	Derrett/Unnamed/Moss/Indian	5 or 17	1,502,480
		Total:	**2,404,106**
	Existing + Additional Total:		**2,558,656**

Option B - WASP Loads

TN: 10 mg/L

			Fraction of Total --->	**0.19**	**0.64**	**0.17**	**0.70**	**0.30**	
TP Scenario	Segment	Flow GPD		NH3 kg/day	NOX kg/day	Org N kg/day	OPO4 kg/day	OrgP kg/day	TP kg/day
3	6	607098		4.40	14.79	3.80	4.83	2.06	6.89
1	6	607098		4.40	14.79	3.80	1.61	0.69	2.30
0.5	6	607098		4.40	14.79	3.80	0.80	0.34	1.15
3	5 or 17	1797008		13.01	43.77	11.24	14.30	6.11	20.41
1	5 or 17	1797008		13.01	43.77	11.24	4.77	2.04	6.80
0.5	5 or 17	1797008		13.01	43.77	11.24	2.38	1.02	3.40

Option C

Entity	Discharge Stream	WASP Segment	Y2030 Ultimate GPD
Aurora	Derrett/Unnamed/Moss/Indian	5 or 17	460,000
Boyd	Derrett/Unnamed/Moss/Indian	5 or 17	171,498
Ivy Hills&Boyette	Derrett/Unnamed/Moss/Indian	5 or 17	435,600
New Fairview	Derrett/Unnamed/Moss/Indian	5 or 17	91,040
Newark	Derrett/Unnamed/Moss/Indian	5 or 17	96,746
Rhome	Derrett/Unnamed/Moss/Indian	5 or 17	197,782
Rolling V Ranch	Derrett/Unnamed/Moss/Indian	5 or 17	1,502,480
		Total:	**2,955,146**
	Existing + Additional Total:		**3,109,696**

Option C - WASP Loads

TN: 10 mg/L

			Fraction of Total --->	**0.19**	**0.64**	**0.17**	**0.70**	**0.30**	
TP Scenario	Segment	Flow GPD		NH3 kg/day	NOX kg/day	Org N kg/day	OPO4 kg/day	OrgP kg/day	TP kg/day
3	5	2955146		21.40	71.97	18.48	23.51	10.05	33.56
1	5	2955146		21.40	71.97	18.48	7.84	3.35	11.19
0.5	5	2955146		21.40	71.97	18.48	3.92	1.67	5.59
3	17	2955146		21.40	71.97	18.48	23.51	10.05	33.56
1	17	2955146		21.40	71.97	18.48	7.84	3.35	11.19
0.5	17	2955146		21.40	71.97	18.48	3.92	1.67	5.59

Table 2 (Continued): Eagle Mountain Eutrophication Impact Calculation of Flows, Nutrients, and Loads

Facility	Existing Median Flow (GPD)
Boyd	83100
Newark	39300
Rhome	32150
Total:	**154550**

	Rhome Frac of Total Nutrient
NH3	**0.19**
NOX	**0.64**
Org N	**0.17**
OPO4	**0.70**
OrgP	**0.30**

Modified Base Case

Projected Additional WWTP Flows

Entity	Discharge Stream	WASP Segment	Y2025 GPD
Aurora	Blue Ck	6	42,720
Boyd	West Fork Trinity	6	66,524
Ivy Hills&Boyette	West Fork Trinity	6	54,800
Rhome	Oats	6	166,192
Newark	Derrett Ck	5	83,921
Rolling V Ranch	Unnamed Ck	5	412,080
		Total:	**826,237**
	Existing + Additional Total:		**980,787**

Modified Base Case - WASP Loads

TN: 10 mg/L

			Fraction of Total --->	**0.19**	**0.64**	**0.17**	**0.70**	**0.30**	
TP Scenario	Segment	Flow GPD		NH3 kg/day	NOX kg/day	Org N kg/day	OPO4 kg/day	OrgP kg/day	TP kg/day
3	6	330236		2.39	8.04	2.07	2.63	1.12	3.75
3	5	496001		3.59	12.08	3.10	3.95	1.69	5.63

Option B

Entity	Discharge Stream	WASP Segment	Y2025 GPD
Boyd	West Fork Trinity	6	66,524
Ivy Hills&Boyette	West Fork Trinity	6	54,800
Newark	Derrett/Unnamed/Moss/Indian	5 or 17	83,921
Rhome	Derrett/Unnamed/Moss/Indian	5 or 17	166,192
Rolling V Ranch	Derrett/Unnamed/Moss/Indian	5 or 17	412,080
		Total:	**783,517**
	Existing + Additional Total:		**938,067**

Option B - WASP Loads

TN: 10 mg/L

			Fraction of Total --->	**0.19**	**0.64**	**0.17**	**0.70**	**0.30**	
TP Scenario	Segment	Flow GPD		NH3 kg/day	NOX kg/day	Org N kg/day	OPO4 kg/day	OrgP kg/day	TP kg/day
3	6	121324		0.88	2.95	0.76	0.97	0.41	1.38
1	6	121324		0.88	2.95	0.76	0.32	0.14	0.46
3	5 or 17	662193		4.79	16.13	4.14	5.27	2.25	7.52
1	5 or 17	662193		4.79	16.13	4.14	1.76	0.75	2.51

Table 3

Annual Total Phosphorus Mean Concentrations

WASP Segment>>>	Seg 6 Headwater	Seg 5 Derrett Cove	Seg 17 Indian Cove	Seg 1 Dam
Calibration	0.098	0.089	0.090	0.065
Modified Base Case	Aurora, Boyd, Rhome Ivy Hills/Boyette	Newark Rolling V Ranch		
TP @ 3 mg/L	0.126	0.118	0.113	0.070
TP @ 1 mg/L	0.107	0.099	0.098	0.067
TP @ 0.5 mg/L	0.103	0.094	0.094	0.066
Option B Scenario A	Boyd Ivy Hills/Boyette	Newark, Rhome Rolling V Ranch		
TP @ 3 mg/L	0.114	0.115	0.111	0.070
TP @ 1 mg/L	0.103	0.098	0.097	0.066
TP @ 0.5 mg/L	0.101	0.094	0.093	0.066
Option B Scenario B	Boyd Ivy Hills/Boyette		Newark, Rhome Rolling V Ranch	
TP @ 3 mg/L	0.113	0.112	0.138	0.069
TP @ 1 mg/L	0.103	0.097	0.106	0.066
TP @ 0.5 mg/L	0.101	0.093	0.098	0.066
Option C Scenario A		Aurora, Boyd, Ivy Hills/Boyette, New Fairview, Newark, Rhome, Rolling V Ranch		
TP @ 3 mg/L	0.104	0.123	0.117	0.071
TP @ 1 mg/L	0.100	0.101	0.099	0.067
TP @ 0.5 mg/L	0.099	0.095	0.094	0.066
Option C Scenario B			Aurora, Boyd, Ivy Hills/Boyette, New Fairview, Newark, Rhome, Rolling V Ranch	
TP @ 3 mg/L	0.103	0.119	0.162	0.070
TP @ 1 mg/L	0.100	0.099	0.114	0.067
TP @ 0.5 mg/L	0.099	0.094	0.102	0.066

2025 Load Scenarios	Seg 6 Headwater	Seg 5 Derrett Cove	Seg 17 Indian Cove	Seg 1 Dam
Modified Base Case (TP@3 mg/L)	0.106	0.098	0.097	0.067
Option B Scenario A (TP@3 mg/L)	0.102	0.098	0.097	0.066
Option B Scenario B (TP@3 mg/L)	0.102	0.097	0.107	0.066
Option B Scenario B (TP@1 mg/L)	0.099	0.092	0.095	0.065

Table 4

Annual TP Increase in Mean

WASP Segment>>>	Seg 6 Headwater	Seg 5 Derrett Cove	Seg 17 Indian Cove	Seg 1 Dam
Calibration	0%	0%	0%	0%
Modified Base Case	Aurora, Boyd, Rhome Ivy Hills/Boyette	Newark Rolling V Ranch		
TP @ 3 mg/L	29%	32%	26%	8%
TP @ 1 mg/L	9%	11%	9%	3%
TP @ 0.5 mg/L	5%	5%	4%	1%
Option B Scenario A	Boyd Ivy Hills/Boyette	Newark, Rhome Rolling V Ranch		
TP @ 3 mg/L	16%	28%	23%	7%
TP @ 1 mg/L	5%	9%	8%	2%
TP @ 0.5 mg/L	3%	5%	4%	1%
Option B Scenario B	Boyd Ivy Hills/Boyette		Newark, Rhome Rolling V Ranch	
TP @ 3 mg/L	15%	26%	54%	7%
TP @ 1 mg/L	5%	8%	18%	2%
TP @ 0.5 mg/L	2%	4%	9%	1%
Option C Scenario A		Aurora, Boyd, Ivy Hills/Boyette, New Fairview, Newark, Rhome, Rolling V Ranch		
TP @ 3 mg/L	6%	37%	31%	9%
TP @ 1 mg/L	2%	12%	10%	3%
TP @ 0.5 mg/L	1%	6%	5%	2%
Option C Scenario B			Aurora, Boyd, Ivy Hills/Boyette, New Fairview, Newark, Rhome, Rolling V Ranch	
TP @ 3 mg/L	5%	33%	81%	8%
TP @ 1 mg/L	2%	11%	27%	3%
TP @ 0.5 mg/L	1%	5%	13%	1%

2025 Load Scenarios	Seg 6 Headwater	Seg 5 Derrett Cove	Seg 17 Indian Cove	Seg 1 Dam
Modified Base Case (TP@3 mg/L)	8%	9%	8%	2%
Option B Scenario A (TP@3 mg/L)	4%	10%	8%	2%
Option B Scenario B (TP@3 mg/L)	4%	8%	19%	2%
Option B Scenario B (TP@1 mg/L)	1%	3%	6%	1%

Table 5

Annual Chlorophyll-a Mean Concentrations

WASP Segment>>>	Seg 6 Headwater	Seg 5 Derrett Cove	Seg 17 Indian Cove	Seg 1 Dam
Calibration	14.00	16.28	16.26	15.10
Modified Base Case	Aurora, Boyd, Rhome Ivy Hills/Boyette	Newark Rolling V Ranch		
TP @ 3 mg/L	24.08	24.51	22.74	16.47
TP @ 1 mg/L	17.47	19.07	18.46	15.55
TP @ 0.5 mg/L	15.74	17.66	17.35	15.33
Option B Scenario A	Boyd Ivy Hills/Boyette	Newark, Rhome Rolling V Ranch		
TP @ 3 mg/L	19.71	23.58	22.06	16.29
TP @ 1 mg/L	15.89	18.77	18.24	15.49
TP @ 0.5 mg/L	14.94	17.50	17.24	15.30
Option B Scenario B	Boyd Ivy Hills/Boyette		Newark, Rhome Rolling V Ranch	
TP @ 3 mg/L	19.48	22.59	30.07	16.19
TP @ 1 mg/L	15.81	18.43	21.09	15.46
TP @ 0.5 mg/L	14.90	17.33	18.65	15.28
Option C Scenario A		Aurora, Boyd, Ivy Hills/Boyette, New Fairview, Newark, Rhome, Rolling V Ranch		
TP @ 3 mg/L	15.95	25.97	24.03	16.64
TP @ 1 mg/L	14.65	19.59	18.91	15.61
TP @ 0.5 mg/L	14.32	17.91	17.57	15.35
Option C Scenario B			Aurora, Boyd, Ivy Hills/Boyette, New Fairview, Newark, Rhome, Rolling V Ranch	
TP @ 3 mg/L	15.58	24.44	36.66	16.48
TP @ 1 mg/L	14.51	19.03	23.60	15.55
TP @ 0.5 mg/L	14.26	17.63	19.90	15.32

2025 Load Scenarios	Seg 6 Headwater	Seg 5 Derrett Cove	Seg 17 Indian Cove	Seg 1 Dam
Modified Base Case (TP@3 mg/L)	16.78	18.73	18.21	15.50
Option B Scenario A (TP@3 mg/L)	15.34	18.79	18.28	15.49
Option B Scenario B (TP@3 mg/L)	15.25	18.43	21.24	15.46
Option B Scenario B (TP@1 mg/L)	14.42	16.99	17.97	15.22

Table 6

Annual Chlorophyll-a Increase in Mean

WASP Segment>>>	Seg 6 Headwater	Seg 5 Derrett Cove	Seg 17 Indian Cove	Seg 1 Dam
Calibration	0%	0%	0%	0%
Modified Base Case	Aurora, Boyd, Rhome Ivy Hills/Boyette	Newark Rolling V Ranch		
TP @ 3 mg/L	72%	51%	40%	9%
TP @ 1 mg/L	25%	17%	14%	3%
TP @ 0.5 mg/L	12%	8%	7%	1%
Option B Scenario A	Boyd Ivy Hills/Boyette	Newark, Rhome Rolling V Ranch		
TP @ 3 mg/L	41%	45%	36%	8%
TP @ 1 mg/L	13%	15%	12%	3%
TP @ 0.5 mg/L	7%	8%	6%	1%
Option B Scenario B	Boyd Ivy Hills/Boyette		Newark, Rhome Rolling V Ranch	
TP @ 3 mg/L	39%	39%	85%	7%
TP @ 1 mg/L	13%	13%	30%	2%
TP @ 0.5 mg/L	6%	7%	15%	1%
Option C Scenario A		Aurora, Boyd, Ivy Hills/Boyette, New Fairview, Newark, Rhome, Rolling V Ranch		
TP @ 3 mg/L	14%	60%	48%	10%
TP @ 1 mg/L	5%	20%	16%	3%
TP @ 0.5 mg/L	2%	10%	8%	2%
Option C Scenario B			Aurora, Boyd, Ivy Hills/Boyette, New Fairview, Newark, Rhome, Rolling V Ranch	
TP @ 3 mg/L	11%	50%	125%	9%
TP @ 1 mg/L	4%	17%	45%	3%
TP @ 0.5 mg/L	2%	8%	22%	1%

2025 Load Scenarios	Seg 6 Headwater	Seg 5 Derrett Cove	Seg 17 Indian Cove	Seg 1 Dam
Modified Base Case (TP@3 mg/L)	20%	15%	12%	3%
Option B Scenario A (TP@3 mg/L)	10%	15%	12%	3%
Option B Scenario B (TP@3 mg/L)	9%	13%	31%	2%
Option B Scenario B (TP@1 mg/L)	3%	4%	11%	1%

APPENDIX D

Table D-1: Modified Base Case - Each City and Large Development Develops Its Own WW System

System Component	Nodes on Map		Quantity	Units	Estimated cost per unit	Total estimated cost in Y2009 $	Estimated costs in each 5-year interval (Y2009 $) 2010-14	2015-19	2020-24	2025-29	2030-34	After 2034	Totals
Improvements to the City of Boyd System													
Sewers from 200 Acre Tract to FM 730 Lift Station(s)													
8-inch gravity sewer (including MHs, etc.)	55	56	6600	LF	$ 70	$ 462,000			462,000				$ 462,000
12-inch gravity sewer (including MHs, etc.)	56	57	1800	LF	$ 80	$ 144,000			144,000				$ 144,000
FM 730 Lift Station(s) and Force Main(s) and Gravity Sewer to Boyd WWTP													
Upgrade existing FM 730 LS (higher capacity pumps)			1	LS	$ 50,000	$ 50,000			50,000				$ 50,000
Future FM 730 LS - 0.100 mgd avg flow			1	LS	$ 150,000	$ 150,000				150,000			$ 150,000
6-inch force main	57		3300	LF	$ 48	$ 158,400				158,400			$ 158,400
12-inch gravity sewer (including MHs, etc.)		41	1200	LF	$ 80	$ 96,000				96,000			$ 96,000
Easements for gravity lines			3000	LF	$ 2.90	$ 8,700		8,700					$ 8,700
Easements for force mains			3300	LF	$ 2.90	$ 9,570		9,570					$ 9,570
Boyd WWTP													
Conventional Secondary (20/20) - Existing													
Ammonia N and TP removal in 2025													
0.120 mgd expansion (total cap. = 0.360 mgd)													
Replacement of 1st Train (Unit cost in $/gpd of cap.)			120,000	gpd	$ 8.50	$ 1,020,000				1,020,000			$ 1,020,000
Additional Train (Unit cost in $/gpd of cap.)			120,000	gpd	$ 8.50	$ 1,020,000						1,020,000	$ 1,020,000
Upgrade existing plant for ammonia N and TP removal			120,000	gpd	$ 3.00	$ 360,000				360,000			$ 360,000
Total for Boyd						$ 3,478,670	-	18,270	656,000	1,784,400	-	1,020,000	3,478,670
Ivy Hills / Boyette WW System													
Sewers in the Boyette Tract flowing to Boyette Tract Lift Station													
8-inch gravity sewer (including MHs, etc.)	52	53	2500	LF	$ 70	$ 175,000		175,000					$ 175,000
12-inch gravity sewer (including MHs, etc.)	53	54	1600	LF	$ 80	$ 128,000		128,000					$ 128,000
Boyette Tract LS (pumping to Ivy Hills WWTP)													
Boyette Tract Lift Station			1	LS	$ 225,000	$ 225,000			225,000				$ 225,000
8-inch force main to Ivy Hills WWTP			6100	LF	$ 57	$ 347,700			347,700				$ 347,700
Easements for gravity lines			0	LF	$ 2.90	$ -							$ -
Easements for force mains			0	LF	$ 2.90	$ -							$ -
Ivy Hills WWTP													
Purchase (reserve) of land for up to 0.5 MGD ultimate capacity			5	acres	$ 15,000	$ 75,000	75,000						$ 75,000
Conventional Secondary (10/15/3)													
Phase I - Capacity in gpd =			250,000	gpd	$ 7.70	$ 1,925,000		1,925,000					$ 1,925,000
Ammonia N and TP removal in 2025													
Upgrade existing plant for ammonia N and TP removal			250,000	gpd	$ 3.00	$ 750,000				750,000			$ 750,000
Phase II - Capacity in gpd =			250,000	gpd	$ 8.50	$ 2,125,000				2,125,000			$ 2,125,000
Total for Ivy Hills / Boyette						$ 5,750,700	75,000	2,228,000	572,700	2,875,000	-	-	5,750,700

Table D-1: Modified Base Case - Each City and Large Development Develops Its Own WW System

System Component	Nodes on Map		Quantity	Units	Estimated cost per unit	Total estimated cost in Y2009 $	Estimated costs in each 5-year interval (Y2009 $) 2010-14	2015-19	2020-24	2025-29	2030-34	After 2034	Totals
Aurora WW System													
Hwy 114 & Blue Creek Sewer to Aurora WWTP at Blue Creek													
12-inch gravity sewer (including MHs, etc.)			4800	LF	$ 80.00	$ 384,000			384,000				$ 384,000
15-inch gravity sewer (including MHs, etc.)		44	2800	LF	$ 100.00	$ 280,000			280,000				$ 280,000
East Aurora Sewer													
8-inch gravity sewer (including MHs, etc.)	45	46	1900	LF	$ 70.00	$ 133,000			133,000				$ 133,000
12-inch gravity sewer (including MHs, etc.)	46		2000	LF	$ 80.00	$ 160,000			160,000				$ 160,000
Aurora East Lift Station and Force Main (pumping west to Hwy 114 Sewer)													
Aurora East LS - 0.380 mgd			1	LS	$ 300,000	$ 300,000			300,000				$ 300,000
8-inch force main			4600	LF	$ 57.00	$ 262,200			262,200				$ 262,200
Easements for gravity lines			11500	LF	$ 2.90	$ 33,350		33,350					$ 33,350
Easements for force mains			4600	LF	$ 2.90	$ 13,340		13,340					$ 13,340
City of Aurora WWTP at Blue Creek													
Purchase of land for up to 1 MGD ultimate capacity			7	acres	$ 15,000	$ 105,000		105,000					$ 105,000
Assumed permit limits for new plant 10/15/2/1 Nitrification, Filtration & Chemical (Alum) Phosphorus Removal													
Phase I - Capacity in gpd =			240,000	gpd	$ 8.50	$ 2,040,000			2,040,000				$ 2,040,000
Phase II - Capacity in gpd =			240,000	gpd	$ 8.50	$ 2,040,000						2,040,000	$ 2,040,000
Total for Aurora						$ 5,750,890	-	151,690	3,559,200	-	-	2,040,000	5,750,890
New Fairview WW System													
New Fairview Sewer Lines													
8-inch gravity sewer (including MHs, etc.)	61	65	2700	LF	$ 70	$ 189,000			189,000				$ 189,000
8-inch gravity sewer (including MHs, etc.)	62	65	1500	LF	$ 70	$ 105,000			105,000				$ 105,000
8-inch gravity sewer (including MHs, etc.)	65	67	6600	LF	$ 70	$ 462,000			462,000				$ 462,000
8-inch gravity sewer (including MHs, etc.)	63	66	2600	LF	$ 70	$ 182,000			182,000				$ 182,000
8-inch gravity sewer (including MHs, etc.)	64	66	1900	LF	$ 70	$ 133,000			133,000				$ 133,000
8-inch gravity sewer (including MHs, etc.)	66	67	2800	LF	$ 70	$ 196,000			196,000				$ 196,000
Easements for gravity lines			18100	LF	$ 2.90	$ 52,490		52,490					$ 52,490
New Fairview WWTP at Upper Elizabeth Creek													
Purchase of land for up to 0.2 MGD ultimate capacity			4	acres	$ 20,000	$ 80,000		80,000					$ 80,000
Conventional Secondary with nitrification (10/15/3)													
Phase I - Capacity in gpd =			100,000	gpd	$ 10.30	$ 1,030,000			1,030,000				$ 1,030,000
Total for New Fairview						$ 2,429,490	-	132,490	2,297,000	-	-	-	2,429,490

Table D-1: Modified Base Case - Each City and Large Development Develops Its Own WW System

System Component	Nodes on Map		Quantity	Units	Estimated cost per unit	Total estimated cost in Y2009 $	Estimated costs in each 5-year interval (Y2009 $) 2010-14	2015-19	2020-24	2025-29	2030-34	After 2034	Totals
City of Rhome WW System													
Upper Oates Branch West Sewer, Rhome West LS, and sewer to Rhome West WWTP													
8-inch gravity sewer (including MHs, etc.)	68	69	8200	LF	$ 70	$ 574,000				574,000			$ 574,000
8-inch gravity sewer (including MHs, etc.)	69		1600	LF	$ 70	$ 112,000				112,000			$ 112,000
Rhome West LS - 0.024 gpd avg flow			1	LS	$ 150,000	$ 150,000				150,000			$ 150,000
4-inch force main			1600	LF	$ 43	$ 68,800				68,800			$ 68,800
8-inch gravity sewer (including MHs, etc.)			2600	LF	$ 70	$ 182,000				182,000			$ 182,000
Diversion of flows from East WWTP													
Rhome East Diversion LS - 0.103 mgd			1	LS	$ 150,000	$ 150,000	150,000						$ 150,000
6-inch force main	1		1600	LF	$ 48	$ 76,800	76,800						$ 76,800
8-inch gravity sewer (including MHs, etc.)			4800	LF	$ 57	$ 273,600	273,600						$ 273,600
Demolish and fill existing tank at East WWTP			1	LS	$ 10,000	$ 10,000	10,000						$ 10,000
Demolish and remove drying beds, etc.			1	LS	$ 10,000	$ 10,000	10,000						$ 10,000
Clean out treatment ponds			15	acres	$ 1,000	$ 15,000	15,000						$ 15,000
Regrade pond site			15	acres	$ 1,000	$ 15,000	15,000						$ 15,000
Easements for gravity lines			9000	LF	$ 2.90	$ 26,100	26,100						$ 26,100
Easements for force mains			1600	LF	$ 2.90	$ 4,640	4,640						$ 4,640
Rhome WWTP													
Conventional Secondary with nitrification (10/15/3) Phase II - Capacity in gpd = Ammonia N and TP removal in 2025			150,000	gpd	$ 7.70	$ 1,155,000	1,155,000						$ 1,155,000
Upgrade existing plant for TP removal			150,000	gpd	$ 3.00	$ 450,000				450,000			$ 450,000
Replacement of exist Ph I (Unit cost in $/gpd of cap.) due to age of steel package plant			150,000	gpd	$ 8.50	$ 1,275,000				1,275,000			$ 1,275,000
Total for Rhome						$ 4,547,940	1,736,140	-	-	2,811,800	-	-	4,547,940
Rolling V Wastewater System													
Oates Branch East Interceptor, Lift Station, Force Main & Diversion to Darrett Cr Interceptor													
8-inch gravity sewer (including MHs, etc.)	11	12	2200	LF	$ 70	$ 154,000		154,000					$ 154,000
Oates Branch East LS - 0.137 mgd			1	LS	$ 150,000	$ 150,000		150,000					$ 150,000
6-inch force main	12	13	3500	LF	$ 48	$ 168,000		168,000					$ 168,000
8-inch gravity sewer (including MHs, etc.)	13	14	2300	LF	$ 70	$ 161,000		161,000					$ 161,000
12-inch gravity sewer (including MHs, etc.)	14	4	3100	LF	$ 80	$ 248,000		248,000					$ 248,000
Derrett Creek Interceptor, Lift Station and Force Main to WWTP													
8-inch gravity sewer (including MHs, etc.)	2	2a	4000	LF	$ 70	$ 280,000		280,000					$ 280,000
12-inch gravity sewer (including MHs, etc.)	2a	3	2600	LF	$ 80	$ 208,000		208,000					$ 208,000
12-inch gravity sewer (including MHs, etc.)	3	4	2700	LF	$ 80	$ 216,000		216,000					$ 216,000
18-inch gravity sewer (including MHs, etc.)	4	5	1200	LF	$ 125	$ 150,000		150,000					$ 150,000
18-inch gravity sewer (including MHs, etc.)	5	6	1900	LF	$ 125	$ 237,500		237,500					$ 237,500
18-inch gravity sewer (including MHs, etc.)	6	7	2300	LF	$ 125	$ 287,500		287,500					$ 287,500
Derrett Cr LS Phase I - 0.5 mgd			1	LS	$ 300,000	$ 300,000		300,000					$ 300,000
10-inch force main	7	8	6500	LF	$ 65	$ 422,500		422,500					$ 422,500
Derrett Cr LS Phase II - 0.5 mgd			1	LS	$ 300,000	$ 300,000						300,000	$ 300,000
10-inch force main	7	8	6500	LF	$ 65	$ 422,500						422,500	$ 422,500

Table D-1: Modified Base Case - Each City and Large Development Develops Its Own WW System

System Component	Nodes on Map	Quantity	Units	Estimated cost per unit	Total estimated cost in Y2009 $	Estimated costs in each 5-year interval (Y2009 $) 2010-14	2015-19	2020-24	2025-29	2030-34	After 2034	Totals
Moss Branch Lift Station & Force Main												
Moss Branch LS Phase I - 0.150 mgd		1	LS	$ 225,000	$ 225,000			225,000				$ 225,000
6-inch force main		4300	LF	$ 57	$ 245,100			245,100				$ 245,100
Moss Branch LS Phase II - 0.250 mgd		1	LS	$ 225,000	$ 225,000						225,000	$ 225,000
8-inch force main		4300	LF	$ 57	$ 245,100						245,100	$ 245,100
Easements for gravity lines		0	LF	$ 2.90	$ -							$ -
Easements for force mains		0	LF	$ 2.90	$ -							$ -
Rolling V WWTP												
Purchase (reserve) of land for up to 1.6 MGD ultimate capacity		8	acres	$ 20,000	$ 160,000	160,000						$ 160,000
Assumed permit limits of 5/5/1/0.5												
WWTP w/ nitrification, filtration and chemical P removal in Phases I & II												
Convert to BNR in Phase III												
Phase I - Capacity in gpd =		400,000	gpd	$ 7.00	$ 2,800,000		2,800,000					$ 2,800,000
Phase II - Capacity in gpd =		400,000	gpd	$ 7.00	$ 2,800,000				2,800,000			$ 2,800,000
Phase III - Capacity in gpd =		800,000	gpd	$ 6.70	$ 5,360,000						5,360,000	$ 5,360,000
Total for Rolling V					**$ 15,765,200**	**160,000**	**5,782,500**	**470,100**	**2,800,000**	**-**	**6,552,600**	**15,765,200**
Newark WW System												
WWTP Improvements												
Assumed permit limits of 5/5/2/1												
WWTP w/ nitrification, filtration and chemical phosphorus removal												
Replace existing WWTP w/ capacity in gpd =		150,000	gpd	$ 8.50	$ 1,275,000	1,275,000						$ 1,275,000
Fill aeration basin after removing equipment		1	LS	$ 10,000	$ 10,000	10,000						$ 10,000
Fill clarifier after removing equipment		1	LS	$ 10,000	$ 10,000	10,000						$ 10,000
Fill clarifier after removing equipment		1	LS	$ 10,000	$ 10,000	10,000						$ 10,000
Drain and clean ponds		9	acres	$ 1,000	$ 9,000	9,000						$ 9,000
Regrade pond site		11	acres	$ 1,000	$ 11,000	11,000						$ 11,000
Total for Newark					**$ 1,325,000**	**1,325,000**	**-**	**-**	**-**	**-**	**-**	**1,325,000**
Subotal - Estimated Construction and Land/Easement Acquisition Costs					$ 39,047,890	3,296,140	8,312,950	7,555,000	10,271,200	-	9,612,600	$ 39,047,890
Contingencies		20%			$ 7,809,578	$ 659,228	$ 1,662,590	$ 1,511,000	$ 2,054,240	$ -	$ 1,922,520	$ 7,809,578
Engineering and Surveying		20%			$ 7,809,578	$ 659,228	$ 1,662,590	$ 1,511,000	$ 2,054,240	$ -	$ 1,922,520	$ 7,809,578
Permitting		5%			$ 1,952,395	$ 164,807	$ 415,648	$ 377,750	$ 513,560	$ -	$ 480,630	$ 1,952,395
Legal / Project Management		5%			$ 1,952,395	$ 164,807	$ 415,648	$ 377,750	$ 513,560	$ -	$ 480,630	$ 1,952,395
Sum of Contingencies, design and management %'s =		50%										
Total Estimated Project Costs					$ 58,571,835	$ 4,944,210	$ 12,469,425	$ 11,332,500	$ 15,406,800	$ -	$ 14,418,900	$ 58,571,835

Table D-2: Option B / East WWTP Site / Effluent Discharge to Unnamed Tributary

System Component	Nodes on Map		Quantity	Units	Estimated cost per unit	Total estimated cost in Y2009 $	Estimated costs in each 5-year interval (Y2009 $) 2010-14	2015-19	2020-24	2025-29	2030-34	After 2034	Totals
Facilities Serving Ivy Hills/Boyette Tract Only													
Ivy Hills Lift Station and Force Main to Gravity Sewer in Boyette Tract													
Lift Station (for Qavg = 0.106 MGD)			1	LS	$ 150,000	$ 150,000		150,000					$ 150,000
6-inch force main	51	52	2100	LF	$ 48	$ 100,800		100,800					$ 100,800
Sewers from Boyette Tract to FM 730 Lift Station(s)													
8-inch gravity sewer (including MHs, etc.)	52	53	2500	LF	$ 70	$ 175,000		175,000					$ 175,000
12-inch gravity sewer (including MHs, etc.)	53	54	1600	LF	$ 80	$ 128,000		128,000					$ 128,000
12-inch gravity sewer (including MHs, etc.)	54	55	2900	LF	$ 80	$ 232,000		232,000					$ 232,000
12-inch gravity sewer (including MHs, etc.)	55		3900	LF	$ 80	$ 312,000		312,000					$ 312,000
15-inch gravity sewer (including MHs, etc.)		56	2700	LF	$ 100	$ 270,000		270,000					$ 270,000
15-inch gravity sewer (including MHs, etc.)	56	57	1800	LF	$ 100	$ 180,000		180,000					$ 180,000
Upgrade existing FM 730 LS (higher capacity pumps)			1	LS	$ 75,000	$ 75,000		75,000					$ 75,000
Future FM 730 Lift Station and Force Main and Gravity Sewer to Boyd WWTP													
FM 730 Lift Station - Phase II - 0.54 gpd avg flow			1	LS	$ 300,000	$ 300,000			300,000				$ 300,000
10-inch force main	57		3300	LF	$ 65	$ 214,500			214,500				$ 214,500
15-inch gravity sewer (including MHs, etc.)		41	1200	LF	$ 100.00	$ 120,000			120,000				$ 120,000
Easements for gravity lines			5700	LF	$ 2.90	$ 16,530	16,530						$ 16,530
Easements for force mains			3300	LF	$ 2.90	$ 9,570	9,570						$ 9,570
Subtotal - Construction Costs for Facilities Serving Ivy Hills/Boyette						$ 2,283,400	$ 26,100	$ 1,622,800	$ 634,500	$ -	$ -	$ -	$ 2,283,400
Facilities Serving Boyd and Ivy Hills/Boyette													
City of Boyd WWTP													
0.36 mgd expansion (total cap. = 0.480 mgd) Ammon N & TP Removal (Unit cost in $/gpd of cap.) Also replaces Phase I plant (0.12 MGD) due to age of steel tankage			360,000	gpd	$ 7.00	$ 2,520,000			2,520,000				$ 2,520,000
0.24 mgd expansion (total cap. = 0.720 mgd) Ammon N & TP Removal (Unit cost in $/gpd of cap.)			240,000	gpd	$ 8.50	$ 2,040,000						2,040,000	$ 2,040,000
Subtotal - Construction Cost for Facilities Serving City of Boyd + Ivy Hills and Boyette Tracts						$ 4,560,000	$ -	$ -	$ 2,520,000	$ -	$ -	$ 2,040,000	$ 4,560,000
City of Aurora													
No Central WW Collection / OSSF only													
New Fairview													
No Central WW Collection / OSSF only													

Table D-2: Option B / East WWTP Site / Effluent Discharge to Unnamed Tributary

System Component	Nodes on Map		Quantity	Units	Estimated cost per unit	Total estimated cost in Y2009 $	Estimated costs in each 5-year interval (Y2009 $) 2010-14	2015-19	2020-24	2025-29	2030-34	After 2034	Totals
Facilities Serving Rhome ONLY													
Upper Oates Branch West Sewer, Rhome West LS, and sewer to Rhome West WWTP													
8-inch gravity sewer (including MHs, etc.)	68	69	8200	LF	$ 70	$ 574,000				574,000			$ 574,000
8-inch gravity sewer (including MHs, etc.)	69		1600	LF	$ 70	$ 112,000				112,000			$ 112,000
Rhome West LS - 0.024 gpd avg flow			1	LS	$ 150,000	$ 150,000				150,000			$ 150,000
4-inch force main			1600	LF	$ 43	$ 68,800				68,800			$ 68,800
8-inch gravity sewer (including MHs, etc.)			2600	LF	$ 70	$ 182,000				182,000			$ 182,000
Diversion of Flows from East Plant into Derrett Creek Interceptor													
8-inch gravity sewer (including MHs, etc.)	1	2	3500	LF	$ 70	$ 245,000		245,000					$ 245,000
Easements for gravity lines			0	LF	$ 2.90	$ -							
Easements for force mains			0	LF	$ 2.90	$ -							
Subtotal - Construction Costs for Facilities Seving Rhome ONLY						$ 1,331,800	$ -	$ 245,000	$ -	$ 1,086,800	$ -	$ -	$ 1,331,800
Cities of Rhome and Newark plus Rolling V Development													
City of Rhome													
Oates Branch East Interceptor, Lift Station, Force Main & Diversion to Darrett Cr Interceptor													
12-inch gravity sewer (including MHs, etc.)	11	12	2800	LF	$ 80	$ 224,000		224,000					$ 224,000
Oates Branch East LS - 0.244 mgd avg flow			1	LS	$ 225,000	$ 225,000		225,000					$ 225,000
8-inch force main	12	13	3500	LF	$ 57	$ 199,500		199,500					$ 199,500
12-inch gravity sewer (including MHs, etc.)	13	14	2300	LF	$ 80	$ 184,000		184,000					$ 184,000
12-inch gravity sewer (including MHs, etc.)	14	4	3200	LF	$ 80	$ 256,000		256,000					$ 256,000
Demolish & remove package plant at Rhome West			1	LS	$ 25,000	$ 25,000			25,000				$ 25,000
Fill wet well after removing pumps			1	LS	$ 10,000	$ 10,000			10,000				$ 10,000
Derrett Creek Interceptor, Lift Station and Force Main to WWTP													
12-inch gravity sewer (including MHs, etc.)	2	2a	4000	LF	$ 80	$ 320,000		320,000					$ 320,000
15-inch gravity sewer (including MHs, etc.)	2a	3	2600	LF	$ 100	$ 260,000		260,000					$ 260,000
15-inch gravity sewer (including MHs, etc.)	3	4	2700	LF	$ 100	$ 270,000		270,000					$ 270,000
18-inch gravity sewer (including MHs, etc.)	4	5	1200	LF	$ 125	$ 150,000		150,000					$ 150,000
18-inch gravity sewer (including MHs, etc.)	5	6	1900	LF	$ 125	$ 237,500		237,500					$ 237,500
21-inch gravity sewer (including MHs, etc.)	6	7	2300	LF	$ 140	$ 322,000		322,000					$ 322,000
Derrett Cr LS - Phase I - 0.5 mgd avg flow			1	LS	$ 300,000	$ 300,000		300,000					$ 300,000
12-inch force main	7	8	6000	LF	$ 75	$ 450,000		450,000					$ 450,000
Derrett Cr LS - Phase II - 0.7 mgd avg flow			1	LS	$ 450,000	$ 450,000					450,000		$ 450,000
12-inch force main	7	8	6000	LF	$ 75	$ 450,000					450,000		$ 450,000
Closure of Rhome East WWTP													
Fill Imhoff Treatment tank after removing equip			1	LS	$ 10,000	$ 10,000		10,000					$ 10,000
Demolish and remove drying beds & misc. structures			1	LS	$ 10,000	$ 10,000		10,000					$ 10,000
Clean vegetation from ponds and drain			5	acres	$ 1,000	$ 5,000		5,000					$ 5,000
Regrade pond site			7	acres	$ 1,000	$ 7,000		7,000					$ 7,000
Closure of Newark's Chisolm Cr Lift Station			1	LS	$ 10,000	$ 10,000		10,000					$ 10,000
15-inch gravity sewer (including MHs, etc.)	4a	4	210	LF	$ 100	$ 21,000		21,000					$ 21,000

Table D-2: Option B / East WWTP Site / Effluent Discharge to Unnamed Tributary

System Component	Nodes on Map	Quantity	Units	Estimated cost per unit	Total estimated cost in Y2009 $	Estimated costs in each 5-year interval (Y2009 $) 2010-14	2015-19	2020-24	2025-29	2030-34	After 2034	Totals
Newark Diversion Lift Station												
Lift Station - 0.130 mgd avg flow		1	LS	$ 150,000	$ 150,000		150,000					$ 150,000
6-inch force main	21 22	7200	LF	$ 48	$ 345,600		345,600					$ 345,600
Closure of Newark's WWTP												
Fill aeration basin after removing equipment		1	LS	$ 10,000	$ 10,000		10,000					$ 10,000
Fill clarifier after removing equipment		1	LS	$ 10,000	$ 10,000		10,000					$ 10,000
Fill clarifier after removing equipment		1	LS	$ 10,000	$ 10,000		10,000					$ 10,000
Fill LS wet well after removing equipment		1	LS	$ 10,000	$ 10,000		10,000					$ 10,000
Demolish and remove sludge drying beds & misc.		1	LS	$ 10,000	$ 10,000		10,000					$ 10,000
Drain and clean ponds		9	acres	$ 1,000	$ 9,000		9,000					$ 9,000
Regrade pond site		11	acres	$ 1,000	$ 11,000		11,000					$ 11,000
Moss Branch Interceptor and Lift Station												
12-inch gravity sewer (including MHs, etc.)	31 32	2200	LF	$ 80	$ 176,000			176,000				$ 176,000
15-inch gravity sewer (including MHs, etc.)	32 33	2700	LF	$ 100	$ 270,000			270,000				$ 270,000
Moss Branch LS Phase I - 0.250 mgd avg flow		1	LS	$ 225,000	$ 225,000			225,000				$ 225,000
8-inch force main	33 34	2300	LF	$ 57	$ 131,100			131,100				$ 131,100
Moss Branch LS Phase II - 0.250 mgd avg flow		1	LS	$ 225,000	$ 225,000						225,000	$ 225,000
8-inch force main	33 34	2300	LF	$ 57	$ 131,100						131,100	$ 131,100
Easements for gravity lines		4900	LF	$ 2.90	$ 14,210		14,210					$ 14,210
Easements for force mains		2300	LF	$ 2.90	$ 6,670		6,670					$ 6,670
Regional Wastewater Treatment Plant												
Purchase of land for up to 2 MGD ultimate capacity		15	acres	$ 20,000	$ 300,000		300,000					$ 300,000
Assumed permit limits of 5/5/1/0.5												
WWTP w/ nitrification, filtration and chemical P removal in Phase I												
Convert to BNR in Phase II												
Phase I - Capacity in gpd =		500,000	gpd	$ 7.00	$ 3,500,000		3,500,000					$ 3,500,000
Phase II - Capacity in gpd =		500,000	gpd	$ 7.70	$ 3,850,000			3,850,000				$ 3,850,000
Phase III - Capacity in gpd =		500,000	gpd	$ 7.70	$ 3,850,000				3,850,000			$ 3,850,000
Phase IV and above - Capacity in gpd =		500,000	gpd	$ 7.70	$ 3,850,000						3,850,000	$ 3,850,000
Total capacity		2,000,000	gpd									
Subtotal - Construction Costs for Regional Facilities serving Cities of Rhome and Newark plus Rolling V Development					$ 21,490,680	$ -	$ 7,847,480	$ 4,687,100	$ 3,850,000	$ 900,000	$ 4,206,100	$ 21,490,680
Subotal - Estimated Construction and Land/Easement Acquisition Costs for all Option B Facilities					$ 29,665,880	$ 26,100	$ 9,715,280	$ 7,841,600	$ 4,936,800	$ 900,000	$ 6,246,100	$ 29,665,880
Contingencies		20%			$ 5,933,176	5,220	1,943,056	1,568,320	987,360	180,000	1,249,220	$ 5,933,176
Engineering and Surveying		20%			$ 5,933,176	5,220	1,943,056	1,568,320	987,360	180,000	1,249,220	$ 5,933,176
Permitting		5%			$ 1,483,294	1,305	485,764	392,080	246,840	45,000	312,305	$ 1,483,294
Legal / Project Management		5%			$ 1,483,294	1,305	485,764	392,080	246,840	45,000	312,305	$ 1,483,294
		50%										
Total Estimated Project Costs					$ 44,498,820	39,150	14,572,920	11,762,400	7,405,200	1,350,000	9,369,150	$ 44,498,820

Note: Totals do not include the cost of OSSFs in Aurora or New Fairview. In Tables 8.1, 8.2 and 8.3 of the report, the cost of stand-alone centralized wastewater systems for Aurora and New Fairview have been added to these totals so that Option B could be more accurately compared with the Modified Base Case and Option C. The costs for these systems came from the costs developed in the Modified Base Case.

Table D-3: Option B - Calculations of Cost Sharing among Participants

Note: Subtotals are from Table D-2 for Option B

Subtotal - Construction Costs for Facilities Serving Ivy Hills/Boyette			$	2,283,400
Ivy Hills/Boyette Tract Cost Participation	2178 EDUs	100%	$	2,283,400
Subtotal - Construction Cost for Facilities Serving City of Boyd + Ivy Hills and Boyette Tracts			$	4,560,000
Ivy Hills/Boyett Cost Participation	2178 EDUs	74%	$	3,389,652
Boyd Cost Participation	752 EDUs	26%	$	1,170,348
Subtotal - Construction Costs for Faciliies Seving Rhome ONLY			$	1,331,800
Rhome Cost Participation	1150 EDUs	100%	$	1,331,800
Subtotal - Construction Costs for Regional Facilities serving Cities of Rhome and Newark plus Rolling V Development			$	21,490,680
Rhome Cost Participation	1150 EDUs	12%	$	2,645,502
Rolling V Ranch Cost Participation	7512 EDUs	80%	$	17,280,881
Newark Cost Participation	680 EDUs	7%	$	1,564,297
	9342	100%		
Total Construction Cost			$	29,665,880

Total Construction Costs by City / Development

Ivy Hills/Boyett Cost Participation	$	5,673,052
Boyd Cost Participation	$	1,170,348
Aurora Cost Participation	$	-
New Fairview Cost Participation	$	-
Rhome Cost Participation	$	3,977,302
Rolling V Ranch Cost Participation	$	17,280,881
Newark Cost Participation	$	1,564,297
Total Construction Cost	$	29,665,880

Total Project Costs by City / Development (Construction Costs above w/ contingencies, etc. added)

Ivy Hills/Boyett Cost Participation	$	8,509,578
Boyd Cost Participation	$	1,755,522
Aurora Cost Participation	$	-
New Fairview Cost Participation	$	-
Rhome Cost Participation	$	5,965,953
Rolling V Ranch Cost Participation	$	25,921,321
Newark Cost Participation	$	2,346,445
Total Construction Cost	$	44,498,820

Table D-4: Option C - Five City Regional Wastewater System

System Component	Nodes on Map		Quantity	Units	Estimated cost per unit	Total estimated cost in Y2009 $	Estimated costs in each 5-year interval (Y2009 $) 2010-14	2015-19	2020-24	2025-29	2030-34	After 2034	Totals
Facilities Serving Ivy Hills/Boyette Tract ONLY													
Ivy Hills Lift Station and Force Main to Gravity Sewer in Boyette Tract													
Lift Station (for Qavg = 0.106 MGD)			1	LS	$ 150,000	$ 150,000		$ 150,000					$ 150,000
6-inch force main	51	52	2100	LF	$ 48	$ 100,800		$ 100,800					$ 100,800
Sewers from Boyette Tract to FM 730 Lift Station(s)													
8-inch gravity sewer (including MHs, etc.)	52	53	2500	LF	$ 70	$ 175,000		$ 175,000					$ 175,000
12-inch gravity sewer (including MHs, etc.)	53	54	1600	LF	$ 80	$ 128,000		$ 128,000					$ 128,000
12-inch gravity sewer (including MHs, etc.)	54	55	2900	LF	$ 80	$ 232,000		$ 232,000					$ 232,000
12-inch gravity sewer (including MHs, etc.)	55		3900	LF	$ 80	$ 312,000		$ 312,000					$ 312,000
15-inch gravity sewer (including MHs, etc.)		56	2700	LF	$ 100	$ 270,000		$ 270,000					$ 270,000
15-inch gravity sewer (including MHs, etc.)	56	57	1800	LF	$ 100	$ 180,000		$ 180,000					$ 180,000
Upgrade existing FM 730 LS (higher capacity pumps)			1	LS	$ 75,000	$ 75,000		$ 75,000					$ 75,000
Future FM 730 Lift Station and Force Main and Gravity Sewer to Boyd WWTP													
FM 730 Lift Station - Phase II - 0.54 gpd avg flow			1	LS	$ 300,000	$ 300,000			$ 300,000				$ 300,000
10-inch force main	57		3300	LF	$ 65	$ 214,500			$ 214,500				$ 214,500
15-inch gravity sewer (including MHs, etc.)		41	1200	LF	$ 100.00	$ 120,000			$ 120,000				$ 120,000
Easements for gravity lines			5700	LF	$ 2.90	$ 16,530	$ 16,530						$ 16,530
Easements for force mains			3300	LF	$ 2.90	$ 9,570	$ 9,570						$ 9,570
Subtotal - Construction Costs for Facilities serving Ivy Hills/Boyette						$ 2,283,400	$ 26,100	$ 1,622,800	$ 634,500	$ -	$ -	$ -	$ 2,283,400
Facilities Serving Boyd and Ivy Hills/Boyette													
City of Boyd WWTP													
Demolish and remove package WWTP			1	LS	$ 25,000	$ 25,000				$ 25,000			$ 25,000
Demolish and remove package WWTP			1	LS	$ 25,000	$ 25,000				$ 25,000			$ 25,000
Demolish and remove drying beds			1	LS	$ 10,000	$ 10,000				$ 10,000			$ 10,000
Demolish and remove drying beds			1	LS	$ 10,000	$ 10,000				$ 10,000			$ 10,000
Note: Keep Equalization Basin and pump station in service for peak wet weather storage.													
Boyd Diversion Interceptor to Blue Creek Lift Station													
18-inch gravity sewer (including MHs, etc.)	41	42	4500	LF	$ 125	$ 562,500			$ 562,500				$ 562,500
West Fork Inverted Siphon	42	43	2200	LF	$ 600	$ 1,320,000			$ 1,320,000				$ 1,320,000
3-barrel siphon (8", 10" & 12" or 16")													
Inlet Box			1	LS	$ 40,000	$ 40,000			$ 40,000				$ 40,000
Outlet Box			1	LS	$ 20,000	$ 20,000			$ 20,000				$ 20,000
18-inch gravity sewer (including MHs, etc.)	43	44	5300	LF	$ 125	$ 662,500			$ 662,500				$ 662,500
Easements for gravity lines			12000	LF	$ 2.90	$ 34,800			$ 34,800				$ 34,800
Easements for force mains			0	LF	$ 2.90	$ -							
Subtotal - Construction costs for facilities serving the City of Boyd and Ivy Hills/Boyette Tract						$ 2,709,800	$ -	$ -	$ 2,639,800	$ 70,000	$ -	$ -	$ 2,709,800

Table D-4: Option C - Five City Regional Wastewater System

System Component	Nodes on Map		Quantity	Units	Estimated cost per unit	Total estimated cost in Y2009 $	Estimated costs in each 5-year interval (Y2009 $) 2010-14	2015-19	2020-24	2025-29	2030-34	After 2034	Totals
Facilities Serving the City of Aurora ONLY													
City of Aurora's Hwy 114 / Blue Creek Sewer to Blue Creek Lift Station													
8-inch gravity sewer (including MHs, etc.)			4800	LF	$ 70	$ 336,000			$ 336,000				$ 336,000
12-inch gravity sewer (including MHs, etc.)		44	2800	LF	$ 80	$ 224,000			$ 224,000				$ 224,000
Easements for gravity lines			7600	LF	$ 2.90	$ 22,040		$ 22,040					$ 22,040
Easements for force mains			0	LF	$ 2.90	$ -							
Subtotal - Project costs for facilities serving the City of Aurora ONLY						$ 582,040	$ -	$ 22,040	$ 560,000	$ -	$ -	$ -	$ 582,040
Facilities Serving the City of Aurora & City of Boyd/Ivy Hills/Boyette		-											
Blue Creek Lift Station and Force Main to East Aurora Interceptor													
Construct Blue Creek LS - Phase I - 0.50 mgd avg flow			1	LS	$ 300,000	$ 300,000			$ 300,000				$ 300,000
12-inch force main	44	45	7000	LF	$ 75	$ 525,000			$ 525,000				$ 525,000
Construct Blue Creek LS - Phase II - 0.40 mgd avg flow			1	LS	$ 300,000	$ 300,000					$ 300,000		$ 300,000
10-inch force main	44	45	7000	LF	$ 65	$ 455,000					$ 455,000		$ 455,000
East Aurora Interceptor													
18-inch gravity sewer (including MHs, etc.)	45	46	1900	LF	$ 125	$ 237,500			$ 237,500				$ 237,500
18-inch gravity sewer (including MHs, etc.)	46	47	5100	LF	$ 125	$ 637,500			$ 637,500				$ 637,500
Easements for gravity lines			7000	LF	$ 2.90	$ 20,300		$ 20,300					$ 20,300
Easements for force mains			7000	LF	$ 2.90	$ 20,300		$ 20,300					$ 20,300
Subtotal - Project costs for facilities Serving the City of Aurora & City of Boyd/Ivy Hills/Boyette						$ 2,495,600	$ -	$ 40,600	$ 1,700,000	$ -	$ 755,000	$ -	$ 2,495,600
Facilities Serving the City of New Fairview ONLY													
New Fairview Sewer Lines, Upper Elizabeth Creek Lift Station and Hwy 287/81 Force Main													
8-inch gravity sewer (including MHs, etc.)	61	65	2700	LF	$ 70	$ 189,000			$ 189,000				$ 189,000
8-inch gravity sewer (including MHs, etc.)	62	65	1500	LF	$ 70	$ 105,000			$ 105,000				$ 105,000
8-inch gravity sewer (including MHs, etc.)	65	67	6600	LF	$ 70	$ 462,000			$ 462,000				$ 462,000
8-inch gravity sewer (including MHs, etc.)	63	66	2600	LF	$ 70	$ 182,000			$ 182,000				$ 182,000
8-inch gravity sewer (including MHs, etc.)	64	66	1900	LF	$ 70	$ 133,000			$ 133,000				$ 133,000
8-inch gravity sewer (including MHs, etc.)	66	67	2800	LF	$ 70	$ 196,000			$ 196,000				$ 196,000
Upper Elizabeth Cr LS - 0.091 mgd avg flow			1	LS	$ 150,000	$ 150,000			$ 150,000				$ 150,000
6-inch force main	67	68	7031	LF	$ 48	$ 337,488			$ 337,488				$ 337,488
Easements for gravity lines			18100	LF	$ 2.90	$ 52,490		$ 52,490					$ 52,490
Easements for force mains			7031	LF	$ 2.90	$ 20,390		$ 20,390					$ 20,390
Subtotal - Project costs for facilities Serving the City of New Fairview ONLY						$ 1,827,368	$ -	$ 72,880	$ 1,754,488	$ -	$ -	$ -	$ 1,827,368
Facilities Serving the Cities of New Fairview & Rhome, and Boyd/Ivy Hills/Boyette													
Upper Oates Branch West Interceptor													
8-inch gravity sewer (including MHs, etc.)	68	69	8200	LF	$ 70	$ 574,000			$ 574,000				$ 574,000
12-inch gravity sewer (including MHs, etc.)	69	47	7100	LF	$ 80	$ 568,000			$ 568,000				$ 568,000

Table D-4: Option C - Five City Regional Wastewater System

System Component	Nodes on Map		Quantity	Units	Estimated cost per unit	Total estimated cost in Y2009 $	Estimated costs in each 5-year interval (Y2009 $) 2010-14	2015-19	2020-24	2025-29	2030-34	After 2034	Totals
Oates Branch West Interceptor, Lift Station, Force Main and Diversion to Oates Branch East													
21-inch gravity sewer (including MHs, etc.)	47	48	1538	LF	$ 140	$ 215,320			$ 215,320				$ 215,320
Oates Branch West LS - Phase I - 0.90 mgd avg flow			1	LS	$ 450,000	$ 450,000			$ 450,000				$ 450,000
16-inch force main	48	49	1800	LF	$ 100	$ 180,000			$ 180,000				$ 180,000
Oates Branch West LS - Phase II - 0.5 avg flow			1	LS	$ 300,000	$ 300,000					$ 300,000		$ 300,000
10-inch force main	48	49	1800	LF	$ 65	$ 117,000					$ 117,000		$ 117,000
21-inch gravity sewer (including MHs, etc.)	49	12	2300	LF	$ 140	$ 322,000			$ 322,000				$ 322,000
Easements for gravity lines			3838	LF	$ 2.90	$ 11,130		$ 11,130					$ 11,130
Easements for force mains			1800	LF	$ 2.90	$ 5,220		$ 5,220					$ 5,220
Subtotal - Construction costs for facilities Serving the Cities of New Fairview & Rhome, and Boyd/Ivy Hills/Boyette						$ 2,404,320	$ -	$ -	$ 1,987,320	$ -	$ 417,000	$ -	$ 2,404,320
Regional Facilities Serving All Participants													
Oates Branch East Interceptor, Lift Station, Force Main & Diversion to Darrett Cr Interceptor													
12-inch gravity sewer (including MHs, etc.)	11	12	2800	LF	$ 80	$ 224,000			$ 224,000				$ 224,000
Oates Branch East LS - Phase I - 1.05 mgd avg flow			1	LS	$ 450,000	$ 450,000			$ 450,000				$ 450,000
16-inch force main	12	13	3500	LF	$ 100	$ 350,000			$ 350,000				$ 350,000
Oates Branch East LS - Phase II - 0.55 mgd avg flow			1	LS	$ 300,000	$ 300,000					$ 300,000		$ 300,000
12-inch force main	12	13	3500	LF	$ 75	$ 262,500					$ 262,500		$ 262,500
21-inch gravity sewer (including MHs, etc.)	13	14	2300	LF	$ 140	$ 322,000			$ 322,000				$ 322,000
21-inch gravity sewer (including MHs, etc.)	14	4	3200	LF	$ 140	$ 448,000			$ 448,000				$ 448,000
Demolish & remove package plant at Rhome West			1	LS	$ 25,000	$ 25,000			$ 25,000				$ 25,000
Fill wet well after removing pumps			1	LS	$ 10,000	$ 10,000			$ 10,000				$ 10,000
Easements for gravity lines			8300	LF	$ 2.90	$ 24,070		$ 24,070					$ 24,070
Easements for force mains			3500	LF	$ 2.90	$ 10,150		$ 10,150					$ 10,150
Derrett Creek Interceptor, Lift Station and Force Main to WWTP													
8-inch gravity sewer (including MHs, etc.)	1	2	3500	LF	$ 70	$ 245,000		$ 245,000					$ 245,000
12-inch gravity sewer (including MHs, etc.)	2	2a	4000	LF	$ 80	$ 320,000		$ 320,000					$ 320,000
15-inch gravity sewer (including MHs, etc.)	2a	3	2600	LF	$ 100	$ 260,000		$ 260,000					$ 260,000
15-inch gravity sewer (including MHs, etc.)	3	4	2700	LF	$ 100	$ 270,000		$ 270,000					$ 270,000
24-inch gravity sewer (including MHs, etc.)	4	5	1200	LF	$ 175	$ 210,000		$ 210,000					$ 210,000
27-inch gravity sewer (including MHs, etc.)	5	6	1900	LF	$ 210	$ 399,000		$ 399,000					$ 399,000
27-inch gravity sewer (including MHs, etc.)	6	7	2300	LF	$ 210	$ 483,000		$ 483,000					$ 483,000
Derrett Cr LS - Phase I - 0.65 mgd avg flow			1	LS	$ 450,000	$ 450,000		$ 450,000					$ 450,000
12-inch force main	7	8	6000	LF	$ 75	$ 450,000		$ 450,000					$ 450,000
Derrett Cr LS - Phase II - 1.85 mgd avg flow			1	LS	$ 650,000	$ 650,000					$ 650,000		$ 650,000
20-inch force main	7	8	6000	LF	$ 125	$ 750,000					$ 750,000		$ 750,000

Table D-4: Option C - Five City Regional Wastewater System

System Component	Nodes on Map		Quantity	Units	Estimated cost per unit	Total estimated cost in Y2009 $	Estimated costs in each 5-year interval (Y2009 $) 2010-14	2015-19	2020-24	2025-29	2030-34	After 2034	Totals
Closure of Rhome East WWTP													
Fill Imhoff Treatment tank after removing equip			1	LS	$ 10,000	$ 10,000		$ 10,000					$ 10,000
Demolish and remove drying beds & misc. structures			1	LS	$ 10,000	$ 10,000		$ 10,000					$ 10,000
Clean vegetation from ponds and drain			5	acres	$ 1,000	$ 5,000		$ 5,000					$ 5,000
Regrade pond site			7	acres	$ 1,000	$ 7,000		$ 7,000					$ 7,000
Closure of Newark's Chisolm Cr Lift Station			1	LS	$ 10,000	$ 10,000		$ 10,000					$ 10,000
15-inch gravity sewer (including MHs, etc.)	4a	4	210	LF	$ 100	$ 21,000		$ 21,000					$ 21,000
Easements for gravity lines			3500	LF	$ 2.90	$ 10,150		$ 10,150					$ 10,150
Easements for force mains			0	LF	$ 2.90	$ -							
Newark Diversion Lift Station													
Lift Station - 0.1 mgd avg flow			1	LS	$ 150,000	$ 150,000		$ 150,000					$ 150,000
6-inch force main	21	22	7200	LF	$ 48	$ 345,600		$ 345,600					$ 345,600
Closure of Newark's WWTP													
Fill aeration basin after removing equipment			1	LS	$ 10,000	$ 10,000		$ 10,000					$ 10,000
Fill clarifier after removing equipment			1	LS	$ 10,000	$ 10,000		$ 10,000					$ 10,000
Fill clarifier after removing equipment			1	LS	$ 10,000	$ 10,000		$ 10,000					$ 10,000
Fill LS wet well after removing equipment			1	LS	$ 10,000	$ 10,000		$ 10,000					$ 10,000
Demolish and remove sludge drying beds & misc.			1	LS	$ 10,000	$ 10,000		$ 10,000					$ 10,000
Drain and clean ponds			9	acres	$ 1,000	$ 9,000		$ 9,000					$ 9,000
Regrade pond site			11	acres	$ 1,000	$ 11,000		$ 11,000					$ 11,000
Easements for gravity lines			0	LF	$ 2.90	$ -	$ -						$ -
Easements for force mains			7200	LF	$ 2.90	$ 20,880	$ 20,880						$ 20,880
Moss Branch Interceptor and Lift Station													
12-inch gravity sewer (including MHs, etc.)	31	32	2200	LF	$ 80	$ 176,000			$ 176,000				$ 176,000
15-inch gravity sewer (including MHs, etc.)	32	33	2700	LF	$ 100	$ 270,000			$ 270,000				$ 270,000
Moss Branch LS Phase I - 0.250 mgd avg flow			1	LS	$ 225,000	$ 225,000			$ 225,000				$ 225,000
8-inch force main	33	34	2300	LF	$ 57	$ 131,100			$ 131,100				$ 131,100
Moss Branch LS Phase II - 0.250 mgd avg flow			1	LS	$ 225,000	$ 225,000			$ 225,000				$ 225,000
8-inch force main	33	34	2300	LF	$ 57	$ 131,100			$ 131,100				$ 131,100
Easements for gravity lines			4900	LF	$ 2.90	$ 14,210		$ 14,210					$ 14,210
Easements for force mains			2300	LF	$ 2.90	$ 6,670		$ 6,670					$ 6,670
Regional Wastewater Treatment Plant													
Purchase of land for up to 3.4 MGD ultimate capacity			15	acres	$ 20,000	$ 300,000		$ 300,000					$ 300,000
Assumed permit limits of 5/5/1/0.5													
WWTP w/ nitrification, filtration and chemical P removal in Phase I													
Convert to BNR in Phase II													
Phase I - Capacity in gpd =			675,000	gpd	$ 6.10	$ 4,117,500		$ 4,117,500					$ 4,117,500
Phase II - Capacity in gpd =			675,000	gpd	$ 6.70	$ 4,522,500			$ 4,522,500				$ 4,522,500
Phase III - Capacity in gpd =			675,000	gpd	$ 6.70	$ 4,522,500				$ 4,522,500			$ 4,522,500
Phase IV and above - Capacity in gpd =			1,350,000	gpd	$ 6.30	$ 8,505,000						$ 8,505,000	$ 8,505,000
Total capacity			3,375,000	gpd									
Subtotal - Construction Costs for Regional Facilities Serving All Participants						$ 30,718,930	$ 20,880	$ 8,198,350	$ 7,509,700	$ 4,522,500	$ 1,962,500	$ 8,505,000	$ 30,718,930

Table D-4: Option C - Five City Regional Wastewater System

System Component	Nodes on Map	Quantity	Units	Estimated cost per unit	Total estimated cost in Y2009 $	Estimated costs in each 5-year interval (Y2009 $) 2010-14	2015-19	2020-24	2025-29	2030-34	After 2034	Totals
Subotal - Estimated Construction and Land/Easement Acquisition Costs for all Option C Facilities					$ 43,021,458	$ 46,980	$ 9,956,670	$ 16,785,808	$ 4,592,500	$ 3,134,500	$ 8,505,000	$ 43,021,458
Contingencies		20%			$ 8,604,292	$ 9,396	$ 1,991,334	$ 3,357,162	$ 918,500	$ 626,900	$ 1,701,000	$ 8,604,292
Engineering and Surveying		20%			$ 8,604,292	$ 9,396	$ 1,991,334	$ 3,357,162	$ 918,500	$ 626,900	$ 1,701,000	$ 8,604,292
Permitting		5%			$ 2,151,073	$ 2,349	$ 497,833	$ 839,290	$ 229,625	$ 156,725	$ 425,250	$ 2,151,073
Legal / Project Management		5%			$ 2,151,073	$ 2,349	$ 497,833	$ 839,290	$ 229,625	$ 156,725	$ 425,250	$ 2,151,073
		50%										
Total Estimated Project Costs					$ 64,532,187	$ 70,470	$ 14,935,005	$ 25,178,712	$ 6,888,750	$ 4,701,750	$ 12,757,500	$ 64,532,187
Construction & Land/Easement Acquisition Costs breakdown												
Collection System subtotal						$ 46,980	$ 5,437,170	$ 12,228,308	$ -	$ 3,134,500	$ -	$ 20,846,958
Treatment Plant subtotal						$ -	$ 4,519,500	$ 4,557,500	$ 4,592,500	$ -	$ 8,505,000	$ 22,174,500
						$ 46,980	$ 9,956,670	$ 16,785,808	$ 4,592,500	$ 3,134,500	$ 8,505,000	$ 43,021,458
Project Capital Costs breakdown												
Collection System subtotal						$ 70,470	$ 8,155,755	$ 18,342,462	$ -	$ 4,701,750	$ -	$ 31,270,437
Treatment Plant subtotal						$ -	$ 6,779,250	$ 6,836,250	$ 6,888,750	$ -	$ 12,757,500	$ 33,261,750
						$ 70,470	$ 14,935,005	$ 25,178,712	$ 6,888,750	$ 4,701,750	$ 12,757,500	$ 64,532,187

Table D-5: Option C Calculations of Cost Sharing among Participants

Note: Subtotals are from Table D-4 for Option C.

Subtotal - Construction Costs for Facilities serving Ivy Hills/Boyette				$ 2,283,400
Ivy Hills/Boyette Tract Cost Participation	2178	EDUs	100%	$ 2,283,400
Subtotal - Construction costs for facilities serving the City of Boyd and Ivy Hills/Boyette Tract				$ 2,709,800
Ivy Hills/Boyett Cost Participation	2178	EDUs	74%	$ 2,014,315
Boyd Cost Participation	752	EDUs	26%	$ 695,485
Subtotal - Project costs for facilities serving the City of Aurora ONLY				$ 582,040
Aurora Cost Participation	2300	EDUs	100%	$ 582,040
Subtotal - Project costs for facilities Serving the City of Aurora & City of Boyd/Ivy Hills/Boyette				$ 2,495,600
Ivy Hills/Boyett Cost Participation	2178	EDUs	42%	$ 1,039,277
Boyd Cost Participation	752	EDUs	14%	$ 358,832
Aurora Cost Participation	2300	EDUs	44%	$ 1,097,491
Subtotal - Project costs for facilities Serving the City of New Fairview ONLY				$ 1,827,368
New Fairview Cost Participation	455	EDUs	100%	$ 1,827,368
Subtotal - Construction costs for facilities Serving the Cities of New Fairview & Rhome, and Boyd/Ivy Hills/Boyette				$ 2,404,320
Ivy Hills/Boyett Cost Participation	2178	EDUs	38%	$ 902,086
Boyd Cost Participation	752	EDUs	13%	$ 311,464
Aurora Cost Participation	2300	EDUs	40%	$ 952,616
New Fairview Cost Participation	455	EDUs	8%	$ 188,452
Rhome Cost Participation	120	EDUs	2%	$ 49,702
Subtotal - Construction Costs for Regional Facilities Serving All Participants				$ 30,718,930
Ivy Hills/Boyett Cost Participation	2178	EDUs	14%	$ 4,452,374
Boyd Cost Participation	752	EDUs	5%	$ 1,537,275
Aurora Cost Participation	2300	EDUs	15%	$ 4,701,773
New Fairview Cost Participation	455	EDUs	3%	$ 930,133
Rhome Cost Participation	1150	EDUs	8%	$ 2,350,886
Rolling V Ranch Cost Participation	7512	EDUs	50%	$ 15,356,399
Newark Cost Participation	680	EDUs	5%	$ 1,390,089
	15027			
Total Construction Cost				$ 43,021,458
Total Construction Costs by City / Development				
Ivy Hills/Boyett Cost Participation				$ 10,691,452
Boyd Cost Participation				$ 2,903,056
Aurora Cost Participation				$ 7,333,920
New Fairview Cost Participation				$ 2,945,954
Rhome Cost Participation				$ 2,400,588
Rolling V Ranch Cost Participation				$ 15,356,399
Newark Cost Participation				$ 1,390,089
Total Construction Cost				$ 43,021,458
Total Project Costs by City / Development (Construction Costs above w/ contingencies, etc. added)				
Ivy Hills/Boyett Cost Participation				$ 16,037,179
Boyd Cost Participation				$ 4,354,584
Aurora Cost Participation				$ 11,000,880
New Fairview Cost Participation				$ 4,418,930
Rhome Cost Participation				$ 3,600,882
Rolling V Ranch Cost Participation				$ 23,034,598
Newark Cost Participation				$ 2,085,134
Total Construction Cost				$ 64,532,187

TABLE D-6

SUMMARY OF UNIT CONSTRUCTION COSTS, CONTINGENCIES AND "SOFT COSTS"

Description	Unit		Unit Cost
Gravity Sewers (including manholes, etc.)			
8 inch Gravity Sewer	LF	$	70.00
12 inch Gravity Sewer	LF	$	80.00
15 inch Gravity Sewer	LF	$	100.00
18 inch Gravity Sewer	LF	$	125.00
21 inch Gravity Sewer	LF	$	140.00
24 inch Gravity Sewer	LF	$	175.00
27 inch Gravity Sewer	LF	$	210.00
Lift Stations (Submersible pumps w/generator)			
0 to 500 gpm peak capacity (or 0.00 to 0.14 mgd avg flow)	EA	$	150,000
501 to 1000 gpm peak capacity (or 0.15 to 0.29 mgd avg flow)	EA	$	225,000
1001 to 2000 gpm peak capacity (or 0.30 to 0.58 mgd avg flow)	EA	$	300,000
2001 to 4000 gpm peak capacity (or 0.59 to 1.15 mgd avg flow)	EA	$	450,000
4001 to 7000 gpm peak capacity (or 1.16 to 2.02 mgd avg flow)	EA	$	650,000
7000 to 12000 gpm peak capacity (or 2.03 to 3.46 mgd avg flow)	EA	$	1,000,000
Force Mains (including fittings, ARVs, etc.)			
4 inch Force Main	LF	$	43.00
6 inch Force Main	LF	$	48.00
8 inch Force Main	LF	$	57.00
10 inch Force Main	LF	$	65.00
12 inch Force Main	LF	$	75.00
14 inch Force Main	LF	$	86.00
16 inch Force Main	LF	$	100.00
20 inch Force Main	LF	$	125.00
Conventional WWTP - Secondary Treatment (20/20)			
WWTP - Average Daily Flow = or < 0.1 MGD	gal of capacity	$	9.75
WWTP - Average Daily Flow = 0.1 to 0.25 MGD	gal of capacity	$	7.25
WWTP - Average Daily Flow = 0.25 to 0.50 MGD	gal of capacity	$	6.00
WWTP - Average Daily Flow = 0.5 to 1 MGD	gal of capacity	$	5.25
WWTP - Average Daily Flow = 1 to 3 MGD	gal of capacity	$	4.95
WWTP - Average Daily Flow = 3 to 5 MGD	gal of capacity	$	4.75
WWTP with Conventional Secondary and Nitrification (10/15/3 or 10/15/2)			
WWTP - Average Daily Flow = or < 0.1 MGD	gal of capacity	$	10.30
WWTP - Average Daily Flow = 0.1 to 0.25 MGD	gal of capacity	$	7.70
WWTP - Average Daily Flow = 0.25 to 0.50 MGD	gal of capacity	$	6.30
WWTP - Average Daily Flow = 0.5 to 1 MGD	gal of capacity	$	5.50
WWTP - Average Daily Flow = 1 to 3 MGD	gal of capacity	$	5.20
WWTP - Average Daily Flow = 3 to 5 MGD	gal of capacity	$	5.00

TABLE D-6

SUMMARY OF UNIT CONSTRUCTION COSTS, CONTINGENCIES AND "SOFT COSTS"

Description	Unit		Unit Cost
WWTP with Nitrification, Filtration & Chemical (Alum) Phosphorus Removal			
WWTP - Average Daily Flow = or < 0.1 MGD	gal of capacity	$	11.40
WWTP - Average Daily Flow = 0.1 to 0.25 MGD	gal of capacity	$	8.50
WWTP - Average Daily Flow = 0.25 to 0.50 MGD	gal of capacity	$	7.00
WWTP - Average Daily Flow = 0.5 to 1 MGD	gal of capacity	$	6.10
WWTP - Average Daily Flow = 1 to 3 MGD	gal of capacity	$	5.75
WWTP - Average Daily Flow = 3 to 5 MGD	gal of capacity	$	5.50
WWTP with BNR, Filtration & Back-up Chemical (Alum) Phosphorus Removal			
WWTP - Average Daily Flow = or < 0.1 MGD	gal of capacity	$	12.70
WWTP - Average Daily Flow = 0.1 to 0.25 MGD	gal of capacity	$	9.40
WWTP - Average Daily Flow = 0.25 to 0.50 MGD	gal of capacity	$	7.70
WWTP - Average Daily Flow = 0.5 to 1 MGD	gal of capacity	$	6.70
WWTP - Average Daily Flow = 1 to 3 MGD	gal of capacity	$	6.30
WWTP - Average Daily Flow = 3 to 5 MGD	gal of capacity	$	6.10
Closure of Existing Treatment Facilities			
Demolish & remove package WWTP	LS	$	25,000
Fill underground tank or wet well	LS	$	10,000
Demolish and remove drying beds & misc. structures	LS	$	10,000
Drain and clean vegetation from ponds	acre	$	1,000
Remove/dispose of liner	acre	$	500
Regrade pond site	acre	$	1,000
On-Site Sewage Facilities (OSSF)			
OSSF (Conventional Septic Tank & Drain Field)	EA	$	4,500
OSSF (Low Pressure Dosing)	EA	$	5,500
OSSF (Aerobic w/ Spray or Drip Irrigation)	EA	$	7,500
OSSF (Evaporation/Transpiration Beds)	EA	$	10,000
Remove OSSF & tie to WWCS	EA	$	3,000
Miscellaneous			
Easement Acquisition (15' Permanent + 35' Temporary)	LF	$	2.90
Land Acquisition	AC	$	20,000
Contingencies and Soft Project Costs			
Contingencies	%		20%
Engineering Design / Surveying Fee's	%		20%
Environmental/Archeological Services	%		5%
Legal Services/Project Management	%		5%

The ENGINEER has no control over the cost of labor, materials, or equipment, or over the Contractor's methods of determining prices, or over competitive bidding or market conditions. As a result, this opinion of probable construction cost is based on the ENGINEER'S experience and qualifications and represents our best judgment as design professionals familiar with the construction industry. The ENGINEER cannot and does not guarantee that proposals, bids or the construction cost will not vary from this opinion of probable cost.

APPENDIX E

Table E-1
Debt Service Calculations
Modified Base Case / City of Boyd Collection and Treatment System

		Collection System (Including Lift Stations & Force Mains)							Treatment Plant (Including Closure of Abandoned Plants)							
Year	Estimated Avg Daily Flow (MGD)	Estimated Project Capital Costs (million $)	Y2015 Bond Sale (million $)	Y2020 Bond Sale (million $)	Y2025 Bond Sale (million $)	Y2030 Bond Sale (million $)	Total Asset Value at End of Period (million $)	Annual Collection System Debt Service ($)	Project Capital Costs (million $)	Y2015 Bond Sale (million $)	Y2020 Bond Sale (million $)	Y2025 Bond Sale (million $)	Y2030 Bond Sale (million $)	Total Asset Value at End of Period (million $)	Annual Treatment Plant Debt Service ($)	**Total Annual Debt Service ($)**
2010	0	$0.00					$0.00		$0.00					$0.00		$0
2011	0						$0.00							$0.00		$0
2012	0						$0.00							$0.00		$0
2013	0						$0.00							$0.00		$0
2014	0						$0.00							$0.00		$0
2015	0.115	$0.27	$0.27				$0.27	$17,564	$0.00	$0.00				$0.00	$0	$17,564
2016	0.118						$0.27	$17,564						$0.00	$0	$17,564
2017	0.120						$0.27	$17,564						$0.00	$0	$17,564
2018	0.123						$0.27	$17,564						$0.00	$0	$17,564
2019	0.125						$0.27	$17,564						$0.00	$0	$17,564
2020	0.128	$0.98		$0.98			$1.25	$81,314	$0.00		$0.00			$0.00	$0	$81,314
2021	0.132						$1.25	$81,314						$0.00	$0	$81,314
2022	0.137						$1.25	$81,314						$0.00	$0	$81,314
2023	0.141						$1.25	$81,314						$0.00	$0	$81,314
2024	0.146						$1.25	$81,314						$0.00	$0	$81,314
2025	0.150	$0.61			$0.61		$1.86	$120,996	$2.07			$2.07		$2.07	$134,656	$255,652
2026	0.155						$1.86	$120,996						$2.07	$134,656	$255,652
2027	0.159						$1.86	$120,996						$2.07	$134,656	$255,652
2028	0.164						$1.86	$120,996						$2.07	$134,656	$255,652
2029	0.168						$1.86	$120,996						$2.07	$134,656	$255,652
2030	0.173	$0.00				$0.00	$1.86	$120,996	$0.00				$0.00	$2.07	$134,656	$255,652
2031	0.178						$1.86	$120,996						$2.07	$134,656	$255,652
2032	0.182						$1.86	$120,996						$2.07	$134,656	$255,652
2033	0.187						$1.86	$120,996						$2.07	$134,656	$255,652
2034	0.191						$1.86	$120,996						$2.07	$134,656	$255,652

Notes:
1 All costs are in Y2009 dollars
2 Intermediate year flows are estimated to increase linearly between 2015 and 2020, between 2020 and 2025, etc.
3 Each bond sale covers anticipated project capital costs for a 5-year period.
4 Total debt service is the sum of the debt service for all bonds sold prior to that year.
5 Interest rate is assumed to be = 5%
6 Bond term is assumed to be = 30 years

Table E-2
O&M Cost Estimates
Modified Base Case / City of Boyd Collection and Treatment System

		Collection System (Including Lift Stations)				Treatment Plant				Collection + Treatment	
Year	Avg Daily Flow (MGD)	Fixed O&M Costs	Variable O&M Costs	Total O&M Costs	Unit O&M Cost ($/1000 gal.)	Fixed O&M Costs	Variable O&M Costs	Total O&M Costs	Unit Cost ($/1000 gal.)	Total O&M Costs	Total Unit O&M Cost ($/1000 gal.)
2010	0.000										
2011	0.000										
2012	0.000										
2013	0.000										
2014	0.000										
2015	0.115	$2,700	$4,198	$6,898	$0.16	$0	$20,988	$20,988	$0.50	$27,885	$0.66
2016	0.118	$2,700	$4,292	$6,992	$0.16	$0	$21,462	$21,462	$0.50	$28,454	$0.66
2017	0.120	$2,700	$4,387	$7,087	$0.16	$0	$21,937	$21,937	$0.50	$29,024	$0.66
2018	0.123	$2,700	$4,482	$7,182	$0.16	$0	$22,411	$22,411	$0.50	$29,593	$0.66
2019	0.125	$2,700	$4,577	$7,277	$0.16	$0	$22,886	$22,886	$0.50	$30,163	$0.66
2020	0.128	$12,500	$4,672	$17,172	$0.37	$0	$23,360	$23,360	$0.50	$40,532	$0.87
2021	0.132	$12,500	$4,833	$17,333	$0.36	$0	$24,163	$24,163	$0.50	$41,496	$0.86
2022	0.137	$12,500	$4,993	$17,493	$0.35	$0	$24,966	$24,966	$0.50	$42,459	$0.85
2023	0.141	$12,500	$5,154	$17,654	$0.34	$0	$25,769	$25,769	$0.50	$43,423	$0.84
2024	0.146	$12,500	$5,314	$17,814	$0.34	$0	$26,572	$26,572	$0.50	$44,386	$0.84
2025	0.150	$18,600	$5,475	$24,075	$0.44	$62,100	$27,375	$89,475	$1.63	$113,550	$2.07
2026	0.155	$18,600	$5,643	$24,243	$0.43	$62,100	$28,215	$90,315	$1.60	$114,557	$2.03
2027	0.159	$18,600	$5,811	$24,411	$0.42	$62,100	$29,054	$91,154	$1.57	$115,565	$1.99
2028	0.164	$18,600	$5,979	$24,579	$0.41	$62,100	$29,894	$91,994	$1.54	$116,572	$1.95
2029	0.168	$18,600	$6,147	$24,747	$0.40	$62,100	$30,733	$92,833	$1.51	$117,580	$1.91
2030	0.173	$18,600	$6,315	$24,915	$0.39	$62,100	$31,573	$93,673	$1.48	$118,587	$1.88
2031	0.178	$18,600	$6,482	$25,082	$0.39	$62,100	$32,412	$94,512	$1.46	$119,594	$1.84
2032	0.182	$18,600	$6,650	$25,250	$0.38	$62,100	$33,252	$95,352	$1.43	$120,602	$1.81
2033	0.187	$18,600	$6,818	$25,418	$0.37	$62,100	$34,091	$96,191	$1.41	$121,609	$1.78
2034	0.191	$18,600	$6,986	$25,586	$0.37	$62,100	$34,931	$97,031	$1.39	$122,617	$1.76

Notes:

1 Intermediate year flows are estimated to increase linearly between 2015 and 2020, between 2020 and 2025, etc.
2 Fixed collection system O&M costs assumed at 1.0% of asset value of collection system
3 Variable collection system O&M costs estimated at $ 0.10 per 1000 gallons (primarily electricity for pumping)
4 Fixed treatment plant O&M costs assumed at 3.0% of asset value of WWTP
5 Variable collection system O&M costs estimated at $ 0.50 per 1000 gallons
6 Unit cost is the sum of the O&M cost divided 365 days and then divided by the average daily flow for that year.

Table E-3
Present Worth Calculations
Modified Base Case / City of Boyd Collection and Treatment System

	Capital Costs by Year				O&M Costs by Year				
Year	Collection System Capital Costs (million $)	Treatment Plant Capital Costs (million $)	Total Capital Costs (million $)	Present Worth (million $)	Collection System O&M Costs (million $)	Treatment Plant O&M Costs (million $)	Total O&M Costs (million $)	Present Worth (million $)	**Total Present Worth (million $)**
2009									
2010	$0.00	$0.00	$0.00	$0.00			$0.000	$0.00	$0.00
2011				$0.00			$0.000	$0.00	$0.00
2012				$0.00			$0.000	$0.00	$0.00
2013				$0.00			$0.000	$0.00	$0.00
2014				$0.00			$0.000	$0.00	$0.00
2015	$0.27	$0.00	$0.27	$0.20	$0.007	$0.021	$0.028	$0.02	$0.22
2016				$0.00	$0.007	$0.021	$0.028	$0.02	$0.02
2017				$0.00	$0.007	$0.022	$0.029	$0.02	$0.02
2018				$0.00	$0.007	$0.022	$0.030	$0.02	$0.02
2019				$0.00	$0.007	$0.023	$0.030	$0.02	$0.02
2020	$0.98	$0.00	$0.98	$0.57	$0.017	$0.023	$0.041	$0.02	$0.60
2021				$0.00	$0.017	$0.024	$0.041	$0.02	$0.02
2022				$0.00	$0.017	$0.025	$0.042	$0.02	$0.02
2023				$0.00	$0.018	$0.026	$0.043	$0.02	$0.02
2024				$0.00	$0.018	$0.027	$0.044	$0.02	$0.02
2025	$0.61	$2.07	$2.68	$1.23	$0.024	$0.089	$0.114	$0.05	$1.28
2026				$0.00	$0.024	$0.090	$0.115	$0.05	$0.05
2027				$0.00	$0.024	$0.091	$0.116	$0.05	$0.05
2028				$0.00	$0.025	$0.092	$0.117	$0.05	$0.05
2029				$0.00	$0.025	$0.093	$0.118	$0.04	$0.04
2030	$0.00	$0.00	$0.00	$0.00	$0.025	$0.094	$0.119	$0.04	$0.04
2031				$0.00	$0.025	$0.095	$0.120	$0.04	$0.04
2032				$0.00	$0.025	$0.095	$0.121	$0.04	$0.04
2033				$0.00	$0.025	$0.096	$0.122	$0.04	$0.04
2034				$0.00	$0.026	$0.097	$0.123	$0.04	$0.04
	Total Present Worth (Y2010 to 2034)			**$2.00**				**$0.65**	**$2.65**

Notes:
1 Interest rate is assumed to be = 5%

Table E-4

Debt Service Calculations

Modified Base Case / Ivy Hills & Boyette Tract Collection and Treatment System

		Collection System (Including Lift Stations & Force Mains)							Treatment Plant (Including Closure of Abandoned Plants)							
Year	Estimated Avg Daily Flow (MGD)	Estimated Project Capital Costs (million $)	Y2015 Bond Sale (million $)	Y2020 Bond Sale (million $)	Y2025 Bond Sale (million $)	Y2030 Bond Sale (million $)	Total Asset Value at End of Period (million $)	Annual Collection System Debt Service ($)	Project Capital Costs (million $)	Y2015 Bond Sale (million $)	Y2020 Bond Sale (million $)	Y2025 Bond Sale (million $)	Y2030 Bond Sale (million $)	Total Asset Value at End of Period (million $)	Annual Treatment Plant Debt Service ($)	**Total Annual Debt Service ($)**
2010	0	$0.00					$0.00		$0.11					$0.00		$0
2011	0						$0.00							$0.00		$0
2012	0						$0.00							$0.00		$0
2013	0						$0.00							$0.00		$0
2014	0						$0.00							$0.00		$0
2015	0.003	$0.45	$0.45				$0.45	$29,273	$2.89	$2.89				$2.89	$187,803	$217,077
2016	0.007						$0.45	$29,273						$2.89	$187,803	$217,077
2017	0.010						$0.45	$29,273						$2.89	$187,803	$217,077
2018	0.014						$0.45	$29,273						$2.89	$187,803	$217,077
2019	0.017						$0.45	$29,273						$2.89	$187,803	$217,077
2020	0.021	$0.86		$0.86			$1.31	$85,217	$0.00		$0.00			$2.89	$187,803	$273,021
2021	0.028						$1.31	$85,217						$2.89	$187,803	$273,021
2022	0.035						$1.31	$85,217						$2.89	$187,803	$273,021
2023	0.041						$1.31	$85,217						$2.89	$187,803	$273,021
2024	0.048						$1.31	$85,217						$2.89	$187,803	$273,021
2025	0.055	$0.00			$0.00		$1.31	$85,217	$4.31			$4.31		$7.20	$468,370	$553,588
2026	0.061						$1.31	$85,217						$7.20	$468,370	$553,588
2027	0.067						$1.31	$85,217						$7.20	$468,370	$553,588
2028	0.074						$1.31	$85,217						$7.20	$468,370	$553,588
2029	0.080						$1.31	$85,217						$7.20	$468,370	$553,588
2030	0.086	$0.00				$0.00	$1.31	$85,217	$0.00				$0.00	$7.20	$468,370	$553,588
2031	0.092						$1.31	$85,217						$7.20	$468,370	$553,588
2032	0.098						$1.31	$85,217						$7.20	$468,370	$553,588
2033	0.105						$1.31	$85,217						$7.20	$468,370	$553,588
2034	0.111						$1.31	$85,217						$7.20	$468,370	$553,588

Notes:

1 All costs are in Y2009 dollars
2 Intermediate year flows are estimated to increase linearly between 2015 and 2020, between 2020 and 2025, etc.
3 Each bond sale covers anticipated project capital costs for a 5-year period.
4 Total debt service is the sum of the debt service for all bonds sold prior to that year.
5 Interest rate is assumed to be = 5%
6 Bond term is assumed to be = 30 years

Table E-5

O&M Cost Estimates

Modified Base Case / Ivy Hills & Boyette Tract Collection and Treatment System

		Collection System (Including Lift Stations)				Treatment Plant				Collection + Treatment	
Year	Avg Daily Flow (MGD)	Fixed O&M Costs	Variable O&M Costs	Total O&M Costs	Unit O&M Cost ($/1000 gal.)	Fixed O&M Costs	Variable O&M Costs	Total O&M Costs	Unit Cost ($/1000 gal.)	Total O&M Costs	Total Unit O&M Cost ($/1000 gal.)
2010	0.000										
2011	0.000										
2012	0.000										
2013	0.000										
2014	0.000										
2015	0.003	$4,500	$110	$4,610	$4.21	$86,610	$657	$87,267	$79.70	$91,877	$83.91
2016	0.007	$4,500	$241	$4,741	$1.97	$86,610	$1,445	$88,055	$36.55	$92,796	$38.52
2017	0.010	$4,500	$372	$4,872	$1.31	$86,610	$2,234	$88,844	$23.86	$93,716	$25.17
2018	0.014	$4,500	$504	$5,004	$0.99	$86,610	$3,022	$89,632	$17.79	$94,636	$18.79
2019	0.017	$4,500	$635	$5,135	$0.81	$86,610	$3,811	$90,421	$14.24	$95,556	$15.05
2020	0.021	$13,100	$767	$13,867	$1.81	$86,610	$4,599	$91,209	$11.90	$105,076	$13.71
2021	0.028	$13,100	$1,015	$14,115	$1.39	$86,610	$6,088	$92,698	$9.14	$106,813	$10.53
2022	0.035	$13,100	$1,263	$14,363	$1.14	$86,610	$7,577	$94,187	$7.46	$108,550	$8.60
2023	0.041	$13,100	$1,511	$14,611	$0.97	$86,610	$9,067	$95,677	$6.33	$110,288	$7.30
2024	0.048	$13,100	$1,759	$14,859	$0.84	$86,610	$10,556	$97,166	$5.52	$112,025	$6.37
2025	0.055	$13,100	$2,008	$15,108	$0.75	$216,000	$12,045	$228,045	$11.36	$243,153	$12.11
2026	0.061	$13,100	$2,234	$15,334	$0.69	$216,000	$13,403	$229,403	$10.27	$244,737	$10.96
2027	0.067	$13,100	$2,460	$15,560	$0.63	$216,000	$14,761	$230,761	$9.38	$246,321	$10.01
2028	0.074	$13,100	$2,686	$15,786	$0.59	$216,000	$16,118	$232,118	$8.64	$247,905	$9.23
2029	0.080	$13,100	$2,913	$16,013	$0.55	$216,000	$17,476	$233,476	$8.02	$249,489	$8.57
2030	0.086	$13,100	$3,139	$16,239	$0.52	$216,000	$18,834	$234,834	$7.48	$251,073	$8.00
2031	0.092	$13,100	$3,365	$16,465	$0.49	$216,000	$20,192	$236,192	$7.02	$252,657	$7.51
2032	0.098	$13,100	$3,592	$16,692	$0.46	$216,000	$21,550	$237,550	$6.61	$254,241	$7.08
2033	0.105	$13,100	$3,818	$16,918	$0.44	$216,000	$22,907	$238,907	$6.26	$255,825	$6.70
2034	0.111	$13,100	$4,044	$17,144	$0.42	$216,000	$24,265	$240,265	$5.94	$257,409	$6.36

Notes:

1 Intermediate year flows are estimated to increase linearly between 2015 and 2020, between 2020 and 2025, etc.
2 Fixed collection system O&M costs assumed at 1.0% of asset value of collection system
3 Variable collection system O&M costs estimated at $ 0.10 per 1000 gallons (primarily electricity for pumping)
4 Fixed treatment plant O&M costs assumed at 3.0% of asset value of WWTP
5 Variable collection system O&M costs estimated at $ 0.60 per 1000 gallons
6 Unit cost is the sum of the O&M cost divided 365 days and then divided by the average daily flow for that year.

Table E-6
Present Worth Calculations
Modified Base Case / Ivy Hills & Boyette Tract Collection and Treatment System

	Capital Costs by Year				O&M Costs by Year				
Year	Collection System Capital Costs (million $)	Treatment Plant Capital Costs (million $)	Total Capital Costs (million $)	Present Worth (million $)	Collection System O&M Costs (million $)	Treatment Plant O&M Costs (million $)	Total O&M Costs (million $)	Present Worth (million $)	**Total Present Worth (million $)**
2009									
2010	$0.00	$0.11	$0.11	$0.10			$0.000	$0.00	$0.10
2011				$0.00			$0.000	$0.00	$0.00
2012				$0.00			$0.000	$0.00	$0.00
2013				$0.00			$0.000	$0.00	$0.00
2014				$0.00			$0.000	$0.00	$0.00
2015	$0.45	$2.89	$3.34	$2.49	$0.005	$0.087	$0.092	$0.07	$2.56
2016				$0.00	$0.005	$0.088	$0.093	$0.07	$0.07
2017				$0.00	$0.005	$0.089	$0.094	$0.06	$0.06
2018				$0.00	$0.005	$0.090	$0.095	$0.06	$0.06
2019				$0.00	$0.005	$0.090	$0.096	$0.06	$0.06
2020	$0.86	$0.00	$0.86	$0.50	$0.014	$0.091	$0.105	$0.06	$0.56
2021				$0.00	$0.014	$0.093	$0.107	$0.06	$0.06
2022				$0.00	$0.014	$0.094	$0.109	$0.06	$0.06
2023				$0.00	$0.015	$0.096	$0.110	$0.06	$0.06
2024				$0.00	$0.015	$0.097	$0.112	$0.05	$0.05
2025	$0.00	$4.31	$4.31	$1.98	$0.015	$0.228	$0.243	$0.11	$2.09
2026				$0.00	$0.015	$0.229	$0.245	$0.11	$0.11
2027				$0.00	$0.016	$0.231	$0.246	$0.10	$0.10
2028				$0.00	$0.016	$0.232	$0.248	$0.10	$0.10
2029				$0.00	$0.016	$0.233	$0.249	$0.09	$0.09
2030	$0.00	$0.00	$0.00	$0.00	$0.016	$0.235	$0.251	$0.09	$0.09
2031				$0.00	$0.016	$0.236	$0.253	$0.09	$0.09
2032				$0.00	$0.017	$0.238	$0.254	$0.08	$0.08
2033				$0.00	$0.017	$0.239	$0.256	$0.08	$0.08
2034				$0.00	$0.017	$0.240	$0.257	$0.08	$0.08
	Total Present Worth (Y2010 to 2034)			**$5.07**				**$1.53**	**$6.61**

Notes:
1 Interest rate is assumed to be = 5%

Table E-7
Debt Service Calculations
Modified Base Case / City of Aurora Collection and Treatment System

		Collection System (Including Lift Stations & Force Mains)							Treatment Plant (Including Closure of Abandoned Plants)							
Year	Estimated Avg Daily Flow (MGD)	Estimated Project Capital Costs (million $)	Y2015 Bond Sale (million $)	Y2020 Bond Sale (million $)	Y2025 Bond Sale (million $)	Y2030 Bond Sale (million $)	Total Asset Value at End of Period (million $)	Annual Collection System Debt Service ($)	Project Capital Costs (million $)	Y2015 Bond Sale (million $)	Y2020 Bond Sale (million $)	Y2025 Bond Sale (million $)	Y2030 Bond Sale (million $)	Total Asset Value at End of Period (million $)	Annual Treatment Plant Debt Service ($)	**Total Annual Debt Service ($)**
2010		$0.00					$0.00		$0.00					$0.00		$0
2011							$0.00							$0.00		$0
2012							$0.00							$0.00		$0
2013							$0.00							$0.00		$0
2014							$0.00							$0.00		$0
2015		$0.07	$0.07				$0.07	$4,554	$0.16	$0.16				$0.16	$10,278	$14,832
2016							$0.07	$4,554						$0.16	$10,278	$14,832
2017							$0.07	$4,554						$0.16	$10,278	$14,832
2018							$0.07	$4,554						$0.16	$10,278	$14,832
2019							$0.07	$4,554						$0.16	$10,278	$14,832
2020	0.007	$2.28		$2.28			$2.35	$152,871	$3.06		$3.06			$3.22	$209,336	$362,206
2021	0.014						$2.35	$152,871						$3.22	$209,336	$362,206
2022	0.021						$2.35	$152,871						$3.22	$209,336	$362,206
2023	0.029						$2.35	$152,871						$3.22	$209,336	$362,206
2024	0.036						$2.35	$152,871						$3.22	$209,336	$362,206
2025	0.043	$0.00			$0.00		$2.35	$152,871	$0.00			$0.00		$3.22	$209,336	$362,206
2026	0.071						$2.35	$152,871						$3.22	$209,336	$362,206
2027	0.099						$2.35	$152,871						$3.22	$209,336	$362,206
2028	0.128						$2.35	$152,871						$3.22	$209,336	$362,206
2029	0.156						$2.35	$152,871						$3.22	$209,336	$362,206
2030	0.184	$0.00				$0.00	$2.35	$152,871	$0.00				$0.00	$3.22	$209,336	$362,206
2031	0.212						$2.35	$152,871						$3.22	$209,336	$362,206
2032	0.240						$2.35	$152,871						$3.22	$209,336	$362,206
2033	0.269						$2.35	$152,871						$3.22	$209,336	$362,206
2034	0.297						$2.35	$152,871						$3.22	$209,336	$362,206

Notes:

1 All costs are in Y2009 dollars
2 Intermediate year flows are estimated to increase linearly between 2015 and 2020, between 2020 and 2025, etc.
3 Each bond sale covers anticipated project capital costs for a 5-year period.
4 Total debt service is the sum of the debt service for all bonds sold prior to that year.
5 Interest rate is assumed to be = 5%
6 Bond term is assumed to be = 30 years

Table E-8

O&M Cost Estimates

Modified Base Case / City of Aurora Collection and Treatment System

		Collection System (Including Lift Stations)				Treatment Plant				Collection + Treatment	
Year	Avg Daily Flow (MGD)	Fixed O&M Costs	Variable O&M Costs	Total O&M Costs	Unit O&M Cost ($/1000 gal.)	Fixed O&M Costs	Variable O&M Costs	Total O&M Costs	Unit Cost ($/1000 gal.)	Total O&M Costs	Total Unit O&M Cost ($/1000 gal.)
2010	0.000										
2011	0.000										
2012	0.000										
2013	0.000										
2014	0.000										
2015	0.000										
2016	0.000										
2017	0.000										
2018	0.000										
2019	0.000										
2020	0.007	$23,500	$256	$23,756	$9.30	$96,540	$1,661	$98,201	$38.43	$121,956	$47.73
2021	0.014	$23,500	$518	$24,018	$4.63	$96,540	$3,369	$99,909	$19.28	$123,927	$23.91
2022	0.021	$23,500	$781	$24,281	$3.11	$96,540	$5,077	$101,617	$13.01	$125,898	$16.12
2023	0.029	$23,500	$1,044	$24,544	$2.35	$96,540	$6,785	$103,325	$9.90	$127,869	$12.25
2024	0.036	$23,500	$1,307	$24,807	$1.90	$96,540	$8,494	$105,034	$8.04	$129,840	$9.94
2025	0.043	$23,500	$1,570	$25,070	$1.60	$96,540	$10,202	$106,742	$6.80	$131,811	$8.40
2026	0.071	$23,500	$2,599	$26,099	$1.00	$96,540	$16,892	$113,432	$4.36	$139,531	$5.37
2027	0.099	$23,500	$3,628	$27,128	$0.75	$96,540	$23,583	$120,123	$3.31	$147,251	$4.06
2028	0.128	$23,500	$4,657	$28,157	$0.60	$96,540	$30,273	$126,813	$2.72	$154,971	$3.33
2029	0.156	$23,500	$5,687	$29,187	$0.51	$96,540	$36,964	$133,504	$2.35	$162,690	$2.86
2030	0.184	$23,500	$6,716	$30,216	$0.45	$96,540	$43,654	$140,194	$2.09	$170,410	$2.54
2031	0.212	$23,500	$7,745	$31,245	$0.40	$96,540	$50,344	$146,884	$1.90	$178,130	$2.30
2032	0.240	$23,500	$8,775	$32,275	$0.37	$96,540	$57,035	$153,575	$1.75	$185,850	$2.12
2033	0.269	$23,500	$9,804	$33,304	$0.34	$96,540	$63,725	$160,265	$1.63	$193,569	$1.97
2034	0.297	$23,500	$10,833	$34,333	$0.32	$96,540	$70,416	$166,956	$1.54	$201,289	$1.86

Notes:

1 Intermediate year flows are estimated to increase linearly between 2015 and 2020, between 2020 and 2025, etc.
2 Fixed collection system O&M costs assumed at 1.0% of asset value of collection system
3 Variable collection system O&M costs estimated at $ 0.10 per 1000 gallons (primarily electricity for pumping)
4 Fixed treatment plant O&M costs assumed at 3.0% of asset value of WWTP
5 Variable collection system O&M costs estimated at $ 0.65 per 1000 gallons
6 Unit cost is the sum of the O&M cost divided 365 days and then divided by the average daily flow for that year.

Table E-9
Present Worth Calculations
Modified Base Case / City of Aurora Collection and Treatment System

	Capital Costs by Year				O&M Costs by Year				
Year	Collection System Capital Costs (million $)	Treatment Plant Capital Costs (million $)	Total Capital Costs (million $)	Present Worth (million $)	Collection System O&M Costs (million $)	Treatment Plant O&M Costs (million $)	Total O&M Costs (million $)	Present Worth (million $)	**Total Present Worth (million $)**
2009									
2010	$0.00	$0.00	$0.00	$0.00			$0.000	$0.00	$0.00
2011				$0.00			$0.000	$0.00	$0.00
2012				$0.00			$0.000	$0.00	$0.00
2013				$0.00			$0.000	$0.00	$0.00
2014				$0.00			$0.000	$0.00	$0.00
2015	$0.07	$0.16	$0.23	$0.17	$0.000	$0.000	$0.000	$0.00	$0.17
2016				$0.00	$0.000	$0.000	$0.000	$0.00	$0.00
2017				$0.00	$0.000	$0.000	$0.000	$0.00	$0.00
2018				$0.00	$0.000	$0.000	$0.000	$0.00	$0.00
2019				$0.00	$0.000	$0.000	$0.000	$0.00	$0.00
2020	$2.28	$3.06	$5.34	$3.12	$0.024	$0.098	$0.122	$0.07	$3.19
2021				$0.00	$0.024	$0.100	$0.124	$0.07	$0.07
2022				$0.00	$0.024	$0.102	$0.126	$0.07	$0.07
2023				$0.00	$0.025	$0.103	$0.128	$0.06	$0.06
2024				$0.00	$0.025	$0.105	$0.130	$0.06	$0.06
2025	$0.00	$0.00	$0.00	$0.00	$0.025	$0.107	$0.132	$0.06	$0.06
2026				$0.00	$0.026	$0.113	$0.140	$0.06	$0.06
2027				$0.00	$0.027	$0.120	$0.147	$0.06	$0.06
2028				$0.00	$0.028	$0.127	$0.155	$0.06	$0.06
2029				$0.00	$0.029	$0.134	$0.163	$0.06	$0.06
2030	$0.00	$0.00	$0.00	$0.00	$0.030	$0.140	$0.170	$0.06	$0.06
2031				$0.00	$0.031	$0.147	$0.178	$0.06	$0.06
2032				$0.00	$0.032	$0.154	$0.186	$0.06	$0.06
2033				$0.00	$0.033	$0.160	$0.194	$0.06	$0.06
2034				$0.00	$0.034	$0.167	$0.201	$0.06	$0.06
	Total Present Worth (Y2010 to 2034)			**$3.29**				**$0.94**	**$4.23**

Notes:
1 Interest rate is assumed to be = 5%

Table E-10
Debt Service Calculations
Modified Base Case / City of New Fairview Collection and Treatment System

		Collection System (Including Lift Stations & Force Mains)							Treatment Plant (Including Closure of Abandoned Plants)							
Year	Estimated Avg Daily Flow (MGD)	Estimated Project Capital Costs (million $)	Y2015 Bond Sale (million $)	Y2020 Bond Sale (million $)	Y2025 Bond Sale (million $)	Y2030 Bond Sale (million $)	Total Asset Value at End of Period (million $)	Annual Collection System Debt Service ($)	Project Capital Costs (million $)	Y2015 Bond Sale (million $)	Y2020 Bond Sale (million $)	Y2025 Bond Sale (million $)	Y2030 Bond Sale (million $)	Total Asset Value at End of Period (million $)	Annual Treatment Plant Debt Service ($)	**Total Annual Debt Service ($)**
2010	0	$0.00					$0.00		$0.11					$0.00		$0
2011	0						$0.00							$0.00		$0
2012	0						$0.00							$0.00		$0
2013	0						$0.00							$0.00		$0
2014	0						$0.00							$0.00		$0
2015	0	$0.08	$0.08				$0.08	$5,074	$0.09	$0.09				$0.09	$5,855	$10,929
2016	0						$0.08	$5,074						$0.09	$5,855	$10,929
2017	0						$0.08	$5,074						$0.09	$5,855	$10,929
2018	0						$0.08	$5,074						$0.09	$5,855	$10,929
2019	0						$0.08	$5,074						$0.09	$5,855	$10,929
2020	0.0007	$1.90		$1.90			$1.98	$128,672	$1.55		$1.55			$1.64	$106,359	$235,031
2021	0.0007						$1.98	$128,672						$1.64	$106,359	$235,031
2022	0.0008						$1.98	$128,672						$1.64	$106,359	$235,031
2023	0.0008						$1.98	$128,672						$1.64	$106,359	$235,031
2024	0.0009						$1.98	$128,672						$1.64	$106,359	$235,031
2025	0.0009	$0.00			$0.00		$1.98	$128,672	$0.00			$0.00		$1.64	$106,359	$235,031
2026	0.0009						$1.98	$128,672						$1.64	$106,359	$235,031
2027	0.0010						$1.98	$128,672						$1.64	$106,359	$235,031
2028	0.0010						$1.98	$128,672						$1.64	$106,359	$235,031
2029	0.0011						$1.98	$128,672						$1.64	$106,359	$235,031
2030	0.0011	$0.00				$0.00	$1.98	$128,672	$0.00				$0.00	$1.64	$106,359	$235,031
2031	0.0012						$1.98	$128,672						$1.64	$106,359	$235,031
2032	0.0012						$1.98	$128,672						$1.64	$106,359	$235,031
2033	0.0013						$1.98	$128,672						$1.64	$106,359	$235,031
2034	0.0013						$1.98	$128,672						$1.64	$106,359	$235,031

Notes:

1 All costs are in Y2009 dollars
2 Intermediate year flows are estimated to increase linearly between 2015 and 2020, between 2020 and 2025, etc.
3 Each bond sale covers anticipated project capital costs for a 5-year period.
4 Total debt service is the sum of the debt service for all bonds sold prior to that year.
5 Interest rate is assumed to be = 5%
6 Bond term is assumed to be = 30 years

Table E-11

O&M Cost Estimates

Modified Base Case / City of New Fairview Collection and Treatment System

		Collection System (Including Lift Stations)				Treatment Plant				Collection + Treatment	
Year	Avg Daily Flow (MGD)	Fixed O&M Costs	Variable O&M Costs	Total O&M Costs	Unit O&M Cost ($/1000 gal.)	Fixed O&M Costs	Variable O&M Costs	Total O&M Costs	Unit Cost ($/1000 gal.)	Total O&M Costs	Total Unit O&M Cost ($/1000 gal.)
2010	0.000										
2011	0.000										
2012	0.000										
2013	0.000										
2014	0.000										
2015	0.000										
2016	0.000										
2017	0.000										
2018	0.000										
2019	0.000										
2020	0.001	$19,780	$24	$19,804	$83.47	$49,050	$142	$49,192	$207.34	$68,996	$290.82
2021	0.001	$19,780	$26	$19,806	$77.52	$49,050	$153	$49,203	$192.58	$69,009	$270.09
2022	0.001	$19,780	$27	$19,807	$72.36	$49,050	$164	$49,214	$179.78	$69,022	$252.13
2023	0.001	$19,780	$29	$19,809	$67.84	$49,050	$175	$49,225	$168.58	$69,034	$236.42
2024	0.001	$19,780	$31	$19,811	$63.86	$49,050	$186	$49,236	$158.70	$69,047	$222.55
2025	0.001	$19,780	$33	$19,813	$60.31	$49,050	$197	$49,247	$149.92	$69,060	$210.23
2026	0.001	$19,780	$35	$19,815	$57.29	$49,050	$208	$49,258	$142.41	$69,072	$199.70
2027	0.001	$19,780	$36	$19,816	$54.55	$49,050	$218	$49,268	$135.63	$69,084	$190.18
2028	0.001	$19,780	$38	$19,818	$52.07	$49,050	$228	$49,278	$129.47	$69,096	$181.54
2029	0.001	$19,780	$40	$19,820	$49.80	$49,050	$239	$49,289	$123.84	$69,109	$173.64
2030	0.001	$19,780	$42	$19,822	$47.72	$49,050	$249	$49,299	$118.69	$69,121	$166.41
2031	0.001	$19,780	$43	$19,823	$45.81	$49,050	$260	$49,310	$113.95	$69,133	$159.75
2032	0.001	$19,780	$45	$19,825	$44.04	$49,050	$270	$49,320	$109.57	$69,145	$153.62
2033	0.001	$19,780	$47	$19,827	$42.41	$49,050	$280	$49,330	$105.52	$69,157	$147.93
2034	0.001	$19,780	$48	$19,828	$40.89	$49,050	$291	$49,341	$101.76	$69,169	$142.66

Notes:

1 Intermediate year flows are estimated to increase linearly between 2015 and 2020, between 2020 and 2025, etc.

2 Fixed collection system O&M costs assumed at 1.0% of asset value of collection system

3 Variable collection system O&M costs estimated at $ 0.10 per 1000 gallons (primarily electricity for pumping)

4 Fixed treatment plant O&M costs assumed at 3.0% of asset value of WWTP

5 Variable collection system O&M costs estimated at $ 0.60 per 1000 gallons

6 Unit cost is the sum of the O&M cost divided 365 days and then divided by the average daily flow for that year.

Table E-12
Present Worth Calculations
Modified Base Case / City of New Fairview Collection and Treatment System

	Capital Costs by Year				O&M Costs by Year				
Year	Collection System Capital Costs (million $)	Treatment Plant Capital Costs (million $)	Total Capital Costs (million $)	Present Worth (million $)	Collection System O&M Costs (million $)	Treatment Plant O&M Costs (million $)	Total O&M Costs (million $)	Present Worth (million $)	**Total Present Worth (million $)**
2009									
2010	$0.00	$0.11	$0.11	$0.10			$0.000	$0.00	$0.10
2011				$0.00			$0.000	$0.00	$0.00
2012				$0.00			$0.000	$0.00	$0.00
2013				$0.00			$0.000	$0.00	$0.00
2014				$0.00			$0.000	$0.00	$0.00
2015	$0.08	$0.09	$0.17	$0.13	$0.000	$0.000	$0.000	$0.00	$0.13
2016				$0.00	$0.000	$0.000	$0.000	$0.00	$0.00
2017				$0.00	$0.000	$0.000	$0.000	$0.00	$0.00
2018				$0.00	$0.000	$0.000	$0.000	$0.00	$0.00
2019				$0.00	$0.000	$0.000	$0.000	$0.00	$0.00
2020	$1.90	$1.55	$3.45	$2.01	$0.020	$0.049	$0.069	$0.04	$2.05
2021				$0.00	$0.020	$0.049	$0.069	$0.04	$0.04
2022				$0.00	$0.020	$0.049	$0.069	$0.04	$0.04
2023				$0.00	$0.020	$0.049	$0.069	$0.03	$0.03
2024				$0.00	$0.020	$0.049	$0.069	$0.03	$0.03
2025	$0.00	$0.00	$0.00	$0.00	$0.020	$0.049	$0.069	$0.03	$0.03
2026				$0.00	$0.020	$0.049	$0.069	$0.03	$0.03
2027				$0.00	$0.020	$0.049	$0.069	$0.03	$0.03
2028				$0.00	$0.020	$0.049	$0.069	$0.03	$0.03
2029				$0.00	$0.020	$0.049	$0.069	$0.03	$0.03
2030	$0.00	$0.00	$0.00	$0.00	$0.020	$0.049	$0.069	$0.02	$0.02
2031				$0.00	$0.020	$0.049	$0.069	$0.02	$0.02
2032				$0.00	$0.020	$0.049	$0.069	$0.02	$0.02
2033				$0.00	$0.020	$0.049	$0.069	$0.02	$0.02
2034				$0.00	$0.020	$0.049	$0.069	$0.02	$0.02
	Total Present Worth (Y2010 to 2034)			**$2.24**				**$0.44**	**$2.68**

Notes:
1 Interest rate is assumed to be = 5%

Table E-13
Debt Service Calculations
Modified Base Case / City of Rhome Collection and Treatment System

		Collection System (Including Lift Stations & Force Mains)							Treatment Plant (Including Closure of Abandoned Plants)							
Year	Estimated Avg Daily Flow (MGD)	Estimated Project Capital Costs (million $)	Y2015 Bond Sale (million $)	Y2020 Bond Sale (million $)	Y2025 Bond Sale (million $)	Y2030 Bond Sale (million $)	Total Asset Value at End of Period (million $)	Annual Collection System Debt Service ($)	Project Capital Costs (million $)	Y2015 Bond Sale (million $)	Y2020 Bond Sale (million $)	Y2025 Bond Sale (million $)	Y2030 Bond Sale (million $)	Total Asset Value at End of Period (million $)	Annual Treatment Plant Debt Service ($)	**Total Annual Debt Service ($)**
2010	0						$0.00							$0.00		$0
2011	0						$0.00							$0.00		$0
2012	0						$0.00							$0.00		$0
2013	0						$0.00							$0.00		$0
2014	0						$0.00							$0.00		$0
2015	0.148	$0.79	$0.79				$0.79	$51,391	$1.81	$1.81				$1.81	$117,743	$169,134
2016	0.153						$0.79	$51,391						$1.81	$117,743	$169,134
2017	0.157						$0.79	$51,391						$1.81	$117,743	$169,134
2018	0.162						$0.79	$51,391						$1.81	$117,743	$169,134
2019	0.166						$0.79	$51,391						$1.81	$117,743	$169,134
2020	0.171	$0.00		$0.00			$0.79	$51,391	$0.00		$0.00			$1.81	$117,743	$169,134
2021	0.176						$0.79	$51,391						$1.81	$117,743	$169,134
2022	0.182						$0.79	$51,391						$1.81	$117,743	$169,134
2023	0.187						$0.79	$51,391						$1.81	$117,743	$169,134
2024	0.193						$0.79	$51,391						$1.81	$117,743	$169,134
2025	0.198	$1.63			$1.63		$2.42	$157,424	$2.59			$2.59		$4.40	$286,031	$443,456
2026	0.204						$2.42	$157,424						$4.40	$286,031	$443,456
2027	0.211						$2.42	$157,424						$4.40	$286,031	$443,456
2028	0.217						$2.42	$157,424						$4.40	$286,031	$443,456
2029	0.224						$2.42	$157,424						$4.40	$286,031	$443,456
2030	0.230	$0.00				$0.00	$2.42	$157,424	$0.00				$0.00	$4.40	$286,031	$443,456
2031	0.236						$2.42	$157,424						$4.40	$286,031	$443,456
2032	0.243						$2.42	$157,424						$4.40	$286,031	$443,456
2033	0.249						$2.42	$157,424						$4.40	$286,031	$443,456
2034	0.256						$2.42	$157,424						$4.40	$286,031	$443,456

Notes:

1 All costs are in Y2009 dollars
2 Intermediate year flows are estimated to increase linearly between 2015 and 2020, between 2020 and 2025, etc.
3 Each bond sale covers anticipated project capital costs for a 5-year period.
4 Total debt service is the sum of the debt service for all bonds sold prior to that year.
5 Interest rate is assumed to be = 5%
6 Bond term is assumed to be = 30 years

Table E-14
O&M Cost Estimates
Modified Base Case / City of Rhome Collection and Treatment System

		Collection System (Including Lift Stations)				Treatment Plant				Collection + Treatment	
Year	Avg Daily Flow (MGD)	Fixed O&M Costs	Variable O&M Costs	Total O&M Costs	Unit O&M Cost ($/1000 gal.)	Fixed O&M Costs	Variable O&M Costs	Total O&M Costs	Unit Cost ($/1000 gal.)	Total O&M Costs	Total Unit O&M Cost ($/1000 gal.)
2010	0.000										
2011	0.000										
2012	0.000										
2013	0.000										
2014	0.000										
2015	0.148	$7,900	$5,402	$13,302	$0.25	$54,300	$32,412	$86,712	$1.61	$100,014	$1.85
2016	0.153	$7,900	$5,570	$13,470	$0.24	$54,300	$33,419	$87,719	$1.57	$101,189	$1.82
2017	0.157	$7,900	$5,738	$13,638	$0.24	$54,300	$34,427	$88,727	$1.55	$102,365	$1.78
2018	0.162	$7,900	$5,906	$13,806	$0.23	$54,300	$35,434	$89,734	$1.52	$103,540	$1.75
2019	0.166	$7,900	$6,074	$13,974	$0.23	$54,300	$36,442	$90,742	$1.49	$104,715	$1.72
2020	0.171	$7,900	$6,242	$14,142	$0.23	$54,300	$37,449	$91,749	$1.47	$105,891	$1.70
2021	0.176	$7,900	$6,439	$14,339	$0.22	$54,300	$38,632	$92,932	$1.44	$107,270	$1.67
2022	0.182	$7,900	$6,636	$14,536	$0.22	$54,300	$39,814	$94,114	$1.42	$108,650	$1.64
2023	0.187	$7,900	$6,833	$14,733	$0.22	$54,300	$40,997	$95,297	$1.39	$110,030	$1.61
2024	0.193	$7,900	$7,030	$14,930	$0.21	$54,300	$42,179	$96,479	$1.37	$111,409	$1.58
2025	0.198	$24,200	$7,227	$31,427	$0.43	$131,910	$43,362	$175,272	$2.43	$206,699	$2.86
2026	0.204	$24,200	$7,461	$31,661	$0.42	$131,910	$44,764	$176,674	$2.37	$208,334	$2.79
2027	0.211	$24,200	$7,694	$31,894	$0.41	$131,910	$46,165	$178,075	$2.31	$209,969	$2.73
2028	0.217	$24,200	$7,928	$32,128	$0.41	$131,910	$47,567	$179,477	$2.26	$211,605	$2.67
2029	0.224	$24,200	$8,161	$32,361	$0.40	$131,910	$48,968	$180,878	$2.22	$213,240	$2.61
2030	0.230	$24,200	$8,395	$32,595	$0.39	$131,910	$50,370	$182,280	$2.17	$214,875	$2.56
2031	0.236	$24,200	$8,629	$32,829	$0.38	$131,910	$51,772	$183,682	$2.13	$216,510	$2.51
2032	0.243	$24,200	$8,862	$33,062	$0.37	$131,910	$53,173	$185,083	$2.09	$218,145	$2.46
2033	0.249	$24,200	$9,096	$33,296	$0.37	$131,910	$54,575	$186,485	$2.05	$219,781	$2.42
2034	0.256	$24,200	$9,329	$33,529	$0.36	$131,910	$55,976	$187,886	$2.01	$221,416	$2.37

Notes:

1 Intermediate year flows are estimated to increase linearly between 2015 and 2020, between 2020 and 2025, etc.
2 Fixed collection system O&M costs assumed at 1.0% of asset value of collection system
3 Variable collection system O&M costs estimated at $ 0.10 per 1000 gallons (primarily electricity for pumping)
4 Fixed treatment plant O&M costs assumed at 3.0% of asset value of WWTP
5 Variable collection system O&M costs estimated at $ 0.60 per 1000 gallons
6 Unit cost is the sum of the O&M cost divided 365 days and then divided by the average daily flow for that year.

Table E-15
Present Worth Calculations
Modified Base Case / City of Rhome Collection and Treatment System

	Capital Costs by Year				O&M Costs by Year				
Year	Collection System Capital Costs (million $)	Treatment Plant Capital Costs (million $)	Total Capital Costs (million $)	Present Worth (million $)	Collection System O&M Costs (million $)	Treatment Plant O&M Costs (million $)	Total O&M Costs (million $)	Present Worth (million $)	**Total Present Worth (million $)**
2009									
2010	$0.00	$0.00	$0.00	$0.00			$0.000	$0.00	$0.00
2011				$0.00			$0.000	$0.00	$0.00
2012				$0.00			$0.000	$0.00	$0.00
2013				$0.00			$0.000	$0.00	$0.00
2014				$0.00			$0.000	$0.00	$0.00
2015	$0.79	$1.81	$2.60	$1.94	$0.013	$0.087	$0.100	$0.07	$2.01
2016				$0.00	$0.013	$0.088	$0.101	$0.07	$0.07
2017				$0.00	$0.014	$0.089	$0.102	$0.07	$0.07
2018				$0.00	$0.014	$0.090	$0.104	$0.07	$0.07
2019				$0.00	$0.014	$0.091	$0.105	$0.06	$0.06
2020	$0.00	$0.00	$0.00	$0.00	$0.014	$0.092	$0.106	$0.06	$0.06
2021				$0.00	$0.014	$0.093	$0.107	$0.06	$0.06
2022				$0.00	$0.015	$0.094	$0.109	$0.06	$0.06
2023				$0.00	$0.015	$0.095	$0.110	$0.06	$0.06
2024				$0.00	$0.015	$0.096	$0.111	$0.05	$0.05
2025	$1.63	$2.59	$4.22	$1.93	$0.031	$0.175	$0.207	$0.09	$2.03
2026				$0.00	$0.032	$0.177	$0.208	$0.09	$0.09
2027				$0.00	$0.032	$0.178	$0.210	$0.09	$0.09
2028				$0.00	$0.032	$0.179	$0.212	$0.08	$0.08
2029				$0.00	$0.032	$0.181	$0.213	$0.08	$0.08
2030	$0.00	$0.00	$0.00	$0.00	$0.033	$0.182	$0.215	$0.08	$0.08
2031				$0.00	$0.033	$0.184	$0.217	$0.07	$0.07
2032				$0.00	$0.033	$0.185	$0.218	$0.07	$0.07
2033				$0.00	$0.033	$0.186	$0.220	$0.07	$0.07
2034				$0.00	$0.034	$0.188	$0.221	$0.07	$0.07
	Total Present Worth (Y2010 to 2034)			**$3.87**				**$1.43**	**$5.30**

Notes:
1 Interest rate is assumed to be = 5%

Table E-16

Debt Service Calculations

Modified Base Case / Rolling V Ranch Collection and Treatment System

		Collection System (Including Lift Stations & Force Mains)							Treatment Plant (Including Closure of Abandoned Plants)							
Year	Estimated Avg Daily Flow (MGD)	Estimated Project Capital Costs (million $)	Y2015 Bond Sale (million $)	Y2020 Bond Sale (million $)	Y2025 Bond Sale (million $)	Y2030 Bond Sale (million $)	Total Asset Value at End of Period (million $)	Annual Collection System Debt Service ($)	Project Capital Costs (million $)	Y2015 Bond Sale (million $)	Y2020 Bond Sale (million $)	Y2025 Bond Sale (million $)	Y2030 Bond Sale (million $)	Total Asset Value at End of Period (million $)	Annual Treatment Plant Debt Service ($)	**Total Annual Debt Service ($)**
2010	0	$0.00					$0.00		$0.24					$0.00		$0
2011	0						$0.00							$0.00		$0
2012	0						$0.00							$0.00		$0
2013	0						$0.00							$0.00		$0
2014	0						$0.00							$0.00		$0
2015	0.024	$4.47	$4.47				$4.47	$291,040	$4.20	$4.20				$4.20	$273,216	$564,256
2016	0.052						$4.47	$291,040						$4.20	$273,216	$564,256
2017	0.080						$4.47	$291,040						$4.20	$273,216	$564,256
2018	0.108						$4.47	$291,040						$4.20	$273,216	$564,256
2019	0.136						$4.47	$291,040						$4.20	$273,216	$564,256
2020	0.164	$0.71		$0.71			$5.18	$336,901	$0.00		$0.00			$4.20	$273,216	$610,117
2021	0.213						$5.18	$336,901						$4.20	$273,216	$610,117
2022	0.262						$5.18	$336,901						$4.20	$273,216	$610,117
2023	0.312						$5.18	$336,901						$4.20	$273,216	$610,117
2024	0.361						$5.18	$336,901						$4.20	$273,216	$610,117
2025	0.410	$0.00			$0.00		$5.18	$336,901	$4.20			$4.20		$8.40	$546,432	$883,333
2026	0.470						$5.18	$336,901						$8.40	$546,432	$883,333
2027	0.531						$5.18	$336,901						$8.40	$546,432	$883,333
2028	0.591						$5.18	$336,901						$8.40	$546,432	$883,333
2029	0.652						$5.18	$336,901						$8.40	$546,432	$883,333
2030	0.712	$0.00				$0.00	$5.18	$336,901	$0.00				$0.00	$8.40	$546,432	$883,333
2031	0.772						$5.18	$336,901						$8.40	$546,432	$883,333
2032	0.833						$5.18	$336,901						$8.40	$546,432	$883,333
2033	0.893						$5.18	$336,901						$8.40	$546,432	$883,333
2034	0.954						$5.18	$336,901						$8.40	$546,432	$883,333

Notes:

1 All costs are in Y2009 dollars
2 Intermediate year flows are estimated to increase linearly between 2015 and 2020, between 2020 and 2025, etc.
3 Each bond sale covers anticipated project capital costs for a 5-year period.
4 Total debt service is the sum of the debt service for all bonds sold prior to that year.
5 Interest rate is assumed to be = 5%
6 Bond term is assumed to be = 30 years

Table E-17

O&M Cost Estimates

Modified Base Case / Rolling V Ranch Collection and Treatment System

		Collection System (Including Lift Stations)				Treatment Plant				Collection + Treatment	
Year	Avg Daily Flow (MGD)	Fixed O&M Costs	Variable O&M Costs	Total O&M Costs	Unit O&M Cost ($/1000 gal.)	Fixed O&M Costs	Variable O&M Costs	Total O&M Costs	Unit Cost ($/1000 gal.)	Total O&M Costs	Total Unit O&M Cost ($/1000 gal.)
2010	0.000										
2011	0.000										
2012	0.000										
2013	0.000										
2014	0.000										
2015	0.024	$44,740	$876	$45,616	$5.21	$126,000	$5,431	$131,431	$15.00	$177,047	$20.21
2016	0.052	$44,740	$1,898	$46,638	$2.46	$126,000	$11,768	$137,768	$7.26	$184,406	$9.72
2017	0.080	$44,740	$2,920	$47,660	$1.63	$126,000	$18,104	$144,104	$4.94	$191,764	$6.57
2018	0.108	$44,740	$3,942	$48,682	$1.23	$126,000	$24,440	$150,440	$3.82	$199,122	$5.05
2019	0.136	$44,740	$4,964	$49,704	$1.00	$126,000	$30,777	$156,777	$3.16	$206,481	$4.16
2020	0.164	$51,790	$5,986	$57,776	$0.97	$126,000	$37,113	$163,113	$2.72	$220,889	$3.69
2021	0.213	$51,790	$7,782	$59,572	$0.77	$126,000	$48,247	$174,247	$2.24	$233,819	$3.00
2022	0.262	$51,790	$9,578	$61,368	$0.64	$126,000	$59,381	$185,381	$1.94	$246,749	$2.58
2023	0.312	$51,790	$11,373	$63,163	$0.56	$126,000	$70,515	$196,515	$1.73	$259,678	$2.28
2024	0.361	$51,790	$13,169	$64,959	$0.49	$126,000	$81,649	$207,649	$1.58	$272,608	$2.07
2025	0.410	$51,790	$14,965	$66,755	$0.45	$252,000	$92,783	$344,783	$2.30	$411,538	$2.75
2026	0.470	$51,790	$17,170	$68,960	$0.40	$252,000	$106,452	$358,452	$2.09	$427,411	$2.49
2027	0.531	$51,790	$19,374	$71,164	$0.37	$252,000	$120,120	$372,120	$1.92	$443,284	$2.29
2028	0.591	$51,790	$21,579	$73,369	$0.34	$252,000	$133,789	$385,789	$1.79	$459,157	$2.13
2029	0.652	$51,790	$23,783	$75,573	$0.32	$252,000	$147,457	$399,457	$1.68	$475,030	$2.00
2030	0.712	$51,790	$25,988	$77,778	$0.30	$252,000	$161,126	$413,126	$1.59	$490,904	$1.89
2031	0.772	$51,790	$28,193	$79,983	$0.28	$252,000	$174,794	$426,794	$1.51	$506,777	$1.80
2032	0.833	$51,790	$30,397	$82,187	$0.27	$252,000	$188,463	$440,463	$1.45	$522,650	$1.72
2033	0.893	$51,790	$32,602	$84,392	$0.26	$252,000	$202,131	$454,131	$1.39	$538,523	$1.65
2034	0.954	$51,790	$34,806	$86,596	$0.25	$252,000	$215,800	$467,800	$1.34	$554,396	$1.59

Notes:

1 Intermediate year flows are estimated to increase linearly between 2015 and 2020, between 2020 and 2025, etc.
2 Fixed collection system O&M costs assumed at 1.0% of asset value of collection system
3 Variable collection system O&M costs estimated at $ 0.10 per 1000 gallons (primarily electricity for pumping)
4 Fixed treatment plant O&M costs assumed at 3.0% of asset value of WWTP
5 Variable collection system O&M costs estimated at $ 0.62 per 1000 gallons
6 Unit cost is the sum of the O&M cost divided 365 days and then divided by the average daily flow for that year.

Table E-18
Present Worth Calculations
Modified Base Case / Rolling V Ranch Collection and Treatment System

	Capital Costs by Year				O&M Costs by Year				
Year	Collection System Capital Costs (million $)	Treatment Plant Capital Costs (million $)	Total Capital Costs (million $)	Present Worth (million $)	Collection System O&M Costs (million $)	Treatment Plant O&M Costs (million $)	Total O&M Costs (million $)	Present Worth (million $)	**Total Present Worth (million $)**
2009									
2010	$0.00	$0.24	$0.24	$0.23			$0.000	$0.00	$0.23
2011				$0.00			$0.000	$0.00	$0.00
2012				$0.00			$0.000	$0.00	$0.00
2013				$0.00			$0.000	$0.00	$0.00
2014				$0.00			$0.000	$0.00	$0.00
2015	$4.47	$4.20	$8.67	$6.47	$0.046	$0.131	$0.177	$0.13	$6.60
2016				$0.00	$0.047	$0.138	$0.184	$0.13	$0.13
2017				$0.00	$0.048	$0.144	$0.192	$0.13	$0.13
2018				$0.00	$0.049	$0.150	$0.199	$0.13	$0.13
2019				$0.00	$0.050	$0.157	$0.206	$0.13	$0.13
2020	$0.71	$0.00	$0.71	$0.41	$0.058	$0.163	$0.221	$0.13	$0.54
2021				$0.00	$0.060	$0.174	$0.234	$0.13	$0.13
2022				$0.00	$0.061	$0.185	$0.247	$0.13	$0.13
2023				$0.00	$0.063	$0.197	$0.260	$0.13	$0.13
2024				$0.00	$0.065	$0.208	$0.273	$0.13	$0.13
2025	$0.00	$4.20	$4.20	$1.92	$0.067	$0.345	$0.412	$0.19	$2.11
2026				$0.00	$0.069	$0.358	$0.427	$0.19	$0.19
2027				$0.00	$0.071	$0.372	$0.443	$0.18	$0.18
2028				$0.00	$0.073	$0.386	$0.459	$0.18	$0.18
2029				$0.00	$0.076	$0.399	$0.475	$0.18	$0.18
2030	$0.00	$0.00	$0.00	$0.00	$0.078	$0.413	$0.491	$0.18	$0.18
2031				$0.00	$0.080	$0.427	$0.507	$0.17	$0.17
2032				$0.00	$0.082	$0.440	$0.523	$0.17	$0.17
2033				$0.00	$0.084	$0.454	$0.539	$0.17	$0.17
2034				$0.00	$0.087	$0.468	$0.554	$0.16	$0.16
	Total Present Worth (Y2010 to 2034)			**$9.04**				**$3.07**	**$12.11**

Notes:
1 Interest rate is assumed to be = 5%

Table E-19
Debt Service Calculations
Modified Base Case / City of Newark Collection and Treatment System

		Collection System (Including Lift Stations & Force Mains)							Treatment Plant (Including Closure of Abandoned Plants)							
Year	Estimated Avg Daily Flow (MGD)	Estimated Project Capital Costs (million $)	Y2015 Bond Sale (million $)	Y2020 Bond Sale (million $)	Y2025 Bond Sale (million $)	Y2030 Bond Sale (million $)	Total Asset Value at End of Period (million $)	Annual Collection System Debt Service ($)	Project Capital Costs (million $)	Y2015 Bond Sale (million $)	Y2020 Bond Sale (million $)	Y2025 Bond Sale (million $)	Y2030 Bond Sale (million $)	Total Asset Value at End of Period (million $)	Annual Treatment Plant Debt Service ($)	**Total Annual Debt Service ($)**
2010	0	$0.00					$0.00		$0.00					$0.00		$0
2011	0						$0.00							$0.00		$0
2012	0						$0.00							$0.00		$0
2013	0						$0.00							$0.00		$0
2014	0						$0.00							$0.00		$0
2015	0.101	$0.00	$0.00				$0.00	$0	$1.99	$1.99				$1.99	$129,452	$129,452
2016	0.103						$0.00	$0						$1.99	$129,452	$129,452
2017	0.105						$0.00	$0						$1.99	$129,452	$129,452
2018	0.108						$0.00	$0						$1.99	$129,452	$129,452
2019	0.110						$0.00	$0						$1.99	$129,452	$129,452
2020	0.112	$0.00		$0.00			$0.00	$0	$0.00		$0.00			$1.99	$129,452	$129,452
2021	0.114						$0.00	$0						$1.99	$129,452	$129,452
2022	0.116						$0.00	$0						$1.99	$129,452	$129,452
2023	0.119						$0.00	$0						$1.99	$129,452	$129,452
2024	0.121						$0.00	$0						$1.99	$129,452	$129,452
2025	0.123	$0.00			$0.00		$0.00	$0	$0.00			$0.00		$1.99	$129,452	$129,452
2026	0.126						$0.00	$0						$1.99	$129,452	$129,452
2027	0.128						$0.00	$0						$1.99	$129,452	$129,452
2028	0.131						$0.00	$0						$1.99	$129,452	$129,452
2029	0.133						$0.00	$0						$1.99	$129,452	$129,452
2030	0.136	$0.00				$0.00	$0.00	$0	$0.00				$0.00	$1.99	$129,452	$129,452
2031	0.139						$0.00	$0						$1.99	$129,452	$129,452
2032	0.141						$0.00	$0						$1.99	$129,452	$129,452
2033	0.144						$0.00	$0						$1.99	$129,452	$129,452
2034	0.146						$0.00	$0						$1.99	$129,452	$129,452

Notes:

1 All costs are in Y2009 dollars
2 Intermediate year flows are estimated to increase linearly between 2015 and 2020, between 2020 and 2025, etc.
3 Each bond sale covers anticipated project capital costs for a 5-year period.
4 Total debt service is the sum of the debt service for all bonds sold prior to that year.
5 Interest rate is assumed to be = 5%
6 Bond term is assumed to be = 30 years

Table E-20

O&M Cost Estimates

Modified Base Case / City of Newark Collection and Treatment System

		Collection System (Including Lift Stations)				Treatment Plant				Collection + Treatment	
Year	Avg Daily Flow (MGD)	Fixed O&M Costs	Variable O&M Costs	Total O&M Costs	Unit O&M Cost ($/1000 gal.)	Fixed O&M Costs	Variable O&M Costs	Total O&M Costs	Unit Cost ($/1000 gal.)	Total O&M Costs	Total Unit O&M Cost ($/1000 gal.)
2010	0.000										
2011	0.000										
2012	0.000										
2013	0.000										
2014	0.000										
2015	0.101	$0	$3,687	$3,687	$0.10	$59,700	$23,962	$83,662	$2.27	$87,349	$2.37
2016	0.103	$0	$3,767	$3,767	$0.10	$59,700	$24,484	$84,184	$2.23	$87,951	$2.33
2017	0.105	$0	$3,847	$3,847	$0.10	$59,700	$25,006	$84,706	$2.20	$88,553	$2.30
2018	0.108	$0	$3,927	$3,927	$0.10	$59,700	$25,528	$85,228	$2.17	$89,156	$2.27
2019	0.110	$0	$4,008	$4,008	$0.10	$59,700	$26,050	$85,750	$2.14	$89,758	$2.24
2020	0.112	$0	$4,088	$4,088	$0.10	$59,700	$26,572	$86,272	$2.11	$90,360	$2.21
2021	0.114	$0	$4,168	$4,168	$0.10	$59,700	$27,094	$86,794	$2.08	$90,962	$2.18
2022	0.116	$0	$4,249	$4,249	$0.10	$59,700	$27,616	$87,316	$2.06	$91,565	$2.16
2023	0.119	$0	$4,329	$4,329	$0.10	$59,700	$28,138	$87,838	$2.03	$92,167	$2.13
2024	0.121	$0	$4,409	$4,409	$0.10	$59,700	$28,660	$88,360	$2.00	$92,769	$2.10
2025	0.123	$0	$4,490	$4,490	$0.10	$59,700	$29,182	$88,882	$1.98	$93,371	$2.08
2026	0.126	$0	$4,584	$4,584	$0.10	$59,700	$29,799	$89,499	$1.95	$94,083	$2.05
2027	0.128	$0	$4,679	$4,679	$0.10	$59,700	$30,415	$90,115	$1.93	$94,795	$2.03
2028	0.131	$0	$4,774	$4,774	$0.10	$59,700	$31,032	$90,732	$1.90	$95,507	$2.00
2029	0.133	$0	$4,869	$4,869	$0.10	$59,700	$31,649	$91,349	$1.88	$96,218	$1.98
2030	0.136	$0	$4,964	$4,964	$0.10	$59,700	$32,266	$91,966	$1.85	$96,930	$1.95
2031	0.139	$0	$5,059	$5,059	$0.10	$59,700	$32,883	$92,583	$1.83	$97,642	$1.93
2032	0.141	$0	$5,154	$5,154	$0.10	$59,700	$33,500	$93,200	$1.81	$98,354	$1.91
2033	0.144	$0	$5,249	$5,249	$0.10	$59,700	$34,117	$93,817	$1.79	$99,065	$1.89
2034	0.146	$0	$5,344	$5,344	$0.10	$59,700	$34,733	$94,433	$1.77	$99,777	$1.87

Notes:

1. Intermediate year flows are estimated to increase linearly between 2015 and 2020, between 2020 and 2025, etc.
2. Fixed collection system O&M costs assumed at 1.0% of asset value of collection system
3. Variable collection system O&M costs estimated at $ 0.10 per 1000 gallons (primarily electricity for pumping)
4. Fixed treatment plant O&M costs assumed at 3.0% of asset value of WWTP
5. Variable collection system O&M costs estimated at $ 0.65 per 1000 gallons
6. Unit cost is the sum of the O&M cost divided 365 days and then divided by the average daily flow for that year.

Table E-21
Present Worth Calculations
Modified Base Case / City of Newark Collection and Treatment System

	Capital Costs by Year				O&M Costs by Year				
Year	Collection System Capital Costs (million $)	Treatment Plant Capital Costs (million $)	Total Capital Costs (million $)	Present Worth (million $)	Collection System O&M Costs (million $)	Treatment Plant O&M Costs (million $)	Total O&M Costs (million $)	Present Worth (million $)	**Total Present Worth (million $)**
2009									
2010	$0.00	$0.00	$0.00	$0.00			$0.000	$0.00	$0.00
2011				$0.00			$0.000	$0.00	$0.00
2012				$0.00			$0.000	$0.00	$0.00
2013				$0.00			$0.000	$0.00	$0.00
2014				$0.00			$0.000	$0.00	$0.00
2015	$0.00	$1.99	$1.99	$1.48	$0.004	$0.084	$0.087	$0.07	$1.55
2016				$0.00	$0.004	$0.084	$0.088	$0.06	$0.06
2017				$0.00	$0.004	$0.085	$0.089	$0.06	$0.06
2018				$0.00	$0.004	$0.085	$0.089	$0.06	$0.06
2019				$0.00	$0.004	$0.086	$0.090	$0.06	$0.06
2020	$0.00	$0.00	$0.00	$0.00	$0.004	$0.086	$0.090	$0.05	$0.05
2021				$0.00	$0.004	$0.087	$0.091	$0.05	$0.05
2022				$0.00	$0.004	$0.087	$0.092	$0.05	$0.05
2023				$0.00	$0.004	$0.088	$0.092	$0.05	$0.05
2024				$0.00	$0.004	$0.088	$0.093	$0.04	$0.04
2025	$0.00	$0.00	$0.00	$0.00	$0.004	$0.089	$0.093	$0.04	$0.04
2026				$0.00	$0.005	$0.089	$0.094	$0.04	$0.04
2027				$0.00	$0.005	$0.090	$0.095	$0.04	$0.04
2028				$0.00	$0.005	$0.091	$0.096	$0.04	$0.04
2029				$0.00	$0.005	$0.091	$0.096	$0.04	$0.04
2030	$0.00	$0.00	$0.00	$0.00	$0.005	$0.092	$0.097	$0.03	$0.03
2031				$0.00	$0.005	$0.093	$0.098	$0.03	$0.03
2032				$0.00	$0.005	$0.093	$0.098	$0.03	$0.03
2033				$0.00	$0.005	$0.094	$0.099	$0.03	$0.03
2034				$0.00	$0.005	$0.094	$0.100	$0.03	$0.03
	Total Present Worth (Y2010 to 2034)			**$1.48**				**$0.90**	**$2.39**

Notes:
1 Interest rate is assumed to be = 5%

Table E-22

Debt Service Calculations

Option B / City of Boyd Collection and Treatment System w/ Service to Ivy Hills & Boyette

		Collection System (Including Lift Stations & Force Mains)							Treatment Plant (Including Closure of Abandoned Plants)							
Year	Estimated Avg Daily Flow (MGD)	Estimated Project Capital Costs (million $)	Y2015 Bond Sale (million $)	Y2020 Bond Sale (million $)	Y2025 Bond Sale (million $)	Y2030 Bond Sale (million $)	Total Asset Value at End of Period (million $)	Annual Collection System Debt Service ($)	Project Capital Costs (million $)	Y2015 Bond Sale (million $)	Y2020 Bond Sale (million $)	Y2025 Bond Sale (million $)	Y2030 Bond Sale (million $)	Total Asset Value at End of Period (million $)	Annual Treatment Plant Debt Service ($)	**Total Annual Debt Service ($)**
2010	0	$0.04					$0.00		$0.00					$0.00		$0
2011	0						$0.00							$0.00		$0
2012	0						$0.00							$0.00		$0
2013	0						$0.00							$0.00		$0
2014	0						$0.00							$0.00		$0
2015	0.117	$2.43	$2.43				$2.43	$158,075	$0.00	$0.00				$0.00	$0	$158,075
2016	0.123						$2.43	$158,075						$0.00	$0	$158,075
2017	0.130						$2.43	$158,075						$0.00	$0	$158,075
2018	0.136						$2.43	$158,075						$0.00	$0	$158,075
2019	0.143						$2.43	$158,075						$0.00	$0	$158,075
2020	0.149	$0.95		$0.95			$3.38	$219,874	$3.78		$3.78			$3.78	$245,894	$465,768
2021	0.160						$3.38	$219,874						$3.78	$245,894	$465,768
2022	0.171						$3.38	$219,874						$3.78	$245,894	$465,768
2023	0.182						$3.38	$219,874						$3.78	$245,894	$465,768
2024	0.193						$3.38	$219,874						$3.78	$245,894	$465,768
2025	0.204	$0.00			$0.00		$3.38	$219,874	$0.00			$0.00		$3.78	$245,894	$465,768
2026	0.215						$3.38	$219,874						$3.78	$245,894	$465,768
2027	0.226						$3.38	$219,874						$3.78	$245,894	$465,768
2028	0.236						$3.38	$219,874						$3.78	$245,894	$465,768
2029	0.247						$3.38	$219,874						$3.78	$245,894	$465,768
2030	0.258	$0.00				$0.00	$3.38	$219,874	$0.00				$0.00	$3.78	$245,894	$465,768
2031	0.269						$3.38	$219,874						$3.78	$245,894	$465,768
2032	0.280						$3.38	$219,874						$3.78	$245,894	$465,768
2033	0.290						$3.38	$219,874						$3.78	$245,894	$465,768
2034	0.301						$3.38	$219,874						$3.78	$245,894	$465,768

Notes:

1. All costs are in Y2009 dollars
2. Intermediate year flows are estimated to increase linearly between 2015 and 2020, between 2020 and 2025, etc.
3. Each bond sale covers anticipated project capital costs for a 5-year period.
4. Total debt service is the sum of the debt service for all bonds sold prior to that year.
5. Interest rate is assumed to be = 5%
6. Bond term is assumed to be = 30 years

Table E-23

O&M Cost Estimates

Option B / City of Boyd Collection and Treatment System w/ Service to Ivy Hills & Boyette

		Collection System (Including Lift Stations)				Treatment Plant				Collection + Treatment	
Year	Avg Daily Flow (MGD)	Fixed O&M Costs	Variable O&M Costs	Total O&M Costs	Unit O&M Cost ($/1000 gal.)	Fixed O&M Costs	Variable O&M Costs	Total O&M Costs	Unit Cost ($/1000 gal.)	Total O&M Costs	Total Unit O&M Cost ($/1000 gal.)
2010	0.000										
2011	0.000										
2012	0.000										
2013	0.000										
2014	0.000										
2015	0.117	$24,300	$4,271	$28,571	$0.67	$0	$25,623	$25,623	$0.60	$54,194	$1.27
2016	0.123	$24,300	$4,504	$28,804	$0.64	$0	$27,025	$27,025	$0.60	$55,829	$1.24
2017	0.130	$24,300	$4,738	$29,038	$0.61	$0	$28,426	$28,426	$0.60	$57,464	$1.21
2018	0.136	$24,300	$4,971	$29,271	$0.59	$0	$29,828	$29,828	$0.60	$59,099	$1.19
2019	0.143	$24,300	$5,205	$29,505	$0.57	$0	$31,229	$31,229	$0.60	$60,734	$1.17
2020	0.149	$33,800	$5,439	$39,239	$0.72	$113,400	$32,631	$146,031	$2.69	$185,270	$3.41
2021	0.160	$33,800	$5,840	$39,640	$0.68	$113,400	$35,040	$148,440	$2.54	$188,080	$3.22
2022	0.171	$33,800	$6,242	$40,042	$0.64	$113,400	$37,449	$150,849	$2.42	$190,891	$3.06
2023	0.182	$33,800	$6,643	$40,443	$0.61	$113,400	$39,858	$153,258	$2.31	$193,701	$2.92
2024	0.193	$33,800	$7,045	$40,845	$0.58	$113,400	$42,267	$155,667	$2.21	$196,512	$2.79
2025	0.204	$33,800	$7,446	$41,246	$0.55	$113,400	$44,676	$158,076	$2.12	$199,322	$2.68
2026	0.215	$33,800	$7,840	$41,640	$0.53	$113,400	$47,041	$160,441	$2.05	$202,081	$2.58
2027	0.226	$33,800	$8,234	$42,034	$0.51	$113,400	$49,406	$162,806	$1.98	$204,841	$2.49
2028	0.236	$33,800	$8,629	$42,429	$0.49	$113,400	$51,772	$165,172	$1.91	$207,600	$2.41
2029	0.247	$33,800	$9,023	$42,823	$0.47	$113,400	$54,137	$167,537	$1.86	$210,360	$2.33
2030	0.258	$33,800	$9,417	$43,217	$0.46	$113,400	$56,502	$169,902	$1.80	$213,119	$2.26
2031	0.269	$33,800	$9,811	$43,611	$0.44	$113,400	$58,867	$172,267	$1.76	$215,878	$2.20
2032	0.280	$33,800	$10,205	$44,005	$0.43	$113,400	$61,232	$174,632	$1.71	$218,638	$2.14
2033	0.290	$33,800	$10,600	$44,400	$0.42	$113,400	$63,598	$176,998	$1.67	$221,397	$2.09
2034	0.301	$33,800	$10,994	$44,794	$0.41	$113,400	$65,963	$179,363	$1.63	$224,157	$2.04

Notes:

1 Intermediate year flows are estimated to increase linearly between 2015 and 2020, between 2020 and 2025, etc.
2 Fixed collection system O&M costs assumed at 1.0% of asset value of collection system
3 Variable collection system O&M costs estimated at $ 0.10 per 1000 gallons (primarily electricity for pumping)
4 Fixed treatment plant O&M costs assumed at 3.0% of asset value of WWTP
5 Variable collection system O&M costs estimated at $ 0.60 per 1000 gallons
6 Unit cost is the sum of the O&M cost divided 365 days and then divided by the average daily flow for that year.

Table E-24

Present Worth Calculations

Option B / City of Boyd Collection and Treatment System w/ Service to Ivy Hills & Boyette

	Capital Costs by Year				O&M Costs by Year				
Year	Collection System Capital Costs (million $)	Treatment Plant Capital Costs (million $)	Total Capital Costs (million $)	Present Worth (million $)	Collection System O&M Costs (million $)	Treatment Plant O&M Costs (million $)	Total O&M Costs (million $)	Present Worth (million $)	**Total Present Worth (million $)**
2009									
2010	$0.04	$0.00	$0.04	$0.04			$0.000	$0.00	$0.04
2011				$0.00			$0.000	$0.00	$0.00
2012				$0.00			$0.000	$0.00	$0.00
2013				$0.00			$0.000	$0.00	$0.00
2014				$0.00			$0.000	$0.00	$0.00
2015	$2.43	$0.00	$2.43	$1.81	$0.029	$0.026	$0.054	$0.04	$1.85
2016				$0.00	$0.029	$0.027	$0.056	$0.04	$0.04
2017				$0.00	$0.029	$0.028	$0.057	$0.04	$0.04
2018				$0.00	$0.029	$0.030	$0.059	$0.04	$0.04
2019				$0.00	$0.030	$0.031	$0.061	$0.04	$0.04
2020	$0.95	$3.78	$4.73	$2.77	$0.039	$0.146	$0.185	$0.11	$2.87
2021				$0.00	$0.040	$0.148	$0.188	$0.10	$0.10
2022				$0.00	$0.040	$0.151	$0.191	$0.10	$0.10
2023				$0.00	$0.040	$0.153	$0.194	$0.10	$0.10
2024				$0.00	$0.041	$0.156	$0.197	$0.09	$0.09
2025	$0.00	$0.00	$0.00	$0.00	$0.041	$0.158	$0.199	$0.09	$0.09
2026				$0.00	$0.042	$0.160	$0.202	$0.09	$0.09
2027				$0.00	$0.042	$0.163	$0.205	$0.09	$0.09
2028				$0.00	$0.042	$0.165	$0.208	$0.08	$0.08
2029				$0.00	$0.043	$0.168	$0.210	$0.08	$0.08
2030	$0.00	$0.00	$0.00	$0.00	$0.043	$0.170	$0.213	$0.08	$0.08
2031				$0.00	$0.044	$0.172	$0.216	$0.07	$0.07
2032				$0.00	$0.044	$0.175	$0.219	$0.07	$0.07
2033				$0.00	$0.044	$0.177	$0.221	$0.07	$0.07
2034				$0.00	$0.045	$0.179	$0.224	$0.07	$0.07
	Total Present Worth (Y2010 to 2034)			**$4.62**				**$1.48**	**$6.10**

Notes:

1 Interest rate is assumed to be = 5%

Table E-25

Debt Service Calculations

Option B / West WWTP Site / Discharge to Unnamed Tributary - Rhome/Newark/Rolling V Ranch Regional Collection and Treatment System

		Collection System (Including Lift Stations & Force Mains)							Treatment Plant (Including Closure of Abandoned Plants)							
Year	Estimated Avg Daily Flow (MGD)	Estimated Project Capital Costs (million $)	Y2015 Bond Sale (million $)	Y2020 Bond Sale (million $)	Y2025 Bond Sale (million $)	Y2030 Bond Sale (million $)	Total Asset Value at End of Period (million $)	Annual Collection System Debt Service ($)	Project Capital Costs (million $)	Y2015 Bond Sale (million $)	Y2020 Bond Sale (million $)	Y2025 Bond Sale (million $)	Y2030 Bond Sale (million $)	Total Asset Value at End of Period (million $)	Annual Treatment Plant Debt Service ($)	**Total Annual Debt Service ($)**
2010	0	$0.00					$0.00		$0.00					$0.00		$0
2011	0						$0.00							$0.00		$0
2012	0						$0.00							$0.00		$0
2013	0						$0.00							$0.00		$0
2014	0						$0.00							$0.00		$0
2015	0.273	$6.28	$6.28				$6.28	$408,523	$5.85	$5.85				$5.85	$380,746	$789,269
2016	0.308						$6.28	$408,523						$5.85	$380,746	$789,269
2017	0.343						$6.28	$408,523						$5.85	$380,746	$789,269
2018	0.377						$6.28	$408,523						$5.85	$380,746	$789,269
2019	0.412						$6.28	$408,523						$5.85	$380,746	$789,269
2020	0.447	$1.20		$1.20			$7.48	$486,585	$5.83		$5.83			$11.68	$759,801	$1,246,385
2021	0.504						$7.48	$486,585						$11.68	$759,801	$1,246,385
2022	0.562						$7.48	$486,585						$11.68	$759,801	$1,246,385
2023	0.619						$7.48	$486,585						$11.68	$759,801	$1,246,385
2024	0.677						$7.48	$486,585						$11.68	$759,801	$1,246,385
2025	0.734	$1.63			$1.63		$9.11	$592,619	$5.78			$5.78		$17.46	$1,135,473	$1,728,091
2026	0.803						$9.11	$592,619						$17.46	$1,135,473	$1,728,091
2027	0.872						$9.11	$592,619						$17.46	$1,135,473	$1,728,091
2028	0.940						$9.11	$592,619						$17.46	$1,135,473	$1,728,091
2029	1.009						$9.11	$592,619						$17.46	$1,135,473	$1,728,091
2030	1.078	$1.35				$1.35	$10.46	$680,438	$0.00				$0.00	$17.46	$1,135,473	$1,815,911
2031	1.147						$10.46	$680,438						$17.46	$1,135,473	$1,815,911
2032	1.216						$10.46	$680,438						$17.46	$1,135,473	$1,815,911
2033	1.284						$10.46	$680,438						$17.46	$1,135,473	$1,815,911
2034	1.353						$10.46	$680,438						$17.46	$1,135,473	$1,815,911

Notes:

1. All costs are in Y2009 dollars
2. Intermediate year flows are estimated to increase linearly between 2015 and 2020, between 2020 and 2025, etc.
3. Each bond sale covers anticipated project capital costs for a 5-year period.
4. Total debt service is the sum of the debt service for all bonds sold prior to that year.
5. Interest rate is assumed to be = 5%
6. Bond term is assumed to be = 30 years

Table E-26

O&M Cost Estimates

Option B / West WWTP Site / Discharge to Unnamed Tributary - Rhome/Newark/Rolling V Ranch Regional Collection and Treatment System

		Collection System (Including Lift Stations)				Treatment Plant				Collection + Treatment	
Year	Avg Daily Flow (MGD)	Fixed O&M Costs	Variable O&M Costs	Total O&M Costs	Unit O&M Cost ($/1000 gal.)	Fixed O&M Costs	Variable O&M Costs	Total O&M Costs	Unit Cost ($/1000 gal.)	Total O&M Costs	Total Unit O&M Cost ($/1000 gal.)
2010	0.000										
2011	0.000										
2012	0.000										
2013	0.000										
2014	0.000										
2015	0.273	$31,400	$9,965	$41,365	$0.42	$117,060	$61,780	$178,840	$1.79	$220,204	$2.21
2016	0.308	$31,400	$11,235	$42,635	$0.38	$117,060	$69,655	$186,715	$1.66	$229,350	$2.04
2017	0.343	$31,400	$12,505	$43,905	$0.35	$117,060	$77,530	$194,590	$1.56	$238,495	$1.91
2018	0.377	$31,400	$13,775	$45,175	$0.33	$117,060	$85,406	$202,466	$1.47	$247,641	$1.80
2019	0.412	$31,400	$15,045	$46,445	$0.31	$117,060	$93,281	$210,341	$1.40	$256,786	$1.71
2020	0.447	$37,400	$16,316	$53,716	$0.33	$233,600	$101,156	$334,756	$2.05	$388,472	$2.38
2021	0.504	$37,400	$18,411	$55,811	$0.30	$233,600	$114,146	$347,746	$1.89	$403,556	$2.19
2022	0.562	$37,400	$20,506	$57,906	$0.28	$233,600	$127,135	$360,735	$1.76	$418,641	$2.04
2023	0.619	$37,400	$22,601	$60,001	$0.27	$233,600	$140,125	$373,725	$1.65	$433,726	$1.92
2024	0.677	$37,400	$24,696	$62,096	$0.25	$233,600	$153,115	$386,715	$1.57	$448,810	$1.82
2025	0.734	$45,550	$26,791	$72,341	$0.27	$349,100	$166,104	$515,204	$1.92	$587,545	$2.19
2026	0.803	$45,550	$29,302	$74,852	$0.26	$349,100	$181,674	$530,774	$1.81	$605,626	$2.07
2027	0.872	$45,550	$31,813	$77,363	$0.24	$349,100	$197,243	$546,343	$1.72	$623,706	$1.96
2028	0.940	$45,550	$34,325	$79,875	$0.23	$349,100	$212,813	$561,913	$1.64	$641,787	$1.87
2029	1.009	$45,550	$36,836	$82,386	$0.22	$349,100	$228,382	$577,482	$1.57	$659,868	$1.79
2030	1.078	$52,300	$39,347	$91,647	$0.23	$349,100	$243,951	$593,051	$1.51	$684,698	$1.74
2031	1.147	$52,300	$41,858	$94,158	$0.22	$349,100	$259,521	$608,621	$1.45	$702,779	$1.68
2032	1.216	$52,300	$44,369	$96,669	$0.22	$349,100	$275,090	$624,190	$1.41	$720,860	$1.62
2033	1.284	$52,300	$46,881	$99,181	$0.21	$349,100	$290,660	$639,760	$1.36	$738,940	$1.58
2034	1.353	$52,300	$49,392	$101,692	$0.21	$349,100	$306,229	$655,329	$1.33	$757,021	$1.53

Notes:

1 Intermediate year flows are estimated to increase linearly between 2015 and 2020, between 2020 and 2025, etc.

2 Fixed collection system O&M costs assumed at 0.5% of asset value of collection system

3 Variable collection system O&M costs estimated at $ 0.10 per 1000 gallons (primarily electricity for pumping)

4 Fixed treatment plant O&M costs assumed at 2.0% of asset value of WWTP

5 Variable collection system O&M costs estimated at $ 0.62 per 1000 gallons

6 Unit cost is the sum of the O&M cost divided 365 days and then divided by the average daily flow for that year.

Table E-27
Present Worth Calculations
Option B / West WWTP Site / Discharge to Unnamed Tributary - Rhome/Newark/Rolling V Ranch Regional Collection and Treatment System

	Capital Costs by Year				O&M Costs by Year				
Year	Collection System Capital Costs (million $)	Treatment Plant Capital Costs (million $)	Total Capital Costs (million $)	Present Worth (million $)	Collection System O&M Costs (million $)	Treatment Plant O&M Costs (million $)	Total O&M Costs (million $)	Present Worth (million $)	**Total Present Worth (million $)**
2009									
2010	$0.00	$0.00	$0.00	$0.00			$0.000	$0.00	$0.00
2011				$0.00			$0.000	$0.00	$0.00
2012				$0.00			$0.000	$0.00	$0.00
2013				$0.00			$0.000	$0.00	$0.00
2014				$0.00			$0.000	$0.00	$0.00
2015	$6.28	$5.85	$12.13	$9.05	$0.041	$0.179	$0.220	$0.16	$9.22
2016				$0.00	$0.043	$0.187	$0.229	$0.16	$0.16
2017				$0.00	$0.044	$0.195	$0.238	$0.16	$0.16
2018				$0.00	$0.045	$0.202	$0.248	$0.16	$0.16
2019				$0.00	$0.046	$0.210	$0.257	$0.16	$0.16
2020	$1.20	$5.83	$7.03	$4.11	$0.054	$0.335	$0.388	$0.23	$4.34
2021				$0.00	$0.056	$0.348	$0.404	$0.22	$0.22
2022				$0.00	$0.058	$0.361	$0.419	$0.22	$0.22
2023				$0.00	$0.060	$0.374	$0.434	$0.22	$0.22
2024				$0.00	$0.062	$0.387	$0.449	$0.22	$0.22
2025	$1.63	$5.78	$7.41	$3.39	$0.072	$0.515	$0.588	$0.27	$3.66
2026				$0.00	$0.075	$0.531	$0.606	$0.26	$0.26
2027				$0.00	$0.077	$0.546	$0.624	$0.26	$0.26
2028				$0.00	$0.080	$0.562	$0.642	$0.25	$0.25
2029				$0.00	$0.082	$0.577	$0.660	$0.25	$0.25
2030	$1.35	$0.00	$1.35	$0.48	$0.092	$0.593	$0.685	$0.25	$0.73
2031				$0.00	$0.094	$0.609	$0.703	$0.24	$0.24
2032				$0.00	$0.097	$0.624	$0.721	$0.23	$0.23
2033				$0.00	$0.099	$0.640	$0.739	$0.23	$0.23
2034				$0.00	$0.102	$0.655	$0.757	$0.22	$0.22
	Total Present Worth (Y2010 to 2034)			**$17.04**				**$4.38**	**$21.42**

Notes:
1 Interest rate is assumed to be = 5%

Table E-28

Debt Service Calculations

Option C / West WWTP Site / Discharge to Unnamed Tributary - Five City Regional Collection and Treatment System

		Collection System (Including Lift Stations & Force Mains)							Treatment Plant (Including Closure of Abandoned Plants)							
Year	Estimated Avg Daily Flow (MGD)	Estimated Project Capital Costs (million $)	Y2015 Bond Sale (million $)	Y2020 Bond Sale (million $)	Y2025 Bond Sale (million $)	Y2030 Bond Sale (million $)	Total Asset Value at End of Period (million $)	Annual Collection System Debt Service ($)	Project Capital Costs (million $)	Y2015 Bond Sale (million $)	Y2020 Bond Sale (million $)	Y2025 Bond Sale (million $)	Y2030 Bond Sale (million $)	Total Asset Value at End of Period (million $)	Annual Treatment Plant Debt Service ($)	**Total Annual Debt Service ($)**
2010	0	$0.07					$0.00		$0.00					$0.00		$0
2011	0						$0.00							$0.00		$0
2012	0						$0.00							$0.00		$0
2013	0						$0.00							$0.00		$0
2014	0						$0.00							$0.00		$0
2015	0.391	$8.16	$8.16				$8.16	$530,494	$6.78	$6.78				$6.78	$440,984	$971,478
2016	0.434						$8.16	$530,494						$6.78	$440,984	$971,478
2017	0.476						$8.16	$530,494						$6.78	$440,984	$971,478
2018	0.519						$8.16	$530,494						$6.78	$440,984	$971,478
2019	0.561						$8.16	$530,494						$6.78	$440,984	$971,478
2020	0.604	$18.34		$18.34			$26.50	$1,723,538	$6.84		$6.84			$13.62	$885,675	$2,609,213
2021	0.680						$26.50	$1,723,538						$13.62	$885,675	$2,609,213
2022	0.755						$26.50	$1,723,538						$13.62	$885,675	$2,609,213
2023	0.831						$26.50	$1,723,538						$13.62	$885,675	$2,609,213
2024	0.906						$26.50	$1,723,538						$13.62	$885,675	$2,609,213
2025	0.982	$0.00			$0.00		$26.50	$1,723,538	$6.89			$6.89		$20.50	$1,333,750	$3,057,287
2026	1.090						$26.50	$1,723,538						$20.50	$1,333,750	$3,057,287
2027	1.198						$26.50	$1,723,538						$20.50	$1,333,750	$3,057,287
2028	1.305						$26.50	$1,723,538						$20.50	$1,333,750	$3,057,287
2029	1.413						$26.50	$1,723,538						$20.50	$1,333,750	$3,057,287
2030	1.521	$4.70				$4.70	$31.20	$2,029,345	$0.00				$0.00	$20.50	$1,333,750	$3,363,094
2031	1.629						$31.20	$2,029,345						$20.50	$1,333,750	$3,363,094
2032	1.737						$31.20	$2,029,345						$20.50	$1,333,750	$3,363,094
2033	1.844						$31.20	$2,029,345						$20.50	$1,333,750	$3,363,094
2034	1.952						$31.20	$2,029,345						$20.50	$1,333,750	$3,363,094

Notes:

1 All costs are in Y2009 dollars
2 Intermediate year flows are estimated to increase linearly between 2015 and 2020, between 2020 and 2025, etc.
3 Each bond sale covers anticipated project capital costs for a 5-year period.
4 Total debt service is the sum of the debt service for all bonds sold prior to that year.
5 Interest rate is assumed to be = 5%
6 Bond term is assumed to be = 30 years

Table E-29

O&M Cost Estimates

Option C / West WWTP Site / Discharge to Unnamed Tributary - Five City Regional Collection and Treatment System

		Collection System (Including Lift Stations)				Treatment Plant				Collection + Treatment	
Year	Avg Daily Flow (MGD)	Fixed O&M Costs	Variable O&M Costs	Total O&M Costs	Unit O&M Cost ($/1000 gal.)	Fixed O&M Costs	Variable O&M Costs	Total O&M Costs	Unit Cost ($/1000 gal.)	Total O&M Costs	Total Unit O&M Cost ($/1000 gal.)
2010	0.000										
2011	0.000										
2012	0.000										
2013	0.000										
2014	0.000										
2015	0.391	$40,775	$14,272	$55,047	$0.39	$135,580	$88,483	$224,063	$1.57	$279,110	$1.96
2016	0.434	$40,775	$15,826	$56,601	$0.36	$135,580	$98,124	$233,704	$1.48	$290,305	$1.83
2017	0.476	$40,775	$17,381	$58,156	$0.33	$135,580	$107,764	$243,344	$1.40	$301,500	$1.73
2018	0.519	$40,775	$18,936	$59,711	$0.32	$135,580	$117,404	$252,984	$1.34	$312,696	$1.65
2019	0.561	$40,775	$20,491	$61,266	$0.30	$135,580	$127,045	$262,625	$1.28	$323,891	$1.58
2020	0.604	$132,475	$22,046	$154,521	$0.70	$272,300	$136,685	$408,985	$1.86	$563,506	$2.56
2021	0.680	$132,475	$24,805	$157,280	$0.63	$272,300	$153,793	$426,093	$1.72	$583,374	$2.35
2022	0.755	$132,475	$27,565	$160,040	$0.58	$272,300	$170,902	$443,202	$1.61	$603,242	$2.19
2023	0.831	$132,475	$30,324	$162,799	$0.54	$272,300	$188,010	$460,310	$1.52	$623,109	$2.05
2024	0.906	$132,475	$33,084	$165,559	$0.50	$272,300	$205,118	$477,418	$1.44	$642,977	$1.94
2025	0.982	$132,475	$35,843	$168,318	$0.47	$410,060	$222,227	$632,287	$1.76	$800,605	$2.23
2026	1.090	$132,475	$39,778	$172,253	$0.43	$410,060	$246,622	$656,682	$1.65	$828,934	$2.08
2027	1.198	$132,475	$43,712	$176,187	$0.40	$410,060	$271,017	$681,077	$1.56	$857,264	$1.96
2028	1.305	$132,475	$47,647	$180,122	$0.38	$410,060	$295,412	$705,472	$1.48	$885,594	$1.86
2029	1.413	$132,475	$51,582	$184,057	$0.36	$410,060	$319,807	$729,867	$1.41	$913,924	$1.77
2030	1.521	$155,980	$55,517	$211,497	$0.38	$410,060	$344,202	$754,262	$1.36	$965,759	$1.74
2031	1.629	$155,980	$59,451	$215,431	$0.36	$410,060	$368,597	$778,657	$1.31	$994,089	$1.67
2032	1.737	$155,980	$63,386	$219,366	$0.35	$410,060	$392,993	$803,053	$1.27	$1,022,418	$1.61
2033	1.844	$155,980	$67,321	$223,301	$0.33	$410,060	$417,388	$827,448	$1.23	$1,050,748	$1.56
2034	1.952	$155,980	$71,255	$227,235	$0.32	$410,060	$441,783	$851,843	$1.20	$1,079,078	$1.51

Notes:

1 Intermediate year flows are estimated to increase linearly between 2015 and 2020, between 2020 and 2025, etc.

2 Fixed collection system O&M costs assumed at 0.5% of asset value of collection system

3 Variable collection system O&M costs estimated at $ 0.10 per 1000 gallons (primarily electricity for pumping)

4 Fixed treatment plant O&M costs assumed at 2.0% of asset value of WWTP

5 Variable collection system O&M costs estimated at $ 0.62 per 1000 gallons

6 Unit cost is the sum of the O&M cost divided 365 days and then divided by the average daily flow for that year.

Table E-30
Present Worth Calculations
Option C / West WWTP Site / Discharge to Unnamed Tributary - Five City Regional Collection and Treatment System

	Capital Costs by Year				O&M Costs by Year				
Year	Collection System Capital Costs (million $)	Treatment Plant Capital Costs (million $)	Total Capital Costs (million $)	Present Worth (million $)	Collection System O&M Costs (million $)	Treatment Plant O&M Costs (million $)	Total O&M Costs (million $)	Present Worth (million $)	**Total Present Worth (million $)**
2009									
2010	$0.07	$0.00	$0.07	$0.07			$0.000	$0.00	$0.07
2011				$0.00			$0.000	$0.00	$0.00
2012				$0.00			$0.000	$0.00	$0.00
2013				$0.00			$0.000	$0.00	$0.00
2014				$0.00			$0.000	$0.00	$0.00
2015	$8.16	$6.78	$14.93	$11.14	$0.055	$0.224	$0.279	$0.21	$11.35
2016				$0.00	$0.057	$0.234	$0.290	$0.21	$0.21
2017				$0.00	$0.058	$0.243	$0.302	$0.20	$0.20
2018				$0.00	$0.060	$0.253	$0.313	$0.20	$0.20
2019				$0.00	$0.061	$0.263	$0.324	$0.20	$0.20
2020	$18.34	$6.84	$25.18	$14.72	$0.155	$0.409	$0.564	$0.33	$15.05
2021				$0.00	$0.157	$0.426	$0.583	$0.32	$0.32
2022				$0.00	$0.160	$0.443	$0.603	$0.32	$0.32
2023				$0.00	$0.163	$0.460	$0.623	$0.31	$0.31
2024				$0.00	$0.166	$0.477	$0.643	$0.31	$0.31
2025	$0.00	$6.89	$6.89	$3.16	$0.168	$0.632	$0.801	$0.37	$3.52
2026				$0.00	$0.172	$0.657	$0.829	$0.36	$0.36
2027				$0.00	$0.176	$0.681	$0.857	$0.36	$0.36
2028				$0.00	$0.180	$0.705	$0.886	$0.35	$0.35
2029				$0.00	$0.184	$0.730	$0.914	$0.34	$0.34
2030	$4.70	$0.00	$4.70	$1.69	$0.211	$0.754	$0.966	$0.35	$2.03
2031				$0.00	$0.215	$0.779	$0.994	$0.34	$0.34
2032				$0.00	$0.219	$0.803	$1.022	$0.33	$0.33
2033				$0.00	$0.223	$0.827	$1.051	$0.33	$0.33
2034				$0.00	$0.227	$0.852	$1.079	$0.32	$0.32
	Total Present Worth (Y2010 to 2034)			**$30.77**				**$6.06**	**$36.83**

Notes:
1 Interest rate is assumed to be = 5%

APPENDIX F

WATER CONSERVATION PLAN GUIDANCE CHECKLIST

This guidance checklist applies to all Texas Water Development Board (TWDB) Financial Assistance Programs specified in its rules under Texas Administrative Code 31, Chapters 355, 363, 371, 375, 382, and 384. **The TWDB will accept Water Conservation Plans determined by the Texas Commission on Environmental Quality (TCEQ) to satisfy the requirements of 30 TAC Chapter 288.**

Basically, *the water conservation plan* is a strategy or combination of strategies for reducing the consumption of water, reducing the loss or waste of water, improving or maintaining the efficiency in the use of water, or increasing recycling and reuse of water. It contains best management practices measures to try to meet the targets and goals identified in the plan. *The Drought Contingency (Emergency Demand Management) Plan* is a strategy or combination of strategies for responding to temporary and potentially recurring water supply shortages and other supply emergencies.

THE WATER CONSERVATION PLAN REQUIREMENTS:

A. _____ An evaluation of the Applicant's water and wastewater system and customer use characteristics to identify water conservation opportunities and potential targets and goals. Completion of the ***Water Conservation Utility Profile,*** **WRD-264,** as part of the evaluation is required. Attach it to the Plan.

B._____ Inclusion of 5-year and 10 –year targets & goals. Target and goals should be specific and quantified for municipal use **expressed in gallons per capita per day (gpcd) as well as goals for water loss programs).** Consider state and regional targets and goals, local climate, demographics, and the utility profile. Consider the anticipated savings that can be achieved by utilizing the appropriate Best Management Practices and other conservation techniques.

C. _____ A schedule for implementing the plan to achieve the applicant's targets and goals.

D. _____ A method for tracking the implementation and effectiveness of the plan. The method should track annual water use and provide information sufficient to evaluate the implementation conservation measures. The plan should measure progress annually, and, at a minimum, evaluate the progress towards meeting the targets and goals every five years.

E. _____ A master meter to measure and account for the amount of water diverted from the source of supply.

F. _____ A program of universal metering of both customer and public uses of water, for meter testing, repair and for periodic replacement.

G. _____ Measures to determine and control unaccounted-for uses of water. (for example, periodic visual inspections along distribution lines; annual or monthly audit of the water system to determine illegal connections, abandoned services, etc.)

H. _____ A continuous program of leak detection, repair, and water loss accounting for the water transmission, delivery, and distribution system in order to control water loss.

I. _____ A program of continuing education and information regarding water conservation. This should include providing water conservation information directly to each residential, industrial and commercial customer annually, and providing water conservation literature to new customers when they apply for service.

J. _____ A water rate structure which is not "promotional," i.e., a rate structure which is cost-based and which does not encourage the excessive use of water. Include copy of the rate structure.

K. ____ A means of implementation and enforcement which shall be evidenced by adoption of the plan:

1. a copy of the ordinance, resolution, or tariff indicating official adoption of the water conservation plan by the applicant and
2. a description of the authority by which the applicant will implement and enforce the conservation plan.

L. _____ If the Applicant will utilize the project financed by the TWDB to furnish water or wastewater services to another supplying entity that in turn will furnish the water or wastewater services to the ultimate consumer, the requirements for the water conservation plan also pertain to these supplier entities.
To comply with this requirement the applicant shall:

1. submit its own water conservation plan;
2. submit the other entity's (or entities) water conservation plan;
3. require, by contract, that the other entity (or entities), adopt a water conservation plan that conforms to the board's requirement and submit it to the board. If the requirement is to be included in an existing water or wastewater service contract, it may be included, at the earliest of the renewal or substantial amendment of that contract, or by other appropriate measures.

M. _____ Documentation that the regional water planning group for the service area of the applicant has been notified of the applicant's water conservation plan.

Note: The water conservation plan may also include other conservation method or technique that the applicant deems appropriate.

N. The Drought Contingency Plan shall include:

1. _____ **Trigger conditions**. Describe information to be monitored. For example, reservoir levels, daily water demand, water production or distribution system limitations. Supply source contamination and system outage or equipment failure should be considered too. Determine specific quantified targets of water use reduction.

2. _____ **Demand management measures**. Refers to actions that will be implemented by the utility during each stage of the plan when predetermined triggering criteria are met. **Drought plans must include quantified and specific targets for water use reductions to be achieved during periods of water shortage and drought.** Supply management measures typically can be taken by the utility to better manage available water supply, as well as the use of backup or alternative water sources. The demand management measures should curtail nonessential water uses, for example, outdoor water use.

3. _____ **Initiation and termination procedures**. The drought plan must include specific procedures to be followed for the initiation or termination of each drought response stage, including procedures for notification of the public.

4. _____ **Variances and enforcement.** The plans should specify procedures for considering (approving and denying) variances to the plan. Equally as important is the inclusion of provisions for enforcement of any mandatory water use restrictions, including specification of penalties for violations of such restrictions.

5. _____ **Measures to inform and educate the public**. Involving the public in the preparation of the drought contingency plan provides an important means for educating the public about the need for the plan and its content.

0. **_____ Adopt the plan.** No plan is complete without formal adoption by the governing body of the entity. For a municipal water system, adoption would be by the city council as an ordinance, or a resolution by an entity's board of directors.

P. ____ Reporting Requirement: Identify who will be responsible for preparing the annual report on the utility profile form WRD-264. Loan/Grant Recipients must maintain an approved water conservation program in effect until all financial obligations to the state have been discharged and shall **report annually** to the executive administrator of the TWDB on the progress in implementing each of the minimum requirements in its water conservation plan and the status of any of its customers' water conservation plan required by contract, within one year after closing on the financial assistance and annually thereafter. The content and format for the annual reporting is included in the form: ***Water Conservation Program Annual Report,*** **WRD-265**.

Assistance: For information and assistance contact:

Adolph L. Stickelbault (adolph.stickelbault@twdb.state.tx.us**)**
Texas Water Development Board
PO Box 13231
Austin, Texas 78711-3231
512-936-2391

Municipal Plan Assistance and Forms:
http://www.twdb.state.tx.us/assistance/conservation/Municipal/Plans/CPlans.asp

Best Management Practices Information:
http://www.twdb.state.tx.us/assistance/conservation/TaskForceDocs/WCITFBMPGuide.pdf

Quantification Techniques:
http://www.twdb.state.tx.us/assistance/conservation/gdsstudy.asp

APPENDIX G

Drought Contingency Plan
for a Retail Public Water Supplier

Texas Commission on Environmental Quality

Instructions: The following form is a model of a drought contingency plan for a retail public water supplier. Not all items may apply to your system's situation. This form is supplied for your convenience, but you are not required to use this form to submit your plan to the TCEQ. Submit completed plans to: Water Supply Division MC 160, TCEQ, P.O. Box 13087, Austin TX 78711-3087.

_____

(Name of Utility)

_____

(Address, City, Zip Code)

_____

(CCN#)

_____

(PWS #s)

_____

(Date)

Section I: Declaration of Policy, Purpose, and Intent

In order to conserve the available water supply and protect the integrity of water supply facilities, with particular regard for domestic water use, sanitation, and fire protection, and to protect and preserve public health, welfare, and safety and minimize the adverse impacts of water supply shortage or other water supply emergency conditions, the _____ (name of your water supplier) hereby adopts the following regulations and restrictions on the delivery and consumption of water through an ordinance/or resolution (see Appendix C for an example).

Water uses regulated or prohibited under this Drought Contingency Plan (the Plan) are considered to be non-essential and continuation of such uses during times of water shortage or other emergency water supply condition are deemed to constitute a waste of water which subjects the offender(s) to penalties as defined in Section XI of this Plan.

Section II: Public Involvement

Opportunity for the public to provide input into the preparation of the Plan was provided by the _____ (name of your water supplier) by means of _____ (describe methods used to inform the public about the preparation of the plan and provide opportunities for input; for example, scheduling and providing public notice of a public meeting to accept input on the Plan).

Section III: Public Education

The _____ (name of your water supplier) will periodically provide the public with information about the Plan, including information about the conditions under which each stage of the Plan is to be initiated or terminated and the drought response measures to be implemented in each stage. This information will be provided by means of _____ (describe methods to be used to provide information to the public about the Plan; for example, public events, press releases or utility bill inserts).

Section IV: Coordination with Regional Water Planning Groups

The service area of the _____ (name of your water supplier) is located within the _____ (name of regional water planning area or areas) and _____ (name of your water supplier) has provided a copy of this Plan to the _____ (name of your regional water planning group or groups).

Section V: Authorization

The _____ (designated official; for example, the mayor, city manager, utility director, general manager, etc.), or his/her designee is hereby authorized and directed to implement the applicable provisions of this Plan upon determination that such implementation is necessary to protect public health, safety, and welfare. The _____, (designated official) or his/her designee, shall have the authority to initiate or terminate drought or other water supply emergency response measures as described in this Plan.

Section VI: Application

The provisions of this Plan shall apply to all persons, customers, and property utilizing water provided by the _____ (name of your water supplier). The terms "person" and "customer" as used in the Plan include individuals, corporations, partnerships, associations, and all other legal entities.

Section VII: Definitions

For the purposes of this Plan**,** the following definitions shall apply:

Aesthetic water use: water use for ornamental or decorative purposes such as fountains, reflecting pools, and water gardens.

Commercial and institutional water use: water use which is integral to the operations of commercial and non-profit establishments and governmental entities such as retail establishments, hotels and motels, restaurants, and office buildings.

Conservation: those practices, techniques, and technologies that reduce the consumption of water, reduce the loss or waste of water, improve the efficiency in the use of water or increase the recycling and reuse of water so that a supply is conserved and made available for future or alternative uses.

Customer: any person, company, or organization using water supplied by _____ (name of your water supplier).

Domestic water use: water use for personal needs or for household or sanitary purposes such as drinking, bathing, heating, cooking, sanitation, or for cleaning a residence, business, industry, or institution.

Even number address: street addresses, box numbers, or rural postal route numbers ending in 0, 2, 4, 6, or 8 and locations without addresses.

Industrial water use: the use of water in processes designed to convert materials of lower value into forms having greater usability and value.

Landscape irrigation use: water used for the irrigation and maintenance of landscaped areas, whether publicly or privately owned, including residential and commercial lawns, gardens, golf courses, parks, and rights-of-way and medians.

Non-essential water use: water uses that are not essential nor required for the protection of public, health, safety, and welfare, including:

(a) irrigation of landscape areas, including parks, athletic fields, and golf courses, except otherwise provided under this Plan;
(b) use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle;
(c) use of water to wash down any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas;
(d) use of water to wash down buildings or structures for purposes other than immediate fire protection;
(e) flushing gutters or permitting water to run or accumulate in any gutter or street;
(f) use of water to fill, refill, or add to any indoor or outdoor swimming pools or jacuzzi-type pools;

(g) use of water in a fountain or pond for aesthetic or scenic purposes except where necessary to support aquatic life;
(h) failure to repair a controllable leak(s) within a reasonable period after having been given notice directing the repair of such leak(s); and
(i) use of water from hydrants for construction purposes or any other purposes other than fire fighting.

Odd numbered address: street addresses, box numbers, or rural postal route numbers ending in 1, 3, 5, 7, or 9.

Section VIII: Criteria for Initiation and Termination of Drought Response Stages

The _____ (designated official) or his/her designee shall monitor water supply and/or demand conditions on a _____ (example: daily, weekly, monthly) basis and shall determine when conditions warrant initiation or termination of each stage of the Plan, that is, when the specified "triggers" are reached.

The triggering criteria described below are based on _____
_____
(*provide a brief description of the rationale for the triggering criteria; for example, triggering criteria / trigger levels based on a statistical analysis of the vulnerability of the water source under drought of record conditions, or based on known system capacity limits*).

Stage 1 Triggers -- MILD Water Shortage Conditions

Requirements for initiation
Customers shall be requested to voluntarily conserve water and adhere to the prescribed restrictions on certain water uses, defined in Section VII–Definitions, when
_____
(*describe triggering criteria / trigger levels; see examples below*).

Following are examples of the types of triggering criteria that might be used in one or more successive stages of a drought contingency plan. One or a combination of such criteria must be defined for each drought response stage, but usually not all will apply. Select those appropriate to your system:

Example 1: *Annually, beginning on May 1 through September 30.*

Example 2: *When the water supply available to the _____ (name of your water supplier) is equal to or less than _____ (acre-feet, percentage of storage, etc.).*

Example 3: *When, pursuant to requirements specified in the _____(name of **your** water supplier) wholesale water purchase contract with _____ (name*

of your wholesale water supplier), notification is received requesting initiation of Stage 1 of the Drought Contingency Plan.

Example 4: *When flows in the _____ (name of stream or river) are equal to or less than ____cubic feet per second.*

Example 5: *When the static water level in the _____ (name of your water supplier) well(s) is equal to or less than _____ feet above/below mean sea level.*

Example 6: *When the specific capacity of the _____ (name of your water supplier) well(s) is equal to or less than _____ percent of the well's original specific capacity.*

Example 7: *When total daily water demand equals or exceeds _____ million gallons for ___consecutive days of ____ million gallons on a single day (example: based on the "safe" operating capacity of water supply facilities).*

Example 8: *Continually falling treated water reservoir levels which do not refill above __ percent overnight (example: based on an evaluation of minimum treated water storage required to avoid system outage).*

The public water supplier may devise other triggering criteria which are tailored to its system.

Requirements for termination
Stage 1 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ___ (e.g. 3) consecutive days.

Stage 2 Triggers -- MODERATE Water Shortage Conditions

Requirements for initiation
Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses provided in Section IX of this Plan when _____ (*describe triggering criteria; see examples in Stage 1*).

Requirements for termination
Stage 2 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ___ (example: 3) consecutive days. Upon termination of Stage 2, Stage 1 becomes operative.

Stage 3 Triggers – SEVERE Water Shortage Conditions

Requirements for initiation
Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses for Stage 3 of this Plan when _____ (*describe triggering criteria; see examples in*

Stage 1).

Requirements for termination
Stage 3 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ___ (example: 3) consecutive days. Upon termination of Stage 3, Stage 2 becomes operative.

Stage 4 Triggers -- CRITICAL Water Shortage Conditions

Requirements for initiation
Customers shall be required to comply with the requirements and restrictions on certain non-essential water uses for Stage 4 of this Plan when _____ (*describe triggering criteria; see examples in Stage 1*).

Requirements for termination
Stage 4 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ___ (example: 3) consecutive days. Upon termination of Stage 4, Stage 3 becomes operative.

Stage 5 Triggers -- EMERGENCY Water Shortage Conditions

Requirements for initiation
Customers shall be required to comply with the requirements and restrictions for Stage 5 of this Plan when _____ (designated official), or his/her designee, determines that a water supply emergency exists based on:

1. Major water line breaks, or pump or system failures occur, which cause unprecedented loss of capability to provide water service; **or**

2. Natural or man-made contamination of the water supply source(s).

Requirements for termination
Stage 5 of the Plan may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ___ (example: 3) consecutive days.

Stage 6 Triggers -- WATER ALLOCATION

Requirements for initiation
Customers shall be required to comply with the water allocation plan prescribed in Section IX of this Plan and comply with the requirements and restrictions for Stage 5 of this Plan when _____ (describe triggering criteria, see examples in Stage 1).

Requirements for termination - Water allocation may be rescinded when all of the conditions listed as triggering events have ceased to exist for a period of ___ (example: 3) consecutive days.

Note: The inclusion of WATER ALLOCATION as part of a drought contingency plan may not be required in all cases. For example, for a given water supplier, an analysis of water supply availability under drought of record conditions may indicate that there is essentially no risk of water supply shortage. Hence, a drought contingency plan for such a water supplier might only address facility capacity limitations and emergency conditions (example: supply source contamination and system capacity limitations).

Section IX: Drought Response Stages

The _____ (designated official), or his/her designee, shall monitor water supply and/or demand conditions on a daily basis and, in accordance with the triggering criteria set forth in Section VIII of this Plan, shall determine that a mild, moderate, severe, critical, emergency or water shortage condition exists and shall implement the following notification procedures:

Notification

Notification of the Public:
The _____ (designated official) or his/ her designee shall notify the public by means of:

Examples:
publication in a newspaper of general circulation,
direct mail to each customer,
public service announcements,
signs posted in public places
take-home fliers at schools.

Additional Notification:
The _____ (designated official) or his/ her designee shall notify directly, or cause to be notified directly, the following individuals and entities:

Examples:
Mayor / Chairman and members of the City Council / Utility Board
Fire Chief(s)
City and/or County Emergency Management Coordinator(s)
County Judge & Commissioner(s)
State Disaster District / Department of Public Safety
TCEQ *(required when* mandatory *restrictions are imposed)*
Major water users

Critical water users, i.e. hospitals
Parks / street superintendents & public facilities managers

Note: The plan should specify direct notice only as appropriate to respective drought stages.

Stage 1 Response -- MILD Water Shortage Conditions

Target: Achieve a voluntary ___ percent reduction in _____(example: total water use, daily water demand, etc.).

Best Management Practices for Supply Management:

D*escribe additional measures, if any, to be implemented directly by (name of your water supplier) to manage limited water supplies and/or reduce water demand. Examples include: reduced or discontinued flushing of water mains, activation and use of an alternative supply source(s); use of reclaimed water for non-potable purposes.*

Voluntary Water Use Restrictions for Reducing Demand :

(a) Water customers are requested to voluntarily limit the irrigation of landscaped areas to Sundays and Thursdays for customers with a street address ending in an even number (0, 2, 4, 6 or 8), and Saturdays and Wednesdays for water customers with a street address ending in an odd number (1, 3, 5, 7 or 9), and to irrigate landscapes only between the hours of midnight and 10:00 a.m. and 8:00 p.m to midnight on designated watering days.

(b) All operations of the _____ (name of your water supplier) shall adhere to water use restrictions prescribed for Stage 2 of the Plan.

(c) Water customers are requested to practice water conservation and to minimize or discontinue water use for non-essential purposes.

Stage 2 Response -- MODERATE Water Shortage Conditions

Target: Achieve a ___ percent reduction in _____ (example: total water use, daily water demand, etc.).

Best Management Practices for Supply Management:

Describe additional measures, if any, to be implemented directly by _____ (name of your water supplier) to manage limited water supplies and/or reduce water demand. Examples include: reduced or discontinued flushing of water mains, reduced or discontinued irrigation of public landscaped areas; use of an alternative supply source(s); use of reclaimed water for non-potable purposes.

Water Use Restrictions for Demand Reduction:
Under threat of penalty for violation, the following water use restrictions shall apply to all persons:

(a) Irrigation of landscaped areas with hose-end sprinklers or automatic irrigation systems shall be limited to Sundays and Thursdays for customers with a street address ending in an even number (0, 2, 4, 6 or 8), and Saturdays and Wednesdays for water customers with a street address ending in an odd number (1, 3, 5, 7 or 9), and irrigation of landscaped areas is further limited to the hours of 12:00 midnight until 10:00 a.m. and between 8:00 p.m. and 12:00 midnight on designated watering days. However, irrigation of landscaped areas is permitted at anytime if it is by means of a hand-held hose, a faucet filled bucket or watering can of five (5) gallons or less, or drip irrigation system.

(b) Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle is prohibited except on designated watering days between the hours of 12:00 midnight and 10:00 a.m. and between 8:00 p.m. and 12:00 midnight. Such washing, when allowed, shall be done with a hand-held bucket or a hand-held hose equipped with a positive shutoff nozzle for quick rises. Vehicle washing may be done at any time on the immediate premises of a commercial car wash or commercial service station. Further, such washing may be exempted from these regulations if the health, safety, and welfare of the public is contingent upon frequent vehicle cleansing, such as garbage trucks and vehicles used to transport food and perishables.

(c) Use of water to fill, refill, or add to any indoor or outdoor swimming pools, wading pools, or jacuzzi-type pools is prohibited except on designated watering days between the hours of 12:00 midnight and 10:00 a.m. and between 8 p.m. and 12:00 midnight.

(d) Operation of any ornamental fountain or pond for aesthetic or scenic purposes is prohibited except where necessary to support aquatic life or where such fountains or ponds are equipped with a recirculation system.

(e) Use of water from hydrants shall be limited to fire fighting, related activities, or other activities necessary to maintain public health, safety, and welfare, except that use of water from designated fire hydrants for construction purposes may be allowed under special permit from the _____ (name of your water supplier).

(f) Use of water for the irrigation of golf course greens, tees, and fairways is prohibited except on designated watering days between the hours 12:00 midnight and 10:00 a.m. and between 8 p.m. and 12:00 midnight. However, if the golf course utilizes a water source other than that provided by the _____ (name of your water supplier), the facility shall not be subject to these regulations.

(g) All restaurants are prohibited from serving water to patrons except upon request of the patron.

(h) The following uses of water are defined as non-essential and are prohibited:

1. wash down of any sidewalks, walkways, driveways, parking lots, tennis courts, or other hard-surfaced areas;
2. use of water to wash down buildings or structures for purposes other than immediate fire protection;
3. use of water for dust control;
4. flushing gutters or permitting water to run or accumulate in any gutter or street; and
5. failure to repair a controllable leak(s) within a reasonable period after having been given notice directing the repair of such leak(s).

Stage 3 Response -- SEVERE Water Shortage Conditions

Target: Achieve a ___ percent reduction in _____ (example: total water use, daily water demand, etc.).

Best Management Practices for Supply Management:

Describe additional measures, if any, to be implemented directly by _____ (name of your water supplier) to manage limited water supplies and/or reduce water demand. Examples include: reduced or discontinued flushing of water mains, reduced or discontinued irrigation of public landscaped areas; use of an alternative supply source(s); use of reclaimed water for non-potable purposes.

Water Use Restrictions for Demand Reduction:
All requirements of Stage 2 shall remain in effect during Stage 3 except:

(a) Irrigation of landscaped areas shall be limited to designated watering days between the hours of 12:00 midnight and 10:00 a.m. and between 8 p.m. and 12:00 midnight and shall be by means of hand-held hoses, hand-held buckets, drip irrigation, or permanently installed automatic sprinkler system only. The use of hose-end sprinklers is prohibited at all times.

(b) The watering of golf course tees is prohibited unless the golf course utilizes a water source other than that provided by the _____ (name of your water supplier).

(c) The use of water for construction purposes from designated fire hydrants under special permit is to be discontinued.

Stage 4 Response -- CRITICAL Water Shortage Conditions

Target: Achieve a ___ percent reduction in _____ (example: total water use, daily water demand, etc.).

Best Management Practices for Supply Management:

Describe additional measures, if any, to be implemented directly by _____ (name of your water supplier) to manage limited water supplies and/or reduce water demand. Examples include: reduced or discontinued flushing of water mains, reduced or discontinued irrigation of public landscaped areas; use of an alternative supply source(s); use of reclaimed water for non-potable purposes.

Water Use Restrictions for Reducing Demand:. All requirements of Stage 2 and 3 shall remain in effect during Stage 4 except:

(a) Irrigation of landscaped areas shall be limited to designated watering days between the hours of 6:00 a.m. and 10:00 a.m. and between 8:00 p.m. and 12:00 midnight and shall be by means of hand-held hoses, hand-held buckets, or drip irrigation only. The use of hose-end sprinklers or permanently installed automatic sprinkler systems are prohibited at all times.

(b) Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle not occurring on the premises of a commercial car wash and commercial service stations and not in the immediate interest of public health, safety, and welfare is prohibited. Further, such vehicle washing at commercial car washes and commercial service stations shall occur only between the hours of 6:00 a.m. and 10:00 a.m. and between 6:00 p.m. and 10 p.m.

(c) The filling, refilling, or adding of water to swimming pools, wading pools, and jacuzzi-type pools is prohibited.

(d) Operation of any ornamental fountain or pond for aesthetic or scenic purposes is prohibited except where necessary to support aquatic life or where such fountains or ponds are equipped with a recirculation system.

(e) No application for new, additional, expanded, or increased-in-size water service connections, meters, service lines, pipeline extensions, mains, or water service facilities of any kind shall be approved, and time limits for approval of such applications are hereby suspended for such time as this drought response stage or a higher-numbered stage shall be in effect.

Stage 5 Response -- EMERGENCY Water Shortage Conditions

Target: Achieve a ___ percent reduction in _____ (example: total water use, daily water demand, etc.).

Best Management Practices for Supply Management:

Describe additional measures, if any, to be implemented directly by _____ (name of your water supplier) to manage limited water supplies and/or reduce water demand. Examples include: reduced or discontinued flushing of water mains, reduced or discontinued irrigation of public landscaped areas; use of an alternative supply source(s); use of reclaimed water for non-potable purposes.

Water Use Restrictions for Reducing Demand. All requirements of Stage 2, 3, and 4 shall remain in effect during Stage 5 except:

(a) Irrigation of landscaped areas is absolutely prohibited.

(b) Use of water to wash any motor vehicle, motorbike, boat, trailer, airplane or other vehicle is absolutely prohibited.

Stage 6 Response -- WATER ALLOCATION

In the event that water shortage conditions threaten public health, safety, and welfare, the _____ (designated official) is hereby authorized to allocate water according to the following water allocation plan:

Single-Family Residential Customers

The allocation to residential water customers residing in a single-family dwelling shall be as follows:

Persons per Household	Gallons per Month
1 or 2	6,000
3 or 4	7,000
5 or 6	8,000
7 or 8	9,000
9 or 10	10,000
11 or more	12,000

"Household" means the residential premises served by the customer's meter. "Persons per household" includes only those persons currently physically residing at the premises and expected to reside there for the entire billing period. It shall be assumed that a particular customer's household is comprised of two (2) persons unless the customer notifies the _____ (name of your water supplier) of a greater number of persons per household on a form prescribed by the _____ designated official). The _____ (designated official) shall give his/her best effort to see that such forms are mailed, otherwise provided, or made available to every residential customer. If, however, a customer does not receive such a

form, it shall be the customer's responsibility to go to the _____ (name of your water supplier) offices to complete and sign the form claiming more than two (2) persons per household. New customers may claim more persons per household at the time of applying for water service on the form prescribed by the _____ (designated official). When the number of persons per household increases so as to place the customer in a different allocation category, the customer may notify the _____ (name of water supplier) on such form and the change will be implemented in the next practicable billing period. If the number of persons in a household is reduced, the customer shall notify the _____(name of your water supplier) in writing within two (2) days. In prescribing the method for claiming more than two (2) persons per household, the _____ (designated official) shall adopt methods to insure the accuracy of the claim. Any person who knowingly, recklessly, or with criminal negligence falsely reports the number of persons in a household or fails to timely notify the _____ (name of your water supplier) of a reduction in the number of person in a household shall be fined not less than $_____.

Residential water customers shall pay the following surcharges:

$____ for the first 1,000 gallons over allocation.
$____ for the second 1,000 gallons over allocation.
$____ for the third 1,000 gallons over allocation.
$____ for each additional 1,000 gallons over allocation.

Surcharges shall be cumulative.

Master-Metered Multi-Family Residential Customers

The allocation to a customer billed from a master meter which jointly measures water to multiple permanent residential dwelling units (example: apartments, mobile homes) shall be allocated 6,000 gallons per month for each dwelling unit. It shall be assumed that such a customer's meter serves two dwelling units unless the customer notifies the _____ (name of your water supplier) of a greater number on a form prescribed by the _____ (designated official). The _____ (designated official) shall give his/her best effort to see that such forms are mailed, otherwise provided, or made available to every such customer. If, however, a customer does not

receive such a form, it shall be the customer's responsibility to go to the _____ (name of your water supplier) offices to complete and sign the form claiming more than two (2) dwellings. A dwelling unit may be claimed under this provision whether it is occupied or not. New customers may claim more dwelling units at the time of applying for water service on the form prescribed by the _____ (designated official). If the number of dwelling units served by a master meter is reduced, the customer shall notify the _____(name of your water supplier) in writing within two (2) days. In prescribing the method for claiming more than two (2) dwelling units, the _____ (designated official) shall adopt methods to insure the accuracy of the claim. Any person who knowingly, recklessly, or with criminal negligence falsely reports the number of dwelling units served by a master meter or fails to timely notify the _____ (name of your water supplier) of a reduction in the number of person in a household shall be fined not less than $_____. Customers billed from a master meter under this provision shall pay the following monthly surcharges:

$____ for 1,000 gallons over allocation up through 1,000 gallons for each dwelling unit.
$____, thereafter, for each additional 1,000 gallons over allocation up through a second 1,000 gallons for each dwelling unit.
$____, thereafter, for each additional 1,000 gallons over allocation up through a third 1,000 gallons for each dwelling unit.
$ ____, thereafter for each additional 1,000 gallons over allocation.

Surcharges shall be cumulative.

Commercial Customers

A monthly water allocation shall be established by the _____ (designated official), or his/her designee, for each nonresidential commercial customer other than an industrial customer who uses water for processing purposes. The non-residential customer's allocation shall be approximately __ (e.g. 75%) percent of the customer's usage for corresponding month's billing period for the previous 12 months. If the customer's billing history is shorter than 12 months, the monthly average for the period for which there is a record shall be used for any monthly period for which no history exists. Provided, however, a customer, __ percent of whose monthly usage is less than ____ gallons, shall be allocated ____ gallons. The _____ (designated official) shall give his/her best effort to see that notice of each non-residential customer's allocation is mailed to such customer. If, however, a customer does not receive such notice, it shall be the customer's responsibility to contact the _____ (name of your water supplier) to determine the allocation. Upon request of the customer or at the initiative of the _____ (designated official), the allocation may be reduced or increased if, (1) the designated period does not accurately reflect the customer's normal water usage, (2) one nonresidential customer agrees to transfer part of its allocation to another nonresidential customer, or (3) other objective evidence demonstrates that the designated allocation is inaccurate under present conditions. A customer

may appeal an allocation established hereunder to the _____ (designated official or alternatively, a special water allocation review committee). Nonresidential commercial customers shall pay the following surcharges:

Customers whose allocation is _____ gallons through _____ gallons per month:

$____ per thousand gallons for the first 1,000 gallons over allocation.
$____ per thousand gallons for the second 1,000 gallons over allocation.
$____ per thousand gallons for the third 1,000 gallons over allocation.
$____ per thousand gallons for each additional 1,000 gallons over allocation.

Customers whose allocation is _____ gallons per month or more:

___ times the block rate for each 1,000 gallons in excess of the allocation up through 5 percent above allocation.
___ times the block rate for each 1,000 gallons from 5 percent through 10 percent above allocation.
___ times the block rate for each 1,000 gallons from 10 percent through 15 percent above allocation.
___ times the block rate for each 1,000 gallons more than 15 percent above allocation.

The surcharges shall be cumulative. As used herein, "block rate" means the charge to the customer per 1,000 gallons at the regular water rate schedule at the level of the customer's allocation.

Industrial Customers

A monthly water allocation shall be established by the _____ (designated official), or his/her designee, for each industrial customer, which uses water for processing purposes. The industrial customer's allocation shall be approximately __ (example: 90%) percent of the customer's water usage baseline. Ninety (90) days after the initial imposition of the allocation for industrial customers, the industrial customer's allocation shall be further reduced to __ (example: 85%) percent of the customer's water usage baseline. The industrial customer's water use baseline will be computed on the average water use for the _____ month period ending prior to the date of implementation of Stage 2 of the Plan. If the industrial water customer's billing history is shorter than ___ months, the monthly average for the period for which there is a record shall be used for any monthly period for which no billing history exists. The _____ (designated official) shall give his/her best effort to see that notice of each industrial customer's allocation is mailed to such customer. If, however, a customer does not receive such notice, it shall be the customer's responsibility to contact the _____ (name of your water supplier) to determine the allocation, and the allocation shall be fully effective notwithstanding the lack of

receipt of written notice. Upon request of the customer or at the initiative of the _____ (designated official), the allocation may be reduced or increased, (1) if the designated period does not accurately reflect the customer's normal water use because the customer had shutdown a major processing unit for repair or overhaul during the period, (2) the customer has added or is in the process of adding significant additional processing capacity, (3) the customer has shutdown or significantly reduced the production of a major processing unit, (4) the customer has previously implemented significant permanent water conservation measures such that the ability to further reduce water use is limited, (5) the customer agrees to transfer part of its allocation to another industrial customer, or (6) if other objective evidence demonstrates that the designated allocation is inaccurate under present conditions. A customer may appeal an allocation established hereunder to the _____ (designated official or alternatively, a special water allocation review committee). Industrial customers shall pay the following surcharges:

Customers whose allocation is _____ gallons through _____ gallons per month:

$____ per thousand gallons for the first 1,000 gallons over allocation.
$____ per thousand gallons for the second 1,000 gallons over allocation.
$____ per thousand gallons for the third 1,000 gallons over allocation.
$____ per thousand gallons for each additional 1,000 gallons over allocation.

Customers whose allocation is _____ gallons per month or more:

___ times the block rate for each 1,000 gallons in excess of the allocation up through 5 percent above allocation.
___ times the block rate for each 1,000 gallons from 5 percent through 10 percent above allocation.
___ times the block rate for each 1,000 gallons from 10 percent through 15 percent above allocation.
___ times the block rate for each 1,000 gallons more than 15 percent above allocation.

The surcharges shall be cumulative. As used herein, "block rate" means the charge to the customer per 1,000 gallons at the regular water rate schedule at the level of the customer's allocation.

Section X: Enforcement

(a) No person shall knowingly or intentionally allow the use of water from the _____ (name of your water supplier) for residential, commercial, industrial, agricultural, governmental, or any other purpose in a manner contrary to any provision of this Plan, or in an amount in excess of that permitted by the drought response stage in effect at the

time pursuant to action taken by _____(designated official), or his/her designee, in accordance with provisions of this Plan.

(b) Any person who violates this Plan is guilty of a misdemeanor and, upon conviction shall be punished by a fine of not less than _____ dollars ($__) and not more than _____ dollars ($__). Each day that one or more of the provisions in this Plan is violated shall constitute a separate offense. If a person is convicted of three or more distinct violations of this Plan, the _____ (designated official) shall, upon due notice to the customer, be authorized to discontinue water service to the premises where such violations occur. Services discontinued under such circumstances shall be restored only upon payment of a re-connection charge, hereby established at $_____, and any other costs incurred by the _____ (name of your water supplier) in discontinuing service. In addition, suitable assurance must be given to the _____ (designated official) that the same action shall not be repeated while the Plan is in effect. Compliance with this plan may also be sought through injunctive relief in the district court.

(c) Any person, including a person classified as a water customer of the _____ (name of your water supplier), in apparent control of the property where a violation occurs or originates shall be presumed to be the violator, and proof that the violation occurred on the person's property shall constitute a rebuttable presumption that the person in apparent control of the property committed the violation, but any such person shall have the right to show that he/she did not commit the violation. Parents shall be presumed to be responsible for violations of their minor children and proof that a violation, committed by a child, occurred on property within the parents' control shall constitute a rebuttable presumption that the parent committed the violation, but any such parent may be excused if he/she proves that he/she had previously directed the child not to use the water as it was used in violation of this Plan and that the parent could not have reasonably known of the violation.

(d) Any employee of the _____ (name of your water supplier), police officer, or other _____ employee designated by the _____ (designated official), may issue a citation to a person he/she reasonably believes to be in violation of this Ordinance. The citation shall be prepared in duplicate and shall contain the name and address of the alleged violator, if known, the offense charged, and shall direct him/her to appear in the _____ (example: municipal court) on the date shown on the citation for which the date shall not be less than 3 days nor more than 5 days from the date the citation was issued. The alleged violator shall be served a copy of the citation. Service of the citation shall be complete upon delivery of the citation to the alleged violator, to an agent or employee of a violator, or to a person over 14 years of age who is a member of the violator's immediate family or is a resident of the violator's residence. The alleged violator shall appear in _____ (example: municipal court) to enter a plea of guilty or not guilty for the violation of this Plan. If the alleged violator fails to appear in _____ (example: municipal court), a warrant for his/her arrest may be issued. A summons to appear may be issued in lieu of an arrest warrant. These cases shall be expedited and

given preferential setting in _____ (example: municipal court) before all other cases.

Section XI: Variances

The _____ (designated official), or his/her designee, may, in writing, grant temporary variance for existing water uses otherwise prohibited under this Plan if it is determined that failure to grant such variance would cause an emergency condition adversely affecting the health, sanitation, or fire protection for the public or the person requesting such variance and if one or more of the following conditions are met:

(a) Compliance with this Plan cannot be technically accomplished during the duration of the water supply shortage or other condition for which the Plan is in effect.
(b) Alternative methods can be implemented which will achieve the same level of reduction in water use.

Persons requesting an exemption from the provisions of this Ordinance shall file a petition for variance with the _____ (name of your water supplier) within 5 days after the Plan or a particular drought response stage has been invoked. All petitions for variances shall be reviewed by the _____ (designated official), or his/her designee, and shall include the following:

(a) Name and address of the petitioner(s).
(b) Purpose of water use.
(c) Specific provision(s) of the Plan from which the petitioner is requesting relief.
(d) Detailed statement as to how the specific provision of the Plan adversely affects the petitioner or what damage or harm will occur to the petitioner or others if petitioner complies with this Ordinance.
(e) Description of the relief requested.
(f) Period of time for which the variance is sought.
(g) Alternative water use restrictions or other measures the petitioner is taking or proposes to take to meet the intent of this Plan and the compliance date.
(h) Other pertinent information.

APPENDIX H

Figure H-1

Southeast Wise County Regional Wastewater Study Modified Base Case Option

Proposed Ivy Hills WWTP

Proposed Boyette Tract Lift Station

FM 730 Lift Station

FM 730 Lift Station Phase II

City of Boyd Existing WWTP

City of Aurora WWTP

Aurora East Lift Station

Rhome West Lift Station

Rhome West WWTP

Oates Branch East Lift Station

Existing Chisholm Creek Lift Station

Derrett Creek Lift Station

Moss Branch Lift Station

Rolling V WWTP

Newark WWTP

City of New Fairview WWTP

Aurora East Lift Station

Rhome East WWTP

Boyd

Aurora

Rhome

Newark

New Fairview

Ivy Hills 578 ac.

Ivy Hills 100 ac.

Boyette Tract 450 ac.

Highland Oaks

200 ac. tract

Chisholm Trail Ranch

Oliver Creek Ranch

Coyote Ridge

Chisholm Hills

Highland Meadows

Fairview Acres

Skyview

Rio Rancho Estates

287 Travel Center

Der-Flughafen Graben

Graben Drive Area

Zion Estates

Strawberry Estates

Singing Meadows

Aurora Vista

Aurora 1/3 ac. tracts

Aurora 2 ac. tracts

Palo Duro 1

Palo Duro 2

Potential Pond Area

Sand Pit

Crown Point

Future High School

Ellis Homestead

Bywell Estates

Rolling V Ranch

Lexington Addition

Sunrise Meadows

Chisholm Creek

Chisholm Trl MS & Prairieview Elem. School

7 Hills Elem. School

Eagle Dr. Area

7 Hills Dr. Area

Lakeside Rd. Area

Eagle Lake Area

Wise Street Area

Mellown Street Area

Newark Area

Sandy Bass Area

Boyd

School

Future High School

Park

730

81

114

407

2264

3433

718

Wise

Parker

Tarrant

Eagle Mountain Reservoir

West Fork Trinity River

Little Walnut Creek

Walnut Creek

Oliver Creek

Teeter Branch

Hackberry Creek

South Fork Hackberry Creek

Blue Creek

Deep Creek

Salt Creek

Walker Creek

Lola Creek

Stream

Elizabeth Creek

Hog Branch

Pond Dry Fork

Oates Branch

Moss Branch

Indian Creek

Swift Branch

Gilmore Branch

Mc Cann Branch

Briar Creek

Cottonwood Branch

Legend

- Proposed Lift Station
- Proposed WWTP
- Existing Lift Station
- Existing WWTP
- Proposed Gravity Sewer or Interceptor
- Proposed Force Main
- Existing Force Main
- Existing Gravity Sewer
- Existing Development, Greater Than 1 Acre Lots
- Existing Development, Less Than 1 Acre Lots
- Future Development, Greater Than 1 Acre Lots
- Future Development, Less Than 1 Acre Lots
- Unclassified Properties
- Schools
- Parks
- Other Features
- Highways
- Minor State Roads
- Streams
- County Boundaries

N

0 0.5 1 2

Miles

Scale 1 inch = 2,000 feet

File: 1-2000 Modified Base Case Option.MXD

Figure H-2

Southeast Wise County Regional Wastewater Study Option B: Partial Regionalization

Legend

- Proposed Lift Station
- Proposed WWTP
- Existing Lift Station
- Existing WWTP
- Proposed Gravity Sewer or Interceptor
- Proposed Force Main
- Existing Force Main
- Existing Gravity Sewer
- Existing Development, Greater Than 1 Acre Lots
- Existing Development, Less Than 1 Acre Lots
- Future Development, Greater Than 1 Acre Lots
- Future Development, Less Than 1 Acre Lots
- Unclassified Properties
- Schools
- Parks
- Other Features
- Highways
- Minor State Roads
- Streams
- County Boundaries
- Treated Effluent Route

N

0 0.5 1 2

Miles

Scale 1 inch = 2,000 feet

File: 1-2000 Option C Five City Regionalization.MXD

Figure H-3

Southeast Wise County Regional Wastewater Study
Option C: Five City Regionalization

Boyd

Aurora

Rhome

New Fairview

Newark

Ivy Hills Lift Station

FM 730 Lift Station

FM 730 Lift Station Phase II

City of Boyd Existing WWTP

Blue Creek Lift Station

Oates Branch West Lift Station

Oates Branch East Lift Station

Rhome West WWTP

Rhome East WWTP

Upper Elizabeth Creek Lift Station

Existing Chisholm Creek Lift Station

Derrett Creek Lift Station

Newark Diversion Lift Station

Newark WWTP

Proposed Regional WWTP

Moss Branch Lift Station

Treated Effluent Route

Legend

- Proposed Lift Station
- Proposed WWTP
- Existing Lift Station
- Existing WWTP
- Proposed Gravity Sewer or Interceptor
- Proposed Force Main
- Existing Force Main
- Existing Gravity Sewer
- Existing Development, Greater Than 1 Acre Lots
- Existing Development, Less Than 1 Acre Lots
- Future Development, Greater Than 1 Acre Lots
- Future Development, Less Than 1 Acre Lots
- Unclassified Properties
- Schools
- Parks
- Other Features
- Highways
- Minor State Roads
- Streams
- County Boundaries
- Treated Effluent Route

N

0 0.5 1 2

Miles

Scale 1 inch = 2,000 feet

File: 1-2000 Option C Five City Regionalization.MXD

APPENDIX I

Draft Memorandum

SE Wise County Regional Wastewater Study – Collection and Treatment System Alternatives

FROM: *Susan K. Roth, P.E. (Susan K. Roth Consulting)*

DATE: *May 31, 2010*

This memorandum summarizes the thought process behind the development of the collection and treatment system alternatives for the Southeast Wise County study area. The timeline for the development of alternatives was through 2030 and also included the retrofit of areas served by septic systems. Prior to the development of the alternatives, each city's existing wastewater system and development patterns were investigated. In addition, the following factors were also considered:

- *Topography of the study area:* The distance between the cities, as well as the direction of the drainage flows in the area impact the planning of a regional system. A ridgeline runs north to the south, parallel to US Highway 81 (reference Figure 1). As a result, gravity sewers in the New Fairview area and eastern part of Rhome would flow to the east; gravity sewers in Aurora, Newark and the western part of Rhome would flow to the southwest (towards Newark);
- *Physical barriers to regionalization:* The West Fork of the Trinity River may present an obstacle to Boyd physically joining a regional system;
- *Number of sub-basins:* The greater the number of lift stations required to pump flows across the sub-basins increases the overall cost (construction and O&M) for each city; and,
- *Existing and anticipated development densities:* If denser developments are encouraged by the cities, the viability of developing or expanding a centralized wastewater system will be improved.

Impact of Development Densities on Cost of Wastewater Systems

The planning of wastewater facilities is often driven by future development rather than existing development. For areas served by a centralized wastewater system, the density of developments typically range from 2 to 3.5 lots per acre. Centralized wastewater service is more expensive than OSSFs for lot sizes greater than an acre.

A majority of the existing developments in the study area have average densities of less than one lot per acre. Development densities have a considerable impact on the sizing of wastewater collection facilities. In order for centralized wastewater treatment to become more cost effective, the cities would need to promote and encourage higher density developments, targeting 2 to 3.5 lots per acre. Figure 2 below depicts the relationship of the lot size versus the cost of implementing septic or centralized wastewater treatment. Note that Wise County requires a minimum lot size of one acre for conventional septic tank/drainfield systems; Figure 2 does not present a cost for these types of systems below a lot size of one acre.

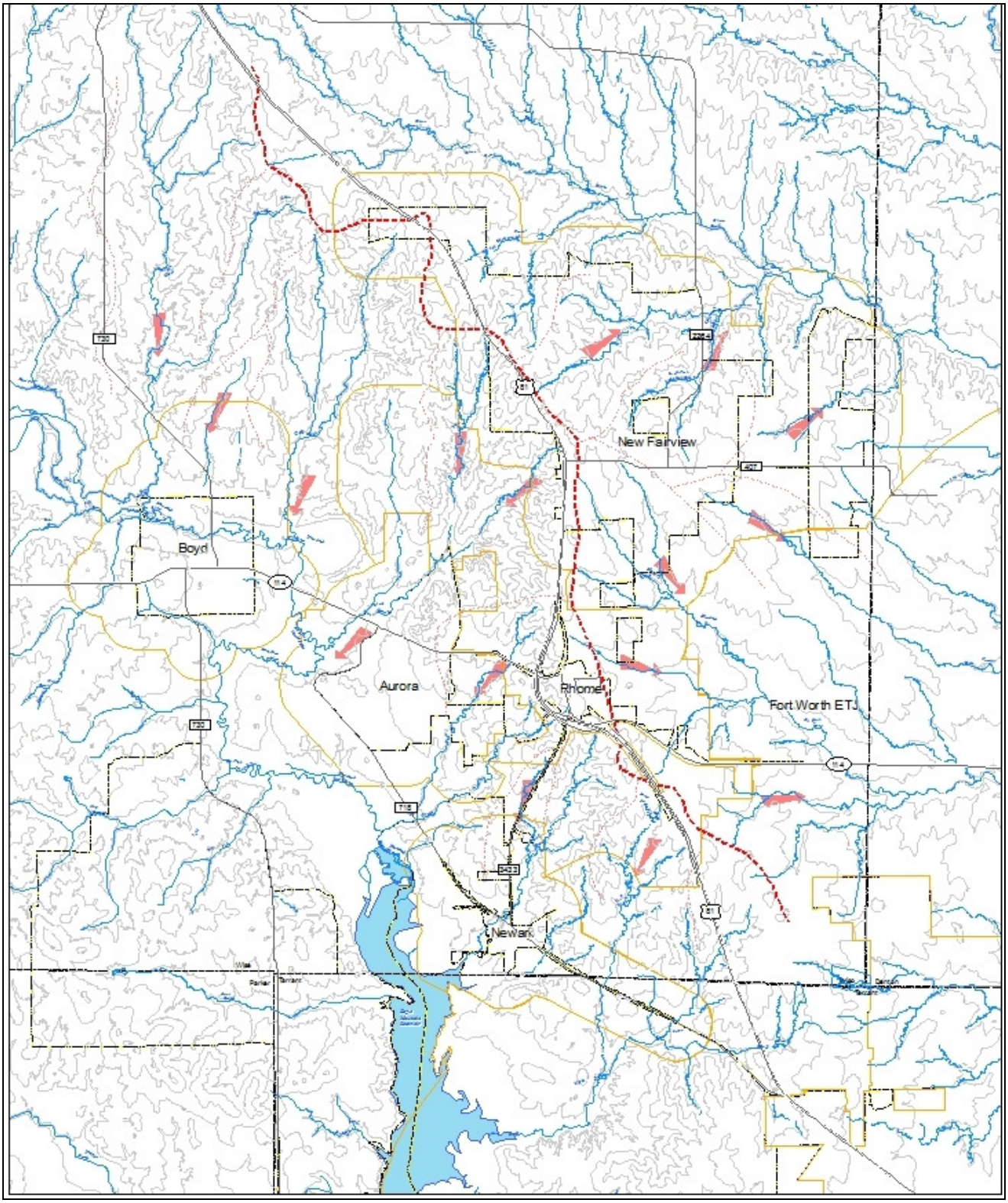
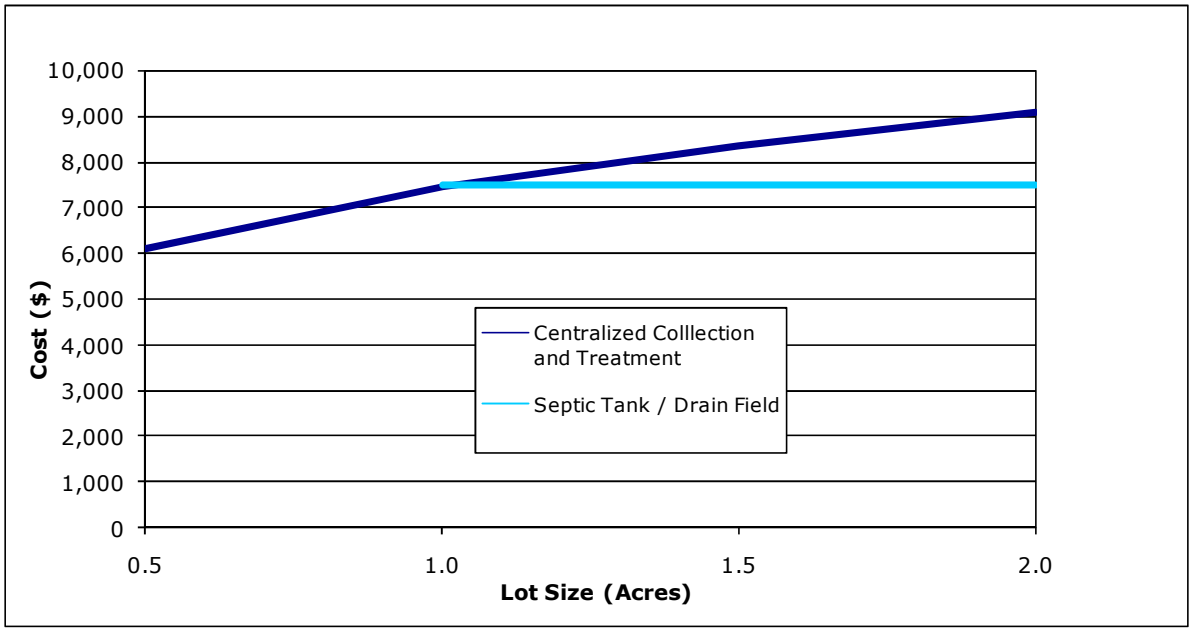


Figure 1: Topographic Map of Study Area

As shown, the cost for implementing centralized wastewater treatment is more cost-effective for lot sizes of one acre and less. This information established the basis for classifying the existing and future developments within each of the cities. The source of the data in Figure 2 is based on bid prices from recent projects of varying capacities.

Since an aerobic-type OSSF system is typical for the rocky terrain, located north of FM 114 in the City of Aurora, the cost estimate for this type of system was estimated at $7,500 and used for cost comparison purposes in Figure 2.

Figure2: Cost Trend for Centralized Service vs. Lot Size



General Observations

A description of each city's existing wastewater system has already been presented in the previous section. Important observations regarding development patterns for each city are noted below.

City of Aurora

Although the City of Aurora is served entirely by septic systems, they have a strong desire to provide wastewater service to commercial developments along the Highway 114 corridor. Previous developments constructed in the City of Aurora have been low density subdivisions with an average of less than one lot per acre. In addition, future development proposed for the area also appears to be planned for low density; however, property along Highway 114 may be developed at a higher density with 1/3 acre lots.

During the data collection activities, the City identified the following areas as potential sites for receiving reuse water:

- Aurora City Park (40 acres)
- Aurora Sand Mining Pit (40 acres)
- Aurora Vista Storage Pond Site (20 acres)

City of Boyd

A majority of the City of Boyd's development is connected to their centralized wastewater system, including the Highland Oaks subdivision. The City's WWTP is relatively new and has been recently expanded to double its treatment design capacity. The City's WWTP will be able to serve a portion of the developments by Larry Cole Communities proposed for the area northwest of Boyd. These developments (Ivy Hills and Boyette Tract) will require doubling the capacity of the existing WWTP again in order to serve their entire build-out of projected equivalent dwelling units (EDUs).

City of Newark

A majority of the City of Newark's development is connected to their centralized wastewater system. However, developments located to the west and north of the City have been typically constructed at one lot per acre and these areas are primarily not connected to the City's wastewater system. Most of the undeveloped property within Newark's ETJ is either within the Rolling V Ranch or borders Highway 718 southeast of the City.

City of New Fairview

Developments to date in the City of New Fairview have been low density since the City is served entirely by septic systems. The City's website indicates there is a one-acre minimum lot size requirement currently in effect; residential developments are fairly dispersed as a result. The 287 Travel Center, Skyview Ranch, and Rio Rancho Estates are the only developments with population densities and potential wastewater flows that might justify the construction of a wastewater system.

A review of New Fairview's future land use plan indicates a continuation of "very low density" residential development. The plan notes that higher densities will "not (be) prohibited but (they would be) expected to be unique in development design". The plan shows that an industrial / commercial strip is proposed along US Highway 287/State Highway 81; approximately nine commercial "nodes" or areas of development are also planned throughout the City's ETJ.

City of Rhome

A majority of the City of Rhome's developments are connected to their centralized wastewater system. Developments in the City have been higher density, except those located in the outlying areas. Since the Rhome East WWTP has outdated technology, the City plans to abandon it in the near future. The Rhome West WWTP is relatively new, but experiences I/I problems which have resulted in WWTP capacity issues. However, the City has plans to conduct an I/I reduction program. The City currently plans to either double or triple the treatment capacity of the Rhome West WWTP. Unless regionalization occurs, the City will abandon the Rhome East WWTP and expand the Rhome West WWTP.

Development and Description of Initial Alternatives

Based on the extent of the existing wastewater systems and on the development patterns and other factors presented in the previous section, a total of eight initial alternatives were developed. These alternatives are described in the following paragraphs. A summary of the advantages and disadvantages is presented in the following section along with the results of the screening of the initial alternatives.

Base Case: No Regionalization

A Base Case alternative was developed to serve as a benchmark against which the alternatives could be compared. The Base Case assumes that the typical development patterns for each city would continue and that large new developments would pursue their own wastewater systems. The Base Case is further described as follows:

- Newark renovates/expands its WWTP and serves smaller new developments;
- Boyd serves some new developments, up to the capacity of its existing WWTP;
- Rhome abandons the Rhome East WWTP and expands the Rhome West WWTP;
- Aurora and New Fairview continue to be served by on-site septic systems;
- The proposed Ivy Hills development builds a 0.300 MGD WWTP northwest of Boyd; and,
- The proposed Rolling V Ranch obtains a wastewater discharge permit and constructs a WWTP east of Newark.

Option A: Cities Remain Independent

In Option A, each of the cities remains independent and continues with their current type of wastewater system. The Cities of Aurora and New Fairview remain on septic systems. However, the Cities of Boyd, Newark and Rhome expand their WWTPs to serve developers nearby and new growth. Details of Option A are presented below:

- Newark renovates & expands its existing WWTP or constructs a new WWTP on a different site; Newark serves Rolling V Ranch and other new developments;
- Boyd serves Ivy Hills and other new developments, expanding the capacity of its existing WWTP by approximately two-fold;
- Rhome abandons the Rhome East WWTP and expands the Rhome West WWTP as needed to serve new developments; and,
- Aurora and New Fairview continue to be served by on-site septic systems.

Option A-1: Cities Remain Independent (WWTPs for Aurora & New Fairview)

In Option A-1, each of the cities remains independent and continues with their current type of wastewater system; however, the Cities of Aurora and New Fairview construct their own package WWTPs to serve commercial areas and/or denser residential developments. The Cities of Boyd, Newark and Rhome expand their WWTPs to serve developers nearby and new growth. Details of Option A-1 are presented below:

- Newark renovates & expands its existing WWTP or constructs a new WWTP on a different site; Newark serves Rolling V Ranch and other new developments;
- Boyd serves Ivy Hills and other new developments, expanding the capacity of its existing WWTP by approximately two-fold;
- Rhome abandons the Rhome East WWTP and expands the Rhome West WWTP as needed to serve new developments; and,
- Aurora and New Fairview build small package WWTPs for commercial areas and/or denser residential developments; however, the City mostly relies on individual on-site septic systems.

Option B: Partial Regionalization (Newark, Rhome & Rolling V Ranch)

In Option B, regionalization would begin with the cooperation of the Cities of Newark and Rhome. A new regional WWTP would be constructed to serve both cities, as well as Rolling V Ranch. The Cities of Aurora and New Fairview remain on septic systems. The City of

Boyd remains independent from the regional system and eventually expands their WWTP to serve other new developments in the area. Option B is further described below:

- Rhome abandons the Rhome East WWTP and pumps to the Rhome West WWTP; flows in excess of the capacity of the West WWTP are routed through Rolling V Ranch to the Regional WWTP; the Rhome West WWTP is eventually abandoned;
- Boyd serves Ivy Hills and other new developments, expanding the capacity of its existing WWTP by approximately two-fold; and,
- Aurora and New Fairview continue to be served by on-site septic systems.

Option B-1: Partial Regionalization (including Aurora)

In Option B-1, regionalization would begin with the cooperation of the Cities of Newark and Rhome; service is extended to the City of Aurora to include them in the regional system. A new regional WWTP would be constructed to serve both cities, as well as Rolling V Ranch. The City of New Fairview would remain on septic systems. The City of Boyd remains independent from the regional system and eventually expands their WWTP to serve other new developments in the area. Option B-1 is further described below:

- Regional entity includes Newark, Rhome, Rolling V Ranch and parts of Aurora;
- As in Option B, Rhome abandons the Rhome East WWTP and pumps to the Rhome West WWTP; flows in excess of the capacity of the West WWTP are routed through Rolling V to the Regional WWTP; eventually the Rhome West WWTP is abandoned;
- Aurora remains primarily on septic systems, but wastewater flows from commercial and denser residential areas are routed through Rolling V Ranch to the Regional WWTP;
- Boyd serves Ivy Hills and other new developments, expanding the capacity of its existing WWTP by approximately two-fold; and,
- New Fairview continues to be served by on-site septic systems.

Option B-2: Partial Regionalization (including Aurora & New Fairview)

In Option B-2, regionalization is initiated with the cooperation of Rolling V Ranch and the Cities of Newark and Rhome; service is extended to the City of Aurora and New Fairview to include them in the regional system. The City of Boyd remains independent from the regional system and eventually expands their WWTP to serve other new developments in the area. Option B-2 is further described below:

- Regional entity renovates & expands Newark's existing WWTP or constructs a new WWTP on a different site; serves Rolling V Ranch, Rhome and parts of Aurora and New Fairview;
- As in Option B, Rhome abandons the Rhome East WWTP and pumps to the Rhome West WWTP; flows in excess of the capacity of the Rhome West WWTP are routed through Rolling V Ranch to the Regional WWTP; eventually the Rhome West WWTP is abandoned;
- Aurora and New Fairview remain primarily on septic systems, but wastewater flows from commercial and denser residential areas are routed to the Regional WWTP; and,
- Boyd serves Ivy Hills and other new developments, expanding the capacity of its existing WWTP by approximately two-fold.

Option C: Partial Regionalization (including Aurora & Boyd)

In Option C, regionalization would begin with the cooperation of Rolling V Ranch and the Cities of Newark and Rhome; service is extended to the Cities of Aurora and Boyd to include them in the regional system. A new regional WWTP would be constructed to serve the entities. The City of New Fairview would remain on septic systems. Option C is further described below:

- As in Option B-1, the regional entity renovates & expands Newark's existing WWTP or constructs a new WWTP on a different site; serves Rolling V Ranch, Rhome, parts of Aurora and Boyd;
- Rhome abandons the Rhome East WWTP and pumps to the Rhome West WWTP; flows in excess of the capacity of the Rhome West WWTP are routed through Rolling V Ranch to the Regional WWTP; eventually the Rhome West WWTP is abandoned;
- Aurora remains primarily on septic systems, but wastewater flows from commercial and denser residential areas are routed through Rolling V Ranch to the Regional WWTP;
- Boyd serves Ivy Hills and other new developments, but does not expand the capacity of its existing WWTP. Wastewater flows in excess of its capacity are routed through Aurora to the Regional WWTP; eventually, the Boyd WWTP is abandoned; and,
- New Fairview continues to be served by on-site septic systems.

Option C-1: Complete Regionalization

In Option C-1, complete regionalization is achieved by starting with the cooperation of Rolling V Ranch and the Cities of Newark and Rhome; service is extended to the Cities of Aurora, Boyd and New Fairview to include them in the regional system. A new regional WWTP would be constructed to serve the entities. Option C-1 is further described below:

- Regional entity renovates & expands Newark's existing WWTP or constructs a new WWTP on a different site; serves the entire area, except for those areas served by septic systems;
- As in Option C, Rhome abandons the Rhome East WWTP and pumps to the Rhome West WWTP; flows in excess of the capacity of the Rhome West WWTP are routed through Rolling V Ranch to the Regional WWTP; eventually the Rhome West WWTP is abandoned; and,
- As in Option C, Aurora remains primarily on septic systems, but wastewater flows from commercial and denser residential areas are routed through Rolling V Ranch to the Regional WWTP;
- As in Option C, Boyd serves Ivy Hills and other new developments, but does not expand the capacity of its existing WWTP. Wastewater flows in excess of its capacity are routed through Aurora to the Regional WWTP; eventually, the Boyd WWTP is abandoned; and,
- New Fairview remains primarily on septic systems, but wastewater flows from commercial and denser residential areas are routed to the Regional WWTP.

In summary, the Base Case assumes that no regionalization will occur and there would essentially be "no change" in the development patterns for each city. The large developers would each develop their own wastewater collection and treatment systems. The Cities of Aurora and New Fairview would continue their reliance on OSSFs. Options A and A-1 are minor variations of the "Base Case" with the Cities of Aurora and New Fairview

constructing their own WWTPs. Cities of Boyd and Newark extend wastewater service to nearby developments.

The "B" options all assume that regionalization would begin with the cooperation of Newark, Rhome and Rolling V Ranch. Options B-1 and B-2 consider variations for extending service to Aurora and New Fairview. The City of Boyd remains independent in all of the "B" options. Options C and C-1 show a regional system including Newark, Rhome, Rolling V Ranch and Aurora. Both options eventually add Boyd to the overall regional system. In Option C-1, New Fairview is also included into the regional system.

Screening of Initial Alternatives

The screening of the initial alternatives was accomplished during the second project meeting on January 26, 2009. The objective of the screening process was to reduce the total number of alternatives from eight down to three final alternatives for further evaluation. For the project meeting, a presentation was given that outlined all eight of the initial alternatives, including the advantages and disadvantages of each. The presentation also included general observations of each alternative that were relevant to the screening process.

The primary observations that were presented addressed the fact that the viability of a regional system will depend on the development density plans for future subdivisions, which influences whether OSSF systems or centralized wastewater collection/treatment systems are constructed. Another key factor involves the willingness of the Cities of Newark and Rhome to work together with the Rolling V Ranch development to achieve economies of scale of a regional wastewater system.

Additional important observations that were presented included the following:

- Beneficial results could be achieved by the City of Boyd and Ivy Hills working together, even if Boyd does not participate in the overall regional system;
- Aurora's participation is not essential to the viability of the initial regionalization, but it would facilitate the inclusion of Boyd into the regional system; and,
- Viability of the regional system is not dependent on New Fairview's participation.

Following the presentation, the participants were divided into three groups for a "working session" to discuss the eight initial alternatives, as well as the observations of the consulting team about the study area. The first group was comprised of the Cities of Aurora and New Fairview since they both were served completely by OSSF systems. The second group was made up of the City of Boyd and Larry Cole Communities because of their close proximity to each other and potential regional opportunities between the two parties. Rolling V Ranch and the Cities of Newark and Rhome met together in the third group since they could most likely be the initial players to form the regional system.

Facilitated discussions were held with each of the three groups as part of the process to gather feedback and narrow down the list of alternatives. During the working session, the following comments were emphasized by the participants about the initial alternatives and the perceived impact on their respective cities:

- The Base Case should be included as one of the final alternatives to evaluate in order to establish a base line for comparison purposes against the regional alternatives;

- Aurora and New Fairview wanted to explore the possibility of constructing centralized wastewater systems in parts of their cities and small package WWTPs to serve these areas in the Base Case alternative;
- Option B, B-1 or B-2 needed to be evaluated because they were expected to compare favorably to the Base Case. Furthermore, all of the "Option B" alternatives could be implemented initially with Newark, Rhome and Rolling V Ranch; however, the regional system could be expanded at a later date to include Aurora, Boyd and New Fairview; and,
- Option C-1 should be selected as one of the final alternatives for evaluation in order to assess the impact of complete regionalization.

As a result, the working session was a successful exercise, and all three groups were able to reach consensus on three final alternatives for further evaluation in the study.

Regional Alternatives Selected for Detailed Evaluation

Based on the feedback received during the working session, three final regional alternatives were selected for evaluation:

- Modified Base Case
- Option B
- Option C (previously referred to as Option C-1)

These three final alternatives are described in further detail in the paragraphs below.

Base Case (Modified)

The modified version of the Base Case includes all of the aspects of the original Base Case Option, but also involves the Cities of Aurora and New Fairview constructing centralized wastewater collection systems with package WWTPs to serve areas of commercial and higher-density residential developments. A summary of this revised alternative is provided below:

- Each party works independently from the others; no regionalization occurs;
- Newark renovates/expands its WWTP and serves smaller new developments (not including Rolling V Ranch);
- Boyd serves some new developments, up to the capacity of its existing WWTP;
- Rhome abandons its East WWTP, expands the West WWTP and serves smaller new development (not including Rolling V Ranch);
- The proposed Ivy Hills development builds a 0.300 MGD WWTP northwest of Boyd;
- The proposed Rolling V Ranch obtains a permit and builds a WWTP east of Newark; and,
- Aurora and New Fairview construct package WWTPs to serve commercial and high-density residential developments.

Regarding the City of Boyd, some new developments located in close proximity to the City would be served by the City's existing WWTP up to its capacity, but developments located outside of the ETJ would be served by WWTPs constructed by developers. As a result, wastewater flows from Highland Oaks and the 200-Acre Tract would be treated by the City of Boyd WWTP, and wastewater flows from the Boyette Tract would be pumped to the Ivy Hills WWTP for treatment. This would probably mean that the discharge permit for the Ivy Hills WWTP would need to be renewed for a higher flow amount.

Option B: Partial Regionalization

As a result of the working session, the participants agreed that Option B seemed the most promising alternative for implementing the regional system. The consulting team identified the existing Newark WWTP site, as well as two other possible sites located within Newark's ETJ for a regional system. A brief description of these plant sites is presented in Section 6.2. Details summarized for this alternative are noted below:

- Regionalization initiated between Rolling V Ranch and the Cities of Newark and Rhome;
- Newark WWTP either expanded or Regional WWTP constructed on a new site to serve Newark, Rolling V Ranch and Rhome;
- Rhome abandons its East WWTP and eventually its West WWTP; flows are routed through Rolling V Ranch to the Regional WWTP;
- Rhome eventually abandons its West WWTP;
- Boyd serves Ivy Hills and other new developments; and,
- Aurora and New Fairview continue to be served by on-site septic systems.

Option C: Complete Regionalization

During the working session, the participants also agreed that Option C should be included in the final evaluation of the project in order to understand the entire plan for a regional wastewater system to serve all cities and developments in the study area. In addition to the existing Newark WWTP site, the consulting team determined that the two other possible sites considered in Option B should also be considered for Option C. A brief description of these plant sites is presented in Section 6.3. Details summarized for this alternative are noted below:

- Wastewater for entire area treated at one WWTP;
- Newark WWTP either expanded or Regional WWTP constructed on a new site to serve the entire study area, except those homes currently on septic systems;
- Rhome abandons its East WWTP; flows are routed through Rolling V Ranch to the Regional WWTP;
- Rhome eventually abandons its West WWTP;
- Aurora remains primarily on septic; flows from commercial/denser residential areas are routed through Rolling V Ranch to the Regional WWTP;
- Boyd serves Ivy Hills and other new developments, but does not expand the capacity of its existing WWTP; flows in excess of the Boyd WWTP capacity are routed through Aurora to the Regional WWTP;
- Boyd eventually abandons its WWTP; and,
- New Fairview remains primarily on septic systems; flows from commercial/denser residential areas routed to the Regional WWTP.

Although the City of Boyd is physically separated from the other cities by the West Fork of the Trinity River, Boyd expressed an interest in knowing what infrastructure would be necessary, along with projected cost estimates, for them to eventually join the regional system in the future.

APPENDIX J

Draft Memorandum

SE Wise County Regional Wastewater Study – Findings and Recommendations

FROM: *Susan K. Roth, P.E. (Susan K. Roth Consulting)*

DATE: *May 31, 2010*

This memorandum summarizes the findings and recommendations for the Southeast Wise County Regional Wastewater Study. As noted in the draft memorandum for the Collection and Treatment System Alternatives, three final options were selected for a complete evaluation based on a preliminary assessment and feedback received on the initial regional alternatives during the working session of the second project meeting on January 26, 2009. Based on the feedback received during the working session, three final regional alternatives were selected for evaluation:

- ***Modified Base Case:*** each entity would construct their own WWTP and no regionalization would occur;
- ***Option B:*** Rolling V Ranch and the Cities of Newark and Rhome would participate in a regional system; the City of Boyd would serve Ivy Hills and the Boyette Tract; and,
- ***Option C (previously referred to as Option C-1):*** all five cities and major planned developments would eventually be served by a regional system.

For Option B, two different wastewater treatment plant locations were considered in accordance with the results of the water quality findings discussed in Chapter 6. Otherwise, the Option B cases were the same.

Evaluation Strategy

To compare the three alternatives selected for the final evaluation, the following strategy was used:

- A preliminary layout for the major components of the collection system was prepared taking into account topography, existing facilities, areas to be served in each alternative, and property boundaries that could be discerned from the aerial photographs available. This included determining where lift stations and force mains would be required.
- Average and peak wastewater flows were then estimated along each component of the collection system and these were used together with the topographic information to determine the size of each wastewater pipe segment. Year 2030 population projections for the cities plus full build-out of the developments were used to calculate the flows used to select each pipe.
- Peak wastewater flows were also used to determine the ultimate required capacity of the lift stations and force mains.
- Average wastewater flows were used to determine the ultimate required capacity of the treatment plants.
- Five-year population and flow projections were then used to determine the phasing of lift stations, force mains and treatment plants. Small lift stations were not phased but it was assumed that large lift stations would be constructed in two phases with a

corresponding force main for each phase. Except in the case of very small plants (capacities less than 0.20 MGD), treatment plants were also to be built in phases. In some cases, as many as five phases were assumed.

- Constructions costs were then prepared for each alternative and the timing of the investment was assigned according to the flow projections for each 5 year interval.
- Soft costs were added to the construction costs and present values were then calculated for the schedule of investments over the planning horizon (years 2010 to 2034).
- Annual operation and maintenance (O&M) costs were then estimated for each alternative over the planning horizon and these were also reduced to present values.
- Finally, present value capital costs and O&M costs were added to obtain total present values for each alternative.

Summaries of the key infrastructure features of each alternative are given in the sections which follow.

Modified Base Case

In the Modified Base Case, each public entity and most of the large private entities would construct and expand their wastewater systems independently of the other entities. Thus, no regionalization would occur in this alternative. The key infrastructure features for each entity are summarized as follows:

City of Boyd

- A lift station and 6-inch FM would be constructed on FM 730 just north of the West Fork of the Trinity River in order to pump wastewater flows from the '200-Acre Tract' to the Boyd WWTP (since this tract is within Boyd's ETJ).
- The City of Boyd's existing two WWTPs have sufficient capacity to serve the growth anticipated in the city's ETJ throughout the planning period. An expansion of the Boyd WWTP would not be needed until after 2034. The ultimate capacity of the plant would be about 0.36 MGD with the addition of a third 0.12 MGD plant after the year 2034.

Ivy Hills & Boyette Tract

- A lift station and 8-inch FM would be constructed to pump flows from the Boyette Tract to the proposed Ivy Hills WWTP, assuming that there were agreements between the developers of Ivy Hills and the Boyette Tract.
- Phase I of the proposed Ivy Hills WWTP (0.25 MGD) would have sufficient capacity through Y2028.
- Phase II of the Ivy Hills WWTP would be built during the period from years 2025-2029 for an ultimate treatment plant capacity of 0.50 MGD.

City of Aurora

- The City would construct 8-inch & 12-inch gravity sewers along Hwy 114.
- A lift station and 8-inch FM would be constructed to pump flows from the eastern side of Aurora to the west (along Hwy 114).
- The Aurora WWTP would be located near Blue Creek and Phase I would be built during the period of years 2020 to 2024 and would have a capacity of about 0.24 MGD, which would be sufficient to serve new developments in Aurora throughout the planning period.

- Phase II of the plant would be built after 2034 and the ultimate treatment capacity would be 0.48 MGD.

City of New Fairview

- 8-inch gravity sewers would be constructed along Hwy 407 and then south to the proposed New Fairview WWTP (located southeast of 287 Travel Center).
- The New Fairview WWTP would be constructed in one phase with a capacity of 0.10 MGD, which would be sufficient capacity to serve developments in the western portion of New Fairview.
- It is assumed that the above described system would be constructed between years 2020 and 2024.

City of Rhome

- Flows from Rhome's East WWTP would be diverted to the West Plant by 2014 in order to eliminate the operational costs and problems associated with the East plant.
- A Phase II expansion of the West WWTP (0.15 MGD) would be constructed prior to Y2014, thereby increasing the total treatment capacity to 0.30 MGD. This capacity would be sufficient to serve anticipated developments in Rhome's ETJ (with the exception of those portions of the Rolling V Ranch Development within Rhome's ETJ) throughout the planning period.
- To serve the northwest side of Rhome, a small lift station and 4-inch FM would be constructed just south of Hwy 114 to pump flow to the West WWTP.

City of Newark

- To serve anticipated developments (with the exception of Rolling V Ranch), additional capacity will be required at the existing Newark WWTP. Due to the condition of this plant, it is assumed that the existing plant would be replaced with a new plant with a capacity of 0.15 MGD. Growth projections indicate that the new plant is needed by year 2013.

Rolling V Ranch

- The main interceptor to serve the large Rolling V Ranch would be located along Derrett Creek, running north to south and parallel and east of FM 3433. This interceptor would be 8-inches in diameter at the north end and 18-inches in diameter at its south end.
- The Derrett Creek LS would be constructed at the south end of the aforementioned interceptor. This lift station will pump flows through 10-inch and 12-inch force mains to the Rolling V Ranch WWTP. Phase I of the LS and the 10-inch FM would be constructed in 2015. Phase II and the second 10-inch FM would be built sometime after 2034.
- To serve the eastern portion of the development, Rolling V Ranch would construct the Moss Branch LS to pump flows from areas within the Moss Branch drainage area to the Rolling V Ranch WWTP. Phase I of the LS and the 6-inch FM would be constructed in 2020. Phase II and the 16-inch FM would be built sometime after year 2034.
- It is assumed that the Rolling V Ranch WWTP would be constructed in 3 (or 4) phases and that the first phase would have a capacity of about 0.40 MGD, which would serve the anticipated development until sometime between 2025 and 2029, when Phase II would be built.
- The ultimate capacity of the Rolling V Ranch WWTP would be about 1.6 MGD.

The total capital cost associated with all the collection and treatment components for the Modified Base Case have been estimated at $58.5 million. This is the sum of the costs for all the entities and for constructing all the components for the ultimate anticipated wastewater flows.

Note that this cost does not represent the total cost for the wastewater systems as the smaller collection lines that would feed into the main lines are not included. These lines would be common to all three options and their location, length and size will be dependent on the detailed development plans for each area. Since these development plans are not available and they are common to all options, their cost is not included and would not affect the relative cost between the three options being evaluated.

Since the Rolling V Ranch site is quite large, the developer may find that the construction of one or more small package treatment plants would be attractive from a cash-flow standpoint, instead of constructing the infrastructure described above during the initial phases of the Rolling V Ranch development.

Option B: Partial Regionalization

Four different WWTP effluent discharge locations were considered for the regional plant sites considered in Option B. However, in accordance with the water quality investigation, the existing Newark WWTP site was eliminated as a potential site for a regional treatment facility. This left two potential WWTP sites and three effluent discharge routes as described below:

- ***Unnamed Tributary Regional Plant Site*:** Construct a new Regional WWTP on a site located south of Rolling V Ranch, north of FM 718 and within Newark's ETJ. This plant would discharge into an unnamed tributary that flows to Eagle Mountain Lake.
- ***Moss Branch Regional Plant Site (Discharge to Moss Branch):*** Construct a new Regional WWTP on a site located about 4,500 feet to the east of the Unnamed Tributary Regional Plant Site. This plant would discharge into Moss Branch.
- ***Moss Branch Regional Plant Site (Discharge to Indian Creek):*** Construct a new Regional WWTP on the same Moss Branch site, but this plant would discharge into Indian Creek.

Except for the location of the regional WWTP and the length of the force mains to the plant, the three Option B cases are the same. The key infrastructure features for all three Option B cases are summarized as follows:

City of Boyd Together With Ivy Hills and Boyette Tract

- A lift station (labeled the "Ivy Hills LS") and a 6-inch FM would be constructed on the southern edge of the Ivy Hills tract in lieu of constructing a WWTP at that location. This pump station would pump wastewater from Ivy Hills to a wastewater interceptor in the Boyette tract. Future topographic studies may indicate that it would be possible to install a gravity line along the West Fork of the Trinity River in a southeasterly direction to avoid the necessity of building a lift station, but the current assessment is that this solution would be difficult to implement.
- An interceptor to transport Ivy Hills' wastewater flows and to collect flows from the Boyette Tract and the 200 Acre Tract would be constructed running in a

southeasterly direction through the Boyette Tract, then through the 200 Acre Tract, and finally to FM 730. This interceptor would be 8-inches in diameter at the north end and 15-inches in diameter from the 200 Acre Tract to FM 730.

- A lift station (labeled the "FM 730 LS") would pump wastewater flows through a 10-inch FM across the West Fork of the Trinity River into a 15-inch gravity interceptor that would flow in an easterly direction into the existing Boyd WWTP site.
- Boyd's two existing WWTPs have sufficient capacity to serve the anticipated growth to about year 2023. The plant would be expanded by 0.24 MGD in the period from 2020 to 2024. The final expansion of another 0.24 MGD) would not be needed until after 2034. Thus, the ultimate capacity of the plant would be about 0.72 MGD.

City of Aurora

- During the working session held at the second project meeting (January 26th), it was decided that the Option B cases would not include centralized wastewater collection or treatment in Aurora, and that future developments would be served by OSSFs. However, centralized collection and treatment were included during the evaluation process of the Option B cases.

City of New Fairview

- During the working session held at the second project meeting (January 26th), it was decided that the Option B cases would not include centralized wastewater collection or treatment in New Fairview, and that future developments would be served by OSSFs. However, centralized collection and treatment were included during the evaluation process of the Option B cases.

Rhome / Newark / Rolling V Ranch Regional System

- To avoid having to divert flows from Rhome's East WWTP to Rhome's West Plant, the East plant would be kept on line until the main interceptor through Rolling V Ranch was constructed. Then, the flows into Rhome's East plant would be diverted into that gravity interceptor. Initial indications are that a gravity connection between the East Plant and the upper end of the Derrett Creek interceptor would be feasible, but this will have to be confirmed by more detailed topographic information.
- As in the Modified Base Case, a main interceptor to serve the large Rolling V Ranch development would be located along Derrett Creek, but in Option B, it would also be sized to handle the flows from Rhome. This interceptor would be 12-inches in diameter at the north end and 21-inches in diameter at its south end.
- To serve the northwest side of Rhome, a small lift station and 4-inch FM would be constructed just south of Hwy 114 to pump flow towards the West WWTP.
- The anticipated flow calculations indicate that Rhome's West Plant has sufficient capacity to serve the western side of Rhome, assuming that the East Plant flows are not diverted to the West Plant. When Rhome's West WWTP reaches the end of its useful life, flows would be diverted into a 12-inch gravity sewer that would flow to the proposed Oates Branch East LS. After this diversion, the West WWTP could be abandoned. It has been assumed that Rhome's West WWTP would be abandoned between the years 2020 and 2024. However, growth in Rhome could dictate the need for an expansion prior to the construction of the infrastructure needed to transport flows from Rhome to the Regional WWTP.

- The Oates Branch East LS would be constructed on the northwestern edge of the Rolling V Ranch development. It would pump wastewater flows diverted from Rhome's West WWTP and from the northwestern sections of Rolling V Ranch through an 8-inch FM over a ridge and into a 12-inch gravity sewer that would run in a southeasterly direction to join the main Derrett Creek interceptor just south of the existing Chisholm Creek development.
- As in the Modified Base Case, the Derrett Creek LS would be constructed at the south end of the Derrett Creek interceptor. However, in Option B, this lift station would be larger and will pump flows through two 12-inch force mains to the Regional WWTP. Phase I of the LS and the first 12-inch FM would be constructed in 2015. Phase II and the second 12-inch FM would be built between the years 2030 and 2034.
- To receive flows from the eastern portion of the Rolling V Ranch development, as well as to collect wastewater from areas between that development and Hwy 718, a 12-inch and 15-inch gravity sewer would be built along Moss Branch.
- A proposed Moss Branch LS would be constructed at the southern end of the aforementioned 12/15-inch sewer. This LS would be built in two phases and would pump flows from areas within the Moss Branch drainage area to the Regional WWTP. Phase I of the LS and the 8-inch FM would be constructed in years 2020 to 2024. Phase II and the second 8-inch FM would be built sometime beyond 2034.
- Due to the condition of Newark's plant, it is assumed that the existing plant would be abandoned by about Y2014, and that the proposed Newark Diversion LS would be constructed. This LS would pump Newark's wastewater through a 6-inch FM to the Regional WWTP.
- It is assumed that the Regional WWTP would be constructed in three to four phases and that the first phase would have a capacity of about 0.50 MGD. Phases II and III, each with a capacity of 0.50 MGD each, would be constructed 5 years and 10 years later, respectively.
- The ultimate capacity of the Regional WWTP would be about 2.0 MGD.

The total capital cost of constructing the system, with the Regional WWTP located on the Unnamed Tributary of Option B, was estimated at $44.5 million. Note that this cost does not include either OSSFs or stand-alone community wastewater systems for Aurora or New Fairview.

Constructing the Regional WWTP at the Moss Branch Site and discharging into either Moss Branch or Indian Creek would require extensions of the force mains from the proposed Derrett Creek Lift Station and the Newark Diversion Lift Station. It would also require an extension of a 15-inch gravity main down Moss Branch, but the 8-inch force mains from the Moss Branch Lift Station would be shorter. The locations of these facilities are shown in Figures 1 and 2. The Moss Branch Regional Plant Site would add approximately $1.3 million to the total capital cost of Option B, compared to the cost for the plant at the Unnamed Tributary Site. According to water quality modeling results, the ammonia nitrogen limit would be slightly higher for the Moss Branch Site (1.9 mg/L vs. 1.3 mg/L for the Unnamed Tributary Site); however, this difference would not result in significant capital or O&M cost savings.

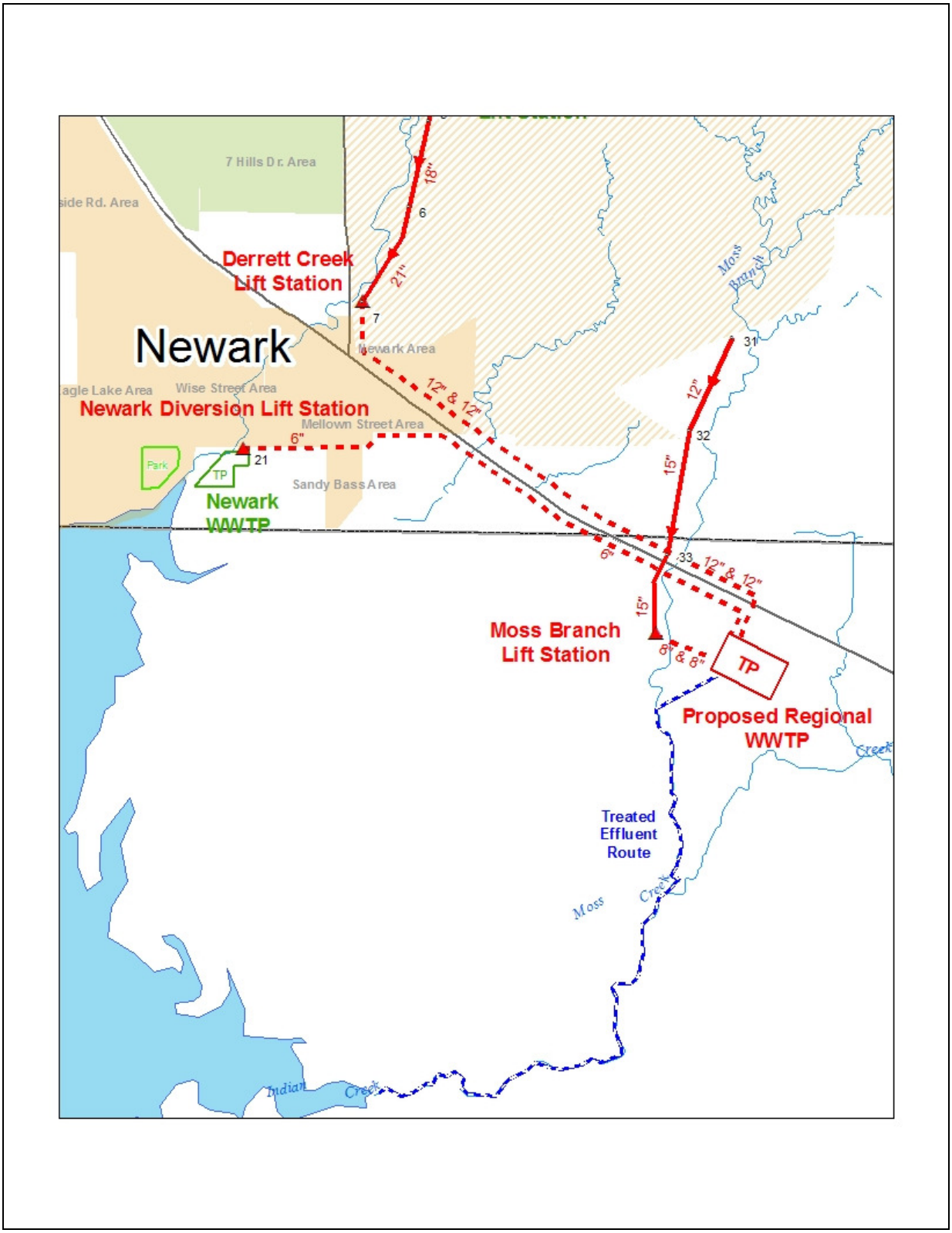


Figure 1: Moss Branch Regional WWTP Site (Discharge to Moss Branch)

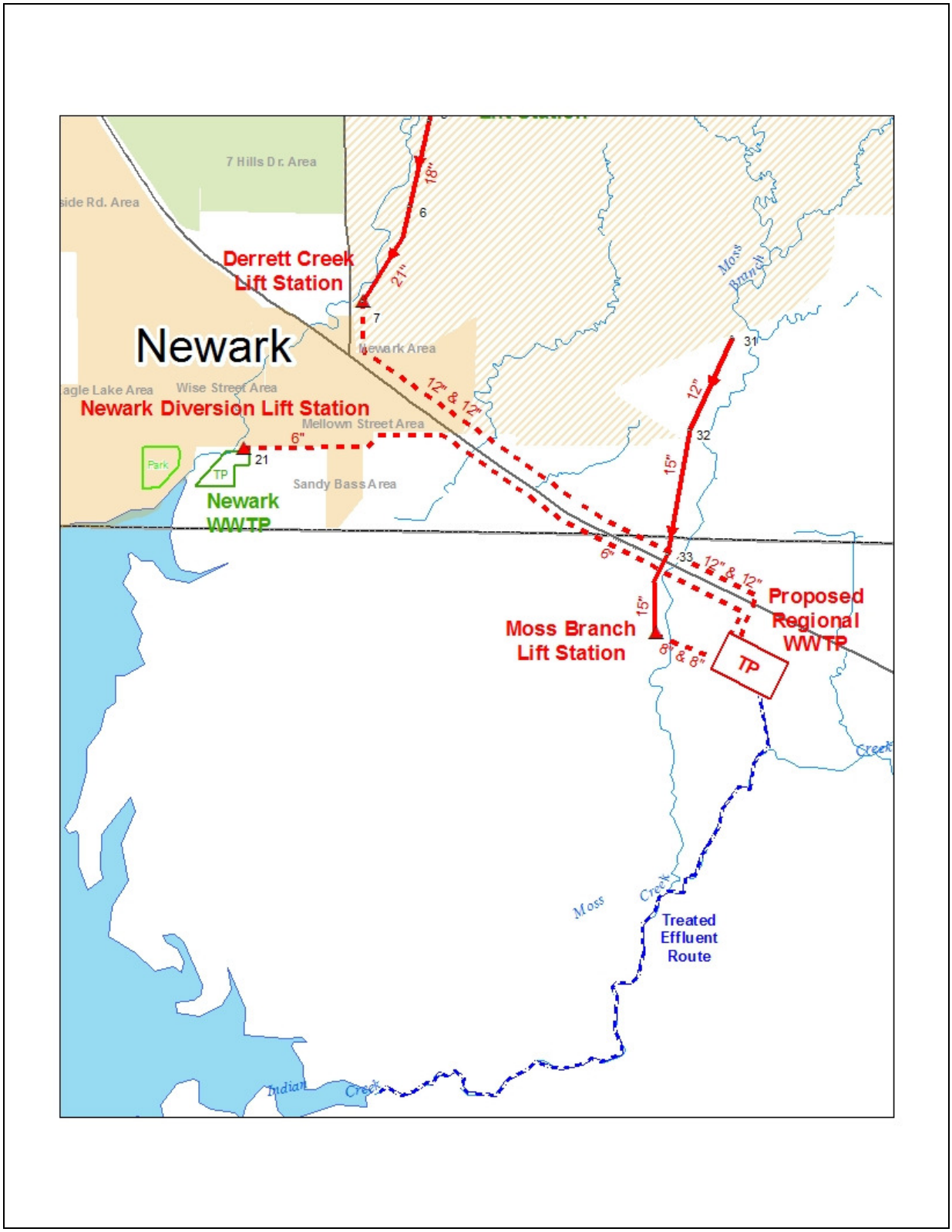


Figure 2: Moss Branch Regional WWTP Site (Discharge to Indian Creek)

Since the Moss Branch Regional Plant Site is $1.3 million more expensive, there is little benefit to considering this site. Thus, the evaluations and comparison with the other alternatives, as described below, assume the plant site will be on the Unnamed Tributary.

Option C: Complete Regionalization

In Option C, Newark, Rhome and Rolling V Ranch would form the initial core of a regional collection and treatment system and complete regionalization would be achieved by eventually extending the system to include Aurora, Boyd and New Fairview.

Many of the key infrastructure features for Option C would be the same as for Option B, except that the size of these facilities would be larger due to the increased wastewater flows. Another difference is that there are only two potential effluent discharge locations based on the results of the water quality modeling. However, the collection system costs will be higher for this WWTP site as noted above for Option B. Thus, only the Unnamed Tributary Regional WWTP Site has been evaluated for Option C. Starting with the initial core of the regional system, the key infrastructure is summarized below:

Rhome / Newark / Rolling V Ranch Regional System

- The diversion of flows from Rhome's East WWTP into the main interceptor through Rolling V Ranch would be the same as for Option B.
- The Derrett Creek interceptor would follow the same route as in Option B, but the southern portions would be larger to carry the additional flows for complete regionalization. This interceptor would be as large as 27-inches in diameter at its southern end.
- Just as in Option B, it is assumed that Rhome's West WWTP would be abandoned between the years of 2020 and 2024 and that flows would be diverted into a 12-inch gravity sewer that would flow to the proposed Oates Branch East LS.
- The Oates Branch East LS would have to be substantially larger since this lift station would eventually receive flows from Boyd, Aurora and New Fairview, in addition to the flows diverted from Rhome's West WWTP and from the northwestern sections of Rolling V Ranch. This LS would be built in two phases and would pump flows through a 12-inch and 16-inch force mains. Phase I of the LS and the 16-inch FM would be constructed between the years of 2020 and 2024. Phase II and the 12-inch FM would be built between the years of 2030 and 2034.
- The interceptor receiving flow from the two force mains mentioned above would need to be about 21-inches in diameter and would flow by gravity in a southeasterly direction to join the main Derrett Creek interceptor just south of the existing Chisholm Creek development.
- The proposed Derrett Creek LS, to be constructed at the south end of the Derrett Creek interceptor, would be built in at least two phases, along with 12-inch and 20-inch force mains which would discharge at the regional WWTP. Phase I of the LS and the 12-inch FM would be constructed between the years of 2015 and 2019. Phase II and the 20-inch FM would be built between the years of 2025 and 2029.
- The system serving the eastern Moss Branch drainage area would be the same as in Option B.
- Newark's existing WWTP would be abandoned by about 2014, and the proposed Newark Diversion LS would pump Newark's wastewater through a 6-inch FM to the regional WWTP.

City of Boyd, Ivy Hills and Boyette Tract

- The system serving Ivy Hills, Boyette Tract and the 200 Acre Tract would be exactly the same as in Option B.
- Boyd's two existing WWTPs have sufficient capacity to serve the anticipated growth to about year 2023. Between years 2020 and 2024, instead of expanding the Boyd WWTP, it would be abandoned after the construction of a diversion system that would consist of an 18-inch interceptor from Boyd's existing WWTP to the west bank of the West Fork of the Trinity River. It is assumed that an inverted siphon could be constructed to cross the river and deliver the wastewater into a continuation of the 18" interceptor. This interceptor would continue to run in a southeasterly direction towards the proposed Blue Creek LS.

City of Aurora

- As in the Modified Base Case, the City of Aurora would construct 8-inch and 12-inch gravity sewers along Hwy 114 and these would flow to the west and then southwest and then into the proposed Blue Creek LS.
- The Blue Creek LS would receive flows from Aurora and eventually all the flow from Boyd, Ivy Hills and the Boyette Tract. This LS would be built in two phases. Phase I of the LS and a 12-inch FM would be constructed between the years of 2020 and 2024. Phase II and the 10-inch FM would be built between 2025 and 2030.
- The eastern end of the two FMs would discharge into an 18-inch interceptor that would run east along Hwy 114, collecting wastewater from developments on the eastern edge of Aurora, and then south to a proposed Oates Branch West LS.
- The proposed Oates Branch West LS would receive wastewater from the Boyd and Aurora areas, as well as from New Fairview as described below. This LS would also be built in two phases. Phase I of the LS and a 10-inch FM would be constructed in between the years of 2020 and 2024. Phase II and a 10-inch FM would be built during the period of years 2030 and 2034.

City of New Fairview

- The sewer system in New Fairview would be the same as in the Modified Base Case, but the sewers would terminate at the proposed Upper Elizabeth Creek LS, which would pump wastewater from New Fairview west and then south along Hwy 287/81 through a 6-inch FM.
- The 6-inch FM would discharge into a gravity sewer that would collect wastewater from the northwest side of Rhome. This gravity sewer would be 8-inch north of Hwy 114 and 12-inch south of the highway. The 12-inch would run in a southwesterly direction until it joined the 18-inch interceptor on the eastern side of Aurora.
- As in the Modified Base Case, it was assumed that the New Fairview System would be built during the period of years 2020 and 2024.

Regional WWTP

- It is assumed that the Regional WWTP would be constructed in four or five phases and that the first phase would be built between the years of 2015 and 2019 and have a capacity of about 0.675 MGD. Phases II and III would be constructed during the periods of 2020 to 2024 and 2025 to 2029, respectively.
- The ultimate capacity of the Option C Regional WWTP would be about 3.4 MGD.

Conclusions and Recommendations

In conclusion, the results of this study indicate that Option B is the most promising alternative for the project participants to initiate a regional wastewater system. Option B represents partial regionalization with Rolling V Ranch and the Cities of Newark and Rhome and could enable more comprehensive regionalization in the future. Based on the results of the water quality modeling activities, the location recommended for constructing a new facility is the Unnamed Tributary Regional WWTP Site. The proposed effluent limits for discharges reaching Eagle Mountain Lake from this site are 5-mg/L $CBOD_5$, 5-mg/L TSS, 1.3-mg/L NH_3-N and 0.5-mg/L TP.

The least expensive solution for the City of Aurora would be to develop their own stand-alone wastewater system, provided it serves developments with higher densities. If the City did develop its own stand-alone wastewater system, and if Rhome, Newark and Rolling V did pursue a regional approach, then the City of Aurora might at some future point in time reconsider participating in a regional system. The proximity of Aurora to Rhome and Rolling V Ranch give it an advantage over Boyd and New Fairview in that regard. Otherwise, OSSFs will continue to be Aurora's most cost-effective alternative. For the City of New Fairview, OSSFs also appear to be the least expensive wastewater alternative unless denser and larger developments are encouraged.

The results of the study also indicated that it would be advantageous for the City of Boyd, Ivy Hills and Boyette Tract to cooperate in a joint wastewater system. Treatment would be provided by the existing City of Boyd Wastewater Treatment Plant (WWTP), which currently has excess capacity and could be expanded and updated as needed to accommodate future flows. The cost of additional treatment processes, such as chemical treatment and filtration to meet stringent nutrient limits, were included in the analysis. A joint system is estimated to be about 25 percent lower on a total project cost basis and about 34 percent lower on a present worth basis (Y2010 to Y2034) when compared to the costs if each entity developed their own system.

From a total project cost standpoint, the evaluation results indicate Option B would be slightly more expensive (approximately 5%) when compared to individual treatment systems for Rolling V Ranch and the Cities of Newark and Rhome. Both cities' share of the project capital costs for Option B and the Modified Base Case would be about the same, approximately $10.7 million. Rolling V Ranch's share of the costs would be about 10% more compared to constructing their own treatment plant. However, when the long term costs of O&M are considered, Option B looks more favorable. From 2010 to 2034, the present worth of the O&M costs for the regional system in Option B is 19% lower than the O&M costs associated with each entity having their own stand-alone system.

Due to the long-term cost advantages and other advantages related to permit and land acquisition, the project team recommends that the Cities of Newark and Rhome work together with Rolling V Ranch to pursue a regional wastewater system. A regional system serving all five cities will most likely become a reality after Year 2030 due to the high cost of transporting wastewater from the Cities of Boyd and New Fairview.

APPENDIX K

Trinity River Authority of Texas

MEETING NOTICE

Southeast Wise County Regional Wastewater Study

Date: Monday, October 20, 2008

Time: 7:00 p.m.

Location: City Hall, City of Aurora
303 Derting Road
Aurora, Texas 76078

Meeting Agenda

Items for Discussion:

(1) Introduction
- Attendees: TWDB & Participants
- Study Overview

(2) Regional Wastewater Study
- Scope of Work
- Project Schedule
- TWDB Project Requirements

(3) Questions

P.O. Box 240
Arlington, Texas 76004-0240
(817) 493-5100

Trinity River Authority of Texas

MEETING NOTICE

Southeast Wise County Regional Wastewater Study

Date: Monday, January 26, 2009

Time: 7:00 p.m.

Location: Newark Community Center
404 Hudson Street
Newark, Texas 76071

Meeting Agenda

Items for Discussion:

(1) Introduction
- Attendees: TWDB & Participants
- Project Background

(2) Regional Wastewater Study
- Review of Data Collection Efforts
- Overview of Initial Observations
- Presentation of Regional Wastewater System Alternatives

(3) Discussion/Q&A Session – Study Participants

(4) Wrap-up

P.O. Box 240
Arlington, Texas 76004-0240
(817) 493-5100

Trinity River Authority of Texas

Northern Region Office

January 8, 2009

7080

PARTICIPANTS
Southeast Wise County Regional Wastewater Study

NOTICE – Monday, January 26, 2009 at 7:00 p.m.
MEETING PLACE – Newark Community Center
404 Hudson Street, Newark, Texas

The Southeast Wise County Regional Wastewater Study meeting will be held on Monday, January 26, 2009 at 7:00 p.m. in the Newark Community Center, 404 Hudson Street, Newark Texas.

This meeting will be a working session to discuss preliminary alternatives for regional wastewater collection, treatment and effluent reuse for the study area. Please have city engineers, public works directors and/or other staff involved with planning aspects for their respective cities attend this meeting to provide input. A copy of the meeting agenda is enclosed.

Please RSVP to Cheryl Abbott at (817) 493-5100 or abbottc@trinityra.org by Thursday, January 22; provide your name and entity you are representing. If you have any questions, please contact me at the TRA Northern Region office at (817) 493-5100.

BILL R. SMITH
Manager of Development
Northern Region

BRS/crt

c: Susan Roth, Susan K. Roth Consulting

Trinity River Authority of Texas

MEETING NOTICE

Southeast Wise County Regional Wastewater Study

Date: Monday, May 18, 2009

Time: 7:00 p.m.

Location: Boyd Community Center
420 E. Morton Avenue
Boyd, Texas 76023

Meeting Agenda

Items for Discussion:

(1) Introduction
- Attendees: TWDB & Participants
- Project Recap

(2) Regional Wastewater Study
- Review of Population Projections
- Summary of Regional Wastewater System Alternatives
- Overview of Water Quality Modeling Activities

(3) Discussion/Q&A Session – Study Participants

(4) Wrap-up

P.O. Box 240
Arlington, Texas 76004-0240
(817) 493-5100

Trinity River Authority of Texas

Northern Region Office

April 28, 2009

PARTICIPANTS
Southeast Wise County Regional Wastewater Study

NOTICE – Monday, May 18, 2009 at 7:00 p.m.
MEETING PLACE – Boyd Community Center
420 E. Morton Avenue, Boyd, Texas

The Southeast Wise County Regional Wastewater Study meeting will be held on Monday, May 18, 2009 at 7:00 p.m. in the Boyd Community Center, 420 E. Morton Avenue, Boyd, Texas.

This meeting will be a working session to discuss the alternatives for regional wastewater collection, treatment and effluent reuse for the study area. Please have city engineers, public works directors and/or other staff involved with planning aspects for their respective cities attend this meeting to provide input. A copy of the meeting agenda is enclosed.

Please RSVP to Cheryl Abbott at (817) 493-5100 or abbottc@trinityra.org by Thursday, May 14; provide your name and entity you are representing. If you have any questions, please contact me at the TRA Northern Region office at (817) 493-5100.

BILL R. SMITH
Manager of Development
Northern Region

BRS/crt

c: Susan Roth, Susan K. Roth Consulting

Trinity River Authority of Texas

MEETING NOTICE

Southeast Wise County Regional Wastewater Study

Date: Monday, August 17, 2009

Time: 7:00 p.m.

Location: Rhome City Annex Building
261 N. School Road
Rhome, Texas 76078

Meeting Agenda

Items for Discussion:

(1) Introduction
- Attendees: TWDB & Participants
- Project Recap

(2) Regional Wastewater Study
- Review of Draft Report
- Timeline to Finalize Report
- Next Steps

(3) Discussion/Q&A Session – Study Participants

(4) Wrap-up

P.O. Box 240
Arlington, Texas 76004-0240
(817) 493-5100

Trinity River Authority of Texas

Northern Region Office

July 9, 2009

PARTICIPANTS
Southeast Wise County Regional Wastewater Study

NOTICE – Monday, August 17, 2009 at 7:00 p.m.
MEETING PLACE – Rhome City Annex Building
261 N. School Road, Rhome, Texas

The Southeast Wise County Regional Wastewater Study meeting will be held on Monday, August 17, 2009 at 7:00 p.m. in the Rhome City Annex Building, 261 N. School Road, Rhome, Texas.

We will discuss the draft report of the final alternatives for regional wastewater collection, treatment and effluent reuse for the study area. A copy of the meeting agenda is enclosed.

Please RSVP to Susan Davis at (817) 493-5100 or daviss@trinityra.org by Thursday, August 13; provide your name and entity you are representing. If you have any questions, please contact me at the TRA Northern Region office at (817) 493-5100.

BILL R. SMITH
Manager of Development
Northern Region

Cc: Susan Roth, Susan K. Roth Consulting

APPENDIX L

Memorandum

SE Wise County Regional Wastewater Study – Response to TWDB Draft Report Review Comments

TO: *Angela Kennedy, P.E. (TWDB)*

FROM: *Susan K. Roth, P.E. (Susan K. Roth Consulting)*

DATE: *June 30, 2010*

This memorandum summarizes the project team's responses to the draft report review comments provided by the Texas Water Development Board (TWDB) for the Southeast Wise County Regional Wastewater Study. As a follow-up to our conversation on May 14, 2010, I've provided the following responses:

General Comments

- Will provide double-sided copies of the final report to both TWDB and the project participants.
- Made the recommended changes to Page 6, Section 3.
- Addressed the comment mentioned regarding consistency of 'MGD' units throughout the entire report.
- Provided the missing units for BOD and TSS values on Page 13, Section 4.3.
- Made the recommended change to Page 50, Section 8.

Scope of Work (SOW) Items

- Due to the lack of data available, maps of the existing wastewater collection and treatment facilities listed under Task 2 of the SOW were not developed for this project.
- A draft memorandum was included regarding collection alternatives to satisfy the requirements of Task 3. This memorandum was also referenced at the end of Section 10 on Page 67 of the final report.
- Appendix E is referenced on Page 46 (Section 7.4) of the final report. O&M costs are also provided on Page 46 (Section 7.4) regarding proper maintenance of septic systems.
- A draft memorandum was included that summarized the findings and recommendations to satisfy the requirements of Task 8. This memorandum was also referenced at the end of Section 10 on Page 67 of the final report.
- Copies of the meeting notices and agendas were provided for each of the four project meetings and included in Appendix L. This appendix was also referenced at the end of Section 10 on Page 67 of the final report.

Comments for Consideration

Since these comments under this section were described as "Optional", our team made an effort to address as many as possible and incorporated the following changes:

- Listed the complete spelling of acronyms referenced for the first time in the draft report (i.e. "WW" on Page 16, "EDUs" on Page 19, "BNR" on Page 46).
- Provided note on the lower right corner of each PowerPoint slide that listed "TP" standing for "Wastewater Treatment Plant".

April 21, 2010

Mr. Bill R. Smith
Trinity River Authority
5300 South Collins Street
Arlington, Texas 76018

Re: Regional Facility Planning Grant Contract between the Texas Water Development Board (TWDB) and the Trinity River Authority (TRA), TWDB Contract No. 0804830844, Draft Final Report Comments

Dear Mr. Smith:

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

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

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

Sincerely,

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

Enclosures

c: Angela Kennedy, TWDB

Attachment I
Trinity River Authority and Wise County
Regional Wastewater Planning Study
(Contract No. 0804830844) Draft Report Review Comments

General:

1. Please provide a double-sided copy of the final report as specified in the study contract.

Section 3:

2. Page 6: first and third full paragraphs refers to data in the Region C **State** Water Plan, but should refer to the Region C **Regional** water plan instead.

Section 4:

3. Page 8, Section 4, line 5: Please consider consistency with the rest of the report and provide sizes of all WWTPs in "MGD" units only (not mixed with gpd); {same item occurs also on pages 20 & 26}

4. Page 13, Section 4.3, paragraph 2, line 6: Please consider providing missing units for BOD & TSS values

Section 8:

5. Page 50, paragraph on New Fairview describes options for the City of **Aurora** instead of New Fairview.

Scope Of Work items:

6. Task 2: Report text (& Appendix B memorandum) appear to be missing *'maps of existing WW collection & treatment facilities that include sizes/capacities of pipelines; and WWTP permitted/design capacities, discharge limitations, future expansions; and areas of projected population growth/service area expansions'*. Figure 4.1 does not meet these requirements. Figure 3.1 does show density development, but contract scope of work deliverable states 'maps of existing and future development in 5-year increments over the 30-year planning horizon'.

7. Task 3: Appendix for *'draft memorandum regarding collection alternatives for 5-year increments through 2030 to serve existing/future growth and retrofit of areas served by septic systems'* appears to be missing. Also, report text should reference this draft memorandum once it has been included in the final report.

8. Task 7: Report section 7.4 text should reference Appendix E (O&M costs). Also, there appear to be no O&M costs provided for *'for areas currently serviced by septic systems, which will be estimated for proper maintenance and/or replacement of a septic system'* as is required in the scope of work.

9. Task 8: Appendix for *'draft memorandum summarizing the findings and recommendations of this task'* appears to be missing.

10. Task 11: Report appears to be missing a section or appendices documenting all required public meetings and project topics covered at each meeting, etc.

Comments for Consideration:

11. Page 4, Figure 2.1: Please consider including point locations for Ivy Hills, Boyette Tract, and Rolling V Ranch that were identified in the ES. Also, please consider showing county lines and county names more clearly, they are difficult to read.

12. Many figures, including Figure 4.1 and Figure 5.1: light colored text/symbols will not show up when pages copied, especially in black & white; suggest changing colors/intensities to correct.

13. Please consider spelling out first use of acronyms; examples: Page 16, paragraph 2, line 1 – "WW"; Page 19, paragraph 1, line 4 – "EDUs"; Page 46, paragraph 3, line 6 – "BNR".

14. Page 7, Figure 3.1: Density Development names are too small to read and the shadowing worsens this problem. Please consider enlarging/reformatting these labels.

15. Page 33, Figure 6.3: Please consider extending bottom of map to include bottom of Eagle Mountain Lake so that all of the discharge point/path can be seen. (there is plenty of blank space on this page for this correction; could also do the same to figures 4.1, 5.1, 6.1-6.6 for consistency if desired).

16. Section 8 figures, Appendix A diagrams & Appendix H maps: Please consider consistency and clarification for acronym "TP"; such as changing to use the full acronym WWTP used in other sections of the report or providing a legend to spell out acronym "TP" to refer to wastewater treatment plant. The report also uses the acronym "TP" for "total phosphorus".