Brazos-Colorado Alliance

Lower Colorado River Authority

Brazos River Authority

In Conjunction with:

City of Hutto

City of Round Rock

Texas Water Development Board

Lower Brushy Creek Wastewater Master Plan

January 31, 2001

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January 31, 2002

Prepared For:

Lower Colorado River Authority
3701 Lake Austin Blvd.
Austin, Texas 78703

Prepared By:

Camp Dresser & McKee Inc.
9111 Jollyville Road
Suite 105
Austin, TX 78759

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Executive Summary

Camp Dresser & McKee Inc. (CDM) was contracted by the Lower Colorado River Authority (LCRA) to conduct an assessment of wastewater collection system and treatment facilities in the Lower Brushy Creek area and develop alternatives to address the long term regional wastewater needs of the area for the next 30 years. Three treatment alternatives were considered: a regional lift station, a regional treatment plant, and a combination of the two. Expansion of the collection systems into new service areas to serve future growth was addressed, as well as necessary modifications to the existing collection and treatment as a result of these recommendations.

Purpose

The study area is bordered to the west by the Upper Brushy Creek Service Area, and it extends north to the southern edge of the City of Georgetown. The eastern boundary lies east of the City of Hutto and then follows the southern border of Williamson County. The study area includes the City of Hutto and its ETJ, portions of the City of Round Rock, and other unincorporated areas of Williamson County.

Mainly due to the location of the study area in the northeast expansion corridor of Austin and Round Rock, it has been identified and studied over the years as an excellent candidate for regional wastewater service. The Brushy Creek Regional WWTP accepts a large portion of the City of Round Rock's wastewater flow, including the area directly west of the study area. Additionally, a few existing package plants in the service area provide wastewater treatment at a localized level. Recent service requests and development inquiries within a major portion of the study area (the City of Hutto ETJ) indicate that growth will continue at or above the current rate of 9-11% per year.

The City of Hutto and its ETJ are located just east of the City of Round Rock, Texas, on U.S. Highway 79. The City placed a new 100,000 gallon per day (gpd) package wastewater treatment plant in service in February, 1997, and treatment plant flow data indicated that by June 1997 it was already operating at design capacity. In 2000, the plant (now owned by LCRA and operated by Brazos River Authority (BRA)) underwent another expansion to 200,000 gpd just to keep up with growth from within the City. The Brazos-Colorado Water Alliance (the Alliance) is currently applying for permit approval for another 750,000 gpd upgrade, to expand the WWTP to 0.95 MGD. However, without the use of multiple lift stations the plant will be unable to treat flow from the entire ETJ due to its location on Cottonwood Creek, upstream of most of the Hutto ETJ.

Findings

The population of Williamson County is one of the fast growing in Texas; the Lower Brushy Creek Study area, which is entirely within Williamson County, is no exception. Another indicator of the dramatic growth within the study area is the increase in number of sewer customers in the City of Hutto. In January 1999 there were just over 300 customers, by January 2001 this number had reached 562 customers, a growth of over 34% annually.

Traffic serial zone (TSZ) population projections from the Capital Area Metropolitan Planning Organization (CAMPO) were determined to be the closest match in absolute numbers to near-term projections in Hutto. Thus, the TSZ data were used for the regional growth projections. TSZ growth projections were transposed to existing property boundaries in 5-year increments to develop maps of the projected growth patterns within the study area.

These population projects were then geographically referenced by parcel and translated into average daily wastewater flow projections. A summary of these projections is presented in Figure ES-1.

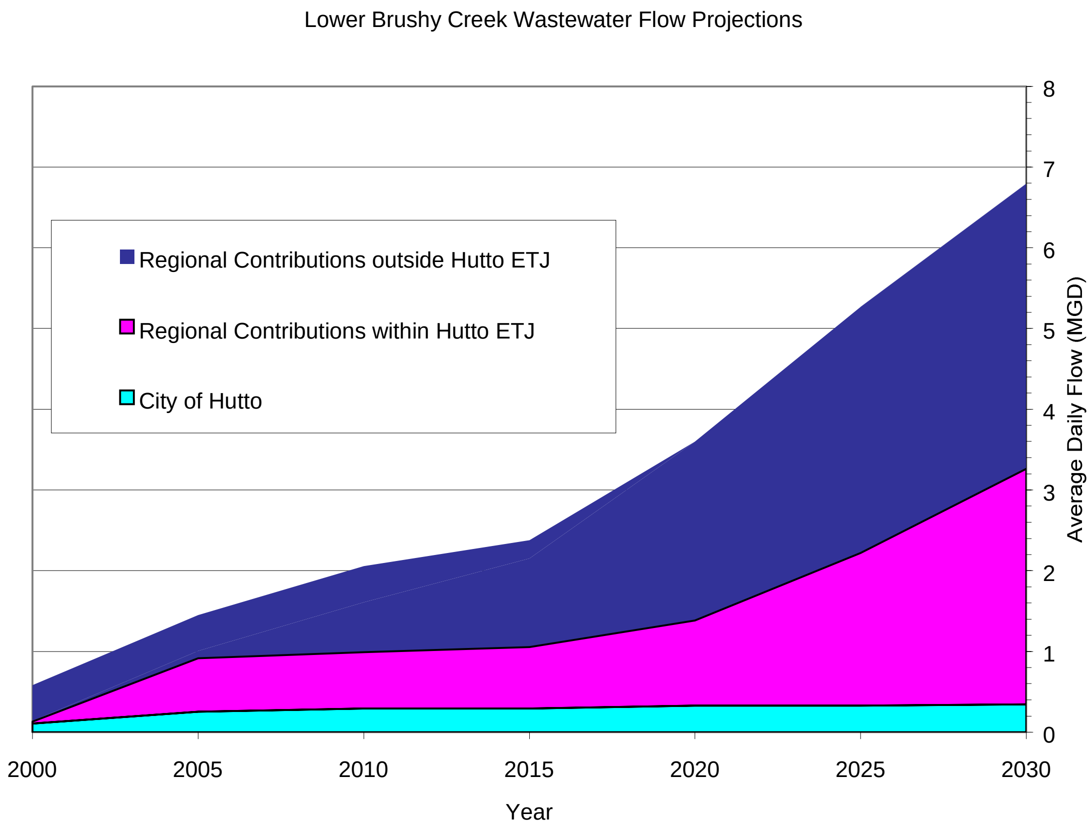

Figure ES-1 Wastewater Flows

Alternatives Evaluated

The three alternatives considered include the following, with sub-alternatives within each one:

Alternative 1: One regional WWTP on Brushy Creek downstream of the Hutto Cemetery.

Alternative 2: A regional lift station (Regional Lift Station) at the same location that would pump back to the Brushy Creek Regional WWTP, with a booster station (McNutt Lift Station) near the confluence of McNutt and Brushy Creeks.

Alternative 3: One regional WWTP on Brushy Creek downstream of the Hutto Cemetery. A regional lift station (McNutt Lift Station) near the confluence of McNutt and Brushy Creek pumping to the Brushy Creek Regional WWTP.

The location of these possible lift stations and treatment plants are seen in Figure ES-2.

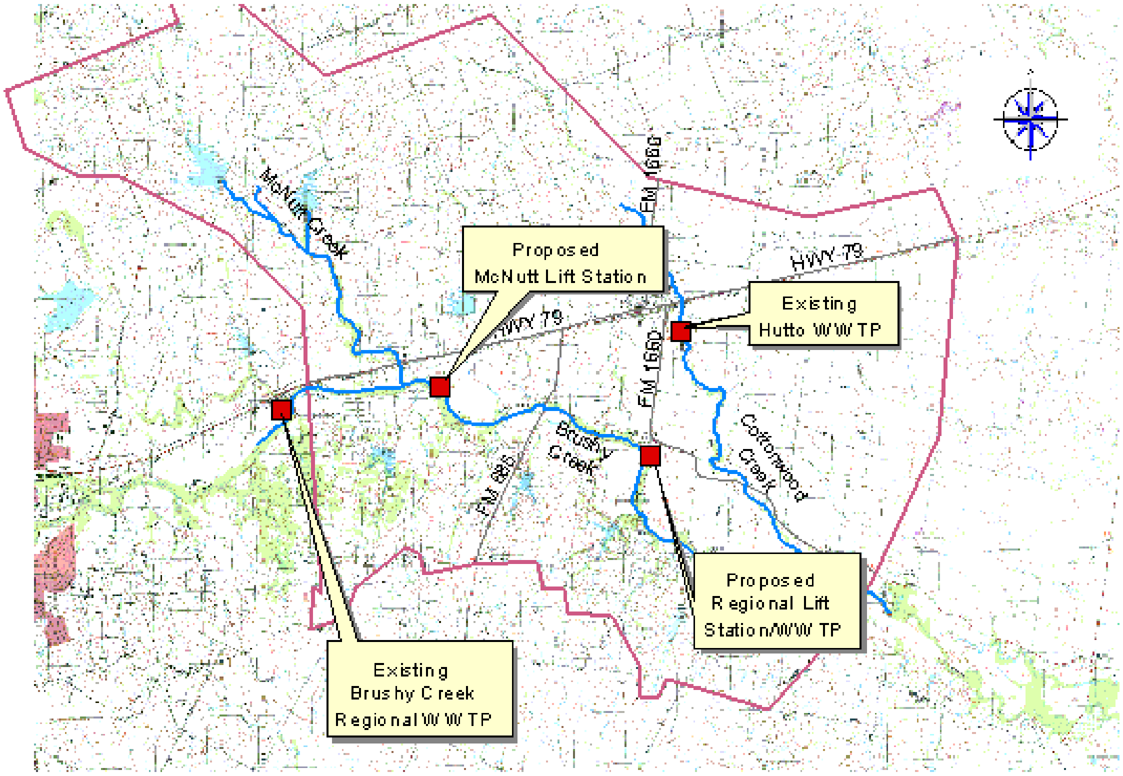

Figure ES-2 Proposed Treatment Plant and Lift Station Locations

Collection systems and treatment facilities were analyzed to assess these alternatives.

In order to evaluate collection systems, a hydraulic model of the collection system was developed. The model is a dynamic flow routing model that routes inflow hydrographs through a pipe system computing a time history of flows and heads throughout the system. Once the models and flow files were established, model runs were performed to determine pipe diameters for each phase of the system. Only two of the three alternatives explored needed to be analyzed in terms of interceptors and collection system.

1. All of the flow will be going to the Regional Plant/Lift Station location, or

2. The flow from McNutt Creek and Forrest Creek will be removed from the system at a lift station at the confluence of these creeks and Brushy Creek.

The existing wastewater facilities were evaluated for expansion potential and suitability for incorporation into a regional treatment scheme, and the requirement for new treatment plants is analyzed for consistency with the collection system alternatives. A summary of the capital costs of these alternatives is presented in Table ES-1.

Lower Brushy Creek Wastewater Master Plan
Alternative Analysis with Phasing
Cost Comparison: Net Present Value

Year	**ALTERNATIVE 1**		**ALTERNATIVE 2**		**ALTERNATIVE 3**	
	Regional WWTP		**Brushy Expansion and Lift Stations**		**Regional WWTP and Brushy Creek Expansion & Lift Station**	
2005	Interim Plant, Initial Interceptors, Collection system	$10,495,200	Both Lift Stations, Initial Interceptors, Collection system	$19,714,700	Interim Plant, Initial Interceptors, Collection system	$10,495,200
2010	WWTP construction & Interceptors to McNutt Creek, Collection system	$26,329,800	Expansion at Brushy Creek, McNutt Creek Interceptors, Collection system	$23,872,300	McNutt Lift Station (2020 Flows); Earlier Brushy Creek Expansion, Collection system	$19,185,600
2015	Collection system	$1,507,700	Collection system	$1,507,700	Collection system	$1,507,700
2020	WWTP Expansion; Hutto offline, Collection system	$10,674,800	Lift Station expansion; Hutto WWTP offline, Collection system	$6,294,800	Regional Plant, Hutto offline, McNutt Lift Station offline, Collection system	$24,624,800
2025	Collection system	$1,897,400	Collection system	$1,897,400	Collection system	$1,897,400
2030	WWTP Expansion	$5,000,000	Additional Brushy Creek Expansion	$10,000,000	Expansion at Regional WWTP	$5,000,000
Net Present Value		$36,351,400		$41,951,900		$38,297,500

Table ES-1 Alternative Cost Comparison

The three alternatives could meet the basic requirement of effectively treating the wastewater in the Lower Brushy Creek area at approximately the same net present value. However, there are other factors, which were considered for alternative selection. The criteria used for this study are reliability, flexibility, ease of operation & maintenance, and implementation. A summary of the alternatives and our evaluation based on each criterion is found in Figure ES-3.

	Reliability	Flexibility	Operation / Maintenance	Implementability
Alternative 1: Regional WWTP	○	◒	◒	◒
Alternative 2: Regional Lift Station	◒	◒	○	◒
Alternative 3: Combination	◒	○	◒	○

○ = Favorable
◒ = Neutral
● = Unfavorable

Figure ES-3 Qualitative Evaluation

Recommendations

While all three of these alternatives would address the area's need in terms of wastewater treatment, the flexibility afforded by the third alternative coupled with its low cost in the first 10 years, when the customer base will continue to be low, makes it an appealing choice. This combination alternative involves lower capital costs upfront, permits more flexibility to adjust for growth, and locates facilities where the development is located.

For these reasons, CDM recommends the third alternative. This is a combination of an interim plant at the proposed regional WWTP site and an interim lift station for McNutt and Forrest

Creek flows from 2005 until 2020, followed by a permanent WWTP at the regional site serving the entire Lower Brushy Creek area after 2020 and the abandonment of the McNutt lift station and possible abandonment of the Hutto WWTP. Long term treatment would be provided by a single Regional WWTP.

Implementation

During the phasing of Alternative 3, flows can be treated in three locations:

- the Hutto WWTP,
- the existing Brushy Creek Regional WWTP (BCR WWTP), and
- the proposed regional system (LBCR WWTP).

As time progresses, the treatment destination for flows from certain areas will change, specifically in McNutt Creek and parts of Cottonwood Creek. Figures ES-4 through ES-7 summarize each phase of the implementation plan. Figure ES-8 provides an estimation of capital cost and customers by year, based on the implementation plan and projected growth in flow.

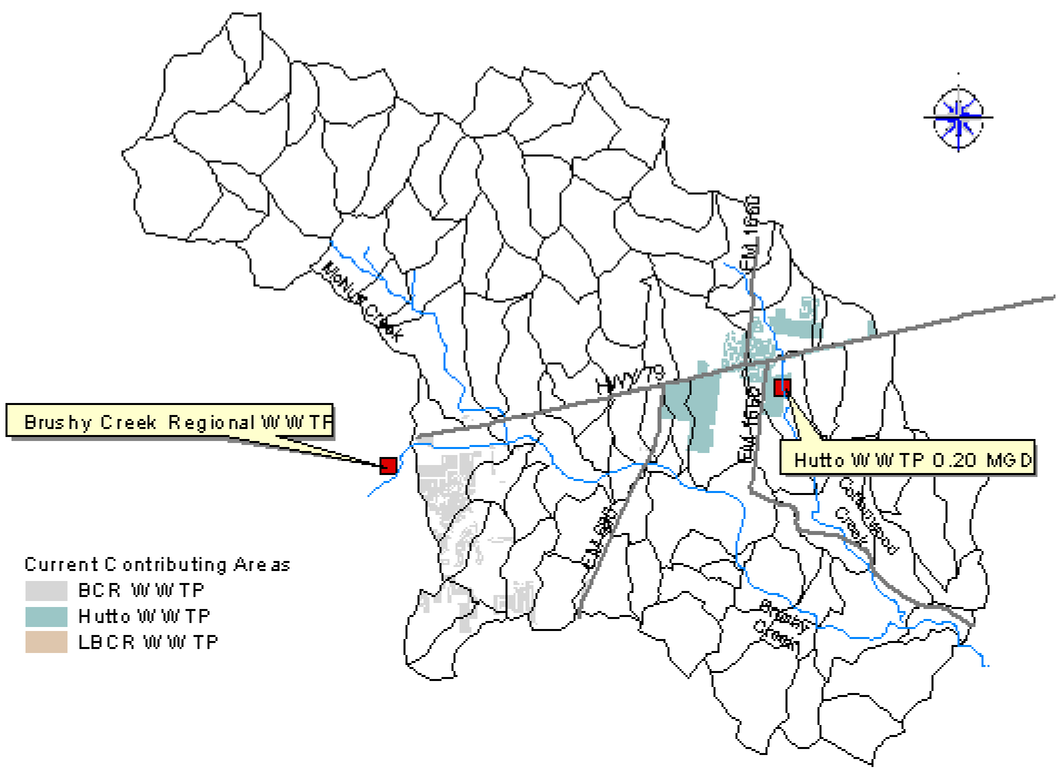

Figure ES-4 Current Wastewater Treatment

Phase 1

After the ***Interim Plant*** is placed online, lift stations in Hutto can be taken offline so that wastewater flow can be split between the Hutto WWTP and the Interim Plant as desired.

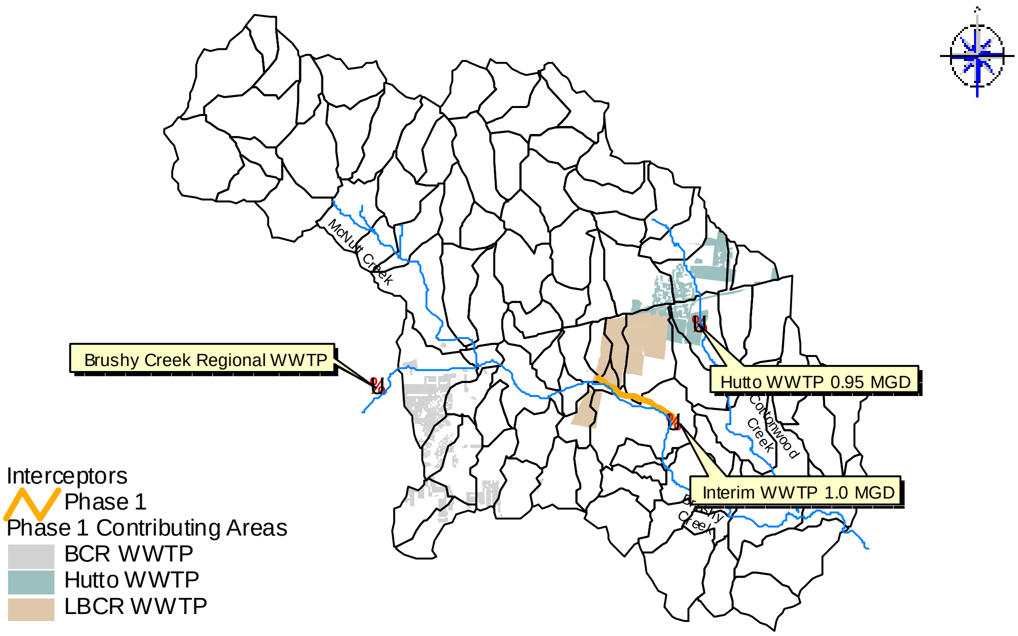

Figure ES-5 Phase 1

Phase 2

The next phase of the project consists of ***the construction of a 2.5 MGD (8 MGD peak flow) lift station and Phase 2 of the gravity interceptor***. The lift station would be constructed just downstream of the Forest Creek subdivision and would lift wastewater from the Forest Creek and McNutt watersheds to the existing BCR WWTP.

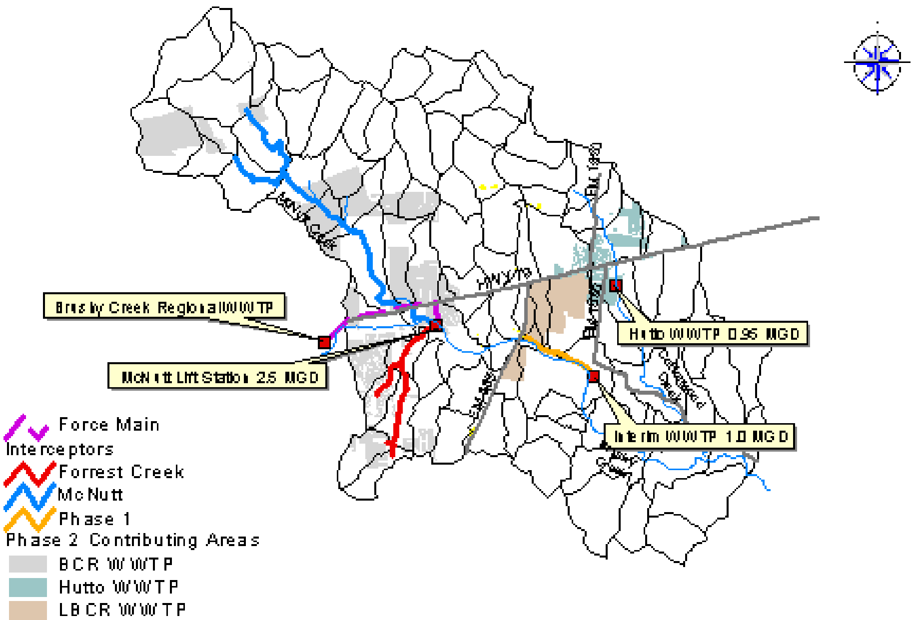

Figure ES-5 Phase 2

Phase 3

The ***permanent treatment plant installation*** is projected to be completed in the year 2020. Completion of Phase 3 of the interceptor line would enable the new permanent plant to treat all of the wastewater originating from the basin studied. Phase 3 of the sewer line consists of connecting the McNutt/Forest Creek interceptor to the Phase 1 interceptor, and connecting the Hutto WWTP to the Lower Brushy Plant so the Hutto Plant can be taken offline.

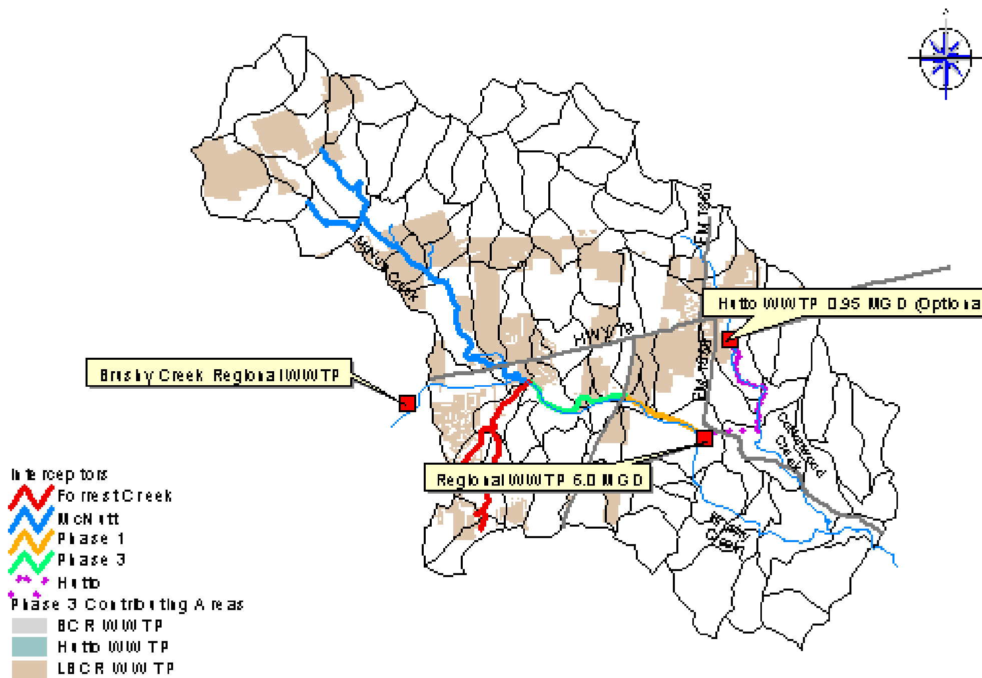

Figure ES-6 Phase 3

Phase 4

If a 6 MGD facility is built in 2020, population projections indicate that it will reach capacity in the middle of 2027; thus, ***another expansion*** would be required. At this period of time the main trunk of the gravity interceptor will be in place and no major interceptor construction will be required.

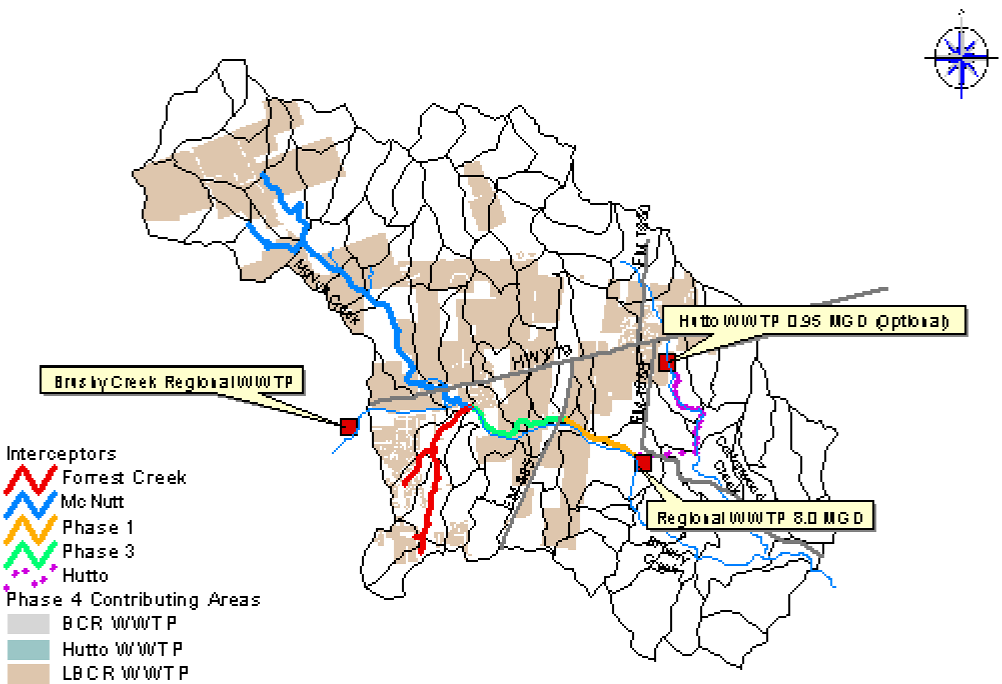

Figure ES-7 Phase 4

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Section 4
Introduction

1.1 Purpose

Camp Dresser & McKee Inc. (CDM) was contracted by the Lower Colorado River Authority (LCRA) to conduct an assessment of wastewater collection system and treatment facilities in the Lower Brushy Creek area and develop alternatives to address the future regional wastewater needs of the area. Three treatment alternatives were considered: a regional lift station, a regional treatment plant, and a combination of the two. Expansion of the collection systems into new service areas to serve future growth was addressed, as well as necessary modifications to the existing collection and treatment as a result of these recommendations.

The study area is part of the rapidly growing region of Williamson County. It lies in the Lower Brushy Creek Watershed, serving the drainage sub-basins which flow into Brushy Creek and Cottonwood Creek, just downstream of the Brushy Creek Regional Wastewater Treatment Plant (BCR WWTP). The study area encompasses the municipalities of Hutto and portions of Round Rock. Figure 1-1 gives a regional perspective of the area of interest; the Hutto Extra Territorial Jurisdiction (ETJ), presented in yellow, lies between Round Rock and Taylor, within Williamson County.

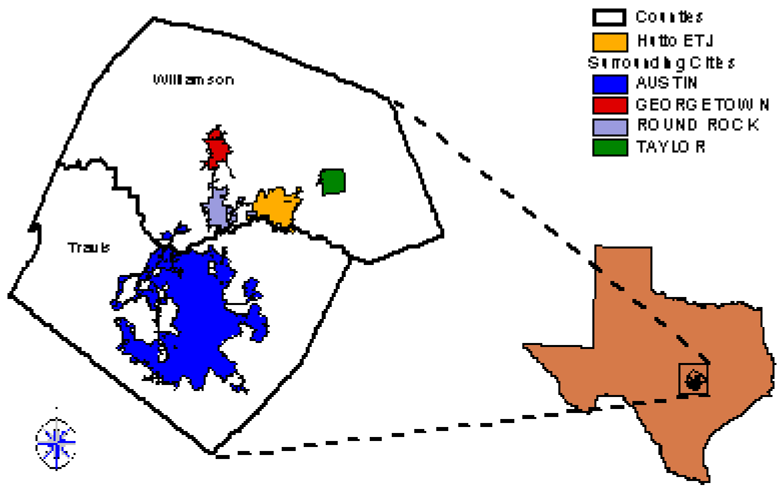


Figure 1–1 Location of Study Area

The study area is bordered to the west by the Upper Brushy Creek Service Area, and it extends north to the southern edge of Georgetown. The eastern boundary lies east of the City of Hutto and then follows the southern border of Williamson County. The study area includes the City of Hutto and its ETJ, portions of Round Rock, and other unincorporated areas of Williamson County. Figure 1-2 illustrates the area of interest, with major road, ETJs and existing wastewater treatment plants.

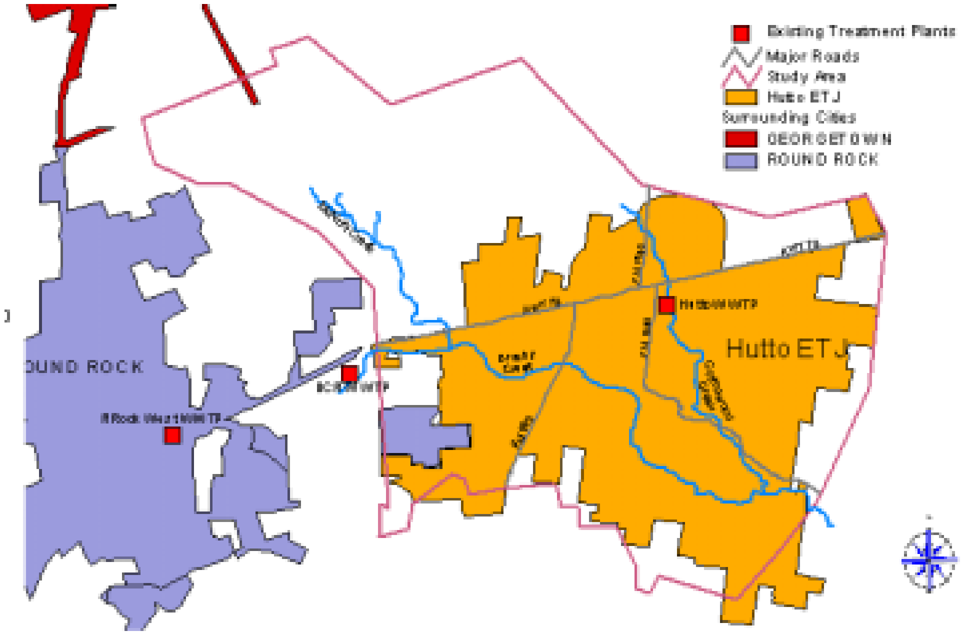


Figure 1-2
Lower Brushy Creek Study Area

Mainly due to the position of the study area in the northeast expansion corridor of Austin and Round Rock, it has been identified and studied over the years as an excellent candidate for regional wastewater service. The BCR WWTP accepts a large portion of the City of Round Rock's wastewater flow, including the area directly west of the study area. Additionally, a few existing package plants in the service area provide wastewater treatment at a localized level. Recent service requests and development inquiries within a major portion of the study area (the City of Hutto ETJ) indicate that growth will continue at or above the current rate of 9-11% per year.

The City of Hutto and its ETJ are located just east of the City of Round Rock, Texas, on U.S. Highway 79. The City placed a new 100,000 gallon per day (gpd) package wastewater treatment plant in service in February, 1997, and treatment plant flow data indicated that by June 1997 it was already operating at design capacity. In 2000, the plant (now owned by LCRA and operated by Brazos River Authority (BRA)) underwent another expansion to 200,000 gpd just to keep up with growth from within the City. The Brazos-Colorado Water Alliance (the Alliance) is currently applying for permit approval for another 750,000 gpd upgrade, to expand the WTTP to 0.95 MGD. However, the plant will be unable to treat flow from the entire ETJ due to its location on Cottonwood Creek, which limits the plant to only treating flows from within the City limits without significant pumping, upstream of most of the Hutto ETJ.

The northern portion of Round Rock and a portion of unincorporated areas of Williamson County would also benefit from the study and implementation of a regional system. Geologic conditions in the area (mostly clayey, calcareous soils) provide extremely poor conditions for septic systems as a viable wastewater treatment alternative. Heightened concern for water conservation and reuse in this area lend themselves to a regional approach that will allow the participating entities to evaluate and take advantage of any reuse possibilities.

1.2 Report Structure

Section 2 - provides an explanation of the sewerage system flows used for this Master Plan. It includes a description of the current flows and customers for the Hutto Wastewater Treatment plant, as well as information on the residential developments currently underway. The development of future land use and future flows based on traffic serial zone data for population projections is also described.

Section 3 - identifies the alternatives being considered for the collection and treatment of wastewater in this Master Plan. The study area was divided into 4 divisions, based on drainage areas: Cottonwood Creek, McNutt Creek, Lower Brushy Creek, and the East Area. The analysis of treatment scenarios and collection system alternatives are presented for each of these areas. Based on this analysis, the three major alternatives are defined: regional treatment plant, regional lift station, and a combination of the two.

Section 4 - provides an in-depth analysis of the collection system alternatives. Collection system alternatives were developed for 5-year increments through the year 2030 to serve existing and future growth, as well as areas currently served by septic tanks. Additionally, detailed alternatives of connecting these areas into a proposed regional wastewater treatment facility are presented (where collection lines exist).

Section 5 - describes alternatives for providing wastewater treatment within the Lower Brushy Creek watershed. The existing wastewater facilities are evaluated for expansion potential and suitability for incorporation into a regional treatment scheme, and the requirement for new treatment plants is analyzed consistent with the collection system alternatives presented in Section 4. Also described are anticipated effluent standards for future wastewater discharges and the potential for wastewater reuse.

Section 6 - presents an environmental assessment of the area, paying particular attention to the possibility of siting a wastewater treatment facility. The assessment includes an analysis of cultural resources and natural resources in the region.

Section 7 - provides an evaluation of the alternatives presented in Sections 4 and 5. This section presents both quantitative and qualitative evaluation. The quantitative evaluation consists of the net present value analysis of the capital costs and operation and maintenance costs. Criteria for the qualitative evaluation include: reliability, flexibility, ease of operation & maintenance, and implementation. Based on this evaluation, the recommended alternative is discussed.

Section 8 - provides an implementation plan for the study area based on the recommended alternative. The implementation plan is presented in phases with the timeline based on the growth projections presented in Section 2. Next, an in-depth analysis of the cost of this implementation plan is included. Finally, the phasing is presented in terms of number of customers, so that customers might serve as triggers in the execution of the schedule presented.

Section 9 - summarizes the funding options.

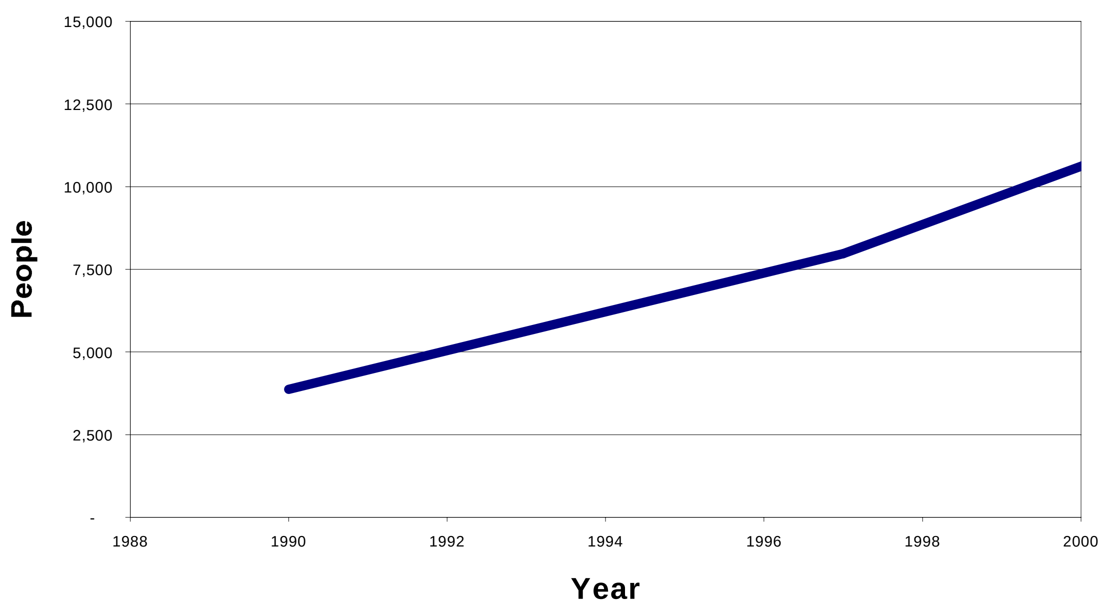
Section 10 - provides a water conservation plan and drought management plan.

Section 2
Sewerage System Flows

This section provides an explanation of the sewer system flow values used in creating this Master Plan. A description of the current flows and customers for the Hutto Wastewater Treatment plant (Hutto WWTP) is presented along with information on the residential developments currently underway. Using traffic serial zone data for population projections in 5-year increments through 2030, the development of future land use and future flows is described.

2.1 Current Population

The population of Williamson County is one of the fast growing in Texas; the Lower Brushy Creek Study area, which is entirely within Williamson County, is no exception. Figure 2-1 illustrates the population growth that has occurred within the study area since 1990.



Source: Capital Area Metropolitan Planning Organization (CAMPO)

Figure 2-1 Population Growth in the Lower Brushy Creek Study Area

Another indicator of the dramatic growth within the study area is the increase in number of sewer customers in the City of Hutto. In January 1999 there were just over 300 customers, by January 2001 this number had reached 562 customers, a growth of over 34% annually.

Current Base Wastewater Flows

Data from the Hutto Wastewater Plant (Hutto WWTP) were used to determine present per-connection wastewater flow values. Figure 2-2 illustrates the influent flows to the wastewater treatment plant and rainfall from September 1998 until January 2001, while Figure 2-3 illustrates a smaller snapshot (the average daily flow for November 2000 until January 2001). In both of these figures, the recorded average daily flows are represented by the line graph. While there is a significant increase of flow on days on or following measurable rainfall, it is apparent that there is an upward trend in the plant influent independent of precipitation. The data indicated by the blue marks, which reflect influent values collected at least three days after a rainfall event, were used to approximate average wastewater flow.

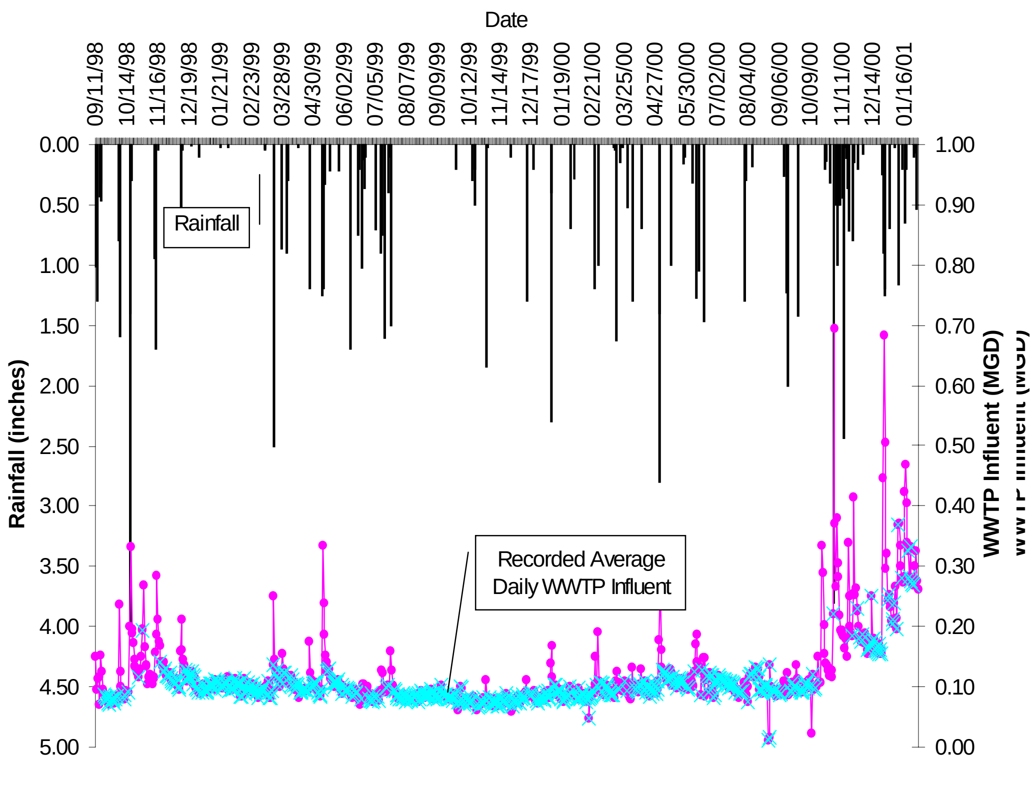
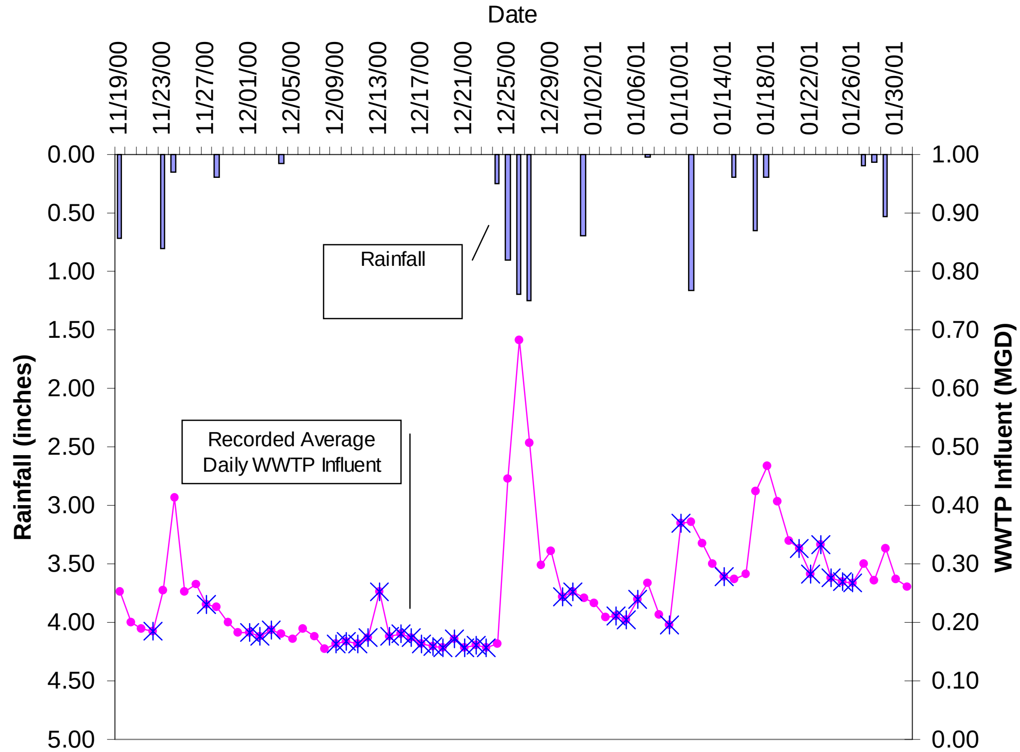


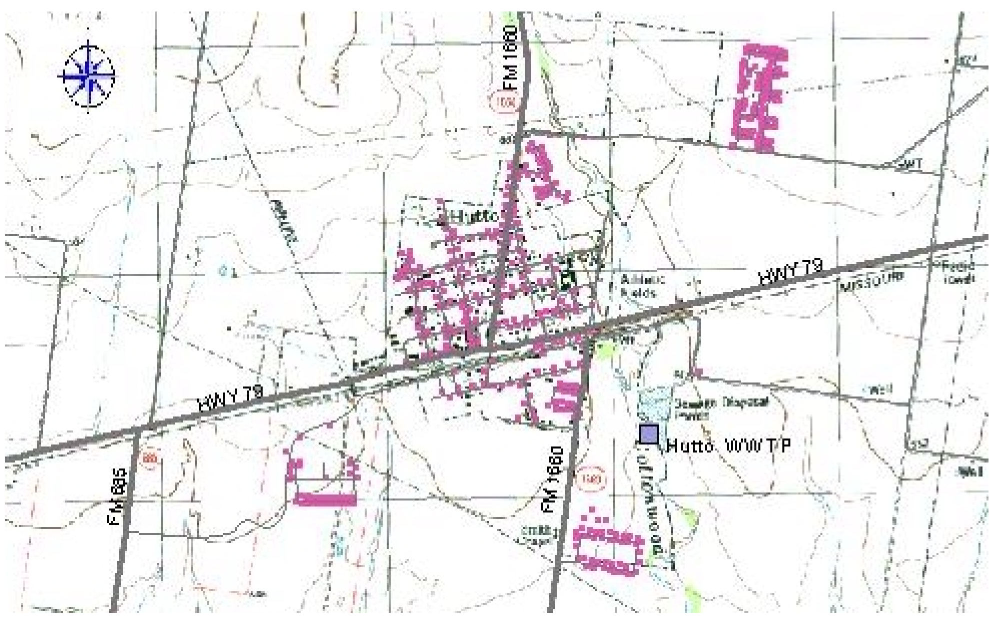
Figure 2-2 Hutto Wastewater Plant Inflows

As of January 15, 2001, there were 562 sewerage connections served by the Hutto WWTP. Figure 2-4 is a map indicating the location of these connections, while Figure 2-5 graphs the growth in number of sewerage connections from January 1999 to January 2001. As can be seen in Figure 2-5, the increased flows in late 2000 was related to the dramatic increase in the number of connections (customers).



x= Average Daily Flow 3 Days after Rainfall

Figure 2-3 Hutto Wastewater Plant Inflows since November 2000



□ = WW Customers as of January 2001

Figure 2-4 Hutto Wastewater Customers January 2001

The flow data and record of customer initiation were used to develop the flow assumptions found in Table 2-1.

Connection Type	Base Wastewater Flow (gpd per connection)	Persons per Connection Equivalent
Residential	250	2.6
Commercial	100	1.4
Industrial	150	1.8

Table 2-1 Flow Assumptions per Connection

From these values, the base wastewater flow at Hutto WWTP is assumed to be 160,000 gpd in January 2001. The Persons per Connection Equivalent assumptions in Table 2-1 were used to link flow projections to documented population projections. In addition to base wastewater flow, assumptions were defined for infiltration and inflow as documented in the next sub-section.

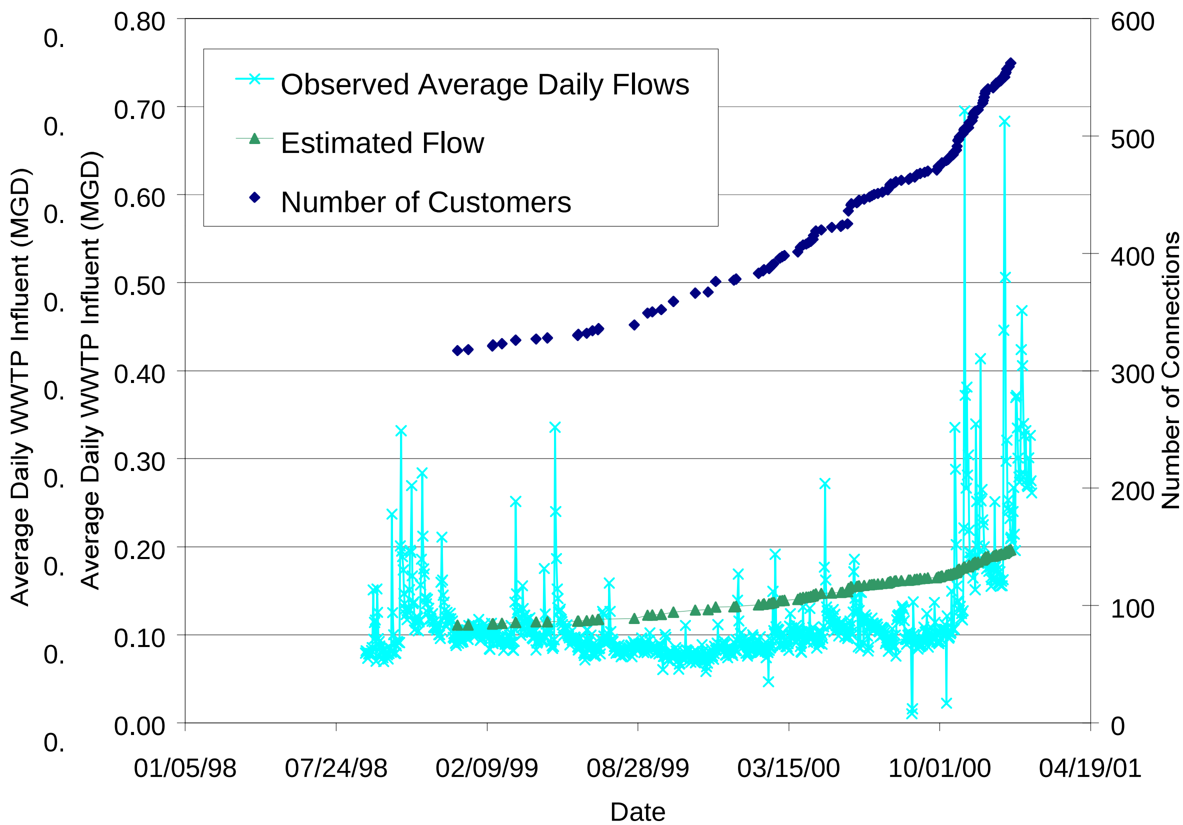


Figure 2-5 Hutto WWTP Flows Customers and Estimated Flows

2.2 Infiltration / Inflow Assumptions

Within the industry, there are a number of different methods that are used to develop the total wet weather flow hydrograph or peak design flow. Several of these methods are discussed here along with a discussion of other data.

Method in 1993 Brushy Creek CI No. 1 Facilities Plan Update

The method used in this study may be summarized as follows:

- Base wastewater flow (not including infiltration) was assumed to be 100 gallon per capita per day (gpcd).
- A peak dry weather flow was then computed as the base wastewater flow times a peaking factor that was based on an exponential function that increases with decreasing average daily flow (or, alternatively, that increases with decreasing population). Although the actual peaking formula used was not listed, the numbers indicate that it was an equation developed by Munksgaard Young (1980) or some close derivative. The Munksgaard and Young equation for computing the peak 4-hour flow is

  $$Q_{peak}=4.06*Q_{BWWF}^{0.9003}$$

  where values of Q are in MGD. For the range of flows anticipated in the Lower Brushy Creek collection system, the dry weather peaking factor would vary from approximately 3 to 5. Shorter duration peak flows would be slightly higher.
- Infiltration and inflow was then added to this peak flow at a rate of 1000 gallon per acre per day (gpad).
- Pipes were then sized to be no greater than 75 percent full under this design flow.

Using the method above with the 4-hour formula, design flows would be approximately 5 to 7 times greater than the base wastewater flows and approximately 3.5 to 5 times greater than the average daily flow (base plus infiltration).

Method in 2000 City of Austin Northeast Service Area Wastewater Master Plan

The method used in this study generally reflects the methodology in the City of Austin Design Criteria manual. These criteria were based on modeling and flow monitoring in the Barton Creek Watershed in 1996-97. It may be summarized as follows:

- Base wastewater flow (not including infiltration) was assumed to be 70 gpcd.
- Peak dry weather flow was calculated using the formula

  $$Q_{peak\text{-}dry}=(18+(0.0206*Q_{BWWF})^{\wedge}.5) / (4+(0.0206*Q_{BWWF})^{\wedge}.5)$$

  where Q is in gpm.

- Peak wet weather flow was calculated as

  $$Q_{peak\text{-}wet} = Q_{peak\text{-}dry} + 750 \text{ gpad}$$

- Pipes 15 inches in diameter and smaller should not exceed 65 percent capacity at the peak dry weather flow rate or 85 percent capacity at the peak wet weather flow.
- Pipes 18 inches in diameter and greater should not exceed 80 percent capacity at the peak wet weather flow.

Flow calculations were done on a sewershed basis, so the peaking factor for larger areas may be somewhat exaggerated since it becomes a weighted sum of all of the tributary sewersheds' peaking factors. The method described above results in wet weather flows that are approximately 4.5 to 6 times the base wastewater flow. Using the higher baseflow per acre values developed for this project (6.5 people / ac * 2.6 people / connection * 250 gpd / connection = 625 gpad) would result in wet weather peaks that would be approximately 3 to 5 times the base wastewater flow values.

Method Used in Studies of Existing Wastewater Collection Systems

The method that is widely used in the analysis of existing wastewater collection systems differs in its approach. The methodology is predicated on existing flow / rain monitoring data from within the collection system. It may be summarized as follows:

- Existing dry weather flow data are decomposed into base wastewater flow and infiltration. Infiltration is generally taken as some fraction of the minimum nighttime flow.
- Dry weather diurnal flows (base wastewater plus infiltration) are subtracted from the total measured hydrographs to determine the wet weather component for multiple storm events.
- The wet weather component is characterized using a set of parameters that is specific to each model.
- Using the dry weather flows and the wet weather flow component parameters, design storms are imposed on the model in order to yield resulting design event hydrographs.

One of the biggest differences between this approach and the two previous to it is the components of the design flows. In this method, the major design flow component is Infiltration / Inflow (I / I) instead of dry weather flow. Additionally, this methodology results in greater variation in design flows throughout the system on a Q_{peak} / Q_{dry} basis, but that is largely because the measured data are there to support the variation. In general, though, many of the measured / projected Q_{peak} / Q_{dry} values fall within the range discussed in the previous two methods.

Analysis of East Brushy Creek WWTP Influent Flow Data

The East Brushy Creek WWTP influent flow data were analyzed to determine what types of peaks are being measured at that plant. The area upstream of that plant is indicative of the design conditions that should be used for collection system planned under this study. Total daily flows and peak 2-hour flows were provided by BRA for the 14-month period covering 1/1/00 through 2/28/01. Rainfall data at the plant for the same time period were also provided. To determine an approximate value of the average daily flow from a record that contained both dry weather and wet weather days, a cut-off value of 10 MGD was used to distinguish between dry and wet weather days. Using this cut-off point, daily flow values of less than 10 MGD were averaged, resulting in an average daily flow value of approximately 8.9 MGD.

For the period of record (1/1/00 through 2/28/01), the highest recorded peak 2-hour flow was 24.2 MGD. This value represents a peak of approximately 2.7 times the average daily flow value. Assuming that the base wastewater flow is approximately 80 percent of the average daily flow (which appears to be reasonable when looking at the average daily flow values), the ratio of the largest peak 2-hour flow to the base wastewater flow is approximately 3.4. The event that produced the largest 2-hour peak flow was 3.3 inches over 48 hours. In the 2½ weeks preceding that event, there was 7.28 inches of rainfall recorded at the plant, so the antecedent conditions were wet. Considering the size of the event and the fact the peak flow data are averaged over 2 hours, it may be reasonable to assume that the collection system just upstream of the plant would experience an even higher peaking factor under design conditions (i.e., a peaking factor greater than 3.4).

Selected Method for Lower Brushy Creek Wastewater Master Plan

For the purposes of this study, the City of Austin method for determining design flows was used, except 1000 gpad was used for I/I instead of 750 gpad. For the typical range of sewersheds used in the study area, the peaking factor (wet weather design flow divided by base wastewater flow) would range from approximately 3 to 5, using 6.5 people per sewered acre and the City of Austin method. Using 1000 gpad for I/I, the peaking factor would range from approximately 3.5 to 5.5. These slightly higher values are closer to what the measured flow data are showing at the East Brushy Creek WWTP. Pipes would be sized to flow at no greater than 80 percent capacity under design flow conditions.

With the infiltration / inflow assumptions defined, the next sections explain the methodology for future land use projections, and thus, flow projections.

2.3 Future Development Underway

Over the past few years there has been a dramatic increase in subdivision development in the Hutto ETJ. While some of these developments have been completed and are already contributing to the Hutto WWTP, there are still nearly 4,000 lots where developers anticipate building in the near future. Not all of these subdivisions will contribute to Hutto WWTP. Two of the recently completed subdivisions have on-site septic systems. The lots in the expansion of the Forrest Creek subdivision will connect to a nearby package plant, while the Lakeside Estates subdivision has entered into a long-term agreement with the Kelly Wastewater plant, whose effluent is reused for an area golf course. Figure 2-6 illustrates the location of the subdivisions presently being developed and the wastewater service utilized or anticipated. Table 2-2 provides a summary of the size and status of these subdivisions. These development data were the basis for the projections of 2005 wastewater needs.

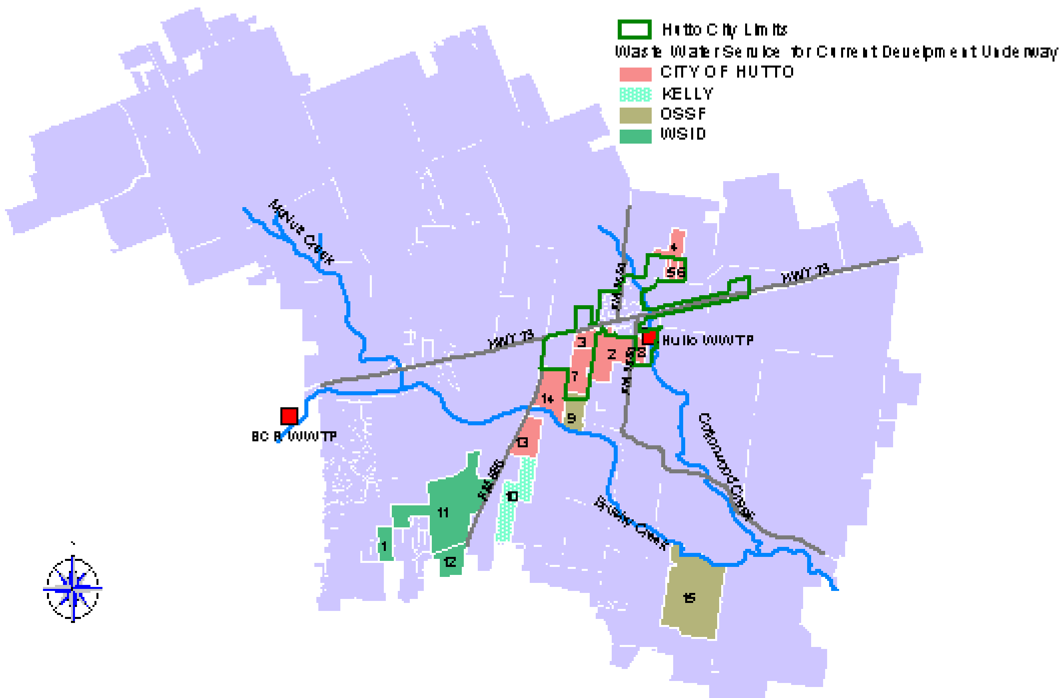


Figure 2-6 Future Development

ID Number	Name	Waste Water Service	Acreage	No. of Lots		Fraction Built
				Resid.	Comm.	
1	Forrest Creek Estates	WSID	62.9	164	0	0.00
2	Bobby Castle	City Of Hutto	180	661	0	0.00
3	Brushy Creek Est. Industrial	City Of Hutto	40.0	0	18	0.50
4	Carol Meadows	City Of Hutto	77.0	289	0	0.00
5	Clarks Crossing	City Of Hutto	19.1	77	0	1.00
6	Clarks Crossing	City Of Hutto	20.0	71	0	1.00
7	Country Estates	City Of Hutto	96.3	456	0	0.20
8	Creekside Estates	City Of Hutto	28.2	54	0	0.20
9	Estates At Brushy Creek	OSSF	80.6	17	0	0.10
10	Lakeside Estates	WSID	41.4	146	0	0.20
11	Forrest Creek Estates	Kelly	611	1200	0	0.00
12	Star Ranch, Section 4	WSID	8.88	26	0	0.00
13	Stillwell Mobile Home/Park Bc	City Of Hutto	90.6	485	0	0.00
14	The Enclave At Brushy Creek	City Of Hutto	144	378	0	0.00
15	Lookout At Brushy Creek	OSSF	503	255	0	1.00
Hutto			***694.3***	***2,471***	***18***	***0.10***
OSSF			***583.6***	***272***	***0***	***0.94***
WSID			***724.1***	***1536***	***0***	***0.02***
Total			**2,002**	**4,279**	**18**	**0.12**

Table 2-2 Subdivision Demographics

Based on Table 2-2, only 10% of the new development lots that would contribute to the Hutto WWTP have been built, leaving 2,223 lots contribute to the Hutto WWTP in the future. Based on the observation that many of these subdivisions are currently under construction, it was assumed that the developments presented in this sub-section comprise the growth during the years 2001 through 2005. This assumption reflects an annual growth rate (40%) in the Hutto WWTP service area, which is on the order of the rate of growth of sewer customers in 2001 (45%).

2.4 Population Projections

In order to make a comparison of the flow projections found in this study to those found in other studies, it was necessary to tie these values back to population. Since the flow values are based on gallons per day per connection, a capita per household had to be assumed to translate the flow projection to population projections. The factor used for this purpose was 2.6 people per residential connection based on Capital Area Metropolitan Planning Organization (CAMPO) data.

According to Table 2-2, there are over 3,700 lots that will be developed in the near future; of these, the Hutto WWTP could be receiving wastewater flows from over 2,200 lots. The development of the 2,200 lots would result in a sewered population increase of 6,201. As many of these developments have already begun, it is assumed that this growth would happen between 2001 and 2005. While an increase in the population from 4,450 to 11,662 represents a significant growth rate, 25% a year, it is less than annual increase in Hutto WWTP customers, 34% annually for the last two years.

The three scenarios used for comparison are the CAMPO traffic serial zone (TSZ) projections, the Texas Water Development Board (TWDB), and the projections from the City of Taylor, Water Supply Study Update. The three published population projections, and the data derived from the developments currently underway within the study area are shown in Figure 2-7.

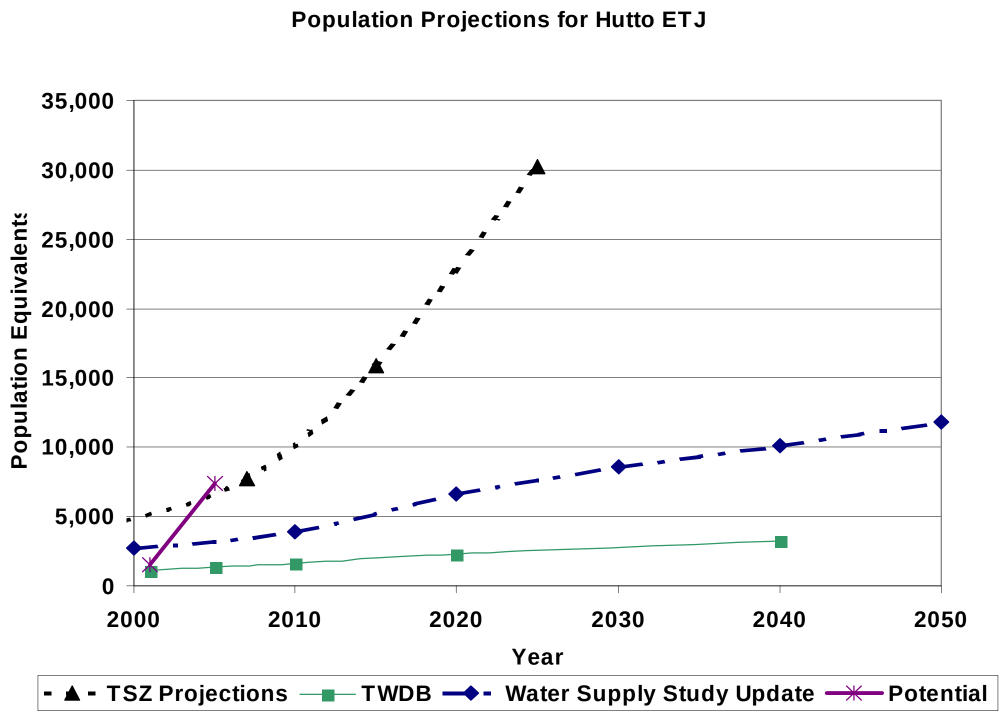


Figure 2-7 Population Projections

Traffic serial zone (TSZ) data were determined to be the closest match in absolute numbers to near-term projections in Hutto made using development that is currently planned or under construction. The TSZ data also provided the closest match to the general growth rate seen in recent years. Thus, the TSZ curve seen in Figure 2-7 was used for the regional growth projections.

2.5 Land Use Projections

TSZ growth projections were transposed to existing property boundaries in 5-year increments to develop maps of the projected growth patterns within the study area. Some modifications were made to the TSZ data to account for the influence of proposed Highway 130. In order to correlate population with land use, average densities and land use concentrations were developed using historical and near-term growth projection data.

Land Use for the year 2005

A parcel map in the ArcView shapefile format served as the base map of the current and future land use projections. The parcel IDs in the shapefile were linked to data from the Williamson County Tax Appraisal District regarding the type of tax applicable to each parcel was subject to. This data was based on year 2000 tax appraisal records and thus served as the year 2000 scenario. Using this information and the data on current developments underway, a 2005 scenario was created. The 2005 scenario is found in Figure 2-8. For these datasets, land use, population, and population density were calculated. As previously stated, under current conditions, each residential parcel was assumed to have 2.6 persons. For the 2005 scenarios, the parcels were developed based on the data provided in Table 2-2; thus the population density ranged from 0.5 to 14 persons per acre.

Methodology for Modification

Once the current and 2005 land use datasets were developed, the next step was to apply the Capital Area Metropolitan Planning Organization (CAMPO) population projections. The CAMPO projections are developed on a TSZ basis within the study area as shown in Figure 2-9. For each TSZ, there is an individual population projection for 2007, 2015 and 2025. A trendline through these projection values was used to develop a number for each 5-year increment of this study from 2005 until 2030. These numbers were then used to create land use maps for the study area illustrating the future land use assumptions.

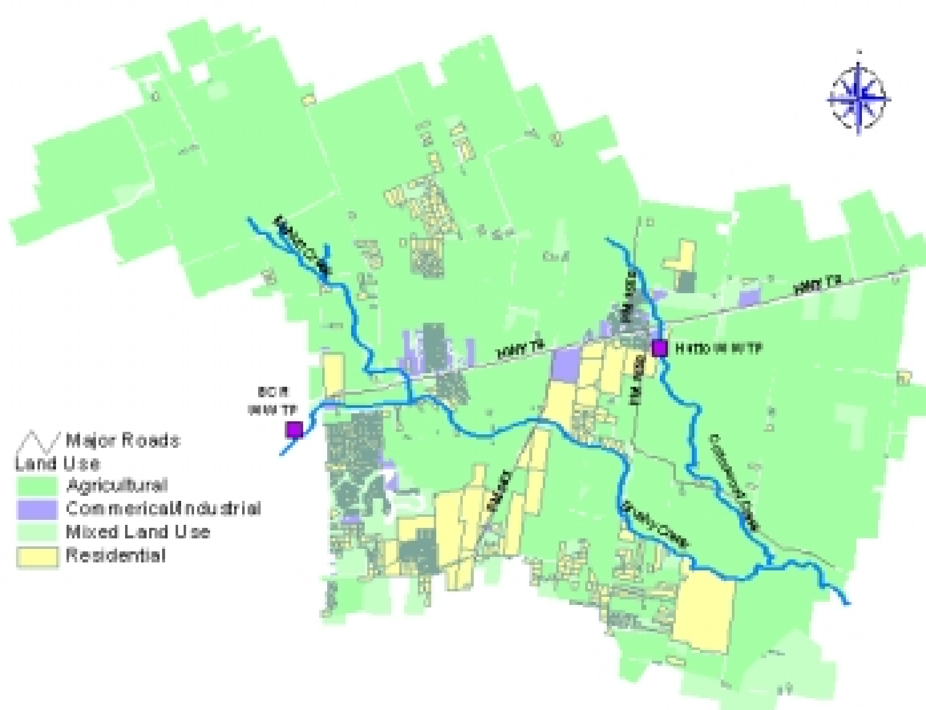


Figure 2-8 2005 Land Use

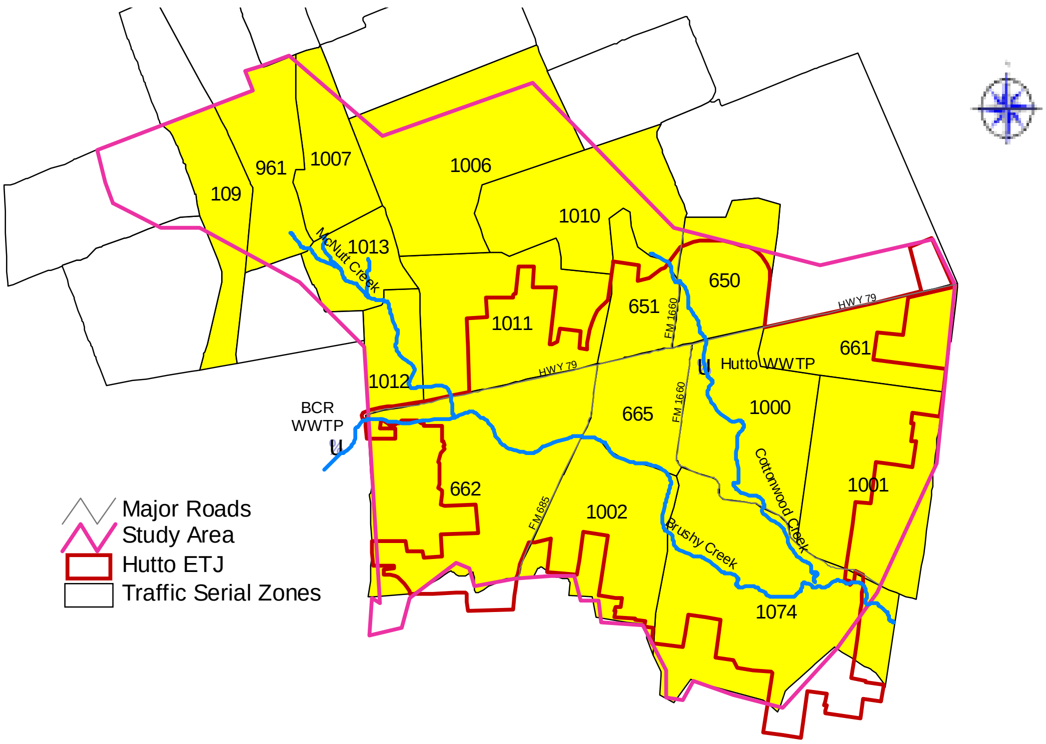


Figure 2-9 Traffic Serial Zones (TSZ) within the Study Area

The TSZ data were applied across the study area by making the following assumptions:

- Only undeveloped (agricultural) land could be developed. (i.e there was no transition of land from commercial to residential use or increase in density for already developed land).
- For any given lot, 20% of the lot is reserved for easements, parks, or other uses.
- New development is assumed to be 90% residential and 10% commercial.
- Residential acreage is assumed to develop at a rate of 3.35 lots per acre. This number was based on the average size (0.3 acre) of current developments underway that are to be connected to sewer.
- Commercial acreage is assumed to develop at a rate of 2 lots per acre; this figure is based on current commercial acreage lot sizes (average commercial lot size is 0.5 acre).

The Total Persons Equivalent was then found using the Per Lot Persons Equivalent data from Table 2-1 (see Table 2-3). For the development of a single acre, the Total Persons Equivalent was found to be 6.53.

	% of Undeveloped Lot	New Development Distribution	Aggregate Distribution	Lots per Acre	Per Lot Persons Equivalent	Total Persons per acre Equivalent
Easements	20%		20%	0	0	
Residential	80%	90%	72%	3.35	2.6	**6.27**
Commercial/Industrial		10%	8%	2	1.6	**0.26**
Total						**6.53**

Table 2-3 Land Use Concentrations

For each 5-year increment, sufficient land would be assumed to develop at this 6.5 Persons Equivalent Rate to match the projected population value in the TSZ. Parcels were chosen based on their size and proximity to roads and other developed areas: thus, land at the intersection of two major roads within a TSZ would be developed prior to an agricultural lot in the midst of 4 other agricultural lots within the same TSZ.

Future Land Use

The future land use for the year 2030 is seen in Figure 2-10. Maps of the other resulting land use projections in 5-year increments are included in Appendix A. Figure 2-11 summarizes the resulting population projections by type of wastewater treatment. The different categories reflect jurisdictional variations.

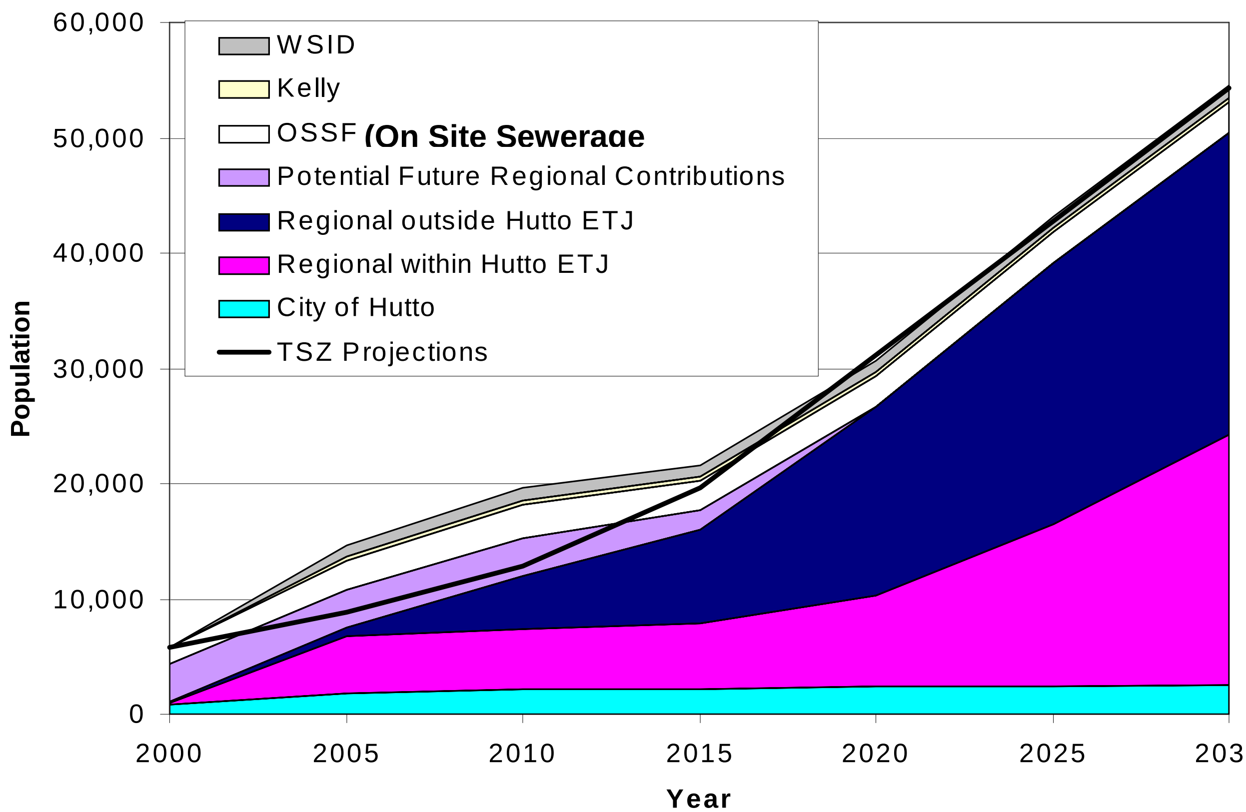


Figure 2-11 Population Projections

WSID and Kelly represent populations being served by other package plants. As the subdivisions being treated by these package plants have entered into long-term agreements, it is assumed the flow from these subdivisions will not be treated by a regional plant within the 30-year planning horizon.

OSSF represents the population presently served by On Site Sewerage Facilities.

It was assumed that all new developments would be sewered, with the exception of the developments underway.

Potential Future Regional Contributions represent two distinct populations. First (and largest) is the subdivision of Forrest Creek, that currently pumps its wastewater by a series of 6 lift stations to the Brushy Regional WWTP. In a regional plan, it might become feasible to include these flows. Second are the potential future contributions of lots currently treated by OSSF, but that are smaller than an acre in size. These subdivisions could be included in a regional framework .

Regional outside the Hutto ETJ includes all growth in the study area that is not part of the Hutto ETJ.

Regional inside the Hutto ETJ includes all growth in the study area that is part of the Hutto ETJ, but outside the current Hutto City limits.

City of Hutto encompasses all growth that it is inside the current Hutto City limits.

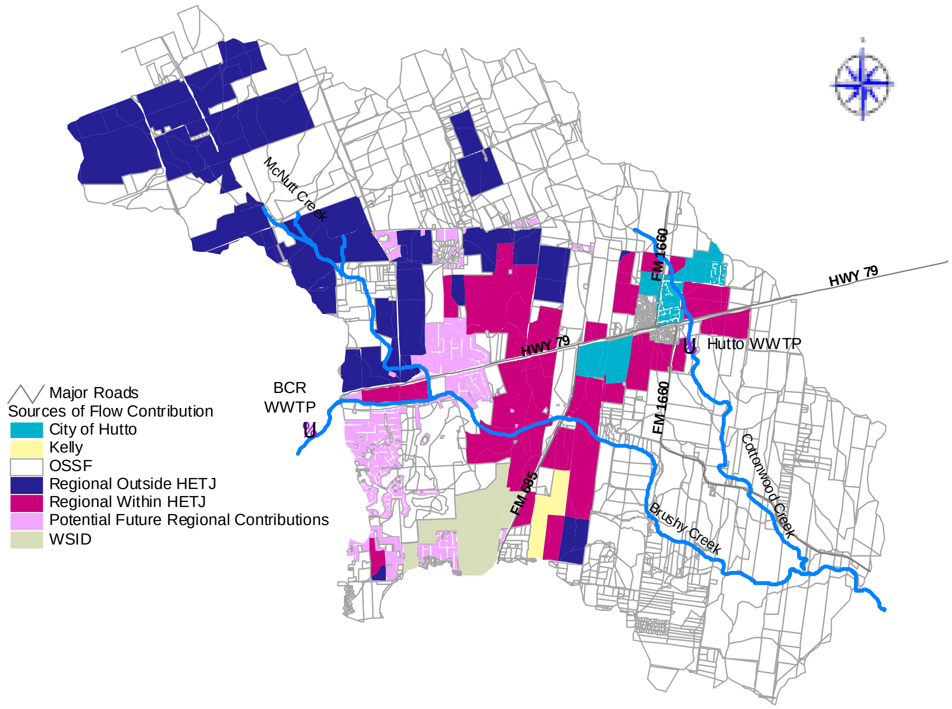
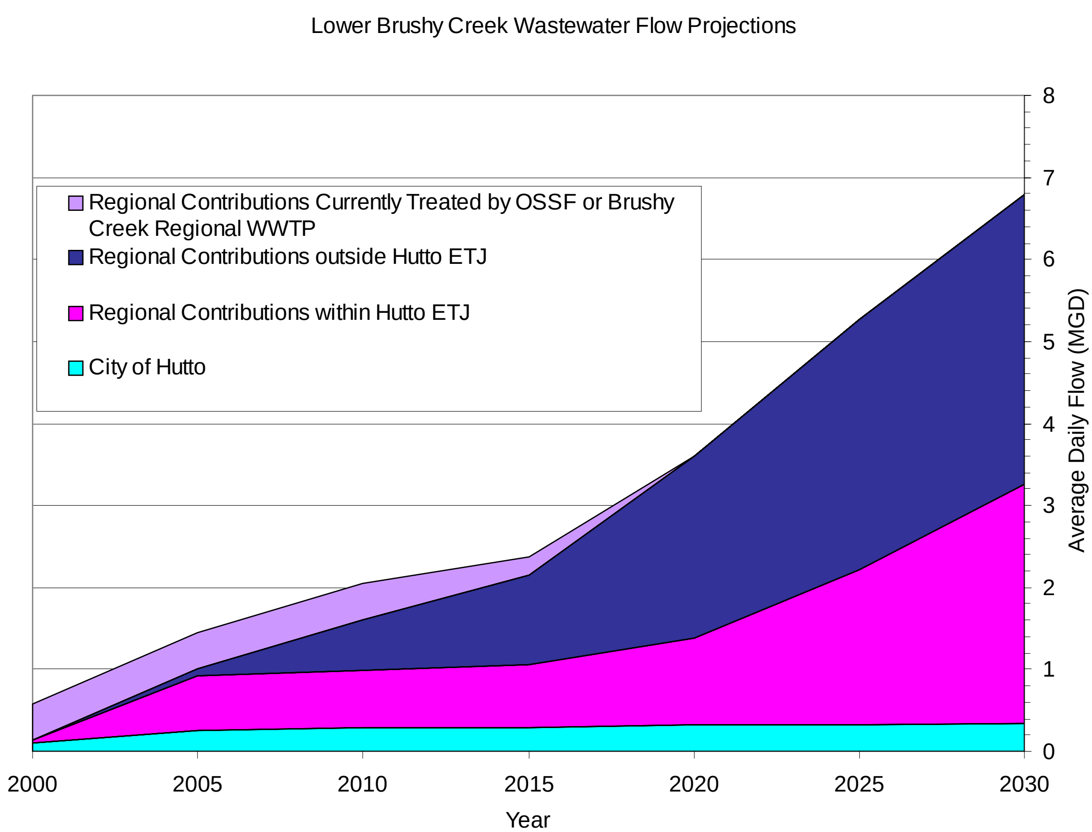


Figure 2-12 Sources of Flow Contribution by 2030

In order to determine average daily wastewater flow; the number of connections were determined by dividing the population number by 2.6 people per connection. Then, the per connection flow value of 350 gpd was applied to incorporate base wastewater flow and infiltration to develop an average daily flow value. Figure 2-13 summarizes the resulting average daily flow projections that might be included in the regional plan.



Section 3
Identification of Alternatives
Collection and Treatment System Alternatives

The three alternatives considered include the following, with sub-alternatives within each one:

The location of these possible lift stations and treatment plants are seen in Figure 3-1.

Alternative 1: One regional WWTP on Brushy Creek downstream of the Hutto Cemetery.

Alternative 2: A regional lift station (Regional Lift Station) at the same location that would pump back to the Brushy Creek Regional WWTP, with a booster station (McNutt Lift Station) near the confluence of McNutt and Brushy Creeks.

Alternative 3: One regional WWTP on Brushy Creek downstream of the Hutto Cemetery. A regional lift station (McNutt Lift Station) near the confluence of McNutt and Brushy Creek pumping to the Brushy Creek Regional WWTP.

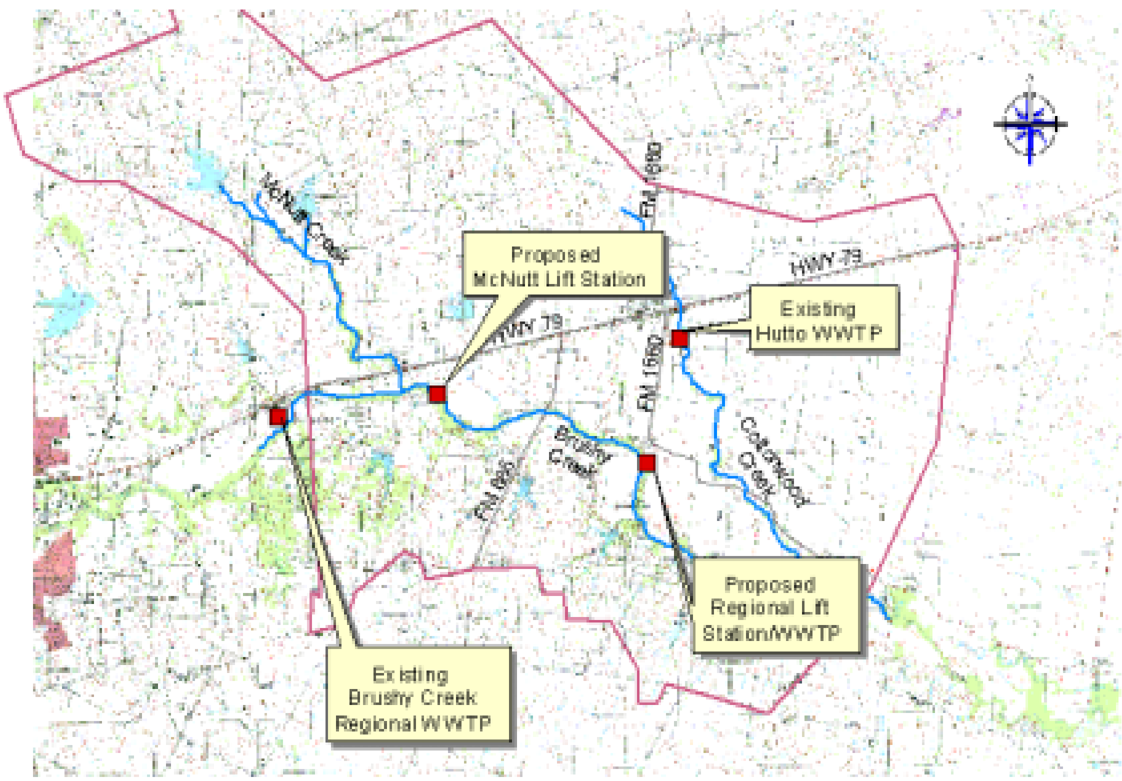


Figure 3-1 Proposed Treatment Plant and Lift Station Locations

For ease of presentation of the alternatives, the study area is divided into four segments as follows:

McNutt Creek – The area tributary to McNutt Creek upstream of Highway 79.

Cottonwood Creek – The area tributary to Cottonwood Creek generally upstream of the existing Hutto WWTP.

East Area – The east portion of the study area that cannot be served by gravity lines to the regional WWTP site.

Lower Brushy Creek – The portion of the study area not contained within the previous three areas.

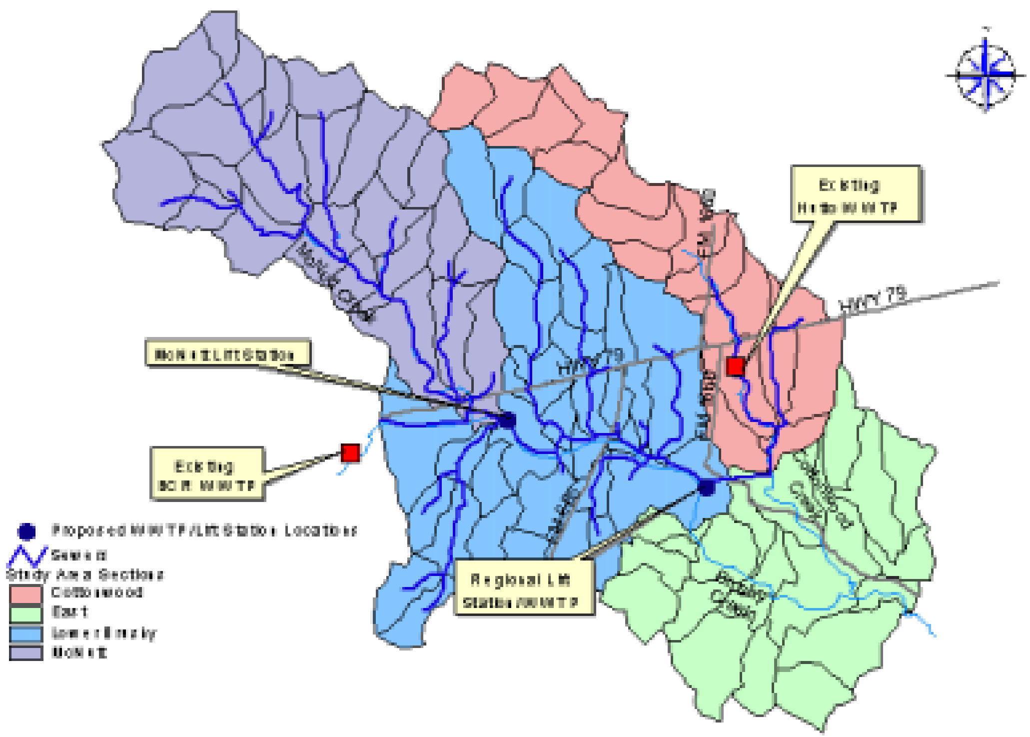


Figure 3-2 Study Area Divisions

Lower Brushy Creek

Option L1: Regional WWTP with no interim lift station.

Option L2: Regional lift station at the regional WWTP site going back to the Brushy Creek Regional WWTP. Another lift station in series would be required—near the confluence of Forest, McNutt, and Brushy Creeks.

Cottonwood Creek

Option C1: Expand Hutto WWTP and keep operational.

Option C2: Expand Hutto WWTP and then phase out as regional WWTP or lift station comes online.

McNutt Creek

Option M1: Downstream lift station to Brushy Creek Regional WWTP –near Forest Creek and Brushy Creek.

Option M2: Tie the McNutt interceptor into the Lower Brushy Creek regional system.

If option M1 is selected, it would be possible to later take this lift station off line and connect to the interceptor; thus treating McNutt flows at the proposed regional plant.

East Area

Option E1: OSSF for entire area.

Option E2: Four lift stations to serve the areas tributary to each stream. The lift stations would be directed towards either the new regional WWTP or the new regional lift station.

Option E3: A combination of OSSF and lift stations.

In summary, there are a several possible combinations under both of the alternatives, as shown in Table 3-1.

	Regional WTTP	Regional Lift Station to East Brushy Creek WTTP	Expand Hutto WWTP		McNutt	East
			≥ 1MGD	< 1MGD		
Alternative 1: Regional WWTP	L1		C1		M2	Any
	L1			C2	M2	Any
Alternative 2: Regional Lift Station		L2	C1		M1	Any
		L2		C2	M1	Any
Alternative 3: Regional Lift Station & WTTP	L1		C1		M1	Any
	L1			C2	M1	Any

Table 3-1 Alternative Matrix

The three alternatives analyzed can be schematically summarized as follows:

Alternative 1: Regional Wastewater Treatment Plant

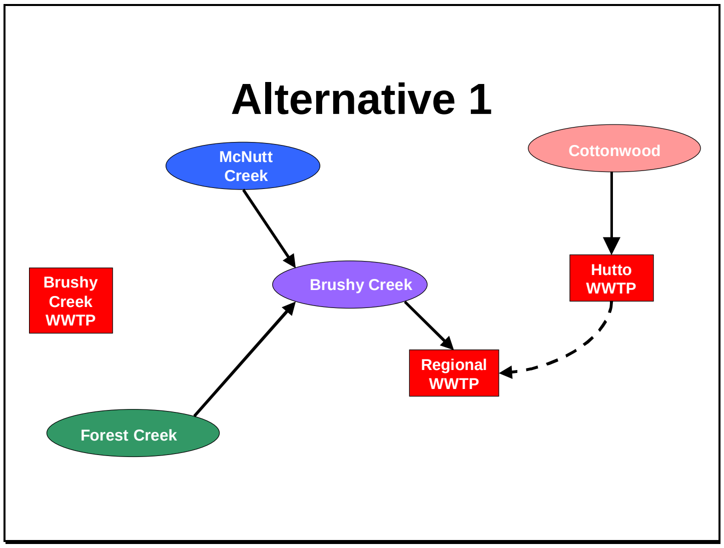


Figure 3-3 Alternative 1 Schematic

Alternative 2: Regional Lift Station, with a booster station at the confluence of Brushy Creek, McNutt Creek, and Forrest Creek.

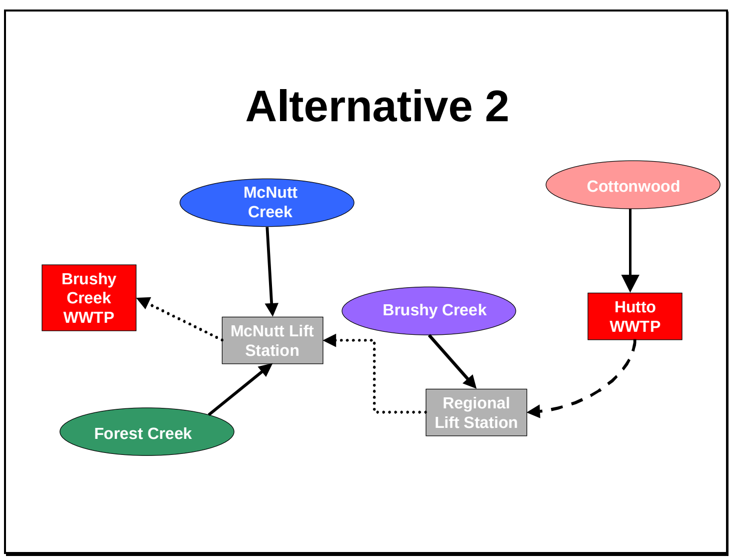


Figure 3-4 Alternative 2 Schematic

Alternative3: Temporary Lift Station at McNutt Creek and Regional Wastewater Treatment Plant.

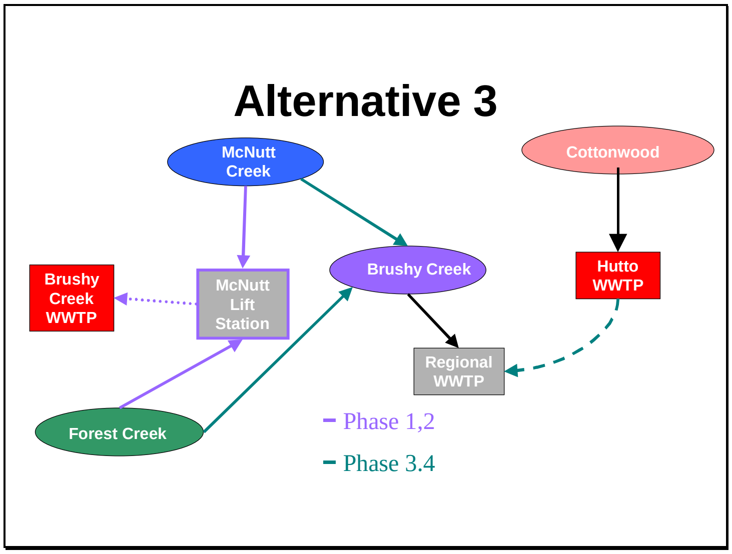


Figure 3-5 Alternative 3 Schematic

Discussion of the decision to phase out Hutto Wastewater Treatment plant is found in Section 8, Implementation Plan.

Section 4
Collection System Alternatives

This section describes the hydraulic model of the Lower Brushy Creek collection system and the results of hydraulic analysis of projected future peak flow conditions to establish current capacities and deficiencies.

4.1 Model Development

The hydraulic model of the collection system was developed using HYDRA™ by PIZER Incorporated. HYDRA is a dynamic flow routing model that routes inflow hydrographs through a pipe system computing a time history of flows and heads throughout the system using Manning's equation. HYDRA injects any combination of these flows into the conveyance system on a pipe-by-pipe basis and dynamically routes them through the collection system. HYDRA requires two distinct data inputs: (1) physical information describing the sanitary sewer system, and (2) flows into the sanitary sewer system. The development of these two inputs are described in the following subsections.

Initial Schematic Development

The schematic model of the system was initially developed in ESRI's ArcView utilizing CRWR-PrePro. CRWR-PrePro developed by the Center for Research in Water Resources, University of Texas – Austin, principally as a pre-processor for another model, is a tool that operates within ArcView that delineates watersheds based on digital topography. Using this tool, the routing of pipes and development of sewersheds were based on a digital elevation model (DEM) of the study area. The resulting sewersheds are shown in Figure 4-1. The sewersheds are categorized by ultimate destination of flow as follows:

Gravity: Flow in these sewersheds could go by gravity to Lower Brushy Creek.

Pump: Pumping would be required for wastewater flow in these sewersheds to be treated in a regional plan.

Upper Brushy Creek: Flow would reach Brushy Creek before the Brushy Creek Regional plant.

Outside: These sewersheds are outside the study area.

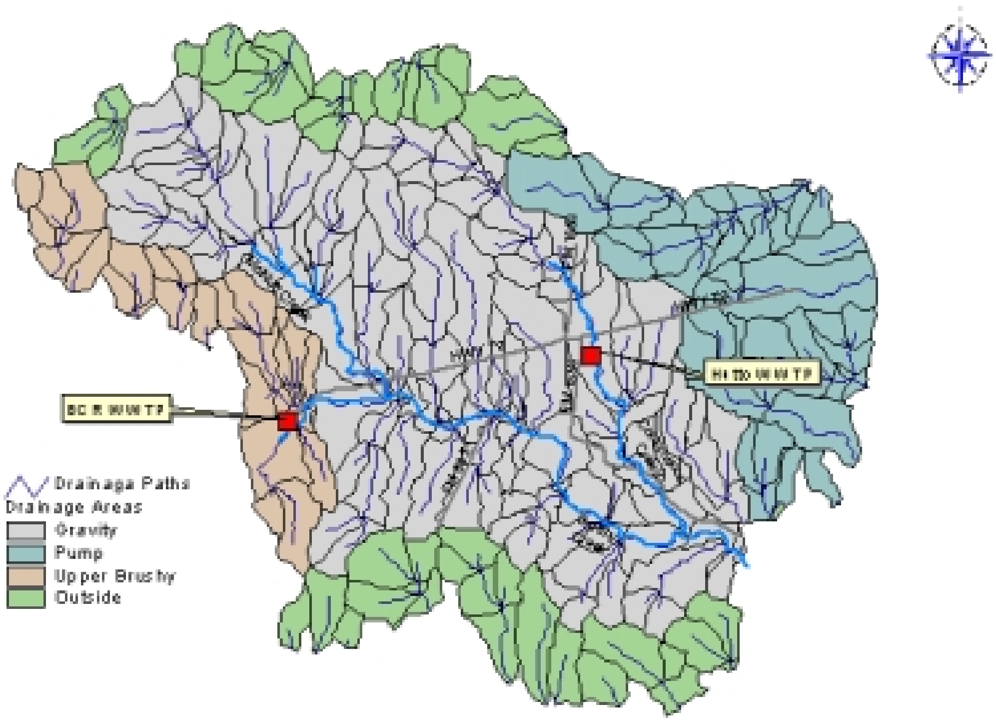


Figure 4-1 Sewersheds based on CRWR-PrePro and 30 meter DEMs

Once the preliminary pipe locations were determined, edits were made to the system to assure the location of the pipes outside of the flood plain, to minimize stream and railroad crossings, and to adjust the size of sewersheds. The resulting network, seen in Figure 4-2, covered the majority of the study area, contains 96 sewersheds, with a mean area of 312 acres; the total pipe length was 64 miles with 762 manholes.

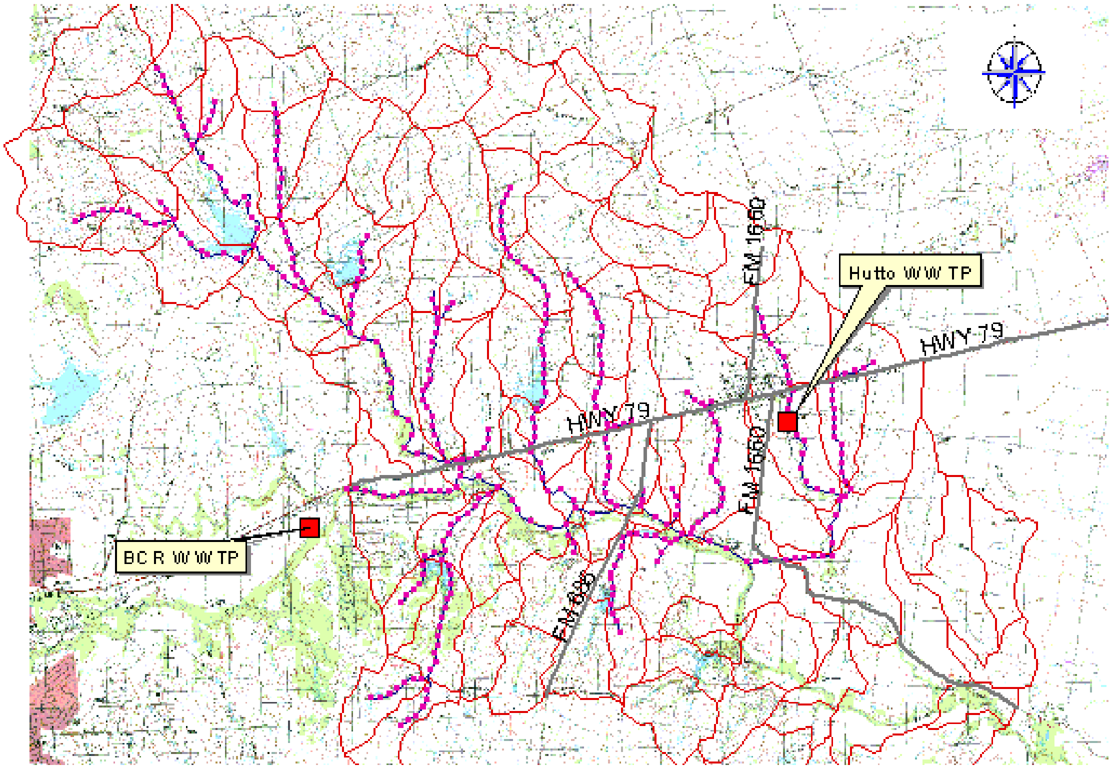


Figure 4-2 Initial Collection System Imported into HYDRA

The manhole rim elevations were populated with elevation from the DEM. Then, using the profiler tool in MIKE SWMM[1], invert elevations were populated based on the following criteria:

- Difference of invert and ground elevation of no less than 5 feet and no greater than 20 feet
- No adverse slopes.
- Changes in slope along pipe runs were kept to a minimum.

Using the HYDRA Layer Wizard, the ArcView shapefiles of the model schematic were imported directly into the HYDRA model.

Flow Data Development

Wastewater flows for each sewershed were developed for the hydraulic model based on the flow projection assumptions presented in Section 2. To assimilate these assumptions into an input file for the HYDRA model, the following steps were followed (modified Austin criteria):

---

[1] MIKE SWMM (Storm Water Management Model) is a modeling package for the analysis of combined and separate drainage systems, which CDM has developed in conjunction with the Danish Hydraulic Institute (DHI). DHI's user interface includes a profile tool that allowed for easy viewing of the change in elevation in pipe runs.

1. Future population projections were divided by 2.6 people per connection and multiplied by 250 gpd to generate the base wastewater flow (Q_{BWWF}).

2. The formula: $Q_{peak\text{-}dry}=(18+(0.0206*Q_{BWWF})^{\wedge}.5)/(4+(0.0206*Q_{BWWF})^{\wedge}.5)$ was used to develop the peak dry weather flow for each sewershed.
   Where, $Q_{peak\text{-}dry\ in}$ is the peak dry weather flow and Q_{BWWF} is the base wastewater flow calculated in the first step.

3. To populate the Infiltration / Inflow values it was assumed that all developed acreage would be sewered; 1000 gpad was then applied to this developed acreage. If tracts were developed at significantly less than 6.5 people per acre, then the developed acreage would be adjusted by dividing the population density by 6.5 and using this factor to decrease the developed acreage.

Once these values were populated within the land use shapefile, the sums of flows were summarized by sewershed and formatted to conform with the HYDRA input file requirements. A flow file was created for each 5-year interval. Likewise, a model was created for each 5-year interval. The only difference between the models was the number of pipes in the model, pipes were added to the model increment as growth dictated.

4.2 Model Analysis

Once the HYDRA models and flow files were established, model runs were performed to determine pipe diameters for each phase of the system. Two collection systems scenarios were modeled:.

3. All of the flow will be going to the Regional Plant/Lift Station location, or

4. The flow from McNutt Creek and Forrest Creek will be removed from the system at a lift station at the confluence of these creeks and Brushy Creek.

The three alternatives were analyzed based on the possible combinations of these two scenarios. Regardless of the alternative chosen, the collection system is the same for the majority of the system, and the difference lies in the interceptor along Brushy Creek between the proposed intermediate lift station (McNutt Lift Station) and the proposed Regional Plant.

The design parameters applied within the HYDRA model are summarized below:

- Minimum diameter = 8 inches

- Manning's n = 0.013

- Maximum d/D (depth of flow over pipe diameter) was set to 70 percent so that the pipes would be sized to flow at no greater than 80 percent capacity under design flow conditions.

A graphical representation of the model results is found in Appendix B for both scenarios. While these results show the required pipe sizes based on the flows at each increment, pipes would be sized based on the 2030 planning horizon. Thus, Figure 4-3 and Figure 4-4 present the pipe sizes for Scenario 1, which is build out for Alternatives 1 and 2, and Scenario 2, which is build out for Alternative 2 respectively. The phasing required for the collection system is presented in Figure 4-5.

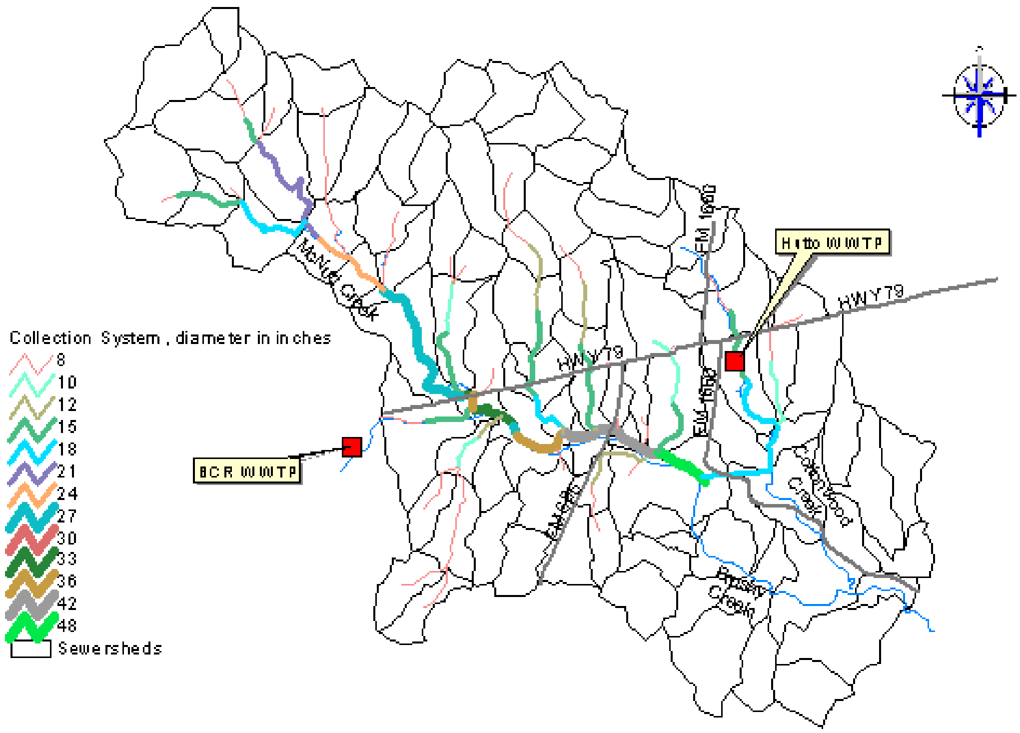


Figure 4-3 Collection System Sizes, Alternative 1, 3

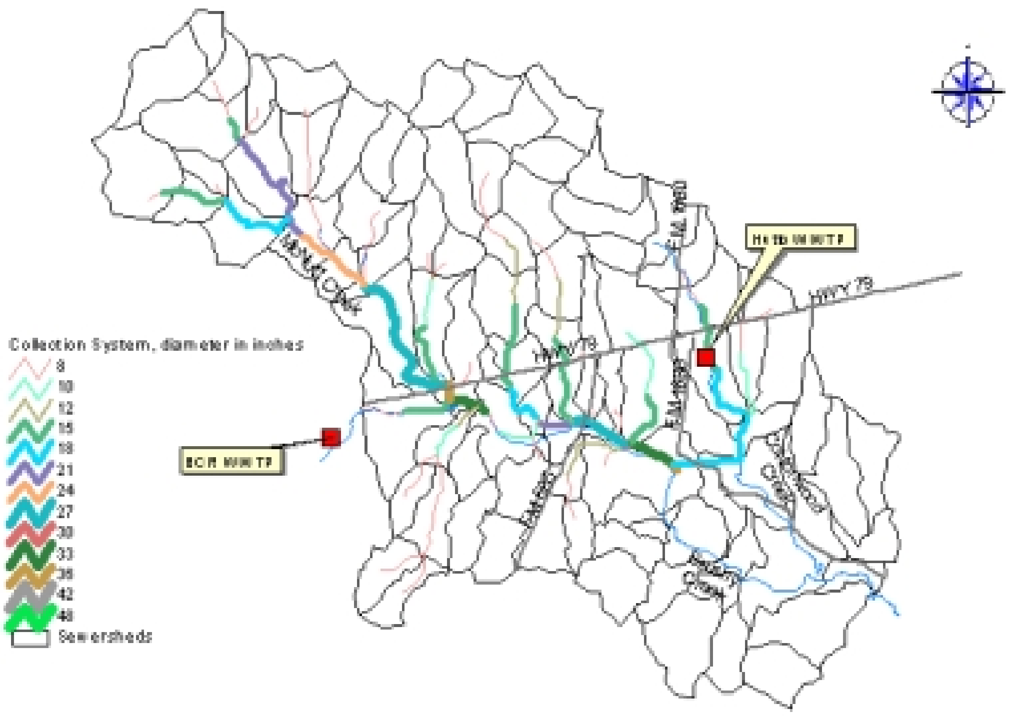


Figure 4-4 Collection System Sizes, Alternative 2

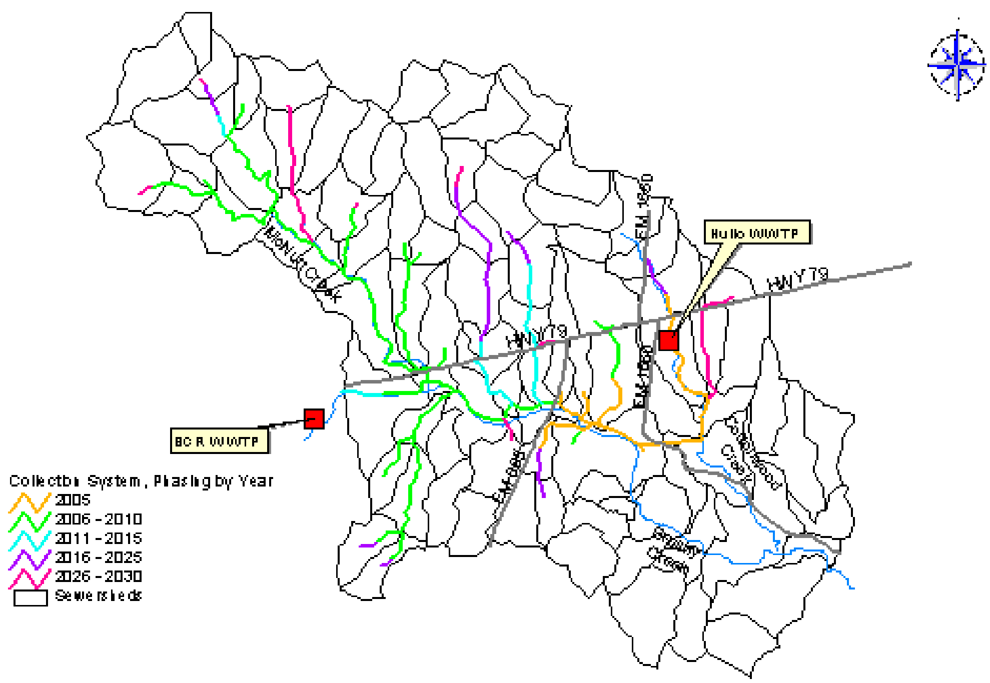


Figure 4-5 Collection System Phasing

Table 4-1 provides a summary of the pipe sizes and the year of implementation for the collection system required regardless of the alternative chosen. These pipes include all the minor lines connecting to the interceptors as well as the interceptors upstream of the McNutt Lift Station location.

Diameter (in)	2005	2010	2015	2020	2025	2030
	Length of Sewer installed by Phase (feet)					
8	3,053	31,023	3,068	9,115	8,364	21,624
10	458	10,971				4,895
12	4,357	2,515	5,044	4,881		
15	9,905	13,007	10,210	3,796		
18	7,633	7,880	3,350			
21		8,135		484		
24		5,608				
27		10,592				
33		3,628				
36		816				
42						
48						
Grand Total	25,406	94,173	21,672	18,276	8,364	26,519

Table 4-1 Collection System Phasing by Year

Table 4-2 provides a summary of the interceptors required, by year, for the two alternatives. The reflects the segment of the collection system between the possible McNutt Lift Station site and the proposed Regional WWTP / Regional Lift Station location.

	WWTP Alternative		Lift Station Alternative	
	2005	2010	2005	2010
Diameter (in)	Length of Interceptor installed by Phase (feet)			
8				1,188
10				3,589
21				2,370
27		494	2,665	1,320
33		649	484	
36		4,086	3,348	
42	3,149	3,690	495	
48	3,843			
Total Length	6,992	8,919	6,992	8,467

Table 4-2 Interceptor Phasing by Year and Alternative

4.3 Force Mains and Lift Stations

For the alternatives involving lift stations and force mains, peak flow served as the basis for sizing requirements. Figure 4-3 shows the proposed location of the force mains. Table 4-3 provides a summary of the force main and lift station sizes.

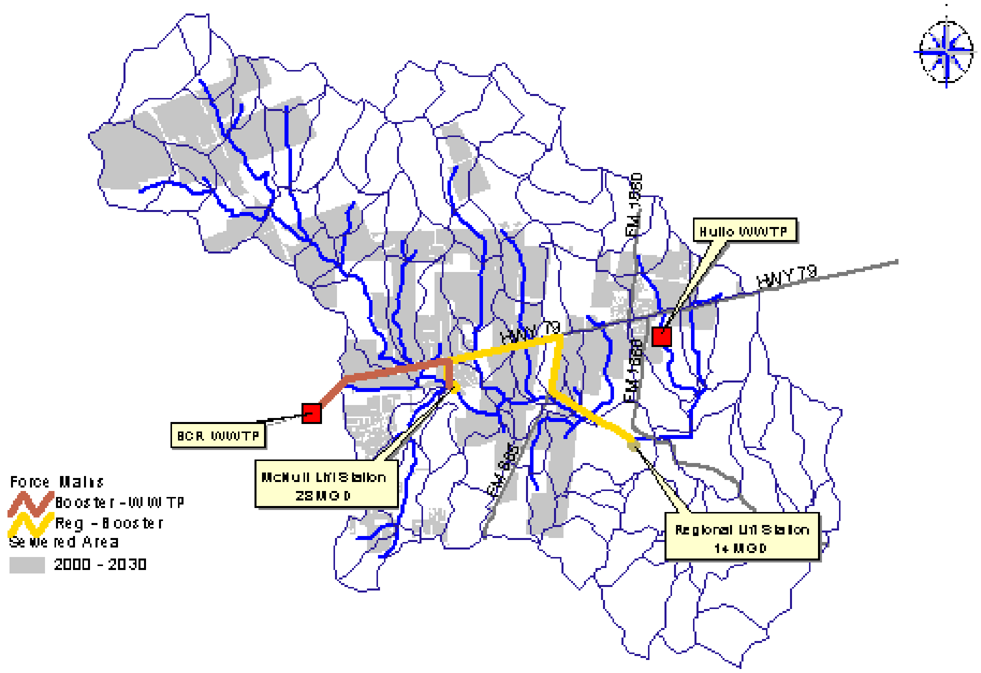


Figure 4-6 Force Main and Lift Station Locations

	Origin	Destination	Static Head (ft)	Distance (miles)	Force Main Size (in)	2030 Peak Flow (MGD)
Regional Lift Station	Regional LS	McNutt LS	38	3.92 miles	30	13.6
McNutt Creek Lift Station	McNutt LS	Brushy Creek WWTP	41	1.81 miles	36	28.7

Table 4-3 Lift Station Details

Section 5
Wastewater Treatment Alternatives

This section describes alternatives for providing wastewater treatment within the Lower Brushy Creek watershed. The existing wastewater facilities are evaluated for expansion potential and suitability for incorporation into a regional treatment scheme, and the requirement for new treatment plants is analyzed for consistency with the collection system alternatives presented in Section 4. Also described are anticipated effluent standards for future wastewater discharges and the potential for wastewater reuse. The wastewater treatment recommendations are provided in Section 7.

5.1 Evaluation Approach

In evaluating different wastewater treatment scenarios, a uniform basis is required for comparison of alternatives. To be consistent with wastewater collection alternatives, which of necessity incorporate wastewater conveyance capacities sufficient to serve the Lower Brushy Creek watershed at buildout, a similar buildout capacity basis is adopted for the wastewater treatment evaluation. Treatment scenarios are compared using the wastewater flow projections for the year 2030, recognizing that phasing is necessary to efficiently provide physical facilities to treat the flows generated in the years prior to buildout. In 2030, average daily wastewater flows are projected at 6.0 MGD without Hutto flows, or approximately 7.0 MGD with Hutto flows.

The wastewater treatment alternatives were compared assuming a required treatment capacity of 8.0 MGD. By planning for 8.0 MGD, flow would be at less than 90% capacity in 2030, when flow is expected to plateau. This would give a comfortable margin of excess capacity and the plant would not require further upgrade. In actuality, decisions made on the basis of an 8.0 MGD ultimate size should still be valid for a plant of slightly greater or lower capacity. Phasing for the project would likely consist of an interim facility, followed in a few years by an initial 6.0 MGD permanent plant, and then a subsequent 2.0 MGD expansion. The projected timing of the various phases is discussed in Section 8.

As presented in Section 3, the three alternatives include building a regional facility, pumping the wastewater flow back to the Brushy Creek Regional facility (BCR WWTP), or a combination of both. The first and third alternatives require analyzing the wastewater treatment options that could be implemented at a new regional site. The second and third alternatives require understanding the existing BCR WWTP.

What follows is a discussion of the factors to be considered in selecting a site and treatment technology for the new Lower Brushy Creek Regional facility. First, the existing treatment plants affecting the area and the BCR WWTP are discussed. Included in this discussion is the expansion possibilities at this plant. Some consideration is given to the treatment of wastewater generated before the new regional plant is in place.

5.2 Evaluation of Existing Plants

In order to analyze the treatment possibilities within the study area both the small plants – less than 1 MGD – currently serving the study area and the Brushy Regional Plant are discussed.

5.2.1 Small WWTP Plants

The Lower Brushy Creek service area contains three existing wastewater treatment plants that are evaluated for suitability of incorporation into a regional treatment scheme. These consist of two small package plants serving the Windermere and Timmerman developments on the south side of the study area, and the Hutto WWTP. In considering potential for expansion into a regional facility, the two smaller plants suffer from numerous limitations including:

- Plants are located in outlying parts of the service area, making it infeasible to serve large portions of the Lower Brushy Creek drainage area;
- Sites are too small for further expansion and / or are nearly surrounded by development;
- Treatment facilities are in poor condition and / or have nearly expended their useful life.

Of the existing plants, only the Hutto WWTP is considered a potential candidate for continued use in a regional treatment scheme. The LCRA / BRA Alliance operates a 0.2 MGD WWTP, but the location of the plant is too far north to serve larger areas in the Lower Brushy Creek basin without extensive pumping. Additionally, this plant is nearing its treatment capacity, and an expansion program for the facility has recently begun. The Hutto plant site is large enough to accommodate additional treatment units, and the size of the plant expansion is currently under evaluation. Based on growth projections in the immediate service area, it is assumed that the Hutto WWTP would have an ultimate buildout flow of 0.95 MGD. Thus, the enlarged Hutto WWTP could serve in a regional treatment scheme to offload flow from a new Lower Brushy Creek regional facility further south.

5.2.2 Brushy Creek Regional Wastewater Treatment Plant

The existing Brushy Creek Regional Wastewater Plant (BCR WWTP) is currently permitted for a flow of 11.8 MGD. Permit requirements dictate that it must achieve 10 / 15 / 3 / 4 mg / L (CBOD, TSS, N-NH3, DO). The plant currently uses conventional aeration followed by secondary clarifiers. The clarifier effluent is disinfected and dechlorinated before being discharged into Brushy Creek. The sludge is dewatered on site and landfilled. Table 5 – 1 presents the schedule capacity demands of the BCR WWTP Brushy Creek Plants.

Year	Average Daily Flows at Brushy Creek (MGD)
2001	11.8
2007	16.8
2015	30
2020	40
Ultimate	45

Table 5–1 Projected Flows for Brushy Creek Regional WWTP

The ultimate capacity of the Brushy Creek WWTP site is 45 MGD. Under the Alternative 2 scenario, when all the wastewater flow from the Lower Brushy Creek study area would go to the BCR WWTP, there is concern that the 7 MGD contributed from Lower Brushy would limit the BCR WWTP from serving its predetermined collection area. One advantage of Alternative 3 is that it would not affect ultimate build out, as the flows would be directed to a Regional WWTP once sufficient treatment capacity was in place at the new site. The one effect of Alternative 3 would be to move the expansion plan for the existing plant up by several years.

The expansion of the BCR WWTP would follow the current layout, utilizing the existing master plan developed by HDR Engineering in 1994. Another 10 MGD of capacity could be added as shown in Figure 5-1. The plant currently uses conventional aeration followed by secondary clarifiers. The clarifier effluent is disinfected and dechlorinated before being discharged into Brushy Creek. The sludge is dewatered and landfilled.

A brief list of the changes to achieve the additional 10 MGD of capacity at the existing plant is as follows:

- Install two-12 MGD submersible pumps at the existing lift station. This would bring the ultimate capacity to 70 MGD with a firm capacity of 58 MGD with the largest pump out of service. This utilizes a peaking factor of 2.9.

- Consider a new mechanical bar screen. Two existing mechanical bar screens can handle up to 66 MGD, so a new mechanical bar screen is not required. The hydraulics through the bar screen channels should, however, be evaluated to verify peak flow capacity.

- Install a new vortex grit removal system. Existing vortex grit removal system can handle flows up to 30 MGD.

- Install two grit pumps similar to the existing pumps to remove grit from vortex hopper and lift the grit into grit washer.

- Install one cyclone and one grit washer similar to the existing grit washers and cyclones.

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Insert Figure 5-1, which is a plant layout of BCR WWTP w/ expansions n basins to match existing four basins. Existing basins utilize fine bubble aeration and are each rated for 2.5 MGD. Basin layout would effectively mirror the existing layout.

- It is anticipated that no new blowers are needed for this expansion.

- Install two more clarifiers to match existing two clarifiers. Each clarifier is rated for 5 MGD. New clarifiers would mirror existing clarifier arrangement.

- Install a new sludge pumping building to pump return activated sludge and waste activated sludge. Recommend mirroring the existing layout in the new building, as well as evaluating the pump capacities and controls.

- Install a new chlorine contact basin similar to the existing basin. Recommend connecting the new basin to the existing basin to utilize the existing dechlorinating equipment and cascade.

- Install new chlorination injection equipment at the head of the new chlorine contact basin.

- Evaluate the existing chlorinators and sulfonators and upsize the existing rotameters if necessary to handle the increased flow.

- Evaluate the existing solids handling facility to handle the increased sludge flow. Consider installing a new building with new equipment to handle the increased sludge. A new building would need to be considered with it effect on ultimate flow.

The above changes would also require the installation of associated piping, valves, power, and controls.

The plant has been laid out such that if the permit requirements change, it could be modified to achieve a 5 / 5 / 2 / 1 / 5 mg/L (CBOD / TSS / N-NH3 / P-PO4 / DO) permit. Modifications would include, but not necessarily be limited to, the installation of anaerobic and anoxic basins before the aeration basins and the installation of effluent filters after the clarifiers.

The flow expected to be lifted from the lower Brushy Creek basin would originate from areas within the Round Rock ETJ. A regional lift station would be sized and located to serve Forest Creek, as well as those areas north of McNutt Creek. The new lift station, along with collection improvements, would allow the existing lift stations serving Forrest Creek to be taken offline. The ultimate flow expected to be lifted to BCR WWTP is 2.2 MGD (8.0 MGD peak). In the future, re-evaluation of flows at the lift station, BCR WWTP, and the Lower Brushy Creek Regional Plant will be necessary to determine the best economic plan to serve the area.

To properly analyze the feasibility of a new wastewater plant in Lower Brushy Creek, appropriate design criteria must first be established. The applicable design criteria are described below.

5.3 Design Criteria for Regional Wastewater Treatment Plant

Criteria necessary for the planning and design of a new regional wastewater treatment plant were developed and are described in this section. Also described are the operating characteristics desired in this type of facility and the corresponding plant design philosophy. Based on the established design philosophy and criteria, the required treatment processes and major items of equipment were identified and are described in this section.

5.3.1 Projected Permit Limits

The site identified for a new regional WWTP is adjacent to Brushy Creek a few miles south of the City of Hutto. Treated wastewater would be discharged to Brushy Creek which flows into the San Gabriel River, thence into the Brazos River. Based on water quality modeling performed by TNRCC, the projected TPDES permit limits for a new regional plant are shown on Table 5-2.

Year	CBOD5 (mg/L)	TSS (mg/L)	Ammonia (mg/L)	DO (mg/L)
2005	10	15	3	4
2010	10	15	3	5
2020	10	15	2	5
2030	7	15	2	5

Table 5-2 Lower Brushy Creek Regional WWTP Projected TPDES Discharge Permit Limits

The permit limits presented in Table 5-1 would require a conventional advanced secondary wastewater treatment plant to achieve carbonaceous BOD removal and nitrification (conversion of ammonia to NO^{-}_{3}). Under this scenario ammonia limits would become more stringent in 2020; however, the basic treatment process would not change although more care would be required in plant operations. The reduction in effluent CBOD in 2030 would require an upgrade of the plant to incorporate tertiary filters. For dissolved oxygen, the proposed 4 mg/L DO limit should be met through conventional treatment processes. Increasing the required DO in 2010 to 5 mg/L would normally require that some type of post aeration measures be added. Based on these limits, the plant should be designed initially to achieve 10/15/2/5 mg/L CBOD/TSS/NH_3-N/DO permit limits.

In addition to the basic 10/15/2 permit limits, the plant design should include provision for the easy incorporation of effluent filters since they will be needed at some point prior to 2030. Also, noting that the upstream Cedar Park WWTP has a tertiary treatment permit including total phosphorus (5/5/2/1 mg/L BOD/TSS/Ammonia/TP), it is possible that more stringent permit limits could be added to the Lower Brushy Creek Regional WWTP in the future. Accordingly, it would be wise to provide a treatment process for the Lower Brushy Creek Regional plant that could be easily upgraded to achieve phosphorus removal in the event it became a TPDES requirement.

5.3.2 Design Criteria

Based on typical domestic wastewater strength, suggested design criteria for the regional WWTP are shown in Table 5-3.

Parameter	Units	Regional Plant @ Buildout
Flow		
Average Day	MGD	6.0
Maximum Month	MGD	7.5
Peak 2 hour	MGD	15.0
Influent BOD5		
Average Day	mg/L	200
Maximum Month	mg/L	250
Average Day	lb/day	10,000
Maximum Month	lb/day	12,500
Influent TSS		
Average Day	mg/L	200
Maximum Month	mg/L	250
Average Day	lb/day	10,000
Maximum Month	lb/day	12,500
Influent Ammonia		
Average Day	mg/L	15
Maximum Month	mg/L	20
Average Day	lb/day	750
Maximum Month	lb/day	1,000
Influent Phosphorus		
Average Day	mg/L	7
Maximum Month	mg/L	10
Average Day	lb/day	350
Maximum Month	lb/day	500
Influent Temperature		
Minimum	ºC	17
Maximum	ºC	31
Influent Alkalinity as $CaCO_3$	mg/L	>160
Effluent BOD		
30-day Average	mg/L	10
Effluent TSS		
30-day Average	mg/L	15
Effluent Ammonia		
30-day Average	mg/L	2
Effluent Phosphorus		
30-day Average	mg/L	N/A
Effluent Dissolved Oxygen		
30-day Average	mg/L	5

Table 5-3 Lower Brushy Creek Regional WWTP Design Criteria

5.3.3 Desired Operating Characteristics

A future 8.0 MGD regional plant in the Lower Brushy Creek watershed would be smaller and somewhat more remote compared to the existing Brushy Creek Regional WWTP, and it is likely that staff would provide operations support using the existing plant as a base. A logical scenario would be to provide operator(s) for the new regional plant only during the day shift, with plant monitoring and control capabilities provided at the existing plant. Therefore, certain operating characteristics are desirable considering the remoteness of the new regional plant and the availability of staff to operate and maintain it. These characteristics include the following:

- The plant should be simple to operate without requiring complex procedures or intensive on-site monitoring.
- The plant should be capable of operating unattended. This would normally be for two shifts per day, although it should be possible to leave it unattended over a weekend if necessary.
- The plant should reliably achieve discharge permit limits over all anticipated flow and loading ranges.
- The plant should utilize conventional equipment that minimizes maintenance requirements. Equipment requiring frequent or complex maintenance should be avoided.
- The plant should incorporate modern energy efficiency measures where feasible.
- The plant should have a low odor producing potential, and any odor generating processes or equipment should be equipped with appropriate odor control measures, or at least be capable of easily accepting odor controls in the future.
- The plant should be equipped with a Supervisory Control and Data Acquisition (SCADA) system. This will allow remote monitoring and control of the plant from the existing Brushy Creek Regional facility.

5.3.4 Plant Design Philosophy

To be consistent with the desired operating characteristics, it is recommended that the plant be a fully aerobic process that will minimize odors and reduce operations complexity. For this reason, primary clarifiers will not be considered, since these units would require handling raw primary sludge, a difficult material, and would increase the odor-producing potential. Attached growth processes, such as trickling filters or rotating biological contactors, is a proven process and can be designed to achieve nitrification. However, in warm climates significant operations effort is required to control snails and filter flies, so this process is not considered appropriate for the new regional plant. Similarly, the provision of anaerobic digestion would require more operator attention and would produce fugitive odors. Accordingly, anaerobic digestion will not be considered as a means of sludge stabilization.

Process alternatives for the new regional plant are described in a subsequent section.

5.4 Treatment Process Evaluation

As a basis for evaluation of the treatment process and sludge processing options, and consistent with the overall design philosophy, this report assumes that the ultimate 7 MGD Lower Brushy Creek Regional WWTP (or 8 MGD if Hutto is a participant) would consist of the following components:

- Influent pump station
- Headworks with screening and grit removal, and equipment for screenings and grit dewatering and compaction
- Activated sludge treatment
- Secondary clarification
- Future effluent filters
- Wastewater disinfection
- Sludge processing facilities
- A small operations building with laboratory and maintenance area
- Required support facilities such as a plant water system, roads, and utilities

After screening and grit removal, the plant flow would be conveyed directly to secondary treatment for removal of BOD, TSS, ammonia, and phosphorus. Secondary treatment for the Lower Brushy Creek Regional WWTP would be provided using one of several candidate activated sludge processes. After clarification, treated secondary effluent would be disinfected and discharged. Waste sludge from the activated sludge process would be transferred to the sludge treatment facilities, either on-site or at the existing Brushy Creek Regional WWTP.

5.4.1 Process Alternatives

The activated sludge process exists in a variety of permutations, a number of which are in common usage. These include:

- Conventional activated sludge
- Oxidation ditch
- Sequencing batch reactor
- Contact stabilization
- Pure oxygen activated sludge
- Fixed film / activated sludge coupled processes

Only the first three listed above are considered applicable for the Lower Brushy Creek Regional WWTP. These three are well-accepted processes with many successful installations. Contact stabilization is an activated sludge variation that has a small aeration zone with very limited nitrification capability. Pure oxygen would be suitable only for large plants and then only under special circumstances. Fixed film processes (e.g., trickling filters, rotating biological contactors) work well, however, they will not be considered due to the difficulty in controlling snails and filter flies in this climate.

In addition to the processes listed above, another activated sludge variant may be appropriate to consider. This is the membrane activated sludge reactor which has only recently been introduced as a full-scale wastewater treatment technology. The membrane reactor eliminates external secondary clarifiers by filtering the water to beyond effluent treatment standards through hollow fiber plastic membranes. Because this technology is relatively expensive, one approach is to size the membrane process for average flows and use a ballasted flocculation enhanced high-rate clarification system for treatment of peak flows. The membrane treatment process and the activated sludge processes are described in greater detail later in this section.

Nutrient Removal Considerations

Given the likelihood that the permit for the Lower Brushy Creek Regional WWTP will require nutrient removal, all of the recommended activated sludge processes would include a bioselector basin upstream of the activated sludge aeration basin. The bioselector is an improvement to the process that provides several benefits. The most significant benefit is that sludge settling is improved in the secondary clarifiers through inhibition of filamentous bacteria in the bioselector. Additionally, the bioselector will be designed to provide denitrification of nitrates in the return activated sludge. Removing this nitrate component will aid in preventing rising sludge due to denitrification in secondary clarifiers. Alkalinity is also released during denitrification and recovered in the process. Although not anticipated, to provide total removal of nitrogen, it would only be necessary to add an internal recycle of nitrified mixed liquor back to the anoxic bioselector. Additionally, adding a small anaerobic bioselector upstream of the anoxic bioselector would enable the plant to achieve biological phosphorus removal should it ever be required.

In addition to providing biological nutrient removal, use of a bioselector will require a smaller downstream aeration basin. And, as a result of denitrification, the total aeration system can be downsized approximately 10%, which provides energy savings.

Conventional Activated Sludge

This alternative consists of a conventional activated sludge reactor incorporating an anoxic bioselector. The bioselector basin would not be aerated but would be completely mixed. Return activated sludge would be introduced into this basin together with the raw influent wastewater.

Activated sludge can be achieved in either complete mix or plug flow reactors; however, plug flow reactors can be about 15% smaller. Basin size would be based on a design solids retention time (SRT) in the 7 – 8 day range, which is the time required to achieve complete nitrification in this climate during prolonged cold weather conditions. Secondary clarifiers would be provided downstream of the activated sludge reactor.

Oxidation Ditch

The oxidation ditch is a long sludge age process that typically operates in an extended aeration mode. The process generates less overall sludge and provides good buffering for peak flows and variations in loading. To provide anaerobic and anoxic bioselectors, tankage would be added to one end of the oxidation ditch, with narrow gates shunting water between the aerobic and anoxic zones. Sizing of the oxidation ditch has historically been based on a SRT of 20 days or more; however more recent practice is to size the process at about 12 days SRT. Because of this longer sludge age, a larger tank is required compared to conventional activated sludge.

Several varieties of oxidation ditch are in use. The most common types are those with horizontal brush rotors, rotating discs, or mechanical aerators. All three varieties provide comparable performance. Basin volumes and aeration power requirements for each system are approximately equal. Each system would also require external secondary clarifiers and a sludge pump station for recycling and wasting.

Sequencing Batch Reactor

Another variation of the activated sludge process is the Sequencing Batch Reactor (SBR), which combines aeration and clarification in a single tank. At least two tanks are required. Typically, the SBR would operate in an extended aeration mode using an SRT of 24 days.

In the typical operating scenario, the SBR is cycled through four treatment stages. In the fill stage, raw wastewater is directed to one SBR tank while the contents are aerated and mixed. After the tank is filled, influent flow is diverted to a second tank and the filled tank enters the react stage. Mixing and aeration continue to reduce BOD and achieve nitrification. The aeration may be cycled on and off to create an anoxic selector and provide denitrification. After the react stage, mixing and aeration cease and the reactor enters the settling stage. Under quiescent conditions, solid/liquid separation takes place. This is followed by the decant stage, where clarified effluent is discharged and an appropriate quantity of sludge is wasted from the system. The cycle is then repeated. In practice the treatment cycles are fully automated using motorized valves, weirs, and controls.

SBRs offer the advantages of not requiring external secondary clarifiers or return activated sludge pumps. However, discharge from the SBR after settling is rapid, and post-treatment equalization may be required to reduce the size of downstream filtration and/or disinfection facilities.

Membrane/Ballasted Flocculation System

The membrane/ballasted flocculation system is a hybrid system employing two state-of-the-art treatment technologies, both of which have only recently been introduced. The system consists of a membrane bioreactor in parallel with a ballasted flocculation enhanced high-rate clarification process. Since the membrane system is relatively expensive, it would be used to treat dry weather flows only. The ballasted flocculation system would be placed in operation to treat peak wet weather flows above the membrane treatment capacity. The ballasted flocculation process is more expensive to operate but inexpensive to construct, whereas the reverse is true for the membrane system. Thus using ballasted flocculation for infrequent peak wet weather flows provides a complementary process to membranes which would be used on a daily basis for dry weather flows. For preliminary design, the membrane reactor would be designed for 8.0 MGD and the ballasted flocculation reactor would be designed for 12.0 MGD. Flows reaching the plant in excess of 8.0 MGD would be routed to the ballasted flocculation system.

Membrane bioreactors for wastewater treatment consist of hollow fiber microfiltration membranes immersed in a conventional aeration basin. The membranes are capable of producing effluent that far exceeds secondary discharge permit standards for BOD and TSS, so no secondary clarifiers are required. Typically, the membrane bioreactor would be designed to operate at a mixed liquor suspended solids level of 10,000-12,000 mg/L and an SRT of 30 days or more. Due to the high MLSS level, the total reactor tank size is less than required with conventional activated sludge. A bioselector would also be provided upstream of the membrane bioreactor to achieve partial denitrification and save aeration energy.

The parallel ballasted flocculation process is a compact clarification system that incorporates coagulation, flocculation, and ballasted sedimentation. The process uses microsand (100 - 150 μm) to enhance the flocculation and settling mechanisms. A coagulant is added to the influent wastewater prior to entering a flash mix tank, where microsand and polymer are added. The coagulant dosing rate is paced from an influent flow meter. The flow passes from the mixing zone to a maturation zone, then to a compact clarifier containing lamella sedimentation tubes. The microsand provides a large number of particles and contact area, enhancing the flocculation rate and acting as ballast, thereby accelerating the sedimentation process. Clarified effluent is discharged from the process over effluent weirs, and the resulting sludge, which contains a mixture of sludge and microsand, is collected at the bottom of the clarifier and pumped to a hydrocyclone where the sludge is separated from the microsand by centrifugal action. The recovered microsand is then recycled back to the flash mix tank, and the separated sludge is continuously wasted from the process. A small amount of new microsand is added to make up for losses in the discharged sludge.

5.4.2 Process Comparison

The four processes described above can be compared based on reliability, flexibility, complexity, performance, maintenance, and implementability. Using these criteria, a qualitative evaluation of the treatment alternatives was performed and is presented in Table 5-3. The results are summarized below.

	Reliability	Flexibility	Complexity	Performance	Maintenance	Implementability
Activated Sludge	◒	○	◒	○	○	○
Oxidation Ditch	○	◒	○	○	○	○
SBR	◒	◒	●	○	◒	○
Membrane/Ballasted Flocculation	◒	○	●	○	◒	◒

○ = Favorable
◒ = Neutral
● = Unfavorable

Table 5-4 Secondary Treatment Alternatives Qualitative Evaluation

The oxidation ditch is an extended aeration process, and as such requires very little process monitoring, making it the most reliable system of the four. The other three systems require somewhat more frequent operator attention and are therefore rated neutral for reliability. The multiple zones of the modern conventional activated sludge process and the dual treatment trains of the membrane/ballasted flocculation process make those systems the most flexible. The single treatment train in the SBR process limits its flexibility, while the oxidation ditch process is rated unfavorable for flexibility because the larger basins required for this process are less economical for large plants. The oxidation ditch is rated favorable for complexity because it is a very simple process, while conventional activated sludge is rated neutral and the other two processes are rated unfavorable due to their inherent operational complexity.

All four processes should perform very well in practice. The conventional activated sludge and oxidation ditch processes should be easily maintained because the equipment should be familiar to treatment plant staff. The SBR and membrane/ ballasted flocculation processes should not present maintenance problems, but are rated neutral for maintenance because the treatment plant staff would need to become familiar with them. Except for the membrane/ballasted flocculation process, all of these processes would be easily implemented since they are in common use. The membrane/ballasted flocculation process is rated neutral for implementability; while there are no processes of this type anywhere in the state, it should be possible to obtain approval from TNRCC with adequate supporting documentation.

A glance at Table 5-3 reveals that the conventional activated sludge and oxidation ditch processes are rated similarly, and slightly better overall than the other two processes. They are also substantially equivalent in capital cost, and either system would provide good performance. The oxidation ditch would perhaps be simpler to operate due to its longer sludge age, plus it would provide more buffering capacity due to its greater volume. However, the activated sludge process would be more cost effective to expand in the future, and would be easier to incorporate into a much larger facility than an oxidation ditch. When the actual site for the Lower Brushy Creek Regional WWTP is acquired, a detailed facilities plan should be conducted to determine the most appropriate treatment process. For this report, further analysis was conducted under the assumption that the Lower Brushy Creek Regional WWTP will ultimately consist of three oxidation ditches and four secondary clarifiers. Under Alternative 1, the project would likely be constructed in 4 phases, beginning with an interim package plant, followed by a 3.0 MGD permanent plant, and then a subsequent 3.0 MGD expansion, and a final 2 MGD upgrade. Under Alternative 3, the project would likely be constructed in 4 phases, beginning with an interim package plant, followed by a 2.5 MGD lift station, a 6.0 MGD permanent plant, and then a subsequent 2.0 MGD expansion.

5.5 Sludge Processing

All of the treatment processes considered will result in the production of waste sludge. The waste sludge must be stabilized in accordance with the requirements of 40 CFR Part 503 and managed in an environmentally acceptable manner. This section describes the feasible alternatives for managing sludge from a future Lower Brushy Creek Regional WWTP.

5.5.1 Sludge Quantity and Quality

The projected quantities of waste sludge produced by the new regional plant are shown in Table 5-4. Some type of sludge thickening will be required for the regional treatment plant, but sludge thickening would not be provided for the interim plant.

Parameter	Interim Plant	6 MGD Regional Plant
Sludge Wasted, lb TS / day	1,000	6,900
Waste Sludge Concentration Range, %	0.6-1.2 %	0.6-1.2 %
Waste Sludge Concentration Average, % TS	0.90%	0.90%
Waste Sludge Average Quantity, gpd	1,400	92,000

Table 5-5 Lower Brushy Creek Regional WWTP Projected Sludge Quantities

Concerning quality, it is expected that the biosolids produced by the Lower Brushy Creek Regional WWTP will meet the most stringent criteria for metals as stipulated in 40 CFR Part 503, Table 3. Sludge from the other Alliance plants meet this criteria; given that the contributing area to the Lower Brushy Creek Regional WWTP will be predominantly residential and commercial, it is anticipated that a high quality sludge will also be generated by this plant.

5.5.2 Regional Treatment Plant Sludge Management

Biosolids management is a rapidly evolving industry – regulatory trends and the need to reduce management costs has spurred the development of many innovative technologies to produce biosolids, especially Class A biosolids. Several Class A technologies (e.g., heat-drying and, more recently, autothermal thermophilic aerobic digestion (ATAD)), have made the transition from innovative to established technologies in a time span as short as 5 years.

Because of these rapid changes in the industry, it would be premature to definitively select a biosolids management strategy for the Lower Brushy Creek Regional WWTP at this time. Instead, this report identifies the method of biosolids management that is most likely to occur, based on the methods currently being used at neighboring treatment plants. Potential alternatives for future sludge management are also discussed.

Initially, the Lower Brushy Creek Regional plant would consist of an interim plant with a capacity around 1.0 MGD. As such, the volume of waste sludge produced would be most economically handled by hauling it (approximately 6 miles) to the existing Brushy Creek Regional WWTP, where sludge is currently being dewatered and disposed of in a landfill. Waste sludge from the 0.2 MGD Hutto WWTP is currently being managed in this fashion. When the need occurs for the first phase permanent regional plant, it would become economically attractive to install dewatering facilities on site. This may consist of a belt filter press along with a bioscrubber to treat building exhaust. The precise time at which on-site dewatering would be required is unknown, but such facilities will likely need to be constructed at the time of the first 6.0 MGD permanent installation. The resulting dewatered sludge would probably be landfilled, as is the case at existing regional plant.

5.5.3 Alternative Sludge Management

Alternative sludge management plans may need to be examined in the future due to potential economic, political, and environmental concerns. It may become desirable to produce Class A biosolids, which are safe for land application and may even be used as a fuel source. Sludge stabilization could either be accomplished on site or at a regional treatment facility.

One proven on-site technology is the BioSet process, which involves treating dewatered sludge with lime and sulfamic acid. Other stabilization processes using lime are also available to achieve either Class A or Class B standards of pathogen and vector attraction reduction. Simple aerobic digestion could be used, for example, if land application of Class B sludge on area farms became attractive.

As an alternative to on-site sludge stabilization, one example of an off-site facility would be a regional composting plant. A regional stabilization facility would accept sludge from surrounding WWTPs, including Hutto, Brushy Creek Regional, Lower Brushy Creek, Round Rock, and perhaps elsewhere. This option offers the benefit that no separate sludge stabilization facilities would be required. Sludge could either be thickened and pumped, or dewatered and trucked to the stabilization facility. The costs of these two sludge transport options would be dependent on the location of the regional sludge handling facility as well as the on-site sludge processing costs. The benefits and costs of a regional composting facility are currently being evaluated by the Alliance.

5.6 Reuse Potential

Future reclaimed water demand exceeds projected reclaimed water supply in the Lower Brushy Creek study area based on the needs surveyed for existing land use and for future development located within the immediate vicinity of the existing and proposed WWTP sites. Greater reclaimed water demand than available supply holds true throughout the entire planning horizon to the year 2030. For instance, the massive agricultural irrigation demand that exists in close proximity to Hutto, alone, can easily exceed the available projected supplies from both the existing WWTP or from the proposed regional WWTP sites. This accounts for the fact that the existing Hutto WWTP is currently seeking a permitted capacity of 0.95 MGD and the proposed Regional WWTP flows are projected to be about 4.0 MGD in 2020 and 6.0 MGD in 2030. Presently, there is already more than 6.0 MGD of apparent agricultural demand located in the immediate Hutto vicinity.

5.6.1 Agricultural Reuse

The Hutto area is blessed with rich, Blackland Prairie soils that support a variety of non-forage crops. The following list identifies the primary agricultural applications that are available for reclaimed water use in the Lower Brushy Creek study area:

- Corn;
- Cotton;
- Sorghum; and
- Wheat.

An agricultural reclaimed water irrigation program that could help serve some of the nearby farmers would be the least expensive water reuse system for the Alliance to develop because of the close proximity of the land to be served. Another strong feature of such a program would be the year-round irrigation demand that exists for those farmers that grow wheat in the winter and other crops during the spring to autumn seasons. Overall agricultural irrigation demand already exceeds the projected 6.0 MGD reclaimed water supply that might be available by the year 2030.

Agricultural irrigation of non-food crops, such as corn, cotton, sorghum, and wheat, are all allowed to utilize Type II reclaimed water, which is the effluent quality that the existing and proposed WWTPs currently produce and are expected to produce during the study's planning period. Type II reclaimed water, as defined by the TNRCC (and presented later this section), includes those uses where the public is not likely to come into contact with the reclaimed water application. Agricultural irrigation programs have been successfully developed throughout Florida, California, and also within Texas (most notably Lubbock). The fact that some area farmers would be able to produce dependable yields of fiber crops without total dependence on natural rainfall is a policy that the Alliance may wish to consider. Multiple benefits of developing an agricultural reclaimed water irrigation program include the availability of a firm, drought-proof irrigation water supply, the fertilizer-value of the source water, and the positive public relations that the Alliance would receive from such a program in the Hutto area.

5.6.2 Urban Reuse

During the next thirty years, much of this agricultural land use is going to begin converting to urban land especially in areas located east of Round Rock, around Hutto, and along the U.S. Highway 79 and F.M. 685 corridors. Of course, as future population growth in the study area escalates, the potential for the development of master-planned, golf course, residential developments (such as Forest Creek in Round Rock) will also grow and will increase the reclaimed water demands in the study area. In central Texas, 18-hole golf courses traditionally utilize a peak daily demand of about 0.5 MGD, on an annual basis and may have peak seasonal demands of 1.0 MGD or greater during summer drought periods. The 1,200 single-family residential home Timmerman Tract located northwest of the intersection of FM 685 and Priem Road (in the southeast portion of the study area) is being developed by the Forest Creek real estate developer and plans to include a golf course. Golf courses, like non-forage agricultural applications also require only Type II reclaimed water quality. Several other master-planned developments with golf courses within the Lower Brushy Creek study area also hold this same future landscape irrigation potential.

Other urban Type II reclaimed water applications that may develop within the Lower Brushy Creek study area in the future as a result of the transition from agricultural to urban use and that were specifically targeted for potential reclaimed water applications include:

- Industrial / Institutional (cooling tower uses)
- Residential (subdivision common areas)
- Cemeteries (landscape irrigation).

Industrial uses may develop along the U.S. Highway 79 corridor similar to the industrial park area located immediately east of the Hutto ISD High School complex near the F.M. 685 intersection. Both industrial facilities and the high school complex may have significant cooling needs that could be met using Type II reclaimed water. Many of the new subdivisions expected to develop, such as the Timmerman tract, will include expansive, landscaped, common areas (roadway medians and right-of-ways) that would also demand significant reclaimed water supplies for irrigation purposes. Finally, cemeteries are another authorized Type II reclaimed water application that could make use of reuse water for landscape irrigation purposes. These potential reuse applications, besides the agricultural demands previously identified, could also account for a significant amount of peak daily demand (at least 3.0 MGD), based on the acreages and demands that are proposed. As a design consideration, future developments are recommended to be plumbed with reclaimed water service lines that are installed parallel to the wastewater collection lines as the wastewater system is installed, wherever possible, to promote engineering and economic efficiency in these identified areas.

This Lower Brushy Creek reclaimed water study was developed through research, personal observations, and a literature review of the following documents.

- HDR Engineering, Inc. (HDR), November 1999, Master Plan for the Development of the Brushy Creek Regional Reclaimed Water System (Draft) Report;
- PBS&J, October 2000, BRA / LCRA Alliance, Brushy Creek Regional Wastewater System Engineering Report;
- Weston / Camp Dresser & McKee (CDM), October 2000, City of Austin – Northeast Service Area Wastewater Master Plan Report.

Both the HDR and Weston / CDM reports concluded that reclaimed water demands far exceed available reclaimed water supplies in the overall Brushy Creek watershed and the adjacent Northeast Service Area (Gilleland and Wilbarger Creek watersheds) throughout this study's 2030 planning horizon. As previously discussed in the wastewater treatment section, both the existing WWTP and the proposed Lower Brushy Creek regional WWTP will produce a secondary treated, good quality effluent for reclaimed water transmission and distribution. The treated effluent will meet the TNRCC Type II reclaimed water quality standard. The TNRCC water quality criteria for Type II reclaimed water is specified by 30 TAC §210.33 and may be summarized as follows (based on a 30-day average unless otherwise noted):

- BOD5 or CBOD5 - 20 mg / l (milligrams per liter);
- Fecal Coliforms - 200 cfu / 100 ml (colony forming units / 100 milliliters)*;
- Fecal Coliforms (not to exceed) - 800 cfu / 100 ml**; and
- Turbidity – no standard for Type II reclaimed water quality.

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* value based on geometric mean.

** value based on a single grab sample.

Type II reclaimed water quality must be used in a restricted manner such that human contact is not likely. Applications include the controlled access, landscape irrigation uses of agricultural areas, golf courses, roadway medians and right-of-ways, cemeteries, and cooling tower use. Therefore, all of the water reuse applications discussed above are available for future use, based on the TNRCC Chapter 210 (Use of Reclaimed Water) regulations and the current design criteria specified for the Lower Brushy Creek study area wastewater treatment facilities. Anticipated future parameters could also result in a Type I reuse water that could be used by residential households for lawn irrigation, school ball fields, and parks.

Section 6
Environmental Assessment

6.1 Cultural Resources Assessment

6.1.1 Introduction

The planning area is situated within the inland edge of the Gulf Coastal Plains physiographic province and the Blackland Prairie geographic province (Arbingast et al. 1976:12-13). Surface geology in the western part of the planning area is the Cretaceous-aged Austin Chalk, which consists of chalky limestone and marl (Fischer 1974). The Navarro and Taylor groups (undivided), which also date to the Cretaceous, are found in the eastern part of the planning area (ibid). These consist of clay and marl.

Topsoils present in the project area are predominantly of the Branyon-Houston Black-Burleson association (Werchan and Coker 1983). These are described as deep, calcareous and noncalcareous, clayey soils. The exception to this soil association occurs along the Brushy Creek stream channel where soils of the Oakalla-Sunev association are present. These are deep, calcareous, loamy soils formed in alluvium on bottomlands and stream terraces. Importantly, deeply buried multi-component prehistoric sites can be present in the Oakalla-Sunev soils. Such sites are potentially significant cultural resources because temporal components can be isolated and because the calcareous nature of the soils aids in the preservation of perishable cultural remains such as bone and charcoal.

Prior to the advent of historic clear landing and agricultural practices, the Blackland Prairie was primarily grassland with little bluestem being predominant. Riparian zones were restricted to the flanks of stream channels where oak, pecan, ash, and hackberry were common. Isolated oak motts were sometimes present in upland areas within areas underlain by the Austin Chalk.

6.1.2 Culture History

The project area lies within the Central Texas prehistoric cultural region (Prewitt 1981). The prehistory of Central Texas has recently been reviewed by several archeologists including Johnson (1994) and Collins (1995). These papers build upon the previous work of Weir (1976) and Prewitt (1981, 1985) that established a detailed cultural chronology and cultural history for the region. Importantly, Johnson's paper includes new data on past climates in Central Texas while Collins discusses past and present research theories and trends in prehistoric archeological research in Central Texas. The reader is referred to these works for in-depth discussions of Central Texas prehistory.

Prehistoric site types in Central Texas consist of camps, caches, isolated artifacts, interments, cemeteries, kill/butcher locales, quarry/workshops, lithic scatters, and rock art sites (Collins 1995:363). Central Texas is perhaps best known for the many burned rock midden sites that occur on the Edwards Plateau. Numerous excavations of major campsites have been conducted along the larger streams and rivers (cf. Peter et al. 1982; Prewitt 1982). Such excavations have demonstrated that Central Texas was occupied for at least 11,500 years prior to the coming of Europeans. These also show that throughout these millennia, prehistoric peoples were nomadic hunter-gatherers who moved across the landscape exploiting seasonally available plant and animal resources.

Although historic settlement of Williamson County began in earnest in the 1830s, the town of Hutto did not have its beginning until the construction of the International-Great Northern Railroad in 1876 (Scarbrough 1973). That year the railroad company purchased five acres of land in south-central Williamson County from James Emory Hutto for construction of a railroad station. The site was soon named Hutto and in 1884, the town had 200 inhabitants, a school, five cotton gins, a post office, and a general store. Many of the early inhabitants were German, Danish, and Swedish immigrants. The town reached a population peak of 900 in 1928, but quickly declined during the Great Depression. In 1990, the population was 630 (Tyler 1996).

6.1.3 File Searches

A check of the cultural resource sites files at TARL showed that there are 28 previously recorded archeological sites within the planning area. These consist of 20 sites with prehistoric remains, 1 with both prehistoric and historic components, 1 historic site, 3 historic cemeteries, and 3 other sites lacking data on temporal components. Not surprisingly, the majority of the prehistoric sites are situated in the vicinity of Brushy Creek. These include prehistoric campsites where nomadic Native American peoples camped intermittently through time. At some of these campsites, artifacts and features occur throughout topsoil deposits that are at least three feet in thickness. Most artifacts appear to be chipped stone tools manufactured from locally available chert (flint). Features mostly consist of burned rock clusters that served for heating and cooking. In a few cases, human burials have been found at some sites. Several burned rock midden sites are also listed in the previously recorded prehistoric sites. These aboriginal sites contain large earth oven features that are represented by dense deposits of fire-cracked limestone rocks. Lithic procurement/scatter sites are a third type of prehistoric site found in the planning area. These occur in upland areas farther distant from stream channels. Often, these sites occur at locations where lag gravel deposits that include chert are strewn across the ground surface. Artifacts typically found at these sites often reflect the early stages of chipped stone tool production.

The two previously recorded historic occupational archeological sites within the planning area consist of a former farmhouse site occupied between 1870 and 1890 and a second that was occupied during the early 20th century. The three historic cemeteries within the planning area consist of the Hutto City Cemetery, the Hutto Lutheran Cemetery, and the Union Hill Cemetery.

A search for old USGS maps was conducted at the TNRIS to examine the locations of historic farmsteads in the countryside outside of the Hutto city limits through time. Three early 20th century USGS maps were found in the TNRIS files. These are 1928, 1949, and 1951 copies of the Round Rock, Texas 15' USGS map. Generally, these maps indicate that most rural farmsteads were situated adjacent to county roads and other unimproved dirt/gravel roads. The maps also suggest that the number of rural farmsteads declined from 1928 to the 1949/1951 eras. This may have occurred due to the decline of the cotton industry during the Great Depression. Additionally, there does not appear to be a great density of farmsteads along the banks of Brushy Creek. This is probably due to the flood potential of the creek.

6.1.4 Field Reconnaissance

On July 24, 2001, Dan Prikryl and Sarah Terry of the LCRA Cultural Resource Staff conducted a brief field reconnaissance of the planning area. Although most of the reconnaissance was restricted to a windshield survey along Brushy Creek south of U. S. Highway 79, several areas were inspected on foot (Figure 6-1). Those areas included in the pedestrian reconnaissance involved visual inspection of the ground surface within public road rights-of-way (ROW). Ground surface visibility within these road ROWs was highly variable.

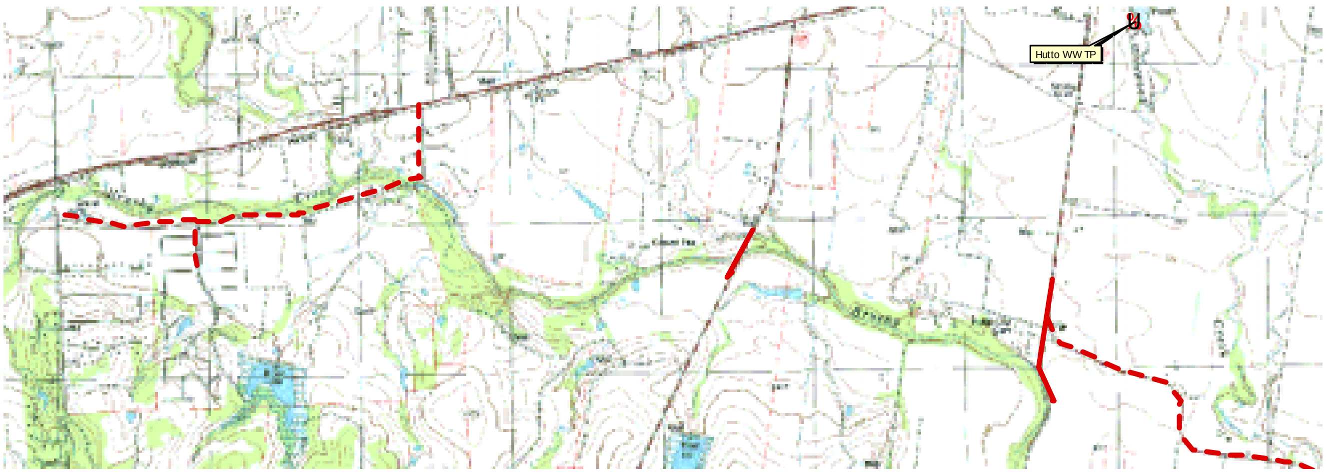

Figure 6-1 Survey Locations

At Field Survey Locale #1, is situated on a terrace east and northeast of the Brushy Creek channel. The Hutto City Cemetery also lies immediately east and northeast of this area. There, ground surface visibility in disturbed ROW areas a county road and adjacent FM 1660 indicated no readily apparent cultural resource sites. A few unaltered low-grade chert cobbles were noted in the clay topsoil. The Geologic Atlas of Texas: Austin Sheet (Fischer 1974) for this location indicates the presence of Pleistocene terrace deposits over most of this area. Chert and quartzite gravels are commonly strewn across the surface of such Pleistocene terraces as lag gravels. No evidences of alteration of these gravel cobbles by prehistoric peoples were evident. Importantly, too, the occurrence of Pleistocene terrace deposits over most of this locale suggests a low potential for any deeply buried prehistoric deposits.

The second area inspected on foot, Field Locale #2, is situated in the FM 685 ROW at the road's crossing of Brushy Creek. However, very few soil exposures were evident there due to dense vegetation. Although no indications of archeological sites were observed, it should be noted that the Geologic Atlas of Texas: Austin Sheet (ibid) shows that deep Holocene era alluvial deposits are present on the south bank of Brushy Creek at this road crossing. Thus, there is a potential for significant, buried prehistoric sites on the south bank.

During the windshield survey, two noteworthy areas were transverse. One of these is the FM 1660 crossing over Cottonwood Creek. Since the road and bridge culverts at this creek crossing are covered with concrete, pedestrian reconnaissance within the road ROW was not attempted. The second area is a county road that runs along the edge of the first terrace on the south side of

Brushy Creek for a length of about 2.4 kilometers. Two previously recorded prehistoric sites 41WM140 and 41WM927 are situated adjacent to this road. However, because of presence of numerous suburban homes along this road, pedestrian reconnaissance was not undertaken. The terrace edge along this county road appeared to be an ideal location for numerous other unrecorded prehistoric occupational sites.

6.1.5 Cultural Resources

A cultural resource files search and initial field reconnaissance for the planning of the Lower Brushy Creek wastewater system project was undertaken by the LCRA Cultural Resource Staff in July 2001. The file search at TARL indicated that there are 28 previously recorded archeological and historical sites within the planning area. These consist of 20 sites with prehistoric remains, 1 with both prehistoric and historic components, 1 historic site, 3 historic cemeteries, and 3 other sites lacking data on temporal components. Not surprisingly, the majority of the prehistoric sites are situated in the vicinity of Brushy Creek. Importantly, there is a high potential for numerous other unrecorded prehistoric sites to be present on the floodplain and on the first terrace of Brushy Creek. During the file search, three early 20th century maps were found in the files of the TRNIS at the Texas Water Development Board. These three maps show the locations of numerous rural farmsteads, including some that may have first been occupied in the mid and late 19th century.

The field reconnaissance of the planning area consisted of one brief trip that focused on the area south of U. S. Highway 79 in the vicinity of Brushy Creek. The majority of the reconnaissance was restricted to a windshield survey. Public road ROWs were briefly examined on foot at two locations. No evidences of prehistoric or historic archeological remains were seen at either location inspected by pedestrian methods.

By utilizing existing data, adverse effects to known cultural resource sites can be avoided and/or minimized. The available data suggests that intensive cultural resource surveys will be needed prior to the construction of various elements of the proposed wastewater system to search for unrecorded cultural resource sites. Any wastewater treatment plant and pipeline system constructed on Brushy Creek or one of its tributaries have the potential to effect prehistoric archeological sites. Further, any pipelines constructed adjacent to rural road ROWs have the potential to effect archeological remains related to unrecorded historic rural farmsteads.

6.2 Natural Resources Assessment

6.2.1 Methods

LCRA staff performed a preliminary natural resources assessment for the area within the Lower Brushy Creek Regional Wastewater planning area. The purpose of this assessment was to provide a general natural resources baseline for the project area based on available, in-house data. A site visit was not conducted for this phase of the natural resources evaluation.

The natural resources concerns that were addressed included: endangered and threatened species and/or habitat; waters of the United States; karst; aquifers; and any other special environmental features noted for the area.

As part of the evaluation, a review was made of the following documents:

- USGS 7.5-minute topographic Hutto, Texas quadrangle
- NRCS Williamson County Soil Survey (NRCS, 1983)
- Data from Texas Parks and Wildlife Department's (TPWD) Wildlife Diversity Center.
- Edwards Aquifer Authority mapping on the USGS 7.5-minute topographic Hutto, Texas quadrangle
- "Karst Regions of Texas" (Smith and Veni, undated)

Particular attention was given to an area on the east side of SH 1660, across from the Hutto Cemetery. This was identified as a possible site for a regional wastewater treatment plant.

6.2.2 Findings

Land Use

The majority of land within the study area is in agriculture or used for livestock grazing. The town of Hutto and scattered residences constitute the primary development in the area. The area on the east side of SH 1660, across from the Hutto Cemetery, is currently planted in corn (personal communication with Dan Prikryl, LCRA archeologist, 8-1-01).

Hydrology/Topography

The USGS Hutto, Texas quadrangle maps the creek systems within the Study Area. Brushy Creek is the main waterway flowing from west to east, then to the southeast, essentially bisecting the Study Area. Named tributaries to Brushy Creek include McNutt Creek, Cottonwood Creek, and Boggy Creek. There are over a dozen unnamed tributaries to Brushy Creek within the planning area, many of which have been dammed.

Waters of the United States are under the jurisdiction of the U.S. Army Corps of Engineers. Waters of the U.S. include, but are not limited to, streams, creeks, ponds, rivers, and wetlands. An area may be considered a water of the U.S. and not be inundated or saturated during portions of the year, including during the growing season. Brushy Creek and its tributaries are considered waters of the United States and may have wetland area associated with them. Stock ponds are scattered throughout the planning area and are considered waters of the U.S. if they were constructed on or within an existing water of the U.S. (e.g. a pond formed by damming a creek).

The topography of the planning area grades from approximately 800-ft elevation to the north and south of Brushy Creek to approximately 600-ft elevation or less at Brushy Creek itself.

The Edwards Aquifer Authority has identified the boundaries of the both the recharge and the contributing zones for the Edwards Aquifer in Williamson County. The planning area is east of and outside of these sensitive zones.

Soils/Geology
The Williamson County General Soil Map indicates two major soil associations for the Study Area. The Branyon-Houston Black-Burleson Association consists of deep calcareous and noncalcareous, clayey soils formed in clayey alluvium and marine clays and shales; on ancient stream terraces and uplands. The Austin-Houston Balck-Castephen Association consists of deep to shallow, calcareous clayey soils formed in marine chalk, marl, shale, and clays; on uplands.

There are no hydric soils listed for Williamson County. The presence or absence of Prime Farmland was not investigated for this planning area.

Karst is a geologic term describing limestone bedrock that has been dissolved by mildly acidic groundwater resulting in a honeycomb appearance. Karst features can harbor endangered or threatened cave invertebrates. The planning area lies to the east and outside of the mapped karst regions of Texas.

Vegetation
The planning area is primarily in agriculture or pasture. There are wooded and/or shrubby riparian areas along many of the waterways in the Brushy Creek system. Such riparian areas can provide many ecological functions including habitat for wildlife.

Species or Habitat of Concern
Species of concern that are identified as potentially occurring in Williamson County include the Mountain Plover, a winter resident to the area. The Mountain Plover is classified as "potentially threatened" on a national level. Two state-listed threatened reptiles may occur in the planning area: the Texas horned lizard (*Phrynosoma cornutum*) and the timber/canebrake rattlesnake (*Crotalus horridus*). If any of these species are encountered, they should not be disturbed or handled.

There are no occurrence records of federally listed species or of habitats of concern within the Study Area.

6.2.3 Summary & Recommendations

No natural resource concerns were noted for the area on the east side of SH 1660, across from the Hutto Cemetery.

A more exhaustive Environmental Assessment should be performed prior to construction of any wastewater facilities in the Study Area. When preparing the Environmental Assessment and performing preliminary engineering, special attention should be paid to waters of the United States. Impacts to these features may require coordination with the U.S. Army Corps of Engineers.

There are no federally listed species or habitats of concern within the planning area.

Riparian areas, wooded or vegetated banks of waterways, are special areas of concern and should be avoided if at all possible.

Section 7
Evaluation of Alternatives

The three alternatives presented in Section 3 and discussed in Sections 4 and 5 are evaluated here and are as follows:

Alternative 1	Regional WWTP
Alternative 2	Regional Lift Station sending flows to the existing Brushy Creek WWTP
Alternative 3	Regional Lift Station serving the McNutt Creek area and Regional WWTP serving the western part of the study area.

The evaluation consists of both quantitative and qualitative factors. First, to aid in the economic evaluation, phasing assumptions and the net present value of the costs of each alternative is presented. Second, each alternative is discussed in terms of the following qualitative factors: reliability, ease of operation, maintenance, implementability. The recommended alternative is then discussed in greater detail at the end of the section. An implementation plan for this alternative is discussed in Section 8.

7.1 Cost Estimates

Costs estimates were developed for all of the alternatives outlined above. The cost estimates are summarized in Tables 7-1 through 7-4. Table 7-1 and 7-2 present system lengths and costs by year and by drainage area, respectively. Table 7-3 outlines the capital costs associated with the different options, while Table 7-4 outlines the present value O&M costs.

7.1.1 Cost Estimate Sources

The objective of the cost estimates is to provide the Alliance with a quantitative means of comparing the alternatives. The estimates presented are suitable for making broad judgments between alternatives, but lack sufficient accuracy for budgeting actual capital improvement funds. Overall, it is felt that the estimates have an accuracy of +50% to -30%; that is, the totals presented may be as much as 50% more than the true total, or as much as 30% less. The large spread in the cost estimate accuracy results from using a variety of disparate sources to develop the costs. These sources include:

- Fundamental construction cost estimates prepared by CDM, using unit prices that are consistent with recent area projects. These estimates should be accurate to within ±20%, which is the degree of contingency included.

- Basic cost allowances. For identified needs where the scope and scale is insufficiently defined to permit either preparation of accurate engineering estimates or cost-of-comparable estimates, a simple cost allowance was assigned to that item based on our best engineering judgment.

- Rule-of-thumb cost estimating techniques. For future plant expansions, a rule-of-thumb estimate of $4.00/gallon per day (gpd) of new plant capacity was used for entirely new facilities. A rule-of-thumb cost of $3.50/gpd was used for interim facilities. For expansion of existing plants, a rule-of-thumb cost of $2.50/gpd of increased plant capacity was used since basic infrastructure (roads, support buildings, and utilities) already exists. For plant decommissioning or closure, a cost of $0.10/gpd of plant capacity was used to account for equipment removal and salvage, basin and digester cleaning, and other required closure costs.

- Historical O&M costs. The annual O&M cost impacts of the various alternatives were difficult to develop; the incremental change in O&M costs at individual plants when flows are increased or decreased is not easily quantified. Further study is necessary to more accurately develop O&M cost impacts of the individual alternatives.

Detailed analysis of all of the various items included in the cost estimates is beyond the scope of this study. Despite the many variables included in the estimates, the totals are still be useful for making judgments between alternatives, as further explained below.

7.1.2 Cost Estimate Accuracy

The cost estimates as presented, with all of their inherent variables, may still provide an accurate means of distinguishing between alternative courses of action, and thus allow the Alliance to make an informed decision on the optimum treatment/collection approach for the future based on each option's cost expressed as net present value. This is possible due to the canceling effect of error differences in individual estimates, based on statistical theory[2].

The accuracy of each cost estimate presented herein varies depending on how well defined the items are. Some numbers are very well defined, while some costs are simply allowances. Without further research into the scope of a project, the true cost may vary from the allowance by as much as 50%. By assigning a standard deviation to each item, the standard deviation of the total estimate can be calculated as the square root of the sum of the squares of all the standard deviations.

In other words, if Total = Item 1 + Item 2 + Item 3, then

$$S^2_{Total} = S^2_{Item\ 1} + S^2_{Item\ 2} + S^2_{Item\ 3} \qquad \text{where S is standard deviation.}$$

Standard deviation is an absolute value, so if an estimate is $100,000 ± 50%, then the standard deviation is $50,000 (i.e., $100,000 * 50%). Based on this equation, the standard deviation of the total is never more than the largest standard deviation of the individual items, and decreases as the number of items increases. For example:

Item	Estimate	% Std Deviation	Std Deviation
1	$ 100,000	50%	$ 50,000
2	$ 500,000	20%	$ 100,000
3	$ 80,000	10%	$ 8,000

[2] Skoog, D.A. and Leary, J.J. (1992) **Principles of Instrumental Analysis**, 4th Ed., Appendix 1, *Evaluation of Analytical Data*, p A-15.

Total	$ 680,000	16%	$ 112,089

The costs for items 1 – 3 are estimated and assigned a percent standard deviation based on the confidence in each number. The standard deviation for each item is the percent standard deviation multiplied by the estimate for that item. The total estimate is the sum of the estimates for Items 1 – 3. The standard deviation of the total is the square root of the sum of the squares of the standard deviations for Items 1 – 3. Finally, the percent standard deviation of the total is the standard deviation of the total divided by the sum of the estimates. Therefore, although Item 1 is only accurate to ± 50%, the total for this project is accurate to within ± 16%.

7.1.3 Cost Estimate Analysis

In order to calculate the costs estimates, certain preliminary phasing assumptions had to be developed for each alternative. While it was not within the scope to determine the detailed phasing for each alternative, estimates were made in 5 year increments for the phasing of interceptors, lift stations, construction and expansion of treatment plants, and the collection system. The timing of each phase or completion of any project can greatly influence the net present value (NPV) of any alternative. Future money is always worth less than present money because of the discount factor. Delaying an item for a few years within an alternative will lower that option's NPV. Care must be taken to make sure that all aspects of an alternative are scheduled at the most likely time.

The sewer system costs can divided into the major interceptors in each watershed – Brushy, McNutt, Cottonwood and Forrest Creek – and the minor (diameters less than 15 inches) collection system. Figure 7-1 illustrates these sewer distinctions. For all of the implementation plans, the collection system (diameters less than 15 inches) is assumed to have the same phasing and be driven by the location of development. The estimated costs of the collection system by 5-year phase are summarized in Table 7-1.

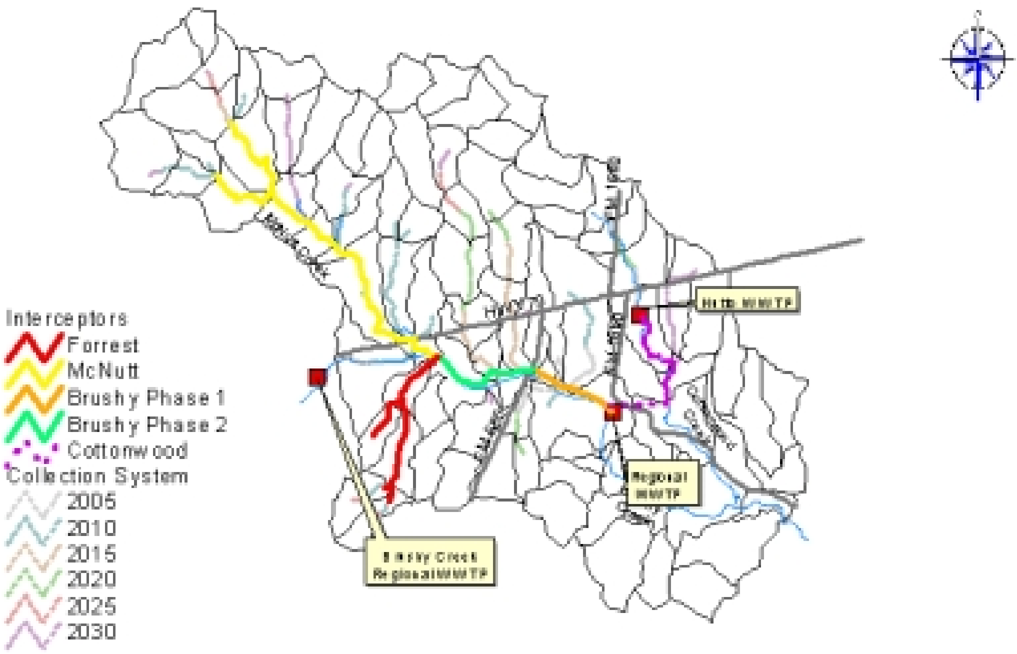

Figure 7-1 Interceptors and Collection System

Year	Length (ft)	Price
2005	18,042	$ 1,805,030
2010	31,392	$ 3,397,744
2015	21,672	$ 2,247,590
2020	18,276	$ 1,507,680
2025	8,364	$ 560,684
2030	26,519	$ 1,897,379

Table 7-1 Collection System Length and Cost by Year

The timing of the interceptors, on the other hand, does vary within alternatives. The costs and lengths of the different interceptors are summarized in Table 7-2. The sizes of the Brushy Creek interceptors vary between alternatives 1, 2, and 3, as reflected by the label Brushy (1) and Brushy (2,3).

Creek	Length (ft)	Price
Brushy (1) Phase 1	6,992	$ 3,491,305
Brushy (1) Phase 2	8,919	$ 3,699,994
Brushy (2,3) Phase 1	6,992	$ 2,350,803
Brushy (2,3) Phase 2	8,919	$ 1,492,470
Cottonwood	7,364	$ 1,019,159
Forrest Creek	20,501	$ 1,561,456
McNutt	42,280	$ 6,871,923

Table 7-2 Interceptor System Length and Cost by Creek

Using these values for the collection system and interceptor costs, and sources mentioned in Section 7.1.1 for treatment and lift station costs, the net present value of the capital costs of each alternative was calculated, as presented in Table 7-3. The costs represent construction costs; while these costs include a 20% contingency, the following are not included in the capital costs below: professional engineering services, land acquisition, and permitting. Appendix D provides more detailed cost estimates.

Lower Brushy Creek Wastewater Master Plan
Alternative Analysis with Phasing
Cost Comparison: Net Present Value

Year	**ALTERNATIVE 1** Regional WWTP		**ALTERNATIVE 2** Brushy Expansion and Lift Stations		**ALTERNATIVE 3** Regional WWTP and Brushy Creek Expansion & Lift Station	
2005	Interim Plant, Initial Interceptors, Collection system	$10,495,200	Both Lift Stations, Initial Interceptors, Collection system	$19,714,700	Interim Plant, Initial Interceptors, Collection system	$10,495,200
2010	WWTP construction & Interceptors to McNutt Creek, Collection system	$26,329,800	Expansion at Brushy Creek, McNutt Creek Interceptors, Collection system	$23,872,300	McNutt Lift Station (2020 Flows); Earlier Brushy Creek Expansion, Collection system	$19,185,600
2015	Collection system	$1,507,700	Collection system	$1,507,700	Collection system	$1,507,700
2020	WWTP Expansion; Hutto offline, Collection system	$10,674,800	Lift Station expansion; Hutto WWTP offline, Collection system	$6,294,800	Regional Plant, Hutto offline, McNutt Lift Station offline, Collection system	$24,624,800
2025	Collection system	$1,897,400	Collection system	$1,897,400	Collection system	$1,897,400
2030	WWTP Expansion	$5,000,000	Additional Brushy Creek Expansion	$10,000,000	Expansion at Regional WWTP	$5,000,000
Net Present Value		$36,351,400		$41,951,900		$38,297,500

Note: Discount Rate 3.5%

Table 7-3 Alternative Cost Comparison

As shown in this table, the net present value of the capital costs alone does not result in one clearly desirable alternative. The difference between the highest and lowest alternative is less than 15%.

In addition to the capital costs, operation and maintenance costs were developed for each alternative based on estimates of the O&M budget for the existing Brushy Creek Regional Plant, provided by the BRA. These O&M costs are presented in Table 7-4.

Lower Brushy Creek Wastewater Master Plan
Alternative Analysis
Annual Operation and Maintenance Costs

Category		ALTERNATIVE 1 Regional WWTP	ALTERNATIVE 2 Brushy Expansion and Lift Stations	ALTERNATIVE 3 Regional WWTP and Brushy Expansion & Lift Station
New Treatment O&M Costs				
Power	See Note 1	$247,902	n/a	$123,951
Labor		$30,000	n/a	$30,000
Treatment Chemicals		$32,027	n/a	$16,013
Maintenance & Repairs		$41,988	n/a	$20,994
Sludge Disposal		$154,983	n/a	$77,492
Other		$336,551	n/a	$168,276
New Treatment SubTotal		*$843,451*	*$0*	*$466,725*
Expanded Treatment O&M Costs				
Power	See Note 1	n/a	$195,831	$97,915
Labor		n/a	$30,000	$0
Treatment Chemicals		n/a	$32,027	$16,013
Maintenance & Repairs		n/a	$41,988	$20,994
Sludge Disposal		n/a	$154,983	$77,492
Other		n/a	$336,551	$168,276
Expanded Treatment Subtotal		*$0*	*$791,380*	*$380,690*
Lift Station O&M Costs				
Power	See Note 1	n/a	$126,407	$42,136
Maintenance & Repairs		n/a	$5,000	$1,750
Lift Station Subtotal		*$0*	*$131,407*	*$43,886*
Total		**$843,451**	**$922,787**	**$861,301**

Notes:

1) Power costs: Based on $0.08/KWh. Power demands were calculated for pumping and aeration requirements.

Table 7-4 Operation and Maintenance Costs

As with the net present value analysis, the difference in the O&M costs alone is not significant enough to make the basis of the alternative selection based on this quantitative measure. It is worth noting that in both the capital costs and O&M costs, Alternatives 1 and 3 are on consistently lower than alternative 2.

While Alternatives 1 and 3 might be lower than alternative 2 in both capital and O&M costs, it is clear that the alternative decision should not be based on the total net present value analysis alone. In order to further analyze these options, there are other factors that need to be considered, including reliability, ease of operation and maintenance, implementability, and overall flexibility. The qualitative analysis is presented in Section 7.2.

7.2 Qualitative Evaluation

While all three alternatives can meet the basic requirement of effectively treating the wastewater in the Lower Brushy Creek area, there are other factors, which the Alliance might consider criteria for alternative selection. The criteria suggested for this study are reliability, flexibility, ease of operation & maintenance, and implementation. A summary of the alternatives and corresponding criteria is found in Figure 7-2.

	Reliability	Flexibility	Operation / Maintenance	Implementability
Alternative 1: Regional WWTP	○	◒	◒	◒
Alternative 2: Regional Lift Station	◒	◒	○	◒
Alternative 3: Combination	◒	○	◒	○

○ = Favorable
◒ = Neutral
● = Unfavorable

Figure 7-2 Qualitative Evaluation

Reliability

All three alternatives can reliably treat the wastewater, so none of them would score negatively in this category. However due to the heavy reliance of alternatives 2 and 3 on lift stations, these alternatives may be less reliable than the regional WWTP.

Flexibility

The real advantage that alternative 3 have over alternatives 1 and 2 is the flexibility inherent in this option. This alternative allows a majority of the capital costs to be delayed until 2020, when the flows are projected to increase dramatically and thus, warrant a regional treatment plant. If the projections for 2020 are too conservative, the capital outlay for a large regional plant can be postponed. Conversely, if the projections underestimate the rate of development in the area, the Alliance can respond by stepping up the implementation plan. In either case, the cost for this flexibility is minimal compared to the other alternatives.

Operation and Maintenance

If an option is chosen which requires the construction of a WWTP (Alternatives 1 and 3), it will be a treatment plant that is easy to maintain and operate. However, the lift station alternative would likely have less operation and maintenance requirements, and thus ranks more favorably in this area.

Ability to Implement

The appeal for Alternative 3 is that the interceptors will be installed as the regional needs dictate. Alternatives 1 and 2 are both implementable; however the oversized force mains in

Alternative 2 (i.e., they are sized for 2030 flows, but will be in use starting in 2005, when flows are less than 20% of the build out flow) and excess capacity in the interceptors for Alternative 1 may cause problems in terms of odor control, corrosion and maintenance

7.3 Recommended Alternative

While all three of these alternatives would meet the areas need in terms of wastewater treatment, the flexibility afforded by the third alternative coupled with its low cost in the first 10 years, when the customer base will continue to be low, makes it an appealing choice. This combination alternative involves lower capital costs upfront, permits more flexibility to adjust for growth, and locates facilities where the development is located.

For these reasons, CDM recommends the third alternative. This is a combination of an interim plant at the proposed regional WWTP site and lift station for McNutt and Forrest Creek flows from 2005 until 2020, followed by a permanent WWTP at the regional site serving the entire Lower Brushy Creek area after 2020. This implementation plan is discussed further in the next section.

A detailed map of the collection and interceptor system and proposed locations of the lift stations and treatment plants for this alternative is presented in Figure 7-3.

INSERT FIGURE 7-3

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Section 8
Implementation Schedule and Costs

As discussed in Section 7, CDM recommends that flows from the Lower Brushy Creek watershed be handled by gravity flow to a proposed Lower Brushy Creek WWTP, supplemented by temporary pumping of McNutt Creek and Forrest Creek flows to the existing Brushy Creek WWTP. This section goes into further detail in describing how the implementation plan would be phased.

8.1 Implementation Schedule

There were several factors considered in developing an implementation plan. First, the construction of new treatment capacity must be complete before flows exceed existing treatment capacity. TNRCC guidelines state that at 75% capacity, an entity must begin planning the next treatment facility expansion; construction must begin by the time the existing WWTP reaches 90% capacity. These guidelines were considered in tandem with the expected durations of the tasks required to complete each project phase. The time that passes between 75% and 100% capacity is entirely dependent on the projected growth rate in the service area, and may or may not be adequate to perform the design and construction services required. Therefore, task durations were estimated using engineering experience, based on the size and type of project.

A time-dependent implementation plan was developed using wastewater flow projections developed in Section 2. These flows are separated by the different drainage areas: Brushy Creek, Cottonwood Creek, and McNutt Creek. A distinction is also made between areas within the Hutto Extra Territorial Jurisdiction (ETJ) and those outside the Hutto ETJ (areas of Round Rock and its ETJ and unincorporated areas of the study area). The flows from these areas are presented both visually and numerically in Figure 8-1 and Table 8-1, respectively.

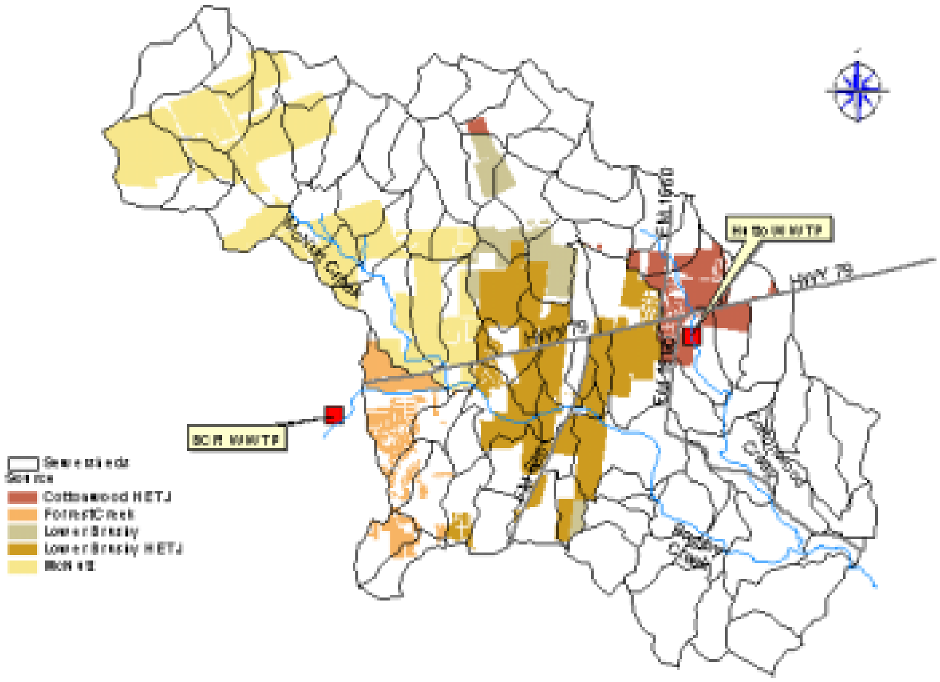

Figure 8-1 Source of Sewer Flows-2030

Month	Year	Projected Average Daily Flows (MGD)					
		Hutto ETJ		Outside Hutto ETJ			Total
		Brushy	**Cottonwood**	**Brushy**	**Forrest**	**McNutt**	
January	2000	0.03	0.10	0.00	0.44	0.01	0.58
October	2002	0.40	0.19	0.02	0.44	0.04	1.08
June	2003	0.48	0.21	0.02	0.44	0.05	1.20
August	2003	0.50	0.21	0.02	0.44	0.05	1.23
October	2003	0.52	0.22	0.02	0.44	0.05	1.26
March	2004	0.58	0.23	0.03	0.44	0.05	1.33
July	2004	0.62	0.24	0.03	0.44	0.06	1.39
January	2005	0.66	0.25	0.03	0.45	0.06	1.45
January	2008	0.70	0.26	0.14	0.45	0.27	1.81
January	2008	0.70	0.27	0.14	0.45	0.28	1.82
March	2008	0.70	0.27	0.14	0.45	0.29	1.84
September	2008	0.70	0.27	0.17	0.45	0.33	1.91
January	2009	0.71	0.27	0.17	0.45	0.34	1.93
January	2010	0.72	0.28	0.21	0.45	0.41	2.05
January	2015	0.78	0.28	0.29	0.45	0.58	2.38
September	2016	0.88	0.29	0.40	0.45	0.79	2.80
January	2018	0.95	0.30	0.47	0.45	0.94	3.11
September	2018	1.00	0.30	0.52	0.45	1.03	3.29
June	2019	1.04	0.31	0.56	0.45	1.12	3.48
January	2020	1.07	0.31	0.59	0.45	1.18	3.60
August	2022	1.52	0.31	0.74	0.45	1.48	4.50
January	2025	1.91	0.31	0.87	0.45	1.74	5.27
May	2025	1.98	0.33	0.88	0.45	1.76	5.40
March	2025	1.96	0.33	0.88	0.45	1.76	5.36
January	2026	2.08	0.36	0.90	0.45	1.81	5.59
April	2027	2.30	0.42	0.95	0.45	1.89	6.00
January	2030	2.72	0.54	1.03	0.45	2.06	6.80
August	2030	2.83	0.57	1.05	0.45	2.10	7.00

Table 8-1 Sewer Flow Projections by Area

During the phasing of Alternative 3, areas can be treated in three locations: the Hutto WWTP, the existing Brushy Creek Regional WWTP (BCR WWTP), and the proposed regional system (LBCR WWTP). As time progresses, the treatment destination for flows from certain areas will change, specifically in McNutt Creek and parts of Cottonwood Creek. Figure 8-2 shows the current treatment scheme for the study areas; Figures 8-3, 8-4, 8-5, and 8-8 represent the four phases of treatment recommended for the future. Table 8-2 provides a list of the actions required to carry out the implementation plan, along with the time at which they are expected to occur. A more detailed implementation plan was created in Microsoft Project and is presented in Figure 8-9.

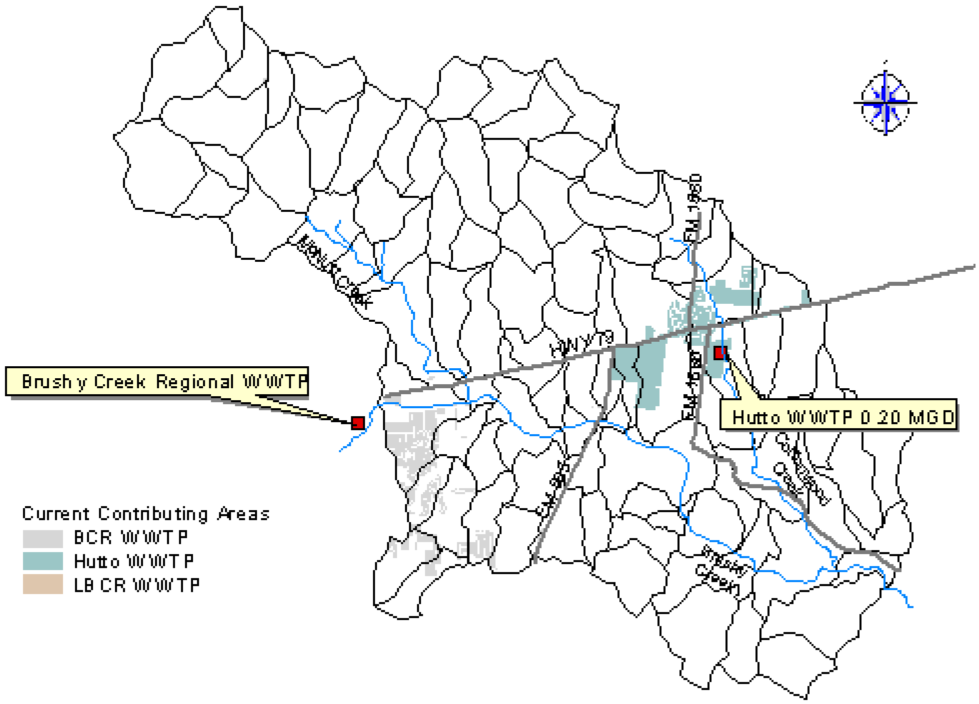

Figure 8-2 Current Wastewater Treatment

Phase 1 (2001-2005)

The implementation plan consists of four Phases, each of which is based on a pre-determined milestone. The first milestone is the completion of work on the interim plant and gravity interceptor along Brushy Creek within the Hutto ETJ. The areas affected by Phase 1 are shown in Figure 8-3.

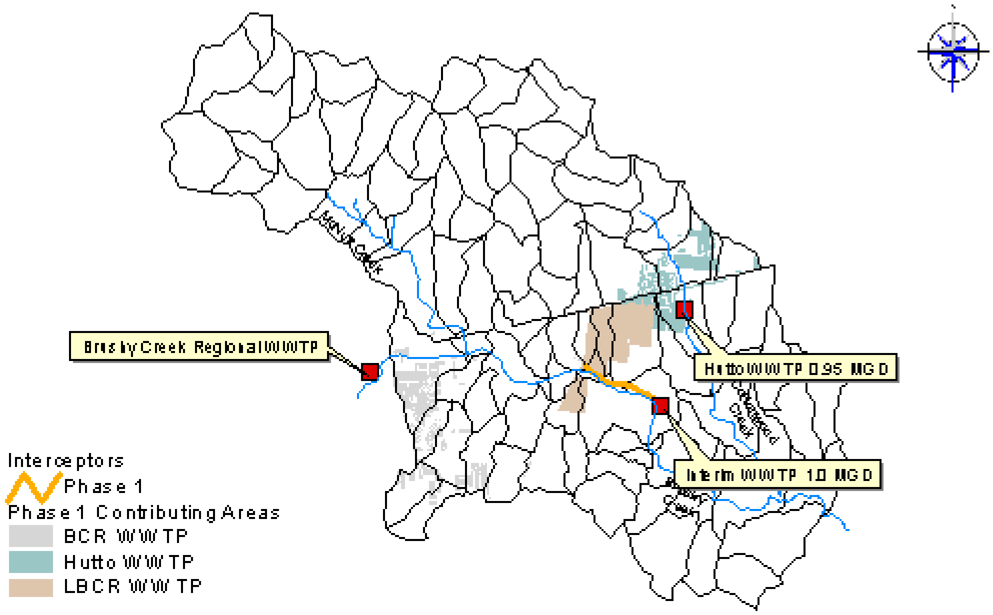

Figure 8-3 Phase 1 Lift Stations

This milestone should occur at the same time at which the existing Hutto WWTP reaches 90% capacity. Both the treatment plant and the sewer line have two main project tasks: design and construction. The design task for the interim treatment plant includes land acquisition, environmental and archeological investigation, permitting, engineering design, and construction bidding.

Work can proceed on most of these tasks concurrently, although work may periodically be required to cease on one task until portions of another task are complete. In its entirety, the design task for the interim treatment plant is expected to take approximately one (1) year. The sewer design task includes easement acquisition, environmental and archeological investigation, engineering design, and construction bidding, and is expected to require a total of nine (9) months. It is estimated that the time required for construction of the interim plant and Phase 1 of the interceptor is nine (9) months and four (4) months, respectively.

After the Interim Plant is place, online lift stations in Hutto can be taken offline so that wastewater flow can be split between the Hutto WWTP and the Interim Plant as desired. In the implementation plan presented above, flows at the Interim Plant are quickly increased to 0.70 MGD, at which level they remain constant. It will be desirable to utilize the Interim Plant quickly because all flows can reach it by gravity. On the other hand, the Interim Plant should not be operated at much more than 70% capacity, so as not to attract attention from TNRCC planning guidelines.

Phase 2 (2006-2010)

The next phase of the project consists of the construction of a 2.5 MGD (8 MGD peak flow) lift station and Phase 2 of the gravity interceptor. The lift station would be constructed just downstream of the Forest Creek subdivision and would lift wastewater from the Forest Creek and McNutt watersheds to the existing Brushy Creek Regional Plant. Phase 2 of the sewer line would consist of two interceptor braches: one extending to Forest Creek and one to McNutt. Flow would occur by gravity in each branch and the lift station would be placed at the intersection. Therefore, all existing lift stations in Forest Creek could be taken out of service. Figure 8-4 illustrates the resulting divisions of flows for Phase 2.

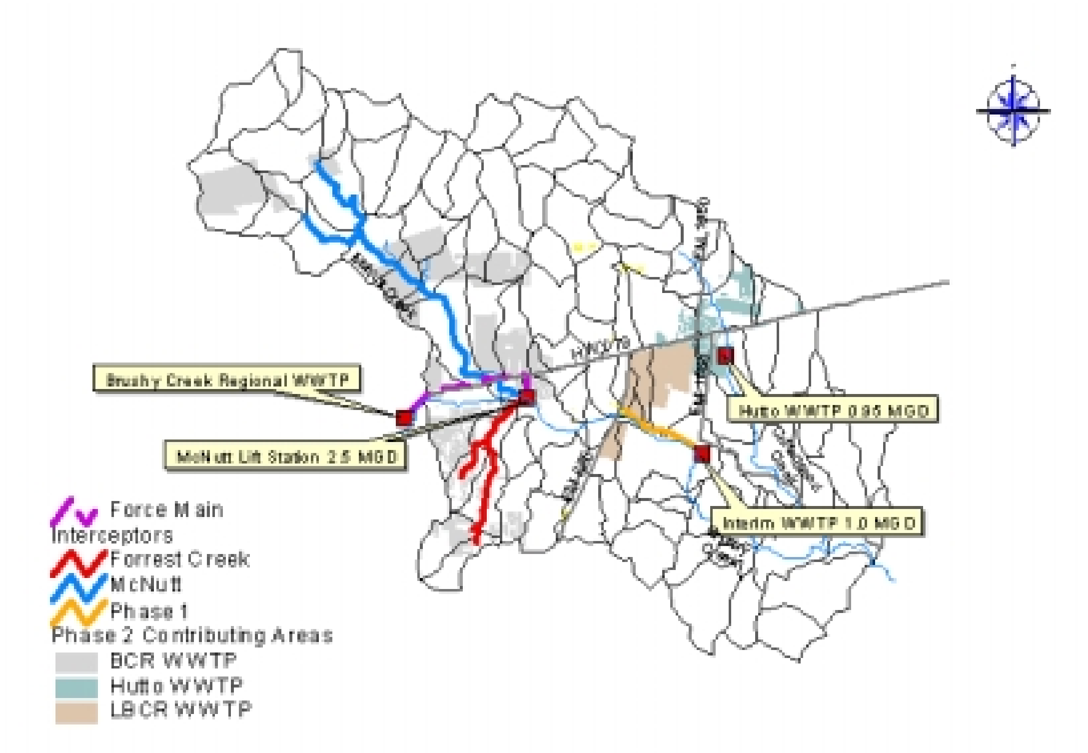

Figure 8-4 Phase 2 Wastewater Treatment and Lift Stations

Smaller connections to the main interceptors would be constructed periodically, as dictated by population growth / flow development. The decision to install the lift station in 2010 was based on the need to have a gravity interceptor in place at McNutt subdivision in this time frame, to treat the increasing wastewater flows. Based on projections made for this report, there is little threat of exceeding treatment capacity at Hutto WWTP or the Interim Plant. In the future, the decision will be reevaluated based on the magnitude and source of the flows, and available funds.

Phase 3 (2015-2020)

The permanent treatment plant installation is completed in approximately the year 2020. At this period in time, wastewater flows at Hutto and the existing Regional Plant are less than 75% capacity, and the lift station is operating below 90% capacity.

Completion of Phase 3 of the interceptor line would enable the new permanent plant to treat all of the wastewater originating from the basin studied. Phase 3 of the sewer line consists of connecting the McNutt/Forest Creek interceptor to the Phase 1 interceptor, and connecting the Hutto WWTP to the Lower Brushy Plant so the Hutto Plant can be taken offline. The implementation of this phase results in all of the sewer flow in the region being treated at the LBCR WWTP, as seen in Figure 8-5.

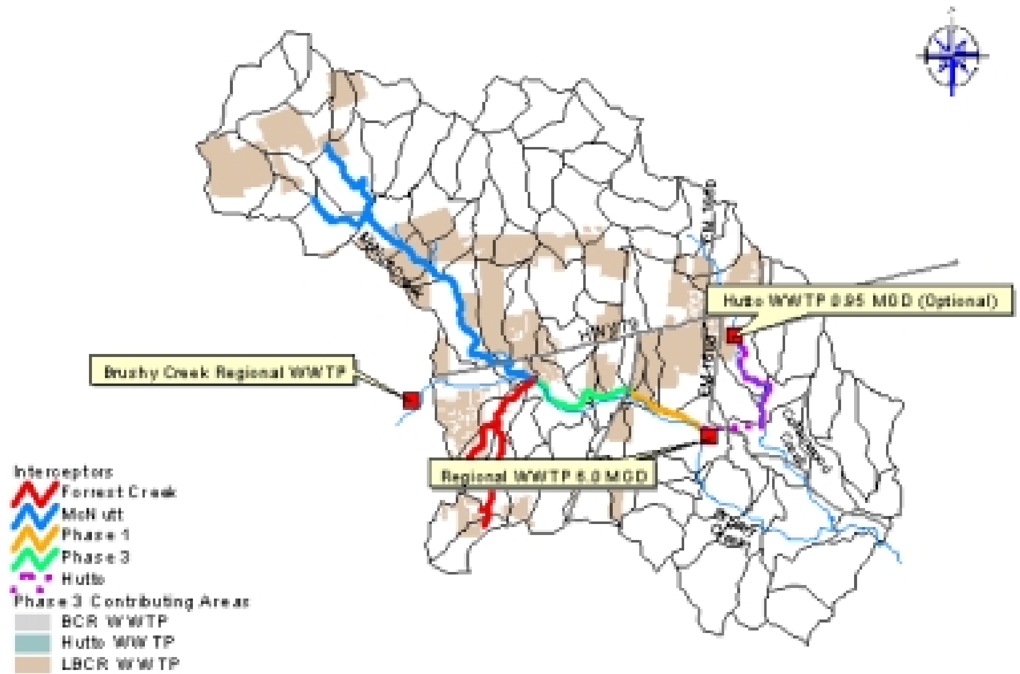

Figure 8-5 Phase 3 Wastewater Treatment

Once again, the decision of when to build the Permanent Plant, and the size at which to build it, is a flexible one. If population growth has been overestimated, and wastewater flows are lower than expected, construction of the plant can be delayed. In fact, the owner may opt to forego construction of a new permanent plant entirely, in favor of expanding the existing Regional Plant master plan and continuing to pump all Forest Creek and McNutt wastewater flows. As before, the decision would take cost considerations into account. However, it is important to note that the implementation plan presented in Table 8-2 does not required the ultimate capacity at the existing Brushy Creek Regional Plant to be increased because treatment capacity is only "borrowed" from the Regional Plant, until the McNutt Creek Lift Station is taken out of service.

A potential treatment schematic for the new regional facility is presented in Figure 8-6. Secondary treatment is accomplished using oxidation ditches, followed by clarification and UV disinfection. In addition to the initial (Phase 3) 6 MGD installation, locations for future (Phase 4) expansion are also indicated. A conceptual site layout is depicted in Figure 8-7. With the minimum TNRCC required buffer zone of 150 feet, the size of the site would be approximately 15 acres; however, CDM recommends using a larger buffer zone and thus the ideal site would be a minimum of 20 acres.

Figures 8-6

Figure 8-7

The decision to take the Hutto WWTP out of service is not absolute, but several factors make it highly likely. First, the Hutto Plant presently under construction can be expected to require considerable maintenance after 20 years of operation. Secondly, it will be desirable to treat all Hutto wastewater flows in one location. The proposed regional site will be much larger, further from population centers, and able to accept all flows by gravity alone. In addition, a central location would decrease the cost and manpower associated with plant operations and solids handling.

Phase 4 (2020-2030)

If a 6 MGD facility is built in 2020, population projections indicate that is will reach capacity in the middle of 2027; thus, another expansion would be required. At this period of time the main trunk of the gravity interceptor will be in place and no major interceptor construction will be required. The area encompassed in this final phase is show in Figure 8-8.

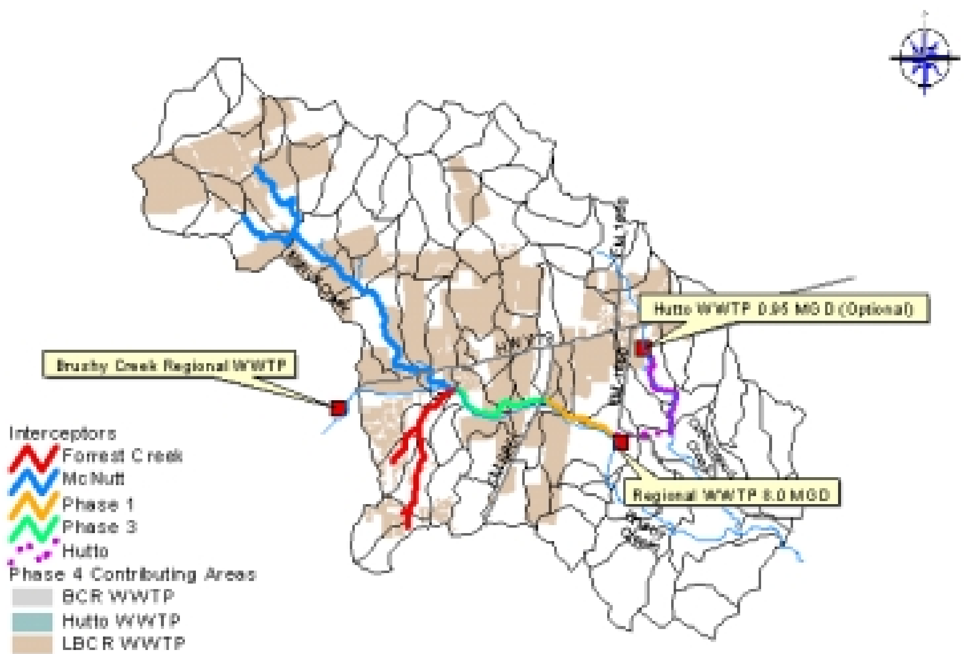

Figure 8-8 Phase 4 Wastewater Treatment

It is estimated that design and construction of a 2 MGD plant upgrade can be completed in six (6) months and 16 months, respectively, as indicated in the implementation plan. Such an upgrade would provide the Lower Brushy Regional Plant with 8.0 MGD of treatment capacity, more than enough to serve the entire basin beyond 2030. The decision to upgrade will need to be reevaluated in the future, when the 6 MGD facility approaches 75% capacity.

All of the phases are summarized in Table 8-2 below. Figure 8-9 presents a Gantt of the implementation plan.

Month	Year	Treatment Schedule - Average Daily Flows (MGD)				Decision Points / Milestones
		Hutto WWTP	Lower Brushy Creek	Existing Brushy Creek	Total	
January	2000	0.13		0.45	0.58	
October	2002	0.58		0.50	1.08	Begin design of Interim Plant
June	2003	0.69		0.51	1.20	Begin design of Gravity Sewer
August	2003	0.71		0.52	1.23	Hutto reaches 75% capacity
October	2003	0.74		0.52	1.26	Begin construction of Interim Plant
March	2004	0.80		0.52	1.33	Begin construction of Gravity Sewer
July	2004	0.85	0.00	0.53	1.39	Hutto reaches 90% capacity Construction of 1.0 MGD Interim Plant and Sewer Line Phase 1 complete
January	2005	0.41	0.50	0.54	1.45	
January	2008	0.26	0.70	0.85	1.81	
January	2008	0.26	0.70	0.86	1.82	Begin design of Gravity Sewer
March	2008	0.26	0.70	0.88	1.84	Begin design of Lift Station & Force Mains
September	2008	0.27	0.70	0.94	1.91	Begin construction of Gravity Sewer (Contracts 1 & 2)
January	2009	0.28	0.70	0.96	1.93	Begin construction of Lift Station & Force Mains
January	2010	0.29	0.70	1.06	2.05	Construction of 2.5 MGD Lift Station and Sewer Line Phase 2 complete
January	2015	0.35	0.70	1.32	2.38	
September	2016	0.47	0.70	1.64	2.80	Begin design of Permanent Plant
January	2018	0.55	0.70	1.86	3.11	Begin construction of Permanent Plant
September	2018	0.60	0.70	1.99	3.29	Beign design of Gravity Sewer
June	2019	0.65	0.70	2.13	3.48	Begin construction of Gravity Sewer
January	2020	0.68	0.70	2.22	3.60	Construction of 6.0 MGD Plant and Sewer Line Phase 3 complete
August	2022		4.50		4.50	Plant reaches 75% capacity
January	2025		5.27		5.27	
May	2025		5.40		5.40	Plant reaches 90% capacity
March	2025		5.36		5.36	Begin design of Plant Upgrade
January	2026		5.59		5.59	Begin construction of Plant Upgrade
April	2027		6.00		6.00	Construction of 2.0 MGD Upgrade (8.0 MGD total) complete
January	2030		6.80		6.80	
August	2030		7.00		7.00	Flow Reaches 7.0 MGD

Table 8-2 Phasing by Year based on Projections

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Insert MS Project Schedule here!!

Insert MS Project Schedule here!!

8.2 Implementation Costs

A approximation of the timing of capital expenditures based on the implementation plan presented in the previous section is found in Figure 8-3. The costs are in 2001 dollars; there is no adjustment for inflation.

8.3 Other Triggers

The implementation plant presented and discussed in Section 8.1 can be converted to a more useful form by converting sewer flows to connections. Sewer connections are easier to track by the Alliance than sewer flow, thereby making an implementation plan based on connections more useful. The conversion was performed by assuming that a single sewer connection contributes 350 gal per capita per day, as documented in Section 2. The resulting form of the implementation plan is presented in Table 8-3.

Number of Connections to Existing Brushy	Number of Connections to Hutto	Number of Connections to Lower Brushy	Decision Points / Milestones
1,431	1,659		Begin design of Interim Plant
1,463	1,958		Beign design of Gravity Sewer
1,472	2,036		Hutto reaches 75% capacity
1,479	2,107		Begin construction of Interim Plant
1,500	2,294		Begin construction of Gravity Sewer
1,516	2,443	0	Hutto reaches 90% capacity Construction of 1.0 MGD Interim Plant and Sewer Line Phase 1 complete
2,462	746	2,000	Begin design of Sewer
2,512	754	2,000	Begin design of Lift Station & Force Mains
2,688	780	2,000	Begin construction of Sewer (Contracts 1 & 2)
2,738	787	2,000	Begin construction of Lift Station & Force Mains
3,039	832	2,000	Construction of 2.5 MGD Lift Station and Sewer Line Phase 2 complete
4,672	1,338	2,000	Begin design of Permanent Plant
5,311	1,572	2,000	Begin construction of Permanent Plant
5,694	1,712	2,000	Beign design of Gravity Sewer
6,077	1,853	2,000	Begin construction of Gravity Sewer
6,333	1,946	2,000	Construction of 6.0 MGD Plant and Sewer Line Phase 3 complete
		12,857	Plant reaches 75% capacity
		15,429	Plant reaches 90% capacity
		15,327	Begin design of Plant Upgrade
		15,981	Begin construction of Plant Upgrade
		17,143	Construction of 2.0 MGD Upgrade (8.0 MGD total) complete
		20,000	Flow Reaches 7.0 MGD

Table 8-3 Customers Triggers/Decision Points

The connections have been divided according to the treatment plant to which they convey wastewater; this reflects the importance of considering the location as well as the magnitude of growth.

Insert Figure 8-3

Figure 8-10 Cost Schedule for Implementation Plan

Section 9
Funding Options

The Lower Colorado River Authority (LCRA) is considering a regional wastewater system for the Lower Brushy Creek region that would serve customers in the Lower Brushy Creek watershed in Williamson County encompassing the municipalities of Round Rock and Hutto. There are numerous ways for funding regional projects. Each regional project has its own set of circumstances, participant's needs and constraints, and political factors that must be carefully evaluated before a final recommendation can be made. This process can take months or even years. All of the options cited herein are to be considered preliminary and could change once the process of negotiating the contracts with the participants is completed.

Within the many options for funding regional projects, we believe that there are three primary legal funding options that should be studied by the LCRA for this expansion. The three methods are:

- LCRA Revenue Bonds (issued on the open market or through the Texas Water Development Board's Clean Water State Revolving Fund);
- LCRA Contract Revenue Bonds supported solely by project revenues;
- Individual participant issued debt.

Each of these options should be able to attain an investment grade bond rating and should additionally be qualified for triple-A rated bond insurance, if necessary. Each of these options should provide for the debt to be tax-exempt and should meet all qualifications for the Clean Water State Revolving Fund lending program offered by the Texas Water Development Board (TWDB). If bonds were to be issued to the Texas Water Development Board through its Clean Water State Revolving Fund (CWSRF), such funds would be subject to the availability of funding from the State, the completion of a pre-application, the rating and ranking of the project by the TWDB, and other application requirements and approval procedures. The CWSRF program provides for funding for the planning, design and construction of, among other things, wastewater treatment facilities and collection systems. The CWSRF funding is provided at interest rates lower than the market offers to political subdivisions and can be advantageous in certain instances involving economically distressed areas. We feel that these options should be considered when implementing the regional plan for the Lower Brushy Creek region.

LCRA revenue bonds would be the highest credit rated of the three options. LCRA sells its revenue bonds for the existing Brushy Creek system and internally bills the Brushy Creek customers for its share of LCRA debt after adding costs for coverage and other contractually agreed upon expenses. This option could be used for expansions to the existing Brushy Creek regional wastewater facility and/or the building of new regional collection and treatment facilities as well.

LCRA Contract Revenue Bonds are similar in that they are issued by the LCRA. However, the holders of these bonds would not be able to look to all LCRA revenues for payment; only to those revenues that

LCRA receives from the contract with the new participants. The ratings would be determined by the credit of the participants rather than the credit of LCRA. Contract revenue bonds are very common in Texas. Most river authorities issue contract revenue bonds rather than system revenue bonds. The Texas Water Development Board has purchased numerous contract revenue bond issues over the years.

Individual member revenue bonds can also be used to fund the project. Under this scenario, LCRA would contract to own and construct the project, but would not issue any bonds for the capital costs. The bonds would be issued by individual members, who would then pay cash for the project. The credit ratings would be determined on an individual issuer basis.

The chart below summarizes the options above.

	LCRA Revenue Bonds	**LCRA Contract Revenue Bonds**	**Participant Revenue Bonds**
Likely Rating	AA category	A category	Multiple
TWDB as Option	Yes	Yes	Yes
Available for Treatment and Collection	Yes	Yes	Yes
Issuer	LCRA	LCRA	Participants
Pledge for repayment	LCRA revenues	Participant Contract Revenues	Individual Participant revenues and/or taxes

In summary, there are many options for funding a regional wastewater solution for the Lower Brushy Creek region in a cost-effective manner. The actual method chosen depends upon the needs, constraints, timing, interest rates, other costs and political situation of the participants at the time of the contract negotiations. The three methods mentioned above are commonly used for regional projects, are accepted by rating agencies, bond insurance companies and the Texas Water Development Board and should be considered as a starting point.

Section 10
Water Conservation and Drought Contingency Plan

The portion of Williamson County included in the Lower Brushy Creek Regional Wastewater Study area receives water from a number of water utilities. The Manville Water Supply Corporation and the Jonah Special Utility District (SUD) provide water to the largest portion of the service area. The cities of Hutto and Round Rock also serve portions of the proposed wastewater service area.

All of these utilities have developed drought contingency plans in accordance with the Texas Natural Resource Conservation Commission (TNRCC) requirements. The Manville Water Supply Corporation has also developed a water conservation plan in accordance with TNRCC requirements. The LCRA will provide assistance to the cities of Hutto and Round Rock and the Jonah SUD with the development of water conservation plans that meet both TNRCC requirements and are in alliance with the Senate Bill 1 Region G recommendations for water conservation. The new plans will be in place by the time any proposed Lower Brushy Creek wastewater facility is completed. All currently completed drought contingency plans and water conservation plans are found in Appendix C.

Wastewater reuse opportunities have already been addressed in Section 5.6 of this report.

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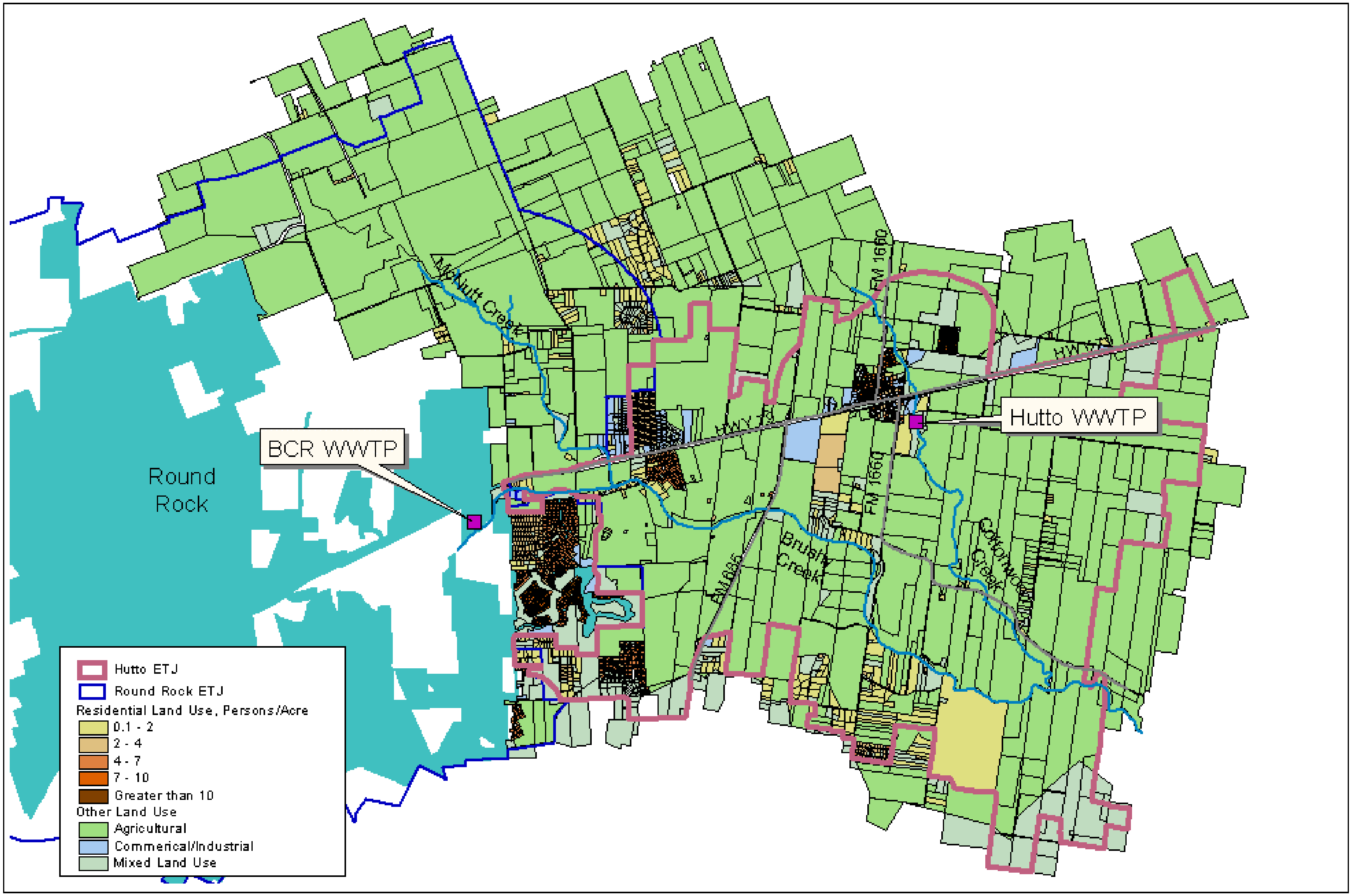
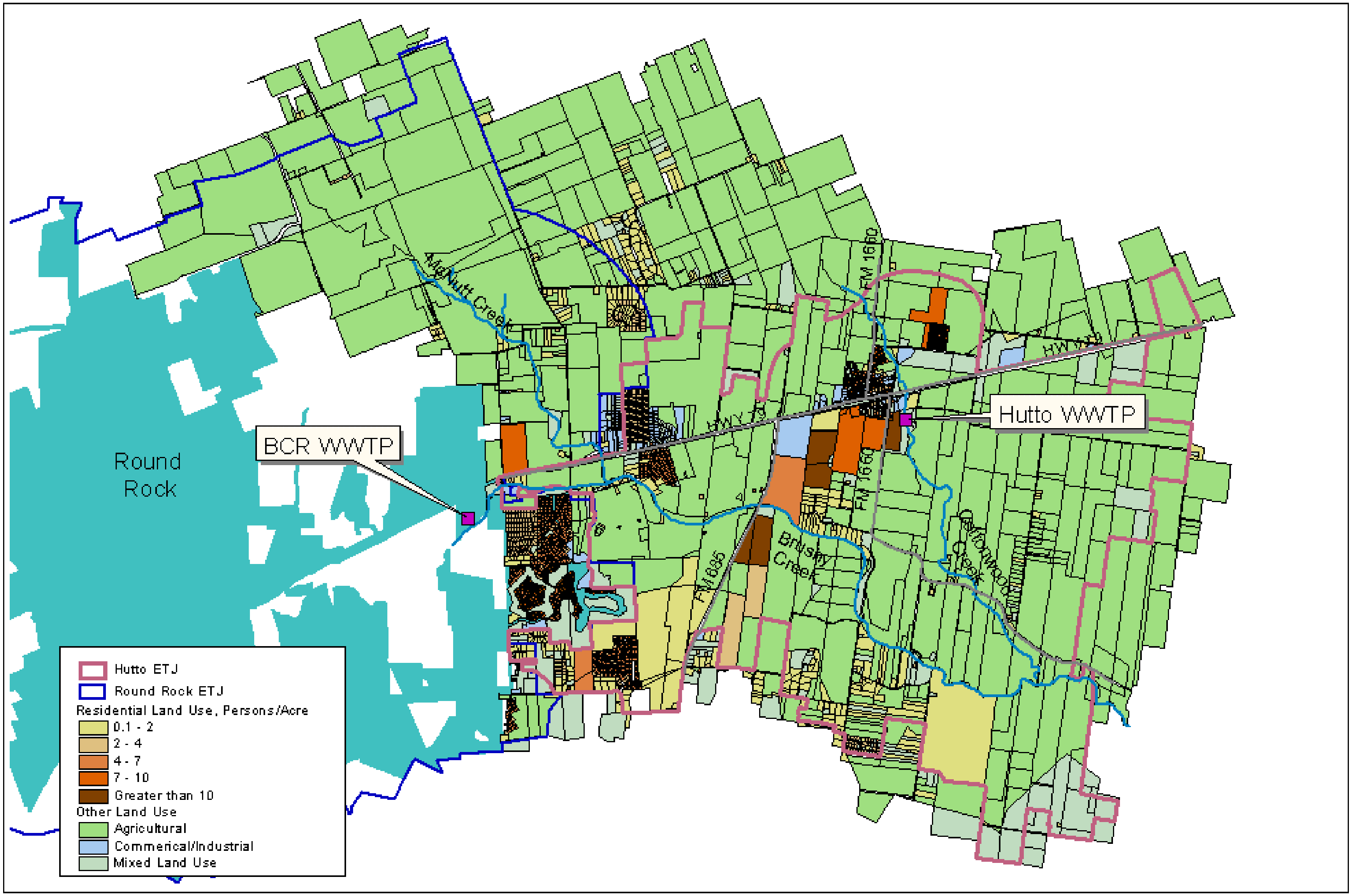


Land Use - 2000

0.4 0 0.4 0.8 1.2 1.6 2 Miles

Figure A-1

CDM

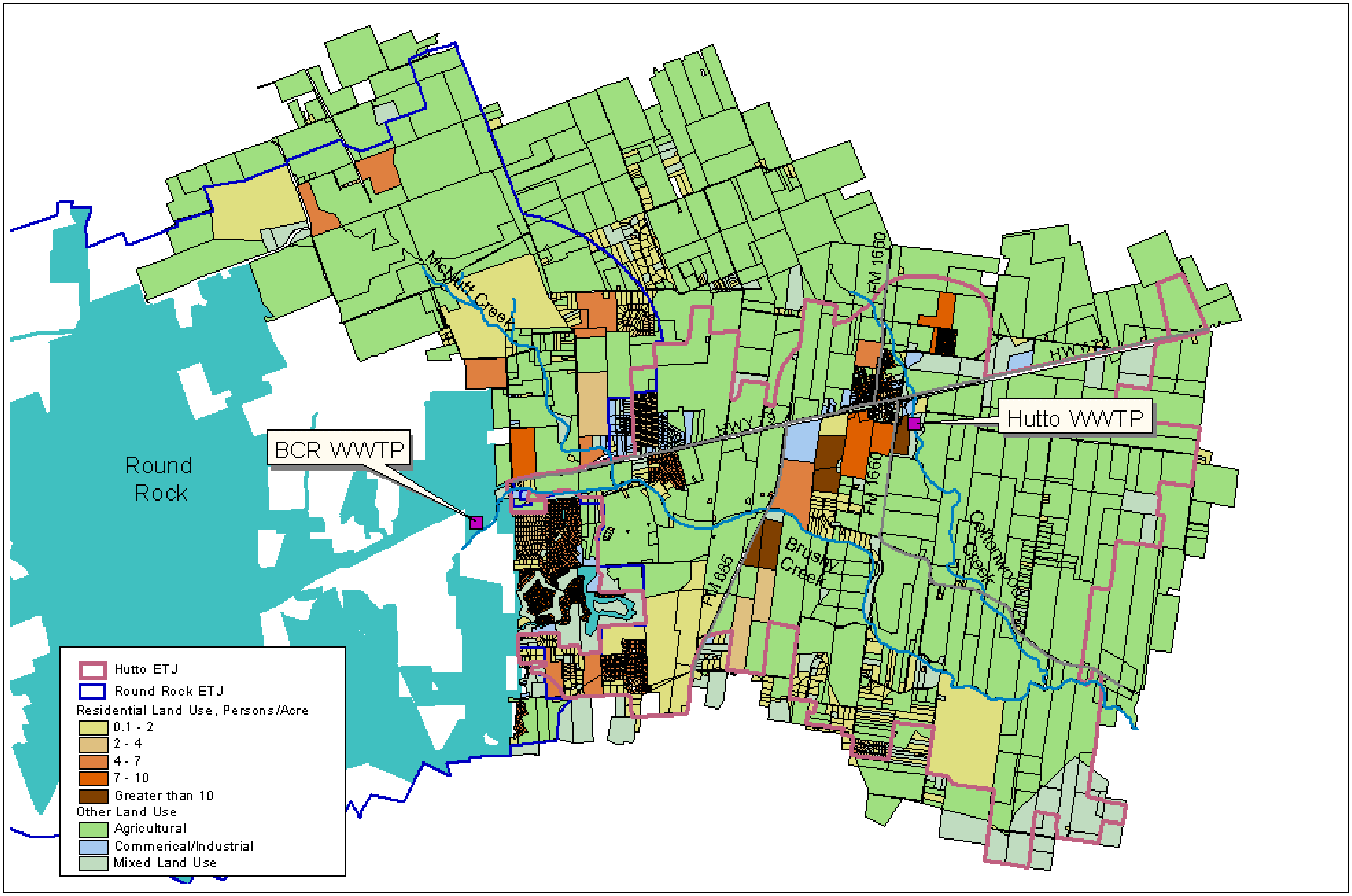


Land Use - 2005

0.4 0 0.4 0.8 1.2 1.6 2 Miles

Figure A-2

CDM

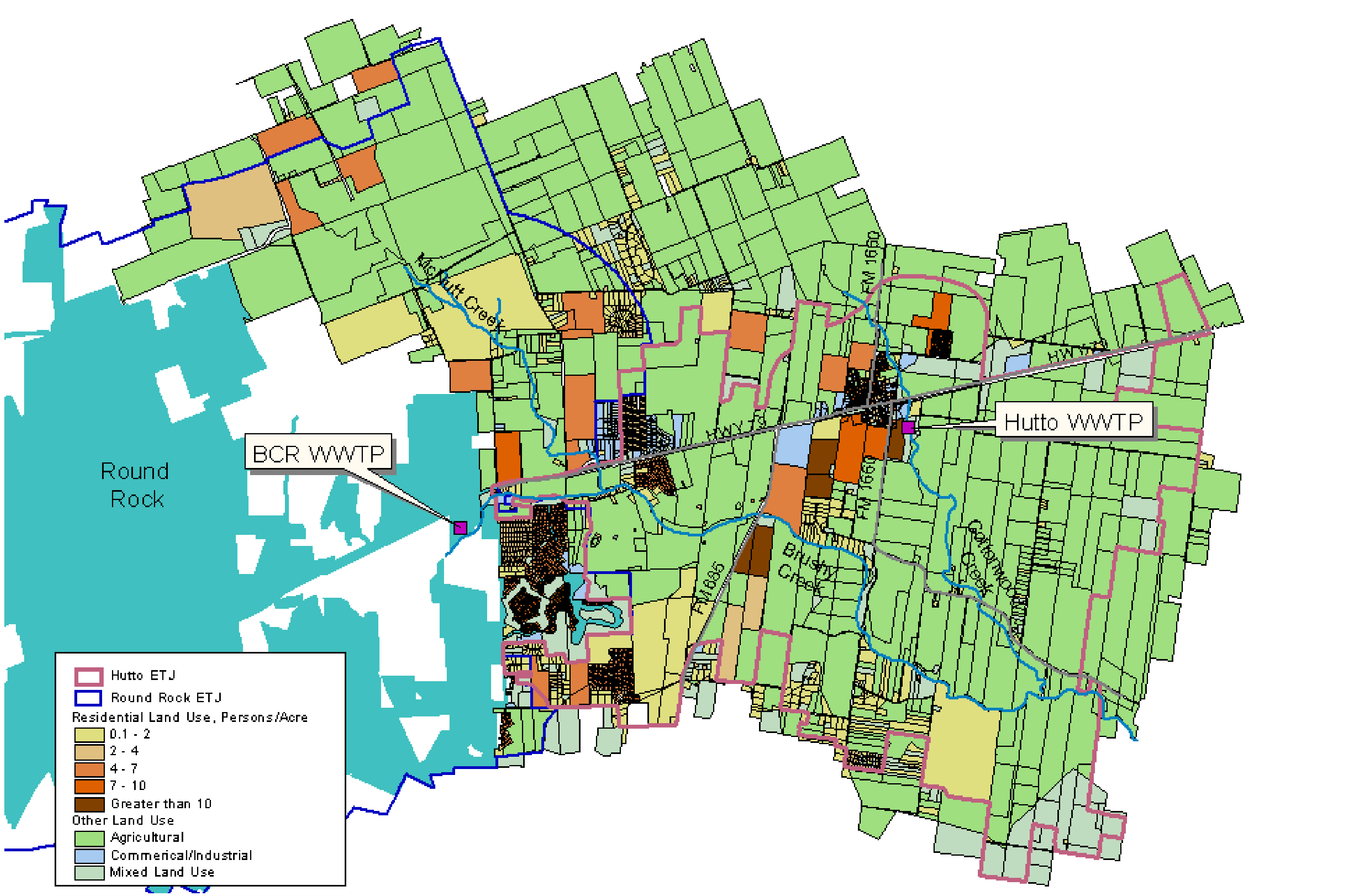


Land Use - 2010

0.4 0 0.4 0.8 1.2 1.6 2 Miles

Figure A-3

CDM

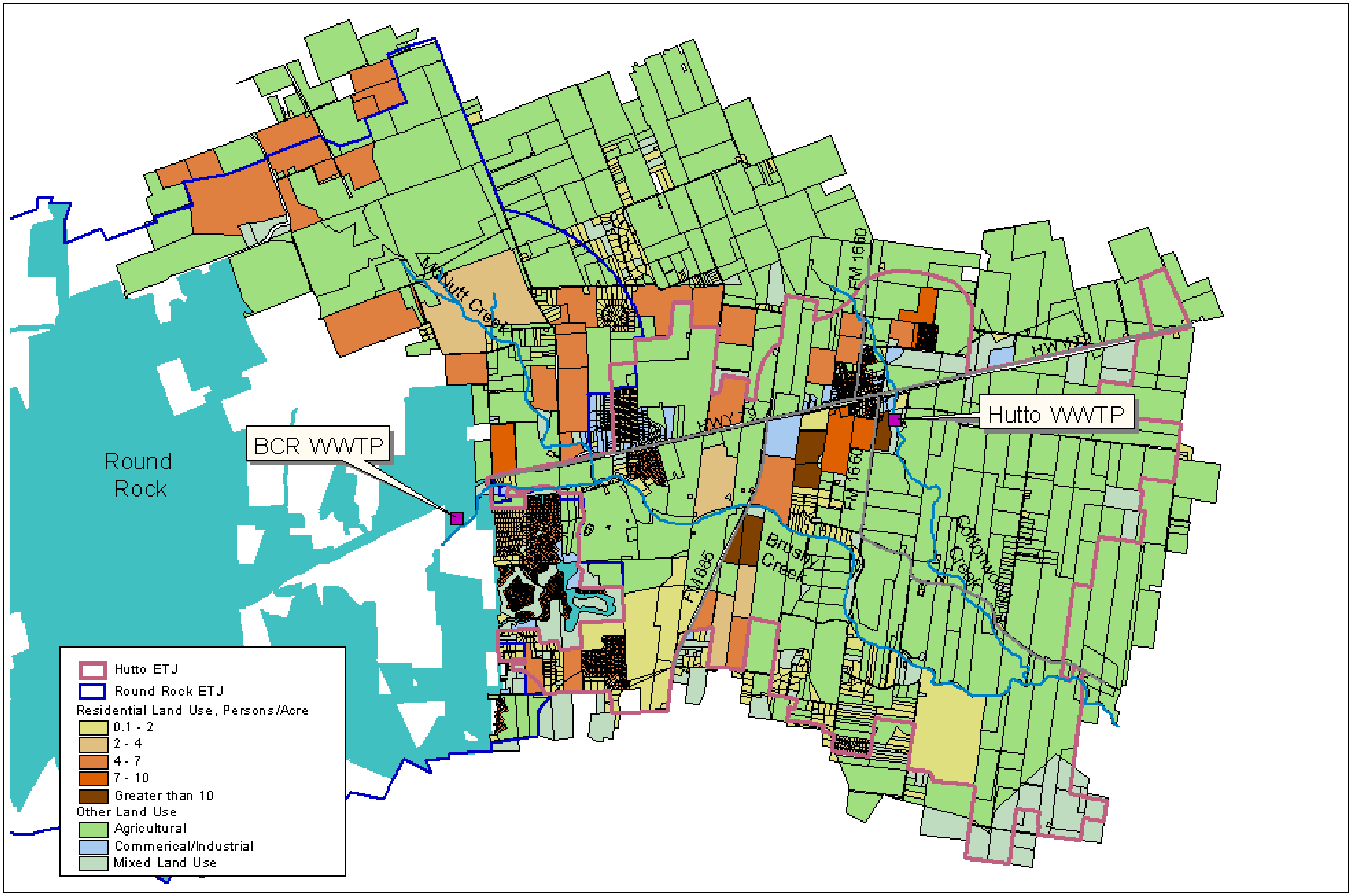


Land Use - 2015

0.4 0 0.4 0.8 1.2 1.6 2 Miles

Figure A-4

CDM

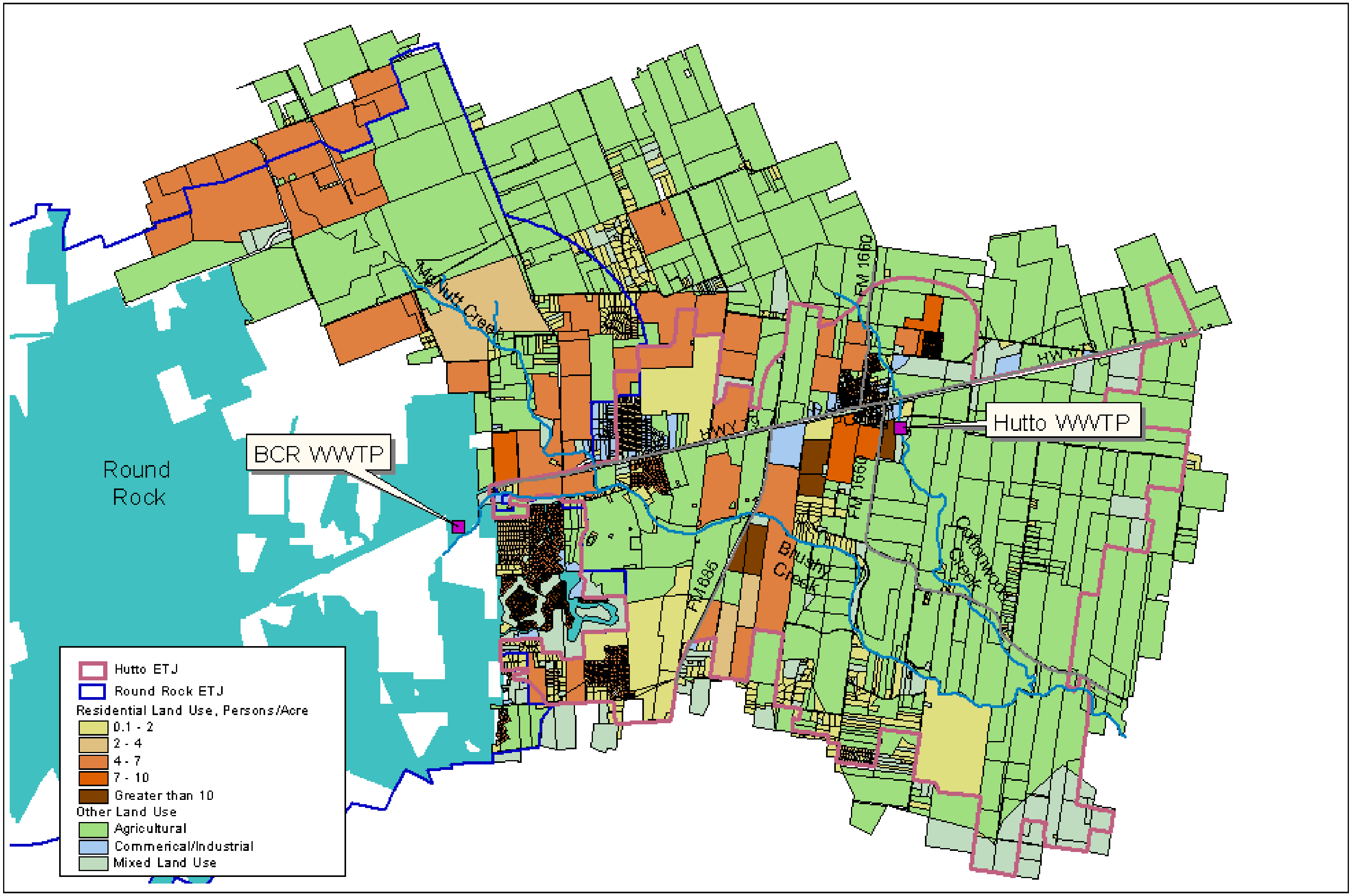


Land Use - 2020

0.4 0 0.4 0.8 1.2 1.6 2 Miles

Figure A-5

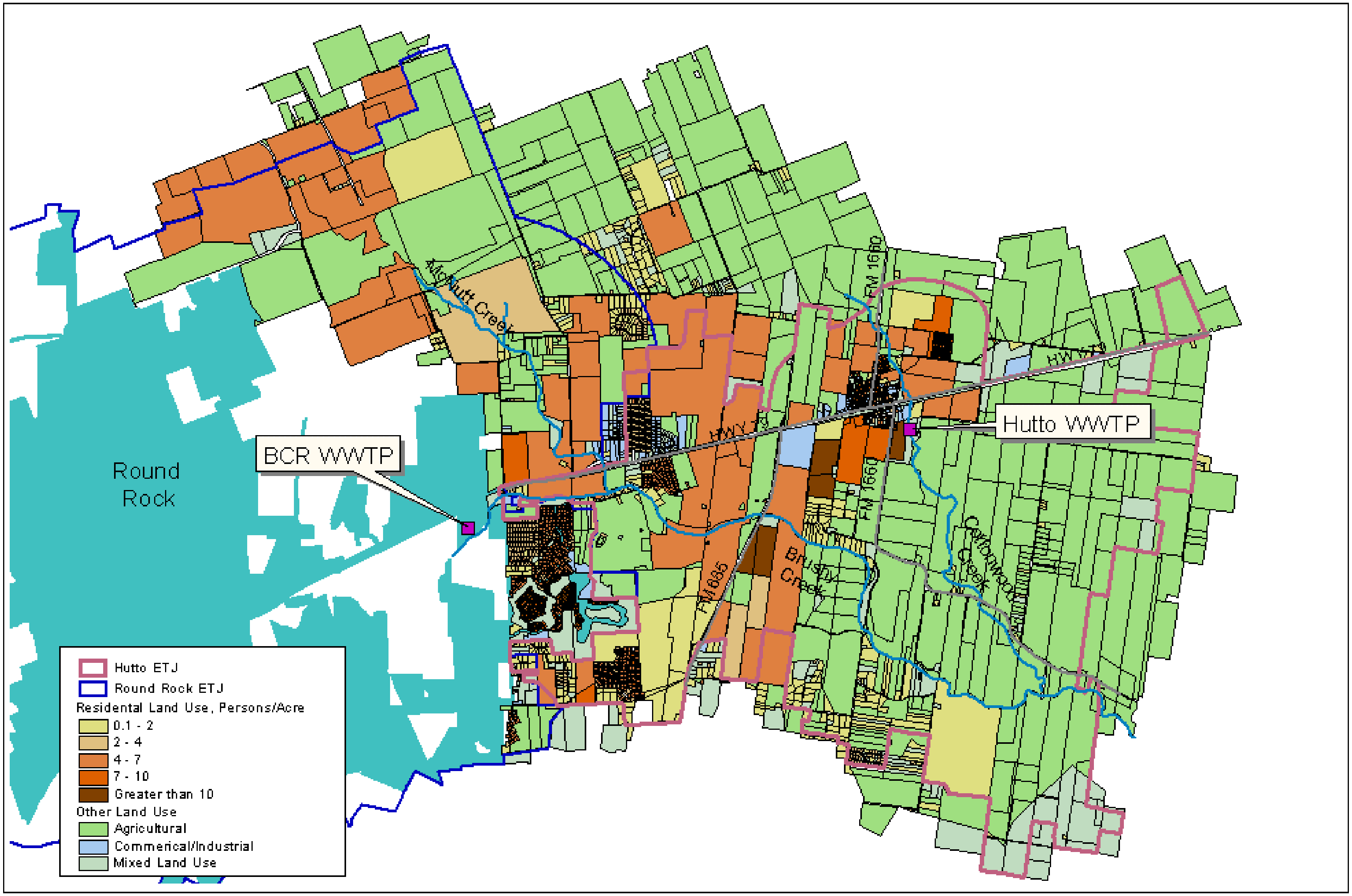
CDM



Land Use - 2025

0.4 0 0.4 0.8 1.2 1.6 2 Miles

Figure A-6



Land Use - 2030

0.4 0 0.4 0.8 1.2 1.6 2 Miles

Figure A-7

CDM

Appendix D
Detailed Cost Estimates

As stated in Section 7:

"The objective of the cost estimates is to provide the Alliance with a quantitative means of comparing the alternatives. The estimates presented are suitable for making broad judgments between alternatives, but lack sufficient accuracy for budgeting actual capital improvement funds. Overall, it is felt that the estimates have an accuracy of +50% to -30%; that is, the totals presented may be as much as 50% more than the true total, or as much as 30% less. The large spread in the cost estimate accuracy results from using a variety of disparate sources to develop the costs."

These sources include: fundamental construction cost estimates prepared by CDM, basic cost allowances., rule-of-thumb cost estimating techniques and historical O&M costs.

Tables D-1 and D-3 provide a summary of these costs by phases and alternatives for treatment and lift stations.

Table D-1
Treatment Costs

	Phase	Cost ($)
Alternative 1: Regional WWTP		
1 MGD Interim Plant	2005	3,500,000
3 MGD Regional Plant	2010	10,250,000
3 MGD Regional Plant Expansion, Hutto Decommissioning	2020	9,095,000
2 MGD Expansion	2030	5,000,000
Alternative 2: Brushy Expansion and Lift Stations		
Cost of 4 MGD of Expansion at Existing Brushy Regional	2010	10,000,000
Decommission Hutto	2020	95,000
Cost of 4 MGD of Expansion at Existing Brushy Regional	2030	10,000,000
Alternative 3: Regional WWTP and Brushy Creek Expansion & Lift Station		
1 MGD Interim Plant	2005	3,500,000
Cost of Speeding up Brushy Creek Expansion 5 years	2010	2,800,705
6 MGD Regional Plant and Decommission Hutto	2020	19,345,000
2 MGD Expansion	2030	5,000,000

Table D-2
Lift Station and Force Main Costs

	Phase	Cost ($)
Alternative 2: Brushy Expansion and Lift Stations		
Regional Lift Station and McNutt Creek Lift Station and Force Mains	2005	13,860,000
Expansion of Lift Stations	2020	4,620,000
Alternative 3: Regional WWTP and Brushy Creek Expansion & Lift Station		
McNutt Lift Station and Force Main	2010	4,005,050

Table D-3 provides a summary of the costs included in calculating interceptor and collection systems costs.

Table D-3
Collection System and Interceptor
Preliminary Construction Cost Basis

Item / Description	Unit	Unit Price
Insurance, Bonds Move-In, etc.	Lump Sum	5%
R-O-W/Site Preparation	Lump Sum	10%
Trench Safety System	Linear Feet	$ 2.00
Sewers	Linear Feet	**see Table D-4**
Manholes	Each	$ 2.00
Jacking, Boring, Tunneling, and Casing	Linear Feet	$ 2.00
Relocate Utilities, etc.	Linear Feet	$ 1.00
Sedimentation/Erosion Control	Linear Feet	$ 2.00
Loaming/Hydroseeding	Square Yards	$ 1.20
Subtotal		
15% Contractor Overhead and Profit		
20 % Contingencies		
TOTAL PROJECT BUDGET		

(1) Estimates do not include:
- legal and administrative expenses for the Alliance
- easements/R-O-W acquisition
- permits and fees
- private utility adjustments
- flow metering
- sampling stations

(2) Includes engineering, surveying, geotechnical, and other professional services

Using the distribution of pipe diameters by phases, shown in Table 4-7 and 4-8, the cost basis found in Table D-3, the per-foot sewer material and installation cost found in Table D-4, and depth information from HYDRA, the collection system costs were developed. Collection system costs are summarized in Tables 7-1 and 7-2.

Table D-4
Sewer Cost by Size and Depth of Cut
Preliminary Construction Cost Basis

($ per linear feet)

Diameter	0'-6' Cut	6'-10' Cut	10'-14' Cut	14'-18' Cut	18'-22' Cut
8	30	33	38	48	68
10	35	40	47	61	89
12	40	47	56	74	110
15	50	58	69	92	138
18	65	74	85	115	175
21	80	90	105	143	219
24	80	90	105	143	219
27	100	110	128	176	272
30	100	110	128	176	272
33	150	160	181	241	356
36	150	160	181	241	356
42	175	190	215	290	420
48	205	220	250	340	490