CAMERON COUNTY
COLONIA WASTEWATER TREATMENT
PLANNING STUDY

FACILITY PLAN
FOR
COMBES, PRIMERA, AND ARROYO COLORADO ESTATES

STATE OF TEXAS
MICHAEL PARNELL SULLIVAN
REGISTERED PROFESSIONAL ENGINEER

6/8/95

BY

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Submitted to: Texas Water Development Board, Austin, Texas

TABLE OF CONTENTS

LIST OF PLATES

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The Texas Water Development Board (TWDB) funded this report to seek regional solutions to wastewater problems in the colonias or economically distressed areas of Cameron County, Texas. The Cameron County Colonia Wastewater Planning Study, Baseline Report, collected much of the information that was used here as a starting point. This report focuses on the towns of Combes and Primera, and the subdivision or colonias of Eggers, Los Ranchitos, Stardust, Lasana, and Arroyo Colorado Estates. Currently the residents of these areas use septic tanks or privies for their wastewater treatment needs.

The project engineers analyzed various alternatives for providing wastewater service to the project areas. The project engineers recommend regional treatment of the wastewater from the project areas at the City of Harlingen Wastewater Treatment Plant # 2. If this project can not be built, for whatever reason, then the next best alternative for Combes and Primera is to build a joint wastewater treatment plant. The second best alternative for Arroyo Colorado Estates is to have their wastewater treated by the City of San Benito.

The Project Engineer recommends that the cities of Primera and Combes provide retail sewer service to their residents. The cities will own and operate their own sewer collection systems, transport the wastewater to a lift station where the wastewater would be metered. Harlingen Waterworks System would be responsible for transporting the wastewater through Harlingen via a system of lift stations and force mains and treating the wastewater at its wastewater plant #2.

Total project costs to build the system are:

Combes	
Sewer collection system	$11,721,728
Water distribution system (Stardust)	1;054,226
Primera	
Sewer collection system	5,036,229
Harlingen	
Lift Station and force main (Re: Combes & Primera)	3,116,036
Arroyo Colorado Estates	1,873,629

Sub-total:	$22,801,848
Loan Administrative Costs	
Bond Counsel and Financial Adviser fees (Estimated, will be revised for Phase II Application)	68,406
Equity Participation Grant	
Grant to Harlingen for plant capacity for current project area residents. (Estimated, Actual to be determined by TWDB)	1,230,067
Total Project Cost:	**$24,100,321**

Development of final sewer rates will depend on the financing from the Texas Water Development Board and the final agreement with the City of Harlingen. If the Texas Water Development Board gives a 90% grant and a 10% loan to the parties, the average bills will be:

Combes:

Average water usage: 9,096 gal/month

Average water bill: $22.64

Average sewer bill: $30.11

Total bill: $52.75

Primera:

Average water usage: 9,026 gal/month

Average water bill: $22.04

Average sewer bill: $15.34

Total bill: $37.38

Arroyo Colorado Estates:

Average water usage (East Rio Hondo WSC): 9,158 gals/month

Average water bill: Not available

Average sewer bill: $22.90

SECTION 1
INTRODUCTION

SECTION 1

GENERAL PROJECT DESCRIPTION

PROJECT AUTHORIZATION/SPONSOR/ENGINEER

This report is one of a series of reports funded by the Texas Water Development Board (TWDB) and the U.S. Environmental Protection Agency (EPA) to provide proposed regional wastewater solutions for the colonias in Cameron County. The "Cameron County Colonia Wastewater Treatment Planning Study, Baseline Report," also funded by the TWDB and EPA and prepared by the Project Engineers, contains much of the preliminary information and design assumptions that are used as the starting point from this report.

Project Engineer information is provided below:

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The scope of work for this project called for the Project Engineer to prepare a Facility Plan for the Towns of Combes and Primera, including the colonias of Stardust, Lasana, Eggers, and the colonia, Arroyo Colorado Estates. The Project Engineer was to examine alternatives to wastewater collection and treatment that included regional treatment at the City of Harlingen's wastewater treatment plant #2 (WWTP #2), construction of separate non-regional treatment facilities and on-site disposal options. In keeping with the preliminary nature of the project, no surveying tasks, geotechnical investigations, or land title or appraisal tasks were provided for within the scope of work. Institutional, and legal tasks were limited to identification of issues to be resolved by the parties and the TWDB.

On May 10, 1994 the Project Engineers received notice to proceed on this report. A Draft version of this report was delivered to the TWDB on November 22, 1994. A meeting was held between the staff of the TWDB, the Project Engineer, and representatives of the City of Combes on November 22, 1994. The purpose of the meeting was to discuss the draft report and receive comments from the City of Combes. Written comments were received from the TWDB staff on January 1, 1995. These comments incorporated responses from Combes, Harlingen, residents of Arroyo Colorado Estates, as well as the TWDB staff. On January 19, 1995 written comments were received from the City of Primera. The Project Engineer then learned that additional significant comments would be coming from the Economically Distressed Areas Program (EDAP) Section of the TWDB, despite some EDAP comments being included in the original TWDB staff comments. Since the comments were significant and would effect all calculations in the report, no work was done on revising the report until all comments were received.

On February 15, 1995, the Project Engineer received the second set of EDAP staff comments. The EDAP staff comments referred to the Plate of the proposed layout for the Combes sewer system and noted that some proposed lines were not eligible for EDAP funding. No map was sent with the comments, so that it was impossible for the Project Engineer to determine which proposed service lines were referred to in the comments. In addition, the comments called for information that had not been included in previous TWDB approved facility plans. The comments were not discussed in the meetings between the Project Engineer and TWDB staff, either before the project started or at any of the numerous coordination meetings between TWDB staff and the project engineer. The EDAP comments also change a design philosophy to relax the pipe sizing design criteria to decrease slopes, decrease lift stations and decrease project costs. These comments required a major re-design of the sewer layouts for the project.

Because of the large number of comments, a meeting was held between the Project Engineer and TWDB staff to review the comments and insure that the Project Engineer understood all TWDB comments. At the meeting, the TWDB did not have the map of Combes showing ineligible lines. Nor was EDAP staff able to identify the ineligible lines on a copy of the map brought by the Project Engineer. On February 28, 1995 the Project Engineer received a map of the Combes area identifying the ineligible areas. With this final comment and information, the Project Engineer was able to proceed with the revisions to the draft report.

INTRODUCTION TO ENGINEERING REPORT

Much of the underlying planning information contained in this report was developed by the Project Team and presented in "Cameron County Colonia Wastewater Treatment Planning Study; Baseline Report." This facility engineering report is a continuation of the prior study. This focus of this report is evaluation of options for wastewater treatment for the towns of Combes, Primera, and the Stardust, Eggers Subdivision, Los Ranchitos, Lasana, and Arroyo Colorado Estates colonias.

This facility engineering report is presented in seven sections:

- **Section 1.0** provides an introduction and brief overview of the project. Additional information on the project areas may be found in the Baseline Report.
- **Section 2.0** addresses the water quality discharge criteria that proposed wastewater treatment plants will have to meet under various levels of treatment.
- **Section 3.0** contains a description of wastewater treatment plant alternatives, an analysis of those alternatives and recommendations.
- **Section 4.0** describes the proposed water distribution systems and wastewater collection systems for the project areas.
- **Section 5.0** summarizes the costs of the project, giving overall project capital costs and estimates of operation and maintenance costs.
- **Section 6.0** outlines institutional and legal issues that will have to be resolved between the parties in order to have a regional wastewater system.

- **Section 7.0** presents a detailed implementation schedule.
- **Appendix A** contains a proposed water conservation plan for the City of Harlingen.

Figures are located following the text in the section where they are referenced. Tables may be included within the text, or following the figures in the back of the section. Both Figures and Tables are numbered with the section number followed by a sequential number. Large Plates of the proposed improvements are located in the pockets following **Section 4.0.**

SECTION 2
WASTELOAD EVALUATION

SECTION 2

WASTELOAD EVALUATION

WASTE LOAD EVALUATION OF PRIMARY DISPOSAL OPTIONS

Water Quality Segment Description

The Arroyo Colorado Above Tidal (Segment 2202 - the portion of the Arroyo Colorado that is above the tidal influence) flows from south of Mission 62.9 miles eastward to 100 yards downstream of Cemetery Road south of Port Harlingen. The Arroyo Colorado Tidal (Segment 2201) continues from this point 26.2 miles to the confluence with the Laguna Madre. The Arroyo Colorado serves communities in Cameron and Hidalgo Counties as a conveyance for flood water and for municipal, industrial and agricultural treated wastewater. The Arroyo also serves as an inland waterway for commercial boat traffic, wildlife habitat, and recreational boating and fishing.

Many studies have been performed for the Arroyo Colorado, including:

- August 1976, an Intensive Survey was conducted by the Texas Department of Water Resources for the tidal portion of the stream. Results of the survey (TDWR, 1984) indicated that the stream has low assimilative capacity during low flow conditions. Nutrient and oxygen-demanding material loading from municipal discharges were determined to be responsible for eutrophic conditions.

- March 1981, a priority pollutant survey was conducted by the TDWR from McAllen to Arroyo City (TDWR, 1984). Twenty-two priority pollutants were detected during the survey, seventeen in significant quantities.

- December 1982 to March 1984, a bacteriological water quality survey was conducted by the TDWR downstream of Harlingen (TNRCC, 1986). Fecal coliform bacteria were found to be significantly elevated in the area, and elevated levels were attributable to municipal dischargers, septic discharges and nonpoint agricultural sources. Nutrient enhancement was determined to be a significant factor in the fecal coliform regrowth potential.

- August 1982, water quality data consisting of flow, field, laboratory, time-of-travel, cross-sectional, fecal coliform and tidal stage data by the TDWR from Mission to the Laguna

Madre (TDWR, 1983). Low flows and high temperatures prevailed throughout the survey.

- August 1983, water quality data also consisting of flow, field, laboratory, time-of-travel, cross-sectional, fecal coliform and tidal stage data were again collected by the TDWR from Mission to the Laguna Madre (TDWR, 1985). The survey took place under low flow and high temperature conditions.

A draft Waste Load Evaluation (WLE) is available for the Arroyo Colorado (TDWR, 1985). Waste load projections were made for the year 2000 for dischargers to the stream using a calibrated and verified QUAL-TX dissolved oxygen model. The model was calibrated using data collected during the August 1983 water quality survey. The model verification was made using data collected during the August 1982 water quality survey. At the time the WLE was drafted, a total of 29 dischargers had been permitted. Of these, four (4) were "No Discharge" permits, two (2) permits were for utility or cooling water returns, with the remaining 23 projected to discharge a total of 35.2 MGD by 2000. A dissolved oxygen projection model was created for low flow, high temperature conditions, and using this model, alternative effluent sets were run for future discharges to the Arroyo Colorado. A Use Attainability Study for the Arroyo performed by the Texas Natural Resource Conservation Commission (TNRCC) and accepted by EPA Region 6, indicated that a 4.0 mg/L minimum D.O. standard is appropriate for both segments. Effluent limits recommended in the WLE as necessary to maintain the 4 mg/L dissolved oxygen standard were, in general, at secondary treatment level with the exception of McAllen, Mission, and Pharr. These were recommended to discharge at advanced secondary treatment with nitrification.

Since the WLE was drafted, the projection model set-up has not been altered by the TNRCC except for the effluent limitations modeled. The most recent update of waste load dischargers to the system includes permitted and projected dischargers as of April, 1990.

The seven-day two-year low flow (7Q2) for Segment 2202 is 0.1 ft^3/sec. Since the Arroyo's effluent and irrigation return was dominate during the dry summer season, the 7Q2 of the tidal portion of the river (Segment 2201) is driven by the quantities of return flows from Segment 2202.

Segment Water Quality Standards

Pursuant to The Texas Water Code §26.023 and The Federal Water Pollution Control Act §303, rules on required water quality standards and numerical criteria have been developed for both segments. The rules concerning Texas Surface Water Quality Standards are contained in 31 TAC §§333.11-333.21 and in the most current TNRCC publication of the Texas Surface Water Quality Standards.

For Segments 2201 and 2202 of the Arroyo Colorado the designated uses are: contact recreation, high quality aquatic habitat, and public water supply. The numerical criteria developed for the Arroyo Colorado are intended to ensure water quality consistent with these designated uses. The water quality criteria for both segments are shown in **Table 2-1**.

Table 2-1
Water Quality Criteria of Segments 2201 and 2202

Parameter	Segment 2201	Segment 2202
Dissolved oxygen	Not less than 4 mg/L	Not less than 4 mg/L
pH (range)	6.5 to 9.0	6.5 to 9.0
Temperature	Not to exceed 95°F	Not to exceed 95°F
Chloride (annual average)	No criteria	Not to exceed 1,200 mg/L
Sulfate (annual average)	No criteria	Not to exceed 1,000 mg/L
Total dissolved solids (annual average)	No criteria	Not to exceed 4,000 mg/L
Fecal coliform (30-day geometric mean)	Not to exceed 200/100 mL	Not to exceed 200/100 mL

The proposed Texas Water Quality Standards condition permit issuance on non impairment of designated uses. Therefore, not only must the numerical criteria of each segment be maintained, but all designated uses must also be maintained. Deviation from these rules can only be accomplished through implementation of a Use Attainability Study conducted under the guidance of the U.S. Environmental Protection Agency.

Determination of criteria attainment is made from samples collected one foot below the water surface (or one third of the water depth if the depth is less than 1.5 feet) if the stream exhibits a vertically mixed water column. If the stream is vertically stratified, a depth integrated sample is required. Sampling is required four or more times a year. Exceptions to these numerical criteria apply whenever the flow equals or exceeds the low flow criteria, defined as either the 7Q2 or 0.1 ft^3/s, whichever value is higher.

Wastewater Discharges

Approved, pending and projected permits for wastewater discharge affecting Segments 2201, 2202 are shown in **Table 2-2**. Existing loadings are based on monthly self-reporting data. Permitted loadings are based on the 30-day (or annual) average value in the permit. Ammonia nitrogen loading is based on an assumed effluent concentration of 15 mg/L NH_3-N for those domestic discharges that do not have a permitted NH_3-N limitation or that did not self-report NH_3-N.

Table 2-2
Current Dischargers to Arroyo Colorado and Current Discharge Parameters

Discharger Name	Discharger Permit Number	Flow (cms)	Effluent D.O. (mg/L)	BOD5 (mg/L)	NH3-N (mg/L)
CP&L Bates	1254.001	0.08758	5.00	2.00	0.10
Mission	10484.001	0.12561	4.00	10.00	3.00
McAllen-S	10633.003	0.36834	4.00	10.00	3.00
McAllen-W	10633.002	0.00878	5.00	0.00	0.00
Pharr	10596.001	0.14432	4.00	10.00	3.00
San Juan	11512.001	0.04654	2.00	20.00	15.00
Alamo	11511.001	0.03599	2.00	30.00	8.00
Hidalgo	11080.001	0.01443	2.00	30.00	8.00
Donna	10504.001	0.05547	2.00	20.00	15.00
Tx Global	2126.001	0.00066	5.00	31.20	0.10
Military Hwy	13462.001	0.01159	4.58	44.66	2.97
Mercedes	10347.001	0.05565	2.00	20.00	15.00
Mercedes	10347.002	0.00001	2.00	20.00	15.00
La Feria	10697.001	0.01911	2.00	30.00	8.00
Winter Garden	11628.001	0.00028	2.00	20.00	15.00
Weisfield	12905.001	0.00158	2.00	20.00	15.00
Harlingen No. 1	10490.002	0.07478	2.00	20.00	15.00
Harlingen No. 2	10490.003	0.13887	4.00	20.00	5.00
CP&L	1256.001	0.03936	5.00	0.00	0.00
San Benito	10473.002	0.08823	2.00	30.00	8.00
Kenwood Inc.	12495.001	0.00088	2.00	20.00	15.00
Rio Hondo	10475.002	0.00595	2.00	20.00	15.00
Harlingen No. 3	10490.004	0.00001	4.00	10.00	3.00
Powell	11490.001	0.00066	2.00	20.00	15.00

Water Quality Conditions

Data stored in the Texas Natural Resources Information Service (TNRIS) Stream Monitoring Network (SMN) data base includes that collected by TNRCC at four monitoring stations within Segment 2201 and 13 stations within Segment 2202.

Classification and Rank

Classification and Rank are taken from The State of Texas Water Quality Inventory (1988) prepared by TNRCC. Segment 2201 is classified as effluent limited and is not ranked in the State's top 40 segments with respect to total BOD_5 load. No current water quality problems exist and a formal use attainability study verified current uses and standards. This segment experiences periods of super saturation and pronounced DO fluctuations resulting from a high algal population. Advanced waste treatment (AWT) is required to maintain Texas Water Quality Standards.

Segment 2202 is classified as water quality limited, which means that no standard effluent limits apply to the entire segment and that new and renewal permit applications are reviewed on an individual and cumulative impact basis. The segment ranks 22nd in the State's ranking of the highest loaded streams. There have been no recorded water quality standard violations over the last four years. However, the elevated levels of total nitrogen and total phosphorus signify potential problems of high algal populations. A minimum of AWT is required to maintain the Segment's designated uses and water quality criteria.

Segment 2301 is classified as effluent limited and is not ranked in the State's top 40 segments with respect to total BOD load. The segment has only one recorded instance of depressed DOs. Segment 2301 occasionally experiences high DOs because of substantial algal populations.

QUAL-TX Surface Water Quality Model Simulations

The Water Quality Assessment Unit of the Texas Water Commission performed a waste load evaluation (WLE) for the Arroyo Colorado (Segments 2301 and 2302) in 1985. The TNRCC study focused on existing permitted facilities or facilities with pending permits applications. In addition, the TNRCC study did not consider development scenarios beyond the proposed maximum lifetime capacities of existing facilities.

As part of 1985 WLE, the TNRCC calibrated and validated the QUAL-TX Water Quality Simulation Model for Segments 2301 and 2302 and the major tributaries using measured data collected during August, 1983 and August 1982, respectively. The segmentation developed for the TNRCC's WLE formed a basis for the segmentations used in this study. Examination of the calibration and validation simulation output demonstrated a reasonable fit with the empirical data.

Model Application

QUAL-TX was applied to all affected existing wastewater treatment plants in Cameron County and all proposed new WWTPs to serve the colonias, with projected 2020 wastewater loads, **Tables 2-3 and 2-4**. If the existing discharges with projected loads and current treatment levels resulted in violation(s) of the established minimum DO criteria for that segment, successively more restrictive treatment levels were applied until DO standards were maintained. For new discharges, future treatment levels were established through successive application of typical effluent characteristics for the various treatment methods, starting with ponds and progressing through secondary treatment, to advanced treatment, and to advanced treatment with nitrification. The treatment type commensurate with the least restrictive treatment level that maintained minimum DO standards was selected as the recommended treatment.

Simulation Results

Examination of **Table 2-5** and **Figure 2-1** indicates that at current levels of treatment, the proposed increases in City of Harlingen wastewater discharge quantities resulting from the projected City growth and plus the waste water flows from Primera, Combes and Arroyo Colorado Estates will maintain the existing 4.0 mg/L minimum DO standard through year 2010. Beyond this period, however, the increased flows will cause a violation of the DO standard without additional treatment. At current treatment levels, the minimum DO in 2020 is projected to be 3.6 mg/L, in 2020 —3.0 mg/L, and in 2040 — 1.6 mg/L.

Table 2-5 and **Figure 2-2** shows the results of imposition of successively more stringent treatment levels on each of the Segment 2201 and 2202 dischargers until the minimum DO standard of 4.0 mg/L can be maintained. Beyond 2010, a minimum treatment level of 10/3/5 ($BOD_5/NH_3\text{-}N/DO_{effluent}$) will be necessary for all dischargers. Even at this level, there will be minor violations of the standard upstream near Mission, McAllen and Pharr.

Recommendation

Future expansions and process and equipment replacement at the City of Harlingen wastewater treatment facility should proceed with the knowledge and understanding that the future required treatment level may need to be increased to a 10/15/4 level by the year 2010 and to 10/3/5 by 2020.

Figure 2-1
Arroyo Colorado Dissolved Oxygen Profile
Current and Future Discharge Rates at
Current Treatment Levels

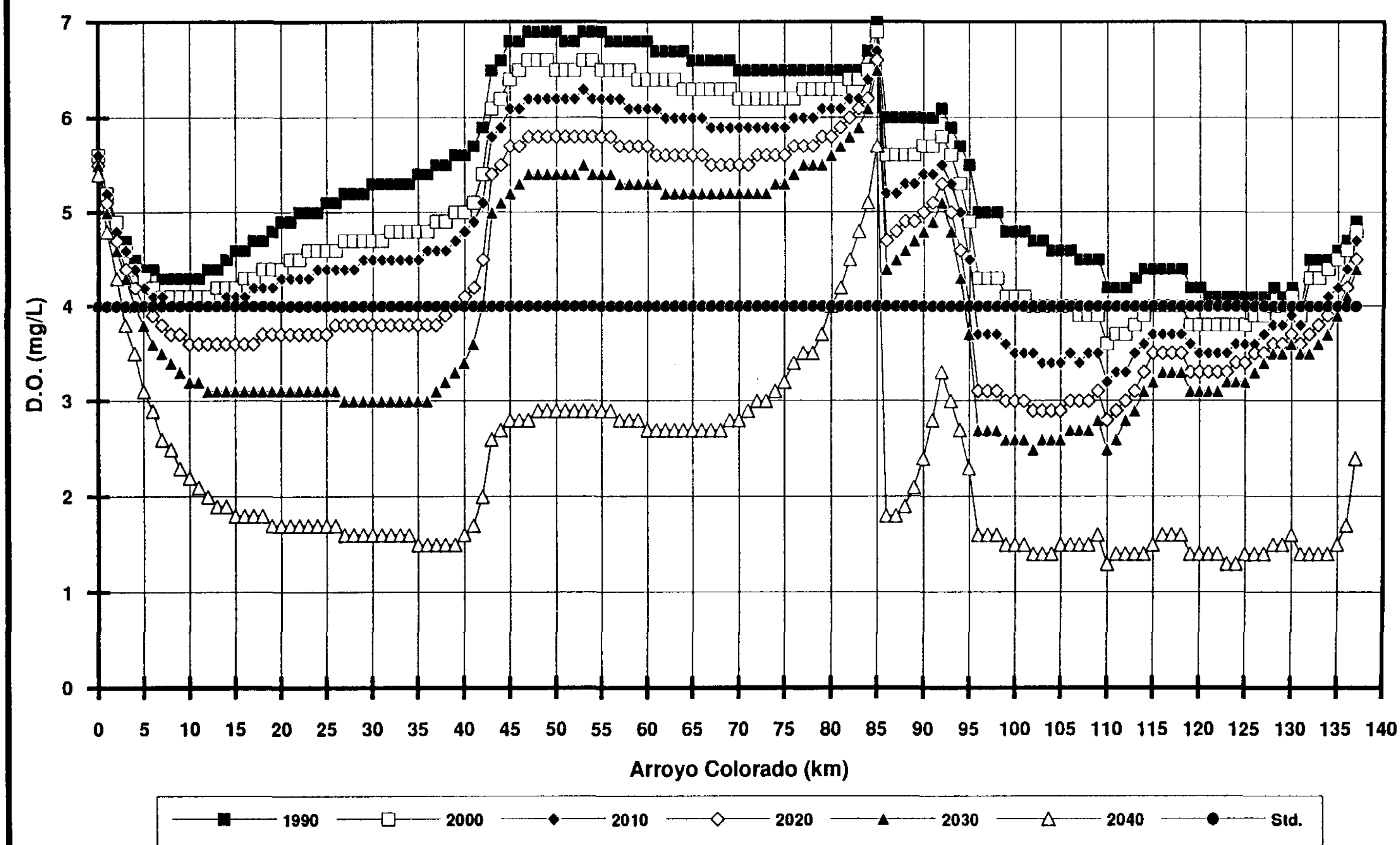


Figure 2-2
Arroyo Colorado Dissolved Oxygen Profile
Current and Future Discharge Rates at
Future Treatment Levels

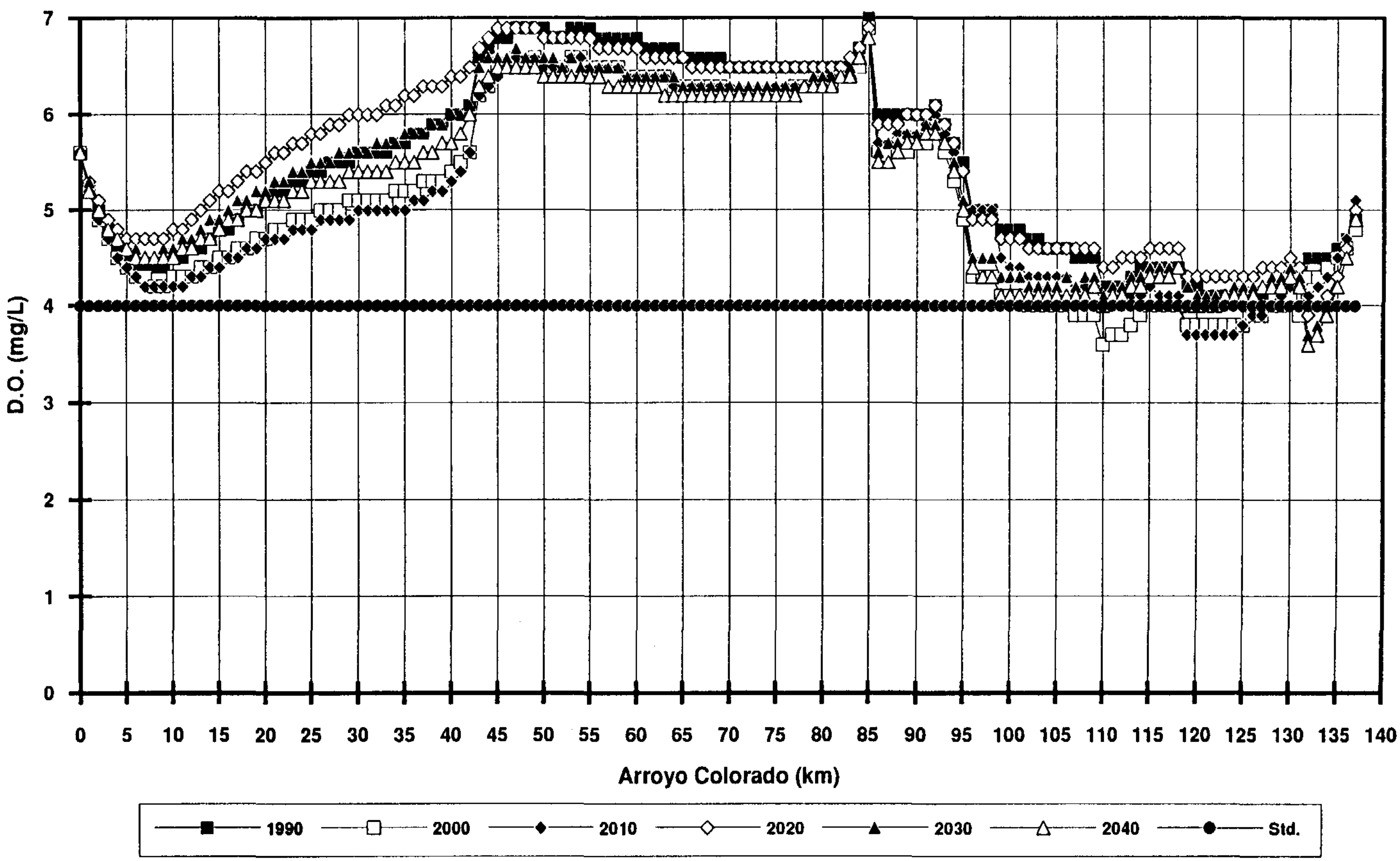


Table 2-3
Projected Populations of Arroyo Colorado Dischargers

	TWDB High Series Population					
	1990	2000	2010	2020	2030	2040
Hidalgo County						
CP&L Bates	-	-	-	-	-	-
Mission	28,653	43,349	60,465	81,806	104,513	121,129
McAllen	84,021	117,637	136,791	158,751	181,174	206,662
Pharr	32,921	46,254	65,260	66,957	114,169	132,618
San Juan	10,615	18,033	25,719	36,302	45,498	52,959
Alamo	8,210	14,094	20,946	28,162	36,583	41,726
Hidalgo	3,292	5,063	7,124	9,694	12,426	14,429
Donna	12,652	17,905	23,792	31,131	38,940	44,655
Tx Global	-	-	-	-	-	-
Military Hwy WSC	-	-	-	-	-	-
Mercedes	12,694	16,063	19,969	24,882	30,069	33,900
Cameron County						
La Feria	4,360	5,408	6,528	7,826	9,220	9,937
Winter Gardens	-	-	-	-	-	-
Weisfield School	-	-	-	-	-	-
Harlingen	48,735	58,148	70,067	82,206	95,675	102,617
CP&L	-	-	-	-	-	-
San Benito	20,125	23,862	28,752	33,733	39,259	42,108
Kenwood Inc.	-	-	-	-	-	-
Rio Hondo	1,793	1,990	2,397	2,813	3,273	3,510
Powell Ranch	-	-	-	-	-	-

Table 2-4
Arroyo Colorado Waste Load Information for Future Development Conditions a/

Discharger		1990				2000				2010			
Discharger Name	Discharger Permit Number	Flow (cms)	Effluent D.O. (mg/L)	BOD5 (mg/L)	NH3-N (mg/L)	Flow (cms)	Effluent D.O. (mg/L)	BOD5 (mg/L)	NH3-N (mg/L)	Flow (cms)	Effluent D.O. (mg/L)	BOD5 (mg/L)	NH3-N (mg/L)
CP&L Bates	1254.001	0.08758	5.00	2.00	0.10	0.08764	5.00	2.00	0.10	0.08758	5.00	2.00	0.10
Mission	10484.001	0.12561	4.00	10.00	3.00	0.19004	4.00	10.00	3.00	0.26507	5.00	10.00	3.00
McAllen-S	10633.003	0.36834	4.00	10.00	3.00	0.51571	4.00	10.00	3.00	0.59968	5.00	10.00	3.00
McAllen-W	10633.002	0.00878	5.00	0.00	0.00	0.01621	5.00	0.00	0.00	0.01621	5.00	0.00	0.00
Pharr	10596.001	0.14432	4.00	10.00	3.00	0.20277	4.00	10.00	3.00	0.28610	5.00	10.00	3.00
San Juan	11512.001	0.04654	2.00	20.00	15.00	0.07906	2.00	20.00	15.00	0.11275	5.00	10.00	3.00
Alamo	11511.001	0.03599	2.00	30.00	8.00	0.06179	2.00	30.00	8.00	0.09183	5.00	10.00	3.00
Hidalgo	11080.001	0.01443	2.00	30.00	8.00	0.02220	2.00	30.00	8.00	0.03123	5.00	10.00	3.00
Donna	10504.001	0.05547	2.00	20.00	15.00	0.07849	2.00	20.00	15.00	0.10430	34.00	10.00	15.00
Tx Global	2126.001	0.00066	5.00	31.20	0.10	0.00066	5.00	31.20	0.10	0.00066	5.00	31.20	0.10
Military Hwy	13462.001	0.01159	4.58	44.66	2.97	0.01640	4.58	44.66	2.97	0.02179	4.58	44.66	2.97
Mercedes	10347.001	0.05565	2.00	20.00	15.00	0.07875	2.00	20.00	15.00	0.10465	3.00	10.00	15.00
Mercedes	10347.002	0.00001	2.00	20.00	15.00	0.00001	2.00	20.00	15.00	0.00001	3.00	10.00	15.00
La Feria	10697.001	0.01911	2.00	30.00	8.00	0.02371	2.00	30.00	8.00	0.02862	3.00	10.00	15.00
Winter Garden	11628.001	0.00028	2.00	20.00	15.00	0.00028	2.00	20.00	15.00	0.00028	3.00	10.00	15.00
Weisfield	12905.001	0.00158	2.00	20.00	15.00	0.00158	2.00	20.00	15.00	0.00158	3.00	10.00	15.00
Harlingen No. 1	10490.002	0.07478	2.00	20.00	15.00	0.08922	2.00	20.00	15.00	0.10751	3.00	10.00	15.00
Harlingen No. 2	10490.003	0.13887	4.00	20.00	5.00	0.16570	4.00	20.00	5.00	0.19966	4.00	10.00	15.00
CP&L	1256.001	0.03936	5.00	0.00	0.00	0.04908	5.00	0.00	0.00	0.04908	5.00	0.00	0.00
San Benito	10473.002	0.08823	2.00	30.00	8.00	0.10461	2.00	30.00	8.00	0.12605	3.00	10.00	8.00
Kenwood Inc.	12495.001	0.00088	2.00	20.00	15.00	0.00088	2.00	20.00	15.00	0.00088	3.00	10.00	15.00
Rio Hondo	10475.002	0.00595	2.00	20.00	15.00	0.00872	2.00	20.00	15.00	0.01051	3.00	10.00	15.00
Harlingen No. 3	10490.004	0.00001	4.00	10.00	3.00	0.00001	4.00	10.00	3.00	0.00001	4.00	10.00	3.00
Powell	11490.001	0.00066	2.00	20.00	15.00	0.00066	2.00	20.00	15.00	0.00066	3.00	10.00	15.00

Discharger		2020				2030				2040			
Discharger Name	Discharger Permit Number	Flow (cms)	Effluent D.O. (mg/L)	BOD5 (mg/L)	NH3-N (mg/L)	Flow (cms)	Effluent D.O. (mg/L)	BOD5 (mg/L)	NH3-N (mg/L)	Flow (cms)	Effluent D.O. (mg/L)	BOD5 (mg/L)	NH3-N (mg/L)
CP&L Bates	1254.001	0.08758	5.00	2.00	0.10	0.08764	5.00	2.00	0.10	0.08764	5.00	2.00	0.10
Mission	10484.001	0.35863	5.00	10.00	3.00	0.45818	5.00	10.00	3.00	0.53102	5.00	10.00	3.00
McAllen-S	10633.003	0.69595	5.00	5.00	2.00	0.79426	5.00	5.00	2.00	0.90599	5.00	5.00	2.00
McAllen-W	10633.002	0.01621	5.00	0.00	0.00	0.01621	5.00	0.00	0.00	0.01621	5.00	0.00	0.00
Pharr	10596.001	0.29354	5.00	10.00	3.00	0.50051	5.00	10.00	3.00	0.58139	5.00	10.00	3.00
San Juan	11512.001	0.15915	5.00	10.00	3.00	0.19946	5.00	10.00	3.00	0.23217	5.00	10.00	3.00
Alamo	11511.001	0.12346	5.00	10.00	3.00	0.16038	5.00	10.00	3.00	0.18292	5.00	10.00	3.00
Hidalgo	11080.001	0.14250	5.00	10.00	3.00	0.05447	5.00	10.00	3.00	0.06326	5.00	10.00	3.00
Donna	10504.001	0.13648	5.00	10.00	3.00	0.17071	5.00	10.00	3.00	0.19576	5.00	10.00	3.00
Tx Global	2126.001	0.00066	5.00	31.20	0.10	0.00066	5.00	31.20	0.10	0.00066	5.00	31.20	0.10
Military Hwy	13462.001	0.02852	4.58	44.66	2.97	0.03567	4.58	44.66	2.97	0.04091	4.58	44.66	2.97
Mercedes	10347.001	0.13693	5.00	10.00	3.00	0.17128	5.00	10.00	3.00	0.19641	5.00	10.00	3.00
Mercedes	10347.002	0.00001	5.00	10.00	3.00	0.00001	5.00	10.00	3.00	0.00001	5.00	10.00	3.00
La Feria	10697.001	0.03431	5.00	10.00	3.00	0.04042	5.00	10.00	3.00	0.04356	5.00	10.00	3.00
Winter Garden	11628.001	0.00028	5.00	10.00	3.00	0.00028	5.00	10.00	3.00	0.00028	5.00	10.00	3.00
Weisfield	12905.001	0.00158	5.00	10.00	3.00	0.00158	5.00	10.00	3.00	0.00158	5.00	10.00	3.00
Harlingen No. 1	10490.002	0.12614	5.00	10.00	3.00	0.14680	5.00	10.00	3.00	0.15745	5.00	10.00	3.00
Harlingen No. 2	10490.003	0.23425	5.00	10.00	3.00	0.27263	5.00	10.00	3.00	0.29241	5.00	10.00	3.00
CP&L	1256.001	0.04908	5.00	0.00	0.00	0.04908	5.00	0.00	0.00	0.04908	5.00	0.00	0.00
San Benito	10473.002	0.14788	5.00	10.00	3.00	0.17211	5.00	10.00	3.00	0.18460	5.00	10.00	3.00
Kenwood Inc.	12495.001	0.00088	5.00	10.00	3.00	0.00088	5.00	10.00	3.00	0.00088	5.00	10.00	3.00
Rio Hondo	10475.002	0.01233	5.00	10.00	3.00	0.01435	5.00	10.00	3.00	0.01539	5.00	10.00	3.00
Harlingen No. 3	10490.004	0.00001	5.00	10.00	3.00	0.00001	5.00	10.00	3.00	0.00001	5.00	10.00	3.00
Powell	11490.001	0.00066	5.00	10.00	3.00	0.00066	5.00	10.00	3.00	0.00066	5.00	10.00	3.00

a/ Discharge flows derived from TWDB High Series future population estimates at 100 gsd except where more relevant information is available.
b/ Discharge treatment levels determined through iteration application of the TNRCC calibrated and verified QUAL-TX Simulation Model.

Table 2-5
Dissolved Oxygen Profiles of the Arroyo Colorado Under Current and Proposed Municipal Treatment Plant Treatment Levels

Reach	Current Treament Levels							Reach	Future Treatment Levels						
	1990	2000	2010	2020	2030	2040	Std.		1990	2000	2010	2020	2030	2040	Std.
0	5.6	5.6	5.6	5.5	5.5	5.4	4.0	0	5.6	5.6	5.6	5.6	5.6	5.6	4.0
1	5.2	5.2	5.2	5.1	5.0	4.8	4.0	1	5.2	5.2	5.2	5.3	5.3	5.2	4.0
2	4.9	4.9	4.8	4.7	4.6	4.3	4.0	2	5.0	4.9	4.9	5.1	5.0	5.0	4.0
3	4.7	4.6	4.6	4.4	4.3	3.8	4.0	3	4.8	4.7	4.7	4.9	4.8	4.8	4.0
4	4.5	4.4	4.4	4.2	4.0	3.5	4.0	4	4.6	4.5	4.5	4.8	4.7	4.7	4.0
5	4.4	4.3	4.2	4.0	3.8	3.1	4.0	5	4.5	4.4	4.4	4.7	4.6	4.6	4.0
6	4.4	4.2	4.1	3.9	3.6	2.9	4.0	6	4.4	4.3	4.3	4.7	4.6	4.5	4.0
7	4.3	4.1	4.1	3.8	3.5	2.6	4.0	7	4.4	4.3	4.2	4.7	4.5	4.5	4.0
8	4.3	4.1	4.0	3.7	3.4	2.5	4.0	8	4.4	4.2	4.2	4.7	4.5	4.5	4.0
9	4.3	4.1	4.0	3.7	3.3	2.3	4.0	9	4.4	4.2	4.2	4.7	4.6	4.5	4.0
10	4.3	4.1	4.0	3.6	3.2	2.2	4.0	10	4.5	4.3	4.2	4.8	4.6	4.5	4.0
11	4.3	4.1	4.0	3.6	3.2	2.1	4.0	11	4.5	4.3	4.2	4.8	4.7	4.6	4.0
12	4.4	4.1	4.0	3.6	3.1	2.0	4.0	12	4.6	4.3	4.3	4.9	4.7	4.6	4.0
13	4.4	4.2	4.0	3.6	3.1	1.9	4.0	13	4.6	4.4	4.3	5.0	4.8	4.7	4.0
14	4.5	4.2	4.1	3.6	3.1	1.9	4.0	14	4.7	4.4	4.4	5.1	4.9	4.7	4.0
15	4.6	4.2	4.1	3.6	3.1	1.8	4.0	15	4.8	4.5	4.4	5.2	4.9	4.8	4.0
16	4.6	4.3	4.1	3.6	3.1	1.8	4.0	16	4.8	4.5	4.5	5.2	5.0	4.9	4.0
17	4.7	4.3	4.2	3.6	3.1	1.8	4.0	17	4.9	4.6	4.5	5.3	5.1	4.9	4.0
18	4.7	4.4	4.2	3.7	3.1	1.8	4.0	18	5.0	4.6	4.6	5.4	5.1	5.0	4.0
19	4.8	4.4	4.2	3.7	3.1	1.7	4.0	19	5.0	4.7	4.6	5.4	5.2	5.0	4.0
20	4.9	4.4	4.3	3.7	3.1	1.7	4.0	20	5.1	4.7	4.7	5.5	5.2	5.1	4.0
21	4.9	4.5	4.3	3.7	3.1	1.7	4.0	21	5.2	4.8	4.7	5.6	5.3	5.1	4.0
22	5.0	4.5	4.3	3.7	3.1	1.7	4.0	22	5.2	4.8	4.7	5.6	5.3	5.1	4.0
23	5.0	4.6	4.3	3.7	3.1	1.7	4.0	23	5.3	4.9	4.8	5.7	5.4	5.2	4.0
24	5.0	4.6	4.4	3.7	3.1	1.7	4.0	24	5.3	4.9	4.8	5.7	5.4	5.2	4.0
25	5.1	4.6	4.4	3.7	3.1	1.7	4.0	25	5.4	4.9	4.8	5.8	5.5	5.3	4.0
26	5.1	4.6	4.4	3.8	3.1	1.7	4.0	26	5.4	5.0	4.9	5.8	5.5	5.3	4.0
27	5.2	4.7	4.4	3.8	3.0	1.6	4.0	27	5.5	5.0	4.9	5.9	5.5	5.3	4.0
28	5.2	4.7	4.4	3.8	3.0	1.6	4.0	28	5.5	5.0	4.9	5.9	5.6	5.3	4.0
29	5.2	4.7	4.5	3.8	3.0	1.6	4.0	29	5.5	5.1	4.9	6.0	5.6	5.4	4.0
30	5.3	4.7	4.5	3.8	3.0	1.6	4.0	30	5.6	5.1	5.0	6.0	5.6	5.4	4.0
31	5.3	4.7	4.5	3.8	3.0	1.6	4.0	31	5.6	5.1	5.0	6.0	5.6	5.4	4.0
32	5.3	4.8	4.5	3.8	3.0	1.6	4.0	32	5.6	5.1	5.0	6.0	5.7	5.4	4.0
33	5.3	4.8	4.5	3.8	3.0	1.6	4.0	33	5.6	5.1	5.0	6.1	5.7	5.4	4.0
34	5.3	4.8	4.5	3.8	3.0	1.6	4.0	34	5.7	5.2	5.0	6.1	5.7	5.5	4.0
35	5.4	4.8	4.5	3.8	3.0	1.5	4.0	35	5.7	5.2	5.0	6.2	5.8	5.5	4.0
36	5.4	4.8	4.6	3.8	3.0	1.5	4.0	36	5.8	5.2	5.1	6.2	5.8	5.5	4.0
37	5.5	4.9	4.6	3.8	3.1	1.5	4.0	37	5.8	5.3	5.1	6.3	5.8	5.6	4.0
38	5.5	4.9	4.6	3.9	3.2	1.5	4.0	38	5.9	5.3	5.2	6.3	5.9	5.6	4.0
39	5.6	5.0	4.7	4.0	3.3	1.5	4.0	39	5.9	5.3	5.2	6.3	5.9	5.7	4.0
40	5.6	5.0	4.8	4.1	3.4	1.6	4.0	40	6.0	5.4	5.3	6.4	6.0	5.7	4.0
41	5.7	5.1	4.9	4.2	3.6	1.7	4.0	41	6.0	5.5	5.4	6.4	6.0	5.8	4.0
42	5.9	5.4	5.1	4.5	4.0	2.0	4.0	42	6.1	5.6	5.6	6.5	6.1	6.0	4.0
43	6.5	6.1	5.8	5.4	5.0	2.6	4.0	43	6.6	6.2	6.2	6.7	6.5	6.3	4.0
44	6.6	6.2	5.9	5.5	5.1	2.7	4.0	44	6.7	6.3	6.3	6.8	6.6	6.4	4.0
45	6.8	6.4	6.1	5.7	5.2	2.8	4.0	45	6.8	6.5	6.4	6.9	6.6	6.5	4.0
46	6.8	6.5	6.1	5.7	5.3	2.8	4.0	46	6.8	6.5	6.5	6.9	6.6	6.5	4.0
47	6.9	6.6	6.2	5.8	5.4	2.8	4.0	47	6.9	6.6	6.6	6.9	6.7	6.5	4.0
48	6.9	6.6	6.2	5.8	5.4	2.9	4.0	48	6.9	6.6	6.6	6.9	6.6	6.5	4.0
49	6.9	6.6	6.2	5.8	5.4	2.9	4.0	49	6.9	6.6	6.6	6.9	6.6	6.5	4.0
50	6.9	6.5	6.2	5.8	5.4	2.9	4.0	50	6.9	6.5	6.5	6.8	6.6	6.4	4.0
51	6.8	6.5	6.2	5.8	5.4	2.9	4.0	51	6.8	6.5	6.5	6.8	6.6	6.4	4.0
52	6.8	6.5	6.2	5.8	5.4	2.9	4.0	52	6.8	6.5	6.5	6.8	6.5	6.4	4.0
53	6.9	6.6	6.3	5.8	5.5	2.9	4.0	53	6.9	6.6	6.6	6.8	6.6	6.4	4.0
54	6.9	6.6	6.2	5.8	5.4	2.9	4.0	54	6.9	6.6	6.6	6.8	6.5	6.4	4.0
55	6.9	6.5	6.2	5.8	5.4	2.9	4.0	55	6.9	6.5	6.5	6.8	6.5	6.4	4.0
56	6.8	6.5	6.2	5.8	5.4	2.9	4.0	56	6.8	6.5	6.5	6.7	6.5	6.4	4.0
57	6.8	6.5	6.2	5.7	5.3	2.8	4.0	57	6.8	6.5	6.5	6.7	6.5	6.3	4.0
58	6.8	6.5	6.1	5.7	5.3	2.8	4.0	58	6.8	6.5	6.5	6.7	6.5	6.3	4.0
59	6.8	6.4	6.1	5.7	5.3	2.8	4.0	59	6.8	6.4	6.4	6.7	6.4	6.3	4.0
60	6.8	6.4	6.1	5.7	5.3	2.7	4.0	60	6.8	6.4	6.4	6.7	6.4	6.3	4.0
61	6.7	6.4	6.1	5.6	5.3	2.7	4.0	61	6.7	6.4	6.4	6.6	6.4	6.3	4.0
62	6.7	6.4	6.0	5.6	5.2	2.7	4.0	62	6.7	6.4	6.4	6.6	6.4	6.3	4.0
63	6.7	6.4	6.0	5.6	5.2	2.7	4.0	63	6.7	6.4	6.4	6.6	6.4	6.2	4.0
64	6.7	6.3	6.0	5.6	5.2	2.7	4.0	64	6.7	6.3	6.3	6.6	6.4	6.2	4.0
65	6.6	6.3	6.0	5.6	5.2	2.7	4.0	65	6.6	6.3	6.3	6.6	6.3	6.2	4.0
66	6.6	6.3	6.0	5.6	5.2	2.7	4.0	66	6.6	6.3	6.3	6.5	6.3	6.2	4.0
67	6.6	6.3	5.9	5.5	5.2	2.7	4.0	67	6.6	6.3	6.3	6.5	6.3	6.2	4.0
68	6.6	6.3	5.9	5.5	5.2	2.7	4.0	68	6.6	6.3	6.3	6.5	6.3	6.2	4.0

Table 2-5 (continued)
Dissolved Oxygen Profiles of the Arroyo Colorado Under Current and Proposed Municipal Treatment Plant Treatment Levels

69	6.6	6.3	5.9	5.5	5.2	2.8	4.0		69	6.6	6.3	6.3	6.5	6.3	6.2	4.0
70	6.5	6.2	5.9	5.5	5.2	2.8	4.0		70	6.5	6.2	6.3	6.5	6.3	6.2	4.0
71	6.5	6.2	5.9	5.5	5.2	2.9	4.0		71	6.5	6.2	6.2	6.5	6.3	6.2	4.0
72	6.5	6.2	5.9	5.6	5.2	3.0	4.0		72	6.5	6.2	6.2	6.5	6.3	6.2	4.0
73	6.5	6.2	5.9	5.6	5.2	3.0	4.0		73	6.5	6.2	6.2	6.5	6.3	6.2	4.0
74	6.5	6.2	5.9	5.6	5.3	3.1	4.0		74	6.5	6.2	6.2	6.5	6.3	6.2	4.0
75	6.5	6.2	5.9	5.6	5.3	3.2	4.0		75	6.5	6.2	6.3	6.5	6.3	6.2	4.0
76	6.5	6.2	6.0	5.7	5.4	3.4	4.0		76	6.5	6.2	6.3	6.5	6.3	6.2	4.0
77	6.5	6.3	6.0	5.7	5.5	3.5	4.0		77	6.5	6.3	6.3	6.5	6.3	6.2	4.0
78	6.5	6.3	6.0	5.7	5.5	3.5	4.0		78	6.5	6.3	6.3	6.5	6.3	6.3	4.0
79	6.5	6.3	6.1	5.8	5.5	3.7	4.0		79	6.5	6.3	6.3	6.5	6.4	6.3	4.0
80	6.5	6.3	6.1	5.8	5.6	4.0	4.0		80	6.5	6.3	6.3	6.5	6.4	6.3	4.0
81	6.5	6.3	6.1	5.9	5.7	4.2	4.0		81	6.5	6.3	6.4	6.5	6.4	6.3	4.0
82	6.5	6.4	6.2	6.0	5.8	4.5	4.0		82	6.5	6.4	6.4	6.5	6.4	6.4	4.0
83	6.5	6.4	6.2	6.1	5.9	4.8	4.0		83	6.5	6.4	6.4	6.6	6.5	6.4	4.0
84	6.7	6.5	6.4	6.2	6.1	5.1	4.0		84	6.7	6.5	6.6	6.7	6.6	6.6	4.0
85	7.0	6.9	6.7	6.6	6.5	5.7	4.0		85	7.0	6.9	6.9	6.9	6.8	6.8	4.0
86	6.0	5.6	5.2	4.7	4.4	1.8	4.0		86	6.0	5.6	5.7	5.9	5.6	5.5	4.0
87	6.0	5.6	5.2	4.8	4.5	1.8	4.0		87	6.0	5.6	5.7	5.9	5.7	5.5	4.0
88	6.0	5.6	5.3	4.9	4.6	1.9	4.0		88	6.0	5.6	5.8	5.9	5.7	5.6	4.0
89	6.0	5.6	5.3	4.9	4.7	2.1	4.0		89	6.0	5.6	5.8	6.0	5.8	5.7	4.0
90	6.0	5.7	5.4	5.0	4.8	2.4	4.0		90	6.0	5.7	5.8	6.0	5.8	5.7	4.0
91	6.0	5.7	5.4	5.1	4.9	2.8	4.0		91	6.0	5.7	5.9	6.0	5.9	5.8	4.0
92	6.1	5.8	5.5	5.3	5.1	3.3	4.0		92	6.1	5.8	6.0	6.1	5.9	5.8	4.0
93	5.9	5.6	5.3	5.0	4.8	3.0	4.0		93	5.9	5.6	5.8	5.9	5.7	5.7	4.0
94	5.7	5.3	5.0	4.6	4.3	2.7	4.0		94	5.7	5.3	5.6	5.7	5.5	5.4	4.0
95	5.5	4.9	4.5	4.0	3.7	2.3	4.0		95	5.5	4.9	5.4	5.4	5.1	5.0	4.0
96	5.0	4.3	3.7	3.1	2.7	1.6	4.0		96	5.0	4.3	5.0	4.9	4.5	4.4	4.0
97	5.0	4.3	3.7	3.1	2.7	1.6	4.0		97	5.0	4.3	5.0	4.9	4.5	4.3	4.0
98	5.0	4.3	3.7	3.1	2.7	1.6	4.0		98	5.0	4.3	5.0	4.9	4.5	4.3	4.0
99	4.8	4.1	3.6	3.0	2.6	1.5	4.0		99	4.8	4.1	4.5	4.7	4.3	4.1	4.0
100	4.8	4.1	3.5	3.0	2.6	1.5	4.0		100	4.8	4.1	4.4	4.7	4.3	4.1	4.0
101	4.8	4.1	3.5	3.0	2.6	1.5	4.0		101	4.8	4.1	4.4	4.7	4.3	4.1	4.0
102	4.7	4.0	3.5	2.9	2.5	1.4	4.0		102	4.7	4.0	4.3	4.6	4.2	4.1	4.0
103	4.7	4.0	3.4	2.9	2.6	1.4	4.0		103	4.7	4.0	4.3	4.6	4.2	4.1	4.0
104	4.6	4.0	3.4	2.9	2.6	1.4	4.0		104	4.6	4.0	4.3	4.6	4.2	4.1	4.0
105	4.6	4.0	3.4	2.9	2.6	1.5	4.0		105	4.6	4.0	4.3	4.6	4.2	4.1	4.0
106	4.6	4.0	3.5	3.0	2.7	1.5	4.0		106	4.6	4.0	4.3	4.6	4.3	4.1	4.0
107	4.5	3.9	3.4	3.0	2.7	1.5	4.0		107	4.5	3.9	4.2	4.6	4.2	4.1	4.0
108	4.5	3.9	3.5	3.0	2.7	1.5	4.0		108	4.5	3.9	4.2	4.6	4.3	4.1	4.0
109	4.5	3.9	3.5	3.1	2.8	1.6	4.0		109	4.5	3.9	4.2	4.6	4.3	4.2	4.0
110	4.2	3.6	3.2	2.8	2.5	1.3	4.0		110	4.2	3.6	4.0	4.4	4.1	4.0	4.0
111	4.2	3.7	3.3	2.9	2.6	1.4	4.0		111	4.2	3.7	4.0	4.4	4.2	4.1	4.0
112	4.2	3.7	3.3	3.0	2.8	1.4	4.0		112	4.2	3.7	4.0	4.5	4.2	4.1	4.0
113	4.3	3.8	3.5	3.1	2.9	1.4	4.0		113	4.3	3.8	4.1	4.5	4.3	4.2	4.0
114	4.4	3.9	3.6	3.3	3.1	1.4	4.0		114	4.4	3.9	4.1	4.5	4.3	4.2	4.0
115	4.4	4.0	3.7	3.5	3.2	1.5	4.0		115	4.4	4.0	4.2	4.6	4.4	4.3	4.0
116	4.4	4.0	3.7	3.5	3.3	1.6	4.0		116	4.4	4.0	4.1	4.6	4.4	4.3	4.0
117	4.4	4.0	3.7	3.5	3.3	1.6	4.0		117	4.4	4.0	4.1	4.6	4.4	4.3	4.0
118	4.4	4.0	3.7	3.5	3.3	1.6	4.0		118	4.4	4.0	4.1	4.6	4.4	4.4	4.0
119	4.2	3.8	3.6	3.3	3.1	1.4	4.0		119	4.2	3.8	3.7	4.3	4.2	4.0	4.0
120	4.2	3.8	3.5	3.3	3.1	1.4	4.0		120	4.2	3.8	3.7	4.3	4.1	4.0	4.0
121	4.1	3.8	3.5	3.3	3.1	1.4	4.0		121	4.1	3.8	3.7	4.3	4.1	4.0	4.0
122	4.1	3.8	3.5	3.3	3.1	1.4	4.0		122	4.1	3.8	3.7	4.3	4.1	4.0	4.0
123	4.1	3.8	3.5	3.3	3.2	1.3	4.0		123	4.1	3.8	3.7	4.3	4.1	4.1	4.0
124	4.1	3.8	3.6	3.4	3.2	1.3	4.0		124	4.1	3.8	3.7	4.3	4.2	4.1	4.0
125	4.1	3.8	3.6	3.4	3.2	1.4	4.0		125	4.1	3.8	3.8	4.3	4.2	4.1	4.0
126	4.1	3.9	3.6	3.5	3.3	1.4	4.0		126	4.1	3.9	3.9	4.3	4.2	4.1	4.0
127	4.1	3.9	3.7	3.5	3.4	1.4	4.0		127	4.1	3.9	3.9	4.4	4.2	4.2	4.0
128	4.2	4.0	3.8	3.6	3.5	1.5	4.0		128	4.2	4.0	4.0	4.4	4.3	4.2	4.0
129	4.1	4.0	3.8	3.6	3.5	1.5	4.0		129	4.1	4.0	4.1	4.4	4.3	4.2	4.0
130	4.2	4.1	3.9	3.7	3.6	1.6	4.0		130	4.2	4.1	4.2	4.5	4.4	4.3	4.0
131	4.0	3.9	3.8	3.6	3.5	1.4	4.0		131	4.0	3.9	4.2	4.4	4.3	4.2	4.0
132	4.5	4.3	4.0	3.7	3.5	1.4	4.0		132	4.5	4.3	4.1	3.9	3.7	3.6	4.0
133	4.5	4.3	4.0	3.8	3.6	1.4	4.0		133	4.5	4.3	4.2	4.0	3.8	3.7	4.0
134	4.5	4.4	4.1	3.9	3.7	1.4	4.0		134	4.5	4.4	4.3	4.1	4.0	3.9	4.0
135	4.6	4.5	4.2	4.0	3.9	1.5	4.0		135	4.6	4.5	4.5	4.3	4.2	4.2	4.0
136	4.7	4.6	4.4	4.2	4.1	1.7	4.0		136	4.7	4.6	4.7	4.6	4.5	4.5	4.0
137	4.9	4.8	4.7	4.5	4.4	2.4	4.0		137	4.9	4.8	5.1	5.0	4.9	4.9	4.0

SECTION 3
WASTEWATER TREATMENT PLANT ALTERNATIVES

SECTION 3

WASTEWATER TREATMENT PLANT ALTERNATIVES

ON-SITE DISPOSAL OPTIONS

The Economically Distressed Areas Program requires that before the Board may fund organized wastewater treatment systems, the Board must determine "that it is not feasible in the area covered by the application to use septic tanks as the method for providing sewer services under the applicant's plan," Section 17.893(g) Texas Water Code.

For purposes of this report, the United States Department of Agriculture's Soil Conservation Service (SCS) soil survey will be used to qualify the ability of specific soil types to adequately accommodate on-site technology. **Table 3-1** summarizes various properties associated with soils found in and around the colonias under evaluation. Of particular interest is the category entitled "Septic Tank Absorption Fields". This category indicates the degree and kind of soil limitations that affect septic tank absorption fields. According to the SCS:

> "The limitations are considered **slight** if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; **moderate** if soil properties and site features are not favorable for the indicated use and special planning, design or maintenance is needed to overcome or minimize the limitations; and **severe** if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possible increased maintenance are required."

All of the individual project areas that are the subject of this report have soil types that are classified as severe.

According to the General Soil Map for Cameron County, seven soil series have been identified in the project area (Williams, 1977). These include: the Hidalgo series, the Mercedes series, the Racombes series, the Raymondville series, the Rio series, the Tiocano series, and the Willacy series. Included within the soil series in the project areas are a total of thirteen separate soil map units. Another column of special interest in **Table 3-1** is the column labeled permeability. Under the current and proposed TNRCC design criteria for on-site systems, soils must have a permeability greater than 1.0 inches per hour (in/hr) for conventional on-site systems. The Hidalgo series has two soil types, fine sandy loam, and sandy clay loam. Both of these soils have the possibility of permeabilities less than 1.0 in/hr. Because of the extremely slow permeability of the soils, trench and soil absorption bed septic tank systems would not be permitted under the on-site regulations.

The bulk of the highly developed areas of Combes and Primera contain soils that are classified as Raymondville-Urban land complex. According to the SCS, urban land consists of areas where streets, sidewalks, driveways and patios have been built. Most of the structures in these areas are single family dwellings. While the soil is not rated for permeability, this land is categorized as sever for suitability for septic tanks.

Of all of the soil types in the project areas, only the Willacy fine sandy loam has an overall acceptable characteristics for on-site systems. This soil series is intermixed with unacceptable soils when it is found in the project areas.

When soils have extremely low permeabilities, evapotranspiration (e.t.) beds are sometimes used as an alternative to soil absorption systems. The TNRCC has sent an advisory letter to all of its local authorized agents for on-site regulatory enforcement, regarding sizing of evapotranspiration beds. The letter advises that the current regulations regarding sizing of these systems are not technically sound. The letter advises sizing evapotranspiration beds using the formula:

$$A = 1.6 \times Q / R_{et}$$

Where: A = total top surface area of the excavation

Q = estimated daily water usage in gallons per day; and

R_{et} = net local evaporation rate given by TNRCC

In order to assess the feasibility of e.t. beds for the project areas, a typical design was calculated. The average water use for the study areas is 10,153 gallons per month, or 334 gallons per household per day. Three hundred fifty (350) gallons per day will be used for the calculations. This is the TNRCC proposed design water usage for a 3 bedroom house. Net evaporation given by the TNRCC is 0.08 in/day. These figures result in:

$$A = 1.6 \times 350 / 0.08 = 7{,}000 \text{ sq. ft.}$$

The TNRCC also recommends that the beds be split into two beds, for alternative dosing and resting. Currently there is a 5 foot required separation distance between the two beds. In addition, current TNRCC rules require a 10 foot setback from property lines and a 5 foot set back from easements. Typical lot sizes in Combes and Primera are 50 x 140 feet or 7,000 sq. ft. In Arroyo Colorado Estates, the typical lot size is 60 x 120 feet or 7,200 sq. ft. Therefore, the e.t. bed would require virtually the entire lot. For that reason e.t. beds are unfeasible as a method of wastewater disposal within any of the project areas.

Conclusions Regarding the Appropriateness of Utilizing Individual or Cluster Type On-Site Wastewater Treatment Technologies

The impact of unfavorable soils on the evaluation of on-site treatment technologies can be significant. Where small lot sizes combine with unsuitable soils, on-site solutions are not feasible. Poor soil conditions may, in some instances, be overcome on larger lots (1/2- acre and larger) by over-sizing the septic tank and drain field system. Each lot, however, poses unique problems, unrelated to soil conditions, which may or may not be capable of being overcome (e.g., the presence of numerous outbuildings, animal pens, vegetable gardens, driveways, trees, etc.). Thus, in developed areas, the presence of suitable soil conditions may not, in themselves, guarantee the successful implementation of a comprehensive on-site solution.

Based on the overall poor soil conditions throughout the study area, and site constraints associated with the 1,618 residential structures identified in the study area, continued reliance on individual on-site wastewater disposal technologies is inappropriate for the colonias and economically distressed areas under evaluation. Cluster type on-site wastewater disposal technologies are not feasible for the same reasons. Additional problems regarding cluster-type systems arise due to the limited availability of suitable parcels of land within or adjacent to the colonias, logistical problems associated with the myriad combinations of lots requiring service in each of the colonias and the quantity of wastewater projected to be generated within each of the colonias. Thus, individual or cluster type on-site wastewater disposal systems will not be recommended for use in conjunction with any part of this project, nor will they be considered further in this study.

CENTRALIZED WASTEWATER TREATMENT OPTIONS

Identification of Alternatives

The following sections describe the various wastewater treatment alternatives that were considered subsequent to the elimination of all on-site wastewater treatment alternatives. These alternatives that were identified and selected for further analysis or costing focused on regional wastewater systems. Regional alternatives were sought in part because the study areas were selected and defined as densely populated urban areas that were thought to be good candidates for regional systems. It is generally thought that regional plants will be able to treat wastewater at a lower cost because of economies of scale in either the capital costs to build the projects, or in operation and maintenance costs for the plant.

An initial list of alternative treatment options was developed for further analysis. That list of options included: non-discharge land treatment of wastewater, both as a regional plant and as individual treatment sites for each of the project areas; and wastewater treatment plants with discharge permits. Options for discharge are limited by topography to the North Floodway and the Arroyo Colorado. Options for types of wastewater treatment plants will be constrained by the required tight discharge permit limits for both of those receiving streams. Separating the wastewater from individual project areas for treatment at individual plants or combining project area wastewater flows at regional treatment plants, completed the list of available options.

After the baseline information was gathered for the project area, a series of coordination meetings were held in April of 1994 between the Project Engineers and the staff of the TWDB. The purpose of those meetings was to identify alternatives for the treatment of wastewater from the project areas and to establish a scope of work for this segment of facility planning.

At the coordination meetings, various wastewater disposal options were discussed. It was decided to eliminate land application from further consideration for the same reasons that land disposal is not a viable on-site option. Most of the soils in the project areas are clay soils unsuitable for land disposal. Most undeveloped land that may be suitable for wastewater disposal is in agricultural production and would be expensive to acquire.

At the conclusion of the meetings, the following alternatives were identified for further analysis and development of cost estimates: (1) a regional treatment plant for all the project areas (Combes, Primera, Eggers, Stardust, Lasana, Los Ranchitos, and Arroyo Colorado Estates) to be operated by the City of Harlingen and located at its existing Wastewater Treatment Plant #2, discharging to the Arroyo Colorado; (2) a combined wastewater treatment plant for Combes, Primera and adjacent colonias, discharging to the North Floodway; and (3) separate wastewater treatment facilities for Combes and Primera and their adjacent colonias, discharging to the North Floodway. In addition, the Project Engineers considered a separate plant for Arroyo Colorado Estates and treatment of Arroyo Colorado Estates wastewater at the existing City of San Benito wastewater treatment plant.

Regional Treatment at the Harlingen Wastewater Treatment Plant #2

The City of Harlingen Wastewater Treatment Plant #2 (WWTP #2) consists of two separate treatment trains (**Figure 3-1**). The first treatment train will be referred to as the municipal treatment train. The municipal treatment train receives wastewater directly from the City of Harlingen. Treatment consists of two primary clarifiers followed by two trickling filters, two bio-towers, a solids contact aeration basin, two final clarifiers, and secondary effluent storage tanks. At this point in the process, approximately 2 MGD of effluent is routed to reverse osmosis (RO) units, for additional treatment and then sent to an off-site industrial plant for use as process water. After use by the industrial facilities, the wastewater is returned to WWTP #2. The industrial treatment train, within WWTP #2, processes the effluent from the industrial plant and wastewater from the RO units. The industrial treatment train consists of an influent lift station, two extended aeration basins, two clarifiers, and a chlorination basin.

Municipal wastewater that does not go to the RO units is chlorinated and mixed with effluent from the industrial treatment train, then dechlorinated prior to discharge.

During the preparation of this report, the City of Harlingen amended its TNRCC/NPDES wastewater discharge permit. At the time of the draft report, the maximum daily or 30-day average effluent limits are 20/20/5/4 ($BOD_5/TSS/NH_3\text{-}N/DO$). The combined discharge from both treatment trains was permitted at 3.5 MGD. Discharge records at the plant from January 1992 to December 1993 indicate that the total monthly flows from the plant varied from 76.8 MG to 163.8 MG, for an average daily flow of 3.6 MGD. Therefore, there was not sufficient capacity at the plant for either City of Harlingen wastewater or wastewater flows from the project areas.

The City of Harlingen obtained its amended WWTP #2 discharge permit on April 17, 1995. Under the terms of its new permit, the combined flows from the WWTP #2 are set at 7.5 MGD. The interim effluent limits are 20/20/5/4 ($BOD_5/TSS/NH_3\text{-}N/DO$) until October 1, 1997. At that date, the effluent limits become 10/15/3/4. The plant currently violates the NH_3-N parameter at times when it is discharging wastewater directly from the municipal treatment train without reuse of the at the industrial plant and subsequent treatment through the extended aeration treatment train. The City of Harlingen is currently in the process of designing a rehabilitation plan for the plant so that it will be able to meet the water quality effluent limits under all operating conditions. Construction of modifications to the plant are expected to start at the beginning of 1996 and are currently estimated to cost 4 to 4.5 million dollars.

Because Harlingen was in the middle of a permit amendment, the Harlingen regional wastewater plant option was evaluated assuming a worst case scenario. The project engineers assumed that there is no available capacity at the existing facility. The City of Harlingen would, therefore, in the near future, be required to expand the plant to meet their own needs. That plant expansion could include additional capacity for the project area design flows.

Because the City of Harlingen received its permit amendment, the plant expansion is not necessary. With the amended permit there would be sufficient capacity at the current plant to handle the design flows from all the project areas. Under the regional wastewater treatment plant option, the TWDB would in effect buy a portion of the wastewater treatment plant for use by the project areas. The TWDB calls this transaction their "Equity Participation Grant." Information on the calculation of the Equity Participation is given in **Section 5 - Project Costs.**

A detailed evaluation of the internal processes of the Harlingen WWTP #2 is beyond the scope of this preliminary engineering report. Such a detailed review would include an evaluation of the physical state of the individual process units, and an evaluation of the actual performance efficiency of each unit. This information is necessary in order to determine whether some existing components of the treatment system can be used in an expanded plant. Because of the lack of such information, it was decided that a proposed upgrade to the wastewater treatment plant would be estimated based on a separate treatment train that would be sized to handle the flows from the project areas and the year 2015 flows from the City of Harlingen. The cost methodology will give the project areas the benefit of any economies of scale realized by the City of Harlingen in constructing a large new plant. This methodology will also produce a cost that is sufficiently accurate to use as a basis to select the most cost effective wastewater treatment option.

Costs were developed using EPA document 430/9-78-009, "Innovative and Alternative Technology Assessment Manual." For purposes of this cost estimate, the 10/15/3 effluent limits were used because of the need to move to those levels in the near future. Appropriate treatment processes to meet the 10/15/3 effluent limits were selected, and the costs for each process were developed from curves presented in the EPA manual. The costs were then updated to current dollars based on the Engineering News Record (ENR) Building Cost Ratio. Some local officials were critical of this cost methodology. The complaint was that local costs from recent projects should be used as the basis for the cost comparison. While the project engineer understands the concern, the scope of services and budget did not allow a detailed evaluation of the Harlingen plant, and the uncertain nature of the outcome of the permit amendment required that we develop the alternative approach that we used. The cost methodology is to be used only to select the most feasible option. For that purpose, the costs are sufficiently accurate. If the cost curves were developed with, or adjusted for, different costs of construction, then the curves would simply shift. The relative advantage of one plant size versus another would remain the same.

In order to respond to the criticism that the costs were too high for current Valley conditions, a second series of cost estimates were developed. The original EPA costs estimates were calibrated to current Valley costs using comparable recent local wastewater plant construction costs. Two recent small wastewater plants capable of meeting the discharge limits were used for this purpose. The local wastewater plant projects were the Rio Hondo plant (1992) and the Sebastian wastewater treatment plant (1995). The Rio Hondo costs were adjusted to 1995 dollars using the ENR index. The two bids were then used to shift the original costs to reflect local conditions.

Operation and Maintenance (O &M) estimates were also adjusted using comparable local operation and maintenance costs. A cost model for the 1995 Sebastian wastewater rate study was used to develop an operation and maintenance cost index, because the Sebastian cost model allowed us to develop the cost of operating and maintaining the treatment plant only and not include O & M costs for the sewer collection system. All O & M costs developed for the original estimates were shifted to reflect this local cost.

The project engineer did not undertake to develop wholly new cost estimates, either for construction or O & M costs, or to verify the accuracy of the estimates for all size treatment plants. Both sets of estimates, the EPA original estimates and the estimates adjusted for local costs, are used to eliminate unfeasible options from further study. With that purpose in mind, the cost estimates are valid and both sets of estimates support the same conclusion.

The costs of treating wastewater from all of the project areas at the Harlingen WWTP #2 assumed that the expansion of that facility would be for the 2015 flows for Harlingen and the related project areas. Project area average wastewater flow estimates came from the Baseline Report. TNRCC regulations call for basing wastewater treatment design flows on the maximum monthly 30 day wet weather flow. A factor of 1.6 was used to estimate the corresponding maximum monthly 30 day wet weather flow for the project areas, based on data developed for the City's 1992 master plan prepared by Camp Dresser & McKee (CDM). **Table 3-2** reviews the populations and design flows. Wastewater flow projections for the City of Harlingen were based on the CDM master plan. The City currently has two wastewater treatment plants. Most of the projected growth in the City is expected to be served by WWTP #2. Therefore, it was assumed that WWTP #1 would not be expanded beyond its current permitted flow of 3.1 MGD and that the remainder of future flow would go to WWTP #2. The master plan listed wastewater flow projections only to the year 2010, so a straight-line relationship was used to extrapolate flow projections to the year 2015. The resulting year 2015 design flow for WWTP #2 was projected to be 16.7 MGD.

The City's current WWTP #2 average flow is 3.6 MGD. For purposes of comparing wastewater treatment plant options it was assumed that the existing facilities could accommodate this flow, but no more. Therefore, to accommodate the City's growth, WWTP #2 would have to be expanded by 13.2 MGD. Total design flow for year 2015 from all the project areas is 1.5 MGD. Total required plant expansion is therefore 14.7 MGD. For planning purposes this was rounded to 15 MGD.

Total cost for construction of the upgrade to handle the year 2015 flows from both the City of Harlingen and the project areas is $35,410,000, including all engineering, legal, administrative and 15% for contingencies. The portion of this cost that is attributable to all the colonia project areas is **$3,541,000**. The proportion of the annual operations and maintenance cost for this alternative that attributable to the colonia project areas is estimated at $379,800. The portion that is attributable to only the Combes-Primera plant is $3,186,900. The portion of the regional plant that is attributable to Arroyo Colorado Estates is $472,133.

Combined Combes-Primera Wastewater Treatment Plant

A partial solution to the wastewater treatment plant problem could potentially be addressed by construction of a new wastewater treatment plant for the combined flows from Combes and Primera. For this alternative, Primera is assumed to include the Eggers and Los Ranchitos Subdivisions; Combes is assumed to include the Stardust and Lasana Subdivisions. If this option is pursued, then additional wastewater treatment capacity, at some other location, will need to be obtained for Arroyo Colorado Estates. Due to topographical and prevailing wind factors, a Combes-Primera treatment plant would be best located north of Primera and west of Combes. Discharge would be to the North Floodway. Anticipated discharge parameters would be 10/15/3/5 (BOD_5/TSS/NH_3-N/DO), based on the most recently issued discharge permit on the North Floodway. Therefore, a mechanical treatment facility capable of advanced secondary treatment with nitrification would be required.

Costs for this alternative were developed using the same methodology as used to cost the Harlingen Regional Treatment plant so that there would be a direct comparison. Any differences in costs will not be due to the use of differing cost methodologies. Design flows are from **Table 3-2.** Total design flow for planning purposes is 1.35 MGD.

Total cost for construction of the wastewater treatment plant, including engineering, legal, administrative, permitting and contingencies, to handle the year 2015 flows from the Combes-Primera project area is estimated to be **$6,774,084.** The total annual operations and maintenance cost for this alternative is estimated at $590,000.

Separate Wastewater Treatment Plants for Combes and Primera

Another potential alternative is to construct separate treatment plants for Combes and Primera. For this alternative, Primera is assumed to include the Eggers and Los Ranchitos Subdivisions; Combes is assumed to include the Stardust and Lasana Subdivisions. If this option is pursued then additional wastewater treatment will also be needed for Arroyo Colorado Estates. The Combes plant would be located north of the town. The Primera plant would also be located north of the town due to topographical and prevailing wind factors. Discharge for both plants would be to the North Floodway. Anticipated discharge parameters would be 10/15/3/5 (BOD_5/TSS/NH_3-N/DO), based on the most recently issued discharge permit on the North Floodway.

Total cost for construction to handle the year 2015 flows from the City of Combes and associated colonias is estimated to be **$4,254,597.** The total annual operations and maintenance cost for this alternative is estimated at $340,000.

Total cost for construction to handle the year 2015 flows from the City of Primera and associated colonias is estimated at **$5,266,600**. The total annual operations and maintenance cost for this alternative is estimated at $440,000.

San Benito Wastewater Treatment Plant

A potential treatment alternative for the Arroyo Colorado Estates project area is to treat all of its effluent at the San Benito Wastewater Treatment Plant. Currently the San Benito plant is a facultative lagoon system combined with a free water surface system constructed wetland. The plant is located to the west of Arroyo Colorado Estates. The City of San Benito has had a series of operational problems with their plant. The City has made several attempts to improve the operation of the plant. These attempts culminated in the City hiring OMI, a private corporation, to manage the facility. The City of San Benito is currently planning to upgrade capacity of the plant by adding a 1.5 MGD extended aeration WWTP prior to the constructed wetlands. Costs for the addition of plant capacity to handle Arroyo Colorado flows were estimated on the same basis as the Harlingen Regional Treatment Plant. The 1.5 MGD flows from San Benito were added to the year 2015 design flows for Arroyo Colorado Estates, 0.2 MGD. The 1.7 MGD plant costs were estimated, and the percentage of costs attributable to Arroyo Colorado Estates are presented.

Cost for construction to handle the year 2015 flows from Arroyo Colorado Estates, assuming that the plant capacity is added to construction of a new facility, so that the project area can take advantage of the economy of scale to be combined with the San Benito plant, is estimated at **$937,769**, for the project areas proportionate cost. The total annual operations and maintenance cost for this alternative is estimated at $80,000.

New Wastewater Treatment Plant for Arroyo Colorado Estates

Another potential alternative for the treatment of Arroyo Colorado Estates wastewater is the construction of a new wastewater treatment plant, specifically for the subdivision, that would discharge to the Arroyo Colorado. A developer for the remaining tracts in Arroyo Colorado Estates has apparently obtained a discharge permit, although a wastewater plant has never been built. The permit will expire in 1995. As a practical matter, the permit would have to be amended to describe the plant actually built. Legal and institutional issues arise from this option. EDAP program statutes and regulations require a political subdivision to apply for and receive EDAP funds. A private developer holding a discharge permit would not be eligible. The East Rio Hondo Water Supply Corporation is a potential applicant and wastewater plant operator, but they have no experience operating a wastewater treatment plant. Using the same cost estimating methodologies used for other options, the total estimated cost to build a separate 0.2 MGD plant for this area would be **$3,347,875**. Total annual operation and maintenance cost is estimated at $250,000.

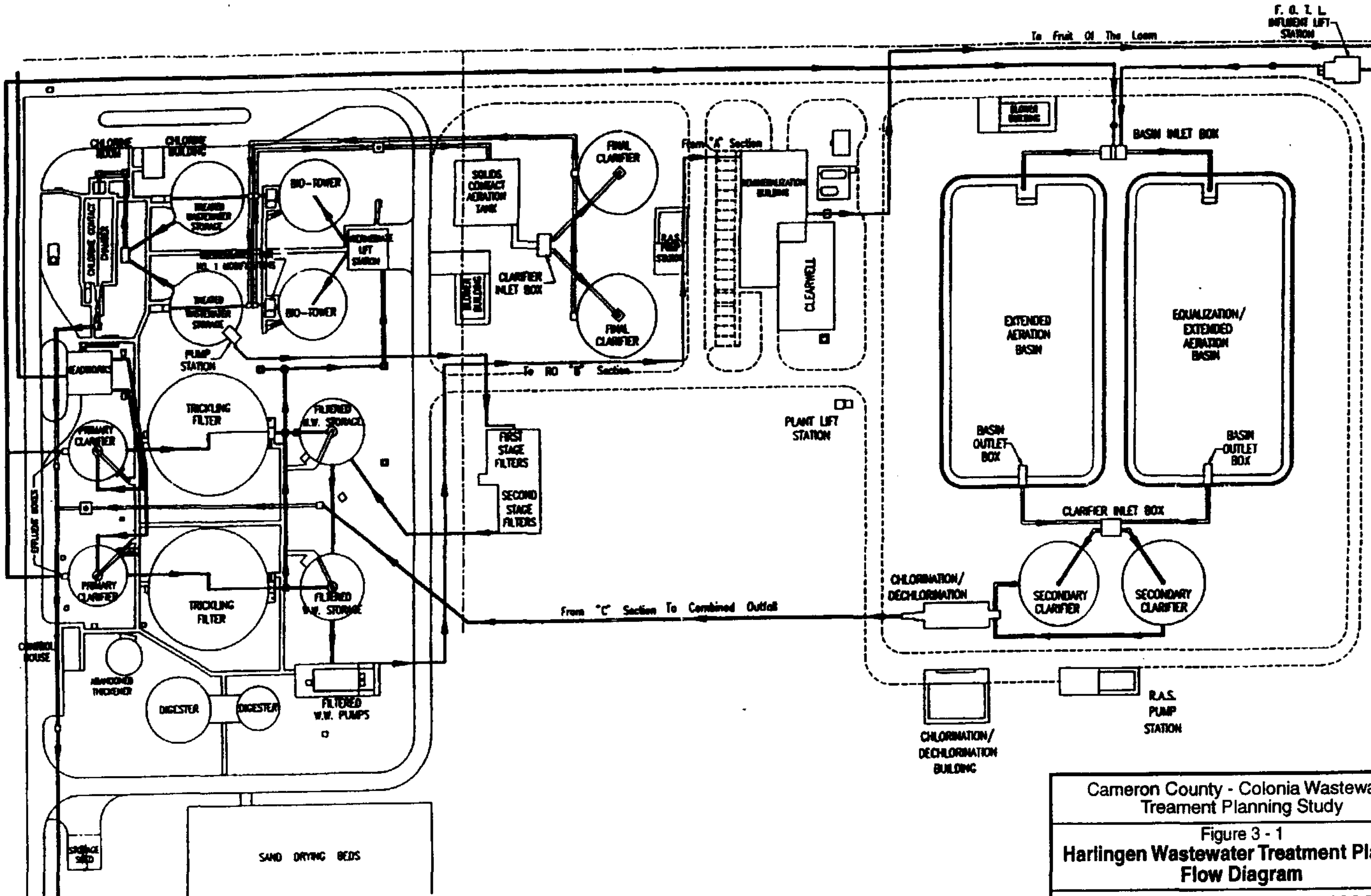
Conclusions and Recommendations Wastewater Treatment Plant Options

The costs associated with the individual alternatives are presented in **Table 3-3.** As previously explained, these costs are relative order of magnitude values and are useful for comparing the relative costs between options and selecting the most feasible option. In reviewing the costs between options, it should be remembered to compare options that include treatment of all the flows from all of the project areas. The regional wastewater plant needs should not be compared with the cost of a Primera plant for example, but as a cost of a combination of plants that will treat all flows.

A review of the costs, both the original EPA cost estimates and the estimates adjusted by local bids, shows that the least cost alternative for providing service to all of the project areas is utilization of the City of Harlingen's existing wastewater treatment facility. The regional treatment option is the least cost to build and the least cost to operate and maintain. The differences in the treatment plant unit costs are due to the economies of scale in providing service at a large regional plant.

The present worth calculations are a way of comparing options that may have a high cost to build but a low cost to maintain with options that have a low cost to build but a high maintenance cost. The present worth calculation gives the lump sum of money that, if invested in a low risk investment, would give the utility enough money to build the plant and operate and maintain it over its useful life. On a present worth basis, the regional treatment plant is also the least cost option when compared to combinations of options that will give treatment for all the project areas.

The combined Combes-Primera wastewater treatment plant is the second best alternative, if regional treatment at a Harlingen wastewater treatment plant is not possible. For Arroyo Colorado Estates, the best option is also treatment at the Harlingen WWTP #2. If that option for any reason becomes unavailable, then treatment of Arroyo Colorado Estates wastewater at the expanded City of San Benito facility is the second best option.



Cameron County - Colonia Wastewater Treament Planning Study

Figure 3 - 1
Harlingen Wastewater Treatment Plant #2 Flow Diagram

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Table 3-1
Summary of Soil Series and Properties
for Soils Found in the Project Area in Cameron County

Soil Series	Proportionate Extent of Soils in Cameron County (% of Total)	Flood Hazard		Depth to Seasonal High Water Table (feet)	Permeability (In/Hr)	Colonia Project Area Where Found	Degree and Kind of Limitation for Septic Tank Absorption Fields*
		Frequency	Duration				
Hidalgo fine sandy loam 0-1 percent slopes	0.2	None	None	3-10	0.63-2.0	Primera	Slight
Hidalgo sandy clay loam Less than 0.5 percent slopes	3.6	None	None	3-10	0.63-2.0	Primera, Combes Stardust	Slight
Hidalgo-Urban land complex 0-3 percent slopes	0.1	None	None	Not estimated	Not estimated	Primera Combes	No interpretation
Mercedes clay 0-1 percent slopes	2.7	None	None	5-10	<0.06	Arroyo Colorado	Severe percs slowly
Mercedes clay 1-3 percent slopes	0.3	None	None	5-10	<0.06	Arroyo Colorado	Severe percs slowly
Racombes sandy clay loam Less than 0.5 percent slopes	3.2	Frequent	Very Brief	3-10	0.63-2.0	Primera, Combes Eggers, Lasana	Severe floods
Racombes soils & Urban land 0-1 percent slopes	0.1	Frequent	Very Brief	3-10	0.63-2.0	Primera Combes	No interpretation
Raymondville clay loam Nearly level soil	8.0	None	None	3-10	0.20-0.63	Primera, Combes Stardust	Severe percs slowly
Raymondville clay loam, saline Less than 0.5 percent slopes	0.1	None	None	3-6	0.06-0.20	Primera Combes	Severe percs slowly
Raymondville-Urban land complex 0-1 percent slopes	0.4	None	None	3-10	Not estimated	Primera Combes	Severe percs slowly
Rio clay loam Nearly level soil	0.2	Frequent	Brief	3-6	0.63-2.0	Primera Lasana	Severe percs slowly; floods
Tiocano clay Less than 0.5 percent slopes	0.6	Frequent	Long	Below observed depths	<0.06	Combes Lasana	Severe; floods percs slowly
Willacy fine sandy loam 0-1 percent slopes	4.6	None	None	Below observed depths	2.0-6.3	Primera, Combes Eggers	Slight

Source:
USDA Soil Conservation Service Soil Survey of Cameron County, Texas

* Soil suitability for septic tank absorption systems:
Severe - soil and site features are so unfavorable that special design, significant increases in costs, and possible special maintenance are required.
Moderate - soil properties and site features are not favorable and special planning, design or maintenance is needed to overcome or the limitations.
Slight - soil and site features are generally favorable for the use and limitation are minor and easily overcome.

TABLE 3-2
Project Area Population and Wastewater Flow

Project Area	1995			2015		
	Population	Average Wastewater \d	Maximum Monthly Wet Weather Flow \e	Population	Average Wastewater \d	Maximum Monthly Wet Weather Flow \e
Primera \a	4,051	324,077	518,523	6,150	510,028	816,045
Combes \b	2,692	215,345	344,552	4,093	304,454	487,126
Arroyo Colorado Estates \c	824	65,926	105,482	1,405	112,372	179,795
Total	7,567	605,348	968,557	11,648	926,854	1,482,966

Notes:

\a Includes Eggers and Los Ranchitos Subdivisions

\b Includes Stardust and Lasana Subdivisions

\c Only includes developed portion of subdivision

\d Gallons per day; Estimate developed in Baseline Report

\e Gallons per day; Required by TNRCC rules; Based on 1.6 times average.

Table 3-3

Wastewater Treatment Plant Cost Estimates

EPA COST ESTIMATES - ADJUSTED BY ENR TO 1995 DOLLARS						
	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
	Regional Treatment Harlingen WWTP #2 (a)	Combined Combes-Primera	Combes	Primera	Arroyo Colorado with San Benito (a)	Arroyo Colorado Stand Alone
Study Area Design Flow	1.5	1.35	0.5	0.65	0.2	0.2
Construction	2,744,680	5,159,000	3,234,000	4,004,000	715,638	2,541,000
Basic Engineering	167,028	340,494	210,857	260,260	56,535	165,165
Additional Services:						
Field Surveying	10,000	27,200	15,000	22,500	2,500	10,000
Geotechnical	3,500	12,500	7,500	10,000	1,250	5,000
Materials Testing	4,250	14,500	10,100	12,000	1,500	7,600
Construction Inspection	18,000	46,000	30,000	35,000	3,000	28,000
TNRCC & NPDES Permits (b)	-	25,000	25,000	25,000	2,500	25,000
Prepare O & M Manual	4,000	17,000	15,000	15,000	200	15,000
Land, ROW, Easements	-	49,000	28,000	42,000	5,800	17,500
Administration	68,068	103,180	64,680	80,080	13,500	50,820
Legal, Fiscal	109,772	206,360	129,360	160,160	28,000	101,640
Contingencies	411,702	773,850	485,100	600,600	107,346	381,150
Total Construction Costs	$3,541,000	$6,774,084	$4,254,597	$5,266,600	$937,769	$3,347,875
Treatment Plant Unit Costs (dollars/gallon)	2.36	5.02	8.51	6.20	4.69	16.74
Annual O & M Costs	$379,800	$590,000	$340,000	$440,000	$80,000	$250,000
Present Worth (c)	8,625,359	14,602,572	8,746,693	11,093,023	1,998,204	6,638,854

EPA COST ESTIMATES - ADJUSTED BY RECENT LOCAL BIDS TO 1995 DOLLARS						
	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Total Construction Costs	$630,000	$4,200,000	$1,500,000	$2,250,000	$155,000	$554,000
Unit Costs (dollars/gallon)	0.42	3.11	3.00	2.65	0.78	2.77
Annual O & M Costs	$207,000	$405,000	$162,500	$265,000	$61,200	$80,000
Present Worth (c)	3,472,358	9,598,462	3,676,202	5,809,636	997,063	1,635,473

Notes:

(a) Costs are for the project area's proportionate cost share only.

(b) Discount Rate = 5.8%; Inflation Rate = 2.9%; Life cycle 20 years

(c) Permits are assumed to be uncontested.

SECTION 4
COLLECTION AND DISTRIBUTION SYSTEMS
PRELIMINARY ENGINEERING

SECTION 4

COLLECTION AND DISTRIBUTION SYSTEMS PRELIMINARY ENGINEERING

Centralized Wastewater Collection Alternatives

When evaluating wastewater collection systems for small communities (within the context of EDAP), two groups of alternatives are applicable. Alternatives include: pressure sewers and gravity sewers. Pressure sewers utilize mechanical pumping units at individual residences to convey wastewater to a common pressurized collection system and ultimately to a point of treatment. Gravity sewers do not require a mechanical component to convey wastewater from the home to the common collector. Depending on topographical constraints or site location, centralized pumping stations (lift stations) may be necessary to convey collected wastewater to another portion of the centralized collection system, regardless of whether a pressure system or gravity system was used as the initial method of collection.

Pressure sewers require the installation of a pump tank, pumping unit, electrical controls, and a backflow control valve at each residence. If the pump malfunctions, wastewater cannot be discharged to the main collection system. The costs associated with pump repair and/or replacement can be a significant burden to low income families. If a low income family cannot afford the cost of repair or replacement, the system will not function and a catastrophic failure will occur. (The inability to afford routine maintenance on existing septic systems (e.g., septic tank cleaning costs) is a common cause for many of the septic system problems identified in the study area.) Thus, to minimize problems with the system, the project sponsor would be responsible for operating and maintaining the individual pump units and associated appurtenances. This amounts to maintaining several hundred miniature lift stations over the life of the project.

Gravity collection systems are designed to function without mechanical intervention, except where lift stations are needed to overcome terrain or system location constraints. Gravity collection systems require no special equipment at the individual residence to convey the wastewater to the common collector. Gravity systems are reliable, easily understood by utility maintenance personnel, and easily maintained.

In terms of general application to the conditions which exist in the low income colonia environment, mechanical systems requiring specialized equipment and maintenance skills would not appear to be appropriate. Only the simplest and most reliable method of wastewater collection should be considered. Thus, only gravity collection systems will be evaluated in this study. Two methods of gravity collection systems will be evaluated for this project. These are the small diameter gravity system and conventional gravity system.

Small Diameter Gravity (SDG) Wastewater Collection Systems

A small diameter gravity (SDG) wastewater collection system collects effluent from septic tanks at each service connection and transports it by gravity to a treatment plant or another gravity sewer. The septic tank removes grit, settleable solids, and grease, and provides some attenuation of peak flows. The main advantage of a SDG system is that effluent entering the gravity portion of the collection system contains little or no solids, allowing collection lines to be sized for less than standard minimum flow velocities. Many times, this results in the use of smaller than typical pipe sizes, when compared to conventional gravity wastewater collection systems. Conventional gravity systems typically are designed to maintain a minimum velocity of 2 fps, when flowing full, to keep the solids portion of the wastewater in suspension. Clogging of the line may occur when solids are allowed to settle and flow velocities are less than 2 fps. Since the solids portion of the wastewater flow is reduced or eliminated by the presence of the septic tank, SDG systems are typically designed for minimum velocities of 1 to 1.5 fps. Due to the corrosive nature of the septic tank effluent, plastic pipe is typically used. Cleanouts are used to provide access for flushing with standard manholes used typically only at main line junctions.

According to the United States Environmental Protection Agency (USEPA), SDG systems are likely to be most cost-effective where housing density is low, the terrain has undulations of low relief, and the elevation of the system terminus is lower than all, or nearly all, of the service area. However, due to the small pipe sizes typically used for SDG systems, these systems must be designed to provide sufficient driving force to prevent wastewater from backing up into the homes which they serve. If gravity is to act as the driving force, the system must be designed such that the lowest connection is still high enough to provide a sufficient force to prevent a backup condition. This is the primary limitation for successful use of this technology. Where sufficient driving force cannot be maintained, lift stations must be installed to artificially provide the driving force necessary to transport the wastewater to its terminus. Adding lift stations and force mains to a SDG system significantly increases its cost, thus reducing its overall cost-effectiveness.

The State of Texas has no published guidelines or criteria for the design of SDG wastewater systems and only one SDG system has ever been approved for use in Texas by the TNRCC. Approval of SDG systems would be on a case-by-case basis.

For a SDG system to function properly, infiltration and inflow (I/I) must be kept to an absolute minimum. Aside from manholes and cleanouts, the primary source of I/I in a SDG system is the homeowners septic tank. If the septic tank is not watertight, I/I rates as high as ten times the average daily flows may occur during wet weather, significantly affecting the performance of the SDG system. As reported in the wastewater surveys and by the TDH, approximately 90-95% of households in the project study area use septic tanks to dispose of wastewater. This would appear to indicate that a significant portion of a typical SDG system would already be in place, thus, effecting a significant potential cost saving. When a SDG system is retrofitted to an existing community, however, most of the existing septic tanks must be replaced to insure water tightness. Since most of the septic systems in the study area have been improperly constructed, it is doubtful that many of the septic tanks in place are watertight or would function adequately in a SDG system. For the purposes of this study, it should be assumed that all of the existing septic tanks would need to be replaced.

The septic tank in a SDG system provides a means of pretreating the wastewater before the wastewater enters the collection system (and ultimately the wastewater treatment facility). As a result, the project sponsor would be responsible for operating and maintaining each of the septic tanks included in the SDG system. The project sponsor would be responsible for insuring that the septic tanks are kept in good repair and that the tanks are cleaned on a routine schedule (typically once every three years). The project sponsor would also be responsible for properly disposing of the septage.

As stated previously, SDG systems work best when the terminus of the system (the wastewater treatment facility) is lower than the area served by the SDG system. The terrain in the project area is essentially flat; thus, it is doubtful that a SDG system would reduce the overall depth of pipe or the number of lift stations necessary to convey wastewater to the receiving wastewater treatment facility.

Due to the lack of operational experience in Texas, the practical need to replace all existing septic tanks, the need for the project sponsor to take responsibility for operating and maintaining individual septic tanks, and the extremely flat terrain in the project area, implementation of a SDG system for this project appears unfeasible.

Due to the apparent unfeasibility of SDG systems with regard to this project, only a conventional gravity collection system will be considered for use in this project.

Conventional Gravity Wastewater Collection Systems

A conventional gravity wastewater collection system carries raw sewage by gravity. These systems are designed by traditional, conservative criteria. In Texas, the TNRCC publishes guidelines and design criteria for the design of conventional systems. The collection system consists of pipes, manholes, and in some instances, cleanouts. The pipe typically is designed to flow at a constant downward slope. If the collection system covers a large area, excavations may become excessive and lift stations and force mains may be required to convey collected wastewater to a terminal treatment plant location. According to USEPA, conventional gravity sewers are best suited to densely populated service areas with a relatively constant, gentle slope toward a desirable treatment plant location. Conventional gravity systems are ordinarily highly reliable. They often require flushing or cleaning to remove deposits of solids and grease. Lift stations generally require frequent maintenance and cleaning.

Combes Sewer System

Currently there is no gravity sewer system in Combes, except a portion of Sunshine Country Club Estates Subdivision. This subdivision straddles the Combes-Harlingen city limits line. The City of Harlingen Waterworks system currently provides retail sewer service to this subdivision. The sewer system proposed by this report does not provide any new sewers to Sunshine Country Club Estates Subdivision. Instead, it is assumed that the City of Harlingen will continue to serve this area directly.

The proposed sanitary sewer system for Combes is presented on **Plate 1**. The Lasana and Stardust colonias, although outside the City Limits of Combes, are proposed to be connected to the Combes system. It is assumed that Combes will provide retail sewer service to these colonias. Except for Stardust and Lasana, the current city limits were assumed to be the service area. The collection mains were extended only to areas with current development.

Elevations were estimated using U.S. Geological Survey (USGS) topographical maps. Locations of houses, streets, alleys, highways, irrigation ditches, railroads and other important features were established by reference to 1993 Texas Department of Transportation (TxDOT) aerial photographs, USGS topographical maps and TxDOT county maps. Generally the wastewater flows west to east and north to south in the proposed system. Because of the almost complete lack of grade, if Combes and Primera decide to build a joint plant rather than have Harlingen treat the wastewater, the sewer system layout would remain the same. In that case, the force main to the City of Harlingen would be changed to a force main to the wastewater treatment plant. The point of delivery to the City of Harlingen for treatment was established in consultation with the City of Harlingen (see the sub-section on the force main routing).

The collection system was designed to flow towards a lift station and force main to be located at the intersection of Primera Road (FM 499) and Crossett Road. The City of Combes will be responsible for operation and maintenance of the collection system before that point of delivery. After that point, the wastewater will proceed via force main to the Harlingen WWTP #2. The City of Harlingen will be responsible for the operation and maintenance of the flow measuring devices, the lift stations and force main.

Every effort was made by the Project Engineer to serve only areas that have existing development. In some instances where the existing development was spare and the area resembled a farm house or isolated dwelling, no serve was attempted. The presumption is that service to those few homes is not cost effective and if the house is experiencing problems with a septic system there is room to enlarge the drainfield and at least improve the performance of the septic system. Every effort has been made to place all proposed sewers within existing right-of-way. Because of the preliminary nature of this facility plan, it was not possible to do an extensive search to verify that all lines are in fact in an existing right-of-way. Texas Water Development Board staff informed the Project Engineer that Economically Distressed Areas Funds would not be available to the City of Combes to purchase right-of-way. If any rights-of-way or easements are necessary for this project, they will either have to be donated or acquired from other funds. Accordingly, no money is included in the proposed budget for right-of-way or easement acquisition.

In keeping with the requirements of the State Design Criteria, the sewer system was designed for "the estimated future population to be served," 31 TAC §317.2(a)(1). However the problem raised by retrofitting a sewer system into a growing community such as Combes, leads to a problem of where within the city boundaries is that growth going to occur? The answer must be an assumption. The assumption leads to differing line sizes. For purposes of calculating design flows the character of the area was examined from aerial photographs and available subdivision plats. For less developed areas within the city, populations and design flows were estimated based on development of 5 houses per acre. Where subdivision plats were available and existing development from the aerial photographs appeared to be consistent with the plats, actual numbers of lots were used with one house per lot assumed. In the more densely populated portions of the town, lots were estimated at 33.33 lots per 1,000 linear feet of sewer line. In the trailer parks, where the most dense development has occurred, lots were estimated based on the observed frequency of development of 46 lots per 1,000 linear feet of sewer line. Household size was assumed to be 3.83 persons per house as indicated by the household survey conducted for the Baseline Report. Wastewater flow was assumed to be 100 gpd with a peaking factor of 4, as per the TNRCC Design Criteria.

Two natural features of the project area proved problematic for the Project Engineer. Groundwater is typically found in the area at eight to ten feet below the land surface. In order to minimize the amount of sewer lines influenced by groundwater, it was decided to limit the maximum depth of sewer inverts to lift stations at 15 ft. This depth constraint was verified as recommended local practice with an experienced local utility operator. The almost complete absence of natural topographic grade in the area was the second physical constraint on sewer system design. The project engineer first considered the use of lines at minimum grade (as defined in the State Design Criteria) and in some cases using larger pipe diameters, at minimum grade, than required by flow. This approach allowed shallower cuts for pipe and fewer lift stations. Relaxation of State Design Criteria has been allowed in the past by the TWDB and TNRCC. This approach in areas of flat grade allows a system to be built that is cheaper to construct and allows for greater growth in the area before lines must be paralleled.

The Texas Water Development Board (TWDB) Economically Distressed Area Program (EDAP) staff commented on the initial approach:

> "*Upon examination of the plans, the wastewater collection lines appear to be* ***over-sized*** (emphasis in original) *using slope as the limiting factor. This design methodology will lead to solid deposition in the collection system. In addition, the velocities will be well below 2.0 ft/sec because the pipes will not be flowing full. Pipe over-sizing creates a long transport time and will cause the generation of*

anaerobic wastewater and hydrogen sulfide. **Please redesign the collection system using flow as the limiting factor,**"(emphasis added).

The proposed sewer system depicted in **Plate 1** adheres to directives from the TWDB not to use over-sizing of lines to minimize the number of lift stations. Minimum pipe sizes and slopes were taken directly from the State Sewer Design Criteria. Pipes were generally laid out at minimum grade. Several alternative layouts were analyzed for each sub-area of the town in order to obtain the most efficient placement of lift stations and minimize the overall cost. In cases where a short segment of pipe joined a deeper pipe running at minimum grade, the slope was increased to increase the velocity of the smaller flows. In no case were slopes allowed to exceed the maximum grade. Some lift stations were allowed at greater depths where a 15 ft limitation would cause an abnormally short distance to the next lift station.

Table 4-1 presents flows and slopes for major pipe segments of the proposed collection system design. **Table 4-2** presents lift station and force main calculations including lift station sizing, force main lengths and diameters, static head and total dynamic head (TDH). These calculations were made on the basis of USGS map contours. No field surveying was in the scope of the Project Engineer's work; therefore, the Project Engineer is not representing these calculations as the basis for design. These calculations must be revised after better information is obtained from field surveys in the design phase.

Table 4-3 summarizes the estimated quantities, unit costs and project costs associated with the proposed collection system. Cost estimates were prepared on the basis of the preliminary design depicted on **Plate 1**. Unit costs were based on the most recent local project known to the Project Engineer. The total estimated cost to construct the Combes sewer system, including engineering design, construction, inspection, but not including costs for the force main through Harlingen or wastewater plant costs, is **$11,721,728**. This is an approximate cost of $18,665 per connection, based on 628 total initial connections, (100% connection rate.)

Combes Water System Improvements

The City of Combes buys potable water from the City of Harlingen and provides retail water service to its residents. The Stardust area, just outside the northern city limits of Combes, lacks water service. The most viable provider of water service for the Stardust area is the existing Combes municipal system.

The current contract between the City of Harlingen and the City of Combes provides for Harlingen to deliver 300 gal/min to Combes. The City of Harlingen Water Works System (HWWS) has calculated that in order to increase the delivery to 600 gal/min, Combes would have to pay an impact fee of $408,196 in order to compensate Harlingen for the capacity in its water treatment plant and water distribution system lines.

The proposed layout of water system improvements to extend service to Stardust is shown on **Plate 2.** Neither pressure tests, computer simulation modeling, nor a detailed evaluation of the existing Combes water system was provided for in the scope of services. Therefore, the Project Engineer's calculations are preliminary and should be reevaluated during the design phase. Distribution system lines were sized based on the AWWA recommendation for fire protection capability with a minimum line size of 6 inches. The next larger pipe size was used to provide two loops around the two major sections of the subdivision. In order to insure pressure in the line that will serve the project area, additional elevated storage was provided. The height of the elevated storage tank and the sizing of the transmission line to the subdivision were calculated as follows:

1. Static pressure of between 60 and 75 lb/in^2 (AWWA recommended). At 60 psi the minimum elevation of water in the elevated storage is:

   $$(60 \text{ psi})(2.31 \text{ ft } H_2O/\text{psi}) = 138.6 \text{ ft of } H_2O. \text{ Use } 140 \text{ ft.}$$

2. The Texas Water Utility Association (TWUA) recommends 30 to 40 psi water pressure for normal domestic use. The maximum design one hour flow equals the maximum year 2015 population times average per capita water use, times a peaking factor.

   $$162 \text{ X } 78 \text{ X } 3.5 = 44{,}226 \text{ gal/day} = 30.7 \text{ gal/min}$$

   Head loss half way around the 8 in distribution system loop:

   Head loss-ft of H_2O =

   $$(.002083)(\text{Length-ft})(100/C)^{1.85}(\text{Flow-gpm}^{1.85}/\text{Diameter-in}^{4.8655})$$

   $$h_f = (.002083)(2325)(100/150)^{1.85}(30.7^{1.85}/8^{4.8655})$$

   $$h_f = .052 \text{ ft of } H_2O$$

$$(30\text{ psi})(2.31\text{ ft of }H_2O/\text{psi}) = 69.3\text{ ft of }H_2O$$

Therefor 69.35 ft of H_2O is need at the join of the loop and the transmission line.

h_f for 8 in pipe of PVC at 30.7 gal/min, through the transmission line of 2550 ft, from Hazen Williams equation is 0.057 ft of H_2O.

69.352 ft + 0.057 ft = 69.357 ft of H_2O, which is more than satisfied by the 140 feet elevated storage.

3. Evaluation of Head Loss Under Fire Flow: A minimum 20 psi is required under fire flow.

   Fire flow from 1 and 2 family dwellings separated by 11 to 30 ft and not exceeding two stories in height, is 1,000 gal/min.

   Maximum domestic daily domestic flow is the product of maximum year 2015 population, an average consumption, and a peaking factor:

$$162 \times 78 \times 2 = 25{,}272\text{ gal/day} = 17.55\text{ gal/min}$$

   Fire Flow plus maximum daily flow: 1,000 + 17.55 = 1,017.55

   Use: 1,020 gal/min

   Head loss half way round the 8 in distribution system loop:

$$h_f = .002083 \times 2325 \times (100/150)^{1.85} \times 1020^{1.85}/8^{4.8655}$$

$$h_f = 33.98 \quad \text{Use 34 ft of } H_2O$$

$$20\text{ psi} \times 2.31\text{ feet of }H_2O = 46.2\text{ feet of }H_2O.$$

   Therefore in order to maintain a minimum pressure of 20 psi half way round the loop, it will take 46.2 + 34 or 80.2 ft of H_2O at the junction of the distribution system loop and the transmission line. Head loss for 8 in PVC pipe of 2,550 feet to elevated storage is 37.27 feet. 80.2 + 37.27 = 117.47 feet of H_2O which is more than satisfied by the 140 feet minimum for the elevated storage.

4. Storage capacity of elevated tank: For fire protection, a minimum capacity of 1,000 gal/min for 2 hours is required. The City of Harlingen is assumed to supply 600 gal/min under the new wholesale water rate to the City of Combes. Therefore, 1,000 gal/min - 600 gal/min = 400 gal/min for 2 hrs required water for fire flow:

   Storage for fire flow: 400 gal/min X 2 hrs X 60 min/hr = 48,000 gals.

   Reserve storage for Stardust is calculated by maximum population for the project area times average daily demand per person:

   162 persons X 78 gals. = 12,636 gals.

   Total storage for Stardust only: 48,000 + 12,636 = 60,636 gals.

Costs for water system improvements are presented in **Table 4-4.** It is assumed that additional water to serve the area will be purchased by Combes from the City of Harlingen. Total project costs, including engineering, land acquisition, legal and administrative costs to extend water service to Stardust is estimated to be approximately **$1,054,226.**

Primera Sewer System

Currently there is no gravity sewer system serving the City of Primera, except for the South Fork Estates subdivision located in the southern portion of the City. The South Fork Estates Subdivision is currently provided sewer service by the City of Harlingen Waterworks System. The sewer system proposed in this report does not provide any new sewer service the South Fork Estates Subdivision. Instead, it is assumes that the City of Harlingen will continue to serve this area directly.

The proposed sanitary sewer system for the City of Primera is presented on **Plate 3**. For the purposes of this report, State Design Criteria were used for determining slopes. The current city limits of Primera were assumed to be the boundaries of the service area. Two additional subdivisions were also included, although outside the city limits. Eggers, the small subdivision located north of Primera, was included in the proposed system design. Los Ranchitos subdivision is located partially within and partially outside the city limits of Primera. All of Los Ranchitos is proposed to be sewered and connected to the Primera system.

The proposed system includes a total of 11 lift stations, 11.9 miles of gravity sewer lines, and 4.6 miles of force main. The point of delivery to the City of Harlingen for treatment was established in consultation with the City of Harlingen, (see the sub-section on the force main routing). Because of the almost complete lack of topographic grade, if Combes and Primera decide to build a joint plant rather than have Harlingen treat the wastewater, the sewer system layout would remain essentially the same. In that case, the force main to the City of Harlingen would be changed to a force main to the proposed Primera/Combes wastewater treatment plant.

The collection system was designed to flow towards a proposed lift station and force main located at the intersection of Primera Road (FM 499) and Crossett Road. The City of Primera will be responsible for operation and maintenance of the collection system before that point of delivery. After that point, the wastewater will proceed via force main to the Harlingen WWTP #2. The City of Harlingen will be responsible for the operation and maintenance of the flow measuring devices, the lift stations and force main to the treatment plant.

All collection system lines are proposed to be placed within existing road right-of-ways.

Table 4- 5 are the segment and flow calculations for the proposed sewer system. The system was designed assuming 4.61 persons per household and five lots per acre would be developed. Maximum flow is assumed at a pipe full at 3/4 depth. **Table 4-6** contains all lift station and force main calculations. The calculations are based on the best available preliminary information. They are not intended to be final design calculation. The calculations must be revised after better topographical information is obtained from field surveying in the design phase.

Table 4-7 summarizes the estimated quantities, unit costs and project costs associated with the proposed improvements. Cost estimates were prepared based on preliminary designs depicted on **Plate 3**. Unit costs were based on the most recent similar project in the Lower Rio Grande Valley. The total estimated cost to construct the proposed Primera sewer system, including engineering design, construction, inspection, but not including costs for the force main through Harlingen or wastewater plant costs, is **$5,036,229**. This is an approximate cost of $6,090 per connection, based on 827 total initial connections, (100% connection rate.)

WASTEWATER FLOW THROUGH HARLINGEN

Previous sections have described the sewer collection systems for Primera and Combes. This section will describe the lift station and force main that will transport the wastewater to the City of Harlingen WWTP #2.

The present City of Harlingen sewer system does not have sufficient capacity to serve as a means of transporting Combes and Primera sewage to the wastewater treatment plant. The City of Harlingen has a Wastewater Collection System Master Plan, prepared by Camp Dresser & McKee Inc (CDM) in 1992. That master plan identifies deficiencies in capacity of gravity lines and lift stations with the current Harlingen sewer system. Construction of a series of force mains is recommended to free capacity in the existing gravity lines for within city users. It is the opinion of CDM that the force main would be cheaper than rehabilitation and enlarging existing gravity lines and lift stations. It is the present plan of the City of Harlingen to relieve capacity of existing gravity lines and lift stations on the north side of Harlingen by constructing a large Force main, as described by CDM, from near Hwy 77 and Loop 499 across the northern portion of Harlingen, then down to WWTP #2 in the southeast portion of the city. The force main system, as described by CDM, would contain line segments varying between 15 in. to 30 in. and would include 4.25 MGD and 7.7 MGD lift stations. While the City of Harlingen intends to build this force main system, no construction financing has been arranged. The City does not presently have a schedule or plan for when they intend to build this system. Other portions of the CDM report recommending a capital improvement plan to rehabilitate the Harlingen sewer system have also not been implemented.

The proposed force main through Harlingen for Project Area flows is presented in **Plate 4**. The lift station and force main routing through Harlingen closely parallels the CDM concept for a large force main from the northwest quadrant around the city to the WWTP #2. The first lift station would be located at the intersection of Crossett Road and Primera Road (Loop 499). A 20 in force main will carry the wastewater along Loop 499 to a lift station located just south of the airport. From there the wastewater would be transported to Grimes Avenue then over and down a series of right-of-ways to a third lift station then to the WWTP #2. The second and third lift stations were added to reduce pump TDH. The force main and lift stations were sized to handle the year 2015 project area design flows. If Harlingen chooses to size the lines larger to accommodate flows from Harlingen, then the City can participate in the financing of the project by paying for any increase in lift station and force main size. Land will have to be acquired for the lift stations. All of the force main is located in existing right-of-way.

Of critical importance to the successful implementation and management of the project is accurate flow measuring at the point where responsibility for the system shifts from Combes and Primera to Harlingen. Harlingen will charge for treating wastewater based on the volume of wastewater it must treat. The proposed design calls for all of the wastewater from Combes and Primera to pass through separate Parshall Flumes with separate metering devices. Parshall Flumes are commonly used for metering of open channel flow were the flow contains large suspended solids. The flume is installed in the channel's flow path to produce a change in water level related to the flow rate. In order to insure accuracy of measurement, turbulence at the flume must be minimized. The proposed design reduces turbulence by first dropping the wastewater into a manhole and having the wastewater travel through a short length of gravity line to the manhole containing the Parshall Flume. A suitable wastewater flow meter will measure and record the flow level. **Figure 4-1** depicts a typical installation of a Parshall Flume in a manhole with the flow meter. Personnel from the City of Harlingen will check the meters every two weeks and retrieve the recorded flow levels.

Table 4-8 presents the lift station and force main calculations for the system. **Table 4-9** summarizes the estimated quantities, unit costs and project costs associated with the Harlingen lift station and force main. Cost estimates were prepared based on preliminary designs depicted on **Plate 4.** The total estimated cost to construct the lift station and force main together with engineering design, construction, and inspection is **$3,116,036.**

ARROYO COLORADO ESTATES SEWER SYSTEM

Arroyo Colorado Estates is located just southeast of the city limits of Harlingen. The subdivision is roughly shaped like a horseshoe and has a distinctly developed area and an undeveloped area. The developed area is the portion of leg of the horseshoe nearest to Harlingen, see Baseline Report Section 3. This report will only consider a sewer system for the developed portion of the subdivision.

Currently there is no gravity sewer system serving Arroyo Colorado Estates. Water service is provided by the East Rio Hondo Water Supply Corp.

The proposed sanitary sewer system layout is presented on **Plate 5**. Only the developed area has proposed sewers. Line sizes for the developed area were based on State Design Criteria and the year 2015 projected flows from only the current developed area. Gravity sewer lines take the wastewater to a lift station located in the northwest corner of the developed area. From the lift station a force main will carry the effluent to the City of Harlingen WWTP #2. All of the gravity lines are within existing right-of-way. Land would have to be acquired for the lift stations.

It can reasonably be anticipated that some new development will occur in the undeveloped portion of the subdivision. An analysis of future development was done to determine impact on the proposed gravity sewer system. Future development was assumed to occur according to the original plat filed for Arroyo Colorado Estates. This is somewhat of a worst case scenario, since it assumes that all of the tract will be used for residential development, including those areas identified in the Baseline Report as potential threatened or endangered species habit. If the undeveloped areas are developed according to the original plat, a reasonable potential layout is indicated in **Plate 5** as dashed lines. Most of the newly developed area would flow in the opposite direction from the proposed sewer for the developed area. For that small area that would best be served by gravity sewer to the proposed system, flows from those areas could be accommodated by the proposed sewer system without a need to enlarge the lines. Flows from the undeveloped area would necessitate a new lift station that would only handle flows from the undeveloped area. Those flows could be force mained to the proposed lift station, but the lift station would have to be increased in size to accommodate these new flows. No calculations were made for the increased size of the lift station because that was outside the scope of this study.

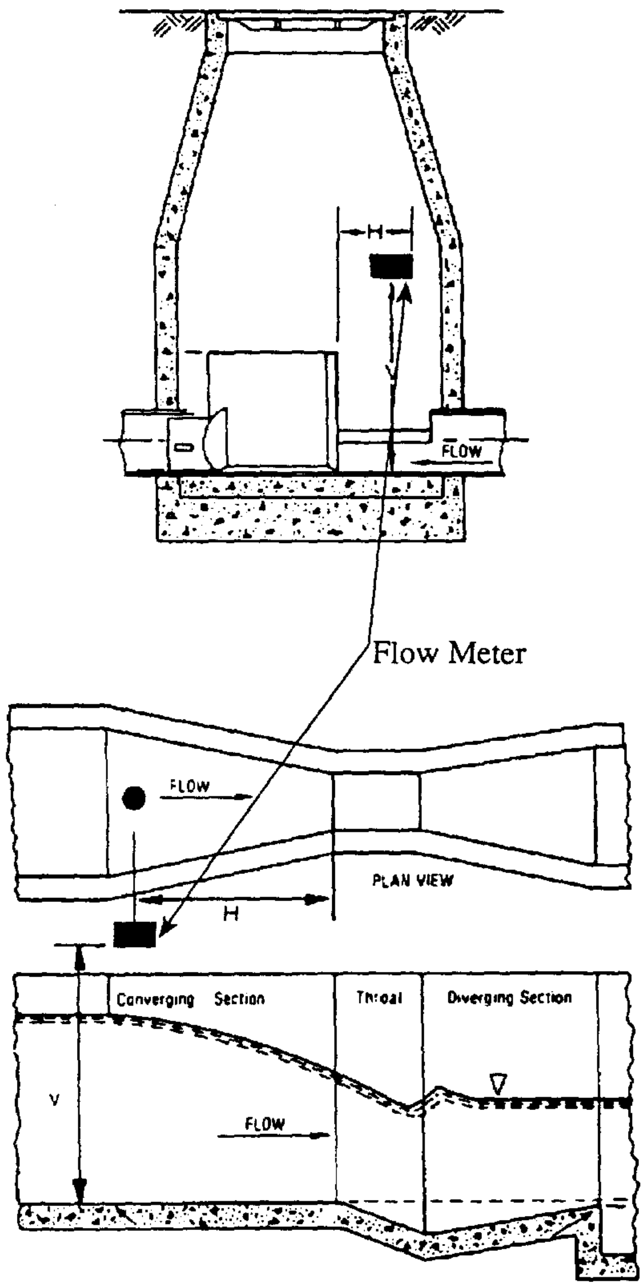
Preliminary flow calculations for the gravity lines within the subdivision are presented in **Table 4-10.** Lift Station and force main calculations are presented in **Table 4-11.** These are not intended by the Project Engineer to be final design calculations. They will have to be recalculated in the design phase after better information is obtained from field surveying.

Because of the potential for endangered or threatened species habitat along the Arroyo Colorado, selection of routes for the force main to the WWTP #2 were limited to existing bridges across the Arroyo Colorado in the project vicinity. Two alternative routes were established based on the two existing bridges. The two alternatives are depicted on **Plate 5** as Alternative A, the most direct route, and Alternative B. Alternative A would require obtaining an easement for a parcel of land. The rest of line A and all of line B is in existing right-of-way. Total costs for construction, engineering design, and land acquisition for Alternative A is estimated at **$1,873,629.** Total cost for construction engineering design, and land acquisition for Alternative B is estimated at $1,937,248. Quantities and unit costs are presented in **Table 4-12.** Force main routing A is recommended unless either environmental objections are raised by permitting agencies, or the cost of acquiring a small easement across a necessary parcel of land is unavailable at a reasonable cost. This is an estimated project cost of $11,495 per connection, based on 163 total initial connections, (100% connection rate.)

Costs of treating the wastewater from Arroyo Colorado Estates are presented in **Section 3.** Treatment at the Harlingen WWTP #2 was the least cost option. However, if this option can not be implemented for any reason, treatment of the wastewater at the San Benito WWTP is a regional option for Arroyo Colorado Estates and is the second best option.

A potentially complicating issue relates to the fact that East Rio Hondo Waster Supply Corporation supplies water to the subdivision. Two important aspects of this situation is monthly water usage readings in order to bill residents for sewer use. The second aspect relates to nonpayment of bills. The most effective way to collect delinquent bills is to cut off service. This typically means cutting off water service which cuts off sewer service. But when two different utilities control water and sewer, the resident may pay the water bill and not pay the sewer bill. Both aspects of the problem can be addressed by interlocal agreement, see **Section 6**.

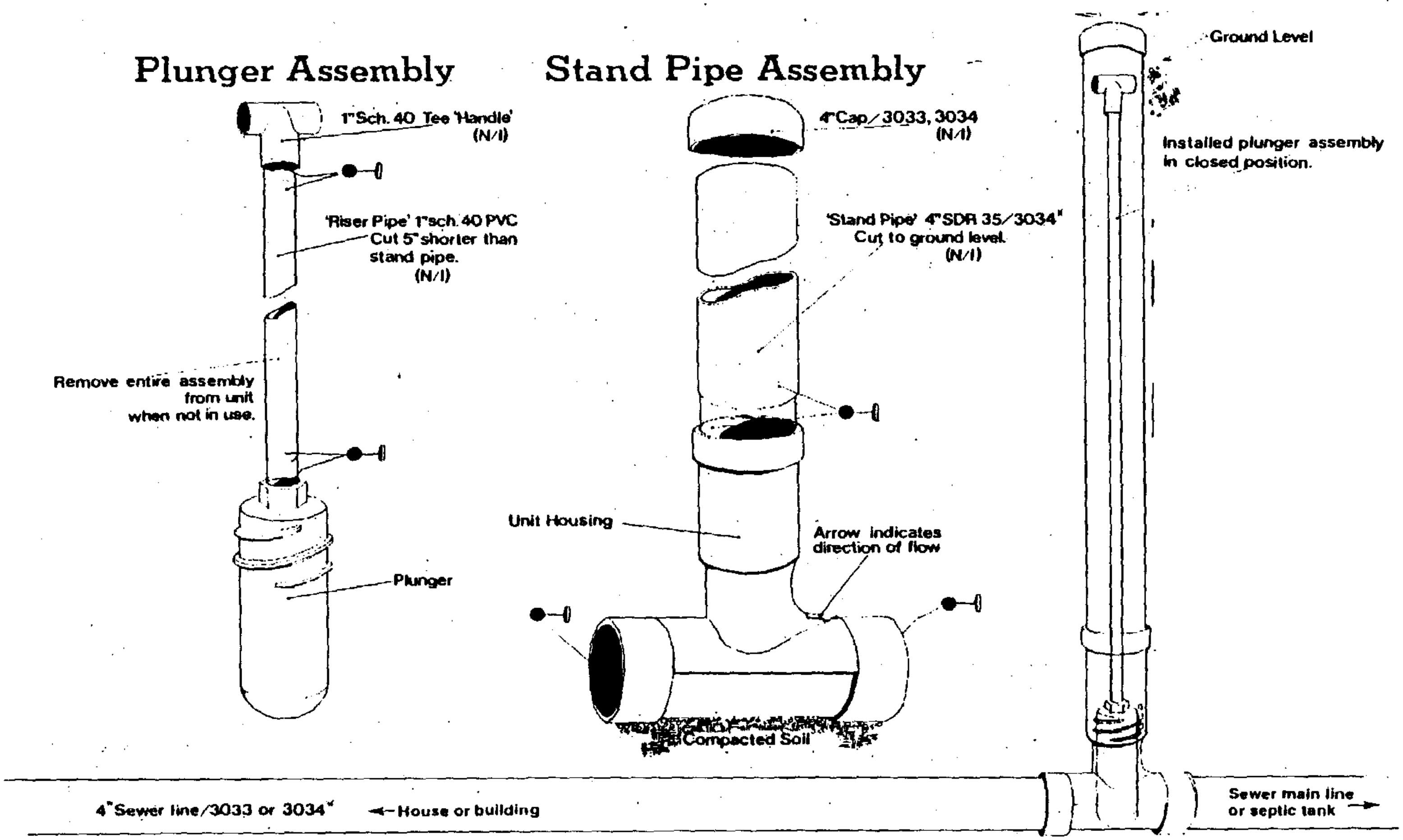
Non-payment of sewer bills can also be handled by a physical solution. There are sewer disconnection devices that can be installed at the time of service connection to remedy this problem. One such device is the Elder Disconnect Cleanout. The device consists of a standpipe installed on a T-valve. If the resident refuses to pay their sewer bill, a removable plunger can be inserted to eliminate waste flow into the sewer system. **Figure 4-2** shows a typical detail of the assembly. The City of Harlingen is currently using this product on all new sewer service areas where they do not control the water service. The cut off value can be placed at the joining of the sewer house lateral and the stub out on the sewer main. If these valves are eligible for funding under the Economically Distressed Areas Program, then a small quantity for existing houses should be added to the project costs.



Cameron County - Colonia Wastewater
Treament Planning Study

Figure 4 - 1
Parshall Flume & Wastewater Flow Meter

MICHAEL SULLIVAN & ASSOC., INC.
Engineering & Environmental Consultants
Air - Water Quality - Water Resources
(512)329-2949 (512)329-2946FAX



Key: ×Recommended- SDR35 (standard dimension ratio) no.3034
N·I-Not Included

Prime & glue joints with an approved rigid PVC primer & cement

Cameron County - Colonia Wastewater Treament Planning Study

Figure 4 - 2
Sewer Disconnect Detail

MICHAEL SULLIVAN & ASSOC., INC.
Engineering & Environmental Consultants
Air - Water Quality - Water Resources
(512) 329-2949 (512) 329-2946 FAX

Table 4-1

City of Combes

Combes Gravity Sewer Calculations

Page 1 of 4

Line Segment	Previous Inflows	Acres	Lots	Max Population	Design Flow gals./day	Diameter	Slope
A	0	18		345	137,880	6"	0.50%
B	137,880	9		173	207,080	8"	0.33%
C	0	21		403	161,200	6"	0.50%
D	0		36	138	55,200	6"	0.50%
E	55,200	40		766	306,400	8"	0.33%
F	368,280	20		383	521,480	10"	0.25%
G	0	13		250	100,000	6"	0.50%
H	0	15		287	114,800	6"	0.50%
I	0	2		38	15,320	6"	0.50%
J	15,320	3.7		71	28,400	6"	0.50%
K	0	11		211	84,400	6"	0.50%
L	0	20		383	153,200	6"	0.50%
M	153,200	10		192	230,000	6"	0.50%
N	448,548		8	31	460,948	10"	0.25%
O	471,672		12	46	490,072	10"	0.25%
P	38,807		12	46	57,207	8"	1.22%
Q	52,849		12	46	71,249	8"	0.40%
R	30,637		12	46	49,037	8"	0.50%
S	190,057		10	38	205,257	8"	0.33%
T	321,695		13	50	341,695	10"	0.25%
U	444,862		15	57	467,662	10"	0.25%
V	957,734		20	77	988,534	15"	0.15%
W	336,800		34	130	388,800	10"	0.64%
X	249,600		57	218	336,800	8"	0.33%
Y	0	13.6		260	104,000	6"	0.50%

Table 4-1

Combes Gravity Sewer Calculations

Line Segment	Previous Inflows	Acres	Lots	Max Population	Design Flow gals./day	Diameter	Slope
a	0		63	291	96,515	6"	0.50%
b	96,515		20	77	127,315	6"	0.50%
c	139,715		12	46	158,115	6"	0.50%
d	170,515		8	31	182,915	6"	0.50%
e	49,024		9	34	62,624	6"	0.50%
f	122,560		17	65	148,560	6"	0.50%
g	128,688		17	65	154,688	6"	0.50%
h	303,248		10	38	318,448	8"	0.50%
i	4,596		33	126	54,996	6"	0.50%
j	54,996		23	88	90,196	6"	0.50%
k	471,268		10	38	486,468	10"	0.56%
l	16,852		22	84	50,452	6"	0.50%
m	719,835				719,835	12"	2.60%
A1	24,512		38	146	82,912	6"	0.50%
A2	4,596		46	176	74,996	6"	0.50%
A3	0		35	134	53,600	6"	0.50%
A4	10,724		32	123	59,924	6"	0.50%
A5	10,724		30	115	56,724	6"	0.50%
A6	0		32	123	49,200	6"	0.50%
A7	53,600		12	46	72,000	6"	0.50%
A8	0		28	107	42,800	6"	0.50%
A9	49,200		12	46	67,600	6"	0.50%
A10	174,724		12	46	193,124	6"	0.50%
A11	317,448		9	35	331,448	8"	0.33%
A12	0		15	58	23,200	6"	0.50%
A13	0		7	27	10,800	6"	0.50%

Table 4-1

Combes Gravity Sewer Calculations

Line Segment	Previous Inflows	Acres	Lots	Max Population	Design Flow gals./day	Diameter	Slope
A14	0		14	54	21,600	6"	0.50%
A15	354,648		5	19	362,248	10"	0.25%
A16	394,648		7	27	405,448	10"	0.25%
A17	0		23	88	35,200	6"	0.50%
A18	21,200		17	65	47,200	6"	0.50%
A19	0		38	146	58,400	6"	0.50%
A20	105,600		17	65	131,600	6"	0.50%
A21	166,800		32	123	216,000	8"	0.33%
A22	621,448		20	77	652,248	12"	0.20%
A23	659,908		3	12	664,708	12"	0.20%
A24	739,704		10	38	754,904	12"	0.20%
A25	0		33	126	50,400	6"	0.50%
A26	0		40	153	61,200	6"	0.50%
A27	111,600		13	50	131,600	6"	0.50%
A28	35,200		40	153	96,400	6"	0.50%
A29	87,324		40	153	148,524	6"	0.50%
A30	0		30	115	46,000	6"	0.50%
A31	194,524		19	73	223,724	8"	0.33%
A32	228,000		13	50	248,000	8"	0.33%
A33	248,000		47	180	320,000	8"	0.33%
A34	543,724		12	46	562,124	12"	0.20%
A35	570,124		12	46	588,524	12"	0.20%
A36	636,016		12	46	654,416	12"	0.20%
A37	698,844		23	88	734,044	12"	0.20%
A38	0		47	180	72,000	6"	0.50%
A39	1,545,748		32	123	1,594,948	18"	0.11%

Table 4-1

Combes Gravity Sewer Calculations

Page 4 of 4

Line Segment	Previous Inflows	Acres	Lots	Max Population	Design Flow gals./day	Diameter	Slope
A40	1,594,948		53	203	1,676,148	18"	0.11%
A41	0	15.2	76	291	116,400	6"	0.50%
A42	0	17.4	87	333	133,200	6"	0.50%

Notes:

For more rural or less developed areas, populations were estimated on acres served and 5 houses per acre.
Where subdivision plats were known, actual numbers of lots were used.
For the more densely populated portions of town, lots were estimated by 33.33 lots per 1,000 linear feet of sewer line.
For trailer parks, lots were estimated by 46 lots per 1,000 linear feet of sewer line.
Population estimates used 3.83 persons per house.
Wastewater design flow was calculated at 100 gpd, with a peaking factor of 4.

Table 4-2

City of Combes

Lift Station and Force Main Calculations

Lift Station	Depth to Invert	Peak Flow gallons per minute	Design Lift Station Flow (a)	Wetwell Working Volume gallons	Velocity feet per second (b)	Force Main [calculated]	Force Main Design Diameter inches	Calculated Velocity in Force Main (c)	Force Main Length	Equivalent Length Fittings in Force Main	Equivalent Length Fittings in Lift Station	Total Force Main Length for Calculation	Head Loss C = 100 (d)	Head Loss C = 140 (d)	Static Discharge Head	Total Dynamic Head
LS #1	19.70	256	313 *	509	3	5.90	8	2.00	5,050	14	170	5,234	18.2	9.8	21.70	39.91
LS #2	12.86	639	639	1,198	3	9.33	10	2.61	2,550	0	205	2,755	12.1	6.5	14.86	26.98
LS #3	11.10	3,434	3,434	6,439	3	21.62	20	3.51	4,950	0	380	5,330	18.1	9.7	11.10	29.15
LS #4	7.25	11	100 *	27	3	1.22	4	2.55	1,850	10	95	1,955	24.0	12.9	8.25	32.27
LS #5	10.10	2,646	2,646	4,961	3	18.98	20	2.70	5,375	0	380	5,755	12.0	6.5	10.10	22.13
LS #6	10.01	107	107	201	3	3.82	4	2.73	1,640	0	95	1,735	24.2	13.0	10.01	34.17
LS #7	8.00	1,347	1,347	2,526	3	13.54	12	3.82	4,250	132	235	4,617	33.2	17.8	8.00	41.24
LS #8	15.25	234	234	439	3	5.64	6	2.66	n/a	n/a	135	135	1.1	0.6	15.25	16.36
LS #9	15.00	1,187	1,187	2,226	3	12.71	12	3.37	2,400	0	235	2,635	15.0	8.1	15.00	30.01
LS #10	12.03	39	100 *	88	3	2.30	4	2.55	n/a	n/a	95	95	1.2	0.6	12.03	13.20
LS #11	14.49	211	211	396	3	5.36	6	2.39	n/a	n/a	135	135	0.9	0.5	14.49	15.41
LS #12	11.85	61	100	161	3	3.32	4	2.55	250	0	95	345	4.2	2.3	11.85	16.09
LS #13	17.00	174	176 *	327	3	4.87	6	2.00	3,300	8	135	3,443	16.7	9.0	17.00	33.74
LS #14	18.32	173	173	324	3	4.85	4	4.42	n/a	n/a	95	95	3.2	1.7	18.32	21.54
LS #15	18.60	560	560	1,050	3	8.73	10	2.29	150	0	205	355	1.2	0.7	18.60	19.82
LS #16	17.15	74	100 *	151	3	3.17	4	2.55	800	11	95	906	11.1	6.0	17.15	28.28
LS #17	13.51	432	432	810	3	7.67	8	2.76	n/a	n/a	170	170	1.1	0.6	13.51	14.58
LS #18	12.90	1,222	1,222	2,291	3	12.90	12	3.47	375	0	235	610	3.7	2.0	12.90	16.57
LS #19	12.04	39	100 *	88	3	2.30	4	2.55	n/a	n/a	95	95	1.2	0.6	12.04	13.21
LS #20	16.13	82	100	163	3	3.34	4	2.55	n/a	n/a	95	95	1.2	0.6	16.13	17.30

Notes:

(a) TNRCC Design Criteria requires a minimum lift station capacity of 100 gals./min. Lift stations marked by asterisk are sized to minimize TDH and maintain a velocity of 2 ft. per sec.

(b) Constraint on velocity for purposes of calculating a Force Main size

(c) Calculation of velocity in design size force main using design flows. Check to demonstrate compliance with TNRCC minimum velocities.

(d) Head loss calculated by Hazen-Williams equation.

Table 4-3

City of Combes

Preliminary Cost Estimate - Wastewater Collection
Conventional Gravity Wastewater Collection System

Bid Item	Depth	Quantity	Unit Cost	Unit	Total Cost
Single Service Connections	All Depths	1,900	$150.00	ea	$285,000.00
Double Service Connections	All Depths	950	$250.00	ea	$237,500.00
6" SDR-35 PVC	0'-8'	32 300	$14.25	lf	$460,275.00
	8'-10'	20 605	$20.25	lf	$417,251.25
	10'-12'	11 210	$26.25	lf	$294,262.50
	12'-14'	4,565	$32.25	lf	$147,221.25
	14'-16'	1,400	$38.25	lf	$53,550.00
	16'-18'	700	$44.25	lf	$30,975.00
8" SDR-35 PVC	0'-8'	1,200	$15.25	lf	$18,300.00
	8'-10'	2,375	$21.25	lf	$50,468.75
	10'-12'	3 140	$27.25	lf	$85,565.00
	12'-14'	1,700	$33.25	lf	$56,525.00
	14'-16'	1,125	$39.25	lf	$44,156.25
	16'-18'	475	$45.25	lf	$21,493.75
10" SDR-35 PVC	0'-8'	325	$18.50	lf	$6,012.50
	8'-10'	650	$23.50	lf	$15,275.00
	10'-12'	1,775	$30.75	lf	$54,581.25
	12'-14'	2 660	$36.85	lf	$98,021.00
12" SDR-35 PVC	0'-8'	275	$20.50	lf	$5,637.50
	8'-10'	725	$27.00	lf	$19,575.00
	12'-14'	120	$34.00	lf	$4,080.00
	14'-16'	950	$41.50	lf	$39,425.00
	16'-18'	775	$49.00	lf	$37,975.00
	18'-20'	400	$56.50	lf	$22,600.00
18" SDR-35 PVC	0'-8'	300	$25.25	lf	$7,575.00
	8'-10'	1,500	$32.25	lf	$48,375.00
	10'-12'	750	$39.25	lf	$29,437.50
Manholes	0'-8'	140	$1,100.00	ea	$154,000
	8'-10'	73	$1,400.00	ea	$102,200
	10'-12'	46	$1,700.00	ea	$78,200
	12'-14'	22	$2,350.00	ea	$51,700
	14'-16'	12	$2,600.00	ea	$31,200
	16'-18'	7	$3,000.00	ea	$21,000
	18'-20'	1	$3,750.00	ea	$3,750
Bore For 6" PVC GM	-	200	$75.00	lf	$15,000.00
Lift stations					
LS #1 - 313 gpm	-	1	$87,500.00	ea	$87,500.00
LS #2 - 639 gpm	-	1	$150,000.00	ea	$150,000.00
LS #3 - 3,434 gpm	-	1	$250,000.00	ea	$250,000.00
LS #4 - 100 gpm	-	1	$75,000.00	ea	$75,000.00
LS #5 - 2,646 gpm	-	1	$250,000.00	ea	$250,000.00
LS #6 - 107 gpm	-	1	$75,000.00	ea	$75,000.00
LS #7 - 1,347 gpm	-	1	$150,000.00	ea	$150,000.00
LS #8 - 234 gpm	-	1	$87,500.00	ea	$87,500.00
LS #9 - 1,187 gpm	-	1	$150,000.00	ea	$150,000.00
LS #10 - 100 gpm	-	1	$75,000.00	ea	$75,000.00
LS #11 - 211 gpm	-	1	$87,500.00	ea	$87,500.00
LS #12 - 100 gpm	-	1	$75,000.00	ea	$75,000.00
LS #13 - 176 gpm	-	1	$75,000.00	ea	$75,000.00
LS #14 - 173 gpm	-	1	$75,000.00	ea	$75,000.00
LS #15 - 580 gpm	-	1	$110,000.00	ea	$110,000.00
LS #16 - 100 gpm	-	1	$750,000.00	ea	$750,000.00
LS #17 - 432 gpm	-	1	$100,000.00	ea	$100,000.00
LS #18 - 1,222 gpm	-	1	$150,000.00	ea	$150,000.00
LS #19 - 100 gpm	-	1	$75,000.00	ea	$75,000.00
LS #20 - 100 gpm	-	1	$75,000.00	ea	$75,000.00
Force Mains:					
4" PVC	-	4,540	$6.00	lf	$27,240.00
6" PVC	-	3,300	$7.75	lf	$25,575.00
8" PVC	-	5,050	$9.50	lf	$47,975.00
10" PVC	-	2,700	$12.50	lf	$33,750.00
12" PVC	-	7,025	$16.00	lf	$112,400.00
20" PVC	-	10,325	$35.00	lf	$361,375.00
Bores for Force Mains:					
4" Force Main	-	600	$52.50	lf	$31,500.00
6" Force Main	-	100	$63.50	lf	$6,350.00
10" Force Main	-	300	$75.00	lf	$22,500.00
12" Force Main	-	900	$91.25	lf	$82,125.00
Pavement Cutting and Replacing					
Paved	-	90,000	$15.00	lf	$1,350,000
Unpaved - Caliche	-	1,300	$5.50	lf	$7,150
U.S. Expwy 77 Bore	-	3	$60,000.00	ea	$180,000
Trench Dewatering - Well Pointing (a)	-	45,000	$15.00	lf	$675,000.00
Trench Safety	All Excav >5 ft.	92,000	$1.50	lf	$138,000
Sub-Total					$9,071,604
15% Contingency					$1,360,740
Sub-Total Estimated Construction Cost					$10,432,343
Land and Easement Acquisition					
Lift Station Site Acquisition (b)					$70,000
Easement Acquisition (c)					$0
Sub-Total Land and Easement Acquisition					$70,000
Engineering Services					
Design Phase					
Basic Design Phase Engineering Fee (d)					$693,978
Geotechnical Investigation					$25,000
Field Surveying					$200,000
Additional Surveying for Unplatted Subdivisions - Lasana & Stardust					$80,600
Project Administration (Additional Service)					$30,000
Construction Phase					
Basic Construction Phase Engineering Fee (d)					$115,408
Full Time Construction Inspection					$100,000
Materials Testing					$15,000
Preparation of Operations and Maintenance Manual (Additional Service)					$15,000
Project Administration (Additional Service)					$25,000
Sub-Total Engineering Services					$1,219,385
Total Construction, Land, and Engineering Costs (e)					$11,721,728

Notes:
(a) Quantity of trench dewatering is based on amount of pipe with depth of > 9'.
(b) Estimated, includes land for lift stations and appraisals, title and legal services.
(c) EDAP staff informed the project engineer that any easements would have to be donated or acquired by other funds.
(d) Basic Design Phase Engineering Fee determined as a percent of Sub-Total of Estimated Construction Cost, based on "Curves of Median Compensation" published by the Consulting Engineers Council of Texas in the document entitled *"General Engineering Services - A Manual of Practice for Engaging the Services of a Consulting Engineer" (1982).*
Curve of median compensation indicates Basic Service compensation is 5.9% for this project.
In the opinion of the Engineer, the complexity of retrofitting a wastewater collection system into an existing residential community warrants a minimum 25% increase in the Total Fee Percentage obtained from the median compensation curves.
Basic Engineering Services will be in general conformance with those defined by CEC.
(e) Includes Lasana and Stardust subdivisions

Table 4-4

City of Combes

Preliminary Cost Estimate - Water Distribution
Service to Stardust

Bid Item	Quantity	Unit Cost	Unit	Total Cost
60,636 Gal Elevated Storage Tank	1	$1.00	gal	$60,636.00
Transmission Mains:				
8" Dia. Main	14,600	$13.00	lf	$189,800.00
6" Dia. Main	4,800	$10.00	lf	$48,000.00
Gate Valves:				
8"	23	$350.00	ea	$8,050.00
6"	15	$300.00	ea	$4,500.00
5 1/4" Fire Hydrant/Flushing Valves	20	$1,200.00	ea	$24,000.00
Air Release Valves	3	$500.00	ea	$1,500.00
Misc. Fittings & Appurtenances	1	$20,000.00	ls	$20,000.00
Wet Connections to Existing System	1	$10,000.00	ls	$10,000.00
Booster Station	1	$50,000.00	ls	$50,000.00
Pavement Cutting and Replacing				
Paved	11,750	$15.00	lf	$176,250.00
Unpaved	7,650	$5.50	lf	$42,075.00
U.S Expwy Bore for 8" line	1	$40,000.00	ls	$40,000.00
Sub-Total				**$674,811**
20% Contingency				$134,962
Sub-Total Estimated Construction Cost				**$809,773**
Land and Easement Acquisition				
Site for Elevated Storage (a)				$3,000
Easement Acquisition (b)				$0
Sub-Total Land and Easement Acquisition				**$3,000**
Engineering Services				
Design Phase				
Basic Design Phase Engineering Fee (c)				$67,110
Update system maps/ Pressure test system/ System modeling				$20,000
Geotechnical Investigation				$10,000
Field Surveying				$50,000
Additional Surveying of Unplatted Subdivision				$20,000
Project Administration (Additional Service)				$5,000
Construction Phase				
Basic Construction Phase Engineering Fee (b)				$11,843
Full Time Construction Inspection				$30,000
Materials Testing				$7,500
Preparation of Operations and Maintenance Manual (Additional Service)				$10,000
Project Administration (Additional Service)				$10,000
Sub-Total Engineering Services				**$241,453**
Total Construction, Land, and Engineering Costs				***$1,054,226***

Notes:
(a) Project will need extensive easements within Stardust. Assumed easements will be donated in exchange for water service. Costs are for legal services.
(b) The Project Engineer was informed that easements could not be funded by EDAP funds.
(c) Basic Design Phase Engineering Fee determined as a percent of Sub-Total of Estimated Construction Cost, based on "Curves of Median Compensation" published by the Consulting Engineers Council of Texas in the document entitled: *"General Engineering Services - A Manual of Practice for Engaging the Services of a Consulting Engineer" (1982).*
Curve of median compensation indicates Basic Service compensation is 7.8% for this project.
In the opinion of the Engineer, the complexity of retrofitting a water distribution system into an unplatted residential community warrants a minimum 25% increase in the Total Fee Percentage obtained from the median compensation curves.
Basic Engineering Services will be in general conformance with those defined by CEC.

Table 4-7

City of Primera

Preliminary Cost Estimate - Wastewater Collection
Conventional Gravity Wastewater Collection System

Bid Item	Depth	Quantity	Unit Cost	Unit	Total Cost
Single Service Connections	All Depths	437	$150.00	ea	$65,550.00
Double Service Connections	All Depths	291	$250.00	ea	$72,750.00
8" SDR-35 PVC	0'-8'	46,580	$15.25	lf	$710,345.00
	8-10'	12,880	$21.25	lf	$273,700.00
	10'-12'	3,140	$27.25	lf	$85,565.00
10" SDR-35 PVC	8'-10'	300	$23.50	lf	$7,050.00
	10'-12'	550	$30.75	lf	$16,912.50
Manholes	0-8'	165	$1,100.00	ea	$181,500
	8'- 10'	39	$1,400.00	ea	$54,600
	10'-12'	12	$1,700.00	ea	$20,400
Lift stations					
LS #1 - 100 gpm	-	1	$75,000.00	ea	$75,000.00
LS #2 - 234 gpm	-	1	$87,500.00	ea	$87,500.00
LS #3 - 1,655 gpm	-	1	$200,000.00	ea	$200,000.00
LS #4 - 259 gpm	-	1	$87,500.00	ea	$87,500.00
LS #5 - 709 gpm	-	1	$150,000.00	ea	$150,000.00
LS #6 - 347 gpm	-	1	$100,000.00	ea	$100,000.00
LS #7 - 2,014 gpm	-	1	$200,000.00	ea	$200,000.00
LS #8 - 2,503 gpm	-	1	$250,000.00	ea	$250,000.00
LS #9 - 2,884 gpm	-	1	$250,000.00	ea	$250,000.00
LS#10 - 290 gpm	-	1	$87,500.00	ea	$87,500.00
Force Mains:					
4" PVC	-	4,500	$6.00	lf	$27,000.00
6" PVC	-	7,750	$7.75	lf	$60,062.50
8" PVC	-	4,100	$9.50	lf	$38,950.00
10" PVC	-	5,100	$12.50	lf	$63,750.00
12" PVC	-	3,300	$16.00	lf	$52,800.00
15" PVC	-	7,600	$20.50	lf	$155,800.00
18" PVC	-	4,300	$24.00	lf	$103,200.00
Bore and Encasement	-	200	$100.00	lf	$20,000.00
U.S. Expwy 77-RR Crossing-Bus. 77	-				
(30" x 800' Steel Pipe Casing)	-	1	$60,000.00	ls	$60,000.00
Pavement Cutting and Replacement					
Paved	-	7,584	$15.00	sy	$113,760.00
Unpaved	-	1,600	$5.50	sy	$8,800
Trench Dewatering - Well Pointing (a)	-	3,702	$15.00	lf	$55,530.00
Trench Safety	All Excav. > 5 ft.	63,450	$1.50	lf	$95,175
Sub-Total					**$3,830,700**
15% Contingency					$574,605
Sub-Total Estimated Construction Cost					**$4,405,305**
Land and Easement Acquisition					
Lift Station Site Acquisition (b)					$35,000
Easement Acquisition (b)					$0
Sub-Total Land and Easement Acquisition					**$35,000**
Engineering Services					
Design Phase					
Basic Design Phase Engineering Fee (c)					$299,561
Geotechnical Investigation					$22,000
Field Surveying					$110,000
Project Administration (Additional Service)					$10,000
Construction Phase					
Basic Construction Phase Engineering Fee (c)					$52,864
Full Time Construction Inspection					$69,000
Materials Testing					$7,500
Preparation of Operations and Maintenance Manual (Additional Service)					$10,000
Project Administration (Additional Service)					$15,000
Sub-Total Engineering Services					**$595,924**
Total Construction, Land, and Engineering Costs (d)					*$5,036,229*

Notes:

(a) Quantity of Trench Dewatering is based on amount of pipe with depth > 10'.

(b) **Estimated, includes appraisal and legal fees**

(c) **Basic Design Phase Engineering Fee determined as a percent of Sub-Total of Estimated Construction Cost, based on "Curves of Median Compensation" published by the Consulting Engineers Council of Texas in the document entitled:** *"General Engineering Services - A Manual of Practice for Engaging the Services of a Consulting Engineer" (1982).*
Curve of median compensation indicates Basic Service compensation is 6.4% for this project.
In the opinion of the Engineer, the complexity of retrofitting a wastewater collection system into an existing residential community warrants a minimum 25% increase in the Total Fee Percentage obtained from the median compensation curves.
Basic Engineering Services will be in general conformance with those defined by CEC.

(d) Includes Eggers and Los Ranchitos subdivisions

Table 4-5

City of Primera

Gravity Sewer Calculations

Line Segment	Previous Inflows	Design Flows	Undeveloped Acres	Max Population	Design Flow cfs	Diameter	Slope
A1		0.027		2,425	0.75	8"	0.33%
B2-1		0.266	37.3	2,425	0.75	8"	0.33%
B2-2		0.009		2,425	0.75	8"	0.33%
B2-3	0.009	0.031	2.5	2,425	0.75	8"	0.33%
B2-4		0.014		2,425	0.75	8"	0.33%
B2-5	0.045	0.068	2.5	2,425	0.75	8"	0.33%
B2-6		0.020		2,425	0.75	8"	0.33%
B2-7	0.088	0.229	22.0	2,425	0.75	8"	0.33%
C3-1		0.052	5.7	2,425	0.75	8"	0.33%
C3-2		0.306	41.7	2,425	0.75	8"	0.33%
C3-3		0.017		2,425	0.75	8"	0.33%
C3-4		0.013		2,425	0.75	8"	0.33%
C3-5		0.007		2,425	0.75	8"	0.33%
C3-6		0.001		2,425	0.75	8"	0.33%
C3-7	0.021	0.039		2,425	0.75	8"	0.33%
C3-8	0.056	0.064		2,425	0.75	8"	0.33%
C3-9	0.064	0.081		2,425	0.75	8"	0.33%
C3-10		0.016		2,425	0.75	8"	0.33%
C3-11	0.097	0.106		2,425	0.75	8"	0.33%
C3-12		0.006		2,425	0.75	8"	0.33%
C3-13	0.111	0.128		2,425	0.75	8"	0.33%
C3-14	0.435	0.480	47.6	2,425	0.75	8"	0.33%
C3-15		0.001		2,425	0.75	8"	0.33%
C3-16	0.481	0.490	47.6	2,425	0.75	8"	0.33%
C3-17		0.017		2,425	0.75	8"	0.33%
C3-18	0.017	0.034	1.4	2,425	0.75	8"	0.33%
C3-19		0.029		2,425	0.75	8"	0.33%

Table 4-5

Primera Gravity Sewer Calculations

Page 2 of 4

Line Segment	Previous Inflows	Design Flows	Undeveloped Acres	Max Population	Design Flow cfs	Diameter	Slope
C3-20		0.010		2,425	0.75	8"	0.33%
C3-21	0.010	0.073		2,425	0.75	8"	0.33%
C3-22		0.006		2,425	0.75	8"	0.33%
C3-23	0.078	0.078		2,425	0.75	8"	0.33%
C3-24	0.141	0.175	1.4	2,425	0.75	8"	0.33%
C3-25		0.020	1.6	2,425	0.75	8"	0.33%
C3-26	0.665	0.674	49.0	3,815	1.18	10"	0.25%
C3-27		0.033		2,425	0.75	8"	0.33%
C3-28	0.778	0.828	56.3	3,815	1.18	10"	0.25%
C3-29		0.146	19.9	2,425	0.75	8"	0.33%
C3-30		0.010		2,425	0.75	8"	0.33%
C3-31	0.156	0.156	19.9	2,425	0.75	8"	0.33%
C3-32		0.023	0.8	2,425	0.75	8"	0.33%
C3-33	0.179	0.179	20.7	2,425	0.75	8"	0.33%
D4-1		0.332	46.5	2,425	0.75	8"	0.33%
D4-2		0.179	25.1	2,425	0.75	8"	0.33%
D4-3		0.066	9.3	2,425	0.75	8"	0.33%
E5-1		0.134	18.8	2,425	0.75	8"	0.33%
E5-2		0.138	19.4	2,425	0.75	8"	0.33%
E5-3	0.273	0.339	47.5	2,425	0.75	8"	0.33%
E5-4		0.469	65.7	2,425	0.75	8"	0.33%
F6-1		0.178	24.9	2,425	0.75	8"	0.33%
F6-2	0.178	0.389	54.5	2,425	0.75	8"	0.33%
F6-3		0.383	53.7	2,425	0.75	8"	0.33%
G7-1		0.007		2,425	0.75	8"	0.33%
G7-2		0.017		2,425	0.75	8"	0.33%
G7-3	0.007	0.013		2,425	0.75	8"	0.33%
G7-4	0.013	0.320		2,425	0.75	8"	0.33%
G7-5		0.044		2,425	0.75	8"	0.33%

Table 4-5

Primera Gravity Sewer Calculations

Page 3 of 4

Line Segment	Previous Inflows	Design Flows	Undeveloped Acres	Max Population	Design Flow cfs	Diameter	Slope
G7-6		0.046		2,425	0.75	8"	0.33%
G7-7	0.090	0.090		2,425	0.75	8"	0.33%
G7-8	0.090	0.135	6.3	2,425	0.75	8"	0.33%
G7-9		0.003		2,425	0.75	8"	0.33%
G7-10		0.071		2,425	0.75	8"	0.33%
G7-11		0.036		2,425	0.75	8"	0.33%
G7-12	0.036	0.106		2,425	0.75	8"	0.33%
G7-13	0.180	0.345	22.5	2,425	0.75	8"	0.33%
H8-1		0.017		2,425	0.75	8"	0.33%
H8-2	0.017	0.024		2,425	0.75	8"	0.33%
H8-3		0.013		2,425	0.75	8"	0.33%
H8-4	0.037	0.046		2,425	0.75	8"	0.33%
H8-5		0.011		2,425	0.75	8"	0.33%
H8-6	0.057	0.184		2,425	0.75	8"	0.33%
H8-7		0.260		2,425	0.75	8"	0.33%
I9-1		0.016		2,425	0.75	8"	0.33%
I9-2	0.016	0.024		2,425	0.75	8"	0.33%
I9-3		0.014		2,425	0.75	8"	0.33%
I9-4	0.039	0.046		2,425	0.75	8"	0.33%
I9-5		0.014		2,425	0.75	8"	0.33%
I9-6	0.060	0.064		2,425	0.75	8"	0.33%
I9-7		0.211	29.2	2,425	0.75	8"	0.33%
I9-8	0.275	0.289	39.2	2,425	0.75	8"	0.33%
I9-9		0.560	78.5	2,425	0.75	8"	0.33%

Table 4-5

Primera Gravity Sewer Calculations

Line Segment	Previous Inflows	Design Flows	Undeveloped Acres	Max Population	Design Flow cfs	Diameter	Slope
J10-1		0.239	33.5	2,425	0.75	8"	0.33%
J10-2		0.023		2,425	0.75	8"	0.33%
J10-3	0.262	0.548	73.6	2,425	0.75	8"	0.33%
J10-4	0.548	0.597	80.4	2,425	0.75	8"	0.33%
J10-5		0.049	6.8	2,425	0.75	8"	0.33%

Table 4-6

City of Primera

Lift Station and Force Main Calculations

Lift Station	Peak Flow gallons per minute	Lift Station Diameter feet	Lift Station Length feet	Lift Station Depth feet	Pumping Velocity feet per sec	T.D.H.	Force Main Diameter inches	Force Main velocity feet per sec
LS #1	100	5.0		16.5	53.2	44.0	4	2.5
LS #2	234	7.5		16.9	43.4	29.2	6	2.6
LS #3	1,655	17.0	17.0	17.7	47.0	34.3	12	4.6
LS #4	259	8.0		16.6	45.5	32.1	6	2.9
LS #5	709	12.0	12.0	16.2	43.0	28.7	10	2.9
LS #6	347	8.0	8.0	17.2	39.6	24.3	8	2.2
LS #7	2,014	20.0	18.0	17.5	42.5	28.0	15	3.6
LS #8	2,503	22.0	20.0	17.7	42.4	27.9	15	4.5
LS #9	2,884	22.0	22.0	18.2	40.5	25.5	18	3.6
LS #10	290	7.0	8.0	16.7	48.5	36.6	6	3.3

Table 4-8

City of Harlingen

Lift Station and Force Main Calculations

Lift Station	Depth to Invert	Peak Flow gallons per minute	Design Lift Station Flow	Wetwell Working Volume gallons	Velocity feet per second (a)	Force Main [calculated]	Force Main Design Diameter inches	Calculated Velocity in Force Main (b)
LS #1	4.25	2,262	2,262	4,241	3	17.55	20	2.31
LS #2	4.25	2,262	2,262	4,241	3	17.55	20	2.31
LS #3	4.25	2,262	2,262	4,241	3	17.55	20	2.31

Lift Station	Force Main Length	Equivalent Length Fittings in Force Main	Equivalent Length Fittings in Lift Station	Total Force Main Length for Calculation	Head Loss C = 100 (c)	Head Loss C = 140 (c)	Static Discharge Head	Total Dynamic Head
LS #1	17,250	104	450	18,762	29.4	15.7	4.75	34.10
LS #2	14,100	140	450	14,690	23.0	12.3	4.75	27.73
LS #3	1,700	45	450	2,195	3.4	1.8	33.75	37.18

Notes:

(a) Constraint on velocity for purposes of calculating a Force Main size

(b) Calculation of velocity in design size force main using design flows.
This is a check to demonstrate compliance with TNRCC minimum velocities.

(c) Head loss calculated by Hazen-Williams equation.

Table 4-9

City of Harlingen

Preliminary Cost Estimate - Force Main

Bid Item	Depth	Quantity	Unit Cost	Unit	Total Cost
Force Mains:					
20" Class 52, DIP	-	33,350	$45.00	lf	$1,500,750
Liftstations					
LS #1 - 2,262 gpm	-	1	$250,000.00	ea	$250,000
LS #2 - 2,262 gpm	-	1	$250,000.00	ea	$250,000
LS #3 - 2,262 gpm	-	1	$250,000.00	ea	$250,000
15" SDR-35 PVC	0-8'	15	$23.00	lf	$345
18" SDR-35 PVC	0-8'	15	$25.25	lf	$379
Manholes	0-8'	4	$1,100.00	ea	$4,400
Manhole Flumes	-	2	$3,000.00	ea	$6,000
Flow Meters	-	2	$4,000.00	ea	$8,000
Pavement Cutting and Replacing	-	1,000	$15.00	lf	$15,000
Trench Safety	All Depths	1,000	$1.50	lf	$1,500
Sub-Total					**$2,286,374**
20% Contingency					$457,274
Sub-Total Estimated Construction Cost					**$2,743,647**
Land and Easement Acquisition					
Liftstation Site Acquisition (a)					$35,000
Easement Acquisition (a)					$0
Sub-Total Land and Easement Acquisition					**$35,000**
Engineering Services					
Design Phase					
Basic Design Phase Engineering Fee (b)					$174,907
Geotechnical Investigation					$15,000
Field Surveying					$50,000
Project Administration (Additional Service)					$5,000
Construction Phase					
Basic Construction Phase Engineering Fee (b)					$34,981
Full Time Construction Inspection					$35,000
Materials Testing					$7,500
Preparation of Operations and Maintenance Manual (Additional Service)					$10,000
Project Administration (Additional Service)					$5,000
Sub-Total Engineering Services					**$337,389**
Total Construction, Land, and Engineering Costs					***$3,116,036***

Notes:

(a) Estimated, includes appraisal and legal fees

(b) Basic Design Phase Engineering Fee determined as a percent of Sub-Total of Estimated Construction Cost, based on "Curves of Median Compensation" published by the Consulting Engineers Council of Texas in the document entitled: *"General Engineering Services - A Manual of Practice for Engaging the Services of a Consulting Engineer" (1982).*
Curve of median compensation indicates Basic Service compensation is 6.8% for this project.
In the opinion of the Engineer, the complexity of retrofitting a wastewater collection system into an existing residential community warrants a minimum 25% increase in the Total Fee Percentage obtained from the median compensation curves.
The following allocation of the Basic Service Compensation applies:
Preliminary Eng. and Environmental Assessment.............................. 10% of Total Fee Percentage
Design Phase Engineering.. 75% of Total Fee Percentage
Construction Phase... 15% of Total Fee Percentage
Basic Engineering Services will be in general conformance with those defined by CEC.

Table 4-10

Arroyo Colorado Estates

Gravity Wastewater Collection System Flow Calculations

Line Segment	Length	Previous Inflows	Lots	Max Population	Q[Segment] gals. / day	Q [Design] gals. / day	Diameter	Slope
A	650	0	22	108	43,384	43,384	6"	1.06%
B	560	0	19	94	37,468	37,468	6"	1.12%
C	560	0	19	94	37,468	37,468	6"	1.00%
D	560	0	19	94	37,468	37,468	6"	0.87%
E	560	0	19	94	37,468	37,468	6"	0.75%
F	560	0	19	94	37,468	37,468	6"	0.62%
G	560	0	19	94	37,468	37,468	6"	0.50%
H	375	771,052	0	0	0	771,052	12"	0.20%
I	300	733,584	0	0	0	733,584	12"	0.20%
J	300	696,116	0	0	0	696,116	12"	0.20%
K	300	658,648	0	0	0	658,648	12"	0.20%
L	300	621,180	0	0	0	621,180	12"	0.20%
M	300	583,712	0	0	0	583,712	12"	0.20%
N	250	546,244	0	0	0	546,244	10"	0.76%
O	1325	0	44	217	86,768	86,768	6"	0.74%
P	1400	0	47	232	92,684	92,684	6"	0.63%
Q	560	0	19	94	37,468	37,468	6"	0.50%
R	560	0	19	94	37,468	37,468	6"	0.80%
S	560	0	19	94	37,468	37,468	6"	1.08%
T	560	0	19	94	37,468	37,468	6"	1.37%
U	560	0	19	94	37,468	37,468	6"	1.65%
V	560	0	19	94	37,468	37,468	6"	1.86%
W	200	0	7	35	13,804	13,804	6"	0.80%
X	300	51,272	0	0	0	51,272	6"	0.50%
Y	300	88,740	0	0	0	88,740	6"	0.50%
Z	300	126,208	0	0	0	126,208	6"	0.50%
aa	225	163,676	0	0	0	163,676	6"	0.50%
ab	75	256,360	0	0	0	256,360	8"	0.33%
ac	225	293,828	0	0	0	293,828	8"	0.33%
ad	75	380,596	0	0	0	380,596	10"	0.25%
ae	250	418,064	0	0	0	418,064	10"	0.25%
af	250	0	8	39	15,776	15,776	6"	0.50%
ag	500	0	17	84	33,524	33,524	6"	0.50%
ah	700	82,824	23	113	45,356	128,180	6"	0.50%
ai	300	47,328	10	49	19,720	67,048	6"	0.50%
aj	200	0	7	35	13,804	13,804	6"	1.30%

Notes:

Populations were estimated on the basis of 60' x 120' lots and 4.93 persons per household. See Baseline Report.
Wastewater design flow was calculated at 100 gpd, and a peaking factor of 4.

Table 4-11

Arroyo Colorado Estates

Lift Station and Force Main Calculations

FORCE MAIN ROUTE A															
Lift Station	Depth to Invert	Peak Flow gallons per minute	Wetwell Working Volume gallons	Velocity feet per second (a)	Force Main [calculated]	Force Main Design Diameter Inches	Calculated Velocity in Force Main (b)	Force Main Length	Equivalent Length Fittings in Force Main	Equivalent Length Fittings in Lift Station	Total Force Main Length for Calculation	Head Loss C = 100 (c)	Head Loss C = 140 (c)	Static Discharge Head	Total Dynamic Head
LS #1 Route A	16.24	380	713	3	7.19	8	2.43	1,100	10	170	1,280	6.4	3.4	18.24	24.62
LS #2 Route A	12.25	566	1,061	3	8.78	8	3.61	4,925	10	170	5,105	53.1	28.5	15.25	68.39
LS #3A	4.50	566	1,061	3	8.78	8	3.61	5,500	10	160	5,670	59.0	31.7	4.50	63.52
LS #4A	4.50	566	1,061	3	8.78	8	3.61	3,200	18	160	3,378	35.2	18.9	6.50	41.66
LS #5	4.50	566	1,061	3	8.78	8	3.61	1,800	72	160	2,032	21.2	11.3	33.50	54.65

FORCE MAIN ALTERNATE ROUTE B															
Lift Station	Depth to Invert	Peak Flow gallons per minute	Wetwell Working Volume gallons	Velocity feet per second (a)	Force Main [calculated]	Force Main Design Diameter Inches	Calculated Velocity in Force Main (b)	Force Main Length	Equivalent Length Fittings in Force Main	Equivalent Length Fittings in Lift Station	Total Force Main Length for Calculation	Head Loss C = 100 (c)	Head Loss C = 140 (c)	Static Discharge Head	Total Dynamic Head
LS #1 Route B	16.24	380	713	3	7.19	8	2.43	1,100	10	170	1,280	6.4	3.4	18.24	24.62
LS #2 Route B	12.25	566	1,061	3	8.78	8	3.61	7,400	34	170	7,604	79.2	42.5	15.25	94.40
LS #3B	4.50	566	1,061	3	8.78	8	3.61	7,100	30	160	7,290	75.9	40.7	5.50	81.38
LS #4B	4.50	566	1,061	3	8.78	8	3.61	5,300	36	160	5,496	57.2	30.7	5.50	62.71
LS #5	4.50	566	1,061	3	8.78	8	3.61	1,800	72	160	2,032	21.2	11.3	33.50	54.65

Notes:

(a) Constraint on velocity for purposes of calculating a Force Main size

(b) Calculation of velocity in design size force main using design flows. Check to demonstrate compliance with TNRCC minimum velocities.

(c) Head loss calculated by Hazen-Williams equation.

Table 4-12

Arroyo Colorado Estates

Preliminary Cost Estimate - Wastewater Collection
Conventional Gravity Wastewater Collection System

Bid Item	Depth	Quantity	Unit Cost	Unit	Total Cost
Single Service Connections	All Depths	88	$150.00	ea	$13,200.00
Double Service Connections	All Depths	44	$250.00	ea	$11,000.00
6" SDR-35 PVC	0'-8'	6,600	$14.25	lf	$94,050.00
	8'-10'	3,140	$20.25	lf	$63,585.00
	10'-12'	2,250	$26.25	lf	$59,062.50
	12'-14'	1,390	$32.25	lf	$44,827.50
	14'-16'	240	$38.25	lf	$9,180.00
8" SDR-35 PVC	14'-16'	300	$39.25	lf	$11,775.00
10" SDR-35 PVC	0'-8'	250	$18.50	lf	$4,625.00
	14'-16'	125	$48.37	lf	$6,046.25
	16'-18'	200	$59.00	lf	$11,800.00
12" SDR-35 PVC	8'-10'	900	$20.50	lf	$18,450.00
	10'-12'	850	$31.00	lf	$26,350.00
	12'-14'	125	$34.00	lf	$4,250.00
Manholes	0-8'	30	$1,100.00	ea	$33,000
	8'- 10'	12	$1,400.00	ea	$16,800
	10'- 12'	8	$1,700.00	ea	$13,600
	12'- 14'	2	$2,350.00	ea	$4,700
	14'-16'	4	$2,600.00	lf	$10,400
	16'-18'	1	$3,000.00	lf	$3,000
Lift Stations					
LS #1 - 360 gpm	-	1	$100,000.00	ea	$100,000
LS #2 - 566 gpm	-	1	$110,000.00	ea	$110,000
LS #5 - 566 gpm	-	1	$110,000.00	ea	$110,000
Force Main 6" at treatment plant	-	1,800	$9.50	lf	$17,100
Force Main 6" at subdivision	-	1,100	$9.50	lf	$10,450
Pavement Cutting and Replacing - Caliche	-	16,370	$5.50	lf	$90,035
Trench Dewatering - Well Pointing (a)	-	5,480	$15.00	lf	$82,200
Trench Safety	-	16,370	$1.50	lf	$24,555
Sub-Total					$1,004,041

Alternative Force Main Routing "A"					
Force Main 8" Diameter	-	13,625	$9.50	lf	$129,437
Lift Stations					
LS #3A - 566 gpm	-	1	$110,000.00	ea	$110,000
LS #4A - 566 gpm	-	1	$110,000.00	ea	$110,000
Bore for 8" force Main	-	100	$63.50	lf	$6,350
Aerial Crossing	-	200	$100.00	lf	$20,000
Sub-Total Construction					$1,373,478
15% Contingency					$206,022
Sub-Total Estimated Construction Cost - Alternative "A"					$1,579,500
Land and Easement Acquisition					
Lift Station Site Acquisition (b)					$20,000
Easement Acquisition 500' (b)					$10,000
Sub-Total Land and Easement Acquisition					$30,000
Engineering Services					
Design Phase					
Basic Design Phase Engineering Fee (c)					$122,510
Geotechnical Investigation					$10,000
Field Surveying					$50,000
Project Administration (Additional Service)					$5,000
Construction Phase					
Basic Construction Phase Engineering Fee (c)					$21,619
Full Time Construction Inspection					$30,000
Materials Testing					$5,000
Preparation of Operations and Maintenance Manual (Additional Service)					$10,000
Project Administration (Additional Service)					$10,000
Sub-Total Engineering Services					$264,129
Total Alternative "A" Construction, Land, and Engineering Costs					$1,873,629

Alternative Force Main Routing "B"					
Force Main 8" Diameter	-	19,800	$9.50	lf	$188,100
Lift Stations					
LS #3B - 566 gpm	-	1	$110,000.00	ea	$110,000
LS #4B - 566 gpm	-	1	$110,000.00	ea	$110,000
Bore for 8" Force Main	-	200	$63.50	lf	$12,700
Aerial Crossing	-	200	$100.00	lf	$20,000
Sub-Total Construction					$1,432,141
15% Contingency					$214,821
Sub-Total Estimated Construction Cost - Alternative "B"					$1,646,962
Land and Easement Acquisition					
Lift Station Site Acquisition (b)					$20,000
Easement Acquisition (b)					$0
Sub-Total Land and Easement Acquisition					$20,000
Engineering Services					
Design Phase					
Basic Design Phase Engineering Fee (c)					$127,743
Geotechnical Investigation					$10,000
Field Surveying					$50,000
Project Administration (Additional Service)					$5,000
Construction Phase					
Basic Construction Phase Engineering Fee (c)					$22,543
Full Time Construction Inspection					$30,000
Materials Testing					$5,000
Preparation of Operations and Maintenance Manual (Additional Service)					$10,000
Project Administration (Additional Service)					$10,000
Sub-Total Engineering Services					$270,286
Total Alternative "B" Construction, Land, and Engineering Costs					$1,937,248

Notes:
(a) Quantity of trench dewatering is based on amount of pipe with depth >10'
(b) Estimated, includes appraisal and legal fees
(c) Basic Design Phase Engineering Fee determined as a percent of Sub-Total of Estimated Construction Cost, based on "Curves of Median Compensation" published by the Consulting Engineers Council of Texas in the document entitled: *"General Engineering Services - A Manual of Practice for Engaging the Services of a Consulting Engineer" (1982).*
Curve of median compensation indicates Basic Service compensation is 7.3% for this project.
In the opinion of the Engineer, the complexity of retrofitting a wastewater collection system into an existing residential community warrants a minimum 25% increase in the Total Fee Percentage obtained from the median compensation curves.
Basic Engineering Services will be in general conformance with those defined by CEC.

SECTION 5
COSTS OF PROJECT

SECTION 5

COSTS OF PROJECT

This section will refine the project costs to include certain administrative costs of obtaining a loan from the Texas Water Development Board (TWDB), present a user charge system for the project areas, present financial information that the TWDB will use to determine the grant to Harlingen for use of its treatment plant capacity, and the TWDB's Equity Participation Grant. This section will also present cost estimates for sewer connections and housing rehabilitation for bathrooms.

ESTIMATED TOTAL COST FOR EACH SEGMENT OF CONSTRUCTION

The proposed project is a gravity sewer collection system for the City of Combes, the City of Primera, Stardust, Eggers, Lasana, Los Ranchitos, and Arroyo Colorado Estates Subdivisions; and a force main to the City of Harlingen WWTP #2. Cost estimates for the land acquisition, design and construction of the facilities were presented in **Section 4**. As described in **Section 3**, the City of Harlingen recently received an amendment to its TNRCC/NPDES wastewater discharge permit for an increase in permitted capacity from 3.5 MGD to 7.5 MGD. Therefore, no wastewater treatment plant expansion costs will be included in this section; plant capacity for the project areas will be assumed to be funded by the TWDB in the form of their "Equity Participation Grant."

In this section, an additional budget item is added to the costs developed in **Section 4**. Since the political subdivision involved in this project will be applying for Economically Distressed Areas Program (EDAP) financial assistance, at this point it will be presumed that, similar to other EDAP projects, some amount of the financial assistance will be provided in the form of a loan to those political subdivisions. Administrative costs are incurred in receiving a loan from the TWDB. Those costs include bond counsel fees and the fees of a professional financial adviser. These fees are customarily based on a small percentage value of the size of the loan and are included in the project costs. Some financial advisers have objected to basing the fee in an EDAP application on the loan amount since the same work is involved on an EDAP project as a loan for the full project amount. That issue will not be resolved here. The purpose in raising this issue is to identify a reasonable amount may be included in the project costs to make the estimates closer to what will be decided as part of the Phase II Application. For purposes of illustration, bond counsel and financial adviser fees will be estimated at 3% of the loan amount and the loan amount will be assumed at 10% of the total project cost. Revised project costs are presented in **Table 5-1**.

TABLE 5-1
TOTAL PROJECT COSTS

Combes	
Sewer collection system	$11,721,728
Water distribution system (Stardust)	1,054,226
Primera	
Sewer collection system	5,036,229
Harlingen	
Lift Station and force main (Re: Combes & Primera)	3,116,036
Arroyo Colorado Estates	1,873,629
Sub-total:	$22,801,848
Loan Administrative Costs	
Bond Counsel and Financial Adviser fees (Estimated will be revised for Phase II Application)	68,406
Equity Participation Grant	
Grant to Harlingen for plant capacity for current project area residents. (Estimated, actual to be determined by TWDB)	1,230,067
Total Project Cost:	**$24,100,321**

DEVELOPMENT OF A USER CHARGE SYSTEM

A user charge system for this project actually consists of a number of separate fee systems: a wholesale service rate that Harlingen will charge Combes and Primera; a retail rate that Combes and Primera will charge their customers; and a retail rate that Harlingen will charge its direct customers in Arroyo Colorado Estates. These rates will be considered in separate subsections.

Wholesale Rate for Harlingen

The wholesale rate is the rate that Harlingen will charge Combes and Primera to treat their wastewater. Several components go into this rate. Those components are: (1) the operation and maintenance cost for the lift station and force main from Combes and Primera through Harlingen; (2) operation and maintenance costs at WWTP #2; (3) Harlingen's capital cost for the lift stations and force main through the city; and (4) Harlingen's capital costs for the wastewater treatment plant that are not compensated by the TWDB's equity participation grant. These items were developed separately.

O & M Lift Station and Force Main

Labor to operate and maintain the short segment of gravity line, wastewater flow meters, force main and three lift stations is estimated at 336 hrs/yr. With average labor cost of $7.50 /hr. and fringe benefit factor of 0.25, the annual labor cost is [336 x 7.5 x 1.25] = $3,150. Each of the three lift stations will have four pumps. Two of the pumps in each lift station are smaller "jockey pumps" to handle smaller flows. When the larger peak flows fill the lift stations, larger pumps will turn on. Power costs for the pumps in the lift station were calculated on the basis of 1 hp equals 0.746 kilowatts; and a power cost of $0.08/kilowatt hour. The smaller pumps are estimated to be on 7.5% of the time; the larger pumps are estimated to be on 2.5% of the time. Annual power costs are therefore $412. Annual pump replacement cost of $4,632 was based on twelve pumps with a useful life of 12.5 years in the three lift stations. Pump replacement costs and annual power costs are shown on **Table 5-2.** Supplies and miscellaneous expenses for the flow meters and lift stations are estimated at $200 per lift station per year. Total estimated annual operation and maintenance costs for the Harlingen lift station and force main are $8,794.

O & M Costs of the Wastewater Treatment Plant

Operation and maintenance costs at the treatment plant were calculated by the Harlingen Waterworks System at $0.49 per 1,000 gallons. This estimate was based on cost accounting and financial records used to develop a user charge for the industrial plant.

Capital Cost of the Force Main

It is assumed that Harlingen will apply for and receive EDAP financial assistance for the force main through the city. EDAP financial assistance is a combination grant and loan, that is determined on a case by case basis by the TWDB. The loan portion, if any, is a capital cost to Harlingen that will be charged to the project area rate payers. Since the loan amount is not determined yet, this report will assume a 10% loan at 7.8% interest for 20 years. This portion of the rate will be recalculated after the TWDB determines the financial assistance. A larger grant from the TWDB to Harlingen will reduce the rate to the project area rate payers. Annual capital costs for the force main are estimated at $31,950.

Capital Cost of Wastewater Treatment Plant

The TWDB provides an "equity participation grant" to a city that allows an economically distressed area to tie into its water or sewer system. The equity participation grant is to compensate the city for the loss of plant capacity to the economically distressed area. The grant serves as a substitute for capital recovery fees that cities would charge to developers. The TWDB's equity participation grant only covers the plant capacity used by current project area residents at the time of project financing. Future increases in use by the project area residents are not provided for in this grant. The design flow for current project area residents is 1 MGD. Therefore when the project area flows exceed this amount, Harlingen will be entitled to increase the wholesale rate to the project areas. Since project area flows are not expected to reach 1 MGD until every currently existing house is connected to the system, the initial Harlingen wholesale rate will not contain any capital plant costs.

Calculation of Harlingen Wholesale Rate

The sum of the capital and operation and maintenance annual costs for the lift station and force main are $40,744. Total annual volume expected to initially flow from Combes and Primera is 197 MG. The cost per gallon without treatment plant costs is, therefore, $0.21 per 1,000 gallons. With the addition of the operation and maintenance cost to treat the wastewater at the plant, the cost of service is **$ 0.70 per 1,000 gallons.**

Sewer Rate for Combes

It is estimated that the City of Combes will have to hire one additional person for operation and maintenance of the gravity mains, lift stations, and force main. With average labor cost of $7.50 per hour and a fringe benefit factor of 0.25, the annual labor cost is $19,500. Power costs for the pumps in the lift stations were calculated on the basis of 1 hp equals 0.746 kilowatts; and a power cost of $0.08/kilowatt hour. The pumps are estimated to be on 10% of the time. Annual pump replacement costs were based on a useful life of 12.5 years. Pump replacement and annual power cost calculations are presented on **Table 5-3.** Other costs were based on similar systems in the area. Insurance for the combined water and sewer operation of Santa Rosa for 1990, the most recent audit, was $9,195.22. Allocated equally between water and sewer, results in $4,598 for insurance for the wastewater operations. Rio Hondo's 1995 budget for insurance for the wastewater system only was $3,132. Given the fact that a least a year and a half to two years of inflation must be added, insurance is estimated to cost $3,300 for the first year of operation. Santa Rosa was not used as a comparison for cost of supplies because of the difficulty in allocating supplies between the water and wastewater portions of the system. Rio Hondo has budgeted $4,610 for supplies for their entire wastewater system for 1995. While the Rio Hondo budget includes the wastewater plant, it also is for a sewer system with only seven lift stations. The 1995 Sebastian rate study estimated $1,000 dollars in supplies for the gravity sewer system and $200 for supplies per lift station. Those estimates result in an estimated annul supply cost for Combes of $5,000.

Of critical importance to the successful operation and maintenance of the sewer system are items of capital equipment that will be used to maintain the system. TWDB staff has informed the Project Engineer that these items are eligible for EDAP financial assistance. Needed equipment and average costs based on the Sebastian project are: tripod and ladderless entry device - $2,866: confined space gas detector - $2,854; self-contained breathing apparatus - $2,794; trailer mounted jet sprayer - $22,927; portable hoist - $1,088. Rather than include the total cost of all these items in the first year's budget, the project engineer assumes that the City will finance this equipment over 48 months at 14.5% interest for an annual payment of $10,765. It is assumed that the City already has a back hoe and pick-up truck that will be shared by the water and sewer department.

The annual costs to operate and maintain the wastewater collection system are estimated in the following pro forma financial statement:

Expenses (wastewater collection only)

Salaries (Including payroll taxes & benefits)	$19,500
Insurance	3,300
Supplies	5,000
Equipment	10,765
Pump Replacement	10,218
Utilities	2,123
Total Expenses	$50,906

EDAP financial assistance is a combination grant and loan, that is determined on a case by case basis by the TWDB. Since the TWDB has not yet determined the loan amount, this report will assume a 10% loan at 7.8% interest for 20 years. This portion of the rate should be recalculated after the TWDB determines the financial assistance. Annual capital costs for the gravity collection system, force mains, and water improvements for the Combes area are estimated at $120,188.

In addition to the debt service payment, the TWDB typically requires the political subdivision to maintain "coverage." "Coverage" is a margin of safety to ensure that the political subdivision is collecting enough revenue for repayment of debt service. The coverage factor reflects the number of times by which annual revenues exceed net operating expenses and debt service requirements. The TWDB will determine the required coverage factor during the processing of the financial application. For purposes of illustrating the calculation a coverage factor of 120% will be used. Therefore the required revenues for the wastewater system are:

O & M Expenses:	$ 50,906
Debt Service (Including Bond & F.A. fees)	120,188
Sub Total	171,094
Coverage Factor	x 120%
Total Required Annual Revenues	$ 205,313

The user charge system was based on the total annual volume of wastewater expected to be received by Harlingen in the first year of operation. The projected total annual wastewater flow is 78,600,925 gallons. In subsequent years, the actual wastewater flows as measured by the City of Harlingen can be used as the basis for expected wastewater usage.

Total Annual Cost / Total Annual Flow = $2.61 per thousand gallons.

In addition the Harlingen wholesale rate of $0.70 per 1,000 gallons must be passed on to the retail customers for a total of $3.31 per 1,000 gallons. The TWDB recommends that an additional $1.00 per connection per month be charged by the City to cover revenues lost to delinquencies.

Retail Water Rate for Stardust

Combes is considering providing retail water service to the Stardust colonia outside its city limits. Section 16.349(b) Texas Water Code prohibits a city that receives EDAP funding from charging the project area residents more than its in-city customers. Therefore, the water rate for Stardust residents would be the in-city Combes retail rate.

The recent session of the Texas Legislature passed an amendment to Section 16.344 in House Bill 1001. If that bill is not vetoed by the Governor, and becomes law, a city that receives EDAP funding for a colonia outside its city limits will be able to charge those colonia residents the lesser of either cost of service or the in city rates plus 15%. Since this bill had not passed the Legislature when this report was prepared, the Project Engineer has assumed that Combes will charge Stardust its in-city water rate.

Sewer Rate for Primera

It is estimated that the City of Primera will have to hire one additional person for operation and maintenance of the gravity mains, lift stations, and force main. With average labor cost of $7.50 per hour and fringe benefit factor of 0.25, the annual labor cost is $19,500. Power costs for the lift station pumps were calculated on the basis of 1 hp equals 0.746 kilowatts; and a power cost of $0.08/kilowatt hour. The pumps are estimated to be on 10% of the time. Annual pump replacement costs were based on a useful life of 12.5 years. Pump replacement and annual power cost calculations are presented in **Table 5-4.** Other costs were based on similar systems in the area. Insurance was estimated as for Combes. The 1995 Sebastian rate study estimated $1,000 dollars in supplies for the gravity sewer system and $200 for supplies per lift station. Those estimates result in an estimated annual supply cost for Primera of $3,000.

As in the Combes budget, we have included funds for the equipment needed to operate the sewer system. Because the project engineer was informed by TWDB staff that these items were ineligible, annual cost for the financing of these items is included in the O & M budget.

The annual costs to operate and maintain the Primera wastewater collection system are estimated in the following pro forma financial statement:

Expenses (wastewater collection only)

Salaries (Including payroll taxes & benefits)	$19,500
Insurance	3,300
Supplies	3,000
Equipment	10,765
Pump Replacement	8,112
Utilities	1,950
Total Expenses:	$46,627

EDAP financial assistance is a combination grant and loan, that is determined on a case by case basis the TWDB. The calculations assume similar financial assistance for both Combes and Primera Annual capital costs for the gravity lines and force mains for the Primera area are estimated at $51,639.

In addition to the debt service payment, the TWDB typically requires the political subdivision to maintain a coverage factor. Coverage for Primera was calculated as for Combes on the basis of 120%. Therefore the required revenues for the wastewater system are:

O & M Expenses:	$ 46,627
Debt Service(Including Bond & F.A. fees)	51,539
Sub Total	98,266
Coverage Factor	x 120%
Total Required Annual Revenues	$ 117,919

The user charge system was based on the total annual volume of wastewater expected to be received by Primera in the first year of operation The projected total annual wastewater flow was 118,288,105 gallons. In subsequent years, the actual wastewater flows as measured by the City of Harlingen can be used as the basis for expected wastewater usage.

Total Annual Cost / Total Annual Flow = $1.00 per thousand gallons.

The Harlingen wholesale rate of $0.70 per 1,00 gallons must be added to the Primera cost for a total user charge rate of $1.70 per 1,000 gallons. The TWDB recommends that an additional $1.00 per connection per month be charged by the City to cover revenues lost to delinquencies.

Harlingen Retail Rate for Arroyo Colorado Estates

This user charge system assumes that the City of Harlingen will provide retail sewer service to Arroyo Colorado Estates. Within this rate, Harlingen must recover all of its costs for billing and collection, operation and maintenance of the gravity system, and its capital costs and a proportionate share of the wastewater treatment plant, and any capital fees that are not compensated by the TWDB's Equity Participation Grant.

Section 16.349(b) Texas Water Code prohibits a city that receives EDAP funding from charging the project area residents more than its in-city customers. Therefore the sewer rate for Arroyo Colorado residents would be the Harlingen in-city rate.

As is the case with Combes and Stardust, recent Legislation will effect the rate Harlingen can charge Arroyo Colorado Estates in the future. The recent session of the Texas Legislature passed an amendment to Section 16.344 in House Bill 1001. Under Section 19 of the session law, Section 16.349 of the Water Code is amended: a city that receives EDAP funding for a colonia outside its city limits will be able to charge those colonia residents the lesser of either cost of service or the in city rates plus 15%. Since this bill had not passed the Legislature when this report was prepared, the Project Engineer has assumed that Harlingen will charge Arroyo Colorado Estates its in-city sewer rate.

EQUITY PARTICIPATION

As a part of the financial package that the TWDB provides to political subdivisions that participate in the Economically Distressed Areas Program, the TWDB allows what it terms an "Equity Participation Grant." The purpose of the grant is to compensate the political subdivision for the plant capacity that would otherwise be utilized to serve its own residents, but will now be utilized by the project area colonia residents. The grant covers current (time of construction) usage of the facilities. Future use of the plant by project area residents is not reimbursed by the TWDB in the Equity Participation Grant. The following information is provided so that the TWDB can calculate the "Equity Participation Grant." The TWDB staff will calculate the complete financial assistance package to the political subdivision after it has received an EDAP Phase II Application. For purposes of this report, the Project Engineer has added the 4.5 million dollar rehabilitation project that the Harlingen Waterworks is currently designing for WWTP #2. The Project Engineer added to rehabilitation costs, since those costs will ensure that the WWTP #2 meets the TNRCC discharge limits.

Capacity at the Harlingen Wastewater Treatment Plant #2: **7.5 MGD** Based on the TNRCC permit.

Usage of Treatment Plant Capacity by Project Areas (1995 Design Flows): **968,557 gpd.**

Percentage of capacity utilized by Project Areas: **13%**

Percentage of capacity utilized or reserved by Harlingen: **87%**

Historical cost to construct plant capacity:

The wastewater treatment plant was constructed in a number of stages over a number of years. The most recent expansions were the 1989 addition of the 3.5 MGD extended aeration treatment process. Sources of funds for that expansion were:

Sources of Funds

TWDB Water Loan Assistance Fund (loan)	$2,000,000
Texas Department of Commerce (grant)	2,500,000
Harlingen Waterworks System (transfer of local funds)	1,500,000
City of Harlingen (transfer of local funds)	1,500,000
Economic Development Agency (grant)	1,750,000
Sub-Total for expansion	$9,250,000
Sub-Total for rehabilitation	$4,500,000
Total	$13,750,000

The costs of the Equity Participation Grant were calculated by subtracting the two grants from the project costs for a dollar figure of $9,500,000. This figure was divided by the plant capacity, or 7.5 MGD, for a result of $1.27 /gal of plant capacity. That cost was multiplied by the capacity to be used by current project area residents, 968,557 gal/day for a resulting equity participation grant of **$1,230,067.**

AVERAGE MONTHLY WATER AND WASTEWATER BILL

The average bill for each study area will be presented based on the rates developed in the user charge system. The water usage information from the baseline report was originally used to develop an average water and wastewater bill. Several local officials commented that the water usage was too high. The Project Engineer then contacted local officials and the Water Use Section of the TWDB for more recent information. Based on the more recent information, both Combes and Primera had an increase in water usage for 1993. For this report the Project Engineer has averaged the Baseline Report information with that of the 1993 Water Use Survey for the cities of Combes and Primera. Individual water usage will vary; and therefore the individual bills will vary. This calculation is presented for comparison purposes only.

Combes:

Average water usage: 9,096 gal/month

Water rate: (See Baseline Report) Average water bill: $22.64

Sewer rate:	$3.31 per 1,000 gals. +$1.00	Average sewer bill:	$30.11
		Total bill:	$52.75

Primera:

Average water usage (See Baseline Report): 9,026 gal/month

Water rate:	(See Baseline Report)	Average water bill:	$22.04
Sewer rate:	$1.70 per 1,000 + $1.00	Average sewer bill:	$15.34
		Total bill:	$37.38

Arroyo Colorado Estates:

Average water usage (Use East Rio Hondo WSC. See Baseline Report): 9,158 gals/month

Water rate:	(Not Available)	Average water bill:	Not available
Sewer rate:	Harlingen In-City Rate	Average sewer bill:	$22.90

COSTS OF DWELLING REHABILITATION AND UTILITY CONNECTION

As a part of the Baseline Report, a door-to-door sample survey was conducted in the project areas. One of the questions on the survey asked about the type of in-door bath and toilet facilities in the home. Responses were broken down into categories of those homes that have complete in-door facilities, those homes with bath and toilet with cold water only, those with piped water but no bath, those with bath and shower, and those with no facilities. The sample survey responses were used to estimate the number of homes in each project area that lacked in-door plumbing facilities. Cost estimates were then developed for the repairs and improvements necessary for each category. These cost estimates were used to develop an estimated total dollar figure needed for housing rehabilitation and sewer hook ups.

Of major significance for the house rehabilitation estimates are the type and manner of code enforcement. The cities of Combes and Primera are responsible for building code enforcement within their city limits. Eggers, a portion of Los Ranchitos, Lasana, Stardust and Arroyo Colorado Estates subdivisions are all outside any city limits. In these areas, Cameron County enforces building codes. Cameron County's current policy is that before a house is connected to water or sewer, all of the house must be brought up to all building codes. For houses located within the 100 year flood plain, the home owner must also elevate the house out of the flood plain and obtain an engineer's certificate of elevation. In order to evaluate costs to bring a house into compliance with all building codes a very specific house by house estimate would have to be conducted. Some houses would have to be totally replaced with a new house. Other houses could be brought up to code with a small amount of dollars and time. Cameron County has estimated that it will take $10 million dollars to bring all of the houses in Cameron Park, a colonia near Brownsville, up to the standards of the County Building Codes.

Even in those areas where existing code enforcement policy will allow a water or sewer hook up without a completely up to code house, substantial problems exist when a house is hooked on to water and sewer. For example there may be structural or foundation problems with the house that will have to be fixed before a bath tub or toilet may be safely added to the house. For reasons of safety, economy and speed of installation, a modular bathroom concept is recommended when more than minimal in-door plumbing improvements need to be made. Figure 5-1 illustrates the modular bathroom concept. Assuming that the units could be mass produced locally, it is estimated that fabrication costs would be approximately $2,850. Installation costs will vary. For purposes of estimating rehabilitation costs, and average installation cost of $1,700 has been assumed. Total estimated costs to install modular bathrooms where needed in all the project areas is $4,213,300.

Sewer yard line installation is estimated at $7.00 /lf for 4-inch SDR-35 PVC and an average yard line of 75 feet. Water yard lines are estimated at $4.50 /lf for 1/4-inch Schedule 40 PVC pipe. Septic tank cleaning and backfilling the septic tank is estimated at $100 per tank. The total cost for all project areas for water line installation, sewer hook-up and taking septic tanks out of service is estimated to be $1,042,850.

Total in-door plumbing rehabilitation using the modular bathroom concept is estimated to be $5,256,150 and connection to water and sewer service for all project areas is estimated at $5,256,150. If strict enforcement of all building codes is required before connection to water and sewer service, a planning estimate, based on the Cameron County estimate for Cameron Park, is $14,525,000.

Funds are available for construction of toilet facilities through the Texas Department of Housing and Community Affairs, Texas Community Development Program, administered through the Community Development Block Grant program. These funds are distributed to the County on an annual basis and are typically used for street and drainage improvements, structural rehabilitation, and water and wastewater improvements for projects throughout the County. The Farmers Home Administration also has funds available for home rehabilitation and improvement, (see Baseline Report Section 10 - Financial Assistance Programs).

DISTRESSED AREAS WATER FINANCING FEE

Financing all or part of this project from a Distressed Areas Water Financing Fee is not recommended.

The Distressed Areas Water Financing Fee was enacted as part of the original Economically Distressed Areas legislation, Senate Bill 2, 71st Legislature (Texas Water Code §§ 16.347 - 16.348). It was intended to work like a stand-by fee. Undeveloped property in the project area would be subject to an annual "fee." The "fee" would function like a tax. The fee for each tract of undeveloped property would be set by the formula:

$$\text{Fee for a particular tract} = (\text{Acres in tract})\left(\frac{\text{Total Project Cost}}{\text{Total Acres Served by Project}}\right)$$

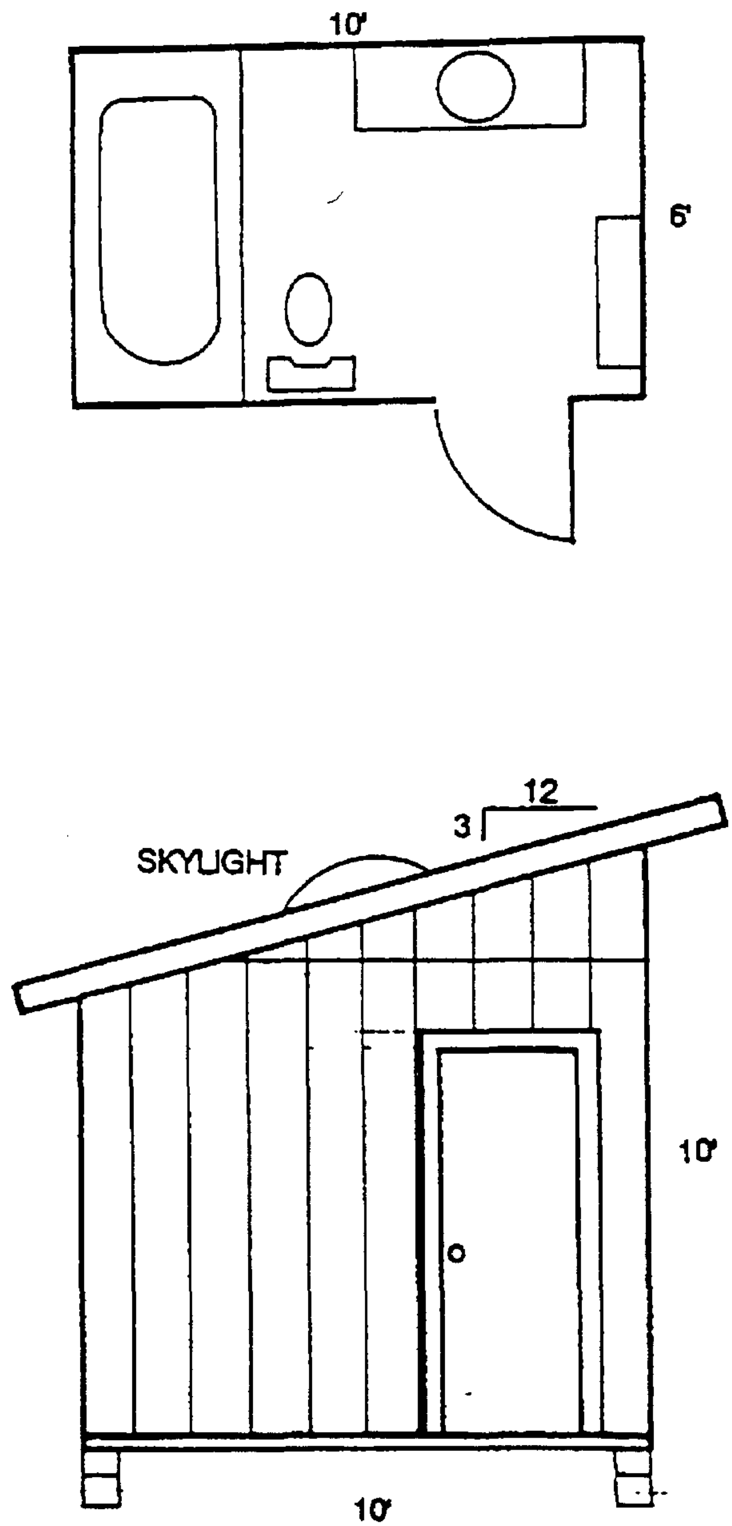
Theoretically, all land in the area would contribute money for the repayment of the loan portion of the project. Developed land would contribute user fees, water and sewer bills. Undeveloped land would contribute the "Distressed Areas Water Financing Fee." The fee would be paid annually. If the fee was not promptly paid, the political subdivision could file suit to foreclose the lien.

The Distressed Area Water Financing Fee functions as what are generally called "stand-by fees." Stand-by fees are justified by the argument that public services that benefit only a portion of the public should be paid by those who benefit. Land owners who buy water or sewer services pay for their benefit through the water and sewer bill. Land owners of vacant land also benefit, it is argued. Their property increases in value because water and sewer lines are available for service to the property. The land owner should pay for the benefit of increased land value.

The fee is not recommended as a source of financing for three reasons. First, the amount of income produced by this fee will be highly unreliable. The overwhelming majority of colonia residents will not be able to afford to pay the fee. If colonia owners of property have not built a home on the property, it is because they are trying to save the money to build. Because of the presumed high delinquency in payment of these fees, the TWDB can't rely on this income stream for repayment of its loans.

Second, payment of the fee reduces money the colonia property owner has available to start construction on a home. The fee serves as a disincentive for build-out of the colonia. The TWDB, in their calculations of the grant-to-loan ratio for project financing, are planning on future development in the colonias. Any disincentives to development will increase the chance of a loan default.

Finally, the wording of the statute does not accomplish the understood intent of the statute. "Undeveloped property" is defined in such a way that both property with a house on it and vacant land would be subject to the tax. People who connect to the system would pay both the Distressed Areas Water Financing Fee and the water and sewer bill. A second statutory problem is that unplatted property is not subject to the tax. Some of the colonias are on unplatted land. The tax would not apply to unplatted colonias, but would apply to other colonias with lawfully subdivided land. Thus, the fee would be applied inequitably because some colonia residents would be subject to the fee, but other colonia residents would escape the fee.



Cameron County - Colonia Wastewater
Treament Planning Study

Figure 5 - 1
Modular Bathroom Concept

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Table 5-2

Harlingen Pump Replacement Cost and Annual Power Cost

Lift Station	Pump	Horsepower	No. Units	Unit Cost (1995)	Total Cost (1995)	Annual Power Cost
LS #1	Flygt CP-3127-432	10.0	2	4,000	8,000	78.42
LS #1	Flygt CP-3170-603	25.0	2	6,400	12,800	65.35
LS #2	Flygt CP-3127-433	7.5	2	3,500	7,000	58.81
LS #2	Flygt CP-3170-605	25.0	2	6,400	12,800	65.35
LS #3	Flygt CP-3127-432	10.0	2	4,000	8,000	78.42
LS #3	Flygt CP-3170-603	25.0	2	6,400	12,800	65.35
				Total:	**$61,400**	**$411.70**

The costs of the pumps must be increased to reflect 12.5 years of inflation, because the pumps will cost more when they have to be replaced.

$61,400 plus 3% inflation compounded for 12.5 years equals: **$88,855**

The annual sum of money that must be saved at 8.5% interest to earn the pump replacement cost in 12.5 years is:

$4,632

Annual power cost is calculated on the basis of 0.746 kilowatts per horsepower.
Smaller jockey pumps on 7.5% of the time and larger pumps on 2.5% of the time.
Power cost of $0.08/kilowatt hour.

Table 5-3

Combes Pump Replacement Cost and Annual Power Cost

Lift Station	Pump	Horsepower	No. Units	Unit Cost (1995)	Total Cost (1995)	Annual Power Cost
#1	Flygt CP 3127-462	7.5	2	3,500	7,000	78.42
#2	Flygt CP 3127-433	7.5	2	3,500	7,000	78.42
#3	Flygt CP 3300-807	60.0	2	13,000	26,000	627.36
#4	Flygt CP 3085-434	3.0	2	2,300	4,600	31.37
#5	Flygt CP 3170-605	25.0	2	6,400	12,800	261.40
#6	Flygt CP 3085-434	3.0	2	2,300	4,600	31.37
#7	Flygt CP 3170-442	30.0	2	7,500	15,000	313.68
#8	Flygt CP 3085-436	2.0	2	1,135	2,270	20.91
#9	Flygt CP 3152-434	20.0	2	4,800	9,600	209.12
#10	Flygt CP 3085-438	2.0	2	1,135	2,270	20.91
#11	Flygt CP 3085-436	2.0	2	1,135	2,270	20.91
#12	Flygt CP 3085-438	2.0	2	1,135	2,270	20.91
#13	Flygt CP 3102-435	5.0	2	2,750	5,500	52.28
#14	Flygt CP 3085/82-414	3.0	2	2,300	4,600	31.37
#15	Flygt CP 3102-441	5.0	2	2,750	5,500	52.28
#16	Flygt CP 3085-434	3.0	2	2,300	4,600	31.37
#17	Flygt CP 3102-442	5.0	2	2,750	5,500	52.28
#18	Flygt CP 3140-614	14.0	2	4,500	9,000	146.38
#19	Flygt CP 3085/82-438	2.0	2	1,135	2,270	20.91
#20	Flygt CP 3085/82-438	2.0	2	1,135	2,270	20.91
				Total:	**$134,920**	**$2,122.56**

The costs of the pumps must be increased to reflect 12.5 years of inflation, because the pumps will cost more when they have to be replaced.

$61,400 plus 3% inflation compounded for 12.5 years equals: **$195,249**

The annual sum of money that must be saved at 8.5% interest to earn the pump replacement cost in 12.5 years is:

$10,218

Annual power cost is calculated on the basis of 0.746 kilowatts per horsepower.
Pumps are estimated on 10% of the time. Power cost is $0.08/kilowatt hour.

Table 5-4

Primera Pump Replacement Cost and Annual Power Cost

Lift Station	Pump	Horsepower	No. Units	Unit Cost (1995)	Total Cost (1995)	Annual Power Cost
#1	Flygt CP 3102-436	4.0	2	2,500	5,000	41.82
#2	Flygt CP 3102-441	5.0	2	2,750	5,500	52.28
#3	Flygt CP 3170-603	25.0	2	6,400	12,800	261.40
#4	Flygt CP 3102-436	5.0	2	2,750	5,500	52.28
#5	Flygt CP 3127-432	10.0	2	4,000	8,000	104.56
#6	Flygt CP 3102-441	5.0	2	2,750	5,500	52.28
#7	Flygt. CP 3201-638	35.0	2	8,300	16,600	365.96
#8	Flygt CP 3201-821	30.0	2	7,500	15,000	313.68
#9	Flygt CP 3300-646	60.0	2	13,000	26,000	627.36
#10	Flygt CP 3127-433	7.5	2	3,500	7,000	78.42
				Total:	**$106,900**	**$1,950.03**

The costs of the pumps must be increased to reflect 12.5 years of inflation, because the pumps will cost more when they have to be replaced.

$61,400 plus 3% inflation compounded for 12.5 years equals: **$154,700**

The annual sum of money that must be saved at 8.5% interest to earn the pump replacement cost in 12.5 years is:

$8,112

Annual power cost is calculated on the basis of 0.746 kilowatts per horsepower.
Pumps are estimated on 10% of the time. Power cost is $0.08/kilowatt hour.

SECTION 6
INTERLOCAL AGREEMENT ISSUES

SECTION 6

INTERLOCAL AGREEMENTS, INSTITUTIONAL AND LEGAL ISSUES

This section identifies issues that will need to be settled by interlocal agreements in order to implement the proposed project. Institutional or legal issues that have been raised by the proposed project will also be briefly identified. Because of the different organizational structures to deliver service to those colonia project areas to the Northwest of Harlingen and those project areas to the Southeast, this section will address those areas separately.

Sections 3 and **4** recommend that Combes and Primera operate their own sewer collection systems and provide retail wastewater service for the project areas. The wastewater would be transported via force main to a point where it would be metered by the City of Harlingen and would then be transported via force mains to Harlingen Waterworks System's (HWS) WWTP #2. The HWS would provide retail wastewater service to Arroyo Colorado Estates. While there is no set procedure at the TWDB for handling multiple entity regional projects, the Project Engineer recommends that the parties consider a joint application by Combes, Primera, and Harlingen for that portion of the project. Harlingen can make a separate application for the Arroyo Colorado Estates project. This procedure would be the simplest for all parties.

INTERLOCAL AGREEMENTS: COMBES AND PRIMERA

An interlocal agreement for wastewater service between the City of Harlingen and the cities of Combes and Primera is recommended. There are a variety of options for the management of a regional sewer system for Combes and Primera. For example, the City of Harlingen could be responsible for operating and maintaining the entire sewer system in a "turn-key" operation. That is operating and maintaining the entire collection system inside Combes and Primera, plus operation of the wastewater treatment plant and direct billing of individual customers. Another option is for Harlingen to operate the system, but the Cities of Combes and Primera to handle billing and collection. There are numerous ways to divide responsibility for the regional system. These responsibilities should be decided prior to construction of a project and expressly stated in an interlocal agreement.

The HWS has stated that they are not interested in providing direct service to the customers of Combes and Primera; Harlingen would consider treating wastewater from Combes and Primera for fees to be paid by the cities. This is similar to the arrangement the cities have for water service. This can be thought of as a "wholesale service" model. Harlingen treats the wastewater from Combes and Primera for a fee. Combes and Primera will in turn operate and maintain the sewer system within their respective city limits. Combes and Primera will also charge their sewer customers a sewer rate that will cover the city's cost to maintain their system and to cover their cost of wastewater treatment from Harlingen.

This report recommends a regional project where Combes and Primera would each operate and maintain a sewer collection system that would deliver wastewater to a manhole at the intersection of Crossett Road and Loop 499. The HWS will operate the system from the manhole to the treatment plant.

The interlocal agreement should establish the initial rates and if the parties can agree, an initial period where the rates would not increase. This will give the parties time to complete construction of the system and connect as many customers as possible in the initial period of service. It will also allow Combes and Primera to build a customer base. This time will be used for the parties to collect additional cost data on the actual expenses of the system to use as a base period for future rate increases.

The interlocal agreement could set out provisions for future rate increases. It is not possible to contract at one time for all future possible rate increases; however, the agreement can specify that Harlingen will give Combes or Primera notice of the rate increase. The City of Harlingen will be required by the TNRCC to keep its rates to Combes and Primera based on its cost of service. If the customer cities feel that any rate increase is not just and reasonable, then the customer city could appeal that rate increase to the TNRCC under the provisions of Section 13.042 Texas Water Code. Of course, if the parties agree on rates as evidenced by the interlocal agreement, there would be no need to appeal to the TNRCC.

The agreement should also establish the mechanics of payment. What will be the billing period? When will the bills be due? What will-be the late charges, if any?

The customer cities should be provided the right to inspect and test the wastewater flow meters. The customer cities' bills will depend on the measured flow for the billing period. Accuracy of the wastewater flow meter is critical for accurate bills. In order to minimize conflicts, the agreement should explain Harlingen's duty to maintain the flow meters and the printed records from the meters. Primera has expressed their desire to have the right to periodically inspect and check the accuracy of the flow meter. The agreement can specify procedures for the resolution of disputes that may arise over the meters.

The agreement should specify that the customer cities must adopt and enforce an industrial pre-treatment order. Harlingen is required to have a pre-treatment program for all industrial wastewater that may enter its treatment plant. Harlingen can not lawfully adopt city ordinances that are effective outside its city limits, so the customer cities must adopt these regulations for Harlingen. The agreement can also address some of the practical problems of implementing an industrial pre-treatment program. For example, the agreement might specify that the customer city will notify Harlingen of any new proposed industrial customer. Harlingen would then have the responsibility to inspect the facility and insure that it complies with the pre-treatment program. The agreement could also require the customer city to require an inspection of industrial facilities when so requested by Harlingen. This provision may be more theoretical than practical since there is only one industrial customer in Combes and Primera. Harlingen does need this provision in order to demonstrate to the U.S. EPA that it has a fully functional industrial pre-treatment program.

Combes and Primera will generally be responsible for construction and inspection of new sewers, lift stations and force mains within their service areas. Of critical importance will be the design and construction of these facilities to minimize groundwater intrusion. This is particularly important since Harlingen will be charging the cities based on metered flow at the point of delivery. Combes and Primera will be paying to treat any groundwater in their sewer systems. Harlingen may wish to have provisions inserted in the interlocal agreement that will give them notice of new subdivisions that wish to connect to the Combes and Primera system and a right to review and comment on proposed designs. This would be a reasonable request since Harlingen will ultimately have to treat the wastewater from these areas.

It is generally recognized that water usage increases in an area after sewers are installed. How big of an increases varies from area to area, with no general norm. Both Primera and Combes presently purchase water wholesale, from Harlingen the contract limits the water to 300 gal/min. Harlingen has expressed a wiliness to sell additional water provided they are compensated for the impact to their system. Harlingen has calculated this impact fee for Combes at $408,196. Details of this agreement need to be finalized or Combes and Primera could be water short.

INTERLOCAL AGREEMENTS: ARROYO COLORADO ESTATES

No interlocal agreements are necessary for the implementation of this portion of the project. Since the East Rio Hondo Water Supply Corporation provides water service to the area, East

Rio Hondo is already in the area reading water meters. The City of Harlingen may find it advantageous to enter into an agreement with the East Rio Hondo Water Supply Corporation for billing and/or collection of bills. An interlocal agreement could be reached that, for a small fee, East Rio Hondo would add Harlingen's sewer bill to its water bill for those customers that receive sewer service.

A management alternative is to have Harlingen provide "wholesale" service to the East Rio Hondo WSC which in turn would bill the customers for service. In this case, the interlocal agreement between Harlingen and the WSC would be similar to the interlocal agreements with Combes and Primera. Harlingen could for an additional fee provide the additional service of maintaining the sewer lines in Arroyo Colorado Estates.

ADDITIONAL INSTITUTIONAL OR LEGAL ISSUES

This section will briefly list other institutional or legal issues raised by this project that were not addressed in the pervious subsection. This list is not intended to be an extensive list of all federal requirements for project funding with federal funds. The TWDB is already familiar with those requirements, so they need not be repeated here. Certain facts have come to the attention of the Project Engineers during the course of preparing this facility plan that impact portions of the implementation of the proposed facilities.

The Water Quality Management Plan, sometimes referred to as the Section 208 Plan, will have to be amended to implement the Primera and Arroyo Colorado Estates portion of this Facility Plan. The City of Combes is currently included within the same water Quality Planning Area as the City of Harlingen. See **Appendix D State Water Quality Management Plan Coordination** in the Baseline Report. **Appendix D** includes a sample resolution that would be necessary to adopt in order to become the designated service provider.

Several issues surrounding Certificates of Convenience and Necessity (CCNs) should be resolved. The portion of Los Ranchitos subdivision that is not inside Primera is within the certificated sewer service area of Harlingen Waterworks System. Primera should apply for and receive a sewer CCN for this area. The TNRCC is likely to permit an overlapping CCN if the affected cities do not object. In addition, Primera should also apply for a sewer CCN for areas outside it city limits that it intends to serve, i.e., Eggers Subdivision. Combes should apply for a sewer CCN for the Lasana and Stardust areas.

A small portion of the Primera project area remains in dispute between the cities of Harlingen and Primera. Primera and Harlingen have had a series of disputes related to the intersection of the city limits of Primera and the extraterritorial jurisdiction of Harlingen. Most of these disputes have been resolved. However, the status of the extreme southeast portion of Primera is still in question. Harlingen claims the area is outside the city limits of Primera by virtue of a declaratory judgment. Primera claims the area is within its city limits by virtue of a validating statute passed by the legislature that was not considered by the judge in the declaratory action.

Cameron County enforcement of Federal Emergency Management Agency (FEMA) regulations and building codes will impact the ability of some residents to connect to the system. Cameron County currently is enforcing building codes in the unincorporated portions of the county. The County does not enforce building codes in Combes and Primera since they are incorporated cities. Project areas outside incorporated cities and subject to the jurisdiction of the County are: Arroyo Colorado Estates, Eggers, a portion of Los Ranchitos, Lasana and Stardust. In those areas the County does not allow sewer connection until the entire house is brought up to the current Southern Electrical, Fire, Plumbing, and Building codes. In addition, for houses in the 100 year flood plain, an elevation certificate from a surveyor must be obtained showing that the living area is elevated out of the level of the 100 year flood.

Primera and Combes have discretion as to stringency of their building code enforcement. Primera and Combes will have to participate in the FEMA program that will require them to enforce the elevation certificate requirement. The TNRCC FEMA coordinator has informed the Project Engineer that both Combes and Primera are presently participating in the FEMA program and have FEMA coordinators.

SECTION 7
PROJECT SCHEDULE

SECTION 7

PROJECT SCHEDULE

ESTIMATED PROJECT SCHEDULE

Table 7-1 summarizes the estimated schedule for design, construction, and first-year operational oversight for a wastewater collection and treatment system to serve the entire Combes, Primera, and Arroyo Colorado Estates study areas.

For purposes of the project schedule the total project is broken into two financial applications: a Harlingen application for Arroyo Colorado Estates; and a joint application by Harlingen, Combes and Primera. From a project management standpoint, this project will be broken into three segments: a force main through Harlingen segment; a Combes collection system segment; and a Primera collection system segment. Obviously some of these segments are dependent upon one another; the Combes collection system should not be completed before the force main through Harlingen is completed. Other segments are not dependent. If Combes and Harlingen are ready to proceed they can do so without Primera, assuming that the TWDB is prepared to fund the full size of the force main without the commitment of Primera.

The following schedule is an estimate. Actual progress depends almost entirely on the parties willingness to work together and quickly and amicably resolve differences. If the local officials or the TWDB wish to accelerate the schedule, they have the greatest control over those tasks involved in processing a financial application. The schedule for construction was prepared after consultation with TWDB construction inspection staff located in the Lower Rio Grande Valley. The construction schedule is based on loss of two weeks due to bad weather, use of two construction crews for the Combes, and Primera collection systems and assumes 150 linear feet of gravity main per day per crew, and 400 feet of force main per day per crew. The schedule for both the design and construction phases depends a great deal on the contractors selected.

Table 7-1
Estimated Schedule for Finalization of Phase I Study and Phase II/III Design/Construction Phases
Combes, Primera, Arroyo Colorado Estates, Harlingen Regional Wastewater Project

FINANCIAL APPLICATIONS

Task		Estimated Duration
1.	Submit Final EDAP Phase I report to TWDB	Complete
2.	Cities adopt model rules and TWDB review and approval (Required by Statute)	1-3 months
3.	Tx Department of Health determination (Required by Statute)	1-3 months
4.	Finalize Environmental Impact Document (EID) and submit to State and Federal agencies for review	3 months
5.	State and Federal agency review of EID	2 - 10 months
6.	Submit Final EID for approval	1 months
7.	All political subdivisions select their Financial Advisors	1 - 3 months
8.	Preparation of a joint EDAP Financial Application	1 - 2 months
9.	Negotiate and sign interlocal agreements	2 - 6 months
10.	Amend CCNs with TNRCC	3-12 months
11.	Resolution to change Designated Management Authorities	1 -3 months
12.	TRAC review of Application	1- 3 months
13.	Consideration of Application by TWDB staff and Finance Committee	1 -2 months
14.	Approval of Application by TWDB	1 month
15.	Preparation and execution of contract between TWDB and Political Subdivisions	3 - 6 months
Total Estimated Duration Financial Application		***8 - 30 months***

COMBES, PRIMERA, AND HARLINGEN
DESIGN AND CONSTRUCTION

Combes Design

1.	Detailed survey of project site and geo-technical investigations	2 - 5 months
2.	Preparation of draft plans and specifications (P & S) for recommended improvements	6 - 8 months
3.	Preparation of engineering report	4 months
4.	Acquire land for lift stations	3 - 12 months

5.	Review of P & S by TWDB	1 - 6 months
6.	Revisions to P & S *	1 - 5 months
7.	Review of revised P & S	1 month
8.	Advertise for bids	1 month
9.	Award bid and start of construction	3 months
Total Estimated Duration - Finalize Combes Design		***16- 40 months***

COMBES CONSTRUCTION

Task		Estimated Duration
1.	Construct recommended wastewater improvements	18 - 22 months
Total Estimated Duration Combes (Two Crews)		***18 - 22 months***

Primera Design

1.	Detailed survey of project site and geo-technical investigations	4 - 5 months
2.	Preparation of draft plans and specifications for recommended improvements	6 - 8 months
3.	Preparation of engineering report	4 months
4.	Acquire land & easements for lift stations	2 - 6 months
5.	Review of P & S by TWDB	1 - 6 months
6.	Revisions to P & S *	1 - 4 months
7.	Review of revised P & S by TWDB	1 month
8.	Advertise for bids	1 month
9.	Award bid and start of construction	3 months
Total Estimated Duration - Finalize Primera Design		***15 - 36 months***

PRIMERA CONSTRUCTION

Task		Estimated Duration
1.	Construct recommended wastewater improvements	14 - 17 months
Total Estimated Duration Primera Construction (Two Crews)		***14 - 17 months***

Harlingen Force Main Design

1.	Detailed survey of project site and geo-technical investigations	2 - 4 months
2.	Preparation of draft plans and specifications for recommended improvements	4 - 6 months
3.	Preparation of engineering report	2 months
4.	Acquire land & easements for lift stations	2 - 6 months
5.	Review of Plans and specification by TWDB	1 - 6 months
6.	Revisions to P & S *	1-4 months
7.	Review of revised P & S by TWDB	1 month
8.	Advertise for bids	1 month
9.	Award bid and start of construction	3 months
Total Estimated Duration - Finalize Force Main Design		***10 - 24 months***

HARLINGEN FORCE MAIN CONSTRUCTION

Task		**Estimated Duration**
1.	Construct recommended wastewater improvements	5 - 7 months
Total Estimated Duration Force Main Construction (Two Crews)		***5 - 7 months***

ARROYO COLORADO ESTATES
DESIGN AND CONSTRUCTION

Arroyo Colorado Estates Design

1.	Detailed survey of project site and geo-technical investigations	2 - 5 months
2.	Preparation of draft plans and specifications for recommended improvements	4 - 6 months
3.	Preparation of engineering report	2 months
4.	Acquire land & easements for lift stations	2 - 6 months
5.	Review of Plans and specification by TWDB	1 - 6 months
6.	Revisions to P & S *	1 - 4 months
7.	Review of revised P & S by TWDB	1 month
8.	Advertise for bids	1 month

9.	Award bid and start of construction	3 months
Total Estimated Duration - Finalize Arroyo Colorado Estates Design		***12 - 30 months***

ARROYO COLORADO ESTATES CONSTRUCTION

Task		**Estimated Duration**
1.	Construct recommended wastewater improvements	8 - 10 months
Total Estimated Duration Complete Construction (One Crew)		***8 - 10 months***

* Only one revision to plans and specifications is assumed. Revisions to plans can take more than one revision.

SECTION 8
REFERENCES CITED

SECTION 8

REFERENCES CITED

Camp Dresser & McKee Inc. 1992 City of Harlingen Waterworks System Wastewater Collection System Master Plan.

Michael Sullivan and Associates, Inc., 1994. Cameron County Colonia Wastewater Treatment Planning Study, Baseline Report.

United States Environmental Protection Agency, Office of Research and Development, 1980, "Innovative and Alternative Technology Assessment Manual".

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Water Resources Planning Group, 1991. Cameron Park Subdivision, Economically Distressed Areas Program, Phase I Facility Engineering Plan and Environmental Assessment.

Williams, D., C.M. Thompson, and J.L. Jacobs. 1977. Cameron County Soil Survey: U.S.D.A., Soil Conservation Service.

APPENDIX A
PROPOSED WATER CONSERVATION PLAN

WATER CONSERVATION AND EMERGENCY WATER DEMAND MANAGEMENT PLAN FOR THE CITY OF HARLINGEN WATERWORKS SYSTEM

WATER CONSERVATION PLAN

Introduction

The Texas Water Development Board has promulgated Financial Assistance Rules that require water conservation planning for any entity receiving financial assistance from the Board. The origin of these requirements is HB 2 and HJR 6, passed by the 65th Texas Legislature in 1985. On November 5th, 1985, Texas voters approved an amendment to the Texas Constitution that provided for the implementation of HB 2.

More specifically, Sections 15.106(b), 15.607, 16.136(4), 17.125(b), 17.277(c), and 17.857(b) of the Texas Water Code and Sections 363.59 and 375.37 of Chapter 31 of the Texas Administrative Code (TAC) require that applicants for financial assistance from the Texas Water Development Board (TWDB) submit a water conservation and emergency water demand management plan to the TWDB for approval, either with the application for financial assistance or after loan approval. In either case, the plan and resulting adopted program must be approved by TWDB before loan funds can be released.

The legislation is intended to encourage cost-effective regional water supply and wastewater treatment facility development. Since the early 1960s, per capita water use in the state has increased approximately four gallons per capita per day per decade. More importantly, per capita water use during droughts is typically about one third greater than during periods of average precipitation. Water use in the residential and commercial sectors involves day-to-day activities of all citizens of the state, and includes drinking, bathing, cooking, fire protection, lawn watering, swimming pools, laundry, dishwashing, car washing and sanitation. Rural areas carry the additional demands of supporting small-scale private livestock production and the, often not-so-small, family garden.

Thus, the goals of the program are to reduce overall water usage through water conservation practices and to provide for a reduction in water usage during times of shortage. The quantity of water required for daily activities can be dramatically reduced through implementation of efficient water use practices that are outlined in the following water conservation plan. The emergency water demand management program provides procedures for both voluntary and mandatory actions to temporarily reduce usage demand during a water shortage crisis. Emergency water demand management procedures include water conservation and prohibition of certain uses.

This chapter is designed to stand alone for submittal to the TWDB as a comprehensive water conservation and emergency water demand management plan for the City of Harlingen Waterworks System (HWWS). The actual TWDB guidelines, which are listed in the TWDB publication "Guidelines for Municipal Water Conservation and Emergency Water Demand Management," are presented in **Table 1** and are offered as an outline for this section. Two copies of this water conservation and emergency water demand management plan, including two copies of the officially adopted plan and documentation of local adoption, should be submitted to:

Mr. Craig Pederson, Executive Director
Texas Water Development Board
P.O. Box 13231, Capitol Station
Austin, Texas 78711-3231

Description of the City of Harlingen Waterworks System

The City of Harlingen is located in the Northwest quadrant of Cameron County. The HWWS currently supplies water to approximately 54,000 customers, with an area of service covering 85 square miles. The HWWS serves 13,533 residential connections, 2,038 commercial connections, and 16 industrial connections. The HWWS's water supplies come from the Rio Grande and flow into two reservoirs. The first reservoir is located the City's Main Water Plant. This plant is capable of producing an average of 8.47 MGD; the current maximum use is 5.80 MGD and the average daily use is 1.02 MGD. The second reservoir is located the Runnion Water Plant which has a 20.20 MGD capacity. This plant currently treats a maximum of 15.30 MGD and delivers an average 8.63 MGD daily. The current Texas Natural Resource Conservation Commission (TNRCC) Sanitary Surveys indicate that neither plant has any notable deficiencies. The HWWS operates under a Certificate of Convenience and Necessity No. 11875 for water and No. 20756 for Wastewater(CCN) which covers the City of Harlingen and surrounding areas (**Figure 1**).

Utility Evaluation Data

Texas Water Development Board Historical Water Use Reports, Water Resource Facility Plan Summaries and actual historical data provided by the HWWS were utilized to evaluate current levels of service within the service area. The TWDB Water Resource Facility Plan Summary

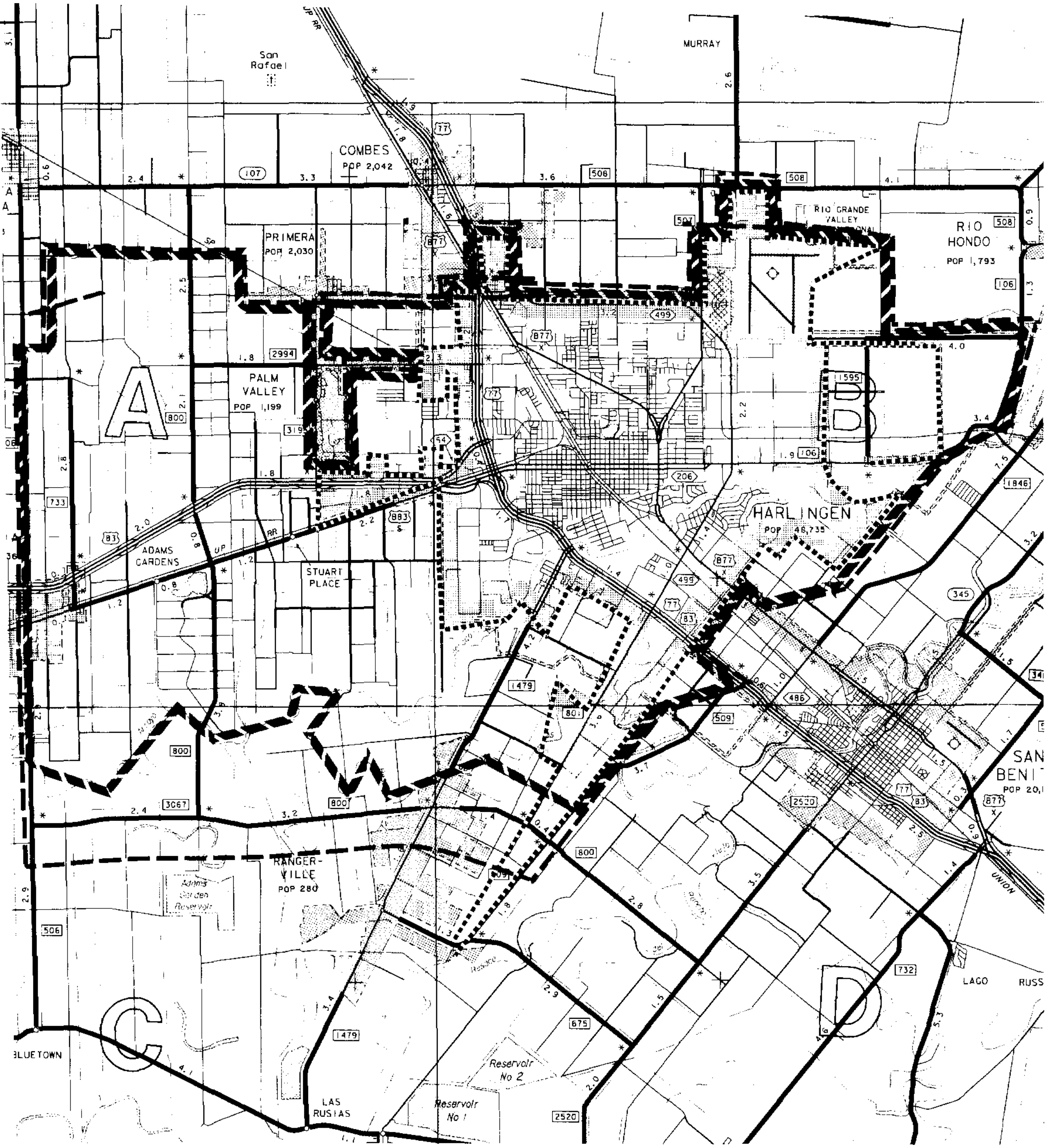
Table 1

Texas Water Development Board Outline for Water Conservation and Emergency Water Demand Management Planning

Table 1 (Cont.)

Texas Water Development Board Outline for Water Conservation and Emergency Water Demand Management Planning

Source: Texas Water Development Board
Note: Check marks indicate completed sections located in this section of the report.



LEGEND

Existing City Limits

Existing Water CCN (No. 11875)

Existing Wastewater CCN (No. 20756)

Cameron County - Colonia Wastewater Treament Planning Study

Figure1

Existing Water and Wastewater CCN for the Harlingen Waterworks System

Michael Sullivan and Assoc., Inc.
Environmental Engineers and Consultants
1250 Capital of Texas Highway #1-270
Austin, Texas 78746

Table 2
UTILITY EVALUATION DATA

The following checklist provides a convenient method to insure that the most important items that are needed for the development of a conservation and drought contingency program are considered.

1. Utility Evaluation Data

A. Population of service area — 54,000 (Number)

B. Area of service area — 85 (Sq. mi.)

C. Number and type of equivalent 5/8" Meter connections in service area — 13,533 (Residential)

2,038 (Commercial)

16 (Industrial)

D. Net rate of new connection additions per year (new connections less disconnects) — 268 (Residential)

43 (Commercial)

2 (Industrial)

E. Water Use information:

1) Water production for the last year — 3,148,259,000 (gal./yr.)

2) Average water production for last 2 years — 2,772,499,000 (gal./yr.)

3) Average monthly water production for last 2 years — 246,698,000 (gal./mo.)

4) Estimated monthly water sales by user category (1000 gal.) Use latest typical year:

Month	Year	Residential	Commercial-Institutional	Industrial	Total
January	1994	108,059	82,464	9,045	199,568
February	1994	93,029	78,457	9,305	180,791
March	1994	113,950	86,358	10,803	211,111
April	1994	126,607	87,174	11,546	225,327
May	1994	136,896	84,679	9,359	230,934
June	1994	167,534	92,643	10,697	270,874
July	1994	177,328	107,068	11,460	295,856
August	1994	203,795	115,955	11,680	331,430
September	1994	143,941	95,074	11,480	250,495
October	1993	126,654	94,470	11,664	232,788
November	1993	110,391	85,128	10,945	206,464
December	1993	120,735	89,444	9,941	220,120
Total		1,628,919	1,098,914	127,925	2,855,758

5) Average daily water use (Res./Comm./Ind.) 9,317,566 (gpd)

6) Peak daily use (Res./Comm./Ind.) 20,000,000 (gpd)

7) Peak to average use ratio (average daily Summer use divided by annual average daily use) 1.32

8) Unaccounted for water (% of water production) 9.30 (%)

F. Wastewater Information

1) Percent of your potable water customers sewered by your wastewater treatment system 86.30 (%)

2) Percent of potable water customers who have septic tanks or other privately operated sewage disposal systems 13.70 (%)

3) Percent of potable water customers sewered by another wastewater utility 0.00 (%)

4) Percent of total potable water sales to the three categories in F (1), F (2), F(3).

a) Percent of total sales to customers you serve 80.80 (%)

b) Percent of total sales to customers who are on septic tanks or private disposal systems 19.20 (%)

c) Percent of total sales to customers who are on other wastewater treatment systems 0.00 (%)

5) Average daily volume of wastewater treated 5,130,000 (gal.)

6) Peak daily wastewater volumes 8,000,000 (gal.)

7) Estimated percent of wastewater flows to your treatment plant that originate from the following categories:

Residential	57.60	(%)
Industrial and Manufacturing	6.60	(%)
Commercial/Institutional	30.80	(%)
Storm Water	5.00	(%)
Other - Explain		(%)

G. Safe annual yield of water supply ______ (gal.) X 1000

H. Peak daily design capacity of water system 27,000 (gal.) X 1000

I. Major high-volume customers: (List) — Quantity (gal/yr):

Customer	Quantity (gal/yr)
Valley Baptist Hospital	70,752,000
Tyson Meats	16,956,000
Fruit of the Loom	4,332,000

J. Population and water use or wastewater volume projections

		WATER	SEWER	WATER	SEWER
Year	Population Potential	Daily Average MGD	Daily Average MGD	Daily Maximum MGD	Daily Maximum MGD
1995	54,000	9.30	5.13	20.00	8.00
2000	59,661	11.40	5.66	22.10	8.80
2010	72,953	13.40	6.90	26.90	10.70
2020	86,141	15.40	8.40	32.80	13.00
2030	104,057	18.30	N/A	N/A	N/A
2040	112,856	19.60	N/A	N/A	N/A

K. Percent of water supply connection in system metered

100 (%) (Residential)

100 (%) (Commercial)

100 (%) (Industrial)

L. Water rate structure / Existing rate structure

Attached

M. Average annual revenues from water and wastewater rates:

Water 4,585,260 (Dollars)

Wastewater 4,287,884 (Dollars)

N. Average annual revenue from non-rate derived sources:

1,033,227 (Dollars)

O. Average annual fixed costs of operation:

2,827,291 (Dollars)

P. Average annual variable costs of operation:

6,443,538 (Dollars)

Q. Average annual water or wastewater revenues for other purposes (if applicable):

-- (Dollars)

R. Applicable local regulations:

S. Applicable State, Federal or other regulations the Public Water Supplier must abide by:

provided information regarding water treatment plant capacity, high service pumping capacity, storage capacity, and ability to meet minimum pressure requirements. The TWDB Historical Water Use Records and actual historical data were used to establish historical water consumption for the City, determine current population, total area within the service area, and number of households served.

Table 2 summarizes the HWWS's utility evaluation data.

Need for and Goals of Program

The water conservation plan outlined below has the overall objective of reducing water consumption in the HWWS's service area. It has the added advantage of reducing the amount of wastewater needing treatment and disposal. Water conservation measures also has the effect of extending the time until additional water and wastewater treatment capacity must be provided.

Various cities throughout the country have adopted water conservation techniques and technologies depending upon the severity of their water supply situation. In particular, California has taken significant steps to reduce water consumption, and here in Texas, the City of Austin has adopted an aggressive water conservation program. Drawing on the experiences of some of these cities, we can make some assumptions about the feasibility, cost and effectiveness of specific measures.

According to Texas Water Development Board high population series figures, the population of the Planning Area is expected to increase 211% percent over the period 1995 to 2040. With such high rates of growth, it is evident that the greatest savings in water usage can be realized by adopting stringent plumbing codes for new construction. Throughout the nation, utilities are finding that revised plumbing codes that reduce new water usage by 25-30 percent can have a significant impact on reducing the high cost of renovating and constructing water and wastewater treatment facilities. However, because water use in rural areas is less weighted toward domestic functions, lesser reductions, on the order of 10-15 percent, can be expected.

Existing plumbing facilities can also be retrofitted in order to reduce water consumption. Although this may involve an initial capital outlay, all of the measures are cost effective in the long term, and various methods have been devised to recover the costs. For example, a San Antonio plan assumes that a two percent increase in water and wastewater rates for 5 years would raise enough money to cover a $100 rebate for each customer retrofitting a toilet to flush on 1.5 gallons (resulting in an overall savings on the customer's water and wastewater bill). An aggressive retrofit program can result in water savings of 15-25 percent per residence. With market penetration typically running at 20-50 percent, this would result in an overall water consumption savings of around 5 percent. In its water conservation program, the City of Austin estimates a 6.7 percent savings within 5 years. This program consists of substituting low-flow shower heads, installing toilet dams, and checking for leaks. The benefit/cost ratio is estimated at more than ten, with an average savings to the customer of $52/year from reductions in water, wastewater and electricity.

Table 3 shows the TWDB's high population projections and water demand projections through the year 2040 with and without conservation measures. **Figure 2** shows water demand through the year 2040 for the City of Harlingen for drought conditions with and without implementation. Overall savings by 2040 are estimated to be approximately 27% or 3.5 MGD. The assumptions made are:

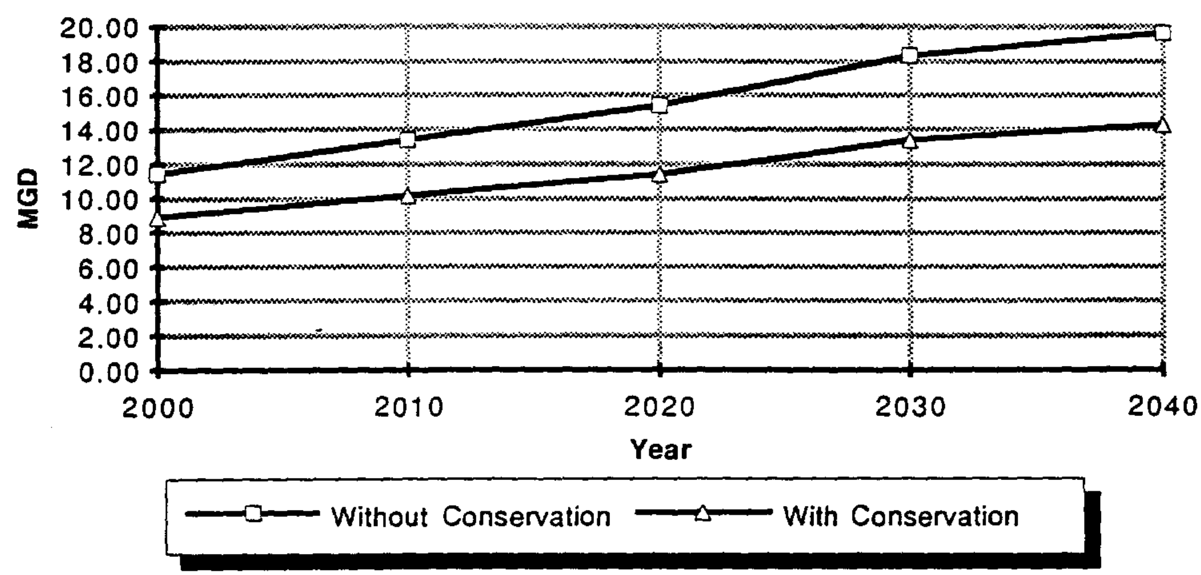
- adoption of a code that would reduce water consumption in all new construction ;
- this code would be phased in during the 1990s and early 2000s (a net water savings of 2% by 1995; 5% by 2000; 7-1/2% by 2005; 10% by 2010; 12-1/2% by 2015 and 15% by 2020);
- existing uses could be reduced by 5 percent through retrofitting and other conservation measures.

The emergency water demand management program includes those measures by which the HWWS can significantly reduce water use on a temporary basis. These measures involve voluntary reductions, restrictions, and/or elimination of certain types of water use and water rationing. Because the onset of an emergency condition is often rapid, it is important that the HWWS be prepared in advance. Further, the citizen or customer must know that certain measures not used in the water conservation program may be necessary if a drought or other emergency condition occurs.

Table 3
Projected Population and Water Demand Projections
(With and Without Water Conservation)

	Projected	Projected Water Demand (MGD)	
Year	Population	(Without Conservation)	(With Conservation)
2000	59,661	11.40	8.89
2010	72,953	13.40	10.13
2020	86,141	15.40	11.39
2030	104,057	18.30	13.4
2040	112,856	19.60	14.29

Figure 2
Water Demand Projections
(With and Without Water Conservation)



LONG-TERM WATER CONSERVATION

Eleven (11) principal water conservation methods are delineated as part of the proposed water conservation plan.

Education and Information

The most readily available and lowest cost method of promoting water conservation is to inform water users about ways to save water inside of homes and other buildings, in landscaping and lawn maintenance, and in recreational uses. An effective education and information program can be easily and inexpensively administered by the HWWS. Information will be distributed to water users as follows:

First-Year Program

The initial year will include the distribution of educational materials. A fact sheet detailing water savings methods that can be practiced by the individual water user is recommended and is available from the TWDB. In addition, the distribution of a fact sheet explaining the newly-adopted water conservation program and the elements of the emergency water demand management plan is recommended. The initial fact sheet will be included with the first distribution of educational material. In addition to activities scheduled in the Long-Term Program, an outline of the program and its benefits will be distributed either through the mail or as a door-to-door hand out.

Long-Term Program

Distribution of educational materials will be made semi-annually, timed to correspond with peak summer demand periods. Such material will incorporate information available from the American Water Works Association (AWWA), Texas Water Development Board and other similar associations in order to expand the scope of this project. A wider range of materials may be obtained from:

CONSERVATION
Texas Water Development Board
P.O. Box 13231 - Capitol Station
Austin, Texas 78711-3231

Information to New Customers

New customers will be provided with a similar package of information as that developed for the first year, namely, educational material, a fact sheet explaining both the water conservation program and the elements of the emergency water demand management Plan, and a copy of "Water Saving Methods That Can Be Practiced by the Individual Water User" available from the TWDB.

Conservation Oriented Water Rate Structure

The structure of rates is as important as the rate itself in sending appropriate signals to consumers. There are over 20 different types of rate structures used throughout the nation, some of which can be used in combination. Some rate structures encourage conservation; others discourage it. Prices should be set to reflect the actual cost of service, including all costs associated with property, hardware, operations, maintenance and personnel. These costs should include depreciation of capital assets and needed planning expenses. Prices should not be hidden in property taxes, as this eliminates a direct incentive for conservation.

There is little consensus regarding what pricing structures are most effective in encouraging conservation. However the following are known about consumer behavior:

- If a new pricing structure results in an unchanged total bill, there will be no response by the users.
- When prices do go up, response is delayed until bills are received.
- The initial response to higher rates may exceed the long term response if the perceived price impact is greater than the ultimate reality.
- If prices are too low in the first place, a price increase may have little impact on demand.

The HWWS's current rate structure is:

Inside City Limits

First 3,000 Gallons	@	$4.00 per thousand
Next 2,000 Gallons	@	$0.75 per thousand
Next 1,000 Gallons	@	$3.30 per thousand
Next 14,000 Gallons	@	$1.10 per thousand
21,000 Gallons and over	@	$1.30 per thousand

Outside City Limits

First 3,000 Gallons	@	$6.00 per thousand
Next 2,000 Gallons	@	$1.125 per thousand
Next 1,000 Gallons	@	$4.95 per thousand
Next 14,000 Gallons	@	$1.65 per thousand
21,000 Gallons and over	@	$1.95 per thousand

Universal Metering and Meter Repair and Replacement

All water users in the HWWS service area are currently metered. All new construction, including multi-family dwellings, is separately metered. The program of universal metering will continue, and is made part of the water conservation plan.

The HWWS, through their billing system, currently monitors water consumption and inspects meters that vary from previously established norms. In addition, the HWWS will establish the following meter maintenance and replacement programs that are recommended by the TWDB :

Meter Type	Test and Replacement Period
Master meter	Annually
Larger than 1 1/2 inch	Annually
1 1/2 inch and less	Every 10 years

The HWWS will continue to maintain a successful meter maintenance program, coupled with computerized billing and leak detection programs.

Water Audits and Leak Detection

The HWWS currently utilizes modern leak detection techniques in locating and reducing leaks. Through their billing program, the HWWS audits and identifies excessive usage and takes steps to determine whether it is a result of leakage. Once located, all leaks are immediately repaired.

Means of Implementation and Enforcement

The staff of the HWWS will administer the water conservation program. They will oversee the execution and implementation of all elements of the program and supervise the keeping of adequate records for program verification.

The plan will be enforced through the adoption of the water conservation plan by the HWWS in the following manner:

- Water service taps will not be provided to customers unless they have met the plan requirements;

- The current rate structure encourages retrofitting of old plumbing fixtures that use large quantities of water; and
- The building inspector will not certify new construction that fails to meet plan requirements.

The HWWS will adopt the final approved plan and commit to maintaining the program for the duration their financial obligation to the State of Texas.

Periodic Review and Evaluation

On a biannual basis, the HWWS will re-evaluate water use rates and per capita consumption figures to determine if there is evidence of increased losses in the system through mechanical breakdown or leakage and if the stated water conservation goals of the original plan are being achieved.

Water Conserving Landscaping

In order to reduce the demands placed on the water system by landscape, livestock and garden watering, the HWWS, through its information and education program, will encourage customers and local landscaping companies to utilize water saving practices during installation of landscaping, gardens and stock watering facilities for residential and commercial institutions. The following methods which are recommended by the TWDB will be promoted by the education and information program:

- Encourage subdivisions and landscape architects to require drought-resistant grasses and plants that require less water and efficient irrigation systems.
- Initiate a program to encourage the adoption of xeriscaping.
- Encourage licensed irrigation contractors to use drip irrigation systems, when possible, and to design all irrigation systems with conservation features such as sprinklers that emit large drops rather than a fine mist and a sprinkler layout that accommodates prevailing wind patterns.
- Encourage commercial establishments to use drip irrigation for landscape watering, when practical, and to install only ornamental fountains that use minimal quantities of water, including recycling features.
- Encourage local nurseries to offer adapted, drought-resistant plants and grasses and efficient watering devices.
- Establish landscape water audit programs, demonstration gardens and related programs.

- Practice other outdoor conservation practices such as covering pools and spas to reduce evaporation.

Distribution System and/or Customer Service Pressure Control

Pressure reductions will help save water by reducing the amount of water that will flow through an opened valve or faucet in a given period of time. Water is also saved by reducing excessive mechanical stress on plumbing fixtures and appliances and on distribution systems. Faucet seats and washers last longer, washing machine and dishwasher valves will break less frequently, pipe joints will be less susceptible to failure, and leaks in the distribution system will loose water more slowly at lower pressure.

The HWWS will evaluate if excessive pressure in parts of the distribution system is a problem and, if it is, provide information on plans to reduce the problem of excessive pressure. It is recommended that pressure in customer service not exceed 80 pounds per square inch.

Recycling and Reuse

Reuse utilizes treated effluent from an industry, municipal system or agricultural return flows to replace an existing use that currently requires fresh water from a utility's supply. Recycling utilizes in-plant process or cooling water to reduce the amount of fresh water required by other industrial operations. The City currently recycles 2 MGD of water from the Runnion Water Plant for industrial reuse at the Fruit of the Loom Plant.

Water Conservation Retrofit Program

The HWWS will make available, through its education and information programs, pertinent information for the purchase and installation of plumbing fixtures, lawn watering equipment and appliances. The advertising program will inform existing users of the advantages of installing water saving devices. The HWWS will contact local plumbing and hardware stores and encourage them to stock water conserving fixtures, including retrofit devices.

In addition, the HWWS will embark upon an aggressive retrofit program. Several alternatives are summarized in **Table 4**. Market penetration is based on the experience of other cities offering such programs. Savings are calculated based on TWDB's high series population projections for the year 2040 (102,617 persons) and an estimated household size of 4 persons per household. The estimated household size was taken directly from the HWWS utility evaluation data sheet.

Table 4

Expected Savings to the HWWS Service Area Through Implementation of a Water Use Retrofit Program

Action	Cost Per House a/	Savings Per House b/ (gpd)	Penetration c/	Total Savings d/ (gpd)	Total Cost e/	Cost Per gpd f/
Distribution of Water Savings Kits g/	$1.00	18.4	50%	260,222	$14,143	$0.05
Vouchers for Shower Heads and Toilet Dams h/	$8.00	38.2	20%	216,097	$45,256	$0.21
Installation of Shower Heads and Toilet Dams i/	$20.00	33.9	50%	479,431	$282,850	$0.59
Refund for Replacing Toilets j/	$400.00	45.7	10%	129,262	$1,131,400	$8.75

a/ Assumes two bathrooms per single-family residence.

b/ Based on 160 gpcd and 4 persons per residence as reported in Utility Evaluation Data Sheet

c/ Percentage of residences participating fully in the program.

d/ Based on 2040 projections of 112,856 persons th HWWS Service Area (28,285 residences).

e/ Total Program implementation cost.

f/ Cost per gpd saved.

g/ Assumes free distribution to all services area residences @ two kits per residence.

h/ Assumes participant retrieval of kits @ two kits per residence.

i/ Assumes installation by HWWS personnel or private contractors.

j/ Assumes $200 per toilet.

The least-cost alternative is to deliver two packages per house containing two flow restrictors, a plastic restrictor for a shower head, a toilet bag and two dye tablets. Based on past experience, the toilet bags are the most acceptable to customers and could be expected to realize savings of 4.8 gpcd in participating households. A more acceptable and more permanent option is to provide customers with low-flow shower heads and toilet dams. Because of the greater costs associated with providing these items, vouchers could be included in the water bill to be exchanged at convenient locations for each customer. It is assumed that most of the equipment claimed through this mechanism would be installed. Another more fool-proof system, used extensively in the City of Austin, involves the installation of low-flow shower heads and toilet dams at no charge to the customer. In Austin, market penetration has exceeded 50 percent and in participating households has resulted in water savings of around 15 percent. A fourth option is to provide rebates of $100 to customers who replace their toilets with those that flush 1.5 gallons.

Water Conservation Plumbing Codes

The HWWS adheres to and enforces the current Standard Plumbing Code of the Southern Building Code. The HWWS also adheres to the legislation, passed by the 72nd Texas Legislature, that requires that plumbing fixtures sold in Texas after January 1, 1992, meet the following standards:

- showers shall be equipped with approved flow control devices to limit total flow to a maximum of 2.75 gallons per minute (gpm) at 80 pounds per square inch of pressure;
- sink faucets shall deliver water at a rate not to exceed 2.2 gpm at 60 pounds per square inch of pressure;
- wall mounted, Flushometer toilets shall use a maximum of 2.0 gallons per flush;
- all other toilets shall use a maximum of 1.6 gallons per flush;
- urinals shall use a maximum of 1.0 gallons per flush;
- and drinking water fountains must be self closing.

EMERGENCY WATER DEMAND MANAGEMENT PLAN

Introduction

Drought and other uncontrollable circumstances can disturb the normal availability of a community or utility water supply. In this emergency water demand management plan, detailed steps are outlined which should be taken to ensure an adequate water supply during drought conditions and trigger conditions for implementing mandatory restrictions. Four water conservation stages are identified in this drought plan:

- Stage 1 - Voluntary Water Conservation
- Stage 2 - Water Shortage Alert
- Stage 3 - Water Shortage Warning
- Stage 4 - Water Shortage Emergency

Emergency Water Demand Management Response Measures

Stage 1 - Voluntary Water Conservation

Upon implementation of this stage of conservation by the Harlingen Waterworks System (HWWS) General Manager, after public announcement and publication of notice, customers of the HWWS shall be requested to voluntarily conserve and limit their use of water. All municipal operations shall be placed on mandatory conservation.

Stage 2 - Water Shortage Alert

Upon implementation of this state of conservation by order of the HWWS General Manager after public announcement and publication of notice, the following restrictions shall apply to all persons. The General Manger, in the exercise of his discretion based upon guidelines established by the HWWS may implement any or all of those elements of Stage 2 deemed necessary at any particular time. The General Manager shall prescribe the provisions of Stage 1 to remain in effect in Stage 2. If any provision in Stage 1 conflicts with a provision in Stage 2, the provision in Stage 2 will control.

(1) Grass, trees, shrubbery, annual, biennial or perennial plants, vines, gardens, and other similar vegetation may be watered, with a hand-held hose equipped with a positive shut-off nozzle or a hand-held bucket or watering can no larger than five

(5) gallons in capacity, a drip irrigation system, or an automatic sprinkler system only between the hours of 6 a.m. to 9 a.m. and 6 p.m. to 9 p.m. on alternating days from Monday through Friday depending on location of the premises. (refer to Stage 1). Those classes of vegetation described herein, excluding lawns, may be watered on the day of planting. The planting of new lawns is prohibited.

(2) Commercial nurseries, commercial sod farms and other similar establishments may water their nursery stock by means of a hand-held bucket or watering can between the hours of 8:30 a.m. and 6:00 p.m. Drip or sprinkler irrigation systems are also permitted to water nursery stock during the hours of 8:30 a.m. to 6:00 p.m. provided irrigation water is recaptured and recirculated.

(3) All water allowed to run off yards, plants, or other vegetation into gutters or streets shall be deemed a waste of water and is prohibited.

(4) Noncommercial washing of automobiles, trucks, trailers, boats, airplanes and other mobile equipment may be done only with a hand-held hose equipped with a positive shut-off nozzle or with a hand-held bucket or watering can not to exceed five (5) gallons in capacity between the hours of 6:00 a.m. to 9:00 a.m. and 6:00 p.m. to 9:00 p.m.

(5) Commercial washing of automobiles, trucks, trailers, boats, airplanes and other mobile equipment shall be limited to the immediate premises of a commercial washing facility and between the hours of 12:00 noon to 6:00 p.m.

(6) The washing of building exteriors and interiors, trailers, trailer houses and railroad cars, is prohibited except that in the interest of public health, the City's Director of Public Health may permit limited use of the water for the uses cited herein as may be necessary.

(7) Permitting or maintaining defective plumbing in a home, business establishment or any location where water is used on the premises is prohibited. Permitting the waste of any water by reason of defective plumbing as mentioned above shall include the existence of water closets in need of repair, underground leaks, defective faucets and taps. Permitting water to flow constantly through a tap, hydrant, valve or otherwise by any user of water connected to the City system, shall be considered a waste of water and prohibited.

(8) The use of fire hydrants for any purpose other than firefighting is prohibited, except that the HWWS General Manager may permit the use of metered fire hydrant water by the HWWS or by commercial operators using jet rodding equipment to clear and clean sanitary and storm sewers.

(9) The use of water in ornamental fountains or in artificial waterfalls where the water is not reused or recirculated in any manner is prohibited.

(10) The use of water to wash down any sidewalks, walkways, driveways, parking lots, tennis courts or other hardsurfaced area, or any building or structure is prohibited except to alleviate immediate health or fire hazards.

(11) The use of water for dust control is prohibited.

(12) The use of potable water by a golf course to irrigate any portion of its grounds is prohibited except those areas designated as tees and greens and only between the hours of 6:00 a.m. to 9:00 a.m. on designated watering days.

(13) Industrial customers are required to implement individual water conservation plans that will be subject to approval by the HWWS in accordance with guidelines as prescribed by the HWWS.

(14) Any use of water for the purposes or in a manner prohibited in this section shall be deemed to be a waste of water and any person violating any of the provisions of this section shall be subject to penalties.

Stage 3 - Water Shortage Warning

Upon implementation of this stage of conservation by the HWWS General Manager after public announcement and publication of notice, the following restrictions shall apply to all persons. The General Manager, in the exercise of this discretion based upon guidelines established by the HWWS, may implement any or all of those elements of Stage 3 deemed necessary at any particular time. The General Manager shall prescribe the provisions of Stage 2 to remain in effect in Stage 3. If any provision in Stage 2 conflicts with a provision in Stage 3, the provision in Stage 3 shall control.

(1) New service connections to the HWWS water system are prohibited where some other source of water independent of the HWWS water system is existing and in use at the time of passage of this Ordinance.

(2) Serving water to a customer in a restaurant is prohibited unless requested by the customer.

(3) The use of water for the expansion of commercial nursery facilities is prohibited.

(4) The use of water for scenic and recreational ponds and lakes (resacas) is prohibited.

(5) The use of water for all privately and publicly owned swimming pools, wading pools, jacuzzi pools, hot tubs and like or similar uses is prohibited.

(6) The use of water to put new agricultural land into production is prohibited.

(7) The use of water for new planting or landscaping is prohibited.

(8) All nonessential water uses or uses not necessary to maintain the public health, safety and welfare are prohibited. Nonessential water uses are defined in this Ordinance to include the watering of grass, trees, plants and other vegetation (except when Stage 2 restrictions specifically remain applicable), the washing (commercial and non-commercial) of automobiles, trucks, trailers, boats, airplanes and other mobile equipment, the watering of golf courses except greens between the hours of 6:00 a.m. to 9:00 a.m. and the use of fountains or artificial waterfalls.

Stage 4 - Water Shortage Emergency

Upon implementation of this stage of conservation by the HWWS General Manager after public announcement and publication of notice, the following restrictions shall apply to all persons. The HWWS General Manager, in the exercise of his discretion based on guidelines established by the HWWS may implement any or all of those elements of Stage 4 deemed necessary at any particular time. The General Manager shall prescribed the provisions of Stage 3 to remain in effect in Stage 4. If any provision of Stage 3 conflicts with a provision in Stage 4, the provision in Stage 4 shall control.

(1) No applications for new, additional, expanded, or increased-in-size water service connections, meters, service lines, pipeline extensions, mains, or other water service facilities of any kind shall be allowed, approved or installed except as approved by the HWWS.

(2) The maximum amounts of monthly water usage for residential and non-residential customers and the accompanying surcharges may be revised during the state of emergency in Stage 4. These revised allocation and surcharge amounts are subject to approval by the City Commission after consultation with the HWWS.

(3) The City Manager and HWWS General Manager are hereby authorized to take any other actions deemed necessary to meet the conditions resulting from the emergency, including, but not limited to, pressure reduction.

Trigger Conditions for Implementing Emergency Water Demand Management Plan

The conditions for triggering voluntary and mandatory restrictions are as follows:

Stage 1 - Voluntary Water Conservation

(1) The Rio Grande Watermaster advises HWWS that a water shortage is possible due to the reduction of the water levels of Amistad and Falcon Reservoirs and/or

(2) Analysis of water supply and demand indicates that the City of Harlingen's annual water allotment may be exhausted and/or

(3) Line Breaks or pump or system failure due to hurricanes, flooding, freezes and/or some other natural or manmade cause which may result in unprecedented loss of capability to provide service and/or

(4) Peak Demands at the Water Distribution and/or Treatment Plants are nearing capacity levels and may place a strain on the systems.

Stage 2 - Water Shortage Alert

(1) The Rio Grande Watermaster advises HWWS that a water shortage exists due to the reduction of the water levels of Amistad and Falcon Reservoirs and/or

(2) Analysis of water supply and demand indicates that the City of Harlingen's annual water allotment will be exhausted if water demand is not reduced and/or

(3) Line Breaks or pump or system failure due to hurricanes, flooding, freezes or some other natural or manmade cause which results in unprecedented loss of capability to provide service and/or

(4) Peak Demands at the Water and/or Wastewater Plants have reached capacity levels and are placing a strain on the systems and/or

(5) Contamination of the raw water transportation system due to hurricanes, flooding, freezes and/or some other natural or manmade cause which may result in unprecedented loss of capability to provide service.

<u>Stage 3 - Water Shortage Warning</u>

(1) The Rio Grande Watermaster advises HWWS that a water shortage exists due to the reduction of the water levels of Amistad and Falcon Reservoirs. The Watermaster takes necessary action to prevent the waste of water or to alleviate the emergency a authorized under the TNRCC: Operation of the Rio Grande (Allocation and Distribution of Waters Section 303.22).

(2) Analysis of water supply and demand indicates that the City of Harlingen's annual water allotment will be exhausted and/or

(3) Major Line Breaks or pump or system failure due to hurricanes, flooding, freezes, and/or some other natural or manmade cause which result in unprecedented loss of capability to provide service.

(4) Peak Demands at the Water Distribution System and/or Treatment Plants have exceeded capacity levels for 3 days and have placed a strain on the systems. Without restrain, service to all utility customers can not be guaranteed and/or

(5) Contamination of the raw water transportation system due to hurricanes, flooding, freezes, and/or some other natural or manmade cause resulting in unprecedented loss of capability to provide service.

<u>Stage 4 - Water Shortage Emergency</u>

Stage 3 Guidelines 1, 2, and 3 are in effect. Reduction in water usage is still insufficient. Additional water use restrictions are required.

(4) Peak Demands at the Water and/or Wastewater Plants have exceeded capacity levels for 5 days and have placed a strain on the systems. Without restrain, service to all utility customers can not be guaranteed and/or

(5) Contamination of the raw water transportation system due to hurricanes, flooding, freezes, and/or some other natural or manmade cause resulting in major unprecedented loss of capability to provide service.

LEGAL AND REGULATORY COMPONENTS

- Plan Adoption Resolution
- Emergency Water Demand Management Ordinance/Regulation
- Means to Pass Requirements on to Customer Utilities if Project Will Be Used by Other Utilities
- Water Conservation Plumbing Code Ordinances/Regulation
- Plumbing Fixture Retrofit Ordinance/Regulation (Optional)
- Conservation-Oriented Rate Ordinance/Regulation (Optional)
- Water Conservation Landscape Ordinance/Regulation (Optional)

CONTRACTS WITH OTHER POLITICAL SUBDIVISIONS

The HWWS will, as part of a contract for sale of water to any other political subdivision, require that entity to adopt applicable provisions of the HWWS's water conservation and emergency water demand management plan or already have a plan in effect. These provisions will be through contractual agreement prior to the sale of water to the political subdivision.

ANNUAL REPORTS

The TWDB requires financial assistance recipients that implement a program of water conservation to submit an annual report to the Executive Administrator describing the implementation, status, and quantitative effectiveness of the water conservation program until its financial obligations to the State have been discharged (31 TAC §363.71). The HWWS will submit an annual report within sixty (60) days after the anniversary date of the loan closing.

CAMERON COUNTY
COLONIA WASTEWATER TREATMENT
PLANNING STUDY
Contract No. 95-483-009

The following Maps are not attached to this report. They are located in the official file and may be copied upon request.

Map No. 1 Plate 1Sanitary Sewer, City of Combes

Map No. 2 – Plate 2 Water Improvements, City of Combes

Map No 3 – Plate 3 – Sanitary Sewer, City of Primera

Map No 4 – Plate 4 – Force Main, City of Harlingen

Map No. 5 – Plate 5 – Sanitary Sewer, Arroyo Colorado Estates

Please Contact Research and Planning Fund Grants Management Division at (512) 463-7926