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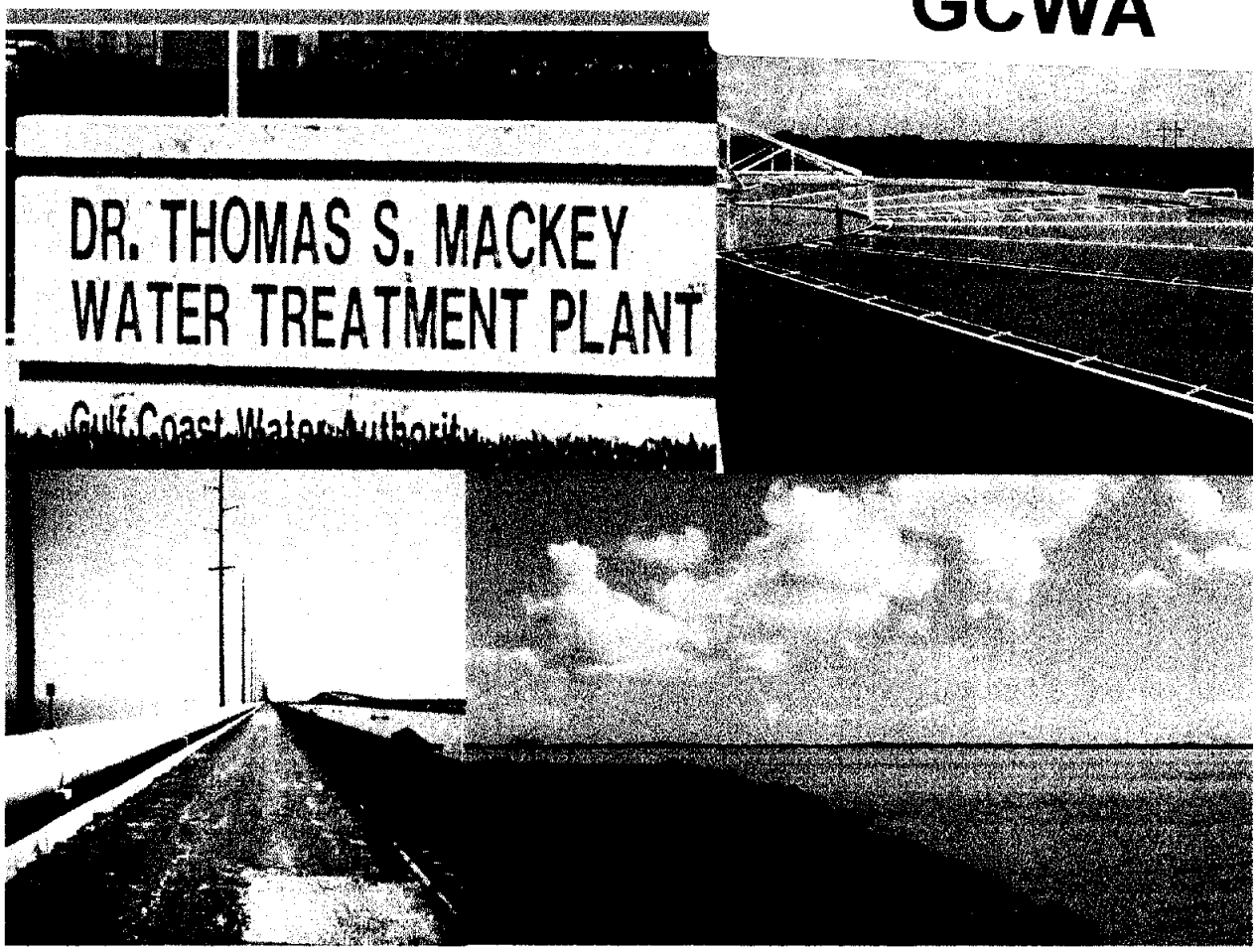
GCWA



GULF COAST WATER AUTHORITY

Trinity Water Transfer Study

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January 2003

Water For
Industry
Agriculture
Municipalities
G C W A

MWH
MONTGOMERY WATSON HARZA

Acknowledgements

The preparation of this report would not have been possible without the assistance and full cooperation of the Gulf Coast Water Authority, City of Houston, Coastal Water Authority and Texas Water Development Board. Special thanks are extended to Robert Istre and Nancy Matthews of the GCWA, Ernest Rebuck and David Messey of the TWDB, Ralph Rundle of the CWA, Jeff Taylor and Jun Chang of the City of Houston and Fred Perrenot of the Perrenot Group for coordinating this project.

MWH is responsible for the completion of this report. Team members include Robert Higgins P.E., Thomas Visosky P.E. and Sushrut Joshi.

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BACKGROUND

The primary water provider for Galveston County is the Gulf Coast Water Authority (GCWA). Though the existing GCWA water supply is adequate to meet the current demands of the region, there is a growing concern about the ability to meet future water demand. The Senate Bill 1 Region H Water Plan determined that the next source of surface water for the Gulf Coast Water Authority would be City of Houston water rights in the Trinity River.

Currently, no mechanism exists to transport this water from the Trinity River to the Gulf Coast Water Authority. Raw surface water is delivered from the Trinity River to Harris county users via the Coastal Water Authority (CWA) canal and pipeline system. It is envisioned that Trinity River water would be delivered to the GCWA via this same system with expansion and extensions as necessary to meet additional demand.

PURPOSE OF THE STUDY

This study was envisioned in an Interlocal Agreement between the City of Houston, GCWA and CWA to determine the most effective and cost efficient manner to utilize their respective resources and system capacities to meet long term regional water needs.

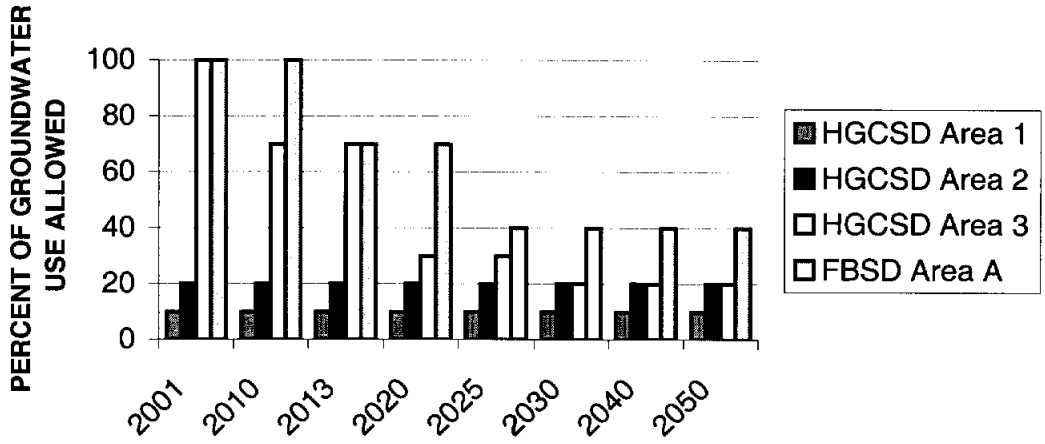
The specific purpose of this **Gulf Coast Water Authority Trinity Water Transfer Study** is to evaluate alternatives for delivering Trinity River water from the City of Houston/CWA to the GCWA. The water basin transfer may include trading of Brazos River water for Trinity River water or water sale. The study will cover years 2010 to 2050. This study was sponsored by GCWA, the City of Houston and CWA, with a matching planning grant from the Texas Water Development Board (TWDB). The development of this report was also coordinated with Camp Dresser and Mckee Inc. (CDM), which was simultaneously conducting a masterplan for the City of Houston's water needs.

This study will also estimate the capital cost to construct a transmission line from the CWA system and any required raw water pumping improvements to CWA system.

PLANNING AREA

The planning area is located in the TWDB Regional Water Planning Area H in southeast Texas. The planning area contains West Harris County, the north part of Brazoria County, the part of Fort Bend County to the east of Brazos River, and Galveston County. The area includes many cities and population centers, such as southwest Harris County, Sugar Land, Missouri City, Fort Bend Water Conservation and Irrigation District No.2 (FBWCID #2), Pearland, Alvin, Angleton, Galveston, League City, Texas City, Dickinson, La Marque and several other communities. Most of the area is under the jurisdiction of either the Fort Bend Subsidence District or the Harris-Galveston Coastal Subsidence District. These subsidence districts have either imposed or are planning to impose groundwater-pumping restrictions, thereby requiring the conversion to surface water or other alternate water sources. The subsidence district rules are summarized in **Figure ES-1**.

FIGURE ES-1
SUBSIDENCE DISTRICT REQUIREMENTS



CURRENT & FUTURE WATER DEMANDS

Future water demand in the area being served by GCWA will determine the size of new facilities and upgrades to existing infrastructure. For the purposes of evaluating future water demand, the GCWA planning area was divided in two regions:

Eastern Service Area – Consisting of cites in Galveston County including Galveston, Texas City, Dickinson, La Marque, Santa Fe, Hitchcock, San Leon, Bayou Vista, Kemah, Bayview and Tiki Island. Industrial customers are also served.

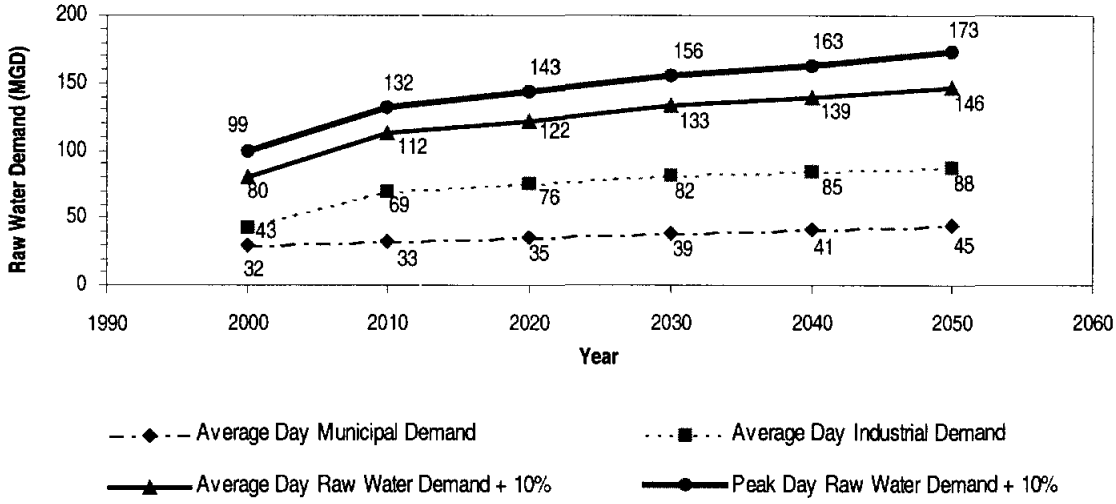
Western Service Area – Consisting of customers in Brazoria, Fort Bend and southwest Harris Counties. Customers with existing water options are the City of Pearland, FBWCID #2, Missouri City and Sugar Land. New customers that could be served are City of Alvin, City of Manvel and the City of Arcola. Potential future customers could be the City of Houston and Municipal Utility Districts in the southwest Harris County.

Water and population projections were evaluated to obtain the projected ultimate capacities for the year 2050. These projections are summarized for each service area.

Raw Water Demand in the Eastern Service Area

Total water demand for the Eastern Service Area is presented in **Figure ES-2.**

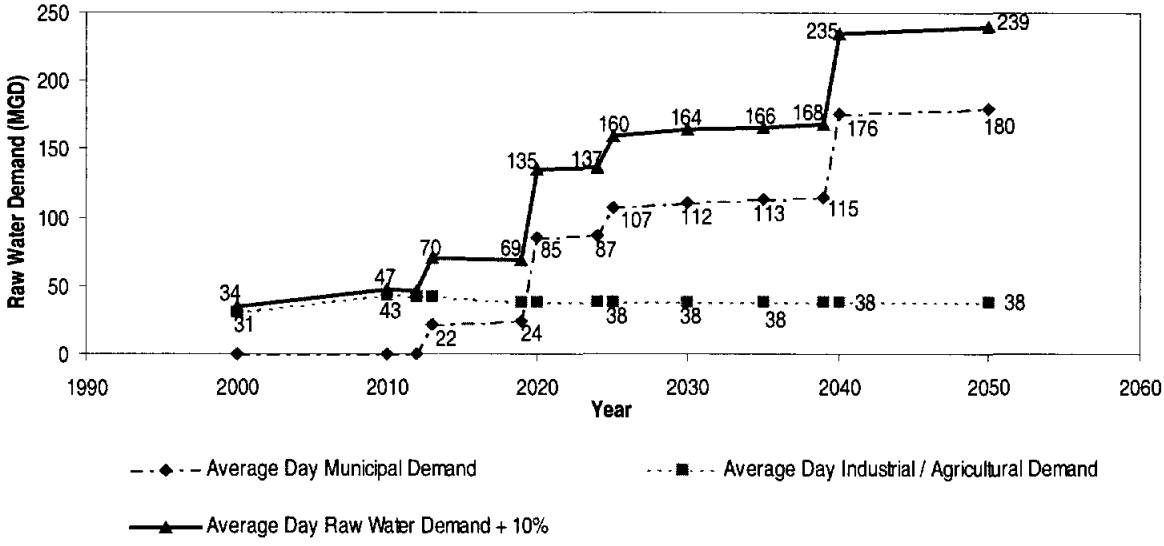
FIGURE ES-2
EASTERN SERVICE AREA RAW WATER PROJECTION (MGD)



Raw Water Demand in Western Service Area

Total water demand for the Western Service Area is presented in **Figure ES-3.**

FIGURE ES-3
WESTERN SERVICE AREA RAW WATER PROJECTION (MGD)



Raw Water Demand Overview and Trinity Transfer Timing

The raw water requirement for the entire planning region is summarized in **Table ES-1**. The Western and Eastern Service Area water demand can be met by the existing GCWA water rights through 2020 when the Southwest Harris County would likely obtain 60 MGD from the new SWWTP. Because of the potential high cost of the facilities to accommodate the Trinity transfer (approximately $200 M), it would be beneficial to delay construction as long as possible by utilizing lower cost water available to the Western Service Area. The temporary 50 MGD to 75 MGD alternate sources could be supplied through short term contracts (2020 – 2030) or by constructing the Trinity Transfer facilities prior to 2030.

The Trinity Transfer project would then come online in 2030 delivering approximately 133 MGD, and could be utilized at a rate equal to the peak day raw water supply requirement for the Eastern Service Area. The design capacity of the Trinity Transfer would be 175 MGD – the 2050 peak day demand for the Eastern Service Area. Thus the entire raw water demand for the Eastern Service Area will be met from the Trinity River source beginning in 2030. Water rights could be obtained through transfer or sale from CWA.

The Western Service Area demand by itself beginning in 2040 will exceed GCWA's existing Brazos River water rights of 212 MGD. To meet this demand, additional permanent raw water sources of approximately 30 MGD will have to be identified. Other raw water sources are identified in **Section 3**.

TABLE ES-1
REGIONAL WATER SUPPLY SCENARIO

Regional Water Needs	2000	2010	2013	2020	2025	2030	2035	2040	2050
Existing GCWA Water Rights	212	212	212	212	212	212	212	212	212
Western Service Area Raw Water Demand	34	47	70	135	160	164	166	235	239
Eastern Service Area Raw Water Demand	80	112	115	122	128	133	139	139	146
Existing Raw Water Deficit or Surplus	98	52	27	-45	-75	-86	-93	-162	-174
Temporary Supplies On-Line				50	75				
Trinity River Water (CWA)						133	139	139	146
Permanent Supplie(Western Service Area)s On-Line								30	30
Surplus Raw Water	**98**	**52**	**27**	**5**	**0**	**47**	**46**	**7**	**2**

PIPELINE CORRIDOR ANALYSIS

The corridor analysis focuses on the route of the raw water pipeline will take from the proposed CWA Take Points to the proposed GCWA Delivery Points. Probable take points were identified based on consultations with CWA and GCWA. Take Point 1 (TP-1) is located at the City Houston's Southeast Water Purification Plant (SEWPP), and Take Point 2 (TP-2) is located at the split of CWA 96" and 60" pipelines as shown in **Figure ES-4**. At either take point a booster pump station will be required because the available head is minimal. The booster pump station would require a site area of approximately ¾ acre. The site would accommodate parking, control building, pump station, and surge tank. Two delivery points were also analyzed. Delivery Point 1 (DP-1) is located on the GCWA canal, and Delivery Point 2 (DP-2) is located at the GCWA Reservoir.

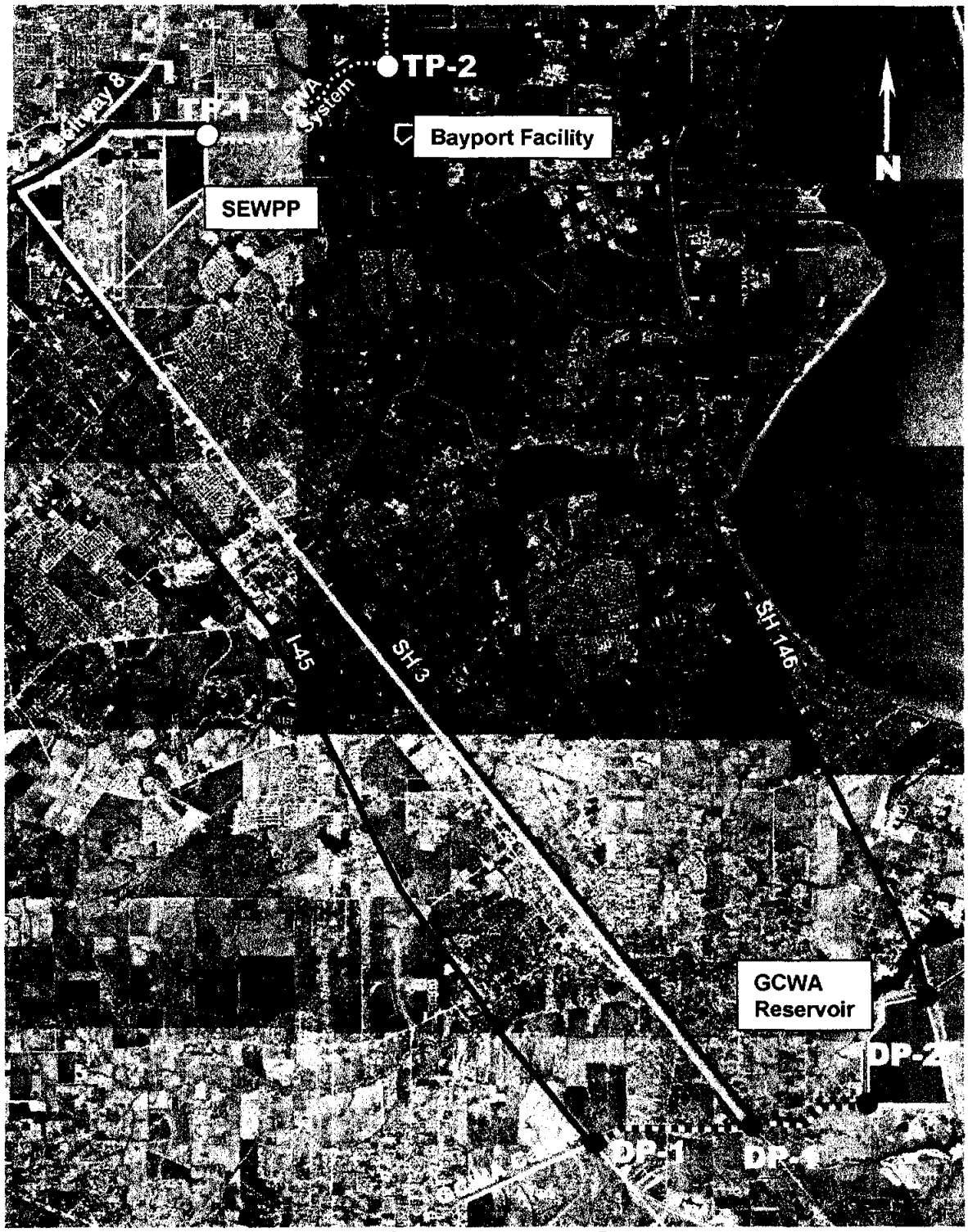


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FIGURE ES-4
Alternate Pipeline Corridors

Four alignments were initially analyzed to convey water from the potential take points to the delivery points. These potential alignments are depicted in **Figure ES-4** and represent an initial evaluation of corridors and representative costs. The Residential Streets to Utility Passageway to SH 3 Corridor from TP-2 to DP-1 appears to be the most promising alignment alternative. A final alignment study will be required in the future.

FRAMEWORK PROJECT & PROBABLE COSTS

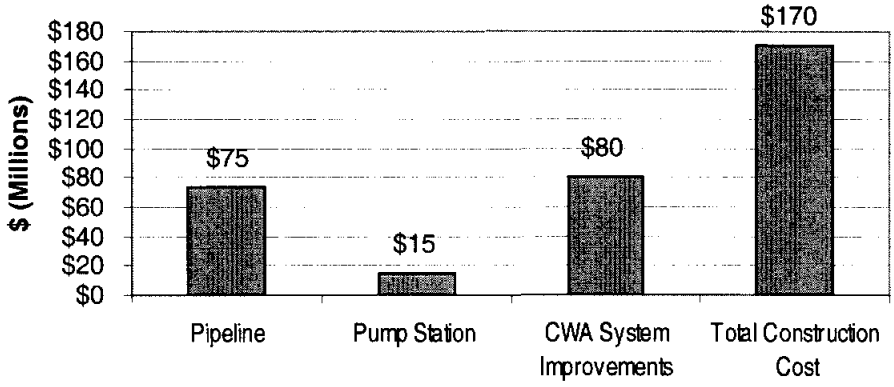
A framework project has been determined to represent the proposed facilities. The framework project capacity would be 175 MGD, the 2050 GCWA peak raw water supply requirement for the Eastern Service Area. The 175 MGD framework project would consist of a pipeline and pump station. The framework project is shown in **Table ES-2**.

TABLE ES-2
FRAMEWORK PROJECT

Alignment	Take Point	Delivery Point	Length (miles)	Capacity (MGD)	Pipeline Diameter (inches)	Booster Pump Station (total installed hp)
Residential Streets to Utility Passageway to SH 3 Corridor	TP-2	DP-1	16.0	175	84	4,700

Construction costs were determined based on past experience with the cost of construction of similar types of facilities and comparison with Region H standard feasibility estimating numbers identified in TWDB Region H Cost Estimate Procedures. Construction costs for the framework project is summarized in **Figure ES-5**. Costs are expressed in current September 2002 dollars (ENR CCI 6588).

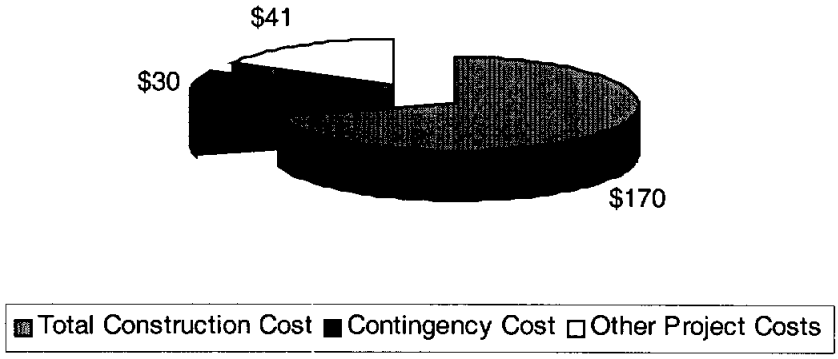
FIGURE ES-5
FRAMEWORK PROJECT CONSTRUCTION COST



Project contingency of 20 percent on the pipeline and pump station along with $12 Million for CWA improvements have been applied to the construction costs, resulting in a total project contingency of $30 Million. Other project costs of 22 percent on the pipeline and pump station along with $18 Million for CWA improvements have been applied to the construction costs plus project contingency, resulting in a other project costs of $41 Million. Other project costs include administration, engineering, legal,

permitting, construction management, land acquisition, and easements. The total project costs of $241 Million are broken-down in **Figure ES-6**. Costs have been rounded to more appropriately reflect accuracy.

FIGURE ES-6
FRAMEWORK PROJECT CONTINGENCY AND OTHER PROJECT COSTS (MILLIONS)

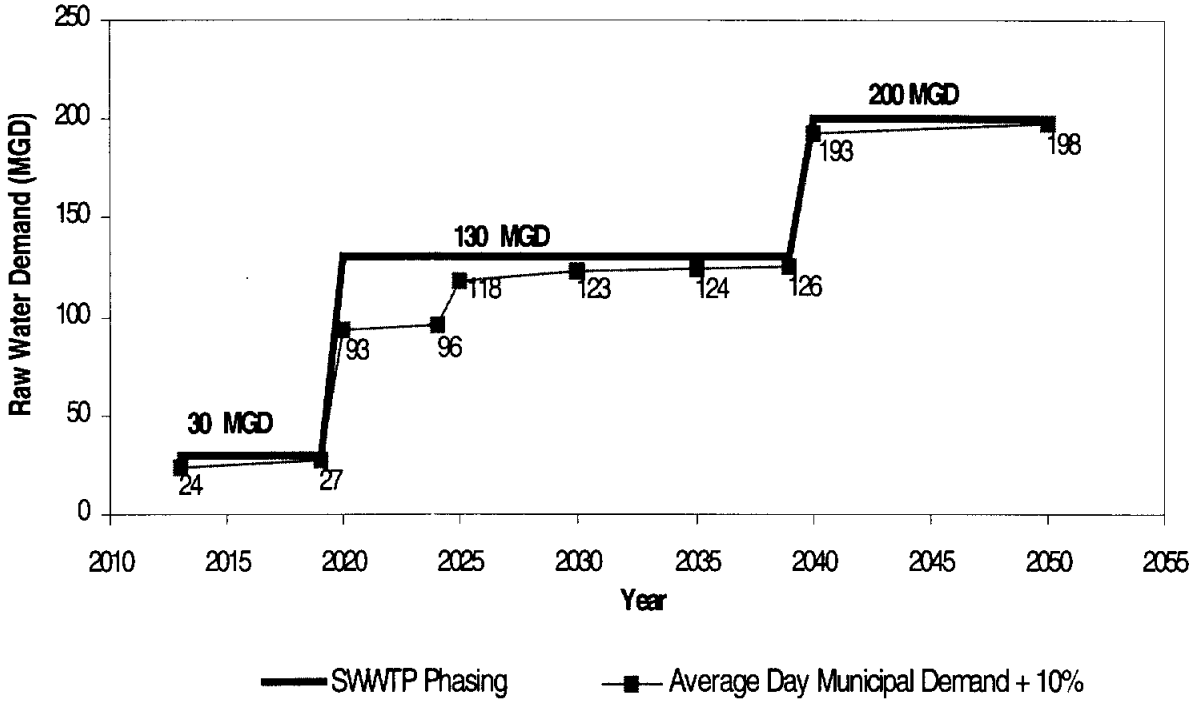


SOUTHWEST WATER TREATMENT PLANT

Currently surface water treatment does not exist in the Western Service Area, therefore, the Southwest Water Treatment Plant (SWWTP) is proposed to be built to meet these demands. The Western Service Area municipal surface water demand projections (average day demand + 10%) along with the proposed SWWTP phasing are shown in **Figure ES-7**. The jumps in water demand correspond to initiation of the Subsidence District Groundwater reduction rules in the region. The water treatment plant can potentially be constructed in three phases, 30 MGD prior to 2013, expansion to 130 MGD prior to 2020, and expansion to 200 MGD prior to 2040. Depending on participation and timing of municipal users, this phasing scenario can be accelerated or reduced to meet actual surface water demand.

FIGURE ES-7

SOUTHWEST WATER TREATMENT PLANT PHASING



BACKGROUND

The primary water provider for Galveston County is the Gulf Coast Water Authority (GCWA). Though the existing GCWA water supply is adequate to meet the current demands of the region, there is a growing concern about the ability to meet future water demand. The Senate Bill 1 of the 75th Texas Legislature Region H Water Plan determined that the next source of surface water for the Gulf Coast Water Authority would be City of Houston water rights in the Trinity River.

Currently, no mechanism exists to transport this water from the Trinity River to the Gulf Coast Water Authority. Raw surface water is delivered from the Trinity River to Harris county users via the Coastal Water Authority (CWA) canal and pipeline system. It is envisioned that Trinity River water would be delivered to the GCWA via this same system with expansion and extensions as necessary to meet additional demand.

PURPOSE OF THE STUDY

This study was envisioned in an Interlocal Agreement between the City of Houston, GCWA and CWA to determine the most effective and cost efficient manner to utilize their respective resources and system capacities to meet long term regional water needs.

The specific purpose of this **Gulf Coast Water Authority Trinity Water Transfer Study** is to evaluate alternatives for delivering Trinity River water from the City of Houston/CWA to the GCWA. The water basin transfer may include trading of Brazos River water for Trinity River water or water sale. The study will cover years 2010 to 2050. This study was sponsored by GCWA, the City of Houston and CWA, with a matching planning grant from the Texas Water Development Board (TWDB). The development of this report was also coordinated with Camp, Dresser and Mckee Inc. (CDM), which was simultaneously conducting a masterplan for the City of Houston's water needs.

This study will also estimate the capital cost to construct a transmission line from the CWA system and any required raw water pumping improvements to CWA system.

SCOPE OF WORK

This regional water supply and facility plan evaluates alternatives for the conveyance of Trinity River water to the GCWA reservoir, and evaluates conveyance of Brazos River water to the new regional surface water plant serving the City of Houston, West Harris County, Fort Bend County and northern Brazoria County. This facility plan does not evaluate requirements for interbasin water transfer. The scope of work includes the following elements:

Task 1 – Review Region H Data and Facilities. Review and summarize reports from the GCWA, City of Houston, and CWA pertaining to existing raw water supply sources and projected water demand.

Task 2 – Develop Water Supply Geographic Delivery Pattern. Review the Texas Water Development Board (TWDB)/GCWA Regional Facility Plan for West Harris, Fort Bend and Brazoria Counties dated September 2000, to identify additional participants in the regional plant. Update projected water plant capacity for years 2010 through 2050. Prepare an overview of the planning area that will receive Trinity River Water and Brazos River Water.

Task 3 – Water Transmission Corridor Study. Identify and evaluate up to three delivery points in the existing GCWA system for Trinity River Water. Identify recommended delivery point for use in the Water Transmission Corridor Study.

Task 4 – Cost Estimates. Evaluate alternative transmission corridors and develop cost estimate for recommended improvement for each alternative and expected annual and operation and maintenance costs. Determine the capital, operation and maintenance costs in terms of present worth. In addition, review Participating Utilities funding mechanisms and identify up to three alternative methods to finance construction of the recommended project.

PLANNING AREA

The planning area is located in the TWDB Regional Water Planning Area H in southeast Texas. The planning area contains West Harris County, the north part of Brazoria County, the part of Fort Bend County to the east of Brazos River, and Galveston County. The area includes many cities and population centers, such as southwest Harris County, Sugar Land, Missouri City, Fort Bend Water Conservation and Irrigation District No.2 (FBWCID #2), Pearland, Alvin, Angleton, Galveston, League City, Texas City, Dickinson, La Marque and several other communities. Most of the area is under the jurisdiction of either the Fort Bend Subsidence District or the Harris-Galveston Coastal Subsidence District. These subsidence districts have either imposed or are planning to impose groundwater-pumping restrictions, thereby requiring the conversion to surface water or other alternate water sources.

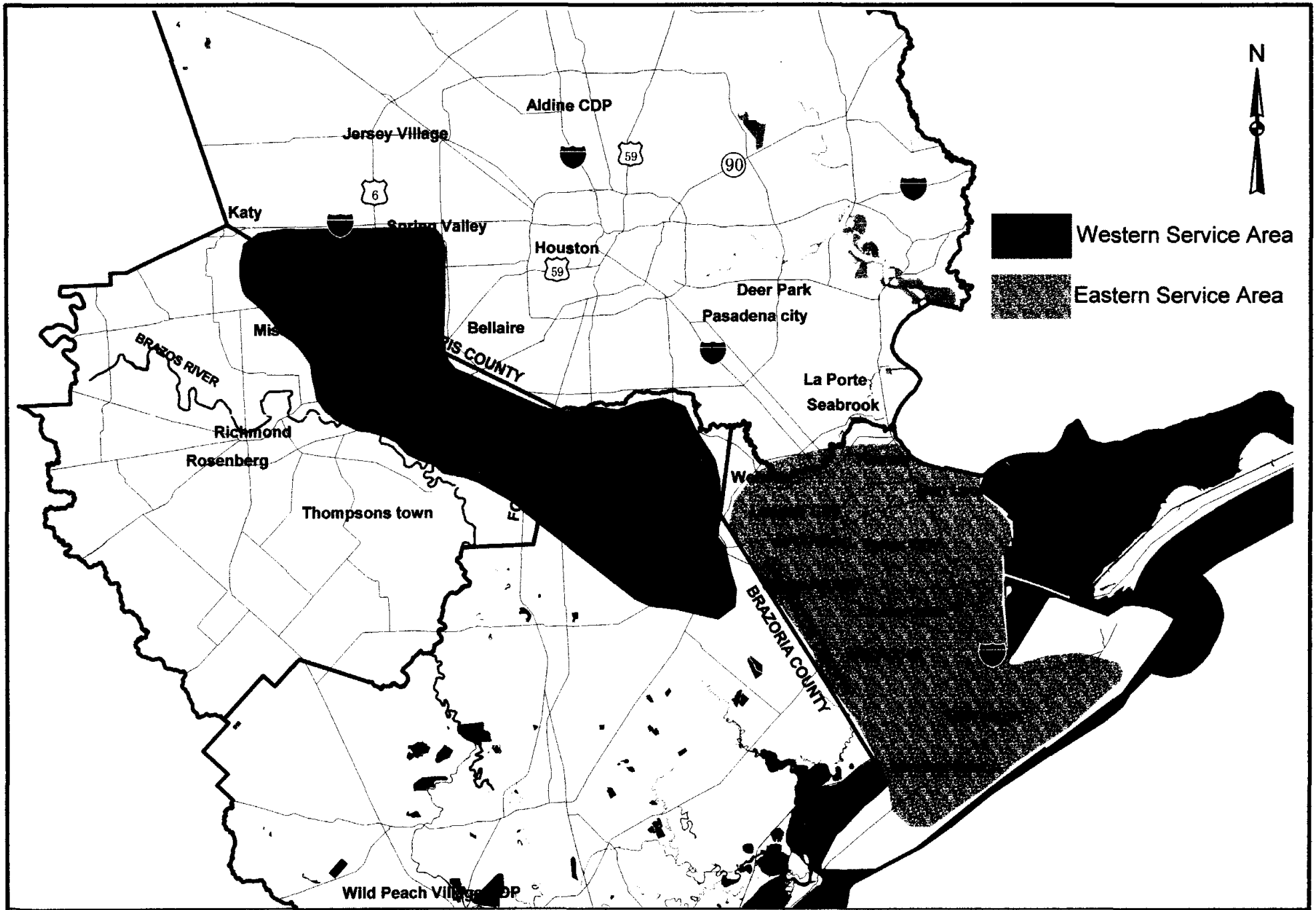
River basins within the planning region include: the lower portion of the Brazos River Basin, the northeast portion of the San Jacinto-Brazos Coastal Basin and the southwest portion of the San Jacinto Coastal Basin. GCWA and City of Houston are the major water providers for the region. CWA serves the region by transporting Trinity River Water to Harris County. A map of the planning area is shown in **Figure 1-1**.

The planning region includes:

- Communities which would receive water from the proposed Southwest Water Treatment Plant to be located in WCID #2, Texas,
- Communities which currently receive water from GCWA in Galveston County

Fort Bend and Harris Galveston Coastal Subsidence Districts

Significant portions of the planning area are using groundwater. Pumping of groundwater and the resulting subsidence have led to localized flooding, inundation, or overflow of areas within the planning area. The Harris-Galveston Coastal Subsidence District (HGCSD) was created in 1975 by the Texas Legislature and the Fort Bend Subsidence District (FBSD) was created by Texas Legislature Chapter 1045, Texas General Laws 4251 in 1989. Both Districts provide for regulation of the withdrawal of groundwater to prevent subsidence. It is estimated that by the year 2050, groundwater use in the planning area will be reduced significantly as a result of mandates from the HGCSD and FBSD. HGCSD currently operates under its 1999 plan, which divides the District into three regulatory areas. Under the 1992 plan, each area must convert a certain portion of its groundwater use to surface water. The 1999 Regulatory Plan divides the District into three Regulatory Areas as presented in **Figure 1-2**.



0 4 8 12 Miles

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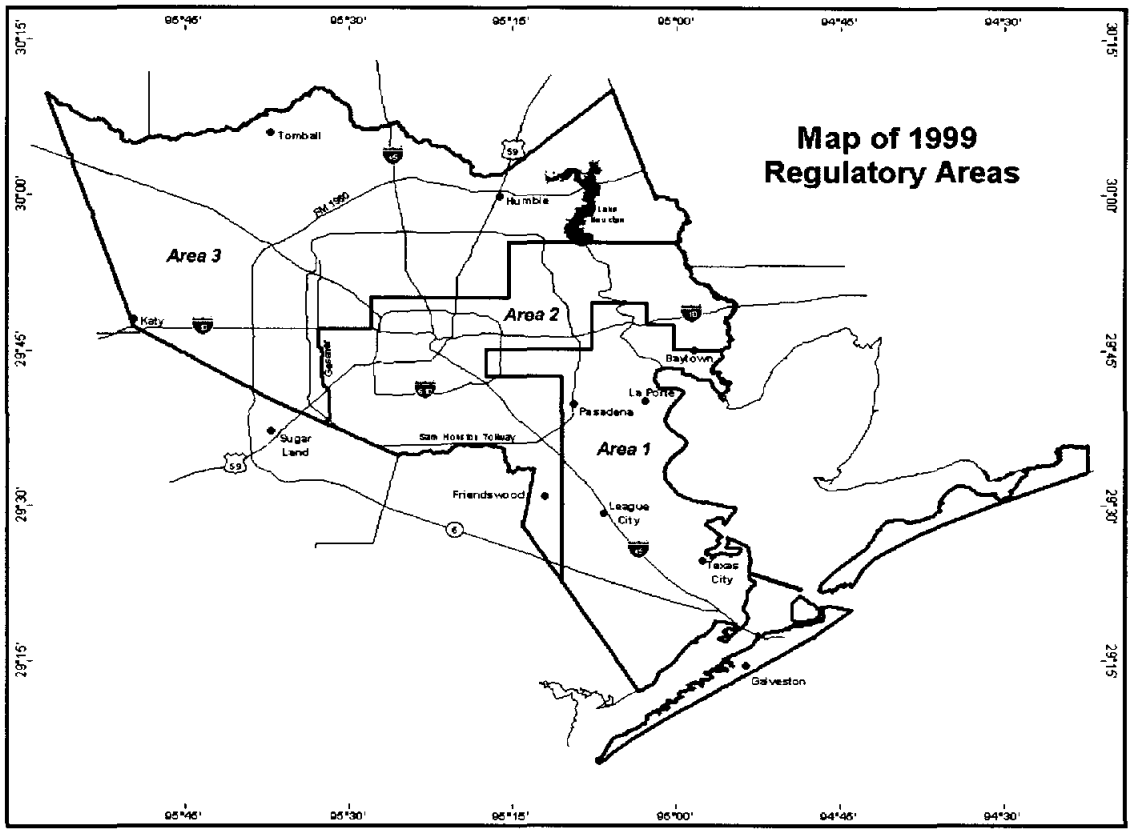
FIGURE 1-1

REGIONAL SERVICE AREAS

JANUARY 2003

FIGURE 1-2
HARRIS GALVESTON COASTAL SUBSIDENCE DISTRICT REGULATORY BOUNDARIES



The Regulatory Areas of this Regulatory Plan have been reconfigured from the 1992 plan to generally reflect converted versus unconverted areas. Area 1 must limit groundwater production to 10 percent of total water demand by 2001. In Area 2, the region must reduce groundwater pumping to 20 percent of the total water use or have a certified groundwater reduction plan in place to attain the 20 percent rule by year 2001. In Area 3, groundwater pumping must be reduced to 70 percent by 2010, 30 percent by 2020, and 20 percent by 2030. Part of the study planning area falls into Area 1, Area 2 and Area 3 of the Subsidence District Groundwater Regulatory Plan.

Other parts of the planning area fall under the FBSD. The FBSD has hired the HGCSD to manage the operations of the Fort Bend District. It is assumed that the conversion plans for the FBSD will be similar to those of the HGCSD. The final rules for Fort Bend County are not expected to be promulgated until the spring of 2003, but based on the draft release it is expected that the rules will require a reduction in groundwater pumping. The anticipated regulations would restrict groundwater usage to 70% of average annual water demand in to 2013 and to 40% prior to 2025.

Section 2
Planning Area Existing Infrastructure

This section reviews and identifies the existing infrastructure of the planning area, and highlights the areas surface water availability and conveyance capacity.

GULF COAST WATER AUTHORITY

Gulf Coast Water Authority (GCWA) was created by the 59th Texas Legislature in 1965 under Chapter 712 and was given legal authority to plan, develop, and operate regional water facilities. The GCWA operates an extensive canal and reservoir system that conveys water from the Brazos River to industrial, agricultural, and municipal customers in Fort Bend, Brazoria and Galveston Counties. The GCWA has over twenty years experience in operating the Dr. Thomas Mackey Water Treatment Plant in Texas City, Texas serving municipal customers in Galveston County.

Surface Water Source and Supply

The GCWA currently draws surface water from the Brazos River. The Brazos River transverses Texas from Lubbock through Waco and Richmond before discharging into the Gulf of Mexico at Freeport. For the period between 1973 and 1995, the Brazos River had an average daily flow at the Richmond – Rosenberg USGS monitoring station of 8,200 mgd.

The GCWA currently has one surface water treatment plant located in Texas City, the Dr. Thomas Mackey Water Treatment Plant that treats surface water from the Brazos River. The GCWA plant has a capacity of 50 mgd.

Water Rights

The right to take water from the Brazos is based on the permit allocation from the State of Texas and the date of the permit. Gulf Coast Water Authority currently holds 3 water permits for diversion of water from the run of the Brazos River and one permit for diversion of water that falls in the Oyster Creek watershed. A summary of these permits and allocations are shown in the following table:

TABLE 2-1
GULF COAST WATER AUTHORITY EXISTING WATER PERMITS

CA Number (Permit #)	Year	Total Withdrawal		Maximum Withdrawal Rate	
		ac-ft / yr	mgd	cfs	mgd
5168 (1040) – GCWA Shannon Pumping Plant	1926	99,932	89	685	443
5171 (1299D) – GCWA Briscoe Pumping Plant	1939 / 1950	125,000	112	600	388
5169 (1467D) – Oyster Creek Withdrawal	1930	12,000	11	60	39
Total	**Total**	**236,932**	**212**	**1,345**	**870**

The GCWA currently holds water rights for an average withdrawal of 201 mgd of run of the river water from the Brazos River. These rights are valid if and only if the Brazos river contains enough water to permit withdrawal at these rates. In the event of low flow in the Brazos, the State of Texas will allocate water usage based on the date of the water permit. In addition to its run of the river rights, GCWA has entered into a contract with the Brazos River Authority (BRA) for water stored in the BRA reservoirs. When flow in the Brazos decreases, the GCWA can request release of the stored BRA water.

Raw Water Conveyance System

Canal System

The GCWA operates two canals from the Brazos River to serve customers in Brazoria and Galveston Counties. These canals are designated System A and System B. They are shown on **Figure 2-1.**

Canal System A traverses approximately 72 miles from the Shannon Pump Station near Fulshear, Texas to the Galveston County Reservoir located north of Texas City, Texas. This system is made up of Jones Creek (18.5 miles), Oyster Creek (14.75 miles), Lateral 10 (6.5 miles) and American Canal (32.3 miles). The Shannon Pump Station has 4 pumps and has a rated capacity of 330 mgd, but current actual available capacity 203 mg. The American canal consists of both natural and manmade sections. Once the flow is lifted from the Brazos River to Jones Creek, the water flows to Oyster Creek to Sugar Land. The 2nd lift Station then lifts flow from Oyster Creek to the American Canal. After the 2nd lift Station, the American Canal flows through Missouri City and adjacent to Manvel, Alvin, Pearland and Friendswood before finally discharging to the GCWA Reservoir. The 2nd Lift Station has 4 pumps with an installed capacity of 220 mgd.

Canal System B traverses 51 miles. This system consists of Briscoe Canal (35 miles), Monsanto Canal (5.5 miles) and Ranch Canal (10.7 miles). The Briscoe Canal starts at the Briscoe Pump Station, which is located on the Brazos River south of Missouri City. The Briscoe Pump Station has 3 pumps with an installed capacity of 300 mgd. Once the water is lifted from the Brazos to the man-made canal, the water flows 51 miles to the Monsanto and Chocolate Bayou Reservoirs. Lateral 10 connects the American and Briscoe Canal near Manvel and is used to convey water from the American Canal to the Briscoe Canal. Flow in Lateral 10 can not be reversed.

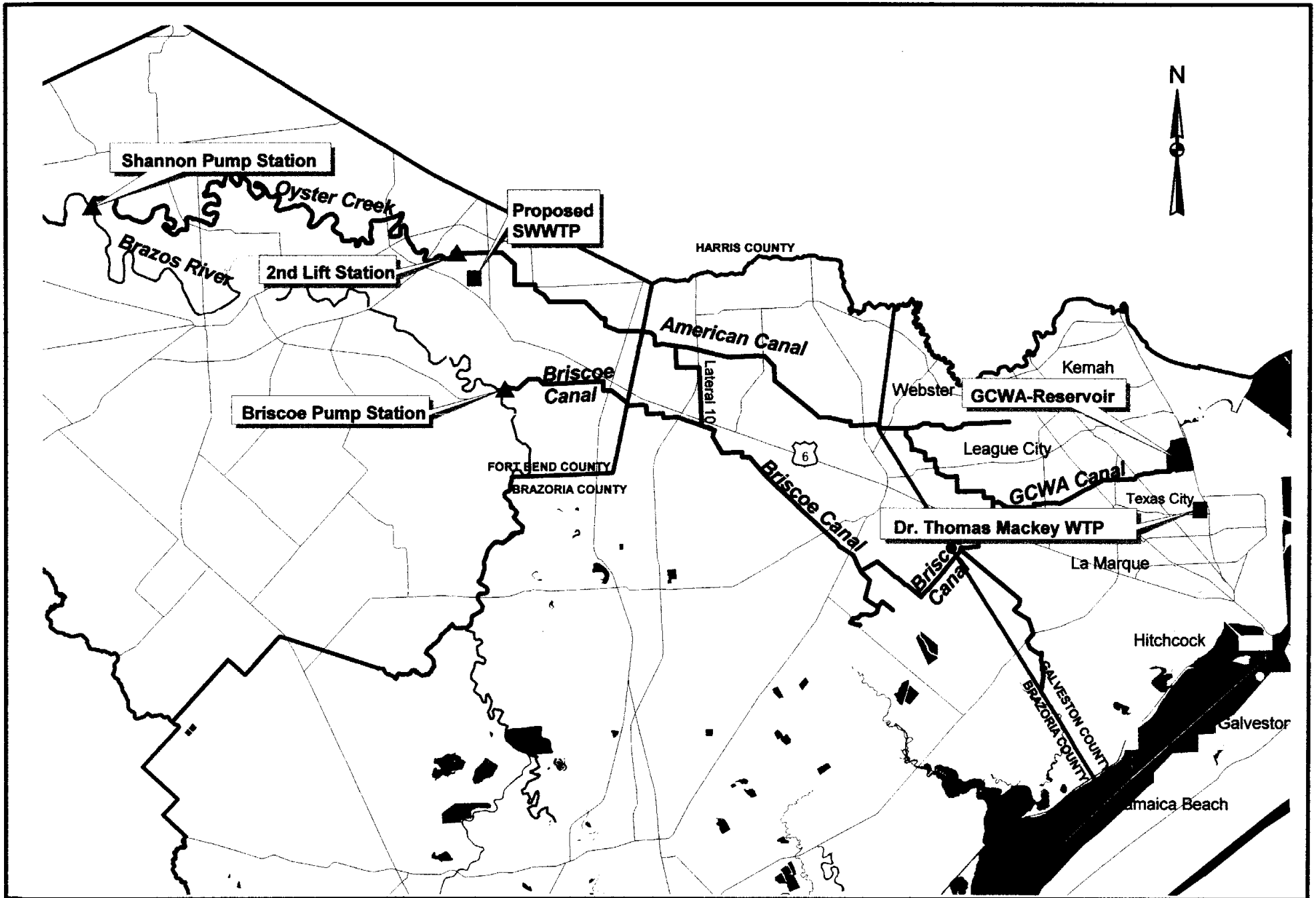
Canal Capacity

The GCWA has recently completed a report entitled "Gulf Coast Water Authority Water Audit Summary". This report reviews the canal system and calculates the theoretical capacity of the canal, and recommends improvements to the System to minimize restrictions in flow. The GCWA Canal System is shown in **Figure 2-1.** The report findings in regards to the capacity of the System A and B canal system are shown in **Table 2-2.**

TABLE 2-2
GCWA CANAL CAPACITY

Canal Segment	Canal System	Clean Capacity (1) (mgd)	Silted (1') Capacity (1) (mgd)
Jones and Oyster Creek	A	175	129
American Canal: 2nd Lift Station to Lateral 10	A	220	197
American Canal: Lateral 10 to New Extension to GCWA Canal	A	129	97
Lateral 10	A	107	107
Briscoe Canal: Briscoe Pump Station to Lateral 10	B	265	252
Briscoe Canal: Briscoe Pump Station to Ranch Canal Take Point	B	291	291

(1): With 1 foot of freeboard


N
Shannon Pump Station
Oyster Creek
Brazos River
Proposed SWWTP
2nd Lift Station
HARRIS COUNTY
American Canal
Briscoe Canal
Briscoe Pump Station
Lateral 10
Kemah
Webster
GCWA-Reservoir
League City
6
FORT BEND COUNTY
BRAZORIA COUNTY
Briscoe Canal
GCWA Canal
Texas City
Dr. Thomas Mackey WTP
La Marque
Briscoe Canal
Hitchcock
GALVESTON COUNTY
BRAZORIA COUNTY
Galvestor
maica Beach
0 3 6 Miles
MWH
MONTGOMERY WATSON HARZA
GCWA - TRINITY RIVER WATER CONVEYANCE STUDY
FIGURE 2-1
GULF COAST WATER AUTHORITY SYSTEM
JANUARY 2003

With a clean canal, the limiting capacity of the American Canal above Lateral 10 is 175 mgd, while the limiting capacity of the American Canal below Lateral 10 drops to 129 mgd. With several modifications noted in the report, the capacity of the Jones and Oyster Creek section could be upgraded to approximately 1,200 mgd. If these improvements were constructed, the limiting silted capacity of the American Canal System above Lateral 10 would be 197 mgd. It is anticipated that a majority of the sedimentation would occur in lakes in Fort Bend County, and the approximately 50 miles of GCWA canal system before the GCWA Texas City Reservoir. Over a long period silting would reduce the capacity of the Reservoir and dredging may be required.

GCWA Texas City Reservoir

The Texas City Reservoir is located along State Highway 146 in Texas City. This reservoir is the raw water source for the Dr. Thomas Mackey Water Treatment Plant and several industries in the area. The reservoir covers approximately 900 acres and has a capacity of 7,300 acre-feet (2,380 MG).

Water Treatment Facilities

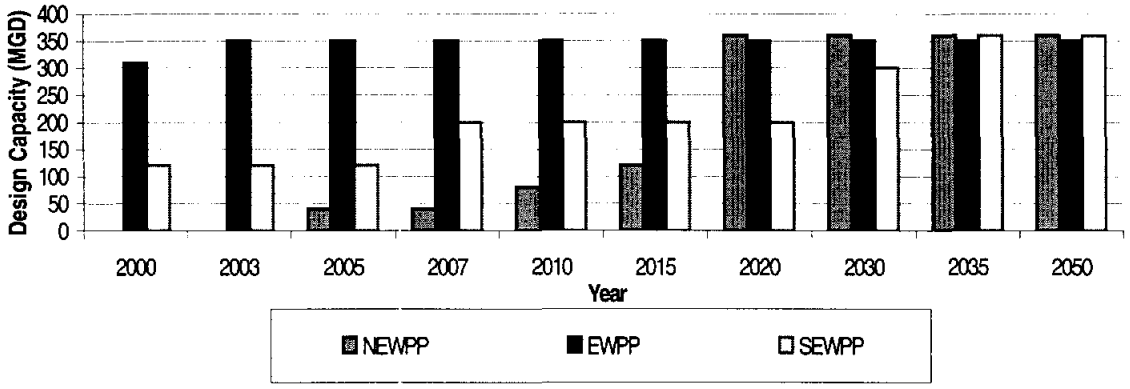
GCWA currently owns and operates the Dr. Thomas Mackey Water Treatment Plant in Texas City, Texas. The plant was expanded to 50 mgd from an original capacity of 25 mgd in 2000. The plant provides potable water to the majority of the residents of Galveston County, including the citizens of Texas City, La Marque, Galveston, Tiki Island, League City, San Leon, Bayou Vista, Kemah, Bayview and Bacliff.

GCWA is a wholesaler supplier and the conventional filtration plant distributes water from the distribution pump station through a series of transmission mains to the ground storage tanks of cities. The plant currently operates the high service pumps at approximately 90 psi.

CITY OF HOUSTON

The City of Houston's potable water demand is met by both groundwater and surface water. The City currently operates two surface water treatment plants and 97 groundwater pumping stations which pump water from 198 wells. The surface water plants are the North East Water Purification Plant (NEWPP) (under construction), East Water Purification Plants (EWPP) I, II and III and the South East Water Purification Plant (SEWPP). The estimated design capacities of these treatment plants are presented in **Figure 2-2.**

FIGURE 2-2
CITY OF HOUSTON WATER TREATMENT PLANT



The southwest portion of the City of Houston within the study region is primarily served with groundwater. The east and southeast part of the City is served by existing surface water treatment plants. The SEWPP receives raw water from Trinity River, which is conveyed by Coastal Water Authority (CWA)'s canal system. The EWPP receives raw water from the Trinity River, and Lake Houston.

The northeast part of the City will be supplied by surface water from the new NEWPP, which is currently under construction. Raw water to this plant is conveyed from Lake Houston.

The City anticipates that the western portion of the city will receive water from their existing plants and the proposed Southwest Water Treatment Plant (SWWTP). It is anticipated that the City would use the Bellaire Braes Pump Station as a booster station for future surface water from the SWWTP. The Bellaire Braes Pump Station currently has a ground storage capacity of 10 mg.

COASTAL WATER AUTHORITY

The Coastal Water Authority (CWA), is a conservation and reclamation district of the State of Texas provides raw water to the three-county area encompassing all of Harris County and parts of Chambers and Liberty Counties. CWA was invested with powers, among others, to transport and deliver raw water within and without its limits, to acquire and construct properties and facilities necessary for these purposes, and to issue bonds supported by water conveyance revenues. CWA has no powers of taxation.

The City of Houston has contracted with CWA to finance, construct, maintain, and operate facilities to transport the City's raw water from the Trinity River to EWPP and SEWPP. The contract expires in the year 2035.

Raw Water Conveyance System

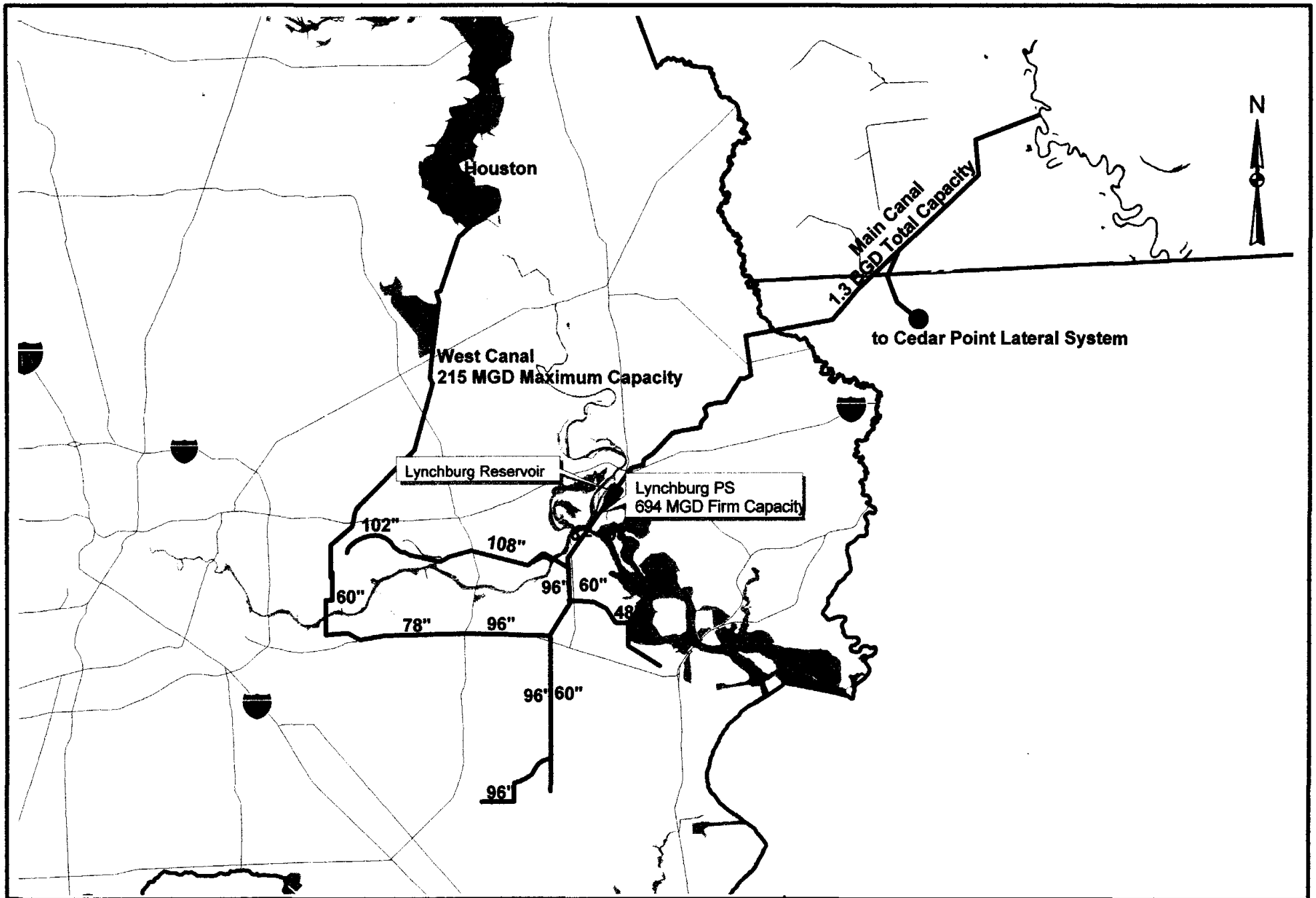
The conveyance facilities include the Trinity River Pump Station, the Main Canal, the Lynchburg Reservoir and the Cedar Point Lateral System. These conveyance facilities are presented in **Figure 2-3**. The Trinity River Pump Station which is located on the Trinity River near Liberty has an existing capacity of 615 MGD, with one pump on stand-by, and an ultimate design capacity of 1.3 billion gallons per day. This station lifts water 50 feet from the Trinity River and discharges it into the Main Canal.

The Main Canal extends westerly 22 miles from the Trinity River Pump Station to the Lynchburg Reservoir located on the north side of the Houston Ship Channel opposite the San Jacinto Monument.

At the southwesterly end of the Main Canal, the water discharges into the Lynchburg Reservoir, an impoundment of approximately 200-acre surface with a capacity of 1.5 billion gallons. The Cedar Point Lateral System comes off of the Main Canal and diverts water to industries in the Cedar Point Area and to agricultural use in Chambers County.

Distribution System

At the south end of the Lynchburg Reservoir, the Distribution System begins with the Lynchburg Pump Station. The Distribution System provides water for the industries on the south side of the Ship Channel from Sims Bayou easterly to Galveston Bay and for the industries in the Bayport Industrial Complex. The Distribution System downstream from the Lynchburg Pump Station provides water to the City of Houston's Southeast Water Purification Plant (SEWPP). The Northwest Lateral provides water to the City of Houston's East Water Purification Plan (EWPP).



MWH
MONTGOMERY WATSON HARZA

GCWA - TRINITY RIVER WATER CONVEYANCE STUDY

FIGURE 2-3
COASTAL WATER AUTHORITY SYSTEM

JANUARY 2003

Section 3
Current and Future Water Demand

Future water demand in the area being served by GCWA will determine the size of new facilities and upgrades to existing infrastructure. For the purposes of evaluating future water demand, the GCWA planning area was divided in two regions:

Eastern Service Area – Consisting of cites in Galveston County including Galveston, Texas City, Dickinson, La Marque, Santa Fe, Hitchcock, San Leon, Bayou Vista, Kemah, Bayview and Tiki Island. Industrial customers are also served.

Western Service Area – Consisting of customers in Brazoria, Fort Bend and southwest Harris Counties. Customers with existing water options are the Cities of Pearland and Sugar Land. New customers that could be served are City of Alvin, FBWCID #2, City of Manvel and the City of Arcola. Potential future customers could be the City of Houston and Municipal Utility Districts in the southwest Harris County. Industrial and agricultural customers would also be served as in the Eastern Service Area.

Water and population projections were evaluated to obtain the projected ultimate capacities for the year 2050. These projections are summarized for each service area.

POPULATION AND RAW WATER USE PROJECTIONS

Data regarding population and water use was collected from the Region H Regional Water Plan. The Region H population and water use projections served as a basis for the State's Year 2002 Water Plan. Detailed breakdowns of the Region H population and water use projections can be found in **Appendix B**.

Eastern Service Area

This section presents the population and water demand projections for utilities, industrial and agricultural customers in the Eastern Service Area.

Current Population and Water Usage

The Eastern Service Area is served by the Gulf Coast Water Authority and has municipal as well as industrial water demands. For utilities and industrial customers in the planning area, **Table 3-1** provides the year 2000 population and water use. For purposes of this Report, municipal utilities with a current water demand of less than 0.5 MGD are represented as "Other Municipal Utilities".

TABLE 3-1
YEAR 2000 EASTERN SERVICE AREA POPULATION AND AVERAGE WATER DEMAND

Municipal Utility	Population	Average Day Water Demand (MGD)
Galveston	65,800	12
Texas City	45,700	6.6
Dickinson	19,600	4
La Marque	14,900	2
Santa Fe	12,100	1.2
Hitchcock	6,900	0.9
Other Municipal Utilities*	15,500	2
Centerpoint	-	2.4
Subtotal	**181,000**	**32**
Industrial Entity		**Industrial Water Demand (MGD)**
British Petroleum	-	24
Dow Chemical Company	-	8
Sterling Chemicals	-	4
Valero Energy	-	3
Marathon Petroleum	-	2.8
ISP	-	1
Eagle Concrete	-	0.02
Subtotal		43
Total Average Day Water Demand		**75**

*These include utilities with current demand of less than 0.5 MGD (San Leon, Bayou Vista, Kemah, Bayview, Bacliff and Tiki Island).

Projected Population

The population projections for the various municipalities are reported in **Table 3-2**. The data lists projected population in 10-year increments to the year 2050. The Region H Regional Water Plan was used as a basis for these population projections. The population is expected to approximately double over the 50-year planning period.

TABLE 3-2
POPULATION PROJECTION FOR CITIES IN THE EASTERN SERVICE AREA

Municipal Utility	2000	2010	2020	2030	2040	2050
Galveston	65,800	73,000	83,600	94,700	107,100	121,300
Texas City	45,700	50,600	55,300	60,200	65,300	68,300
Dickinson	19,600	22,600	26,100	30,200	32,800	34,500
La Marque	14,900	16,700	18,900	20,700	21,800	22,900
Santa Fe	12,100	16,600	19,900	22,800	24,500	26,300
Hitchcock	6,900	7,800	9,300	10,700	11,600	12,200
Other Municipal Utilities	15,500	17,300	19,000	21,000	22,800	24,800
Total	181,000	205,000	232,000	260,000	286,000	310,000

Municipal Water Demand Projections

Given the population projections for the various cities, the corresponding Region H Regional Water Plan municipal water use projections are shown in **Table 3-3**. These water use projections represent the expected annual water use reported as average daily demand in MGD.

TABLE 3-3
MUNICIPAL AVERGE DAY WATER DEMAND PROJECTIONS FOR EASTERN SERVICE AREA (MGD)

Municipal Utility	2000	2010	2020	2030	2040	2050
Galveston	12	12.2	13	15	16	19
Texas City	6.6	6.9	7.1	7.6	8	8.3
Dickinson	4	4.3	4.7	5.4	5.8	6
La Marque	2	2.1	2.2	2.3	2.4	2.5
Santa Fe	1.2	1.5	1.7	1.9	2	2.1
Hitchcock	0.9	1	1.1	1.2	1.3	1.4
Centerpoint	2	3	3	3	3	3
Other Municipal Utilities	2.2	2.2	2.3	2.4	2.5	2.6
Total	32	33	35	39	41	45

Based on planned development, the cities of Galveston, Texas City, Kemah, San Leon and Tiki Island anticipate a faster growth rate than Region H projections. These utilities may need to monitor their growth trends closely. If these utilities grow more aggressively than Region H projections, provisions would have to be made for additional raw water sources and projects would have to be implemented at an earlier date as required. Incorporating the faster growth rates of these utilities would approximately double the average daily municipal demand in 2050.

Peak Day Demand

The water use projections reported in **Table 3-3** represent the average day demand projections. To convert this demand to peak day demand, peaking factors were used. The peaking factors for each utility are shown in **Table 3-4**. The peaking factors are influenced by the distribution of residential, commercial and industrial customers throughout the utility.

TABLE 3-4
EASTERN SERVICE AREA PEAKING FACTORS*

Municipal Utility	Peaking Factors
Galveston	1.42
Texas City	1.40
League City	1.87
Friendswood	2.13
Dickinson	2.00
La Marque	1.48
Santa Fe	2.00
Hitchcock	1.90
Other Municipal Utilities*	1.61

*Peaking factor is the weighted average of municipal utilities in this category
* Source: GCWA New Water Supply for Galveston, La Marque & Texas City, Texas December 1996

The corresponding peak flows are listed in **Table 3-5**. Because of the subsidence district requirements the municipal utilities meet this peak demand by treating surface water.

TABLE 3-5
PROJECTED PEAK DAY MUNICIPAL WATER DEMAND IN EASTERN SERVICE AREA (MGD)

Municipal Utility	2000	2010	2020	2030	2040	2050
Galveston	16	17	18	21	22	27
Texas City	9	10	10	11	11	12
Dickinson	8	9	9	11	12	12
LaMarque	2.9	3.1	3.3	3.5	3.5	3.7
Santa Fe	2.4	3	3.4	3.8	4	4.3
Hitchcock	1.7	1.8	2.1	2.3	2.5	2.6
Centerpoint	2	3	3	3	3	3
Other Municipal Utilities	4.6	4.7	4.8	5	5	5.2
Total	**47**	**51**	**54**	**60**	**63**	**69**

Industrial Water Demand Projections

Industrial demand in this service area constitutes more than half the total demand water demand. The industrial water use projections are presented in **Table 3-6**. The GCWA conducts annual surveys, and the demand projections are the results of these surveys.

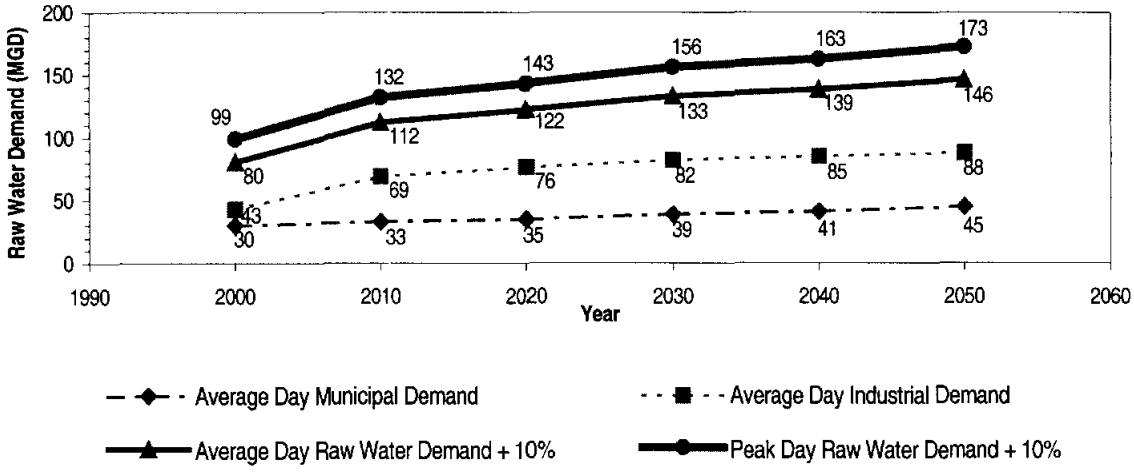
TABLE 3-6
PROJECTED INDUSTRIAL WATER DEMAND IN EASTERN SERVICE AREA (MGD)

Industrial Demand	2000	2010	2020	2030	2040	2050
British Petroleum	24	33	36	37	38	39
Dow Chemical Company	8	13	14	16	18	20
Sterling Chemicals	4	9	12	15	15	15
Valero Energy	3	9	9	9	9	9
Marathon Petroleum	3	4	4	4	4	4
ISP	1	1	1	1	1	1
Eagle Concrete	0.02	0.02	0.02	0.02	0.02	0.02
Total Industrial Water Demand	43	69	76	82	85	88

Raw Water Demand in the Eastern Service Area

Total water demand for both municipal and industrial GCWA customers is presented in **Figure 3-1**. For estimating demand in the Eastern Service Area, the projected peak water demand is used to determine the raw water demand of the area. Peak raw water demand was estimated as projected peak water demand plus 10% allowance for evaporation and seepage.

FIGURE 3-1
EASTERN SERVICE AREA RAW WATER PROJECTION (MGD)



Western Service Area

The Western Service Area has municipal, industrial and agricultural demand. The cities of Sugar Land, Missouri City, Pearland, Alvin, Manvel, Arcola, along with FBWCID #2 constitute the municipal demand in this service area. This area will also likely include southwest Harris County. Analysis of southwest Harris County was studied by City of Houston in an unpublished planning study. Potential water demands for sothwest Harris County are provided in the section on surface water requirements.

Current Population and Water Usage

For utilities and industrial customers in the planning area, **Table 3-7** provides the year 2000 population and water use as reported in the Region H Plan. The current average day water demand for the Western Service Area is 64 MGD. Since the Southwest Harris County region is not demarcated, its population and average day water demand is unknown and hence not presented.

TABLE 3-7
YEAR 2000 WESTERN SERVICE AREA POPULATION AND AVERAGE WATER DEMAND

Municipal Demand (City)	Population	Average Day Water Demand (MGD)
Sugar Land	79,800	12
Missouri City	63,500	11
Pearland	32,000	4
Alvin	24,100	3
FBWCID #2	17,000	2
Manvel	5,200	0.6
Arcola	1,000	0.11
Subtotal	**222,600**	**33**
Industrial/Agricultural Demand		
Chocolate Bayou Water Company	-	13
OxyChem	-	6
Solutia (Monsanto)	-	5
Farmers on B System	-	5
Texas Brine	-	0.8
American Golf/Southwyck Golf/General Homes	-	0.3
Sugar Creek Country Club	-	0.2
Golf Unlimited	-	0.18
Texas Department of Corrections	-	0.16
River Bend Country Club	-	0.14
Fluor Daniel	-	0.08
First Colony/Commons/Baker Land/Trammel Crow	-	0.01
Farmers on A System	-	0
Subtotal	**-**	**31**
Total Average Day Water Demand		**64**

Projected Population

The population projections for the various municipalities in Fort Bend and Brazoria Counties are reported in **Table 3-8**. The data lists projected population in 10-year increments to the year 2050.

TABLE 3-8
POPULATION PROJECTION IN WESTERN SERVICE AREA*

Municipal Utility	2000	2010	2020	2030	2040	2050
Sugar Land	79,800	98,700	123,000	151,500	183,000	217,500
Missouri City**	63,500	72,270	91,800	114,840	141,660	174,780
Pearland	32,000	42,300	53,100	65,600	77,300	91,200
Alvin	24,100	28,700	33,800	40,200	45,700	51,900
FBWCID #2	17,000	22,000	28,500	36,100	44,900	55,900
Manvel	5,200	6,100	7,100	8,400	9,400	10,600
Arcola	1,000	1,000	1,100	1,100	1,200	1,300
Total	**222,600**	**271,070**	**338,400**	**417,740**	**503,160**	**603,180**

*Does not include any service area in Southwest Harris County

** Population data from 2010 through 2050 reduced by 10% of Region H values after consultations with City of Missouri City's Director of Public Works, Lee Dorger.

Municipal Water Demand Projection

As compared to the Eastern Service Area, this Area has predominantly municipal demand. Data regarding population and water use for this area was collected from the Texas Water Development Board (TWDB) Region H Plan. The Fort Bend Subsidence District (FBSD) and Harris and Galveston Coastal Subsidence District (HGCSD) conversion schedules were then applied to the water demand projections to calculate the surface water component of the total water demand.

The average day municipal water demand is presented in **Table 3-9**. The demand projection shown in **Table 3-9** represents the total water demand for the Western Service Area exclusive of any demand for southwest Harris County.

TABLE 3-9
MUNICIPAL AVERAGE DAY WATER PROJECTION DEMAND FOR WESTERN SERVICE AREA (MGD)*

Municipal Demand (Utility)	2000	2010	2020	2030	2040	2050
Sugar Land	12	14	17	21	25	29
Missouri City	11	12	14	17	21	25
Pearland	4	5	6	8	9	10
Alvin	2.9	3.3	3.7	4.2	4.7	5.3
FBWCID #2	2	2.4	3	3.6	4.3	5.4
Manvel	0.6	0.7	0.8	0.9	1	1.1
Arcola	0.11	0.12	0.13	0.14	0.15	0.16
Total Average Day Water Demand	**33**	**38**	**44**	**55**	**65**	**76**

*Does not include any demand from southwest Harris County.

Peak Day Demand

The water use projections reported in **Table 3-9** represent the average day demand projections. To convert this demand to peak day demand, peaking factors were used. The peaking factors for each utility are shown in **Table 3-10**. The peaking factors are influenced by the distribution of residential, commercial and industrial customers throughout the utility.

TABLE 3-10
WESTERN SERVICE AREA PEAKING FACTORS*

Municipal Utility	Peaking Factors
Sugar Land	2.4
Missouri City	1.81
Pearland	2
Alvin	1.64
FBWCID #2	2.24
Manvel	1.5
Arcola	1.5

*Source: Regional Surface Water Plant Feasibility Study for Brazoria, Fort Bend, and West Harris Counties, November 2000.

The corresponding peak flows are listed in **Table 3-11**.

TABLE 3-11
PROJECTED PEAK DAY MUNICIPAL WATER DEMAND IN WESTERN SERVICE AREA (MGD)*

Municipal Utility	2000	2010	2020	2030	2040	2050
Sugar Land	29	34	41	50	60	70
Missouri City	20	22	25	31	38	45
Pearland	8	10	12	16	18	20
Alvin	4.8	5.4	6.1	6.9	7.7	8.7
FBWCID #2	4	5	7	8	10	12
Manvel	0.9	1.05	1.2	1.35	1.5	1.65
Arcola	0.17	0.18	0.20	0.21	0.23	0.24
Total	67	77	92	114	135	158

*Does not include any demand from southwest Harris County.

The water treatment facilities for the Western Service Area will be designed for average day demand. The peak demands presented in **Table 3-11** will be met by utilizing groundwater wells.

Surface Water Requirement

The actual surface water component required to meet the **average day** water demand for the Western Service Area was calculated by taking in to consideration the groundwater reduction plans of the Harris Galveston Coastal Subsidence and the Fort Bend Subsidence Districts. The City of Houston's consultant who conducted their latest planning effort provided the surface water component for southwest Harris County. The City of Houston's planning report has not been finalized, and the surface water component could potentially be modified.

The following criteria was assumed to calculate the surface water requirements for other cities in the Western Service Area:

- **FBSD *proposed* groundwater reduction plan requirements:** The FBSD is divided into two areas. Currently groundwater withdrawal regulations are being proposed for Area A (northeast Fort Bend County). The cities of Missouri City and FBWCID #2 fall under Area A of the FBSD Regulatory Rule, and hence are required to meet 30% of average annual water demand by surface water in to 2013 and by 60% in to 2025. It was assumed that for 2025 and beyond, these cities would continue with the 60% surface water rule.

  The City of Sugar Land provided surface water projections. These projections were used without applying the FBSD conversion schedule. The City of Pearland has water options with the GCWA, and is interested in obtaining surface water from the South West Water Treatment Plant (SWWTP). The City of Pearland provided surface water demands for the purpose of this Report. Though the cities of Alvin, Manvel and Arcola are currently not regulated, the surface water requirements for the cities of were calculated by applying the FBSD Area A Regulatory Rules. These cities have also expressed interest in being included in the SWWTP.

- **HGCSD *approved* groundwater reduction plan requirements:** The HGCSD is divided into three regulatory areas. The 1999 District Regulatory Plan sets out a schedule for regulating groundwater withdrawal for each of the three areas.

  Area 1: Groundwater withdrawals must comprise no more than 10% of the utility's total water demand by 2001.

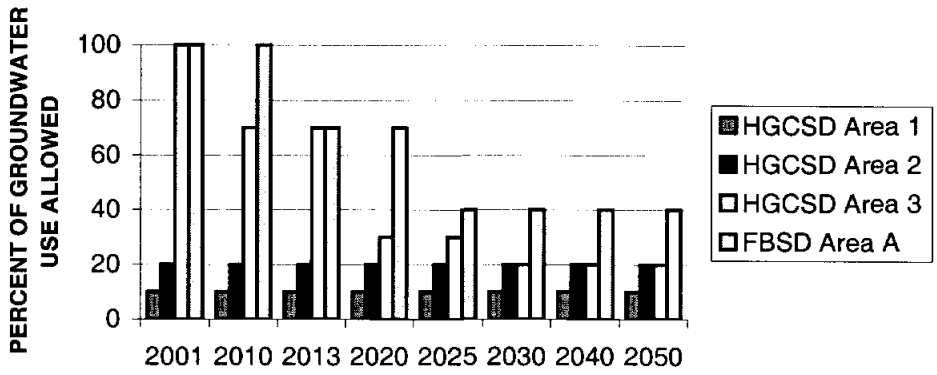
  Area 2: Groundwater withdrawals must comprise no more than 20% of the utility's total water demand by 2001.

  Area 3: Groundwater withdrawals to comprise no more than 70% of the permittee's total water demand. by 2010, 30% by 2020 and 20% by 2030.

  The surface water requirements for City of Houston and non-City of Houston in the southwest Harris County (HGCSD Area 3) is included in the demand data obtained from City of Houston as provided by CDM, the City of Houston's water planning consultant.

  These subsidence rules are summarized in **Figure 3-2.**

FIGURE 3-2
SUBSIDENCE DISTRICT REQUIREMENTS



Any water demand beyond those noted above will be supplied by surface water, and potential problems with blending ground and surface waters will be resolved.

Using these assumptions, the surface required to meet the projected water demand is presented in **Table 3-12**. Surface water requirements for Southwest Harris County were obtained from CDM and determined by analyzing census data and using a per capita water generation factor. This process was explained in a meeting with CDM, and the results were presented in **Appendix C**.

TABLE 3-12
PROJECTED MUNICIPAL SURFACE WATER REQUIREMENTS IN THE WESTERN SERVICE AREA (MGD)

Municipal Demand (City)	Subsidence Area	2000	2010	2013	2020	2025	2030	2035	2040	2050
Southwest Harris County*	HGCSD AREA 3	0	0	0	60	60	60	60	120	120
Sugar Land	FBSD AREA A	0	0	7	10	12	21	21	21	21
Missouri City	FBSD AREA A	0	0	4	4	9	10	11	12	15
Pearland*	-	0	10**	10	10	15	15	15	15	15
Alvin	-	0	0	1	1.1	2.4	2.5	2.7	3.8	4.2
FBWCID #2	FBSD AREA A	0	0	0.8	0.9	1.9	2.1	2.4	2.6	3.2
Manvel	-	0	0	0.22	0.23	0.49	0.53	0.55	0.77	0.87
Arcola	-	0	0	0.04	0.04	0.08	0.08	0.09	0.12	0.13
Total Average Day Surface Water Requirement		**0**	**10**	**23**	**87**	**101**	**112**	**113**	**176**	**180**

*Data obtained from CDM.

*Demand based on water options with GCWA for years 2010 and 2020. Beyond 2020, demand based on City projections.

**City of Pearland 10 MGD requirement in 2010 maybe delayed until 2013. 2013 is utilized for WTP Phasing

Industrial and Agricultural Water Demand Projections

The projected industrial and agricultural water use for Western Service Area is presented in **Table 3-13**. This demand projection data was obtained from GCWA.

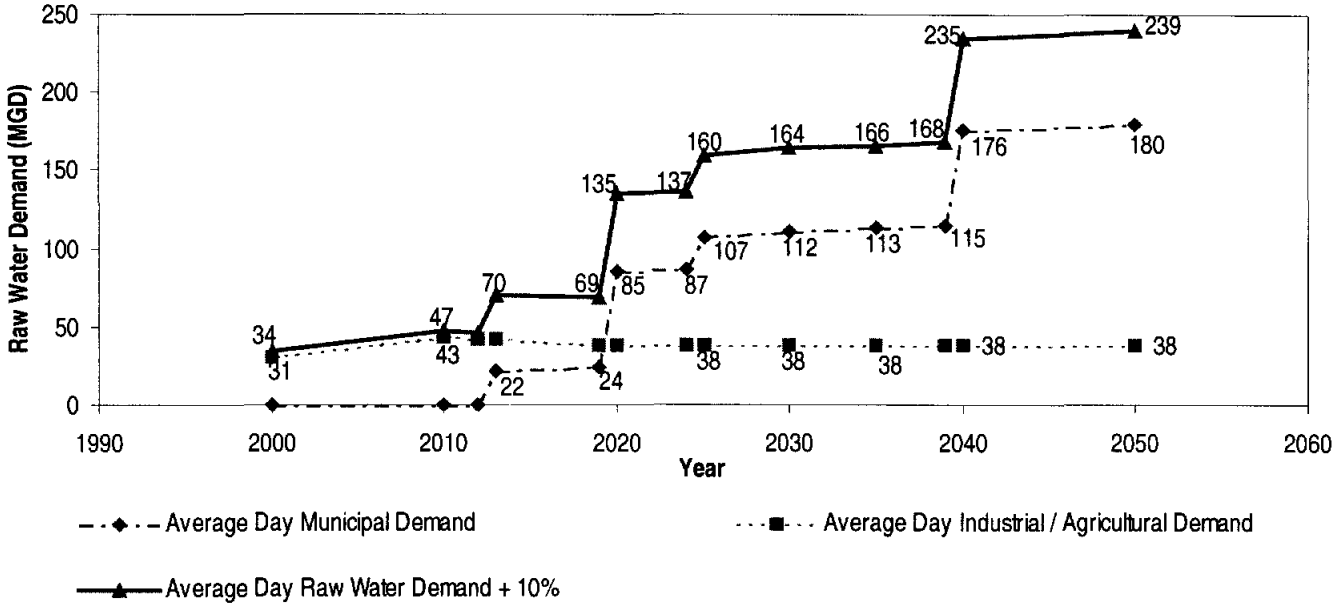
TABLE 3-13
PROJECTED INDUSTRIAL AND AGRICULTURAL WATER DEMAND IN WESTERN SERVICE AREA (MGD)

Industrial/Agricultural Demand	2000	2010	2020	2030	2040	2050
Chocolate Bayou Water Company	13	13	13	13	13	13
Solutia (Monsanto)	5	10	10	10	10	10
Oxy Chem	6	8	8	8	8	8
Farmers on B System	5	8	4	4	4	4
Farmers on A System	0	2.2	1.1	1.1	1.1	1.1
Texas Brine	0.8	0.8	0.8	0.8	0.8	0.8
American Golf/Southwyck Golf/General Homes	0.3	0.3	0.3	0.3	0.3	0.3
Sugar Creek Country Club	0.2	0.2	0.2	0.2	0.2	0.2
Golf Unlimited	0.2	0.2	0.2	0.2	0.2	0.2
Texas Department of Corrections	0.2	0.2	0.2	0.2	0.2	0.2
River Bend Country Club	0.1	0.1	0.1	0.1	0.1	0.1
Fluor Daniel	0.1	0.1	0.1	0.1	0.1	0.1
First Colony/Commons/Baker Land/Trammel Crow	0	0.014	0.014	0.014	0.014	0.014
Total Average Day Water Demand	**31**	**43**	**38**	**38**	**38**	**38**

Raw water demand in the Western Service Area

Total water demand for both municipal and industrial GCWA customers is presented in **Figure 3-3**. For the purpose of estimating demand in the Western Service Area, the projected average day water demand is used to determine the raw water demand of the area. Peak raw water demand was estimated as projected peak water demand plus 10% allowance for losses in the canal and in water treatment plants.

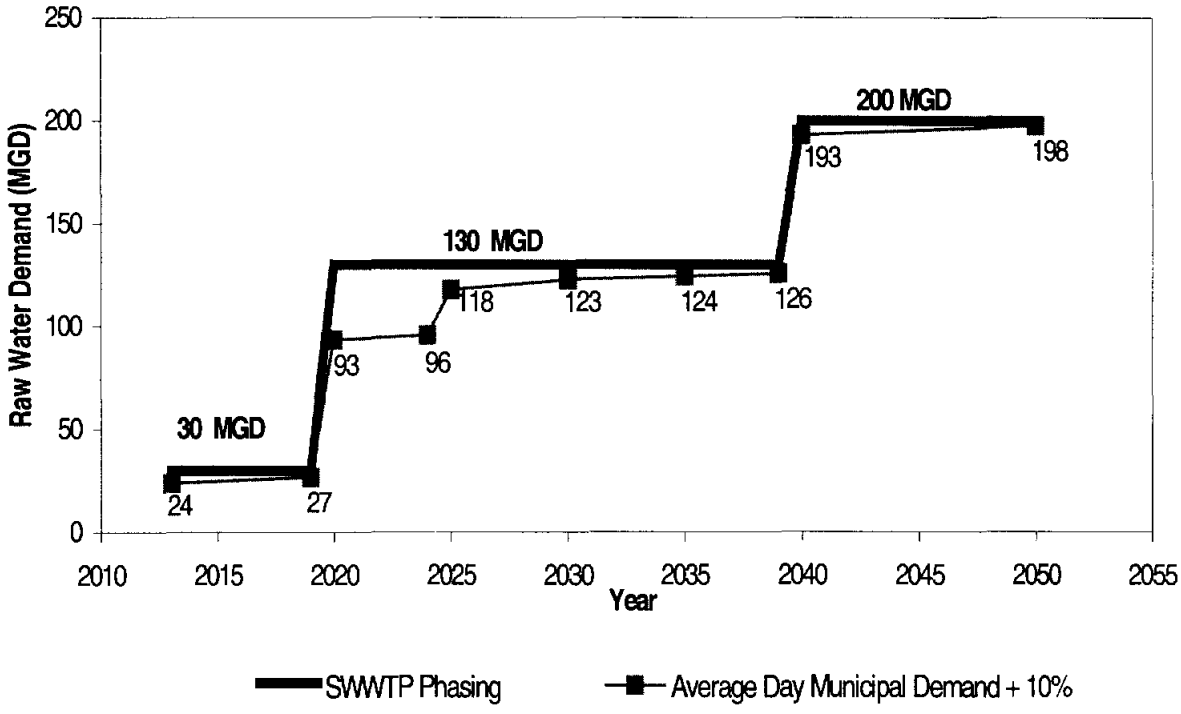
FIGURE 3-3
WESTERN SERVICE AREA RAW WATER PROJECTION (MGD)



Southwest Water Treatment Plant

Currently surface water treatment does not exist in the Western Service Area, therefore, the Southwest Water Treatment Plant (SWWTP) is proposed to be built to meet these demands. The Western Service Area municipal surface water demand projections (average day demand + 10%) along with the proposed SWWTP phasing are shown in **Figure 3-4**. The jumps in water demand correspond to initiation of the Subsidence District Groundwater reduction rules in the region. The water treatment plant can potentially be constructed in three phases, 30 MGD prior to 2013, expansion to 130 MGD prior to 2020, and expansion to 200 MGD prior to 2040. Depending on participation and timing of municipal users, this phasing scenario can be accelerated or reduced to meet actual surface water demand.

FIGURE 3-4
SOUTHWEST WATER TREATMENT PLANT PHASING



Regional Water Needs

The raw water requirement for the entire planning region is summarized in **Table 3-14**. The Western and Eastern Service Area water demand can be met by the existing GCWA water rights through 2020 when the Southwest Harris County would likely obtain 60 MGD from the new SWWTP. Because of the potential high cost of the facilities to accommodate the Trinity Transfer (approximately $200 M), it would be beneficial to delay construction as long as possible by utilizing lower cost water available to the Western Service Area. The temporary 50 MGD to 75 MGD alternate sources could be supplied through short term contracts (2020 – 2030) or by constructing the Trinity Transfer facilities prior to 2030.

The Trinity Transfer project would then come online in 2030 delivering approximately 133 MGD, and could be utilized at a rate equal to the peak day raw water supply requirement for the Eastern Service Area. The design capacity of the Trinity Transfer would be 175 MGD – the 2050 peak day demand for the Eastern Service Area. Thus the entire raw water demand for the Eastern Service Area will be met from the Trinity River source beginning in 2030. Water rights could be obtained through transfer or sale from CWA.

The Western Service Area demand by itself beginning in 2040 will exceed GCWA's existing Brazos River water rights of 212 MGD. To meet this demand, additional permanent raw water sources of approximately 30 MGD will have to be identified. Other raw water sources are identified in the next subsection.

TABLE 3-14
REGIONAL WATER SUPPLY SCENARIO

Regional Water Needs	2000	2010	2013	2020	2025	2030	2035	2040	2050
Existing GCWA Water Rights	212	212	212	212	212	212	212	212	212
Western Service Area Raw Water Demand	34	47	70	135	160	164	166	235	239
Eastern Service Area Raw Water Demand	80	112	115	122	128	133	139	139	146
Existing Raw Water Deficit or Surplus	98	52	27	-45	-75	-86	-93	-162	-174
Temporary Supplies On-Line				50	75				
Trinity River Water (CWA)						133	139	139	146
Permanent Supplies On-Line (Western Service Area)								30	30
Surplus Raw Water	**98**	**52**	**27**	**5**	**0**	**47**	**46**	**7**	**2**

Other potential raw water sources

The planning region has potential sources of raw water apart from those considered in this study. These sources would be required to meet the region's water needs before the Trinity Transfer occurs as can be seen from **Table 3-14**.

These potential options for raw water include:

- The current available BRA water rights of 40 MGD,
- Conversion or sale of Industrial/Agricultural Demand to Municipal
- Water rights of 138 MGD from the Chocolate Bayou Water Company,
- 29 MGD from Twin Oaks Reservoir located in central Robertson County,
- 26 MGD available to the Brazos River Authority (BRA) from the Allen's Creek Reservoir,
- 60 MGD available to the City of Houston from the Allen's Creek Reservoir
- Desalination.
- Scalping portion of flood flows into off-channel reservoirs.

Section 4
Pipeline Corridor and Raw Water Improvements

This section discusses the new facilities and improvements necessary to convey water from the CWA system to GCWA system. Potential raw water take points, booster pump station sites, transmission corridors, and delivery points are identified and analyzed.

PIPELINE CORRIDOR

The corridor analysis focuses on the route of the raw water pipeline from the proposed CWA Take Points to the proposed GCWA Delivery Points. Given the alternative locations of the Take Points and Delivery Points, alternative pipeline corridors were identified. These alternative corridors were then evaluated to determine a preferred routing of the pipelines. Factors considered in the selection of routes include the following:

- Length of corridor
- Known environmental impacts along route
- Land ownership
- Constructability

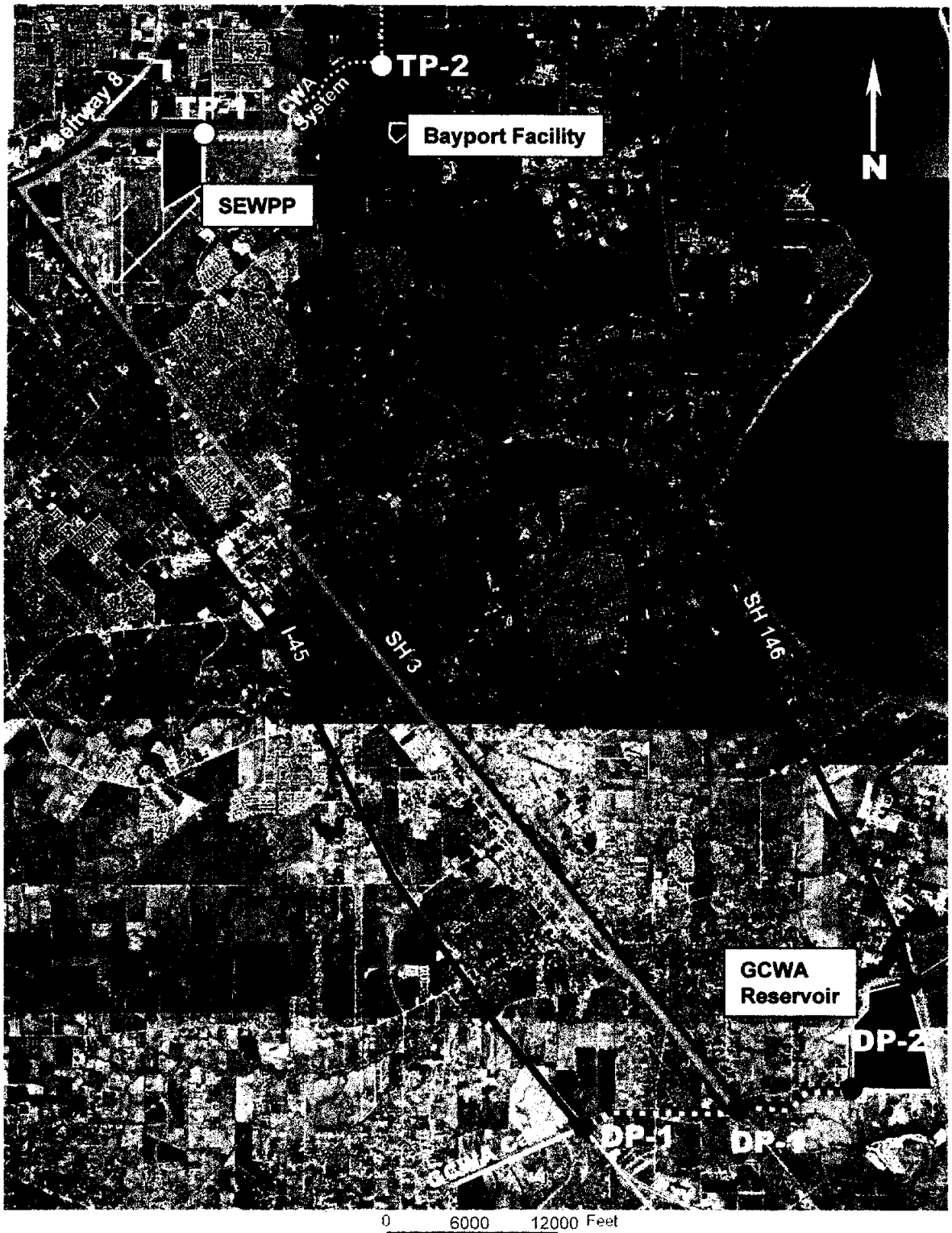
Each corridor has a general economic cost associated with the construction of a pipeline through the corridor. As the length of the corridor increases, so does the length of the pipeline and the construction costs. Construction cost also increases if the pipeline passes through an environmentally sensitive area. Wetlands for example would require some form of mitigation. If the corridor is owned by a public agency, it is likely that right-of-way for the finished water pipeline can be obtained without expensive easement agreements. If a corridor traverses private land, pipeline easements will be required. These easements will increase the overall project costs. If the proposed corridor passes through developed areas, the corridor will likely contain existing utilities that will impact the alignment of the pipeline. Construction around these utilities will increase the cost of construction and impact utility services to the surrounding area.

Take Points

A take point is defined as the transfer point at which the City of Houston will transport raw water to the proposed GCWA delivery points. At the take points, a flow meter will be installed to record and monitor the total flow delivered to GCWA.

Probable take points are presented in **Figure 4-1**. The location of these take points were decided based on consultations with CWA and GCWA. Take Point 1 (TP-1) is located at the City Houston's Southeast Water Purification Plant (SEWPP), and Take Point 2 (TP-2) is located at the split of CWA 96" and 60" pipelines. Note: The City of Houston/CWA has only 60 MGD of raw water available in the current system until 2035 when the City of Houston plans to expand its SEWPP to 360 MGD. At that time an additional CWA line from the Lynchburg pump station would be necessary and could be sized to deliver as much flow to the GCWA Eastern Service Area as required..

At either take point a booster pump station will be required because the available head is minimal. The booster pump station would require a site area of approximately ¾ acre. The site would accommodate parking, control building, pump station, and surge tank. An emergency generator would not be needed because of the storage capacity of the GCWA reservoir.



LEGEND

- I-45 Corridor
- SH-146 Corridor
- SH-3 Corridor
- Residential Streets to Utility Passageway to SH-3 Corridor

MWH
MONTGOMERY WATSON HARZA

GCWA-TRINITY RIVER WATER CONVEYANCE STUDY

FIGURE 4-1
Alternate Pipeline Corridors

Delivery Points

A delivery point is defined as the point where GCWA's current system will receive raw water from the new source. The probable alternative delivery points are shown in **Figure 4-1**. Delivery Point 1 (DP-1) is located on the GCWA canal, and Delivery Point 2 (DP-2) is located at the GCWA Reservoir.

It is anticipated that the discharge flow will be variable and delivered to the Delivery Point with minimal head. However, at either delivery point an energy dissipation structure will be required to prevent erosion or overflow. The dissipation structure would dissipate any extra head and rip-rap or concrete lining would installed in the existing canal to prevent erosion. No expansion would be required to enlarge the existing canal or reservoir.

Initial Alignments and Screening

Four alignments were initially analyzed to convey water from the potential take points to the delivery points. These potential alignments are depicted in **Figure 4-1** and represent an initial evaluation of corridors and representative costs. A final alignment study will be required in the future. The four initial alignments along with the results of the initial screening are described in the **Table 4-1**. Initial screening was preformed by evaluation of basic topographic mapping, large-scale aerial photography, and general construction issues.

TABLE 4-1
ALIGNMENT DESCRIPTION AND INITIAL SCREENING

Alignment Description	Take Point	Delivery Point	Initial Screening Issues	Results
SH 3 Corridor	TP-1	DP-1	• Segmental population density along corridor • Moderate crossing of Clear Lake • Moderate construction safety risks • Moderate public disturbance	• **Corridor acceptable for future analysis.**
I 45 Corridor	TP-1	DP-1	• Narrow construction corridor within right of way near overpasses • High construction safety risks • High public disturbance	• Corridor determined too difficult. Alignment corridor dropped from further analysis.
SH 146 Corridor	TP-2	DP-2	• Dense population near Kemah • Difficult crossing of Clear Lake near Kemah • High construction safety risks • Texas Department of Transportation recommendation to find alternate corridor • High public disturbance	• Corridor determined too difficult. Alignment corridor dropped from further analysis.
Residential Streets to Utility Passageway to SH 3 Corridor	TP-2	DP-1	• Segmental population density along corridor • Moderate construction safety risks • Shared utility corridor • Moderate public disturbance (High on residential streets)	• **Corridor acceptable for future analysis.**

Alignment Analysis

The construction corridors along the proposed alignment were evaluated from large-scale aerial photography and assigned a rating for construction difficulty. Note: No site visits were preformed during feasibility analysis. The rating scale is from A to F, with A being the least difficult and F being the most difficult. The rating scale is outlined in **Table 4-2**.

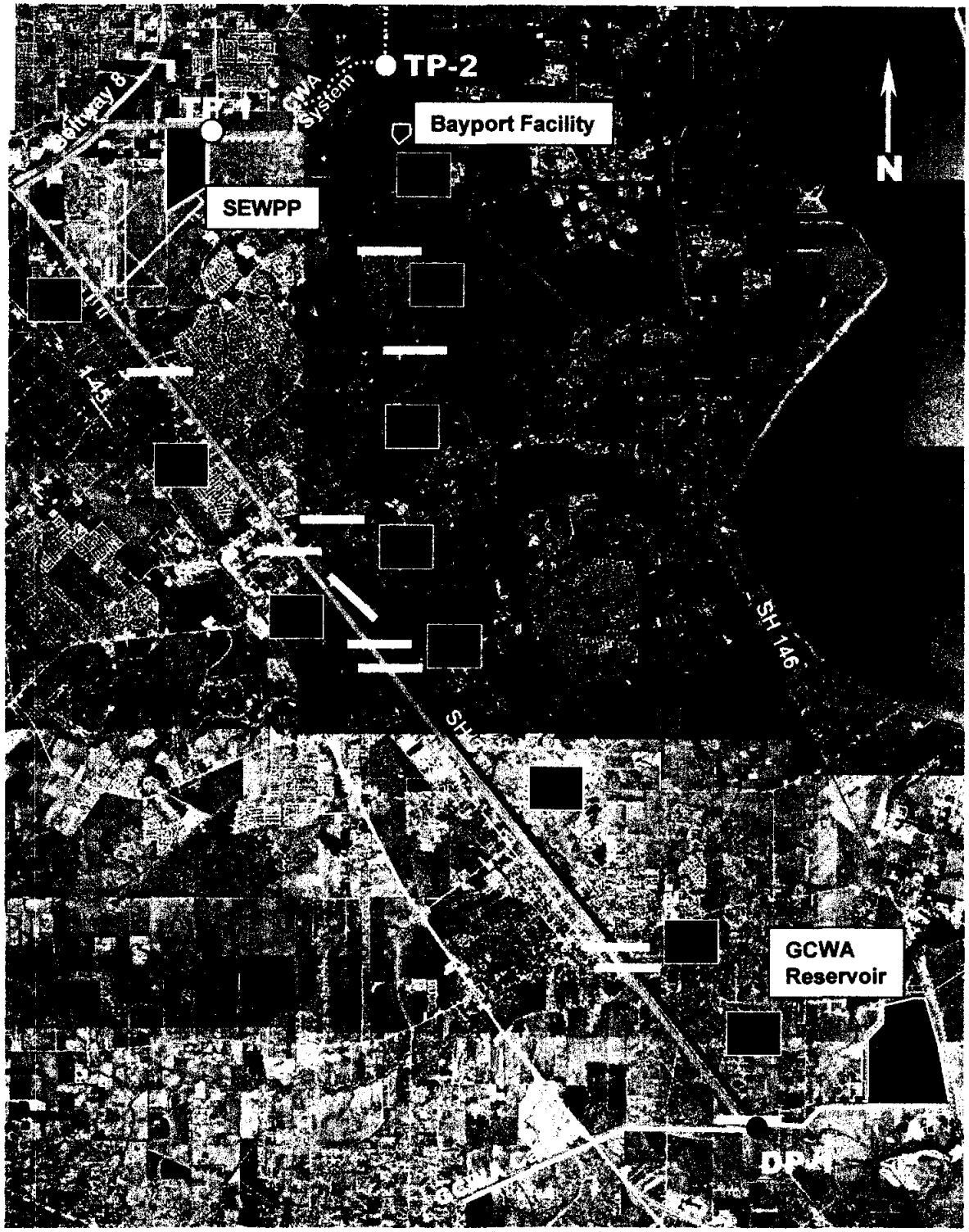
TABLE 4-2
ALIGNMENT RATING SCALE

Corridor Description	Difficulty
Rural	A
Utility Corridor	B
Construction along Highway/Street – Relatively Open	C
Construction along Highway/Street – Relatively Congested	D
Construction along Highway/Street – Highly Congested	E
Tunneling	F

The construction difficulty segments for each proposed alignment is shown graphically in **Figure 4-2**. The construction difficulty ratings as a percentage of total length of each proposed alignment, SH 3 Corridor and Residential Streets to Utility Passageway to SH 3 Corridor, respectively, are summarized in **Table 4-3** and **Table 4-4**.

TABLE 4-3
RATING OF DIFFICULTY AS A PERCENT OF LENGTH FOR SH 3 CORRIDOR

Difficulty	Number of Segments	Length (feet)	Percentage of Length
A	0	0	0
B	0	0	0
C	3	48,000	50
D	1	27,000	28
E	1	16,500	19
F	2	3,000	3
Total		**94,500**	**100**



LEGEND
Alignment Rating Scale
A - Rural
B - Utility Corridor
C - Construction along Highway/Street - Relatively Open
D - Construction along Highway/Street - Relatively Congested
E - Construction along Highway/Street - Highly Congested
F - Tunneling

LEGEND
SH-3 Corridor
Residential Streets to Utility Passageway to SH-3 Corridor

MWH
MONTGOMERY WATSON HARZA

GCWA-TRINITY RIVER WATER CONVEYANCE STUDY

FIGURE 4-2
Pipeline Alignment Rating Scale

TABLE 4-4
RATING OF DIFFICULTY AS A PERCENT OF LENGTH FOR RESIDENTIAL STREETS TO UTILITY PASSAGEWAY TO SH 3 CORRIDOR

Difficulty	Number of Segments	Length (feet)	Percentage of Length
A	1	6,000	7
B	1	13,500	16
C	4	54,500	65
D	0	0	0
E	1	7,500	9
F	2	3,000	3
Total		**84,500**	**100**

FEASIBILITY CRITERIA ASSUMPTIONS

This paragraph identifies the feasibility criteria assumptions that are utilized to perform all evaluation and cost estimating. The feasibility criteria assumptions are engineering judgements of the potential facilities employing industry standards for this type of construction. Detailed analysis would need to be done in future studies.

Pipeline Feasibility Criteria Assumptions

To form a basis of evaluation, pipeline feasibility criteria assumptions are outlined in **Table 4-5**.

TABLE 4-5
PIPELINE FEASIBILITY CRITERIA ASSUMPTIONS

Description	Criteria
Pipeline Materials	Welded Steel Pipe (AWWA C200) or Reinforced Concrete Cylinder Pipe (AWWA C300)
Maximum Velocity	8 ft/s
Pipe Diameter	Varies – Based on Velocity
Depth of Cover	5 feet minimum
Trench Width	1.2 * Diameter + 96 inches minimum
Permanent Easement	50 feet width minimum
Temporary Easement	150 feet width as required
Appurenances	Access Manways, Air Valves Assemblies, and Blowoffs will be provided.

Booster Pump Station Feasibility Criteria Assumptions

Table 4-6 outlines the booster pump station feasibility criteria assumptions.

TABLE 4-6
BOOSTER PUMP STATION DESIGN CRITERIA ASSUMPTIONS

Description	Criteria
Pipeline Losses	C = 140
Minor Losses	4% of Pipeline Losses
Pump Type	Vertical Turbine
Pump Efficiency	85%
Motor Efficiency	90%
Number of Pumps	5 Duty VFDs
Available Head @ Take Point	15 feet including elevation
Free Water Surface @ Delivery Point	15 feet including elevation
Permanent Easement	¾ acre

CONSTRUCTABILITY, PROPERTY, AND ENVIRONMENT EVALUATION

The proposed alignments have been evaluated for constuctability, property requirements, and environmental issues and the results are shown in **Table 4-7**. Evaluation was conducted from large-scale aerial photography, no site visits were conducted.

TABLE 4-7
CONSTRUCTABILITY, PROPERTY, AND ENVIRONMENT EVALUATION

Alignment	Constructability	Property Requirements	Environmental
SH 3 Corridor	• Limited construction access in wetland areas, near Ellington air Field and near urban development along SH 3 • Dewatering will likely be required • Frequent submergence of pipeline may create long-term corrosion potential • Limited location for maintenance road • Security issues for appurtenances	Shared Easement for Pipeline along: • City of Houston Southeast Water Treatment Plant • Industrial Streets • Beltway 8 Feeder Road • SH 3 • GCWA Canal Shared or New Easement for Pump Station at: • City of Houston Southeast Water Treatment Plant New Permanent Easement for: • Pipeline along SH 3 Temporary Easement for Construction: • Along entire alignment	• Airport disturbance • 2 Bayou crossings, that will require directional drilling or microtunneling. • Residential disturbance
Residential Streets to Utility Passageway to SH 3 Corridor	• Limited construction access in wetland areas and near urban development along SH 3 • Dewatering will likely be required • Frequent submergence of pipeline may create long-term corrosion potential • Limited location for maintenance road • Security issues for appurtenances	Shared Easement for Pipeline along: • Residential Streets • Utility Corridor • SH 3 • GCWA Canal New Permanent Easement for: • Pipeline along Rural Land • Pipeline along SH 3 • Pump Station Temporary Easement for Construction: Along entire alignment	• Potential wetlands southwest of Bayport pump station and Hwy 146 • 2 Bayou crossings, that will require directional drilling or microtunneling. • Residential disturbance

The SH 3 Corridor is 1.9 miles longer and the construction cost would be $9,000,000 more than the Residential Streets to Utility Passageway to SH 3 Corridor. Therefore, Residential Streets to Utility Passageway to SH 3 Corridor appears to be the most promising preliminary alignment alternative and will be used for cost estimating.

FRAMEWORK PROJECT

Based on the analysis performed in Section 3 and Section 4, a framework project has been determined to represent the proposed facilities. The framework project capacity would be 175 MGD, the 2050 GCWA peak raw water supply requirement for the Eastern Service Area. The 175 MGD framework project would consist of a pipeline and pump station. The pipeline and pump station for the 175 MGD project are assumed to be constructed in one phase, but the pump station could be constructed in multiple phases depending on actual demands to reduce initial costs.

Table 4-8 identifies the framework projects that probable costs will be determined on in Section 5.

TABLE 4-8
FRAMEWORK PROJECT

Alignment	Take Point	Delivery Point	Length (miles)	Capacity (MGD)	Pipeline Diameter (inches)	Booster Pump Station (total installed hp)
Residential Streets to Utility Passageway to SH 3 Corridor	TP-2	DP-1	16.0	175	84	4,700

Section 5
Cost and Financing Alternatives

This section discusses the cost estimate for the proposed facilities and pipeline conveyance corridor for the framework project identified in Section 4.

PROBABLE COST

The probable cost will be broken down in five categories: Pipeline, Pump Station, Operations and Maintenance, Contingency, and Other Costs. These categories allow each facility type analysis to be evaluated separately. The cost developed are based on past experience with the cost of construction of similar types of facilities and comparison with Region H standard feasibility estimating numbers identified in Region H Cost Estimate Procedures (ENR CCI 6018). Costs have been updated are expressed in current September 2002 dollars (ENR CCI 6588). The parameters to be applied to each of these categories are identified in **Table 5-1**. The Region H cost data is presented in **Appendix D**. Cost information from City of Houston and Kellog Brown and Root (KBR) were obtained during meetings held with them. Cost data from MWH are based on MWH standards.

TABLE 5-1
COST ESTIMATE PARAMETERS

Cost Category	Breakdown	Estimating Parameter	Source
Pipelines	84" Construction	$9/(diameter inch * linear feet)	Region H
	84" Tunneling	$24/(diameter inch * linear feet)	Region H
	CWA Expansion	$80 Million	KBR
Pump Station	4,700 hp	$15,108,000	Region H
Operations and Maintenance	Pipeline	1% of Construction Cost	Region H
	Pump Station	2.5% of Construction Cost	Region H
	Electricity	$0.066/kw	Region H
	CWA	$0.10/1000 gallons	City of Houston
	Annual Capital Cost 30 year period	6% discount rate (7.26% annually)	Region H
Contingency	Trinity Transfer Facilities	20% of Construction Cost	MWH
	CWA Expansion	$12 Million	KBR
Other Project Costs (Administration, Engineering, Legal, Permitting, Construction Management, Land Acquisition, and Easements)	Trinity Transfer Facilities	22% of Construction Cost	MWH
	CWA Expansion	$18 Million	KBR

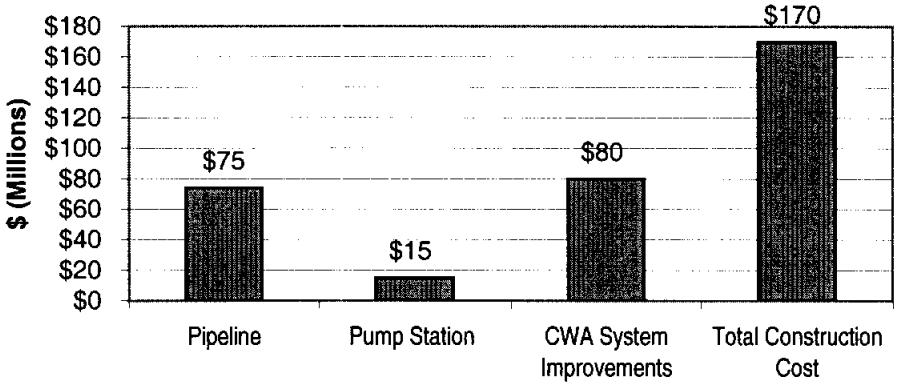
Certain assumptions have been made regarding the design and construction of the facilities in this project. Allowances have been made based on available feasible level information without review of geotechnical or hazardous material information. Probable costs are based on American Association of Cost Engineer Reconnaissance Estimate and are considered accurate to +50%/-30% as they were prepared without detailed engineering data. The final cost of the project will depend on actual labor and material costs, market conditions, site conditions, final project scope, schedule and other variable factors.

Cost estimates were performed on the identified framework projects in **Table 4-8** using the parameters from above. The framework project capacity would be 175 MGD, the 2050 GCWA peak day raw water supply requirement for the Eastern Service Area.

Framework Project Construction Costs

Construction cost results for the framework project is summarized in **Figure 5-1**.

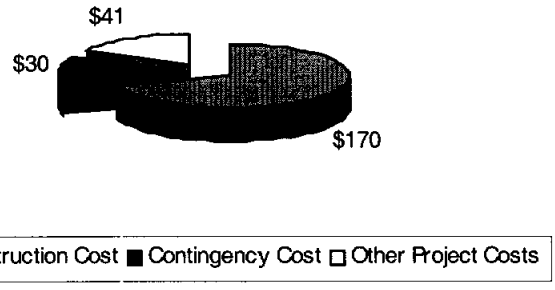
FIGURE 5-1
FRAMEWORK PROJECT CONSTRUCTION COST



Framework Project Contingency and Other Project Costs

Project contingency of 20 percent on the pipeline and pump station along with $12 Million for CWA improvements have been applied to the construction costs, resulting in a total project contingency of $30 Million. Other project costs of 22 percent on the pipeline and pump station along with $18 Million for CWA improvements have been applied to the construction costs plus project contingency, resulting in a other project costs of $41 Million. Other project costs include administration, engineering, legal, permitting, construction management, land acquisition, and easements. The total project costs of $241 Million are broken-down in **Figure 5-2**. Costs have been rounded to more appropriately reflect accuracy.

FIGURE 5-2
FRAMEWORK PROJECT CONTINGENCY AND OTHER PROJECT COSTS
(MILLIONS)



Framework Project Operations and Maintenance – Unit Cost for New Deliveries

Operations and maintenance costs for operation at full capacity are summarized in **Table 5-2** depicting a unit cost for new deliveries.

TABLE 5-2
FRAMEWORK PROJECT OPERATIONS AND MAINTENANCE – UNIT COST FOR NEW DELIVERIES*

Facility Costs (Millions per Year)	Electricity (Millions per Year)	CWA (Millions per Year)	Annual Capital Costs (Millions per Year)	O&M Cost (Millions per Year)	Unit Cost for Deliveries ($/1,000 gallons)
$ 1.1	$ 1.6	$ 1.0	$ 17.5	$ 21.2	**$ 0.33**

* Based on 175 MGD peak delivery.

Note: Annual capital costs would be paid off during the first 30 years of the facilities 50-year life cycle. Detailed breakdown of facility sizing and cost analysis is included in **Appendix D**.

FINANCING ALTERNATIVES

GCWA currently has the authority "...to conserve, store, transport, treat and purify, distribute, sell and deliver water..." (59th Legislature, Chapter 712). Given this authority, multiple options existing to finance this project including:

- GCWA sells bonds and passes cost to users,
- GCWA requires up-front funding and users sell bonds,
- Establishment of a new Non Profit Water Corporation, or
- Privatization.

Each of these alternatives is reviewed in **Table 5-3**.

TABLE 5-3
FINANCING ALTERNATIVES

Financing Alternatives	Advantages	Disadvantages
GCWA sells bonds and passes cost to users	• GCWA has existing authority to implement and finance necessary improvements • Use of revenue bonds does not require voter approval • Revenue bonds do not count against bonding capcity of governmental agency • GCWA remains in control of facility	• Up-front capital expense (financial and technical feasibility report and bond report)
GCWA requires up-front funding and users sell bonds	• Use of revenue bonds does not require voter approval • GCWA remains in control of facility • No up-front capital expense to GCWA	• Multiple bond issues will likely translate into higher interest costs • All users have vested interest in each user's approval • All users may not have ability to be bonded.
Establishment of a Non Profit Water Corporation	• Can design, build, and operate facilities (i.e. alternate project delivery)	• No taxing authority • Requires backing from an established governmental entity • Usually carries higher interest rate because new corporation does not have collateral • May not be GCWA controlled
Privatization (Design, Build, Operate, Own, Transfer – DBOOT)	• Can design, build, operate, and own facilities (i.e. alternate project delivery) • Contracted water delivery costs	• Private money usually carries higher interest rate • Operated and owned by private corporation • Not under direct GCWA control • 20 to 30 year commitment to privatization corporation.

Appendix A
References

References

1. Texas Water Development Board: Region H Water Plan, January 2001. Prepared by the Joint Venture of Brown & Root and Turner Collie & Braden, Ekistics Corp. and LBG-Guyton Associates.
2. USGS Water Quality Monitoring Network Data – Station 08114000 Brazos River at Richmond, TX.
3. Regional Surface Water Treatment Plant Feasibility Study for Brazoria, Fort Bend, and West Harris Counties, Gulf Coast Water Authority, November 2000. Prepared by Montgomery Watson Harza.
4. Gulf Coast Water Authority New Water Supply for Galveston, La Marque and Texas City, Texas, December 1996. Prepared by Montgomery Watson Harza.
5. Gulf Coast Water Authority Water Conservation Plan. Prepared by Montgomery Watson Harza.
6. Regional Surface Water Treatment Plant Feasibility Study for Mid-Brazoria County Planning Group, September 2001. Prepared by Montgomery Watson Harza.
7. Gulf Coast Water Authority Water Audit Summary. Prepared by Freese and Nichols, September 28, 1999.
8. The C.W.A. System. Prepared by Coastal Water Authority.
9. Meetings with KBR, CDM. Information obtained from these meetings:
   - Southwest Harris County surface water requirements;
   - O&M Cost rates for CWA system;

Appendix B

Region H Water Plan Population and Consumptive Water Demand Projections

POPULATION & CONSUMPTIVE WATER DEMAND FORECASTS
(Water use in acre-feet per year)
PREPARED BY TURNER COLLIE & BRADEN INC.

GALVESTON COUNTY
MOST LIKELY GROWTH SCENARIO

Forecast Item	1990	2000	2010	2020	2030	2040	2050
BAYOU VISTA							
Population	1,320	1,677	2,179	2,744	3,345	3,756	4,217
1990 Use	258						
Below Normal Rainfall							
* Expected Conservation		304	361	421	502	560	624
Advanced Conservation		282	310	332	397	442	496
Normal rainfall							
Expected Conservation		299	354	412	495	547	609
Advanced Conservation		276	303	323	390	433	482
CLEAR LAKE SHORES							
Population	1,096	1,354	1,839	2,377	2,500	2,500	2,500
1990 Use	187						
Below Normal Rainfall							
* Expected Conservation		214	264	312	322	316	316
Advanced Conservation		197	225	245	252	249	249
Normal rainfall							
Expected Conservation		208	255	304	311	305	305
Advanced Conservation		193	216	237	244	241	241
DICKINSON							
Population	9,497	19,598	22,638	26,093	30,215	32,844	34,544
1990 Use	1,554						
Below Normal Rainfall							
* Expected Conservation		4,368	4,818	5,290	6,024	6,476	6,771
Advanced Conservation		4,237	4,540	4,939	5,652	6,070	6,385
Normal rainfall							
Expected Conservation		3,491	3,829	4,209	4,772	5,076	5,340
Advanced Conservation		3,381	3,627	3,945	4,502	4,856	5,069
FRIENDSWOOD (P)							
Population	14,979	21,079	27,673	35,063	42,936	48,310	54,357
1990 Use	1,873						
Below Normal Rainfall							
* Expected Conservation		3,070	3,720	4,438	5,290	5,845	6,576
Advanced Conservation		2,952	3,471	4,045	4,858	5,412	6,089
Normal rainfall							
Expected Conservation		2,668	3,193	3,771	4,521	4,978	5,601
Advanced Conservation		2,550	2,976	3,457	4,184	4,654	5,237
GALVESTON							
Population	59,070	65,836	73,019	83,629	94,654	107,133	121,257
1990 Use	11,526						
Below Normal Rainfall							
* Expected Conservation		12,906	13,659	15,082	16,646	18,481	20,781
Advanced Conservation		12,611	13,005	14,145	15,904	17,761	19,966
Normal rainfall							
Expected Conservation		12,021	12,760	14,051	15,480	17,161	19,287
Advanced Conservation		11,726	12,187	13,208	14,738	16,561	18,608

HITCHCOCK							
Population	5,868	6,909	7,821	9,294	10,652	11,578	12,178
1990 Use	694						
Below Normal Rainfall							
* Expected Conservation		1,022	1,086	1,218	1,360	1,453	1,514
Advanced Conservation		983	1,025	1,135	1,277	1,375	1,432
Normal rainfall							
Expected Conservation		813	859	958	1,062	1,115	1,159
Advanced Conservation		782	806	895	1,002	1,076	1,119
JAMAICA BEACH							
Population	624	790	827	848	888	943	998
1990 Use	156						
Below Normal Rainfall							
* Expected Conservation		192	194	190	195	204	214
Advanced Conservation		188	184	177	184	194	203
Normal rainfall							
Expected Conservation		184	185	183	187	195	204
Advanced Conservation		179	176	168	177	186	196
KEMAH							
Population	1,094	1,625	1,708	1,815	1,901	1,949	1,999
1990 Use	400						
Below Normal Rainfall							
* Expected Conservation		555	560	573	594	600	616
Advanced Conservation		541	534	535	556	567	580
Normal rainfall							
Expected Conservation		444	449	459	473	479	488
Advanced Conservation		433	429	433	450	458	466
LA MARQUE							
Population	14,120	14,905	16,734	18,931	20,711	21,769	22,881
1990 Use	2,204						
Below Normal Rainfall							
* Expected Conservation		2,204	2,324	2,460	2,622	2,682	2,794
Advanced Conservation		2,120	2,156	2,269	2,436	2,536	2,640
Normal rainfall							
Expected Conservation		1,870	1,949	2,078	2,181	2,219	2,332
Advanced Conservation		1,803	1,818	1,908	2,042	2,121	2,204
LEAGUE CITY (P)							
Population	30,026	46,754	54,474	63,038	72,092	77,485	83,280
1990 Use	4,130						
Below Normal Rainfall							
* Expected Conservation		6,023	6,590	7,202	7,995	8,420	8,955
Advanced Conservation		5,813	6,163	6,708	7,510	7,986	8,489
Normal rainfall							
Expected Conservation		5,760	6,285	6,920	7,671	7,986	8,582
Advanced Conservation		5,551	5,919	6,426	7,188	7,638	8,116
SAN LEON (CDP)							
Population	3,328	4,139	4,229	4,237	4,159	3,999	3,875
1990 Use	457						
Below Normal Rainfall							
* Expected Conservation		543	521	493	466	430	412
Advanced Conservation		520	484	446	429	404	386
Normal rainfall							
Expected Conservation		482	464	436	410	376	360
Advanced Conservation		464	427	394	382	359	338

SANTA FE							
Population	8,429	12,086	16,567	19,932	22,794	24,498	26,329
1990 Use	746						
Below Normal Rainfall							
* Expected Conservation		1,367	1,707	1,920	2,119	2,223	2,389
Advanced Conservation		1,300	1,577	1,741	1,966	2,086	2,212
Normal rainfall							
Expected Conservation		1,070	1,318	1,474	1,634	1,701	1,799
Advanced Conservation		1,029	1,225	1,362	1,506	1,592	1,711
TEXAS CITY							
Population	40,822	45,715	50,607	55,261	60,214	65,322	68,275
1990 Use	5,787						
Below Normal Rainfall							
* Expected Conservation		7,425	7,766	7,985	8,498	9,000	9,330
Advanced Conservation		7,169	7,256	7,366	7,891	8,488	8,795
Normal rainfall							
Expected Conservation		5,889	6,122	6,314	6,610	6,951	7,189
Advanced Conservation		5,684	5,725	5,819	6,205	6,658	6,883
TIKI ISLAND							
Population	537	787	881	951	1,016	1,076	1,102
1990 Use	67						
Below Normal Rainfall							
* Expected Conservation		93	98	99	101	102	103
Advanced Conservation		89	90	90	93	96	98
Normal rainfall							
Expected Conservation		90	95	95	98	99	100
Advanced Conservation		86	86	87	91	94	94
COUNTY - OTHER							
Population	26,589	16,402	18,813	25,047	31,859	31,157	18,839
1990 Use	3,648						
Below Normal Rainfall							
* Expected Conservation		2,389	2,481	2,949	3,513	3,338	2,127
Advanced Conservation		2,297	2,259	2,841	3,271	3,172	2,003
Normal rainfall							
Expected Conservation		2,309	2,380	2,840	3,364	3,153	2,024
Advanced Conservation		2,212	2,186	2,726	3,112	3,017	1,948
MUNICIPAL TOTALS							
Population	217,399	259,656	300,009	349,260	399,936	434,319	456,631
1990 Use	33,687						
Below Normal Rainfall							
* Expected Conservation		42,675	46,149	50,632	56,247	60,130	63,522
Advanced Conservation		41,299	43,279	47,014	52,676	56,838	60,023
Normal rainfall							
Expected Conservation		37,598	40,497	44,504	49,269	52,341	55,379
Advanced Conservation		36,349	38,106	41,388	46,213	49,944	52,712
MANUFACTURING	58,077	64,614	70,905	75,743	80,269	88,858	97,460
S.E. POWER COOLING	1,229	1,500	1,500	1,500	1,500	1,500	1,500
MINING	33	84	63	55	44	42	44
IRRIGATION	20,685	10,334	10,334	10,334	10,334	10,334	10,334
LIVESTOCK	244	182	182	182	182	182	182

TOTAL COUNTY WATER USE	113,955						
Below Normal Rainfall							
* Expected Conservation		119,389	129,133	138,446	148,576	161,046	173,042
Advanced Conservation		118,013	126,263	134,828	145,005	157,754	169,543
Normal Rainfall							
Expected Conservation		114,312	123,481	132,318	141,598	153,257	164,899
Advanced Conservation		113,063	121,090	129,202	138,542	150,860	162,232

* Municipal use for cities excludes any wholesale municipal sales and identified sales to industrial users
* Below normal rainfall with expected conservation is the primary municipal water use scenario.

POPULATION & CONSUMPTIVE WATER DEMAND FORECASTS
(Water use in acre-feet per year)
PREPARED BY TURNER COLLIE & BRADEN INC.

FORT BEND COUNTY
MOST LIKELY GROWTH SCENARIO

Forecast Item	1990	2000	2010	2020	2030	2040	2050
FULSHEAR							
Population	557	872	1,087	1,307	1,525	2,007	2,312
1990 Use	97						
Below Normal Rainfall							
* Expected Conservation		167	200	229	259	336	380
Advanced Conservation		163	187	211	242	314	358
Normal rainfall							
Expected Conservation		157	187	213	244	312	358
Advanced Conservation		152	176	197	227	294	337
HOUSTON (P)							
Population	27,027	51,378	71,751	97,235	127,570	161,304	203,958
1990 Use	4,749						
Below Normal Rainfall							
* Expected Conservation		10,360	13,824	17,972	23,150	28,729	36,097
Advanced Conservation		10,071	13,181	16,991	22,006	27,645	34,726
Normal rainfall							
Expected Conservation		8,748	11,654	15,139	19,434	24,031	30,157
Advanced Conservation		8,575	11,172	14,377	18,720	23,309	29,472
KATY (P)							
Population	709	1,499	2,204	3,076	4,107	5,235	6,673
1990 Use	116						
Below Normal Rainfall							
* Expected Conservation		227	309	407	534	668	852
Advanced Conservation		218	289	372	492	622	792
Normal rainfall							
Expected Conservation		191	259	338	442	557	703
Advanced Conservation		183	242	314	409	522	658
MEADOWS							
Population	4,606	7,261	9,061	11,407	14,285	17,654	21,819
1990 Use	773						
Below Normal Rainfall							
* Expected Conservation		1,131	1,288	1,495	1,824	2,195	2,713
Advanced Conservation		1,049	1,096	1,162	1,440	1,760	2,151
Normal rainfall							
Expected Conservation		1,016	1,146	1,316	1,600	1,939	2,370
Advanced Conservation		936	965	1,009	1,248	1,523	1,857
MISSION BEND (CDP) (P)							
Population	14,195	20,409	23,659	25,356	27,458	29,672	31,287
1990 Use	1,898						
Below Normal Rainfall							
* Expected Conservation		3,292	3,604	3,664	3,845	4,022	4,206
Advanced Conservation		3,178	3,339	3,323	3,537	3,756	3,925
Normal rainfall							
Expected Conservation		2,720	2,968	3,011	3,137	3,257	3,399
Advanced Conservation		2,629	2,756	2,727	2,891	3,058	3,189

MISSOURI CITY (P)							
Population	32,219	56,517	72,282	92,580	117,269	145,778	181,218
1990 Use	6,005						
Below Normal Rainfall							
* Expected Conservation		10,636	12,873	15,659	19,441	23,840	29,637
Advanced Conservation		10,319	12,145	14,623	18,258	22,535	28,014
Normal rainfall							
Expected Conservation		9,624	11,578	14,104	17,471	21,391	26,389
Advanced Conservation		9,306	10,930	13,170	16,551	20,411	25,170
NEEDVILLE							
Population	2,199	3,457	4,644	6,146	7,949	9,982	12,535
1990 Use	245						
Below Normal Rainfall							
* Expected Conservation		418	510	633	792	972	1,221
Advanced Conservation		399	473	572	731	906	1,124
Normal rainfall							
Expected Conservation		330	401	489	605	749	927
Advanced Conservation		313	370	448	561	693	870
RICHMOND							
Population	9,801	15,235	19,883	25,857	33,630	41,559	51,359
1990 Use	1,780						
Below Normal Rainfall							
* Expected Conservation		2,577	3,140	3,852	4,897	5,959	7,364
Advanced Conservation		2,492	2,939	3,562	4,558	5,587	6,904
Normal rainfall							
Expected Conservation		2,065	2,472	3,042	3,843	4,655	5,695
Advanced Conservation		1,980	2,316	2,809	3,579	4,376	5,408
ROSENBERG							
Population	20,183	31,939	38,483	47,204	58,072	71,124	87,109
1990 Use	2,707						
Below Normal Rainfall							
* Expected Conservation		4,437	4,958	5,710	6,830	8,206	9,953
Advanced Conservation		4,258	4,656	5,287	6,375	7,728	9,368
Normal rainfall							
Expected Conservation		3,793	4,268	4,864	5,790	6,931	8,392
Advanced Conservation		3,685	3,966	4,494	5,399	6,533	8,001
STAFFORD (P)							
Population	8,090	16,410	21,296	27,547	35,119	43,794	54,614
1990 Use	931						
Below Normal Rainfall							
* Expected Conservation		2,169	2,600	3,148	3,896	4,758	5,872
Advanced Conservation		2,077	2,409	2,869	3,580	4,414	5,505
Normal rainfall							
Expected Conservation		1,783	2,123	2,561	3,147	3,826	4,711
Advanced Conservation		1,709	1,979	2,346	2,911	3,581	4,466

SUGAR LAND							
Population	42,856	79,758	98,651	122,975	151,477	183,031	217,453
1990 Use	4,253						
Below Normal Rainfall							
* Expected Conservation		13,936	16,134	19,147	23,246	27,677	32,883
Advanced Conservation		13,401	15,249	17,770	21,548	25,832	30,691
Normal rainfall							
Expected Conservation		11,883	13,813	16,253	19,682	23,373	27,769
Advanced Conservation		11,435	13,040	15,152	18,495	22,142	26,063
TOWN WEST (CDP)							
Population	6,166	9,099	10,049	10,777	11,443	12,365	13,486
1990 Use	1,077						
Below Normal Rainfall							
* Expected Conservation		1,743	1,846	1,883	1,948	2,064	2,221
Advanced Conservation		1,692	1,722	1,739	1,820	1,939	2,084
Normal rainfall							
Expected Conservation		1,640	1,733	1,762	1,833	1,926	2,084
Advanced Conservation		1,590	1,621	1,629	1,705	1,815	1,963
COUNTY - OTHER							
Population	56,813	78,832	132,885	211,613	324,386	424,124	515,951
1990 Use	11,738						
Below Normal Rainfall							
* Expected Conservation		17,991	27,065	39,949	59,243	75,847	91,801
Advanced Conservation		17,383	25,828	37,107	55,610	71,472	86,494
Normal rainfall							
Expected Conservation		16,088	23,761	34,951	51,568	66,433	79,589
Advanced Conservation		15,618	22,831	32,936	49,180	63,026	75,462
MUNICIPAL TOTALS							
Population	225,421	372,666	505,935	683,080	914,290	1,147,629	1,399,774
1990 Use	38,687						
Below Normal Rainfall							
* Expected Conservation (afpy)		**69,084**	**88,351**	**113,748**	**149,905**	**185,273**	**225,200**
* Expected Conservation (MGD)		**62**	**79**	**102**	**134**	**165**	**201**
Advanced Conservation		66,700	83,513	105,588	140,197	174,510	212,136
Normal rainfall							
Expected Conservation		60,038	76,363	98,043	128,796	159,380	192,543
Advanced Conservation		58,111	72,364	91,608	121,876	151,283	182,916
MANUFACTURING	18,909	21,139	23,616	25,556	27,401	30,592	33,639
S.E. POWER COOLING	62,805	70,000	70,000	70,000	70,000	70,000	70,000
MINING	161	258	250	235	219	220	228
IRRIGATION	53,176	62,045	62,045	62,045	62,045	62,045	62,045
LIVESTOCK	1,113	1,134	1,134	1,134	1,134	1,134	1,134
TOTAL COUNTY WATER USE	174,851						
Below Normal Rainfall							
* Expected Conservation		223,660	245,396	272,718	310,704	349,264	392,246
Advanced Conservation		221,276	240,558	264,558	300,996	338,501	379,182
Normal Rainfall							
Expected Conservation		214,614	233,408	257,013	289,595	323,371	359,589
Advanced Conservation		212,687	229,409	250,578	282,675	315,274	349,962

* Municipal use for cities excludes any wholesale municipal sales and identified sales to industrial users

* Below normal rainfall with expected conservation is the primary municipal water use scenario.

POPULATION & CONSUMPTIVE WATER DEMAND FORECASTS
(Water use in acre-feet per year)
PREPARED BY TURNER COLLIE & BRADEN INC.

BRAZORIA COUNTY
MOST LIKELY GROWTH SCENARIO

Forecast Item	1990	2000	2010	2020	2030	2040	2050
ALVIN							
Population	19,220	24,075	28,723	33,822	40,240	45,715	51,935
1990 Use	2,589						
Below Normal Rainfall							
* Expected Conservation		3,290	3,668	4,092	4,733	5,274	5,934
Advanced Conservation		3,182	3,443	3,826	4,462	5,018	5,643
Normal rainfall							
Expected Conservation		3,020	3,378	3,751	4,327	4,762	5,410
Advanced Conservation		2,912	3,185	3,523	4,102	4,609	5,178
ANGLETON							
Population	17,140	23,870	28,737	34,037	40,661	46,372	52,884
1990 Use	2,015						
Below Normal Rainfall							
* Expected Conservation		3,235	3,670	4,117	4,737	5,298	5,983
Advanced Conservation		3,128	3,444	3,850	4,509	5,090	5,746
Normal rainfall							
Expected Conservation		2,887	3,219	3,621	4,190	4,622	5,272
Advanced Conservation		2,781	3,058	3,394	3,963	4,467	5,036
BAILEY'S PRAIRIE							
Population	634	735	758	769	812	857	903
1990 Use	89						
Below Normal Rainfall							
* Expected Conservation		108	106	102	104	106	110
Advanced Conservation		105	98	93	96	100	104
Normal rainfall							
Expected Conservation		102	99	96	97	99	103
Advanced Conservation		99	93	88	91	94	97
BRAZORIA							
Population	2,717	3,276	3,945	4,619	5,461	5,829	6,222
1990 Use	339						
Below Normal Rainfall							
* Expected Conservation		382	430	471	538	562	592
Advanced Conservation		371	402	434	508	535	565
Normal rainfall							
Expected Conservation		357	393	434	495	510	544
Advanced Conservation		341	371	404	465	489	516
BROOKSIDE VILLAGE							
Population	1,470	2,059	2,282	2,551	2,934	3,337	3,696
1990 Use	207						
Below Normal Rainfall							
* Expected Conservation		283	297	311	345	385	422
Advanced Conservation		274	276	285	322	362	397
Normal rainfall							
Expected Conservation		251	260	272	302	333	365
Advanced Conservation		242	242	251	283	318	348

CLUTE							
Population	8,910	10,445	12,963	15,169	17,936	19,144	20,433
1990 Use	1,282						
Below Normal Rainfall							
* Expected Conservation		1,579	1,830	2,039	2,351	2,466	2,609
Advanced Conservation		1,533	1,742	1,920	2,230	2,359	2,495
Normal rainfall							
Expected Conservation		1,381	1,597	1,784	2,049	2,123	2,266
Advanced Conservation		1,345	1,525	1,682	1,949	2,059	2,174
DANBURY							
Population	1,447	1,870	2,174	2,442	2,804	3,079	3,381
1990 Use	177						
Below Normal Rainfall							
* Expected Conservation		246	266	279	308	332	360
Advanced Conservation		236	245	255	286	310	338
Normal rainfall							
Expected Conservation		197	209	218	242	255	280
Advanced Conservation		189	195	203	227	244	266
FREEPORT							
Population	11,389	14,344	15,374	16,696	18,796	20,062	21,413
1990 Use	2,426						
Below Normal Rainfall							
* Expected Conservation		3,069	3,151	3,291	3,622	3,798	4,029
Advanced Conservation		2,989	2,997	3,086	3,432	3,640	3,862
Normal rainfall							
Expected Conservation		2,443	2,497	2,601	2,842	2,966	3,142
Advanced Conservation		2,377	2,376	2,450	2,737	2,876	3,046
HILLCREST							
Population	695	891	995	1,245	1,479	1,592	1,696
1990 Use	101						
Below Normal Rainfall							
* Expected Conservation		127	134	157	182	189	200
Advanced Conservation		121	123	144	169	178	186
Normal rainfall							
Expected Conservation		118	126	148	169	177	184
Advanced Conservation		115	116	135	157	166	175
HOLIDAY LAKES							
Population	1,039	1,423	1,833	2,264	2,782	3,256	3,811
1990 Use	141						
Below Normal Rainfall							
* Expected Conservation		175	203	231	274	314	363
Advanced Conservation		163	172	178	215	248	286
Normal rainfall							
Expected Conservation		158	181	203	240	274	320
Advanced Conservation		145	152	155	184	212	243

IOWA COLONY							
Population	675	851	922	1,086	1,272	1,375	1,477
1990 Use	95						
Below Normal Rainfall							
* Expected Conservation		123	128	143	161	170	178
Advanced Conservation		120	119	130	149	160	169
Normal rainfall							
Expected Conservation		118	121	135	152	159	169
Advanced Conservation		115	113	124	143	151	159
JONES CREEK							
Population	2,160	2,532	3,187	3,729	4,409	4,706	5,023
1990 Use	272						
Below Normal Rainfall							
* Expected Conservation		343	400	439	504	527	557
Advanced Conservation		332	371	401	469	496	523
Normal rainfall							
Expected Conservation		272	314	343	390	406	428
Advanced Conservation		261	293	313	365	385	405
LAKE JACKSON							
Population	22,776	27,171	32,034	37,429	44,287	50,046	56,555
1990 Use	3,266						
Below Normal Rainfall							
* Expected Conservation		3,683	4,091	4,528	5,208	5,717	6,461
Advanced Conservation		3,591	3,840	4,235	4,912	5,494	6,145
Normal rainfall							
Expected Conservation		3,591	3,948	4,360	5,011	5,549	6,208
Advanced Conservation		3,470	3,731	4,067	4,762	5,269	5,955
MANVEL							
Population	3,733	5,152	6,084	7,080	8,352	9,412	10,606
1990 Use	519						
Below Normal Rainfall							
* Expected Conservation		710	784	856	983	1,075	1,212
Advanced Conservation		687	730	785	917	1,013	1,140
Normal rainfall							
Expected Conservation		624	681	746	852	928	1,033
Advanced Conservation		601	634	690	795	886	986
OYSTER CREEK							
Population	912	1,205	1,266	1,482	1,752	1,870	1,996
1990 Use	130						
Below Normal Rainfall							
* Expected Conservation		185	184	204	234	245	259
Advanced Conservation		178	173	188	218	230	244
Normal rainfall							
Expected Conservation		147	146	161	183	191	201
Advanced Conservation		142	136	149	173	180	190

PEARLAND (P)							
Population	17,234	29,480	39,464	49,742	61,929	73,332	86,834
1990 Use	2,788						
Below Normal Rainfall							
* Expected Conservation		4,458	5,569	6,631	8,046	9,364	11,088
Advanced Conservation		4,293	5,217	6,129	7,562	8,871	10,408
Normal rainfall							
Expected Conservation		4,260	5,305	6,352	7,700	8,953	10,505
Advanced Conservation		4,128	4,995	5,850	7,215	8,461	9,921
RICHWOOD							
Population	2,732	3,203	4,170	4,959	5,961	6,797	7,750
1990 Use	294						
Below Normal Rainfall							
* Expected Conservation		377	448	505	588	647	738
Advanced Conservation		362	420	461	541	609	694
Normal rainfall							
Expected Conservation		326	383	428	494	548	616
Advanced Conservation		312	355	394	461	518	582
SURFSIDE BEACH							
Population	611	769	837	995	1,178	1,371	1,534
1990 Use	156						
Below Normal Rainfall							
* Expected Conservation		222	232	265	309	353	393
Advanced Conservation		216	220	248	291	336	373
Normal rainfall							
Expected Conservation		199	209	239	279	318	354
Advanced Conservation		195	199	225	264	304	337
SWEENY							
Population	3,297	3,680	4,180	4,891	5,782	6,172	6,589
1990 Use	414						
Below Normal Rainfall							
* Expected Conservation		457	482	526	596	623	657
Advanced Conservation		437	445	487	557	587	619
Normal rainfall							
Expected Conservation		416	435	477	537	560	591
Advanced Conservation		400	407	438	505	532	561
WEST COLUMBIA							
Population	4,372	5,482	6,035	6,720	7,671	8,363	9,118
1990 Use	530						
Below Normal Rainfall							
* Expected Conservation		744	763	798	877	936	1,011
Advanced Conservation		712	710	731	816	880	950
Normal rainfall							
Expected Conservation		584	601	624	678	711	776
Advanced Conservation		565	554	572	636	684	735

COUNTY - OTHER							
Population	68,544	78,720	83,556	91,092	102,276	111,831	135,982
1990 Use	9,652						
Below Normal Rainfall							
* Expected Conservation		10,902	10,811	11,160	12,051	12,786	15,400
Advanced Conservation		10,461	10,069	10,146	11,142	12,042	14,497
Normal rainfall							
Expected Conservation		9,567	9,491	9,716	10,432	11,016	13,251
Advanced Conservation		9,214	8,842	8,909	9,754	10,529	12,657
MUNICIPAL TOTALS							
Population	191,707	241,233	279,519	322,819	378,774	424,518	489,838
1990 Use	27,482						
Below Normal Rainfall							
* Expected Conservation		34,698	37,647	41,145	46,751	51,167	58,556
Advanced Conservation		33,491	35,256	38,012	43,803	48,558	55,384
Normal rainfall							
Expected Conservation		31,018	33,593	36,709	41,661	45,460	52,018
Advanced Conservation		29,949	31,572	34,016	39,231	43,433	49,567
MANUFACTURING	199,242	228,424	257,569	274,057	288,204	316,451	344,404
S.E. POWER COOLING	0	0	0	0	0	0	0
MINING	954	1,511	1,305	1,169	1,114	1,043	1,063
IRRIGATION	113,389	131,207	118,758	108,276	104,256	101,833	101,833
LIVESTOCK	1,261	1,066	1,066	1,066	1,066	1,066	1,066
TOTAL COUNTY WATER USE	342,328						
Below Normal Rainfall							
* Expected Conservation		396,906	416,345	425,713	441,391	471,560	506,922
Advanced Conservation		395,699	413,954	422,580	438,443	468,951	503,750
Normal Rainfall							
Expected Conservation		393,226	412,291	421,277	436,301	465,853	500,384
Advanced Conservation		392,157	410,270	418,584	433,871	463,826	497,933

* Municipal use for cities excludes any wholesale municipal sales and identified sales to industrial users

* Below normal rainfall with expected conservation is the primary municipal water use scenario.

Appendix C

Southwest Harris County Data

MEETING MINUTES

MWH
MONTGOMERY WATSON HARZA

Project:	Trinity River Regional Water Transfer Plan			**Meeting Date:**	September 6, 2002
				Time:	9:00 AM
Subject:	Information on City of Houston water supply plan.			**Prepared By:**	Sushrut Joshi
Attendees:	KBR: David Jackson	MWH: Robert Higgins, Thomas Visosky, Sushrut Joshi	CDM: Dominic DiCenso, Dannelle H. Belhateche	CITY OF HOUSTON: Jun Chang	

MEETING OBJECTIVE

To obtain information on the current City of Houston water supply plan that can be used in Gulf Coast Water Authority's Trinity Water Transfer Study. The City of Houston and Coastal Water Authority are participants in the Study. The Agenda covers the information needed to complete the Study and to be have the Study and the City of Houston Plan to be in agreement once complete. A draft of the Study is due the end of September.

DISCUSSION NOTES

Project Overview:

The meeting started with a brief overview of the regional water swap concept. The project was conceived by the ex-General Manager of GCWA, Mr. Gordon Myers. The concept was to meet the Galveston County water demand by using Trinity River Water, and the Fort Bend and West Harris County demand by the Brazos River Water.

City of Houston finished water demand projection:

CDM mentioned that they had made progress in completing their masterplan report fort the City of Houston. From their demand and population projection calculations, Dannelle said that Region H numbers were good numbers to use. Dannelle explained that their calculations were based on census tract data. It was further mentioned that CDM's study utilized a peak day factor of 1.5 versus average day. CDM to provide a copy of a table outlining predicted total demand from existing WTP and new SWWTP. According to projections made by CDM, the West-Harris County (excluding City of Houston) demand would be 40 MGD, and the southwest City of Houston demand would be 20 MGD by 2015. The non COH 40 MGD demand is from multiple (100+) municipal utility districts and it is unknown what their exact plans are to convert this groundwater demand to surface water. Each MUD is required to submit a Groundwater Reduction Plan in 2003, so details may not be available until then.
The COH currently plans to meet Harris Galveston subsidence district groundwater reduction requirements by early overcoversion (50% surface water in 2004). Additional conversion would

not be required until 2033. Harris Galveston subsidence district regulatory requirements are 30% conversion by 2010, 70% conversion by 2020, and 80% conversion by 2030.

City of Houston plans for raw water supply for SWWTP:

The COH plans to have a potential 120 MGD available to the SWWTP. 60 MGD from a swap from CWA to GCWA and 60 MGD from Allen's Creek reservoir. The 60 MGD swap would be available until 2030 when the COH's SEWTP would be expanded to 300 MGD. At this time it was noted that an additional CWA line from Lynchburg would be necessary and could be sized to continue to deliver 60 MGD or more. Additional water would also potentially be available for swap or purchase in the amount of 100 MGD from the industries along the Bay are currently using CWA water. A feasibility study has been completed that recommends use of effluent from a WW plant be utilized.

West Harris-Fort Bend County water demand projections:

Robert Istre presented water demand projections from the Fort Bend Subsidence District, which showed that the Fort Bend County would start experiencing water shortages from the year 2025 of 40 MGD. By the year 2030, this shortage will increase to 56 MGD. Note: Fort Bend County customers currently have contracts with GCWA for 60 MGD. The driver to this demand is the Fort Bend Subsidence District's regulatory plan that requires reduction of groundwater utilization by 30% in 2013 and 60% in 2025.

Thus, the total projected demands for Fort Bend County and West Harris County (include COH) would be approximately 120 MGD in the year 2015, and increasing to 180 MGD by the year 2030.

These demand numbers suggested that a South West Water Treatment Plant would be feasible with a first phase of 120 MGD, with further expansions to meet the 2030 demand of 180 MGD.

Cost of raw water in CWA system including O&M:

Jun Chang mentioned that currently the City of Houston uses a rate of 10 cents per 1,000 gallons (upon verification) for raw water O&M. It was also mentioned to contact Gilbert Garcia at the City of Houston's accounting department to get raw water O&M rates. Dave Jackson further mentioned that the other potential raw water sources/upgrades were Luces Bayou (before 2020 @ $114M), new CWA channel crossing (2020 to 2030 @ $110M), and Allen Creek Reservoir (2030 to 2050 @ $110M). Bob Higgins further stated that construction costs for the Trinity Transfer pipeline were approximately $60M + $5M for a pump station. GCWA and COH to discuss offline raw water cost for swap and additional water purchase.

Meeting Summary:

In summarizing, the West-Harris County has a surface water demand that has to be met to comply with the Harris Galveston Subsidence District's Groundwater Reduction Plan.

This surface water demand added to the surface water requirements in the Fort Bend County represent the need for the Southwest Water Treatment Plant in the region. The difficulty in making this plant a reality was the need to organize the disparate probable customers in the region.

ACTION ITEMS

City of Houston and West and Southwest Harris County water demand data	CDM

RECOMMENDED ULTIMATE PLANT STAGING PLAN

PLANNING YEAR	2000	2003	2005	2007	2010	2015	2020	2030	2035	2045	2050
	PRODUCTION CAPACITY - MGD										
SURFACE WATER TREATMENT PLANTS											
EWPP	308	350	350	350	350	350	350	350	350	350	350
SEWPP	120	120	120	200	200	200	200	300	360	360	360
NEWPP	0	0	40	40	80	120	360	360	360	360	360
SWWPP	0	0	0	0	0	60	60	60	60	120	120
Total:	***428***	***470***	***510***	***590***	***630***	***730***	***970***	***1070***	***1130***	***1190***	***1190***
City Surface Water Demand	257	274	278	281	343	353	444	491	504	531	544
Non-City Surface Water Demand	120	125	127	129	234	247	419	514	542	598	626
Total:	***377***	***399***	***405***	***410***	***577***	***600***	***863***	***1005***	***1046***	***1129***	***1170***
Surface Water Excess:	*51*	*71*	*105*	*180*	*53*	*130*	*107*	*65*	*84*	*61*	*20*