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June 1, 1999

Mr. Curtis Johnson, P.E.
Technical Coordinator
1700 N. Congress Ave., Rm. 461
Austin, TX 78711-3231

Re: Four Corners Area Regional Planning Study
TWDB Contract No. 97-483-206

Dear Mr. Johnson:

In accordance with our agreement, enclosed please find 9 copies of our Final Report and one unbound copy in accordance with our agreement. Should you have any comments or questions regarding the transmittal of this report please do not hesitate to call me at 214-630-8867.

Very truly yours,
Earth Tech, Inc.

Joe W. Ezzell

Joe W. Ezzell, P.E.
Project Manager

Ms. Marilynn Kindell, Fort Bend Co. 3 copies
Ernesto Abila, Four Corners WSC, 2 copies
Mark Loethen, P.E., Pate Engineers
Charles Gooden, P.E., Gooden Consulting

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FINAL REPORT

WATER AND
WASTEWATER FACILITIES

PLANNING STUDY

FOR

THE FOUR CORNERS AREA

OF

FORT BEND COUNTY,
TEXAS

Prepared by:
Earth Tech
with
Pate Engineers
Goodsen Consulting Engineers
BC&AD Archaeology
HVJ Associates

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STATE OF TEXAS
JOE W. EZZELL
64491
REGISTERED
PROFESSIONAL ENGINEER

Joe W. Ezzell
5-19-99

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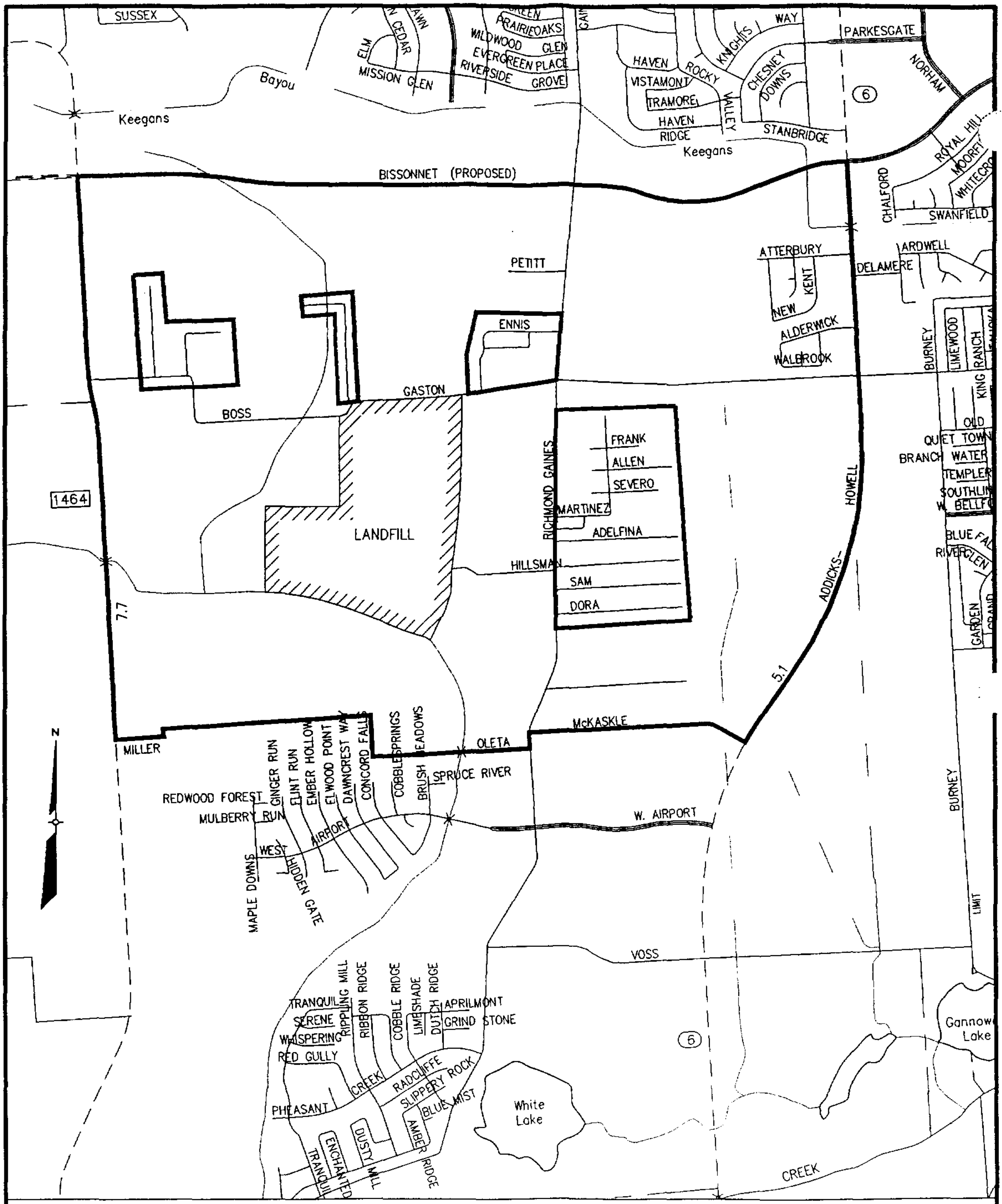
1.0 PLANNING AREA

The planning area for the Four Corners water and sanitary sewer study encompasses approximately 1,775 acres of land located in north central Fort Bend County, Texas. The planning area boundaries are generally defined by State Highway 6 on the east, McKaskle Road to the south, FM 1464 to the west and the southern boundary of South Mission Glen MUD to the north. Major roadways within the planning area include Richmond-Gaines Road which runs north-south through the area and Boss Gaston/Old Richmond Road which traverses east to west across the north central part of the planning area connecting State Highway 6 with FM 1464. Both roads are two-lane asphalt roadways with open ditch drainage. The entire planning area is not located within the corporate limits of any city, but lies wholly within the extra-territorial jurisdiction of the City of Houston. A map of the planning area is shown on page 2 of this section.

Much of the service area consists primarily of open pasture/range land with sparse tree cover. Ground elevations within the area indicate that the overall slope of the area is from north to south with elevations ranging from 85 feet to 95 feet mean sea level (1928 NGVD). Red Gully flows from north to south through the area and provides primary outfall drainage. Smaller lateral channels convey flows to Oyster Creek (south of the area) and to Red Gully itself.

1.1 GOALS OF PLANNING STUDY

The goal of this planning study is to determine the feasibility of providing public water and sanitary sewer service to the currently inserved Four Corners/Petitt Road area of Fort Bend County. This area is an unincorporated area of the county. This study will look at the existing and future water and sanitary sewer demands, define necessary infrastructure improvements for service. This study will also identify the associated projected costs of the proposed utilities.



FOUR CORNERS WSC
WATER & WASTEWATER PROJECT

FIGURE 1

4CORNER1.DWG (URBAN.PCP)

To accomplish this objective, this study will:

a) Collect and review data pertaining to population and land use, soil conditions, construction materials and methods, and governmental approval and permitting requirements.
b) Identify potential treated water sources and wastewater treatment facilities for the area.
c) Define water distribution and sanitary sewer collection system to serve the area.
d) Prepare conceptual costs of the recommended project.

1.2 EXISTING DEVELOPMENT

Within the 1,775 acre planning area, existing development is sparse consisting primarily of clusters of residential housing (small single family homes and manufactured housing), isolated commercial development, a solid waste landfill facility, tree farm and undeveloped/agricultural acreage. Residential development within the area is located primarily along Richmond-Gaines Road. This includes a pocket of housing units located at the northwest corner of Richmond-Gaines Road and Boss Gaston Road in addition to the Sweet City Acres and Atanacia Martinez Tract subdivisions located along Richmond-Gaines Road between Boss Gaston and Mckaskle Road. The other concentration of housing units is located adjacent to Boss Gaston Road to the west of the solid waste landfill. Undeveloped areas are generally small, non-contiguous tracts divided among different landowners.

Much of the acreage surrounding the planning area is in various stages of development consisting primarily of dense single-family residential subdivisions with water and sewer services provided by municipal utility districts. Adjacent residential subdivisions to the Four Corners area include: Waterford, Kingsbridge Place, Mission Glen, Village of Oak Lakes and Oak Lakes Estates. In addition, commercial developments are located along State Highway 6 in many of the adjacent municipal utility districts.

1.3 AREA SOIL CONDITIONS

Rust Environment and Infrastructure contracted with HVJ Associates, Inc. to conduct a geotechnical site reconnaissance survey of the Four Corners area located in Fort Bend County, Texas.

These services included a review of previous geotechnical investigations in the area of the project, and a site reconnaissance survey. The study covers the general vicinity of each area. The site reconnaissance was performed along the streets in each study area and selected adjacent streets.

The available information for this project and the on-site reconnaissance conducted in October 1998 are summarized as follows:

The Four Corners area is located in northeast Fort Bend County and is bounded by the Bissonnet ROW on the north, SH 6 on the east, a line parallel to McKaskle Road on the south, and FM 1464 on the west. Keegans Bayou is located immediately north of the site and Red Gully bisects it. The area is mostly undeveloped, however rural homes are located throughout the area and some modern residential developed is located in the northeast part. The Sprint Landfill is located near the center. South and west of Red Gully the project lies in the Quaternary alluvial deposits associated with the Brazos River floodplain. Sands and silts, along with clayey soils are common in these alluvial deposits. Northeast of Red Gully the area is underlain by clayey soils associated with the Beaumont Formation. Higher groundwater may be expected in the southern part of the area. Two known active faults are near the area. The nearest known fault is the Clodine Fault which crosses FM 1464 about 1500 feet northwest of area. The Renn Scarp is located about 2000 feet northeast of the site. Neither of these faults are known to be within the Four Corners area. During our reconnaissance we did not observe any conclusive evidence of adverse geological conditions apart from occasional broken or poor pavement and several buildings with structural damage.

A search and review of existing geotechnical reports firm HVJ Associates files, private records and public records was done to obtain geotechnical information relevant to the study areas in this project. Our findings are summarized in the following table.

Service Area	**Generalized Soil Conditions**	**Groundwater Level Range**
Four Corners	Surface strata consisting of firm to very stiff clays and generally underlain by very loose to medium dense sands and silts	8 to 15 feet

Available geotechnical data indicates that soil conditions in and near the study area are typical of the Beaumont Formation and Quaternary alluvial deposits. Additional geotechnical data within the project areas are required to confirm soil stratigraphy at the facility locations and to provide in situ property information for detailed design. Where no surficial evidence of active faulting was observed during the field reconnaissance, it does not preclude the presence of active faults.

Note that this summary does not fully relate findings and opinions of HVJ Associates, Inc. Those findings and opinions are only related through their full report located in the Appendix.

1.4 POPULATION – EXISTING AND PROJECTED

1990 Census data for this area of Fort Bend County was obtained from the Houston-Galveston Area Council (HGAC) and used to determine existing population estimates within the planning area. According to the census data, in 1990 approximately 1,150 people resided within the planning area in 350 housing units which is equivalent to 3.3 persons per household. A recent field survey of the planning area indicates that several older housing units appear to be uninhabited but that new housing units have been constructed (primarily in the Atanacia Martinez subdivision) since the 1990 census. For this water and sewer study, the 1998 estimated population for the planning area was held at 1,150 persons with approximately 350 existing housing units within the planning area.

The population of Fort Bend County grew at an average annual rate of just under ten percent in the 1980's and continued to grow at an average rate of just under six percent during the 1990's. The HGAC forecasts that the average annual growth rate within the county will slow to less than three percent through the year 2020. Historically, the Four Corners area has not observed population increases that mirrored the rest of Fort Bend County. With the construction of water and sanitary sewer facilities within the Four Corners area, population increases within the area are to be expected. For the purposes of this planning study, average annual population increases of three percent (consistent with the rest of Fort Bend County) were used for the Four Corners planning area. Based upon this rate, the population of the Four Corners area is projected to increase from 1,150 in 1998 to 2,200 in the Year 2020. Table 1.4.1 includes a summary of the population information.

TABLE 1.4.1

POPULATION PROJECTIONS

Census Tract 703.51	1990 Census	1998 Estimated	2020 Projected
Housing Units	350	350	670
Population	1,150	1,150	2,200
Occupants per Household	3.3	3.3	3.3

1.5 EXISTING/PROJECTED WATER AND SEWER DEMANDS

Water and sanitary sewer demands were developed using the estimated 1998 population of the area and the projected growth through the Year 2020. Demands were based upon design values for water and sewer utilized by the Texas Natural Resource Conservation Commission (TNRCC). These design values are 120 gallons per capita day for average daily water demand and 100 gallons per capita day for average daily wastewater demand. Peaking factors for both water and sewer flows were used to estimate peak daily demands. The water and sewer demands calculated for the planning area are presented in Table 1.5.1.

Projected average daily water demand for the service area is estimated to increase from 138,000 gallons per day (gpd) in 1998 to 264,420 gpd in the Year 2020. Similarly, average daily sewer flows are estimated to increase from 115,000 gpd in 1998 to 220,350 gpd in the Year 2020. For the purposes of this study, the water distribution and wastewater collection systems were evaluated for the current demands within the area and the projected demands in the Year 2020. In addition to the average daily demands, peak hour water demands and design fire flows defined by the State Board of Insurance are utilized in the water system design. Peak wastewater flows are developed for lift station design. These flows are also presented in Table 1.5.1.

TABLE 1.5.1

WATER AND SEWER DEMAND PROJECTIONS

	Existing 1998	Projected 2020
WATER SYSTEM		
Average Daily Demand (gallons)⁽¹⁾	138,000	264,420
Peaky Daily Demand (gpm)⁽²⁾	240	460
Fire Flow (gpm)	500	500
SANITARY SEWER SYSTEM		
Average Daily Demand (gallons)⁽³⁾	115,000	220,350
Peak Daily Demand (gallons)⁽⁴⁾	460,000	881,410

(1) Based upon 120 gallons per capita day
(2) 2.5 x Average Daily Demand
(3) Based upon 100 gallons per capita day
(4) 4 x Average Daily Demand

1.6 ASSESSED VALUES

Property values for acreage within the planning area were obtained from the Fort Bend County Appraisal District and were separated into general land classifications including: agricultural/open space, landfill, light industrial/commercial, rights-of-way/easements and single family residential. Table 1.6.1 summarizes the 1998 assessed values for property in the Four Corners area.

TABLE 1.6.1

1998 ASSESSED VALUES

Land Classification	Total Assessed Value
Agricultural/Open Space	$ 1,589,600
Light Industrial/Commercial	3,982,450
Landfill	694,650
Rights-of-Way/Easements	900
Single Family (< 1 acre)	9,211,000
Single Family (1-2 acres)	2,321,650
Single Family (> 2 acres)	4,724,300
TOTAL ASSESSED VALUE	$22,524,550

2.0 AREA ENVIRONMENTAL ASSESSMENT

2.1. EVALUATION OF AREA'S HISTORIC LAND USAGE

2.1.1. INTRODUCTION

Earth Tech, formerly Rust Environment & Infrastructure, Inc. contracted with BC&AD Archaeology, Inc. (BCAD) to determine the potential presence of cultural resources in the areas that could be eligible for inclusion in the National Register or Historic Places or warrant designation as Texas State Archaeological Land marks. This work is been completed for a Fort Bend County for water wastewater treating systems study in the Four Corners area. This area is shown in Figure I, Section 1.

2.1.2. ENVIRONMENTAL BACKGROUND

The Colorado, Brazos, Trinity, Neches and Sabine Rivers originate north of the Texas Coastal Plain. They flow southward through the plain to the Gulf of Mexico. These rivers are pro-Pleistocene in age. Smaller creeks such as the Oyster Creek and Jones Creek developed during the Pleistocene and parallel the major waterways. Fort Bend County is located in the Western Gulf section of the Coastal Plain,

Fort Bend County's location in the Western Gulf section of the Coastal Plain places it within a subtropical belt. The modem climate is characterized by high humidity. The biggest factor controlling the regional climate is the Gulf of Mexico. Summers are hot arid humid and winters are generally mild (Story, 1990). The mean annual temperature of the area is 20 degrees centigrade with a mean average of rainfall of 46.1 inches. Prevailing winds are south and southeast, except during the winter when fronts shift the wind from the north. The modern climate is generally considered to be similar to the climate that existed 5,000 years ago.

The flora and fauna or the project areas when first settled could include open land, woodland and wetland habitats. The following are excerpt from a book by A. A. Parker (1835).

> "..list of the forest trees, shrubs, vines i.e. red, black, white, willow; post and live oaks; pine, cedar, cottonwood, mulberry, hickory, ash elm cypress, box-wood, elder, dogwood, walnut, pecan, moscheto-a species of locust, holly, haws, hackberry, magnolia, chinquspin, wild peacan, suple jack, cane brake, palmetto, various kinds of grapevines, creepers, rushes, Spanish-moss, prairie grass and a great variety of flowers....
>
> ...Then there are bear, mexican hog, wild geese, rabbits and a great variety of ducks..."

Wild herbaceous plants that were native to this area include bluestem, indiangrass, croton. beggerwood. pokeweed. partridgepea, ragweed and fescue. Examples of native hardwood trees would be oak, mulberry, sweetgum, pecan, hawthorn, dogwood, persimmon, sumac, hichory, black walnut, maple and greenbrier.. Coniferous plants included red cedar arid coast juniper. Shrubs included American beauty berry, farkleberry. yaupon and possumhaw. Wetland plants such as smartweed, wild millet, bulrushes, saltgrass and cattail are native to the area (U.S. Department of Agriculture, 1976).

This vegetative environment supported wildlife such as bear, rabbit, red fox, deer, coyotes, racoon, opossum, muskrat, beaver, alligator, armadillo, squirrel, and skunk. A wide variety of birds were present such as quail, dove, prairie chicken, song birds, herons and kingfishers. The area was also a winter home for a number of migratory birds such as geese, ducks, egrets, coots, etc. (U.S. Department of Agriculture, 1976).

2.2. EVALUATION OF AREA'S POTENTIAL WETLANDS

2.2.1 BACKGROUND INFORMATION

Pursuant to Section 404 of the Clean Water Act and the rules and regulations promulgated thereunder by the United States Environmental Protection Agency (EPA) and the United States Army Corps of Engineers (USACE), the discharge of dredged or fill material into waters of the United States, including wetlands, requires the issuance of a permit from the USACE (33 CFR Parts 320-330). For the purposes of administering the Section 404 permit program, the USACE defines wetlands as follows:

> Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. (33 CFR 328.3)

The Corps of Engineers Wetlands Delineation Manual (Technical Report Y-87-1), issued by the USACE in 1987, states that wetlands must possess three essential characteristics. Under normal circumstances, these characteristics include the presence of:

- hydrophytic (water-loving) vegetation,
- hydric soils, and
- wetland hydrology.

If all three of these criteria are present on a particular property, then a permit or notification under Nationwide Permit 26 must be submitted to the USACE in order to fill all or a portion of those areas.

Anyone conducting a regulated activity or discharge activity within the United States and its territories must adhere to the provisions of the Clean Water Act. If any contemplated activity might impact waters of the United States, including adjacent or isolated wetlands, the USACE must be contacted for an official determination of the presence of jurisdictional wetlands. If jurisdictional wetlands are found to exist, then any activity which would involve filling or dredging these wetlands would require the issuance of a permit.

2.2.2 RESOURCE REVIEW

This preliminary wetlands investigation consisted of a review of all available published data for the study area including topographic maps, a National Wetlands Inventory map (draft), aerial photographs, infrared aerial photographs, and soil information published in the Soil Survey of Fort Bend County, Texas.

Based on this preliminary investigation, numerous waters of the United States, including wetlands, and areas potentially containing waters of the United States, were identified within the boundaries of the study area. Following this resource review, ground truthing field activities were initiated for the purpose of further identifying waters of the United States, including wetlands, located within the study area.

2.2.3 FIELD INVESTIGATION

In order to determine the potential presence and extent of jurisdictional waters of the United States, including wetlands, located within the study area, a preliminary wetlands determination was conducted. The wetlands field investigation of the study area was conducted over the course of four days; field investigation dates included October 15, November 9, November 10, and November 19, 1998.

The field investigation aspect of this project involved the systematic evaluation of all readily accessible undeveloped parcels of property. Several inaccessible parcels of land were however not physically visited during this investigation. Additionally, based on the review of the published resources during the initial phase of this investigation, urban areas (developed residential, commercial, or industrial properties) were not investigated for potential wetlands. Also, several areas which could be inferred as upland areas based on the resource review were not physically visited during this investigation. Though numerous parcels of undeveloped land were physically evaluated during this study, each parcel was not investigated as thoroughly as would be the practice during a more extensive wetlands determination or delineation activity.

2.2.4 WETLANDS INVESTIGATION FINDINGS

This preliminary wetlands investigation (both the resource review and the field investigation) resulted in the creation of an exhibit which details the waters of the United States, including wetlands, which were identified within the boundaries of the study area. A cursory evaluation of the soils, hydrology, and vegetation in most of the areas visited during the field investigation phase of this project was conducted based on field conditions or reviewed resources. For the purposes of this preliminary wetlands investigation, the undeveloped parcels of property evaluated during this study were categorized as follows:

- Upland areas or primarily upland areas. These areas were identified using both the resource review and field investigation phases of this project.
- Wetland areas or potential wetland areas. These areas were identified using both the resource review and field investigation phases of this project.
- Areas recently cleared which are developing wetland characteristics. These areas were identified during the field investigation phase of this project. At least two parcels of undeveloped property were observed to be recently cleared; these areas were most likely cleared within the past 6 to 9 months. Each of these areas now possess an undulating ground surface which is conducive for collecting and trapping water. Wetland vegetation was observed to be growing in many of the depressions created by the clearing activities. At present, two of the three wetland criteria (e.g., hydrology and vegetation) were met in these areas. Without appropriate intervention, wetlands may establish in these rather flat, poorly drained areas. Further research would need to be conducted to determine whether or not wetlands historically existed in these areas.
- Areas not physically visited. These areas include areas which were not walked during the field investigation aspect of this study and which the resource review of these areas was not definitive as to whether or not wetlands existed in these areas. Based on the ground truthing activities which were conducted within the study area, most of the areas not physically visited are most likely to contain upland or primarily upland areas.

Overall, ground truthing was accomplished for the majority of the undeveloped parcels of property located within the study area. Additionally, Keegans Bayou and Red Gully are considered jurisdictional waters of the United States. Any activities impacting these waters, such as outfalls, road crossings, etc., would need to be evaluated for potential permitting requirements under Section 404 of the Clean Water Act and/or the Rivers and Harbors Act of 1899.

2.3.5 SUMMARY

A thorough wetland determination and/or delineation should be conducted on any parcels of property identified for the purpose of constructing water or wastewater facilities. Even areas identified as uplands or primarily uplands in this preliminary wetlands investigation should be evaluated for potential wetland areas once potential facility locations have been identified.

This preliminary wetlands investigation was performed by Earth Tech in accordance with generally accepted practices as set forth in the Corps of Engineers Wetlands Delineation Manual (Technical Report Y-87-1). Earth Tech observed the same degree of care and skill generally exercised by wetland professionals under similar circumstances. The conclusions are based on our professional judgement regarding the significance of the information gathered during the course of this study. Specifically, Earth Tech does not and cannot represent that all or any portion of the study area is in fact jurisdictional waters of the United States, including wetlands, under Section 404 of the Clean Water Act inasmuch as such legal determinations can only be made by authorized staff members of the U.S. Army Corps of Engineers.

2.3. DESCRIPTION OF AREA'S POTENTIAL HISTORIC SITES

2.3.1. HISTORICAL BACKGROUND

The wide variety of native floral and faunal resources supported an indigenous population in Fort Bend County. When Cabeza de Vaca, a survivor of the Narvaez expedition to colonize southern Florida, was shipwrecked in 1528 on what has often been identified as Galveston Island (probably Oyster Bay Peninsula), he was met by the native Americans of the area (Krieger, 1959). This group of Native Americans was part of the Karankawa group that was probably made up to at least five tribes (Aten. 1983). There were three other related native groups on the upper Texas coast at that time; the Akokisa who occupied the

Galveston Bay area northward to Conroe and east to approximately Beaumont; the Atakapa who occupied the area east of Beaumont into western Louisiana; and the Bidai who occupied the territory north of the Akokisa which included the Huntsville and Liberty areas (Aten, 1983). From the ethnohistoric records as well as (lie archaeological information, the groups were hunting and gathering peoples (Hester, 1980; Aten, 1983; Story, 1990). From ca. 3000 BC to AD 100, no important technological or social advances have been identified among the Native American groups. From AD 100 to AD 800, ceramics were being used the bow and arrow was introduced and there was some recognition of territorial boundaries indicating social structure. From AD 800 until contact, there was refinement in ceramic production and increased use of the bow and arrow.

At the time of contact, the sociopolitical structure of the groups would be classified as tribes (Aten, 1983). During the warm seasons, they were dispersed in band sized groups. They gathered into villages during the colder seasons with populations ranging from 400 to 500. Cabeza de Vaca's account of these groups was that they lived in a state of starvation the year around even though they had access to all of the marine resources of a coastal environment. Caleza de Vaca lived in this area for six years and became a trader for the Native Americans, bartering sea shells and other coastal products for hides and lithic resources from inland groups (Newcomb, 1961). The archaeological record indicates that ceramics appeared with the Atakapa in 70 BC, with the Akokisa in AD 100, with the Karonkawa in AD 300 and with the Bidai in AD 500. The origin of this ceramic technology would appear to be the Lower Mississippi Valley and was adopted from east to west over time (Aten, 1983).

Some of the project areas in Fort Bend County were part of the original Stephen F. Austin colony. Their location along the Brazos River was advantageous, as it was easily navigated which gave ready access to the Gulf of Mexico.

2.3.2. METHODOLOGY

BCAD conducted archival research on the project areas prior to field surveys at the Texas Archaeological Research Laboratory (TARL) and the General Land Office in Austin, Texas; at the Fort Bend County Museum; and it the Texas Room of the Houston Public Library. The files of National Register of Historic Places, National Register of Eligible Sites and the Texas State Archaeological Sites were reviewed. The General Land Office provided information on the original Spanish land grants and owners of the project areas. Early Texas history was reviewed as well as the biographies of the original owners of the land tracts. Aerial photographs were studied to determine more recent land use.

BCAD conducted reconnaissance surveys of the project areas on September 22, 1998 to the extent or ready accessibility to the areas. Natural drainage channels were located because the banks of waterways were frequently preferred for campsites by prehistoric peoples.

The architecture of those existing buildings that could meet the requirements for inclusion in the National Register or Historic Places was examined. The structure must be fifty years old and meet one or more of the following requirements:

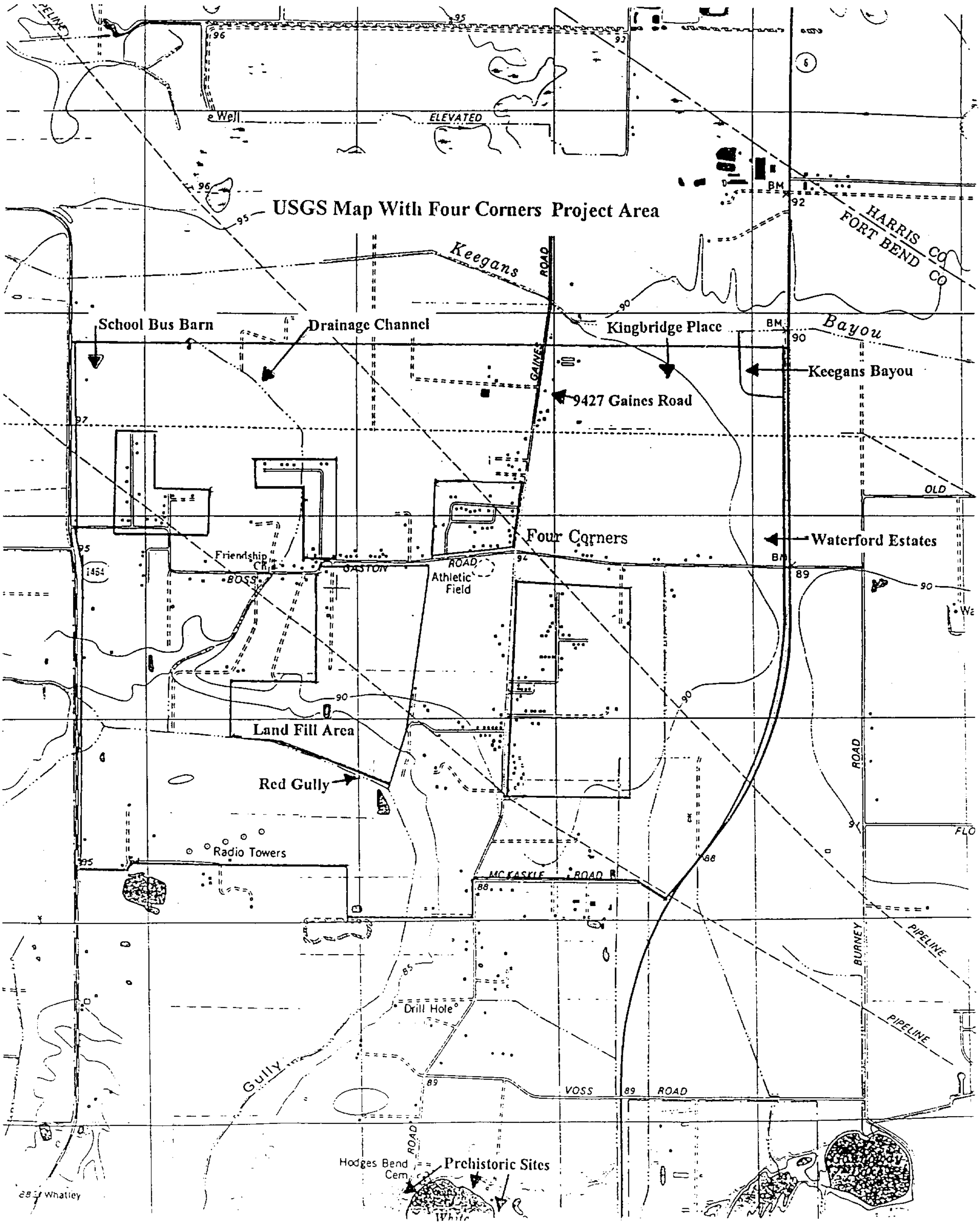
1. The structure is associated with events that have made a significant contribution to the broad patterns of history.
2. The structure is associated with the lives of persons significant in our past.
3. The structure is important to a particular cultural or ethnic group.
4. The structure is the work of a significant architect, master builder, or craftsman.
5. The structure embodies the distinctive characteristic of a type, period, or method of construction, possesses high aesthetic value, or represents a significant and distinguishable entity whose components may lack individual distinctions.
6. The structure has yielded or may be likely to yield information important to the understanding of Texas culture or history.

2.3.3. RESULTS OF THE FOUR CORNERS SITE SURVEY

Archival Research - The attached map presents the Clodine, Texas U.S. Geological Survey Map with the Four Corners project area superimposed. Research at TARL indicated no previously recorded archaeological sites on the project area. However, nine prehistoric sites (41FB201, 41FB202, 41FB203, 41FB210, 41FB214. 41FB215, 41FB216, 41FB217 and 41FB221) have been recorded around the northern shores of White Lake located approximately a mile to the south of the project area.

The original owners of the land in the project area include Jesse H. Cartwright, Mills M. Battle, D. A. Conner, John Leverton, Andrew M. Clopper and the I. & G.N. RR Co. Jesse H Cartwright has been discussed in the history of the Cummings Road project area. Mills M. Battle was also a member of the "Old Three Hundred" of the Austin colony. He is listed as a contractor and carpenter in business. He was at various times, justice of the peace, deputy clerk of the probate court, notary public and county clerk in Fort Bend County. He helped nominate Sam Houston for President of the Republic of Texas in 1841 (Tyler, 1996). No background information could be located for D. A. Connor and John Leverton. Andrew M. Clopper was the son of Nicholas Clopper. Nicholas Clopper joined the Austin colony in 1822 and was instrumental in developing a trade route using Buffalo Bayou. Nicholas was responsible for the acquisition of the "Twin Sisters" used in the Battle of San Jacinto (Tyler, 1996). Andrew was a courier for President David Burnett during the Texas Revolution and later worked as a surveyor in the general area (Lapham Letters, 1909). Also shown on Figure VI is the estimated route of General Santa Anna on April 14th and 15th of 1836 on his way to Harrisburg and eventually, the Battle of San Jacinto (Wharton, 1939). This route was reconstructed using the personal narrative of Jose Enrique de la Pena as well as recollections handed down from eyewitness accounts. Santa Ana crossed the Brazos River on April 14th, 1836 at Thompsons Ferry, moved north crossing Jones Creek and supposedly made camp at nightfall on the western Andrew

USGS Map With Four Corners Project Area



Clopper land tract. By noon on April 15, 1836, he had moved southeast and burnt the plantation of William Stafford (located just cast of the George Brown and Charles Belknap tract) which has been documented historically. This route on the morning or April 15th could have taken him across the southern portion of the Four Corners project area. The actual route has not been firmly documented historically or archaeologically (Jeff Dunn, personal communication, 1998).

There is no archival evidence that any of the original owners of the land built plantations or habitations in the project area. In the case of Battle and Cartwright, it is more likely that their residences would have been built on Oyster Creek, south of the project area. Since first settled, the main land use of the project area has been for growing crops (corn, cotton potatoes and sugar cane) and/or for grazing cattle and horses (Lipham Letters, 1909). A 1956 aerial photograph, shows that the entire project area has been under cultivation at some time (Fort Bend Soil Survey, 1956). Approximately, thirty houses exist on this photograph that are also present in the attached map.

The highest potential for prehistoric sites in this area is along the banks of Keegans Bayou located behind the Kingbridge Development in the upper northeast section of the area and the banks of two drainage channels, one in the northwestern section of the project area drains into Red Gully in the southwest section of the project area. Keegans Bayou appears to have been rerouted to its present location and the area has been extensively modified by new construction. Limited access to the banks of the drainage channels prevented a complete walk-through survey of these areas for potential prehistoric sites. However, limited observations during the field survey and the aerial photographs indicate that the northwest drainage channel has been heavily impacted by cultivation as well as construction since 1956. Visual observations indicate that the banks of Red Gulch have been extensively modified from the southwestern point adjacent to the landfill to the southern edge of the project area by landfill operations and construction. Visual observations and the aerial photographs indicate that the banks of the western extension of Red Gulch to the western boundary of the project area have been impacted by cultivation.

The remaining houses that meet the age requirement for the National Register of Historic Places were examined and only one could possibly qualify based on any of the other requirements. This is the residence at 9427 Gaines Road. There was no evidence of any remains of preexisting historic structures on the rest of the project area which has also been heavily impacted by cultivation and new construction based on limited visual observations and the aerial photographs.

2.3.4. FOUR CORNERS SITE SPECIFICS

The residence at 9427 Gaines Road could possibly qualify for the National Register of Historic Places. Avoidance of this structure is recommended.

The archival research has indicated that there is a probability that the southern portion of the Four Corners area was crossed by Santa Anna's army during the Texas Revolution. There is however, little probability of finding significant archaeological deposits associated with this event because the army marched rather quickly between the previous night's campsite and Stafford's plantation. It might be possible to find isolated artifacts, but nothing that would add to the better understanding of Texas History. It is unlikely that any further archaeological studies would be required concerning this event. However, if during construction of the proposed projects artifacts relating to this event are found, an archaeologist should be contacted.

2.4. EVALUATION OF AREA'S POTENTIAL ENDANGERED SPECIES HABITATS

As part of the environmental investigation of the study area, the Texas Parks and Wildlife Department and the U.S. Fish and Wildlife Service were contacted regarding the possible occurrence of threatened or endangered species within the boundaries of the study area.

In correspondence dated September 30, 1998, the Texas Parks and Wildlife Department (TPWD), Texas Biological Conservation Data System office, the TPWD Wildlife Habitat Assessment Program, and the U.S. Fish and Wildlife Service (USFWS) were officially contacted for a review of sensitive species (e.g., threatened or endangered species) and natural communities which could potentially occur within the study area.

In correspondence dated October 6, 1998, the USFWS stated that a review of the U.S. Fish and Wildlife Service files and your project information indicate that no federally listed or proposed threatened or endangered species are likely to occur at the project site."

In correspondence dated October 14, 1998, the TPWD Wildlife Habitat Assessment Program stated that sensitive wildlife habitats that should incorporate planning considerations within this study area include mature woodlands, riparian vegetation associated with creek drainage, native grasslands, and wetlands. Development of project alternative alignments should include considerations for sequentially avoiding, minimizing or compensating losses of these sensitive habitats. Where possible, water and wastewater lines should follow existing rights-of-way. Mitigation measures to offset unavoidable losses to these habitats should be included in project planning. Such measures may include provisions for tree and shrub plantings and for revegetation of disturbed areas using native plant species." Such ecological considerations would need to be taken into account once project alternatives or options have been identified.

As of November 24, 1998, correspondence from the TPWD Texas Biological Conservation Data System office has not been received. To date, information received by the USFWS and TPWD indicate that threatened and endangered species of plants and animals are not considered to be a concern within the confines of the study area.

All correspondence pertaining to threatened and endangered species is provided in Appendix D of this report.

2.5. EXTENT OF FLOOD PLAIN IN AREA

As part of this investigation, the Federal Emergency Management Agency (FEMA) National Flood Insurance Program Flood Insurance Rate Maps (FIRMs) were evaluated for the study area. The FIRM panel 120 of 550, map number 48157C0120-H, dated September 30, 1992, and map number 48157C0120-J, dated January 3, 1997, were reviewed for this project.

The northeastern-most corner of the study area boundary crosses the well defined channel of Keegans Bayou at two locations. Keegans Bayou is designated as a "Zone AE" area which consists of a special flood hazard area potentially inundated by a 100-year flood. The 100-year flood is contained within the channel of Keegans Bayou in this area according to the FIRMs reviewed during this investigation. Zone AE specifically refers to areas of the 100-year flood in which base flood elevations have been determined.

The southwestern-most corner of the study area is encompassed by a flood zone associated with Red Gully, based on the FIRMs reviewed for this area. Red Gully generally flows southeast and south within the boundaries of the study area and then flows south/southeast into Oyster Creek. Oyster Creek flows into the Brazos River which then flows into the Gulf of Mexico.

The area surrounding Red Gully is designated as a Zone AE. This area which consists of a special flood hazard area that has a potential to be inundated by a 100-year flood; floodway areas in Zone AE are also designated on the FIRMs. The Red Gully 100-year flood zone is not contained within the channel similar to the well defined channel of Keegans Bayou.

Additionally, a Zone X area is also located in the southwestern-most corner of the study area. Zone X areas are defined as areas below the 500-year flood elevation and areas within the 100-year flood area with average depths of less than one foot or with drainage areas less than one square mile, and/or areas protected by levees from the 100-year flood. Specifically, Sweet City Acres, a small residential subdivision located along the southern boundary of the study area, consists of an area protected from the 100-year flood by a levee; this levee could however be subject to possible failure or overtopping during larger floods.

Aside from the channel of Keegans Bayou, located in the northeastern corner of the study area, and the area surrounding Red Gully, located in the southwestern corner of the study area, no other flood zones were identified during the course of this study.

Figure II illustrates the FEMA designated flood zones located within the study area.

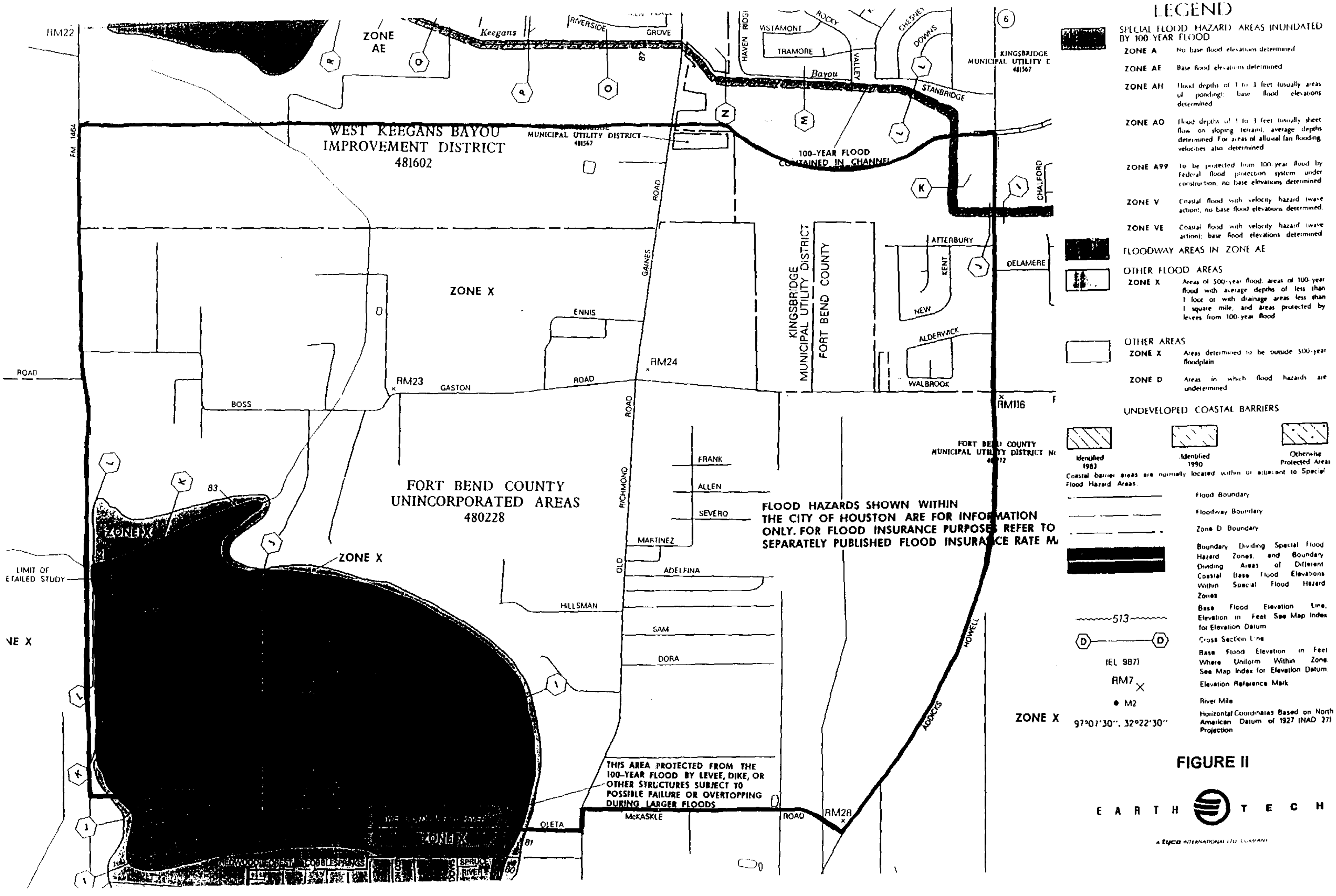


FIGURE II

EARTH TECH

A tyco INTERNATIONAL LTD. COMPANY

3.0 EVALUATION OF AREA EXISTING PRIVATE WELLS AND EXISTING SEPTIC SYSTEMS

The Four Corners area considered by this study generally consists of low income residential housing including small single family houses and mobile homes. Some light commercial developments are interspersed within residential development in the area. Currently, no community water system exists in the Four Corners area. Private water wells supply the limited domestic water to residences in the area. Sanitary sewage treatment is accomplished by with septic fields serving individual lots. The approximate locations of existing private water wells and existing private septic systems are shown on the attached Exhibit A.

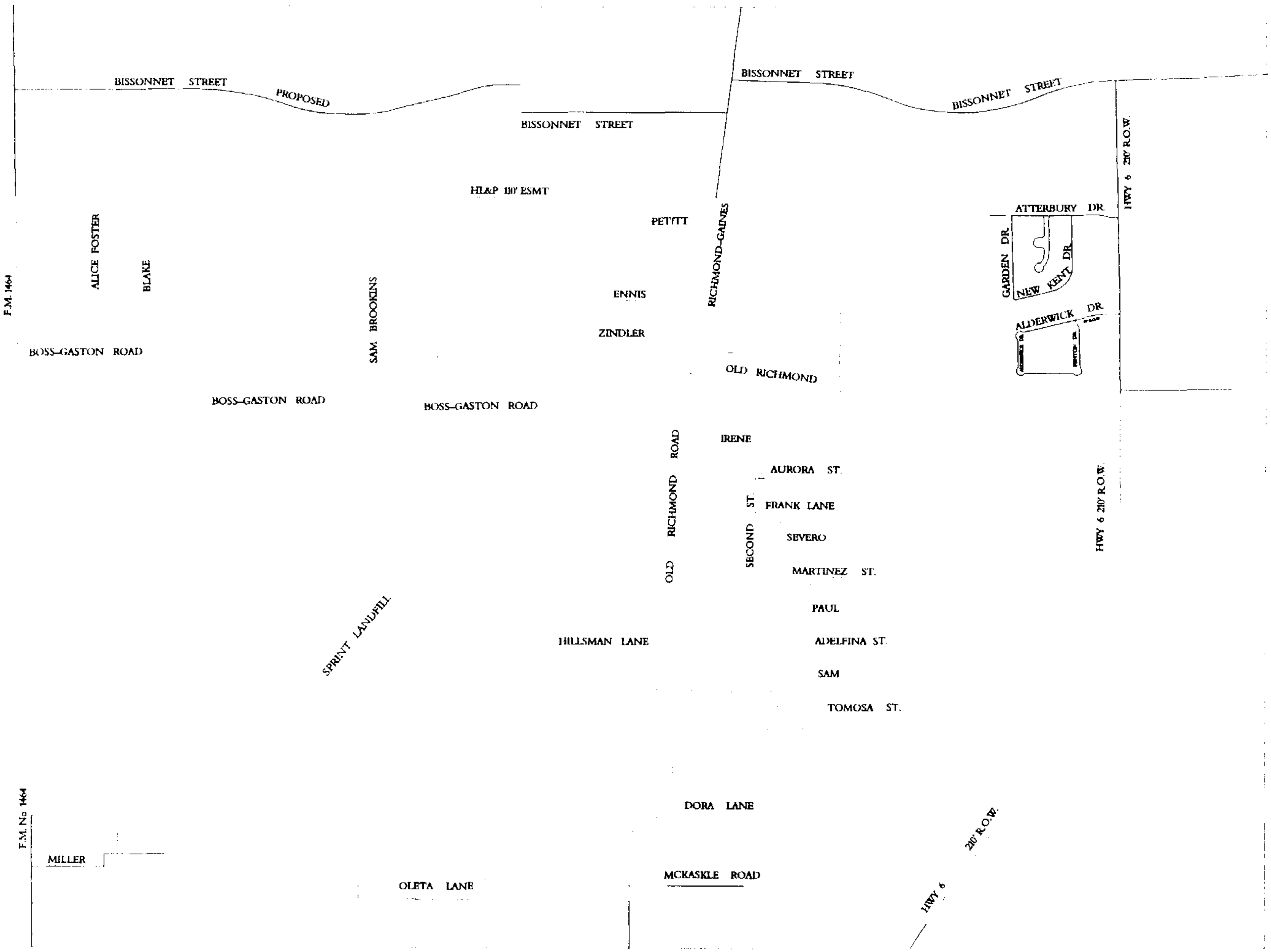
Monitoring wells around the Sprint Landfill located in the center of the study area. Samples from monitoring wells were analyzed for the following:

Cadmium (dissolved)
Chloride
Iron (dissolved)
Manganese (dissolved)
Total Dissolved Solids
Zinc (dissolved)
SP Conductance
pH
Total Organic Carbon
Lead (dissolved)

Of those listed the regulated inorganic chemicals listed in the Safe Drinking Water Act regulations are, Cadmium and Lead. The maximum contaminant limit for these is 0.005 mg/l and 0.015 mg/l respectively. The SDWA lead and copper rule determining values for drinking water are to be established from customer tap samples and take into account background concentration levels. It is not known what background levels may be present to enable a determination whether levels indicated in monitoring reports are elevated above normal levels.

Test results received from the TNRCC for monitoring wells are located in Appendix G.

Based upon information from the Fort Bend appraisal district maps and records, the typical residential lot size (east of Richmond_Gaines Road) is 70' x 150'. This typical lot size is inadequate to meet the TNRCC's distance requirements between an on-site treatment facility and a public drinking water well. A close distance between waste and water facilities contributes to drinking water quality deterioration.



SEPTIC SYSTEM PRIVATE

WATER WELL PRIVATE

STUDY AREA BOUNDARY

CHARLES
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PROJECT:
FORT BEND COUNTY REGIONAL WATER
AND WASTEWATER PLANNING STUDY

SCALE NONE

DATE FEBRUARY 8, 1999 SHEET 1 OF 1

4.0 PROJECT JUSTIFICATION

4.1. EXISTING CONDITIONS

The Fort Bend County, Four Corners area is an unincorporated area within the county that is home to approximately 1,150 primarily low income, minority residents. There currently is no public water supply or wastewater collection and treatment. Currently, residents obtain water from private wells. To date, some of the area's homeowners shallow water wells have gone dry, forcing them to get water from their neighbor's wells. Some residents use privies and other inadequate means of on-site sewage disposal. On-site sewage disposal systems located on small lots can contribute to groundwater well contamination. Contaminated well water by the inadequate disposal methods poses a health hazard to area residents. It has been estimated that 90% of the area residents buy bottled water. Additional residents moving into the Four Corners area has stress the already inadequate resources.

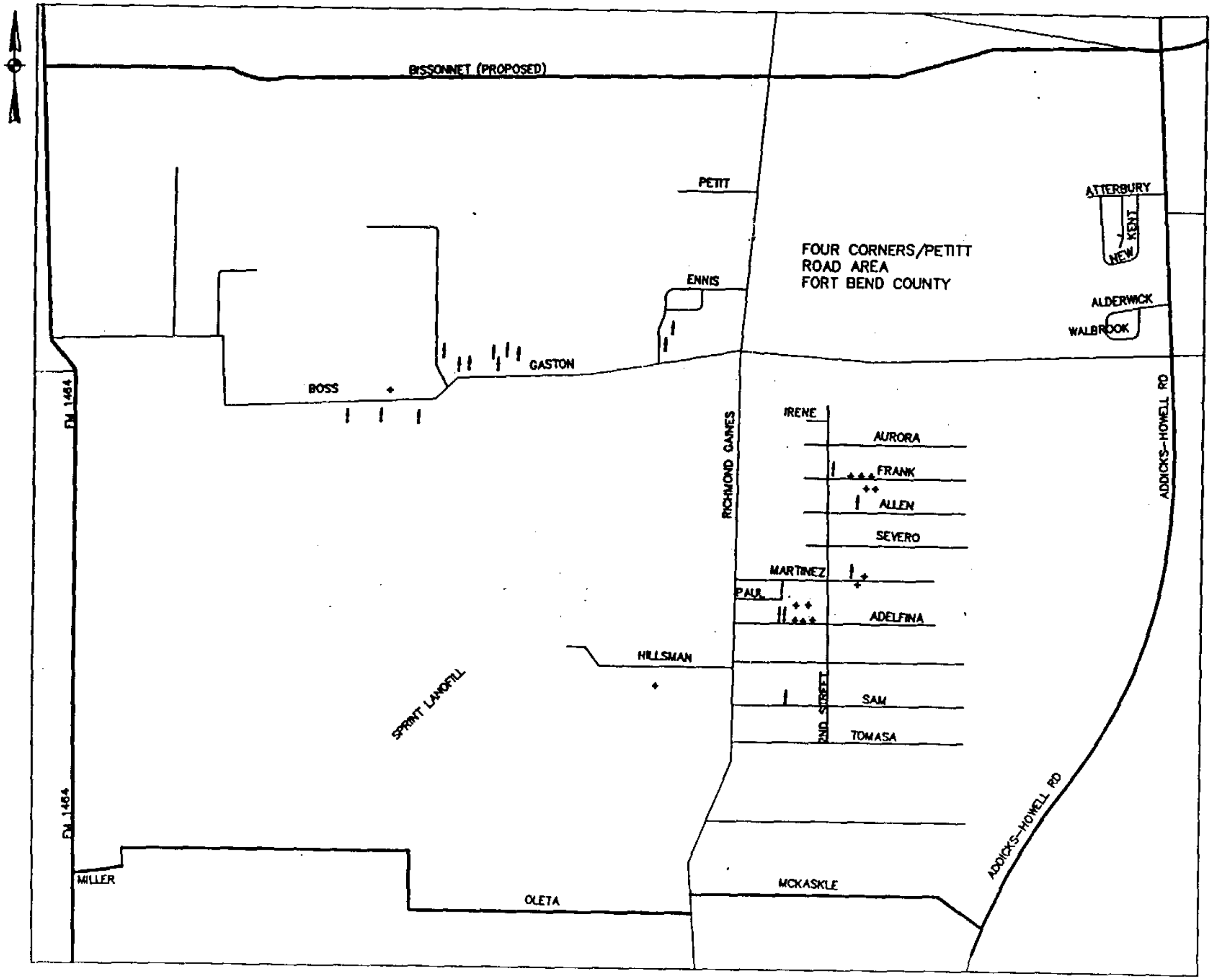
4.2. DISCUSSION OF HISTORY OF HEALTH VIOLATIONS

According to Fort Bend County Environmental Health Department there have been approximately one hundred seventy (170) complaints for septic systems in the project area over the past ten (10) years. The locations of the complaints by street name are listed in Table 4.1.

Table 4.1

STREET	NUMBER OF COMPLAINTS
Adelfina	19
Aurora	8
Blake	1
Frank	16
Martinez	18
Old Richmond Road	13
Paul	34
Sam	24
Second	17
Severo	8
Tomasa	12
	Total 170

Currently operating on-site treatment systems are experiencing a high degree of failure to properly treat the area population's domestic waste. This condition can primarily be attributed to the overloading of the existing systems. Higher household populations than systems can handle and inadequate treatment system maintenance. The high number of complaints is evidence of the pressing need of the area to have wastewater collection system in place to replace the stressed on-site treatment systems currently in use in the area.



LEGEND

ǀ SEPTIC SYSTEM – PRIVATE
+ WATER WELL

NOTE:

THE ONLY SEPTIC SYSTEMS APPEARING ON THIS EXHIBIT ARE THOSE THAT HAVE BEEN INSPECTED BY THE FORT BEND COUNTY HEALTH DEPARTMENT

CHARLES D. GOODEN CONSULTING ENGINEERS, INC.

2656 SOUTH LOOP WEST, SUITE 380
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PROJECT: FORT BEND COUNTY REGIONAL WATER AND WASTEWATER PLANNING STUDY
EXHIBIT A
SCALE: NTS

5.0 ALTERNATIVE WATER AND WASTEWATER SYSTEMS

5.1 CHEMICAL ANALYIS–ADJACENT PUBLIC WATER WELLS

Engineering consultants and water/sewer operators for Municipal Utility Districts in the area adjacent to the Four Corners planning area were contacted regarding available chemical analyses of existing water supply wells. Information was provided for public water supply wells in Fort Bend County MUD No. 2, Kingsbridge MUD, North Mission Glen MUD and Fort Bend County MUD No. 41.

Based upon the information provided by the water system operators, water supply wells within each of the four adjacent districts are within the regulatory maximum contaminant levels for minerals, metals and volatile organic compounds. These maximum contaminant levels are established by the Texas Natural Resource Conservation Commission. Total hardness for water from several of the wells is classified as moderate to hard. However, this is not uncommon for groundwater supplies in the Gulf Coast area and does not pose problems for use as potable water supply.

5.2 AREA HYDROGEOLOGIC CONDITIONS AND - GENERAL SOIL GROUNDWATER CHARACTERISTICS

The soils encountered in the reports reviewed are typical of the Beaumont formation and the Quaternary alluvial deposits. Based on the geotechnical information from these reports, we do not expect any unusual problems in the project areas. Most of the soils may be tentatively classified as type B for stiff to hard clays above the water table, and type C for weaker clays, granular soils and soils below the water table, based on OSHA trench safety requirements as presented in Appendix B of 29 CFR part 1926. Since some of the borings were drilled at distances up to about 5 miles from the project areas, we are uncertain of soil conditions at specific project locations.

Groundwater level measurements were documented in several of the projects reviewed. It should be noted, however, that groundwater levels may fluctuate seasonally, climatically and due to other factors not evident at the time of drilling. If clay soils exist to a significant depth below the base of the trench excavation, a pump and sump dewatering system will probably be adequate for trench excavation. If granular soils are encountered above or close to the base of excavation, a well point dewatering system may be required.

Thirteen investigations containing 72 borings were reviewed for this sub-area. The terminal depths of the borings ranged from 5 to 50 feet below ground surface. The soils encountered were mostly firm to very stiff clay, sandy clay, and silty clay surface stratums which ranged in thickness from 4 to 25 feet. The plasticity index of the cohesive soils ranged from about 10 to 70. The cohesive soils were generally underlain by very loose to medium dense sands and silts. Most of the very sandy and silty soils with plasticity indices less than 7 occurred to the south of the sub-area where surface strata occasionally consisted of sands and silts. Calcareous and ferrous nodules were usually scattered throughout the depth of exploration for most of the borings in and near the sub-area. Surface layers of fill material ranging from about 2 to 4 feet in thickness occurred fairly often on the boring logs. In one case, the fill material extended to about 10 feet below ground surface. Groundwater was recorded at levels ranging from 8 to 15 feet below ground surface. However, several borings with depths up to 20 feet were dry.

5.3 WATER AND WASTEWATER SYSTEM REQUIREMENTS

Public water distribution and supply systems must be designed in accordance with Texas Natural Resource Conservation Commission (TNRCC) permanent rules, Chapter 290 (Water Hygiene). Sanitary sewer collection and treatment systems must be designed in accordance with TNRCC permanent rules, Chapter 317 (Design Criteria for Sewage Systems). The Four Corners planning area lies within the Extra-Territorial Jurisdiction of the City of Houston. In addition to the requirements of TNRCC, water and sanitary sewer facilities must be designed in accordance with the September 1996 "Design Manual for Wastewater Collection Systems, Water Lines, Storm Drainage and Street Paving" issued by the City of Houston Department of Public Works and Engineering. City of Houston design requirements are more stringent than TNRCC with respect to certain design elements of water and wastewater systems. Construction drawings for water and sanitary sewer facilities must be approved and signed by the City of Houston prior to the initiation of construction.

WASTEWATER COLLECTION SYSTEM

The gravity sanitary sewer system design is based on minimum lateral pipe diameter of 8 inches. The service leads may be as small as 6 inches. Minimum grades for various pipe diameters in the design are listed the following table.

Diameter (in.)	Grade (%)
6	0.65
8	0.44
10	0.33
12	0.26

The grades above will provide a minimum full-flow velocity of 2.3 feet per second to minimize sedimentation in the pipe. All gravity line design calculations are based on a Manning's "n" value of 0.013.

All wastewater collection lines were designed with capacity to meet flow requirements described in other sections of this report. Flow capacities based on the above minimum grades for each pipe size are listed in the following table.

Diameter (in.)	Capacity (gpd)
6	303,400
8	518,030
10	813,420
12	1,174,070

Minimum depth at the upstream end of all lateral sewers is 3 feet from natural ground to top of pipe. This is necessary to allow for connections from individual housing units. Maximum depth of 8 inch, 10 inch and 12 inch pipe is 20 feet from natural ground to pipe flowline per City of Houston guidelines. This limitation reduces the construction of deep sanitary sewers in areas with potential for water bearing sands. To take advantage of the lesser grades, several pipes were over-sized, with excess flow capacity. This allowed for greater distances between lift stations while minimizing the number of lift stations and the depth of gravity sewers.

Wet well dimensions will vary with each lift/pump station and with the phase of construction being considered. The diameter of the wet well must accommodate the number of pumps needed to handle the design flow while maintaining adequate clearance between each pump. Wet well volume is a function of flow rate and pump cycle time. Minimum allowable cycle time is 6 minutes from start to start. The size of pumps required varies from ~2 hp to ~45 hp.

Due to the distance between the service area and the source of wastewater treatment, a pump station and force main will be needed to serve Area 1. The flows for the pump/ lift station for Area 1 vary substantially from initial to ultimate conditions. This station should be designed with two pumps for the initial conditions and will ultimately require three pumps to meet future conditions. The wet well should be large enough to allow for a third pump to be added as future demands warrant it. At that time, two pumps will handle the design flow, and the third will operate as a backup.

The lift stations, which are significantly smaller than the pump station, require installation of only two pumps for operation. Lift station pumps should be selected such that a single pump can handle the design flow allowing the second pump to serve as backup. The lift stations for Area 2 and 3 should be designed to transition from initial to ultimate flows, if necessary, by pump modifications.

WATER DISTRIBUTION SYSTEM

In addition to hydraulic and pressure considerations, the following design criteria was applied to sizing the water distribution system.

Diameter	Design Limitations
4-inch	Only on dead-end lines within cul-de-sacs supplying maximum of 16 connections.

6-inch	Maximum length is 1000 feet when interconnected between two waterlines 8-inch or larger. Maximum length is 500 feet on permanent dead-end terminating with fire hydrant or flushing valve. Only one fire hydrant or flushing valve is allowed.
8-inch	Required for line lengths greater than 1000 feet or when two or more fire hydrants/flushing valves required.
≥12-inch	To be determined by the Professional Engineer and verified by City of Houston Water Engineering Section.

Water line diameter selection is also impacted by pressure requirements in the system. Minimum working pressure under normal conditions should exceed 35 pounds per square inch (psi) at all points in the system. When the system is expected to provide fire-fighting capability, a minimum pressure of 20 psi must be maintained under combined fire and drinking water flow conditions.

Gate valves on waterlines 4 inch through 12 inch in diameter must be spaced at a maximum of 1000 feet. Valves must also be placed at line intersections. The number of valves should equal the number lines leading out of the intersection minus one. Fire hydrants in a single family residential development should be spaced at 500 feet.

5.4 ALTERNATIVE SYSTEM LAYOUTS

Two concepts for water supply and wastewater treatment were investigated as part of this study. One concept included the construction of a water supply plant and wastewater treatment plant within the limits of the planning area (referred to as the "On-site" option) which would provide services only for properties within the planning area boundaries. The other concept involves the acquisition of "surplus" capacity in water supply and wastewater treatment facilities within neighboring municipal utility districts. Use of surplus capacity requires the Four Corners area to construct only the water distribution and wastewater collection systems within their area and these systems would then be "hooked up" to the adjacent water supply and wastewater treatment plants. Only two adjacent districts, Kingsbridge MUD and North Mission Glen MUD indicated that water and/or sewer capacity was currently available or would be available in the near term (see Section 10 for summary of all district contacts).

Appendices A, B, and C provide water distribution and wastewater collection system layouts for the alternatives considered from Kingsbridge MUD, North Mission Glen MUD, and On-site, respectively. Water distribution layouts are shown only for the On-site option and connection to Kingsbridge MUD. North Mission Glen is currently evaluating their water supply system and will not be able to assess their surplus water capacity until completion of their study. Wastewater collection systems are shown for all three options.

The wastewater collection schemes for the On-site, Kingsbridge MUD and North Mission Glen MUD options are very similar with 12-inch gravity trunk sewer lines being located on Richmond-Gaines Road and Boss-Gaston Road and 8-inch gravity sewer lines being used throughout the residential areas. Three lift/pump stations are required to provide service to the total planning area because of the size of the planning area, the limitations on the depths of gravity sanitary sewer construction and the potential for construction in wet sand conditions. Under the On-site scenario, one of the three stations would be constructed at the site of the wastewater treatment plant facility.

Under the Kingsbridge MUD and North Mission Glen MUD scenarios, the wastewater from the Four Corners area will be collected into a single pump station to be located adjacent to Old Richmond Road south of Boss-Gaston Road. From this pump station, wastewater will be pumped via force main to an existing 12-inch gravity sanitary sewer located at the intersection of Bissonnet Road and Richmond-Gaines Road (Kingsbridge MUD scenario) or to the North Mission Glen MUD wastewater treatment plant located on Keegans Bayou, north of the Four Corners area (North Mission Glen scenario).

For the On-site scenario, a wastewater treatment plant site is tentatively located along Old Richmond Road near the southern limits of the planning area and discharges to Red Gully. No specific tract of land has been identified at this time for the treatment plant site.

However, the southern portion of the planning area provides the most accessible possibilities for outfall into Red Gully.

Water distribution system layouts for the on-site and Kingsbridge scenarios are very similar with the use of 12-inch water mains along Richmond-Gaines and Boss-Gaston Roads. Six-inch and eight-inch water lines are used throughout the rest of the system. Under the Kingsbridge scenario, the Four Corners distribution system will connect to the Kingsbridge water supply through an existing 12-inch water line located on Boss-Gaston Road east of Richmond-Gaines Road and to an existing 12-water line located at the intersection of Bissonnet and Richmond-Gaines. This layout will provide the Four Corners area with two points of connection to the Kingsbridge water supply system.

The on-site water scenario shows the construction of a water supply plant near Old Richmond Road south of Boss-Gaston Road. As with the on-site wastewater system scenario, no specific tract of land has been identified for the water plant location. However, the location shown on the layout in Appendix C is centrally located to the entire planning area.

5.5 ALTERNATIVE SYSTEMS COSTS

Construction cost estimates for the alternative water and sewer systems evaluated in the study were broken down into two separate components. The first component included the construction costs for water distribution and wastewater collection systems within the Four Corners planning area. The configurations of these systems were dictated by the physical locations of water supply and wastewater treatment in addition to regulatory requirements. The second component involves the construction costs for the water supply plant and the wastewater treatment plant which are based upon the cost of new facility construction or in the case of existing plant availability, the capital recovery costs of the facilities already constructed. All construction cost estimates are based upon current unit costs for projects similar to scope and size of those evaluated in the study.

Table 5.5.1 provides a summary of the construction costs for the water supply, wastewater treatment, water distribution and wastewater collection systems alternatives. Detailed cost construction costs estimates for water distribution and wastewater collection systems evaluated are included in the appendices of this report.

TABLE 5.5.1

FOUR CORNERS WATER AND SEWER ALTERNATIVE SYSTEM COSTS

	N. Mission Glen MUD	Kingsbridge MUD	On-Site W & WW	On-Site WW Contract Water
WASTEWATER COLLECTION				
Construction	$ 3,406,475	$ 3,326,555	$ 3,176,075	$ 3,176,075
Contingencies(15%)	510,970	498,980	476,410	476,410
Engineering(10%)	391,740	382,550	365,250	365,250
Site Acquisition/Easement	5,100	5,100	34,000	34,000
Administration(5%)	215,710	210,660	202,590	202,590
TOTAL WASTEWATER COLLECTIO	$ 4,529,995	$ 4,423,845	$ 4,254,325	$ 4,254,325
WATER DISTRIBUTION				
Construction	N/A	$ 2,171,800	$ 2,093,960	$ 2,171,800
Contingencies(15%)		325,770	314,090	325,770
Engineering(10%)		249,760	240,810	249,760
Site Acquistion/Easements			24,000	
Administration (5%)		137,370	133,640	137,370
TOTAL WATER DISTRIBUTION	$ -	$ 2,884,700	$ 2,806,500	$ 2,884,700
WASTEWATER TREATMENT				
Construction			$ 345,000	$ 345,000
Engineering(10%)			34,500	34,500
Site Acquisition/Easements				
Administration(5%)			18,980	18,980
Capital Recovery(350 Con	$ 423,500	$ 203,500	N/A	N/A
TOTAL WASTEWATER TREATMENT			$ 398,480	$ 398,480
WATER SUPPLY				
Construction			$ 1,397,250	
Engineering(10%)			139,730	
Administration(5%)			76,850	
Site Acquisition/Easements			21,000	
Capital Recovery(350 Con	N/A	$ 395,230	N/A	$ 395,230
TOTAL WATER SUPPLY			$ 1,634,830	
TOTAL WATER SUPPLY AND DISTRIBUTION	N/A	$ 3,279,930	$ 4,441,330	$ 3,279,930
TOTAL WASTEWATER TREATMENT AND COLLECTION	$ 4,953,495	$ 4,627,345	$ 4,652,805	$ 4,652,805
GRAND TOTAL WATER & SEWER	N/A	**$ 7,907,275**	**$ 9,094,135**	**$ 7,932,735**

6.1 WATER AND WASTEWATER SYSTEM LAYOUT

With the exception of the points of source connection for water supply and wastewater treatment, there is very little difference in the overall water and sewer system layouts for the three scenarios evaluated (On-site, Kingsbridge MUD and North Mission Glen MUD). Due to the size of the planning area, pump stations and lift stations are necessary for an efficient wastewater collection system for each of the scenarios evaluated.

Section 6.2 discusses the recommended source of water supply and wastewater treatment as the Kingsbridge MUD option. As shown in the water distribution system layouts and wastewater collection system layouts in Appendix A, the Four Corners Planning Area was broken down into three geographic service areas. These areas account for the majority of the existing 350 connections. The detailed cost estimates provided in Appendix A for this scenario include a breakdown of water distribution and wastewater collection system costs by each individual area. Table 6.1.1 provides a summary of the water distribution and wastewater collection system costs for the Kingsbridge MUD option.

TABLE 6.1.1

COST SUMMARY
WATER DISTRIBUTION & WASTEWATER COLLECTION SYSTEMS

KINGSBRIDGE MUD OPTION

	SERVICE AREA 1	SERVICE AREA 2	SERVICE AREA 3	TOTAL AREA FOUR CORNERS
WASTEWATER COLLECTION SYSTEM				
Construction	$2,237,015	$ 449,260	$ 640,280	$ 3,326,555
Contingencies (15%)	335,550	67,390	96,040	498,980
Engineering (10%)	257,260	51,670	73,620	382,550
Site Acquisition/Easements	1,700	1,700	1,700	5,100
Administration (5%)	141,580	28,500	40,580	210,660
Total Cost	$2,973,105	$ 598,520	$ 852,220	$ 4,423,845
WATER DISTRIBUTION SYSTEM				
Construction	$1,580,340	$ 322,130	$ 269,330	$ 2,171,800
Contingencies (15%)	237,050	48,320	40,400	325,770
Engineering (10%)	181,740	37,050	30,970	249,760
Administration (5%)	$ 99,960	$ 20,380	$ 17,030	$ 137,370
Total Cost	$2,099,090	$ 427,880	$ 357,730	$ 2,884,700
TOTAL WATER DISTRIBUTION & WASTEWATER COLLECTION	**$5,072,195**	**$ 1,026,400**	**$ 1,209,950**	**$ 7,308,545**

Total construction cost for the water distribution and wastewater collection system to serve the 350 existing connections in the planning area is $7,308,545. If phasing of the overall water and sewer system is required to meet available funding sources, the three service areas shown in the cost estimate provide a geographic breakdown for implementation. Implementation of water and sewer service in areas one and two would provide utility service to approximately 200 of the existing 350 connections.

6.2 WATER SUPPLY AND WASTEWATER TREATMENT PLANT REQUIREMENTS

The average daily water demand for the existing 350 connections is 138,000 gallons per day (gpd) while the average daily wastewater flows is 115,000 gpd. Details of available water supply and wastewater treatment capacity from Municipal Utility Districts adjacent to the Four Corners area provided in Section 10.1 of this report. Kingsbridge MUD currently has surplus wastewater capacity available and will have water supply capacity available in the near term.

Acquisition of capacity from Kingsbridge MUD is the recommended alternative for several reasons. The capital recovery costs for the water supply and wastewater treatment facilities are less than those available from North Mission Glen MUD and are less than the costs to construct water supply and wastewater treatment facilities within the planning area. Four Corners will not have to apply for water supply and wastewater discharge permits (a lengthy and unpredictable process) because Kingsbridge MUD is currently operating under its own permits. The cost for operation and maintenance of the water supply plant and wastewater treatment plant, sludge disposal and permit renewals/reporting/testing is built into the rate structure to be charged to the Four Corners Area.

The capital recovery costs and water/sewer rates provided by Kingsbridge MUD are shown in Table 6.2.1. A copy of the District's response letter regarding availability and costs are included in Appendix A.

TABLE 6.2.1
KINGSBRIDGE MUD
WATER SUPPLY AND
WASTEWATER TREATMENT COST

Wastewater Treatment (Capital Recovery Costs)		
350 Single Family Connections	$	185,000
Contingencies (10%)		18,500
TOTAL WASTEWATER TREATMENT	$	203,500
Cost per connection	$	581
Water Supply (Capital Recovery Costs)		
350 Single Family Connections	$	359,300
Contingencies (10%)		35,930
TOTAL WATER SUPPLY	$	395,230
Cost per connection	$	1,129
TOTAL COST PER CONNECTION	$	1,711

6.3 SYSTEM HYDRAULICS AND PUMPING REQUIREMENTS

The existing residences to be served within the Four Corners Planning Area are distributed throughout the service area which requires long runs of waterlines and sanitary sewer lines to provide service. Waterlines operate under pressure and are typically installed at depths of 4-6 feet below natural ground. The proposed Kingsbridge layout for the water distribution, shown in Appendix A, provides for two points of connection to the Kingsbridge water supply system. This allows Four Corners a back up source of water in the event that one supply connection is out of service.

Sanitary sewer lines operate under the influence of gravity and some of the lengths of runs in the planning area would require sewers to be constructed at depths in excess of 20 feet to meet design criteria of the City of Houston and the TNRCC. Additionally, construction of the sanitary sewer lines at shallower depths can reduce the cost of construction and minimize the potential impacts of wet sand conditions. The proposed Kingsbridge layout for the wastewater collection system makes use of two lift stations and one pump station. The pump station, to be located in the vicinity of Old Richmond Road will collect all wastewater flows from the Four Corners area and pump them to the Kingsbridge MUD sanitary sewer system. The pump station will be sized to accommodate future growth within the planning are but will initially include pumping equipment necessary to serve the 350 connections. The two lift stations, one located on Boss-Gaston Road and the other on Old Richmond Road near Dora Lane, are necessary to lift flows into the shallow gravity sanitary sewer thus eliminating the need to construct deep trunk gravity sewers (>20 feet) along Old Richmond Road and Boss-Gaston Road.

6.4 PERMITTING REQUIREMENTS

Construction and operation of a wastewater treatment facility requires the acquisition of a wastewater discharge permit from the Texas Pollutant Discharge Elimination Program. This program created in 1998 consolidates the previous permitting requirements of the Environmental Protection Agency (EPA) and the Texas Natural Resource Conservation Commission (TNRCC) under a single permitting process administered by the TNRCC. The permitting process generally consists of submittal of wastewater permit applications with engineering analysis, agency staff review, public notice, public hearing, review by a hearing examiner, and ultimate issuance of a discharge permit. The time and effort involved in this process is not predictable due to the potential for public input during the permitting process. However, typically 12-18 months is required to secure a permit.

To address the issue of land subsidence due to the removal of groundwater in the greater Houston area, groundwater supply plants must secure water well permits. For wells constructed in Fort Bend County, a water well permit application must be submitted and approved by the Fort Bend Subsidence District. If approved by the District, a permit will be issued with an annual limit on the amount of groundwater permitted for withdrawal by the permit holder. Historically, no significant problems have been encountered in acquisition of water well permits in Fort Bend County.

If water supply and wastewater treatment capacity is secured by the Four Corners area from an adjacent utility district, no permits from the TNRCC or the Fort Bend Subsidence District will be necessary. The existing water supply and wastewater treatment systems will be covered under permits issued to the district owning and operating the facilities. However, construction drawings for any water distribution/supply and wastewater collection/treatment proposed to serve the Four Corners area must be approved by the City of Houston and the TNRCC.

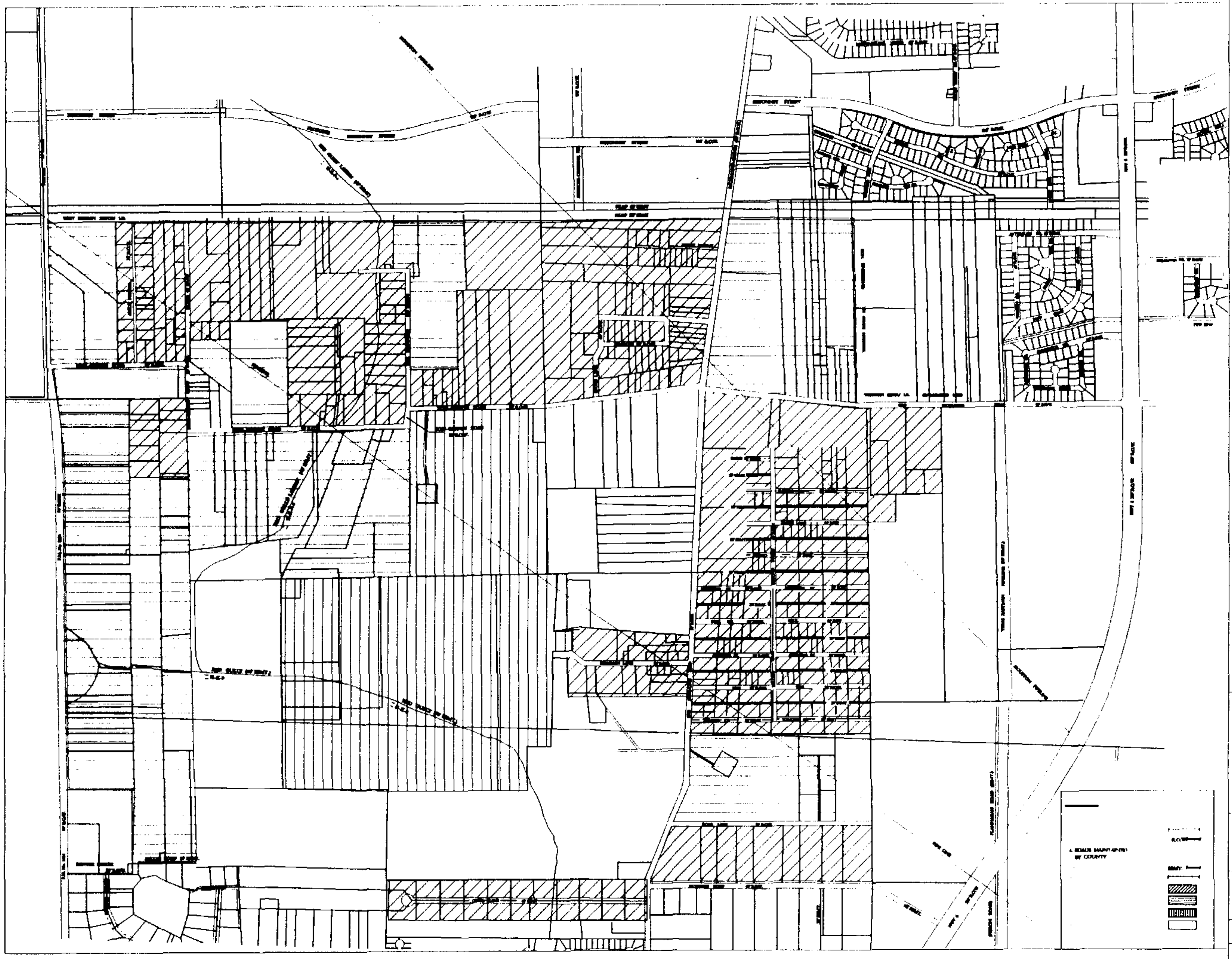
6.5 RIGHT-OF-WAY REQUIREMENTS

The proposed trunk water and sanitary sewer facilities to serve the Four Corners area will be constructed along the major roadways of Boss-Gaston/Old Richmond Road and Richmond-Gaines Road. Right-of-way widths along these roadways vary in width from 50 to 70 feet. No additional right-of-way acquisition would be anticipated. However, field visits have found evidence of gas, electric and telephone utilities along both roadways. Exact locations of these facilities will be necessary in final design and may dictate the location of the proposed water and sewer facilities relative to the existing roadway/drainage and utilities. To provide for a looped connection of the water system east of Richmond-Gaines Road, acquisition of a water line easement along the east side of the Atanacia Martinez subdivision from Old Richmond Road south to Dora Lane will be required.

Lift station and pump station sites have been preliminarily located along Boss-Gaston Road and Richmond-Gaines Road as shown on the sanitary sewer system layout in the Appendices. These locations include some flexibility in terms of their physical location on each roadway but acquisition of each site will be necessary as each proposed station is included in the final design.

The streets within the Atanacia Martinez subdivision include a combination of dedicated street rights-of-way and easements for access to existing housing units in the subdivision. Many of the east-west streets in the subdivision between Second Street and Richmond-

Gaines Road have dedicated right-of-way widths of 50-60 feet. Those portions of the same streets located east of Second Street appear to exist only as access easements. In order to construct public water and sanitary sewer facilities within the access easements, granting of utility easements from the underlying property owner will be necessary or the easements may be converted to public road rights-of-way. Conversion of the easements to right-of-way will require coordination with the property owner and Fort Bend County to ensure that platting and roadway construction issues are addressed.



CHARLES D. GOODEN CONSULTING ENGINEERS, INC.

2806 SOUTH LOOP WEST, SUITE 300
HOUSTON, TEXAS 77054 (713) [illegible]

PROJECT:
FORT BEND COUNTY REGIONAL WATER
AND WASTEWATER PLANNING STUDY

EASEMENTS, RIGHTS OF WAY
AND
PROPERTY OWNERSHIP MAP

SCALE [illegible]

[illegible] 1 OF 1

7.0 OPERATIONAL COSTS

With the acquisition of surplus water supply and wastewater treatment capacity from Kingsbridge MUD, no operation and maintenance costs for the water supply plant and wastewater treatment plant will be born directly by the Four Corners area. The annual costs for the operation of the plant facilities is incorporated into the rate structure for water and sewer service provided by Kingsbridge MUD.

The costs for operation and maintenance of the wastewater collection system, lift/pump stations and the water distribution system will be the responsibility of the Four Corners area. These costs can be assessed by the Four Corners Waster Supply Corporation or similar entity on the customers within the planning area on a monthly basis by incorporating the costs into the ultimate rate charges to the customers. These ultimate rate charges would include the actual cost of service from Kingsbridge MUD in addition to a surcharge to cover operation, maintenance and administrative costs. Most utility districts contract with an operations company to maintain their water and sewer facilities using state licensed operating personnel.

Costs for operation and maintenance of wastewater collection systems and the water distribution systems vary between different municipalities and utility districts within the southeast Texas area. Larger, more complex systems require more intensive operator involvement in day to day operations. However, the major maintenance/operational issue for proposed water and wastewater systems for the Four Corners area will be the lift/pumping stations. Because the facilities involve mechanical and electrical equipment, the potential for breakdown exists. Based upon reviews of operation and administration costs for similar types of water distribution and wastewater collection systems in the area, an annual budget amount of $50,000 to $100,000 could be expected for the Four Corners area.

8.0 PROPOSED WATER CONSERVATION AND DROUGHT MANAGEMENT PLAN

8.1. UTILITY SYSTEM DESCRIPTION

The Four Corners study area is located in north central Fort Bend County, Texas. This area has an estimated population of 1,150. The proposed water system will provide water service through approximately 350 residential customer connections. The Four Corners water supply comes from the Kingsbridge MUD. The proposed system's treated water average daily demand of 138,000 gal/day, for current resident service. A projected peak daily use capacity of 240 gal/day. The service area is shown on Sheet 1 of 1 in Appendix A.

8.2. UTILITY EVALUATION DATA

The water conservation plan presented herein has an overall objective of reducing water consumption in the proposed service area. A benefit of water conserved is the associated reduction in the amount of wastewater needing treatment and disposal. Water conservation measures also can extend the time period in which additional water and wastewater treatment capacity must be provided to the service area.

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

According to the 1990 census figures, the population of the area was 350. This is also the estimated current population. The projected population of the area is projected to be 670 by the year 2020.

Generally, the greatest savings in water usage can be realized by adopting stringent plumbing codes for new construction. Throughout the nation, utilities have found that by revising plumbing codes, reductions in new water usage of 25-30% can be achieved. This type of reduction can have a significant impact on reducing the high cost of renovating and constructing water and wastewater treatment facilities. Water use reductions in rural areas on the order of 10-15%, should be expected for less developed rural areas.

Existing plumbing facilities can also be retrofitted in order to reduce water consumption. Although this may involve an initial capital outlay, all of the measures are cost effective in the long-term. Utilities have employed various methods to recover the costs of plumbing retrofit incentive programs. An aggressive retrofit program can result in water savings of 15-25% per residence. Participation level of 20-50 %, can result in an overall water consumption savings of around 5%.

The population growth projection was applied to the 1,150 current estimated population and average daily water demand of 264,420 gallons was projected for the year 2020 with and without conservation measures. An overall savings of approximately 10% could be achieved by 2020 by adoption of a guidelines that reduce water consumption in new construction;

- Guidelines phased in can result in projected a net water savings of 2% by 2005, 5% by 2010, 7-1/2% by 2015, and 10% by 2020;
- Initial area consumption could be reduced by 5% through a retrofitting program and other conservation measures.

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

8.3. LONG-TERM WATER CONSERVATION

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

1. Education and Information

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

1.1. First-Year Program

- The initial year program includes the distribution of educational materials including a fact sheet detailing water savings methods that can be practiced by the individual water user;
- Distribution of a fact sheet explaining the Water Conservation program and the elements of the emergency water demand management Plan;
- Activities scheduled for the "Long Term Program" is outlined and its benefits are distributed.

1.2. Long Term Program

The Long Term Program consists of distribution of educational materials semi-annually. Information distribution should correspond with peak summer demand periods. Such material should incorporate information available from the American Water Works Association (AWWA), the TWDB, and other similar associations. Materials regarding water conservation can be obtained from:

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

1.3. Information to New Customers

New customers should be provided with a package of information namely, educational material, a fact sheet explaining both the Water Conservation Program and the elements of a Emergency Water Demand Management Plan and a copy of "Water Saving Methods That Can Be Practiced by the Individual Water Users".

2. Conservation-Oriented Water Rate Structure

The structure of rates can be as important as the rate itself in consumer water conservation. Some rate structures encourage conservation, while others may have little affect. Rates should be structured to reflect the cost of service, including property, hardware, operations, maintenance, personnel, the depreciation of capital assets, and needed planning expenses.

An effective rate structure can encourage conservation. Rate structures that result in an unchanged total utility bill are ineffective in encouraging conservation. Additionally, water conserved in response to increased price is delayed until utility bills are received by consumers.

Anticipated water use reductions by customers in response to the higher rates may not be effective when base prices for service are too low. Low base prices for utility service dampens the impact on utility bills by increasing rates. In order for rates to affect water conservation levels, a rate increase needs to have an impact on utility service charges.

A flat rate structure, such as $13.00 for the first 3,000 gallons; 1.50 for each 1,000 gallons after the base amount, neither encourages nor discourages water conservation.

3. Universal Metering and Meter Repair and Replacement

All water users in the service area must be metered. All new construction, including multi-family dwellings, must be separately metered. The universal metering is part of the overall Water Conservation Plan. The following meter maintenance and replacement programs has been recommended by the TWDB:

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

Another segment of a successful conservation program the proposed district must maintain a meter maintenance program, coupled with computerized billing and leak detection programs.

4. Water Audits and Leak Detection

Through their billing program, the proposed utility should audit billings to identify excessive usage and then take steps to determine whether it is a result of leakage. Once located, all leaks should be immediately repaired. A continuous leak detection and repair program is key to minimizing unaccounted for system water losses.

5. Implementation and Enforcement

The utility will be responsible for administering their Water Conservation Program. They should oversee the execution and implementation of their program and supervise the keeping of adequate records for program verification.

The Water Conservation Plan can be enforced by a utility through the adoption and implementation of the by the following sample guidelines.

- Water service taps will not be provided to customers unless they meet the plan requirements;
- The adoption of a rate structure that will encourage retrofitting of old plumbing fixtures that use large quantities of water; and
- Withhold meter installation to new construction that fails to meet plan requirements.

The utility will adopt a final and approved plan, committed to maintaining a conservation program for the duration of their financial obligation to the State of Texas.

6. Periodic Review and Evaluation

On a biannual basis, the utility should evaluate water use rates and per capita consumption figures to determine if there is evidence of an increase in system losses due to mechanical breakdown or leakage and if water conservation goals are being achieved.

7. Water Conserving Landscaping

A utility can reduce the demands placed on the water distribution system by landscape and garden watering by encouraging customers to incorporate water saving practices in landscaping, garden watering facilities. The methods recommended by the TWDB can be promoted by the utility through an education and information program include:

- Xeriscaping landscape programs.
- The use of drip irrigation systems, when possible, and to design all irrigation systems with conservation features such as sprinklers that emit large drops rather than a fine mist and a sprinkler layout that accommodates prevailing wind patterns.
- Installation of ornamental fountains that use minimal quantities of water and include recycling features.
- Use of drought-resistant plants and grasses and efficient watering devices.
- Establish a landscape water audit program, demonstration gardens and related programs.

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

8. Distribution System and/or Customer Service Pressure Control

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

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

9. Recycling and Reuse

   Reuse utilizes treated effluent from the wastewater treatment facility can be to replace a user that requires fresh water from a potable water supply. The area currently has no potential customers for reuse however, recycle use might reduce the amount of fresh water required by a future commercial operations.

10. Water Conservation Retrofit Program

    The water district utility through an education and information programs providing pertinent information regarding the purchase and installation of plumbing fixtures, lawn watering equipment and appliances. This program will inform users of the advantages of installing water saving devices.

    An aggressive retrofit program can have a dramatic impact on water system demands. Several alternatives are summarized in Tables 3. Market penetration is based on the experience of other cities offering such programs.

    The least-cost alternative is to provide packages to customers containing a flow restrictor for a showerhead, a toilet bag and two dye tablets. Based on past experience, the toilet bags are the most acceptable to customers and could be expected to realize savings of 4.8 gallons per capita per day in participating households. A more acceptable and more permanent option is to provide customers with low-flow showerheads and toilet dams. A system used extensively in the City of Austin was the installation of low-flow showerheads and toilet dams at no charge to the customer. Through this program, the Austin market penetration has exceeded 50%. Participating households experienced resulting water savings of around 15%. Another option is to provide rebates of $100 to customers who replace their toilets with those that flush 1.5 gallons.

11. Plumbing Code Water Conservation

Legislation, passed by the 72nd Texas Legislature, that requires that plumbing fixtures sold in Texas after January 1,1992, meet the following standards:

- Showers shall be equipped with approved flow control devices to limit total flow to a maximum of 2.75 gpm at 80 psi of pressure;
- Sink faucets shall deliver water at a rate not to exceed 2.2 gpm at 60 psi of pressure;
- Wall mounted, Flushometer toilets shall use a maximum of 2.0 gallons per flush;
- All other toilets shall use a maximum of 1.6 gallons per flush;
- Urinals shall use a maximum of 1.0 gallons per flush;
- And drinking water fountains must be self-closing.

8.4 EMERGENCY WATER DEMAND MANAGEMENT PROGRAM

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

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

8.4.1 EMERGENCY WATER DEMAND MANAGEMENT RESPONSE MEASURES

Stage 1 - Voluntary Water Conservation
Upon implementation of this stage of conservation by the utility manager, after public announcement and publication of notice, customers of the system shall be requested to voluntary conserve and limit their use of water. All utility operations will be placed on mandatory conservation.

Stage 2 - Water Shortage Alert
Upon implementation of this state of conservation by order of the utility manager, after public announcement and publication of notice, the following restrictions apply to all persons. The manager, in the exercise of his discretion

based upon guidelines established by the governing board may implement any or all of those elements of Stage 2 deemed necessary at any particular time. The manager shall prescribe the provisions of Stage 1 to remain in effect during Stage 2. If any provision in Stage 1 conflicts with a provision in Stage 2, the provision in Stage 2 will control.

(1) Grass, trees, shrubbery, annual, biennial or perennial plants, vines, gardens, and other similar vegetation may be watered, with a hand-held hose equipped with a positive shut-off nozzle or a hand-held bucket or watering can no larger than five (5) gallons in capacity, a drip irrigation system, or an automatic sprinkler system only between the hours of 6 a.m. to 9 a.m. and 6 p.m. to 9 p.m. on alternating days from Monday through Friday depending on location of the premises. Those classes of vegetation described herein, excluding lawns, may be watered on the day of planting. The planting of new lawns is prohibited.

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

(3) All run-off from watering bushes, plants, or other vegetation into gutters or streets shall be deemed a waste of water and is prohibited.

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

(5) The washing of building exteriors and interiors, trailers, trailer houses and railroad cars, is prohibited except that in the interest of public health.

(6) Director of Public Health may permit limited use of the water for the uses cited herein as may be necessary.

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

(8) The use of fire hydrants for any purpose other than fire fighting is prohibited, except that the manager may permit the use of metered fire

hydrant water by the utility or by a commercial operators using jet rodding equipment to clear and clean sanitary sewers.

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

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

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

(12) The use of potable water by a golf course to irrigate any portion if its grounds is prohibited except those areas designated as tees and greens and only between the hours of 6:00 p.m. to 9:30 a.m. on designated watering days.

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

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

Stage 3 - Water Shortage Warning

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

(1) New service connections to the water system where some other source of water independent of the system is existing is prohibited.

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

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

(4) The use of water for scenic and/or recreational ponds and lakes prohibited.

(5) The use of water for all privately and publicly owned swimming pools,

wading pools, jacuzzi pools, hot tubs and like or similar uses is prohibited.

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

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

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

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

Upon implementation of the conservation plan by the water system, after public announcement and publication of notice, the following restrictions shall apply to all persons. The manager, in the exercise of his discretion based upon the guidelines established, may implement any or all of those elements of Stage 4 deemed necessary at any particular time. The manager shall prescribe the provisions of Stage 3 to remain in effect in Stage 4. If any provision in Stage 3 conflicts with a provision in Stage 4, the provision in Stage 4 will control.

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

(2) The maximum amounts of monthly water usage for residential and non-residential customers and the accompanying surcharges may be revised during the state of emergency in Stage 4. These revised allocation and surcharged amounts are subject to approval by the utility system board.

(3) The utility system manager is hereby authorized to take any other actions deemed necessary to meet the conditions resulting from the emergency, including, but not limited to, pressure reduction.

8.4.2 TRIGGER CONDITIONS FOR IMPLEMENTING EMERGENCY WATER DEMAND MANAGEMENT PLAN

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

Stage 1 - Voluntary Water Conservation

(1) The water system advises possible shortages due to the reduction of the groundwater levels or that a water shortage is projected, or

(2) Analysis of water supply sources and demand indicates that the water supply may be exhausted if water demand is not reduced, or

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

(4) Peak demands at the water and/or wastewater facilities are nearing capacity levels and may place a strain on the systems.

Stage 2 - Water Shortage Alert

(1) The manager of the water system advises that a water shortage exists due to the reduction of the groundwater levels, or

(2) Analysis of water sources and demand indicates that the water supply will be exhausted if water demand is not reduced, or

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

(4) Peak demands at the water and/or wastewater plants have reached capacity levels and are placing a strain on the system, or

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

Stage 3 – Water Shortage Warning

(1) The manager of the water system advises that a water shortage exists due to the reduced groundwater levels. The manager of the water system takes necessary action to prevent the waste of water or to alleviate the emergency.

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

(3) Peak demands at the water and/or wastewater facilities have exceeded capacity levels for three days and have placed a strain on the system(s). Without restraint, service to all utility customers can not be guaranteed, or

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

Stage 4 - Water Shortage Emergency

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

(4) Peak Demands on the water and/or wastewater facilities have exceeded capacities for 5 days and have placed a strain on the systems. Without restraint, service to all utility customers can not be guaranteed, or

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

8.4.3 LEGAL AND REGULATORY COMPONENTS

- Plan Adoption Resolution by utility (required)
- Emergency Water Demand Management Regulation (required)
- Water Conservation Plumbing Regulation (Required if Plumbing Regulations are implemented by utility)
- Plumbing Fixture Retrofit Ordinance/Regulation (Optional)
- Conservation-Oriented Rate Ordinance/Regulation (Optional)
- Water Conservation Landscape Ordinance/Regulation (Optional)

8.4.4 CONTRACTS WITH OTHER POLITICAL SUBDIVISIONS

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

8.4.5 ANNUAL REPORTS

The TWDB requires financial assistance recipients that implement a program of water conservation to submit an annual report to the Executive Administrator describing the implementation, status, and quantitative effectiveness of the water conservation program until its financial obligations to the State have been discharged (31 TAC §363-71). The utility system administrator will be required to submit a report within sixty (60) days after the anniversary date of the loan closing.

9.0 IMPLEMENTATION AND FUNDING PLAN

9.1. DESCRIPTION OF ENTITIES NECESSARY TO IMPLEMENT RECOMMENDED PROJECT

In order to access financing sewer facilities in the Four Corners area, a Water District will have to be formed. Water Supply Corporations (WSC) formed to serve specific areas can seek loans to construct water facilities however the loan requirements for sewer facilities require the additional security that a district provides. Unlike WSC's, Districts have the ability to levy taxes to cover their debt when revenues are insufficient.

Water districts are local political subdivisions of the state governed by a board of directors. Water districts in Texas derive their authority from the Texas Constitution, Article III, Section 52 or Article XVI, Section 59. All water districts must comply with the laws contained in the Texas Water Code and other applicable statutes. The TNRCC has "continuing right of supervision" over water districts in accordance with the Texas Water Code. Districts also are subject to regulation by state and federal agencies that issue and monitor permits for the various activities of the district. For example, drinking water quality and wastewater discharges are regulated by the TNRCC and the U.S. Environmental Protection Agency.

Districts are governed by a board of directors elected by the voters in the district. Board members must meet the qualifications for serving outlined in the Texas Water Code. The district's board is responsible for all the business of the district, including those functions that are contracted to other parties. In order to meet the financial obligations of the district a tax may be levied upon all property in the district on an ad valorem basis. The tax rate authorized by voters cannot be exceeded without additional voter approval.

Once a district has been established, the TNRCC has "continuing right of supervision" over water districts in accordance with the Texas Water Code. Districts also are subject to regulation by state and federal agencies that issue and monitor permits for the various activities of the district. Drinking water quality and wastewater discharges are regulated by the TNRCC and the U.S. Environmental Protection Agency.

In order to provide customer service and establish a system, an engineering study must be made and accepted by funding and regulating agencies; construction plans must be prepared, reviewed and approved by various government agencies. Seeking a loan to finance the construction and the loan approval process takes time. Once plans are approved and financing arranged, usually start construction as soon as possible.

9.2. REQUIREMENTS TO OBTAIN PROJECT FUNDING

There are numerous funding sources for communities seeking financial assistance funding for the construction of water and wastewater utilities. In most financially needy communities money to construct the water plants and pipelines, wastewater treatment plants and sewer lines comes from loans provided by the Rural Utilities Service (RUS) or through the Texas Water Development Board (TWDB). Of the funding available, the RUS provides below market interest rates and grants of up to 75% for the most needy of communities. Loan repayments and daily operational costs are then generally paid off with revenue from utility service sales. Because the funds and customer base are so limited, rural utilities are generally not "over-built" to accommodate future growth. Therefore, future applicants to a rural system may have to pay his share of the cost of enlarging or extending services.

The following table presents a listing of funding sources developed by the Texas Natural Resource Conservation Commission (TNRCC).

Program or Agency **Contact Name** **Phone**	**Description**	**This Program or Agency Works With***
United Financial of Illinois, Inc. Scott D. Pinckard 630/ 955-0188	Finances capital equipment and projects for counties, cities, IOUs, WSCs, and local governments. Loans, Sales and Leaseback, and Master Lease is offered. Loan amounts are from $50,000 to $10,000,000. 100% financing offered including engineering and construction costs.	Almost any project
USDA, Rural Development **Rural Utilities Service** J. Gary Lightsey 254-742-9789	RUS Water and Waste Disposal loan funds are used to develop water and waste disposal systems (including solid waste disposal and storm drainage) in rural areas and towns with a population of 10,000 or less. In some cases, grants may be given for up to 75 percent of eligible project costs.	Cities, Water Districts, Water Supply Corporations (WSCs), Counties, and Indian tribes
TNRCC **Texas Small Towns Environment Program** (Texas STEP) Jane Scheidler 512-239-6156	Uses community self-help resources (people power and affordable budgets) to cut costs on water and wastewater projects. Loan funds may be available for projects which have a significant component of self-help. Works with local "sparkplugs" to accomplish projects.	Political subdivisions and communities in unincorporated areas
Texas Department of Housing and Community Affairs **Texas Community Development Program** 512-475-3800	Provides funding to eligible cities and counties through the Community Development Block Grant (CDBG) program. A county may apply for assistance for an unincorporated area in their county. Projects are funded through a regional competition, with a deadline for applications. Limited disaster relief and urgent-need funds are also available. The availability of funds is based on state and federal appropriations.	Cities and Counties
Melbye & Associates Russ Melbye 214-985-8560	Provides financing to IOUs, WSCs and political subdivisions in the form of lease/purchase, straight leasing and loans. Loan amounts begin at $20,000.	Political subdivisions, Investor-owned Utilities (IOUs), and WSCs
Government Funding Group, Inc. Maria D. Middleton 800-561-0461	Arranges financing for political subdivisions. Will also work with districts, IOUs and WSCs in specific cases. Minimum loan amount is $10,000.	Political subdivisions, IOUs, and WSCs
First Commercial Capital Bill Duncan 800-349-7917	Provides Small Business Administration (SBA) and other government-backed loans. A cash flow lender. Offers long-term financing for major capital Improvements, new acquisitions, and refinancing of existing debt. Loan amounts range from $50,000 to $10,000,000.	IOUs and WSCs
Texas Water Development Board **Financial Assistance Programs** 512-463-7847	Provides financing for water supply projects and water quality projects including wastewater treatment, non-point source pollution control, and flood control. Financing is provided through state-backed bonds or a combination of state bond proceeds and federal grant funds. Also administers Economically Distressed Area Program (EDAP) for financial assistance to economically distressed areas in 27 designated counties.	Political subdivisions and WSCs
Co-Bank Steve Gustafson 800-542-8072	Provides financing for water and waste disposal systems serving predominantly unincorporated areas or communities of 20,000 or less population, including IOUs, WSCs, and political subdivisions such as cities or water districts. Co-Bank is a cash flow lender and will work with borrower to complete application. Loan amounts begin at $1,000,000.	Incorporated Cities, Water Districts, IOUs, and WSCs

* The term "political subdivision" usually includes incorporated cities, water districts and counties.

In order for a community to obtain funding assistance from the RUS, applicants are encouraged to contact the Agency processing office early in the planning stages of their project. Agencies such as the Community Resource Group are available to provide general advice and assistance regarding RUS programs, other funding sources, and types of systems or improvements appropriate for the applicant's needs. This agency can also provide access to technical assistance and other information resources for other project development issues such as public information, income surveys, developing rate schedules, system operation and maintenance, and environmental compliance requirements. Throughout the planning, application processing and construction of the project, Agency personnel will work closely and cooperatively with the applicant and their representatives, other State and Federal agencies and technical assistance providers.

9.3. RUS FUNDING APPLICATION.

On order to fund construction of facilities for the Four Corner residents, an initial application must be submitted to the RUS Regional Office in Angelton, Texas. The address and contact is:

Mr. James R. Copeland
Community Development Specialist
209 E. Mulberry, Suite 500
Angleton, TX 77515

This initial application consist of a completed form SF 424.2 and two copies of the PER.

9.4 RUS APPLICATION REQUIREMENTS:

(a) One copy of a completed SF 424.2;

(b) A copy of the State intergovernmental comments or one copy of the filed application for State intergovernmental review; and

(c) Two copies of the preliminary engineering report (PER) for the project.

 (1) The PER may be submitted to the processing office prior to the rest of the application material if the applicant desires a preliminary review.

 (2) The processing office will forward one copy of the PER with comments and recommendations to the State staff engineer for review upon receipt from the applicant.

(3) The State staff will consult with the applicant's engineer as appropriate to resolve any questions concerning the PER and any environmental concerns. Written comments will be provided by the State staff engineer and State Environmental Coordinator to the processing office to meet eligibility determination time lines.

(d) Written certification that other credit is not available.

(e) Supporting documentation necessary to make an eligibility determination such as financial statements, audits, organizational documents, or existing debt instruments. The processing office will advise applicants regarding the required documents. Applicants that are indebted to RUS will not need to submit documents already on file with the processing office.

(f) Form RD 1940-20, "Request for Environmental Information" or comparable information. The applicant should consult with the processing office to determine what information should be included with this form.

(g) The applicants Internal Revenue Service Taxpayer Identification Number (TIN). The TIN will be used by the Agency to assign a case number which will be the applicant's or transferee's TIN preceded by State and County Code numbers. Only one case number will be assigned to each applicant regardless of the number of loans or grants or number of separate facilities, unless an exception is authorized by the National Office.

(h) Other Forms and certifications. Applicants will be required to submit the following items to the processing office, upon notification from the processing office to proceed with further development of the full application:

(1) Form RD 442-7, "Operating Budget";

(2) Form RD 1910-11, "Application Certification, Federal Collection Policies for Consumer or Commercial Debts";

(3) Form RD 400-1, "Equal Opportunity Agreement";

(4) Form RD 400-4, "Assurance Agreement";

(5) Form AD-1047, "Certification Regarding Debarment, Suspension and other Responsibility Matters";

(6) Form AD-1049, Certification regarding Drug-Free Workplace Requirements (Grants) Alternative I for Grantees Other Than Individuals;

(7) Certifications for Contracts, Grants, and Loans (Regarding Lobbying); and

(8) Certification regarding prohibited tying arrangements. Applicants that provide electric service must provide the Agency a certification that they will not require users of a water or wastewater facility financed under this part to accept electric service as a condition of receiving assistance.

9.5 RUS ADDITIONAL ASSISTANCE PROGRAMS

House connections and plumbing improvements are not part of this project. The RUS does have an additional program that has grant money available to elderly who are at least 62 years of age and the disabled. Loan money at a 1-% interest rate is available to qualifying residents under the age of 62. These loans and grants are made to individuals on a case by case basis. An individual's application for assistance must be made by each resident. The Community Resource Group can assist with these applications.

10.0 ALTERNATIVE WATER SUPPLY AND WASTEWATER TREATMENT

10.1 AVAILABILITY FROM ADJACENT DISTRICTS

The Four Corners planning area is surrounded by several existing municipal utility districts which serve the adjacent residential and commercial developments. Municipal utility districts are taxing entities operating under the jurisdiction of the Texas Natural Resource Conservation Commission (TNRCC). These entities provide water and sanitary sewer service to residents and customers within the boundaries of the district. Potable water is supplied from water supply plants and distribution systems owned and operated by the districts. Sanitary sewer services are provided by wastewater collection systems and treatment plants owned and operated by the districts. Surplus water supply and wastewater treatment capacity can be sold by a district to out of district customers, such as Four Corners area residents, provided that capital and operational costs are recouped from the rates charged for such services.

Five existing utility districts in the immediate vicinity of the Four Corners planning area were contacted regarding the availability of water supply and wastewater treatment capacity. These districts include Fort Bend County MUD No. 2, Fort Bend County MUD No. 25, Fort Bend County MUD No. 41, Kingsbridge MUD and North Mission Glen MUD. Each district was surveyed regarding the availability of existing or near term water supply and wastewater treatment capacity.

The following summarizes the findings regarding available capacity from adjacent districts:

Fort Bend County MUD No. 2 – Water supply is provided by in-District wells but no surplus capacity currently exists or is anticipated in the near future. Wastewater treatment is provided by City of Houston wastewater facility but the district has allocated all of its available plant capacity.

Fort Bend County MUD No. 25 – Water supply is provided by in-District water well but no surplus well capacity is currently available nor is any surplus capacity planned for the near future. The district owns and operates its own wastewater treatment plant but has no available capacity and does not have any future plant expansions planned at this time.

Fort Bend County MUD No. 41 – Water supply is provided by in-District well. No capacity is available at this time and no future expansions are anticipated. Wastewater treatment is provided by facilities owned and operated by the district. Wastewater treatment plant is near capacity with no surplus available at this time or in the near future.

Kingsbridge MUD – The District is currently supplied with groundwater from a single water supply well. However, the District has plans to construct a new water supply plant in the Providence subdivision located east of Richmond-Gaines Road between Bissonnet and Old Richmond Road. Surplus capacity will be available in the plant and the District has indicated a willingness to sell capacity to the Four Corners area. While no time table has been established for the well construction, cost sharing of the construction with Four Corners may help to better define a construction date.

Wastewater treatment for Kingsbridge MUD is provided by the Renn Road Wastewater Treatment Plant located east of State Highway 6 and is jointly owned by Renn Road MUD and Kingsbridge MUD. Kingsbridge MUD indicated that they would be interested in selling surplus capacity in the plant under their ownership to accommodate 350 single family connections.

North Mission Glen MUD – Groundwater supply for the District is provided by a single water supply plant located in the Mission Glen Subdivision north of Keegans Bayou and west of Addicks-Clodine Road. The well was originally drilled as a high capacity well but has not been utilized as such due to the limited development within the District. Currently the District is evaluating the true production capacity of the well and may have surplus capacity available for purchase by the Four Corners area at some future time but no commitment can be made at this time.

The District is planning to expand their wastewater treatment plant capacity to 0.75 million gallons per day (MGD) which will have surplus treatment capacity available for 350 single family connections. Construction drawings for the expansion have been completed and the District will be selling bonds to fund the construction. Start of construction is anticipated in mid-1999. The plant is located on the south side of Keegans Bayou, just west of Addicks-Clodine Road.

10.2 COST OF SERVICE FROM ADJACENT DISTRICTS

Of the five adjacent districts contacted regarding available water and sanitary sewer service, North Mission Glen and Kingsbridge MUD were the only two districts with currently available capacity or the potential for available capacity in the near term. Purchase of capacity will involve two cost components. The first includes the capital costs to cover the actual construction of the facilities (direct payment for new construction or reimbursement for previous construction). The second component will be the rates charged on a per unit basis to the Four Corners area for water supply and wastewater treatment. These rates include the cost of operation and maintenance of the water supply and wastewater treatment facilities in addition to their distribution and collection systems.

Capital recovery costs for water supply and wastewater treatment were previously discussed in Section 5.5 but are summarized again in Table 10.2.2. Additionally, the estimated monthly costs per connection are provided for water and sewer service from Kingsbridge MUD and sewer service only from North Mission Glen MUD. The costs presented in this report, are as provided by representatives of each district.

TABLE 10.2.1

WATER SUPPLY AND WASTEWATER TREATMENT COSTS

	North Mission Glen MUD	Kingsbridge MUD
Wastewater Treatment (Capital Recovery Costs)		
350 Single Family Connections	$ 385,000	$ 185,000
Contingencies (10%)	38,500	18,500
TOTAL WASTEWATER	**$ 423,500**	**$ 203,500**
Water Supply (Capital Recovery Costs)		
350 Single Family Connections	N/A	$ 359,300
Contingencies (10%)		35,930
TOTAL WATER		**$ 395,230**
Residential Monthly Water Rates (Up to 8,000 gallons)	N/A	$ 15.50
Residential Monthly Sewer Rates	$ 20.00	$ 22.00
Wastewater Cost (per connection)	$ 1,210	$ 581
Water Cost (per connection)	N/A	$ 1,129

FOUR CORNERS AREA

WATER & WASTEWATER FACILITIES PLANNING STUDY

PRELIMINARY COST ESTIMATE

Water Distribution System from Kingsbridge MUD

ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
Area 1 (Richmond-Gaines/Boss Gaston Road Area)				
6-inch Water Line	L.F.	4250	$15.00	$63,750
8-inch Water Line	L.F.	25680	$18.00	$462,240
12-inch Water Line	L.F.	8530	$25.00	$213,250
Fire Hydrant	EA.	73	$2,000.00	$146,000
2-inch Blow-off Valve	EA.	7	$500.00	$3,500
6-inch Gate Valve	EA.	9	$550.00	$4,950
8-inch Gate Valve	EA.	48	$750.00	$36,000
12-inch Gate Valve	EA.	14	$1,200.00	$16,800
Connection to Existing Water Line	EA.	2	$1,000.00	$2,000
Appurtenances (wet sand, steel sections, etc.)	L.S.	1	$263,390.00	$263,390
Trench Safety System for Water Line	L.F.	38460	$1.00	$38,460
Service Tap w/ Connection to Existing Residence	EA.	275	$1,200.00	$330,000
Area 1 Subtotal				**$1,580,340**
Area 2 (Boss Gaston Road west of Landfill)				
6-inch Water Line	L.F.	600	$15.00	$9,000
8-inch Water Line	L.F.	9360	$18.00	$168,480
Fire Hydrant	EA.	20	$2,000.00	$40,000
2-inch Blow-off Valve	EA.	1	$500.00	$500
8-inch Gate Valve	EA.	14	$750.00	$10,500
Appurtenances (wet sand, steel sections, etc.)	L.S.	1	$53,688.00	$53,690
Trench Safety System for Water Line	L.F.	9960	$1.00	$9,960
Service Tap w/ Connection to Existing Residence	EA.	25	$1,200.00	$30,000
Area 2 Subtotal				**$322,130**
Area 3 (Richmond Road south of Dora Lane)				
6-inch Water Line	L.F.	1620	$15.00	$24,300
8-inch Water Line	L.F.	5180	$18.00	$93,240
Fire Hydrant	EA.	16	$2,000.00	$32,000
2-inch Blow-off Valve	EA.	2	$500.00	$1,000
6-inch Gate Valve	EA.	2	$550.00	$1,100
8-inch Gate Valve	EA.	8	$750.00	$6,000
Appurtenances (wet sand, steel sections, etc.)	L.S.	1	$44,888.00	$44,890
Trench Safety System for Water Line	L.F.	6800	$1.00	$6,800
Service Tap w/ Connection to Existing Residence	EA.	50	$1,200.00	$60,000
Area 3 Subtotal				**$269,330**
SUBTOTAL CONSTRUCTION				**$2,171,800**
CONTINGENCIES (15%)				$325,770
ENGINEERING (10%)				$249,760
ADMINISTRATION (5%)				$137,370
TOTAL WATER DISTRIBUTION SYSTEM				**$2,884,700**

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2/11/99 DH

Revised 2/10/99

MILLER & ASSOCIATES
Consulting • Engineers • Surveying

December 3, 1998

Mr. Mark L. Loethen, P.E.
Pate Engineers
13405 Northwest Freeway, Suite 300
Houston, Texas 77040-6071

Re: Kingsbridge M.U.D.
Water Supply and Wastewater Capacity
For Four Corners Water Supply Corporation

Dear Mr. Loethen:

At your request, the District Board has reviewed your request on behalf of Four Corners Water Supply Corporation concerning the willingness and ability of Kingsbridge M.U.D. to provide water supply, wastewater treatment, water distribution and conveyance of wastewater generated by approximately existing 350 single-family residential connections. Although the following generally summarizes the District's current infrastructure in contemplating serving the Four Corners Water Supply Corporation (Four Corners), other items will need to be carefully considered before the Kingsbridge M.U.D. Board of Directors comes to a decision of whether or not to enter into an agreement with Four Corners.

Water and Sewer capacity is available for the 350 connections contingent upon Kingsbridge's Bond Issue No. 4 and Water Plant No. 2 construction.

Water distribution lines exist along Old Richmond Road (District's Southwest Corner) and at the West end of Bissonnet Road at Richmond-Gaines Road (District's Westerly boundary).

A wastewater collection line exists at the west end of Bissonnet Road and Richmond-Gaines Road (District's westerly boundary) which leads to a District duplex lift station (two pumps) located on Rocky Valley Drive. This lift station was sized for high-density apartment flows and has ample capacity for the District's future needs.

The Estimated Capital Costs which Four Corners would be expected to contribute to Kingsbridge M.U.D. would be $ 544,300.00.

1)	Water Plant No. 2 (350 of 1,700 connections = 21%)	225,000.00
2)	Modifications to Ground Storage Tank - Water Plant No. 1	27,300.00
3)	Bond Issue No. 4	2,000.00
4)	Water Interconnect with Mission Bend M.U.D. No. 1	50,000.00

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5)	12" Water Main Extension to Old Richmond Road (Kingsbridge Place, Section Two)	55,000.00
6)	Wastewater Treatment Plant Capital Recovery	$185,000.00
	TOTAL	$544,300.00

The Anticipated Rate for Water and Sewer Service (Residential) would be as follows:

a. Water - $15.50/mo up to 8,000 gallons.
b. Sewer - $22.00/mo.

Contingencies that may affect water supply and wastewater treatment capacity availability for Four Corners are as follows:

- District Bond Issue No. 4
- Water Plant No. 2 Construction
- District Development
- Agreement with District

From the Board's standpoint, they are willing to consider this request but have concern over how the day-to-day servicing, billing and collection from customers will be ensured. Also, if the original homeowners for whom these services are being sought are bought out, the land redeveloped, and the "hardship" character of the landowners changes, then Kingsbridge M.U.D. would reserve the right to renegotiate or terminate an agreement with Four Corners.

I trust that this is the information which you desire. Please contact me if you have any questions.

Sincerely,

MILLER & ASSOCIATES
for
Kingsbridge Municipal Utility District

David E. Miller, P.E.

DEM/hrs

cc: Mr. Andrew P. Johnson III - Johnson, Radcliffe & Petrov, L.L.P.
Mr. Robert C. Shindler, Jr. - President, Board of Directors
Board of Directors
File: 0601-000-43

FOUR CORNERS AREA
WATER & WASTEWATER FACILITIES PLANNING STUDY

PRELIMINARY COST ESTIMATE
Sanitary Sewer System to Kingsbridge MUD

ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
Area 1 (Richmond-Gaines/Boss Gaston Road Area)				
Pump Station (Ultimate 612 gpm)	L.S.	1	$250,000.00	$250,000
8-inch Force Main	L.F.	5300	$18.00	$95,400
Sanitary Sewer Manhole	EA.	101	$2,500.00	$252,500
8-inch Gravity Sanitary Sewer	L.F.	18205	$25.00	$455,125
12-inch Gravity Sanitary Sewer	L.F.	11320	$30.00	$339,600
Appurtenances (wet sand, D.I. sections, etc.)	L.S.	1	$372,840.00	$372,840
Trench Safety System for Sanitary Sewers	L.F.	29525	$2.00	$59,050
Service Tap w/ Connection to Existing Residence	EA.	275	$1,500.00	$412,500
Area 1 Subtotal				**$2,237,015**
Area 2 (Boss Gaston Road west of Landfill)				
Intermediate Lift Station (Ultimate 72 gpm)	L.S.	1	$75,000.00	$75,000
Sanitary Sewer Manhole	EA.	23	$2,500.00	$57,500
8-inch Gravity Sanitary Sewer	L.F.	6420	$25.00	$160,500
12-inch Gravity Sanitary Sewer	L.F.	970	$30.00	$29,100
Appurtenances (wet sand, D.I. sections, etc.)	L.S.	1	$74,880.00	$74,880
Trench Safety System for Sanitary Sewers	L.F.	7390	$2.00	$14,780
Service Tap w/ Connection to Existing Residence	EA.	25	$1,500.00	$37,500
Area 2 Subtotal				**$449,260**
Area 3 (Richmond Road south of Dora Lane)				
Intermediate Lift Station (Ultimate 116 gpm)	L.S.	1	$100,000.00	$100,000
Sanitary Sewer Manhole	EA.	29	$2,500.00	$72,500
8-inch Gravity Sanitary Sewer	L.F.	4930	$25.00	$123,250
12-inch Gravity Sanitary Sewer	L.F.	4780	$30.00	$143,400
Appurtenances (wet sand, D.I. sections, etc.)	L.S.	1	$106,710.00	$106,710
Trench Safety System for Sanitary Sewers	L.F.	9710	$2.00	$19,420
Service Tap w/ Connection to Existing Residence	EA.	50	$1,500.00	$75,000
Area 3 Subtotal				**$640,280**
SUBTOTAL CONSTRUCTION				**$3,326,555**
CONTINGENCIES (15%)				498,980
ENGINEERING (10%)				382,550
SITE ACQUISITION/EASEMENTS				$5,100
ADMINISTRATION (5%)				210,660
TOTAL WASTEWATER COLLECTION SYSTEM				**$4,423,845**

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FOUR CORNERS AREA
WATER & WASTEWATER FACILITIES PLANNING STUDY

PRELIMINARY COST ESTIMATE
Sanitary Sewer System to North Mission Glen MUD

ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
Area 1 (Richmond-Gaines/Boss Gaston Road Area)				
Pump Station (Ultimate 612 gpm)	L.S.	1	$250,000.00	$250,000
8-inch Force Main	L.F.	9000	$18.00	$162,000
Sanitary Sewer Manhole	EA.	101	$2,500.00	$252,500
8-inch Gravity Sanitary Sewer	L.F.	18205	$25.00	$455,125
12-inch Gravity Sanitary Sewer	L.F.	11320	$30.00	$339,600
Appurtenances (wet sand, D.I. sections, etc.)	L.S.	1	$386,160.00	$386,160
Trench Safety System for Sanitary Sewers	L.F.	29525	$2.00	$59,050
Service Tap w/ Connection to Existing Residence	EA.	275	$1,500.00	$412,500
Area 1 Subtotal				**$2,316,935**
Area 2 (Boss Gaston Road west of Landfill)				
Intermediate Lift Station (Ultimate 72 gpm)	L.S.	1	$75,000.00	$75,000
Sanitary Sewer Manhole	EA.	23	$2,500.00	$57,500
8-inch Gravity Sanitary Sewer	L.F.	6420	$25.00	$160,500
12-inch Gravity Sanitary Sewer	L.F.	970	$30.00	$29,100
Appurtenances (wet sand, D.I. sections, etc.)	L.S.	1	$74,880.00	$74,880
Trench Safety System for Sanitary Sewers	L.F.	7390	$2.00	$14,780
Service Tap w/ Connection to Existing Residence	EA.	25	$1,500.00	$37,500
Area 2 Subtotal				**$449,260**
Area 3 (Richmond Road south of Dora Lane)				
Intermediate Lift Station (Ultimate 116 gpm)	L.S.	1	$100,000.00	$100,000
Sanitary Sewer Manhole	EA.	29	$2,500.00	$72,500
8-inch Gravity Sanitary Sewer	L.F.	4930	$25.00	$123,250
12-inch Gravity Sanitary Sewer	L.F.	4780	$30.00	$143,400
Appurtenances (wet sand, D.I. sections, etc.)	L.S.	1	$106,710.00	$106,710
Trench Safety System for Sanitary Sewers	L.F.	9710	$2.00	$19,420
Service Tap w/ Connection to Existing Residence	EA.	50	$1,500.00	$75,000
Area 3 Subtotal				**$640,280**
SUBTOTAL CONSTRUCTION				**$3,406,475**
CONTINGENCIES (15%)				$510,970
ENGINEERING (10%)				$391,740
SITE ACQUISITION/EASEMENTS				$5,100
ADMINISTRATION (5%)				$215,710
TOTAL WASTEWATER COLLECTION SYSTEM				**$4,529,995**

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FOUR CORNERS AREA

WATER & WASTEWATER FACILITIES PLANNING STUDY

PRELIMINARY COST ESTIMATE

Water Distribution System from On-Site Water Plant

ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
Area 1 (Richmond-Gaines/Boss Gaston Road Area)				
6-inch Water Line	L.F.	4250	$15.00	$63,750
8-inch Water Line	L.F.	27140	$18.00	$488,520
12-inch Water Line	L.F.	5420	$25.00	$135,500
Fire Hydrant	EA.	70	$2,000.00	$140,000
2-inch Blow-off Valve	EA.	7	$500.00	$3,500
6-inch Gate Valve	EA.	9	$550.00	$4,950
8-inch Gate Valve	EA.	51	$750.00	$38,250
12-inch Gate Valve	EA.	9	$1,200.00	$10,800
Appurtenances (wet sand, steel sections, etc.)	L.S.	1	$250,420.00	$250,420
Trench Safety System for Water Line	L.F.	36810	$1.00	$36,810
Service Tap w/ Connection to Existing Residence	EA.	275	$1,200.00	$330,000
Area 1 Subtotal				**$1,502,500**
Area 2 (Boss Gaston Road west of Landfill)				
6-inch Water Line	L.F.	600	$15.00	$9,000
8-inch Water Line	L.F.	9360	$18.00	$168,480
Fire Hydrant	EA.	20	$2,000.00	$40,000
2-inch Blow-off Valve	EA.	1	$500.00	$500
8-inch Gate Valve	EA.	14	$750.00	$10,500
Appurtenances (wet sand, steel sections, etc.)	L.S.	1	$53,690.00	$53,690
Trench Safety System for Water Line	L.F.	9960	$1.00	$9,960
Service Tap w/ Connection to Existing Residence	EA.	25	$1,200.00	$30,000
Area 2 Subtotal				**$322,130**
Area 3 (Richmond Road south of Dora Lane)				
6-inch Water Line	L.F.	1620	$15.00	$24,300
8-inch Water Line	L.F.	5180	$18.00	$93,240
Fire Hydrant	EA.	16	$2,000.00	$32,000
2-inch Blow-off Valve	EA.	2	$500.00	$1,000
6-inch Gate Valve	EA.	2	$550.00	$1,100
8-inch Gate Valve	EA.	8	$750.00	$6,000
Appurtenances (wet sand, steel sections, etc.)	L.S.	1	$44,890.00	$44,890
Trench Safety System for Water Line	L.F.	6800	$1.00	$6,800
Service Tap w/ Connection to Existing Residence	EA.	50	$1,200.00	$60,000
Area 3 Subtotal				**$269,330**
SUBTOTAL CONSTRUCTION				**$2,093,960**
CONTINGENCIES (15%)				$314,090
ENGINEERING (10%)				$240,810
WATER PLANT SITE/EASEMENTS				$24,000
ADMINISTRATION (5%)				$133,640
TOTAL WATER DISTRIBUTION SYSTEM				**$2,806,500**

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Revised 2/10/99

FOUR CORNERS AREA
WATER & WASTEWATER FACILITIES PLANNING STUDY

PRELIMINARY COST ESTIMATE
Sanitary Sewer System to On-Site WWTP Facility

ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
Area 1 (Richmond-Gaines/Boss Gaston Road Area)				
Intermediate Lift Station (Ultimate 410 gpm)	L.S.	1	$220,000.00	$220,000
Sanitary Sewer Manhole	EA.	101	$2,500.00	$252,500
8-inch Gravity Sanitary Sewer	L.F.	18205	$25.00	$455,125
12-inch Gravity Sanitary Sewer	L.F.	11320	$30.00	$339,600
Appurtenances (wet sand, D.I. sections, etc.)	L.S.	1	$347,760.00	$347,760
Trench Safety System for Sanitary Sewers	L.F.	29525	$2.00	$59,050
Service Tap w/ Connection to Existing Residence	EA.	275	$1,500.00	$412,500
Area 1 Subtotal				**$2,086,535**
Area 2 (Boss Gaston Road west of Landfill)				
Intermediate Lift Station (Ultimate 72 gpm)	L.S.	1	$75,000.00	$75,000
Sanitary Sewer Manhole	EA.	23	$2,500.00	$57,500
8-inch Gravity Sanitary Sewer	L.F.	6420	$25.00	$160,500
12-inch Gravity Sanitary Sewer	L.F.	970	$30.00	$29,100
Appurtenances (wet sand, D.I. sections, etc.)	L.S.	1	$74,880.00	$74,880
Trench Safety System for Sanitary Sewers	L.F.	7390	$2.00	$14,780
Service Tap w/ Connection to Existing Residence	EA.	25	$1,500.00	$37,500
Area 2 Subtotal				**$449,260**
Area 3 (Richmond Road south of Dora Lane)				
Intermediate Lift Station (Ultimate 116 gpm)	L.S.	1	$100,000.00	$100,000
Sanitary Sewer Manhole	EA.	29	$2,500.00	$72,500
8-inch Gravity Sanitary Sewer	L.F.	4930	$25.00	$123,250
12-inch Gravity Sanitary Sewer	L.F.	4780	$30.00	$143,400
Appurtenances (wet sand, D.I. sections, etc.)	L.S.	1	$106,710.00	$106,710
Trench Safety System for Sanitary Sewers	L.F.	9710	$2.00	$19,420
Service Tap w/ Connection to Existing Residence	EA.	50	$1,500.00	$75,000
Area 3 Subtotal				**$640,280**
SUBTOTAL CONSTRUCTION				**$3,176,075**
CONTINGENCIES (15%)				$476,410
ENGINEERING (10%)				$365,250
WWTP & LIFT STATION SITES/EASEMENTS				$34,000
ADMINISTRATION (5%)				$202,590
TOTAL WASTEWATER COLLECTION SYSTEM				**$4,254,325**

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2/11/99 DH

Revised 2/10/99

TEXAS
PARKS &
WILDLIFE

To manage and conserve the natural and cultural resources of Texas for the use and enjoyment of present and future generations.

October 14, 1998

Ms. Kimberly A. Chesler
Rust Environment & Infrastructure Inc.
2929 Briarpark Drive, Suite 600
Houston, TX 77042-3703

Re: Four Corners Water/Wastewater Planning Study

Dear Ms. Chesler:

Department staff has reviewed the information transmitted by your letter of September 30, 1998 concerning the referenced project.

As indicated by the attached imagery, particularly sensitive wildlife habitats that should incorporate planning considerations within this study area include mature woodlands, riparian vegetation associated with creek drainages, native grasslands, and wetlands. Development of project alternative alignments should include considerations for sequentially avoiding, minimizing or compensating losses of these sensitive habitats. Where possible, water and wastewater lines should follow existing rights-of-way. Mitigation measures to offset unavoidable losses to these habitats should be included in project planning. Such measures may include provisions for tree and shrub plantings and for revegetation of disturbed areas using native plant species.

Please contact Ms. Shannon Breslin at 512-912-7021 for specific information concerning threatened and endangered species.

Thank you for early coordination on this project.

Sincerely,

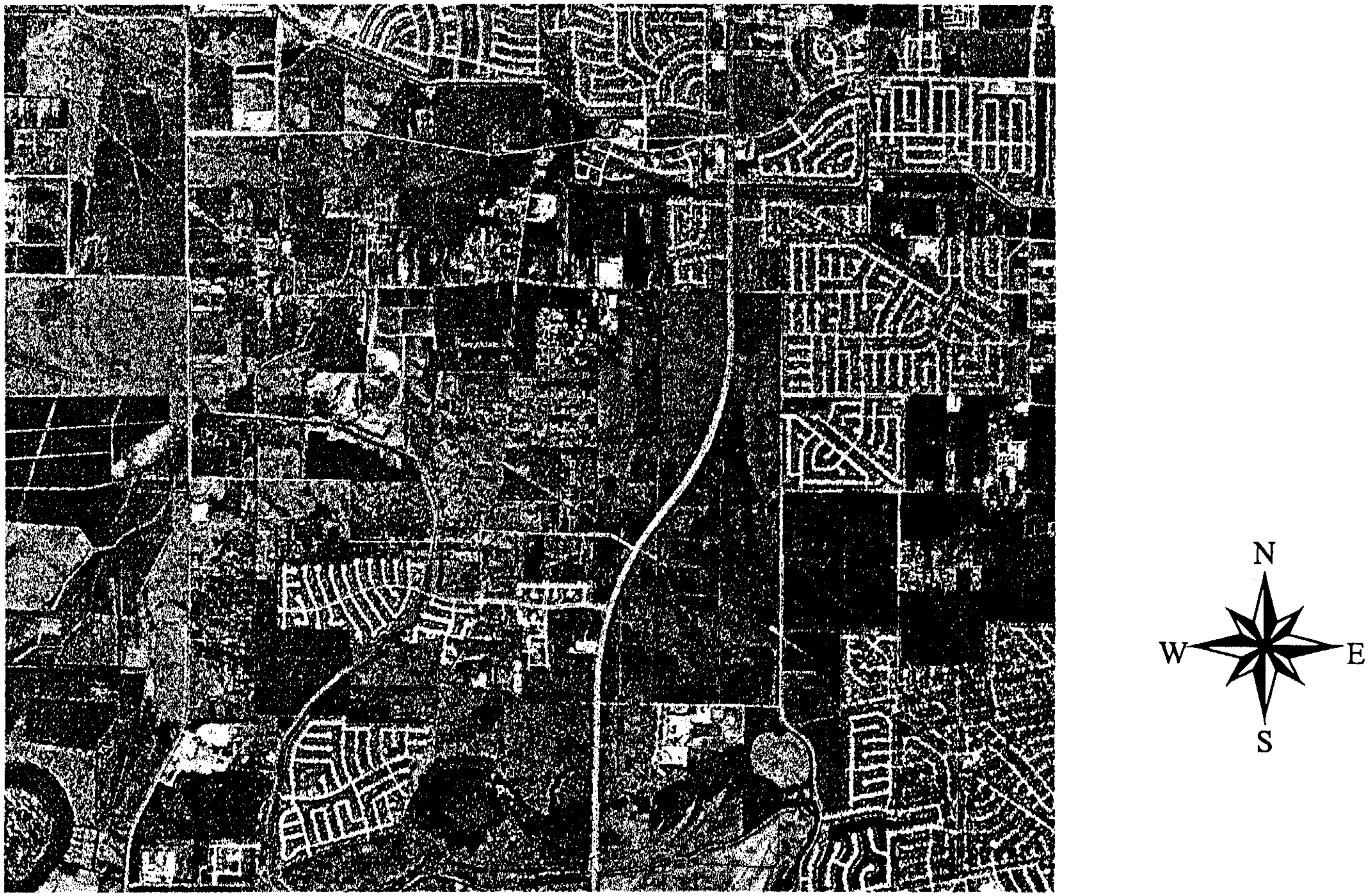
Roy G. Frye

Roy G. Frye
Wildlife Habitat Assessment Program
Wildlife Division

RGF:dab

Attachment

4200 SMITH SCHOOL ROAD
AUSTIN, TEXAS 78744-3291
512-389-4800
www.tpwd.state.tx.us



Four Corners Area
Ft. Bend County

RECEIVED
OCT - 5 1998
USFWS ClearLake ES

RUST **Rust Environment & Infrastructure Inc.**

A Rust International Company
2929 Briarpark Drive, Suite 600
Houston, TX 77042-3703
Phone 713.785.9800
Fax 713.785.9779

A review of U.S. Fish and Wildlife Service files and your project information indicate that no federally listed or proposed threatened or endangered species are likely to occur at the project site.

Appr:

Dat: October 6, 1998

for **Carlos H. Mendoza**
Project Leader, Clear Lake ES Field Office
U.S. Fish and Wildlife Service
17629 El Camino Real, Suite 211
Houston, Texas 77058

September 30, 1998

Mr. Frederick T. Werner
Chief, Regulatory Activities
U.S. Fish and Wildlife Service
Division of Ecological Services
17629 El Camino Real, Suite 221
Houston, Texas 77058

Re: Sensitive Species and Natural Communities Review
Water and Wastewater Regional Planning Study
Four Corners Area, Fort Bend County, Texas

Dear Mr. Werner:

On behalf of our client, Fort Bend County, Earth Tech, Inc., formerly Rust Environment & Infrastructure, is preparing a Water and Wastewater Regional Planning Study for the "Four Corners" Area located west of the City of Houston. The Planning Area for this project, as illustrated on the attached map, is bounded on the east by State Highway 6 and on the west by FM 1464. The northern boundary is the proposed westward extension of Bissonnet Road, approximately 1,000 feet south of Keegans Bayou, while the southern boundary of the Planning Area consists of Miller Road, Oleta Road, and McKaskle Road.

The objectives of this project include the following:

- to develop alternatives for meeting water and wastewater facility needs of the Planning Area communities (including construction of water and/or wastewater treatment plants, purchasing water and/or wastewater treatment from adjacent municipal utility districts, etc.)
- to determine the costs associated with each alternative; and
- to identify institutional arrangements for providing water and wastewater services to the area.

At this time, Earth Tech would like to request a review of the Planning Area for available information on sensitive species and/or natural communities which may exist within or near the Planning Area.

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For your information, the Planning Area is located on the Clodine, Texas 7.5 minute quadrangle map. A map illustrating the location of the Planning Area is enclosed to assist you with your review of this area. If you have any questions, or if you require any additional information regarding this project, please phone me at (713) 953-5185 or Mr. Glenn Laird, Senior Consultant, at (713) 953-5156. As always, we sincerely appreciate your assistance with this information.

Sincerely,

Earth Tech

Kimberly A. Chesler
Environmental Scientist
Life Sciences Department

KAC/kc

Attachments: Planning Area Boundary Map

cc: Mr. Joe Ezzell, Earth Tech, Dallas, Texas
Project File # 103748

RUST Rust Environment & Infrastructure Inc.

A Rust International Company
2929 Briarpark Drive, Suite 600
Houston, TX 77042-3703

Phone 713.785.9800
Fax 713.785.9779

September 30, 1998

Ms. Shannon Breslin
Texas Biological and Conservation Data System
Texas Parks and Wildlife Department, Resource Protection Division
3000 S. IH-35, Suite 100
Austin, Texas 78704

Re: Sensitive Species and Natural Communities Review
Water and Wastewater Regional Planning Study
Four Corners Area, Fort Bend County, Texas

Dear Ms. Breslin:

On behalf of our client, Fort Bend County, Earth Tech, Inc., formerly Rust Environment & Infrastructure, is preparing a Water and Wastewater Regional Planning Study for the "Four Corners" Area located west of the City of Houston. The Planning Area for this project, as illustrated on the attached map, is bounded on the east by State Highway 6 and on the west by FM 1464. The northern boundary is the proposed westward extension of Bissonnet Road, approximately 1,000 feet south of Keegans Bayou, while the southern boundary of the Planning Area consists of Miller Road, Oleta Road, and McKaskle Road.

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- to determine the costs associated with each alternative; and
- to identify institutional arrangements for providing water and wastewater services to the area.

At this time, Earth Tech would like to request a review of the Planning Area for available information on sensitive species and/or natural communities which may exist within or near the Planning Area. If available, Earth Tech would like to request the individual species account information sheets for each quadrangle map within the Study Area. These are the sheets which list the name, status, quad map, county, direction, management comments, etc., for each species.

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Sincerely,

Earth Tech

Kimberly A. Chesler
Environmental Scientist
Life Sciences Department

KAC/kc

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cc: Mr. Joe Ezzell, Earth Tech, Dallas, Texas
Project File # 103748

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RUST Rust Environment & Infrastructure Inc.

A Rust International Company
2929 Briarpark Drive, Suite 600
Houston, TX 77042-3703

Phone 713.785.9800
Fax 713.785.9779

September 30, 1998

Mr. Robert W. Spain, Chief
Habitat Assessment Branch
Resource Protection Division
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, Texas 78744

Re: Sensitive Species and Natural Communities Review
Water and Wastewater Regional Planning Study
Four Corners Area, Fort Bend County, Texas

Dear Mr. Spain:

On behalf of our client, Fort Bend County, Earth Tech, Inc., formerly Rust Environment & Infrastructure, is preparing a Water and Wastewater Regional Planning Study for the "Four Corners" Area located west of the City of Houston. The Planning Area for this project, as illustrated on the attached map, is bounded on the east by State Highway 6 and on the west by FM 1464. The northern boundary is the proposed westward extension of Bissonnet Road, approximately 1,000 feet south of Keegans Bayou, while the southern boundary of the Planning Area consists of Miller Road, Oleta Road, and McKaskle Road.

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Sincerely,

Earth Tech

Kimberly A. Chesler
Environmental Scientist
Life Sciences Department

KAC/kc

Attachments: Planning Area Boundary Map

cc: Mr. Joe Ezzell, Earth Tech, Dallas, Texas
Project File # 103748

RUST Rust Environment & Infrastructure Inc.

A Rust International Company
2929 Briarpark Drive, Suite 600
Houston, TX 77042-3703
Phone 713.785.9800
Fax 713.785.9779

September 30, 1998

Mr. Frederick T. Werner
Chief, Regulatory Activities
U.S. Fish and Wildlife Service
Division of Ecological Services
17629 El Camino Real, Suite 221
Houston, Texas 77058

Re: Sensitive Species and Natural Communities Review
Water and Wastewater Regional Planning Study
Four Corners Area, Fort Bend County, Texas

Dear Mr. Werner:

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Environmental Scientist
Life Sciences Department

KAC/kc

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Project File # 103748

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TEXAS
PARKS &
WILDLIFE

To manage and conserve the natural and cultural resources of Texas for the use and enjoyment of present and future generations.

October 14, 1998

Ms. Kimberly A. Chesler
Rust Environment & Infrastructure Inc.
2929 Briarpark Drive, Suite 600
Houston, TX 77042-3703

Re: Four Corners Water/Wastewater Planning Study

Dear Ms. Chesler:

Department staff has reviewed the information transmitted by your letter of September 30, 1998 concerning the referenced project.

As indicated by the attached imagery, particularly sensitive wildlife habitats that should incorporate planning considerations within this study area include mature woodlands, riparian vegetation associated with creek drainages, native grasslands, and wetlands. Development of project alternative alignments should include considerations for sequentially avoiding, minimizing or compensating losses of these sensitive habitats. Where possible, water and wastewater lines should follow existing rights-of-way. Mitigation measures to offset unavoidable losses to these habitats should be included in project planning. Such measures may include provisions for tree and shrub plantings and for revegetation of disturbed areas using native plant species.

Please contact Ms. Shannon Breslin at 512-912-7021 for specific information concerning threatened and endangered species.

Thank you for early coordination on this project.

Sincerely,

Roy G. Frye

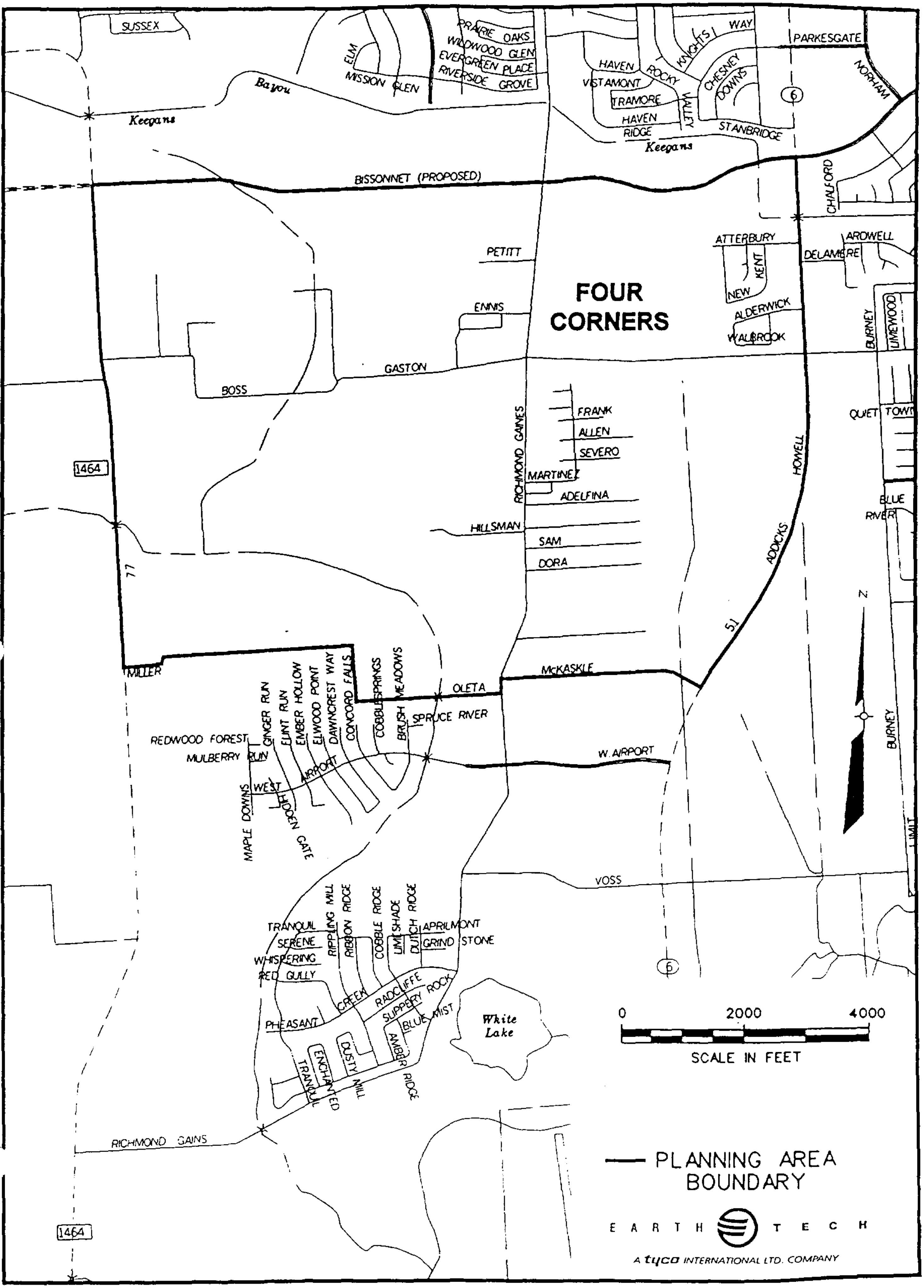
Roy G. Frye
Wildlife Habitat Assessment Program
Wildlife Division

RGF:dab

Attachment

4200 SMITH SCHOOL ROAD
AUSTIN, TEXAS 78744-3291
512-389-4800
www.tpwd.state.tx.us

Four Corners Area
Ft. Bend County


FOUR CORNERS
SUSSEX
PRAIRIE OAKS
WILDWOOD GLEN
EVERGREEN PLACE
RIVERSIDE GROVE
ELM
MISSION GLEN
Bayou
Keegans
HAVEN
VISTAMONT
TRAMORE
HAVEN RIDGE
ROCKY VALLEY
KNIGHTS
WAY
CHESNEY DOWNS
STANBRIDGE
PARKESGATE
NORHAM
6
BISSONNET (PROPOSED)
CHALFORD
ATTERBURY
ARDWELL
DELAMERE
KENT
NEW
ALDERWICK
WALBROOK
BURNEY
LIMEWOOD
PETITT
ENNIS
GASTON
BOSS
1464
QUIET TOWN
FRANK
ALLEN
SEVERO
MARTINEZ
ADELFINA
RICHMOND GAINES
HILLSMAN
SAM
DORA
HOWELL
ADDICKS
51
BLUE RIVER
77
N
MILLER
McKASKLE
OLETA
SPRUCE RIVER
W. AIRPORT
REDWOOD FOREST
MULBERRY RUN
GINGER RUN
FLINT RUN
EMBER HOLLOW
ELWOOD POINT
DAWNCREST WAY
CONCORD FALLS
COBBLESPRINGS
MEADOWS
BRUSH
WEST AIRPORT
MAPLE DOWNS
HIDDEN GATE
VOSS
LIMIT
TRANQUIL
SERENE
WHISPERING
RED GULLY
RIPPLING MILL
RIBBON RIDGE
COBBLE RIDGE
LIMESHADE
DUTCH RIDGE
APRILMONT
GRIND STONE
CREEK
RADCLIFFE
SLIPPERY ROCK
BLUE MIST
PHEASANT
ENCHANTED
DUSTY MILL
AMBER RIDGE
White Lake
RICHMOND GAINS
0
2000
4000
SCALE IN FEET
PLANNING AREA BOUNDARY
EARTH TECH
A tyco INTERNATIONAL LTD. COMPANY

GEOTECHNICAL RECONNAISSANCE REPORT
FOUR CORNERS &
CUMMINGS ROAD AREAS
FORT BEND COUNTY, TEXAS

PREPARED FOR
RUST ENVIRONMENT AND INFRASTRUCTURE, INC.
2929 BRIARPARK, SUITE 600
HOUSTON, TEXAS 77042

PREPARED BY
HVJ ASSOCIATES, INC.
HOUSTON, TEXAS
OCTOBER 26, 1998

REPORT NO. 97-183G-00
KEY MAP 527 & 604

HVJ ASSOCIATES, INC.

Geotechnical Engineers
Materials Engineers
Environmental Engineers

October 26, 1998

Mr. Joe Ezzell, P.E.
Rust Environment and Infrastructure, Inc.
2929 Briarpark, Suite 600
Houston, Texas 77042

Re: Geotechnical Reconnaissance Report
Four Corners Area and
Cummings Road Area (Tinsley Estates, Rio Brazos, & CJ Dickerson Subdivisions)
Fort Bend County, Texas
HVJ Report No. 97-183G-00

Gentlemen:

Presented herein is our Geotechnical Reconnaissance Study for the above project. The study was performed in general accordance with our proposal number 97-183PG-00 dated October 17, 1997, revised March 12, 1998.

This report presents HVJ Associates' understanding of the project's scope, the methodology we employed in executing the work, and the conclusions we reached subject to the limitations discussed in Section 7 of the report.

It has been a pleasure to work with you on this project, and we appreciate the opportunity to be of service. Please read the entire report and notify us if there are questions or comments or if we may be of further assistance.

Sincerely,

HVJ ASSOCIATES, INC.

Michael Hasen, P.E.
Senior Engineer

Eli Zlotnik
Senior Hydrogeologist

MH/EZ:zm/co

Copies submitted: 4

The seal appearing on this document was authorized by Michael Hasen, P.E. 57498 on October 26, 1998. Alteration of a sealed document without proper notification to the responsible engineer is an offense under the Texas Engineering Practice Act.

10/26/98

The following lists the pages which complete this report:

- Main Text - 16 pages
- Plates - 9 pages
- Appendix A - 6 pages
- Appendix B - 105 pages

TABLE OF CONTENTS

EXECUTIVE SUMMARY

HVJ Associates, Inc. conducted a geotechnical site reconnaissance survey of the Four Corners and Cummings Road (Tinsley Estates, Rio Brazos and C.J. Dickerson Subdivisions) located in Fort Bend County, Texas.

Our services included a review of previous geotechnical investigations in the area of the project, and a site reconnaissance survey. The study covers the general vicinity of each area. The site reconnaissance was performed along the streets in each study area and selected adjacent streets.

The available information for this project and the on-site reconnaissance conducted in October 1998 are summarized below:

- **Four Corners.** The Four Corners area is located in northeast Fort Bend County and is bounded by the Bissonnet ROW on the north, SH 6 on the east, a line parallel to McKaskle Road on the south, and FM 1464 on the west. Keegans Bayou is located immediately north of the site and Red Gully bisects it. The area is mostly undeveloped, however rural homes are located throughout the area and some modern residential developed is located in the northeast part. The Sprint Landfill is located near the center. South and west of Red Gully the project lies in the Quaternary alluvial deposits associated with the Brazos River floodplain. Sands and silts, along with clayey soils are common in these alluvial deposits. Northeast of Red Gully the area is underlain by clayey soils associated with the Beaumont Formation. Higher groundwater may be expected in the southern part of the area. Two known active faults are near the area. The nearest known fault is the Clodine Fault which crosses FM 1464 about 1500 feet northwest of area. The Renn Scarp is located about 2000 feet northeast of the site. Neither faults are known within the Four Corners area. During our reconnaissance we did not observe any conclusive evidence of adverse geological conditions apart from occasional broken or poor pavement, and several buildings with structural damage.

- **Cummings Road.** The three subdivisions in the Cummings Road area are located immediately north of the Brazos River and east of FM 723. The area is developed with rural homes along two lane asphalt roadways with ditch drainage. No industrial or commercial development is present. The area is underlain by Quaternary alluvial deposits associated with the Brazos River. In this area sandy point bar deposits may be present in some locations. No active faults are known in the Cummings Road area. We observed residential development, vacant lots used for grazing, and farming in the area.

A search and review of existing geotechnical reports from HVJ Associates files, private and public records was done to obtain geotechnical information relevant to the study areas in this project. Our findings are summarized in the following table:

Service Area	Generalized Soil Conditions	Groundwater Level Range
Four Corners	Surface strata consisting of firm to very stiff clays and generally underlain by very loose to medium dense sands and silts	8 to 15 feet
Cummings Road	Surface strata from 2 to 8 feet in thickness occurring as either clays or granular soils underlain by frequently alternating layers	31 to 35 feet (based on borings south of Brazos River, in Beaumont Fm.)

ILLUSTRATIONS

APPENDICES

EXECUTIVE SUMMARY

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Cummings Road	Surface strata from 2 to 8 feet in thickness occurring as either clays or granular soils underlain by frequently alternating layers	31 to 35 feet (based on borings south of Brazos River, in Beaumont Fm.)

Available geotechnical data indicate that soil conditions in and near the study areas are typical of the Beaumont Formation and Quaternary alluvial deposits. Additional geotechnical data within the project areas are required to confirm soil stratigraphy at the facility locations and to provide in situ property information for detailed design. Where no surficial evidence of active faulting was observed during the field reconnaissance, it does not preclude the presence of active faults.

Please note that this executive summary does not fully relate our findings and opinions. Those findings and opinions are only related through our full report.

INTRODUCTION

Project Objective

HVJ Associates, Inc. was contracted by Rust Environment and Infrastructure, Inc. (REI) to perform a geotechnical reconnaissance survey for the Four Corners Area and the area of the Tinsley Estates, and the Rio Brazos and C.J. Dickerson Subdivisions for Fort Bend County. The project areas are located in the northeast and central part of Fort Bend County, Texas (Plate 1).

It is HVJ Associates' understanding that the project will involve design and construction of new infrastructure facilities to include roads, sanitary sewers, and water mains. The objectives of this study are to identify and summarize existing, available geotechnical and geological information in order to provide guidance on the potential location of fault lines, unstable soils, high groundwater, difficult dewatering, and other subsurface conditions which may impact the project.

Project Scope

The scope of services we provided for this study involved a file and literature review and a site reconnaissance. Specifically, the following tasks were performed:

1. A review of existing HVJ Associates reports in the vicinity of the projects to obtain geotechnical information on the project sites and in the immediate vicinity of the sites;
2. A search and review for additional geotechnical reports from public records to supplement the information from HVJ Associates' reports;
3. Review of geological records and literature for evidence of ground fault activity and subsidence in the study area, and characterization of the hydrogeologic setting;
4. A physical site reconnaissance to identify potential areas or items of geotechnical concern; and,
5. Preparation of a report that summarizes our findings, conclusions and recommendations.

Basis of Report

Although this study has been a reasonably thorough attempt to identify geotechnical conditions in the project area, there is a possibility that some conditions have escaped detection due to the limitations of this study or the lack of geotechnical information in the area.

HVJ Associates reserves the right to alter our conclusions and recommendations based on our review of any information obtained after the date of this report.

Our professional services have been performed using that degree of care and skill ordinarily exercised, under similar conditions, by geotechnical consultants practicing in this or similar localities. No warranty, express or implied, is made as to the professional information included in this report.

SITE OVERVIEWS

Detailed maps of each area are presented on Plates 2 and 3.

Four Corners Area

The Four Corners area is bounded by the State Highway 6 on the east, a line roughly parallel to McKaskle Road on the south, FM 1464 on the west, and the proposed Bissonnet Road right of way on the north. The area is bisected by Old Richmond-Boss Gaston Roads in an east to west direction, and by Old Richmond-Gaines Roads in a north-south direction. The total study area is about 3.7 square miles. Roads within the area are generally two lane asphaltic concrete with roadside ditches. Little commercial development is present. The Sprint Landfill is located near the center of the site (Plate 2).

Cummings Road Area

The three subdivisions in the Cummings Road area are all located immediately north of the Brazos River along stretches of Cummings Road, east of FM 723. Roads in the Tinsley Estates, Rio Brazos and C.J. Dickerson Subdivisions consist of two-lane asphalt roadways with roadside ditches.

GEOLOGIC DATA REVIEW

Geologic Setting

A review of the Bureau of Economic Geology 1982 Geologic Atlas of Texas, Houston Sheet, indicates that the uppermost geologic formation underlying the study areas is the Pleistocene Beaumont Formation and Quaternary alluvial deposits associated with the Brazos River (Plate 4).

The Beaumont Formation (Qb, Plate 4) sediments consist primarily of clays, silts and sands which were deposited in fluvial (river derived) and deltaic environments during the Pleistocene Epoch by the ancestor of the present day Brazos River. The environments of deposition for sediments of the Beaumont Formation are variable across the area. Distributary channels, levees, point bars, and back marsh deposits are common in the Beaumont Formation.

The Quaternary alluvial deposits (Qal, Plate 4) of the Brazos River were deposited in a broad floodplain ranging in width from two to five miles in Fort Bend County. The current course of the river is located in the southern part of the floodplain and Oyster Creek, located in the northern part, represents an abandoned course of the river. Sediments are primary sands and gravels associated with channels, and clays associated with interchannel area.

In the Four Corners area the contact of the Beaumont Formation and Quaternary alluvium roughly coincides with Red Gully. North and east of the gully, the area is located within the Beaumont Formation. South and west of the gully, the soils are associated with the Quaternary alluvial deposits of the Brazos River (Plates 4 and 6.1). In general the southern and western part of the Four Corners area is likely to contain more sand deposits associated with the alluvial formations, whereas the northern and eastern part is likely to be underlain by more clay deposits.

In the Cummings Road area the soils are entirely located within the Quaternary alluvial deposits of the Brazos River. The Brazos River in this area takes a broad left bend and the subdivision is located on the side of the river where point bar deposits have developed in the recent geologic past. On the south side of the river, where Rosenberg is located, a cut bank is present and no recent point bar deposits are present. Point bar deposits consist of crescent shaped sand bodies deposited on the inside curve of a river bend, where deposition of sands and other sediments is a result of lower river flow velocities. On the outside curve of the river's meander, erosion of the bank occurs. A similar location was studied by the Bureau of Economic Geology about two miles downstream near Richmond. A view of the regional topographic map shows that the BEG study area is very analogous to the Cummings Road area. Two geologic cross sections are presented in Appendix A (Plate A-1) which shows the that sand and gravel deposits are present to at least 60 feet in depth. Interbedded with these sand bodies are discontinuous clay lenses representing interchannel deposits.

Faulting

In the Texas gulf coast region, faults associated with deep-seated salt domes are common, and many subsurface faults extend to the land surface in the Pleistocene formations. Further, growth faults which are not directly related to a salt dome occur throughout the area. Groundwater or hydrocarbon production and accompanying subsidence activates these faults by differential compaction of the sediments. Active surface faults, although slow moving, will eventually damage buildings, deform rail lines, crack and deform roadbeds and damage sewers.

The nearest fault to the project is the Clodine Fault, which crosses FM 1464 about 1500 feet northwest of the northwest corner of the Four Corners area. The Renn Scarp is also a known fault about one mile east-northeast of the Four Corners area. Neither the Clodine Fault or the Renn Scarp are known to be present in the study area. A map showing the location of major faults and in the area is presented on Plate 5, and a detailed map of the Clodine Fault, the closest active fault near the Four Corners area is included in Appendix A. No active faults are known to be present in the Cummings Road area.

Site reconnaissance did not reveal any evidence of active or potentially active faults in the Four Corners or the Cummings Road areas. There is a potential for faults to become active in the future. As further development occurs in this area, additional structures and/or pavements will be built which are susceptible to faulting. With fewer roads and structures in these area at this time, the likelihood of identifying an active fault is less.

Subsidence

Subdivisions and industrial sites surrounding the study areas draw down groundwater for municipal, industrial and commercial usage; the principal cause of localized land-surface subsidence in the study areas. Subsidence has been measured by the U.S.G.S. between 1906 and 1978 throughout the study areas. Recently, annual measurements by the Harris-Galveston Coastal Subsidence District (HGCSD) were conducted on several extensometers located in the Houston area. Total subsidence in the project area ranges from three feet in the Four Corners Area to about one foot at the Cummings Road area. Copies of maps showing the regional subsidence in Fort Bend County from the HGCSD are included in Appendix A. In the project areas groundwater is the main source of water. Therefore, it is likely that subsidence will continue in the area. The primary consequence of this subsidence has been the alteration of natural drainage patterns and the revisions of floodplain designations.

Topography

Four Corners. A copy of the Clodine USGS 7.5 minute quadrangle map is included in Plate 6.1. The ground surface in most of the project area gently slopes to the southwest toward the Brazos River. In the northern part of the area, surface runoff flows into ditches which drain into Keegans Bayou, which eventually empties into Brays Bayou about eight miles east of the area. Most of the area, however, drains southward through ditches and empties into Red Gully, which eventually empties into Oyster Creek about one mile south of the area. The elevation in the study area ranges from approximately 94 feet above mean sea level (MSL) at the Four Corners road crossing to about 83 feet MSL in the southern part of the site along Red Gully.

Cummings Road Area. A copy of the Richmond USGS 7.5 minute quadrangle map is included in Plate 6.2. The ground surface in the Cummings Road area slopes to the south toward the Brazos River, which borders the site. The elevation in the study area ranges from approximately 88 feet MSL to less than 85 feet near the river.

SOIL AND GROUNDWATER DATA REVIEW

Sources of Information

Generalized soil and groundwater conditions were determined from reports available from the HVJ Associates files and other sources corresponding to the investigations conducted in the vicinity of the project area. Other sources from which available geotechnical data was requested include the Fort Bend County, City of Rosenberg, City of Richmond, various subdivisions, municipal utility districts, and the Texas Department of Transportation.

HVJ Associates reviewed available geotechnical reports prepared in-house within several miles of the two areas. We identified several geotechnical investigations which, by their proximity, are useful. The approximate locations of these investigations are shown on Plate 7.

Some of the reports identified from HVJ Associates files and all reports obtained from outside sources were performed for public projects. These reports are identified in the reference section by number. The approximate location of the study for each of these reports is shown on Plate 7. Available boring logs, plans and profiles from the public domain reports are also included in Appendix B.

The information for private clients such as residential and commercial developments is referenced but no boring logs, maps, or other documents contained within those reports are reproduced in this report. However, the general nature of soil conditions encountered at these sites has been considered in developing this report. It is possible that additional geotechnical data exists which we were unable to consider for this study.

General Soil and Groundwater Characteristics

The soils encountered in the reports reviewed are typical of the Beaumont formation and the Quaternary alluvial deposits. Based on the geotechnical information from these reports, we do not expect any unusual problems in the project areas. Most of the soils may be tentatively classified as type B for stiff to hard clays above the water table, and type C for weaker clays, granular soils and soils below the water table, based on OSHA trench safety requirements as presented in Appendix B of 29 CFR part 1926. Since some of the borings were drilled at distances up to about 5 miles from the project areas, we are uncertain of soil conditions at specific project locations.

Groundwater level measurements were documented in several of the projects reviewed. It should be noted, however, that groundwater levels may fluctuate seasonally, climatically and due to other factors not evident at the time of drilling. If clay soils exist to a significant depth below the base of the trench excavation, a pump and sump dewatering system will probably be adequate for trench excavation. If granular soils are encountered above or close to the base of excavation, a well point dewatering system may be required.

Four Corners Area

Thirteen investigations containing 72 borings were reviewed for this sub-area. The terminal depths of the borings ranged from 5 to 50 feet below ground surface. The soils encountered were mostly firm to very stiff clay, sandy clay, and silty clay surface stratums which ranged in thickness from 4 to 25 feet. The plasticity index of the cohesive soils ranged from about 10 to 70. The cohesive soils were generally underlain by very loose to medium dense sands and silts. Most of the very sandy and silty soils with plasticity indices less than 7 occurred to the south of the sub-area where surface strata occasionally consisted of sands and silts. Calcareous and ferrous nodules were usually scattered throughout the depth of exploration for most of the borings in and near the sub-area. Surface layers of fill material ranging from about 2 to 4 feet in thickness occurred fairly often on the boring logs. In one case, the fill material extended to about 10 feet below ground surface. Groundwater was recorded at levels ranging from 8 to 15 feet below ground surface. However, several borings with depths up to 20 feet were dry.

Cummings Road Area

Four investigations with a total of 19 borings were reviewed for this sub-area. The terminal depths of the borings ranged from 4 to 80 feet below ground surface. The soils encountered were generally alternating strata of sandy and silty clays with sands and silts. Surface layers ranging from about 2 to 8 feet in thickness were made up of either clays or sands. Loose to medium dense silt, sand, and silty sand occurred from about 2 to 15 feet below ground surface. The consistency of the cohesive soils ranged from firm to very stiff. The plasticity index of the cohesive soils ranged from 8 to 53. Surface layers of fill material occurred with depths ranging from 4 to 10 feet below ground surface. Ferrous and calcareous nodules were scattered throughout the depth of exploration for borings in the area. Groundwater levels ranged from 31 to 35 feet below ground surface in borings located just south of the Cummings Road area on the southern side of the Brazos River. Borings north of the Brazos River were dry or no groundwater information was available. Note that near the Cummings Road area the geology changes from the Beaumont Formation on the south side of the Brazos River to Quaternary alluvium on the north side.

SITE RECONNAISSANCE

A site reconnaissance of the area was performed on October 10 and 15, 1998 on foot and by automobile. Streets and surrounding land were observed for land use. In addition, the reconnaissance included a check for evidence, such as broken pavement, of subsidence, heaving soils, and faulting such as broken pavement.

Four Corners Area

Most of the land in this sub-area appeared as large tracts of generally wooded land. The next most predominant use of land occurred as residential use. Most of the residential developments were rural developments with approximately one-acre lots. However, at least one modern urban development with closely-spaced homes was observed along the south side of Bissonnet between Richmond-Gaines Rd. and State Highway 6. Several of the rural lots were vacant or used for horse grazing and gardening. Most of the commercial and industrial land use occurred along State Highway 6 near Bissonnet and intermittently along FM 1464 between Bissonnet and Pecan. Kingsbridge Elementary School was observed on the north side of Bissonnet west of State Highway 6 and Hodges Bend Middle School was observed along the north side of Bissonnet just east of FM 1464. Most of the streets in this sub-area were asphalt pavements drained by roadside ditches and lined with overhead power lines. Other utilities such as telephone and cable appear to carried by overhead and buried lines. At least one gravel road, Oleta Lane, was observed and some concrete pavements with curb and gutter were also observed in the area. The pavements and structures in the area appeared to be in good condition. A north-south drainage ditch that appears to be part of the upstream section of Red Gully crosses Oleta Lane under a wooden bridge approximately 1500 feet west of Old Richmond Rd. Adjacent the west side of the drainage ditch is a levee that turns west about 150 feet north of Oleta Lane and then forms the northern border for residential properties on the north side and west end of Oleta Lane. Another notable feature in the area is an east-west easement located just south of Bissonnet that contains a power transmission line and buried pipelines.

Cummings Road Area

Land use in this sub-area is predominantly rural residential. Several of the lots are vacant or being used for horse grazing or gardening. Other properties in the area are used for large scale crop farming. No notable commercial or industrial structures along with schools were observed. Streets in the area are asphalt pavements with roadside drainage ditches and overhead power lines. The overhead lines also appear to carry telephone and cable utilities. The streets and other structures in the area appeared to be in good condition. An east-west easement containing an overhead power transmission line crossed the area just south of Cay Rd. The easement turned and followed a north-south alignment just west of Rustic.

SUMMARY OF FINDINGS/CONCLUSIONS

Based on our site reconnaissance and review of available information obtained for this project, our findings and conclusions are summarized below:

Findings

- The project areas are located in northeast and central Fort Bend County, Texas in rural settings with mostly rural home sites and undeveloped land.

- The northern and eastern part of the Four Corners area is located on the Beaumont Formation which consists primarily of clays with interbedded sands and silts. The southern part is located on Quaternary alluvial deposits of the Brazos River floodplain and the Oyster Creek floodplain. Since the present day Brazos River is located in the southern part of the floodplain, soils in the southern and western parts of the Four Corners area may be slightly sandier than those located on the Beaumont Formation. However, clay bearing soils should predominate over most of the Four Corners area.

- The Cummings Road area is located entirely within the Quaternary alluvial deposits of the present day Brazos River, which borders the site to the south. The broad bend of the river south of the area suggests that the site should be underlain by point bar deposits which were laid down as the river's meander migrated south through the area. Sands and gravels should be present to depths up to 60 feet with interbedded clay lenses which represent interchannel deposits of the pre-historic Brazos River.

- Two active geologic faults are located north and east of the Four Corners area. The Clodine Fault crosses FM 1464 about 1500 feet northwest of the northwest corner of the Four Corners area. The Renn Scarp has been mapped about 2000 feet east of the site. Neither of the two faults are known to cross the site. No active faults are known to be present in the Cummings Road area. Site reconnaissance did not reveal evidence of active faulting.

- Ground subsidence in the eastern part of Fort Bend County is associated with general subsidence found in the greater Houston area. In general, the farther east one goes, the greater the total subsidence. Subsidence has been attributed to groundwater withdrawals which is still the main source of water for Fort Bend County and southwest Harris County. Total subsidence in the Four Corners area is about two to three feet and less than one foot in the Cummings Road area.

- Large tracts of wooded land along with mostly rural residential properties are the predominant use of land in the Four Corners area. The area also contains some commercial and industrial properties along with at least two public schools. Streets were usually asphalt pavements with roadside drainage ditches and appeared to be in good condition. Concrete pavements with curb and gutter along with at least one gravel road, Oleta Lane, were also observed. Electrical power was generally carried by overhead lines along the roads. Other utilities such as cable and telephone appeared to be carried by overhead and buried lines. Other features in the area include a levee protecting residential properties at the western end of Oleta Lane and an easement containing overhead power transmission lines and buried pipelines.

- Rural residential properties provided the predominant land use in the Cummings Road area. Other properties were used for agricultural purposes. Streets were asphalt pavements with roadside drainage ditches and appeared to be in good condition. Overhead lines along the roads carried electrical power and appeared to carry telephone and cable utilities as well. An easement containing overhead power transmission line was observed along the southern boundary of the area.

Conclusions

A review of the available geotechnical data indicate that the site soils are typical of the Beaumont Formation in the Four Corners area and Quaternary alluvial deposits in the Cummings Road area. The soils should not present any unusual problems. We expect mostly clay soils interlayered occasionally with granular layers. The alternating layers may be more frequent in the southern portion of the Four Corners area and in the Cummings Road area. Since some of the borings reviewed for geotechnical information were drilled at distances up to about 5 miles from the project areas, we are uncertain of soil conditions at specific project locations. We recommend that soil borings be drilled along proposed water and sewer alignments and at structure locations to confirm soil stratigraphy and to provide in situ geotechnical information for detailed design.

Reviewed documents indicated groundwater depths below ground surface ranging from 10 to 15 feet in the Four Corners area and 31 to 35 feet in the Cummings Road area. However, several borings with depths up to 20 feet in the Four Corners area and 15 feet in the Cummings Road area were dry. Based on the data reviewed, we expect well point dewatering may be needed in some locations for trenches deeper than about 13 feet.

Where no surficial evidence of active faulting was observed during the field reconnaissance, it does not preclude the presence of active faults.

Based on our review of available geotechnical reports, HVJ Associates found no other geotechnical or geologic reason to exclude these areas from consideration.

LIMITATIONS

This report is an instrument of service of HVJ Associates, Inc. The report was prepared for and is intended for the exclusive use of Rust Environment and Infrastructure, Inc. (REI) and Fort

Bend County. The report's contents may not be relied upon by any other party without the express written permission of HVJ Associates.

The report's findings are based on conditions that existed on the date of HVJ Associates' site visit and available records and should not be relied upon to precisely represent conditions at any other time.

HVJ Associates has based the conclusions included in this report on its observation of existing site conditions, its interpretation of available geological and geotechnical studies, and its interpretation of the site usage information it was able to access. It is possible that HVJ Associates' research, while fully appropriate for a Geotechnical Reconnaissance Study, failed to indicate the existence of important information sources. Assuming such sources actually exist, their information could not have been considered in the formulation of HVJ Associates' findings and opinions. All conclusions are qualified by the fact that no borings were made and no soil, sediment, or groundwater sampling or testing was conducted. Conclusions about site conditions under no circumstances comprise a warranty that conditions in all areas within the site and study area (and below existing grade) are of the same quality that HVJ Associates has inferred from observable site conditions and readily available site history.

HVJ Associates' findings and opinions must be considered probabilities based on professional judgment applied to the limited data HVJ Associates was able to gather during the course of this study.

REFERENCES

The following references were used to compile this report:

- Clodine, Texas 7.5 Minute Topographic Quadrangle Map, United States Geological Survey, 1982.
- Richmond, Texas 7.5 Minute Topographic Quadrangle Map, United States Geological Survey, 1980.
- Houston, Texas 30 by 60 minute Topographic Quadrangle Map, United States Geological Survey, 1992.
- Approximate Land-Surface Subsidence in the Houston-Galveston Region, Texas 1906-78, 1943-78, and 1973-78, Open File Report 80-338, United States Geological Survey, March 1980.
- Effect of Water-Level Recoveries on Fault Creep, Houston, Texas, T.L. Holzer and R.K. Gabrysch. Ground Water, July-August, Vol. 25, No. 4, 1987.
- Faults in Parts of North-Central and Western Houston Metropolitan Area, Texas. E.R. Verbeek, K.W. Ratzlaff, and U.S. Clanton, U.S.G.S. Miscellaneous Field Studies Map MF-1136, 1979.
- Focus on Subsidence, Harris-Galveston Coastal Subsidence District, Spring 1993. With supplemental data to 1994.
- Geologic Atlas of Texas, Houston Sheet, Bureau of Economic Geology, University of Texas at Austin, 1982.

- Historically Active Faults in the Houston Metropolitan Area, Texas, in Houston Area Environmental Geology: Surface Faulting, Ground Subsidence, Hazard Liability, Verbeek E.R. and Clanton, U.S., Houston Geological Society, 1981.

- Effect of Water-Level Recoveries on Fault Creep, Houston, Texas. Holzer, Thomas L., and Gabrysch, Robert K. Groundwater, Vol. 25, No. 4, July-August 1987.

- Soil Survey of Fort Bend County. US Department of Agriculture, Soil Conservation Service. February 1960.

- Recent Sediments of Southeast Texas - A Field Guide to the Brazos Alluvial and Deltaic Plains and the Galveston Barrier Island Complex. Bernard, H.A., et. al. University of Texas, Bureau of Economic Geology, Guidebook 11, July 1970.

The following geotechnical and/or soil reports were used for subsurface information in this report. The numbers are plotted on Plate 7 and indicate the approximate location of the report. Available boring logs, plans, and profiles are included in Appendix B in the order listed below. Reports for private/commercial clients are also plotted on Plate 7 but are not included in Appendix B.

1. Geotechnical Investigation - Golfview Regional Waste Water Treatment Facility (for James H. Suchma Consulting Engineers); HVJ Report No. 92-160G, July 1992.

2. Geotechnical Engineering Investigation - Stafford City Park and Galena Manor Community Center (for Harris County Engineering Department); HVJ Report No. 89-114G, May 1989.

3. Commercial Geotechnical Investigation - HVJ Report No. 95-101G, January 1995.

4. Commercial Geotechnical Investigation - HVJ Report No. 93-316G, September 1993.

5. Private Geotechnical Investigation - HVJ Report No. 88-1010G-01, February 1988.

6. Private Geotechnical Investigation - HVJ Report No. 92-276G, April 1993.

7. Geotechnical Investigation - Proposed Improvements at Sugar Land Park (for Clark Condon Associates); HVJ Report No. 94-201G, September 1994.

8. Geotechnical Investigation - Proposed Sugar Land Soccer Complex (for Carter & Burgess, Inc.); HVJ Report No. 97-197G-00, March 1998.

9. Commercial Geotechnical Investigation - HVJ Report No. 95-155G, September 1995.

10. Geotechnical Investigation - Proposed Lost Creek Park (for Clark Condon Associates); HVJ Report No. 95-217G-00, March 1996.

11. Geotechnical Investigation - Proposed Detention Pond for West Airport/Dairy Ashford Projects (for Lockwood Andrews & Newnam, Inc.); HVJ Report No. 95-184G-01, August 1997.

12. Commercial Geotechnical Investigation - HVJ Report No. 94-206G, September 1994.

13. Commercial Geotechnical Investigation - HVJ Report No. 93-344G, November 1993.

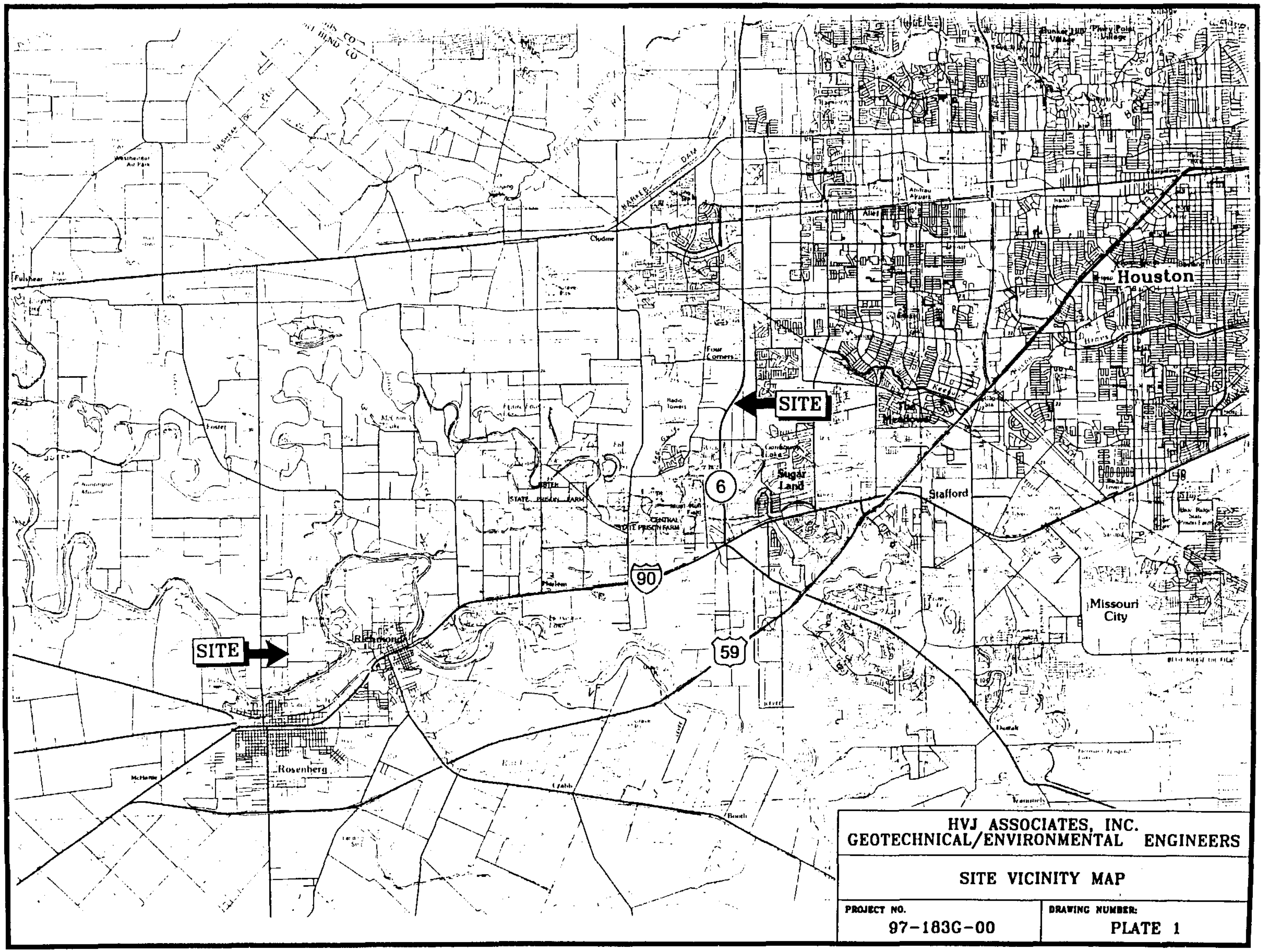
14. Geotechnical Study - Wastewater Treatment Plant Expansion in North Mission Glen MUD (for Turner, Collie & Braden, Inc.); Fugro-McClelland (Southwest), Inc. Report No. 0401-3956, March 1998.

15. Geotechnical Utility Study - Village of Oak Lake, Section 4 (for Oak Lake Estates, LTD.); Paradigm Consultants, Inc. Report No. 98-1127, September 1998.

16. Geotechnical Investigation - SH 99 in Fort Bend County (Grand Parkway); Texas Department of Highways and Public Transportation, June 1990.

17. Geotechnical Investigation - FM 723 at Brazos River in Rosenberg, Texas; Texas Department of Highways and Public Transportation, May 1954.

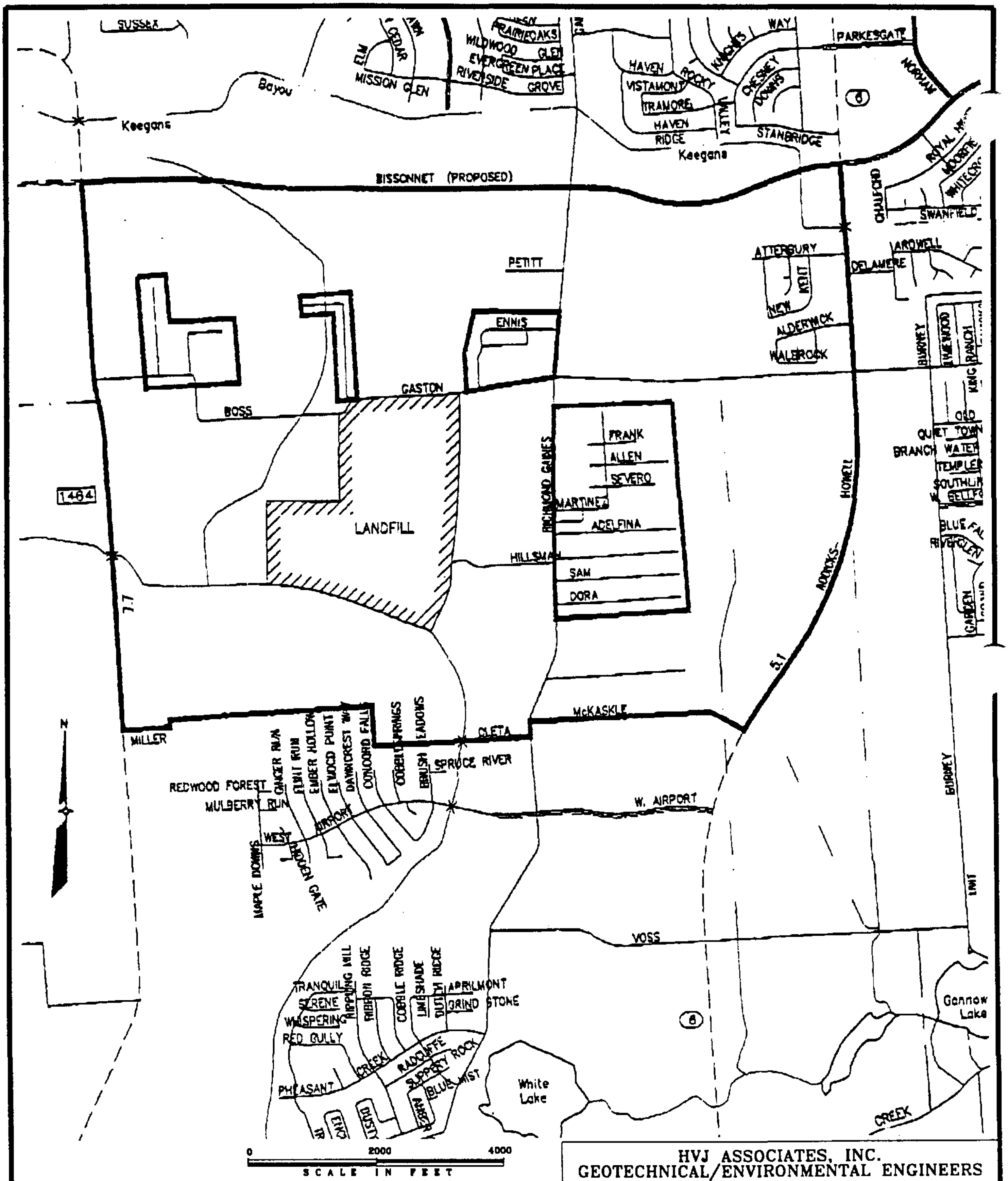
PLATES



HVJ ASSOCIATES, INC.
GEOTECHNICAL/ENVIRONMENTAL ENGINEERS

SITE VICINITY MAP

PROJECT NO.	DRAWING NUMBER:
97-183G-00	PLATE 1

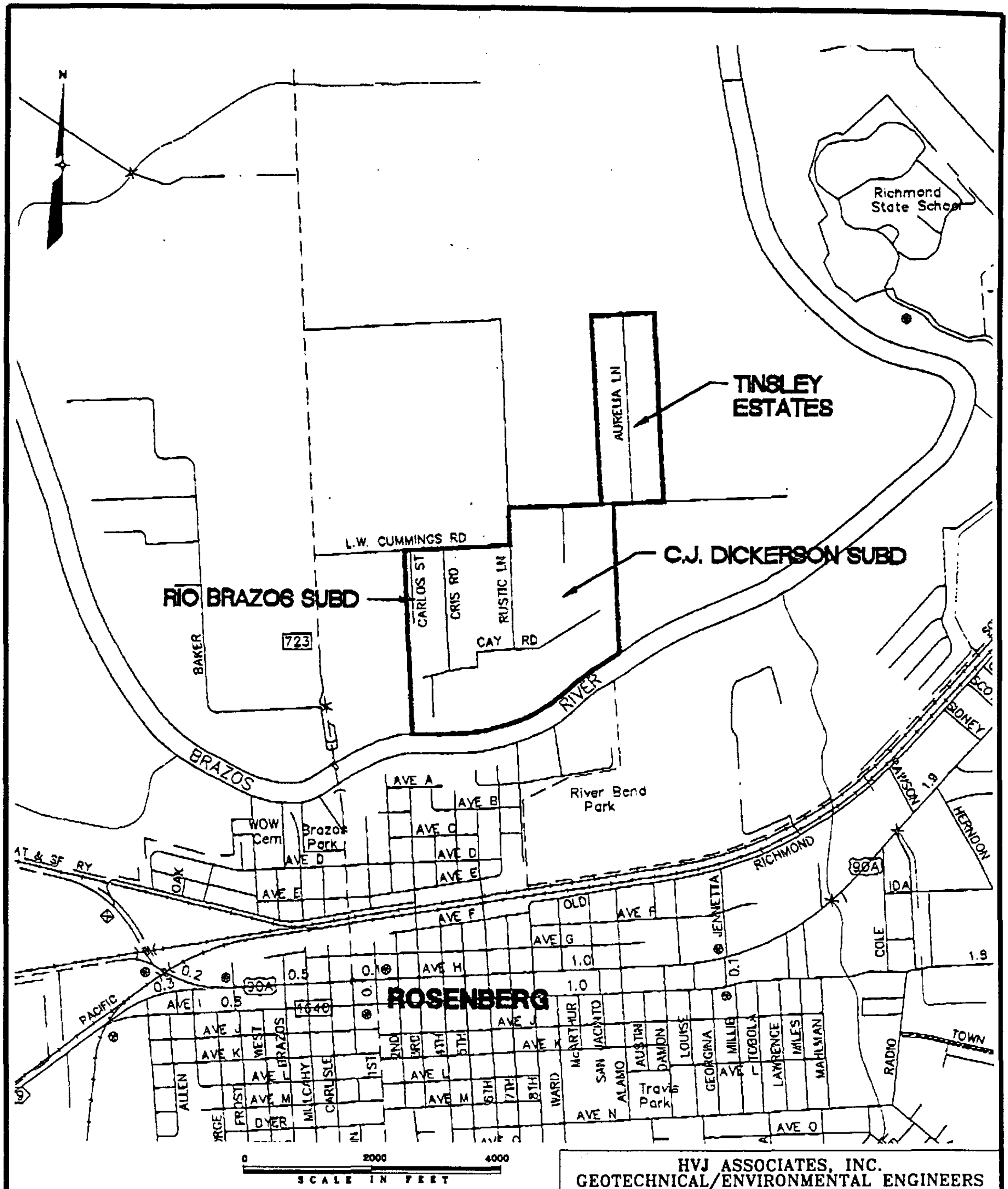


HVJ ASSOCIATES, INC.
GEOTECHNICAL/ENVIRONMENTAL ENGINEERS

SCALE: 1"=2000' DATE: 10/1598	APPROVED BY: EZ	PREPARED BY: JGC

AREA MAP
FOUR CORNERS

PROJECT NO. 97-183G-00	DRAWING NUMBER: PLATE 2

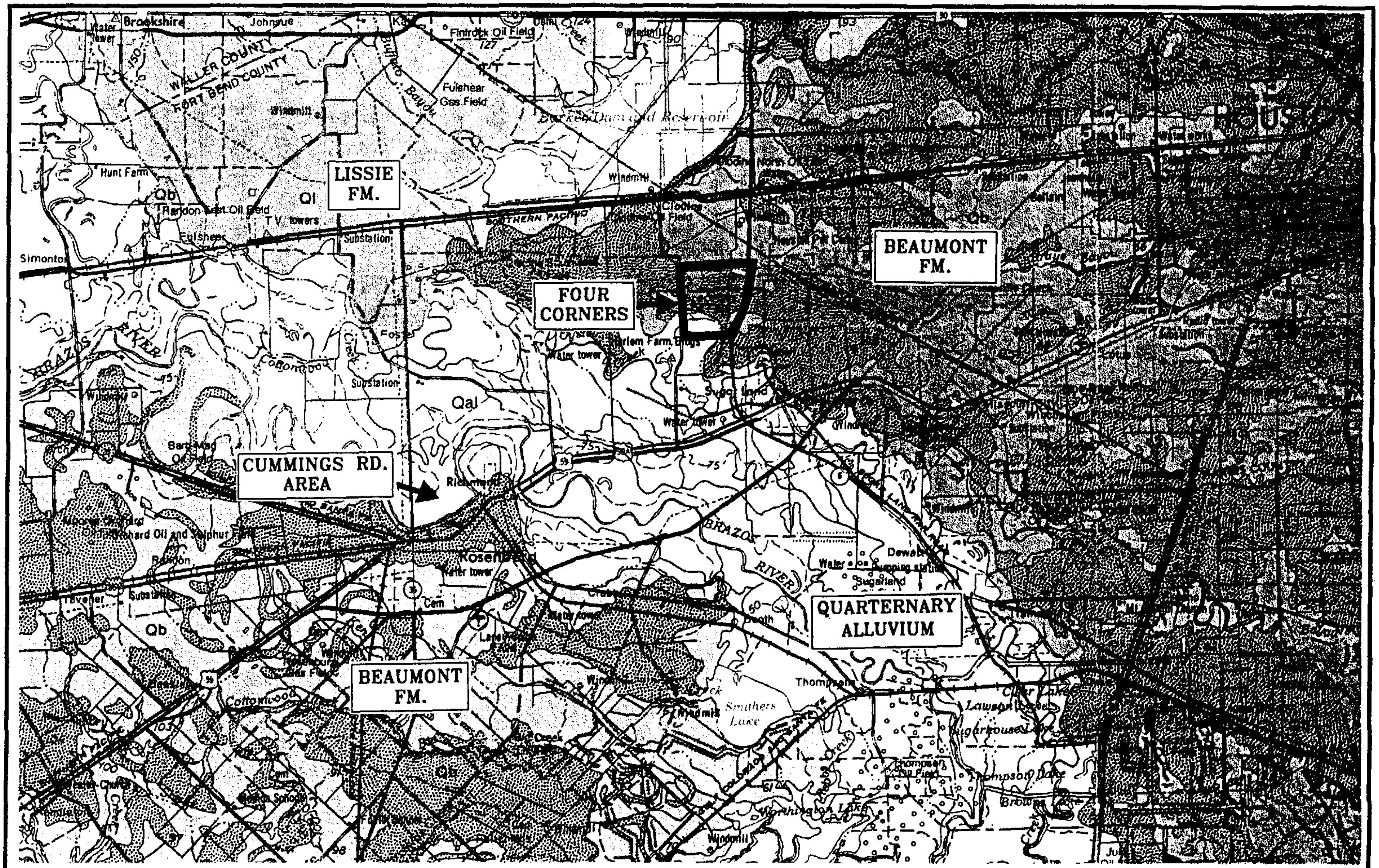


HVJ ASSOCIATES, INC.
GEOTECHNICAL/ENVIRONMENTAL ENGINEERS

SCALE: 1"=2000'
DATE: 10/1598
APPROVED BY: EZ
PREPARED BY: JGC

AREA MAP
CUMMINGS ROAD

PROJECT NO. 97-183G-00
DRAWING NUMBER: PLATE 3



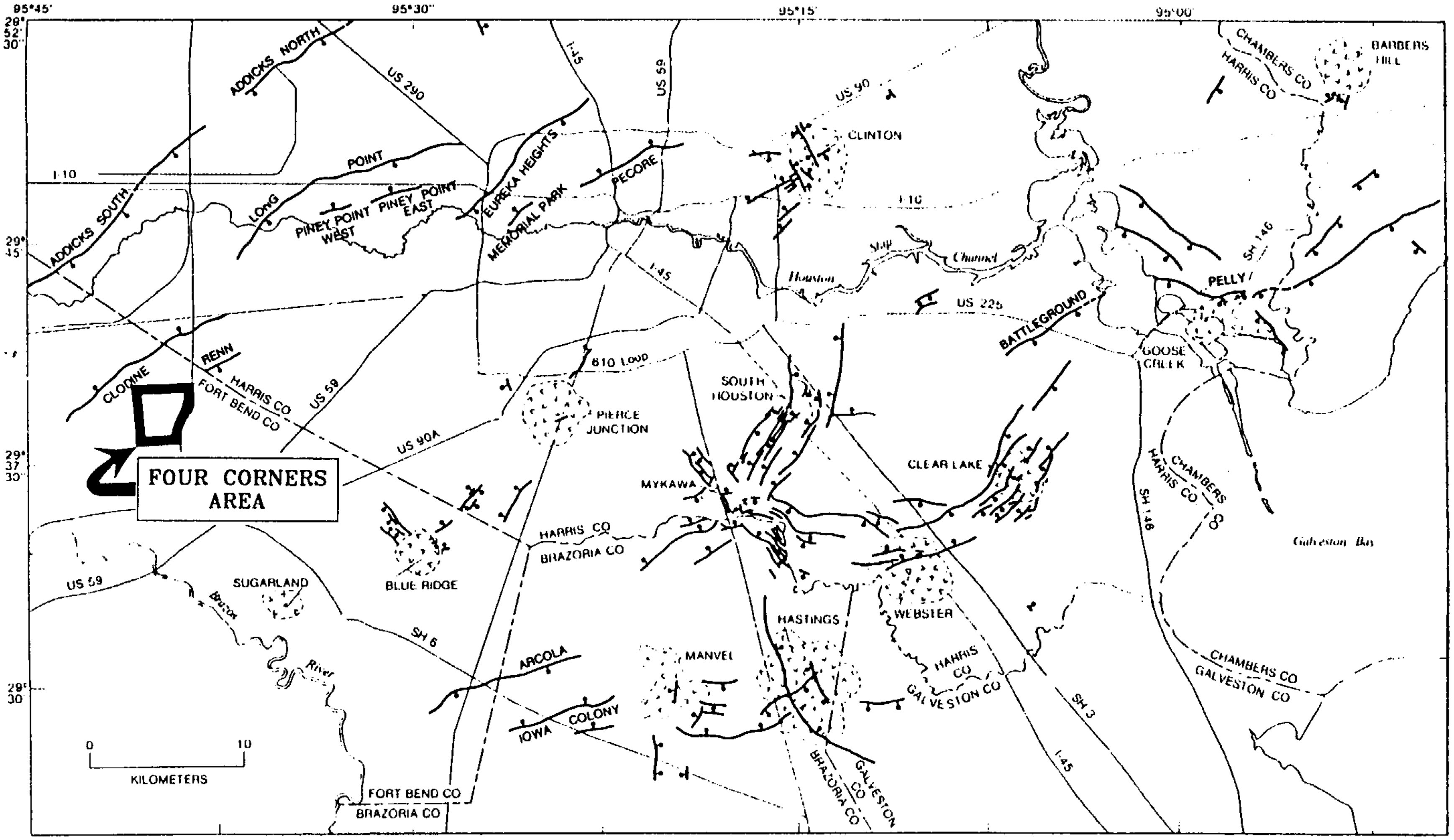
REGIONAL GEOLOGIC MAP

FOUR CORNERS, TINSLEY, RIO BRAZOS & C.J. DICKERSON AREAS

FORT BEND COUNTY, TEXAS

1" ≈ 21,000' ≈ 3.95 mi; 1:250,000

FROM GEOLOGIC ATLAS OF TEXAS, HOUSTON SHEET



Surface fault pattern of the Houston metropolitan area. Within this region of roughly 4600km^2 are at least 160 faults with a cumulative scarp length of more than 400 km (not all 160 faults can be shown at the scale of this map).

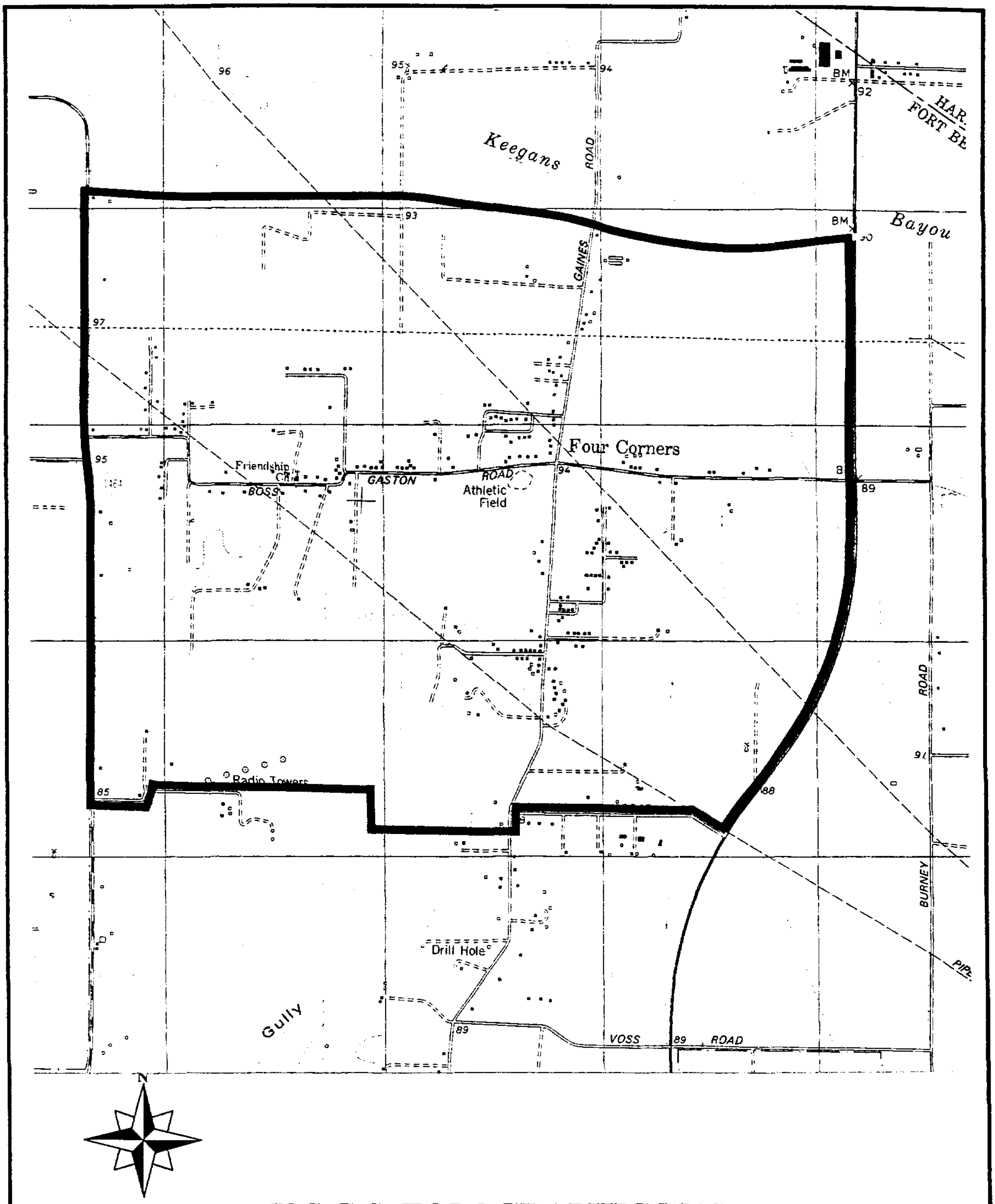
Ball–and–bar symbols are on downthrown sides of faults. Patterned areas indicate oil fields, all of which are associated with known or suspected salt domes.

Map from: Houston Area Environmental Geology: Surface Faulting, Ground Subsidence, Hazard Liability. Houston Geological Society, 1981.

HVJ ASSOCIATES, INC.
GEOTECHNICAL/ENVIRONMENTAL ENGINEERS

REGIONAL FAULT MAP
FOUR CORNERS AREA, FORT BEND CO., TEXAS

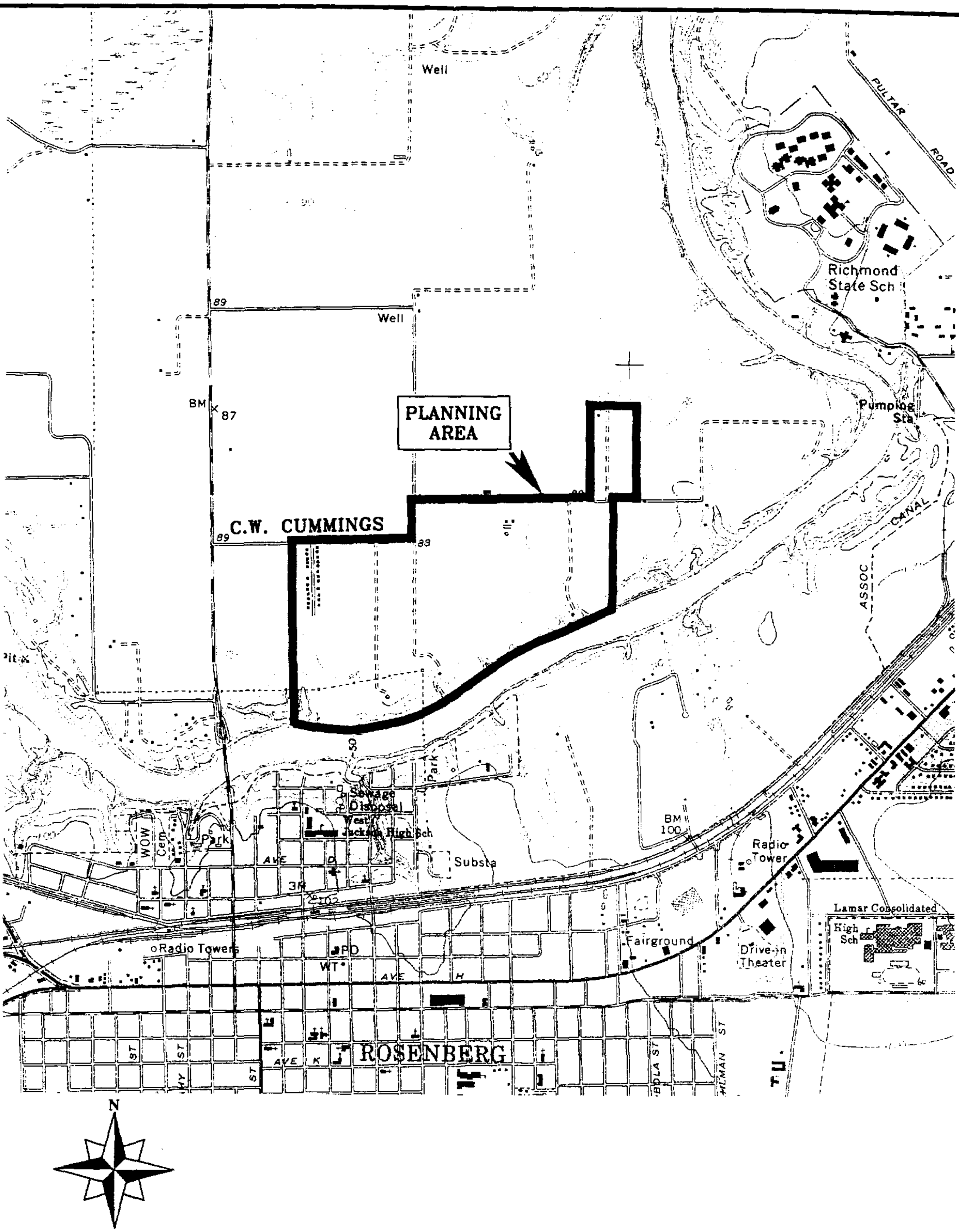
PROJECT NO.	DRAWING NUMBER:
97-183G-00	PLATE 5



U.S.G.S. TOPOGRAPHIC MAP

FOUR CORNERS AREA

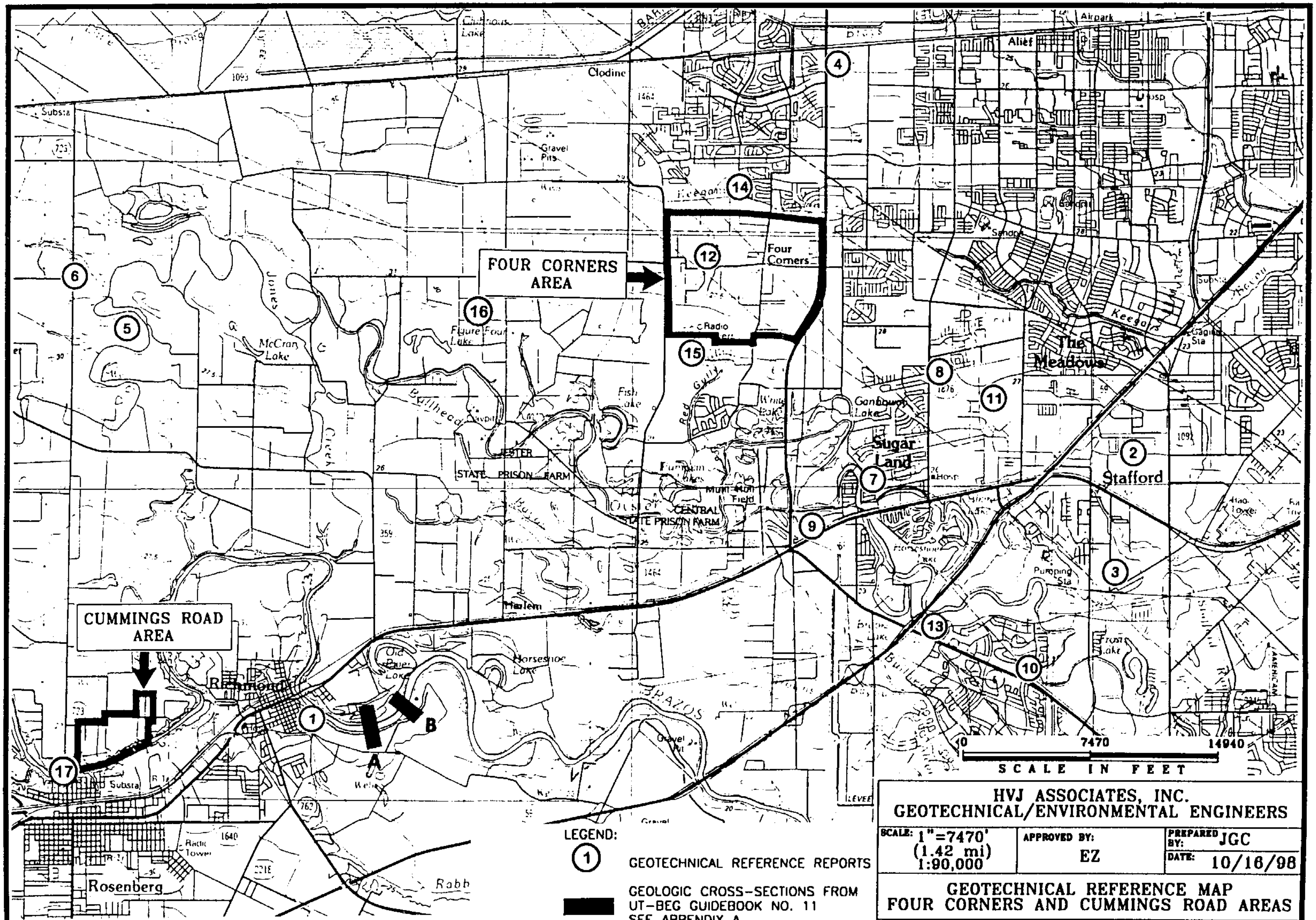
CLODINE, 7.5 MINUTE QUADRANGLE, 1982



U.S.G.S. TOPOGRAPHIC MAP

CUMMINGS ROAD AREA

BELLAIRE, 7.5 MINUTE QUADRANGLE, 1980



LEGEND:

① GEOTECHNICAL REFERENCE REPORTS

▬ GEOLOGIC CROSS-SECTIONS FROM UT-BEG GUIDEBOOK NO. 11 SEE APPENDIX A

LOCATIONS ARE APPROXIMATE

HVJ ASSOCIATES, INC.
GEOTECHNICAL/ENVIRONMENTAL ENGINEERS

SCALE: 1"=7470' (1.42 mi) 1:90,000	APPROVED BY: EZ	PREPARED BY: JGC DATE: 10/16/98

GEOTECHNICAL REFERENCE MAP
FOUR CORNERS AND CUMMINGS ROAD AREAS

PROJECT NO. 97-183G-00	DRAWING NUMBER: PLATE 7

APPENDIX A
GEOLOGIC AND SUBSIDENCE DATA

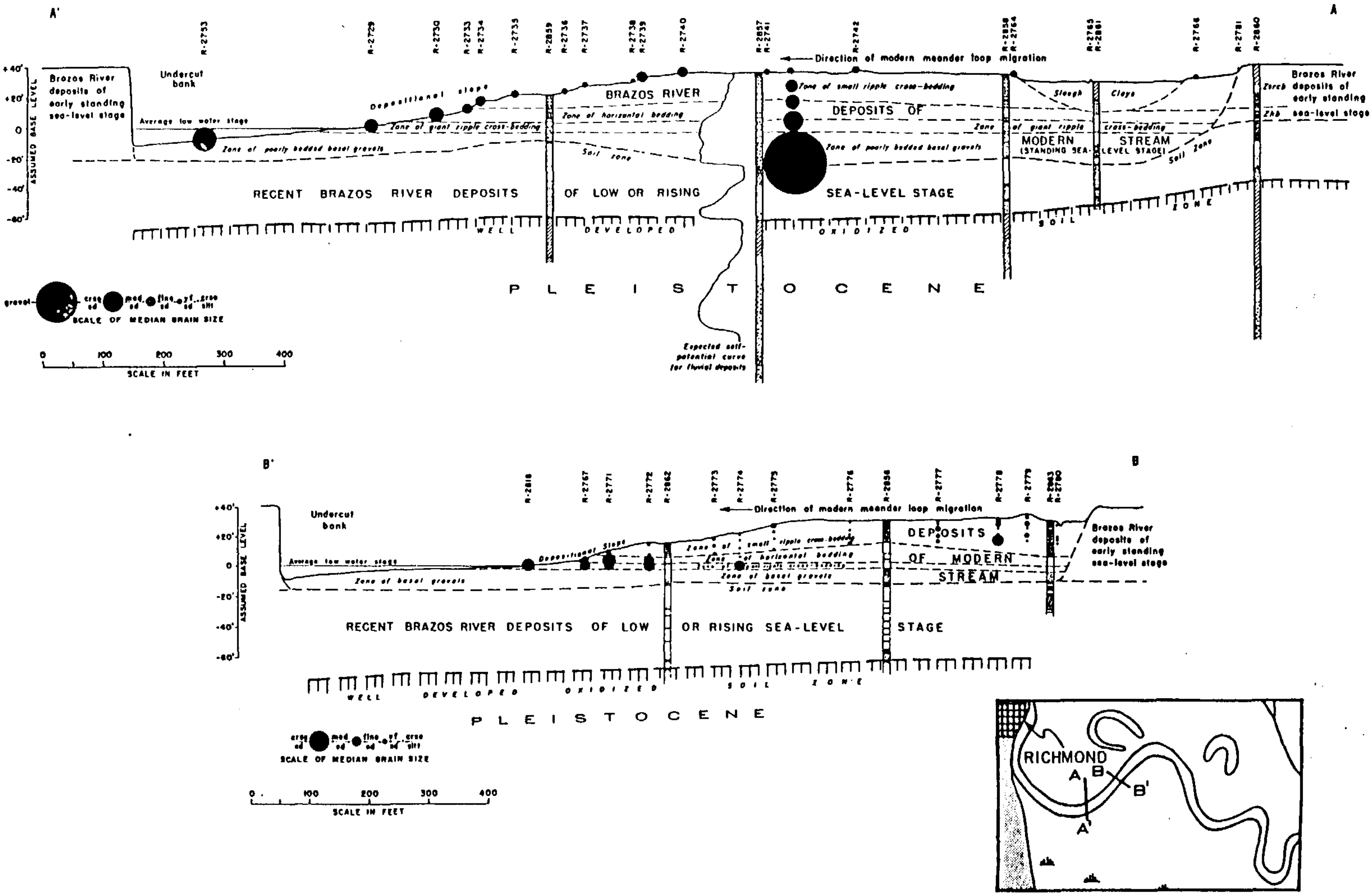
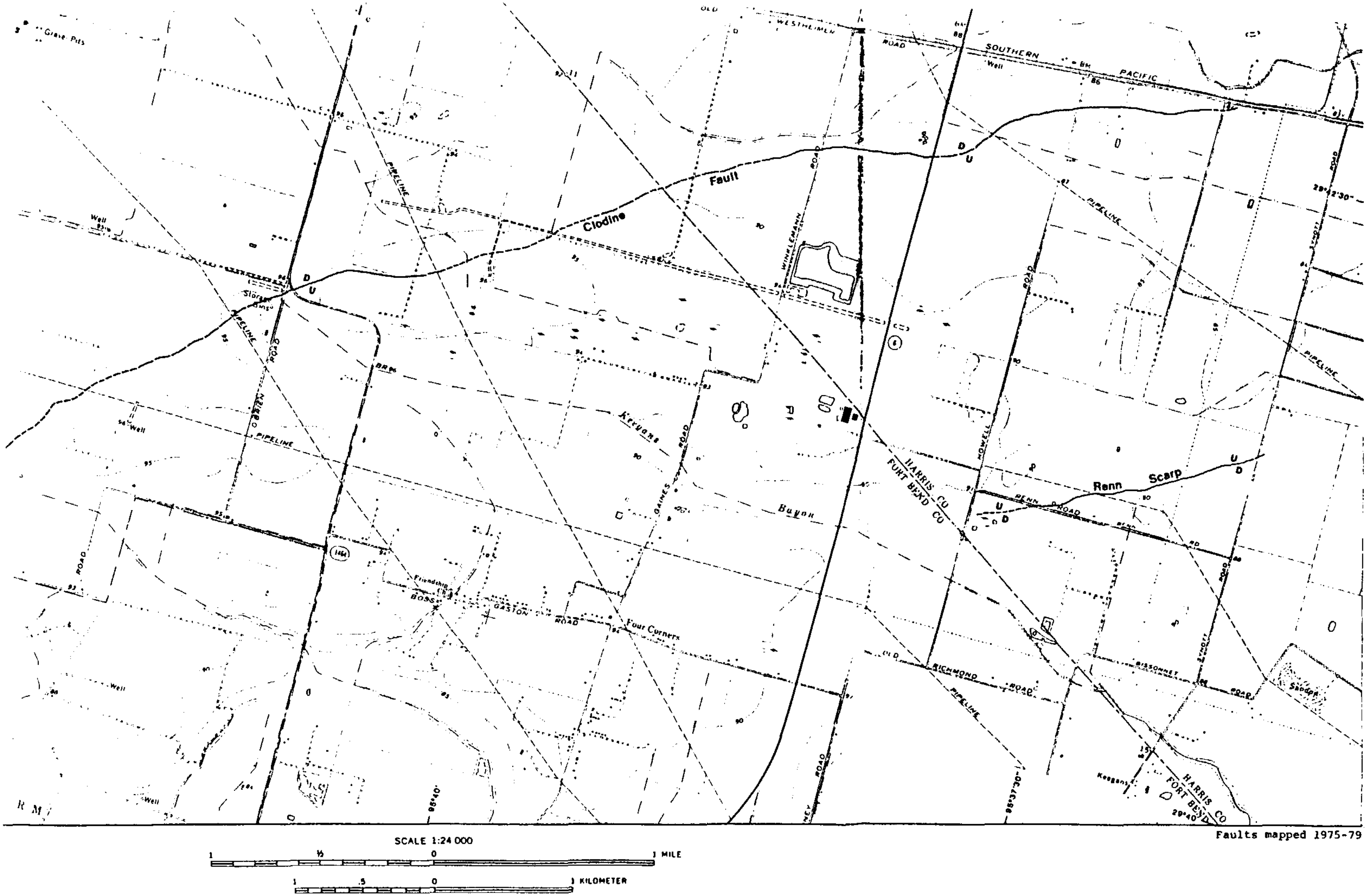


Fig. 6 - Cross sections of the Brazos point bar near Richmond, Texas. Note the relationships between the sequence of deposits including grain size and the genesis of the deposits.

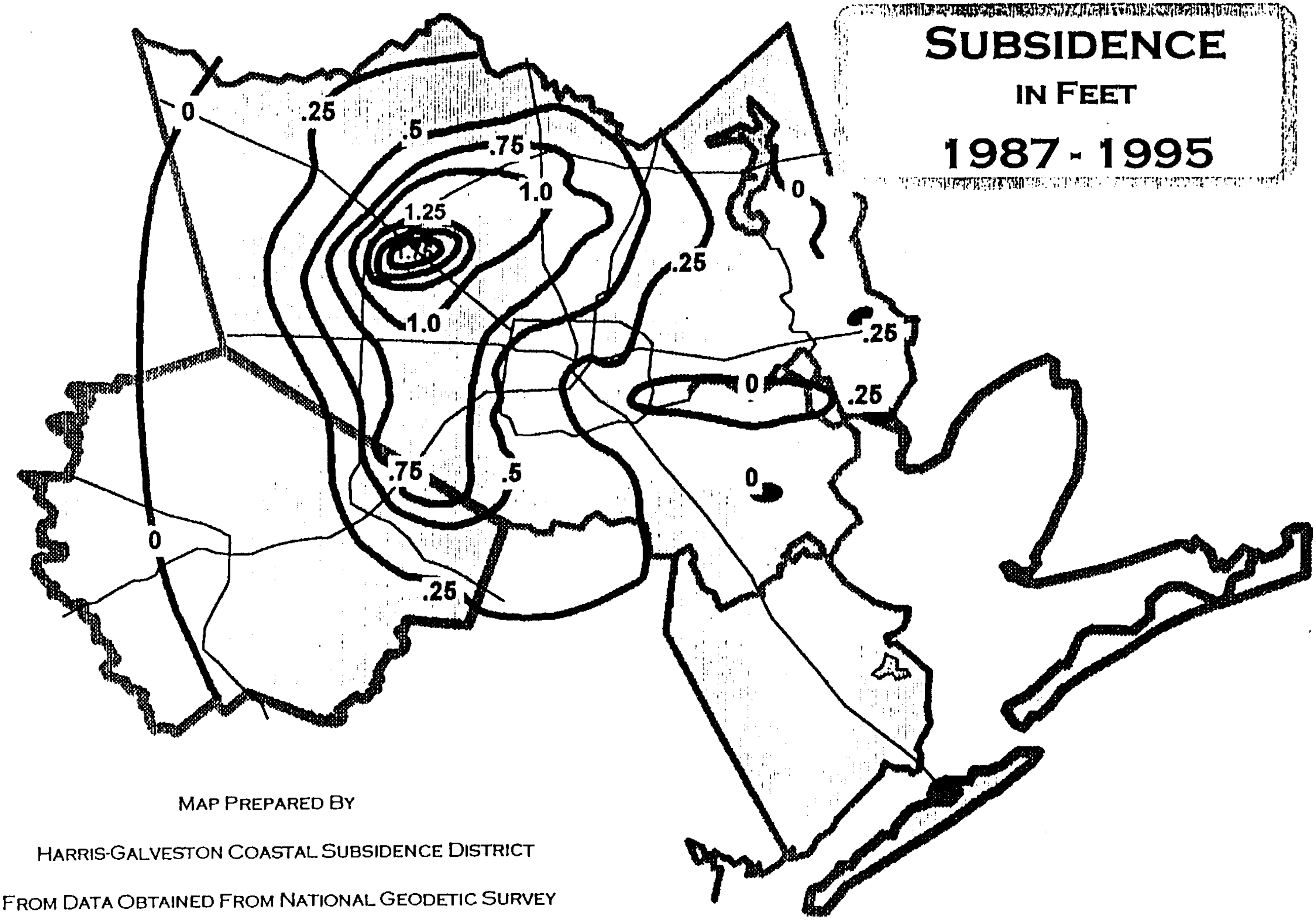
PLATE A-1



MAP OF THE CLODINE FAULT AND RENN SCARP, HOUSTON METROPOLITAN AREA, TEXAS

97-183G-

LATE A-2



SUBSIDENCE

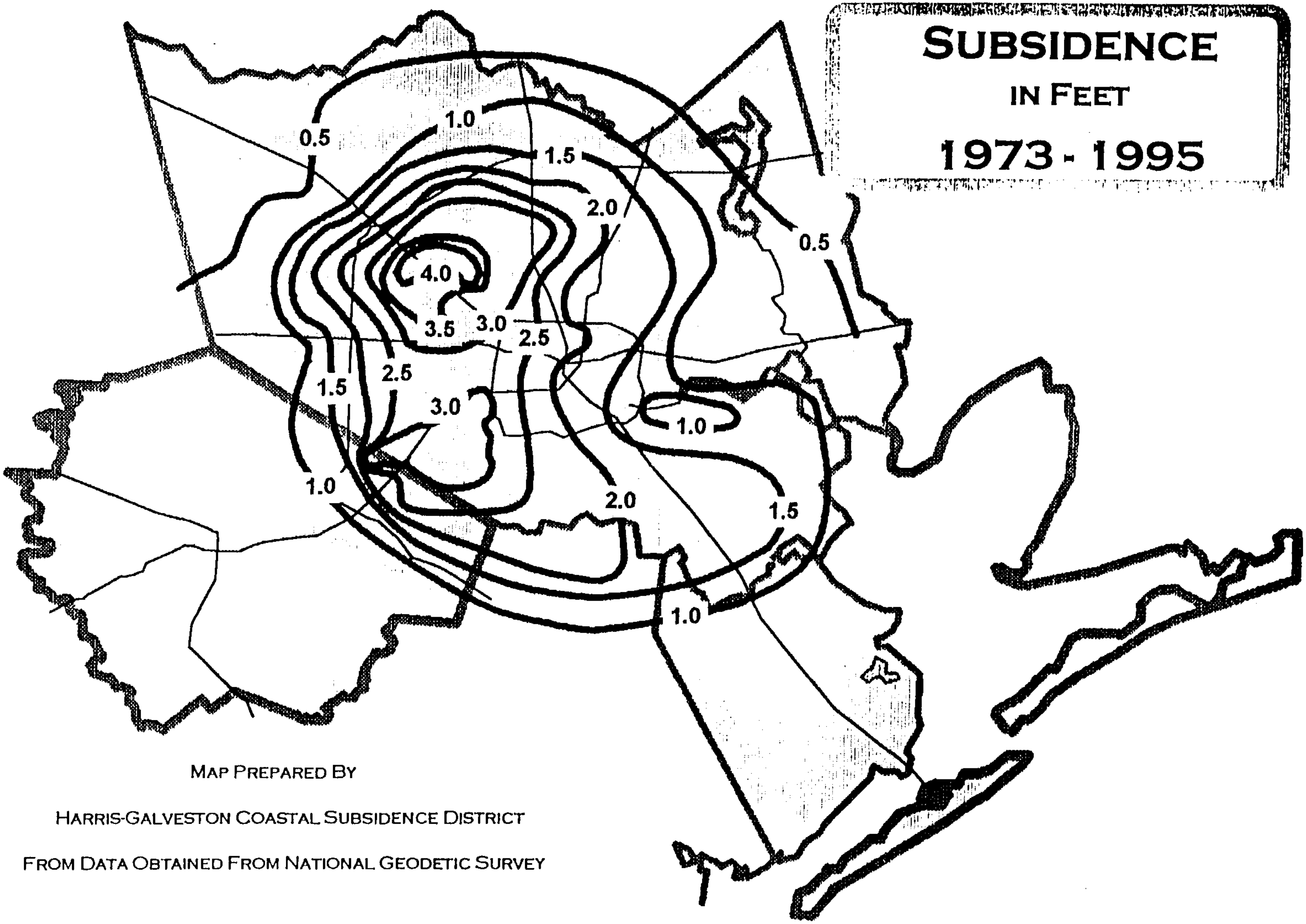
IN FEET

1987 - 1995

MAP PREPARED BY

HARRIS-GALVESTON COASTAL SUBSIDENCE DISTRICT

FROM DATA OBTAINED FROM NATIONAL GEODETIC SURVEY



SUBSIDENCE

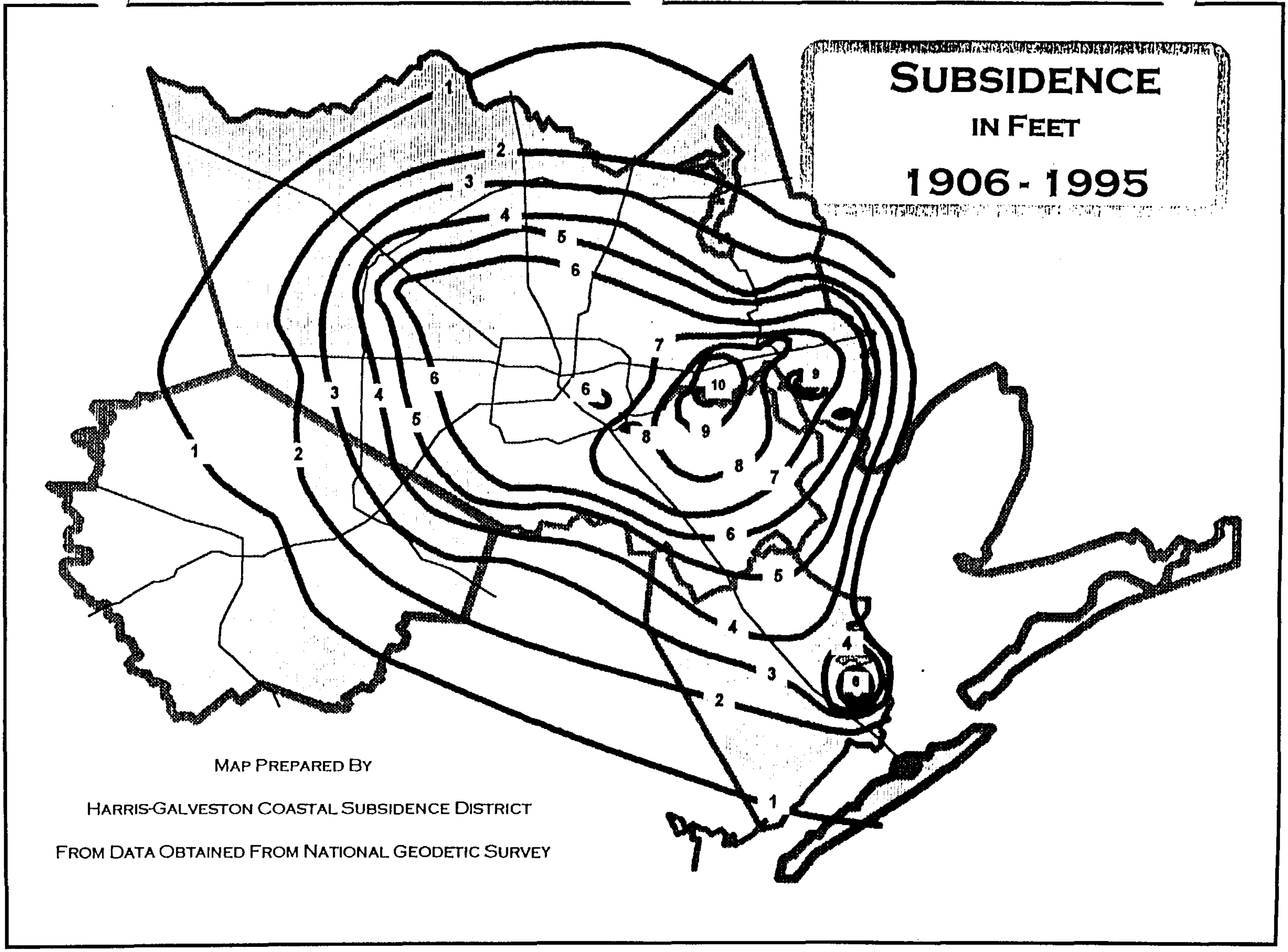
IN FEET

1973 - 1995

MAP PREPARED BY

HARRIS-GALVESTON COASTAL SUBSIDENCE DISTRICT

FROM DATA OBTAINED FROM NATIONAL GEODETIC SURVEY



SUBSIDENCE
IN FEET
1906 - 1995

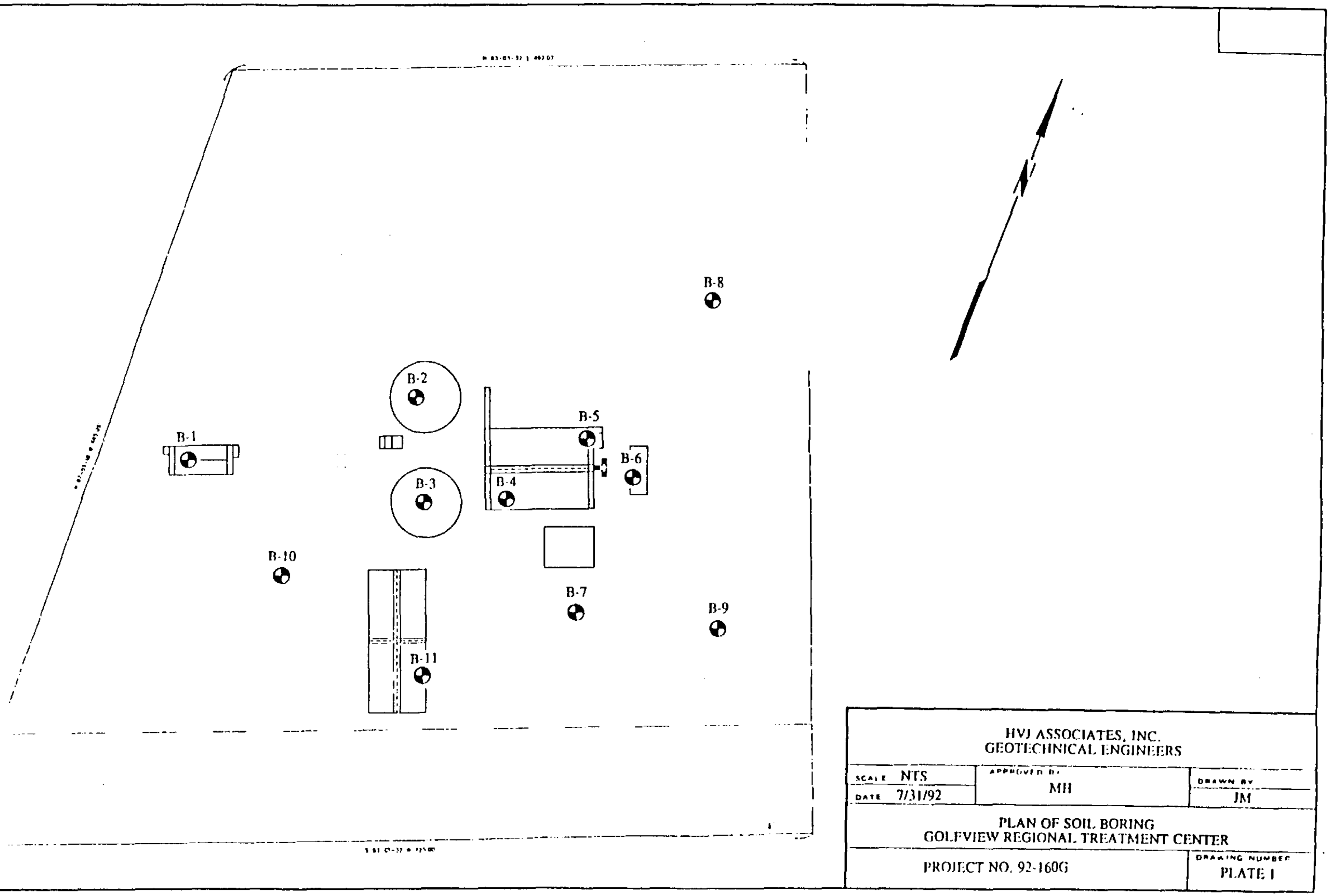
MAP PREPARED BY

HARRIS-GALVESTON COASTAL SUBSIDENCE DISTRICT

FROM DATA OBTAINED FROM NATIONAL GEODETIC SURVEY

APPENDIX B
BORING LOGS AND SITE PLANS FROM PUBLIC PROJECTS

REPORT NO. 1



HVJ ASSOCIATES, INC.
GEOTECHNICAL ENGINEERS

SCALE NTS
DATE 7/31/92
APPROVED BY MH
DRAWN BY JM

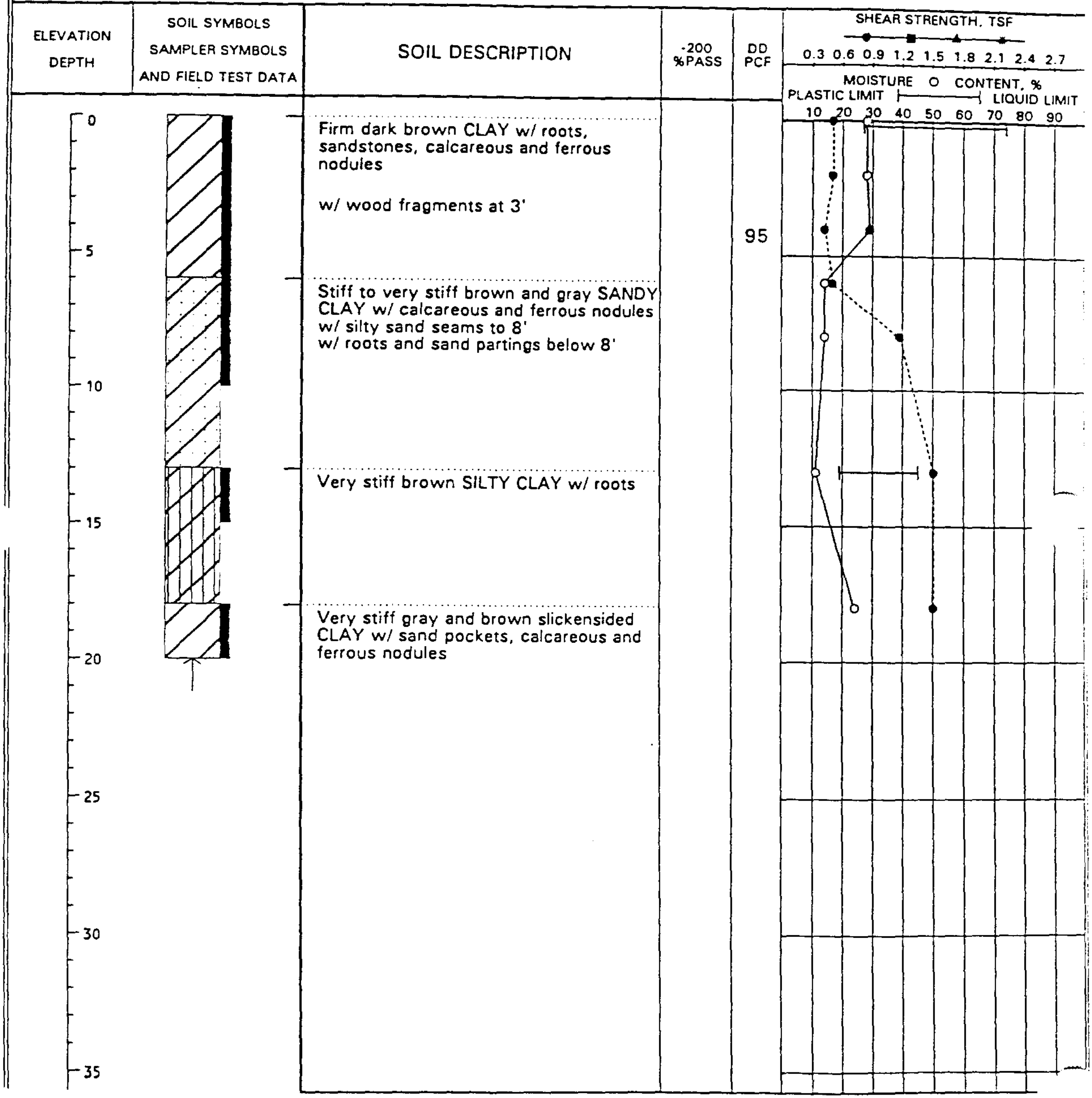
PLAN OF SOIL BORING
GOLFVIEW REGIONAL TREATMENT CENTER

PROJECT NO. 92-160G
DRAWING NUMBER PLATE 1

LOG OF SOIL BORING

Project Name: Richmond Treatment Plant
Boring No.: B-1 Date: July 14, 1992
Depth of water encountered during drilling: none
Groundwater at none after 1/2 hour

Project No. 92-160G
Elevation: See text
Depth to caving: none



Firm dark brown CLAY w/ roots, sandstones, calcareous and ferrous nodules

w/ wood fragments at 3'

Stiff to very stiff brown and gray SANDY CLAY w/ calcareous and ferrous nodules
w/ silty sand seams to 8'
w/ roots and sand partings below 8'

Very stiff brown SILTY CLAY w/ roots

Very stiff gray and brown slickensided CLAY w/ sand pockets, calcareous and ferrous nodules

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

See Plate 1 for boring location.

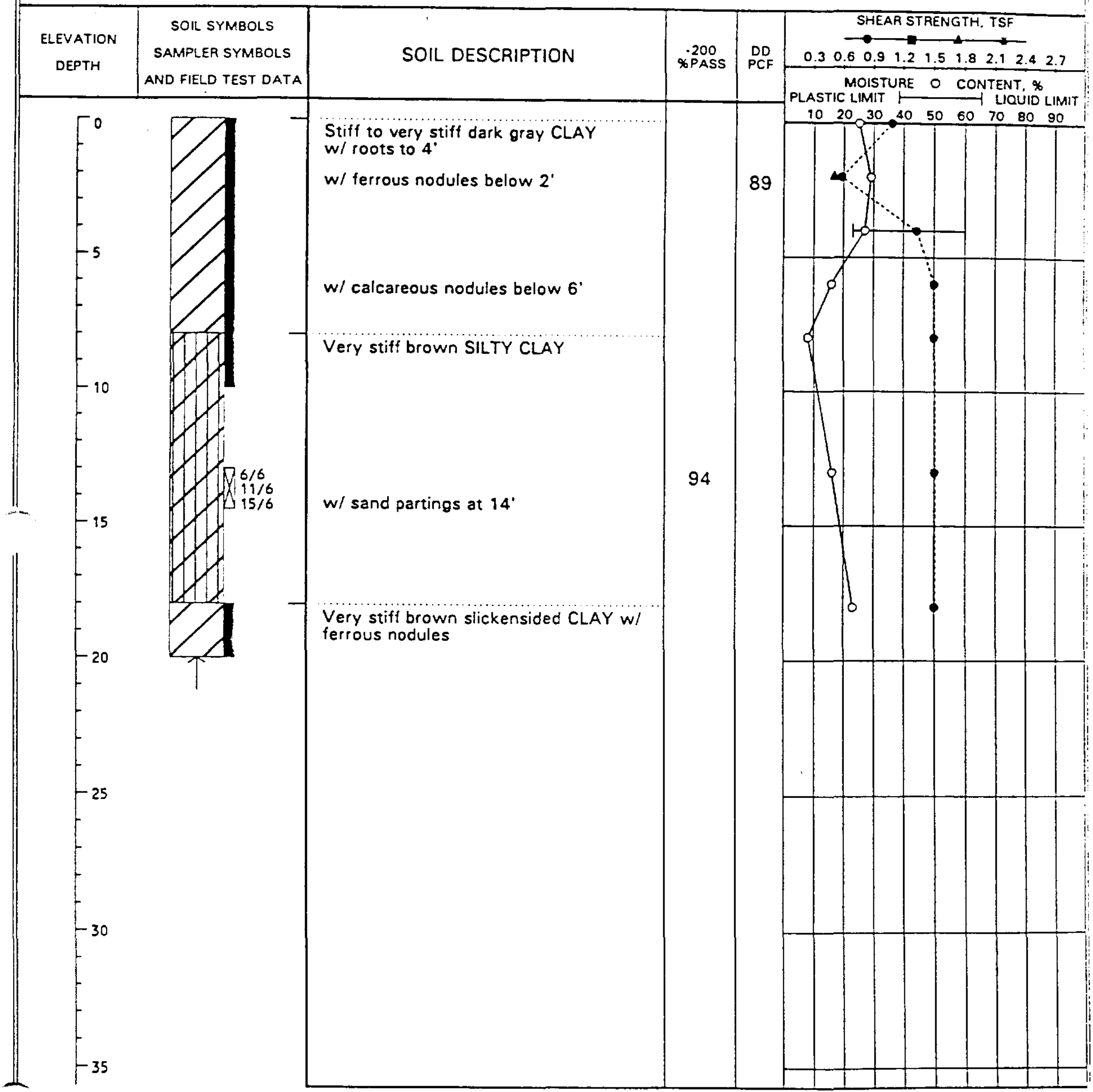
Plate 2

LOG OF SOIL BORING

Project Name: Richmond Treatment Plant
Boring No.: B-2 Date: July 15, 1992
Depth of water encountered during drilling: none
Groundwater at none after 1/2 hour

Project No. 92-160G
Elevation: See text

Depth to caving: none



Stiff to very stiff dark gray CLAY w/ roots to 4'

w/ ferrous nodules below 2'

w/ calcareous nodules below 6'

Very stiff brown SILTY CLAY

w/ sand partings at 14'

Very stiff brown slickensided CLAY w/ ferrous nodules

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

See Plate 1 for boring location.

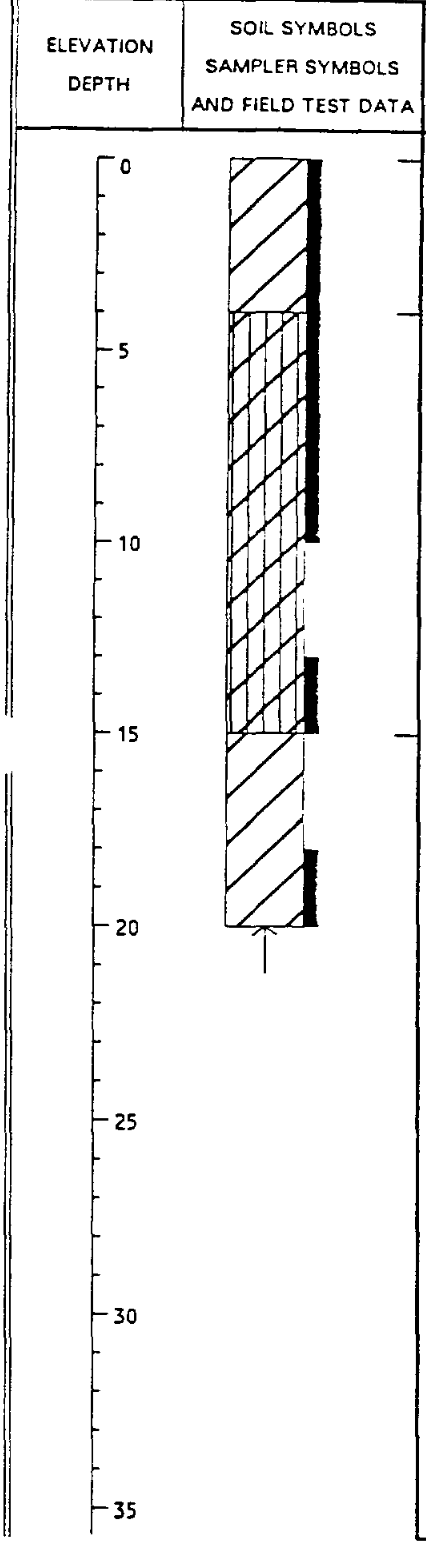
Plate 3

HVJ ASSOCIATES, INC.

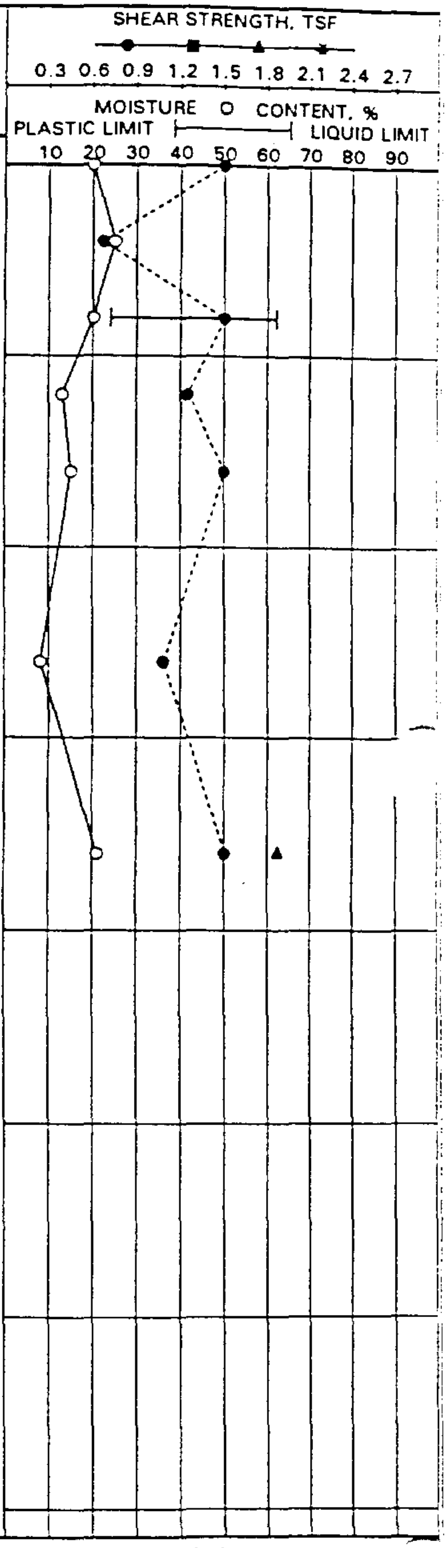
LOG OF SOIL BORING

Project Name: Richmond Treatment Plant
Boring No.: B-3 Date: July 17, 1992
Depth of water encountered during drilling: none
Groundwater at none after 1/2 hour

Project No. 92-160G
Elevation: See text
Depth to caving: none



SOIL DESCRIPTION	-200 %PASS	DD PCF
Stiff to very stiff brown and gray CLAY w/ calcareous and ferrous nodules and roots		
Very stiff brown and gray SILTY CLAY w/ calcareous and ferrous nodules w/ silt partings at 7' w/ clay seams and roots at 9'	90	
Very stiff brown and gray slickensided CLAY w/ calcareous and ferrous nodules		102



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. * = UU Triaxial

See Plate 1 for boring location.

Plate 4

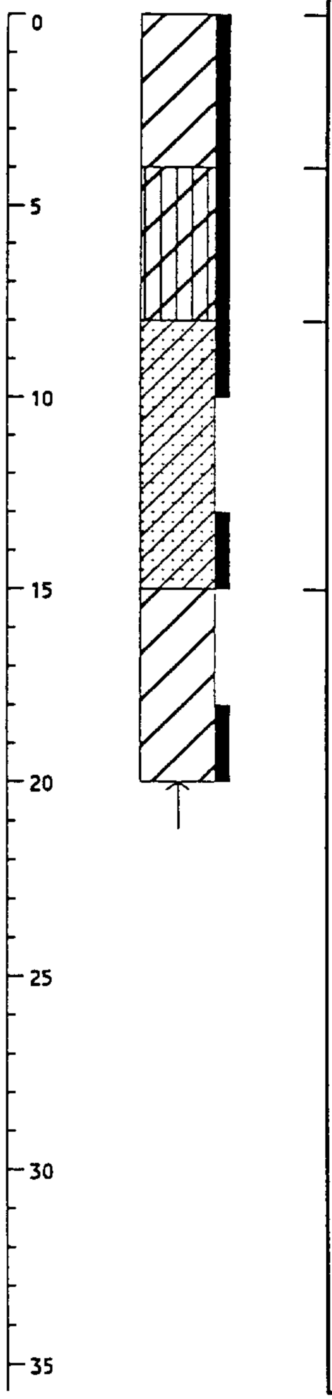
HVJ ASSOCIATES, INC.

LOG OF SOIL BORING

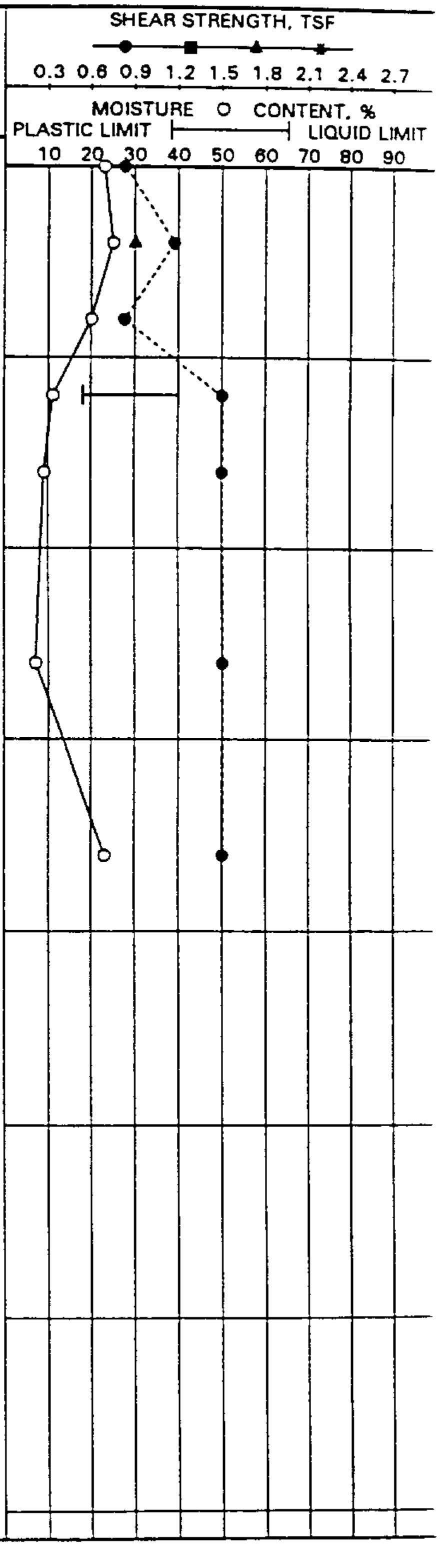
Project Name: Richmond Treatment Plant
Boring No.: B-4 Date: July 15, 1992
Depth of water encountered during drilling: none
Groundwater at none after 1/2 hour

Project No. 92-160G
Elevation: See text
Depth to caving: none

ELEVATION DEPTH | SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA



SOIL DESCRIPTION	-200 %PASS	DD PCF
Stiff to very stiff gray CLAY w/ roots and stones w/ ferrous nodules and sandstones below 2'		96
Stiff to very stiff brown and gray SILTY CLAY w/ calcareous nodules w/ roots to 6' w/ stones and ferrous nodules below 6'		
Medium dense CLAYEY SAND	39	
Very stiff brown slickensided CLAY w/ calcareous nodules and sand partings		



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

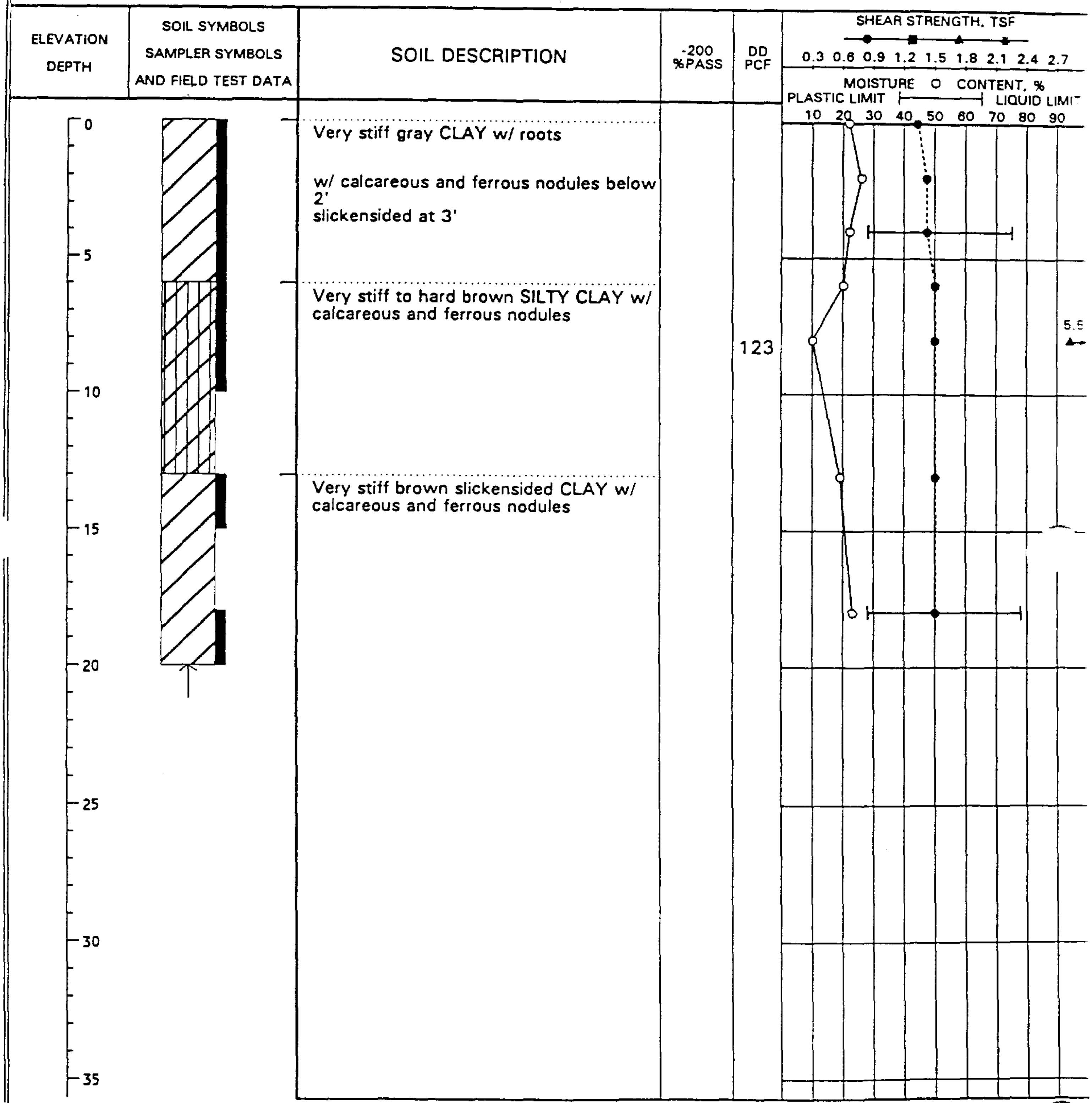
See Plate 1 for boring location.

Plate 5

LOG OF SOIL BORING

Project Name: Richmond Treatment Plant
Boring No.: B-5
Date: July 15, 1992
Depth of water encountered during drilling: none
Groundwater at none after 1/2 hour

Project No. 92-160G
Elevation: See text
Depth to caving: none



SOIL DESCRIPTION	-200 %PASS	DD PCF
Very stiff gray CLAY w/ roots w/ calcareous and ferrous nodules below 2' slickensided at 3'		
Very stiff to hard brown SILTY CLAY w/ calcareous and ferrous nodules		123
Very stiff brown slickensided CLAY w/ calcareous and ferrous nodules		

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

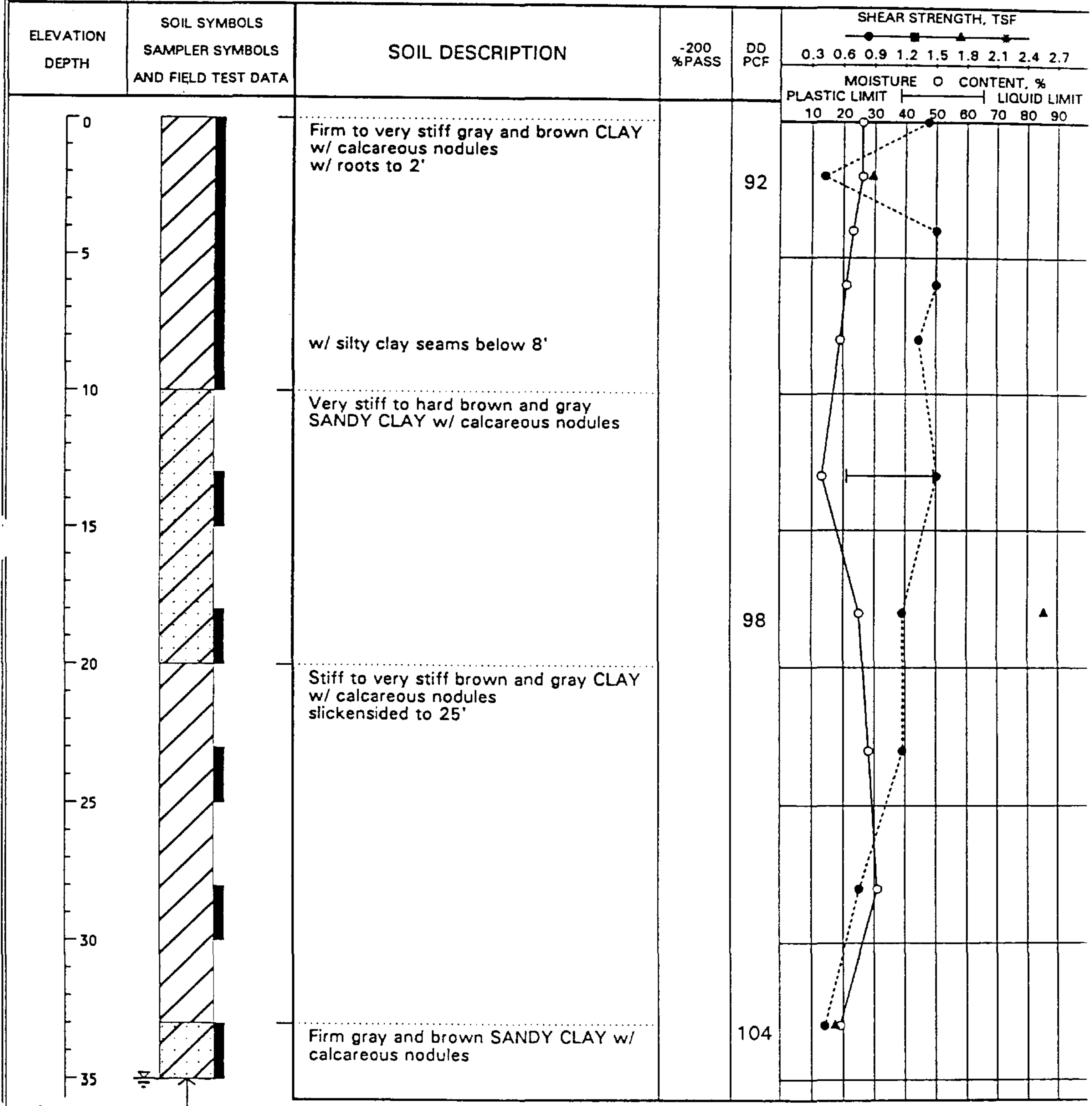
See Plate 1 for boring location.

Plate 6

LOG OF SOIL BORING

Project Name: Richmond Treatment Plant
Boring No.: B-6 Date: July 16, 1992
Depth of water encountered during drilling: 35 feet
Groundwater at - after -

Project No. 92-160G
Elevation: See text
Depth to caving: 15 feet



Firm to very stiff gray and brown CLAY
w/ calcareous nodules
w/ roots to 2'

w/ silty clay seams below 8'

Very stiff to hard brown and gray
SANDY CLAY w/ calcareous nodules

Stiff to very stiff brown and gray CLAY
w/ calcareous nodules
slickensided to 25'

Firm gray and brown SANDY CLAY w/
calcareous nodules

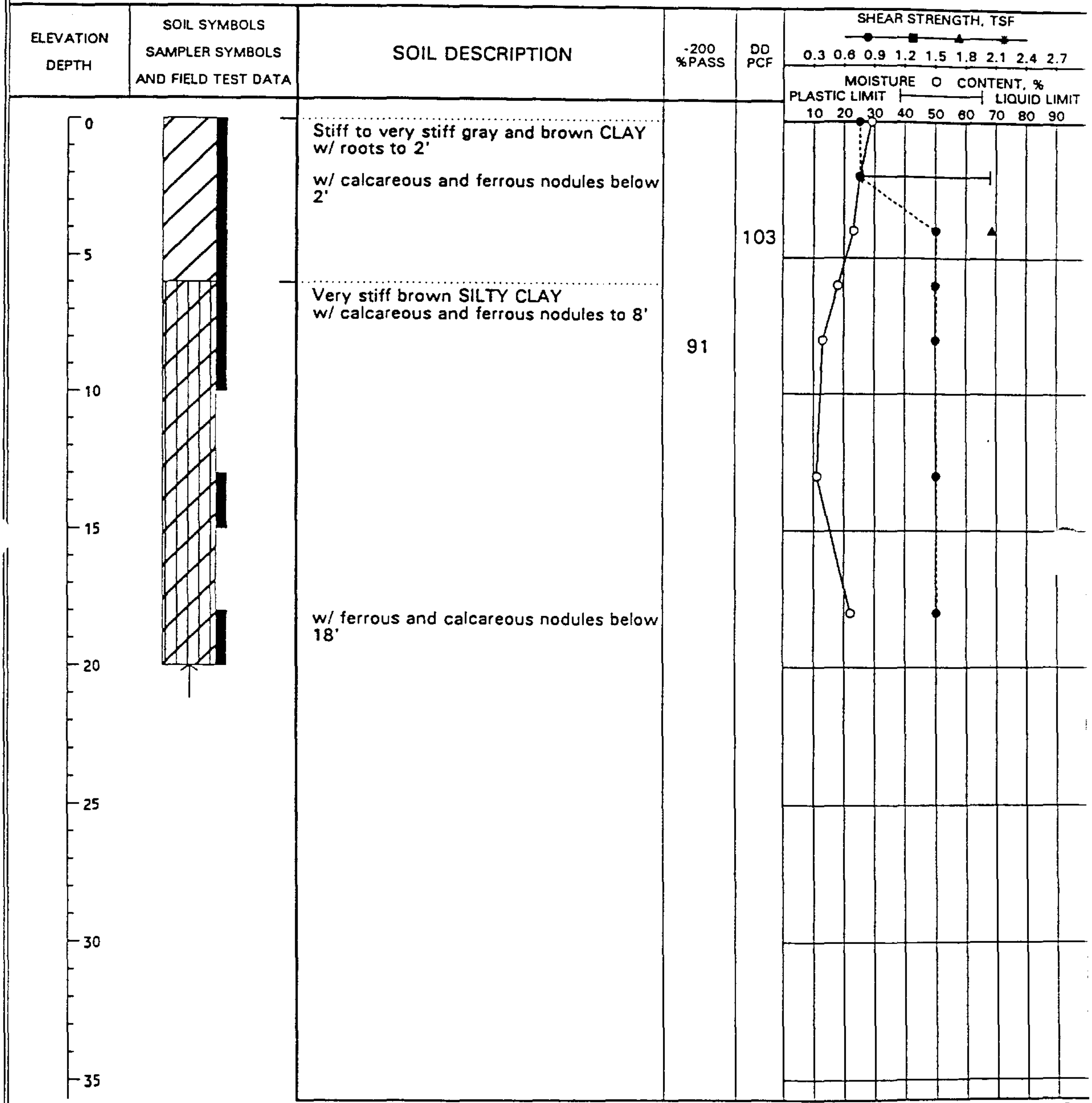
Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

See Plate 1 for boring location.

Plate 7

LOG OF SOIL BORING

Project Name: Richmond Treatment Plant
Project No. 92-160G
Boring No.: B-7
Date: July 15, 1992
Elevation: See text
Depth of water encountered during drilling: none
Groundwater at none after 1/2 hour
Depth to caving: none



Stiff to very stiff gray and brown CLAY w/ roots to 2'

w/ calcareous and ferrous nodules below 2'

103

Very stiff brown SILTY CLAY w/ calcareous and ferrous nodules to 8'

91

w/ ferrous and calcareous nodules below 18'

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

See Plate 1 for boring location.

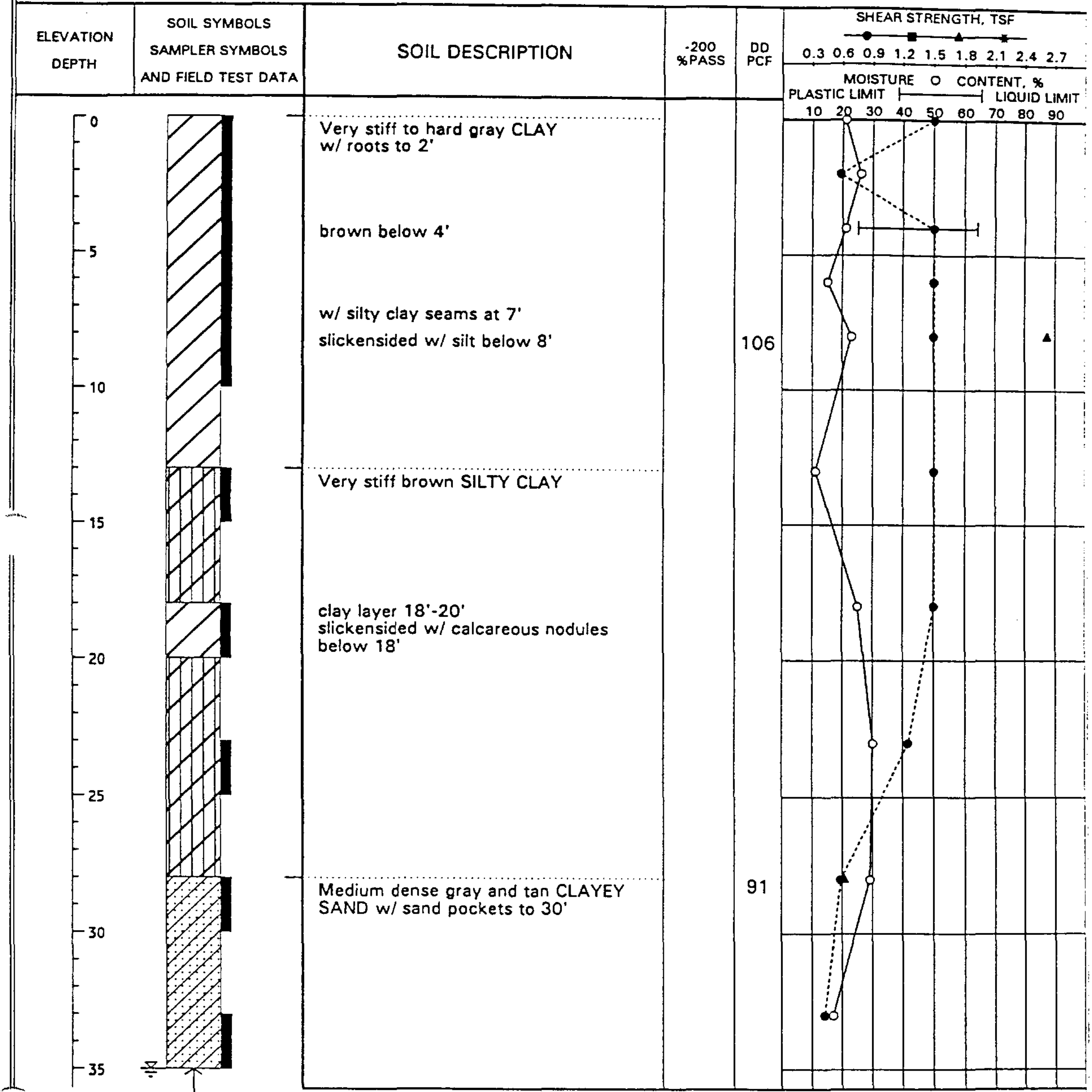
Plate 8

LOG OF SOIL BORING

Project Name: Richmond Treatment Plant
Boring No.: B-8 Date: July 16, 1992
Depth of water encountered during drilling: 35 feet
Groundwater at - after -

Project No. 92-160G
Elevation: See text

Depth to caving: 15 feet



Very stiff to hard gray CLAY w/ roots to 2'

brown below 4'

w/ silty clay seams at 7'

slickensided w/ silt below 8'

106

Very stiff brown SILTY CLAY

clay layer 18'-20'
slickensided w/ calcareous nodules below 18'

Medium dense gray and tan CLAYEY SAND w/ sand pockets to 30'

91

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

See Plate 1 for boring location.

Plate 9

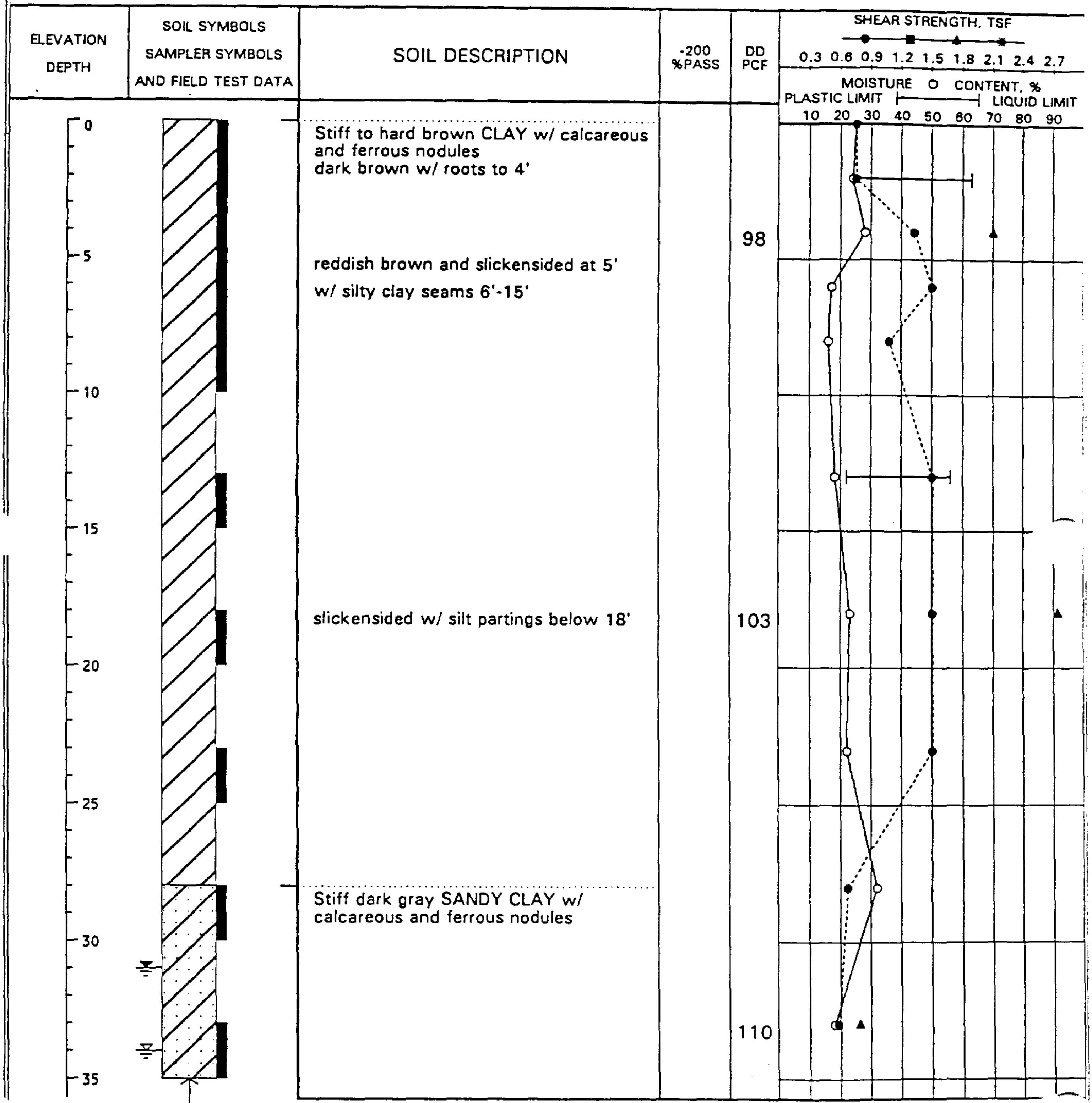
HVJ ASSOCIATES, INC.

LOG OF SOIL BORING

Project Name: Richmond Treatment Plant
Boring No.: B-9 Date: July 17, 1992
Depth of water encountered during drilling: 34 feet
Groundwater at 31 feet after 1/2 hour

Project No. 92-160G
Elevation: See text

Depth to caving: 32 feet



Stiff to hard brown CLAY w/ calcareous and ferrous nodules
dark brown w/ roots to 4'

98

reddish brown and slickensided at 5'
w/ silty clay seams 6'-15'

slickensided w/ silt partings below 18'

103

Stiff dark gray SANDY CLAY w/ calcareous and ferrous nodules

110

Shear Types: • = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. * = UU Triaxial

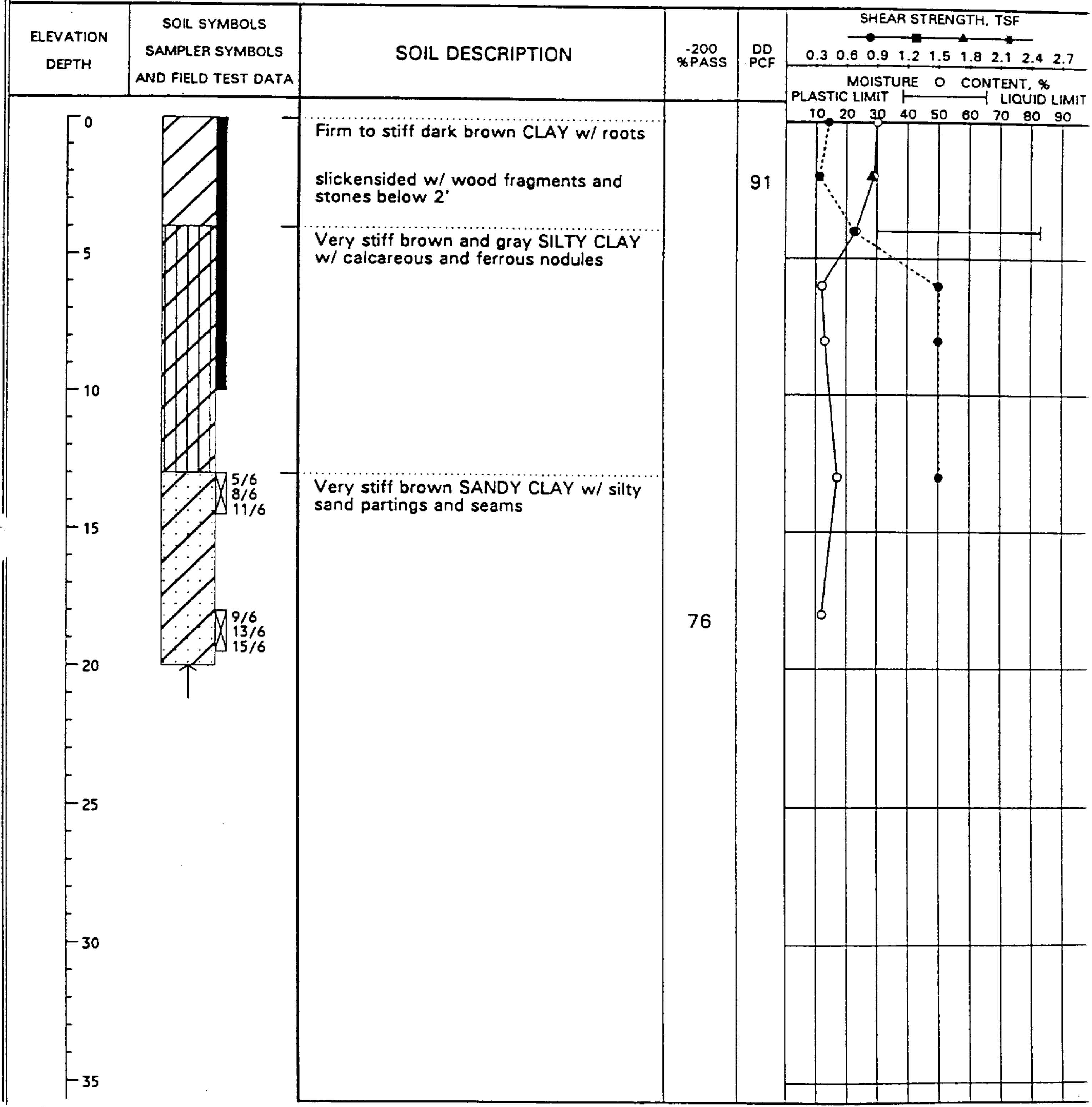
See Plate 1 for boring location.

Plate 10

HVJ ASSOCIATES, INC.

LOG OF SOIL BORING

Project Name: Richmond Treatment Plant
Project No. 92-160G
Boring No.: B-10
Date: July 14, 1992
Elevation: See text
Depth of water encountered during drilling: none
Groundwater at none after 1/2 hour
Depth to caving: none



Firm to stiff dark brown CLAY w/ roots

slickensided w/ wood fragments and stones below 2'

Very stiff brown and gray SILTY CLAY w/ calcareous and ferrous nodules

Very stiff brown SANDY CLAY w/ silty sand partings and seams

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. * = UU Triaxial

See Plate 1 for boring location.

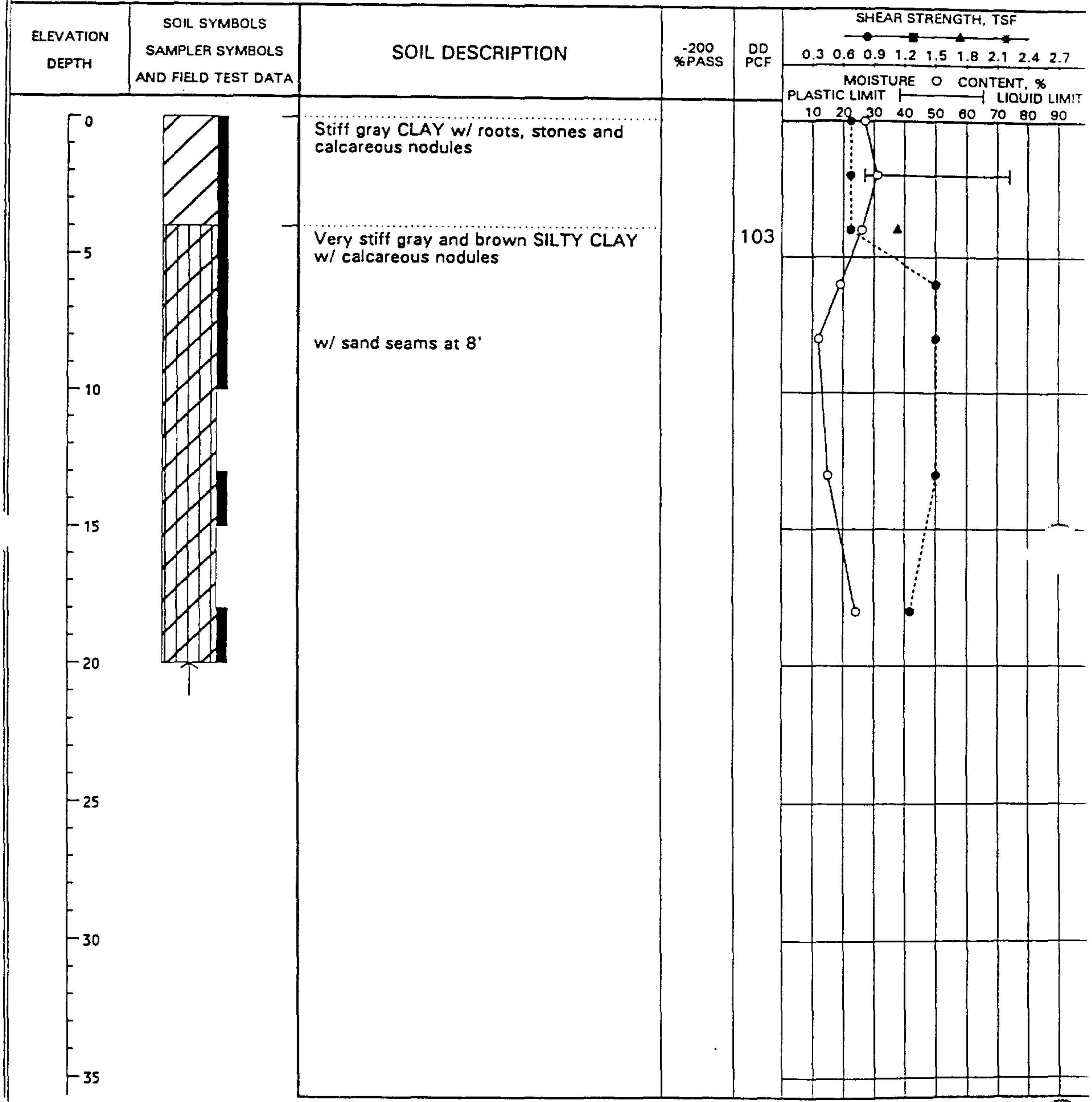
Plate 11

LOG OF SOIL BORING

Project Name: Richmond Treatment Plant
Boring No.: B-11 Date: July 15, 1992
Depth of water encountered during drilling: none
Groundwater at none after 1/2 hour

Project No. 92-160G
Elevation: See text

Depth to caving: none



Stiff gray CLAY w/ roots, stones and calcareous nodules

Very stiff gray and brown SILTY CLAY w/ calcareous nodules

w/ sand seams at 8'

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. * = UU Triaxial

See Plate 1 for boring location.

Plate 12

KEY TO SYMBOLS

Symbol	Description
Strata symbols	
▨	Clay
▨	Sandy Clay
▥	Silty Clay
▨	Clayey Sand
Misc. Symbols	
●	Hand Penetrometer Test
◥	Torvane Test
▲	Unconfined Compression Test
✳	Unconsolidated Undrained Triaxial Test
↑	End of boring

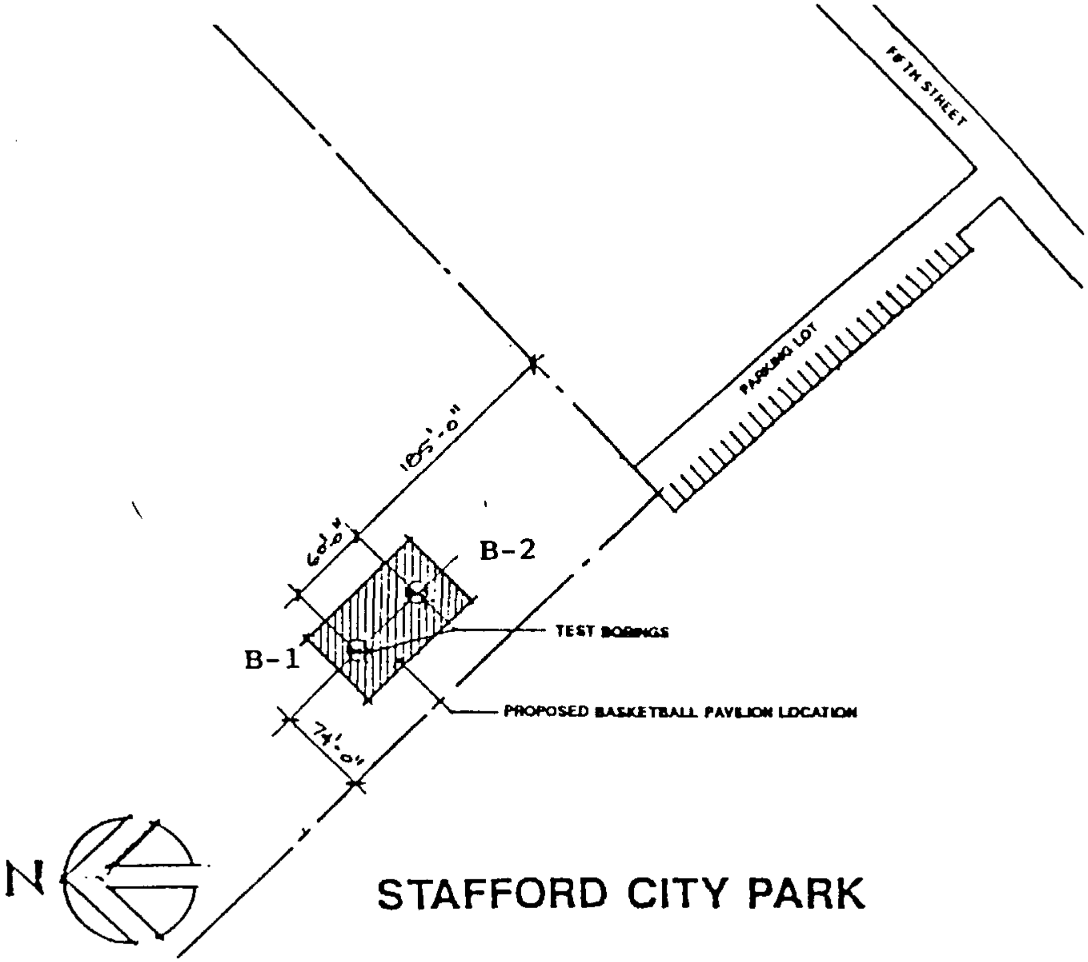
Symbol	Description
Soil Samplers	
■	Shelby Tube
☒	Split Barrel

Notes:

Abbreviations used are:

-200 = Percent Passing #200 Sieve (%)
DD = Dry Density (pcf)

REPORT NO. 2



STAFFORD CITY PARK

HVJ ASSOCIATES, INC.
GEOTECHNICAL CONSULTANTS

STAFFORD CITY PARK
PLAN OF BORING

DRAWN BY:	DATE:	PROJECT NO:
MM	5/8/89	89-114G
CHECKED BY:	SCALE:	DRAWING NO:
	NTS	

89-114G **LOG OF BORING NO.** B-1 (Stafford Site)

DEPTH, FT.	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS / FT.	%PASSING NO.200	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	%MOISTURE CONTENT	UNIT DRY WT. PCF	SOIL SHEAR STRENGTH TONS/SQ.FT. TORVANE	SOIL SHEAR STRENGTH TONS/SQ.FT. HANDPENETROMETER	SOIL SHEAR STRENGTH TONS/SQ.FT. UNCONFINE COMPRESS.	ROCK-COMPRESS. STRENGTH TSF
			Very stiff, dark gray CLAY			55	25	30	17			1.4		
									27		1.5	1.1		
			With calcareous nodules 4'-6'											
5									19	107	1.3	1.5^+	2.0	
			Very stiff, dark tan SANDY CLAY with calcareous nodules			38	15	23	14			1.5^+		
			Loose, tan CLAYEY SAND	15	46				12					
10														
				16					21					
15														

COMPLETION DEPTH 15 Feet

LOCATION See Plate 1

DATE May 1, 1989

WATERTABLE 13.0 Feet

HVJ ASSOCIATES INC

89-114G **LOG OF BORING NO.** B-2 (Stafford Site)

DEPTH, FT.	SYMBOL	SAMPLES	SOIL DESCRIPTION	BLOWS / FT.	% PASSING NO.200	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	% MOISTURE CONTENT	UNIT DRY WT. PCF	SOIL SHEAR STRENGTH TONS/SQ.FT.			ROCK-COMPRESS. ST GTH TSF
						LL	PL	PI			TORVANE	HANDPENETROMETER	UNCONFINED COMPRESS.	
	▨	■	Stiff, dark gray CLAY						23		1.2	0.9		
	▨	■	Very stiff below 2'			68	26	42	24			1.1		
5	▨	■	With calcareous and fe nodules			69	26	43	21			1.4		
	▨	■	Very stiff tan SANDY CLAY						18	109	1.2	1.5+	1.3	
	▨	☒	Very loose, tan CLAYEY SAND	13					9					
10	▨													
	▨	☒	Loose at 13'-15'	17	22				19					
15														

COMPLETION DEPTH 15 Feet

LOCATION See Plate 1

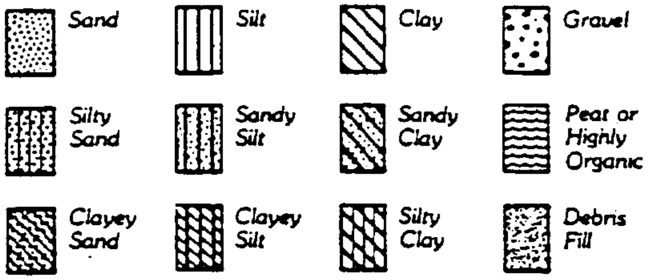
DATE May 1, 1989

WATERTABLE 13.0 Feet

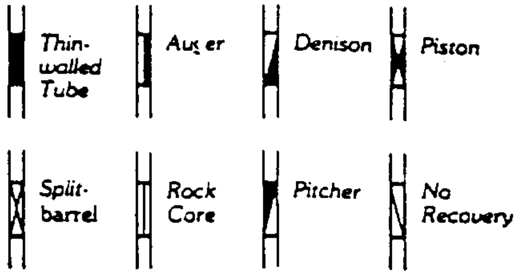
HVJ ASSOCIATES INC

TERMS AND SYMBOLS USED ON BORING LOGS

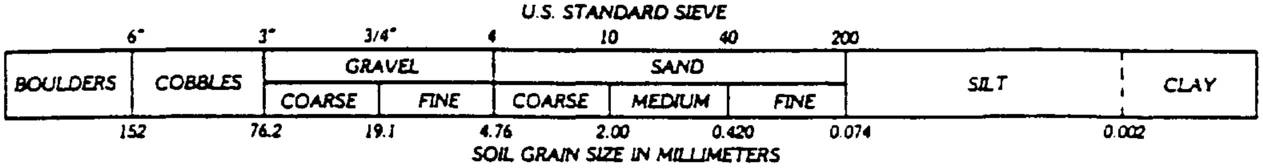
SOIL TYPES



SAMPLER TYPES



SOIL GRAIN SIZE



STRENGTH OF COHESIVE SOILS (1)

Consistency	Undrained Shear Strength, Kips Per Sq Ft
Very Soft	less than 0.25
Soft	0.25 to 0.50
Firm	0.50 to 1.00
Stiff	1.00 to 2.00
Very Stiff	2.00 to 4.00
Hard	greater than 4.00

DENSITY OF GRANULAR SOILS (2,3)

Descriptive Term	*Relative Density, %
Very Loose	less than 15
Loose	15 to 35
Medium Dense	35 to 65
Dense	65 to 85
Very Dense	greater than 85

*Estimated from sampler driving record

SPLIT-BARREL SAMPLER DRIVING RECORD

Blows Per Foot	Description
25	25 blows drove sampler 12 inches, after initial 6 inches of seating.
50/7"	50 blows drove sampler 7 inches, after initial 6 inches of seating.
Ref/3"	50 blows drove sampler 3 inches during initial 6-inch seating interval.

Note : To avoid damage to sampling tools, driving is limited to 50 blows during or after seating interval.

SOIL STRUCTURE (1)

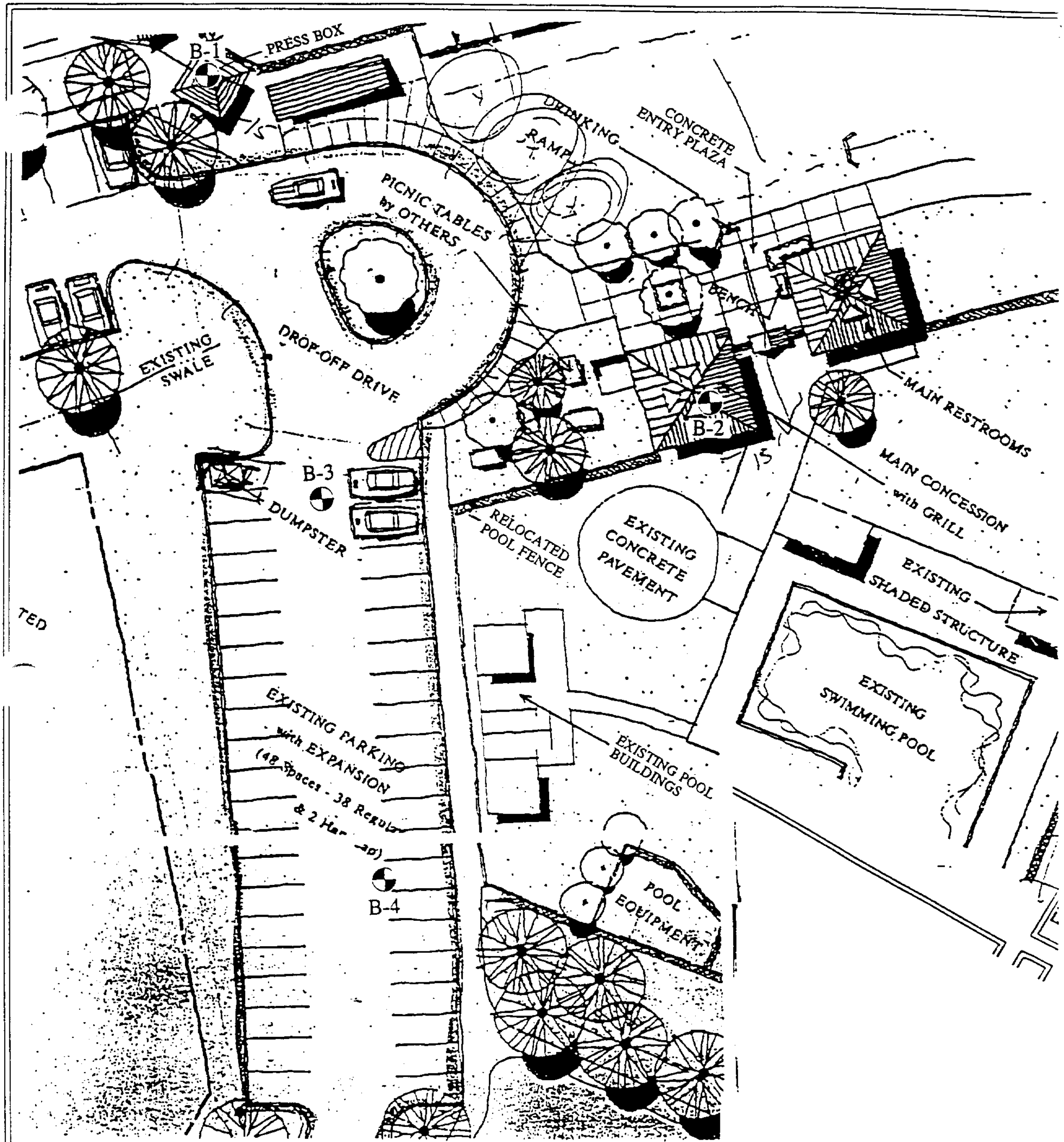
Slickensided	Having planes of weakness that appear slick and glossy. The degree of slickensidedness depends upon the spacing of slickensides and the ease of breaking along these planes.
Fissured	Containing shrinkage or relief cracks, often filled with fine sand or silt; usually more or less vertical.
Pocket	Inclusion of material of different texture that is smaller than the diameter of the sample.
Parting	Inclusion less than 1/8 inch thick extending through the sample.
Seam	Inclusion 1/8 inch to 3 inches thick extending through the sample.
Layer	Inclusion greater than 3 inches thick extending through the sample.
Laminated	Soil sample composed of alternating partings or seams of different soil type.
Interlayered	Soil sample composed of alternating layers of different soil type.
Intermixed	Soil sample composed of pockets of different soil type and layered or laminated structure is not evident.
Calcareous	Having appreciable quantities of carbonate.

REFERENCES :

(1) ASTM D 2488
(2) ASCE Manual 56 (1976)
(3) ASTM D 2049

Information on each boring log is a compilation of subsurface conditions and soil or rock classifications obtained from the field as well as from laboratory testing of samples. Strata have been interpreted by commonly accepted procedures. The stratum lines on the logs may be transitional and approximate in nature. Water level measurements refer only to those observed at the times and places indicated, and may vary with time, geologic condition or construction activity.

REPORT NO. 7



⊕ BORING LOCATION

HVJ ASSOCIATES, INC.
GEOTECHNICAL ENGINEERS

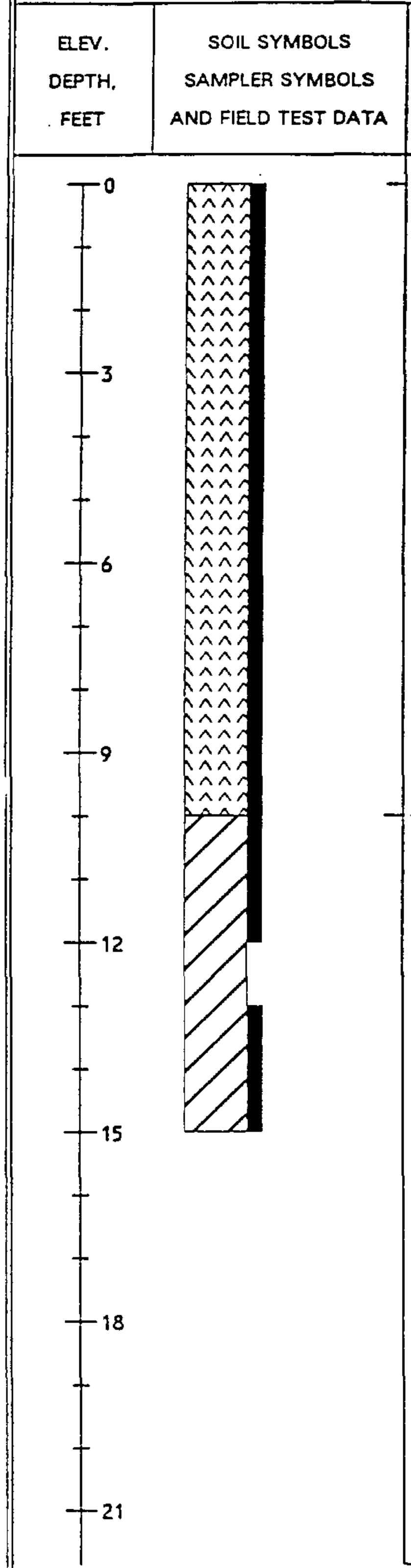
SCALE: NTS DATE: 09/12/94	APPROVED BY: MK	PREPARED BY: EP

PLAN OF BORINGS
PROPOSED IMPROV., SUGARLAND PARK

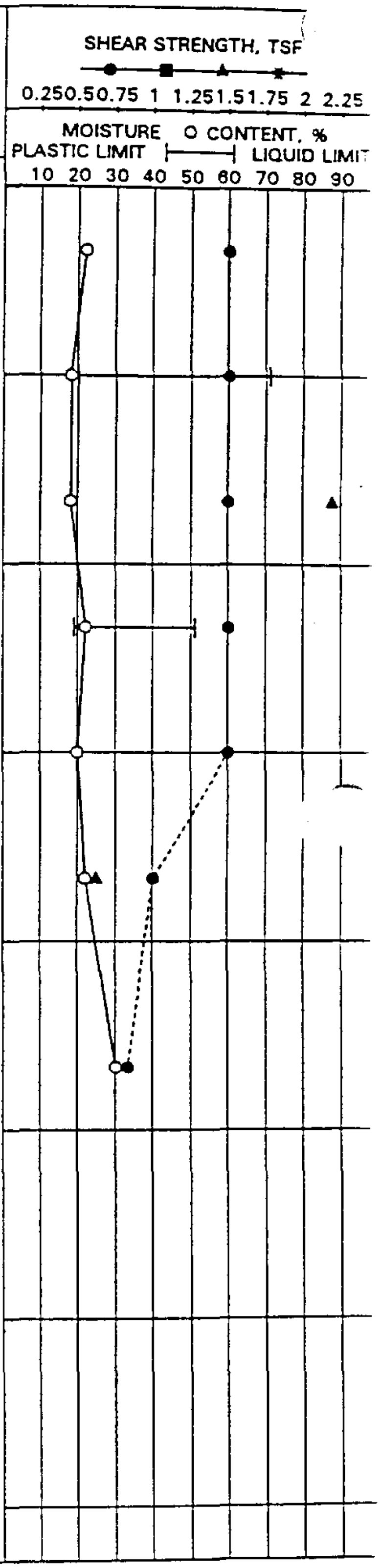
PROJECT NO. 94-201G	DRAWING NUMBER: PLATE 1

LOG OF SOIL BORING

Project Name: Proposed Improvements, Sugar Land Park
Project No. 94-201G
Boring No.: B-1
Date: 08-31-94
Elevation:
Groundwater during drilling: none



SOIL DESCRIPTION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF
Fill: brown and yellowish red sandy clay w/ roots and calcareous nodules		
yellowish red and dark gray clay below 2' w/ calcareous nodules to 6'		
		111
w/ sand pockets 6'-8'		
Stiff yellowish red and gray CLAY		106
w/ silt pockets below 13'		



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. * = UU Triaxial

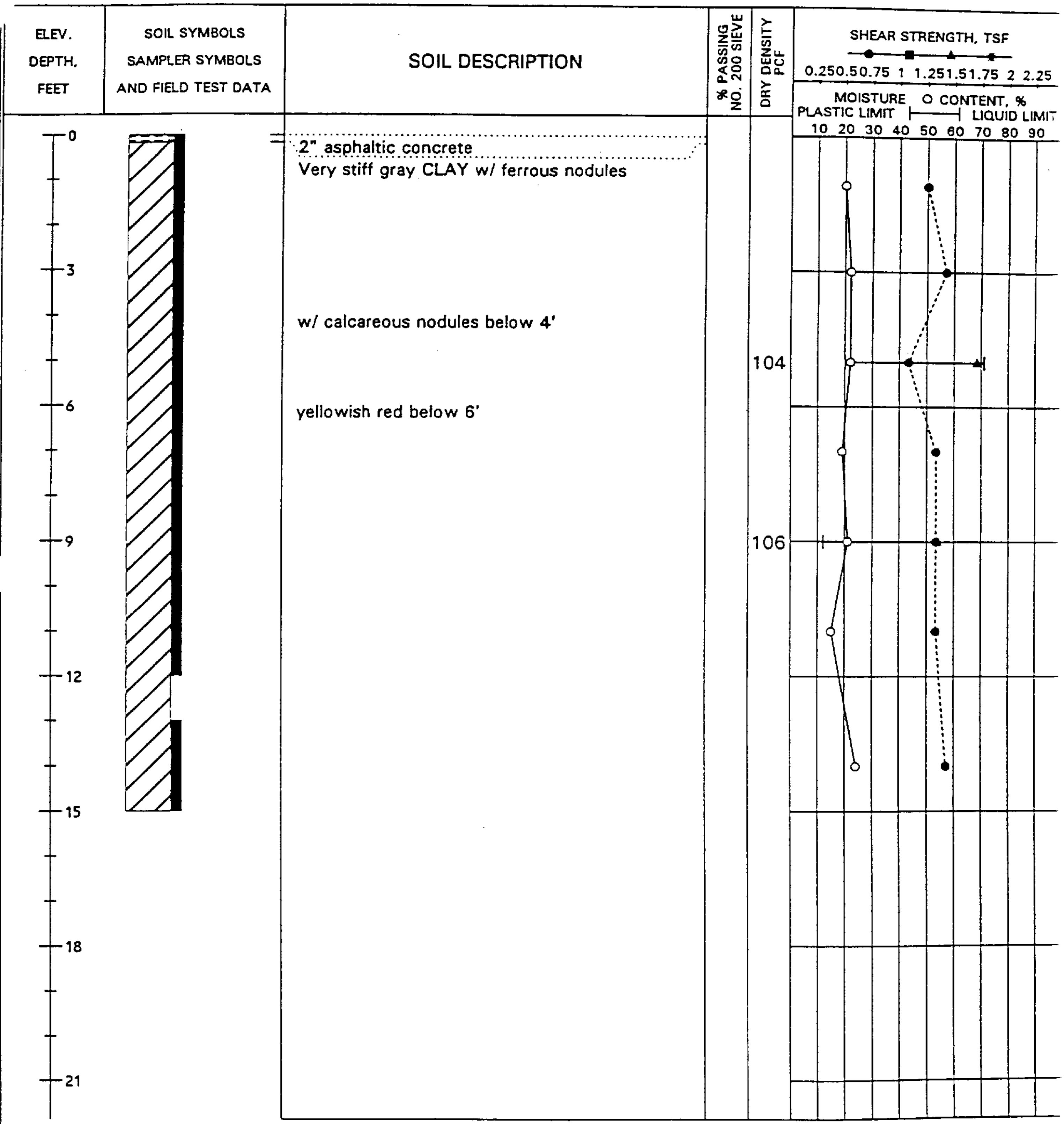
See Plate 1 for boring location.

Plate 2

HVJ ASSOCIATES, INC.

LOG OF SOIL BORING

Project Name: Proposed Improvements, Sugar Land Park
Project No. 94-201G
Boring No.: B-2
Date: 08-31-94
Elevation:
Groundwater during drilling: none



2" asphaltic concrete

Very stiff gray CLAY w/ ferrous nodules

w/ calcareous nodules below 4'

yellowish red below 6'

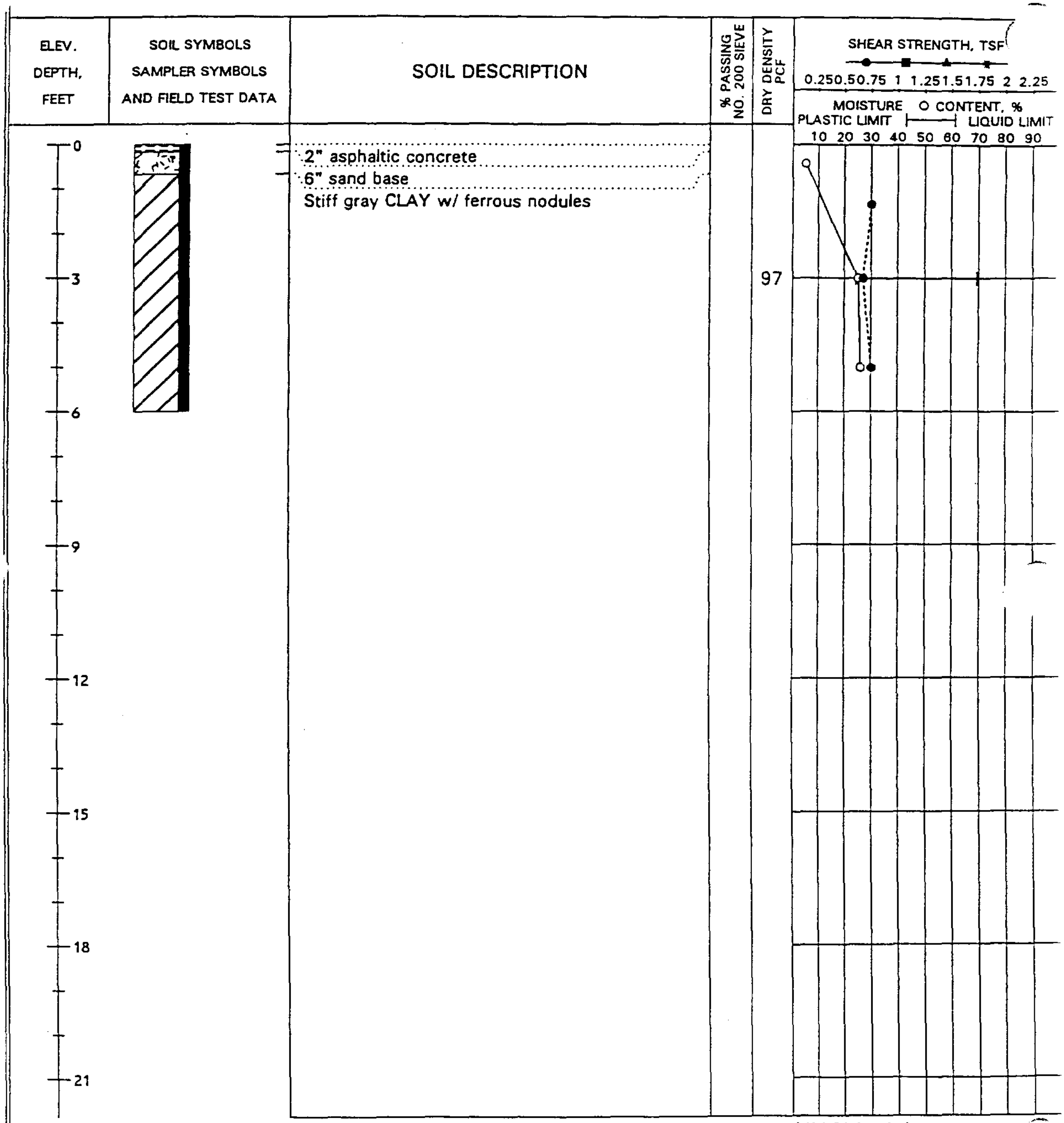
Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

See Plate 1 for boring location.

Plate 3

LOG OF SOIL BORING

Project Name: Proposed Improvements, Sugar Land Park
Project No. 94-201G
Boring No.: B-3
Date: 08-31-94
Elevation:
Groundwater during drilling: none



2" asphaltic concrete
6" sand base
Stiff gray CLAY w/ ferrous nodules

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

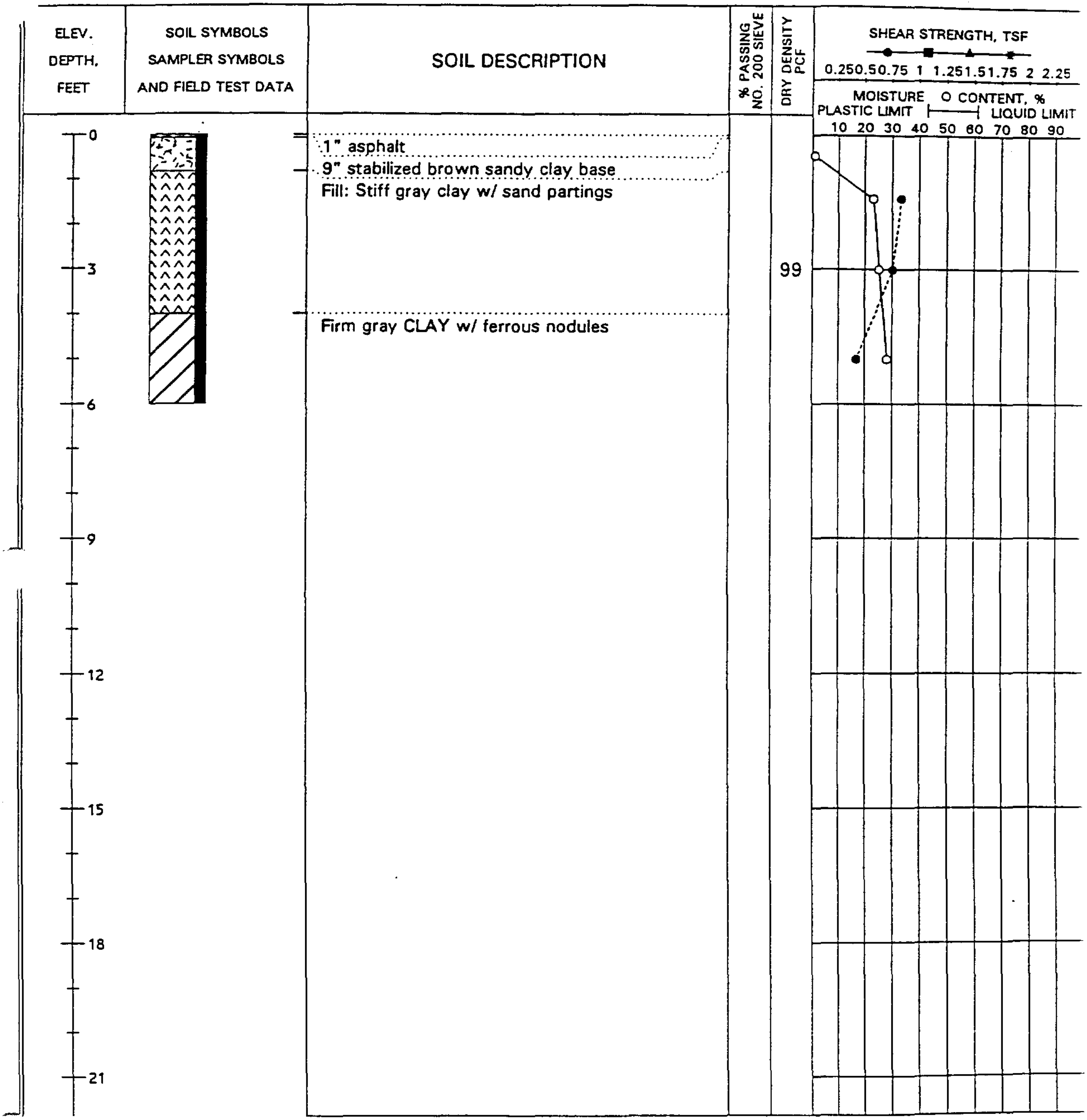
See Plate 1 for boring location.

Plate 4

HVJ ASSOCIATES, INC.

LOG OF SOIL BORING

Project Name: Proposed Improvements, Sugar Land Park
Project No. 94-201G
Boring No.: B-4
Date: 08-31-94
Elevation:
Groundwater during drilling: none



1" asphalt

9" stabilized brown sandy clay base

Fill: Stiff gray clay w/ sand partings

Firm gray CLAY w/ ferrous nodules

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

See Plate 1 for boring location.

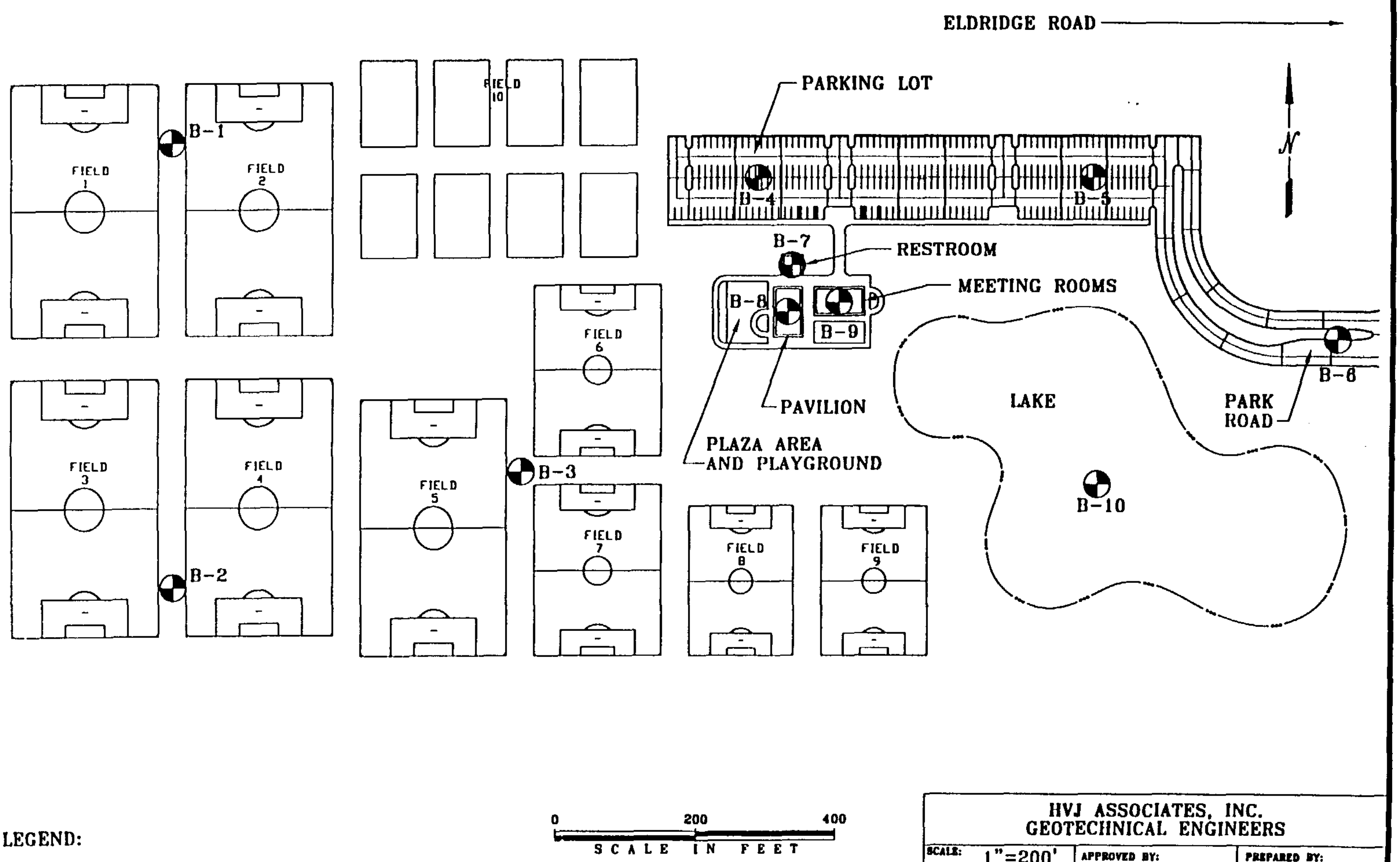
Plate 5

HVJ ASSOCIATES, INC.

SYMBOLS USED ON BORING LOGS

Symbol	Description
Strata symbols	
⩓	Fill Material
▨	Clay
▤	Asphaltic Concrete
⁙	Base Material
Soil Samplers	
■	Shelby Tube

REPORT NO. 8



LEGEND:

◐ APPROXIMATE BORING LOCATIONS

HVJ ASSOCIATES, INC.
GEOTECHNICAL ENGINEERS

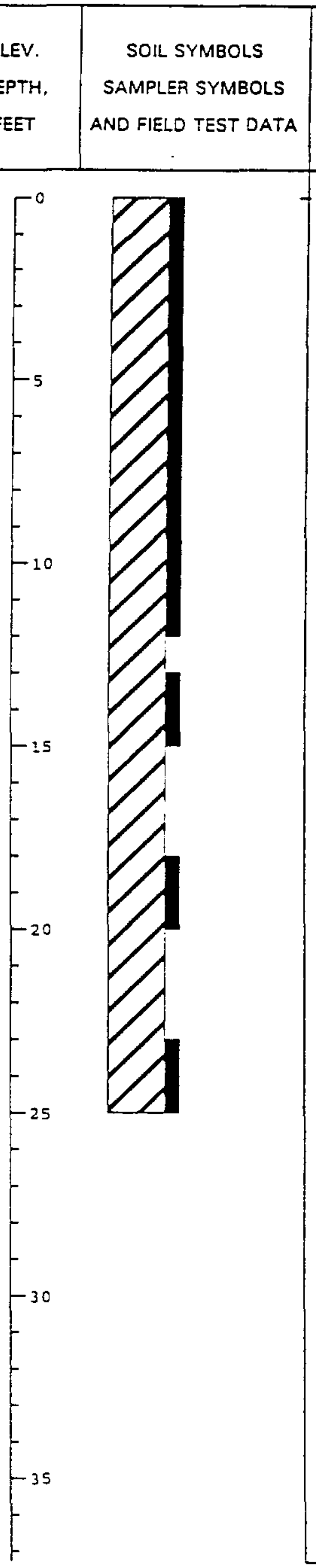
SCALE: 1"=200'	APPROVED BY: DC	PREPARED BY: JGC
DATE: 03/04/98		

PLAN OF BORINGS
SUGAR LAND SOCCER COMPLEX

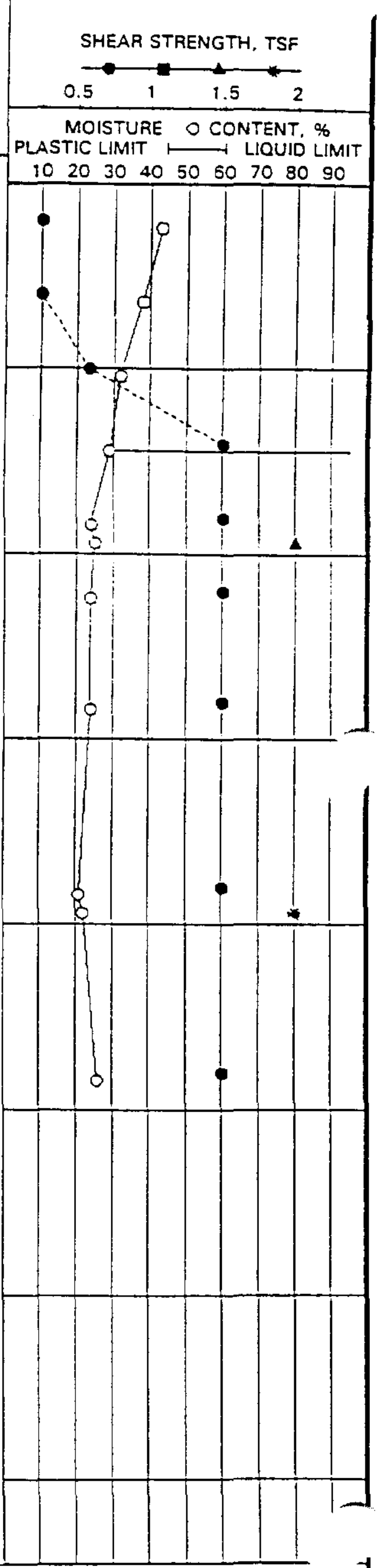
PROJECT NO. 97-197G-00	DRAWING NUMBER: PLATE 2

LOG OF SOIL BORING

Project Name: Sugar Land Soccer Complex
Boring No.: B-1
Date: 02-09-98
Project No. 97-197G-00
Elevation: -
Groundwater during drilling: none



SOIL DESCRIPTION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF
Firm dark gray CLAY		
stiff at 5'		
very stiff brownish yellow w/ calcareous and ferrous nodules below 6' and slickensides to 15'		
hard reddish brown and light gray		
very stiff below 10'		104
reddish brown below 13'		
		110

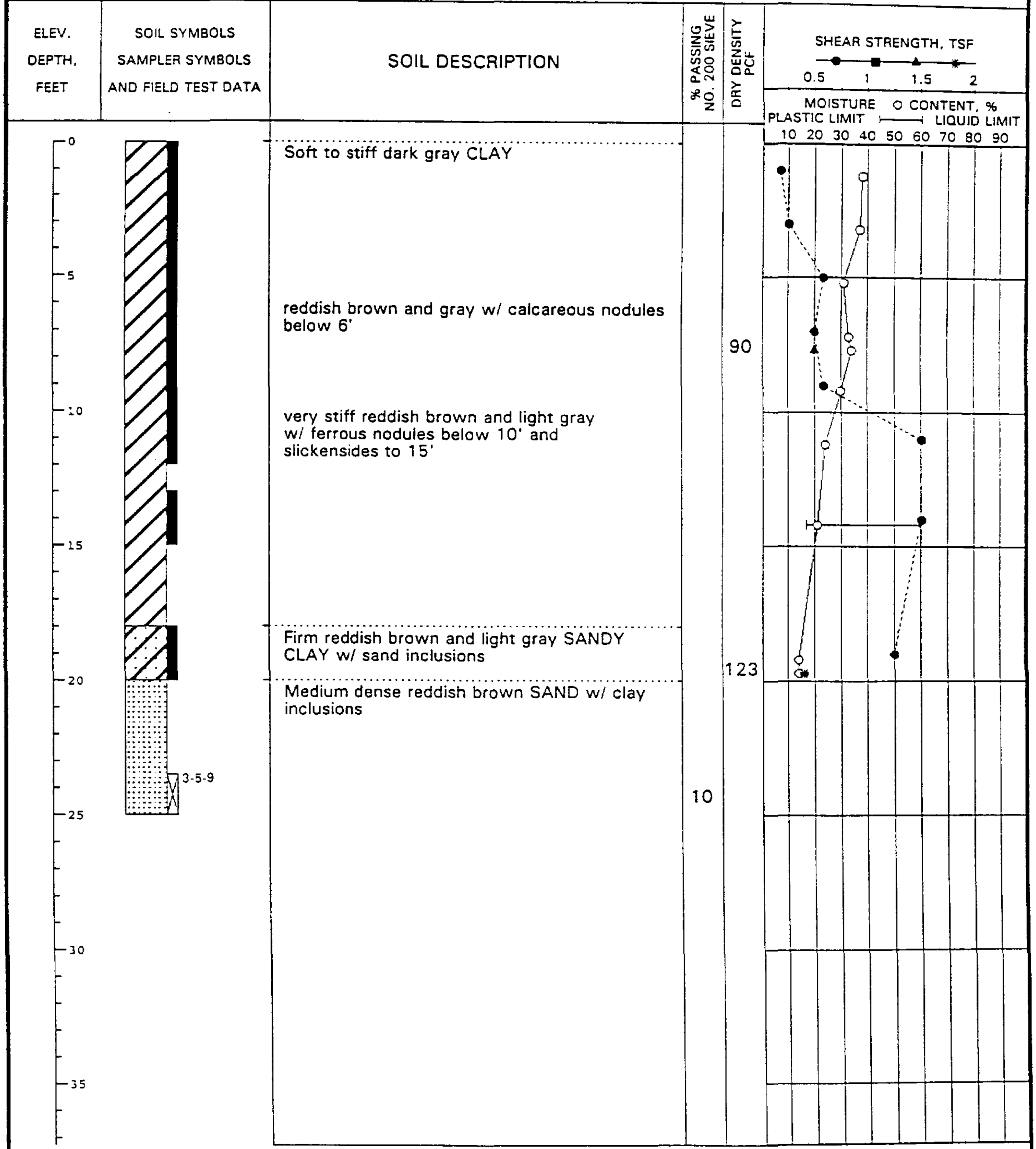


Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

See Plate 2 for boring location.

LOG OF SOIL BORING

Project Name: Sugar Land Soccer Complex
Boring No.: B-2
Date: 02-09-98
Groundwater during drilling: none
Project No. 97-197G-00
Elevation: -



Soft to stiff dark gray CLAY

reddish brown and gray w/ calcareous nodules below 6'

very stiff reddish brown and light gray w/ ferrous nodules below 10' and slickensides to 15'

Firm reddish brown and light gray SANDY CLAY w/ sand inclusions

Medium dense reddish brown SAND w/ clay inclusions

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

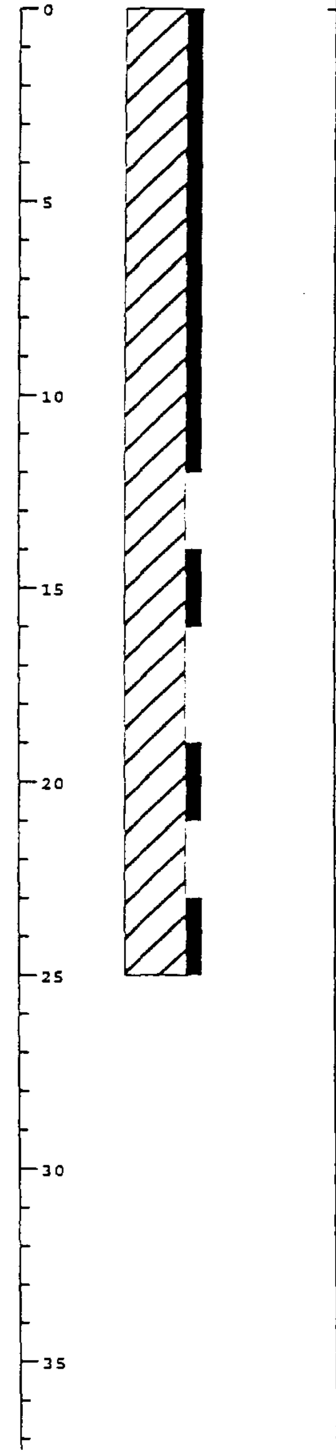
See Plate 2 for boring location.

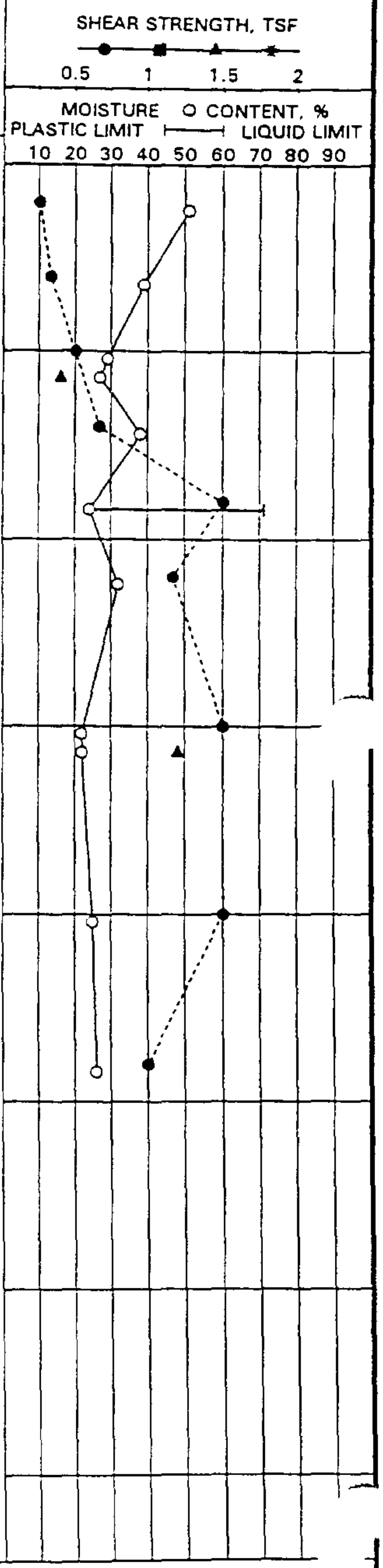
Plate 4

LOG OF SOIL BORING

Project Name: Sugar Land Soccer Complex
Project No. 97-197G-00
Boring No.: B-3
Date: 02-09-98
Elevation: -
Groundwater during drilling: none

ELEV. DEPTH, FEET	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	SOIL DESCRIPTION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF
		Firm dark gray CLAY w/ roots		
		gray w/ calcareous nodules below 4'		
		stiff w/ slickensides to 8'		91
		very stiff reddish brown and light gray		
		reddish brown w/ ferrous nodules below 14'		108





Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ∗ = UU Triaxial

See Plate 2 for boring location.

Plate 5

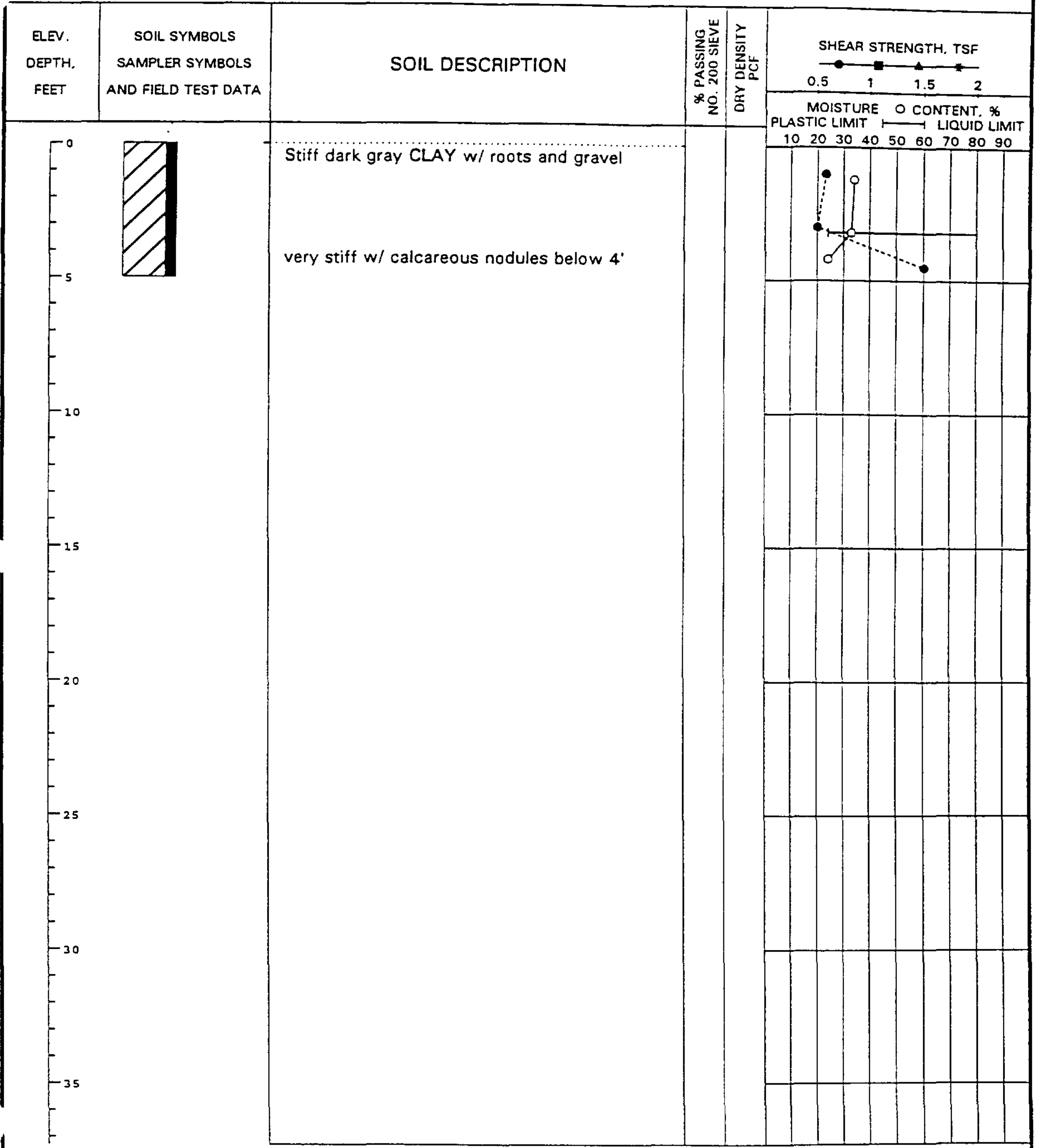
HVJ ASSOCIATES, INC.

LOG OF SOIL BORING

Project Name: Sugar Land Soccer Complex
Boring No.: B-4
Groundwater during drilling: none

Date: 02-09-98

Project No. 97-197G-00
Elevation: -



Stiff dark gray CLAY w/ roots and gravel

very stiff w/ calcareous nodules below 4'

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

See Plate 2 for boring location.

Plate 6

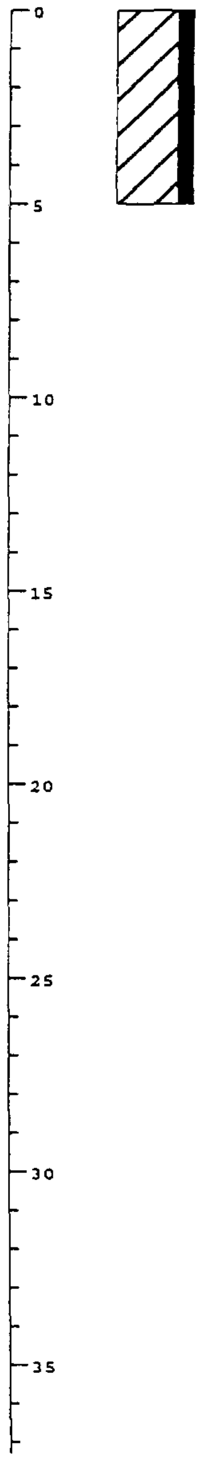
HVJ ASSOCIATES, INC.

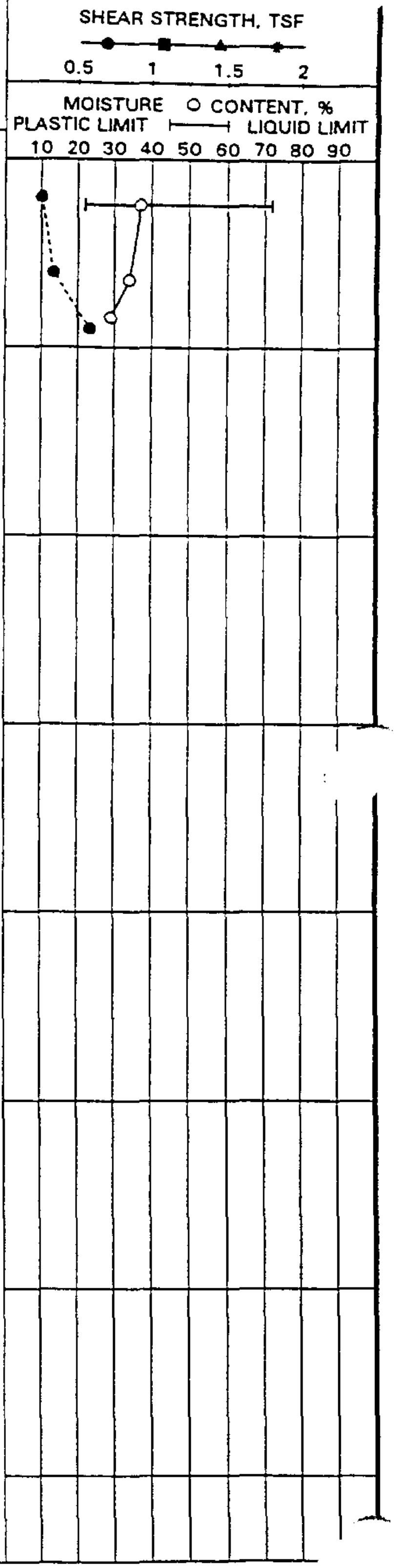
LOG OF SOIL BORING

Project Name: Sugar Land Soccer Complex
Boring No.: B-5
Date: 02-09-98
Groundwater during drilling: none

Project No. 97-197G-00
Elevation: -

ELEV. DEPTH, FEET	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	SOIL DESCRIPTION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF
0		Firm dark gray CLAY w/ roots		
		stiff below 4'		





Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

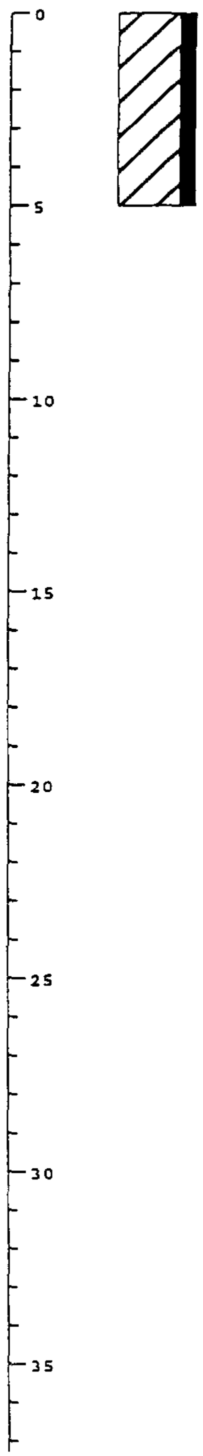
See Plate 2 for boring location.

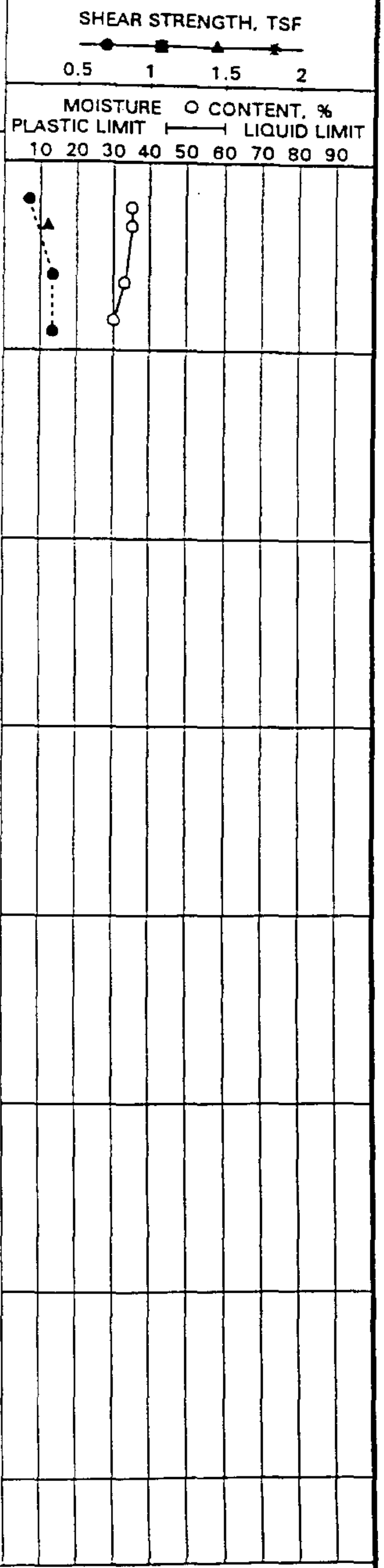
Plate 7

LOG OF SOIL BORING

Project Name: Sugar Land Soccer Complex
Boring No.: B-6
Date: 02-09-98
Groundwater during drilling: none
Project No. 97-197G-00
Elevation: -

ELEV. DEPTH, FEET	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	SOIL DESCRIPTION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF
		Firm dark gray CLAY w/ roots		86
		w/ calcareous nodules below 4'		





Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

See Plate 2 for boring location.

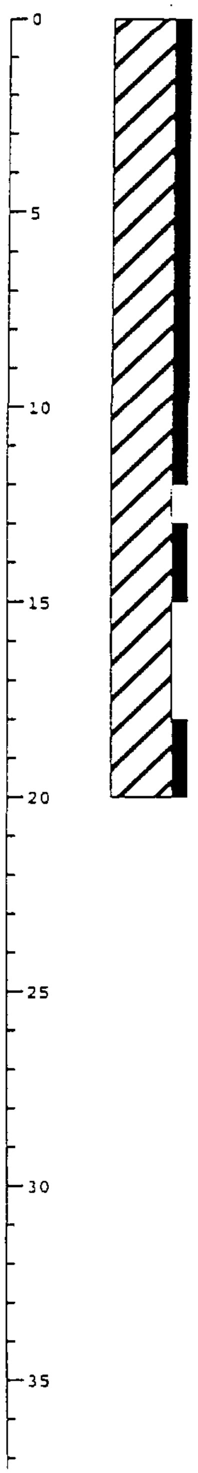
Plate 8

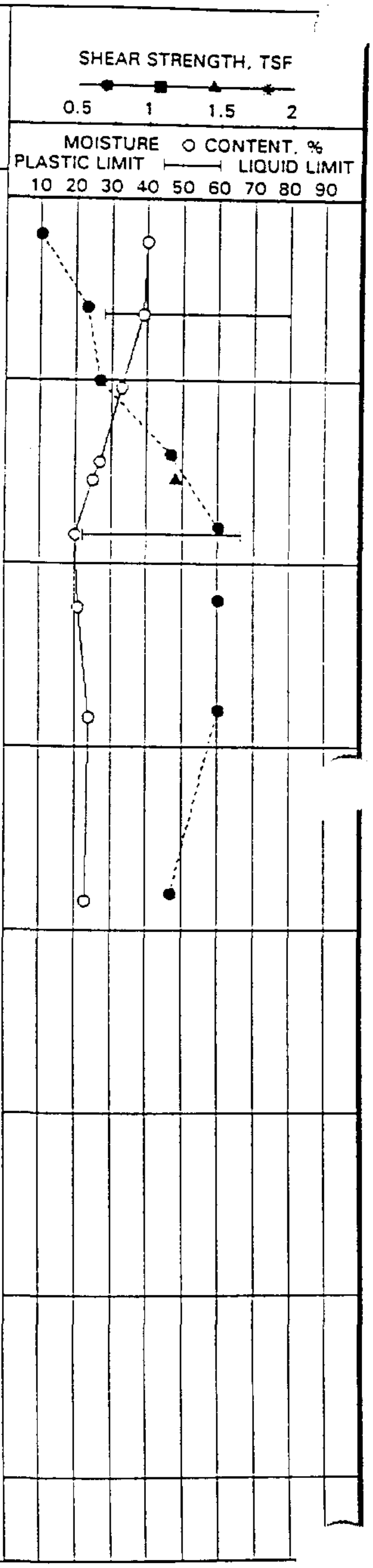
HVJ ASSOCIATES, INC.

LOG OF SOIL BORING

Project Name: Sugar Land Soccer Complex
Project No. 97-197G-00
Boring No.: B-7
Date: 02-09-98
Elevation: -
Groundwater during drilling: none

ELEV. DEPTH, FEET	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	SOIL DESCRIPTION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF
0		Firm dark gray CLAY w/ roots		
		stiff at 2'		
		very stiff light brown and reddish brown w/ calcareous deposits and nodules below 6'		
		reddish brown w/ ferrous nodules below 8'		104
		w/ slickensides below 10'		
		reddish brown and light gray below 18'		





Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

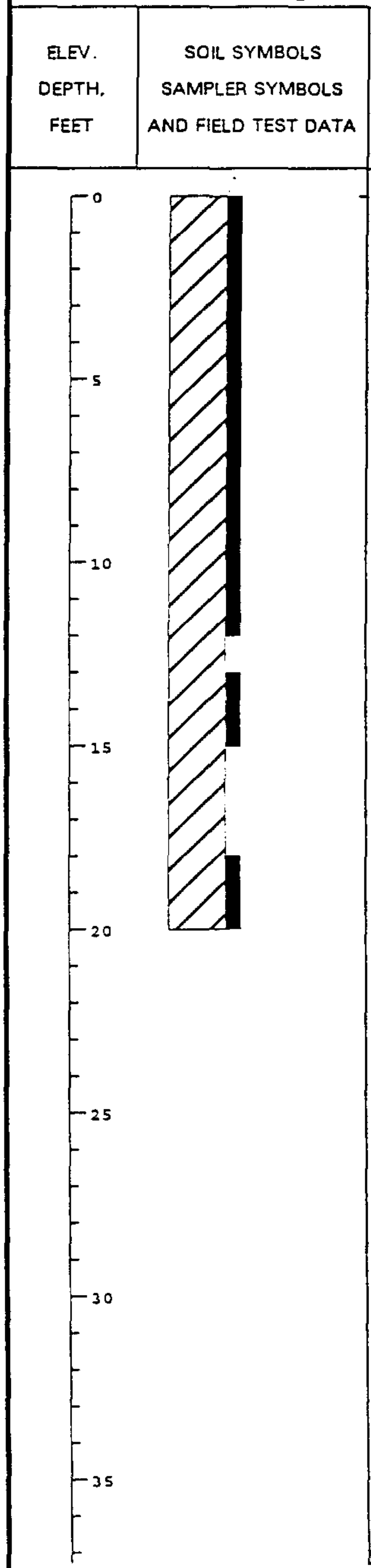
See Plate 2 for boring location.

Plate 9

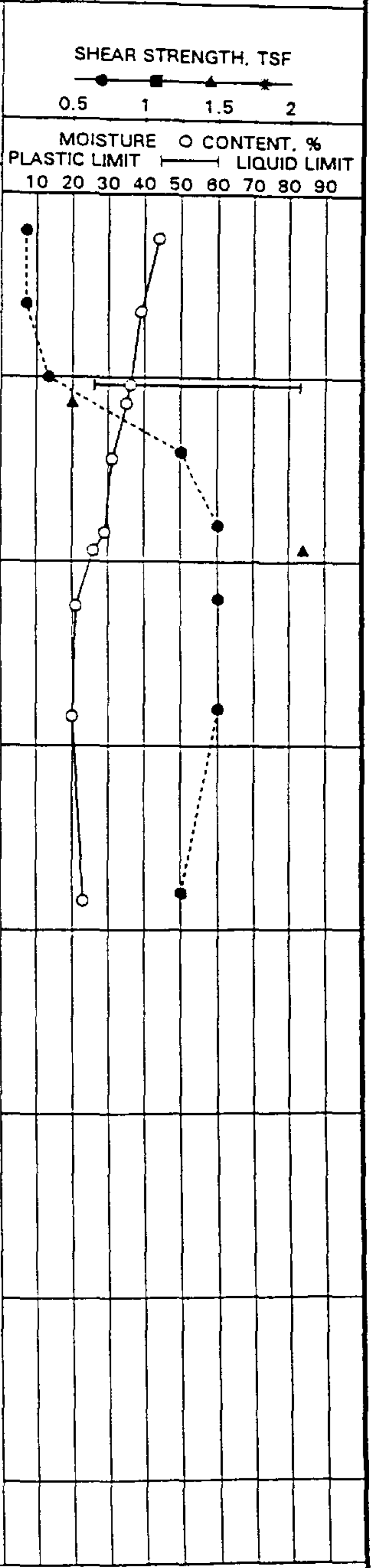
HVJ ASSOCIATES, INC.

LOG OF SOIL BORING

Project Name: Sugar Land Soccer Complex
Project No. 97-197G-00
Boring No.: B-8
Date: 02-09-98
Elevation: -
Groundwater during drilling: none



SOIL DESCRIPTION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF
Soft dark gray CLAY w/ roots		
stiff		
very stiff light brown and brownish yellow w/ calcareous nodules below 6'		89
hard reddish brown w/ ferrous stains below 8' and slickensides to 12'		101
very stiff reddish brown and light gray below 10'		

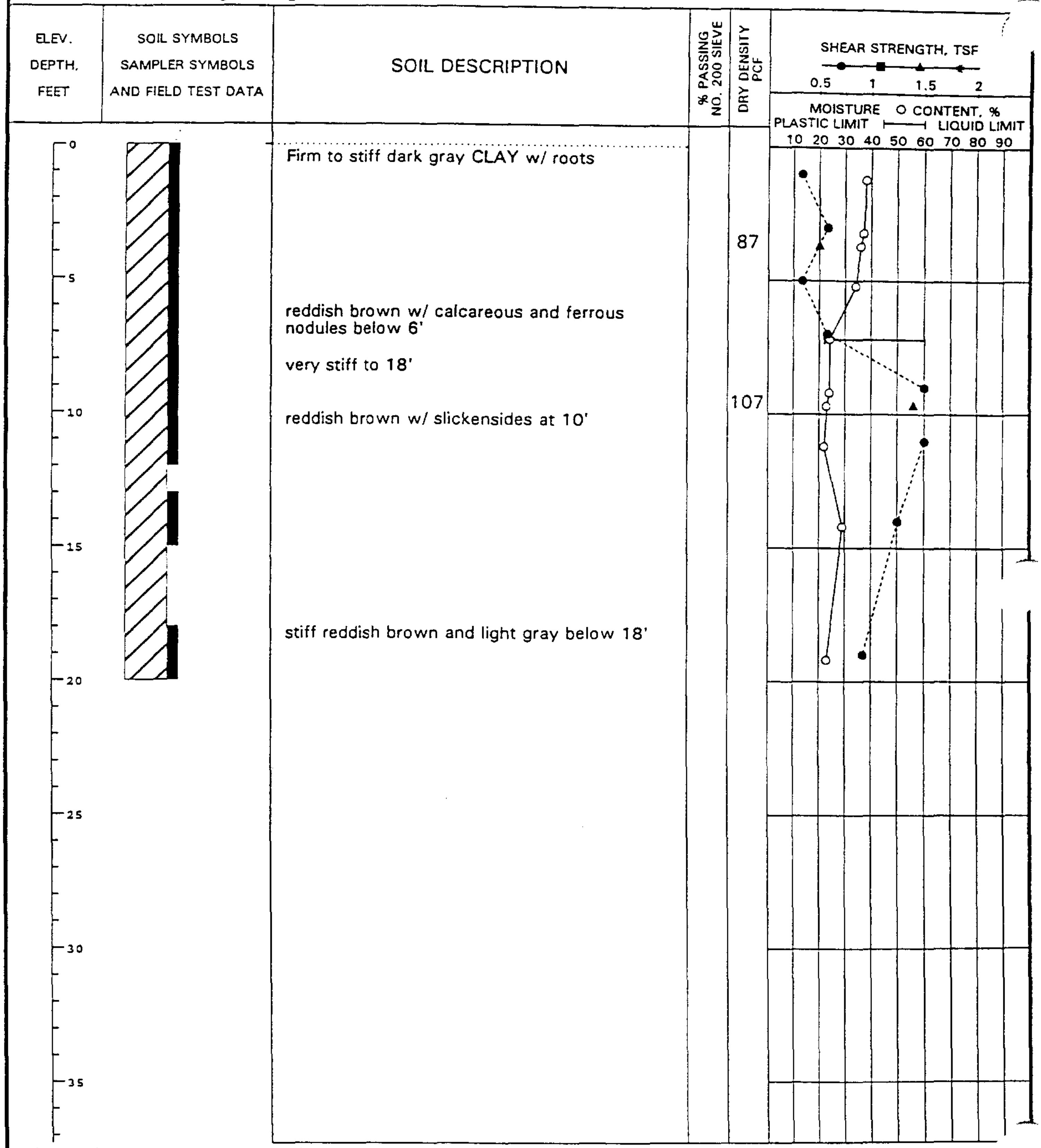


Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

See Plate 2 for boring location.

LOG OF SOIL BORING

Project Name: Sugar Land Soccer Complex
Boring No.: B-9
Date: 02-09-98
Groundwater during drilling: none
Project No. 97-197G-00
Elevation: -



Firm to stiff dark gray CLAY w/ roots

reddish brown w/ calcareous and ferrous nodules below 6'

very stiff to 18'

reddish brown w/ slickensides at 10'

stiff reddish brown and light gray below 18'

Dry Density, PCF
87
107

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

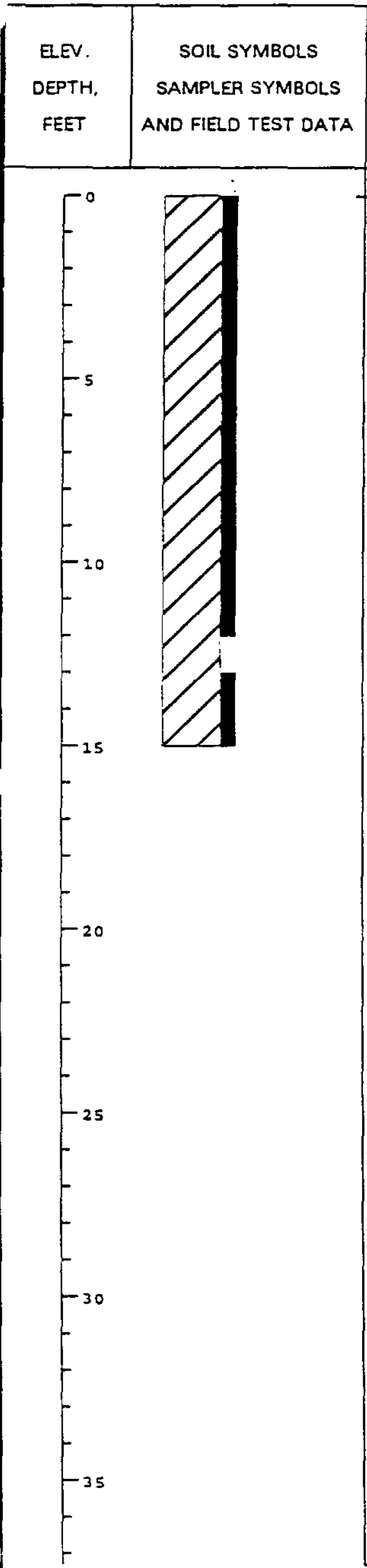
See Plate 2 for boring location.

Plate 11

HVJ ASSOCIATES, INC.

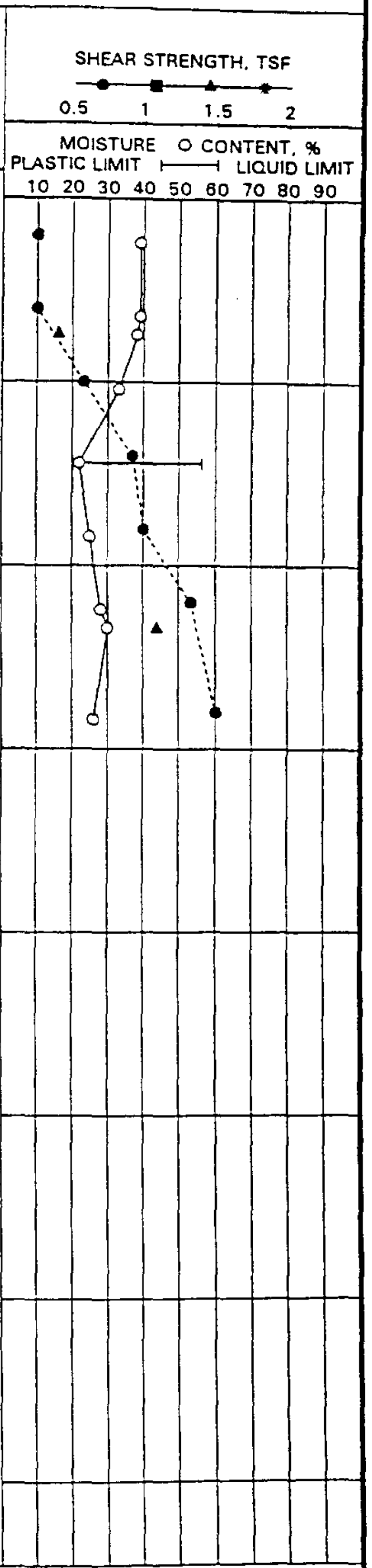
LOG OF SOIL BORING

Project Name: Sugar Land Soccer Complex
Project No. 97-197G-00
Boring No.: B-10
Date: 02-09-98
Elevation: -
Groundwater during drilling: none



SOIL DESCRIPTION

Depth	SOIL DESCRIPTION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF
0	Firm dark gray CLAY w/ roots		
			82
	stiff		
	reddish brown w/ calcareous and ferrous nodules below 6'		
	reddish brown and light gray below 8'		
	very stiff w/ slickensides below 10'		
			98



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

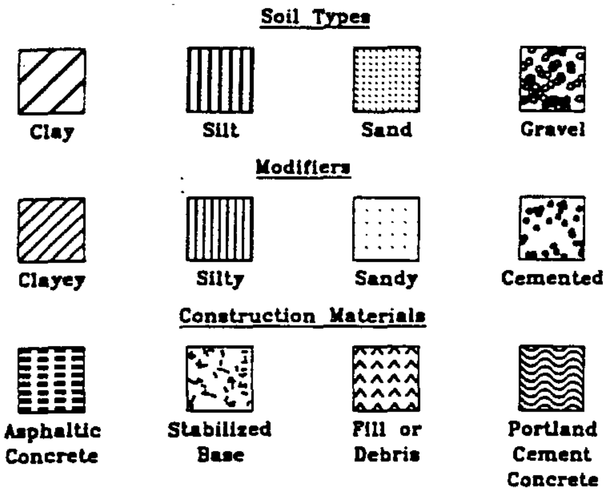
See Plate 2 for boring location.

Plate 12

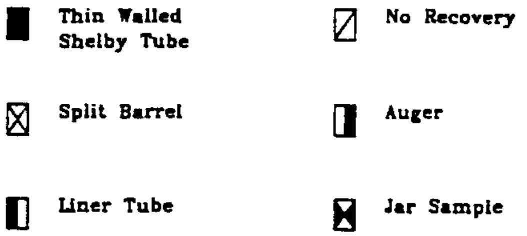
HVJ ASSOCIATES, INC.

KEY TO TERMS AND SYMBOLS USED ON BORING LOGS

SOIL SYMBOLS



SAMPLER TYPES



WATER LEVEL SYMBOLS

▽ Groundwater level determined during drilling operations

▼ Groundwater level after drilling in open borehole or piezometer

SOIL GRAIN SIZE

Classification	Particle Size	Particle Size or Sieve No. (U.S. Standard)
Clay	< 0.002 mm	< 0.002 mm
Silt	0.002 - 0.075 mm	0.002 mm - #200 sieve
Sand	0.075 - 4.75 mm	#200 sieve - #4 sieve
Gravel	4.75 - 75 mm	#4 sieve - 3 in.
Cobble	75 - 200 mm	3 in. - 8 in.
Boulder	> 200 mm	> 8 in.

DENSITY OF COHESIONLESS SOILS

Descriptive Term	Penetration Resistance "N" * Blows/Foot
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

CONSISTENCY OF COHESIVE SOILS

Consistency	Undrained Shear Strength (tsf)
Very Soft	0 - 0.125
Soft	0.125 - 0.25
Firm	0.25 - 0.5
Stiff	0.5 - 1.0
Very Stiff	1.0 - 2.0
Hard	> 2.0

PENETRATION RESISTANCE

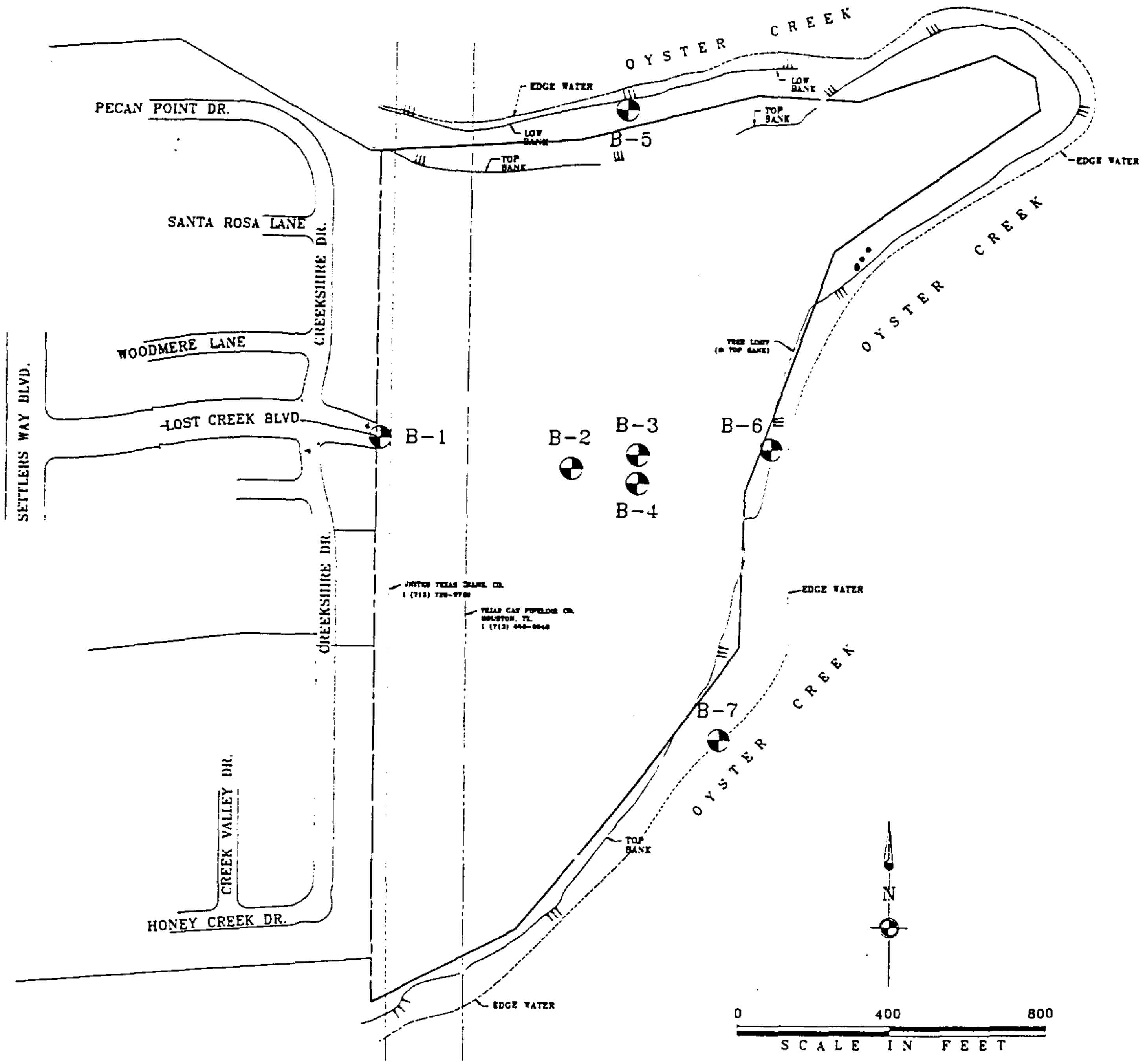
3/6	Blows required to penetrate each of three consecutive 6-inch increments per ASTM D-1586 *
50/4"	If more than 50 blows are required, driving is discontinued and penetration at 50 blows is noted
0/18"	Sampler penetrated full depth under weight of drill rods and hammer

* The N value is taken as the blows required to penetrate the final 12 inches

TERMS DESCRIBING SOIL STRUCTURE

Slickensided	Fracture planes appear polished or glossy, sometimes striated
Fissured	Breaks along definite planes of fracture with little resistance to fracturing
Inclusion	Small pockets of different soils, such as small lenses of sand scattered through a mass of clay
Parting	Inclusion less than 1/4 inch thick extending through the sample
Seam	Inclusion 1/4 inch to 3 inches thick extending through the sample
Layer	Inclusion greater than 3 inches thick extending through the sample
Laminated	Soil sample composed of alternating partings of different soil type
Stratified	Soil sample composed of alternating seams or layers of different soil type
Intermixed	Soil sample composed of pockets of different soil type and laminated or stratified structure is not evident
Calcareous	Having appreciable quantities of calcium carbonate
Ferrous	Having appreciable quantities of iron
Nodule	A small mass of irregular shape

REPORT NO. 10



LEGEND:

● APPROXIMATE BORING LOCATIONS

HVJ ASSOCIATES, INC.
GEOTECHNICAL ENGINEERS

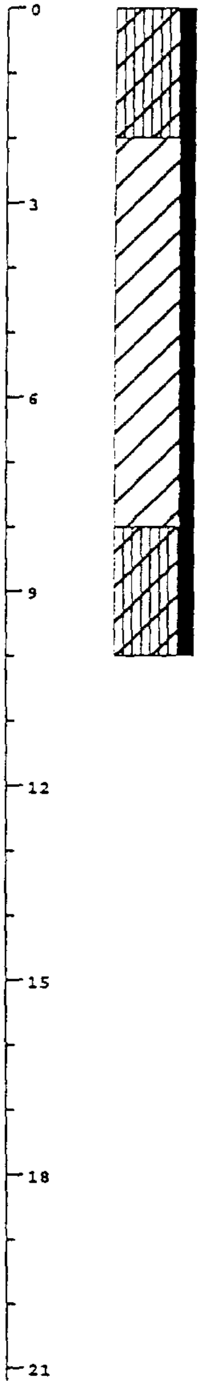
SCALE: 1"=400' DATE: 02/27/96	APPROVED BY: CO	PREPARED BY: EP

PLAN OF BORING
LOST CREEK PARK

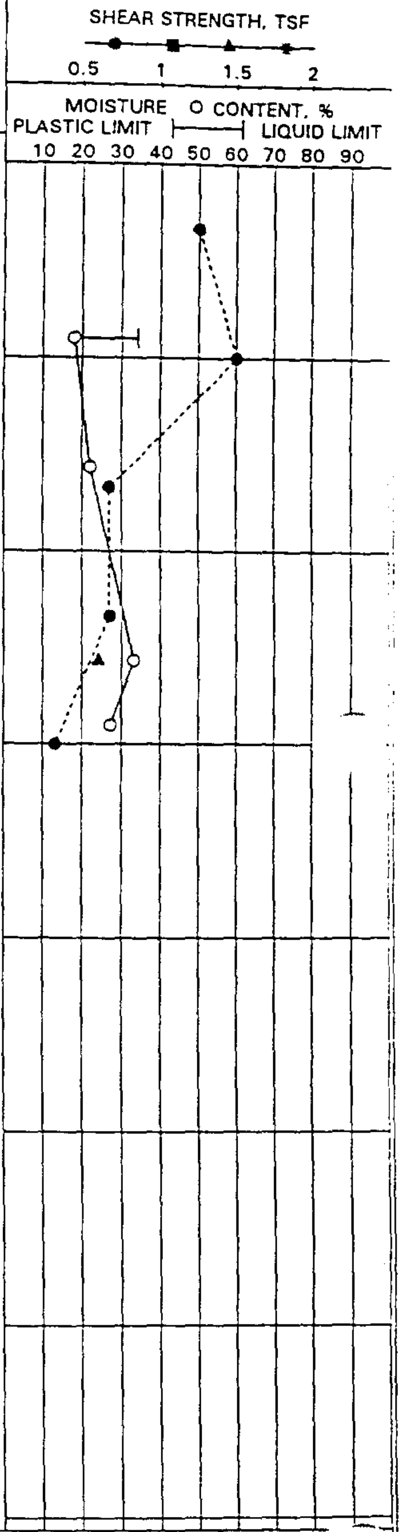
PROJECT NO. 95-217G-00	DRAWING NUMBER: PLATE 1

LOG OF SOIL BORING

Project Name: Lost Creek Park
Boring No.: B-1
Date: 02-13-96
Project No. 95-217G-0
Elevation: -
Groundwater during drilling: none



SOIL DESCRIPTION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF
Very stiff brown SILTY CLAY w/ sand inclusions w/ wood fragments and roots to 3'		
Stiff brown CLAY w/ silt partings, fragmented to 6'		88
Firm brown SILTY CLAY w/ sand inclusions		



Shear Types: ● =Hand Penet. ■ =Torvane ▲ =Unconf. Comp. ✱ =UU Triaxial

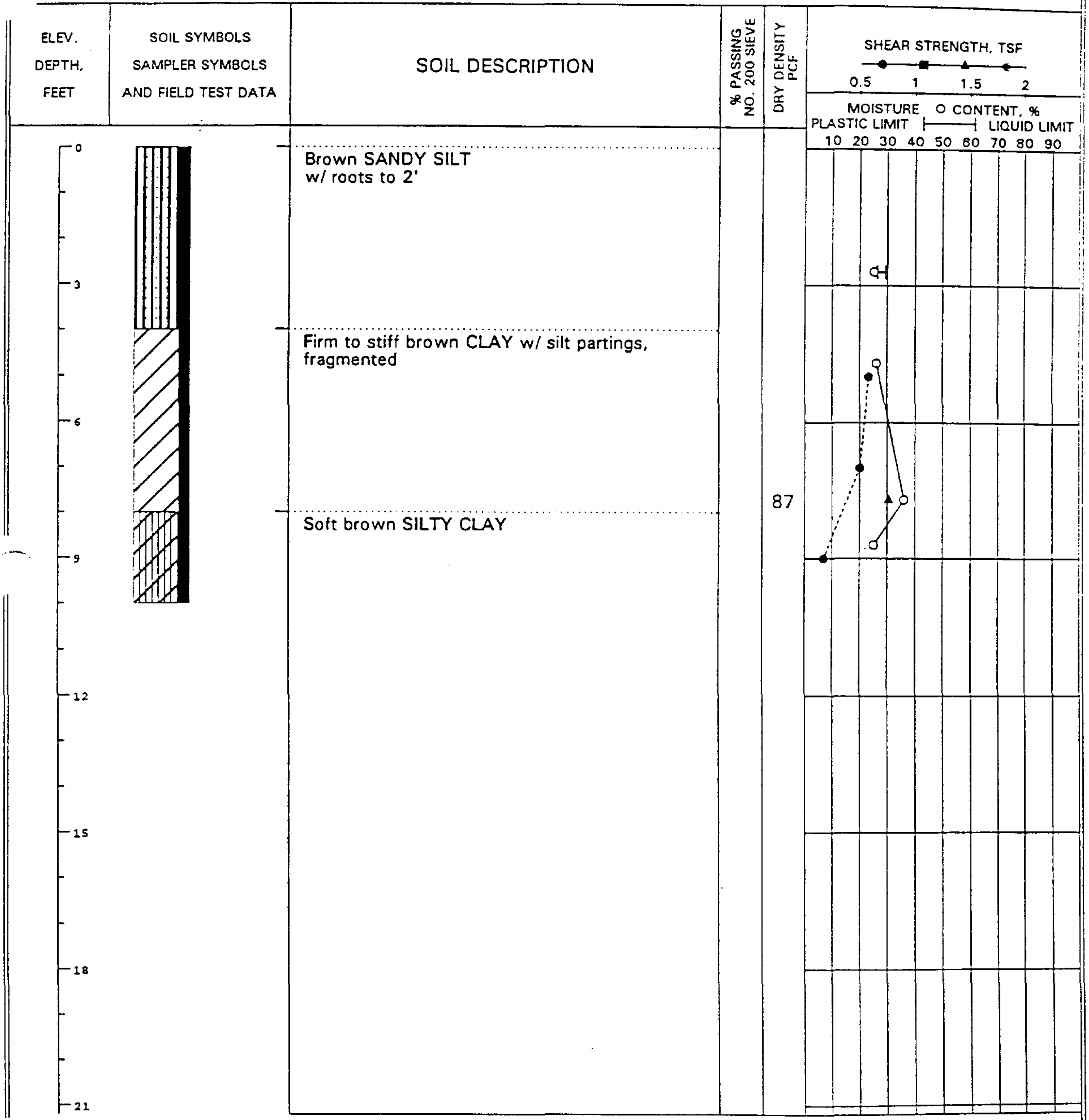
See Plate 1 for boring location.

Plate 2

HVJ ASSOCIATES, INC.

LOG OF SOIL BORING

Project Name: Lost Creek Park
Boring No.: B-2
Date: 02-13-96
Project No. 95-217G-00
Elevation: -
Groundwater during drilling: none



Brown SANDY SILT
w/ roots to 2'

Firm to stiff brown CLAY w/ silt partings, fragmented

Soft brown SILTY CLAY

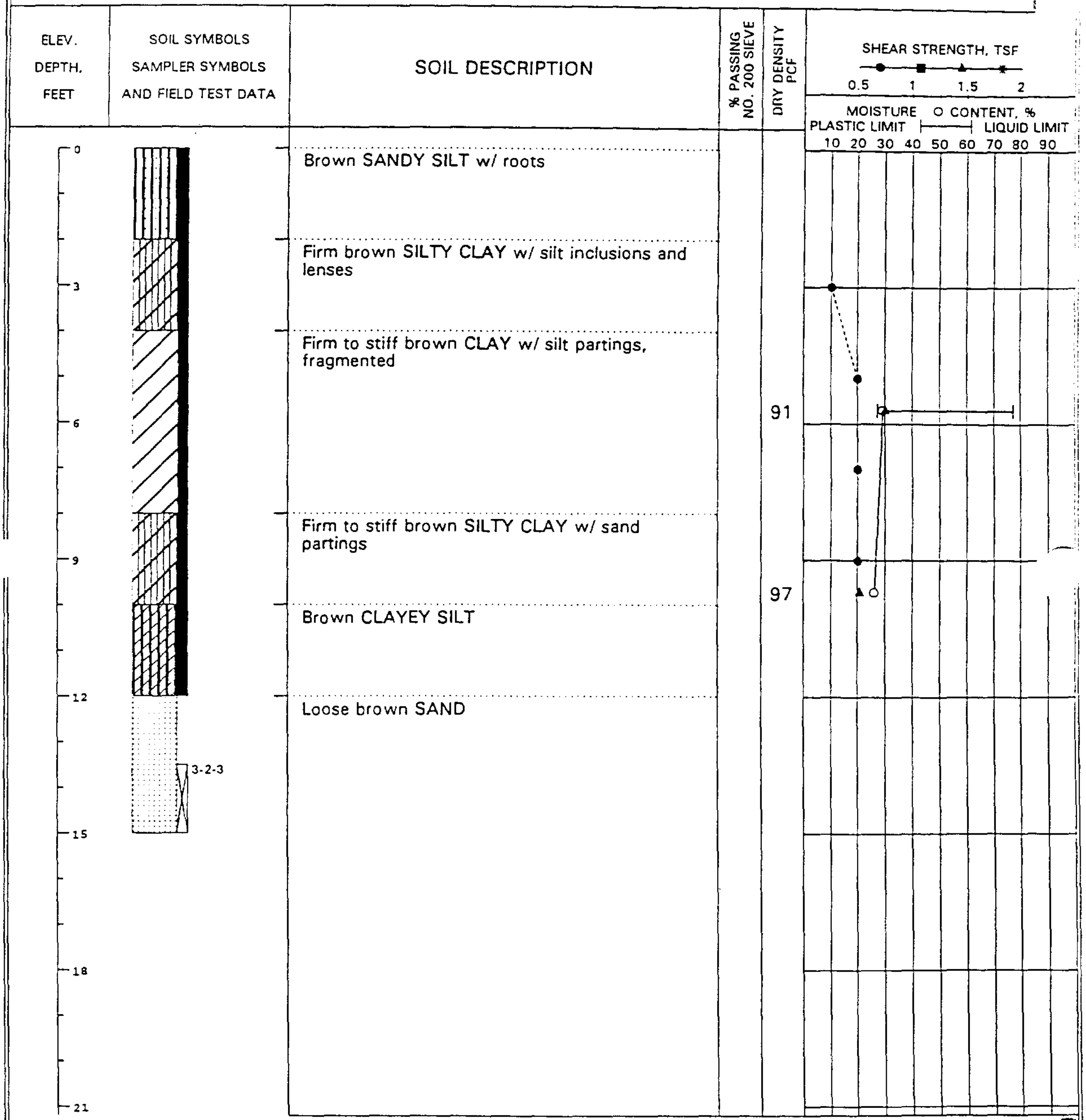
Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

See Plate 1 for boring location.

Plate 3

LOG OF SOIL BORING

Project Name: Lost Creek Park
Boring No.: B-3
Date: 02-13-96
Groundwater during drilling: none
Project No. 95-217G-00
Elevation: -



Brown SANDY SILT w/ roots

Firm brown SILTY CLAY w/ silt inclusions and lenses

Firm to stiff brown CLAY w/ silt partings, fragmented

91

Firm to stiff brown SILTY CLAY w/ sand partings

97

Brown CLAYEY SILT

Loose brown SAND

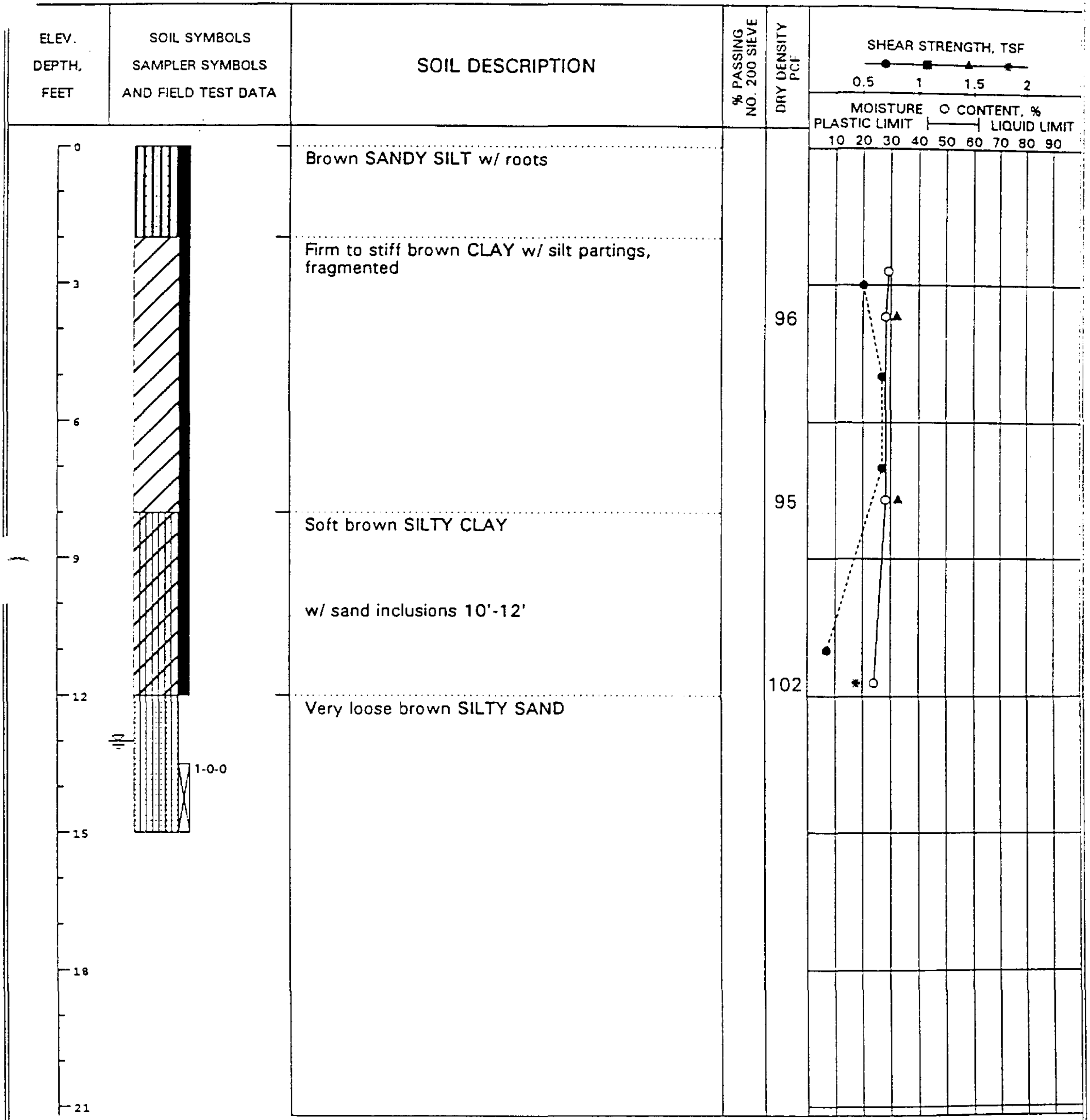
Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

See Plate 1 for boring location.

Plate 4

LOG OF SOIL BORING

Project Name: Lost Creek Park
Project No. 95-217G-00
Boring No.: B-4
Date: 02-13-96
Elevation: -
Groundwater during drilling: 13.0 feet



Brown SANDY SILT w/ roots

Firm to stiff brown CLAY w/ silt partings, fragmented

Soft brown SILTY CLAY

w/ sand inclusions 10'-12'

Very loose brown SILTY SAND

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

See Plate 1 for boring location.

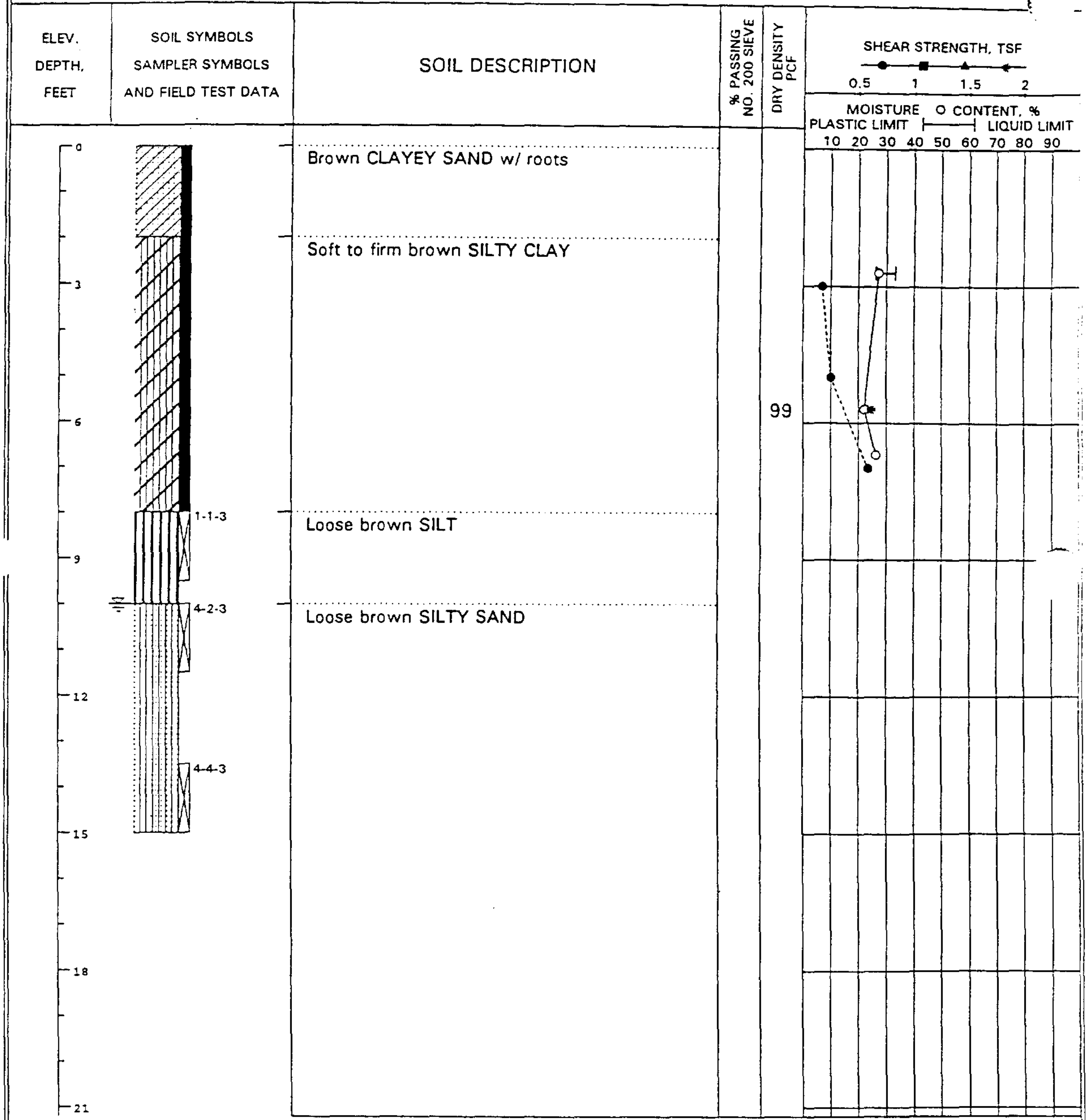
Plate 5

HVJ ASSOCIATES, INC.

LOG OF SOIL BORING

Project Name: Lost Creek Park
Boring No.: B-5
Date: 02-13-96
Groundwater during drilling: 10.0 feet

Project No. 95-217G-00
Elevation: -



Brown CLAYEY SAND w/ roots

Soft to firm brown SILTY CLAY

Loose brown SILT

Loose brown SILTY SAND

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

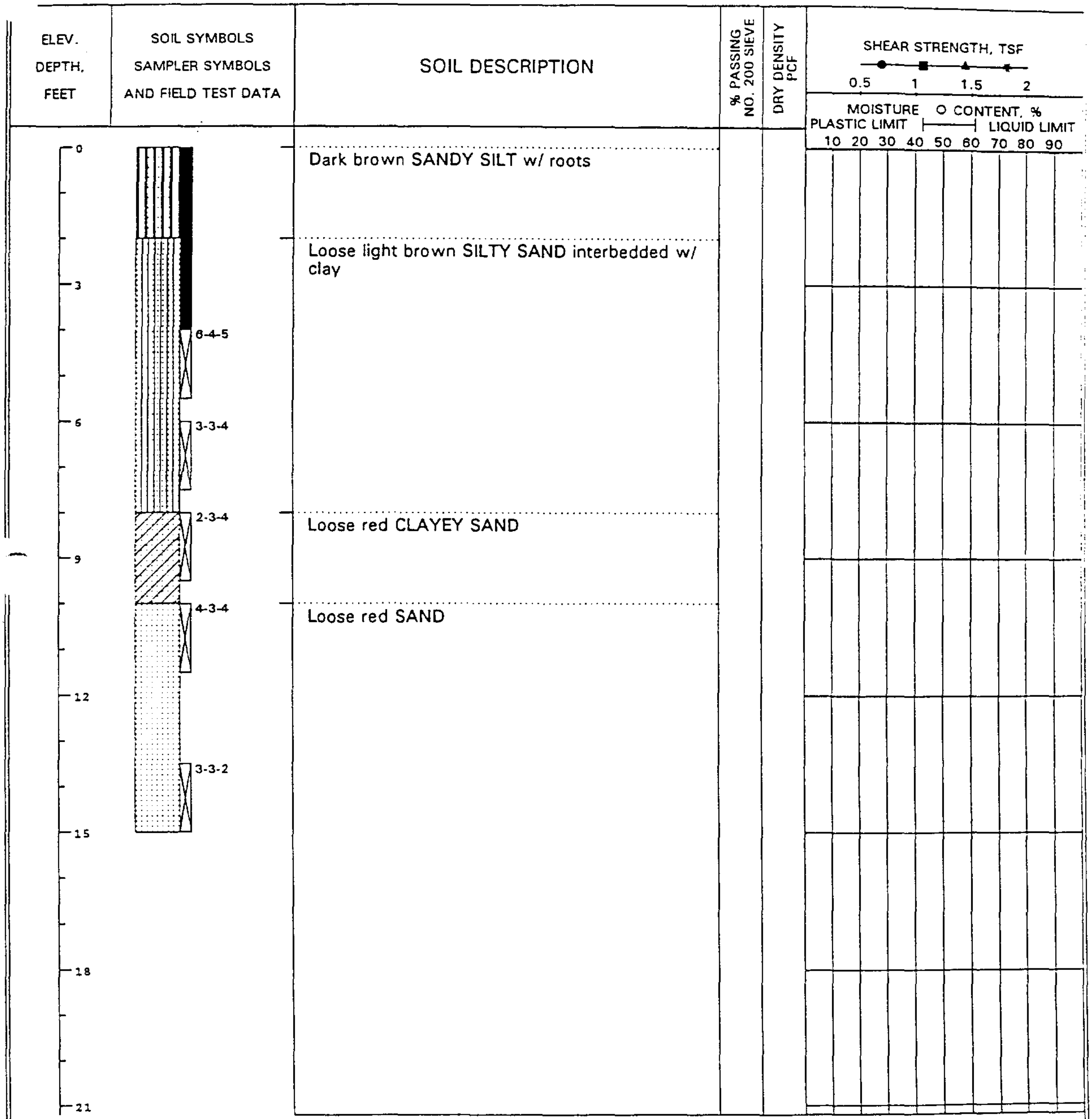
See Plate 1 for boring location.

Plate 6

HVJ ASSOCIATES, INC.

LOG OF SOIL BORING

Project Name: Lost Creek Park
Project No. 95-217G-00
Boring No.: B-6
Date: 02-13-96
Elevation: -
Groundwater during drilling: none



Dark brown SANDY SILT w/ roots

Loose light brown SILTY SAND interbedded w/ clay

Loose red CLAYEY SAND

Loose red SAND

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

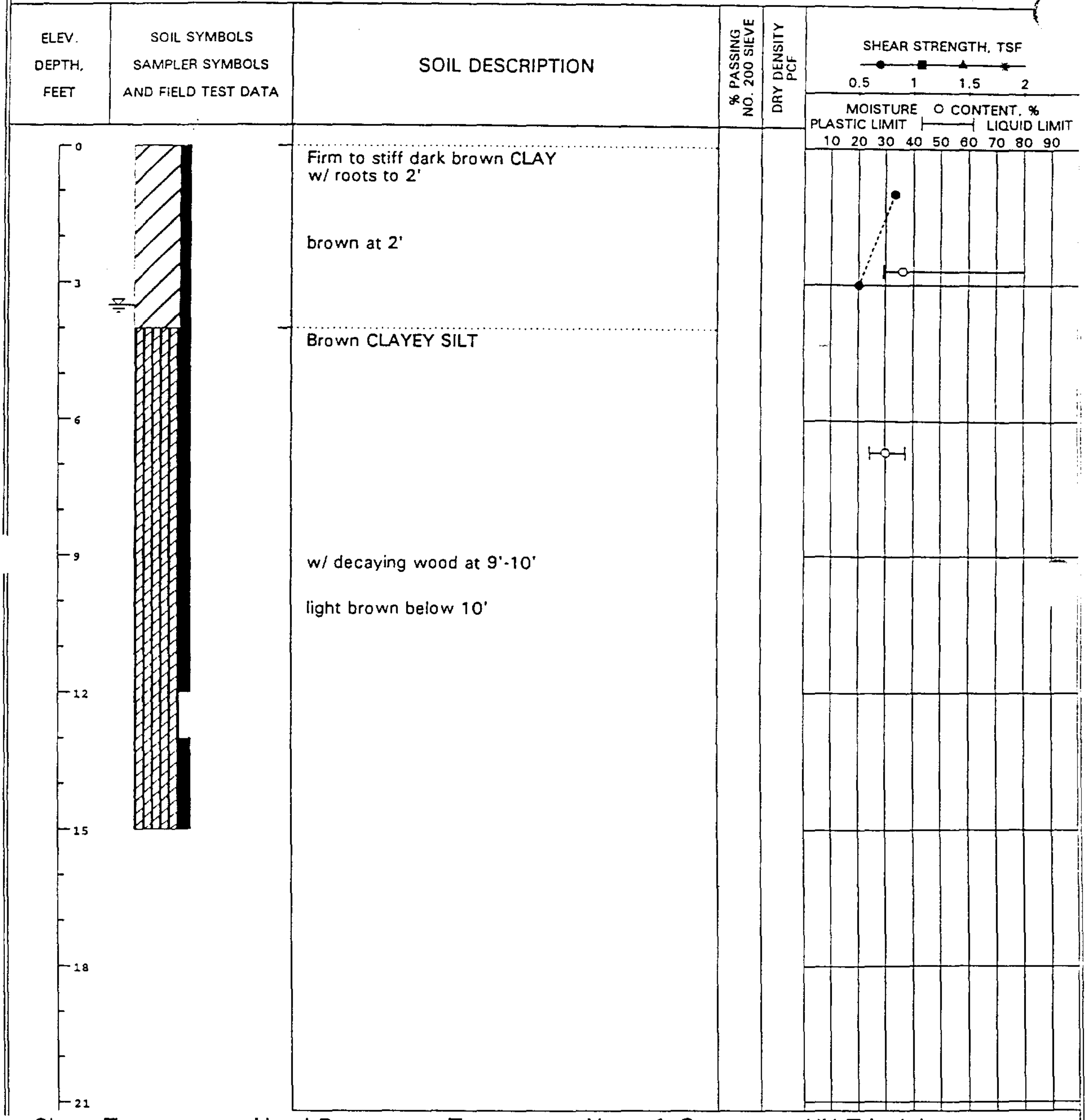
See Plate 1 for boring location.

Plate 7

LOG OF SOIL BORING

Project Name: Lost Creek Park
Boring No.: B-7 Date: 02-13-96
Groundwater during drilling: 3.5 feet

Project No. 95-217G-00
Elevation: -



Firm to stiff dark brown CLAY w/ roots to 2'

brown at 2'

Brown CLAYEY SILT

w/ decaying wood at 9'-10'

light brown below 10'

Shear Types: ● =Hand Penet. ■ =Torvane ▲ =Unconf. Comp. ✱ =UU Triaxial

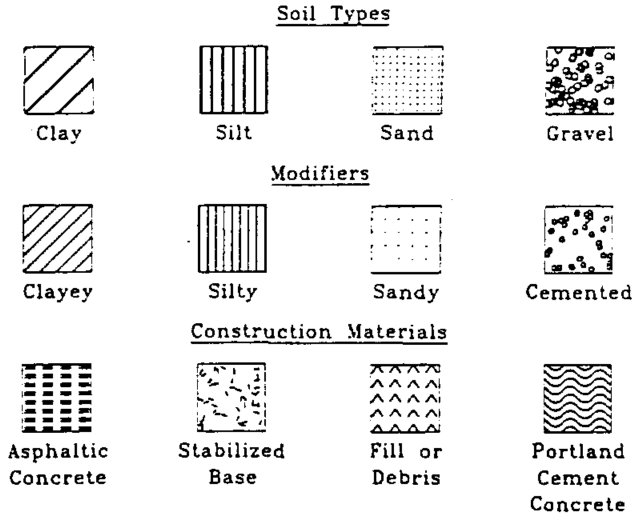
See Plate 1 for boring location.

Plate 8

HVJ ASSOCIATES, INC.

KEY TO TERMS AND SYMBOLS USED ON BORING LOGS

SOIL SYMBOLS



SAMPLER TYPES

■	Thin Walled Shelby Tube	▨	No Recovery
☒	Split Barrel	◨	Auger
◧	Liner Tube	◫	Rock Core

WATER LEVEL SYMBOLS

▽ Groundwater level determined during drilling operations

▼ Groundwater level after drilling in open borehole or piezometer

SOIL GRAIN SIZE

Classification	Particle Size	Particle Size or Sieve No. (U.S. Standard)
Clay	< 0.002 mm	< 0.002 mm
Silt	0.002 - 0.075 mm	0.002 mm - #200 sieve
Sand	0.075 - 4.75 mm	#200 sieve - #4 sieve
Gravel	4.75 - 75 mm	#4 sieve - 3 in.
Cobble	75 - 200 mm	3 in. - 8 in.
Boulder	> 200 mm	> 8 in.

DENSITY OF COHESIONLESS SOILS

Descriptive Term	Penetration Resistance "N" * Blows/Foot
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

CONSISTENCY OF COHESIVE SOILS

Consistency	Undrained Shear Strength (tsf)
Very Soft	0 - 0.125
Soft	0.125 - 0.25
Firm	0.25 - 0.5
Stiff	0.5 - 1.0
Very Stiff	1.0 - 2.0
Hard	> 2.0

PENETRATION RESISTANCE

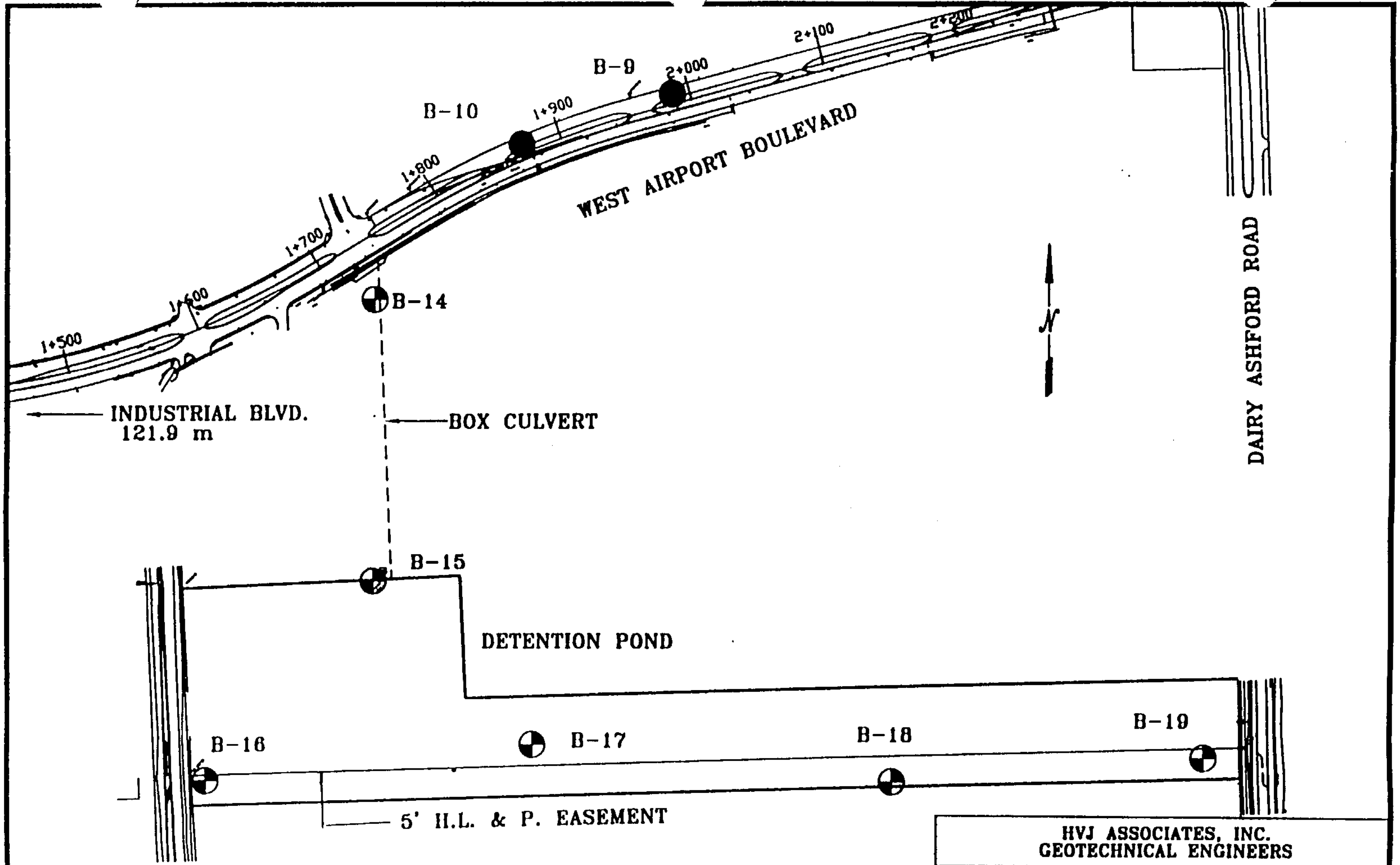
3-10-15	Blows required to penetrate three consecutive 6-inch increments per ASTM D-1586 *
50/4"	If more than 50 blows are required, driving is discontinued and penetration at 50 blows is noted
0/18"	Sampler penetrated full depth under weight of drill rods and hammer

* The N value is taken as the blows required to penetrate the final 12 inches

TERMS DESCRIBING SOIL STRUCTURE

Slickensided	Fracture planes appear polished or glossy, sometimes striated
Fissured	Breaks along definite planes of fracture with little resistance to fracturing
Inclusion	Small pockets of different soils, such as small lenses of sand scattered through a mass of clay
Parting	Inclusion less than 1/4 inch thick extending through the sample
Seam	Inclusion 1/4 inch to 3 inches thick extending through the sample
Layer	Inclusion greater than 3 inches thick extending through the sample
Laminated	Soil sample composed of alternating partings of different soil type
Stratified	Soil sample composed of alternating seams or layers of different soil type
Intermixed	Soil sample composed of pockets of different soil type and laminated or stratified structure is not evident
Calcareous	Having appreciable quantities of calcium carbonate
Ferrous	Having appreciable quantities of iron
Nodule	A small mass of irregular shape

REPORT NO. 11



LEGEND:

◐ APPROXIMATE BORING LOCATIONS

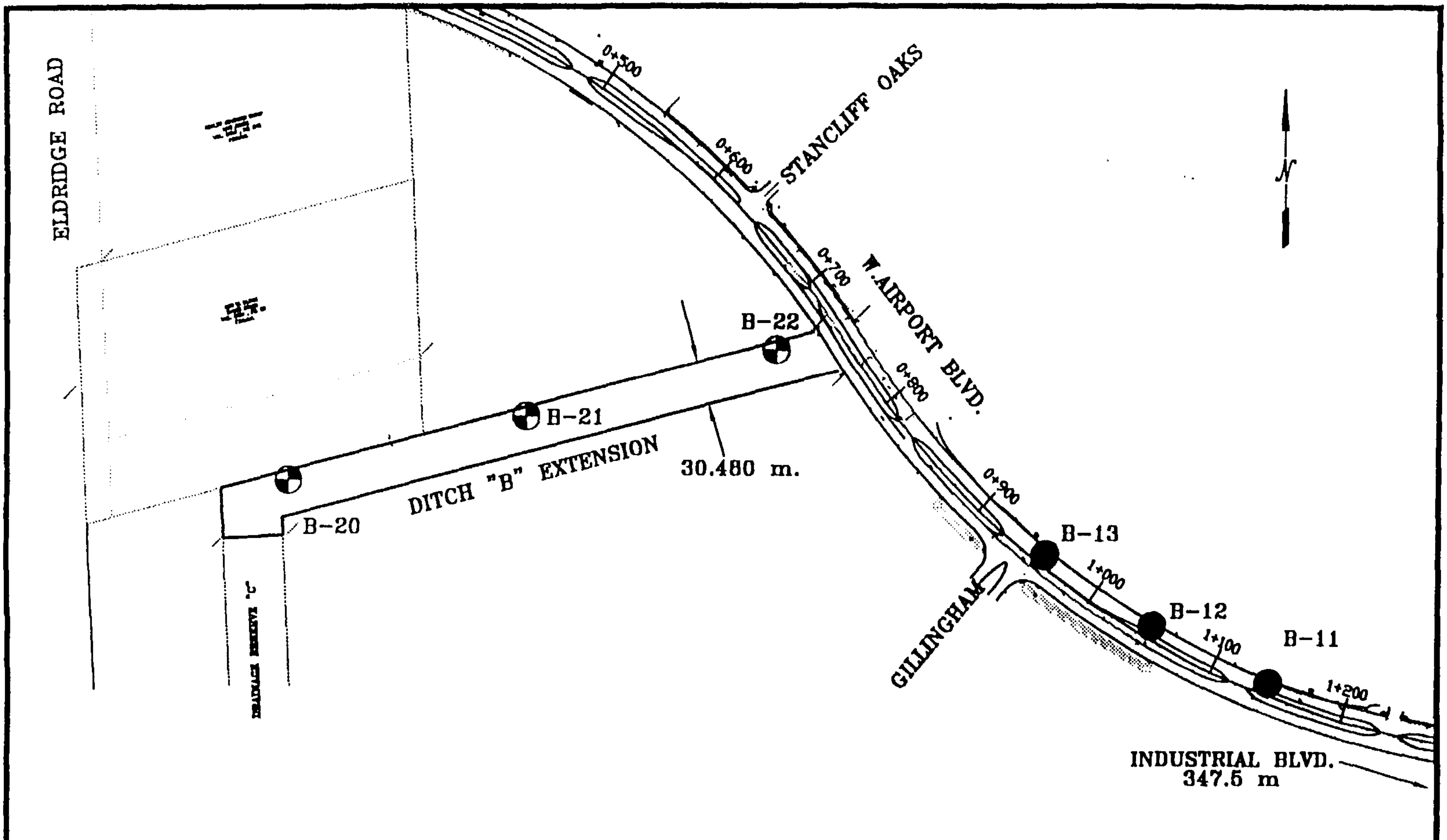
● APPROXIMATE BORING LOCATIONS FROM PREVIOUS INVESTIGATION
(HVJ PROJECT NO. 95-184G-00)

HVJ ASSOCIATES, INC.
GEOTECHNICAL ENGINEERS

SCALE: 1cm ≈ 40m
DATE: 07/22/97
APPROVED BY: PGA
PREPARED BY: DY

PLAN OF BORINGS
PROPOSED DETENTION POND
WEST AIRPORT DRAINAGE

PROJECT NO. 95-184G-01
DRAWING NUMBER: PLATE A-1



LEGEND:

- ◒ APPROXIMATE BORING LOCATIONS
- ● APPROXIMATE BORING LOCATIONS FROM PREVIOUS INVESTIGATION (HVJ PROJECT NO. 95-184G-00)

HVJ ASSOCIATES, INC.
GEOTECHNICAL ENGINEERS

SCALE: 1cm ≈ 40m
DATE: 07/22/97
APPROVED BY: PGA
PREPARED BY: DY

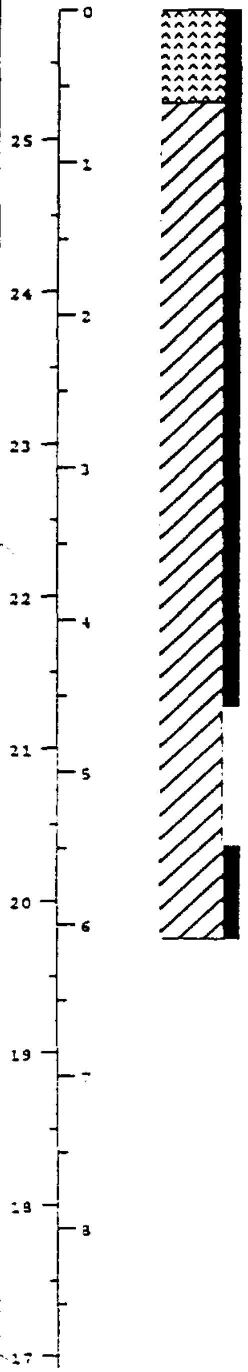
PLAN OF BORINGS
DITCH "B" EXTENSION
WEST AIRPORT DRAINAGE

PROJECT NO. 95-184G-01
DRAWING NUMBER: PL 1-2

LOG OF SOIL BORING

Project Name: W. Airport
Boring No.: B-9
Date: 07-23-96
Groundwater during drilling: none
Northing: 4206371.527 m
Easting: 929034.404 m
Project No. 95-184G-00
Elevation: 25.85 m
Station: 1+987.57 m
Offset: 7.458 m L

ELEV. DEPTH, METERS | SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA | SOIL DESCRIPTION | % PASSING NO. 200 SIEVE | DRY DENSITY kg/cu. m



Fill: very stiff dark gray clay w/ roots

Very stiff dark gray CLAY

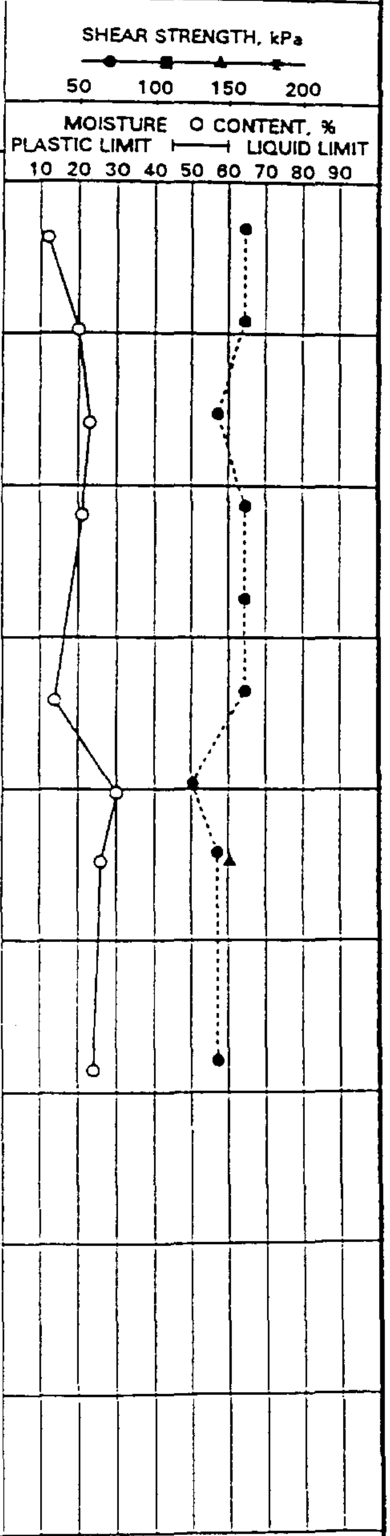
w/ ferrous deposits at 1.524 m

w/ calcareous deposits 1.829 m - 3.658 m

gray and brown at 2.134 m

reddish brown w/ calcareous deposits below 3.048 m

1618



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✦ = UU Triaxial

See Appendix C for boring location.

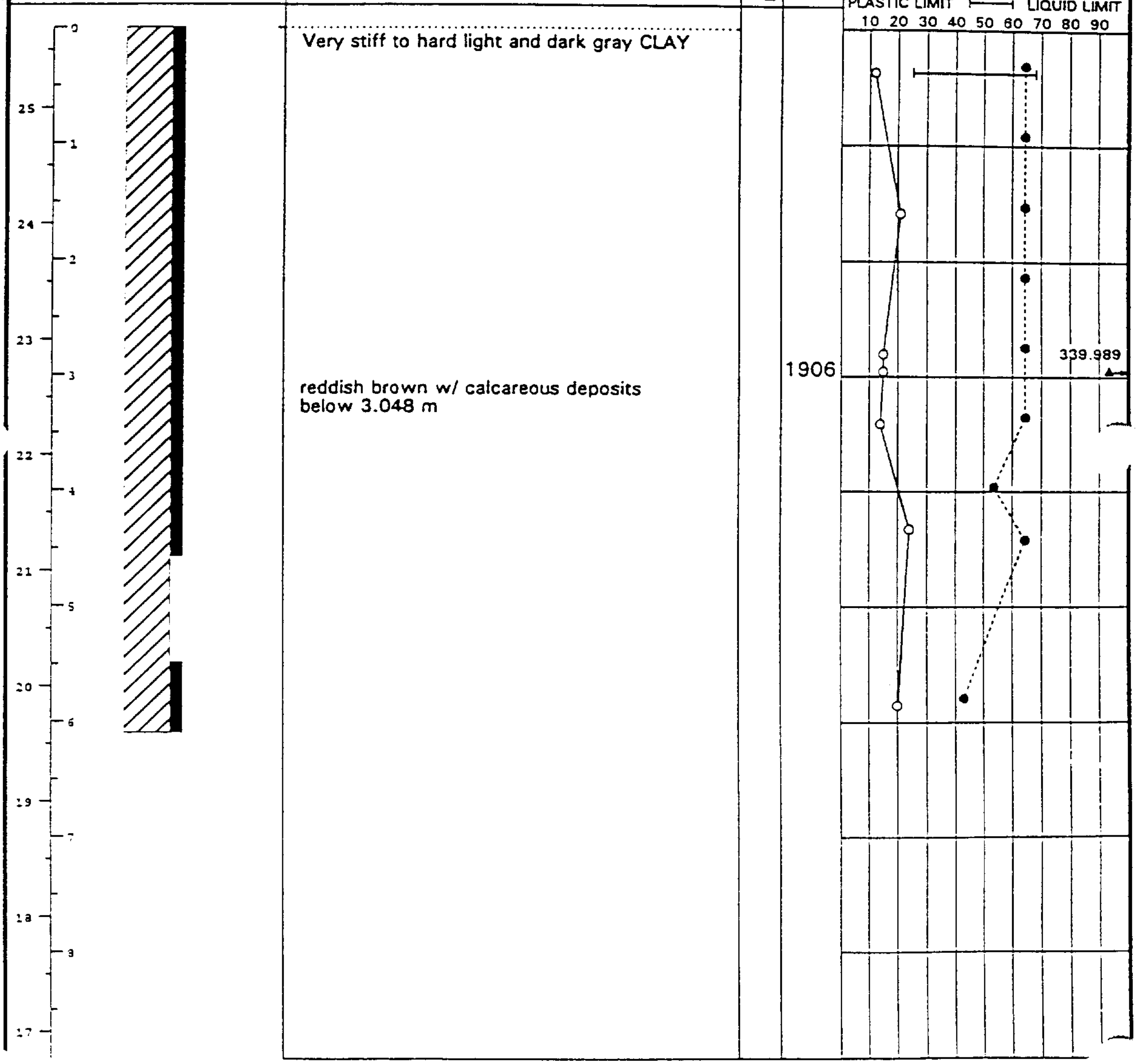
Plate C-1

HVJ ASSOCIATES, INC.

LOG OF SOIL BORING

Project Name: W. Airport
Boring No.: B-10
Date: 07-23-96
Groundwater during drilling: none
Northing: 4206335.266 m
Easting: 928923.777 m
Project No. 95-184G-00
Elevation: 25.70 m
Station: 1+872.00 m
Offset: 6.621 m L

ELEV. DEPTH, METERS	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	SOIL DESCRIPTION	% PASSING NO. 200 SIEVE	DRY DENSITY kg/cu. m	SHEAR STRENGTH, kPa 50 100 150 200 / MOISTURE ○ CONTENT, % PLASTIC LIMIT ├─┤ LIQUID LIMIT 10 20 30 40 50 60 70 80 90
		Very stiff to hard light and dark gray CLAY			
		reddish brown w/ calcareous deposits below 3.048 m		1906	



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✦ = UU Triaxial

See Appendix C for boring location.

Plate C-2

HVJ ASSOCIATES, INC.

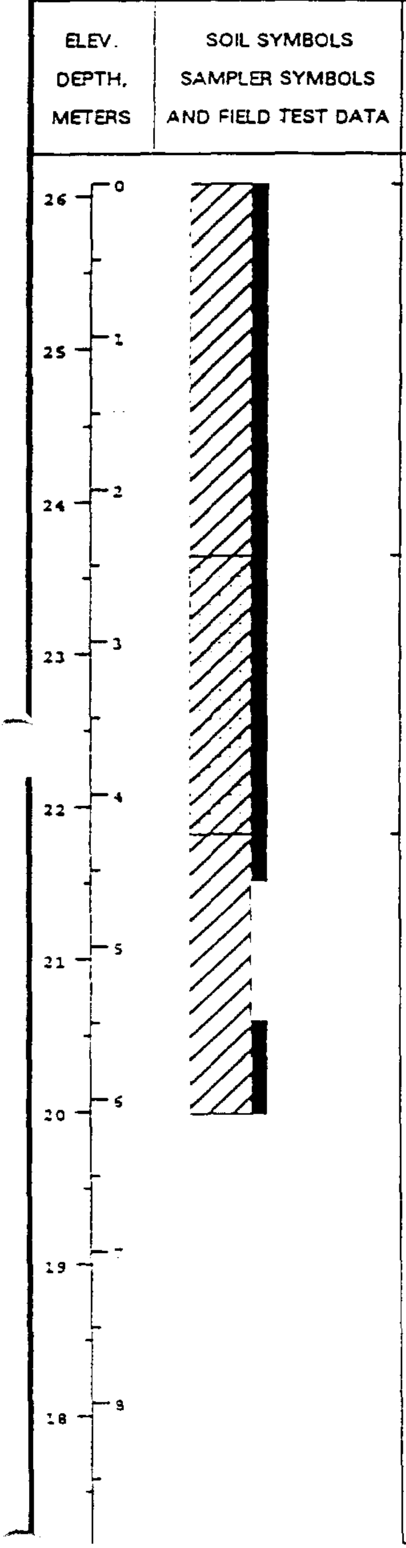
LOG OF SOIL BORING

Project Name: W. Airport
Boring No.: B-11
Groundwater during drilling: none

Date: 07-23-96

Northing: 4206205.301 m
Easting: 928243.323 m

Project No. 95-184G-00
Elevation: 26.09 m
Station: 1 + 142.45 m
Offset: 9.619 m L



SOIL DESCRIPTION

Very stiff dark gray CLAY
w/ roots to 0.610 m

gray and brown w/ calcareous nodules and
ferrous deposits at 1.524 m

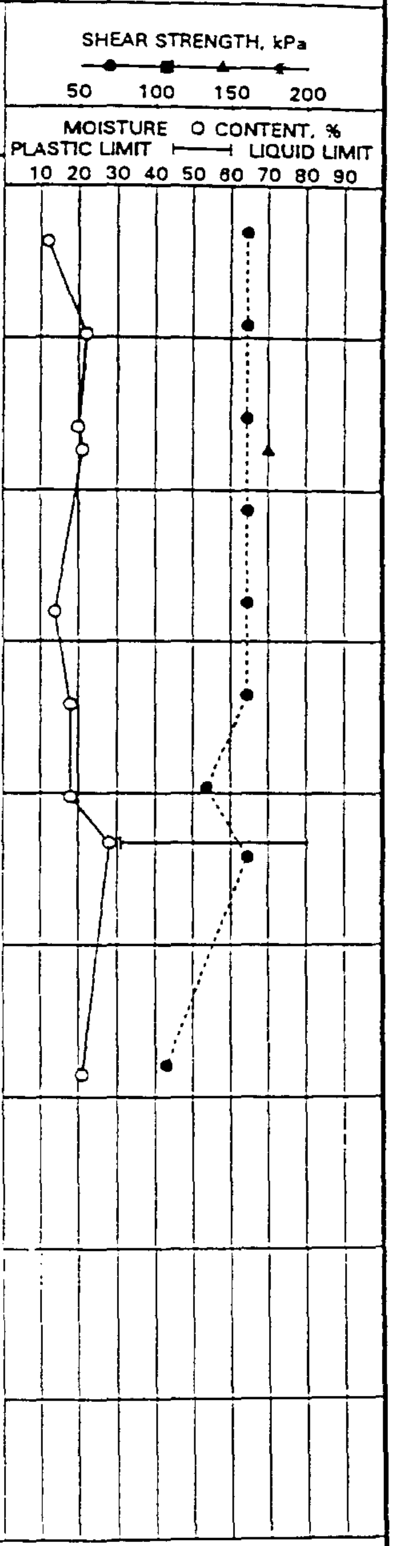
Very stiff light gray and brownish yellow
SANDY CLAY

w/ sand layer at 3.962 m

Stiff to very stiff reddish brown and light
gray CLAY

% PASSING NO. 200 SIEVE

DRY DENSITY kg/cu. m: 1730



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✦ = UU Triaxial

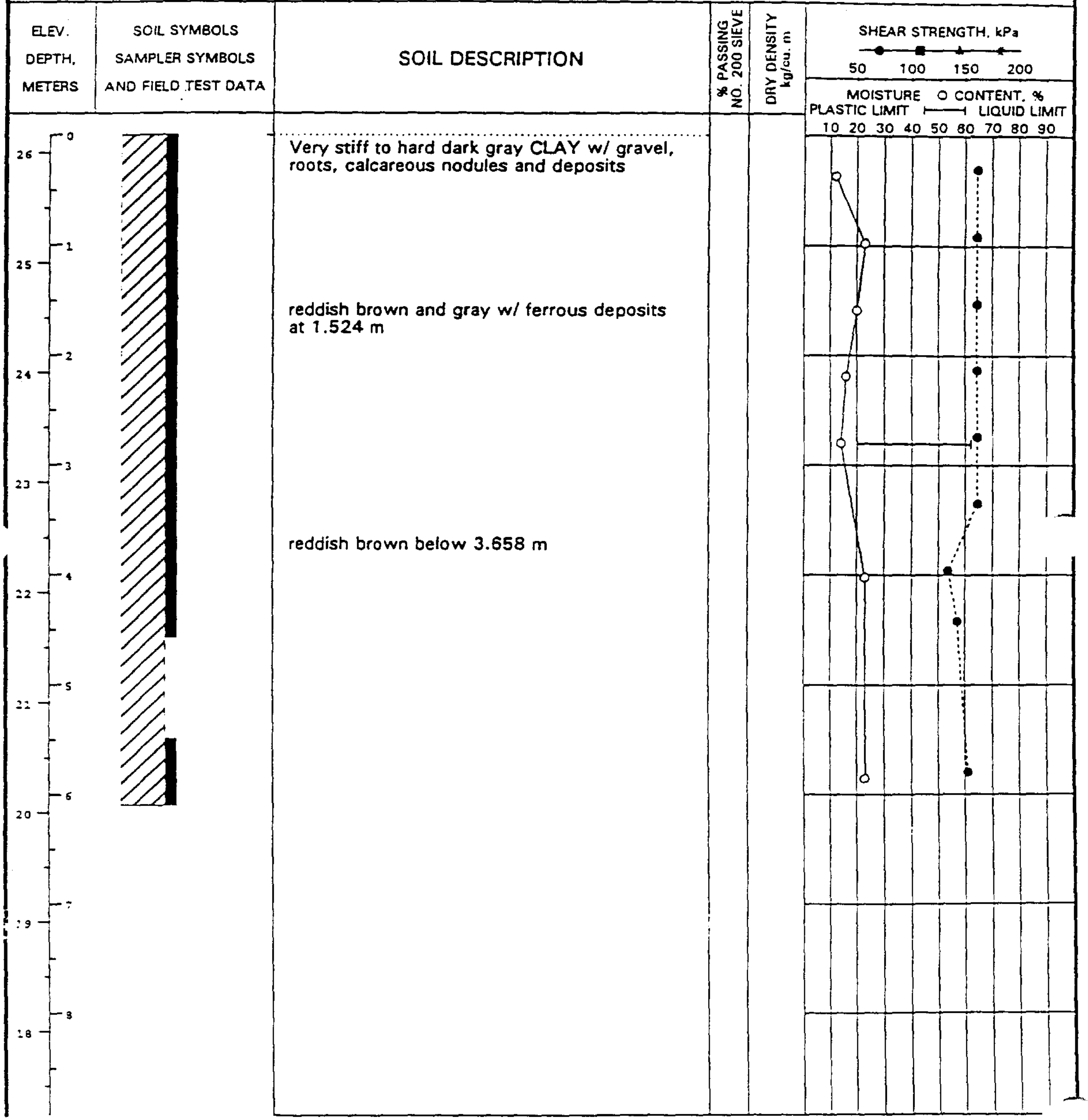
See Appendix C for boring location.

Plate C-3

HVJ ASSOCIATES, INC.

LOG OF SOIL BORING

Project Name: W. Airport
Boring No.: B-12
Date: 07-23-96
Groundwater during drilling: none
Northing: 4206245.578 m
Easting: 928159.833 m
Project No. 95-184G-00
Elevation: 26.17 m
Station: 1+048.12 m
Offset: 10.320 m L



Very stiff to hard dark gray CLAY w/ gravel, roots, calcareous nodules and deposits

reddish brown and gray w/ ferrous deposits at 1.524 m

reddish brown below 3.658 m

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ◆ = UU Triaxial

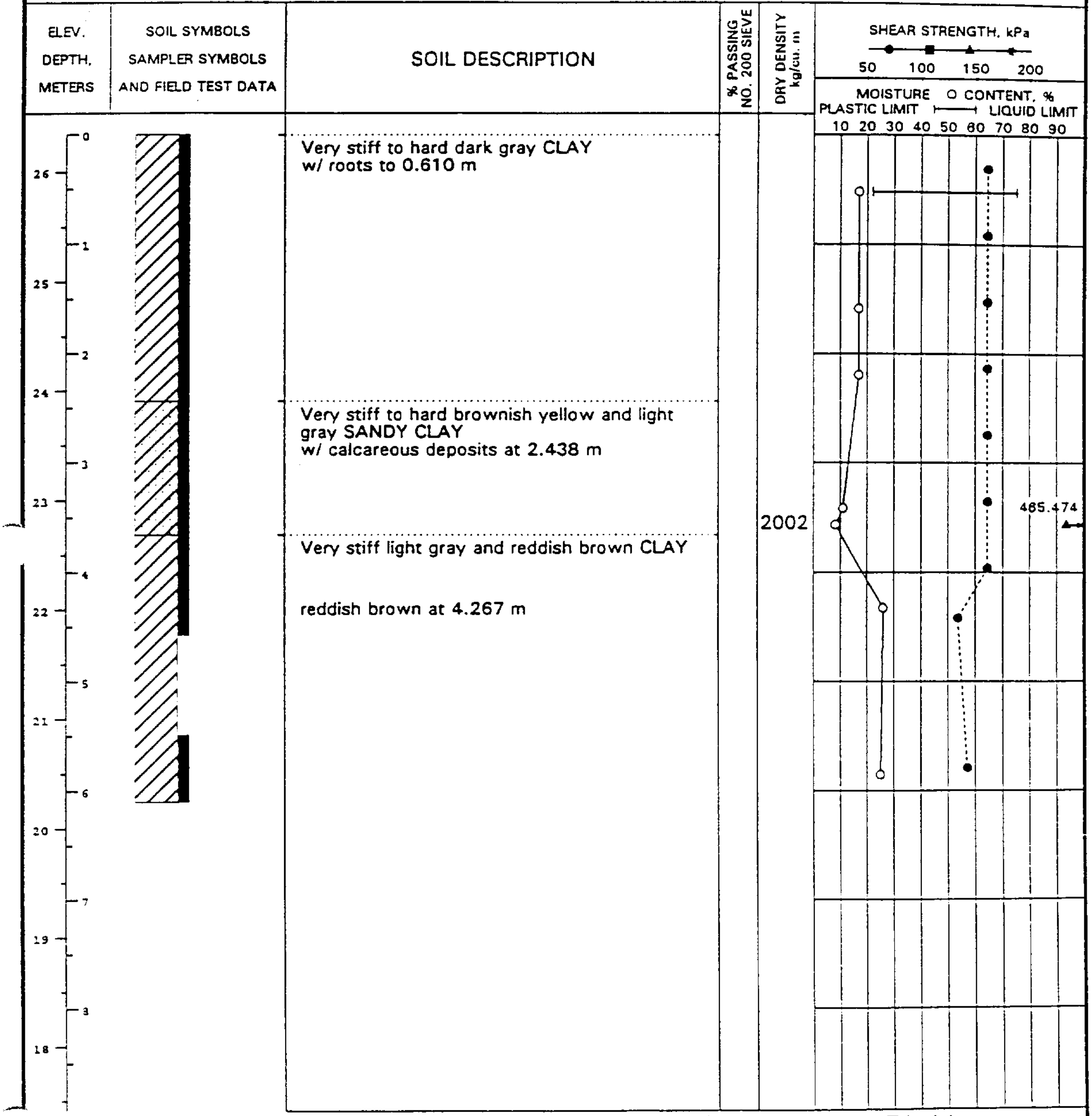
See Appendix C for boring location.

Plate C-4

HVJ ASSOCIATES, INC.

LOG OF SOIL BORING

Project Name: W. Airport
Boring No.: B-13
Date: 07-23-96
Groundwater during drilling: none
Northing: 4206295.867 m
Easting: 928083.029 m
Project No. 95-184G-00
Elevation: 26.35 m
Station: 0+954.77 m
Offset: 8.832 m L



Very stiff to hard dark gray CLAY
w/ roots to 0.610 m

Very stiff to hard brownish yellow and light gray SANDY CLAY
w/ calcareous deposits at 2.438 m

2002

Very stiff light gray and reddish brown CLAY

reddish brown at 4.267 m

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✦ = UU Triaxial

See Appendix C for boring location.

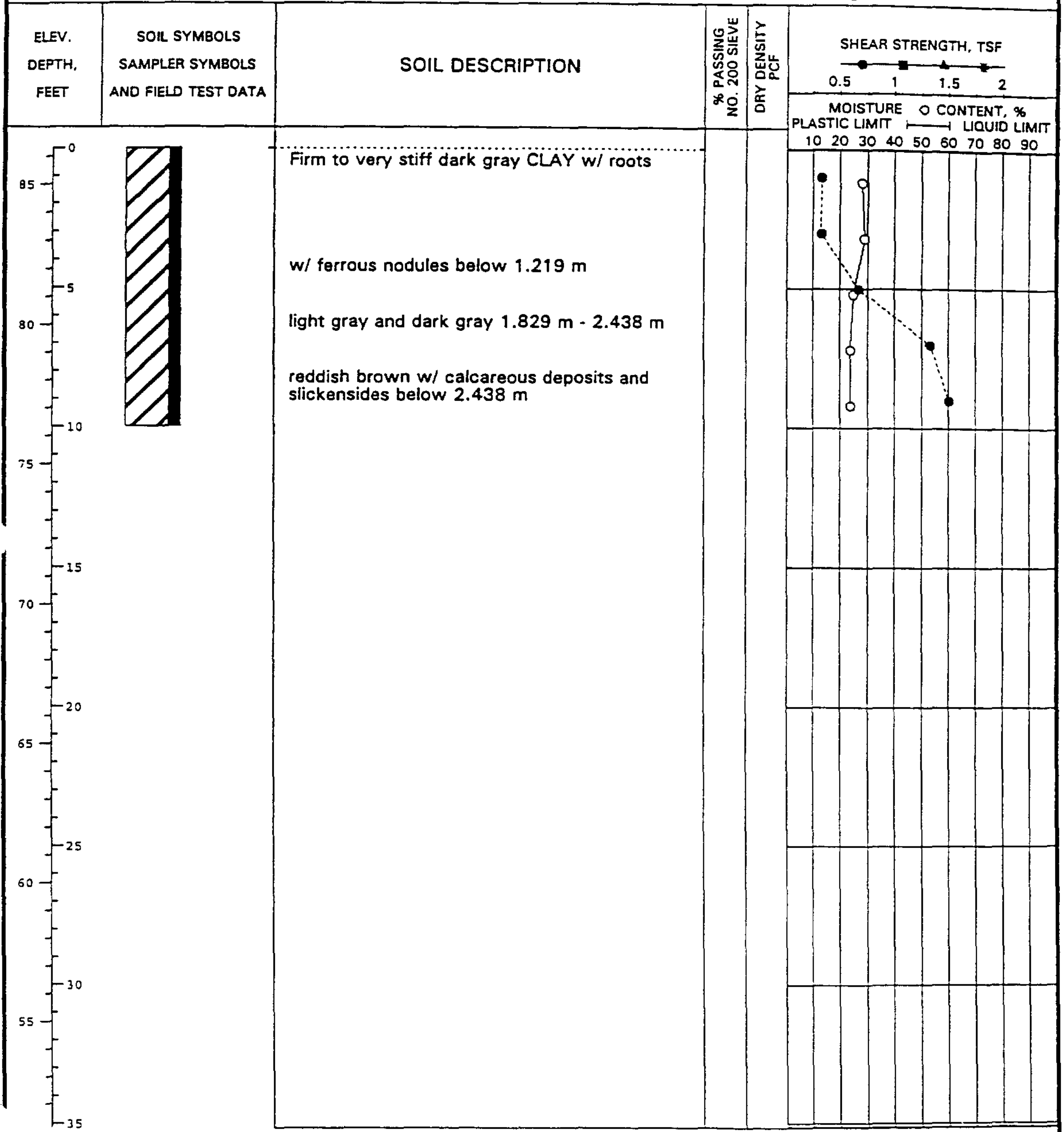
Plate C-5

HVJ ASSOCIATES, INC.

LOG OF SOIL BORING

Project Name: Proposed Detention Pond
Boring No.: B-14 Date: 06-12-97
Groundwater during drilling: none

Project No. 95-184G-01
Elevation: 86.32 feet
Northing: 4206225.471
Easting: 928825.522



Firm to very stiff dark gray CLAY w/ roots

w/ ferrous nodules below 1.219 m

light gray and dark gray 1.829 m - 2.438 m

reddish brown w/ calcareous deposits and slickensides below 2.438 m

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

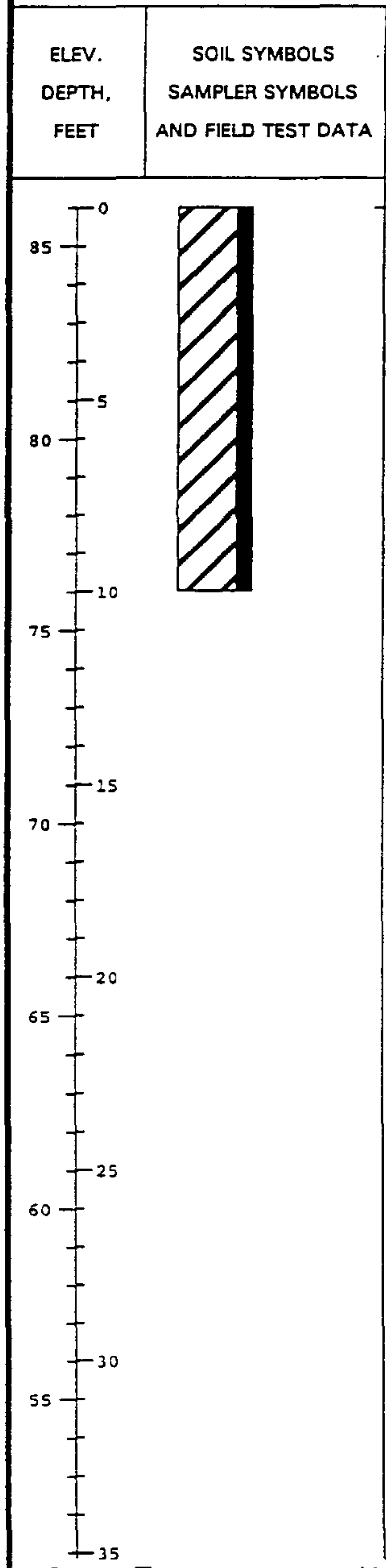
See Appendix A for boring location. Plate B-1

HVJ ASSOCIATES, INC.

LOG OF SOIL BORING

Project Name: Proposed Detention Pond
Boring No.: B-15 Date: 06-12-97
Groundwater during drilling: none

Project No. 95-184G-01
Elevation: 86.02 feet
Northing: 4206020.181
Easting: 928815.889



SOIL DESCRIPTION

% PASSING NO. 200 SIEVE

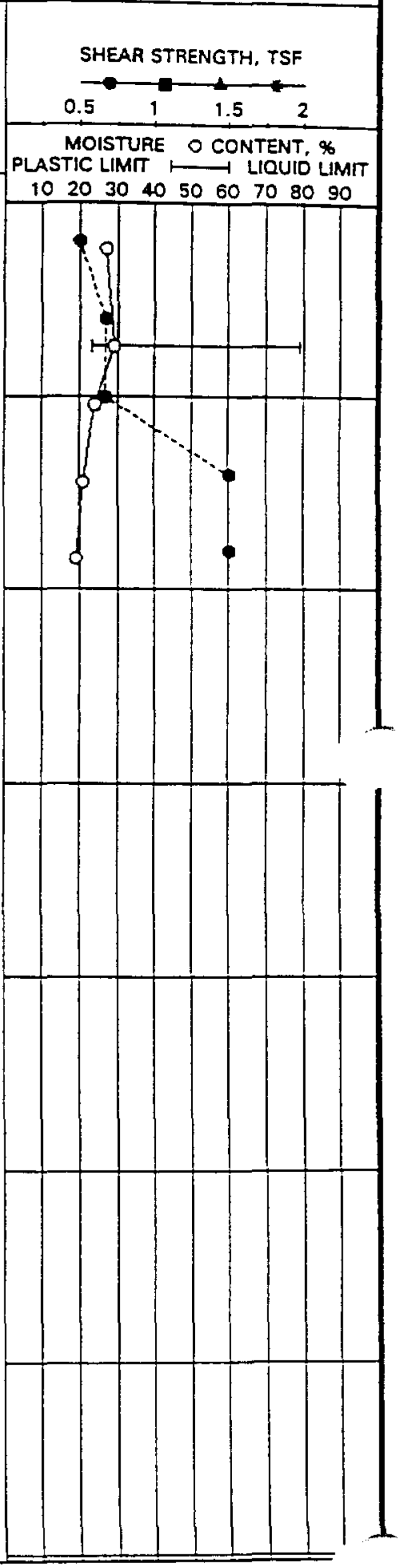
DRY DENSITY PCF

Stiff to very stiff dark gray CLAY

w/ ferrous deposits below 1.219 m

brownish yellow 1.829 m - 2.438 m

reddish brown w/ calcareous nodules below 2.438 m



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

See Appendix A for boring location.

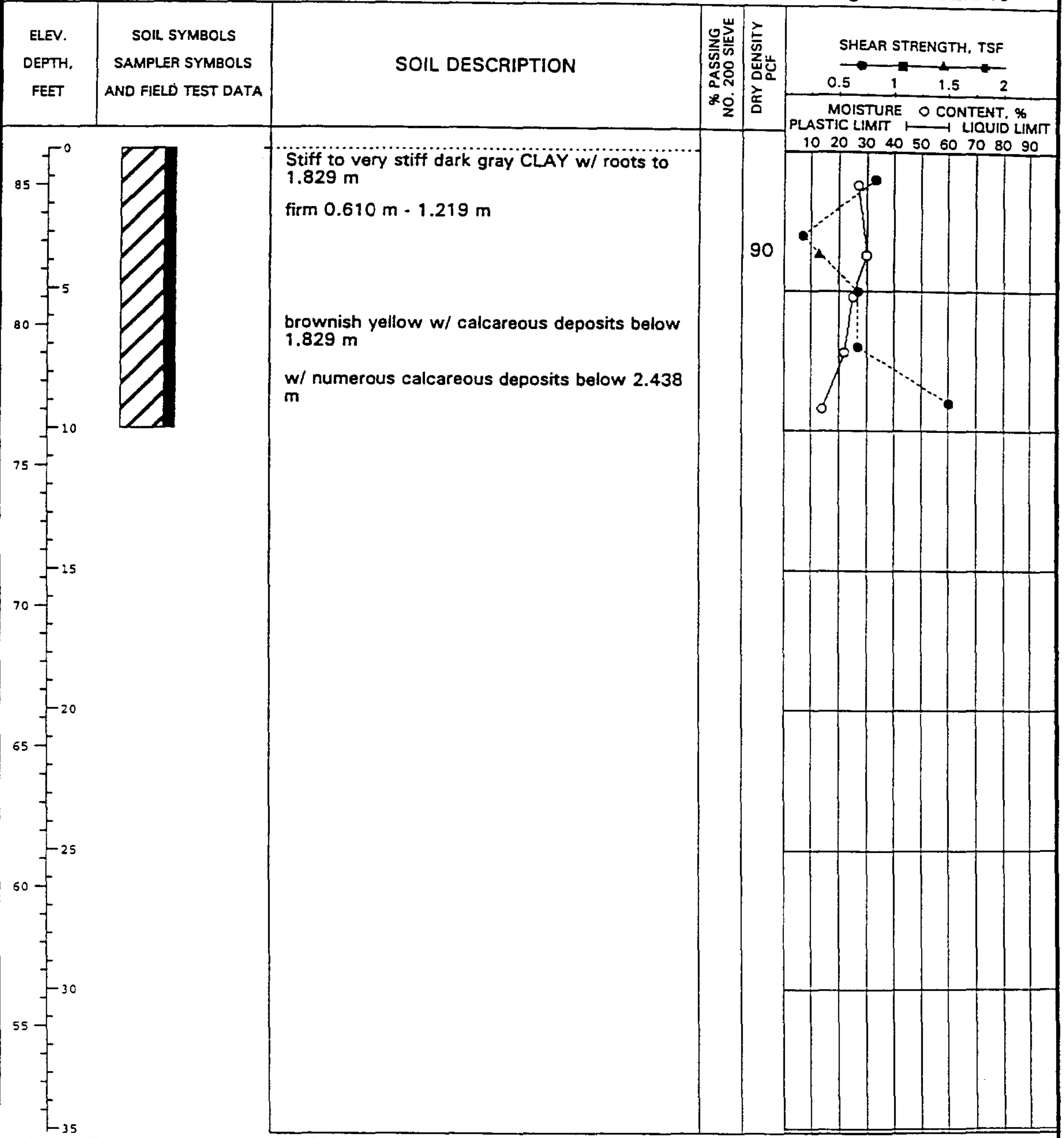
Plate B-2

HVJ ASSOCIATES, INC.

LOG OF SOIL BORING

Project Name: Proposed Detention Pond
Boring No.: B-16 Date: 06-12-97
Groundwater during drilling: none

Project No. 95-184G-01
Elevation: 86.33 feet
Northing: 4205876.438
Easting: 928692.549



Stiff to very stiff dark gray CLAY w/ roots to 1.829 m

firm 0.610 m - 1.219 m

brownish yellow w/ calcareous deposits below 1.829 m

w/ numerous calcareous deposits below 2.438 m

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

See Appendix A for boring location. Plate B-3

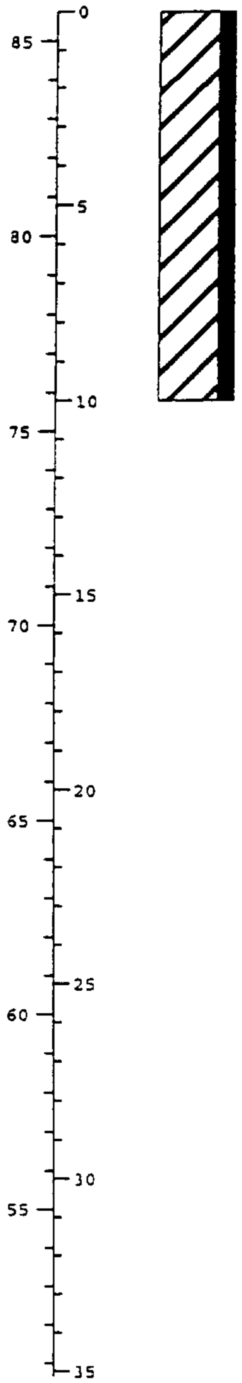
HVJ ASSOCIATES, INC.

LOG OF SOIL BORING

Project Name: Proposed Detention Pond
Boring No.: B-17 Date: 06-12-97
Groundwater during drilling: none

Project No. 95-184G-01
Elevation: 85.79 feet
Northing: 4205902.11
Easting: 928932.925

ELEV. DEPTH, FEET | SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA | SOIL DESCRIPTION | % PASSING NO. 200 SIEVE | DRY DENSITY PCF

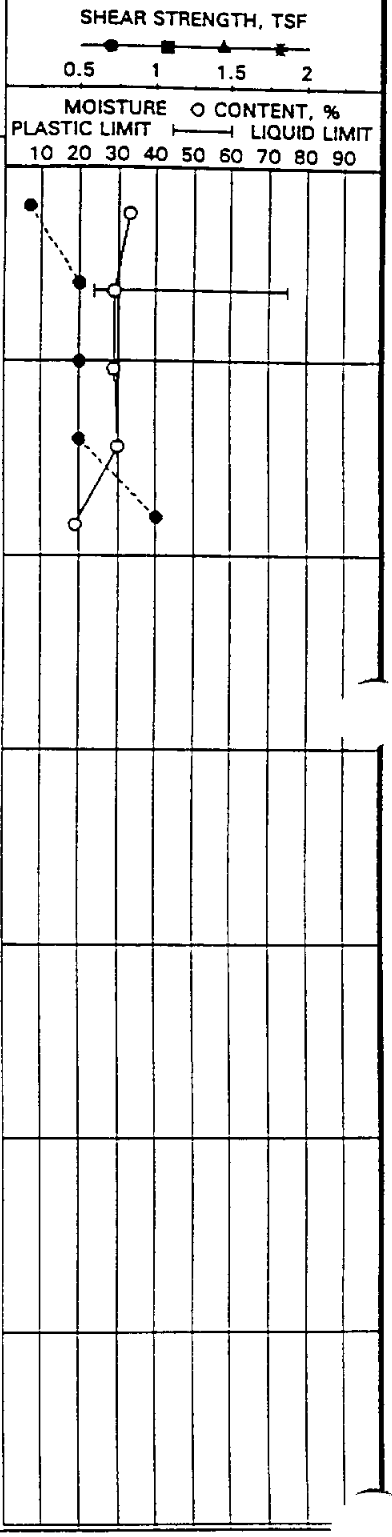


Stiff to very stiff dark gray CLAY
soft to 0.610 m

light gray 1.219 m - 2.438 m

w/ ferrous deposits below 1.829 m

reddish brown w/ calcareous deposits below 2.438 m



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

See Appendix A for boring location.

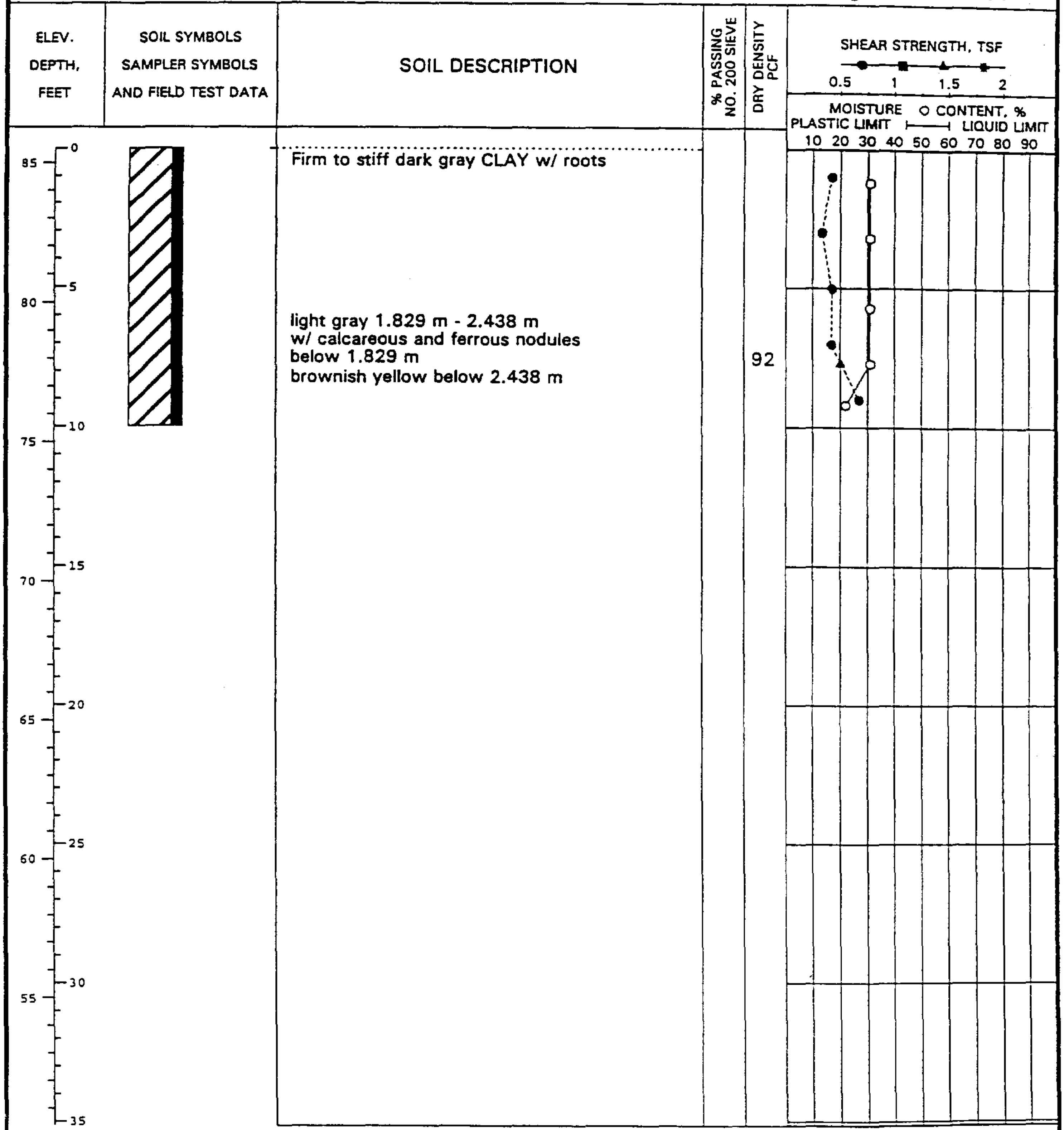
Plate B-4

HVJ ASSOCIATES, INC.

LOG OF SOIL BORING

Project Name: Proposed Detention Pond
Boring No.: B-18 Date: 06-12-97
Groundwater during drilling: none

Project No. 95-184G-01
Elevation: 85.55 feet
Northing: 4205875.598
Easting: 929197.631



Firm to stiff dark gray CLAY w/ roots

light gray 1.829 m - 2.438 m
w/ calcareous and ferrous nodules
below 1.829 m
brownish yellow below 2.438 m

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

See Appendix A for boring location.

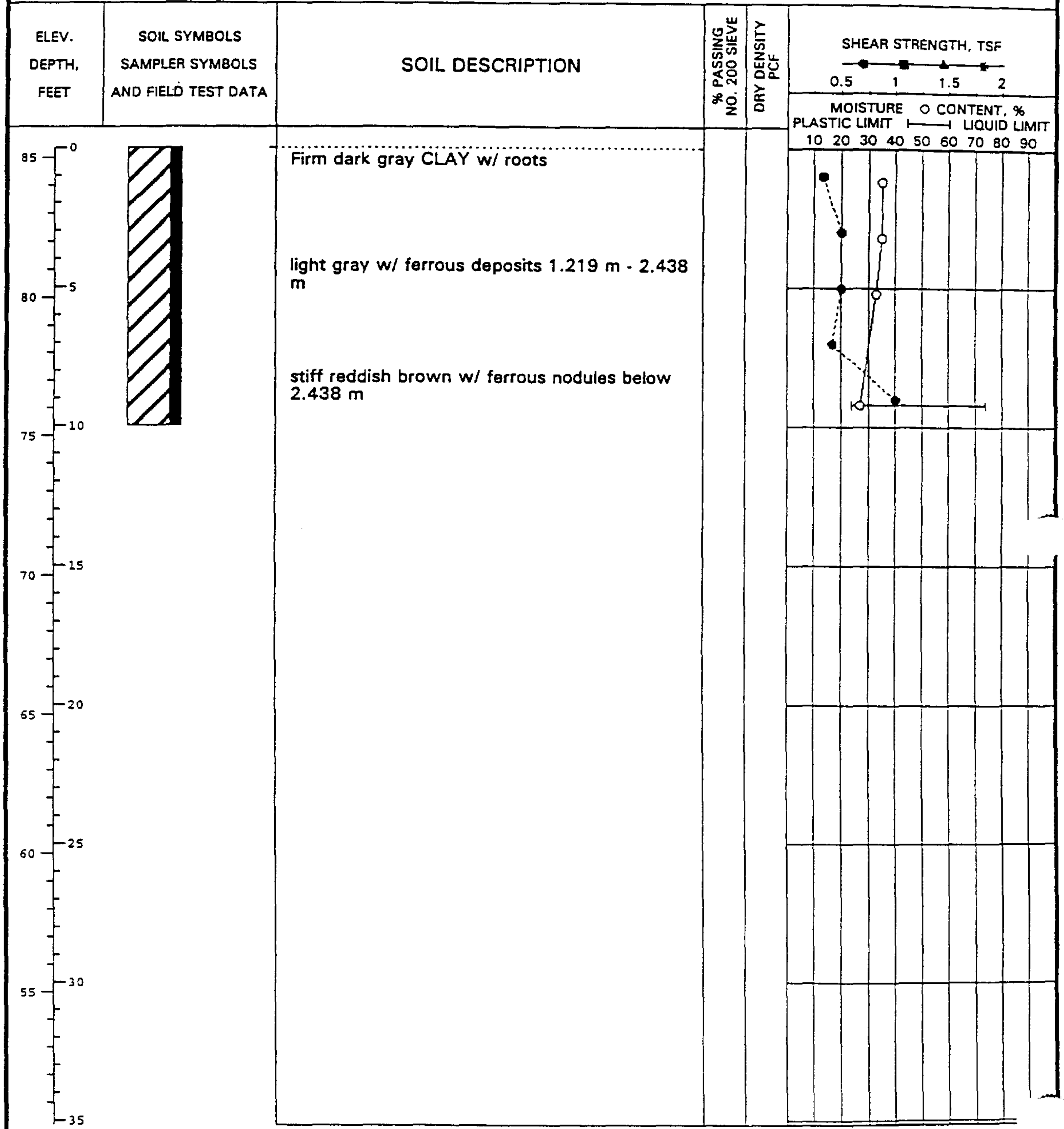
Plate B-5

HVJ ASSOCIATES, INC.

LOG OF SOIL BORING

Project Name: Proposed Detention Pond
Boring No.: B-19 Date: 06-12-97
Groundwater during drilling: none

Project No. 95-184G-01
Elevation: 85.37 feet
Northing: 4205893.57
Easting: 929426.984



Firm dark gray CLAY w/ roots

light gray w/ ferrous deposits 1.219 m - 2.438 m

stiff reddish brown w/ ferrous nodules below 2.438 m

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

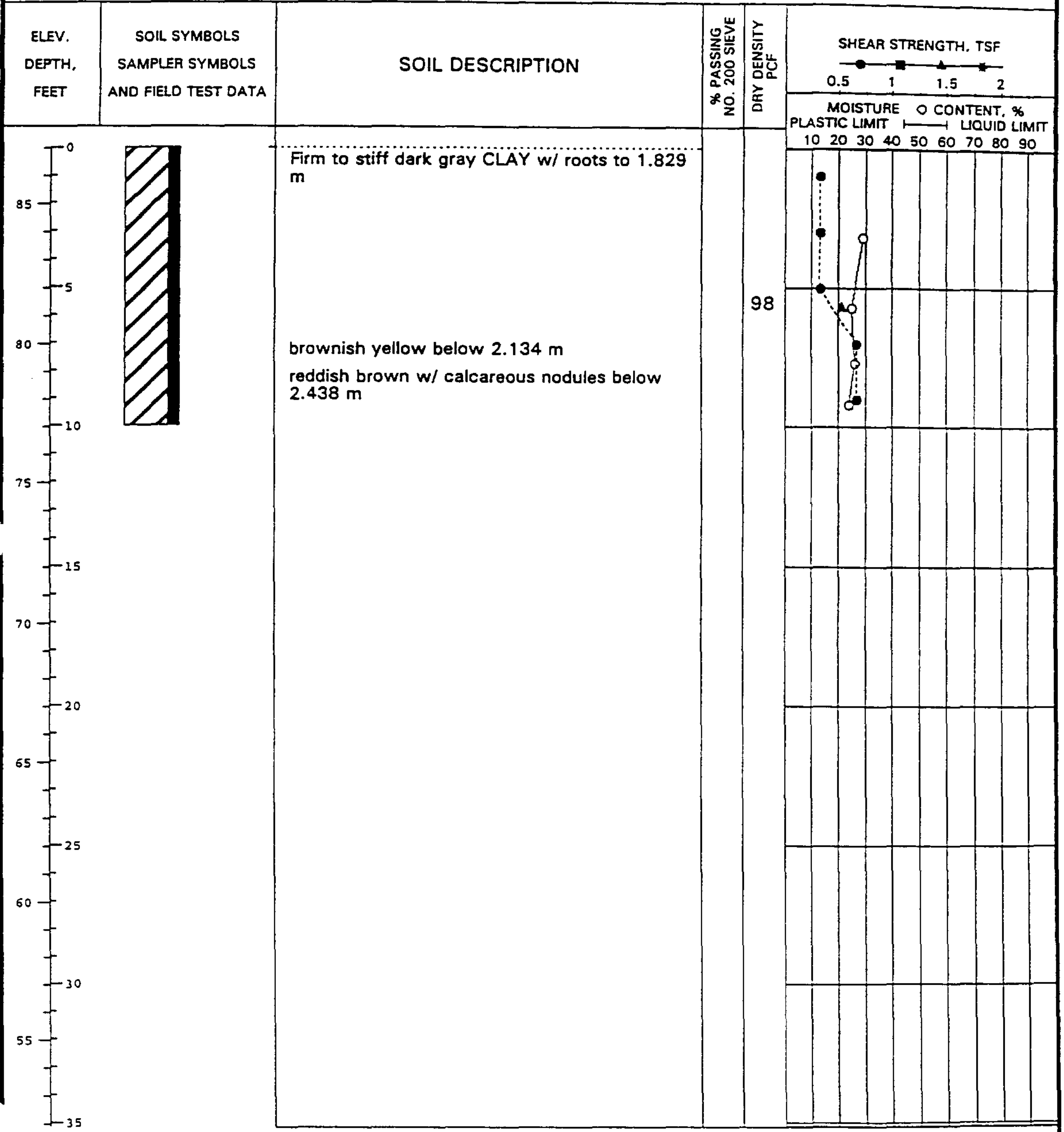
See Appendix A for boring location. Plate B-6

HVJ ASSOCIATES, INC.

LOG OF SOIL BORING

Project Name: Proposed Ditch "B" Extension
Boring No.: B-20 Date: 06-12-97
Groundwater during drilling: none

Project No. 95-184G-01
Elevation: 87.06 feet
Northing: 4206346.451
Easting: 927545.630



Firm to stiff dark gray CLAY w/ roots to 1.829 m

brownish yellow below 2.134 m

reddish brown w/ calcareous nodules below 2.438 m

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

See Appendix A for boring location.

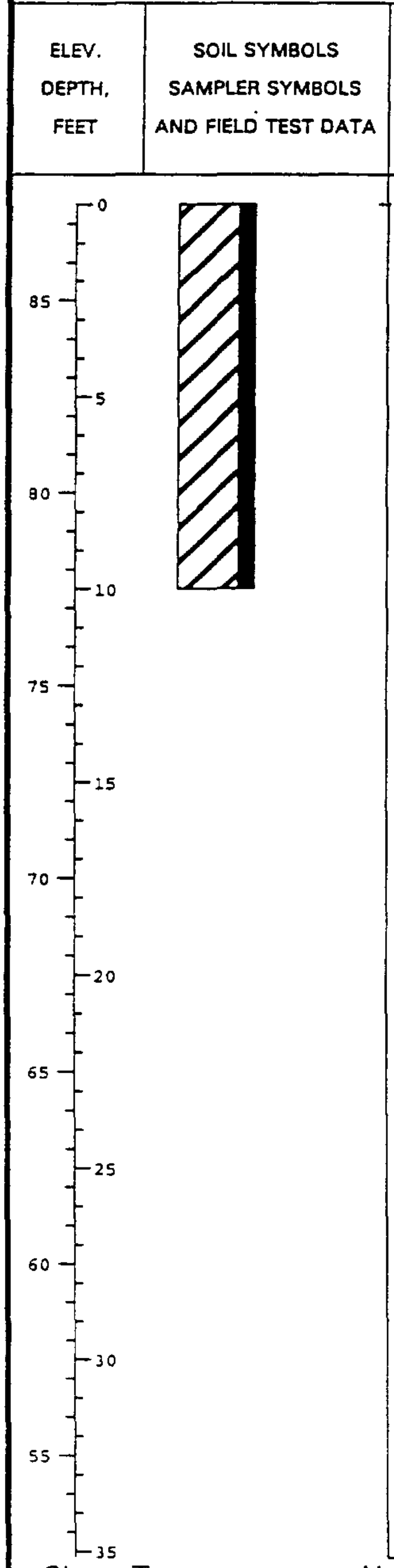
Plate B-7

HVJ ASSOCIATES, INC.

LOG OF SOIL BORING

Project Name: Proposed Ditch "B" Extension
Boring No.: B-21
Date: 06-12-97
Groundwater during drilling: none

Project No. 95-184G-01
Elevation: 87.50 feet
Northing: 4206390.29
Easting: 927714.372



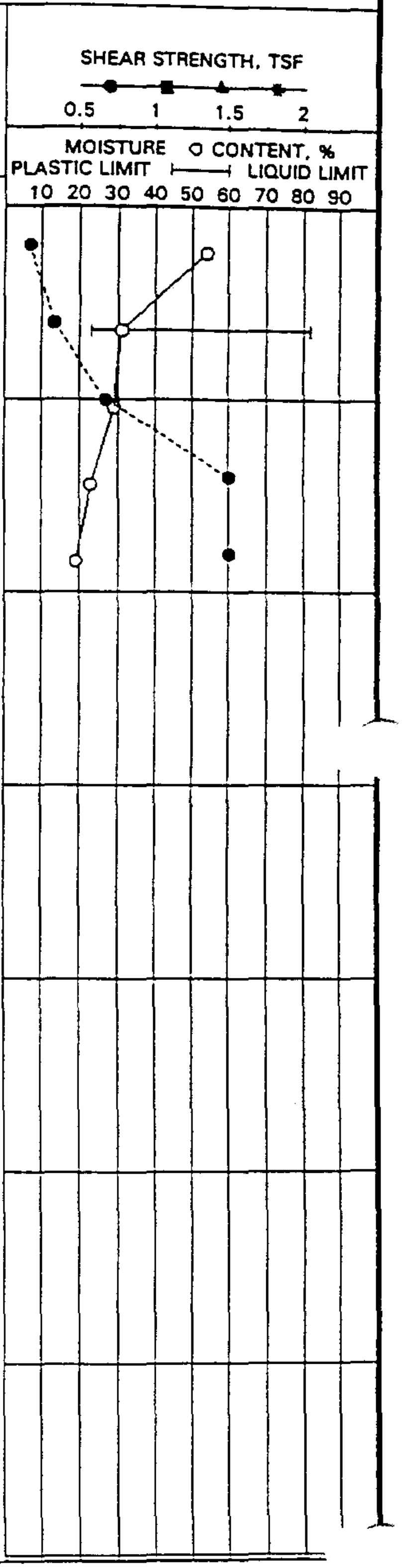
SOIL DESCRIPTION

Firm to very stiff dark gray CLAY w/ roots to 1.829 m
soft to 0.610 m

light gray w/ ferrous nodules 2.134 m - 2.438 m
reddish brown w/ calcareous deposits below 2.438 m

% PASSING NO. 200 SIEVE

DRY DENSITY PCF



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

See Appendix A for boring location.

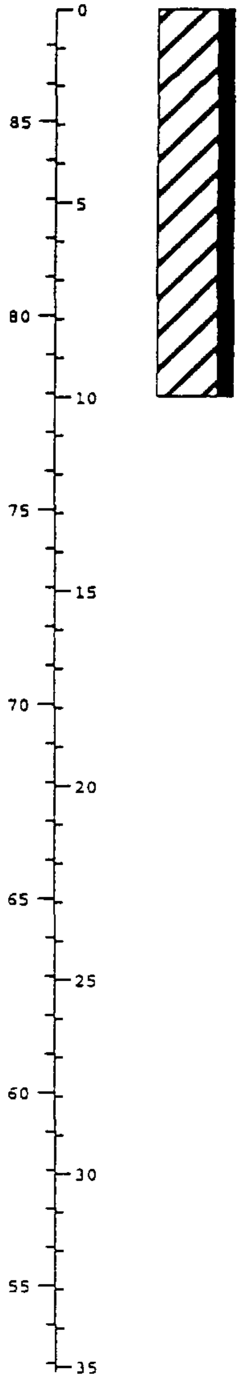
Plate B-8

LOG OF SOIL BORING

Project Name: Proposed Ditch "B" Extension
Boring No.: B-22 Date: 06-12-97
Groundwater during drilling: none

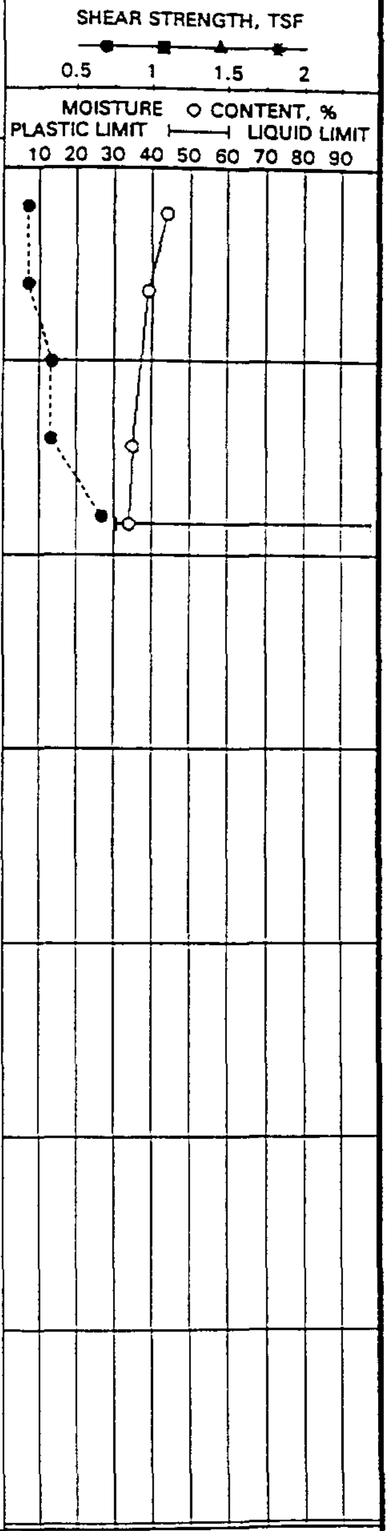
Project No. 95-184G-01
Elevation: 87.90 feet
Northing: 4206436.419
Easting: 927891.334

ELEV. DEPTH, FEET	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	SOIL DESCRIPTION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF



Soft to stiff dark gray CLAY w/ roots

brownish yellow w/ ferrous and calcareous nodules below 2.438 m



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✱ = UU Triaxial

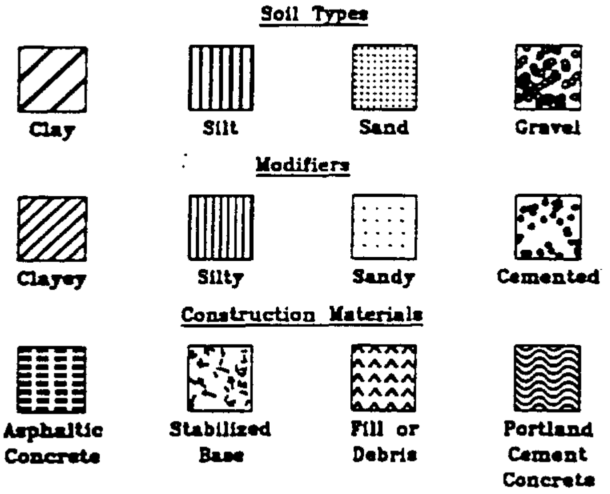
See Appendix A for boring location.

Plate B-9

HVJ ASSOCIATES, INC.

KEY TO TERMS AND SYMBOLS USED ON BORING LOGS

SOIL SYMBOLS



SAMPLER TYPES

■	Thin Walled Shelby Tube	⧄	No Recovery
☒	Split Barrel	◨	Auger
◧	Liner Tube	⧗	Jar Sample

WATER LEVEL SYMBOLS

▽ Groundwater level determined during drilling operations

▽ Groundwater level after drilling in open borehole or piezometer

SOIL GRAIN SIZE

Classification	Particle Size	Particle Size or Sieve No. (U.S. Standard)
Clay	< 0.002 mm	< 0.002 mm
Silt	0.002 - 0.075 mm	0.002 mm - #200 sieve
Sand	0.075 - 4.75 mm	#200 sieve - #4 sieve
Gravel	4.75 - 75 mm	#4 sieve - 75 mm
Cobble	75 - 200 mm	75 mm - 200 mm
Boulder	> 200 mm	> 200 mm

DENSITY OF COHESIONLESS SOILS

Descriptive Term	Penetration Resistance "N" * Blows/300 mm
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

CONSISTENCY OF COHESIVE SOILS

Consistency	Undrained Shear Strength (kpa)
Very Soft	0 - 13
Soft	13 - 27
Firm	27 - 54
Stiff	54 - 107
Very Stiff	107 - 215
Hard	> 215

PENETRATION RESISTANCE

3-10-15	Blows required to penetrate each of three consecutive 150 mm increments per ASTM D-1586 *
50/100 mm	If more than 50 blows are required, driving is discontinued and penetration at 50 blows is noted
0/450 mm	Sampler penetrated full depth under weight of drill rods and hammer

* The N value is taken as the blows required to penetrate the final 300 mm

TERMS DESCRIBING SOIL STRUCTURE

Slickensided	Fracture planes appear polished or glossy, sometimes striated
Fissured	Breaks along definite planes of fracture with little resistance to fracturing
Inclusion	Small pockets of different soils, such as small lenses of sand scattered through a mass of clay
Parting	Inclusion less than 6 mm thick extending through the sample
Seam	Inclusion 6 mm to 75 mm thick extending through the sample
Layer	Inclusion greater than 75 mm thick extending through the sample
Laminated	Soil sample composed of alternating partings of different soil type
Stratified	Soil sample composed of alternating seams or layers of different soil type
Intermixed	Soil sample composed of pockets of different soil type and laminated or stratified structure is not evident
Calcareous	Having appreciable quantities of calcium carbonate
Ferrous	Having appreciable quantities of iron
Nodule	A small mass of irregular shape

RECEIVED

OCT - 5 1998

USFWS ClearLake ES

RUST **Rust Environment & Infrastructure Inc.**

A Rust International Company
2929 Briarpark Drive, Suite 600
Houston, TX 77042-3703

Phone 713.785.9800
Fax 713.785.9779

A review of U.S. Fish and Wildlife Service files and your project information indicate that no federally listed or proposed threatened or endangered species are likely to occur at the project site.

Appr:

Da: October 6, 1998

for **Carlos H. Mendoza**
Project Leader, Clear Lake ES Field Office
U.S. Fish and Wildlife Service
17629 El Camino Real, Suite 211
Houston, Texas 77058

September 30, 1998

Mr. Frederick T. Werner
Chief, Regulatory Activities
U.S. Fish and Wildlife Service
Division of Ecological Services
17629 El Camino Real, Suite 221
Houston, Texas 77058

Re: Sensitive Species and Natural Communities Review
Water and Wastewater Regional Planning Study
Four Corners Area, Fort Bend County, Texas

Dear Mr. Werner:

On behalf of our client, Fort Bend County, Earth Tech, Inc., formerly Rust Environment & Infrastructure, is preparing a Water and Wastewater Regional Planning Study for the "Four Corners" Area located west of the City of Houston. The Planning Area for this project, as illustrated on the attached map, is bounded on the east by State Highway 6 and on the west by FM 1464. The northern boundary is the proposed westward extension of Bissonnet Road, approximately 1,000 feet south of Keegans Bayou, while the southern boundary of the Planning Area consists of Miller Road, Oleta Road, and McKaskle Road.

The objectives of this project include the following:

- to develop alternatives for meeting water and wastewater facility needs of the Planning Area communities (including construction of water and/or wastewater treatment plants, purchasing water and/or wastewater treatment from adjacent municipal utility districts, etc.)
- to determine the costs associated with each alternative; and
- to identify institutional arrangements for providing water and wastewater services to the area.

At this time, Earth Tech would like to request a review of the Planning Area for available information on sensitive species and/or natural communities which may exist within or near the Planning Area.

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For your information, the Planning Area is located on the Clodine, Texas 7.5 minute quadrangle map. A map illustrating the location of the Planning Area is enclosed to assist you with your review of this area. If you have any questions, or if you require any additional information regarding this project, please phone me at (713) 953-5185 or Mr. Glenn Laird, Senior Consultant, at (713) 953-5156. As always, we sincerely appreciate your assistance with this information.

Sincerely,

Earth Tech

Kimberly A. Chesler
Environmental Scientist
Life Sciences Department

KAC/kc

Attachments: Planning Area Boundary Map

cc: Mr. Joe Ezzell, Earth Tech, Dallas, Texas
Project File # 103748

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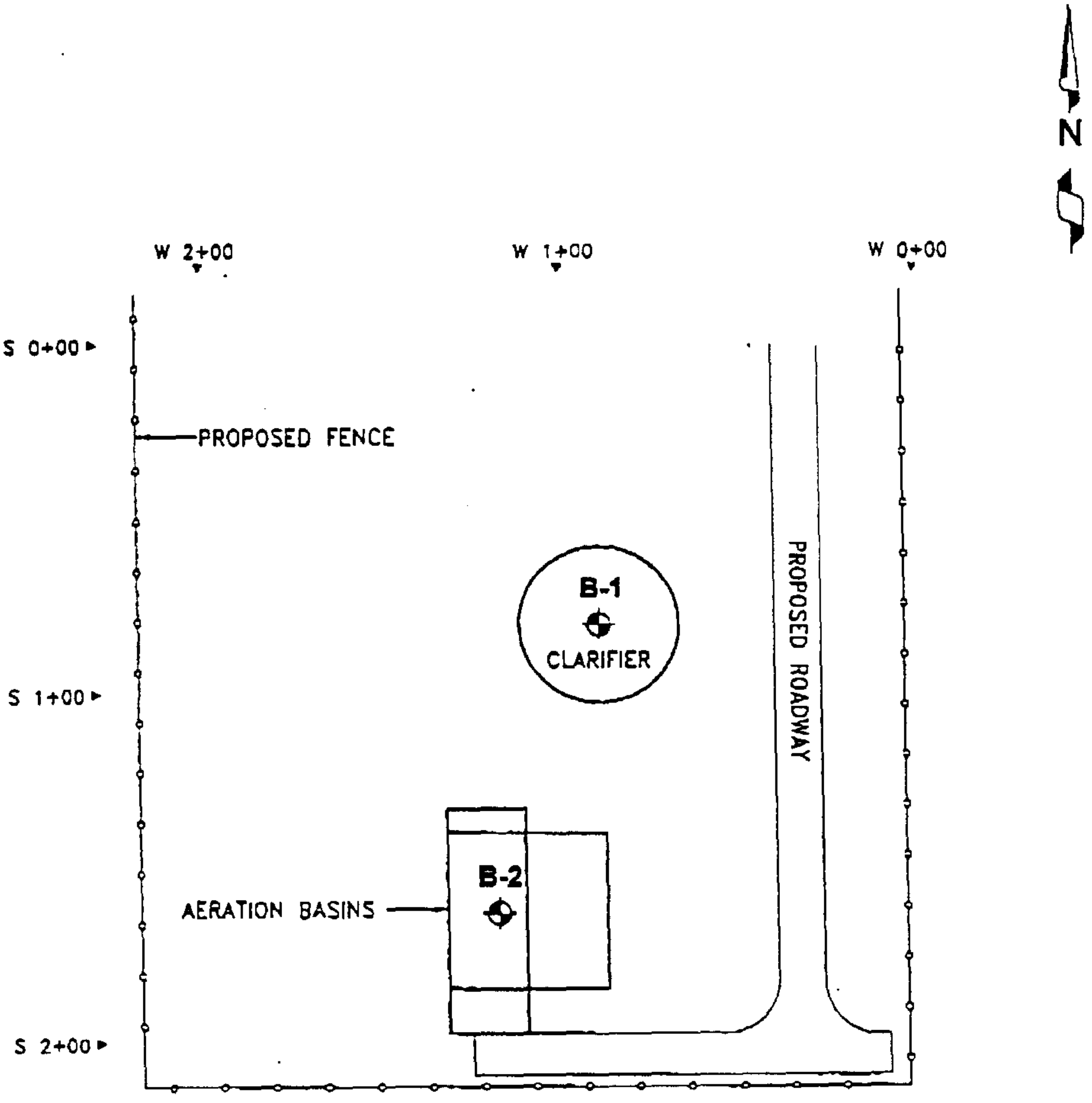
REPORT NO. 14



NOTE: BORING LOCATIONS ARE APPROXIMATE.

PLAN OF BORINGS

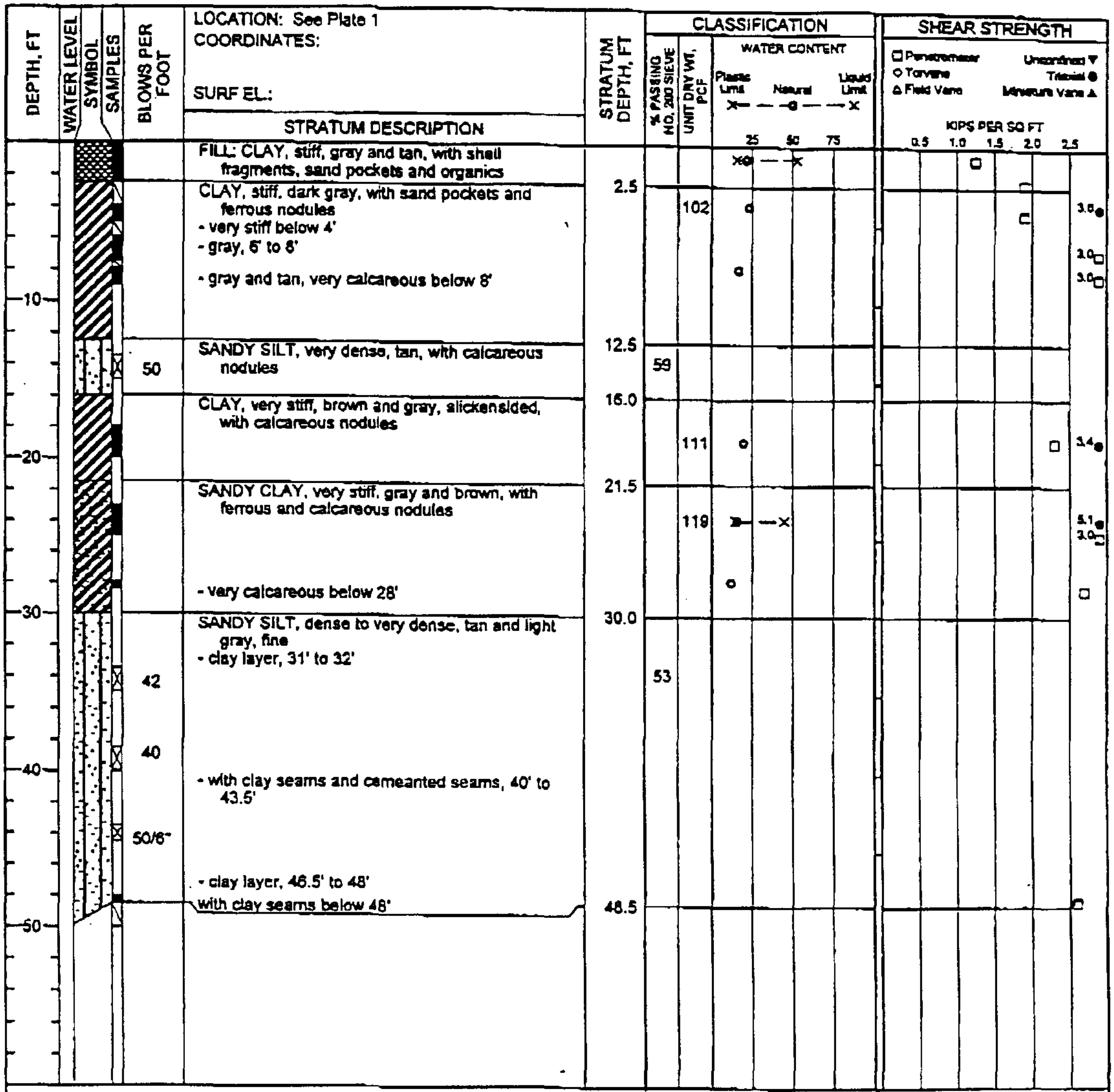
PLATE 1

Report No. 0401-3956

FUGRO

LOCATION: See Plate 1
COORDINATES:

SURF EL:



BLOWS PER FOOT	STRATUM DESCRIPTION	STRATUM DEPTH, FT	% PASSING NO. 200 SIEVE	UNIT DRY WT, PCF
	FILL: CLAY, stiff, gray and tan, with shell fragments, sand pockets and organics	2.5		
	CLAY, stiff, dark gray, with sand pockets and ferrous nodules - very stiff below 4' - gray, 6' to 8' - gray and tan, very calcareous below 8'	12.5		102
50	SANDY SILT, very dense, tan, with calcareous nodules	16.0	59	
	CLAY, very stiff, brown and gray, slickensided, with calcareous nodules	21.5		111
	SANDY CLAY, very stiff, gray and brown, with ferrous and calcareous nodules - very calcareous below 28'	30.0		119
42 40 50/6"	SANDY SILT, dense to very dense, tan and light gray, fine - clay layer, 31' to 32' - with clay seams and cemeanted seams, 40' to 43.5' - clay layer, 46.5' to 48' with clay seams below 48'	48.5	53	

NOTES:

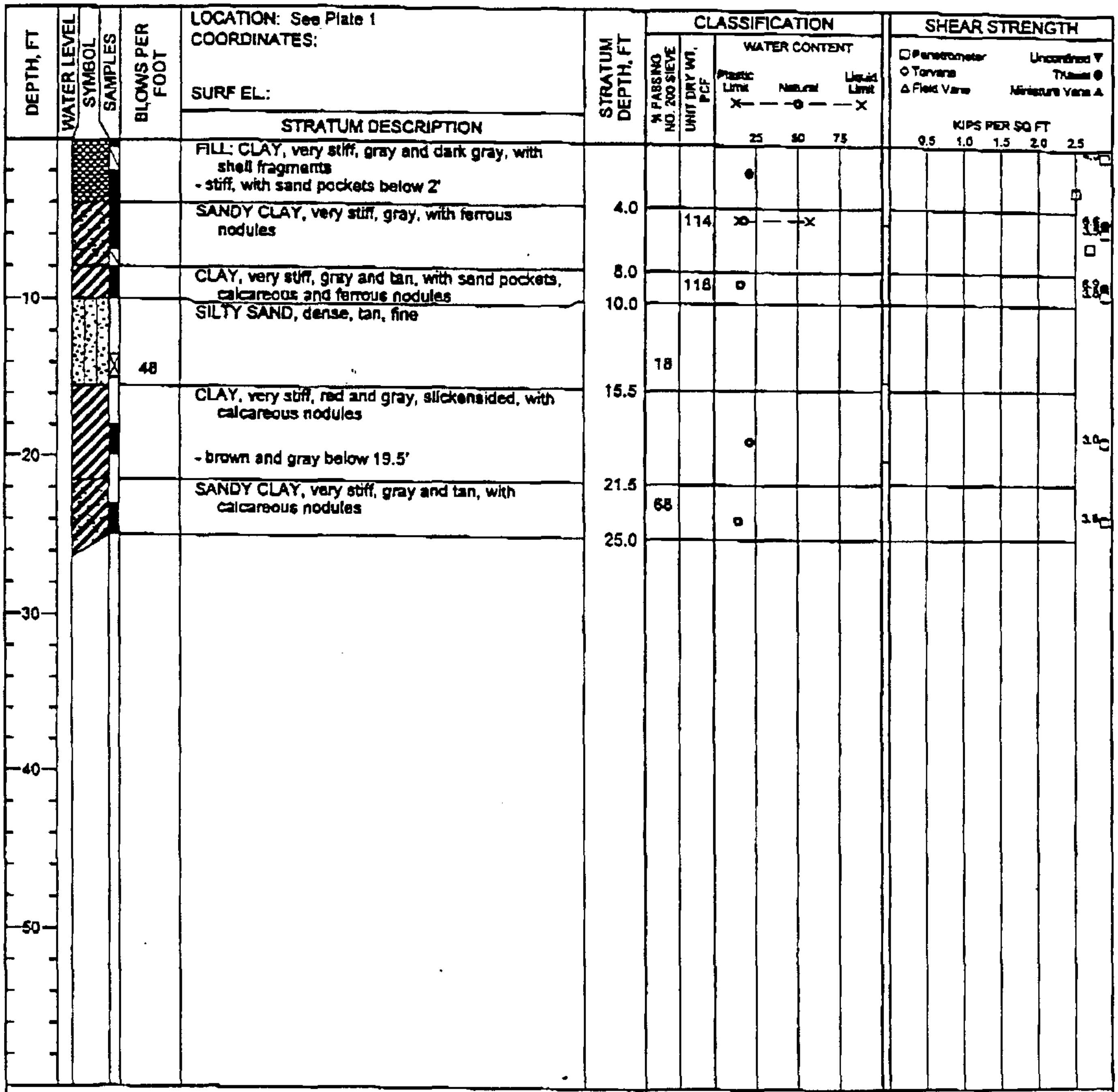
1. Water not encountered to a depth of 15' during drilling.
2. Terms and symbols defined on Plate 4.

DATE: January 31, 1998
TOTAL DEPTH: 48.5'
CAVED DEPTH: Not Applicable
DRY AUGER: 0 To 15.0'
WET ROTARY: Below 15.0'
BACKFILL: Cement-Bentonite Grout
LOGGER: T. Mireles

LOG OF BORING NO. 1
WASTEWATER TREATMENT PLANT EXPANSION
NORTH MISSON GLEN MUD
FORT BEND COUNTY, TEXAS

PLATE 2

Report No. 0401-3956



LOCATION: See Plate 1
COORDINATES:
SURF EL.:

STRATUM DESCRIPTION	STRATUM DEPTH, FT	BLOWS PER FOOT	% PASSING NO. 200 SIEVE	UNIT DRY WT. PCF
FILL: CLAY, very stiff, gray and dark gray, with shell fragments - stiff, with sand pockets below 2'	4.0			
SANDY CLAY, very stiff, gray, with ferrous nodules	8.0			114
CLAY, very stiff, gray and tan, with sand pockets, calcareous and ferrous nodules	10.0			118
SILTY SAND, dense, tan, fine	15.5	48	18	
CLAY, very stiff, red and gray, slickensided, with calcareous nodules - brown and gray below 19.5'	21.5			
SANDY CLAY, very stiff, gray and tan, with calcareous nodules	25.0		68	

NOTES:

1. Water level not measured during drilling.
2. Terms and symbols defined on Plate 4.

DATE: January 31, 1998
TOTAL DEPTH: 25.0'
CAVED DEPTH: Not Applicable
DRY AUGER: Not Applicable
WET ROTARY: 0 To 25.0'
BACKFILL: Cement-Bentonite Grout
LOGGER: T. Mireles

LOG OF BORING NO. 2
WASTEWATER TREATMENT PLANT EXPANSION
NORTH MISSON GLEN MUD
FORT BEND COUNTY, TEXAS

SOIL / MATERIAL TYPES

- ░ Sand
- ▥ Silt
- ▨ Clay
- ☰ Gravel
- ░ Silty Sand
- ▥ Sandy Silt
- ▨ Sandy Clay
- ☰ Peat or Highly Organic
- ▨ Clayey Sand
- ▥ Clayey Silt
- ▨ Silty Clay
- ▩ Debris or Mixed Fill
- ■ Asphalt
- ░ Concrete

SAMPLER TYPES

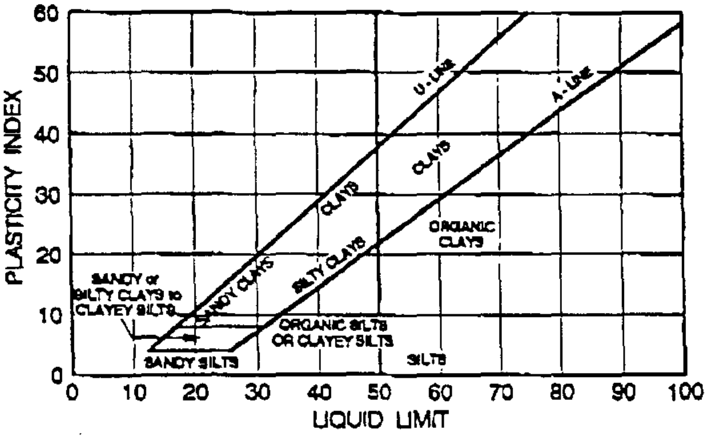
- Thin-walled Tube
- Partial Recovery w/ Tube
- Auger
- Split-Barrel
- No Recovery
- Pitcher
- Piston
- Rock Core

SOIL GRAIN SIZE

U. S. Standard Sieve

6"	3"	3/4"	4	10	40	200		
Boulders	Cobbles	Gravel		Sand			Silt	Clay
		Coarse	Fine	Coarse	Medium	Fine		
152	76.2	19.1	4.76	2.00	0.420	0.074	0.002	(mm)

PLASTICITY CHART



SOIL STRUCTURE

Slickensided	Having planes of weakness that appear slick and glossy.
Fissured	Containing shrinkage or relief cracks, often filled with fine sand or silt, usually more or less vertical.
Pocket	Inclusion of material of different texture that is smaller than the diameter of the sample.
Parting	Inclusion less than 1/8 inch thick extending through the sample.
Seam	Inclusion 1/8 inch to 3 inches thick extending through the sample.
Layer	Inclusion greater than 3 inches thick extending through the sample.
Laminated	Soil sample composed of alternating partings or seams of different soil type.
Interlayered	Soil sample composed of alternating layers of different soil type.
Intermixed	Soil sample composed of pockets of different soil type and layered or laminated structure is not evident
Calcareous	Having appreciable quantities of carbonate. (12 to 49%)
Carbonate	Having more than 50% carbonate content.

TERMS AND SYMBOLS USED ON BORING LOGS
SOIL CLASSIFICATION (1 OF 2)

PLATE 4a

STANDARD PENETRATION TEST (SPT)

A 2-in.-OD, 1-3/8-in.-ID split spoon sampler is driven 1.5 ft into undisturbed soil with a 140 - pound hammer free falling 30 in. After the sampler is seated 6 in. into undisturbed soil, the number of blows required to drive the sampler the last 12 in. is the Standard Penetration Resistance or "N" value, which is recorded as blows per foot as described below.

Blows Per Foot	Description
25	25 blows drive sampler 12 inches, after initial 6 inches of seating.
50/7"	50 blows drive sampler 7 inches, after initial 6 inch seating.
Ref/3"	50 blows drive sampler 3 inches, during initial 6 inches of seating interval.

NOTE: To avoid damage to sampling tools, driving is limited to 50 blows during or after seating interval.

DENSITY OF GRANULAR SOILS

Descriptive Term	*Relative Density, %	**Blows Per Foot (SPT)
Very Loose	< 15	0 to 4
Loose	15 to 35	5 to 10
Medium Dense	35 to 65	11 to 30
Dense	65 to 85	31 to 50
Very Dense	> 85	> 50

*Estimated from sampler driving record.
**Requires correction for depth, groundwater level, and grain size.

STRENGTH OF COHESIVE SOILS

Term	Undrained Shear Strength, ksf	Blows Per Foot (SPT) (approximate)
Very Soft	< 0.25	0 to 2
Soft	0.25 to 0.50	2 to 4
Firm	0.50 to 1.00	4 to 8
Stiff	1.00 to 2.00	8 to 16
Very Stiff	2.00 to 4.00	16 to 32
Hard	> 4.00	> 32

SHEAR STRENGTH TEST METHOD

U = Unconfined Q = Unconsolidated - Undrained Triaxial
P = Pocket Penetrometer T = Torvane V = Miniature Vane F = Field Vane

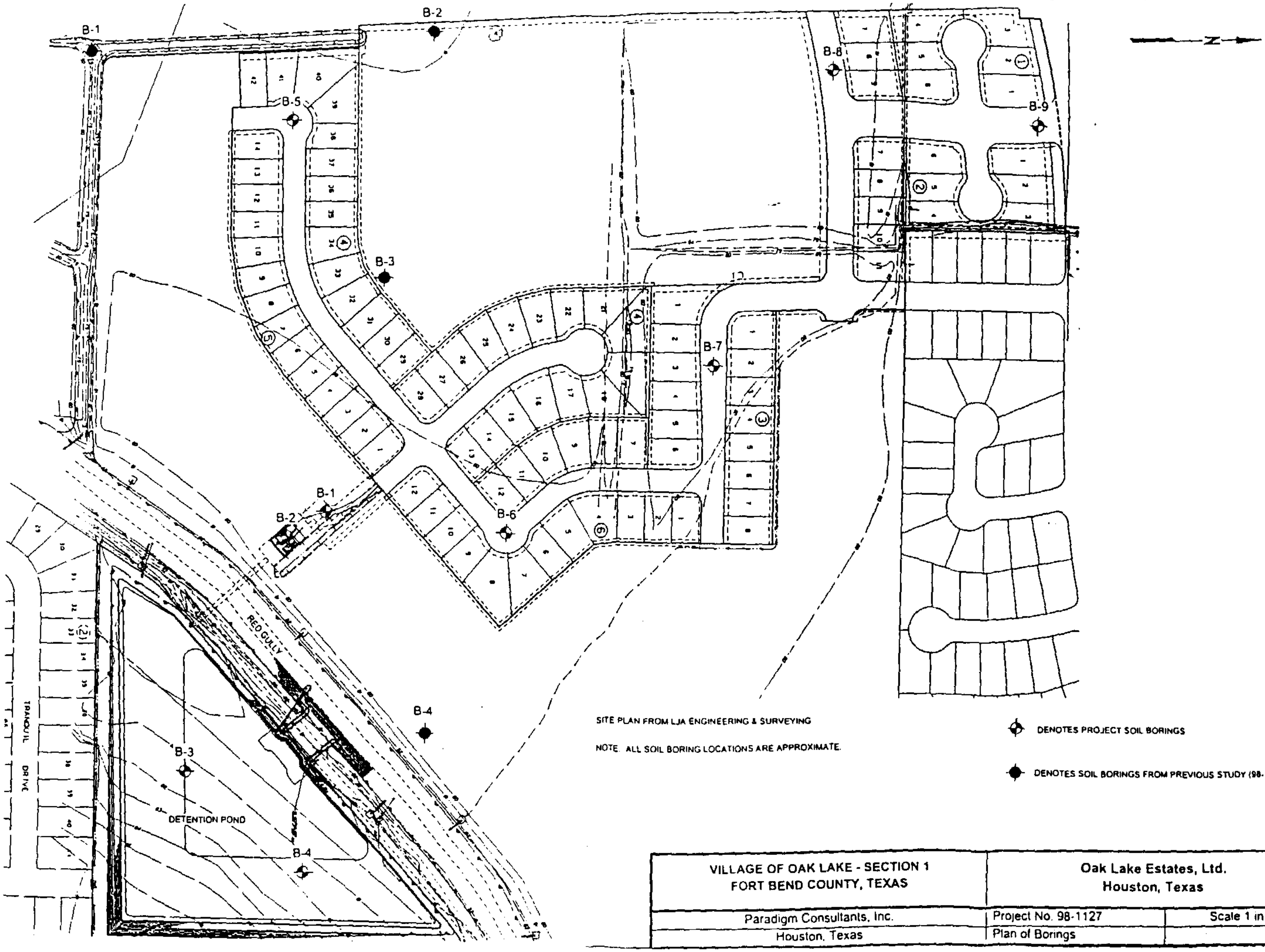
HAND PENETROMETER CORRECTION

Our experience has shown that the hand penetrometer generally overestimates the in-situ undrained shear strength of overconsolidated Pleistocene Gulf Coast clays. These strengths are partially controlled by the presence of macroscopic soil defects such as slickensides, which generally do not influence smaller scale tests like the hand penetrometer. Based on our experience, we have adjusted these field estimates of the undrained shear strength of natural, overconsolidated Pleistocene Gulf Coast soils by multiplying the measured penetrometer readings by a factor of 0.6. These adjusted strength estimates are recorded in the "Shear Strength" column on the boring logs. Except as described in the text, we have not adjusted estimates of the undrained shear strength for projects located outside of the Pleistocene Gulf Coast formations.

Information on each boring log is a compilation of subsurface conditions and soil or rock classifications obtained from the field as well as from laboratory testing of samples. Strata have been interpreted by commonly accepted procedures. The stratum lines on the logs may be transitional and approximate in nature. Water level measurements refer only to those observed at the time and places indicated, and can vary with time, geologic condition, or construction activity.

TERMS AND SYMBOLS USED ON BORING LOGS
SOIL CLASSIFICATION (2 OF 2)

REPORT NO. 15



SITE PLAN FROM LJA ENGINEERING & SURVEYING

NOTE: ALL SOIL BORING LOCATIONS ARE APPROXIMATE.

⊕ DENOTES PROJECT SOIL BORINGS

● DENOTES SOIL BORINGS FROM PREVIOUS STUDY (98-1090)

VILLAGE OF OAK LAKE - SECTION 1 FORT BEND COUNTY, TEXAS	Oak Lake Estates, Ltd. Houston, Texas	
Paradigm Consultants, Inc.	Project No. 98-1127	Scale 1 in. = 200 ft
Houston, Texas	Plan of Borings	Figure 1

PROJECT: Geotechnical Utility Study
Village of Oak Lake - Section 4
Fort Bend County, Texas

CLIENT: Oak Lake Estates, Ltd.
Houston, Texas

PROJECT NO. 98-1127
BORING NO. B-1
DATE 7/29/98

SHEET 1 of

DRILLING METHOD(S):
Boring drilled using dry auger drilling methods to 20 ft.

GROUNDWATER INFORMATION:
Water in open borehole encountered at 16 ft during drilling and 12.4 ft 1 day after drilling.

SURFACE ELEVATION:

	FIELD DATA			LABORATORY DATA									
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	OTHER TESTS/ COMMENTS	DESCRIPTION OF STRATUM
▨		■	P=2.7	22									Stiff to very stiff dark gray CLAY (CH) with organic matter at 1 ft
▨	1												
▨	2	■	P=1.8										
▨	3												
▨	4	■	P=2.7	28									slickensided at 4 ft
▨	5												
▨	6	■	P=2.6										tan and gray below 6 ft
▨	7												
▨	8	■	P=2.3	24									with calcareous deposits below 8 ft
▨	9												
▨	10												
▨	11												
▨	12												
▨	13	■	P=1.5	27				96	1.60	3			
▨	14												
▨	15												
░	16												Loose tan SAND (SP)
░	17												
░	18												
░	19	☒	N=9									-200=3%	
	20												Boring terminated at 20 ft

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Hand penetrometer measurements adjusted by a factor of 0.6.
Borehole backfilled with soil cuttings on July 30, 1998.

Paradigm Consultants, Inc.

LOB 8127 8/21/98

LOG OF BORING

PROJECT: Geotechnical Utility Study
Village of Oak Lake - Section 4
Fort Bend County, Texas

CLIENT: Oak Lake Estates, Ltd.
Houston, Texas

PROJECT NO. 98-1127
BORING NO. B-2
DATE 7/29/98

SHEET 1

DRILLING METHOD(S):
Boring drilled using dry auger drilling methods to 20 ft and wet rotary drilling methods from 20 ft to 35 ft.

GROUNDWATER INFORMATION:
Water in open borehole encountered at 19.5 ft during drilling and at 12.6 ft 1 day after drilling.

SURFACE ELEVATION:

FIELD DATA				LABORATORY DATA									
					ATTERBERG LIMITS								
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	OTHER TESTS/ COMMENTS	DESCRIPTION OF STRATUM
▨	1	■	P = 2.7	25									Stiff to very stiff dark gray CLAY (CH)
▨	2	■	P = 2.7										
▨	3												
▨	4	■	P = 2.7	23	86	27	59						
▨	5												
▨	6	■	P = 2.7										slickensided at 6 ft
▨	7												tan and gray below 6 ft
▨	8	■	P = 2.7	27				96	4.48	2			with calcareous nodules below 8 ft
▨	9												hard at 8 ft
▨	10												
▨	11												
▨	12		▼										
▨	13	■	P = 2.7	24									slickensided at 13 ft
▨	14												
▨	15												
▨	16												
▨	17												
▨	18	■	P = 2.0	30				95	1.79	6			
▨	19		▽										
▨	20												sand layer at 19.5 ft
░	21												Stiff to very stiff tan and gray SANDY CLAY (CL)
░	22												with calcareous nodules
░	23	■	P = 2.7	15									
░	24												
░	25												
░	26												
░	27												
░	28	■	P = 2.7	17				115	4.73	6			hard at 28 ft
░	29												
░	30												
░	31												
░	32												
░	33	■	P = 1.2	21									with silt pockets at 33 ft
░	34												
	35												Boring terminated at 35 ft

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Hand penetrometer measurements adjusted by a factor of 0.6.
Borehole backfilled with soil cuttings on July 30, 1998.

Paradigm Consultants, Inc.

LOG OF BORING

PROJECT: Geotechnical Utility Study
Village of Oak Lake - Section 4
Fort Bend County, Texas

CLIENT: Oak Lake Estates, Ltd.
Houston, Texas

PROJECT NO. 98-1127
BORING NO. B-3
DATE 7/29/98

SHEET 1 of

DRILLING METHOD(S):
Boring drilled using dry auger drilling methods to 15 ft.

GROUNDWATER INFORMATION:
Water in open borehole encountered at 14 ft during drilling.

SURFACE ELEVATION:

FIELD DATA				LABORATORY DATA									
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	OTHER TESTS/ COMMENTS	DESCRIPTION OF STRATUM
▨	1	■	P = 2.7	16									Very stiff dark gray SANDY CLAY (CL) with organic matter at 1 ft
▨	2–3	■	P = 2.7	12	45	18	27						
▨	4–5	■	P = 2.7	13				119	7.42	1			hard at 4 ft tan and gray below 4 ft
▨	6–7	■	P = 2.7	15									
░	8–9	☒	N = 16									-200 = 29%	Medium dense tan SILTY SAND (SM)
░	10–13												
░	14–15	☒	N = 16	▽ 20									
													Boring terminated at 15 ft

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Hand penetrometer measurements adjusted by a factor of 0.6.
Borehole backfilled with soil cuttings on July 30, 1998.

Paradigm Consultants, Inc.

LOG OF BORING

PROJECT: Geotechnical Utility Study
Village of Oak Lake - Section 4
Fort Bend County, Texas

CLIENT: Oak Lake Estates, Ltd.
Houston, Texas

PROJECT NO. 98-1127
BORING NO. B-4
DATE 7/29/98

SHEET 1

DRILLING METHOD(S):
Boring drilled using dry auger drilling methods to 15 ft.

GROUNDWATER INFORMATION:
Water in open borehole not encountered during drilling.

SURFACE ELEVATION:

	FIELD DATA			LABORATORY DATA	ATTERBERG LIMITS								
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	OTHER TESTS/ COMMENTS	DESCRIPTION OF STRATUM
▨		■	P=2.7	13									Very stiff dark gray SANDY CLAY (CL)
▨	1												
▨	2	■	P=2.7	13									tan below 2 ft
▨	3												
▨	4	■	P=2.7	5									with calcareous nodules at 4 ft
░	5												Medium dense tan SAND (SP-SM)
░	6												
░	7	☒	N=22	5								-200=10%	
░	8												
░	9	☒	N=13	5									
░	10												
░	11												
░	12												
░	13												
░	14	☒	N=17	11									
	15												Boring terminated at 15 ft

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Hand penetrometer measurements adjusted by a factor of 0.6.
Borehole backfilled with soil cuttings on July 30, 1998.

Paradigm Consultants, Inc.

LOG OF BORING

PROJECT: Geotechnical Utility Study
Village of Oak Lake - Section 4
Fort Bend County, Texas

CLIENT: Oak Lake Estates, Ltd.
Houston, Texas

PROJECT NO. 98-1127
BORING NO. B-5
DATE 7/29/98

SHEET 1 of

DRILLING METHOD(S):
Boring drilled using dry auger drilling methods to 15 ft.

GROUNDWATER INFORMATION:
Water in open borehole not encountered during drilling.

SURFACE ELEVATION:

	FIELD DATA			LABORATORY DATA									
					ATTERBERG LIMITS								
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	OTHER TESTS/ COMMENTS	DESCRIPTION OF STRATUM
▨	1	■	P=2.7	23									Very stiff reddish brown and gray CLAY (CH) with ferrous nodules
▨	2	■	P=2.7	15	51	23	28						Stiff to very stiff dark gray SANDY CLAY (CL) with ferrous and calcareous nodules
	3												
	4	■	P=2.7										
	5												
	6	■	P=1.8	22									tan and gray below 6 ft
	7												
	8	■	P=2.0	24				105	1.92	7			
	9												
	10												
░	11												Loose tan SAND (SP)
	12												
	13												
	14	☒	N=9	22								-200=4%	
	15												Boring terminated at 15 ft

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Hand penetrometer measurements adjusted by a factor of 0.6.
Borehole backfilled with soil cuttings on July 30, 1998.

LOB 8127 8/21

PROJECT: Geotechnical Utility Study
Village of Oak Lake - Section 4
Fort Bend County, Texas

CLIENT: Oak Lake Estates, Ltd.
Houston, Texas

PROJECT NO. 98-1127
BORING NO. B-6
DATE 7/29/98

SHEET 1

DRILLING METHOD(S):
Boring drilled using dry auger drilling methods to 15 ft.

GROUNDWATER INFORMATION:
Water in open borehole encountered at 15 ft during drilling.

SURFACE ELEVATION:

	FIELD DATA			LABORATORY DATA									
					ATTERBERG LIMITS								
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	OTHER TESTS/ COMMENTS	DESCRIPTION OF STRATUM
▨	1	■	P=2.7	22	76	28	48						Very stiff dark gray CLAY (CH) with calcareous nodules
▨	2												
▨	3	■	P=2.7	13									Very stiff dark gray SANDY CLAY (CL) with ferrous nodules
▨	4												
▨	5	■	P=2.7										
▨	6												
▨	7	■	P=2.6	17				113	3.94	15			tan and gray below 6 ft
▨	8												
▨	9	■	P=2.4	18									
▨	10												
▨	11												
░	12												Loose tan SAND (SP)
░	13												
░	14	☒	N=10	22								-200=5%	
	15		▽										Boring terminated at 15 ft

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Hand penetrometer measurements adjusted by a factor of 0.6.
Borehole backfilled with soil cuttings on July 30, 1998.

Paradigm Consultants, Inc.

LOB 8127 9/3/98

PROJECT: Geotechnical Utility Study
Village of Oak Lake - Section 4
Fort Bend County, Texas

CLIENT: Oak Lake Estates, Ltd.
Houston, Texas

PROJECT NO. 98-1127
BORING NO. B-7
DATE 7/29/98

SHEET 1 of

DRILLING METHOD(S):
Boring drilled using dry auger drilling methods to 15 ft.

GROUNDWATER INFORMATION:
Water in open borehole not encountered during drilling.

SURFACE ELEVATION:

	FIELD DATA			LABORATORY DATA									
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	OTHER TESTS/ COMMENTS	DESCRIPTION OF STRATUM
▨		■	P = 2.7	24									Very stiff reddish brown and gray CLAY (CH) with organic matter
▨	1												
▨	2	■	P = 2.7	17									Very stiff tan and gray SANDY CLAY (CL) with ferrous and calcareous nodules
▨	3												
▨	4	■	P = 2.7	17									
▨	5												
▨	6	■	P = 2.7	15				115	3.59	4			
▨	7												
▨	8	■	P = 2.6	13									
░	9												Loose tan SILTY SAND (SM)
░	10												
░	11												
░	12												
░	13												
░	14	☒	N = 10	22								-200 = 14%	
	15												Boring terminated at 15 ft

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Hand penetrometer measurements adjusted by a factor of 0.6.
Borehole backfilled with soil cuttings on July 30, 1998.

Paradigm Consultants, Inc.

LOB 8127 8/2.

LOG OF BORING

PROJECT: Geotechnical Utility Study
Village of Oak Lake - Section 4
Fort Bend County, Texas

CLIENT: Oak Lake Estates, Ltd.
Houston, Texas

PROJECT NO. 98-1127
BORING NO. B-8
DATE 7/29/98

SHEET 1

DRILLING METHOD(S):
Boring drilled using dry auger drilling methods to 15 ft.

GROUNDWATER INFORMATION:
Water in open borehole not encountered during drilling.

SURFACE ELEVATION:

FIELD DATA				LABORATORY DATA									
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	OTHER TESTS/ COMMENTS	DESCRIPTION OF STRATUM
	1		P=2.7	24									Very stiff reddish brown and gray CLAY (CH) with organic matter
	2		P=2.7	17									Very stiff tan and gray SANDY CLAY (CL)
	3												
	4		P=2.7	17	38	18	20						
	5												
	6		P=2.7	11				122	5.95	4			hard at 6 ft
	7												
	8												Medium dense tan SILTY SAND (SM)
	9		N=11	13									
	10												
	11												
	12												
	13												
	14		N=18	21								-200=29%	with clay seams at 13.5 ft
	15												Boring terminated at 15 ft

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Hand penetrometer measurements adjusted by a factor of 0.6.
Borehole backfilled with soil cuttings on July 30, 1998.

LOB 8127 8/21/98

LOG OF BORING

PROJECT: Geotechnical Utility Study
Village of Oak Lake - Section 4
Fort Bend County, Texas

CLIENT: Oak Lake Estates, Ltd.
Houston, Texas

PROJECT NO. 98-1127
BORING NO. B-9
DATE 7/29/98

SHEET 1 of

DRILLING METHOD(S):
Boring drilled using dry auger drilling methods to 15 ft.

GROUNDWATER INFORMATION:
Water in open borehole not encountered during drilling.

SURFACE ELEVATION:

FIELD DATA				LABORATORY DATA									
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	OTHER TESTS/ COMMENTS	DESCRIPTION OF STRATUM
▨	1	■	P = 2.7	25									Very stiff reddish brown and gray CLAY (CH) with organic matter
▨	2 3	■	P = 2.7	16									Very stiff tan and gray SANDY CLAY (CL) with ferrous nodules
▨	4 5	■	P = 2.7										
▨	6 7	■	P = 2.7	11				122	7.65	4			hard at 6 ft
░	8 9 10	☒	N = 18	6								-200 = 27%	Medium dense tan SILTY SAND (SM) with clay seams at 8.5 ft
░	11 12 13 14 15	☒	N = 13	4									
													Boring terminated at 15 ft

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Hand penetrometer measurements adjusted by a factor of 0.6.
Borehole backfilled with soil cuttings on July 30, 1998.

Paradigm Consultants, Inc.

LOB 8127 8/21.

KEY TO SOIL CLASSIFICATION TERMS AND SYMBOLS

Unified Soil Classification System Symbols

⁘	GW	Well-graded Gravel
⁘	GP	Poorly-graded Gravel
▥	GM	Silty Gravel
▨	GC	Clayey Gravel
⁘	SW	Well-graded Sand
⁘	SP	Poorly-graded Sand
▥	SM	Silty Sand
▨	SC	Clayey Sand
▥	ML	Sandy Silt
▦	ML	Clayey Silt
☰	OL	Organic Silt
▥	MH	Inorganic Silt
▨	CH	Clay
▨	CL	Sandy Clay
▨	CL	Silty Clay
▨	OH	Organic Clay
⁘	PT	Peat
▩	FILL	Fill

Sampler Symbols	Meaning
■	Depth of thin-walled tube sample
☒	Depth of Standard Penetration Test (SPT)
◧	Depth of auger sample
⧄	Depth of sampling attempt with no recovery

Field Test Data

N = SPT Value (blows/ft)
P = Pocket Penetrometer Reading (tsf)
T = Pocket Torvane Shear Strength (tsf)
R = Recovery (%)
RQD = Rock Quality Designation

Terms Describing Soil Structure

Parting	paper thin in thickness
Seam	1/8" to 3" in thickness
Layer	greater than 3" in thickness
Calcareous	calcium carbonate (nodules)
Ferrous	iron oxide (nodules)
Fissured	containing shrinkage cracks, frequently filled with fine sand or silt, usually more or less vertical
Interbedded	composed of alternate layers of different soil types
Laminated	composed of thin layers of varying color and texture
Slickensided	having inclined planes of weakness with slick, glossy appearance

---

RELATIVE DENSITY OF COHESIONLESS & SEMI-COHESIONLESS SOILS
(Major portion retained on No. 200 Sieve)

The following descriptive terms for relative density apply to cohesionless soils such as gravels, silty fine sands, and fine sands as well as semi-cohesive soils such as sandy silts, clayey silts, and clayey sands.

Relative Density	Typical SPT "N" Value Range
Very Loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	Over 50

CONSISTENCY OF COHESIVE SOILS

The following descriptive terms for consistency apply to cohesive soils such as clays, sandy clays, and silty clays.

Typical Unconfined Compressive Strength(tsf)	Consistency
$q_u < 0.25$	Very Soft
$0.25 \leq q_u < 0.50$	Soft
$0.50 \leq q_u < 1.00$	Firm
$1.00 \leq q_u < 2.00$	Stiff
$2.00 \leq q_u < 4.00$	Very Stiff
$q_u \geq 4.00$	Hard

PROJECT: Preliminary Geotechnical Study
Oaklake Estates Tract
Fort Bend County, Texas

CLIENT: Amvest Properties, Inc.
Houston, Texas

PROJECT NO. 98-1090
BORING NO. B-1
DATE 4/27/98

SHEET 1 of

DRILLING METHOD(S):
Boring drilled using dry auger drilling methods to 15 ft, and wet rotary drilling methods from 15 ft to 20 ft.

GROUNDWATER INFORMATION:
Water in open borehole encountered during drilling at about 10.5 ft.

SURFACE ELEVATION:

FIELD DATA				LABORATORY DATA									
					ATTERBERG LIMITS								
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	OTHER TESTS/ COMMENTS	DESCRIPTION OF STRATUM
▨		■	P=1.7	23	75	26	49						Firm to stiff dark gray and brown CLAY (CH) with roots
▨	1	■											
▨	2	■	P=0.9	25				93	0.88	2			
▨	3	■											
▨	4	■	P=2.1	15									Stiff to very stiff tan and gray SANDY CLAY (CL) with roots
▨	5	■											
▨	6	■	P=1.2	17									
▨	7	■											
▨	8	■	P=1.2	18									
▨	9	■											
░	10			▽									Loose to medium dense SILTY SAND (SM)
░	11												
░	12												
░	13												
░	14	☒	N=8										
░	15												
░	16												
░	17												
░	18												
░	19	☒	N=25	21								-200=31%	
	20												Boring terminated at 20 ft

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Hand penetrometer measurements adjusted by a factor of 0.6.
Borehole backfilled with soil cuttings on April 28, 1998.

Paradigm Consultants, Inc.

PROJECT: Preliminary Geotechnical Study
Oaklake Estates Tract
Fort Bend County, Texas

CLIENT: Amvest Properties, Inc.
Houston, Texas

PROJECT NO. 98-1090
BORING NO. B-2
DATE 4/27/98

SHEET 1

DRILLING METHOD(S):
Boring drilled using dry auger drilling methods to 15 ft, and wet rotary drilling methods from 15 ft to 20 ft.

GROUNDWATER INFORMATION:
Water in open borehole encountered during drilling at about 10 ft.

SURFACE ELEVATION:

FIELD DATA				LABORATORY DATA									
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	OTHER TESTS/ COMMENTS	DESCRIPTION OF STRATUM
			P=1.7	24									Firm to stiff reddish brown and gray CLAY (CH) with roots to 1 ft
	1												
	2		P=0.9	18	57	17	40						tan and gray with ferrous nodules below 2 ft
	3												
	4		P=1.7	15									Stiff tan and gray SANDY CLAY (CL) with ferrous and calcareous nodules
	5												
	6		P=2.0	14									
	7												
	8		P=1.1	17				115	1.15	6			
	9												
	10			▽									Medium dense tan and gray SILTY SAND (SM)
	11												
	12												
	13												
	14		N=15	21								-200=27%	with clay seams at 13.5 ft
	15												
	16												
	17												
	18												
	19		N=21										
	20												Boring terminated at 20 ft

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Hand penetrometer measurements adjusted by a factor of 0.6.
Borehole backfilled with soil cuttings on April 28, 1998.

Paradigm Consultants, Inc.

PROJECT: Preliminary Geotechnical Study
Oaklake Estates Tract
Fort Bend County, Texas

CLIENT: Amvest Properties, Inc.
Houston, Texas

PROJECT NO. 98-1090
BORING NO. B-3
DATE 4/27/98

SHEET 1 of

DRILLING METHOD(S):
Boring drilled using dry auger drilling methods to 15 ft, and wet rotary drilling methods from 15 ft to 20 ft.

GROUNDWATER INFORMATION:
Water in open borehole encountered during drilling at about 11 ft.

SURFACE ELEVATION:

	FIELD DATA			LABORATORY DATA									
					ATTERBERG LIMITS								
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	OTHER TESTS/ COMMENTS	DESCRIPTION OF STRATUM
			P=0.8	25									Firm to stiff reddish brown and gray CLAY (CH)
	1												
	2		P=1.1	20									tan and light gray below 2 ft with calcareous nodules below 2 ft
	3												
	4		P=0.9	20	54	15	39						
	5												
	6		P=1.2	16				115	2.33	9			Stiff tan and gray SANDY CLAY (CL) with calcareous and ferrous nodules
	7												
	8		P=1.2	19									
	9												with sand seams at 9 ft
	10												
	11			▽									Medium dense reddish brown and light gray SILTY SAND (SM)
	12												
	13												
	14		N=26	24								-200=64%	with clay seams and layers at 13.5 ft
	15												
	16												
	17												
	18												
	19		N=25	22								-200=12%	
	20												Boring terminated at 20 ft

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Hand penetrometer measurements adjusted by a factor of 0.6.
Borehole backfilled with soil cuttings on April 28, 1998.

LOG 8090 9/3/98

PROJECT: Preliminary Geotechnical Study
Oaklake Estates Tract
Fort Bend County, Texas

CLIENT: Amvest Properties, Inc.
Houston, Texas

PROJECT NO. 98-1090
BORING NO. B-4
DATE 4/27/98

SHEET

DRILLING METHOD(S):
Boring drilled using dry auger drilling methods to 20 ft.

GROUNDWATER INFORMATION:
Water in open borehole encountered during drilling at about 18 ft.

SURFACE ELEVATION:

FIELD DATA				LABORATORY DATA									
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: TONS/SQ FT PERCENT RECOVERY/ ROCK QUALITY DESIGNATION	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	PLASTIC LIMIT PL	PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ FT)	FAILURE STRAIN (%)	CONFINING PRESSURE (POUNDS/SQ IN)	OTHER TESTS/ COMMENTS	DESCRIPTION OF STRATUM
▨		■	P=0.8	33									Firm dark gray CLAY (CH) with roots to 1 ft
▨	1	■											
▨	2	■	P=0.5	25				93	0.62	1			
▨	3	■											
▨	4	■	P=2.1	22									very stiff with ferrous nodules below 4 ft tan and light gray, 4 ft to 13 ft
▨	5	■											
▨	6	■	P=2.4	26	87	25	62						with calcareous nodules below 6 ft
▨	7	■											
▨	8	■	P=2.6	24									
▨	9	■											
▨	10												
▨	11												
▨	12												
▨	13	■	P=2.7+	23									reddish brown and light gray below 13 ft
▨	14	■											
▨	15												
▨	16												
▨	17												
	18		∇										Medium dense tan SILTY SAND (SM)
	19	☒	N=14	21								-200=19%	
	20												Boring terminated at 20 ft

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - POCKET TORVANE SHEAR STRENGTH

REMARKS:
Hand penetrometer measurements adjusted by a factor of 0.6.
Borehole backfilled with soil cuttings on April 28, 1998.

LOB 8090 9/3/98

REPORT NO. 16

DRILLING LOG

FOR INFORMATION ONLY

COUNTY FORT BEND CO.
HIGHWAY NO SH 99
CONTROL 3510-04-002
IPE

STRUCTURE STORM SEWER EXPLORATION
HOLE NO 10
STATION 1042+2339
LOCATION 294.40' RT

THD DIST 12
DATE 6/12/90
GRD. ELEV. 92.1
GRD. WATER ELEV. 84.1 *(Averag

ELEV FT.		LOG	THD PEN. TEST NO. OF BLOWS 1ST 6"	2ND 6"	DESCRIPTION OF MATERIAL		METHOD OF CORING
92.1	0				CLAY,BLACK,BROWN,FERROUS,MOIST	0	
			5 (6.0")	5 (6.0")			
	10		9 (6.0")	9 (6.0")		10	
81.1					SAND,CLAYEY,TAN,SL.COMPACT,MOIST		
78.1					CLAY,SANDY,BROWN,STIFF,W.B.		
			13 (6.0")	8 (6.0")			
76.1					SAND,CLAYEY,BROWN,LOOSE W.B.		
	20					20	

*REMARKS: GWE IS AN AVERAGE VALUE

DRILLER MIKE BAHM
LOGGER AL FARRELL
TITLE ENGR. TECH.III

DRILLING LOG

FOR INFORMATION ONLY

COUNTY	FORT BEND CO.	STRUCTURE	STORM SEWER EXPLORATION	THD DIST	12
HIGHWAY NO	SH 99	HOLE NO	7	DATE	6/12/90
CONTROL	3510-04-002	STATION	1139+11.40	GRD. ELEV.	99.6
IPE		LOCATION	5.63' RT	GRD.WATER ELEV.	91.5 (Average

ELEV FT.		LOG	THD PEN. TEST NO. OF BLOWS 1ST 6"	2ND 6"	DESCRIPTION OF MATERIAL		METHOD OF CORING
99.6	0				CLAY.BLACK.GRAY.BRN.MOIST	0	
			2 (6.0")	3 (6.0")			
	10		5 (6.0")	5 (6.0")		10	
85.6					CLAY.SANDY.GRAY.BRN.VERY STIFF.FER.		
			9 (6.0")	12(6.0")			
	20		10(5.0")	14(6.0")		20	

*REMARKS: GWE IS AN AVERAGE VALUE

DRILLER MIKE BAHM LOGGER AL FARRELL TITLE ENGR. TECH.III

FED. ROAD DIV. NO.	STATE	FEDERAL AID PROJECT NO.	SHEET NO.
6	TEXAS	C 3510-4-2	1

STATE DIST. NO.	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	HIGHWAY NO.
12	FT BEND	3510	04	002	SH 99

INDEX OF SHEETS

NO. DESCRIPTION

SHEET NO. 2 FOR INDEX

STATE OF TEXAS
STATE DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION

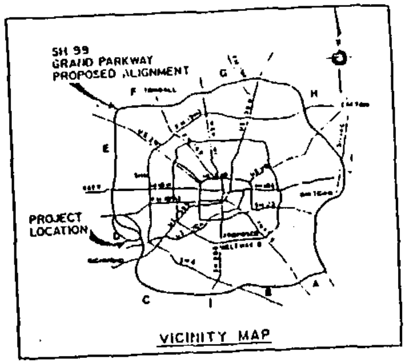
PLANS OF PROPOSED STATE HIGHWAY IMPROVEMENT

STATE PROJECT NO.
C3510-4-2
SCALE AS NOTED

ROADWAY	= 31401.36 FT.	= 5.947 MI.
BRIDGE	= 85.00 FT.	= 0.016 MI.
TOTAL LENGTH	= 31486.36 FT.	= 5.963 MI.

DESIGN SPEED

MAINLANES	60 MPH
FRONTAGE ROADS	45 MPH



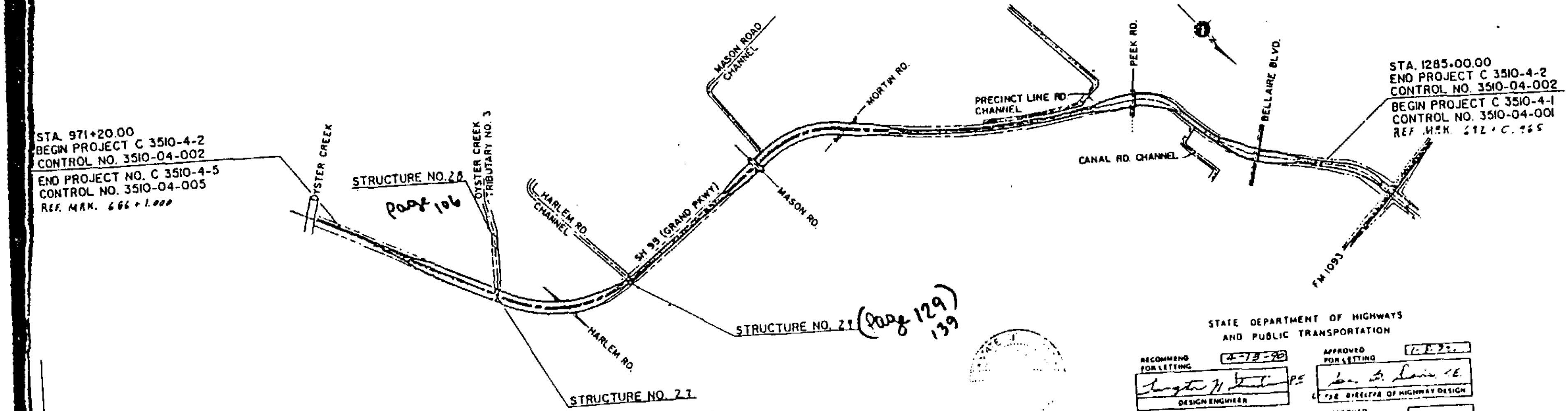
VICINITY MAP

FT. BEND COUNTY
S. H. 99 (GRAND PARKWAY)

LIMITS: NORTH OF OYSTER CREEK TO SOUTH OF FM 1093

CONSTRUCTION OF A NEW LOCATION FREEWAY FACILITY
CONSISTING OF: GRADING, EMBANKMENT, LIME TREATED SUBGRADE, CEMENT STABILIZED BASE, CONTINUOUSLY REINFORCED CONCRETE PAVEMENT, STRUCTURES, STORM SEWERS, PAVEMENT MARKINGS & SIGNING.

FOR INFORMATION ONLY



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(Page 129)
139

Page 105
& 134

LAYOUT SCALE 1" = 1500'

STATE DEPARTMENT OF HIGHWAYS
AND PUBLIC TRANSPORTATION

RECOMMEND FOR LETTING 4-13-90
P.E.
DESIGN ENGINEER

APPROVED FOR LETTING 1-8-92
P.E.
FOR DIRECTOR OF HIGHWAY DESIGN

RECOMMEND FOR LETTING 5/15/90
P.E.
DISTRICT ENGINEER

APPROVED FOR LETTING

BRIDGE ENGINEER

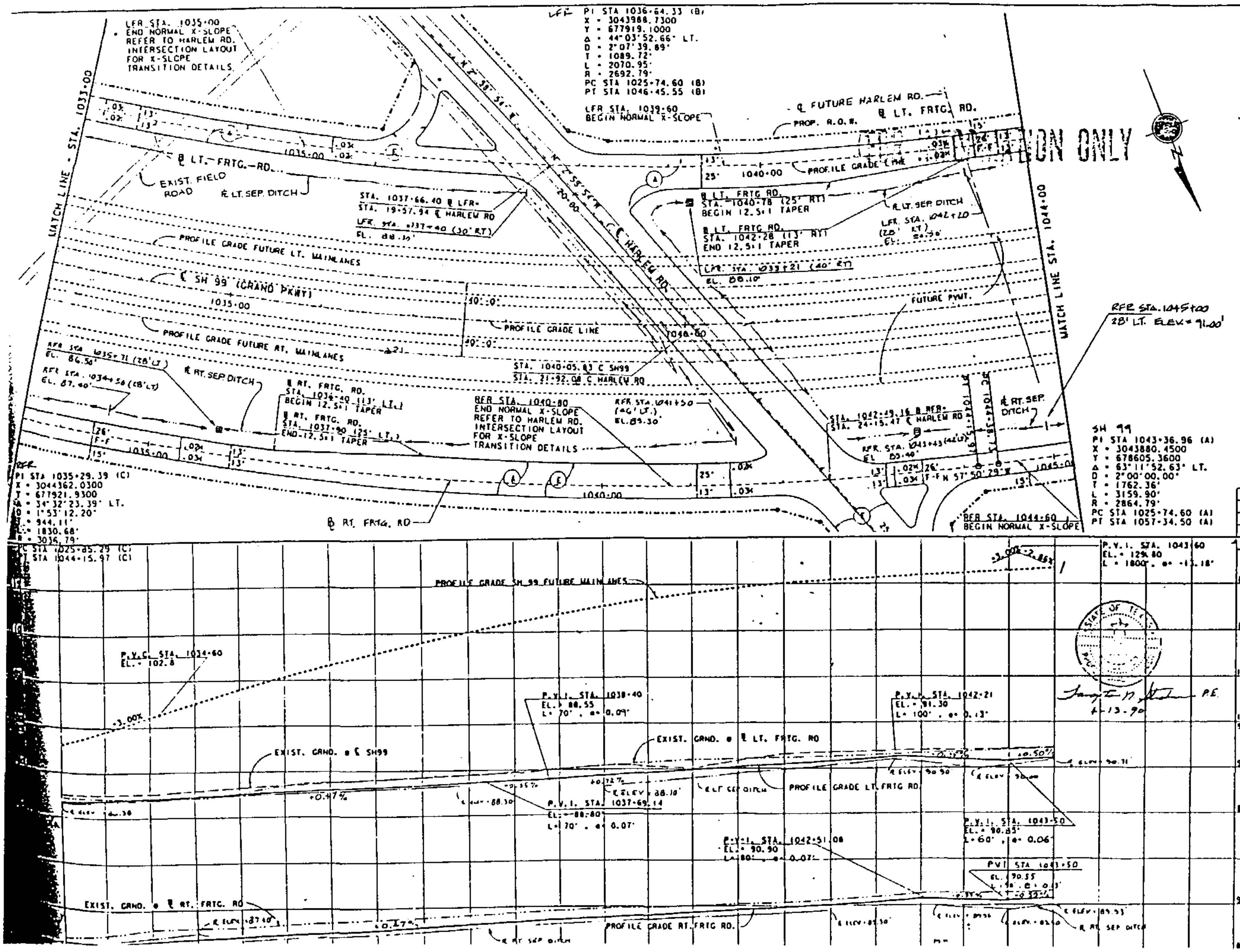
THOSE PLAN SHEETS WHICH REFLECT THE SAME SEAL AND SIGNATURE AS SHOWN BELOW HAVE BEEN PREPARED OR MODIFIED BY.

Russ E. 2/12/90
TURNER COLLIE & BRADEN DATE

SPECIFICATIONS ADOPTED BY THE STATE DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION OF TEXAS SEPTEMBER 1, 1982, AND SPECIFICATION ITEMS LISTED AS FOLLOWS SHALL GOVERN ON THIS PROJECT: SPECIAL LABOR PROVISIONS FOR STATE PROJECTS (000— 60 [illegible])

EXCEPTIONS:	NONE
RAILROAD CROSSING:	NONE
EQUATIONS:	ONE

SH 99 STA. 1057+34.50 BK.
SH 99 STA. 1056+28.4 [illegible]



P.E.
4-13-90

LEGEND

Ⓐ 10" CRCP
Ⓔ 6" MONO CURB
Ⓖ RAIL TY T501 (SPL)
Ⓜ METAL BEAM GUARD FENCE
Ⓝ CL B RIPRAP
Ⓢ BROADCAST SEEDING

▭ BLOCK SOD
▭ EXIST. CONC. PAV. TO BE REMOVED
● R.O.W. MARKER
⬡ TYPICAL SECTION NO.
□ P.I. NO.
▲ BENCH MARK LOCATION

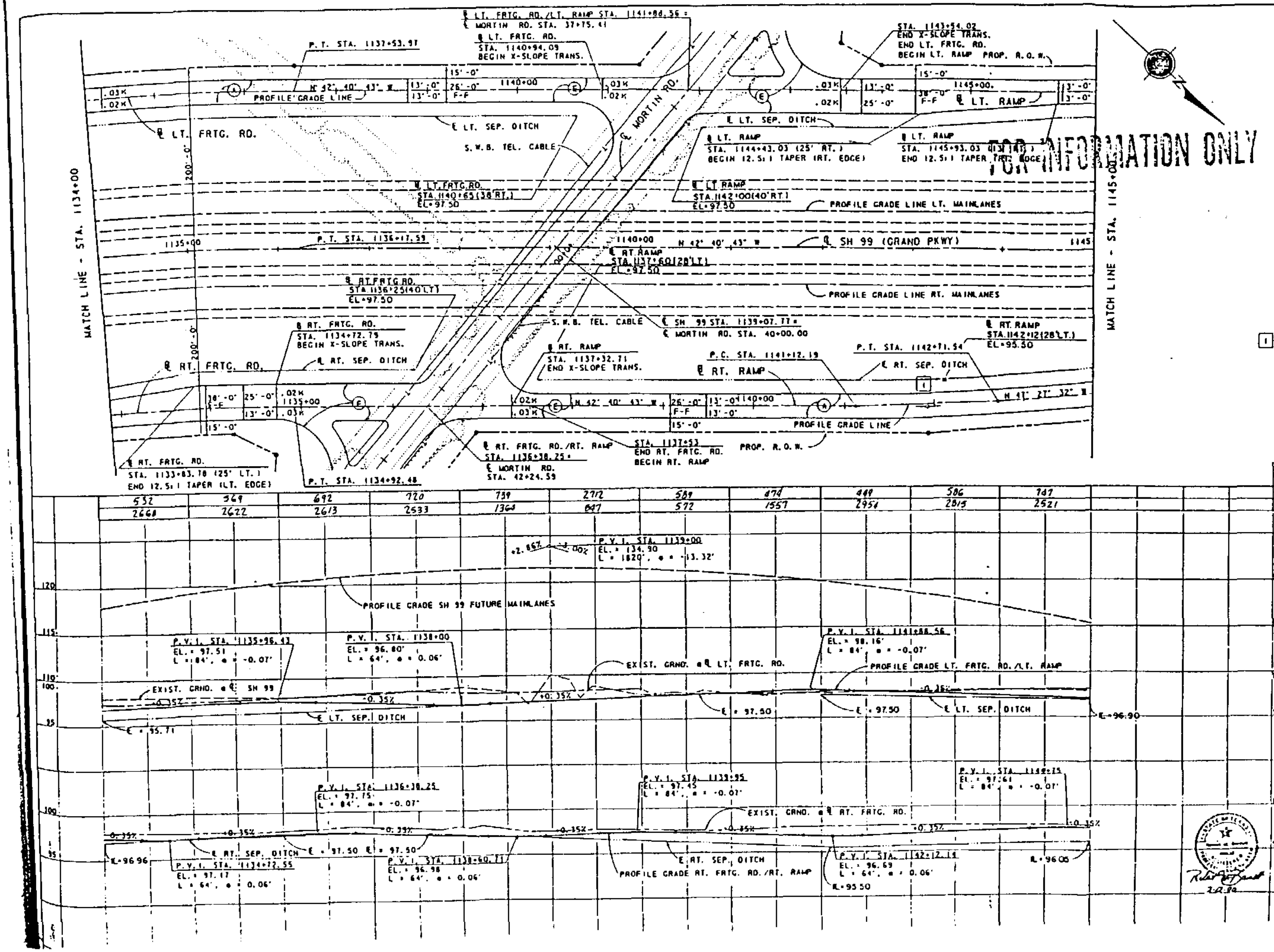
NOTE: REFER TO SHEET 63 FOR HARLEM RD INTERSECTION DETAILS AND LIMITS OF PAT.
SEE STORM SEWER PLAN PROFILE SHEETS FOR TRUNKLINE LOCATION.

SHEET TOTAL			
EST	FINAL	UNIT	
3129		CY	EXCAVATION
614		CY	EMBK DENS CONT (TY C)
8,785		CY	EMBK DENS CONT (TY C)
9,399			

* EMBANKMENT FROM CHANNEL EXCAV.

STATE DEPARTMENT OF HIGHWAYS
AND PUBLIC TRANSPORTATION

SH 99
ROADWAY PLAN & PROFILE
STA. 1033+00 TO STA. 1044+00



FOR INFORMATION ONLY

LEGEND

- Ⓐ 10' CRCP
- Ⓔ 6" MONO CURB
- Ⓖ RAIL TY T501 (SPL)
- Ⓜ METAL BEAM GUARD FENCE
- Ⓝ CL B RIPRAP
- ● R.O.W. MARKER
- 10 P.I. NO.
- ▲ BENCH MARK LOCATION

1 P.I. STA. 1141+91.91 ℄ RT. RAMP
STA. 1143+17.02 (172' RT.) ℄ SH
X = 3034054.5241 Y = 68061
Δ = 4° 46' 49" LT. D = 3° 00
T = 79.72' L = 159.

SHEET TOTAL			
EST	FINAL	UNIT	
8809		CY	EXCAVATI
23066		CY	EMBANKME

BENCHMARK DATA

GP-12 5/8" IRON ROD
℄ SH 99 STA 1135+39
ELEV = 98.65
N = 680207.6007
E = 3034 43.5340

Robert Jarrell
2-2-94

Turner Collie & Brad

STATE DEPARTMENT OF H
AND PUBLIC TRANSPO

SH 99
ROADWAY PLAN & PR
STA. 1134+00 TO STA.

REPORT NO. 17

Texa Hwy Department
Form 11-53-10m

DI ING REPORT

(For Use with sturbed Sampling & Testing)

1 of

County Ft. Bend; Project No. IPE 741; Date 5-18-54; Gnd. Elev. 101'; Sta. No. 28/47

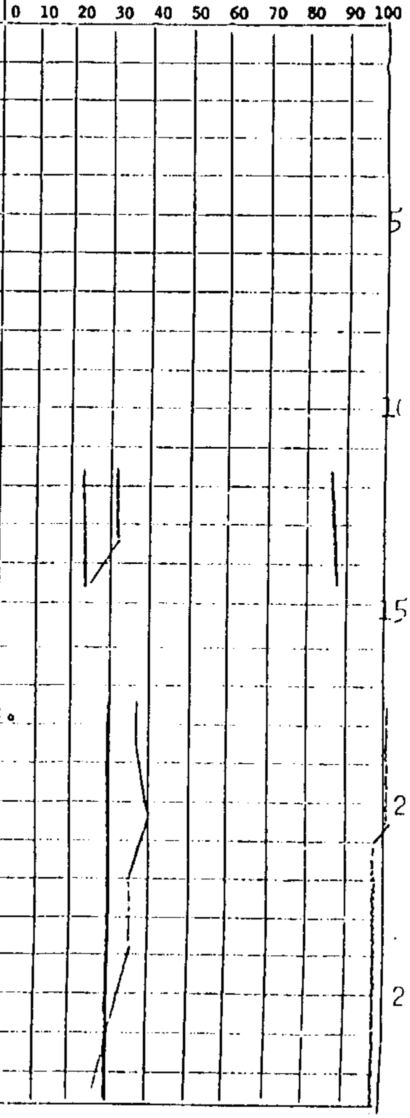
Hwy. No. FM 723; Control 188-9; Stream Xing Brazos River at Rosenberg; Hole No.

FOR INFORMATION ONLY

7.0' Lft of ℄

Depth & Bore Type	Symbol	Lt. Pressure	Sample	Sample Number	Wet Den. #/c.f.	P.I.	Remarks and Description of Stratum
Reamer							
							Disregarded
5							Fill Material.
10							
							160# 5/6 6/6
Denison			0	1-1A			
		0		1-1B	107	63	Brown & black silty clay, highly plastic, (may be fill mat'l)
				1-2A			Brown silty sand, disturbed.
15				1-2B		NP	
				1-3			Same as above sample.
		0		1-4	104	84	Black highly plastic clay, slightly silty-very small calc. nodules, slickensided.
		5		1-5A	103		Same as above sample.
20		10		1-5B	104		
							200# 6/6 7/6
		15		1-6	108	67	Brown & gray slightly silty clay-highly plastic, slick.
25		0		1-7A	108		Same as above sample.
			0	1-7B			
		5		1-8A	111		Same as above sample.

Liquid Limit
Moisture Ct. %
Plastic Limit



Driller Cleveland

Inspector Knutson

87788-1153-10m

Texas Highway Department
Form 534 11-53-10m

DRILLING REPORT

(For Use with Undisturbed Sampling & Testing)

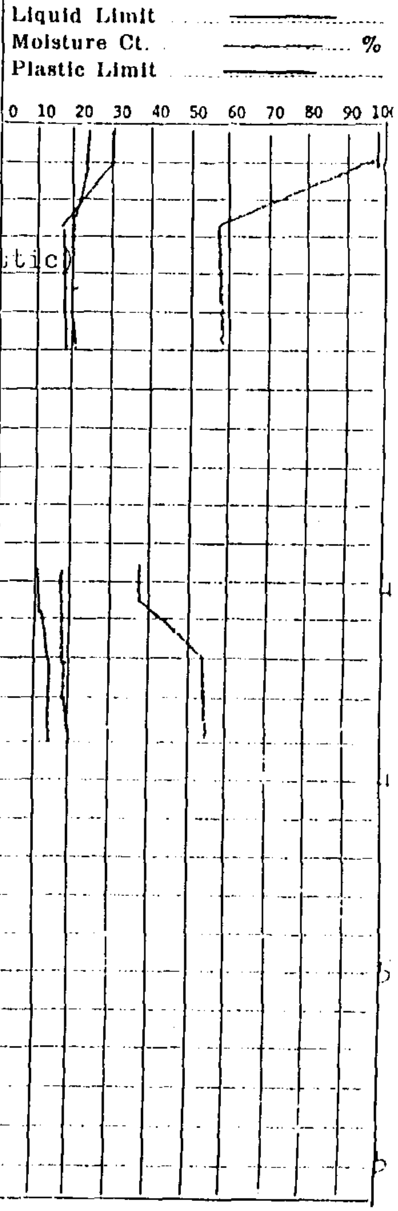
Sheet 2 of 3.

FOR INFORMATION ONLY

County Ft. Bend ; Project No. IPE 741 ; Date 5-18-54 ; Gnd. Elev 100' ; Sta. No. [illegible]

Hwy. No. FM-723 ; Control 188-9 ; Stream Xing Brazos River at Rosenberg ; Hole No. 1

	Depth & Bore Type	Symbol	Lt. Pressure	Sample	Sample Number	Wet. Den. #/c.f.	P. I.	Remarks and Description of Stratum
	Denison			0	1-8B			Brown & gray silty clay, highly plastic, slickensided.
30								250# 7/6 9/6
			0		1-9	115	35	Brown & gray slightly sandy clay, may have some silt?Plastic)
			5		1-10A	119		Tan & gray mottled sandy clay, plastic.
			0		1-10B	116		Tan & gray very sandy clay - plastic.
35					1-11A		9	Tan & gray sand some silt. Moist.
					1-11B			Gray sand with some silt, moist.
			0		1-12A	117		Brown & gray slightly sandy clay, lot of calc. material.
			5		1-12B	120	27	Plastic, some silt.
			10		1-13A	120		Brown & gray silty clay, calc. material-may have some
40			0		1-13B	120		silt or fine sand.
								280# 12/6 14/6
					1-14A		41	Brown slightly sandy clay-gray spots, scattered small
					1-14B			calc. nodules.
45			0		1-15	116	7	Brown sand-some silt & calc. material.
					1-16A		NP	Brown sand some silt & may have a little clay.
					1-16B			
					1-17A		..	Brown sand and some shaley clay.
					1-17B			Brown sand & silt-almost water bearing.
50					(Lost Sample)			Same as above.
					(picked up with			reamer)Brown & gray sandy clay with some calc. material.
								at 51.0'.
								320# 25/6 53/6 (May have hit some calc. mat'l)
					1-18A		6	Brown sand with some silt.
55					1-18B			4.0" layer of brown clay & sand & graygravel at bottom
								Lost samples, mostly sand with pockets of silty clay.



D[illegible] Cleveland

Inspector Knutson

153-10m

Tex ghway Department
For 11-53-10m

D' LING REPORT
(For Use with isturbed Sa & Testing)

FOR INFORMATION ONLY

3 of 3

County Ft. Bend; Project No. IPE 741; Date 5-18-54; Gnd. Elev. 100'; Sta. No. 28/47

Hwy. No. FM 723; Control 188-9; Stream Xing Brazos River at Rosenberg; Hole No. 1

Depth & Bore Type	Symbol	Lt. Pressure	Sample	Sample Number	Wet. Den. #/c.f.	P. I.	Remarks and Description of Stratum	Liquid Limit / Moisture Ct. % / Plastic Limit (0 10 20 30 40 50 60 70 80 90 100)
Denison							Same as above sample.	
				1-19A			Tan course water bearing sand and pea gravel.	
				1-19B				
60								
							360# 20/6 16/6	
				1-20		NP	Tan water bearing sand.	
65								65

Driller Cleveland

Inspector Knutson

87788-1153-10m

Texas Highway Department
Form 554 11-53-10m

DRILLING REPORT
(For Use with Undisturbed Sampling & Testing)

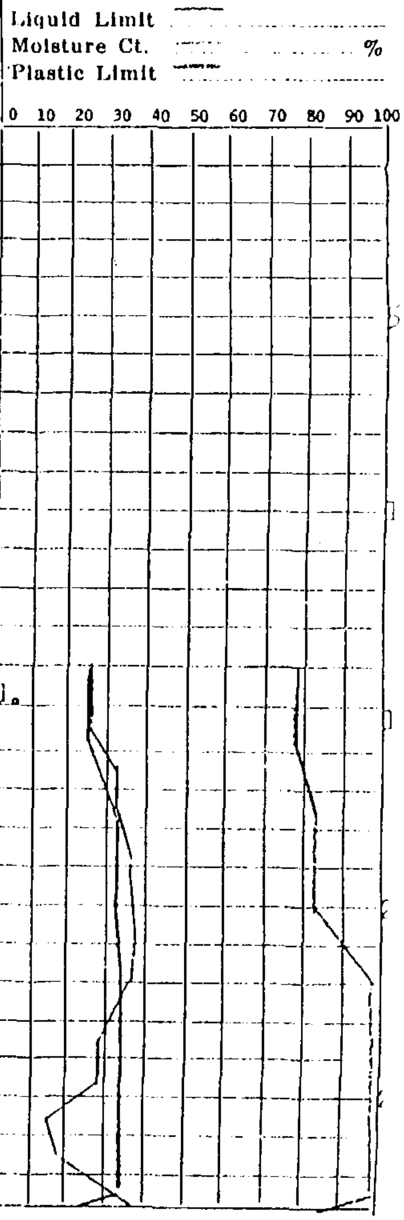
FOR INFORMATION ONLY

Sheet L of 3

County Ft. Bend; Project No. IPE 741; Date 5-24-54; Gnd. Elev. ; Sta. No. 3

Hwy. No. FM 723; Control 188-9; Stream Xing Brazos River; Hole No. 3

	Depth & Bore Type	Symbol	Lt. Pressure	Sample	Sample Number	Wet. Den. #/c.f.	P. I.	8.0' Lft. of ℄ Remarks and Description of Stratum
	Reamer							Tan dry silt & fine sand.
5	Denison				3-1A			Tan dry silt & fine sand.
					3-1B		NP	
					3-2A			Same as above sample.
10					3-2B			
					3-3A			Same as above sample.
					3-3B			
								160# 10/6 9/6
					3-4A		52	Brown plastic clay, very small calc. nodules-slickensided.
15					3-4B			Sheared in barrel, may have slight amount of silt.
					3-5A		51	Same as above sample.
			15		3-5B	107		
			0		3-6A	108		Same as above sample.
20			5		3-6B	108		
			10		3-7A	104	64	Brown & dark gray mottled highly plastic clay-very small
			0		3-7B	107		calc. nodules - slickensided.
							200#	8/6 9/6
			15		3-8A	115		
25			5		3-8B	115		Brown highly plastic clay, may be slightly silty-very
								small scattered calc. nodules.
				0	3-9A			Same as above sample.
			0		3-9B	111	61	



Cleveland

1153-10m

Inspector Knutson

Texa hway Department
Forr 11-63-10m

DR ING REPORT

(For Use wit turbed Sampling & ng)

FOR INFORMATION ONLY

Sh t 2 of 3

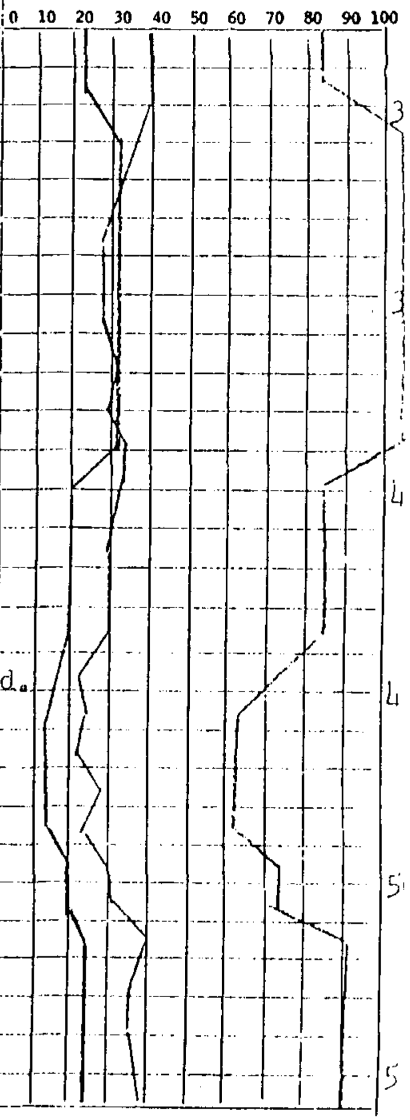
County Ft. Bend; Project No. IPE 741; Date 5-24-54; Gnd. Elev. 88.0; Sta. No.

Hwy. No. FM 723; Control 188-9; Stream Xing Brazos River; Hole No. 3

8.01 Lft. of C

Depth & Bore Type	Symbol	Lt. Pressure	Sample	Sample Number	Wet. Den. #/c.f.	P. I.	Remarks and Description of Stratum
Denison		15		3-10A	108		Dark gray silty clay, highly plastic, some fine sand.
30		10		3-10B	107	75	Slickensided.
		5		3-11A	107		Same as above sample.
			0	3-11B			
							240# 6,6 7/6
		15		3-12A	114		
35			0	3-12B			Dark gray & brown clay, slightly sandy-slickensided. Small scattered calc. nodules.
		10		3-13A	108		Same as above sample.
		0		3-13B	109		
			0	3-14A			Same as above sample.
40		5		3-14B	112	65	
							280# 7/6 7/6
		15		3-15A	111		
		10		3-15B	111		Dark gray & brown clay-slightly sandy and slickensided. Small scattered calc. nodules.
		15		3-16A	115	50	
45		0		3-16B	115		Brown & gray mottled slightly sandy clay, small scattered. calc. nodules.
				3-17A			Brown & gray mottled sandy clay, plastic-disturbed-some calc. material.
				3-17B			
		15		3-18A	110		Same as above sample.
		5		3-18B	110	53	
50		15		3-19A	110		
		0		3- 19B	106	67	Dark gray slightly silty clay, highly plastic.
							320# 7/6 9/6
		10		3-20A	111		Same as above sampoe.
55		5		3-20B	107		

Liquid Limit
Moisture Ct. %
Plastic Limit



Driller Cleveland

Inspector Knutson

87788-1153-10m

Texas Highway Department
Form 554 11-53-10m

DRILLING REPORT

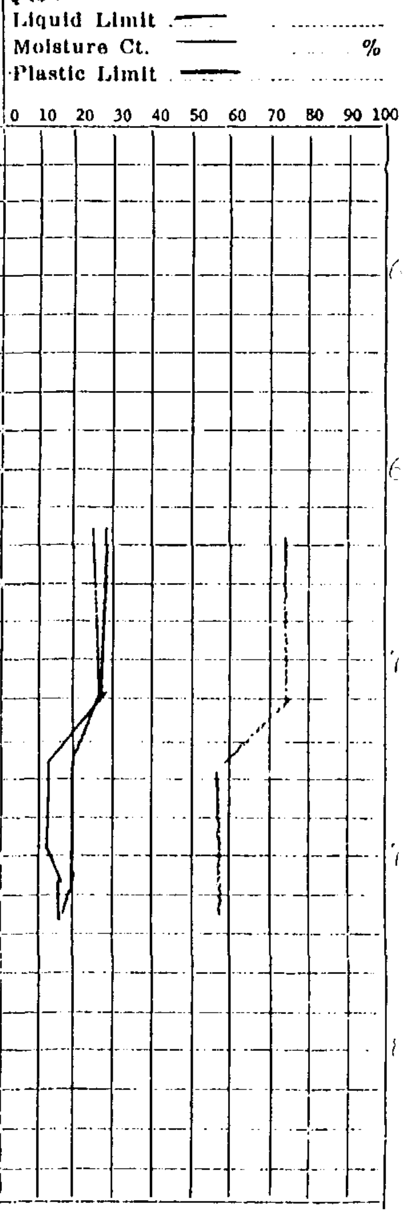
(For Use with Undisturbed Sampling & Testing)

Sheet 3 of 3

County Ft. Bend ; Project No. IPE 741 ; Date 5-24-54 ; Gnd. Elev. 88.0' ; Sta. No. 35/43
Hwy. No. FM 723 ; Control 188-9 ; Stream Xing Brazos River ; Hole No. 3

FOR INFORMATION ONLY

Depth & Bore Type	Symbol	Lt. Pressure	Sample	Sample Number	Wet. Den. #/c.f.	P.I.	8.0' Lft. C L Remarks and Description of Stratum
Denison		15		3-21A		43	Brown plastic clay-some silt scattered calc. nodules.
				3-21B		NP	Tan water bearing sand & silt.
				3-22A			Tan water bearing coarse sand.
				3-22B			Some small gravel.
60							
				3-23A			Same as above sample.
				323B		NP	
							360# 18,6 17/6
65							Lost sample.
							Sand.
		15		3-24A	117	47	Brown clay, gray lines, slightly slickensided-3.0" layer
			0	3-24B			of hard sandstone.
70				3-25A			Same as above sample - disturbed.
				3-25B			
							400# 11/6 14/6
				3-26		46	Greenish gray & brown slightly sandy clay.
		10		3-27A	115		
75		15		3-27B	116	42	Brown & bluish gray mottled slightly sandy clay, small scattered calc. nodules, slightly slickensided.
		0		3-28A	120		Same as above sample.
			0	3-28B			Brown sand & silt with some clay & shale.
				3-29A		NP	Brown packed sand & silt layer of sandstone.
80				3-29B			
				3-30A			Brown fine water bearing sand & silt.
				3-30B		NP	
							440# 40/6 60/5.75



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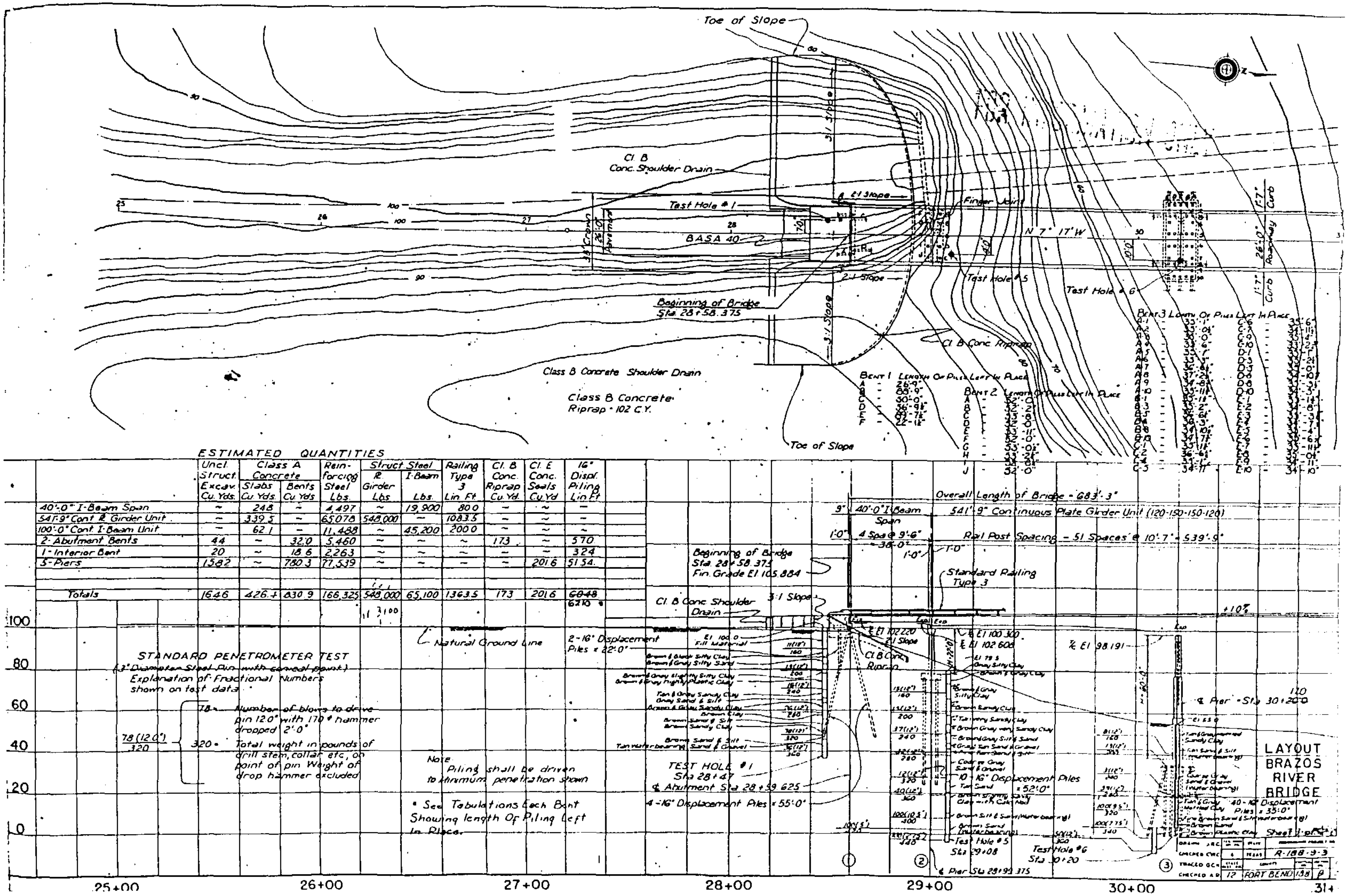
Inspector Knutson

1153-10m



LAYOUT BRAZOS RIVER BRIDGE

STANDARD PENETROMETER TEST

~~(3" Diameter Steel Pin with conical point)~~

Explanation of Fractional Numbers shown on test data

78 (12.0")
320

78 - Number of blows to drive pin 12.0" with 170 # hammer dropped 2'-0"

320 - Total weight in pounds of drill stem, collar, etc., on point of pin. Weight of drop hammer excluded

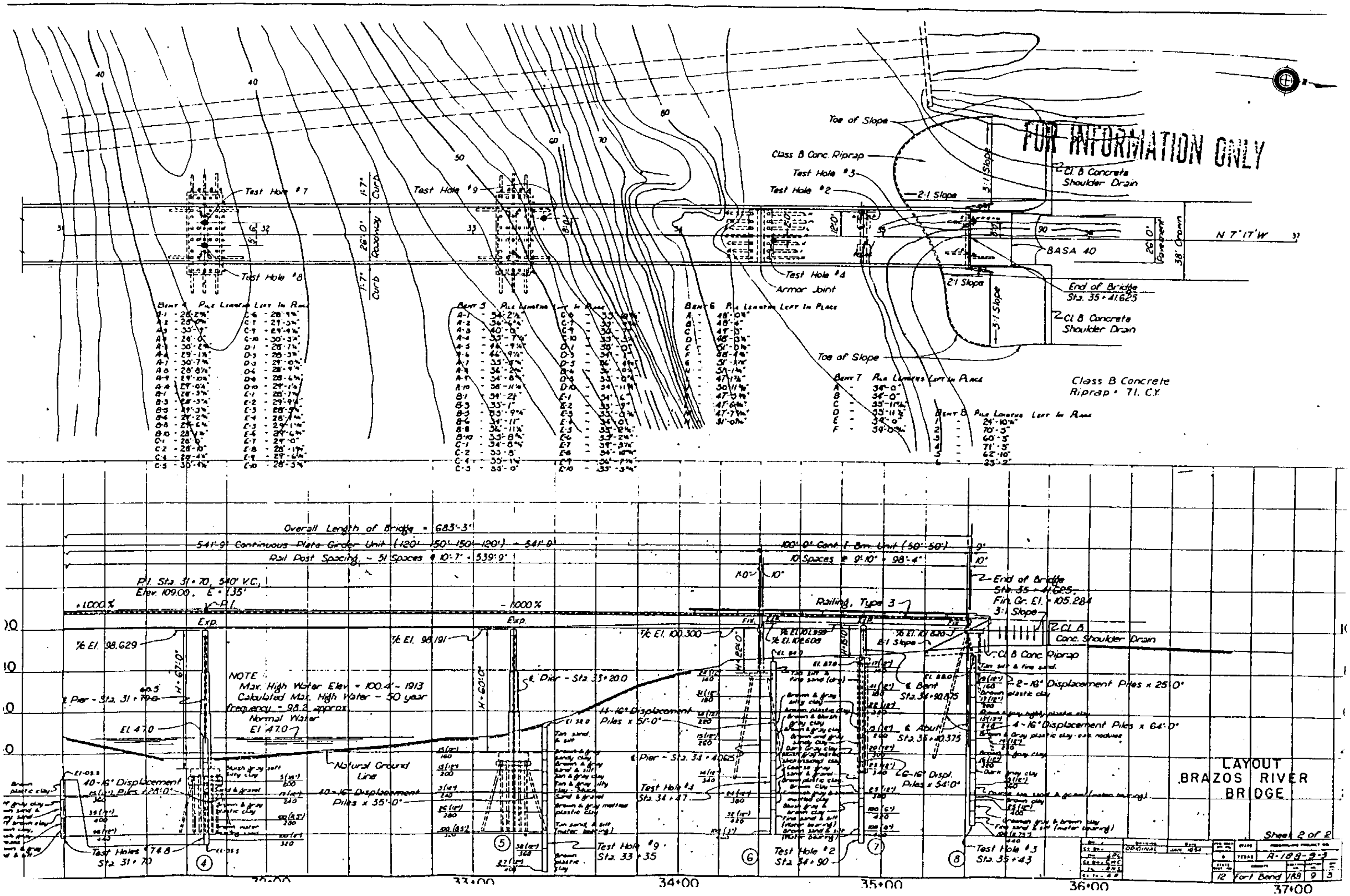
Note: Piling shall be driven to minimum penetration shown

* See Tabulations Each Bent Showing length Of Piling Left In Place.

ESTIMATED QUANTITIES

	Uncl. Struct. Excav. Cu. Yds.	Class A Concrete Slabs Cu. Yds.	Class A Concrete Bents Cu. Yds.	Reinforcing Steel Lbs.	Struct. Steel ℞ Girder Lbs.	Struct. Steel I-Beam Lbs.	Railing Type 3 Lin. Ft.	Cl. B Conc. Riprap Cu. Yd.	Cl. E Conc. Seals Cu. Yd.	16" Displ. Piling Lin. Ft.
40'-0" I-Beam Span	~	24.8	~	4,497	~	19,900	80.0	~	~	~
541'-9" Cont. ℞ Girder Unit	~	339.5	~	65,078	548,000	~	1083.5	~	~	~
100'-0" Cont. I-Beam Unit	~	62.1	~	11,488	~	45,200	200.0	~	~	~
2-Abutment Bents	44	~	32.0	5,460	~	~	~	173	~	570
1-Interior Bent	20	~	18.6	2,263	~	~	~	~	~	324
5-Piers	1582	~	780.3	77,539	~	~	~	~	201.6	5154.
Totals	1646	426.4	830.9	166,325	548,000	65,100	1363.5	173	201.6	~~6048~~ 6210

FOR INFORMATION ONLY



CULTURAL RESOURCE INVESTIGATIONS

THE CUMMINGS ROAD WSC AREA

and

THE FOUR CORNERS WSC AREA

BC & AD Archaeology, Inc.
5380 W. 34th Street, Suite 223
Houston, Texas 77092

for

Rust Environment & Infrastructure, Inc.
2929 Briarpark Dr., Suite 600
Houston, Texas 77042

October, 1998

INTRODUCTION

Rust Environmental & Infrastructure Inc. (RUST) is conducting feasibility studies for Fort Bend County for water/wastewater treating systems in the Four Corners WSC and the Cummings Road WSC project areas, Figures I and II respectively. RUST has contracted BC & AD Archaeology, Inc. (BCAD) to determine the potential presence of cultural resources in the areas that could be eligible for inclusion in the National Register of Historic Places or warrant designation as Texas State Archaeological Landmarks.

ENVIRONMENTAL BACKGROUND

The Colorado, Brazos, Trinity, Neches and Sabine Rivers originate north of the Texas Coastal Plain. They flow southward through the plain to the Gulf of Mexico. These rivers are pre-Pleistocene in age. Smaller creeks such as the Oyster Creek and Jones Creek developed during the Pleistocene and parallel the major waterways. Fort Bend County is located in the Western Gulf section of the Coastal Plain.

Fort Bend County's location in the Western Gulf section of the Coastal Plain places it within a subtropical belt. The modern climate is characterized by high humidity. The biggest factor controlling the regional climate is the Gulf of Mexico. Summers are hot and humid and winters are generally mild (Story, 1990). The mean annual temperature of the area is 20 degrees centigrade with a mean average rainfall of 46.1 inches. Prevailing winds are south and southeast, except during the winter when fronts shift the wind from the north. The modern climate is generally considered to be similar to the climate that existed 5,000 years ago.

The flora and fauna of the project areas when first settled could include openland, woodland and wetland habitats. The following are excerpt from a book by A. A. Parker (1835).

> "..list of the forest trees, shrubs, vines i.e. red, black, white, willow; post and live oaks; pine, cedar, cottonwood, mulberry, hickory, ash, elm, cypress, box-wood, elder, dogwood, walnut, pecan, moscheto-a species of locust, holly, haws, hackberry, magnolia, chinquspin, wild peach, suple jack, cane brake, palmetto, various kinds of grapevines, creepers, rushes, Spanish-moss, prairie grass and a great variety of flowers....
>
> ...Then there are bear, mexican hog, wild geese, rabbits and a great variety of ducks..."

Wild herbaceous plants that were native to these area include bluestem, indiangrass, croton, beggerwood, pokeweed, partridgepea, ragweed and fescue. Examples of native hardwood trees would be oak, mulberry, sweetgum, pecan, hawthorn, dogwood, persimmon, sumac, hickory, black walnut, maple and greenbrier. Coniferous plants included red cedar and coast juniper. Shrubs included American beauty berry, farkleberry, yaupon and possumhaw. Wetland plants such as smartweed, wild millet, bulrushes, saltgrass and cattail are native to the area (U.S. Department of Agriculture, 1976).

This vegetative environment supported wildlife such as bear, rabbit, red fox, deer, coyotes, raccoon, opossum, muskrat, beaver, alligator, armadillo, squirrel, and skunk. A wide variety of birds were present such as quail, dove, prairie chicken, song birds, herons and kingfishers. The area was also a winter home for a number of migratory birds such as geese, ducks, egrets, coots, etc. (U.S. Department of Agriculture, 1976).

HISTORICAL BACK GROUND

The wide variety of native floral and faunal resources supported an indigenous population in Fort Bend County. When Cabeza de Vaca, a survivor of the Narvaez expedition to colonize southern Florida, was shipwrecked in 1528 on what has often been identified as Galveston Island (probably Oyster Bay Peninsula), he was met by the native Americans of the area (Krieger, 1959). The group of native Americans were part of the Karankawa group that was probably made up of at least five tribes (Aten, 1983). There were three other related native groups on the upper Texas coast at that time; the Akokisa who occupied the Galveston Bay area northward to Conroe and east to approximately Beaumont; the Atakapa who occupied the area east of Beaumont into western Louisiana; and the Bidai who occupied the territory north of the Akokisa which included the Huntsville and Liberty areas (Aten, 1983). From the ethnohistoric records as well as the archaeological information, the groups were hunting and gathering peoples (Hester, 1980; Aten, 1983; Story, 1990). From ca. 3000 BC to AD 100, no important technological or social advances have been identified among the Native American groups. From AD 100 to AD 800, ceramics were being used, the bow and arrow was introduced and there was some recognition of territorial boundaries indicating social structure. From AD 800 until contact, there was refinement in ceramic production and increased use of the bow and arrow.

At the time of contact, the sociopolitical structure of the groups would be classified as tribes (Aten, 1983). During the warm seasons, they were dispersed in band sized groups. They gathered into villages during the colder seasons with populations ranging from 400 to 500. Cabeza de Vaca's account of these groups was that they lived in a state of starvation the year around even though they had access to all of the marine resources of a coastal environment. Cabeza de Vaca lived in this area for six years and became a trader for the Native Americans, bartering sea shells and other coastal products for hides and lithic resources from inland groups (Newcomb, 1961). The archaeological record indicates that ceramics appeared with the Atakapa in 70 BC, with the Akokisa in AD 100, with the Karonkawa in AD 300 and with the Bidai in AD 500. The origin of this ceramic technology would appear to be the Lower Mississippi Valley and was adopted from east to west over time (Aten, 1983).

Some of the project areas in Fort Bend County were part of the original Stephen F. Austin colony. Their location along the Brazos River was advantageous, as it was easily navigated which gave ready access to the Gulf of Mexico.

METHODOLOGY

BCAD conducted archival research on the project areas prior to field surveys at the Texas Archaeological Research Laboratory (TARL) and the General Land Office in Austin, Texas; at the Fort Bend County Museum; and at the Texas Room of the Houston Public Library. The files of National Register of Historic Places, National Register of Eligible Sites and the Texas State Archaeological Sites were reviewed. The General Land Office provided information on the original Spanish land grants and owners of the project areas. Early Texas history was reviewed as well as the biographies of the original owners of the land tracts. Aerial photographs were studied to determine more recent land use.

BCAD conducted reconnaissance surveys of the project areas on September 22, 1998 to the extent of ready accessability to the areas. Natural drainage channels were located because the banks of waterways were frequently preferred for campsites by prehistoric peoples.

The architecture of those existing buildings that could meet the requirements for inclusion in the National Register of Historic Places was examined. The structure must be fifty years old and meet one or more of the following requirements:

1. The structure is associated with events that have made a significant contribution to the broad patterns of history.

2. The structure is associated with the lives of persons significant in our past.

3. The structure is important to a particular cultural or ethnic group.

4. The structure is the work of a significant architect, master builder, or craftsman.

5. The structure embodies the distinctive characteristic of a type, period, or method of construction,

possesses high aesthetic value, or represents a significant and distinguishable entity whose components may lack individual distinctions.

6. The structure has yielded or may be likely to yield information important to the understanding of Texas culture or history.

RESULTS

CUMMINGS ROAD SITE

Archival Research - Figure III presents the Richmond, Texas U.S. Geological Survey Map with the Cummings Road project area superimposed. Research at TARL indicated no previously recorded archaeological sites on the project area. However, two prehistoric sites (41FB252 and 41FB250) have been recorded nearby.

The Cummings Road project area is located on the original Spanish land grants of William Andrews and Samuel Isaacks in 1824 (General Land Office, 1895). Both men were part of the "Old Three Hundred" of Stephen F. Austin's first colony. William Andrews evidently sold his league shortly after coming to Texas and then left the area. Samuel Isaacks was born April 25, 1803. He arrived in Texas (1822) about the same time as Austin.. He did not live many years on his original grant in Fort Bend County. He sold his league to Jesse H. Cartwright in 1830 before the Texas Revolution and moved to Bernard. He served in the Jasper volunteers in the Texas revolution, perhaps at San Jacinto and therefore he was living in Jasper County where his father and siblings had settled (Wharton, 1939). There is no archival evidence that either Andrews or Isaacks built plantations or habitations in the project area. Jesse H. Cartwright, however, did build his home on the original Isaacks league but it was located north at the head of Oyster Creek and is currently still in existence. Jesse Cartwright was also a member of the original Austin colony. He helped buy supplies during the Texas Revolution and represented the area in the House of the First Congress. He became a prominent business man and realtor (Tyler, 1996).

Since first settled, the main land use of the project area has been for growing crops (corn, cotton, potatoes and sugar cane) and/or for grazing cattle and horses (Lapham Letters, 1909). A 1956 aerial photograph, Figure IV, shows that the entire project area has been under cultivation for some time (Fort Bend Soil Survey, 1956). Two houses exist on this photograph that are also present in Figure III, both located close to the bank of the Brazos River.

Field Survey - The highest potential for prehistoric sites in this area is along the high banks over looking the Brazos River and the western bank of a drainage channel just east of the Tinsley Estates. Limited access to the banks of the Brazos River prevented a walk-through survey of this area of potential prehistoric sites. Both the field survey and the aerial photographs indicate that the Tinsley Estate area has been heavily impacted by cultivation as well as construction since 1956. The two houses that meet the age requirement for the National Register of Historic Places were examined and neither would qualify based on any of the other requirements. There was no visual evidence of any remains of pre-existing historic structures on the rest of the project area which has also been heavily impacted by cultivation and new construction.

FOUR CORNERS SITE

Archival Research - Figure V presents the Clodine, Texas U.S. Geological Survey Map with the Four Corners project area superimposed. Research at TARL indicated no previously recorded archaeological sites on the project area. However, nine prehistoric sites (41FB201, 41FB202, 41FB203, 41FB210, 41FB214, 41FB215, 41FB216, 41FB217 and 41FB221) have been recorded around the northern shores of White Lake located approximately a mile to the south of the project area.

Figure VI presents the Four Corners project area drawn on a Fort Bend County map from the General Land Office showing the original owners of the land. They include Jesse H. Cartwright, Mills M. Battle, D. A. Conner, John Leverton, Andrew M. Clopper and the I. & G.N. RR Co. Jesse H. Cartwright has been discussed in the history of the Cummings Road project area. Mills M. Battle was also a member of the "Old Three Hundred" of the Austin colony. He is listed as a contractor and carpenter in business. He was at various times, justice of the peace, deputy clerk of the probate court, notary public and county clerk in Fort Bent County. He helped nominate Sam Houston for President of the Republic of Texas in 1841 (Tyler, 1996). No background information could be located for D. A. Connor and John Leverton. Andrew M. Clopper was the son of Nicholas Clopper. Nicholas Clopper joined the Austin colony in 1822 and was instrumental in developing a trade route using Buffalo Bayou. Nicholas was responsible for the acquisition of the "Twin Sisters" used in the Battle of San Jacinto (Tyler, 1996). Andrew was a courier for President David Burnett during the Texas Revolution and later worked as a surveyor in the general area (Lapham Letters, 1909). Also shown on Figure VI is the estimated route of General Santa Anna on April 14th and 15th of 1836 on his way to Harrisburg and eventually, the Battle of San Jacinto (Wharton, 1939). This route was reconstructed using the personal narrative of Jose Enrique de la Pena as well as recollections handed down from eye witness accounts. Santa Anna crossed the Brazos River on April 14th, 1836 at Thompsons Ferry, moved north crossing Jones Creek and supposedly made camp at nightfall on the western Andrew Clopper land tract. By noon on April 15, 1836, he had moved southeast and burnt the plantation of William Stafford (located just east of the George Brown and Charles Belknap tract) which has been documented historically. This route on the morning of April 15th could have taken him across the southern portion of the Four Corners project area. The actual route has not been firmly documented historically or archaeologically (Jeff Dunn, personal communication, 1998).

There is no archival evidence that any of the original owners of the land built plantations or habitations in the project area. In the case of Battle and Cartwright, it is more likely that their residences would have been built on Oyster Creek, south of the project area. Since first settled, the main land use of the project area has been for growing crops (corn, cotton potatoes and sugar cane) and/or for grazing cattle and horses (Lapham Letters, 1909). A 1956 aerial photograph, Figure VII, shows that the entire project area has been under cultivation at some time (Fort Bend Soil Survey, 1956). Approximately, thirty houses exist on this photograph that are also present in Figure V.

Field Survey - The highest potential for prehistoric sites in this area is along the banks of Keegans Bayou located behind the Kingbridge Development in the upper northeast section of the area and the banks of two drainage channels, one in the northwestern section of the project area (Figure V) which drains into Red Gully in the southwest section of the project area. Keegans Bayou appears to have been rerouted to its present location and the area has been extensively modified by new construction. Limited access to the banks of the drainage channels prevented a complete walk-through survey of these areas for potential prehistoric sites. However, limited observations during the field survey and the aerial photographs indicate that the northwest drainage channel has been heavily impacted by cultivation as well as construction since 1956. Visual observations indicate that the banks of Red Gulch have been extensively modified from the southwestern point adjacent to the land fill to the southern edge of the project area by landfill operations and construction. Visual observations and the aerial photographs indicate that the banks of the western extension of Red Gulch to the western boundary of the project area have been impacted by cultivation.

The remaining houses that meet the age requirement for the National Register of Historic Places were examined and only one could possibly qualify based on any of the other requirements. This is the residence at 9427 Gaines Road. There was no evidence of any remains of preexisting historic structures on the rest of the project area which has also been heavily impacted by cultivation and new construction based on limited visual observations and the aerial photographs.

DISCUSSION AND CONCLUSIONS

CUMMINGS ROAD SITE

No structures were located that have the potential to qualify for the National Register of Historic Places. However, since the banks of rivers and other waterways were preferred by prehistoric peoples as locations for campsites, the banks of the Brazos River should be avoided. If the proposed project should affect these areas, further archaeological work could be necessary.

FOUR CORNERS SITE

The residence at 9427 Gaines Road could possibly qualify for the National Register of Historic Places. Avoidance of this structure is recommended.

The archival research has indicated that there is a probability that the southern portion of the Four Corners area was crossed by Santa Anna's army during the Texas Revolution. There is, however, little probability of finding significant archaeological deposits associated with this event because the army marched rather quickly between the previous night's campsite and Stafford's plantation. It might be possible to find isolated artifacts, but nothing that would add to the better understanding of Texas history. It is unlikely that any further archaeological studies would be required concerning this event. However, if during construction of the proposed projects artifacts relating to this event are found, an archaeologist should be contacted.

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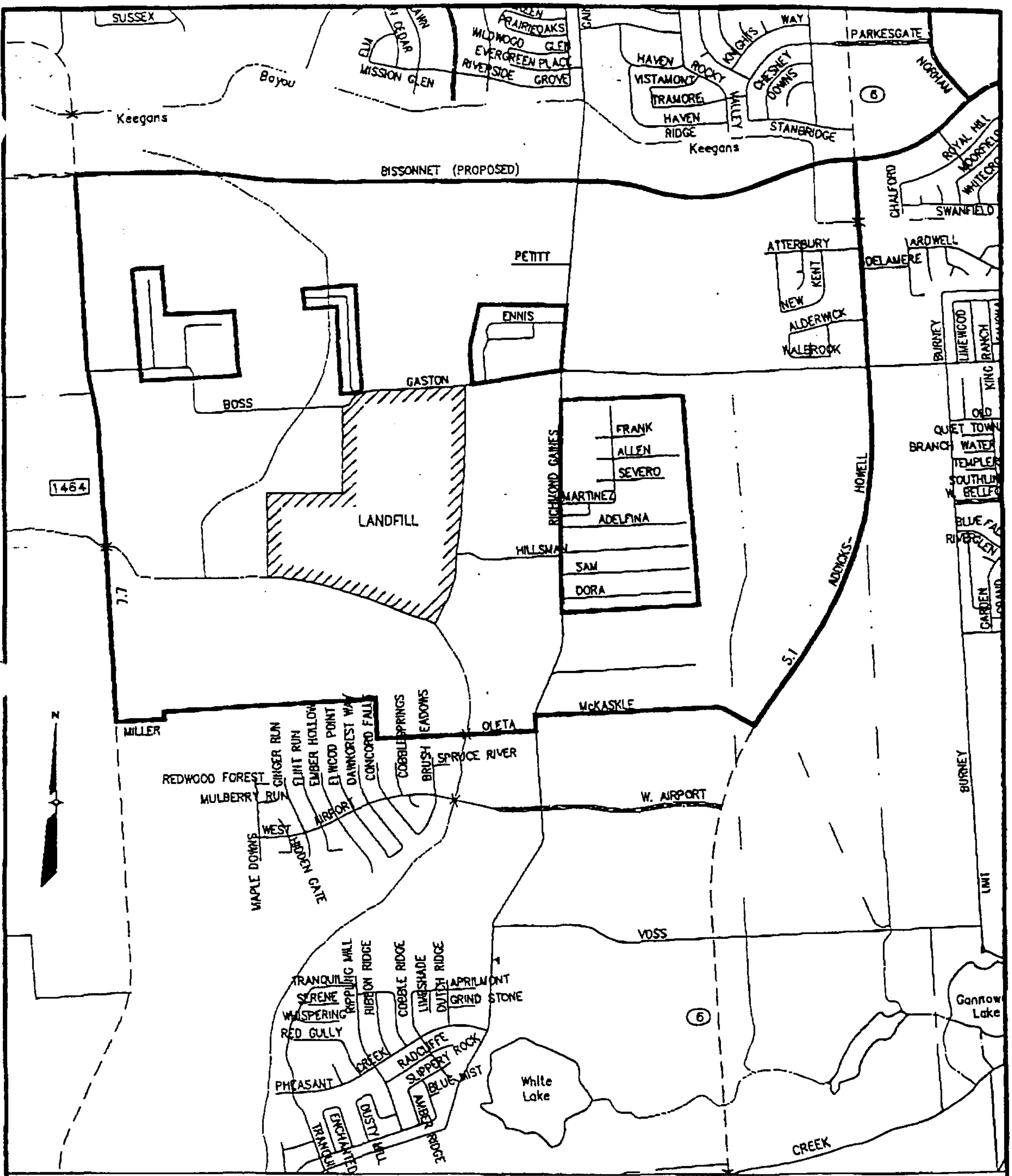


LEGEND

TWBD PLANNING AREA

RUS PROJECT BOUNDARY

0 1000 2000 4000

SCALE IN FEET

FIGURE I

FOUR CORNERS WSC
WATER & WASTEWATER PROJECT

RUST

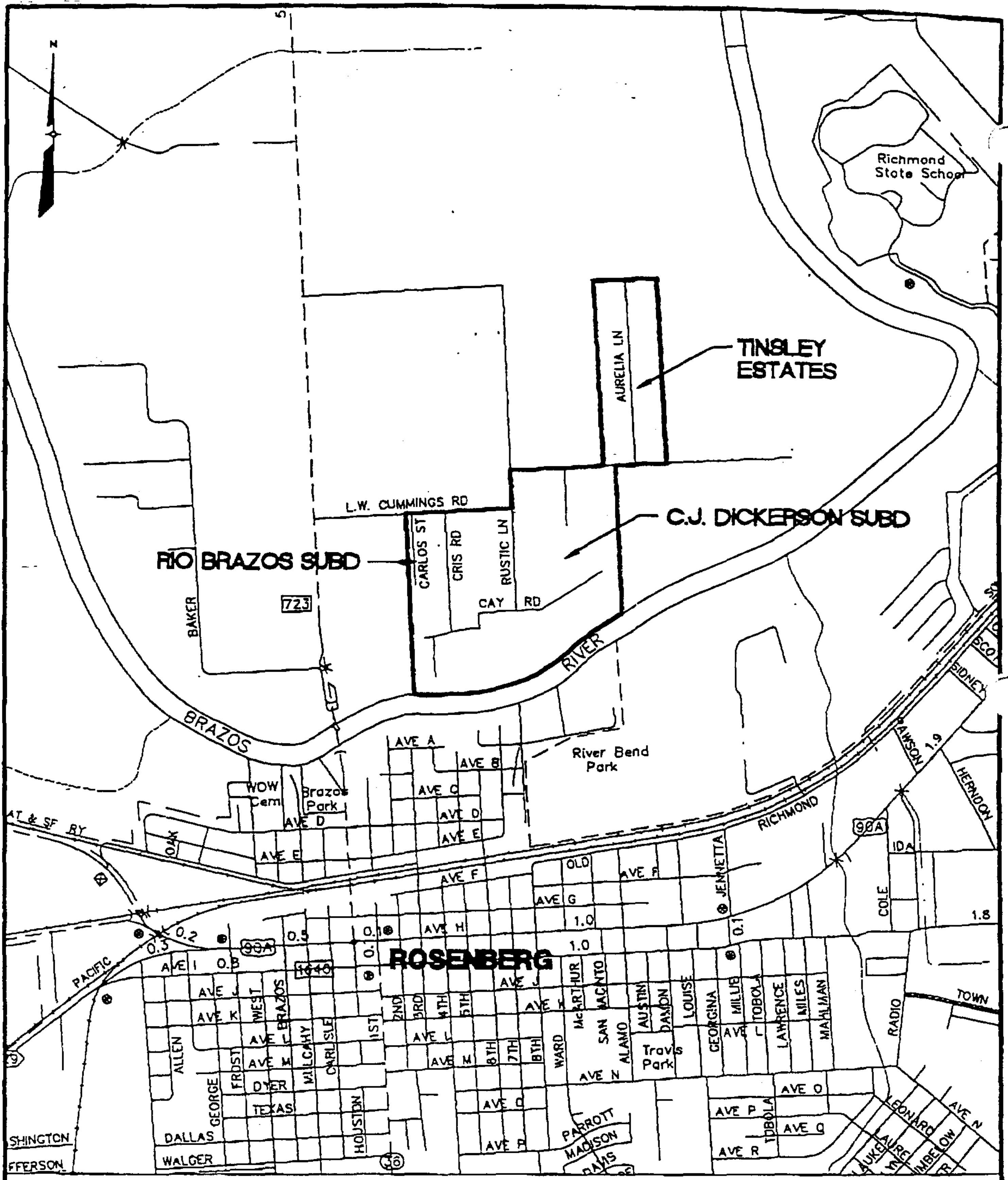
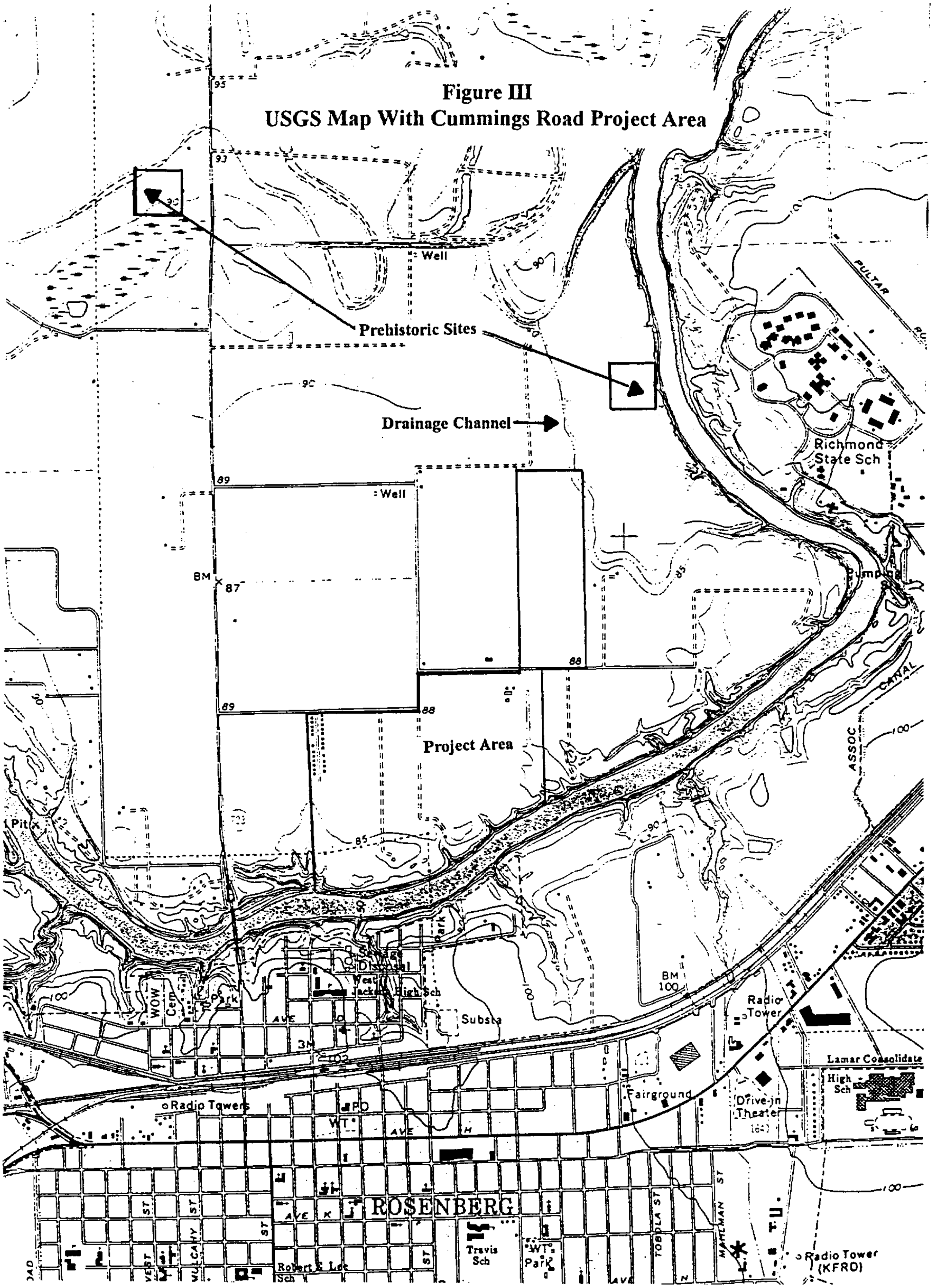


FIGURE II
CUMMINGS ROAD WSC
WATER & WASTEWATER PROJECT

Figure III
USGS Map With Cummings Road Project Area



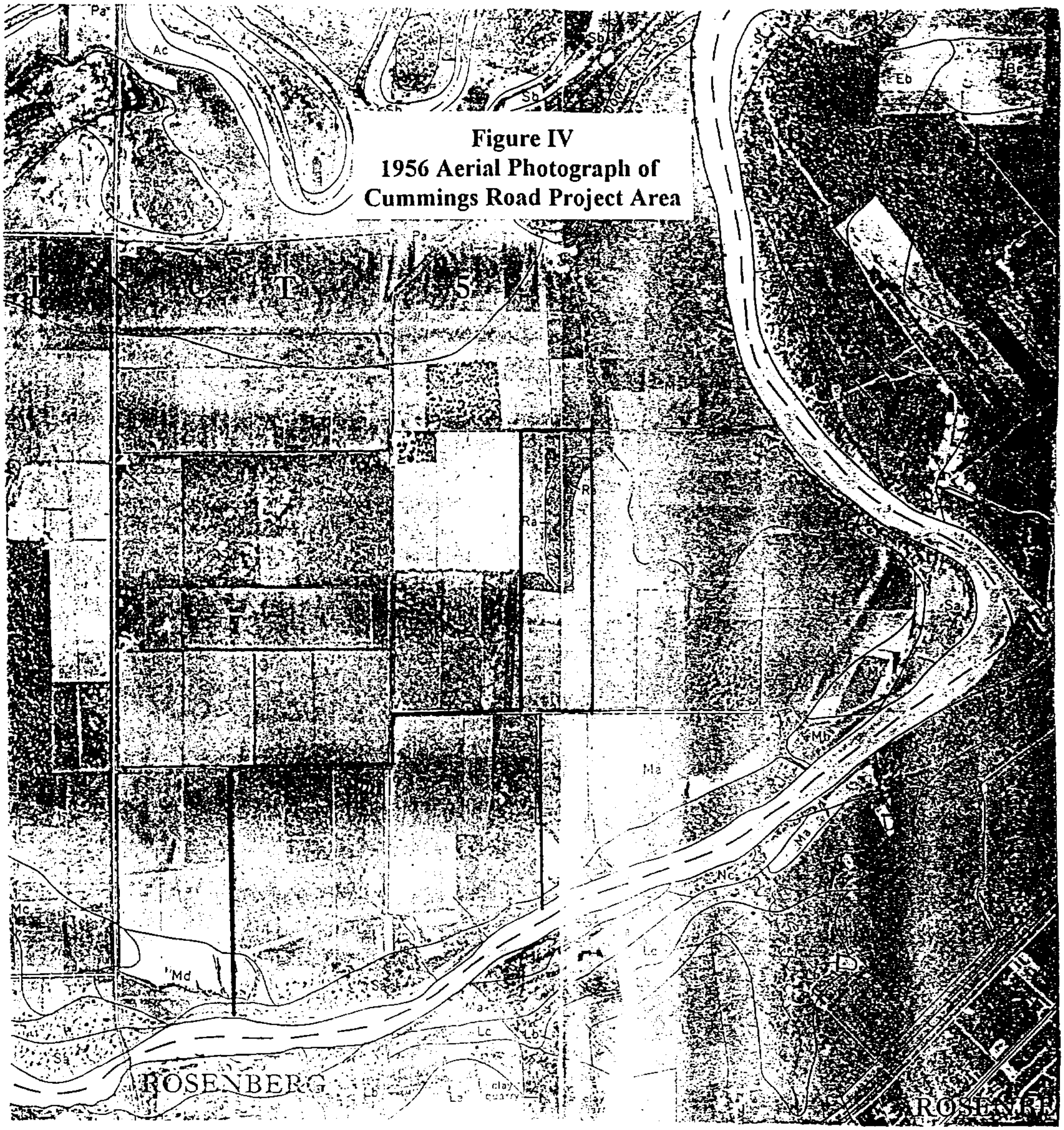


Figure IV
1956 Aerial Photograph of
Cummings Road Project Area

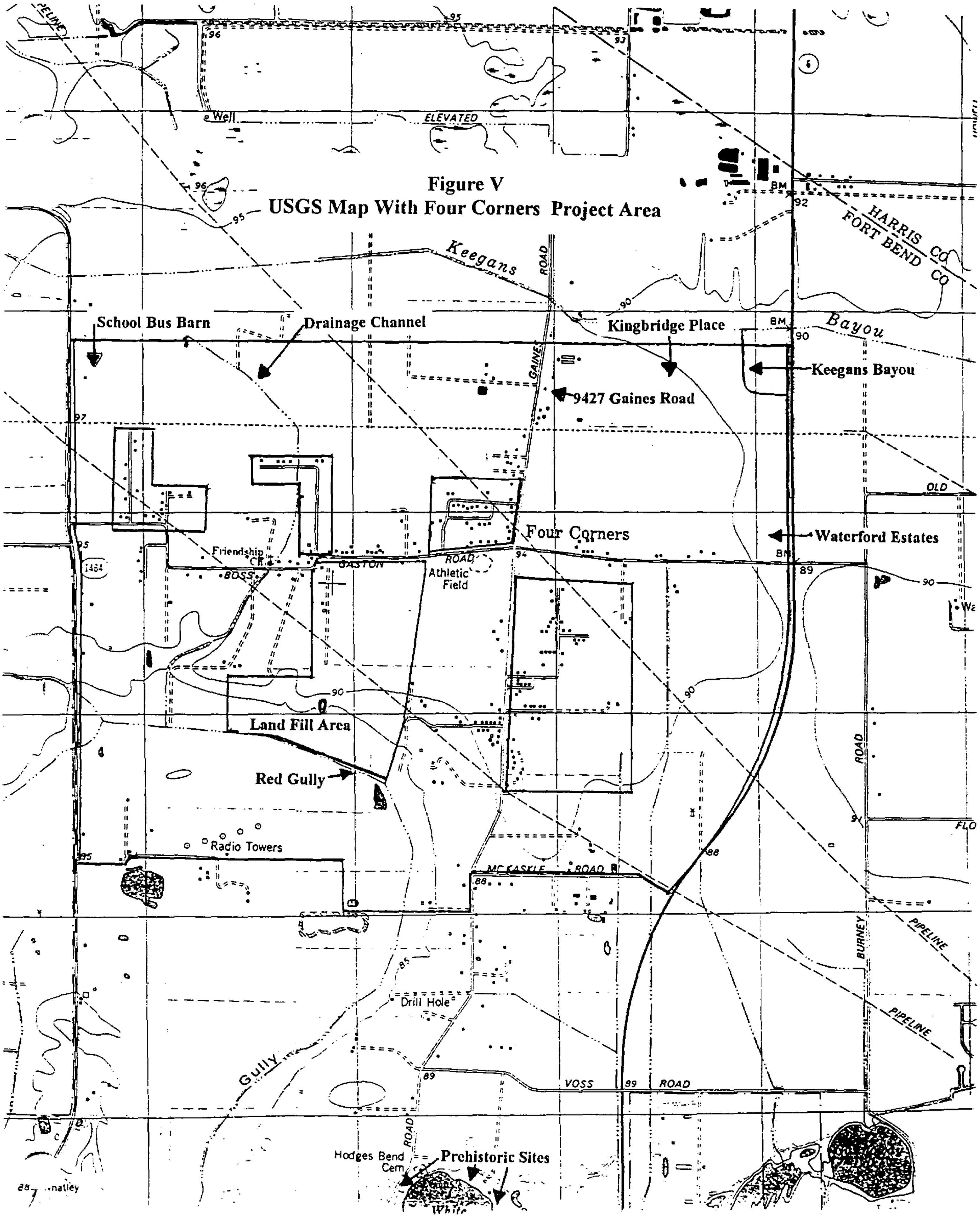


Figure V
USGS Map With Four Corners Project Area

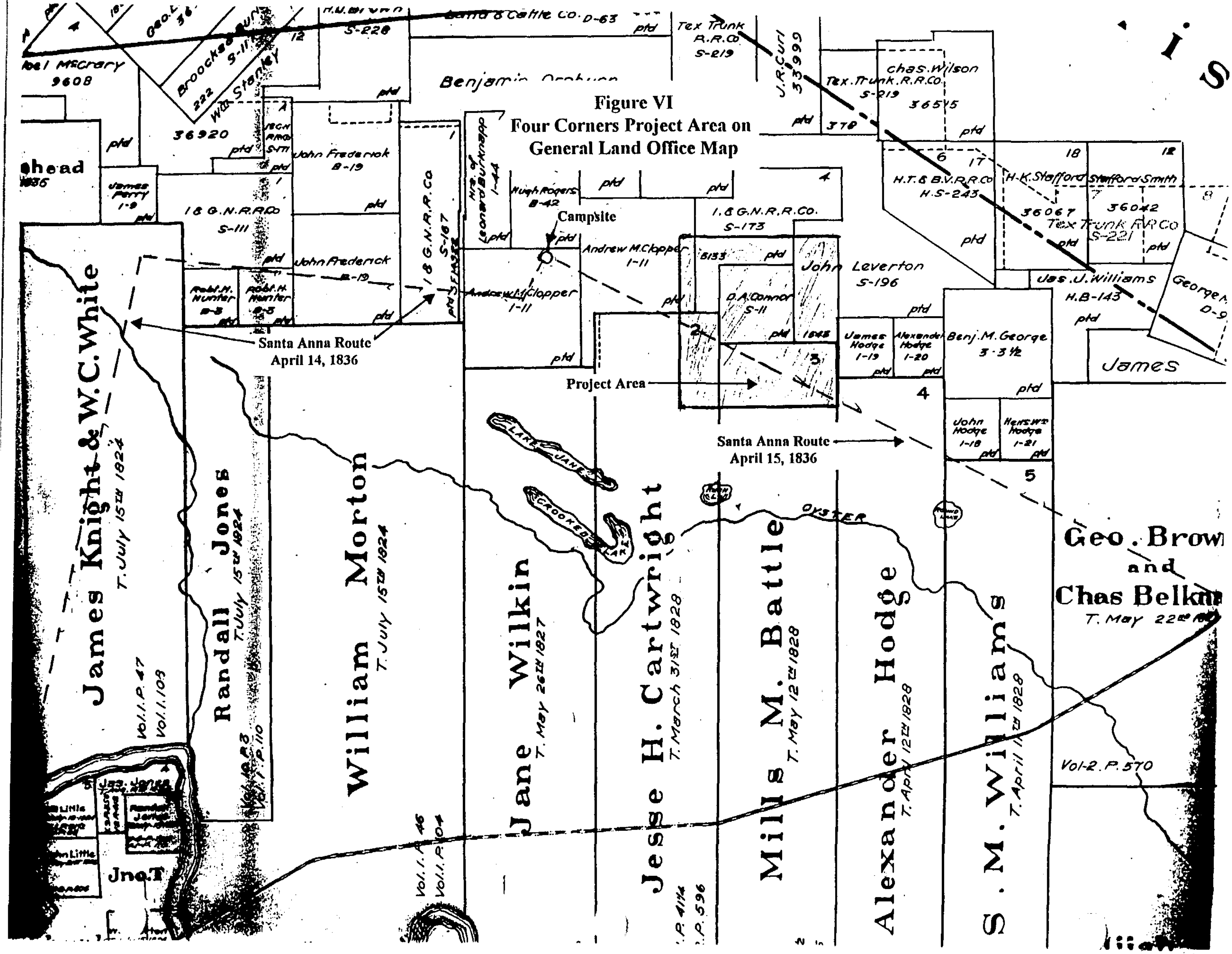


Figure VI
Four Corners Project Area on General Land Office Map

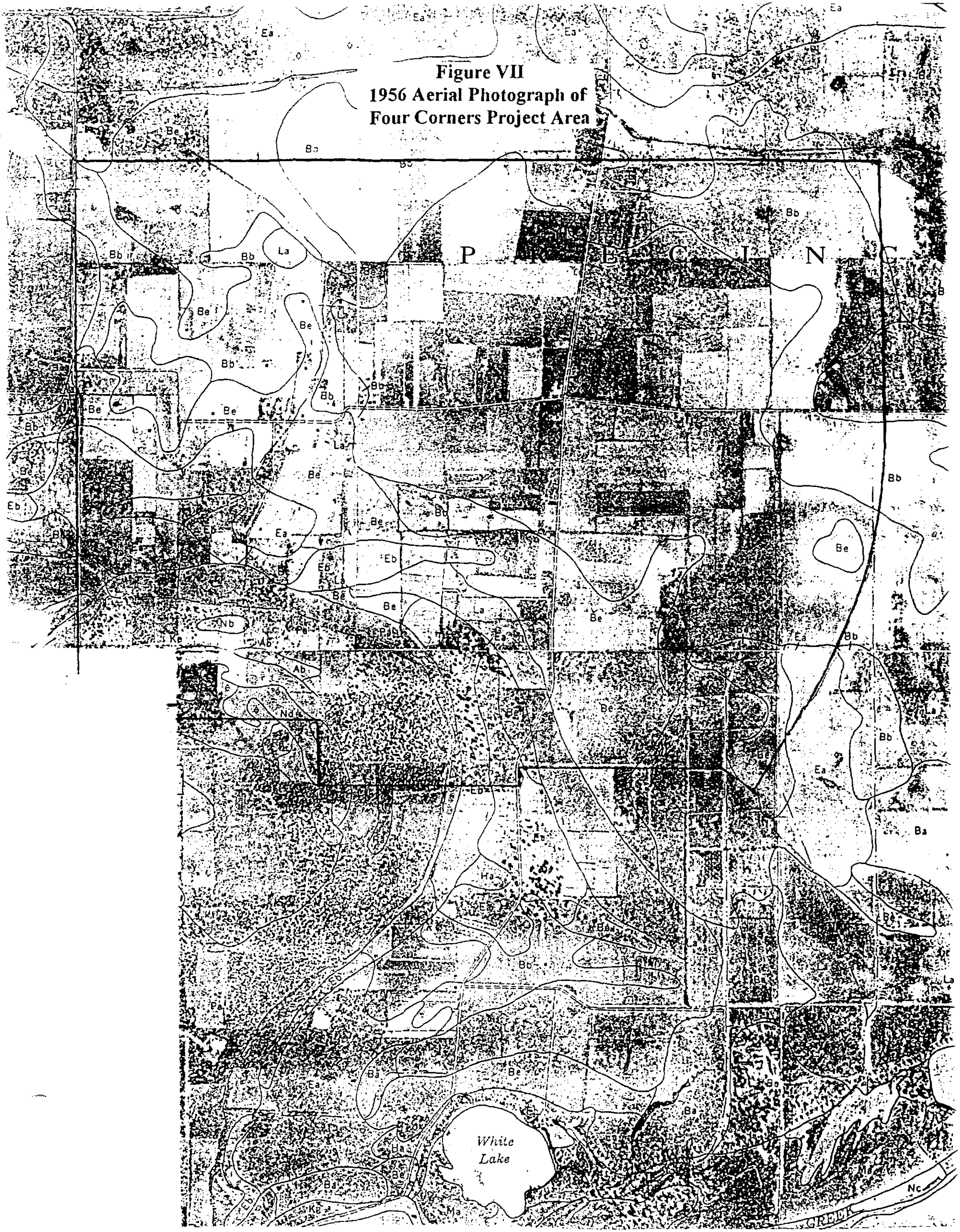
Campsite

Santa Anna Route April 14, 1836

Project Area

Santa Anna Route April 15, 1836

Figure VII
1956 Aerial Photograph of Four Corners Project Area



Hydrogeologic / Engineering Of Texas, Inc.
Groundwater Specialists
P.O. Box 1252 • Galveston, Texas 77553-1252

January 25, 1998
H/ET 9712-009

Texas Natural Resource Conservation Commission
Ground-Water Monitoring Team
Compliance and Enforcement Section
Municipal Solid Waste Division
P.O. Box 13087
Austin, Texas 78711-3087

Attention: Ms. Ada Lichaa

Sprint-Fort Bend County Landfill
16007 Boss Gaston Road
Richmond, Texas 77469

Attention: Mr. Kyle Cain

Monitoring-Well Sampling and Analytical Testing
Sprint-Fort Bend County Landfill
Permit Numbers 1396, 1683, & 1797
Fort Bend County, Texas

Hydrogeologic/Engineering of Texas, Inc. (H/ET) is pleased to present this report regarding the second quarterly background monitoring-well sampling event performed on the above mentioned site in December, 1997.

The sampling was performed on the eight (8) monitoring-wells on located site in accordance with our standard operation procedures and the Texas Natural Resource Conservation Commission suggested methods. The sampling was performed on December 30, 1997.

Initial water level measurements were taken at each designated well location with a decontaminated electronic water-level indicator prior to purging the wells. The water level readings from top of casing and corresponding elevations in feet (MSL) are summarized below in Table 1:

Local (409) 740-2606 • Fax (409) 762-1006

Page 1 1

WCS
ENVIRONMENTAL LABORATORY
17459 Village Green Drive • Houston, TX 77040 • (713) 466-0958 FAX: (713) 466-9882

Analysis Request and Chain of Custody Record

Name/Address/Phone/Fax
H/ET
P.O. Box 1252
Gal TX 77553

Project Name/Number
Sprint - Fort Bend County
1st Quarterly Background

Lab ID No.	Field Sample No./Identification	Date and Time	Grab	Comp	Sample Container (Size/Mat'l)	Sample Type (Liquid Sludge, Etc)	Preservative	ANALYSIS REQUESTED	LABORATORY REMARKS
4866	MW-107	9/30 11:20	✓		1 L 4-40mL	water	H_2SO_4	Cadmium (dissolved), Chloride,	
4867	MW-109	9/30 11:45	✓		1-L 4-40mL		H_2SO_4	Iron (dissolved) Manganese	(dissolved)
4868	MW-203	9/30 12:00	✓		1-L 4-40mL		H_2SO_4	TDS, Zinc (dissolved)	
4869	MW-105	9/30 10:15	✓		1-L 4-40mL		H_2SO_4	SP Cond, pH, TOC	
4870	MW-106	9/30 10:45	✓		1-L 4-40mL		H_2SO_4	Lead (dissolved).	
4871	Dup 101	9/30	✓		1-L 1-40mL		H_2SO_4		
4872	FB201	9/30	✓		1-L 1-40mL		H_2SO_4	See Attached	
4873	EB 301	9/30 10:40	✓		1L 1-40mL		H_2SO_4	Sheet	

SAMPLER STAMOULIS

Relinquished by: (signature)

Date: 9/30
Time: 3:42

Received by: (signature)

Date: 9/30/97
Time: 1542

REMARKS:
203 - Slight Tint

SC.

Sprint-Fort Bend County Landfill

Second Quarterly Background
Ground-Water Sampling Event - 1997

Sprint-Fort Bend County Landfill, L.P.
Fort Bend County, Texas

Permit Numbers: 1396, 1683, & 1796

Table 1
Water-level Summary

Monitoring Well Designation	Top of Casing (T.O.C.) Elev.	Water Level Reading (FT.) From (T.O.C.)	Water Level Elevations In Feet (MSL)
MW-102	97.04'	Dry	Dry
MW-103	93.65'	49.78'	43.87'
MW-104	93.73'	48.36'	45.37'
MW-105	84.61'	42.58'	42.03'
MW-106	85.24'	39.19'	46.05'
MW-107	84.13'	40.21'	42.92'
MW-108	84.08'	Dry	Dry
MW-109	88.46'	30.84'	37.62'
MW-110	95.29'	Dry	Dry
MW-111	95.86'	37.27'	58.59'
MW-112	95.67'	37.92'	57.75'
MW-201	95.39'	45.04'	50.35'
MW-202	94.21'	104.99'	-10.78'
MW-203	84.18'	62.43'	21.75'
MW-204	95.98'	42.64'	53.34'

Purging of the wells was performed using a decontaminated Grundfos Rediflo II electric pump with prepackaged, disposable poly tubing. A minimum of three (3) well volumes were evacuated from all the other wells at each location.

Monitoring-wells designated as MW-201, MW-202, MW-203 and MW-204 were not sampled during this sampling event. Monitoring-wells designated as MW-102, MW-108, and MW-110 were dry and no samples were taken.

Field parameters, including pH, temperature and conductivity were monitored during the purging process. Parameters were measured on intervals of 5 to 10 gallons purged. Each well appeared to stabilize during purging.

Field measurements, at the time of sampling are summarized below in Table 2:

Table 2
Field Measurements

Well Designation	pH	Temp °Celsius	Specific Conductance µMHOS	Water Condition
MW-102	N/A	N/A	N/A	N/A
MW-103	7.4	23°	1642	Clear
MW-104	7.6	22°	971	Clear
MW-105	7.6	21°	934	Clear
MW-106	7.8	21°	607	Clear
MW-107	7.4	22°	1335	Clear
MW-108	N/A	N/A	N/A	N/A
MW-109	7.4	20°	1434	Clear
MW-110	N/A	N/A	N/A	N/A
MW-111	7.6	22°	1194	Clear
MW-112	7.7	22°	1323	Slight Tint
MW-201	N/A	N/A	N/A	N/A
MW-202	N/A	N/A	N/A	N/A
MW-203	N/A	N/A	N/A	N/A
MW-204	N/A	N/A	N/A	N/A

The samples from monitoring-wells were obtained after allowing the wells to recover using a Grundfos Rediflo II electric pump. Decontamination of equipment was performed using deionized water and Liquinox detergent followed by a final deionized rinse. Samples were obtained and labeled at each location, logged and transported to the analytical laboratory under chain-of-custody documentation. The analytical laboratory, Water Quality Services, Inc., performed the following analyses on the samples as presented in the following Table 3:

Table 3
Analytical Testing Summary

Monitoring-Well Designation	Test Assignments
MW-103 MW-104 MW-105 MW-106 MW-107 MW-109 MW-111 MW-112 + Duplicate Field Blank Equipment Blank	Cadmium (dissolved), Chloride, Iron (dissolved), Manganese (dissolved), TDS, Zinc (dissolved), Lead (dissolved), Sp Cond, pH, TOC

Note: Analytical parameters as specified in the GWSAP.
+ Duplicate sample collected from MW-109.

The Analytical results for the monitoring-well designated as MW-103 yielded T.O.C. values of 19.0, 18.7, 18.6, and 18.7. We will verify these results on the next sampling event.

Chain-of-Custody documentation, and the analytical results for each monitoring-well are enclosed. Should you have any questions concerning the sampling event, please feel free to call me at (800) 763-2606.

Respectfully submitted,

HYDROGEOLOGIC/ENGINEERING OF TEXAS, INC.

Stefan Stamoulis
Principal Hydrogeologist

January 19, 1998

GROUNDWATER MONITORING REPORT

TDH Permit No. 1396 Monitoring Well I.D. No. MW-103
(Sprint-Fort Bend County)

cted for X Background Data ____ Semiannual/Annual Data ____ 4th Year Data
urpose of Groups 1,2,3,4 Groups 3,4 Groups 2,3,4

ate Sampled: 12/30/97 Volume Collected: 1160 mls Sampled by: S. Stamoulis.
epresenting: Site Operator Sprint Consultant H/ET Laboratory Personnel WQS.
ell Purged/Bailed Before Sampling: Yes X No ____ How Long Before: 5 minutes.
o. Well Vol. Purged: 3+ Depth to Water Before Bailing: 49.78 ft Elev 43.87 MSL
ow Were Samples Collected: Rediflow II.
ere sample preservation procedures in accordance with TDH Guidelines: Yes X No.
QS ID 6336 Std. Mthds. 18th Ed.

GROUP	PARAMETER	LEVEL	UNITS	ANALYTICAL METHOD
1	Arsenic	NR	mg/l	3113 B
	Barium	NR	mg/l	3110 D
	Dissolved Cadmium	<0.005	mg/l	200.7
	Chromium	NR	mg/l	3111 B
	Copper	NR	mg/l	3111 B
	Dissolved Lead	<0.05	mg/l	3111 B
	Mercury	NR	mg/l	3112 B
	Selenium	NR	mg/l	3113 B
	Silver	NR	mg/l	3111 B
	Dissolved Zinc	0.06	mg/l	200.7
2	Calcium	NR	mg/l	3111 B
	Magnesium	NR	mg/l	3111 B
	Sodium	NR	mg/l	3111 B
	Potassium	NR	mg/l	3111 B
	Carbonate	NR	mg/l	2320 B
	Bicarbonate	NR	mg/l	2320 B
	Sulfate	NR	mg/l	4500-SO4 E
	Fluoride	NR	mg/l	4500-F- C
	Nitrate	NR	mg/l	4500-NO3 E
	Phenolphthalein Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Hardness ($CaCO_3$)	NR	mg/l	2340 B
	Anion-Cation Balance	NR	meq/meq	Calculated
3	Chloride	64	mg/l	300.0
	pH	6.7		4500-H+ B
	Specific Conductance	1570	µmho/cm	2510 B
	Total Dissolved Solids	996	mg/l	160.1
	Total Organic Carbon	19.0	mg/l	415.1
	Total Organic Carbon	18.7	mg/l	415.1
	Total Organic Carbon	18.6	mg/l	415.1
	Total Organic Carbon	18.7	mg/l	415.1
4	Dissolved Iron	<0.10	mg/l	200.7
	Dissolved Manganese	0.42	mg/l	200.7

Not Requested
atory Representative Signature: Gari Reynolds Phone: (713) 466-0958
(Gari Reynolds)
aboratory Name: WQS Environmental Lab. Address: 17459 Village Green
Houston, Texas 77040
ite Operator Signature: Date: 2-1-98.
(TDH Form SE 65)

January 19, 1998

GROUNDWATER MONITORING REPORT

TDH Permit No. 1396 Monitoring Well I.D. No. MW-104
(Sprint-Fort Bend County)

ubmitted for X Background Data ___ Semiannual/Annual Data ___ 4th Year Data
urpose of Groups 1,2,3,4 Groups 3,4 Groups 2,3,4

ate Sampled: 12/30/97 Volume Collected: 1160 mls Sampled by: S. Stamoulis .
epresenting: Site Operator Sprint Consultant H/ET Laboratory Personnel WQS .
ell Purged/Bailed Before Sampling: Yes X No ___ How Long Before: 5 minutes .
o. Well Vol. Purged: 3+ Depth to Water Before Bailing: 48.36 ft Elev 45.37 MSL
ow Were Samples Collected: Rediflow II .
ere sample preservation procedures in accordance with TDH Guidelines: Yes X No.
QS ID 6337 Std. Mthds. 18th Ed.

GROUP	PARAMETER	LEVEL	UNITS	ANALYTICAL METHOD
1	Arsenic	NR	mg/l	3113 B
	Barium	NR	mg/l	3110 D
	Dissolved Cadmium	<0.005	mg/l	200.7
	Chromium	NR	mg/l	3111 B
	Copper	NR	mg/l	3111 B
	Dissolved Lead	<0.05	mg/l	3111 B
	Mercury	NR	mg/l	3112 B
	Selenium	NR	mg/l	3113 B
	Silver	NR	mg/l	3111 B
	Dissolved Zinc	0.02	mg/l	200.7
2	Calcium	NR	mg/l	3111 B
	Magnesium	NR	mg/l	3111 B
	Sodium	NR	mg/l	3111 B
	Potassium	NR	mg/l	3111 B
	Carbonate	NR	mg/l	2320 B
	Bicarbonate	NR	mg/l	2320 B
	Sulfate	NR	mg/l	4500-SO4 E
	Fluoride	NR	mg/l	4500-F- C
	Nitrate	NR	mg/l	4500-NO3 E
	Phenolphthalein Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Hardness ($CaCO_3$)	NR	mg/l	2340 B
	Anion-Cation Balance	NR	meq/meq	Calculated
3	Chloride	66	mg/l	300.0
	pH	7.1		4500-H+ B
	Specific Conductance	892	µmho/cm	2510 B
	Total Dissolved Solids	546	mg/l	160.1
	Total Organic Carbon	<1.0	mg/l	415.1
	Total Organic Carbon	<1.0	mg/l	415.1
	Total Organic Carbon	<1.0	mg/l	415.1
	Total Organic Carbon	<1.0	mg/l	415.1
4	Dissolved Iron	<0.10	mg/l	200.7
	Dissolved Manganese	0.05	mg/l	200.7

- Not Requested

aboratory Representative Signature: Gari Reynolds Phone: (713) 466-095
(Gari Reynolds)

aboratory Name: WQS Environmental Lab. Address: 17459 Village Green
Houston, Texas 77040

ite Operator Signature: Date: 2-1-98 .

(TDH Form SE 65)

January 19, 1998

GROUNDWATER MONITORING REPORT

TDH Permit No. 1396 Monitoring Well I.D. No. MW-105
(Sprint-Fort Bend County)

itted for X Background Data ___Semiannual/Annual Data ___4th Year Data
urpose of Groups 1,2,3,4 Groups 3,4 Groups 2,3,4

ate Sampled: 12/30/97 Volume Collected: 1160 mls Sampled by: S. Stamoulis.
epresenting: Site Operator Sprint Consultant H/ET Laboratory Personnel WQS.
ell Purged/Bailed Before Sampling: Yes X No ___How Long Before: 5 minutes.
o. Well Vol. Purged: 3+ Depth to Water Before Bailing: 42.58 ft Elev 42.03 MSL
ow Were Samples Collected: Rediflow II.
ere sample preservation procedures in accordance with TDH Guidelines: Yes X No.
QS ID 6338 Std. Mthds. 18th Ed.

GROUP	PARAMETER	LEVEL	UNITS	ANALYTICAL METHOD
1	Arsenic	NR	mg/l	3113 B
	Barium	NR	mg/l	3110 D
	Dissolved Cadmium	<0.005	mg/l	200.7
	Chromium	NR	mg/l	3111 B
	Copper	NR	mg/l	3111 B
	Dissolved Lead	<0.05	mg/l	3111 B
	Mercury	NR	mg/l	3112 B
	Selenium	NR	mg/l	3113 B
	Silver	NR	mg/l	3111 B
	Dissolved Zinc	<0.02	mg/l	200.7
2	Calcium	NR	mg/l	3111 B
	Magnesium	NR	mg/l	3111 B
	Sodium	NR	mg/l	3111 B
	Potassium	NR	mg/l	3111 B
	Carbonate	NR	mg/l	2320 B
	Bicarbonate	NR	mg/l	2320 B
	Sulfate	NR	mg/l	4500-SO4 E
	Fluoride	NR	mg/l	4500-F- C
	Nitrate	NR	mg/l	4500-NO3 E
	Phenolphthalein Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Hardness ($CaCO_3$)	NR	mg/l	2340 B
	Anion-Cation Balance	NR	meq/meq	Calculated
3	Chloride	17	mg/l	300.0
	pH	7.1		4500-H+ B
	Specific Conductance	889	µmho/cm	2510 B
	Total Dissolved Solids	612	mg/l	160.1
	Total Organic Carbon	2.1	mg/l	415.1
	Total Organic Carbon	2.1	mg/l	415.1
	Total Organic Carbon	2.2	mg/l	415.1
	Total Organic Carbon	2.1	mg/l	415.1
4	Dissolved Iron	<0.10	mg/l	200.7
	Dissolved Manganese	0.64	mg/l	200.7

Not Requested
atory Representative Signature: Gari Reynolds Phone: (713) 466-0958
(Gari Reynolds)
aboratory Name: WQS Environmental Lab. Address: 17459 Village Green
Houston, Texas 77040
ite Operator Signature: Date: 2-1-98.
(TDH Form SE 65)

January 19, 1998

GROUNDWATER MONITORING REPORT

TDH Permit No. 1396 Monitoring Well I.D. No. MW-106
(Sprint-Fort Bend County)

itted for X Background Data ___ Semiannual/Annual Data ___ 4th Year Data
rpose of Groups 1,2,3,4 Groups 3,4 Groups 2,3,4

te Sampled: 12/30/97 Volume Collected: 1160 mls Sampled by: S. Stamoulis .
presenting: Site Operator Sprint Consultant H/ET Laboratory Personnel WQS .
ll Purged/Bailed Before Sampling: Yes X No ___ How Long Before: 5 minutes .
. Well Vol. Purged: 3+ Depth to Water Before Bailing: 39.19 ft Elev 46.05 MSL
w Were Samples Collected: Rediflow II .
re sample preservation procedures in accordance with TDH Guidelines: Yes X No.
S ID 6339 Std. Mthds. 18th Ed.

GROUP	PARAMETER	LEVEL	UNITS	ANALYTICAL METHOD
1	Arsenic	NR	mg/l	3113 B
	Barium	NR	mg/l	3110 D
	Dissolved Cadmium	<0.005	mg/l	200.7
	Chromium	NR	mg/l	3111 B
	Copper	NR	mg/l	3111 B
	Dissolved Lead	<0.05	mg/l	3111 B
	Mercury	NR	mg/l	3112 B
	Selenium	NR	mg/l	3113 B
	Silver	NR	mg/l	3111 B
	Dissolved Zinc	<0.02	mg/l	200.7
2	Calcium	NR	mg/l	3111 B
	Magnesium	NR	mg/l	3111 B
	Sodium	NR	mg/l	3111 B
	Potassium	NR	mg/l	3111 B
	Carbonate	NR	mg/l	2320 B
	Bicarbonate	NR	mg/l	2320 B
	Sulfate	NR	mg/l	4500-SO4 E
	Fluoride	NR	mg/l	4500-F- C
	Nitrate	NR	mg/l	4500-NO3 E
	Phenolphthalein Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Hardness ($CaCO_3$)	NR	mg/l	2340 B
	Anion-Cation Balance	NR	meq/meq	Calculated
3	Chloride	13	mg/l	300.0
	pH	7.2		4500-H+ B
	Specific Conductance	582	µmho/cm	2510 B
	Total Dissolved Solids	330	mg/l	160.1
	Total Organic Carbon	<1.0	mg/l	415.1
	Total Organic Carbon	1.0	mg/l	415.1
	Total Organic Carbon	1.0	mg/l	415.1
	Total Organic Carbon	<1.0	mg/l	415.1
4	Dissolved Iron	<0.10	mg/l	200.7
	Dissolved Manganese	<0.02	mg/l	200.7

Not Requested

ratory Representative Signature: Gari Reynolds Phone: (713) 466-095
(Gari Reynolds)

boratory Name: WQS Environmental Lab. Address: 17459 Village Green
Houston, Texas 77040

te Operator Signature: Date: 2-1-98

(TDH Form SE 65)

January 19, 1998

GROUNDWATER MONITORING REPORT

TDH Permit No. 1396 Monitoring Well I.D. No. MW-107
(Sprint-Fort Bend County)

Submitted for X Background Data ___Semiannual/Annual Data ___4th Year Data
Purpose of Groups 1,2,3,4 Groups 3,4 Groups 2,3,4

Date Sampled: 12/30/97 Volume Collected: 1160 mls Sampled by: S. Stamoulis.
Representing: Site Operator Sprint Consultant H/ET Laboratory Personnel WQS.
Well Purged/Bailed Before Sampling: Yes X No ___How Long Before: 5 minutes.
No. Well Vol. Purged: 3+ Depth to Water Before Bailing: 40.21 ft Elev 42.92 MSL
How Were Samples Collected: Rediflow II.
Were sample preservation procedures in accordance with TDH Guidelines: Yes X No.
WQS ID 6340 Std. Mthds. 18th Ed.

GROUP	PARAMETER	LEVEL	UNITS	ANALYTICAL METHOD
1	Arsenic	NR	mg/l	3113 B
	Barium	NR	mg/l	3110 D
	Dissolved Cadmium	<0.005	mg/l	200.7
	Chromium	NR	mg/l	3111 B
	Copper	NR	mg/l	3111 B
	Dissolved Lead	<0.05	mg/l	3111 B
	Mercury	NR	mg/l	3112 B
	Selenium	NR	mg/l	3113 B
	Silver	NR	mg/l	3111 B
	Dissolved Zinc	<0.02	mg/l	200.7
2	Calcium	NR	mg/l	3111 B
	Magnesium	NR	mg/l	3111 B
	Sodium	NR	mg/l	3111 B
	Potassium	NR	mg/l	3111 B
	Carbonate	NR	mg/l	2320 B
	Bicarbonate	NR	mg/l	2320 B
	Sulfate	NR	mg/l	4500-SO4 E
	Fluoride	NR	mg/l	4500-F- C
	Nitrate	NR	mg/l	4500-NO3 E
	Phenolphthalein Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Hardness ($CaCO_3$)	NR	mg/l	2340 B
	Anion-Cation Balance	NR	meq/meq	Calculated
3	Chloride	150	mg/l	300.0
	pH	7.0		4500-H+ B
	Specific Conductance	1290	µmho/cm	2510 B
	Total Dissolved Solids	742	mg/l	160.1
	Total Organic Carbon	1.2	mg/l	415.1
	Total Organic Carbon	1.0	mg/l	415.1
	Total Organic Carbon	1.1	mg/l	415.1
	Total Organic Carbon	1.2	mg/l	415.1
4	Dissolved Iron	<0.10	mg/l	200.7
	Dissolved Manganese	0.30	mg/l	200.7

Not Requested
Laboratory Representative Signature: Gari Reynolds Phone: (713) 466-0958
(Gari Reynolds)
aboratory Name: WQS Environmental, Lab. Address: 17459 Village Green
Houston, Texas 77040
ite Operator Signature: Date: 2-1-98.
(TDH Form SE 65)

January 19, 1998

GROUNDWATER MONITORING REPORT

TDH Permit No. 1396 Monitoring Well I.D. No. MW-109
(Sprint-Fort Bend County)

ıbmitted for _X_ Background Data ___ Semiannual/Annual Data ___ 4th Year Data
ırpose of Groups 1,2,3,4 Groups 3,4 Groups 2,3,4

ıte Sampled: 12/30/97 Volume Collected: 1160 mls Sampled by: S. Stamoulis .
epresenting: Site Operator Sprint Consultant H/ET Laboratory Personnel WQS .
ell Purged/Bailed Before Sampling: Yes _X_ No ___ How Long Before: 5 minutes .
. Well Vol. Purged: 3+ Depth to Water Before Bailing: 30.84 ft Elev 37.62 MSL
ow Were Samples Collected: Rediflow II .
ere sample preservation procedures in accordance with TDH Guidelines: Yes X No.
QS ID 6341 Std. Mthds. 18th Ed.

GROUP	PARAMETER	LEVEL	UNITS	ANALYTICAL METHOD
1	Arsenic	NR	mg/l	3113 B
	Barium	NR	mg/l	3110 D
	Dissolved Cadmium	<0.005	mg/l	200.7
	Chromium	NR	mg/l	3111 B
	Copper	NR	mg/l	3111 B
	Dissolved Lead	<0.05	mg/l	3111 B
	Mercury	NR	mg/l	3112 B
	Selenium	NR	mg/l	3113 B
	Silver	NR	mg/l	3111 B
	Dissolved Zinc	<0.02	mg/l	200.7
2	Calcium	NR	mg/l	3111 B
	Magnesium	NR	mg/l	3111 B
	Sodium	NR	mg/l	3111 B
	Potassium	NR	mg/l	3111 B
	Carbonate	NR	mg/l	2320 B
	Bicarbonate	NR	mg/l	2320 B
	Sulfate	NR	mg/l	4500-SO4 E
	Fluoride	NR	mg/l	4500-F- C
	Nitrate	NR	mg/l	4500-NO3 E
	Phenolphthalein Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Hardness ($CaCO_3$)	NR	mg/l	2340 B
	Anion-Cation Balance	NR	meq/meq	Calculated
3	Chloride	230	mg/l	300.0
	pH	7.0		4500-H+ B
	Specific Conductance	1380	µmho/cm	2510 B
	Total Dissolved Solids	826	mg/l	160.1
	Total Organic Carbon	<1.0	mg/l	415.1
	Total Organic Carbon	<1.0	mg/l	415.1
	Total Organic Carbon	<1.0	mg/l	415.1
	Total Organic Carbon	<1.0	mg/l	415.1
4	Dissolved Iron	<0.10	mg/l	200.7
	Dissolved Manganese	0.23	mg/l	200.7

Not Requested

ıboratory Representative Signature: Gari Reynolds Phone: (713) 466-0958
(Gari Reynolds)

ıboratory Name: WQS Environmental Lab. Address: 17459 Village Green
Houston, Texas 77040

.te Operator Signature: Date: 2-1-98 .

(TDH Form SE 65)

January 19, 1998

GROUNDWATER MONITORING REPORT

TDH Permit No. 1396 Monitoring Well I.D. No. MW-111
(Sprint-Fort Bend County)

ubmitted for urpose of X Background Data Groups 1,2,3,4 ___ Semiannual/Annual Data Groups 3,4 ___ 4th Year Data Groups 2,3,4

ate Sampled: 12/30/97 Volume Collected: 1160 mls Sampled by: S. Stamoulis .
epresenting: Site Operator Sprint Consultant H/ET Laboratory Personnel WQS .
ell Purged/Bailed Before Sampling: Yes X No ___ How Long Before: 5 minutes .
o. Well Vol. Purged: 3+ Depth to Water Before Bailing: 37.27 ft Elev 38.59 MSL
ow Were Samples Collected: Rediflow II .
ere sample preservation procedures in accordance with TDH Guidelines: Yes X No.
QS ID 6342 Std. Mthds. 18th Ed.

GROUP	PARAMETER	LEVEL	UNITS	ANALYTICAL METHOD
1	Arsenic	NR	mg/l	3113 B
	Barium	NR	mg/l	3110 D
	Dissolved Cadmium	<0.005	mg/l	200.7
	Chromium	NR	mg/l	3111 B
	Copper	NR	mg/l	3111 B
	Dissolved Lead	<0.05	mg/l	3111 B
	Mercury	NR	mg/l	3112 B
	Selenium	NR	mg/l	3113 B
	Silver	NR	mg/l	3111 B
	Dissolved Zinc	<0.02	mg/l	200.7
2	Calcium	NR	mg/l	3111 B
	Magnesium	NR	mg/l	3111 B
	Sodium	NR	mg/l	3111 B
	Potassium	NR	mg/l	3111 B
	Carbonate	NR	mg/l	2320 B
	Bicarbonate	NR	mg/l	2320 B
	Sulfate	NR	mg/l	4500-SO4 E
	Fluoride	NR	mg/l	4500-F- C
	Nitrate	NR	mg/l	4500-NO3 E
	Phenolphthalein Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Hardness ($CaCO_3$)	NR	mg/l	2340 B
	Anion-Cation Balance	NR	meq/meq	Calculated
3	Chloride	39	mg/l	300.0
	pH	7.0		4500-H+ B
	Specific Conductance	1120	µmho/cm	2510 B
	Total Dissolved Solids	718	mg/l	160.1
	Total Organic Carbon	<1.0	mg/l	415.1
	Total Organic Carbon	<1.0	mg/l	415.1
	Total Organic Carbon	<1.0	mg/l	415.1
	Total Organic Carbon	<1.0	mg/l	415.1
4	Dissolved Iron	<0.10	mg/l	200.7
	Dissolved Manganese	0.33	mg/l	200.7

Not Requested

aboratory Representative Signature: Gari Reynolds Phone: (713) 466-0958
(Gari Reynolds)

aboratory Name: WQS Environmental Lab. Address: 17459 Village Green
Houston, Texas 77040

te Operator Signature: Date: 2-1-98 .

(TDH Form SE 65)

January 19, 1998

GROUNDWATER MONITORING REPORT

TDH Permit No. 1396 Monitoring Well I.D. No. MW-112
(Sprint-Fort Bend County)

ubmitted for X Background Data ___Semiannual/Annual Data ___4th Year Data
urpose of Groups 1,2,3,4 Groups 3,4 Groups 2,3,4

ate Sampled: 12/30/97 Volume Collected: 1160 mls Sampled by: S. Stamoulis .
epresenting:Site Operator Sprint Consultant H/ET Laboratory Personnel WQS .
ell Purged/Bailed Before Sampling: Yes X No ___How Long Before: 5 minutes .
o. Well Vol. Purged: 3+ Depth to Water Before Bailing: 51.92 ft Elev 57.75 MSL
ow Were Samples Collected: Rediflow II .
ere sample preservation procedures in accordance with TDH Guidelines:Yes X No.
QS ID 6343 Std. Mthds. 18th Ed.

GROUP	PARAMETER	LEVEL	UNITS	ANALYTICAL METHOD
1	Arsenic	NR	mg/l	3113 B
	Barium	NR	mg/l	3110 D
	Dissolved Cadmium	<0.005	mg/l	200.7
	Chromium	NR	mg/l	3111 B
	Copper	NR	mg/l	3111 B
	Dissolved Lead	<0.05	mg/l	3111 B
	Mercury	NR	mg/l	3112 B
	Selenium	NR	mg/l	3113 B
	Silver	NR	mg/l	3111 B
	Dissolved Zinc	<0.02	mg/l	200.7
2	Calcium	NR	mg/l	3111 B
	Magnesium	NR	mg/l	3111 B
	Sodium	NR	mg/l	3111 B
	Potassium	NR	mg/l	3111 B
	Carbonate	NR	mg/l	2320 B
	Bicarbonate	NR	mg/l	2320 B
	Sulfate	NR	mg/l	4500-SO4 E
	Fluoride	NR	mg/l	4500-F- C
	Nitrate	NR	mg/l	4500-NO3 E
	Phenolphthalein Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Hardness ($CaCO_3$)	NR	mg/l	2340 B
	Anion-Cation Balance	NR	meq/meq	Calculated
3	Chloride	54	mg/l	300.0
	pH	7.1		4500-H+ B
	Specific Conductance	1240	µmho/cm	2510 B
	Total Dissolved Solids	824	mg/l	160.1
	Total Organic Carbon	<1.0	mg/l	415.1
	Total Organic Carbon	<1.0	mg/l	415.1
	Total Organic Carbon	<1.0	mg/l	415.1
	Total Organic Carbon	<1.0	mg/l	415.1
4	Dissolved Iron	<0.10	mg/l	200.7
	Dissolved Manganese	0.59	mg/l	200.7

- Not Requested
aboratory Representative Signature: Gari Reynolds Phone: (713) 466-09
(Gari Reynolds)
aboratory Name: WQS Environmental Lab. Address: 17459 Village Green
Houston, Texas 77040
ite Operator Signature: Date: 2-1-98 .
(TDH Form SE 65)

January 19, 1998

GROUNDWATER MONITORING REPORT

TDH Permit No. 1396 Monitoring Well I.D. No. Dup
(Sprint-Fort Bend County)

ubmitted for X Background Data ___Semiannual/Annual Data ___4th Year Data
urpose of Groups 1,2,3,4 Groups 3,4 Groups 2,3,4

ate Sampled: 12/30/97 Volume Collected: 1040 mls Sampled by: S. Stamoulis .
epresenting:Site Operator Sprint Consultant H/ET Laboratory Personnel WQS .
ell Purged/Bailed Before Sampling: Yes X No ___How Long Before: 5 minutes .
o. Well Vol. Purged: 3+ Depth to Water Before Bailing:_______ft Elev_______MSL
ow Were Samples Collected: Rediflow II .
ere sample preservation procedures in accordance with TDH Guidelines:Yes X No.
QS ID 6344 Std. Mthds. 18th Ed.

GROUP	PARAMETER	LEVEL	UNITS	ANALYTICAL METHOD
1	Arsenic	NR	mg/l	3113 B
	Barium	NR	mg/l	3110 D
	Dissolved Cadmium	<0.005	mg/l	200.7
	Chromium	NR	mg/l	3111 B
	Copper	NR	mg/l	3111 B
	Dissolved Lead	<0.05	mg/l	3111 B
	Mercury	NR	mg/l	3112 B
	Selenium	NR	mg/l	3113 B
	Silver	NR	mg/l	3111 B
	Dissolved Zinc	<0.02	mg/l	200.7
2	Calcium	NR	mg/l	3111 B
	Magnesium	NR	mg/l	3111 B
	Sodium	NR	mg/l	3111 B
	Potassium	NR	mg/l	3111 B
	Carbonate	NR	mg/l	2320 B
	Bicarbonate	NR	mg/l	2320 B
	Sulfate	NR	mg/l	4500-SO4 E
	Fluoride	NR	mg/l	4500-F- C
	Nitrate	NR	mg/l	4500-NO3 E
	Phenolphthalein Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Hardness ($CaCO_3$)	NR	mg/l	2340 B
	Anion-Cation Balance	NR	meq/meq	Calculated
3	Chloride	130	mg/l	300.0
	pH	7.0		4500-H+ B
	Specific Conductance	1340	µmho/cm	2510 B
	Total Dissolved Solids	802	mg/l	160.1
	Total Organic Carbon	<1.0	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
4	Dissolved Iron	<0.10	mg/l	200.7
	Dissolved Manganese	0.25	mg/l	200.7

ot Requested

a..atory Representative Signature: Gari Reynolds Phone: (713) 466-0958
(Gari Reynolds)

aboratory Name: WQS Environmental Lab. Address: 17459 Village Green
Houston, Texas 77040

ite Operator Signature: Date: 2-1-98 .

(TDH Form SE 65)

January 19, 1998

GROUNDWATER MONITORING REPORT

TDH Permit No. 1396 Monitoring Well I.D. No. FB
(Sprint-Fort Bend County)

Submitted for Purpose of X Background Data Groups 1,2,3,4 ___ Semiannual/Annual Data Groups 3,4 ___ 4th Year Data Groups 2,3,4

Date Sampled: 12/30/97 Volume Collected: 1040 mls Sampled by: S. Stamoulis .
Representing: Site Operator Sprint Consultant H/ET Laboratory Personnel WQS .
Well Purged/Bailed Before Sampling: Yes X No ___ How Long Before: 5 minutes .
No. Well Vol. Purged: 3+ Depth to Water Before Bailing: ______ ft Elev ______ MSL
How Were Samples Collected: Rediflow II .
Were sample preservation procedures in accordance with TDH Guidelines: Yes X No.
WQS ID 6345 Std. Mthds. 18th Ed.

GROUP	PARAMETER	LEVEL	UNITS	ANALYTICAL METHOD
1	Arsenic	NR	mg/l	3113 B
	Barium	NR	mg/l	3110 D
	Dissolved Cadmium	<0.005	mg/l	200.7
	Chromium	NR	mg/l	3111 B
	Copper	NR	mg/l	3111 B
	Dissolved Lead	<0.05	mg/l	3111 B
	Mercury	NR	mg/l	3112 B
	Selenium	NR	mg/l	3113 B
	Silver	NR	mg/l	3111 B
	Dissolved Zinc	<0.02	mg/l	200.7
2	Calcium	NR	mg/l	3111 B
	Magnesium	NR	mg/l	3111 B
	Sodium	NR	mg/l	3111 B
	Potassium	NR	mg/l	3111 B
	Carbonate	NR	mg/l	2320 B
	Bicarbonate	NR	mg/l	2320 B
	Sulfate	NR	mg/l	4500-SO4 E
	Fluoride	NR	mg/l	4500-F- C
	Nitrate	NR	mg/l	4500-NO3 E
	Phenolphthalein Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Hardness ($CaCO_3$)	NR	mg/l	2340 B
	Anion-Cation Balance	NR	meq/meq	Calculated
3	Chloride	<1	mg/l	300.0
	pH	8.3		4500-H+ B
	Specific Conductance	4.9	µmho/cm	2510 B
	Total Dissolved Solids	<1	mg/l	160.1
	Total Organic Carbon	<1.0	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
4	Dissolved Iron	<0.10	mg/l	200.7
	Dissolved Manganese	<0.02	mg/l	200.7

- Not Requested

Laboratory Representative Signature: Gari Reynolds Phone: (713) 466-09
(Gari Reynolds)

Laboratory Name: WQS Environmental Lab. Address: 17459 Village Green
Houston, Texas 77040

Site Operator Signature: Kyle C Date: 2-1-98 .

(TDH Form SE 65)

January 19, 1998

GROUNDWATER MONITORING REPORT

TDH Permit No. 1396 Monitoring Well I.D. No. EQB
(Sprint-Fort Bend County)

Submitted for Purpose of	X Background Data Groups 1,2,3,4	___ Semiannual/Annual Data Groups 3,4	___ 4th Year Data Groups 2,3,4

Date Sampled: 12/30/97 Volume Collected: 1160 mls Sampled by: S. Stamoulis .
Representing: Site Operator Sprint Consultant H/ET Laboratory Personnel WQS .
Well Purged/Bailed Before Sampling: Yes X No ___ How Long Before: 5 minutes .
No. Well Vol. Purged: 3+ Depth to Water Before Bailing: 49.78 ft Elev 43.87 MSL
How Were Samples Collected: Rediflow II .
Were sample preservation procedures in accordance with TDH Guidelines: Yes X No.
WQS ID 6346 Std. Mthds. 18th Ed.

GROUP	PARAMETER	LEVEL	UNITS	ANALYTICAL METHOD
1	Arsenic	NR	mg/l	3113 B
	Barium	NR	mg/l	3110 D
	Dissolved Cadmium	<0.005	mg/l	200.7
	Chromium	NR	mg/l	3111 B
	Copper	NR	mg/l	3111 B
	Dissolved Lead	<0.05	mg/l	3111 B
	Mercury	NR	mg/l	3112 B
	Selenium	NR	mg/l	3113 B
	Silver	NR	mg/l	3111 B
	Dissolved Zinc	<0.02	mg/l	200.7
2	Calcium	NR	mg/l	3111 B
	Magnesium	NR	mg/l	3111 B
	Sodium	NR	mg/l	3111 B
	Potassium	NR	mg/l	3111 B
	Carbonate	NR	mg/l	2320 B
	Bicarbonate	NR	mg/l	2320 B
	Sulfate	NR	mg/l	4500-SO4 E
	Fluoride	NR	mg/l	4500-F- C
	Nitrate	NR	mg/l	4500-NO3 E
	Phenolphthalein Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Hardness ($CaCO_3$)	NR	mg/l	2340 B
	Anion-Cation Balance	NR	meq/meq	Calculated
3	Chloride	<1	mg/l	300.0
	pH	8.1		4500-H+ B
	Specific Conductance	6.2	µmho/cm	2510 B
	Total Dissolved Solids	2	mg/l	160.1
	Total Organic Carbon	<1.0	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
4	Dissolved Iron	<0.10	mg/l	200.7
	Dissolved Manganese	<0.02	mg/l	200.7

Not Requested

aboratory Representative Signature: Gari Reynolds Phone: (713) 466-0958
(Gari Reynolds)

aboratory Name: WQS Environmental Lab. Address: 17459 Village Green
Houston, Texas 77040

te Operator Signature: Date: 2-1-98 .

(TDH Form SE 65)

January 19, 1998

GROUNDWATER MONITORING REPORT

TDH Permit No. 1396 Monitoring Well I.D. No. MW-102 (DRY)
(Sprint-Fort Bend County)

mitted for X Background Data ___Semiannual/Annual Data ___4th Year Data
urpose of Groups 1,2,3,4 Groups 3,4 Groups 2,3,4

ate Sampled: Dry Volume Collected: NA Sampled by: S. Stamoulis .
epresenting: Site Operator Sprint Consultant H/ET Laboratory Personnel WQS .
ell Purged/Bailed Before Sampling: Yes ___ No ___ How Long Before: ___ .
o. Well Vol. Purged: ___ Depth to Water Before Bailing: Dry ft Elev ___ MSL
ow Were Samples Collected: ___ .
ere sample preservation procedures in accordance with TDH Guidelines: Yes X No.
QS ID (DRY) Std. Mthds. 18th Ed.

GROUP	PARAMETER	LEVEL	UNITS	ANALYTICAL METHOD
1	Arsenic	NR	mg/l	3113 B
	Barium	NR	mg/l	3110 D
	Dissolved Cadmium	NR	mg/l	200.7
	Chromium	NR	mg/l	3111 B
	Copper	NR	mg/l	3111 B
	Dissolved Lead	NR	mg/l	3111 B
	Mercury	NR	mg/l	3112 B
	Selenium	NR	mg/l	3113 B
	Silver	NR	mg/l	3111 B
	Dissolved Zinc	NR	mg/l	200.7
2	Calcium	NR	mg/l	3111 B
	Magnesium	NR	mg/l	3111 B
	Sodium	NR	mg/l	3111 B
	Potassium	NR	mg/l	3111 B
	Carbonate	NR	mg/l	2320 B
	Bicarbonate	NR	mg/l	2320 B
	Sulfate	NR	mg/l	4500-SO4 E
	Fluoride	NR	mg/l	4500-F- C
	Nitrate	NR	mg/l	4500-NO3 E
	Phenolphthalein Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Hardness ($CaCO_3$)	NR	mg/l	2340 B
	Anion-Cation Balance	NR	meq/meq	Calculated
3	Chloride	NR	mg/l	300.0
	pH	NR		4500-H+ B
	Specific Conductance	NR	µmho/cm	2510 B
	Total Dissolved Solids	NR	mg/l	160.1
	Total Organic Carbon	NR	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
4	Dissolved Iron	NR	mg/l	200.7
	Dissolved Manganese	NR	mg/l	200.7

- Not Requested

oratory Representative Signature: ___ Phone: (713) 466-095
(Gari Reynolds)

aboratory Name: WQS Environmental Lab. Address: 17459 Village Green
Houston, Texas 77040

ite Operator Signature: ___ Date: 2-1-98 .

(TDH Form SE 65)

January 19, 1998

GROUNDWATER MONITORING REPORT

TDH Permit No. 1396 Monitoring Well I.D. No. MW-108 (DRY)
(Sprint-Fort Bend County)

Submitted for _X_Background Data ___Semiannual/Annual Data ___4th Year Data
Purpose of Groups 1,2,3,4 Groups 3,4 Groups 2,3,4

Date Sampled: Dry Volume Collected: NA Sampled by: S. Stamoulis .
Representing: Site Operator Sprint Consultant H/ET Laboratory Personnel WQS .
Well Purged/Bailed Before Sampling: Yes ___No ___How Long Before:________.
No. Well Vol. Purged:____Depth to Water Before Bailing: Dry ft Elev________MSL
How Were Samples Collected:________________.
Were sample preservation procedures in accordance with TDH Guidelines: Yes_X_No.
WQS ID (DRY) Std. Mthds. 18th Ed.

GROUP	PARAMETER	LEVEL	UNITS	ANALYTICAL METHOD
1	Arsenic	NR	mg/l	3113 B
	Barium	NR	mg/l	3110 D
	Dissolved Cadmium	NR	mg/l	200.7
	Chromium	NR	mg/l	3111 B
	Copper	NR	mg/l	3111 B
	Dissolved Lead	NR	mg/l	3111 B
	Mercury	NR	mg/l	3112 B
	Selenium	NR	mg/l	3113 B
	Silver	NR	mg/l	3111 B
	Dissolved Zinc	NR	mg/l	200.7
2	Calcium	NR	mg/l	3111 B
	Magnesium	NR	mg/l	3111 B
	Sodium	NR	mg/l	3111 B
	Potassium	NR	mg/l	3111 B
	Carbonate	NR	mg/l	2320 B
	Bicarbonate	NR	mg/l	2320 B
	Sulfate	NR	mg/l	4500-SO4 E
	Fluoride	NR	mg/l	4500-F- C
	Nitrate	NR	mg/l	4500-NO3 E
	Phenolphthalein Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Hardness ($CaCO_3$)	NR	mg/l	2340 B
	Anion-Cation Balance	NR	meq/meq	Calculated
3	Chloride	NR	mg/l	300.0
	pH	NR		4500-H+ B
	Specific Conductance	NR	μmho/cm	2510 B
	Total Dissolved Solids	NR	mg/l	160.1
	Total Organic Carbon	NR	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
4	Dissolved Iron	NR	mg/l	200.7
	Dissolved Manganese	NR	mg/l	200.7

Not Requested

Laboratory Representative Signature: Gari Reynolds Phone: (713) 466-0958
(Gari Reynolds)

Laboratory Name: WQS Environmental Lab. Address: 17459 Village Green
Houston, Texas 77040

Site Operator Signature: Date: 2-1-98 .

(TDH Form SE 65)

January 19, 1998

GROUNDWATER MONITORING REPORT

TDH Permit No. 1396 Monitoring Well I.D. No. MW-110 (DRY)
(Sprint-Fort Bend County)

ubmitted for X Background Data ___Semiannual/Annual Data ___4th Year Data
urpose of Groups 1,2,3,4 Groups 3,4 Groups 2,3,4

ate Sampled: Dry Volume Collected: NA Sampled by: S. Stamoulis.
epresenting: Site Operator Sprint Consultant H/ET Laboratory Personnel WQS.
ell Purged/Bailed Before Sampling: Yes ___No ___How Long Before:___.
o. Well Vol. Purged:___ Depth to Water Before Bailing: Dry ft Elev___MSL
ow Were Samples Collected:___.
ere sample preservation procedures in accordance with TDH Guidelines: Yes X No.
QS ID (DRY) Std. Mthds. 18th Ed.

GROUP	PARAMETER	LEVEL	UNITS	ANALYTICAL METHOD
1	Arsenic	NR	mg/l	3113 B
	Barium	NR	mg/l	3110 D
	Dissolved Cadmium	NR	mg/l	200.7
	Chromium	NR	mg/l	3111 B
	Copper	NR	mg/l	3111 B
	Dissolved Lead	NR	mg/l	3111 B
	Mercury	NR	mg/l	3112 B
	Selenium	NR	mg/l	3113 B
	Silver	NR	mg/l	3111 B
	Dissolved Zinc	NR	mg/l	200.7
2	Calcium	NR	mg/l	3111 B
	Magnesium	NR	mg/l	3111 B
	Sodium	NR	mg/l	3111 B
	Potassium	NR	mg/l	3111 B
	Carbonate	NR	mg/l	2320 B
	Bicarbonate	NR	mg/l	2320 B
	Sulfate	NR	mg/l	4500-SO4 E
	Fluoride	NR	mg/l	4500-F- C
	Nitrate	NR	mg/l	4500-NO3 E
	Phenolphthalein Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Hardness ($CaCO_3$)	NR	mg/l	2340 B
	Anion-Cation Balance	NR	meq/meq	Calculated
3	Chloride	NR	mg/l	300.0
	pH	NR		4500-H+ B
	Specific Conductance	NR	µmho/cm	2510 B
	Total Dissolved Solids	NR	mg/l	160.1
	Total Organic Carbon	NR	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
4	Dissolved Iron	NR	mg/l	200.7
	Dissolved Manganese	NR	mg/l	200.7

- Not Requested

aboratory Representative Signature: Gari Reynolds Phone: (713) 466-09
(Gari Reynolds)

aboratory Name: WQS Environmental Lab. Address: 17459 Village Green
Houston, Texas 77040

ite Operator Signature: Date: 2-1-98.

(TDH Form SE 65)

October 16, 1997

GROUNDWATER MONITORING REPORT

TDH Permit No. 1396 Monitoring Well I.D. No. MW-111
(Sprint-Fort Bend County)

itted for X Background Data ___Semiannual/Annual Data ___4th Year Data
urpose of Groups 1,2,3,4 Groups 3,4 Groups 2,3,4

ate Sampled: 10/01/97 Volume Collected: 1160 mls Sampled by: S. Stamoulis .
epresenting: Site Operator Sprint Consultant H/ET Laboratory Personnel WQS .
ell Purged/Bailed Before Sampling: Yes X No ___ How Long Before: 5 minutes .
o. Well Vol. Purged: 3+ Depth to Water Before Bailing: 37.40 ft Elev 58.46 MSL
ow Were Samples Collected: Rediflow II .
ere sample preservation procedures in accordance with TDH Guidelines: Yes X No.
QS ID 4915 Std. Mthds. 18th Ed.

GROUP	PARAMETER	LEVEL	UNITS	ANALYTICAL METHOD
1	Arsenic	NR	mg/l	3113 B
	Barium	NR	mg/l	3110 D
	Dissolved Cadmium	<0.005	mg/l	200.7
	Chromium	NR	mg/l	3111 B
	Copper	NR	mg/l	3111 B
	Dissolved Lead	<0.05	mg/l	3111 B
	Mercury	NR	mg/l	3112 B
	Selenium	NR	mg/l	3113 B
	Silver	NR	mg/l	3111 B
	Dissolved Zinc	<0.02	mg/l	200.7
2	Calcium	NR	mg/l	3111 B
	Magnesium	NR	mg/l	3111 B
	Sodium	NR	mg/l	3111 B
	Potassium	NR	mg/l	3111 B
	Carbonate	NR	mg/l	2320 B
	Bicarbonate	NR	mg/l	2320 B
	Sulfate	NR	mg/l	4500-SO4 E
	Fluoride	NR	mg/l	4500-F- C
	Nitrate	NR	mg/l	4500-NO3 E
	Phenolphthalein Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Hardness ($CaCO_3$)	NR	mg/l	2340 B
	Anion-Cation Balance	NR	meq/meq	Calculated
3	Chloride	38.4	mg/l	300.0
	pH	7.0		4500-H+ B
	Specific Conductance	1070	µmho/cm	2510 B
	Total Dissolved Solids	624	mg/l	160.1
	Total Organic Carbon	0.7	mg/l	415.1
	Total Organic Carbon	0.8	mg/l	415.1
	Total Organic Carbon	1.5	mg/l	415.1
	Total Organic Carbon	0.9	mg/l	415.1
4	Dissolved Iron	<0.10	mg/l	200.7
	Dissolved Manganese	0.284	mg/l	200.7

Not Requested

ratory Representative Signature: Gari Reynolds Phone: (713) 466-0958
(Gari Reynolds)

aboratory Name: WQS Environmental Lab. Address: 17459 Village Green
Houston, Texas 77040

ite Operator Signature: Date: 10-27-97 .

(TDH Form SE 65)

October 16, 1997

GROUNDWATER MONITORING REPORT

TDH Permit No. 1396 Monitoring Well I.D. No. MW-112
(Sprint-Fort Bend County)

ꟷmitted for urpose of	X Background Data Groups 1,2,3,4	___Semiannual/Annual Data Groups 3,4	___4th Year Data Groups 2,3,4

ate Sampled: 10/01/97 Volume Collected: 1160 mls Sampled by: S. Stamoulis .
epresenting: Site Operator Sprint Consultant H/ET Laboratory Personnel WQS .
ell Purged/Bailed Before Sampling: Yes X No ___How Long Before: 5 minutes .
o. Well Vol. Purged: 3+ Depth to Water Before Bailing: 37.94 ft Elev 57.73 MSL
ow Were Samples Collected: Rediflow II .
ere sample preservation procedures in accordance with TDH Guidelines: Yes X No.
QS ID 4916 Std. Mthds. 18th Ed.

GROUP	PARAMETER	LEVEL	UNITS	ANALYTICAL METHOD
1	Arsenic	NR	mg/l	3113 B
	Barium	NR	mg/l	3110 D
	Dissolved Cadmium	<0.005	mg/l	200.7
	Chromium	NR	mg/l	3111 B
	Copper	NR	mg/l	3111 B
	Dissolved Lead	<0.05	mg/l	3111 B
	Mercury	NR	mg/l	3112 B
	Selenium	NR	mg/l	3113 B
	Silver	NR	mg/l	3111 B
	Dissolved Zinc	<0.02	mg/l	200.7
2	Calcium	NR	mg/l	3111 B
	Magnesium	NR	mg/l	3111 B
	Sodium	NR	mg/l	3111 B
	Potassium	NR	mg/l	3111 B
	Carbonate	NR	mg/l	2320 B
	Bicarbonate	NR	mg/l	2320 B
	Sulfate	NR	mg/l	4500-SO4 E
	Fluoride	NR	mg/l	4500-F- C
	Nitrate	NR	mg/l	4500-NO3 E
	Phenolphthalein Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Hardness ($CaCO_3$)	NR	mg/l	2340 B
	Anion-Cation Balance	NR	meq/meq	Calculated
3	Chloride	50.3	mg/l	300.0
	pH	7.1		4500-H+ B
	Specific Conductance	1280	µmho/cm	2510 B
	Total Dissolved Solids	820	mg/l	160.1
	Total Organic Carbon	0.7	mg/l	415.1
	Total Organic Carbon	0.5	mg/l	415.1
	Total Organic Carbon	0.7	mg/l	415.1
	Total Organic Carbon	0.6	mg/l	415.1
4	Dissolved Iron	<0.10	mg/l	200.7
	Dissolved Manganese	0.532	mg/l	200.7

- Not Requested

ꟷoratory Representative Signature: Gari Reynolds Phone: (713) 466-095
(Gari Reynolds)

aboratory Name: WQS Environmental Lab. Address: 17459 Village Green
Houston, Texas 77040

ite Operator Signature: Date: 10-27-97 .

(TDH Form SE 65)

October 16, 1997

GROUNDWATER MONITORING REPORT

TDH Permit No. 1396 Monitoring Well I.D. No. MW-201
(Sprint-Fort Bend County)

mitted for _X_Background Data ___Semiannual/Annual Data ___4th Year Data
urpose of Groups 1,2,3,4 Groups 3,4 Groups 2,3,4

ate Sampled: 10/01/97 Volume Collected: 1160 mls Sampled by: S. Stamoulis .
epresenting: Site Operator Sprint Consultant H/ET Laboratory Personnel WQS .
ell Purged/Bailed Before Sampling: Yes _X_No ___How Long Before: 5 minutes .
o. Well Vol. Purged: 3+ Depth to Water Before Bailing: 45.00 ft Elev 50.39 MSL
ow Were Samples Collected: Rediflow II .
ere sample preservation procedures in accordance with TDH Guidelines: Yes _X_No.
QS ID 4917 Std. Mthds. 18th Ed.

GROUP	PARAMETER	LEVEL	UNITS	ANALYTICAL METHOD
1	Arsenic	NR	mg/l	3113 B
	Barium	NR	mg/l	3110 D
	Dissolved Cadmium	<0.005	mg/l	200.7
	Chromium	NR	mg/l	3111 B
	Copper	NR	mg/l	3111 B
	Dissolved Lead	<0.05	mg/l	3111 B
	Mercury	NR	mg/l	3112 B
	Selenium	NR	mg/l	3113 B
	Silver	NR	mg/l	3111 B
	Dissolved Zinc	<0.02	mg/l	200.7
2	Calcium	NR	mg/l	3111 B
	Magnesium	NR	mg/l	3111 B
	Sodium	NR	mg/l	3111 B
	Potassium	NR	mg/l	3111 B
	Carbonate	NR	mg/l	2320 B
	Bicarbonate	NR	mg/l	2320 B
	Sulfate	NR	mg/l	4500-SO4 E
	Fluoride	NR	mg/l	4500-F- C
	Nitrate	NR	mg/l	4500-NO3 E
	Phenolphthalein Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Hardness ($CaCO_3$)	NR	mg/l	2340 B
	Anion-Cation Balance	NR	meq/meq	Calculated
3	Chloride	41.3	mg/l	300.0
	pH	7.4		4500-H+ B
	Specific Conductance	608	µmho/cm	2510 B
	Total Dissolved Solids	387	mg/l	160.1
	Total Organic Carbon	2.0	mg/l	415.1
	Total Organic Carbon	2.0	mg/l	415.1
	Total Organic Carbon	1.6	mg/l	415.1
	Total Organic Carbon	2.1	mg/l	415.1
4	Dissolved Iron	<0.10	mg/l	200.7
	Dissolved Manganese	0.086	mg/l	200.7

– Not Requested

oratory Representative Signature: Gari Reynolds Phone: (713) 466-0958
(Gari Reynolds)

Laboratory Name: WQS Environmental Labs Address: 17459 Village Green
Houston, Texas 77040

ite Operator Signature: Date: 10-27-97 .

(TDH Form SE 65)

October 16, 1997

GROUNDWATER MONITORING REPORT

TDH Permit No. 1396 Monitoring Well I.D. No. MW-202
(Sprint-Fort Bend County)

mitted for X Background Data ___Semiannual/Annual Data ___4th Year Data
urpose of Groups 1,2,3,4 Groups 3,4 Groups 2,3,4

ate Sampled: 10/01/97 Volume Collected: 1160 mls Sampled by: S. Stamoulis .
epresenting: Site Operator Sprint Consultant H/ET Laboratory Personnel WQS .
ell Purged/Bailed Before Sampling: Yes X No ___ How Long Before: 5 minutes .
o. Well Vol. Purged: 3+ Depth to Water Before Bailing: 104.98 ft Elev-10.77 MSL
ow Were Samples Collected: Rediflow II .
ere sample preservation procedures in accordance with TDH Guidelines: Yes X No.
QS ID 4912 Std. Mthds. 18th Ed.

GROUP	PARAMETER	LEVEL	UNITS	ANALYTICAL METHOD
1	Arsenic	NR	mg/l	3113 B
	Barium	NR	mg/l	3110 D
	Dissolved Cadmium	<0.005	mg/l	200.7
	Chromium	NR	mg/l	3111 B
	Copper	NR	mg/l	3111 B
	Dissolved Lead	<0.05	mg/l	3111 B
	Mercury	NR	mg/l	3112 B
	Selenium	NR	mg/l	3113 B
	Silver	NR	mg/l	3111 B
	Dissolved Zinc	<0.02	mg/l	200.7
2	Calcium	NR	mg/l	3111 B
	Magnesium	NR	mg/l	3111 B
	Sodium	NR	mg/l	3111 B
	Potassium	NR	mg/l	3111 B
	Carbonate	NR	mg/l	2320 B
	Bicarbonate	NR	mg/l	2320 B
	Sulfate	NR	mg/l	4500-SO4 E
	Fluoride	NR	mg/l	4500-F- C
	Nitrate	NR	mg/l	4500-NO3 E
	Phenolphthalein Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Hardness ($CaCO_3$)	NR	mg/l	2340 B
	Anion-Cation Balance	NR	meq/meq	Calculated
3	Chloride	93.2	mg/l	300.0
	pH	7.3		4500-H+ B
	Specific Conductance	819	µmho/cm	2510 B
	Total Dissolved Solids	482	mg/l	160.1
	Total Organic Carbon	0.7	mg/l	415.1
	Total Organic Carbon	0.6	mg/l	415.1
	Total Organic Carbon	0.9	mg/l	415.1
	Total Organic Carbon	0.9	mg/l	415.1
4	Dissolved Iron	<0.10	mg/l	200.7
	Dissolved Manganese	0.306	mg/l	200.7

- Not Requested

aboratory Representative Signature: Gari Reynolds Phone: (713) 466-095
(Gari Reynolds)

aboratory Name: WQS Environmental Lab. Address: 17459 Village Green
Houston, Texas 77040

ite Operator Signature: Date: 10-27-97 .

(TDH Form SE 65)

October 16, 1997

GROUNDWATER MONITORING REPORT

TDH Permit No. 1396 Monitoring Well I.D. No. MW-203
(Sprint-Fort Bend County)

ubmitted for X Background Data ___Semiannual/Annual Data ___4th Year Data
urpose of Groups 1,2,3,4 Groups 3,4 Groups 2,3,4

ate Sampled: 09/30/97 Volume Collected: 1160 mls Sampled by: S. Stamoulis .
epresenting: Site Operator Sprint Consultant H/ET Laboratory Personnel WQS .
ell Purged/Bailed Before Sampling: Yes X No ___How Long Before: 5 minutes .
o. Well Vol. Purged: 3+ Depth to Water Before Bailing: 62.65 ft Elev 21.53 MSL
ow Were Samples Collected: Rediflow II .
ere sample preservation procedures in accordance with TDH Guidelines: Yes X No.
QS ID 4868 Std. Mthds. 18th Ed.

GROUP	PARAMETER	LEVEL	UNITS	ANALYTICAL METHOD
1	Arsenic	NR	mg/l	3113 B
	Barium	NR	mg/l	3110 D
	Dissolved Cadmium	<0.005	mg/l	200.7
	Chromium	NR	mg/l	3111 B
	Copper	NR	mg/l	3111 B
	Dissolved Lead	<0.05	mg/l	3111 B
	Mercury	NR	mg/l	3112 B
	Selenium	NR	mg/l	3113 B
	Silver	NR	mg/l	3111 B
	Dissolved Zinc	<0.02	mg/l	200.7
2	Calcium	NR	mg/l	3111 B
	Magnesium	NR	mg/l	3111 B
	Sodium	NR	mg/l	3111 B
	Potassium	NR	mg/l	3111 B
	Carbonate	NR	mg/l	2320 B
	Bicarbonate	NR	mg/l	2320 B
	Sulfate	NR	mg/l	4500-SO4 E
	Fluoride	NR	mg/l	4500-F- C
	Nitrate	NR	mg/l	4500-NO3 E
	Phenolphthalein Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Hardness ($CaCO_3$)	NR	mg/l	2340 B
	Anion-Cation Balance	NR	meq/meq	Calculated
3	Chloride	78.9	mg/l	300.0
	pH	7.2		4500-H+ B
	Specific Conductance	801	µmho/cm	2510 B
	Total Dissolved Solids	520	mg/l	160.1
	Total Organic Carbon	1.0	mg/l	415.1
	Total Organic Carbon	1.0	mg/l	415.1
	Total Organic Carbon	0.9	mg/l	415.1
	Total Organic Carbon	1.3	mg/l	415.1
4	Dissolved Iron	<0.10	mg/l	200.7
	Dissolved Manganese	0.059	mg/l	200.7

ot Requested

aboratory Representative Signature: Gari Reynolds Phone: (713) 466-0958
(Gari Reynolds)

aboratory Name: WQS Environmental Lab. Address: 17459 Village Green
Houston, Texas 77040

ite Operator Signature: Date: 10-27-97 .

(TDH Form SE 65)

October 16, 1997

GROUNDWATER MONITORING REPORT

TDH Permit No. 1396 Monitoring Well I.D. No. MW-204
(Sprint-Fort Bend County)

Submitted for Purpose of	_X_ Background Data Groups 1,2,3,4	___ Semiannual/Annual Data Groups 3,4	___ 4th Year Data Groups 2,3,4

Date Sampled: 10/01/97 Volume Collected: 1160 mls Sampled by: S. Stamoulis .
Representing: Site Operator Sprint Consultant H/ET Laboratory Personnel WQS .
Well Purged/Bailed Before Sampling: Yes _X_ No ___ How Long Before: 5 minutes .
No. Well Vol. Purged: 3+ Depth to Water Before Bailing: 42.85 ft Elev 53.13 MSL
How Were Samples Collected: Rediflow II .
Were sample preservation procedures in accordance with TDH Guidelines: Yes X No.
WQS ID 4918 Std. Mthds. 18th Ed.

GROUP	PARAMETER	LEVEL	UNITS	ANALYTICAL METHOD
1	Arsenic	NR	mg/l	3113 B
	Barium	NR	mg/l	3110 D
	Dissolved Cadmium	<0.005	mg/l	200.7
	Chromium	NR	mg/l	3111 B
	Copper	NR	mg/l	3111 B
	Dissolved Lead	<0.05	mg/l	3111 B
	Mercury	NR	mg/l	3112 B
	Selenium	NR	mg/l	3113 B
	Silver	NR	mg/l	3111 B
	Dissolved Zinc	<0.02	mg/l	200.7
2	Calcium	NR	mg/l	3111 B
	Magnesium	NR	mg/l	3111 B
	Sodium	NR	mg/l	3111 B
	Potassium	NR	mg/l	3111 B
	Carbonate	NR	mg/l	2320 B
	Bicarbonate	NR	mg/l	2320 B
	Sulfate	NR	mg/l	4500-SO4 E
	Fluoride	NR	mg/l	4500-F- C
	Nitrate	NR	mg/l	4500-NO3 E
	Phenolphthalein Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Hardness ($CaCO_3$)	NR	mg/l	2340 B
	Anion-Cation Balance	NR	meq/meq	Calculated
3	Chloride	43.5	mg/l	300.0
	pH	8.1		4500-H+ B
	Specific Conductance	509	µmho/cm	2510 B
	Total Dissolved Solids	281	mg/l	160.1
	Total Organic Carbon	0.3	mg/l	415.1
	Total Organic Carbon	0.3	mg/l	415.1
	Total Organic Carbon	0.2	mg/l	415.1
	Total Organic Carbon	0.3	mg/l	415.1
4	Dissolved Iron	<0.10	mg/l	200.7
	Dissolved Manganese	0.006	mg/l	200.7

- Not Requested

Laboratory Representative Signature: Gari Reynolds Phone: (713) 466-09
(Gari Reynolds)

Laboratory Name: WQS Environmental Lab. Address: 17459 Village Green
Houston, Texas 77040

Site Operator Signature: Date: 10-27-97 .

(TDH Form SE 65)

October 16, 1997

GROUNDWATER MONITORING REPORT

TDH Permit No. 1396 Monitoring Well I.D. No. Dup 101
(Sprint-Fort Bend County)

itted for urpose of: X Background Data Groups 1,2,3,4 ___ Semiannual/Annual Data Groups 3,4 ___ 4th Year Data Groups 2,3,4

ate Sampled: 09/30/97 Volume Collected: 1040 mls Sampled by: S. Stamoulis .
epresenting: Site Operator Sprint Consultant H/ET Laboratory Personnel WQS .
ell Purged/Bailed Before Sampling: Yes ___ No ___ How Long Before: ________ .
o. Well Vol. Purged: ____ Depth to Water Before Bailing: _______ ft Elev _______ MSL
ow Were Samples Collected: ________ .
ere sample preservation procedures in accordance with TDH Guidelines: Yes X No.
QS ID 4871 Std. Mthds. 18th Ed.

GROUP	PARAMETER	LEVEL	UNITS	ANALYTICAL METHOD
1	Arsenic	NR	mg/l	3113 B
	Barium	NR	mg/l	3110 D
	Dissolved Cadmium	<0.005	mg/l	200.7
	Chromium	NR	mg/l	3111 B
	Copper	NR	mg/l	3111 B
	Dissolved Lead	<0.05	mg/l	3111 B
	Mercury	NR	mg/l	3112 B
	Selenium	NR	mg/l	3113 B
	Silver	NR	mg/l	3111 B
	Dissolved Zinc	<0.02	mg/l	200.7
2	Calcium	NR	mg/l	3111 B
	Magnesium	NR	mg/l	3111 B
	Sodium	NR	mg/l	3111 B
	Potassium	NR	mg/l	3111 B
	Carbonate	NR	mg/l	2320 B
	Bicarbonate	NR	mg/l	2320 B
	Sulfate	NR	mg/l	4500-SO4 E
	Fluoride	NR	mg/l	4500-F- C
	Nitrate	NR	mg/l	4500-NO3 E
	Phenolphthalein Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Hardness ($CaCO_3$)	NR	mg/l	2340 B
	Anion-Cation Balance	NR	meq/meq	Calculated
3	Chloride	14.9	mg/l	300.0
	pH	7.2		4500-H+ B
	Specific Conductance	536	µmho/cm	2510 B
	Total Dissolved Solids	337	mg/l	160.1
	Total Organic Carbon	1.1	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
4	Dissolved Iron	<0.10	mg/l	200.7
	Dissolved Manganese	<0.005	mg/l	200.7

Not Requested

atory Representative Signature: Gari Reynolds Phone: (713) 466-0958
(Gari Reynolds)

aboratory Name: WQS Environmental Lab. Address: 17459 Village Green
Houston, Texas 77040

ite Operator Signature: ________ Date: 10-27-97 .

(TDH Form SE 65)

October 16, 1997

GROUNDWATER MONITORING REPORT

TDH Permit No. 1396 Monitoring Well I.D. No. FB-201
(Sprint-Fort Bend County)

bmitted for X Background Data; ___Semiannual/Annual Data ___4th Year Data
Purpose of Groups 1,2,3,4 Groups 3,4 Groups 2,3,4

Date Sampled: 09/30/97 Volume Collected: 1040 mls Sampled by: S. Stamoulis.
Representing: Site Operator Sprint Consultant H/ET Laboratory Personnel WQS.
Well Purged/Bailed Before Sampling: Yes_____No___How Long Before:___________.
No. Well Vol. Purged:____Depth to Water Before Bailing:_______ft Elev_______MSL
How Were Samples Collected:________________________.
Were sample preservation procedures in accordance with TDH Guidelines: Yes X No.
WQS ID 4872 Std. Mthds. 18th Ed.

GROUP	PARAMETER	LEVEL	UNITS	ANALYTICAL METHOD
1	Arsenic	NR	mg/l	3113 B
	Barium	NR	mg/l	3110 D
	Dissolved Cadmium	<0.005	mg/l	200.7
	Chromium	NR	mg/l	3111 B
	Copper	NR	mg/l	3111 B
	Dissolved Lead	<0.05	mg/l	3111 B
	Mercury	NR	mg/l	3112 B
	Selenium	NR	mg/l	3113 B
	Silver	NR	mg/l	3111 B
	Dissolved Zinc	<0.02	mg/l	200.7
2	Calcium	NR	mg/l	3111 B
	Magnesium	NR	mg/l	3111 B
	Sodium	NR	mg/l	3111 B
	Potassium	NR	mg/l	3111 B
	Carbonate	NR	mg/l	2320 B
	Bicarbonate	NR	mg/l	2320 B
	Sulfate	NR	mg/l	4500-SO4 E
	Fluoride	NR	mg/l	4500-F- C
	Nitrate	NR	mg/l	4500-NO3 E
	Phenolphthalein Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Hardness ($CaCO_3$)	NR	mg/l	2340 B
	Anion-Cation Balance	NR	meq/meq	Calculated
3	Chloride	<0.05	mg/l	300.0
	Ph	7.8		4500-H+ B
	Specific Conductance	1.5	µmho/cm	2510 B
	Total Dissolved Solids	22	mg/l	160.1
	Total Organic Carbon	0.6	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
4	Dissolved Iron	<0.10	mg/l	200.7
	Dissolved Manganese	<0.005	mg/l	200.7

- Not Requested

boratory Representative Signature: Gari Reynolds Phone: (713) 466-095
(Gari Reynolds)

Laboratory Name: WQS Environmental, Lab. Address: 17459 Village Green
Houston, Texas 77040

Site Operator Signature: ____________ Date: 10-27-97.

(TDH Form SE 65)

October 16, 1997

GROUNDWATER MONITORING REPORT

TDH Permit No. 1396 Monitoring Well I.D. No. EB-301
(Sprint-Fort Bend County)

ubmitted for X Background Data ___Semiannual/Annual Data ___4th Year Data
urpose of Groups 1,2,3,4 Groups 3,4 Groups 2,3,4

ate Sampled: 09/30/97 Volume Collected: 1040 mls Sampled by: S. Stamoulis .
epresenting: Site Operator Sprint Consultant H/ET Laboratory Personnel WQS .
ell Purged/Bailed Before Sampling: Yes ____No___How Long Before:__________.
o. Well Vol. Purged:____Depth to Water Before Bailing:_______ft Elev______MSL
ow Were Samples Collected:_________________.
ere sample preservation procedures in accordance with TDH Guidelines: Yes X No.
QS ID 4873 Std. Mthds. 18th Ed.

GROUP	PARAMETER	LEVEL	UNITS	ANALYTICAL METHOD
1	Arsenic	NR	mg/l	3113 B
	Barium	NR	mg/l	3110 D
	Dissolved Cadmium	<0.005	mg/l	200.7
	Chromium	NR	mg/l	3111 B
	Copper	NR	mg/l	3111 B
	Dissolved Lead	<0.05	mg/l	3111 B
	Mercury	NR	mg/l	3112 B
	Selenium	NR	mg/l	3113 B
	Silver	NR	mg/l	3111 B
	Dissolved Zinc	<0.02	mg/l	200.7
2	Calcium	NR	mg/l	3111 B
	Magnesium	NR	mg/l	3111 B
	Sodium	NR	mg/l	3111 B
	Potassium	NR	mg/l	3111 B
	Carbonate	NR	mg/l	2320 B
	Bicarbonate	NR	mg/l	2320 B
	Sulfate	NR	mg/l	4500-SO4 E
	Fluoride	NR	mg/l	4500-F- C
	Nitrate	NR	mg/l	4500-NO3 E
	Phenolphthalein Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Alkalinity ($CaCO_3$)	NR	mg/l	2320 B
	Hardness ($CaCO_3$)	NR	mg/l	2340 B
	Anion-Cation Balance	NR	meq/meq	Calculated
3	Chloride	0.10	mg/l	300.0
	pH	7.4		4500-H+ B
	Specific Conductance	1.6	μmho/cm	2510 B
	Total Dissolved Solids	12	mg/l	160.1
	Total Organic Carbon	0.4	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
	Total Organic Carbon	NR	mg/l	415.1
4	Dissolved Iron	<0.10	mg/l	200.7
	Dissolved Manganese	<0.005	mg/l	200.7

Not Requested

aboratory Representative Signature: Gari Reynolds Phone: (713) 466-0958
(Gari Reynolds)

aboratory Name: WQS Environmental Lab. Address: 17459 Village Green
Houston, Texas 77040

ite Operator Signature: ____________ Date: 10-27-97 .

(TDH Form SE 65)

TEXAS NATURAL RESOURCE CONSERVATION COMMISION

GROUND-WATER SAMPLING INFORMATION

Analytical Results for Permit 1396 - Sprint Fort Bend County LF, L.P.

Well Number MW-01

	01/12/82	10/12/82	10/21/82	06/28/85	12/12/85	07/18/86	03/26/87	07/06/87	02/01/88	07/26/88
HEAVY METALS (mg/L)										
Arsenic	< 0.005		< 0.010							
Barium	< 0.500		< 0.500							
Cadmium	< 0.020		< 0.005							
Chromium	< 0.020		< 0.020							
Copper			< 0.020							
Iron		< 0.020	0.300	0.020	0.020	< 0.020	**0.700**		0.120	0.130
Lead	< 0.005		< 0.020							
Manganese		**0.110**	**0.150**			0.050	**0.110**		**0.190**	**0.100**
Mercury	< 0.001		< 0.000							
Selenium	< 0.005		< 0.002							
Silver	< 0.020		< 0.010							
Zinc			0.050							

** Bold items indicate an exceedance

TEXAS NATURAL RESOURCE CONSERVATION COMMISION

GROUND-WATER SAMPLING INFORMATION

Analytical Results for Permit 1396 - Sprint Fort Bend County LF, L.P.

Well Number MW-01

	01/04/89	07/05/89	03/01/90	07/10/90	01/30/91	07/10/91	01/06/92	07/28/92	01/13/93	07/01/93
HEAVY METALS (mg/L)										
Arsenic								0.002	< 0.002	
Barium								0.260	< 0.250	
Cadmium								**0.011**	< 0.013	
Chromium								< 0.050	< 0.050	
Copper								0.020	< 0.020	
Iron	0.120	0.030	**0.740**	**0.770**	0.200	< 0.020	**2.070**	**1.600**	< 0.100	< 0.100
Lead								**0.040**	< 0.050	
Manganese	0.040	**0.190**	**0.190**	**0.340**	**0.360**	**0.800**	**0.400**	**0.770**	**0.170**	**0.440**
Mercury								< 0.001	< 0.001	
Selenium								< 0.002	< 0.001	
Silver								< 0.010	< 0.020	
Zinc								0.050	< 0.010	

** Bold items indicate an exceedance

TEXAS NATURAL RESOURCE CONSERVATION COMMISION

GROUND-WATER SAMPLING INFORMATION

Analytical Results for Permit 1396 - Sprint Fort Bend County LF, L.P.

Well Number MW-01

	01/17/94	07/13/94
HEAVY METALS (mg/L)		
Arsenic		
Barium		
Cadmium		
Chromium		
Copper		
Iron	< 0.100	0.300
Lead		
Manganese	**0.250**	**0.210**
Mercury		
Selenium		
Silver		
Zinc		

** Bold items indicate an exceedance

TEXAS NATURAL RESOURCE CONSERVATION COMMISION

GROUND-WATER SAMPLING INFORMATION

Analytical Results for Permit 1396 - Sprint Fort Bend County LF, L.P.

Well Number MW-01

	01/12/82	10/12/82	10/21/82	06/28/85	12/12/85	07/18/86	03/26/87	07/06/87	02/01/88	07/26/88
OTHER (mg/L)										
Alkalinity			349.0				329.0			
Anion-cation							9.9			
Anion-cation							9.5			
Bicarbonate			426.0				401.0			
Calcium			116.0				80.9			
Carbonate			0.0				0.0			
Chloride		97.0	103.0	58.0	57.0	62.0	63.0		66.0	60.0
Fluoride			0.4	0.6	0.5	0.5	0.5	0.4	0.5	0.6
Hardness (CaCO3)			420.0				446.0			
Magnesium			31.0				35.6			
Nitrate (N)		0.1	0.0	0.4	0.1	0.4	4.2	0.1	0.1	0.1
Phenolphthalein		< 0.0	< 0.0	< 0.0	< 0.0	< 0.0	0.0		< 0.0	< 0.0
Potassium							1.4			
Sodium		93.0	65.0				58.0			
Total dissolved		590.0	580.0	478.0	500.0	540.0	636.0		617.0	693.0
Total organic carbon				6.0	4.0	7.0	3.0		3.0	0.6
Total organic carbon							3.0		3.0	0.7
Total organic carbon							4.0		3.0	0.6
Total organic carbon							3.0		3.0	0.3
Total organic carbon				6.0	4.0	7.0	3.2		3.0	0.6

TEXAS NATURAL RESOURCE CONSERVATION COMMISION
GROUND-WATER SAMPLING INFORMATION
Analytical Results for Permit 1396 - Sprint Fort Bend County LF, L.P.
Well Number MW-01

	01/04/89	07/05/89	03/01/90	07/10/90	01/30/91	07/10/91	01/06/92	07/28/92	01/13/93	07/01/93
OTHER (mg/L)										
Alkalinity					330.0			375.0	392.0	
Anion-cation					11.5			10.5	13.5	
Anion-cation					12.1			11.2	13.1	
Bicarbonate					400.0			458.0	478.0	
Calcium					128.0			81.4	134.0	
Carbonate					0.0			0.0	0.0	
Chloride	55.0	69.0	56.0	53.0	55.0	55.0	56.0	50.0	68.0	78.0
Fluoride	0.5				0.4			0.5	0.3	
Hardness (CaCO3)					462.0			366.0	504.0	
Magnesium					34.5			39.6	41.2	
Nitrate (N)	1.0				4.9			0.3	0.2	
Phenolphthalein					0.0			0.0	0.0	
Potassium					1.6			1.7	1.2	
Sodium					65.7			71.9	67.9	
Total dissolved	495.0	757.0	511.0	760.0	683.0	843.0	698.0	831.0	731.0	735.0
Total organic carbon	4.3	4.3	3.0	4.2	3.2	3.4	1.3	1.4	2.1	1.5
Total organic carbon	3.9	4.1	3.0	3.9	2.9	3.5	1.8	0.8	2.1	1.5
Total organic carbon	3.4	4.4	3.1	3.6	2.9	3.4	2.1	0.9	2.1	1.6
Total organic carbon	3.5	4.3	3.1	3.7	2.5	3.0	1.2	0.8	2.1	1.9
Total organic carbon	3.8	4.3	3.1	3.9	2.9	3.3	1.6	1.0	2.1	1.6

** Bold items indicate an exceedance

TEXAS NATURAL RESOURCE CONSERVATION COMMISION

GROUND-WATER SAMPLING INFORMATION

Analytical Results for Permit 1396 - Sprint Fort Bend County LF, L.P.

Well Number MW-01

	01/17/94	07/13/94
OTHER (mg/L)		
Alkalinity		
Anion-cation		
Anion-cation		
Bicarbonate		
Calcium		
Carbonate		
Chloride	94.0	96.0
Fluoride		
Hardness (CaCO3)		
Magnesium		
Nitrate (N)		
Phenolphthalein		
Potassium		
Sodium		
Total dissolved	780.0	735.0
Total organic carbon	0.9	9.4
Total organic carbon	0.8	**10.4**
Total organic carbon	0.8	**10.1**
Total organic carbon	1.3	9.0
Total organic carbon	1.0	9.7

** Bold items indicate an exceedance

TEXAS NATURAL RESOURCE CONSERVATION COMMISION

GROUND-WATER SAMPLING INFORMATION

Analytical Results for Permit 1396 - Sprint Fort Bend County LF, L.P.

Well Number MW-02

	10/12/82	10/21/82	06/28/85	12/12/85	07/18/86	01/25/87	03/26/87	08/06/87	01/25/88	07/26/88
HEAVY METALS (mg/L)										
Arsenic	< 0.005	< 0.010								
Barium	0.540	0.500								
Cadmium	< 0.020	< 0.005								
Chromium	< 0.020	< 0.020								
Copper		< 0.020								
Iron	< 0.020	**0.420**	0.020	0.240	0.020	0.180	**0.900**			0.120
Lead	< 0.005	< 0.020								
Manganese	**0.130**	**0.190**			< 0.010	0.050	**0.060**			0.010
Mercury	< 0.001	< 0.000								
Selenium	< 0.005	< 0.002								
Silver	< 0.020	< 0.010								
Zinc		0.080								

** Bold items indicate an exceedance

TEXAS NATURAL RESOURCE CONSERVATION COMMISION
GROUND-WATER SAMPLING INFORMATION
Analytical Results for Permit 1396 - Sprint Fort Bend County LF, L.P.
Well Number MW-02

	01/04/89	07/05/89	03/01/90	07/10/90	01/30/91	07/10/91	01/06/92	07/28/92	01/13/93	07/01/93
HEAVY METALS (mg/L)										
Arsenic								< 0.002	< 0.002	
Barium								< 0.250	< 0.250	
Cadmium								**0.011**	< 0.013	
Chromium								< 0.050	< 0.050	
Copper								0.010	< 0.020	
Iron	0.110	0.030	**1.390**	**0.820**	0.100	< 0.020	0.120	< 0.100	< 0.100	< 0.100
Lead								< 0.040	< 0.050	
Manganese	0.020	0.040	**0.110**	**0.570**	**0.080**	0.050	0.010	**0.060**	0.030	< 0.020
Mercury								< 0.002	< 0.001	
Selenium								< 0.002	0.002	
Silver								< 0.010	< 0.020	
Zinc								0.030	< 0.010	

** Bold items indicate an exceedance

TEXAS NATURAL RESOURCE CONSERVATION COMMISION
GROUND-WATER SAMPLING INFORMATION
Analytical Results for Permit 1396 - Sprint Fort Bend County LF, L.P.
Well Number MW-02

	01/17/94	07/13/94
HEAVY METALS (mg/L)		
Arsenic		
Barium		
Cadmium		
Chromium		
Copper		
Iron	< 0.100	< 0.010
Lead		
Manganese	0.040	**0.180**
Mercury		
Selenium		
Silver		
Zinc		

** Bold items indicate an exceedance

TEXAS NATURAL RESOURCE CONSERVATION COMMISION
GROUND-WATER SAMPLING INFORMATION
Analytical Results for Permit 1396 - Sprint Fort Bend County LF, L.P.
Well Number MW-02

	10/12/82	10/21/82	06/28/85	12/12/85	07/18/86	01/25/87	03/26/87	08/06/87	01/25/88	07/26/88
OTHER (mg/L)										
Alkalinity		369.0					339.0			
Anion-cation							8.6			
Anion-cation							8.2			
Bicarbonate		450.0					414.0			
Calcium		92.0					66.8			
Carbonate		0 0					0.0			
Chloride	38.0	40.0	27.0	23.0	26.0	36.0	20.0			22.0
Fluoride		0.6	0.7	0.5	0.6		0.6	0.5	0.6	0.6
Hardness (CaCO3)		340.0					379.0			
Magnesium		27.0					30.6			
Nitrate (N)	0.1	0.0	0.4	0.1	0.4		2.0	1.4	0.1	0.1
Phenolphthalein		< 0.0	< 0.0		< 0.0		0.0		< 0.0	< 0.0
Potassium							1.3			
Sodium	58.0	57.0					53.1			
Total dissolved	470.0	465.0	452.0	430.0	508.0	672.0	540.0			715.0
Total organic carbon			6.0	4.0	7.0	**19.0**	2.0			4.3
Total organic carbon						**14.0**	2.0			6.6
Total organic carbon						**15.0**	2.0			6.7
Total organic carbon						9.0	2.0			4.7
Total organic carbon			6.0	4.0	7.0	**14.3**	2.0			5.6

** Bold items indicate an exceedance

TEXAS NATURAL RESOURCE CONSERVATION COMMISION
GROUND-WATER SAMPLING INFORMATION
Analytical Results for Permit 1396 - Sprint Fort Bend County LF, L.P.
Well Number MW-02

	01/04/89	07/05/89	03/01/90	07/10/90	01/30/91	07/10/91	01/06/92	07/28/92	01/13/93	07/01/93
OTHER (mg/L)										
Alkalinity					414.0			395.0	437.0	
Anion-cation					13.3			14.4	15.2	
Anion-cation					14.4			14.5	15.5	
Bicarbonate					505.0			482.0	533.0	
Calcium					142.0			106.0	167.0	
Carbonate					0.0			0.0	0.0	
Chloride	21.0	28.0	21.0	16.0	40.0	18.0	18.0	22.0	20.0	29.0
Fluoride	0.5				0.4			0.5	0.3	
Hardness (CaCO3)					533.0			590.0	665.0	
Magnesium					43.3			79.1	60.3	
Nitrate (N)	0.1				0.5			0.1	0.1	
Phenolphthalein	< 0.0				< 0.0			0.0	0.0	
Potassium					1.1			1.2	1.0	
Sodium					60.3			61.2	49.1	
Total dissolved	710.0	694.0	686.0	683.0	803.0	838.0	793.0	737.0	900.0	779.0
Total organic carbon	2.1	3.1	1.8	1.9	2.5	**11.2**	1.3	0.7	4.0	7.4
Total organic carbon	2.0	3.0	2.2	1.9	1.6	1.6	1.2	0.9	2.2	7.0
Total organic carbon	2.0	3.0	2.3	1.8	1.6	**13.4**	1.6	0.8	2.6	7.2
Total organic carbon	1.9	3.1	2.4	1.8	2.0	9.9	1.2	1.1	2.3	6.7
Total organic carbon	2.0	3.1	2.2	1.9	1.9	9.0	1.3	0.9	2.8	7.1

** Bold items indicate an exceedance

TEXAS NATURAL RESOURCE CONSERVATION COMMISION
GROUND-WATER SAMPLING INFORMATION
Analytical Results for Permit 1396 - Sprint Fort Bend County LF, L.P.
Well Number MW-02

	01/17/94	07/13/94
OTHER (mg/L)		
Alkalinity		
Anion-cation		
Anion-cation		
Bicarbonate		
Calcium		
Carbonate		
Chloride	45.0	42.0
Fluoride		
Hardness (CaCO3)		
Magnesium		
Nitrate (N)		
Phenolphthalein		
Potassium		
Sodium		
Total dissolved	1040.0	1140.0
Total organic carbon	5.1	4.8
Total organic carbon	4.0	7.4
Total organic carbon	3.6	4.6
Total organic carbon	3.8	4.4
Total organic carbon	4.1	5.3

** Bold items indicate an exceedance

TEXAS NATURAL RESOURCE CONSERVATION COMMISION

GROUND-WATER SAMPLING INFORMATION

Analytical Results for Permit 1396 - Sprint Fort Bend County LF, L.P.

Well Number MW-03

	12/13/83	12/14/83	06/28/85	12/12/85	07/18/86	01/25/87	03/26/87	08/05/87	01/25/88	07/26/88
HEAVY METALS (mg/L)										
Arsenic		< 0.010								
Barium		< 0.500								
Cadmium		< 0.010								
Chromium		< 0.050								
Copper										
Iron		**0.490**	0.020	0.300	0.020	0.210	**0.930**			0.100
Lead		< 0.010								
Manganese		**0.240**			0.030	0.030	**0.060**			0.020
Mercury		< 0.001								
Selenium		< 0.010								
Silver		< 0.050								
Zinc										

** Bold items indicate an exceedance

TEXAS NATURAL RESOURCE CONSERVATION COMMISION
GROUND-WATER SAMPLING INFORMATION
Analytical Results for Permit 1396 - Sprint Fort Bend County LF, L.P.
Well Number MW-03

	01/04/89	07/05/89	03/23/90	07/10/90	01/30/91	07/10/91	01/06/92	07/30/92	01/13/93	07/01/93
HEAVY METALS (mg/L)										
Arsenic								0.003	< 0.002	
Barium								< 0.250	< 0.250	
Cadmium								< 0.005	< 0.013	
Chromium								< 0.020	< 0.050	
Copper								< 0.020	< 0.020	
Iron	0.080	0.160	0.070	**3.860**	**0.800**	< 0.020	**0.590**	**0.560**	**0.520**	< 0.100
Lead								< 0.040	< 0.050	
Manganese	0.020	0.040	< 0.010	**0.150**	**0.130**	**0.180**	**0.090**	**0.070**	**0.080**	**0.090**
Mercury								< 0.001	< 0.001	
Selenium								< 0.002	< 0.001	
Silver								< 0.010	< 0.020	
Zinc								< 0.020	< 0.010	

** Bold items indicate an exceedance

TEXAS NATURAL RESOURCE CONSERVATION COMMISION
GROUND-WATER SAMPLING INFORMATION
Analytical Results for Permit 1396 - Sprint Fort Bend County LF, L.P.
Well Number MW-03

	01/17/94	07/13/94
HEAVY METALS (mg/L)		
Arsenic		
Barium		
Cadmium		
Chromium		
Copper		
Iron	< 0.100	< 0.100
Lead		
Manganese	< 0.020	0.030
Mercury		
Selenium		
Silver		
Zinc		

** Bold items indicate an exceedance

TEXAS NATURAL RESOURCE CONSERVATION COMMISION
GROUND-WATER SAMPLING INFORMATION
Analytical Results for Permit 1396 - Sprint Fort Bend County LF, L.P.
Well Number MW-03

	12/13/83	12/14/83	06/28/85	12/12/85	07/18/86	01/25/87	03/26/87	08/05/87	01/25/88	07/26/88
OTHER (mg/L)										
Alkalinity	299.0	308.0					304.0			
Anion-cation	10.9						8.6			
Anion-cation	10.8						8.1			
Bicarbonate	365.0	308.0					371.0			
Calcium	100.0	32.9					70.1			
Carbonate	0.0	0.0					0.0			
Chloride	142.0	137.0	62.0	38.0	95.0	77.0	61.0			45.0
Fluoride	0.2	0.2	0.2	0.2	0.2		0.3	0.3	0.3	0.4
Hardness (CaCO3)	312.0	334.0					344.0			
Magnesium	15.0	18.4					17.9			
Nitrate (N)	0.0	0.1	0.4	0.1	0.4		2.2	3.9	0.1	0.1
Phenolphthalein	< 0.0	< 0.0	< 0.0		< 0.0		0.0		< 0.0	< 0.0
Potassium							2.2			
Sodium	103.0						71.0			
Total dissolved	587.0	803.0	500.0	386.0	552.0	558.0	560.0			498.0
Total organic carbon	4.0		6.0	7.0	5.0	1.0	3.0			5.8
Total organic carbon						1.0	3.0			6.0
Total organic carbon						4.0	3.0			5.9
Total organic carbon						4.0	3.0			5.8
Total organic carbon	4.0		6.0	7.0	5.0	2.5	3.0			5.9

** Bold items indicate an exceedance

TEXAS NATURAL RESOURCE CONSERVATION COMMISION
GROUND-WATER SAMPLING INFORMATION
Analytical Results for Permit 1396 - Sprint Fort Bend County LF, L.P.
Well Number MW-03

	01/04/89	07/05/89	03/23/90	07/10/90	01/30/91	07/10/91	01/06/92	07/30/92	01/13/93	07/01/93
OTHER (mg/L)										
Alkalinity					380.0			216.0	269.0	
Anion-cation					11.4			7.6	11.1	
Anion-cation					12.2			7.7	10.9	
Bicarbonate					460.0			263.0	328.0	
Calcium					104.0			56.0	112.0	
Carbonate					0.0			0.0	0.0	
Chloride	37.0	57.0	40.0	46.0	40.0	73.0	78.0	64.0	80.0	65.0
Fluoride	0.4				0.3			0.3	0.2	
Hardness (CaCO3)					383.0			237.0	385.0	
Magnesium					29.9			23.6	25.6	
Nitrate (N)	0.1				0.5			0.7	0.3	
Phenolphthalein	< 0.0				< 0.0			0.0	0.0	
Potassium					2.6			1.6	1.7	
Sodium					84.5			67.3	73.2	
Total dissolved	445.0	507.0	517.0	594.0	693.0	870.0	588.0	495.0	623.0	489.0
Total organic carbon	2.9	3.3	4.3	2.3	4.7	3.6	1.7	2.5	2.0	2.8
Total organic carbon	3.1	3.1	4.3	2.4	1.9	3.6	2.3	2.0	2.1	2.0
Total organic carbon	3.0	2.9	4.2	2.2	2.3	3.2	1.8	1.9	1.9	1.5
Total organic carbon	3.1	2.9	4.3	2.5	1.8	3.3	1.4	1.8	1.9	1.9
Total organic carbon	3.0	3.1	4.3	2.4	2.7	3.4	1.8	2.0	2.0	2.1

** Bold items indicate an exceedance

TEXAS NATURAL RESOURCE CONSERVATION COMMISION
GROUND-WATER SAMPLING INFORMATION
Analytical Results for Permit 1396 - Sprint Fort Bend County LF, L.P.
Well Number MW-03

	01/17/94	07/13/94
OTHER (mg/L)		
Alkalinity		
Anion-cation		
Anion-cation		
Bicarbonate		
Calcium		
Carbonate		
Chloride	71.0	71.0
Fluoride		
Hardness (CaCO3)		
Magnesium		
Nitrate (N)		
Phenolphthalein		
Potassium		
Sodium		
Total dissolved	405.0	396.0
Total organic carbon	5.1	4.4
Total organic carbon	4.0	**10.6**
Total organic carbon	4.0	7.5
Total organic carbon	4.5	9.5
Total organic carbon	4.4	8.0

** Bold items indicate an exceedance

TDH
Texas Department of Health

William R. Archer III, M.D.
Commissioner of Health

1100 West 49th Street
Austin, Texas 78756-3199
(512) 458-7111
http://www.tdh.state.tx.us

Patti J. Patterson, M.D., M.P.H.
Executive Deputy Commissioner

October 5, 1998

EPA
Attention: Tom Poeton
Dallas, TX

Dear Mr. Poeton:

Attached is the list of laboratories in the State of Texas certified to test for coliforms in drinking water. All of these labs except for Edwards Aquifer Research and Data Center are also certified to test for *E coli* in drinking water. Four labs are certified to test for fecal coliforms in drinking water:

Edwards Aquifer Research and Data Center
Houston Health and Human Services Department
New Braunfels Utilities
Texas Department of Health - Austin

In addition to the attached list is:

Texas Department of Health
Bureau Of Laboratories
ATTN: Po Chang
Section Chief, Consumer Microbiology
1100 W. 49th Street
Austin, TX 78756
(512)458-7562

Sincerely,

Alice Brenner, M.S.P.H.

Water Labs Certified by the State of Texas Located in the Dallas/Ft. Worth Area

Tarrant County Public Health Department
ATTN: Guy Dixon, Ph.D.
Laboratory Manager
1800 University Drive
Fort Worth, TX 76107
(817)-871-7249
871-7245

City of Arlington
Pierce-Burch Water Treatment Plant
ATTN: Star F. Birch
Laboratory Manager
1901 Lakewood Dr.
Arlington, TX 76013
(817)-457-7550

Dallas Water Utilities
East Side Water Treatment Plant
ATTN: Simson Mammen
Senior Chemist
405 Long Creek Road
Sunnyvale, TX 75182
(214)-670-0917

Dallas Water Utilities
Bachman Water Treatment Plant
ATTN: Laurence O. Robinson
Laboratory Supervisor
2605 Shorecrest
Dallas, TX 75235
(214)-670-6587

Dallas Water Utilities
Elm Fork Water Treatment Plant
ATTN: Gamaliel Guzman
Laboratory Supervisor
1440 Whitlock Lane
Carrollton, TX 75006
(972)-389-6012

Dallas County
Park Cities Municipal Water District
ATTN: Bill White
General Manager
1811 Regal Row
Dallas, TX 75235
(214)-652-8639

Garland Water Utilities Lab
Duck Creek Wastewater Plant
ATTN: Wesley Kucera
Laboratory Supervisor
750 Duck Creek Way
Sunnyvale, TX 75182-9319
(972)-203-4309

Trinity River Authority
Northern Division
ATTN: Mary C. Henderson
Laboratory Supervisor
6500 W. Singleton Blvd.
Dallas, TX 75212
(972)-263-2251

North Texas Municipal Water District
ATTN: Michael Gooch
Laboratory Supervisor
P.O. Box 2408
Wylie, TX 75098
(972)-442-5405

Water Labs Certified by the State of Texas

ane Public Health
partment
ATTN: Nancy Jennings
Laboratory Manager
P.O. Box 6489
Abilene, TX 79608-6489
(915)-692-5600

Brazoria County Health
Department Water Lab
ATTN: Mike Green
Laboratory Supervisor
434 East Mulberry
Angleton, TX 77515
(409)-849-5711 X-1628

Brazos County Health
Department
ATTN: Bill Rosser
Laboratory Director
201 North Texas Avenue
Bryan, TX 77803-5317
(409)-361-4450

Corpus Christi-Nueces County
Public Health District
ATTN: Irma Rios
ratory Director
. Box 9727
Corpus Christi, TX 78469
(512)-851-7214

El Paso City-County Health
District
ATTN: Joe Veale
Laboratory Director
1148 Airway Blvd.
El Paso, TX 79925
(915)-543-3536
543-3537

Tarrant County Public Health
Department
ATTN: Guy Dixon, Ph.D.
Laboratory Manager
1800 University Drive
Fort Worth, TX 76107
(817)-871-7249
871-7245

Greenville-Hunt County Health
Department
ATTN: Joe Lilly
Laboratory Director
Lee Street
nville, TX 75401
(903)-408-4140

Houston Health & Human
Services Department
ATTN: S. Vern Juchau, Ph.D.,
MPH
Chief, Laboratory Services
1115 South Braeswood
Houston, TX 77030
(713)-558-3471

Galveston County Health District
ATTN: Doug Simburger
Laboratory Director
P.O. Box 939
La Marque, TX 77568
(409)-938-7221

Lubbock City Health Department
ATTN: Tommy Camden
Laboratory Director
P.O. Box 2548
Lubbock, TX 79408-2548
(806)-767-2908

Laredo City Health Department
ATTN: Ricardo D. Martinez
Chief, Laboratory Services
P.O. Box 2337
Laredo, TX 78044
(956)-723-2051 X-259

Midland Health Department
ATTN: Celestino R. Garcia
Laboratory Director
3303 W. Illinois, Space 22
Midland, TX 79703
(915)-681-7613

Paris-Lamar County Health
Department
ATTN: Pauline McDonald
Laboratory Director
P.O. Box 938
Paris, TX 75461
(903)-785-4561

Port Arthur City Health
Department
ATTN: Lloyd Haggard
Laboratory Director
431 Beaumont Ave.
Port Arthur, TX 77640
(409)-983-8830

San Antonio Metropolitan Health
District
ATTN: Anna C. Crowder
Laboratory Director
332 West Commerce
San Antonio, TX 78205
(210)-207-8747

South Texas Hospital
ATTN: Graciela R. Garza
Laboratory Director
P.O. Box 592
Harlingen, TX 78551
(210)-423-3420 X-288

Sweetwater-Nolan County Health
Department
ATTN: Kathy Rosson
Laboratory Director
P.O. Box 458
Sweetwater, TX 79556
(915)-235-5463

Smith County Public Health
District
ATTN: Bruce Anthony Stevens
Laboratory Director
P.O. Box 2039
Tyler, TX 75710-0209
(903)-535-0090

Waco-McLennan County Public
Health District
ATTN: Ruth E. Vaughan
Laboratory Director
225 West Waco Drive
Waco, TX 76707
(254)-750-5471

Wichita Falls- Wichita County
Public Health District
ATTN: Paul G. Gwynn, Jr.
Laboratory Director
1700 Third Street
Wichita Falls, TX 76301
(817)-761-7873

Victoria County Health
Department
ATTN: Eloy Saldivar
Laboratory Manager
P.O. Box 2350
Victoria, TX 77902
(512)-578-6281 X-41

Houston Health & Human
Services Department
North Environmental Lab
ATTN: Larry Bagwill
boratory Supervisor
1828 Rankin Road
Houston, TX 77073
(281)-233-2563

Nova Biologicals, Inc.
ATTN: Paul J. Pearce, Ph.D.
Vice-President, Laboratory
Director
1775 E. Loop 336, Suite 4
Conroe, TX 77303
(409)-756-5333

Eastex Environmental Lab, Inc.
ATTN: Jody E. Jeansonne
Inorganic Lab Manager
P.O. Box 859
Coldspring, TX 77331
(409)-653-3249

North Water District Laboratory
Services, Inc.
ATTN: Steve Grychka
Laboratory Supervisor
9391 Grogan's Mill, Suite A-4
The Woodlands, TX 77380
(281)-363-8740

LabTech Corporation
ATTN: Joyce Stevens
Manager
6919 Mayard
Houston, TX 77041
(713)-849-2872

Angelina & Neches River
Authority
ATTN: Beverly McGee
Laboratory Manager
P.O. Box 387
Lufkin, TX 75902-0387
(409)-632-7795

City of Arlington
Pierce-Burch Water Treatment
Plant
ATTN: Star F. Birch
Laboratory Manager
1901 Lakewood Dr.
Arlington, TX 76013
(817)-457-7550

City of Amarillo Environmental
Lab
ATTN: David Reasoner
Laboratory Supervisor
P.O. Box 1971
Amarillo, TX 79186
(806)-342-1549

City of Austin Water and
Wastewater Dept.
Water Quality Lab
ATTN: Maria R. Barrios
Laboratory Supervisor
3500 W. 35th Street
Austin, TX 78703
(512)-421-3777

Baytown Area Water Authority
ATTN: Armando Martinez
Laboratory Supervisor
7425 Thompson Road
Baytown, TX 77521
(281)-426-3517

Beaumont Water Purification
Plant
ATTN: Ronnie L. Heiman
Laboratory Supervisor
P.O. Box 3827
Beaumont, TX 77704
(409)-838-3524

Preventive Medicine Service
Environmental Health Section
ATTN: Major Chris Jenkins
Laboratory Officer
William Beaumont Army Medical
Center, Bldg. 118
El Paso, TX 79920-5001
(915)-568-7016

Borger Water Treatment Plant
ATTN: Paul Waterstraat
Utility Director
P.O. Box 5250
Borger, TX 79008-5250
(806)-273-0965

Water Plant No. 1 Laboratory
ATTN: Isidoro Urbano, Jr.
Laboratory Supervisor
P.O. Box 3270
Brownsville, TX 78520
(982)-982-6380

Lower Colorado River Authority
ATTN: Alicia Gill
Laboratory Manager
P.O. Box 220
Austin, TX 78767
(512)-356-6022

City of Corpus Christi
O.N. Stevens Water Treatment
Plant
ATTN: M.P. Sudhakaran
Laboratory Supervisor
P.O. Box 9277
Corpus Christi, TX 78469-9277
(512)-241-1171

Dallas Water Utilities
East Side Water Treatment Plant
ATTN: Simson Mammen
Senior Chemist
405 Long Creek Road
Sunnyvale, TX 75182
(214)-670-0917

Dallas Water Utilities
Bachman Water Treatment Plant
ATTN: Laurence O. Robinson
Laboratory Supervisor
2605 Shorecrest
Dallas, TX 75235
(214)-670-6587

Dallas Water Utilities
Elm Fork Water Treatment Plant
ATTN: Gamaliel Guzman
Laboratory Supervisor
1440 Whitlock Lane
Carrollton, TX 75006
(972)-389-6012

Dallas County
Park Cities Municipal Water
District
ATTN: Bill White
General Manager
1811 Regal Row
Dallas, TX 75235
(214)-652-8639

Denton Municipal Laboratory
ATTN: Howard Martin
Director of Environmental
Services
1100 Mayhill
Denton, TX 76208
(940)-383-7509

Edwards Aquifer Research and
Data Center
ATTN: Glenn Longley, Ph.D.
Laboratory Director
Freeman Bldg. Room 248
San Marcos, TX 78666-4616
(512)-245-2329

City of Deer Park
Surface Water Treatment Plant
ATTN: Bill Healer
boratory Supervisor
O. Box 700
Deer Park, TX 77536
(281)-478-7255

Central Laboratory
ATTN: Paul Rivas
Laboratory Supervisor
P.O. Box 511
El Paso, TX 79961
(915)-594-5722

Fort Worth Water Department
Rolling Hills WTP
ATTN: Richard S. Talley
Laboratory Services Manager
P.O. Box 870
Fort Worth, TX 76101-0870
(817)-572-3154

Guadalupe- Blanco River
Authority
ATTN: Debbie Magin
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P.O. Box 271
Seguin, TX 78156-0271
(379)-379-5822

land Water Utilities Lab
uck Creek Wastewater Plant
ATTN: Wesley Kucera
Laboratory Supervisor
750 Duck Creek Way
Sunnyvale, TX 75182-9319
(972)-203-4309

USA MEDDAC Preventive
Medicine Service
ATTN: Dave Hagood
Laboratory Supervisor
Building 76022
Fort Hood, TX 76544-5063
(254)-288-1665

Trinity River Authority
Lake Livingston Project
ATTN: J. Michael Knight
Laboratory Supervisor
P.O. Box 360
Livingston, TX 77351
(409)-365-2292

Trinity River Authority
Northern Division
TN: Mary C. Henderson
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0 W. Singleton Blvd.
Dallas, TX 75212
(972)-263-2251

Harlingen Water Works System
ATTN: Richard Glick
Water Plant Superintendent
P.O. Box 1950
Harlingen, TX 78551
(956)-430-8163

City of Huntsville - Parker Creek
WWP
ATTN: Debra Daugette
Laboratory Supervisor
9446 Ellisor Road
Huntsville, TX 77340
(409)-295-5957

City of Houston Clinton Dr.
Facility PUD
Water QC Branch
ATTN: Vera Smart
Laboratory Supervisor
2300 Federal Avenue
Houston, TX 77015
(713)-450-5117

Guadalupe Basin Natural
Resources Center
ATTN: Scott Loveland
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125 Lehman Drive Suite 100
Kerrville, TX 78028-5908
(830)-896-5445

City of Lewisville Environmental
Services
ATTN: Richard Bruno
Laboratory Supervisor
P.O. Box 299002
Lewisville, TX 75029
(972)-219-3548

City of Laredo
Water Treatment Laboratory
ATTN: Gerardo Pinzon
Assistant Utility Director
P.O. Box 2950
Laredo, TX 78044
(956)-795-2620
795-2708
795-2700

Upper Leon River Authority
ATTN: John L. Davis
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(254)-879-2258

City of Lubbock Water Treatment
Laboratory
ATTN: Tony Flores
Micro Lab Supervisor
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Lubbock, TX 79457
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City of McAllen Central
Laboratory
ATTN: Patrick Asogwa
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(956)-631-4431

New Braunfels Utilities
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620-5098

Sabine River Authority of Texas
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Laboratory
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Port Arthur Water Purification
Plant
ATTN: Alfreda Samuel
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1401 19th Street
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und Rock, TX 78664
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City of San Angelo
Water Treatment Plant
Laboratory
ATTN: Ron Ruiz
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(915)-657-4298

San Antonio River Authority
ATTN: Mark Gonzales
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P.O. Box 830027
San Antonio, TX 78283
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Water Quality Laboratory
San Antonio Water System
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San Antonio, TX 78220
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erman Utilities Laboratory
TN: Nathan Whiddon
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Sherman, TX 75091-1106
(903)-892-4545

Texarkana Water Utilities
Laboratory
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Texarkana, TX 75504
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City of Waco Utility Services
Laboratory
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(254)-751-8554 X-12

North Texas Municipal Water
District
ATTN: Michael Gooch
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lie, TX 75098
(972)-442-5405

City of Wichita Falls
Jasper Water Treatment Plant
ATTN: Cheryl Routh
Supervisor
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Wichita Falls, TX 76307-1431
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El Paso Water Utilities
Jonathan Rogers Water
Treatment Plant
ATTN: Teresa Alcala
Laboratory Supervisor
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El Paso, TX 79961
(915)-594-5750

City of Denison Water Treatment
Plant
ATTN: Melva Palmer
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4631 Randell Lake Road
Denison, TX 75020
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Environmental Health
Laboratories
ATTN: Dale Piechocki
Quality Assurance Scientist
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South Bend, IN 46617
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Bioenvironmental Engineering
Flight
ATTN: Capt. Carl Sepulveda
Laboratory Supervisor
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Laughlin AFB, TX 78843
(830)-298-6806

TDH

Texas Department of Health

1100 West 49th Street
Austin, Texas 78756-3199
http://www.tdh.state.tx.us

Laboratories Certified for Drinking Water Chemical Testing

July 31, 1998

Accu-Labs Research, Inc.
4663 Table Mountain Drive
Golden, CO 80403-1650
(303) 277-9514

American Analytical & Technical Services, Inc.
11950 Industriplex Blvd
Baton Rouge, LA 70809-5191
(504) 753-8650

Anacon, Inc.
730 FM 1959
Houston, TX 77034
(713) 922-7000

Ana-Lab Corporation
P.O. Box 9000
Kilgore, TX 75663-9000
(903) 984-0551

City of Arlington Water Utilities Laboratory Services
1901 Lakewood Drive
Arlington, TX 76013
(817) 457-7550

Aqua Tech Environmental Laboratories, Inc.
1776 Marion-Waldo Rd
P.O. Box 436
Marion, OH 43301-0436
(800) 783-5991
Marion, OH facility

Aqua Tech Environmental Laboratories, Inc.
1776 Marion-Waldo Rd
P.O. Box 436
Marion, OH 43301-0436
(800) 783-5991
Melmore, OH facility

Barringer Laboratories, Inc.
15000 West 6th Avenue, Suite 300
Golden, CO 80401
(303) 277-1689

Continental Analytical Services, Inc.
1804 Glendale Road
Salina, KS 67401-6675
(800) 535-3076

EMSL Analytical, Inc.
3 Cooper Street
Westmont, NJ 08108
(609) 858-4800

Environmental Health Laboratories
110 S. Hill Street
South Bend, IN 46617
(800) 332-4345

Environmental Physics, Inc.
2040 Savage Road
Charleston, SC 29414
(803) 556-8171

General Engineering Laboratories, Inc.
2040 Savage Road
Charleston, SC 29414
(803) 556-8171

LNS Environmental Services, Inc.
903 North Bowser, Suite 230
Richardson, TX 75081
(~~214~~) 699-3772
(972)

Lower Colorado River Authority Laboratory
P.O. Box 220
Austin, TX 78767-0220
(512) 473-3322

QST Environmental
P.O. Box 1703
Gainesville, FL 32602-1703
(352) 332-3318

Recra LabNet - Chicago
2417 Bond Street
University Park, IL 60466-3182
(708) 534-5200

Savannah Laboratories & Environmental Services, Inc.-Savannah
5102 LaRoche Avenue
Savannah, GA 31404
(912) 354-7858

Savannah Laboratories & Environmental Services, Inc. - Tallahassee
2846 Industrial Plaza Drive
Tallahassee, FL 32301
(904) 878-3994

Southwest Laboratory of Oklahoma, Inc.
1700 West Albany
Broken Arrow, Oklahoma 74012
(918) 251-2858

SVL Analytical, Inc.
One Government Gulch
Kellogg, ID 83837
(208) 784-1258

Texas Department of Health
Environmental Sciences Division
1100 West 49th Street
Austin, TX 78756
(512) 458-7587
*EPA certified

U.S. Army Center for Health Promotion and Preventive Medicine
Building E-2100
Aberdeen Proving Ground, Maryland 21010
(410) 671-4465

A list of the specific categories and analytes for which a laboratory is certified may be obtained from the individual laboratory or the Texas Department of Health, (512) 458-7587.

Laboratories Certified for Drinking Water Chemical Testing
July 31, 1998

The table given below shows the chemical categories (in bold) and the contaminants within each category for which certification may be granted. The certification status for each contaminant is indicated by "C" for certified and "NC" for not certified for the six certified laboratories located in Texas.

Chemical Categories and Contaminants	Anacon, Inc.	Ana-Lab Corporation	City of Arlington Water Utilities	LNS Environmental Services, Inc.	Lower Colorado River Authority	Texas Department of Health
Routine Inorganics						
Fluoride	NC	NC	NC	C	NC	C
Cyanide	NC	NC	NC	C	NC	C
Nitrate and Nitrite						
Nitrate-N	C	NC	C	NC	C	C
Nitrite-N	C	NC	C	NC	C	C
Metals						
Antimony	NC	NC	C	C	C	C
Arsenic	C	C	C	C	C	C
Barium	C	C	NC	C	C	C

Chemical Categories and Contaminants	Anacon, Inc.	Ana-Lab Corporation	City of Arlington Water Utilities	LNS Environmental Services, Inc.	Lower Colorado River Authority	Texas Department of Health
Beryllium	C	C	C	C	C	C
Cadmium	C	C	C	C	C	C
Chromium	C	C	C	C	C	C
Mercury	C	C	C	C	C	C
Nickel	NC	C	C	C	C	C
Selenium	NC	NC	C	C	C	C
Thallium	NC	NC	NC	C	C	C
Lead and Copper						
Copper	C	C	C	C	C	C
Lead	NC	NC	C	C	C	C
Trihalomethanes						
Total Trihalomethanes	C	C	C	C	C	C
Volatile Organics						
Benzene	C	C	C	C	C	C

Chemical Categories and Contaminants	Anacon, Inc.	Ana-Lab Corporation	City of Arlington Water Utilities	LNS Environmental Services, Inc.	Lower Colorado River Authority	Texas Department of Health
Carbon tetrachloride	C	C	C	C	C	C
Chlorobenzene	C	C	C	C	C	C
1,2-Dichlorobenzene	C	C	C	C	C	C
1,4-Dichlorobenzene	C	C	C	C	C	C
1,2-Dichloroethane	C	C	C	C	C	C
1,1-Dichloroethylene	C	C	C	C	C	C
cis-1,2-Dichloroethylene	C	C	C	C	C	C
trans-1,2-Dichloroethylene	C	C	C	C	C	C
Dichloromethane	NC	C	C	C	C	C
1,2-Dichloropropane	C	C	C	C	C	C
Ethylbenzene	C	C	C	C	C	C
Styrene	C	C	C	C	C	C
Tetrachloroethylene	C	C	C	C	C	C
Toluene	C	C	C	C	C	C

Chemical Categories and Contaminants	Anacon, Inc.	Ana-Lab Corporation	City of Arlington Water Utilities	LNS Environmental Services, Inc.	Lower Colorado River Authority	Texas Department of Health
1,1,1-Trichloroethane	C	C	C	C	C	C
1,1,2-Trichloroethane	C	C	C	C	C	C
Trichloroethylene	C	C	C	C	C	C
1,2,4-Trichlorobenzene	NC	NC	NC	C	C	C
Vinyl chloride	C	C	C	C	C	C
Total Xylenes	NC	C	C	C	C	C
Insecticides and Herbicides						
Alachlor	NC	NC	C	C	C	C
Atrazine	C	NC	NC	C	C	C
Chlorodane	C	NC	C	C	C	C
2,4-D	NC	NC	NC	C	C	C
Dalapon	NC	NC	NC	C	C	C
Dinoseb	NC	NC	NC	C	C	C
Endrin	C	NC	C	C	C	C

Chemical Categories and Contaminants	Anacon, Inc.	Ana-Lab Corporation	City of Arlington Water Utilities	LNS Environmental Services, Inc.	Lower Colorado River Authority	Texas Department of Health
Heptachlor	C	NC	C	C	C	C
Heptachlor epoxide	C	NC	C	C	C	C
Hexachlorobenzene	NC	NC	C	C	C	C
Hexachlorocyclopentadiene	NC	NC	C	C	C	C
Lindane	C	NC	C	C	C	C
Methoxychlor	C	NC	C	C	C	C
Pentachlorophenol	NC	NC	NC	C	C	C
Picloram	NC	NC	NC	C	C	C
Simazine	C	NC	C	C	C	C
2,4,5-TP (Silvex)	C	NC	NC	C	C	C
Toxaphene	C	NC	C	C	C	C
Carbamate Insecticides						
Aldicarb	NC	NC	NC	NC	C	C
Aldicarb sulfone	NC	NC	NC	NC	C	C

Chemical Categories and Contaminants	**Anacon, Inc.**	**Ana-Lab Corporation**	**City of Arlington Water Utilities**	**LNS Environmental Services, Inc.**	**Lower Colorado River Authority**	**Texas Department of Health**
Aldicarb sulfoxide	NC	NC	NC	NC	C	C
Carbofuran	NC	NC	NC	NC	C	C
Oxamyl (Vydate)	NC	NC	NC	NC	C	C
EDB and DBCP						
1,2-Dibromo-3-chloropropane	NC	NC	NC	NC	NC	C
Ethylene dibromide	NC	NC	NC	NC	NC	C
Synthetic Organics						
Benzo(a)pyrene	NC	NC	NC	C	C	C
Di(2-ethylhexyl) adipate	NC	NC	NC	C	NC	C
Di(2-ethylhexyl) phthalate	NC	NC	NC	C	NC	C
PCBs as decachlorobiphenyl	NC	NC	NC	C	NC	C
Endothall	NC	NC	NC	NC	NC	C
Glyphosate	NC	NC	NC	NC	NC	C
Diquat	NC	NC	NC	NC	NC	C

Chemical Categories and Contaminants	Anacon, Inc.	Ana-Lab Corporation	City of Arlington Water Utilities	LNS Environmental Services, Inc.	Lower Colorado River Authority	Texas Department of Health
Radiochemicals						
Gross alpha	NC	NC	NC	NC	NC	C
Gross beta	NC	NC	NC	NC	NC	C
Radium-226	NC	NC	NC	NC	NC	C
Radium-228	NC	NC	NC	NC	NC	C
Uranium	NC	NC	NC	NC	NC	C
Strontium-89	NC	NC	NC	NC	NC	C
Strontium-90	NC	NC	NC	NC	NC	C
Tritium	NC	NC	NC	NC	NC	C
Iodine-131	NC	NC	NC	NC	NC	C
Gamma emitters (cobalt-60, zinc-65, cesium-134, cesium-137, barium-133)	NC	NC	NC	NC	NC	C
Asbestos	NC	NC	NC	NC	NC	NC
Dioxin	NC	NC	NC	NC	NC	NC

engineering and technology **tech** for the planet.

PRELIMINARY ENGINEERING REPORT

FOR

Water and Wastewater Facilities

For

The Four Corners Area

OF

Fort Bend County, Texas

JOE W. EZZELL
64491

Joe W Ezzell
12-28-98

Prepared by:
Earth Tech
with
Pate Engineers
Goodsen Consulting Engineers
BC&AD Archaeology
HVJ Associates

TWDB Contract No. 97-483-206

December 1998

PRELIMINARY ENGINEERING REPORT

FOR

WATER AND WASTEWATER FACILITIES

FOR

THE FOUR CORNERS AREA

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FORT BEND COUNTY, TEXAS

JOE W. EZZELL
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Earth Tech
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TWDB CONTRACT NO. 97-483-206

DECEMBER 1998

Table of Contents

Four Corners Area
Water and Sewer Facilities

I. Project Planning Area

A. Project Location - The planning area for the Four Corners water and sanitary sewer study encompasses approximately 1,775 acres of land located in north central Fort Bend County, Texas. The planning area boundaries are generally defined by State Highway 6 on the east, McKaskle Road to the south, FM 1464 to the west and the southern boundary of South Mission Glen MUD to the north. Major roadways within the planning area include Richmond-Gaines Road which runs north-south through the area and Boss Gaston/Old Richmond Road which traverses east to west across the north central part of the planning area connecting State Highway 6 with FM 1464. Both roads are two-lane asphalt roadways with open ditch drainage. The entire planning area is not located within the corporate limits of any city, but lies wholly within the extra-territorial jurisdiction of the City of Houston.

Much of the service area consists primarily of open pasture/range land with sparse tree cover. Ground elevations within the area indicate that the overall slope of the area is from north to south with elevations ranging from 85 feet to 95 feet mean sea level (1928 NGVD). Red Gully flows from north to south through the area and provides primary outfall drainage. Smaller lateral channels convey flows to Oyster Creek (south of the area) and to Red Gully itself.

B. Environmental Resources - The Colorado, Brazos, Trinity, Neches and Sabine Rivers originate north of the Texas Coastal Plain. They flow southward through the plain to the Gulf of Mexico. These rivers are pro-Pleistocene in age. Smaller creeks such as the Oyster Creek and Jones Creek developed during the Pleistocene and parallel the major waterways. Fort Bend County is located in the Western Gulf section of the Coastal Plain,

Fort Bend County's location in the Western Gulf section of the Coastal Plain places it within a subtropical belt. The modem climate is characterized by high humidity. The

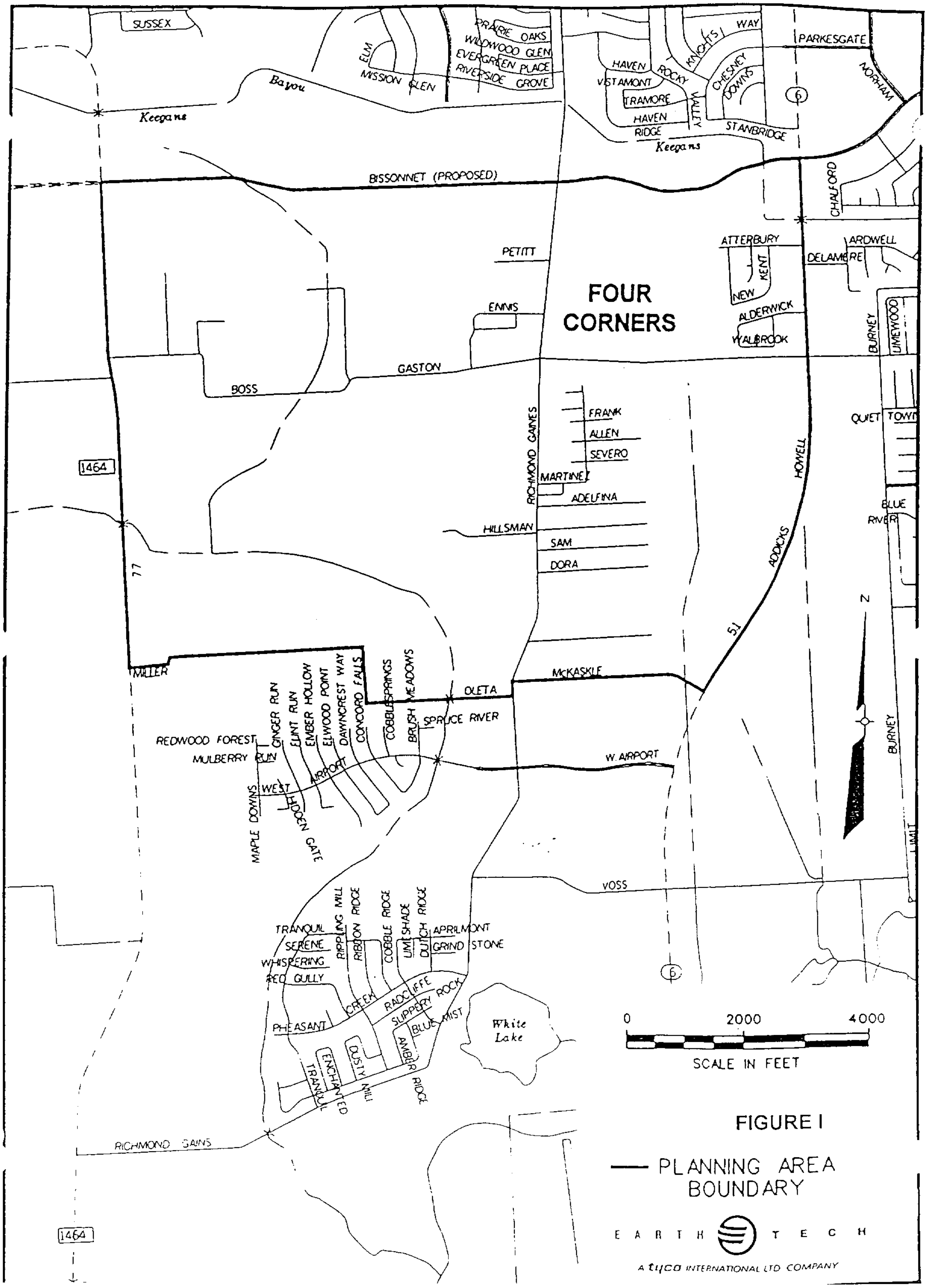
SUSSEX
PRAIRIE OAKS
WILDWOOD GLEN
EVERGREEN PLACE
RIVERSIDE GROVE
ELM
MISSION GLEN
Bayou
Keegans
KNIGHTS WAY
PARKESGATE
HAVEN
ROCKY
VISTAMONT
CHESNEY
DOWNS
TRAMORE
VALLEY
HAVEN
RIDGE
STANBRIDGE
NORHAM
6
Keegans
BISSONNET (PROPOSED)
CHALFORD
PETITT
ATTERBURY
ARDWELL
DELAMERE
KENT
NEW
FOUR CORNERS
ENNIS
ALDERWICK
WALBROOK
BURNEY
LIMEWOOD
GASTON
BOSS
FRANK
ALLEN
SEVERO
RICHMOND GAINES
MARTINEZ
HOWELL
QUIET TOWN
1464
ADELFINA
HILLSMAN
SAM
DORA
BLUE RIVER
77
ADDICKS
51
N
MILLER
McKASKLE
OLETA
COBBLESPRINGS
MEADOWS
CONCORD FALLS
DAWNCREST WAY
ELWOOD POINT
EMBER HOLLOW
FLINT RUN
GINGER RUN
BRUSH
SPRUCE RIVER
REDWOOD FOREST
MULBERRY RUN
W. AIRPORT
WEST AIRPORT
BURNEY
MAPLE DOWNS
HIDDEN GATE
LIMIT
VOSS
TRANQUIL
RIPPLING MILL
RIBBON RIDGE
COBBLE RIDGE
LIMESHADE
DUTCH RIDGE
APRILMONT
SERENE
GRIND STONE
WHISPERING
RED GULLY
6
RADCLIFFE
SLIPPERY ROCK
CREEK
PHEASANT
BLUE MIST
White Lake
AMBER RIDGE
DUSTY MILL
ENCHANTED
TRANQUIL
RICHMOND GAINS
1464
0
2000
4000
SCALE IN FEET
— PLANNING AREA BOUNDARY
EARTH TECH
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FIGURE I

biggest factor controlling the regional climate is the Gulf of Mexico. Summers are hot arid humid and winters are generally mild (Story, 1990). The mean annual temperature of the area is 20 degrees centigrade with a mean average of rainfall of 46.1 inches. Prevailing winds are south and southeast, except during the winter when fronts shift the wind from the north. The modern climate is generally considered to be similar to the climate that existed 5,000 years ago.

The flora and fauna or the project areas when first settled could include open land, woodland and wetland habitats. The following are excerpt from a book by A. A. Parker (1835).

> "...list of the forest trees, shrubs, vines i.e. red, black, white, willow; post and live oaks; pine, cedar, cottonwood, mulberry, hickory, ash elm cypress, box-wood, elder, dogwood, walnut, pecan, moscheto-a species of locust, holly, haws, hackberry, magnolia, chinquspin, wild peacan, suple jack, cane brake, palmetto, various kinds of grapevines, creepers, rushes, Spanish-moss, prairie grass and a great variety of flowers...
>
> ...Then there are bear, mexican hog, wild geese, rabbits and a great variety of ducks..."

Wild herbaceous plants that were native to this area include bluestem, indiangrass, croton. beggerwood. pokeweed. partridgepea, ragweed and fescue. Examples of native hardwood trees would be oak, mulberry, sweetgum, pecan, hawthorn, dogwood, persimmon, sumac, hichory, black walnut, maple and greenbrier.. Coniferous plants included red cedar arid coast juniper. Shrubs included American beauty berry, farkleberry. yaupon and possumhaw. Wetland plants such as smartweed, wild millet, bulrushes, saltgrass and cattail are native to the area (U.S. Department of Agriculture, 1976).

This vegetative environment supported wildlife such as bear, rabbit, red fox, deer, coyotes, racoon, opossum, muskrat, beaver, alligator, armadillo, squirrel, and skunk. A wide variety of birds were present such as quail, dove, prairie chicken, song birds, herons and kingfishers. The area was also a winter home for a number of migratory birds such as geese, ducks, egrets, coots, etc. (U.S. Department of Agriculture, 1976).

C. Areas Potential Wetlands – A preliminary wetlands investigation consisted of a review of all available published data for the study area including topographic maps, a National Wetlands Inventory map (draft), aerial photographs, infrared aerial photographs, and soil information published in the Soil Survey of Fort Bend County, Texas.

Based on this preliminary investigation, numerous waters of the United States, including wetlands, and areas potentially containing waters of the United States, were identified within the boundaries of the study area. Following this resource review, ground truthing field activities were initiated for the purpose of further identifying waters of the United States, including wetlands, located within the study area.

The field investigation aspect of this project involved the systematic evaluation of all readily accessible undeveloped parcels of property. Several inaccessible parcels of land were however not physically visited during this investigation. Additionally, based on the review of the published resources during the initial phase of this investigation, urban areas (developed residential, commercial, or industrial properties) were not investigated for potential wetlands. Also, several areas which could be inferred as upland areas based on the resource review were not physically visited during this investigation. Though numerous parcels of undeveloped land were physically evaluated during this study, each parcel was not investigated as thoroughly as would be the practice during a more extensive wetlands determination or delineation activity.

This preliminary wetlands investigation (both the resource review and the field investigation) resulted in the creation of an exhibit which details the waters of the United States, including wetlands, which were identified within the boundaries of the study area. A cursory evaluation of the soils, hydrology, and vegetation in most of the areas visited during the field investigation phase of this project was conducted based on field conditions or reviewed resources. For the purposes of this preliminary wetlands investigation, the undeveloped parcels of property evaluated during this study were categorized as follows:

- Upland areas or primarily upland areas. These areas were identified using both the resource review and field investigation phases of this project.

- Wetland areas or potential wetland areas. These areas were identified using both the resource review and field investigation phases of this project.

- Areas recently cleared which are developing wetland characteristics. These areas were identified during the field investigation phase of this project. At least two parcels of undeveloped property were observed to be recently cleared; these areas were most likely cleared within the past 6 to 9 months. Each of these areas now possess an undulating ground surface which is conducive for collecting and trapping water. Wetland vegetation was observed to be growing in many of the depressions created by the clearing activities. At present, two of the three wetland criteria (e.g., hydrology and vegetation) were met in these areas. Without appropriate intervention, wetlands may establish in these rather flat, poorly drained areas. Further research would need to be conducted to determine whether or not wetlands historically existed in these areas.

- Areas not physically visited. These areas include areas which were not walked during the field investigation aspect of this study and which the resource review of these areas was not definitive as to whether or not wetlands existed in these areas. Based on the ground truthing activities which were conducted within the study area, most of the areas not physically visited are most likely to contain upland or primarily upland areas.

Overall, ground truthing was accomplished for the majority of the undeveloped parcels of property located within the study area. Additionally, Keegans Bayou and Red Gully are considered jurisdictional waters of the United States. Any activities impacting these waters, such as outfalls, road crossings, etc., would need to be evaluated for potential permitting requirements under Section 404 of the Clean Water Act and/or the Rivers and Harbors Act of 1899.

D. Historical Background – The wide variety of native floral and faunal resources supported an indigenous population in Fort Bend County. When Cabeza de Vaca, a survivor of the Narvaez expedition to colonize southern Florida, was shipwrecked in 1528 on what has often been identified as Galveston Island (probably Oyster Bay Peninsula), he was met by the native Americans of the area (Krieger, 1959). This group of Native Americans was part of the Karankawa group that was probably made up to at least five tribes (Aten. 1983). There were three other related native groups on the upper

Texas coast at that time; the Akokisa who occupied the Galveston Bay area northward to Conroe and east to approximately Beaumont; the Atakapa who occupied the area east of Beaumont into western Louisiana; and the Bidai who occupied the territory north of the Akokisa which included the Huntsville and Liberty areas (Aten, 1983). From the ethnohistoric records as well as (lie archaeological information, the groups were hunting and gathering peoples (Hester, 1980; Aten, 1983; Story, 1990). From ca. 3000 BC to AD 100, no important technological or social advances have been identified among the Native American groups. From AD 100 to AD 800, ceramics were being used the bow and arrow was introduced and there was some recognition of territorial boundaries indicating social structure. From AD 800 until contact, there was refinement in ceramic production and increased use of the bow and arrow.

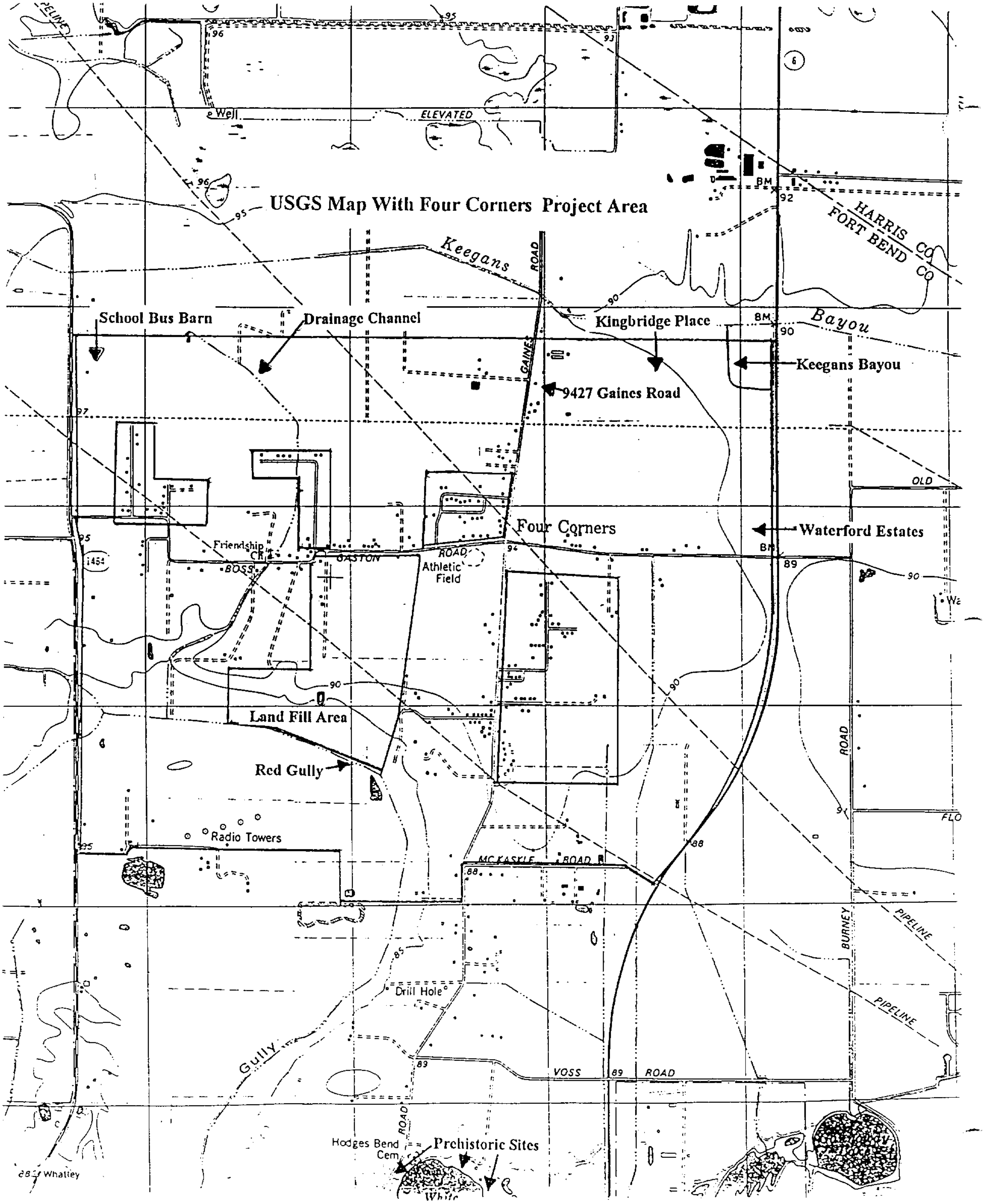
At the time of contact, the sociopolitical structure of the groups would be classified as tribes (Aten, 1983). During the warm seasons, they were dispersed in band sized groups. They gathered into villages during the colder seasons with populations ranging from 400 to 500. Cabeza de Vaca's account of these groups was that they lived in a state of starvation the year around even though they had access to all of the marine resources of a coastal environment. Caleza de Vaca lived in this area for six years and became a trader for the Native Americans, bartering sea shells and other coastal products for hides and lithic resources from inland groups (Newcomb, 1961). The archaeological record indicates that ceramics appeared with the Atakapa in 70 BC, with the Akokisa in AD 100, with the Karonkawa in AD 300 and with the Bidai in AD 500. The origin of this ceramic technology would appear to be the Lower Mississippi Valley and was adopted from east to west over time (Aten, 1983).

Some of the project areas in Fort Bend County were part of the original Stephen F. Austin colony. Their location along the Brazos River was advantageous, as it was easily navigated which gave ready access to the Gulf of Mexico.

Field survey indicates the highest potential prehistoric sites in this area are; (1) along the banks of Keegans Bayou located behind the Kingbridge Development in the upper northeast section of the area and, (2) the banks of two drainage channels, one in the northwestern section of the project area drains into Red Gully in the southwest section of the project area. Keegans Bayou appears to have been rerouted to its present location and the area has been extensively modified by new construction. Limited access to the banks of the drainage channels prevented a complete walk-through survey of these areas for potential prehistoric sites. However, limited observations during the field survey and the aerial photographs indicate that the northwest drainage channel has been heavily impacted by cultivation as well as construction since 1956. Visual observations indicate that the banks of Red Gulch have been extensively modified from the southwestern point adjacent to the landfill to the southern edge of the project area by landfill operations and construction. Visual observations and the aerial photographs indicate that the banks of the western extension of Red Gulch to the western boundary of the project area have been impacted by cultivation.

The remaining houses that meet the age requirement for the National Register of Historic Places were examined and only one could possibly qualify based on any of the other requirements. This is the residence at 9427 Gaines Road, it could possibly qualify for the National Register of Historic Places. Avoidance of this structure is recommended. There was no evidence of any remains of preexisting historic structures on the rest of the project area which has also been heavily impacted by cultivation and new construction based on limited visual observations and the aerial photographs.

The archival research has indicated that there is a probability that the southern portion of the Four Corners area was crossed by Santa Anna's army during the Texas Revolution. There is however, little probability of finding significant archaeological deposits associated with this event because the army marched rather quickly between the previous night's campsite and Stafford's plantation. It might be possible to find isolated artifacts, but nothing that would add to the better understanding of Texas History. It is unlikely that any further archaeological studies would be required concerning this event. However, if during construction of the proposed projects artifacts relating to this event are found, an archaeologist should be contacted.



USGS Map With Four Corners Project Area

E. Area's Potential Endangered Species Habitats - As part of the environmental investigation of the study area, the Texas Parks and Wildlife Department and the U.S. Fish and Wildlife Service were contacted regarding the possible occurrence of threatened or endangered species within the boundaries of the study area.

In correspondence dated September 30, 1998, the Texas Parks and Wildlife Department (TPWD), Texas Biological Conservation Data System office, the TPWD Wildlife Habitat Assessment Program, and the U.S. Fish and Wildlife Service (USFWS) were officially contacted for a review of sensitive species (e.g., threatened or endangered species) and natural communities which could potentially occur within the study area.

In correspondence dated October 6, 1998, the USFWS stated that a review of the U.S. Fish and Wildlife Service files and your project information indicate that "no federally listed or proposed threatened or endangered species are likely to occur at the project site."

In correspondence dated October 14, 1998, the TPWD Wildlife Habitat Assessment Program stated that sensitive wildlife habitats that should incorporate planning considerations within this study area include mature woodlands, riparian vegetation associated with creek drainage, native grasslands, and wetlands. Development of project alternative alignments should include considerations for sequentially avoiding, minimizing or compensating losses of these sensitive habitats. Where possible, water and wastewater lines should follow existing rights-of-way. Mitigation measures to offset unavoidable losses to these habitats should be included in project planning. Such measures may include provisions for tree and shrub plantings and for revegetation of disturbed areas using native plant species." Such ecological considerations would need to be taken into account once project alternatives or options have been identified.

As of November 24, 1998, correspondence from the TPWD Texas Biological Conservation Data System office has not been received. To date, information received by the USFWS and TPWD indicate that threatened and endangered species of plants and animals are not considered to be a concern within the confines of the study area.

F. Extent Of Flood Plain In Area - As part of this investigation, the Federal Emergency Management Agency (FEMA) National Flood Insurance Program Flood Insurance Rate Maps (FIRMs) were evaluated for the study area. The FIRM panel 120 of 550, map number 48157C0120-H, dated September 30, 1992, and map number 48157C0120-J, dated January 3, 1997, were reviewed for this project.

The northeastern-most corner of the study area boundary crosses the well defined channel of Keegans Bayou at two locations. Keegans Bayou is designated as a "Zone AE" area which consists of a special flood hazard area potentially inundated by a 100-year flood. The 100-year flood is contained within the channel of Keegans Bayou in this area according to the FIRMs reviewed during this investigation. Zone AE specifically refers to areas of the 100-year flood in which base flood elevations have been determined.

The southwestern-most corner of the study area is encompassed by a flood zone associated with Red Gully, based on the FIRMs reviewed for this area. Red Gully generally flows southeast and south within the boundaries of the study area and then flows south/southeast into Oyster Creek. Oyster Creek flows into the Brazos River which then flows into the Gulf of Mexico.

The area surrounding Red Gully is designated as a Zone AE. This area which consists of a special flood hazard area that has a potential to be inundated by a 100-year flood; floodway areas in Zone AE are also designated on the FIRMs. The Red Gully 100-year flood zone is not contained within the channel similar to the well defined channel of Keegans Bayou.

Additionally, a Zone X area is also located in the southwestern-most corner of the study area. Zone X areas are defined as areas below the 500-year flood elevation and areas within the 100-year flood area with average depths of less than one foot or with drainage

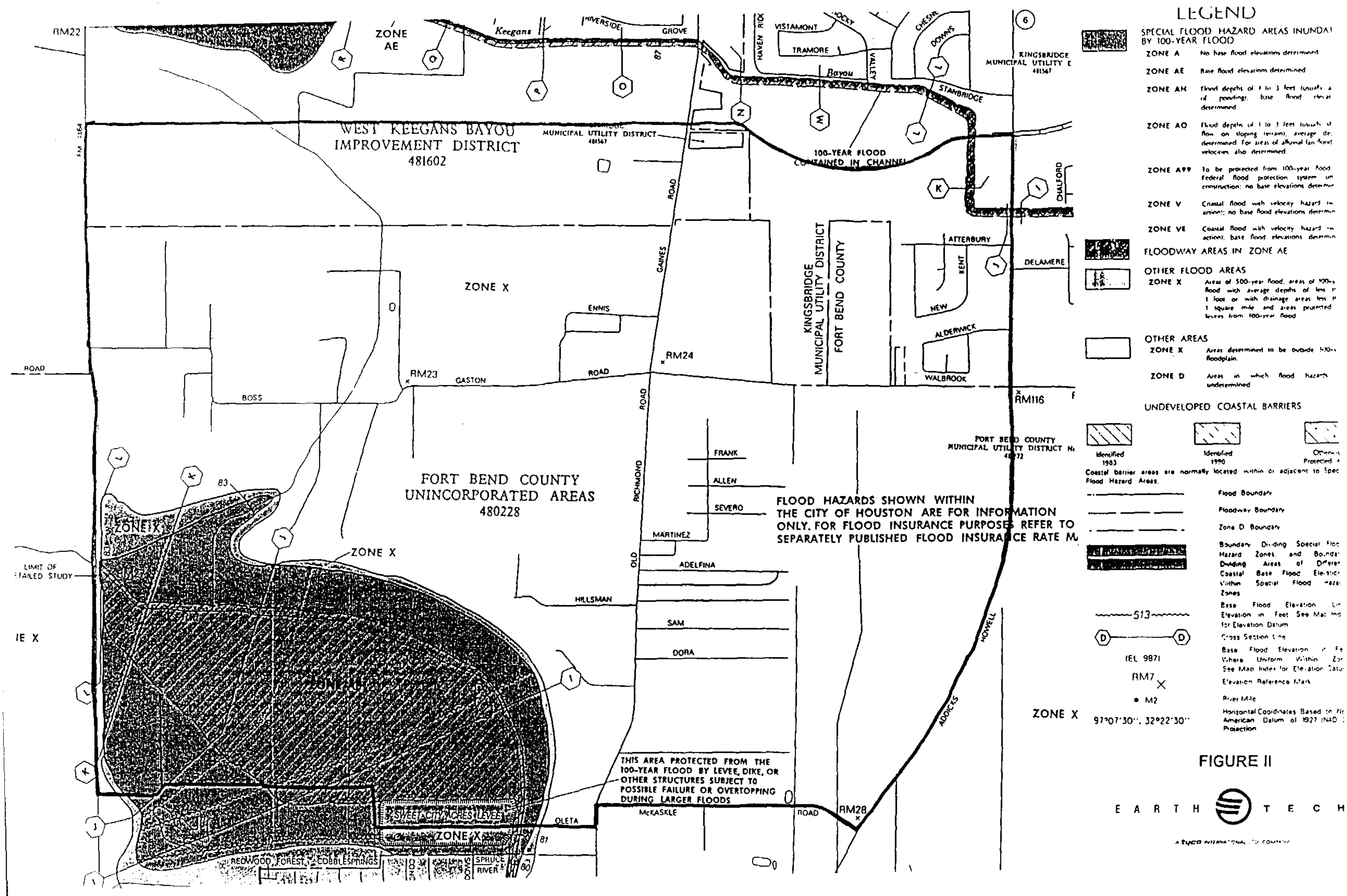


FIGURE II

EARTH TECH

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areas less than one square mile, and/or areas protected by levees from the 100-year flood. Specifically, Sweet City Acres, a small residential subdivision located along the southern boundary of the study area, consists of an area protected from the 100-year flood by a levee; this levee could however be subject to possible failure or overtopping during larger floods.

Aside from the channel of Keegans Bayou, located in the northeastern corner of the study area, and the area surrounding Red Gully, located in the southwestern corner of the study area, no other flood zones were identified during the course of this study.

G. Growth Areas and Population Trends - 1990 Census data for this area of Fort Bend County was obtained from the Houston-Galveston Area Council (HGAC) and used to determine existing population estimates within the planning area. According to the census data, in 1990 approximately 1,150 people resided within the planning area in 350 housing units which is equivalent to 3.3 persons per household. A recent field survey of the planning area indicates that several older housing units appear to be uninhabited but that new housing units have been constructed (primarily in the Atanacia Martinez subdivision) since the 1990 census. For this water and sewer study, the 1998 estimated population for the planning area was held at 1,150 persons with approximately 350 existing housing units within the planning area.

The population of Fort Bend County grew at an average annual rate of just under ten percent in the 1980's and continued to grow at an average rate of just under six percent during the 1990's. The HGAC forecasts that the average annual growth rate within the county will slow to less than three percent through the year 2020. Historically, the Four Corners area has not observed population increases that mirrored the rest of Fort Bend County. With the construction of water and sanitary sewer facilities within the Four Corners area, population increases within the area are to be expected. For the purposes of this planning study, average annual population increases of three percent (consistent with the rest of Fort Bend County) were used for the Four Corners planning area. Based upon this rate, the population of the Four Corners area is projected to increase from

1,150 in 1998 to 2,200 in the Year 2020. The following Table includes a summary of the population information.

POPULATION PROJECTIONS

Census Tract 703.51	1990 Census	1998 Estimated	2020 Projected
Housing Units	350	350	670
Population	1,150	1,150	2,200
Occupants per Household	3.3	3.3	3.3

H. Existing/Projected Water And Sewer Demands - Water and sanitary sewer demands were developed using the estimated 1998 population of the area and the projected growth through the Year 2020. Demands were based upon design values for water and sewer utilized by the Texas Natural Resource Conservation Commission (TNRCC). These design values are 120 gallons per capita day for average daily water demand and 100 gallons per capita day for average daily wastewater demand. Peaking factors for both water and sewer flows were used to estimate peak daily demands

Projected average daily water demand for the service area is estimated to increase from 138,000 gallons per day (gpd) in 1998 to 264,420 gpd in the Year 2020. Similarly, average daily sewer flows are estimated to increase from 115,000 gpd in 1998 to 220,350 gpd in the Year 2020. For the purposes of this study, the water distribution and wastewater collection systems were evaluated for the current demands within the area and the projected demands in the Year 2020. In addition to the average daily demands, peak hour water demands and design fire flows defined by the State Board of Insurance are utilized in the water system design. Peak wastewater flows are developed for lift station design.. The water and sewer demands calculated for the planning area are presented in the following Table.

WATER AND SEWER DEMAND PROJECTIONS

	Existing 1998	Projected 2020
WATER SYSTEM		
Average Daily Demand (gallons)(1)	138,000	264,420
Peaky Daily Demand (gpm)(2)	240	460
Fire Flow (gpm)	500	500
SANITARY SEWER SYSTEM		
Average Daily Demand (gallons)(3)	115,000	220,350
Peak Daily Demand (gallons)(4)	460,000	881,410

(1) Based upon 120 gallons per capita day
(2) 2.5 x Average Daily Demand
(3) Based upon 100 gallons per capita day
(4) 4 x Average Daily Demand

II. Existing Facilities

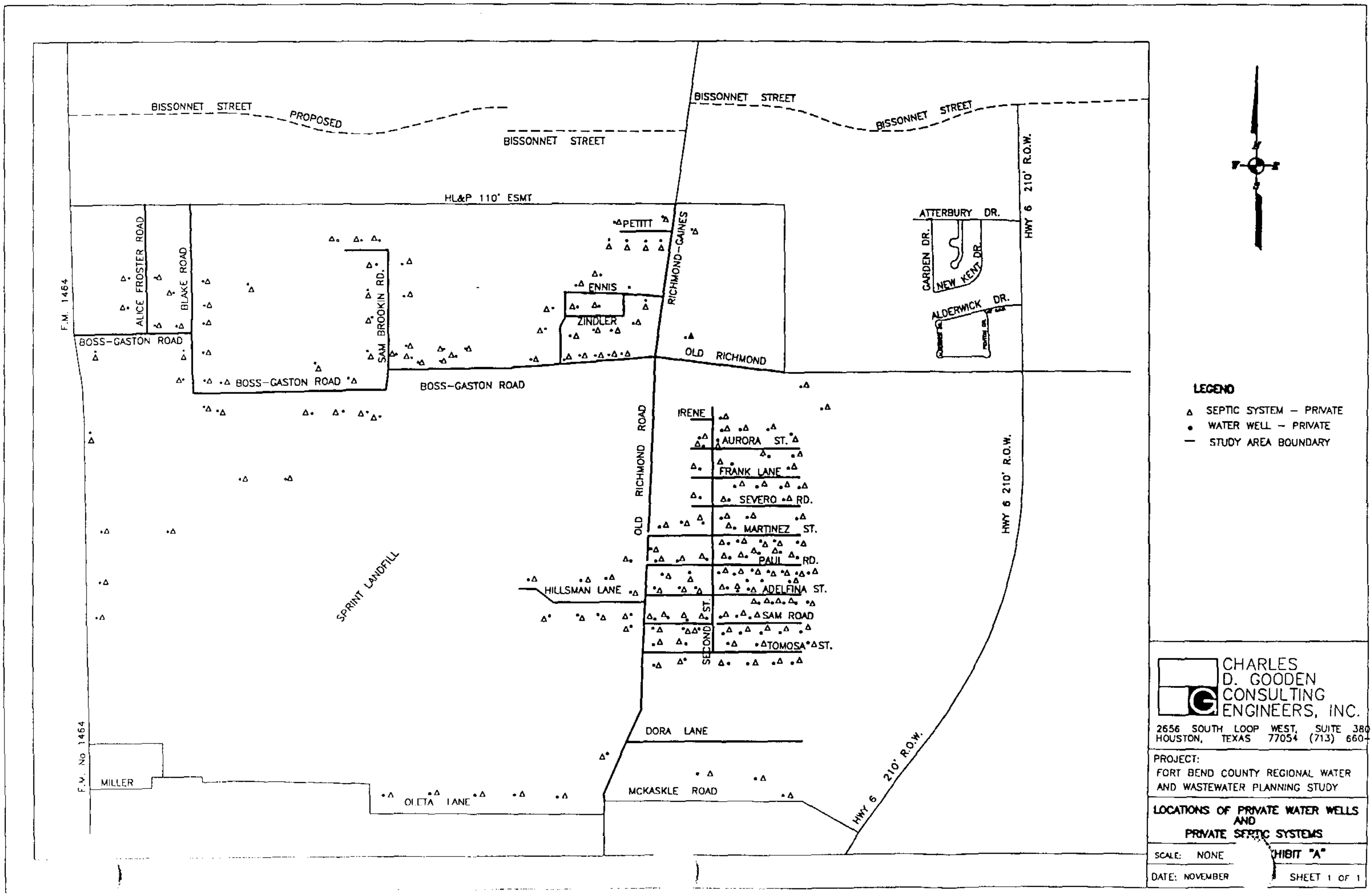
A. Existing Private Wells And Septic Systems - The Four Corners area considered by this study generally consists of low income residential housing including small single family houses and mobile homes. Some light commercial developments are interspersed within residential development in the area. Currently, no community water system exists in the Four Corners area. Private water wells supply the limited domestic water to residences in the area. Sanitary sewage treatment is accomplished by with septic fields serving individual lots. The approximate locations of existing private water wells and existing private septic systems are shown on the attached Figure.

III. Need for Project

A. Health and Satety - According to Fort Bend County Environmental Health Department there have been approximately one hundred seventy (170) complaints by the City of Sugar Land for septic systems in the project area over the past ten (10) years. The locations of the complaints by street name are listed in the following Table.

Septic Tank Violation Complaints	
STREET	NUMBER OF COMPLAINTS
Adelfina	19
Aurora	8
Blake	1
Frank	16
Martinez	18
Old Richmond Road	13
Paul	34
Sam	24
Second	17
Severo	8
Tomasa	12
Total	170

Currently operating on-site treatment systems are experiencing a high degree of failure to properly treat the area population's domestic waste. This condition can primarily be attributed to the overloading of the existing systems. Higher household populations than systems can handle and inadequate treatment system maintenance. The high number of



CHARLES
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2656 SOUTH LOOP WEST, SUITE 380
HOUSTON, TEXAS 77054 (713) 660-6

PROJECT:
FORT BEND COUNTY REGIONAL WATER
AND WASTEWATER PLANNING STUDY

LOCATIONS OF PRIVATE WATER WELLS
AND
PRIVATE SEPTIC SYSTEMS

SCALE: NONE
HIBIT "A"

DATE: NOVEMBER
SHEET 1 OF 1

complaints is evidence of the pressing need of the area to have wastewater collection system in place to replace the stressed on-site treatment systems currently in use in the area.

Engineering consultants and water/sewer operators for Municipal Utility Districts in the area adjacent to the Four Corners planning area were contacted regarding available chemical analyses of existing water supply wells. Information was provided for public water supply wells in Fort Bend County MUD No. 2, Kingsbridge MUD, North Mission Glen MUD and Fort Bend County MUD No. 41.

Based upon the information provided by the water system operators, water supply wells within each of the four adjacent districts are within the regulatory maximum contaminant levels for minerals, metals and volatile organic compounds. These maximum contaminant levels are established by the Texas Natural Resource Conservation Commission. Total hardness for water from several of the wells is classified as moderate to hard. However, this is not uncommon for groundwater supplies in the Gulf Coast area and does not pose problems for use as potable water supply.

IV. Alternatives Considered

A. Description - Two concepts for water supply and wastewater treatment were investigated as part of this study. One concept included the construction of a water supply plant and wastewater treatment plant within the limits of the planning area (referred to as the "On-site" option) which would provide services only for properties within the planning area boundaries. The other concept involves the acquisition of "surplus" capacity in water supply and wastewater treatment facilities within neighboring municipal utility districts. Use of surplus capacity requires the Four Corners area to construct only the water distribution and wastewater collection systems within their area and these systems would then be "hooked up" to the adjacent water supply and wastewater treatment plants. Only two adjacent districts, Kingsbridge MUD and North Mission Glen MUD indicated that water and/or sewer capacity was currently available or would be available in the near term (see Section 10 for summary of all district contacts).

Appendices A, B, and C provide water distribution and wastewater collection system layouts for the alternatives considered from Kingsbridge MUD, North Mission Glen MUD, and On-site, respectively. Water distribution layouts are shown only for the On-site option and connection to Kingsbridge MUD. North Mission Glen is currently evaluating their water supply system and will not be able to assess their surplus water capacity until completion of their study. Wastewater collection systems are shown for all three options.

The wastewater collection schemes for the On-site, Kingsbridge MUD and North Mission Glen MUD options are very similar with 12-inch gravity trunk sewer lines being located on Richmond-Gaines Road and Boss-Gaston Road and 8-inch gravity sewer lines being used throughout the residential areas. Three lift/pump stations are required to provide service to the total planning area because of the size of the planning area, the limitations on the depths of gravity sanitary sewer construction and the potential for construction in wet sand conditions. Under the On-site scenario, one of the three stations would be constructed at the site of the wastewater treatment plant facility.

Under the Kingsbridge MUD and North Mission Glen MUD scenarios, the wastewater from the Four Corners area will be collected into a single pump station to be located adjacent to Old Richmond Road south of Boss-Gaston Road. From this pump station, wastewater will be pumped via force main to an existing 12-inch gravity sanitary sewer located at the intersection of Bissonnet Road and Richmond-Gaines Road (Kingsbridge MUD scenario) or to the North Mission Glen MUD wastewater treatment plant located on Keegans Bayou, north of the Four Corners area (North Mission Glen scenario).

For the On-site scenario, a wastewater treatment plant site is tentatively located along Old Richmond Road near the southern limits of the planning area and discharges to Red Gully. No specific tract of land has been identified at this time for the treatment plant site. However, the southern portion of the planning area provides the most accessible possibilities for outfall into Red Gully.

Water distribution system layouts for the on-site and Kingsbridge scenarios are very similar with the use of 12-inch water mains along Richmond-Gaines and Boss-Gaston Roads. Six-inch and eight-inch water lines are used throughout the rest of the system. Under the Kingsbridge scenario, the Four Corners distribution system will connect to the Kingsbridge water supply through an existing 12-inch water line located on Boss-Gaston Road east of Richmond-Gaines Road and to an existing 12-water line located at the intersection of Bissonnet and Richmond-Gaines. This layout will provide the Four Corners area with two points of connection to the Kingsbridge water supply system.

The on-site water scenario shows the construction of a water supply plant near Old Richmond Road south of Boss-Gaston Road. As with the on-site wastewater system scenario, no specific tract of land has been identified for the water plant location. However, the location shown on the layout in Appendix C is centrally located to the entire planning area.

B. Design Criteria - Public water distribution and supply systems must be designed in accordance with Texas Natural Resource Conservation Commission (TNRCC) permanent rules, Chapter 290 (Water Hygiene). Sanitary sewer collection and treatment systems must be designed in accordance with TNRCC permanent rules, Chapter 317 (Design Criteria for Sewage Systems). The Four Corners planning area lies within the Extra-Territorial Jurisdiction of the City of Houston. In addition to the requirements of TNRCC, water and sanitary sewer facilities must be designed in accordance with the September 1996 "Design Manual for Wastewater Collection Systems, Water Lines, Storm Drainage and Street Paving" issued by the City of Houston Department of Public Works and Engineering. City of Houston design requirements are more stringent than TNRCC with respect to certain design elements of water and wastewater systems. Construction drawings for water and sanitary sewer facilities must be approved and signed by the City of Houston prior to the initiation of construction.

C. Right-Of-Way Requirements - The proposed trunk water and sanitary sewer facilities to serve the Four Corners area will be constructed along the major roadways of Boss-Gaston/Old Richmond Road and Richmond-Gaines Road. Right-of-way widths along these roadways vary in width from 50 to 70 feet. No additional right-of-way acquisition would be anticipated. However, field visits have found evidence of gas, electric and telephone utilities along both roadways. Exact locations of these facilities will be necessary in final design and may dictate the location of the proposed water and sewer facilities relative to the existing roadway/drainage and utilities. To provide for a looped connection of the water system east of Richmond-Gaines Road, acquisition of a water line easement along the east side of the Atanacia Martinez subdivision from Old Richmond Road south to Dora Lane will be required.

Lift station and pump station sites have been preliminarily located along Boss-Gaston Road and Richmond-Gaines Road as shown on the sanitary sewer system layout in the Appendices. These locations include some flexibility in terms of their physical location on each roadway but acquisition of each site will be necessary as each proposed station is included in the final design.

The streets within the Atanacia Martinez subdivision include a combination of dedicated street rights-of-way and easements for access to existing housing units in the subdivision. Many of the east-west streets in the subdivision between Second Street and Richmond-Gaines Road have dedicated right-of-way widths of 50-60 feet. Those portions of the same streets located east of Second Street appear to exist only as access easements. In order to construct public water and sanitary sewer facilities within the access easements, granting of utility easements from the underlying property owner will be necessary or the easements may be converted to public road rights-of-way. Conversion of the easements to right-of-way will require coordination with the property owner and Fort Bend County to ensure that platting and roadway construction issues are addressed.

D. Impacts on Construction - The Four Corners area is an area that is mostly undeveloped, however rural homes are located throughout the area and some modern residential developed is located in the northeast part. The Sprint Landfill is located near the center. South and west of Red Gully the project lies in the Quaternary alluvial deposits associated with the Brazos River floodplain. Sands and silts, along with clayey soils are common in these alluvial deposits. Northeast of Red Gully the area is underlain by clayey soils associated with the Beaumont Formation. The major impact on construction will be the presence of a high groundwater level that may be encountered in the southern part of the area. The nearest known fault is the Clodine Fault which crosses FM 1464 about 1500 feet northwest of area. The Renn Scarp is located about 2000 feet northeast of the site. These are the known active faults in the area and neither are known to be within the Four Corners area.

Existing geotechnical reports relevant to the study area are summarized in the following table.

Service Area	Generalized Soil Conditions	Groundwater Level Range
Four Corners	Surface strata consisting of firm to very stiff clays and generally underlain by very loose to medium dense sands and silts	8 to 15 feet

E. Cost Estimates of Alternative Systems Costs - Construction cost estimates for the alternative water and sewer systems evaluated in the study were broken down into two separate components. The first component included the construction costs for water distribution and wastewater collection systems within the Four Corners planning area. The configurations of these systems were dictated by the physical locations of water supply and wastewater treatment in addition to regulatory requirements. The second component involves the construction costs for the water supply plant and the wastewater treatment plant which are based upon the cost of new facility construction or in the case of existing plant availability, the capital recovery costs of the facilities already constructed. All construction cost estimates are based upon current unit costs for projects similar to scope and size of those evaluated in the study.

The Alternative System Cost Table provides a summary of the construction costs for the water supply, wastewater treatment, water distribution and wastewater collection systems alternatives. Detailed cost construction costs estimates for water distribution and wastewater collection systems evaluated are included in the appendices of this report.

FOUR CORNERS WATER AND SEWER
ALTERNATIVE SYSTEM COSTS

	N. Mission Glen MUD	Kingsbridge MUD	On-Site
WASTEWATER COLLECTION			
Construction	$ 3,406,475	$ 3,326,555	$ 3,176,075
Contingencies(15%)	510,970	498,980	476,410
Engineering(13%)	509,270	497,320	474,820
Administration(5%)	221,340	216,140	206,370
TOTAL WASTEWATER COLLECTION	$ 4,648,055	$ 4,538,995	$ 4,333,675
WATER DISTRIBUTION			
Construction	N/A	$ 2,171,800	$ 2,093,960
Contingencies(15%)		325,770	314,090
Engineering(13%)		324,680	313,050
Administration (5%)		141,110	136,060
TOTAL WATER DISTRIBUTION	$ -	$ 2,963,360	$ 2,857,160
WASTEWATER TREATMENT			
Construction			$ 345,000
Engineering(13%)			44,850
Administration(5%)			19,490
Capital Recovery(350 Conn.)	$ 423,500	$ 203,500	
WATER SUPPLY			
Construction			$ 1,397,250
Engineering(13%)			181,640
Administration(5%)			78,940
Capital Recovery(350 Conn.)	N/A	$ 395,230	
TOTAL WATER SUPPLY AND DISTRIBUTION	N/A	$ 3,358,590	$ 4,514,990
TOTAL WASTEWATER TREATMENT AND COLLECTION	$ 5,071,555	$ 4,742,495	$ 4,743,015
GRAND TOTAL WATER & SEWER	N/A	**$ 8,101,085**	**$ 9,258,005**

V. Proposed Project

A. Recommended Alternative - With the exception of the points of source connection for water supply and wastewater treatment, there is very little difference in the overall water and sewer system layouts for the three scenarios evaluated (On-site, Kingsbridge MUD and North Mission Glen MUD). Due to the size of the planning area, pump stations and lift stations are necessary for an efficient wastewater collection system for each of the scenarios evaluated.

The recommended source of water supply and wastewater treatment as the Kingsbridge MUD option. As shown in the water distribution system layouts and wastewater collection system layouts in Appendix A, the Four Corners Planning Area was broken down into three geographic service areas. These areas account for the majority of the existing 350 connections. The detailed cost estimates provided in Appendix A for this scenario include a breakdown of water distribution and wastewater collection system costs by each individual area. The following table provides a summary of the water distribution and wastewater collection system costs for the Kingsbridge MUD option.

COST SUMMARY
WATER DISTRIBUTION & WASTEWATER COLLECTION SYSTEMS

KINGSBRIDGE MUD OPTION

	SERVICE AREA 1	SERVICE AREA 2	SERVICE AREA 3	TOTAL AREA OUR CORNER
WASTEWATER COLLECTION SYSTEM				
Construction	$2,237,015	$ 449,260	$ 640,280	$ 3,326,555
Contingencies (15%)	335,550	67,390	96,040	498,980
Engineering (13%)	334,440	67,160	95,720	497,320
Administration (5%)	145,350	29,190	41,600	216,140
Total Cost	$3,052,355	$ 613,000	$ 873,640	$ 4,538,995
WATER DISTRIBUTION SYSTEM				
Construction	$1,580,340	$ 322,130	$ 269,330	$ 2,171,800
Contingencies (15%)	237,050	48,320	40,400	325,770
Engineering (13%)	236,260	48,160	40,260	324,680
Administration (5%)	$ 102,680	$ 20,930	$ 17,500	$ 141,110
Total Cost	$2,156,330	$ 439,540	$ 367,490	$ 2,963,360
TOTAL WATER DISTRIBUTION & WASTEWATER COLLECTION	**$5,208,685**	**$ 1,052,540**	**$ 1,241,130**	**$ 7,502,355**

Total construction cost for the water distribution and wastewater collection system to serve the 350 existing connections in the planning area is $7,502,355. If phasing of the overall water and sewer system is required to meet available funding sources, the three service areas shown in the cost estimate provide a geographic breakdown for implementation. Implementation of water and sewer service in areas one and two would provide utility service to approximately 200 of the existing 350 connections.

B. Project Water Supply And Wastewater Treatment Plant Requirements - The average daily water demand for the existing 350 connections is 138,000 gallons per day (gpd) while the average daily wastewater flows is 115,000 gpd. The adjacent district, Kingsbridge MUD currently has surplus wastewater capacity available and will have water supply capacity available in the near term.

Acquisition of capacity from Kingsbridge MUD is the recommended alternative for several reasons. The capital recovery costs for the water supply and wastewater treatment facilities are less than those available from North Mission Glen MUD and are less than the costs to construct water supply and wastewater treatment facilities within the planning area. Additionally, Four Corners will not have to apply for water supply and wastewater discharge permits (a lengthy and unpredictable process) because Kingsbridge MUD is currently operating under its own permits. The cost for operation and maintenance of the water supply plant and wastewater treatment plant, sludge disposal and permit renewals/reporting/testing is built into the rate structure to be charged to the Four Corners Area.

The capital recovery costs and water/sewer rates provided by Kingsbridge MUD are shown in the following table.

KINGSBRIDGE MUD OPTION WATER SUPPLY AND WASTEWATER TREATMENT COST

Wastewater Treatment (Capital Recovery Costs)		
350 Single Family Connections	$	185,000
Contingencies (10%)		18,500
TOTAL WASTEWATER TREATMENT	$	203,500
Cost per connection	$	581
Water Supply (Capital Recovery Costs)		
350 Single Family Connections	$	359,300
Contingencies (10%)		35,930
TOTAL WATER SUPPLY	$	395,230
Cost per connection	$	1,129
TOTAL COST PER CONNECTION	$	1,711

C. Recommended System Requirements - The existing residences to be served within the Four Corners Planning Area are distributed throughout the service area which requires long runs of waterlines and sanitary sewer lines to provide service. Waterlines operate under pressure and are typically installed at depths of 4-6 feet below natural ground. The recommended Kingsbridge layout for the water distribution, shown in Appendix A, provides for two points of connection to the Kingsbridge water supply system. This allows Four Corners a back up source of water in the event that one supply connection is out of service.

Sanitary sewer lines operate under the influence of gravity and some of the lengths of runs in the planning area would require sewers to be constructed at depths in excess of 20 feet to meet design criteria of the City of Houston and the TNRCC. Additionally, construction of the sanitary sewer lines at shallower depths can reduce the cost of construction and minimize the potential impacts of wet sand conditions. The recommended Kingsbridge layout for the wastewater collection system makes use of two lift stations and one pump station. The pump station, to be located in the vicinity of Old Richmond Road will collect all wastewater flows from the Four Corners area and pump them to the Kingsbridge MUD sanitary sewer system. The pump station can be sized to accommodate some growth within the planning are but will initially sized with pumping equipment necessary to serve the 350 connections. The system includes two lift stations, one located on Boss-Gaston Road and the other on Old Richmond Road near Dora Lane, are necessary to lift flows into the shallow gravity sanitary sewer thus eliminating the need to construct deep trunk gravity sewers (>20 feet) along Old Richmond Road and Boss-Gaston Road.

D. Operational Costs - With the acquisition of surplus water supply and wastewater treatment capacity from Kingsbridge MUD, no operation and maintenance costs for the water supply plant and wastewater treatment plant will be born directly by the Four Corners area. The annual costs for the operation of the plant facilities is incorporated into the rate structure for water and sewer service provided by Kingsbridge MUD.

The costs for operation and maintenance of the wastewater collection system, lift/pump stations and the water distribution system will be the responsibility of the Four Corners area. These costs can be assessed by the Four Corners Waster Supply Corporation or similar entity on the customers within the planning area on a monthly basis by incorporating the costs into the ultimate rate charges to the customers. These ultimate rate charges would include the actual cost of service from Kingsbridge MUD in addition to a surcharge to cover operation, maintenance and administrative costs. Most utility districts contract with an operations company to maintain their water and sewer facilities using state licensed operating personnel.

Costs for operation and maintenance of wastewater collection systems and the water distribution systems vary between different municipalities and utility districts within the southeast Texas area. Larger, more complex systems require more intensive operator involvement in day to day operations. However, the major maintenance/operational issue for proposed water and wastewater systems for the Four Corners area will be the lift/pumping stations. Because the facilities involve mechanical and electrical equipment, the potential for breakdown exists. Based upon reviews of operation and administration costs for similar types of water distribution and wastewater collection systems in the area, an annual budget amount of $50,000 to $100,000 could be expected for the Four Corners area.

Projected water and sewer rates for the Four Corners area are $16/month for water and $24/month for sewer. Total projected annual income from 350 connections is $168,000. Utilizing the cost per connection presented in this report, the cost per connection for water and sewer service for this project is $23,146.

Estimated Construction Cost	$7,502,355
Kingsbridge	395,230 (water)
Capitol Recovery	203,500 (sewer)
TOTAL Project Cost	$8,101,085

TEXAS WATER DEVELOPMENT BOARD

April 1, 1999

Mr. Ernest Abila, President
Four Corners Water-Sewer Supply Corporation
16308 Old Richmond Road
Sugar Land, Texas 77478

Re: Review Comments for Draft Report Submitted by Four Corners Water-Sewer Supply Corporation (Corporation), TWDB Contract No. 97-483-206

Dear Mr. Abila:

Staff members of the Texas Water Development Board have completed a review of the draft report under TWDB Contract No. 97-483-206. As stated in the above referenced contract, the Corporation will consider incorporating comments from the EXECUTIVE ADMINISTRATOR shown in Attachment 1 and other commentors on the draft final report into a final report. The Corporation must include a copy of the EXECUTIVE ADMINISTRATOR's comments in the final report.

The Board looks forward to receiving one (1) unbound camera-ready original and nine (9) bound double-sided copies of the Final Report on this planning project. Please contact Mr. Curtis Johnson, the Board's Contract Manager, at (512) 463-8060, if you have any questions about the Board's comments.

Sincerely,

Tommy Knowles

Tommy Knowles, Ph.D., P.E.
Deputy Executive Administrator
Office of Planning

cc: Ms. Marilynn Kindell, Fort Bend County Community Development
Mr. Joe Ezzell, Earth Tech
Mr. Curtis Johnson, TWDB

\\TWDB02\DIV\PLAN\RPFGM\DRAFT\97483206.ltr.doc

Our Mission
Provide leadership, technical services and financial assistance to support planning, conservation, and responsible development of water for Texas.

P.O. Box 13231 • 1700 N. Congress Avenue • Austin, Texas 78711-3231
Telephone (512) 463-7847 • Telefax (512) 475-2053 • 1-800- RELAY TX (for the hearing impaired)
URL Address: http://www.twdb.state.tx.us • E-Mail Address: info@twdb.state.tx.us
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ATTACHMENT 1
TEXAS WATER DEVELOPMENT BOARD

COMMENTS: FOUR CORNERS WATER-SEWER CORPORATION
Contract No. 97-483-206

- Population: The Texas Water Development Board does not prepare population projections for specific unincorporated areas of a county. Consequently, we do not have projections to compare with the population projections presented in the report. However, the annual percentage increase that was used for projecting the study area population was obtained from the Houston-Galveston Area Council of Governments for Fort Bend County and is acceptable for facility planning. The Board's projected annual growth rate for Fort Bend County is higher that the growth rate used for projecting the study area population through the year 2020.

- Water Demands: Although the per capita water use estimate that is used to project municipal water use is slightly higher than the per capita water use identified for some of the cities near the study area, this per capita water use estimate is acceptable for facility planning. The projected water and wastewater use for the study area is acceptable for planning purposes.

- The environmental information and baseline assessment information provided in the draft engineering report entitled "PRELIMINARY ENVIRONMENTAL ASSESSMENT", includes some basic background environmental and cultural resource information and indicates those cultural resource management and environmental issues that will likely come into play if a full environmental assessment is done on whichever project is ultimately proposed

TEXAS NATURAL RESOURCE CONSERVATION COMMISION
GROUND-WATER SAMPLING INFORMATION
Analytical Results for Permit 1396 - Sprint Fort Bend County LF, L.P.
Well Number MW-03

	01/17/94	07/13/94
HEAVY METALS (mg/L)		
Arsenic		
Barium		
Cadmium		
Chromium		
Copper		
Iron	< 0.100	< 0.100
Lead		
Manganese	< 0.020	0.030
Mercury		
Selenium		
Silver		
Zinc		

** Bold items indicate an exceedance

TEXAS NATURAL RESOURCE CONSERVATION COMMISION
GROUND-WATER SAMPLING INFORMATION
Analytical Results for Permit 1396 - Sprint Fort Bend County LF, L.P.
Well Number MW-03

	12/13/83	12/14/83	06/28/85	12/12/85	07/18/86	01/25/87	03/26/87	08/05/87	01/25/88	07/26/88
OTHER (mg/L)										
Alkalinity	299.0	308.0					304.0			
Anion-cation	10.9						8.6			
Anion-cation	10.8						8.1			
Bicarbonate	365.0	308.0					371.0			
Calcium	100.0	32.9					70.1			
Carbonate	0.0	0.0					0.0			
Chloride	142.0	137.0	62.0	38.0	95.0	77.0	61.0			45.0
Fluoride	0.2	0.2	0.2	0.2	0.2		0.3	0.3	0.3	0.4
Hardness (CaCO3)	312.0	334.0					344.0			
Magnesium	15.0	18.4					17.9			
Nitrate (N)	0.0	0.1	0.4	0.1	0.4		2.2	3.9	0.1	0.1
Phenolphthalein	< 0.0	< 0.0	< 0.0		< 0.0		0.0		< 0.0	< 0.0
Potassium							2.2			
Sodium	103.0						71.0			
Total dissolved	587.0	803.0	500.0	386.0	552.0	558.0	560.0			498.0
Total organic carbon	4.0		6.0	7.0	5.0	1.0	3.0			5.8
Total organic carbon						1.0	3.0			6.0
Total organic carbon						4.0	3.0			5.9
Total organic carbon						4.0	3.0			5.8
Total organic carbon	4.0		6.0	7.0	5.0	2.5	3.0			5.9

** Bold items indicate an exceedance

TEXAS NATURAL RESOURCE CONSERVATION COMMISION

GROUND-WATER SAMPLING INFORMATION

Analytical Results for Permit 1396 - Sprint Fort Bend County LF, L.P.

Well Number MW-03

	01/04/89	07/05/89	03/23/90	07/10/90	01/30/91	07/10/91	01/06/92	07/30/92	01/13/93	07/01/93
OTHER (mg/L)										
Alkalinity					380.0			216.0	269.0	
Anion-cation					11.4			7.6	11.1	
Anion-cation					12.2			7.7	10.9	
Bicarbonate					460.0			263.0	328.0	
Calcium					104.0			56.0	112.0	
Carbonate					0.0			0.0	0.0	
Chloride	37.0	57.0	40.0	46.0	40.0	73.0	78.0	64.0	80.0	65.0
Fluoride	0.4				0.3			0.3	0.2	
Hardness (CaCO3)					383.0			237.0	385.0	
Magnesium					29.9			23.6	25.6	
Nitrate (N)	0.1				0.5			0.7	0.3	
Phenolphthalein	< 0.0				< 0.0			0.0	0.0	
Potassium					2.6			1.6	1.7	
Sodium					84.5			67.3	73.2	
Total dissolved	445.0	507.0	517.0	594.0	693.0	870.0	588.0	495.0	623.0	489.0
Total organic carbon	2.9	3.3	4.3	2.3	4.7	3.6	1.7	2.5	2.0	2.8
Total organic carbon	3.1	3.1	4.3	2.4	1.9	3.6	2.3	2.0	2.1	2.0
Total organic carbon	3.0	2.9	4.2	2.2	2.3	3.2	1.8	1.9	1.9	1.5
Total organic carbon	3.1	2.9	4.3	2.5	1.8	3.3	1.4	1.8	1.9	1.9
Total organic carbon	3.0	3.1	4.3	2.4	2.7	3.4	1.8	2.0	2.0	2.1

** Bold items indicate an exceedance

TEXAS NATURAL RESOURCE CONSERVATION COMMISION
GROUND-WATER SAMPLING INFORMATION
Analytical Results for Permit 1396 - Sprint Fort Bend County LF, L.P.
Well Number MW-03

	01/17/94	07/13/94
OTHER (mg/L)		
Alkalinity		
Anion-cation		
Anion-cation		
Bicarbonate		
Calcium		
Carbonate		
Chloride	71.0	71.0
Fluoride		
Hardness (CaCO3)		
Magnesium		
Nitrate (N)		
Phenolphthalein		
Potassium		
Sodium		
Total dissolved	405.0	396.0
Total organic carbon	5.1	4.4
Total organic carbon	4.0	**10.6**
Total organic carbon	4.0	7.5
Total organic carbon	4.5	9.5
Total organic carbon	4.4	8.0

** Bold items indicate an exceedance

TDH
Texas Department of Health

William R. Archer III, M.D.
Commissioner of Health

1100 West 49th Street
Austin, Texas 78756-3199
(512) 458-7111
http://www.tdh.state.tx.us

Patti J. Patterson, M.D., M.P.H.
Executive Deputy Commissioner

October 5, 1998

EPA
Attention: Tom Poeton
Dallas, TX

Dear Mr. Poeton:

Attached is the list of laboratories in the State of Texas certified to test for coliforms in drinking water. All of these labs except for Edwards Aquifer Research and Data Center are also certified to test for *E coli* in drinking water. Four labs are certified to test for fecal coliforms in drinking water:

Edwards Aquifer Research and Data Center
Houston Health and Human Services Department
New Braunfels Utilities
Texas Department of Health - Austin

In addition to the attached list is:

Texas Department of Health
Bureau Of Laboratories
ATTN: Po Chang
Section Chief, Consumer Microbiology
1100 W. 49th Street
Austin, TX 78756
(512)458-7562

Sincerely,

Alice Brenner, M.S.P.H.

Water Labs Certified by the State of Texas Located in the Dallas/Ft. Worth Area

Tarrant County Public Health Department
ATTN: Guy Dixon, Ph.D.
Laboratory Manager
1800 University Drive
Fort Worth, TX 76107
(817)-871-7249
871-7245

City of Arlington
Pierce-Burch Water Treatment Plant
ATTN: Star F. Birch
Laboratory Manager
1901 Lakewood Dr.
Arlington, TX 76013
(817)-457-7550

Dallas Water Utilities
East Side Water Treatment Plant
ATTN: Simson Mammen
Senior Chemist
405 Long Creek Road
Sunnyvale, TX 75182
(214)-670-0917

Dallas Water Utilities
Bachman Water Treatment Plant
ATTN: Laurence O. Robinson
Laboratory Supervisor
2605 Shorecrest
Dallas, TX 75235
(214)-670-6587

Dallas Water Utilities
Elm Fork Water Treatment Plant
ATTN: Gamaliel Guzman
Laboratory Supervisor
1440 Whitlock Lane
Carrollton, TX 75006
(972)-389-6012

Dallas County
Park Cities Municipal Water District
ATTN: Bill White
General Manager
1811 Regal Row
Dallas, TX 75235
(214)-652-8639

Garland Water Utilities Lab
Duck Creek Wastewater Plant
ATTN: Wesley Kucera
Laboratory Supervisor
750 Duck Creek Way
Sunnyvale, TX 75182-9319
(972)-203-4309

Trinity River Authority
Northern Division
ATTN: Mary C. Henderson
Laboratory Supervisor
6500 W. Singleton Blvd.
Dallas, TX 75212
(972)-263-2251

North Texas Municipal Water District
ATTN: Michael Gooch
Laboratory Supervisor
P.O. Box 2408
Wylie, TX 75098
(972)-442-5405

Water Labs Certified by the State of Texas

ne Public Health
partment
ATTN: Nancy Jennings
Laboratory Manager
P.O. Box 6489
Abilene, TX 79608-6489
(915)-692-5600

Brazoria County Health
Department Water Lab
ATTN: Mike Green
Laboratory Supervisor
434 East Mulberry
Angleton, TX 77515
(409)-849-5711 X-1628

Brazos County Health
Department
ATTN: Bill Rosser
Laboratory Director
201 North Texas Avenue
Bryan, TX 77803-5317
(409)-361-4450

Corpus Christi-Nueces County
Public Health District
ATTN: Irma Rios
ratory Director
. Box 9727
Corpus Christi, TX 78469
(512)-851-7214

El Paso City-County Health
District
ATTN: Joe Veale
Laboratory Director
1148 Airway Blvd.
El Paso, TX 79925
(915)-543-3536
543-3537

Tarrant County Public Health
D partment
ATTN: Guy Dixon, Ph.D.
Laboratory Manager
1800 University Drive
Fort Worth, TX 76107
(817)-871-7249
871-7245

Greenville-Hunt County Health
Department
ATTN: Joe Lilly
Laboratory Director
Lee Street
nville, TX 75401
(03)-408-4140

Houston Health & Human
Services Department
ATTN: S. Vern Juchau, Ph.D.,
MPH
Chief, Laboratory Services
1115 South Braeswood
Houston, TX 77030
(713)-558-3471

Galveston County Health District
ATTN: Doug Simburger
Laboratory Director
P.O. Box 939
La Marque, TX 77568
(409)-938-7221

Lubbock City Health Department
ATTN: Tommy Camden
Laboratory Director
P.O. Box 2548
Lubbock, TX 79408-2548
(806)-767-2908

Laredo City Health Department
ATTN: Ricardo D. Martinez
Chief, Laboratory Services
P.O. Box 2337
Laredo, TX 78044
(956)-723-2051 X-259

Midland Health Department
ATTN: Celestino R. Garcia
Laboratory Director
3303 W. Illinois, Space 22
Midland, TX 79703
(915)-681-7613

Paris-Lamar County Health
Department
ATTN: Pauline McDonald
Laboratory Director
P.O. Box 938
Paris, TX 75461
(903)-785-4561

Port Arthur City Health
Department
ATTN: Lloyd Haggard
Laboratory Director
431 Beaumont Ave.
Port Arthur, TX 77640
(409)-983-8830

San Antonio Metropolitan Health
District
ATTN: Anna C. Crowder
Laboratory Director
332 West Commerce
San Antonio, TX 78205
(210)-207-8747

South Texas Hospital
ATTN: Graciela R. Garza
Laboratory Director
P.O. Box 592
Harlingen, TX 78551
(210)-423-3420 X-288

Sweetwater-Nolan County Health
Department
ATTN: Kathy Rosson
Laboratory Director
P.O. Box 458
Sweetwater, TX 79556
(915)-235-5463

Smith County Public Health
District
ATTN: Bruce Anthony Stevens
Laboratory Director
P.O. Box 2039
Tyler, TX 75710-0209
(903)-535-0090

Waco-McLennan County Public
Health District
ATTN: Ruth E. Vaughan
Laboratory Director
225 West Waco Drive
Waco, TX 76707
(254)-750-5471

Wichita Falls- Wichita County
Public Health District
ATTN: Paul G. Gwynn, Jr.
Laboratory Director
1700 Third Street
Wichita Falls, TX 76301
(817)-761-7873

Victoria County Health
Department
ATTN: Eloy Saldivar
Laboratory Manager
P.O. Box 2350
Victoria, TX 77902
(512)-578-6281 X-41

Houston Health & Human
Services Department
North Environmental Lab
ATTN: Larry Bagwill
boratory Supervisor
1828 Rankin Road
Houston, TX 77073
(281)-233-2563

Nova Biologicals, Inc.
ATTN: Paul J. Pearce, Ph.D.
Vice-President, Laboratory
Director
1775 E. Loop 336, Suite 4
Conroe, TX 77303
(409)-756-5333

Eastex Environmental Lab, Inc.
ATTN: Jody E. Jeansonne
Inorganic Lab Manager
P.O. Box 859
Coldspring, TX 77331
(409)-653-3249

North Water District Laboratory
Services, Inc.
ATTN: Steve Grychka
Laboratory Supervisor
9391 Grogan's Mill, Suite A-4
The Woodlands, TX 77380
(281)-363-8740

LabTech Corporation
ATTN: Joyce Stevens
Manager
6919 Mayard
Houston, TX 77041
(713)-849-2872

Angelina & Neches River
Authority
ATTN: Beverly McGee
Laboratory Manager
P.O. Box 387
Lufkin, TX 75902-0387
(409)-632-7795

City of Arlington
Pierce-Burch Water Treatment
Plant
ATTN: Star F. Birch
Laboratory Manager
1901 Lakewood Dr.
Arlington, TX 76013
(817)-457-7550

City of Amarillo Environmental
Lab
ATTN: David Reasoner
Laboratory Supervisor
P.O. Box 1971
Amarillo, TX 79186
(806)-342-1549

City of Austin Water and
Wastewater Dept.
Water Quality Lab
ATTN: Maria R. Barrios
Laboratory Supervisor
3500 W. 35th Street
Austin, TX 78703
(512)-421-3777

Baytown Area Water Authority
ATTN: Armando Martinez
Laboratory Supervisor
7425 Thompson Road
Baytown, TX 77521
(281)-426-3517

Beaumont Water Purification
Plant
ATTN: Ronnie L. Heiman
Laboratory Supervisor
P.O. Box 3827
Beaumont, TX 77704
(409)-838-3524

Preventive Medicine Service
Environmental Health Section
ATTN: Major Chris Jenkins
Laboratory Officer
William Beaumont Army Medical
Center, Bldg. 118
El Paso, TX 79920-5001
(915)-568-7016

Borger Water Treatment Plant
ATTN: Paul Waterstraat
Utility Director
P.O. Box 5250
Borger, TX 79008-5250
(806)-273-0965

Water Plant No. 1 Laboratory
ATTN: Isidoro Urbano, Jr.
Laboratory Supervisor
P.O. Box 3270
Brownsville, TX 78520
(982)-982-6380

Lower Colorado River Authority
ATTN: Alicia Gill
Laboratory Manager
P.O. Box 220
Austin, TX 78767
(512)-356-6022

City of Corpus Christi
O.N. Stevens Water Treatment
Plant
ATTN: M.P. Sudhakaran
Laboratory Supervisor
P.O. Box 9277
Corpus Christi, TX 78469-9277
(512)-241-1171

Dallas Water Utilities
East Side Water Treatment Plant
ATTN: Simson Mammen
Senior Chemist
405 Long Creek Road
Sunnyvale, TX 75182
(214)-670-0917

Dallas Water Utilities
Bachman Water Treatment Plant
ATTN: Laurence O. Robinson
Laboratory Supervisor
2605 Shorecrest
Dallas, TX 75235
(214)-670-6587

Dallas Water Utilities
Elm Fork Water Treatment Plant
ATTN: Gamaliel Guzman
Laboratory Supervisor
1440 Whitlock Lane
Carrollton, TX 75006
(972)-389-6012

Dallas County
Park Cities Municipal Water
District
ATTN: Bill White
General Manager
1811 Regal Row
Dallas, TX 75235
(214)-652-8639

Denton Municipal Laboratory
ATTN: Howard Martin
Director of Environmental
Services
1100 Mayhill
Denton, TX 76208
(940)-383-7509

Edwards Aquifer Research and
Data Center
ATTN: Glenn Longley, Ph.D.
Laboratory Director
Freeman Bldg. Room 248
San Marcos, TX 78666-4616
(512)-245-2329

City of Deer Park
Surface Water Treatment Plant
ATTN: Bill Healer
boratory Supervisor
). Box 700
Deer Park, TX 77536
(281)-478-7255

Central Laboratory
ATTN: Paul Rivas
Laboratory Supervisor
P.O. Box 511
El Paso, TX 79961
(915)-594-5722

Fort Worth Water Department
Rolling Hills WTP
ATTN: Richard S. Talley
Laboratory Services Manager
P.O. Box 870
Fort Worth, TX 76101-0870
(817)-572-3154

Guadalupe-Blanco River
Authority
ATTN: Debbie Magin
Laboratory Director
P.O. Box 271
Seguin, TX 78156-0271
(379)-379-5822

land Water Utilities Lab
uck Creek Wastewater Plant
ATTN: Wesley Kucera
Laboratory Supervisor
750 Duck Creek Way
Sunnyvale, TX 75182-9319
(972)-203-4309

USA MEDDAC Preventive
Medicine Service
ATTN: Dave Hagood
Laboratory Supervisor
Building 76022
Fort Hood, TX 76544-5063
(254)-288-1665

Trinity River Authority
Lake Livingston Project
ATTN: J. Michael Knight
Laboratory Supervisor
P.O. Box 360
Livingston, TX 77351
(409)-365-2292

Trinity River Authority
Northern Division
TN: Mary C. Henderson
oratory Supervisor
0 W. Singleton Blvd.
Dallas, TX 75212
(972)-263-2251

Harlingen Water Works System
ATTN: Richard Glick
Water Plant Superintendent
P.O. Box 1950
Harlingen, TX 78551
(956)-430-8163

City of Huntsville - Parker Creek
WWP
ATTN: Debra Daugette
Laboratory Supervisor
9446 Ellisor Road
Huntsville, TX 77340
(409)-295-5957

City of Houston Clinton Dr.
Facility PUD
Water QC Branch
ATTN: Vera Smart
Laboratory Supervisor
2300 Federal Avenue
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(713)-450-5117

Guadalupe Basin Natural
Resources Center
ATTN: Scott Loveland
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(830)-896-5445

City of Lewisville Environmental
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City of Laredo
Water Treatment Laboratory
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Assistant Utility Director
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(956)-795-2620
795-2708
795-2700

Upper Leon River Authority
ATTN: John L. Davis
Laboratory Supervisor
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Comanche, TX 76442
(254)-879-2258

City of Lubbock Water Treatment
Laboratory
ATTN: Tony Flores
Micro Lab Supervisor
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(806)-775-2614

City of McAllen Central
Laboratory
ATTN: Patrick Asogwa
Laboratory Supervisor
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McAllen, TX 78501
(956)-631-4431

New Braunfels Utilities
ATTN: Tommy Thompson
Laboratory Director
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New Braunfels, TX 78131
(830)-608-8907
620-5098

Sabine River Authority of Texas
Environmental Services Division
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Environmental Control
Laboratory
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Laboratory Supervisor
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(915)-335-4625

OMI - Pampa Water Treatment
Plant
ATTN: Glenn Turley
Project Manager
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(806)-669-5830

Port Arthur Water Purification
Plant
ATTN: Alfreda Samuel
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City of Round Rock
ATTN: Kim Lutz
Environmental Supervisor
221 E. Main Street
und Rock, TX 78664
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City of San Angelo
Water Treatment Plant
Laboratory
ATTN: Ron Ruiz
Laboratory Manager
1324 Metcalfe St.
San Angelo, TX 76903
(915)-657-4298

San Antonio River Authority
ATTN: Mark Gonzales
Chief, Environmental Services
P.O. Box 830027
San Antonio, TX 78283
(210)-227-1373

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San Antonio Water System
ATTN: Donna Fossum
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San Antonio, TX 78220
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erman Utilities Laboratory
TN: Nathan Whiddon
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(903)-892-4545

Texarkana Water Utilities
Laboratory
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Water Production Manager
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City of Waco Utility Services
Laboratory
ATTN: Jerry McMillon
Water Quality Coordinator
P.O. Box 2570
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(254)-751-8554 X-12

North Texas Municipal Water
District
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Laboratory Supervisor
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lie, TX 75098
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City of Wichita Falls
Jasper Water Treatment Plant
ATTN: Cheryl Routh
Supervisor
P.O. Box 1431
Wichita Falls, TX 76307-1431
(817)-322-5638

El Paso Water Utilities
Jonathan Rogers Water
Treatment Plant
ATTN: Teresa Alcala
Laboratory Supervisor
P.O. Box 511
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(915)-594-5750

City of Denison Water Treatment
Plant
ATTN: Melva Palmer
Laboratory Supervisor
4631 Randell Lake Road
Denison, TX 75020
(903)-464-4480

Environmental Health
Laboratories
ATTN: Dale Piechocki
Quality Assurance Scientist
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South Bend, IN 46617
(219)-233-4777

Bioenvironmental Engineering
Flight
ATTN: Capt. Carl Sepulveda
Laboratory Supervisor
590 Mitchell Blvd.
Laughlin AFB, TX 78843
(830)-298-6806

TDH

TEXAS DEPARTMENT OF HEALTH

Texas Department of Health

1100 West 49th Street
Austin, Texas 78756-3199
http://www.tdh.state.tx.us

Laboratories Certified for Drinking Water Chemical Testing
July 31, 1998

Accu-Labs Research, Inc.
4663 Table Mountain Drive
Golden, CO 80403-1650
(303) 277-9514

American Analytical & Technical Services, Inc.
11950 Industriplex Blvd
Baton Rouge, LA 70809-5191
(504) 753-8650

Anacon, Inc.
730 FM 1959
Houston, TX 77034
(713) 922-7000

Ana-Lab Corporation
P.O. Box 9000
Kilgore, TX 75663-9000
(903) 984-0551

City of Arlington Water Utilities Laboratory Services
1901 Lakewood Drive
Arlington, TX 76013
(817) 457-7550

Aqua Tech Environmental Laboratories, Inc.
1776 Marion-Waldo Rd
P.O. Box 436
Marion, OH 43301-0436
(800) 783-5991
Marion, OH facility

Aqua Tech Environmental Laboratories, Inc.
1776 Marion-Waldo Rd
P.O. Box 436
Marion, OH 43301-0436
(800) 783-5991
Melmore, OH facility

Barringer Laboratories, Inc.
15000 West 6th Avenue, Suite 300
Golden, CO 80401
(303) 277-1689

Continental Analytical Services, Inc.
1804 Glendale Road
Salina, KS 67401-6675
(800) 535-3076

EMSL Analytical, Inc.
3 Cooper Street
Westmont, NJ 08108
(609) 858-4800

Environmental Health Laboratories
110 S. Hill Street
South Bend, IN 46617
(800) 332-4345

Environmental Physics, Inc.
2040 Savage Road
Charleston, SC 29414
(803) 556-8171

General Engineering Laboratories, Inc.
2040 Savage Road
Charleston, SC 29414
(803) 556-8171

LNS Environmental Services, Inc.
903 North Bowser, Suite 230
Richardson, TX 75081
(~~214~~) 699-3772
(972)

Lower Colorado River Authority Laboratory
P.O. Box 220
Austin, TX 78767-0220
(512) 473-3322

QST Environmental
P.O. Box 1703
Gainesville, FL 32602-1703
(352) 332-3318

Recra LabNet - Chicago
2417 Bond Street
University Park, IL 60466-3182
(708) 534-5200

Savannah Laboratories & Environmental Services, Inc.-Savannah
5102 LaRoche Avenue
Savannah, GA 31404
(912) 354-7858

Savannah Laboratories & Environmental Services, Inc. - Tallahassee
2846 Industrial Plaza Drive
Tallahassee, FL 32301
(904) 878-3994

Southwest Laboratory of Oklahoma, Inc.
1700 West Albany
Broken Arrow, Oklahoma 74012
(918) 251-2858

SVL Analytical, Inc.
One Government Gulch
Kellogg, ID 83837
(208) 784-1258

Texas Department of Health
Environmental Sciences Division
1100 West 49th Street
Austin, TX 78756
(512) 458-7587
*EPA certified

U.S. Army Center for Health Promotion and Preventive Medicine
Building E-2100
Aberdeen Proving Ground, Maryland 21010
(410) 671-4465

A list of the specific categories and analytes for which a laboratory is certified may be obtained from the individual laboratory or the Texas Department of Health, (512) 458-7587.

Laboratories Certified for Drinking Water Chemical Testing
July 31, 1998

The table given below shows the chemical categories (in bold) and the contaminants within each category for which certification may be granted. The certification status for each contaminant is indicated by "C" for certified and "NC" for not certified for the six certified laboratories located in Texas.

Chemical Categories and Contaminants	Anacon, Inc.	Ana-Lab Corporation	City of Arlington Water Utilities	LNS Environmental Services, Inc.	Lower Colorado River Authority	Texas Department of Health
Routine Inorganics						
Fluoride	NC	NC	NC	C	NC	C
Cyanide	NC	NC	NC	C	NC	C
Nitrate and Nitrite						
Nitrate-N	C	NC	C	NC	C	C
Nitrite-N	C	NC	C	NC	C	C
Metals						
Antimony	NC	NC	C	C	C	C
Arsenic	C	C	C	C	C	C
Barium	C	C	NC	C	C	C

Chemical Categories and Contaminants	Anacon, Inc.	Ana-Lab Corporation	City of Arlington Water Utilities	LNS Environmental Services, Inc.	Lower Colorado River Authority	Texas Department of Health
Beryllium	C	C	C	C	C	C
Cadmium	C	C	C	C	C	C
Chromium	C	C	C	C	C	C
Mercury	C	C	C	C	C	C
Nickel	NC	C	C	C	C	C
Selenium	NC	NC	C	C	C	C
Thallium	NC	NC	NC	C	C	C
Lead and Copper						
Copper	C	C	C	C	C	C
Lead	NC	NC	C	C	C	C
Trihalomethanes						
Total Trihalomethanes	C	C	C	C	C	C
Volatile Organics						
Benzene	C	C	C	C	C	C

Chemical Categories and Contaminants	**Anacon, Inc.**	**Ana-Lab Corporation**	**City of Arlington Water Utilities**	**LNS Environmental Services, Inc.**	**Lower Colorado River Authority**	**Texas Department of Health**
Carbon tetrachloride	C	C	C	C	C	C
Chlorobenzene	C	C	C	C	C	C
1,2-Dichlorobenzene	C	C	C	C	C	C
1,4-Dichlorobenzene	C	C	C	C	C	C
1,2-Dichloroethane	C	C	C	C	C	C
1,1-Dichloroethylene	C	C	C	C	C	C
cis-1,2-Dichloroethylene	C	C	C	C	C	C
trans-1,2-Dichloroethylene	C	C	C	C	C	C
Dichloromethane	NC	C	C	C	C	C
1,2-Dichloropropane	C	C	C	C	C	C
Ethylbenzene	C	C	C	C	C	C
Styrene	C	C	C	C	C	C
Tetrachloroethylene	C	C	C	C	C	C
Toluene	C	C	C	C	C	C

Chemical Categories and Contaminants	Anacon, Inc.	Ana-Lab Corporation	City of Arlington Water Utilities	LNS Environmental Services, Inc.	Lower Colorado River Authority	Texas Department of Health
1,1,1-Trichloroethane	C	C	C	C	C	C
1,1,2-Trichloroethane	C	C	C	C	C	C
Trichloroethylene	C	C	C	C	C	C
1,2,4-Trichlorobenzene	NC	NC	NC	C	C	C
Vinyl chloride	C	C	C	C	C	C
Total Xylenes	NC	C	C	C	C	C
Insecticides and Herbicides						
Alachlor	NC	NC	C	C	C	C
Atrazine	C	NC	NC	C	C	C
Chlorodane	C	NC	C	C	C	C
2,4-D	NC	NC	NC	C	C	C
Dalapon	NC	NC	NC	C	C	C
Dinoseb	NC	NC	NC	C	C	C
Endrin	C	NC	C	C	C	C

Chemical Categories and Contaminants	Anacon, Inc.	Ana-Lab Corporation	City of Arlington Water Utilities	LNS Environmental Services, Inc.	Lower Colorado River Authority	Texas Department of Health
Heptachlor	C	NC	C	C	C	C
Heptachlor epoxide	C	NC	C	C	C	C
Hexachlorobenzene	NC	NC	C	C	C	C
Hexachlorocyclopentadiene	NC	NC	C	C	C	C
Lindane	C	NC	C	C	C	C
Methoxychlor	C	NC	C	C	C	C
Pentachlorophenol	NC	NC	NC	C	C	C
Picloram	NC	NC	NC	C	C	C
Simazine	C	NC	C	C	C	C
2,4,5-TP (Silvex)	C	NC	NC	C	C	C
Toxaphene	C	NC	C	C	C	C
Carbamate Insecticides						
Aldicarb	NC	NC	NC	NC	C	C
Aldicarb sulfone	NC	NC	NC	NC	C	C

Chemical Categories and Contaminants	Anacon, Inc.	Ana-Lab Corporation	City of Arlington Water Utilities	LNS Environmental Services, Inc.	Lower Colorado River Authority	Texas Department of Health
Aldicarb sulfoxide	NC	NC	NC	NC	C	C
Carbofuran	NC	NC	NC	NC	C	C
Oxamyl (Vydate)	NC	NC	NC	NC	C	C
EDB and DBCP						
1,2-Dibromo-3-chloropropane	NC	NC	NC	NC	NC	C
Ethylene dibromide	NC	NC	NC	NC	NC	C
Synthetic Organics						
Benzo(a)pyrene	NC	NC	NC	C	C	C
Di(2-ethylhexyl) adipate	NC	NC	NC	C	NC	C
Di(2-ethylhexyl) phthalate	NC	NC	NC	C	NC	C
PCBs as decachlorobiphenyl	NC	NC	NC	C	NC	C
Endothall	NC	NC	NC	NC	NC	C
Glyphosate	NC	NC	NC	NC	NC	C
Diquat	NC	NC	NC	NC	NC	C

Chemical Categories and Contaminants	Anacon, Inc.	Ana-Lab Corporation	City of Arlington Water Utilities	LNS Environmental Services, Inc.	Lower Colorado River Authority	Texas Department of Health
Radiochemicals						
Gross alpha	NC	NC	NC	NC	NC	C
Gross beta	NC	NC	NC	NC	NC	C
Radium-226	NC	NC	NC	NC	NC	C
Radium-228	NC	NC	NC	NC	NC	C
Uranium	NC	NC	NC	NC	NC	C
Strontium-89	NC	NC	NC	NC	NC	C
Strontium-90	NC	NC	NC	NC	NC	C
Tritium	NC	NC	NC	NC	NC	C
Iodine-131	NC	NC	NC	NC	NC	C
Gamma emitters (cobalt-60, zinc-65, cesium-134, cesium-137, barium-133)	NC	NC	NC	NC	NC	C
Asbestos	NC	NC	NC	NC	NC	NC
Dioxin	NC	NC	NC	NC	NC	NC

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PRELIMINARY ENGINEERING REPORT

FOR

WATER AND WASTEWATER FACILITIES

FOR

THE FOUR CORNERS AREA

OF

FORT BEND COUNTY, TEXAS

STATE OF TEXAS
JOE W. EZZELL
64491
REGISTERED PROFESSIONAL ENGINEER

Joe W Ezzell
12-28-98

Prepared by:
Earth Tech
with
Pate Engineers
Goodsen Consulting Engineers
BC&AD Archaeology
HVJ Associates

TWDB CONTRACT NO. 97-483-206

DECEMBER 1998

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DECEMBER 1998

Table of Contents

Four Corners Area
Water and Sewer Facilities

I. Project Planning Area

A. Project Location - The planning area for the Four Corners water and sanitary sewer study encompasses approximately 1,775 acres of land located in north central Fort Bend County, Texas. The planning area boundaries are generally defined by State Highway 6 on the east, McKaskle Road to the south, FM 1464 to the west and the southern boundary of South Mission Glen MUD to the north. Major roadways within the planning area include Richmond-Gaines Road which runs north-south through the area and Boss Gaston/Old Richmond Road which traverses east to west across the north central part of the planning area connecting State Highway 6 with FM 1464. Both roads are two-lane asphalt roadways with open ditch drainage. The entire planning area is not located within the corporate limits of any city, but lies wholly within the extra-territorial jurisdiction of the City of Houston.

Much of the service area consists primarily of open pasture/range land with sparse tree cover. Ground elevations within the area indicate that the overall slope of the area is from north to south with elevations ranging from 85 feet to 95 feet mean sea level (1928 NGVD). Red Gully flows from north to south through the area and provides primary outfall drainage. Smaller lateral channels convey flows to Oyster Creek (south of the area) and to Red Gully itself.

B. Environmental Resources - The Colorado, Brazos, Trinity, Neches and Sabine Rivers originate north of the Texas Coastal Plain. They flow southward through the plain to the Gulf of Mexico. These rivers are pro-Pleistocene in age. Smaller creeks such as the Oyster Creek and Jones Creek developed during the Pleistocene and parallel the major waterways. Fort Bend County is located in the Western Gulf section of the Coastal Plain,

Fort Bend County's location in the Western Gulf section of the Coastal Plain places it within a subtropical belt. The modem climate is characterized by high humidity. The

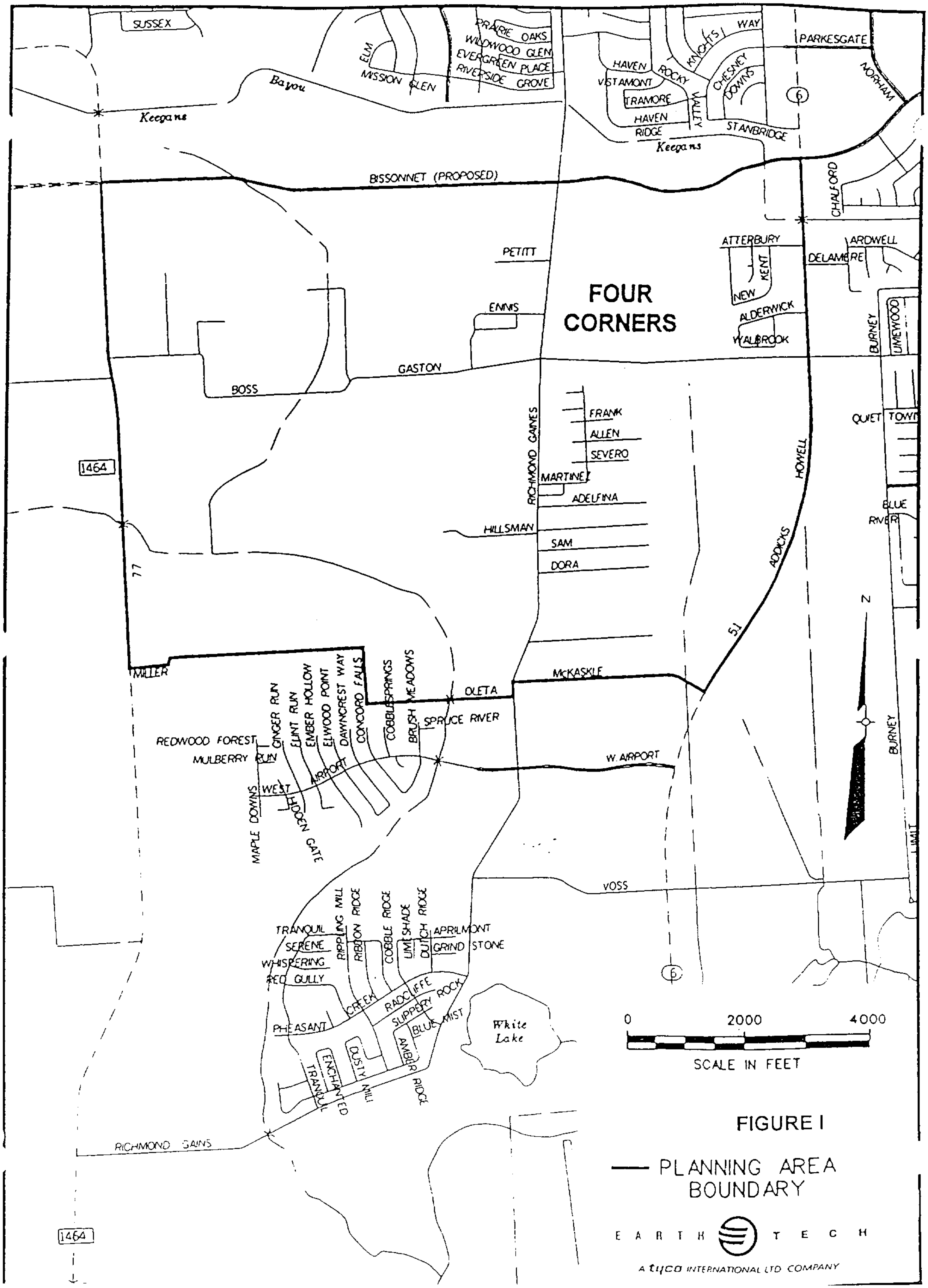

SUSSEX
PRAIRIE OAKS
WILDWOOD GLEN
EVERGREEN PLACE
RIVERSIDE GROVE
ELM
MISSION GLEN
Bayou
Keegans
KNIGHTS WAY
PARKESGATE
HAVEN
ROCKY
VISTAMONT
TRAMORE
VALLEY
HAVEN
RIDGE
CHESNEY
DOWNS
STANBRIDGE
NORHAM
6
Keegans
BISSONNET (PROPOSED)
CHALFORD
PETITT
ATTERBURY
ARDWELL
DELAMERE
NEW
KENT
ALDERWICK
WALBROOK
FOUR CORNERS
ENNIS
BURNEY
LIMEWOOD
GASTON
BOSS
FRANK
ALLEN
SEVERO
RICHMOND GAINES
MARTINEZ
QUIET TOWN
1464
HOWELL
ADELFINA
HILLSMAN
SAM
DORA
BLUE RIVER
ADDICKS
77
51
N
MILLER
McKASKLE
OLETA
COBBLESPRINGS
MEADOWS
CONCORD FALLS
DAWNCREST WAY
ELWOOD POINT
EMBER HOLLOW
FLINT RUN
GINGER RUN
BRUSH
SPRUCE RIVER
REDWOOD FOREST
MULBERRY RUN
W. AIRPORT
BURNEY
WEST AIRPORT
MAPLE DOWNS
HIDDEN GATE
LIMIT
VOSS
RIPPLING MILL
RIBBON RIDGE
COBBLE RIDGE
LIMESHADE
DUTCH RIDGE
TRANQUIL
APRILMONT
SERENE
GRIND STONE
WHISPERING
RED GULLY
6
RADCLIFFE
CREEK
SLIPPERY ROCK
PHEASANT
BLUE MIST
White Lake
AMBER RIDGE
DUSTY MILL
ENCHANTED
TRANQUIL
RICHMOND GAINS
1464
0
2000
4000
SCALE IN FEET
PLANNING AREA BOUNDARY
EARTH TECH
A tyco INTERNATIONAL LTD COMPANY

FIGURE I

biggest factor controlling the regional climate is the Gulf of Mexico. Summers are hot arid humid and winters are generally mild (Story, 1990). The mean annual temperature of the area is 20 degrees centigrade with a mean average of rainfall of 46.1 inches. Prevailing winds are south and southeast, except during the winter when fronts shift the wind from the north. The modern climate is generally considered to be similar to the climate that existed 5,000 years ago.

The flora and fauna or the project areas when first settled could include open land, woodland and wetland habitats. The following are excerpt from a book by A. A. Parker (1835).

> "...list of the forest trees, shrubs, vines i.e. red, black, white, willow; post and live oaks; pine, cedar, cottonwood, mulberry, hickory, ash elm cypress, box-wood, elder, dogwood, walnut, pecan, moscheto-a species of locust, holly, haws, hackberry, magnolia, chinquspin, wild peacan, suple jack, cane brake, palmetto, various kinds of grapevines, creepers, rushes, Spanish-moss, prairie grass and a great variety of flowers...
>
> ...Then there are bear, mexican hog, wild geese, rabbits and a great variety of ducks..."

Wild herbaceous plants that were native to this area include bluestem, indiangrass, croton. beggerwood. pokeweed. partridgepea, ragweed and fescue. Examples of native hardwood trees would be oak, mulberry, sweetgum, pecan, hawthorn, dogwood, persimmon, sumac, hichory, black walnut, maple and greenbrier.. Coniferous plants included red cedar arid coast juniper. Shrubs included American beauty berry, farkleberry. yaupon and possumhaw. Wetland plants such as smartweed, wild millet, bulrushes, saltgrass and cattail are native to the area (U.S. Department of Agriculture, 1976).

This vegetative environment supported wildlife such as bear, rabbit, red fox, deer, coyotes, racoon, opossum, muskrat, beaver, alligator, armadillo, squirrel, and skunk. A wide variety of birds were present such as quail, dove, prairie chicken, song birds, herons and kingfishers. The area was also a winter home for a number of migratory birds such as geese, ducks, egrets, coots, etc. (U.S. Department of Agriculture, 1976).

C. Areas Potential Wetlands – A preliminary wetlands investigation consisted of a review of all available published data for the study area including topographic maps, a National Wetlands Inventory map (draft), aerial photographs, infrared aerial photographs, and soil information published in the Soil Survey of Fort Bend County, Texas.

Based on this preliminary investigation, numerous waters of the United States, including wetlands, and areas potentially containing waters of the United States, were identified within the boundaries of the study area. Following this resource review, ground truthing field activities were initiated for the purpose of further identifying waters of the United States, including wetlands, located within the study area.

The field investigation aspect of this project involved the systematic evaluation of all readily accessible undeveloped parcels of property. Several inaccessible parcels of land were however not physically visited during this investigation. Additionally, based on the review of the published resources during the initial phase of this investigation, urban areas (developed residential, commercial, or industrial properties) were not investigated for potential wetlands. Also, several areas which could be inferred as upland areas based on the resource review were not physically visited during this investigation. Though numerous parcels of undeveloped land were physically evaluated during this study, each parcel was not investigated as thoroughly as would be the practice during a more extensive wetlands determination or delineation activity.

This preliminary wetlands investigation (both the resource review and the field investigation) resulted in the creation of an exhibit which details the waters of the United States, including wetlands, which were identified within the boundaries of the study area. A cursory evaluation of the soils, hydrology, and vegetation in most of the areas visited during the field investigation phase of this project was conducted based on field conditions or reviewed resources. For the purposes of this preliminary wetlands investigation, the undeveloped parcels of property evaluated during this study were categorized as follows:

- Upland areas or primarily upland areas. These areas were identified using both the resource review and field investigation phases of this project.

- Wetland areas or potential wetland areas. These areas were identified using both the resource review and field investigation phases of this project.

- Areas recently cleared which are developing wetland characteristics. These areas were identified during the field investigation phase of this project. At least two parcels of undeveloped property were observed to be recently cleared; these areas were most likely cleared within the past 6 to 9 months. Each of these areas now possess an undulating ground surface which is conducive for collecting and trapping water. Wetland vegetation was observed to be growing in many of the depressions created by the clearing activities. At present, two of the three wetland criteria (e.g., hydrology and vegetation) were met in these areas. Without appropriate intervention, wetlands may establish in these rather flat, poorly drained areas. Further research would need to be conducted to determine whether or not wetlands historically existed in these areas.

- Areas not physically visited. These areas include areas which were not walked during the field investigation aspect of this study and which the resource review of these areas was not definitive as to whether or not wetlands existed in these areas. Based on the ground truthing activities which were conducted within the study area, most of the areas not physically visited are most likely to contain upland or primarily upland areas.

Overall, ground truthing was accomplished for the majority of the undeveloped parcels of property located within the study area. Additionally, Keegans Bayou and Red Gully are considered jurisdictional waters of the United States. Any activities impacting these waters, such as outfalls, road crossings, etc., would need to be evaluated for potential permitting requirements under Section 404 of the Clean Water Act and/or the Rivers and Harbors Act of 1899.

D. Historical Background – The wide variety of native floral and faunal resources supported an indigenous population in Fort Bend County. When Cabeza de Vaca, a survivor of the Narvaez expedition to colonize southern Florida, was shipwrecked in 1528 on what has often been identified as Galveston Island (probably Oyster Bay Peninsula), he was met by the native Americans of the area (Krieger, 1959). This group of Native Americans was part of the Karankawa group that was probably made up to at least five tribes (Aten. 1983). There were three other related native groups on the upper

Texas coast at that time; the Akokisa who occupied the Galveston Bay area northward to Conroe and east to approximately Beaumont; the Atakapa who occupied the area east of Beaumont into western Louisiana; and the Bidai who occupied the territory north of the Akokisa which included the Huntsville and Liberty areas (Aten, 1983). From the ethnohistoric records as well as (lie archaeological information, the groups were hunting and gathering peoples (Hester, 1980; Aten, 1983; Story, 1990). From ca. 3000 BC to AD 100, no important technological or social advances have been identified among the Native American groups. From AD 100 to AD 800, ceramics were being used the bow and arrow was introduced and there was some recognition of territorial boundaries indicating social structure. From AD 800 until contact, there was refinement in ceramic production and increased use of the bow and arrow.

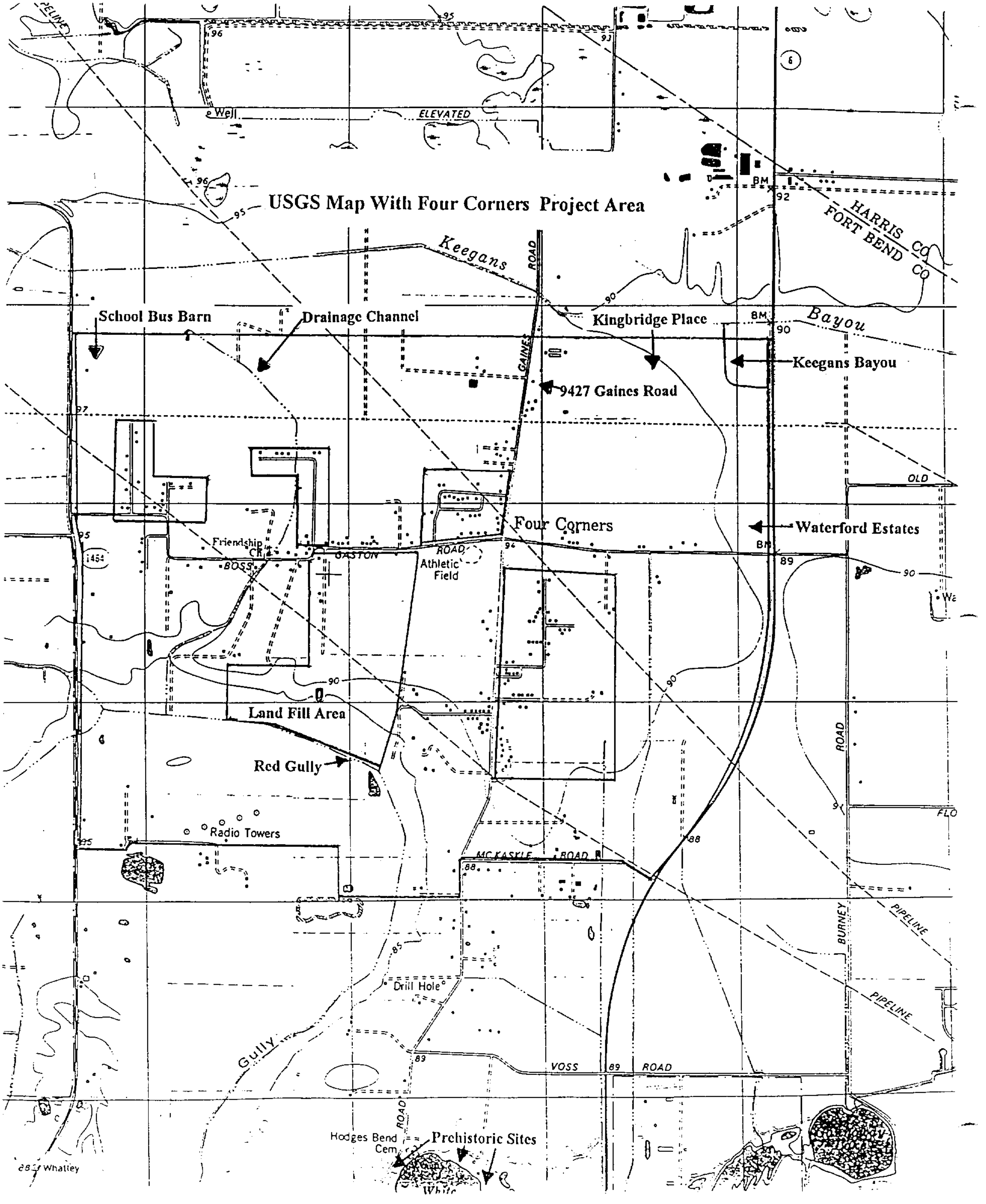
At the time of contact, the sociopolitical structure of the groups would be classified as tribes (Aten, 1983). During the warm seasons, they were dispersed in band sized groups. They gathered into villages during the colder seasons with populations ranging from 400 to 500. Cabeza de Vaca's account of these groups was that they lived in a state of starvation the year around even though they had access to all of the marine resources of a coastal environment. Caleza de Vaca lived in this area for six years and became a trader for the Native Americans, bartering sea shells and other coastal products for hides and lithic resources from inland groups (Newcomb, 1961). The archaeological record indicates that ceramics appeared with the Atakapa in 70 BC, with the Akokisa in AD 100, with the Karonkawa in AD 300 and with the Bidai in AD 500. The origin of this ceramic technology would appear to be the Lower Mississippi Valley and was adopted from east to west over time (Aten, 1983).

Some of the project areas in Fort Bend County were part of the original Stephen F. Austin colony. Their location along the Brazos River was advantageous, as it was easily navigated which gave ready access to the Gulf of Mexico.

Field survey indicates the highest potential prehistoric sites in this area are; (1) along the banks of Keegans Bayou located behind the Kingbridge Development in the upper northeast section of the area and, (2) the banks of two drainage channels, one in the northwestern section of the project area drains into Red Gully in the southwest section of the project area. Keegans Bayou appears to have been rerouted to its present location and the area has been extensively modified by new construction. Limited access to the banks of the drainage channels prevented a complete walk-through survey of these areas for potential prehistoric sites. However, limited observations during the field survey and the aerial photographs indicate that the northwest drainage channel has been heavily impacted by cultivation as well as construction since 1956. Visual observations indicate that the banks of Red Gulch have been extensively modified from the southwestern point adjacent to the landfill to the southern edge of the project area by landfill operations and construction. Visual observations and the aerial photographs indicate that the banks of the western extension of Red Gulch to the western boundary of the project area have been impacted by cultivation.

The remaining houses that meet the age requirement for the National Register of Historic Places were examined and only one could possibly qualify based on any of the other requirements. This is the residence at 9427 Gaines Road, it could possibly qualify for the National Register of Historic Places. Avoidance of this structure is recommended. There was no evidence of any remains of preexisting historic structures on the rest of the project area which has also been heavily impacted by cultivation and new construction based on limited visual observations and the aerial photographs.

The archival research has indicated that there is a probability that the southern portion of the Four Corners area was crossed by Santa Anna's army during the Texas Revolution. There is however, little probability of finding significant archaeological deposits associated with this event because the army marched rather quickly between the previous night's campsite and Stafford's plantation. It might be possible to find isolated artifacts, but nothing that would add to the better understanding of Texas History. It is unlikely that any further archaeological studies would be required concerning this event. However, if during construction of the proposed projects artifacts relating to this event are found, an archaeologist should be contacted.



USGS Map With Four Corners Project Area

E. Area's Potential Endangered Species Habitats - As part of the environmental investigation of the study area, the Texas Parks and Wildlife Department and the U.S. Fish and Wildlife Service were contacted regarding the possible occurrence of threatened or endangered species within the boundaries of the study area.

In correspondence dated September 30, 1998, the Texas Parks and Wildlife Department (TPWD), Texas Biological Conservation Data System office, the TPWD Wildlife Habitat Assessment Program, and the U.S. Fish and Wildlife Service (USFWS) were officially contacted for a review of sensitive species (e.g., threatened or endangered species) and natural communities which could potentially occur within the study area.

In correspondence dated October 6, 1998, the USFWS stated that a review of the U.S. Fish and Wildlife Service files and your project information indicate that "no federally listed or proposed threatened or endangered species are likely to occur at the project site."

In correspondence dated October 14, 1998, the TPWD Wildlife Habitat Assessment Program stated that sensitive wildlife habitats that should incorporate planning considerations within this study area include mature woodlands, riparian vegetation associated with creek drainage, native grasslands, and wetlands. Development of project alternative alignments should include considerations for sequentially avoiding, minimizing or compensating losses of these sensitive habitats. Where possible, water and wastewater lines should follow existing rights-of-way. Mitigation measures to offset unavoidable losses to these habitats should be included in project planning. Such measures may include provisions for tree and shrub plantings and for revegetation of disturbed areas using native plant species." Such ecological considerations would need to be taken into account once project alternatives or options have been identified.

As of November 24, 1998, correspondence from the TPWD Texas Biological Conservation Data System office has not been received. To date, information received by the USFWS and TPWD indicate that threatened and endangered species of plants and animals are not considered to be a concern within the confines of the study area.

F. Extent Of Flood Plain In Area - As part of this investigation, the Federal Emergency Management Agency (FEMA) National Flood Insurance Program Flood Insurance Rate Maps (FIRMs) were evaluated for the study area. The FIRM panel 120 of 550, map number 48157C0120-H, dated September 30, 1992, and map number 48157C0120-J, dated January 3, 1997, were reviewed for this project.

The northeastern-most corner of the study area boundary crosses the well defined channel of Keegans Bayou at two locations. Keegans Bayou is designated as a "Zone AE" area which consists of a special flood hazard area potentially inundated by a 100-year flood. The 100-year flood is contained within the channel of Keegans Bayou in this area according to the FIRMs reviewed during this investigation. Zone AE specifically refers to areas of the 100-year flood in which base flood elevations have been determined.

The southwestern-most corner of the study area is encompassed by a flood zone associated with Red Gully, based on the FIRMs reviewed for this area. Red Gully generally flows southeast and south within the boundaries of the study area and then flows south/southeast into Oyster Creek. Oyster Creek flows into the Brazos River which then flows into the Gulf of Mexico.

The area surrounding Red Gully is designated as a Zone AE. This area which consists of a special flood hazard area that has a potential to be inundated by a 100-year flood; floodway areas in Zone AE are also designated on the FIRMs. The Red Gully 100-year flood zone is not contained within the channel similar to the well defined channel of Keegans Bayou.

Additionally, a Zone X area is also located in the southwestern-most corner of the study area. Zone X areas are defined as areas below the 500-year flood elevation and areas within the 100-year flood area with average depths of less than one foot or with drainage

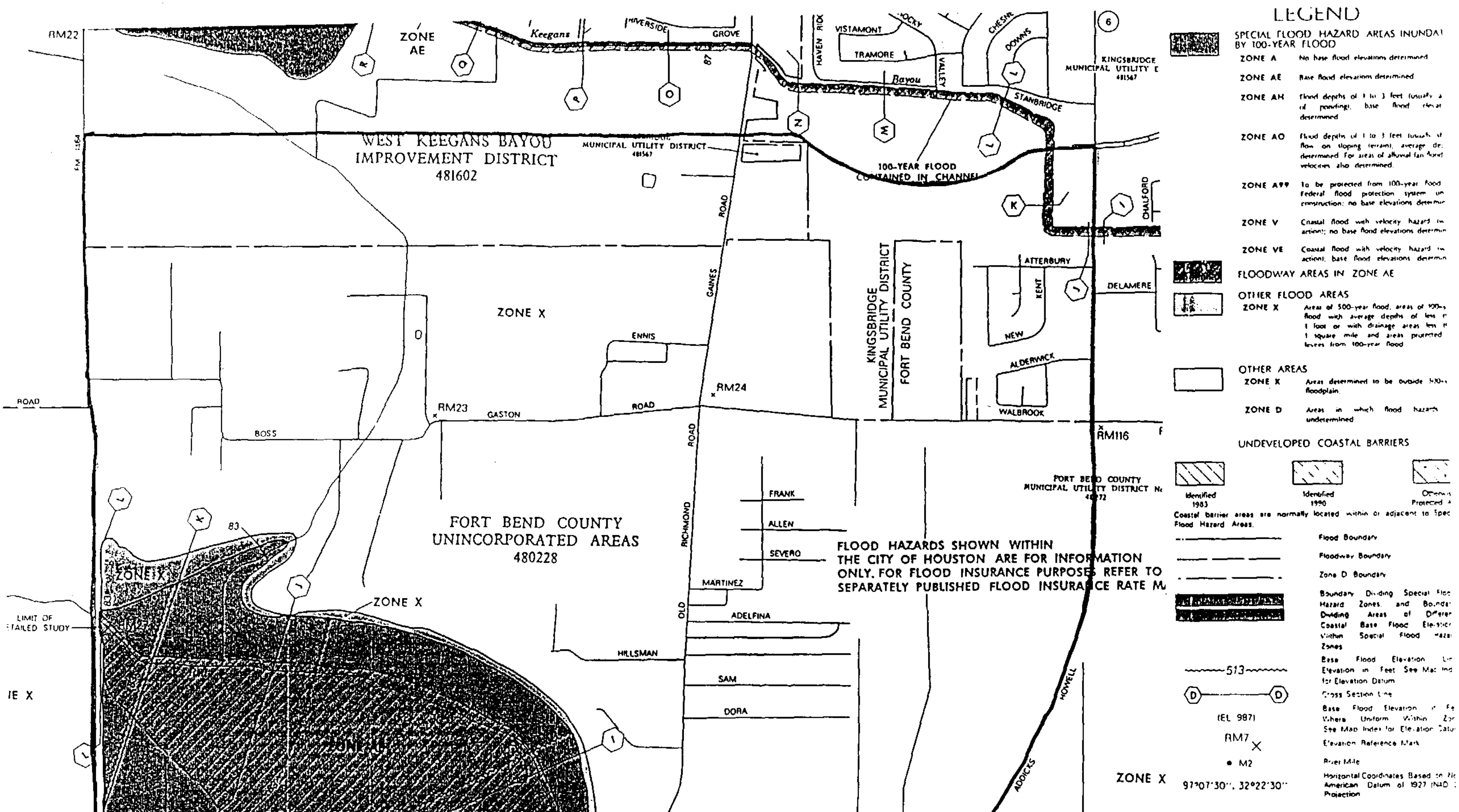


FIGURE II

EARTH TECH

A tyco INTERNATIONAL LTD. COMPANY

areas less than one square mile, and/or areas protected by levees from the 100-year flood. Specifically, Sweet City Acres, a small residential subdivision located along the southern boundary of the study area, consists of an area protected from the 100-year flood by a levee; this levee could however be subject to possible failure or overtopping during larger floods.

Aside from the channel of Keegans Bayou, located in the northeastern corner of the study area, and the area surrounding Red Gully, located in the southwestern corner of the study area, no other flood zones were identified during the course of this study.

G. Growth Areas and Population Trends - 1990 Census data for this area of Fort Bend County was obtained from the Houston-Galveston Area Council (HGAC) and used to determine existing population estimates within the planning area. According to the census data, in 1990 approximately 1,150 people resided within the planning area in 350 housing units which is equivalent to 3.3 persons per household. A recent field survey of the planning area indicates that several older housing units appear to be uninhabited but that new housing units have been constructed (primarily in the Atanacia Martinez subdivision) since the 1990 census. For this water and sewer study, the 1998 estimated population for the planning area was held at 1,150 persons with approximately 350 existing housing units within the planning area.

The population of Fort Bend County grew at an average annual rate of just under ten percent in the 1980's and continued to grow at an average rate of just under six percent during the 1990's. The HGAC forecasts that the average annual growth rate within the county will slow to less than three percent through the year 2020. Historically, the Four Corners area has not observed population increases that mirrored the rest of Fort Bend County. With the construction of water and sanitary sewer facilities within the Four Corners area, population increases within the area are to be expected. For the purposes of this planning study, average annual population increases of three percent (consistent with the rest of Fort Bend County) were used for the Four Corners planning area. Based upon this rate, the population of the Four Corners area is projected to increase from

1,150 in 1998 to 2,200 in the Year 2020. The following Table includes a summary of the population information.

POPULATION PROJECTIONS

Census Tract 703.51	1990 Census	1998 Estimated	2020 Projected
Housing Units	350	350	670
Population	1,150	1,150	2,200
Occupants per Household	3.3	3.3	3.3

H. Existing/Projected Water And Sewer Demands - Water and sanitary sewer demands were developed using the estimated 1998 population of the area and the projected growth through the Year 2020. Demands were based upon design values for water and sewer utilized by the Texas Natural Resource Conservation Commission (TNRCC). These design values are 120 gallons per capita day for average daily water demand and 100 gallons per capita day for average daily wastewater demand. Peaking factors for both water and sewer flows were used to estimate peak daily demands

Projected average daily water demand for the service area is estimated to increase from 138,000 gallons per day (gpd) in 1998 to 264,420 gpd in the Year 2020. Similarly, average daily sewer flows are estimated to increase from 115,000 gpd in 1998 to 220,350 gpd in the Year 2020. For the purposes of this study, the water distribution and wastewater collection systems were evaluated for the current demands within the area and the projected demands in the Year 2020. In addition to the average daily demands, peak hour water demands and design fire flows defined by the State Board of Insurance are utilized in the water system design. Peak wastewater flows are developed for lift station design.. The water and sewer demands calculated for the planning area are presented in the following Table.

WATER AND SEWER DEMAND PROJECTIONS

	Existing 1998	Projected 2020
WATER SYSTEM		
Average Daily Demand (gallons)(1)	138,000	264,420
Peaky Daily Demand (gpm)(2)	240	460
Fire Flow (gpm)	500	500
SANITARY SEWER SYSTEM		
Average Daily Demand (gallons)(3)	115,000	220,350
Peak Daily Demand (gallons)(4)	460,000	881,410

(1) Based upon 120 gallons per capita day
(2) 2.5 x Average Daily Demand
(3) Based upon 100 gallons per capita day
(4) 4 x Average Daily Demand

II. Existing Facilities

A. Existing Private Wells And Septic Systems - The Four Corners area considered by this study generally consists of low income residential housing including small single family houses and mobile homes. Some light commercial developments are interspersed within residential development in the area. Currently, no community water system exists in the Four Corners area. Private water wells supply the limited domestic water to residences in the area. Sanitary sewage treatment is accomplished by with septic fields serving individual lots. The approximate locations of existing private water wells and existing private septic systems are shown on the attached Figure.

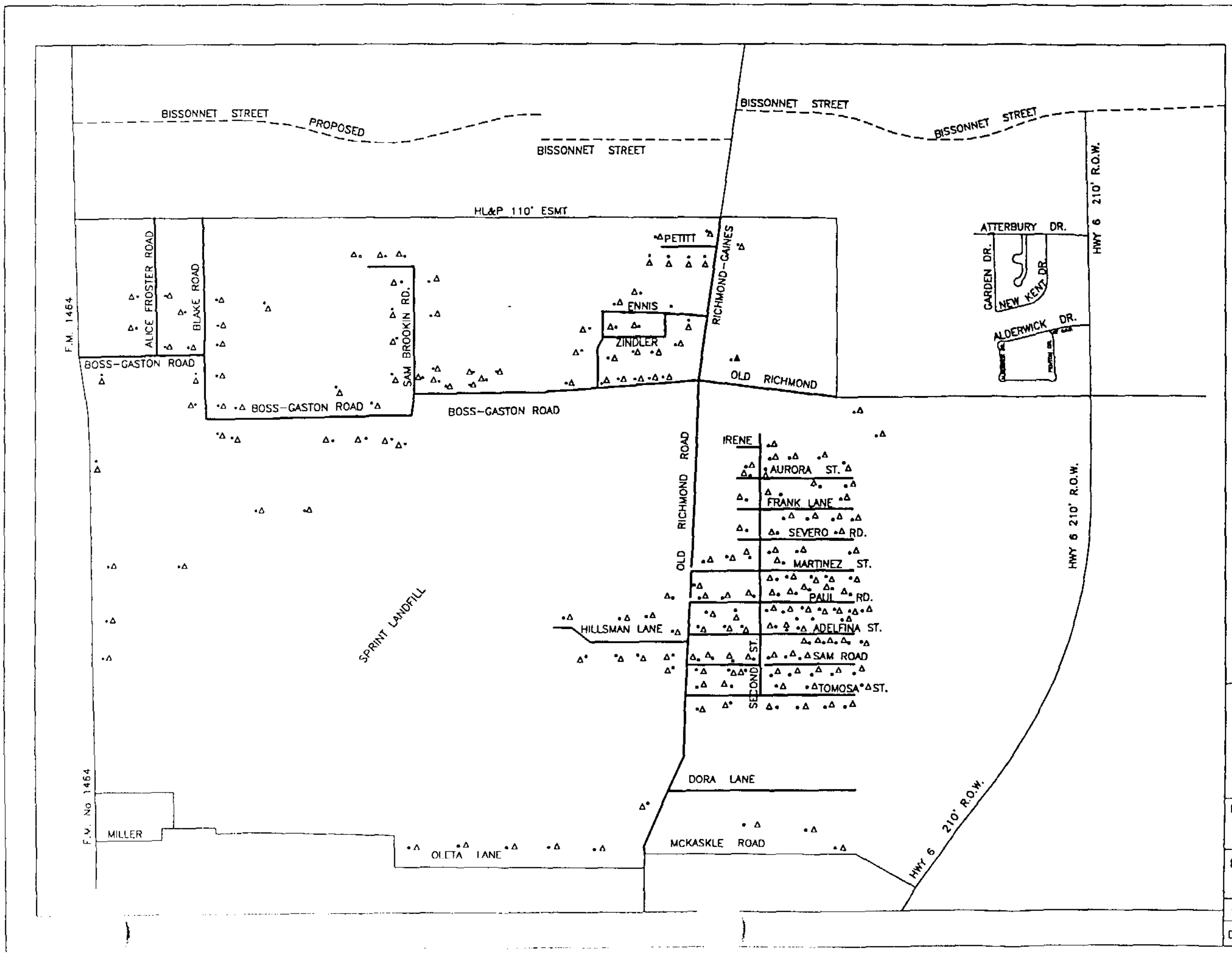
III. Need for Project

A. Health and Satety - According to Fort Bend County Environmental Health Department there have been approximately one hundred seventy (170) complaints by the City of Sugar Land for septic systems in the project area over the past ten (10) years. The locations of the complaints by street name are listed in the following Table.

Septic Tank Violation Complaints

STREET	NUMBER OF COMPLAINTS
Adelfina	19
Aurora	8
Blake	1
Frank	16
Martinez	18
Old Richmond Road	13
Paul	34
Sam	24
Second	17
Severo	8
Tomasa	12
Total	170

Currently operating on-site treatment systems are experiencing a high degree of failure to properly treat the area population's domestic waste. This condition can primarily be attributed to the overloading of the existing systems. Higher household populations than systems can handle and inadequate treatment system maintenance. The high number of



LEGEND

△ SEPTIC SYSTEM – PRIVATE

● WATER WELL – PRIVATE

— STUDY AREA BOUNDARY

CHARLES
D. GOODEN
CONSULTING
ENGINEERS, INC.

2656 SOUTH LOOP WEST, SUITE 380
HOUSTON, TEXAS 77054 (713) 660-6

PROJECT:
FORT BEND COUNTY REGIONAL WATER
AND WASTEWATER PLANNING STUDY

LOCATIONS OF PRIVATE WATER WELLS AND PRIVATE SEPTIC SYSTEMS

SCALE: NONE
HIBIT "A"

DATE: NOVEMBER
SHEET 1 OF 1

complaints is evidence of the pressing need of the area to have wastewater collection system in place to replace the stressed on-site treatment systems currently in use in the area.

Engineering consultants and water/sewer operators for Municipal Utility Districts in the area adjacent to the Four Corners planning area were contacted regarding available chemical analyses of existing water supply wells. Information was provided for public water supply wells in Fort Bend County MUD No. 2, Kingsbridge MUD, North Mission Glen MUD and Fort Bend County MUD No. 41.

Based upon the information provided by the water system operators, water supply wells within each of the four adjacent districts are within the regulatory maximum contaminant levels for minerals, metals and volatile organic compounds. These maximum contaminant levels are established by the Texas Natural Resource Conservation Commission. Total hardness for water from several of the wells is classified as moderate to hard. However, this is not uncommon for groundwater supplies in the Gulf Coast area and does not pose problems for use as potable water supply.

IV. Alternatives Considered

A. Description - Two concepts for water supply and wastewater treatment were investigated as part of this study. One concept included the construction of a water supply plant and wastewater treatment plant within the limits of the planning area (referred to as the "On-site" option) which would provide services only for properties within the planning area boundaries. The other concept involves the acquisition of "surplus" capacity in water supply and wastewater treatment facilities within neighboring municipal utility districts. Use of surplus capacity requires the Four Corners area to construct only the water distribution and wastewater collection systems within their area and these systems would then be "hooked up" to the adjacent water supply and wastewater treatment plants. Only two adjacent districts, Kingsbridge MUD and North Mission Glen MUD indicated that water and/or sewer capacity was currently available or would be available in the near term (see Section 10 for summary of all district contacts).

Appendices A, B, and C provide water distribution and wastewater collection system layouts for the alternatives considered from Kingsbridge MUD, North Mission Glen MUD, and On-site, respectively. Water distribution layouts are shown only for the On-site option and connection to Kingsbridge MUD. North Mission Glen is currently evaluating their water supply system and will not be able to assess their surplus water capacity until completion of their study. Wastewater collection systems are shown for all three options.

The wastewater collection schemes for the On-site, Kingsbridge MUD and North Mission Glen MUD options are very similar with 12-inch gravity trunk sewer lines being located on Richmond-Gaines Road and Boss-Gaston Road and 8-inch gravity sewer lines being used throughout the residential areas. Three lift/pump stations are required to provide service to the total planning area because of the size of the planning area, the limitations on the depths of gravity sanitary sewer construction and the potential for construction in wet sand conditions. Under the On-site scenario, one of the three stations would be constructed at the site of the wastewater treatment plant facility.

Under the Kingsbridge MUD and North Mission Glen MUD scenarios, the wastewater from the Four Corners area will be collected into a single pump station to be located adjacent to Old Richmond Road south of Boss-Gaston Road. From this pump station, wastewater will be pumped via force main to an existing 12-inch gravity sanitary sewer located at the intersection of Bissonnet Road and Richmond-Gaines Road (Kingsbridge MUD scenario) or to the North Mission Glen MUD wastewater treatment plant located on Keegans Bayou, north of the Four Corners area (North Mission Glen scenario).

For the On-site scenario, a wastewater treatment plant site is tentatively located along Old Richmond Road near the southern limits of the planning area and discharges to Red Gully. No specific tract of land has been identified at this time for the treatment plant site. However, the southern portion of the planning area provides the most accessible possibilities for outfall into Red Gully.

Water distribution system layouts for the on-site and Kingsbridge scenarios are very similar with the use of 12-inch water mains along Richmond-Gaines and Boss-Gaston Roads. Six-inch and eight-inch water lines are used throughout the rest of the system. Under the Kingsbridge scenario, the Four Corners distribution system will connect to the Kingsbridge water supply through an existing 12-inch water line located on Boss-Gaston Road east of Richmond-Gaines Road and to an existing 12-water line located at the intersection of Bissonnet and Richmond-Gaines. This layout will provide the Four Corners area with two points of connection to the Kingsbridge water supply system.

The on-site water scenario shows the construction of a water supply plant near Old Richmond Road south of Boss-Gaston Road. As with the on-site wastewater system scenario, no specific tract of land has been identified for the water plant location. However, the location shown on the layout in Appendix C is centrally located to the entire planning area.

B. Design Criteria - Public water distribution and supply systems must be designed in accordance with Texas Natural Resource Conservation Commission (TNRCC) permanent rules, Chapter 290 (Water Hygiene). Sanitary sewer collection and treatment systems must be designed in accordance with TNRCC permanent rules, Chapter 317 (Design Criteria for Sewage Systems). The Four Corners planning area lies within the Extra-Territorial Jurisdiction of the City of Houston. In addition to the requirements of TNRCC, water and sanitary sewer facilities must be designed in accordance with the September 1996 "Design Manual for Wastewater Collection Systems, Water Lines, Storm Drainage and Street Paving" issued by the City of Houston Department of Public Works and Engineering. City of Houston design requirements are more stringent than TNRCC with respect to certain design elements of water and wastewater systems. Construction drawings for water and sanitary sewer facilities must be approved and signed by the City of Houston prior to the initiation of construction.

C. Right-Of-Way Requirements - The proposed trunk water and sanitary sewer facilities to serve the Four Corners area will be constructed along the major roadways of Boss-Gaston/Old Richmond Road and Richmond-Gaines Road. Right-of-way widths along these roadways vary in width from 50 to 70 feet. No additional right-of-way acquisition would be anticipated. However, field visits have found evidence of gas, electric and telephone utilities along both roadways. Exact locations of these facilities will be necessary in final design and may dictate the location of the proposed water and sewer facilities relative to the existing roadway/drainage and utilities. To provide for a looped connection of the water system east of Richmond-Gaines Road, acquisition of a water line easement along the east side of the Atanacia Martinez subdivision from Old Richmond Road south to Dora Lane will be required.

Lift station and pump station sites have been preliminarily located along Boss-Gaston Road and Richmond-Gaines Road as shown on the sanitary sewer system layout in the Appendices. These locations include some flexibility in terms of their physical location on each roadway but acquisition of each site will be necessary as each proposed station is included in the final design.

The streets within the Atanacia Martinez subdivision include a combination of dedicated street rights-of-way and easements for access to existing housing units in the subdivision. Many of the east-west streets in the subdivision between Second Street and Richmond-Gaines Road have dedicated right-of-way widths of 50-60 feet. Those portions of the same streets located east of Second Street appear to exist only as access easements. In order to construct public water and sanitary sewer facilities within the access easements, granting of utility easements from the underlying property owner will be necessary or the easements may be converted to public road rights-of-way. Conversion of the easements to right-of-way will require coordination with the property owner and Fort Bend County to ensure that platting and roadway construction issues are addressed.

D. Impacts on Construction - The Four Corners area is an area that is mostly undeveloped, however rural homes are located throughout the area and some modern residential developed is located in the northeast part. The Sprint Landfill is located near the center. South and west of Red Gully the project lies in the Quaternary alluvial deposits associated with the Brazos River floodplain. Sands and silts, along with clayey soils are common in these alluvial deposits. Northeast of Red Gully the area is underlain by clayey soils associated with the Beaumont Formation. The major impact on construction will be the presence of a high groundwater level that may be encountered in the southern part of the area. The nearest known fault is the Clodine Fault which crosses FM 1464 about 1500 feet northwest of area. The Renn Scarp is located about 2000 feet northeast of the site. These are the known active faults in the area and neither are known to be within the Four Corners area.

Existing geotechnical reports relevant to the study area are summarized in the following table.

Service Area	**Generalized Soil Conditions**	**Groundwater Level Range**
Four Corners	Surface strata consisting of firm to very stiff clays and generally underlain by very loose to medium dense sands and silts	8 to 15 feet

E. Cost Estimates of Alternative Systems Costs - Construction cost estimates for the alternative water and sewer systems evaluated in the study were broken down into two separate components. The first component included the construction costs for water distribution and wastewater collection systems within the Four Corners planning area. The configurations of these systems were dictated by the physical locations of water supply and wastewater treatment in addition to regulatory requirements. The second component involves the construction costs for the water supply plant and the wastewater treatment plant which are based upon the cost of new facility construction or in the case of existing plant availability, the capital recovery costs of the facilities already constructed. All construction cost estimates are based upon current unit costs for projects similar to scope and size of those evaluated in the study.

The Alternative System Cost Table provides a summary of the construction costs for the water supply, wastewater treatment, water distribution and wastewater collection systems alternatives. Detailed cost construction costs estimates for water distribution and wastewater collection systems evaluated are included in the appendices of this report.

FOUR CORNERS WATER AND SEWER
ALTERNATIVE SYSTEM COSTS

		N. Mission Glen MUD		Kingsbridge MUD		On-Site
WASTEWATER COLLECTION						
Construction	$	3,406,475	$	3,326,555	$	3,176,075
Contingencies(15%)		510,970		498,980		476,410
Engineering(13%)		509,270		497,320		474,820
Administration(5%)		221,340		216,140		206,370
TOTAL WASTEWATER COLLECTION	$	4,648,055	$	4,538,995	$	4,333,675
WATER DISTRIBUTION						
Construction		N/A	$	2,171,800	$	2,093,960
Contingencies(15%)				325,770		314,090
Engineering(13%)				324,680		313,050
Administration (5%)				141,110		136,060
TOTAL WATER DISTRIBUTION	$	-	$	2,963,360	$	2,857,160
WASTEWATER TREATMENT						
Construction					$	345,000
Engineering(13%)						44,850
Administration(5%)						19,490
Capital Recovery(350 Conn.)	$	423,500	$	203,500		
WATER SUPPLY						
Construction					$	1,397,250
Engineering(13%)						181,640
Administration(5%)						78,940
Capital Recovery(350 Conn.)		N/A	$	395,230		
TOTAL WATER SUPPLY AND DISTRIBUTION		N/A	$	3,358,590	$	4,514,990
TOTAL WASTEWATER TREATMENT AND COLLECTION	$	5,071,555	$	4,742,495	$	4,743,015
GRAND TOTAL WATER & SEWER		N/A	$	**8,101,085**	$	**9,258,005**

V. Proposed Project

A. Recommended Alternative - With the exception of the points of source connection for water supply and wastewater treatment, there is very little difference in the overall water and sewer system layouts for the three scenarios evaluated (On-site, Kingsbridge MUD and North Mission Glen MUD). Due to the size of the planning area, pump stations and lift stations are necessary for an efficient wastewater collection system for each of the scenarios evaluated.

The recommended source of water supply and wastewater treatment as the Kingsbridge MUD option. As shown in the water distribution system layouts and wastewater collection system layouts in Appendix A, the Four Corners Planning Area was broken down into three geographic service areas. These areas account for the majority of the existing 350 connections. The detailed cost estimates provided in Appendix A for this scenario include a breakdown of water distribution and wastewater collection system costs by each individual area. The following table provides a summary of the water distribution and wastewater collection system costs for the Kingsbridge MUD option.

COST SUMMARY
WATER DISTRIBUTION &
WASTEWATER COLLECTION SYSTEMS

KINGSBRIDGE MUD OPTION

	SERVICE AREA 1	SERVICE AREA 2	SERVICE AREA 3	TOTAL AREA OUR CORNER
WASTEWATER COLLECTION SYSTEM				
Construction	$2,237,015	$ 449,260	$ 640,280	$ 3,326,555
Contingencies (15%)	335,550	67,390	96,040	498,980
Engineering (13%)	334,440	67,160	95,720	497,320
Administration (5%)	145,350	29,190	41,600	216,140
Total Cost	$3,052,355	$ 613,000	$ 873,640	$ 4,538,995
WATER DISTRIBUTION SYSTEM				
Construction	$1,580,340	$ 322,130	$ 269,330	$ 2,171,800
Contingencies (15%)	237,050	48,320	40,400	325,770
Engineering (13%)	236,260	48,160	40,260	324,680
Administration (5%)	$ 102,680	$ 20,930	$ 17,500	$ 141,110
Total Cost	$2,156,330	$ 439,540	$ 367,490	$ 2,963,360
TOTAL WATER DISTRIBUTION & WASTEWATER COLLECTION	**$5,208,685**	**$ 1,052,540**	**$ 1,241,130**	**$ 7,502,355**

Total construction cost for the water distribution and wastewater collection system to serve the 350 existing connections in the planning area is $7,502,355. If phasing of the overall water and sewer system is required to meet available funding sources, the three service areas shown in the cost estimate provide a geographic breakdown for implementation. Implementation of water and sewer service in areas one and two would provide utility service to approximately 200 of the existing 350 connections.

B. Project Water Supply And Wastewater Treatment Plant Requirements - The average daily water demand for the existing 350 connections is 138,000 gallons per day (gpd) while the average daily wastewater flows is 115,000 gpd. The adjacent district, Kingsbridge MUD currently has surplus wastewater capacity available and will have water supply capacity available in the near term.

Acquisition of capacity from Kingsbridge MUD is the recommended alternative for several reasons. The capital recovery costs for the water supply and wastewater treatment facilities are less than those available from North Mission Glen MUD and are less than the costs to construct water supply and wastewater treatment facilities within the planning area. Additionally, Four Corners will not have to apply for water supply and wastewater discharge permits (a lengthy and unpredictable process) because Kingsbridge MUD is currently operating under its own permits. The cost for operation and maintenance of the water supply plant and wastewater treatment plant, sludge disposal and permit renewals/reporting/testing is built into the rate structure to be charged to the Four Corners Area.

The capital recovery costs and water/sewer rates provided by Kingsbridge MUD are shown in the following table.

KINGSBRIDGE MUD OPTION WATER SUPPLY AND WASTEWATER TREATMENT COST

Wastewater Treatment (Capital Recovery Costs)		
350 Single Family Connections	$	185,000
Contingencies (10%)		18,500
TOTAL WASTEWATER TREATMENT	$	203,500
Cost per connection	$	581
Water Supply (Capital Recovery Costs)		
350 Single Family Connections	$	359,300
Contingencies (10%)		35,930
TOTAL WATER SUPPLY	$	395,230
Cost per connection	$	1,129
TOTAL COST PER CONNECTION	$	1,711

C. Recommended System Requirements - The existing residences to be served within the Four Corners Planning Area are distributed throughout the service area which requires long runs of waterlines and sanitary sewer lines to provide service. Waterlines operate under pressure and are typically installed at depths of 4-6 feet below natural ground. The recommended Kingsbridge layout for the water distribution, shown in Appendix A, provides for two points of connection to the Kingsbridge water supply system. This allows Four Corners a back up source of water in the event that one supply connection is out of service.

Sanitary sewer lines operate under the influence of gravity and some of the lengths of runs in the planning area would require sewers to be constructed at depths in excess of 20 feet to meet design criteria of the City of Houston and the TNRCC. Additionally, construction of the sanitary sewer lines at shallower depths can reduce the cost of construction and minimize the potential impacts of wet sand conditions. The recommended Kingsbridge layout for the wastewater collection system makes use of two lift stations and one pump station. The pump station, to be located in the vicinity of Old Richmond Road will collect all wastewater flows from the Four Corners area and pump them to the Kingsbridge MUD sanitary sewer system. The pump station can be sized to accommodate some growth within the planning are but will initially sized with pumping equipment necessary to serve the 350 connections. The system includes two lift stations, one located on Boss-Gaston Road and the other on Old Richmond Road near Dora Lane, are necessary to lift flows into the shallow gravity sanitary sewer thus eliminating the need to construct deep trunk gravity sewers (>20 feet) along Old Richmond Road and Boss-Gaston Road.

D. Operational Costs - With the acquisition of surplus water supply and wastewater treatment capacity from Kingsbridge MUD, no operation and maintenance costs for the water supply plant and wastewater treatment plant will be born directly by the Four Corners area. The annual costs for the operation of the plant facilities is incorporated into the rate structure for water and sewer service provided by Kingsbridge MUD.

The costs for operation and maintenance of the wastewater collection system, lift/pump stations and the water distribution system will be the responsibility of the Four Corners area. These costs can be assessed by the Four Corners Waster Supply Corporation or similar entity on the customers within the planning area on a monthly basis by incorporating the costs into the ultimate rate charges to the customers. These ultimate rate charges would include the actual cost of service from Kingsbridge MUD in addition to a surcharge to cover operation, maintenance and administrative costs. Most utility districts contract with an operations company to maintain their water and sewer facilities using state licensed operating personnel.

Costs for operation and maintenance of wastewater collection systems and the water distribution systems vary between different municipalities and utility districts within the southeast Texas area. Larger, more complex systems require more intensive operator involvement in day to day operations. However, the major maintenance/operational issue for proposed water and wastewater systems for the Four Corners area will be the lift/pumping stations. Because the facilities involve mechanical and electrical equipment, the potential for breakdown exists. Based upon reviews of operation and administration costs for similar types of water distribution and wastewater collection systems in the area, an annual budget amount of $50,000 to $100,000 could be expected for the Four Corners area.

Projected water and sewer rates for the Four Corners area are $16/month for water and $24/month for sewer. Total projected annual income from 350 connections is $168,000. Utilizing the cost per connection presented in this report, the cost per connection for water and sewer service for this project is $23,146.

Estimated Construction Cost	$7,502,355	
Kingsbridge	395,230	(water)
Capitol Recovery	203,500	(sewer)

TOTAL Project Cost	$8,101,085	

TEXAS WATER DEVELOPMENT BOARD

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April 1, 1999

Mr. Ernest Abila, President
Four Corners Water-Sewer Supply Corporation
16308 Old Richmond Road
Sugar Land, Texas 77478

Re: Review Comments for Draft Report Submitted by Four Corners Water-Sewer Supply Corporation (Corporation), TWDB Contract No. 97-483-206

Dear Mr. Abila:

Staff members of the Texas Water Development Board have completed a review of the draft report under TWDB Contract No. 97-483-206. As stated in the above referenced contract, the Corporation will consider incorporating comments from the EXECUTIVE ADMINISTRATOR shown in Attachment 1 and other commentors on the draft final report into a final report. The Corporation must include a copy of the EXECUTIVE ADMINISTRATOR's comments in the final report.

The Board looks forward to receiving one (1) unbound camera-ready original and nine (9) bound double-sided copies of the Final Report on this planning project. Please contact Mr. Curtis Johnson, the Board's Contract Manager, at (512) 463-8060, if you have any questions about the Board's comments.

Sincerely,

Tommy Knowles

Tommy Knowles, Ph.D., P.E.
Deputy Executive Administrator
Office of Planning

cc: Ms. Marilynn Kindell, Fort Bend County Community Development
Mr. Joe Ezzell, Earth Tech
Mr. Curtis Johnson, TWDB

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Our Mission
Provide leadership, technical services and financial assistance to support planning, conservation, and responsible development of water for Texas.

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ATTACHMENT 1
TEXAS WATER DEVELOPMENT BOARD

COMMENTS: FOUR CORNERS WATER-SEWER CORPORATION
Contract No. 97-483-206

- Population: The Texas Water Development Board does not prepare population projections for specific unincorporated areas of a county. Consequently, we do not have projections to compare with the population projections presented in the report. However, the annual percentage increase that was used for projecting the study area population was obtained from the Houston-Galveston Area Council of Governments for Fort Bend County and is acceptable for facility planning. The Board's projected annual growth rate for Fort Bend County is higher that the growth rate used for projecting the study area population through the year 2020.

- Water Demands: Although the per capita water use estimate that is used to project municipal water use is slightly higher than the per capita water use identified for some of the cities near the study area, this per capita water use estimate is acceptable for facility planning. The projected water and wastewater use for the study area is acceptable for planning purposes.

- The environmental information and baseline assessment information provided in the draft engineering report entitled "PRELIMINARY ENVIRONMENTAL ASSESSMENT", includes some basic background environmental and cultural resource information and indicates those cultural resource management and environmental issues that will likely come into play if a full environmental assessment is done on whichever project is ultimately proposed