CHAPTER 3

Affected Environment

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CHAPTER 3
AFFECTED ENVIRONMENT

The proposed project (Grand Parkway Segments H and I-1) is located on the northeast side of the greater Houston metropolitan area from US 59 (N) to IH 10 (E) generally between FM 2100 and SH 146 **(Exhibit 1-2: Preliminary Study Area Map)**. Segment H extends from US 59 (N) (near Community Drive) to US 90. Segment I-1 continues south from US 90 to IH 10 (E), for a total distance of approximately 36 miles (mi). Due to the similarity between Segment H and Segment I-1, it was agreed upon by FHWA and TxDOT that these segments could be studied as one project for the purposes of evaluating environmental impacts, as opposed to individual segments in the cases of Segments A, B, C, D, E, F-1, F-2, G, and I-2. Segments H and I-1 collectively constitute the proposed project evaluated in this DEIS.

The proposed project traverses parts of Montgomery, Harris, Liberty, and Chambers counties. Cities within the study area include Mont Belvieu, Dayton, Plum Grove, Patton Village, and Woodbranch. The town of Roman Forest and the unincorporated community of New Caney are also located within the study area. The study area includes the north eastern portion of Lake Houston, Caney and Peach Creeks, the East Fork San Jacinto River, Luce Bayou, Cedar Bayou, and several drainage and irrigation canals.

3.1 LAND USE

The Segments H and I-1 study area is mostly in agricultural usage or is undeveloped (78%) with about 16% residential development and 1% commercial development. Most of the developed land is within and adjacent to the northern portion of the study area along US 59 (N) and FM 1485 and along the southern portion in Mont Belvieu. The 4,787-ac Lake Houston Park, operated by the City of Houston Parks and Recreation Department, is a major constraint within the study area. **Exhibit 1-2: Preliminary Study Area Map** outlines the boundaries of the study area used to examine land use. Refer to **Exhibit 1-2: Preliminary Study Area Map** for the location of parks and cities within the study area. Other land uses within the study area include the following:

- Dempsey Henley State Prison is located north of Dayton on the eastern edge of the study area.
- Two salt domes, the Esperson Dome northwest of Dayton and the Barbers Hill Dome near Mont Belvieu, are prominent in the study area.

- Several oil fields are located throughout the study area, including in the area of Splendora, Dayton, and Mont Belvieu.
- There is one state Superfund site in the study area, the Cox Road Dump (also known as Liberty Waste Disposal Landfill), which is located 1 mi north of FM 1413 on the west side of County Road 491 (Cox Road), in Dayton (Liberty County).
- A number of primarily residential developments stretch between the east shore of Lake Houston and FM 2100. The largest of these is The Commons of Lake Houston, a large lot subdivision.
- Large expanses of agricultural land are located throughout the study area.

The bulk of the proposed project would be constructed in Liberty County. While a substantial portion of the county is devoted to agriculture, it is a part of the Houston metropolitan statistical area (MSA) and is experiencing the advancement of urban development outward from Harris County. Between 1997 and 2002, the latest available census of agriculture, Liberty County experienced a reduction of 2,209 acres of farmland. During this five-year period, the number of farms actually increased, resulting in a reduction in the average size of farms from 270 acres in 1997 to 191 acres in 2002. More than 53% of the principal farm operators have a non-farming principal occupation and more than 44% of the principal farm operators worked more than 200 days out of the year off the farm.

Land use designations and geographic information system (GIS) data were obtained from the Houston-Galveston Area Council (H-GAC), a review of recent aerial photography, and field reconnaissance of the study area. Refer to **Exhibit 3-1: General Land Use** for the general land use types within the study area. The H-GAC land use designations described below are limited to commercial, residential, industrial, other, and open space (undeveloped). Refer to **Table 3-1** for the acreage and percentages of general land use within the study area.

<u>Commercial</u>

The commercial category includes businesses, restaurants, retail centers, entertainment-oriented businesses, convenience stores, and other similar structures or uses.

Residential

The residential category includes single- and multi-family dwellings including both permanent and non-fixed structures.

Industrial

The industrial category includes large refineries, warehouses, distribution centers, and oil and gas production facilities.

Other

The other category includes land devoted to recreational and outdoor leisure activities such as sports facilities, public parks, nature centers, etc.

Open Space

The open space category includes land with few or no permanent structures present, evidence of cultivated crops, rangeland, orchards, plant production, or timber production. This category includes land that would be considered undeveloped or agricultural.

Table 3-1: General Land Use Within the Study Area

Land Use	Acreage Within the Study Area	% of Study Area
Commercial	2,278	1
Industrial	1,203	1
Other	10,721	5
Residential	34,905	16
Agricultural and Undeveloped (Open Spaces)	175,734	78

Source: H-GAC, 2006

The majority of the study area is mapped as undeveloped (open spaces) which includes forested areas or areas in agricultural production. Only 16% of the study area is currently mapped as residential.

Historical aerial photography and GIS data obtained from the H-GAC show that from 1970 to 2000, residential growth, as represented by households, has occurred primarily in unincorporated Harris County, Fort Bend County, and Montgomery County. Growth in Chambers County represented less than 1% of the metropolitan growth in households, while Liberty County accounted for 1.3% of the household growth during the 1970s, 1.0% in the 1980s and 1.6% during the 1990s.

3.1.1 Section 4(f) Properties

Under Section 4(f) of the 1966 Transportation Act, projects which impact or use publicly owned parklands, wildlife or waterfowl refuges, recreational areas, or known historic sites must perform a Section 4(f) evaluation. Lake Houston Park covers 4,787 ac in the northwest portion of the study area, just south of FM 1485. Ownership passed from TPWD to the City of Houston in 2006, and the park is now operated by the City of Houston Parks and Recreation Department. There are no other Section 4(f) resources located within the study area. In addition, there are no areas of unique scenic beauty or other lands of national, state, or local importance.

3.1.2 Existing Utilities

A visual survey and secondary source data review was performed to identify the major utilities within the study area. Based on the visual observation, the following above-ground utilities were observed in the study area: pipelines, cable, conduit, fiber, water lines, sanitary sewer lines, cell towers, water and sewer plants, refineries, metering stations, and overhead transmission lines. Pipelines were further researched based on recorded data provided by the Texas Railroad Commission. Refer to **Table 3-2** for a listing of the major pipeline companies with line diameter sizes ranging from 2.38 in. to 40 in. within the study area.

Table 3-2: Pipelines Within the Study Area

Owner/Operator	Diameter	Commodity Description
ExxonMobil Pipeline Company	6.63"	Propylene
Gulf Coast Pipeline, L.P.	8.63"	Crude Butadiene
Mobil Vanderbilt-Beaumont P/L Co.	4.50"	Natural Gas
Mobil Pipeline Company	8.63"	Refined Products
Duke Energy Field Services, L.P.	12.75"	Natural Gas Liquids
Citgo Products Pipeline Company	12.75"	Liquefied Petroleum Gas
Houston Pipeline Company L.P.	12.75"	Natural Gas
Sunoco Pipeline L.P.	6.63"	Crude Oil
Shell Pipeline Company L.P.	20.00"	Crude Oil
Kinder Morgan Tejas Pipeline, L.P.	2.38"	Natural Gas
Kinder Morgan Tejas Pipeline, L.P.	8.63"	Natural Gas
El Paso Field Services, L.P.	8.63"	Natural Gas
Natural Gas Pipeline Co. of Amer.	30.00"	Natural Gas
Black Hills Operating Co. LLC	10.75"	Crude Oil
Dynegy NGL Pipeline Company, LLC	12.75"	Natural Gas Liquids
Colonial Pipeline Company	40.00"	Gasoline/Fuel Oil/Kerosene
Explorer Pipeline Company	28.00"	Refined Petroleum Products
Valero Logistics Operations L.P.	8.63"	Propylene

Table 3-2 (Cont.): Pipelines Within the Study Area

Owner/Operator	Diameter	Commodity Description
Enterprise Products Operating L.P.	14.00”	Natural Gas Liquids
Koch Pipeline Company, L.P.	12.75”	Crude Oil
TE Products Pipeline Co. L.P.	10.75”	Liquefied Petroleum Gas
Exxon Corp.	2.38”	Crude Oil
Buckeye Gulf Coast Pipelines, L.P.	8.63”	Ethylene
Equistar Chemicals, L.P.	6.63”	Butane
Buckeye Gulf Coast Pipelines, L.P.	6.63”	Propylene
Mustang Pipeline Company	6.63”	Propylene
Trunkline Gas Company, LLC	24.00”	Natural Gas
Transcontinental Gas Pipeline Corp.	30.00”	Natural Gas
Chevron Pipeline Company	8.63”	Refined Products
BP Pipelines (North America), Inc.	4.50”	Empty
Dow Pipeline Company	8.63”	Liquefied Petroleum Gas
Phillips Pipeline Company	8.63”	EP Mix/Propane
Seadrift Pipeline Corporation	12.75”	Ethane
Texas Genco, L.P.	24.00”	Natural Gas
Teppco	12.75”	Crude Oil
Phoenix Hydrocarbons Operating	4.50”	Natural Gas

Source: RRC, 2006

3.2 COMMUNITY RESOURCES

3.2.1 Social and Economic Conditions

Municipal Characteristics

The following profiles describe the existing demographic make-up of the six municipalities located along the proposed project improvement limits, as well as general business trends and current major planned development. The community of New Caney is not included in the following profiles because it is unincorporated and not defined as a city. However, New Caney is discussed in the following sections and community impacts are described. The (limited) data described throughout this discussion represents the best available data for the proposed study area.

City of Dayton

According to Census 2000, the city has a total population of 5,741 and a median household income of $37,401. The city encompasses approximately 11.4 square miles. The City of Dayton is located on the very eastern edge of the central portion of the study area.

According to the “Texas Crime Report” published by the Texas Department of Public Safety, Dayton ranks in the top 10 safe places to live among towns its size in all of Texas. The Dayton Community Development

Corporation states "no other area of the country offers greater opportunity to families, new businesses and industry than Dayton, TX."

Located roughly midway between Houston and Beaumont, Dayton is located at the key intersection of four important highways including US 90, SH 146, SH 321, and FM 1960. The City of Dayton is also served by an extensive rail transportation system with Union Pacific and Burlington Northern/Santa Fe Railroad operating facilities in the area.

City of Mont Belvieu

The City of Mont Belvieu has a total population of 2,264 and a median household income of $54,732, according to Census 2000. The city encompasses approximately 14.5 square miles, and is located at the southern end of the study area near IH 10.

Located on a salt dome in Chambers County, the city's economy is deeply tied to the petroleum industry, and the salt dome storage of petroleum products. Due to its proximity and its location at the junction of IH 10 and SH 146, the city is also closely tied to the Houston-Baytown area.

Mont Belvieu is home to the Eagle Pointe Golf Club and Recreation Complex, one of the premier golf and recreation facilities in the Houston area.

City of Patton Village

The City of Patton Village has a total population of 1,333 and a median household income of $32,619, according to Census 2000. The city encompasses approximately 2 square miles on the eastern side of Montgomery County. The City of Patton Village is located in the extreme northwestern corner of the study area by US 59 (N).

City of Plum Grove

The City of Plum Grove has a total population of 870 and a median household income of $42,232, according to Census 2000. The city encompasses approximately 7.3 square miles on the west edge of Liberty County. The City of Plum Grove is located on the far northern edge of the study area.

City of Woodbranch

The City of Woodbranch has a total population of 1,345 and a median household income of $51,932, according to Census 2000. The city encompasses approximately 2 square miles on the eastern side of Montgomery County. The City of Woodbranch is located in the northwest corner of the study area on US 59 (N).

Town of Roman Forest

The town of Roman Forest has a total population of 1,301 and a median household income of $67,679, according to Census 2000. The city encompasses approximately 1.5 square miles in eastern Montgomery County. The town of Roman Forest is located in the northwest corner of the study area.

Population and Demographic Characteristics

The proposed project falls within the Houston MSA, which is defined as the 10 counties of Austin, Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, San Jacinto, and Waller. The study area is located east of the City of Houston and within four counties – Montgomery, Harris, Liberty, and Chambers counties. Twenty-four census tracts (CTs) are all or partially located within the study area. The study area boundary for social and economic conditions was determined by examining the CTs that are all or partially located within the project limits outlined in **Exhibit 1-2: Preliminary Study Area Map**. These CTs are identified in **Exhibit 3-2: Census Tracts and Block Groups Within the Study Area**.

For statistical purposes, the CTs are used to describe the social and economic characteristics of the study area. CTs provide the appropriate level of detail for an area that is sufficiently small to characterize the area of impact. Population data at the CT level for the year 2000, from the U.S. Census Bureau, has been used in this socioeconomic analysis. However, county data from *Census 2000* is used throughout the population and employment projection analysis.

A more detailed profile of the study area reveals a total population of 157,593 spanning across 24 CTs. Overall, minorities account for 18.6% of the study area population and 52.5% of the associated counties' population. Two of the CTs in the study area have a minority population percentage greater than 50%, CT 2528 (Harris County) and CT 7009 (Liberty County). The term minority is defined by FHWA as a person who is Black, Hispanic, Asian American, American Indian/Alaskan Native, or Pacific Islander. The two predominant minority groups of the study area include Hispanics (10.7%) and Blacks (6.4%). The federal government considers race and Hispanic origin to be two separate and distinct concepts. *Census 2000* uses the Office of Management and Budget definition of Hispanic or Latino to be "a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race." **Table 3-3** contains the percent minority population for each CT within the study area. The total minority population for the study area is 18.6%.

Table 3-3: Racial and Ethnic Composition of Population - 2000

Study Area	Total Population	Not Hispanic or Latino						Hispanic or Latino of Any Race	Total Minority Population
		Population of One Race					Two or More Races		
		Black or African American	American Indian and Alaska Native	Asian	Pacific Islander	Other Race			
Montgomery County	**293,768**	**9,899 3.4%**	**1,387 0.5%**	**3,039 1.0%**	**195 0.1%**	**14,911 5.1%**	**3,251 1.1%**	**37,066 12.6%**	**51,586 17.6%**
CT 6923	7,556	165 2.2%	6 0.1%	158 2.1%	0 0.0%	716 9.5%	76 1.0%	1,530 20.2%	1,859 24.6%
CT 6924	4,353	55 1.3%	30 0.7%	56 1.3%	0 0.0%	180 4.1%	56 1.3%	452 10.4%	593 13.6%
CT 6925	6,894	202 2.9%	43 0.6%	27 0.4%	8 0.1%	350 5.1%	54 0.8%	764 11.1%	1,044 15.1%
CT 6926	10,804	100 0.9%	139 1.3%	0 0.0%	0 0.0%	665 6.2%	380 3.5%	1,551 14.4%	1,790 16.6%
CT 6927	5,619	87 1.5%	114 2.0%	33 0.6%	0 0.0%	151 2.7%	33 0.6%	454 8.1%	688 12.2%
CT 6928	11,273	88 0.8%	67 0.6%	59 0.5%	0 0.0%	443 3.9%	254 2.3%	902 8.0%	1,116 9.9%
Harris County	**3,400,578**	**618,551 18.2%**	**8,014 0.2%**	**171,178 5.0%**	**1,098 0.0%**	**4,558 0.1%**	**47,968 1.4%**	**1,120,625 33.0%**	**1,918,368 56.4%**
CT 2509	6,822	116 1.7%	0 0.0%	205 3.0%	0 0.0%	36 0.5%	52 0.8%	272 4.0%	593 8.7%
CT 2515	15,032	241 1.6%	70 0.5%	390 2.6%	0 0.0%	91 0.6%	205 1.4%	890 5.9%	1,591 10.6%
CT 2516	3,780	0 0.0%	17 0.4%	23 0.6%	36 1.0%	37 1.0%	52 1.4%	168 4.4%	244 6.5%
CT 2517	5,718	92 1.6%	17 0.3%	54 0.9%	6 0.1%	179 3.1%	42 0.7%	384 6.7%	553 9.7%
CT 2518	1,672	18 1.1%	0 0.0%	0 0.0%	0 0.0%	52 3.1%	16 1.0%	150 9.0%	168 10.0%
CT 2519	9,694	546 5.6%	28 0.3%	60 0.6%	0 0.0%	374 3.9%	170 1.8%	667 6.9%	1,301 13.4%
CT 2527	3,489	370 10.6%	0 0.0%	49 1.4%	0 0.0%	275 7.9%	10 0.3%	470 13.5%	889 25.5%
CT 2528	5,282	2,595 49.1%	14 0.3%	27 0.5%	0 0.0%	313 5.9%	169 3.2%	701 13.3%	3,337 63.2%
CT 2531	2,995	521 17.4%	0 0.0%	100 3.3%	0 0.0%	348 11.6%	67 2.2%	634 21.2%	1,255 41.9%
CT 2532	7,009	326 4.7%	33 0.5%	44 0.6%	0 0.0%	862 12.3%	30 0.4%	1,472 21.0%	1,875 26.8%
Liberty County	**70,154**	**8,818 12.6%**	**312 0.4%**	**166 0.2%**	**36 0.1%**	**4,098 5.8%**	**726 1.0%**	**7,661 10.9%**	**16,993 24.2%**
CT 7003	8,184	443 5.4%	42 0.5%	2 0.0%	0 0.0%	770 9.4%	118 1.4%	1,405 17.2%	1,892 23.1%
CT 7004	5,386	9 0.2%	6 0.1%	0 0.0%	0 0.0%	63 1.2%	8 0.1%	124 2.3%	139 2.6%
CT 7008	8,605	598 6.9%	89 1.0%	10 0.1%	0 0.0%	295 3.4%	77 0.9%	569 6.6%	1,266 14.7%

Table 3-3 (Cont.): Racial and Ethnic Composition of Population - 2000

Study Area	Total Population	Not Hispanic or Latino						Hispanic or Latino of Any Race	Total Minority Population
		Population of One Race					Two or More Races		
		Black or African American	American Indian and Alaska Native	Asian	Pacific Islander	Other Race			
CT 7009	5,637	2,145 38.1%	36 0.6%	50 0.9%	14 0.2%	443 7.9%	94 1.7%	939 16.7%	3,184 56.5%
CT 7010	4,080	411 10.1%	26 0.6%	80 2.0%	0 0.0%	344 8.4%	85 2.1%	689 16.9%	1,206 29.6%
CT 7011	6,512	440 6.8%	38 0.6%	47 0.7%	0 0.0%	206 3.2%	19 0.3%	453 7.0%	978 15.0%
Chambers County	**26,031**	**2,494 9.6%**	**82 0.3%**	**79 0.3%**	**3 0.0%**	**8 0.0%**	**231 0.9%**	**2,836 10.9%**	**5,494 21.1%**
CT 7101	5,242	130 2.5%	15 0.3%	0 0.0%	0 0.0%	127 2.4%	60 1.1%	312 6.0%	457 8.7%
CT 7102	7,955	375 4.7%	15 0.2%	13 0.2%	3 0.0%	365 4.6%	81 1.0%	866 10.9%	1,272 16.0%
Study Area Total	**157,593**	**10,073 6.4%**	**845 0.5%**	**1,487 0.9%**	**67 0.04%**	**7,685 4.9%**	**2,208 1.4%**	**16,818 10.7%**	**29,290 18.6%**

S Source: U.S. Census Bureau, Census 2000. Note: CT numbers identified on Exhibit 3-2 contain "00" at the end of the CT number referenced in the table.

3.2.1.1 Environmental Justice

Environmental justice addresses the fundamental human desires for fairness, equity, and social and economic justice. Environmental justice is defined as the fair treatment of all people in terms of the distribution of benefits and costs resulting from transportation projects, programs, and policies. Fair treatment means that a disproportionate share of adverse effects would not fall upon the low-income or minority populations.

In response to EO 12898, signed by President Clinton on February 11, 1994, the USDOT developed an environmental justice strategy that follows within the framework of the NEPA and Title VI of the Civil Rights Act of 1964, which was clarified in the Civil Rights Restoration Act of 1987. EO 12898 Federal Actions to Address Environmental Justice in Minority Populations and Low–Income Populations mandates that federal agencies identify and address, as appropriate, disproportionately high and adverse human health or environmental effects, including social and economic effects, of their programs on minority and low-income populations. A minority is a person who is Black, Hispanic, Asian American, American Indian/Alaskan Native, or Pacific Islander.

FHWA defines a minority population as any readily identifiable group of minority persons who live in geographic proximity and if circumstances warrant, geographically dispersed/transient persons who would be similarly affected by a proposed FHWA program, policy, or activity. FHWA Order 6640.23 defines a low-income population as any readily identifiable group of low-income persons who live in geographic proximity, and if circumstances warrant, geographically dispersed/transient persons (such as migrant workers or Native Americans) who would be similarly affected by a proposed FHWA program, policy, or activity.

FHWA Order 6640.23, Actions to Address Environmental Justice in Minority Populations and Low-Income Populations defines adverse effects as the totality of substantial individual or cumulative human health or environmental effects, including interrelated social and economic effects, which may include, but are not limited to: bodily impairment, infirmity, illness or death; air, noise, and water pollution and soil contamination; destruction or disruption of man-made or natural resources; destruction or disruption of community cohesion or a community's economic vitality; destruction or disruption of the availability of public and private facilities and services; vibration; adverse employment effects; displacement of persons, businesses, farms, or nonprofit organizations; increased traffic congestion; isolation, exclusion, or separation of minority or low-income individuals within a given community from the broader community; and the denial of, reduction in, or substantial delay in the receipt of, benefits of FHWA programs, policies, or activities.

Under EO 12898, disproportionately high or adverse effects are defined as effects that "would be suffered by the minority population or low-income population and is appreciably more severe or greater in magnitude than the adverse effect that would be suffered by the non-minority population or non-low-income population."

<u>Definition of Minority and Low-Income Population Study Areas</u>

The study areas for the minority and low-income population analyses differ due to the availability of census data. A quarter-mile buffer for each of the alternatives was utilized to create a study area which identifies those populations who reside adjacent to the roadway. The census blocks intersecting this quarter-mile buffer comprise the "minority population study area." The area traversed by the proposed alternatives lies within 24 census block groups. These 24 census block groups comprise the direct impacts study area for household income and poverty populations, and would be referred to as the "low-income population study area." The block groups corresponding to each alternative are listed on **Table 3-4** and shown in **Exhibit 3-2: Census Tracts and Census Block Groups within the Study Area**.

Table 3-4: Block Groups Per Alternative

Census Tract	Block Group	County	Alternatives
CT 25.15	1	Harris	7, 8, 9, 10, 11
CT 25.16	1	Harris	7, 8, 9, 10, 11
CT 25.16	2	Harris	2, 3, 4, 5, 6, 7, 8, 9, 10, 11
CT 25.18	1	Harris	6, 11
CT 25.27	3	Harris	6, 11
CT 69.25	1	Montgomery	7, 8, 9, 10, 11
CT 69.25	2	Montgomery	7, 8, 9, 10, 11
CT 69.25	3	Montgomery	7, 8, 9, 10
CT 69.26	2	Montgomery	7, 8, 9, 10, 11
CT 69.27	2	Montgomery	2, 3, 4, 5, 6
CT 69.28	3	Montgomery	2, 3, 4, 5, 6, 7, 8, 9, 10, 11
CT 69.28	4	Montgomery	2, 3, 4, 5, 6, 7, 8, 9, 10, 11
CT 69.28	5	Montgomery	2, 3, 4, 5, 6
CT 69.28	6	Montgomery	2, 3, 4, 5, 6
CT 70.03	5	Liberty	2, 3, 4, 5, 6, 7, 8, 9, 10, 11
CT 70.09	1	Liberty	2, 3, 4, 5, 6, 7, 8, 9, 10, 11
CT 70.09	2	Liberty	2, 3, 7, 8
CT 70.10	1	Liberty	2, 3, 4, 5, 6, 7, 8, 9, 10, 11
CT 70.10	3	Liberty	2, 3, 4, 5, 6, 7, 8, 9, 10, 11
CT 70.11	3	Liberty	2, 4, 7, 9
CT 71.01	1	Chambers	2, 3, 4, 5, 6, 7, 8, 9, 10, 11
CT 71.01	2	Chambers	2, 3, 4, 5, 6, 7, 8, 9, 10, 11
CT 71.01	3	Chambers	2, 3, 4, 5, 6, 7, 8, 9, 10, 11
CT 71.02	2	Chambers	2, 3, 4, 5, 6, 7, 8, 9, 10, 11

Source: U.S. Census Bureau

Origin-Destination Analysis

Origin-destination (O&D) data secured from H-GAC can be used for further analysis of "user impacts" of the Grand Parkway (Segments H and I-1) on low-income and minority populations. Studying O&D data can determine travel patterns of traffic along a transportation facility during a typical day. This form of analysis is useful in assessing "user impacts" as the number of trips associated with specific population characteristics can be studied to provide general travel assumptions of those specific populations. Trips are defined as a one-way movement from where a person starts (origin) to where the person is going (destination).

The information associated with the O&D analysis is organized by census block groups, a geographical unit used by the U.S. Census Bureau which is a subdivision of a census tract. The O&D data presented in **Chapter 4 (Environmental Consequences)** is normalized for census block groups using Traffic Analysis

Zones (TAZ). TAZs are small geographic units of area that are developed as a basis for estimate of travel. TAZs may vary in size, are determined by the roadway network and homogeneity of development, and directly reflect demographic data generated by the U.S. Census Bureau. Delineated by state and/or transportation officials for tabulating traffic-related data, TAZs usually consist of one or more census blocks, block groups, or census tracts.

3.2.1.2 Limited English Proficiency (LEP)

Executive Order 13166 on LEP calls for all agencies to ensure that their federally conducted programs and activities are meaningfully accessible to LEP individuals. CT data was obtained from the U.S. Census Bureau *Census 2000* database. This data indicates that 2% of the population within the study area CTs (5 years and older) speak English "Not Well" or "Not at All." **Table 3-5** contains the percent LEP population for each CT in the study area. Census data at the census block group level is presented in **Chapter 4 (Environmental Consequences)**. In a windshield survey along the proposed study area, English was the only language observed on billboards and signs.

Table 3-5: Percentage LEP Population - 2000

Census Tract	Total Population 5 Years and Older	Total Number Who Speak English "Not Well" or "Not at All"	% LEP
Montgomery County	**271,298**	**9,821**	**3.6**
CT 6923	6,943	369	5.3
CT 6924	4,080	27	0.7
CT 6925	6,226	201	3.2
CT 6926	9,867	291	2.9
CT 6927	5,174	90	1.7
CT 6928	10,439	167	1.6
Harris County	**3,121,999**	**330,874**	**10.5**
CT 2509	6,520	58	0.9
CT 2515	13,827	41	0.3
CT 2516	3,491	7	0.2
CT 2517	5,358	134	2.5
CT 2518	1,581	15	0.9
CT 2519	9,017	119	1.3
CT 2527	3,147	110	3.5
CT 2528	4,893	217	4.4
CT 2531	2,686	84	3.1
CT 2532	6,599	125	1.9
Liberty County	**65,425**	**1,907**	**2.9**
CT 7003	7,569	277	3.7
CT 7004	5,030	10	0.2
CT 7008	8,051	162	2.0
CT 7009	5,524	167	3.0
CT 7010	3,714	85	2.3
CT 7011	6,021	36	0.6

Table 3-5 (Cont.): Percentage LEP Population - 2000

Census Tract	Total Population 5 Years and Older	Total Number Who Speak English "Not Well" or "Not at All"	% LEP
Chambers County	**24,205**	**725**	**2.9**
CT 7101	4,887	38	0.8
CT 7102	7,398	133	1.8
Total Study Area	**148,042**	**2,963**	**2.0**

Source: U.S. Census Bureau, Census 2000

3.2.1.3 Community Cohesion

As defined in the FHWA Technical Advisory T 6640.8A, changes in community cohesion because of highway construction and improvements may be beneficial or adverse. Changes in community cohesion may include splitting neighborhoods, isolating a minority group or a portion of a neighborhood, generating new development, terminating residential roads, and separating residents from community facilities.

There are a number of definitions for the term community. Community is defined in part by common behavior patterns of individuals in a given area. These behavior patterns are expressed through daily social interactions, the use of local facilities, participation in local organizations, and involvement in activities that satisfy the population's social and economic needs. Community cohesion is a term that refers to an aggregate quality of a residential area. It is a social attribute that indicates a sense of community, common responsibility, and social interaction within a limited geographical area. It is the degree to which residents have a sense of belonging to their neighborhood or community or a strong attachment to neighbors, groups, and institutions as a continual association over time.

The northern portion of the study area contains developing communities, such as Roman Forest and Kings Colony. Roman Forest is an established community that is experiencing new development and Kings Colony has been platted but is still in the early development stage. Some of these communities are densely populated while others are in the early stages of development with only street infrastructure in place. Some large areas have been cleared in preparation of impending development. Other scattered areas consist of low-lying floodplain areas. Along US 59 (N), the study area appears mostly developed with residential areas and commercial strip centers. Some undeveloped forested areas are present north of FM 1485 as well as floodplains and wetlands in and around Caney Creek and Peach Creek in the vicinity of Patton Village. Residences and businesses become increasingly sparse along FM 1485 as you travel further from US 59 (N). Lake Houston Park is along the south side and adjacent to FM 1485; however, there is no entrance to the park along FM 1485. In order to access Lake Houston Park, traffic must travel along FM 1485 to Baptist Encampment Road on the west side of the park.

The central portion of the study area to the east of Lake Houston Park and south along FM 2100 is also forested; however, there is evidence of impending development including subdivision construction and commercial strip development.

The majority of the central portion consists of wide open spaces that are maintained as farms and pastures. The topography is very level through most of the center of the study area with the exception of a salt dome near FM 686. Crops include rice, sorghum, soybeans and hay. Railroad lines exist along FM 1960 and US 90 and are traveled daily in and out of Houston. The City of Dayton is within this area along the eastern edge of the study area and contains many old homes and buildings including a central business area. Several rail lines converge within the City of Dayton near the central area and an old rice industrial complex is prominently seen. An area of oil and gas activity is also present in the vicinity of the Dayton landfill.

The southern portion of the study area is characterized by heavy oil and gas industrial activities immediately north of the City of Mont Belvieu. The City of Mont Belvieu is positioned on a salt dome which can be seen as a raised landform. Surrounding the salt dome is a concentration of wells and supporting industrial facilities. Oil and gas wells, storage facilities, emission stacks, and processing plants are dense in Mont Belvieu. The residential communities of Cherry Point and Country Creek are located in the area as well as churches, businesses, and schools. The new location of the City of Mont Belvieu is physically separated from the industrial area (old Mont Belvieu) by a canal. Residents and visitors in the Mont Belvieu area view roadways that are at-grade, rural facilities with limited traffic. Traffic does; however, consist of a high percentage of trucks due to the industry in the area.

Service area boundaries such as school districts and municipalities can be used to define communities. The Cities of Mont Belvieu, Dayton, Plum Grove, Patton Village, and Woodbranch are located within the study area. The town of Roman Forest and the unincorporated community of New Caney are also included in the study area boundary. The populations of these municipalities range from 870 persons (City of Plum Grove) to 5,741 persons (City of Dayton).

The study area lies within 10 school districts: Barbers Hill Independent School District (ISD) (serving the Mont Belvieu area), Cleveland ISD, Crosby ISD, Dayton ISD, Goose Creek Consolidated ISD, Huffman ISD, Humble ISD, New Caney ISD, Splendora ISD, and Tarkington ISD. Refer to **Exhibit 3-3: School Districts** for locations of school districts within the study area.

New Caney ISD serves the urbanized portion of the study area between US 59 (N) and FM 2100. Schools in the Huffman ISD are located on the western edge of the study area. Schools in the Dayton ISD and Barbers Hill ISD are located on the eastern edge of the study area. The remaining school district's boundaries enter into the Segments H and I-1 study area, and include Cleveland ISD, Crosby ISD, Goose Creek Consolidated ISD, Humble ISD, Splendora ISD, and Tarkington ISD.

3.2.1.4 Economic Conditions

The Houston MSA's economic assets are linked to petrochemical industries, area universities and colleges, and medical complexes. The study area is a very small portion of the Houston region in terms of geography and economy. Its economic growth depends on economic activity at a broader regional scale. As the area grows and develops, the study area, which is primarily rural in character, would continue to diversify with an assortment of commercial and industrial enterprises. The data provided throughout the following sections is the best available data and reflects economic conditions at a regional or county level as smaller geographic areas of economic data are currently not available. General economic impacts of the proposed project are not discussed in **Chapter 4 (Environmental Consequences)** but are discussed in **Chapter 5 (Indirect Impacts)**; however, the economic impact of tolling is discussed in **Chapter 4**.

<u>Employment Characteristics</u>

Education, health, professional management, and manufacturing services comprise the major sectors of the Houston MSA economy. The *Census 2000* indicated that 17.6% of the non-agricultural employees in the Houston MSA worked in educational, health, or social service industries, the dominant economic sector during 2000. The manufacturing industry was the second largest industry, employing 12.1% of the Houston MSA population in 2000, with the professional management industry ranking third at 11.8%.

The residents of the four counties associated with the study area are predominantly employed by the management/professional and sales/office occupations. The agricultural industry, represented by farming/fishing/forestry occupations, employs a minimal percentage of the area population. The importance of the four-county industry contributions to the Houston MSA economy is illustrated in **Table 3-6**.

Table 3-6: Number of Persons Employed by Occupation - 2000

Occupational Category	Montgomery County		Harris County		Liberty County		Chambers County		Statewide %
	No.	%	No.	%	No.	%	No.	%	
Management/Professional	46,376	33.9	538,143	34.8	5,432	20.4	3,161	26.9	33.3
Service	17,388	12.7	214,052	13.8	4,126	15.5	1,471	12.5	14.6
Sales/Office	38,367	28.1	428,185	27.7	6,232	23.5	2,715	23.1	27.2
Farming/Fishing/Forestry	426	0.3	1,959	0.1	268	1.0	213	1.8	0.7
Construction/Extraction	17,092	12.5	168,840	10.9	4,961	18.7	1,599	13.6	10.9
Production/Transport	16,969	12.4	194,754	12.6	5,555	20.9	2,577	22.0	13.2

Source: U.S. Census Bureau, Census 2000

The major employers located within the study area are listed in **Table 3-7**. The Texas Workforce Commission (TWC) provides regional labor market analysis data through the SOCRATES web-based application. Major employers provide services ranging from education to retail, with a fair amount dedicated to manufacturing and distribution.

Table 3-7: Major Employers in the Study Area - 2006

Employer	Location	No. of Local Employees
Montgomery County		
East Montgomery County Fair	New Caney	100-499
Gerlands 92 Food and Drug	New Caney	100-499
Harris County		
Kmco Co.	Crosby	100-499
Huffman Lodge	Huffman	100-499
Triple B Construction Service	Huffman	100-499
Liberty County		
Criminal Justice Department	Dayton	100-499
Dayton High School	Dayton	100-499
Insteel Wire Products Co.	Dayton	100-499
Sam's Distribution Center	Dayton	100-499
Tanner Construction Co.	Dayton	100-499
Chambers County		
Enterprise Products	Mont Belvieu	100-499
Pol-Tex International	Mont Belvieu	100-499

Source: SOCRATES, TWC. http://socrates.cdr.state.tx.us/index.asp.

The Career Development Resources (CDR) Unit of the TWC utilizes the CDR economic diversification index which measures the degree to which a county economy is diversified relative to the Texas economy. Concentrating employment in only one or two industrial sectors makes an area less diversified and more susceptible to widespread decline should a key sector suffer a substantial loss. A statistically diverse economy does not necessarily correlate with higher growth. The study area has an economic base which is of average diversity. The H-GAC lists the existing total employment estimate for 2005 as shown in **Table 3-8**.

Table 3-8: 2005 County Employment

Area	Total Employment Estimate 2005
Montgomery County	108,000
Harris County	2,060,000
Liberty County	21,000
Chambers County	8,000
Area Total	**2,197,000**

Source: H-GAC, 2035 Forecast Data, 2006, http://www.h-gac.com/HGAC/home/Default.htm.

Median Household Incomes

Low-income is defined as a household income at or below the Department of Health and Human Services (DHHS) poverty guidelines. The U.S. Census Bureau uses a set of money income thresholds that vary by family size and composition to determine who is low-income. The Bureau follows the Office of Management and Budget's Statistical Policy Directive 14 in establishing the thresholds. In 2007, the weighted average threshold for a four person family was $20,650. In 2008, this threshold increased to $21,200 and is currently $22,050 for 2009. A comparison of median household income and poverty status for the study area is shown in **Table 3-9**. Median household income of CTs comprising the study area ranged from $32,347 to $127,406 in 1999. **Exhibit 3-2: Census Tracts and Block Groups Within the Study Area** contains a map of the CTs within the study area.

Table 3-9: Median Household Income and Poverty Status – 1999

Area	Population*	Median Household Income	Persons Below Poverty Level	
			Number	%
Montgomery County	**291,519**	**$50,864**	**27,376**	**9.4**
CT 6923	7,556	$42,358	590	7.8
CT 6924	4,333	$44,911	415	9.6
CT 6925	6,869	$95,313	916	13.3
CT 6926	10,614	$39,184	1,434	13.5
CT 6927	5,598	$32,347	986	17.6
CT 6928	11,229	$40,216	1,356	12.1
Harris County	**3,360,536**	**$42,598**	**503,234**	**15.0**
CT 2509	6,822	$127,406	56	0.8
CT 2515	15,032	$91,609	320	2.1
CT 2516	3,780	$51,941	213	5.6
CT 2517	5,682	$52,848	294	5.2
CT 2518	1,672	$47,083	63	3.8

**Population for whom poverty status has been determined.*

Table 3-9 (Cont.): Median Household Income and Poverty Status – 1999

Area	Population*	Median Household Income	Persons Below Poverty Level	
			Number	%
CT 2519	9,670	$61,098	836	8.6
CT 2527	3,468	$41,409	430	12.4
CT 2528	5,282	$35,260	947	17.9
CT 2531	2,989	$63,075	112	3.7
CT 2532	6,981	$61,142	450	6.4
Liberty County	**64,878**	**$38,361**	**9,296**	**14.3**
CT 7003	8,149	$39,360	1,282	15.7
CT 7004	5,328	$45,442	483	9.1
CT 7008	8,553	$44,943	1,022	11.9
CT 7009	1,731	$39,107	217	12.5
CT 7010	4,080	$39,563	650	15.9
CT 7011	6,425	$49,375	605	9.4
Chambers County	**47,964**	**$25,719**	**2,833**	**5.9**
CT 7101	5,225	$56,042	345	6.6
CT 7102	7,949	$67,083	492	6.2
Total Study Area	**155,017**	**N/A**	**14,514**	**9.4**

**Population for whom poverty status has been determined.*
Note: CT numbers identified on Exhibit 3-2 contain "00" at the end of the CT number referenced in the table.
Source: U.S. Census Bureau, Census 2000.

All CTs in the study area exhibit median household incomes greater than the poverty threshold. The percentage of the total study area population with incomes below the poverty level is 9.4%. As shown in the table, the percentage of study area persons living below poverty level per census tract ranges from 0.8 to 17.9%.

3.2.2 Pedestrian and Bicyclists

Segments H and I-1 of the Grand Parkway would accommodate access to "Proposed Shared-Use Path/Trails" as identified in H-GAC's Regional Bikeway Plan. These include a shared-use path/trail along FM 2100. The study area boundary used for pedestrians and bicyclists includes all of the existing and proposed paths and trails within the project limits.

3.2.3 Visual and Aesthetic Qualities

Title 23 U.S.C., Section 109 (h) requires that visual effects be considered as a part of the EIS process. The visual character of an area includes landforms and topography, water features, parks, vegetation and man-made features such as statues, historic features and buildings, roadways, bridges, industries, businesses, and residences. Existing visual resources in the study area can be viewed both from the driver's perspective traveling through the study area as well as from the residents, workers and visitors whose view is of the roadway. The study area overall is heavily disturbed due to previous development, farming, ranching, and industrial use. Existing roadways are unobtrusive since they are at-grade and there are no existing elevated structures with the exception of bridges slightly elevated over waterways and termini at interchanges with US 59 (N) and IH 10 (E). Most of the existing roadways are two-lane rural facilities within narrow ROWs. The following discussion characterizes the visual resources within the study area.

Along US 59 (N), the study area appears mostly developed with residential areas and commercial strip centers. The view from the existing roadways in this area is characterized and constrained by forested areas. Traveling along FM 1485 from US 59 (N) also lends a view of a forested area adjacent to a narrow rural roadway. Residences and businesses become increasingly sparse along FM 1485 as you travel further from US 59 (N). Lake Houston Park is along the south side and adjacent to FM 1485; however, there is no entrance to the park along FM 1485. FM 1485 crosses Caney Creek and Peach Creek and the view from the roadway bridges overlooks well defined creek channels at both locations.

The central portion of the study area to the east of Lake Houston Park and south along FM 2100 is also forested; however, there is evidence of impending development including subdivision construction and commercial strip development. The FM 2100 roadway is narrow and the view is contained primarily to the roadway ROW and adjacent development in this area. The view along FM 1960 and US 90 traveling east-west consists of expansive vistas of open rural areas. Several rail lines converge within the City of Dayton near the central area and an old rice industrial complex is prominently seen. Traveling south from Dayton, a large rail yard can be viewed to the west near SH 146. An area of oil and gas activity is also present in the vicinity of the Dayton landfill.

The southern portion of the study area is characterized by heavy oil and gas industrial activities. Immediately north of the City of Mont Belvieu, the view is open across farms and pastures. The City of Mont Belvieu is positioned on a salt dome which can be seen as a raised landform. An extensive network of pipelines and industrial plants can be seen from the roadway traversing throughout the area. A few residential communities are located in the area as well as churches, businesses, and schools. The new location of the City of Mont Belvieu is physically separated from the industrial area (old Mont Belvieu) by a canal. Residents and visitors in the Mont Belvieu area view roadways that are at-grade, rural facilities with limited traffic.

3.3 SOILS AND FARMLANDS

The study area for these resources includes the geology, soils, and farmlands mapped within the project limits as outlined in **Exhibit 1-2: Preliminary Study Area Map**.

3.3.1 Physiographic Setting

There are seven physiographic provinces in Texas. Each physiographic province has characteristic geologic structure, rock and soil types, vegetation, and climate. The study area is located in the southeast part of Texas in the Coastal Prairies of Texas as shown in **Exhibit 3-4: Physiographic Provinces of Texas**, which consists of a nearly level topographic setting, bisected by many rivers, creeks, bayous, and floodplains. A portion of this region to the north is part of the Big Thicket, a forested area with a wide variety of trees including pine, oak, ash, hickory, cypress, and walnut trees. The southern section contains Gulf prairies and marshes.

3.3.2 Geology

The study area from northwest to southeast is geologically characterized as the Lissie (Ql) and Beaumont (Qb) Formations, respectively, which were deposited during the Quaternary Period, less than two million years ago. Refer to **Exhibit 3-5: Geologic Formations** for the geological formations within the study area. Prior to this period over 200 million years ago, dry climatic conditions resulted in evaporation of the sea, and salt was subsequently deposited over the area. Two salt domes, the Esperson Dome northwest of Dayton and the Barbers Hill Dome near Mont Belvieu, are prominent in the study area. Several oil fields are located throughout the study area, including in the area of Splendora, Dayton, and Mont Belvieu.

Caney Creek, Peach Creek, the East Fork of the San Jacinto River and the lower portion of the Lake Houston Park are characterized on the Beaumont Sheet of the Geologic Atlas of Texas, as the Deweyville Formation (Qd) and Alluvium (Qal). The Deweyville Formation consists of sand, silt, and clay with some gravel and includes point bars, natural levees, stream channels, and backswamps slightly above the current floodplain. The Alluvium includes clay, silt, and sand with organic matter.

The northern portion of Lake Houston Park and the northern part of the study area is characterized as the Lissie Formation which consists of clay, silt, sand with gravel, pebbles and calcareous and iron manganese concretions. The remainder of the study area to the east and south is made up of the Beaumont

Formation. The portion of the study area south of US 90 can be found on the Geologic Site Atlas, Houston Sheet. The Beaumont Formation is characterized by mostly clay, silt, and sand and includes mainly stream channels, point bars, natural levees, backswamps, and some coastal marsh and mud-flat deposits.

3.3.3 Soils

Soils are the primary contact point between living organisms and are a biologically, chemically, and physically active portion of the environment. Soil is a display of thousands of years of decomposition and weathering resulting in the product of a living ecosystem. Because of unique processes that occur as water infiltrates and percolates through the soil profile, such as ion exchange, microbial digestion and plant nutrient uptake, water is filtered of many impurities. Soil, therefore, serves as a pollution barrier for the ecosystem as it filters runoff. Certain soil characteristics must be considered when determining engineering constraints. The *Soil Survey of Montgomery County, Soil Survey of Harris County, Soil Survey of Liberty County*, and *Soil Survey of Chambers County* supply data applicable to the engineering principles as they pertain to the construction of a roadway (Natural Resources Conservation Service [NRCS], 1972; NRCS, 1976; NRCS, 1996; NRCS, 1976).

The characteristics mentioned include the shrink-swell capacity of soils, road sub-grade or road fill, and highway location. The shrink-swell capacity is an indication of the volume change to be expected in the soil material as the moisture content changes. Shrinkage and swelling of soils causes much damage to building foundations, roads, and other structures. All the soils in the study area have a high shrink-swell potential and poor traffic supporting capacity, which poses engineering constraints.

3.3.3.1 Soil Associations in the Grand Parkway Segments H and I-1 Study Area

Dominant soil associations included in the study area are shown in **Exhibit 3-6: Soil Types**. Soil associations within Montgomery County include the Splendora-Boy-Segno association and the Sorter association. The Splendora-Boy-Segno association consists of deep, nearly level to gently sloping, somewhat poorly drained to well drained, loamy and sandy soils that have loamy lower layers. The Sorter association consists of deep, level, poorly drained soils that are loamy throughout.

Dominant soil associations included in the study area within Harris County include the Lake Charles-Bernard association, the Midland-Beaumont association, the Wockley-Gessner Association, the

Aldine-Ozan association, and the Segno-Hockley association. The Lake Charles-Bernard association consists of somewhat poorly drained, very slowly permeable, clayey and loamy soils. The Midland-Beaumont association consists of poorly drained, very slowly permeable, loamy and clayey soils. The Wockley-Gessner association consists of somewhat poorly drained and poorly drained, very slowly permeable soils. The Aldine-Ozan association consists of somewhat poorly drained and poorly drained, very slowly permeable and slowly permeable soils. The Segno-Hockley association consists of moderate well drained, moderately slowly permeable soils.

Dominant soil associations included in the study area within Liberty County include the Beaumont-Lake Charles association, Bernard-Morey-Morey association, Vamont-Woodville-Aldine association, and the Kirby-Waller-Sorter association. The Beaumont-Lake Charles association consists of nearly level to gently sloping, somewhat poorly drained and poorly drained, very slowly permeable, clayey soils. The Bernard-Morey-Morey association consists of nearly level, somewhat poorly drained, very slowly permeable and slowly permeable, loamy soils. The Vamont-Woodville-Aldine association consists of nearly level, to moderately sloping, somewhat poorly drained, very slowly permeable, clayey and loamy soils. The Kirby-Waller-Sorter association consists of nearly level, somewhat poorly drained and poorly drained, moderately permeable and slowly permeable, loamy soils.

Dominant soil associations included in the study area within Chambers County include the Beaumont-Morey-Lake Charles association, the Anahuac-Morey-Frost association and the Valden-Acadia-Calhoun association. The study area is immediate adjacent to the Wallisville Reservoir, but not within the reservoir boundary. The Beaumont-Morey-Lake Charles association consists of acid to neutral, clayey and loamy soils. The Anahuac-Morey-Frost association consists of acid loamy soils, and the Valden-Acadia-Calhoun association is acid, clayey and loamy soils.

3.3.3.2 Mapped Soil Series

Ninety-eight different soil types are found within the Grand Parkway Segments H and I-1 study area. **Exhibit 3-6: Soil Types** is a map of the soil types found in the study area, shown by mapping unit. **Tables 3-10** through **3-13** list the different soil types and corresponding county hydric soil status in the study area. Hydric soils are those that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation.

Hydric soils that occur in areas having positive indicators of hydrophytic vegetation and wetland hydrology are wetland soils.

Table 3-10: Soil Types Located Within the Study Area: Montgomery County

Soil Type	Description	Hydric Status (NRCS, NTCHS)
Albany fine sand (Ab)	Occupies slightly convex ridges on stream terraces. Slopes are dominantly 0-3% but range up to 6%.	Non-hydric
Angie fine sand (An)	Occupies slightly convex ridges on stream terraces. Slopes are from 0- 2%.	Non-hydric
Bibb soils, frequently flooded (Bb)	Have slopes of less than 1% and occupy the floodplain of streams draining sandy and loamy soils.	Hydric
Blanton fine sand, 0 to 5% slopes (BIC)	This soil occupies convex slopes on ridge crests.	Non-hydric
Boy fine sand (Bo)	This level to gently sloping soil occupies convex areas. Slopes are dominantly 0-5% but in places range up to 7%.	Non-hydric
Bruno loamy fine sand (Br)	Occupies the natural levees next to the channel in the floodplain of streams. It has a plane to slightly convex slope of less than 1%.	Non-hydric
Crowley fine sandy loam (Cw)	Occupies terraces and broad upland interstream divides. Slopes are generally less than 1%, but range up to 2% and are plane to slightly concave.	Hydric
Eustics loamy fine sand (Eu)	Occupies both ridge crests and foot slopes. Slopes are mainly 0-5%, but range up to 7%, and are convex on ridge crests and concave foot slopes.	Non-hydric
Fuquay loamy fine sand, terrace (Ft)	This nearly level to slightly convex soil occupies low stream terraces and has slopes less than 1%.	Non-hydric
Fuquay loamy fine sand (Fs)	This soil has mainly slightly convex slopes of 0-3%, but some slopes range to 5%.	Non-hydric
Garner clay (Ga)	This soil level is slightly convex. Slopes are dominantly between 0.5 and 1.5% but range up to 3%.	Non-hydric
Lucy loamy fine sand (Lu)	This nearly level to gently sloping soil has convex slopes that are mainly 0.5-3%, but some slopes range up to 8% on the narrow breaks to the bottom lands.	Non-hydric
Segno fine sandy loam (Se)	Occupies broad, low, convex ridges. Slopes are dominantly 0.5-2% but range up to 5% in a few places.	Non-hydric
Sorter silt loam (So)	This nearly level to slightly depressional soil has a slope of less than 1%.	Non-hydric
Splendora fine sandy loam (Sp)	This soil has a plane slope of less than 1%.	Non-hydric
Susquehanna fine sandy loam, 1-5% (SuC)	Occupies broad interstream divides. Soil areas are irregular and have slightly convex surfaces.	Non-hydric
Tuckerman loam, heavy substratum (Tk)	Occupies slightly depressional areas on low stream terraces and has a slope of less than 0.3%.	Hydric
Waller loam (Wa)	This level to slightly depressional soil has a slope of less than 0.3%. Water is removed from the surface of this soil very slowly.	Hydric
Wicksburg loamy fine sand, 5-12% slopes (WkD)	This soil has strong; convex slopes.	Non-hydric

S Sources: Soil Survey of Montgomery County, NRCS 1972; NTCHS.
Note: Soil series shown as having hydric inclusions are not included on the hydric soils list. However, they may contain small, unmapped soils with hydric conditions.

Table 3-11: Soil Types Located Within the Study Area: Harris County

Soil Type	Description	Hydric Status (NRCS, NTCHS)
Addicks loam (Ad)	A nearly level soil in broad areas on the upland prairies. The surface is plane to slightly convex. The slope ranges from 0-1% but averages about 0.3%.	Hydric
Addicks-Urban land complex (Ak)	A nearly level complex in rural areas. The surface is plane to slightly convex. The slope ranges from 0-1% and averages about 0.3%.	Hydric
Aldine very fine sandy loam (Am)	A nearly level soil in broad, oblong and oval wooded areas. The surface is plain to slightly convex. The slope is 0 to 1%, but averages about 0.6%.	Non-hydric
Aldine-Urban land complex (An)	A nearly level to gently sloping complex in metropolitan areas and in rural areas where the population is increasing. The slope is mainly 0-2% but ranges to 3%.	Non-hydric
Atasco find sandy loam, 1-4% slopes. (AtB)	A gently sloping soil in oblong and oval areas along ridges and natural drainageways. The surface is plane to convex. The slope averages about 2.5%.	Non-hydric
Beaumont clay (Ba)	A nearly level soil on the coastal prairie. The slope ranges from 0-1% but average 0.3%.	Hydric
Bernard clay loam (Bd)	A nearly level soil in broad, irregularly shaped areas. The slope ranges from 0 to 1% but averages less than 0.5%.	Hydric
Bernard-Edna complex (Be)	This complex is in broad areas on the costal prairie. The surface is convex and is characterized by many distinctive knolls and pimple mounds. The slopes average 0.8%.	Hydric
Beaumont-Urban land complex (Bc)	A nearly level complex in broad metropolitan areas and surrounding rural areas. The slope ranges from 0-1% but averages about 0.3%.	Non-hydric
Bernard-Urban land complex (Bg)	A nearly level complex in broad metropolitan areas and rural areas where the population is increasing. The slope is 0-1% but averages 0.5%.	Non-hydric
Clodine loam- (Cd)	Nearly level soils that are generally low on the landscape. Slopes are 0-1% but average 0.5%.	Hydric
Clodine-Urban land complex (Ce)	A nearly level complex in broad, irregular areas. The slope ranges from 0-1% but averages 0.6%.	Hydric
Edna fine sandy loam (Ed)	A nearly level soil on the prairie. The slope is mainly 0-2% but average 0.8%.	Hydric
Gessner loam (Ge)	A nearly level soil in broad irregular areas in small, round depressions. It is lower than the adjacent soils. Slopes are mainly less that 0.5%, but range 0-1%. The surface is plane to slightly concave.	Hydric
Hockley fine sandy loam, 1-4% slopes. (HoB)	This is a gently sloping soil in forest areas and pastures. Slopes are slightly convex and average 2%.	Non-hydric
Katy fine sandy loam (Kf)	This is nearly level soil in broad areas on the coastal prairie. The areas are generally high on the landscape and surround small depressions. The surface is plane to convex. The slope average is about 0.3%.	Hydric
Lake Charles clay, 0-1% slopes (LcA)	Soils are nearly level and are in broad, irregular areas. Slopes average 0.2%. A mulch of fine, discrete, very hard aggregates is on the surface of undisturbed areas.	Non-hydric
Lake Charles clay, 1-3% slopes (LcB)	Gently sloping soil along ridges and natural drainage ways. Areas are oblong and oval. The surface is plane to convex, and slopes average 2%.	Non-hydric
Lake Charles-Urban land complex (Lu)	Soils are nearly level and are in broad, irregular areas. Slopes range mainly from 0-1%, but range from 0-3% in some areas leading to drainage ways.	Non-hydric
Midland silty clay loam (Md)	Soils are nearly level and are in broad, irregular areas. Slopes range from 0-1%.	Hydric
Midland-Urban land complex (Mu)	Soils are nearly level and are in broad, irregular areas. Slopes range from 0-1%. Most areas are open prairie but some are covered with native hardwood.	Non-hydric
Ozan loam (Oa)	Nearly level soil in broad areas and on the floor of enclosed depressions. Slopes are plane to slightly concave and average 0.2%.	Hydric
Ozan-Urban land complex (On)	The nearly level soils on this complex are in built up rural and urban areas. The boundaries of this complex generally coincide with those of built-up subdivisions.	Hydric
Vamont clay, 0-1% slopes (VaA)	Nearly level soil in areas with slopes that average 0.5%. The surface is undisturbed and is characterized by gilgai micro relief.	Non-hydric
Vamont clay, 1-4% slopes (VaB)	Gently sloping soil in areas leading to the low terraces and floodplains of major streams and drainage ways. Slopes are 1-4%.	Non-hydric
Wockley fine sandy loam (Wo)	Nearly level soils in areas of prairie and woodlands. Areas are irregularly shaped. The surface is plane to slightly concave. Slopes average 0.3%.	Hydric
Wockley-Urban land complex (Wy)	Nearly level soils in areas of prairie and woodlands.	Non-hydric

Source: Soil Survey of Harris County, NRCS 1976; NTCHS.
Note: Soil series shown as having hydric inclusions are not included on the hydric soils list. However, they may contain small, unmapped soils with hydric conditions.

Table 3-12: Soil Types Located Within the Study Area: Liberty County

Soil Type	Description	Hydric Status (NRCS, NTCHS)
Aldine silt loam (AdA)	Nearly level, gently sloping soil on uplands of coastal prairie. Areas are elongated or oval.	Hydric
Aldine-Aris complex (Ae)	Nearly level soils are in mounded areas of the coastal prairie and flatwoods. Most areas are broad, slopes are 0-1%.	Hydric
Anahuac-Aris complex (An)	Nearly level soils are in mounded areas of the coastal prairie. Areas are irregular in shape; slopes are 0-1%.	Hydric
Aris silt loam (Ar)	Nearly level soil on broad flats along drainage ways. Areas are long and narrow or irregular in shape; slopes are 0-1%.	Hydric
Beaumont Clay (Ba)	Nearly level soils are in broad areas of the coastal prairie; slopes are 0-1%.	Hydric
Bernard clay loam (Be)	Nearly level soils are in areas of the coastal prairie. Areas are elongated or irregular in shape; slopes are 0-1%.	Hydric
Bernard-Morey complex (Bm)	Nearly level soils are in mounded areas of the coastal prairie. Areas are elongated or irregular in shape; slopes are 0-1%.	Hydric
Bienville loamy fine sand, 0-2% slope (BnB)	Nearly level and gently sloping soil on stream terraces. Areas are oval or elongated.	Hydric
Bienville-Kenefick complex, 1-3% slopes (BvB)	Gently undulating soils on stream terraces. Areas are oval or elongated.	Hydric
Dylan Clay, 3-6% slopes (DyC)	Gently sloping and moderately sloping soil on side slopes along major drainage ways. Areas are elongated or irregular in shape.	Non-hydric
Estes Clay, frequently flooded (Es)	Nearly level soil on the floodplain of rivers and streams. Areas are long and narrow; slopes are 0-1%.	Hydric
Guyton-Aldine Complex (Gy)	Nearly level soils are in mounded areas of the coastal prairie. Areas are broad and irregular in shape.	Hydric
Hatliff clay loam, occasionally flooded (Ha)	Nearly level soil on the floodplain of rivers and major creeks. Areas are long and narrow; slopes are 0-1%.	Hydric
Kaman clay, frequently flooded (Kf)	Nearly level soil along the floodplain of the Trinity River and other large streams. Areas are long and broad; slopes are 0-1%.	Hydric
Kemah silt loam (Kh)	Nearly level soil in broad areas on uplands of coastal prairie. Areas are elongated or irregular in shape; slopes 0-1%.	Hydric
Kemah-Aris complex (Km)	Nearly level soils are in mounded areas of the coastal prairie. Most areas are broad, slopes are 0-1%.	Hydric
Kenefick fine sandy loam (Kn)	Nearly level soil in stream terraces. Areas are irregular in shape; slopes are 0-1%.	Hydric
Kirbyville fine sandy loam (Kr)	Nearly level soil on broad upland areas, irregular in shape. Slopes are 0-1%.	Hydric
Lake Charles clay, 0-1% slopes (LaA)	Nearly level soil on broad upland areas, irregular in shape.	Hydric
Mantachie loam, frequently flooded (Ma)	Nearly level soil on the floodplain of rivers and streams. Areas are long and narrow; slopes are 0-1%.	Hydric
Mocarey-Yeaton complex (My)	Nearly level soils on broad mounded areas of the coastal prairie. Areas are generally oblong in shape; slopes are 0-1%.	Hydric
Otanya fine sandy loam, 1-3% slopes (OyB)	Gently sloping soils on broad ridges and mounds of flatwoods. Areas are irregular in shape.	Hydric
Owentown fine sandy loam, occasionally flooded (Oz)	Nearly level soil on the floodplains of rivers and streams. Areas are long and narrow; slopes are 0-1%.	Hydric
Pits (Pt)	This map unit is mainly on stream terraces along the Trinity River. Areas are rectangular or oblong.	Non-hydric
Sengo fine sandy loam (Sa)	Nearly level soils on broad, low ridges in uplands. Areas are irregular in shape; slopes are 0-1%.	Hydric
Sorter loam (Sb)	Nearly level soil in slightly depressed areas of the flatwoods. Areas are broad and irregular in shape. Slopes are plane or convex, and less than 1%.	Hydric
Sorter-Dallardsville complex (Sd)	Nearly level soil on mounds of the flatwoods. Areas are broad and irregular in shape. Slopes are 0-1%.	Hydric
Sorter-Kirbyville complex (Sk)	Nearly level soil on mounds of the flatwoods. Areas are broad and irregular in shape. Slopes are 0-1%.	Hydric
Spurger fine sandy loam, 0-2% slopes (SrB)	This map unit is nearly level and gently sloping soil on low ridges of stream terraces along the floodplains of the Trinity River and large local streams.	Hydric
Spurger-Waller complex, 0-2% slopes (SwB)	Nearly level and gently sloping soil in stream terraces. Areas are broad and irregular in shape.	Hydric

Source: Soil Survey of Liberty County, NRCS 1996; NTCHS.

Table 3-12 (Cont.): Soil Types Located Within the Study Area: Liberty County

Soil Type	Description	Hydric Status (NRCS, NTCHS)
Vamont silty clay, depressional (Vd)	Nearly level soils in broad areas of the coastal prairie. Areas are irregular in shape; slopes are 0-1%.	Hydric
Verland clay loam (Ve)	Nearly level soils in plane to slightly concave areas of the coastal prairie. Areas are irregular in shape; slopes are 0-1%.	Hydric
Voss fine sand, occasionally flooded (Vo)	This map unit is nearly level soil along the floodplains of the Trinity River and large streams. Areas are generally long and narrow. Slopes are 0-1%.	Hydric
Voss fine sand, frequently flooded (Vs)	This map unit is nearly level soil along the floodplains of the Trinity River and major streams. Areas are generally long and narrow. Slopes are 0-1%.	Hydric
Waller loam (Wa)	Nearly level soils in broad areas of the flatwoods. Areas are irregular in shape; slopes are 0-1%.	Hydric
Waller loam, depressional (Wc)	Nearly level soils in depressional areas of the flatwoods. Areas are round or elongated in shape; slopes are 0-1%	Hydric
Waller-Dallardsville complex (Wd)	Nearly level soils on broad mounded areas of stream terraces and flatwoods. Areas are irregular in shape. Slopes are 0-1%.	Hydric
Waller-Kirbyville complex (Wk)	Nearly level soils on broad mounded areas of flatwoods. Areas are irregular in shape. Slopes are 0-1%.	Hydric
Waller-Splendora complex (Wn)	Nearly level soils on mounds of the flatwoods. Areas are irregular in shape. Slopes are 0-1%.	Hydric
Wockley fine sandy loam (Wo)	Nearly level soils in broad, plane to slightly concave areas of the flatwoods. Areas are irregular in shape. Slopes are 0-1%.	Hydric
Woodville fine sandy loam, 1-3% slopes (WvB)	Very gently sloping soil on broad uplands. Areas are irregular in shape.	Non-hydric
Woodville fine sandy loam, 5-8% slopes (WvD)	Moderately sloping soil on uplands along drainage ways. Areas are generally long and narrow.	Non-hydric

Source: Soil Survey of Liberty County, NRCS 1996; NTCHS.
Note: Soil series shown as having hydric inclusions are not included on the hydric soils list. However, they may contain small, unmapped parcels of soils exhibiting hydric characteristics within the larger map unit.

Table 3-13: Soil Types Located Within the Study Area: Chambers County

Soil Type	Description	Hydric Status (NRCS, NTCHS)
Anahuac silt loam (An)	This soil is in long, narrow, slightly elevated areas. It is deep, nearly level, loamy soils.	Hydric
Beaumont clay (Be)	Deep nearly level, clayey soils on broad flats. Where this soil is in native range or improved pasture, the upper 4 in. has granular structure. Where it is used for rice, the surface layer is massive or has coarse platy structure.	Hydric
Frost silt loam (Fo)	Deep, acid, loamy soils that are nearly level or depressional. Slopes are less than 0.5% and are convex.	Hydric
Frost-Anahuac complex, undulating (FrB)	Deep, acid, loamy soils that are nearly level or depressional. It is 50-70% Frost silt loam, 25-45% Anahuac silt Loam and 5-25% other soils.	Hydric
Frost-Morey complex, leveled (Fs)	Deep, acid, loamy soils that are nearly level or depressional. It is 45-65% Frost silt loam, 25-55% Morey silt loam, and 5-50% other soils. Water stands on the surface of these soils for long periods after rains.	Hydric
Lake Charles clay, 0-1% slopes (LaA)	Deep, nearly level or gently sloping, clayey soils. In most places, it is not affected by floodwaters from Gulf storms. Slopes are less than 1%.	Hydric
Morey silt loam, leveled (Mo)	Deep, nearly level, loam soils. Slopes are less than 1%.	Hydric
Vaiden clay, 0-1% slopes (VaA)	Deep, nearly level or gently sloping clayey soils. Slopes are less than 1%.	Hydric
Vaiden clay, 1-5% slopes (VaB)	Deep, nearly level or gently sloping clayey soils. This soil is on narrow side slopes that lead to low terraces and floodplains of natural drainage ways. Slopes are 1-5%.	Hydric

Source: Soil Survey of Chambers County, NRCS 1976; NTCHS.
Note: Soil series shown as having hydric inclusions are not included on the hydric soils list. However, they may contain small, unmapped soils with hydric characteristics within the larger map unit.

3.3.3.3 Prime and Statewide or Local Important Farmland Soils

The U.S. Department of Agriculture (USDA) is the agency primarily responsible for the implementation of federal policy concerning farmland. Guiding farmland policy is the Farmland Protection Policy Act of 1981 (FPPA), U.S. Code, Title 7, Chapter 73, Section 4201. The general provisions of Section 4201 state that "the Nation's farmland is a unique natural resource that provides food and fiber necessary for the continued welfare of the people of the United States." Section 4201 also states that "the Department of Agriculture and other federal agencies should take steps to assure that the actions of the Federal Government do not cause United States farmland to be irreversibly converted to nonagricultural uses in cases in which other national interests do not override the importance of the protection of farmland nor otherwise outweigh the benefits of maintaining farmland resources". Each year, a large amount of the nation's farmland is irrevocably converted from actual or potential agricultural use to nonagricultural use.

Section 4201 defines prime farmland as "land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, and without intolerable soil erosion." Prime farmland may include land that is currently being used to produce livestock and timber. Farmlands of statewide importance are generally considered to be those lands that are nearly prime farmland and that produce high yields of crops in an economic manner when treated and managed according to acceptable farming methods. Farmlands of statewide importance may also include tracts of land that have been designated for agriculture by state law. Farmlands of local importance are additional lands used for farming that are identified by local agency or agencies concerned. Farmlands of local importance may also include tracts of land designated for agriculture by local ordinance.

According to the NRCS, much of the region associated with the study area contains prime and statewide or locally important farmland soils. The Segments H and I-1 study area contains 113,401 ac of prime farmland and an additional 161,139 ac that would be considered prime farmland if the soil was drained. Refer to **Table 3-14** for a list of the prime farmland soils within the study area.

Table 3-14: Prime Farmland Soil Types Located Within the Study Area

County	Soil Map Units
Montgomery County	Angie fine sand (An) and Waller loam (Wa).
Harris County	Bernard clay loam (Bd), Bernard-Edna complex (Be), Hockley fine sandy loam, 1-4% slopes (HoB), Katy fine sandy loam (Kf), Lake Charles clay, 0-1% slopes (LcA), Lake Charles clay, 1-3% slopes (LcB), Vamont clay, 0-1% slopes (VaA), Vamont clay, 1-4% slopes (VaB), and Wockley fine sandy loam (Wo). If drained: Beaumont Clay (Ba), Clodine loam (Cd), Gessner loam (Ge), Verland silty clay loam (Md), and Ozan loam (Oa).
Liberty County	Bernard clay loam (Be), Bienville-Kenefick complex, Kenefick fine sandy loam (Kn), Kirbyville fine sandy loam (Kr), Lake Charles clay, 0-1% slopes (LaA), Otanya fine sandy loam, 1-3% slopes (OyB), Owentown fine sandy loam, occasionally flooded (Oz), Sengo fine sandy loam (Sa), Spurger fine sandy loam, 0-2% slopes (SrB), Vamont silty clay, 0-1% slopes (VaA), and Wockley fine sandy loam (Wo). If drained: Aldine silt loam (AdA), Aldine-Aris complex (Ae), Anahuac-Aris complex (An), Bernard-Morey complex (Bm), Mocarey-Yeaton complex (My), Sorter loam (Sb), Sorter-Dallardsville complex (Sd), Sorter-Kirbyville complex (Sk), Spurger-Waller complex, 0-2% slopes (SwB), Vamont silty clay, depressional (Vd), Waller loam (Wa), Waller-Dallardsville complex (Wd), Waller-Kirbyville complex (Wk), and Waller-Splendora complex (Wn).
Chambers County	Anahuac silt loam (An), Lake Charles clay, 0-1% slopes (LaA), and Vaiden clay, 0-1% slopes (VaA). If drained: Beaumont clay (Be), Frost silt loam (Fo), Frost-Anahuac complex, undulating (FrB), Frost-Morey complex, leveled (Fs), Morey silt loam, leveled (Mo).

Source: NRCS, 2006

3.4 AIR QUALITY

Air pollution may contribute to adverse human health effects and ecosystem degradation. Motor vehicles, industries, construction equipment and some commercial operations are among the sources of air pollution in the Houston area. The main air pollutants emitted from motor vehicles are volatile organic compounds (VOCs), nitrogen oxides (NO_X), carbon monoxide (CO), carbon dioxide (CO_2), particulate matter (PM) and a class of compounds called mobile source air toxics (MSAT).

3.4.1 Criteria Pollutants

The NEPA of 1969 and the Clean Air Act of 1970 (CAA), as amended, resulted in federal requirements for United States Department of Transportation (USDOT) to consider the impact proposed highways, such as the Grand Parkway, may have on the local air quality. Under the CAA, the EPA sets national ambient air quality standards (NAAQS) for seven criteria air pollutants to protect public health and the environment, with an adequate margin of safety. The NAAQS for the seven pollutants are listed in **Table 3-15**. NAAQS exist for: CO, ozone (O_3), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), PM for both 10 and 2.5 microns and less (PM_{10} and $PM_{2.5}$), and lead (Pb). The Clean Air Act Amendments (CAAA) of 1990 establishes specific milestones toward attaining the NAAQS, depending on the severity of the air pollution problem in the region. The EPA classified the Houston-Galveston-Brazoria Ozone nonattainment area, which includes Harris County, as a severe O_3 nonattainment area with an attainment date of June 15, 2019. By letter dated June 15, 2007, the Governor of Texas working with the TCEQ submitted a letter to the EPA requesting that the area be reclassified to "severe" nonattainment. The EPA has completed the process of reclassification that will result in an attainment date of June 15, 2019 (TCEQ, 2007) and has published a proposed notice of intent to reclassify the Houston-Galveston-Brazoria Ozone Nonattainment Area in the Federal Register dated December 31, 2007. The final rule reclassifying the area to severe nonattainment was issued in October, 2008. Currently, the Houston area exceeds the national O_3 standard for about 40 days per year. The Houston area is in attainment for all other NAAQS.

Table 3-15: National Ambient Air Quality Standards (NAAQS)

Pollutant	Primary Standards	Averaging Times	Secondary Standards
Carbon Monoxide	9 ppm (10mg/m^3)	8-hr[1]	None
	35 ppm (40 mg/m^3)	1-hr[1]	None
Lead	1.5 µg/m^3	Quarterly Average	Same as Primary
Nitrogen Dioxide	0.053 ppm (100 µg/m^3)	Annual (Arithmetic Mean)	Same as Primary
Particulate Matter (PM_{10})	150 ug/m^3	24-hr[1]	Same as Primary
Particulate Matter ($PM_{2.5}$)	15.0 µg/m^3	Annual[2] (Arithmetic. Mean)	Same as Primary
	35 ug/m^3	24-hr[3]	Same as Primary
Ozone	0.075 ppm 0.08 ppm	8-hr[4] 8-hr[5]	Same as Primary
Sulfur Dioxide	0.03 ppm	Annual (Arithmetic Mean)	-------
	0.14 ppm	24-hr[1]	-------
	-------	3-hr[1]	0.5 ppm (1300 ug/m^3)

Source: http://www.epa.gov/air/criteria.html, accessed November 2009.
[1] Not to be exceeded more than once per year.
[2] To attain this standard, the 3-yr average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 ug/m^3.
[3] To attain this standard, the 3-yr average of the 98th percentile of 24-hr concentrations at each population-oriented monitor within an area must not exceed 35 ug/m^3.
[4] To attain this standard, the 3-yr average of the fourth-highest daily maximum eight-hour average O_3 concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.
[5] To attain this standard, the 3-yr average of the fourth-highest daily maximum eight-hour average O_3 concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm.

CO is a very reactive gas that can cause asphyxiation. Because of its high reactivity, it does not persist in the air long after it is emitted, and therefore CO is a local problem where it occurs. CO emissions are primarily from the combustion of fuel in motor vehicles. Emissions of CO from motor vehicles are affected by both temperature and speed and may be roughly twice as high in winter months as in summer months.

CO_2 is an inert, non-toxic gas that most animals produce in respiration and most plants absorb for photosynthesis. It is also the main product of fuel combustion in motor vehicles. Increasing levels of carbon dioxide in the atmosphere also contribute to global warming, in which the Earth's solar radiation balance is altered as the opacity of the atmosphere to infrared light radiated back to space from the surface increases. At this writing, federal motor vehicle regulations do not control CO_2 emissions; although the April 2007 U.S. Supreme Court ruling stated EPA has jurisdiction to develop such regulations. In addition, on May 14, 2007, President Bush issued Executive Order (EO): "Cooperation Among Agencies in Protecting the Environment with Respect to Greenhouse Gas Emissions from Motor Vehicles, Nonroad Vehicles, and Nonroad Engines." Although some states have enacted controls, Texas has not, and thus, CO_2 emissions are unregulated in the study area.

VOCs in motor vehicle emissions are created by incomplete combustion. Some of these VOCs contribute to O_3 and smog formation, while others, such as benzene and formaldehyde, are toxic or carcinogenic. Trucks and older cars emit much more VOCs than newer cars.

Nitrogen oxides (NOx) are created inside the combustion chambers of motor vehicles. When under high heat and pressure, nitrogen molecules in the air are split into reactive nitrogen atoms, which then combine with oxygen. NO_X also react with oxygen and VOCs in the atmosphere to form O_3 and smog. Motor vehicles produce the least emissions of NO_X per mile between 20 and 30 mph. NO_X emissions per mile increase as vehicles move slower or faster, so simply increasing or decreasing average traffic speed can increase NO_X emission.

PM consists of tiny particles that are emitted by vehicle engines (especially the diesel engines of trucks), brake pads, tires, and other moving parts of motor vehicles. These particles contribute to smog and haze, and are dangerous to human health, especially to people with respiratory conditions. The EPA provides health criteria for particles smaller than ten microns (about one-seventh the width of a human hair) and for particles smaller than 2.5 microns.

VOCs from motor vehicles, industry, and other sources can combine with NOx in a series of photochemical reactions under certain conditions to form O_3. These reactions take place over a period of several hours and can result in high concentrations of O_3 that are often far downwind from the precursor sources. Determining the cause of O_3 through modeling requires long-term meteorological data and detailed area-wide emission rates for all potential sources (industry, business, and transportation).

The EPA designates the status of a county's ambient air with respect to compliance to the NAAQS. The designations are as follows:

Designation	Definition
Attainment	Meets or is better than requirements
Nonattainment	Did not meet requirements
Unclassifiable	Cannot be classified

EPA has determined that Harris County and the seven other counties (including Montgomery, Liberty, and Chambers Counties) that comprise the Houston-Galveston–Brazoria area are in attainment for all of the NAAQS pollutants except the eight-hour O_3 air quality standards. EPA regulations require that a nonattainment area demonstrate that its RTP and Transportation Improvement Program (TIP) conform to the intent of the State Implementation Plan (SIP) by showing that the emissions under the plan are less than the emission budget set in the SIP. Under the regulations, added capacity projects, such as the Grand Parkway, may advance to construction only if they are part of the RTP and TIP that have been determined to conform to the SIP by the MPO and USDOT. The proposed project is included in the area's financially constrained 2035 RTP and FY 2008-2011 TIP, adopted by H-GAC on August 24, 2007 and found to conform to the SIP by FHWA/FTA on November 9, 2007.

Existing background CO concentrations, attributable to emissions in the general community and to CO transported into that community, for the study area are estimated to be 4.5 and 2.8 parts per million (ppm) for the existing one-hour and eight-hour concentrations, respectively. These estimated background CO concentrations were obtained from TxDOT's 2006 *Air Quality Guidelines*. TCEQ has several Continuous Air Monitoring Stations (CAMS) located throughout the state that monitor air quality in Texas. These sites measure different parameters such as, but not limited to, CO, nitric oxide (NO), nitrogen dioxide (NO_2), and O_3. The closest stations to the study area that measures CO are CAMS C35 and C403, which are located on Durant Street in Deer Park and Clinton Drive in Houston, respectively. Air pollution in the Houston area has been monitored since the early 1970s. There are currently 57 active CAMS within the TCEQ's Region 12. Those in the study area are shown in **Exhibit 3-7: Houston Area Continuous Air Monitoring Sites**.

3.4.2 Mobile Source Air Toxics (MSAT)

In addition to the criteria air pollutants for which there are NAAQS, the EPA also regulates toxic air pollutants. Most toxic air pollutants originate from human-made sources, including onroad mobile sources (e.g., cars, light trucks, motorcycles, and 18-wheelers), nonroad mobile sources (e.g., airplanes), area sources (e.g., dry cleaners and gas stations), and stationary/point sources (e.g., electric utilities, petrochemical refining, and other industries).

MSAT are a subset of the 188 toxic air pollutants defined by the CAAA. MSAT are compounds emitted from highway vehicles and nonroad equipment. Some toxic compounds are present in fuel and are emitted into the air when the fuel evaporates or passes through the engine unburned, for example benzene. Other toxics are emitted from the incomplete combustion of fuels or as secondary combustion products. Metal air toxics also result from engine wear or from impurities in oil or gasoline (EPA, 2000a). In a 2001 rulemaking, EPA identified six priority MSAT: acetaldehyde, acrolein, benzene, 1,3-butadiene, diesel exhaust (including diesel PM and organic gases), and formaldehyde (EPA, 2001a, 66 CFR 17230).

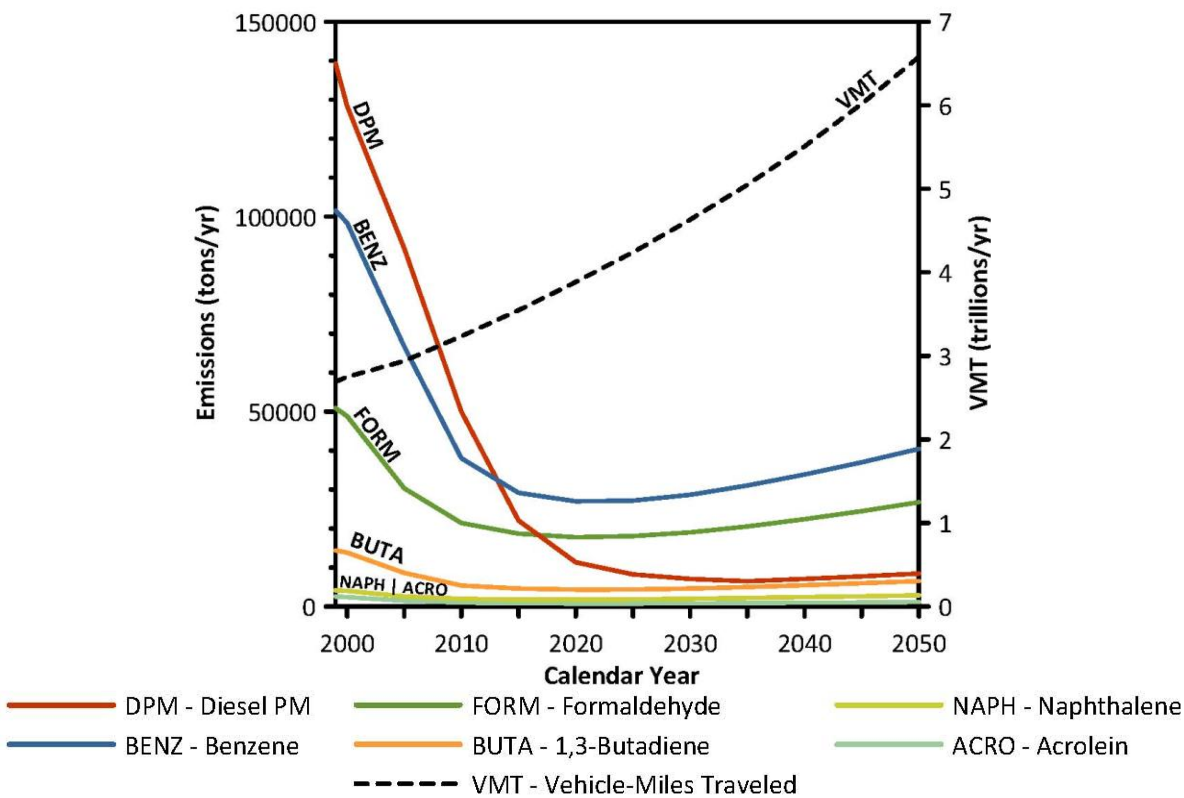
The EPA is the lead federal agency for administering the CAA and has some responsibilities on the health effects of MSAT. The EPA issued a final rule on controlling emissions of hazardous air pollutants from mobile sources (66 CFR 17229, March 29, 2001). In its rule, the EPA examined the impacts of existing and newly promulgated mobile source control programs, including its reformulated gasoline (RFG) program, its national low emission vehicle (NLEV) standards, its Tier 2 motor vehicle emissions standards and gasoline sulfur control requirements, and its proposed heavy-duty engine and vehicle standards and on-highway diesel fuel sulfur control requirements. Between 2000 and 2020, FHWA projects with a 64% increase in vehicle miles of travel (VMT), the mobile source control programs would reduce on-highway emissions of benzene, formaldehyde, 1, 3-butadiene, and acetaldehyde by 57% to 65%, and would reduce on-highway diesel PM emissions by 87%.

In an ongoing review of MSAT, the EPA finalized additional rules under the authority of CAA Section 202(l) to further reduce MSAT emissions to even a greater extent than is reflected in the following graph (**Figure 3-1**). The EPA issued Final Rules on Control of Hazardous Air Pollutants from Mobile Sources (72 CFR 8427, February 26, 2007) under Title 40 Code of Federal Regulations Parts 59, 80, 85 and 86. The rule changes were effective on April 27, 2007. As a result of this review, EPA adopted the following new requirements to substantially lower emissions of benzene and the other MSAT by: (1) lowering the benzene content in gasoline; (2) reducing evaporative emissions that permeate through portable fuel containers; and (3) reducing non-methane hydrocarbon exhaust emissions from passenger vehicles operated at cold temperatures (under 75 degrees Fahrenheit) (EPA, 2007a).

In addition, EPA identified seven compounds with significant contributions from mobile sources that are among the national and regional-scale cancer risk drivers from their 1999 National Air Toxics Assessment (NATA) (http://www.epa.gov/ttn/atw/nata1999/). These are *acrolein, benzene, 1,3-butidiene, diesel particulate matter plus diesel exhaust organic gases (diesel PM), formaldehyde, naphthalene, and polycyclic organic matter.* While FHWA considers these the priority mobile source air toxics, the list is subject to change and may be adjusted in consideration of future EPA rules.

The 2007 EPA rule mentioned above requires controls that will dramatically decrease MSAT emissions through cleaner fuels and cleaner engines. According to a FHWA analysis using EPA's MOBILE6.2 model, even if vehicle activity (vehicle-miles travelled, VMT) increases by 145 percent as assumed, a combined reduction of 72 percent in the total annual emission rate for the priority MSAT is projected from 1999 to 2050, as shown in **Figure 3-1**.

Figure 3-1: National Emission Trends 1999 – 2050 For Vehicles Operating on Roadways Using EPA's Mobile 6.2 Model



Note: (1) Annual emissions of polycyclic organic matter are projected to be 561 tons/yr for 1999, decreasing to 373 tons/yr for 2050.
(2) Trends for specific locations may be different, depending on locally derived information representing vehicle-miles travelled, vehicle speeds, vehicle mix, fuels, emission control programs, meteorology, and other factors

Source: U.S. Environmental Protection Agency. MOBILE6.2 Model run 20 August 2009.

Beginning in 2011, petroleum refineries nationwide must meet an annual average gasoline benzene content standard of 0.62% by volume, for both reformulated and conventional gasoline. This would be a 38% reduction from 2007. EPA standards to reduce non-methane hydrocarbon (NMHC) exhaust emissions from new gasoline-fueled passenger vehicles would become effective in phases. Standards for light-duty vehicles and trucks (≤ 6000 pounds [lbs]) become effective during the period of 2010 to 2013, and standards for heavy light-duty trucks (6,000 to 8,000 lbs) and medium-duty passenger vehicles (up to 10,000 lbs) become effective during the period of 2012 to 2015. Evaporative requirements for portable gas containers become effective with containers manufactured in 2009. Evaporative emissions must be limited to 0.3 grams of hydrocarbons per gallon per day (EPA, 2007a).

EPA has also adopted more stringent evaporative emission standards (equivalent to current California standards) for new passenger vehicles. The new standards became effective in 2009 for light vehicles and in 2010 for heavy vehicles. In addition to the reductions from the 2001 rule, the new rules would substantially reduce annual national MSAT emissions. The EPA estimates that emissions in the year 2030, when compared to emissions in the base year prior to the rule, would show a reduction of 330,000 tons of MSAT (including 61,000 tons of benzene), more than one million tons of volatile organic compounds, and more than 19,000 tons of $PM_{2.5}$ (EPA, 2007a).

3.4.2.1 Existing Environment /TCEQ Monitor Data

TCEQ and other local entities operate air quality monitors in the Houston area. This network of monitors measures the air quality and determines the levels of the various pollutants in the air. The two closest air quality monitors to Segments H and I-1 are 4.9 mi (CAMS 309) and 9.5 mi (CAMS 148) away from the study area. The official monitor data is found on EPA's national air quality monitor web site (www.epa.gov/air/data). As can be seen in **Table 3-16**, not all monitors sample for the same pollutants, nor do all the monitors have one year of complete data to compile an annual average for any given pollutant.

Table 3-16: Local Monitor Data

Monitor ID	2006 Annual Average 1-Hour $PM_{2.5}$	2006 Peak 24-Hour Annual Average					Distance From Recommended Alternative (mi)
		Benzene	1,3 Butadiene	Formaldehyde	Acetaldehyde	Acrolein	
CAMS 1	13.21 ug/m3	N/A	N/A	N/A	N/A	N/A	19.3
CAMS 15	12.47 ug/m3	4.79 ug/m3	2.12 ug/m3	2.60 ug/m3	2.79 ug/m3	0.44 ug/m3	13.0
CAMS 26	N/A	9.48 ug/m3	0.17 ug/m3	N/A	N/A	N/A	27.2
CAMS 45	11.42 ug/m3	N/A	N/A	N/A	N/A	N/A	18.9
CAMS 78	11.06 ug/m3	N/A	N/A	N/A	N/A	N/A	19.1
CAMS 309	11.59 ug/m3	N/A	N/A	N/A	N/A	N/A	4.9
CAMS 148	N/A	10.41 ug/m3	0.69 ug/m3	N/A	N/A	N/A	9.5

Notes: EPA disclaimer regarding this data: "Readers are cautioned not to infer a qualitative ranking order of geographic areas based on AirData reports. Air pollution levels measured in the vicinity of a particular monitoring site may not be representative of the prevailing air quality of a county or urban area. Pollutants emitted from a particular source may have little impact on the immediate geographic area, and the amount of pollutants emitted does not indicate whether the source is complying with applicable regulations."
* Not a regulatory monitor for $PM_{2.5}$, these monitors do not use the same collection and analysis methods for measuring $PM_{2.5}$ data and therefore are not used for compliance monitoring.
** Currently, no NAAQS have been established for any of the priority MSAT. The EPA is in the process of assessing the risks of exposure to these pollutants. For more information see the MSAT Technical Report (Appendix E) or http://www.epa.gov/iris for potential human health effects that may result from exposure to various MSAT.
Source: EPA, 2007b

3.4.2.2 Existing Environment/Proximity to Roadways and the Potential to Impact Health

Some recent studies have reported that proximity to roadways is related to adverse health outcomes, particularly respiratory problems. Much of this research is not specific to MSAT, instead surveying the full spectrum of both criteria and other pollutants. FHWA cannot evaluate the validity of these studies, but more importantly, these studies do not provide information that would be useful to alleviate the uncertainties associated with MSAT analysis and enable us to perform a more comprehensive evaluation of the health impacts specific to this project. In addition, as mentioned previously, EPA has not developed a health based standard for MSAT, and instead has focused on regulation to substantially reduce onroad MSAT emissions nationwide.

3.4.2.3 Existing MSAT Levels

A basic quantitative analysis of the total mass of MSAT emissions from the traffic study area of Segments H and I-1 was completed. The traffic study area used for this analysis includes all major roadways potentially affected by the proposed new transportation facility. These segments are located on the northeast side of the greater Houston metropolitan area and span the area from US 59 (N) to IH 10 (E) between FM 2100 and SH 146 in Montgomery, Harris, Liberty, and Chambers Counties, a distance of approximately 36 mi.

A discussion of how total MSAT levels were estimated and some of the limitations and cautions regarding these estimations is contained in **Section 4.4** and **Appendix E (Mobile Source Air Toxics (MSATs) Technical Report)**. A summary of these emissions for the base year is shown in **Table 3-17**.

Table 3-17: Total MSAT Emissions Tons/Year For The Segments H and I-1 Traffic Study Area

Compound	2007 Base Year
Acetaldehyde	12.1
Acrolein	0.8
Benzene	33.3
Butadiene	5.0
Formaldehyde	17.6
Diesel Particulate Matter	53.3
Total MSAT – Segments H and I-1	**122**

Source: Study Team, 2007

3.4.2.4 MSAT Summary

For MSAT modeled for the Grand Parkway, Segments H and I-1 was found to be lower in the future years (2019 and 2039) than the base year (2007). The MSAT from mobile sources, especially benzene, have decreased dramatically since 1995, and are expected to continue decreasing. The introduction of Re-formulated Gasoline (RFG) has lead to a substantial part of this improvement. In addition, Tier 2 automobiles introduced in model year 2004 would continue to help reduce MSAT. Diesel exhaust emissions have been falling since the early 1990s with the passage of the CAAA. The CAAA provided for improvement in diesel fuel through reductions in sulfur and other diesel fuel improvements. In addition, the EPA has further reduced the sulfur level in diesel fuel, effective in 2006. The EPA also has called for dramatic reductions in NOx emissions, and PM from onroad and off-road diesel engines. In 2007, the EPA implemented an additional MSAT rule to further reduce both MSAT and VOC emissions.

3.5 TRAFFIC NOISE

Sound from highway traffic is generated primarily from a vehicle’s tires, engine, and exhaust. It is commonly measured in decibels and is expressed as "dB." Sound occurs over a wide range of frequencies. However, not all frequencies are detectable by the human ear. Therefore, an adjustment is made to the high and low frequencies to approximate the way an average person hears traffic sounds. This adjustment is called A-weighting and is expressed as "dBA." Also, because traffic sound levels are never constant due to the changing number, type and speed of vehicles, a single value is used to represent the average or equivalent sound level and is expressed as "Leq."

The traffic noise analysis typically includes the following elements:

- Identification of land use activity areas that might be impacted by traffic noise
- Determination of existing noise levels
- Prediction of future noise levels
- Identification of possible noise impacts
- Consideration and evaluation of measures to reduce noise impacts

FHWA has established the Noise Abatement Criteria (NAC), shown in **Table 3-18**, for various land use activity areas that are used as one of two means to determine when a traffic noise impact would occur.

Table 3-18: FHWA Noise Abatement Criteria

Activity Category	dBA Leq	Description of Land Use Activity Areas
A	57 (exterior)	Lands on which serenity and quiet are of extra-ordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries and hospitals.
C	72 (exterior)	Developed lands, properties or activities not included in categories A or B above.
D	--	Undeveloped lands.
E	52 (interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals and auditoriums.

***NOTE**: Primary consideration is given to exterior areas (Category A, B, or C) frequently used by humans. However, interior areas (Category E) are used if exterior areas are physically shielded from the roadway or if there is little or no human activity in exterior areas adjacent to the roadway.*

A noise impact occurs when either the absolute or relative criterion is met. These criteria are defined as follows:

Absolute criterion: the predicted noise level at a receiver approaches, equals, or exceeds the NAC. "Approach" is defined as 1 dBA below the NAC. For example: a noise impact would occur at a Category B residence if the noise level is predicted to be 66 dBA or above.

Relative criterion: the predicted noise level substantially exceeds the existing noise level at a receiver even though the predicted noise level does not approach, equal, or exceed the NAC. “Substantially exceeds” is defined as more than 10 dBA. For example: a noise impact would occur at a Category B residence if the existing level is 54 dBA and the predicted level is 65 dBA (11 dBA increase).

To assess the ambient noise (existing conditions) within the Segments H and I-1 study area, noise monitoring was conducted in accordance with FHWA guidelines on June 22, 2006. Short-term noise measurements of 10 minutes duration each were conducted at the selected monitoring sites using a Quest Technologies 2900 Integrating/Logging Sound Level Meter. The approximate location of these sites is shown in **Exhibit 3-8: Ambient Noise Levels**. These ambient noise monitoring sites were chosen to represent the land use activity areas and to determine the existing background noise levels within the study area outlined in **Exhibit 1-2: Preliminary Study Area Map**. Simultaneous traffic counts were also recorded for nearby roadways as applicable. **Table 3-19** lists the existing noise level samples within the Segments H and I-1 study area.

Table 3-19: Ambient Noise Levels in the Study Area

Location Number	Site Location	Noise Level (dBA Leq)
1	FM 1485	61
2	Roman Forest	47
3	FM 686	48
4	FM 1413	55
5	Cherry Point	46
6	FM 1942	49

Source: Study Team, 2006

Existing background noise levels measured in the field at the various monitoring sites ranged from 46 to 61 dBA Leq. The highest measured noise levels occurred near a convenience store just south of FM 1485 in the northwest part of the study area. The lowest noise levels were measured at a site near a church along FM 3360 in the southeastern part of the study area. These measured ambient sound levels characterize the existing noise conditions within the Segments H and I-1 study area.

3.6 WATER QUALITY

There are three drainage basins that envelop the study area: the San Jacinto River Basin (5,600 mi^2), the transitional Trinity-San Jacinto Coastal Basin (247 mi^2) and the Lower Trinity River Basin (750 mi^2). The individual watersheds for Segments H and I-1 are described in a north-to-south direction for the remainder of this study, i.e., the general direction of flow. Many minor tributaries feed all major streams in the study area. The study area for water quality was determined by examining those areas of each watershed that fall within the project limits outlined in **Exhibit 1-2: Preliminary Study Area Map**.

3.6.1 Watersheds

The Peach Creek watershed is primarily undeveloped. The geography of the watershed has similar characteristics to that of the East Fork San Jacinto River watershed with the major land use category being forest. The Peach Creek watershed area is 151 mi^2, encompassing land from its confluence with Caney Creek in Montgomery County north 57 mi to SH 150 in Walker County. The creek enters the study area 2,500 ft north of US 59 (N) at the southern limits of the City of Splendora and flows south over 6 mi to the confluence with Caney Creek. The Peach Creek floodplain at the City of Splendora is 2,200 ft wide with a base flood evaluation (BFE) of 100 ft and a channel centerline water depth of approximately 15 ft. The 100-yr peak discharge is approximately 39,000 cubic feet per second (cfs) with a velocity of 2.0 feet per second (fps). As the creek traverses south, it passes through the small towns of Patton Village, Woodbranch, and Roman Forest and crosses FM 1485. Floodplain widths vary from 1,800 ft at US 59 (N) and the UPRR to over 5,000 ft at the Caney Creek junction, which is approximately 4,000 ft north of the Harris County line. At the Caney Creek confluence, the Peach Creek BFE is 71 ft; the 100-yr flow is approximately 44,000 cfs with a velocity slightly exceeding 2.0 fps. The flood stage water depth is approximately 25 ft.

The Caney Creek watershed is also largely undeveloped and the major land use category is forest. From its confluence with the East Fork San Jacinto River in Harris County, north through Montgomery County to SH 150 in Walker County, the watershed encompasses 222 mi^2. The reach length is also 57 mi long, of which approximately 7 mi lies within the study area. The creek enters the study area approximately 2,500 ft northwest of US 59 (N) where the floodplain is approximately 1,500 ft wide. The BFE is 84 ft with a 100-yr peak flow around 27,000 cfs, which creates a velocity of slightly over 3.0 fps. The centerline floodwater depth would be nearly 24 ft. Caney Creek crosses FM 1485 approximately 2 mi downstream and establishes its confluence with Peach Creek approximately 3 mi further. The 100-yr floodplain varies from approximately 3,000 ft wide near FM 1485 to approximately 1 mi wide at the Peach Creek junction. At the junction, the BFE is approximately 71 ft; the 100-yr peak discharge is 66,000 cfs with a velocity of approximately 2.5 fps. The main channel flood stage would be nearly 23 ft deep. The confluence of Caney Creek and White Oak Creek is approximately 1.5 mi south of the Harris County line. During a 100-yr flood event, this junction would experience backwater effects from the East Fork San Jacinto River, which has confluence with Caney Creek 4,400 ft farther downstream. At the White Oak Creek confluence, the BFE is 58.0 ft. The floodplain is 2,800 ft wide with a 100-yr peak discharge of approximately 66,000 cfs. The corresponding velocity would be near 3.0 fps. At the confluence of Caney Creek and the East Fork San Jacinto River, the BFE is 57.0 ft and the floodplain is 1 mi wide.

Although White Oak Creek drains a sub-watershed within the Caney Creek watershed, it deserves mention here since its drainage area is 29.5 mi^2 and it contributes a 100-yr peak discharge of over 4,000 cfs to the flow of Caney Creek and subsequently the East Fork San Jacinto River. White Oak Creek has nearly 7 mi of stream reach within the study area. The floodplain is 2,000 ft wide at US 59 (N) and narrows to 900 ft wide approximately 2 mi downstream. At the Harris County line, the floodplain is 4,000 ft wide and indistinguishable from that of Caney Creek. Although the entire watersheds of the East Fork San Jacinto River, as well as those of Peach and Caney Creeks are mostly undeveloped, there is substantial subdivision development within the study area.

Luce Bayou is located 3 mi north of Dayton in west central Liberty County and flows from the northeast to the southwest as it transects the northeastern portion of the study area. The watershed is largely non-urbanized with an area of approximately 227 mi^2. Approximately 14 mi of the bayou's reach is within the study area. The watershed is primarily flat terrain with local escarpments and surface sandy loam soil, in places, that supports heavy forests and agriculture. Roughness values indicate the bayou channel is irregular with the cross-section alternating frequently and displaying heavy vegetation. The floodplain is most often heavily wooded and exhibits tall grasses. Storm water runoff is slow and there are long duration flood concentrations. Flow is intermittent in the upper reaches and very sluggish elsewhere.

Luce Bayou enters the study area 1,000 ft upstream of SH 321 where the BFE is 97.5 ft and the floodplain is 7,500 ft wide. The 100-yr peak discharge is approximately 4,000 cfs with a velocity of 0.5 fps. The centerline water depth, relative to the BFE, is approximately 13 ft. The Luce Bayou confluence with Tarkington Bayou is 4 mi downstream. At this juncture, the floodplain is approximately 3,000 ft wide. The 100-yr flow is 16,900 cfs with a velocity of less than 2.0 fps. Backwater effects from Tarkington Bayou extend nearly 3 mi up Luce Bayou which is indicative of the flat channel, floodplain, and watershed. The floodplain narrows to 1,000 ft wide in places downstream. Nine miles beyond Tarkington Bayou where Luce Bayou enters Harris County, the floodplain is 2,200 ft wide. Three miles farther, the floodplain narrows to 1,700 ft at FM 2100. Approximately 7.3 mi downstream of the county line, Luce Bayou meets the East Fork San Jacinto River among subdivision development. The 100-yr peak discharge at this point is approximately 16,100 cfs, and the BFE is 50.5 ft with a floodplain width of 6,000 ft. The 100-yr flood stage is 34.0 ft with a velocity of 1.0 fps.

All watersheds described thus far are part of the San Jacinto River Basin. Cedar Bayou is the primary water body in the transitional Trinity-San Jacinto Coastal Basin. The 247-mi^2 watershed is characterized by level terrain that slopes gently to the south. Headwaters of the bayou are found in Liberty County 7.5 mi northeast of the FM 1960 intersection with the Liberty County/Harris County line. The channel forms most of the boundary between Harris, Liberty, and Chambers counties, with approximately half of the watershed in Harris County. Much of the watershed is undeveloped with the exception of Mont Belvieu and the City of Baytown. Flooding is frequent with extended periods of storm water concentrations. Based on roughness values, the bayou channel has a fairly high degree of irregularity with the cross-section alternating frequently and often covered with heavy vegetation. Floodplain widths vary dramatically from 1,000 ft to 14,000 ft. The Harris County Flood Control District (HCFCD) maintains at least 14 channels within the study area that discharge into Cedar Bayou.

At the upstream end of Cedar Bayou, the 100-yr flow is approximately 900 cfs. Downstream 5.2 mi at the Liberty County/Harris County line, the 100-yr peak discharge is 4,400 cfs with an average velocity of less than 2.0 fps. The floodplain is 2,000 ft wide with a BFE of 71 ft and a centerline floodwater depth of 16 ft. Cedar Bayou intersects FM 1960 approximately 2,000 ft downstream where the floodplain widens to 14,000 ft, primarily on the west side of the channel. The channel grade line and associated floodplain flatten near FM 1960 with flood stage channel velocities generally less than 2.0 fps downstream. At the US 90 intersection, 7.8 mi downstream, the BFE is 57 ft; the 100-yr flow is approximately 7,200 cfs and the floodplain is 4,500 ft wide. The flood stage water depth is 17 ft. Four-and-a-half miles farther, at the confluence with Adlong Ditch, Cedar Bayou has a peak flow over 8,000 cfs with a floodplain width of approximately 10,000 ft. Harris, Liberty, and Chambers counties intersect approximately 2.3 mi downstream where the floodplain is 6,000 ft wide and the BFE is 36 ft. One mile to south is the junction with Hickory Island Gully, a stream with a 6-mi reach, which contributes a peak discharge of 1,600 cfs to Cedar Bayou. Approximately 3.2 mi farther, Cedar Bayou passes FM 1942 where the floodplain narrows to 1,500 ft wide. The bayou exits the study area 3.6 mi downstream, approximately 1,500 ft south of IH 10. Flood stage water depth is over 30 ft at the channel centerline. The 100-yr peak flow is 17,000 cfs and the floodplain is 3,000 ft wide.

The City of Mont Belvieu, in Chambers County, lies within the Trinity-San Jacinto Coastal Basin and occupies a topographic high elevation in the southeast corner of the study area. Phase I of the Grand Parkway Segment I-2 has completed construction south of IH 10 to FM 1405 and intersects the interstate 2,300 ft south of the Mont Belvieu city limits. Smith Gully traverses the center of town as it drains 4.3 mi^2. It converges with Cedar Bayou north of IH 10 and west of Loop 207. The 100-yr peak discharge is 2,400 cfs and the floodplain is approximately 700 ft wide with out-of-bank flooding and shallow ponding common. The BFE north of Mont Belvieu is 54 ft and the BFE is 24 ft at SH 146 near Cedar Bayou.

The proposed intersection of IH 10 and Segments H and I-1 represents the eastern limits of the transitional Trinity-San Jacinto Coastal Basin and the western limits of the Lower Trinity River Basin. The BFE is 32 ft with a 100-yr peak flow of 2,000 cfs where Hackberry Gully bisects the proposed IH 10 and Segments H and I-1 intersection. Approximately 2,000 ft south where Hackberry Gully exits the study area, the BFE is 27 ft and the floodplain width is approximately 300 ft.

The remainder of the study area lies within the Lower Trinity River Basin and the storm water runoff direction is generally from west to east. The terrain slopes gently and has low relief. Ground cover is typical for the Coastal Province. Roughness values indicate heavy brush with forests in the floodplains. The soils are principally dark clays and sandy loams. The City of Dayton, in Liberty County, is found at the east-central boundary of the study area. The western edge of the Trinity River 100-yr floodplain is approximately 1 mi east of the intersection of US 90 and SH 146 where the BFE is 28.5 ft. The surrounding natural ground elevation is approximately 80 ft. Two branches of Linney Creek, a minor tributary of the Trinity River, are located approximately 2 mi north of Dayton. This creek has yet to be studied by the Federal Emergency Management Agency (FEMA) but does not appear to be a major source of flooding. The East and West Dayton Ditches that intersect FM 1960 are located approximately 4 mi west of Dayton. Each ditch has a peak discharge of approximately 550 cfs. The floodplain is approximately 1 mi wide and has a BFE, at FM 1960, of approximately 77.5 ft. The East Prong Old River crosses SH 146 approximately 3.8 mi south of Dayton, and the West Prong crossing is approximately 2 mi further downstream. Neither of the watersheds has been studied in great detail by FEMA. Therefore, an additional hydrologic study would be required in the future.

3.6.2 Surface Water

The Texas Surface Water Quality Standards (TSWQS) apply to all surface water features in the state. These standards are enumerated in Title 30, Chapter 307 of the Texas Administrative Code. The standards were approved by the EPA in accordance with Section 303 of the Clean Water Act (CWA) and, as required by the statute, are updated every 3 years. The standards are typically designed to protect the most sensitive beneficial use within a water body. The TCEQ distributes the information provided by the TSWQS and administers compliance with the standards. Five general categories for water use are defined in the TSWQS: aquatic life use, contact recreation, general use, public water supply, and fish consumption.

The TCEQ carries out a regular program of monitoring and assessment to compare conditions in Texas surface waters to established standards and to determine which water bodies are meeting the standards. The results of the assessment are published periodically in the Texas Water Quality Inventory and 303(d) List, as required by Sections 305(b) and 303(d) of the CWA. The Texas Water Quality Inventory and 303(d) List is an overview of the status of surface waters of the state, including concerns for public health, fitness for use by aquatic species and other wildlife, and specific pollutants and their possible sources.

As a result of this assessment, the state of Texas must develop action plans to remediate those water bodies that are impaired through the development of a total maximum daily load (TMDL) which determines the maximum amount of pollutants that a water body can receive and still both attain and maintain its water quality standards and which allocates this allowable amount (load to point and non-point sources in the watershed). The TCEQ monitoring program divides the state's surface water into river basin data and further divides this data into specific segments which are each allocated a segment identification number.

According to the 2008 Texas 303(d) list, two listed segments are within the study area. Cedar Bayou Above Tidal (Segment ID: 0902) is listed as impaired from a point 1.4 mi upstream of IH 10 in Chambers/Harris County to a point 4.6 mi upstream of FM 1960 in Liberty County where it is listed as a Category 5c, Rank D because of low dissolved oxygen. Category 5 waters are those which do not meet applicable water quality standards or are threatened for one or more designated uses by one or more pollutants. Category 5c waters are those where additional information would be collected before a TMDL is scheduled. A rank of "D" indicates that additional data would be collected before a TMDL is scheduled. Cedar Bayou Tidal (Segment ID: 0901) is listed along its entire length as impaired due to dioxin in catfish and crab tissue (Category 5a, Rank U). The Category 5a designation means that a TMDL is scheduled, underway or would be scheduled for the waterway in question. The Rank of "U" indicates that a TMDL study is underway.

3.6.3 Groundwater

The major aquifer underlying the study area is the Gulf Coast Aquifer. This aquifer contains large quantities of fresh water that extend to a depth of 1800 ft below sea level (Anders, 1968). The Gulf Coast aquifer has been divided into five hydrostratigraphic units: Catahoula confining system, Jasper aquifer, Burkeville confining system, Evangeline aquifer, and Chicot aquifer (TWDB, 2006). These units dip from land surface southeastward at slight angles toward the Gulf of Mexico (USGS, 2002). The units then crop out in bands approximately parallel to the coast.

Recharge to the Gulf Coast aquifer mainly occurs from rainfall that falls on the outcrop areas (TWDB, 2006). Most of the rainfall is taken up by evapotranspiration (water loss from the surface of soils and plants) before reaching the zone of saturation. Water also drains into the aquifer from some reaches of the numerous streams that cross the Gulf Coast. In addition, major pumping centers that form large cones of depression may capture recharged water that was naturally discharging to local streams, thereby increasing downdip recharge. Recharge through the unconfined, permeable, sandy portions of the aquifer may be relatively fast, while recharge to the confined portions of the aquifer may be considerably slow.

Throughout the early to mid-1900's, numerous studies in the region linked groundwater withdrawal to subsidence (HGSD, 2009). In 1961, when Hurricane Carla resulted in much more flooding than was expected, local governments began to look at what could be done about the impact of subsidence on the economy and quality of life in the area. As a result, in 1975 the Texas Legislature created the Harris-Galveston Subsidence District (HGSD), the first of its kind in the United States. The Lone Star Groundwater Conservation District (GCD) was created for Montgomery County in 2001 by the Texas Legislature. Authorized as regulatory agencies, the HGSD and Lone Star GCD were given powers to restrict groundwater withdrawals within their jurisdictions.

3.6.4 Water Well Review

Public well records from the TCEQ and private water well records and driller's reports from the Texas Water Development Board (TWDB) were reviewed for the study area. Both agencies maintain a listing of existing water wells in the area. However, the databases only include wells that have been reported to the TCEQ or the TWDB and may not include all water wells in the study area. The results of the water well review indicate that there are a total of 314 water wells within the study area (TCEQ, 2007; TWDB, 2007). Of this total, 80 are public water supply wells. The remaining 234 are private, which are not presently afforded protection by any regulations.

The state's Source Water Protection (SWP) program is a community based, voluntary pollution prevention program that was created by the 1996 Safe Drinking Water Act Amendments and the expansion of the Wellhead Protection Program. All public water supply systems are eligible to participate in the state's SWP program. This program establishes procedures and criteria for identifying the boundaries of areas which constitute the sources of water used by public water systems. It also sets out procedures for identifying potential sources of contaminants within these areas and provides for the development and implementation of plans for managing the potential sources to prevent contamination.

3.7 WATERS OF THE U.S., INCLUDING WETLANDS AND VEGETATIVE COMMUNITIES

3.7.1 Regional Setting

The study area is consistent with and lies at the southern edge of the Pineywoods and the northern and eastern portion of the Gulf Coastal Prairies and Marshes natural ecological regions as designated by the TPWD **(Exhibit 3-9: Natural Regions of Texas)**. Within the study area, the Pineywoods natural region covers the northern and western half of the study area, approximately 103,426 ac or 46% of the study area, while the Gulf Coastal Prairies and Marshes covers approximately 121,413 ac or 54% of the study area. The study area encompasses those wetlands and vegetative communities that exist within the project limits defined in **Exhibit 1-2: Preliminary Study Area Map**.

As depicted on the TPWD *Vegetation Types of Texas* (TPWD, 1984) map, there are four vegetation types mapped within the study area. A majority of the northern one-third of the study area is mapped as pine-hardwood forests. This area is interspersed with native pine-hardwood vegetation, farmlands, and pastures. A small area designated as young forest/grasslands is located in the northwest corner of the study area. This area exhibits various combinations and age classes of pine and re-growth of southern red oak, sweetgum, and other oaks resulting from recent harvesting of pine or pine-hardwood forests and the establishment of pine plantations or young pine-hardwood forests. A small area designated as other native or introduced grasses is located in the northeast portion of the study area. This area is a mixture of native and introduced grasses and forbs on grassland sites or mixed herbaceous communities resulting from the clearing of woody vegetation. The southern two-thirds of the study area is designated as crops with the exception of the land adjacent to Cedar Bayou which is designated as pine-hardwood forests. Of the 224,840 acres contained within the study area, approximately 122,650 acres (54.6%) are designated as crops, approximately 91,700 acres (40.8%) are designated as pine-hardwood forest, approximately 9,930 acres (4.4%) are designated as young forest/grasslands, and approximately 560 acres (0.2%) are designated as other native or introduced grasses. Generally, vegetation in the study area is consistent with the TPWD designations. These vegetation areas are shown in **Exhibit 3-10: Vegetation Types**.

The vegetative communities described above represent a regional description of vegetation within the study area as mapped by TPWD. These vegetative community descriptions differ from those listed in **Chapter 4 (Environmental Consequences)**. The vegetative communities described in **Chapter 4, Section 4.7.3** detail vegetative communities within the proposed ROW of the reasonable alternatives and are based on aerial photo interpretation and field reconnaissance.

The study area, located in the Austroriparian Biotic Province **(Exhibit 3-11: Biotic Provinces)**, is characterized as an ecotonal region including the Gulf coastal plain from the Atlantic Ocean to Eastern Texas. The western boundary of this province is approximated by a north-south line from western Harris County to Red River County. The western boundary of the Austroriparian Biotic Province is the western extent of pine and hardwood forests of the eastern Gulf plain. The vegetation of this province includes two regions; the longleaf pine and the pine-oak forests. In the most recent decades, the faunal distribution within the study area has been primarily impacted by development, both urban and the clearing of forested land for agricultural use. Consequently, the distribution of forest habitat specialty species has become more restricted due to loss of habitat; many species once associated with the gulf coastal prairies are no longer found in many areas due to conversion of habitat to agricultural crop production.

3.7.2 Waters of the U.S.

The EPA and the USACE are charged with the protection of "Waters of the U.S." under the Federal Water Pollution Control Act of 1972, amended in 1977 to the CWA. The term "Waters of the U.S.," as defined in 33 CFR 328.3, denotes:

- All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;
- All interstate waters including wetlands;
- All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce.

To characterize surface drainage systems (streams), the designations perennial, intermittent, and ephemeral are used:

- Perennial streams flow year-round during a typical year. The water table is located above the stream bed for most of the year and groundwater is a primary source for stream flow. A perennial stream is typically capable of supporting aquatic life.
- Intermittent streams flow during certain parts of the year, typically seasonally, when groundwater provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Rainfall is a supplemental source of flow. Biological constituents are adapted to wet and dry fluctuations.
- Ephemeral streams only flow for short durations after precipitation. Ephemeral beds are located above the water table year round. Runoff from rainfall is the primary source of flow. Aquatic life is extremely scarce or typically absent. Many ephemeral streams are not USACE regulated waters. In order to be considered jurisdictional, ephemeral streams must have a surface connection to jurisdictional waters and exhibit an ordinary high water mark (OHWM).

All tidal waters, interstate waters and intrastate waters whose use, degradation, or destruction could affect interstate commerce are considered jurisdictional and subject to USACE regulation. In practical application, this includes all perennial and intermittent streams and all ephemeral streams exhibiting an OHWM. Also included are natural lakes and ponds with surface connections to navigable water or other ties to interstate commerce, all impounded lakes or ponds created from jurisdictional waters described above, and their adjacent wetlands.

Five watersheds are found within the study area: Buffalo-San Jacinto, East Fork San Jacinto, Lower Trinity, North Galveston Bay, and West Fork San Jacinto **(Exhibit 3-12: Regional Watersheds)**. Within these five watersheds, a total of 53 named potential waters of the U.S. were identified in the study area: Adlong Ditch, Ash Gully, Barbers Hill Canal, Big Ditch, Camp Branch, Caney Creek, Cary Bayou, Casey Gully, Casey Pond, Cat Pond, Cedar Bayou, Cherry Point Gully, Church House Gully, Clawson Ditch, Coastal Water Authority Canal, Cotton Bayou, Dayton Canal, Dunks Ditch, East Fork Cedar Bayou, East Fork San Jacinto River, East Prong Old River, Ellis Branch, Frost Reservoir, Green Tree Ditch, Gum Gully, Hackberry Gully, Harvard Ditch, Hickory Island Gully, Krenek Ditch, Lakeland Lake, Lick Branch, Linney Creek, Long John Creek, Luce Bayou, Lynchburg Canal, Magee Gully, Maple Branch, Mare Branch, Mexican Gully, Orange Branch, Orton Gully, Patton Lake, Peach Creek, Peach Creek Lake, Robinson Gully, Rocky Branch, Shadow Lake, Shook Bayou, Smith Gully, Tarkington Bayou, Taylor Gully, West Prong Old River, and White Oak Creek. Various other unnamed ponds, streams, and ditches were also identified in the study area.

3.7.3 Wetlands

Wetlands are zones of transition between terrestrial (upland) ecosystems and aquatic habitats. The wetlands in the study area are generally found near streams and rivers or as man-made or natural impoundments. Wetlands can also be found in depressional areas where the ground elevations result in the formation of ponds or areas that tend to remain wet longer than the surrounding landscape.

The term "wetlands", as applied in the CWA and by the USACE, includes those areas that are "inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances typically do support, a prevalence of vegetation typically adapted for life in saturated soils." Inherent in this definition is the presence of three mandatory criteria: hydric soils, hydrophytic vegetation, and wetland hydrology.

The primary function of wetlands relates to their physical, chemical, and biological attributes. The CWA recognizes water quality benefits and the uniqueness of habitat associated with standing water as the principle reasons for regulating wetlands and avoiding unnecessary impacts. Examples of wetland functions include flood flow alteration, wildlife habitat, and groundwater recharge. The term "values" may be used to describe those functions that are generally regarded as beneficial to society. Recreation and uniqueness are examples of values. Values are typically associated and weighed by a combination of a wetland's inherent capabilities combined with the opportunity to perform those functions. Accordingly, a wetland might have the potential to remove contaminants from a waterway, but its value may be low because of the lack of opportunity to do so. All or part of society may not value some wetland functions. For example, nutrient removal and transformation may not be considered a value if that function leads to algal blooms and noxious odors.

Wetlands are especially valued because of their location on the landscape, the variety of functions they perform, and the uniqueness of their plant and animal communities. Individual landowners and members of the general public also value wetlands for their open space and aesthetic qualities, as locations of important historic and archeological sites and as locations for conveying floodwaters.

The USFWS, for the purpose of their designation and inventory of wetlands, defines "wetlands" as "lands transitional between the terrestrial and aquatic system where the water table is usually at or near the surface or the land is covered by shallow water." Only one of the three parameters required by the USACE is necessary to establish a wetland using the FWS Cowardin designation as applied on their National Wetland Inventory (NWI) maps; therefore, many NWI wetlands are not jurisdictional wetlands regulated by the USACE. This fact is emphasized in the USACE 1987 Wetland Delineation Manual (TR Y-87-1), which specifies that USFWS Cowardin NWI definition of wetlands only requires a positive indicator for one of the three parameters (hydric soils, hydrophytic vegetation, and wetland hydrology) required for consideration as a regulated wetland pursuant to Section 404 of the CWA.

The USFWS Wetland Designation System designates wetlands hierarchically by system, subsystem, class, and subclass. Additional modifiers (such as regime) and dominance type (dominant species present) may also be assigned. Hence, riverine wetlands are subsequently assigned to a subsystem based on flow (e.g. tidal, perennial, or intermittent), to a class based on general appearance of the environment (e.g., substrate or shoreline), to a subclass (e.g., finer distinction of substrate or shoreline), and to a regime (e.g., permanently or intermittently flooded). A dominance type may be assigned based on the species or species complex dominating the substrate or the upper level of emergent vegetation.

Wetland types identified within the study area include palustrine, riverine, and lacustrine. Refer to **Exhibit 3-15: NWI Wetlands within the Study Area** for NWI wetlands within the study area.

Palustrine System

The palustrine system includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent lichens, or mosses and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5%. Palustrine systems are bounded by uplands or any of the other Cowardin systems. The palustrine system typically includes those areas called marshes, swamps, and bogs.

There are approximately 2,242 ac of palustrine wetlands within the study area. This acreage includes approximately 453 ac of forested wetlands, 78 ac of shrub-scrub wetlands, 296 ac of emergent herbaceous wetlands, 1,188 ac of farmed emergents (likely to be non-jurisdictional rice fields), 210 ac of unconsolidated bottom, 11 ac of aquatic bed, and 6 ac of unconsolidated shoreline. Unconsolidated bottom consists of all wetland and deepwater habitats that are characterized by less than 30% vegetative cover and a lack of large stable surfaces for plant and animal attachment. Aquatic bed consists of wetlands dominated by plants that grow on or beneath the surface of the water for most of the growing season. Unconsolidated shoreline consists of wetlands having less than 75% rock cover, less than 30% vegetation cover, and flooded conditions.

It is likely that the 453 ac of forested wetlands, 296 ac of emergent herbaceous wetlands, and 78 ac of shrub-scrub wetlands would be jurisdictional provided they are adjacent to navigable waters and/or are connected by a surface tributary to a navigable water. The jurisdictional status of the unconsolidated bed and shoreline areas and aquatic bed areas depends upon the hydrology and connection to navigable waters and would be determined during the USACE verification process.

Riverine System

Riverine systems include all wetland and deepwater habitats (greater than 6 ft deep) contained within a channel except for:

1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens
2) habitats with water containing ocean-derived salts in excess of 0.5%

Riverine systems are bounded on the landward side by upland, by the channel bank, or by wetlands dominated by trees, shrubs, persistent emergents, or emergent mosses or lichens.

Approximately 218 ac of riverine wetlands lie within the study area. These wetlands include areas in Caney Creek, Peach Creek, the East Fork of the San Jacinto River, Luce Bayou, Cedar Bayou, and the Dayton Canal. These riverine wetlands are almost exclusively lower perennial systems and would all be jurisdictional waters.

Lacustrine System

Lacustrine wetlands include wetlands with all of the following characteristics:
1) situated in a topographic depression or dammed river channel;
2) lacking trees, shrubs, persistent emergents, emergent mosses, or lichens with greater than 30% areal coverage; and
3) total area exceeds 20 ac. Similar habitats less than 20 ac can be classified as lacustrine if an active wave-formed or bedrock shoreline feature makes up part of the boundary or if water depth exceeds 6.5 ft at low water. Lacustrine wetlands may be tidal or nontidal but must have an ocean-derived salinity of less than 0.5%.

There are approximately 250 ac of lacustrine wetlands within the study area. This includes open water areas greater than 6.5 ft deep (limnetic) and areas less than 6.5 ft deep, to the shoreward edge of the system. Dammed river channels and naturalized depressional areas with surface connections to navigable waters are likely to be jurisdictional. Man-made depressions excavated from upland and/or isolated features may not be jurisdictional areas. This determination would be made during the USACE verification process.

3.7.4 Vegetative Communities

The major ecological regions within the study area are the Pineywoods and the Gulf Coastal Prairies and Marshes. The designated TPWD vegetation types within the study area are dominated by the pine-hardwood forests in the north and crops found in the southern portion.

The typical vegetation species associated within the pine-hardwood forest vegetation type include shortleaf pine (*Pinus echinata*), water oak (*Quercus nigra)*, white oak (*Quercus alba),* southern red oak (*Quercus falcata)*, winged elm (*Ulmus alata)*, beech (*Fagus grandifolia)*, blackgum (*Nyssa sylvatica*), magnolia (*Magnolia grandiflora)*, American beautyberry (*Callicarpa americana*), American hornbeam (*Carpinus caroliniana*), flowering dogwood (*Cornus florida*), yaupon (*Ilex vomitoria*), hawthorn (*Crataegus sp.*), supplejack (*Berchemia scandens*), Virginia creeper (*Parthenocissus quinquefolia*), wax myrtle (*Myrica cerifera*), red bay (*Persea borbonia* var. *borbonia*), sassafras (*Sassafras albidum*), southern arrowwood (*Viburnum dentatum*), poison ivy (*Toxicodendron radicans*), greenbriar (*Smilax sp.*) and blackberry (*Rubus sp.*). The following species may be found within the study area along deep sand ridges: black hickory (*Carya texana*), sandjack oak (*Quercus incana*), common persimmon (*Diospyros virginiana*), sweetgum (*Liquidambar styraciflua*), beaked panicum (*Panicum anceps*), Indiangrass (*Sorghastrum nutans*), switchgrass (*Panicum virgatum*), three-awn (*Aristida sp.*) and, bushclover (*Lespedeza sp.*).

TPWD maps indicate that the southern portion of the study area is designated as crops vegetation type. This vegetation type includes either cover crops or row crops including rice fields which provide food and/or fiber for man or domestic animals. Crops can also include grasslands associated with crop rotations.

In addition, infrared aerials with a 2004 publish date were obtained from the Texas Natural Resource Information System (TNRIS) and used to further identify the vegetative communities. Based off of this research, the agricultural land, agricultural wetlands, forested land, forested wetlands, and riparian zones were identified within the study area.

Agricultural land within the study area closely matches the definition given by TPWD. Agricultural wetlands identified via infrared aerial interpretation would more than likely contain wetland plant species that are often associated with areas disturbed from recent agricultural activity. These species may consist of: green flat sedge (*Cyperus virens*), Dombey's spike-rush (*Eleocharis montana*), falling beakrush (*Rhynchospora caduca*), and broad leaf cattail (*Typha latifolia*). In general, the quality of this type of wetland is low especially in areas where agricultural activity is active and the land is routinely disturbed.

Forested land also closely fit the description provided by TPWD for pine-hardwood forest, as described above. Wetlands within these forested areas are considered important habitats for wildlife and are of value for the conservation of biological diversity (TPWD). Species composition within these areas generally consist of bald cypress (*Taxodium distichum*), water oak, willow oak (*Quercus phellos*), water hickory (*Carya aquatica*), green ash (*Fraxinus pennsylvanica*), buttonbush (*Cephalanthus occidentalis*), swamp privet (*Foresteriera acuminate*), swamp smartweed (*Polygnoum hydropiperoides*), arrow head (*Sagittaria latifolia*), raven-foot sedge (*Carex crus-corvi*), Cherokee sedge (*Carex cherokeensis*), woodoats (*Chasmanthium sessiliflorum*), cutgrass (*Leersia hexandra*), lizard tail (*Saururus cernuus*), and spider lily (*Hymenocallis liriosme*).

Riparian zones are defined by areas that fall within a 100-year floodplain of a stream, or if a floodplain is absent, a zone hydrologically influenced by a stream or river (Hunt, 1988). Riparian ecosystems are maintained by high water tables and periodic flooding (NRC Wetlands, p152). Riparian zones are significant in ecology, environmental management, and civil engineering because of their role in soil conservation, their biodiversity, and the influence they have on aquatic ecosystems. Vegetation within riparian zones can vary greatly depending on location. Within the study area, vegetation would generally consist of water oak, willow oak, bald cypress, water hickory, raven-foot sedge, Cherokee sedge, switchgrass, Indian sea-oats (*Chasmanthium latifolium*), and various species of fern.

3.7.4.1 TxDOT-TPWD MOU

Of the special habitat features listed in the Memorandum of Understanding (MOU) between TxDOT and TPWD, bottomland hardwoods and water bodies have been identified in the study area. In accordance with Provision (4)(A)(ii) of the TxDOT-TPWD MOU, and at the TxDOT Houston District's discretion, habitats given consideration for non-regulatory mitigation during project planning include the following:

1. habitat for federal candidate species (impacted by the project) if mitigation would assist in the preservation of the listing of the species;
2. rare vegetation series (S1, S2, or S3) that also locally provide habitat for a state-listed species;
3. all vegetation communities listed as S1 or S2, regardless of whether or not the series in question provide habitat for state-listed species;
4. bottomland hardwoods, native prairies, and riparian sites; and
5. any other habitat feature considered locally important that the TxDOT District chooses to consider.

Habitats given consideration for non-regulatory mitigation would be avoided, if possible. According to the TPWD Texas Natural Diversity Database (TxNDD), a water oak-willow oak rare vegetation series, which is a bottomland hardwood plant community with a state rank S3, is located in the study area just north of Lake Houston. These areas are accounted for within the 91,700 acres of pine-hardwood forest. Additionally, riparian sites are present within the study area. Attempts would be made to avoid rare vegetation series and riparian sites during the design phase if one of the ten alternative alignments is selected as the preferred alternative; however, complete avoidance of riparian sites is unlikely. No known habitat for federal candidate species, S1 or S2 vegetation communities, or native prairies, occur within the study area.

3.7.4.2 Beneficial Landscape Practices

In accordance with the Executive Memorandum of August 10, 1995, all agencies shall comply with the NEPA as it relates to vegetation management and landscape practices for all federally-assisted projects. The Executive Memorandum directs that where cost-effective and to the extent practicable, agencies would (1) use regionally native plants for landscaping; (2) design, use, or promote construction practices that minimize adverse effects on the natural habitat; (3) seed to prevent pollution by, among other things, reducing fertilizer and pesticide use; (4) implement water-efficient and run-off reduction practices; and (5) create demonstration projects employing these practices. Landscaping included with this project would be in compliance with this Executive Memorandum and the guidelines for environmentally and economically beneficial landscape practices.

3.7.4.3 Invasive Species

On February 3, 1999, the President issued Executive Order (EO) 13112 to prevent the introduction of invasive species and provide for their control, and to minimize their economic, ecological, and human health impacts. In accordance with EO 13112 on Invasive Species and the Executive Memorandum on Beneficial Landscaping, landscaping would be limited to seeding or planting of the proposed study area with native species of grasses or other vegetation, as appropriate.

3.8 WILDLIFE

This section provides an overview of the wildlife resources within the study area. The wildlife species having a potential to occur within the study area are described based upon vegetation types established for

Texas by the TPWD that occur within the project limits defined in **Exhibit 1-2: Preliminary Study Area Map**.

Agriculture has substantially impacted most of the study area. Cultivated fields producing a variety of crops for human consumption as well as domestic animals now dominate the landscape in the southern portion of the study area. With the removal or decline of native vegetation and human encroachment into habitats, the wildlife species composition and diversity also show a decline from the abundant communities that probably once existed throughout the Pineywoods and Gulf Coastal Prairies and Marshes regions of East Texas.

Agricultural fields that may seem to have very little wildlife, however, may support multiple species within the ecotonal areas along fence rows and in the isolated pockets or fields that still exhibit native or fallow vegetation. Species may also utilize crop and fallow fields for feeding and temporary shelter. Rodent species like the fulvous harvest mouse (*Reithrodontomys fulvescens*) can be found in crop fields and fence rows within the study area. Some species, such as the northern pygmy mouse (*Baiomys taylori*), may have expanded their ranges using fence rows as travel corridors. Larger wildlife species like the hispid cotton rat (*Sigmodon hispidus*), the eastern cottontail (*Sylvilagus floridanus*), striped skunk (*Mephitis mephitis*), bobcat (*Lynx rufus*), gray fox (*Urocyon cinereoargenteus*), and coyote (*Canus latrans*) may occasionally utilize ecotonal areas around agricultural fields. Many of these species, including the white-tailed deer (*Odocoileus virginianus*), are still present in parts of the study area. Avian species such as the chipping sparrow (*Spizella passerine*) and the lark sparrow (*Chondestes grammacus*) may utilize these farmland areas as permanent breeding residents and/or as wintering residents. The eastern meadowlark (*Sturnella magna*) is a permanent resident that may nest in hayfields or disturbed grasslands. Other avian species such as the broad-winged hawk (*Buteo platypterus*), red-shouldered hawk (*Buteo lineatus*), red-tailed hawk (*Buteo jamaicensis*), American kestrel (*Falco sparverius*), loggerhead shrike (*Lanius ludovicianus*), and the barn owl (*Tyto alba*) can be found locally.

Some of the avian species that may be found in the Pineywoods natural region, located in the northern and western portion of the study area, include Bachman's sparrow (*Aimophila aestivalis*), Swallow-tailed kite (*Elanoides forficatus*), red-cockaded woodpecker (*Picoides borealis*), and barred owl (*Strix varia*). Mammals that can be found in the Pineywoods natural region (forested) of East Texas include river otter

(*Lutra canadensis*), swamp rabbit (*Sylvilagus aquaticus*), Rafinesque's big eared bat (*Corynorhinus rafinesquii*), southeastern myotis bat (*Myotis austroriparius*), and eastern spotted skunk (*Spilogale putorius*). Reptiles associated with the Pineywoods natural region of East Texas include timber rattlesnake (*Crotalus horridus*), Louisiana pine snake (*Pituophis ruthveni*), alligator snapping turtle (*Macrochelys temminckii*), and a variety of salamanders.

3.8.1 Migratory Bird Treaty Act

The Migratory Bird Treaty Act of 1918 (MBTA) states it is unlawful to kill, capture, collect, possess, buy, sell, trade, or transport any migratory bird, nest, or egg in part or in whole, without a federal permit issued in accordance with the Act's policies and regulations.

A cursory nest survey would be conducted for the Final Environmental Impact Statement (FEIS) once a preferred alternative has been selected.

3.9 THREATENED AND ENDANGERED SPECIES

The regulation of threatened and endangered fish and wildlife species in Texas has been delegated to the USFWS and the TPWD. The Endangered Species Act of 1973 (ESA) assigns the responsibility of enforcing the ESA to the Secretary of the Interior and the USFWS. Chapters 68 and 88 of the TPWD Code address the TPWD's responsibilities regarding state-listed threatened and endangered species. The study area for threatened and endangered species was evaluated against the TPWD's lists of federal and state listed threatened and endangered species for each county within the project limits.

3.9.1 U.S. Fish and Wildlife Service (USFWS)

The purpose of the ESA is to protect threatened and endangered species and their critical habitat. Under the ESA, a species may be listed as threatened or endangered. Endangered means a species is in danger of extinction throughout all or a substantial portion of its range. Threatened means that a species is likely to become endangered in the future throughout all or a substantial portion of its range. In addition, the USFWS maintains a list of "candidate" species. A candidate species is one for which there is enough information to warrant listing, but it is not listed because of higher priorities for listing other species.

3.9.2 Texas Parks and Wildlife Department (TPWD)

In 1973, the Texas legislature authorized the TPWD to develop a list of threatened and endangered animal species. In 1988, the Texas legislature further authorized the TPWD to develop a list of threatened and endangered plants for the state. Chapter 68 of the TPWD Code requires the Department to manage and ensure the conservation and preservation of indigenous fish or wildlife that are threatened with extinction in the state. The protection of threatened and endangered plants is addressed in Chapter 88 of the TPWD Code.

The TPWD maintains a database, the Texas Natural Diversity Database (TxNDD), which contains data on known locations of rare, threatened, and endangered species in the state. The TxNDD is comprised of data obtained from museum and herbarium collection records, peer reviewed publications, experts in the scientific community, organizations, qualified individuals, and on-site surveys conducted by the TPWD on public lands or private lands with written permission. However, because the majority of the state is in private ownership, substantial data gaps exist in the TxNDD data.

3.9.3 Listing and Monitoring Process

3.9.3.1 Federally-Listed Species

The ESA assigns the responsibility for determining whether to place a plant or animal on the endangered species list to the Secretary of the Interior. The Secretary of the Interior delegates the responsibility of approving petitions for listing species, the proposals for listing species, and the final listing determinations to the Director of the USFWS.

Section 4 of the ESA identifies five criteria for a species to be listed as threatened or endangered:

- the present or threatened destruction, modification, or curtailment of its habitat or range;
- overutilization for commercial, recreational, scientific, or educational purposes;
- disease or predation;
- the inadequacy of existing regulatory mechanisms; or
- other natural or manmade factors affecting its continued existence.

The proposed Segments H and I-1 of the Grand Parkway are located in Montgomery, Harris, Liberty, and Chambers counties. The federally-listed threatened and endangered species lists were obtained from the USFWS Region 2 office's website (USFWS, 2009) for these four counties and are presented in **Table 3-20**.

In addition, known locations of federally-listed threatened and endangered species were obtained from the TPWD's TxNDD (mimic version) on July 17, 2009.

Table 3-20: Federally-Listed Threatened and Endangered Species Within the Study Area

Common Name	Specific Epithet	Listing Status	County	Habitat	Habitat Potential
Bald eagle	*Haliaeetus leucocephalus*	DM[1]	Chambers, Harris, Liberty, Montgomery	Near water areas, in tall trees	Yes
Brown pelican	*Pelecanus occidentalis*	DM,E[2]	Chambers	Islands near coastal areas	No
Red-cockaded woodpecker	*Picoides borealis*	E	Liberty, Montgomery	Nests in 60+ year pines, forages in 30+ pines	Yes
Piping plover	*Charadrius melodus*	E,T[2]	Chambers	beaches and bayside mud or salt flats	No
Green sea turtle	*Chelonia mydas*	E,T[2]	Chambers	Gulf and bay system	No
Atlantic hawksbill sea turtle	*Eretmochelys imbricate*	E	Chambers	Gulf and bay system	No
Kemp's ridley sea turtle	*Lepidocheleys kempii*	E	Chambers	Gulf and bay system	No
Leatherback sea turtle	*Dermochelys coriacea*	E	Chambers	Gulf and bay system	No
Loggerhead sea turtle	*Caretta caretta*	T	Chambers	Gulf and bay system	No
Texas prairie dawn	*Hymenoxys texana*	E	Harris	Poorly drained areas in open grasslands; pimple mounds	Yes

AD – Proposed delisting; DM – Delisted taxon, recovered, being monitored for the first 5 years; E – Endangered; T – Threatened;
[1] The bald eagle is protected by the Bald and Golden Eagle Protection Act of 1940.
[2] Multiple listing statuses are indicative of species with populations and/or subspecies that fall into more than one listing status category.
Note: Species such as the Houston Toad and Whooping Crane are listed by the U.S. Wildlife Service, however, they are not listed to occur within this county by the Clear Lake office of the U.S. Fish and Wildlife Service (2009).

The TxNDD does not show any known location records for the brown pelican, piping plover, and five sea turtle species in the TxNDD for the study area. Although the TxNDD does not comprise a complete survey of all areas of the state, these species require coastal and pelagic (open sea) habitat not available within the study area. Therefore, these species are not expected to occur within the study area.

3.9.3.2 State-Listed Species

The county lists of state-listed threatened and endangered species were obtained from the TPWD's Wildlife Diversity program for the four counties located within the study area. Known location data for state-listed threatened and endangered species was obtained from the TPWD's TxNDD in July 2009. A list of state threatened and endangered species is presented in **Table 3-21**.

Table 3-21: State-Listed Threatened and Endangered Species Within the Study Area

Common Name	Specific Epithet	Listing Status[1]	County	Habitat	Habitat Potential
Houston toad	*Bufo houstonensis*	E	Harris, Liberty	Sandy soil, breeds in ephemeral pools	No
American peregrine falcon	*Falco peregrinus anatum*	T	Chambers, Harris, Liberty, Montgomery	Potential migrant	Yes
Arctic peregrine falcon	*Falco peregrinus tundrius*	SOC	Chambers, Harris, Liberty, Montgomery	Potential migrant	Yes
Bachman's sparrow	*Aimophila aestivalis*	T	Liberty	inhabits open pine forests with grassy understory or open habitats with dense ground cover of grasses and forbs	Yes
Bald eagle	*Haliaeetus leucocephalus*	T	Chambers, Harris, Liberty, Montgomery	Near water areas, in tall trees	Yes
Black Rail	*Laterallus jamaicensis*	SOC	Chambers, Harris	Salt, brackish, and freshwater marches, pond borders, wet meadows, and grassy swamps	Yes
Brown pelican	*Pelecanus occidentalis*	E	Chambers, Harris	Islands near coastal areas	No
Henslow's sparrow	*Ammodramus henslowii*	SOC	Chambers, Harris, Liberty, Montgomery	Weedy fields or cut-over areas	Yes
Mountain plover	*Charadrius montanus*	SOC	Harris	High plains or shortgrass prairie	No
Piping plover	*Charadrius melodius*	T	Chambers, Liberty, Montgomery	beaches and bayside mud or salt flats	No
Red-cockaded woodpecker	*Picoides borealis*	E	Harris, Liberty, Montgomery	Nests in 60+ year pines, forages in 30+ pines	Yes
Reddish egret	*Egretta rufescens*	T	Chambers	Brackish marshes, shallow salt ponds, and tidal flats; nests on dry coastal islands in brushy thickets	No
Snowy plover	*Charadrius alexandrinus*	SOC	Chambers, Harris	Potential migrant	Yes
Southeastern snowy plover	*Charadrius alexandrinus tenuirostris*	SOC	Chambers, Harris	beaches and bayside mud or salt flats	No
Western snowy plover	*Charadrius alexandrinus nivosus*	SOC	Chambers	Potential migrant	Yes
Swallow-tailed kite	*Elanoides forficatus*	T	Chambers, Liberty	Lowland forests, especially swampy areas, ranging into open woodland; marshes, along rivers, lakes	Yes
White-faced ibis	*Plegadis chihi*	T	Chambers, Harris, Liberty, Montgomery	Freshwater, brackish, or salt marshes	Yes
White-tailed hawk	*Buteo albicaudatus*	T	Harris	Coastal Prairies	Yes
Whooping crane	*Grus americana*	E	Harris	Winters in Aransas NWR	No
Wood stork	*Mycteria americana*	T	Chambers, Harris, Liberty, Montgomery	Prairie ponds and flooded pastures	Yes
American eel	*Anguilla rostrata*	SOC	Chambers, Harris, Liberty	Coastal waterways below reservoirs to gulf	Yes
Creek chubsucker	*Erimyzon oblongus*	T	Harris, Liberty, Montgomery	Variety of small rivers and creeks, prefers headwaters	Yes
Paddlefish	*Polyodon spathula*	T	Liberty, Montgomery	Free-flowing rivers, shallow water over gravel bars; larvae may drift from reservoir to reservoir	Yes
Smalltooth sawfish	*Pristis pectinata*	E	Chambers, Harris	Sheltered bays, on shallow banks, and in estuaries or river mouths	No

Table 3-21 (Cont.): State-Listed Threatened and Endangered Species Within the Study Area

Common Name	Specific Epithet	Listing Status[1]	County	Habitat	Habitat Potential
A mayfly	*Tricorythodes curvatus*	SOC	Montgomery	bankside vegetation	Yes
A mayfly	*Plauditus gloveri*	SOC	Montgomery	bankside vegetation	Yes
Gulf coast clubtail	*Gomphus modestus*	SOC	Liberty, Montgomery	Medium river, moderate gradient, and streams with silty sand or rocky bottoms	Yes
Texas emerald dragonfly	*Somatochlora margarita*	SOC	Montgomery	East Texas pineywoods; springfed creeks and bogs; small sandy forested streams with moderate current	Yes
Black bear	*Ursus americana*	T/SA	Liberty	Desert lowlands, high elevation forests and woodlands; rock piles, cliff overhangs, caves	Yes
Louisiana black bear	*Ursus americana luteolus*	T	Chambers, Harris, Liberty, Montgomery	Bottomland hardwoods; large, undisturbed forested areas	No
Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	T	Harris, Liberty, Montgomery	Cavity trees in hardwood forest, concrete culverts, abandon buildings	Yes
Red wolf	*Canis rufus*	E	Chambers, Harris, Liberty, Montgomery	Extirpated; Brushy, forested areas, coastal prairies	No
Plains spotted skunk	*Spilogale putorius interrupta*	SOC	Chambers, Harris, Liberty, Montgomery	Open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands	Yes
Southeastern myotis bat	*Myotis austroriparius*	SOC	Chambers, Harris, Liberty, Montgomery	Cavity trees in bottomland hardwoods, concrete culverts, and abandoned man-made structures	Yes
Creeper (squawfoot)	*Strophitus undulates*	SOC	Liberty, Montgomery	Small to large streams, prefers gravel or gravel and mud in flowing water	Yes
Fawnsfoot	*Truncilla donaciformis*	SOC	Liberty, Montgomery	Small and large rivers	Yes
Little spectaclecase	*Villosa lienosa*	SOC	Harris, Liberty, Montgomery	Creeks, rivers, and reservoirs	Yes
Louisiana pigtoe	*Pleurobema riddellii*	T	Chambers, Harris, Liberty, Montgomery	Streams and moderate-size rivers	Yes
Pistolgrip	*Tritogonia verrucosa*	SOC	Harris, Liberty, Montgomery	Stable substrate, rock, hard mud, silt, and soft bottoms	Yes
Rock pocketbook	*Arcidens confragosus*	SOC	Harris, Liberty, Montgomery	Mud, sand and gravel substrates of medium to large rivers	Yes
Sandbank pocketbook	*Lampsilis satura*	T	Harris, Liberty, Montgomery	Small to large rivers on gravel, gravel-sand, and sand bottoms	Yes
Texas heelsplitter	*Potamilus amphichaenus*	T	Liberty	Quiet waters in mud or sand and also in reservoirs	Yes
Texas pigtoe	*Fusconaia askewi*	T	Harris, Liberty, Montgomery	Rivers with mixed mud, sand, and fine gravel	Yes
Wabash pigtoe	*Fusconaia flava*	SOC	Harris, Liberty, Montgomery	Creeks to large rivers on mud, sand, and gravel	Yes
Alligator snapping turtle	*Macrochelys temminckii*	T	Chambers, Harris, Liberty, Montgomery	Deep water of rivers and canals	Yes
Atlantic hawksbill sea turtle	*Eretmochelys imbricata*	E	Chambers	Gulf and bay system	No
Green sea turtle	*Chelonia mydas*	T	Chambers, Harris	Gulf and bay system	No
Gulf saltmarsh snake	*Nerodia clarkia*	SOC	Chambers	Saline flats, coastal bays, and brackish river mouths	No

Table 3-21 (Cont.): State-Listed Threatened and Endangered Species Within the Study Area

Common Name	Specific Epithet	Listing Status[1]	County	Habitat	Habitat Potential
Kemp's ridley sea turtle	*Lepidochelys kempii*	E	Chambers, Harris	Gulf and bay system	No
Leatherback sea turtle	*Dermochelys coriacea*	E	Chambers, Harris	Gulf and bay system	No
Loggerhead sea turtle	*Caretta caretta*	T	Chambers, Harris	Gulf and bay system	No
Louisiana pine snake	*Pituophis ruthveni*	T	Liberty, Montgomery	Sandy, longleaf piney woods	Yes
Northern scarlet snake	*Cemophora coccinea copei*	T	Chambers, Liberty	Mixed hardwood scrub on sandy soils	Yes
Smooth green snake	*Liochlorophis vernalis*	T	Chambers, Harris	Gulf coastal prairies, prefers dense vegetation	Yes
Texas diamondback terrapin	*Malaclemys terrapin littoralis*	SOC	Chambers	Coastal marshes, tidal flats, coves, estuaries, and lagoons behind barrier beaches	No
Texas horned lizard	*Phrynosoma cornutum*	T	Chambers, Harris, Liberty, Montgomery	Open, semi-arid regions, with bunch grass	No
Timber/Canebrake rattlesnake	*Crotalus horridus*	T	Chambers, Harris, Liberty, Montgomery	Swamps/floodplains of hardwood and upland pine	Yes
Coastal gay-feather	*Liatris bracteata*	SOC	Harris	Black clay soils of prairie remnants	Yes
Correll's false dragon-head	*Physostegia correllii*	SOC	Montgomery	Wet soils including riverbanks, streamsides, creekbeds, roadside ditches, and irrigation channels	Yes
Giant sharpstem umbrella-sedge	*Cyperus cephalanthus*	SOC	Harris	Remnant coastal prairies	Yes
Houston daisy	*Rayjacksonia aurea*	SOC	Harris	Seasonally wet, saline barren areas	No
Texas meadow-rue	*Thalictrum texanum*	SOC	Harris	Mesic woodlands or forests	Yes
Texas prairie dawn	*Hymenoxys texana*	E	Harris	Poorly drained areas in open grasslands; pimple mounds	Yes
Texas windmill-grass	*Chloris texensis*	SOC	Chambers, Harris	Open to sometimes barren areas in prairies and grasslands	Yes
Threeflower broomweed	*Thurovia triflora*	SOC	Harris	black clay soils of remnant grasslands, also tidal flats	Yes

Source: TPWD, 2009.
[1] T-Threatened, E-Endangered, T/SA-Threatened by Similarity of Appearance, SOC – Species of Concern

The bald eagle was delisted June 28, 2007; however, it is protected by the Bald and Golden Eagle Protection Act of 1940 and by the MBTA.

The piping plover, green sea turtle, and loggerhead sea turtle are listed as state threatened species as well as being listed as threatened on the federal endangered species list. In addition, the brown pelican, red-cockaded woodpecker, Atlantic hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, and Texas prairie dawn are listed as endangered on both the state and federal endangered species lists.

In addition to the state-listed threatened and endangered species listed above, several special habitats and features occur within the study area. The rare (G4, S3) water oak (*Quercus nigra*)/willow oak (*Q. phellos*) vegetation series is known to occur within Lake Houston Park and surrounding areas. This vegetation supports many animal species, such as the state threatened Rafinesque's big-eared bat, that depend on mature, bottomland hardwood habitats. The water oak/willow oak habitat is a deciduous bottomland hardwood forest located in often-inundated floodplains of East Texas. Plant species commonly associated with this vegetation series include sweetgum (*Liquidambar styraciflua*), cherrybark oak (*Q. pagoda*), ash (*Fraxinus* spp.), and overcup oak (*Q. lyrata*). Ironwood (*Carpinus caroliniana*), eastern hop-hornbeam (*Ostrya virginiana*), deciduous holly (*Ilex decidua*), and Florida maple (*Acer barbatum*) often compose the understory of this vegetation series.

Numerous colonial waterbird rookeries associated with riparian, bottomland, wetland, swamp, and marshland areas are known to occur throughout the study area. Rookeries are common in these areas as well as along the many impoundments and lakes within the study area and along the coastal areas of Trinity Bay, Burnet Bay, and Scott Bay. Anhinga (*Anhinga anhinga*), great blue herons (*Ardea herodias*), little blue herons (*Egretta caerulea*), cattle egrets (*Bubulcus ibis*), great egrets (*Casmerodius albus*), snowy egrets (*Egretta thula*), white ibis (*Eudocimus albus*), white-faced ibis, olivaceous cormorants (*Phalacrocorax olivaceus*), and roseate spoonbills (*Ajaia ajaja*) are known to congregate and nest in rookeries throughout the study area.

According to the TxNDD, one state-listed threatened species, one state-listed species of concern, and two rare plant communities have been documented within a 1.5-mile radius of the study area. There have been no other recorded sightings of any federally- or state-listed species within close proximity of the study area. However, it should be noted that an absence of data for a particular species does not mean an absence of occurrence for threatened, endangered, and rare species.

The following are the results of the TxNDD search, including the element of occurrence identification (EOID):

- Rafinesque's big eared bat (*Corynorhinus rafinesquii*) – EOID 5412
- Threeflower broomweed (*Thurovia triflora*) – EOID 7357

- Loblolly pine-white oak-southern red oak series (*Pinus taeda*-*Quercus alba*-*Quercus falcata* series) – EOID 5487 and EOID 1489
- Water oak-willow oak series (*Quercus nigra*-*Quercus phellos* series) – EOID 1910

Those species listed in the TxNDD could potentially occur in areas of suitable habitat. Additionally, depending on the alternative ultimately selected for Segments H and I-1, the potential for appropriate habitat within the study area could exist for the American peregrine falcon, Arctic peregrine falcon, Bachman's sparrow, swallow-tailed kite, white-faced ibis, white-tailed hawk, wood stork, creek chubsucker, paddlefish, black bear, alligator snapping turtle, Louisiana pine snake, northern scarlet snake, smooth green snake, and timber rattlesnake.

The TPWD lists species of concern along with the state list of threatened and endangered species. The species of concern with potential for appropriate habitat in the four counties within the study area include Henslow's sparrow, snowy plover, western snowy plover, black rail, American eel, two species of mayfly, gulf coast clubtail, Texas emerald dragonfly, plains spotted skunk, southeastern myotis bat, creeper (squawfoot), fawnsfoot, little spectaclecase, pistolgrip, rock pocketbook, Wabash pigtoe, coastal gay-feather, Correll's false dragon-head, giant sharpstem umbrella-sedge, Houston daisy, Texas meadow-rue, Texas windmill-grass, and threeflower broomweed.

3.10 FLOODPLAINS

Floodplains (Zone A – 100 Year) in the study area are depicted on **Exhibit 3-13: Creeks and Floodplains**. The FEMA administers the National Flood Insurance Program (NFIP). All counties in the study area are participating members of the NFIP. The floodplains encountered are all Zone A. Zone A signifies a special flood hazard area that is inundated by 100-yr floods.

FEMA has examined in detail the majority of the rivers, bayous and streams within the study area and flood hazard areas were established. They delineated Zones A, 100-yr floodplains with no BFE, and Zones AE, 100-yr floodplains that exhibit BFEs that are annotated on the Flood Insurance Rate Maps, also known as FIRM panels. Both zones were digitized by FEMA as Quality Level 3 Digital FIRM (Q3). The Q3 flood data is controlled to the USGS mapping at 1:24,000 scale. The FEMA Flood Insurance Studies contain water surface profiles for the 10-, 50-, 100- and 500-yr floods.

Elevations of all types cited herein for Montgomery, Liberty, and Chambers counties are referenced to the National Geodetic Vertical Datum of 1929 (NGVD) with various updates. Harris County elevations are based on Tropical Storm Allison Recovery Project data (TSARP), which is year 2001 surface data with considerations for subsidence since 1973. TSARP technology resulted in 2-ft contour intervals for Harris County. The USGS mapping (Q3), used for the majority of the study area, is based on 5-ft contour intervals. According to the literature, a number of technical differences in the new TSARP approach make direct comparisons to the old studies or adjacent studies inappropriate. A direct relationship between TSARP in Harris County would only be established as other areas are mapped at the same level of technology.

There are three drainage basins that envelope the study area: the San Jacinto River Basin (5,600 mi^2), the transitional Trinity-San Jacinto Coastal Basin (247 mi^2) and the Lower Trinity River Basin (750 mi^2). The individual watersheds, water bodies, and floodplains for the study area would be described in a north-to-south direction, the general direction of flow. Flooding commonly occurs along all reaches of the streams studied with 100-yr velocities typically slow at less than 4.0 fps. In many cases, the peak discharges are attenuated in the downstream direction due to over bank storage. Many minor tributaries feed all major streams in the study area.

It should be noted that a floodway is considered the channel of a stream, including some adjacent floodplain area that must be kept free of encroachment. The 100-yr peak discharge conveyed within the floodway is not allowed to create substantial increase in the BFE. FEMA has instituted a 1 ft maximum increase provided high velocities are not created. The floodway fringe is the area between the floodway and the outer limits of the floodplain. For floodway computations, equal conveyance reduction from each side of the floodplain is normally used. Thus, it is possible to ascertain topographical change based on the floodway location relative to the entire 100-yr floodplain.

The East Fork San Jacinto River enters the study area from Liberty County and traverses southwest approximately 2 mi where it crosses the Montgomery County line. In the northwest portion of the study area, and beyond, the river watershed contains approximately 404 mi^2 at the confluence with Caney Creek. The watershed is primarily Pineywoods and Blackland Prairie. The river extends upstream 75 mi to US 190 in Walker County. There is approximately 9.5 mi of the river's reach within the study area. The Peach and Caney Creek watersheds exhibit similar characteristics to that of the East Fork.

The East Fork San Jacinto River channel was analyzed by FEMA with specific roughness factors (Manning's "n") that indicate a channel with a moderate degree of irregularity that occasionally alternates, has medium density of vegetation and a moderate amount of meandering. The river contains some sluggish reaches, a substantial amount of weeds and deep pools. Over bank roughness values indicate floodplains with medium to dense brush and dense forests, in parts, with flood stage reaching branches. The large drainage area of the river, coupled with flat topography, results in slow runoff and long duration flood concentrations.

The BFE at the river intersection with the northern study limits is approximately 95 ft., which translates to a 1 mi wide floodplain. The 100-yr peak discharge is approximately 57,000 cfs. Maximum water depth at flood stage is around 25 ft with a velocity of 2.5 fps. This location is within the limits of the City of Plum Grove. Approximately 2.75 mi downstream, beyond the City of Roman Forest, and near the intersection of the Montgomery, Harris, and Liberty county lines, the 100-yr floodplain widens to over 6,500 ft. The BFE is 81.0 ft at this location with the depth at the center of the channel near 26 ft. The 100-yr flow is approximately 56,000 cfs with a corresponding velocity of 3.0 fps.

As the river traverses the east side of Lake Houston Park, the 100-yr floodplain narrows to 1,500 ft in places. The junction of the river and Caney Creek binds the southern end of the park where the BFE is 57 ft. and the floodplain is approximately 1 mi wide. The river continues south for approximately 2.5 mi to the Luce Bayou junction. Here the floodplain expands to 6,000 ft at a BFE of 50.5 ft. Approximately 4,500 ft downstream, the East Fork San Jacinto River discharges into Lake Houston, just outside the study area, where the floodplain is 3,000 ft wide. The watershed at this point represents 2,900 mi^2. Normal pool elevation of the lake is approximately 44 ft. The BFE of Lake Houston is approximately 50 ft and the peak discharge of the river entering the lake is 252,000 cfs.

FEMA Q3 GIS data was used to approximate the acreages of floodway and 100-yr floodplain within the study area for each major river or stream. The estimated amounts of floodway and 100-yr floodplain are shown in **Table 3-22.**

Table 3-22: Study Area Floodways and 100-year Floodplains

Stream	Floodways within the Study area (acres)	100-year Floodplains within the Study area (acres)
Caney Creek	1077.9	2363.0
Cedar Bayou	3577.4	11817.0
East Fork Cedar Bayou	65.0	230.2
East Fork San Jacinto River	2477.8	5396.4
Luce Bayou	1899.3	4028.0
Peach Creek	893.4	2508.3
Total	**9990.7**	**26342.9**

Source: FEMA Digital Q3 Data, 2000

3.11 WILD AND SCENIC RIVERS

The Wild and Scenic Rivers Act of October 2, 1968 was enacted to preserve outstandingly remarkable rivers in free-flowing condition, and to protect their immediate environments for the benefit and enjoyment of present and future generations. There are no rivers or river segments within the study area that are listed as part of, or under study for designation to, the National Inventory of the National Wild and Scenic River System.

3.12 COASTAL BARRIERS

The Coastal Barrier Resources Act of 1982 created the John H. Chafee Coastal Barrier Resources System. The law encourages conservation of coastal barriers by restricting federal expenditures that encourage development. There are no coastal barriers located within the study area.

3.13 COASTAL ZONE MANAGEMENT

The Coastal Zone Management Act of 1972, administered by National Oceanic and Atmospheric Administration (NOAA), provides for management of the nation's coastal resources and balances economic development with environmental conservation. The Texas Coastal Management Program was approved by NOAA in 1996 to improve the management of the state's coastal resources. The southern limit of the study area abuts IH 10 (E), the Coastal Zone boundary in Chambers County.

3.14 ESSENTIAL FISH HABITAT

In 1996, Congress revised the Magnuson-Stevens Act and emphasized the need to protect fish habitat. The Act requires that fishery management plans identify essential fish habitat (EFH), areas that are necessary to fish for their basic life functions. EFH areas were obtained from the NOAA Essential Fish Habitat Mapper (NOAA, 2009). According to the NOAA, EFH for coastal migratory pelagic species, reef fish, red drum, shrimp, and stone crab is located within the study area in the East Fork San Jacinto River, to approximately 3 miles upstream from Lake Houston. Additionally, Cedar Bayou is mapped as tidally influenced up to 1.4 mi north of IH 10 (E) on the west side of Mont Belvieu and may potentially contain EFH.

3.15 CULTURAL RESOURCES

Cultural resources are structures, buildings, archeological sites, districts (a collection of related structures, buildings and/or archeological sites), cemeteries, and objects. Both federal and state laws require consideration of cultural resources during project planning. At the federal level, NEPA and the National Historic Preservation Act (NHPA) of 1966, among others, apply to transportation projects such as this one. In addition, state laws such as the Antiquities Code of Texas apply to these projects. Compliance with these laws often requires consultation with the Texas Historical Commission/Texas State Historic Preservation Officer and/or federal-recognized tribes to determine the project's effects on cultural resources. Review and coordination of this project would follow approved procedures for compliance with federal and state laws.

3.15.1 Archeological Resources

According to the Houston Potential Archeological Liability Map (PALM) GIS database compiled by TxDOT ENV, the study area traverses Map Units 1, 2, 2a, 3, 3a, and 4. For Map Unit 1, a surface survey is recommended, and deep reconnaissance is recommended if deep impacts are anticipated. For Map Unit 2, a surface survey is recommended, and deep reconnaissance is not recommended. For Map Unit 2a, a surface survey of mounds is recommended, and deep reconnaissance is not recommended. For Map Unit 3, a surface survey is not recommended; however, deep reconnaissance is recommended if deep impacts are anticipated. For Map Unit 3a, a surface survey is not recommended; however, deep reconnaissance is recommended only if severe deep impacts are anticipated. For Map Unit 4, no survey is recommended. PALM Map data is limited to only those portions of the study area which fall inside Harris and Montgomery Counties **(Exhibit 3-17: Houston-PALM)**. PALM Map data is not available for Liberty and Chambers Counties.

A review of the Texas Historical Commission's (THC) Texas Archeological Research Lab (TARL) online archeological database reveals that nine previously recorded archeological sites are present within the study area; four of these sites are in Liberty County and five in Harris County. No known archeological sites are known to exist within the study area for either Chambers or Montgomery counties. Attributes for the nine known archeological sites are summarized in **Table 3-23**. Each site is individually described below by county.

Table 3-23: Known Archeological Sites

COUNTY	SITE NUMBER	HISTORIC OR PREHISTORIC	SITE TYPE	CULTURAL AFFILIATION	NATIONAL REGISTER STATUS	FURTHER WORK
Liberty	41LB44	Prehistoric	Occupation	Unknown	Unknown	Unknown
Liberty	41LB45*	Prehistoric	Occupation	Unknown	Unknown	Unknown
Liberty	41LB46*	Prehistoric	Occupation	Unknown	Unknown	No
Liberty	41LB50	Historic	Historic House	Unknown	Unknown	Unknown
Harris	41HR313	Prehistoric	Unknown	Unknown	Unknown	Unknown
Harris	41HR639	Prehistoric	Mound	Orcoquisac	Unknown	Yes
Harris	41HR641	Prehistoric	Occupation	Unknown	Unknown	Yes
Harris	41HR642	Prehistoric	Occupation	Unknown	Unknown	Yes
Harris	41HR684	Prehistoric	Occupation	Orcoquisac	Unknown	No

*Sites destroyed by previous activities.
Source: THC, 2007

During an examination of the archeological database for each of the counties, one observation was the difference between the numbers of sites reported for each. As shown in **Table 3-24**, the number of sites per square mile varies by county. These numbers do not necessarily reflect on the occurrence of sites per county, but likely reflects the greater amount of surveys conducted in particular counties (i.e. Harris County) as to historic and prehistoric settlement patterns.

Table 3-24: Number of Archeological Sites and County Acreage

COUNTY	# OF SITES*	# OF SURVEYS	COUNTY SQUARE MILE**	SITES PER SQUARE MILE	SURVEYS PER SQUARE MILE
Chambers	402	208	606	0.7	0.3
Harris	1085	1048	1,778	0.6	0.6
Liberty	108	93	1,174	0.1	0.1
Montgomery	225	221	1,047	0.2	0.2
Average	**455**	**392**	**1,151**	**0.4**	**0.3**

* Data for archeological surveys obtained from the online Texas Archeological Sites Atlas, maintained by the THC. http://nueces.thc.state.tx.us/.
** Data for county size obtained from the Texas State Historical Association, The Handbook of Texas Online. http://www.tsha.utexas.edu/handbook/online/.

The prehistory of Texas spans at least 13,000 years from at least 11,500 B.C. to the time of the European contact in the seventeenth century. The periods of Texas' prehistory are divided into three broad periods; Paleoindian, Archaic, and the Late Prehistoric.

3.15.1.1 Paleoindian (11,500 B.C. – 6,000 B.C.)

The Paleoindian period represents the earliest known occupation in the East Central Texas. People during this period relied on mega fauna (predominantly mammoth and *Bison antiquus*) as well as broader-based hunting and gathering for their subsistence needs. Paleoindian artifacts included distinctive lanceolate projectile points, side scrapers, end scrapers, gravers, modified flake tools, and drills. These tools are sometimes found associated with the remains of extinct mega fauna species. Typically, Paleoindian sites are located near playa lakes and relict streambeds or along small rises and ridges. These sites are usually ephemeral, however, and may be difficult to recognize. Differences in topographic settings and artifact and faunal assemblages have led archaeologists to interpret Paleoindian sites in terms of function classes, based on the activities inferred to have taken place there. Typical site types of this period include campsites, kill sites, processing sites, and quarry sites. During the Paleoindian period, the climate was vastly different than it is today. It has been marked by continuous environmental change over several thousand years. During the earlier phases, the environment was wetter and cooler. Throughout the course of the Paleoindian period, the climate became increasingly arid with greater seasonal variation. These conditions resulted in shifting vegetation patterns and faunal extinctions, which, in turn, affected Paleoindian subsistence strategies, settlement patterns, and lithic technologies.

3.15.1.2 Archaic (6,000 B.C. – 700 A.D.)

The Archaic period, lasting some 5,000 to 6,000 years, is ascribed more longevity than other prehistoric cultural periods. Despite the fact that many sites in East Central Texas have been assigned to the Archaic period, relatively little is known about this time period. Subsistence adaptations, during the Archaic period, are thought to have generally changed from a reliance on big game hunting to a more broad-based hunting and foraging strategy. Archaic period occupations are distinguished from earlier and later occupations by side- and corner-notched projectile points, bifaces, flake scrapers, and drills. These sites typically consist of lithic and fire-cracked rock scatters that are often situated in areas that overlook drainages.

3.15.1.3 Late Prehistoric (700 A.D. to Historic Period)

Beginning sometime between A.D. 600 and 900 and continuing to as late as A.D. 1550, the archeological record of southeastern East Central Texas reflects increasing regional and interregional variability. Also during this period several technological developments occurred, namely the development of the bow and arrow, ceramics, and other distinctive types of stone tools. These developments marked a change of this period from the preceding Archaic. Cultural identifiers during the Late Historic Period include material culture, and hunting patterns. Settlement patterns included sedentary villages, and ceremonial centers. Social-cultural features included an established social hierarchy. One distinctive aspect of the Late Prehistoric was widespread, long-distance trade.

3.15.2 Non-Archeological Historic Resources

Project historians conducted a records search of the study area in May and June 2007. Repositories consulted included a variety of national, state, and local lists of historic site designations to identify any previously documented non-archeological historic resources in the study area. Specifically, the project historians reviewed the following:

- The National Register of Historic Places (NRHP);
- THC *Texas Historic Sites Atlas*;
- THC State Archaeological Landmarks Structure list (SAL);
- THC Recorded Texas Historic Landmarks list (RTHL);
- THC Local Survey Files;
- Official Texas Historical Markers (OTHM); and
- Texas Department of Agriculture Family Land Heritage Farm list.

The TxDOT Historic Bridge and Roadside Parks Databases were not consulted because the proposed Build Alternatives, if selected, would be on new alignment. A review was made of secondary sources to gain a general knowledge of the area's historical background. Historic city, county, and state maps were reviewed for locations of historic-age resources. The study area is not included in any Sanborn Fire Insurance Maps or city directories. Chambers, Harris, Liberty, and Montgomery County General Highway Maps were consulted for locations of farmsteads, canals, and other historic-age resources (1940, 1961 Texas State Department of Highways) within the study areas.

The Non-Archeological Historic Resources Preliminary Survey was conducted after consultation with TxDOT ENV as part of an effort involving the FHWA and the SAFETEA-LU proposal to streamline EISs, and was not meant to serve as a reconnaissance survey; rather, it was conducted during early corridor planning efforts to note, and if possible avoid, any historic-age resources that were listed, recorded, or recommended eligible for listing in the NRHP. Project historians, using historic contexts as a guide, searched for accessible and visible historic-age properties within the study area of potential effect (APE) and ROW that might be individually substantial or contribute to the significance of a historic district. Although the historians did not conduct a reconnaissance survey, historians did record historic-age resources in the proposed project APE for the various project alternatives. They did not record resources that could not be seen from the ROW and they did not have right-of-entry on any of the resources discussed. While most structures could be viewed and evaluated under these circumstances, some structures, such as canals, could not be thoroughly documented and evaluated.

3.15.2.1 Methodology

According to the First Amended 2005 Programmatic Agreement for Transportation Undertakings (PA-TU), the APE is limited to 300 feet beyond the edge of the proposed ROW because all construction for this project would be on new location. The project team contacted TxDOT ENV before beginning the Non-Archeological Historic Resources Preliminary Survey. In subsequent e-mails in July 2007, TxDOT ENV stated that the methodology for this preliminary survey was approved with reservations (because of the potential risk of having to survey all potential alignments in the future) and that no Research Design was required. As agreed, the Non-Archeological Historic Resources Preliminary Survey study area is 1300 feet beyond the edge of the proposed ROW for all corridors examined.

The Secretary of the Interior's guidelines prescribes that resources be 50 years of age or older for consideration for NRHP eligibility. Also, the PA-TU authorized among the FHWA, the Advisory Council on Historic Preservation (ACHP), the Texas State Historic Preservation Officer (SHPO), and TxDOT on December 29, 2005, prescribed the consideration of resources 50 years of age or older. However, a 45-year cut-off (45-years prior to the letting date) is suggested in the guidelines provided in the September 8, 2006 Draft of *Historic Resources Section 106 Review and NEPA Guide* published by TxDOT ENV. The term "historic-age resource or historic-age property", as it is used in this report follows the 45-year cut-off guidelines. Thus, because the projected letting date is 2018, 1973 was the cut-off date used for determining which buildings and structure sites met the historic-age criteria.

Historians reviewed historic maps of Chambers, Harris, Liberty, and Montgomery counties for locations of non-archeological historic resources, but also utilized the results of a previous report prepared by HNTB, Historic Resources Constraints (June 2006). The 2006 report provided an inventory of listed historical resources contained within the preliminary study area, which included SH 99 from US 59 (N) near Porter, Texas to IH 10 (E) in Mont Belvieu, Texas, a distance of approximately 36 miles. Currently, none of the previously listed historical resources identified in the 2006 report are located in the Non-Archeological Historic Resources Preliminary Survey Study Area or APE. A review was also made of entries in secondary sources to gain a general knowledge of the area's historical background. A complete list of resources that were consulted is included in **Appendix J (Non-Archeological Historic Resources Preliminary Survey).**

In order to determine possible historic resource constraints within the study area, it is necessary to identify the historic contexts that may exist. According to the Secretary of the Interior's *Standards* and Guidelines [As Amended and Annotated] (accessed 07/20/2009, www.nps.gov/history/local-law/arch_stnds_1.htm.), historic contexts enable the organization of properties so that they can be evaluated for historic significance. Within the study area, seven historic contexts have been identified. Each historic context is discussed briefly below.

3.15.2.2 Agricultural Resources

Agriculture, particularly rice cultivation, has been one of the primary uses of land in the study area, particularly portions of Harris, Liberty, and Chambers counties. The Gulf Coastal Plain is a low-lying geographical area which experiences natural flooding and is well-suited to this crop. Entrepreneurs developed systems of irrigation canals in the early part of the twentieth century, which greatly aided rice production.

Upon the recommendation of TxDOT ENV, HHM, Inc. conducted an intensive level historic resources survey on the Dayton Canal along SH 146, producing the 2006 report *Intensive-Level Historic Resources Survey Report, Dayton Canal Along SH 146, Liberty County, Texas* (HHM 2006). The portions of that canal system that were surveyed were determined to be eligible for listing in the NRHP under Criterion A by TxDOT ENV.

3.15.2.3 Community Development

Within the study area, there are few large towns, Mont Belvieu and Dayton being the largest. Smaller settlements in the area include, New Caney, Eastgate and Huffman. Dayton may contain historic resources relating to the rice culture, as well as the oil industry. Mont Belvieu is a highly industrialized area that has a primary economic focus on the petrochemical industry.

3.15.2.4 Engineering

Large-scale rice production required accessible transportation options and improved technology, particularly in irrigation systems and harvesting. Rice canal systems in Texas pumped water from pumping stations on rivers or lakes using centrifugal or vacuum pumps. Steam power or draft animals provided the power to dig canals which ranged in width from 20 to 150 ft.

3.15.2.5 Industry

Prospecting for oil began around 1901 primarily in the southern part of Liberty County. Oil industry-related resources are likely to be found in all four counties within the study area. Revenue from oil and gas contributed to the economic development of each of these counties. Businesses, homes, schools, parks, and libraries were just some of the benefits that most communities experienced as a result of oil and gas money. Other industries included brick production and lumber production.

3.15.2.6 Ethnic Heritage

A Bohemian/Czech settlement was located in Eastgate, a small community in western Liberty County, named for a fence gate along the Beaumont, Sour Lake, and Western Railway. Liberty County experienced a small influx of Czechoslovakian immigrants during the 1920s, part of a larger wave that immigrated to Texas during the first three decades of the twentieth century.

3.15.2.7 Recreation

The Champion Paper Company allowed recreational hunting on land that is now part of Lake Houston Park in Harris and Montgomery counties. In 1955, the San Jacinto Girl Scout Council acquired 202 ac from

Champion Realty Corporation and built Peach Creek Girl Scout Camp. In the early 1980s, the State of Texas also purchased 4,710 ac from Champion Realty Corporation to establish Lake Houston State Park and in 1990 acquired the Girl Scout Camp which was added to the state park. In 2006, TPWD transferred Lake Houston State Park to the City of Houston Parks and Recreation Department.

3.15.2.8 Transportation

After the Civil War, several railroads were constructed in the region, including the Galveston, Houston and Henderson; the Texas and New Orleans; the Houston and Texas Central; the Houston Tap and Brazoria; the Houston and Great Northern; the Trinity and Brazos Valley; the Burlington-Rock Island; the Cypress, Hockley, and Hempstead; the Beaumont, Sour Lake, and Western Railway; the Gulf, Colorado, and Santa Fe; and the Dayton-Goose Creek Railroad (another local railroad).

The Trinity River, which runs to the east of the proposed project, provided a means of moving goods to and from ships in Trinity Bay, but various obstacles made navigation further north a challenge.

By 1879, there were roads that generally followed what became the US 90 and the US 59 (N) corridors, although it would be decades before pavement and drainage made the roads reliable for transportation on a regular basis. The Interstate Highway System began in the 1950s under the Eisenhower administration; IH 10 (E) serves as the southern terminus for the project.

3.16 HAZARDOUS MATERIALS

Land uses within the study area are a mixture of industrial, commercial, residential, and agricultural. Major concentrations of developed areas are located at the northern and southern boundaries. Large rural tracts, used for farming and other types of agricultural uses, are located throughout the study area. The developed area in the northern section is primarily residential. The overall region is known for its petroleum-based industries, including numerous oil and gas refineries. These large petroleum-based facilities are located throughout the study area with a heavy concentration in the southern portion.

There are also numerous oil and gas wells including pipelines within the study area. Two salt domes are located in the study area. One is located in Mont Belvieu at the southern end of the study area and another is located northwest of Dayton in the northern portion of the study area. A salt dome can form pockets and reservoirs where petroleum and natural gas can collect. Oil from these pools can be extracted and is used as a major source of petroleum produced along the Gulf of Mexico.

Hazardous materials are generally defined as any material that has or would have, when combined with other materials, a deleterious effect on humans or the natural environment. Characterized as reactive, toxic, infectious, flammable, explosive, corrosive, or radioactive, hazardous materials may be solid, sludge, liquid, or gas. Potential hazardous materials sites include service stations, landfills, salvage yards, and industrial sites, as well as aboveground and underground storage tanks (ASTs and USTs). The EPA and TCEQ maintain various databases of regulated sites, including landfills and facilities that transport, store, and treat hazardous materials.

A records search was conducted for hazardous materials sites and/or areas of potential concern and is provided as a GIS database. In addition, the Railroad Commission of Texas (RRC) was also contacted and GIS spatial data layers were obtained providing locations of oil and gas wells and pipelines for all four counties within the study area. Ortho-photography along with limited field visits was also used in locating and defining additional areas of concern.

3.16.1 Hazardous Materials Sites

There are 933 hazardous materials sites located within the study area. **Tables 3-25** and **Table 3-26** provide a summary of the potential hazardous materials sites identified during the initial search of the study area. **Exhibit 3-14: Hazardous Materials within the Study Area** depicts the locations of the sites within the study area. Refer to **Appendix G (Hazardous Materials Database Search – Condensed Version)** for individual in-depth site information.

Table 3-25: Federal Regulatory Database Search

Database Abbreviation	Database Description	Number of Sites
NPL	*National Priorities List* – Priority sites for cleanup under the federal Superfund program. EPA has determined that these sites pose a threat to human health and remediation is required.	0
CERCLIS	*Comprehensive Environmental Response, Compensation, and Liability Information System* – Listing of Superfund sites that the EPA has investigated or is currently investigating for a release or threatened release of hazardous substances. Contains sites which are either proposed or on the NPL and sites which are in the screening and assessment phase for possible inclusion on the NPL.	1
CERCLIS –NFRAP	*CERCLIS "No Further Remedial Action Planned"* –Contains information on sites that have been removed and archived from the inventory of Superfund sites. Archive status indicates that, to the best of EPA's knowledge, federal Superfund assessment of a site is complete and it has been determined that no further steps would be taken to list the site on the NPL.	6

Table 3-25 (Cont.): Federal Regulatory Database Search

Database Abbreviation	Database Description	Number of Sites
CORRACTS	*Corrective Action Report* – Identifies Hazardous Waste Handlers with RCRA Corrective Action Activity.	6
RCRA	*Resource Conservation and Recovery Act Information* – Identifies sites that generate, transport, store, treat and/or dispose of hazardous waste.	103
ERNS	*Emergency Response Notification System* – Records and stores information on reported releases of oil and hazardous substances.	110
HMIRS	*Hazardous Material Incident Report System* – Contains hazardous material spill incidents reported to the DOT.	13
TRIS	*Toxic Chemical Release Inventory System* – Identifies facilities which release toxic chemicals to the air, water and land in reportable quantities under SARA Title III Section 313.	5
TSCA	*Toxic Substance Control Act* – Identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list.	12
FTTS	*FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)* –Tracks administrative cases and pesticide enforcement actions.	5
PADS	*PCB Activity Database* – Identifies generators, transporters, commercial storers and/or brokers and disposers of PCB's who are required to notify the EPA.	1
MINES	*Mines Master Index File* – Contains all mine identification numbers issued for mines active or opened since 1971.	1
FINDS	*Facility Index System* – Contains both facility information and 'pointers' to other sources that contain more detail.	169

Source: Environmental Data Resources (EDR), 2007

Table 3-26: State/Local Regulatory Database Search

Database Abbreviation	Database Description	Number of Sites
SHWS	*State Superfund Registry* –These sites may or may not already be listed on the federal CERCLIS list. Priority sites planned for cleanup using state funds (state equivalent of Superfund) are identified along with sites where cleanup would be paid for by potentially responsible parties.	1
LPST	*Leaking Petroleum Storage Tank* – An inventory of reported leaking petroleum storage tank incidents.	58
UST	*Underground Storage Tank* – Registered Underground Storage Tanks.	190
AST	*Aboveground Storage Tank* – Registered Aboveground Storage Tanks.	38
TxSpills	*Spills Database* – Information on hazardous spills reported to the TCEQ from 1972 to the present.	43
TxVCP	*Texas Voluntary Cleanup Program Site* –Provides an incentive to remediate Oil & Gas related pollution by participants as long as they did not cause or contribute to the contamination. Applicants to the program receive a release of liability to the state in exchange for a successful cleanup.	3
Dry Cleaners	*Dry Cleaner Registration Database* – A listing of dry cleaning facilities.	11
ENF	*Enforcement Report* – A listing of permit violations.	4
Ind. Haz Waste	*Industrial and Hazardous Waste Database* – Summary reports reported by waste handlers, generators and shippers in Texas.	142
AIRS	*Current Emission Inventory Data* – Air accounts that emit EPA criteria Pollutants.	11

Source: Environmental Data Resources (EDR), 2007

3.16.1.1 State Superfund Site

There is one state Superfund site in the study area, the Cox Road Dump (also known as Liberty Waste Disposal Landfill), which is located 1 mi north of FM 1413 on the west side of County Road 491 (Cox

Road), in Dayton (Liberty County) (Texas Secretary of State, 2006). This site was evaluated in August 2004 using the Hazard Ranking System (HRS) which is the principle screening guide used by TCEQ and was given a ranking of 13.14 (TCEQ, 2006). This ranking is used to determine if a site qualifies as a state funded or a federal funded site. In order for a location to be eligible as a federally-funded site, it must have an HRS score of at least 28.5. If the site has an HRS score between 5 and 28.5 it is eligible for designation as a state Superfund site. Therefore, the Cox Road Dump site meets the state Superfund site criteria. On February 10, 2006, a legal notice was published in the Texas Register (31 TexReg 907-908) proposing the site for listing on the state Superfund registry. The site falls within the TCEQ Region Houston-12.

The Cox Road Dump is an 83-ac landfill that was operated by the Joiner Oil Company from 1969 to 1983. The site is now owned by the Joiner Liquidating Trust. The TCEQ cited at a public meeting held March 16, 2006, that numerous parties had been identified as responsible for dumping at this location. Analytical results of soil and water as reported by TCEQ indicates the presence of arsenic, barium, boron, chromium, lead, mercury, Aroclor 1016, cadmium, cobalt, cyanide, phenol, toluene, xylene, and pesticide 4,4-DDE (TCEQ, 2006). It is still unknown at this time the extent of contamination or migration of waste into groundwater and the surrounding areas. The Cox Road Dump site was designated as a state Superfund site on the TCEQ web site March 17, 2006.

Aerial photography and site visits were used to determine the boundary for the Cox Road dump site. The boundary around the Cox Road dump site was set as a constraint for alternatives analysis and a 1-mi buffer was also created to provide adequate avoidance distances for preliminary alternatives and reducing the possibility of impacting potential contaminated areas. The size of the buffer was determined by the search criteria set by TxDOT for a state Superfund site as noted in TxDOT's *Hazardous Materials in Project Development Guidance Document* (TxDOT, 2006).

3.16.1.2 Oil Wells

The RRC Information Service Division was contacted and the digital well location mapping, including the American Petroleum Institute (API) database information, was acquired for the study area. The RRC regulates and issues permits for drilling of oil and gas wells within the State of Texas. All permitted wells are maintained in a Geographic Information Systems (GIS) database by the RRC. An estimated 6,644 oil and/or gas wells were identified within the study area for Segments H and I-1.