Final Environmental Impact Statement: Volume I

Grand Parkway (State Highway 99) Segment B:
From SH 288 to IH 45 South, Houston District
3510-01-001, 3510-01-003, 3510-02-001,
3510-02-003, 3510-02-004, & 3510-02-905
Brazoria & Galveston Counties, Texas
April 2016

Submitted Pursuant to 42 U.S.C. 4332 920 (c) and 49 U.S.C. 303 by the:
Texas Department of Transportation
Grand Parkway Association
Cooperating Agency:
U.S. Army Corps of Engineers

The environmental review, consultation, and other actions required by applicable Federal environmental laws for this project are being, or have been, carried-out by TxDOT pursuant to 23 U.S.C. 327 and a Memorandum of Understanding dated December 16, 2014, and executed by FHWA and TxDOT.

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GRAND PARKWAY (STATE HIGHWAY 99) SEGMENT B
FROM SH 288 TO IH 45 SOUTH

CSJs 3510-01-001, 3510-01-003, 3510-02-001, 3510-02-003, 3510-02-004, and 3510-02-905

BRAZORIA AND GALVESTON COUNTIES, TEXAS

FINAL ENVIRONMENTAL IMPACT STATEMENT

Submitted Pursuant to 42 U.S.C. 4332 920 (c)
and 49 U.S.C. 303 by the

Texas Department of Transportation
Grand Parkway Association

Cooperating Agency
U.S. Army Corps of Engineers

5/25/16
Date of Approval

Texas Department of Transportation

The environmental review, consultation, and other actions required by applicable Federal environmental laws for this project are being, or have been, carried-out by TxDOT pursuant to 23 U.S.C. 327 and a Memorandum of Understanding dated December 16, 2014, and executed by FHWA and TxDOT.

Comments on the FEIS (due 30 days from the date the Notice of Availability [NOA] is published in the Texas Register) should be sent to the Grand Parkway Association, Attention: Mr. David Gornet, 4544 Post Oak Place, Suite 222, Houston, Texas 77027, or to the Texas Department of Transportation, Attention: Director of Project Development, 7600 Washington Avenue (or P.O. Box 1386), Houston, Texas 77251-1386.

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April 2016

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For additional information concerning the document please contact:

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ABSTRACT: The proposed State Highway (SH) 99 (Grand Parkway) Segment B would include the construction of an approximately 28.6-mile alignment, on new location, from SH 288 to Interstate Highway (IH) 45 South through Brazoria and Galveston Counties. The proposed SH 99 Segment B would be constructed as a four-lane, controlled-access tollway facility, consisting of two lanes in each direction within a 400-foot-wide right-of-way (ROW) and auxiliary lanes between on-ramps and off-ramps where appropriate. The social, economic, and environmental impacts of the proposed SH 99 Segment B are evaluated for resources such as land use, farmland, social, economics, air quality, noise, wetlands, floodplains, water quality, biology, cultural, parklands, hazardous/regulated materials, and visual aesthetics. The Preferred Build Alternative for the proposed SH 99 Segment B (Preferred Alternative) as analyzed in the Final Environmental Impact Statement (FEIS) is comprised of minor alignment adjustments made to the Draft Environmental Impact Statement (DEIS) Recommended Alternative that were made after the August 2012 Public Hearing. The Preferred Alternative was chosen as the Alternative Alignment that would best fulfill the need for and purpose of the transportation improvements, while also minimizing impacts to social, economic, and environmental resources. The Preferred Alternative would require new ROW (approximately 1,072 acres), the adjustment of utility lines, and the filling of aquatic resources, including jurisdictional wetlands. Thirteen business and 17 residential displacements would occur. Archeological resources and non-archeological historic-age resources are still under review at the present time. No threatened or endangered species would be impacted. A total of 31 noise receiver locations would experience noise impacts from the Preferred Alternative.

Comments on the FEIS are due by July 11, 2016 and should be sent to:

The Grand Parkway Association
7600 Washington Avenue
Houston, Texas 77007
E-mail: segmentbcomments@grandpky.com
Attn.: Mr. David W. Gornet

Or:

Texas Department of Transportation, Attention Director of Project Development
7600 Washington Avenue (or P.O. Box 1386)
Houston, Texas 77007 (77251-1386)

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EXECUTIVE SUMMARY

The State Highway (SH) 99 Segment B from SH 288 to Interstate Highway (IH) 45 South would be a four-lane, controlled-access toll road with discontinuous frontage roads on a new location. The proposed SH 99 Segment B's 400-foot right-of-way (ROW) would accommodate one of the following typical roadway sections:

- A four-lane section without frontage roads,
- A four-lane section with frontage roads, or
- A four-lane section with exit and entrance ramps.

The proposed SH 99 Segment B would have independent utility and logical termini that would provide for a continuous highway facility and access to many of the region's existing roadways, including SH 288, SH 6, SH 35, Farm-to-Market (FM) 517, FM 528, FM 646, FM 1462, FM 2403, and IH 45 South.

The Environmental review, consultation, and other actions required by applicable Federal environmental laws for this project are being, or have been, carried-out by TxDOT pursuant to 23 U.S.C. 327 and a Memorandum of Understanding dated December 16, 2014, and executed by Federal Highway Administration (FHWA) and the Texas Department of Transportation (TxDOT).

ES 1 PROJECT NEED AND PURPOSE

The Grand Parkway, in its entirety, was conceived in the 1960s as an approximate 180-mile circumferential, four-lane, controlled-access facility around the greater City of Houston (Houston) area. In general, the Grand Parkway, and specifically the proposed SH 99 Segment B, is needed for the following reasons.

- **System linkage:** The existing transportation system does not allow for efficient circumferential traffic movement (i.e., the current system does not provide efficient connections or linkages between major suburban communities and major roadways that radiate outward from Houston).
- **Expanded capacity:** Transportation demand exceeds the current and future capacity of the existing transportation system.
- **Safety (hurricane evacuation route):** Many radial roadways leading outside of the greater Houston area are characterized by conditions that result in higher congestion during peak travel times or emergency events. Because radial facilities leading into the greater Houston area converge near the center of the City, bottlenecks are created causing increased congestion, especially during an evacuation event. Therefore, there is a need to provide an additional circumferential roadway that would allow evacuees to bypass the greater Houston area.
- **Economic development:** The expected growth in population is likely to continue to strain existing transportation infrastructure, which, in turn, would create a barrier to businesses, commuters, and economic development. With an increasing population and corresponding

increases in traffic and congestion throughout the region, it could become progressively more difficult for businesses to function efficiently.

ES 1.1.1 Purpose

The purpose of the proposed SH 99 Segment B is to efficiently link suburban communities and major roadways, to enhance mobility, to respond to economic growth, and to provide an additional hurricane evacuation route.

ES 2 ALTERNATIVES ANALYSIS

ES 2.1 Transportation System Improvement Options

Various transportation system improvements were analyzed as potential options by which to improve the existing transportation facilities or provide additional methods of travel to enhance and facilitate the movement of people and goods.

ES 2.1.1 Description of Alternative Transportation Modes

Six modal alternatives were initially considered: extending bus transit service, increasing bus/public transit options, adding high occupancy vehicle (HOV) lanes, expanding rail transit service, enhancing bicycle and pedestrian facilities, and adding single occupancy vehicle (SOV) capacity on the existing roadways or via a new controlled-access highway. Based on projected growth and development within the region, each of the proposed transportation improvement would not adequately address the need for expanded capacity. The modal alternatives would also not provide system linkage, an additional emergency evacuation route, or the support of economic development. Therefore, the modal alternatives, as stand-alone options to solve the needs of the study area, were eliminated from further consideration.

ES 2.1.2 Transportation System Management (TSM) Alternatives

Transportation System Management (TSM) alternatives are low-cost, small-scale projects that intend to improve the efficiency of a roadway or highway (e.g., park-and-ride lots, ridesharing, traffic signal coordination). TSM alternatives alone cannot provide the long-range capacity required to improve system linkage or to develop the economic vitality of the area. Additionally, TSM alternatives do not provide sufficient improvements for additional emergency evacuation. As such, the TSM alternatives were also eliminated from further consideration.

ES 2.1.3 Travel Demand Management (TDM) Alternatives

Travel Demand Management (TDM) alternatives are low-cost, small-scale improvements and programs designed to change commuter travel patterns and create a more efficient use of the existing traffic systems (e.g., mass transit, carpool/vanpool programs, and the active support of flextime work hours and telecommuting). However, the low-density, rural character of a large portion of the study area, coupled with limited accessibility to transit and other alternatives to driving, limit the application of many TDM measures. TDM alternatives would not address the need for additional capacity and would not materially contribute to congestion relief, system linkage, additional emergency evacuation routes, and economic development. Therefore, the TDM alternatives were eliminated from further consideration.

ES 2.1.4 No-Build Alternative

The No-Build Alternative anticipates that future travel demand would be met using existing and planned roadway and transportation facilities. Linkage, capacity, evacuation, and economic needs would be addressed through using the collective system of existing transportation facilities and the construction of planned and committed local improvements within the study area as defined in Houston-Galveston Area Council's (H-GAC's) *2040 Regional Transportation Plan (RTP)*, exclusive of the proposed SH 99 Segment B (H-GAC 2015).

ES 2.2 Transportation System Improvements Selected for Further Study

ES 2.2.1 No-Build Alternative

The No-Build Alternative would represent an initial cost savings compared to the build alternatives. However, there would be higher maintenance requirements and user costs on existing roadways because of the increased traffic volumes and travel delays. The No-Build Alternative would also require additional short-term restoration and improvements to continue any semblance of operational efficiency and safety on the existing roadways. Traffic congestion during periods of required roadway maintenance and reconstruction would be more frequent under the No-Build Alternative. The No-Build Alternative would also not provide system linkage, economic development, and an additional emergency evacuation route to relieve anticipated congestion on the existing major arterial roadways leading away from the coast.

While the No-Build Alternative fails to satisfy the need and purpose of the proposed SH 99 Segment B, it is retained as a basis for comparison with the transportation system improvement options carried forward for detailed study as required by the Council on Environmental Quality (CEQ) regulations.

ES 2.2.2 Build Alternatives

Construction of a new alignment was determined to best meet the need and purpose of the proposed SH 99 Segment B. A controlled-access highway on new ROW, with the possible incorporation of portions of existing ROWs, would provide an alternate travel route for traffic moving between SH 288 and IH 45 South. The option would be expected to relieve congestion on existing roadways presently used by the traveling public traversing the study area. A newly constructed, controlled-access highway would also provide system linkage, a new route for evacuation during emergency situations, and economic development opportunities within the study area and the greater Houston area.

A variety of 400-foot-wide corridor components were generated that, when combined, would traverse the length of the proposed SH 99 Segment B study area from SH 288 to IH 45 South. The intent of aligning components through undeveloped areas was to minimize potential impacts to exiting roadways and residential, commercial, and industrial areas. A total of 16 possible alternative highway alignments were developed. Various parameters were used to compare and evaluate the 16 alignments, which led to the selection of three representative Alternative Alignments. Subsequent coordination with property owners, residents, and representatives from the City of Alvin (Alvin) resulted in the consideration of additional Alternative Alignments. In all, a total of seven Alternative Alignments were evaluated, the Northern, Northern 2, Central, Central-South, Southern, South-New, and Southern 2 alternatives.

ES 2.2.3 Selection of a Preferred Build Alternative

After review of public and agency input and evaluation of environmental, engineering, and traffic criteria, the South-New Alternative was selected as the Preferred Build Alternative for the proposed SH 99 Segment B (Preferred Alternative). The South-New Alternative received the most support from the general public and elected officials.

The Preferred Alternative would be a four-lane rural, controlled-access toll road on a new location that would fulfill the purpose and need of the proposed SH 99 Segment B. The Preferred Alternative would begin at SH 288 and continue to IH 45 South and would consist of an open-ditch design within a 400-foot-wide ROW. The total length of the Preferred Alternative would be approximately 28.6 miles and would require approximately 1,072 acres of new ROW and 391 acres of existing ROW.

The Preferred Alternative would be consistent with the *2040 RTP* that identifies the addition of tolled facilities, including the proposed SH 99 Segment B, as necessary to address congestion and future growth in the H-GAC planning region. The estimated construction cost for the proposed SH 99 Segment B, per the *2040 RTP* (September 11, 2015), would be approximately $1.2 billion, and it is anticipated that the proposed SH 99 Segment B would be completed and open to traffic in 2035.

ES 3 ENVIRONMENTAL ISSUES

ES 3.1 Land Use

The Preferred Alternative would convert approximately 1,072 acres (0.01 percent) of existing land use in the proposed SH 99 Segment B study area into new ROW for a transportation use. (Additionally, 391 acres of existing ROW would be used for the Preferred Alternative.) Land use would be converted from primarily vacant/developable land (864.01 acres) to a transportation use. Residential land use (81.76 acres) would be the next most prevalent land use category converted within the Preferred Alternative's ROW.

Many of the cities and communities anticipate construction of the proposed SH 99 Segment B and have included the future highway on many area maps as "proposed" or "future." Based on interviews that were held with local officials in the region, the proposed SH 99 Segment B and the associated Preferred Alternative would be in conformance with many of the current and forecasted land use policies.

ES 3.2 Geology, Soils, and Farmlands

The Preferred Alternative would traverse similar topography consisting of broad, flat plains on predominantly clayey substrate of the Beaumont Formation and alluvial deposits and soils that primarily have a high shrink-swell potential. Geologic resources (i.e., faults) in the study area are influenced by regional conditions that have the potential to impact the Preferred Alternative. Where unavoidable impacts occur, mitigation measures would offset the impact to the various geological resources. Special consideration would also be given to the selection of materials for fill and the design of the roadbed.

The Preferred Alternative would impact 1,305 acres of Prime Farmland in the study area. Of the 1,305 acres of impacted Prime Farmland Soils, 1,072 acres of this would be new ROW that would be converted to transportation land use. The remaining 233 acres are located within exiting ROW.

A Farmland Conversion Impact Rating Form for Corridor Type Projects (NRCS-CPA-106) calculated the relative impact of the Preferred Alternative on prime farmland. Land evaluation and site assessment scores estimate the value of the impacted farmland and can add up to a maximum of 260 points. A critical score is 160 points, with a project receiving a score less than 160 points being given a minimal level of consideration for protection.

Per coordination with the NRCS it was determined that the critical score for the proposed project would be 174. As this is above 160, the NRCS recommends that alternatives that would not convert prime farmland soils, or attempts to minimize the conversion of farmland soils be considered in final project development. Coordination with the NRCS will continue. For copies of agency coordination letters please see ***Appendix B.***

ES 3.3 Social Characteristics

ES 3.3.1 Neighborhoods and Community Cohesion

While the proposed SH 99 Segment B study area largely exists within rural areas, there are over 100 existing neighborhoods/subdivisions located within or near the study area. Using a buffer of 2,000 feet along the Preferred Alternative, it was determined that there would be no community cohesion impacts with the implementation of the Preferred Alternative. During construction, short-term impacts would occur because of the movement of workers, equipment, and materials throughout the study area. Coordination between TxDOT and landowners regarding detours, construction scheduling, and access to the area during construction would help minimize the temporary disruptions. Overall, construction of the Preferred Alternative would benefit adjacent neighborhoods by improving mobility.

ES 3.3.2 Community/Public Resources

No churches, cemeteries, community services (e.g., police, fire, and emergency medical services), parks and recreational facilities, or other public facilities would be directly impacted by the Preferred Alternative. There would also not be a Section 4(f) impact as a result of the Preferred Alternative. In the short term, there may be an increase in traffic congestion and potential changes in traffic patterns during construction, but the effects would be temporary, and access to community and public facilities would be maintained during construction activities.

ES 3.3.3 Displacements and Relocations

The Preferred Alternative would potentially cause 17 residential, 13 business, and 34 other (e.g., parking areas, cell tower, and outbuildings) displacements. However, within the proposed SH 99 Segment B study area, adequate housing and areas for commercial business relocations would be available to accommodate the relocations. It would be anticipated that residents and businesses would relocate within the study area.

ES 3.3.4 Environmental Justice

Although minority and low-income populations may be affected by residential relocations, increased traffic noise, and short-term impacts related to air quality and noise, impacts would occur throughout the study area and would not be limited to or would not disproportionally impact minority and low-income populations. Regarding impacts related to tolling, there would be no potential for a disproportionate negative effect to environmental justice (EJ) populations from the proposed SH 99 Segment B. Instead, the entire region, including the analyzed EJ zones, would experience a benefit in travel time savings. However, potential users who are unable to afford the toll or maintain a toll tag (e.g., some low-income populations) would be denied the travel benefit of reduced travel time associated with using the tolled facility.

A notice announcing the availability of the Final Environmental Impact Statement (FEIS) would be published in local newspapers in English and Spanish to allow the public (including minority and low-income populations) the opportunity to comment on the Preferred Alternative. Persons who own property directly adjacent to the proposed ROW would receive the meeting notice.

ES 3.4 Economics

ES 3.4.1 Property Tax Revenue

Long-term economic effects of the Preferred Alternative would include the permanent removal of taxable property (for ROW acquisition) in Brazoria and Galveston Counties from the tax rolls of local government entities and ISDs. The largest direct loss of future tax revenues as a result of proposed ROW acquisition would be to the major taxing jurisdictions. The loss of taxable property may be offset by increased values of land adjacent to the Preferred Alternative as new development occurs. In addition, new businesses that may develop adjacent to the Preferred Alternative would generate new employment opportunities, income potential, sales tax, and other business tax revenues.

ES 3.4.2 Employment and Income during Construction

Construction of the Preferred Alternative would have direct, indirect, and induced effects on local, regional, and state employment, output, and income. Overall, the Preferred Alternative would contribute $1.0 billion of direct and indirect income and create 32,901 jobs in and around the study area and for the larger regional economy.

ES 3.4.3 Long-term Employment Growth

Implementation of the Preferred Alternative would provide additional access within the study area and would likely induce growth and development in the long term. The Preferred Alternative may also help to facilitate economic growth by facilitating and possibly accelerating projected employment growth within some traffic analysis zones (TAZs) because of improved mobility and accessibility within the study area.

ES 3.5 Pedestrians and Bicyclists

Pedestrian and bicycle facilities were identified within and adjacent to the Preferred Alternative. Although pedestrian and bicycle facilities are not planned for the Preferred Alternative, construction and operation

of the Preferred Alternative would not disrupt the use or expansion of existing or future pedestrian or bicycle facilities in the study area.

ES 3.6 Air Quality

The proposed action is consistent with H-GAC's financially constrained *2040 RTP* and the *2015-2018 TIP*, as amended, which were initially found to conform to the TCEQ State Implementation Plan (SIP) by FHWA and FTA on September 11, 2015 and December 2, 2014, respectively. Copies of the *RTP* and *TIP* pages are included in ***Appendix A***. All projects in the *2015-2018 TIP* that are proposed for federal or state funds were initiated in a manner consistent with federal guidelines in Section 450, of Title 23 CFR and Section 613.200, Subpart B, of Title 49 CFR.

The average annual daily traffic projections for the project do not exceed 140,000 vehicles per day (vpd), and traffic data for the design year 2035 is ranges from 5,638 to 26,525 vpd. Therefore, a Traffic Air Quality Analysis was not required.

Under the Preferred Alternative in the design year, it is expected that there would be slightly higher mobile source air toxic (MSAT) emissions in the study area relative to the No-Build Alternative. However, the EPA's vehicle and fuel regulations would bring about significantly lower MSAT levels for the area in the future than today.

In an effort to reduce congestion and the need for SOV lanes in the region, TxDOT and H-GAC will continue to promote appropriate congestion reduction strategies through the Congestion Mitigation and Air Quality program, the Congestion Management Process (CMP), and the *2040 RTP*. The congestion reduction strategies considered for this project would help alleviate congestion in the SOV study area boundary, but would not eliminate it.

The construction activity phase of this project may generate a temporary increase in MSAT emissions from construction activities, equipment, and related vehicles. However, considering the temporary and transient nature of construction-related emissions, as well as the mitigation actions to be utilized, it is not anticipated that emissions from construction of this project would have any significant impact on air quality in the area.

ES 3.7 Noise

The Preferred Alternative would result in a traffic noise impact on 31 noise representative receiver locations, and noise abatement in the form of noise barriers was determined to provide the best abatement to reasonably and feasibly mitigate traffic noise impacts. Based on preliminary analysis, five noise barriers were considered reasonable and feasible for 12 impacted representative receivers. The final decision to construct each proposed noise barrier would not be made until after the completion of the proposed SH 99 Segment B design, utility evaluation, and polling of adjacent property owners.

Noise associated with the construction of the Preferred Alternative is difficult to predict. However, none of the receivers are expected to be exposed to construction noise for a long duration; therefore, any extended disruption of normal activities is not expected. Provisions will be included in the plans and

specifications that require the contractor to make every reasonable effort to minimize construction noise through abatement measures.

ES 3.8 Water Quality

ES 3.8.1 Surface Water

The Preferred Alternative would cross four larger streams and numerous smaller streams and drainages. The Preferred Alternative would also result in approximately 461 acres of impervious cover, which would represent approximately 0.12 percent of the total area of the watersheds traversed by the Preferred Alternative. Potential effects of the Preferred Alternative would generally occur from construction-related activities, highway and bridge runoff, and maintenance-related work associated with the long-term operations. However, construction, operation, and maintenance activities would not result in contamination to or adverse effect on a public water supply, as water sources are typically obtained from underground aquifers rather than from surface water sources.

A stormwater pollution prevention plan (SW3P) would be developed in accordance with TxDOT policies, and coordination with the Texas Commission on Environmental Quality (TCEQ) would be conducted to comply with Texas Pollutant Discharge Elimination System (TPDES) Construction General Permit requirements. Temporary and permanent erosion control practices would be in place prior to and during the construction period and would be maintained throughout construction to minimize impacts to surface water quality. Contractors would take appropriate measures to prevent or minimize and control hazardous material spills in construction assembly areas.

ES 3.8.2 Groundwater

Potential adverse effects on groundwater quality would be related to stormwater discharges from both the construction and the operation of the Preferred Alternative. Potential adverse effects to groundwater quality because of spills would be minimized by the characteristically low permeability of the clayey soils and clay substrate. Stormwater control practices would also be implemented so that construction and operation of the Preferred Alternative would have minimal, if any, impact to regional groundwater resources.

ES 3.8.3 Public Drinking Water Systems

Five public water supply wells would occur within 0.25 mile of the Preferred Alternative. Two wells would be within the proposed ROW of the Preferred Alternative and would be directly impacted. Eight private water wells would be located within 0.25 mile of the Preferred Alternative ROW. One well would be directly impacted by the Preferred Alternative. Wells occurring within the Preferred Alternative ROW would be plugged and abandoned according to TCEQ regulations to eliminate the potential for impacts to groundwater resources.

ES 3.9 Wetlands and Other Waters of the U.S.

ES 3.9.1 Navigable Waters of the U.S.

Geisler Bayou (in the eastern portion of the study area) is identified as a tidal water segment. Coordination with the U.S. Coast Guard would be required to construct a bridge structure over Geisler Bayou, and coordination with the U.S. Army Corps of Engineers (USACE) may be required to authorize discharges into tidal (Section 10) waters to construct the bridge.

ES 3.9.2 Waters of the U.S.

Through identification and delineation of potentially jurisdictional waters of the U.S., approximately 25.2 acres of streams, canals, drainageways, and ponds (i.e., non-wetland waters) have been identified within the Preferred Alternative ROW. The Preferred Alternative's crossing of four bayous and three irrigation canals would likely be bridged, and smaller waters of the U.S. would either be bridged or placed within culverts. Other waters of the U.S. would likely be filled during construction. Specific impacts to jurisdictional waters of the U.S. would be identified during final design, and coordination with the USACE would be conducted for required permits.

ES 3.9.3 Wetlands

Despite planning efforts to avoid and minimize impacts to wetlands, the distribution of wetlands within the Preferred Alternative ROW and the geometric configuration of the proposed highway's design would make complete avoidance impractical.

Right of entry was not granted for approximately 70 percent of the Preferred Alternative ROW. As such, a detailed delineation of waters of the U.S., including wetlands, could not be performed. Instead, USGS 7.5-minute topographic quadrangle maps, recent color aerial photography, and available LiDAR data were reviewed to determine the location of potential wetlands, and observations were made at locations in which right of entry was granted to verify desktop findings. An estimated 142 wetlands totaling approximately 54.5 acres were identified within the Preferred Alternative ROW.

A USACE permit application would be prepared for impacts to jurisdictional waters of the U.S. regulated under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act. A compensatory mitigation plan would be included as part of the permit application. Water quality certification as required by Section 401 of the Clean Water Act would be assessed by the TCEQ as part of the USACE permit review process.

ES 3.10 Vegetation and Wildlife

ES 3.10.1 Vegetation

Vegetation impacts would occur primarily to agricultural land and grasslands/pasturelands, as the areas comprise the majority of the Preferred Alternative ROW. Construction of the Preferred Alternative would permanently remove agricultural land and pastureland from crop production and livestock pasture. However, agricultural land and pastureland immediately adjacent to the Preferred Alternative would

likely remain available for such uses. Riparian, woodland, and urban areas would also be permanently converted to maintained herbaceous ROW.

Construction activities would unavoidably affect vegetative communities, potentially fragmenting habitat, reducing riparian and other vegetation, and modifying hydrologic flows. Riparian vegetation is a relatively small component of the vegetation types within the Preferred Alternative ROW. Some disturbance of stream and drainage channels may occur as riparian vegetation is removed during construction, but the condition would be temporary, as the areas would be revegetated with predominantly herbaceous species that would be maintained according to standard TxDOT practices.

ES 3.10.2 Wildlife

Construction of the Preferred Alternative would permanently convert agricultural, woodland, and other habitats to highway ROW, reducing the overall area of habitat, fragmenting the habitat types, and possibly eliminating less mobile animals or animals that seek cover in debris or fallen vegetation from the movements of heavy equipment during construction. Displaced wildlife retreating to similar adjacent or nearby habitat may be affected by isolation from other populations, crowding, and increased competition for available food resources. Operation and maintenance of the Preferred Alternative would potentially result in direct impacts to wildlife from vehicle collisions and the possible introduction of roadway pollutants. Wildlife diversity and species composition would be altered as a result of construction, but no long-term impacts to wildlife populations would be expected.

ES 3.11 Threatened and Endangered Species

Potential habitat for federally-listed threatened or endangered species would not be expected to occur within the Preferred Alternative ROW, but potential habitat for state-listed threatened or species of greatest conservation need (SGCN) would be present. An occurrence of two state-listed SGCN has been recorded within 1.5 miles of the Preferred Alternative ROW. Construction of the Preferred Alternative would not be expected to impact any federally or state-listed threatened and endangered species or habitat suitable for supporting such species.

Through limited field investigation and the interpretation of aerial photography, LiDAR, and existing records, habitat types (e.g., open fields, abandoned pasture and farmland, forests, and forested and emergent wetlands) would exist within the proposed ROW of the Preferred Alternative. Further field investigations would be conducted when right-of-entry is obtained to determine if suitable threatened and endangered species habitat would occur within the Preferred Alternative ROW. Should threatened or endangered species be determined to occur within the ROW, coordination with the USFWS and TPWD would commence to establish the need for further investigations or possible consultation under Section 7 of the Endangered Species Act.

ES 3.12 Floodplains

Portions of the Preferred Alternative would traverse areas that are designated by the Federal Emergency Management Agency (FEMA) as Special Flood Hazard Areas. A hydraulic study would be conducted during the design phase of the Preferred Alternative to evaluate existing floodplains and predicted

stormwater runoff. The Preferred Alternative would be designed not to increase the risk of flooding by incorporating necessary drainage features, such as culverts and bridges, into the design.

ES 3.13 Wild and Scenic Rivers

The Preferred Alternative would not be located in the vicinity of any rivers or river segments listed in the National Inventory of the National Wild and Scenic River System. Therefore, no impacts would be expected.

ES 3.14 Coastal Barriers

The Preferred Alternative would not be located on a coastal barrier island and are not included on the Coastal Barrier Resource System map. Therefore, no impacts to coastal barrier resources would be expected.

ES 3.15 Coastal Zone Management Plan and Essential Fish Habitat

The eastern terminus of the Preferred Alternative (ending at IH 45 South) would border the Texas Coastal Management Zone boundary. Additionally, the boundary encroaches into the southern portion of the proposed SH 99 Segment B study area along Chocolate Bayou, south of the intersection of SH 35 and Chocolate Bayou. Formal coordination with the General Land Office would be required to ensure consistency with the Texas Coastal Management Program. A bridge permit from the U.S. Coast Guard would be required for the proposed roadway crossings of Geisler Bayou.

According to TCEQ's Texas Water Quality Inventory, Geisler Bayou is the only tidally-influenced water body that would be crossed by the Preferred Alternative. Therefore, the Preferred Alternative could potentially impact essential fish habitat and would be subject to the Magnuson Stevens Fishery Conservation and Management Act. Coordination with the National Marine Fisheries Service was initiated October 1, 2015 and is still in progress (***Appendix E***). Potential impacts to essential fish habitat would be identified following final design of the Preferred Alternative. Should adverse impacts to essential fish habitat be identified for the tidal waters of Geisler Bayou occurring within the Preferred Alternative ROW, additional coordination with the National Marine Fisheries Service would be conducted as part of the required coordination process.

ES 3.16 Cultural Resources

ES 3.16.1 Archeological Resources

Of the 30 percent of the Area of Potential Effect (APE) that was examined for archeological resources, no further archaeological work is recommended. However, investigation should still occur in those portions of the study area where right-of-entry was not granted prior to construction. Additionally, once the state has taken ownership of the Preferred Alternative ROW, backhoe work should be conducted within the areas the Potential Archeological Liability Map (PALM) model recommends for deep reconnaissance.

The proposed SH 99 Segment B will be coordinated according to the First Amended Programmatic Agreement for Transportation Undertakings (PA-TU) among the FHWA, TxDOT, the Texas Historical

Commission (THC), and the Advisory Council on Historic Preservation (ACHP) and Memorandum of Understanding (MOU) between TxDOT and the THC (13 Texas Administrative Code (TAC) 26.14(e)(1) and 43 TAC 2.24(e)(1)) to ensure that any archeological materials associated with proposed SH 99 Segment B construction would be properly evaluated, including any accidental discovery that arises following the archeological field survey. If archeological materials or human remains are identified within the Preferred Alternative ROW during construction, or a department-designated material source, all construction and related activities must cease. The find is to be reported to the TxDOT project inspector or the area engineer in accordance with TxDOT's Emergency Discovery Guidelines. If archeological materials or human remains are introduced into the Preferred Alternative ROW or easements in materials obtained from a material source under option to the contractor, all use of materials from the source must cease and the find reported to TxDOT project inspector or the area engineer in accordance with TxDOT's Emergency Discovery Guidelines.

ES 3.16.2 Historic Non-Archeological Properties

There are three previously determined or recommended National Register of Historic Places (NRHP)-listed or eligible resources within the APE; the ca. 1908 American Rice Canal (Resource 54); the ca. 1925 Briscoe Canal (Resource 16); and the 1935 South Texas Water Company Canal (Resource 1). The three structures are considered locally significant under Criterion A in the area of agriculture for their associations with rice cultivation. The Briscoe Canal may also be eligible under Criterion B in the area of agriculture for its associations with its founder, and the South Texas Water Company Canal may be eligible under Criterion C in the area of engineering as an excellent example of its type. These canal systems retain a high degree of integrity. For more detailed information on the evaluation of these resources as well as a description of Criterion B and C.

Although the three canals consist of miles of linear canal, the APE crosses each feature only once. Because the Preferred Alternative would require no property from the parcels on which the three resources are located, it is anticipated that there would be no direct effect to the resources. It is recommended that the design plans protect each resource with a design that the resource be spanned by pilings or bents separated from the resource by a 20-foot buffer. No components of the Preferred Alternative would physically impact the three resources, and their historic function, the ability to carry water, would be maintained.

Pursuant to Stipulation VI "Undertakings with the Potential to Cause Effect" of the PA-TU among FHWA, the State Historic Preservation Office, ACHP, and the TxDOT MOU, TxDOT Environmental Division historians will determine NRHP eligibility for the historic-age resources identified in the Historic Resources Survey Report. TxDOT is committed to avoiding impacts to historic-age resources determined eligible. Because the design is preliminary and detailed design plans are not yet available, it is not currently possible to evaluate effects to historic-age resources. Further information concerning the avoidance of direct and indirect impacts to NRHP-eligible resources will be addressed later in the project development process. TxDOT ENV will determine if the proposed SH 99 Segment B would have no

adverse effect to any historic-age resources. Because the proposed SH 99 Segment B is a major federal action requiring the preparation of an EIS, individual project coordination with the SHPO is anticipated.

ES 3.17 Hazardous Materials

Construction of the Preferred Alternative would have a low potential for intensifying hazardous material impacts on the environment. Impacts associated with hazardous materials would most likely occur during construction and would be related to activities on or near the existing 53 hazardous material sites. It is anticipated that a Phase II Environmental Site Assessment would be required for any high or moderate risk sites that would be adjacent to the Preferred Alternative ROW.

The relocation and removal of all existing structures along the Preferred Alternative ROW would require completing asbestos and lead-based paint surveys. Asbestos and lead-based paint inspections, specifications, notification, license, accreditation, abatement, and disposal (as applicable) would comply with all federal and state regulations. Asbestos and lead-based paint issues would be addressed during ROW acquisition and prior to construction.

Twenty of the approximately 117 oil and gas well sites in the proposed SH 99 Segment B study area would be within or adjacent to the Preferred Alternative ROW. Oil and gas wells located within the proposed ROW of the Preferred Alternative would be plugged. Additional investigation would be warranted at any of the sites prior to ROW acquisition. The Preferred Alternative would cross 42 petroleum pipelines. During ROW acquisition, additional investigation would be required to determine if removal or adjustments to the pipelines would be necessary.

ES 3.18 Visual and Aesthetic Qualities

Construction of the Preferred Alternative would remove existing vegetation and introduce a new visual element in the immediate area of the proposed roadway, which would alter the rural setting in some portions of the study area. Where practical, mitigation measures would establish vegetation within medians, minimize ROW clearing design specifications in order to blend into the existing landscape, and promote roadside native wildflower planting programs. Traffic noise, electronic toll collection gantries, and ambient light levels would also be introduced by the Preferred Alternative. If appropriate, noise barriers would be constructed to minimize noise intrusion. Ambient light levels would be considered during final design so as to not impose an undue burden on residents living near the Preferred Alternative. To the extent possible, the Preferred Alternative would be designed to create a visually and aesthetically pleasing experience for the traveler and the adjacent residents and landowners.

ES 3.19 Energy

Energy, in the form of various fossil fuels and electricity, would be necessary during construction, maintenance, and future repair of the Preferred Alternative. Following construction, maintenance and highway repairs would also require energy use. However, the Preferred Alternative would ease congestion by diverting vehicles from current travel routes. Decreased vehicle delays and more efficient vehicle operating speeds would allow for increased energy efficiency. Long-term operational energy savings would be expected to offset the initial energy requirements to construct the Preferred Alternative.

ES 3.20 Construction Impacts

Construction of the Preferred Alternative would affect residents, businesses, and the traveling public in the study area. However, construction impacts would be temporary, and work would be planned and scheduled to maintain the flow of traffic on the existing roadway network and to minimize adverse impacts to travelers. Best management practices (BMPs) for erosion and sediment control would be implemented during construction to minimize or prevent the introduction of pollutants into area waters. Coordination with utility vendors or officials would be conducted to coordinate work schedules to minimize impacts to and avoid disruption of utility facilities.

ES 3.21 The Relationship between Local Short-term Uses versus Long-term Productivity

Short-term uses of the environment associated with the Preferred Alternative would be typical of roadway construction and would have limited impacts. The primary long-term benefits of the Preferred Alternative would be improved local and regional system linkage, decreased congestion, increased safety, and improved emergency evacuation. Additionally, several long-term economic benefits would result from construction.

ES 3.22 Irreversible and Irretrievable Commitments of Resources

Construction of the Preferred Alternative would involve the commitment of natural, physical, human, and fiscal resources. The commitment of resources would be based on the concept that residents in the immediate area, region, and state would benefit by the improved quality of the transportation system. The benefits would consist of improved mobility, safety, and system linkage, resulting in time savings and infrastructure to support population growth. The benefits would be anticipated to outweigh the commitment of resources.

ES 4 INDIRECT IMPACTS

The indirect impacts analysis was prepared in accordance with TxDOT's seven-step approach outlined in its revised *Guidance on Preparing Indirect and Cumulative Impact Analyses* (TxDOT 2010). An Area of Influence (AOI) was established in order to assess the resources evaluated in the affected environment analysis. Potential indirect impacts could entail:

- Development and land use changes because of improved access, including:
  - Approximately 187,039 acres of vacant/developable (includes farming) land that would be within the area of potential indirect development, and
  - Social resources that would be indirectly impacted through an increase in population because of development;
- An increase in commercial development, additional tax revenues, and increased efficiency in the local roadway network;
- Effects to water resources through degradation of surface water and groundwater, more rapid discharge of stormwater, and additional pollutant loadings of waterways, including:

  - Water resources such as wetlands and waters of the U.S. that would be indirectly impacted by possible loss of wetlands, which would be mitigated as part of USACE permitting requirements; and

- A change in wildlife habitat value in areas of increased development spurred by the Preferred Alternative.

The possible indirect impacts to each resource would be addressed by adherence to local plans and policies as well as through mitigation opportunities.

ES 5 CUMULATIVE IMPACTS

The cumulative impacts analysis was prepared in accordance with TxDOT's new five-step approach outlined in its *Cumulative Impacts Analysis Guidelines* (TxDOT 2014). Based on the previous direct and indirect impact assessments, resources were further clarified to consider the cumulative impacts that could occur from the Preferred Alternative and other past, present, and reasonably foreseeable future actions. In order to assess potential cumulative impacts, a Resource Study Area (RSA) was established for land use, social resources, water quality/resources, and vegetation/wildlife. It was determined that while cumulative impacts would be likely for some of the resources as a result of the Preferred Alternative, some of the resources would also be impacted by the No-Build Alternative. Mitigation opportunities are identified for each resource analyzed.

ES 6 AGENCY AND PUBLIC INVOLVEMENT

A number of federal, state, and local government agencies were consulted prior to and during the preparation of the Draft and FEIS. Elected officials and agency representatives were notified of upcoming public meetings, were invited to attend special briefing meetings prior to each public meeting. Efforts were made to locate, inform, and seek input from interested individuals and organized groups throughout the proposed SH 99 Segment B development process. Communication with the public included public meetings, newsletters, a Grand Parkway Association (GPA) website, and advertisements of upcoming meetings and the availability of project documents. Additional agency coordination and public involvement activities with communities, resource agencies, elected and public offices, and local/regional news outlets were conducted prior to and during the preparation of the EIS.

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Table of Contents

SECTION 1: PROJECT NEED AND PURPOSE 1-1
1.1 Need for and Purpose of the proposed project 1-1
1.1.1 Need 1-1
1.1.2 Purpose 1-2
1.2 Detailed Transportation Needs Analysis 1-3
1.2.1 System Linkage 1-3
1.2.2 Expanded Capacity 1-4
1.2.3 Safety (Hurricane Evacuation Route) 1-8
1.2.4 Economic Development 1-16

SECTION 2: ALTERNATIVES ANALYSIS 2-1
2.1 Transportation System Improvement Options 2-1
2.1.1 Description of Alternative Transportation Modes (Modal Alternatives) 2-1
2.1.2 Transportation System Management (TSM) Alternatives 2-4
2.1.3 Travel Demand Management (TDM) Alternatives 2-5
2.1.4 No-Build Alternative 2-6
2.2 Assessment of Transportation System improvement options 2-6
2.2.1 Transportation System Improvement Options Eliminated From Further Study 2-7
2.2.2 Transportation System Improvement Options Selected For Further Study 2-8
2.3 Selection of A Recommended Alternative 2-9
2.3.1 Developing the Proposed SH 99 Segment B Study Area 2-9
2.3.2 Development of the Preliminary Build Alternatives 2-10
2.3.3 Development of the Candidate Alternative Alignments 2-10
2.3.4 Traffic Analysis for Selected Alternatives 2-16
2.3.5 Selection of a Recommended Preferred Build Alternative 2-16
2.3.6 Selection of a Preferred Build Alternative 2-16

SECTION 3: AFFECTED ENVIRONMENT 3-1
3.1 Land Use and Transportation Planning 3-1
3.1.1 Existing Land Uses 3-1
3.1.2 Land Use Planning 3-2
3.1.3 Transportation Planning 3-3
3.2 Geology, Soils, and Farmlands 3-3
3.2.1 Geology 3-3
3.2.2 Soils 3-4
3.2.3 Farmlands 3-4
3.3 Social Characteristics 3-5
3.3.1 Population and Demographic Characteristics 3-6
3.3.2 Neighborhoods and Community Cohesion 3-8
3.3.3 Social and Community Resources 3-8
3.4 Economics 3-14
3.4.1 Income 3-14
3.4.2 Employment and Households 3-15
3.4.3 Property Tax Revenues 3-17
3.5 Pedestrians and Bicyclists 3-18
3.6 Air Quality 3-19
3.6.1 Qualitative MSAT Assessment 3-19
3.7 Noise 3-21
3.7.1 Characteristics of Noise 3-21

3.7.2 Existing Noise Levels....3-21
3.8 Water Quality....3-22
3.8.1 Surface Water....3-22
3.8.2 Groundwater and the Public Drinking Water Systems....3-24
3.9 Wetlands and Other Waters of the U.S....3-25
3.9.1 Navigable Waters of the U.S....3-26
3.9.2 Waters of the U.S....3-26
3.9.3 Wetlands....3-27
3.10 Vegetation and Wildlife....3-28
3.10.1 Vegetation....3-28
3.10.2 Wildlife....3-35
3.11 Threatened and Endangered Species....3-36
3.11.1 U.S. Fish and Wildlife Service....3-36
3.11.2 Texas Parks and Wildlife Department....3-37
3.11.3 Listing and Monitoring Process....3-37
3.12 Floodplains....3-44
3.13 Wild and Scenic Rivers....3-45
3.14 Coastal Barriers....3-45
3.15 Coastal Zone Management Plan and Essential fish habitat....3-45
3.15.1 Coastal Management Zone....3-45
3.15.2 Essential Fish Habitat....3-45
3.16 Cultural Resources....3-46
3.16.1 Archeological Resources....3-46
3.16.2 Historic Non-Archeological Properties....3-48
3.17 Hazardous Materials....3-50
3.17.1 Hazardous Materials Sites....3-51
3.17.2 Oil and Gas Well Sites....3-52
3.18 Visual and Aesthetic Qualities....3-52

SECTION 4: ENVIRONMENTAL CONSEQUENCES....4-1
4.1 Land Use....4-1
4.2 Geology, Soils, and Farmlands....4-3
4.2.1 Geology and Soils....4-3
4.2.2 Farmlands....4-4
4.3 Social Characteristics....4-5
4.3.1 Neighborhoods and Community Cohesion....4-5
4.3.2 Social and Community Resources....4-6
4.3.3 Displacements and Relocations....4-9
4.3.4 Environmental Justice....4-12
4.3.5 Limited English Proficiency....4-26
4.3.6 Population Age Distribution....4-30
4.4 Economics....4-31
4.4.1 Property Tax Revenue....4-31
4.4.2 Employment and Income during Construction....4-32
4.4.3 Long-term Employment Growth....4-33
4.5 Pedestrians and Bicyclists....4-34
4.6 Air Quality....4-34
4.6.1 Preferred Alternative Impacts....4-34
4.6.2 No-Build Alternative Impacts....4-39
4.7 Noise....4-40
4.8 Water Quality....4-48

4.8.1 Surface Water 4-48
4.8.2 Short-term Water Quality Impacts 4-48
4.8.3 Long-term Water Quality Impacts 4-49
4.8.4 Groundwater 4-50
4.8.5 Public Drinking Water Systems 4-51
4.9 Wetlands and Other Waters of the U.S. 4-52
4.9.1 Navigable Waters of the U.S. 4-52
4.9.2 Waters of the U.S. 4-52
4.9.3 Wetlands 4-53
4.10 Vegetation and Wildlife 4-56
4.10.1 Vegetation 4-56
4.10.2 Wildlife 4-59
4.11 Threatened and Endangered Species 4-62
4.11.1 Texas NDD-Listed Species 4-62
4.11.2 State-Listed Threatened, Endangered, and Species of Greatest Conservation Need 4-63
4.11.3 Federally Listed Threatened and Endangered Species 4-66
4.11.4 Bald and Golden Eagle Protection Act 4-66
4.12 Floodplains 4-66
4.13 Wild and Scenic Rivers 4-69
4.14 Coastal Barriers 4-69
4.15 Coastal Zone Management Plan and Essential Fish Habitat 4-69
4.15.1 Coastal Management Zone 4-69
4.15.2 Essential Fish Habitat 4-70
4.16 Cultural Resources 4-70
4.16.1 Archeological Resources 4-70
4.16.2 Historic Non-Archeological Properties 4-72
4.17 Hazardous Materials 4-74
4.17.1 Regulated Hazardous Materials Sites 4-75
4.17.2 Materials Containing Asbestos and Lead-based Paint 4-81
4.17.3 Potential Impacts from Construction Activities 4-82
4.17.4 Oil and Gas Well Installations and Pipelines 4-82
4.18 Visual and Aesthetic Qualities 4-84
4.18.1 Preferred Alternative Visual Impacts 4-84
4.18.2 Preferred Alternative Aesthetic Impacts 4-85
4.18.3 No-Build Alternative Impacts 4-85
4.19 Energy 4-85
4.20 Construction Impacts 4-86
4.20.1 Water Quality Construction Impacts 4-86
4.20.2 Maintenance and Control of Traffic 4-86
4.20.3 Health and Safety 4-87
4.20.4 Pollution Control 4-87
4.20.5 Construction Impact Coordination 4-87
4.21 The Relationship between Local Short-term Uses Versus Long-term Productivity 4-88
4.22 Irreversible and Irretrievable Commitments of Resources 4-88
4.23 Preferred Alternative recommendation 4-89

SECTION 5: INDIRECT IMPACT ANALYSIS 5-1
5.1 Step 1: Scoping 5-2
5.2 Step 2: Identify the Study Area's Goals and Trends 5-3
5.2.1 Goals 5-3
5.2.2 Trends 5-4

5.3 Step 3: Inventory the Study Area's Notable Features....5-7
5.3.1 Ecosystem Conditions....5-7
5.3.2 Socioeconomic Conditions....5-7
5.3.3 Notable Features....5-8
5.4 Steps 4 through 7 Per Resource....5-10
5.4.1 Land Use....5-10
5.4.2 Soils and Farmlands....5-15
5.4.3 Social....5-17
5.4.4 Air Quality....5-19
5.4.5 Water Quality....5-20
5.4.6 Wetlands and Waters of the U.S. 5-23
5.4.7 Floodplains....5-25
5.4.8 Vegetation and Wildlife Habitat....5-27
5.4.9 Essential Fish Habitat....5-30
5.4.10 Cultural Resources 5-32
5.4.11 Visual and Aesthetic Qualities 5-34
5.5 Regional Indirect Effects of Tolling Facilities and Managed Lanes 5-36
5.5.1 Regional Perspective....5-36
5.5.2 Demographics....5-39
5.5.3 Conclusion....5-40

SECTION 6: CUMULATIVE EFFECTS ANALYSIS 6-1
6.1 Introduction 6-1
6.1.1 Methodology for Cumulative Impact Analysis 6-1
6.2 Steps 1 Through 5 Per Resource....6-8
6.2.1 Land Use 6-8
6.2.2 Social....6-14
6.2.3 Water Quality 6-21
6.2.4 Floodplains....6-24
6.2.5 Wetlands and Waters of the U.S. 6-26
6.2.6 Vegetation and Wildlife Habitat....6-29
6.2.7 Essential Fish Habitat....6-32
6.2.8 Threatened and Endangered Species....6-34
6.2.9 Conclusions....6-38
6.3 Cumulative Regional Effects of Tolled Facilities and Managed Lanes 6-39
6.3.1 Overview 6-39
6.3.2 Air Quality....6-40
6.3.3 Water Quality 6-41
6.3.4 Vegetation 6-42
6.3.5 Land Use 6-43
6.3.6 Economics 6-45
6.3.7 Environmental Justice 6-48

SECTION 7: PERMITS, MITIGATION, AND COMMITMENTS FOR THE PREFERRED ALTERNATIVE 7-1
7.1 Introduction 7-1
7.2 Social Characteristics 7-2
7.2.1 Neighborhoods and Community Cohesion 7-2
7.2.2 Displacements and Relocations....7-2
7.3 Air Quality....7-3
7.4 Noise....7-3
7.5 Water Quality 7-4

7.5.1 Surface Water 7-4
7.5.2 Groundwater 7-5
7.5.3 Public Drinking Water Systems 7-5
7.6 Wetlands and Other Waters of the U.S. 7-5
7.6.1 Navigable Waters of the U.S. 7-5
7.6.2 Waters of the U.S., Including Wetland Mitigation 7-5
7.7 Vegetation and Wildlife 7-6
7.7.1 Vegetation 7-6
7.7.2 Wildlife 7-7
7.8 Migratory Bird Treaty Act 7-8
7.9 Threatened and Endangered Species 7-9
7.10 Floodplains 7-9
7.11 Coastal Zone Management Plan and essential fish habitat 7-10
7.12 Archeological 7-10
7.13 Hazardous Materials 7-10
7.14 Visual and Aesthetic Qualities 7-11
7.15 Construction Impacts 7-12

SECTION 8: AGENCY AND PUBLIC COORDINATION 8-1
8.1 Agency Coordination 8-1
8.2 Public Involvement 8-5
8.3 Additional Agency Coordination and Public Involvement Activities 8-8

SECTION 9: LIST OF PREPARERS 9-1

SECTION 10: DISTRIBUTION LIST 10-1

SECTION 11: BIBLIOGRAPHY 11-1

SECTION 12: INDEX 1

List of Figures

Figure 3-1: Projected National MSAT Emission Trends 2010 to 2050 for Vehicles Operating on Roadways using EPA's MOVES2010b Model....3-20
Figure 5-1: Proposed 2035 Regional Roadway Network....5-37
Figure 5-2: 2035 Future Corridor and Capital Facilities Projects....5-39
Figure 6-1: Level of Mobility (AM Peak)....6-41
Figure 6-2: Expenditures by Category (in $ Billions)....6-46
Figure 6-3: Expenditures by Mode (in $ Billions)....6-47
Figure 6-4: Revenue Sources (in $ Billions)....6-48
Figure 6-5: H-GAC Region with Environmental Justice Communities of Concern....6-51
Figure 6-6: 2035 RTP Managed Road System....6-52
Figure 6-7: 2035 No-Build RTP Managed Road System....6-53
Figure 6-8: 2035 RTP Managed Road System....6-58

List of Tables

Table 1: Proposed Grand Parkway Segments....iii
Table 1-1: Projected Traffic Volumes for the Preferred Alternative....1-6
Table 1-2: LOS Category Characteristics....1-7
Table 1-3: Estimated LOS within the Study Area for the 2035 No-Build Conditions....1-7
Table 1-4: Projected Growth Factors per County....1-9
Table 1-5: Estimated Evacuation Vehicle Volumes....1-9
Table 1-6: Estimated Evacuation Destination Cities Percentage....1-10
Table 1-7: Estimated Evacuation Vehicle Volumes per Segment....1-11
Table 1-8: Hourly Service Volumes per Route....1-11
Table 1-9: Projected Evacuation Totals and Clearance Times....1-12
Table 2-1: Preliminary Alternative Alignment Evaluation Matrix....2-12
Table 2-2: Candidate Alternative Alignment Evaluation Matrix....2-14
Table 3-1: Existing Land Use in the Study Area....3-1
Table 3-2: Existing and Projected Population Growth in the Study Area and Associated Counties....3-6
Table 3-3: Population and Demographic Statistics in the Study Area, Associated Counties, and Local Cities/Communities....3-6
Table 3-4: Age Characteristics of Population in the Study Area and Associated Counties....3-8
Table 3-5: Schools and Educational Facilities near the Preferred Alternative....3-9
Table 3-6: Churches and Cemeteries near the Preferred Alternative....3-10
Table 3-7: Income Characteristics of the Study Area, Associated Counties, and Local Cities/Communities3-14
Table 3-8: Projected Households and Employment in the Study Area and Associated Counties....3-15
Table 3-9: Employment by Industry in Brazoria and Galveston Counties....3-16
Table 3-10: Commute Characteristics of Residents within the Study Area, Brazoria County, and Galveston County....3-16
Table 3-11: Civilian Labor Force, Total Employment, and Unemployment Rate in the Study Area and Associated Counties....3-17
Table 3-12: Property Tax Revenues and Rates for Major Taxing Jurisdictions in the Study Area....3-17
Table 3-13: Project National MSAT Emission Trends (2010 through 2050) for Vehicles Operating on Roadways using EPA's Moves2010b Model....3-20
Table 3-14: Noise Measurement Data....3-21
Table 3-15: Water Body Segments within the Study Area....3-23
Table 3-16: EMST Classification Discrepancies....3-34

Table 3-17: State and Federal Threatened and Endangered Species of Brazoria County....3-38
Table 3-18: State and Federal Threatened and Endangered Species of Galveston County]....3-40
Table 3-19: Hazardous Material Regulatory Database Summary....3-51
Table 4-1: Land Use Impacts under the Preferred Alternative....4-1
Table 4-2: Prime Farmland Soil Impacts under the Preferred Alternative....4-4
Table 4-3: Potential Residential, Business, and Other Displacements under the Preferred Alternative....4-9
Table 4-4: Single-Family Housing Availability within the Study Area Zip Codes....4-10
Table 4-5: Business Properties/Land for Sale or Lease in the Study Area Zip Codes....4-11
Table 4-6: Toll Road Fee Exceptions....4-16
Table 4-7: HCTRA Toll Rates....4-18
Table 4-8: EZ Tag Fees....4-19
Table 4-9: Potential Person Trips in the EJ and Non-EJ Zones....4-23
Table 4-10: AM Peak HBW Trips for Build and No-Build Scenarios[1]....4-24
Table 4-11: AM Peak HBNW Trips for Build and No-Build Scenarios[1]....4-24
Table 4-12: Potential Economic Impact for Brazoria and Galveston Counties....4-25
Table 4-13: LEP Census Tract and Census Block Group Populations under the Preferred Alternative..4-28
Table 4-14: Population Age Characteristics of the 12 Census Tract Area....4-31
Table 4-15: Estimates of Economic Effects from Construction of the Preferred Alternative....4-33
Table 4-16: Operational Improvements in the Travel Corridor....4-35
Table 4-17: FHWA NAC Criteria....4-40
Table 4-18: Traffic Noise Levels (dB(A) L_{eq})....4-41
Table 4-19: Traffic Noise Barrier Proposal (Preliminary)....4-46
Table 4-20: Traffic Noise Impact Contours....4-47
Table 4-21: Public Water Supply Wells Located within 0.25 Mile of the Preferred Alternative....4-51
Table 4-22: Private Water Supply Wells Located within 0.25 Mile of the Preferred Alternative....4-52
Table 4-23: Estimated and Field-verified Wetlands within the Preferred Alternative ROW....4-54
Table 4-24: Vegetation Impacts within the Preferred Alternative....4-57
Table 4-25: Regulated Hazardous Materials Sites....4-76
Table 4-26: Oil and Gas Wells Within and Adjacent to the Preferred Alternative....4-82
Table 5-1: Existing and Projected Population, Employment, and Households for Associated Counties and Cities in the AOI....5-5
Table 5-2: Proposed and Planned Development within the AOI....5-10
Table 5-3: Land Use in the AOI....5-12
Table 5-4: Development within the AOI (Past/Existing Development)....5-14
Table 5-5: Regional Roadway Network (lane miles)....5-36
Table 5-6: Projected Demographic Changes in H-GAC Region 2000 to 2035....5-39
Table 5-7: Percent of Households in the H-GAC Region within Income Categories....5-40
Table 6-1: Guidelines for Identifying and Assessing Cumulative Effects....6-1
Table 6-2: Determination of Resources/Issues Considered in the Cumulative Effects Analysis....6-4
Table 6-3: Proposed Transportation Projects in the RSA....6-11
Table 6-4: Population, Demographic, and Median Household Income Statistics for the Associated Counties, and Local Cities/Communities in the Social RSA....6-15
Table 6-5: Alternative Growth Scenarios....6-44
Table 6-6: Distribution of Environmental Justice Communities in the H-GAC Region....6-49
Table 6-7: 2035 Home Based Work Person Trips[a]....6-55
Table 6-8: 2035 Home Based Non-Work Person Trips[a]....6-56
Table 6-9: Regional VMT and VHT....6-57
Table 7-1: Measures Required to Avoid or Minimize Construction Impacts....7-12

List of Exhibits

Exhibit 1-1: SH 99 (Grand Parkway) Segments
Exhibit 1-2: Study Area
Exhibit 1-3: Evacuation Zones
Exhibit 1-4: Census Tracts
Exhibit 2-1: Segment B Study Area
Exhibit 2-2: Existing Conditions 2009 Traffic Operations
Exhibit 2-3: 2035 No-Build Traffic Operations
Exhibit 2-4: Preliminary Build Alternatives
Exhibit 2-5: Candidate Alternatives
Exhibit 2-6: 2035 South-New Alternative Traffic Operations
Exhibit 2-7: 2035 Northern Alternative Traffic Operations
Exhibit 2-8: 2035 Central Alternative Traffic Operations
Exhibit 2-9: 2035 Southern 2 Alternative Traffic Operations
Exhibit 2-10: Recommended Preferred Build Alternative and Residential Communities
Exhibit 2-11: Preferred Build Alternative and Residential Communities
Exhibit 3-1: Current Land Use
Exhibit 3-2: Soils
Exhibit 3-3: Census Tracts and Block Groups
Exhibit 3-4: Community Resources and ISD
Exhibit 3-5: Bicycle & Pedestrian Facilities (Existing & Proposed)
Exhibit 3-6: Noise Field Measurement Locations
Exhibit 3-7: Water Resources
Exhibit 3-8: Water Wells
Exhibit 3-9: USGS Topographic Map
Exhibit 3-10: National Wetlands Inventory Map
Exhibit 3-11: Ecological Mapping Systems
Exhibit 3-12: Potential Archeological Liability Map
Exhibit 3-13: Historical Resources
Exhibit 3-14: Hazardous Materials Sites
Exhibit 4-1a: Displacements
Exhibit 4-1b: Displacements Data Table
Exhibit 4-2: Affected Census Blocks
Exhibit 4-3: EJ-Related Demographics by TAZ
Exhibit 4-4: Noise Impacts
Exhibit 4-5: Waters of the U.S.
Exhibit 5-1: Area of Influence
Exhibit 5-2: 1975 Development in the AOI
Exhibit 5-3: 1987 Development in the AOI
Exhibit 5-4: 1995 Development in the AOI
Exhibit 5-5: 2008 Development in the AOI
Exhibit 5-6: 2012 Development in the AOI
Exhibit 6-1: Travel Study Area
Exhibit 6-2: RSA for Water Resources

List of Appendices

Appendix A: 2040 RTP and 2015–2018 TIP
Appendix B: Soils and Prime Farmland Found Within the Proposed SH 99 Segment B Study Area and NRCS-CPA-106 Form
Appendix C: Census Data
Appendix D: Biological Evaluation Form
Appendix E: NMFS Coordination
Appendix F: Hazardous Materials
Appendix G: Cultural Resource Reports
Appendix H: Responses to Comments from the 2012 Public Hearing

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LIST OF ACRONYMS AND ABBREVIATIONS

ACC	Alvin Community College
ACS	American Community Survey
a.m.	ante meridiem
AOI	Area of Influence
ASTM	American Society for Testing and Materials
ATL	average trip length
BMP	best management practice
CEQ	Council on Environmental Quality
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFR	Code of Federal Regulations
CGP	Construction General Permit
CMP	Congestion Management Process
CMSA	Consolidated Metropolitan Statistical Area
CO	Carbon Monoxide
CR	County Road
CSJ	control-section-job
dB	decibel
dBA	decibel (A-weighted)
DCR	Dry Cleaner Registration
E	endangered
e.g.	*exempli gratia*, for example
EIS	Environmental Impact Statement
EJ	environmental justice
EMS	emergency medical services
EMST	Ecological Mapping System of Texas
EPA	U.S. Environmental Protection Agency
EOID	element of occurrence identification
et al.	*et alia,* and others
ETC	electronic toll collection
etc.	*et cetera*, and other things
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FM	Farm-to-Market
FPPA	Farmland Protection Policy Act
FRSTX	Facility Registry System
FTA	Federal Transit Administration
GIS	geographic information system
GPA	Grand Parkway Association
GWCC	Groundwater Contamination Case
HBNW	home-based, non-work
HBW	home-based work

HCTRA	Harris County Toll Road Authority
HEI	Health Effects Institute
H-GAC	Houston-Galveston Area Council
HGB	Houston-Galveston-Beaumont
HGSD	Harris-Galveston Subsidence District
HOT	high occupancy toll
HOV	high occupancy vehicle
i.e.	*id est,* that is
ICISNPDES	Integrated Compliance Information System National Pollutant Discharge Elimination System
IH	Interstate Highway
IHW	industrial and hazardous waste
IRIS	Integrated Risk Information System
ISD	Independent School District
LEP	limited English proficient
L_{eq}	sound level equivalent
lf	linear feet
LiDAR	Light Detection and Ranging
LOS	level of service
LPST	leaking petroleum storage tanks
METRO	Metropolitan Transit Authority of Harris County
mg/l	milligrams per liter
MOVES	MOtor Vehicle Emission Simulator
MOU	Memorandum of Understanding
mph	miles per hour
MS4	Municipal Separate Storm Sewer System
MSAT	mobile source air toxic
NAC	noise abatement criteria
NASA	National Aeronautics and Space Administration
NCHRP	National Cooperative Highway Research Program
NEPA	National Environmental Policy Act
NFRAP	No Further Remedial Action Planned
NOA	Notice of Availability
NOI	Notice of Intent
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
PALM	Potential Archeological Liability Map
p.m.	post meridiem
PST	petroleum storage tank
PUD	Planned Unit Development
RAZ	regional analysis zone
RCRAGR06	Resource Conservation and Recovery Act: Generator Facilities
REC	recognized environmental condition

ROW	right-of-way
RSA	Resource Study Area
RTP	Regional Transportation Plan
SGCN	species of greatest conservation need
SH	State Highway
SIP	State Implementation Plan
SOV	single occupancy vehicle
SW3P	Storm Water Pollution Prevention Plan
T	threatened
TAC	Texas Administration Code
TAZ	traffic analysis zone
TCAP	Texas Conservation Action Plan
TCEQ	Texas Commission on Environmental Quality
TDM	Travel Demand Management
THC	Texas Historical Commission
TIERII	Tier II Chemical Reporting Program Facilities.
TIP	Transportation Improvement Program
TMA	Transportation Management Area
TMDL	total maximum daily load
TPDES	Texas Pollutant Discharge Elimination System
TPWD	Texas Parks and Wildlife Department
TSM	Transportation System Management
TSWQS	Texas Surface Water Quality Standards
TTI	Texas Transportation Institute
TWDB	Texas Water Development Board
TxDOT	Texas Department of Transportation
TXNDD	Texas Natural Diversity Database
U.S.	United States
USACE	U.S. Army Corps of Engineers
U.S.C.	U.S. Code
USDOT	U.S. Department of Transportation
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VFD	volunteer fire department
VMT	vehicle miles traveled
vpd	vehicles per day
YMCA	Young Men’s Christian Association

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GLOSSARY

Alternative: A general term that refers to possible approaches to meeting the need for and purpose of the proposed State Highway (SH) 99 (Grand Parkway) Segment B (proposed SH 99 Segment B).

Alternative alignment: A proposed routing of the proposed SH 99 Segment B. There are seven Alternative Alignments for the proposed SH 99 Segment B: Northern, Northern 2, Central, Central-South, South New, Southern, and Southern 2 alternatives.

Ambient Air Quality: The state of quality of the air in the surrounding environment.

Aquatic Resources: For the purpose of the Final Environmental Impact Statement (FEIS), aquatic resources are defined as waters of the United States (U.S.), including wetlands.

Aquifer: A water-bearing geologic unit of permeable rock, sand, or gravel that yields considerable quantities of water to springs and wells.

Area of Influence (AOI): The geographic boundary within which possible indirect development and potential indirect impacts could occur.

Arterial: A roadway that provides intra-community service and connects roadways to the urban highway system.

At-grade: A section of a roadway or the proposed SH 99 Segment B that will be relatively close to the existing ground elevation and not elevated on a bridge structure.

At-grade intersection: A point where two roadways meet and traffic is controlled by a traffic signal or stop sign.

Attainment: An EPA designated area that meets the National Ambient Air Quality Standards for a specified criteria pollutant.

Average Daily Traffic: Average traffic volume in a 24-hour period on a particular roadway.

Bottomland hardwoods: Deciduous, wetland, forested areas dominated by mesic hardwood tree species that occur primarily within the 100-year floodplain. Bottomland hardwoods are commonly found wherever streams or rivers (at least occasionally) cause flooding beyond their channel confines.

Build Alternative: See alternative alignment.

Carbon monoxide (CO): A colorless, odorless, gas that is formed as a product of the incomplete combustion of carbon and is emitted directly by automobiles and trucks.

Circumferential roadway: A facility that is oriented in a circular manner, such as a beltway.

Coastal barrier: Unique land forms that provide protection for diverse aquatic habitats and serve as the mainland's first line of defense against the impacts of severe coastal storms and erosion.

Coastal Zone Management: A voluntary federal and state partnership that manages, protects, restores, and is responsible for the development of our nation's diverse coastal communities and resources.

Collector roadways: Roadways that provide service to any county seat, large town, or other major traffic generator not served by the arterial system. The roadways provide links to the higher classified routes and serve as important intra-county travel corridors.

Community cohesion: The connections between and within communities that are essential for serving the needs of the residents.

Controlled-access toll road: A limited-access facility that has no at-grade intersections and only allows access at specific locations (e.g., on-ramps and off-ramps).

Corridor: A broad geographical band with no predefined size or scale that follows a general directional flow connecting major sources of trips. A corridor involves a nominally linear transportation service area that may contain a number of streets, highways, and transit route alignments.

Cultural resources: Patterned physical remains of human activity distributed over the landscape through time.

Cumulative impact/effect: An impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions.

Direct impact: Caused by the action (the proposed SH 99 Segment B) and occurs at the same time and place (40 Code of Federal Regulations [CFR] 1508.8)

Endangered species: A species that is in danger of extinction throughout all or a significant portion of its range.

Environmental Justice (EJ): The avoidance of actions that cause disproportionately high and adverse impacts on minority and low-income populations with respect to human health and the environment in accordance with Executive Order 12898.

Essential Fish Habitat: Areas designated as essential fish habitat contain habitat essential to the long-term survival and health of the nation's fisheries.

Final Environmental Impact Statement (FEIS): A full disclosure document that details the process by which a transportation project was developed. An FEIS includes consideration of a range of reasonable alternatives (i.e., alternative alignment), analyzes the potential impacts resulting from the alternative alignments, and demonstrates compliance with other applicable environmental laws and executive orders.

Floodplain: The portion of a river or stream valley, adjacent to the channel, which is covered with water when the river or stream overflows its banks at flood stage. A floodplain is also defined as lowland and relatively flat areas adjoining inland and coastal waters including, at a minimum, the area subject to a 1 percent or greater chance of flooding in any given year (i.e., the 100-year floodplain).

Floodway: The channel of a river or other watercourse and the adjacent land areas that must be reserved to discharge the base flood elevation without cumulatively increasing the water surface elevation more than a designated height.

Grand Parkway Association (GPA): A nonprofit transportation organization acting on behalf of the Texas Department of Transportation (TxDOT) to facilitate the efficient development of Houston's third outer highway loop to serve the regional mobility needs of metropolitan Greater Houston area. The GPA operates on funds received from various sources including TxDOT, Metropolitan Transit Authority of Harris County METRO, Harris County, Fort Bend County, Chambers County, Galveston County, and Brazoria County. The GPA is active in the promotion and development of SH 99 to assist TxDOT in obtaining land and funding to meet the primary legal, engineering, and right-of-way (ROW) requirements for proposed SH 99 Segment B.

Greater Houston area: The metropolitan area of Houston-The Woodlands-Sugar Land as defined by the Office of Management and Budget. The area encompasses nine counties: Harris, Fort Bend, Montgomery, Brazoria, Galveston, Liberty, Waller, Chambers, and Austin counties.

Groundwater: Subsurface water that occurs beneath the water table in soils and geologic formations that are fully saturated.

Historic Archeological Site: Any subsurface cultural manifestation dated post-European contact.

Houston-Galveston Area Council (H-GAC): A region-wide voluntary association of 133 local governments and local elected officials in the 13-county Gulf Coast Planning Region of Texas. The Gulf Coast Planning Region consists of Austin, Brazoria, Chambers, Colorado, Fort Bend, Galveston, Harris, Liberty, Matagorda, Montgomery, Walker, Waller, and Wharton counties. Organized in 1966, H-GAC provides a forum for the discussion of area-wide concerns, while promoting regional cooperation through comprehensive planning and services to local governments.

Houston-Galveston-Brazoria Consolidated Metropolitan Statistical Area (CMSA): An area consisting of eight counties: Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller counties.

Impact/effect: Used in the environmental analyses to express the extent or severity of an environmental problem. As indicated in Council of Environmental Quality (CEQ) 1500 (Section 1508.8), impacts and effects are considered to be synonymous. Impacts or effects may be ecological, aesthetic, historic, cultural, economic, social, or health related, and each may be direct, indirect, or cumulative.

Indirect impact/effect: An impact that is caused by an action and is later in time or farther in distance but is still reasonably foreseeable.

Interstate Highways (IH)/Freeways: Divided highways with two or more lanes designated for the exclusive use of traffic in each direction. The roadways are intended to provide uninterrupted flow. There are no signalized or stop-controlled, at-grade intersections. Direct access from adjacent properties is not permitted. Access is limited to ramp locations, and opposing directions are separated by a raised barrier, a median, or a raised traffic island. Examples of Interstate Highways are IH 10, IH 45, and IH 610. The term "freeway" in the FEIS is consistent with terminology in the Transportation Research Board's *Highway Capacity Manual* (TRB 2000, 2010). Any divided arterial with complete access control and unimpeded traffic flow is designated a freeway, whether it is tolled or not.

Level of service (LOS): The operating conditions within a stream of traffic describing safety, traffic interruptions, speed, freedom to maneuver, comfort, and convenience. Six LOSs are defined, designated A through F, with A representing the best conditions and F the worst.

Limited English Proficiency: Individuals who do not speak English as their primary language and who have a limited ability to read, speak, write, or understand English can be limited English proficient, or "LEP." These individuals may be entitled language assistance with respect to a particular type or service, benefit, or encounter.

Logical termini: The rational end points for a transportation improvement and the rational end points for a review of environmental impacts.

Low-income population: A population whose household income is below the U.S. Department of Health and Human Services poverty guidelines.

Metropolitan Planning Organization (MPO): A federally designated, regional agency that works with state and local governments, the private sector, and the region's citizens to plan coordinated transportation systems designed to move goods and people affordably, efficiently, and safely. Major products produced by an MPO include a long-range Regional Transportation Plan (RTP), a shorter term Transportation Improvement Program (TIP), a Congestion Management Process, and a Unified Planning Work Program.

Mitigation: A measure that 1) avoids an impact altogether by not taking a certain action or parts of an action; 2) minimizes an impact by limiting the degree or magnitude of the action and its implementation; 3) rectifies the impact by

repairing, rehabilitating, or restoring the affected environment; 4) reduces or eliminates the impact over time by preservation and maintenance operations during the life of the action; or 5) compensates for the impact by replacing or providing substitute resources or environments.

Mobile Source Air Toxics (MSAT): A category of substances in the air that are known or suspected of causing cancer or other health problems in humans, and for which a NAAQS does not exist (i.e., excluding ozone, CO, particulate matter, sulfur dioxide, lead and nitrogen dioxide).

National Environmental Policy Act (NEPA) Document: Any document or report prepared by or on behalf of a fe deral agency pursuant to NEPA for a proposed project, including, but not necessarily limited to, any Environmental Assessment (EA), Finding of No Significant Impact, DEIS, FEIS, or Record of Decision, but not including any pre-decisional, deliberative, or privileged materials.

Nitrogen oxides: Colorless, sweet-tasting gas emitted directly by automobiles and trucks.

No-Build Alternative: A continuation of the existing transportation facilities, which incorporates the execution of planned and/or committed roadway improvements; Transportation System Management (TSM), Transportation Demand Management (TDM), and modal transportation improvements; new planned roadway construction; and Smart Streets. (The No-Build Alternative does not include the construction of the proposed SH 99 Segment B.)

Non-attainment: An EPA designated area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) the NAAQS for the established criteria pollutants.

Notice of Intent (NOI): A notice published in the Federal Register to notify the public that an agency is preparing an EIS.

Ozone: Unstable blue gas with a pungent odor formed principally in indirect reactions involving volatile organic compounds, nitrogen oxides, and sunlight.

Palustrine wetland: Wetlands occurring in the Palustrine System. Palustrine wetlands include all non-tidal wetlands dominated by trees, shrubs, persistent emergent plants, or emergent mosses or lichens, as well as small, shallow open water ponds or potholes. Palustrine wetlands are often called swamps, marshes, potholes, bogs, or fens. Palustrine wetlands documented in the FEIS include Palustrine Unconsolidated Bottom, Palustrine Emergent, Palustrine Forested, and Palustrine Scrub Shrub.

Preferred Alternative: The alternative alignment that the proponent (FHWA/ TxDOT/GPA) believes would best fulfill its statutory mission and responsibilities and is consistent with the need for and purpose of the proposed SH 99 S egment B. The Preferred Alternative considers economic, environmental, technical, and other factors, including public and agency comments received in response to the DEIS. The Preferred Alternative may or may not be the same as the Recommended Alternative identified in the DEIS.

Prehistoric Archeological Site: Any cultural manifestation predating European contact.

Prime Farmland: Land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is suitable for cropland, pastureland, rangeland, or forestland. It is not suited to urban or water use. It has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods.

Proposed project (the proposed SH 99 Segment B): The whole of an action that has a potential for resulting in a physical change in the environment, directly or ultimately, and that is any of the following:

(1) An activity directly undertaken by any public agency, including public works construction and related activities, clearing or grading of land, improvements to existing public structures, enactment and amendment of zoning ordinances, and the adoption and amendment of local general plans or elements thereof pursuant to Government Code sections 65100-65700.
(2) An activity undertaken by a person, which is supported in whole or in part through public agency contracts, grants, subsidies, loans, or other forms of assistance from one or more public agencies.
(3) An activity involving the issuance to a person of a lease, permit, license, certificate, or other entitlement for use by one or more public agencies.

Radial roadway: Roadways that radiate outward from the core of the metropolitan area like spokes on a wheel. The radial roadways typically become less dense in outer suburbs.

Recommended Alternative: The recommended routing of the alternative alignments at the time of DEIS publication. Selection of the Recommended Alternative is based on public and agency outreach results and an analysis and comparison of the potential effects on the physical, biological, and human environment of each alternative alignment.

Regional Transportation Plan (RTP): The long-range transportation vision and plan for the Houston-Galveston-Brazoria CMSA that serves as the blueprint guiding the development of the area's transportation system through the next 30 years. H-GAC's current long-range transportation plan is the *2040 RTP*.

Regulatory floodway: The portion of the 100-year floodplain within which the majority of the flood waters are carried and where flooding hazards are the highest.

Right-of-way (ROW): Land, property, or interest therein acquired for and devoted to transportation purposes, including construction, maintenance, operations, and protection of a roadway.

Riparian: Pertaining to anything connected with or immediately adjacent to the banks of a stream.

Section 106: Pertains to the protection and preservation of historic resources as defined in Section 106 of the National Historic Preservation Act of 1966, 16 United States Code (U.S.C.) 470f.

Section 4(f): Pertains to the protection of a Section 4(f) resource as defined in Section 4(f) of the Department of Transportation Act of 1966, 49 U.S.C. 303(c).

Section 4(f) resource: Any publicly owned park, recreation area, wildlife or waterfowl refuge or historic site that is protected under Section 4(f).

SH 99 Segment B Study Team: The consultant team consisting of AECOM (Prime), Jacobs Engineering, Inc., Atkins, Baker, Barton Smith, Roger Moore, Prewitt and Associates, Inc. and The Lentz Group.

Social Economic Study Area: Consists of a number of regional analysis zones (RAZs) and traffic analysis zones (TAZs), as defined by H-GAC, within Brazoria and Galveston Counties.

State Implementation Plan: A state plan that is administered by the U.S. Environmental Protection Agency (EPA) in compliance with the federal Clean Air Act for the establishment, regulation, and enforcement of air pollution standards for the State of Texas.

Study area: The area in which the development of the seven Alternative Alignments was studied to address the need for and purpose of the proposed SH 99 Segment B.

Superfund: A federal environmental program established to address and clean up the nation's uncontrolled hazardous waste sites.

Surface water: Water that is on the earth's surface, such as in a s tream, river, lake, or reservoir.

System linkage: The connection of major facilities within a highway system.

Threatened species: A species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Topography: Configuration (relief) of the land surface. Topography includes the graphic delineation or portrayal of that configuration in map form, as by contour lines.

Traffic Analysis Zone (TAZ): A unit of geography most commonly used in conventional transportation planning models. The size of a TAZ varies, but f or typical metropolitan planning software, a zone of under 3,000 people is common. The spatial extent of a TAZ typically varies in models, ranging from very large areas in the exurbs to as small as city blocks or buildings in central business districts.

Transportation Demand Management (TDM) Alternative: Behavioral changes to commuters' travel habits that result in fewer vehicles during peak hours. Examples of TDM alternatives would be carpooling/vanpooling, employee trip reduction programs, compressed work weeks, telecommuting, flex-time, and employer incentives.

Transportation Improvement Program (TIP): A comprehensive listing of transportation projects approved for funding and implementation within a 4-year period. H-GAC, as the MPO for the eight-county CMSA, develops the TIP in a collaborative effort with local governments, transit and transportation agencies, and TxDOT.

Transportation System Management (TSM) Alternative: Management techniques to make the existing transportation system as efficient as possible. Examples of TSM alternatives would be park-and-ride lots, ridesharing, high occupancy vehicle (HOV) facilities, traffic signal coordination, and intersection improvements.

Travel demand: The number of users desiring to travel the highway system based on the available roadway network.

TxDOT Houston District Potential Archeological Liability Map (PALM): A geo-archeological model designed as a decision-support tool for use by TxDOT in the compliance process. The PALM allows a priority assessment of geo-archeological potential and the potential impact on archeological resources by transportation activities without requiring a field visit.

Upland Habitat: Land that has sufficiently dry conditions for hydrophytic vegetation, hydric soils, and /or wetland hydrology to be lacking. Any area that is not a wetland, deepwater aquatic habitat, or other special aquatic site is considered upland habitat.

Vehicle Hours Traveled (VHT): The time (in hours) that users spend on the roadway system during a specific time period.

Viewshed: All land seen from one static point.

Watershed: A specific geographic area drained by a major stream or river.

Wetland (Adjacent): Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal conditions do support, a prevalence of vegetation typically adapted for life in saturated conditions. Adjacent wetlands also lie within the 100-year floodplain and/or have a hydrologic connection to navigable waters.

Wetland (Isolated): Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal conditions do support, a prevalence of vegetation typically adapted for life in saturated conditions. Isolated wetlands do n ot lie within the 100-year floodplain nor do they have a hydrologic connection to navigable waters.

Wild and Scenic Rivers: Congress established a National Wild and Scenic Rivers System (National System) to preserve forever in a free-flowing condition some of the nation's most precious rivers. To qualify, a ri ver or river segment must be in a free-flowing condition and must be deemed to have one or more "outstandingly remarkable" scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values.

Note: For further reference, please consult the TxDOT website at: http://onlinemanuals. txdot.gov/ txdotmanuals/glo/index.htm.

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INTRODUCTION

The proposed State Highway (SH) 99 (Grand Parkway) is planned as an approximate 180-mile circumferential facility that would serve as a third loop around the greater City of Houston (Houston) area (***Exhibit 1-1***). The proposed SH 99 Segment B from SH 288 to Interstate Highway (IH) 45 South is the segment of the Grand Parkway under study in the Final Environmental Impact Statement (EIS). The proposed SH 99 Segment B would be a new transportation facility built on new location to accommodate a 70 miles-per-hour (mph) design speed. The proposed SH 99 Segment B's 400-foot right-of-way (ROW) would accommodate the following typical roadway sections:

- A four-lane section without frontage roads,
- A four-lane section with frontage roads, or
- A four-lane section with exit and entrance ramps.

In its entirety, the Grand Parkway would traverse Harris, Montgomery, Liberty, Chambers, Galveston, Brazoria, and Fort Bend counties, Texas, and would provide access to many of the radial highways in the greater Houston area, including IH 10, United States (US) Highway 290, SH 249, IH 45, and US 59.

DESCRIPTION OF THE PROPOSED SH 99 SEGMENT B

To be located on the south side of Houston, the proposed SH 99 Segment B would begin at SH 288 and extend east to IH 45 South. Seven Alternative Alignments were evaluated in the Draft EIS (DEIS), and the South-New Alternative Alignment was selected as the Preferred Alternative to be carried forward into the Final EIS (FEIS). The Preferred Alternative would be a four-lane, controlled-access toll road with discontinuous frontage roads on a new location within a 400-foot ROW.

The proposed SH 99 Segment B would traverse Brazoria and Galveston Counties, providing access specifically to SH 288 and IH 45 South (both of which are radial freeways that lead to/from Houston). According to the Houston-Galveston Area Council's (H-GAC's) *2040 Regional Transportation Plan Update* (*2040 RTP*), approved September 11, 2015, the total cost for all SH 99 Segment B's would be approximately $1.2 billion. Currently four of the control section jobs (CSJs), are listed in the 2040 *RTP* and three are listed in Appendix D of the *2015-2018 Transportation Improvement Program (TIP)*. Please see bullets below for details per CJS. All of the CSJs will be added to the *RTP* and the *TIP* prior to final approval.

The proposed SH 99 Segment B is composed of four CSJs numbers as assigned by TxDOT. These job numbers, limits, descriptions and estimated project cost include:

- CSJ 3510-01-001: Galveston County: From IH 45 S to Brazoria County Line: Construct 4-Lane Tollway with interchanges and two non-continuous 2-Lane Frontage Roads: $231,500,000; Letting date: 2020; Opening date: 2025 (listed in the *2040 RTP* and the *2015-2018 TIP*)

- CSJ 3510-01-003 (previously listed as 3510-01-009): Galveston County: At IH 45 S: Construct 4 Direct Connectors (Toll): $80,800,000; Letting date: 2020; Opening date: 2025 (listed in the *2040 RTP* and the *2015-2018 TIP*)
- CSJ 3510-02-001: Brazoria County: From SH 288 to Galveston County Line: Construct 4-Lane Tollway with interchanges and two non-continuous 2-Lane Frontage Roads: $690,800,000; Letting date: 2020; Opening date: 2025 (listed in the *2040 RTP* Update and the *2015-2018 TIP*)
- CSJ 3510-02-004: Brazoria County: At SH 288: Construct 4 Direct Connectors (Toll): $74,900,000; Letting date: 2024; Opening date: 2035 (listed in the *2040 RTP* but not listed in the *2015-2018 TIP*)
- CSJ 3510-02-905: Brazoria County: Construct 4 Direct Connectors at SH 288 (Toll): $104,000,000; Letting date: 2030; Opening date: 2035 (listed in the *2040 RTP* as MPOID 15589 or not listed in the *2015-2018 TIP*)
- CSJ 3510-02-003: Construct 4 Direct Connectors at SH 35 (Toll): $72,000,000; Letting date: n/a; Opening date: n/a (not listed in the *2040 RTP* or the *2015-2018 TIP*)

OVERALL PROJECT HISTORY

Harris County and the Houston Planning Commission first proposed the Grand Parkway, as a concept, in 1961 under the assumption that if Houston's historical growth continued in the future, planning would be needed for additional circumferential transportation facilities. The corridor for the Grand Parkway was placed on city maps in 1968, but funds were not readily available to advance the Grand Parkway at that time. With the development of the greater Houston area, the need for additional transportation facilities became more evident. County officials and landowners mapped a proposed corridor for the Grand Parkway and submitted the plan to the Texas Highway Commission.

In 1984, the Texas Legislature authorized the creation and organization of various nonprofit transportation corporations to act on behalf of the Texas Department of Transportation (TxDOT) in the promotion and development of public transportation facilities and systems within Texas. The Grand Parkway Association (GPA), the first of the corporations created, was charged with assisting the Texas Transportation Commission in obtaining land and funding to meet the planning, legal, engineering, and ROW requirements of the Grand Parkway. Since its inception, the GPA has worked directly with landowners; city, county, state, and federal governmental agencies; and elected officials in an effort to complete the Grand Parkway.

LEGISLATION

The proposed SH 99 Segment B is included in various federal transportation legislations, including the 1995 National Highway System designation, the 1991 Intermodal Surface Transportation Efficiency Act, the North American Free Trade Agreement, and the Transportation Efficiency Act for the 21st century.

Portions of the proposed SH 99 Segment B are included in H-GAC's financially constrained *2040 RTP* and the fiscal years *2015-2018 TIP*. The proposed SH 99 Segment B is required to be consistent with the updated and amended *2040 RTP* and *2015-2018 TIP* prior to approval. The Federal Highway Administration (FHWA) and Federal Transit Authority (FTA) found the fiscally constrained *2040 RTP* and the *2015-2018 TIP* to conform to the State Implementation Plan (SIP) on September 11, 2015, and December 2, 2014 respectively (***Appendix A***).

CURRENT STATUS

Table 1 lists the current status and ***Exhibit 1-1*** illustrates the current location for each segment of the Grand Parkway.

Table 1: Proposed Grand Parkway Segments

Segment	Proposed Location	Approx. Length (Miles)	County	Status
A	SH 146 west to IH 45	6.5	Galveston	Feasibility study completed in 2010
B	**IH 45 west to SH 288**	**28.2**	**Galveston and Brazoria**	**Release of FEIS (Early 2016)**
C	SH 288 west to US 59	26.9	Brazoria and Fort Bend	ROD received March 2013
D	US 59 north to IH 10	18.2	Fort Bend and Harris	Construction completed in 1994
E	IH 10 north to US 290	15.2	Harris	Opened to traffic in January 2014
F-1	US 290 east to SH 249	11.9	Harris	Currently under construction and scheduled to be open to traffic in 2015
F-2	SH 249 east to IH 45	12.1	Harris	Currently under construction and scheduled to be open to traffic in 2015
G	IH 45 east to US 59	13.6	Harris and Montgomery	Currently under construction and scheduled to be open to traffic in 2015
H	US 59 south to US 90	22.5	Montgomery and Harris	ROD received June 2014
I-1	US 90 south to IH 10	14.8	Harris, Liberty, and Chambers	ROD received June 2014
I-2	IH 10 south to SH 225	14.5	Chambers and Harris	Phase 1 opened to traffic in 2008

Source: GPA 2014.

Notes: Bold text indicates the segment included in the FEIS. FEIS = Final Environmental Impact Statement; IH = Interstate Highway; ROD = Record of Decision; SH = State Highway; US = U.S. Route.

INDEPENDENT UTILITY AND LOGICAL TERMINI

The Grand Parkway was separated into the 11 segments described in ***Table 1*** to facilitate planning, design, and construction because of limited funding. While the proposed SH 99 Segment B would contribute to the overall purpose of the Grand Parkway, the segment would also fulfill the transportation needs within northern Brazoria and Galveston Counties. As presented in the *2040 RTP*, residential and

commercial development would continue to expand outward from the central section of Houston beyond the Sam Houston Tollway. Therefore, northern Brazoria and Galveston counties would require improved and additional transportation facilities to accommodate the anticipated increase in traffic volumes.

SECTION 1: PROJECT NEED AND PURPOSE

Section 1 was prepared in accordance with FHWA's Technical Advisory T 6640.8A, *Guidance for Preparing and Processing Environmental and Section 4(f) Documents* (FHWA 1987), FHWA's memorandum titled *Need and Purpose in Environmental Documents* (FHWA 1990), FHWA and FTA's joint memorandum titled *Integration of Planning and National Environmental Policy Act (NEPA) Processes* (FHWA and FTA 2005), and Texas Department of Transportation's (TxDOT's) memorandum titled *Guidance on Need and Purpose* (TxDOT 2001). FHWA indicates that the need for and purpose of a project may, and should, evolve during the project development process as information is gathered and more is learned (FHWA 1990). Studies conducted for the proposed SH 99 Segment B included substantial interaction with stakeholders that included the general public, local businesses and landowners, local officials and community leaders, regulatory agencies, FHWA, and TxDOT.

1.1 Need for and Purpose of the proposed project

1.1.1 Need

Detailed in the previous section, the Grand Parkway, in its entirety, was conceived in the 1960s as an approximate 180-mile circumferential, four-lane, controlled-access facility around the greater Houston area (***Exhibit 1-1***). In that form, the Grand Parkway has been included in regional planning studies since the 1980s. Adjustments and further study have modified the proposed route to presently be approximately 185 miles.

In general, the Grand Parkway, and specifically the proposed SH 99 Segment B, is needed for the following reasons.

- **System linkage:** The existing transportation system does not allow for efficient circumferential traffic movement (i.e., the current system does not provide efficient connections or linkages between major suburban communities and major roadways that radiate outward from Houston).
- **Expanded capacity:** Transportation demand exceeds the current and future capacity of the existing transportation system.
- **Safety (hurricane evacuation route):** Many radial roadways leading outside of the greater Houston area are characterized by conditions that result in higher congestion during peak travel times or emergency events. Congestion was a major issue when over 2 million evacuees fled the area before Hurricane Rita on September 22, 2005. Typical travel destinations during the evacuation were to the cities of Austin, San Antonio, and Dallas, which caused severe congestion in and around the greater Houston area. Eventually, contraflow lanes (i.e., one or more off-peak lanes are borrowed for peak direction use) were implemented to assist in moving people out of the surge zone in a timelier manner. However, the plan hindered the inflow of goods needed to re-supply gas and food. While congestion was not as severe during the evacuation for Hurricane Ike on September 13, 2008, according to a study conducted in March 2009 by Rice University, only 24 percent of Harris County residents evacuated during Hurricane Ike (a Category 2 storm) as

compared to 52 percent of residents that evacuated during Hurricane Rita (a Category 4 storm) (Rice News 2009). The study also noted that 75 percent of Harris County residents said they would evacuate if a Category 4 storm threatened Houston. The percentage is a substantial increase from those who evacuated for hurricanes Rita or Ike. The population in the greater Houston area is forecast to increase from 5.8 million in 2010 to 8.8 million in 2035. Therefore, it is anticipated that the increase in evacuations would create a greater level of congestion than experienced during Hurricane Rita. Therefore, there is a need to provide an additional circumferential roadway that would allow evacuees to bypass the greater Houston area.

- **Economic development:** The expected growth in population is likely to continue to strain existing transportation infrastructure, which, in turn, would create a barrier to businesses, commuters, and economic development. Over the next 25 years, H-GAC predicts that an additional 3.0 million people will move into the eight-county, Houston-Galveston region, which would increase the current population by approximately 65 percent (H-GAC 2014a). With an increasing population and corresponding increases in traffic and congestion throughout the region, it could become progressively more difficult for businesses to function efficiently. For example, congestion issues could cause consumers to visit other business that are more easily accessible.

1.1.2 Purpose

The purpose of the proposed SH 99 Segment B is to efficiently link suburban communities and major roadways, enhance mobility, respond to economic growth, and provide an additional hurricane evacuation route. The overall goals of the proposed SH 99 Segment B are described as follows.

- **System linkage:** The proposed SH 99 Segment B would improve system connectivity or linkage within the existing transportation system. The proposed SH 99 Segment B would also provide circumferential linkage between SH 288 and IH 45 South.
- **Expanded capacity:** The proposed SH 99 Segment B would address transportation demand, improve the level of service (LOS) in and around the proposed SH 99 Segment B study area, reduce traffic congestion, and provide travel options.
- **Safety (hurricane evacuation route):** The proposed SH 99 Segment B would provide an additional hurricane and emergency evacuation route for the greater Houston area consistent with Minute Order No. 82325, signed on October 25, 1984. The Grand Parkway, and specifically proposed SH 99 Segment B, could alleviate a portion of the congestion during mass evacuations, which would create safer and more efficient evacuation conditions.
- **Economic development:** The proposed SH 99 Segment B would accommodate demographic and economic growth by improving the movement of persons and goods, thereby minimizing barriers among businesses, consumers, and transportation infrastructure.

1.2 DETAILED TRANSPORTATION NEEDS ANALYSIS

1.2.1 System Linkage

The IH system was developed to connect the nation's major urban areas and tie together the lower 48 states. The regional highway system is predominately an east-west and north-south transportation system. Circumferential highway linkage near the proposed SH 99 Segment B study area is limited to the IH 610 Loop and the Sam Houston Tollway.

As depicted on ***Exhibit 1-2***, the following roadways serve nine cities within the boundaries of the study area: SH 288, SH 6, SH 35, Farm-to-Market (FM) 517, FM 528, FM 646, FM 1462, FM 2403, and IH 45 South. The cities that the roadways serve are listed along with current populations from the *2010 U.S. Census* (U.S. Census Bureau 2010).

- City of Alvin (Alvin), population 24,236
- Iowa Colony, population 1,170
- Hillcrest Village (Hillcrest), population 730
- City of Manvel (Manvel), population 5,179
- City of Dickinson (Dickinson), population 18,680
- City of Santa Fe (Santa Fe), population 12,222
- City of Friendswood (Friendswood), population 35,805
- League City, population 83,560
- City of Liverpool (Liverpool), population 482

The community of Algoa, which is located along SH 6 between Alvin and Santa Fe, is also located within the study area and is served by the above-noted roadways. The population of Algoa is approximately 135 people (Gard 2012). In addition, Alvin Community College (ACC) generates a large amount of traffic within the study area. Of the roadways serving the listed communities and ACC, only two extend to SH 288 (i.e., FM 1462 and SH 6), and only three extend to IH 45 South (i.e., SH 6, FM 517, and FM 646).

SH 6 is the only roadway that connects SH 288 to IH 45 South. If SH 6 is congested, travelers within the study area would have to use alternate routes such as IH 45 South or SH 288 to Beltway 8, or would have to travel partially along FM 517 to SH 35 and then go north or south on SH 35 to SH 6 or FM 1462, respectively, to SH 288 for circumferential trips.

An additional benefit to linking between SH 288 and IH 45 South would be to divert traffic from one major arterial to another at times when there may be a major incident on one of the arterials or during hurricane evacuation.

1.2.2 Expanded Capacity

1.2.2.1 Transportation Demand

Over the next 30 years, H-GAC predicts that an additional 3.0 million people will move into the Houston-Galveston region to increase the regional population to 8.8 million people by 2035. Much of the growth would be concentrated within the study area, and it is expected that development would progress in a manner consistent with suburban growth trends nationally: where jobs typically follow population growth, and suburban areas become self-contained with their own residential, retail, and employment centers. U.S. Census data, H-GAC, and Harris County Toll Road Authority (HCTRA) projections all point to the growth trend as presently underway and likely to continue within the Houston-Galveston region.

Population growth (as indicated by an increase in the number of households) and total employment are primary demographic and economic indicators for travel demand, which is defined as the number, purpose, and type of trips in an area. To analyze the study area, population and demographic data have been defined within 25 Census tracts that intersect or are included within the study area (the 25 Census Tract Area). The 25 Census Tract Area is shown on ***Exhibit 1-4***.

Between 2010 and 2035, it is estimated that the aggregate number of households within the 25 Census tracts area either wholly or partially located within the proposed SH 99 Segment B study area, will increase from 53,290 to 154,623, a 190 percent increase (H-GAC 2006 and 2014d). Between 2010 and 2035, it is estimated that employment within the 25 Census Tract Area will increase from 28,167 to 65,473 people employed, a 132 percent increase (H-GAC 2006 and 2014d). Between 2010 and 2035, it is estimated that the aggregate number of households in Brazoria and Galveston Counties will increase from 106,587 to 208,916 in Brazoria County, a 96 percent increase, and from 108,924 to 204,790, an 88 percent increase, in Galveston County (H-GAC 2006 and 2014d). Between 2010 and 2035, it is estimated that employment within the Brazoria and Galveston Counties will increase from 302,601 to 541,341 people employed in Brazoria County, a 79 percent increase, and from 286,922 to 504,790 people employed in Galveston County, a 76 percent increase (H-GAC 2006 and 2014d). The predicted percent increases in the number of households and total employment within the 25 Census tract area by year 2035 would be higher than that of Brazoria and Galveston Counties. This indicates that much of the growth within the two counties would occur within the study area.

Annually, the Texas Transportation Institute (TTI) ranks major metropolitan areas with respect to the level of traffic congestion occurring on an area's highways. The ranking is reflected in the Roadway Congestion Index. An Index of 1.00 or greater indicates congestion levels that are undesirable. The Index for Houston in the 2012 Urban Mobility Report was 1.15 (TTI 2012). Since 1992, the Index for the greater Houston area has continued to rise and TTI reports that nearly 69 percent of all peak period travel in the area experiences considerable congestion. Anticipated population and employment growth is expected to intensify the issue.

H-GAC, with input from TxDOT, the Harris County Metropolitan Transit Authority (METRO), numerous local governments, and the larger community, has developed a long-term transportation plan to keep people and goods moving. H-GAC's *2040 RTP* offers multiple transportation alternatives and modes in major corridors throughout the region (H-GAC 2014a). However, even with the planned investment in the transportation system over the next 25 years, increased congestion is expected to continue because of continued population and employment growth in the region. The proposed SH 99 Segment B study area is no exception to the larger regional trend.

1.2.2.2 Traffic Analysis

The existing and future transportation conditions demonstrate a clear need for additional transportation improvements to serve circumferential travel and to provide improved connections between suburban communities and major roadway facilities. Generally, traffic conditions are defined in terms of the number of existing and projected vehicles per day (vpd) and LOS rating for a roadway based on a travel demand model for an area. The need for expanded capacity is often due to a higher vpd and a lower LOS on a specific roadway or within a particular area.

H-GAC's regional travel demand model for the greater Houston area was used to determine the future (2035) traffic projections within the study area. Base year and future traffic were compared to determine the change in traffic demand over time. H-GAC's model determines traffic volumes on roadway facilities based on current and projected population and employment data, in addition to the transportation network available to travelers.

The analysis of the study area's roadways was conducted for the following types of facilities (as defined by FHWA within the study area).

- IHs: IHs are divided with full access control and two or more lanes for the exclusive use of traffic in each direction. The highways are intended to provide uninterrupted flow. There are no signalized or stop-controlled, at-grade intersections, and direct access from adjacent property is not permitted. Access is limited to ramp locations, and opposing directions are separated by a raised barrier, an at-grade median, or a raised traffic island. An example of an IH in the study area is IH 45 South.
- Principal arterials: Principal arterials provide an integrated network of roadways that connect principal metropolitan areas and serve virtually all urban areas with a population greater than 25,000. The roadways also serve long-distance travel demands, such as statewide and interstate travel. Examples of principal arterials in the study area are SH 35 and SH 288.
- Minor arterials: Minor arterials interconnect and supplement the principal arterial system with greater emphasis on land access and a lower level of traffic mobility. The roadways provide intercommunity service and connect rural collectors to the urban highway system. Examples of minor arterials in the study area are SH 6, FM 517, FM 528, FM 646, FM 1462, and FM 2403.
- Collector roadways: Collector roadways provide service to any county seat, large town, or other major traffic generator not served by the arterial system. The roadways provide links to the higher

classified routes and serve as important intra-county travel corridors. Examples of collector roadways in the study area are Algoa-McFarland Road, Algoa-Friendswood Road, Manvel-Sandy Road, and Heights Road.

As listed in ***Table 1-1***, the Preferred Alternative's traffic volume projections would range from 5,638 to 26,525 vpd.

Table 1-1: Projected Traffic Volumes for the Preferred Alternative

Limits	Year 2035 Traffic Volumes (vpd)
SH 288 to FM 1462	6,133
FM 1462 to SH 35	5,638
SH 35 to SH 35 Bypass south	8,814
SH 35 Bypass south to SH 35 Bypass north	15,783
SH 35 Bypass north to FM 646	19,823
FM 646 to IH 45 South	26,525
IH 45 South to east of IH 45 South	18,208

Source: SH 99 Segment B Study Team 2014.

Notes: FM = Farm-to-Market; IH = Interstate Highway; SH = State Highway; vpd = vehicles per day.

In line with population growth, traffic volumes would continue to increase, which would increase congestion along the existing roadways. Another way to understand the need for expanded capacity is in terms of LOS, which is a qualitative measure related to the operating conditions of a roadway. LOS categories range from ratings of A through F, and the range describes a progressive deterioration of operating conditions from A (which indicates very good operating conditions) through F (which essentially represents the functional failure of the roadway in terms of traffic movement). ***Table 1-2*** describes the characteristics of each LOS category.

Table 1-2: LOS Category Characteristics

LOS Rating	Description
A	Free flow with low volumes and high speeds
B	Reasonably free flow, but speeds beginning to be restricted by traffic conditions
C	In stable flow zone, but most drivers are restricted in the freedom to select their own speeds
D	Approaching unstable flow where drivers have little freedom to select their own speeds
E	Unstable flow and may require short stoppages
F	Unacceptable congestion, stop-and-go, and forced flow

Source: TRB 2000.

Most of the roadways within the study area are expected to experience major increases in average daily traffic from 2010 to 2035. As depicted in ***Table 1-3***, even with planned and programmed transportation improvements, there are still roadways within the study area that would experience an LOS of D or F.

Table 1-3: Estimated LOS within the Study Area for the 2035 No-Build Conditions

Roadway	LOS
SH 35 Bypass	D
SH 6 east of SH 35 Bypass	F
FM 517: from SH 35 Bypass to IH 45 South	F
FM 646: from FM 1764 to IH 45 South	D

Source: SH 99 Segment B Study Team 2014.

Notes: FM = Farm-to-Market; IH = Interstate Highway; LOS = level of service; SH = State Highway.

Increasing vpd and deteriorating LOS within the study area reveal a need for expanded capacity within the region, of which the proposed SH 99 Segment B would address these needs.

1.2.2.3 Grand Parkway and the Proposed SH 99 Segment B Independent Utility and Logical Termini

Detailed in ***Table 1*** and on ***Exhibit 1-1***, the Grand Parkway is divided into 11 segments, each of which has logical termini and independent utility to facilitate planning, design, and construction. Limited state and federal funding provides no assurance that all the Grand Parkway segments would be constructed. Each segment connects at least two existing major transportation corridors to ensure independent utility as required by FHWA regulations (23 Code of Federal Regulations [CFR] 771.111 (f)). The U.S. Congress confirmed the segment-by-segment development approach to be in compliance with federal law in the "Department of Transportation and Related Agencies Appropriations Bill of 1993."

While the proposed SH 99 Segment B supports the overall purpose of the Grand Parkway, the segment would also support the same purpose relevant to the transportation needs specific to northeast Brazoria

County and northwest Galveston County. As residential and commercial development continues to expand from Houston's current outer loop (Beltway 8), northeast Brazoria County and northwest Galveston County will require improved and additional roadways to accommodate the anticipated increase in traffic volumes. To that end, the proposed SH 99 Segment B would connect to two major transportation corridors (i.e., SH 288 and IH 45 South) to ensure independent utility as well as independent significance. The proposed SH 99 Segment B would have logical termini at radial freeways, making it functional even if implemented independently from the other Grand Parkway segments.

In addition, while the proposed SH 99 Segment B and C together would more efficiently serve as a hurricane evacuation route, proposed SH 99 Segment B alone would still provide an additional route for those living within the proposed SH 99 Segment B study area to get to either SH 288 or IH 45 South, as well as would provide an additional route west for when traffic queues occur along IH 45 South, allowing traffic to disperse between SH 288 and IH 45 South.

1.2.3 Safety (Hurricane Evacuation Route)

The Grand Parkway will play a potentially significant role in the evacuation of residents and tourists from the surge vulnerable areas of Galveston and Brazoria Counties in Texas. The location of the proposed corridor will provide an additional means for evacuees to reach intended destinations. The magnitude of the role that the Grand Parkway may play is a function of how many evacuees would logically use the route given their location and intended destination and the relief that the Grand Parkway provides to expected evacuation bottlenecks in the area. Given the location of the Galveston/Brazoria/Houston Metropolitan area along the northwest Gulf Coast and the intense recent hurricane activity such as storms Rita and Ike, hurricane evacuation is a critical public safety issue.

1.2.3.1 Evacuation Trip Generation

For Galveston, Brazoria, and Harris Counties, a number of evacuation vehicles were developed relevant to the analysis for a 2010 base year and future year 2035. The evacuation model developed for the Galveston region study area (from a recent H-GAC funded effort in coordination with the U.S. Army Corps of Engineers) as a starting point and made modifications based on new zip code based evacuation zones delineated by the counties relevant to the Grand Parkway. The finalized evacuation areas by zip code zone are displayed on each county's emergency management website. Evacuation zones form the basis of areas contributing evacuation traffic to the existing and future evacuation routes (***Exhibit 1-3***). Numbers of evacuating vehicles were generated and projected forward using growth factors developed for each county based on information from the Texas State Data Center.

Using finalized census figures for 2000 and 2010, and the Texas State Data Center population projections, growth factors developed for each county are listed in ***Table 1-4***.

Table 1-4: Projected Growth Factors per County

	2000 Census Population	2010 Census Population	2035 Population Projection	2035 Growth Factor
Galveston County	250,158	291,309	324,071	1.11
Brazoria County	241,767	313,166	371,957	1.19
Harris County	3,400,578	4,092,459	5,033,382	1.23

Source: Census 2010; Texas State Data Center 2014

Evacuation vehicles leaving the area from candidate feeder evacuation zones were then generated by applying the growth factors to the Year 2010 baseline figures developed from the zip code modified H-GAC/Corps Hazard Elimination Safety traffic model, as shown in ***Table 1-5***.

Table 1-5: Estimated Evacuation Vehicle Volumes

	Modeled Outbound Evacuation Vehicles Year 2000 Generated from Zip Code Zones	Modeled Outbound Evacuation Vehicles Year 2010 Generated from Zip Code Zones	Estimated Total Outbound Evacuation Vehicles Year 2035 Generated from Zip Code Zones
Galveston Zones	117,235	130,983	145,714
Harris Zones	184,799	265,211	326,187
Brazoria Zones	72,077	83,711	99,426
Totals	374,111	479,905	571,327

Source: USACE/FEMA Hazard Elimination Safety Study

1.2.3.2 Behavioral Data

Of critical importance to determining which evacuation zones might use each existing evacuation route and the proposed Grand Parkway Segment B and C (and to what degree), all available behavioral information was collected and reviewed. The American Red Cross was able to accomplish approximately 4,000 telephone surveys in the early eighties to learn what Gulf Coast residents did regarding Hurricane Allen. Texas A&M University conducted a series of behavioral interviews in 1990 which were more hypothetical in nature but presumably allowed residents to reflect on Hurricane Alicia of 1983. More recently, Dr. Michael Lindell and Carla Prater of the Hazard Reduction and Recovery Center of Texas A&M University published a report entitled "Behavioral Analysis Texas Hurricane Evacuation Study, February 2008" that provided a wealth of behavioral parameters for each coastal region of Texas. A Houston Chronicle/KHOU Hurricane Rita Survey by Robert Stein and Richard Murray also provided key behavioral information for the recent evacuations.

Data regarding direction of travel and intended destinations were of primary significance to this analysis. A composite of available behavioral information led to these assumed percentages presented in ***Table 1-6***.

Table 1-6: Estimated Evacuation Destination Cities Percentage

Direction of Evacuation Traffic	Average Percent	Destination Cities	Average Percent
North	45%	Austin	15%
Northeast	10%	Dallas/Ft. Worth	25%
West	15%	Houston	20%
Northwest	30%	San Antonio	15%
		Other	25%
Total	**100%**	**Total**	**100%**

Source: Lindell & Prater 2008

1.2.3.3 Potential Grand Parkway Evacuation Traffic

Using the generated evacuation vehicle and behavioral data, it was concluded that a number of evacuating vehicles would potentially use the Grand Parkway Segments B and C as evacuation routes. Segment B must be in place for Segment C to function as a major evacuation route. Vehicle figures for both segments were developed for the year 2035. Assumptions regarding what portion of each evacuation zone's directional traffic is using each segment are as follows:

- Grand Parkway Segments B and C in place.
- Harris County zones will not use the Grand Parkway given location to other regional roadways.
- Galveston Zones (including tourists) will comprise 90% of westbound evacuation traffic and up to one third of northwest bound evacuation traffic using Grand Parkway Segments B and C.
- Brazoria zones – one third of westbound and one third of northwest bound evacuation traffic will use Segment C, up to one fifth of northbound traffic will use Segment C if Segments E and F are in place.

Using these key assumptions, the evacuation vehicle data (generated by zone), and the directional percentages (listed previously) the following maximum potential evacuation vehicle volumes were generated by segment for the year 2035 are shown in ***Table 1-7***.

Table 1-7: Estimated Evacuation Vehicle Volumes per Segment

Contributing Area	Grand Parkway Segment B	Grand Parkway Segment C
Galveston zones	34,097 evacuation vehicles	34,097 evacuation vehicles
Brazoria zones	0	23,713 evacuation vehicles
Harris zones	0	0
Total by Segment	**34,097 evacuation vehicles**	**57,810 evacuation vehicles**

Source: USACE/FEMA Hazard Elimination Safety Study

1.2.3.4 Evacuation Route Capacities

Route characteristics were examines to ascertain the existing number of lanes by direction that will be used in evaluations. Route characteristics, including the number of lanes by direction, were used to develop hourly flow rates for each evacuation route in the study area. The H-GAC future year model parameters were reviewed to ascertain the planned/future number of lanes by direction on each route. Data from post storm evacuation assessment work for Federal Emergency Management Agency (FEMA) and the U.S. Army Corps of Engineers (USACE) contain actual hour-by-hour traffic counts during major evacuations over the last twenty years, and this data helped in developing appropriate service volumes for this analysis. The estimated average hourly evacuation volumes, by route out of the immediate evacuated area/vulnerable zones, are shown in ***Table 1-8***.

Table 1-8: Hourly Service Volumes per Route

	Current Year 2010	Future Year 2035
Galveston Routes		
SH 6	1,000 vph	1,800 vph
SH 146	1,200 vph	2,100 vph
I H 45 South	4,800 vph	6,500 vph
Grand Parkway Segment B/C	not in place	3,000 vph
Brazoria Routes		
SH 288	1,850 vph	1,850 vph
SH 36	800 vph	800 vph
FM 521	800 vph	800 vph
SH 35	800 vph	800 vph

Source: USACE/FEMA Hazard Elimination Safety Study

1.2.3.5 Evacuation Clearance Times

For evacuation traffic desiring to go out of county, Grand Parkway Segments B and C provide additional capacity to both Galveston County and Brazoria county evacuation zones attracting evacuation traffic that might otherwise congest Harris County evacuation routes. The clearance times provided in **Table 1-9** below reflect these benefits. A simplified method was used for calculating overall clearance time, whereby evacuating vehicles from an area are divided by the total of hourly average evacuation route capacities serving that area. However, to add a degree of realism and accuracy regarding the Grand Parkway role in evacuation, vehicles identified (above) as potentially using the Grand Parkway were subtracted out and the resulting calculations made.

Table 1-9: Projected Evacuation Totals and Clearance Times

Year 2035 Gross Out of County Clearance Time Estimates Based on Zip Code Zones	2035 Total Evacuation Vehicles	2035 Planned Hourly Route Capacities	2035 Clearance Time with Planned Widenings	2035 Route Capacities w/o Planned Widenings	2035 Clearance Time w/o Planned Widenings
Galveston Zones Exiting Evacuation Traffic and Routes					
With Grand Parkway SH6, SH146, IH 45 South	274,711	10,400	26.4 hours	7,000	39.2 hours
Grand Parkway Segment B	34,097	3,000	11.4 hours	3,000	11.4 hours
Without Grand Parkway (no build) SH 6, SH 146, IH 45 South	308,808	10,400	29.7 hours	7,000	44.1 hours
With Reverse Lane on IH 45 South & With Grand Parkway SH6, SH146, I45	274,711	15,400	17.8 hours	10,000	27.5 hours
Grand Pkwy Segment B	34,097	3,000	11.4 hours	3,000	11.4 hours
With Reverse Lane on IH 45 & Without Grand Parkway (no build) SH6, SH146, IH 45 South	308,808	15,400	20.1 hours	10,000	30.9 hours
Brazoria Zones Exiting Evacuation Traffic and Routes					
With Grand Parkway SH 288, SH 36, FM 521, SH 3	75,713	4,250	17.8 hours	4,250	17.8 hours
Grand Parkway Segment C with Galveston County Traffic	57,810	3,000	19.3 hours	3,000	19.3 hours
Without Grand Parkway (no build) SH 288, SH 36, FM 521, SH 3	99,426	4,250	23.4 hours	4,250	23.4 hours

Source: USACE/FEMA Hazard Elimination Safety Study; Grand Parkway Study Team 2014

If planned improvements on each evacuation route and Grand Parkway Segments B and C are not built, clearance time in the year 2035 would increase to greater than 44 hours for the Galveston zones. If planned improvements to each evacuation route are built, but Grand Parkway Segments B and C are not built, clearance times will be just under 30 hours for the Galveston area. With the Grand Parkway and with planned improvements, evacuation times fall to approximately 26 hours. As the clearance time calculations indicate, the Grand Parkway alone would save almost five hours of evacuation clearance time for the Galveston area. For Brazoria evacuees who are leaving to go out of county, the above table shows that the Grand Parkway also can save over four hours of clearance time for those evacuees as well.

Clearance times are also provided for an IH 45 South reverse lane strategy, as local officials are likely to implement this as a result of the difficult evacuation experienced with Hurricane Rita. Even with a reverse lane strategy on IH 45 South, the Grand Parkway would save over an additional three hours of clearance time.

This savings in time is significant in two respects. First, in situations (like a Hurricane Opal) where the storm rapidly increases in forward speed and intensity, the Grand Parkway may give over 40,000 evacuees the opportunity to evacuate who would not have been able to evacuate otherwise. (Emergency management officials have to add a block of what is called pre-landfall hazards time to clearance time to estimate the total number of hours before eye landfall at which to start evacuating the public. Pre-landfall hazards time is the number of hours before eye landfall at which either wind or flooding conditions make it impossible to continue traveling on the roadways.) Depending on the size and meteorological characteristics of the hurricane, pre-landfall hazards could be anywhere from three to eight hours. With pre-landfall hazards times added to the 44-hour and 30-hour times calculated without the Grand Parkway, an event like Opal could happen where there is not enough existing roadway capacity to handle the needed evacuation movements.

The second significant effect of the time savings due to the Grand Parkway is that it allows evacuation clearance time plus pre-landfall hazards time to drop below 24 hours which is a key warning timeframe of the National Hurricane Center. This would be a scenario where the Grand Parkway is in place and IH 45 South is placed under a reverse lane strategy. Communities that can reduce their evacuation times below 24 hours have the ability to issue evacuation advisories with much more confidence in projected landfall location and time of arrival.

A final evacuation benefit is that the Grand Parkway provides another access-controlled evacuation route for Galveston and Brazoria Counties in the case of a major accident on IH 45 South or SH 288 south of the Sam Houston Tollway.

1.2.3.6 Hurricane Rita and Hurricane Ike

Hurricane Rita

Hurricane Rita was the tenth hurricane, and second Category 5 hurricane, of the 2005 Atlantic hurricane season. The storm attributed to the death of six people directly and over 100 indirectly, mostly because of evacuation struggles, such as lengthy evacuation times in the heat, lack of proper provisions and water, and accidents (Houston Chronicle 2007). The threat of this storm prompted the largest peacetime evacuation in U.S. history and tested the existing roadway system and current state and local emergency management plans. It is estimated that 2.5 to 3.5 million people evacuated between Wednesday, September 21 and Friday, September 23, 2005. Early estimated total evacuation time was 31 hours.

Wednesday, September 21, 2005, three days prior to landfall, mandatory evacuations were put into effect for storm surge zones, flood-prone areas, persons with special needs, and mobile home residents (Harris County Office of Emergency Management 2006). According to the Harris County Office of Emergency Management, evacuation of surge zones A through C were to be staggered with Zone A beginning at 6 p.m. on Wednesday, followed by Zone B at 6 a.m. on Thursday and Zone C by 12 p.m. on Thursday. Officials hoped that the designation of Zones would prevent bottlenecks leaving the area. However, with the recent Hurricane Katrina disaster that hit Louisiana three weeks earlier, numerous residents outside the mandatory evacuation zones opted to voluntarily evacuate at the same time as those who were under mandatory evacuation, causing gridlock on all the major arterial roadways in and out of Houston and drastically increasing the travel evacuation times for those in the mandatory evacuation zones. Travel times to typical evacuation-destination cities, such as the cities of Austin, College Station, San Antonio, Dallas, Huntsville, and Lufkin, took upwards of 24 hours. The current local evacuation plan calls for opening of high occupancy vehicle (HOV) lanes outbound only, suspending passenger requirements, and waiving all tolls on toll roads in an effort to relieve congestion. However, due to the large number of evacuees, these initial measures did not relieve congestion and contraflow lanes were initiated on IH 45 and IH 10. While contraflow is not a preferred evacuation method, congestion was relieved, and by Friday, September 23, 2005, nearly 3 million people were evacuated prior to landfall of Hurricane Rita. However, the reverse laning hindered the shipment of supplies (food and gas) into the Houston-Galveston area, resulting in a gas shortage that left many evacuees stranded en route to their destination. It took several days after landfall to replenish the fuel and food supply.

While the evacuation was considered a success, in that millions were evacuated prior to landfall, State and local officials conducted a study to reevaluate existing emergency management plans and improve current roadway conditions in an attempt to better prepare the Houston-Galveston area for the next hurricane event.

From this study, Houston and the surrounding counties created a zip code evacuation plan. The intent of the zip code zone plan is to ease traffic congestion and assist residents of low-lying portions of Galveston, Brazoria, and Harris counties to evacuate before those outside the risk areas enter the roadways. The four zip code zones, which generally correspond to hurricane storm surge risk areas, begin along the coast and

continue inland toward the greater Houston area, with the coastal zone evacuating first, and inland zones evacuating in succession until all coastal residents have evacuated.

Hurricane Ike

Hurricane Ike was the ninth named storm and fifth hurricane of the 2008 Atlantic Hurricane season. Ike made U.S. landfall at Galveston, Texas on September 13, 2008, as a Category 2 hurricane. Mandatory evacuations for the coastal areas began three days before Hurricane Ike made landfall. Implementation of the zip code evacuation zones dramatically reduced the evacuation times from that of Hurricane Rita and prevented the need to implement the contraflow plan. While congestion was not as severe during the evacuation for Hurricane Ike on September 13, 2008, a study conducted by Rice University showed that only 24 percent of Harris County residents evacuated during Hurricane Ike, a Category 2 storm, versus the 52 percent that evacuated during Hurricane Rita, a Category 4 storm (Rice News 2009). The study also showed that 75 percent of Harris County residents said they would evacuate if a Category 4 hurricane threatened Houston. This is a substantial increase from those that evacuated for Hurricanes Rita or Ike. Therefore, it is expected that this increase in evacuations would create the same roadway gridlock experienced during Hurricane Rita.

1.2.3.7 Evacuation Alternatives

Various organizations have set forth several alternatives which they believe would relieve the need for the proposed project to be built, at least in regards to hurricane evacuation. Those alternatives are as follows:

- Use of public transit
- Widening of existing routes

The use of public transit has been suggested as an evacuation alternative to building the Grand Parkway Segments B and C. Public transit has been used in a very limited fashion in other parts of the coastal United States for evacuation purposes. It has been used in resort areas such as Atlantic City, New Jersey and Hilton Head, South Carolina where there is a large tourist population without personal vehicles. Transit has also been used to evacuate migrant farm workers from substandard housing in hurricane-vulnerable areas in selected rural communities. Southeast Florida counties such as Dade and Broward have circulated transit vehicles along their barrier islands during major hurricane events such as Hurricane Andrew. However, very few residents have been willing to use the service even though pick up points have been well planned and advertised.

Public transit use for evacuations by its very nature takes evacuees to designated public shelters. Most people do not want to go to public shelters and do not like the idea of leaving their residence with no personal freedom to come back on their own. Most pre- and post-storm hurricane behavioral analyses indicate no more than about one percent of the evacuating population intending to use or actually using public transit during an evacuation. To significantly reduce clearance times, transit use would need to be at least 15 to 20 percent of evacuees' mode choice and that is not realistic in a private auto- dominant community like the Galveston-Houston metropolitan area.

The second suggested alternative of widening existing routes has already been factored into this analysis. The 2035 model for the area incorporates a number of lane additions. In many cases the lane additions are the maximum that can be implemented within existing or available right-of-way (ROW). As shown previously, with these roadway widenings and without the Grand Parkway, clearance times can drop to just under 30 hours. However, when adding a pre-landfall hazards time of three to eight hours to this figure, the area still is in the difficult dilemma of having to start evacuation outside the National Hurricane Center's 24-hour warning threshold. Implementing the Grand Parkway project coupled with the widenings and IH 45 South reverse lane strategy allows the communities to fall within the warning capabilities of the National Hurricane Center.

1.2.4 Economic Development

Population and employment are primary demographic and economic indicators for travel demand. As previously established, H-GAC predicts a population increase from 5.8 million in 2010 to 8.8 million in 2035 for the greater Houston area (H-GAC 2014a). A 60 percent increase in employment is also expected in the same period of time (H-GAC 2014a). It is anticipated that development would progress in a manner consistent with suburban growth trends nationally: where jobs typically follow population growth, and suburban areas become self-contained with their own residential, retail, and employment centers.

With the predicted added congestion to the region, it would be increasingly difficult for businesses to function efficiently. The rate and distribution of population and employment growth within the study area would influence travel demand and the associated need for and practicality of transportation improvements and alternative solutions. In the *2040 RTP*, H-GAC predicts that because of the extent of traffic increases, serious and severe levels of future congestion would not be relieved solely through current recommendations for advancing public transportation and traffic management initiatives. The proposed SH 99 Segment B would provide the necessary additional roadway capacity for the movement of goods and services throughout the region. The proposed SH 99 Segment B would also provide an alternative circumferential route that would avoid local traffic conflicts and connect to local communities to accommodate existing and future growth.

SECTION 2: ALTERNATIVES ANALYSIS

Section 2 documents the analysis and development of the proposed transportation system improvement options, as well as the selection criteria and interdisciplinary approach that was applied when analyzing the environment, feasibility, and engineering impacts for each of the proposed SH 99 Segment B transportation system improvement options. The following analysis ultimately led to the selection of a single Preferred Alternative that would best serve the need and purpose of the proposed SH 99 Segment B and would best avoid or minimize environmental impacts.

As part of the evaluation process, initial planning activities required clearly identifying a defined area between SH 288 and IH 45 South within which proposed transportation system improvements would be evaluated. Coordination with elected officials and representatives of local communities resulted in the establishment of the proposed SH 99 Segment B study area (study area) presented on ***Exhibit 2-1***. The western boundary of the study area incorporates the intersections of several county roads with SH 288, including the intersection with County Road (CR) 60, which would be the east terminus of the proposed SH 99 Segment C that would extend westward from SH 288 to US 59. The eastern boundary of the study area includes the intersections of IH 45 South with FM 646 and SH 96.

After establishing the study area, a number of transportation system improvement options were identified and assessed for their effectiveness to reasonably and feasibly meet mobility requirements, while avoiding or minimizing major impacts to the human and natural environments within the study area. Brazoria County's *Transit Feasibility Study* (1995), H-GAC's *2035 RTP Update* (H-GAC 2014a), H-GAC's *2040 RTP*, LOS performance measures based on the Transportation Research Board's *Highway Capacity Manual* (TRB 2010), FHWA's *Congestion Management Process* (FHWA 2011), H-GAC's *2035 Draft Vision* (H-GAC 2012), and H-GAC's *Regional Commuter Rail Connectivity Study* (H-GAC 2008a) were all referenced to identify planning needs in the study area relative to regional travel demand and travel patterns.

2.1 TRANSPORTATION SYSTEM IMPROVEMENT OPTIONS

Transportation system improvement options are means by which the existing transportation facilities could be improved or additional methods of travel could be implemented to enhance and facilitate the movement of people and goods, the linking of the existing transportation system, the expansion of hurricane evacuation routes, and the further economic development of the proposed study area and the greater Houston area.

2.1.1 Description of Alternative Transportation Modes (Modal Alternatives)

Six modal alternatives were initially considered for the proposed SH 99 Segment B. The modal alternatives were extending bus transit service, increasing bus/public transit options, adding HOV lanes, expanding rail transit service, enhancing bicycle and pedestrian facilities, and adding single occupancy vehicle (SOV) capacity on the existing roadways or via a new controlled-access highway.

2.1.1.1 Bus Transit Service

Bus transit service is not currently provided by METRO within the study area or within Galveston or Brazoria counties. The *Gulf Coast Region; Updated Regionally Coordinated Transportation Plan* , provides some guidance in advancing transit services planning and coordination activities in the region for the next few year (H-GAC 2011). The plan includes the expansion of the Coordinated Voucher Program to Brazoria and Galveston Counties through intra-local agreements with Gulf Coast Connect and Fort Bend County through Fort Bend County Transit. The plan also includes the expansion of the existing Car-share and Volunteer Driver Voucher programs.

METRO's recommended future service concept would implement the METRO Solutions transit system plan. The planning study for the SH 288 corridor would include new park-and-ride lots, but construction of the facilities would first depend on executing inter-county agreements that would extend bus transit service outside the current METRO service area. In addition, the Galveston County Transit District is currently seeking funding for the extension of an Island Transit bus route. The extension would send buses to the Bay Area Park-and-Ride in Houston, where riders could then board buses serving Houston's Metro transit system.

2.1.1.2 Section 18 Public Transit Implementation

The U.S. Department of Transportation established the Section 18 public transit program to provide start-up funding and operation subsidies for public transit providers in rural communities (i.e., communities with populations under 50,000). Section 18 agencies typically provide demand-responsive rather than fixed-route service. Users arrange in advance to be picked up or dropped off, and the transit provider attempts to group as many person-trips as practicable for a single trip. Funding is also given to rural government entities to provide a minimal level of transit service to transit-dependent populations (e.g., persons with disabilities, the elderly, and persons unable to drive). There is currently one public transit firm (Gulf Coast Connect Transportation) operating in Brazoria County under the plan.

2.1.1.3 High Occupancy Vehicle (HOV) Lanes

The HOV lane concept is often implemented in conjunction with an existing roadway that is experiencing considerable traffic congestion. HOV lanes are most effective when paired with park-and-ride lots, employer-based vanpool and carpool plans, and commuter parking subsidies. HOV lanes are often successful when potential ride-sharers have common geographic trip origins and destinations within similar time frames. In an established system, an HOV lane can move 4,000 to 5,000 persons per hour, as compared to an average traffic lane that moves 2,000 vehicles per hour with an average of 1.25 persons per vehicle, which is equivalent to 2,500 persons per hour. HOV lane implementation can vary according to traffic demands and typically entails the following lane configurations.

- **Contraflow lanes** are non-SOV lanes that are borrowed for peak direction use through the daily deployment (placement and removal) of moveable barriers to separate the opposing flow of traffic.

- **Diamond lanes** are designated non-SOV lanes in the direction of congested traffic that are generally separated by striping and a buffer zone and operate either 24 hours a day or during certain portions of a day, reverting to general use during off-peak periods.
- **A barrier-separated, reversible HOV lane** is a single, non-SOV lane separated from all traffic with various access points along the route and in which traffic can be reversed to accommodate peak traffic flow.
- **Barrier-separated, two-way HOV lanes** are two-way HOV lanes that accommodate traffic in both directions continuously.
- **High occupancy toll (HOT) lanes** are single-directional or two-way dedicated traffic lanes separated from all general purpose lanes with only a few access points along the route. Typically HOVs would travel for free and SOVs would pay a static or dynamic toll as established by an agency.

Although METRO operates HOV lanes in Houston and Harris County on several major radial highway corridors and HCTRA manages the HOT lanes on IH 10, there are currently no HOV/HOT lanes on highways within the study area. However, future HOV lane service could be provided on IH 45 South and SH 6 by METRO and TxDOT through inter-agency agreements or in conjunction with the Gulf Coast Center – Connect Transit.

2.1.1.4 Rail Transit Service

Rail transit service would likely involve both commuter rail and a stand-alone rail transit system, similar to METRO's current system in operation between downtown Houston and IH 610 South. Comparable to adding HOV lanes to an existing highway, a rail transit system would be most effective where commuters have common geographic trip origins and destinations. Located east of the study area, H-GAC's *Regional Commuter Rail Connectivity Study* identified the SH 3/Galveston commuter corridor as one of the most promising early implementation corridors (H-GAC 2008a). The study also recommended that engineering studies of other priority corridors be conducted to establish a timeline for implementing a complete regional and long-distance commuter rail system within 10 to 15 years. Currently, there is no commuter rail transit service within the study area, and while the SH 3/Galveston commuter corridor has been identified as a priority for further study, there are no immediate plans to construct a rail transit system within the study area.

2.1.1.5 Bicycle and Pedestrian Facilities

Alvin, League City, and TxDOT are collaborating to construct bicycle and pedestrian improvements as part of several master-planned communities in Brazoria County. Improvements proposed to benefit bicyclists and pedestrians would include sidewalks, bicycle lanes, hiking paths, and other amenities (e.g., lockers, showers, and secure storage facilities). Proposed improvements, such as full shoulders and minimal ditch slopes for new rural CRs or curb offsets and sidewalks for urban CRs, would also benefit bicyclists and pedestrians. Despite the proposed improvements, the feasibility and effectiveness of bicycle

and pedestrian alternatives are heavily dependent on trip length, and the trip lengths required to address regional mobility within the study area would be considered extreme for bicyclists and pedestrians.

2.1.1.6 Single Occupancy Vehicle (SOV) Capacity

Three types of added SOV capacity alternatives were considered for the study area: the widening of existing arterials, the construction of new arterials, and the construction of a new controlled-access highway.

Widening of Existing Arterials

Currently, several existing arterials within the study area are planned to be widened and improved per the *2040 RTP*, including SH 6, IH 45, and SH 35 (H-GAC 2014a). However, because of existing development along the arterials, any transportation improvements that require additional ROW could result in residential relocations and/or commercial and community facility displacements. In addition, arterials in densely developed areas tend to have lower speeds and more traffic control devices. While widening and realigning one or more of the arterials would increase capacity, improve local mobility, and decrease congestion at certain points within the study area, the proposed improvements would not likely relieve future regional congestion, provide additional system linkage or hurricane evacuation capacity, or advance economic development. However, the widening and realigning of any of the existing arterials could be included as part of the development of other transportation improvements.

Construction of a New Arterial or Controlled-Access Highway

The primary consideration for the development of a new arterial or highway alignment would be the efficient movement of people and goods across the study area to SH 288 and/or IH 45 South. It is well known that arterials in developed areas often experience lower capacity and speeds when compared to a controlled-access highway of the same size because of the presence of traffic control devices and driveways along the arterial. Therefore, a new arterial would not be as effective as a new controlled-access highway in meeting the linkage, capacity, evacuation, and economic needs of the study area. In addition, the study area's general rural character and prevalence of undeveloped land both facilitate the planning of a controlled-access highway on new ROW.

2.1.2 Transportation System Management (TSM) Alternatives

Transportation System Management (TSM) alternatives are low-cost, small-scale projects that intend to improve the efficiency of a roadway or highway. Examples of TSM projects that would affect overall vehicle miles travelled (VMT) and/or travel speeds would be:

- **Park-and-ride lots** that encourage ridesharing, carpool and vanpool programs, and HOV lane use;
- **Ridesharing** to decrease the number of vehicles on existing roadways or highways by combining trips of similar origin and destination;
- **Traffic signal coordination** to optimize traffic signal phasing and sequencing of successive intersections along a thoroughfare;

- **Intersection improvements** that would offer additional or continuous turn lanes, re-striping, and/or widening of intersections in addition to traffic signal synchronization;
- **HOV lanes** where traffic lanes on existing highways would be restricted to non-SOV use during peak hours (HOV facilities could be implemented on SH 6, FM 517, SH 35, and FM 1462);
- **Intelligent transportation systems** to leverage technology (e.g., cameras, detectors, and variable/changeable message signs) to provide traffic and accident information; and
- **Motorist assistance programs** that could function as courtesy patrols to assist stranded or disabled vehicles.

Future mobility needs are identified in the *2040 RTP*, and the *2035 METRO Long Range Plan* recommends significant expansion of the current transit system to include a network of integrated, high-capacity transit facilities on major travel corridors for service expansion beyond the current METRO service area (H-GAC 2014a; METRO 2007). Key elements of the METRO plan include 89 miles of fixed light rail transit, 84 miles of commuter rail transit, and 40 miles of signature bus service.

The *Gulf Coast Region; Updated Regionally Coordinated Transportation Plan* identified gaps in service, noted barriers to limit the coordination of transportation activities, developed recommendations, and devised an action plan. Based, in part, on that study, the *2035 RTP Update* offered a number of transit recommendations (H-GAC 2011). These recommendations were also carried forward to the *2040 RTP*.

- Expand public transportation services by filling gaps inside and outside the METRO service area and by expanding service to cover the 13-county Gulf Coast region.
- Improve connectivity by exploring opportunities to expand and develop transit facilities that serve as multi-modal transportation hubs for connecting local and express buses, taxis, vanpools, and airport shuttles.
- Work with local transportation providers to develop flexible and seamless fare polices that would allow customers to use a single ticket (or pass) to travel on all public transit providers.
- Explore projects that use public-private partnerships to fast track commuter rail in the US 90A, US 290, and SH 3 corridors.
- Promote Jobs Access and Reverse Commute programs to assist former welfare recipients and other low-income residents with obtaining access to public transportation.
- Explore other potential high-capacity transit corridors. Currently, H-GAC has identified corridors along SH 249, US 290, FM 521, SH 288, SH 225, SH 146, and SH 35 as meriting further consideration for high-capacity transit (H-GAC 2014a).

2.1.3 Travel Demand Management (TDM) Alternatives

Similar to TSM measures, Travel Demand Management (TDM) alternatives are low-cost, small-scale improvements and programs designed to change commuter travel patterns and create a more efficient use of the existing traffic systems. TDM measures provide alternatives to SOV travel, such as mass transit,

carpool/vanpool programs, and the active support of flextime work hours and telecommuting. Traffic condition information services, guaranteed ride home options, and restricted parking availability are also potential TDM programs.

Overall, the success of TDM alternatives has been limited because options are predominately implemented on a voluntary basis rather than being mandated by law. While employers were provided incentives and encouraged to initiate programs such as flextime work hours and telecommuting, most concluded that employee response was limited, and the programs were short lived. The Employer Trip Reduction Program of 1994 (repealed in 1995) was an unsuccessful example of a TDM strategy that targeted a 25 percent reduction of SOV commutes to work sites. However, from this, H-GAC developed the Commute Solutions Program to increase transit use, carpooling, and other forms of trip reduction within congested employment centers and travel routes. In addition, H-GAC and METRO began sponsoring a Regional Vanpool Program (METRO STAR) that currently operates vanpools in Brazoria County.

2.1.4 No-Build Alternative

The No-Build Alternative anticipates that future travel demand would be met using existing and planned roadway and transportation facilities. Linkage, capacity, evacuation, and economic needs would be addressed through using the collective system of existing transportation facilities and the construction of planned and committed local improvements within the study area as defined in the *2040 RTP*, exclusive of the proposed SH 99 Segment B.

2.2 ASSESSMENT OF TRANSPORTATION SYSTEM IMPROVEMENT OPTIONS

The transportation improvements presented above represent options for meeting the need and purpose of the proposed SH 99 Segment B. However, each option is not necessarily exclusive, in that the implementation of one option does not preclude implementation of all or part of another option. Each transportation improvement was evaluated on its ability to satisfy the need and purpose of the proposed SH 99 Segment B, while simultaneously avoid or minimize adverse impacts to the human and natural environments of the study area. Whether implemented in whole, in part, or in combination, any recommended option must represent a viable means of addressing future travel demand and enhancing linkage, evacuation, and economic development within the study area and the greater Houston area.

Assessing the transportation improvements consisted of a multi-step effort involving public outreach, identification of environmental resources within the study area, and the review and analysis of each option. Information on existing and planned transportation facilities and projected trends in traffic and population growth within the study area was obtained. Sensitive environmental resources, such as wetlands, floodplains, schools, parks, and residential/commercial developments, were identified and mapped. Analysis of each transportation improvement was conducted based on public input received and review of existing environmental constraints. From these efforts, some options were eliminated and some were selected for further study, as described in the following sections.

2.2.1 Transportation System Improvement Options Eliminated From Further Study

Each of the transportation system improvement options previously described would address certain aspects of the linkage, capacity, evacuation, and economic needs of the study area. However, because the subsequent options do not expand capacity, enhance system linkage, provide additional hurricane evacuation routes, or further develop the economy within the study area and the greater Houston area, they to not effectively improve long-term regional mobility.

2.2.1.1 Modal Alternatives

The modal alternatives of extending bus transit service, increasing Section 18 public transit options, adding HOV lanes, expanding rail transit service, enhancing bicycle and pedestrian facilities, and adding SOV capacity to existing arterials could be implemented within the study area. However, based on projected growth and development within the region, each of the proposed transportation improvement would not adequately address the need for expanded capacity. The modal alternatives would also not provide system linkage, an additional emergency evacuation route of sufficient capacity to serve the evacuation needs of the study area and greater Houston area, or the support of economic development. Therefore, the modal alternatives, as stand-alone options to solve the needs of the study area, were eliminated from further consideration.

2.2.1.2 TSM Alternatives

As small-scale projects intending to improve existing roadway efficiency, TSM alternatives can improve traffic operations, but the alternatives alone cannot provide the long-range capacity required to improve system linkage or to develop the economic vitality of the area. Examples of proposed TSM measures evaluated were the addition of left-turn lanes for IH 45 at FM 646, new signals on FM 528 at SH 6 (Gordon Street) and FM 1462 at CR 190, and the construction of intelligent transportation systems communication networks along the SH 35 corridor. Additionally, TSM alternatives do not provide sufficient improvements for additional emergency evacuation. As such, the TSM alternatives were also eliminated from further consideration.

2.2.1.3 TDM Alternatives

The low-density, rural character of a large portion of the study area, coupled with limited accessibility to transit and other alternatives to driving, limit the application of many TDM measures. TDM alternatives would not address the need for additional capacity to accommodate predicted future growth in traffic and the corresponding deterioration of roadway LOS. TDM alternatives would also not materially contribute to congestion relief, system linkage, additional emergency evacuation routes, and economic development. Therefore, the TDM alternatives were eliminated from further consideration.

2.2.2 Transportation System Improvement Options Selected For Further Study

2.2.2.1 No-Build Alternative

The No-Build Alternative assumes the existing transportation system as presently configured, but also includes planned and committed construction and improvements to existing transportation facilities. Anticipated future population growth and development within the proposed SH 99 Segment B study area will increase traffic volumes on the existing roadway network, resulting in increased congestion. ***Exhibit 2-2*** shows traffic operations within the proposed SH 99 Segment B study area based on 2009 traffic data. The existing and future condition traffic projections/data were extracted from the H-GAC Travel Demand Model and TxDOT. ***Exhibit 2-3*** shows the projected traffic operations for 2035 for the proposed SH 99 Segment B study area with the No-Build Alternative. The projected traffic operations show that some roadways that are currently operating at acceptable LOS D or better are projected to be near or over capacity in 2035 with the No-Build Alternative. LOS F with volume-to-capacity ratios of more than 1.0 are projected on several roadway segments in both the existing and future 2035 scenarios.

On first glance, the No-Build Alternative would represent a cost savings compared to the build alternatives. However, there would be higher maintenance requirements and user costs on existing roadways because of the increased traffic volumes and travel delays. The No-Build Alternative would also require additional short-term restoration and improvements to continue any semblance of operational efficiency and safety on the existing roadways. Traffic congestion during periods of required roadway maintenance and reconstruction would be more frequent under the No-Build Alternative, which would result in increased user costs. The No-Build Alternative would also not provide system linkage, economic development, and an additional emergency evacuation route to relieve anticipated congestion on the existing major arterial roadways leading away from the coast.

While the No-Build Alternative fails to satisfy the need and purpose of the proposed SH 99 Segment B, it is retained as a basis for comparison with the transportation system improvement options carried forward for detailed study as required by the Council on Environmental Quality (CEQ) regulations.

2.2.2.2 Build Alternative

Based on the assessment of the transportation system improvement options, construction of a new alignment was determined to be best meet the need and purpose of the proposed SH 99 Segment B. A controlled-access highway on new ROW, with the possible incorporation of portions of existing ROWs, would provide an alternate travel route for traffic moving between SH 288 and IH 45 South. The option would be expected to relieve congestion on existing roadways presently used by the traveling public traversing the study area. A newly constructed, controlled-access highway would also provide system linkage, a new route for evacuation during emergency situations, and economic development opportunities within the study area and the greater Houston area.

The primary goal of the Build Alternative would be to meet the mobility and evacuation needs of the study area. Alvin, which is centrally located within the study area, would serve as the center for the routing of the various alternative highway alignments under the Build Alternative. As such, various

Alternative Alignments were developed to route the traveling public north of Alvin, through Alvin (incorporating part of the existing SH 35 ROW), or south of Alvin.

2.3 SELECTION OF A RECOMMENDED ALTERNATIVE

Selection of a new, controlled-access highway as the recommended transportation system improvement option required that additional analysis be conducted to identify potential alignments for the proposed highway. The analysis consisted of a multi-phase screening process to develop a defined set of Alternative Alignments from a number of possible alternative highway alignments.

2.3.1 Developing the Proposed SH 99 Segment B Study Area

As previously stated, coordination with elected officials and local community representatives resulted in identifying an applicable study area between SH 288 and IH 45 South, within which the analysis of the transportation system improvement options was conducted (***Exhibit 2-1***). The western and eastern boundaries of the study area include intersections with existing roadways at SH 288 and IH 45 South, respectively. The intersections are logical terminus points where the traveling public might enter or exit the study area via the bordering radial freeways.

The study area encompasses approximately 170 square miles and includes all or part of nine incorporated communities, with Alvin being somewhat centrally located within the study area. Major roadways within the study area include SH 6, SH 35, FM 517, and FM 1462. Although residential, commercial, and industrial development is present, the majority of the study area is undeveloped and rural property.

Initial planning activities within the study area included data collection to identify potential environmental constraints, such as floodplains, wetlands as mapped by the U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) mapping, riparian habitat areas, existing and proposed residential development, parks, schools, churches, cemeteries, landfills, known cultural resources sites, and known toxic/hazardous waste sites. Major thoroughfare plans indicating the locations of planned roadway improvements in the region and existing and proposed stormwater drainage improvements were reviewed.

Local governments (e.g., counties, cities, drainage districts, and regional planning organizations) and representatives from federal, state, and local agencies, including the USACE, USFWS, Texas Parks and Wildlife Department (TPWD), Texas Historical Commission (THC), Texas Commission on Environmental Quality (TCEQ), Natural Resources Conservation Service (NRCS), U.S. Environmental Protection Agency (EPA), Galveston Bay Foundation, and others were invited to a separate meeting with the proposed SH 99 Segment B Study Team (and to provide written input if they could not attend the meeting) for the purpose of discussing environmental and other issues of concern in the study area. Areas of concern included wetlands, riparian and prairie habitats, threatened and endangered species, water bodies, safety, and cultural resources. Collected data were used to create maps illustrating potential environmental constraints relative to existing and planned roadways and drainage improvements within the boundaries of the study area (***Exhibit 2-1***). The maps were presented at a public scoping meeting held

for elected officials, local representatives, resource agency personnel, and the general public on September 12, 2002.

After the public scoping meeting, analyses of the various transportation improvements were conducted, which led to the determination that new alignment construction was the preferred transportation system improvement option. Development of various alternative highway alignments was then initiated.

2.3.2 Development of the Preliminary Build Alternatives

Current aerial photography, potential environmental constraints, utility maps, and public scoping meeting comments were supplemented by field inspections from public ROWs to generate a variety of 400-foot-wide corridor components that, when combined, would traverse the length of the study area from SH 288 to IH 45 South. Along the western study area boundary, corridor components were configured to intersect with SH 288 at FM 1462, CR 60, and CR 56. Along the eastern study area boundary, corridor components were configured to intersect with IH 45 South at FM 646 and the SH 96 interchange. Corridor components were aligned along existing roadways and through undeveloped areas. The intent of aligning components through undeveloped areas was to minimize potential impacts to existing roadways and residential, commercial, and industrial areas. However, corridor components were also aligned along existing roadways because incorporating existing ROW may minimize potential adverse impacts to sensitive environmental resources. Mapped wetlands and water bodies, riparian habitat, floodplains, and sensitive natural features were avoided to the extent practicable. The numerous corridor components and combinations thereof represented the universe of alternative roadway alignments evaluated (***Exhibit 2-4***).

Alvin and SH 35, both of which are located near the center of the study area, served as reference points for labeling the various corridor components as east, west, north, or south, depending on its location relative to Alvin or SH 35. Eleven corridor components were created: three east of SH 35, four west of SH 35, two north of Alvin, and two south of Alvin. A portion of the existing SH 35 Bypass (Alvin Bypass) on the east side of Alvin served as a corridor component. Overall, the various corridor components were developed such that several components could be combined to form the alternative roadway alignments.

A total of 16 possible alternative roadway alignments were developed. Five of the alignments incorporated the existing SH 35 Bypass; four alignments were located north of Alvin, and six were located south of Alvin. One additional alignment (Alignment X) was created using the existing roadways of FM 1462, SH 35, and FM 517. ***Table 2-1*** summarizes the results of the environmental evaluation of the 16 possible alignments.

2.3.3 Development of the Candidate Alternative Alignments

Although the corridor components could be combined to create numerous alternative roadway alignments, some corridor components and the resulting alignments had characteristics that were less desirable for further consideration. For example, the east terminus of the alignments and corridor components intersecting IH 45 South at the interchange of SH 96 and Brittany Bay Boulevard resulted in undesirable geometric configurations that could potentially impact existing development in the study area.

Therefore, alignments terminating at the intersection of IH 45 South and FM 646 would be more desirable than the intersection of IH 45 South and SH 96.

Various human and natural resource parameters common to each alternative roadway alignment (e.g., communities impacted, displacements, wetlands, floodplain, ROW acreage, bridge/drainage structures, and overall length) were also identified. The parameters were used to compare and evaluate the 16 alignments, which led to the selection of three representative Alternative Alignments: the Northern Alternative, the Central Alternative, and the Southern Alternative.

Meetings with the public, elected officials, and representatives of resource and regulatory agencies were then conducted to obtain input on the preliminary Alternative Alignments (***Exhibit 2-4***) and, more specifically, the three Alternative Alignments that had been selected for further analysis. A public workshop held on February 25, 2003, presented the corridor components constituting the universe of alternative roadway alignments and highlighted the three selected Alternative Alignments. Based on additional public comment and input from elected officials, the Alternative Alignments were refined to improve geometric configuration when intersecting with proposed major thoroughfares, to enhance overpass crossings, and to reduce the number of partial property acquisitions. The input led to the revised Northern, Central, and Southern Alternatives as shown on ***Exhibit 2-5***.

After refining the three candidate Alternative Alignments, property owners, residents, and representatives from Alvin requested the consideration of additional alternative roadway alignments in the western portion of the study area from SH 288 to the SH 35 Bypass to reduce the number of potential displacements. In a meeting with area representatives on September 25, 2003, three additional alignments to the Central Alternative were proposed. Two of the proposed alignments were minor variations in the routing of the Central Alternative, and one was routed partially on the Southern Alternative and partially on a new location.

Table 2-1: Preliminary Alternative Alignment Evaluation Matrix

Alignments from SH 288 to IH 45 South	Human and Natural Environmental Parameters						
	Wetlands **Acres (No. of Potential Sites)**	**Floodplains Acres**	**Community Bisector? Yes/No (No. Affected)**	**Displacements**	**ROW Acres**	**Bridges/ Drainage (No. of Structures)**	**Alignment Length in Miles**
Preliminary Build Alternatives							
N 1	24 (42)	183	Yes (3)	37	1,012	20	20.88
N 1 to N 2	33 (45)	396	Yes (3)	31	1,058	21	21.84
3 E - 2 W	25 (52)	389	Yes (2)	22	1,071	22	22.10
2 E - 3 E - 2 W	25 (44)	481	Yes (3)	30	1,093	23	22.58
2 E - N 1 - N 2	32 (46)	396	Yes (3)	30	1,034	22	22.91
2 E (Rev) - N1 - N - N2	24 (9)	338	Yes (2)	30	1,125	25	23.21
X (Existing Roadways)	12 (36)	215	Yes (4)	244	454	20	23.57
1 E - SH 35 - 3 W	44 (48)	419	Yes (2)	24	1,017	28	23.84
2 E - SH 35 - 3 W	32 (44)	335	Yes (2)	23	1,012	28	24.65
1 E - SH 35 - 4 W	49 (48)	313	Yes (4)	29	1,019	28	24.01
2 E - SH 35 - 3 W - 4 W	38 (43)	254	Yes (3)	29	1,067	28	25.78
C-Alt1	46 (9)	274	Yes (3)	23	1,013	32	24.43
C-Alt2	45 (9)	274	Yes (3)	22	1,010	32	24.38
C-S Alt	41 (17)	245	Yes (1)	16	1,020	33	26.44
S 1	46 (50)	150	Yes (3)	29	1,364	30	28.12
S 2 (1 E to SH 35 To S 1)	36 (41)	237	Yes (2)	44	1,059	20	26.31

Source: SH 99 Segment B Study Team.

Notes: E = East; N = North; No. = number; ROW = right-of-way; S = South; W = West.

An evaluation of the additional Alternative Alignments when compared to the Central Alternative revealed that two of the alignments would be shorter in length and require less overall ROW acreage. However, both alignments would result in a greater number of displacements. While the alternative roadway alignment routed partially on the Southern Alternative would result in fewer displacements, the alignment would be slightly longer and would require more ROW acreage than the other two alignments. Because of the favorable characteristics of reduced displacements and improved geometry, the alignment partially routed on the Southern Alternative was selected as the fourth Alternative Alignment and named the Central-South Alternative for further study.

Coordination with the public and local elected officials continued as part of the alternatives evaluation and public involvement process. Comments received during the period resulted in the development of another candidate alternative roadway alignment in the western portion of the study area. The alignment would incorporate a combination of a new location and a portion of the Southern Alternative on its western end, and then it would turn northeast along the SH 35 corridor toward Alvin, where it would merge with the Central Alternative at the SH 35 Bypass. The fifth Alternative Alignment was identified as the South-New Alternative and included with the other Alternative Alignments for further detailed analysis.

The proposed SH 99 Segment B study area boundary was subsequently adjusted slightly to accommodate the five Alternatives Alignments as shown on ***Exhibit 2-5***.

Continued coordination resulted in considering additional alternative roadway alignments with a logical terminus at SH 288, other than at CR 60. Two alignments were selected for further evaluation. One was a variation of the Northern Alternative, where the western portion of the alignment would incorporate the northern corridor component that intersects SH 288 at CR 56. The other alignment would follow the existing roadways of FM 1462, SH 35, and FM 517 for the majority of its length. The latter alignment would incorporate the intersection of FM 1462 and SH 288 near the western boundary of the study area. Near the eastern study area boundary, the alignment would turn northward to intersect with the roadway segment common to all of the Alternative Alignments, rather than follow FM 517 to its intersection with IH 45 South. The two additional Alternative Alignments were identified as the Northern 2 Alternative and Southern 2 Alternative and included with the other alternative alignments for further detailed analysis.

All seven Alternative Alignments are shown on ***Exhibit 2-5***, and ***Table 2-2*** summarizes the results of the environmental evaluation of the candidate alternatives as presented in the DEIS and the August 2012 Public Hearing.

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Table 2-2: Candidate Alternative Alignment Evaluation Matrix

Component	Unit	Northern Alignment	Northern 2 Alignment	Central Alignment	Central-South Alignment	South-New Alignment[a]	Southern Alignment	Southern 2 Alignment	No-Build
Length	Miles	**23.20**	**21.20**	**24.80**	**26.33**	**28.16**	**28.17**	**22.56**	**0**
Required ROW	Acres	**1,125**	**1,029**	**1,034**	**1,109**	**1,182**	**1,366**	**803**	**0**
Wetlands									
Forested	Acres	**0**	**2**	**19**	**20**	**10**	**5**	**3**	**0**
Non-Forested	Acres	**24**	**33**	**26**	**22**	**35**	**31**	**3**	**0**
Water Resources									
Stream Crossings	Number	**13**	**9**	**13**	**13**	**14**	**11**	**11**	**0**
Canals	Number	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**0**
Stock Ponds	Number	**1**	**6**	**3**	**1**	**3**	**0**	**10**	**0**
Floodplains	LF	**36,870**	**21,362**	**29,880**	**26,899**	**22,667**	**11,649**	**18,592**	**0**
Floodways	LF	**2,387**	**41,503**	**4,830**	**2,088**	**2,093**	**7,153**	**2,351**	**0**
T&E and SOC Habitat									
Animals	Y/N	**Y (Equal chance along all seven Alternative Alignments where habitat is present)**							**N**
Plants	Y/N								**N**
Vegetative Communities									
Agricultural	Acres	**923**	**832**	**759**	**890**	**770**	**1,008**	**384**	**0**
Urban/Residential	Acres	**47**	**48**	**65**	**61**	**241**	**38**	**268**	**0**
Riparian	Acres	**22**	**9**	**37**	**23**	**25**	**64**	**28**	**0**
Wooded Lot	Acres	**118**	**59**	**147**	**136**	**84**	**171**	**94**	**0**
Other	Acres	**13**	**96**	**23**	**7**	**62**	**83**	**314**	**0**
Prime Farmland	Acres	**531**	**912**	**1,101**	**919**	**1,065**	**787**	**676**	**0**
Potential Residential Noise Impacts	Number	**117**	**153**	**85**	**66**	**61**	**87**	**229**	**0**
Air Quality	Y/N	**N**	**N**	**N**	**N**	**N**	**N**	**N**	**0**
Hazardous Materials Sites within ½ Mile of ROW	No. of Sites	**12**	**15**	**32**	**33**	**35**	**10**	**37**	**0**
Public Water Wells within ¼ Mile of ROW	Number	**0**	**0**	**0**	**1**	**0**	**3**	**2**	**0**

Table 2-2: Candidate Alternative Alignment Evaluation Matrix

Component	Unit	Northern Alignment	Northern 2 Alignment	Central Alignment	Central-South Alignment	South-New Alignment[a]	Southern Alignment	Southern 2 Alignment	No-Build
Private Water Wells within ¼ Mile of ROW	Number	**5**	**7**	**7**	**7**	**8**	**8**	**12**	**0**
Cultural Resources									
Prev. Rec. Arch. Sites	Number	**23 sites near the study area and 1 within the study area**							
Prev. Rec. Hist. Sites	Number	**115 properties documented within the study area**							
Displacements/ Relocations									
Residential	Number	**56**	**53**	**13**	**9**	**13**	**18**	**130**	**0**
Business	Number	**8**	**10**	**3**	**2**	**9**	**6**	**57**	**0**
Schools	Number	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Churches	Number	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**
Section 4(f) Properties	Number	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**
Parks and Rec. Areas	Number	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**
Cemeteries	Number	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
EJ Considerations	Y/N	**N**							**N**
Visual and Aesthetics	High/Low	**Low: Equal along all seven Alternative Alignments**							**Low**
Indirect and Cumulative	Y/N	**Yes: Equal along all seven Alternative Alignments**							**N**

Source: SH 99 Segment B Study Team; Grand Parkway SH 99 Segment B DEIS (June 2012).

[a] Presented as the Recommend Preferred Alternative in the DEIS and at the August 2012 Public Hearing.

Notes: EJ = environmental justice; LF = linear feet; No. = number; ROW = right-of-way; SOC = species of concern; T&E = threatened and endangered; Y/N = Yes/No.

2.3.4 Traffic Analysis for Selected Alternatives

Because of similarities between the Central and Central-South Alternatives and the Southern and South-New Alternatives, a traffic analysis using forecasted 2035 traffic volumes was completed using the H-GAC 2035 regional model for only three of the seven Alternative Alignments (i.e., the South-New, Northern, and Central Alternatives) and the No-Build Alternative. For traffic analysis purposes, it was assumed that LOS for the South-New Alternative would also apply to the Southern Alternative.

The results of the traffic analysis for four of the seven Alternative Alignments (i.e., the South-New, Northern, Central, and Southern 2 Alternatives) for 2035 are shown on ***Exhibit 2-6*** through ***Exhibit 2-9***, respectively. In general, constructing any of the four Alternative Alignments would reduce congestion on some local arterials by providing increased access to SH 288 and IH 45 South and through reducing reliance on SH 35 as a north-south route. Traffic volumes on SH 288 and IH 45 South would potentially increase, but traffic volumes on some sections of SH 35 that are not a part of the proposed SH 99 Segment B would decrease. Congestion would be reduced on the existing east-west arterials, as the Alternative Alignments would provide alternate routes to SH 288 and IH 45 South.

2.3.5 Selection of a Recommended Preferred Build Alternative

Based on public input, the evaluation criteria listed in ***Table 2-2***, and 2035 projected development within the proposed SH 99 Segment B study area, the South-New Alternative was recommended as the Preferred Alternative for further study in the FEIS. The Recommend Preferred Alternative is highlighted on ***Exhibit 2-10***.

2.3.6 Selection of a Preferred Build Alternative

Prior to the August 2012 Public Hearing, coordination with stakeholders and review of the South-New Alternative by the design engineers resulted in a revision of the alignment that differed slightly from what was presented in the DEIS. In the western portion of the alignment, the radius of the southeastern turn east of SH 288 was minimized to reduce the proposed roadway's impact on the underlying land parcel. In the southwestern portion of the alignment, Brazoria County requested that the proposed alignment be shifted from the north side of Brunner Ditch to the south side so as not to interrupt surface storm water flows moving southward toward the ditch. The revised South-New Alternative alignment was presented at the Public Hearing.

After the August 2012 Public Hearing, coordination with the public, stakeholders, adjacent property owners, and the design engineers resulted in slight modifications and a revised alignment for the recommended South-New Alternative to create what is currently the Preferred Alternative (***Exhibit 2-11***). The primary goal for considering any alignment revision was to continue to avoid impacts and work with all interested parties to determine the alignment that best fit the purpose and need of the proposed SH 99 Segment B, in addition to accommodating current engineering standards. The alignment revision addressed comments received from the reviewing engineers concerning less than acceptable turn curvatures that would affect sight distances. Modifications to the alignment were conducted within the same property parcels that would be traversed by the previously defined Preferred Alternative. As such,

the currently configured Preferred Alternative has been carried forward into the FEIS for further detailed analysis.

In all, the Preferred Alternative would be a four-lane rural, controlled-access toll road on a new location that would fulfill the purpose and need of the proposed SH 99 Segment B. The Preferred Alternative would begin at SH 288 and continue to IH 45 South and would consist of an open-ditch design within a 400-foot-wide ROW. The total length of the Preferred Alternative would be approximately 28.6 miles and would require approximately 1,072 acres of ROW.

The Preferred Alternative would be a proposed toll road consistent with the *2040 RTP* that identifies the addition of tolled facilities, including the proposed SH 99 Segment B, as necessary to address congestion and future growth in the H-GAC planning region. The estimated construction cost for the proposed SH 99 Segment B, per the *2040 RTP* (September 11, 2015), would be approximately $1.2 billion. It is anticipated that the proposed SH 99 Segment B would be completed and open to traffic in 2035.

SECTION 3: AFFECTED ENVIRONMENT

Section 3 discusses existing conditions within the proposed SH 99 Segment B study area. The study area limits are as defined in the DEIS, and are depicted on ***Exhibit 2-5***. Technical and scientific information is presented throughout as a means to define the existing physical, biological, and socioeconomic environments that may be impacted by construction of the proposed SH 99 Segment B's Preferred Alternative.

3.1 LAND USE AND TRANSPORTATION PLANNING

The proposed SH 99 Segment B study area includes portions of Algoa, Alvin, Dickinson, Friendswood, Hillcrest Village, Iowa Colony, League City, Liverpool, Manvel, and Santa Fe. Land use and transportation planning for the region is accomplished either by the local government or through H-GAC. Alvin and League City both have a *Comprehensive Plan* that serves as a guideline for how the municipalities prioritize public funds for infrastructure and land use decisions in regards to any future growth, as well as for the maintenance of its existing obligations. Because most of the study area cities/communities are suburban or rural in nature, most do not perform land use or transportation planning. In some cases the cities/communities perform Thoroughfare Mapping, which is a projected scenario for transportation infrastructure needs. It is used as a tool to prioritize projects for implementation into the *2015-2018 TIP* and *2040 RTP*. In instances where Thoroughfare Mapping is not performed, information from H-GAC or Brazoria and Galveston Counties Thoroughfare Maps is used.

3.1.1 Existing Land Uses

In order to evaluate and present existing land use within the study area, geographical information system (GIS) data from H-GAC was mapped and analyzed. As illustrated on ***Exhibit 3-1***, there are ten distinct land use categories in the study area, with vacant/developable land having the most acreage, followed by residential land uses. ***Table 3-1*** summarizes the existing land use by category within the study area.

Table 3-1: Existing Land Use in the Study Area

Land Use Category	Acreage	Percent of the Study Area
Commercial	1,689	1.64
Government/Medical/Education	1,217	1.18
Industrial	760	0.74
Other	107	0.10
Parks/Open Space	903	0.88
Residential	26,026	25.30
Undevelopable	10,492	10.20
Unknown	39	0.04
Vacant/Developable (includes farming)	61,595	59.87
Water	48	0.05
Total	**102,876**	**100.00**

Source: H-GAC 2014c.

3.1.2 Land Use Planning

Some of the cities and communities conduct land use planning, and in instances where a city or community does not, it refers to H-GAC's land use mapping. The proposed SH 99 Segment B study area is comprised of a variety of land uses. Of the cities and communities in the study area, the portion of the proposed SH 99 Segment B that traverses Alvin has the greatest diversity of land use designations because of the proposed SH 99 Segment B's proximity to the city.

The following provides an overview of land use planning for cities/communities in the study area.

- Algoa is a rural community southeast of Alvin. It does not have any land use policies.
- Alvin uses the term "character" for land use analysis in its Comprehensive Plan. The city defines its policy as follows, "The character of uses – individually and collectively – have essential land use policy implications that must be handled according to their performance in the context of their natural and built environments to achieve the intended outcome." In addition to the standard land use classifications (e.g., commercial or residential), the city has developed the character assessment with the following categories: urban, auto-urban, suburban, and rural (Alvin 2005).
- Located within the study area, the western portion of Dickinson (west of IH 45 South) is primarily residential, with the exception of the areas near IH 45 South. Dickinson has both land use policies and zoning in place to monitor the development pattern of the city.
- The study area encompasses the southeastern-most point of Friendswood's jurisdictional boundary. That portion of the city is currently undeveloped, but there are preliminary plans for a planned unit development (PUD). The predominant land use category in Friendswood is residential, although there are limited commercial and government/medical/education uses.
- Hillcrest Village is located southeast of Alvin and the SH 35 Bypass. While the city does have a City Council, there are no land use policies in place currently.
- Iowa Colony is southwest of Manvel, in the northwestern portion of the study area, and does not currently have any land use policies.
- League City's *2035 Comprehensive Plan* was approved in 2011 and is reflective of the vision the city has for its land use and infrastructure. League City is a bedroom community that primarily serves much of the Johnson Space Center population. There are proposed plans for a three-phased PUD west of IH 45 South, but at this time, the plans have not been approved. The preliminary plan for the PUD would include the proposed SH 99 Segment B (League City 2011).
- Liverpool is located south of Alvin and the SH 35 Bypass. The city does not currently perform any type of land use planning.
- Manvel is primarily a rural small town, although there are some pockets of commercial, institutional, and residential land use. The proposed SH 99 Segment B would not traverse through Manvel.

- Santa Fe is located along SH 6, just west of IH 45 South. The city does not have any land use policies, but it does have a zoning map (Santa Fe 2014).

3.1.3 Transportation Planning

The study area includes Traffic Analysis Zones (TAZs) and Regional Analysis Zones (RAZs), as defined by H-GAC, within Brazoria and Galveston Counties. TAZs are geographic areas that are used for land use projections, traffic demand modeling, and transportation planning at the local level. RAZs are geographic areas composed of several TAZs. While there are hundreds of TAZs within the study area, the following RAZs were identified for the analysis: 167, 168, 169, 170, 171, 172, 173, 174, 175, 177, 178, and 179. The RAZ/TAZ data enabled the SH 99 Segment B Study Team to evaluate existing traffic patterns to determine areas where origin and destination data yield common locations and how the results affect the overall land use pattern.

Transportation planning for the study area is primarily conducted through Thoroughfare Mapping. For projects found to be financially feasible, H-GAC's *2015-2018 TIP* and *2040 RTP* are the region-wide conformance plans for transportation planning. League City and Alvin have Comprehensive Plans, but they do not include a transportation element (League City 2011; Alvin 2005). Instead, the cities defer to the Thoroughfare Mapping that H-GAC and Brazoria and Galveston Counties perform for the region.

3.2 GEOLOGY, SOILS, AND FARMLANDS

3.2.1 Geology

According to the U.S. Geological Survey (USGS), 12 geologic provinces are within the contiguous U.S., and each has a characteristic geologic structure, rock/soil type, vegetation, and climate (USGS 2011). Of the twelve provinces, the proposed SH 99 Segment B study area is located within the Atlantic Plain Province, which is the flattest of the provinces. Within the Atlantic Plain Province, the study area is located within the Gulf Prairie, where the land surface is nearly level to gently sloping with natural drainage features that have associated floodplains and several manmade drainage features (USGS 2011). The natural drainage features include Chocolate Bayou and Mustang Bayou, both of which have several tributaries that transverse the study area.

Two geologic units are within the study area: the Beaumont Formation and Alluvium. Generally, each unit is comprised of sedimentary deposits of clay, silt, and sand with minor amounts of siliceous gravel.

Faulting is common in the Gulf Coast area. Most faults are strike faults that appear to be related to gradual subsidence and tilting of the underlying strata and the resulting adjustment of the overlying sediment.

Land-surface subsidence is another natural geologic process that is a function of the depositional environment of the Texas Coastal Plain. The natural rate of subsidence has been accelerated from the increased use of groundwater. Excessive groundwater withdrawal is the primary cause of land-surface subsidence (HGSD 2013a). The land-surface subsidence already experienced is irreversible, with the land

surface in the study area having already subsided approximately 1 to 2 feet between 1906 and 1995 (HGSD 2013b).

3.2.2 Soils

The soil data for the study area was obtained from the NRCS' Web Soil Survey for Brazoria and Galveston Counties (NRCS 2014). The following soil associations make up 82 percent of Brazoria County and 61 percent of Galveston County:

- Brazoria County includes Lake Charles, Bernard-Edna, and Edna-Aris soil associations.
- Galveston County includes Mocarey-Leton-Algoa, Lake Charles-Baycliff, Bernard-Verland, and Bernard-Edna soil associations.

All of the soils are in broad, nearly level areas that are far enough inland so that each is not influenced by tides or salt from the Gulf of Mexico. The main limitations for urban use are wetness and the shrink-swell potential of most of the soils.

The soils within the study area consist of 24 soil mapping units: Aris fine sandy loam (1, Ar), Asa silty clay loam (3), Bacliff clay 0 to 1 percent slopes (6, Ba), Bernard clay loam (7, Be), Bernard-Edna complex (8, Bn), Bernard-Urban land complex (9, Bu), Edna-Aris complex (15, Es), Edna fine sandy loam 0 to 1 percent slopes (13, Ed), Edna fine sandy loam 1 to 5 percent slopes (14, Ed), Kemah silt loam 0 to 1 percent slopes (KeA), Kemah silt loam 1 to 3 percent slopes (KeB), Lake Charles clay 0 to 1 percent slopes (24, LaA), Lake Charles clay 2 to 5 percent slopes (25, LaB), Lake Charles-Urban land complex (26, Lb), Leton loam (27, LetA), Leton-Aris complex (28, Ls), Mocarey loam (Ma), Mocarey-Algoa complex (Mb), Mocarey-Cieno complex (Mc), Morey silt loam (29, Me), Morey-Leton complex (Mf), Pits/sand (Pa), Vamont clay (VamA), and Verland silty clay loam (Ve). Generally, the mapping units consist of nearly level to gently sloping, somewhat poorly drained to poorly drained, and loamy to clayey soils.

Specific soil mapping units, including a description and a hydric and prime farmland classification, occurring within the study area are listed in ***Appendix B*** of the FEIS and depicted on ***Exhibit 3-2***.

3.2.3 Farmlands

The Farmland Protection Policy Act (Subtitle I of Title XV of the Agricultural and Food Act of 1981) (FPPA) provides protection to prime and unique farmlands, all of which are classified into four distinct types, as defined by FHWA's Technical Advisory T6640.8A. The four types are prime farmland, unique farmland, other farmlands of statewide importance, and other farmlands of local importance (FHWA 1987). The purpose of the FPPA is to minimize the extent to which federal projects contribute to the unnecessary and irreversible conversion of prime, unique, and other farmlands of statewide or local importance to non-agricultural uses.

As defined by the U.S. Department of Agriculture, prime farmland is best suited to produce food, feed, forage, and oilseed crops. Such soils have properties that are favorable for the production of sustained

high yields. Prime farmland typically produces the highest yields with a minimum of energy and economic consumption, and farming the soils often has minimal environmental damage. Prime farmland is generally considered cropland, pasture, or woodland, but prime farmland may also be used for other uses that produce food or fiber.

Urban or built-up land, public land, and water areas cannot be considered prime farmland. Urban or built-up land is considered any contiguous unit of land 10 acres or more in size that is used for such purposes as housing, industrial, and commercial sites, and would include sites for institutions or public buildings, small parks, golf courses, cemeteries, railway yards, airports, sanitary landfills, sewage treatment plants, and water control structures. Public land is not available for farming in national forests, national parks, military reservations, and state parks (USDA 2014).

The U.S. Department of Agriculture recognizes the following areas as not being subject to the FPPA:

- Lands that are already in or committed to urban development or water storage, including lands with a density of 30 structures per 40 acres;
- Lands with a tint overprint on USGS topographical maps;
- Lands identified as urbanized area on U.S. Census Bureau maps; and
- Lands that receive a combined score of 160 points or less on form AD-1006 (or NRCS-CPA-106) for corridor-type projects.

Presented on ***Exhibit 3-2***, 14 soils in the study area (Aris fine sandy loam, Asa silty clay loam, Bacliff clay, Bernard clay loam, Bernard-Edna complex, Lake Charles clay 0 to 1 percent slopes, Lake Charles clay 2 to 5 percent slopes, Leton loam, Leton-Aris complex, Mocarey loam, Mocarey-Algoa complex, Mocarey-Cieno complex, Morey silt loam, and Morey-Leton complex) are considered prime or other important farmland soils (NRCS 2014).

3.3 SOCIAL CHARACTERISTICS

The following sections describe the social and economic conditions within the proposed SH 99 Segment B study area, focusing on population, demographic, employment, and income characteristics.

Socioeconomic information was collected from the U.S. Census Bureau and the 2010 Census for Census tracts, cities, and counties that intersect or are included in the study area. Population and employment projections were obtained from H-GAC. The latest available income data were obtained from the American Community Survey (ACS) for years ranging from 2008 to 2012. It should be noted that ACS data are estimates, not actual counts. Race and ethnicity data are presented below at the Census tract level for a direct comparison to population projections. Census data at the block group and block levels will be included as available in ***Section 4*** of the FEIS. ***Section 4*** of the FEIS will also discuss environmental justice (EJ) and limited English proficient (LEP) information for the Preferred Alternative. ***Appendix C*** includes population, race, and ethnicity for the Census tracts, block groups, and blocks that intersect or are included within the Preferred Alternative.

3.3.1 Population and Demographic Characteristics

The proposed SH 99 Segment B study area is located within Brazoria and Galveston Counties, which are both part of the eight-county Houston-Galveston-Brazoria Consolidated Metropolitan Statistical Area (CMSA). The eight-county area covers a region of more than 7,000 square miles and had 5.9 million residents in 2010. To analyze the study area, population and demographic data have been defined within 25 Census tracts that intersect or are included within the study area (the 25 Census Tract Area).

3.3.1.1 Population

According to 2010 Census data, the population within the Houston-Galveston-Brazoria CMSA increased from approximately 4.7 million people in 2000 to 5.9 million people in 2010 (a 25.5 percent increase) (U.S. Census 2010). Based on H-GAC's 2035 Regional Growth Forecast and as listed in ***Table 3-2***, the two counties and Census tracts within the 25 Census Tract Area are forecasted to continue to grow as well.

Table 3-2: Existing and Projected Population Growth in the Study Area and Associated Counties

Location	Population		Percent Change	Percent Annual Growth Rate
	2010	2035		
25 Census Tract Area[a]	161,890	171,521	5.9	0.2
Brazoria County	313,166	541,341	72.9	2.9
Galveston County	291,309	504,790	73.3	2.9

Source: U.S. Census 2010 (Summary File 1, Table P9); H-GAC 2014d.

[a] The 25 Census tracts that intersect or are within the study area.

3.3.1.2 Demographics

Area demographics are best represented through defining population, race, and ethnicity on a regional (i.e., by county and city designation) and more specific (i.e., the identified Census tracts that intersect or are within the study area) level. ***Table 3-3*** and ***Exhibit 3-3*** present the area's population and racial/ethnic distribution. As shown, with exception of Iowa Colony, the percent minority within the cities/communities listed is generally consistent with, or lower than, that of Brazoria and Galveston Counties (U.S. Census 2010).

Table 3-3: Population and Demographic Statistics in the Study Area, Associated Counties, and Local Cities/Communities

Geographic Area	2010 Population	Race/Ethnicity by Percent Total Population Non-Hispanic of Latino				Hispanic or Latino	Percent Minority[a]
		White	Black	Asian	Other		
25 Census Tract Area[b]	161,890	62.7	7.1	3.2	1.9	25.1	37.3
Brazoria County	313,166	53.2	11.8	5.4	1.9	27.7	46.8
Galveston County	291,309	59.3	13.5	2.9	1.9	22.4	40.7
Alvin	24,236	58.7	2.9	0.9	1.4	36.1	41.3

Table 3-3: Population and Demographic Statistics in the Study Area, Associated Counties, and Local Cities/Communities

Geographic Area	2010 Population	Race/Ethnicity by Percent Total Population Non-Hispanic of Latino				Hispanic or Latino	Percent Minority[a]
		White	Black	Asian	Other		
Dickinson	18,680	52.3	11.2	1.9	1.9	32.7	47.7
Friendswood	35,805	77.5	3.3	4.8	1.9	12.5	22.5
Hillcrest Village	730	85.2	0.3	0.7	1.5	12.3	14.8
Iowa Colony	1,170	46.0	5.6	5.6	3.2	39.6	54.0
League City	83,560	68.2	6.9	5.3	2.3	17.3	31.8
Liverpool	482	80.9	1.1	0.0	0.6	17.4	19.1
Manvel	5,179	54.0	16.5	5.2	1.7	22.6	46.0
Santa Fe	12,222	86.4	0.3	0.5	1.2	11.6	13.6
State of Texas	25,145,565	45.3	11.5	3.8	1.8	37.6	54.7

Source: U.S. Census 2010 (Summary File 1, Table P9).

[a] Percent minority includes all non-white races and persons of Hispanic origin.

[b] The 25 Census tracts that intersect or are within the study area.

Notes: Algoa is not a Census designated place; therefore, it is not discussed in this table.

3.3.1.3 Population Age

Table 3-4 provides the area's population age distribution for the 25 Census Tract Area and Brazoria and Galveston Counties. To look at community characteristics in these areas, age characteristics were examined. The focus of the age distribution was on environmentally sensitive populations, such as children ranging from 0-19 year old and seniors (ages 60 years and older).

According to EPA's Air Quality Index, *A Guide to Air Quality and Your Health Report*, during the normal aging process, older adults experience health risks from exposure to unhealthy air. Studies indicate that some people become more sensitive in their mid-60s. However, the risk of heart attacks, and thus the risk from particulate pollution, may begin as early as the mid-40s for men and mid-50s for women (EPA 2009). Therefore, the age category of 45 to 64 was added to ***Table 3-4***. Environmental impacts, such as declining air quality and increases in noise, can impact people at any age, but age-sensitive populations could be at greater risk for health impacts.

During the field investigation, no eldercare facilities were identified within the study area, but ACC, churches, and schools were identified in close proximity to the study area (***Exhibit 3-4***). In ***Section 4*** of the FEIS tract level age data are provided for the Census tracts that intersect or are within the Preferred Alternative. The age distribution percent within the 25 Census Tract Area is generally consistent with, or lower than, that of Brazoria and Galveston Counties.

Table 3-4: Age Characteristics of Population in the Study Area and Associated Counties

Ages	25 Census Tract Area	Brazoria County	Galveston County
Under 5 Years Old	6.5%	7.8%	6.8%
5-14 Years Old	15.2%	15.3%	14.2%
15-19 Years Old	7.3%	7.0%	7.1%
45-64 Years Old	27.3%	25.4%	28.0%
65 Years and Older	9.3%	9.7%	10.3%

Source: U.S. Census 2014 (2008-2012 ACS, Table S0101).
Notes: % = percent.

3.3.2 Neighborhoods and Community Cohesion

As defined by FHWA, community cohesion represents patterns of behavior that individuals or groups of individuals hold in common. Residential subdivisions may develop a sense of community cohesion through social interaction or participation in neighborhood organizations. For example, if a local church or school provides a location where residents of a neighborhood or community can assemble and associate with one another, or a neighborhood association or neighborhood watch program is in place to serve the community and satisfy the residents' economic and social needs, then some sense of cohesion would likely exist. Cohesion may also be based on common characteristics of interest shared by members of the community, such as a religion, ethnicity, or income level (FHWA 1996).

The study area largely exists within rural areas that do not contain dense residential, commercial, retail, or industrial development (with the exception of the area that follows the existing SH 35 and SH 35 Bypass and near the intersection of FM 646 and IH 45 South). However, there are over 100 existing neighborhoods/subdivisions located within or near the study area as shown on ***Exhibit 2-11***.

3.3.3 Social and Community Resources

Social and community resources and facilities, which include schools, police and fire stations, hospitals, churches, cemeteries, and park and recreational areas, were identified through a compilation of existing mapping sources, aerial photography, limited field reconnaissance surveys, the internet, and information provided by local and state agencies, and organizations. ***Exhibit 3-4*** depicts the social and community resources and facilities located in close proximity to the Preferred Alternative.

3.3.3.1 Schools and Educational Facilities

Six independent school districts (ISDs) (Alvin, Angleton, Clear Creek, Dickinson, Friendswood, and Santa Fe ISDs) and 17 schools and educational facilities are located within the study area. ***Table 3-5*** lists the schools, the respective ISDs, their addresses, and the distance from the Preferred Alternative. The Angleton, Friendswood, and Santa Fe ISDs have no schools within the study area.

Table 3-5: Schools and Educational Facilities near the Preferred Alternative

ISD	School Name	Address	Distance from Preferred Alternative (in feet)
Alvin	Alvin Elementary	1910 Rosharon Road, Alvin	4,763
Alvin	Alvin Evening School	802 South Johnson Street, Alvin	6,148
Alvin	Alvin High School	802 South Johnson Street, Alvin	6,605
Alvin	Alvin Junior High	2300 South Street, Alvin	6,610
Alvin	Alvin Primary	2200 West Park Drive, Alvin	5,789
Alvin	Assets Learning Center	605 West House Street, Alvin	5,836
Alvin	Don Jeter Elementary	2455 County Road 58, Manvel	4,212
Alvin	G.W. Harby Junior High	1500 Heights Road, Alvin	6,069
Alvin	Hood-Case Elementary	1450 Heights Road, Alvin	6,434
Alvin	Longfellow Elementary	1300 East House Street, Alvin	851
Alvin	Mark Twain Primary	610 East Clemens Street, Alvin	2,170
Alvin	Melba Passmore Elementary	600 East Kost Road, Alvin	8,323
Alvin	RL Stevenson Primary	4715 Mustang Road, Alvin	6,025
Alvin	Walt Disney Elementary	5000 Mustang Road, Alvin	6,716
Clear Creek	Victory Lakes Intermediate	2880 West Walker, League City	3,043
Dickinson	Bay Colony Elementary	101 Bay Colony Elementary Drive, Dickinson	1,706
N/A	Alvin Community College	3110 Mustang Road, Alvin	975
N/A	Nolan Ryan Center (ACC)	2925 South Bypass 35, Alvin	38

Source: SH 99 Segment B Study Team 2014; Texas Education Agency 2013.

Notes: ACC = Alvin Community College; ISD = independent school district.

Activities associated with area schools and educational facilities, such as athletics, school clubs, fine arts, and other school-sponsored organizations and activities, would involve students from all over the Gulf Coast Region and typically require students to travel to various locations within and outside the study area for many University Interscholastic League activities.

3.3.3.2 Police Protection, Fire Protection, and Medical Services

As noted above, the study area encompasses primarily rural areas. Areas outside of incorporated city limits are served by the Brazoria County and Galveston County Sheriff's departments. The League City, Friendswood, and Alvin Police departments serve the incorporated areas. There would be no police stations located directly adjacent to or within the Preferred Alternative.

The study area is also served by six volunteer fire departments (VFDs): Alvin, Friendswood, League City, Iowa Colony, Dickinson, and Manvel VFDs. However, no VFD stations would be located directly adjacent to or within the Preferred Alternative (***Exhibit 3-4***). The Alvin VFD serves a 100-square-mile area and operates three fire stations, all within the study area (Alvin VFD 2014). Fire Station No. 1 is at 302 West House Street, and Fire Station No. 2 is at 110 Medic Lane. The third station is at 2700

FM 1462. The Friendswood VFD operates four fire stations, one of which is within the study area located at 2605 West Parkwood (FM 528) (Friendswood VFD 2014). The League City VFD operates five fire stations. Fire Station No. 5, located at 2898 Bay Creek Drive, is within the eastern portion of the study area (League City VFD 2014). The Iowa Colony VFD serves the western portion of the study area, operating a single fire station east of SH 288 on 12009 CR 65 (Iowa Colony VFD 2014). The Dickinson VFD operates two fire stations, one of which is within the study area. Fire Station No. 2 serves the eastern portion of the study area and is located at 221 FM 517 West (Dickinson VFD 2014). The Manvel VFD and its emergency medical services (EMS) are located outside the study area at 1128 Masters Road.

Alvin Community Hospital is the closest emergency care center to the study area. The closest full service hospital is Clear Lake Regional Hospital, located in the City of Webster. Ambulance service in the greater Alvin area is provided by the Alvin EMS. The EMS Department is comprised of three full-time employees: the Director, Assistant Director, and an administrative assistant. The service is also comprised of 27 part-time paramedics and 25 emergency medical technicians (Alvin EMS 2014). The Friendswood and League City EMSs serve the eastern portion of the study area (Friendswood VFD 2014; League City VFD 2014). There are no EMS facilities located directly adjacent to or within the Preferred Alternative.

3.3.3.3 Churches and Cemeteries

Forty-nine churches and two cemeteries are located within the study area. ***Table 3-6*** lists the churches and cemeteries, their addresses, and distance from the Preferred Alternative. ***Exhibit 3-4*** shows these churches identified with the numbers listed below; cemeteries are identified with their names.

Table 3-6: Churches and Cemeteries near the Preferred Alternative

ID Number	Church/Cemetery Name	Address	Distance from Preferred Alternative (feet)
1	Victorious Living Christian Center	5225 East FM 1462, Rosharon	3,740
2	Rosharon Bible Baptist Church	7925 CR 121, Rosharon	8,994
3	Samakee Buddhist Temple	7106 Ross Road, Rosharon	11,366
4	Christ Covenant Church	831 FM 2917 Road, Alvin	3,527
5	Breath of Life Ministries	4001 FM 2403, Alvin	2,634
6	First Assembly of God Church	1031 West Sealy Street, Alvin	5,895
7	New Life Missionary Baptist Church	4102 CR 424, Alvin	3,281
8	Church of Jesus Christ of Latter Day Saints	3311 Mustang Road, Alvin	2,639
9	River of Life Worship Center	CR 155, Alvin	12,788
10	Alvin Evangelical Lutheran Church	1462 FM 1462, Alvin	4,014
11	St. John the Baptist Catholic Church	110 East South Street, Alvin	2,328
12	First Methodist Church of Alvin	611 West South Street, Alvin	3,160
13	South Park Baptist Church	1718 South Johnson Street, Alvin	3,468

Table 3-6: Churches and Cemeteries near the Preferred Alternative

ID Number	Church/Cemetery Name	Address	Distance from Preferred Alternative (feet)
14	Alvin Church of Nazarene	1611 West South Street, Alvin	5,227
15	Alvin Gleaner Church	2730 Stadium Drive, Alvin	59,936
16	Alvin Missionary Baptist Church	2102 West Lang Street, Alvin	10,760
17	Alvin United Pentecostal Church	414 South 7th Street, Alvin	9,524
18	Apostolic Faith Church	1405 West Lang Street, Alvin	8,923
19	Church of the Nazarene	P.O. Box 1261, Alvin	6,444
20	Alvin Church of Christ	1325 South Johnson Street, Alvin	5,140
21	Bayou Drive Baptist Church	612 East Dumble Street, Alvin	2,273
22	Amistad Community Church	620 East House Street, Alvin	2,482
23	Igelsia Christian Fe En Accion	642 County Road 296D, Alvin	5,636
24	Fountain of Salvation	2006 Stapelton Drive, Friendswood	5,823
25	Iglesia Bautista Nueva Vida	602 North Jackson Street, Alvin	6,265
26	Reflections of Christ Kingdom	415 West Adoue Street, Alvin	5,858
27	First Presbyterian Church of Alvin	302 South Johnson Street, Alvin	6,970
28	Alvin Assembly of God	1031 West Sealy Street, Alvin	8,060
29	The Church of God of Prophecy	214 North Beauregard Street, Alvin	7,502
30	Grace Episcopal Church	200 West Lang Street	5,120
31	Cristo La Roca Brethren in Christ Church	104 East Bell Street, Alvin	4,733
32	Primera Iglesia Bautista	302 Avenue K, Alvin	3,173
33	Greater New Hope Baptist	908 North 2nd Street, Alvin	9,158
34	HWY 6 Church of Christ	1908 West Highway 6, Alvin	8,265
35	Westside Church of Christ	831 Heights Road, Alvin	7,285
36	Ilgesias Chistianas Church	222 Avenue E, Alvin	5,261
37	First Baptist Church of Alvin	415 West Adoue Street, Alvin	4,277
38	Northside Pentecostal Church	1508 Texas Street, Alvin	4,503
39	Gordon Street Baptist Church	407 S Gordon Street, Alvin	2,454
40	Congregation Of Jehovah's Witnesses	701 FM 517, Alvin	2,625
41	Real Life Ministries	2201 Highway 35 Bypass North, Alvin	143
42	Esmirna Pentecostal Holiness Church	310 Lulac Street, Alvin	1,352
43	Living Stones Church Inc.	1407 Victory Lane, Alvin	2,614
44	Faith Community Church of Alvin Inc.	4085 FM 528 Road, Alvin	4,767
45	Heights Baptist Church	1591 CR 144, Alvin	12,049
46	Friendswood Community Church Inc.	2821 West Parkwood, Friendswood	7,229

Table 3-6: Churches and Cemeteries near the Preferred Alternative

ID Number	Church/Cemetery Name	Address	Distance from Preferred Alternative (feet)
47	Magnolia Creek Baptist Church	3535 Calder Drive, League City	1,776
48	First United Methodist Church	200 Highway 517 West, Dickinson	7,325
49	First Presbyterian Church	215 Pine Drive, Dickinson	6,513
N/A	Confederate Cemetery	110 Cemetery Road, Alvin	56
N/A	Oak Park Cemetery	300 Oak Park Drive, Alvin	2,458

Source: SH 99 Segment B Study Team 2014.

Notes: CR = Country Road; FM = Farm-to-Market; N/A = not applicable; SH = State Highway.

The closest cemetery to the proposed project is the Confederate Cemetery. This cemetery was established in the 1890s as a burial ground for Confederate veterans. However, it appears likely that graves predate that era, as among the dead buried there are a handful of Union soldiers, suggesting a 1860s date for the earliest burials. The cemetery opened to the public in the 1900s and has continued to be used into the modern era. The cemetery has a Texas Historical Marker (#9549). Currently the cemetery has an entrance from the SH 35 bypass and Dickinson Road. There are still active burials taking place at this cemetery.

3.3.3.4 Parks and Recreation

Several publicly- and privately-owned parks and recreational areas are located within the study area, including the Thelma Ley Anderson Family Young Men's Christian Association (YMCA), the Living Stones Church and Park, the Nolan Ryan Center, Camp Mohawk, TxDOT's SH 35 roadside rest area, Brazoria County Chocolate Bayou boat ramp, and Resoft County Park.

The Thelma Ley Anderson Family YMCA is part of the greater Houston YMCA network and is located on a 14.38-acre tract leased from Alvin. This site is directly adjacent to the Preferred Alternative.

An approximately 28-acre private park is associated with the Living Stones Church at the corner of Victory Lane and Clifford Road. The park is approximately 2,500 feet north of the Preferred Alternative.

The Nolan Ryan Center, located on the ACC campus, is also the ACC Continuing Education Center. Approximately one-third of the building is leased to the foundation for use as a baseball exhibit. The Nolan Ryan exhibit originated from an agreement between ACC and the Nolan Ryan Foundation. The exhibit is a showcase of the baseball career and life of Nolan Ryan. The center includes interactive exhibits and memorabilia in honor of Nolan Ryan (The Nolan Ryan Foundation 2014).

Five commercial recreational facilities were identified in the study area. There is a water ski school with an associated lake on County Road (CR) 121 at CR 60. The other four commercial recreational facilities are in the eastern portion of the study area: the Alvin Youth Livestock Area Association Rodeo Grounds, Big League Dreams Park, Bayou Wildlife Park, and Skeeter MX Park. The Alvin Youth Livestock Area Association Rodeo Grounds (located on CR 351 and FM 517) is used for regional youth rodeos throughout the year. Big League Dreams Park, the newest facility in the study area, is a 32-acre,

privately-owned park with baseball fields and an indoor soccer stadium located on Calder Road. Bayou Wildlife Park is an 86-acre private park with a guided tram tour that allows park visitors to feed and observe exotic wildlife. The Skeeter MX Park is located near the intersection of Algoa-Friendswood and Hayes roads outside of Algoa in western Galveston County. The private park is used for recreational dirt bike activities (The Daily News 2014).

Pedestrian and bicycle facilities are discussed in ***Section 3.5*** of the FEIS.

3.3.3.5 Section 4(f) and Section 6(f) Lands

Section 4(f) of the Department of Transportation Act of 1966 (as amended) states that "the Secretary may approve a transportation program or project requiring use of publicly-owned (sic) land of a public park, recreational area, or wildlife/waterfowl refuge, or land of a historic site of National, State, or local significance…only if: 1) there is no prudent and reasonable alternative to such use, and 2) the project includes all possible planning to minimize harm." Section 6(f) of the Land and Water Conservation Act requires that recreational facilities that receive U.S. Department of the Interior funding under the act, as allocated by the TPWD, may not be converted to non-recreational uses unless approval is granted by the director of the National Park Service.

Camp Mohawk, owned and maintained by the Brazoria County Parks Department, is located directly west of the Preferred Alternative at 110 CR 193. Brazoria County purchased the 53-acre, day-use park in 2001, and it is currently open to the public daily from 8 a.m. to dusk (Brazoria County Parks Department 2014a).

Resoft County Park is also owned and maintained by the Brazoria County Parks Department. This 80-acre day-use park is located in the northern portion of the study area at the end of Cornett Road, just off CR 281 and SH 35. Resoft features covered pavilions, barbeque pits, a large multi-stage playground, a series of regulation soccer fields with tournament lighting, horseshoes, basketball courts, volleyball, a fishing pond with piers, extended walking, and jogging trails, ample paved parking, and restroom facilities (Brazoria County Parks Department 2014b).

A TxDOT roadside rest area and the Brazoria County Chocolate Bayou boat ramp are both located within and adjacent to the Preferred Alternative on the east side of SH 35, south of the crossing of Chocolate Bayou. A roadside historical marker is located within the TxDOT rest area, and a short, half-circle drive allows motorist to exit SH 35 and view the historic marker, and/or access the Chocolate Bayou boat ramp via a paved road. The boat ramp is approximately 0.2 mile east of SH 35 and accommodates small fishing boats, canoes and other small watercraft. The only access to the boat ramp is through the TxDOT rest area. There are no recreational amenities (e.g., picnic tables or pavilions) associated with the rest area or boat ramp, nor are the areas dedicated as parkland. The TxDOT rest area provides a place for motorists to pull over and rest and to safely view the historic marker. Roadside rest areas are considered to be part of a transportation facility (SH 35 in this case), and as such, the requirements of Section 4(f) do not apply to the resource. The boat ramp property is owned and maintained by Brazoria County and is located outside of the Preferred Alternative.

In addition to the identified parks and recreational areas on ***Exhibits 3-4*** and ***3-5***, there is also a recently deeded property, shown as "City-owned Land," located west of FM 646. The property was deeded to the League City Patrons of the Park Foundation by the Bay Colony West planned unit development in lieu of a park impact fee. While the land is publicly owned, there are no recreational amenities (e.g., picnic tables or pavilions) associated with the property, nor is it currently accessible to the public (the property is gated and fenced). A second agreement between League City and the League City Patrons of the Park Foundation contains a transportation easement on the southern border of the property to accommodate (if required) the proposed SH 99 Segment B once designed and constructed. The Preferred Alternative is situated beyond the southern boundary of the property; therefore, the requirements of Section 4(f) do not apply to the city-owned land.

3.4 ECONOMICS

The Houston Metropolitan Statistical Area's (MSA's) economic assets are often linked to petrochemical industries, area universities and colleges, and medical complexes. The study area is a portion of the Greater Houston area in terms of population and economy. As such, the study area's economic growth depends on economic activity at a broader and more regional level. As the Greater Houston area expands and develops, the study area (the majority of which is rural in character) would continue to diversify with an assortment of commercial and industrial enterprises. The data provided in the following sections reflect economic conditions at a regional or county level, with limited information for smaller geographic areas.

3.4.1 Income

Table 3-7 lists the median household income and per capita income for Brazoria and Galveston Counties, in addition to the cities/communities completely or partially within the study area. Median household income is defined as the income of householders and all other individuals 15 years or older (U.S. Census 2014). The definition for per capita income is defined as income per person, or the mean income received per person in a geographic area (ages 15 years and older) divided by the total population in that area (U.S. Census 2014). The median household income within the 25 Census Tract Area ranges from a low of $46,779 in Tract 7209.00 to a high of $117,465 in Tract 7203.02. Median household income by Census Tract is included in ***Appendix C***.

Table 3-7: Income Characteristics of the Study Area, Associated Counties, and Local Cities/Communities

Geographic Area	Median Household Income	Per Capita Income
25 Census Tract Area[a]	$53,979	$21,819
Brazoria County	$68,008	$29,042
Galveston County	$61,555	$30,804
Alvin	$45,638	$20,965
Dickinson	$62,105	$28,928
Friendswood	$102,811	$42,289

Table 3-7: Income Characteristics of the Study Area, Associated Counties, and Local Cities/Communities

Geographic Area	Median Household Income	Per Capita Income
Hillcrest	$82,708	$36,614
Iowa Colony	$68,587	$24,298
League City	$88,289	$37,517
Liverpool	$36,397	$23,555
Manvel	$76,205	$31,621
Santa Fe	$60,442	$27,357

Source: U.S. Census 2014 (2008-2012 ACS, Table B19013).

[a] The 25 Census tracts that intersect or are within the study area.

Notes: The poverty guideline for a family of four people in 2014, as defined by the U.S. Department of Health and Human Services, was a total annual household income of $23,850. Algoa is not a Census designated place; therefore, it is not discussed in this table.

3.4.2 Employment and Households

Population growth (as indicated by an increase in the number of households) and total employment are two of the leading demographic and economic indicators for travel demand, which is defined as the number, purpose, and type of trips. Between 2010 and 2035, it is estimated that within the 25 Census Tract Area the number of households will increase from 53,290 to 154,623 (H-GAC 2006 and 2014d). Between 2010 and 2035, it is estimated that within the 25 Census Tract Area the number of jobs will increase from 28,167 to 65,473 (H-GAC 2006 and 2014d). As shown in ***Table 3-8***, the predicted increase in the number of households and total employment within the 25 Census Tract Area by 2035 is higher than that of Brazoria and Galveston Counties. The statistics indicate that much of the growth for the two counties would occur within the study area.

Table 3-8: Projected Households and Employment in the Study Area and Associated Counties

Geographic Area	Households		Percent Change	Employment		Percent Change
	2010	2035		2010	2035	
25 Census Tract Area[a]	53,290	154,623	190.2	28,167	65,473	132.4
Brazoria County	106,587	208,916	96.0	302,601	541,341	78.9
Galveston County	108,924	204,790	88.0	286,922	504,790	75.9

Source: H-GAC 2006 and 2014d.

[a] The 25 Census tracts that intersect or are within the study area.

Table 3-9 lists employment statistics for Brazoria and Galveston Counties. The leading occupational category for both counties is education, health care, and social services occupations. The second largest category is manufacturing, and the third largest category is professional, scientific and management, administrative, and waste management services.

Table 3-9: Employment by Industry in Brazoria and Galveston Counties

Industry Sector	Brazoria County	Percent of Total	Galveston County	Percent of Total
Agricultural, forestry, fishing and hunting, and mining	3,383	2.3	2,111	1.5
Manufacturing	19,530	13.5	15,597	11.2
Construction	13,735	9.5	11,869	8.6
Wholesale trade	4,492	3.1	3,645	2.6
Retail trade	14,211	9.8	12,877	9.3
Transportation and warehousing, and utilities	7,198	5.0	8,577	6.2
Professional, scientific and management, administrative, and waste management services	15,777	10.9	14,244	10.3
Information	2,211	1.6	1,701	1.2
Financial and insurance, and real estate	7,108	4.9	8,913	6.4
Education services, health care, and social service	33,551	23.2	34,490	24.8
Arts, entertainment, recreation and accommodation, and food services	9,266	6.4	12,551	9.0
Other services, except public administration	7,276	5.0	6,262	4.5
Public administration	6,882	4.8	6,168	4.4
Total	**144,620**	**100.0**	**139,005**	**100.0**

Source: U.S. Census 2014 (2008-2012 ACS, Table DP03).

Table 3-10 presents commute characteristics of residents within the study area and Brazoria and Galveston Counties. The commute characteristics for workers within the two counties and the 25 Census Tract Area are similar.

Table 3-10: Commute Characteristics of Residents within the Study Area, Brazoria County, and Galveston County

Total Workers and Commute Characteristics	25 Census Tract Area[a]	Brazoria County	Galveston County
Total workers (16 years and over)	75,053	142,224	136,822
Car, truck, or van (drove alone)	83.9%	84.5%	80.2%
Car, truck, or van (carpool)	9.9%	10.0%	10.3%
Public transportation (excluding taxicabs)	0.7%	0.3%	1.0%
Walk	0.8%	1.0%	2.1%
Other means	1.9%	1.8%	3.3%
Worked at home	2.7%	2.5%	3.1%
Mean travel time to work (in minutes)	30.0	28.5	26.4

Source: U.S. Census 2014 (2008-2012 ACS, Table DP03).

[a] The 25 Census tracts that are completely or partially within the study area.

Table 3-11 contains data for the civilian labor force (over 16 years old), percent employed, percent unemployed, percent of workers in the Armed Forces, and percent of workers not in the labor force for the 25 Census Tract Area and Brazoria and Galveston Counties. The 25 Census Tract Area employment rate is between 8 to 13 percent lower than Brazoria and Galveston Counties, and workers currently not in the labor force are slightly lower in the 25 Census Tract Area. Overall, the unemployment rate is similar for the study area compared to Brazoria and Galveston Counties.

Table 3-11: Civilian Labor Force, Total Employment, and Unemployment Rate in the Study Area and Associated Counties

Employment Status	25 Census Tract Area[a]	Brazoria County	Galveston County
Population 16 years and older	142,836	236,481	227,203
Civilian labor force	69.9%	65.3%	66.9%
Employed	53.1%	61.2%	66.6%
Unemployed	4.1%	4.2%	5.4%
Armed Forces	0.2%	0.1%	0.3%
Not in Labor Force	31.6%	34.5%	33.1%

Source: U.S. Census 2014 (2008-2012 ACS, Table DP03).

3.4.3 Property Tax Revenues

Table 3-12 shows the major taxing jurisdictions within the study area where ROW would be required. The following table includes the taxes collected for the 2012 to 2013 tax year and the tax rates for the various ISDs, cities/communities, and counties within the study area.

Table 3-12: Property Tax Revenues and Rates for Major Taxing Jurisdictions in the Study Area

Taxing Jurisdiction	Net Property Tax Revenues in 2012-2013	2012-2013 Tax Rate (Per $100 Valuation)
Brazoria County		
Brazoria County	$85,719,496.94	0.492020
Alvin	$7,099,395	0.843600
Alvin ISD	$67,588,812.18	1.329100
Angleton ISD	$31,728,313.69	1.455200
Galveston County		
Galveston County	$111,819,095	0.599915
Friendswood	$12,933,644	0.597000
League City	$30,340,097	0.597000
Dickinson ISD	$33,875,380	1.540000
Friendswood ISD	$27,044,502	1.367000

Table 3-12: Property Tax Revenues and Rates for Major Taxing Jurisdictions in the Study Area

Taxing Jurisdiction	Net Property Tax Revenues in 2012-2013	2012-2013 Tax Rate (Per $100 Valuation)
Clear Creek ISD	$202,921,667	1.360000
Santa Fe ISD	$10,531,764	1.453900

Source: Brazoria County Tax Office 2013; Galveston County Tax Office 2013.
Note: ISD = independent school district.

3.5 PEDESTRIANS AND BICYCLISTS

Alvin Mustang Bayou Trail (Upper Texas Coast Site 087) on the Great Texas Coastal Birding Trail is located on the Tom Blakeney Jr. Memorial Hike and Bike Trail, near Business SH 35 (Gordon Street) in Alvin. The trailhead begins near the intersection of Willis Street and Business SH 35 in Alvin, and is adjacent to the historic railroad depot; it passes through the National Oak and Prairie Dog parks, follows Mustang Bayou (with a bridge crossing the bayou), and ends at the Bob S. Owen public pool. The asphalt trail is connected to street trails and sidewalks that join many schools and parks (Alvin Parks and Recreation Department 2014). Signs identifying the trail are near the intersection of South Street and SH 35 and the intersection of Willis Street and Business SH 35. Bird watchers can follow the trail system to identify and observe various bird species.

There are also a number of other existing and proposed hiking and bicycling trails within the study area. One of the trails is a designated bicycling lane located along FM 1462. Phase 1 of a hiking and bicycling network is currently located in League City, with more planned. Several of the proposed hiking and bicycling trails would be within the study area, although the trails would be north of the Preferred Alternative and west of IH 45 South (League City 2014).

H-GAC is the intergovernmental regional planning entity responsible for reviewing pedestrian and bicycle facilities in the study area for consistency with regional planning goals. Regional planning goals are based on H-GAC's *2035 Regional Bikeway Plan*, which was created to provide facilities designed for safe use by bicyclists on longer trips (4 miles or more), to identify existing and planned bikeways, and to encourage the development of safer, more convenient, and better connected bikeways (H-GAC 2014a). The *2035 Regional Bikeway Plan* is a framework for identifying investments that enhance the reach and connectivity of the bikeway system, while offering transportation engineers and planners information about existing and proposed bikeways or pedestrian facilities.

As presented on ***Exhibit 3-5*** and verified with H-GAC personnel, there is a bicycle route within the study area that would be located at the Preferred Alternative's proposed intersection with FM 1462. The route, a one-shoulder lane, is on the north and south sides of FM 1462 between Sky Ranch Road and ACC. As shown on ***Exhibit 3-5***, several other proposed pedestrian and bicycle facilities would be in and around the study area.

Pedestrian and bicycle facilities are not currently planned to be incorporated as part of the proposed SH 99 Segment B. However, future planning activities could include design revisions to accommodate bicycle and pedestrian facilities within the ROW of the proposed SH 99 Segment B.

3.6 AIR QUALITY

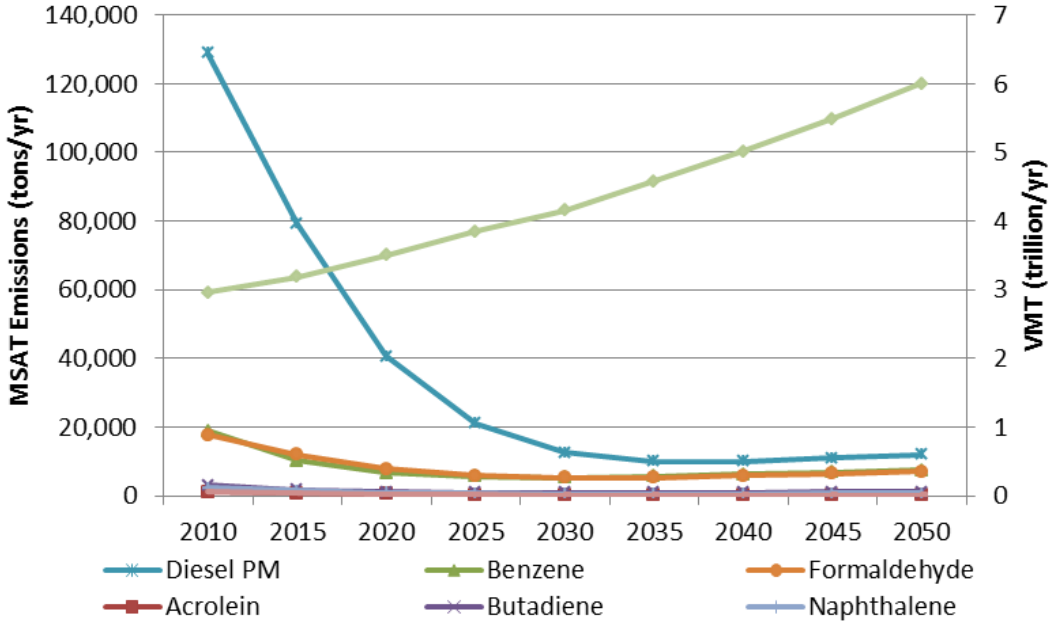
The proposed project is located within both Brazoria and Galveston Counties, which are part of the Greater Houston area that has been designated by the EPA as a marginal nonattainment area for the 2008 ozone standard; therefore, transportation conformity rules would apply.

3.6.1 Qualitative MSAT Assessment

Controlling air toxic emissions became a national priority with the passage of the Clean Air Act Amendments of 1990, whereby Congress mandated that the EPA regulate 188 air toxics, also known as hazardous air pollutants. The EPA has assessed this expansive list in their latest rule on the Control of Hazardous Air Pollutants from Mobile Sources (Federal Register, Vol. 72, No. 37, page 8430, February 26, 2007), and identified a group of 93 compounds emitted from mobile sources that are listed in their Integrated Risk Information System (IRIS) (http://www.epa.gov/iris/). 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-butadiene, 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 MSAT rule mentioned above requires controls that will dramatically decrease MSAT emissions through cleaner fuels and cleaner engines. Based on an FHWA analysis using EPA's MOVES2010b model, as shown on ***Figure 3-1*** and in ***Table 3-13***, even if VMT increases by 102 percent, as assumed from 2010 to 2050, a combined reduction of 83 percent in the total annual emissions for the priority MSATs is projected for the same time period.

Figure 3-1: Projected National MSAT Emission Trends 2010 to 2050 for Vehicles Operating on Roadways using EPA's MOVES2010b Model



Source: ***Table 3-13*** of the FEIS.

Note: Trends for specific locations may be different depending on locally derived information representing VMT, vehicle speeds, vehicle mix, fuels, emission control programs, meteorology, and other factors.

Table 3-13: Project National MSAT Emission Trends (2010 through 2050) for Vehicles Operating on Roadways using EPA's Moves2010b Model

Pollutant / VMT	Pollutant Emissions (in tons) and VMT by Calendar Year									Change
	2010	2015	2020	2025	2030	2035	2040	2045	2050	2010 to 2050
Acrolein	1,244	805	476	318	258	247	264	292	322	-74%
Benzene	18,995	10,195	6,765	5,669	5,386	5,696	6,216	6,840	7,525	-60%
Butadiene	3,157	1,783	1,163	951	890	934	1,017	1,119	1,231	-61%
Diesel PM	128,847	79,158	40,694	21,155	12,667	10,027	9,978	10,942	11,992	-91%
Formaldehyde	17,848	11,943	7,778	5,938	5,329	5,407	5,847	6,463	7,141	-60%
Naphthalene	2,366	1,502	939	693	607	611	659	727	802	-66%
Polycyclics	1,102	705	414	274	218	207	219	240	262	-76%
VMT (trillions)	2.96	3.19	3.5	3.85	4.16	4.58	5.01	5.49	6	102%

Source: EPA MOVES2010b model runs conducted during May through June 2012 by FHWA.

Notes: % = percent; PM = particulate matter; VMT= vehicle miles traveled.

Air toxic analysis is a continuing area of research. While much work has been done to assess the overall health risk of air toxics, many questions remain unanswered. In particular, the tools and techniques for assessing project-specific health outcomes as a result of lifetime MSAT exposure remain limited. These limitations impede the ability to evaluate how the potential health risks posed by MSAT exposure are to be factored into project-level decision making within the context of NEPA. The FHWA, the EPA, the Health Effects Institute (HEI), and others have funded and conducted research studies to try to more

clearly define potential risks from MSAT emissions associated with highway projects. The FHWA will continue to monitor the developing research in this emerging field.

3.7 NOISE

3.7.1 Characteristics of 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. The adjustment is called A-weighting and is expressed as "dB(A)."

Also, because traffic sound levels are never constant because of 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 "L_{eq}."

3.7.2 Existing Noise Levels

Dominant noise sources within the proposed SH 99 Segment B study area include traffic on existing roadways, various local activities, and sounds created by animals. On-site, short-term noise level measurements were conducted at 15 sites within the study area during April 2013. The sites were selected to be representative of noise-sensitive land uses that are most likely to be affected by noise produced by the proposed SH 99 Segment B. ***Table 3-14*** provides an overview by site number, location, description, and actual noise level readings of the representative noise-sensitive sites in the study area. ***Exhibit 3-6*** depicts the same locations.

Table 3-14: Noise Measurement Data

Site No.	Location	Description	Noise Level	Associated Receiver
1	Near the intersection of Inland Breeze Lane and Palm Crest Drive	Residential	42	
2	Rosharon Estates (Avenue C)	Residential	42	R1
3	Surrey Oak Court	Residential	52	R2-R15
4	Custom Drive at Keith Circle	Residential	43	R16-R44
5	Quail West Road near FM 2403	Residential	50	
6	Highland Square Apartments at SH 35 South Johnson Street (near SH 35)	Residential	55	R45
7	Apartment complex at Koster Road, adjacent to South Gordon Street	Residential; Multifamily	57	
8	Mustang Road at Pennington Drive, near the SH 35 Bypass	Residential	64	R46-R53
9	Hillcrest Village Apartments on Nelson Road, adjacent to the SH 35 Bypass	Residential; Multifamily	53	
10	The Kenton Apartments, adjacent to the SH 35 Bypass	Residential; Multifamily	58	R54

Table 3-14: Noise Measurement Data

Site No.	Location	Description	Noise Level	Associated Receiver
11	La Quinta Inn and Suites in Alvin, adjacent to the SH 35 Bypass	Commercial	64	R55-R61
12	Steele Road near Clifford Street	Commercial	60	R62-R63
13	Arbor Springs Lane near a cul-de-sac, adjacent to the Preferred Alternative	Residential	51	R64-R70, R77-R80
14	Morningmist Lane at the end of the cul-de-sac, near Preferred Alternative	Residential	55	R71-R76
15	Corner of Easton Glen Lane and Cambridge Meadow Lane, near IH 45 South	Residential	57	R81

Source: SH 99 Segment B Study Team 2014.

Notes: All noise levels are represented in dB(A) L_{eq}. FM = Farm-to-Market; IH = Interstate Highway; SH = State Highway.

3.8 WATER QUALITY

3.8.1 Surface Water

The TCEQ's Chapter 307, Texas Surface Water Quality Standards (TSWQS), effective July 22, 2010, presents surface water quality standards that apply to all surface waters in Texas (TCEQ 2014a). The standards are rules designed to establish goals for water quality throughout the state and provide a basis on which TCEQ regulatory programs can establish reasonable methods to implement and attain those goals for water quality. In compliance with Section 303(d) of the federal Clean Water Act, the TCEQ identifies water bodies in the state that do not meet the TSWQS. The compilation of the water bodies is known as the 303(d) List (TCEQ 2014b). The major surface waters are classified in the TSWQS as "segments" for the purposes of water quality management and designation of site-specific standards.

The proposed SH 99 Segment B study area is located in Basin 11, which is also known as the San Jacinto-Brazos Coastal Basin. Five surface waters occur in the study area in the general vicinity of the Preferred Alternative (***Exhibit 3-7***). The five waters are Chocolate Bayou, Dickinson Bayou Tidal, Dickinson Bayou Above Tidal, Geisler Bayou, and Mustang Bayou. There are also three channelized water canals that cross through the general area of the Preferred Alternative: the American Canal, Briscoe Canal, and South Texas Water Company Canal. Dickinson Bayou Tidal is classified as Segment 1103; Dickinson Bayou Above Tidal is classified as Segment 1104, and Chocolate Bayou Above Tidal is classified as Segment 1108. Segments 1103, 1104, and 1108 are listed on the 2012 Texas Water Quality Inventory (TCEQ 2014b). Segment 1103 is a tidal stream and is designated high aquatic life use. Segments 1104 and 1108 are freshwater streams. Segment 1104 is designated for intermediate aquatic life use, and Segment 1108 is designated for high aquatic life use.

Unclassified water bodies are included if sufficient historical Storm Water Quality Management data are available for assessment of at least one designated beneficial use. As such, Magnolia Creek (Segment 1101A), Chigger Creek (Segment 1101B), Bordens Gully (Segment 1103B), Geisler Bayou (Segment 1103C), Cedar Creek (Segment 1103E), Unnamed Tributary of Dickinson Bayou Above Tidal (Segment 1104A), and Mustang Bayou (Segment 2432A) are unclassified water bodies within the study area.

Magnolia Creek and Chigger Creek are freshwater tributaries of Clear Creek. Bordens Gully and Geisler Bayou are designated by TCEQ as tidal tributaries of Dickinson Bayou. Cedar Creek and Unnamed Tributary of Dickinson Bayou Above Tidal are freshwater tributaries of Dickinson Bayou. Mustang Bayou is a freshwater tributary of New Bayou. The only designated water body use for the unclassified segments is high aquatic life use.

Table 3-15 describes the classified and unclassified water body segments in the study area.

Table 3-15: Water Body Segments within the Study Area

Segment No.	Segment Name	Description
1101A	Magnolia Creek	From Clear Creek Tidal confluence upstream to 0.5 mile upstream of the confluence with the second unnamed tributary
1101B	Chigger Creek	From Clear Creek Tidal confluence to the Brazos River Authority Canal near County Road 143 in Galveston County
1103	Dickinson Bayou Tidal	From the Dickinson Bay confluence 1.3 miles downstream of SH 146 in Galveston County to a point 2.5 miles downstream of FM 517 in Galveston County
1103B	Bordens Gully	From Dickinson Bayou Tidal confluence to a point 0.87 mile upstream of FM 646 in Galveston County
1103C	Geisler Bayou	From Dickinson Bayou Tidal confluence to a point 0.85 mile upstream of FM 646 in Galveston County
1103E	Cedar Creek	From Dickinson Bayou Tidal confluence to a point 0.39 mile upstream of FM 517 in Galveston County
1104	Dickinson Bayou Above Tidal	From a point 2.5 miles downstream of FM 517 in Galveston County to FM 528 in Galveston County
1108	Chocolate Bayou Above Tidal	From a point 2.6 miles downstream of SH 35 in Brazoria County to SH 6 in Brazoria County
1104A	Unnamed Tributary of Dickinson Bayou Above Tidal	From the Dickinson Bayou Above Tidal confluence to SH 6
2432A	Mustang Bayou	From the New Bayou confluence upstream to an unnamed tributary 0.19 mile upstream of SH 35 to an unnamed tributary downstream of Cartwright Road

Source: TCEQ 2014b.

Notes: FM = Farm-to-Market; SH = State Highway; TSWQS = Texas Surface Water Quality Standards.

As previously stated, TCEQ is required under Section 303(d) of the Clean Water Act to identify water bodies that do not meet, or are not expected to meet, applicable water quality standards for their designated uses, which are defined in the 303(d) List. Some of the streams in Basin 11 are heavily urbanized and receive treated domestic and industrial wastewater as well as agricultural and urban runoff; however, Segments 1101A, 1103, and 1103C are listed on the 2012 303(d) List. Category 5b concerns for the stream segments are bacteria for Magnolia Creek (Segment 1101A); bacteria, dissolved oxygen, dioxin, and polychlorinated biphenyls for Dickinson Bayou Tidal (Segment 1103); dissolved oxygen for Geisler Bayou (Segment 1103C); and bacteria for Cedar Creek (Segment 1103E). A review of the

standards for one or more parameters would be conducted before a management strategy is selected, including the possible revision of the water quality standards (TCEQ 2014b).

The TCEQ prioritizes water bodies on the 303(d) List to schedule development of a total maximum daily load (TMDL). A TMDL is a technical analysis that determines maximum loadings of a pollutant of concern that a water body can receive and still meet water quality standards, which allocates the allowable loading to different point and non-point pollutant sources in a watershed (TCEQ 2012). A TMDL for bacteria has been developed for Dickinson Bayou (Segment 1104) and the three tidal tributaries that include Geisler Bayou (Segment 1103C) (TCEQ 2012). The implementation plan for Dickinson Bayou and the three tidal tributaries was approved January 15, 2014 (TCEQ 2014c). The implementation plan includes both voluntary and regulatory activities to reduce bacterial levels within the watershed of Dickinson Bayou.

3.8.2 Groundwater and the Public Drinking Water Systems

The Gulf Coast aquifer extends along the Gulf of Mexico from Florida to Mexico. In Texas, the aquifer provides water to all or parts of 54 counties and extends from the Rio Grande northeastward to the Texas-Louisiana border. The aquifer consists of complex interbedded clays, silts, sands, and gravels of the Cenozoic age, which are hydrologically connected to form a large, leaky artesian aquifer system. The system is comprised of four major components consisting of several recognized water-producing formations. The deepest formation is the Catahoula that contains groundwater near the outcrop in relatively restricted sand layers. Above the Catahoula is the Jasper aquifer, primarily contained within Oakville sandstone. The Burkeville confining layer separates the Jasper aquifer from the overlying Evangeline aquifer, which is contained within Fleming and Goliad sands. The Chicot aquifer, which is the upper component of the Gulf Coast aquifer system, consists of the Lissie, Willis, Bentley, Montgomery, and Beaumont formations and overlying alluvial deposits.

Aquifer water quality is described in terms of concentrations of dissolved solids, such as chlorides, expressed in milligrams per liter (mg/l) and is classified as fresh (less than 1,000 mg/l), slightly saline (1,000 to 3,000 mg/l), moderately saline (3,000 to 10,000 mg/l), and very saline (10,000 to 35,000 mg/l). Water quality is generally good in the shallower portion of the aquifer. Groundwater containing less than 500 mg/l dissolved solids is usually encountered to a maximum depth of 3,200 feet in the aquifer from the San Antonio River Basin northeastward to Louisiana (Texas Water Development Board [TWDB] 1995).

TWDB's groundwater database was searched for water wells located within the study area. A total of 158 wells registered with the database were reported to be in the study area (***Exhibit 3-8***). The majority of the wells were placed in the Chicot aquifer, but six wells were placed in the Evangeline aquifer. Primary uses listed for the wells were domestic, industrial, irrigation, public supply, and unused. Fifteen wells are listed as plugged or destroyed. Of the 158 water wells, 63 wells are listed as used for public water supply. Many of the wells reported as unused were developed as water supply wells at oil and gas well sites (TWDB 2014).

The state's Source Water Protection Program is a community-based, voluntary pollution prevention program that helps public water systems protect their drinking water sources. The program was created by the 1986 Safe Drinking Water Act Amendments and the expansion of the Wellhead Protection Program. All public water supply systems are eligible to participate in the program, which establishes procedures and criteria for identifying the boundaries of areas that constitute the sources of water used by public water systems. The program also defines procedures for identifying potential sources of contaminants within the same areas and provides for the development and implementation of plans for managing potential contaminant sources to prevent contamination.

3.9 WETLANDS AND OTHER 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, which was amended in 1977 to the Clean Water Act. The term "waters of the U.S.," as defined in 33 CFR 328.3, means:

1. All waters that are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters that are subject to the ebb and flow of the tide;
2. All interstate waters including wetlands; and
3. 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, that the use, degradation, or destruction of which could affect interstate or foreign commerce, including such waters:
    i. Which are or could be used by interstate or foreign travelers for recreational or other purposes; or
    ii. From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or
    iii. Which are used or could be used for industrial purpose by industries in interstate commerce.
4. All impoundments of water otherwise defined as waters of the U.S. under the definition.
5. Tributaries of waters identified in items 1-4 above.
6. The territorial seas.
7. Wetlands adjacent to waters (other than waters that are themselves wetlands) identified in items 1-6 above.

To characterize surface drainage systems (streams), the designations "perennial," "intermittent," and "ephemeral" are used and defined as follows.

- 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 times 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 streams 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. Not all ephemeral streams are USACE-regulated waters. To be considered jurisdictional, ephemeral streams must have a hydrological connection to jurisdictional waters.

3.9.1 Navigable Waters of the U.S.

As defined in 33 CFR 329.4, navigable waters of the U.S. are waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. The Texas coastal zone boundary, as defined by General Land Office's Coastal Management Program, encroaches into the eastern portion of the proposed SH 99 Segment B study area along IH 45 South, and in the southern portion where the study area boundary crosses Chocolate Bayou near Liverpool. According to TCEQ, Bordens Gully (Segment 1103B) and Geisler Bayou (Segment 1103C) are identified as tidal tributaries of Dickinson Bayou, and a portion of Chocolate Bayou (Segment 1107) near the southern limits of the study area is identified as a tidal steam segment. Assuming that the stream segments identified as being tidal by TCEQ are subject to the ebb and flow of the tide, these three stream segments would be considered navigable waters of the U.S. within the study area.

3.9.2 Waters of the U.S.

The proposed SH 99 Segment B study area is located within two hydrologic units or regional watersheds: West Galveston Bay (Hydrologic Unit Code [HUC] 12040204) and Austin-Oyster (HUC 12040205) (Seaber 1994). Based on limited field investigation and review of USGS 7.5-minute topographic quadrangle maps and TCEQ stream assessment units, there are multiple drainage ditches, irrigation ditches, swales, oxbows, ponds, and streams within the study area in the general vicinity of the Preferred Alternative (TCEQ 2014d) (***Exhibit 3-9***). As stated above, there are four named stream crossings, Chocolate Bayou, Dickinson Bayou, Geisler Bayou, and Mustang Bayou, and three named irrigation ditch crossings, the American Canal, Biscoe Canal, and South Texas Water Company Canal. Wetlands and other waters of the U.S. determined by the USACE to be jurisdictional would be subject to regulation under Section 404 of the Clean Water Act and/or Section 10 of the Rivers and Harbors Act.

3.9.3 Wetlands

As shown on ***Exhibit 3-10***, potential wetlands and other waters of the U.S. were identified using NWI maps, referencing the Cowardin classification system of wetlands and deepwater habitats (Cowardin 1979). Limited field investigation, and review of the USGS 7.5-minute topographic quadrangle maps, recent aerial photography, and available light detection and ranging data were conducted as part of the preliminary identification.

According to NWI mapping, five major subclasses of wetlands (described in the following sections) are within the study area in the general vicinity of the Preferred Alternative.

3.9.3.1 Palustrine Emergent

Palustrine Emergent wetlands are non-tidal, and vegetation is usually dominated by perennial plants that are present for most of the growing season (Cowardin 1979). According to the NWI, the majority of the Palustrine Emergent wetlands is persistent in nature and is either temporarily or seasonally inundated. Persistent wetlands are dominated by plant species that normally remain standing until the next growing season. Based on field reconnaissance and general knowledge of the region, plants that are commonly found in this wetland system include sand spikerush (*Eleocharis montevidensis*), soft rush (*Juncus effusus*), short-bristle beakrush (*Rhynchospora corniculata*), swamp smartweed (*Persecaria hydropiperoides*), Cherokee sedge (*Carex cherokeensis*), marsh flatsedge (*Cyperus pseudovegetus*), green flatsedge (*Cyperus virens*), and jointed flatsedge (*Cyperus articulatus*).

Numerous Palustrine Emergent wetlands associated with the study area have been farmed. With farmed wetlands, the soil surface has been mechanically or physically altered for the production of crops. However, hydrophytic vegetation would likely colonize the areas once farming practices have stopped. Farmed wetlands within the study area are generally characterized by persistent depressions on the landscape.

3.9.3.2 Palustrine Forested

Palustrine Forested wetlands are characterized by woody vegetation at least 20 feet tall and are usually hydrologically influenced by flood events (Cowardin 1979). Forested wetlands within the study area are dominated mostly by broad-leaved deciduous trees. The majority of the forested wetlands in the study area occur within the floodplains of creeks and tributaries.

According to field reconnaissance and general knowledge of the region, examples of woody vegetation within this wetland system include willow oak (*Quercus phellos*), overcup oak (*Q.lyrata*), black willow (*Salix nigra*), green ash (*Fraxinus pennsylvanica*), sweetgum (*Liquidambar styraciflua*), and American elm (*Ulmus americana*). Woody vines found in these areas include greenbriars (*Smilax spp.*), trumpet creeper (*Campsis radicans*), and Alabama supplejack (*Berchemia scandens*). Louisiana blackberry (*Rubus louisianus*) and deciduous holly (*Ilex decidua*) are common shrubs within the wetland areas. Common herbaceous species include Cherokee sedge, other sedges (*Carex spp.*), rushes (*Juncus spp.*), and slender spikegrass (*Chasmanthium laxum*).

3.9.3.3 Palustrine Scrub-Shrub

Palustrine Scrub-Shrub wetlands are dominated by woody vegetation less than 20 feet tall. Dominant species include true shrubs, saplings, and stunted trees or shrubs (Cowardin 1979). The wetlands occur in depressed areas on the landscape that are hydrologically driven by rainwater or groundwater. According to the NWI, Palustrine Scrub-Shrub wetlands in the study area are dominated by broad-leaved deciduous species generally situated in persistently depressed landscape positions that are either temporarily or seasonally inundated. According to field reconnaissance and general knowledge of the region, shrubs and saplings common to these wetlands include Drummond's rattlebox (*Sesbania drummondii*), eastern baccharis (*Baccharis halimifolia*), and common buttonbush (*Cephalanthus occidentalis*).

3.9.3.4 Palustrine Unconsolidated Bottom

Palustrine Unconsolidated Bottom wetlands are non-tidal and are most likely natural or man-made ponds. Little emergent vegetation is generally present and typically occurs in shallow waters near the shoreline. Palustrine Unconsolidated Bottom wetlands in the study area are commonly excavated features created to retain storm water runoff for agricultural purposes, including watering livestock. According to field reconnaissance and general knowledge of the region, plants that might occur in Palustrine Unconsolidated Bottom wetlands include sand spikerush, floating seedbox (*Ludwigia peploides*), soft rush, short-bristle beakrush, and swamp smartweed.

3.9.3.5 Riverine

Riverine wetlands are contained in natural or artificial channels that convey flowing water or form a link between two bodies of water. A low gradient and slow water velocity characterize riverine wetlands with no tidal influence (Cowardin 1979). Riverine wetlands in the study area are associated with the Chocolate Bayou and Dickinson Bayou stream channels, and the excavated American Canal and Briscoe Canal. According to the NWI, the streams and canals are permanently flooded waterbodies.

According to the NWI, approximately 31.7 acres of wetlands are mapped as occurring within the Preferred Alternative. The mapped wetlands are comprised of approximately 9.2 acres of Palustrine Emergent wetlands, 11.8 acres of Palustrine Forested wetlands, 5.9 acres of Palustrine Scrub-Shrub wetlands, 2.2 acres of Palustrine Unconsolidated wetlands, and 2.6 acres of Riverine wetlands.

3.10 VEGETATION AND WILDLIFE

3.10.1 Vegetation

According to the ecoregions of Texas, the proposed SH 99 Segment B study area is situated within the Western Gulf Coastal Plain Ecoregion of Texas (Griffith et al. 2007). The ecoregion is characterized by relatively flat topography and primarily grassland as its potential natural vegetation. A high percentage of the land is cropland, but urban and industrial land uses are expanding, and oil and gas production is common.

More specifically, the study area is located in the Northern Humid Gulf Coastal Prairies area of the Western Gulf Coastal Plain Ecoregion. The area is characterized by low relief and generally poor drainage. Historically, the area was mostly tallgrass grasslands with scattered oak mottes and maritime woodlands. Dominant grass species were little bluestem (*Schizachyrium scoparium*), yellow Indiangrass (*Sorghastrum nutans*), brownseed paspalum (*Paspalum plicatulum*), gulf muhly (*Muhlenbergia capillaris*), and switchgrass (*Panicum virgatum*) that have mixed with hundreds of other herbaceous species. Pecan (*Carya illinoinensis*), sugarberry (*Celtis laevigata*), ash (*Fraxinus* sp.), southern live oak (*Quercus virginiana*), and cedar elm (*Ulmus crassifolia*) are important riparian overstory species. Annual precipitation varies from 37 to 58 inches. Soil textures vary, but tend to be fine-textured with clay, clay loam, or sandy clay loam. The area has a long history of alteration, including the historical use of fire, domestic cattle grazing, agriculture, and, more recently, urban development. Almost all of the coastal prairies have been converted to cropland, rangeland, pasture, or urban and industrial land uses. Additionally, drainage and irrigation canals have been constructed, and stream channelization has occurred in many areas.

Typical of the Western Gulf Coastal Plain Ecoregion, the study area has been impacted by agricultural practices and urban development. Historical natural plant communities have generally been converted to other uses. While riparian forests exist along Dickinson Bayou, Chocolate Bayou, and tributaries of Chocolate Bayou, the agricultural and urban nature of the remaining portion of the study area supports ornamental plants and assemblages of native and exotic species indicative of frequent and heavy disturbance that has occurred over several decades. No relict prairies are known to occur within the study area.

3.10.1.1 Agricultural and Pastureland

Agricultural land and pastureland comprise the majority of the study area. Historically, corn, rice, grain sorghum, soybeans, and cotton were commonly cultivated throughout the study area (Griffith et al. 2007). Some agricultural fields in the study area appear to be in active production, while others appear to be fallow. The fallow fields often accommodate the growth of aggressively growing and/or undesirable herbaceous and woody species, such as Brazilian vervain (*Verbena brasiliensis*), annual sumpweed (*Iva annua*), deep-rooted flatsedge (*Cyperus entrerianus*), Chinese tallow (*Triadica sebifera*), southern dewberry (*Rubus trivialis*), eastern baccharis, huisache (*Acacia smallii*), and Macartney rose (*Rosa bracteata*).

Pasturelands consist of open grassland communities that have been disturbed through farming practices or grazing. Grazing pressure and the lack of fire have allowed less desirable weedy species to dominate the landscape, which include Bermuda grass (*Cynodon dactylon*), annual ryegrass (*Lolium perenne*), Mexican primrose (*Oenothera speciosa*), Canada goldenrod (*Solidago canadensis*), southern carpetgrass (*Axonopus affinis*), golden tickseed (*Coreopsis tinctoria*), and West Indian dropseed (*Sporobolus indicus*). Little bluestem, broomsedge (*Andropogon virginicus*), and brownseed paspalum can be found in pastures that have not been heavily grazed.

Fallow agricultural fields and pastureland in the study area exhibit herbaceous and woody species typical of the overall region.

3.10.1.2 Urban and Residential Areas

Landscaped urban and residential areas are also present throughout the study area. These areas have been disturbed by activities that have removed the majority of native vegetation and now typically support ornamental plant communities. Ornamental plantings of woody species include crepe myrtle (*Lagerstroemia indica*), loblolly pine (*Pinus taeda*), bald cypress (*Taxodium distichum*), and many species of shrubs and bushes. Bermuda grass and Saint Augustine grass (*Stenotaphrum secundatum*) are the most common herbaceous plants within the residential and urban areas. Live oak and pecan are also common throughout the residential areas. Vegetation in the study area along existing roadway ROWs is generally comprised of herbaceous species that are routinely maintained by mowing.

3.10.1.3 Riparian Forests

Limited riparian habitat occurs within the study area. The riparian forests along Chocolate Bayou and Dickinson Bayou comprise the majority of the forests. Small riparian corridors also exist along the banks of Chocolate Bayou's tributaries. The dominant overstory trees within the riparian corridors include sugarberry, eastern cottonwood (*Populus deltoides*), and live oak. The range of tree heights in the riparian forests is 30 to 55 feet, and the diameter at breast height ranges from 4 to 18 inches, with an average of 14 inches. Percent canopy cover in the corridors is approximately 70 percent. Non-dominant trees that occur in the overstory include black willow, hickory (*Carya* sp.), and green ash. Dominant shrubs in the riparian forests are yaupon (*Ilex vomitoria*) and dwarf palmetto (*Sabal minor*), and poison ivy (*Toxicodendron radicans*) and saw-greenbriar (*Smilax bona-nox*) are common vines. Because of the dense canopy, very little herbaceous vegetation grows within the riparian forests.

3.10.1.4 Woodlots

Numerous small woodlot acres are present throughout the study area. The woodlots appear to be old farm or pasturelands that are passing through succession and exhibit characteristics of natural abandonment. Loblolly pine and water oak (*Quercus nigra*) are the dominant overstory tree species within the wooded areas. The range of tree heights in the woodlots is 20 to 30 feet, and the diameter at breast height ranges from 4 to 10 inches, with an average of 6 inches. Percent canopy cover in the woodlots is approximately 45 percent. Non-dominant trees that occur in the overstory include sugarberry and sweetgum. The dominant shrub in the woodlots is yaupon, and poison ivy and saw-greenbriar are common vines. Because of the presence of dense yaupon cover, little to no herbaceous vegetation is present within the woodlots.

3.10.1.5 TxDOT/TPWD MOU and TPWD Coordination

The purpose of the TxDOT/TPWD September 1, 2013 Memorandum of Understanding (MOU) is to provide a formal mechanism by which TPWD may review TxDOT transportation projects, including the projects that have the potential to affect natural resources within areas owned or managed by TPWD. Rule §2.205 of the MOU requires TxDOT to perform a Tier I site assessment to determine impacts and

the need for coordination with TPWD. The Tier I site assessment defines the type and amount of habitat impacted using information from the Texas Conservation Action Plan (TCAP); *Ecological Mapping Systems of Texas* (EMST); Texas Natural Diversity Database (TXNDD); county lists of Rare and Protected Species of Texas maintained by TPWD; county lists of endangered, threatened, and candidate species maintained by the USFWS; and current aerial photography.

TxDOT would compare the results of the Tier I assessment with the threshold triggers and with the Threshold Table Programmatic Agreement. If any triggers or thresholds are met or exceeded, TxDOT would coordinate with TPWD. If administered coordination is conducted, a Tier II Site Assessment would serve as the primary environmental report to evaluate project impacts. Tier II Site Assessments would include the following:

1. A description and goals of the project, including the natural setting in which the proposed project occurs, the limits of the project, the existing conditions, any proposed mitigation and the proposed action.

2. A review of the TCAP and documentation of the potential direct impacts from the project to ecosystems, plant community associations, preferred habitat for Species of Greatest Conservation Need (SGCN) that are within range, easements, and land set aside for conservation (e.g., parks, wildlife management areas, mitigation areas).

3. Field verification to confirm potential direct and indirect impacts, to assess the fish and wildlife resources potentially impacted by the project, and to confirm the areal extent of ecological systems and plant community associations for the entire project area.

4. A review of TXNDD information for the following:

    a) All records within 1.5 miles of the project:

        i. A list of Element Occurrence Identification records (including Element Occurrence Identification [EOID] numbers and species name) for all records within 1.5 miles of the project, or if applicable, a statement that no records were found within 1.5 miles.

        ii. A list of managed areas within 1.5 miles of the project, or if applicable, a statement that no managed areas were found within 1.5 miles.

    b) For TXNDD records that intersect or overlap a project location, an evaluation of potential direct or indirect impacts due to the project to the recorded species or their habitats.

    c) For TXNDD records that are not directly on the project site but are within 1.5 miles, an explanation of potential direct or indirect impacts to the recorded species or its habitat, or if applicable, an explanation of how the habitat on the project site is different from the habitat at the location of the record.

5. A review of the EMST at the project location to include:

    a) A general description of the vegetation type (ecological system) as described in the EMST including:

        i. Names of the dominant plant species, or plant community associations;

        ii. Maps, aerial photographs with dates, photographs, or other visual representations of data (when available) provided to supplement the general description of the area and the description of what vegetation occurs within and abutting to the ROW; and

        iii. Project areas that contain multiple EMST vegetation types will include a map that shows the project footprint on recent aerial imagery overlaid with labeled EMST vegetation type boundaries.

6. If the vegetation in the project area does not match the description in the EMST a description of the vegetation should be provided. If the vegetation in the project area matches the description in the EMST, state that in the Tier II site assessment.

7. If unusual vegetation is found in the project area, temporary and permanent impacts to unusual vegetation features will be described and quantified. Unusual vegetation features may include:

    a) Unmaintained vegetation;

    b) Trees or shrubs along a fenceline (ROW) adjacent to a field (fencerow vegetation);

    c) Riparian vegetation (particularly where fields/cropland extends up to or abuts the vegetation associated with the riparian corridor); and

    d) Trees that are considered historically significant, ecologically significant, or locally important.

8. A description of the quantity and quality of any habitat within or abutting the ROW that may be suitable for state or federally listed threatened or endangered species or SGCN included on the appropriate TPWD County list.

9. A determination of whether special habitat features are present. If special habitat features are not present, the site assessment should state that. If special habitat features are present, then a description of those features should be provided in the Tier II site assessment. Temporary and permanent impacts to special habitat features would be described and quantified. Special habitat features include:

    a) Bottomland hardwoods;

    b) Caves;

    c) Cliffs and bluffs;

d) Native prairies (particularly those with climax species of native grasses and forbs);

e) Seeps or springs;

f) Snags (dead trees) or groups of snags;

g) Existing bridges with known or observed bird or bat colonies;

h) Rookeries; and

i) Prairie dog towns.

10. A description of aquatic habitat including ponds (temporary and permanent, natural and man-made), playa lakes, waterways/streams, wetlands and potential impacts to these resources. Descriptions of aquatic habitat should include a characterization of permanence (e.g., intermittent or perennial), and a general description of the substrate. Descriptions of expected impacts should include the acreage (include linear footage for streams) of temporary and permanent disturbance to the aquatic habitat.

11. For proposed projects on new location or those that require additional ROW or easements, the site assessment shall include 1-10 (above) and the following additional information, as appropriate:

a) Dominant species for each vegetation strata including tree, shrub, vine, and herbaceous (grass and forb) layers present;

b) Acres of each vegetation type in the project area;

c) Descriptions of land use within and adjacent to the proposed ROW (For projects with multiple alternatives, all alternatives will be evaluated to the same level of detail.); and

d) Lack of access to the new ROW may limit the amount of information available for the habitat description (Existing data shall be used to provide a best estimate in these circumstances).

e) A review of the EMST data was conducted; however, the analysis was constrained because of limited right-of-entry available within the Preferred Alternative ROW. Where right-of-entry was not available, observations of the Preferred Alternative were made from adjacent parcels and roadway ROW where possible. For areas of the Preferred Alternative ROW unable to be accessed or viewed from adjacent parcels or ROW, the existing EMST vegetation conditions as mapped by TPWD were used. The review revealed discrepancies between the EMST data and conditions observed during field investigations (***Table 3-16*** and ***Exhibit 3-11***).

f) Field observations indicated that areas identified as Coastal Grassland appear to be abandoned agricultural fields or overgrown pastures, and were reclassified as Agriculture, Disturbed Prairie, or Mixed Woodlands and Forest. Other areas mapped as Coastal Grassland currently exhibit developed conditions (e.g., roads, residential, and utility easements) and were reclassified as Urban.

g) Areas observed directly in the field (i.e., roads and ROWs, residences, shopping centers, utility easements, maintained irrigation canals, and ponds) that were not identified as Urban in the EMST data were reclassified as Urban. Based on field observations over 90 percent of the mapped Post Oak Savanna vegetation type was reclassified as Urban because existing conditions show that the areas are roadway ROW or overhead utility easements. Additional analysis of the Preferred Alternative ROW would be conducted as required by the MOU when right-of-entry is available in order to document discrepancies between the EMST-mapped vegetation types and vegetation observed in the field.

Table 3-16: EMST Classification Discrepancies

EMST		Reclassified EMST	
MOU Classification	**Acres**	**MOU Classification**	**Acres**
Agriculture	91.6	Agriculture	100.9
Coastal Grassland	762.4	Coastal Grassland	510.1
Disturbed Prairie	192.1	Disturbed Prairie	282.9
Mixed Woodlands and Forest	0.1	Mixed Woodlands and Forest	67.9
Post Oak Savanna	2.6		0.38
Riparian	73.5	Riparian	39.3
Tidal and Salt Marsh	63.6		45.9
Urban	291.7	Urban	430.1

Source: SH 99 Segment B Study Team 2014

h) TxDOT has developed the Biological Evaluation Form 320.01 used to document natural resource elements associated with a project, such as essential fish habitat as defined by the Magnuson-Stevens Fishery Conservation and Management Act, the Coastal Barrier Resources Act, the Marine Mammal Protection Act, the Migratory Bird Treaty Act, the Bald and Golden Eagle Protection Act, the Fish and Wildlife Coordination Act, Executive Order 13112 on Invasive Species, the Executive Memorandum on Beneficial Landscaping, and the Farmland Protection Policy Act. Information on both state and federally listed threatened and endangered species, federal candidate species, and SGCN is included in the Biological Evaluation Form. The Biological Evaluation Form also includes information related to the TXNDD, TCAP, and the EMST database that would indicate the necessity of TPWD coordination as required by the MOU. The Biological Evaluation Form prepared for the Preferred Alternative ROW is included as ***Appendix D***. Additional analysis relative to the Biological Evaluation Form would be conducted when access to the Preferred Alternative ROW is available.

i) TPWD has indicated that they would not review a Tier I Site Assessment for the proposed SH 99 Segment B project, but rather would review this FEIS documenting the Tier II Site Assessment information as the administered coordination for the proposed project. A copy of the FEIS will be provided to TPWD for review.

3.10.1.6 Beneficial Landscape Practices

In accordance with the Executive Memorandum of August 10, 1995, all agencies are to comply with NEPA as it relates to vegetation management and landscape practices for all federally-assisted projects. The memorandum directs that, where cost-effective and to the extent practicable, agencies will:

- Use regionally native plants for landscaping;
- Design, use, or promote construction practices that minimize adverse impacts on the natural habitat;
- Seed to prevent pollution by, among other things, reducing fertilizer and pesticide use;
- Implement water-efficient and runoff reduction practices; and
- Create outdoor demonstration projects employing the above measures and practices.

Landscaping related to the proposed SH 99 Segment B would be in compliance with the memorandum and the guidelines for environmentally and economically beneficial landscape practices.

3.10.1.7 Invasive Species

On February 3, 1999, Executive Order 13112 on Invasive Species was issued to prevent the introduction, to provide control, and to minimize economic, ecological, and human health impacts of invasive species. In accordance with the order, native plant species would be used in the landscaping and seed mixes (where practicable) for the proposed SH 99 Segment B.

3.10.2 Wildlife

Native wildlife populations of northeastern Brazoria County and western Galveston County have been largely displaced by development and land clearing activities for agricultural purposes that have resulted in habitat fragmentation (Griffith et al. 2007). The majority of prairie and woody vegetation, which provides cover for wildlife, has been removed. However, wildlife's ability to adapt to open habitats has likely occurred throughout the study area.

Birds that use open habitats in the region include the northern mockingbird (*Mimus polyglottos*), red-winged blackbird (*Agelaius phoeniceus*), scissor-tailed flycatcher (*Tyrannus forficatus*), mourning dove (*Zenaida macroura*), and chipping sparrow (*Spizella passerina*). Birds commonly found within urban and residential areas include the northern cardinal (*Cardinalis cardinalis*), common grackle (*Quiscalus quiscula*), northern mockingbird, European starling (*Sturnus vulgaris*), house sparrow (*Passer domesticus*), and blue jay (*Cyanocitta cristata*). Riparian habitat adjacent to the creeks and drainages provides cover, foraging, and perching habitat for many species of birds, including neo-tropical migrants. Ponds and active rice fields provide habitat for waterfowl and wading birds.

Mammal species adaptable to living in fragmented habitats and open fields are also commonly found within the study area. These species include raccoon (*Procyon lotor*), skunk (*Mephitis mephitis*), eastern cottontail (*Sylvilagus floridanus*), armadillo (*Dasypus novemcinctus*), Virginia opossum (*Didelphis*

virginiana), marsh rice rat (*Oryzomys palustris*), hispid cotton rat (*Sigmodon hispidus*), and white-footed mouse (*Peromyscus leucopus*). Because of lack of suitable cover, the presence of large mammals is limited within the study area. However, transient occurrences of white-tailed deer (*Odocoileus virginianus*), feral pigs (*Sus scrofa*), and coyote (*Canis latrans*) might occur throughout the study area. Mammals typically inhabiting urban areas include the black rat (*Rattus rattus*), Norway rat (*Rattus norvegicus*), house mouse (*Mus musculus*), Virginia opossum, and gray squirrel (*Sciurus carolinensis*).

Southeast Texas has a diverse assemblage of reptiles and amphibians. Turtles and lizards that could be present within the study area include the red-eared slider (*Trachemys scripta elegans*), snapping turtle (*Chelydra serpentina*), green anole (*Anolis carolinensis*), and five-lined skinks (*Eumeces fasciatus*). The eastern garter snake (*Thamnophis sirtalis sirtalis*), western cottonmouth (*Agkistrodon piscivorous leucostama*), Texas rat snake (*Elaphe obsolete lindheimerii*), and diamondback water snake (*Nerodia rhombifer*) are common snakes that might occur in the study area as well. Amphibians that could be found in the study area include the southern leopard frog (*Rana utricularia*), bullfrog (*Rana catesbeiana*), and cricket frog (*Acris crepitans blanchardi*).

3.11 THREATENED AND ENDANGERED SPECIES

The Endangered Species Act of 1973 assigns the responsibility of enforcement to the Secretary of the Interior and the USFWS. Chapters 68 and 88 of the TPWD code address TPWD's responsibilities regarding state-listed threatened and endangered species. The proposed SH 99 Segment B was evaluated against both the USFWS and TPWD lists of federal and state-listed threatened and endangered species for Brazoria and Galveston Counties. Limited right-of-entry within the proposed SH 99 Segment B ROW constrained the ability to identify suitable habitat for the listed species. Estimates of suitable habitat were based on the interpretation of aerial photography, light detection and ranging (LiDAR) data, existing records/documentation of habitat types, and observed habitat types (e.g., open fields, abandoned pasture and farmland, forest, forested wetlands, and emergent wetlands). Further field investigations would be conducted when right-of-entry is obtained for the proposed SH 99 Segment B ROW to determine if suitable habitat is present within the ROW for listed threatened and endangered species.

3.11.1 U.S. Fish and Wildlife Service

The purpose of the Endangered Species Act is to protect threatened and endangered species and their critical habitat. Endangered is defined as a species that is in danger of extinction throughout all or a substantial portion of its range. Threatened is defined as a species that is likely to become endangered in the future throughout all or a substantial portion of its range. In addition to endangered and threatened species, the USFWS maintains a list of "candidate" species. According to the USFWS, candidate species are plants and animals for which the agency has sufficient information on their biological status and threats to propose the species as endangered or threatened under the Endangered Species Act, but for which development of a proposed listing regulation is precluded by other higher priority listing activities.

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

- The present or threatened destruction, modification, or curtailment of a species' 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 the species' continued existence.

3.11.2 Texas Parks and Wildlife Department

In 1973, the Texas legislature authorized TPWD to develop a list of threatened and endangered animal species. In 1988, the legislature further authorized TPWD to develop a list of threatened and endangered plants for the state. Chapter 68 of the TPWD code requires the agency 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.

TPWD maintains a database, the TXNDD, that 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 TPWD on public or private lands with written permission. However, because a majority of the state is in private ownership, substantial data gaps exist in the TXNDD data. TXNDD data received from TPWD were reviewed for recorded locations of federally-listed threatened or endangered species in the study area.

3.11.3 Listing and Monitoring Process

3.11.3.1 Federally-Listed Species

The proposed SH 99 Segment B study area is located in Brazoria and Galveston Counties. The federal and state-listed species data for Brazoria and Galveston Counties, as maintained by USFWS and TPWD, and compiled by TxDOT, are presented in ***Table 3-17*** and ***Table 3-18***.

Table 3-17: State and Federal Threatened and Endangered Species of Brazoria County

Common Name	Scientific Name	State Status	Federal Status	Habitat Description	Habitat Present	Effect/ Impact
Birds						
American peregrine falcon	*Falco peregrinus anatum*	T	DM†	Potential migrant	Yes	Yes
Arctic peregrine falcon	*Falco peregrinus tundrius*	SGCN	DM†	Potential migrant	Yes	Yes
Bald eagle (Nesting)	*Haliaeetus leucocephalus*	T	DM	Near water areas, in tall trees	Yes	Yes
Black rail	*Laterallus jamaicensis*	SGCN	‡	Marshes, pond borders, wet meadows, and grassy swamps	Yes	Yes
Brown pelican (nesting)	*Pelecanus occidentalis*	SGCN	DM	Island near coastal areas	No	No
Eskimo Curlew	*Numenius borealis*	E	E†	Grasslands, pastures, plowed fields, marshes, mudflats (likely extinct)	Yes	No
Henslow's sparrow (wintering)	*Ammodramus henslowii*	SGCN	*	weedy fields, fields with bunch grass, vines, and brambles, need bare ground	Yes	Yes
Piping plover (wintering)	*Charadrius melodus*	T	T	Beach and bayside mud or salt flats	No	No
Red knot	*Calidris cantus rufa*	SGCN	T	Intertidal marine habitats, especially near coastal inlets, estuaries, and bays. Mudflats	No	No
Reddish egret	*Egretta rufescens*	T	*	Brackish marshes and tidal flats	No	No
Snowy plover	*Charadrius alexandrinus*	SGCN		Coastal winter migrant	Yes	Yes
Southeastern snowy plover	*Charadrius alexandrinus tenuirostris*	SGCN	*	Winter migrant on Texas coast beaches, bayside mud or salt flats	No	No
Western snowy plover	*Charadrius alexandrinus nivosus*	SGCN	T†	Coastal winter migrant	Yes	Yes
Sooty tern	*Sterna fuscata*	T		Maritime bird	No	No
Sprague's pipit	*Anthus spragueii*	SGCN	C	Migrant, upland prairie, coastal grasslands	Yes	Yes
White-faced ibis	*Plegadis chihi*	T	*	Freshwater marshes, but some brackish or salt marshes	Yes	Yes
White-tailed hawk	*Buteo albicaudatus*	T		Coastal Prairies	Yes	Yes
Whooping crane	*Grus americana*	E	E	Winters in Aransas National Wildlife Refuge	No	Yes
Wood stork	*Mycteria americana*	T	T†	Prairie ponds and flooded pastures	Yes	Yes
Fishes						
American eel	*Anguilla rostrata*	SGCN	‡	Coastal waterways below reservoirs to Gulf of Mexico	Yes	Yes
Sharpnose shiner	*Notropis oxyrhynchus*	T	E†	Large turbid river, sand, gravel, and clay-mud bottom	No	No
Smalltooth sawfish	*Pristis pectinata*	E	E†	Sheltered bays, shallow banks, estuaries and river mouths	No	No

Table 3-17: State and Federal Threatened and Endangered Species of Brazoria County

Common Name	Scientific Name	State Status	Federal Status	Habitat Description	Habitat Present	Effect/ Impact
Mammals						
Jaguarundi	*Herpailurus yaguarondi*	E	E†	Thick brushland near water	No	No
Louisiana black bear	*Ursus americanus luteolus*	T	T†	Bottomland hardwoods; large, undisturbed forested areas	No	No
Ocelot	*Leopardus pardalis*	E	E†	Dense chaparral; mesquite-thorn scrub and live oak mottes	No	No
Plains spotted skunk	*Spilogale putoria interrupta*	SGCN	‡	Open fields, prairies, croplands, fence rows, farm yards, brushy areas, and tall grass prairies	Yes	Yes
Red wolf	*Canis rufus*	E	E†	Extirpated, brushy, forested areas, coastal prairies	No	No
West Indian manatee	*Trichechus manatus*	E	E	Gulf and bay system	No	No
Mollusks						
False spike mussel	*Quadrula mitchelli*	T	‡	Cobble and mud substrate with water lilies present	No	No
Smooth pimpleback	*Quadrula houstonensis*	T	C	Mixed mud, sand, and fine gravel, tolerates slow to moderate flow rates.	Yes	Yes
Texas fawnsfoot	*Truncilla macrodon*	T	C	Possibly sand, gravel, and perhaps sandy-mud in moderate flows.	Yes	Yes
Reptiles						
Alligator snapping turtle	*Macrochelys temminckii*	T	‡	Water bodies with mud bottom and abundant vegetation	Yes	Yes
Atlantic hawksbill sea turtle	*Eretmochelys imbricata*	E	E	Gulf and bay system	No	No
Green sea turtle	*Chelonia mydas*	T	T	Gulf and bay system	No	No
Kemp's ridley sea turtle	*Lepidochelys kempii*	E	E	Gulf and bay system	No	No
Leatherback sea turtle	*Dermochelys coriacea*	E	E	Gulf and bay system	No	No
Loggerhead sea Turtle	*Caretta caretta*	T	T	Gulf and bay system	No	No
Texas diamondback terrapin	*Malaclemys terrapin littoralis*	SGCN	*	Coastal marshes, tidal flats, coves, estuaries, and lagoons behind barrier beaches.	No	No
Texas horned lizard	*Phrynosoma cornutum*	T	*	Open, semi-arid regions, with bunch grass	No	No
Timber/canebrake rattlesnake	*Crotalus horridus*	T	*	Swamps/floodplains of hardwood/upland pine	Yes	Yes
Plants						
Coastal gay-feather	*Liatris bracteata*	SGCN		Coastal prairie grasslands	Yes	Yes
Giant sharpstem umbrella-sedge	*Cyperus cephalanthus*	SGCN		on saturated, fine sandy loam soils or on heavy black clay	Yes	Yes
Texas meadow-rue	*Thalictrum texanum*	SGCN		woodlands and woodland margins on sandy loam, on pimple mounds, clay pan savannahs	Yes	Yes
Texas windmill grass	*Chloris texensis*	SGCN		Sandy to sandy loam soils in bare areas	Yes	Yes

Table 3-17: State and Federal Threatened and Endangered Species of Brazoria County

Common Name	Scientific Name	State Status	Federal Status	Habitat Description	Habitat Present	Effect/ Impact
Threeflower broomweed	*Thurovia triflora*	SGCN		low vegetation, on light colored silt or fine sand over saline clay.	Yes	Yes

Source: TPWD 2015a, TPWD 2015c.

* These species occur on the state listing of threatened or endangered species; however, they are not federally listed at this time by the USFWS (2015).

† These species are listed by the USFWS; however, they are not listed to occur within this county by the USFWS (2015).

-- Not listed for TPWD for this county (2015).

‡ Under Review for Federal Listing (5/2015).

E = endangered; T = threatened; H = historical occurrence; I = introduced population; C = candidate species; SGCN = species of greatest conservation need; DM = delisted taxon, recovered, being monitored first five years; AD = proposed delisting; SAT = similarity of appearance to a threatened taxon; D = delisted taxon; PDL= proposed for delisting; PE = Proposed for Federally Endangered.

Table 3-18: State and Federal Threatened and Endangered Species of Galveston County]

Common Name	Scientific Name	State Status	Federal Status	Habitat Description	Habitat Present	Effect/ Impact
Amphibians						
Southern crawfish frog	*Lithobates areolatus areolatus*	SGCN		Abandoned crawfish holes and small mammal burrows in moist meadows, pasturelands, pine scrub and river floodplains	Yes	Yes
Birds						
American peregrine falcon	*Falco peregrinus anatum*	T	DM †	Potential migrant	Yes	Yes
Arctic peregrine falcon	*Falco peregrinus tundrius*	SGCN	DM†	Potential migrant	Yes	Yes
Attwater's greater prairie-chicken	*Tympanuchus cupido attwateri*	E	E†	Thick 1-3' tall grass from 0'-200' above sea level along coast	No	No
Bald eagle	*Haliaeetus leucocephalus*	T	DM†	Near water areas, in tall trees	Yes	Yes
Black rail	Laterallus jamaicensis	SGCN	‡	Marshes, pond borders, wet meadows, and grassy swamps	Yes	Yes
Brown pelican (nesting)	*Pelecanus occidentalis*	SGCN	DM	Island near coastal areas	No	No
Eskimo curlew	*Numenius borealis*	E	E	Non-breeding; grasslands and pastures (likely extinct)	Yes	No
Henslow's sparrow (wintering)	*Ammodramus henslowii*	SGCN	*	weedy fields, fields with bunch grass, vines, and brambles, need bare ground	Yes	Yes
Mountain plover	*Charadrius montanus*	SGCN	*	Short grass plains and bare dirt (plowed fields)	No	No
Piping plover (wintering)	*Charadrius melodus*	T	T	Beach and bayside mud or salt flats	No	No
Red knot	*Calidris Canutus Rufa*	SGCN	T†	Coastal Shorelines	No	No

Table 3-18: State and Federal Threatened and Endangered Species of Galveston County]

Common Name	Scientific Name	State Status	Federal Status	Habitat Description	Habitat Present	Effect/ Impact
Reddish egret	*Egretta rufescens*	T	*	Brackish marshes and tidal flats	No	No
Snowy plover	*Charadrius alexandrinus*	SGCN		Coastal winter migrant	Yes	Yes
Southeastern snowy plover	*Charadrius alexandrinus tenuirostris*	SGCN	*	Winter migrant on Texas coast beaches, bayside mud or salt flats	No	No
Sprague's pipit	*Anthus spragueii*	SGCN	C	Migrant, upland prairie, coastal grasslands	Yes	Yes
White-faced ibis	*Plegadis chihi*	T	*	Freshwater marshes, but some brackish or salt marshes	Yes	Yes
White-tailed hawk	*Buteo albicaudatus*	T		Coastal Prairies	Yes	Yes
Whooping crane	*Grus americana*	E	E†	Winters in Aransas National Wildlife Refuge	No	Yes
Wood stork	*Mycteria americana*	T	T†	Prairie ponds and flooded pastures	Yes	Yes
Fishes						
American eel	*Anguilla rostrata*	SGCN	‡	Coastal waterways below reservoirs to gulf	Yes	Yes
Smalltooth sawfish	*Pristis pectinata*	E	E†	Sheltered bays, shallow banks, estuaries and river mouths	No	No
Mammals						
Louisiana black bear	*Ursus americanus luteolus*	T	T†	Bottomland hardwoods; large, undisturbed forested areas	No	No
Plains spotted skunk	*Spilogale putoria interrupta*	SGCN	‡	Open fields, prairies, croplands, fence rows, farm yards, brushy areas, and tall grass prairies	Yes	Yes
Red wolf	*Canis rufus*	E	E†	Extirpated, brushy, forested areas, coastal prairies	No	No
West Indian manatee	*Trichechus manatus*	E	E	Gulf and bay system	No	No
Reptiles						
Alligator snapping turtle	*Macroclemys temminckii*	T	‡	Deep water of rivers and canals	Yes	Yes
Atlantic hawksbill sea turtle	*Eretmochelys imbricata*	E	E	Gulf and bay system	No	No
Green sea turtle	*Chelonia mydas*	T	T	Gulf and bay system	No	No
Kemp's ridley sea turtle	*Lepidochelys kempii*	E	E	Gulf and bay system	No	No
Leatherback sea turtle	*Dermochelys coriacea*	E	E	Gulf and bay system	No	No
Loggerhead sea turtle	*Caretta caretta*	T	T	Gulf and bay system	No	No

Table 3-18: State and Federal Threatened and Endangered Species of Galveston County]

Common Name	Scientific Name	State Status	Federal Status	Habitat Description	Habitat Present	Effect/ Impact
Texas diamondback terrapin	*Malaclemys terrapin littoralis*	SGCN	*	Coastal marshes, tidal flats, coves, estuaries, and lagoons behind barrier beaches.	No	No
Texas horned lizard	*Phrynosoma cornutum*	T	*	Open, semi-arid regions, with bunch grass	No	No
Timber/canebrake rattlesnake	*Crotalus horridus*	T	*	Swamps/floodplains of hardwood/ upland pine	Yes	Yes
Plants						
Coastal gay-feather	*Liatris bracteata*	SGCN		Coastal prairie grasslands	Yes	Yes
Correll's false dragon-head	*Physostegia corellii*	SGCN	‡	Wet, silty clay loam on streamsides	Yes	Yes
Grand prairie evening primrose	*Oenothera pillosa sppsessilis*	SGCN		moist to dry tallgrass prairies on sandy or silty Alfisols over claypan on ancient river terraces	No	No
Houston daisy	*Rayjacksonia aurea*	SGCN	*	on or around naturally barren ground, saline slick spots, or pimple mounds	No	No
Texas windmill-grass	*Chloris texensis*	SGCN	*	Sandy to sandy loam soils in bare areas	Yes	Yes
Threeflower broomweed	*Thurovia triflora*	SGCN		Low vegetation, on light colored silt or fine sand over saline clay	Yes	Yes

Source: TPWD 2015b, TPWD 2015c.

* These species occur on the state listing of threatened or endangered species; however, they are not federally listed at this time by the USFWS (2015).

† These species are listed by the USFWS; however, they are not listed to occur within this county by the USFWS (2015).

-- Not listed for TPWD for this county (5/2015).

‡ Under Review for Federal Listing (5/2015).

E = endangered; T = threatened; H = historical occurrence; I = introduced population; C = candidate species; SGCN = species of greatest conservation need; DM = delisted taxon, recovered, being monitored first five years; AD = proposed delisting; SAT = similarity of appearance to a threatened taxon; D = delisted taxon; PDL= proposed for delisting; PE = Proposed for Federally Endangered.

The Attwater's greater prairie-chicken is federally- and state-listed as endangered in Galveston County. Coastal prairies are slowly diminishing because of agriculture, urbanization, and industrialization. With this loss of habitat, the Attwater's greater prairie-chicken is close to extinction. Habitat for this bird consists of coastal prairie with tallgrasses and intermittent shortgrass flats for booming grounds (USFWS 2010). Since the Attwater's greater prairie-chicken is limited to a preserve outside of the proposed SH 99 Segment B study area, it is not expected to occur within the study area.

The brown pelican was federally delisted in Brazoria and Galveston Counties on December 17, 2009 and will be monitored for five years by the USFWS (USFWS 2009a). The brown pelican is primarily a coastal species that rarely ventures far out to sea or inland. In Texas, it occurs primarily along the lower and middle coast, but occasional sightings are reported on the upper coast and inland to central, north central, and eastern Texas. The brown pelican could occur on a transient basis within the study area.

The Eskimo curlew is a shorebird that is critically endangered and may be near extinction, if not already extinct. The bird breeds in the open arctic tundra of Canada and migrates to wintering grounds in Argentina. Food resources include insects, spiders, grubs and cutworms, small snails, earthworms, seeds, and berries (USFWS 2011). The Eskimo curlew may pass through Texas during spring migration. The conversion of native grasslands to agricultural and urban uses has significantly reduced suitable spring migration habitat and food resources. Due to the general absence of suitable spring migration habitat in the study area, the Eskimo curlew is not expected to occur.

The piping plover is federally listed as threatened in both counties. The piping plover is a statewide migrant that winters along the Gulf Coast. Preferred wintering habitats include beaches, sandflats, mudflats, algal mats, and dunes along the Gulf Coast and adjacent offshore islands, and spoil islands in intracoastal waterways (USFWS 2009b). The piping plover is not expected to occur within the study area.

The Whooping Crane is a federally endangered species in Brazoria County. The crane winters in the prairies, salt marshes, and bays along the Texas coast (USFWS 2012). The Whooping Crane could occur within the study area as a transient migratory species.

The proposed SH 99 Segment B study area does not contain marine habitat. Therefore, the federally listed marine reptiles are not expected to occur within the study area.

3.11.3.2 State-Listed Species

Both Brazoria and Galveston Counties' list of state-listed threatened and endangered species and SGCN were obtained from the TPWD's Wildlife Diversity program for the study area. Known location data for state-listed threatened and endangered species were obtained from the TXNDD. ***Table 3-17*** and ***Table 3-18*** present a list of state threatened and endangered species, and the proposed project potential to impact this species or its habitat.

According to the TXNDD, one state-listed plant SGCN and one unlisted species have been documented within a 1.5-mile radius of the study area. There have been no other recorded sightings of any federal or state-listed species within close proximity of the study area. However, an absence of data for a particular species does not indicate an absence of occurrence for threatened and/or endangered species or SGCN. The following provides a description of the element of occurrences, including the element of occurrence identification (EOID) number within 1.5 miles of the study area.

Texas windmill-grass (Chloris texensis): EOID 8010

Texas windmill-grass is a state-listed species of SGCN. The TXNDD indicates an element of occurrence in the south-central portion of the study area; however, the precision of location is approximately 1 mile. Texas windmill-grass is a tufted perennial grass that occurs in open or barren areas within prairies along the Texas coast and flowers in October and November. Microhabitat for Texas windmill-grass includes sandy openings on or at the base of pimple mounds. The last observation of the species was November 4, 1966.

Southern Crawfish Frog (Lithobates areolatus areolatus): EOID 11524

The southern crawfish frog is listed by TPWD only on the Galveston County list as a SGCN. The southern crawfish frog is listed within the TXNDD with a Global Rank of G4, or demonstrably secure globally, and a State Rank of S3, or very rare and local throughout its range or found locally in restricted range, typically 21 to 100 viable occurrences. The TXNDD indicates an element of occurrence in the western portion of the study area; however, the precision of location is approximately 5 miles. It was last observed as a specimen collected from Chocolate Bayou on August 5, 1948, without specific location information. Southern crawfish frogs are found primarily in association with crayfish burrows in prairie and grassland or pastures and overgrown field habitats (Nunziata 2011).

3.12 FLOODPLAINS

As described earlier, the proposed SH 99 Segment B study area is located within the San Jacinto-Brazos Coastal Basin (Basin 11) in Brazoria and Galveston Counties. Having a drainage area of approximately 1,440-square miles, the basin is bordered by Galveston Bay on the east and the Brazos River Basin on the west. Average annual rainfall in the basin ranges from 35 to 70 inches. As described in ***Section 3.9.2***, the study area is also located within two USGS HUCs: West Galveston Bay (HUC 12040204) and Austin-Oyster (HUC 12040205) (Seaber 1994). Both basins drain into the Galveston Bay system. Various streams, canals, minor streams and bayous, and ponds of varying size also occur in the study area.

Executive Order 11988 requires federal agencies to avoid activities that directly or indirectly result in the development of a floodplain area. Proposed roadways would be impermeable surfaces that deflect, rather than absorb or store, water. As such, the presence of floodplains in the study area would be an important construction consideration. Building the proposed SH 99 Segment B would likely increase the potential for flooding impacts because of the added impermeable surface area. Additionally, roadway construction could alter the extent of the 100-year floodplain by acting as a levee or barrier to the natural flow of stormwater.

Flood Insurance Rate maps published by FEMA were obtained for the study area to determine the locations of flood hazard areas. As shown on ***Exhibit 3-7***, portions of the study area are located within FEMA-designated floodways, 100-year floodplains and 500-year floodplains of area waterways. The majority of the floodplain area is located along Chocolate Bayou and its tributaries in the western portion of the study area. In the eastern portion of the study area, 100-year and 500-year floodplains are present along Dickinson Bayou and its tributaries. In the central portion of the study area, floodways, 100-year and 500-year floodplains occur along Mustang Bayou. South of Alvin, an area of 100-year floodplain is located adjacent to the north side of Briscoe Canal that is associated with Mustang Bayou.

Brazoria and Galveston Counties participate in the National Flood Insurance Program. The program makes flood insurance available and supports local communities' efforts to reduce the risks of serious flooding. To participate, a community must agree to adopt and enforce sound floodplain management regulations and ordinances, and in exchange, FEMA makes flood insurance available to homeowners, business owners, and renters in the communities.

3.13 WILD AND SCENIC RIVERS

The Wild and Scenic Rivers Act was enacted on October 2, 1968. Section 1(b) of the act defines Congressional policy regarding the protection and preservation of certain rivers of the U.S. The act states that if a selected river's immediate environment possesses outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, the river is to be preserved in free-flowing condition. The river's immediate environment is also to be protected for the benefit and enjoyment of present and future generations (National Park Service 2005).

No river or river segments listed in the national inventory of the National Wild and Scenic Rivers System are located within the proposed SH 99 Segment B study area.

3.14 COASTAL BARRIERS

The Coastal Barrier Resources Act of 1982 addresses potential impacts to coastal barriers caused by development and transportation projects. The proposed SH 99 Segment B study area is not mapped as part of the Coastal Barrier Resources System.

3.15 COASTAL ZONE MANAGEMENT PLAN AND ESSENTIAL FISH HABITAT

3.15.1 Coastal Management Zone

The Coastal Zone Management Act of 1972 (as amended in 1996) provides for the preservation, protection, development, restoration, and enhancement (where feasible) of coastal zones in the U.S. In Texas, the General Land Office is designated as the lead agency that coordinates the development and implementation of the Texas Coastal Management Plan. The Coastal Coordination Advisory Committee assists in administering the program and adopting uniform goals and policies to guide decision making by all entities that regulate or manage the use of natural resource within the Texas coastal area.

The boundary of the Texas Coastal Management Zone was delineated in accordance with the requirements of the Coastal Zone Management Act, federal program development and approval regulations, and the Texas Coastal Coordination Act. Requirements dictate that a state's coastal zone boundaries include four elements: an inland boundary, seaward boundary, interstate boundaries, and federal land excluded from the boundary.

As illustrated on ***Exhibit 3-7***, the eastern limit of the proposed SH 99 Segment B study area is situated slightly inside the coastal zone boundary east of IH 45 South. Additionally, the coastal zone boundary encroaches into the southern portion of the study area near Liverpool, following a portion of the Chocolate Bayou channel as it approaches SH 35.

3.15.2 Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act (as amended on October 11, 1996) directs that all federal agencies proposing actions that would impact essential fish habitat consult with the National Marine Fisheries Service regarding potential adverse impacts. Although Chocolate Bayou, Dickinson Bayou, Mustang Bayou, and numerous tributaries traverse the study area, according to the

TCEQ's stream segments for the state of Texas, only a small portion of Chocolate Bayou near the southern boundary of the study area, and Bordens Gully and Geisler Bayou in the eastern portion of the study area are identified as a tidal waters. Otherwise, the water courses in the study area are not tidally influenced.

3.16 CULTURAL RESOURCES

Cultural resources are structures, buildings, archeological sites, districts, (a collection of related structures, buildings and/or archeological sites), cemeteries, and objects of historical significance. Both state and federal laws mandate the consideration and protection of cultural resources during a project's planning stage. At the federal level, NEPA and the National Historic Preservation Act of 1966 (among others) would apply to transportation projects, such as the proposed SH 99 Segment B. At the state level, state laws would apply to transportation projects. The proposed SH 99 Segment B would fall under the purview of the Antiquities Code of Texas because it would involve lands owned or controlled by the state or any city, county, or local municipality.

Compliance with all laws often requires consultation with the THC, the Texas State Historic Preservation Officer (SHPO), and/or federally recognized tribes to determine impacts on cultural resources. Review and coordination of the proposed SH 99 Segment B would follow approved procedures for compliance with all state and federal laws.

NEPA requires consideration of important historic, cultural, and natural aspects of our national heritage. Important aspects of our national heritage that may be present have been considered under Section 106 of the National Historic Preservation Act, as amended. The act requires federal agencies to account for the effect that an undertaking will have on cultural resources.

3.16.1 Archeological Resources

According to the Houston District's Potential Archeological Liability Map (PALM) GIS database compiled by TxDOT Environmental Division (ENV), the study area traverses Map Units 1, 2, and 2a. 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, but deep reconnaissance is not recommended. For Map Unit 2a, a surface survey of mounds is recommended, but deep reconnaissance is not recommended. PALM data are limited to only those portions of the study area that fall inside Brazoria and Galveston Counties (***Exhibit 3-12***).

Known archeological site locations were researched using the THC's online *Texas Archeological Sites Atlas*. The records revealed sites within 2 kilometers of the current study area. There are five pre-historic sites at Camp Mohawk County Park. Additionally, a historic Confederate Cemetery is directly adjacent to the study area near the intersection of SH 35 with Shirley Avenue.

The prehistory of Texas spans at least 13,000 years from at least 11,500 BC to the time of the European contact in the 17th century. The periods of Texas' prehistory are divided into three broad periods: Paleo-Indian, Archaic, and the Late Prehistoric.

The study area is in the Southeast Texas Archeological Region (Patterson 1995). Other recent prehistoric summaries with the prehistory of the Houston area include Ensor and Moore and Moore, both of which include detailed data on the prehistory of the region (Ensor 1991; Moore and Moore 1991).

Previous investigations in Southeast Texas have demonstrated that occupation of the region began as early as 12,000 years ago. All through prehistory, the inhabitants were nomadic hunter-gatherers. Ensor has proposed a prehistoric cultural sequence of periods for Southeast Texas that are as follows: Paleo-Indian (10,000 to 8,000 BC), Early Archaic (8,000 to 5,000 BC), Middle Archaic (5,000 to 1,000 BC), Late Archaic (1,000 BC to AD 400), Early Ceramic (AD 400 to AD 800), and Late Ceramic (AD 800 to AD 1750).

Evidence for prehistoric occupation of Southeast Texas is scarce in the Paleo-Indian period and ambiguous through the Middle Archaic period (Patterson 1983; Aten 1983:156-157). Although most previously recorded sites date to the Late Archaic and Ceramic periods, it is probable that earlier dating sites have been lost to erosion, channel cutting, and, in the case of very early sites, to rising sea levels. In cases where early-dating artifacts have been found, such as Wheat's finds of projectile points dating from the Paleo-Indian through Middle Archaic periods at Addicks Reservoir in western Harris County, the materials occur in deposits with poor contextual integrity (Wheat 1953).

Sites dating from the Late Archaic through the Ceramic periods are more commonly found in the region. During the Late Archaic period, modern climatic conditions evolved, sea level rose and stabilized, and coastal woodlands expanded. Aten hypothesizes that an increase in population and the establishment of seasonal rounds, including regular movement from littoral to inland areas occurred during the Late Archaic period (Aten 1983). Relevant to the study area's prehistory is Hall's data from the Allens Creek project in nearby Austin County, Texas (Hall 1984). Excavations of a large cemetery there suggest a Late Archaic trade system linking Southeast Texas to Central Texas and into Arkansas.

Aten has proposed that ceramics were introduced in the artifact assemblage on the Upper Texas Coast at AD 100 (Aten 1983). Ensor placed the beginnings of the Early Ceramic period at AD 400, which may be more applicable for inland areas (Ensor 1991). The Early Ceramic period was characterized by a continued growth in population. Ensor placed the beginning of the Late Ceramic at AD 800, coinciding with the introduction of the bow and arrow (Ensor 1991). Plain sand-tempered pottery dominated throughout both parts of the Ceramic era. Story defined the Mossy Grove Cultural Tradition for Late Prehistoric cultures in Southeast Texas with sandy paste pottery being the principle diagnostic artifact (Story et al. 1990).

Although European settlement did not begin seriously to disrupt aboriginal habitation in the areas inland from the Upper Texas Coast until after AD 1700, European diseases, probably introduced by explorers and early traders, began to have impacts as early as AD 1528 (Patterson 1995: 249). Seven recorded epidemics ran through the tribes of the study area between that year and AD 1890 (Ewers 1974). The study area appears to have been within the territory of the Akokisa in the 18th and 19th centuries (Aten 1983). Other groups that may have resided in Harris County include the Atakapan, Karankawa, and

Tonkawa. During the 18th and 19th century disease, the mission system and the fur trade acted to reduce, and in some cases exterminate, the indigenous populations.

On the eastern edge of Alvin, there is a cemetery referred to as the Confederate Cemetery. This cemetery was established in the 1890s as a burial ground for Confederate veterans and the families thereof. However, it appears likely that graves predate that era, as among the dead buried there are a handful of Union soldiers, suggesting a 1860s date for the earliest burials. However, at some point in its history, the cemetery was available to the public at large, and this burial ground has continued to be used into the modern era. The cemetery has a Texas Historical Marker (#9549).

3.16.2 Historic Non-Archeological Properties

3.16.2.1 Regulatory Requirements

In accordance with the regulations of the Advisory Council on Historic Preservation (ACHP) pertaining to the protection of historic properties (36 CFR 800.4), federal agencies are required to identify and evaluate historic-age, non-archeological resources for National Register of Historic Places (NRHP) eligibility and assess the effects that the undertaking would have on historic resources. A historic-age resource as defined in accordance with 36 CFR 60 is a building, structure, object, district or site that is within the area of potential effects (APE) and at least 50-years old at the time of project letting. The Programmatic Agreement for Transportation Undertakings (PA-TU) authorized among FHWA, the ACHP, the SHPO, and TxDOT outlines a streamlined approach for conducting Section 106 consultation and review with the SHPO. The document provides regulatory authority to TxDOT ENV to identify and evaluate cultural resources for NRHP eligibility, and when NRHP-listed or eligible resources are present, assess potential impacts and/or effects.

The proposed SH 99 Segment B study area also falls under the purview of the Antiquities Code of Texas. The code allows all such resources to be considered as State Antiquities Landmarks and requires that each be examined in terms of possible significance. Standards for the code are outlined under Chapter 26 of the THC Rules of Practice and Procedure for the Antiquities Code of Texas and closely follow those of the Secretary of the Interior's Standards and Guidelines.

If an effect is determined to be adverse, the agency must take steps to avoid, minimize, and/or mitigate the adverse effect. The consultation process of identification, evaluation, and assessment used to address the requirements of Section 106 of National Historic Preservation Act is codified in the PA-TU. If a transportation activity has the potential to adversely affect a historic resource and includes the proposed taking or use of the property for a transportation activity, the special provision of Section 4(f) of the U.S. Department of Transportation (USDOT) Act of 1966 (now 23 CFR 774) must also be addressed. Considerations must include any feasible and prudent alternatives and plan to minimize harm.

3.16.2.2 Survey Study Area and the Historic-Age Cut-off Date

The Survey Study Area (SSA) is defined as 1,300 feet beyond the Preferred Alternative ROW. The APE along a new location is defined as 300 feet beyond the proposed ROW of the Preferred Alternative and

includes all land parcels partially or wholly therein. The APE along the existing transportation corridor (i.e., SH 35 and its Alvin bypass) is defined as 150 feet beyond the proposed ROW and includes all land parcels partially or wholly therein. The criterion of 50 years prior to the construction letting date to define historic-age is prescribed within the Secretary of the Interior's guidelines for NRHP eligibility and the current PA-TU among FHWA, the ACHP, the SHPO, and TxDOT. All resources in the APE constructed by 1975 were identified and, to the extent possible, documented during field investigations. However, a 45-year cut-off (45 years prior to the letting date) to allow for project changes and/or delays is suggested in the September 8, 2006, Draft Historic Resources Section 106 Review and NEPA Guide, published by TxDOT ENV. The 1975 date accommodates both the recommended 45-year guideline for identifying historic-age resources and the estimated March 1, 2020, construction-letting date for the proposed SH 99 Segment B.

3.16.2.3 File and Literature Review Methodology

A file search guided the identification of designated historic properties and previously documented historic-age resources in the 1,300-foot study area. Information was gathered from THC's *Texas Historic Sites Atlas* on National Historic Landmarks; NRHP properties; State Antiquities Landmarks; Official Texas Historical Markers of all types; cemetery, military, neighborhood, and museum surveys; the National Park Service's Historic American Buildings Survey, Historic American Landscapes Survey, and Historic American Engineering Record; and the Texas Department of Agriculture's Family Land Heritage Program. The Brazoria and Galveston County Historical Commissions were contacted by e-mail on January 28, 2014, to collect information about locally significant historical resources. These inquiries were sent to both the Brazoria County Historical Commission chairman and marker chairman and the Galveston County Historical Commission chairman and marker chairman. No responses have been received to date. The file search also included review of a 2003 preliminary study prepared for the Grand Parkway Segment B project, which covered a much larger study area and included a windshield survey to note common property types and extant historic-age resources (Dase 2003a).

Maps, aerial images, and appraisal district records were useful for detecting potential locations of previously undocumented historic-age resources. Twentieth-century topographic and highway maps trace mid to late 20th century development (Armstrong and Barrow 1939; Armstrong and Morriss 1947; Brazoria County Abstract Company 1918; Historic Aerials 1929, 1932, 1946, 1957; Tennessee Valley Authority 1943a-d; Texas State Highway Department 1939, 1940, 1961a, 1961b; U.S. Army Map Service 1943; U.S. Department of the Interior, U.S. Geological Survey 1932a, 1932b, 1952, 1955, 1956a, 1956b, 1963a-c, 1969a-c, 1974a, 1974b). Mid-century and recent aerial images were analyzed (U.S. Department of Agriculture, Agricultural Stabilization and Conservation Service 1944a, 1944b; U.S. Department of Agriculture, National Agriculture Imagery Program 2013a, 2013b; U.S. Department of the Interior, U.S. Geological Survey 1961a, 1961b, 1969d, 1969e). Appraisal district records were reviewed for both Brazoria and Galveston Counties (Brazoria County Appraisal District 2014; Galveston Central Appraisal District 2014). These records often show approximate construction dates for improvements and are particularly reliable for those resources built in the last quarter of the 20th century and later. Discrepancies in earlier dates are frequent, but these were rectified during field investigations.

3.16.2.4 Results of File and Literature Review

The file search identified two designated Official Texas Historical Marker subject markers and a cemetery in the study area. One marker notes early settlement along Oyster Creek and Chocolate Bayou (Texas Historical Commission 1968a), and the other marker describes the Confederate Cemetery at Alvin, which was also recorded in a cemetery survey (Texas Historical Commission n.d., 1968b). No resources in the study area have National Historic Landmark, NRHP, State Antiquities Landmark, or Recorded Texas Historic Marker designations. Additionally, no resources in the study area have been previously identified or documented as part of military, neighborhood, or museum surveys; are in the Historic American Buildings Survey, Historic American Landscapes Survey, or Historic American Engineering Record; or are a part of the Family Land Heritage Program.

The previously recorded historic resources within the APE and SSA are shown on ***Exhibit 3-13***.

A research design was prepared to summarize the results of the file search and literature review and to guide field investigations based on TxDOT documentation standards for historic resources research designs (TxDOT 2014a). TxDOT approved the research design on April 18, 2014. The literature review identified four relevant historic contexts for the 1850 to 1975 period of significance: early Anglo American settlement, community planning and development, agriculture, and industrial extraction and processing.

Because of consultation with TxDOT ENV historians, a reconnaissance survey was conducted. The survey used an APE of feet from the Preferred Alternative ROW along new location and an APE of 150 feet from the Preferred Alternative ROW along existing transportation corridor. The projected letting date would be 2020; therefore, 1975 was the criterion used to determine the historic-age criteria cut-off date. The purpose of the survey was to identify previously designated NRHP, Recorded Texas Historic Landmark, and/or State Antiquities Landmark resources, as well as to identify historic-age resources considered to have NRHP eligibility potential, in an effort to avoid these resources to the maximum extent practicable.

3.16.2.5 Historical Resources Studies Report Methodology

A Non-Archeological Historical Resources Study Report (HRSR) for the proposed SH 99 Segment B was submitted on June 25, 2013 (***Appendix G***) and is discussed in more detail in *Section 4.16*. TxDOT ENV will make the final determinations of eligibility and effects to historic properties and will coordinate with the SHPO per the First Amended PA-TU.

3.17 HAZARDOUS MATERIALS

Hazardous materials are generally defined as any material that has or would have, when combined with other materials, an adverse 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, industrial sites, and aboveground and underground storage tanks. 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 in the vicinity of the proposed SH 99 Segment B study area. In addition, the Railroad Commission of Texas was also contacted, and GIS spatial data layers were obtained that provide locations of oil and gas wells and pipelines within the study area. Ortho-photography and limited field visits were also used to locate and define additional areas of concern.

3.17.1 Hazardous Materials Sites

There are 90 hazardous materials sites associated with 53 Map ID numbers located within the study area. ***Table 3-19*** provides a summary of the potential hazardous materials sites identified during the initial search, and ***Exhibit 3-14*** depicts the locations of the potential hazardous materials sites within the study area. ***Appendix F*** provides detailed information for the individual sites.

Table 3-19: Hazardous Material Regulatory Database Summary

Regulatory Database Searched	Sites Mapped	Radius Search
Federal		
Facility Registry System (FRSTX)	11	Target Property
Integrated Compliance Information System (ICISNPDES)	1	Target Property
Resource Conservation & Recovery Act - Generator Facilities (RCRAGR06)	2	Target Property and Adjoining
Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS)	1	0.5 mile
No Further Remedial Action Planned Sites (NFRAP)	1	0.5 mile
Resource Conservation & Recovery Act - Corrective Action Facilities (RCRAC)	1	1 mile
State (Texas)		
Groundwater Contamination Cases (GWCC)	2	Target Property
Notice of Violations (NOV)	4	Target Property
Dry Cleaner Registration Database (DCR)	3	0.25 mile
Industrial And Hazardous Waste Corrective Action Sites (IHWCA)	3	0.5 mile
Industrial And Hazardous Waste Sites (IHW)	13	0.25 mile
Petroleum Storage Tank (PST)	31	0.25 mile
Affected Property Assessment Report (APAR)	1	0.5 mile
Leaking Petroleum Storage Tank (LPST)	14	0.5 mile
Tier II Chemical Reporting Program Facilities (TIERII)	2	0.5 mile

Source: GeoSearch 2014.

Notes: The Hazardous Materials Database Report provides a more complete listing of databases searched (Appendix F of the FEIS).

3.17.2 Oil and Gas Well Sites

As described, the Railroad Commission of Texas Information Service Division was contacted, and the digital well location mapping, including the American Petroleum Institute database information, was acquired for the study area. The Railroad Commission of Texas regulates and issues permits for drilling oil and gas wells within Texas. All permitted wells are maintained in a GIS database by the commission. An estimated 117 oil and/or gas wells were identified within the study area. ***Appendix F*** provides individual site information.

3.18 VISUAL AND AESTHETIC QUALITIES

Aesthetic quality refers to an individual's perception of natural beauty in a landscape. It can be determined by the presence of designated scenic areas, overlooks along trails or roadways, or a positive endorsement of a particular view by the public. Aside from general descriptors, a number of other factors may be taken into account when considering the aesthetic quality of a certain feature or landscape. Among the factors are the following:

- Uniqueness of the landscape in relation to the region as a whole;
- Whether the scenic area is a foreground, middle-ground, or background view;
- Focus of the view;
- Scale of elements in a scene;
- Number of potential viewers;
- Duration of the view; and
- The amount of previous modifications or disturbances to the landscape.

Based on the listed criteria, the proposed SH 99 Segment B study area exhibits a low to medium degree of aesthetic quality, with few unique or necessarily spectacular views. Although a majority of the study area is categorized as vacant/developable, many areas (primarily near Alvin and IH 45 South) have experienced an increase in development relative to residential, commercial, and institutional land uses. The proposed SH 99 Segment B has been included in many preliminary plans for cities/communities in the area, such as Alvin, Friendswood, and League City.

In areas of existing roadway ROW, such as FM 1462, SH 35, or FM 517, residents and travelers would be accustomed to the vistas and aesthetic nature of those roadway portions. Existing developed areas within the study area are supportive of the conversion to a highway facility. Along the southern and eastern portions of study area, the scenic attributes are primarily vistas of either current agricultural use or undeveloped areas that historically have been farmland or pastureland. The scenic vistas are generally associated with a rural lifestyle and possess an intrinsic value for those who live and travel through the area. As a traveler leaves the southern or eastern portion of the study area and travels towards Alvin or IH 45 South, the scenic attributes become more urban in character. The urbanized areas are comprised of residential, commercial, and institutional uses that are typically encountered near highway corridors.

SECTION 4: ENVIRONMENTAL CONSEQUENCES

Section 4 describes the anticipated direct impacts of the Preferred Alternative and the No-Build Alternative on the physical, biological, and socioeconomic resources within the proposed SH 99 Segment B study area and the proposed ROW of the Preferred Alternative. Direct impacts are effects that can be attributed to construction, operation, and maintenance of the proposed SH 99 Segment B or to the continuation of the existing activities under the No-Build Alternative. The section builds upon the affected environment established for each resource in ***Section 3***.

4.1 LAND USE

As shown in ***Table 4-1*** and depicted on ***Exhibit 3-1***, land within the proposed ROW of the Preferred Alternative would be converted from primarily vacant/developable land to a transportation use. Traveling from west to east along the Preferred Alternative, the density and development pattern would increase, and there would be a greater diversity of land use. Areas near Alvin and League City would have commercial activities adjacent to the Preferred Alternative, along with some industrial and government/medical/education facilities. Other than vacant/developable and undevelopable land use, residential land use would be the next most prevalent land use category found within the Preferred Alternative ROW. Many of the small cities and unincorporated communities in the proposed SH 99 Segment B study area serve as suburban communities for the major employers in the overall Houston-Galveston-Brazoria CMSA (e.g., Houston Medical Center, the National Aeronautics and Space Administration [NASA], and Clear Lake/Webster Medical Center) (Buehler 2014; Allender 2014). As these industries and employers continue to grow and expand their services the need for additional residential and commercial development will continue.

Table 4-1: Land Use Impacts under the Preferred Alternative

Land Use Category	Total Impact (Acres)	Percent Impact of Total Acres
Commercial	9.2	0.90
Government/Medical/Education	0.90	0.08
Industrial	8.19	0.76
Other	0.00	0.00
Parks/Open Space	0.00	0.00
Residential	81.76	7.62
Undevelopable	108.21	10.04
Unknown	0.00	0.00
Vacant/Developable (includes farming)	864.01	80.6
Water	0.00	0.00
Total	**1,072.3**	**100.00**

Source: H-GAC 2014c.

Note: Includes impacts to the Preferred Alternative ROW.

As described in ***Section 3.1.2*** of the FEIS, three cities have comprehensive plans or land use policies that serve as a guideline for how the city prioritizes public funds for both infrastructure and land use decisions in regard to any future growth and for the maintenance of its existing obligations. The following are the plans and/or ordinances guiding development in the study area.

- *The Alvin Plan, City of Alvin, TX, 2035 Comprehensive Plan Update, Crossroads 2035* (Alvin 2014)
- Dickinson Land Use Policies published May 2004 and Dickinson Code of Ordinances/Zoning Regulations published July 2001 (Dickinson 2004, 2007)
- *League City 2035 Comprehensive Plan* published May 2011 (League City 2011)

Many of the cities and communities anticipate construction of the proposed SH 99 Segment B and have included the future highway on many area maps as "proposed" or "future," with the understanding that the proposed SH 99 Segment B is currently under evaluation. Friendswood has a proposed master planned development in the southeast portion of its city limits that includes the proposed SH 99 Segment B on its preliminary site plan. League City's western city limit has a similar scenario for a three-phased master planned community. Based on interviews that were held with local officials in the region, the proposed SH 99 Segment B and the associated Preferred Alternative would be in conformance with many of the current and forecasted land use policies.

In order to assess the direct impacts to land use within the proposed ROW of the Preferred Alternative, the analysis is divided by two limits: the SH 288/western terminus to SH 35/Alvin limit and the SH 35/Alvin to IH 45 South limit.

4.1.1.1 SH 288/Western Terminus to SH 35/Alvin

The first limit would begin at SH 288 and proceed eastward to Alvin. As shown on ***Exhibit 3-1***, a large amount of undeveloped land would be located in the westernmost portion of the Preferred Alternative ROW. As noted in ***Table 4-1***, vacant/developable and undevelopable land uses would be impacted the most. The two land uses are indicative of a rural lifestyle, and based on the acreages shown, the lifestyle would be directly impacted by the Preferred Alternative.

4.1.1.2 SH 35/ Alvin to Eastern Terminus/IH 45 South

As the Preferred Alternative nears Alvin, the land use pattern would change considerably. The second limit of the Preferred Alternative would have pockets of commercial, industrial, and residential uses. As the Preferred Alternative moves toward IH 45 South, there would be considerable residential development and supporting commercial uses. Impacts to land use would be minor in much of the area because the Preferred Alternative would follow existing roadway ROW in many instances. In total, the Preferred Alternative would only convert 0.01 percent of the existing land use into a transportation use.

No-Build Alternative Impacts

The No-Build Alternative would not result in direct impacts to land use. However, with implementation of only the proposed improvements to the existing transportation infrastructure, anticipated increases in traffic congestion would likely strain the developed and developing parts of the proposed SH 99 Segment B study area. The congestion and associated strain would have a direct impact on travel demand along existing infrastructure and the accompanying land uses in the study area. Existing commercial and industrial areas may struggle to serve their respective customer base without adequate transportation facilities.

4.2 GEOLOGY, SOILS, AND FARMLANDS

4.2.1 Geology and Soils

Although impacts to soils would be unavoidable, the Preferred Alternative would cross topography and soils that consist of broad, flat plains on predominantly clayey substrate of the Beaumont Formation and alluvial deposits. ***Appendix B*** provides a table of the soils within the Preferred Alternative ROW, including the descriptions and the hydric and prime farmland status of each soil. Where unavoidable impacts do occur, such as at localized cut and fill areas, mitigation measures would offset the impact to these resources. However, the geologic resources (i.e., faults) within the study area are influenced by regional conditions that have the potential to impact the SH 99 Segment B. Subsidence and faults in the Texas Coastal Zone are unavoidable. However, proper engineering design can accommodate the low rates of differential movement along the faults and in areas of subsidence.

The Preferred Alternative would traverse soils that primarily have a high shrink-swell potential. This potential means that volume varies because of the interaction of clay minerals with water and with the amount and type of clay minerals in the soil. The load size on the soil and the magnitude of the change in soil moisture content would influence the amount of soil swelling. Construction of a roadway involves compaction of soils and removal of vegetation, which can increase the amount of erosion and subsequent sedimentation. Slope, soil texture, and precipitation during construction will determine the soil loss potential. Erosion and sediment control measures, such as reseeding and phasing vegetation removal, would effectively minimize erosion and soil loss during construction. ***Section 4.8.2*** of the FEIS describes additional erosion control and slope stabilization techniques. To the maximum extent possible and where required, material excavated from road cuts would be used as fill material. If suitable soils are not found within the ROW, soils would be obtained from other sites within a reasonable haul distance of the Preferred Alternative. Detailed investigation of soils for construction would be conducted during the final design phase of project development. During final design, special consideration would be given to the selection of fill materials, which would be specifically noted for roadbed materials to offset any adverse impact from area soil conditions.

The Preferred Alternative is not anticipated to have any significant impacts to the region's topography, soils, or geologic resources.

No-Build Alternative Impacts

No impacts are expected under the No-Build Alternative as related to soils or geologic resources. However, other types of development may occur within the study area that could impact or be impacted by geologic resources.

4.2.2 Farmlands

Farmlands impacts are defined as impacts to farmland soils protected under the FPPA and do not include non-FPPA-protected soils that are in existing agricultural use. Based on data obtained from the NRCS, ***Table 4-2*** summarizes the amount and type of prime farmland soils that would be impacted by the Preferred Alternative. ***Exhibit 3-2*** identifies the location of prime farmland soils in relation to the Preferred Alternative ROW.

Table 4-2: Prime Farmland Soil Impacts under the Preferred Alternative

Soil Type	Total Impact (Acres)
Aris fine sandy loam (1, Ar)	12.90
Bacliff clay (6, Ba)	77.36
Bernard clay loam (7, Be)	289.12
Bernard-Edna complex (8, Bn)	232.88
Lake Charles clay, 0-1 percent slopes (24, LaA)	689.76
Leton-Aris complex (28, Ls)	0.70
Morey silt loam (29, Me)	2.28
Total	**1,305**

Source: SH 99 Segment B Study Team 2014.

Of the 1,305 acres of impacted Prime Farmland Soils, 1,072 acres of this would be new ROW that would be converted to transportation land use. The remaining 233 acres are located within exiting ROW. Impacts to prime farmland soils should be avoided where practicable. However, because of the large acreage of prime farmland in Brazoria and Galveston Counties, the Preferred Alternative would have an unavoidable effect on some prime farmland soils.

Related to direct farmland acreage impacts, bisection of farms would not only convert existing farmland or prime and statewide important farmland soils (potential farmland) to a transportation use, but it would also result in the disruption of some farming operations. However, the Preferred Alternative may result in positive impacts to local farming operations as well by increasing the accessibility to FM roadways in the area. An improved transportation system in Brazoria and Galveston Counties would improve highway safety for the transport of farm products and equipment.

A Farmland Conversion Impact Rating Form for Corridor Type Projects (NRCS-CPA-106) calculated the relative impact of the Preferred Alternative on prime farmland. Land evaluation and site assessment scores estimate the value of the impacted farmland and can add up to a maximum of 260 points. One-hundred and sixty points is a critical score, with a project receiving a score less than 160 points being given a minimal level of consideration for protection.

Per coordination with the NRCS it was determined that the critical score for the proposed project would be 174. As this is above 160, the NRCS recommends that alternatives that would not convert prime farmland soils, or attempts to minimize the conversion of farmland soils be considered in final project development. Coordination with the NRCS will continue. For copies of agency coordination letters please see ***Appendix B.***

No-Build Alternative Impacts

The No-Build Alternative would not result in immediate or direct impacts to prime and statewide important farmland soils. However, general development pressure could eventually result in the conversion of prime or statewide important farmland to non-farmland uses.

4.3 SOCIAL CHARACTERISTICS

The Preferred Alternative would potentially have social impacts on the cities/communities within the proposed SH 99 Segment B study area. This section evaluates the positive and negative effects of the proposed action on the social environment. This includes impacts to all people, including environmental justice communities (minorities and low-income), children and seniors, and people with limited English proficiency, by examining potential displacements and relocations, loss of property taxes to local taxing entities, impacts to public facilities, and aesthetic impacts due to the proposed action. Noise impacts to communities along the Preferred Alternative are discussed in detail ***Section 4.7***. The data presented below are based on the U.S. Census Bureau, H-GAC, and other public sources of data.

4.3.1 Neighborhoods and Community Cohesion

As defined in FHWA's Technical Advisory T 6640.8A, changes in community cohesion may be beneficial or adverse as a result of highway construction and improvements. Community cohesion modifications may involve dividing neighborhoods, isolating a portion of a neighborhood or an ethnic group, generating new development, changing property values, terminating residential roadways, and separating residents from community facilities.

The study area largely exists within rural areas that do not contain dense residential, commercial, retail, or industrial development (with the exception of the area that follows the existing SH 35 and SH 35 Bypass and near the intersection of FM 646 and IH 45 South). However, there are over 100 existing neighborhoods/subdivisions located within or near the study area as shown on ***Exhibit 2-11***. Some of these neighborhoods/subdivisions would be in close proximity to the Preferred Alternative as shown on ***Exhibit 2-10***. Using a buffer of 2,000 feet along the Preferred Alternative, it was determined that there would be no community cohesion impacts with the implementation of the Preferred Alternative. As

defined above, this includes impacts of dividing neighborhoods, isolating a portion of a neighborhood or an ethnic group, generating new development, changing property values, and separating residents from community facilities. All named roadways traversed by the Preferred Alternative would be bridged or re-routed to accommodate existing traffic.

During construction, short-term impacts would occur because of the movement of workers, equipment, and materials throughout the study area. Construction noise and dust and temporary disruption of traffic on local roads would temporarily affect residents, businesses, and farming operations in the vicinity of the Preferred Alternative. The temporary impacts would primarily occur in areas where Preferred Alternative ROW would follow or cross an existing roadway. Specific information about potential detours in the construction areas is not known at this time, and will not be available until the final engineering design of the Preferred Alternative. Coordination between TxDOT and landowners regarding detours, construction scheduling, and access to the area during construction would help minimize the temporary disruptions.

While single-family communities, multi-family/apartment communities, and residents living in rural areas would potentially be impacted by residential displacements, loss of property, a potential increase in traffic noise, visual and aesthetic impacts, and short-term construction impacts, construction of the Preferred Alternative would benefit adjacent neighborhoods by improving mobility. Anticipated improved mobility and accessibility would benefit the overall study area and nearby communities. Discussion of impacts due to displacements and noise are included in ***Sections 4.3.3*** and ***4.7***.

No Build Alternative Impacts

The No-Build Alternative would not result in direct impacts to neighborhoods and community cohesion. However, general development pressure could eventually result in the dividing of neighborhoods, isolating a portion of a neighborhood or an ethnic group, changing property values, terminating residential roadways, and separating residents from community facilities.

4.3.2 Social and Community Resources

The following sections describe the limited impacts to local community resources that would be associated with construction of the Preferred Alternative (see ***Section 3.3.3*** of the FEIS for the location of each listed community facility, service, and resource). No church, community, or other public facilities would be directly impacted by the Preferred Alternative. In the short-term, there may be an increase in traffic congestion and potential changes in traffic patterns during construction. However, any potential effects would be temporary, and access to community and public facilities would be maintained during construction.

4.3.2.1 Schools and Educational Facilities

No public schools, private schools, or other educational facilities would be located within the proposed ROW of the Preferred Alternative. The closest of the 17 schools and educational facilities to the Preferred Alternative would be the Nolan Ryan Center (ACC), which would be 38 feet from the proposed ROW.

All others would be 851 feet or more from the proposed ROW (***Exhibit 3-4***). ***Table 3-5*** lists the schools, the respective ISDs, their addresses, and the distance from the Preferred Alternative.

Impacts would include construction and existing school bus routes which may require route changes to accommodate roadway system alterations for the Preferred Alternative. In the long-term, the Preferred Alternative would improve school bus service within the various ISDs by improving access to rural areas and by enhancing area-wide mobility. See ***Section 4.3.2.2*** for information on impacts to Access and Parking that would apply to the Nolan Ryan Center (ACC).

No-Build Alternative Impacts

The No-Build Alternative would not result in direct impacts to schools and educational facilities, as the study area would remain in its current condition.

4.3.2.2 Access and Parking

Access and parking would be impacted at a historical marker located at a TxDOT roadside rest area within the Preferred Alternative ROW. The historical marker and rest area would need to be relocated to accommodate the Preferred Alternative.

No-Build Alternative Impacts

Under the No-Build Alternative, the Preferred Alternative would not be constructed, and the study area would remain in its current condition. There would be no impacts to access and parking.

4.3.2.3 Police Protection, Fire Protection, and Medical Services

No police stations, fire stations, or EMS facilities would be located within or immediately adjacent to the proposed ROW of the Preferred Alternative. As such, no related facilities would be displaced by the Preferred Alternative (***Exhibit 3-6***). In the short-term, there may be an increase in traffic congestion and potential changes in traffic patterns in the vicinity of the facilities during construction, which could possibly cause temporary delays for emergency responders. Emergency service providers (i.e., police protection, fire protection, and EMS) would receive notification and accommodations to roadway construction, ramp closings, or the closure of any adjacent roads or streets, so that emergency responders could plan their detours in advance of an emergency situation.

In the long term, the Preferred Alternative would improve access for police, fire, and EMS service to rural areas by providing new or improved access to areas that previously had no or limited access because of the absence of major roadways. The Preferred Alternative would also improve public safety within the region by providing an alternative evacuation route in case of regional emergencies, such as during a hurricane. However, with the addition of another thoroughfare in the study area, there would be more potential for traffic accidents to occur, which would necessitate additional emergency response needs.

No-Build Alternative Impacts

The No-Build Alternative would not result in direct impacts to police protection, fire protection, or EMS services.

4.3.2.4 Churches

No churches or other religious facilities would be located within the proposed ROW of the Preferred Alternative. As such, no related facilities would be displaced by the Preferred Alternative.

Real Life Ministries would be located approximately 122 feet northwest of the Preferred Alternative off of FM 528 in Alvin (***Exhibit 3-6***). In the short-term, there may be an increase in traffic congestion and potential changes in traffic patterns in the vicinity of the church during construction. Coordination between the church and TxDOT on the construction schedule and access would help minimize temporary disruptions.

No Build Alternative Impacts

The No-Build Alternative would not result in direct impacts to any churches or other religious facilities in the study area.

4.3.2.5 Cemeteries

There are no cemeteries located within the Preferred Alternative ROW; therefore, no cemeteries would be impacted by the Preferred Alternative. The Confederate Cemetery, located adjacent to SH 35 in Alvin approximately 56 feet east of the Preferred Alternative ROW, would be the closest cemetery to the Preferred Alternative (***Exhibit 3-6***). There are two entrances to the Confederate Cemetery; one is located adjacent to the SH 35 frontage road and the other entrance is located on Dickinson Road/FM 517. During construction, access would be maintained to both entrances. The cemetery would not be impacted by construction or operation of the Preferred Alternative. Roadway construction may temporarily impact traffic near the cemetery.

As discussed in *Section 4.7*, the traffic noise analysis showed that the proposed project would cause a traffic noise impact at the Confederate Cemetery, and a noise barrier is proposed. A noise barrier would be expected to be constructed along the Preferred Alternative ROW, adjacent to the cemetery property. The final decision to construct the proposed noise barrier would not be made until after the completion of the proposed SH 99 Segment B design, utility evaluation, and polling (agreement) of the cemetery owner.

No-Build Alternative Impacts

The No-Build Alternative would not result in direct impacts to any cemeteries in the study area.

4.3.2.6 Parks and Recreation

As detailed in ***Section 3.3.3*** of the FEIS, the Preferred Alternative ROW would be directly adjacent to Camp Mohawk on SH 35 south of Alvin. A TxDOT-owned roadside rest area currently resides in the

same area. The Chocolate Bayou boat ramp would be located approximately 380 feet east of the Preferred Alternative ROW (***Exhibit 3-4***). Camp Mohawk and the public boat ramp are both owned by Brazoria County.

At present, the TxDOT-owned rest area is only accessible from SH 35. This area consists of a mowed and maintained area with a circular drive where visitors can safely park and read the information on a historical marker. It does not have seating or play areas and does not appear to be frequented by locals. The historical marker would need to be relocated to accommodate the Preferred Alternative. This marker does not indicate a specific important location, but rather provides information about the history of the area in general. Therefore, relocating the marker would not interfere with its meaning and interpretation.

Acquisition of proposed ROW would also impact a portion of the entrance to the Camp Mohawk property. However, the Preferred Alternative would not impact the Chocolate Bayou boat ramp. There would not be a Section 4(f) impact as a result of the implementation of the Preferred Alternative.

The Nolan Ryan Center would be located approximately 38 feet from the Preferred Alternative ROW, and the Preferred Alternative would also be directly adjacent to the Thelma Ley Anderson Family YMCA facility. However, neither of the two facilities would be impacted by the Preferred Alternative.

The park associated with the Living Stones Church, Resoft Park, and the five commercial recreational facilities discussed in ***Section 3.3.3.4*** of the FEIS would not be impacted by the implementation of the Preferred Alternative.

No-Build Alternative Impacts

The No-Build Alternative would not result in direct impacts to any parks and/or recreation facilities in the study area.

4.3.3 Displacements and Relocations

The potential relocations, listed in ***Table 4-3***, are based on review of aerial photography, Google Earth online mapping, and site reconnaissance conducted in January 2014 from various public roadways (H-GAC 2014c). ***Exhibit 4-1a*** identifies the anticipated displacements, and ***Exhibit 4-1b*** contains a description, map identification number (Map ID #), zip code, and address (if known) of each displacement.

Table 4-3: Potential Residential, Business, and Other Displacements under the Preferred Alternative

Type	Number of Displacements
Single-family residential	17
Businesses	13
Outbuildings (i.e., sheds, barns, and garages)	25
TxDOT Park and Ride parking area	1

Table 4-3: Potential Residential, Business, and Other Displacements under the Preferred Alternative

Type	Number of Displacements
Historical marker and TxDOT rest area	1
Electric or cell phone towers	2
Gasoline dispensing facilities	2
Other[a]	3

Sources: SH 99 Segment B Study Team 2014; Google Earth; H-GAC 2014c.

[a] "Other" includes billboards and farm buildings

Notes: The Historical marker and TxDOT rest area are at the same location.

A majority of the buildings to be displaced by the Preferred Alternative would be outbuildings (i.e., 25 sheds, barns, or residential machine shops) as shown on ***Exhibit 4-1a*** and ***4-1b***. Eleven of the 17 single-family residential displacements would be mobile homes; one of the single-family homes appears dilapidated and is potentially abandoned. Of the 13 potential business displacements, one business appears to be closed. The Preferred Alternative would also impact the location of a historical marker and a TxDOT rest area (Map ID #23).

4.3.3.1 Residential and Business Property Availability

Current available single-family residential housing was examined to determine if adequate housing is available near the proposed residential displacements. The proposed SH 99 Segment B study area lies primarily within eight zip codes: 77511, 77517, 77539, 77546, 77573, 77577, 77578, and 77583. ***Table 4-4*** lists the number of single-family homes within the $10,000 to $500,000 price range that are available for sale within the eight zip codes as of March 2014 (Houston Association of Realtors 2014a). The 34 listed housing units contain at least two bedrooms and one full bathroom.

Table 4-4: Single-Family Housing Availability within the Study Area Zip Codes

Price Range	Zip Codes								Total
	77511	77517	77539	77546	77573	77577	77578	77583	
$10,000 - $50,000	0	0	3	0	0	0	0	0	**3**
$50,000 - $100,000	8	2	6	0	1	1	0	1	**19**
$100,000 - $150,000	0	0	5	0	0	0	1	1	**7**
$150,000 - $200,000	1	1	0	0	0	0	0	1	**3**
$200,000 - $250,000	2	0	0	0	0	0	0	0	**2**
$250,000 - $300,000	0	0	0	0	0	0	0	0	**0**
$300,000 - $350,000	0	0	0	0	0	0	0	0	**0**
$350,000 - $400,000	0	0	0	0	0	0	0	0	**0**

Table 4-4: Single-Family Housing Availability within the Study Area Zip Codes

Price Range	Zip Codes								Total
	77511	77517	77539	77546	77573	77577	77578	77583	
$400,000 - $450,000	0	0	0	0	0	0	0	0	**0**
$450,000 - $500,000	0	0	0	0	0	0	0	0	**0**
Total	**11**	**3**	**14**	**0**	**1**	**1**	**1**	**3**	**34**

Source: Houston Association of Realtors 2014a.

Notes: Listings are as of March 2014. All housing units listed contain at least two bedrooms and one full bathroom.

Much of the land immediately adjacent to the Preferred Alternative would be undeveloped land, which could be available for purchase or lease for new home construction or mobile home relocation. Adequate housing and undeveloped land exist in the study area to accommodate potential residential relocations that may occur as a result of the Preferred Alternative.

Available commercial, office/retail, industrial, and undeveloped land/unimproved properties for sale or for lease in the study area were identified to determine the number of properties that could accommodate business relocations. The Houston Association of Realtors Commercial Gateway website provided the number of available commercial properties for sale or lease within the study area as represented in ***Table 4-5***: 75 office/retail properties for lease, 22 office/retail properties for sale, 5 industrial properties for lease, 16 industrial properties for sale, 89 undeveloped land/unimproved land properties for lease, and 154 undeveloped land/unimproved properties for sale. Office/retail, industrial, and undeveloped property availability were searched by zip code in the study area for this analysis.

Table 4-5: Business Properties/Land for Sale or Lease in the Study Area Zip Codes

Type of Property (For Sale or Lease)	77511	77517	77539	77546	77573	77577	77578	77583	Total
For Sale									
Office/Retail Properties	6	0	5	0	7	1	3	0	22
Industrial Properties	5	0	1	1	6	1	2	0	16
Land	49	3	31	9	22	0	18	22	154
Total Properties	60	3	37	10	35	2	23	22	192
For Lease									
Office/Retail Properties	22	0	5	23	24	0	1	0	75
Industrial Properties	8	0	1	0	0	0	0	0	9
Land	0	0	1	0	1	0	1	2	5
Total Properties	30	0	7	23	25	0	2	2	89
Total Available Properties	90	3	44	33	60	2	25	24	281

Source: Houston Association of Realtors 2014b.

Notes: Office/retail, industrial, and undeveloped property availability were searched by zip code in the study area.

As of January and March 2014, the Houston Association of Realtors listed properties within the study area zip codes that contained one or more buildings or consisted of undeveloped land that has been zoned or is designated for retail/office or industrial uses (Houston Association of Realtors 2014a, 2014b). While the properties represent listings by the Houston Association of Realtors, it is likely that there are other retail/office and industrial properties available for sale or lease in addition to those listed. For the 13 anticipated business displacements, a sufficient number of replacement sites would likely be available.

4.3.3.2 Uniform Relocation and Real Property Acquisition Policies Act of 1970

TxDOT's acquisition and relocation assistance program would provide assistance to residents and businesses that are required to relocate. The relocation assistance program is conducted in accordance with the Uniform Relocation and Real Property Acquisition Policies Act of 1970, as amended. Relocation resources are available, without discrimination, to all residents and businesses required to relocate as a result of implementation of the Preferred Alternative. No person would be displaced by the Preferred Alternative unless and until adequate replacement housing has already been provided or is in place. Replacement housing would be fair housing and would be offered to all displaced persons regardless of race, color, religion, sex, or national origin. All replacement housing would be decent, safe, and sanitary, without causing undue financial hardship. An adequate supply of housing meeting this description is anticipated either through existing homes for sale or new home sites in the study area. For the 13 anticipated business displacements, a sufficient number of replacement sites would likely be available in the study area.

No-Build Alternative Impacts

The No-Build Alternative would not result in residential, business, or other relocations. However, continued growth and development in the area could require the displacement and relocation of residents and existing structures.

4.3.4 Environmental Justice

Executive Order 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 of programs on minority and low-income populations (59 Federal Register 7629-7633, February 16, 1994).

According to FHWA Order 6640.23 and the USDOT Order 5610.2(a), disproportionately high and adverse effects on minority or low-income populations are generally defined as an adverse effect that is predominantly borne, or would be suffered by, a minority population and/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 and/or non-low-income population (USDOT 2012). In response to Executive Order 12898, the USDOT developed an EJ strategy that follows within the framework of NEPA and Title VI of the Civil Rights Act of 1964, which was clarified in the Civil Rights Restoration Act of 1987.

A minority is defined under Order 5610.2(a) as:

- Black (a person having origins from any of the black racial groups of Africa),
- Hispanic or Latino (a person of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race),
- Asian American (a person having origins in any of the original peoples of the Far East, Southeast Asia, or Indian subcontinent),
- American Indian and Alaskan Native (a person having origins in any of the original people of North America, South America [including Central America], and who maintains cultural identification through tribal affiliation or community recognition), and
- Native Hawaiian and other Pacific Islander (a person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands).

Low income is defined under Order 5610.2(a) as a person whose median household income is at or below the U.S. Department of Health and Human Services poverty guidelines. Poverty guidelines are categorized by the number of persons living in a household. The poverty guideline for a family of four people in 2014 (in the 48 contiguous states), as defined by the U.S. Department of Health and Human Services, is a total annual household income of $23,850.

The definitions for minority and low-income populations are intended to be consistent with the definitions that have been issued by the CEQ and EPA. As defined, a minority or low-income population is present in the affected area when the percentage of the population that is minority and/or low-income is 50 percent or more, or the minority or low-income population percentage is meaningfully greater than the minority or low-income population percentage in an appropriate comparison group(s) (CEQ 1997; EPA 1998).

For race/ethnicity, the most detailed level for evaluation is the Census block level. For income and LEP, the most detailed level for evaluation is the Census block group level. As depicted on ***Exhibit 4-2***, the areas of analysis include the 2010 Census population and the race/ethnicity data for a 178 Census block area that would intersect or would be included within the proposed ROW of the Preferred Alternative. Data sources also include 2008 to 2012 ACS income and LEP data for a 19 Census block group area that would be completely or partially within the Preferred Alternative ROW (***Exhibit 3-3***) (U.S. Census Bureau 2014).

Individual Census block groups and blocks along the proposed ROW of the Preferred Alternative were examined to identify populations that had greater than 50 percent minority and/or low-income populations within Census block groups where median household incomes were below the 2014 poverty threshold. ***Appendix C*** of the FEIS provides a complete listing of race, ethnicity, and median household income data for the 12 Census tracts that intersect with the Preferred Alternative (12 Census Tract Area), 19 Census block group area, and 178 Census block area.

Within the 178 Census block area traversed by the Preferred Alternative, 19 blocks would have high (i.e., more than 50 percent) minority populations. In the 19 Census block group area, none of the Census block groups would have high (i.e., more than 50 percent) low-income populations or low median household incomes. ***Exhibit 4-2*** illustrates the Census blocks with a high minority population.

Of the 178 Census blocks, 100 have a reported population of zero. Determination of the race/ethnicity for an area population is based on useable population data reported to be greater than zero. The average median household income for the 19 Census block group area is $81,335, according to 2008 to 2012 ACS data.

4.3.4.1 Environmental Justice

Although none of the Census blocks or Census block groups, where displacements or noise receivers would occur, would contain more than 50 percent of minority or low-income populations, minority or low-income individuals could be adversely impacted because of displacements of homes, businesses, and/or noise impacts. However, mitigation measures would be in place to provide assistance with locating and purchasing replacement housing and business locations affected by relocations. If feasible and reasonable, mitigation for traffic noise would be provided to those impacted by the Preferred Alternative.

Impacts from Displacements

Within the 19 Census blocks with high minority populations, none of the blocks would have residential and business displacements. Minority and low-income individuals could be impacted by the proposed residential and business displacements, but impacts to one geographic area with greater than 50 percent minority or low-income populations are not anticipated.

Impacts from Noise

As discussed in ***Section 4-7*** of the FEIS, noise impacts are anticipated within areas of high minority populations. Noise impacts to residential communities were analyzed according to the FHWA's noise abatement criteria (NAC). As discussed, noise mitigation, such as noise barriers, would be proposed for some communities, including adversely impacted EJ communities that meet the requirements for a noise barrier or noise mitigation.

Impacts from Air Quality

As described in ***Section 4-6***, localized increases in MSAT emissions could occur and would likely be most pronounced in the immediate area of the Preferred Alternative. However, even if increases in MSAT emissions occur, over time the emissions would be reduced from implementation of EPA vehicle and fuel regulations. Increases in MSAT emissions would occur throughout the corridor, but would not disproportionately impact EJ populations compared to non-EJ populations.

Impacts from Construction

Short-term, localized effects to air quality (e.g., increase in dust) and noise levels (e.g., generated by construction equipment and activities) may occur in the immediate area adjacent to the Preferred Alternative during construction. However, the impacts would be temporary and not limited to minority and/or low-income populations. Rather, the effects would impact all residents and businesses within and around the Preferred Alternative ROW.

Impacts to all users of local roadways, including EJ populations, would be affected by temporary delays during construction. Access would be provided to all businesses and residents during construction of the Preferred Alternative. Construction would not restrict access to any existing public or community facilities. Implementation of the Preferred Alternative would not cause disproportionate impacts to minority or low-income populations.

4.3.4.2 Project-level Environmental Justice Toll Analysis

A project-level toll analysis was conducted to determine the potential impacts that tolling would have on EJ communities in and around the Preferred Alternative ROW. To complete the evaluation, H-GAC utilized a travel demand model to identify potential toll road users and to conduct a travel time analysis for persons residing in EJ TAZs and non-EJ TAZs. In addition, an evaluation of toll policies, toll rates, and available non-toll facilities was conducted to fully evaluate the potential for disproportionate impacts to EJ communities.

Non-Toll Facilities

The main lanes of the Preferred Alternative are proposed to be tolled lanes. However, there are arterials within the proposed SH 99 Segment B study area that would generally parallel the Preferred Alternative, including FM 1462, SH 35, and FM 517. The free roadway network, which connects SH 288 to IH 45 South, is comprised of local and FM roads that are typically two-lane facilities. The approximate 27-mile existing non-toll route through the study area entails traveling along SH 288 south to FM 1462, FM 1462 south to SH 35, SH 35 to FM 517, and FM 517 to FM 646. There are no existing toll facilities or transit services within the study area.

Toll Policies

Based on Senate Bill 792, TxDOT has agreed to a consistent application of HCTRA's policies for all Grand Parkway projects, but specific toll policies and rates are to be set by order of the Texas Transportation Commission. The fees include reasonable fees for administering electronic toll collection (ETC) customer accounts, toll tags, toll collection, and toll transactions. For the purposes of the analysis in the FEIS, HCRTA toll policies were used. As listed in ***Table 4-6***, HCTRA's tolling policies have identified various circumstances for which non-tolled or free passage on area toll roads is allowed to certain individuals, certain types of vehicles, and under special circumstances.

Table 4-6: Toll Road Fee Exceptions

Category	Description
Vehicles	1. Marked police vehicles, fire department vehicles, and ambulances.
	2. Authorized emergency vehicles identified in Texas Transportation Code §541.201.
	3. Vehicles designated by the Department of Public Safety as emergency vehicles during disasters declared by the governor of Texas (Texas Transportation Code §546.006).
	4. Individual military vehicles and convoys (considering the technological and personnel limitations of operating the toll project) (Texas Transportation Code §362.901). • Clearly identifiable military vehicles may use the electronic tolling lanes. • Military vehicles that are not clearly identifiable should use the collector lane and "sign through" on a log maintained by the collector. • Military vehicles that are not clearly identifiable will not be allowed free passage on toll roads where there are no collector lanes.
	5. Vehicles that are part of a funeral procession, provided that: • HCTRA is notified at least 24 hours in advance; • HCTRA's Director determines that it is in the interest of public safety that the procession be routed onto the toll road system; • The procession is escorted by certified peace officers; and • The procession enters and exits the toll road system outside of these hours: Monday through Friday – 6:00 AM to 9:00 AM. and 4:00 PM to 7:00 PM.
	6. Processions and motorcades for heads-of-state and dignitaries (if the procession/motorcade is escorted by the United States Secret Service, Texas Department of Public Safety, or other law enforcement agency responsible for safety and security).
	7. Harris County owned/leased vehicles while used in the performance of County business.
Individuals	1. Current federal and state military members with Military ID are permitted free passage through collector lanes. • Requires presenting valid military ID and signing a non-revenue sheet. • Free passage not available on Toll Roads with no collector lanes or through combination collector/electronic tolling lanes if vehicle is equipped with an EZ TAG device.
	2. HCTRA employees who must incur a toll to access or depart their duty stations at Hardy North Toll Plaza, Hardy South Toll Plaza, Sam Houston North Toll Plaza, and Sam Houston South Toll Plaza.
	3. HCTRA employees assigned to the Sam Houston Toll Bridge or Sam Houston East Plaza, whose route to work includes crossing the Toll Bridge are permitted sign through privileges for the Toll Bridge.
	4. HCTRA employees who must use the Toll Roads on HCTRA-related business (during working hours) in their private vehicles are permitted sign-through privileges upon presentation of proper authorization.

Table 4-6: Toll Road Fee Exceptions

Category	Description
Circumstances	The Commissioners Court authorizes free passage on the Toll Roads when there is sufficient notice of an impending catastrophic event. When the emergency or event is unexpected or unforeseen, authority is delegated to persons in the best position to exercise informed judgment as outlined below: • **Large-scale emergency or calamity:** The County Judge is authorized to permit free passage on part or all of the Toll Roads when a large-scale emergency or calamity (natural or man-made) threatens public safety and necessitates the immediate evacuation or relocation of large numbers of people that may obstruct or impede rapid movement on the Toll Roads. • **Localized emergency or condition:** In the event of a localized emergency or condition (such as refinery explosions, gas leaks, hazardous material spills, flooding, traffic accidents, lane closures, etc.) that substantially threatens public safety and mobility, an on-site Incident Management certified peace officer may permit limited free passage for a period of no more than one hour. Approval of the County Judge, Executive Director of Harris County Public Infrastructure, or the Director of HCTRA must be obtained to extend free passage beyond the initial one-hour period. • **Lane and/or road closures:** When closures required for construction and maintenance of the Toll Roads are expected to substantially and adversely affect traffic flow and/or threaten public safety, free passage may be permitted by the Director of HCTRA, the Executive Director of Harris County Public Infrastructure, or their designee. • **Ramp tolls:** HCTRA may elect to not collect tolls at ramps on dates or during hours where the Director concludes that the amount of vehicle traffic at those ramps and the tolls likely to be collected do not justify the cost of assigning collectors during those times. • **Opening a new road project or segment:** HCTRA's Director may designate a time period where free passage may be permitted to allow for testing of the infrastructure supporting the toll collection process. If the test period needs to exceed 45 days, HCTRA's Director should obtain authorization from Commissioners Court to extend the test period.

Source: HCTRA 2014a.

It should be noted that a specific tolling authority for the proposed SH 99 Segment B has not been determined at the present time. Per Senate Bill 1420, TxDOT has the authority to select a tolling entity to govern tolling policies and rules specifically for the proposed SH 99 Segment B. The selection of a toll entity is currently ongoing and has yet to be determined.

In addition and consistent with the Texas Transportation Commission Minute Order No. 82325 (signed October 25, 1984), the entire Grand Parkway would serve as an additional hurricane and emergency evacuation route for the Greater Houston area. In order to alleviate congestion during mass evacuations and create safer, more efficient evacuation conditions, tolls on the Grand Parkway would be suspended during hurricane evacuation.

Anticipated Toll Rate

The anticipated toll rate for the Grand Parkway project (all segments) would be a schedule of rates that would not exceed the average per mile toll rates for electronic toll transactions in force and effect for the HCTRA-operated toll road system. The current toll rates are identified in ***Table 4-7***. The initial toll rate may be higher or lower and may increase in later years. Toll rate increases would require approval from the Commissioners Court.

Table 4-7: HCTRA Toll Rates

Vehicle Axles	Mainline Plaza
2 axle	$1.45 EZ Tag $1.75 Cash
3 axle	$3.50
4 axle	$5.25
5 axle	$7.00
6 axle	$8.75

Source: HCTRA 2014a.

Methods of Toll Collection

Tolls would be collected using only an ETC system. No toll booths are proposed, and therefore, no cash payment would be accepted. The ETC system requires that users of the toll road have a toll tag that registers on the ETC system as the vehicles pass under the toll gantry. The ETC equipment would be placed on toll gantries positioned at specific locations along the mainlanes and at certain ramps.

The ETC system allows participating motorists to prepay their tolls using a major credit/debit card or direct debit payment option. A small adhesive transponder (i.e., toll tag) that communicates electronically with a computer via radio frequencies is affixed to the inside of the windshield. As motorists use the facility, tolls are electronically deducted from their pre-paid account. When an account reaches the minimum balance level, it automatically charges (i.e., debits) the customer's credit card or bank account to bring it back to the original deposit amount. A cash payment option is currently not available. It has also yet to be determined what requirements would exist for account maintenance.

Motorists using the toll road without a toll tag would be charged via the video tolling system. The ETC video records a photograph of the vehicle’s license plate, and a monthly invoice would be mailed to the registered owner of the vehicle. The assessed toll fee for the motorists is higher than that for toll tag users, and an additional collection fee is included on the monthly invoices. The tolling program allows infrequent users without a transponder/toll tag to travel the toll road without having to stop and pay. The video tolling method is more expensive for users who do not have an active toll account because fees associated with billing and handling of the periodic billing statements are added to the costs.

Any EZ TAG account set up with a toll facility operator in Texas would be able to access toll roads or managed lanes in any of the toll authority areas, while having the tolls charged to the user’s home account. To achieve the objective, toll tags or transponders issued by a toll authority in one area of the state would be capable of registering toll transactions to the user’s home toll account. Users from other states or international drivers would be billed similarly to users without toll tags.

The EZ TAG program requires an initial prepayment of $40 for credit/debit card payment, and $80 for funds directly deducted from a bank, plus a $15 per-tag activation fee for the first three TAGs and $10 per tag thereafter. Monthly statements for the previous 18 months of an account usage are available at no

charge with an online account, or printed statements may be mailed. ***Table 4-8*** lists the associated fees for enrolling in the EZ TAG program.

Table 4-8: EZ Tag Fees

Number of Vehicle(s)	Pre-Paid Deposit	Balance at which Replenishment Required (¼ of Deposit)	Activation Fee (per EZ TAG)
1 - 3	$40	$10	$15
4 - 6	$80	$20	$10
7 - 9	$120	$30	$10
Etc.	Maximum $600 (or optional higher balance)	Maximum $150 (or ¼ of optional higher balance)	$10

Source: HCTRA 2014b.

The user would be required to set up a prepaid account that would automatically transfer funds from their credit card or bank account to the toll account. The minimum account balance is determined by the type of payment used for the account as well as the number of EZ TAGs on the account. The typical credit card-backed account with one to three EZ TAGs has a required replenishment amount of $40 and a low balance amount of $10. As a motorist travels through the EZ TAG lanes and the account goes to $10 or below, the credit/debit card will automatically be charged $40 per the EZ Agreement.

The typical bank account EZ account with one to three EZ TAGs has a required replenishment amount of $80 and a low balance amount of $20. Similarly, if the balance falls below $20, the system will automatically replenish the EZ TAG account to the $80 minimum. Frequent toll road users would see multiple replenishment charges on their bank account in a month. A $25.00 fee is applied to each rejected withdraw from the bank account. If a bank charge fails after three consecutive attempts or three times in a 12-month period, a credit card would be required as the primary form of payment. Currently, cash accounts are not accepted to maintain an EZ TAG. Toll accounts issued by other Texas transportation entities, such as the TxTag and Texas Toll Tag, would be accepted on the EZ TAG system.

Toll Booth Locations

As the Grand Parkway is proposed as an all-electronic toll road with no cash payments, no toll booths are being considered. The mainlane toll gantries would span both directions of travel on a structure similar to a typical sign bridge. The gantry would support ETC reader units, video enforcement system cameras, illumination devices, automatic vehicle identification antennae, communications gear, and other necessary equipment. The equipment would be supported approximately 20 feet above the roadway surface and would be used to collect electronic toll data. Similar, smaller gantries would be needed at some ramps as well, except the gantries would only span the width of the particular entrance or exit ramp. The exact location of the toll gantries (ramps and mainlane) would be determined during final design. Advantages of the ETC system include the following elements.

- The system minimizes the amount of ROW needed for the proposed toll collection facilities because additional lanes for cash toll booths and parking and other facilities for toll attendants would not be required.
- The gantry minimizes the acceleration and deceleration of traffic that usually accompanies toll booth collections because cash would not be accepted.
- Last-minute lane changes between toll and cash lanes would not occur, providing smoother traffic conditions at toll collection locations.
- Lighting impacts would be minimized because the gantries would not require any lighting beyond typical roadway-specific lighting for the video enforcement cameras.

Since the ETC system does not require the installation of toll booths, there would be no disproportionate impact to EJ communities regarding toll booth placement.

Tolling and Environmental Justice

H-GAC's evaluation to determine the effects of tolling the proposed SH 99 Segment B on EJ populations used the travel demand model in conjunction with the 2010 Census blocks and block groups that contained 51 percent or more of minority and/or low-income populations. Once the EJ blocks and block groups were identified, EJ TAZs were established if 50 percent or more of its area was identified as an EJ population. ***Exhibit 4-3*** shows the EJ-related demographic data for the TAZs within the proposed SH 99 Segment B study area. Of the 88 TAZs within the study area (71 in Brazoria County and 17 in Galveston County), 21 are identified as EJ TAZs (23 in Brazoria County and three in Galveston County). The proposed SH 99 Segment B would traverse through or along the border of four EJ TAZs in Brazoria County.

Following the identification of the EJ TAZs, the *2035 RTP* Build network scenario and the *2035 RTP* No-Build network scenario were utilized to conduct travel time evaluations for persons within the EJ TAZs and non-EJ TAZs. The Build scenario includes the new tolled lanes, managed lanes, and HOT projects identified in the *2035 RTP Update*. The No-Build scenario includes the current roadway network, the fiscally-constrained *2035 RTP Update* roadway network, and the existing plus the committed managed lane system (e.g., BW 8), but the scenario excludes the proposed SH 99 Segment B.

Travel Demand Assumptions and Methodology

The region's travel demand model does not provide a means for tracking travel at an individual household level, but the model does provide a means for tracking travel at a zonal level. For purposes of analysis, the zones are specified as either EJ zones or non-EJ zones based on the socioeconomic characteristics of the zonal populations. Some regional travel models employ a generalized cost assignment procedure for toll analyses. The H-GAC models perform toll analyses at the mode choice level. Hence, the H-GAC travel demand model uses a multi-class assignment procedure, rather than a generalized cost procedure.

The mode choice models are applied by trip purpose. For the mode choice toll analyses, two travel time estimates are developed from each zone to all other zones:

- The travel time using both toll and non-toll links (commonly referred to as "toll path" travel times), and
- The travel time using only non-toll links (commonly referred to as the "free path" travel time).

In the mode choice model, if the toll path does not offer a shorter travel time between two zones than the free path travel time, the trip is not considered a "candidate" for the toll facility. If a trip can save travel time using a toll path over a free path, then it is considered a "candidate" trip. Of course, not all candidate trips will choose to use a tolled path. The probability of a candidate trip using a tolled path is a function of a number of variables, such as the magnitude of the potential travel time savings, the toll costs, and the income characteristics of the zone's residents. Aspects of the approach are employed in the analyses presented.

In mode choice model applications, a single highway network is used to estimate the travel times for toll paths and free paths. For the regional toll analyses, there are two networks as noted earlier: the "Build" network (i.e., the forecasted roadway network containing the subject toll facilities) and the "No-Build" network (i.e., the network containing all the forecasted roadways except the proposed SH 99 Segment B). Existing and committed toll facilities are contained in both networks. In the analytical setting, simply comparing the toll path option versus the free path option would not identify the candidate trips for only the new toll facilities being studied. Indeed, such a grouping would include trips using both existing and proposed toll facilities.

To focus on candidate trips for the new toll facility, the travel time for toll paths in the Build network is compared to the toll path travel time in the No-Build network. Trips that have a shorter toll path travel time in the Build network than the toll path travel time in the No-Build network are defined as candidate trips for the new toll facilities. The trips for a given trip purpose are segmented into four groups:

- Trips produced by EJ zones that are classified as "Candidate" trips;
- The remaining trips produced by EJ zones that are classified as non-"Candidate" trips;
- Trips produced by non-EJ zones that are classified as "Candidate" trips; and
- The remaining trips produced by non-EJ zones that are classified as non-"Candidate" trips.

In summary, assumptions and limitations specifically for the proposed SH 99 Segment B project-level toll analysis are as follows.

- The model is based on the latest adopted H-GAC 2035 household and employment forecast as of November 2011 (Household and employment numbers are used for trip generation only, not population).

- The model was validated to 2005 traffic counts within acceptable industry and H-GAC standards.
- The model includes all system expansions as listed in the *2035 RTP Update*, and the "No-Build" scenario removes only the segment (i.e., the proposed SH 99 Segment B) being tested.
- The model uses the same H-GAC 2035 household and employment forecast for both the "Build" and "No-Build" scenarios.

For the analysis, an EJ zone is any TAZ that meets the minimum criteria as defined under Title VI. The model does not use separate individual households. All travels in the model from households in an EJ zone are assumed to be EJ, regardless of their individual income levels or composition. The model's trip generation step does consider a household's income level as a factor for trip generation. The general assumption is that higher income households tend to make more trips.

The modeling analysis includes only direct home-based work (HBW) trips and home-based, non-work (HBNW) trips. Non-home-based trips (i.e. "trip chains") are not included in the analysis. The H-GAC model includes non-home-based trips for travel demand forecasting, but for the project-level EJ analysis, only HBW and HBNW trips are used.

Results

To determine the time analysis for the different types of trip scenarios, trips were divided into HBW and HBNW for both tolled and free facilities. ***Table 4-9*** lists the number of HBW and HBNW trips under the proposed SH 99 Segment B.

Using toll path travel times and free path travel times from the Build and No-Build networks, there are four travel times for each type of trip (e.g., HBW and HBNW):

- The Build network-toll path option;
- The Build network-free path option;
- The No-Build network-toll path option; and
- The No-Build network free path option.

By computing the average trip lengths (ATLs) for each of the four options, the impacts of the two networks on the choice options can be quantified, compared, and analyzed.

Table 4-9: Potential Person Trips in the EJ and Non-EJ Zones

Zone	2035 HBW Person Trips			2035 HBNW Person Trips		
	Toll Candidate	Non-Candidate	Total	Toll Candidate	Non-Candidate	Total
EJ Zone	470,692	2,180,287	2,650,979	268,338	6,142,685	6,411,023
Percent of Total	**17.8%**	**82.2%**	N/A	**4.2%**	**95.8%**	N/A
Non-EJ Zone	698,143	2,408,955	3,107,098	413,411	6,416,788	6,830,199
Percent of Total	**22.5%**	**77.5%**	N/A	**6.1%**	**93.9%**	N/A

Source: H-GAC 2011.

Notes: EJ = Environmental Justice; HBW = home-based work trips; HBNW = home-based, non-work trips; N/A = not applicable; % = percent.

As shown in ***Table 4-9***, approximately 18 percent of the HBW trips identified within EJ zones would be toll candidates. Additionally, nearly 23 percent HBW trips identified within non-EJ zones would be toll candidates. Of the HBNW trips, approximately 4 percent of the trips identified within EJ zones would be toll candidates, and roughly 6 percent of the HBNW trips identified within non-EJ zones would be toll candidates.

Utilizing the data, further evaluation was conducted to determine the free path travel and tolled travel path for both the Build and No-Build network scenarios. The ATL in minutes was the measure used in the evaluation for both types of trips within the EJ and non-EJ zones.

The results of the HBW and HBNW trips analysis for the proposed SH 99 Segment B are presented in ***Table 4-10*** and ***Table 4-11***.

Table 4-10: AM Peak HBW Trips for Build and No-Build Scenarios[1]

Zones	2035 HBW Trip Scenarios	2035 HBW Trips	Build Network		No-Build Network		Difference: Tolled Facility[2]	Difference: Free Facility[2]
			ATL: Tolled Facility	ATL: Free Facility	ATL: Tolled Facility	ATL: Free Facility		
EJ Zone	New tolled facility: trips that save 0+ minutes	470,692	45.25 minutes	51.73 minutes	46.30 minutes	51.64 minutes	0.45 minute	-0.09 minute
	New tolled facility: trips that cannot save 0+ minutes	2,180,287	29.21 minutes	30.18 minutes	29.15 minutes	30.12 minutes	-0.06 minute	-0.06 minute
Non-EJ Zone	New tolled facility: trips that save 0+ minutes	698,143	62.49 minutes	70.68 minutes	63.21 minutes	70.43 minutes	0.72 minute	-0.25 minute
	New tolled facility: trips that cannot save 0+ minutes	2,408,955	36.20 minutes	37.51 minutes	36.10 minutes	37.41 minutes	-0.10 minute	-0.10 minute

Source: H-GAC 2011.

[1] AM Peak Average Trip Length (ATL) in minutes for free and tolled facilities under the Build and No-Build network scenarios.

[2] No-Build ATL minutes minus Build ATL minutes (differences are in AM peak ATL in minutes).

Notes: EJ = Environmental Justice; HBW = home based work trips.

Table 4-11: AM Peak HBNW Trips for Build and No-Build Scenarios[1]

Zones	2035 HBNW Trip Scenarios	2035 HBNW Trips	Build Network		No-Build Network		Difference: Tolled Facility[2]	Difference: Free Facility[2]
			ATL: Tolled Facility	ATL: Free Facility	ATL: Tolled Facility	ATL: Free Facility		
EJ Zone	New tolled facility: trips that save 0+ minutes	268,338	34.21 minutes	36.30 minutes	34.45 minutes	36.35 minutes	0.24 minute	0.05 minute
	New tolled facility: trips that cannot save 0+ minutes	6,142,685	15.91 minutes	16.00 minutes	15.90 minutes	15.99 minutes	-0.01 minute	-0.01 minute
Non-EJ Zone	New tolled facility: trips that save 0+ minutes	413,411	52.09 minutes	55.51 minutes	53.01 minutes	55.83 minutes	0.92 minute	0.32 minute
	New tolled facility: trips that cannot save 0+ minutes	6,416,788	24.92 minutes	25.10 minutes	24.82 minutes	24.99 minutes	-0.10 minute	-0.11 minute

Source: SH 99 Segment B Study Team 2014.

[1] AM Peak Average Trip Length (ATL) in minutes for free and tolled facilities under the Build and No-Build network scenarios.

[2] No-Build ATL minutes minus Build ATL minutes (differences are in AM peak ATL in minutes).

Notes: EJ = Environmental Justice; HBNW = home-based, non-work trips.

The results for the HBW and HBNW trip analysis indicate the following conclusions.

- The addition of the proposed SH 99 Segment B to the regional roadway network under the Build scenario would result in a minor reduction of travel time in the EJ and Non-EJ zones for HBW and HBNW trips.
- While the users of the toll facility under the Build scenario within the EJ zones would receive a greater time savings benefit than the users on the free network, there would be no appreciable change in travel time on the free network in the EJ and Non-EJ zones. As a result, there would be no potential for a disproportionate negative effect to the EJ populations from the proposed SH 99 Segment B. In fact, the entire region, including the EJ zones, would experience a benefit in travel time savings because of the added capacity that the entire toll roadway network facilities would provide to the regional roadway network. Also see the regional toll analysis in ***Section 5.6*** and ***Section 6.2*** of the FEIS.

Potential Economic Impact

Potential economic impacts to individuals using the proposed SH 99 Segment B can be illustrated using the 2010 HCTRA toll rates and the median household income for the study area. Currently, the low, mid-range, and high toll rates are 12.3, 20.0, and 33.6 cents per mile, respectively. The potential cost per household calculations assumes that a toll road user would make 500 trips (250 round-trips) per year along the toll way from SH 288 to IH 45 South. ***Table 4-12*** presents the annual cost and percentage of income used for low, mid-range, and high toll rates would be approximately $1,722, $2,800, and $4,704, respectively.

Table 4-12: Potential Economic Impact for Brazoria and Galveston Counties

Toll Range	Toll Rate Per Mile[1]	Trips Per Year	Miles Per Trip	Total Cost Per Year	Median HH Income[2]	Median HH Income[3]	Poverty Level Income[4]
Low	$0.123	500	28	$1,722	2.5%	3.0%	7.2%
Mid-range	$0.20	500	28	$2,800	4.1%	5.0%	12.0%
High	$0.336	500	28	$4,704	7.0%	8.0%	20.0%

Source: H-GAC 2011.

[1] Per HCTRA 2012 toll rates.

[2] The 2012 median household income for Brazoria County is $68,008.

[3] The 2012 median household income for Galveston County is $61,555.

[4] The 2014 Health and Human Services poverty guideline level is $23,850 for a family of four.

Notes: HCRTA = Harris County Toll Road Authority; HH = household; % = percent.

A user with an annual household income that would be equal to the 2012 median Brazoria County household income of $68,008 would spend 2.5, 4.1, and 7.0 percent of their household income on tolls. Galveston County users with a 2012 median household income of $61,555 would spend 3.0, 5.0, and 8.0 percent of their income on tolls. Users with an annual household income that falls within the U.S.

Department of Health and Human Services poverty level of $23,850 would spend 7.2, 12.0, and 20.0 percent of their household income on tolls.

Assuming the same level of use, low-income populations would pay a larger percentage of their income in tolls when compared to the general population. If toll costs are beyond the affordability of low-income travelers, the travelers would have the alternative of using the existing non-tolled transportation network. As a result, potential users who are unable to afford the toll or maintain a toll tag would be denied the travel benefit (reduced travel time) associated with using the tolled facility.

Availability of Tolling Information

The HCTRA website provides information regarding the EZ TAG, toll road network, toll charges or violations, and safety on the toll roads. Currently, the website is only available in English, but toll road users can purchase toll tags and access information on Houston area toll roads (including the Grand Parkway) in Spanish on the TxTag website at www.txtag.org. The TxTag website also provides contact information for the deaf and hard of hearing ([TDD/TTY] 1-866-590-5155).

The state-owned Grand Parkway system is covered by the provisions of Section 504 of the Americans with Disability Act providing services and programs in the most integrated setting appropriate to the needs of qualified individuals with disabilities and making all reasonable modifications in policies, practices, and procedures to avoid discrimination on the basis of disability in accordance with department rules and regulations.

No-Build Alternative Impacts

The No-Build Alternative would not result in disproportionately high or adverse impacts to EJ populations. Under the No-Build Alternative, the entire community, including minority and low-income populations, would not experience displacements, noise, air quality, and construction impacts related to construction and operation of the Preferred Alternative. However, the community would also not experience the benefits of decreased traffic congestion, improved mobility, a new evacuation route, and improved safety conditions resulting from the Preferred Alternative.

4.3.5 Limited English Proficiency

Executive Order 13166, *Improving Access to Services for Persons with Limited English Proficiency*, requires agencies to examine the services they provide, identify any need for services to those with LEP, and develop and implement a system to provide those services so that LEP persons can have meaningful access to the services.

The most detailed LEP data are available at the Census block group level. The data were used for analysis of the Preferred Alternative. According to 2008 to 2012 ACS data, approximately 8.6 percent of persons residing within the 19 Census block group area speak English less than “very well,” which is considered LEP. The LEP language distribution is 79.5 percent Spanish, 4.1 percent Indo-European, 15.3 percent Asian and Pacific Islander, and 1.0 Other.

Table 4-13 shows that Spanish is the dominant language of the LEP populations. Accommodations for individuals speaking Spanish were made at the public meetings and hearings. During the field investigation within the proposed SH 99 Segment B study area, no signs or other indicators were observed in languages other than English. Census Tract 6616.02, Block Group 2, and Census Tract 6618, Block Group 2, both reported an LEP population over 20 percent, which is more than double the LEP averages for Brazoria and Galveston Counties. Displacement of two residential homes (Map ID #7 and 8 on ***Exhibit 4-1a***), an electric tower, and a business (Map ID #49 on ***Exhibit 4-1a***) are expected to occur in Census Tract 6618, Block Group 2. Potential noise impacts are anticipated to occur in Census Tract 6616.02, Block Group 2.

Table 4-13 provides the LEP population for the counties, Census tracts, and Census block groups associated with the Preferred Alternative.

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Table 4-13: LEP Census Tract and Census Block Group Populations under the Preferred Alternative

Geographic Area	Limited English Proficiency			Percent Composition LEP by Language			
	Total Population Sampled	LEP	Percent LEP	Spanish	Indo-European	Asian/Pacific	Other
Brazoria County	289,310	22,434	7.8	79.7	4.8	14.4	0.80
Galveston County	272,873	18,360	6.7	81.3	5.1	12.9	0.50
Affected Census Tracts and Census Block Groups							
6611	2,867	276	9.6	100.0	0.0	0.0	0.0
6611, Block Group 1	1,533	181	11.8	100	0.0	0.0	0.0
6611, Block Group 2	1,334	95	7.1	100	0.0	0.0	0.0
6612	3,471	182	5.2	87.4	0.0	12.6	0.0
6612, Block Group 1	1,185	1	0.1	0.0	0.0	100.0	0.0
6612, Block Group 2	553	36	6.5	83.3	0.0	16.7	0.0
6612, Block Group 3	1,733	129	8.4	89	0.0	11	0.0
6614	6,108	371	6.1	100.0	0.0	0.0	0.0
6614, Block Group 4	735	35	4.8	100	0.0	0.0	0.0
6615.02	4,423	195	4.5	83.1	9.2	7.7	0.0
6615.02, Block Group 1	1,035	118	4.1	72.0	15.3	12.7	0.0
6616.01	5,690	439	7.7	96.6	3.4	0.0	0.0
6616.01, Block Group 2	1,035	129	12.5	100	0.0	0.0	0.0
6616.01, Block Group 3	878	15	1.7	0.0	100.0	0.0	0.0
6616.01, Block Group 4	2,736	153	5.6	100	0	0.0	0.0
6616.02	3,634	600	16.5	89.8	10.2	0.0	0.0
6616.02, Block Group 1	962	61	6.3	0.0	100.0	0.0	0.0
6616.02, Block Group 2	2,672	539	**20.2**	100	0.0	0.0	0.0
6617	2,392	85	3.6	100.0	0.0	0.0	0.0
6617, Block Group 3	653	35	5.4	100	0.0	0.0	0.0

Table 4-13: LEP Census Tract and Census Block Group Populations under the Preferred Alternative

Geographic Area	Limited English Proficiency			Percent Composition LEP by Language			
	Total Population Sampled	LEP	Percent LEP	Spanish	Indo-European	Asian/Pacific	Other
6618	6,182	740	11.9	59.1	0.0	36.3	4.6
6618, Block Group 2	3,065	618	**20.2**	51	0.0	43.5	5.5
6619	12,099	924	7.6	87.9	0.0	12.1	0.0
6619, Block Group 1	3,073	413	13.4	72.9	0.0	27.1	0
7206	2,556	544	4.9	76.1	8.1	15.8	0.0
7206, Block Group 1	1,779	41	2.3	100	0.0	0.0	0.0
7206, Block Group 2	9,141	503	5.5	74.2	8.7	17.1	0.0
7207	8,342	748	8.9	61.1	14.2	24.7	0.0
7207, Block Group 3	2,844	262	9.2	100	0.0	0.0	0.0
7208	3,414	208	6.1	91.3	0.0	8.6	0.0
7208, Block Group 2	849	18	2.1	0	0.0	100.0	0.0
12 Census Tract Total/Average	**61,178**	**5,312**	**7.6**	**81.4**	**4.6**	**16.4**	**0.8**
19 Census Block Group Total/Average	**36,671**	**3,398**	**8.6**	**79.5**	**4.1**	**15.4**	**1.0**

Source: U.S. Census 2014 (2008-2012 ACS, Table B16001).

Notes: Bold indicates a high LEP population. LEP = limited English proficiency; % = percent.

Opportunities for community input in the NEPA process have been and will continue to be provided. Further described in ***Section 8*** of the FEIS, two public meetings were held at ACC in Alvin on September 12, 2002, and February 25, 2003. A Public Hearing on two separate nights was also held in August 2012 at Alvin High School in Alvin and the Johnnie Arolfo Civic Center in League City.

The meetings and hearing were announced in local newspapers, and meeting/hearing notices and newsletters were mailed to elected officials, government agencies, local organizations, civic groups, the media, businesses, and interested citizens. The Public Hearing and availability of the FEIS were also announced in a Spanish-language newspaper. All meeting materials were provided in English and Spanish. TxDOT has attempted to address issues of concern expressed at the Public Hearing and meetings throughout the development of the FEIS.

To comply with Executive Order 12898, a notice in English and Spanish that announced the availability of the DFEIS was published in local newspapers on June 6, 2012, to allow the public (including minority and low-income individuals and populations) the opportunity to comment on the proposed SH 99 Segment B. A notice was published in English and Spanish announcing the Public Hearing in July and August 2012.

No-Build Alternative Impacts

The No-Build Alternative would not result in direct impacts to LEP individuals or populations.

4.3.6 Population Age Distribution

Age distribution is evaluated to identify environmentally sensitive populations, such as children (0 to19 years old) and the elderly (60 years and older). Age distribution was examined for each individual Census tract. During the field investigation, it was determined that no eldercare facilities or schools would be within the proposed ROW of the Preferred Alternative (see ***Table 3-5*** in ***Section 3.3.3.1*** of the FEIS).

As listed in ***Table 4-14***, none of the 12 Census tracts (12 Census Tract Area) that intersect with the Preferred Alternative contain more than a 50 percent population of children or seniors.

Table 4-14: Population Age Characteristics of the 12 Census Tract Area

Census Tract	Under 5 Years Old	5-14 Years Old	15-19 Years Old	45-64 Years Old	65 Years and Older
CT 6611.00	7.5%	16.3%	6.0%	19.9%	7.4%
CT 6612.00	8.2%	12.7%	7.0%	22.8%	11.8%
CT 6614.00	7.3%	14.4%	7.1%	24.5%	11.2%
CT 6615.02	2.4%	14.9%	8.3%	32.0%	10.3%
CT 6616.01	6.8%	15.4%	11.5%	24.1%	9.1%
CT 6616.02	7.1%	23.6%	4.8%	20.1%	6.0%
CT 6617.00	3.5%	13.1%	10.2%	33.6%	13.0%
CT 6618.00	5.8%	17.3%	8.6%	28.5%	8.4%
CT 6619.00	3.1%	6.6%	3.8%	36.9%	5.5%
CT 7206.00	9.9%	17.9%	5.0%	22.0%	4.3%
CT 7207.00	5.9%	14.1%	7.2%	26.2%	8.6%
CT 7208.00	7.6%	14.4%	3.2%	27.3%	14.8%

Source: U.S. Census 2014 (2008-2012 ACS, Table S0101).

Notes: Age distribution information for ages 20 to 44 was not included because the ages are not defined as environmentally sensitive. % = percent.

Because the Preferred Alternative would cause displacements and potential noise impacts, it is expected that seniors and children could be directly impacted by the Preferred Alternative. As discussed in ***Sections 4-3 and 4-7*** of the FEIS, impacts are evaluated, and mitigation measures would be in place to provide assistance with locating and purchasing replacement housing and business locations affected by relocations. If feasible and reasonable, mitigation for traffic noise would be provided to those that would be impacted by the Preferred Alternative.

No-Build Alternative Impacts

The No-Build Alternative would not result in direct impacts to age distribution or environmentally sensitive populations in the study area.

4.4 ECONOMICS

4.4.1 Property Tax Revenue

Long-term economic effects of the Preferred Alternative would include the permanent removal of taxable property (for ROW acquisition) in Brazoria and Galveston Counties from the tax rolls of local government entities and ISDs. ***Table 3-12*** presents the major taxing jurisdictions within the proposed SH 99 Segment B study area where ROW would be required. ROW needed for the Preferred Alternative would total 1,080 acres, 688 acres in Brazoria County and 392 acres in Galveston County. Approximately

236 parcels in Brazoria County and 46 parcels in Galveston County would have some right of way impact.

The largest direct loss of future tax revenues as a result of ROW acquisition would be to the major taxing jurisdictions. Based on the average market value per acre provided by the Brazoria and Galveston County appraisal districts for parcels that may be acquired, the total estimated value of the proposed ROW would be approximately $51,316,627 in Brazoria County and approximately $3,089,156 in Galveston County. Furthermore, the Preferred Alternative would result in an estimated loss of about $136,729 from Brazoria County and $79,988 from Galveston County in annual property tax revenues. The loss is based on a combined 2012 to 2013 tax rate (County, City, and School taxes) of $2.66472 per $100 taxable value for Brazoria County and $2.556915 per $100 taxable value for Galveston County.

In the long term, the loss of taxable property may be expected to be offset by increased values of land adjacent to the Preferred Alternative as new development occurs. In addition, new businesses that may develop adjacent to the Preferred Alternative would generate new employment opportunities, income potential, sales tax, and other business tax revenues.

No-Build Alternative Impacts

The No-Build Alternative is not expected to affected property tax revenues.

4.4.2 Employment and Income during Construction

Construction of the Preferred Alternative would have direct, indirect, and induced effects on local, regional, and state employment, output, and income. Direct effects would include those arising from purchases made by the new highway construction sector. Direct costs would be wages and salaries paid to workers directly engaged in constructing the Preferred Alternative, as well as capital costs for equipment, materials, and supplies during construction. Induced effects of the Preferred Alternative would be generated by the consumption of goods and services made possible by the payrolls associated with construction. Indirect effects would be the sum of all the rounds of purchases by the interrelated sectors of the state's economy (including direct, induced, and all additional effects), beginning with those that supply the suppliers of the new highway construction sector. Indirect effects would distribute throughout the economy with each round of purchases.

The number of construction-related jobs would vary depending on the phasing of Preferred Alternative construction. Regardless of the phasing, the local economy would likely experience a temporary increase in spending by construction employees at businesses and restaurants in the vicinity of the Preferred Alternative during construction. Local employment would not be expected to be adversely impacted, as roadway construction activities would create new job opportunities and income potential in the area over the short term.

The economic effects of the Preferred Alternative are estimated by using the Texas State Office of the Comptroller's input/output model and the Regional Economic Model, Inc., which have multipliers for

final demand, employment, and income related to highway construction. When multiplied by the total construction cost of the Preferred Alternative, the factors produce estimates of the economic impacts of construction on a statewide basis. The proportion of economic effects retained locally depends on capturing local materials and labor during the construction process. ***Table 4-15*** shows the total employment, additional income, and statewide effect from the Preferred Alternative.

Table 4-15: Estimates of Economic Effects from Construction of the Preferred Alternative

	Income (millions)			Employment			Statewide Final Demand (billions)
	Direct	Indirect	Total (Billion)	Direct	Indirect	Total	
Preferred Alternative	$347.1	$695.8	$1.0	16,699	16,202	32,901	$3.3

Source: Texas State Office of Comptroller 2014.

Overall, the Preferred Alternative would have a beneficial effect on income and employment in and around the proposed SH 99 Segment B study area and for the larger regional economy.

No-Build Alternative Impacts

The No-Build Alternative would provide some additional short-term employment opportunities through income generated by current planned improvements to roadways within the study area. However, the increase in employment would not be as extensive or for as long of a period of time as under the Preferred Alternative.

4.4.3 Long-term Employment Growth

Implementation of the Preferred Alternative would provide additional access within the study area and would likely induce growth and development in the long term. Undeveloped tracts of land adjacent to the Preferred Alternative would likely be developed in the future. Undeveloped areas that were previously inaccessible (or had limited access) may be developed to accommodate new land uses and development, such as residential and commercial uses/development. It would be anticipated that any induced development would occur gradually. New businesses would provide additional employment opportunities, income potential, and business and sales tax revenues in the study area. The Preferred Alternative, if implemented, may help to facilitate the economic growth expected to occur throughout the study area.

The projected increase in employment as a result of the Preferred Alternative was discussed in the June 2012 DFEIS document. The Preferred Alternative would facilitate and possibly accelerate projected employment growth within some TAZs because of improved mobility and accessibility within the study area.

No-Build Alternative Impacts

As discussed, the study area is expected to continue to develop. Under the No-Build Alternative, the rate of growth and development would likely occur more slowly because of the lack of roadway access to some undeveloped areas.

4.5 PEDESTRIANS AND BICYCLISTS

Pedestrian and bicycle facilities were identified within and adjacent to the Preferred Alternative, as illustrated on ***Exhibit 3-5*** and described in ***Section 3.5*** of the FEIS. The Preferred Alternative would not impact existing pedestrian or bicycle facilities. Overpasses would typically be constructed where the Preferred Alternative would intersect with an existing roadway; therefore, pedestrian or bicycle facilities associated with the existing roadways would not be impacted by construction of the Preferred Alternative. Pedestrian and bicycle facilities are not planned to be constructed as part of the Preferred Alternative, as they are not allowed on this type of roadway.

Construction and operation of the Preferred Alternative would not disrupt the use or expansion of existing pedestrian or bicycle facilities in the study area. Although traffic congestion may increase as additional development occurs outside the Preferred Alternative ROW, the Preferred Alternative would not interfere with the planning or installation of additional pedestrian or bicycle facilities in the study area.

No-Build Alternative Impacts

The No-Build Alternative would not result in direct impacts to any pedestrian or bicycle facilities in the study area.

4.6 AIR QUALITY

4.6.1 Preferred Alternative Impacts

The proposed action is consistent with H-GAC's financially constrained *2040 RTP* and the *2015-2018 TIP*, as amended, which were initially found to conform to the TCEQ State Implementation Plan (SIP) by FHWA and FTA on September 11, 2015 and December 2, 2014, respectively. Copies of the *RTP* and *TIP* pages are included in ***Appendix A***. All projects in the *2015-2018 TIP* that are proposed for federal or state funds were initiated in a manner consistent with federal guidelines in Section 450, of Title 23 CFR and Section 613.200, Subpart B, of Title 49 CFR.

4.6.1.1 Carbon Monoxide Traffic Air Quality Analysis

Traffic volume projections for the design year 2035 for the Preferred Alternative's would range from 5,638 to 26,525 vpd. A prior TxDOT modeling study and previous analyses of similar projects demonstrated that it is unlikely that a carbon monoxide (CO) standard would ever be exceeded as a result of any project with average annual daily traffic below 140,000. The average annual daily traffic projections for the project do not exceed 140,000 vpd; therefore a Traffic Air Quality Analysis was not required.

4.6.1.2 Congestion Management Process

The CMP is a systematic process for managing congestion that provides information on transportation systems performance and on alternative strategies for alleviating congestion and enhancing the mobility of persons and goods to levels that meet state and local needs. The project was developed from H-GAC's operational CMP, which meets all requirements of 23 CFR 500.109. The CMP was adopted by H-GAC on January 25, 2013.

The region commits to operational improvements and travel demand reduction strategies at two levels of implementation: program level and project level. Program-level commitments are inventoried in the regional CMP, which was adopted by H-GAC. These commitments are included in the financially constrained *2040 RTP*, and future resources are reserved for implementation of the projects.

The CMP element of the plan carries an inventory of all project commitments (including those resulting from major investment studies) that details type of strategy, implementing responsibilities, schedules, and expected costs. At the project's programming stage, travel demand reduction strategies and commitments will be added to the regional TIP or included in the construction plans. The regional TIP provides for programming of projects at the appropriate time with respect to the SOV facility implementation and project-specific elements.

Committed congestion reduction strategies and operational improvements within the study boundary will consist of roadway widening, HOV widening, new highway construction, roadway rehabilitation, grade separation, interchange improvements, ROW acquisitions, relocations, utility adjustments, and traffic flow improvements. Individual projects are listed in ***Table 4-16***.

Table 4-16: Operational Improvements in the Travel Corridor

Street	From Location	To Location	Project Description	Project Status
CR 185	SH 6	CR 35	Widen to two-lane rural with shoulders and new location two-lane rural	T
CR 181	SH 6	CR 179	Reconstruct and widen to four-lane	L
FM 528	BS 35/Gordon Street	SH 6	Extend FM 528 across Gordon Street (SH 35B) to SH 6	L
FM 528	Davis Bend Road	FM 1462	Extend roadway two lanes on new location and along CR 284	L
SH 288	CR 58	SH 99	Construct four toll lanes	L
SH 288	Brazoria County Line	FM 518	Widen from six to eight lanes	T

Table 4-16: Operational Improvements in the Travel Corridor

Street	From Location	To Location	Project Description	Project Status
SH 35	South of FM 1462	FM 2403	Add auxiliary lane	T
SH 35	Bellfort Avenue	FM 1462	Construct controlled-access toll facility	L

Source: H-GAC 2015.

Notes: CR = County Road; FM = Farm-to-Market; L = Long Range 2025-2040 RTP; T= TIP; S = Short Range 2017-2024 RTP; SH = State Highway.

In an effort to reduce congestion and the need for SOV lanes in the region, TxDOT and H-GAC will continue to promote appropriate congestion reduction strategies through the Congestion Mitigation and Air Quality program, the CMP, and the *2040 RTP*. The congestion reduction strategies considered for this project would help alleviate congestion in the SOV study area boundary, but would not eliminate it.

Therefore, the proposed project is justified. The CMP analysis for added SOV capacity projects in the Transportation Management Area (TMA) is on file and available for review at H-GAC.

4.6.1.3 Hot Spot Analysis

The project is not located within a CO and particulate matter nonattainment or maintenance area; therefore, a project-level hot spot analysis is not required.

4.6.1.4 Project-specific MSAT Information

A qualitative analysis provides a basis for identifying and comparing the potential differences among MSAT emissions, if any, from the various alternatives. The qualitative assessment presented below is derived in part from a study conducted by the FHWA entitled *A Methodology for Evaluating Mobile Source Air Toxic Emissions among Transportation Project Alternatives*, found at http://www.fhwa.dot.gov/environment/air_quality/air_toxics/research_and_analysis/mobile_source_air_toxics/msatemissions.pdf

For each alternative in this document, the amount of MSAT emitted would be proportional to the vehicle miles traveled, or VMT, assuming that other variables such as fleet mix are the same for each alternative. The VMT estimated for each of the Build Alternatives is slightly higher than that for the No Build Alternative, because the additional capacity increases the efficiency of the roadway and attracts rerouted trips from elsewhere in the transportation network. This increase in VMT would lead to higher MSAT emissions for the preferred action alternative along the highway corridor, along with a corresponding decrease in MSAT emissions along the parallel routes. The emissions increase is offset somewhat by lower MSAT emission rates due to increased speeds; according to EPA's MOVES2010b model, emissions of all of the priority MSAT decrease as speed increases. Because the estimated VMT under each of the Alternatives are nearly the same, varying by less than 5 percent, it is expected there would be no appreciable difference in overall MSAT emissions among the various alternatives. Also, regardless of

the alternative chosen, emissions will likely be lower than present levels in the design year as a result of EPA's national control programs that are projected to reduce annual MSAT emissions by over 80 percent between 2010 and 2050. Local conditions may differ from these national projections in terms of fleet mix and turnover, VMT growth rates, and local control measures. However, the magnitude of the EPA-projected reductions is so great (even after accounting for VMT growth) that MSAT emissions in the study area are likely to be lower in the future in nearly all cases.

The additional travel lanes contemplated as part of the project alternatives will have the effect of moving some traffic closer to nearby homes, schools, and businesses; therefore, under each alternative there may be localized areas where ambient concentrations of MSAT could be higher under certain Build Alternatives than the No Build Alternative. The localized increases in MSAT concentrations would likely be most pronounced along the expanded roadway sections that would be built. However, the magnitude and the duration of these potential increases compared to the No-Build alternative cannot be reliably quantified due to incomplete or unavailable information in forecasting project-specific MSAT health impacts. In sum, when a highway is widened, the localized level of MSAT emissions for the Build Alternative could be higher relative to the No-Build Alternative, but this could be offset due to increases in speeds and reductions in congestion (which are associated with lower MSAT emissions). Also, MSAT will be lower in other locations when traffic shifts away from them. However, on a regional basis, EPA's vehicle and fuel regulations, coupled with fleet turnover, will over time cause substantial reductions that, in almost all cases, will cause region-wide MSAT levels to be significantly lower than today.

4.6.1.5 Incomplete or Unavailable Information for Project-Specific MSAT Health Impacts Analysis

In FHWA's view, information is incomplete or unavailable to credibly predict the project-specific health impacts due to changes in MSAT emissions associated with a proposed set of highway alternatives. The outcome of such an assessment, adverse or not, would be influenced more by the uncertainty introduced into the process through assumption and speculation rather than any genuine insight into the actual health impacts directly attributable to MSAT exposure associated with a proposed action.

The EPA is responsible for protecting the public health and welfare from any known or anticipated effect of an air pollutant. They are the lead authority for administering the Clean Air Act and its amendments and have specific statutory obligations with respect to hazardous air pollutants and MSAT. The EPA is in the continual process of assessing human health effects, exposures, and risks posed by air pollutants. They maintain IRIS, which is "a compilation of electronic reports on specific substances found in the environment and their potential to cause human health effects" (EPA, http://www.epa.gov/iris/). Each report contains assessments of noncancerous and cancerous effects for individual compounds and quantitative estimates of risk levels from lifetime oral and inhalation exposures with uncertainty spanning perhaps an order of magnitude.

Other organizations are also active in the research and analyses of the human health effects of MSAT, including the HEI. Two HEI studies are summarized in Appendix D of FHWA's Interim Guidance

Update on Mobile source Air Toxic Analysis in NEPA Documents. Among the adverse health effects linked to MSAT compounds at high exposures are; cancer in humans in occupational settings; cancer in animals; and irritation to the respiratory tract, including the exacerbation of asthma. Less obvious is the adverse human health effects of MSAT compounds at current environmental concentrations (HEI, http://pubs.healtheffects.org/view.php?id=282) or in the future as vehicle emissions substantially decrease (HEI, http://pubs.healtheffects.org/view.php?id=306).

The methodologies for forecasting health impacts include emissions modeling; dispersion modeling; exposure modeling; and then final determination of health impacts – each step in the process building on the model predictions obtained in the previous step. All are encumbered by technical shortcomings or uncertain science that prevents a more complete differentiation of the MSAT health impacts among a set of project alternatives. These difficulties are magnified for lifetime (i.e., 70 year) assessments, particularly because unsupportable assumptions would have to be made regarding changes in travel patterns and vehicle technology (which affects emissions rates) over that time frame, since such information is unavailable.

It is particularly difficult to reliably forecast 70-year lifetime MSAT concentrations and exposure near roadways; to determine the portion of time that people are actually exposed at a specific location; and to establish the extent attributable to a proposed action, especially given that some of the information needed is unavailable.

There are considerable uncertainties associated with the existing estimates of toxicity of the various MSAT, because of factors such as low-dose extrapolation and translation of occupational exposure data to the general population, a concern expressed by HEI (http://pubs.healtheffects.org/view.php?id=282). As a result, there is no national consensus on air dose-response values assumed to protect the public health and welfare for MSAT compounds, and in particular for diesel PM. The EPA (http://www.epa.gov/risk/basicinformation.htm#g) and the HEI (http://pubs.healtheffects.org/getfile.php?u=395) have not established a basis for quantitative risk assessment of diesel PM in ambient settings.

There is also the lack of a national consensus on an acceptable level of risk. The current context is the process used by the EPA as provided by the Clean Air Act to determine whether more stringent controls are required in order to provide an ample margin of safety to protect public health or to prevent an adverse environmental effect for industrial sources subject to the maximum achievable control technology standards, such as benzene emissions from refineries. The decision framework is a two-step process. The first step requires EPA to determine an “acceptable” level of risk due to emissions from a source, which is generally no greater than approximately 100 in a million. Additional factors are considered in the second step, the goal of which is to maximize the number of people with risks less than 1 in a million due to emissions from a source. The results of this statutory two-step process do not guarantee that cancer risks from exposure to air toxics are less than 1 in a million; in some cases, the residual risk determination could result in maximum individual cancer risks that are as high as approximately 100 in a million. In a

June 2008 decision, the U.S. Court of Appeals for the District of Columbia Circuit upheld EPA's approach to addressing risk in its two step decision framework.

Information is incomplete or unavailable to establish that even the largest of highway projects would result in levels of risk greater than deemed acceptable. Because of the limitations in the methodologies for forecasting health impacts described, any predicted difference in health impacts between alternatives is likely to be much smaller than the uncertainties associated with predicting the impacts. Consequently, the results of such assessments would not be useful to decision makers, who would need to weigh this information against project benefits, such as reducing traffic congestion, accident rates, and fatalities plus improved access for emergency response, that are better suited for quantitative analysis.

Conclusion

In this document, a qualitative MSAT assessment has been provided relative to the various alternatives of MSAT emissions and has acknowledged that the Preferred Alternative of the project alternatives may result in increased exposure to MSAT emissions in certain locations, although the concentrations and duration of exposures are uncertain, and because of this uncertainty, the health effects from these emissions cannot be estimated.

4.6.1.6 Air Quality Construction Emissions Reduction Strategies

During the construction phase of this project, temporary increases in air pollutant emissions may occur from construction activities. The primary construction-related emissions would be particulate matter (fugitive dust) from site preparation. These emissions are temporary in nature (only occurring during actual construction); it is not possible to reasonably estimate impacts from these emissions due to limitations of the existing models. However, the potential impacts of particulate matter emissions will be minimized by using fugitive dust control measures such as covering or treating disturbed areas with dust suppression techniques, sprinkling, covering loaded trucks, and other dust abatement controls, as appropriate.

The construction activity phase of this project may generate a temporary increase in MSAT emissions from construction activities, equipment, and related vehicles. The primary MSAT construction-related emissions would be particulate matter from site preparation and diesel particulate matter from diesel powered construction equipment and vehicles. The Texas Emissions Reduction Plan includes incentive programs to encourage the development of multi-pollutant approaches to ensure that the air in Texas is both safe to breathe and meets minimum federal standards. TxDOT encourages construction contractors to utilize this program to the fullest extent possible to minimize diesel emissions. Information about the Texas Emissions Reduction Plan program can be found at: http://www.tceq.state.tx.us/ implementation/air/terp/.

However, considering the temporary and transient nature of construction-related emissions, as well as the mitigation actions to be utilized, it is not anticipated that emissions from construction of this project would have any significant impact on air quality in the area.

4.6.2 No-Build Alternative Impacts

Under the No-Build Alternative, additional air emissions may be associated with the increased congestion on existing local roadways. Current trends of improving air quality for criteria pollutants and MSAT region-wide would be expected to continue regardless of the Build or No-Build Alternative.

4.7 NOISE

The traffic noise analysis was accomplished in accordance with TxDOT's (FHWA-approved) *Guidelines for Analysis and Abatement of Roadway Traffic Noise*, dated April 2011 (TxDOT 2011). A 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; and
- Consideration and evaluation of measures to reduce noise impacts.

FHWA has established the following NAC for various land use activity areas that are used as one of two means to determine when a traffic noise impact will occur (***Table 4-17***).

Table 4-17: FHWA NAC Criteria

Activity Category	dB(A) L_{eq}	Description of Land Use Activity Areas
A	57 (exterior)	Lands on which serenity and quiet are of extraordinary 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)	Residential
C	67 (exterior)	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f sites, schools, television studios, trails, and trail crossings.
D	52 (interior)	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E	72 (exterior)	Hotels, motels, offices, restaurants/bars, and other developed lands, properties, or activities not included in A through D or F.
F	--	Agricultural, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	--	Undeveloped lands that are not permitted.

Source: TxDOT 2011.

A noise impact would occur when either the absolute or relative criterion is met.

- Absolute criterion: The predicted noise level at a receiver approaches, equals, or exceeds the FHWA NAC (***Table 4-17***). "Approach" is defined as one dB(A) below the NAC. For example: a noise impact would occur at a Category B residence if the noise level is predicted to be 66 dB(A) 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 (Table 1). "Substantially exceeds" is defined as more than 10 dB(A). For example: a noise impact would occur at a Category B residence if the existing level is 54 dB(A) and the predicted level is 65 dB(A) (11 dB(A) increase).

When a traffic noise impact occurs, noise abatement measures must be considered. A noise abatement measure is any positive action taken to reduce the impact of traffic noise on an activity area.

Traffic noise modeling was performed using the FHWA's approved Traffic Noise Model 2.5 (TNM). The model was used to calculate existing and predicted traffic noise levels at receiver locations that represent the land use activity areas adjacent to the Preferred Alternative that might be impacted by traffic noise and potentially benefit from feasible and reasonable noise abatement. The noise model primarily considers the number, type, and speed of vehicles; highway alignment and grade; cuts, fills, and natural berms; surrounding terrain features; and the locations of activity areas likely to be impacted by the associated traffic noise.

Table 4-18 lists the existing and predicted traffic noise levels within the proposed SH 99 Segment study area. ***Exhibit 4-4*** marks the location of the 81 designated receivers.

Table 4-18: Traffic Noise Levels (dB(A) L_{eq})

Representative Receiver		NAC Category	NAC Level	Existing	Site Locations	Predicted 2035	Change (+/-)	Noise Impact
R1	Residence	B	67	42	2	48	+6	No
R2	Residence	B	67	52	3	51	-1	No
R3	Residence	B	67	52	3	58	+6	No
R4	Residence	B	67	52	3	49	-3	No
R5	Residence	B	67	52	3	60	+8	No
R6	Residence	B	67	52	3	62	+10	No
R7	Residence	B	67	52	3	63	+11	Yes
R8	Residence	B	67	52	3	49	-3	No
R9	Residence	B	67	52	3	58	+6	No

Table 4-18: Traffic Noise Levels (dB(A) L_{eq})

Representative Receiver		NAC Category	NAC Level	Existing	Site Locations	Predicted 2035	Change (+/-)	Noise Impact
R10	Residence	B	67	52	3	62	+10	No
R11	Residence	B	67	52	3	60	+8	No
R12	Residence	B	67	52	3	59	+7	No
R13	Residence	B	67	52	3	57	+5	No
R14	Residence	B	67	52	3	59	+7	No
R15	Residence	B	67	52	3	59	+7	No
R16	Residence	B	67	43	4	52	+9	No
R17	Residence	B	67	43	4	54	+11	Yes
R18	Residence	B	67	43	4	49	+6	No
R19	Residence	B	67	43	4	54	+11	Yes
R20	Residence	B	67	43	4	60	+17	Yes
R21	Residence	B	67	43	4	57	+14	Yes
R22	Residence	B	67	43	4	52	+9	No
R23	Residence	B	67	43	4	59	+16	Yes
R24	Residence	B	67	43	4	49	+6	No
R25	Residence	B	67	43	4	57	+14	Yes
R26	Residence	B	67	43	4	60	+17	Yes
R27	Residence	B	67	43	4	54	+11	Yes
R28	Residence	B	67	43	4	60	+17	Yes
R29	Residence	B	67	43	4	50	+7	No
R30	Residence	B	67	43	4	50	+7	No
R31	Residence	B	67	43	4	57	+14	Yes
R32	Residence	B	67	43	4	62	+19	Yes
R33	Residence	B	67	43	4	57	+14	Yes
R34	Residence	B	67	43	4	56	+13	Yes
R35	Residence	B	67	43	4	52	+9	No
R36	Residence	B	67	43	4	52	+9	No
R37	Residence	B	67	43	4	52	+9	No
R38	Residence	B	67	43	4	56	+13	Yes
R39	Residence	B	67	43	4	57	+14	Yes
R40	Residence	B	67	43	4	53	+10	No

Table 4-18: Traffic Noise Levels (dB(A) L_{eq})

Representative Receiver		NAC Category	NAC Level	Existing	Site Locations	Predicted 2035	Change (+/-)	Noise Impact
R41	Residence	B	67	43	4	51	+8	No
R42	Residence	B	67	43	4	51	+8	No
R43	Residence	B	67	43	4	55	+12	Yes
R44	Residence	B	67	43	4	48	+5	No
R45	YMCA Pool	C	67	55	6	53	-2	No
R46	Residence	B	67	64	8	60	-4	No
R47	Apartments	B	67	64	8	67	+3	Yes
R48	Apartments	B	67	64	8	66	+2	Yes
R49	Apartments	B	67	64	8	67	+3	Yes
R50	Apartments	B	67	64	8	65	+1	No
R51	Residence	B	67	64	8	64	0	No
R52	Apartments	B	67	64	8	68	+4	Yes
R53	Apartments	B	67	64	8	68	+4	Yes
R54	Apartments	B	67	58	10	56	-2	No
R55	Hotel Pool	E	72	64	11	63	-1	No
R56	Hotel Pool	E	72	64	11	63	-1	No
R57	Hotel Pool	E	72	64	11	62	-2	No
R58	Hotel Pool	E	72	64	11	60	-4	No
R59	Cemetery	C	67	64	11	66	+2	Yes
R60	Cemetery	C	67	64	11	67	+3	Yes
R61	Residence	B	67	64	11	64	0	No
R62	Residence	B	67	60	12	58	-2	No
R63	Church	D	52	40	12	38	-2	No
R64	Residence	B	67	51	13	57	+6	No
R65	Residence	B	67	51	13	55	+4	No
R66	Residence	B	67	51	13	66	+15	Yes
R67	Residence	B	67	51	13	65	+14	Yes
R68	Residence	B	67	51	13	64	+13	Yes
R69	Residence	B	67	51	13	63	+12	Yes
R70	Residence	B	67	51	13	63	+12	Yes
R71	Residence	B	67	55	14	56	+1	No

Table 4-18: Traffic Noise Levels (dB(A) L_{eq})

Representative Receiver		NAC Category	NAC Level	Existing	Site Locations	Predicted 2035	Change (+/-)	Noise Impact
R72	Residence	B	67	55	14	55	0	No
R73	Residence	B	67	55	14	55	0	No
R74	Residence	B	67	55	14	55	0	No
R75	Residence	B	67	55	14	57	+2	No
R76	Residence	B	67	55	14	60	+5	No
R77	Residence	B	67	51	13	64	+13	Yes
R78	Residence	B	67	51	13	63	+12	Yes
R79	Residence	B	67	51	13	54	+3	No
R80	Residence	B	67	51	13	53	+2	No
R81	Residence	B	67	57	15	59	+2	No

Source: SH 99 Segment B Study Team 2014.

Notes: See Table 3-14 for site locations used to represent existing noise levels for representative receivers of similar location. dB(A) = a-weighted decibels; L_{eq} = sound level equivalent; NAC = noise abatement criteria; R = receiver.

As indicated in ***Table 4-18***, the Preferred Alternative would result in a traffic noise impact, and the following noise abatement measures were considered: traffic management, alteration of horizontal and/or vertical alignments, acquisition of undeveloped property to act as a buffer zone, and the construction of noise barriers.

Before any abatement measure can be proposed for incorporation into the proposed SH 99 Segment B, it must be both feasible and reasonable. In order to be "feasible," the abatement measure must be able to reduce the noise level at greater than 50 percent of impacted, first row receivers by at least 5 dB(A); and to be "reasonable," it must not exceed the cost-effectiveness criterion of $25,000 for each receiver that would benefit by a reduction of at least 5 dB(A), and the abatement measure must be able to reduce the noise level of at least one impacted, first row receiver by at least 7 dB(A).

Traffic management: Control devices could be used to reduce the speed of the traffic; however, the minor benefit of 1 dB(A) per 5 mph reduction in speed does not outweigh the associated increase in congestion and air pollution. Other measures such as time or use restrictions for certain vehicles are prohibited on state highways.

Alteration of horizontal and/or vertical alignments: Any alteration of the existing alignment would displace existing businesses and residences, require additional ROW and not be cost effective/reasonable.

Buffer zone: The acquisition of undeveloped property to act as a buffer zone is designed to avoid rather than abate traffic noise impacts and, therefore, is not feasible.

Noise barriers are the most commonly used noise abatement measure. Noise barriers were evaluated for each of the impacted receiver locations.

Noise Barriers – Not Feasible

Noise barriers would not be feasible and reasonable for any of the following impacted receivers and, therefore, are not proposed for incorporation into the Preferred Alternative.

R7, R17, R19, R20-R21, R23, R25, and R26-R28: These receivers each represent a single residence with driveways facing the roadway. A continuous noise barrier would restrict access to these residences. Gaps in a noise barrier would satisfy access requirements but the resulting non-continuous barrier segments would not be sufficient to achieve the minimum feasible noise reduction of 5 dB(A) or the noise reduction design goal of 7 dB(A).

R31: This receiver represents 3 residences with a driveway facing the roadway. A continuous noise barrier would restrict access to these residences. Gaps in a noise barrier would satisfy access requirements but the resulting non-continuous barrier segments would not be sufficient to achieve the minimum feasible noise reduction of 5 dB(A) or the noise reduction design goal of 7 dB(A).

R32: This receiver represents 2 residences with a driveway facing the roadway. A continuous noise barrier would restrict access to these residences. Gaps in a noise barrier would satisfy access requirements but the resulting non-continuous barrier segments would not be sufficient to achieve the minimum feasible noise reduction of 5 dB(A) or the noise reduction design goal of 7 dB(A).

R33-R34, R38-R39, and R43: These receivers each represent a single residence with driveways facing the roadway. A continuous noise barrier would restrict access to these residences. Gaps in a noise barrier would satisfy access requirements but the resulting non-continuous barrier segments would not be sufficient to achieve the minimum feasible noise reduction of 5 dB(A) or the noise reduction design goal of 7 dB(A).

R47 to R48: These receivers represent a total of four apartment buildings. The apartment buildings have multiple driveways facing the Preferred Alternative. A continuous noise barrier would restrict access to these residences. Gaps in a noise barrier would satisfy access requirements but the resulting non-continuous barrier segments would not be sufficient to achieve the reasonable noise reduction design goal of at least 7 dB(A) at one receiver with a minimum noise reduction of at least 5 dB(A) at greater than 50 percent of the first row benefitted receivers.

Noise Barriers - Feasible

Noise barriers would be feasible and reasonable for the following impacted or representative receivers and, therefore, are proposed for incorporation into the Preferred Alternative (***Table 4-19***).

R49 and R50: The receivers represent a total of four apartment buildings. Three of the apartment buildings have four apartments facing the Preferred Alternative and one apartment building has two apartments facing the Preferred Alternative, for a total of 14 apartments. Based on preliminary calculations, a segmented noise barrier 650 feet in total length and 20 feet in height would reduce noise levels by at least 7 dB(A) at one receiver with a minimum of at least 5 dB(A) at greater than 50 percent of the first row benefited receivers at a total cost of $234,000 or $16,714 for 14 benefited receivers.

R52 and R53: The receivers represent a total of two apartment buildings with four apartments facing the Preferred Alternative per building and an entryway facing the Preferred Alternative. Based on preliminary calculations, a segmented noise barrier 246 feet in total length and 8 feet in height would reduce noise levels by at least 7 dB(A) at one receiver with a minimum of at least 5 dB(A) at greater than 50 percent of the first row benefited receivers at a total cost of $35,424 or $8,856 for four benefited receivers.

R59 and R60: The receivers represent a cemetery of approximately 1,149 feet adjacent to the proposed SH 99 Segment B. For the cemetery, a residential lot width of 80 feet was used to estimate 14 receptors. Based on preliminary calculations, a noise barrier 1,126 feet in total length and 12 feet in height would reduce noise levels by at least 7 dB(A) at one receiver with a minimum of at least 5 dB(A) at greater than 50 percent of the first row benefited receivers at a total cost of $243,216 or $17,373 for 14 benefited receivers.

R66 to R70: The receivers represent a total of 24 residences. Based on preliminary calculations, a noise barrier 2,088 feet in length and 14 feet in height would reduce noise levels by at least 7 dB(A) at one receiver with a minimum of at least 5 dB(A) at greater than 50 percent of the first row benefited receivers at a total cost of $526,176 or $23,917 for 22 benefited receivers.

R77 to R81: The receivers represent a total of 39 residences. Based on preliminary calculations, a noise barrier 2,143 feet in length and 18 feet in height would reduce noise levels by at least 7 dB(A) at one receiver with a minimum of at least 5 dB(A) at greater than 50 percent of the first row benefited receivers at a total cost of $694,332 or $18,766 for 37 benefited receivers. This barrier is located on land owned by the county, city, utility district, or home owners association and is to be considered for use for proposed mitigation.

Table 4-19: Traffic Noise Barrier Proposal (Preliminary)

Barrier	Segment	Representative Receivers	Total # Benefited	Length (feet)	Height (feet)	Total Cost	$/Benefited Receiver
1	3	R49-R50	14	650	20	$234,000	$16,714
2	1	R52-R53	4	246	8	$35,424	$8,856
3	-	R59-R60	14	1,126	12	$243,216	$17,373
4	-	R66-R70	22	2,088	14	$526,176	$23,917
5	-	R77-R81	37	2,143	18	$694,332	$18,766

Source: SH 99 Segment B Study Team 2014.

Notes: $ = dollar; # = number; R = receiver; Segment = number of divisions/gaps between a barrier (–) is no division/gap.

Any subsequent project design changes may require a reevaluation of the noise barrier proposal. The final decision to construct the proposed noise barrier would not be made until after the completion of the proposed SH 99 Segment B design, utility evaluation, and polling of adjacent property owners.

To avoid noise impacts that may result from future development of properties adjacent to the Preferred Alternative, local officials responsible for land use control programs must ensure, to the maximum extent possible, no new activities are planned or constructed along or within the following predicted (2035) noise impact contours.

Table 4-20: Traffic Noise Impact Contours

Undeveloped Area	Land Use	Impact Contour	Distance from ROW
SH 99 (Segment B) between SH 288 and FM 192	NAC B and C	66 dB(A)	Inside proposed ROW
SH 99 (Segment B) between SH 288 and FM 192	NAC E	71 dB(A)	Inside proposed ROW
SH 99 (Segment B) between FM 192 and Wheeler Drive	NAC B and C	66 dB(A)	10 feet
SH 99 (Segment B) between FM 192 and Wheeler Drive	NAC E	71 dB(A)	Inside proposed ROW
SH 99 (Segment B) between SH 35 and Calder Drive	NAC B and C	66 dB(A)	Inside proposed ROW
SH 99 (Segment B) between SH 35 and Calder Drive	NAC E	71 dB(A)	Inside proposed ROW

Source: SH 99 Segment B Study Team 2014.

Notes: dBA = a-weighted decibels; FM = Farm-to-Market NAC = noise abatement criteria; ROW = right-of-way; SH = State Highway.

Noise associated with the construction of the Preferred Alternative is difficult to predict. Heavy machinery, the major source of noise in construction, is constantly moving in unpredictable patterns. However, construction normally occurs during daylight hours when occasional loud noises are more tolerable. None of the receivers are expected to be exposed to construction noise for a long duration; therefore, any extended disruption of normal activities is not expected. Provisions will be included in the

plans and specifications that require the contractor to make every reasonable effort to minimize construction noise through abatement measures such as work-hour controls and proper maintenance of muffler systems. A copy of this traffic noise analysis will be made available to local officials to ensure, to the maximum extent possible, future developments are planned, designed, and programmed in a manner that would avoid traffic noise impacts. On the date of approval of the FEIS (Date of Public Knowledge), Galveston and Brazoria counties and TxDOT are no longer responsible for providing noise abatement for new development adjacent to the Preferred Alternative.

No-Build Alternative Impacts

The No-Build Alternative would not cause short-term impacts to noise in or around the proposed SH 99 Segment B study area. However, congestion would continue to increase in the study area, which would cause an increase in traffic noise levels in the area.

4.8 WATER QUALITY

4.8.1 Surface Water

Stormwater discharges are generated by runoff from land and impermeable surface areas, such as paved streets and roadways, parking lots, and driveways during rainfall events. Potential effects of the Preferred Alternative on surface water quality would generally occur from construction-related activities, roadway and bridge runoff, and maintenance-related work associated with long-term operation of the Preferred Alternative.

The Preferred Alternative would cross four larger streams and numerous smaller streams and drainages. According to the TCEQ's Texas Water Quality Inventory, stream segments that would be crossed by the Preferred Alternative include Chocolate Bayou Above Tidal, Dickinson Bayou Above Tidal, Geisler Bayou, and Mustang Bayou. Chocolate Bayou Above Tidal and Dickinson Bayou Above Tidal are classified surface water bodies, while Geisler Bayou and Mustang Bayou are unclassified water bodies. Geisler Bayou is included in TCEQ's 2012 303(d) List, but the other segments are not listed (TCEQ 2014b). TCEQ's water quality concern for Geisler Bayou is depressed dissolved oxygen levels. Therefore, this segment was determined to not meet the standards for the life uses evaluated. Construction of the Preferred Alternative would not delay restoration of this impaired stream segment to meet use classifications.

Proposed crossings of Chocolate, Dickinson, Geisler, and Mustang bayous would be bridged, while the smaller streams and drainages would be crossed by either bridge structures or the installation of culverts. The Preferred Alternative would result in the construction of approximately 461 acres of impervious cover in the form of travel lanes, entrance and exit ramps, and frontage roads, which would increase the volume of stormwater runoff generated within the proposed ROW of the Preferred Alternative. The remaining area of the proposed ROW would be vegetated primarily with herbaceous species. The Preferred Alternative would result in short-term (construction-related) and long-term surface water

quality impacts. Prior to construction of the proposed project, TxDOT would coordinate with the TCEQ regarding Geisler Bayou, which is included in the 303(d) List of impaired water bodies.

4.8.2 Short-term Water Quality Impacts

The Texas Pollutant Discharge Elimination System (TPDES) program implements the federal National Pollutant Discharge Elimination System program. TCEQ administers stormwater permits for construction projects disturbing at least 1 acre within the state. The Preferred Alternative would disturb more than 1 acre of land, thereby requiring the preparation of a Storm Water Pollution Prevention Plan (SW3P). In addition, because the Preferred Alternative would disturb more than 5 acres, a Notice of Intent (NOI) for coverage under the TPDES Construction General Permit (CGP) would also be required. Once construction has been completed, a Notice of Termination would be filed per permit requirements. Lastly, in accordance with Clean Water Act Section 402, where stormwater runoff would discharge to a Municipal Separate Storm Sewer System (MS4), the MS4 permittee would be notified of the construction activity.

As noted, a SW3P would be developed for the Preferred Alternative in accordance with TxDOT policies, and measures would be taken to prevent or correct erosion that may develop during construction. Guidance documents, such as TxDOT's *Storm Water Management Guidelines for Construction Activities*, discuss temporary erosion control measures to be implemented to minimize impacts to water quality during construction (TxDOT 2002). The Preferred Alternative would use both temporary and permanent erosion control practices from TxDOT's *Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges* (TxDOT 2004). The practices would be in place prior to and during the construction period and would be maintained throughout construction of the Preferred Alternative.

Temporary soil erosion and sedimentation controls may include the use of silt fencing, temporary berms, inlet protection barriers, hay bales, seeding or sodding of bare areas, or other suitable means of containment. Temporary erosion control structures would be installed where appropriate before construction begins and would be maintained throughout construction of the Preferred Alternative. During construction, the amount of cleared or non-vegetated soils would be restricted to minimize additional erosion and sedimentation. When construction is completed, disturbed areas would be restored according to TxDOT specifications. Mitigation for all impacts mentioned above would include TxDOT best management practices (BMPs) that have been designed to limit water quality degradation from construction activities. Contractors would take appropriate measures to prevent or minimize and control hazardous material spills in construction assembly areas. Removal and disposal of waste materials by the contractors would be in compliance with applicable federal and state guidelines and laws.

4.8.3 Long-term Water Quality Impacts

Long-term operational effects on surface water quality would include changes in the volume of rainfall runoff and constituents carried in the runoff. Generally, runoff would contain sediment or pollutants in quantities that could impact water quality. For example, runoff from paved surfaces would carry particulate matter from tire wear and oils and greases from vehicles, and would be expected to include

urban litter, such as paper and plastic goods. There is also the possibility of collisions on any roadway, regardless of operating characteristics and traffic volumes. Collisions can contribute to pollutants being conveyed in stormwater runoff, as a minimal amount of spilled chemicals would run off or be flushed into adjacent drainageways.

Although construction of the Preferred Alternative would result in approximately 461 acres of impervious cover, the Preferred Alternative would represent a small fraction (approximately 0.12 percent) of the total area of the watersheds traversed by the Preferred Alternative. While localized runoff contributed by the Preferred Alternative may represent an increase compared to existing conditions, the percentage increase in total runoff from the watersheds would be minimal. Stormwater runoff from the Preferred Alternative would likely have little adverse effect on area receiving waters, as vegetated swales and retention/detention facilities would collect the runoff before it enters a receiving water. Vegetated swales promote settling of suspended solids and infiltration of runoff into the soil and thus, for some constituents, may also lead to reduced concentrations. A reduction in the volume of pollutants would result in a reduced pollutant load potentially conveyed in the stormwater runoff. Vegetated swales are effective because of their wide adaptability, low costs, and minimal maintenance requirements.

Construction, operation, and maintenance activities associated with the Preferred Alternative would not adversely impact water quality in the proposed SH 99 Segment B study area. BMPs implemented during construction and operation would reduce the introduction of pollutants into receiving waters. Construction of the Preferred Alternative would not result in contamination to or adverse effect on a public water supply, as potable water sources are typically obtained from underground aquifers rather than from surface water sources.

No-Build Alternative Impacts

The No-Build Alternative would have no impacts to existing surface water quality conditions. However, the No-Build Alternative would not provide improvements, protection measures, or BMPs to reduce impacts to existing water resources and water quality. As a result, stormwater runoff would continue to flow directly to receiving waters within the study area.

4.8.4 Groundwater

Brazoria and Galveston Counties are underlain by the major Gulf Coast aquifer. The Gulf Coast aquifer is broken up into layers that include the Chicot, Evangeline, Jasper, and Catahoula aquifers and the Burkesville confining layer. The majority of water from the Gulf Coast aquifer is for public, agricultural, and industrial uses. The aquifer has not been designated by the EPA as a sole-source aquifer.

Impacts on groundwater quality from the Preferred Alternative would be related to stormwater discharges from both construction and operation. During construction, spills would be mainly limited to fuels (i.e., petrochemicals) and lubricants used for construction equipment. Impacts to groundwater quality because of surface spills would be minimized by the characteristically low permeability of the clayey soils and clay substrate and spill prevention measures. Described further in ***Section 4.17*** of the FEIS, the Preferred

Alternative would require the removal of underground storage tanks because of the displacements of gas stations. Possible impacts due to removal of underground storage tanks along the Preferred Alternative ROW are discussed in ***Section 4.17***, Hazardous Materials.

Undeveloped land provides a natural filtering function, absorbing precipitation and slowly releasing it into the ground. The increase of approximately 461 acres of impermeable surface area resulting from construction of the Preferred Alternative would represent a minimal reduction in undeveloped land when compared to the large contiguous areas of undeveloped land within the watersheds traversed by the Preferred Alternative that would remain available to absorb and filter precipitation.

During construction, appropriate measures would be implemented to prevent, minimize, and/or control hazardous materials spills in construction assembly areas. Removal and disposal of materials by the contractor would be conducted in accordance with applicable federal and state regulations and laws in order to not degrade groundwater quality. As detailed in the previous section, stormwater control measures and BMPs would be implemented so that construction and operation of the Preferred Alternative would have minimal, if any, impact to regional groundwater resources.

No-Build Alternative Impacts

The No-Build Alternative would have no direct impacts to groundwater resources within the proposed SH 99 Segment B study area.

4.8.5 Public Drinking Water Systems

All public water supply systems are eligible to participate in the Source Water Protection Program. According to data reviewed from TCEQ's Public Water Supply Section, Alvin and Friendswood are enrolled in the Wellhead Protection Program (TCEQ 2014e). Appropriate precautions, such as establishment of BMPs, would be implemented to avoid impact to waters in the Wellhead Protection Program.

Potential impacts to water supply wells were assessed using data gathered from TCEQ and TWDB databases. Results of a water well review for the Preferred Alternative indicate that a total of five public water supply wells would occur within 0.25 mile of the Preferred Alternative ROW. Two wells would be within the proposed ROW of the Preferred Alternative and would be directly impacted. ***Table 4-21*** details the five public water supply wells that would be within or adjacent to the Preferred Alternative.

Table 4-21: Public Water Supply Wells Located within 0.25 Mile of the Preferred Alternative

Well ID	Owner	Aquifer	Well Depth (feet)	Approximate Distance from Preferred Alternative (feet)
6538903	FKR Enterprise	Chicot	0	110
6538904	Southmeadows Sections	Chicot	170	1,259
6539710	Texas American Water	Chicot, Upper	170	1,320

Table 4-21: Public Water Supply Wells Located within 0.25 Mile of the Preferred Alternative

Well ID	Owner	Aquifer	Well Depth (feet)	Approximate Distance from Preferred Alternative (feet)
6546313	Red Oak 102	Chicot	500	Within ROW
6546504	Alvin Food Mart #2	Chicot	132	Within ROW

Source: TWDB 2014.

Notes: ID = identification; ROW = right-of-way.

Additional results of the water well review indicate that a total of eight private water wells would be located within 0.25 mile of the Preferred Alternative ROW. One well would be directly impacted by the Preferred Alternative. ***Table 4-22*** details the private water supply wells that would be within or adjacent to the Preferred Alternative.

Table 4-22: Private Water Supply Wells Located within 0.25 Mile of the Preferred Alternative

Well ID	Owner	Primary Use	Aquifer	Well Depth (feet)	Approximate Distance from Preferred Alternative (feet)
6539703	Gulf Oil Corp.	Industrial	Chicot	155	178
6540119	Parker Brothers	Domestic	Chicot	457	1,314
6540403	McCarthy Drilling Co.	Industrial	Gulf Coast	731	120
6546312	Everybody Welcome Bar	Unused	Chicot	180	Within ROW
6539701	Phillips Petroleum Co.	Unused	Chicot, Upper	156	420
6545305	Jack Aaron	Industrial	Chicot	133	820
6546305	Rowan Drilling Co.	Unused	Chicot, Lower	485	140
6546307	Gulf Coast CMA	Unused	Chicot, Lower	550	578

Source: TWDB 2013.

Notes: The water wells included in the table do not include undocumented wells not reported or verified by TWDB that occur in the study area. ID = identification; ROW = right-of-way.

Wells occurring within the Preferred Alternative ROW would be plugged and abandoned according to TCEQ regulations to eliminate the potential for impacts to groundwater resources.

No-Build Alternative Impacts

The No-Build Alternative would not result in direct impacts to the public drinking water systems in the proposed SH 99 Segment B study area.

4.9 WETLANDS AND OTHER WATERS OF THE U.S.

4.9.1 Navigable Waters of the U.S.

The only tidal water segment as identified by TCEQ that traverses the Preferred Alternative ROW is Geisler Bayou. As such, its waters would be subject to the ebb and flow of the tide, thereby meeting the

definition of a navigable water of the U.S. Construction of a bridge structure over Geisler Bayou where the bayou would be traversed by the Preferred Alternative would require coordination with the U.S. Coast Guard under Section 9 of the Rivers and Harbors Act and the General Bridge Act. Coordination with the USACE may be necessary to authorize bridge construction should the bridge structure require discharges of dredged or fill material into waters regulated by the USACE under Section 10 of the Rivers and Harbors Act.

No-Build Alternative Impacts

The No-Build Alternative would have no direct impact to navigable waters of the U.S.

4.9.2 Waters of the U.S.

Potentially jurisdictional waters of the U.S., including wetlands, within the Preferred Alternative ROW would be unavoidably impacted by construction activities. An identification and delineation of potentially jurisdictional waters of the U.S. have been conducted for the Preferred Alternative (***Exhibit 4-5***). Access to the proposed ROW of the Preferred Alternative was limited because right-of-entry permission was not granted by all current landowners. Access was unavailable to approximately 70 percent of the parcels that would be traversed by the Preferred Alternative. Therefore, the identification and delineation of potentially jurisdictional waters of the U.S. were performed using a combination of collected field data and interpretation of aerial photography and LiDAR data. The USACE would be requested to verify the delineation to make the official determination of jurisdictional waters of the U.S. for the Preferred Alternative. USACE determinations are typically valid for 5 years. Design of the Preferred Alternative would avoid or minimize impacts to waters of the U.S., including wetlands, to the extent practicable.

The Preferred Alternative would cross four named bayous and three irrigation canals. The crossings of Chocolate, Dickinson, and Mustang bayous would be bridged. The Preferred Alternative would also cross Geisler Bayou, a tidal water according to the TCEQ's Texas Water Quality Inventory, at two locations near its eastern terminus at IH 45 South. The downstream crossing would likely be bridged. The upstream crossing may be bridged or possibly placed within culverts, depending on final design of the Preferred Alternative. The American Canal, Biscoe Canal, and South Texas Water Company Canal would likely be bridged. Smaller stream crossings would either be bridged or placed within culverts. Crossings of streams would require the removal of vegetation in the immediate area of the streams. Some bank stabilization may also be required to protect stream banks from the erosive forces of storm flows within the channels. Impacts to jurisdictional waters of the U.S. below the plane of ordinary high water of the stream channel, or below the elevation of mean higher high water, would require authorization from the USACE prior to construction. At the present time, specific impacts cannot be assessed until final design plans are completed.

A temporary increase in suspended sediments may occur in the areas of the proposed water crossings during construction. To mitigate any issue, BMPs (e.g., hay bales, silt fences, and rock berms) would be installed to minimize potential impacts to jurisdictional waters of the U.S. in the immediate construction area. Impacts from turbidity would likely be short term and localized, as sediments would quickly settle

from the water column downstream of the disturbed areas. To minimize such impacts, placement, and monitoring of erosion control measures at the initiation of, during, and following construction would be incorporated into project plans according to TxDOT SW3P guidelines. Revegetation of the Preferred Alternative would adhere to TxDOT revegetation guidelines. Required permits and USACE coordination are discussed further in ***Section 7*** of the FEIS.

No-Build Alternative Impacts

The No-Build Alternative would have no direct impact to waters of the U.S.

4.9.3 Wetlands

Executive Order 11990, *Protection of Wetlands*, established a national policy "to avoid to the extent possible, the long-term and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative." FHWA Technical Advisory T 6640.8a provides guidelines for addressing wetland impacts in environmental documents, including identification of the extent of wetlands impacted, their type, quality, and function (FHWA 1987). Alternatives for avoidance and practicable measures to minimize harm to wetlands are to be addressed, and the relative importance of the wetland resource, its function within the area, and any uniqueness that may contribute to the importance of the wetland are to be presented.

As previously stated, right-of-entry was not granted for approximately 70 percent of the Preferred Alternative ROW. As such, a detailed delineation of waters of the U.S., including wetlands, could not be performed. Instead, USGS 7.5-minute topographic quadrangle maps, recent color aerial photography, and available LiDAR data were reviewed to determine the location of potential wetlands, and observations were made at locations in which right-of-entry was granted to verify desktop findings. Depicted on ***Exhibit 4-5***, identified wetland areas were delineated, transferred to an aerial background image using GIS, and characterized as adjacent (i.e., within the 100-year floodplain and potentially jurisdictional) or isolated. An estimated 142 wetlands totaling approximately 54.5 acres were identified within the Preferred Alternative ROW. The 142 wetlands were grouped as isolated or adjacent wetlands, with the total acreage of each type listed in ***Table 4-23***.

Table 4-23: Estimated and Field-verified Wetlands within the Preferred Alternative ROW

Wetland Type	Acreage Estimated from Photography and LiDAR	Surveyed Acreage	Total
Isolated Wetlands	29.41	1.34	30.75
Adjacent Wetlands	23.10	0.67	23.77
		Total	**54.52**

Source: SH 99 Segment B Study Team 2014.

Many of the identified wetlands may be determined by the USACE to be isolated rather than adjacent, as the wetlands have no apparent nexus to traditional navigable waters. According to the 2001 U.S. Supreme

Court ruling on Solid Waste Agency of Northern Cook County, Petitioner v. U.S. Army Corps of Engineers, et al., isolated wetlands are outside of the USACE's Clean Water Act jurisdiction. On June 5, 2007, the EPA and USACE provided additional guidance on determining jurisdictional waters of the U.S. that followed the U.S. Supreme Court's decision in Rapanos v. U.S. and Carabell v. U.S. The guidance discusses additional information on determining whether a wetland is jurisdictional by using significant nexus as a determining factor. For a wetland to be jurisdictional, it has to have more than a speculative or insubstantial effect on the chemical, physical, and/or biological integrity of a traditional navigable water. Current guidance from the USACE, Galveston District, indicates that isolated wetlands have no apparent connection to other waters of the U.S. or tributaries and are situated outside the mapped 100-year floodplain. Interpretation of aerial photography would suggest that several wetlands within the proposed ROW of the Preferred Alternative may be isolated, based on the USACE, Galveston District, guidance. However, the USACE is the agency to make the final determination as to the jurisdictional status of any wetland. Because a complete field delineation and jurisdictional determination have not been performed, it is assumed, for the FEIS, that all wetlands occurring within the Preferred Alternative ROW would be jurisdictional. When a field delineation of the Preferred Alternative has been completed, a draft jurisdictional determination would be conducted, and the resulting report would be submitted to the USACE for verification.

Planning the alignment of the Preferred Alternative included efforts to avoid and minimize impacts to wetlands. However, the distribution of wetlands within the Preferred Alternative ROW and the geometric configuration of the proposed highway's design made complete avoidance impractical. Therefore, construction of the Preferred Alternative would require the unavoidable placement of fill material into wetlands. Additional efforts would be made during final design to refine the Preferred Alternative to avoid wetlands and to incorporate practical measures to minimize unavoidable impacts to wetlands.

Construction of the Preferred Alternative would impact wetlands and aquatic systems to varying degrees. Land clearing during construction would remove vegetative cover and may increase surface water runoff, which could lead to erosion. To minimize potential impacts from the introduction of erosion and sediment material into receiving waters, installation and monitoring of erosion control measures at the initiation of, during, and following construction would be incorporated into project plans according to TxDOT's SW3P guidelines. Vegetation establishment along the proposed ROW of the Preferred Alternative would adhere to TxDOT revegetation guidelines.

The loss of wetlands within the Preferred Alternative ROW could potentially have an adverse effect on water quality and hydrology outside the limits of the Preferred Alternative. The removal of vegetative cover and the filling of depressional wetlands, which would be replaced with impervious travel lanes and maintained grassed medians, could increase runoff into receiving waters. The increase in runoff could elevate sedimentation and pollutants, potentially modifying water chemistry and negatively impacting aquatic organisms. Additionally, the removal of depressional wetlands could reduce the flood control function, increasing stormwater runoff during storm events. Instead of water collecting in the wetland basins, water would run off into area streams or canals, thereby increasing flow. However, the potential

increases in stormwater runoff would be mitigated through the construction of detention facilities. The detention facilities would retain runoff until high flows and water levels in nearby receiving waters subside. Also, the retained discharge would increase the time that low and medium flows are conveyed away from the Preferred Alternative. The increased travel time, along with contact with vegetated swales and areas within the detention facilities, would reduce sediments and other pollutants potentially entering the Chocolate Bayou, Dickinson Bayou, Mustang Bayou, and other watersheds that would be crossed by the Preferred Alternative. BMPs would be implemented during construction of the Preferred Alternative to minimize potential short-term increases in pollutants, including sedimentation. Construction of detention facilities as part of the Preferred Alternative would reduce long-term sediment and pollutant loads entering into receiving waters.

Wetland Functions and Values

Although no site-specific assessments have been conducted, it is anticipated that the functions of wetlands occurring within the proposed ROW of the Preferred Alternative would be permanently lost as a result of the Preferred Alternative. The functions might include food chain support, providing plant and animal habitat, flood control, and nutrient/pollutant retention. Assessing the functions for all waters of the U.S., including streams and wetlands, would require right-of-entry access for the entire Preferred Alternative ROW. To the extent practicable, aquatic resource functions would be replaced, in accordance with USACE requirements, as part of compensatory mitigation.

Aquatic resource values would also be assessed during the functions analysis of the Preferred Alternative. Examples of values would include aesthetics, recreation, and uniqueness. Aquatic resource values would be considered during development of compensatory mitigation.

No-Build Alternative Impacts

The No-Build Alternative would have no direct impact to waters of the U.S., including wetlands.

4.10 VEGETATION AND WILDLIFE

4.10.1 Vegetation

Vegetation within the proposed ROW of the Preferred Alternative would be impacted by site preparation and construction activities. Clearing and grading of the Preferred Alternative ROW would remove the existing vegetative cover and replace it with impervious cover associated with travel lanes, entrance and exit ramps, frontage roads, and areas of herbaceous vegetation that would be routinely maintained by mowing. Removal of vegetation within the Preferred Alternative ROW would have some impact on vegetation communities, wildlife, water quality, biomass, nutrient cycling, and visual aesthetics.

Vegetation impacts would occur primarily to agricultural land, disturbed grasslands/pasturelands, and urban areas, as these areas comprise the majority of the Preferred Alternative ROW. Because right-of-entry to approximately 70 percent of the Preferred Alternative was not granted, the identification of

vegetation types relied on TPWD's EMST, with some limited field investigation where right-of-entry was available (TPWD 2014e).

Review of TPWD's EMST data, combined with limited field investigations, revealed discrepancies between the EMST-mapped vegetation and vegetation observed in the field. The discrepancies are discussed in ***Section 3.10.1.5*** of the FEIS. TPWD has indicated that they would not review the proposed project under the Tier I Site Assessment procedures of the TxDOT/TPWD 2013 MOU, but rather would conduct administered coordination using the information presented in this FEIS. The FEIS will be submitted to TPWD for review. Additional Tier II Site Assessment information would become available as right-of-entry within the Preferred Alternative ROW is obtained and field investigations are performed.

Review of the vegetation data indicated that some of the individual vegetation types were indistinguishable in the field and on the aerial photography, which is likely the result of similar disturbances from previous agricultural production and livestock grazing having been applied to most of the region, thereby diminishing or eliminating subtle changes vegetation characteristics. For example, EMST-mapped Coastal Grassland, Disturbed Prairie, Tidal and Salt Marsh, and Agriculture vegetation types looked very similar to one another. The review of the EMST data conducted as part of a Tier I Site Assessment required by the TxDOT/TPWD 2013 MOU resulted in the reclassification of vegetation types within the Preferred Alternative ROW. The vegetation was reclassified into eight vegetation types: Agriculture, Coastal Grassland, Disturbed Prairie, Mixed Woodlands and Forest, Post Oak Savanna, Riparian, Tidal and Salt Marsh, and Urban. ***Table 4-24*** presents the approximate acreage by vegetative type that would be impacted by the Preferred Alternative, in addition to the percentage of the Preferred Alternative ROW that each type represents.

Table 4-24: Vegetation Impacts within the Preferred Alternative

Vegetation Type	Acreage (approximate)	Percent of Preferred Alternative
Agriculture	100.9	6.83
Coastal Grassland	510.1	34.52
Disturbed Prairie	282.9	19.15
Mixed Woodlands and Forest	67.9	4.59
Post Oak Savanna	0.38	0.03
Riparian	39.3	2.66
Tidal and Salt Marsh	45.9	3.11
Urban	430.1	29.11

Source: SH 99 Segment B Study Team 2014.
Notes: ROW = right-of-way.

Construction of the Preferred Alternative would permanently remove agricultural land and pastureland from crop production and livestock pasture. However, agricultural land and pastureland immediately

adjacent to the Preferred Alternative would remain available for such uses. Landowner decisions would determine whether or not the lands would continue to be used for similar purposes. Likewise, riparian, wooded, and urban areas would be permanently converted to highway and maintained as herbaceous ROW. The conversion would represent a loss of trees that provide habitat, aesthetic value, and shade tree value. Riparian, wooded areas, and ornamental plantings in urban areas outside the proposed ROW of the Preferred Alternative would be expected to remain, thereby contributing to the aesthetic quality of the adjacent areas for travelers along the Preferred Alternative.

Construction activities would unavoidably impact vegetative communities within the Preferred Alternative ROW, potentially fragmenting habitat, reducing riparian vegetation, and modifying hydrologic flows. Although the effects can vary, habitat fragmentation may lead to a decline in biological diversity. Fragmentation would reduce the amount of total habitat area, decrease interior and increase the edge ratio, possibly expose some wildlife to increased predation, and may facilitate the introduction of exotic or pest species, all of which can disrupt the natural ecological balance. The majority of the proposed SH 99 Segment B study area, including areas within the Preferred Alternative ROW, has been subjected to disturbance from the conversion of previous natural grasslands and other habitats to agricultural and urban uses. Wildlife able to adapt to the changed conditions have remained within the study area, while wildlife unable to adapt have likely been displaced into areas of similar natural habitats in the region. The result is a possible shift in wildlife population densities and diversity compared to ecological conditions prior to disturbances from agricultural and urban land uses.

Riparian vegetation is a relatively small component of the vegetation types within the Preferred Alternative ROW, which is reflective of the limited riparian vegetation in the study area. Previous agricultural activities have encroached into riparian areas associated with stream and tributary channels throughout the study area, and existing roadways and utility easements have removed riparian vegetation in areas where the roadways and utilities intersect streams and drainageways. Although the removal of riparian vegetation would create an interruption in the continuity of the riparian corridor in the immediate area of the Preferred Alternative's crossing, the interruption would not be a unique feature on the landscape, as vegetation removal has occurred with other roadway and utility crossings in the study area. Additionally, a portion of the Preferred Alternative would incorporate the existing ROW of SH 35, which would minimize the amount of riparian vegetation that would be removed where that portion of the Preferred Alternative would cross streams and drainageways. Riparian vegetation shades streams and drainageways and provides natural vegetation filter strips for stormwater runoff. Removal of riparian corridor vegetation could increase water temperature in the immediate area of the Preferred Alternative ROW and remove protective cover used by wildlife. Some disturbance of stream and drainage channels may occur as riparian vegetation is removed during construction, but the condition would be temporary. The proposed ROW of the Preferred Alternative would be revegetated with predominantly herbaceous species, which would be maintained according to standard TxDOT practices and would reduce sediment loads entering into receiving waters.

Landscaping of the Preferred Alternative ROW would be in accordance with Executive Order 13112 on invasive species and the Executive Memorandum on beneficial landscaping. TxDOT would adhere to the following sustainable landscape measures and practices where cost effective and to the extent practicable.

- Use regionally native plants for landscaping.
- Design, use, or promote construction practices that minimize adverse effects on the natural habitat.
- Reduce fertilizer and pesticide use.
- Implement water-efficient and runoff-reduction practices.
- Create outdoor demonstration projects employing the above measures and practices.

No-Build Alternative Impacts

The No-Build Alternative would not result in direct impacts to vegetation. However, some impacts to vegetation may occur from construction activities associated with other planned roadway improvements and development within the study area.

4.10.2 Wildlife

Construction of the Preferred Alternative would result in potential impacts to wildlife from movements of heavy construction equipment, loss of habitat, habitat fragmentation, and vehicle/animal strikes. Operation of the Preferred Alternative would potentially result in impacts to wildlife from vehicle collisions and the possible introduction of roadway pollutants.

4.10.2.1 Agricultural Land and Pastureland

In general, cropland and open pastureland provide limited habitat for wildlife. As such, impacts on cultivated lands would likely have minimal impact on wildlife. Use of agricultural and pastureland vegetation communities by large mammals other than domestic livestock is also minimal, as this type of habitat offers little vegetative cover for large mammals. Although an occasional transient occurrence would be possible, the Preferred Alternative would not adversely affect large mammal populations. These habitat types receive more use by small and medium-sized mammals.

Construction of the Preferred Alternative would permanently convert agricultural lands and pasturelands to highway ROW, fragmenting the habitat types and possibly eliminating less mobile animals or animals that seek cover in debris or fallen vegetation from the movements of heavy equipment during construction. More mobile animals would be displaced by construction activities into similar adjacent or nearby habitat. Because the overall amount of habitat would be reduced, displaced wildlife retreating to similar adjacent or nearby habitat may be affected by isolation from other populations, crowding, and increased competition for available food resources. Following construction, additional wildlife losses could occur from injuries or death caused by collisions with passing vehicles.

TPWD biologists conduct wintering waterfowl counts on at least an annual basis in Brazoria and Galveston Counties. Since approximately the 1970s, wintering waterfowl numbers have been decreasing in both counties. The reasons for the trending decline are unknown, but biologists have suggested a combination of climate change, habitat loss, and a decrease in rice production within the two counties may be the cause. The declining numbers of wintering waterfowl in Brazoria and Galveston Counties do not necessarily correlate to an overall waterfowl population decline, but instead suggests that waterfowl may be relocating to other overwintering areas, possibly in other states north and east of Texas (TPWD 2009).

Detailed rice harvest data were obtained from the U.S. Department of Agriculture for Brazoria and Galveston Counties dating back to 1968. In 1968, approximately 63,150 and 12,600 acres of rice were planted in Brazoria and Galveston Counties, respectively. In 2004, approximately 1,000 acres of rice were planted in Galveston County, and in 2007, approximately 11,700 acres of rice were planted in Brazoria County. Decreasing rice production, which is an important component of the wintering waterfowl diet, may be due to altered or different agricultural practices and global competition. A continuation of the declining trend of rice planted in the study area could also correlate to a continued decline in the number of waterfowl overwintering in the two counties. The declining trends are due to factors already in place and would not be the result of Preferred Alternative construction.

Other birds using agricultural land and pastureland communities within the proposed ROW of the Preferred Alternative would be permanently displaced by construction, resulting in a permanent reduction of the habitat type. Displaced birds would be expected to move to similar habitat adjacent to the Preferred Alternative or to other areas of similar habitat in Brazoria and Galveston Counties. Displaced birds could be affected by crowding and increased competition for food and shelter resources. Similar to small and medium-sized mammals, some individual birds may be eliminated by heavy equipment during construction, and additional losses may occur because of bird/vehicle strikes along the completed Preferred Alternative.

The Migratory Bird Treaty Act protects migratory birds, active nests, eggs, and/or their young. In the event that migratory birds are encountered onsite during construction of the Preferred Alternative, every effort would be made to avoid harm to migratory birds, their eggs, nests, and young. If necessary, old migratory bird nests would be removed from structures after the nesting season (generally March through August) to prevent reuse of old nests. For planned and upcoming construction, preventive measures would be taken to prevent birds from building new nests in the proposed construction area.

Reptiles and amphibians (herptiles) that occur in agricultural and pastureland communities would either be displaced or eliminated during construction. Additional losses of individual animals may also occur as a result of being struck by passing vehicles. Snakes often use paved surfaces to regulate body temperatures and, therefore, would have an increased risk of being struck by vehicles. Being less mobile than some other wildlife species, herptiles would be more vulnerable to mortality by vehicle strikes.

4.10.2.2 Riparian and Wooded Habitat

Riparian and wooded habitat within the proposed SH 99 Segment B study area is limited, but that does not change the fact that both habitats are important for wildlife. The two habitat types are becoming increasingly more important to resident and migrant birds because of habitat loss from changing land use and urban sprawl. Riparian and wooded habitats provide travel corridors, migratory fallout areas for neotropical migrants, and vertical layers for foraging and nesting. The habitats also provide hard and soft mast for consumption. Riparian habitat offers shade and protection for aquatic organisms in area streams, and mammals and birds use riparian habitat for foraging, travel, and cover.

Construction of the Preferred Alternative would permanently remove and convert riparian and wooded habitats from within the proposed ROW of the Preferred Alternative to a transportation use. Loss of habitat would directly impact indigenous and migrant arboreal and other species requiring woodland habitat. The removal of trees and snags would also reduce possible roosting spots for bats. Fragmentation of woodland habitat would reduce the overall amount of the habitat type and could adversely impact species that require mature, non-fragmented habitat. Conversely, the creation of additional edge habitats would positively affect species favoring edge habitats. Displaced wildlife would be expected to move into similar habitat areas adjacent to or nearby the Preferred Alternative. However, crowding and competition for food and shelter may force some wildlife to use outlying woodland habitats with less desirable characteristics and vertical structure.

Removal of riparian and wooded habitats from within the Preferred Alternative ROW would interrupt contiguous riparian habitat used as travel routes, potentially exposing wildlife to automobile traffic. Bridge structures spanning streams and drainageways would allow wildlife to continue to move along the water course, with terrestrial wildlife passing under the bridge structure. Smaller water courses placed within culverts would allow wildlife traveling along the water course the opportunity to pass under the roadway; however, some wildlife may pass over the roadway exposing animals to oncoming vehicular traffic, thereby increasing the risk of injury or mortality.

A portion of the Preferred Alternative would incorporate the existing SH 35 ROW. Although the Preferred Alternative would remove additional riparian vegetation, the overall impact of riparian habitat removal from areas where SH 35 currently crosses streams and drainageways would be reduced because of the disturbed conditions already present within the existing ROW.

Roadway pollutants flushed from the Preferred Alternative during storm events or accidentally released as the result of vehicle collisions could impact wildlife adjacent to the Preferred Alternative ROW. Wildlife in aquatic habitats receiving pollutant runoff from the Preferred Alternative could also be impacted. However, the introduction of such pollutants would likely occur during storm events that would dilute potential contaminants, thereby minimizing impacts to aquatic resources. The impact of pollutants introduced directly into an aquatic system would depend on the quantity, concentration, and toxicity of the pollutant released. Implementation of BMPs designed to minimize erosion and filter contaminants would reduce impacts to aquatic habitats.

The primary impacts to wildlife inhabiting or migrating through the Preferred Alternative ROW would be habitat loss and fragmentation. Wildlife species within the study area typically occur throughout the region, and therefore, adverse impacts to individual species would not be anticipated to adversely affect species populations. Overall, wildlife diversity and composition would be altered as a result of constructing the Preferred Alternative, but no long-term impacts to wildlife populations would be expected.

No-Build Alternative Impacts

The No-Build Alternative would not result in direct impacts to wildlife. However, some impacts may occur from construction activities associated with other planned roadway improvements and development within the study area.

4.11 THREATENED AND ENDANGERED SPECIES

The following sections present the potential occurrence of federally and state-listed threatened and endangered species, as well as species of greatest conservation need (SGCN) that may be impacted by the Preferred Alternative. ***Table 3-17*** and ***Table 3-18*** in ***Section 3.11*** of the FEIS provides the listing, status, and habitat requirements of federally and state-listed threatened and endangered species and SGCN that have the potential to occur in Brazoria and Galveston Counties.

Through limited field investigation and the interpretation of aerial photography, LiDAR, and existing records, habitat types (e.g., open fields, abandoned pasture and farmland, forests, and forested and emergent wetlands) would exist within the proposed ROW of the Preferred Alternative. Further field investigations would be conducted as part of an administered coordination Tier II Site Assessment under the TxDOT/TPWD 2013 MOU as additional right-of-entry is obtained to determine if suitable threatened and endangered species habitat would occur within the Preferred Alternative ROW. Should threatened or endangered species be determined to occur within the ROW, coordination with the USFWS and TPWD would commence to establish the need for further investigations or possible consultation under Section 7 of the Endangered Species Act.

4.11.1 Texas NDD-Listed Species

A review of TPWD's TXNDD (obtained March 18, 2014) does not indicate any known location records for federally and/or state-listed threatened or endangered species that may be present within a 1.5-mile distance from the Preferred Alternative. The TXNDD did show an occurrence of two species listed by the state as SGCN that may be present within a 1.5-mile distance from the Preferred Alternative. There have been no other recorded occurrences of any federally or state-listed species within close proximity to the Preferred Alternative. It should be noted that an absence of data for a particular species does not demonstrate an absence of occurrence for a threatened, endangered, or SGCN.

The following are the results of the TXNDD search, including EOID numbers for the species that may be present within a 1.5-mile distance from the Preferred Alternative.

Texas Windmill-Grass (EOID 8010): SGCN (G2, S2)

Texas windmill-grass is a tufted perennial grass that occurs in sandy to sandy loam soils in open or barren areas or at the base of pimple mounds within prairies along the Texas coast. Texas windmill-grass flowers in October and November. The TXNDD element of occurrence could be 0.6 mile from the Preferred Alternative. TxDOT would follow the vegetation BMPs as stated in the Best Management Practices Programmatic Agreement (BMPPA) under the 2013 MOU between TxDOT and TPWD to reduce impacts, if any, to this species.

Southern Crawfish Frog (EOID 11524): SGCN (G4, S3)

Southern crawfish frogs are found primarily in association with crayfish burrows in prairies and grassland or pastures and overgrown field habitats. The species is not identified as a federally or state-listed threatened or endangered species, but is listed as a state SGCN in Galveston County. The TXNDD element of occurrence could be 3.8 miles from the Preferred Alternative, with a precision of location of 5 miles. The frog does not have federal or state protection under the Endangered Species Act or Chapters 68 and 88 of the TPWD code. TxDOT would follow the BMPs as stated in the BMPPA to reduce the impacts, if any, to this species; however, there are currently no specific BMPs for amphibian species.

4.11.2 State-Listed Threatened, Endangered, and Species of Greatest Conservation Need

The state-listed bald eagle (threatened [T]), timber/canebrake rattlesnake (T), and Texas meadow-rue (SGCN) require forests, forested wetland, and wetland habitats. Habitats for the black rail (SGCN), Correll's false dragon-head flower (SGCN), white-tailed hawk (T), white-faced ibis (T), and wood stork (T) are generally found in salt to freshwater marshes, prairie ponds, flooded pastures, and wet soils along riverbanks and irrigation channels. All identified habitats would occur within the proposed ROW of the Preferred Alternative, and construction would eliminate these habitats within the ROW. TxDOT would follow the BPMs as stated in the BMPPA to reduce the impacts, if any, to these species.

Remnant prairie habitats, improved pastures, or weedy fields are habitats for the Henslow's sparrow (SGCN), plains spotted skunk (SGCN), coastal gay-feather (SGCN), giant sharpstem umbrella-sedge (SGCN), and threeflower broomweed (SGCN). Construction of the Preferred Alternative would eliminate these habitats within the ROW. TxDOT would follow the BMPs as stated in the BMPPA to reduce the impacts, if any, to these species.

The bald eagle was federally delisted in 2007. However, the bird remains listed as threatened in Texas by TPWD, and the bald eagle is protected by the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. Increased traffic and construction noise in or in close proximity to the Preferred Alternative ROW may decrease the attractiveness of the area to potential breeding eagles. Should nesting bald eagles be identified within or in close proximity to the ROW, construction outside of the breeding season may be considered to reduce potential stress on nesting eagles. Coordination with the USFWS and TPWD would be initiated should bald eagles be identified within or in close proximity to the Preferred

Alternative ROW. TxDOT would follow the Bird BMPs as stated in the BMPPA and comply with the Bald and Golden Eagle Protection Act to reduce the impacts, if any, to the bald eagle.

Impacts to aquatic state-threatened species and SGCN, such as the false spike mussel (T), smooth pimpleback (T), Texas fawnsfoot (T), American eel (SGCN), and alligator snapping turtle (T) would be avoided or minimized by bridging streams that would be crossed by the Preferred Alternative. TxDOT would follow the Freshwater Mussel, Fish, and Reptile BMPs as stated in the BMPPA to reduce the impacts, if any, to these species. The use of temporary and permanent stormwater BMPs to control sediment and runoff would further minimize possible impacts from construction of the Preferred Alternative.

The state-listed American peregrine falcon (T) and Arctic peregrine falcon (SGCN) could potentially occur within the Preferred Alternative as migrants through the region. Peregrine falcons are known to assemble on the Texas coast to rest and replenish fat stores before continuing their migrations. Therefore, it is possible that the falcons could forage near the Preferred Alternative during spring and fall. However, as the falcons' passage through the area would be temporary, and the species would likely avoid construction activities and the resulting maintained highway habitat associated with the Preferred Alternative, no impacts to peregrine falcons are expected. TxDOT would follow the Bird BMPs as stated in the BMPPA to reduce the impacts, if any, to these species.

The state-listed snowy plover (SGCN) and western snowy plover (SGCN) could also occur within the Preferred Alternative as potential migrants. Snowy plovers are shorebirds preferring sparsely vegetated sand beaches, dry salt flats, beaches, and dune habitats. Similar to peregrine falcons, the plover's passage through the area would be temporary, and the species would likely avoid construction activities and the resulting maintained highway habitat associated with the Preferred Alternative. TxDOT would follow the Bird BMPs as stated in the BMPPA to reduce the impacts, if any, to these species.

TPWD's lists of threatened and endangered species identify 22 federally listed species that may occur within Brazoria and Galveston Counties. Twelve are endangered: the Attwater's greater prairie-chicken, Eskimo curlew, whooping crane, sharpnose shiner, smalltooth sawfish, jaguarundi, ocelot, red wolf, West Indian manatee, Atlantic hawksbill sea turtle, Kemp's Ridley sea turtle, and leatherback sea turtle. The jaguarundi, ocelot, and red wolf have been extirpated from Brazoria and Galveston Counties. As such, the Preferred Alternative would have no effect on the three species.

The Eskimo curlew is a spring migrant through Texas on the way to breeding grounds in the tundra of the Northwest Territories (USFWS 2011). The Eskimo curlew prefers burned and disturbed prairie habitats and agricultural fields where the species feeds primarily on grasshopper egg cases and emerging nymphs. Therefore, Eskimo curlew may occur during spring migration within the proposed SH 99 Segment B study area. TxDOT would follow the Bird BMPs as stated in the BMPPA to reduce the impacts, if any, to this species. Since the Eskimo curlew's passage through the study area would be temporary, and the species would be expected to avoid construction activities and the resulting maintained highway habitat

associated with the Preferred Alternative, no effect to the Eskimo curlew would be anticipated from construction and operation of the Preferred Alternative.

The whooping crane is a transient migratory species and may occur within the area of the Preferred Alternative. TxDOT would follow the Bird BMPs as stated in the BMPPA to reduce the impacts, if any, to this species. Since the whooping crane's passage through the study area would be temporary, and the species would be expected to avoid construction activities and the resulting maintained highway habitat associated with the Preferred Alternative, no effect to the whooping crane would be anticipated from construction and operation of the Preferred Alternative.

The current range of the smalltooth sawfish in the U.S. is the peninsula of Florida, where it prefers shallow coastal water. The smalltooth sawfish has been shown to have a salinity preference of 18 to 24 parts per thousand (NOAA 2013). Streams occurring within the Preferred Alternative ROW would be predominantly freshwater, and therefore, the Preferred Alternative would have no effect on this fish.

The sharpnose shiner has been extirpated from the lower segments of the Brazos River basin and is found only in the upper Brazos River segments (Federal Register, 2014, Endangered and Threatened Wildlife and Plants; determination of Endangered Status for the Sharpnose Shiner and Smalleye Shiner, Vol. 79, No. 149 pp. 45274-45285). The Preferred Alternative is located outside of the Brazos River basin watershed; therefore, the Preferred Alternative would have no effect on the sharpnose shiner.

Seven of the federally listed species identified as threatened on the TPWD county lists of species that could potentially occur within Brazoria and/or Galveston Counties are piping plover, red knot, western snowy plover, wood stork, Louisiana black bear, green sea turtle, and loggerhead sea turtle. The Louisiana black bear has been extirpated from Brazoria and Galveston Counties; therefore, the Preferred Alternative would have no effect on the mammal (TPWD 2014d). Suitable habitat for the piping plover or the red knot is not present within the Preferred Alternative, and no effect to these species is anticipated. As a potential migrant in the project area, the western snowy plover would likely avoid the maintained highway habitat associated with the Preferred Alternative; therefore, there would be no effect to the species. The wood stork could potentially occur where suitable habitat is present within the Preferred Alternative ROW; however, similar habitat is available in areas surrounding the Preferred Alternative. TxDOT would follow the Bird BMPs stated in the BMPPA to reduce adverse effects to the wood stork. Lastly, there would be no marine habitat present within the Preferred Alternative ROW, so there would be no effect on the green sea turtle and loggerhead sea turtle.

Three of the federally listed species on the TPWD county lists are identified as federal candidate species within Brazoria and Galveston Counties. The three species are Sprague's pipit, Texas fawnsfoot, and smooth pimpleback. Federal candidate species do not have protection under the Endangered Species Act. Sprague's pipit is a winter migrant in the southern states of Arizona, Texas, Oklahoma, Arkansas, Mississippi, Louisiana, and New Mexico that feeds mostly on insects and spiders and some seeds on open grasslands (USFWS 2014b). It is possible that Sprague's pipit could forage in the study area during winter. TxDOT would follow the Bird BMPs as stated in the BMPPA to reduce the impacts, if any, to this

species. Since the Sprague's pipit's use of the study area would be temporary, and the species would likely avoid construction activities and the resulting maintained highway habitat associated with the Preferred Alternative, the Preferred Alternative would have no effect on the bird. The Texas fawnsfoot and smooth pimpleback are aquatic mollusks. TxDOT would follow the Freshwater Mussel BMPs as stated in the BMPPA to reduce the impacts, if any, to these species.

4.11.3 Federally Listed Threatened and Endangered Species

Potential habitat for the federally listed endangered Attwater's greater prairie-chicken consists of coastal prairie with tallgrasses and intermittent shortgrass flats for booming grounds (USFWS 2010). The Attwater's greater prairie-chicken is limited to a preserve located outside the study area. Therefore, the bird is not expected to occur within the study area, and there would be no anticipated effect to the species from construction and operation of the Preferred Alternative. The brown pelican is a delisted species (USFWS 2009).

The remainder of the federally listed threatened and endangered species that would have potential to occur in Brazoria and Galveston Counties (with the exception of the Eskimo curlew discussed above) require marine habitat (i.e., the sea turtles) or are coastal water birds (i.e., the piping plover, red knot, and whooping crane). As habitat for the marine and coastal species would not occur within the Preferred Alternative ROW, the Preferred Alternative would have no effect on these species.

4.11.4 Bald and Golden Eagle Protection Act

On August 8, 2007, the bald eagle was removed from the USFWS threatened and endangered species list (USFWS 2007). The USFWS could propose to relist the bald eagle if it appears that the species needs further protection under the Endangered Species Act. Although the bald eagle is no longer protected under the Act, it is currently protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. In addition, the bald eagle currently retains its status as a state-threatened species on TPWD's lists of threatened and endangered species. Although no bald eagles are known to nest within or in the immediate vicinity of the Preferred Alternative ROW, bald eagles are known to feed along riparian corridors of waterways. Potential impacts to the bald eagle were previously discussed above.

No-Build Alternative Impacts

The No-Build Alternative would have no direct impact on federally or state-listed endangered, threatened, or SGCN that are indigenous to or potentially migrate through the study area.

4.12 FLOODPLAINS

Portions of the Preferred Alternative would traverse areas that are designated by FEMA as Special Flood Hazard Areas. A hydraulic study would be conducted during the design phase of the Preferred Alternative, including an evaluation of existing floodplains and predicted stormwater runoff. The

Preferred Alternative would be designed not to increase the risk of flooding by incorporating necessary drainage features, such as culverts and bridges, into the design.

TxDOT would comply with the regulatory requirements and processes related to floodplain management. Development associated with the portions of the Preferred Alternative located within a Special Flood Hazard Area would require coordination with local floodplain administrators and/or drainage districts for Brazoria and Galveston Counties.

Section 60.3 (d)(3) of the National Flood Insurance Program regulations states that a community is to "prohibit encroachments, including fill, new construction, substantial improvements, and other development within the adopted regulatory floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the proposed encroachment would not result in any increase in flood levels within the community during the occurrence of the base (100-year) flood discharge" (FEMA 2000).

Based on program regulations, prior to issuance of any construction permits involving activities in a regulated floodway, an engineering or "no-rise" certification would be obtained. The request for certification must be supported by technical data stating that construction of the Preferred Alternative would not impact the base flood elevations, floodway elevations, or floodway data widths that are present prior to construction. A hydraulic analysis to current FEMA mapping standards for the Preferred Alternative would be performed to support a "no-rise" certification.

4.12.1.1 Hydrology and Drainage

Construction of the Preferred Alternative would not substantially alter rainfall drainage patterns in the area of the Preferred Alternative. As detailed in ***Section 4.8*** of the FEIS, rainfall runoff rates would increase slightly from construction of impermeable paved surface area. However, the increase would be mitigated through the creation of drainage improvements, including detention facilities that would be constructed in compliance with guidelines of the affected cities and flood control districts.

Due to the relatively level topography in the area of the Preferred Alternative and the limited number of drainage features, sheet flow patterns would be a primary consideration when designing drainage structures. Adversely impacting sheet flow would limit its effectiveness in slowing runoff velocities and in filtering out sediments and other pollutants. Sheet flow patterns would be considered during roadway design, and mitigation measures would be incorporated into the final design, as needed. Mitigation measures may include cross-drainage structures and long, elevated bridge structures to allow sheet flow patterns to continue unchanged relative to existing conditions. Cross-drainage structures (e.g., culverts) would allow water that is not confined to a stream channel to move from one side of the highway to the other without crossing over the highway and potentially eroding the surface.

No-Build Alternative Impacts

The No-Build Alternative would not impact drainage patterns within the study area.

4.12.1.2 Floodplains

Exhibit 3-7 shows the FEMA-mapped flood hazard areas within the study area and surrounding vicinity. Approximately 343 acres of flood hazard areas are mapped within the Preferred Alternative. These include the 100-year and 500-year floodplains of Chocolate Bayou, Dickinson Bayou, Geisler Bayou, and Mustang Bayou, and an area of floodway associated with Chocolate Bayou. The Dickinson Bayou floodplain and the floodplain south of Alvin adjacent to the Briscoe Canal associated with Mustang Bayou would represent the most extensive floodplain areas crossed by the Preferred Alternative.

The total 100-year floodplain acreage within the proposed ROW of the Preferred Alternative would be approximately 307 acres. The total 500-year floodplain would be approximately 21 acres, and the floodway associated with Chocolate Bayou would be approximately 15 acres. These acreages are based on FEMA mapping of Brazoria and Galveston Counties. In accordance with 23 CFR 650.113, FHWA will not approve a proposed action that includes a significant floodplain encroachment, unless FHWA finds that the proposed encroachment is the only practicable alternative. The hydraulic design of the Preferred Alternative would be in accordance with current FHWA and TxDOT design policies. The Preferred Alternative would permit the conveyance of the 100-year flood, inundation of the highway being acceptable, without causing significant damage to the highway, stream, or other property. The Preferred Alternative would not increase the base flood elevation to a level that would violate applicable floodplain regulations and ordinances. Coordination with the local floodplain administrators and/or drainage districts for Brazoria and Galveston Counties would be required.

A hydraulic study would be performed during the preliminary and final design of the Preferred Alternative, and areas sensitive to local flooding would be identified. The study would provide detailed hydraulic information necessary to determine the use of culverts and bridges at each stream crossing to confirm that the Preferred Alternative would not increase the risk of flooding. Hydraulic features for the Preferred Alternative would be designed in accordance with current TxDOT and FHWA design policies and standards. To the extent practicable, the design would also minimize the area of floodplains impacted by the Preferred Alternative. Fill material placed in a floodplain would be mitigated with equivalent floodplain storage in the vicinity of the Preferred Alternative.

Construction of culverts and bridges would require the removal of riparian and other vegetation within the proposed ROW of the Preferred Alternative. Depending on the design, water courses that would intersect the Preferred Alternative may be partially filled, reconfigured, and/or graded. While the continuation of flood conveyance capacities would be accommodated in the design of the Preferred Alternative, the continuity of the riparian corridor or other vegetation along water courses and drainage ways may be interrupted, thereby exposing wildlife movements in the disturbed areas and potentially placing wildlife at risk of being struck by passing motor vehicles.

The Preferred Alternative would be designed to meet the requirements for approval as an emergency evacuation route, likely related to hurricane evacuation. The Preferred Alternative would include construction of the proposed SH 99 Segment B at an elevation approximately 1 foot above the 100-year

frequency flood elevations. As previously stated, the placement of fill in the floodplain would be mitigated with equivalent floodplain storage in the vicinity of the Preferred Alternative.

Other potential impacts to floodplains would include increased flows from the Preferred Alternative, with its associated increase in impermeable cover. The increased flows would be mitigated with detention facilities in proximity to the Preferred Alternative. The detention facilities would offset increases in flows and would add additional floodplain storage to the watershed, which would preserve existing floodplain values.

No-Build Alternative Impacts

The No-Build Alternative would result in no new encroachment on the 100-year floodplain and, therefore, would have no direct impacts on floodplains. However, future growth in the area would probably continue, and the expected growth and development could potentially impact floodplains. Any potential floodplain impacts would be regulated by floodplain policy.

4.13 WILD AND SCENIC RIVERS

The Preferred Alternative and No-Build Alternative would not be located in the vicinity of any rivers or river segments listed in the national inventory of the National Wild and Scenic River System. Therefore, no impacts to wild and scenic rivers would be expected.

4.14 COASTAL BARRIERS

The Preferred Alternative and No-Build Alternative would not be located on a coastal barrier island and are not included on the Coastal Barrier Resource System map. Therefore, no impacts to coastal barrier resources would be expected.

4.15 COASTAL ZONE MANAGEMENT PLAN AND ESSENTIAL FISH HABITAT

4.15.1 Coastal Management Zone

As depicted on ***Exhibit 3-7***, the Preferred Alternative would be located within Brazoria and Galveston Counties, both of which are partially located within the Texas Coastal Management Zone boundaries as defined in the General Land Office's Coastal Coordination Council rules, 30 Texas Administrative Code (TAC) 503.1. The eastern terminus of the Preferred Alternative (ending at IH 45 South) would border the Texas Coastal Management Zone boundary. Additionally, the boundary encroaches into the southern portion of the proposed SH 99 Segment B study area along Chocolate Bayou, south of the intersection of SH 35 and Chocolate Bayou.

During preliminary project coordination, the General Land Office explained that typically Coastal Consistency determinations are required for a project in the coastal zone, if a project is required to receive permit authorization under Section 10 of the Rivers and Harbors Act or Section 404 of the Clean Water Act for impacts to waters of the U.S. Formal coordination with the General Land Office would be required to ensure consistency with the Texas Coastal Management Program, as a portion of the Preferred

Alternative ROW associated with Chocolate Bayou would occur within the mapped Texas Coastal Management Zone boundary. Additionally, a bridge permit from the U.S. Coast Guard would be required for the crossings of the Preferred Alternative over the tidally-influenced waters of Geisler Bayou.

No-Build Alternative Impacts

The No-Build Alternative would not impact the Texas Coastal Management Zone.

4.15.2 Essential Fish Habitat

The Preferred Alternative would cross Chocolate Bayou, Dickinson Bayou, Geisler Bayou, Mustang Bayou, and numerous smaller tributaries and drainages. According to the TCEQ's Texas Water Quality Inventory, of the bayous named above, Geisler Bayou is the only tidally-influenced water body at the proposed locations where the Preferred Alternative would cross the bayous. Current plans show the Preferred Alternative crossing Geisler Bayou at two locations; therefore, the Preferred Alternative could potentially impact essential fish habitat as defined by 16 United States Code (U.S.C.) 1802, and would be subject to the Magnuson Stevens Fishery Conservation and Management Act. The waters of Geisler Bayou may be bridged or placed within culverts. Coordination with the NMFS was indicated October 1, 2015 and is currently in progress (***Appendix E***). Subsequent to final design development, impacts of SH 99 Segment B to the tidal waters of Geisler Bayou would be determined, and permitted as needed. Impacts to essential fish habitat would be avoided to the extent practicable; however, if impacts are unavoidable, additional coordination with the National Marine Fisheries Service regarding the tidal waters of Geisler Bayou within the proposed ROW of the Preferred Alternative would be conducted as part of the required coordination process.

No-Build Alternative Impacts

The No-Build Alternative would not impact essential fish habitat.

4.16 CULTURAL RESOURCES

4.16.1 Archeological Resources

Known site locations were researched using the THC's online *Texas Archeological Sites Atlas*. As a result of the official archeological records review, five previously recorded sites were identified within the Grand Parkway Segment B reasonable alternatives or Preferred Alternative ROWs. The archeological survey report was reviewed and coordinated with the SHPO and THC, and is included in ***Appendix G***. The coordination was submitted on August 19, 2013, and the THC concurred with the findings and recommendations. TxDOT further requested the THC's concurrence to defer the remainder of the survey to allow the NEPA process to continue and for property acquisition to proceed. TxDOT will be obligated to complete the survey and coordinate the results with THC once the remainder of the Preferred Alternative ROW has been acquired

Section 106 consultation with federally recognized Native American tribes with a demonstrated historic interest in the area was initiated on February 22, 2008. The tribal consultation comment period ended on July 26, 2013, without any expressions of concern.

High Probability Areas (HPA) were identified for areas that may contain archeological resources based on the assumptions set forth in the Houston District's PALM and the review of historical literature. The PALM was consulted to determine the potential presence of archeological sites within Brazoria and Galveston Counties (***Exhibit 3-12***). While the Houston District's PALM has been shown to illustrate the potential for prehistoric sites in the area, it is not intended to predict the location of historical archeological sites.

Following the identification of a Preferred Alternative, an archeological field survey was initiated to examine HPAs along the Preferred Alternative ROW in compliance with Section 106 regulations, 36 CFR 8001.14 of the NHPA. The APE for archeological resources was defined as the required ROW for the Preferred Alternative. Archeological fieldwork was conducted by qualified archeologists in August and September 2014.

Approximately 30 percent of the APE was tested along the proposed ROW of the Preferred Alternative and within areas determined to need survey by the PALM model that the landowners were willing to provide permission before fieldwork started. Because it was not possible to examine the entire Preferred Alternative ROW, These areas will need to be examined by a qualified archaeologist once right-of-entry has been secured.

Additionally, 11 percent of the APE has previously been tested. This included a survey conducted by Brazos Valley Research Associates (BVRA) at the proposed site of the Camp Mohawk County Park in 2000. The survey was located to the west of the proposed project near Chocolate Bayou. An additional survey near Camp Mohawk was conducted by the USACE along the banks of Chocolate Bayou, southeast of the proposed project in 1986. Surveys have also been conducted by the State Department of Highways and Public Transportation north of Alvin along West Parkwood Avenue (in 1987) and Steele Road (in 1989) near their intersections with SH 35. The Bureau of Land Management and the American Association of Professional Landmen conducted a survey along the American Canal in 1988, would parallel an eastern segment of the Preferred Alternative ROW. A survey conducted by Blanton and Associates in 2003 along 16th Street would intersect with the Preferred Alternative ROW near the intersection of 16th Street and IH 45.

BVRA identified five pre-historic sites within its survey at Camp Mohawk. These sites were described as special activity areas related to specific tasks, including tool production and subsistence activities. Four of the sites were single component sites dating to the Late Prehistoric period based on the presence of sandy paste pottery materials and diagnostic lithics. The age of the fifth site could not be determined because no diagnostic materials were found. Additionally, a historic Confederate Cemetery would be directly adjacent to the proposed ROW of the Preferred Alternative near the intersection of SH 35 with Shirley Avenue. At this time, it is unknown as to whether additional archeological work will be necessary along

the frontage of this cemetery. Such a decision will need to be made between TxDOT and the THC once final plans for the proposed SH 99 Segment B are complete.

Of the 30 percent of the APE that was examined for cultural resources, no further archaeological work is recommended. However, investigation should still occur in those portions of the study area where right-of-entry was not granted prior to construction. Additionally, once the state has taken ownership of the Preferred Alternative ROW, backhoe work should be conducted within the areas the PALM model recommends for deep reconnaissance.

The proposed SH 99 Segment B will be coordinated according to the First Amended PA-TU among the FHWA, TxDOT, the THC, and the ACHP and MOU between TxDOT and the THC (13 TAC 26.14(e)(1) and 43 TAC 2.24(e)(1)) to ensure that any archeological materials associated with proposed SH 99 Segment B construction would be properly evaluated, including any accidental discovery that arises following the archeological field survey. If archeological materials or human remains are identified within the Preferred Alternative ROW during construction, or a department-designated material source, all construction and related activities must cease. The find is to be reported to the TxDOT project inspector or the area engineer in accordance with TxDOT's Emergency Discovery Guidelines. If archeological materials or human remains are introduced into the Preferred Alternative ROW or easements in materials obtained from a material source under option to the contractor, all use of materials from the source must cease and the find reported to TxDOT project inspector or the area engineer in accordance with TxDOT's Emergency Discovery Guidelines.

No-Build Alternative Impacts

The No-Build Alternative would not result in archeological resource impacts associated with the construction or operation of the proposed SH 99 Segment B.

4.16.2 Historic Non-Archeological Properties

A Non-Archeological Historical Resources Study Report (HRSR) for the proposed SH 99 Segment B was submitted on June 25, 2013. The report is on file at both TxDOT Houston District and TxDOT ENV offices and is included in its entirety in ***Appendix G*** of this FEIS. The survey included all historic-age resources located on parcels wholly or partially within the APE for the proposed project in Brazoria and Galveston Counties. An APE of 300 feet along new location and 150 feet along existing transportation corridor from the existing or proposed ROW of the Preferred Alternative was used for historic resources, and a cut-off date of 1975 was used to determine historic-age for all resources. The study was reviewed and TxDOT ENV determined that coordination with the THC and SHPO could not begin until more detailed design is available.

There are three previously determined or recommended NRHP-listed or eligible resources within the APE, all of which are depicted on ***Exhibit 3-13***: the ca. 1908 American Rice Canal (Resource 54); the ca. 1925 Briscoe Canal (Resource 16); and the 1935 South Texas Water Company Canal (Resource 1). The three structures are considered locally significant under Criterion A in the area of agriculture for their

associations with rice cultivation. The Briscoe Canal may also be eligible under Criterion B in the area of agriculture for its associations with its founder, and the South Texas Water Company Canal may be eligible under Criterion C in the area of engineering as an excellent example of its type. These canal systems retain a high degree of integrity. For more detailed information on the evaluation of these resources as well as a description of Criterion B and C, please see ***Appendix G***.

4.16.2.1 Results of Field Survey

Because of the field survey conducted for the HRSR, 69 historic-age resources were identified within the APE. A list of these resources can be found in Table 2 of Appendix A of the HRSR located in ***Appendix G*** of this FEIS. This table lists the resources by county and property type. The HRSR recommends three resources to be NRHP eligible. TxDOT ENV will make the final determinations of eligibility and effects, coordinating with the SHPO. Detailed NRHP evaluations for each of the historic-age resources recommended not eligible for the NRHP are also contained in the HRSR. The three resources that are recommend as eligible for the NRHP are as follows:

Resource 54: 1908 American Rice Canal

Originally constructed in 1908, Resource 54 is the 1908 American Rice Canal, which is a linear rice irrigation system that is an agricultural resource. The canal would extend north-south perpendicular to the Preferred Alternative in Galveston County. The HRSR includes photographs showing the extent of the canal. Within the APE, the Preferred Alternative would cross the 1908 American Rice Canal at one location east of the intersection of the Preferred Alternative and Clifford Street in Alvin. The canal was determined to be historically significant at the local level under Criterion A: Agriculture in the area of agriculture for its associations with rice cultivation with the period of significance extending to 1964, as it continued to function in its original capacity during that time.

Resource 16: 1925 Briscoe Irrigation Company Canal

Originally constructed in 1925, Resource 16 is the 1925 Briscoe Irrigation Company Canal, which is a linear rice irrigation system that is an agricultural resource. The canal would extend northwest-southeast perpendicular to the existing SH 35 and the Preferred Alternative in Brazoria County. The HRSR includes photographs showing the extent of the canal. Within the APE, the Preferred Alternative would cross the 1925 Briscoe Irrigation Company Canal at one location west of the intersection of SH 35 and FM 2403. The canal was determined to be historically significant at the local level under Criterion A: Agriculture in the area of agriculture for its associations with rice cultivation with the period of significance extending to 1964, as it continued to function in its original capacity during that time. The 1925 Briscoe Irrigation Company Canal may also be eligible under Criterion B: Agriculture for its associations with founder Robert T. Briscoe.

Resource 1: 1935 South Texas Water Company Canal

Originally constructed in 1935, Resource 1 is the 1935 South Texas Water Company Canal, which is a linear rice irrigation system that is an agricultural resource. The canal would cross perpendicularly CR 60

in Brazoria County at the Preferred Alternative. The HRSR includes photographs showing the extent of the canal. Within the APE, the Preferred Alternative would cross the 1935 South Texas Water Company Canal at one location east SH 288. The canal was determined to be historically significant at the local level under Criterion A: Agriculture in the area of agriculture for its associations with rice cultivation with the period of significance extending to 1964, as it continued to function in its original capacity during that time. The 1935 South Texas Water Company Canal may also be eligible under Criterion C in the area of engineering as an excellent example of its type.

4.16.2.2 Conclusion

Although the three canals consist of miles of linear canal, the APE crosses each feature only once. Because the Preferred Alternative would require no property from the parcels on which the three resources are located, it is anticipated that there would be no direct effect to the resources. It is recommended that the design plans protect each resource with a design that the resource be spanned by pilings or bents separated from the resource by a 20-foot buffer. No components of the Preferred Alternative would physically impact the three resources, and their historic function, the ability to carry water, would be maintained.

Pursuant to Stipulation VI "Undertakings with the Potential to Cause Effect" of the PA-TU among FHWA, the SHPO, ACHP, and the TxDOT MOU, TxDOT ENV historians will determine NRHP eligibility for the historic-age resources identified in the HRSR. TxDOT is committed to avoiding impacts to historic-age resources determined eligible. Because the design is preliminary and detailed design plans are not yet available, it is not currently possible to evaluate effects to historic-age resources. Further information concerning the avoidance of direct and indirect impacts to NRHP-eligible resources will be addressed later in the project development process. TxDOT ENV will determine if the proposed SH 99 Segment B would have no adverse effect to any historic-age resources. Because the proposed SH 99 Segment B is a major federal action requiring the preparation of an FEIS, individual project coordination with the SHPO is anticipated.

No-Build Alternative

Effects to historic-age resources in the study area would not occur under the No-Build Alternative.

4.17 HAZARDOUS MATERIALS

Construction of the Preferred Alternative would have a low potential for intensifying hazardous material impacts on the environment. Impacts associated with hazardous materials would most likely occur during construction and would be related to activities on or near existing hazardous material sites. The hazardous material sites either have already impacted and/or have the potential to impact the existing environment. Regulated sites would also create the potential of contaminating sites adjacent to them, creating a risk for the acquisition of properties. Prior to ROW negotiation and acquisition, a formal American Society for Testing and Materials (ASTM) Phase I Environmental Site Assessment would need to be conducted for sites where right-of-entry was not granted. A Phase II Environmental Site Assessment may also be

necessary depending on the findings of Phase I. The Phase II Environmental Site Assessment would provide additional testing and sampling of all potential hazardous sites and would include a remediation plan, if warranted.

4.17.1 Regulated Hazardous Materials Sites

As documented ***Appendix F*** of this FEIS, all 53 sites associated with the regulatory database search within the Preferred Alternative ROW were reviewed for potential impacts. Of the 53 regulated hazardous material sites identified within the ASTM standard search radii for the Preferred Alternative, 26 documented sites would fall within, or would be adjacent to, the proposed ROW.

Each of the sites were ranked on a level of risk (i.e., low, moderate, high) for encountering recognized environmental conditions (RECs) during construction of the Preferred Alternative. An REC is defined in ASTM Practice E1527-13 as, "The presence or likely presence of any hazardous substances or petroleum products in, on, or at a property: (1) due to release to the environment; (2) under conditions indicative of a release to the environment; or (3) under conditions that pose a material threat of a future release to the environment. *De minimis* conditions are not recognized environmental conditions [sic]" (ASTM 2013). The risk level was based on the nature of the condition, the documented status of the site, and whether the REC would be adjacent to or within the proposed ROW of the Preferred Alternative. "High risk" sites are sites that are potentially or known to be contaminated and would be within the existing or proposed ROW. "Moderate risk" sites are sites that would be adjacent to or within the proposed ROW with a lower possibility to contaminate the ROW based on the planned highway construction. "Low risk" sites are sites that may potentially be contaminated, but would likely not pose a contamination problem to the planned highway construction. The documented sites are summarized in ***Table 4-25*** and mapped on ***Exhibit 3-13***.

Table 4-25: Regulated Hazardous Materials Sites

Map ID No.	Database Type	Name	ID	Status	Address	Potential Risk (Low/Medium/High)
1	LPST	Alvin Food Mart 2	112144	Removed from Ground	8332 South Highway 35 Alvin, Texas 77511	High
	NOV		RN101245850	Active		
	PST		66620	Active		
	FRSTX		110033365515	N/A		
	GWCC	Ky Vun Tong	112144	Investigation		
2	PST	BUC-EES 14	73187	Active	780 Highway 35 Bypass North Alvin, Texas 77511	Moderate
	FRSTX		10033527734	N/A		
	NOV		RN102494184	Resolved		
3	FRSTX	110024258916	NTB No. 762	N/A	130 North Highway 35 Bypass Alvin, Texas 77511 (Map ID does not show in the correct location.)	Low
	FRSTX	110022531474	Home Depot US HD6539	N/A	140 North Highway 35 Bypass Alvin, Texas 77511 (Map ID does not show in the correct location.)	
5	LPST	Lee Oil Company, Inc.	096453	Final Concurrence Issued, Case Closed	1655 35 Bypass South Alvin, Texas 75211	Moderate
	PST		16742	Active		
	TIERII		49EZ4S002LQC	N/A		
	TIERII		5NAJUF002A56	N/A		
	FRSTX		110039180310	N/A		
	FRSTX		110033880628	N/A		
	ICISNPDES		TXG830063	Terminated		
	GWCC		096453	Action Completed		

Table 4-25: Regulated Hazardous Materials Sites

Map ID No.	Database Type	Name	ID	Status	Address	Potential Risk (Low/Medium/High)
6	PST	Alvin Express	76318	Active	680 Highway 35 Bypass N Alvin, Texas 77551	Moderate
	FRSTX		110033543636	N/A		
	NOV		RN104793054	Resolved		
7	PST	Red Oak 102	70433	Active	6735 South Highway 35 Alvin, Texas 77511	Moderate
	FRSTX		110034604649	N/A		
	NOV		RN101772002	Resolved		
8	FRSTX	Alvin Plant 384	10041739214	N/A	3030 Highway 35 South Alvin, Texas 77512 (Map ID does not show in the correct location.)	Moderate
9	FRSTX	Wal-Mart 462	110037844517, 110005069996	N/A	1701 Fairway Drive, Suite 500 Alvin, Texas 77511	Low
10	LPST	Exxon 64197	110936	Removed from the ground	1920 East Highway 6 Alvin, Texas 77511	Moderate
	PST	Raceway 6932	26708	Active		
	IHW	Exxon 64197	77054	Inactive		
12	PST	Corner Spot	75038	Active	1809 FM 646 RD W Dickinson, Texas 77539	Moderate
13	RCRAGR06	NTB No. 762	TXR00066357	Active: Small quantity generator	130 North Highway 35 Bypass Alvin, Texas 77511	Low
14	PST	Yellow Jacket Grocery	27202	Abandoned: Active per database	3202 FM 013 Road Alvin, Texas 77511	High
15	PST	7-Eleven Store 36522	69868	Active	2480 South Highway 35 Bypass Alvin, Texas 7551	Moderate
16	PST	Former Wendels Tool Rental	59647	Inactive: All tanks removed from the ground	1640 South Highway 35 Bypass Alvin, Texas 77511	Moderate
	LPST	Wendels Tool Rental	110274	Final concurrence issued; case closed		

Table 4-25: Regulated Hazardous Materials Sites

Map ID No.	Database Type	Name	ID	Status	Address	Potential Risk (Low/Medium/High)
17	RCRAGR06	CVS Pharmacy 6727	TXR000080786	Small quantity generator	1600 South Highway 35 Bypass Alvin, Texas 77511	Low
	IHW		91220	Inactive		
18	IHW	Alvin Pest Control	71284	Inactive	206 Fritz Road Alvin, Texas 77511	Low
19	PST	J.C. Vacuum Service	64447	Inactive: All tanks removed from the ground	4504 South Highway 35 Bypass Alvin, Texas 77511	Low
	IHW		86431	Active		
20	PST	Ninda Conoco	5469	Inactive: All tanks removed from the ground	102 Oak Manor Drive Alvin, Texas 77511	Moderate
21	PST	Alvin Chevron	73788	Active	1650 North Highway 30 Bypass Alvin, Texas 77511	Low
22	NFRAP	Mustang AG Services	TXD981048291	No further action planned	So. of Highway 35 East of Wal-Mart Alvin, Texas 77511	Moderate
	CERCLIS			No further action planned		
23	DCR	Manchester Cleaners	RN104656822	Active	1804 FM 646 West Dickinson, Texas 77359	Low
24	LPST	Diamond Shamrock Stop-n-Go 2382	100420	Final concurrence issued; case closed	2000 East Highway 6 Alvin, Texas 77511	Moderate
	LPST	Chantis Quick Stop	115919	Tank removed from the ground		
	PST	Chantis Quick Stop	23887	Inactive: All tanks removed from the ground		
	LPST	Former Chater Food Store 2698	097792	Final concurrence issued; case closed		
25	PST	Kroger Fuel Facility 321	74864	Active	3100 South Highway 35 Alvin, Texas 77511	Moderate
27	PST	Donald Alford Location	54267	Inactive	3904 County Road 60 Rosharon, Texas 77583	Low

Table 4-25: Regulated Hazardous Materials Sites

Map ID No.	Database Type	Name	ID	Status	Address	Potential Risk (Low/Medium/High)
28	IHW	Farms of Texas Chocolate Bayou Division	39170	Inactive: Small Quantity Generator	201 FM 2917 Alvin, Texas 77511	Low
30	PST	Wal-Mart Store 462	58469	Inactive: All tanks removed from the ground	1701 Fairway Drive, Suite 500 Alvin, Texas 77511	Low
	IHW		74071	Inactive: Conditionally exempt small quantity generator		

Source: GeoSearch 2014; SH 99 Segment B Study Team 2014.

Notes: CERCLIS = Comprehensive Environmental Response, Compensation, and Liability Information System; DCR = Dry Cleaner Registration; FRSTX = Facility Registry System; GWCC = Groundwater Contamination Case; ICISNPDES = Integrated Compliance Information System National Pollutant Discharge Elimination System; IHW = Industrial and Hazardous Waste; LPST = Leaking Petroleum Storage Tanks; N/A = not applicable; NFRAP = No Further Remedial Action Planned; NOV = Notice of Violations; PST = Petroleum Storage Tanks; RCRAGR06 = Resource Conservation and Recovery Act: Generator Facilities; TIERII = Tier II Chemical Reporting Program Facilities.

In addition to the documented sites listed in ***Table 4-25***, the following sites were identified during a March 2014 field visit as a moderate risk because of their location in relation to the proposed ROW of the Preferred Alternative.

- Snider Transmission, Kwik Kar Brakes-Alignments & Inspections, and Kwik Kar Lube & Services are located along the north side of the SH 35 Bypass between FM 1462 and Mustang Road and would be adjacent to the Preferred Alternative ROW.
- Y&T Metal Recycling Center is located at 15902 SH 35 South, just south of FM 2917. ROW would be required from the facility for the construction of the Preferred Alternative.
- The Shop and Alvin Marine is an automotive repair and boat repair shop located at 6202 SH 35 and would be adjacent to the Preferred Alternative ROW.

There is one Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) site, Mustang AG Services (Map ID #22), that would be adjacent to the Preferred Alternative ROW. The records for the site indicated that no further activity is planned for the site, although limited information was available. Therefore, the site was determined to have a potentially moderate risk for the Preferred Alternative to encounter a REC onsite, with possible migration to adjacent parcels. The site is also listed as the only No Further Remedial Action Planned (NFRAP) site that would be adjacent to or within the proposed ROW of the Preferred Alternative, with no further activity planned.

Six sites are listed on the Industrial and Hazardous Waste (IHW) database. Only one of the six records was listed as active. During the March 2014 site visit, several old aboveground storage tanks were observed on the J.C. Vacuum Service property (Map ID #19). The facility appears to be the storage yard and truck yard for a septic tank vacuum service. When located adjacent to the Preferred Alternative ROW, the sites would pose a low risk, if no other records were documented. However, the IHW sites would pose a moderate risk of encountering a REC when located within the proposed ROW for the Preferred Alternative. The J.C. Vacuum Service property (Map ID #19) poses a low risk since it is adjacent to the proposed ROW, not within the proposed ROW.

Two sites are documented in the Resource Conservation and Recovery Act: Generator Facilities (RCRAGR06) database. Only one site is listed as active, NTB No. 762 (Map ID #13). The site has a status listing as a conditionally exempt small quality generator, with no corrective actions. When located adjacent to the Preferred Alternative, the RCRAGR06 sites would pose a low risk because no other records were documented onsite.

Two Groundwater Contamination Case (GWCC) sites would be within or adjacent to the proposed ROW of the Preferred Alternative. The first site, Ky Nun Tong (Map ID #1), is also known as the Alvin Food Mart and is currently still under investigation to determine the extent, composition, and/or other properties and circumstances of the contamination. At the present time, no cleanup has been completed. ROW would be required from the site, meaning the site has a high-risk determination. The second site, Lee Oil Co., Inc. (Map ID #5), is designated as “action complete,” and the remediation has been completed. The site would be considered a moderate risk.

There are a total of 10 Facility Registry System (FRSTX), two Tier II Chemical Reporting Program Facilities (TIERII), one Integrated Compliance Information System National Pollutant Discharge Elimination System (ICISNPDES), one Dry Cleaner Registration (DCR), and four Notice of Violations (NOV) sites that would be within or adjacent to the Preferred Alternative ROW. Each of the sites would pose a low risk, if no other records were documented. However, the sites would pose a moderate risk of encountering RECs when located within the proposed ROW of the Preferred Alternative.

Seventeen petroleum storage tank (PST) sites would be within or adjacent to the Preferred Alternative ROW. A site was documented as a moderate or high risk if the tanks remained onsite and were in use, temporarily out of use, or permanently filled in place. A site was considered a low risk if the tanks were removed from the ground and no other RECs were documented on the site.

As listed below, seven leaking petroleum storage tank (LPST) sites would be within or adjacent to the Preferred Alternative ROW.

- One LPST record had a status of monitoring, and no noted groundwater impacts have occurred.
- One LPST record was issued as final occurrence, case closed, with groundwater impacts.
- One LPST record had a status of pre-assessment/release determination with no apparent receptors impacted.
- Two LPST records were issued final occurrence, case closed, with groundwater impacts.
- Two LPST records were issued final occurrence, case closed, with soils impacts.

Each of the sites that would be within or adjacent to the Preferred Alternative ROW were determined to be a moderate or high risk. The determination was made because of the nature of the release and the potential for encountering residual or migrated contamination within soils or groundwater at or near each location.

Of the 53 hazardous materials sites that would have the potential of being impacted or impacting the Preferred Alternative, four sites (Map ID #1, #7, #12, and #19) would be directly impacted, with the remaining sites being located adjacent to or in close proximity of the proposed ROW. It is anticipated that a Phase II Environmental Site Assessment would be required for each location, as well as for any high or moderate risk sites that would be adjacent to the Preferred Alternative ROW.

To review the hazardous materials Initial Site Assessment (ISA) report please see ***Appendix F***.

4.17.2 Materials Containing Asbestos and Lead-based Paint

The relocation and removal of all existing structures along the Preferred Alternative ROW would require completing asbestos and lead-based paint surveys. Asbestos and lead-based paint inspections, specifications, notification, license, accreditation, abatement, and disposal (as applicable and described further below) would comply with all federal and state regulations. Asbestos and lead-based paint issues would be addressed during ROW acquisition and prior to construction.

If suspect asbestos material is encountered, a mitigation plan for the removal and disposal of any hazardous materials would be developed in accordance with all federal, state, and local regulations, such as the Texas Asbestos Health Protection Act and the National Emissions Standards for Hazardous Air Pollutants. Prior to project letting, an asbestos inspection and subsequent abatement would be conducted for any bridge structures or buildings that would require renovation or demolition. Additionally, the Department of State Health and Human Services is to be notified (with a 10-day notification) prior to asbestos-contaminated materials abatement and/or the demolition of a bridge structure.

The presence or absence of lead-based paint on structures to be demolished is to be determined through testing or process knowledge prior to project letting. If lead-based paint is discovered, contingencies would be developed to address worker safety, material recycling, and proper management and disposal of any paint-related wastes, as necessary.

4.17.3 Potential Impacts from Construction Activities

Storage and use of hazardous materials would be necessary during construction of the Preferred Alternative. Temporary aboveground storage tanks containing oil and diesel would typically be used to provide fuels for equipment and vehicles used for construction. The aboveground storage tanks would be regulated and would require control measures for spills and leaks. Potential impacts could occur from small spills and leaks from fueling and maintenance of the equipment and vehicles. The impacts would likely be minimal and would not pose a substantial impact to the environment. Every effort would be taken to reduce related impacts during construction.

4.17.4 Oil and Gas Well Installations and Pipelines

Based on Railroad Commission of Texas GIS data, 20 of the approximately 117 oil and gas well sites in the proposed SH 99 Segment B study area would be within or adjacent to the Preferred Alternative ROW. ***Table 4-26*** provides a summary of the 20 relevant oil and gas wells, all of which are shown on ***Exhibit 3-13.***

Table 4-26: Oil and Gas Wells Within and Adjacent to the Preferred Alternative

Map ID	Well Status	Well Type	Well ID No.	API No.
1	N/A	Dry Hole	167681	039
2	N/A	Dry Hole	166795	039
3	N/A	Dry Hole	068518	167
4	N/A	Dry Hole	167608	167
5	N/A	Dry Hole	166021	039
6	N/A	Dry Hole	168393	167
7	N/A	Plugged Oil Well	168377	167
8	N/A	Plugged Oil Well	168381	167
9	N/A	Plugged Gas Well	165649	03901558

Table 4-26: Oil and Gas Wells Within and Adjacent to the Preferred Alternative

Map ID	Well Status	Well Type	Well ID No.	API No.
10	N/A	Shut-in-Well (gas)	1087427	03932792
11	Plug	Plugged Gas Well	168384	16730800
12	Plug	Dry Hole	168483	16701806
13	N/A	Dry Hole	165566	039
15	N/A	Permitted Location	165736	039
18	Plug	Dry Hole	166023	03931512
21	Plug	Plugged Gas Well	165650	03901584
23	N/A	Permitted Location	165735	039
25	N/A	Gas Well	1098149	1098149
27	N/A	Dry Hole	166372	039
33	Plug	Dry Hole	165651	03937587

Source: GeoSearch 2014; SH 99 Segment B Study Team 2014.

Notes: API = American Petroleum Institute; ID = identification; N/A = not applicable.

Oil and gas wells located within the proposed ROW of the Preferred Alternative would be plugged. Requirements for the proper plugging procedures are provided in the TAC, Title 16, Part I, Chapter 3, Section 3.14, under the jurisdiction of the Railroad Commission of Texas. Additional investigation would be warranted at any of the sites prior to ROW acquisition.

Naturally occurring radioactive material can be brought to the ground's surface in the formation of water and could accumulate during oil and gas production. Material levels from the water are typically low and are not a problem in Texas, unless accumulation occurs. The accumulation of material could pose health risks to exposed workers if digested or inhaled. However, health effects from potential impacts would likely not be an issue, if wells are plugged and abandoned properly.

The Preferred Alternative would cross 42 petroleum pipelines. The pipelines range in size from 2.38 inches to 36 inches in diameter. During ROW acquisition, additional investigation would be required to determine if removal or adjustments to the pipelines would be necessary. A summary of the petroleum pipelines identified within the study area is presented in ***Appendix F*** of the FEIS.

No-Build Alternative Impacts

Current conditions on existing hazardous materials sites would remain unaltered with the No-Build Alternative, unless remediation plans are in place. Existing remediation plans, would continue to occur independently of the proposed project under the jurisdiction of the TCEQ and EPA.

4.18 VISUAL AND AESTHETIC QUALITIES

The analysis of visual and aesthetic impacts is limited to addressing publicly accessible views of the landscape, which are confined primarily to roadways and public lands. Viewer groups include viewers with potential views from the Preferred Alternative (travelers) and those with potential views of the Preferred Alternative (residents and landowners). Vehicular passengers with views from the Preferred Alternative may originate from the local area, Texas, or others outside state boundaries who are visiting the area.

4.18.1 Preferred Alternative Visual Impacts

Visual and scenic resources along the Preferred Alternative would include streams, wetlands, riparian areas, and pastureland. Riparian areas are presently adjacent to Dickinson and Chocolate bayous and their tributaries. However, the riparian areas and the other resources noted above are not unique in the context of regional landscape features.

As discussed in ***Section 1*** of the FEIS, the Preferred Alternative would be constructed within a 400-foot ROW with some highway curves and bridging that would potentially provide scenic views of the area's natural features. Fertile soils and relatively level topography have made the proposed SH 99 Segment B study area ideal for agricultural purposes, but the opportunities for scenic vistas are limited because of the flat terrain.

Near the western terminus and in some areas closer to the eastern terminus, construction of the Preferred Alternative would require the removal of existing vegetation that may be considered a favorable aspect of the scenic atmosphere. Although visual impacts to residential structures and other developments located in close proximity to the Preferred Alternative may occur, the scattered nature of the rural residential developments would limit the number of residents and structures potentially affected. In areas near Alvin or IH 45 South, the scenic attributes tend to be more urban in character, with structures and commercial activities typical with that of highway ROW and more densely developed areas.

Where practical, mitigation measures would establish vegetation within medians, minimize ROW clearing design specifications in order to blend into the existing landscape, and promote roadside native wildflower planting programs. All landscaping would be in accordance with Executive Order 13112 on invasive species and the Executive Memorandum on beneficial landscaping, including the use of regionally native plants for landscaping and implementing design and construction practices that minimize adverse effects on the natural habitat. To the extent possible, the Preferred Alternative would be designed to create a visually and aesthetically pleasing experience for the traveler and the adjacent residents and landowners.

4.18.2 Preferred Alternative Aesthetic Impacts

The rural character and aesthetic quality of the western portion of the study area would be impacted by construction of the Preferred Alternative because of the changes in noise and ambient light along the proposed ROW and within the surrounding areas. Final design would incorporate the findings of the noise analysis, and if appropriate, noise barriers would be constructed to minimize noise intrusion on the surrounding communities. Ambient light levels would also be monitored and considered in final design so as to not impose an undue burden for those living near the Preferred Alternative.

4.18.3 No-Build Alternative Impacts

The No-Build Alternative would not result in direct impacts to the visual and aesthetic qualities of the study area. However, projected increases in traffic congestion associated with the No-Build Alternative could lead to short and long-term impacts on the visual quality of the area for users of the roadway network and for landowners adjacent to the roadway network.

4.19 ENERGY

Energy, in the form of various fossil fuels and electricity, would be necessary during construction, maintenance, and future repair of the Preferred Alternative. ROW clearing, roadway base grading and preparation, and travel lane installation and finishing would require varying levels of energy to accomplish. Energy use would increase proportionally relative to the length of the highway and the number of features incorporated into the design (e.g., bridges/overpasses and drainage crossings).

Following construction, routine maintenance of the proposed ROW, maintenance of the travel lanes, and highway repairs (conducted on an as-needed basis) would also require energy use. Diesel fuel would be the primary type of energy required during construction, maintenance, and repair activities. Necessary fuel supplies would likely be available from fuel storage or vending sources in the area. Electrical demand would not affect the electrical supply characteristics of the region. Prudent energy conservation features would be incorporated into final design whenever possible. Overall, energy requirements for the Preferred Alternative would not have a substantial impact on energy requirements of the proposed SH 99 Segment B study area, the region, the state, or the U.S.

Completion of the Preferred Alternative would ease congestion within the study area by diverting vehicles from current travel routes. Decreased vehicle delays and more efficient vehicle operating speeds would allow for increased energy efficiency along the Preferred Alternative and within the study area. Long-term operational energy savings would be expected to offset the initial energy requirements to construct the Preferred Alternative.

No-Build Alternative Impacts

The No-Build Alternative would not result in any associated energy consumption in or around the study area. However, congestion would continue to increase in the study area on local roadways, and travelers would not have additional travel options within the study area and larger region. The lack of options would lead to increased travel times and energy consumption in and around the study area.

4.20 CONSTRUCTION IMPACTS

The following section describes potential impacts from construction of the Preferred Alternative. The section only includes construction impacts for resources that were not discussed in the previous sections.

The Preferred Alternative would result in construction impacts affecting residents and businesses within the proposed SH 99 Segment B study area and the traveling public in the vicinity. Potential impacts may include:

- Temporary degradation of air, noise, and water quality;
- Temporary disruption of traffic for residents, businesses, and travelers, including maintenance, traffic control, and safety concerns;
- Public health and safety hazards;
- Stockpiling and disposing of construction materials and waste;
- Use of borrow areas and the construction and use of haul roads; and
- Temporary disruption of utilities.

All construction impacts would be temporary in nature, and an estimate for constructing the Preferred Alternative would be a construction let date of 2020, with an estimated construction completion date of 2023. A more accurate construction schedule would be established during final design. Postings of the current project status and milestone construction schedules would be available on the GPA website at http://www.grandpky.com.

4.20.1 Water Quality Construction Impacts

As noted, construction of the Preferred Alternative would require a USACE Section 404 permit. A condition of the permit would be that appropriate soil erosion and sediment controls be implemented and maintained in effective operating condition during construction. The contractor would be required to apply BMPs for erosion and sediment control and exercise reasonable precautions during construction to prevent pollution of bayous, streams, canals, and similar water bodies. Temporary erosion control features may consist of berms, dikes, temporary seeding, sediment traps, geotextile fiber mats, silt fences, hay bales, slope drains, mulches, crushed stone, and any other measures applicable under TxDOT guidelines. High priority would be given to the treatment of stream banks and areas of construction access. Effects to water quality resulting from erosion, sedimentation, and pollutants (e.g., chemicals, sewage, and other harmful waste) would be controlled in accordance with TxDOT guidance documents, such as *Storm Water Management Guidelines for Construction Activities* (TxDOT 2002) and *Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges* (TxDOT 2004).

4.20.2 Maintenance and Control of Traffic

Construction work would be planned and scheduled to maintain the flow of traffic on the existing roadway network and to minimize adverse impacts to all travelers. Traffic control measures would be implemented through traffic control plans and construction contract specifications as outlined in *Texas*

Manual on Uniform Traffic Control Devices (TxDOT 2012) guidelines. News releases of major construction activities and schedules would be provided to the local public. Emergency service providers (police protection, fire protection, and EMS) would receive notification and accommodations prior to roadway construction or ramp closings. With this information, emergency responders can plan their detours in advance of an emergency situation.

Although the majority of the Preferred Alternative would be constructed on a new location, traffic on area roadways would still be disrupted. The portions of intersecting roadways required to remain open for traffic would be relatively short, but a section of the Preferred Alternative within and south of Alvin would incorporate a portion of SH 35. The area would require special attention and traffic control plans. The number of disturbances within individual communities would be limited as much as possible. Because traffic disturbances on existing streets would be limited, most of the traffic control practices would use flagging operations and temporary widening of existing roadways. Work zone signage in accordance with the Texas Manual on Uniform Traffic Control Devices (TxDOT 2012) would also be used.

4.20.3 Health and Safety

The contractor would comply with all federal, state, and local laws, including Occupational Health and Safety Administration regulations governing safety, health, and sanitation. Reasonable safety measures and safeguarding actions would be implemented to protect the life, health, and property of construction personnel and the general public throughout the construction phase of the Preferred Alternative. The contractor would develop a site-specific health and safety plan for areas that are determined to pose risks associated with potential hazardous materials contamination.

4.20.4 Pollution Control

Roadway and bridge construction activities would involve excavation of possibly unsuitable materials, placement of embankments, and use of highway construction materials (e.g., crushed aggregates, asphalt, and cement). Stockpiling and disposal of excavated and construction materials may be considered aesthetically displeasing by some residents and businesses within study area. Through the use of BMPs for erosion control measures, stockpiling would be a temporary condition and would cause no adverse permanent impacts. The contractor would place erosion and pollution control measures on haul roads, construction access areas, borrow pits, embankments, and areas designated for disposal of waste materials.

The Preferred Alternative and its associated facilities (e.g., on-ramps and off-ramps) would be adjusted during final design to avoid or minimize impacts to streams and other environmentally sensitive areas.

4.20.5 Construction Impact Coordination

Utilities in the study area include water, wastewater, oil and gas pipelines, electric transmission lines, and telecommunication lines. To minimize impacts to and avoid disruption of any utility facility, the contractor would contact the appropriate utility vendor or officials to coordinate work schedules.

Other construction activities requiring coordination with local and state officials may include stockpiling of borrow and waste materials, materials collected as a result of clearing and grubbing, and construction of haul roads. The contractor would obtain the necessary permits and clearances for borrow pits and project-specific locations identified outside the proposed ROW of the Preferred Alternative.

No-Build Alternative Impacts

The No-Build Alternative would not result in construction-related impacts.

4.21 THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES VERSUS LONG-TERM PRODUCTIVITY

The short-term uses of the environment associated with the Preferred Alternative would be typical of roadway construction and would have limited impacts. As described throughout, short-term impacts from construction may include disturbances to local businesses and residences that have the potential to produce minor traffic delays. Other short-term environmental impacts may involve:

- Minor air quality impacts from clearing, earthwork, construction, and fugitive dust from construction vehicles;
- Construction-related noise impacts that would normally be limited to daylight hours when occasional loud noises are more tolerable;
- Temporary water quality impacts; and,
- Visual impacts related to construction.

In comparison, the primary long-term benefits of the Preferred Alternative would be improved local and regional system linkage, decreased congestion, increased safety, and improved emergency evacuation. Additionally, several long-term economic benefits would result from construction.

No-Build Alternative Impacts

The No-Build Alternative would not lead to any short-term use impacts or have any impacts on long-term productivity.

4.22 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Construction of the Preferred Alternative would involve the commitment of natural, physical, human, and fiscal resources. Land use for the Preferred Alternative would be considered an irreversible commitment during the period that the land is used for a transportation purpose. However, if a greater need arose, or if the highway is no longer needed, the land could be converted to another use. Presently, there is no reason to consider that a greater need would require the proposed roadway to be converted to another use.

Natural resources that would be required for construction include aggregate, cement, asphalt, sand, and iron ore for steel products. Once used for construction, the resources cannot be replaced as natural resources. As the resources are readily available, use would not have an adverse effect on continued availability of the resources.

Construction would also require an expenditure of fossil fuel. Although fossil fuel is an irretrievable resource, the amount expended toward construction could be offset by the benefits of improved mobility in the region that could improve fuel efficiency.

The commitment of resources would be based on the concept that residents in the immediate area, region, and state would benefit by the improved quality of the transportation system. The benefits would consist of improved mobility, safety, and system linkage, resulting in time savings and infrastructure to support population growth. Overall, the benefits would be anticipated to outweigh the commitment of resources.

No-Build Alternative Impacts

The No-Build Alternative would involve no irreversible or irretrievable commitment of resources.

4.23 PREFERRED ALTERNATIVE RECOMMENDATION

The purpose of the proposed SH 99 Segment B is to provide system linkage, expand capacity, support economic development, and enhance safety by providing an additional emergency evacuation route. As discussed in ***Section 2*** of the FEIS, the No-Build Alternative would not accommodate projected traffic volumes within the proposed SH 99 Segment B study area or offer linkage amongst area transportation systems. In addition, the No-Build Alternative would not support economic development or enhance safety by providing an additional emergency evacuation route.

After review of public and agency input and evaluation of environmental, engineering, and traffic criteria, the South-New Alternative was selected as the Preferred Alternative. The South-New Alternative received the most support from the general public and elected officials. The Preferred Alternative would be approximately 28.6 miles in length and would require approximately 1,072 acres of proposed ROW.

SECTION 5: INDIRECT IMPACT ANALYSIS

Section 5 describes the indirect impact analysis conducted for the proposed SH 99 Segment B's Preferred Alternative. The analysis was conducted in accordance with CEQ, FHWA, and TxDOT regulations and guidance documents. CEQ defines indirect impacts as:

> Effects, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems. (40 CFR 1508.8)

As to the cause and effect relationship between the Preferred Alternative and any indirect impacts, CEQ defines related indirect impacts that may include induced changes to land use resulting in resource impacts. Other indirect impacts may involve the potential alteration of, or encroachment on, the physical environment.

TxDOT's *Guidance on Preparing Indirect and Cumulative Impact Analyses* defines three general categories of indirect effects:

- Encroachment-Alteration Effects
- Access-Alteration Effects (or Project-Influenced Effects), and
- Effects Related to Project-Influenced Development (TxDOT 2010).

The resources from ***Section 4*** of the FEIS were evaluated based on the three categories and were narrowed in focus based on the analysis. As a result, the resource categories that were evaluated for potential indirect effects were land use, farmlands, communities/quality of life (social) resources, air quality, water quality, floodplains, wetlands and waters of the U.S., vegetation and wildlife habitat, archeological and historical resources, and visual aesthetics.

It was determined that the above-listed resource categories would be indirectly impacted by one or more of the indirect effect categories through methods such as ROW acquisition (encroachment-alteration), mitigation of water bodies (access-alteration effects), or expansion or increase in development activity (project-influenced development). The examples are just some of the items that may be indirectly impacted. Additional analysis is provided herein for each resource category.

Methodology

The methodology for the indirect impact analysis is based on the findings in the National Cooperative Highway Research Program (NCHRP) *Report 466: Desk Reference for Estimating Indirect Effects of Proposed Transportation Projects* and the revised *Guidance on Preparing Indirect and Cumulative Analyses* (NCHRP 2002; TxDOT 2010). Both sets of guidance specify a seven-step process for analyzing indirect impacts. Another reference that was used is the NCHRP 25-25, Task 11, *Indirect and Cumulative*

Impact Analysis, which elaborated further on some of the terminology and definitions that are used for indirect impact analyses (NCHRP 2006).

Step 1: Scoping

Step 2: Identify the Study Area's Goals and Trends

Step 3: Inventory the Study Area's Notable Features

Step 4: Identify Impact-Causing Activities of Proposed Action and Alternatives

Step 5: Identify Potentially Substantial Indirect Effects for Analysis

Step 6: Analyze Indirect Effects and Evaluate Results

Step 7: Assess Consequences and Consider/Develop Mitigation (when appropriate)

5.1 STEP 1: SCOPING

Step 1 identifies the context for the indirect impact analysis by setting the appropriate boundaries (or the Area of Influence [AOI]) for the analysis. Transportation improvements often reduce the time/cost of travel, enhancing the attractiveness of surrounding land to developers and consumers. Development on undeveloped land, or the conversion of the built environment to more intensive uses, is often a consequence of highway projects (NCHRP 2002).

One starting point for establishing an adequate AOI begins by understanding that "development effects are most often found up to 1 mile around a freeway interchange, up to 2 to 5 miles along major feeder roadways to the interchange, and up to one-half (sic) mile around a transit station" (NCHRP 2002).

According to the TxDOT, there are three approaches most often used to establish an AOI:

- The AOI and Study Area for direct impacts are the same;
- The AOI is based on a commute shed; or
- The AOI is based on habitat (TxDOT 2010).

Due to the magnitude that the Preferred Alternative would be a newly constructed, limited-access highway, the optimal method selected was to analyze the commute shed. The initial physical boundary of the AOI was developed by analyzing RAZ/TAZ data and jurisdictional boundaries and by considering existing features and constraints. Once the initial AOI was defined by desktop analysis, the Preferred Alternative AOI, as shown on ***Exhibit 5-1***, was defined through one-on-one meetings held with several of the local jurisdictions and other groups that track and monitor social and economic indicators in the region. Meetings were held with Alvin, Friendswood, Angleton, Brazoria County, League City, Alvin ISD, and the Bay Area Houston Economic Partnership to establish a temporal and physical boundary of the AOI. After meeting with each group and other entities, it was determined that the initial AOI would remain as the AOI for the indirect effects analysis of the Preferred Alternative.

As illustrated, the AOI is approximately 397,239 acres and 620 square miles in total. It is bounded on the north by the jurisdictional boundaries of the City of Brookside Village (Brookside Village), the City of

Pearland (Pearland), Friendswood, League City, and the City of Clear Lake (Clear Lake). The western boundary is the Brazoria County/Fort Bend County line. The southern boundary is RAZ Nos. 167 and 168. The eastern boundary is SH 146 and RAZ No. 179.

According to the NCHRP, "Temporal boundaries should correlate to impacts or actions that would be reasonably foreseeable" (NCHRP 2002). When considering the temporal boundary for the AOI, it was determined that the planning horizon of the *2035 RTP Update* would be the most relevant measurement because ancillary growth as a result of transportation improvements in the AOI would be reasonably foreseeable until 2035. It is understood that development would continue past 2035; therefore, the analysis does not represent the ultimate development.

5.2 STEP 2: IDENTIFY THE STUDY AREA'S GOALS AND TRENDS

Step 2 focuses on assembling information regarding general goals and trends within the study area (or the AOI). The goals and trends in question are independent of the Preferred Alternative and typically involve social, economic, ecological, and/or demographic issues.

5.2.1 Goals

As noted in ***Section 4.1*** of the FEIS, Alvin, Dickinson, and League City all have comprehensive plans that contain goals for how each city sees their futures. While not all the cities and communities in the AOI have stated goals in regards to their future, the omission or lack of identifying those goals is considered suitable for their size, population, and density. Those cities that did have the opportunity to identify goals are larger in scale, and the cities found that the lack of goal-setting would hamper a desirable outcome for the ongoing growth.

Alvin's comprehensive plan is broken down into topic areas, and within each topic, goals are identified (Alvin 2005). The topic areas include land use, parks and recreation, and growth strategies. The overall vision for Alvin is that "a vision is the first step toward understanding the past, recognizing existing circumstances, collectively deciding on a preferred scenario, and setting a course of action for realizing what is envisioned in its future…Casting a vision allows the community to come together to decide what it will be like in 20 years, and to put a plan in motion to achieve it" (Alvin 2005). Alvin is positioned to experience the greatest impact as a result of the Preferred Alternative, and based on conversations held with their Economic Development Director; Alvin has planned for and anticipated implementation of the proposed SH 99 Segment B. As of spring 2014, Alvin has been updating its Comprehensive Plan and anticipates continuing to be mindful of the impact the Preferred Alternative would have on their long-range planning efforts.

Dickinson did not have a full comprehensive plan available, but the City did outline several goals within its land use policies.

- Achieve a balanced and desirable pattern of land uses within the City.
- Meet the housing needs of Dickinson residents by developing and maintaining safe, attractive and high-quality neighborhoods.

- Encourage viable, vibrant and well-designed commercial areas with a variety of uses to serve community-wide as well as more localized needs.
- Focus industrial development in selected areas with adequate utilities and transportation access and set apart from any existing or future residential neighborhoods or other incompatible land uses. (Dickinson 2004)

League City's *2035 Comprehensive Plan* is also broken down into topic areas and then goal-setting. The topic areas are land use, mobility, parks and recreation, hazard mitigation, community facilities, infrastructure, and economic development (League City 2011). Within each of these topic areas, goals and policies were identified, and are too numerous to mention herein. However, the plan did summarize the issues the City chose to address for an overall assessment on how the plan would help overcome its current infrastructure needs.

- Difficult to sustain development patterns
- Failure of transportation and stormwater infrastructure to keep pace
- Inadequate water capacity
- Lack of common focus, sense of identity and community ownership
- Missing great places
- Retail and employment leakage (League City 2011)

Interviews with League City staff revealed that there is a pending master planned area east of IH 45 South that it hopes to develop. Some of the necessary utilities have been put in place, but without implementation of the Preferred Alternative, the development is likely to be delayed.

5.2.2 Trends

One of the more dominant transportation features in the western portion of the AOI is SH 288. Construction of SH 288 from Houston into Brazoria County in the late 1970s to the early 1980s provided access to large tracts of undeveloped land previously only accessible by two-lane county roads. Construction of SH 288 was considered one of the key items that brought development to that part of the region.

A large portion of the AOI remains undeveloped, much of which is in agricultural production for crops and livestock. Alvin is near the center of the AOI, at the junction of SH 6 and SH 35. Alvin is the oldest city in Brazoria County with a population of approximately 24,326 (U.S. Census 2010). League City, in the northeastern portion of the AOI, is one of the largest cities in the AOI, with a population of approximately 83,560 (U.S. Census 2010). Low-density residential land use is scattered throughout the AOI, with retail, commercial, high-density residential, and other land uses concentrated in the northern portion of the AOI, in addition to along and near major roadways, such as FM 517, FM 518, SH 6, SH 35, SH 288, and IH 45 South.

5.2.2.1 Population Trends

Between 2010 and 2035, Brazoria County, Galveston County, and cities in the AOI are projected to have population, household, and employment increases. ***Table 5-1*** uses U.S. Census data for 2010 population, but all other data was obtained from H-GAC's 2035 population, household, and employment projections. The trends show increases in population, employment, and households for Brazoria County, Galveston County, and all of the cities within the AOI. Housing and associated commercial development is occurring in response to the demand created by the increasing population and employment in the region.

Table 5-1: Existing and Projected Population, Employment, and Households for Associated Counties and Cities in the AOI

Location	Population		Households		Employment	
	2010	2035	2010	2035	2010	2035
Alvin	24,236	29,544	9,184	11,223	9,571	13,106
Bonney	310	475	146	188	355	395
Brookside Village	1,523	2,257	571	855	133	215
Clear Lake Shores	1,063	1,999	615	867	337	347
Danbury	1,715	2,007	603	718	655	830
Dickinson	18,680	24,318	6,375	9,797	3,124	4,891
Friendswood	35,805	50,185	12,229	19,712	5,399	9,664
Hillcrest Village	730	783	275	329	1	5
Iowa Colony	1,170	3,220	304	1,218	49	193
Kemah	1,773	3,216	944	1,406	2,637	4,669
La Marque	17,509	22,420	6,249	9,858	6,129	10,619
League City	83,560	84,630	21,224	33,434	14,261	21,474
Liverpool	482	568	195	213	6	11
Manvel	5,179	12,035	1,552	4,630	1,453	2,754
Pearland	91,252	93,477	23,492	35,980	24,278	38,262
Santa Fe	12,222	17,138	5,045	7,188	5,109	8,771
Brazoria County	313,166	541,341	109,183	183,926	102,027	147,719
Galveston County	291,309	504,790	113,708	168,850	117,061	169,492

Source: U.S. Census 2010 (Summary File 1, Table P9); H-GAC 2014d.

Note: Algoa and Sandy Point are Census designated places, and data was not available to include in the table.

5.2.2.2 Transportation Trends

The anticipated population and employment growth would be expected to increase the number of vehicles using the existing transportation infrastructure, thereby potentially increasing travel times for commuters and travelers, and possibly influencing travel routes and the selection of business/commercial destinations. The TTI annually ranks major metropolitan areas with respect to the level of traffic congestion occurring on highways. Since 1992, the TTI Roadway Congestion Index for the Greater

Houston area has continued to rise. TTI reports that nearly 69 percent of all peak-period travel in the Greater Houston area experiences considerable congestion (TTI 2012). Anticipated population and employment growth in the region is expected to intensify the condition.

H-GAC, with input from TxDOT, METRO, local governments, and the community, has developed a long-term transportation plan. The *2035 RTP Update* offers multiple transportation alternatives and modes in major corridors throughout the region. However, even with the planned investment in the transportation system over the next 20 years, the trend of increasing congestion is expected to continue because of the continued population and employment growth in the region. Therefore, the same trend is anticipated to occur within the AOI as well.

5.2.2.3 Development Trends

The majority of development in the AOI has been largely single-family developments with supporting commercial uses (***Exhibit 5-1***). ***Exhibits 5-2*** through ***5-5*** show the sequence of development over time in relation to the temporal boundary for the AOI. As demonstrated through the Exhibits, development has increased in the region. Each type of development is primarily associated with established communities situated in the northern and eastern portions of the AOI. Existing residential and commercial development is concentrated around existing communities, such as Alvin, Friendswood, League City, Manvel, Pearland, and Santa Fe. Some low-density residential areas are interspersed throughout the AOI; however, the majority of the central and southern portions of the AOI are undeveloped land. Isolated dwellings and vacant large lots associated with agricultural activities exist in rural portions of the AOI. Except for SH and FM roadways, the transportation network in the AOI is somewhat discontinuous. There are numerous self-contained, isolated dwellings and vacant large lots, with little interconnectivity of the roadway network. Thoroughfares are typically constructed as area development occurs, leaving gaps between communities. Schools and medical services have followed the residential growth southward. It is anticipated that the development that has occurred in southern Brazoria and northern Galveston counties will continue.

Based on historic aerial photographs, approximately 25,500 acres of the AOI were developed in 1975, or roughly 7 percent of the AOI. Development increased to approximately 33,400 acres in 1987 and 50,000 acres in 1995, or about 14 percent of the AOI. During the 20-year period, the average increase of developed area was approximately 3.5 percent per year. By 2008, the amount of developed land was about 89,400 acres, or approximately 25 percent of the AOI. Development in the AOI increased approximately 39,400 acres from 1995 to 2008, a rate of almost 4.5 percent per year. The amount of developed land in 2012 was approximately 105, 400 acres. Based on the changes in development acreage historically, it is evident that development in the area will likely continue to increase.

As noted above, most of the AOI is in the unincorporated area of Brazoria County where there are few land use controls. The unincorporated areas of Brazoria County and Alvin have no zoning, so there would likely be few restrictions to development in that portion of the AOI once access is provided aside from utilities development, building codes, economics, and natural constraints, such as floodplains. Large undeveloped tracts may be suitable for the assemblage of land for large developments, especially in the

southern portion of the AOI. Pearland and other areas, such as League City and Friendswood in Galveston County, have zoning that provides some land use controls in undeveloped areas. It is important to note that the overall development trend is neither declining nor static, but is increasing. The Preferred Alternative would possibly support the trend by providing new transportation infrastructure.

5.3 STEP 3: INVENTORY THE STUDY AREA'S NOTABLE FEATURES

Step 3 involves gathering additional data on environmental features and compiling the data to create a baseline of ecosystem conditions, socioeconomic conditions, and notable features. The baseline would be used to assess notable features or specifically valued, vulnerable, or unique elements of the environment that could be indirectly impacted by the Preferred Alternative. The notable features found in the AOI are depicted on ***Exhibit 5-1.*** Because of the size and magnitude of the AOI, the list of notable features in its entirety is not included herein, but some key features have been identified in ***Section 5.3.1*** through ***5.3.3***. A more complete listing is depicted on ***Exhibit 5-1***.

The resources analyzed in ***Section 3*** and ***Section 4*** of the FEIS identified and evaluated the direct impacts to all applicable resources. Notable features associated with each resource could be indirectly impacted within the AOI. Within the resources, there were a number of features that should be highlighted.

5.3.1 Ecosystem Conditions

Because a significant majority of the AOI is former or existing pastureland, there are vegetative ecosystem conditions still in place. However, south and east of the AOI, along Galveston Bay and the Gulf of Mexico, there are numerous refineries that have had an impact on the natural ecosystems of the region, particularly the water-dependent ecosystems. Within the AOI, Cedar Creek, Chocolate Bayou Tidal, Clear Creek Above Tidal, Clear Creek Tidal, Dickinson Bayou Tidal, Flores Bayou, Geisler Bayou, Gum Bayou, Halls Bayou Tidal, Jarbo Bayou, Magnolia Creek, Moses Bayou, Oyster Creek Above Tidal, and an Unnamed Tributary of Mary's Creek are water segments on the TCEQ's 2012 303(d) list of impaired waters, indicating that each water segment does not meet designated water quality standards (TCEQ 2014b). Elevated bacteria is the most frequently recorded water quality concern for the stream segments, with depressed dissolved oxygen, dioxin, and polychlorinated biphenyls being additional concerns for some water segments. Elevated bacteria levels can be caused by agricultural activities, stormwater runoff, and wastewater overflows from treatment facilities or septic systems. Stormwater runoff and discharges into other streams and drainage-ways from developed, undeveloped, and agricultural areas could affect other water courses and tributaries within the AOI.

5.3.2 Socioeconomic Conditions

There are a variety of features that influence the socioeconomic conditions of the AOI. As described in ***Section 3***, ***Section 4***, and ***Section 5.4.3*** of the FEIS, the socially related direct and indirect impacts are assessed in detail. In terms of the socioeconomic attributes that are noteworthy, there are a number of publicly and privately owned parks, recreational areas, and facilities within the AOI:

- The Thelma Ley Anderson Family YMCA,

- The Nolan Ryan Center,
- Camp Mohawk,
- TxDOT SH 35 roadside rest area,
- Brazoria County Chocolate Bayou boat ramp,
- Resoft Park,
- The Alvin Youth Livestock Area Association Rodeo Grounds,
- Big League Dreams Park,
- Bayou Wildlife Park, and
- Skeeter MX Park.

There are also 80 public and private schools within the Alvin, Clear Creek, Dickinson, Friendswood, Pearland, and Santa Fe ISDs. Private schools are run independently from the ISDs. The region is also represented well with religious facilities, as107 religious facilities are in Brazoria County and 77 are in Galveston County.

Due to the rich history found in this region, numerous historic features have been commemorated. The Alvin Museum Society is an all-volunteer organization that operates the Alvin Historical Museum and the Marguerite Rogers House Museum. While there are several cemeteries found in the AOI, there is a historically significant one that is simply referred to as the Confederate Cemetery. It is located in Alvin and was founded in June 1898. The Magnolia Creek Cemetery (a.k.a. Butler Cemetery) is in League City. The first recorded burial was in 1859. While it is only 4 acres in size, in 1982 the cemetery was deemed a historical site by the Texas Historic Commission. ***Section 5.4.11*** of the FEIS provides additional information on the cemetery.

5.3.3 Notable Features

According to the TxDOT, notable features can be narrowed in scope by highlighting sensitive species and habitats, valued environmental components, unusual landscape features or things that are of relative uniqueness, and elements of the population that might be considered vulnerable (TxDOT 2010). For the indirect impact analysis, the highlighted notable features are identified using TxDOT's approach.

5.3.3.1 Sensitive Species and Habitats

According to the TCEQ Texas Water Quality Inventory, 36 water segments are identified within the AOI. There are also numerous tributaries and smaller drainages leading to the water segments. The water segments are associated with six watersheds in the AOI: Austin Bayou, Clear Creek, Dickinson Bayou, Halls Bayou, Middle Oyster Creek, and Mustang Bayou.

According to NWI mapping, the majority of the wetlands in the AOI are forested and emergent wetlands, comprising approximately 35 percent and 17 percent of the wetlands in the AOI, respectively. Lacustrine and estuarine wetlands comprise approximately 13 percent each of the wetlands in the AOI, and

freshwater ponds comprise approximately 12 percent. The remaining wetlands mapped in the AOI are scrub-shrub and riverine wetlands, comprising approximately 5 percent each.

The AOI is primarily level pastureland used for farming and grazing. Areas in active agricultural production or livestock pasture are typically dominated by herbaceous species. Fallow and active agricultural fields, livestock pasture, woodlots, riparian areas, and water courses within the AOI provide a variety of habitat types for indigenous and transient wildlife species. Developed areas generally do not provide the same variety of habitats as found in undeveloped areas; however, such areas do provide habitat for certain species of wildlife that have adapted to living in urban conditions.

The eastern portion of the AOI contains estuarine habitats; however, federally and state-listed sea turtles would be unlikely to occur in the estuarine areas. The Texas City Preserve, which supports a population of the endangered Attwater's greater prairie-chicken, is located near the eastern boundary of the AOI. Habitats potentially supporting state-listed threatened and endangered species and SGCN are likely within the AOI, and listed bird species (e.g., peregrine falcon, Eskimo curlew, Sprague's pipit, and snowy plover) may occur as migrants through the AOI.

5.3.3.2 Valued Environmental Components

Chocolate Bayou (within the Mustang Bayou watershed) and Oyster Creek are considered both historical and environmentally valuable to the region. Both water bodies serve the region with widespread access and contribute to the overall water bodies for the AOI as well as the region.

5.3.3.3 Unique Landscape Features

There are no unique landscape features found in the AOI. The vegetation found in the AOI is described in detail in ***Section 5.4.9*** of the FEIS.

5.3.3.4 Vulnerable Population

Vulnerable populations were evaluated as a component of the social impacts analysis. As noted in ***Section 5.4.3*** of the FEIS, construction of the Preferred Alternative would traverse areas of existing rural development such as farms and low-density residential areas. The Preferred Alternative would also affect existing residential and commercial areas along SH 35 and FM 646. Displacement of residents and commercial businesses from areas within the proposed ROW of the Preferred Alternative would be 17 residential displacements and 13 business displacements. The Preferred Alternative would require ROW from approximately 236 parcels. Displacement of residences and businesses, and loss of property would be an unavoidable consequence of constructing the Preferred Alternative. The Preferred Alternative would also increase traffic noise, affect visual and aesthetic quality, and there would be short-term impacts from construction. However, anticipated mobility and accessibility would benefit the nearby communities and the traveling public.

5.4 STEPS 4 THROUGH 7 PER RESOURCE

5.4.1 Land Use

Step 4: Identify Impact-Causing Activities of the Proposed Action and Alternatives

The Preferred Alternative would require 1,072 acres of new ROW. The acquisition of ROW for the Preferred Alternative could divide larger tracts of land.

Residential and commercial displacements for the Preferred Alternative would be 17 and 13 displacements, respectively. Residential and commercial properties are available for sale or lease in the AOI; however, displaced residences and businesses may or may not relocate in the AOI. A summary of the displacements under the Preferred Alternative is shown on ***Table 4-5***.

Development within the AOI is subject to fluctuations in the economy and necessary approvals by city and community leaders (e.g., city council and town council). Based on the best available data at the time the section was prepared, proposed and/or planned development projects are shown in ***Table 5-2***.

Table 5-2: Proposed and Planned Development within the AOI

Land Developments in the Study Area	Project Location	Project Type	Project Acreage[a]
Bay Colony	Near IH 45 South and FM 646	Single-family residential development with some commercial development	664
Bay Colony West	Near IH 45 South and FM 646	Single-family residential development with some commercial development	338
The Duncan PUD	FM 517 to 2.1 miles north (adjacent to and west of Prairie Estates)	Single-family residential development with community and commercial facilities	1,705
The Lloyd PUD	FM 517 to the American Canal	Single-family residential, commercial, light industrial and public uses	2,051
The McAlister PUD	FM 517 to the American Canal (between the Lloyd PUD properties)	The majority designated as single-family residential. Other future uses include public, light industrial commercial, and multi-family residential	838
The Victory Lakes PUD	East of IH 45 South near FM 646	Single-family residential, commercial, and public	542
Kendall Lakes	Located between Burlington Northern Santa Fe Railroad and SH 35, on the north side of the City of Alvin	Residential development	600
Morgan's Point	Located adjacent to CR 144, adjacent to Pine Colony subdivision	Residential development	293
Presidio at Manvel	Located at SH 6 and SH 288	Planned mixed use, including single-family residential, commercial, civic, etc.	394
Seven Oaks Ranch	South of SH 6, east of SH 288 at CR 56	Mixed residential, civic, open space, and commercial	1,498
Lakes of Savannah	2.3 miles west of SH 288, 1.6 miles east of FM 521	Residential development	1,425

Table 5-2: Proposed and Planned Development within the AOI

Land Developments in the Study Area	Project Location	Project Type	Project Acreage[a]
Magnolia Bend	East of SH 288 frontage road and South of CR 63	Residential development	115
Palm Crest	East of SH 288, 1 mile north of FM 1462	Residential development (Custom Home Builders)	165

Source: SH 99 Segment B Study Team.

[a] Acreages of land development projects are approximations.

Notes: CR = County Road; FM = Farm-to-Market; IH = Interstate Highway; PUD = Planned Unit Development; SH = State Highway.

Step 5: Identify Potentially Substantial Indirect Effects for Analysis

Predicting specifically where and when development might occur in the AOI is difficult. Development generally tends to follow established infrastructure patterns, and in turn, additional infrastructure (e.g., transportation improvements) follows development. The Preferred Alternative would provide access to properties and areas with previously limited access, potentially making the areas more desirable for development. Indirect effects were identified and examined for the potential to be substantial.

Encroachment-alteration Effects

Construction of the Preferred Alternative would be a new roadway primarily on a new alignment, traversing areas of developed and undeveloped land. The highway would provide access to areas that presently have limited or no access via public roads. The Preferred Alternative would involve 30 displacements, which include residences and businesses. Property values may potentially change in the vicinity of the Preferred Alternative, if constructed. Portions of vegetation communities would be converted to highway use, possibly fragmenting wildlife habitat, and wildlife would be displaced into other habitat areas adjacent to or near the proposed ROW of the Preferred Alternative. Stormwater flows would be redirected to roadside drainage swales, and detention facilities would be constructed to regulate the discharge of stormwater flows.

Induced Growth Effects

The presence of the Preferred Alternative is expected to result in some amount of additional development within the AOI, which would include the conversion of presently undeveloped lands to developed conditions, and possibly a change of some areas from a present use to a different use. The conversion of such areas to new or different land uses would remove existing vegetation and replace it with structures, impervious cover, and possibly ornamental landscape plantings. Stormwater drainage improvements would also be expected as part of the developed conditions. Additional streets and roadways could provide new access to areas near developments. New or differing land uses, therefore, may have a substantial effect on ecological resources in the AOI.

Subsequent land use changes may affect neighborhood cohesion and stability. Altered land uses from current conditions may also be perceived as diminishing the aesthetic value of the landscape in more rural portions of the AOI.

Induced growth resulting from construction of the Preferred Alternative would likely occur in areas adjacent to or near the ROW of the Preferred Alternative. In developed areas, land use changes may differ completely from the existing use, or the modified use may be an intensification of an existing use. For example, a use may shift from low-density residential to high-density residential. The effects of land use changes could be positive or negative, depending on the perspective of the stakeholder.

Effects Related to Induced Growth

In undeveloped areas, land use changes could represent a notable change on the landscape, as vegetated pastures or farmlands are converted to another use. Changing land uses would convert presently undeveloped areas to developed conditions, which would result in further habitat loss and fragmentation, changes in stormwater runoff, and the introduction of new structural elements in rural landscapes. Development would increase the local tax base, which would be expected to have a positive effect on the local economy, as additional residential properties, commercial establishments, and public and private services and facilities would be developed.

Step 6: Analyze Indirect Effects and Evaluate Results

Land use changes would be expected to occur in areas of existing population concentrations and would include the development of residential and commercial areas that would be near or adjacent to the Preferred Alternative ROW or in the vicinity of an intersection and a major roadway. The Preferred Alternative would likely have an effect on development because of the large, undeveloped tracts occurring in the western portion of the AOI. However, for development to occur, the local governments (i.e., the cities or counties) must be in agreement to provide adequate infrastructure (e.g., water and sewer). The land use category with the most available acreage in the AOI is vacant/developable, which includes farming (***Table 5-3***). Most of this acreage is located in the southern portion of the AOI, near the Preferred Alternative.

Table 5-3: Land Use in the AOI

Land Use	Total Acreage in the AOI
Commercial	9,563
Government/Medical/Education	28,078
Industrial	6,413
Other	377
Parks/Open Space	4,068
Residential	91,000
Undevelopable	64,317
Unknown	348
Vacant/developable (includes farming)	187,039

Table 5-3: Land Use in the AOI

Land Use	Total Acreage in the AOI
Water	6,036
Total	**397,239**

Source: H-GAC 2014c.

In order to assess the possible changes in land use based on development trends in the AOI, a survey was developed and provided to several key officials at several of the local governments found in the AOI and one of the school districts. The survey was reviewed in meetings that were held with the following: Alvin, Friendswood, Angleton, Brazoria County, League City, Alvin ISD, and the Bay Area Houston Economic Partnership.

The survey identified the planning horizon as 2035 and asked respondents to determine if the Preferred Alternative would impact future development. The results of the survey generally support that the Preferred Alternative would affect the development pattern in the AOI. Taking into account that the Preferred Alternative would be a new highway and would provide additional access to areas that are presently served by only two-lane county roads, the increased acreage of development could be expected to range between 3 percent and 20 percent.

The northern portion of the AOI is more developed than the southern portion. The trend is projected to continue because of the proximity to employment centers in the urbanized area, thus the impact of the Preferred Alternative on development in the northern portion of the AOI would be less than in the southern portion. The southern portion of the AOI is less developed and is served by fewer thoroughfares. Consequently, a newly constructed highway that improves mobility and access would have a greater impact on undeveloped land uses.

Using the range of a 3 to 20 percent increase in development from implementation of the Preferred Alternative allows for an estimation of the number of acres of development potentially induced by the Preferred Alternative. Assuming a 3 percent increase in development for the areas closer to IH 45 South, approximately 4,980 additional acres of development could occur within the AOI by the year 2035 when compared to the No-Build Alternative. Assuming a 20 percent increase in development for the western portion of the AOI, approximately 33,200 acres of additional development could occur within the AOI by the year 2035, as compared to the No-Build Alternative. The developed acreage would likely not be concentrated in a small area within the AOI, but would potentially occur throughout the AOI. Induced development would likely occur initially near intersections of the Preferred Alternative and existing roadways and in areas where development already exists. The disparity in the range of developed acreage is reflective of the development trend in the AOI. Projections from H-GAC indicate that approximately 68 percent of the AOI would be developed by 2035 if the Preferred Alternative is not constructed, and that 70 percent of the AOI would be developed if the Preferred Alternative is constructed. Therefore, within the AOI, if the Preferred Alternative is constructed, a total of approximately 265,200 acres would be developed by 2035.

The results of the survey indicated that the regional economy is a primary factor influencing development. Lack of development regulations and accessibility are the next most important factors. With few development restrictions in the AOI and inadequate infrastructure in place, the regional economy and accessibility would likely affect development, but only with the fiscal support necessary to build and maintain the proposed development.

Induced development of an additional 4,980 to 33,200 acres would encroach into areas of undeveloped land within the AOI. Areas that are presently woodlots, pasture, or farmland would be converted to developed uses, thereby changing the character of the undeveloped areas. Developed uses would potentially permanently remove existing vegetation and replace it primarily with structures and impervious cover. In areas that currently support developed conditions, induced development may change the current condition to a different or altered land use, possibly displacing residents, businesses, and structures that may be incompatible with the changed or altered land use. The changed conditions may be favorably embraced by residents and commuters as additional housing, commercial enterprises, and services are provided within the AOI. Conversely, the same conditions may be viewed unfavorably by others as permanent changes to the landscape and increased access to areas where access was previously limited.

Step 7: Assess Consequences and Consider/Develop Mitigation

Induced development is expected to occur in the AOI with implementation of the Preferred Alternative. In the northern portion of the AOI, where more development exists, potential development induced by construction of the Preferred Alternative would likely be less than in the southern portion. Future development in northern areas could take the form of infill development and could be of higher intensity than in undeveloped areas. In the southern portion of the AOI, where there is less development, the Preferred Alternative could induce new development, such as low-density residential and supporting commercial activities. The majority of the new development would be in the unincorporated area of Brazoria County, where there are few land use controls or adequate infrastructure. Development would be regulated by subdivision ordinances of the counties and local jurisdictions. Water supply requirements and floodplain regulations could be factors influencing the location and density of development. ***Table 5-4*** summarizes past/existing development within the AOI and predicted future development for the Preferred and No-Build alternatives.

Table 5-4: Development within the AOI (Past/Existing Development)

Year	Acres of Induced Development	Total Developed Acres	Percent of AOI[a]
1975	N/A	25,500	7%
1995	N/A	50,000	13%
2008	N/A	89,400	24%

Table 5-4: Development within the AOI (Past/Existing Development)

Year	Acres of Induced Development	Total Developed Acres	Percent of AOI[a]
No-Build Alternative (2035)[a]	N/A	255,000	68%
Preferred Alternative (2035)[b]	29,550	265,200	70%

Source: SH 99 Segment B Study Team.

[a] Approximate percent of the total acreage in the AOI (376,668 acres).

[b] Assumes a 4 percent annual growth rate.

Notes: AOI = Area of Influence; N/A = not applicable; % = percent.

Undeveloped tracts of land in the vicinity of the proposed ROW of the Preferred Alternative could be developed in the future without the Preferred Alternative; however, construction of the Preferred Alternative is expected to induce additional development within the AOI. The Preferred Alternative would be a controlled-access toll facility with frontage roads only where a portion of the alignment would coincide with existing roadways and at connections to major cross streets. In the long term, implementation of the Preferred Alternative would be expected to improve regional mobility, facilitate access to undeveloped areas, and induce additional development to accommodate anticipated demand for residential, commercial, industrial, and public facilities.

The No-Build Alternative would not cause indirect impacts to land use.

5.4.2 Soils and Farmlands

Step 4: Identify Impact-Causing Activities of the Proposed Action and Alternatives

Induced development would result in a direct loss of some soils, including prime farmland soils, because of the land alteration created by the construction of the Preferred Alternative. In addition, indirect impacts to geological and soil resources would be expected from potential new construction sites adjacent to the proposed ROW in areas where the Preferred Alternative would intersect with major thoroughfares. The development induced by the Preferred Alternative would primarily occur on undeveloped agriculture or pasture land.

Step 5: Identify Potentially Substantial Indirect Effects for Analysis

Encroachment-alteration Effects

Construction of the Preferred Alternative would be on a new alignment, traversing areas of developed and undeveloped land. Encroachment-alteration effects to farmlands are not anticipated because of the Preferred Alternative.

Induced Growth Effects

New highway construction would potentially lead to the conversion of farmland soils into other uses, by providing access to areas that presently have limited or no access via public roadways. Additional access may increase the attractiveness of these areas for further land development. There are no polices in place that would discourage this type of development in the area. The conversion of such areas to new or

different land uses would remove existing vegetation and replace it with structures, impervious cover, and possibly ornamental landscape plantings.

Effects Related to Induced Growth

As detailed in ***Section 4.2.2*** of the FEIS, approximately 1,305 acres of prime farmland soils would be directly impacted by the Preferred Alternative. New highway construction would have the potential to divide individual properties and disrupt farming/pasture operations. As described above in the *Land Use* portion of the indirect analysis, 187,039 acres of vacant or developable (includes farming) land could be converted to higher intensity uses.

Step 6: Analyze Indirect Effects and Evaluate Results

The AOI contains approximately 351,489 acres of prime farmland soils. However, the potential indirect impacts to prime farmland soils related to the reasonably foreseeable development is anticipated to be minimal compared to the total acreage of prime farmland soils found within the AOI. As documented in ***Section 4*** of the FEIS, the Preferred Alternative would directly impact approximately 1,305 acres of prime farmland soils. However, the acreage is considered to be a minor impact and scored below 160 with a score of 92 on the NRCS Form CPA-106 (***Appendix B***). Actual indirect farmland conversion due to increased development associated with induced growth effects is also anticipated to be considered a minor impact based on NRCS ratings; therefore, no substantial indirect impacts to prime farmland soils are anticipated under the Preferred Alternative.

Step 7: Assess Consequences and Consider/Develop Mitigation

The Preferred Alternative would be a controlled-access toll facility with intermittent frontage roads in areas where portions of the proposed alignment would coincide with an existing road and at connections to major cross streets. Limiting access to properties that already have roadway frontage may reduce the conversion of existing undeveloped land. However, the Preferred Alternative could have a greater impact on new development in the future, particularly in the southern portion of the AOI where there is less development. The majority of the new development would be in the unincorporated area of Brazoria County where there are few land use controls.

Mitigation of the potential impacts of induced growth within the AOI considered for the assessment would rest with the agencies that have the authority to implement such controls. The authority rests with the municipal governments and to a lesser extent, the county governments. Examples of municipal government regulations include land development code tree ordinances. The responsibility of transportation providers such as the Grand Parkway Association, TxDOT, local and regional transit agencies, and the local governments would be to implement a transportation system to complement the land use or development controls currently in place.

5.4.3 Social

Step 4: Identify Impact-Causing Activities of the Proposed Action and Alternatives

Construction of the Preferred Alternative would traverse areas of existing rural development such as farms and low-density residential areas. The Preferred Alternative would also affect existing residential and commercial areas along SH 35 and FM 646. Displacement of residents and commercial businesses from areas within the proposed ROW of the Preferred Alternative would be 17 residential displacements and 13 business displacements. The Preferred alternative would require ROW from approximately 236 parcels. Displacement of residences and businesses and loss of property would be an unavoidable consequence of constructing the Preferred Alternative. The Preferred Alternative would also increase traffic noise, affect visual and aesthetic quality, and there would be short-term impacts from construction. However, anticipated mobility and accessibility would benefit the nearby communities and the traveling public.

Construction of the Preferred Alternative would provide construction-related employment and spending for labor and materials needed. Spending by laborers in local restaurants, stores, and gas stations would also be expected during construction of the Preferred Alternative. In the long term, maintenance of the Preferred Alternative would require spending for materials and labor related to repairs and possible upgrades.

Step 5: Identify Potentially Substantial Indirect Effects for Analysis

Encroachment-alteration Effects

The Preferred Alternative would affect existing communities within the AOI, potentially affecting neighborhood and/or communities due to commercial and residential displacements. Property values may change in the areas adjacent to the Preferred Alternative, as the Preferred Alternative would provide access to areas that were previously inaccessible or had only limited access via public roads. In areas where the Preferred Alternative would intersect existing named roads, the roadway would be bridged or re-routed.

Induced Growth Effects

Induced growth resulting from the Preferred Alternative would bring additional residential, commercial, and possibly industrial facilities into the AOI. As residential and commercial areas are established, private and public services and facilities would also be established in response to demand from area residents.

Effects Related to Induced Growth

Induced residential and commercial development would provide housing and purchasing opportunities for area residents. Increasing population and economic growth could induce additional development, thereby creating a demand for additional needs, such as medical facilities, child care, educational facilities, and social services. Induced growth would be expected to increase the availability of social resources within the AOI.

Induced development and potential community change can be perceived as positive or negative. Because of the controlled-access nature of the Preferred Alternative, an impetus for indirect development at or near entrance/exit ramps and at interchanges with major thoroughfares may exist. Residents of low-density communities in rural areas may perceive induced development as a negative impact to quality of life, as land is converted to residential and commercial uses and area population increases. However, if induced residential development occurs, the communities could see increased property values and more readily available commercial services in closer proximity to their homes, which could be viewed as a positive impact.

Step 6: Analyze Indirect Effects and Evaluate Results

Implementation of the Preferred Alternative would provide access to new areas within the AOI, which would induce long-term growth and development. The impact that the Preferred Alternative would have on household and employment growth is measured within the context of the current growth and development trends within the AOI, where growth is expanding out from the central city (Houston) toward suburban and rural areas. Current economic and population growth and development trends would be expected to continue. Residential and commercial properties that would be displaced by ROW acquisition may relocate to other locations within or outside the AOI. Residential and commercial properties are available for sale or lease in the AOI; however, some of the properties may be currently undeveloped land that would be available for construction as opposed to developed parcels. Induced development as a result of the Preferred Alternative could affect residents in the communities, as retail and commercial businesses (e.g., gas stations, convenience stores, shopping centers, restaurants, and possibly office buildings) are constructed in areas that were previously only residential areas. In the long term, induced development would provide additional businesses and housing for residents within the AOI. The induced growth would be expected to occur over an extended period of time. Existing residential areas may become more densely populated, requiring additional utility and public services.

Residential and commercial development in the AOI would lead to the construction of schools, parks, and public services for the benefit of the growing population. Induced development would likely occur gradually, with new businesses providing additional employment opportunities, income potential, and business and sales tax revenues. Local governments could use the tax dollars to increase and improve community services, maintain and improve local roadways, and improve and provide public recreational opportunities. Growth in residential and commercial development would increase the demand for consumer services including, but not limited to, retail, banking, medical, and recreational services. Overall, the Preferred Alternative would facilitate additional economic growth within the AOI.

Proposed construction expenditures for materials and labor would have indirect and other induced effects on local, regional, and state employment, output, and income. Induced effects are included as indirect effects of the Preferred Alternative and can be generated by the consumption of goods and services made possible by the payrolls that accompany construction and employment associated with induced development. Indirect economic effects could include changes in property values as a result of encroachment and/or induced development, sales taxes from new commercial activity, and employment

accompanying new businesses. As discussed in ***Section 4.4.3*** of the FEIS, the Preferred Alternative would have an indirect effect of $695.8 million in additional income, and 16,202 jobs in the regional economy. The total statewide effect would be $3.3 billion in additional income.

A long-term indirect effect of the No-Build Alternative to neighborhoods, communities, and the traveling public would be the continued reduction of mobility in the AOI. Without the Preferred Alternative, new development associated with increased population and employment in the AOI would cause increased traffic congestion and reduced LOS on existing roadways, likely resulting in increased traffic delays. In addition, without the Preferred Alternative, already burdened hurricane evacuation routes would not facilitate the movement of residents in communities in Brazoria and Galveston Counties during emergency evacuations.

Step 7: Assess Consequences and Consider/Develop Mitigation

Implementation of the Preferred Alternative would benefit mobility and provide access to new areas within the AOI. VMT in the Houston-Galveston-Brazoria TMA are projected to substantially increase, according to the *2035 RTP Update*. The Preferred Alternative would help alleviate congestion by providing improved connectivity in the area of the Houston-Galveston-Brazoria TMA. Reduced travel times and reduced congestion could improve the quality of life for residents within the AOI and commuters in the region. The improved mobility and availability of additional housing, commercial and institutional facilities, and public and private services would be expected to be a benefit to communities in the AOI.

5.4.4 Air Quality

Step 4: Identify Impact-Causing Activities of the Proposed Action and Alternatives

The proposed project is located within both Brazoria and Galveston Counties, which are part of the Greater Houston area that has been designated by the EPA as a marginal nonattainment area for the 2008 ozone standard. The proposed SH 99 Segment B would have the impact activity of changing traffic. The proposed project is mostly on new location, and is planned as part of the regional tolling network. The proposed project is expected to reduce congestion by improving traffic operations along existing roadways. The proposed project would also result in roadway network enhancements which can result in land use changes, and improved mobility and access. All such actions can result in changes of traffic patterns, and thus have the potential to indirectly impact air quality in the area.

Step 5: Identify Potentially Substantial Indirect Effects for Analysis

Encroachment-alteration Effects

The AOI is part of the EPA designated eight-county marginal nonattainment area for 2008 ozone National Ambient Air Quality Standards. The AOI is currently in attainment or unclassifiable for all other National Ambient Air Quality Standards pollutants. ***Section 4.6*** of the FEIS presents the air quality assessment for the proposed project. Based on the results of Steps 1 through 4 that evaluated the possible project-related actions that can indirectly impact air, the proposed project would not be anticipated to cause indirect air quality impacts in the AOI. No change in attainment status is anticipated within the study area as a result

of emissions associated with the proposed project. In order for the region to achieve ozone attainment, a variety of point, non-point, and mobile source emission reduction strategies must be implemented for the entire Houston-Galveston-Brazoria area as outlined in the SIP. Indirect air quality impacts from MSATs are unquantifiable due to existing limitations to determine pollutant emissions, dispersion, and impacts to human health. Emissions would likely be lower than present levels in future years as a result of the EPA's national control regulations (i.e., new light-duty and heavy-duty on-road fuel and vehicle rules and the use of low sulfur diesel fuel). Even with an increase in VMT and possible temporary emission increases related to construction activities, the EPA's vehicle and fuel regulations, coupled with fleet turnover, will cause substantial reductions of on-road emissions over time, including CO, MSATs, and the ozone precursors volatile organic compounds and nitrogen oxides. As the proposed SH 99 Segment B is not anticipated to result in indirect air quality impacts, further discussion in Steps 6 through 7 is not necessary.

5.4.5 Water Quality

Step 4: Identify Impact-Causing Activities of the Proposed Action and Alternatives

The Preferred Alternative would cross several streams and channels of varying size that would either be spanned by bridge structures or placed in culverts. Construction of the Preferred Alternative would add impervious cover to areas that are currently vegetated, and would convert areas of trees, shrubs, pastureland and cropland to maintained herbaceous roadway ROW. Stormwater runoff would be directed to vegetated roadside drainage swales and detention facilities before being conveyed to area water courses. BMPs would be implemented during construction to minimize the introduction of erosion and sedimentation materials into receiving waters. Construction of vegetated drainage swales and detention facilities as part of the Preferred Alternative would allow for settling and possible capture of some physical and chemical constituents in stormwater runoff from the highway prior to being discharged into area water courses.

Step 5: Identify Potentially Substantial Indirect Effects for Analysis

Encroachment-alteration Effects

The majority of the Preferred Alternative is composed of undeveloped land. Construction of the Preferred Alternative in undeveloped areas would generate stormwater runoff from the paved lanes and direct the runoff to vegetated roadside drainage swales within the proposed ROW, thereby altering stormwater runoff patterns compared to pre-construction conditions. The runoff may contain chemicals and pollutants flushed from the paved lanes. The increased volume of stormwater runoff, potentially containing an increased pollutant load, would be directed to receiving waters traversed by the Preferred Alternative. The additional pollutants could impact surface water quality within the drainage swales adjacent to the Preferred Alternative and within downstream portions of the receiving waters. Impacts to the quality of shallow groundwater may occur because of the potential increase in pollutants in the receiving waters, but the water quality of the deeper aquifers used for public water supplies would not be likely, as these aquifers are several hundred feet below the surface with inter-bedded restrictive layers.

Induced Growth Effects

The Preferred Alternative would induce additional development within the AOI. Induced growth would likely occur in areas where infrastructure elements, such as water, wastewater, and electrical utilities, are present or could be reasonably extended. Land use changes, which would include the construction of buildings, streets and roadways, parking areas, walkways, and other developed facilities, would likely occur initially in the Alvin area, and possibly in the areas of Friendswood and League City. Development in the area east of SH 288 and extending toward Alvin would likely be delayed, as the lack of infrastructure elements would impede development in this area. The construction would include the removal of vegetated areas that would be replaced primarily by impervious cover that would be expected to increase the volume of surface water runoff and possibly contain increased pollutants. Patterns of surface water flow may be changed, and stormwater drainage channels may be altered because of the construction. Stormwater that might otherwise infiltrate into natural ground surfaces would be directed into constructed or improved drainage channels, possibly affecting the volume of flows conveyed to receiving waters. The stormwater runoff may contain chemicals and materials that are conveyed to receiving waters, potentially affecting the water quality of the receiving waters.

Effects Related to Induced Growth

Induced development would result in the removal and reduction of natural vegetation and permeable surfaces available to slow and absorb surface runoff, meaning more runoff would be directed into area water courses. The patterns of stormwater runoff would change as a result of the development. Oil, grease, and other elements from vehicles traveling on newly constructed streets and roadways or parked in vehicle parking areas would be flushed from the surfaces during storm events. Additionally, fertilizers, herbicides, and other chemicals used on residential lawns and landscaped areas may be introduced into stormwater runoff. Other liquid and solid elements occurring within developed residential, commercial, and industrial areas may also be conveyed to receiving waters through stormwater runoff. Concentrations of chemicals and other materials in stormwater runoff could be sufficient to substantially affect the water quality of the receiving waters and the quality of shallow groundwater. Impacts to the deeper aquifers of the Gulf Coast Aquifer system used as public water supply sources would not be substantial because of the vertical separation of the surface waters from the aquifers and restrictive layers within the aquifer system.

Step 6: Analyze Indirect Effects and Evaluate Results

Development induced by the Preferred Alternative would remove areas of natural vegetation and vegetated areas associated with cropland, pastureland, and urban development. Induced development would alter the landscape and surface drainage patterns and increase the amount of impermeable surface, which would increase stormwater runoff and non-point source pollution from roadways and other developed structures and facilities. The loss of vegetated areas would reduce or eliminate the benefit of vegetated surfaces in slowing and absorbing surface runoff, and possibly filtering pollutants before being conveyed to receiving waters. Construction activities associated with the installation of infrastructure and development of new structures and facilities could also introduce eroded earthen materials and chemicals

into stormwater runoff, causing siltation, turbidity, and contamination that could adversely affect water quality, particularly in the immediate area of the discharge.

As the acreage of vegetated areas converted to developed conditions increases, the increased volume of surface runoff, particularly during large storm events, could increase hydraulic forces within the receiving water channels, possibly resulting in accelerated erosion within the channels. Increased non-point source pollution conveyed with stormwater runoff to receiving waters could result in higher concentrations of pollutants in the receiving waters, thereby degrading overall water quality.

Step 7: Assess Consequences and Consider/Develop Mitigation

Construction activities related to induced development would be required to comply with TCEQ's TPDES regulations regarding water quality. Implementation of BMPs, such as silt fencing, rock berms, and sodding of exposed soils, and development of a SW3P for water quality control would assist in limiting the transport of pollutants with surface runoff from construction sites. Containment, removal, and proper disposal of materials by contractors would be expected to comply with applicable state and federal requirements such that hazardous or toxic materials used during construction activities would not adversely impact surface water or groundwater resources. Although temporary BMPs may be installed during construction that would allow for the capture of some pollutants carried in stormwater runoff, pollutant loads entering downstream waters could still occur, and would likely be more noticeable in the area of discharge.

More permanent BMPs for erosion and sedimentation control, such as the construction of stormwater detention facilities, vegetated swales, and possibly other stormwater control features, would likely be implemented as part of new development. These and possibly other water quality management protective measures that may be available at the time of construction would assist in reducing the conveyance of pollutants into receiving waters and minimizing water quality impacts to water resources.

Implementation of temporary (i.e., construction) and permanent BMPs may reduce the amount of pollutants conveyed with stormwater runoff, and any residual pollutants entering receiving waters may settle, disperse, or dilute as waters move downstream. However, as development continues, there would be an increase in stormwater runoff volumes from the increased acreage of impervious cover, which provides the opportunity for the increased stormwater volume to carry increased pollutants to receiving waters. The increased pollutant loads may occur in quantities or concentrations that are not able to be assimilated by the receiving waters, which could lead to chronic water quality issues in the receiving waters. Water quality impacts to surface waters could lead to impacted water quality in shallow groundwater; however, impacts to the deeper aquifers in the Gulf Coast Aquifer system would not be likely because of the vertical separation of the deeper aquifers from the impacted surface waters.

5.4.6 Wetlands and Waters of the U.S.

Step 4: Identify Impact-Causing Activities of the Proposed Action and Alternatives

Based on limited field investigations and interpretation of aerial photography and LiDAR data, implementation of the Preferred Alternative would impact approximately 79.7 acres of waters of the U.S., which includes approximately 25.2 acres of streams, canals, and ponds, and approximately 54.5 acres of wetlands. Clearing and grading of the proposed ROW of the Preferred Alternative would result in direct impacts (i.e., filling) of wetlands within the area of proposed construction. The functions and values of the impacted wetlands would be lost. Stream and drainage channels would either be bridged or placed in culverts, depending on their size, resulting in impacts to a portion of these waters. Detention facilities constructed as part of the Preferred Alternative could offset the loss of stormwater storage provided by impacted wetlands. Direct impacts to non-wetland waters of the U.S. would not be able to be assessed until design plans are prepared.

Step 5: Identify Potentially Substantial Indirect Effects for Analysis

Encroachment-alteration Effects

The identified wetlands do not occur entirely within the Preferred Alternative ROW. The boundaries of several wetlands extend beyond the limits of the proposed ROW. Although the portions of the wetlands occurring outside the ROW would not be filled, the remaining portions of these wetlands could be adversely impacted. Efforts would be made during construction to avoid water within the wetlands being allowed to drain into the Preferred Alternative ROW. The placement of a small earthen berm along the edge of the ROW for the length of the wetland would assist in retaining surface water within the wetland. The identified wetlands are typically situated within depressed positions on the landscape; therefore, the source of hydrology would be direct precipitation and stormwater runoff from the surrounding localized area. Even though wetlands can be persistent on the landscape, the functions provided by the remaining portions of wetlands outside the ROW, such as sediment capture, stormwater storage, water filtration, and wildlife habitat, would be reduced or possibly eliminated. Wetlands on the down-gradient side of the Preferred Alternative may have their hydrologic source disrupted or discontinued by the Preferred Alternative's interception of stormwater runoff. If the disruption of hydrology is severe, the wetland may become dry over time and lose its wetland characteristics, which would represent a loss of wetland acreage and a loss of wildlife habitat.

Stormwater intercepted by the Preferred Alternative would be directed through vegetated roadside drainage swales to non-wetland receiving waters (i.e., natural streams and drainages). Increased stormwater flows may increase hydraulic forces in the receiving water channels, possibly altering the physical character of the channel through erosion and incising.

Induced Growth Effects

Construction of the Preferred Alternative would induce additional development within the AOI, which would include the conversion of presently undeveloped lands to developed conditions. The conversion of such areas to new or different land uses would likely result in the filling of wetlands, either eliminating a

wetland completely or reducing its size. Clearing and grading of project sites would likely alter stormwater flow patterns, and stormwater drainage improvements, which would be expected to be part of developed conditions, may redirect stormwater flows away from wetland areas. Redirected stormwater flows may be concentrated in newly constructed stormwater drainage channels or improved natural channels. The concentrated flows could require the capacity of the receiving water channels to be expanded to convey the increased volume of stormwater.

Effects related to Induced Growth

The installation of infrastructure for utilities, and the construction of structures, street and roadways, parking areas, and stormwater conveyance and detention facilities that would be part of induced development would convert wetland areas to developed conditions. The conversion would directly eliminate wetlands, or possibly reduce the functional capacity of avoided wetlands by altering the hydrologic regime or isolating the wetlands in the context of surrounding developed conditions. The long-term effects of eliminating wetlands or reducing their functional capacity could be reduced floodwater storage, reduced wildlife habitat, and an increase in sediments and pollutants entering receiving waters. The character of receiving waters could be altered by the conveyance of increased stormwater volumes, or by channel rectification, slope stabilization, or capacity expansion to accommodate stormwater flows that have been concentrated within developed areas.

Step 6: Analyze Indirect Effects and Evaluate Results

It is likely that wetland areas would not be converted to developed conditions at the same rate as upland areas, particularly if there is sufficient contiguous upland acreage available to accomplish a development without having to fill wetland areas. However, the direct loss of wetlands as part of development activities would likely be unavoidable. Wetlands that are randomly interspersed on the landscape that occur within the footprints of planned developments based on construction of a unified land use, such as a residential subdivision or a commercial business park, are generally incompatible with the developments. Avoidance of these wetlands would likely interrupt the layout or configuration of streets, lots, or building pad sites. Even if some wetlands are avoided within the footprint of a proposed development, site grading and stormwater drainage improvements in the immediate area of the avoided wetlands could degrade habitat quality, surface water storage capabilities, and other functions provided by wetlands.

The unavoidable loss of wetlands related to induced development would reduce the overall acreage of wetlands in the AOI, and would remove the functions provided by those wetlands. Wildlife dependent on wetlands for life cycle requirements would likely perish if other nearby wetlands are not available. Similarly, the location of non-wetland waters within a development may be incompatible with the planned configuration of facilities within the development. Stream channels may be filled and rerouted, or the channels may be rectified or improved to convey stormwater generated from the development. The loss of the channel or the alteration of channel characteristics would likely degrade biological functions provided by the channel. The channel loss or alteration would degrade wetlands dependent on the channel as the source of hydrology. The effect of the loss or degradation of wetland and non-wetland waters resulting from induced development could be substantial.

Step 7: Assess Consequences and Consider/Develop Mitigation

The permanent loss of wetlands and alteration of non-wetland resources would represent a loss of habitat and a reduction or elimination of functional benefits provided by these resources, such as stormwater storage, sediment trapping, and bio-filtration. Developments sponsored by public and private entities must identify anticipated impacts to jurisdictional waters of the U.S., including wetlands, in coordination with the USACE, prior to construction. As part of the USACE permitting process, mitigation would be required to compensate for adverse impacts to wetland and stream resources. Mitigation measures, such as the purchase of credits from an authorized wetland or stream mitigation bank, enhancement of stream/riparian habitat, restoration of wetlands, creation of wetlands, or preservation of existing wetlands would be required to compensate for impacts to jurisdictional streams and wetlands. Compensatory mitigation for non-jurisdictional waters of the U.S., including wetlands, would not be required as part of USACE permitting. Therefore, functions provided by non-jurisdictional wetlands and other aquatic resources would likely not be replaced.

Impacts to jurisdictional wetlands can sometimes occur that are not assessed or reported to the USACE through a Department of the Army permit application. The loss of waters of the U.S., including wetlands, from unauthorized fill activities that may occur in the AOI would not be compensated through the USACE permitting process. Therefore, the functions of wetlands and other waters of the U.S. impacted in that manner would not be replaced.

5.4.7 Floodplains

Step 4: Identify Impact-Causing Activities of the Proposed Action and Alternatives

Approximately 343 acres of flood hazard areas, as mapped by FEMA, would occur within the Preferred Alternative ROW. The flood hazard areas include 100-year and 500-year floodplains, and floodway. The length of flood hazard areas crossed by the Preferred Alternative would be approximately 33,760 linear feet (approximately 6.4 miles). Crossings of streams and drainages would be bridged or placed in culverts. A hydraulic study would be performed during final design to confirm that the Preferred Alternative would not increase the risk of flooding. The Preferred Alternative would be designed to not increase the base flood elevation to a level that would violate applicable floodplain regulations and ordinances. Fills placed within floodplains would be compensated with equivalent floodplain storage in the vicinity of the Preferred Alternative.

Step 5: Identify Potentially Substantial Indirect Effects for Analysis

Encroachment-alteration Effects

The Preferred Alternative would be constructed primarily on new location, and would traverse areas mapped as floodplains and floodway. A hydraulic analysis would be performed to appropriately size bridges and culverts to allow conveyance of the 100-year storm. To meet the requirements for approval as an emergency evacuation route, the Preferred Alternative would be constructed approximately one foot above the 100-year flood elevations. Fill material that would be required to be placed within the mapped floodplains would require the creation of sufficient flood storage volume to mitigate for the fill.

Construction of the Preferred Alternative would be in compliance with floodplain regulations and ordinances, and would likely not impact floodplains traversed by the Preferred Alternative.

Induced Growth Effects

The Preferred Alternative would provide access to areas that presently have no, or limited, public access, which is expected to induce development in the vicinity of the highway. Some of this development would likely occur in areas mapped as 100-year floodplain, and development activities would involve fills and construction of impervious cover within the 100-year floodplain. Developments would be required to comply with floodplain regulations and ordinances; therefore, impacts to mapped floodplains would not likely be substantial.

Effects Related to Induced Growth

Construction related to induced development would require clearing and grading of areas for streets, buildings, and other facilities. Floodplain areas would likely be impacted by fill associated with the developed structures and facilities, or by roadways and utilities crossing floodplains. Impervious cover associated with developed areas would generate additional stormwater runoff that may increase storm flows in existing drainage channels. Enlarging or realigning drainage channels to improve conveyance capacities, and constructing stormwater detention/retention facilities required by floodplain regulations and guidelines would likely be required so as not to increase the risk of flooding within the developments or the surrounding areas. Development plans and designs would be required to accommodate 100-year storm flows and compensate for fills placed within floodplains; therefore, there would be no substantial impacts to floodplains.

Step 6: Analyze Indirect Effects and Evaluate Results

Induced development within the AOI may initially occur in areas outside mapped floodplains, where there would not be restrictions on development related to floodplains. However, some planned developments would likely involve some amount of fill, grading, and vegetation removal within floodplains. Increased stormwater runoff from developed areas may increase flows conveyed to and through streams and drainage channels. Improvements to streams and drainage channels necessary to facilitate the conveyance of 100-year storm flows would be expected as a result of induced development.

Regulations and guidelines related to development in floodplains are intended to maintain appropriate flood elevations and the continued conveyance of flood flows, thereby reducing the risk of flooding in developed areas. As drainage improvements are implemented in developed areas, revisions of the extent and configuration of the mapped 100-year floodplain boundaries would be expected.

Floodplains are typically associated with streams and water courses supporting riparian vegetation, although not all riparian vegetation is encompassed within a mapped floodplain. Development activities and construction of detention facilities may require the removal of riparian vegetation occurring within or outside of mapped floodplains. The removal of riparian vegetation would represent a loss of potential wildlife habitat.

Step 7: Assess Consequences and Consider/Develop Mitigation

Development within floodplains would occur in accordance with the National Flood Insurance Program and local regulations, which would require the incorporation of design features, such as channel improvements and detention/retention facilities, to maintain the storage capacity of floodplains and allow for the conveyance of flood flows without adversely affecting base floodplain elevations. Individual developments would be responsible for calculating and detaining additional runoff generated by the construction of impermeable surfaces, as well as maintaining conveyance capacities to accommodate expected flood flows. Individual developments may incorporate measures during the planning and design stages of projects to reduce or minimize potential impacts to floodplains that are present within the footprints of the developments.

5.4.8 Vegetation and Wildlife Habitat

Step 4: Identify Impact-Causing Activities of the Proposed Action and Alternatives

Construction of the Preferred Alternative would incorporate approximately 391 acres of existing roadway ROW and would require the acquisition of approximately 1,072 acres of new ROW. Construction would primarily impact agriculture, coastal grasslands, disturbed prairies, and tidal and salt marsh vegetation, as these vegetation communities represent approximately 69 percent of the Preferred Alternative ROW, according to TPWD's Ecological Mapping Systems of Texas. Collectively, these vegetative communities total approximately 1,010 acres. Riparian, post oak savanna, mixed woodlots, and forest vegetation communities, collectively totaling approximately 68 acres, would also be impacted. Approximately 386 acres of the Preferred Alternative ROW are classified as urban, ROW, roadway, and median. The Preferred Alternative would permanently remove these vegetation communities and replace them with travel lanes, entrance and exit ramps, frontage roads, and maintained herbaceous ROW. The removal would represent a loss of the vegetation communities and a corresponding loss of wildlife habitat. Areas within the proposed the Preferred Alternative ROW that would not be converted to impervious cover would be replanted with herbaceous vegetation that would be periodically maintained as part of the highway system.

Step 5: Identify Potentially Substantial Indirect Effects for Analysis

Encroachment-alteration Effects

The Preferred Alternative would traverse undeveloped areas, dividing agricultural fields and pasturelands, thereby fragmenting previously contiguous areas. The proposed conversion of vegetated areas to highway ROW and stormwater detention facilities would reduce the overall acreage of the vegetation community types that are converted. The Preferred Alternative would also traverse streams supporting associated riparian vegetation, and areas of woodland and forest. The proposed clearing of riparian and woodland vegetation to construct the Preferred Alternative would interrupt the continuity of riparian corridors and wooded areas. Altered stormwater drainage patterns may affect the hydrology of vegetation communities adjacent to the Preferred Alternative. The altered hydrology could cause a degradation in the quality of a vegetation community (e.g., from an increase or decrease in stormwater runoff), or possibly result in a

gradual change in vegetation species composition that could affect the habitat suitability for wildlife, thereby potentially affecting the composition of wildlife species.

The existing vegetation communities provide habitat for wildlife. The conversion to highway use would remove food, shelter, and nesting resources. Wildlife displaced by construction of the Preferred Alternative would likely move into areas of similar habitat in the vicinity of the proposed highway. Competition for available resources may cause a decline in the health of some individual animals, possibly resulting in the death of a few animals as the habitat area adjusts to a carrying capacity equilibrium. Wildlife using riparian corridors for travel would likely be exposed where the Preferred Alternative crosses streams and drainages. The exposure could result in increased predation. Traffic on the Preferred Alternative would also expose wildlife to the possibility of vehicle strikes, likely resulting in increased incidences of wildlife injury or mortality.

Induced Growth Effects

Induced growth is expected to result from the proposed construction of the Preferred Alternative. Within the footprints of developed areas, vegetation communities supporting vegetative species typical of the region, as well as areas supporting landscaped or ornamental vegetative species, would be removed and replaced with structures, impervious cover, stormwater management facilities, and landscape plantings. Impacted vegetation would include herbaceous, shrub, tree, and vine species. The conversion of vegetated areas to developed conditions would reduce the overall amount of the vegetation community types in the AOI. Food, shelter, and nesting resources available to wildlife would also be reduced. The conversion of habitat to developed conditions would displace wildlife into surrounding areas of similar habitat. Increased vehicular traffic would likely result in an increased number of vehicle-animal strikes.

Effects Related to Induced Growth

Areas of native, non-native, and ornamental vegetation would be largely removed during site preparation and construction activities related to the development of roadways, and residential, commercial, and other urban facilities within the AOI. Residential yards, community parks and green spaces, and landscaped areas may retain some natural vegetation, but the areas would most likely be planted with turf grasses and ornamental plantings that would be routinely maintained. Agricultural land and pastureland areas outside of developed footprints may remain in active production, or possibly become fallow areas. The construction of roadways, streets, structures, parks, and other urban facilities would fragment wildlife habitat, and remove resources available to wildlife. Increased vehicular traffic would likely result in increased mortality from vehicle strikes. Developed areas may induce additional development to accommodate expected increases in population and employment. The additional development, which would convert vegetation communities and wildlife habitat to urban uses, would further fragment wildlife habitat. The direct loss and possible degradation of vegetation communities and wildlife habitat as a result of development activities would likely be substantial.

Step 6: Analyze Indirect Effects and Evaluate Results

Residential, commercial, and other development within the AOI would directly convert vegetation communities to developed conditions. The loss of portions of existing vegetation communities would be an unavoidable consequence of development. Areas of vegetation communities occurring within the footprint of a development may remain within the development and not be converted to developed conditions. However, such areas may be impacted by vegetation management or maintenance practices for the vegetated areas to be compatible with the aesthetics of the adjacent development. Vegetation communities outside the footprints of a development would not be removed as a part of the development, but may be affected by altered hydrology or the creation of increased edge along a portion of the boundary of a vegetation community, which could provide an opportunity or the introduction of native and non-native species that were previously not a component of the vegetation community.

Riparian and woodland vegetation communities would be impacted by development. Roadways, utility easements, and other urban facilities would traverse streams and drainages with riparian vegetation. The developed features would likely require removal of the naturally occurring species within the ROWs and easements of the crossings, thereby creating an interruption in the continuity of the riparian corridor or woodland vegetation community and reducing the overall acreage of riparian corridors and woodlands.

Continued development would result in the conversion of vegetation communities to developed conditions, which would permanently remove increasing acreages of the vegetation communities from within the AOI. Remaining portions of the communities could be separated by varying distances such that they become isolated from areas of similar vegetation communities. The loss of vegetation community acreage would also remove habitat resources upon which wildlife species depend. The loss of habitat and the associated reduction in available food, shelter, and nesting resources would likely reduce the number of individual animals that could be supported within the remaining habitat areas. Development would be accompanied by increases in vehicular traffic, lighting, human activity levels, and noise. The majority of vegetation within developed areas would likely be routinely maintained, with ornamental plantings being a common feature. These factors and increased pollutants generated within developed areas that would be conveyed in stormwater runoff would likely reduce the habitat quality of remaining areas of vegetation communities, potentially affecting wildlife use of remaining habitat areas and increasing stress levels on wildlife inhabiting the remaining vegetation communities.

Wildlife displaced by continued development within the AOI would be forced to seek other habitats in the vicinity of developed areas. However, the resulting urban conditions may provide additional habitat to support wildlife species able to adapt to urban conditions. Wildlife able to adapt to urban environments may thrive as additional urban habitat is created. In general, wildlife inhabiting developed areas would be at greater risk of injury of mortality from increased encounters with humans and increased traffic on area streets and roadways.

As vegetation communities continue to be converted to developed conditions, and wildlife is displaced by the conversions, additional plant and animal species could become federally or state-listed as threatened or endangered. Developers and other project sponsors would be responsible for determining the presence

of threatened or endangered species, or suitable habitat for such species, within the areas of proposed construction. Potential impacts would require coordination with appropriate federal and state agency representatives to determine the impacts the proposed developments would have on listed species.

Step 7: Assess Consequences and Consider/Develop Mitigation

The conversion of undeveloped acreage to roadways, streets, structures, impervious cover, landscaped plantings, and other developed conditions would reduce the overall acreages of vegetation communities and available habitat for wildlife. The abundance and quality of vegetation communities and wildlife habitats would be expected to decline as land is converted from undeveloped to developed conditions. A reduction in the diversity of vegetation and habitats available to wildlife would likely mean a general reduction in the diversity of vegetation and wildlife species. Progressive measures during the planning and design stages of development projects may incorporate features, such as natural green space, vegetated corridors, and landscaping using native species, to maintain some natural vegetation within the development and to accommodate wildlife movements and life-cycle requirements, which may allow wildlife to remain in, or more easily traverse through, developed areas.

5.4.9 Essential Fish Habitat

Step 4: Identify Impact-Causing Activities of the Proposed Action and Alternatives

Construction of the Preferred Alternative would cross Geisler Bayou at two separate locations. Geisler Bayou is identified by the TCEQ as a tidal water segment. The waters would be subject to the ebb and flow of the tide, thereby classifying Geisler Bayou as a navigable water of the U.S. The proposed crossings of Geisler Bayou would likely be bridged, or possibly constructed using culverts. The crossings would not restrict flows within the bayou, or prevent or impede the movement of aquatic species. However, construction of the bridge structures or culverts may impact Geisler Bayou below the elevation of mean higher high water, which could affect essential fish habitat. Additionally, the Preferred Alternative may introduce additional pollutants into Geisler Bayou from roadway stormwater runoff. Coordination with the National Marine Fisheries Service was initiated on October 1, 2015 and is still in progress (**Appendix E**). Following the development of the final design for the Preferred Alternative, potential impacts to essential fish habitat associated with the tidal waters Geisler Bayou would be identified. Impacts to essential fish habitat would be avoided to the extent practicable; however, should potential adverse impacts to essential fish habitat be identified, additional coordination with the National Marine Fisheries Service would be conducted as part of the required coordination process.

Step 5: Identify Potentially Substantial Indirect Effects for Analysis

Encroachment-alteration Effects

Geisler Bayou is the only water identified within the proposed ROW of the Preferred Alternative that is tidally influenced. The proposed crossings would not restrict normal flows or adversely affect the movements of aquatic species. Therefore, encroachment-alteration effects would likely not result from construction of the Preferred Alternative.

Induced Growth Effects

The Preferred Alternative would induce additional development within the AOI, and the development may occur in areas where tidal waters would be present. Potential effects to essential fish habitat may occur from stream and channel improvements/expansions to convey stormwater runoff flows and from additional pollutants that may enter tidal waters with stormwater runoff flows.

Effects Related to Induced Growth

Induced development would convert vegetated areas within the AOI to roadway, residential, commercial, and industrial land uses, thereby increasing the volume of stormwater runoff from impervious surfaces. The runoff would likely be directed to stormwater management facilities and/or improved drainage-ways as the stormwater is conveyed to receiving waters in the AOI. The altered physical character of improved stream channels and drainage-ways could adversely affect essential fish habitat. The increased stormwater volume may contain additional pollutants that could adversely affect downstream tidal waters and essential fish habitat.

Step 6: Analyze Indirect Effects and Evaluate Results

Additional development in the AOI would reduce vegetated areas and permeable surfaces that could slow and absorb surface runoff. Consequently, the increased stormwater runoff would be directed to natural or constructed channels and drainage-ways to be conveyed away from developed areas. Although stormwater management facilities would help regulate the conveyance of stormwater runoff, improvements to channels and drainage-ways may be required to increase conveyance capacities for the efficient movement of stormwater flows. Structural improvements to channels and drainage-ways could alter the physical characteristics of the channels/drainage-ways. If such improvements occur in tidally-influenced waters, essential fish habitat could be affected.

Development that occurs in areas upstream of tidally-influenced waters could still affect essential fish habitat through discharges of pollutants that are carried downstream to tidally-influenced waters. Pollutants reaching tidally-influenced waters would likely be diluted during conveyance downstream, but could occur in quantities or concentrations that may degrade the quality of essential fish habitat in downstream tidally-influenced waters. Overall, additional development would likely incorporate temporary and permanent stormwater best management practices such that impacts to essential fish habitat would not be substantial.

Step 7: Assess Consequences and Consider/Develop Mitigation

Essential fish habitat could be affected by induced development within the AOI. Potential adverse effects may occur from physical alteration of streams and drainage-ways, or from pollutants conveyed with stormwater runoff to essential fish habitat areas. Street and roadway crossings of tidally-influenced waters would likely be bridged or would possibly incorporate culverts as part of the crossing design. Bridges and culverts would likely not restrict normal flows within the channel or drainage-ways. Bridge structures would allow for the movements of aquatic species within the underlying waters, and depending on the design, culverts may or may not impede the movements of aquatic species. Developments potentially affecting tidally-influenced waters and associated essential fish habitat would be subject to the Magnuson Stevens Fishery Conservation and Management Act. Coordination with the National Marine Fisheries Service would be required prior to construction to ensure that measures are incorporated into project planning to limit potential impacts to essential fish habitat.

Construction of developments within or upstream of tidally-influenced waters could introduce additional pollutants into essential fish habitat. The incorporation of stormwater management features (e.g., detention/retention facilities and grass-lined swales) would assist in limiting the possible introduction of pollutants into stormwater runoff, thereby decreasing potential impacts to essential fish habitat in tidally-influenced receiving waters within the AOI.

5.4.10 Cultural Resources

Step 4: Identify Impact-Causing Activities of the Proposed Action and Alternatives

As discussed in *Section 4.16*, ROE was only granted for 30 percent of the APE for archeological resources. Within the area available for survey, no further archaeological work is recommended. However, investigation should still occur in those portions of the study area where right-of-entry was not granted prior to construction. Additionally, once the state has taken ownership of the Preferred Alternative ROW, backhoe work should be conducted within the areas the PALM model recommends for deep reconnaissance.

There are three previously determined or recommended NRHP-listed or eligible resources within the APE for historic resources, all of which are depicted on ***Exhibit 3-13***: the ca. 1908 American Rice Canal (Resource 54); the ca. 1925 Briscoe Canal (Resource 16); and the 1935 South Texas Water Company Canal (Resource 1). The three structures are considered locally significant under Criterion A in the area of agriculture for their associations with rice cultivation. The Briscoe Canal may also be eligible under Criterion B in the area of agriculture for its associations with its founder, and the South Texas Water Company Canal may be eligible under Criterion C in the area of engineering as an excellent example of its type. These canal systems retain a high degree of integrity. For more detailed information on the evaluation of these resources as well as a description of Criterion B and C, please see ***Appendix G***.

Land use changes are expected to occur as a result of SH 99 Segment B within properties adjacent to the acquired ROW, changing from a currently undeveloped or lower density development to a higher density development because of improved access and mobility. Due to the controlled access of SH 99 Segment

B, this development would be more likely to occur in areas where intersections are created by SH 99 Segment B at an existing or proposed major roadway.

Step 5: Identify Potentially Substantial Indirect Effects for Analysis

Encroachment-alteration effects

SH 99 Segment B would provide access to new areas within the AOI. Indirect effects to archeological resources would be expected from development induced by the proposed roadway rather than encroachment-alterations effects. However, impacts to non-archeological historic resources could be affected by encroachment-alterations by changing the integrity of the location, design, materials, workmanship, historic setting, feeling, and/or association of the resource (known as the seven aspects of integrity). A historic resource is considered eligible for the NRHP based on its association with significant themes and retaining the aspects of integrity that allow that particular property to convey its significance, which may no longer exist as future development occurs.

Induced Growth effects

Archeological sites are typically directly affected through site clearing, grading, or excavation during development.

Effects related to Induced Growth

In areas of induced growth, cultural resources could be degraded by increases in vehicular traffic, changes in setting, human activity levels, and noise, which would impact potential cultural resources within the developing areas.

Step 6: Analyze Indirect Effects and Evaluate Results

Archeological Resources

The impacts to archeological sites from induced development under the Build or No-Build Alternatives may be substantial if sites are eligible or potentially eligible for the NRHP or as SALs. However, it cannot be determined whether development under the Build and No-Build Alternatives would result in substantial impacts to these sites because the quantity, location, and character of individual resources are unknown.

Historical Resources

To be listed in the National Register of Historic Places, a property must not only be shown to be significant under the National Register criteria, but it also must have integrity by retaining the seven aspects of integrity that allow that particular property to convey its significance; such as location, design, setting, materials, workmanship, feeling, and association.

Typical residential and commercial development within the AOI, associated with either the Build or No-Build Alternative, could result in both the direct physical loss of some properties and the loss of historic integrity of other properties. Potential indirect impacts to historical resources such as visual, noise, atmospheric, or other effects could occur well outside the construction area of SH 99 Segment B.

While the facility would be controlled access, it is assumed that patterns of development in the project area would likely continue, which would contribute to an indirect impact on historic resources. Increased development could increase looting, vandalism, and non-scientific collection of historical resources.

However, it is unknown if any indirect effects would be considered substantial and adverse. This depends on a clear understanding as to why each historic resource is eligible; in other words, one needs to know the integrity of the resource to know whether the integrity has been impaired to determine if the resulting action could affect the resource.

Step 7: Assess Consequences and Consider/Develop Mitigation

Some of the development under any of the Build Alternative Alignments may fall under federal or state regulatory resource protection review, and therefore, archeological resources could be protected, preserved, or mitigated. If development is publicly funded, or if private development requires certain federal permits, such as a permit under Section 404 of the CWA, then it would likely be subject to federal or state regulations and any mitigation measures required by federal or state regulations. However, most of the development, such as residential and commercial development, would not fall under the regulatory review process; therefore, archeological resources would have no protection under federal or state laws.

5.4.11 Visual and Aesthetic Qualities

Step 4: Identify Impact-Causing Activities of the Proposed Action and Alternatives

The Preferred Alternative would introduce a new visual element into the AOI, altering the rural setting in some portions, particularly those portions where there are no existing major roadways and where there is existing low-density residential development adjacent to the Preferred Alternative. Potential grade separations constructed at major intersections and possibly at stream crossings could be prominent visual features in the general area of any elevated structures. An additional visual and aesthetic impact would be the placement of necessary traffic noise barriers and an increase in nighttime ambient light levels from safety lighting. In general, the lighting system for the Preferred Alternative would be restricted to those areas where on-ramps and off-ramps would be located.

Step 5: Identify Potentially Substantial Indirect Effects for Analysis

Encroachment-alteration Effects

Construction of the Preferred Alternative would not be expected to have an encroachment-alteration effect on visual and aesthetic qualities. Changes in visual and aesthetic attributes would be the result of land use changes associated with induced development.

Induced Growth Effects

The Preferred Alternative is expected to induce growth within the AOI. Development in areas that are currently undeveloped would introduce new visual elements into the viewshed, possibly interrupting views of natural features, agricultural land, pastureland, and other undeveloped areas within the viewshed.

Effects Related to Induced Growth

Structures, streets and roadways, utilities, landscaping, and lighting associated with induced development would bring changes into the viewshed, altering the visual attributes of the AOI. Development would include street lighting and security lighting that would be expected to result in incremental and localized increases in ambient light levels, glare, and nightglow. The changed conditions would be subject to interpretation by residents and motorists, as changes in visual attributes within the AOI may be perceived as positive, negative, or neutral.

Step 6: Analyze Indirect Effects and Evaluate Results

Development induced by the Preferred Alternative in areas that already support existing development would likely be an intensification of the same or similar land uses. Initially, development may occur in areas that are already experiencing growth and in areas created by the intersections of major roadways. Induced development in already developed areas may be in the form of a greater number of, or possibly taller, structures (i.e., an increase in the density of development). The visual and aesthetic impact in the areas may not be as great because development is a current part of the landscape. Induced development in more rural areas would bring new visual elements into the viewshed that would be more noticeable on the otherwise relatively undeveloped landscape.

The new visual elements introduced into the viewshed from induced residential, commercial, and other development may be perceived by some as an adverse impact because the development detracts from the view of a previously rural or undeveloped landscape. Conversely, others may perceive the changed conditions positively, as new development would represent progress since access to goods and services may be more conveniently located within the community.

Step 7: Assess Consequences and Consider/Develop Mitigation

Structures, paving, and other development components that would occur as part of induced development would introduce new visual elements into the viewshed. New structures would be more noticeable in areas that are currently undeveloped, as opposed to areas where existing development is present. Depending on the type of proposed development and design specifications, visual mitigation measures could include the preservation of naturally vegetated areas or the incorporation of landscape features the might blend with the existing landscape. The use of regionally native plants for landscaping could provide some continuity of vegetation between developed and undeveloped areas. Additionally, lighting modifications in developed areas may be available to reduce glare and nightglow that might otherwise affect nighttime ambient light conditions. There are no requirements that developments mitigate for potential visual impacts. Incorporation of visual and aesthetic measures into development projects would be at the discretion of the individual developers.

5.5 REGIONAL INDIRECT EFFECTS OF TOLLING FACILITIES AND MANAGED LANES

5.5.1 Regional Perspective

The freeway and toll road system is a major component of the Houston-Galveston regional transportation system. Currently, the freeway and toll road system represents nearly 19 percent of regional lane miles, but carries more than 48 percent of VMT. Although growth in vehicle travel may be mitigated by transit expansion, improved operation of major arterial streets and growth of teleworking and e-business options, regional, and state economic growth would require continued expansion of the region's freeway and toll road network.

METRO is the region's largest transit provider. Its service area encompasses approximately 1,300 square miles. The agency has 100 miles of barrier-separated HOV lanes operating on six freeways that carry 73,000 carpool and vanpool passengers daily.

Inherent to the region's freeways are the high costs of maintenance and improvements. Although they generate few operational costs once constructed, building, maintaining, and expanding freeway facilities is very expensive. Over the last few years, the idea of user-fee based roadways has been growing in acceptance and popularity, and recently the Texas Transportation Commission adopted a favorable toll road policy to promote the study of additional toll roads throughout the state.

The Houston-Galveston region has been a national leader in using toll roads as a method of financing facilities and improving mobility for more than two decades. Currently, there are four toll roads in operation - the Hardy, Sam Houston Parkway, Westpark, and Fort Bend Parkway. As seen in ***Table 5-5***, the system of toll roads and managed HOT lanes is planned to grow from approximately 289 lane miles today to over 853 lane miles by 2035. In addition to increasing system capacity, the development of managed lanes would provide travel priority for transit buses, carpools, and vanpools on an expanded number of roadways, thereby greatly increasing their attractiveness to commuters and reducing congestion.

Table 5-5: Regional Roadway Network (lane miles)

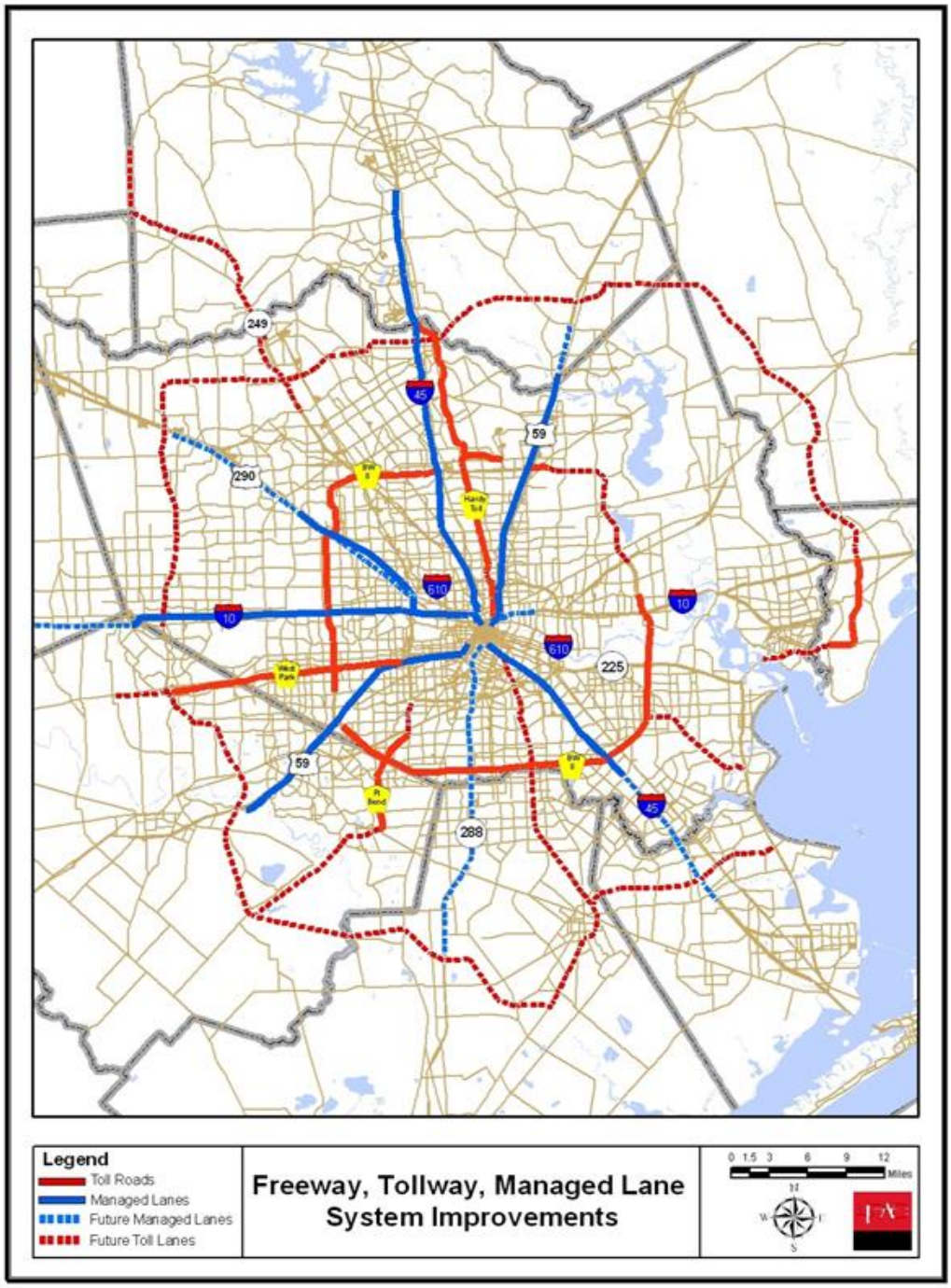
Year	Freeway	Toll Roads	Managed Lanes	Arterial	Total Lane Miles
2009 Network	3,669	658	289	19,955	24,571
2035 RTP	4,339	2,049	853	25,614	32,855

Source: H-GAC 2013.

Managed lanes use pricing as a means to manage demand. In essence, during peak periods managed lanes carry vehicles with a certain minimum number of occupants for no or low toll amounts with SOV paying a higher toll. This "management" allows for fine tuning of HOV lane eligibility because tolls can be varied to find the appropriate price to generate only sufficient additional demand to use any spare capacity. This use of capacity would not slow travel time because the pricing component ensures that the federal requirements regarding HOT lanes with speed limits greater than 50 mph must maintain a speed of 45 mph 90 percent of the time during peak periods is upheld.

Figure 5-1 illustrates the toll and managed lane improvements to the roadway system contained in the fiscally constrained RTP for 2035.

Figure 5-1: Proposed 2035 Regional Roadway Network



Source: H-GAC 2013.

As regional and population and employment continue to grow, transit will become an increasingly important tool for improving mobility. Transit is forecasted to significantly increase from its current

485,000 daily passenger boardings, to over 725,000 daily passenger boardings by 2035. This significant increase will be attributed to:

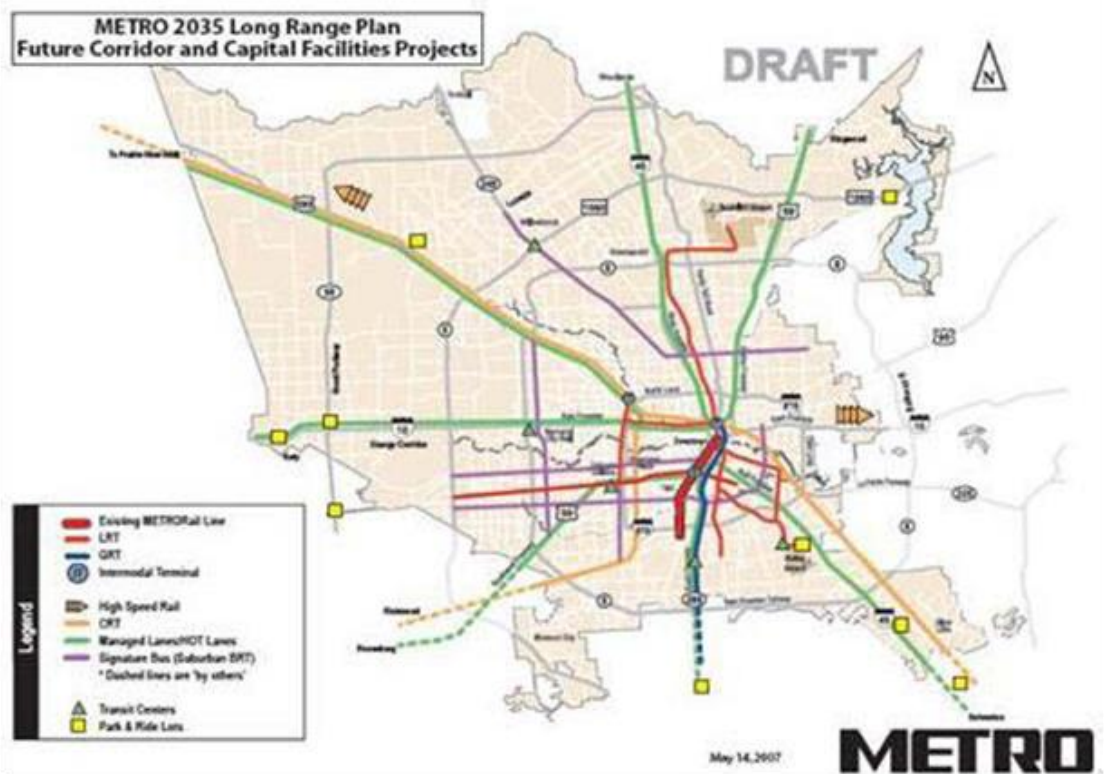
- Expansion of transit services (increased bus and rail transit services);
- New transit modes (commuter rail transit and signature express bus service);
- Transit connectivity to multiple employment centers; and
- Coordination of transit services among regional public transportation providers.

The 2035 METRO Long Range Plan is an iterative process incorporating the 2025 METRO Solutions Plan and future mobility needs identified in regional planning efforts (METRO 2007). METRO's 2035 Long Range Plan recommends significant expansion of the current transit system and includes a network of integrated high-capacity transit facilities on major travel corridors. The plan also identifies service expansions beyond the METRO service area. New improvements scheduled for implementation through 2035 include HOT lanes, a new intermodal terminal, park-n-ride facilities, and several new high-capacity transit corridors throughout the region. Additional key elements of the METRO Solutions plan include:

- 89 miles of fixed light rail transit;
- 84 miles of commuter rail transit; and
- 40 miles of signature bus service.

Figure 5-2 illustrates the Future Corridor and Capital Facilities projects in the 2035 METRO Long Range Plan.

Figure 5-2: 2035 Future Corridor and Capital Facilities Projects



Source: H-GAC 2013.

5.5.2 Demographics

The following information and projections provide an overview of H-GAC demographics at the regional level. The 2000 population of the Houston-Galveston region is over 4.5 million people, which includes eight counties and covers more than 7,000 square miles. Several counties in the region are listed among the top ten for growth in the nation, having experienced double-digit population growth for over a decade. Significant investments have been made to the regional transportation system, such as the expansion of our major highways and toll road systems. The region is anticipated to grow by more than 3 million new residents by 2035. ***Table 5-6*** shows the projected demographic changes expected in the region by 2035.

Table 5-6: Projected Demographic Changes in H-GAC Region 2000 to 2035

H-GAC Region	2000	2035	Percent Change
Population	4,669,571	8,835,000	89.20
Households	1,639,401	3,302,013	101.40
Percent Minority	52.10	68.97	16.87
Percent Non-Minority	47.80	31.02	-16.87
Percent Zero-Auto Households	8.28	14.10	5.82

Source: U.S. Census 2000.

As can be seen in ***Table 5-7***, significant changes in the distribution of household income are also projected to occur in the H-GAC region between 2000 and 2035. The analysis divided household income into five groups: 0 to $15,000, $15,000 to $30,000, $30,000 to $50,000, $50,000 to $75,000, and $75,000 and above. The income figures are presented in 1995 base year dollars since the travel demand model is estimated based on the 1995 household survey. The year 2000 household income distribution has the least percentage of households in the lowest income quintile ($0 to $15,000) and the highest percentage of households in the highest income quintile ($75,000 and above).

The projection for 2035 shows this distribution reversing, with the highest income quintile having the lowest household percentage share, and the lowest income quintile the second highest household percentage share. While the percentage of households within the middle quintile ($30,000 to $50,000) is projected to increase by 2035, the largest projected increase is in the lowest quintile. The projections indicate that overall wealth, as indicated by income, would decrease in the future. The shift in the percentage of the populations within income quintiles indicates a potential change and possible increase in future EJ zones.

Table 5-7: Percent of Households in the H-GAC Region within Income Categories

Household Income (1995 Dollars)	2000 (Percent)	2035 (Percent)	Percent Change
$0 to $15,000	14.31	18.07	3.79
$15,000 to $30,000	18.32	21.60	3.28
$30,000 to $50,000	22.27	24.41	2.14
$50,000 to $75,000	18.91	19.03	0.12
$75,000 and above	26.19	16.89	-9.30

Source: U.S. Census 2000.

5.5.3 Conclusion

The expanding regional roadway network, including tolled facilities and managed lanes, along with the expanding transit network could have indirect and cumulative impacts. However, the impacts would not be isolated to one location and would be better evaluated at the regional level. As a result, the consideration of a regional tolled roadway network is included in ***Section 6*** of the FEIS.

SECTION 6: CUMULATIVE EFFECTS ANALYSIS

Section 6 presents the cumulative effects analysis conducted for the Preferred Alternative and the No-Build Alternative. The section includes an introduction to the background and project-specific requirements for the cumulative effects evaluation, followed by a description of the methodology used to perform the analysis. Subsequent subsections provide the resource-specific cumulative effects evaluations, all of which is followed by a summary of the results of the analysis.

6.1 INTRODUCTION

The CEQ regulations implementing NEPA define cumulative effects as an "impact on the environment which results from the incremental impact of the action (project) when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7).

Cumulative effects (impacts) include both direct and indirect or induced effects that would result from a project, as well as the effects from other projects (past, present, and reasonably foreseeable future actions) not related to or caused by the proposed action. The cumulative effects analysis considers the magnitude of the cumulative effect on the resource health. Health refers to the general overall condition, stability, or vitality of the resource and the trend of that condition. Laws, regulations, policies, or other factors that may change or sustain the resource trend were considered to determine if more or less stress on the resource is likely in the foreseeable future. Opportunities to mitigate adverse cumulative effects on a stressed resource, or a resource that will continue to be stressed, are discussed.

6.1.1 Methodology for Cumulative Impact Analysis

To evaluate cumulative effects, a five-step approach was used based on the TxDOT's *Cumulative Impacts Analysis Guidelines* as outlined in ***Table 6-1*** (TxDOT 2014).

Table 6-1: Guidelines for Identifying and Assessing Cumulative Effects

Step	Identification and Assessment Process
1	Resource Study Area, Conditions, and Trends
2	Direct and Indirect Effects on each Resource from the Proposed Project
3	Other Actions – Past, Present, and Reasonably Foreseeable – and their Effect on each Resource
4	The Overall Effects of the Proposed Project Combined with other Actions
5	Mitigation of Cumulative Effects

Source: TxDOT 2014.

The five steps used in this cumulative effects analysis are described below.

Step 1: Resource Study Area, Conditions, and Trends

The first step in performing the cumulative impact analysis was to identify which resources to consider in the analysis. The cumulative impact analysis should focus only on (1) those resources significantly impacted (directly or indirectly) by a project, and (2) resources currently in poor or declining health or at risk even if the project impacts are relatively small (less than significant).

The cumulative effects analysis considered both geographic and temporal study limits where applicable. A Resource Study Area (RSA) was defined for those resources that were carried forward in the cumulative impacts analysis and is discussed in those subsections. The RSAs were used for characterization of the health condition and trend for each resource, and to determine the potential cumulative effects on a resource when quantitative information was not available. Cumulative effects were determined considering the potential cumulative effect on the health and trend on the resource within the RSA.

Step 2: Direct and Indirect Effects on each Resource from the Proposed Project

This step identifies the direct and indirect effects that could result from the Preferred Alternative that may contribute to a cumulative effect when added to non-project related effects. Direct and indirect impacts are defined by CEQ regulations (40 CFR 1508.8) as follows: "Direct impacts are caused by the action and occur at the same time and place," whereas, "Indirect (secondary) impacts are caused by the action and are later in time and farther removed in distance, but are still reasonably foreseeable. Indirect impacts may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate and related effects on air and water and other natural systems, including ecosystems" (40 CFR 1508.8). A summary of the direct and indirect effects is presented for each resource.

Step 3: Other Actions – Past, Present and Reasonably Foreseeable – and their Effect on each Resource

The historical context of each resource is described and presented in each resource subsection. This information is important to establish the baseline condition and trend the resource is experiencing to be able to estimate the magnitude of the effect on the resource. The historical context is first described to provide an explanation of the factors that have caused the current health of the resource. Past actions are the general or specific projects, activities, and patterns in the area that have cumulatively caused the current status, health, viability, and trend of the resources in each resource section.

A cumulative and indirect effects analysis requires consideration of past, present, and reasonably foreseeable future actions. The approach used for this cumulative effects analysis included an assessment of past, present, and future actions with the purpose of characterizing the types of actions that are representative of past, present, and future development in the RSA. This provides a context for the types of development projects that have caused the current health of the land and other resources and the trends the resources are experiencing. It also provides insight as to the effect of development on future resource stress and future trends.

The year 1975 was selected as the baseline year for the cumulative effects analysis for the resources that were analyzed. This timeframe coincides with the construction of SH 288 and the 1970's economic boom for the Houston metro area. Quantification of individual past actions was not performed, and past actions were considered collectively as the development that had occurred as of 1975. Present actions are considered to be the development that has occurred between 1995 and 2014. Current land use (year 2014) is shown in ***Exhibit 3-1***. The change in the development area was determined by comparing the development shown on 1975 aerial photography to that in 1987, 1995, 2008 and 2014. Reasonably foreseeable future actions included current and planned land development projects and planned transportation projects included in the *2035 RTP Update*.

Step 4: The Overall Effects of the Proposed Project Combined with Other Actions

Quantitative assessment of the cumulative effects on resource health and trends in the RSA was the goal of the cumulative effects analysis. However, where incomplete or unavailable information precluded a quantitative assessment of all resources, a qualitative assessment of the cumulative effect on each resource was performed. The cumulative effects analysis considered the direct and indirect effects of the Preferred Alternative, together with the effects of past, present, and reasonably foreseeable future projects. The magnitude of the cumulative effect was determined by comparing the effect to the health and trend of the affected resource.

Step 5: Mitigation of Cumulative Effects

Opportunities for mitigation of adverse effects are discussed for each resource. These are not meant to be mitigation measures that TxDOT would or has the authority to implement. Rather, they are intended to disclose steps or actions that could be undertaken by local, state, and federal agencies and organizations to minimize the potential cumulative effect on each resource health and trend.

Table 6-2 summarizes each resource impact, presents a determination of which resources would be carried forward and evaluated in the cumulative effects analysis, and identifies why some resources and effects categories were eliminated from the cumulative effects evaluation.

Table 6-2: Determination of Resources/Issues Considered in the Cumulative Effects Analysis

Resource	Direct Effects	Indirect Effects	Topic to be Including in Cumulative Effect Analysis	Reason Eliminated from Cumulative Impact Analysis
Land Use	1,072 acres of existing land uses would be converted to roadway ROW. The Preferred Alternative is compatible with local land use plans.	Approximately 187,039 acres of vacant/ developable (includes farming) land is within the area of potential indirect development.	Yes	N/A
Soils and Farmlands	1,313 acres of prime farmland soils would be impacted.	New highway construction would potentially lead to the conversion of farmland soils into other uses, by providing access to areas that presently have limited or no access via public roadways.	No	Indirect farmland conversion due to increased development associated with induced growth or direct effects are anticipated to be considered minor based on NRCS ratings; therefore, no substantial indirect impacts to prime farmland soils are anticipated with the Preferred Alternative.
Social: Displacements and Relocations	The Preferred Alternative would displace 17 residential, 13 business displacements, and 34 other (e.g., parking areas, cell tower, and outbuildings) displacements. Approximately 282 parcels would have some ROW acquisition.	Development induced by the Preferred Alternative could cause displacements and relocations of residences and businesses. Indirect impacts to housing or alternative business locations are anticipated; however, adequate replacement housing and business replacement alternatives are available in the study area where the potential displacements/ relocations would occur.	Yes	N/A
Social: Community and Public Resources	In the short term, an increase in traffic congestion and potential changes in travel patterns would be expected due to roadway construction. In the long term, the Preferred Alternative would improve mobility in the study area and for community and public resources.	Induced development and urbanization in the proposed study area would increase the overall population and require the development of additional infrastructure elements to serve the demands for energy, water and wastewater utilities, municipal services, medical services, police and fire protection, and other services.	Yes	N/A

Table 6-2: Determination of Resources/Issues Considered in the Cumulative Effects Analysis

Resource	Direct Effects	Indirect Effects	Topic to be Including in Cumulative Effect Analysis	Reason Eliminated from Cumulative Impact Analysis
Social: EJ Populations and Demographics	Minority, low-income, LEP, and age-sensitive individuals could be impacted by loss of property due to ROW acquisition.	No indirect impacts to EJ populations or demographic changes in the study area are expected as a result of Preferred Alternative.	No	EJ populations would have the opportunity to mitigate any possible property loss due to ROW acquisition.
Social: Pedestrians and Bicyclists	Pedestrian and bicycle facilities are not currently planned to be incorporated as part of the proposed SH 99 Segment B. Overpasses would typically be constructed where the Preferred Alternative would intersect with an existing roadway; therefore, pedestrian or bicycle facilities associated with the existing roadways would not be impacted by construction.	Construction and operation of the Preferred Alternative would not disrupt the use or expansion of existing pedestrian or bicycle facilities in the study area. Although traffic congestion may increase as additional development occurs outside the Preferred Alternative ROW, the Preferred Alternative would not interfere with the planning or installation of additional pedestrian or bicycle facilities in the project area.	No	The Preferred Alternative is not anticipated to result in significant direct or indirect pedestrian and bicycle impacts.
Social: Economic Resources	Direct impacts include purchases made by the new construction sector and the creation of new job opportunities and income potential in the study area. Long-term effects would include the permanent removal of taxable property in Brazoria and Galveston Counties from the tax rolls of local government entities and school districts.	Indirect impacts and induced effects on local, regional, and state employment, output, and income would be expected. Indirect economic benefits to the local economy would be indirectly induced by the Preferred Alternative.	Yes	N/A

Table 6-2: Determination of Resources/Issues Considered in the Cumulative Effects Analysis

Resource	Direct Effects	Indirect Effects	Topic to be Including in Cumulative Effect Analysis	Reason Eliminated from Cumulative Impact Analysis
Air Quality	The proposed project is located within Brazoria and Galveston Counties which are part of the Houston-Galveston area that has been designated by EPA as a marginal non-attainment area for the 2008 ozone standard. The localized level of MSAT emissions for the Build Alternative could be higher relative to a No-Build alternative, but this could be offset because of increases in speeds and reductions in congestion. Also, MSAT would be lower in other locations when traffic shifts away from them.	No change in attainment status is anticipated within the study area as a result of emissions associated with the proposed project. The proposed project is not anticipated to result in indirect impacts to air quality. Indirect air quality impacts from MSAT are unquantifiable due to existing limitations to determine pollutant emissions, dispersion, and impacts to human health.	No	The Preferred Alternative is not anticipated to result in direct or indirect air quality impacts.
Water Quality	During construction, exposed soil could runoff into streams and increase turbidity and sediment loading downstream.	The Preferred Alternative would induce development. The indirect effect of development would be an increase in impermeable cover that could increase pollutants entering receiving waters with stormwater flows.	Yes	N/A
Floodplain	Direct impacts to flood hazard areas from ROW acquisition would be approximately 343 acres. The Preferred Alternative would not raise base floodplain elevations.	Induced development that may occur within floodplains would be constructed in accordance with federal and local regulations. Stormwater detention facilities and hydraulic features would offset increases in flows due to the addition of impermeable cover. Indirect impacts from development would not be expected to raise 100-year floodplain elevations.	Yes	N/A

Table 6-2: Determination of Resources/Issues Considered in the Cumulative Effects Analysis

Resource	Direct Effects	Indirect Effects	Topic to be Including in Cumulative Effect Analysis	Reason Eliminated from Cumulative Impact Analysis
Wetlands/ Waters of the United States (U.S.)	Direct impacts to wetlands from ROW acquisition and construction would be approximately 54.5 acres. Several waters of the U.S. (streams and drainageways) totaling approximately 25.2 acres would likely be impacted through the construction of bridges and the installation of culverts.	The Preferred Alternative would induce development. The indirect effect of the induced development would be the loss of additional acres of wetlands and impacts to waters of the U.S. Compensatory mitigation required as part of USACE permitting would offset the loss of jurisdictional waters and wetlands.	Yes	N/A
Vegetation and Wildlife Habitat	Areas of various vegetation communities would be directly impacted from ROW acquisition and construction. Wildlife would be displaced or possibly killed during construction. Areas within the proposed ROW not paved would likely be vegetated with herbaceous species that would be routinely maintained. Wildlife habitat would be reduced, and injury and mortality from vehicle traffic would likely increase.	The Preferred Alternative would induce development. The indirect effect of induced development would be the development of undeveloped areas of various vegetation communities. The indirect effect on wildlife would be the continued removal of vegetation and habitats, as well as displacement and possible mortality of some individuals. Developed areas would likely contain maintained landscaping and ornamental plantings that may provide habitat for some wildlife.	Yes	N/A
Essential Fish Habitat (EFH)	Direct impacts to Geisler Bayou (a tidal water) could occur at the crossings of the Preferred Alternative.	The Preferred Alternative would induce development. The indirect effect of induced development would be channel improvements within tidally-influenced waters required to accommodate storm water and flood flows, possibly altering hydraulic flow conditions. Additional pollutants from developed areas could be discharged directly into tidally-influenced waters or in upstream waters that are conveyed to tidally-influenced waters.	Yes	N/A

Table 6-2: Determination of Resources/Issues Considered in the Cumulative Effects Analysis

Resource	Direct Effects	Indirect Effects	Topic to be Including in Cumulative Effect Analysis	Reason Eliminated from Cumulative Impact Analysis
Threatened and Endangered Species	The Preferred Alternative would traverse vegetation communities and aquatic resources that provide potential habitat for federally and state-listed threatened and endangered species. Construction of the Preferred Alternative would convert potential habitat areas to roadway ROW, permanently removing these potential habitat areas.	The Preferred Alternative would induce development. The indirect effect of induced development would be the conversion of vegetation communities, which may be potential habitat areas, to developed conditions. Although the Endangered Species Act and other applicable laws protect listed species, the continued removal of vegetation and habitat areas would reduce habitat available to accommodate displaced individuals or the expansion of recovering populations.	Yes	N/A
Cultural Resources	TxDOT will consult with THC regarding any potential effect that the proposed undertaking may have on historic properties and archeological resources		No	N/A
Visual and Aesthetic Qualities	Views within the study area would change depending on the perspective of the viewer. The Preferred Alternative would be a new facility that would include safety lighting and possibly elevated overpasses.	Induced development would cause changes in land use and would introduce new elements into the viewshed. The visual character of the areas in which new development occurs may be affected. New structures and increased ambient light conditions, noise, and human activity levels would be expected in developed areas.	No	Visual and aesthetic qualities in the area of the Preferred Alternative would unavoidably change as a consequence of land uses changes. Individual developments would be responsible for the aesthetic character of structures and facilities constructed within the developments.

Source: The table summarizes ***Section 4*** and ***Section 5*** of the FEIS.

Note: See the list of acronyms and abbreviations for a full listing of abbreviations used in the table.

6.2 STEPS 1 THROUGH 5 PER RESOURCE

6.2.1 Land Use

6.2.1.1 Resource Study Area, Conditions, and Trends

The RSA for land use is the same as the AOI described in ***Section 5.1*** of the FEIS and shown on ***Exhibit 5-1***. The RSA is the area defined by the 12 RAZs that were used for population and employment growth forecasts. The RSA encompasses approximately 396,885 acres (approximately 620 square miles) in the south/southeast Greater Houston area and includes cities/communities such as Algoa, Alvin,

Bonney, Friendswood, Hillcrest Village, Iowa Colony, League City, Manvel, Pearland, and Santa Fe. The temporal boundary for land use is from 1975 to 2035.

During the 1970s, approximately 80,000 new residents were added to the CMSA population annually. Brazoria and Galveston Counties were experiencing an average population growth of over 4.5 percent per year during the decade. While suburban development was generally concentrated near the boundary of Harris County, the construction of SH 288 opened up new opportunities for development in southern Harris and northern Brazoria counties.

Typical suburbanization of the Houston metropolitan area in the 1970s led to the "leap frog" nature of suburban development, with new "master-planned" communities developing farther away from Houston employment centers such as downtown, the Galleria area, Greenway Plaza, and the Medical Center. Houston's economic base changed in the mid-1980s, which in turn slowed population and employment growth in suburban areas. The recovery of the economy in the early 1990s stimulated population and employment growth within suburban areas, thereby affecting development patterns. Suburban development of the 1990s was fueled by the increase in employment growth outside of traditional Houston employment centers, the exhaustion of large parcels of land closer to central Houston for the development of master-planned communities, and the improvement of transportation infrastructure. By the latter part of the 1990s, several new subdivisions had been started in the RSA, including Silver Lakes, West Oaks, Oakbrook, The Forest, Claremont Park, and Eagle Lakes. In total, 68 new major subdivisions were initiated in northern Brazoria and Galveston Counties.

In the five-year period from 2000 to 2005, the Houston economy slowed due to a decrease in energy prices; however, the non-energy related economy continued to thrive and overall employment grew by two percent. Even with a weak economy, the Houston metropolitan area experienced an increase in housing demand. This increased demand is thought to coincide with a national trend of low-interest rates that kept housing affordability at record levels, but as interest rates begin to climb, this suburban building trend is expected to decrease. The Great Recession that began in 2008 caused development to slow in some areas, but this part of the Houston metro region continued to develop, particularly in areas such as Pearland and Friendswood. ***Exhibit 5-2*** through ***Exhibit 5-6*** demonstrate this trend.

Aerial photographs from the U.S. Department of Agriculture were reviewed for a general assessment of development within the RSA (USDA 1974, 1976). At that time, SH 288 was under construction, and residential and commercial development was concentrated around existing communities such as Alvin, Friendswood, League City, Manvel, Pearland, and Santa Fe. Some low-density residential areas were interspersed throughout the RSA; however, the majority of the central and southern portions were undeveloped land. USGS and H-GAC aerial photographs of the RSA were also reviewed to estimate the extent of development between this period (USGS 1995; H-GAC 2008, 2014). In 1995, approximately 13 percent of the RSA was developed. The remaining approximately 87 percent was undeveloped or agricultural land. By 2008, approximately 24 percent of the RSA was developed and the remaining approximately 68 percent was undeveloped/agricultural. In 2012, 70 percent of the AOI was developed.

Residential and commercial development was prominent in the northern portion of the RSA in and around established communities. Development also occurred along portions of SH 288 and SH 6.

Housing and associated commercial development within the RSA are expected to continue in response to the demand created by increasing population and employment in the region. Planned residential/commercial developments are shown in ***Table 5-2***. Areas of undeveloped land in the RSA will likely convert to residential and commercial use over time. Residential and commercial growth is also expected along major transportation facilities within the RSA such as SH 288, SH 6, FM 517, and IH 45 South.

Much of the land use is primarily flat pastureland used for farming and grazing. Currently 187,039 acres (47 percent) of the RSA is vacant developable land, which includes farmland. In 2002, the total amount of agricultural land in the RSA was 230,500 acres, approximately 65 percent. Early development has been in the form of large-lot residential areas scattered throughout the RSA. The development that has occurred since 2002 has encroached primarily into available grassland.

6.2.1.2 Direct and Indirect Effects on each Resource from the Proposed Project

Summary of Direct Effects

Transportation facilities are only one factor in creating favorable land development conditions. Other requisites for land development opportunities include the demand for new development, favorable local and regional economic conditions, adequate utilities, and supportive local land development regulations and policies. Development effects, both beneficial and adverse, would continue under the No-Build Alternative regardless of when or if the Preferred Alternative is constructed. The Preferred Alternative would require the acquisition of approximately 1,072 acres of new ROW and result in an estimated 17 residential, 13 business, and 34 other (e.g., parking areas, cell tower, and outbuildings) displacements. Approximately 282 parcels would require ROW acquisition. The 2014 H-GAC land cover data shows that 187,039 acres (47 percent) of the RSA is vacant/developable, 9,563 acres commercial (3 percent), 90,999 residential (24 percent), and 28,077 government/medical/educational (7 percent). Prime and statewide important farmland soils exist in the RSA and would be impacted by the Preferred Alternative. The total acres of prime and statewide important farmland soils impacted by the Preferred Alternative are approximately 1,305 acres. Details on the impact of the Preferred Alternative on these soils can be found in ***Section 4.2*** of the FEIS.

Summary of Indirect Effects

Residential development, particularly in the communities in the northern and eastern portions of the RSA, has been occurring at a relatively rapid pace and is expected to continue to accommodate the housing needs of residents moving into the area. Residential development typically involves the construction of a large number of homes and the infrastructure necessary to support the development. Commercial developments such as restaurants, retail, and convenience stores are often associated with areas of residential construction. Retail and institutional construction generally follows residential development. Office and industrial construction usually requires that residential and retail development be in place before such construction is economically feasible. Consequently, there is typically a time lag between

residential development and office/industrial growth. However, some retail/industrial development may be generated with or without residential expansion.

Land use changes would occur as an indirect effect of the Preferred Alternative. Residential and commercial properties would be displaced by ROW acquisition, and displaced owners may relocate within the RSA, possibly in areas that are currently undeveloped. Induced development would result in a direct loss of some soils, including prime farmland soils, because of soils being removed from construction sites. In addition, indirect impacts to geological and soil resources are expected from potential new construction sites adjacent to the Preferred Alternative in areas where the Preferred Alternative intersects with major thoroughfares. Because the Preferred Alternative would be a controlled access facility, land use changes would be more likely in areas where intersections are created by the Preferred Alternative and major roadways, such as SH 288, SH 35, SH 6, FM 1462, FM 517, FM 528, FM 646, and IH 45 South, where direct access would be available. Cumulative impacts on farmlands are expected as farmlands are sold for the Preferred Alternative and other projected development in the RSA.

6.2.1.3 Other Actions – Past, Present, and Reasonably Foreseeable – and their Effect on each Resource

Land use changes to support residential and commercial development are expected to continue in response to increases in regional population and employment. Regional land use change within the RSA suggests that development activities to accommodate projected population and employment growth would represent a continuation of the growth already being experienced in the RSA. This projected growth is expected to have a greater influence on the densities of development in areas that are already experiencing growth rather than on the amount of acreage consumed for development.

Transportation projects that traverse the RSA are shown in ***Table 6-3***. Projects listed were identified as reasonably foreseeable transportation projects because they were listed in the *2035 RTP Update*, which identifies projects through the year 2035. In the vicinity of proposed transportation projects, improved mobility may facilitate continued growth. Similarly, planned flood control improvements such as channel modifications and detention construction would reduce potential flood risks in certain areas, which may facilitate continued development. Direct and indirect impacts of other projects unrelated to the Preferred Alternative would be expected to affect land use within the RSA as additional land is consumed for residential, commercial, transportation, and other uses.

Table 6-3: Proposed Transportation Projects in the RSA

Project Name	CSJ # or CIP ID	Project Limits	Project Description	Fiscal Year	RSA Affected
FM 517	CSJ 1002-02-016	FM 646 to Brazoria County Line	Reconstruct and widen to 4 lanes	2028	Land Use, Social, and Water Quality
CR 58	CIP 228	SH 288 to FM 1128	Widen to 4 lanes	2020	Land Use, Social, and Water Quality

Table 6-3: Proposed Transportation Projects in the RSA

Project Name	CSJ # or CIP ID	Project Limits	Project Description	Fiscal Year	RSA Affected
CR 59	N/A	Fort Bend County Line to CR 48	Widen to 4 lanes with a bridge	2023	Land Use, Social, and Water Quality
SH 288	0598-02-093	CR 58 to SH 99	Construct 4 toll lanes, with grade separations	2032	Land Use, Social, and Water Quality
CR 403	N/A	CR 94 to FM 865	Widen to 4 lanes with median, shoulders, and sidewalks	2017	Land Use, Social, and Water Quality
Mykawa Road	CIP T68976	Beltway 8 to FM 518	Widen to 4 lanes with medians	2016	Land Use, Social, and Water Quality
FM 2351	N/A	SH 35 to Galveston County Line	Reconstruct and widen to a 4-lane roadway	2020	Land Use, Social, and Water Quality
CR 185	N/A	SH 6 to SH 35	Reconstruct and widen, existing 2-lane rural with shoulders and new location 2-lane rural section	2016	Land Use, Social, and Water Quality
CR 48	CSJ 0912-31-224	CR 894 to SH 6	Reconstruct and widen to 4 lanes	2013	Land Use, Social, and Water Quality
CR 48	CIP CR48N	FM 518 to CR 894	Widen to 4 lanes, with shoulders	2015	Land Use, Social, and Water Quality
IH 45 South	CSJ 0500-04-096	North of FM 517 to south of FM 518	Widen to 8 lanes (includes mainlanes and two frontage road lanes)	2032	Social, and Water Quality
IH 45 South	CSJ 0500-04-106	North of FM 1764 to north of FM 517	Widen to 8 lanes (includes mainlanes and two frontage road lanes)	2033	Land Use, Social, and Water Quality
SH 99 Segment C	CSJ 3510-03-001	FM 762 to Brazoria County Line	Construct 4-lane tollway with limited 2-lane frontage roads at interchanges	2017	Land Use, Social, and Water Quality

Source: H-GAC 2014a.

Note: See the list of acronyms and abbreviations for a full listing of abbreviations used in the table.

6.2.1.4 The Overall Effects of the Proposed Project Combined with Other Actions

The Preferred Alternative would convert approximately 1,072 acres of land to roadway ROW, and would cause some indirect changes to land use. Induced development associated with the Preferred Alternative would likely occur in areas where intersections are created by the Preferred Alternative at an existing or proposed major roadway. Planned development projects, as presented in ***Table 5-2***, would convert approximately 10,628 acres within the RSA to developed conditions. Proposed transportation projects,

including those presented in ***Table 6-3***, may improve mobility and facilitate access in the RSA. Greater access from new or widened roadways may enhance opportunities for the development of properties adjacent to existing or acquired ROW.

In the near term, land use changes would be expected in the vicinity of major roadways and in areas currently experiencing growth. Land use changes would likely be in the form of converting areas of vacant land to developed conditions. These changes could also include redevelopment of existing developed areas to another use, such as from a lower density development to a higher density development. Approximately 187,039 acres of vacant/developable land (including farmland), which is approaching 50 percent of the RSA, could be developed. The conversion of vacant land to developed conditions would be more likely to occur in the southern portion of the RSA where there is available undeveloped/agricultural land, while the northern portion of the RSA would likely experience land use changes through redevelopment activities.

Cumulatively, the Preferred Alternative has the potential to increase the rate of development within the RSA. However, development within the RSA would likely occur in response to the projected trend of continued growth in population and employment throughout the region, and would not be appreciatively affected by the Preferred Alternative. Factors affecting development include regional economic conditions and the availability of utility infrastructure, such as electricity, natural gas, water, and wastewater, or the ability to extend such infrastructure from nearby areas. Therefore, even though land is available for development, the quantity (acres) of land that might be developed and the location or pattern of development would be difficult to predict. Within the RSA, residential and commercial developments would be expected to continue in order to accommodate the increasing regional population and employment, and this trend would likely continue with minimal influence from the Preferred Alternative.

6.2.1.5 Mitigation of Cumulative Effects

Large areas of undeveloped land exist within portions of the central and southern areas of the RSA, and many of these areas are in active agricultural production or used as livestock pasture. Because contiguous areas of undeveloped land are available to meet the demand for land resources, the southward expansion of residential, commercial, and other development in the RSA is likely to continue. An increase in land value due to proximity to development may provide landowners willing to sell or develop their property an opportunity to realize a monetary gain greater than from continuation of farming and/or ranching activities, or as a vacant tract of land. Effective competing opportunities of equivalent or greater value offered to landowners to purchase the development rights or to dedicate their property to a use other than development would be needed to deter the continued conversion of undeveloped land to other land uses.

The majority of the projected future development would be in the unincorporated area of Brazoria County where there are few land use controls. Development would be regulated by the subdivision ordinances of the counties and local jurisdictions. Water supply requirements and floodplain regulations would be the primary limitations to the location and density of development.

Private, non-profit organizations dedicated to preserving undeveloped land and/or farmland may be interested in acquiring the development rights to properties in the RSA. Preservation efforts could be implemented through foundations and local subdivision regulations to protect valuable farmland from suburban encroachment.

6.2.2 Social

This section addresses social impacts, which are community and quality of life issues. The following attributes were reviewed for cumulative impacts: displacements and relocations, economic resources, and communities and public resources.

The temporal boundary for social resources is from 1975 to 2035. The year 1975 was selected as the baseline year for the cumulative effects analysis for the resources that were analyzed. This timeframe coincides with the construction of SH 288 and the 1970's economic boom for the Houston metro area. When considering the temporal boundary for the AOI, it was determined that the planning horizon of the *2035 RTP Update* would be the most relevant measurement since ancillary growth as a result of transportation improvements in the AOI would be reasonably foreseeable till 2035.

6.2.2.1 Resource Study Area, Conditions, and Trends

The social RSA is the approximate 396,885-acre study area corresponding with the AOI for indirect impacts. Social impacts are primarily expected in this geographic area. Economic impacts are expected at the local, regional, and state levels, as discussed in *Table 6.2*. The boundaries of the social RSA is shown on ***Exhibit 5-1***. The social RSA is located within Brazoria and Galveston Counties, and is wholly or partially located with 18 cities or communities. H-GAC's population, household and employment growth forecasts were examined for these counties, and cities/communities. The social RSA encompasses approximately 396,885 acres in the south/southeast Houston metropolitan area, and includes the communities of Algoa, Alvin, Bonney, Brookside Village, Clear Lake Shores, Danbury, Dickinson, Friendswood, Hillcrest Village, Iowa Colony, Kemah, La Marque, League City, Liverpool, Manvel, Pearland, Sandy Point, and Santa Fe (***Exhibit 5-1***). Economic impacts will be discussed on a regional and statewide basis.

The social RSA intersects or is included within Brazoria and Galveston Counties, and includes 18 cities or communities. The cities or communities boundaries within the RSA are shown on ***Exhibit 5-1***. The 2010 population and demographics is shown in ***Table 6-4***. The median household income within the social RSA ranges from a low of $36,397 in Liverpool to a high of $117,465 in Friendswood.

Table 6-4: Population, Demographic, and Median Household Income Statistics for the Associated Counties, and Local Cities/Communities in the Social RSA

Geographic Area	Population	Race/Ethnicity by Percent Total Population Non-Hispanic of Latino				Hispanic or Latino	Percent Minority[a]	Median Household Income
		White	Black	Asian	Other			
Brazoria County	313,166	53.2	11.8	5.4	1.9	27.7	46.8	$68,008
Galveston County	291,309	59.3	13.5	2.9	1.9	22.4	40.7	$61,555
Alvin	24,236	58.7	2.9	0.9	1.4	36.1	41.3	$45,638
Bonney	310	53.9	9.0	3.2	1.0	32.9	46.1	$53,750
Brookside Village	1,523	52.1	6.2	0.7	1.2	39.7	47.9	$65,000
Clear Lake Shores	1,063	89.7	1.0	0.7	1.1	7.6	10.3	$82,604
Danbury	1,715	83.3	0.6	0.5	1.9	13.7	16.7	$56,136
Dickinson	18,680	52.3	11.2	1.9	1.9	32.7	47.7	$62,105
Friendswood	35,805	77.5	3.3	4.8	1.9	12.5	22.5	$102,811
Hillcrest Village	730	85.2	0.3	0.7	1.5	12.3	14.8	$82,708
Iowa Colony	1,170	46.0	5.6	5.6	3.2	39.6	54.0	$68,587
Kemah	1,773	70.1	4.4	6.1	1.7	17.7	29.9	$68,977
La Marque	14,509	38.7	36.3	0.6	1.9	22.5	61.3	$46,070
League City	83,560	68.2	6.9	5.3	2.3	17.3	31.8	$88,289
Liverpool	482	80.9	1.1	0.0	0.6	17.4	19.1	$36,397
Manvel	5,179	54.0	16.5	5.2	1.7	22.6	46.0	$76,205
Pearland	91,252	48.8	16.1	12.3	2.3	20.5	51.2	$85,452
Santa Fe	12,222	86.4	0.3	0.5	1.2	11.6	13.6	$60,442

Source: U.S. Census 2010 (Summary File 1, Table P9), 2014 (2008-2012 ACS, Table B19013).

[a] Percent minority includes all non-white races and persons of Hispanic origin.

Notes: The poverty guideline for a family of four people in 2014, as defined by the U.S. Department of Health and Human Services, was a total annual household income of $23,850. Algoa and Sandy Point are not a Census designated place; therefore, both are not discussed in the table.

The 2014 H-GAC land cover data shows that 187,039 acres (47 percent) of the RSA is vacant/developable, 9,563 acres commercial (3 percent), 90,999 residential (24 percent), and 28,077 government/medical/educational (7 percent). ***Section 5.1***, ***Section 6.1***, ***Table 5-2***, and ***Table 6-3*** describe reasonably foreseeable land development and transportation projects in the RSA. Large areas of undeveloped land are planned to be developed as residential and master-planned communities. Commute times for residents in rural portions of the RSA to retail, service, and employment areas may improve due to the addition of transportation facilities in the area.

As shown in ***Table 5-1***, the population, households, and employment in Brazoria and Galveston Counties, and all 18 cities/communities within the RSA are projected to increase from 2010 to 2035. Population growth (as indicated by an increase in the number of households) and total employment represent the

primary demographic and economic indicators for travel demand, which is defined by the number, purpose, and type of trips. Employment and housing is projected to increase by approximately 190.2, and 132.4 percent, respectively between the years 2010 and 2035 (H-GAC 2014[d]). Increase in population and housing and associated commercial development are occurring in response to the demand created by increasing population and employment in the region.

6.2.2.2 Direct and Indirect Effects on each Resource from the Proposed Project

Summary of Direct Effects

The Preferred Alternative would displace businesses, residences (single-family), and community and public facilities. The Preferred Alternative would require 1,072 acres of ROW acquisition, and 17 residential, 13 business, 34 other (e.g., parking areas, cell tower, and outbuildings) displacements. Property acquisition would change the tax status of the land and cause a loss of property tax revenue for local taxing entities, as discussed in ***Section 4.3.3*** of the FEIS. Residential and commercial properties that would be displaced by ROW acquisition may relocate within or outside the RSA. Residential and commercial properties are available for sale or lease in the RSA; however, some of the properties may be currently undeveloped land that would be available for construction as opposed to developed parcels. Currently, an adequate housing and commercial site supply for displaced property owners is available.

The Preferred Alternative would be a limited access roadway, likely focusing induced development in the vicinity of entrance/exit ramps and interchanges with major thoroughfares. The Preferred Alternative would potentially cause a reduction in tax revenues for taxing entities; however, continued development in the RSA would contribute to an overall increase in property values, which would increase and possibly offset the loss in property tax revenue.

Construction would have direct and indirect beneficial effects on local, regional, and state employment. Direct impacts include those arising from purchases made by the new construction sector. Roadway construction activities would create new job opportunities and income potential in the area in the short term. Potential losses of jobs could also occur as a result of the relocation of businesses. Although TxDOT would attempt to maintain access to all businesses during construction, loss of customers due to difficult access could result in temporary loss of income to businesses affected by construction. Some minority and/or low-income populations or individuals may be impacted by the loss of property or home relocations.

All communities may experience short-term effects due to noise, increased travel time in areas where roadways already exist, and change in access during construction. Some areas would experience direct noise impacts, as discussed in ***Section 4.7*** of FEIS. Minor visual and aesthetic impacts could also impact communities, as discussed in ***Section 4.18*** of the FEIS.

A long-term indirect effect of the No-Build Alternative to several neighborhoods or communities and the traveling public would be the increased traffic congestion and reduced area mobility due to increased population and employment in the vicinity of the Preferred Alternative and the Houston metropolitan area. In addition, without the Preferred Alternative, already burdened hurricane evacuation routes would

not facilitate the movement of residents in communities in Brazoria and Galveston Counties during emergency evacuations.

Summary of Indirect Effects

The Preferred Alternative would provide new access to existing communities within the RSA, potentially affecting neighborhood and/or communities. Property values may increase in the area of the Preferred Alternative, as the proposed roadway would provide access to areas that were previously inaccessible, or had only limited access via public roads.

Induced development and potential community change can be perceived as positive or negative. To some, this change is unwanted and development is undesirable, as land is converted to residential and commercial uses, and area populations increase. For others, new development often means new jobs and positive economic benefits. Due to the controlled access of the Preferred Alternative, the roadway would provide an impetus for indirect development at or near entrance/exit ramps and at interchanges with major thoroughfares. Residents of low-density communities in rural areas may perceive induced development as a negative impact to quality of life, as land is converted to residential and commercial uses and area populations increase. However, if induced residential development occurs, these communities could see increased property values and more readily available commercial services in closer proximity to their homes, which could be viewed as a positive impact.

The proposed construction expenditures for materials and labor would have indirect and other induced effects on local, regional, and state employment, output, and income. The indirect effect of the Preferred Alternative on the local economy is projected to create 16,202 jobs, as well as generate $695.8 in income. The statewide economic effect of construction of the Preferred Alternative would is $3.3 billion (***Table 4-15***). During construction, the local economy would be positively affected by a temporary increase in spending by construction employees at businesses and restaurants in the vicinity of the Preferred Alternative. Indirect impacts include those arising from purchases made by the new construction sector. Roadway construction activities would create new job opportunities and income potential in the area in the short term.

Some jobs may be lost in the short term, as displaced businesses are relocated. In the long term, new jobs would likely be created as induced development occurs; however, employment would be expected to be influenced by market factors.

A long-term indirect effect of the No-Build Alternative to neighborhoods, communities, and the traveling public would be the continued reduction of mobility in the RSA. Without the Preferred Alternative, new development associated with increased population and employment in the RSA would cause increased traffic congestion and reduced LOS on existing roadways, likely resulting in increased traffic delays. In addition, without the Preferred Alternative, already burdened hurricane evacuation routes would not facilitate the movement of residents in communities in Brazoria and Galveston Counties during emergency evacuations.

6.2.2.3 Other Actions – Past, Present, and Reasonably Foreseeable – and their Effect on each Resource

Reasonably foreseeable projects in the social RSA include roadway projects and large master-planned communities. As discussed in ***Section 5.4.1*** of the FEIS, there are multiple existing and proposed residential developments within the social RSA and the land use RSA. Land use changes to support residential and commercial development are expected to continue in response to increases in regional population and employment. This projected growth is expected to have a greater influence on the densities of development in areas that are already experiencing growth rather than on the amount of acreage consumed for development.

Sections of or entire transportation projects included in the *2035 RTP Update* that transverse the social RSA are shown in ***Table 6-3***. In the vicinity of proposed transportation projects, improved mobility may facilitate continued growth. Direct and indirect impacts of other projects unrelated to the Preferred Alternative would be expected to affect land use within the land use RSA as additional land is consumed for residential, commercial, transportation, and other uses.

6.2.2.4 The Overall Effects of the Proposed Project Combined with Other Actions

In the social RSA, other sections of major roadway projects are currently underway or planned in response to increased population growth and the need for improved mobility in the region. With each major roadway project there is the potential for displacement and relocation of businesses, single- and multi-family residential homes, community resources (including parks, schools, cemeteries, public facilities, police, fire, and EMS facilities, and churches), and other facilities.

Although roadway improvements (***Table 6-3***) and approximately 10,628 acres of development (***Table 5-2***) are planned within the RSA, additional development would also be expected to occur in response to projected increases in regional population and employment. ***Exhibits 5-2*** through ***5-6*** depict the progression of development that has occurred within the RSA from 1975 to 2012. Development is generally concentrated in and around cities and communities within the RSA such as Alvin, Dickinson, Friendswood, League City, Manvel, Pearland, and Santa Fe. Overall, developed conditions are more prevalent in the northern, eastern, and portions of the central areas of the RSA. The approximately 187,039 acres of vacant/developable land within the RSA (***Table 5-3***) are composed of the collective areas of undeveloped land (i.e. not contiguous). Larger contiguous areas of vacant/developable land, which includes farmlands, generally occur in the southern, western, and parts of the central portions of the RSA.

Continued development within the RSA would be expected to follow the historical pattern of being concentrated in and around existing cities and communities. New development would be anticipated to occur on available vacant/developable land. Development projects would also likely include some redevelopment in the more populated areas of the RSA. The location, amount of land acquisition, and timing of future development is unknown, and would be affected by factors such as the regional economy, local market conditions, access, and regulatory requirements. Potential impacts that may occur include displacements of businesses, single-family and multi-family residential properties, and community

resources that would be required to construct future roadways or other residential or commercial land development projects in the RSA. However, both new development (e.g., master planned communities and other residential and commercial projects) and the redevelopment of properties in the more populated areas of the RSA would generate increased tax revenue that could benefit local communities through improvements to the transportation system and the provision of municipal and other services. Although roadway improvements would have some influence on land development, most future development within the RSA would be primarily related to forecasted increases in regional population and employment.

The cumulative impact of displacements for the Preferred Alternative would not be expected to adversely affect regional housing and business resources because alternative residential, commercial, and undeveloped land is available and is currently being developed in the RSA. In the short term, access to some community facilities and resources would be adversely impacted in areas of construction. However, in the long term, improving transportation facilities in the region would reduce congestion. The cumulative impact of the Preferred Alternative and other foreseeable transportation projects would be improved mobility for the traveling public and access to community resources.

It would be expected that overall positive cumulative impacts to employment and income would result from construction of the Preferred Alternative and other roadway projects in the RSA. Roadway construction activities would create job opportunities and income potential in the area during the period of construction. During construction, the local economy would be expected to be indirectly affected by temporary spending by construction employees at retail businesses and restaurants in the vicinity of the Preferred Alternative. Some potential customers may avoid areas under construction. TxDOT would maintain access to retail businesses and restaurants during construction to help minimize potential adverse economic impacts to area businesses.

The proposed construction expenditures for materials and labor would have indirect and other induced effects on local, regional, and state employment, output, and income. The combined impacts of the Preferred Alternative and other proposed roadway projects in the RSA would provide additional capital entering into the local and state economy. The Preferred Alternative would generate revenue for the construction, operation, and maintenance of this segment and additional proposed segments of the Grand Parkway that would help complete the area's regional mobility plans. Revenue from tolling the Preferred Alternative would only be used for the construction, operation, and maintenance of Segment B and additional segments of the Grand Parkway.

Community and public resources in the area include schools, churches, cemeteries, parks, police protection, fire protection, and medical services. In areas of the Preferred Alternative where rural areas are being developed, it is expected that additional schools, parks, and churches would be constructed to serve new residential areas. Similarly, emergency services (police, fire, and medical) would expand to meet the needs of the public, and the Preferred Alternative would serve as an additional route to respond in a timely manner to emergencies in the RSA. Emergency service providers (police protection, fire protection, and EMS) would receive notification and accommodations prior to roadway construction or

ramp closings. With this information, emergency responders would be able to plan their routes in advance of an emergency situation. In the long term, implementation of the Preferred Alternative would improve area-wide access and mobility in the region.

Transportation improvement projects in the region include highway, road, bridge, or overpass construction, reconstruction, widening, or upgrades to accommodate current and projected growth in the area. These transportation projects and studies are some of the actions that federal, state, and local transportation planners are involved in to improve existing and future transportation and public safety in the RSA and the Houston metropolitan area. The plan for the Preferred Alternative would help move citizens safely and efficiently out of harm's way during large-scale and mandatory hurricane evacuations. The cumulative impact of new and improved transportation facilities in the Houston metropolitan area would be improved traffic flow and reduced travel times for the public, communities in the RSA, and emergency vehicles. In the long term, the No-Build Alternative would result in an increase in future traffic congestion, which would increase travel times for all vehicles and reduce public safety, resulting in impacts to quality of life for communities in the RSA.

Negative impacts to communities, including minority and low-income populations in the RSA, would not be expected as a result of tolling of the Preferred Alternative. All users, including minority and low-income individuals and populations, would be able to use existing non-tolled roadways in the RSA. Cumulative impacts to low-income and/or minority communities as a result of tolled roadways in the H-GAC region are discussed further below. The Preferred Alternative would benefit the traveling public, communities, and low-income and minority individuals and populations by improving mobility in the RSA. Additionally, during emergency evacuations, the tolled facility would be available as a free travel route for all persons, including low-income and minority populations. The cumulative impact of new and improved transportation facilities in the Houston metropolitan area would be improved mobility for all populations in the RSA.

6.2.2.5 Mitigation of Cumulative Effects

TxDOT would maintain access to businesses during construction to help minimize potential adverse economic impacts to area businesses. In areas where the Preferred Alternative would intersect existing named roads, the roadway would be bridged or re-routed. Emergency service providers (police protection, fire protection, and EMS) would receive notification and accommodations prior to roadway construction or lane closings. With this information, emergency responders would be able to plan their alternate routes in advance of an emergency situation.

In final design, noise abatement measures and provisions would be included in the plans and specifications that require the contractor to make every reasonable effort to minimize construction noise through abatement measures such as work-hour controls and proper maintenance of systems.

6.2.3 Water Quality

6.2.3.1 Resource Study Area, Conditions, and Trends

The RSA for cumulative impacts to water resources was developed by identifying the watersheds that intersect the proposed SH 99 Segment B study area and the Land Use RSA. The cumulative effects RSA boundary for water resources was defined by connecting the outer limits of each of the watersheds that intersect the RSA for Land Use. The watersheds included are Austin Bayou, Clear Creek, Dickinson Bayou, Halls Bayou, Middle Oyster Creek, and Mustang Bayou. As noted in Step 3, the temporal boundary for water quality is the same and is from 1975 to 2035. The RSA for water resources is approximately 695,750 acres in Brazoria, Fort Bend, Galveston, and Harris counties (***Exhibit 6-2***). Over the last 15 to 20 years, agencies and local governments have moved toward managing water quality by using a watershed approach (EPA 2005). TCEQ manages water pollution reduction in Texas.

Every two years, the TCEQ assesses the quality of its waters in Texas and reports to the EPA the extent to which each water body in the state meets water quality standards. The number of stream miles assessed has increased every year since 1996, leading to an increased number of waters identified as having impaired water quality. In general, over 70 percent of the assessed streams met water quality standards. Within the RSA, Cedar Creek, Chocolate Bayou Tidal, Clear Creek Above Tidal, Clear Creek Tidal, Dickinson Bayou Tidal, Flores Bayou, Geisler Bayou, Gum Bayou, Halls Bayou Tidal, Jarbo Bayou, Magnolia Creek, Moses Bayou, Oyster Creek Above Tidal, and an Unnamed Tributary of Mary's Creek are on the TCEQ's 2012 Texas Water Quality Inventory and 303(d) list, indicating that they do not meet certain water quality standards. Elevated bacteria levels constitute the primary water quality concern for these stream segments (TCEQ 2012). Elevated bacteria levels in a stream can come from both human and non-human sources. The water resources RSA is above the Gulf Coast Major Aquifer. Use of groundwater in the area will continue to decrease, as the water supply is converted to surface water use due to regional subsidence concerns.

Water quality has been impacted in the Gulf Coast region primarily due to agricultural practices, oil and gas production, and the conversion of undeveloped land to an urban environment. In agricultural practices, the use of herbicides, pesticides, and concentrated animal waste contribute to water quality concerns. Oil and gas exploration creates additional concerns with the possibility of spills. Urbanization has introduced additional potential contaminants into the area via household chemicals, domestic pet waste, and pollutants from automobiles.

6.2.3.2 Direct and Indirect Effects on Each Resource from the Proposed Project

Summary of Direct Effects

Construction of the Preferred Alternative could impact water quality on a temporary basis. An increase in suspended sediments could occur at or near areas under construction; however, BMPs such as hay bales, silt fences, or rock berms would be implemented during construction to minimize potential impacts to waters in the immediate construction area. Adverse water quality impacts would be expected to be short term and localized, as sediments would likely quickly settle from the water column downstream of disturbed areas. Operation of the roadway would cause an increase in stormwater runoff due to an

increase in impermeable cover, and the runoff could contain oil, grease, and other constituents that could be carried to water bodies outside of the roadway ROW. However, the net increase of impermeable area from construction of the Preferred Alternative in comparison to the drainage area of the watersheds would be approximately 0.1 percent. Compliance with regulations related to water quality and implementation of BMPs for both construction and long-term operation of the Preferred Alternative would minimize pollutants potentially entering drainageways and stream channels receiving stormwater flows.

Summary of Indirect Effects

Construction of the Preferred Alternative or the expansion of other roadways would increase the amount of impermeable surface within the RSA and would indirectly contribute to increased stormwater runoff and non-point source pollution from the roadways. Temporary and permanent erosion and sedimentation controls and other water quality protection measures, such as those discussed in ***Section 4.8*** of FEIS, would minimize short-term and long-term impacts to water resources in the RSA. Implementation of water quality control measures would therefore minimize adverse impacts to water quality.

Increased land development and some redevelopment are expected to occur as an indirect effect of the Preferred Alternative, which would potentially cause increased stormwater runoff during and after construction. The increased stormwater runoff could contain additional pollutants from developed areas. Potential impacts to water quality would be reduced or mitigated through compliance with state and local regulations, thereby minimizing indirect impacts to water quality.

6.2.3.3 Other Actions – Past, Present, and Reasonably Foreseeable – and their Effect on each Resource

Reasonably foreseeable actions are those that are likely to occur, or are probable, rather than those that are possible. Reasonably foreseeable projects in the RSA include roadway projects, large master planned communities, and commercial development. ***Section 6.2.1*** of the FEIS, in addition to ***Table 6-3*** and ***Table 6-4***, describe reasonably foreseeable land development and transportation projects in the RSA. These reasonably foreseeable projects could cause potential temporary and permanent degradation or loss of water resources from an increase in storm water runoff, and possible stream modifications due to an increase in stormwater runoff. Adherence to regulations and guidance related to stormwater quality and development within floodplains would avoid or minimize adverse impacts to the quality of surface water and groundwater.

6.2.3.4 The Overall Effects of the Proposed Project Combined with Other Actions

The RSA has experienced increased development in recent years in response to increases in regional population and employment. Additional transportation improvements (***Table 6-3***) and residential, commercial, and other development is planned, such as the 10,628 acres identified in ***Table 5-2***. Historically, development has been generally concentrated in and around cities and communities such as Alvin, Dickinson, Friendswood, Galveston, La Marque, League City, Manvel, Pearland, Santa Fe, and Texas City. Because of recent increases in land development in the RSA and surrounding areas, water quality has become a concern. The increase in development creates new sources for point and non-point

source pollution, such as the introduction of potential contaminants into the area via household chemicals, domestic pet waste, and pollutants from automobiles.

Development is more prevalent and concentrated in the northern and eastern portions of the RSA. Any future development would likely be a continuation of development and redevelopment in these areas, with development of larger master planned communities and commercial facilities occurring in the southern and western portions of the RSA, where contiguous tracts of vacant lands are more likely to be available. Major streams traversing the RSA include Armand Bayou, Chocolate Bayou, Clear Creek, Dickinson Bayou, Halls Bayou, Mustang Bayou, and Oyster Creek. The Brazos River forms a portion of the western RSA boundary. There are also numerous smaller streams and tributaries in the RSA. Construction activities associated with new development and redevelopment could impact water quality on a temporary basis. During construction, exposed soil could erode into receiving waters, thereby increasing turbidity and sediment loading downstream. Development in the northern and eastern portions of the RSA has increased the overall area of impervious surface, which has increased the volume of stormwater runoff directed to drainageways and streams. Continued residential and commercial development in these areas could lead to the possibility of elevated quantities and/or concentrations of pollutants entering receiving waters and being conveyed downstream to larger water courses. Future development in the southern and western portions of the RSA would also increase areas of impervious surface; however, depending on the density and type of development, pollutant quantities and concentrations may be reduced compared to more populated areas of the RSA. Stormwater runoff generated from areas of concentrated development and population, even though conveyed through stormwater management facilities, would be more likely to contain contaminants that could be carried to water bodies within the RSA. Adverse changes in water quality would be influenced primarily by the continued forecasted increases in population and employment rather than from stormwater runoff generated by improvements to the transportation system.

6.2.3.5 Mitigation of Cumulative Effects

Potential impacts to water quality from the Preferred Alternative would be mitigated through development and implementation of a SW3P. The plan would address measures to prevent or correct erosion that may develop during construction. BMPs for temporary and permanent soil erosion and sedimentation controls would be implemented, as would measures to prevent and control hazardous materials spills during construction. Other developments within the RSA would also be required to prepare SW3Ps and implement BMPs to minimize pollutants from entering area waters. Stormwater discharges would be collected in retention/detention facilities or directed to culverts and open drainageways. Increased stormwater/vegetation contact and slowed flows through retention/detention facilities would promote settling of suspended solids and reduce potential pollutant concentrations. Short-term and long-term BMPs implemented as part of development projects would minimize water quality degradation of surface waters and groundwater in the RSA.

6.2.4 Floodplains

6.2.4.1 Resource Study Area, Conditions, and Trends

The cumulative effects RSA boundary for water resources was defined by connecting the outer limits of each of the watersheds that intersect the Land Use RSA. The watersheds included are Austin Bayou, Clear Creek, Dickinson Bayou, Halls Bayou, Middle Oyster Creek, and Mustang Bayou. The RSA for water resources is approximately 695,750 acres in Brazoria, Fort Bend, Galveston, and Harris counties (***Exhibit 6-2***). As noted in Step 3, the temporal boundary is the same for floodplains and is from 1975 to 2035. FEMA and the local counties manage and oversee floodplains in the region.

Within the RSA, approximately 239,585 acres are mapped as floodway and 100-year floodplain. Development has occurred within the floodplains of the RSA. This development, particularly older developments, has likely contributed to an increase in stormwater runoff flows within the region. However, stricter development regulations have been implemented to aid in the reduction of impacts that developments have on the 100-year floodplain. Design criteria must be incorporated into transportation and development plans to mitigate for potential floodplain impacts. Brazoria and Galveston Counties are participants in the NFIP and currently regulate development in the 100-year floodplain.

In the Gulf Coast region, flooding has been an issue and continues to be an issue because of increases in development. Historically, development in the floodplains of the RSA watersheds has contributed to an increase in runoff volumes. EO 11988 requires federal agencies to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative to development within a floodplain. Additionally, the counties and other local agencies regulate development in floodplains.

6.2.4.2 Direct and Indirect Effects on each Resource from the Proposed Project

Summary of Direct Effects

Approximately 343 acres of floodplains are located within the proposed ROW of the Preferred Alternative. The drainage study that would be conducted for the Preferred Alternative would provide detailed hydraulic information necessary to determine the use of culverts and bridges at each stream crossing to confirm that the Preferred Alternative would not increase the risk of flooding. Hydraulic features for the Preferred Alternative would be designed in accordance with current TxDOT and FHWA design policies and standards. Roadway drainage facilities would permit conveyance of the 100-year flood without causing substantial impacts to the main lanes of the proposed highway, streams, or adjacent property. The proposed design would not adversely impact the base flooding elevations to a level that would violate applicable floodplain regulations and ordinances. To the extent practicable, the design would also minimize the area of a floodplain impacted by the Preferred Alternative. Fill placement in the floodplain would be mitigated with equivalent floodplain storage in the vicinity of the Preferred Alternative.

Summary of Indirect Effects

Development within floodplains would be in accordance with the NFIP and local regulations. Indirect development induced by the Preferred Alternative could occur in areas located within mapped 100-year floodplains. Stormwater detention facilities and hydraulic features designed as part of development projects would offset increases in stormwater flows due to the addition of impermeable cover. No adverse indirect impacts to floodplains would be anticipated from development induced by the Preferred Alternative.

6.2.4.3 Other Actions – Past, Present, and Reasonably Foreseeable – and their Effect on each Resource

Reasonably foreseeable actions are those that are likely to occur, or are probable, rather than those that are possible. Reasonably foreseeable projects in the RSA include roadway projects, large master planned communities, and commercial development. ***Section 6.2.1*** of the FEIS, in addition to ***Table 6-3*** and ***Table 6-4***, describe reasonably foreseeable land development and transportation projects in the RSA. These reasonably foreseeable projects could cause potential temporary and permanent degradation or loss of water resources from the construction of impermeable surfaces, an increase in stormwater runoff, and possible stream modifications because of an increase in stormwater runoff. Adherence to regulations and guidance related to development within floodplains would avoid or minimize adverse impacts to floodplain elevations.

6.2.4.4 The Overall Effects of the Proposed Project Combined with other Actions

Development within the RSA would be expected to continue to follow the historic pattern of growth as depicted in ***Exhibits 5-2*** through ***5-6*** in response to projected increases in regional population and employment. Residential, commercial, and public development projects to accommodate the increasing population would include transportation improvements, such as those identified in ***Table 6-3***. Continued development would likely affect areas occurring both within and outside of mapped floodplains. Floodplain boundaries within the more densely developed northern and eastern portions of the RSA have been affected by modifications to streams and drainageways. Increases in the amount of impervious surface area increase the volume of stormwater runoff; therefore, channel modifications, such as bank stabilization, channelization, or complete relocation of a drainage channel, have been required to increase stormwater conveyance capacities to accommodate the increased volume of storm flows. Continued development within the RSA would require additional modifications to streams and drainageways to convey increased storm flow volumes as more impervious cover is created on lands converted to developed conditions.

Increased stormwater runoff could pose a flood risk for areas downstream of concentrated discharges. The construction of retention/detention facilities within or near a planned development may be required to regulate the discharge of stormwater flows so as not to overwhelm the capacity of receiving waters. Development on vacant/developable land in the southern and western portions of the RSA would likely require stream modifications to alter floodplain boundaries. The forecasted growth in regional population and employment would be expected to result in unavoidable encroachments into, and modifications of,

floodplains in the RSA. The majority of floodplain encroachments and modifications would be in response to the projected increased population and employment growth rather than from construction of transportation improvements.

6.2.4.5 Mitigation of Cumulative Effects

Proposed developments within the RSA, such as residential, commercial, and transportation projects that may occur within mapped floodplains, would be required to adhere to local and state floodplain regulations, and not adversely impact the base flooding elevations to a level that would violate applicable floodplain regulations and ordinances. Implementation of short-term (i.e., construction) and long-term BMPs would mitigate discharges of stormwater from developed areas. Construction of retention/detention facilities and possibly other design features would assist in offsetting anticipated increases in stormwater flows generated from impervious cover associated with development projects. Fill placed in floodplain areas would be mitigated with equivalent floodplain storage in the vicinity of the developments, thereby limiting impacts to floodplains in the RSA.

6.2.5 Wetlands and Waters of the U.S.

6.2.5.1 Resource Study Area, Conditions, and Trends

The cumulative effects RSA boundary for wetlands and waters of the U.S. is the water resources RSA. The watersheds included are Austin Bayou, Clear Creek, Dickinson Bayou, Halls Bayou, Middle Oyster Creek, and Mustang Bayou. The RSA encompasses approximately 695,750 acres in Brazoria, Fort Bend, Galveston, and Harris counties (***Exhibit 6-2***). As noted in Step 3, the temporal boundary for wetlands and waters of the U.S. is the same and is from 1975 to 2035. The USACE has jurisdiction over waters of the U.S., including wetlands.

There have been substantial losses to wetlands and other habitats in the greater Houston metropolitan area since the 1950s. Conversion of natural areas to agricultural production, livestock grazing, and development resulted in the loss of upland and wetland acreage. Continued urbanization and industrialization of the Houston metropolitan area will cause continued pressure on remaining habitats and ecosystems, including wetlands. Since the early to mid-1990s, the area south and southeast of Houston has experienced an increase in land development projects. The increase in residential development has led to the development of retail centers and other businesses providing goods and services to local residents. These land development activities, and others, have led to the loss of open, undeveloped land throughout the area south and southeast of Houston.

Many waters of the U.S., including wetlands, within the RSA have been filled and converted to developed uses, and streams have been modified to reduce the risk of flooding in the region. The stream modifications improve flow but reduce the natural diversity of the stream channels, and potentially remove riparian habitat. The watersheds in northern Brazoria and Galveston Counties are currently under development pressure, resulting in the need to increase channel capacities for flows in streams located in the northern portion of the RSA. Modifications have included the rectification of channels. Rectifying

stream channels usually requires the removal of streamside vegetation and straightening meanders in the streams.

6.2.5.2 Direct and Indirect Effects on each Resource from the Proposed Project

Summary of Direct Effects

Wetlands identified within the Preferred Alternative ROW encompass approximately 54.5 acres, and include emergent wetlands, forested wetlands, and scrub-shrub wetlands. All of the wetlands would be filled and graded by initial ROW clearing and roadbed preparation activities for the Preferred Alternative. Approximately 30.7 acres of the identified wetlands may be non-jurisdictional, meaning there is no apparent hydrological connection to other jurisdictional waters of the U.S., and therefore they would likely not be regulated by the USACE. Approximately 23.8 acres of the identified wetlands do appear to be hydrologically connected to other jurisdictional waters of the United States and would likely be regulated by the USACE. Non-wetland waters of the U.S. identified within the proposed ROW of the Preferred Alternative total approximately 25.2 acres and include ponds, streams/bayous, swales, irrigation ditches, and canals. The larger waters include named water courses (Chocolate Bayou, Dickinson Bayou, Geisler Bayou, and Mustang Bayou), smaller tributaries of these bayous, and canals (American Canal, Briscoe Canal, and South Texas Water Company Canal). There are also several smaller ditches and drainages within the ROW.

Construction of the Preferred Alternative would result in impacts to non-wetland waters of the U.S., although specific impacts would not be assessed until final design is completed. Waters such as Chocolate, Dickinson, Geisler, and Mustang, bayous would likely be bridged, and smaller waters of the U.S. would either be bridged or placed within culverts. Compensatory mitigation for impacts to wetland and non-wetland water resources would be required as part of USACE permitting.

Summary of Indirect Effects

Construction of the Preferred Alternative would indirectly cause development or some redevelopment of land in the RSA. It is predicted that by 2035 a majority of the Land Use RSA would be developed. The sequence of planning for proposed development would be to initially attempt to avoid impacts to jurisdictional waters of the U.S. If avoidance could not be accomplished, impacts would be minimized, with compensatory mitigation being required for unavoidable impacts. It would be expected that compensatory mitigation would offset the impacts in accordance with USACE permitting requirements. Compensation for impacts to non-jurisdictional waters of the U.S., including wetlands, may not be implemented, as there would be no regulatory requirement to compensate for such waters. Therefore, functions provided by such non-jurisdictional waters would be lost as these waters are filled for development.

Drainage modifications to improve channel capacities to facilitate the conveyance of stormwater flows would likely impact jurisdictional waters of the U.S. Impacts to the jurisdictional waters would require authorization from the USACE prior to construction. Channel modifications could remove some or all of the vegetation associated with these channels in the area of modification.

6.2.5.3 Other Actions – Past, Present, and Reasonably Foreseeable – and their Effect on each Resource

Reasonably foreseeable actions are those that are likely to occur, or are probable, rather than those that are possible. Reasonably foreseeable projects in the area include transportation projects, master planned communities, and commercial developments. Reasonably foreseeable projects would likely impact jurisdictional and non-jurisdictional wetland resources and other waters of the U.S. The amount of impact would be dependent on the size and location of the proposed projects. Vegetation communities associated with jurisdictional waters of the U.S., even though potentially not regulated by the USACE, would likely be lost as projects are constructed.

6.2.5.4 The Overall Effects of the Proposed Project Combined with Other Actions

The land use analysis indicates that the Preferred Alternative would have an indirect effect of increasing the acreage of land used for development. As shown in ***Table 5-2***, approximately 10,628 acres of residential, commercial, and other development is proposed within the RSA. Transportation improvement projects are also proposed (***Table 6-3***). Land development is more concentrated in the northern and eastern portions of the RSA, as compared to the relatively undeveloped or low-density development conditions in the remainder of the RSA. Lands converted to developed uses in the RSA likely contained jurisdictional waters of the U.S., including wetlands. The majority of such waters would have been permanently removed from within the development footprints. The continued conversion of lands within the portions of the RSA with concentrated development would be expected to remove additional jurisdictional waters of the U.S., including wetlands. Some identified aquatic resources may be avoided within or adjacent to developed areas; however, the functions and services of these resources may be degraded because of the surrounding urban conditions. Continued development in undeveloped or lower-density development areas within the RSA, as a response to projected increases in regional population and employment growth, would be expected to affect lands containing some amount of jurisdictional waters of the U.S., including wetlands, depending on the size and location of the development.

New development and possibly redevelopment projects would involve clearing and grading, and the construction of roadway improvements, streets, structures, utility infrastructure, and other urban facilities. Development projects would also involve the construction of bridges, the installation of culverts or the extension of existing culverts, channel modifications to improve stormwater conveyance, and alteration of surface drainage patterns directing stormwater runoff to area water courses. Design plans may provide opportunities to incorporate existing aquatic resources into the development rather than filling or adversely impacting the aquatic resources, which could result in compensation for the impacts outside the development footprint, and possibly outside the watershed in which the development occurs. Opportunities to create or adjust development plans to incorporate existing aquatic resources into project designs may be more likely for projects in the less developed southern and western portions of the RSA rather than in the northern and eastern portions.

The federal mandate of “no net loss” of wetlands requires compensatory mitigation for the loss of jurisdictional wetlands and other waters of the U.S. caused by transportation, residential, commercial, and

other projects. Jurisdictional waters of the U.S., including wetlands, filled or adversely impacted by development would need to be compensated as part of required USACE permitting; however, the compensation may not occur within the same geographic area as the development.

6.2.5.5 Mitigation of Cumulative Effects

Development projects implemented within the RSA would be required to compensate for jurisdictional waters of the U.S., including wetlands, adversely impacted by construction. Discharges of fill material to raise the grade for roadways, streets, structures, and other facilities, or to construct embankments for overpasses or bridge crossings, would likely impact jurisdictional waters of the United States, including wetlands. Off-site or possibly on-site compensatory mitigation may be considered. The USACE's preferred method of compensatory mitigation would be the purchase of credits from an approved wetlands mitigation bank. Another option could be payment of an in-lieu fee to an approved third-party entity as compensation for anticipated adverse impacts. Opportunities for on-site mitigation may be limited due to the required dedication of sufficient area to construct or enhance wetlands, and/or the costs of obtaining additional land parcels immediately adjacent to the development for wetland creation or enhancement. Mitigation options, as available, could be investigated and evaluated in coordination with appropriate regulatory and resource agencies during the planning stages of development projects. A compensatory mitigation plan would be prepared and submitted to the USACE as part of a Section 404 permit application.

Potential compensatory mitigation opportunities for non-wetland waters of the U.S. could be planting native vegetation species along disturbed stream banks, reestablishing riparian corridors, replacing/enhancing vegetated fringes near the water's edge, purchasing appropriate stream credits from an approved mitigation bank, or payment of an in-lieu fee to another entity as compensation for adverse impacts. Off-site mitigation accomplished through the purchase of credits from a wetland mitigation bank or payment of an in-lieu fee may not replace the functions of impacted jurisdictional waters in the immediate geographic area as the area of impact. Compensation for non-jurisdictional waters of the U.S., including wetlands, would not be required as part of USACE permitting; therefore, additional wetlands losses could occur as development continues within the RSA.

6.2.6 Vegetation and Wildlife Habitat

6.2.6.1 Resource Study Area, Conditions, and Trends

The cumulative effects RSA for vegetation and wildlife habitat is the same as the RSA for land use because changes in land use would be the primary cause of changes to or alteration of vegetation resources. The vegetation RSA encompasses approximately 396,885 acres (***Exhibit 5-1***) and is composed mostly of agriculture, coastal grasslands, disturbed prairie, and tidal and salt marsh vegetation communities, which would be the primary vegetation communities impacted. The temporal boundary for vegetation is from 1975 to 2035.

Native vegetation areas and habitats in the greater Houston metropolitan area have been mostly lost due to the conversion of natural areas to agricultural production, livestock grazing, and development. Continued

urbanization and industrialization of the Houston area would cause continued pressure on remaining habitats and ecosystems. Since the early to mid-1990s, the area south and southeast of Houston has experienced an increase in land development projects. The increase in residential development has led to the development of retail centers and other businesses providing goods and services to local residents. These land development activities, and others, have led to the loss of undeveloped land throughout the area south and southeast of Houston.

Wooded riparian habitat areas associated with watersheds in the northern portion of the RSA are currently under development pressure because of the need to increase channel capacities for stormwater flows in streams located in this portion of the RSA. Modifications have also occurred for roadway and utility easement crossings. The majority of the modifications have included clearing in-stream vegetation and some rectification of channels. Rectifying stream channels usually requires the removal of streamside vegetation and straightening meanders in the streams. The majority of the riparian habitat has been removed in the RSA; however, Chocolate Bayou and some of the larger stream segments in the RSA still retain riparian corridors.

6.2.6.2 Direct and Indirect Effects on each Resource from the Proposed Project

Summary of Direct Effects

Approximately 1,072 acres of new ROW would be acquired to construct the Preferred Alternative. The majority of the vegetation impacts would occur to agricultural, coastal grasslands, disturbed prairie, and tidal and salt marsh vegetation communities, as these communities comprise approximately 69 percent of the Preferred Alternative ROW. Although clearing of the Preferred Alternative ROW would permanently remove native and introduced species as well as some crops, the acreage of the vegetation communities noted above occurring within the Preferred Alternative ROW represents less than one percent of these vegetation communities in the RSA. Wildlife inhabiting the vegetation communities within the Preferred Alternative ROW would be displaced to other habitat areas in the vicinity of the Preferred Alternative.

The majority of plants and trees in urban and residential communities associated with the Preferred Alternative ROW are ornamental plantings that exist in a previously disturbed environment. The removal of these landscaped areas would reduce aesthetic value and shade tree value within the Preferred Alternative ROW; however, similar urban/landscaped habitat exists throughout developed areas in the RSA.

Summary of Indirect Effects

Construction of the Preferred Alternative would indirectly cause development or some redevelopment of land in the RSA. Induced development would impact naturally vegetated areas and areas that have been previously disturbed by agricultural and other activities, as development projects would convert undeveloped land to developed conditions. Habitats associated with natural and possibly some disturbed vegetation areas would likely be changed to landscaped conditions typically associated with urban environments. Naturally vegetated habitats would likely be fragmented by development, and wildlife would be displaced to available habitat areas in the vicinity of the developments. Compensation for permanent impacts to, or the permanent removal of naturally vegetated areas is not required as part of

development planning; therefore, ecological and habitat functions provided by naturally vegetated areas would be largely lost as these areas are converted to more urban conditions. Wildlife able to adapt to urban conditions may relocate into areas exhibiting more urban characteristics.

6.2.6.3 Other Actions – Past, Present, and Reasonably Foreseeable – and their Effect on each Resource

Reasonably foreseeable actions are those that are likely to occur, or are probable, rather than those that are possible. Reasonably foreseeable projects in the area include transportation projects, master planned communities, and commercial developments. The reasonably foreseeable projects would encroach into agriculture, grassland, woodland, riparian, and urban vegetation communities and habitats. The result would be the incremental permanent conversion of the vegetation communities and associated habitats to urban developed conditions. Wildlife would be displaced into available habitat areas that may be fragmented from other similar habitat areas.

6.2.6.4 The Overall Effects of the Proposed Project Combined with Other Actions

Most of the native vegetation within the RSA has been impacted by urbanization or farming/ranching practices. The majority of the vegetation that would be impacted by proposed future development, such as the planned developments shown in ***Table 5-2*** and the proposed transportation improvements as shown in ***Table 6-3***, would have been previously altered and would be either part of urban environments, ongoing farmland or ranchland operations, or idle/undeveloped land. Vegetation changes would be directly affected by land use changes. As future development occurs, vegetation and its associated wildlife habitat function would be largely eliminated through construction of housing, business centers, and commercial developments. During recent years, development has steadily increased within the land use RSA. This development has been mostly concentrated in the northern, eastern, and parts of the central portions of the RSA. Continued development in these portions of the RSA would convert areas of natural vegetation to developed conditions, thereby compromising the quality of these areas as wildlife habitat, especially for species that do not adapt well to urban conditions. Even though vegetation in the southern, western, and parts of the central portions of the RSA has been largely impacted by farmland and ranchland activities and some urbanization, much of these portions exhibit a lower intensity of daily human activity and vehicular traffic, thereby providing somewhat improved habitat conditions for wildlife compared to areas that are more densely populated and developed. The historical trend of development occurring in and near cities and communities within the RSA would be expected to continue. The increasing demand for residential, commercial, and other development caused by the forecasted growth in regional population and employment would result in the incremental conversion of vegetation communities and wildlife habitat to developed conditions.

6.2.6.5 Mitigation of Cumulative Effects

Unavoidable vegetation and wildlife habitat impacts would be expected to occur as part of implementing planned development within the RSA. Planned development would likely continue to increase as regional population and employment continue to increase. Development would likely encroach into riparian vegetation adjacent to water courses within the RSA. Riparian and other vegetation communities would

also likely be impacted by construction of roadways and utilities traversing the RSA. The conversion of natural vegetation communities to developed urban conditions would likely reduce the abundance and diversity of habitats, and possibly the species composition, associated with these vegetation communities.

Mitigation for vegetation impacts could be provided by leaving some natural vegetation in place as part of developed conditions, or landscaping developed areas with native species to possibly blend with adjacent or nearby naturally vegetated areas. Enhanced plantings along greenbelts or other open areas within developments may compensate for some vegetation losses and provide food resources and shelter to conceal wildlife movements.

6.2.7 Essential Fish Habitat

6.2.7.1 Resource Study Area, Conditions, and Trends

The RSA for cumulative impacts to essential fish habitat is the water resources RSA, which includes the Austin Bayou, Clear Creek, Dickinson Bayou, Halls Bayou, Middle Oyster Creek, and Mustang Bayou watersheds, and encompasses approximately 695,750 acres in Brazoria, Fort Bend, Galveston, and Harris Counties (***Exhibit 6-2***). The temporal boundary for essential fish habitat is 1975 to 2035. Essential fish habitat resources are managed by the National Marine Fisheries Service.

As discussed in ***Sections 6.2.4*** and ***6.2.5***, water resources in the RSA have been impacted by the conversion of natural areas to agricultural production, livestock grazing, and development. Natural waterways have been altered through the removal of adjacent vegetation and channel reconfiguration to improve conveyance capacity and facilitate the movement of stormwater flows. Continued increases in population and employment in the Houston metropolitan area will lead to land use changes in the RSA to accommodate economic growth and the increasing number of residents. As additional development occurs, waterways may be impacted by vegetation removal, conveyance capacity improvements, and increases in stormwater discharges from developed areas.

6.2.7.2 Direct and Indirect Effects on each Resource from the Proposed Project

Summary of Direct Effects

Essential fish habitat identified within the Preferred Alternative ROW is limited to the proposed roadway crossings of Geisler Bayou at two separate locations. The crossings would either be spanned by bridge structures or constructed using culverts. The type of crossing would be determined during project design. The crossings would be designed to not restrict flows within the bayou, or prevent or impede the movement of aquatic species. However, construction activities may involve work below the elevation of mean higher high water, which could affect essential fish habitat in the areas of the proposed crossings. Additionally, stormwater runoff from the Preferred Alternative directed through roadside drainage features to Geisler Bayou could introduce additional pollutants into Geisler Bayou.

Summary of Indirect Effects

Construction of the Preferred Alternative would indirectly cause development and redevelopment within the RSA. Development would convert vegetated areas to roadway, utility, residential, commercial, and industrial uses, and would likely convert some areas of lower density development to higher density development. Development activities would include the construction of stormwater management facilities and improved drainageways to convey increased stormwater volumes to receiving waters. Structural improvements to channels and drainageways associated with tidally-influenced waters could alter the physical character of the channels/drainages, thereby potentially affecting essential fish habitat. Stormwater flows directed to tidally-influenced waters from developed areas could also contain pollutants that may adversely affect essential fish habitat. Development occurring in areas upstream of tidally-influenced waters may affect essential fish habitat through discharges of pollutants conveyed downstream to tidally-influenced waters that could degrade the quality of essential fish habitat.

6.2.7.3 Other Actions – Past, Present, and Reasonably Foreseeable – and their Effect on each Resource

Reasonably foreseeable actions are those that are likely to occur, or are probable, rather than those that are possible. Reasonably foreseeable projects in the area include transportation projects, master planned communities, and commercial developments. Reasonably foreseeable projects would require stormwater drainage improvements to convey increased stormwater volumes generated from impervious cover associated with developed conditions. Physical alteration of natural water courses or drainageways conveying tidally-influenced waters may adversely affect essential fish habitat. Pollutants conveyed with stormwater entering tidally-influenced waters, or pollutants that are conveyed downstream to tidally-influenced waters from upstream non-tidal areas could degrade the quality of essential fish habitat.

6.2.7.4 The Overall Effects of the Proposed Project Combined with Other Actions

Forecasted increases in regional population and employment are expected to continue within the RSA. The land use analysis indicates that construction of the Preferred Alternative would have the indirect effect of increasing the acreage of land used for development. Planned development in the RSA includes the approximately 10,628 acres identified in ***Table 5-2***, and transportation improvements shown in ***Table 6-3***. These projects and additional lands converted to developed uses would remove vegetation that helps slow, absorb, and filter surface stormwater runoff, and would increase the area of impermeable surfaces, thereby generating additional stormwater runoff volume. The northern and eastern portions of the RSA exhibit an increased concentration of development compared to the southern and western portions; therefore, a higher volume of stormwater runoff would be expected from these more intensely developed areas. It is anticipated that future development will continue the historical trend of being concentrated in the northern and eastern portions of the RSA.

Conveying additional stormwater volume away from developed areas would require the construction of stormwater drainage improvements, including the creation of excavated drainageways and detention facilities, the rectification of channels, and the creation of additional conveyance capacity within existing

channels and drainageways. The physical alteration of channels and drainageways conveying tidally-influenced waters may adversely affect essential fish habitat that may be present within the channels/drainageways. Potential adverse effects to essential fish habitat from physical channel alterations would be more likely to occur in the eastern and southern portions of the RSA, as these areas are closer to the tidally-influenced waters of Galveston Bay. However, stormwater conveyed away from developed areas throughout the RSA may contain increased pollutant loads, even though the stormwater may have been directed through vegetated drainageways, detention ponds, or other stormwater management facilities. Increased pollutant loads reaching tidally-influenced waters could contain pollutants in sufficient quantities or concentrations to adversely affect the water quality of essential fish habitat areas. The potential for increased pollutant loads reaching essential fish habitat areas would be greater in the eastern and southern portions of the RSA, where the distance between a discharge carrying pollutants and tidally-influenced waters, and by association areas of essential fish habitat, would be shorter. The likelihood of pollutant loads adversely affecting essential fish habitat from discharges in developed areas in the northern and western portions of the RSA would be expected to be reduced because of the increased distance of conveyance to tidally-influenced waters and the probable dilution of concentrations as discharged pollutants are conveyed downstream.

6.2.7.5 Mitigation of Cumulative Effects

Development projects within the RSA may involve construction activities within or immediately adjacent to tidally-influenced waters. Development projects would also increase the areal extent of impervious cover, thereby increasing the volume of stormwater runoff generated from developed areas and requiring the construction of stormwater management facilities. Development activities involving the construction of structures or the discharge of fill material into jurisdictional waters of the U.S., including tidally-influenced waters, would be expected to require permit authorization from the USACE. Permit applicants must comply with certain conditions as part of permit issuance; for example not disrupting the movements of aquatic life species, avoiding physical destruction of spawning areas during spawning seasons, and maintaining the course, condition, capacity, and location of open waters. Activities proposed within navigable waters of the United States (i.e., tidally-influenced waters) generally require coordination with the National Marine Fisheries Service regarding potential impacts to essential fish habitat. Implementation of short-term and long-term BMPs as required by TCEQ's regulations and guidelines related to stormwater management would assist in limiting pollutant loads that might adversely affect essential fish habitat from discharges directly into tidally-influenced waters, or in upstream waters that would be conveyed downstream to tidally-influenced waters.

6.2.8 Threatened and Endangered Species

6.2.8.1 Resource Study Area, Conditions, and Trends

The cumulative effects RSA for threatened and endangered species is the same as the RSA for land use because changes in land use would be the primary cause of changes to or alteration of vegetation resources potentially providing suitable habitat for threatened and endangered species. The threatened and endangered species RSA encompasses approximately 396,885 acres (***Exhibit 5-1***), with undeveloped

areas being composed mostly of agriculture, coastal grassland, disturbed prairie, and tidal and salt marsh vegetation communities. These would be the primary vegetation communities impacted by continued development within the RSA. The temporal boundary for threatened and endangered species is from 1975 to 2035.

Similar to the greater Houston metropolitan area, the RSA has experienced past conversions of naturally vegetated areas to agricultural production, livestock grazing, and development. The conversion of these vegetation communities, and the potential habitat they offered to threatened and endangered species, has reduced available habitats remaining to support life cycle needs. Continued development for residential, retail, commercial, and industrial purposes would lead to the continued loss of undeveloped land throughout the RSA, resulting in the potential loss of these remaining habitats.

Development within the RSA has affected terrestrial and aquatic habitats. Upland areas typically have been impacted by the conversion of vegetated areas to impervious cover and maintained or landscaped conditions. Aquatic areas have been impacted by the modification of tributaries and drainage channels to increase capacities for the efficient conveyance of stormwater runoff away from developed areas into receiving waters. Stream rectification and removal of streamside vegetation has reduced the variability of habitats and limited vegetative cover available to conceal wildlife movements along riparian corridors.

6.2.8.2 Direct and Indirect Effects on each Resource from the Proposed Project

Summary of Direct Effects

The acquisition of approximately 1,072 acres of new ROW would be required to construct the Preferred Alternative. Clearing of the Preferred Alternative ROW would permanently remove existing developed and undeveloped areas, including agriculture, coastal grassland, disturbed prairie, and tidal and salt marsh vegetation communities. Although on-site surveys have not been conducted to determine if threatened or endangered species are present within the proposed ROW, potential habitat that may be available to threatened or endangered species would be lost. Coordination with the USFWS and TPWD would be required should a threatened or endangered species be identified as inhabiting, or temporarily using in the case of migrant species, habitat within the ROW of the Preferred Alternative.

Summary of Indirect Effects

Construction of the Preferred Alternative would indirectly cause development and likely some redevelopment of land in the RSA. Development activities would convert naturally vegetated areas to developed conditions, changing natural habitat areas potentially able to support threatened or endangered species to landscaped conditions associated with urban environments. Continued development would likely further fragment vegetation communities and associated habitat. A reduction in available habitat may require that a threatened or endangered species adapt to a smaller habitat area that may be less suitable or possibly dislocated from other available habitat areas, depending on the amount and location of available habitat in the vicinity of the developments. Mitigation to compensate for permanent impacts to, or the loss of, vegetation communities is typically not required as part of development. Therefore, unless there is a specific designation of habitat for a threatened or endangered species, or a species is

known to occur in the area of proposed development, the habitat functions provided by the vegetation communities in the RSA would likely be lost as these vegetation communities are converted to urban conditions.

6.2.8.3 Other Actions – Past, Present, and Reasonably Foreseeable – and their Effect on each Resource

Within the RSA, natural vegetation communities and associated habitat have been impacted by past agricultural and ranching activities and urban development. Development is presently occurring, and is expected to continue into the future to accommodate increasing population and employment growth in the region. Reasonably foreseeable actions are those that are likely to occur, or are probable, rather than those that are possible. Reasonably foreseeable projects in the RSA would include transportation improvement projects, master planned communities, and commercial developments. The reasonably foreseeable projects would encroach into vegetation communities and habitats, including habitats potentially supporting threatened and endangered species. The result would be the incremental permanent conversion of vegetation areas and habitats to developed conditions, which would reduce the amount of habitat available for use by threatened and endangered species. Remaining habitat areas may not exhibit characteristics that are favorable for individuals recruiting into these areas or that are displaced from disturbed habitat areas. Species relocating to different habitat areas could be at risk from potential exposure and increased predation or attempting to meet life cycle requirements in reduced quality habitat conditions. The Endangered Species Act and TPWD regulations protect federally and state-listed species, respectively. Coordination with the USFWS and TPWD would be required should a listed species be identified within areas of proposed development.

6.2.8.4 The Overall Effects of the Proposed Project Combined with Other Actions

The majority of the vegetation communities and habitats within the RSA have been impacted by previous farming and ranching activities and subsequent urbanization. Planned transportation improvement projects would include those listed in ***Table 6-3***, and the approximately 10,628 acres of development shown in ***Table 5-2***. Continued development in the RSA would be expected to follow the historic pattern of being concentrated in and around cities and communities, which are primarily located in the northern, eastern, and central portions of the RSA. The conversion of naturally vegetated lands to developed conditions would eliminate vegetation communities that provide wildlife habitat, including habitats that may be potentially favorable for supporting threatened or endangered species. As potentially suitable habitat areas are lost, remaining vegetative communities may be small, widely separated, and/or exhibit unfavorable conditions for habitation or use by threatened and endangered species. Remaining vegetation communities in the areas of concentrated development in the northern, eastern, and central portions of the RSA would likely not exhibit favorable conditions for threatened and endangered species. The result would be that sensitive species seeking suitable habitat in the areas of concentrated development may not be able to locate suitable habitat, or if located, the habitat may be of insufficient size or quality. The increasing acreage of future developed conditions within the RSA would also likely eliminate naturally vegetated terrestrial corridors on the landscape and continuous vegetated riparian corridors potentially

used by threatened or endangered species for travel to different locations. Motile terrestrial species would be at an increased risk of vehicle strikes and possible harm if their presence is revealed in urban environments.

Continued development within the RSA in response to forecasted increases in regional population and employment growth would result in the incremental loss or degradation of vegetation communities that may provide habitat conditions favorable to support threatened and endangered species. This incremental loss of potential habitat may be more noticeable in the southern and western portions of the RSA where there are larger contiguous tracts of undeveloped land. As the acreage of developed land increases, fewer areas of potentially suitable habitat would be available for threatened and endangered species. The incremental loss or degradation, or the possible widely dispersed locations of remaining habitat areas, would likely limit the ability of a threatened or endangered species to expand its range, accommodate additional individuals, or use the available habitat areas for resting, nesting, or foraging. Examples of species potentially affected by the incremental loss of marshes, ponds, and flooded pastures would be the black rail, white-tailed hawk, white-faced ibis, and wood stork. The timber/canebrake rattlesnake, plains spotted skunk, Henslow's sparrow, and several plant species would be impacted by the loss of forest and weedy field habitats. Aquatic species such as the alligator snapping turtle, American eel, false spike mussel, smooth pimpleback, and Texas fawnsfoot could be impacted by modifications to natural streams and channels. Migrant bird species such as the American peregrine falcon, Arctic peregrine falcon, Sprague's pipit, snowy plover, western snowy plover, and Eskimo curlew may not be able to locate suitable habitat areas in the RSA as development continues. Individuals of threatened and endangered species that may be displaced because of development could perish if they are unable to adapt to urban environments or changing habitat conditions. Although roadway improvements would have some influence on land development, most of the anticipated future development within the RSA, and the associated incremental loss of vegetative communities and wildlife habitat, would be primarily related to forecasted increases in regional population and employment.

6.2.8.4 Mitigation of Cumulative Effects

Development within the RSA would be expected to continue as regional population and employment continue to grow. Planned developments and transportation improvements would cause the unavoidable conversion of vegetation communities and habitats potentially available for threatened and endangered species to developed conditions. A reduction in the amount and possibly the quality of available habitat, and the lack of connectivity because of the developed urbanized conditions, would limit the ability of threatened and endangered species to locate and/or inhabit the available habitat.

The Endangered Species Act protects federally listed threatened and endangered species. The identification of a federally listed species within the footprint of a proposed project would require coordination with representatives of the USFWS to mitigate potentially adverse effects to the species. Similarly, state listed species are protected by TPWD regulations. The identification of a state listed species would require coordination with representatives of TPWD to mitigate potentially adverse impacts

to the species. Mitigation opportunities may include an alteration of the project design, or relocation of the species to another suitable location.

6.2.9 Conclusions

Adverse impacts to natural resources in the region have resulted from the general trends of increasing population growth and economic development. Such effects would be expected to continue to occur as a result of development related to anticipated growth in the region. These impacts, and impacts resulting from the Preferred Alternative, would combine and interact to result in cumulative effects in the proposed SH 99 Segment B study area and the region. Potentially adverse cumulative effects associated with past and continued future development in the study area include loss of natural habitat, air and water quality impacts, and conversion of land uses. Beneficial effects of development in the region would include new economic opportunities, improved transportation, housing alternatives, employment opportunities, and recreational resources.

Additional housing, infrastructure, and commercial and public land uses required to serve the projected population would result in continued development and land use changes in the region. Extensive residential development is proposed in many of the communities in the proposed SH 99 Segment B study area. Restaurants, retail shops, office complexes, business parks, and convenience stores are typical commercial developments that would be constructed in the region. As development occurs, the need for additional infrastructure and services (e.g., schools, transportation, utilities, fire, police, and EMS facilities) would increase.

Development impacts associated with anticipated growth in the region are expected to result in conversion of wetland, riparian, and upland habitats, and agricultural lands to commercial, residential, or industrial land uses as well as additional infrastructure and services as people continue to move into the area. Habitat fragmentation from infrastructure construction or changes in land use have disrupted and dispersed fish and wildlife populations. Both natural and artificial processes, including human-induced subsidence and draining and filling wetlands for development, have resulted in the conversion of wetland habitats to open water, upland habitat, or developed land. However, some losses have been partly offset by gains in emergent wetlands that took place in transitional areas peripheral to wetlands (related to subsidence or water management programs). Although there have been substantial losses of wetlands and other habitats since the 1950s and the continued urbanization and industrialization of the Houston-Galveston area would cause continued pressure on these habitats and ecosystems, efforts to preserve, restore, and create valuable habitat are underway to minimize the adverse impacts associated with urbanization and industrialization in the region. Beneficial uses of detention basins could aid in this effort by creating open areas and wetlands to support plant growth and wildlife. To a large extent, impacts to wetlands and protected species within the proposed SH 99 Segment B study area would be avoided, minimized, or mitigated by compliance with existing federal statutes that apply to private and government interests.

Various existing and planned developments in the area would have a potential cumulative water quality impact on receiving water bodies in the study area because of wastewater discharges and urban runoff.

Use of BMPs for controlling runoff and thereby limiting potential contamination of receiving waters, and spill prevention and control measures for minimizing impacts of accidental spills, would result in minimal adverse impacts to water quality and aquatic resources.

In conclusion, the many projects occurring in the general vicinity of the Preferred Alternative are part of the continued urbanization of the overall region. Potential cumulative effects of these projects accompanying this trend and would affect environmental, social, and economic resources. Existing governmental regulations, in conjunction with the goals and coordination of community planning efforts, address the many and varied issues that influence the local and ecosystem-level conditions. The vision, goals, and, ultimately, the coordination of the numerous stakeholder groups by local organizations, and the regulatory powers of state and federal programs serve to safeguard these resources and prevent or minimize negative impacts that would threaten the general health and sustainability of the region.

6.3 CUMULATIVE REGIONAL EFFECTS OF TOLLED FACILITIES AND MANAGED LANES

As noted throughout, most of the proposed SH 99 Segment B is included in H-GAC's *2035 RTP Update* (MPO long-range plan). The proposed SH 99 Segment B is consistent with the conformity determination (*2035 RTP Update*).

6.3.1 Overview

As the Metropolitan Planning Organization for the Houston-Galveston-Brazoria region, the H-GAC is charged with enabling and creating a regional perspective for transportation and mobility.

To maintain mobility in the region, the *2035 RTP Update* provides major strategies, which used together would preserve needed regional mobility. The *2035 RTP Update* recognizes that although the region cannot build itself out of congestion, adding system capacity cannot be avoided and is, therefore, an important strategy for improving mobility. Adding capacity to the roadway network is costly, and with dwindling funding, such strategies as tolled facilities have become an increasingly attractive option as a means of adding capacity to the network. The Houston-Galveston region is now one of the few regions in the country that has or is on the verge of having a regional tolled roadway network. The H-GAC conducted analyses on the regional indirect and cumulative effects of tolled facilities and managed lanes. The report was last updated in October 2013 and is titled *Regional Cumulative and Indirect Effects of Toll Facilities* (H-GAC 2013). The analysis focuses on a regional tolled roadway network and its indirect and cumulative impacts on the above-mentioned resources.

Cumulative impacts may result from individually minor, but collectively significant actions taking place over time. H-GAC plans for regional changes over a long-term horizon, 30 years, thereby providing a means to assess cumulative impacts to a region. Indirect effects are typically observed after the action occurs. Consideration of both the indirect and cumulative effects of a regional tolled roadway network is essential to the analysis of tolled facilities because the existence of this type of network can cause long term changes in air and water quality, vegetation, and land use patterns. Air and water quality are most affected by the increase the number of vehicles and non-permeable surface area, respectively.

Furthermore, as the regional tolled roadway network increases, the potential for changes in land use also increases. Land use changes often result because the regional tolled roadway network and proposed additions are located outside of the core urban area where development is not yet clearly defined or existing.

Indirect and cumulative impacts from a regional tolled roadway network may also be evident in EJ populations because these populations are most sensitive to a tolled roadway network in relation to access. Restricting access based on pricing has the potential to create disproportionate adverse effects. The analysis focuses on quantifying the benefits and/or disbenefits to the identified EJ populations based on accessibility and travel time.

It is also likely that a tolled roadway network would also have an impact on the regional economy because freight and transportation are vital to the health of the Houston-Galveston regional economy. The analysis concluded that a regional tolled roadway network is not expected to have any significant adverse cumulative or indirect impacts.

6.3.2 Air Quality

The Clean Air Act Amendments of 1990 require transportation plans, programs, and projects in nonattainment areas, which are funded or approved by the FHWA or FTA, to conform to the SIP. This ensures that transportation plans, programs, and projects do not produce new air quality violations, worsen existing violations, or delay timely attainment of the NAAQS.

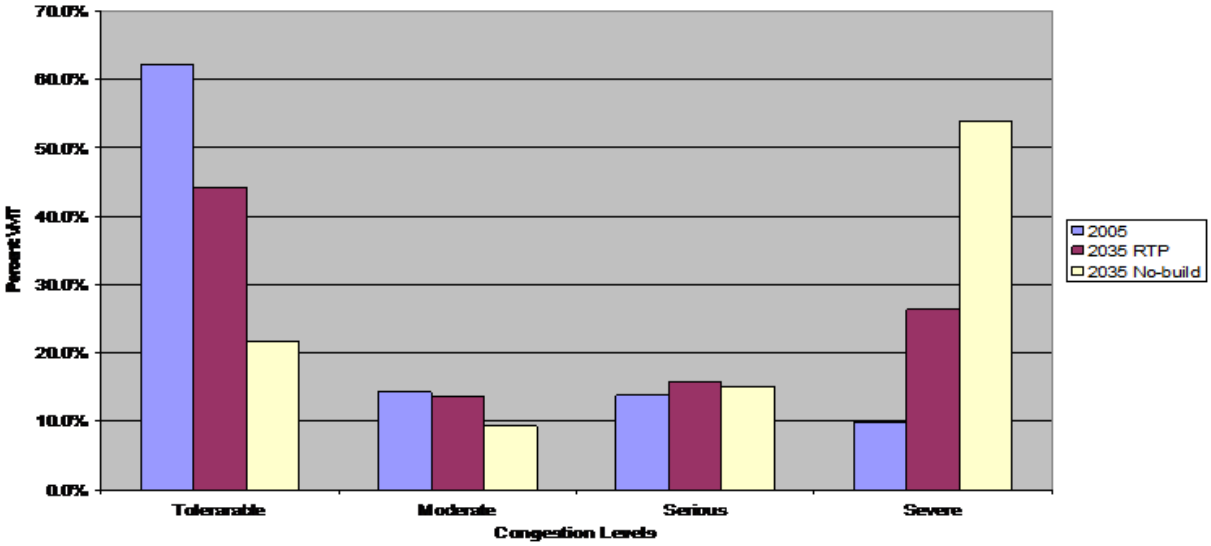
Under the Clean Air Act, the EPA established criterion called the National Ambient Air Quality Standards to determine the health threat of criteria pollutants, generally located within CMSAs. If a CMSA has a health threat, it is designated as a ‘nonattainment’ area until compliance is achieved. The Houston-Galveston-Brazoria region is classified as a nonattainment area for the 2008 8-hour ozone standard, and it has been further classified as “marginal.”

Transportation conformity is an analytical methodology that establishes the connection between projected on-road emissions from the *2035 RTP Update* and the known reductions in the motor vehicle emission budget from the SIP. Through the process of transportation conformity, the *2035 RTP Update* uses the SIP on-road mobile strategies and air quality targets to demonstrate if the *2035 RTP Update* complies with the federal air quality requirements. Vehicle emissions resulting from the implementation of transportation projects in the *2035 RTP Update* cannot exceed emission budgets established by the SIP. The Houston-Galveston region must demonstrate that the *2015-2018 TIP* and the long-range plan (*2035 RTP Update*) result in less volatile organic compounds and nitrogen oxides than established and approved by EPA for each analysis year. The USDOT (FHWA and FTA) determined that the *2035 RTP Update* and the *2015-2018 TIP* conformed to the requirements of the SIP for the Houston-Galveston ozone nonattainment area on January 25, 2011, and December 2, 2014, respectively.

Level of mobility was developed to illustrate the degree of congestion on roadways within the region. The H-GAC analyzed the relative distribution of morning peak period congestion levels for the current and future regional roadway network as a percentage of VMT in each level of mobility category (***Figure 6-1***).

There will be an increase in regional congestion levels if the forecasted growth occurs. The most significant changes would be at the low end of the range (tolerable congestion levels) and high end (severe) congestion levels, between the current system performance and a future scenario without the *2035 RTP Update* project (the No-Build scenario). The proposed *2035 RTP Update* Regional Roadway Network would reduce the percentage of severely congested VMT in the morning peak period from approximately 50 percent to less than 30 percent compared to the 2035 No-Build Scenario.

Figure 6-1: Level of Mobility (AM Peak)



Source: H-GAC 2013.

Air Quality Findings

The introduction of additional priced facilities into the existing roadway network would not cause any cumulative impacts to air quality. Moreover, a regional priced roadway system provides additional travel capacity to the roadway network, which creates a greater flow of traffic, decreasing the amount of cars traveling at lower speeds or idling conditions. This would result in less fuel combustion and lower emissions including MSAT, CO, and ozone. EPA's vehicle and fuel regulations, coupled with fleet turnover, are expected to result in significant reductions of on-road emissions, including MSAT, CO, and ozone precursors.

6.3.3 Water Quality

The Houston-Galveston region has an abundance of water resources including rivers, lakes, and bays. The TCEQ, along with the Clean Rivers Program and numerous local agencies, are responsible for monitoring all major bodies of water and reporting those conditions in a biennial Texas Water Quality Inventory report. Section 303(d) of this report details those water bodies TCEQ has identified as impaired because of water contamination.

The 303(d) list identifies several major water systems as impaired with pollutants and bacteria in the Houston-Galveston Transportation Management Area. Most of the waterways located in the Trinity-San Jacinto Coastal Basin, San Jacinto River Basin, San Jacinto-Brazos Coastal Basin, Brazos-Colorado

Coastal Basin, including bays and estuaries that flow to the Gulf of Mexico, are impaired and are included in the 303(d) list. Construction of the proposed priced facility system would cross and impact these water bodies at multiple locations and could cause water quality impacts. The increase of impervious square footage from adding capacity to the roadway network would greatly increase non-point source pollution and the potential to cause further impairment to the region's waterways.

TCEQ regulates water quality through SWP3, MS4, and BMPs. All construction of the priced facilities in the *2035 RTP Update* would follow these water quality regulations that would aid in preventing further pollution to these impaired waters and to waters that are not impaired. Additionally, any land use development that would occur from the construction of these facilities would follow TCEQ's regulations for water quality through SWP3 and MS4.

Water Quality Findings

Although overall impacts cannot be avoided, the above mentioned mitigation techniques would ensure that the regional priced facility would not have significant cumulative impacts to water quality.

6.3.4 Vegetation

Prairie, wetland, bottomland forest, upland forest, and riparian corridor ecosystems are located in the Houston region. Each of these resources provides vital functions for flood protection, air quality, water quality, and wildlife habitat. Protection of these natural resources that contribute to the region's quality of life is an important priority for planning the region's future growth and transportation requirements, a desire that was strongly echoed at the Envision Houston Region workshops and forums. The H-GAC launched the Envision Houston Region initiative in 2005 to facilitate citizen involvement in the process of analyzing how future population growth could affect land use and transportation plans across the region and to identify innovative approaches to meet transportation challenges associated with rapid growth.

As growth and development are part of our region's future, it is not feasible that every environmental parcel could be conserved. However, it is feasible that the region could identify and work to conserve those areas that are most significant ecologically. The H-GAC identified areas of concern that are distinct environmental resources within the H-GAC region for special consideration in the transportation planning process. However, the identification is not intended to be used for project-level screening. The results are intended to be used for long-range planning purposes and screening to identify areas where future transportation projects or development may potentially impact the sensitive environmental resources. In addition, the identified environmental resources are areas where mitigation efforts may be focused.

In some instances, disturbing natural resources may be unavoidable for regionally significant projects or projects located on facilities that are multiple-lane, limited-access facilities, such as highways and tollways. Because of their scale, regionally significant projects potentially have a larger impact on the environment than a local project and, therefore, are closely examined. Currently, projects within the *2035 RTP Update* are individually subject to environmental requirements but have no mechanism for cumulatively identifying or mitigating environmental impacts. At the project level, wetlands mitigation

would occur through the permitting process under the jurisdiction of the USACE. Locally, cities can also curb vegetation loss by implementing measures to protect vegetation areas.

Vegetation Findings

Impacts to vegetation would undoubtedly occur from the regional priced facility system; however, these impacts are best evaluated and mitigated at the project level. Regional impacts on vegetation would be minimal from toll network facilities.

6.3.5 Land Use

While we can increase system capacity, manage demand, and improve the efficiency of the existing system, the strategy with potentially the most effect upon improving mobility and quality of life is that of connecting transportation and land use. Land use has a direct impact on the ability of the region's transportation system and agencies to deliver a variety of travel choices. The *2035 RTP Update* has shown that sustained major investments in roadway capacity would only moderate, and would not eliminate the level of future traffic congestion; however, significant mobility gains are possible through better coordinated land use and transportation planning.

The Envision Houston Region process initiated by H-GAC and its partners engaged residents in a discussion of the region's future growth and development, focusing on land use and transportation alternatives. Citizen input from workshops was used to develop growth scenarios representing two different types of alternative development patterns. The objective was to provide information on the projected impacts of the alternatives and to highlight the difference between the two growth scenarios developed from the workshops and the Base Case or traditional growth scenario. ***Table 6-5*** shows the statistics produced through the analysis of each scenario. Brief descriptions of each scenario are below:

- Scenario A (fiscally constrained *2035 RTP Update* network) denotes the current growth and development pattern for the Houston region, based on H-GAC's 2035 demographic forecasts. It is characterized by low-density housing development in currently undeveloped portions of the region with mixed-use development along major roadways. Jobs are concentrated in the central business district, and several other employment centers are scattered throughout the region.
- Scenario B indicates the workshop participants' ideal growth pattern, adjusted to the regional forecast of household and job growth. This scenario is characterized by development along major roadways, in a radial pattern, creating centers at major intersections.
- Scenario C signifies the workshop participants' ideal growth pattern, adjusted to the forecast of household and job growth by county. This scenario clusters mixed-use development in satellite cities and along major roadways in a radial pattern. Satellite employment centers emerge throughout the region.

Table 6-5: Alternative Growth Scenarios

Data of Interest	Scenario A	Scenario B	Scenario C
Transit Boardings	758,000	+10%[a]	+20%[a]
VMT	248 million	-7%[a]	-7%[a]
VHT	7 million	-16%[a]	-15%[a]
NO_x Emissions	46.58	46.43	43.74
VOC Emissions	50.72	48.65	47.65

Source: H-GAC 2013d.

[a] Denotes change over Scenario A.

Notes: NO_x = nitrogen oxides; VMT = Vehicle Miles Traveled; VHT = Vehicle Hours Traveled; VOC = volatile organic compounds; % = percent.

These results reinforce the public's intuitive notions about coordinated transportation and land use planning. The H-GAC has identified a three-pronged land use and transportation coordination strategy (3Cs) that calls for the creation of bicycle and pedestrian friendly centers; establishment of better connections between the centers; and designs based on the context of the surrounding land uses. The 3Cs strategy, in addition to enhancing mobility choices, is expected to produce economic, environmental and "quality of place" benefits for the region.

To integrate the 3Cs concepts into regional transportation planning, the H-GAC has identified the following five strategies:

- Coordinate transit and roadway planning to connect existing and planned centers with the region's multimodal transportation network;
- Promote roadway designs appropriate for the context of the surrounding community to ensure safe, convenient travel choices for all user modes;
- Coordinate transportation improvements and private sector development efforts to promote projects that combine sustainable mobility and economic benefits;
- Help fund local planning studies to assist in the development of centers; and
- Provide funding support for infrastructure projects that enhance connections within and between centers.

In addition to expanding the regional transit system, transit ridership and efficiency can be improved by coordinating transit and land use. Development along transit lines that increases density and integrates transit with development can make transit more accessible and decrease the need for SOV trips. Recommended strategies include:

- Promote community design that provides convenient access to transit systems;
- Promote transit-oriented development investments around regional transit facilities; and
- Enhance access opportunities for the transportation disadvantaged.

These land use and transportation coordination tools can be used in the H-GAC region to reduce the need for additional infrastructure for the region, including utilities, transportation, water, and tolled facilities. Without sustainable land use, the additional cost of new infrastructure items will increase beyond the current estimated costs.

The current future roadway facility outlined in the fiscally constrained *2035 RTP Update* (Scenario A) is in support of the predicted land use changes and growth in the region. To meet the demand of the expansive growth and changes in land use from development, the aim of the 2035 regional roadway network is to supply the transportation portion of infrastructure requirements for the expanding growth and development. Current and future predicted available funds from the federal government for transportation alone will not be able meet the demands for the transportation infrastructure needed to support the predicted changes. Toll roads and managed lanes are methods that the *2035 RTP Update* uses to ensure the transportation demands from future growth are met based on limited transportation funds.

Land Use Findings

The proposed 2035 toll network may affect land use within the Metropolitan Planning Organization boundaries by creating land development opportunities. However, the toll network is only one factor in creating favorable land development conditions; other prerequisites for growth in the region include demand for new development, favorable local and regional economic conditions, adequate utilities, and supportive local land development policies. The proposed 2035 toll network as currently envisioned may, with the right conditions, help influence the additional planned regional land use conversion, redevelopment, and growth.

6.3.6 Economics

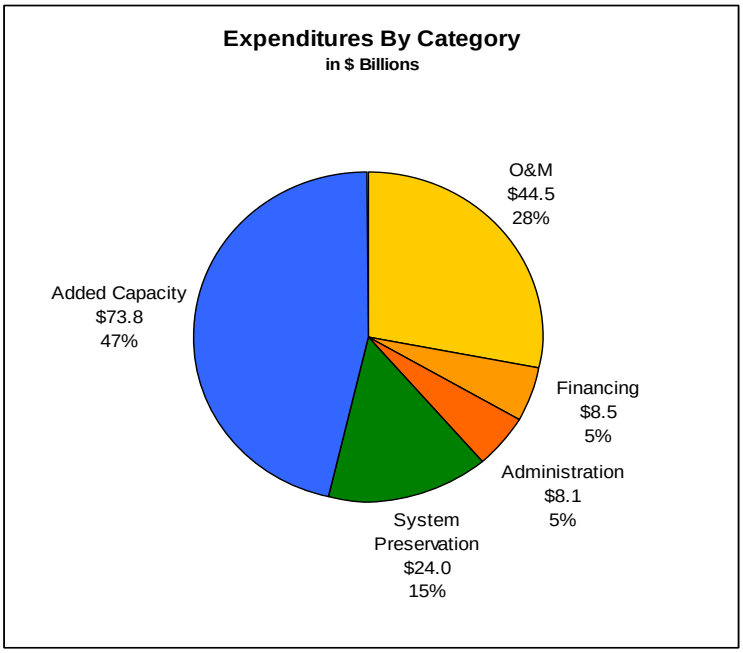
In 2006, H-GAC completed an extensive financial survey that included local governments and agencies with significant expenditures on the transportation network and services. The survey gave a more complete understanding of how much, by whom, and where transportation dollars are being spent. It indicated a significant undercounting in previous plans (based on preliminary results) of the contribution by local governments on transportation investments. However, for the purposes of fiscal constraint, this undercounting is neither surprising nor alarming because a large portion of local transportation investment is made on local street networks that are not included in the *2035 RTP Update* because they are not considered to be of regional significance. Fiscal constraint is demonstrated for the regionally significant transportation projects.

The financial summary is different from those in past plans in that it conforms to new federal regulations requiring the expression of future costs and revenues in year-of-expenditure dollar values, that is, the effects of inflation must be included. The rate of inflation from 1996-2005 has been, on average, 2.53 percent. Another innovation is expressing the cost of projects in terms of their total costs. This includes the costs of ROW, realignment of utilities, and engineering, all of which are paid for from statewide accounts, rather than federal or state dollars that are directly apportioned to the Houston-Galveston area.

6.3.6.1 Expenditures

Expenditures on the transportation network include building new and improving existing roadways and transit lines (added capacity), operating and maintaining the network in good repair (operations and maintenance), reconstructing existing facilities when they have reached the end of their useful life (system preservation), financing costs associated with debt incurred for transportation projects (financing), and wages and salaries paid to various staff of the roadway and transit agencies (administration). The total estimated expenditures in 2035 are $158.9 billion (***Figure 6-2***).

Figure 6-2: Expenditures by Category (in $ Billions)

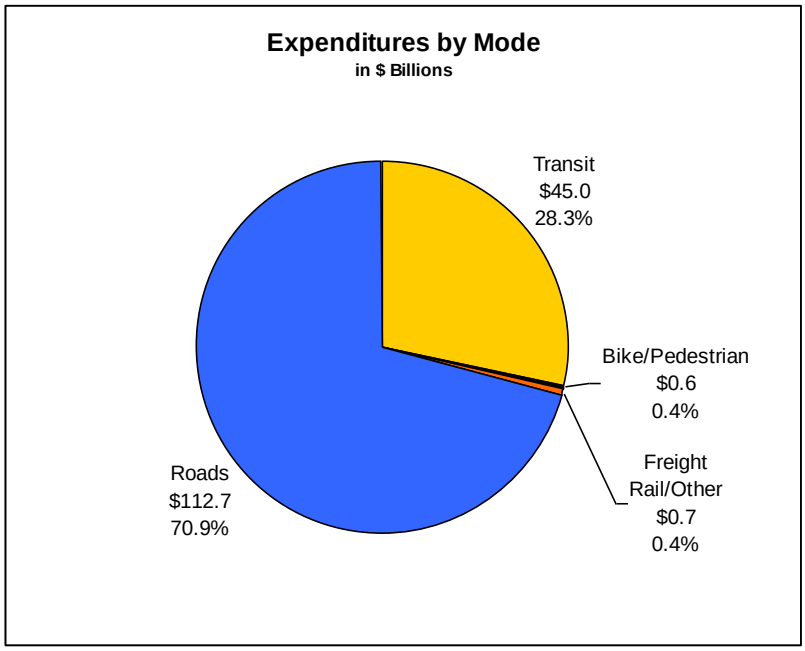


Source: H-GAC 2013.

For the next several years, the region is expecting to continue the trend of expanding the transportation network through added capacity projects. However, in the 2006 edition of the H-GAC *Texas Metropolitan Mobility Plan*, findings indicate that added capacity projects would decrease in spending relative to system preservation costs. Not only would there be a larger network to maintain in the future, but system preservation efforts are currently under-funded. In the future, more revenues would be needed for system preservation to prevent further deterioration of roadway surfaces.

When examined by mode of travel (roadway, transit, or bicycle), nearly 71 percent of all expenditures are for roadway projects that support the automobile (***Figure 6-3***). In a region known for its dispersed suburbanized housing, this percentage is not unusual. However, over the last several years, transit investments have increased dramatically, and this trend is expected to continue.

Figure 6-3: Expenditures by Mode (in $ Billions)

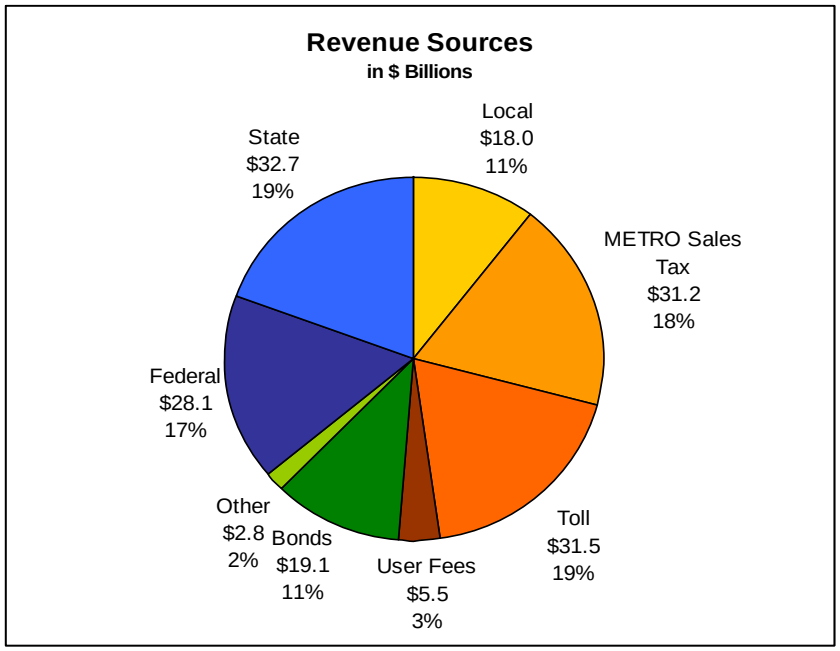


Source: H-GAC 2013.

6.3.6.2 Revenues

The estimated total revenue available for the *2035 RTP Update* is $168.9 billion (***Figure 6-4***). These revenues come from a variety of federal, state, and local sources. Federal sources include the federal gas tax and programmed funds from the FHWA and FTA. State sources include the motor fuel tax, vehicle registration fees, pass-through financing agreements, and other state allocations. Local sources include property and sales taxes collected by the cities and counties, toll revenues, bonds, and user fees from transit agencies. As a group, the local sources provide the greatest amount of revenues for the *2035 RTP Update*.

Figure 6-4: Revenue Sources (in $ Billions)



Source: H-GAC 2013.

It is particularly important to note that the region's reliance on toll receipts to fund the *2035 RTP Update* is growing each year. New toll roads, such as the SH 99 (Grand Parkway), as well as managed lanes, are scheduled to come on line in the next 30 years. Although the Harris, Fort Bend, Brazoria, and Montgomery County Toll Road Authorities are not obligated to spend tolling receipts on non-toll transportation projects, in the past they have reinvested all toll-generated revenues into both the toll and connecting roadway road systems.

6.3.7 Environmental Justice

6.3.7.1 Methodology

The H-GAC conducted an evaluation to determine the effects of a regional tolled roadway network on EJ populations. The unit used for the analysis is the TAZ. The Title VI/EJ zones TAZs were selected based on the Census 2000 block groups that contain 51 percent or greater minority and low-income populations. A TAZ is recognized as an EJ zone if 50 percent its area is covered by EJ block groups.

As shown in ***Table 6-6***, in 2000, approximately 31 percent of the H-GAC regional population has been identified as being within EJ zones. This represents approximately 46 percent of the total number of TAZ in the eight-county region. Therefore, 1,383 of the total 3,000 TAZs are considered to be EJ TAZs. As can be seen in ***Figure 6-5***, there are significant EJ communities located throughout the H-GAC region, but most of the EJ communities are located within Harris County and are generally clustered within the Sam Houston Toll Road. ***Figure 6-5*** shows a subset of the EJ zones that have minority or low-income population that are greater than 51 percent of the total TAZ population.

Table 6-6: Distribution of Environmental Justice Communities in the H-GAC Region

Designation	Population (2000)	Percent of Total	Number of TAZ	Percent of Total
Total Population within EJ Zones	1,634,500	31.3	1,383	46.1
Total Regional Population	5,214,051	100	3,000	100

Source: H-GAC 2013.

Notes EJ = environmental justice; TAZ = traffic analysis zone.

6.3.7.2 Analysis Approach

The analysis addresses the potential impacts of tolled facilities on accessibility by analyzing their impacts on the travel time choices of the persons residing in EJ zones and Non-EJ zones. The introduction of tolled facilities generally results in a travel time benefit (i.e., a travel time savings) to those who choose to use the facilities (both EJ and Non-EJ users). It is a user decision whether or not to use a new tolled facility. From an EJ perspective, it appears the issue should be whether the introduction of the proposed tolled facilities is expected to have a significant and/or disproportionate adverse impact on the EJ population. This issue is addressed by analyzing forecasted trips made by the EJ population that are "candidate" trips for the new tolled facilities.

Two networks were used for purposes of the analyses: *2035 RTP Update* Build and *2035 RTP Update* No-Build Managed Road (No-Build network). The full extent of the toll and managed lane system as contained in the fiscally constrained *2035 RTP Update* can be seen on ***Figure 6-6***. As seen on ***Figure 6-7***, the No-Build network is essentially the fiscally constrained *2035 RTP Update* network with the existing, plus committed, managed lane system (the Katy Freeway HOT lanes are included).

6.3.7.3 Analysis Assumptions and Limitations

The region's travel demand models do not provide a means for tracking travel at an individual household level, but do provide a means for tracking travel at a zonal level. For purposes of the analyses, the zones are specified as either EJ zones or Non-EJ zones based on the socioeconomic characteristics of the zonal populations. Some regional travel models use a generalized cost assignment procedure for toll analyses. The H-GAC models perform toll analyses at the mode choice level. Therefore, the H-GAC travel model uses a multiclass assignment procedure rather than a generalized cost procedure.

The mode choice models are applied by trip purpose. For the mode choice toll analyses, two travel time estimates are developed from each zone to all other zones: 1) the travel time using both toll and non-toll links (commonly referred to as "toll path" travel times), and 2) the travel time using only non-toll links (commonly referred to as the "free path" travel time). In the mode choice model, if the toll path does not offer a shorter travel time between two zones than the free path travel time, the trip is not considered a "candidate" for the toll facility. If a trip can save travel time using a toll path over a free path then it is considered a "candidate" trip. Of course, not all "candidate" trips will choose to use a tolled path. The probability of a "candidate" trip using a tolled path is a function of a number of variables, such as the magnitude of the potential travel time savings, the toll costs, and the income characteristics of the zones residents. Aspects of this approach are used in the analyses presented in this report.

In mode choice model applications, there is a single highway network used to estimate the travel times for toll paths and free paths. For the regional toll analyses, there are two networks: the Build network (i.e., the forecasted roadway network containing the subject toll facilities) and the No-Build network (i.e., the network containing all the forecasted roadways except the subject toll facilities). Existing and committed toll facilities are contained in both networks. In this analytical setting, simply comparing the toll path versus free path option will not identify the candidate trips for only the new toll facilities being studied. Rather, such a grouping would include trips using both existing and proposed toll facilities.

To focus on candidate trips for the new toll facilities, the travel time for toll paths in the Build network is compared to the toll path travel time in the No-Build network. Trips that have a shorter toll path travel time in the Build network than the toll path travel time in the No-Build network are defined as candidate trips for the new toll facilities. The trips from EJ zones are stratified as either candidate trips or non-candidate trips using the data from the two networks. Likewise, the trips produced by the Non-EJ zone are similarly stratified. Stated differently, the trips for a given trip purpose is segmented into four groups:

- Trips produced by EJ zones that are classified as "candidate" trips;
- The remaining trips produced by EJ zones are classified as non-"candidate" trips;
- Trips produced by non-EJ zones that are classified as "candidate" trips; and
- The remaining trips produced by non-EJ zones are classified as non-"candidate" trips.

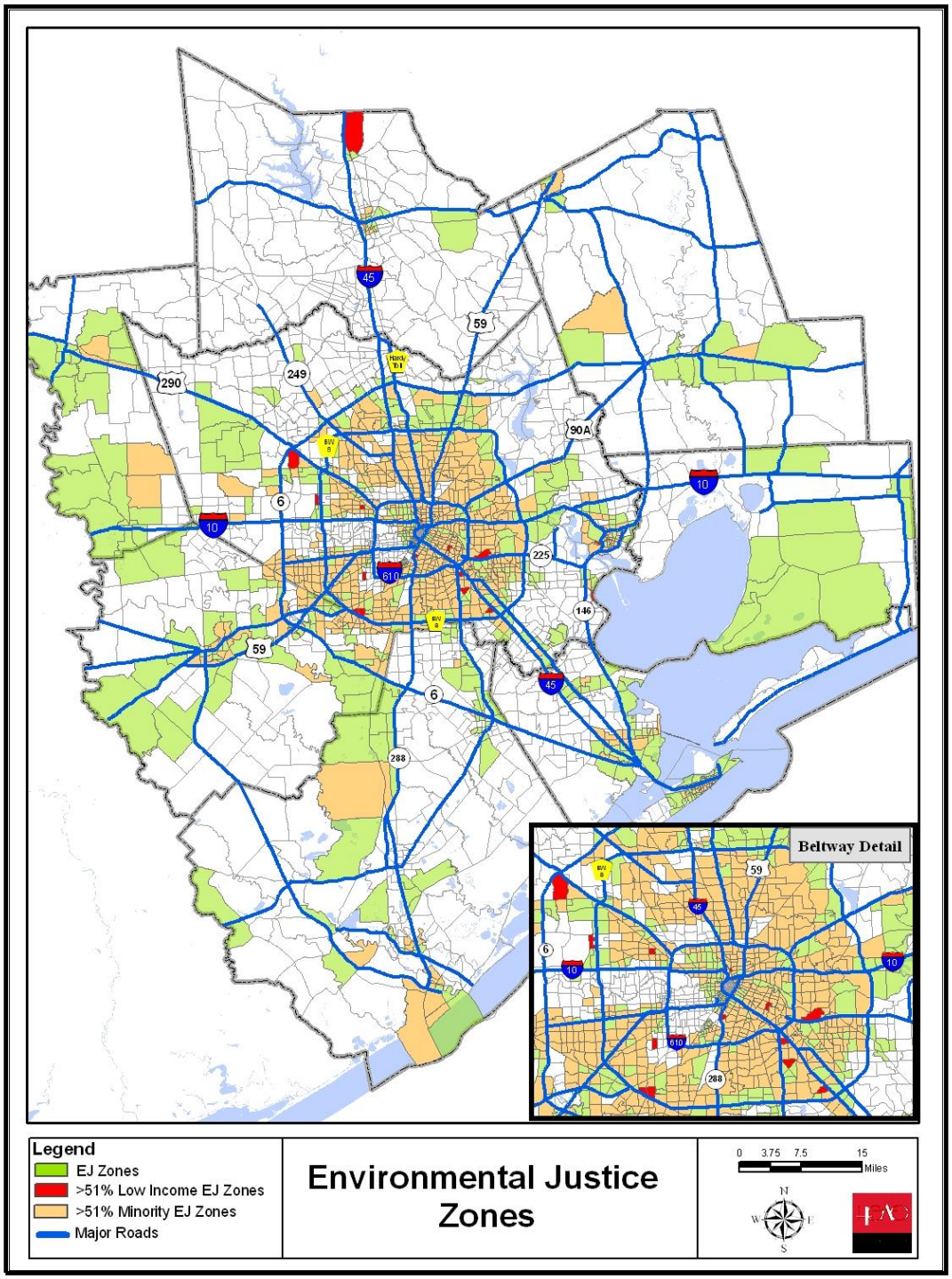
Using toll path travel times and free path travel times from the Build and the No-Build networks, there are four travel times for each trip: 1) Build network-toll path option, 2) Build network-free path option, 3) No-Build network-toll path option, and 4) No-Build network-free path option). By computing the average trip lengths for each of the options, the impacts of the two networks on the choice options can be quantified, compared, and analyzed.

Using this approach, the results allow the comparison of the toll and free path options for each network for each segmentation of trips. Clearly, the implementation of new toll facilities should be expected to benefit those who might choose to use a toll facility. Of perhaps more interest is determining if there are any expected overall disadvantages to those who might choose not to use a toll facility or that are not candidates for using one of the new toll facilities.

One of the interesting side benefits of the approach is that it calls attention to the fact that there will be some potential travel time savings realized for trip makers who choose not to use a toll facility. These time savings would be expected to accrue from the reduced congestion on free facilities because of trips diverted to toll facilities.

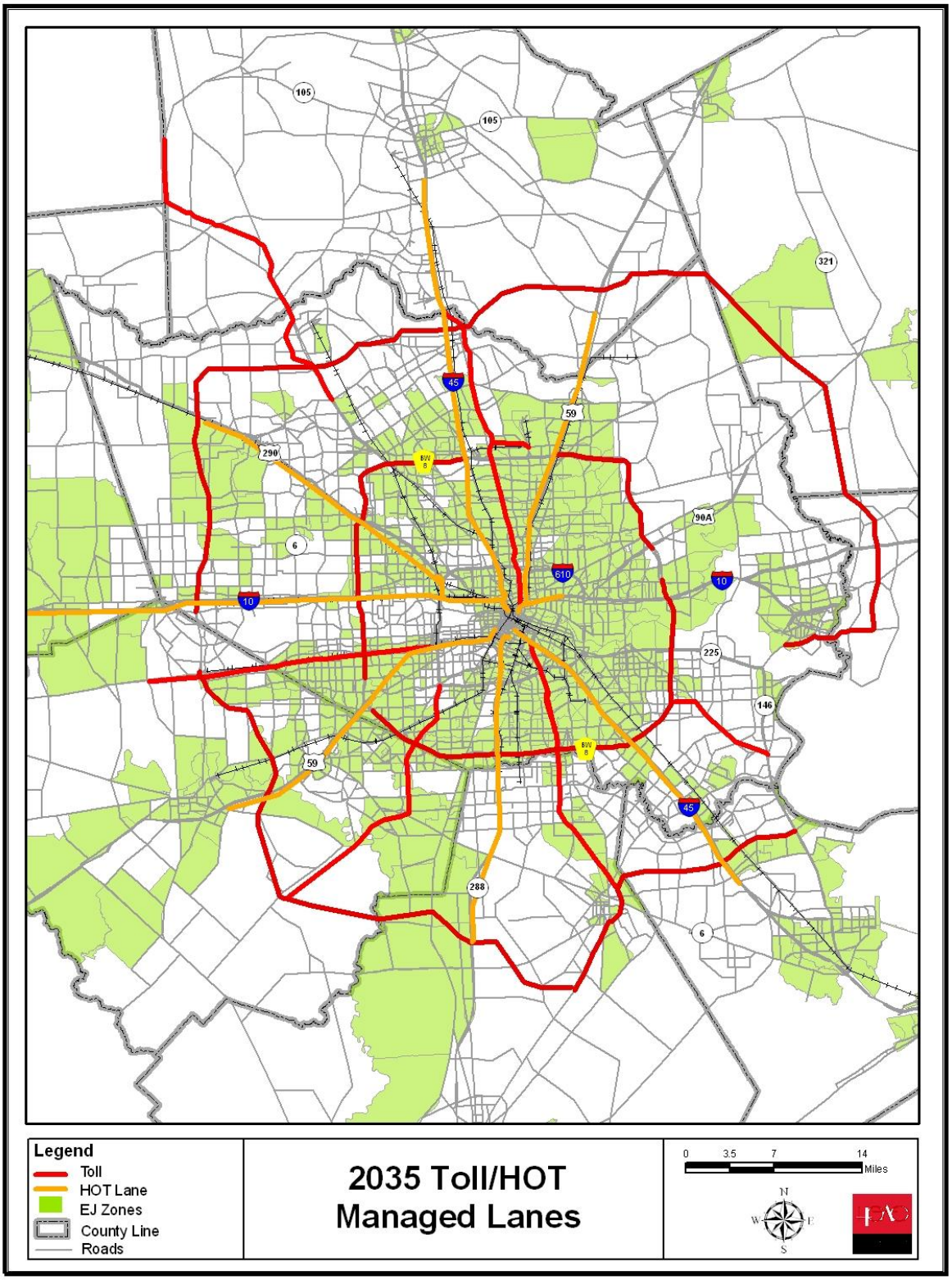
The analyses are regional level analyses and focus on average regional results; and they do not isolate any zone-specific analyses or the impacts in the immediate proximity of the new proposed facilities. Those impacts were addressed by the analyses performed for the individual facilities. Indeed, the purpose of these analyses is to determine if there are any cumulative regional impacts to the EJ populations represented by the zones designated as EJ zones.

Figure 6-5: H-GAC Region with Environmental Justice Communities of Concern



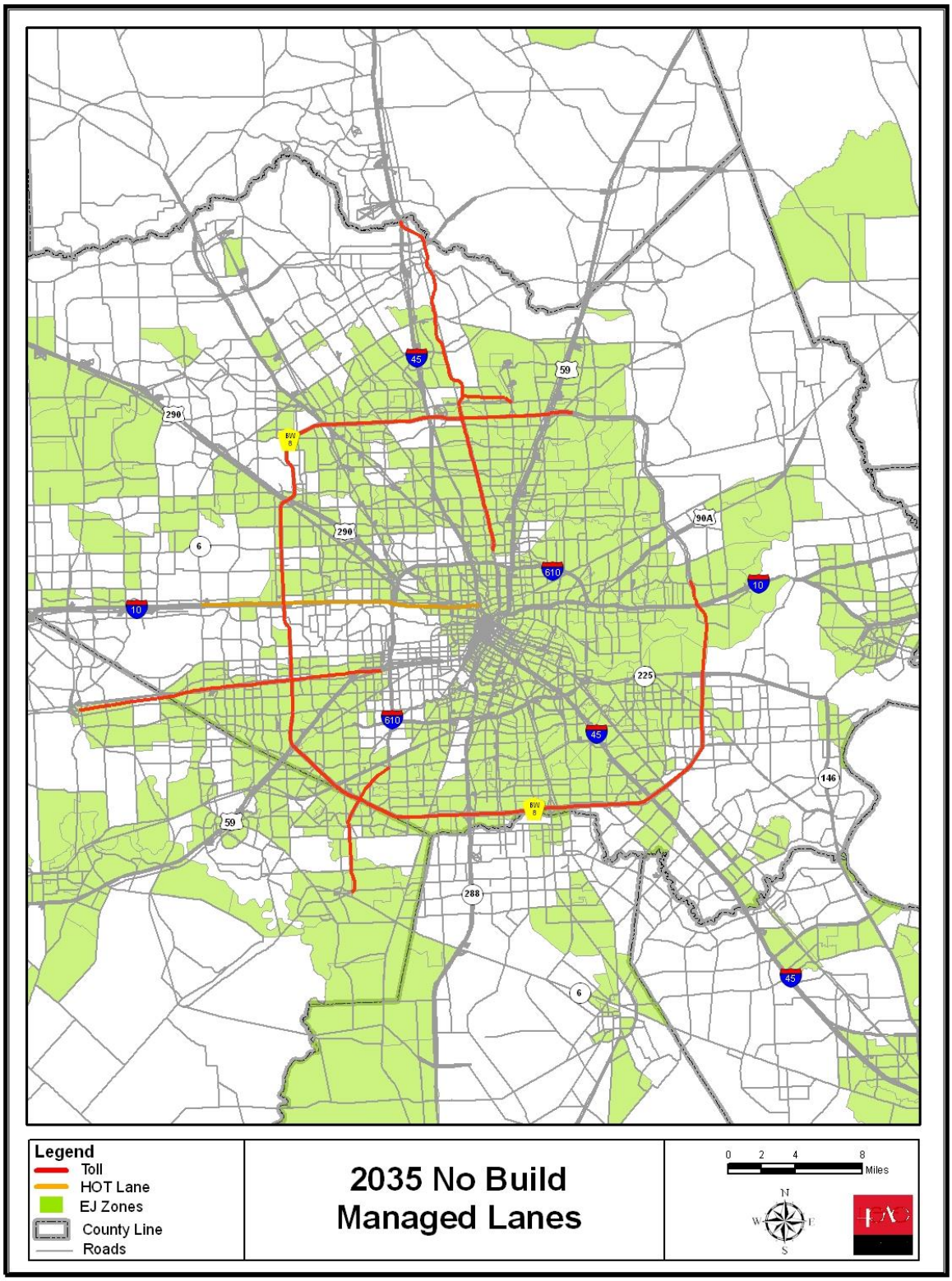
Source: H-GAC 2013.

Figure 6-6: 2035 RTP Managed Road System



Source: H-GAC 2013.

Figure 6-7: 2035 No-Build RTP Managed Road System



Source: H-GAC 2013.

A key focus of the analysis was to determine if the "free" path travel time under the Build scenario is significantly greater than the "free" path travel time under the No-Build scenario for the EJ and Non-EJ zones. The analyses show the expected travel time benefits that may be realized by EJ and Non-EJ zone residents if they choose the pay options for their travel.

Trips were divided into Home-Based Work trips (HBW) and Home-Based Non-Work trips (HBNW), and for both EJ zones and Non-EJ zones that can save highway travel time by using one of the new proposed toll facilities. For a given trip purpose, the forecasted person travel was divided into four market segments for analysis:

- Trips produced by an EJ zone that are candidates for using one of the proposed new toll facilities (i.e., that could save travel time by electing to use one of the proposed new tolled facilities for their scheduled travel);
- Trips produced by an EJ zone that are not candidates for using one of the proposed new toll facilities (i.e., that could not save travel time by electing to use one of the proposed new tolled facilities for their scheduled travel);
- Trips produced by an EJ zone that are candidates for using one of the proposed new toll facilities (i.e., that could save travel time by electing to use one of the proposed new tolled facilities for their scheduled travel); and
- Trips produced by a Non-EJ zone that are not candidates for using one of the proposed new toll facilities (i.e., that could not save travel time by electing to use one of the proposed new tolled facilities for their scheduled travel).

As mentioned in the discussion of the approach, the objective of the EJ analysis is to quantify the impacts of the Build and the No-Build options on the travel time of potential users. Examination of the results shows whether the introduction of the proposed new tolled facilities is expected to generally have a significant and/or disproportionate negative impact on the EJ population of the region.

6.3.7.4 Analysis Findings

Home-Based Work Trips

Table 6-7 shows the number of year 2035 HBW person trips and the expected average trip length (ATL) for free and tolled path options under both the Build and No-Build networks. The travel times are based upon AM peak period congested travel times. EJ and non-EJ population trips are each segmented into two separate groups:

- Those trips that can save travel time by using a toll facility; these trips are "candidate" trips for using a toll facility; and
- Those trips that cannot save travel time by using a toll road; these trips are "non-candidate" trips for using a toll facility. Consequently, for purposes of the analysis, only the free path is examined for these trips.

Table 6-7: 2035 Home Based Work Person Trips[a]

Zone	2035 HBW Trip Scenario	Number of 2035 HBW Person Trips	Build Network		No-Build Network		Difference: Toll Facility Option	Difference: Free Facility Option
			ATL: Tolled Facility	ATL: Free Facility	ATL: Tolled Facility	ATL: Free Facility		
EJ Zone	Trips that save 0+ minutes using a new tolled facility	1,124,064	34.72	42.88	36.30	43.70	1.58	0.82
	Trips that *cannot* save 0+ minutes using a new tolled facility	1,517,692	18.36	18.80	18.50	18.95	0.14	0.15
Non-EJ Zone	Trips that save 0+ minutes using a new tolled facility	1,571,960	44.57	54.84	49.18	56.96	4.61	2.12
	Trips that *cannot* save 0+ minutes using a new tolled facility	1,526,036	20.56	20.89	20.96	21.3	0.40	0.41

Source: H-GAC 2013.

[a] AM Peak average trip length (ATL) in minutes for free and tolled path options under the Build and No-Build network.

[b] No-Build ATL minutes minus Build ATL minutes (differences are in AM peak ATL in minutes).

Notes: ATL = average trip length; EJ = environmental justice; HBW = home based work trips.

Both EJ and Non-EJ Zones Benefit from the Build Alternative

From an EJ perspective, perhaps the most important observation in ***Table 6-7*** is that ATL for both toll path options and free paths are reduced under the Build Alternative for both EJ and Non-EJ zones. Therefore, the analyses did not find any significant and/or disproportionate adverse impacts on the ATL of the choice options for the EJ zones; in fact, these results show that both EJ and Non-EJ zones realize an overall benefit from the proposed new toll facilities in the Build Alternative.

Home-Based Non-Work Trips

Table 6-8 shows the number of 2035 HBNW person trips and their expected ATL for free and tolled path options under both the Build and No-Build networks. Since most of the HBNW trips do not occur during the peak traffic periods, the travel times based on the 24-hour speeds were used for these analyses. The 24-hour speeds are generally considered to represent typical off-peak speeds. Therefore, the 24-hour travel times are used by the H-GAC's HBNW mode choice model rather than the peak travel times. Again, the EJ and Non-EJ population trips are each segmented into two separate sub-groups:

- Those trips that can save any travel time by using a toll facility (*i.e.*, "candidate" trips for using a toll facility); and
- Those trips that cannot save any travel time by using a toll road. Most of these trips don't have a minimum time path that would use any toll facility. There are some trips in this group that do not have a toll path and, therefore, are unable to be toll users. These trips are "non-candidate" trips for using a toll facility. Therefore, for purposes of the EJ analyses, only the free path travel times are examined for these trips.

Table 6-8: 2035 Home Based Non-Work Person Trips[a]

Zone	2035 HBNW Trip Scenario	Number of 2035 HBNW Person Trips	Build Network		No-Build Network		Difference: Toll Facility Option	Difference: Free Facility Option
			ATL: Tolled Facility	ATL: Free Facility	ATL: Tolled Facility	ATL: Free Facility		
EJ Zone	Trips that save 0+ minutes using a new tolled facility	1,134,814	25.65	30.07	27.27	31.08	1.62	1.01
	Trips that cannot save 0+ minutes using a new tolled facility	5,266,409	12.13	12.26	12.26	12.39	0.13	0.13
Non-EJ Zone	Trips that save 0+ minutes using a new tolled facility	1,313,864	28.92	34.22	34.13	37.32	5.21	3.10
	Trips that cannot save 0+ minutes using a new tolled facility	5,306,422	13.54	13.59	14.09	14.14	0.55	0.55

Source: H-GAC 2013.

[a] 24-hour ATL in minutes for free and tolled path options under the Build and No-Build network.

[b] No-Build ATL minutes minus Build ATL minutes (differences are in AM peak ATL in minutes).

Notes: ATL = average trip length; EJ = Environmental Justice; HBNW = home based non-work trips.

Toll Path Option Benefit for the Build Alternative for Both EJ and Non-EJ Zones

From an EJ perspective, perhaps the most important observation in **Table 6-8** is that ATL for both the toll path and free path options are reduced under the Build Alternative for both EJ and Non-EJ zones. Therefore, the analyses did not find any significant and/or disproportionate negative impacts on the ATL of the toll path options for the EJ zones. In fact, these results show that both EJ and Non-EJ zones realize an overall benefit from the proposed new toll facilities in the Build network.

Latent demand is essentially unrealized demand of travel due to constraints of the roadway network that are realized when improvements to the network are made, and can show increases in traffic on capacity-enhanced networks. The travel demand model used in the analysis uses an equilibrium assignment that disperses any latent demand throughout the toll and non-toll network, thereby reducing the overall congestion in the region. This is evident by observing the changes in VMT and VHT in the Build network, which includes the regional tolled roadway network. As seen in ***Table 6-9***, the daily VMT decreases by approximately 1.5 million miles in the Build network versus No-Build network. Furthermore, daily VHT decreases by approximately 5 percent for the region when the network is fully built out. This gives evidence that the 2035 roadway network with toll facilities would improve the overall system performance and provide travel time savings to both EJ and Non-EJ populations.

Table 6-9: Regional VMT and VHT

Designation	Build	No-Build
Daily VMT	252,578,686	254,031,712
Daily VHT	7,349,969	7,761,311
AM VMT	42,929,640	43,058,792

Source: H-GAC 2013.

Notes: VMT = Vehicle Miles Traveled; VHT = Vehicle Hours Traveled.

6.3.7.5 Environmental Justice Toll Network Findings

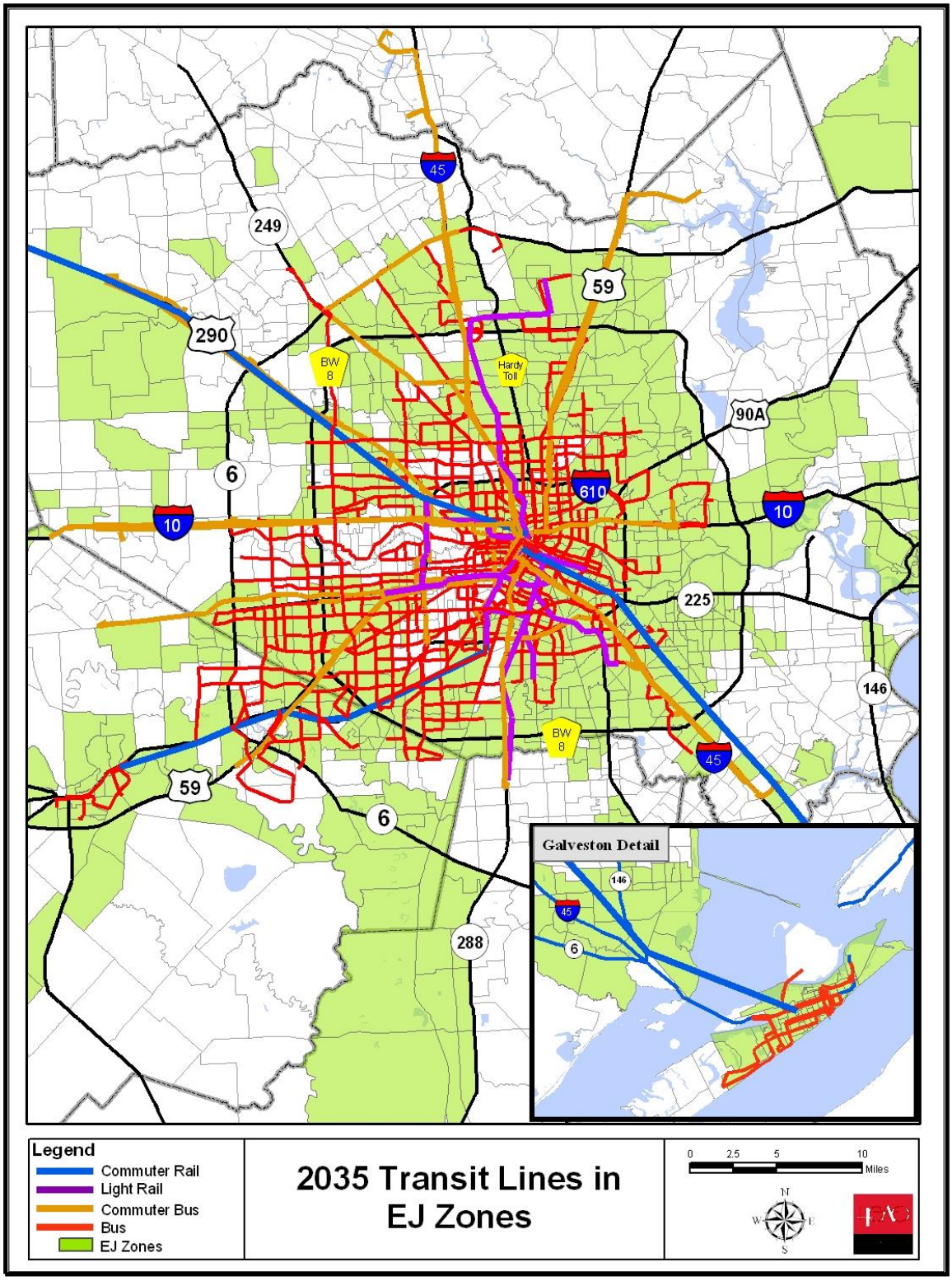
For HBW trips and HBNW trips, EJ population trips that are candidate toll users are benefited by the introduction of the new toll facilities in terms of both the toll and free path travel times. Equally important, EJ population trips that are not candidate toll users benefit by the introduction of the new toll facilities because the free path travel time ATL is reduced between the No-Build and Build networks. Therefore, EJ populations experience an overall benefit under the Build network for their HBW and HBNW travel.

Although EJ zones are spread throughout the region, they are generally clustered within BW 8 and are not as close to most of the future toll facilities as the Non-EJ zones are. Consequently, because the ATL of the EJ zones is less than the ATL of Non-EJ zones, the EJ zones cannot derive as much travel time savings as the longer trips from Non-EJ zones. However, the analysis did not explicitly examine the impact on ATL. As seen on ***Figure 6-8***, the significant amount of future transit improvements are targeted at EJ zones; the ATLs for the populations within those zones would tend to improve because of increased access to improved transit facilities.

Although EJ populations would see an increase in spending for toll facilities, the entire region would also see an increase in spending and usage as the toll and managed lane system expands. Both EJ and Non-EJ populations would benefit greatly from future toll facilities. In fact, the *2035 RTP Update* relies heavily on toll funding to finance a significant portion of future added-capacity projects, both free and toll. Additionally, for both populations who choose to use non-toll options, the Build scenario for 2035 would provide a roadway network that would operate at better traffic conditions than the No-Build scenario and would provide an increased benefit for those users over the No-Build scenario.

An analysis was also conducted to determine the annual financial burden of utilizing the toll road system for HBW trips. The analysis assumed a 2035 toll rate per mile of 19.96 cents (current toll rate of 10 cents per mile with an annual escalation rate of 2.5 percent). In addition, the analysis assumed that an average HBW trip length is 23.30 miles and the SOV user makes 250 round-trips per year using the toll facility. Under this scenario, the annual cost would be approximately $2,325 per year. However, the accrual cost should be substantially less since the likelihood of a trip using only tolled facilities is small.

Figure 6-8: 2035 RTP Managed Road System



Source: H-GAC 2013.

The 2013 HHS poverty guideline for a family of four is $23,550, of which approximately 10 percent would equate to the annual cost per year for using the toll road system for HBW trips. Based on the previous discussion and analysis, the Build scenario for the *2035 RTP Update* would not cause cumulative disproportionately high and adverse effects on any EJ populations, per EO 12898 regarding EJ.

The results of the analysis suggest that although most of the new toll facilities would not be implemented in EJ zones, EJ populations would enjoy benefits the of future toll facilities. It is important to note that future toll facilities are generally not being proposed in EJ zones because those zones are largely inside the urban core. The cost of ROW acquisitions, community disruption, etc., makes those locations prohibitive. However, it is important to note that much of the proposed light rail and bus improvements in the region are being implemented in the EJ zones identified in the analysis, thereby improving mobility for those populations.

This analysis only sought to determine whether disproportionate travel benefits or disbenefits are accruing to Title VI and Non-Title VI populations based upon travel time savings. In no way does this analysis replace the work required in the project development phase of a project per NEPA. The potential impacts of the actual placement of superstructures and their entry and exit ramps on communities and public health will still be the focus of any Title VI analysis of toll facilities in the future.

6.3.7.6 Environmental Justice Conclusion

The regional priced facility system would cause minor impacts to some of the resources discussed in the analysis. Regional mitigation for some of the resources is addressed by the H-GAC. As part of the Transportation Planning Process, H-GAC address issues related to air quality and EJ. The priced facility projects would be included in the STIP/TIP and MTP, and the STIP/TIP and MTP would need to be found to conform to the SIP. Additionally, the transportation planning process would need to comply with the requirements of Title VI of the Civil Rights Act of 1964 and Executive Order 12898 on Environmental Justice. This assures that the STIP/TIP and MTP are in compliance for air quality under the CAAA and EJ under Title VI of the Civil Rights Act of 1964 and Executive Order 12898.

Although land use impacts cannot be mitigated at a regional level, they can be mitigated and/or controlled at the municipality level because these entities have direct control over land use. However, the MPO can aid in land use impact avoidance at the regional level by only funding transportation projects consistent with the regional vision and by working with municipalities to address regional infrastructure changes in their comprehensive plans. State and federal regulatory agencies that have direct jurisdiction over natural and cultural resources would be responsible for requiring avoidance, minimization, and mitigation from any entity whose proposed project (transportation or other type) has a direct impact to any of these resources on their project.

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SECTION 7: PERMITS, MITIGATION, AND COMMITMENTS FOR THE PREFERRED ALTERNATIVE

7.1 INTRODUCTION

Efforts have been made in the planning process to avoid adverse impacts to the human and natural environment. When impacts are unavoidable, steps are taken to minimize impacts and mitigate for the impacts, as required under NEPA, FHWA, and TxDOT guidelines. According to CEQ regulations (40 CFR 1508.20), mitigation efforts may be defined as:

- Avoiding an impact altogether;
- Minimizing the impact;
- Limiting the degree or magnitude of the action;
- Rectifying the impact;
- Repairing, rehabilitating, or restoring the resource;
- Reducing or eliminating the impact over time;
- Preservation and maintenance activities;
- Compensating for the impact; and
- Replacing or providing substitutes to the impacted resource.

Efforts were made in the selection of alternatives and the identification of the Preferred Alternative to avoid or minimize adverse effects. Where impacts to resources require coordination and permitting, required processes would be followed with the appropriate jurisdictional agency.

As discussed in ***Section 3*** and ***Section 4*** of the FEIS, several resources either do not occur within the proposed SH 99 Segment B study area, or adverse impacts to the resource would not occur as a result of constructing the Preferred Alternative. In those cases, permitting or mitigation would not be proposed for the resources. The following is a list of the resources that would not be adversely impacted based on information available at the time the EIS was prepared.

- Land Use;
- Geology, soils, and farmlands;
- Minority or low-income populations;
- LEP populations;
- Economics;
- Pedestrian and bicycle accommodations;
- Wild and Scenic Rivers;

- Coastal Barriers;
- Historic Non-Archeological resources; and
- Energy.

7.2 SOCIAL CHARACTERISTICS

7.2.1 Neighborhoods and Community Cohesion

Efforts were made during the planning stages of evaluating and selecting the Preferred Alternatives to minimize adverse impacts to neighborhoods and community cohesion. Single-family communities and residents living in rural areas would be impacted by residential displacements, loss of property, a potential increase in traffic noise, visual and aesthetic impacts, and short-term construction impacts. However, development of the Preferred Alternative could benefit adjacent neighborhoods and communities by improving mobility and accessibility within the overall proposed SH 99 Segment B study area. As discussed, where feasible and reasonable, noise barriers would be proposed to abate traffic noise impacts to adjacent areas and relocation assistance would be offered to all landowners affected by residential displacements.

7.2.2 Displacements and Relocations

During the planning and evaluation stages of the Preferred Alternative, efforts were made to align the Preferred Alternative to avoid or minimize displacements. However, the Preferred Alternative would potentially require 17 single-family residential and 13 business displacements.

Because of adequate available housing, commercial space, and vacant land within the proposed SH 99 Segment B study area to accommodate residential and business relocations, affected properties would likely relocate within the study area, most likely within Brazoria or Galveston Counties. Access and parking would be impacted at a historical marker located at a TxDOT roadside rest area within the Preferred Alternative ROW. The historical marker and rest area would need to be relocated to accommodate the Preferred Alternative.

TxDOT's acquisition and relocation assistance program would provide assistance to residents and businesses that are required to relocate. The relocation assistance program is conducted in accordance with the Uniform Relocation and Real Property Acquisition Policies Act of 1970, as amended. Relocation resources are available, without discrimination, to all residents and businesses required to relocate as a result of implementation of the Preferred Alternative. No person would be displaced by the Preferred Alternative unless and until adequate replacement housing has already been provided or is in place. Replacement housing would be fair housing and would be offered to all displaced persons regardless of race, color, religion, sex, or national origin. All replacement housing would be decent, safe, and sanitary, without causing undue financial hardship. An adequate supply of housing meeting this description is anticipated either through existing homes for sale or new home sites in the study area.

Public meetings have been held, and additional one-on-one meetings would be held, as needed, during the environmental process to discuss specific displacement and/or relocation concerns prior to construction of

the Preferred Alternative. Existing roadways used for property access that may be split by the Preferred Alternative would be re-aligned in accordance with TxDOT policies to accommodate the property owner's access needs.

7.3 AIR QUALITY

The proposed project is located within Galveston and Brazoria counties, which are within the Houston area's financially constrained *2040 RTP* and fiscal year 2015-2018 TIP. Both H-GAC's *2035 RTP Update* and the *2015-2018 TIP*, as amended were found to conform to the SIP by FHWA on September 11, 2015. At this time the proposed SH 35 direct connectors included in the proposed project are not included in the STIP, it is anticipated that this portion of the proposed project would be included in the 2040 RTP Update, and at that time a conformity determination will be made. The proposed project will not be issued a Record of Decision (ROD) until this time.

The proposed congestion management strategies in the vicinity of the project, included in the *2040 RTP*, that are anticipated to have an effect on the level of mobility are listed in ***Table 4-16***. The proposed project is not anticipated to have any long-term impacts on air quality in the region. During the construction phase of the project, temporary impacts on air quality include additional dust generated from construction activities. Efforts would be made to mitigate for temporary air quality impacts during construction, including minimizing or eliminating unnecessary idling of construction vehicles and employing a combination of watering, chemical stabilization, and vehicle speed reduction techniques.

The contractor would be required to adhere strictly to dust control measures as outlined in the current TxDOT specifications, which would help minimize air quality impacts. Following the standard procedures, efficient dust control measures would be implemented in areas where fugitive dust control is a problem. Any debris material not disposed of in a landfill would be mulched. Open burning of waste such as vegetative material would not be allowed.

7.4 NOISE

As indicated in ***Table 4-18***, the Preferred Alternative would result in a traffic noise impacts. Noise abatement measures (i.e., traffic management, alteration of horizontal and/or vertical alignments, acquisition of undeveloped property to act as a buffer zone, and the construction of noise barriers) were considered at the affected locations. Of the impacted receivers, noise barriers were found to be feasible and reasonable for all of listed in ***Table 4-19*** and would, therefore, be proposed for incorporation into the Preferred Alternative.

Any subsequent project design changes may require a reevaluation of the noise barrier proposal. The final decision to construct the proposed noise barrier would not be made until after the completion of the proposed SH 99 Segment B design, utility evaluation, and polling of adjacent property owners.

To avoid noise impacts that may result from future development of properties adjacent to the Preferred Alternative, local officials responsible for land use control programs must ensure, to the maximum extent

possible, no new activities are planned or constructed along or within the following predicted (2035) noise impact contours.

Noise associated with the construction of the Preferred Alternative is difficult to predict. Heavy machinery, the major source of noise in construction, is constantly moving in unpredictable patterns. However, construction normally occurs during daylight hours when occasional loud noises are more tolerable. None of the receivers are expected to be exposed to construction noise for a long duration; therefore, any extended disruption of normal activities is not expected. Provisions will be included in the plans and specifications that require the contractor to make every reasonable effort to minimize construction noise through abatement measures such as work-hour controls and proper maintenance of muffler systems. A copy of this traffic noise analysis will be made available to local officials to ensure, to the maximum extent possible, future developments are planned, designed, and programmed in a manner that would avoid traffic noise impacts. On the date of approval of the FEIS (Date of Public Knowledge), Brazoria and Galveston Counties and TxDOT are no longer responsible for providing noise abatement for new development adjacent to the Preferred Alternative.

7.5 WATER QUALITY

7.5.1 Surface Water

Water quality impacts of the Preferred Alternative would include highway and bridge runoff, construction-related impacts, and maintenance-related impacts. Long-term operational effects on surface water quality would entail changes in the volume of stormwater runoff and constituents carried in the runoff. Runoff from the Preferred Alternative could contain sediment or pollutants in quantities that could impact water quality. To offset potential adverse impacts, stormwater BMPs (e.g., grass-lined swales and detention/retention facilities) would be implemented to mitigate the changes in stormwater runoff. The combination of BMPs implemented for the Preferred Alternative would minimize adverse effects of stormwater runoff to surface water quality.

The Preferred Alternative would disturb more than 1 acre of land, thereby requiring the preparation of a SW3P. In addition, because the Preferred Alternative would disturb more than 5 acres, an NOI for coverage under the TPDES Construction General Permit (CGP) would also be required. Once construction has been completed, a Notice of Termination would be filed per permit requirements. Lastly, in accordance with Clean Water Act Section 402, where stormwater runoff would discharge to a Municipal Separate Storm Sewer System (MS4), the MS4 permittee would be notified of the construction activity. In addition, TxDOT will coordinate the county floodplain administrator prior to construction activities.

Guidance documents, such as TxDOT's *Storm Water Management Guidelines for Construction Activities*, discuss temporary erosion control measures to be implemented to minimize impacts to water quality during construction. Prior to construction of the proposed project, TxDOT would coordinate with the TCEQ regarding Geisler Bayou, which is on the 303(d) List of impaired water bodies.

Discharges of dredged or fill material into waters of the U.S. regulated by the USACE would require authorization through evaluation of a Department of the Army permit. Under Section 401 of the Clean Water Act, the TCEQ regulates water quality for waters of the state. Permit applications for USACE-regulated waters are a joint application with the TCEQ for evaluation of project impacts to water quality. Therefore, potential impacts to water quality would be reviewed by the TCEQ during evaluation of the Department of the Army permit submitted to the USACE for the Preferred Alternative.

7.5.2 Groundwater

During final design of the Preferred Alternative, measures such as minor alignment shifts to minimize or avoid impacts to public or private water wells would be evaluated. Water wells directly impacted by the Preferred Alternative would be plugged and abandoned according to TCEQ regulations. A stormwater management plan would be developed to reduce the risk of contaminating local aquifers. Stormwater BMPs would be implemented during construction and operation of the Preferred Alternative to minimize the potential introduction of erosion and sedimentation materials, particulates, and contaminants from affecting regional groundwater resources.

7.5.3 Public Drinking Water Systems

As stated above, water wells within the Preferred Alternative ROW would be plugged and abandoned according to TCEQ regulations to eliminate the potential for impacts to groundwater resources. Implementation of a stormwater management plan and BMPs for construction and operation of the Preferred Alternative would avoid stormwater runoff from entering groundwater aquifers at wellheads.

7.6 WETLANDS AND OTHER WATERS OF THE U.S.

7.6.1 Navigable Waters of the U.S.

Navigable waters (i.e., waters that are subject to the ebb and flow of the tide) are limited to Geisler Bayou in the eastern portion of the Preferred Alternative. Coordination with the U.S. Coast Guard would be initiated prior to construction to authorize bridge structures over the navigable waters of Geisler Bayou under the General Bridge Act and Section 9 of the Rivers and Harbors Act. Coordination with the USACE would be required to authorize the discharge of any fill material from the Preferred Alternative into Section 10 waters associated with bridge construction or culvert installation.

7.6.2 Waters of the U.S., Including Wetland Mitigation

Efforts were made during the planning stages of the Preferred Alternative to avoid impacts to waters of the U.S. The efforts would continue during final design. Larger waters of the U.S. traversed by the Preferred Alternative, such as Chocolate, Dickinson, Geisler, and Mustang bayous, would likely be bridged, and smaller waters of the U.S. would either be bridged or placed within culverts. Construction of bridges and culverts to convey normal and stormwater flows through stream channels and drainage-ways may involve discharges of dredged or fill material below the plane of ordinary high water or below the elevation of mean higher high water. An accurate quantification of required discharges would be identified following final design.

Such discharges would require authorization from the USACE and U.S. Coast Guard, as appropriate. A permit application submitted to the USACE would include proposed mitigation to compensate for impacts to the identified streams and drainage-ways. The USACE's stream assessment procedure would be used to identify stream functions and services, which would serve as the basis for the development of compensatory mitigation to be considered as part of permit evaluation. Mitigation for stream impacts would likely be accomplished through the purchase of stream credits from an approved mitigation bank. Natural resource agencies would be involved in the review of the permit application and the proposed compensatory mitigation plan.

Similar to waters of the U.S., efforts were made during the planning stages of the seven Alternative Alignments and the Preferred Alternative to avoid impacts to wetlands. However, the distribution of wetlands within the Preferred Alternative ROW and the geometric configuration of the proposed highway's design made complete avoidance impractical. Construction of the Preferred Alternative would unavoidably impact wetlands. To the extent practicable, impacts to wetlands would be minimized during final design. The discharge of dredged or fill material into wetlands determined to be regulated by the USACE (jurisdictional wetlands) would require authorization under a Department of the Army permit. An accurate determination of the location and extent of jurisdictional wetlands, and the functions and services provided by the identified wetlands, would be made following final design. The Department of the Army permit application would include proposed mitigation to compensate for the lost functions and services. Compensation would likely be accomplished through the purchase of wetlands credits from a mitigation bank approved by the USACE. Natural resource agencies would be involved in the review of the permit application and the proposed compensatory mitigation.

Following final design of the Preferred Alternative, an assessment of impacts to jurisdictional waters of the U.S., including wetlands, from stream and drainageway crossings and fill and grading activities would be conducted to determine an accurate measurement of anticipated impacts. The impacts would be analyzed relative to the limitations of applicable permits within the USACE's nationwide permit program. If anticipated impacts exceed the limitations of permits within the nationwide permit program, a Department of the Army individual permit would be required. Any permit application submitted to the USACE would include a mitigation plan to compensate for unavoidable adverse impacts to jurisdictional waters of the U.S., including wetlands. Water quality certification as required by Section 401 of the Clean Water Act would be assessed by the TCEQ as part of the Department of the Army permit review process.

7.7 VEGETATION AND WILDLIFE

7.7.1 Vegetation

Construction of the Preferred Alternative would unavoidably impact vegetative communities. An analysis of the vegetation types as mapped by the TPWD's EMST revealed that discrepancies exist between the EMST-mapped vegetation types and vegetation directly observed or interpreted from aerial photography within the Preferred Alternative ROW. Based on the reclassified vegetation types, impacts would occur primarily to agricultural, disturbed prairie, and urban communities, as these communities comprise approximately 89 percent of the vegetation within the Preferred Alternative. The Preferred Alternative

would also impact agricultural drainage and irrigation ditches, mixed woodlands and forest, and riparian communities, but these would be smaller components of the overall vegetation within the Preferred Alternative. Construction activities would permanently remove these vegetation communities and replace each with impervious surface and maintained herbaceous species. The FEIS serves as Administrated Coordination with TPWD for the proposed SH 99 Segment B. Additional Tier II Site Assessment information would be obtained as access to the Preferred Alternative ROW becomes available.

During construction, areas of exposed soil within the Preferred Alternative ROW would be revegetated with herbaceous species to minimize the introduction of eroded materials into receiving waters. Following construction, landscaping of the Preferred Alternative would be in accordance with Executive Order 13112 on invasive species and the Executive Memorandum on beneficial landscaping. Vegetation within the Preferred Alternative ROW would be maintained according to standard TxDOT practices.

7.7.2 Wildlife

Construction of the Preferred Alternative would unavoidably impact vegetative communities that provide habitat for wildlife. Wildlife displaced from the construction area would be expected to move to similar habitat areas outside the Preferred Alternative ROW. The influx of additional individuals of wildlife species into nearby similar habitat may stress existing food and other resources. The increased stress on limited habitat resources could result in mortality of some wildlife during the time that a carrying capacity equilibrium would be established. Potential impacts to wildlife would be mitigated through the construction of bridge structures over streams and drainage-ways or the installation of culverts to provide wildlife the opportunity to travel under the Preferred Alternative, rather than pass over the roadway and be exposed to possible predation or vehicle collisions. Landscaping the Preferred Alternative with native vegetation and developing a maintenance mowing schedule that would allow for the reseeding of native species would benefit wildlife able to use the herbaceous habitats outside the paved areas of the Preferred Alternative ROW.

Impacts to wildlife and habitat resources can be minimized through the use of a combination of any of the following generally recommended methods or other BMPs not specifically identified below, but that may be appropriate to address unanticipated site conditions.

- Minimize the crossing of flowing streams and utilize bridge spans to the greatest extent (as opposed to fill) to minimize impacts on riparian and aquatic communities.
- Have the ROW surveyed to identify significant wildlife areas, high quality vegetation, and sensitive features, such as caves, springs, and colonial nesting areas.
- Particularly dangerous wildlife crossings (i.e., where culverts, bridge spans, etc., are not practicable) can be fenced to divert wildlife through wooded areas along the ROW to culverts or bridge spans where crossings can be more safely made.
- Limit the use of herbicides and other chemicals for ROW maintenance.

- In accordance with Executive Order 13112 on invasive species and the Executive Memorandum on beneficial landscaping, landscaping would be limited to seeding and or planting of the ROW with native species of grasses, shrubs, or trees. Soil disturbance would be minimized to ensure that invasive species would not establish in the ROW.
- Schedule mowing for ROW maintenance to facilitate the natural reseeding of indigenous spring and autumnal herbaceous communities.
- Thoroughly clear areas identified as harboring oak wilt infestation and properly dispose of all plant material. All working surfaces (e.g., blades and buckets) of equipment used in clearing and grading such areas are to be cleaned with a strong bleach or chlorine (hypochlorite) solution prior to use in other areas.
- Minimize the use of construction haul work roadways and minimize construction traffic impact areas. Work road areas would be restored following construction to as good as or better than conditions that existed prior to construction.
- Because of safety requirements, no trees can be left within 30 feet of the roadway without roadside protection. Trees outside the safety zone that are not affected by construction would be preserved.
- If nesting or wintering migratory bird species or rookeries are identified on or along the route, deferring especially loud or noisy activities in the adjacent areas until after the birds have left the area would reduce negative impacts to the species.

The FEIS serves as Administrated Coordination with TPWD for the proposed SH 99 Segment B. Additional Tier II Site Assessment information would be obtained as access to the Preferred Alternative ROW becomes available. The information would be used to assess potential impacts to wildlife species or loss of habitat associated with the Preferred Alternative. If necessary, coordination would also be conducted with the USFWS.

7.8 MIGRATORY BIRD TREATY ACT

The Migratory Bird Treaty Act of 1918 states that 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 Tier II Site Assessment, as required by the TxDOT/TPWD 2013 MOU, would be conducted when access to the Preferred Alternative ROW is available to determine if suitable migratory bird habitat occurs within the Preferred Alternative ROW. The FEIS serves as Administrated Coordination with TPWD for the proposed SH 99 Segment B. Once right-of-entry is obtained, a cursory nest survey would be conducted by qualified personnel prior to construction. To avoid impacts to migratory birds, any active breeding areas found during the cursory survey would be avoided entirely during the breeding season of any migratory birds identified within the study area. In accordance with the Migratory Bird Treaty Act, no vegetation would be removed containing nests, eggs, or young should clearing occur during the nesting and breeding season. If a nest, eggs, or young of a ground-dwelling bird is observed before or during construction, the participating

agencies would be notified, and steps would be taken to avoid impacts to the bird and the nest. Every effort will be made to prevent migratory birds from nesting in the study area during the breeding season.

7.9 THREATENED AND ENDANGERED SPECIES

According to TPWD's TXNDD, two SGCN (Texas windmill-grass and southern crawfish frog) have been recorded as potentially occurring within 1.5 miles of the Preferred Alternative ROW. Potential habitat for the state threatened bald eagle, white-faced ibis, white-tailed hawk, wood stork, smooth pimpleback, Texas fawnsfoot, alligator snapping turtle, timber/canebreak rattlesnake, and SGCN southern crawfish frog, black rail, Henslow's sparrow, Sprague's pipit, American eel, plains spotted skunk, coastal gayfeather, Correll's false dragonhead, giant sharpstem umbrella-sedge, Texas meadow rue, Texas windmill grass, and threeflower broomweed may occur in the proposed SH 99 Segment B study area. The state endangered Eskimo curlew, the state-threatened American peregrine falcon, and SGCN Arctic peregrine falcon, snowy plover, and Western snowy plover may occur in the study area as potential migrants.

There have been no other recorded occurrences of federal or state-listed species in close proximity to the Preferred Alternative ROW. The FEIS serves as Administrated Coordination with TPWD for the proposed SH 99 Segment B. Additional Tier II Site Assessment information would be obtained as access to the Preferred Alternative ROW becomes available. The information would be used to assess potential impacts to threatened and endangered species or loss of habitat associated with the Preferred Alternative ROW. No impacts to threatened or endangered species are anticipated. Prior to construction of the Preferred Alternative, surveys for listed species or their preferred habitat would be conducted to ensure the Preferred Alternative would have no effect on the listed species. Should a listed species be identified within the Preferred Alternative ROW, coordination the USFWS and TPWD would be initiated, and species-specific mitigation strategies would be developed to avoid, minimize, and/or compensate for potential impacts to a threatened or endangered species.

7.10 FLOODPLAINS

The Preferred Alternative would traverse areas mapped by FEMA as special flood hazard areas (i.e., floodways, 100-year floodplains, and 500-year floodplains). A Tier II Site Assessment, as required by the TxDOT/TPWD 2013 MOU, would be conducted when access to the Preferred Alternative ROW is available to assess potential impacts to flood hazard areas associated with the Preferred Alternative. The FEIS serves as Administrated Coordination with TPWD for the proposed SH 99 Segment B. A hydraulic study would be performed for the Preferred Alternative during final design to determine areas where bridges, culverts, or other cross-drainage structures would be required. Federal, state, and local authorities would have the opportunity to review the hydraulic study to verify that appropriate measures have been identified so as not to increase the flood risk to adjacent properties. Bridges, culverts, and cross-drainage structures would be designed to FHWA and TxDOT standards to accommodate the 100-year storm event, periods of high flows, and sheetflow without impacting upstream or downstream areas. BMPs, such as the construction of grass-lined swales and detention/retention facilities, would be incorporated into the final design of the Preferred Alternative to offset increased flows from areas of impervious surface. Hydraulic

design features incorporated into the Preferred Alternative would be in accordance with current FHWA and TxDOT design policies and standards. Construction of the Preferred Alternative would be in compliance with county and local floodplain guidelines and policies.

7.11 COASTAL ZONE MANAGEMENT PLAN AND ESSENTIAL FISH HABITAT

The Preferred Alternative would traverse Geisler Bayou, which is identified in the TCEQ's Texas Water Quality Inventory as a tidal water. Construction of bridge or culvert crossings of Geisler Bayou may potentially impact essential fish habitat. Coordination with the National Marine Fisheries Service was in initiated on October 1, 2015 and is still in progress (***Appendix E***). Following final design of the Preferred Alternative, potential impacts to essential fish habitat would be identified. Impacts to the tidal waters of Geisler Bayou within the proposed ROW of the Preferred Alternative would be avoided to the extent practicable; however, should potentially adverse impacts to essential fish habitat be identified, additional coordination with the National Marine Fisheries Service would be conducted as part of the required coordination process.

7.12 ARCHEOLOGICAL

Only 30 percent of the Preferred Alternative ROW was available for examination of archeological resources. Of the 30 percent of the APE that was examined for cultural resources, no further archaeological work is recommended. However, investigation should still occur in those portions of the study area where right-of-entry was not granted prior to construction. Additionally, once the state has taken ownership of the Preferred Alternative ROW, backhoe work should be conducted within the areas the PALM model recommends for deep reconnaissance.

If archeological materials or human remains are identified within the proposed ROW of the Preferred Alternative during construction or a department-designated material source, all construction and related activities must cease. The discovery will be reported to the TxDOT project inspector or the area engineer in accordance with TxDOT's Emergency Discovery Guidelines. If archeological materials or human remains are introduced into the Preferred Alternative ROW or easements in materials obtained from a material source under option to the contractor, all use of materials from this source must cease and the discovery reported to the TxDOT project inspector or the area engineer in accordance with TxDOT's Emergency Discovery Guidelines.

The archeological survey report is currently being reviewed and coordinated with SHPO and the THC. TxDOT will ask for THC's concurrence to defer the remainder of the survey to allow the NEPA process to continue and for property to be acquired. TxDOT will be obligated to complete the survey and coordinate the results with THC once the remainder of the Preferred Alternative ROW has been acquired

7.13 HAZARDOUS MATERIALS

Construction of the Preferred Alternative could have additional impacts on potential hazardous materials sites. However, risks can be minimized by conducting a Phase I and II Environmental Site assessments in accordance with the ASTM standards to identify, avoid, and mitigate hazardous materials sites. It is anticipated that a Phase II Environmental Site Assessment would be required for each location, as well as

for any high or moderate risk sites that would be adjacent to the Preferred Alternative ROW identified in ***Section 4.17.1*** of the EIS. If hazardous materials are found during the construction phase, then TxDOT standard guidelines would be followed.

Asbestos and lead-based paint investigations for all structures impacted by the Preferred Alternative would be addressed during the ROW acquisition process prior to construction. If suspect material is encountered, a mitigation plan for the removal and disposal of materials containing hazardous materials would be developed in accordance with federal, state, and local regulations. The project's plans, specifications, and estimates would disclose areas of asbestos and lead-based paint that would be disturbed. Special provisions would be developed for asbestos-related activities, notifications, required licenses, and monitoring.

Numerous documented federal or state-regulated hazardous materials sites, as defined by the ASTM, were identified within the proposed ROW of the Preferred Alternative. The hazardous materials sources identified reflect the results of regulatory database queries provided by GeoSearch in 2014. The regulatory databases are maintained in electronic storage formats by federal and state agencies and contain geo-coded (geographic information system capable) information pertaining to a variety of hazardous materials releases or potential releases. The databases include EPA, TCEQ, and Railroad Commission of Texas listings of sites where hazardous materials are suspected to have been stored, used, and/or released to the environment. The federal and state databases that were reviewed are described in ***Section 3*** of the EIS. If an undocumented site is encountered during construction, a detailed evaluation would need to occur. Mitigation, if warranted, would depend on the type, size, and location of the encountered hazardous materials.

7.14 VISUAL AND AESTHETIC QUALITIES

Construction of the Preferred Alternative would introduce a new visual element into the landscape, altering the rural setting in the areas where the Preferred Alternative would not follow existing roadways and areas where the Preferred Alternative would be constructed adjacent to existing residential development. Visual and aesthetic changes would likely be most pronounced near intersections of the Preferred Alternative and existing roadways, where structures and associated lighting may be constructed. As currently proposed, lighting for the Preferred Alternative would be restricted to on-ramps and off-ramps and mainlane toll gantries. The lighting system would consist of low-impact, downward directional lighting. However, development outside the Preferred Alternative ROW would likely result in incremental and localized increases in ambient light levels, glare, and nightglow.

In addition to vegetated medians, visual and aesthetic measures that could be incorporated into the design of the Preferred Alternative may include design specifications to blend with the surrounding landscape and the use of native plant species and native wildflower plantings along the highway ROW to improve aesthetics and to control the introduction of invasive species.

7.15 CONSTRUCTION IMPACTS

The contractor would be required to take every reasonable step and follow mitigation procedures in accordance with state and local governing regulations to avoid or minimize construction impacts as detailed in ***Table 7-1***. During the construction phase, short-term effects related to noise and dust would be minimized. Traffic delays would be minimized through coordination between TxDOT, contractors, and affected neighborhoods or landowners (in the areas immediately adjacent to the proposed ROW) and by developing a construction schedule that would allow for a minimum delay for movement across the proposed ROW. Efforts would also be made to provide appropriate construction detours, informative signage, and maintenance of access to residences, farms, businesses, and community facilities where practicable. Potential development associated with the construction of the Preferred Alternative could have additional impacts on potential hazardous material sites. However, risks can be minimized by conducting a Phase I Environmental Site Assessment in accordance with ASTM standards to identify, avoid, and mitigate hazardous material sites. If hazardous materials are found during construction, TxDOT standard guidelines would be followed.

Storage and use of hazardous materials would be necessary during construction of the Preferred Alternative. Temporary aboveground storage tanks containing oil and diesel would typically be used to provide fuels for the equipment and vehicles used for construction. The aboveground storage tanks would be regulated and would require control measures for spills and leaks. Potential impacts could occur from small spills and leaks from fueling and maintenance of the equipment and vehicles. The impacts would likely be minimal and would not pose a substantial impact to the environment. Every effort would be taken to reduce related impacts during construction. Activities dealing with the use and storage of hazardous materials during construction would be required to conform to TxDOT standards for spill containment and control strategies.

Table 7-1: Measures Required to Avoid or Minimize Construction Impacts

Construction Related Impact	Contractor Mitigation Measure(s)
Air quality	Implementing dust control measures, such as the use of water sprinklers, and prohibiting open burning except in accordance with applicable laws and regulations would minimize impacts to air quality.
Water quality	Preparation of a SWPPP pursuant to TxDOT guidelines are to include berms, dikes, temporary seeding, sodding, sediment traps, geotextile fiber mats, silt fences, hay bales, slope drains, mulches, and crushed stone (TxDOT 2000). An emergency spill control pollution prevention plan would be developed and coordinated with local officials prior to construction. Avoidance measures would include spanning major drainages along the Preferred Alternative. A Section 404 nationwide or individual permit application would be submitted to the USACE following the FEIS or Record of Decision for the Proposed SH 99 Segment B during the design phase of the Preferred Alternative. A Section 401 Water Quality Certification would be coordinated with the TCEQ as a part of the USACE permit process. The contractor would be required to follow the permit conditions.
Noise	Timing of construction will take into account neighboring properties and appropriate “noise tolerant” periods. Use of mufflers on construction equipment near residential areas.

Table 7-1: Measures Required to Avoid or Minimize Construction Impacts

Construction Related Impact	Contractor Mitigation Measure(s)
Maintenance and control of traffic	Construction in a single geographic area would be limited to avoid inundating the adjacent communities with construction zones.
Health and safety	The contractor would comply with all federal, state, and local laws, including the Occupational Safety and Health Administration regulations governing safety, health, and sanitation of construction personnel and the general public.
Hazardous materials	If hazardous materials are discovered during the construction phase, TxDOT standard guidelines would be followed.
Pollution control on haul roads, borrow/material pits, and waste material disposal areas	The contractor is to implement a combination of erosion and pollution control measures listed under air and water quality control.

Source: SH 99 Segment B Study Team 2014.

Note: See the list of acronyms and abbreviations for a full listing of abbreviations used in the table.

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SECTION 8: AGENCY AND PUBLIC COORDINATION

Section 8 summarizes the agency coordination and public involvement process for the FEIS.

8.1 AGENCY COORDINATION

Contact with Agencies

As part of the proposed SH 99 Segment B project development process, a number of federal, state, and local government agencies were consulted prior to and during the preparation of the EIS. The following agencies were requested, by correspondence, to provide input on the proposed SH 99 Segment B and were invited to attend the proposed SH 99 Segment B information meetings (discussed in the next section).

Federal Government Agencies

Federal Highway Administration (FHWA)
Federal Transit Administration (FTA)
Interstate Commerce Commission
Natural Resources Conservation Service (NRCS)
U.S. Army Corps of Engineers (USACE)
U.S. Environmental Protection Agency (EPA)
U.S. Fish and Wildlife Service (USFWS)

State Government Agencies

Texas Department of Transportation (TxDOT)
Texas Turnpike Authority
Texas Historical Commission (THC)
Coastal Permit Service Center
Texas Parks and Wildlife Department (TPWD)
Homeland Security Defense
Texas Commission on Environmental Quality (TCEQ) (formerly known as Texas Natural Resource Conservation Commission)
Texas General Land Office
Texas Transportation Commission
Texas Department of Public Safety Hazard Mitigation

Local Government Agencies

Brazoria County
Brazos River Authority
City of Alvin
City of Dickinson
City of Friendswood
City of Iowa Colony
City of League City
City of Manvel
City of Pearland
City of Santa Fe
City of Texas City
Galveston County
Harris County Toll Road Authority (HCTRA)
Metropolitan Transit Authority of Harris County (METRO)
Houston-Galveston Area Council (H-GAC)
Port of Houston Authority

Meetings with Agencies

Prior to each public meeting, elected officials and agency representatives were mailed notifications of the upcoming public meetings and were invited to attend special briefing meetings prior to each public meeting. The following sections summarize the agency meetings that have been held to date.

August 7, 2002: Agency Kickoff Meeting (ACC)

The kickoff meeting briefed the agencies about the proposed SH 99 Segment B prior to the Public Scoping Meeting. The meeting also solicited input about specific environmental, engineering, drainage, and community issues. The information gathered during the meeting assisted the SH 99 Segment B Study Team in developing the material that was presented at the Public Scoping Meeting held on September 12, 2002. A total of 21 people attended the meeting, including representatives from Brazoria and Galveston Counties, Alvin, Friendswood, League City, H-GAC, and TPWD.

The meeting involved reviewing exhibits, providing introductions, and presenting a brief overview of the proposed SH 99 Segment B history, Study Team, schedule, the upcoming scoping meeting, meeting goals, and designation of agency contacts. The attendees then broke into four separate focus groups (i.e., drainage, environmental, engineering, and community) to discuss issues and concerns. The primary points of discussion in each focus group were as follows.

Drainage

Study Area

- Alternative roadway alignments within the southern portion of the proposed SH 99 Segment B study area or incorporating a slight southern extension on the west end of the study area would meet less neighborhood/residential resistance.
- A possible crossing of Chocolate Bayou could be south of SH 35 or north of SH 35, near the southern boundary of the study area.

Regional Issues/Concerns

- Major water crossings (e.g., Chocolate Bayou) would need to be coordinated with Brazoria County drainage improvements.
- The SH 99 Segment B Study Team should be aware of a city's dumps and the various subdivision locations.

Policy and Procedures

- The SH 99 Segment B Study Team should review the Drainage Master Plan for Brazoria County.
- The SH 99 Segment B Study Team should review the Drainage Criteria Manual for Brazoria County.

Environmental

- Alternative roadway alignments should avoid riparian habitat along Chocolate Bayou.
- Alternative roadway alignments should avoid relic prairie west of Alvin and at other locations. (It was not definitely known at that time whether relic prairie existed in the study area.)
- The preferred crossing of Chocolate Bayou is at FM 1462.

- Alternative roadway alignments should avoid "potential" swallow-tailed kite habitat.
- Alternative roadway alignments should use existing roadways.
- Alternative roadway alignments should avoid wetlands (both directly and indirectly) (i.e., draining).
- The SH 99 Segment B Study Team should show prairie and other sensitive habitat on the constraints map.
- There are no known new laws or regulations.
- The SH 99 Segment B Study Team should expand the study area northeast to include SH 96.

Engineering

- The study area should be out of the storm surge.
- A potential corridor exists at FM 646 and IH 45 South.
- There is an agreement with the five cities on Dickinson Bayou.
- Grade separations are needed at SH 6, SH 35, and FM 517.
- The SH 99 Segment B Study Team should review Brazoria County's *Major Thoroughfare Plan* when the plan is released.

Community

Study Area

- The SH 99 Segment B Study Team should consider extending the study area south to CR 51 because of the possible auto race track covering 2,880 acres southeast of SH 288 and FM 1462.

Regional Development Issues

- Additional development is planned north of FM 1462.
- Alternative roadway alignments should avoid the Savannah Plantation Residential Development.
- Alternative roadway alignments should avoid single-family residential areas and the runway/airfield north of FM 1462.
- The Alvin landfill has +/-177 acres.
- The Briscoe family has extensive property holdings.
- Reliant Power has transmission lines throughout the study area.
- Most development is around CRs.
- The SH 99 Segment B Study Team should consider future planned developments that could impact ROW costs.
- Many small parcels exist in the study area.

- Iowa Colony objects to any alternative roadway alignment that impacts its area.
- The Bay Colony Development is near IH 45 South.
- Owners of large land tracts may donate ROW.

Alignment Alternatives

- The SH 99 Segment B Study Team should consider an alternative roadway alignment that merges with FM 1462 in the western portion of the study area.
- The SH 99 Segment B Study Team should consider alternative roadway alignments north and south of Alvin.
- Alternative roadway alignments should tie in to FM 1462 and SH 35 around Alvin.
- The evacuation route should be above the 100-year floodplain.
- Frontage roads are needed if using existing roadways.
- A realignment of SH 99 Segment C should be considered to FM 1462 away from CR 60.
- The SH 99 Segment B Study Team should be aware of a railroad underpass on existing SH 35 east of Alvin.
- League City is considering two possible routes west of IH 45 South, with a preference for a southerly route.
- If a southerly route around Alvin is not acceptable, the SH 99 Segment B Study Team should consider a route north of Alvin.
- The SH 99 Segment B Study Team should consider commuters from the southern areas of Brazoria County, such as Angleton, Lake Jackson, and Freeport, that would want access to IH 45 South.
- ROW for FM 646 at IH 45 South has been preserved.
- Brazoria County would like a route south of Alvin to be considered.
- SH 35 around Alvin could be developed as a freeway.
- A toll road-type facility would impact routing choice.

September 12, 2002: Public Scoping Meeting Briefing (ACC)

On the day of the Public Scoping Meeting, two separate sessions were held for elected officials (from 11 a.m. to 1 p.m.) and agency representatives (from 2 p.m. to 4 p.m.). Attendees were briefed on the information that would be presented to the public and encouraged to offer comments. A total of 32 people attended the elected officials session, including 14 elected officials, nine agency representatives, four Sierra Club members, three citizens, and two members of the media. The agency session was attended by 23 people, including 18 agency representatives, three citizens, one elected official, and one Sierra Club member.

January 21, 2003: Development Advisory Committee (Alvin City Hall)

Many of the comments received at the Scoping Meeting focused on existing and future community development impacts. Comprised of county, city, TxDOT, H-GAC, and economic development agency representatives, a Development Advisory Committee was created to review forecasts and analyses prepared by the Study Team for use in determining direct, indirect, and cumulative impacts that the seven Alternative Alignments would have on cities/communities within the study area and the surrounding region. Attendees of the meeting included representatives from Brazoria County, Alvin, Friendswood, League City, and H-GAC.

February 25, 2003: Public Workshop Briefing (ACC)

The GPA and the SH 99 Segment B Study Team conducted individual meetings with USACE, TPWD, Brazoria and Galveston Counties, and the various cities/communities within the study area prior to the Public Workshop on February 25, 2003. For those who could not meet with the SH 99 Segment B Study Team prior to the Public Workshop, the agencies and elected officials were invited to attend either of the two Public Workshop sessions from 2 p.m. to 4 p.m. and from 6 p.m. to 8 p.m. A total of 23 agency representatives and 10 elected officials attended the early session, and three agency representatives and one elected official attended the evening session.

8.2 PUBLIC INVOLVEMENT

Communication with Public

Throughout the preparation of the Draft and FEIS, an effort has been made to locate, inform, and seek input from interested individuals and organized groups. The effort involved the issuance of public notices and conducting a Public Scoping Meeting and Public Workshop. An initial SH 99 Segment B mailing list of approximately 1,000 persons was researched and developed to distribute mailed notification of the Public Scoping Meeting. Those who had attended the public meetings, submitted correspondence, or requested to be added to the list increased the mailing list to approximately 1,900 people. Those on the mailing list have and will continue to receive all public notices regarding the proposed SH 99 Segment B, including notice of the Public Hearing.

Newsletters

Two weeks prior to the Public Scoping Meeting and Public Workshop, a SH 99 Segment B newsletter was sent to everyone on the mailing list to inform and update them about the proposed SH 99 Segment B and invite them to the public meeting. A second newsletter was prepared and mailed after the September 12, 2002, Public Scoping Meeting to recap the meeting, provide an update on study progress and schedule of the proposed SH 99 Segment B, announce the creation of the Development Advisory Committee, and inform readers of the upcoming Public Workshop on February 25, 2003. A third newsletter was prepared and mailed after the February 25, 2003, Public Workshop to the entire mailing list to update the study progress and schedule of the proposed SH 99 Segment B, to update the status of toll road concerns, and to recap the Public Workshop. The third newsletter also included an overview of alterations to the three recommended Alternative Alignments, which resulted from comments received at the Public Workshop.

Advertising

As required by 40 CFR 1508.22, a formal Notice of Intent (NOI) was printed in the Texas Register and Federal Register 30 days prior to the Public Scoping Meeting. Public legal notices were placed in the *Houston Chronicle* 30 and 10 days prior to the Public Scoping Meeting and Public Workshop. Additionally, display advertisements were placed in *The Galveston County Daily News* and *The Alvin Sun-Advertiser* approximately 2 weeks prior to both the Public Scoping Meeting and Public Workshop. There were no local papers within the proposed SH 99 Segment B study area for distribution of public notices in other languages.

A Notice of Availability (NOA) was published in the Texas Register and Federal Register on June 29, 2012, informing the public of the availability of the Draft EIS. Public legal notices were placed in the *Houston Chronicle* 30 and 10 days prior to the Public Hearing. Additionally, display advertisements were placed in *The Galveston County Daily News*, *The Alvin Sun-Advertiser*, the *Bay Area Citizen*, and Pearland/Friendswood journals approximately 30 and 10 days prior to the Public Hearing. A display advertisement in Spanish was placed in *La Subasta Newspaper* on August 8, 2012.

Website

The GPA established a website (www.grandpky.com) to provide information and updates on all of the segments of the Grand Parkway. Information posted for Segment B entailed proposed SH 99 Segment B status, maps, newsletters, environmental documents, public meeting dates, and Public Hearing dates. Visitors to the website could also request to be added to the SH 99 Segment B mailing list.

Public Meeting Summaries

The following summarizes public and small group meetings held for the proposed SH 99 Segment B.

September 12, 2002: Public Scoping Meeting (ACC)

The first public meeting for the proposed SH 99 Segment B was a Public Scoping Meeting. The purpose of the meeting was to introduce the proposed SH 99 Segment B and present the proposed SH 99 Segment B's purpose, process, objectives, and preliminary study area. The meeting also provided the public with an opportunity to identify specific concerns and opinions prior to further study. Attendance exceeded 300 people. Attendees of the open house meeting (from 5 p.m. to 8 p.m.) viewed a video presentation describing the proposed SH 99 Segment B's objective, study process, and schedule. Attendees were then encouraged to review the exhibits and talk with the SH 99 Segment B Study Team. Attendees were also encouraged to complete and submit written comment forms provided at the meeting or send their comments in by mail or email.

Overall, the feedback received was positive. Most agreed that a new transportation option was needed in the area, particularly as an emergency evacuation route; however, many expressed concerns about how the proposed SH 99 Segment B would affect their communities. The most common concerns included air quality and noise issues, displacements/relocations, drainage and flooding, traffic impacts, and preservation of wildlife and historical/cultural landmarks.

In addition to identifying issues of concern, many also offered specific suggestions for possible transportation routes, including ways to facilitate evacuation and minimize displacement of homes and businesses. Based on input received, the southern border of the study area was expanded slightly, and SH 96 was included as a possible eastern terminus.

February 25, 2003: Public Workshop (ACC)

Approximately 180 people attended the public meeting held in two identical open house Public Workshop sessions from 2 p.m. to 4 p.m. and from 6 p.m. to 8 p.m. The primary purpose of the workshops was to present and receive input on the preliminary alternative roadway alignments. Attendees viewed a brief video presentation describing the proposed SH 99 Segment B's objective, study process, schedule, and status. Exhibits included descriptions of modal alternatives, maps displaying the alternative roadway alignments being studied during the preliminary analysis, and the three recommended initial Alternative Alignments. Other exhibits outlined evaluation criteria by which the alternative roadway alignments were compared.

More than 90 comments were received during the Public Workshop's official comment period, which extended 2 weeks following the workshop. Comments were collected at the workshop and were received via mail, email, fax, and in person. As a result of the public comments and input received from local, state, and federal agencies and officials, alterations were made to the alternative roadway alignments to better serve the community.

September 26, 2003 and October 4, 2003: Freeman Community Group Meetings

There were two meetings with various community groups near the FM 1462 area organized by Ms. Willie Mae Freeman to discuss possible changes to the Central Alternative.

August 21 and 23, 2012: Public Hearing (Alvin High School and Johnnie Arolfo Civic Center)

A Public Hearing was held over two nights to solicit comments related to the environmental impacts presented in the Draft EIS. During both meetings, an open house session was conducted from 6 p.m. to 7 p.m., allowing attendees to view exhibit boards and maps. The boards presented the study area; the environmental evaluation of the seven Alternative Alignments; the need, purpose, and schedule of the proposed SH 99 Segment B; a proposed typical section; and how to provide comments. The maps presented the seven Alternative Alignments evaluated to arrive at the Preferred Alternative. The open house session also gave attendees the opportunity to visit with the SH 99 Segment B Study Team. Copies of the Draft EIS were available for review or purchase, and representative of TxDOT's ROW Department were available to provide information and to answer questions regarding TxDOT's property acquisition process.

The Public Hearing, which began at 7 p.m., included a presentation of the proposed SH 99 Segment B and a summary of the findings of the Draft EIS. The presentation reviewed information displayed on the open house boards and provided additional detail about the environmental evaluation and the Preferred Alternative. A public comment period followed the presentation, and a court reporter recorded a transcript

of the presentation and the verbal public comments. Following adjournment of the Public Hearing, the public was invited to return to the open house area to speak with the SH 99 Segment B Study Team.

Attendees had the opportunity to submit written comments using the comment form provided at the Public Hearing or could voice verbal comments made to the court reporter. Written comments could also be mailed or emailed during the comment period, which ended on September 26, 2012. Over 160 people attended the Public Hearing. A total of 53 individuals/entities provided verbal or written comments at the Public Hearing or via mail or email during the comment period. Comments and concerns expressed by the commenting individuals/entities were compiled, and responses were prepared. The comments and responses are included in Section 9, Comments of the Public Hearing Summary Report located in ***Appendix H***.

8.3 ADDITIONAL AGENCY COORDINATION AND PUBLIC INVOLVEMENT ACTIVITIES

Listed below is additional agency coordination and public involvement activities with other communities, resource agencies, elected officials and public offices, and local/regional news outlets conducted throughout the Draft and FEIS phases.

Whispering Pines Meetings

03-23-03 Presented at the Whispering Pines neighborhood meeting

06-29-03 Presented at the Whispering Pines neighborhood meeting

Other Community Meetings

10-04-03 Presented to a homeowner-called property owners' meeting

01-05-04 Attended the Alvin Segment B Meeting at the Senior Citizen Center

05-12-04 Participated in the Brazoria County Realtor Event as requested by the Savannah Plantation Residential Development at the Brazoria County Courthouse hosted by Judge John Willy

Resource Agencies

02-11-03 Met with John Machol, USACE Galveston District Operations Manager

02-20-03 Met with Andy Sipocz, TPWD Biologist; Woody Woodrow, TPWD Coastal Conservation Program Director; and Edith Erfling, USFWS Field Supervisor

01-07-04 Met with John Isaacs and Andy Hogan of Brazoria County Drainage District #5

02-15-07 Met in Austin with TxDOT ENV, TxDOT (Houston District), FHWA, and the Office of the Attorney General regarding TxDOT (Houston District)'s concern related to timely review of the environmental process and approval by reviewing agencies

Elected Officials and Local/Regional Offices

01-23-03 Presented to the Bay Area Transportation Partnership Long Range Planning Committee in League City

01-23-03 Met with Jim Clawson, Brazoria County Commissioner for Precinct 2; Donald "Dude"

	Payne, Brazoria County Commissioner for Precinct 1; and Brazoria County Judge John Willy
01-24-03	Met with Ken Clark, Galveston County Commissioner for Precinct 4
02-03-03	Met with the Manvel mayor and other city officials
02-05-03	Met with the Alvin mayor and other city officials
02-06-03	Met with the League City mayor
02-11-03	Met with the Dickinson mayor
02-19-03	Met with the Friendswood mayor and other city officials
02-20-03	Presented to the Bay Area Transportation Partnership Board of Directors
04-07-03	Met with Chuck Herrington, City Manager of League City
05-19-03	Met with Jim Clawson, Brazoria County Commissioner for Precinct 2
05-20-03	Met with Senator Mike Jackson's office
06-19-03	Met with Ken Clark, Galveston County Commissioner for Precinct 4, to deliver the map of alternatives
08-11-03	Updated a presentation to the Brazoria County Commissioners' Court
08-18-03	Met with Paul Horn, City Manager of Alvin
08-20-03	Met with Mike Fitzgerald, Galveston County Engineer
08-29-03	Met with Mike Fitzgerald, Galveston County Engineer
10-01-03	Presented to the Friendswood Economic Development Council
10-16-03	Met with Cathy Laney representing Jim Clawson, Brazoria County Commissioner for Precinct 2
10-17-03	Met with Paul Horn, City Manager of Alvin
11-03-03	Met with Jack Harris, Brazoria County Commissioner for Precinct 3
11-04-03	Attended the Alvin County Transportation Committee Meeting
11-06-03	Met with Brazoria County Judge John Willy and Larry Stanley, Brazoria County Commissioner for Precinct 4
11-06-03	Presented to the Friendswood Chamber of Commerce
11-13-03	Presented to the Alvin Rotary Club
12-10-03	Met with Larry Stanley, Brazoria County Commissioner for Precinct 4, and Donald "Dude" Payne, Brazoria County Commissioner for Precinct 1
01-15-04	Met with Congressman Tom DeLay's office regarding a disgruntled landowner
02-25-04	Met with Texas House of Representative Glenda Dawson, Precinct 29
02-25-04	Attended the Brazoria County Commissioners' Court Public Meeting
03-01-04	Met with Paul Horn, City Manager of Alvin
03-24-04	Met with Brazoria County Judge John Willy
03-31-04	Met with State Representative Dennis Bonnen, District 25
07-11-05	Met with Jack Murphy, City Engineer for League City
08-23-05	Presented to the Bay Area Transportation Partnership's Board of Directors
10-17-05	Met with Brazoria County Judge John Willy; Kent Burkett; Larry Stanley, Brazoria County Commissioner for Precinct 4; and Gerald Roberts, Brazoria County Engineer
02-10-06	Met with Ken Clark, Galveston County Commissioner for Precinct 4

02-13-06	Met with Eddie Janek, Galveston County Commissioner for Precinct 2
09-28-06	Met with Paul Horn, City Manager of Alvin, and Jim Heacock, TxDOT (Houston District), regarding the SH 35 Corridor Study and the proposed connection of SH 99 to SH 35
11-29-06	Met with Mike Fitzgerald, Galveston County Engineer
09-20-07	Met with Paul Horn, City Manager of Alvin
11-20-07	Met with the League City Chamber of Commerce regarding Patrons of the Park Foundation issues
04-28-08	Met with Bryan Lamb, Galveston County Commissioner of Precinct 2, in Texas City
04-29-08	Met with Mike Fitzgerald, Galveston County Engineer, in League City
06-17-08	Met with Carol Nixon of Gunda Corp and others regarding the *Lake Houston State Park Transportation Plan*
11-10-09	Presented to the League City Economic Development Corporation regarding updates
02-04-10	Met with Senator Mike Jackson's office regarding updates
02-08-10	Presentation to Galveston County Commissioners' Court regarding updates
05-02-11	Met with Matthew Sebesta, Brazoria County Commissioner for Precinct 2
11-02-12	Met with Gerald Roberts, Brazoria County Engineer, regarding updates
12-30-13	Met with Stacy Adams, Brazoria County Commissioner
02-26-14	Met with Matt Hanks, Brazoria County Engineer and Michael Shannon, Assistant Brazoria County Engineer
03-24-214	Met with Linc Wright, League City Engineer

Local and Regional News Affiliates

02-20-03	Telephone interview with Carlos Armintor, *The Brazoria Facts*
02-26-03	Telephone interview with Carlos Armintor, *The Brazoria Facts*
03-03-03	Telephone interview with Kim Strube, *Pearland Reporter*
03-24-03	Telephone interview with Carlos Armintor, *The Brazoria Facts*
03-31-03	Telephone interview with Kelly Hawes, *The Brazoria Facts*
06-18-03	Television interview with Mike Zientek of KHOU-TV Channel 11
06-18-03	Telephone interview with Ted Streuli, *Galveston Daily News*
08-20-03	Face-to-face interview with Michael Clements, *Texas City Sun*
10-08-03	In-house interview with reporter Richard Stewart of the *Houston Chronicle*, Brazoria County Bureau
11-19-03	Telephone interview with Garrett Bryce, *The Alvin Sun-Advertiser*
03-26-04	Telephone interview with Corey Mitchell, *The Baytown Sun*
07-07-04	Telephone interview with Louis Garrett, *The Alvin Sun-Advertiser*

SECTION 9: LIST OF PREPARERS

TEXAS DEPARTMENT OF TRANSPORTATION (TxDOT) – HOUSTON DISTRICT	
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Dr. Stanley W. Cooper Environmental Coordinator	B.S. and M.S. in Biology and a Ph.D. in Zoology, specializing in Animal Behavior and Ecology, with 16 years of experience in NEPA, wetland delineation, permitting, and noise analysis.
TEXAS DEPARTMENT OF TRANSPORTATION (TxDOT) – ENVIRONMENTAL AFFAIRS DIVISION	
Mr. Carlos Swonke Division Director	B.S. in Geology with 25 years of transportation and environmental experience in both the public and private sector.
Ms. Susan Theiss Deputy Director	B.A. in Government with 22 years of NEPA experience.
Ms. Julia Ragsdale Project Manager	B.S. in Chemical Engineering with 8 years of managing the environmental coordination of transportation projects.
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Timothy Love Environmental Specialist	BA Biology & MS Botany & Microbiology with 23 years of experience in wetland delineation, Department of the Army permit coordination, and NEPA document preparation.
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June Farrell Urban Planner	MS Urban and Regional Planning, BA in Sociology, 12 years of NEPA document experience, 18 years of urban planning experience.
Patricia Parmley Environmental Specialist	MS Environmental Biology with14 years environmental experience, NEPA document preparation.
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JACOBS CORPORATION	
Robb Fishman Project Manager AICP/REM	B.A. in geology and geography with 30 years experience in NEPA studies, NEPA document preparation, project management, and qa/qc.
Robin Sterry Senior Environmental Planner	B.S. in Engineering Technology with 30 years of experience in NEPA document preparation, including EIS documentation, permitting, Section 4 and 6(f), noise and air analyses, and EIS documents, project management and qa/qc
Angela McMurray Environmental Planner	B.A. in Geography/Landscape Ecology with 9 years of experience in NEPA document preparation, wetland delineation and permitting, natural resource surveys, and socioeconomic analysis
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PRESERVATION CENTRAL, INC. (PCI)	
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Mr. Douglas G. Mangum, M.A. Principal Investigator, Historian	M.A. in History with 20 years years of experience in cultural resource management, archeological fieldwork, and archeological report preparation.
PREWITT AND ASSOCIATES, INC.	
Amy Dase Historican	BA, MA, PhD (ABD) in History with 27 years experience in cultural resources management.

SECTION 10: DISTRIBUTION LIST

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STATE AGENCIES		
Carter P. Smith Executive Director Texas Parks and Wildlife Department 4200 Smith School Road Austin, Texas 78744		1

Name & Address	Hard Copy, Letter with Weblink and NOA	Letter with Weblink and NOA
Michael Warriner Nongame and Rare Species Program Supervisor Texas Parks and Wildlife Department Nongame and Rare Species Program 4200 Smith School Road Austin, Texas 78744		1
Bob Gottfried Texas Parks and Wildlife Department Texas Natural Diversity Database 4200 Smith School Road Austin, Texas 78744		1
Amy Turner, PhD Habitat Assessment Biologist Texas Parks and Wildlife Department Nongame and Rare Species Program 4200 Smith School Road Austin, Texas 78744		1
State Historic Preservation Officer (SHPO) Mark Wolfe, Executive Director Texas Historical Commission P.O. Box 12276 Austin, Texas 78711-2276 Attention: Linda Henderson		1
Kate McGrath Deputy Director Governor's Office of Budget, Planning and Policy P.O. Box 12428 Austin, Texas 78711		1
David W. Galindo (MC145) Director, Water Quality Division Texas Commission on Environmental Quality P.O. Box 13087 Austin, Texas 78711-3087		1
Mr. David Brymer (MC206) Director, Air Quality Division Texas Commission on Environmental Quality P.O. Box 13087 Austin, Texas 78711-3087		1
Richard Hyde, PE Executive Director Texas Commission on Environmental Quality P.O. Box 13087 Austin, Texas 78711-3087		1

Name & Address	Hard Copy, Letter with Weblink and NOA	Letter with Weblink and NOA
Hal Croft Deputy Commissioner Texas General Land Office Asset Management P.O. Box 12873 Austin, Texas 78711-2873 Attention: Amy Nunez		1
Milton Rister Executive Director Railroad Commission of Texas 1701 North Congress Austin, Texas 78701		1
Julia Ragsdale Texas Department of Transportation Environmental Affairs Division 118 East Riverside Drive Austin, Texas 78704	1	1
LOCAL AGENCIES		
Alan Clark MPO Director Houston-Galveston Area Council P.O. Box 22777 Houston, Texas 77227-2777		1
Gary K. Trietsch Director Harris County Toll Road Authority 7701 Wilshire Place Drive Houston, Texas 77040		1
STATE GOVERNOR		
Governor Greg Abbott P.O. Box 12428 Austin, Texas 78711-2428		
U.S. SENATORS		
John Cornyn U.S. Senator for Texas 5300 Memorial Drive, Suite 980 Houston, Texas 77007		1
Ted Cruz U.S. Senator for Texas 185 Dirksen Senate Office Building Washington, D.C. 20510		1
U.S. REPRESENTATIVES		

Name & Address	Hard Copy, Letter with Weblink and NOA	Letter with Weblink and NOA
Congressman Randy Weber Congressional District 14 122 West Way, Suite 301 Lake Jackson, Texas 77566		1
Congressman Pete Olson Congressional District 22 17225 El Camino Real, Suite 447 Houston, Texas 77058		1
TEXAS STATE SENATORS		
Larry Taylor Texas State Senator – District 11 6117 Broadway, Suite 122 Pearland, Texas 77581		1
Joan Huffman Texas State Senator – District 17 P.O. Box 541774 Houston, Texas 77254		1
TEXAS STATE REPRESENTATIVES		
Greg Bonnen Texas State Representative – District 24 174 Calder Road, Suite 116 League City, Texas 77573		1
Dennis Bonnen Texas State Representative – District 25 122 East Myrtle Angleton, Texas 77515		1
Congressman Ed Thompson Congressional District 29 P.O. Box 2910 Austin, Texas 78768		1
Dennis Paul Texas State Representative – District 129 17225 El Camino Real Blvd, Suite 415 Houston, Texas 77058		1
BRAZORIA COUNTY		
Matt Sebasta, Jr. Brazoria County Judge 111 East Locust Street, Suite 102 Angleton, Texas 77515		1
Matt Hanks, JD, PE Brazoria County Engineer Brazoria County Engineering Department 451 North Velasco, Suite 230 Angleton, Texas 77515		1

Name & Address	Hard Copy, Letter with Weblink and NOA	Letter with Weblink and NOA
Donald "Dude" Payne Brazoria County Commissioner – Precinct 1 1432 Highland Park Drive P.O. Box 998 Clute, Texas 77531		1
Ryan Cade Brazoria County Commissioner – Precinct 2 21017 County Road 171 Angleton, Texas 77515		1
Stacy L. Adams Brazoria County Commissioner – Precinct 3 2508 North Gordon P.O. Box 548 Alvin, Texas 77512		1
David Linder Brazoria County Commissioner – Precinct 4 121 North 10th Street West Columbia, Texas 77486		1
Brazoria County Parks Department 313 West Mulberry Angleton, Texas 77515		1
GALVESTON COUNTY		
Mark Henry Galveston County Judge 722 Moody Avenue, Suite 200 Galveston, Texas 77550		1
Michael C. Shannon Galveston County Engineer 722 Moody Avenue Galveston, Texas 77550		1
Ryan Dennard Galveston County Commissioner – Precinct 1 722 Moody Avenue Galveston, Texas 77550		1
Joe Giusti Galveston County Commissioner – Precinct 2 11730 State Highway 6 P.O. Box B Santa Fe, Texas 77510		1
Stephen D. Holmes Galveston County Commissioner – Precinct 3 9850 A Emmett F. Lowry Expressway, Suite A100 Texas City, Texas 77591		1

Name & Address	Hard Copy, Letter with Weblink and NOA	Letter with Weblink and NOA
Ken Clark Galveston County Commissioner – Precinct 4 174 Calder Road, Rm 112 League City, Texas 77573		1
Galveston County Department of Parks 4102 Main (FM 519) La Marque, Texas 77568		1
CITY OFFICIALS		
Jeff Tambrella City of Santa Fe Mayor 12002 State Highway 6 P.O. Box 950 Santa Fe, Texas 77510		1
Pat Hallisey City of League City Mayor 300 West Walker League City, Texas 77573		1
Michael Holton City of Iowa Colony Mayor 12003 County Road 65 Rosharon, Texas 77583		1
Delores Martin City of Manvel Mayor 20025 State Highway 6 P.O. Box 187 Manvel, Texas 77578		1
Julie Masters City of Dickinson Mayor 4403 State Highway 3 Dickinson, Texas 77539		1
Tom Wilson City of Hillcrest Village Mayor Pro Tempore P.O. Box 1172 Alvin, Texas 77512		1
Paul Horn City of Alvin Mayor 216 West Sealy Alvin, Texas 77511		1
Kevin M. Holland City of Friendswood Mayor 910 South Friendswood Drive Friendswood, Texas 77546		1

Name & Address	Hard Copy, Letter with Weblink and NOA	Letter with Weblink and NOA
LIBRARIES		
Alvin Library 105 South Gordon Street Alvin, Texas 77511	1	
Angleton Library 401 East Cedar Street Angleton, Texas 77515	1	
Helen Hall Library 100 W. Walker Street League City, Texas 77573	1	
Houston Public Library (Texas Room) 500 McKinney Street Houston, Texas 77002	1	
Manvel Library 20514B State Highway 6 Manvel, Texas 77578	1	
PUBLIC COMMENTERS		
DeAnn Arnold-Wilson 5119 Quail West Road Alvin, Texas 77511		1
Matthew Brannen 8434 E. Copper Village Houston, Texas 77095		1
Larry Buehler Economic Development Director City of Alvin 216 West Sealy Street Alvin, Texas 77511		1
Jivanji N. Burhani 4715 N. Pine Brook Way Houston, Texas 77059		1
Yasser Burhani 4715 N. Pine Brook Way Houston, Texas 77059		1
Gloria Catalini Highland Resources, Inc. 1001 Fannin, #4700 Houston, Texas 77002		1
Dan Chernosky Brazoria County Drainage District 5 P.O. Box 789 Alvin, Texas 77512		1
Charles A. and Kathaleen M. Clark 4510 State Highway 35 Alvin, Texas 77511		1

Name & Address	Hard Copy, Letter with Weblink and NOA	Letter with Weblink and NOA
Susan Cook 413 County Road 192 Alvin, Texas 77511		1
Billy Dewitt 1965 Troon Drive Alvin, Texas 77511		1
Suzanne Dillmann 2096 County Road 928B Alvin, Texas 77511		1
John C. and Susan F. Driskill 7218 County Road 865 Alvin, Texas 77511		1
Peter and Dawn Gemmill 5520 State Highway 35 Alvin, Texas 77511		1
Shannon and Bobbie Howard 4303 County Road 60 Rosharon, Texas 77583		1
Scott A. Jones Galveston Bay Foundation 17330 State Highway 3 Webster, Texas 77598		1
Billy and Kathy Kahn 1133 My Road Alvin, Texas 77511		1
Jena LeBlanc 3729 County Road 163 Alvin, Texas 77511-6939		1
Thom Liston 126 Bristol Bend Lane Dickinson, Texas 77539		1
Brandt Mannchen Sierra Club – Houston Regional Group 5431 Carew Houston, Texas 77096		1
Thomas McKissick 2298 County Road 145 Alvin, Texas 77511		1
Clarence G. and Rosemary Mills 2506 Clifford Street Alvin, Texas 77511		1
Dr. Joseph Mills 205 Hillcrest Drive Alvin, Texas 77511		1
Brenda Adams Minnis 1213 Hopkins Dr. Denton, Texas 76205		1

Name & Address	Hard Copy, Letter with Weblink and NOA	Letter with Weblink and NOA
Ramiro Mondragon 1809 Fulton Alvin, Texas 77511		1
Anna Moore 2047 County Road 152 Alvin, Texas 77511		1
C. Kenneth and Martha D. Moore 2905 Clifford Street Alvin, Texas 77511		1
Mary Morrison P.O. Box 5637 Alvin, Texas 77512		1
Sandi and Fred Paulus 7118 Bayou Timber Drive Alvin, Texas 77511		1
Jamie Perkins 6410 Hunters Bend Alvin, Texas 77511		1
Marci Perry Citizens' Transportation Coalition P.O. Box 66532 Houston, Texas 77266-6532		1
Alan Ping 6015 Pine Tree Trail Alvin, Texas 77511		1
Russell and Dori Rhoades 2044 County Road 152 Alvin, Texas 77511		1
Charles and Sharon Rutan 6055 E. FM 1462 Rosharon, Texas 77583		1
Salvador Salinas State Conservationist Natural Resources Conservation Service 101 South Main Street Temple, Texas 76501-7502		1
Dee Ann Schneble 2250 County Road 179 Alvin, Texas 77511		1
Matt Sebesta Brazoria County 21017 County Road 171 Angleton, Texas 77515		1
Sheryl Spears P.O. Box 1329 Manvel, Texas 77578		1

Name & Address	Hard Copy, Letter with Weblink and NOA	Letter with Weblink and NOA
Stephen R. Spencer Regional Environmental Officer U.S. Department of the Interior Office of Environmental Policy and Compliance 1001 Indian School Road NW, Suite 348 Albuquerque, New Mexico 87105		1
Roger Stuska 2185 Troon Drive Alvin, Texas 77511		1
E. W. and Brenda Sturman 5526 State Highway 35 Alvin, Texas 77511		1
George Tacquard 3815 County Road 155 Alvin, Texas 77511		1
Kenneth J. and Deborah Wood 6210 State Highway 35 Alvin, Texas 77511		1

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SECTION 11: BIBLIOGRAPHY

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SECTION 12: INDEX

Access xv, 1-5, 2-4, 2-5, 4-7, 4-15, 4-26, 4-53, 5-1, 7-2

Acquisition 4-9, 4-12, 7-2

Aesthetic 3-52, 4-84, 4-85, 5-34, 6-8, 7-11

Agency x, 1-11, 3-9, 4-54, 8-1, 8-2, 8-8

Air Quality xiii, 2-14, 3-7, 3-19, 4-14, 4-34, 4-36, 4-39, 5-19, 6-6, 6-40, 6-41, 7-3

Alignment i, 2-10, 2-12, 2-13, 2-14, 8-4

Alternativexiii, xvi, xvii, xviii, i, 2-1, 2-6, 2-8, 2-9, 2-10, 2-11, 2-12, 2-13, 2-14, 2-15, 2-16, 2-17, 3-5, 3-10, 3-13, 3-22, 3-34, 3-48, 4-1, 4-2, 4-3, 4-4, 4-5, 4-6, 4-7, 4-8, 4-9, 4-10, 4-11, 4-12, 4-13, 4-15, 4-26, 4-30, 4-31, 4-32, 4-33, 4-34, 4-39, 4-46, 4-47, 4-48, 4-49, 4-50, 4-51, 4-52, 4-53, 4-54, 4-55, 4-56, 4-57, 4-58, 4-59, 4-60, 4-61, 4-62, 4-63, 4-64, 4-65, 4-66, 4-67, 4-68, 4-69, 4-70, 4-71, 4-72, 4-73, 4-74, 4-75, 4-80, 4-81, 4-84, 4-85, 4-87, 4-88, 4-89, 5-2, 5-3, 5-9, 5-10, 5-11, 5-12, 5-13, 5-14, 5-15, 5-16, 5-17, 5-18, 5-19, 5-20, 5-23, 5-25, 5-27, 5-28, 5-30, 5-31, 5-33, 5-34, 6-1, 6-5, 6-6, 6-10, 6-11, 6-16, 6-17, 6-19, 6-20, 6-22, 6-24, 6-25, 6-27, 6-30, 6-44, 6-55, 6-56, 7-2, 7-3, 7-4, 7-5, 7-6, 7-7, 7-8, 7-9, 7-10, 7-11, 7-12, 8-2, 8-3, 8-4, 8-5, 8-7

Alvin x, 1-3, 2-3, 2-8, 2-9, 2-10, 2-11, 2-13, 3-1, 3-2, 3-3, 3-6, 3-8, 3-9, 3-10, 3-11, 3-12, 3-14, 3-17, 3-18, 3-22, 3-44, 3-48, 3-49, 3-50, 3-52, 4-1, 4-2, 4-8, 4-30, 4-51, 4-68, 4-71, 4-73, 4-76, 4-77, 4-78, 4-79, 4-80, 4-84, 4-87, 5-2, 5-3, 5-4, 5-5, 5-6, 5-8, 5-10, 5-13, 5-21, 6-8, 6-9, 6-14, 6-15, 8-1, 8-2, 8-3, 8-4, 8-5, 8-6, 8-7, 8-8, 8-9, 8-10

AOI x, xiii, 5-2, 5-3, 5-4, 5-5, 5-6, 5-7, 5-8, 5-9, 5-10, 5-11, 5-12, 5-13, 5-14, 5-15, 5-16, 5-17, 5-18, 5-19, 5-21, 5-23, 5-24, 5-25, 5-26, 5-28, 5-29, 5-31, 5-32, 5-33, 5-34, 5-35, 6-8, 6-9, 6-14

Archeological xi, xv, xvi, xviii, 3-46, 3-47, 3-48, 4-70, 4-71, 4-72, 5-33, 7-2, 7-10

Area of Influence x, xiii, 5-2, 5-15

ATL x, 4-23, 4-24, 6-54, 6-55, 6-56, 6-57

attainment xvi, 5-19, 6-6, 6-40

average trip length x, 4-22, 6-50, 6-54, 6-55, 6-56

Beneficial Landscape 3-35

Bicycle 2-3

Brazoria County xiv, i, ii, 1-4, 1-8, 1-9, 2-1, 2-2, 2-3, 2-6, 2-16, 3-4, 3-6, 3-8, 3-9, 3-12, 3-13, 3-14, 3-15, 3-16, 3-17, 3-18, 3-23, 3-35, 3-38, 3-43, 3-44, 3-49, 4-9, 4-20, 4-25, 4-28, 4-31, 4-32, 4-35, 4-60, 4-73, 5-2, 5-3, 5-4, 5-5, 5-6, 5-8, 5-13, 5-14, 5-16, 6-11, 6-12, 6-13, 6-15, 8-1, 8-2, 8-3, 8-4, 8-5, 8-8, 8-9, 8-10

Business 2-15, 3-18, 4-9, 4-10, 4-11

CAAA 6-59

Capacity xv, 1-4, 2-1, 2-4

carbon monoxide 4-34

Cemeteries 2-15, 3-10, 4-8

census 1-4, 1-9

church 3-8, 4-6, 4-8

Clean Air Act Amendments 3-19, 6-40

CMP x, 4-35, 4-36

CMSA x, xv, xvii, xviii, 3-6, 4-1, 6-9, 6-40

CO x, xiii, xvi, 4-34, 4-36, 5-20, 6-41

Coastal Management Zone 3-45, 4-69, 4-70

cohesion xiii, 3-8, 4-5, 4-6, 5-11, 7-2

commercial iv, 1-8, 2-4, 2-6, 2-9, 2-10, 3-2, 3-5, 3-8, 3-12, 3-14, 3-37, 3-52, 4-1, 4-2, 4-3, 4-5, 4-9, 4-11, 4-33, 4-84, 5-4, 5-5, 5-6, 5-9, 5-10, 5-12, 5-14, 5-15, 5-17, 5-18, 5-19, 5-21, 5-24, 5-28, 5-29, 5-31, 5-33, 5-34, 5-35, 6-9, 6-10, 6-11, 6-13, 6-15, 6-16, 6-17, 6-18, 6-19, 6-22, 6-25, 6-26, 6-28, 6-31, 6-38, 7-2

communities xiii, 1-1, 1-2, 1-3, 1-5, 1-15, 1-16, 2-1, 2-2, 2-3, 2-9, 2-11, 3-1, 3-2, 3-6, 3-14, 3-17, 3-29, 3-30, 3-44, 3-52, 4-1, 4-2, 4-5, 4-6, 4-14, 4-15, 4-20, 4-56, 4-57, 4-59, 4-60, 4-85, 4-87, 5-1, 5-3, 5-6, 5-9, 5-11, 5-17, 5-18, 5-19, 5-27, 5-28, 5-29, 5-30, 6-7, 6-8, 6-9, 6-10, 6-14, 6-15, 6-16, 6-17, 6-18, 6-20, 6-22, 6-25, 6-28, 6-29, 6-30, 6-31, 6-35, 6-38, 6-48, 6-59, 7-2, 7-6, 7-7, 7-8, 7-13, 8-5, 8-6, 8-8

community xiii, 1-1, 1-3, 1-5, 1-15, 2-4, 2-9, 3-2, 3-7, 3-8, 3-25, 3-31, 3-32, 3-37, 3-44, 3-50, 4-2, 4-5, 4-6, 4-13, 4-15, 4-26, 4-30, 4-67, 5-3, 5-4, 5-6, 5-10, 5-18, 5-27, 5-28, 5-29, 5-35, 6-4, 6-14, 6-16, 6-17, 6-18, 6-19, 6-39, 6-44, 6-59, 7-2, 7-12, 8-2, 8-5, 8-7

conformity 3-19, 6-39, 6-40

congestion 1-1, 1-2, 1-4, 1-5, 1-6, 1-7, 1-14, 1-15, 1-16, 2-2, 2-4, 2-7, 2-8, 2-16, 2-17, 4-3, 4-6, 4-7, 4-8, 4-17, 4-26, 4-34, 4-35, 4-36, 4-39, 4-44, 4-47, 4-85, 4-88, 5-5, 5-6, 5-19, 5-36, 6-4, 6-5, 6-6, 6-16, 6-17, 6-19, 6-20, 6-39, 6-40, 6-43, 6-50, 6-56, 7-3

Consolidated Metropolitan Statistical Area x, xv, 3-6

construction xvi, xvii, iii, 1-7, 2-2, 2-4, 2-6, 2-7, 2-8, 2-10, 2-17, 3-1, 3-35, 3-44, 3-49, 4-1, 4-2, 4-3, 4-5, 4-6, 4-7, 4-8, 4-11, 4-15, 4-17, 4-26, 4-32, 4-33, 4-34, 4-35, 4-39, 4-44, 4-47, 4-48, 4-49, 4-50, 4-52, 4-53, 4-55, 4-56, 4-58, 4-59, 4-60, 4-62, 4-63, 4-64, 4-65, 4-66, 4-67, 4-68, 4-71, 4-72, 4-74, 4-75, 4-80, 4-81, 4-82, 4-84, 4-85, 4-86, 4-87, 4-88, 4-89, 5-9, 5-12, 5-14, 5-15, 5-16, 5-17, 5-18, 5-20, 5-21, 5-22, 5-23, 5-24, 5-25, 5-26, 5-27, 5-28, 5-30, 5-31, 5-32, 5-33, 6-3, 6-4, 6-5, 6-6, 6-7, 6-9, 6-10, 6-11, 6-14, 6-16, 6-17, 6-19, 6-20, 6-21, 6-22, 6-23, 6-25, 6-26, 6-27, 6-28, 6-29, 6-31, 6-32, 6-38, 6-42, 7-2, 7-3, 7-4, 7-5, 7-7, 7-8, 7-9, 7-10, 7-11, 7-12, 7-13

cultural xv, xvi, xix, 2-9, 3-45, 3-46, 3-47, 3-48, 4-13, 4-71, 5-33, 6-59, 7-10, 8-6

Cultural Resources 2-15, 3-46, 4-70, 5-32, 6-8

CWA 5-34

DEIS xvi, xvii, i, 2-13, 2-15, 2-16

design i, iii, 1-7, 2-16, 2-17, 3-19, 3-50, 4-3, 4-6, 4-19, 4-45, 4-47, 4-53, 4-55, 4-66, 4-67, 4-68, 4-74, 4-84, 4-85, 4-86, 4-87, 5-23, 5-25, 5-27, 5-30, 5-32, 5-33, 5-35, 6-20, 6-24, 6-26, 6-27, 6-44, 7-3, 7-5, 7-6, 7-9, 7-11, 7-12

development xiii, xiv, xvii, ii, iv, 1-1, 1-2, 1-4, 1-7, 1-8, 1-16, 2-1, 2-4, 2-6, 2-7, 2-8, 2-9, 2-10, 2-13, 2-16, 3-2, 3-5, 3-8, 3-14, 3-18, 3-24, 3-25, 3-29, 3-35, 3-36, 3-44, 3-45, 3-49, 3-50, 3-52, 4-1, 4-2, 4-3, 4-4, 4-5, 4-6, 4-12, 4-30, 4-32, 4-33, 4-34, 4-39, 4-47, 4-56, 4-59, 4-62, 4-67, 4-69, 4-74, 4-89, 5-1, 5-2, 5-3, 5-4, 5-5, 5-6, 5-9, 5-10, 5-11, 5-12, 5-13, 5-14, 5-15, 5-16, 5-17, 5-18, 5-19, 5-21, 5-22, 5-23, 5-24, 5-26, 5-28, 5-29, 5-30, 5-31, 5-32, 5-33, 5-34, 5-35, 5-36, 6-2, 6-3, 6-4, 6-5, 6-6, 6-7, 6-8, 6-9, 6-10, 6-11, 6-13, 6-14, 6-15, 6-16, 6-17, 6-18, 6-19, 6-22, 6-23, 6-24, 6-25, 6-26, 6-27, 6-28, 6-29, 6-30, 6-31, 6-38, 6-40, 6-42, 6-43, 6-44, 6-45, 6-59, 7-2, 7-3, 7-4, 7-6, 7-11, 7-12, 8-1, 8-3, 8-5

displacement 4-9, 4-12, 6-7, 6-18, 7-2, 8-7

Economic xvii, 1-2, 1-16, 4-25, 4-32, 4-33, 5-2, 5-3, 5-13, 6-5, 6-14, 8-9, 8-10

EIS x, xvi, i, 3-1, 3-5, 3-7, 3-51, 4-2, 4-3, 4-6, 4-8, 4-9, 4-13, 4-14, 4-15, 4-25, 4-30, 4-31, 4-33, 4-34, 4-50, 4-53, 4-55, 4-56, 4-62, 4-67, 4-72, 4-73, 4-74, 4-75, 4-83, 4-84, 4-89, 5-1, 5-3, 5-7, 5-8, 5-9, 5-16, 5-19, 5-40, 6-8, 6-10, 6-16, 6-18, 6-22, 6-25, 7-1, 7-11, 8-1, 8-6, 8-7

EJ x, xiv, 2-15, 3-5, 4-12, 4-14, 4-15, 4-20, 4-21, 4-22, 4-23, 4-24, 4-25, 4-26, 5-40, 6-5, 6-40, 6-48, 6-49, 6-50, 6-54, 6-55, 6-56, 6-57, 6-59

employment 1-4, 1-5, 1-16, 2-6, 3-5, 3-15, 3-17, 4-21, 4-22, 4-32, 4-33, 5-4, 5-5, 5-6, 5-13, 5-17, 5-18, 5-19, 5-28, 5-37, 5-38, 6-5, 6-8, 6-9, 6-10, 6-11, 6-14, 6-15, 6-16, 6-17, 6-18, 6-19, 6-25, 6-31, 6-38, 6-43

Endangered Species 3-36, 4-62, 4-63, 4-65, 4-66

Environmental Justice xiv, 4-12, 4-14, 4-15, 4-20, 4-23, 4-24, 6-48, 6-49, 6-51, 6-56, 6-57, 6-59

EPA x, xvii, 2-9, 3-7, 3-19, 3-20, 3-25, 3-50, 4-13, 4-14, 4-37, 4-38, 4-50, 4-54, 4-84, 5-19, 6-6, 6-21, 6-40, 6-41, 7-11, 8-1

Essential Fish Habitat xiv, 3-45, 4-69, 4-70, 5-30, 6-7

Executive Order xiv, 3-34, 3-35, 3-44, 4-12, 4-26, 4-30, 4-53, 4-58, 4-84, 6-59, 7-7, 7-8

Farmland x, xvi, 2-14, 3-4, 3-34, 4-4, 4-5

Federal x, xiv, xvi, iii, 1-7, 1-11, 3-19, 3-38, 3-40, 3-42, 3-51, 4-12, 4-65, 6-1, 6-47, 7-9, 8-1, 8-6

Federal Highway Administration x, iii, 8-1

Federal Transit Administration x, 8-1

FEIS xiii, xiv, xv, xvi, i, iii, 2-16, 2-17, 3-4, 3-13, 3-20, 4-30, 4-47, 7-4, 7-7, 7-8, 7-9, 7-12, 8-1, 8-5, 8-8

FHWA x, xvi, iii, 1-1, 1-5, 1-7, 2-1, 3-4, 3-8, 3-19, 3-20, 3-48, 3-49, 4-5, 4-12, 4-14, 4-36, 4-37, 4-40, 4-41, 4-54, 4-68, 4-72, 4-74, 5-1, 6-24, 6-40, 6-47, 7-1, 7-3, 7-9, 8-1, 8-8

Floodplain xiv, 5-26, 6-6

Floodplains2-12, 2-14, 3-44, 4-66, 4-67, 5-25, 5-26, 6-24, 7-9

FTA x, iii, 1-1, 6-40, 6-47, 8-1

Grand Parkway x, xiii, xiv, i, ii, iii, 1-1, 1-2, 1-7, 1-8, 1-9, 1-10, 1-11, 1-12, 1-13, 1-15, 1-16, 2-15, 3-49, 4-15, 4-17, 4-19, 4-26, 4-70, 5-16, 6-19, 6-48, 8-6

Grand Parkway Association x, xiv, ii, 5-16

Greater Houston area xiv, 3-14, 3-19, 4-17, 5-6, 5-19, 6-8

Groundwater x, xiv, 3-24, 3-51, 4-50, 4-79, 4-80, 7-5

Habitats 4-63, 5-8, 5-9, 6-30

Hazardous 2-14, 3-19, 3-50, 3-51, 4-50, 4-74, 4-75, 4-76, 4-79, 4-80, 4-82, 7-10, 7-13

Hazardous Materials 2-14, 3-50, 3-51, 4-50, 4-74, 4-75, 4-76, 7-10

Health Effects Institute xi, 3-20

HEI xi, 3-20, 4-37, 4-38

H-GAC xi, xv, xvii, xviii, i, iii, 1-2, 1-4, 1-5, 1-8, 1-9, 1-11, 1-16, 2-1, 2-2, 2-3, 2-4, 2-5, 2-6, 2-8, 2-16, 2-17, 3-1, 3-2, 3-3, 3-5, 3-6, 3-15, 3-18, 4-1, 4-5, 4-9, 4-10, 4-15, 4-20, 4-21, 4-22, 4-23, 4-24, 4-25, 4-35, 4-36, 5-5, 5-6, 5-13, 5-36, 5-37, 5-39, 5-40, 6-9, 6-10, 6-12, 6-14, 6-15, 6-16, 6-20, 6-39, 6-40, 6-41, 6-42, 6-43, 6-44, 6-45, 6-46, 6-47, 6-48, 6-49, 6-51, 6-52, 6-53, 6-55, 6-56, 6-57, 6-58, 6-59, 7-3, 8-1, 8-2, 8-5

Highway xi, xii, xiii, xv, i, ii, iii, 1-6, 1-7, 2-1, 2-4, 3-11, 3-12, 3-22, 3-23, 3-49, 4-36, 4-47, 4-76, 4-77, 4-78, 5-11

Historic xi, xv, xvii, 3-46, 3-48, 3-49, 3-50, 4-72, 5-8, 5-33, 7-2

Household 3-14, 4-21, 5-40, 6-15

Housing 4-10, 5-5, 6-10

Houston xi, xiv, xv, xvii, xviii, i, ii, iv, 1-1, 1-2, 1-3, 1-4, 1-5, 1-8, 1-9, 1-10, 1-13, 1-14, 1-15, 1-16, 2-1, 2-2, 2-3, 2-6, 2-7, 2-8, 3-6, 3-12, 3-14, 3-42, 3-46, 3-47, 4-1, 4-10, 4-11, 4-12, 4-16, 4-26, 4-70, 4-72, 5-2, 5-4, 5-6, 5-13, 5-18, 5-19, 5-20, 5-36, 5-39, 6-3, 6-6, 6-9, 6-14, 6-16, 6-20, 6-26, 6-29, 6-38, 6-39, 6-40, 6-41, 6-42, 6-43, 6-45, 6-48, 7-3, 8-1, 8-6, 8-8, 8-10

Houston-Galveston Area Council xi, xv, i, 8-1

Income 3-14, 4-12, 4-32, 4-33, 5-40, 6-15

Industrial 3-1, 3-51, 4-1, 4-11, 4-52, 4-79, 4-80, 5-12

Integrated Risk Information System xi, 3-19

Invasive Species 3-34, 3-35

IRIS xi, 3-19, 4-37

Land Use 3-1, 3-2, 4-1, 4-2, 4-40, 4-47, 5-10, 5-12, 5-16, 6-4, 6-8, 6-11, 6-12, 6-21, 6-24, 6-27, 6-43, 6-45, 7-1

Landscaping 3-34, 3-35, 4-58, 7-7

LEP xi, xv, 3-5, 4-13, 4-26, 4-27, 4-28, 4-29, 4-30, 6-5, 7-1

level of service xi, 1-2, 1-7

LOSxi, xv, 1-2, 1-5, 1-6, 1-7, 2-1, 2-7, 2-8, 2-16, 5-19, 6-17

Magnolia 3-12, 3-22, 3-23, 5-7, 5-8, 5-11, 6-21

METRO xi, xiv, 1-5, 2-2, 2-3, 2-5, 2-6, 5-6, 5-36, 5-38, 8-1

Metropolitan Transit Authority of Harris County xi, xiv, 8-1

Minority 4-12, 4-14, 5-39, 6-5, 7-1

mitigation 3-31, 4-3, 4-14, 4-31, 4-39, 4-56, 4-67, 4-82, 4-84, 5-1, 5-4, 5-25, 5-34, 5-35, 6-3, 6-7, 6-27, 6-28, 6-29, 6-42, 6-59, 7-1, 7-6, 7-9, 7-11, 7-12

Mitigation xv, 4-36, 4-49, 4-67, 5-2, 5-14, 5-16, 5-19, 5-22, 5-25, 5-27, 5-30, 5-32, 5-34, 5-35, 6-1, 6-3, 6-13, 6-20, 6-23, 6-26, 6-29, 6-31, 6-32, 7-5, 7-6, 7-11, 7-12, 8-1

Mobile Source Air Toxic xvi, 4-36

Mobility 1-4, 6-41, 6-46

Montgomery County 6-48

MPO xv, xviii, 6-39, 6-59

MSATxi, xvi, 3-19, 3-20, 4-14, 4-36, 4-37, 4-38, 4-39, 6-6, 6-41

MSATs 3-19, 5-20

Mykawa 6-12

NAAQS xvi, 6-40

National Ambient Air Quality Standards xiii, 5-19, 6-40

National Cooperative Highway Research Program xi, 5-1

National Environmental Policy Act xi, xvi, 1-1

NCHRP xi, 5-1, 5-2, 5-3

Need and Purpose 1-1

NEPA xi, xvi, 1-1, 3-20, 3-35, 3-46, 3-49, 4-12, 4-30, 4-37, 4-70, 6-1, 6-59, 7-1, 7-10

Newsletters 8-5

No-Build xvi, 1-7, 2-6, 2-8, 2-14, 2-16, 4-1, 4-3, 4-4, 4-5, 4-6, 4-7, 4-8, 4-9, 4-12, 4-20, 4-21, 4-22, 4-23, 4-24, 4-26, 4-30, 4-31, 4-32, 4-33, 4-34, 4-39, 4-47, 4-50, 4-51, 4-52, 4-53, 4-56, 4-59, 4-62, 4-66, 4-67, 4-69, 4-70, 4-72, 4-74, 4-84, 4-85, 4-88, 4-89, 5-13, 5-14, 5-15, 5-19, 5-33, 6-1, 6-6, 6-10, 6-16, 6-17, 6-20, 6-41, 6-49, 6-50, 6-53, 6-54, 6-55, 6-56, 6-57

NOI xi, xvi, 4-48, 7-4, 8-6

Noise 2-14, 3-21, 4-5, 4-14, 4-40, 4-41, 4-44, 4-45, 4-46, 4-47, 7-3, 7-4, 7-12

non-attainment 6-6

Notice of Intent xi, xvi, 4-48, 8-6

ozone xvi, 3-19, 5-19, 6-6, 6-40, 6-41

Park 2-2, 2-4, 3-9, 3-10, 3-12, 3-13, 3-14, 3-45, 3-46, 3-49, 4-9, 4-71, 5-8, 6-9, 8-10

parks 4-40

Parks and Recreation 3-12, 3-18, 4-8

Pearland 5-3, 5-5, 5-6, 5-7, 5-8, 6-9, 6-14, 6-15, 8-1, 8-6, 8-10

Pedestrian 2-3, 3-13, 3-19, 4-34, 6-5, 7-1

permitxvii, 4-17, 4-48, 4-68, 4-69, 4-86, 5-25, 5-34, 6-24, 6-29, 7-4, 7-5, 7-6, 7-8, 7-12

Permit x, 4-48, 7-4, 7-5, 8-1

Population 1-4, 1-9, 1-16, 3-5, 3-6, 3-7, 3-8, 3-15, 3-17, 4-28, 4-30, 4-31, 5-5, 5-9, 5-39, 6-15, 6-49

Preferred Alternative xvi, i, 1-6, 2-1, 2-15, 2-16, 2-17, 3-1, 3-5, 3-7, 3-8, 3-9, 3-10, 3-12, 3-13, 3-14, 3-18, 3-22, 3-26, 3-27, 3-28, 3-33, 3-34, 4-1, 4-2, 4-3, 4-4, 4-5, 4-6, 4-7, 4-8, 4-9, 4-10, 4-11, 4-12, 4-13, 4-14, 4-15, 4-26, 4-27, 4-28, 4-30, 4-31, 4-32, 4-33, 4-34, 4-39, 4-41, 4-44, 4-45, 4-46, 4-47, 4-48, 4-49, 4-50, 4-51, 4-52, 4-53, 4-54, 4-55, 4-56, 4-57, 4-58, 4-59, 4-60, 4-61, 4-62, 4-63, 4-64, 4-65, 4-66, 4-67, 4-68,

4-69, 4-70, 4-71, 4-72, 4-73, 4-74, 4-75, 4-80, 4-81, 4-82, 4-83, 4-84, 4-85, 4-86, 4-87, 4-88, 4-89, 5-1, 5-2, 5-3, 5-4, 5-7, 5-9, 5-10, 5-11, 5-12, 5-13, 5-14, 5-15, 5-16, 5-17, 5-18, 5-19, 5-20, 5-21, 5-23, 5-25, 5-26, 5-27, 5-28, 5-30, 5-31, 5-32, 5-34, 5-35, 6-1, 6-2, 6-3, 6-4, 6-5, 6-6, 6-7, 6-8, 6-10, 6-11, 6-16, 6-17, 6-18, 6-19, 6-20, 6-21, 6-22, 6-23, 6-24, 6-25, 6-27, 6-28, 6-30, 6-38, 6-39, 7-1, 7-2, 7-3, 7-4, 7-5, 7-6, 7-7, 7-8, 7-9, 7-10, 7-11, 7-12, 8-7

Preservation xvii, 3-46, 3-48, 6-14, 7-1

Public Drinking Water System 3-24, 4-51, 7-5

Public Involvement 8-5, 8-8

Public Meeting 8-6, 8-9

Railroad 3-51, 3-52, 4-82, 4-83, 5-10, 7-11

Recommended Alternative xvi, xvii, 2-9

Region xv, 2-2, 2-5, 3-9, 3-47, 5-39, 5-40, 6-42, 6-43, 6-49, 6-51

Relocation 4-12, 7-2

Residential2-14, 2-15, 3-1, 3-8, 3-21, 3-22, 3-30, 4-1, 4-9, 4-10, 4-40, 5-10, 5-11, 5-12, 5-18, 5-28, 5-29, 6-10, 6-11, 6-16, 8-3, 8-8

Resource Study Area xii, 6-1, 6-2, 6-8, 6-14, 6-21, 6-24, 6-26, 6-29

right-of-way xii, xiv, i, 1-16, 2-12, 2-15, 4-47, 4-51, 4-52, 4-57

Roadway 1-4, 1-7, 4-40, 4-61, 4-87, 5-5, 5-36, 5-37, 6-16, 6-17, 6-19, 6-24, 6-41

ROW xii, xiv, xvii, i, ii, 1-16, 2-4, 2-8, 2-9, 2-10, 2-11, 2-12, 2-13, 2-14, 2-15, 2-17, 3-17, 3-19, 3-32, 3-33, 3-34, 3-36, 3-50, 3-52, 4-1, 4-2, 4-3, 4-4, 4-6, 4-7, 4-8, 4-9, 4-13, 4-15, 4-20, 4-30, 4-31, 4-32, 4-34, 4-35, 4-44, 4-47, 4-48, 4-50, 4-51, 4-52, 4-54, 4-55, 4-56, 4-57, 4-58, 4-59, 4-60, 4-61, 4-62, 4-63, 4-65, 4-66, 4-68, 4-69, 4-70, 4-71, 4-72, 4-74, 4-75, 4-80, 4-81, 4-82, 4-83, 4-84, 4-85, 4-88, 4-89, 5-1, 5-9, 5-10, 5-11, 5-12, 5-15, 5-17, 5-18, 5-20, 5-23, 5-25, 5-27, 5-31, 5-32, 6-4, 6-5, 6-6, 6-7, 6-10, 6-11, 6-16, 6-22, 6-24, 6-27, 6-30, 6-45, 6-59, 7-2, 7-5, 7-6, 7-7, 7-8, 7-9, 7-10, 7-11, 7-12, 8-3, 8-4, 8-7

RSA xii, 6-2, 6-3, 6-8, 6-9, 6-10, 6-11, 6-13, 6-14, 6-15, 6-16, 6-17, 6-18, 6-19, 6-20, 6-21, 6-22, 6-23, 6-24, 6-25, 6-26, 6-27, 6-28, 6-29, 6-30, 6-31

Safety 1-1, 1-2, 1-8, 1-9, 4-16, 4-87, 7-13, 8-1

School xi, 2-15, 3-8, 3-9, 4-6, 4-30, 4-32, 5-6, 8-7

Section 4(f) xvii, 1-1, 2-15, 3-13, 3-14, 3-48, 4-9

SH 288 i, ii, iii, 1-2, 1-3, 1-5, 1-6, 1-8, 1-11, 1-12, 1-13, 2-1, 2-2, 2-4, 2-5, 2-8, 2-9, 2-10, 2-11, 2-12, 2-13, 2-16, 2-17, 3-10, 4-2, 4-15, 4-25, 4-35, 4-47, 4-73, 5-4, 5-10, 5-11, 5-21, 6-3, 6-9, 6-10, 6-11, 6-12, 6-14, 8-3

SH 99 xiii, xiv, xvi, xvii, i, ii, iii, 1-1, 1-2, 1-3, 1-4, 1-5, 1-6, 1-7, 1-8, 1-16, 2-1, 2-6, 2-8, 2-9, 2-12, 2-13, 2-15, 2-16, 2-17, 3-1, 3-2, 3-3, 3-5, 3-6, 3-9, 3-12, 3-14, 3-19, 3-21, 3-22, 3-26, 3-28, 3-34, 3-35, 3-36, 3-37, 3-42, 3-43, 3-44, 3-45, 3-46, 3-48, 3-49, 3-51, 3-52, 4-1, 4-2, 4-3, 4-4, 4-5, 4-10, 4-15, 4-17, 4-20, 4-21, 4-22, 4-23, 4-24, 4-25, 4-27, 4-30, 4-31, 4-33, 4-35, 4-41, 4-44, 4-46, 4-47, 4-50, 4-51, 4-52, 4-54, 4-57, 4-58, 4-60, 4-64, 4-68, 4-69, 4-71, 4-72, 4-74, 4-79, 4-82, 4-83, 4-84, 4-85, 4-86, 4-89, 5-1, 5-3, 5-11, 5-15, 5-19, 5-20, 5-32, 5-33, 6-5, 6-12, 6-21, 6-38, 6-39, 6-48, 7-1, 7-2, 7-3, 7-7, 7-8, 7-9, 7-12, 7-13, 8-1, 8-2, 8-3, 8-4, 8-5, 8-6, 8-7, 8-10

SIP xii, iii, 5-20, 6-40, 6-59, 7-3

Soil 3-4, 3-29, 4-4, 7-8

State xii, xiii, xvii, i, iii, 1-6, 1-7, 1-8, 1-9, 1-14, 3-12, 3-13, 3-22, 3-23, 3-38, 3-40, 3-43, 3-44, 3-46, 3-48, 3-49, 3-50, 3-51, 4-32, 4-33, 4-36, 4-47, 4-63, 4-71, 4-82, 5-11, 6-47, 6-59, 8-1, 8-9, 8-10

State Implementation Plan xii, xvii, iii

Surface Water xii, 3-22, 3-23, 4-48, 7-4

TAZ xii, xviii, 3-3, 4-22, 5-2, 6-48, 6-49

TCEQ xii, 2-9, 3-22, 3-23, 3-24, 3-26, 3-46, 3-50, 4-48, 4-51, 4-52, 4-53, 4-70, 4-84, 5-7, 5-8, 5-22, 5-30, 6-21, 6-41, 6-42, 7-5, 7-6, 7-10, 7-11, 7-12, 8-1

TDM xii, xvi, xviii, 2-5, 2-6, 2-7

Texas Commission on Environmental Quality xii, 2-9, 8-1

Texas Department of Transportation xii, xiv, ii, 8-1

Texas Parks and Wildlife Department xii, 2-9, 3-37, 8-1

THC xii, 2-9, 3-46, 3-48, 3-49, 4-70, 4-71, 4-72, 6-8, 7-10, 8-1

Threatened xviii, 3-36, 3-38, 3-40, 4-62, 4-63, 4-66, 6-8, 7-9

Threatened and Endangered Species 3-36, 3-38, 3-40, 4-62, 4-66, 6-8, 7-9

TIP xii, xv, xviii, i, ii, 3-1, 3-3, 4-35, 4-36, 6-40, 6-59, 7-3

TPWD xii, 2-9, 3-13, 3-30, 3-31, 3-32, 3-34, 3-36, 3-37, 3-40, 3-42, 3-43, 3-44, 4-56, 4-57, 4-59, 4-62, 4-63, 4-64, 4-65, 4-66, 5-27, 7-6, 7-8, 7-9, 8-1, 8-2, 8-5, 8-8

Traffic xiii, xviii, 1-5, 1-6, 1-10, 1-12, 2-4, 2-6, 2-8, 2-16, 3-3, 4-34, 4-40, 4-41, 4-44, 4-46, 4-47, 4-86, 4-87, 5-28, 7-12

traffic analysis zone xii, xvii, 6-49

transit xiv, xviii, 1-15, 2-1, 2-2, 2-3, 2-5, 2-6, 2-7, 4-15, 5-2, 5-16, 5-36, 5-37, 5-38, 5-40, 6-44, 6-46, 6-47, 6-57

Transportation Improvement Program xii, xv, xviii

TxDOT xii, xiv, xvi, xviii, xix, i, ii, 1-1, 1-5, 2-3, 2-8, 3-12, 3-13, 3-30, 3-31, 3-34, 3-37, 3-46, 3-48, 3-50, 4-6, 4-7, 4-8, 4-9, 4-10, 4-12, 4-15, 4-17, 4-30, 4-34, 4-36, 4-39, 4-40, 4-47, 4-49, 4-53, 4-55, 4-57, 4-58, 4-62, 4-66, 4-68, 4-70, 4-71, 4-72, 4-73, 4-74, 4-86, 4-87, 5-1, 5-2, 5-6, 5-8, 5-16, 6-1, 6-3, 6-8, 6-16, 6-19, 6-20, 6-24, 7-1, 7-2, 7-3, 7-4, 7-7, 7-8, 7-9, 7-10, 7-11, 7-12, 7-13, 8-1, 8-5, 8-7, 8-8, 8-10

U.S. Army Corps of Engineers xii, 1-11, 4-54, 8-1

U.S. Department of Transportation xii, 2-2, 3-48

U.S. Environmental Protection Agencyx, xvii, 2-9, 8-1

U.S. Fish and Wildlife Service xii, 2-9, 3-36, 8-1

USACE xii, 1-11, 2-9, 3-25, 3-26, 4-52, 4-53, 4-54, 4-56, 4-71, 4-86, 5-25, 6-7, 6-26, 6-27, 6-28, 6-29, 6-43, 7-5, 7-6, 7-12, 8-1, 8-5, 8-8

USDOT xii, 3-48, 4-12, 6-40

USFWS xii, 2-9, 3-31, 3-36, 3-40, 3-42, 3-43, 4-62, 4-63, 4-64, 4-65, 4-66, 7-8, 7-9, 8-1, 8-8

Vegetation 3-28, 3-30, 4-55, 4-56, 4-57, 5-27, 5-29, 6-7, 6-28, 6-29, 6-31, 6-42, 6-43, 7-6, 7-7

Vehicle Hours Traveled xviii, 6-44, 6-57

Vehicle Miles Traveled 6-44, 6-57

VHT xviii, 6-44, 6-56, 6-57

Visual 2-15, 3-52, 4-84, 4-88, 5-34, 6-8, 7-11

VMT xii, 2-4, 3-19, 3-20, 5-19, 5-20, 5-36, 6-40, 6-44, 6-56, 6-57

Water Quality 3-22, 4-48, 4-49, 4-53, 4-70, 4-86, 5-8, 5-20, 6-6, 6-11, 6-12, 6-21, 6-41, 6-42, 7-4, 7-10, 7-12

Wetland xviii, 4-54, 4-56, 7-5

Wetlands xi, xvi, 2-9, 2-12, 2-14, 3-25, 3-26, 3-27, 4-52, 4-53, 4-54, 5-23, 5-24, 6-7, 6-26, 6-27, 7-5

Wild and Scenic Rivers xix, 3-45, 4-69, 7-1

Wildlife 3-12, 3-28, 3-34, 3-35, 3-38, 3-41, 3-43, 4-56, 4-58, 4-59, 4-61, 5-8, 5-24, 5-27, 5-28, 5-29, 6-7, 6-29, 6-30, 6-31, 7-6, 7-7