

CHAPTER 2

Alternatives Analysis

CHAPTER 2: ALTERNATIVES ANALYSIS

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CHAPTER 2 ALTERNATIVES ANALYSIS

This chapter discusses the alternatives development, corridor level analysis, and decision making process utilized during the project planning phase. A full range of alternatives, including the No-Build Alternative, were analyzed during the study process. This chapter also summarizes the alternative selection criteria and its interdisciplinary approach involving analysis of environmental, traffic operations, and engineering aspects of each alternative. Input and comments from members of the public, and local, state, and federal agencies were carefully considered during the evaluation process.

The environmental analysis was conducted thoroughly and systematically considering resource and constraints mapping, environmental issues, traffic, engineering, and public involvement. This process enabled the reviewers to compare and evaluate alternatives through an iterative series of evaluation criteria phases. It also provided the basis to select a single Recommended Alternative that best serves the project's need and purpose and avoids or minimizes environmental impacts.

The identification of the Recommended Alternative in this DEIS was consistent with the guidelines and regulations that were set forth by FHWA and the Council on Environmental Quality (CEQ) (23 CFR 771.125, 40 CFR 1502 and FHWA, 1987). The multi-step development process also meets various requirements of the National Environmental Policy Act (NEPA) and Section 404 of the Clean Water Act (CWA) permit process.

2.1 UNIVERSE OF ALTERNATIVES

Prior to development of any alternatives, initial public scoping meetings were held on February 28 and March 1, 2006 to present study area information to members of the public, governmental and agency officials, and, thus, receive feedback on resource mapping, schedule, and methodologies to be used in the development and analysis of alternatives. The constraints map was revised based on the feedback received during the scoping meetings. In addition, comments were received from members of the public and taken into consideration.

In addition to public comments, input was also obtained from agencies including the U.S. Army Corps of Engineers (USACE), Texas Parks and Wildlife Department (TPWD), Texas Commission on Environmental Quality (TCEQ), the U.S. Fish and Wildlife Service (USFWS), and the Environmental Protection Agency (EPA). Useful information was received relating to:

- Location of potential habitat for protected species
- Distinction between floodplain and wetland sites
- Preferred locations for stream crossings
- Previous wetland mitigation sites

The identification of transportation Build Alternatives known as the “universe of alternatives” was developed from three sources:

- Results from the Corridor Analysis Tool (CAT), a Geographic Information System (GIS) based spatial analysis software (**Appendix F**),
- Existing and previously studied corridors , including those found in TxDOT’s Environmental Overview of the Grand Parkway, the City of Houston’s 2005 Major Thoroughfare Map, the Mount Belvieu Comprehensive Plan, H-GAC 2035 RTP, and 2005 public hearing exhibits for transfer of Lake Houston Park from TPWD to the City of Houston, and
- Alternatives generated by the study team incorporating public and agency input.

Refer to **Exhibit 2-1: Previously Mapped and Publicly Available Alternatives** for previously published alternatives in the Segments H and I-1 study area.

Alternatives for Segments H and I-1 start at US 59 (N) just south of Splendora and continue southeasterly across US 90, ending at IH 10 (E) near Mont Belvieu. Four begin and four end points along US 59 (N) and IH 10 (E), respectively, were selected at logical points based on constraints and existing cross street locations. The CAT was used to map alternatives using GIS software that plotted alternatives while avoiding and minimizing impacts to environmental constraints. Refer to **Exhibit 2-2: CAT Alternatives** for the CAT begin and end points and alternatives. Similarly, the study team used the constraints map to develop other combinations of alternatives that would likely meet the need and purpose of the project. Constraints were considered at different levels of avoidance as described below:

- Schools, high density and clustered developments, archeological sites, cemeteries, parks, potential habitats of threatened and endangered species, a potential state superfund site, and clusters of oil/gas wells were considered as total avoidance constraints;
- Churches, 100-year floodplains, non-impaired and ecologically substantial streams, individual oil wells, high value wetlands, water/wastewater plants, electric substations, water wells and other major utility facilities were considered points of high value constraints for avoidance or minimization; and
- Public facilities, major roads, rail lines, impaired streams, hazardous materials locations, and medium value wetlands were ranked as medium to low value constraints for avoidance or minimization.

The study team evaluated the maps from previous studies as well as the CAT generated alternatives. Based on the CAT results, the study team made adjustments near the begin and end points to improve feasibility of the initial alternatives. Although four end points were input into CAT, the resulting outcome yielded only two feasible connections to IH 10. To supplement the initial set of alternatives, the study team used the constraints map to generate additional alternatives across a wider range within the study area. In addition, the study team created alternatives using portions of the previously published alternatives (**Exhibit 2-1**) with adjustments to avoid impacts to Lake Houston Park. The consultant study team-generated alternatives are shown together with the previously published alternatives which yielded the universe of alternatives (**Exhibit 2-3: Study Team Universe of Alternatives**).

For the evaluation of the large set of universe of alternatives, a broader set of initial criteria was used. To be conservative, an 800-ft wide corridor was established for identifying potential impacts. The universe of alternatives was studied in multidiscipline team workshops using professional judgment and input received from the first series of public scoping meetings. The study team performed a constraints analysis on the universe of alternatives. Due to both agency and public input, it was determined early in scoping that parklands (such as Lake Houston Park), and any potential habitat for threatened and endangered species should be avoided whenever possible. Therefore, these were the only constraints considered during initial alternatives development.

2.2 PRELIMINARY ALTERNATIVES

Corridors passing the fatal flaw analysis were carried forward for further study as preliminary alternatives. The preliminary alternatives traversed a wide band of the study area and were divided into three sections:

A, B, and C (**Table 2-1**). The section limits were established where several alternatives passed through a common point of intersection before dispersing again. This common point was used as a natural divide between adjacent sections. The portions of the alternatives within each section were then independently studied and compared for impacts (**Exhibit 2-4: Preliminary Alternatives with Recommended Reasonable Alternatives**). This allowed the study team to compare the alternatives at a more detailed level and then combine various sections to create more flexibility in consideration of the overall alternatives.

Table 2-1: Description of Sections of Preliminary Alternatives

Section	Description of Section Limits	Avoided or Minimized Impacts to Constraints
A	Begins at US 59 (N) and proceeds east, ending near the East Fork of the San Jacinto River, east of Lake Houston Park	Lake Houston Park, developed areas, wetlands, potential threatened and endangered species habitat, the confluence of streams, and forested habitat.
B	From Section A, proceeds southeast, crossing FM 1960, and staying southwest of Dayton to approximately 1 mi south of US 90	Developed areas, two salt domes, a hazardous waste site and minimizing impacts to other constraints such as floodplains, wetlands, oil and gas wells, schools, and churches.
C	From Section B, proceeds south through City of Mont Belvieu to IH 10 (E)	Developed areas, industrial areas, utility stations, floodplains, schools, and churches.

Source: Study Team, 2006

2.2.1 Preliminary Alternatives Evaluation

The purpose of the proposed facility is to improve the mobility of people and goods in the area by enhancing the existing transportation system in terms of discontinuous system linkage, decreased mobility, compromised safety, and a lack of infrastructure to support population growth while avoiding and/or minimizing adverse impacts to the community, natural resources, and existing infrastructure. The preliminary analysis was based on a broad range of multidisciplinary evaluation criteria including environmental, engineering, traffic/mobility, and public/agency input. Although a 400-ft wide corridor is proposed for Segments H and I-1, as a conservative approach, an 800-ft corridor was used to quantify the impacts of the preliminary alternatives for comparison. The study team obtained outputs of all quantifiable impacts through CAT analysis.

The environmental criteria at this level evaluated the impacts on buildings, developed areas, floodplains, wetlands, managed land (parkland), hazardous material sites, threatened and endangered species, and major streams. The Lake Houston Park was a major constraint within the study area that was avoided during the development of the preliminary alternatives. The engineering criteria considered right-of-way (ROW) needs, construction complexity, and cost factors, including length of alternative, floodplain

crossings, road and railroad crossings, major utilities, and existing facilities to be reconstructed. Traffic and mobility criteria investigated included emergency and hurricane evacuation facilitation, connectivity to existing roadway systems, travel time along alternatives, and conformance with area transportation plans.

Following the technical evaluations, additional input was sought and gathered from the Fast-Track Advisory and Streamlining Team (FAST). The FAST included representatives from TxDOT Environmental Affairs Division (TxDOT ENV), TxDOT Houston and Beaumont Districts, FHWA, Grand Parkway Association (GPA), and the consultant team.

To complete the evaluation of preliminary alternatives, a second series of public scoping meetings was held on May 8 and 9, 2007. The universe and preliminary alternatives were presented, as well as the recommendations for reasonable alternatives. **Exhibit 2-4: Preliminary Alternatives with Recommended Reasonable Alternatives** shows the preliminary alternatives (green and yellow together) in two colors to distinguish between the ones recommended to be carried forward for the second series of public scoping meetings. These meetings were held in May of 2007. Feedback was received from the general public, public officials and agency officials on the alternatives shown within each of the three sections. Section 2.2.2 below discusses the outcome of the May 2007 public scoping meetings and preliminary alternative evaluation.

2.2.2 Alternative Sections Not Recommended

The preliminary alternatives discussed below were shown at the second series of public scoping meetings held in May of 2007 as recommended reasonable alternatives. Upon completion of the preliminary alternative evaluation and consideration of input received from the public, the following preliminary alternatives discussed in the sections below were eliminated from further study.

2.2.2.1 Section A

Preliminary Alternative A-1 was originally selected as a recommended reasonable alternative. However, it had the longest offset from Segment G, an adjacent Grand Parkway Segment to the west under study (**Exhibit 2-4**), and was considered confusing and difficult to negotiate by the general public because it connects to SH 242 on the west side of US 59 (N). Further, it received low support from the public and elected officials.

Preliminary Alternative A-3 would require reconstruction of existing FM 1485 for the entire length of the alternative, which also would result in impacts to developed areas; therefore, A-3 was not selected as a recommended reasonable alternative.

Preliminary Alternative A-5 was very similar to A-4; however, A-5 required ROW from Lake Houston Park which would result in impacts to the park. Because of these impacts, this alternative was eliminated from further study.

In summary, Preliminary Alternatives A-1, A-3 and A-5 within Section A were eliminated from further detailed study in this DEIS.

2.2.2.2 Section B

Preliminary Alternative B-3 was originally selected as a recommended reasonable alternative. Alternative B-3 would require more existing local roadway closures than B-2 and B-5, which were carried forward. Alternative B-3 would cross FM 686 at three separate locations and could result in portions of it being closed.

Preliminary Alternative B-4 crossed US 90 in close proximity to FM 1413, which may impact residential development. The public was also concerned about flooding.

Preliminary Alternatives B-6, B-7, and B-8 follow existing roadways resulting in impacts to populated areas and received unfavorable public input. A large portion of Alternative B-6 was within the floodplain and a large portion of B-8 impacted existing roadways.

In summary, Preliminary Alternatives B-3, B-4, B-6, B-7 and B-8 within Section B were eliminated from further detailed study in this DEIS.

2.2.2.3 Section C

Preliminary Alternative C-1 required reconstruction of SH 146 for a portion of its length. It was undesirable from a traffic and mobility perspective because it did not provide an alternate route and did not adequately

address the needs of the overall study area. Alternative C-1 was very similar to C-2 which received more public support.

Preliminary Alternatives C-4 and C-7 were offset from Grand Parkway Segment I-2 (adjacent Grand Parkway Segment to the south), which may create traffic handling difficulties during evacuations, and were considered confusing and difficult to negotiate by the general public. There is also an abundance of pipelines on the west side of Mont Belvieu that would further reduce the viability of Alternatives C-4 and C-7. They received unfavorable support by the public and elected officials.

Preliminary Alternative C-5 was similar to C-6, but had more impacts to industrial and residential development and received less support from the public and elected officials than C-6.

In summary, Preliminary Alternatives C-1, C-4, C-5, and C-7 within Section C were eliminated from further detailed study in this DEIS.

2.2.3 Alternative Sections Carried Forward for Further Analysis

The public input was evaluated and incorporated into the preliminary alternatives evaluation. Multidiscipline team workshops were conducted to review the technical analysis, public input, and project need and purpose and to recommend alternatives to be carried forward for further study. Listed below are the alternatives recommended as reasonable within each of the three sections.

2.2.3.1 Section A

Preliminary Alternative A-2 received positive public feedback. Compared to the eliminated alternatives, it would have minimal impacts to the environmental and engineering criteria categories listed in **Section 2.2.1**. It would provide for the avoidance of parklands and would not bisect any developed communities. Preliminary Alternative A-2 would bisect an undeveloped platted community (Kings Colony) that has been platted since the 1970s but has remained undeveloped.

Preliminary Alternative A-4 received the highest public support and no opposition from elected officials. Impacts to Lake Houston Park property are not anticipated; however, any future plans for direct access to Lake Houston Park would have to be evaluated at a later date when those plans are available to determine

the nature of the impacts. No impacts are anticipated for any other sites within the APE. Additionally, this alternative would not bisect any communities. It would have minimal impacts to the environmental and engineering criteria categories listed in **Section 2.2.1** and a favorable impact on traffic. Preliminary Alternative A-4 would connect to the potential alternative of Grand Parkway Segment G at US 59 (N).

Within Section A, Preliminary Alternatives A-2 and A-4 were carried forward for more detailed study in this DEIS.

2.2.3.2 Section B

Preliminary Alternative B-1 received the highest public and elected official support and would have minimal impacts to the environmental and engineering criteria categories listed in **Section 2.2.1**. Alternative B-1 would serve Dayton and underserved populated areas in the eastern portion of the study area.

Preliminary Alternative B-2 received high public support, and because it is centrally located it would serve the entire study area. Alternative B-2 overall would have minimal impacts to the environmental and engineering criteria categories listed in **Section 2.2.1** and a favorable impact on traffic. It would also provide a transportation facility to underserved areas of Liberty County.

Preliminary Alternative B-5 received moderate public support and little opposition and would provide an acceptable interchange location at US 90. It would provide a transportation facility to underserved areas. This alternative would have minimal environmental impacts and a favorable impact on traffic.

Within Section B, Preliminary Alternatives B-1, B-2 and B-5 were carried forward for more detailed study within this DEIS.

2.2.3.3 Section C

Preliminary Alternative C-2 received the highest public support and would follow the 2010 Mont Belvieu Thoroughfare Plan. Alternative C-2 would have minimal impacts to existing developments in Mont Belvieu and would provide direct connectivity to the Grand Parkway Segment I-2 providing an additional north-south evacuation route.

Preliminary Alternative C-3 received public support and would follow the Mont Belvieu 2010 Thoroughfare Plan. Alternative C-3 would have minimal impacts to existing developments in Mont Belvieu and would provide direct connectivity to Grand Parkway Segment I-2, thus providing an additional north-south evacuation route. It would have minimal impacts to the environmental and engineering criteria categories listed in **Section 2.2.1** and a favorable impact on traffic.

Preliminary Alternative C-6 received strong support from elected officials and would also follow the Mont Belvieu Thoroughfare Plan. Alternative C-6 would have minimal impacts to existing developments in Mont Belvieu and would provide direct connectivity to Grand Parkway Segment I-2 providing an additional north-south evacuation route.

Within Section C, Preliminary Alternatives C-2, C-3 and C-6 were carried forward for more detailed study in this DEIS.

2.2.4 Adjustments to Preliminary Alternative Sections

The universe and preliminary alternatives were developed using GIS as a series of line segments connected together. While this was acceptable for the scale and level of detail used in the preliminary evaluation, the preliminary alternatives carried forward as reasonable were further refined using Computer Aided Design and Drafting (CADD) software to add curves between the lines and develop horizontal alignments that meet the TxDOT Roadway Design Manual (2006) for a 70 mile per hour (mph) design speed. During the refinement process, the alternatives were adjusted where possible to further minimize potential impacts. Some of the adjustments are described below:

- A-4 was better aligned within the Grand Parkway dedicated corridor at Community Drive east of US 59 (N). Where A-4 parallels FM 1485, it was also shifted slightly north to avoid impacts to Lake Houston Park.
- The northern portion of B-1 was shifted south to minimize impacts to existing local roads and maintain access to farmlands.
- B-2 was modified to reduce impacts to sensitive habitats near Cedar Bayou.
- B-5, near the Harris County line, was shifted west to minimize Luce Bayou floodplain impacts.
- C-3 was modified to address public input and avoid impacts to development in Mont Belvieu.

Refer to **Exhibit 2-5: Reasonable Alternatives** for the locations of the reasonable alternatives.

2.2.5 Recommended Complete End-to-End Alternatives

Following refinement, the preliminary alternatives recommended for further study within each of the three sections were combined to form complete end-to-end reasonable alternatives from US 59 (N) to IH 10 (E). All possible combinations from the three different sections were formed. The result was 10 reasonable Build Alternatives, plus the No-Build Alternative resulting in 11 total reasonable alternatives. The reasonable alternatives to be carried forward for further study are named for future reference in **Table 2-2**.

Table 2-2: End-to-End Reasonable Alternatives

Alternative	Description
1	No-Build
2	A-2, B-1, C-2
3	A-2, B-1, C-3
4	A-2, B-2, C-2
5	A-2, B-2, C-3
6	A-2, B-5, C-6
7	A-4, B-1, C-2
8	A-4, B-1, C-3
9	A-4, B-2, C-2
10	A-4, B-2, C-3
11	A-4, B-5, C-6

Source: Study Team, 2007

Within the Segments H and I-1 study area, the 10 reasonable Build Alternatives would fulfill the need and purpose of the project while avoiding and/or minimizing potential environmental impacts. As these alternatives have common sections, they overlap each other demonstrating similar environmental and engineering impacts within those reaches. The end-to-end combinations for reasonable alternatives are shown in **Exhibit 2-5: Reasonable Alternatives**.

2.3 TRANSPORTATION MODE STUDY

An analysis was conducted for 10 distinct reasonable Build Alternatives which were derived from the previous analysis of the preliminary alternatives. These 10 Build Alternatives were evaluated against the No-Build Alternative to evaluate the extent to which the stated need and purpose for this study was met. Within this section, there are references to the Segments H and I-1 “traffic study area.” The traffic study area extends beyond the study area. Because implementation of the proposed Segments H and I-1 would affect traffic beyond the study area, it is necessary to quantify these effects when discussing traffic impacts

and benefits. The traffic study area includes all roadways within the study area as well as roadways outside the study area that experience a change in traffic volumes of plus or minus 5%, based on the traffic model, due to the addition of Segments H and I-1.

2.3.1 No-Build Alternative

The No-Build Alternative comprises all committed projects included in the 2035 RTP with the exception of Segments H and I-1. The 2035 RTP is the H-GAC’s transportation plan for the eight-county Houston area. These improvements include added capacity projects (such as new roadways and roadway widening) as well as modal improvements such as transit. These improvements are already a part of the ongoing plan for upgrades to the existing roadway system. Transportation system management (TSM), travel demand management (TDM), modal transportation improvements, and Smart Street components of the No-Build Alternative are detailed in the following sections.

2.3.1.1 Transportation System Management (TSM) Measures

TSM measures implemented at critical locations can improve traffic operations and safety. These types of improvements are typically low cost measures that improve traffic flow by making better use of the existing transportation system. They typically include intersection improvements, parking and turn restrictions, traffic signal upgrades, signal coordination, median improvements, and access control improvements. TSM measures identified for Segments H and I-1 traffic study area in the 2035 RTP are summarized in **Table 2-3**.

Table 2-3: TSM Projects in the 2035 RTP

Project ID	Description	Location
9709	Construct Grade Separation	On US 90 at Union Pacific Railroad (UPRR) in Dayton
472	Construct Grade Separation	On US 90 at FM 563
6095	Construct Railroad Grade Separation Structure and Approaches	On FM 2100 at Southern Pacific Railroad (SPRR) in Crosby
1102	Install CMTS-including surveillance system, communication system, satellite computer facility, and monitoring control	On US 90 from IH 10 (E) to Liberty County Line
10834	Construct right-turn lane	SH 242 at FM 1314
10162	Addition of CCTV, DMS, HAR and Environmental Monitoring	US 59 (N) at San Jacinto River Bridge

Source: H-GAC 2035 RTP

Table 2-3 (Cont.): TSM Projects in the 2035 RTP

Project ID	Description	Location
13561	Realign south u-turn, construct parking lots, install drainage structures & pedestrian rail	US 59 (N) (u-turns at San Jacinto River Bridge)
1102	Install CMTS-including surveillance system, communication system, satellite computer facility, and monitoring control	On US 90 from IH 10 (E) to Liberty County Line

Source: H-GAC 2035 RTP

One of the major benefits of proposed Segments H and I-1 is the improvement in north-south mobility. Currently, north-south mobility in the study area is provided by SH 146/SH 321 and FM 2100. These roadways are located near the far ends of the study area and do not adequately serve the center of the study area. Both SH 146 and FM 2100 are identified in the 2035 RTP for widening from two lanes to four lanes. For the traffic needs analysis, 2039 was selected as the horizon year (design year), with 2019 as the interim year (construction completion date). The travel demand model utilized for analysis used the 2035 RTP, which was adopted in August 2007. H-GAC provided demographic forecasts through 2050 and, therefore, provided a year 2039 dataset which comprises 2039 travel demand on the 2035 RTP roadway network. In the 2039 No-Build Alternative, SH 146 is projected to carry 56,600 vpd between FM 1942 and IH 10, which would result in a level of mobility (LOM) rating of serious (refer to **Chapter 1, Section 1.2.2.1** for a description of LOM). FM 2100 is projected to carry 53,350 vpd between FM 1960 and US 90, which would result in a LOM rating of severe (refer to **Table 1-5**). The higher volume sections of FM 2100 from FM 1960 to IH 10 are projected to carry 83,100 to 86,000 vpd and would also operate at a severe LOM. Clearly, not only would these facilities not be able to adequately handle the projected traffic demand, they are not controlled-access facilities and would not be suited for the longer distance regional trips that Segments H and I-1 could accommodate. The presence of traffic signals along these roadways would also result in more vehicular stops, a potential safety concern, and less mobility compared to the level of service that a controlled-access roadway such as Segments H and I-1 could provide. Additionally, because these roadways are not controlled-access, future development along the ROW would likely hamper mobility and result in reduced efficiency for local trips as well.

While the TSM improvements included in the 2035 RTP are expected to ease congestion and travel time for local trips, these improvements do not adequately address critical issues identified in the project need and purpose statement such as discontinuous system linkage, decreased mobility, compromised safety, and lack of infrastructure to support population growth.

2.3.1.2 Travel Demand Management (TDM) Measures

TDM measures are strategies and programs that encourage commuters to use alternatives to driving alone, especially during periods of heavy congestion. These strategies typically contribute to reducing congestion along a corridor as they manage the demand placed on the transportation system. TDM measures are generally behavioral changes for the commuting public and also include employers offering flexibility and incentives to their employees to modify their travel patterns and modes. Examples of TDM measures include carpooling/vanpooling, park and pool/park and ride lots, flexible work hours, telecommuting, employer incentives, and transit. TDM measures identified in the 2035 RTP for the Grand Parkway Segments H and I-1 study area include the Liberty County Park and Ride Facility to be located southwest of Dayton along US 90, and the Atascocita Park and Ride Facility to be located on FM 1960 west of Lake Houston Parkway (neither Park and Ride Facility has been constructed as of the date of this document).

Although TDM measures could help improve congestion in an urban area, these measures alone would not be sufficient to effectively accommodate the projected increase in traffic demand through 2039. The TDM components of the No-Build Alternative, by themselves, would not address critical issues identified in the project need and purpose statement such as system linkage, improved mobility, enhanced safety, emergency evacuation, and infrastructure to provide support for population growth.

A Congestion Mitigation Analysis (CMA) was conducted for parallel roadway facilities that would be impacted by the construction of Segments H and I-1. The CMA included TSM and TDM improvements too small to be incorporated into H-GAC's regional travel demand model. The study revealed that both TSM and TDM measures alone would not sufficiently improve LOM for the study area.

2.3.1.3 Modal Transportation Improvements

Modal transportation improvements include bus transit, rail transit, and HOV lanes. The largest public transit provider in the region is the Metropolitan Transit Authority of Harris County (METRO). The 2035 RTP incorporates the 2035 METRO Long Range Plan, which is an iterative process incorporating the 2025 METRO Solutions Plan and future mobility needs identified in regional planning efforts. METRO's 2035 Long Range Plan recommends substantial expansion of the current transit system and includes a network of integrated high capacity transit facilities on major travel corridors; however, there are no improvements planned in the study area.

Bus Transit

In addition to METRO, public transit services in the H-GAC Transportation Management Area are provided by the Brazos Transit District, Island Transit, and Connect Transportation. METRO, in conjunction with Harris County Precinct 2, created a park and ride service to downtown Houston from the San Jacinto Mall in 2007 southwest of the project area. A Liberty County Park and Ride Facility located southwest of Dayton along US 90 is currently listed in the long range regional transportation plan. Neither METRO nor any of these other transit providers currently serves the immediate study area or has documented plans to do so in the near future.

Rail Transit

METRO Solutions (Phase 2 Implementation Plan) includes future deployment of light rapid transit and commuter rail. The plan includes 89 mi of rapid transit corridors. Four of these corridors, the North, East End, Southeast, and Uptown would initially begin as bus rapid transit convertible, ultimately becoming light rail lines. Added to the planned University corridor, and the Red Line which is currently operating, METRO intends for these to form the inner-city rapid transit network. The plan also includes 84 mi of commuter rail along US 90A (in southwest Houston), US 290, and a new Galveston Line through Clear Lake and NASA. METRO Solutions does not include improvements in the study area. Currently, there are no plans to serve the study area with rail transit.

High Occupancy Vehicle (HOV)/High-Occupancy Toll (HOT) Lanes

The TDM toolbox includes the HOV lane which is a roadway lane(s) reserved for exclusive use by cars with a driver and one or more passengers and by buses and vanpools. It is a congestion mitigation measure typically utilized on an existing freeway facility to improve traffic operation particularly for commuting traffic during the peak hours. Closely related to the HOV concept is the implementation of HOT/managed lanes. A HOT lane is a designated lane for high occupancy vehicles (2 or more) as well as for toll-paying vehicles that do not meet the required occupancy. This concept is seen as especially important in congested corridors with limited potential for the building of additional lanes. The 2035 RTP identifies regional increases in HOT lane and regular toll lane miles. METRO currently operates a number of HOV lanes in the H-GAC area.

The only freeways in the Grand Parkway Segments H and I-1 traffic study area are US 59 (N) and IH 10 (E). The 2035 RTP shows plans for HOT/managed lanes along US 59 (N) north of FM 1960. The 2035 RTP does not show any HOV or HOT/managed lanes along IH 10 (E) in the study area.

2.3.1.4 Smart Street Alternatives

The Smart Street concept was developed and introduced in the 2025 RTP as an additional tool to improve mobility, transit access and safety by providing operational improvements along strategic regional thoroughfares. A Smart Street is a roadway that incorporates traffic management and technological improvements to improve traffic flow and capacity rather than adding lanes. Smart Street enhancements in the 2035 RTP focus on a range of operational management techniques to reduce delay such as:

- traffic light synchronization
- deployment of roundabouts
- medians
- constructing or extending (as needed) turn bays
- consolidation of duplicate driveways
- partial grade separation of some traffic lanes at major intersections

The following are the Smart Streets identified in the 2035 RTP in the Segments H and I-1 traffic study area:

- US 90 (Liberty County line to FM 770)
- FM 1960 (Liberty County line to IH 45)
- SH 321 (US 90 to SH 105)
- Kingwood Drive (from US 59 (N) to east of FM 2100)
- SH 146 (Grand Parkway Segment I-2 to US 90)
- FM 2100 (FM 1960 to IH 10)
- Lake Houston Parkway (Grand Parkway to south of FM 1960)
- SH 242 (IH 45 to US 59)
- FM 1314 (Lake Houston Parkway to south of Creighton Road)

Although the implementation of Smart Streets would improve traffic operations along these study area roadways, the enhancements would not sufficiently address the study area linkage needs and would not provide the additional circumferential capacity to handle the projected traffic demand.

2.3.1.5 No-Build Alternative Summary

The No-Build Alternative includes all improvements identified in the 2035 RTP with the exception of Segments H and I-1, and includes all TSM, TDM, and modal transportation improvements. Based on analysis of these components individually and collectively, it was found that although the No-Build Alternative would result in some improvements to regional congestion due to planned improvements to the existing roadway network listed in the 2035 RTP, it would not adequately address the system linkage, improved mobility, enhanced safety, emergency evacuation, and infrastructure to provide support for population growth needs in the study area.

2.3.2 Build Alternatives

Segments H and I-1 are planned by TxDOT and the GPA as a controlled-access toll facility to be constructed on new location, consistent with the 2035 RTP. The Build Alternatives are proposed to complement the No-Build Alternative, not replace any of the improvements identified therein. The Build Alternatives include all improvements identified in the No-Build Alternative such as added capacity projects, TSM, TDM, and Smart Streets. The Build Alternative is specifically targeted at relieving local and regional congestion, improving mobility, providing system linkage, and enhancing safety on congested roadways within the region, including an improved emergency evacuation route. All Build Alternatives meet the need and purpose of the project.

Funding for new roadways through traditional means has become difficult as travel demand has outpaced roadway network improvements. This trend is projected to continue and as such, the 2035 RTP identifies the key role that toll roads and other managed facilities would play in the expansion of the regional roadway system. Segments H and I-1 are specifically included on the 2035 RTP as a four-lane tolled facility. Because there is currently no federal funding allocated or planned for the construction of Segments H and I-1, a free or non-tolled Build Alternative was not considered as part of this study.

2.3.2.1 Alternative Transportation Modes Eliminated from Detailed Study

The alternatives analysis process followed a sequential and logical methodology designed to evaluate alternatives for their ability to meet the need and purpose of the project. Other considerations included avoidance and/or minimization of adverse environmental impacts and public input. Alternatives that met these criteria were advanced to the next phase of study. Alternative improvements comprising TSM, TDM,

bus transit, rail transit, HOV/HOT lanes, and Smart Street alternatives were eliminated from detailed study for the reasons summarized below.

TSM Alternatives

Although TSM measures are designed to relieve congestion and improve traffic flow, they are generally most effective in areas with a roadway system that is operating at or above designed capacity. Without a roadway system in place that serves the circumferential travel demands of the study area, implementation of additional TSM measures on existing roadways would not adequately accommodate the projected travel demands. Without increased circumferential roadway capacity, TSM alternatives would not sufficiently improve the congestion projected for the No-Build Alternative.

TDM Alternatives

TDM measures rely heavily on behavioral changes by commuters and other roadway users. These improvements would not provide the magnitude of benefits needed to accommodate the local and regional demands for improved transportation system linkage, improved mobility, enhanced safety, emergency evacuation, and infrastructure to provide support for population growth.

Bus Transit

There are no plans for bus transit service in the study area. Although implementation of bus transit could potentially provide congestion relief on some sections of existing roadway, it would not address the absence of a circumferential roadway to meet the needs for improved transportation system linkage, improved mobility, enhanced safety, emergency evacuation, and infrastructure to provide support for population growth.

Rail Transit

Rail alternatives have been found to be most effective when oriented radially to serve commuters traveling during peak hours into and out of the central business core of a city. A rail transit alternative positioned radially or circumferentially, as would be required in the Segments H and I-1 study area, would not be anticipated to serve enough of the study area to satisfy the need and purpose of the project.

Smart Street Alternatives

It was found that the Smart Street component of the No-Build Alternative had substantial deficiencies in meeting the demand for circumferential travel within the Segments H and I-1 study area. This alternative would provide some improvement for existing roadways, but would neither provide circumferential connectivity nor meet the identified need for enhanced safety and improved mobility to accommodate projected travel demand.

2.3.2.2 Alternative Transportation Modes Advanced for Further Study

No-Build Alternative

The No-Build Alternative does not include construction of Segments H and I-1. This alternative consists of a continuation of the existing transportation facilities and incorporates the implementation of planned and committed improvements identified in the 2035 RTP for the study area. The Segments H and I-1 study area would continue to experience growth with or without construction of the new facility. The No-Build Alternative would result in a transportation system network that is not able to support the future increase in traffic volumes. The lack of adequate improvements to system linkage and mobility fails to satisfy the need and purpose of the project.

Although the No-Build Alternative would not satisfy the need and purpose, it was retained and utilized as the basis of comparison for the Build Alternatives and further consideration as required by CEQ regulations.

Build Alternatives

The Build Alternatives are approximately 35-41 mi in length. The facility would consist of a four-lane controlled-access toll road within 400 ft of ROW. The facility would have termini at US 59 (N) and IH 10 (E) and provide access via interchanges to freeways and major cross streets such as US 90, FM 1960, and others. As described in **Section 2.2 (Preliminary Alternatives)**, 10 Build Alternatives were developed through a cooperative process of public outreach, agency coordination, and avoidance and minimization of impacts to various resources. All projects in the No-Build Alternative are also part of the Build Alternative, including added capacity improvements, TSM, TDM, Smart Streets, and modal improvements. The Build Alternatives would provide the system linkage lacking in the No-Build Alternative, accommodate circumferential travel demand, improve mobility, enhance safety, provide a new emergency evacuation route, and provide the infrastructure to support population growth in a previously underserved area.

2.3.2.3 Traffic and Transportation Analysis

Discontinuous System Linkage

The existing transportation system in the study area for Segments H and I-1 does not have efficient circumferential connections to major radial roadways such as US 59 (N) and IH 10 (E). The interstate and regional highways are predominantly oriented in either an east-west or a north-south direction at the boundaries of the Segments H and I-1 study area. IH 10, US 90, and US 59 are three radial facilities connecting Houston to its suburbs and further destinations. Beyond Beltway 8, these radial facilities become increasingly further apart and there are no connecting facilities within the Segments H and I-1 study area. Below are additional existing system linkage conditions within the study area:

- The existing transportation system within the study area does not provide efficient connections to the suburban communities of Kingwood, New Caney, Huffman, Dayton, and Mont Belvieu.
- Major industrial complexes within the Segments H and I-1 study area include a Chevron refinery plant located along IH 10 (E), the Dow Industrial Chemical Plant, an Exxon refinery plant, Wal-Mart Distribution Center north of Dayton, and numerous gas storage facilities associated with two salt dome formations in Mont Belvieu and west of Dayton. The study area lacks an efficient circumferential connection for these industrial complexes to US 59 (N) and IH 10 (E).
- The study area is bound by radial roadways US 59 (N) and IH 10 (E), which are circuitously connected by minor arterials and collector roadways within the study area, such as FM 1485, FM 2100, FM 3360, FM 1413, Loop 494, and SH 146. To accomplish circumferential movements across the study area, travelers must use the radial roadways to reach the minor arterial and collector roadways.
- Freight traffic is transported via trucks from the Port of Houston through the study area to the major industrial complexes, as well as to US 59 (N) for national distribution. Trucks currently use the existing 2-lane local roadways in the study area for long trips which present traffic operation and safety issues.

Table 2-4 summarizes daily Vehicle Hours of Travel (VHT) per 24 hours for the No-Build Alternative and Build Alternatives for 2019 and 2039. The change in daily VHT varies depending on the facility type. The proposed Segments H and I-1 would reduce VHT on arterials and collectors as trips would be attracted to the more efficient controlled-access toll facility. While the results summarized in **Table 2-4** demonstrate a relatively small increase in overall VHT for the Build Alternative, this additional traffic is carried by the proposed Grand Parkway Segments H and I-1, which traffic models indicate would operate at a LOS B or better.

The proposed Grand Parkway Segments H and I-1 would result in time savings for travel along traffic study area interstates and arterials. Daily VHT in 2039 is projected to reduce by approximately 2% (8,414 hours) along interstates and by 19% (77,607 hours) along principal arterials. Daily VHT is projected to increase along minor arterials overall, but this is indicative of the change in traffic patterns with the construction of the proposed Segments H and I-1.

Table 2-4: Daily VHT by Facility Type in the Segments H and I-1 Traffic Study Area

Facility	2007	2019			2039		
		No-Build	Build	% Change	No-Build	Build	% Change
Interstates	139,801	221,983	221,474	-0.23	388,302	379,888	-2.17
Principal Arterials	79,809	138,071	138,205	0.10	402,698	325,091	-19.27
Proposed Grand Parkway (H and I-1)	N/A	N/A	5,609	N/A	N/A	10,091	N/A
Minor Arterials	115,322	203,583	199,498	-2.01	318,885	372,010	16.66
Collector Roads	24,911	46,345	45,060	-2.77	103,572	126,481	22.12
Total	359,843	609,982	609,846	-0.02	1,213,457	1,213,561	0.01

Source: Study Team, 2007; H-GAC, 2007.

Drivers would use some of these roadways to access the Grand Parkway Segments H and I-1 in order to save time on their overall trip. Therefore, even though their VHT on these facilities may increase, drivers would experience VHT savings on principal arterials, interstates, and the proposed Grand Parkway Segments H and I-1.

Decreased Mobility

The H-GAC regional travel demand model for the eight-county greater Houston metropolitan area was utilized in estimating base and future year traffic volumes for the No-Build Alternative and Build Alternatives. The model incorporates existing and planned roadway infrastructure as well as existing and forecasted demographics for the region. **Table 2-5** summarizes the No-Build Alternative and Build Alternatives ADT volumes and LOM for Segments H and I-1 and other major roadways in the traffic study area. The time horizons utilized for comparison are base year (2007), opening year (2019), and design year (2039). The No-Build Alternative includes all projects in the 2035 RTP with the exception of Segments H and I-1.

Table 2-5: Segments H and I-1 Traffic Study Area Base and Future ADT and LOM

Facility	From	To	2007 Base Year		2019					2039				
			ADT	LOM	No-Build ADT	No-Build LOM	Build ADT	Build LOM	% ADT Change	No-Build ADT	No-Build LOM	Build ADT	Build LOM	% ADT Change
US Highways and Interstates														
US 59 (N)	SH 105	Community Dr.	49,300	Tolerable	69,960	Tolerable	68,930	Tolerable	-1	102,650	Moderate	99,810	Tolerable	-3
US 59 (N)	Community Dr.	BW 8	104,480	Tolerable	144,220	Tolerable	146,550	Tolerable	2	218,320	Moderate	221,040	Moderate	1
IH 10 (E)	BW 8	FM 2100	128,800	Tolerable	175,050	Serious	171,660	Moderate	-2	252,170	Serious	246,930	Serious	-2
IH 10 (E)	FM 2100	SH 146	66,420	Tolerable	87,580	Tolerable	84,340	Tolerable	-4	127,070	Tolerable	123,120	Tolerable	-3
IH 10 (E)	SH 146	FM 563	62,460	Tolerable	78,200	Moderate	77,340	Moderate	-1	117,480	Moderate	118,350	Moderate	1
BW 8	E. of IH 45	US 59	100,950	Tolerable	113,850	Tolerable	117,730	Tolerable	3	157,500	Serious	162,220	Serious	3
BW 8	US 59	US 90	33,510	Tolerable	72,450	Tolerable	70,050	Tolerable	-3	115,760	Moderate	112,010	Moderate	-3
BW 8	US 90	IH 10	53,050	Tolerable	83,550	Tolerable	80,380	Tolerable	-4	110,900	Serious	107,350	Serious	-3
Grand Parkway	US 59	US 90	N/A	N/A	N/A	N/A	12,910	Tolerable	N/A	N/A	N/A	23,170	Tolerable	N/A
Grand Parkway	US 90	IH 10	N/A	N/A	N/A	N/A	6,540	Tolerable	N/A	N/A	N/A	11,750	Tolerable	N/A
Principal Arterials														
US 90	BW 8	FM 2100	30,090	Tolerable	76,310	Tolerable	74,210	Tolerable	-3	178,580	Serious	174,700	Serious	-2
US 90	FM 2100	SH 321	17,470	Tolerable	25,420	Serious	25,320	Serious	0	55,830	Serious	54,840	Serious	-2
US 90	SH 321	FM 770	14,100	Tolerable	18,510	Tolerable	19,580	Tolerable	6	26,880	Moderate	28,150	Moderate	5
FM 1960	BW 8	FM 2100	25,120	Serious	27,450	Serious	27,260	Serious	-1	40,640	Severe	40,330	Severe	-1
FM 1960	FM 2100	SH 321	11,110	Tolerable	14,740	Serious	13,330	Serious	-10	18,520	Severe	17,240	Serious	-7
Kingwood Dr./ Treaschwig Rd.	FM 1960	US 59	21,780	Tolerable	27,530	Serious	27,630	Serious	0	49,030	Severe	49,110	Severe	0
Kingwood Dr.	US 59	FM 2100	19,890	Tolerable	30,250	Moderate	30,650	Moderate	1	39,940	Serious	40,430	Serious	1
Kingwood Dr.	FM 2100	Proposed Grand Parkway	N/A	N/A	N/A	N/A	5,790	Tolerable	N/A	N/A	N/A	8,930	Tolerable	N/A
SH 105	US 59	SH 321	14,970	Serious	17,620	Severe	17,000	Serious	-4	28,250	Serious	26,600	Serious	-6
SH 105	SH 321	SH 146	6,100	Tolerable	8,260	Tolerable	8,000	Tolerable	-3	11,640	Serious	10,740	Moderate	-8
W. Lake Houston Pkwy.	Roman Forest Blvd.	Kingwood Dr.	12,820	Tolerable	13,800	Tolerable	13,720	Tolerable	-1	26,720	Tolerable	26,100	Tolerable	-2
W. Lake Houston Pkwy.	Kingwood Dr.	BW 8	27,440	Serious	28,010	Serious	27,770	Serious	-1	47,940	Severe	47,240	Severe	-1
Diamondhead Blvd.	BW 8	US 90	1,790	Tolerable	6,400	Tolerable	6,320	Tolerable	-1	42,270	Severe	41,810	Severe	-1
SH 146	IH 10	Loop 201	18,320	Tolerable	33,360	Tolerable	33,140	Tolerable	-1	59,050	Tolerable	58,230	Tolerable	-1

Table 2-5 (Cont.): Segments H and I-1 Traffic Study Area Base and Future ADT and LOM

Facility	From	To	2007 Base Year		2019					2039				
			ADT	LOM	No-Build ADT	No-Build LOM	Build ADT	Build LOM	% ADT Change	No-Build ADT	No-Build LOM	Build ADT	Build LOM	% ADT Change
SH 146 / LP 201	BS 146	Fred Hartman Bridge	7,600	Tolerable	12,790	Tolerable	12,930	Tolerable	1	21,340	Tolerable	23,260	Tolerable	9
FM 2100	US 90	IH 10	17,330	Tolerable	29,960	Severe	29,910	Severe	0	61,100	Severe	60,680	Severe	-1
Minor Arterials														
SH 321	FM 105	FM 1960	5,900	Tolerable	8,070	Tolerable	7,540	Tolerable	-7	15,750	Serious	14,970	Moderate	-5
FM 2100	FM 1485	FM 1960	9,600	Tolerable	20,990	Moderate	18,770	Tolerable	-11	32,670	Severe	32,390	Severe	-1
FM 2100	FM 1960	US 90	13,680	Serious	22,200	Severe	22,530	Severe	1	53,350	Severe	53,220	Severe	0
SH 146	SH 105	US 90	8,120	Tolerable	9,380	Moderate	9,310	Moderate	-1	15,450	Tolerable	14,880	Tolerable	-4
SH 146	US 90	IH 10	7,920	Tolerable	15,960	Tolerable	15,610	Tolerable	-2	31,450	Tolerable	31,280	Tolerable	-1
Cedar Bayou Lynchburg Rd.	Spur 330	Sjolander	6,590	Tolerable	11,620	Tolerable	11,410	Tolerable	-2	16,180	Tolerable	16,070	Tolerable	-1
FM 563	US 90	IH 10	3,730	Tolerable	5,510	Tolerable	5,480	Tolerable	-1	8,440	Tolerable	8,720	Moderate	3
FM 1010	SH 105	FM1485	3,150	Tolerable	5,440	Tolerable	5,780	Tolerable	6	9,250	Tolerable	9,700	Tolerable	5
FM 1409/ FM 565	US 90	IH 10	3,890	Tolerable	5,010	Tolerable	4,690	Tolerable	-6	7,650	Tolerable	7,350	Tolerable	-4
FM 1942	FM 2100	SH 146	7,230	Tolerable	10,010	Moderate	9,940	Moderate	-1	23,470	Severe	23,350	Severe	-1
Collector Roads														
FM 1485	Loop 494	W. Lake Houston Pkwy.	9,200	Serious	8,260	Tolerable	3,390	Tolerable	-59	11,800	Tolerable	7,610	Tolerable	-36
FM 1485	W. Lake Houston Pkwy.	FM 2100	6,940	Tolerable	8,750	Tolerable	2,010	Tolerable	-77	17,220	Tolerable	14,990	Tolerable	-13
FM 1413	Wolfe Island Rd.	SH 146	1,060	Tolerable	4,080	Tolerable	4,170	Tolerable	2	9,210	Serious	9,330	Severe	1
FM 3360	SH 146	IH 10	1,300	Tolerable	3,640	Tolerable	3,120	Tolerable	-14	5,900	Tolerable	5,050	Tolerable	-15
Ford/Mills Branch Rd.	Loop 494	Kingwood Dr.	9,610	Tolerable	12,350	Serious	12,320	Serious	0	18,860	Serious	18,750	Serious	-1
Roman Forest Blvd.	US 59	Tram (Galaxy)	8,220	Tolerable	13,130	Serious	11,820	Moderate	-10	19,050	Severe	19,460	Severe	2
FM 1008	SH 321	FM 1960	2,940	Tolerable	4,140	Tolerable	4,080	Tolerable	-1	5,840	Tolerable	5,430	Tolerable	-7
FM 163	SH 105	FM 1008	720	Tolerable	930	Tolerable	940	Tolerable	1	1,920	Tolerable	1,770	Tolerable	-8
FM 686	FM 1960	SH 321	1,020	Tolerable	1,590	Tolerable	1,750	Tolerable	10	2,830	Tolerable	2,970	Tolerable	5

Source: H-GAC, 2007

The Build Alternative includes everything in the No-Build Alternative plus Segments H and I-1. Overall, the results summarized in **Table 2-5** demonstrate that the construction of the Build Alternative would result in reduced traffic volumes on the traffic study area roadway network. **Table 2-5** shows that in 2039 the construction of the proposed Grand Parkway Segments H and I-1 would result in a 3% reduction in ADT along US 59 (N) (SH 105 to Community Drive). Without the Grand Parkway Segments H and I-1 there is limited north-south access in the study area. There are proposed ramp connections for FM 1010 (Huffman/Cleveland Road) at the Grand Parkway Segments H and I-1. For example, traffic from Cleveland headed south can use FM 1010 to get to the Grand Parkway Segments H and I-1 and travel south, rather than use US 59 (N). The same holds true for traffic headed to Cleveland from the east along major routes such as IH 10, FM 1960, and US 90. These diversions would result in a reduction in volume on US 59 (N). Additionally, there is a 3% reduction in ADT along IH 10 (E) (FM 2100 to SH 146). As well as reducing highway traffic volumes, the Build Alternative would also result in reduced traffic volumes along other roadways in the traffic study area. The proposed Grand Parkway Segments H and I-1 are projected to reduce daily traffic along SH 105, a principal arterial, by up to 8% in 2039, with LOM along this facility improving from serious to moderate. Other principal arterials that are projected to have reductions in ADT in 2039 include sections of FM 1960 and US 90, from Beltway 8 to SH 321 with reductions of up to 7% and 2% respectively. SH 321, a minor arterial is projected to have a 5% reduction in ADT in 2039 under the Build Alternative.

In general, collector roadways are projected to experience reduced traffic volumes as a result of the proposed Grand Parkway Segments H and I-1. In the Build Alternative in 2039, FM 1485 is projected to experience a reduction in ADT between 13% and 36%. FM 3360 is projected to experience a 15% reduction in ADT. Other collector roads in the study area that would experience a reduction in ADT are Ford/Mills Branch Road, FM 1008, and FM 163. ADT reduction on these roads range from 1% to 8%.

Traffic volumes on three collectors are projected to increase with the construction of the Grand Parkway Segments H and I-1. Under the Build Alternative in 2039, FM 1413 is projected to experience a 1% increase in ADT, Roman Forest a 2% increase, and FM 686 a 5% increase. However, this is attributable to their unique function in the study area network. As currently proposed, both FM 1413 and FM 686 would provide direct access to the Grand Parkway. Though it doesn't have a direct connection to the Grand Parkway, Roman Forest Boulevard is the primary roadway that would carry traffic from that built-up

community to the Grand Parkway via the interchange at Tram (Galaxy). The projected increase in traffic volume along these collectors, therefore, is reflective of the desire of traffic to utilize the more efficient Grand Parkway Segments H and I-1 for longer trips.

Compromised Safety

A crash analysis was conducted to determine how travel safety would be affected by a new circumferential highway. According to TxDOT, highways have lower crash rates than lower classified roads due to the design of the highways, fewer access points, fewer driver distractions, and less stop-and-go conditions. Therefore, diverting traffic from collector roadways to a limited access facility such as Segments H and I-1 would be expected to reduce the study area roadway crash rates.

Crash rates were previously calculated for study area roadways based on the number of crashes per 100 Million Vehicle Miles Traveled (MVMT). Crash rates are influenced by traffic volume, roadway segment length, roadway type, conditions, travel speed, and accessibility. Typically, roadways are considered to have a substantial crash problem when the crash rate is at least double the statewide average for that particular facility type. **Table 2-6** shows the roadways that were found to have a crash rate more than or close to double the statewide average. The table also shows the amount of projected traffic that would be diverted by Segments H and I-1.

Table 2-6: Segments H and I-1 Study Area Crash Rates (2006 - 2008)

Roadway Segment	Limits	Length (Mi)	Crash Rate (crashes/100 MVMT)	Statewide Average (crashes/100 MVMT)	ADT and % Change with Construction of Segments H and I-1					
					2019			2039		
					No-Build	Build	% Change	No-Build	Build	% Change
IH 10 (E)	Garth Road to Eagle/FM 3180	8.53	89.50	51.30	76,934	72,432	-5.85	105,518	103,331	-2.07
FM 1485	Loop 464 to FM 2100	8.96	214.10	125.70	6,872	2,007	-70.79	12,246	9,900	-19.16
FM 3360	FM 565 to SH 146	2.28	602	125.70	1,869	1,674	-10.43	4,411	4,070	-7.73

Source: TxDOT, 2009

Note: This table includes facilities with crash rates more than or close to double the statewide average.

As shown in **Table 2-6**, traffic volumes on these roadways with high crash rates would be reduced by as much as 71% in 2019 and by as much as 19% in 2039. These are facilities that would have traffic diverted onto the proposed Segments H and I-1. The crash rate takes into account the length of roadway segments and traffic volume and provides a very strong indication of traffic safety. Other factors such as accessibility, roadway type and travel speed influence the crash rate. Based on historical data, diversion of traffic

volumes from study area roadways onto a high-speed restricted access facility such as the Grand Parkway Segments H and I-1 is projected to reduce crash rates on those roadways.

In addition to crash safety, improved hurricane evacuation was identified as a need within the study area. During hurricane Rita in 2005, hurricane evacuation was impeded by the lack of circumferential highways in this region. Traffic trying to evacuate to the north had limited choices on facilities available. According to the Houston-Galveston Area Evacuation and Response Task Force Recommendation Report, SH 146 was backed up from Dayton south to Mont Belvieu due to limited capacity and connectivity with US 59 (N), lack of an evacuation plan, and more people evacuating than necessary. Segments H and I-1 would provide additional evacuation capacity and a direct route to US 59(N), as well as connectivity to Segment G. The No-Build Alternative does not address this need. During a hurricane or emergency evacuation, the tolls would be waived for the proposed Segments H and I-1.

2.3.2.4 Recommended Alternative Transportation Mode

The results of the traffic and transportation analysis for the Segments H and I-1 study area are summarized below with regard to discontinuous system linkage, decreased mobility, and compromised safety. The lack of infrastructure to support population growth need was not included in the traffic and transportation analysis because this need is based on population projections instead of traffic projections.

Discontinuous System Linkage

The Segments H and I-1 study area is served by only two freeways – US 59 (N) and IH 10 (E). US 59 (N) provides north-south mobility on the northwestern edge of the study area and IH 10 (E) provides east-west mobility along the southern edge. Principal arterials include SH 146/SH 321, US 90, and FM 1960. SH 146 and SH 321 are two-lane north-south roadways along the eastern edge of the study area. US 90 is a four-lane roadway and FM 1960 a two-lane roadway. Both serve east-west movements in the study area.

No current facility connecting major radial facilities exists in the Segments H and I-1 study area. Currently travelers utilize FM 1485, FM 1960, FM 2100, and SH 146 to make such connections. Secondary roads include FM 3360, FM 1942, FM 1413, and FM 1314. The central portion of the study area is especially deficient in good transportation infrastructure to support north-south and circumferential mobility. Though

the 2035 RTP identifies plans to upgrade some of the existing facilities, the roadway network would not be sufficient to handle the projected traffic volumes.

Decreased Mobility

In the No-Build Alternative, which includes the existing roadway infrastructure and committed improvements, congestion on the roadway network would increase as the study area experiences growth. **Table 2-7** summarizes the percentage of roadway miles, by functional classification, operating at different levels of mobility for 2007, 2019, and 2039. The percent of interstate miles operating at a tolerable LOM is projected to decrease from 88% in 2007 to 36% in 2039 under the No-Build Alternative, while the Build Alternatives maintain 37% at tolerable LOM. Furthermore, under the No-Build Alternative, the percent of principal arterial miles operating at tolerable LOM is projected to reduce from 66% in 2007 to 25% by 2039, while the Build Alternatives maintain 30% tolerable LOM. Similarly, under the No-Build Alternative, 61% of the principal arterial miles operate at serious and severe LOM by 2039, compared to only 55% in the Build Alternatives.

Table 2-7: LOM by Percentage of Roadway Miles for Segments H and I-1 Traffic Study Area

LOM	2007 Base Year	2019		2039	
		No-Build	Build	No-Build	Build
Interstates					
Tolerable	88%	79%	79%	36%	37%
Moderate	10%	6%	7%	32%	31%
Serious	1%	13%	12%	20%	20%
Severe	1%	2%	2%	12%	11%
Principal Arterials					
Tolerable	66%	50%	52%	25%	30%
Moderate	12%	15%	13%	14%	15%
Serious	13%	17%	18%	28%	21%
Severe	9%	18%	17%	33%	34%
Proposed Grand Parkway					
Tolerable	N/A	N/A	100%	N/A	100%
Moderate	N/A	N/A	0%	N/A	0%
Serious	N/A	N/A	0%	N/A	0%
Severe	N/A	N/A	0%	N/A	0%
Minor Arterials					
Tolerable	83%	69%	70%	50%	46%

Source: H-GAC, 2007

Table 2-7 (Cont.): LOM by Percentage of Roadway Miles for Segments H and I-1 Traffic Study Area

LOM	2007 Base Year	2019		2039	
		No-Build	Build	No-Build	Build
Minor Arterials Cont.					
Moderate	8%	13%	13%	11%	14%
Serious	6%	13%	12%	19%	20%
Severe	3%	6%	5%	20%	20%
Collector Roadways					
Tolerable	93%	78%	76%	51%	50%
Moderate	2%	7%	9%	7%	8%
Serious	3%	7%	7%	17%	16%
Severe	2%	8%	8%	25%	26%
Total Roadway Miles					
Tolerable	84%	70%	71%	44%	46%
Moderate	7%	11%	11%	14%	15%
Serious	6%	12%	11%	21%	18%
Severe	3%	7%	7%	22%	21%

Source: H-GAC, 2007

Currently, 9% of all study area roadway miles operate at serious and severe LOM. Assuming that all programmed improvements are implemented, excluding the proposed Segments H and I-1, it is projected that 43% of the study area roadway miles would operate at serious and severe LOM by 2039, in contrast to the Build Alternatives for which only 39% would operate at serious and severe LOM. In addition, 44% of all the study area miles would operate at a tolerable LOM by 2039 in the No-Build Alternative while construction of Segments H and I-1 would result in 46% of all study area roadway miles operating at a tolerable LOM.

Compromised Safety

Nationally, highways have lower crash rates than lower classified roads due to the design of the highways, fewer access points, fewer driver distractions, and less stop-and-go conditions. Therefore, diverting traffic from collector roadways to a limited access facility such as the proposed Segments H and I-1 is expected to reduce roadway crash rates in the study area. In addition, Segments H and I-1 provide additional emergency evacuation capacity and a direct route to US 59(N), as well as connectivity to Segment G. The No-Build Alternative does not address this need.

Conclusion

Given the above results, the Build Alternatives were advanced for further study. Although the No-Build Alternative would not satisfy the need and purpose of the project, it was retained and utilized as the basis of comparison for the Build Alternatives and for further consideration as required by CEQ regulations. The next section summarizes analyses conducted for the individual Build Alternatives selected as reasonable alternatives within the Segments H and I-1 study area.

2.4 REASONABLE ALTERNATIVES

2.4.1 Description of Reasonable Alternatives

2.4.1.1 Alternative 1

The No-Build Alternative does not satisfy the need and purpose for the proposed improvements and it is not consistent with the 2035 RTP; however, FHWA, TxDOT, and CEQ guidelines for the preparation of environmental documents require that the No-Build Alternative be carried forward as the basis of comparison for all reasonable alternatives.

The No-Build Alternative involves the construction of other projects currently planned and programmed in the H-GAC's 2035 RTP. The No-Build Alternative would offer no additional capacity and only minor mobility improvements to the study area. In addition, the No-Build Alternative would not provide an additional evacuation route to enhance safety or provide additional infrastructure to support population growth.

2.4.1.2 Alternative 2

Alternative 2 combines Sections A-2, B-1, and C-2 and is approximately 38.2 mi in length. Alternative 2 begins at Roman Forest Boulevard and US 59 (N), approximately 1.5 mi north of FM 1485. After bridging over Loop 494 and the Union Pacific Railroad (UPRR), it travels east crossing Peach Creek and the East Fork San Jacinto River to the Liberty County line. Alternative 2 traverses east further for approximately 9 mi before turning south and traversing 7 mi while crossing over the UPRR, FM 1960, and US 90 approximately 3 mi east of Dayton. Alternative 2 crosses FM 1413 and UPRR and then travels south between the railroad and SH 146. It then turns southeast crossing SH 146 and FM 565 east of Mont Belvieu before terminating at IH 10 (E), 2.0 mi east of SH 146. All 38.2 mi of Alternative 2 would be on a new location. Alternative 2 would require approximately 1,852 acres (ac) of ROW.

2.4.1.3 Alternative 3

Alternative 3 combines Sections A-2, B-1, and C-3 and is approximately 39.4 mi in length. Alternative 3 begins at Roman Forest Boulevard on US 59 (N), approximately 1.5 mi north of FM 1485. After bridging over Loop 494 and the UPRR, it travels east crossing Peach Creek and the East Fork San Jacinto River to the Liberty County line. Alternative 3 traverses east further for approximately 9 mi before turning south and traversing 7 mi while crossing over the UPRR, FM 1960, and US 90 approximately 3 mi east of Dayton. Approximately 3 miles south of US 90, Alternative 3 turns in a southwesterly direction crossing FM 1413 and traversing south while staying west of the UPRR. It then turns east bridging over the railroad and crosses Alternative 2 and SH 146, FM 565 east of Mont Belvieu, and eventually terminating at IH 10 (E). All 39.4 mi of Alternative 3 would be on new location. Alternative 3 would require approximately 1,910 ac of ROW.

2.4.1.4 Alternative 4

Alternative 4 combines Sections A-2, B-2, and C-2 and is approximately 35.4 mi in length. Alternative 4 begins at Roman Forest Boulevard on US 59 (N), approximately 1.5 mi north of FM 1485. After bridging over Loop 494 and the UPRR, it travels east crossing Peach Creek and the East Fork San Jacinto River to the Liberty County line. Alternative 4 traverses east further for approximately 1.5 mi before turning southeast for approximately 13 mi crossing over the UPRR, FM 1960, and US 90 approximately 3 mi east of Dayton. Alternative 4 crosses FM 1413 and the UPRR and then travels south between the railroad and SH 146. It then turns southeast crossing SH 146 and FM 565 east of Mont Belvieu before terminating at IH 10 (E), 2.0 mi east of SH 146. All 35.4 mi of Alternative 4 would be on new location. Alternative 4 would require approximately 1,716 ac of ROW.

2.4.1.5 Alternative 5

Alternative 5 combines Sections A-2, B-2, and C-3 and is approximately 36.6 mi in length. Alternative 5 begins at Roman Forest Boulevard on US 59 (N), approximately 1.5 mi north of FM 1485. After bridging over Loop 494 and the UPRR, it travels east crossing Peach Creek and the East Fork San Jacinto River to the Liberty County line. Alternative 5 traverses east further for approximately 1.5 mi before turning southeast for approximately 13 mi crossing over the UPRR, FM 1960, and US 90 approximately 3 mi east of Dayton. Approximately 3 miles south of US 90, Alternative 5 turns in a southwesterly direction crossing FM 1413 and traversing south while staying west of the UPRR. It then turns east bridging over the railroad

and crosses Alternative 2 and SH 146, FM 565 east of Mont Belvieu, and eventually terminating at IH 10 (E). All 36.6 mi of Alternative 5 would be on new location. Alternative 5 would require approximately 1,775 ac of ROW.

2.4.1.6 Alternative 6

Alternative 6 combines Sections A-2, B-5, and C-6 and is approximately 35.4 mi in length. Alternative 6 begins at Roman Forest Boulevard on US 59 (N), approximately 1.5 mi north of FM 1485. After bridging over Loop 494 and the UPRR, it travels east crossing Peach Creek and the East Fork San Jacinto River to the Liberty County line. Alternative 6 traverses east further for approximately 1 mi before turning south where it traverses approximately 7 mi before crossing FM 1960 and the UPRR. It continues southeast for approximately 6 mi to its crossing with US 90 near the Liberty/Harris County line. Alternative 6 traverses for another 6 mi southeast in Liberty and Harris counties before entering Chambers County and turning east where it joins Alternative 2 north of Mont Belvieu crossing the UPRR, SH 146, FM 565 east of Mont Belvieu, and eventually terminating at IH 10 (E). All 35.4 mi of Alternative 6 would be on new location. Alternative 6 would require approximately 1,716 ac of ROW.

2.4.1.7 Alternative 7

Alternative 7 combines Sections A-4, B-1, and C-2 and is approximately 39.7 mi in length. Alternative 7 begins at Community Drive on US 59 (N), approximately 1.5 mi south of FM 1485. It then bridges over Loop 494 and the Southern Pacific Railroad (SPRR) and continues in a northeasterly direction for approximately 3 mi crossing Caney Creek before turning west near Peach Creek where it overlaps with FM 1485 north of Lake Houston Park for approximately 3.5 mi crossing East Fork San Jacinto River. Alternative 7 continues east of FM 1485 for roughly 10.5 mi before turning south and traversing 7 mi while crossing over the UPRR, FM 1960, and US 90 approximately 3 mi east of Dayton. Alternative 7 crosses FM 1413 and UPRR and then travels south between the railroad and SH 146. It then turns southeast crossing SH 146 and FM 565 east of Mont Belvieu before terminating at IH 10 (E), 2.0 mi east of SH 146. Approximately 3.5 miles of Alternative 7 follows existing FM 1485 with the remaining 36.2 mi on new location. Alternative 7 would require approximately 1,925 ac of ROW.

2.4.1.8 Alternative 8

Alternative 8 combines Sections A-4, B-1, and C-3 and is approximately 41.0 mi in length. Alternative 8 begins at Community Drive on US 59 (N), approximately 1.5 mi south of FM 1485. It then bridges over Loop 494 and the SPRR and continues in a northeasterly direction for approximately 3 mi crossing Caney Creek before turning west near Peach Creek where it overlaps with FM 1485 north of Lake Houston Park for approximately 3.5 mi crossing East Fork San Jacinto River. Alternative 8 continues east of FM 1485 for roughly 10.5 mi before turning south and traversing 7 mi while crossing over the UPRR, FM 1960, and US 90 approximately 3 mi east of Dayton. Approximately 3 miles south of US 90, Alternative 8 turns in a southwesterly direction crossing FM 1413 and traversing south while staying west of the UPRR. It then turns east bridging over the railroad and crossing Alternative 2 and SH 146, FM 565 east of Mont Belvieu, and eventually terminating at IH 10 (E). Approximately 3.5 miles of Alternative 8 follows existing FM 1485 with the remaining 37.5 mi on new location. Alternative 8 would require approximately 1,988 ac of ROW.

2.4.1.9 Alternative 9

Alternative 9 combines Sections A-4, B-2 and C-2 and is approximately 36.9 mi in length. Alternative 9 begins at Community Drive on US 59 (N), approximately 1.5 mi south of FM 1485. It then bridges over Loop 494 and the SPRR and continues in a northeasterly direction for approximately 3 mi crossing Caney Creek before turning west near Peach Creek where it overlaps with FM 1485 north of Lake Houston Park for approximately 3.5 mi crossing East Fork San Jacinto River. Alternative 9 continues east of FM 1485 for roughly 2.5 mi before turning southeast for approximately 13 mi crossing over the UPRR, FM 1960, and US 90 approximately 3 mi east of Dayton. Alternative 9 crosses FM 1413 and UPRR and then travels south between the railroad and SH 146. It then turns southeast crossing SH 146 and FM 565 east of Mont Belvieu before terminating at IH 10 (E), 2.0 mi east of SH 146. Approximately 3.5 miles of Alternative 9 follows existing FM 1485 with the remaining 33.4 mi on new location. Alternative 9 would require approximately 1,789 ac of ROW.

2.4.1.10 Alternative 10

Alternative 10 combines Sections A-4, B-2, and C-3 and is approximately 37.4 mi in length. Alternative 10 begins at Community Drive on US 59 (N), approximately 1.5 mi south of FM 1485. It then bridges over Loop 494 and the SPRR and continues in a northeasterly direction for approximately 3 mi crossing

Caney Creek before turning east near Peach Creek where it overlaps with FM 1485 north of Lake Houston Park for approximately 3.5 mi crossing East Fork San Jacinto River. Alternative 10 continues east of FM 1485 for roughly 2.5 mi before turning southeast for approximately 13 mi crossing over the UPRR, FM 1960, and US 90 approximately 3 mi east of Dayton. Approximately 3 miles south of US 90, Alternative 10 turns in a southwesterly direction crossing FM 1413 and traversing south while staying west of the UPRR. It then turns east bridging over the railroad and crossing Alternative 2 and SH 146, FM 565 east of Mont Belvieu, and eventually terminating at IH 10 (E). Approximately 3.5 miles of Alternative 10 follows existing FM 1485 with the remaining 33.9 mi on new location. Alternative 10 would require approximately 1,813 ac of ROW.

2.4.1.11 Alternative 11

Alternative 11 combines Sections A-4, B-5, and C-6 and is approximately 37.0 mi in length. Alternative 11 begins at Community Drive on US 59 (N), approximately 1.5 mi south of FM 1485. It then bridges over Loop 494 and the SPRR and continues in a northeasterly direction for approximately 3 mi crossing Caney Creek before turning west near Peach Creek where it overlaps with FM 1485 north of Lake Houston Park for approximately 3.5 mi crossing East Fork San Jacinto River. Alternative 11 continues east of FM 1485 for roughly 2.5 mi before turning south where it traverses approximately 7 mi before crossing FM 1960 and the UPRR. It continues southeast for approximately 6 mi to its crossing with US 90 near the Liberty/Harris County line. Alternative 6 traverses for another 6 mi southeast in Liberty and Harris counties before entering Chambers County and turning east where it joins Alternative 2 north of Mont Belvieu crossing the UPRR, SH 146, FM 565 east of Mont Belvieu, and eventually terminating at IH 10 (E). Approximately 3.5 miles of Alternative 11 follows existing FM 1485 with the remaining 33.5 mi on a new location. Alternative 11 would require approximately 1,794 ac of ROW.

2.4.2 Evaluation of Reasonable Alternatives

The environmental criteria listed along the top of **Table 2-8** were used to evaluate the potential impacts of the reasonable alternatives on the natural and human environment. When possible, CAT was used to quantify the impacts. Desktop aerial interpretation with limited field visits for data verification facilitated the evaluation. The desktop aerial interpretation consisted of using a GIS software program to view mapped environmental constraints that were layered on top of the H-GAC 2008 aerial photographs of the study area. Input from the public and agencies such as FHWA, TxDOT, and elected officials was also considered

to determine the Recommended Alternative. The reasonable alternatives were evaluated following FHWA Technical Advisory T 6640.8A guidance and other applicable regulations.

Public and elected agency officials supported the Build Alternatives versus the No-Build Alternative. All alternatives that provided system connectivity with Grand Parkway Segments G and I-2 received positive feedback from the public. This included Alternatives 7-11 (all those including Preliminary Alternative A-4). Alternative 8 (A-4, B-1, C-3) had the highest public and agency support.

Environmental evaluation criteria included: land use impacted by type, total proposed ROW, visual and potential access impacts; natural resource impacts including forested and non-forested wetlands impacted, impaired and ecologically substantial streams crossed, threatened and endangered species, species of concern, 100-yr floodways and floodplains, prime farmlands and century farms impacted; cultural resources impacted including recorded archeological sites, archeological high priority areas, historic resources, and cemeteries; air and noise impacts including number of sensitive receptors and receivers; socioeconomic impacts including residential and commercial displacements, changes in community cohesion and environmental justice issues; public and private water wells impacted; and hazmat issues including regulated sites, oil and gas wells, and other sites of concern. All of these constraints were evaluated equally for comparison purposes in selection of the Recommended Alternative. Refer to **Table 2-8** for a matrix with the results of the environmental evaluation for each of the reasonable alternatives.

Engineering evaluation criteria included estimated ROW cost, major utility impacts, complexity of drainage consisting of number and length of floodplain crossings and length of corridor with limited access to outfalls, and finally construction cost, excluding ROW, utilities and special drainage facilities accounted for in the other three criteria. Refer to **Table 2-9** for a matrix with the results of the engineering evaluation for each of the reasonable alternatives.

Traffic and mobility evaluation criteria included: emergency evacuation consisting of evacuation efficiency, population served, and average study area travel speed; transportation system connections including average daily volume on the proposed alternative, regional vehicle miles traveled and street closures; travel efficiency measured by level of service on study area roadways, vehicle hours of travel reductions in study area and in region, and travel time on alternative; and conformance with transportation plans. Alternatives

that would result in high numbers of street closures were considered less favorable than alternatives with low numbers of proposed street closures. Refer to **Table 2-10** for a matrix with the results of the traffic evaluation for each of the reasonable alternatives.

Table 2-8: Environmental Evaluation Matrix of Reasonable Alternatives

Reasonable Alternative	Length (miles)	Land Use												Natural Resources										Cultural Resources				Air	Noise	Socioeconomic/EJ					Water Wells		Hazmat			
		Commercial (acres)	Agricultural (acres)**	Residential (acres)	Schools (Number)	Churches (acres of parcels)**	Industrial (acres)	Preliminary Platted (acres)	Undeveloped Platted (acres)	Managed Lands (acres)	Other Undeveloped (acres)	Total Proposed ROW (acres)	Visual and Potential Access Impacts	Wetlands		Streams		Threatened and Endangered Species	Species of Concern	Wildlife habitat****	Floodway	100-Year Floodplain (acres)	Prime Farmlands (acres)	Century Farms	Recorded Archeological Sites	Archeological High Probability Areas (acres)	Historic Resources	Cemeteries	Number of Sensitive Receptors	Potential Noise Impacts	Residential Displacements	Commercial Displacements	Churches Displaced	Changes in Community Cohesion	Environmental Justice Issues	Public	Private	Regulated Sites	Oil Wells	Other sites of Concern
														Forested Wetlands (acres)	Non-Forested Wetlands (acres)	Impaired Streams Crossed	Ecologically Significant Streams Crossed																							
1	0	0	0	0	0	0	0	0	0	0	0.0	No	0	0	-	-	-	-	0	0	0	0	-	0	0	0	0	0	0	0	0	0	No	No	0	0	0	0	0	
2	38.2	0	1008	56	0	0	31	22	132	0	603	1852	Yes	4.4	40.9	-	2	-	-	674.93	38.52	84.08	906	-	0	1981	0	0	1	48	6	0	0	Yes	Yes	5	2	4	8	2
3	39.4	0	1058	56	0	0	34	22	132	0	608	1910	Yes	23.7	38.6	-	2	-	-	694.84	38.52	84.08	917	-	0	996	0	0	1	49	6	0	0	Yes	Yes	5	2	8	9	2
4	35.4	0	922	41	0	0	31	22	132	0	568	1716	Yes	2.8	19.1	-	2	-	-	635.50	46.42	128.99	900	-	0	1622	0	0	1	7	10	0	0	Yes	Yes	3	2	3	15	2
5	36.6	0	972	41	0	0	34	22	132	0	574	1775	Yes	22.1	16.8	-	2	-	-	655.41	46.42	128.99	911	-	0	1637	0	0	1	8	10	0	0	Yes	Yes	3	2	7	16	2
6	35.4	0	634	53	0	0	32	37	132	0	827	1715	Yes	27.3	23.1	3^	2	-	-	808.57	57.86	182.98	1071	-	0	1180	0	0	1	35	7	0	0	Yes	Yes	3	1	6	13	2
7	39.7	6	1008	152	0	7	35	0	0	0	717	1925	Yes	6.1	41.2	-	3	-	-	663.85	35.35	113.64	941	-	0	2040	1	0	4	120	37	5	2	Yes	Yes	9	3	7	8	4
8	41.0	6	1058	152	0	7	38	0	0	0	727	1988	Yes	25.4	38.8	-	3	-	-	683.74	35.35	113.64	952	-	0	2055	1	0	4	121	37	5	2	Yes	Yes	9	3	11	9	4
9	36.9	6	922	138	0	7	35	0	0	0	681	1789	Yes	4.5	19.3	-	3	-	-	824.42	43.26	158.55	935	-	0	1681	1	0	4	79	41	5	2	Yes	Yes	7	3	6	15	4
10*	37.4	6	1038	138	0	7	29	0	0	0	595	1813	Yes	23.8	17.0	-	3	-	-	644.33	36.2	158.55	946	-	0	1696	1	0	4	80	41	5	2	Yes	Yes	7	3	10	16	4
11	37.0	6	634	150	0	7	36	16	0	0	944	1793	Yes	28.9	23.3	3^	3	-	-	797.51	54.64	212.54	1106	-	0	1239	1	0	4	107	38	5	2	Yes	Yes	7	2	9	13	4

Source: Study Team, 2007

^ The same stream (Cedar Bayou) is crossed 3 different times.

"-" No resource located within alternative

* Recommended Alternative

** 7 acres of church parcels consist of 2 separate parcels that contain 1 church each that would be displaced

*** Acreages have been determined using aerial photo interpretation of 2008 H-GAC aerials

**** Acreages presented are a summary of wetlands, forested wetlands, non-forested wetlands, and forested areas. These acreages exclude agricultural land.

Table 2-9: Engineering Evaluation Matrix of Reasonable Alternatives

	Data Category	Data Description	Reasonable Alternatives										
			1	2	3	4	5	6	7	8	9	10	11
			No-Build	A-2 B-1 C-2	A-2 B-1 C-3	A-2 B-2 C-2	A-2 B-2 C-3	A-2 B-5 C-6	A-4 B-1 C-2	A-4 B-1 C-3	A-4 B-2 C-2	A-4 B-2 C-3	A-4 B-2 C-3
ROW	Cost	Total cost of right-of-way required from different land uses (in Millions)	0.00	8.28	8.77	7.79	8.28	8.93	12.95	13.44	12.46	12.95	13.60
UTILITY	Major Utility Lines (Number of Crossings)	Major Pipelines, Electric Transmission Lines	0	313	492	313	492	456	318	497	318	497	461
DRAINAGE	Outfall Spacing	Total length of sections between canals with inadequate outfalls (in Miles)	0	22	23.1	13.9	15	3.6	22	23.1	13.9	15	3.6
	Number of Floodplain Crossings	Total number of sites requiring mitigation for fill in floodplain	0	5	5	7	7	13	5	5	7	7	13
	Total Length of Floodplain Crossings	Total length of Floodplain crossings indicating amount/cost of mitigation. (in Miles)	0	2.61	2.61	3.47	3.47	5.28	2.94	2.94	3.79	3.79	5.67
CONSTRUCTION COST	Cost	Roadway, Bridges, Ret Walls, Ditches, Signing, Lighting, TCP, Misc (in Millions)	0.0	506.8	513.5	497.9	504.6	516.2	526.0	532.7	517.2	523.9	535.5

Source: Study Team, 2007

Table 2-10: Traffic Evaluation Matrix of Reasonable Alternatives

Criteria	Measure	REASONABLE ALTERNATIVES										
		1	2	3	4	5	6	7	8	9	10	11
		No-Build	A-2 B-1 C-2	A-2 B-1 C-3	A-2 B-2 C-2	A-2 B-2 C-3	A-2 B-5 C-6	A-4 B-1 C-2	A-4 B-1 C-3	A-4 B-2 C-2	A-4 B-2 C-3	A-4 B-5 C-6
Emergency Evacuation	Evacuation efficiency (Qualitative)		Medium	Medium	Medium	Medium	Medium	High	High	High	High	High
	Population Served (persons)		76,900	74,100	77,800	75,000	106,200	106,800	104,000	107,700	104,900	136,100
	Average Study Area Travel Speed (mph)	41.0	44.1	43.9	43.9	44.0	44.2	44.1	44.0	44.0	44.0	43.5
Transportation System Connections	Average Daily Volume on the Grand Parkway H&I-1 (vpd)		12,533	11,203	17,729	16,480	17,908	14,467	13,263	19,591	18,312	19,236
	Regional VMT Reduction (over No-build)		-8,065,600	-7,962,900	-7,979,500	-8,003,400	-7,923,400	-8,060,000	-8,080,800	-7,951,000	-8,095,100	-7,918,700
	Street Closures		29	30	30	31	39	10	11	11	12	20
Travel Efficiency	LOS by Study Area Roadway Miles											
	% Roadway Miles LOS A-C	19%	39%	39%	40%	41%	40%	38%	39%	39%	42%	41%
	% Roadway Miles LOS E-F	65%	46%	47%	50%	49%	48%	47%	47%	50%	48%	49%
	VHT Reduction (over No-build)											
	Study Area VHT Reduction		-2,700	-2,800	-2,600	-3,400	-2,500	-3,400	-3,600	-3,300	-3,727	-1,200
	Regional VHT Reduction		-347,100	-338,700	-343,400	-342,600	-338,700	-348,900	-346,900	-342,000	-340,614	-341,300
	Travel Time (minutes) on Grand Parkway		36.0	37.0	33.7	34.7	34.1	33.4	34.4	31.1	32.0	31.5
Conformance with Transportation Plans	Degree of conformity/compliance		Medium	Medium	Medium	Medium	Medium	High	High	High	High	High

Source: Study Team, 2007

2.5 RECOMMENDED ALTERNATIVE

During the evaluation of the reasonable alternatives, emphasis was placed on criteria distinguishing those alternatives which best met the project need and purpose. The traffic/mobility criteria provided the strongest measure with regard to meeting the need and purpose, while the engineering and environmental criteria provided a measure of cost, efficiency and avoidance of environmental impacts among the different alternatives; however, in most instances, the differences in the engineering and environmental evaluation were not large enough to clearly distinguish one particular alternative over another. The alternatives discussed below did not meet the evaluation criteria and were eliminated from further consideration. Refer to **Table 2-8**, **Table 2-9**, and **Table 2-10** for the evaluation matrices comparing the impacts for each of the alternatives discussed below.

2.5.1 Alternatives Not Recommended

Alternatives 2 through 6 were not recommended because they have undesirable traffic and mobility effects as a result of a lack of connectivity with Grand Parkway Segment G and, therefore, provide a lower level of regional transportation system connectivity. Because of the disjointed link with Segment G in Alternatives 2 through 6, east west traffic between Grand Parkway Segments G and H would produce operational impacts on US 59 (N). This lack of system connectivity would also be problematic to the evacuation system on US 59 (N).

Alternatives 2 through 6 are located far north of Lake Houston Park and do not improve access to the park. Improved access was requested by the City of Houston during the study. These alternatives traverse through the Roman Forest residential neighborhood and have a higher number of street closures.

Alternatives 2, 3, 7, and 8 were not recommended because they are located near the northeastern limits of the study area, thereby attracting fewer travelers than alternatives more centrally located within the study area. These alternatives included the B-1 alternative, which when modeled, caused longer travel times than the other alternatives and approximately 5,000 to 6,000 fewer vpd than the other alternatives.

Alternatives 2, 4, 7, and 9 are confined between the UPRR and SH 146. This narrow area is constrained with very limited grade separations to cross the railroad. The area east of the railroad is currently served by SH 146, but there is no major roadway which serves the area immediately west of the railroad. These

alternatives do not adequately serve the large portion of the study area west of the railroad and may hinder additional forecasted development, thus they were eliminated from further consideration.

Alternatives 6 and 11 were not recommended due to the substantially higher number of floodplain impacts throughout the study area and particularly in the vicinity of Cedar Bayou near the Liberty/Harris County line. These impacts would result in a greater amount of floodplain mitigation, detention ponds, and longer bridges, all resulting in higher costs.

2.5.2 Recommended Alternative

After careful review of the public and agencies' input and environmental, engineering, and traffic criteria, Alternative 10 (A-4, B-2, C-3) was selected as the Recommended Alternative to be carried forward into the Final Environmental Impact Statement (FEIS) for further detailed evaluation (**Exhibit 2-6: Recommended Alternative**). A discussion of the reasons for selection of Alternative 10 is discussed below.

Unlike the other alternatives analyzed in **Section 2.5.1** above, the northern portion of Alternative 10 provides direct connectivity with Grand Parkway Segment G. This connection to Segment G is important as it allows traffic direct access to IH 45 which is officially designated as an evacuation route. Without a direct connection to Segment G, evacuating traffic from Segment H headed to IH 45 would have to exit onto US 59 (N) and travel south in order to get to Grand Parkway Segment G. The southern portion of Alternative 10 also provides a direct connection to Segment I-2. This also provides improved connectivity during evacuations.

On the north end, Alternative 10 follows the existing FM 1485 alignment. This is beneficial for Lake Houston Park as it provides direct access for traffic to and from the Grand Parkway Segments H and I-1. An important benefit of Alternative 10 on the north end is the safety improvement to FM 1485. Alternative 10 includes the reconstruction of FM 1485 from a two-lane roadway, to a pair of one-way frontage roads with two travel lanes in each direction on either side of the Grand Parkway Segments H and I-1 toll facility. In addition to increasing the capacity on FM 1485, Alternative 10 is projected to reduce the ADT on FM 1485 from 28,800 vpd in 2039 under the No-Build Alternative to 22,400 vpd in the Build Alternative. The increase in capacity for FM 1485 and the reduction in traffic volume would result in a reduction in crash rate and an improvement in safety. These benefits are applicable to Reasonable Alternatives 7-11.

The central portion of Alternative 10 is located closer to the center of the study area, which has the benefit of serving a greater portion of the study area. This is directly reflected by the higher travel demand attracted by Alternatives 4, 5, 6, 9, 10 and 11. This is evident when comparing Alternatives 8 and 10, for example. These alternatives follow the same alignment in the north and south and the only difference is in the central portion of the alternative where Alternative 8 comprises Preliminary Alternative B-1 (closer to Dayton) and Alternative 10 comprises Preliminary Alternative B-2. The weighted average daily traffic volume for Alternative 10 as a whole is 5,000 vpd more than for Alternative 8 in the year 2039.

The southern portion of Alternative 10 lies west of the UPRR, improving transportation system connections for what is currently an underserved area. With SH 146 located east of the railroad, a new facility located west of the railroad would help support the economic growth this area is anticipated to experience in the future. Location of the proposed Grand Parkway Segments H and I-1 at a distance greater than a mile from SH 146 would better complement the area transportation network than having the Grand Parkway Segments H and I-1 either along or immediately adjacent to the existing SH 146 facility. As such, Alternative 10, which passes west of the railroad and SH 146 is more favorable than Alternatives 2, 4, 7 and 9, which all pass between the railroad and SH146. Alternative 10 also is more favorable than Alternatives 6 and 11, the western-most corridors closer to Cedar Bayou, due to the floodplain and drainage impacts associated with these alternatives. All of the benefits described in the southern portion of the study area are realized by Alternatives 3, 5, 8 and 10.

Considering the benefits in the northern, central, and southern portions of the study area discussed above, Alternative 10 is the alternative which best realizes the benefits described in all three portions of the study area.

Alternative 10 (A-4, B-2, C-3) is proposed as a four-lane rural controlled-access toll road on new location and would fulfill the need and purpose of the proposed project and meet the needs identified for the proposed Segments H and I-1. The Recommended Alternative would begin at US 59 (N) and continue to IH 10 (E) and would consist of an open ditch design within a 400-ft wide ROW. Refer to **Exhibit 2-7: Proposed Typical Section** for a proposed typical section for Segments H and I-1. The Recommended Alternative is proposed as a toll road in order to be consistent with the H-GAC 2035 RTP that identifies the addition of tolled facilities, including the Grand Parkway Segments H and I-1, as necessary to address

congestion and future growth in the H-GAC planning region. Final selection of the preferred alternative would occur after comments are received from the public hearing process and have been fully evaluated. Following the selection of the preferred alternative, the alternative would be evaluated to a higher level of detail in the FEIS.