

## CHAPTER 5

### Indirect Effects

## CHAPTER 5: INDIRECT IMPACTS TABLE OF CONTENTS

|         |   |      |
|---------|---|------|
| 5.1     | METHODOLOGY .....   | 5-1  |
| 5.2     | INDIRECTS IMPACT ANALYSIS: STEPS 1-4.....   | 5-3  |
| 5.2.1   | Step 1: Scoping .....   | 5-3  |
| 5.2.2   | Step 2: Identify the Study Area’s Direction and Goals .....                         | 5-8  |
| 5.2.3   | Step 3: Inventory of Study Area’s Notable Features .....                            | 5-11 |
| 5.2.4   | Step 4: Identify Impact-Causing Activities of Proposed Action and Alternatives..... | 5-12 |
| 5.3     | INDIRECT IMPACTS ANALYSIS: STEPS 5-8.....   | 5-15 |
| 5.3.1   | Land Use .....  | 5-16 |
| 5.3.2   | Section 4(f) Properties .....   | 5-20 |
| 5.3.3   | Community Resources.....  | 5-20 |
| 5.3.3.1 | Environmental Justice.....  | 5-20 |
| 5.3.3.2 | Community Cohesion .....  | 5-21 |
| 5.3.3.3 | Economic Impacts .....  | 5-21 |
| 5.3.3.4 | Pedestrians and Bicyclists .....  | 5-27 |
| 5.3.3.5 | Visual and Aesthetic Impacts.....   | 5-28 |
| 5.3.4   | Soils and Farmlands.....  | 5-28 |
| 5.3.5   | Air Quality .....   | 5-29 |
| 5.3.6   | Water Quality .....   | 5-30 |
| 5.3.7   | Waters of the U.S., Including Wetlands and Vegetative Communities .....             | 5-30 |
| 5.3.7.1 | Waters of the U.S., Including Wetlands .....  | 5-30 |
| 5.3.7.2 | Vegetative Communities .....  | 5-31 |
| 5.3.8   | Wildlife.....   | 5-32 |
| 5.3.9   | Threatened and Endangered Species.....  | 5-32 |
| 5.3.10  | Floodplains .....   | 5-33 |
| 5.3.11  | Wild and Scenic Rivers .....  | 5-34 |
| 5.3.12  | Coastal Barriers .....  | 5-34 |
| 5.3.13  | Coastal Zone Management .....   | 5-34 |
| 5.3.14  | Essential Fish Habitat .....  | 5-34 |
| 5.3.15  | Archeological Resources.....  | 5-34 |
| 5.3.16  | Non-Archeological Historic Resources .....  | 5-35 |
| 5.3.17  | Construction Impacts.....   | 5-35 |
| 5.4     | Summary .....   | 5-36 |
| 5.5     | Regional Indirect Effects of Toll Facilities.....                                   | 5-38 |
| 5.6     | Conclusion .....  | 5-40 |

## LIST OF TABLES

|  |      |
|--|------|
| Table 5-1: Example of Indirect Impacts .....   | 5-2  |
| Table 5-2: Eight-Step Approach to Estimate Indirect Impacts .....  | 5-3  |
| Table 5-3: Project Stakeholders .....  | 5-4  |
| Table 5-4: Expert Panel .....  | 5-7  |
| Table 5-5: Area of Influence (15-Minute Travel Shed) .....   | 5-8  |
| Table 5-6: Housing Characteristics .....   | 5-10 |
| Table 5-7: Single-Family Building Permits .....  | 5-11 |
| Table 5-8: School District Enrollment Totals .....   | 5-11 |
| Table 5-9: Reasonably Foreseeable Developments .....   | 5-14 |
| Table 5-10: Land Development within the AOI .....  | 5-16 |
| Table 5-11: Potential Indirect Land Use and Resource Impacts Within the AOI .....                            | 5-18 |
| Table 5-12: Construction Costs of Segments H and I-1 Alternatives .....                                      | 5-24 |
| Table 5-13: Output Impacts Using 2007 Construction Costs Dollars .....                                       | 5-24 |
| Table 5-14: Value Added Impacts Using 2007 Construction Costs Dollars .....                                  | 5-25 |
| Table 5-15: Indirect Business Taxes Impacts Using 2007 Construction Costs Dollars .....                      | 5-26 |
| Table 5-16: Employment Impacts .....   | 5-26 |
| Table 5-17: Summary of Potential Indirect Effects from Segments H and I-1<br>(Recommended Alternative) ..... | 5-37 |
| Table 5-18: Regional Roadway Network (lane miles) .....  | 5-38 |

## LIST OF FIGURES

|  |      |
|--|------|
| Figure 5-1: Proposed 2035 Regional Roadway Network .....               | 5-39 |
| Figure 5-2: 2035 Future Corridor and Capital Facilities Projects ..... | 5-40 |

## CHAPTER 5 INDIRECT IMPACTS

### 5.1 METHODOLOGY

In order to maintain a level of consistency among Grand Parkway (SH 99) environmental documents, a workshop was held between the Federal Highway Administration (FHWA) and the Texas Department of Transportation (TxDOT) on October 16, 2008. The intent of this workshop was to develop guidance that would aid in the analysis of the Indirect and Cumulative Impacts (ICI). The preparers of the DEIS document(s) were instructed to use this October 2008 guidance. However, in September 2010, the Environmental Affairs Division of TxDOT issued new guidance on preparing ICI analyses.

Based on mutual agreement between TxDOT and FHWA, the DEIS document provided all the necessary data for FHWA and TxDOT to analyze potential indirect or cumulative impacts to any given resource for the alternatives considered. Since the TxDOT September 2010 ICI guidance is a tool to maintain a consistent level of detail and is not a regulatory requirement, FHWA and TxDOT have concurred that the DEIS document was submitted following the October 2008 guidance. However, this Final Environmental Impact Statement (FEIS) was updated to follow guidance on preparing ICI analyses that is current at the time the FEIS is being prepared.

The following proposed methodology describes the indirect impacts analysis. Resources such as decennial census data, Houston-Galveston Area Council (H-GAC) 2035 population projections and the *Envision Houston Region* report, Texas Education Agency data, stakeholder interviews, expert panel surveys, and employment forecasts and analysis allow for the establishment of quantitative assumptions which have been utilized to develop the findings discussed in the following sections. A Geographic Information System (GIS)-based analysis was used to quantify the data gathered. Given the nature of indirect impacts, it must be stated that the analysis primarily relies upon projected data and qualitative assumptions. Various qualitative assumptions used during the analysis include anticipated demographic trends and associated travel demands along with recognized development trends.

The Council on Environmental Quality (CEQ) defines indirect impacts as those that are “caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect

impacts may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems” (40 Code of Federal Regulations [CFR] §1508.8). Indirect impacts were assessed based on requirements and process outlines in 23 CFR 771, and guidance described in the Transportation Research Board’s (TRB) National Cooperative Highway Research Program (NCHRP) *Report 466: Desk Reference for Estimating the Indirect Effect of Proposed Transportation Projects* (TRB, 2002), NCHRP *Report 25-25, Task 22: Forecasting Indirect Land Use Effects of Transportation Projects* (TRB, 2007), Federal Highway Administration (FHWA) Technical Advisory 6640.8A, *Questions and Answers Regarding the Consideration of Indirect and Cumulative impacts in the NEPA Process* (FHWA, 2003), and the Texas Department of Transportation (TxDOT) *Guidance on Preparing Indirect and Cumulative Impacts Analysis* (TxDOT, 2006). Indirect impacts differ from the direct impacts associated with the construction and operation of the proposed project and are caused by an action or actions that have an established relationship or connection to the proposed project. As to the cause and effect relationship between the project and the indirect impact, CEQ states that indirect effects may include induced changes to land use resulting in resource impacts (40 CFR 1508.8). Other indirect effects include the potential alteration of or encroachment on the affected environment. Examples of indirect impacts of several types of transportation projects are summarized in **Table 5-1**.

**Table 5-1: Example of Indirect Impacts**

| Project Action | Indirect Impact  |
|----------------|--|
| Bypass Highway | Farmland converted to residential use. New residences produce new labor force attracting new businesses. |
| New Light Rail | New businesses open producing jobs/taxes. Traditional businesses/residents priced out.                   |
| New Highway    | Development alters character of historic area. Visitors increase to historic area.                       |

Source: NCHRP Report 466.

Indirect impacts are commonly related to changes in land use. Changes in travel patterns may also occur if the project is on new location, adds capacity, or is one where tolling is involved. When a project is constructed, indirect impacts may occur as development is induced by the project. This induced development would likely include a variety of commercial land uses, such as convenience stores, gas stations, retail shops, restaurants, office buildings, and residential uses, including single- and multi-family developments.

The NCHRP has developed procedures for estimating indirect impacts of transportation projects (NCHRP Report 466, 2002). This guidance utilizes an eight-step approach to assess the indirect impacts of transportation projects on resources within the defined study area. The eight steps are listed in **Table 5-2**.

**Table 5-2: Eight-Step Approach to Estimate Indirect Impacts**

| Step No. | Step  |
|----------|---|
| 1        | Scoping.  |
| 2        | Identify the Study Area's Direction and Goals.                          |
| 3        | Inventory the Study Area's Notable Features.                            |
| 4        | Identify Impact-Causing Activities of Proposed Action and Alternatives. |
| 5        | Identify Potentially Significant Indirect Effects for Analysis.         |
| 6        | Analyze Indirect Effects.   |
| 7        | Evaluate Analysis Results.  |
| 8        | Assess Consequences and Develop Mitigation.                             |

Source: National Cooperative Highway Research Program, 2002.

The eight-step process outlined above would serve as the basic approach for this indirect impacts analysis.

## **5.2 INDIRECTS IMPACT ANALYSIS: STEPS 1-4**

### **5.2.1 Step 1: Scoping**

The geographic boundary of the “indirect impacts study area” for the indirect impact analysis is defined by a 15-minute travel shed extending from the proposed Grand Parkway Segments H and I-1 study area (**Exhibit 5-1: Segments H and I-1 15-Minute Travel Shed**). This indirect impacts study area is based on previous studies and methodologies, using the travel assumption that a typical Houston area commute is 45 minutes long. This 45-minute commute is further assumed to be broken into three 15-minute segments: from the starting point 15 minutes is spent on streets getting to the tollway, 15 minutes is spent driving on the tollway, and 15 minutes is spent getting from the tollway to the end destination. This shape was then modified to follow the nearest Traffic Analysis Zone (TAZ). The indirect impacts study area includes the area in which the proposed Grand Parkway Segments H and I-1 could influence local traffic patterns or land development. It is assumed that areas outside the indirect impacts study area are better served by other roadways. The indirect impacts study area was mapped by the project team. A panel of experts, including H-GAC personnel, as well as local and county planning personnel was consulted for the analysis of indirect impacts.

There are also elements of the CEQ regulations relevant to indirect impacts analysis. These include:

- Environmental analyses and proposals of cooperating agencies should be used to the maximum extent possible.

- Cooperating agencies with jurisdiction by law or special expertise should be included and those who might not be in accord with the project on environmental grounds.
- Integration and compliance should occur at the earliest time possible.
- Interagency cooperation is required to identify impacts of concern to the agencies with regulatory oversight.
- Environmental effects should be identified in the early stages of planning and issues deserving of substantial study versus those that do not necessitate detailed analysis should be differentiated.
- The identification of environmental effects and values should be analyzed in adequate detail and circulated at the same time as economic and technical analyses in order to give a more balanced consideration of potential project impacts.
- Both short- and long-term environmental effects of land use and a discussion of mitigation must be addressed.

Analyzing the likelihood of development in a defined study area once construction is completed is a key component of evaluating the potential for indirect impacts. Agency and community stakeholders were engaged in the project from the early planning stages to determine the likelihood of indirect and cumulative impacts from the proposed project. A full list of stakeholders involved in the project is included in the Project Coordination Plan (**Appendix H**). **Table 5-3** includes a list of the stakeholders.

**Table 5-3: Project Stakeholders**

| Community Level  | Agency Level   |
|--|--|
| <u>Elected Officials</u><br>Local – Council Members, County Officials and Mayors | <u>Local</u><br>Private – Utility companies, Railroads, Industries<br>Public – Counties, HCTRA, Municipalities, TxDOT Houston, TxDOT Beaumont, H-GAC |
| <u>Communities and Stakeholders</u><br>Homeowner Associations<br>Developers      | <u>Regional</u><br>Federal – FHWA, USACE, USFWS, NRCS, EPA<br>State – TCEQ, TxDOT Environmental Affairs Division, THC, TPWD                          |
| <u>Various Special Interest Groups</u><br>Sierra Club                            | FAST – FHWA, TxDOT Environmental Affairs Division, TxDOT Houston and Beaumont Districts, Grand Parkway Association                                   |

Source: Study Team, 2007

The indirect effects analysis includes evaluating population and land use trends in a defined study area and projecting areas of development that may be induced by the proposed project. To determine the extent of potential induced development, city and county land use planning authorities in the study area were consulted in 2007 and 2008 during meetings called to gather local data for the planning process. Meetings

with local city and county officials, as well as officials from area school districts, and H-GAC officials were organized to discuss existing, proposed, and potential development within the 15-minute travel shed (**Exhibit 5-1: Segments H and I-1 15-Minute Travel Shed**). This 15-minute travel shed provides the geographic boundary for the indirect impacts study area. This area is referred to as the “area of influence” or “AOI” throughout the indirect impacts analysis. The topics discussed for this project included existing development, proposed development, relation to proposed project and development patterns/trends. A list of all project meetings is included in **Chapter 8 (Agency and Public Coordination)**. Questions asked during these meetings with stakeholders included:

#### Existing Development

1. Are you aware of any other land development, land use changes, building activity, or infrastructure improvements by others that do not appear on the constraints map shown in **Exhibit 2-6: Recommended Alternative?**

#### Proposed Development

1. Are there any pending subdivision applications in the defined study area?
2. Are you aware of any infrastructure improvement (including transportation and utilities) or land development plans by other agencies or private interests in the defined study area? If yes, by whom/request information?

#### Relation to Proposed Project

1. Would improvements, development, or other land use designations have occurred if there were no plans to construct the proposed Grand Parkway Segments H and I-1?
2. Are you aware of any development that has occurred in response to plans to construct the proposed Grand Parkway Segments H and I-1 and that would not have occurred otherwise? (For any, follow-up for specifics – location, size, when developed, etc.)

#### Development Patterns/Trends

1. If constructed, how would Grand Parkway Segments H and I-1 affect land development in the defined study area?

2. In which areas would you expect development to be concentrated if the proposed roadway is constructed?
3. In which areas would you expect development to be concentrated if the proposed roadway is not constructed?
4. To what degree would you expect the proposed project to influence development patterns within the defined study area?
5. To what degree would you expect the proposed project to influence development patterns at interchanges? Within what distance of these interchanges would you expect development to be concentrated?

The data provided from the stakeholder meetings held during 2007-2008 included specific information planned development within the region. This data was used to map reasonably foreseeable development within the 15-minute travel shed.

Another method for performing the indirect effects analysis and evaluating population and land use trends within a defined study area includes the formal surveying of local and regional experts on land use plans in the area. In late 2008 and early 2009, formal surveys were sent to the original stakeholders queried during 2007-2008, and additional stakeholders identified in the winter of 2008-2009. The expert panel survey questionnaire was developed by the project team, in conjunction with TxDOT, TxDOT-ENV, and FHWA representatives. To determine the extent of potential induced development, regional, city and county land use planning authorities were contacted and asked to fill out a questionnaire regarding the potential for the proposed project to induce development. The surveyed experts were also asked to give their opinions on the percentage of planned growth dependent on the Grand Parkway Segments H and I-1, and if possible, provide information on the size and location of this growth. The study area for the indirect impacts questionnaire was the 15-minute travel shed. **Table 5-4** lists the expert panel that returned responses to the survey.

**Table 5-4: Expert Panel**

| Name              | Agency or Municipality Affiliation   |
|-------------------|--|
| Jeff Taebel       | Director, Community and Environmental Planning; Houston-Galveston Area Council (H-GAC) |
| Bill Cobabe       | City of Mont Belvieu, City Planner   |
| David Draz        | City of Dayton, Director of Planning   |
| Don Brandon, P.E. | Chambers County, County Engineer   |
| Harold Cheek      | City of Baytown, City Planner  |

Source: Study Team, 2008

From the analysis of the expert panel survey results, it was determined that areas with the greatest potential for induced development are located at major intersections and adjacent to existing cities. The H-GAC also provided the *Envision Houston Region* report with the survey response. Scenario A of this report includes the current growth forecast and development for the region, based on the H-GAC’s 2035 population forecast, and assumes the complete build out of the planned regional toll system. In this scenario, development follows tollway extensions along the circumferential pattern of the planned Grand Parkway Segments.

The results of the expert panel survey were combined with the data from the stakeholder meetings and data provided in the *Envision Houston Region* report to project the future reasonable and foreseeable development within the AOI, including induced development.

The total AOI is comprised of 770,300 ac or 1,204 square miles (m<sup>2</sup>) within Harris County, Montgomery County, Liberty County, Chambers County, San Jacinto County, and the Cities of Huffman, Patton Village, Roman Forest, Baytown, Mont Belvieu, and Dayton. **Table 5-5** provides the land area detail.

**Table 5-5: Area of Influence (15-Minute Travel Shed)**

|                       | Acres<br>(rounded) | Square Miles | Percentage of<br>Indirect Impacts<br>Study Area |
|-----------------------|--------------------|--------------|---|
| Total Land in the AOI | 770,300            | 1,204        | --  |
| Harris County         | 222,100            | 347          | 28.8  |
| Montgomery County     | 177,720            | 278          | 23.1  |
| Liberty County        | 258,280            | 403          | 33.5  |
| Chambers County       | 106,740            | 167          | 13.9  |
| San Jacinto County    | 5,460              | 9            | 0.7   |

Source: Study Team, 2007

The project team gathered reasonable and potential scenarios of future land use and associated demographics. For this analysis, the No-Build Alternative is defined as the existing and planned developments within the AOI without improvements to Grand Parkway Segments H and I-1. The Build Alternative is defined as the existing and planned developments within the AOI including improvements to Grand Parkway Segments H and I-1. Change in land use is seen as the most influential indirect impact for all resources, both human and natural, in the AOI. Data was gathered through various resources and included meetings with officials from the Cities of Houston, Baytown, Mont Belvieu, Splendora, Woodbranch, Patton Village, Roman Forest, and Dayton, Harris County, Liberty County, Chambers County, Montgomery County, the H-GAC, U.S. Environmental Protection Agency (EPA), USFWS, U.S. Army Corps of Engineers (USACE), U.S. Coast Guard (USCG), TPWD, and the Texas Historical Commission (THC). A complete list of stakeholders consulted is included in the coordination plan in **Appendix H (Project Coordination Plan)**. A panel of experts (refer to **Table 5-4**) in planning and development of this region were consulted and provided quantitative estimates of the acreage of development induced by the proposed project.

### **5.2.2 Step 2: Identify the Study Area's Direction and Goals**

After scoping and delineation of the study area are complete, it is important to gather a wide range of data about the study area. This second step in the indirect impacts analysis framework focuses on assembling information regarding trends and goals within the AOI. The trends and goals within the AOI are independent of the proposed transportation project and typically concern social, economic, ecological, and/or growth related issues. Social, economic, and environmental goals expressed through formal plans reflect a current vision of the future. Consideration of various goals early in the planning process can help

focus the effort towards balancing transportation and other needs, and also towards understanding potential indirect effects.

The H-GAC 2035 RTP defines transportation systems and services in the area containing the boundaries of the AOI. The RTP addresses regional transportation needs that are identified through forecasting current and future travel demand, developing and evaluating system alternatives and selecting those options which best meet the mobility needs of the region. The proposed facility is included in this plan.

When a transportation project is constructed, indirect impacts may occur where land use changes are induced by the project. Land development, in turn, results in the transformation of agricultural uses, undeveloped areas, wetlands, forested areas, etc., within the AOI to residential and commercial land uses. Increased development can alter the landscape, increase impervious cover, modify species composition of any remaining habitats, and introduce anthropogenic chemicals into the biotic system.

The various factors that influence the distribution of growth within a region include the following:

1. Economy (growth, strength of regional economy, employment centers in vicinity, other economic factors)
2. Travel time to places of interest (employment, services, retail, medical, entertainment, other community facilities)
3. Infrastructure (transportation, including interregional, arterial, local roadways; water, wastewater; electricity, other utilities)
4. Development advantages (low land cost, good availability; natural amenities)
5. Development constraints (high land cost, low availability; physical constraints, such as terrain, soils, and floodplains; regulatory constraints, including regional growth management policies, environmental regulations, and local ordinances)
6. Social considerations (schools, churches, neighborhoods, selection of housing, parks, taxes)

The majority of Liberty County is agricultural to the central and northern portions of the county and industrial in the southern areas of the county, with selected areas of residential development concentrated around cities and small towns. Portions of Harris, Montgomery, and Chambers counties have recently experienced higher rates of residential growth. Current H-GAC models used for the RTP 2035 show these

development patterns—slower in the central project corridor, and faster paced growth in the north and south areas of the project—continuing into the future. The H-GAC plans to re-run the 2035 projection models without the Grand Parkway Segments H and I-1 facility to determine what impacts the project might have on area growth and mobility. When completed, the results of this H-GAC modeling study would be included in the Final Environmental Impact Statement (FEIS). Regardless of the reasonable alternative chosen, the indirect effects are anticipated to be similar in nature.

### Other Indicators of Growth

Residential growth, specifically home construction, was utilized as an indicator of historical growth in the AOI. Research indicates that prior to 1939, 114 homes were constructed in the municipalities that are located within the AOI. In the 1970s and 1980s, there was a boost in new home construction. During the 1990s, new housing construction showed no substantial growth, yet remained steady.

These past development trends defined the construction of public facilities and implementation of public services as well as commercial/retail land uses that occurred after the 1930s. See **Table 5-6** for historic housing characteristics for the municipalities located within the AOI.

**Table 5-6: Housing Characteristics**

| Geographic Area        | Number of New Homes Built & Year Built |           |           |           |           |           |           |                 |
|------------------------|--|-----------|-----------|-----------|-----------|-----------|-----------|-----------------|
|                        | 1999-March 2000                        | 1995-1998 | 1990-1994 | 1980-1989 | 1970-1979 | 1960-1969 | 1940-1959 | 1939 or Earlier |
| City of Dayton         | 71                                     | 246       | 124       | 649       | 405       | 225       | 254       | 79              |
| City of Mont Belvieu   | 39                                     | 168       | 112       | 156       | 290       | 40        | 32        | 9               |
| City of Patton Village | 22                                     | 56        | 31        | 84        | 165       | 99        | 48        | 22              |
| City of Plum Grove     | 38                                     | 80        | 28        | 26        | 54        | 42        | 26        | 2               |
| Town of Roman Forest   | 9                                      | 42        | 45        | 67        | 254       | 7         | 2         | 0               |
| City of Woodbranch     | 4                                      | 33        | 13        | 138       | 219       | 71        | 2         | 2               |

Source: U.S. Census Bureau, [www.census.gov](http://www.census.gov)

### Real Estate Center

Single-family building permit information was collected for Chambers, Harris, Liberty, and Montgomery Counties from 1997 to 2006. The number of building permits has fluctuated during the past 11 years as shown in **Table 5-7**. The year 2003 is documented as the peak year for single-family building permits during this timeframe; this trend is attributed to the rise in population growth the H-GAC region experienced.

**Table 5-7: Single-Family Building Permits**

| Year | Chambers County |          | Harris County  |          | Liberty County |          | Montgomery County |          |
|------|-----------------|----------|----------------|----------|----------------|----------|-------------------|----------|
|      | No. of Permits  | % Change | No. of Permits | % Change | No. of Permits | % Change | No. of Permits    | % Change |
| 1997 | 128             | -        | 13,407         | -        | 195            | -        | 3,110             | -        |
| 2000 | 209             | 63.2     | 18,148         | 35.3     | 213            | 9.2      | 4,049             | 30.1     |
| 2003 | 417             | 99.5     | 26,450         | 45.7     | 258            | 21.1     | 5,581             | 37.8     |
| 2006 | 368             | -11.7    | 32,919         | 24.4     | 292            | 13.1     | 7,309             | 30.9     |

Source: U.S. Census Bureau, [www.census.gov](http://www.census.gov)

### Texas Education Agency

Four school districts are located within the AOI. New Caney ISD was identified as the fastest-growing school district within the AOI with an 11.2 percent (%) enrollment change from the 2005-06 to 2006-07 school years. The four school districts located within the AOI are listed in **Table 5-8**.

**Table 5-8: School District Enrollment Totals**

| District Name    | 2005-2006 Enrollment | 2006-2007 Enrollment | 2-year Growth | % Growth |
|------------------|----------------------|----------------------|---------------|----------|
| Barbers Hill ISD | 3,519                | 3,549                | 30            | 0.8      |
| Dayton ISD       | 4,986                | 4,967                | -19           | -0.3     |
| Huffman ISD      | 3,044                | 3,071                | 27            | 0.8      |
| New Caney ISD    | 8,022                | 8,362                | 340           | 11.2     |

Source: Texas Education Agency, <http://www.tea.state.tx.us/>; accessed April 2008.

### 5.2.3 Step 3: Inventory of Study Area's Notable Features

The baseline conditions for environmental resources that exists before project construction are included in the DEIS. The environmental resources identified in **Chapter 3 (Affected Environment)** include land, water, vegetation, air, wildlife, cultural resources, and communities. Notable resources that could be indirectly impacted within the AOI mirror the list of resources evaluated for direct impacts in **Chapters 3 (Affected Environment)** and **4 (Environmental Consequences)**. Resources within the AOI, such as floodplains, wetlands, forests, rural landscape, farmlands, surface water, and vegetation have been defined and delineated based on available information. These notable land use and natural resource features have been delineated within the AOI based on available information. Vegetation and wildlife habitat was generally characterized through interpretation of H-GAC's high resolution aerial photography for the year 2008, and data obtained from the 2001 National Land Cover Data (NLCD). Threatened and endangered species critical habitat was obtained from the Texas Parks and Wildlife (TPWD) in August 2007. Current

and future environmental justice areas were mapped from data available from the H-GAC 2035 RTP, which was based on the U.S. Census Bureau data. The data for the 100-year floodplain was obtained from the Texas Natural Resource Information System (TNRIS). Data was obtained from the Texas General Land Office in August 2007, and U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) maps, dated 2003, were utilized for information regarding potential waters of the U.S., including wetlands. Park data was gathered in August 2007 from Harris County's database and ESRI's national geodatabase. National Resource Conservation Service (NRCS) 2005 prime farmlands data was also utilized. Information on the various resources studied was digitized, and spatial data was developed through the use of GIS software. Existing and proposed development plans were gathered from local school districts, counties, cities, and other organizations, such as the H-GAC, to determine the area extent of residential, industrial, and commercial growth. All developmental data was also digitized and is shown on **Exhibit 5-2: Indirect Development within the Area of Influence (AOI)**.

#### **5.2.4 Step 4: Identify Impact-Causing Activities of Proposed Action and Alternatives**

Indirect effects are commonly related to land use changes and may be positive or negative. For example, when a transportation project is constructed, the enhanced access to the project area may attract new development or accelerate already planned development in the area. The development may occur in the form of residential developments or in the form of restaurants, gas stations, and other commercial establishments. This "induced development" would be an indirect impact of the proposed project. Generally, it would be reasonable to expect that projects on new locations or larger scale projects (e.g. upgrading an existing facility to a controlled access freeway) would have more potential to cause indirect effects than smaller scale projects or projects being constructed in already developed areas.

Examples of indirect impacts that could potentially occur or may already have occurred as a result of the proposed Grand Parkway Segments H and I-1 project would be the influx of businesses that depend upon proximity to highways with frontage roads, and increased business patronage due to improved access from highway improvements. Similarly, residential development could be enhanced due to improved access provided by the improvements. Existing residents would also benefit from the convenience of these additional services.

The proposed Grand Parkway Segments H and I-1 project has been a planned transportation corridor in Chambers, Harris, Liberty, and Montgomery counties for decades. Current and future land uses have been developed around the initial planning locations of the proposed roadway and assume its full build-out. It should be recognized that the proposed project is needed to address the region's inadequate system linkage, reduced mobility, compromised safety, and lack of infrastructure to support population growth. The Grand Parkway Segments H and I-1 project is a new location project and as such is expected to influence land use and potentially result in substantial indirect impacts.

Examples of indirect land use impacts that have or may occur, with anticipation of the construction of proposed Grand Parkway Segments H and I-1, are located throughout the AOI. Some example developments which would benefit from the proposed construction of Grand Parkway Segments H and I-1 are the Aperion Communities master planned community north of Mont Belvieu and the John P. Dalton residential subdivision just west of Dayton. Other "reasonably foreseeable" developments located within the AOI likely to be influenced by the proposed construction of the Grand Parkway Segments H and I-1 are included in **Table 5-9**. Developments considered "reasonably foreseeable" include projects that have been approved by the local government development process (e.g. a plat has been filed), possess appropriate funding, etc. These reasonably foreseeable projects were determined from 2007-2008 stakeholder meetings and research of platted developments and have been taken into consideration through Steps 5-8 of the indirect impacts analysis. These reasonably foreseeable projects fall within the AOI. It should be noted that the quantifications associated with the AOI in the following sections represent the resources found within the footprint of the AOI. The reasonably foreseeable projects are not anticipated to affect the entire footprint of the AOI. Due to data limitations, quantification of the impacts is limited to the footprint of the AOI to provide a conservative measurement.

**Table 5-9: Reasonably Foreseeable Developments**

| Development                      | Approximate Size (acres) | Relationship with Alternative     | Stage of Development |
|----------------------------------|--------------------------|-----------------------------------|----------------------|
| <b>City of Dayton</b>            |                          |                                   |                      |
| Fordland Estates                 | 40.97                    | 3.5 miles east of 2, 3, 7, 8      | Developing           |
| John P. Dalton                   | 677.37                   | 2.5 miles east of 2, 3, 7, 8      | Future               |
| Oakwood                          | 28.97                    | 1.75 miles east of 2, 3, 7, 8     | Developing           |
| The Meadows                      | 7.96                     | 3 miles east of 2, 3, 7, 8        | Developing           |
| Gus Prevot Subdivision           | 148.39                   | 0.5 mile west of 2, 3, 7, 8       | Future               |
| <b>City of Old River Winfree</b> |                          |                                   |                      |
| Indian Ridge                     | 276.69                   | 3 miles east of 2-11              | Developing           |
| <b>City of Plum Grove</b>        |                          |                                   |                      |
| HF Houston Green Land LP         | 8725.87                  | 2-11                              | Future               |
| <b>City of Roman Forest</b>      |                          |                                   |                      |
| Residential Subdivision          | 111.77                   | 2-6                               | Future               |
| <b>City of Mont Belvieu</b>      |                          |                                   |                      |
| Aperion Communities              | 17560.86                 | 2-5, 7-10                         | Future               |
| <b>Unincorporated</b>            |                          |                                   |                      |
| Oaks of Trinity                  | 184.93                   | 5 miles east of 2, 3, 7, 8        | Developing           |
| West Dayton Manor                | 78.49                    | 0.75 mile west of 4, 5, 9, 10     | Developing           |
| Cedar Springs                    | 463.63                   | 300 ft west of 3, 5, 8, 10        | Planned              |
| Southwood                        | 83.54                    | 3.5 miles east of 2, 4, 7, 9      | Planned              |
| Auroras LLP                      | 1050.00                  | 2.5 miles east of 2, 3, 7, 8      | Future               |
| Alders parcel                    | 247.44                   | 2 miles northeast of 2, 3, 7, 8   | Future               |
| Alders parcel                    | 185.13                   | 3.5 miles northeast pf 2, 3, 7, 8 | Future               |
| BCD Services                     | 206.72                   | 400 ft east of 6, 11              | Future               |
| Kings Colony                     | 395.86                   | 2-6                               | Planned              |
| Ramiro Cano #1                   | 78.66                    | 6, 11                             | Future               |
| Pecan Grove                      | 31.25                    | 0.5 mile west of 4, 5, 9, 10      | Future               |
| Country Place                    | 107.82                   | 0.5 mile west of 4, 5, 9, 10      | Future               |

Source: Study Team, 2008

Based on the results of the expert panel survey, it was determined that areas with the greatest potential for induced development are located at major intersections and adjacent to existing municipalities. Specifically, the expert panel predicted that the corridor would likely see an increase in commercial and industrial land uses, due to the proximity to the Port of Houston and the Bayport Container Facility. In addition to the development noted in **Table 5-9**, the expert panel survey results predicted that approximately 1,000 acres (ac) at the intersection of the Grand Parkway Segments H and I-1 and IH 10 (E) would likely be developed for retail and commercial uses; 5,000 ac each at the intersection of the Grand Parkway Segments H and I-1 and SH 146 and the intersection of the Grand Parkway Segments H and I-1 and FM 1960 would likely be developed for residential uses; and approximately 1,000 ac of commercial and

retail development would occur where the Grand Parkway Segments H and I-1 intersect with FM 1960, US 90 and SH 146. An additional 1,500 ac of industrial development is predicted within outlying parcels in the central portion of the AOI, for each of the alternatives. Alternative A of the *Envision Houston Region* report includes the current growth forecast and development for the region, based on the H-GAC's 2035 population forecast, and assumes the complete build out of the planned regional toll system. In this alternative, development follows tollway extensions along the circumferential pattern of the planned Grand Parkway system. The results of the expert panel survey were combined with the data from the stakeholder meetings, and with data provided in the *Envision Houston Region* report to project the future reasonable and foreseeable development within the AOI, including induced development. The anticipated indirect development is shown on **Exhibit 5-2: Indirect Development within the Area of Influence (AOI)**.

### 5.3 INDIRECT IMPACTS ANALYSIS: STEPS 5-8

Each resource examined was taken through Steps 5 through 8 of the indirect impacts analysis as listed below:

- Step 5: Identify potentially significant indirect effects for analysis
- Step 6: Analyze indirect effects
- Step 7: Evaluate analysis results
- Step 8: Assess consequences and develop mitigation

The objective of Step 5 is to evaluate the potential impact-causing actions of the proposed project on the notable features and compare the actions to land use planning goals within the AOI. Indirect effects identified through Step 5 have been analyzed herein, and indirect effects to resources within the AOI have been quantified to the extent practicable in Step 6. In addition, where it is not possible to quantify indirect effects, they are discussed qualitatively. In addition, other indirect effects, such as habitat alteration and encroachment, are discussed qualitatively. The objective of Step 7 is to evaluate and summarize the results of the analysis. The objective of Step 8 is to assess consequences and develop mitigation.

Resource specific indirect impacts were evaluated within an identified AOI (the 15-minute travel shed shown in **Exhibit 5-1: Segments H and I-1 15-Minute Travel Shed**) and are discussed in the following sections. Where possible, the project team quantitatively determined the potential induced or indirect growth impact of the reasonable alternatives compared to the No-Build Alternative based on mapping

prepared as a result of the stakeholder and expert panel coordination described above in **Section 5.1** and in **Chapter 8 (Agency and Public Coordination)**.

### 5.3.1 Land Use

**Table 5-10** summarizes land development within the AOI gathered from the data sources noted in the previous **Section 5.2**. Based on the results of the expert panel survey, approximately 60% of planned development in the AOI (**Table 5-10**) is dependent on the Grand Parkway Segments H and I-1. In addition to the reasonably foreseeable development listed in **Table 5-9**, the expert panel concluded that the majority of induced development would occur at, or adjacent to, major intersections, including 6,000 ac of residential and commercial developments at the intersections of each reasonable alternative with SH 146 and FM 1960, and 1,000 ac of commercial development at the intersections of the Grand Parkway Segments H and I-1 with US 90. The panel also anticipated that 1,500 ac of outlying property around the City of Dayton may be developed for industrial uses due to the construction of Grand Parkway Segments H and I-1. The total planned development, which includes reasonably foreseeable development and induced development based on the results of the expert panel survey, totals 50,100 acres within the AOI.

As shown in **Table 5-10**, 31% of the total land in the AOI is already developed, and approximately 6% of the AOI is planned for development or would potentially develop as a result of construction of Grand Parkway Segments H and I-1. Therefore, approximately 37% of the AOI is already developed or planned for development, leaving approximately 57% or 437,830<sup>1</sup> ac of open land available for development.

**Table 5-10: Land Development within the AOI**

|                                   | Acres       | Square Miles | Percentage |
|-----------------------------------|-------------|--------------|------------|
| Total land in the AOI             | 770,300     | 1,204        | --         |
| Developed Land                    | 239,370     | 374          | 31         |
| Planned/Induced Development       | 50,100*     | 78           | 6          |
| Potential Developable/Open Land** | 437,830 *** | 684          | 57         |

Source: Study Team, 2008

\*Note: Total acreage based on sum of induced development based on results of expert panel survey and reasonably foreseeable development.

\*\*Note: Several creeks, streams, and a river run through a large portion of the potential developable land. Adjacent areas located within the 100-year floodplain would pose a challenge for development in these areas.

\*\*\* Potential developable land is an estimated sum, based on the total land available within the AOI, minus areas previously developed and planned for development, parkland, and land containing mapped waters of the U.S.

<sup>1</sup> Potential developable land is an estimated sum, based on the total land available within the AOI, minus areas previously developed and planned for development, parkland, and land containing mapped waters of the U.S.

The maximum possible indirect impact would be the remaining 437,830 ac of open, potential developable land. However, as discussed in Step 4, the most reasonable area of development indirectly caused by the proposed project would be within the AOI along the length of the proposed Segments H and I-1. Therefore, the estimate of 437,830 ac of induced development was determined to be unreasonable.

**Table 5-11** shows an estimate of induced developmental effects, ranging from approximately 24,442 to 27,502 ac, for each of the reasonable alternatives based on the results of the expert panel survey, the *Envision Houston Region* report growth projections, and meetings with stakeholders held throughout the planning process. This data is a summary per resource based on acreages presented in **Table 5-10** and anticipated induced development acreages provided by the expert panel.

**Table 5-11: Potential Indirect Land Use and Resource Impacts Within the AOI**

| Alternative  | Description   | Total Acres of AOI | Potential Acres of Induced Development within AOI | Acres of Parkland within Induced Development | Acres of 100-yr Floodplains within Induced Development | Acres of Forests within Induced Development | Acres of Prime Farmland within Induced Development | Acres of T&E Habitat within Induced Development | Acres of Waters of the U.S. within Induced Development | Acres of Wetlands within Induced Development |
|--------------|---------------|--------------------|---|--|--|---|--|---|--|--|
| 1 (No-Build) | No-Build      | --                 | --  | --   | --   | --  | --   | --  | --   | --   |
| 2            | A-2, B-1, C-2 | 770,300            | 24,912  | 0  | 2,072  | 2,597                                       | 14,129   | 7   | 0  | 2,870  |
| 3            | A-2, B-1, C-3 | 770,300            | 24,912  | 0  | 2,072  | 2,597                                       | 14,129   | 7   | 0  | 2,870  |
| 4            | A-2, B-2, C-2 | 770,300            | 26,413  | 0  | 2,072  | 2,615                                       | 14,432   | 7   | 0  | 3,015  |
| 5            | A-2, B-2, C-3 | 770,300            | 26,413  | 0  | 2,072  | 2,615                                       | 14,432   | 7   | 0  | 3,015  |
| 6            | A-2, B-5, C-6 | 770,300            | 27,502  | 0  | 3,167  | 2,634                                       | 14,277   | 7   | 0  | 3,671  |
| 7            | A-4, B-1, C-2 | 770,300            | 24,442  | 0  | 2,006  | 2,518                                       | 14,091   | 7   | 0  | 2,852  |
| 8            | A-4, B-1, C-3 | 770,300            | 24,442  | 0  | 2,006  | 2,518                                       | 14,091   | 7   | 0  | 2,870  |
| 9            | A-4, B-2, C-2 | 770,300            | 25,944  | 0  | 2,006  | 2,536                                       | 14,394   | 7   | 0  | 2,997  |
| 10           | A-4, B-2, C-3 | 770,300            | 25,944  | 0  | 2,006  | 2,536                                       | 14,394   | 7   | 0  | 2,997  |
| 11           | A-4, B-5, C-6 | 770,300            | 27,033  | 0  | 3,102  | 2,555                                       | 14,239   | 7   | 0  | 3,653  |

The general estimate of the total acres of undeveloped land within the AOI and the areas of potential induced development does not take into consideration the potential for existing physical and natural barriers to induced development, such as railroad tracks, and/or hazardous material sites in the southern corridors. Two salt domes, a superfund site, and the industrialized nature of the AOI may limit development. Floodplains, as well as the Lake Houston Park along the northern corridor following FM 1485, would also be deterrents to development in these areas.

Based on input received from the entities with planning jurisdiction and other stakeholders, it is anticipated that only a portion of these areas along each alternative has the potential to develop even in the absence of the proposed project. In addition, while the new location facility may influence the rate of development, based on H-GAC growth models for the year 2035 which include the proposed Grand Parkway facility, areas that currently are experiencing low growth rates, would continue to remain relatively unchanged, such as portions of Liberty County. However, increased access through Liberty County may indirectly impact economic development by increasing commercial and industrial development associated with recent Port of Houston expansion projects.

An *Indirect Land Use Impacts Assessment* located in **Appendix K** analyzes the potential for indirect land use impacts related to the construction of the Grand Parkway Segments H and I-1. The *Indirect Land Use Impacts Assessment* was conducted in accordance with NCHRP Report 25-25, Task 22: *Forecasting Indirect Land Use Effects of Transportation Projects*. The indirect land use impacts outlined in the analysis possess a strong to very strong potential for land use change. Existing comprehensive plans and associated zoning would likely not change as the proposed project is a planned transportation corridor that would benefit from coordinated design, infrastructure, and compatibility of land uses set forth by the Cities of Mont Belvieu and Dayton. However, future comprehensive plans or other land use regulations set forth by other municipalities within the AOI may be influenced by the proposed Grand Parkway Segments H and I-1 as the lack of land use regulation in the AOI creates the potential for such influence.

The growth-related indirect impacts of the proposed action are anticipated to be comparable with forecasted land uses within the AOI. Land converted to developed uses is estimated to be between 24,442 to 27,502 ac (**Table 5-11**); this would account for approximately 3.2 to 3.6% of the total land in the AOI. There would be no indirect effects as a result of the No-Build Alternative.

### **5.3.2 Section 4(f) Properties**

Lake Houston Park, McCollum Park, Authur Bayer Park, Jesse Jones County Park, Crosby Park, Eisenhower Park, Cedar Grove Park, Sheldon Lake State Park, Stratford Park, Highlands Park, Monterief Park, Meadowbrook Park, David Burnett Park, Mont Belvieu City Park, and River Terrace Park are located within the AOI. The proximity impacts to these parks would be primarily in the form of future development, which could change their setting and accessibility. A direct benefit to Lake Houston Park might be improved access to the facility, while negative impacts could be increased air quality and noise impacts. The implementation of mitigation measures may be required if substantial impact on these locations is recognized during subsequent planning activities. The Lake Houston Park is located immediately adjacent to the proposed project; however, no parkland would be directly impacted by the proposed project. Indirect impacts to parklands may occur as a result of increased park usage due to induced growth.

### **5.3.3 Community Resources**

#### **5.3.3.1 Environmental Justice**

The environmental justice community, as a subset of the larger AOI community, would experience indirect impacts that mirror those of the general population. Impacts relating to the economic impacts of tolling on environmental justice populations are considered a direct impact and have been addressed in **Chapter 4 (Environmental Consequences)**.

Potential adverse effects would include displacements of low-income or minority persons, or groups of persons, and additional noise and visual impacts. Beneficial effects could also occur to these populations. For example, induced land use development could create additional job opportunities and increased access to job opportunities through enhanced transportation infrastructure. Indirect impacts pertaining to air quality, access to public facilities and services, traffic operations and traffic noise would be experienced by the environmental justice population to the same extent and in the same manner (whether positive or negative) as experienced by the general population. Because indirect effects to environmental justice communities of concern can be both adverse and beneficial, and because proactive public involvement and coordination with local planning officials can help avoid disproportionate impacts, potential indirect effects of Grand Parkway Segments H and I-1 on environmental justice communities of concern are not considered to be substantial.

### **5.3.3.2 Community Cohesion**

Under any situation where tolling is used as a funding mechanism in the Build Alternative, the potential exists for motorists who do not elect to or can only on occasional basis afford to pay tolls to divert to other corridors. However, the tolled facility under the Build Alternative is a new location facility and would have a net effect of increasing the available capacity by adding tolled expressway through-lanes to the existing network. In essence, the Grand Parkway Segments H and I-1 tolled expressway lanes add grade-separated controlled-access flow capacity for that portion of motorists who elect or can only on occasional basis afford to pay for improved LOS. Those who do not elect or cannot afford to pay the toll would continue to use the existing facilities and should benefit from reduced traffic on those roadways because of the new roadway. A change in access for communities from induced development, i.e. a change in current rural areas to become more suburban, or change in travel patterns would include more travel options. Therefore, indirect impacts to community cohesion are not anticipated.

### **5.3.3.3 Economic Impacts**

The estimated economic impacts resulting only from the highway construction expenditures on the Segments H and I-1 reasonable alternatives in Montgomery, Harris, Liberty, and Chambers counties are presented in this section. A more detailed methodology (including travel efficiency benefits) would be provided for the FEIS once the preferred alternative is selected.

### **Methodology**

The economic analysis presented in this section discusses potential direct and indirect impacts that would occur as a result of the construction of Segments H and I-1. The analysis used a computer-based modeling program called IMPLAN Professional version 2.0 model (IMPLAN) developed by the Minnesota IMPLAN Group, Inc. Through the model, construction cost data were input to calculate direct, indirect, induced, and total impacts which translate to gross revenues attributable to specific industry sectors. To run the input-output model, the construction cost estimates were applied to IMPLAN Sector 39 Highway, Street, Bridge, and Tunnel Construction Industry. The input-output model predicted the effects that highway construction would have on the economies of the four counties through which the project would cross as money flows into the highway, street, bridge, and tunnel construction industry, then is spent and re-spent within each county. All values are presented in 2007 dollars.

As these dollars are spent and re-spent within each county economy, this translates into direct, indirect, and induced impacts to value-added, total output, employment, and indirect business taxes. Direct impacts are impacts that affect only the specific industry in which expenditures are spent. Direct impacts resulting from construction expenditures would occur only within the construction industry. Indirect and induced impacts, commonly referred to as multiplier impacts, occur in all other applicable industries within the user defined impact area. Construction industry purchases of goods and services from other industries and the purchases by those industries, in turn, of goods and services from other industries create indirect impacts. Induced impacts are the result of the purchases by employees from labor income received from the directly and indirectly impacted industries. Total economic impacts are the cumulative direct, indirect, and induced impacts.

As the analysis defined impact area pertains to the aggregation of the four counties in which the reasonable alternatives occur, the estimated impacts apply only to the aggregated impact area, and not specifically to each of the individual counties that comprise the aggregated impact area. In order to determine the economic impacts per county, the economic impacts calculated for the aggregated impact area by IMPLAN are proportioned and allocated to each of the counties by the percentage of total highway construction costs per county. All four of the counties in the aggregated impact area are economically interdependent, and expenditures in one county easily flow into the other three. To fully take this into consideration and accurately capture the economic interrelationship, the counties were aggregated for impact purposes and the impacts proportioned and allocated to each county.

This economic impact analysis is limited in that IMPLAN does not take into consideration expenditure leakages outside the analysis defined impact area. Although the aggregated impact represents the best possible impact area to account for the economic interdependency of the four aggregated counties, IMPLAN is not able to estimate the economic impacts resulting from inevitable leakages outside the defined impact area. It is assumed that the impacts resulting from expenditure leakages outside the defined area are negligible. Also, this analysis only considers the impacts associated with the initial construction phase of Segments H and I-1 and does not take into consideration the potential economic impacts resulting from changing land use patterns.

IMPLAN is a static model, in that it estimates economic impacts only at a specific period of time. It is not capable of estimating changing economic impacts over a period of time. Economic impacts calculated by IMPLAN in this analysis, resulting from the proposed highway construction of the Segments H and I-1, are expressed and represent impacts over the construction period. Because the construction expenditures are not ongoing, the estimated economic impacts would only occur once and eventually taper off.

### **Construction Costs**

Construction costs have been estimated for each of the reasonable alternatives of Segments H and I-1 for each of the four counties in which the segments would be aligned (**Table 5-12**). These estimated construction costs are anticipated to occur over the 2016-2018 time period, with the associated impacts expected during the same timeframe. Total construction costs, calculated from the summation of the cost estimates for each of the counties, serve as the input data into IMPLAN to determine the economic impacts of the proposed construction. Estimated construction costs only account for the initial cost of constructing the proposed facility and do not take into consideration the subsequent operations and maintenance costs incurred after the initial construction phase, because these latter costs are unknown at this time.

Because all the construction expenditures for the 10 reasonable alternatives are all applied to the same industry sector and geographical defined region within IMPLAN, the variations in the economic indicators occur only in direct proportion to the magnitude of the construction expenditures. It is the case that the alternative with the lowest estimated construction expenditures would yield the smallest relative economic impacts, while the alternative with the highest estimated construction expenditures would yield the largest relative economic impacts, for each of the economic impact indicators. Alternatives 4 and 11 have the lowest and highest estimated construction expenditures, respectively, and therefore, exhibit the smallest and largest economic impacts across all economic impact indicators, relative to the other alternatives.

**Table 5-12: Construction Costs of Segments H and I-1 Alternatives**

| Alternative  | Montgomery    | Harris       | Liberty       | Chambers     | Total         |
|--------------|---------------|--------------|---------------|--------------|---------------|
| 1 (No-Build) | N/A           | N/A          | N/A           | N/A          | N/A           |
| 2            | \$134,804,000 | \$19,767,000 | \$283,052,000 | \$68,091,000 | \$505,714,000 |
| 3            | \$134,804,000 | \$19,767,000 | \$277,347,000 | \$80,463,000 | \$512,380,000 |
| 4            | \$134,804,000 | \$19,767,000 | \$274,187,000 | \$68,091,000 | \$496,849,000 |
| 5            | \$134,804,000 | \$19,767,000 | \$268,484,000 | \$80,463,000 | \$503,518,000 |
| 6            | \$134,804,000 | \$59,705,000 | \$233,333,000 | \$87,244,000 | \$515,086,000 |
| 7            | \$148,670,000 | \$25,143,000 | \$283,052,000 | \$68,091,000 | \$524,956,000 |
| 8            | \$148,670,000 | \$25,143,000 | \$277,347,000 | \$80,463,000 | \$531,622,000 |
| 9            | \$148,670,000 | \$25,143,000 | \$274,187,000 | \$68,091,000 | \$516,091,000 |
| 10*          | \$148,670,000 | \$25,143,000 | \$268,484,000 | \$80,463,000 | \$522,760,000 |
| 11           | \$148,670,000 | \$65,125,000 | \$233,333,000 | \$87,244,000 | \$534,372,000 |

\* Recommended Alternative  
Source: Study Team, 2007.

### Impacts by Type

IMPLAN estimates the output, value added, indirect business taxes, and employment impacts resulting from the proposed construction expenditures. Economic impact estimates are calculated by the model for each alternative once the construction cost estimates are applied to the appropriate industry sector within the model and the model run for each of the reasonable alternatives. These impacts are relative to the No-Build Alternative.

### Output Impacts

Economic output is the total value of all final goods and services produced within a defined geographic or economic region. Output impacts resulting from the construction expenditures of the reasonable alternatives are displayed in **Table 5-13**, expressed in direct, indirect, induced, and total economic output impacts, with the latter ranging between around \$800 million (Alternative 4) to \$861 million (Alternative 11).

**Table 5-13: Output Impacts Using 2007 Construction Costs Dollars**

| Alternative  | Direct        | Indirect      | Induced       | Total         |
|--------------|---------------|---------------|---------------|---------------|
| 1 (No-Build) | N/A           | N/A           | N/A           | N/A           |
| 2            | \$493,067,000 | \$99,818,000  | \$222,012,000 | \$814,898,000 |
| 3            | \$499,567,000 | \$101,134,000 | \$224,939,000 | \$825,640,000 |
| 4            | \$484,424,000 | \$98,068,000  | \$218,120,000 | \$800,612,000 |
| 5            | \$490,926,000 | \$99,384,000  | \$221,048,000 | \$811,359,000 |
| 6            | \$502,205,000 | \$101,688,000 | \$226,127,000 | \$829,999,000 |
| 7            | \$511,828,000 | \$103,616,000 | \$230,460,000 | \$845,904,000 |
| 8            | \$518,328,000 | \$104,932,000 | \$233,386,000 | \$856,646,000 |
| 9            | \$503,184,000 | \$101,866,000 | \$226,568,000 | \$831,618,000 |
| 10*          | \$509,687,000 | \$103,182,000 | \$229,496,000 | \$842,365,000 |
| 11           | \$521,009,000 | \$105,474,000 | \$234,592,000 | \$861,077,000 |

\* Recommended Alternative  
Source: Minnesota IMPLAN Group, Inc., 2000.

*Value Added*

Value added is the supplementary value measured contribution to intermediary purchased goods or services in the production process. In a geographically defined impact area, the value added is the measure of the total additional, dollar value, inputs into the production process: in this instance, the construction industry. Value added is an aspect of economic output. IMPLAN calculates value added through the summation of four value added components: employee compensation, or labor income; proprietor’s income; other property income; and indirect business taxes.

Value added economic impacts attributable to the estimated construction expenditures of the reasonable alternatives are displayed in **Table 5-14**, expressed in direct, indirect, induced, and total value added impacts. Total value added associated with the construction of the project is estimated to range between \$318 million and \$342 million, depending on the alternative.

**Table 5-14: Value Added Impacts Using 2007 Construction Costs Dollars**

| Alternative  | Direct        | Indirect     | Induced       | Total         |
|--------------|---------------|--------------|---------------|---------------|
| 1 (No-Build) | N/A           | N/A          | N/A           | N/A           |
| 2            | \$143,208,000 | \$48,401,000 | \$131,696,000 | \$323,305,000 |
| 3            | \$145,096,000 | \$49,039,000 | \$133,432,000 | \$327,566,000 |
| 4            | \$140,697,000 | \$47,553,000 | \$129,387,000 | \$317,637,000 |
| 5            | \$142,586,000 | \$48,191,000 | \$131,124,000 | \$321,901,000 |
| 6            | \$145,862,000 | \$49,298,000 | \$134,136,000 | \$329,296,000 |
| 7            | \$148,657,000 | \$50,243,000 | \$136,706,000 | \$335,606,000 |
| 8            | \$150,545,000 | \$50,881,000 | \$138,443,000 | \$339,868,000 |
| 9            | \$146,146,000 | \$49,394,000 | \$134,398,000 | \$329,938,000 |
| 10*          | \$148,035,000 | \$50,033,000 | \$136,135,000 | \$334,202,000 |
| 11           | \$151,323,000 | \$51,144,000 | \$139,159,000 | \$341,626,000 |

\* Recommended Alternative  
Source: Minnesota IMPLAN Group, Inc., 2000.

*Indirect Business Taxes*

Indirect business taxes are an element of value added and pertain to the general taxes collected by businesses during normal business operations, excluding taxes imposed on corporate profits or income. Collected taxes by businesses during normal operations include: excise taxes, property taxes, sales taxes, fees, and licensing costs. Though IMPLAN does not distinguish which government jurisdiction imposes the taxes in the calculation of indirect business taxes, indirect business taxes include both state and local (county and municipal) taxes.

Indirect business taxes attributable to the estimated construction expenditures of the reasonable alternatives are displayed in **Table 5-15**, expressed in direct, indirect, induced, and total indirect business taxes. Total indirect business taxes related to the construction of the project are estimated to increase by \$17 million to \$18.3 million, depending on the alternative.

**Table 5-15: Indirect Business Taxes Impacts Using 2007 Construction Costs Dollars**

| Alternative  | Direct      | Indirect    | Induced      | Total        |
|--------------|-------------|-------------|--------------|--------------|
| 1 (No-Build) | N/A         | N/A         | N/A          | N/A          |
| 2            | \$1,721,000 | \$4,100,000 | \$11,528,000 | \$17,349,000 |
| 3            | \$1,743,000 | \$4,154,000 | \$11,680,000 | \$17,577,000 |
| 4            | \$1,690,000 | \$4,028,000 | \$11,326,000 | \$17,044,000 |
| 5            | \$1,713,000 | \$4,082,000 | \$11,478,000 | \$17,273,000 |
| 6            | \$1,752,000 | \$4,176,000 | \$11,742,000 | \$17,670,000 |
| 7            | \$1,786,000 | \$4,256,000 | \$11,967,000 | \$18,009,000 |
| 8            | \$1,809,000 | \$4,310,000 | \$12,119,000 | \$18,237,000 |
| 9            | \$1,756,000 | \$4,184,000 | \$11,765,000 | \$17,705,000 |
| 10*          | \$1,779,000 | \$4,238,000 | \$11,917,000 | \$17,933,000 |
| 11           | \$1,818,000 | \$4,332,000 | \$12,181,000 | \$18,332,000 |

\* Recommended Alternative  
Source: Minnesota IMPLAN Group, Inc., 2000.

### Employment

Employment is the number of jobs created within the defined impact area. Employment attributable to the estimated construction expenditures of the alternatives of the Segments H and I-1 are displayed in **Table 5-16**, expressed in direct, indirect, induced, and total employment impacts, the latter ranging between 4,430 jobs (Alternative 4) and 4,770 jobs (Alternative 11).

**Table 5-16: Employment Impacts**

| Alternative  | Direct | Indirect | Induced | Total |
|--------------|--------|----------|---------|-------|
| 1 (No-Build) | N/A    | N/A      | N/A     | N/A   |
| 2            | 2,350  | 510      | 1,650   | 4,510 |
| 3            | 2,380  | 520      | 1,680   | 4,570 |
| 4            | 2,310  | 500      | 1,630   | 4,430 |
| 5            | 2,340  | 510      | 1,650   | 4,490 |
| 6            | 2,390  | 520      | 1,690   | 4,600 |
| 7            | 2,440  | 530      | 1,720   | 4,680 |
| 8            | 2,470  | 530      | 1,740   | 4,740 |
| 9            | 2,400  | 520      | 1,690   | 4,600 |
| 10*          | 2,430  | 530      | 1,710   | 4,660 |
| 11           | 2,480  | 540      | 1,750   | 4,770 |

\* Recommended Alternative  
Source: Minnesota IMPLAN Group, Inc., 2000.

Economic impacts related to the development of Segments H and I-1 include short-term construction-related employment, an increase in other forms of employment, a reduction in travel costs, and additional local and regional income generation from sources such as transportation related taxes.

Economic impacts estimated for each of the reasonable alternatives do not fluctuate substantially in magnitude and vary only in direct proportion to the level of proposed highway construction expenditures. Alternative 4 is expected to yield the smallest economic impacts while Alternative 11 is expected to yield the largest economic impacts because of the lowest and highest, respectively, relative estimated construction costs.

In terms of total economic impact, relative to the No-Build Alternative, total economic output for the aggregate impact area is about \$832 million; total value added is about \$330 million; total indirect business taxes is about \$17.7 million; and total employment is about 4,600 jobs for the averages of the 10 reasonable alternatives. For every dollar of highway construction expenditures, \$1.61 of economic output, \$0.64 for value added, and \$0.03 in indirect business taxes are created. For every \$1 million of highway construction expenditures, 8.9 total jobs are created.

Liberty County is expected to be impacted, in terms of the economic indicators, the most of the four aggregated counties, because the largest percentage of total highway construction expenditures would occur within Liberty County. Liberty County is followed by Chambers, Montgomery, and Harris counties, respectively, in terms of the magnitude of the expected economic impacts.

The primary economic benefits of the proposed project are improved accessibility and improved traffic congestion management. The proposed project would provide a route for truck traffic from the Port of Houston to other industrial areas within the project area without traveling through the congested freeways and local roadways in the city. This would result in substantial time and cost savings for travelers and result in some congestion relief on the freeways within Houston. Reduced congestion would result in increased safety, which would be an added economic benefit.

#### **5.3.3.4 Pedestrians and Bicyclists**

Grand Parkway Segments H and I-1 reasonable alternatives are on new location and would not indirectly

impact pedestrian or bicyclist facilities. The No-Build Alternative would not indirectly impact pedestrian or bicyclist facilities.

### **5.3.3.5 Visual and Aesthetic Impacts**

As a result of the reasonable alternatives, with the implementation of lighting, both potential positive and negative indirect impacts could result. The design of the proposed project would be in keeping with the TxDOT Houston District's Green Ribbon Project. When proper corridor lighting is applied to roadway design, the increased visibility would provide social and economic benefits to the public, to include the following:

- Reduction of nighttime accidents
- Aid of police protection to the community

Roadway lighting does also have some negative side effects which would be associated with the environmental impacts of lighting design. Negative side effects include the following:

- Confusion or visual distraction
- Roadside hazards the lighting structures impose
- General public annoyance

These items would be taken into consideration when designing the roadway lighting system of the proposed corridor. A properly designed lighting system would minimize negative light pollution aspects and would increase the social and economic benefits to the public. The lighting, signage, landscape, and roadway designs would be used to enhance the aesthetics of the proposed AOI, not destroy it. Other indirect visual and aesthetic effects may be related to induced development. These impacts may include a change in the viewshed or ambient light within the AOI. Outside of zoned areas, this effect would not be regulated. However, indirect visual and aesthetic impacts to the AOI are anticipated to be minor.

### **5.3.4 Soils and Farmlands**

The AOI contains approximately 348,650 ac of prime farmland soils. Within areas estimated to be indirectly impacted by construction of the Grand Parkway, the approximate area of farmland soils ranges from 14,091 ac to 14,432 ac, dependent on the reasonable alternative chosen (**Table 5-11**). However, the potential indirect impacts to prime farmland soils related to the reasonably foreseeable development is

anticipated to be minimal compared to the total acreage of prime farmland soils found within the AOI. The No-Build Alternative would not indirectly impact farmland soils; however, conversion of farmland soils in the central area would continue with the current development trend. As documented in **Chapter 4 (Environmental Consequences)**, the reasonable alternatives would directly impact between 900 to 1,106 ac of prime farmland soils, dependent on the reasonable alternative chosen. However, these acreages are considered to be a minor impact, and scored below 160 on the Form CPA-106. Coordination with NRCS will take place for approval of the scoring for each reasonable alternative and the results will be updated in this DEIS. Actual indirect farmland conversion due to increased development associated with reasonably foreseeable projects is also anticipated to be considered a minor impact based on NRCS ratings; therefore, no substantial indirect impacts to prime farmland soils are anticipated with the proposed project.

### **5.3.5 Air Quality**

The AOI is part of the EPA designated eight-county nonattainment area for ozone. The AOI is currently in attainment for all other NAAQS pollutants, including CO, please refer to Section 4.4.1. Based on the results of Steps 1 through 4 that evaluated the possible project-related actions that can indirectly impact air, it was determined that the proposed project would be anticipated to cause indirect air quality impacts in the AOI.

The potential indirect impacts on air quality and MSATs are primarily related to any expected development/redevelopment resulting from project's increased accessibility or capacity to the area. The project would be expected to result in increased development in the area that could include residential, restaurants, gas stations, and other commercial developments.

However, any increased air pollutant or MSAT emissions resulting from the potential development or redevelopment of the area must meet regulatory emissions limits established by the TCEQ and EPA, as well as obtain appropriate authorization from the TCEQ. Regulatory emission limits set by TCEQ and EPA are established to attain and maintain the NAAQS by assuring any emissions sources resulting from new development or redevelopment will not cause or contribute to a violation of those standards.

Therefore, because the project's potential direct and indirect impacts on air quality and MSATs are projected to be offset by federal fuel and vehicle control programs or state and federal regulatory programs, negative impacts on air quality are not anticipated.

### **5.3.6 Water Quality**

Development under any of the reasonable alternatives and the No-Build Alternative could result in some adverse effects to water resources through degradation of surface water and groundwater. Development effects that contribute to water quality degradation include increased impermeable surface and increased non-point source pollution (e.g. from fertilizers, pesticides, sediments, and vehicle residues). The indirect impacts of this development could include increased stormwater runoff velocities and pollutant loads leading to impacts to surface waters and, subsequently, groundwater.

Within the study area, two stream segments are listed on the 2008 303(d) List: Cedar Bayou Above Tidal (Segment 0902) and Cedar Bayou Tidal (Segment 0901). Water quality protection is mandated by numerous federal, state, and local ordinances within the AOI. Water quality in the State of Texas is protected by Sections 401 and 402 of the Clean Water Act and the Texas Water Code.

Section 401 Water Quality Certification of Federal Actions, such as permits for work in jurisdictional waters, requires that specific Best Management Practices (BMPs) be used to address erosion, sedimentation, and post-construction total suspended solids control. Substantial differences in impacts to water quality are not anticipated for the 10 reasonable alternatives and the No-Build Alternative.

No public or private ground water wells would be impacted by development under the No-Build Alternative. Potential development associated with the 10 reasonable alternatives could impact four to 12 public and private wells. Impacted wells would be plugged. Indirect impacts to groundwater wells are anticipated to be minor in the context of the regional development as a whole.

### **5.3.7 Waters of the U.S., Including Wetlands and Vegetative Communities**

#### **5.3.7.1 Waters of the U.S., Including Wetlands**

Under any of the reasonable alternatives or the No-Build Alternative, some degradation of waters of the U.S., including wetlands, could occur within the AOI. Any potential impacts would be mitigated via local water quality rules and regulations, including state and federal laws.

Potential impacts to waters of the U.S. from development indirectly related to the project include placement of fill and degradation of function through encroachment and as a result of increased runoff. Within the AOI there are 81,650 ac of streams and wetlands, as defined by the National Wetland Inventory and the topographical maps utilized for this analysis. The potential indirect impacts to waters of the U.S. and wetlands due to induced development within the AOI is anticipated to be zero acreage of waters of the U.S. and ranges from 2,852 to 3,671 ac of wetlands, dependent on the reasonable alternative chosen (**Table 5-11**). The No-Build Alternative would not indirectly impact waters or wetlands; however, impacts to these resources would continue with the planned development trends. Not all of these streams or wetlands would be considered jurisdictional by the USACE and subject to protection under Section 404 of the Clean Water Act (CWA). Regardless of whether the forecasted development would be public or private, these developments would have to comply with Sections 404 and 401 of the CWA, which regulates the filling of and encroachment on these resources. The USACE administers Section 404 of the CWA and operates under “no net loss” policy for wetlands, requiring avoidance and minimization of impacts, and compensatory mitigation for unavoidable impacts. Compensatory mitigation may include mitigation banking under specific criteria defined and approved by EPA and the USACE. Therefore, indirect impacts to waters of the U.S. including wetlands would be considered minor.

### **5.3.7.2 Vegetative Communities**

Loss of vegetation would be a potential indirect impact from proposed roadway improvements. The vegetative communities considered for direct and indirect impacts consist of agricultural wetlands, agricultural land, forest, forest wetlands, non-forested wetlands, and riparian zones. Specifically, vegetation could be indirectly impacted by the proposed project if the roadway improvements influenced an increase in development in the AOI. The direct impacts to vegetation for the 10 reasonable alternatives ranges from 1,532 to 1,737 ac. It is estimated that indirect impacts to mature woody vegetation (forest) would be limited to less than 2,518 to 2,634 ac for the 10 reasonable alternatives within the AOI (**Table 5-11**). Areas of potential indirect land use impacts to undeveloped land which contains the remaining vegetative communities are estimated to be approximately an additional 24,442 ac to 27,502 ac with the construction of the reasonable alternatives (**Table 5-11**). The No-Build Alternative would not indirectly impact vegetative communities along the corridor. Creation of the new corridor may indirectly impact vegetative communities due to area development; however, indirect impacts to vegetative resources are not expected to be substantial when compared to the acreage of vegetation available within the entire AOI.

### **5.3.8 Wildlife**

Loss of wildlife habitat or habitat fragmentation would be a potential indirect impact from proposed roadway improvements. Specifically, wildlife habitat could be indirectly impacted by the proposed project if the roadway improvements influence an increase in development in the AOI. Under the No-Build Alternative, approximately 270,000 ac are developed and planned for development. Areas of potential indirect land use impacts to undeveloped land are estimated to be approximately an additional 24,442 ac to 27,502 ac with the construction of the reasonable alternatives (**Table 5-11**). This portion of undeveloped land that would be indirectly impacted contains wildlife habitat consisting of forested wetlands, non-forested wetlands, and forest. A large portion of the 437,830 acres of undeveloped land within the AOI is farm and pasture land. As noted in **Chapter 4 (Environmental Consequences)**, the existing habitat has largely been fragmented by development, timber industry, and agricultural practices. Activities within the AOI may have the potential to impact foraging, breeding, or roosting activities of some species, and some terrestrial species may relocate due to changes in available habitat. However, species within the AOI are largely found throughout the region and substantial impacts to individual species are not anticipated. Therefore, additional indirect impacts to wildlife species or their habitats are not expected to be substantial.

### **5.3.9 Threatened and Endangered Species**

To determine the potential indirect impacts to threatened and endangered species, known occurrences of federal- and state-listed species provided by the Texas Natural Diversity Database (TxNDD) were compared with the Grand Parkway Segments H and I-1 study area (TPWD, 2009). In addition, potential habitat for the bald eagle, red-cockaded woodpecker, and Texas prairie dawn are within the AOI. The TPWD review gave the potential threatened and endangered species habitat as one combined GIS file, and did not distinguish individual species or habitat locations.

Under the No-Build Alternative, 270,000 ac of land is developed and planned for development within the AOI. Preferred habitat located within these areas could be negatively impacted where federal oversight would not be required (such as with private residential and commercial development). However, these developers are required to coordinate with the USFWS on all activities involving threatened and endangered species.

Of the 35,150 ac identified as potential habitat defined by the TPWD TxNDD review within the AOI for the

bald eagle, Texas prairie dawn, red-cockaded woodpecker, 11,680 ac are included within parks which are protected from development. This 35,150 ac identified as potential habitat by TPWD also includes habitat for the state threatened Rafinesque's big eared bat. In addition, approximately 10,860 acres of the potential threatened and endangered species habitat documented within the AOI occurs within the 100-year floodplain. Therefore, development in these areas may be limited and is currently regulated. Approximately 7 ac of these areas designated as potential habitat for threatened or endangered species are located within the areas denoted by the expert panel as potentially developed areas under the reasonable alternatives.

It is expected that any undeveloped areas, both planned and unplanned, could be developed under the No-Build Alternative, and continued loss of habitat may occur if these areas are not developed in compliance with the Endangered Species Act. It is impossible to determine the degree to which future development would comply with the Endangered Species Act. However, based on the land use analysis (**Chapter 4 (Environmental Consequences)**) and current federal and state laws and regulations, it is expected that the development of properties containing threatened or endangered species preferred habitat within the AOI would not be affected by any of the reasonable alternatives of the Grand Parkway Segments H and I-1 project. Therefore, indirect impacts are not anticipated from the proposed Grand Parkway Segments H and I-1 project on the bald eagle, red-cockaded woodpecker, or Texas prairie dawn within the AOI.

### **5.3.10 Floodplains**

Floodplains pose a constraint to development of transportation, commercial, and residential projects. This constraint relates to the regulation of these floodplains through county and local ordinances. While these ordinances do not prohibit development within the floodplain, they limit and regulate development to eliminate or reduce potential damage from future floods. Executive Order 11988 (1977), Floodplain Management, and county and local ordinances would minimize floodplain encroachment, to the extent allowable within the regulations, thereby preserving some of a floodplain's natural values. These values include retention of riparian vegetative buffers, which preserve wildlife habitat and provide natural filtration for improved water quality.

Within the AOI, there are 179,507 ac of 100-year floodplains, 19,813 ac of which are within current and future development under the No-Build Alternative. Potential indirect impacts to floodplains range from 2,006 ac to 3,167 ac, based on the expert panel survey estimates of potential developed areas. However,

indirect impacts to floodplains would be considered minor because the areas located within the 100-year floodplain are subject to local regulations and would pose a challenge for development.

### **5.3.11 Wild and Scenic Rivers**

No rivers identified as a National Wild and Scenic River are located within the AOI; therefore, no indirect impacts to wild and scenic rivers are anticipated with any of the reasonable alternatives or the No-Build Alternative.

### **5.3.12 Coastal Barriers**

No coastal barrier areas are located within the AOI; therefore, no indirect impacts to coastal barriers are anticipated with any of the reasonable alternatives or the No-Build Alternative.

### **5.3.13 Coastal Zone Management**

The proposed project is not located within the Coastal Zone Management (CZM) boundary; however, the CZM boundary does fall along the edge of the AOI. No indirect impacts to the CZM are anticipated with the No-Build Alternative, or any of the reasonable alternatives.

### **5.3.14 Essential Fish Habitat**

The proposed project does not intersect any tidally influenced waters and would not impact Essential Fish Habitat (EFH); however, the larger indirect impact study area within the AOI does include tidally influenced waters. No indirect impacts to the EFH are anticipated with any of the reasonable alternatives or the No-Build Alternative.

### **5.3.15 Archeological Resources**

Land use changes could impact archeological resources through site clearing, grading, or excavation during development. Some of the development may fall under federal or state regulatory resource protection review, and therefore, archeological sites could be protected, preserved, and mitigated. Within the AOI, numerous archeological sites may exist especially within the land available for development adjacent to creeks. Indirect impacts to archeological sites could result; however, it cannot be determined whether this development would result in substantial impacts to these sites because the quantity, location, and integrity of individual resources are unknown.

### **5.3.16 Non-Archeological Historic Resources**

For the purpose of this analysis, non-archeological historic resources include those buildings, structures, objects, and non-archeological districts that are listed or eligible for listing in the National Register of Historic Places (NRHP). Indirect impacts to non-archeological historic resources could occur if the proposed improvements were to attract development that would replace these resources. Therefore, any indirect impacts to land use changes attributed to the proposed improvements of Grand Parkway Segments H and I-1 have the potential to have an indirect impact to historic resources. As with archeological sites, some of the development under the reasonable alternatives or the No-Build Alternative may fall under federal or state regulatory resource protection review; therefore, these historic properties may be protected or preserved. However, most of the development under either alternative would be residential and commercial and would not fall under the regulatory review process; therefore, historic properties potentially affected by such development would not have protection under federal or state laws.

Of the properties identified within the Grand Parkway Segments H and I-1 AOI, one historic-age non-archeological resource has been determined eligible for listing in the NRHP (Property Number 123). Two other properties, Property Numbers 102 (Peach Creek Girl Scout Camp) and 104 (a single dwelling) are recommended as eligible for the NRHP, pending the Reconnaissance Survey and additional research. Potential effects from development may include both the direct physical loss of some properties yet unidentified, or the loss of historic integrity of other properties.

Development forecasted in the AOI could result in indirect effects to non-archeological historic properties; however, it cannot be determined whether development under the reasonable alternatives or the No-Build Alternative would result in substantial effects to historic properties because the quantity, location, and character of individual resources are unknown.

### **5.3.17 Construction Impacts**

There would be no indirect construction phase impacts under the No-Build Alternative. Social, economic, and environmental direct impacts resulting from the construction of Grand Parkway Segments H and I-1 would be temporary with any of the reasonable alternatives. No indirect impacts are anticipated from the construction phase of the proposed project.

## 5.4 Summary

The indirect impacts to resources presented in this chapter have been quantified based on development forecasted through 2039 by local planners, stakeholders, and an evaluation of the difference of this anticipated development between the build and No-Build Alternative. **Table 5-17** provides a summary of the potential indirect effects from the Grand Parkway Segments H and I-1. In some cases, such as waters of the U.S. and floodplains, this may represent an overstatement of effects, as inclusion of resource features within a geographically defined development area does not imply that all such resources would be adversely affected. Actual impacts to some of these resources could be reduced, as federal and state regulations and local ordinances regulate development affecting these resources. Other resources, such as soils and farmlands, wildlife habitat, and parkland, are not effectively regulated for either public or private development. The indirect effects to resources presented in this chapter represent the anticipated development forecasted through 2039. Further, this summary does not account for the potential decreases or increases in impacts associated with the potential redistribution of development from other parts of the region. This is because it is impossible to determine the amount or location of this redistribution.

While Grand Parkway Segments H and I-1 would cause both adverse and beneficial indirect effects from induced development, this development, and its resulting effects, is a relatively small addition to what would happen under the No-Build Alternative. The anticipated indirect effects to the resources evaluated in this analysis are not likely to be substantial.

**Table 5-17: Summary of Potential Indirect Effects from Segments H and I-1 (Recommended Alternative)**

| Resource or Effect                                |                              | Unit     | Resources and Potential Indirect Effects Attributed to Segments H and I-1 within the AOI (15-Minute Travel Shed)   |
|---|------------------------------|----------|--|
| Land Use  |                              | Acres    | 770,300 ac are within the AOI; Range of 24,442 to 27,502 ac (3.2 to 3.6% of the AOI) may be impacted   |
| Section 4(f) Properties                           |                              | -        | No indirect impacts to parklands are anticipated because it is unlikely that private development would occur within these public lands.  |
| Community Impacts Assessment                      | Environmental Justice        | -        | Potential indirect effects could include additional noise and visual impacts. Beneficial effects could also occur to these populations. For example, induced land use development could create additional job opportunities and increased access to job opportunities through enhanced transportation infrastructure.  |
|   | Community Cohesion           | -        | The tolled facility under the reasonable alternatives is a new location facility and would have a net effect of increasing the available capacity by adding tolled expressway through-lanes to the existing network. In essence, the Grand Parkway Segments H and I-1 tolled expressway lanes add grade-separated access-controlled flow capacity for that portion of motorists who elect or can only on occasional basis afford to pay for improved LOS. Those who do not elect or cannot afford to pay the toll would continue to use the existing facilities and should benefit from reduced traffic on those roadways because of the new roadway. Therefore, indirect impacts to community cohesion are not anticipated. |
|   | Economic Conditions          | -        | The Segments H and I-1 project is anticipated to have a beneficial effect on local and regional economies. The increase in the rate of development would also increase the demand for consumer services.   |
|   | Pedestrians and Bicyclists   | -        | Grand Parkway Segments H and I-1 reasonable alternatives are on new location and would not indirectly impact pedestrian or bicyclist facilities.   |
|   | Visual and Aesthetic Impacts | -        | Indirect visual and aesthetic effects may be related to induced development. Outside of zoned areas, this effect would not be regulated. However, indirect visual and aesthetic impacts to the AOI are anticipated to be minor.  |
| Soils and Farmlands                               |                              | Acres    | 348,648 ac within the AOI; Range of 14,901 to 14,432 ac may be indirectly impacted   |
| Air Quality                                       | Criteria Pollutants          | -        | No change in attainment status is anticipated.   |
|   | MSATs                        | -        | Up to 4.2 tons may be contributed due to increased industrial activity; however, MSATs are anticipated to decrease over time.  |
| Water Quality                                     | Surface Water                | -        | Development under either alternative could result in adverse effects to water resources through degradation of surface water and groundwater, more rapid discharge of stormwater, and additional pollutant loadings of waterways.  |
|   | Groundwater Wells            | Site     | No public or private ground water wells would be impacted by development under the No-Build Alternative. Potential development associated with the 10 reasonable alternatives could impact 4 to 12 public and private wells. Impacted wells would be plugged. Indirect impacts to groundwater wells are anticipated to be minor in the context of the regional development as a whole.   |
| Waters of the U.S., including Wetlands Vegetation |                              | Acres    | 81,650 ac (waters and wetlands within the AOI); Range 2,870 to 3,671 (wetlands within the AOI) and 0 ac waters<br>Range of 2,518 to 2,634 ac of woody vegetation may be indirectly impacted  |
| Wildlife/Wildlife Habitat                         |                              | Acres    | 437,830 ac of potential wildlife habitat with the AOI; Range of 24,442 to 27,502 ac may be indirectly impacted<br>No wildlife species are anticipated to be indirectly impacted by the proposed project.   |
| Threatened and Endangered Species                 |                              | -        | Approximately 7 ac designated as potential habitat for threatened or endangered species are located within the areas denoted by the expert panel as potentially induced developed areas.<br>It is anticipated that all areas would be developed in compliance with the Endangered Species Act. Therefore, No indirect effects to threatened or endangered species are anticipated.   |
| 100-Year Floodplains                              |                              | Acres    | 179,507 ac of 100-year floodplains within the AOI; range of 2,006 to 3,167 ac may be indirectly impacted. However, impacts to floodplains are unlikely due to limits to development within floodplains   |
| Wild and Scenic Rivers                            |                              | -        | No rivers identified as a National Wild and Scenic River are located within the AOI; therefore, no indirect impacts to wild or scenic rivers are anticipated.  |
| Coastal Barriers                                  |                              | -        | No coastal barrier areas are located within the AOI; therefore, no indirect impacts to coastal barriers are anticipated.   |
| Coastal Zone Management                           |                              | -        | The proposed project is not located within the Coastal Zone Management (CZM); however, the CZM boundary does fall along the edge of the AOI. No indirect impacts to the CZM are anticipated.   |
| Essential Fish Habitat                            |                              | -        | The proposed project does not intersect any tidally influenced waters and would not impact Essential Fish Habitat (EFH); however, the larger indirect impact study area within the 15-minute travel shed area does include tidally influenced waters. No indirect impacts to the EFH are anticipated.  |
| Cultural Resources                                | Archeological                | Site     | The total number of sites that could be affected is unknown. Only a portion of sites would be recommended for further testing, and a small subset of this portion would be considered eligible for the NRHP or as a SAL.   |
|   | Non-Archeological Historic   | Resource | The total number of historic-age non-archeological resources that could be affected is unknown, but there are only three non-archeological historic resources (those listed, determined eligible, or recommended eligible for listing in the NRHP) in the APE. It is unlikely that the non-archeological historic-age reconnaissance survey would encounter more historic resources. Forecasted development under the Build Alternative is not anticipated to impact any historic resources.   |
| Construction Impacts                              |                              | -        | No indirect impacts are anticipated from the construction phase of the proposed project.   |

Source: Study Team, 2008

### 5.5 Regional Indirect Effects of Toll Facilities

The freeway and toll road system is a major component of the Houston-Galveston regional roadway network. Currently, the freeway/toll road system represents nearly 19 percent of regional lane miles and carries more than 48 percent of vehicle miles traveled. The 2009 regional roadway network consists of nearly 24,571 total lane miles. This includes nearly 658 tolled lane miles and 289 managed lane miles (Table 5-18). By 2035, these numbers are expected to increase to 32,855 lane miles of which 2,049 are tolled lane miles and 853 are managed lane miles. Figure 5-1 shows the tolled and managed lane improvements to the regional roadway network by year 2035.

**Table 5-18: Regional Roadway Network (lane miles)**

|                     | Freeway | Toll Roads | Managed Lanes | Arterial | Total Lane Miles |
|---------------------|---------|------------|---------------|----------|------------------|
| <b>2009 Network</b> | 3,669   | 658        | 289           | 19,955   | 24,571           |
| <b>2035 Network</b> | 4,339   | 2,049      | 853           | 25,614   | 32,855           |

Source: H-GAC 2009.

In addition, the transit system has 485,000 daily passenger boardings and is expected to increase to nearly 725,000 by 2035. This increase would be attributed to:

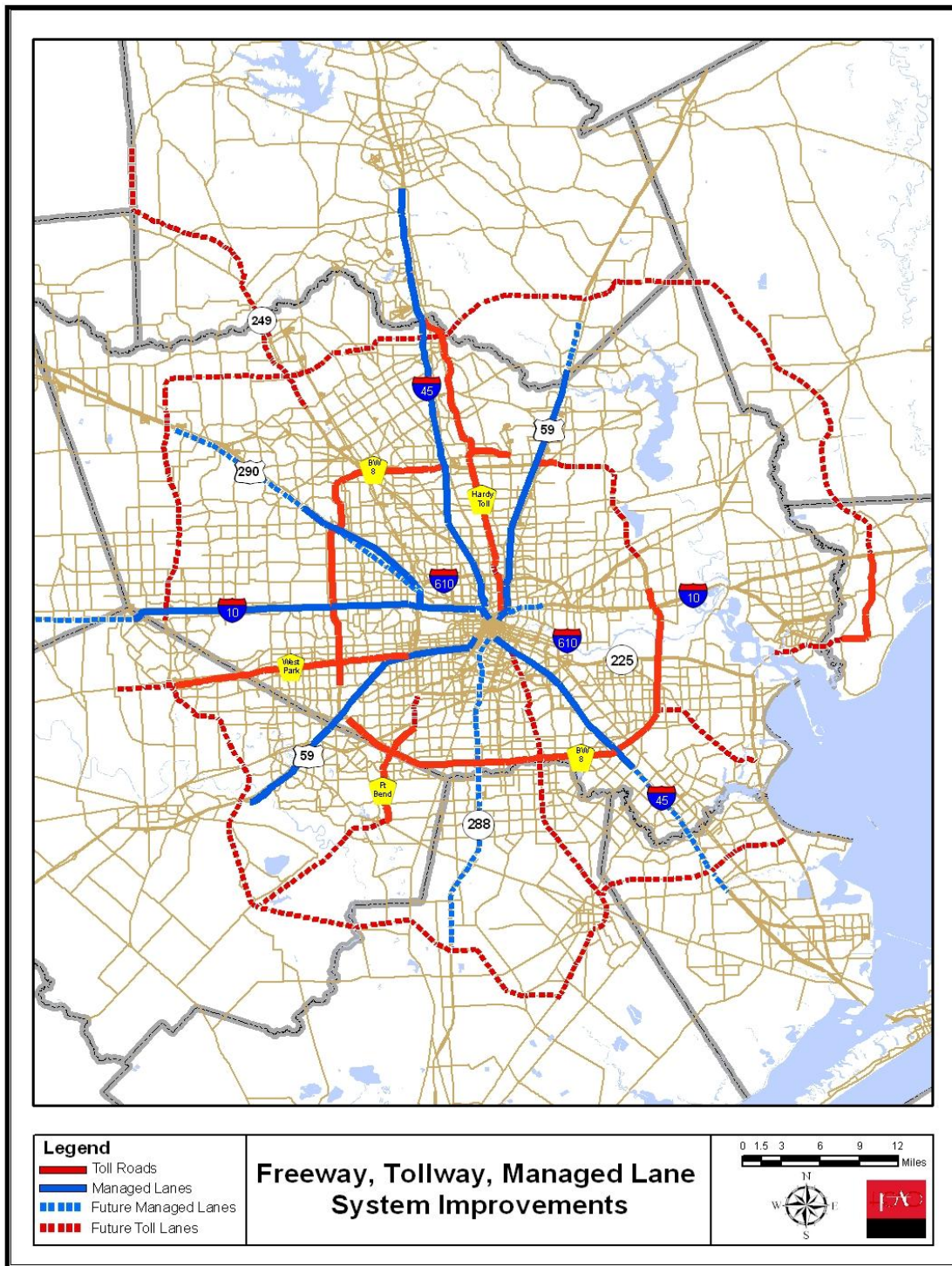
- Expansion of transit services (increased bus and rail transit services),
- New transit modes (commuter rail transit and signature express bus service),
- Transit connectivity to multiple employment centers, and
- Coordination of transit services among regional public transportation providers.

METRO's 2035 Long Range Plan recommends significant expansion of the current transit system and includes a network of integrated high capacity transit facilities on major travel corridors. This plan also identifies service expansions beyond the METRO service area. New improvements scheduled for implementation through the year 2035 include high occupancy tolls, a new intermodal terminal, park-n-ride facilities, and several new high capacity transit corridors throughout the region. Additional key elements of the plan include:

- 89 miles of fixed guideway transit – Light Rail Transit (LRT)
- 84 miles of Commuter Rail Transit (CRT)
- 40 miles of Signature Bus

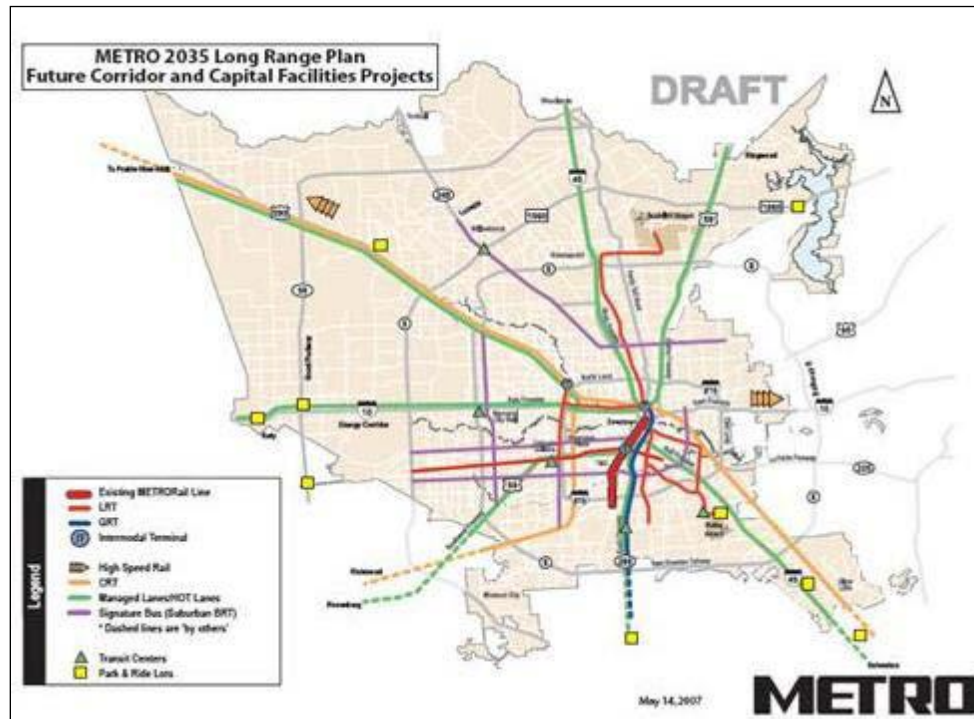
Figure 5-2 shows the future corridor and capital facilities projects in the 2035 METRO Long Range Plan.

Figure 5-1: Proposed 2035 Regional Roadway Network



Source: H-GAC 2009

Figure 5-2: 2035 Future Corridor and Capital Facilities Projects



Source: Metro, 2007

## 5.6 Conclusion

The expanding regional roadway network, including tolled facilities and managed lanes, along with the expanding transit network could have indirect and cumulative impacts. However, the impacts are not isolated to one location and would be better considered at the regional level. As a result, the consideration of the regional tolled roadway network is included in the cumulative impacts portion of this document.