CHAPTER 5: INDIRECT IMPACTS
TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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 Draft Environmental Impact Statement (EIS) document(s) were instructed to use this October 2008 guidance. However, in September 2010, the Environmental Affairs Division of TxDOT (TxDOT ENV) issued updated guidance for preparing ICI analyses. The Final EIS has been updated to follow TxDOT's September 2010 revised guidance on preparing ICI analyses.

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 were used. Additional information was obtained using Texas Education Agency data, stakeholder interviews, expert panel surveys, and employment forecasts and analyses. This information allows 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 heavily 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), FHWA

Technical Advisory 6640.8A, *Questions and Answers Regarding the Consideration of Indirect and Cumulative impacts in the NEPA Process* (FHWA 2003), and the TxDOT Revised *Guidance on Preparing Indirect and Cumulative Impacts Analysis* (TxDOT 2010). 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: TRB 2002, 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, TRB 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: NCHRP 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: TRB 2002, NCHRP Report 466

The eight-step process outlined above served as the initial approach for this indirect impacts analysis. The analysis was updated in 2012 to include the most recent TxDOT *Revised Guidance on the Preparation of Indirect and Cumulative Impacts Analysis* (TxDOT 2010). Under the TxDOT's Revised 2010 Guidance, there are three categories of indirect effects:

- Encroachment-Alteration Effects;
- Induced Growth Effects, and
- Effects Related to Induced Growth-Related Effects.

Encroachment-Alteration Effects are those that alter the behavior and functioning of the physical environment. These effects are related to project design features, but are separated from the project by time and/or distance.

Induced Growth Effects are also known as Project-Influenced Effects or the Land Use Effect. Changes in access and mobility can result in changes in land use. Highway projects may promote development or influence an increase in the rate of development.

Effects Related to Induced Growth-Related Effects are those effects that are attributable to the induced growth itself.

The TxDOT 2010 *Revised Guidance* uses a variation of the 2002 NCHRP Report 466 process, and recommends conducting an Indirect Impact Analysis using a seven-step process, as shown in **Table 5-3** below.

Table 5-3: TxDOT Seven-Step Approach to Estimate Indirect Impacts

Step 1 – Scoping: The basic approach, effort required, and geographical boundaries of the study are determined.
Step 2 – Identify the Study Area's Goals and Trends: Information regarding the study area is compiled with the goal of defining the context for assessment.
Step 3 – Inventory the Study Area's Notable Features: Additional data on environmental features are gathered and synthesized with a goal of identifying specific environmental issues by which to assess the project.
Step 4 – Identify Impact-Causing Activities of Proposed Action and Alternatives: Fully describe the component activities of each project alternative
Step 5 – Identify Potentially Substantial Indirect Effects for Analysis: Indirect effects associated with project activities and alternatives are catalogued, and potentially substantial effects meriting further analysis are identified.
Step 6 – Analyze Indirect Effects and Evaluate Results: Qualitative and quantitative techniques are employed to estimate the magnitude of the potentially substantial effects identified in Step 5 and describe future conditions with and without the proposed transportation improvement. The uncertainty of the results of the indirect effects analysis is evaluated for its ramification on the overall assessment.
Step 7 – Assess Consequences and Consider/Develop Mitigation (when appropriate): The consequences of indirect effects are evaluated in the context of the full range of project effects. Strategies to avoid or lessen any effects found to be unacceptable are developed. Effects are reevaluated in the context of those mitigation strategies.

Source: TxDOT *Revised Guidance on the Preparation of Indirect and Cumulative Impacts**Error! Bookmark not defined.** Analysis* (2010)

All indirect effects would occur outside of the existing or proposed ROW. As to the cause and effect relationship between the proposed improvements and the indirect impact, CEQ states that indirect effects may include induced changes to land use resulting in resource impacts (40 C.F.R. § 1508.8). Indirect effects can be linked to direct effects in a causal chain (NCHRP Report 466). The chain can be extended as indirect effects produce further consequences. Probability also helps distinguish indirect effects from direct effects; direct effects are often inevitable while indirect effects are merely probable. Each step of the seven-step indirect impact analysis has been applied to the proposed project and the findings documented in this FEIS.

5.1.1 Stakeholder and Expert Panel Involvement

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 B)**. **Table 5-4** includes a general list of the project stakeholders.

Table 5-4: Project Stakeholders

Community Level	Agency Level
Elected Officials Local – Council Members, County Officials and Mayors	Local Private – Utility companies, Railroads, Industries Public – Counties, HCTRA, Municipalities, TxDOT Houston, TxDOT Beaumont, H-GAC
Communities and Stakeholders Homeowner Associations Developers Various Special Interest Groups Sierra Club	Regional Federal – FHWA, USACE, USFWS, NRCS, EPA State – TCEQ, TxDOT Environmental Affairs Division, THC, TPWD 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 identifying 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, officials from area school districts, and H-GAC officials were organized to discuss existing, proposed, and potential development within a 15-minute travel shed. The 15-minute travel shed factored heavily into the development of the "indirect impacts study area, or area of influence (AOI)" **(Exhibit 5-1).** Questions asked during these meetings with stakeholders included:

Existing Development

- 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 provided?

Proposed Development

- Are there any pending subdivision applications in the defined study area?
- 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

- 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?
- 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

- If constructed, how would Grand Parkway Segments H and I-1 affect land development in the defined study area?
- In which areas would you expect development to be concentrated if the proposed roadway is constructed?
- In which areas would you expect development to be concentrated if the proposed roadway is not constructed?
- To what degree would you expect the proposed project to influence development patterns within the defined study area?
- 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 gathered during the stakeholder meetings held during 2007-2008 included specific information for planned development within the region. This data was used to initially map and document reasonably foreseeable development within the 15-minute travel shed.

In addition to these initial stakeholder meetings held during 2007-2008, a panel of experts (including H-GAC personnel, as well as local and county planning personnel) was consulted for the analysis of indirect impacts. In late 2008 and early 2009, formal surveys were sent to the original stakeholders queried during 2007-2008, as well as 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 AOI (study area) for the indirect impacts questionnaire was the 15-minute travel shed. **Table 5-5** lists the expert panel that returned responses to the survey.

Table 5-5: 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
Dave 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, 2008-2009

Based on 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 (2035 RTP Update Appendix A). Scenario 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 scenario, development follows the pattern of the planned Grand Parkway segments.

The results of the expert panel survey conducted in 2008-2009 were combined with the data from the 2007-2008 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. All future reasonable and foreseeable development data was digitized and is shown on **Exhibit 5-2**.

In 2013, the survey results and future development information provided by the 2008-2009 expert panel were reviewed for applicability to the Preferred Alternative in the current year. The land use planning documents provided by the 2008-2009 expert panel and those analyzed in the **Indirect Land Use Impacts Assessment** (**Appendix O)** are still in use by local area planners and city officials. Therefore, the analysis presented in the Indirect Land Use Impacts Assessment (**Appendix O**) and future development information provided by the expert panel remains valid for the Preferred Alternative, and can be considered conservative given the current economic climate.

5.2 Step 1: Scoping

Scoping is the key to proper and timely identification and analysis of indirect effects. Scoping is a process used to determine the extent of the potential area of impact. The scoping process has two overall goals:

(1) determining the level of effort and approach needed to complete the analysis, and (2) determining the location and extent of the indirect impact study area.

The geographic boundary of the AOI 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)**. The methodology for developing the AOI was based on the approach applied for Grand Parkway Segment G. This methodology used 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 coincide with the boundaries of the nearest Traffic Analysis Zones (TAZ). The AOI includes the area in which the proposed Grand Parkway Segments H and I-1 could influence local traffic patterns and/or land development. It is assumed that areas outside the AOI are better served by other roadways.

The total AOI is comprised of 770,300 acres (ac) or 1,204 square miles (m^2) within Harris County, Montgomery County, Liberty County, Chambers County, San Jacinto County. The AOI encompasses the cities of Huffman, Patton Village, Roman Forest, Baytown, Mont Belvieu, and Dayton. **Table 5-6** provides the land area detail.

Table 5-6: Area of Influence (15-Minute Travel Shed)

	Acres (rounded)	Square Miles	Percentage of AOI
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
Total Land in the AOI	770,300	1,204	100.0

Source: Study Team, 2007

The project team gathered reasonable and potential scenarios of future land use and associated demographics through a planning horizon of 2035. 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 the construction of 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 which 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), US Fish and Wildlife Service (USFWS), U.S. Army Corps of Engineers (USACE), U.S. Coast Guard (USCG), Texas Parks and Wildlife Department (TPWD), and the Texas Historical Commission (THC). A complete list of stakeholders consulted is included in the Project Coordination Plan in **Appendix B**. As previously stated, a panel of experts (refer to **Table 5-5**) in planning and development of this region were consulted and provided estimates of the acreage of potential development that could be induced by the proposed project.

5.3 Step 2: Identify the Study Area's Goals & Trends

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 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.

5.3.1 Study Area Goals

The proposed toll facility has been planned for many years, and the (minimal) existing land use planning for the region reflects the anticipated presence of the Grand Parkway Segments H and I-1. Publicly planned development goals for each of the jurisdictions in the study area are discussed in further detail in the **Indirect Land Use Impacts Assessment** (**Appendix O**) and assume that the proposed Grand Parkway Segments H and I-1 would be constructed. The H-GAC 2035 Regional Transportation Plan (RTP) Update defines transportation systems and services within the boundaries of the AOI (2010). The RTP Update 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. The basic land use patterns surrounding the anticipated construction and the proposed Preferred Alternative alignment for Grand Parkway Segments H & I-1 is also similar to the alignment included in the City of Mont Belvieu master plan.

Refer to **Appendix O** for the **Indirect Land Use Impacts Assessment** which is a report initially developed in 2008 that identifies and analyzes the potential for indirect land use impacts related to the proposed construction of Grand Parkway Segments H and I-1.

5.3.2 Study Area Trends

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 2035 RTP Update show these development patterns—slower in the central project corridor, and faster paced growth in the northern and southern areas of the project—continuing into the future.

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 5-7** for historic housing characteristics for the municipalities located within the AOI.

Table 5-7: New Home Construction

Geographic Area	Number of New Homes Built & Year Built								
	2005 or later	2000-2004	1990-1999	1980-1989	1970-1979	1960-1969	1950-1959	1940-1949	1939 or Earlier
City of Dayton	85	369	380	382	251	173	171	149	86
City of Mont Belvieu	157	162	247	156	324	67	7	6	41
City of Patton Village	6	28	35	92	167	70	34	0	2
City of Plum Grove	0	27	36	38	51	24	15	8	0
City of Roman Forest	118	231	705	872	707	173	125	55	13
City of Woodbranch	0	15	76	89	210	72	6	0	0

Source: U.S. Census Bureau, *2006-2010 American Community Survey*

Real Estate Center

Single-family building permit information was collected for Chambers, Harris, Liberty, and Montgomery counties from 1997 to 2011. The number of building permits has fluctuated during the past 14 years as

shown in **Table 5-8**. The year 2006 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 5-8: 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
2011	216	-41.3	17,388	-47.2	260	-11	4,009	-45.1

Source U.S. Census Bureau: State and County QuickFacts, 2010

Texas Education Agency

Ten school districts are located within the AOI. New Caney Independent School District (ISD) was identified as the fastest growing school district within the AOI with a 20.9 percent enrollment change from the 2006-07 to 2010-11 school years, followed by Barber's Hill (18.9 percent growth) at the opposite termini. The growth trends from the school enrollment data suggest strong growth surrounding both areas of the project logical termini, with little to negative growth through the center of the AOI corridor. The 10 school districts and their growth trends located within the AOI are listed in **Table 5-9**.

Table 5-9: School District Enrollment Growth Trends

District Name	2006-2007 Enrollment	2007-2008 Enrollment	2008-2009 Enrollment	2009-2010 Enrollment	2010-2011 Enrollment	5-year Growth	% Growth
Barbers Hill ISD	3,549	3,708	3,903	4,121	4,220	671	18.9%
Cleveland ISD	3,478	3,539	3,672	3,779	3,866	388	11.2%
Crosby ISD	4,715	4,884	4,998	5,034	5,119	404	8.6%
Dayton ISD	4,967	4,896	4,772	4,912	4,927	-40	-0.8
Goose Creek ISD	20,293	20,354	20,698	20,954	21,283	990	4.9%
Huffman ISD	3,071	3,092	3,054	3,152	3,168	97	3.2%
Humble ISD	31,327	32,970	33,883	34,923	35,913	4,586	14.6%
New Caney ISD	8,362	8,676	9,122	9,609	10,106	1,744	20.9%
Splendora ISD	3,365	3,378	3,413	3,382	3,487	122	3.6
Tarkington ISD	1,974	1,994	1,934	1,986	1,909	-65	-3.2%

Source: Texas Education Agency, September 2012

5.4 Step 3: Inventory of Study Area's Notable Features

The baseline conditions for the environmental resources that exist before project construction are included in **Chapter 3 (Affected Environment)**. The AOI is mostly undeveloped with pockets of residential,

industrial, commercial, and parkland development. As stated in **Chapter 3**, most of the developed land is within and adjacent to the northern portion of the study area along US 59 (N)/Interstate Highway (I) 69 and FM 1485 and along the southern portion in Mont Belvieu. Notable features that could be indirectly impacted within the AOI are listed below and illustrated in **Exhibits 5-1** and **5-2**.

- Lake Houston;
- Lake Houston Wilderness Area;
- Salt domes (e.g. Humble, Esperson, Barbers Hill, Lol Rich, Conroe, North Dayton, South, Moss Bluff, and Turtle Bay salt domes);
- The Dayton Canal System (rice irrigation system, of which the Dayton Main Canal and Big Ditch are NRHP-eligible components); and
- The Coastal Water Authority Canal system.

These notable features are composed of valued environmental components. Lake Houston serves as a municipal water supply for the City of Houston as well as a major local recreational area. Lake Houston Wilderness Area serves as an ecological and recreational resource in a largely urban area. Salt domes are unique geological and notable ecological features along the Gulf Coast. The Dayton Canal System and Coastal Water Authority Canal system provide water to municipal, industrial, and agricultural entities throughout the area. As generally documented throughout the FEIS, each of these notable features plays a unique role in the ecological, economic, and agricultural contexts within the AOI.

5.5 Step 4: Identify Impact-Causing Activities of Proposed Action and Alternatives

Gaining a thorough understanding of project design features and the range of impacts they may cause is the first step toward the identification of indirect effects. Transportation projects on new locations such as the proposed Grand Parkway Segments H and I-1 could involve a number of impact causing activities. This step is intended to conceptualize and quantify, if possible, potential indirect impacts that would occur because of the proposed project. The general types of project impact-causing activities include the following (NCHRP Report 466):

- **Modification of regime effects** – Approximately 690 ac of wildlife habitat, 39 ac of forested wetlands, and 15.5 ac of non-forested wetland habitat may be impacted as a result of the construction of the proposed project.
- **Land transformation and construction** – The proposed project consists of the construction of new toll lanes of Segments H and I-1 of the Grand Parkway facility. An estimated 1,933 ac of proposed ROW would be required for the proposed action.

- **Processing** – Storage of materials would occur off-site. It is anticipated, based on usual practices, that the contractor, when selected, would negotiate the location for the contractor's field office and storage site. If the contractor chooses to use undeveloped land or another site for material storage, impacts to natural resources may increase.
- **Land alteration** – Land alteration as a result of the proposed project would largely be limited to the areas of proposed ROW and areas that could be affected by encroachment-alteration activities (e.g. changes in travel patterns and access). Areas of vegetation disturbed during construction activities would be reseeded/revegetated with native vegetation after construction is completed.
- **Resource renewal** – The total number of large individual trees that may be removed and total acreage of riparian woodland affected may change during final design. TxDOT would minimize the loss by preserving as many trees as possible.
- **Changes in traffic** – The proposed project is on a new location, and is planned as part of the regional tolling network. The proposed project is expected to reduce congestion by improving traffic operations along existing roadways. The proposed project would also result in roadway network enhancements which can result in land use changes, and improved mobility and access. All such actions can result in changes of traffic patterns, and thus have the potential to indirectly impact air quality in the area.
- **Waste emplacement and treatment** – Soil excavated from the proposed project limits would likely be stockpiled for use on another project or sold for other uses, depending on the results of soil testing. The contractor, when selected, may choose to provide portable sanitary facilities for employees at the field office. No other sanitary waste discharge is anticipated.
- **Chemical treatment** – No use of fertilizer is anticipated during revegetation. Periodic applications of herbicide may occur during the maintenance phase of the proposed project.
- **Access alteration** – Access alteration from a new location facility may be the largest contributor to indirect impacts to land use. Proposed changes in access are discussed in **Chapter 4**. Major roadway and railroad crossings in the proposed project corridor would be bridged to avoid impacts to through traffic. Final overpass, interchange, and road closure locations would be determined during the design phase of the project.

5.6 Step 5: Identify potentially Substantial Indirect Effects for Analysis

Step 5 examines the probability for substantial indirect impacts associated with the proposed project. The objective of this step is to compare project impact-causing actions with the list of goals and notable features to explore potential cause-effect relationships and establish which effects are potentially substantial and merit subsequent detailed analysis (or conversely, which effects are not potentially substantial and require no further assessment). Based upon the information provided in the previous steps, the indirect effects may be identified. This step is essentially a screening step; only those impacts which may be substantial require further analysis. This step should clearly define which effects may be and are not substantial, and the environmental document should discuss how and why the determination was made. The context of the

AOI intensity of the impact should be considered when determining if an impact may be substantial. Each type of indirect effect should be considered for relevance to the project. Types of indirect effects include: (a) encroachment alteration effects; (b) induced growth effects; and (c) effects related to induced growth.

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, which can be perceived as a positive change in the community. 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 previously developed areas.

5.6.1 Encroachment-Alteration Effects

Ecological Effects

Project biologists have determined that ecological encroachment-alteration effects including the 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. Because of potential loss of vegetation and modifications to former agricultural land resulting from the Preferred Alternative, vegetative communities were studied further.

Potential impacts to Waters of the U.S., including wetlands, 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 (USFWS 2004). The indirect effects to waters of the U.S., including wetlands were studied further.

Potential indirect effects on floodplains from roadway projects include increases in stormwater runoff due to changes in land use and increased development that may be accelerated by improved mobility and managed congestion on the transportation system on land surrounding the proposed facility. The indirect effects to floodplains as a result of the Preferred Alternative were studied further.

The AOI is part of the EPA designated eight-county marginal nonattainment area for 2008 ozone NAAQS. The AOI is currently in attainment for all other National Ambient Air Quality Standards (NAAQS) pollutants. Please refer to **Section 4.4.1** for the air quality assessment for the proposed project. Based on the results of Steps 1 through 4 that evaluated the possible project-related actions that can indirectly impact air, the proposed project would not be anticipated to cause indirect air quality impacts in the AOI. No change in attainment status is anticipated within the study area as a result of emissions associated with the proposed project. In order for the region to achieve ozone attainment, a variety of point, non-point, and mobile source emission reduction strategies must be implemented for the entire HGB area as outlined in the SIP. Indirect air quality impacts from MSATs are unquantifiable due to existing limitations to determine pollutant emissions, dispersion, and impacts to human health. Emissions would likely be lower than present levels in future years as a result of the EPA's national control regulations (i.e., new light-duty and heavy-duty on-road fuel and vehicle rules and the use of low sulfur diesel fuel). Even with an increase in VMT and possible temporary emission increases related to construction activities, the EPA's vehicle and fuel regulations, coupled with fleet turnover, will cause substantial reductions of on-road emissions over time, including CO, MSATs, and the ozone precursors VOC and NOx. As the proposed project is not anticipated to result in indirect air quality impacts, further discussion in Steps 6-7 below is not necessary.

Socio-economic Effects

Encroachment-alteration effects to socio-economic resources were identified as potentially substantial due to the improved access and mobility that would occur as a direct result of the new location facility. Two broad forms of socio-economic impacts include: 1) changes in travel patterns and access, and 2) direct relocation of homes and businesses. These direct impacts may lead to indirect effects on neighborhood cohesion, neighborhood stability, travel patterns, changes in the local economy, changes in access to specific services, recreation patterns at public facilities, pedestrian dependency and mobility, perceived quality of the natural environment, and perceived visual and aesthetic impacts, among others. Changes in access can include driveway changes, relocations of ramps, introduction of raised medians, alterations of intersections that restrict access to local streets, or the introduction of bicycle and pedestrian facilities. These may result in changes of travel patterns throughout an area. Additionally, changes in travel patterns and access could result in substantial impacts to public services and facilities; these issues were studied further.

5.6.2 Induced Growth Effects

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.

An *Indirect Land Use Impacts Assessment* provided in **Appendix O** 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 portions of the AOI creates the potential for such influence.

Examples of indirect impacts that could potentially occur 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 businesses.

Examples of indirect land use impacts that may occur with anticipation of the construction of proposed Grand Parkway Segments H and I-1 are located throughout the AOI. According to the expert panel surveyed in 2008-2009, a range of 10,000 acres up to 30,000 acres (up to 60 percent of approximately 50,100 acres of planned development) may be indirectly influenced by the proposed project. 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 5-10**.

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 5-7 of the indirect impacts analysis (**Exhibit 5-2**). These reasonably foreseeable projects, which are primarily residential developments, are located within the AOI. It should be noted that the quantifications associated with the AOI in the following discussions represent the resources located 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 5-10: Reasonably Foreseeable Developments

Development	Approximate Size (acres)	Relationship with Alternative	Stage of Development*
City of Dayton			
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
City of Old River Winfree			
Indian Ridge	276.69	3 miles east of 2-11	Developing
City of Plum Grove			
HF Houston Green Land LP (residential/	8,725.87	2-11	Future
City of Roman Forest			
Residential Subdivision	111.77	2-6	Future
City of Mont Belvieu			
Aperion Communities	17,560.86	2-5, 7-10	Future
Unincorporated			
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	1,050.00	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 of 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
Total	**30,692.32**		

Source: Study Team, 2008
* The terms "planned" and "future" are equivalent to platted (according to the H-GAC) and future planned projects, respectively.

Based on the results of the expert panel survey conducted in 2008-2009, 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. 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 I-10 (E) would likely be developed for retail and commercial

uses. Approximately 5,000 ac at each intersection of the Grand Parkway Segments H and I-1 with SH 146 and FM 1960 would likely be developed for residential uses, and approximately 1,000 ac of commercial and retail development would occur at each intersection of Grand Parkway Segments H and I-1 with FM 1960, US 90, FM 1413, 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. This estimate of induced development is shown on **Table 5-12**, with factoring for existing development in the intersection areas and constraints that may limit the potential for development, such as rail lines or waterways.

Scenario 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. Under this alternative, development follows tollway extensions along the circumferential pattern of the planned Grand Parkway system. The total acreage of these sources combined with existing development is approximately 270,000 ac for the year 2035.

The results of the 2008-2009 expert panel survey were combined with (1) information obtained during the 2007-2008 stakeholder meetings, and (2) data provided in the *Envision Houston Region* report to project the future reasonable and foreseeable development within the AOI of approximately 50,100 acres. The estimated 50,100 acres of future reasonable and foreseeable development includes the acreage of induced development associated with the Preferred Alternative which totals approximately 25,944 acres (discussed further in Step 6). The location of anticipated reasonable and foreseeable development and induced development is illustrated on **Exhibit 5- 2**. Because planned development and induced development have great potential to emerge within the AOI, induced growth effects were studied further.

5.6.3 Effects Related to Induced Growth

Induced growth may result in substantial ecological effects, based on the reasons previously provided. Habitat fragmentation and human activity is expected to continue throughout the AOI. Additional development could further reduce the amount of wildlife habitat available and also impact water quality. Soils and farmlands, archeological resources, as well as non-archeological resources could also be affected by induced growth. **Appendix O: Indirect Land Use Impacts Assessment** identifies and analyzes the potential for land use impacts related to the Preferred Alternative. The analysis of indirect land use impacts describes how land use would be different under two alternatives: one with the proposed transportation improvement, and one without it. Information gathered during the 2007-2008 stakeholder

meetings and the results of the expert panel survey conducted in 2008-2009 were also heavily relied upon for further analysis. Because induced growth could result in substantial impacts to wildlife habitat/threatened and endangered species, water quality, soils and farmlands, archeological resources, and non-archeological resources, these resources were studied further.

5.7 Step 6: Analyze Indirect Effects and Evaluate the Results

The objective of this step is to assess the effects identified in the previous step by determining magnitude, probability of occurrence, timing and duration, and degree to which the effect can be controlled or mitigated to determine if those effects have the potential to be substantial. Indirect effects identified in Step 5 have been analyzed herein, and indirect effects to resources within the AOI have been quantified to the extent practicable in Step 6. Where it is not possible to quantify indirect effects, they are discussed qualitatively.

Resource specific indirect impacts were evaluated within an identified AOI (the 15-minute travel shed shown in **Exhibit 5-1**) and are discussed in the following sections. Where possible, the project team quantitatively determined the potential induced or indirect growth impact of the Preferred Alternative compared to the No-Build Alternative based on mapping prepared as a result of the stakeholder and expert panel coordination described above in **Section 5.1.1** and in **Chapter 8 (Agency and Public Coordination)**.

5.7.1 Encroachment-Alteration Effects

5.7.1.1 Ecological Effects

<u>Vegetative Communities</u>

Loss of vegetation is a potential indirect impact from the proposed construction of the Preferred Alternative. As stated previously, the vegetative communities considered for direct and indirect impacts consist of agricultural wetlands, agricultural land, forest, forest wetlands, non-forested wetlands, and riparian zones. No ecological notable features (Lake Houston, Lake Houston Wilderness Area, salt domes) would be indirectly impacted by the Preferred Alternative. The loss of vegetation is not anticipated to extend beyond the construction limits and would not further encroach upon the ecological notable features. However, continued fragmentation of habitat could occur along the boundaries of the Preferred Alternative resulting from future construction of residential and commercial properties.

Waters of the U.S., including Wetlands

Regarding waters of the U.S., including wetlands, any potential direct impacts would be mitigated via local water quality rules and regulations, including state and federal laws. Because the proposed project would not alter the hydric regime or reduce diversity within the ecosystem, potential indirect effects as a result of encroachment alteration impacts are not anticipated.

Floodplains

Potential indirect effects on floodplains from roadway projects include increases in stormwater runoff due to changes in land use and increased development that may be accelerated by improved mobility and managed congestion on the transportation system to land surrounding the proposed facility.

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.

5.7.1.2 Socio-Economic Effects

Changes in Travel Patterns and Access

In terms of traffic operations, construction of the Preferred Alternative would address existing issues related to system linkage, mobility, safety, and lack of infrastructure to support population growth. Construction of the Preferred Alternative is anticipated to provide system linkage, improve mobility, enhance safety, and provide infrastructure to support forecasted population growth. Populations residing within the AOI would experience some degree of adverse impact due to increased noise, and visual intrusion. However, these populations would benefit from the indirect effects of north-south mobility, improved local and regional access, and improved safety. Traffic diversion (or redistribution) to the existing local roadway network within the AOI as a result of tolling avoidance is not anticipated because as discussed in Chapter 1, the existing transportation system does not provide north-south connectivity for suburban communities and industries located within and near the Grand Parkway Segments H and I-1 study area. It is anticipated that

travelers would either utilize the tolled Preferred Alternative (if constructed) or continue to travel along the minor arterials and collector roadways currently utilized. Other detailed socio-economic indirect effects are discussed below.

Other Socio-economic Indirect Effects

With respect to encroachment-alteration effects to socio-economic resources, indirect impacts would be driven by changes in travel patterns and access associated with the proposed Grand Parkway project. The potential indirect impacts resulting from implementation of the proposed improvements would include improved vehicular access to employment opportunities, markets, goods or services, residential uses, and public facilities due to increased vehicular mobility. Other factors, such as real estate market conditions, local government development codes and plans, city financing opportunities (for various public facility improvements), anticipated growth, public facility and amenities siting (schools, health care facilities, greenspace, etc.), changes in energy costs, and other local and regional roadway improvements play a role in nearby land development investment decisions. However, real estate investment decisions are typically made with regard to factors such as transportation access and mobility. Although not the sole factor in inducing these development projects, the proposed project may have introduced a potential acceleration in these land development decisions.

Other socio-economic indirect impacts that could result from the implementation of the proposed project include expedited and localized economic growth due mainly to increases in land rents, market capture, and related development pressures associated with increased visibility and improved north-south mobility and access in the northeast region of the greater metropolitan area. It is anticipated that the proposed improvements would have a beneficial effect on overall socio-economic conditions within the AOI.

Environmental Justice

The environmental justice community, as a subset of the communities located within the AOI, would experience indirect impacts due to tolling that mirror those of the general population. No disproportional impacts are anticipated to affect environmental justice communities. 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)**. As stated in **Chapter 4**, low-income populations who elect or can occasionally afford to pay access tolls would be impacted by toll rates, toll collection, and other matters associated with user fees. In addition, the economic impact of tolling the

mainlanes would be higher for low-income users because the cost of paying tolls would represent a higher percentage of household income than for non-low-income users. However, when considering the totality of significant individual or cumulative human health or environmental impacts, there appears to be an overall benefit provided to minority and/or low-income populations, as well as the entire community. The benefits associated with the proposed Grand Parkway Segments H and I-1 project would improve system linkage, mobility, and enhance safety. It would also provide infrastructure to support population growth. Regional indirect effects of toll facilities and managed lanes are assessed in **Section 5.9**.

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 public facilities and services access, 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 non-environmental justice 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. The proposed project may have a beneficial indirect impact on the overall socio-economic conditions within the AOI.

Visual and Aesthetic Impacts

As a result of construction of any of the Preferred Alternative, and 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, including the following:

- Reduction of nighttime accidents; and
- Aid of police protection to the community.

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

- Confusion or visual distraction;
- Lighting structures can create roadside hazards and
- 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.

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.

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 REMI.

As 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.

Travel Efficiencies and Tolling Impacts

Changes in travel demand characteristics stemming from the Grand Parkway result in travel-time, vehicle-operating, and safety cost changes accruing to households and business within the defined study area, and thus results in economic impacts.

Grand Parkway is expected to increase vehicle miles travelled in the regional study area. This would increase vehicle-operating costs and thus negative economic impacts, as those direct costs, are attributed to the sectors in the economic model (as appropriate, depending on the trip purpose) and run through the economic multipliers. Although network vehicle miles travelled are expected to increase with the implementation of the Grand Parkway, resulting in vehicle operation cost increases, the vehicle hours travelled are expected to decline, leading to travel time savings. Accidents, as a function of vehicle miles travelled and the accident rates per mile, are also expected to decline in aggregate across the analysis horizon, as traffic shifts from the overall network to the Grand Parkway highway (with the highway configuration having notably reduced accident rates than the overall network). Consequently, the accident reduction leads to societal accident costs savings, which are translated into positive economic impacts. Imposition of tolling on the local population is an out-of-pocket cost to household and businesses and generally by itself results in negative economic impacts.

Combining the results of the various travel demand characteristic related economic impacts yields net positive results across the entire analysis horizon, although the impacts are negative in a few years following the opening of the Grand Parkway facility, but within a few years revert to net positive impacts that escalate rather quickly thereafter. Reasoning for the pattern of impacts, beginning in the negative and then crossing into the positive and escalating thereafter, is driven by the negative impacts attributable to the vehicle operating cost increases and tolling impositions that are not sufficiently offset initially by accident and travel time savings. Furthermore, because the travel time savings escalate at a higher rate than the annual changes in the other travel demand characteristic related components, the aggregate savings turn positive, together with the resulting total economic impacts around 2025.

Combining all the components, the economic impacts resulting from travel efficiencies and tolling implementation on the Grand Parkway is estimated to amount to $1.44 billion in economic value-added and 10,030 job years over the analysis horizon spanning 2019 through 2039 for the regional study area, and $1.52 billion and 11,120, respectively for the entire State of Texas.

Summary of Economic Impacts

This analysis examined two main sources of potential economic impacts arising from the Grand Parkway investment: expenditures and travel efficiencies based. The travel efficiency benefits arise as a result of (dis)savings accruing to users of the facility such as travel time savings, vehicle operating costs savings and accident savings, while the expenditures-based impacts are a function of the magnitude of the outlays on the facility and the input-output structure of the regional economy.

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.

Based on the REMI model economic analysis, the proposed Grand Parkway corridor is expected to bring employment and economic activity to the Houston regional and statewide economies. The combined (of the different impact categories), cumulative (over the entire 2016-2039 analysis horizon) total employment impact is projected to amount to almost 21,100 job-years in the Houston Region and 24,500 Statewide. Corresponding economic activity (Gross Regional Product) impacts are projected to measure $2.1 billion and $2.4 billion in increased value added for the Houston Region, and Statewide, respectively.

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.

5.7.2 Induced Growth Effects

Table 5-10 provided in **Section 5.6.2** summarizes reasonably foreseeable development within the AOI gathered from the data sources noted in the previous **Sections 5.1.1 and 5.2**. The total planned development, which includes reasonably foreseeable development listed in **Table 5-10**, digitized growth projections from the *Envision Houston* report, and induced development based on the results of the expert panel survey, totals 50,100 ac within the AOI. Based on the results of the 2008-2009 expert panel survey, and after geographic analysis of the areas identified for potential induced growth, the study team

determined that approximately 25,944 acres (approximately 52 percent of planned development) in the AOI is dependent on the Grand Parkway Segments H and I-1 (**Table 5-12**).

As shown in **Table 5-11**, approximately 31 percent of the total land in the AOI is already developed, and approximately 7 percent of the AOI is either planned for development independently of the project or would potentially develop as a result of construction of Grand Parkway Segments H and I-1. Therefore, approximately 38 percent of the AOI is already developed or planned for development, leaving approximately 57 percent or 437,830[1] ac of open land available for development.

Table 5-11: Land Development within the AOI

Type of Land Development	Acres	Square Miles	Percentage
Developed Land	239,370	374	31
Planned/Induced Development	50,100*	78	7
Potential Developable/Open Land**	437,830 ***	684	57
Total land in the AOI	**770,300**	**1,204**	**100**

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.

As noted from the 2008-2009 expert panel survey, the most reasonable area of development indirectly caused by construction of the Preferred Alternative would be within the AOI along the length of the proposed Segments H and I-1. **Table 5-12** shows an estimate of induced developmental effects for the No-Build, the alternatives studied, and the Preferred Alternative based on the results of the expert panel survey conducted in 2008-2009, the *Envision Houston Region* report growth projections, and meetings with stakeholders held throughout the planning process beginning in 2007-2008. This data is a summary per resource based on acreages presented in **Table 5-10**, the *Envision Houston* report, and anticipated induced development acreages provided by the expert panel survey conducted in 2008-2009, adjusted to account for constraints and existing development present at the major intersections.

[1] 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.

Table 5-12: 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
10R**	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

* Calculations reflect specific land uses that were assessed for indirect impacts.
** Preferred Alternative
Study Team, 2012

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. Salt domes (notable features), a superfund site, and the industrialized nature of the AOI may limit development. Floodplains, as well as the Lake Houston Wilderness 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 Preferred Alternative 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 (e.g. 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.

5.7.3 Effects Related to Induced Growth

Vegetative Communities

The direct impacts to vegetation for the Preferred Alternative is approximately 1,700 ac, including land in agricultural use, forest, riparian zones, and non-forested wetlands. Areas of potential indirect land use impacts to undeveloped land which contains the remaining vegetative communities are estimated to be approximately 25,944 ac with the construction of the Preferred Alternative (**Table 5-12**). Of the 25,944 ac of vegetation potentially impacted by induced development, it is estimated that indirect impacts to mature woody vegetation (forest) would be 2,536 ac for the Preferred Alternative within the AOI (**Table 5-12**). The No-Build Alternative would not indirectly impact vegetative communities along the corridor. Construction of the new corridor may indirectly impact vegetation communities due to future 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.

Waters of the U.S., including Wetlands

Within the AOI there are 41,665 ac of waters and 120,141 ac wetlands, as defined by the National Wetland Inventory and the topographical maps utilized for this analysis. The potential direct impact to wetlands and

Waters of the U.S. for the Preferred Alternative is estimated to be approximately 327.4 ac of wetlands and 22.9 ac of potential Waters of the U.S. 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 2,997 ac of wetlands for the Preferred Alternative (**Table 5-12**). Not all of these streams or wetlands would be considered jurisdictional by the USACE and subject to protection under Section 404 of the 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. Because of the mitigation required, indirect impacts to Waters of the U.S. including wetlands would be considered minor.

Floodplains

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. The anticipated direct impact to floodplains under the Preferred Alternative is approximately 159 ac. The potential indirect impacts to floodplains are approximately 2,006 ac under the Preferred Alternative, based on the expert panel survey estimates of potential developed areas (**Table 5-12**). 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. Therefore, the indirect effects to floodplains are anticipated to be minimal.

Wildlife

Potential indirect effects on wildlife habitat from roadway projects include impacts from induced development. Approximately 437,830 ac of potential wildlife habitat is located with the AOI. Of the available habitat, approximately 25,944 ac of vegetation, including land in agricultural use, may be indirectly impacted (**Table 5-12**). Existing wildlife habitat within the AOI is either protected from development by a park or floodplain designation (e.g. the Lake Houston Wilderness Area, which is a notable feature), or is interspersed with existing development and pasturelands. The proposed project would not alter the hydric regime or reduce diversity within the ecosystem.

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, a total of approximately 270,000 ac are already developed and planned for development independently of the Grand Parkway. The direct impact to wildlife habitat under the Preferred Alternative is estimated to be approximately 665 ac. Areas of potential indirect land use impacts to undeveloped land are estimated to be approximately an additional 25,944 ac with the construction of the Preferred Alternative (**Table 5-12**). This portion of undeveloped land that would be indirectly impacted contains wildlife habitat consisting of forested wetlands, non-forested wetlands, farmland, and forest. As noted in **Chapter 4 (Environmental Consequences)**, the existing habitat has largely been fragmented by development, the 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.

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, 2012). 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, an approximate total of 270,000 ac of land is already developed and planned for development within the AOI. Preferred habitat located within these areas designated for future development could be negatively impacted where federal oversight would not be required (such as with private residential and commercial development). However, developers are required to coordinate with the USFWS on all activities involving threatened and endangered species.

Approximately 35,150 ac were identified by the TPWD TxNDD as potential threatened or endangered species habitat within the AOI for the bald eagle, Texas prairie dawn, red-cockaded woodpecker, and the

Rafinesque's big-eared bat. The TxNDD review for habitat documented that approximately 11,680 ac are included within parks, which are protected from development. Approximately 10,860 ac 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 Preferred Alternative.

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 the Preferred Alternative 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.

Water Quality

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 41,665 ac of waters and 120,141 ac wetlands, as defined by the National Wetland Inventory and the topographical maps utilized for this analysis. Any potential direct impacts would be mitigated via local water quality rules and regulations, including state and federal laws. The Coastal Water Authority Canal system (a notable feature and potential Waters of the U.S.) is partially located within the path of planned and induced development. As previously stated, conversion of farmland is anticipated to continue with the forecasted development trend. Significant impacts to the Coastal Water Authority Canal system are not anticipated given the regulatory review process associated with Waters of the U.S.; however, the true degree of impact to the canal system as a whole resulting from future private development cannot be determined at this time.

Development induced by the Preferred 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 direct impact's study area of the Preferred Alternative, two stream segments are listed on the 2010 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 (CWA) 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 Preferred Alternative compared to the No-Build Alternative. Substantial indirect impacts to the water quality of Lake Houston (a notable feature) are not anticipated; however, impacts could occur as a result of planned or induced development.

No public or private groundwater wells would be impacted by development under the No-Build Alternative. The Preferred Alternative would require groundwater pollution prevention measures to minimize potential impacts to up to seven well capture zones. Indirect impacts to groundwater wells and capture zones are anticipated to be minor in the context of the regional development as a whole.

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 Preferred Alternative, the approximate area of farmland soils is approximately 14,394 ac (**Table 5-12**). However, the potential indirect impacts to prime farmland soils related to the reasonably foreseeable development is anticipated to be minimal compared to the total acreage of prime farmland soils found within the AOI. As documented in **Chapter 4 (Environmental Consequences)**, the Preferred Alternative would directly impact approximately 960 ac of prime farmland

soils. However, this acreage is considered to be a minor impact, and scored below 160 on the Natural Resources Conservation Service (NRCS) Form CPA-106. 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. 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.

Archeological Resources

Land use changes have the potential to 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. Direct impacts to known archeological sites are not anticipated as a result of construction of the Preferred Alternative. Indirect impacts to archeological sites could result from construction of the Preferred Alternative; 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.

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 result in changes to land use and spur 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 induced development related to the Preferred Alternative may fall under federal or state regulatory resource protection review; therefore, these historic properties would be protected or preserved. However, most of the development induced by the Preferred Alternative would be (private) residential and commercial development, and would not fall under the regulatory review process; therefore, historic-age properties potentially affected by such development

would not have protection under federal or state laws. Components of the Dayton Canal system (which includes the NRHP-eligible Dayton Main Canal and Big Ditch) are notable features which are located within the path of planned and induced development. As previously stated, conversion of farmland is anticipated to continue with the forecasted development trend. Significant impacts to the Dayton Main Canal and Big Ditch are not anticipated given the regulatory review process associated with the NRHP; however, the true degree of impact to the Dayton Canal system as a whole resulting from future private development cannot be determined at this time.

5.8 Step 7: Assess Consequences and Consider/Develop Mitigation (When Appropriate)

In summary, construction of the Preferred Alternative would result in indirect impacts to various ecological and socio-economic resources throughout the AOI. The severity of the anticipated indirect impacts ranges from minor to less than significant depending on the resource. For example, indirect impacts to Waters of the U.S., including wetlands; floodplains; water quality; soils and farmland are anticipated to be minor. Indirect impacts to vegetation and wildlife are not anticipated to be substantial compared to the breadth of those resources found within the AOI. Beneficial indirect impacts are anticipated in terms of enhanced travel patterns, increased accessibility and traffic congestion management, economic efficiency benefits related to travel, and increased employment and economic activity throughout the greater Houston region. The potential exists for some populations within the AOI to bear minor adverse effects associated with visual, traffic noise, and access impacts.

The potential for any of the AOI's notable features to be significantly or negatively impacted is unlikely as a result of the construction of the Preferred Alternative. Lake Houston and the Lake Houston Wilderness Park are protected resources that would serve as development deterrents in that portion of the AOI. The industrialized nature of the various salt dome locations would likely limit or discourage any future development induced by the Preferred Alternative. The Dayton Canal system and the Coastal Water Authority Canal system are not anticipated to be significantly impacted given the regulatory review process associated with these resources.

Based on the results of the information obtained during stakeholder meetings held in 2007-2008, the **Indirect Land Use Impacts Assessment** (**Appendix O**) initially conducted in 2008, and the results of the 2008-2009 expert panel surveys, it is evident that the proposed Grand Parkway Segments H and I-1

presents a strong potential for land use changes and has influenced development decisions within the AOI. Mitigation of the potential 25,944 acres of induced development within the AOI considered for this assessment would rest with the agencies that have the authority to implement such controls. This authority rests with the municipal governments and to a lesser extent, the county governments. Examples of municipal government regulations include land development code tree ordinances. The responsibility of transportation providers such as the Grand Parkway Association, TxDOT, local and regional transit agencies, and the local governments would be to implement a transportation system to complement the land use or development controls currently in place.

5.9 Indirect Regional Effects of Toll Facilities and Managed Lanes

Regional Perspective

The freeway and toll road system is a major component of the Houston-Galveston regional transportation system. Currently, the freeway/toll road system represents nearly 19 percent of regional lane miles, but carries more than 48 percent of VMT. Although growth in vehicle travel may be mitigated by transit expansion, improved operation of major arterial streets and growth of teleworking and e-business options, regional and State economic growth would require continued expansion of the region's freeway/toll road network.

METRO is the region's largest transit provider. Its service area encompasses approximately 1,300 square miles. The agency has 100 miles of barrier-separated HOV lanes operating on six freeways that carry 73,000 carpool and vanpool passengers daily.

Inherent to the region's freeways are the high costs of maintenance and improvements. Although they generate few operational costs once constructed, building, maintaining, and expanding freeway facilities is very expensive. Over the last few years, the idea of user-fee based roadways has been growing in acceptance and popularity, and recently the Texas Transportation Commission adopted a favorable toll road policy to promote the study of additional toll roads throughout the State.

The Houston-Galveston region is a national leader in using toll roads as a method of financing facilities and improving mobility for more than two decades. Currently, there are four toll roads in operation - the Hardy, Sam Houston Parkway, Westpark, and Fort Bend Parkway Toll Roads. As seen in **Table 5-13**, the system of toll roads and "managed" (HOT) lanes is planned to grow from approximately 947 lane miles today to

over 2,902 lane miles by 2035. In addition to increasing system capacity, the development of managed lanes would provide travel priority for transit buses, carpools, and vanpools on an expanded number of roadways, thereby greatly increasing their attractiveness to commuters and reducing congestion.

Table 5-13: Transportation System Expansion (Lane Miles)

Year	Freeway	Toll Roads	HOT Lanes	Arterial	Total Lane Miles
2009 Network	3,669	658	289	19,955	24,571
2035 RTP	4,339	2,049	853	25,614	32,855

Source: H-GAC, Regional Cumulative and Indirect Effects of Toll Facilities, October 2013.

Managed lanes use pricing as a means to manage demand. In essence, during peak periods managed lanes carry vehicles with a certain minimum number of occupants for no or low toll amounts with SOV paying a higher toll. This "management" allows for fine tuning of HOV lane eligibility because tolls can be varied to find the appropriate price to generate only sufficient additional demand to utilize any spare capacity. This use of capacity would not slow travel time because the pricing component ensures that the federal requirements regarding HOT lanes with speed limits greater than 50 mph must maintain a speed of 45 mph 90 percent of the time during peak periods is upheld.

Figure 1 in **Appendix P** shows the toll and managed lane improvements to the roadway system contained in the fiscally constrained RTP for the year 2035.

As regional and population and employment continue to grow, transit will become an increasingly important tool for improving mobility. Transit is forecasted to significantly increase from its current 485,000 daily passenger boarding's, to over 725,000 daily passenger boarding's by 2035. This significant increase will be attributed to:

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

The 2035 METRO Long Range Plan (**Figure 5-1**) is an iterative process incorporating the 2025 METRO Solutions Plan and future mobility needs identified in regional planning efforts. METRO's 2035 Long Range

Plan recommends 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 significant 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 METRO Solutions plan include:

- 89 miles of fixed light rail transit (LRT);
- 84 miles of commuter rail transit (CRT); and
- 40 miles of signature bus service.

Figure 5-1 shows the future corridor and capital facilities projects in the 2035 METRO Long Range Plan.

Figure 5-1: Proposed 2035 Future Corridor and Capital Facilities Projects

Source: H-GAC, 2013

Demographics

The following information and projections provide an overview of H-GAC demographics at the regional level. The 2000 population of the Houston-Galveston region is over 4.5 million people, which includes eight counties and covers more than 7,000 square miles. Several counties in the region are listed among the top ten for growth in the nation having experienced double-digit population growth for over a decade.

Significant investments have been made to the regional transportation system, such as the expansion of our major highways and our toll road systems. The region is anticipated to grow by more than 3 million new residents by 2035. **Table 5-14**, below, shows the projected demographic changes expected in the region by 2035.

Table 5-14: Projected Demographic Changes in H-GAC Region 2000-2035

H-GAC Region	2000	2035	Percent Change
Population	4,669,571	8,835,000	89.20
Households	1,639,401	3,302,013	101.40
Percent Minority	52.10	68.97	16.87
Percent Non-Minority	47.80	31.02	-16.87
Percent Zero-Auto Households	8.28	14.10	5.82

Source: U.S. Census Bureau, 2000.

As can be seen in **Table 5-15**, significant changes in the distribution of household income are also projected to occur in the H-GAC region between 2000 and 2035. This analysis divided household income into five groups: 0 to $15,000; $15,000 to $30,000; $30,000 to $50,000; $50,000 to $75,000; and $75,000 and above. The income figures are presented in 1995 base year dollars since the travel demand model is estimated based on the 1995 household survey. The year 2000 household income distribution has the least percentage of households in the lowest income quintile ($0 to $15,000) and the highest percentage of households in the highest income quintile ($75,000 and above).

The projection for year 2035 shows this distribution trend reversing. By 2035 the highest income quintile would have the lowest household income percentage share. While the percentage of households within the middle quintile is projected to increase by 2035, the largest projected increase is in the lowest quintile, increasing by 3.79 percent. These projections indicate that overall wealth, as indicated by income, would decrease in the future. This shift in the percentage of the populations within income quintiles indicates a potential change and possible increase in future EJ zones.

Table 5-15: Percent of Households in the H-GAC Region within Income Categories

Household Income (1995 Dollars)	2000 (Percent)	2035 (Percent)	Percent Change
$0 to $15,000	14.31	18.07	3.79
$15,000 to $30,000	18.32	21.60	3.28
$30,000 to $50,000	22.27	24.41	2.14
$50,000 to $75,000	18.91	19.03	0.12
$75,000 and above	26.19	16.89	-9.30

Source: U.S. Census Bureau, 2000.

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 (**Section 6.4**).