SH 16 FEASIBILITY ANALYSIS
FINAL REPORT

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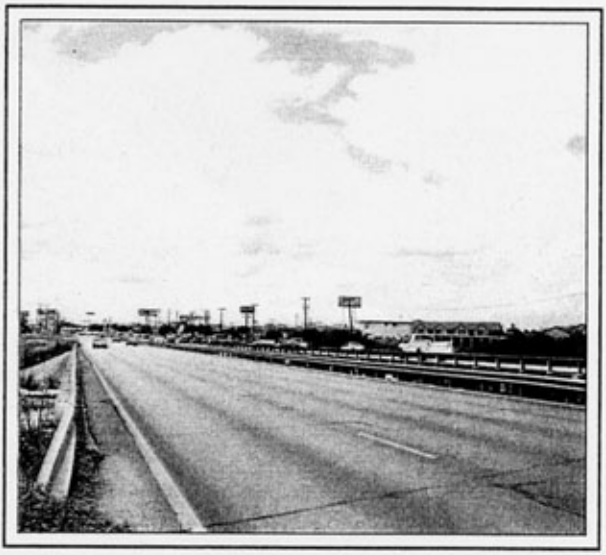

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SH 16 FEASIBILITY ANALYSIS

EXECUTIVE SUMMARY

Corridor Description. The SH 16 corridor is located in the northwest quadrant of San Antonio, Texas, in Bexar County. The study evaluated two primary alignment concepts: first, the existing SH 16 (Bandera Road) right-of-way, from IH 410 to just north of Loop 1604, a total of seven miles in length; and second, the Leon Creek floodway, from SH 151, traversing northeasterly to SH 16 where it takes a northwesterly turn, following the SH 16 right-of-way to Loop 1604. The Leon Creek alignment is approximately 10 miles in length. (Refer to Figures A-1, A-2, and A-3).

Purpose and Need. The Metropolitan Planning Organization, the Texas Department of Transportation (TxDOT) and the Alamo Regional Mobility Authority have selected SH 16 as an important route in need of capacity improvements. This N-S route serves a large San Antonio commuting population, and supports highly commercialized land use. Traffic congestion is common, and travel times for this nearly seven mile long segment of roadway are considered excessive, even during the off-peak time periods. In accordance with TxDOT's policy, the new capacity improvements are to be evaluated for feasibility. Therefore, TxDOT secured the services of Huitt-Zollars, Inc., to prepare a feasibility study for an elevated roadway along the median of SH 16 from IH 410 to Loop 1604 and the alternate route (Leon Creek Route) described above.

Development and Evaluation of Alternatives. The study team considered several important aspects of the design, toll feasibility, and construction of the proposed alternatives. Each alternative was evaluated based upon constructability, cost, impacts upon the roadway network, and environmental impacts, as well as other factors. Further, the financial analysis shows that each alternative generates sufficient gross revenue to pay for annual operating and maintenance costs, with net revenue remaining to be applied to capital costs; therefore, toll revenue did not become part of the decision criteria for the evaluation of alternatives. The work done in the preliminary environmental surveys, mapping, and evaluations, are considered to be of primary importance. At this preliminary stage, no "fatal flaws" were identified in the environmental analysis, although the Leon Creek alignment alternatives show significant additional environmental considerations and complexities than the alternatives that conform more to existing roadways. Each criterion is reported in depth in latter sections of this report. No public involvement activities were performed in this study. It is understood that there is little or no available funding for the construction of this roadway; therefore, it was determined early in the study that funding for such a major SH 16 corridor improvement could only come from toll revenues.

Recommendations. The design team has demonstrated through preliminary environmental analysis, traffic and revenue study, and conceptual design that each of the alternatives studied are feasible for achieving TxDOT's goal of completing construction in the year 2013. It is recommended that an Environmental Assessment be performed to identify a Preferred Alternative through public involvement, additional environmental analysis, development of schematics, and determine if there are any significant impacts to which would require additional environmental study (Environmental Impact Statement).

A. INTRODUCTION

The purpose of this Feasibility Analysis was to study alignment alternatives, perform preliminary environmental studies and to identify constructability issues involved in determining the feasibility of constructing a high speed relief route within the SH 16 corridor. This study also evaluated existing traffic information and planned roadway improvements, while adhering to the goals established by the Texas Department of Transportation (TxDOT). These goals are understood to encompass the following:

1) Design the elevated roadway within the existing SH 16 median;
2) Minimize impacts to existing roadways, drainage, and utilities;
3) Minimize need to purchase additional right-of-way.

The work included the following tasks:

- bridge, drainage, and roadway design;
- preliminary environmental analysis;
- diagrammatic layouts and cost estimates;
- traffic studies and revenue forecasts;
- toll feasibility analysis;
- report and recommendations.

The results of this analysis will determine if further study is warranted.

B. PROJECT DESCRIPTION

Location and Limits. The SH 16 corridor is located in the northwest quadrant of the City of San Antonio, Texas, in Bexar County. The study evaluated two distinct alternative routes: first, the existing SH 16 (Bandera Road) right-of-way, from IH 410 to just north of Loop 1604, to the north, a distance of approximately seven miles; and second, the Leon Creek floodway, from SH 151, generally traversing northeasterly to SH 16 at Leon Valley. From there, the alignment takes a northwesterly turn, following the SH 16 right-of-way to Loop 1604, where it terminates just north of Loop 1604. The Leon Creek alignment is approximately 10 miles in length.

Scope. Three alignment alternatives were required by TxDOT for analysis. For each alignment, varying lane configurations were considered and are as follows:

1) Interim condition 2 lanes with 1 lane in each direction;
2) 3-lane with center lane reversible; and
3) Ultimate condition 4-lane with 2 lanes in each direction.

C. PRELIMINARY ENVIRONMENTAL ANALYSES

Preliminary environmental surveys, mapping and evaluations were performed for the SH 16 corridor and for the Leon Creek alternative. At this preliminary stage, no "fatal flaws" were identified from an environmental standpoint for either area. However, the Leon Creek alignment alternatives have more significant additional environmental considerations and complexities than the SH 16 alternatives, which more closely follow existing roadways. Appendix III contains the environmental and social justice maps for this level of study.

Natural Resources. Preliminary evaluations were conducted concerning land use, topography, soils, geology, wetlands (e.g., waters of the U.S.), vegetation, habitat, and threatened and endangered species. These evaluations did not reveal any significant environmental issues. Crossings of waters of the US are a factor for all alignment alternatives. Initial surveys identified no endangered species habitats at this preliminary stage. In addition, this project area has a low probability for the occurrence of underground karst habitats and related endangered species.

Cultural Resources. Preliminary desktop and database searches, Texas Historical Atlas searches, aerial and topographical studies were undertaken to identify significant archeological sites, historical structures, buildings, objects, sites, or districts located in the proposed path of the project. This research and preliminary study did not reveal any significant environmental issues. Based on this preliminary study, one structure older than 50 years was noted, along with numerous recorded archeological sites in the northern and southern termini of the project area. There is a high probability that field archeological and/or historical surveys will discover additional sites in the project areas, especially along Leon Creek.

Socio-Economic Resources. Current local demographic data as well as apparent environmental justice issues were reviewed over the extents of the project area. Preliminary evaluation revealed that the construction of the proposed alternatives would have no apparent adverse impact on social groups, neighborhoods, communities or public facilities.

Air Quality. This project area and Bexar County is in a non-attainment deferred status, at least through December 2007. The San Antonio region received a "basic" 8-hour non-attainment classification. However, the non-attainment area requirements have been deferred since the area counties banded together in an Early Action Compact to implement air quality improvement practices before the practices were required. As long as the current regional air plan is active, the non-attainment requirements and programs are neither required in this region nor for this project.

but ends in 2007 construction begins 2009 / road opens 2013

Noise. In this study, potential sensitive noise receptors such as schools, churches, residential areas, hospitals and parks were identified. Available projected traffic data was also considered in this study. Noise analyses for project alternatives are warranted for the project design alternatives presented.

Hazardous Materials. Commercial information databases were reviewed to determine the presence and proximity of sites or facilities that could present potential sources of hazardous materials to the ROW. This review included PST and LPST sites, RCRA facilities, and other sites regulated by state and federal entities. There were no Superfund sites discovered in the project area. Although numerous hazardous material sites were found around and within the study area, these were not considered to be fatal flaws for the purpose of this preliminary environmental investigation. These sites would have to be dealt with in a consistent, normal, and customary project environmental clearance, conforming to roadway planning and construction practices.

D. DIAGRAMMATIC LAYOUT

The diagrammatic layout for this project was developed in accordance with the TxDOT Roadway Design Manual; Hydraulic Design Manual; the Bridge Design Manual; the 2001 AASHTO Specifications; and other TxDOT policies, procedures, and standards. The design team first examined the existing SH 16 lane and intersection configurations in order to determine the constructability of building a major elevated freeway facility within the median of a high volume, high capacity arterial. An important aspect of this constructability aspect was the ability to maintain traffic capacity on the existing roadway during construction. TxDOT advised the consultant that any plan for maintenance of traffic must include maintaining the same number of lanes in operation throughout the construction period as are presently operating within this corridor.

Constructability. An important and integral part of the feasibility study was the determination of the constructability of each alternative. The project team analyzed and evaluated the impacts that each alternative option would have on the existing traffic for both the SH 16 and the Leon Creek corridors. It was determined that, in order to construct an elevated roadway through the heavily traveled SH 16, corridor-wide improvements, such as adding temporary lanes, intersection modifications, and other special considerations need to be made to maintain traffic during a potentially prolonged and disruptive construction period.

Right-of-Way Determination. The TxDOT right-of-way plats for SH 16 proved to be inconclusive based upon the current land use, roadway locations, and utility pole placement. After exhaustive research and "fitting" of the

recorded right-of-way documents, and determining that the record plats are probably not representative of the existing right-of-way, the consultant proposed that the SH 16 right-of-way lines be shown as approximately 200 feet in width in much of the corridor, and should generally follow the utility pole placement line along SH 16. In concurrence with this recommendation, TxDOT noted that the SH 16 right-of-way would be verified independently after the completion of this study.

The Leon Creek alignment falls in the floodplain of Leon Creek and crosses several private properties. HZI researched the Bexar County Appraisal District records and recorded the ownership of all potentially affected properties, as well as the appraised value of each. Since this alignment, from SH 151 to SH 16, is a new location, only the crossing of existing roads would be issues for consideration in the constructability of the project. Hence, right-of-way issues were determined to exist within this section of the alignment study.

Traffic Control During Construction. The constructability of each alternative option was studied. For the SH 16 alternatives, levels of traffic impacts are considered high. For the Leon Creek alternatives, only minor impacts to traffic are expected. The following is a general assessment of the traffic impacts along SH 16 and along Leon Creek:

1) **SH 16, from IH 410 to Loop 1604.** Additional lanes would be built on the outside of the existing SH 16 in order to maintain the existing level of roadway capacity during construction. In addition, intersection and signal modifications would be implemented during construction in order to construct the center columns. Driveways through the corridor would be affected once temporary and permanent widening of SH 16 is underway. Non-signalized intersections and median turn bays will also be subject to temporary closure.

   At the southern terminus with the construction of the direct connectors at IH 410, adjacent local streets, as well as IH 410, would be temporarily affected due to the placement of foundations, columns, beams, and pavement for the direct connectors.

   At the northern terminus, the Loop 1604 intersection would experience traffic impacts due to the construction of the exit and entrance ramps on each side of Loop 1604, as well as to the construction of the bridge over 1604.

2) **Surface Access Study at the Termini of New IH 410 Direct Connectors (DC).** Presently, TxDOT has awarded the contract for the construction of two new DCs to IH 410. During the course of

this study, TxDOT requested that HZI investigate the feasibility of a southern terminus that would allow traffic to "touch down" onto the surface of SH 16 before taking the proposed elevated northern roadway (similarly, to allow the proposed SB traffic to reach the surface road of SH 16.) With this design, traffic could exit/enter the DCs, continue on the proposed elevated SH 16, and use the surface road to exit onto SH 16. However, after studying this option, it was determined that this configuration would not be further developed. The reasons are as follows:

- Several cross streets would have to be closed permanently (e.g. Grass Hill, Echo Hill, Seneca Dr., etc);
- Additional ROW would need to be acquired to allow the frontage roads to shift outwards and to accommodate the proposed roadway to touch down;
- Significant utility relocations would be needed;
- Drainage relocations that otherwise would not be needed would be required;
- Left turns from existing land uses (e.g. commercial and residential) would be eliminated at this location.

3) **Leon Creek Alignment.** Since this alternative is to be built almost entirely within a floodplain, the only traffic control challenges will occur at the termini (SH 151 and SH 16); at the streets that cross the proposed alignment (Military Rd., Culebra Rd., Ingram Rd., Grissom Rd., Heath Lane); at the IH 410 crossing; and at a few private roads, construction roads and driveways. For the Leon Creek alternative that extends to Loop 1604 (LL2 and LL4), the traffic control issues at Loop 1604 are the same as described in Traffic Control item 1), above.

Sight Distance Studies. There are approximately 134 intersections along the SH 16 corridor, many of which are not signalized. For these intersections and/or crossings, the construction of a major elevated structure having a minimum of 12-foot wide center columns is a significant consideration in the feasibility of this project. HZI performed a sight distance analysis for a typical condition where the median width is 20 feet in width. Using a spacing of 125 feet between columns, it was determined that sight distance can be obtained for intermediate and non-signalized crossings. In areas where there is less than 20 feet of median width, median widening may be an option. Should neither the above conditions be obtained, the crossing will need to be eliminated. Figure D-1 depicts the sight distance for a typical 20-foot wide median.

E. STRUCTURAL ANALYSIS AND OPTIONS

Each alternative was developed with the structural viability of other alternatives in mind. Typical sections were developed and submitted to TxDOT for review and comment. The following is a general discussion of the structural types considered:

SH 16, from IH 410 to Loop 1604. For the SH 16 corridor, two structural options showing three separate roadway widths were studied, and a fourth considered and eliminated.

1) **Type IV Beam Design Option.** Two structural options were supported by columns having a width of 12 feet and were situated in the median at approximately 120-foot spans using Type IV beams. The first option, an interim construction option called for a bent cap of 92 feet in width; however, to minimize initial capital costs, only enough roadway would be built to support one lane of traffic in each direction. The second structural option allowed for the TxDOT recommended 92-foot typical roadway section with two lanes in each direction and full 10-foot shoulders.

2) **Segmental Bridge Option.** This structural option would require a center column 8 feet in width, but would only support a typical 80-foot roadway section. This section would be similar to the first option, but would have 4-foot interior shoulders, and would require that the engineer obtain a design exception from TxDOT. This structural design was selected for study due to its ability to be pre-cast and due to its ability to be set in place with a traffic impact to the existing SH 16 corridor that would be less than the options involving the cast-in-place 92-foot width bent caps.

3) **Straddle Bent Option.** The fourth option, a straddle bent design, was considered in the analyses. However, since the use of a straddle bent design significantly impacts the utilities and potentially impacts driveway access, this option was not considered as a viable structural alternative.

F. DRAINAGE ANALYSIS

The scope of work for this project differs slightly for each of the proposed alignments. The scope for the SH 16 alignment, from IH 410 to Loop 1604, consists of evaluating the hydraulic capacity of the existing eight major and minor cross drainage structures, estimating the existing allowable peak discharge for each structure, and where applicable, providing proposed bridge span widths or culvert sizes for the inadequate structures. The scope for the Leon Creek to Loop 1604 alignment consists of evaluating the same cross drainage structures except where the alignment begins to follow Leon Creek south to SH 151. In this alternative, the scope includes plotting the Leon Creek flood plain limits and using the 100-year existing, 50- and 100-year developed water surface elevations (WSEL) to

identify and/or reduce potential impacts. The scope also includes evaluating up to three major alignment crossings over Leon Creek and approximately 6 tributary crossings, establishing estimates of peak flow at the crossings, and proposing bridge spans widths or culvert sizes for each.

In performing the hydraulic analysis of existing cross drainage structures along SH 16 from IH 410 to Loop 1604, the consultant has identified that two of the three major cross drainage structures and two of the five minor cross drainage structures are inadequately sized to accommodate the calculated peak flows for the various storm frequencies. Huebner Creek and French Creek are the two major cross drainage structures deemed inadequate. (See Appendix VII for relating tables and exhibits.)

The Leon Creek alternative alignment would be elevated from SH 16 to SH 151. Since it would be elevated above the Leon Creek flood plain, it will have no bridge openings to be sized. The only measures required in regards to the hydrology and hydraulics would be issues related to the mitigation of fill or construction in the floodplain. The consultant recommends that all measures be taken to ensure the replacement of any vegetation disturbance and to protect the necessary bridge abutments and concrete columns on slopes over 3:1, etc. (See Exhibit C, Appendix VII for a summary of the HEC-2 FEMA Effective Model water surface elevations along Leon Creek obtained from the City of San Antonio flood study for the 100-year existing, 25- and 100-year developed storm frequencies to be used for the proposed roadway elevations.)

G. INTERIM ALIGNMENT OPTIONS

As part of this scope, interim typical sections were considered. This was done in order to determine the revenue viability of each alternative interim typical section on its own merits. Through a cooperative effort between the consultants and TxDOT, the following interim typical sections were adopted for study:

Bandera Road (SH 16) Interim (BR2) Alignment. This alternative alignment calls for the construction of a two-lane elevated roadway within the existing median of SH 16 from IH 410 to LP 1604. The roadway connects to IH 410 via four direct connector ramps. Two of the connectors, IH 410 WB to SH 16 NB and SH 16 WB to IH 410 EB are currently under construction. Two other connectors, IH 410 EB to SH 16 NB and SH 16 SB to IH 410 WB will be constructed as part of the project improvements. Construction of these ramps would require the acquisition of commercial property for additional ROW in the NW quadrant of the interchange with IH 410.

The northern terminus of the project falls north of Loop 1604. However, there will be an exit ramp just south of Loop 1604, with one northbound continuing over Loop 1604. Similarly, one SB on-ramp will be added to the SB bridge over Loop 1604 and merge into the southbound lane. On the north side of Loop 1604, the road terminates onto the existing SH 16 with both NB and SB ramps to and from SH 16. No provision is made for intermediate NB entrance ramps or SB exit ramps between IH 410 and LP 1604. However, a SB entrance ramp is provided at Seneca Road to serve the direct connector ramps at IH 410. The length of this alignment is approximately 7 miles.

The constructability of this option was studied. Since the full-width bent caps are to be built for this option, the level of traffic impacts is considered high. Additional lanes will need to be built on the outside of the existing SH 16 in order to maintain the existing level of roadway capacity during the construction. In addition, intersection modifications and signals will need to be implemented during construction in order to construct the center columns. Driveways through the corridor will be affected while temporary and permanent widening of SH 16 is underway. The typical section for the BR2 configuration is found in Appendix II.

Leon Creek Short Interim (LS2) Alignment. This alternative alignment follows Leon Creek Long from SH 151 to SH 16. At SH 16, the roadway connects to the existing SH 16 roadway with a NB exit ramp and a SB entrance ramp. The length of this alignment is approximately 6 miles. The two-lane alternative was to be placed to the south side of the ultimate Leon Creek right-of-way to allow for the addition of another bridge to complete the four-lane typical section in the future. The typical section for the LS2 configuration is found in Appendix II.

Leon Creek Long Interim (LL2) Alignment. This alternative alignment follows Leon Creek Short from SH 151 to SH 16 and continues in the median of SH 16 to a point just north of Loop 1604, following the previously described BR2 alignment. At SH 16 the roadway connects to the proposed SH 16 lanes with NB and SB direct connects. The length of this alignment is approximately 9 miles. Within the Leon Creek floodplain, the elevated two-lane alternative was designed on the south side of the ultimate Leon Creek right-of-way to allow for the addition of another bridge to complete the four-lane typical section in the future. The typical section for the LL2 configuration is found in Appendix II.

H. ULTIMATE ALIGNMENT OPTIONS

SH 16 Ultimate 92' (BR4) Alignment. This alternative alignment employs the construction of a four-lane elevated roadway within the existing median of SH 16 from IH 410 to LP 1604. As in the BR2 alignment, the proposed roadway

connects to IH 410 via four direct connector ramps. Two of the connectors, IH 410 WB to SH 16 NB and SH 16 WB to IH 410 EB, are currently under construction. Two other connectors, IH 410 EB to SH 16 NB and SH 16 SB to IH 410 WB, will be constructed as part of this project. Construction of these ramps would require acquisition of commercial property for additional ROW in the NW quadrant of the interchange with IH 410. The typical section for the BR4 configuration is found in Appendix II.

The northern terminus of the project falls just north of Loop 1604. However, just south of Loop 1604, one NB lane is dropped, so that only one lane will cross over Loop 1604. Similarly, one SB on-ramp will be added to the existing SB bridge above Loop 1604 to complete the typical bi-directional 2-lane configuration. On the north side of Loop 1604, the project terminates onto existing SH 16, with both NB and SB ramps, to and from SH 16. In this study, no provision is made for intermediate NB entrance ramps or SB exit ramps between IH 410 and LP 1604. However, a SB entrance ramp is provided at Seneca Road to serve the direct connector ramps at IH 410. The length of this alignment is approximately 7 miles.

SH 16 Ultimate 80' Segmental (BR 4 (Seg)) Alignment. This alternative alignment is similar to the BR 4 alignment and allows for the construction of a four-lane elevated road within the existing median of SH 16 from IH 410 to LP 1604. As in the BR 4 alternative, the roadway connects to IH 410 via four direct connector ramps, two of which are already existing and two of which are to be included in this project. The one major modification to this alignment as it relates to the BR 4 alignment is the ultimate cross-sectional width of the bridge (80') and the segmental section construction, versus the standard I-beam construction. The typical section for this configuration is found in Appendix II.

Leon Creek Short Ultimate (LS4) Alignment. This alternative alignment follows the same alignment as the Leon Creek Long alignment from SH 151 to SH 16. At SH 16, this roadway connects to existing SH 16 with a NB exit ramp and a SB entrance ramp. The length of this alignment is approximately 6 miles. For this alignment, only the conventional construction of a 4-lane center column with 102-foot spans using Type IV beams was analyzed. The typical section for this configuration is found in Appendix II.

Leon Creek Long Ultimate (LL4) Alignment. This alternative alignment begins at SH 151 with NB and SB Direct Connectors, continues in a northeasterly direction, and traverses IH 410 without a connection. The alignment follows along Leon Creek, is completely elevated, and would require acquiring mostly undeveloped property within the Leon Creek floodway. At SH 16, it then follows the same alignment as the SH 16 (Bandera Road) alternative. In this study, no provision is made for intermediate NB entrance ramps or SB exit ramps between SH 151 and LP

1604. The length of this alignment is approximately 10 miles. The typical section for this configuration is found in Appendix II.

I. TRAFFIC AND REVENUE ANALYSIS

A sketch level planning toll evaluation was performed for SH 16 (Bandera Road) between IH 410 and Loop 1604. The project spans approximately 7 miles in the northwest San Antonio area. In the existing configuration, SH 16 is a four-lane major arterial between IH 410 and Loop 1604. The future configuration is proposed to have elevated toll lanes between IH 410 and Loop 1604 with the existing arterial lanes remaining as an alternative "non-toll" route. Three different alignments were analyzed with varying lane configurations as previously described in Sections G and H, above and as listed, below:

- Bandera Road (BR) alignment: 2 lanes, 3 lanes with center reversible lane, and 4 lanes
- Leon Long (LL) alignment: 2 lanes, 3 lanes with center reversible lane, and 4 lanes
- Leon Short (LS) alignment: 2 lanes, 3 lanes with center reversible lane, and 4 lanes

Study Background. Diversion of traffic from existing "non-toll" routes to toll lanes are based on factors such as the socio-economic factors of the surrounding community, number and capacity of alternative "non-toll routes," and predicted traffic growth in the area. These factors were considered in the evaluation of constructing toll lanes along SH 16.

Median household income information for Bexar County was obtained from the Texas State Data Center. This information was input into the planning models to aid in determining traffic diversion from an existing free route to a toll route.

Identifying alternative "free routes" is a major element in determining traffic diversion to a toll route. Alternative routes were determined for each of the alignment options. The alternative routes do not have to be an alternative for the entire segment of SH 16 from IH 410 to Loop 1604 but may only be an alternative route for a smaller segment of SH 16. The alternative routes varied slightly by alignment option, but each generally included the existing SH 16, SH 151, FM 3487, FM 471, Spur 345, and IH 10. The capacity of the alternative routes was a factor in the model; the future capacity was determined based on information obtained from the San Antonio Metropolitan Planning Organization (SAMPO).

Traffic growth on the alternative routes as well as on the potential toll routes was also included in the models. The Texas Department of Transportation's

traffic history counts on SH 16 and the other alternative routes were used as the basis for determining the growth rates. In addition, the growth rates were established by using the traffic forecasts shown in the SAMPO 2030 Transportation Plan as a model. It should be noted that the SAMPO 2030 traffic forecasts for the study area were aggressive and displayed some of the highest estimated growth in the City of San Antonio. Table I-1 shows a summary of the historic growth rates, and Table I-2 shows the SAMPO 2030 traffic forecasts.

Table I-1.
Summary of Historic Growth Rates on Alternative Routes

ROUTE	FROM	TO	1990 ADT	2003 ADT	1990-2003 Annual Growth Rate
SH 16	Callaghan Rd.	IH 410	61,000	55,000	-0.8%
	IH 410	Wurzbach Rd.	49,000	53,000	0.6%
	Wurzbach Rd.	Loop 1604	14,300	31,000	6.1%
				AVERAGE	**2.0%**
SH 151	US 90	IH 410	16,100	39,000	7.0%
	IH 410	Loop 1604	4,100	13,400	9.5%
				AVERAGE	**8.3%**
FM 3487	IH 410	FM 471	23,000	44,000	**5.1%**
FM 471	SH 16	FM 3487	15,600	21,000	2.3%
	FM 3487	Loop 1604	10,200	18,100	4.5%
				AVERAGE	**3.4%**
Spur 345	IH 410	IH 10/US 87	34,000	36,000	0.4%
IH 10	IH 410	Spur 345	121,000	197,000	3.8%
	Spur 345	Loop 1604	45,000	123,000	8.0%
				AVERAGE	**5.9%**

Table I-2.
Summary of SAMPO 2030 Traffic Forecasts on Alternative Routes

ROUTE	FROM	TO	2003 ADT	2030 ADT (SAMPO)	2003-2030 Annual Growth Rate
SH 16	Callaghan Rd.	IH 410	55,000	109,300	2.6%
	IH 410	Wurzbach Rd.	53,000	106,900	2.6%
	Wurzbach Rd.	Loop 1604	31,000	68,300	3.0%
				Average	**2.7%**
SH 151	US 90	IH 410	39,000	145,400	5.0%
	IH 410	Loop 1604	13,400	42,100	4.3%
				Average	**4.7%**
FM 3487	IH 410	FM 471	44,000	55,800	**0.9%**
FM 471	SH 16	FM 3487	21,000	25,300	0.7%
	FM 3487	Loop 1604	18,100	47,400	3.6%
				Average	**2.2%**
Spur 345	IH 410	IH 10/US 87	36,000	49,000	1.2%
IH 10	IH 410	Spur 345	197,000	205,300	0.2%
	Spur 345	Loop 1604	123,000	185,900	1.5%
				Average	**0.9%**

Traffic Forecasts. Based on the previously discussed factors such as socio-economic factors, location and capacity of alternative "non-toll" routes, and area growth rates, traffic forecasts were developed for the three different alignments of the proposed SH 16 tollway. Forecast year 2035 traffic volumes for the SH 16 tollway are shown in Figures 4, 5, and 6. The ramp distributions are based upon existing traffic distribution on SH 16 and the surrounding roadways.

Revenue forecasts. Revenue forecasts were developed based on the traffic forecasts for the proposed alignments of the SH 16 tollway and tollway assumptions consistent with prior Texas Turnpike Authority (TTA) projects.

Basic Assumptions. The following basic assumptions were made when completing the revenue forecasts:

1. The base toll rate will be 13.0 cents per mile for automobiles and 31.8 cents per mile for trucks.
2. The toll rates will be increased every five years to account for inflation, which was assumed to be 3.0 percent annual growth.
3. Electronic toll collection (ETC) will be the only form of toll collection along SH 16. Ramp-up factors were applied to account for initial resistance to the toll facility, such as unfamiliarity with tollways as well as resistance to obtaining an ETC card.
4. SH 16 will operate as a "controlled access" facility. Between IH 410 and Seneca Drive, vehicles are freely allowed to enter and exit the tollway without paying a toll. Between Seneca Drive and Loop 1604, only EZ tag drivers are authorized to access the tollway at these exclusive beginning and end points.
5. All major highway improvements assumed in the SAMPO 2030 Transportation Plan will be implemented during the projection period. No additional competing or feeder routes were assumed during the forecast period.

non-compete

Based on the assumptions stated above, a traffic and revenue analysis was performed for the three alignment options with varying cross-section configurations. A summary of the gross annual revenue before operations and maintenance (O&M) costs is shown in Figures I-1 through I-3 for each of the alternatives. Please note that the revenue is based on the cost per mile; therefore, the shorter alignments result in less revenue. Figures 4 through 6 illustrate the 2035 mainline and ramp 24-hour volumes, as well as the ramp and gantry locations.

Figure I-1.
Summary of Gross Revenue before O&M for 2-Lane Alternatives

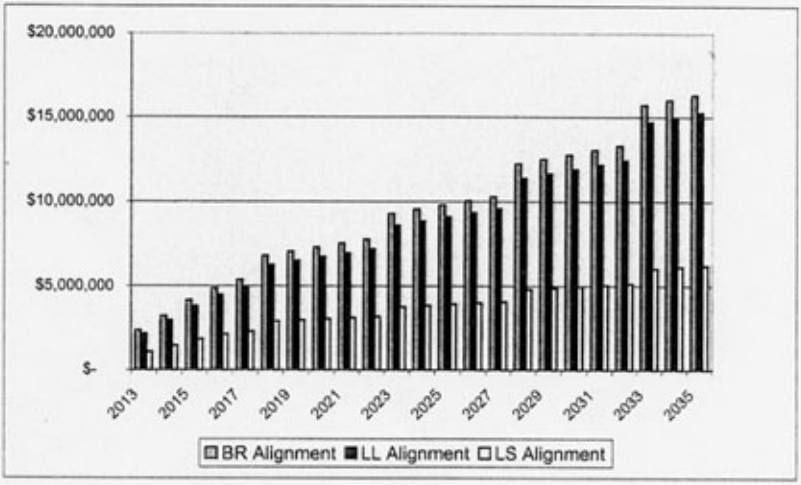


Figure I-2.
Summary of Gross Revenue before O&M for 3-Lane Alternatives

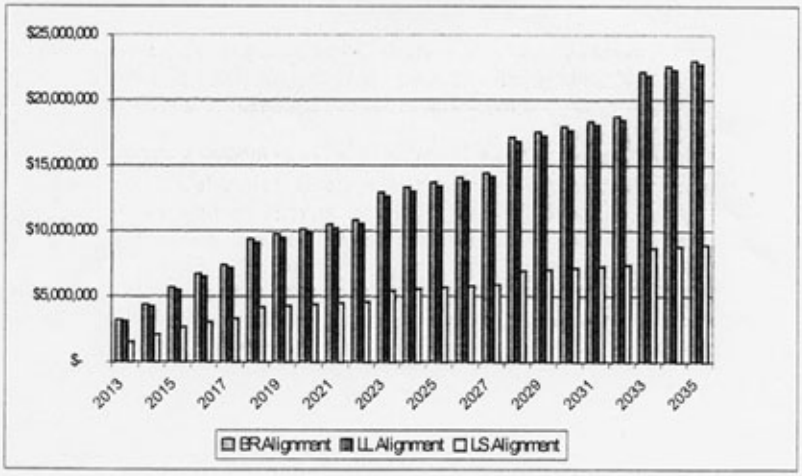
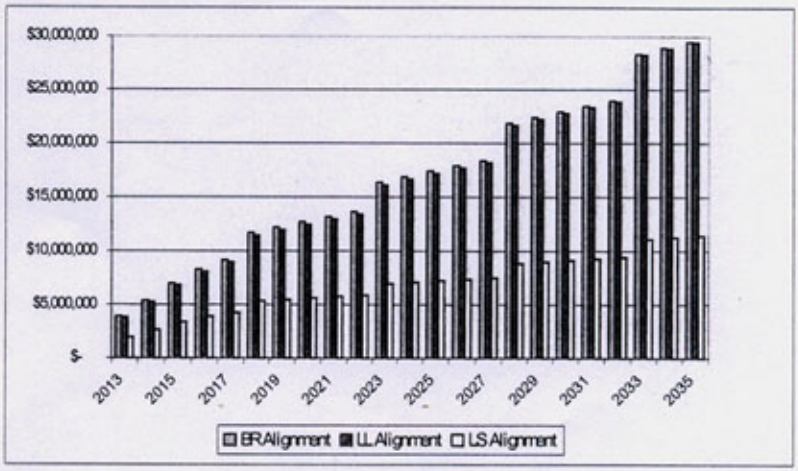


Figure I-3.
Summary of Gross Revenue before O&M for 4-Lane Alternatives



Discussion and Summary. A toll feasibility study was conducted for three different alignments for the proposed SH 16 tollway's three previously mentioned alignments. The estimated traffic growth in the area was based on TxDOT's traffic history counts while using the traffic forecasts from the SAMPO 2030 Transportation Plan as a target. It should be noted that the SAMPO traffic forecasts were aggressive for the study area and resulted in some of the highest estimated growth in the City of San Antonio. Therefore, as the alternative "free routes" reach capacity, the tollway becomes more attractive resulting in higher estimated traffic volumes.

The BR alignment yielded the highest estimated traffic volumes for the SH 16 tollway. The BR alignment offers the most options for the driver because it will attract through-trips (drivers traveling on SH 16 from IH 410 to Loop 1604) as well as drivers whose origins or destinations include the downtown area or IH 10 or IH 410. The LL alignment results in similar revenue to the BR alignment due to the longer route; however, the estimated traffic volumes are significantly lower. The LL alignment will attract through-trips on SH 16 as well as drivers whose origins or destinations include the downtown area; however, the LL alignment is not as attractive to drivers for accessing IH 10 and IH 410. The LS alignment will attract similar trips as the LL alignment but will result in less revenue due to the shorter length of the route.

It is important to note that the level of detail in this analysis is only intended to provide a sense of a project's feasibility. This analysis should not be used for financing purposes.

Reversible Lanes Option. In addition to the above-mentioned alignment options, constructing the toll lanes as two-lane reversible lanes versus a bi-directional facility was also considered during the analysis process. The two-lane reversible lane alternative would provide all lanes in one direction during the AM peak hour (inbound to downtown) and reverse the lanes during the PM peak hours (outbound from downtown). According to the Freeway Management and Operation Handbook published by the Federal Highway Administration, peak period traffic volumes should exhibit or anticipate exhibiting significant direction imbalance to warrant reversible lanes (e.g. 70/30 percent). If warranted, reversible lanes can use right-of-way more efficiently and economically. The traffic volumes on SH 16 exhibit only slightly unbalanced traffic volumes in the AM and PM peak periods. Additionally, the traffic volumes are balanced in the off-peak periods. According to the San Antonio Metropolitan Planning Organization's traffic forecasts, the traffic distribution would become more evenly split as the development continues outward. The implementing agency may wish to consider further analysis of origin and destination studies before committing to this option.

Analysis also included the option of constructing a 3-lane facility with a center reversible lane. This option would provide two lanes inbound to downtown and one lane outbound from downtown in the AM peak hour. This configuration would be reversed in the PM peak hour. This alternative is a viable option of a facility such as SH 16 with slightly uneven traffic distribution. It should be noted that the toll revenue analysis of this option did not take into consideration the additional operations and maintenance of a reversible facility.

J. COST ESTIMATES

Cost Estimates for Alternatives. Conceptual study level cost estimates for seven alternative options have been prepared for this study. Each cost estimate was based upon the following criteria:

1) Quantities were computed for each alignment based upon the proposed geometric configuration for each.
2) TxDOT unit prices were used for construction items, wherever possible. Where no TxDOT unit costs were available, the engineer used other recent unit prices for work items.
3) Right-of-way was based upon computed areas of take needed for construction. The Bexar County Appraisal District data was used to as a basis for the fair market value of the properties affected.

4) A 20 percent contingency for unknown conditions was applied to the total construction costs.
5) An additional 20 percent "soft costs", consisting of engineering, inspection, and environmental permits.

K. FINANCIAL ANALYSIS

Each of the seven alternatives was analyzed using the standard TTA Preliminary Revenue Analysis method (Table K-1). Analysis shows that each alternative generates sufficient gross revenue to pay for annual operating and maintenance costs with net revenue remaining to be applied to capital costs. This method used the net revenue from the 15th year of a 40-year bond term to determine bonding capacity. According to this method, the Leon Creek 4-Lane (LL 4) Alternative had the greatest bonding capacity at $196,617,000; however, the two 4 lane alternatives for Bandera Road, Bandera Road 4-Lane Conventional (BR 4,) and Bandera Road 4-Lane Segmental (BR 4 (Seg),) were close with $178,436,000 each. The two Leon Creek Short alternatives had the least bonding capacity with LS 2 at $38,146,000 and LS 4 at $68,711,000.

The Revenue Analysis Worksheets are shown in Appendix V.

Table K-1.
Standard TTA Analysis

ALT	BOND DEBT	% FUNDED W/ BONDS	OTHER FUNDING REQUIRED	RUNNING EXCESS (SHORTFALL)	ROW COSTS
BR 2	$102,698,000	33%	$178,833,000	$250,342,000	$7,964,000
BR 4	$178,436,000	46%	$179,959,000	$451,538,000	$7,964,000
BR 4 (S)	$178,436,000	47%	$168,692,000	$451,538,000	$7,964,000
LL 2	$104,908,000	33%	$178,152,000	$238,257,000	$3,195,000
LL 4	$196,617,000	33%	$336,819,000	$466,135,000	$3,195,000
LS 2	$38,146,000	23%	$105,580,000	$85,227,000	$2,807,000
LS 4	$68,711,000	22%	$201,246,000	$153,167,000	$2,807,000

"OTHER FUNDING REQUIRED" is an estimate of the amount of funding required beyond the funding received from bonding necessary to construct the project.

"RUNNING EXCESS (SHORTFALL)" is the net revenue generated by the project over a 40-year period.

BANDERA RD 4 LANE (SEG)

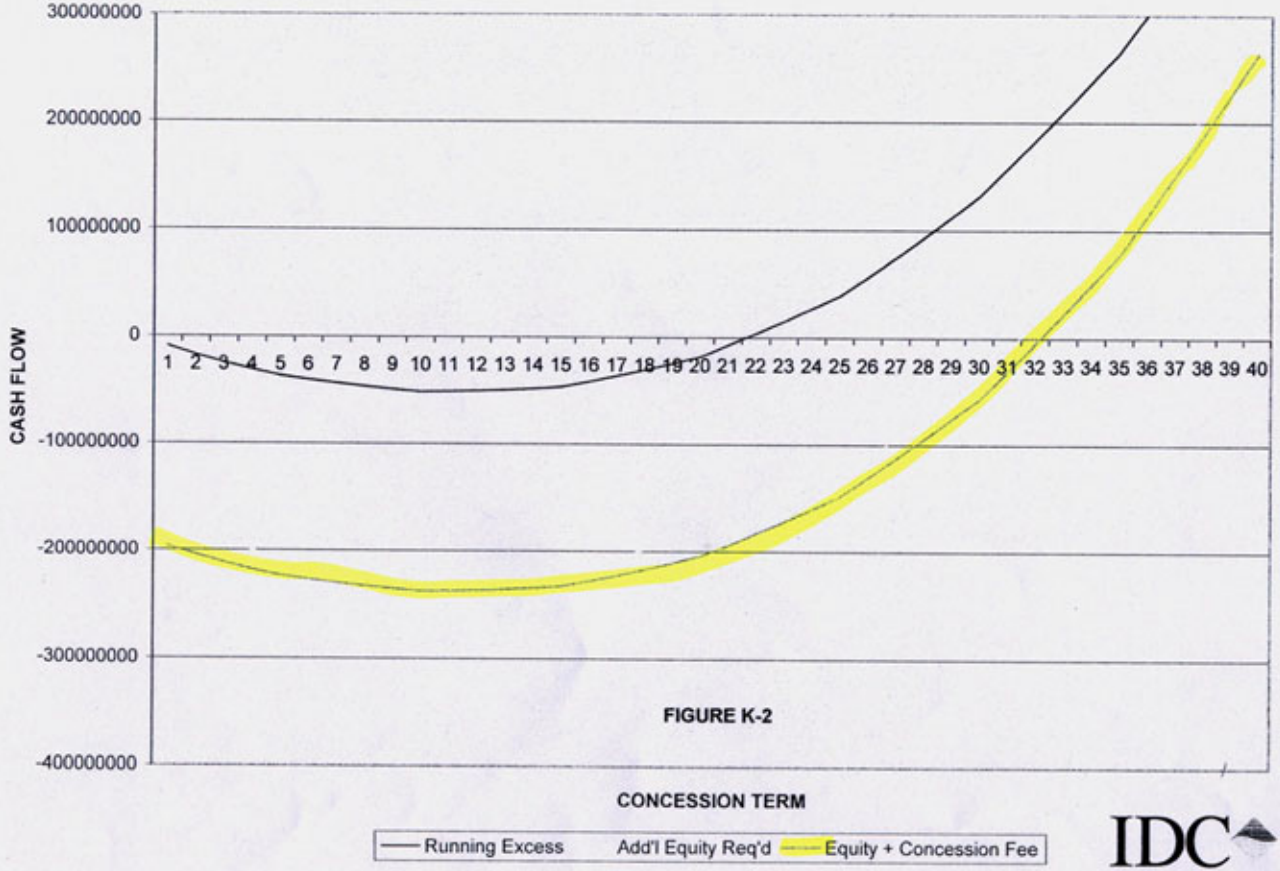


FIGURE K-2

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In order to illustrate graphically the cash flow analysis of the alternatives, refer to the graph in Figure K-2 for the analysis of alternative BR 4 (Seg). Graphs for the remaining alternatives are shown in Appendix VI Cash Flow Analysis. The graphs indicate the need for additional funding during extended terms of over 30 years in order to realize positive cash flows.

L. TIMELINE AND CDA PROCUREMENT

In accordance with the information obtained from TxDOT, construction on the selected alternative should be completed by year 2013. Based upon this information and assuming that this will become a Comprehensive Development Agreement (CDA), HZI has prepared a procurement timeline that it believes is achievable. Refer to Figure L-1.

Based upon prior experience, and in conjunction with discussions with TxDOT District staff, it was assumed that the project would most likely be built through a CDA with the Alamo Regional Mobility Authority, with the project construction completion date of year 2013. The Gant Chart of the proposed CDA timeline follows the conclusions.

M. EVALUATION MATRIX

Based upon the analyses performed and the criteria, an evaluation matrix was developed in the effort to define an alternative that clearly could be identified as the preferred alternative. No particular alternative showed total rankings that would clearly permit the best or preferred option. Refer to Figure M-1.

N. CONCLUSIONS

Seven alternative elevated roadway options were studied. A comparison of the criteria is shown in the SH 16 Evaluation Matrix to help evaluate the best option(s). These seven options coincide with the nomenclature used in Sections I and H, above. To summarize, they are:

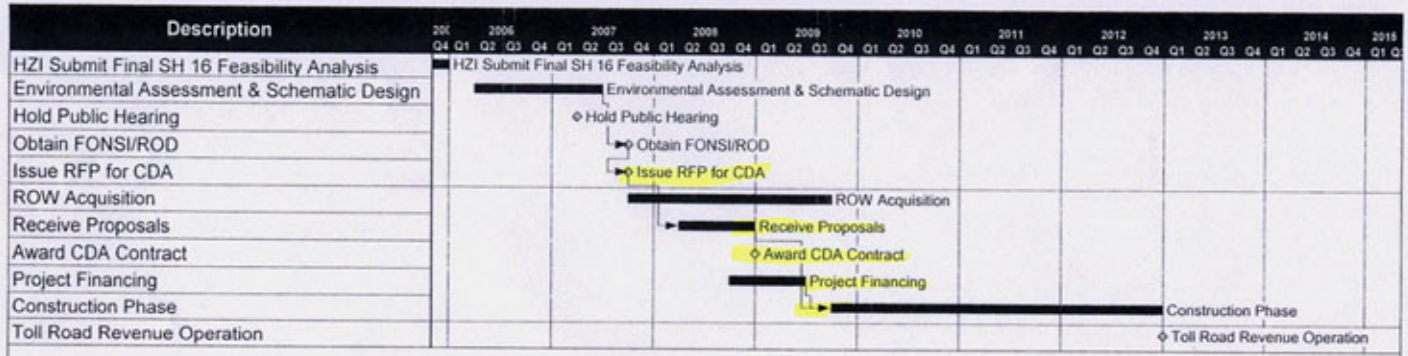
BR 2 - Bandera Road 2-lane conventional bridge section, one lane in each direction

BR 4 - Bandera Road 4-lane conventional bridge, two lanes in each direction

BR 4 (Seg) - Bandera Road 4-lane segmental bridge, two lanes in each direction

LS 2 - Leon Creek Short 2-lane conventional bridge, one lane in each direction

LS 4 - Leon Creek Short 4-lane convention bridge, two lanes in each direction



SH 16 CDA Procurement Timeline

FIGURE L-1

LL 2 - Leon Creek Long 2-lane conventional bridge, two lanes in each direction

LL 4 - Leon Creek Long 4-lane conventional bridge, two lanes in each direction

Basis for Evaluation. An Evaluation Matrix was developed to assist in the decision-making process of selecting other most favorable alternative. Major criteria were ranked based upon the following basis:

1) Existing conditions as shown on typical sections, and line diagrammatic schematics;
2) Cost Estimates: SH 16 Toll Road Feasibility Study - Estimate (46' Interim Option): From IH-410 to North of LP 1604; SH 16 Toll Road Feasibility Study Estimate (92' Ultimate Option): From IH-410 to North of LP 1604)); SH 16 Toll Road Feasibility Study Estimate (Leon Creek Stand Alone 2 Lanes); SH 16 Toll Road Feasibility Study Estimate (Leon Creek Stand Alone 4 Lanes); SH 16 Toll Road Feasibility Study Estimates for Leon Creek (4-Lanes to LP 1604);
3) Preliminary environmental maps.

Criteria and Definitions. The following terms were used in the context of defining the criteria for the study:

- **Improved SH 16 Congestion** - ranked by the number of improvements to SH 16;
- **ROW Displacements** - ranked by the number of existing businesses displaced, or, if viable access remains, partially displaced;
- **Construction Impacts** - ranked by the number of existing roadways that would need traffic maintenance during construction;
- **Environmental Issues** - ranked by cultural impacts, socio-economic impacts, potential wetlands and floodplain issues, etc., as shown on the environmental maps;
- **Constructability** - ranked by comparing the Bandera Road alternatives along the more developed 6-lane SH 16 ROW with the Leon Creek alternatives having no existing roadway;
- **AADT** - used the forecasted Average Annual Daily Traffic values to rank by improved mobility;
- **Construction Cost/Lane** - used the construction cost of each alternative shown on the Preliminary Revenue Analysis spreadsheet; alternatives were ranked by effective construction cost per lane mile;
- **ROW Cost/length** - used ROW costs shown in Appendix IV Cost Estimates divided by the appropriate length;
- **Connectivity to IH 410** - ranked by considering the direct connectors that are provided;
- **Connectivity to Loop 1604** - ranked by considering the Loop 1604 ramp improvements of each alternative.

Ranking System. Values in the Evaluation Matrix were reviewed with the consultant and TxDOT to determine the reasonableness of the evaluation. A sensitivity analysis was used where possible to verify what is the most important criteria factor and how the options compared to each other. The ranking system used is as follows:

Best equals: *+1* **Middle equals:** *0* **Worst equals:** *–1*

FIGURE No. M-1

SH 16 EVALUATION MATRIX

		RATINGS			
NO.	CRITERIA	BR 2	BR 4	BR 4 (Seg)	LL 2
1	Improve SH 16 Congestion	1	1	1	0
2	ROW displacements	-1	-1	-1	1
3	Construction Impacts	-1	-1	-1	0
4	Environmental Issues	1	1	1	-1
5	Constructibility	-1	-1	-1	0
6	AADT	0	1	1	-1
7	Construction cost/lane mi	-1	0	1	0
8	ROW cost/ length	-1	-1	-1	1
9	Connectivity to IH-410	1	1	1	-1
10	Connectivity to Loop-1604	1	1	1	1
	TOTAL	-1	1	2	0

Ranking System: -1 worst, 0 middle, +1 best

CONSIDERATIONS

1	Improve SH 16 Congestion	adds 3 ramps from exist. SH16 to new road, adds 2 bridges over/south of 1604 to SH16	adds 3 ramps from exist SH16 to new road, adds 2 bridges over/south of 1604 to SH16	adds 3 ramps from exist SH16 to new road, adds 2 bridges over/south of 1604 to SH16	adds 1 exist and entrance to SH 1 south of Guilbea
2	ROW displacements	DCs @ 410 impact existing business:Cabana, Thor, Shell,& 5 others	DCs @ 410 impact existing business:Cabana, Thor, Shell,& 5 others	DCs @ 410 impact existing business:Cabana, Thor, Shell,& 5 others	DCs @ 510 impa existing business:San Antonio Water
3	Construction Impacts-Maintenance of traffic during construction	1604/410 & all of SH 16 maint. of traffic, driveway closures	1604/410 & all of SH 16 maint. of traffic, driveway closures	1604/410 & all of SH 16 maint. of traffic, driveway closures	1604/151/410/Mi ary Road,Culebr Road & Half of S 16 maint. of traffi driveway closure
4	Environmental Issues	3 churches and 3 schools	3 churches and 3 schools	3 churches and 3 schools	potential wetland flood plain
5	Constructibility	SH 16 has a narrow more developed ROW for construction	SH 16 has a narrow more developed ROW for construction	SH 16 has a narrow more developed ROW for construction	Use 1/2 SH 16 narrow dev.ROW & 1/2 less dev. Leon Creek area
6	AADT 2035 Average Daily Traffic	35,100	65,700	65,700	14,800
7	Construction cost	$234million	$291 million	$281 million	$235 million
	Lane miles	14.2	28.4	28.4	20.4
	Const. cost/lane mile($million/lane mi)	$16.47	$10.25	$9.89	$11.50
8	ROW cost	$ 7,183,300	$ 7,183,300	$ 7,183,300	$ 2,882,39
	length	7.1	7.1	7.1	10
	ROW cost/length $million/mi	$1.01	$1.01	$1.01	$0.2
9	Connectivity to IH-410	4 DCs provided	4 DCs provided	4 DCs provided	no DC provided
10	Conectivity to Loop 1604	only ent./exit ramps	only ent./exit ramps	only ent./exit ramps	only ent./exit ram

E No. M-1
UATION MATRIX

4 (Seg)	LL 2	LL 4	LS 2	LS 4
1	0	0	-1	-1
-1	1	1	1	1
-1	0	0	1	1
1	-1	-1	-1	-1
-1	0	0	1	1
1	-1	0	-1	-1
1	0	0	0	1
-1	1	1	0	0
1	-1	-1	-1	-1
1	1	1	-1	-1
2	0	1	-2	-1

ramps st SH16 to d, adds 2 over/south to SH16	adds 1 exist and 1 entrance to SH 16 south of Guilbeau	adds 1 exist and 1 entrance to SH 16 south of Guilbeau	adds 1 exist and 1 entrance to SH 16 south of Guilbeau	adds 1 exist and 1 entrance to SH 16 south of Guilbeau
410 impact :Cabana, ell,& 5	DCs @ 510 impact existing business:San Antonio Water	DCs @ 510 impact existing business:San Antonio Water	DCs @ 510 impact existing business:San Antonio Water	DCs @ 510 impact existing business:San Antonio Water
0 & all of aint. of iveway	1604/151/410/Military Road,Culebra Road & Half of SH 16 maint. of traffic, driveway closures	1604/151/410/Military Road,Culebra Road & Half of SH 16 maint. of traffic, driveway closures	151/410Military Road, Culebra Road & SH 16 @ Guilbeau maint. Of traffic	151/410Military Road, Culebra Road & SH 16 @ Guilbeau maint. Of traffic
es and 3	potential wetlands flood plain	potential wetlands flood plain	potential wetlands flood plain	potential wetlands flood plain
as a nore ed ROW ruction	Use 1/2 SH 16 narrow dev.ROW & 1/2 less dev. Leon Creek area	Use 1/2 SH 16 narrow dev.ROW & 1/2 less dev. Leon Creek area	Guilbeau@SH 16 higher develop. narrow ROW; the rest is less dev.	Guilbeau@SH 16 higher develop. narrow ROW; the rest is less dev.
,700	14,800	29,400	10,300	18,900
llion	$235 million	$442 million	$121 million	$228 million
8.4	20.4	40.8	12.0	24.0
89	$11.50	$10.80	$10.10	$9.50
7,183,300	$ 2,882,390	$ 2,882,390	$ 2,532,390	$ 2,532,390
7.1	10.2	10.2	6	6
$1.01	$0.28	$0.28	$0.42	$0.42
ovided	no DC provided	no DC provided	no DC provided	no DC provided
exit ramps	only ent./exit ramps	only ent./exit ramps	no improv. @ 1604	no improv. @ 1604

Evaluation Matrix
Figure No. M-1

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