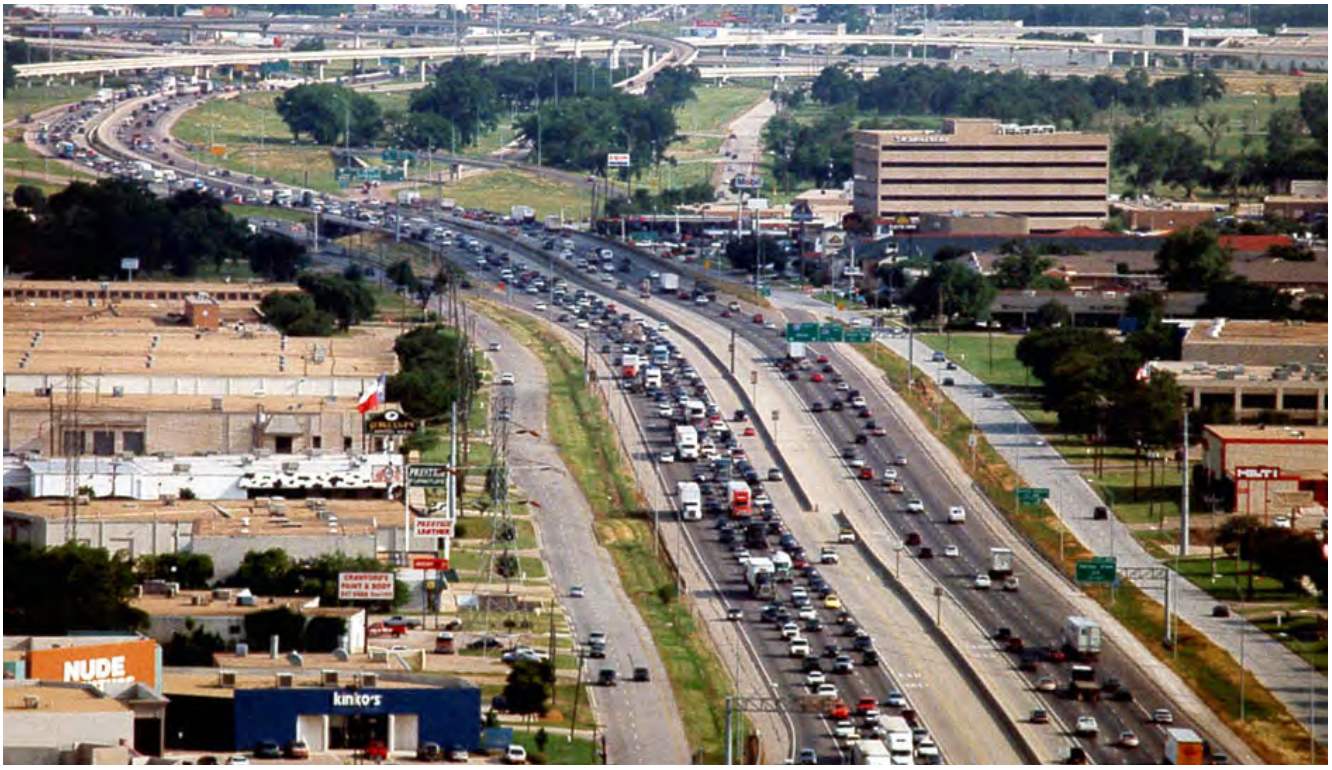
Preliminary VALUE ENGINEERING STUDY REPORT

Texas Department of Transportation
Dallas District

I-35E Managed Lanes Project



STUDY DATES: August 16-18, 23-25, 2010

REPORT DATE: September 2010

Prepared and Submitted by:
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Memorandum

Date: **September 5, 2010**

To: **All Recipients of Preliminary Value Engineering Report for I-35E Managed Lanes Project**

From: **Martin Y. Hsu, PE, CVS-Life**
Martin Y. Hsu, PE, CVS & Associates, Inc. (MHA, Inc.)

Martin Y. Hsu, PE, CVS & Associates, Inc. is pleased to transmit this Preliminary Value Engineering Study Report for the referenced project. To assist the reader in using this report, the organization and content of this report, as well as key definitions used in the VE Study Report, are described in the following pages. This report summarizes the results and events of the study conducted August 16-18, 23-25, 2010, in TxDOT-Dallas District Office, Dallas, Texas.

DECISION-MAKERS PLEASE NOTE: Please use the attached **VE Implementation Matrix** to provide your decisions and comments. You are asked to accept, conditionally accept, or reject each VE alternative included in this report. In addition, you will be asked to agree or disagree with the cost savings and performance measures ratings the VE team applied to each VE alternative that is accepted or conditionally accepted.

The VE process is complete only when the implementation decisions for every VE alternative have been received from the Project Manager and documented in the VE report. The *Assess Alternatives* and *Resolve Alternatives* activities provide the VE team, the Project Manager, TxDOT/TTA, and local stakeholders the assurance that the alternatives are properly evaluated and the implementation decisions are based on the merit of the alternative. This process helps to eliminate inaccurate study alternatives and legitimizes the results of the study.

If you have any questions or comments concerning the final report, please contact me at 214-223-4139.

Sincerely,

Martin Y. Hsu, PE, CVS-Life

Value Engineering Study Report Structure and Content

PURPOSE OF REPORT

To improve reader understanding of the VE Study Report, information relating to the organization of the report is provided. Key definitions are also provided. The Final VE Study Report will be circulated to the same parties who received a copy of the Preliminary VE Study Report. The Final Report documents changes made as a result of the comments received on the preliminary report, implementation decisions related to alternatives, and if appropriate, follow-up activities required for closing out the VE activities. In addition, key project information analysis that was integral to the development of the VE alternatives is included in this document.

A GUIDE TO READING THIS REPORT

The VE Study Report includes:

• **Transmittal Letter**	Letter from the VE Study Facilitator transmitting the report.
• **Executive Summary**	Overview of the project and the results of the VE Study.
• **VE Study Summary Report**	Database format summary to be used by the TxDOT VE Program Administrators for auditing and reporting purposes.
• **VE Alternatives**	Documentation of the findings of the value analysis of the project.
• **Project Analysis**	Documentation of the findings of the project derived from the VE tools.
• **Project Description**	Narrative of the project scope and cost that formed the basis for the VE Study.
• **Idea Evaluation**	List of all the creative ideas and their evaluations.
• **Value Engineering Process**	Description of the VE methodology employed by TxDOT, the study agenda, and participants.

The **Report Structure and Content** information is provided to assist reader understanding of the VE Report. The purpose and content of each section and key definitions are provided.

The first page of the **Executive Summary** provides a "Synopsis", a *very brief* summary of the VE Study and results. The Executive Summary itself elaborates on the Synopsis, providing brief descriptions of the project, issues associated with the project, the findings resulting from using the VE tools to analyze the project, and a summary of the key VE alternatives produced. Performance rating, developed by the VE team and decision-makers for the accepted VE alternatives, are presented.

The **VE Study Summary Report (VESSR)** is a database-format summary of study participants, activities, and results. It provides lists of VE alternatives proposed, accepted, and/or conditionally accepted, along with the cost and performance impacts of each alternative listed.

The **VE Alternatives** section presents in detail, including sketches, performance measures, assumptions and calculations in addition to cost estimates.

The **Project Analysis** section goes into some detail about the VE tools used by the VE team to analyze the project and discusses the results of those analyses.

The Project Description section elaborates on the scope of the project studies and provides a copy of the project cost estimate used by the VE team.

The **Idea Evaluation** section provides the reader with a list of the ideas generated by the VE team, how each idea was evaluated and ranked, and an understanding why certain ideas were not developed.

The **VE Process** section describes the VE Methodology. It includes detailed descriptions of the activities included in the VE Study process with special emphasis on the performance measures process used by the VE Team. A copy of the VE Study Agenda and the Meeting Attendance list are also provided.

Definitions of **Key Terms** used in VE Study Report are listed below:

Original Concept is the design solution that is used as the baseline for the VE Study. This can be either one of the EIS alternatives or the PS&E design, depending on the point in time that the VE study is being performed. The VE analysis, proposed changes, and cost and performance potential changes are all referenced against the original concept.

VE Alternatives are developed by the VE team as items to be considered as alternatives to either replace or enhance elements of the original concept.

Performance Measurement is a unique methodology developed to measure the effectiveness of the project scope of various alternatives. This permits the interrelationship between cost and performance to be quantified and compared in terms of how they contribute to overall value.

Initial Cost refers to the costs for construction, right-of-way, and support that are expended to complete the project and have it open to the public.

Subsequent Cost refers to operations, maintenance, and other costs that are necessary to keep the facility functioning over the projected life of the project. Typically, a 30-year life is used for life cycle cost comparisons (50 years for bridge structures).

Life Cycle Costs (LCC) consider all costs estimated for a facility over a designated time period (typically 30 years) and adjusts those costs to today's dollars so that alternatives that have different aspects can be compared, assisting in determining the most cost effective solution for the project.

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EXECUTIVE SUMMARY

PRELIMINARY

SYNOPSIS

The proposed I-35E Managed Lanes project is approximately 28.0 miles long and extends from US 380 in Denton County to I-635 in Dallas County. The I-35E corridor serves as the primary route from Denton to Dallas and the project has been divided into three segments for analysis: south, middle and north. The geographical limit of each segment is derived from the city and county limits, economic activity, geometric configurations, and the traffic characteristics particular to each segment.

The limits of the segments are provided below:

- **South Segment:** I-635 to President George Bush Turnpike (PGBT)
- **Middle Segment:** President George Bush Turnpike (PGBT) to FM 2181/Swisher Road
- **North Segment:** FM 2181/Swisher Road to US 380

The planned improvements of this project are to widen the highway footprint and:

- increase the total number of the general purpose lanes from six to eight between I-635 and US 377
- increase the total number of the general purpose lanes from four to six between US 377 and I-35W
- increase the total number of the general purpose lanes from four to ten between I-35W and US 380
- add a barrier separated bi-directional managed lane facility
    - with four lanes from I-635 to US 77
    - with two lanes from US 77 to I-35W
    - with four lanes from I-35W to US 380

The total overall construction cost is currently estimated at $4.0 billion. This total includes the cost of all construction activity to deliver the planned facility, environmental mitigation, right-of-way, utility relocation, and all associated planning, design, and engineering.

The I-35E VE team identified twenty (20) key VE alternatives that were considered to address the functions of *Optimize Funding*, *Enhance Mobility,* and *Reduce Congestion.* All of the alternatives maintain functionality, offer performance improvements, an, reduce initial costs for construction and/or life cycle costs over the longer term.

The I-35E VE team developed two sets of alternatives to illustrate potential combinations that may be chosen for implementation. The alternatives included in the two sets are those deemed by the team to represent the best value when considering the impact of the alternatives on project performance and cost savings.

Two sets of alternatives were combined for consideration by the decision makers:

Set No.	Description	Initial Cost savings	Change in Performance	Change in Value
1	Maximize Affordability of Project	$2,208,000,000	-28%	+61%
2	Maintain Stakeholder Acceptance	$1,659,940,000	-1 %	+17%

INTRODUCTION

This Value Engineering (VE) Study Report summarizes the events of the I-35E VE study conducted for TxDOT by Martin Y. Hsu, PE, CVS-Life of *Martin Y. Hsu, PE, CVS & Associates, Inc*. The subject of the study is the 28-mile I-35E Managed Lanes project in Dallas and Denton Counties, Texas.

PROJECT DESCRIPTION

Existing Configuration

The existing I-35E is a six-lane freeway from I-635 to Quail Run just north of the Lake Lewisville Bridge and a four-lane freeway from Quail Run to US 380. The southern portion of I-35E from I-635 to SH 121 has an interim single lane concurrent high occupancy vehicle (HOV) lane in each direction. To implement this interim HOV lane, the three general purpose lanes in each direction were reduced to a lane width of 11 feet and the inside shoulder was reconstructed to provide space for the HOV lane.

Existing Condition

The section of I-35E under consideration for this project was constructed in the late 1950's and early 1960's as part of the United States Interstate Highway System. Roadway design standards have improved greatly since its initial design and construction. The current roadway exhibits design deficiencies including: inadequate shoulder and lane widths, inadequate ramp acceleration and deceleration distances, inadequate ramp length, inadequate ramp spacing to cross streets, inadequate bridge clearance and unofficial ramps. Additionally, the limited number of existing lanes does not meet the current traffic demands and result in severe congestion. This situation is likely to get worse with future growth and increasing traffic.

Existing Mobility on I-35E

The need for the proposed project is to address the transportation congestion of the area resulting from an increase in population and the subsequent increased travel demand. The proposed project, which traverses Dallas and Denton Counties, is an essential element in the local and regional transportation system. Within the region, I-35E functions as an interstate highway, serves as the primary north/south commuter corridor between Denton and Dallas, and also serves as a local route for trips to and from work, school, shopping, etc. As an important regional commuter route, I-35E connects the Cities of Dallas, Farmers Branch, Carrollton, Lewisville, Highland Village, Lake Dallas, Corinth, Town of Hickory Creek, and Denton as well as neighboring developing communities.

Proposed Mobility on I-35E

The purpose of the proposed project is to address the transportation needs on the corridor by increasing capacity, reducing traffic congestion, improving mobility, and improving roadway deficiencies within the DFW metropolitan area. The project will also serve to enhance the overall regional and national transportation system.

The proposed improvements for the project include widening the general purpose lanes (free main-lanes) and upgrading the interim concurrent HOV facility by adding a barrier separated bi-directional fully operational and accessible managed lane facility.

The proposed I-35E improvements include increasing the main-lane capacity by:

- Increasing the number of general purpose lanes from six to eight between I-635 and US 377
- Increasing the number of general purpose lanes from four to six between US 377 and I-35W
- Increasing the number of general purpose lanes from four to ten between I-35W and US 380
- Adding a barrier separated bi-directional managed lane facility
    - with four lanes from I-635 to US 77

    - with two lanes from US 77 to I-35W
    - with four lanes from I-35W to US 380
- Providing access to the barrier separated bi-directional managed lane facility at major traffic demand locations such as major intersections and major developed areas along the corridor
- Modifying access to the general purpose lanes to benefit main lane traffic by decreasing the amount of weaving interaction while maintaining accessibility and conforming to current design standards

The total overall construction cost is currently estimated at $4.0 billion. This total includes the cost of all construction activity to deliver the planned facility, environmental mitigation, right-of-way, utility relocation, and all associated planning, design, and engineering.

PROJECT ANALYSIS

The I-35E VE team analyzed the project using the VE tools and job plan.

Using function analysis, the team defined the highest order functions of this project as:

- *Increase Capacity*
- *Enhance Mobility*
- *Manage Peak Traffic*
- *Improve Air Quality*

Asking how we achieve these highest order functions listed above resulted in the identifying the key basic functions: *Improve Local Acces*s, *Upgrade/Meet Standards,* and *Accommodate Multimodal Options.* Analysis of the functions helped the team focus on the purpose and need of the project and consequently, determine how to craft alternative concepts that would provide the required functions.

In addition to the project functions, ten (10) specific performance criteria were developed in cooperation with the Project Development Team (PDT) and TxDOT. These performance criteria were ranked by weighting them using a paired comparison approach. The paired comparison method assessed the importance of each performance criteria in turn against all others to derive a total importance per criteria. From this assessment, the ranking was calculated. These criteria were used to evaluate ideas and alternative concepts. These criteria are identified later in this section under the heading Performance and Value Improvement.

Of the ten (10) performance criteria assessed, the PDT identified the following seven (7) performance criteria as essential to the success of the project:

- Revenue Impacts
- Environmental Impacts
- Stakeholder Acceptance
- Schedule Impact
- Traffic Operations- General Purpose Lanes
- Traffic Operations – Local
- Right of Way Impact

An analysis of the project cost estimates ranked, as a percentage of overall cost, all construction elements or categories which form part of the overall total project construction cost. This ranking identified the significant cost items and therefore, the *cost drivers* for the project. This ranking helped to guide the I-35E VE team in the development of ideas during the VE study.

The analysis revealed that approximately 80% of the construction cost will occur in approximately 20% of the project elements. For each segment, the rankings illustrate the following:

South Segment:

- The highest cost item, approximately 8% of the total construction cost is Mobilization which is related directly to the function *Initiate Construction.*

- The second highest cost item is Traffic Control, also representing 8% of the total cost and serving the function *Maintain Traffic, Protect Workers/Motorists.*

Middle Segment:

- The highest cost item, approximately 40% of the total construction cost, is Bridges (concrete over Lake Lewisville, both Managed and General Purpose Lanes) which is related directly to the functions *Carry Traffic* and *Span Water.*

- The second highest cost item is Mobilization, representing 8.5% of the total cost and serving the function of *Initiate Construction.*

North Segment:

- The highest cost item, approximately 9% of the total construction costs, is bridges (concrete, General Purpose Lanes) which are related directly to the functions *Carry Traffic, and Separate Grades*.

- The second highest cost item is Retaining Walls, representing 8.5% of the total construction costs, and serving the functions *Minimize ROW and Retain Earth*.

DEVELOPMENT OF VE ALTERNATIVES

A creative ideas session generated a list of potential ideas for the project. The ideas were separated into four (4) groups as follows:

- General/Phasing/Traffic Control = 60 ideas
- Middle Segment = 21 ideas
- South Segment = 14 ideas
- North Segment = 14 ideas

For each if these ideas, advantages and disadvantages were discussed and listed and the idea was ranked on a scale as follows:

- Rank 5 to 4 = Most likely to be developed
- Rank 3 = Design suggestion
- Rank 1 to 2 = Least likely to be developed
- WD = Withdrawn
- RQ = Required

There were 21 ideas that ranked 5 to 4 and these ideas were put forward for further consideration. The I-35E VE team was split into four groups and each group was assigned a number of the 21 ideas to assess and work out potential cost savings associated with each. Each item was described in a document including all relevant details, costs, advantages, and disadvantages. Each document was peer reviewed by all other members of the VE team and following these individual assessments, five VE alternatives were

accepted and three additional VA alternatives were conditionally accepted as being most realistic to develop. Please refer to "*VE Implementation Matrix*" immediately after this page.

Of the accepted alternatives, the VE team grouped these into two sets of alternatives to illustrate potential combinations that may be chosen for implementation. The alternatives included in the sets are those deemed by the team to represent the best value when considering the impact of the alternatives on project performance and cost savings.

Descriptions of *selected* VE alternatives are given below; summary lists and detailed documentation of all VE alternatives are in section 4 of this report.

Alternative Number	Description	Potential Savings *(Additional Cost)*	Performance
GENERAL/PHASING/TRAFFIC CONTROL			
1.0	**Defer new frontage road construction (where feasible)**	**$179,918,000**	**-1%**
	By deferring construction of the frontage roads (where feasible), the initial capital costs are reduced while the level of service on the GPs and MLs is not significantly impacted. The frontage road section being investigated, as proposed in the baseline case, provides frontage road continuity and a sidewalk for pedestrians. Without this section of frontage road, the managed lanes could be used for incident management. Also, because the quantity of bridges is being reduced, the cost of maintenance is reduced.		
2.0	**Defer 4th General Purpose Lane and Provide 12 ft. Outside Shoulder**	**$159,000,000**	**+1%**
	An alternative to defer construction of the 4th GP lane construction in the south and middle segments to 2030 and 2040 have previously been evaluated by the Project Development Team. Traffic and revenue analysis indicates that managed lane toll revenue could potentially increase by not implementing the 4th GP lane. Cost savings for these alternatives were estimated at approximately $17 and $45 million respectively for the south and middle segments. These cost savings assumed retaining walls and bridge structures were unchanged from the base project but did reduce excavation and embankment quantities as well as other incidental quantities which were not included in this analysis. The total savings of $159M includes the cost savings in construction plus the additional revenue generated in the managed lanes due to reduced capacity on the general purpose lanes.		
4.0	**Early implementation of HOT lanes (convert existing HOV to HOT) – allowed under current legislation**	**$9,000,000**	**+3%**
	Early implementation of HOT lanes helps to generate early revenue to support construction of the full project. The current HOV lane is under-utilized during the peak hours. Converting the HOV lanes to HOT lanes will relieve traffic congestion and generate revenue before completion of construction of the full project scope.		
5.2	**Defer ROW acquisition and construction of the northern part of Middle Segment and the complete North Segment (defer from Valley Ridge Blvd. north)**	**$1,800 million**	**+6%**

Alternative Number	Description	Potential Savings *(Additional Cost)*	Performance
	This VE alternative proposes to reduce the project scope to be in line with funding available today, including potential revenue generated by traffic. When additional funding is available, the remaining part of the Middle segment and all of the North section can be developed in 2040. This alternative will potentially make a more financially viable project to begin construction in 2011. This alternative proposes to construct and acquire ROW only for the south segment and part of the middle segment, i.e. construction 12 miles out of the total 28 miles and construction the remainder in 2040.		
6.0	**Construct elevated Managed Lanes or Managed Lanes on outside, defer construction of General Purpose lanes**	**$408,000,000**	**-2%**
	The primary justification for constructing elevated managed lanes and deferring the reconstruction of general purpose, frontage roads, and cross streets allows for an early revenue stream while adding capacity and reducing the ultimate ROW requirements. Cost of project to achieve managed lanes is reduced from $4B to $1B. Because the elevated structures can be constructed with minimal impact to the existing facility and the construction duration is significantly reduced, the revenue stream from the managed lanes can be collected sooner than in the baseline case. Additionally, because the capacity of the general purpose lanes is not increased until the general purpose lanes, frontage roads, and cross streets are constructed at a later date (deferred), and because the volume of traffic is expected to increase over time, it can be assumed that more traffic will use the managed lanes therefore reducing the ramp-up period on the managed lanes bringing in more revenue sooner.		
MIDDLE SEGMENT			
13.0	**Shorten Bridge (over water) length**	**$170,251,000**	**+8%**
	The highway, in its current configuration, is built on fill with a single bridge opening (1000' span) over Lake Lewisville. The current proposed concept calls for a 9100' bridge spanning the entire lake. The reason for this is the avoidance of mitigation for additional fill to be placed in the lake as required by the US Army Corps of Engineers (COE). This alternative concept will require additional coordination with the COE to find a suitable location to mitigate the loss of lake capacity. Assuming mitigation is feasible, the concept will result in substantial savings in construction cost and construction schedule.		
SOUTH SEGMENT			
15.0	**Extend frontage road (auxiliary lanes) from ramp to ramp instead of ramp to cross street**	**$1,164,000**	**-8%**
	There are several areas in the south segment that may benefit from a reduction in the number of frontage lanes without jeopardizing access to businesses and the highway. Removing a 12' frontage road from ramp to cross-street reduces the upfront cost of the project along with a savings in future maintenance work.		
NORTH SEGMENT			

Alternative Number	Description	Potential Savings *(Additional Cost)*	Performance
16.0	**Allow purchase ROW (by individual parcel or selected) but defer construction of North Segment**	**$846,297,000**	**-6%**
	Currently, there is a significant funding gap to construct the proposed ultimate I-35E corridor improvements. In addition, traffic and revenue studies indicate that construction of the ultimate improvements in the North Segment generate a smaller amount of revenue compared to the South and Middle Segments. The North Segment is, therefore, the least attractive segment within the I-35E Corridor as part of any potential investment. Due to this limited funding and lower revenue potential, the alternative considers the deferral of construction of the North segment until funding becomes available. However, once environmental clearance has been obtained, the ROW acquisition could still begin as the first stage of project development. The $425M cost for acquisition of the ROW in the North segment will be about 33% of the total North segment costs. At least $663M in construction costs will be deferred. The remaining $183M in utility relocation and engineering could also be deferred for a total deferral of $846M. This is 67% of the total North segment construction cost of $1,271M.		
17.0	**Flip the connection at US 77 with I-35E at grade**	**$15,329,000**	**-1%**
	Flipping the connection between US 77 and I-35E has the potential to reduce quantities and costs for retaining walls, pavement, and structures. In addition to flipping this interchange, reconfiguration of the connection between the managed lanes was considered. Both ramps from US 77 were relocated to merge into the center of the managed lanes on I-35E. This would reduce construction costs by keeping these two facilities on the same structure. The SB US 77 to I-35E general purpose lanes and the SB US 77 to I-35E frontage road ramps were also merged into a two lane ramp to the I-35E frontage road. An entrance ramp was then added to the south from the I-35E frontage road to the I-35E general purpose lane. Relocating this entrance ramp to connect to the frontage road then allowed removing the entrance ramp approximately 1,000 feet to the north (part of the existing braided ramp configuration). Flipping the interchange presented in this concept would also eliminate the San Jacinto crossing of I-35E.		

VALUE ENGINEERING STUDY SUMMARY REPORT

INTRODUCTION

The Value Engineering Summary Report (VESSR) is filled out portion-by-portion as the VE Study progresses, and it is submitted as part of the Final VE Study Report.

The VESSR includes:

VESSR – Participants and Schedule: This page identifies the VE team and other key participants involved in the VE Study. The schedule of key events is also listed on this page.

VESSR – Proposed Alternatives: All VE alternatives are listed with their potential cost and performance changes. The VE team establishes sets of selected VE alternatives to provide reviewers guidance and added understanding of how the alternatives can fit together into a solution for the project. The sets and their cost, performance, and value changes are listed on this page. Cost savings and cost increases are totaled separately.

VESSR – Accepted Alternatives: Accepted VE alternatives are listed with their validated cost and performance changes. The total impact of the accepted VE alternatives is determined and the cost, performance, and value changes are listed on this page. Note: The total cost or performance changes are not necessarily the sum of the accepted VE alternatives, as there may be overlapping or synergistic effects of combining certain VE alternatives. Cost savings and cost increases are totaled separately.

VESSR – Conditionally Accepted Alternatives: If, after the Implementation Meeting, there are conditionally accepted VE alternatives, they are listed on this page and their information is summarized similar to the accepted VE alternatives.

VA PARTICIPANTS AND SCHEDULE

The six-day study was performed during the period of August 16-18, 23-25, 2010, at TxDOT-Dallas District conference room, located in Mesquite, Texas. The VE study was led by Martin Hsu, PE, CVS-Life, from *Martin Y. Hsu, PE, CVS & Associates, Inc.* The VE team members are listed below:

Name	Function/Position	Organization
Bowen, Doug	Roadway Design	Jacobs
Chan, Eva	Civil Engineer/O&M	Halcrow
Chapman, Dan	Civil Engineer	HNTB
Craig, Matt	PM-Schematic/EA	Halff Associates, Inc.
Daily, Kimberly	Project Manager	Jacobs
Drayton, Michael	Finance/Revenue	KPMG
Frye, James	Landscape Architect	HNTB
Gardiner, Chad	Project Engineer	Halff Associates, Inc.
Graff, Joe	Civil Engineer	Halcrow
Hammons, Tom	Transportation Engineer	City of Carrollton
Irani, Spenta	Transportation Engineer	Jacobs
Ji, Jerry	T&R	Wilbur Smith Associates
Kerrigan, Michael	Sr. Consultant	Halcrow
McGahan, Jeremy	Project Engineer	Halff Associates, Inc.
Nguyen, John	CDA	TxDOT
Reichert, Bill	CDA Program Specialist	TxDOT
Riou, Charles	Design/Transportation	TxDOT
Taylor, Mark	Civil Engineer	Halcrow
Ullman, Phil	Project Manager	HDR
Vasquez, Lucio	CDA Program Specialist	TxDOT
Walters, Shane	Project Engineer	HDR
Martin Hsu	Team Leader	Martin Y. Hsu, PE, CVS & Associates, Inc.

The VE team was supported by several members of the TxDOT project development team and other stakeholders throughout the VE session. These participants included:

Name	Function/Position	Organization
Brown, Bob	CDA Manager	TxDOT
MacGregor, Matt	CDA Project Manager, MDP	TxDOT
Askari, Nasser		TxDOT
Murphy, James		Army Corps of Engineers

VE STUDY SUMMARY REPORT PROPOSED ALTERNATIVES *I-35E Managed Lanes Project*	**TxDOT**

Summary of *Proposed* Alternatives Study Savings

VE Alt. #s	Initial Costs	Subsequent Costs	Total LCC (NPV) Costs	Change in Performance
1.0	$179,918,000		$179,918,000	-1%
2.0	$159,000,000		$159,000,000	+1%
3.0	$76,872,000		$76,872,000	-2%
4.0	$9,000,000		$9,000,000	+3%
5.1	$1,523,000,000		$1,523,000,000	+4%
5.2	$1,800,000,000		$1,800,000,000	+6%
6.0	$408,000,000		$408,000,000	-2%
7.0	$18,546,400		$18,546,400	+8%
8.0	($82,619,000)	$665,000,000	$582,346,000	-4%
9.0		$401,000,000	$401,000,000	+2%
10.0	30,000,000		30,000,000	+8%
11.0	$22,000,000		$22,000,000	+0%
12.0	$26,994,401		$26,994,401	-2%
13.0	$170,251,000		$170,251,000	+8%
14.0	$179,416,000		$179,416,000	-5%
15.0	$1,164,000		$1,164,000	-8%
16.0	$846,297,000		$846,297,000	-6%
17.0	$15,329,000		$15,329,000	-1%
18.0	$1,378,000		$1,378,000	-2%
19.0	$3,270,000		$3,270,000	-10%

Summary of *Proposed* VE Alternatives – *Cumulative* Study Savings

VE Set	VE Alt Numbers	Costs Savings / Cost Increase	Subsequent Costs	Total LCC (NPV) Costs	Change in Performance	Change in Value
1	5.2, 6.0	$2,208,000,000	$0	$2,208,000,000	-28%	+61%
2	All (except 5.1, 5.2 6.0)	$629,940,000	$1,066,000,000	$1,659,940,000	-1 %	+17%

VE STUDY SUMMARY REPORT ACCEPTED ALTERNATIVES *I-35E Managed Lanes Project*	**TxDOT**

Summary of Accepted VE Alternatives

VE Alt. #s	Initial Costs	Subsequent Costs	Total LCC (NPV) Costs	Change in Performance
TBD				

Comments

Cumulative Total of *Accepted* Savings

VE Alt. #s	Initial Costs Savings / Cost Increase	Subsequent Costs	Total LCC (NPV) Costs	Change in Performance	Change in Value

Comments

VE STUDY SUMMARY REPORT CONDITIONALLY ACCEPTED ALTERNATIVES *I-35E Managed Lanes Project*	**TxDOT**

Summary of *Conditionally Accepted* VE Alternatives

VE Alt. #s	Initial Costs	Subsequent Costs	Total LCC (NPV) Costs	Change in Performance
TBD				

VE Alt. #s	Initial Costs Savings (Cost Increase)	Subsequent Costs	Total LCC (NPV) Costs	Change in Performance	Change in Value

Comments

Follow-up actions for conditionally approved alternatives:

-

Comments:

VE ALTERNATIVES

INTRODUCTION

The results of this study are presented as individual alternatives to the original concept.

VE ALTERNATIVES

Each alternative consists of a summary of the original concept, a description of the suggested change, a cost comparison, change in performance, a listing of its advantages and disadvantages, and a brief narrative comparing the original design with the alternative. Sketches, calculations, and benefits are also presented.

Performance measures are calculated by rating on a scale 1 to 10, the overall project against each of the weighted criteria to arrive at a total score (rating times weight, and totals for all criteria added together). The difference between the score for the project with that VE alternative incorporated and the score for the project baseline concept, is expressed as a percentage.

The cost comparisons reflect the comparable level of detail as in the original estimate. A life cycle benefit-cost analysis for major alternatives is included where appropriate.

ALTERNATIVE SETS

VE sets are established by the VE team as their "best value" solution, based on improved performance, likelihood of implementation, improvements to the local and mainline operations, capacity improvements, cost savings, or any combination of criteria. A VE set may contain one or more alternatives and each set is typically mutually exclusive of other sets (i.e., implementing VE Set 1 precludes implementation of VE Set 2). VE sets are selected alternatives combined from mutually exclusive groups that can compete in whole or in part against the original design concept. This requires an additional performance rating and totaling of costs for the sets.

The VE team developed two sets of alternatives to illustrate potential combinations that may be chosen for implementation. The alternatives included in the sets are those deemed by the team to represent the best value when considering the impact of the alternatives on project performance.

SUMMARY OF VE ALTERNATIVES				TxDOT	
Alt. No.	**Description**	**Potential Savings**	**Potential Performance Improvement**	**Validated Cost Savings Initial**	**Validated Performance Improvement**
GENERAL/PHASING/TRAFFIC CONTROL					
1.0	Defer new frontage road construction (where feasible)	$179,918,000	-1%		
2.0	Defer 4th General Purpose Lane and Provide 12 ft. Outside Shoulder	$159,000,000	+1%		
3.0	Defer wishbones and use slip ramps instead (where applicable)	$76,872,000	-2%		
4.0	Early implementation of HOT lanes (convert existing HOV to HOT) – allowed under current legislation	$9,000,000	+3%		
5.1	Defer ROW acquisition and construction of northern part of Middle Segment and North Segment (defer Garden Ridge north)	$1,523 million	+4%		
5.2	Defer ROW acquisition and construction of northern part of Middle Segment and North Segment (defer Valley Ridge north)	$1,800 million	+6%		
6.0	Construct elevated Managed Lanes or Managed Lanes on outside, defer construction of General Purpose lanes	$408,000,000	-2%		
7.0	Interim Managed Lanes in the median south of US 77 to north of FM 2181 (Swisher Rd) – defer the ultimate construction	$18,546,400	+8%		
8.0	Optimize pavement design alternatives (baseline is perpetual – 48" for ramps, CD, GP, ML and 36" for frontage road)	Additional Initial Cost: ($82,619,000) O&M Savings: $665,000,000 Total LCC: $582,346,000	-4%		

SUMMARY OF VE ALTERNATIVES				TxDOT	
Alt. No.	**Description**	**Potential Savings**	**Potential Performance Improvement**	**Validated Cost Savings Initial**	**Validated Performance Improvement**
9.0	5-year maintenance contract post construction completion, 15-year CMA post construction completion	Deferred savings: $401million	+2%		
MIDDLE SEGMENT					
10.0	Revise wishbone design (instead of going over, go under)	30,000,000	+8%		
11.0	Combine GP and CD lanes (7 lanes total) between PGBT and SH121	$22,000,000	+0%		
12.0	Construct Corporate, FM 407, Country Lane/S Denton, Turbeville, over I-35E	$26,994,401	-2%		
13.0	Shorten Bridge (over water) length	$170,251,000	+8%		
14.0	Eliminate frontage roads over Lake	$179,416,000	-5%		
SOUTH SEGMENT					
15.0	Extend frontage road (auxiliary lanes) from ramp to ramp instead of ramp to cross street	$1,164,000	-8%		
NORTH SEGMENT					
16.0	Allow purchase ROW (by individual parcel or selected) but defer construction of North Segment	$846,297,000	-6%		
17.0	Flip the connection at US 77 with IH 35E at grade	$15,329,000	-1%		
18.0	Combine exit ramps from US 77 to IH 35E, relocate braided ramp to south	$1,378,000	-2%		
19.0	Push NB General Purpose lanes out at I-35W to eliminate one bridge	$3,270,000	-10%		

Note: Alts. 5.1 & 5.2 exclude all North Segment alternatives
Alts. 13.0 and 14.0 are mutually exclusive

SUMMARY OF VE DESIGN SUGGESTIONS	
Idea No.	**Description**
GENERAL/PHASING/TRAFFIC CONTROL	
P-9	Use rigid pavement
P-9a	Allow precast pavement options
P-10	Use alternative materials for bridges (fiber reinforced polymers)
P-11	Maximize use of standard spans on bridges (geometric adjustments)
P-18	Evaluate typical section to use more of existing profile (ML can have reverse cross slopes)
P-22	Eliminate barriers in sections where possible
P-26	Stagger gores to minimize structure/ROW
P-29	Lock developer into fixed price at earliest stage possible
P-31	Incentivize developer for accelerated delivery
P-32	Minimize green space between roadways (GPs and frontage road) – squeeze ROW
P-33	Sell naming rights for key structures and retaining walls
P-34	Incorporate themes into the aesthetics
P-36	Ask Oklahoma Casinos for contribution
P-40	Study linear need for sidewalks and add if warranted
P-41	Special enhancements to pedestrian/bicycle facilities near transit facilities
P-42	Eliminate free right turns at signalized intersections

SUMMARY OF VE DESIGN SUGGESTIONS	
Idea No.	**Description**
P-43	Provide protected refuge areas in median at crossings
P-44	14’ outside lanes or bike lanes (coordinate with local bike groups) exclusive of offset, curb and gutter
P-45	Seek funding from connecting facilities (635 and SH121 and PGBT)
P-47	Evaluate alternatives to drilled shaft walls/wall systems
P-48	Re-evaluate mobilization and traffic control percentages
P-49	Re-evaluate unit prices
P-50	Investigate incentives for low emission vehicles
P-52	Utilize more existing pavement
P-54	Review ROW, identify properties that could be saved
P-55	Sharing of costs for tolling with NTTA
P-56	Use movable barriers during construction to encourage ease of construction, safety, etc and to maximize lane flow
P-57	Use of movable barrier in terms of permanent ML applications
P-59	Optimize geometrics to reduce ROW acquisitions
P-60	Utilize more of existing pavement – bring to the center, convert to ML and add GP to the outside using existing shoulder
MIDDLE SEGMENT	
M-15	Reduce frontage road total lanes from 3 to 2 and/or 4 to 2
M-19	Access recreational area via old embankment off of Garden Ridge to eliminate new RR crossing

SUMMARY OF VE DESIGN SUGGESTIONS	
Idea No.	**Description**
M-20	Parking for recreation area could be under highway structure and route trail under existing roadway and rail bridges along shoreline
M-17	Sell naming rights to Lewisville Lake bridge
M-21	Reduce water crossing structures by working with COE to reduce floodway width and marsh areas/wetlands (streams)
SOUTH SEGMENT	
S-11	Find usage for water being pumped for example irrigation or water feature
S-14	Optimize connections to 635 MLs and 35E MLs to enhance revenue generation
NORTH SEGMENT	
N-9	Make cross streets come in at 90 degrees where possible
N-12	Confirm capacity and functionality of pedestrian bridge, make it expandable? Two smaller bridges?
N-14	Investigate ROW minimizing since traffic volumes are lower

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*	**TxDOT/TTA**	
FUNCTION: Access Freeway/Properties	**IDEA NO.** P-3	**ALTERNATIVE NO.** 1.0
TITLE: Defer new frontage road construction (where feasible)		**PAGE NO.** 1 of 7

ORIGINAL CONCEPT: (Attach sketch where appropriate)

The baseline assumes that new frontage roads will be constructed where none exist today. For example, this is the area across the Lake Lewisville.

ALTERNATIVE CONCEPT: (Attach sketch where appropriate)

This alternative concept assumes that new frontage road construction will be deferred to 2030 unless operations require a new frontage road to be constructed. This alternative assumes a frontage road will not be built across Lake Lewisville.

ADVANTAGES:

- Saves upfront cost (majority of bridges, most of the bridges over Lake Lewisville)
- Reduces maintenance costs
- Reduces columns in the flood storage area
- Uses of more of existing structure (bridge over lake)
- Defers impact to COE recreation area.

DISADVANTAGES:

- Affects access to COE recreation area. (Would change mitigation and access plan.)
- Limited application
- May increase cost to construct later
- Incident management flexibility is reduced.

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Net Present Value
Original Concept	$ 321,334,000	$ 0	$ 321,334,000
Alternative Concept	$ 141,416,000	$ 0	$ 141,416,000
Savings	$ 179,918,000	$ 0	$ 179,918,000

Team Member:	Spenta Irani, Charles Riou, Bill Reichert, Kim Daily	**Discipline:**	Design Design TTA Assistant	**PERFORMANCE:** **-1%**

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*	TxDOT/TTA	
TITLE: Defer new frontage road construction (where feasible)	**ALTERNATIVE NO.** 1.0 (P-3)	**PAGE NO** 2 of 7

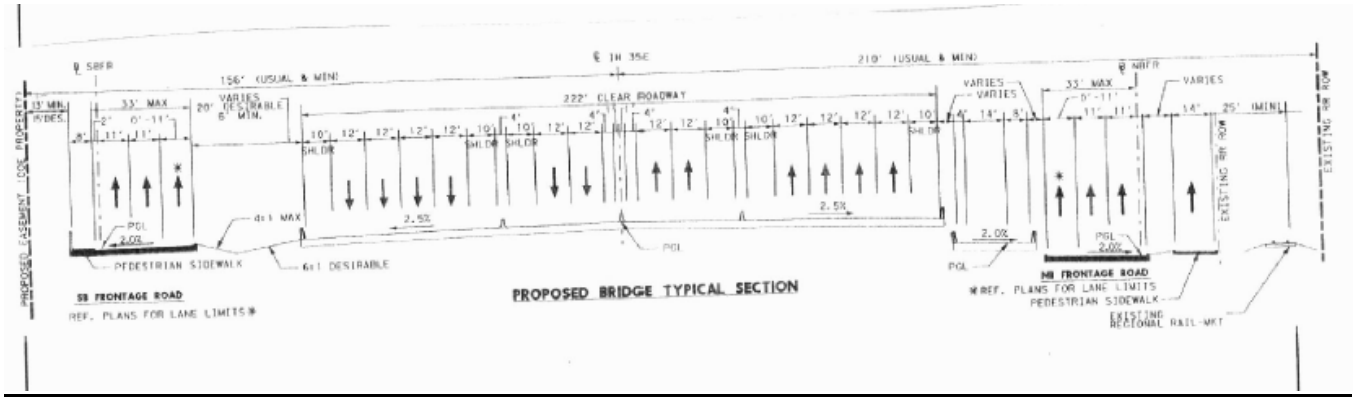
DISCUSSION / JUSTIFICATION:

By deferring construction of the frontage roads where feasible, the initial capital costs are reduced while the level of service on the GPs and MLs are not significantly impacted. The frontage road section being investigated, in the baseline case, provides frontage road continuity and a sidewalk for pedestrians.

The managed lanes could be used for incident management.

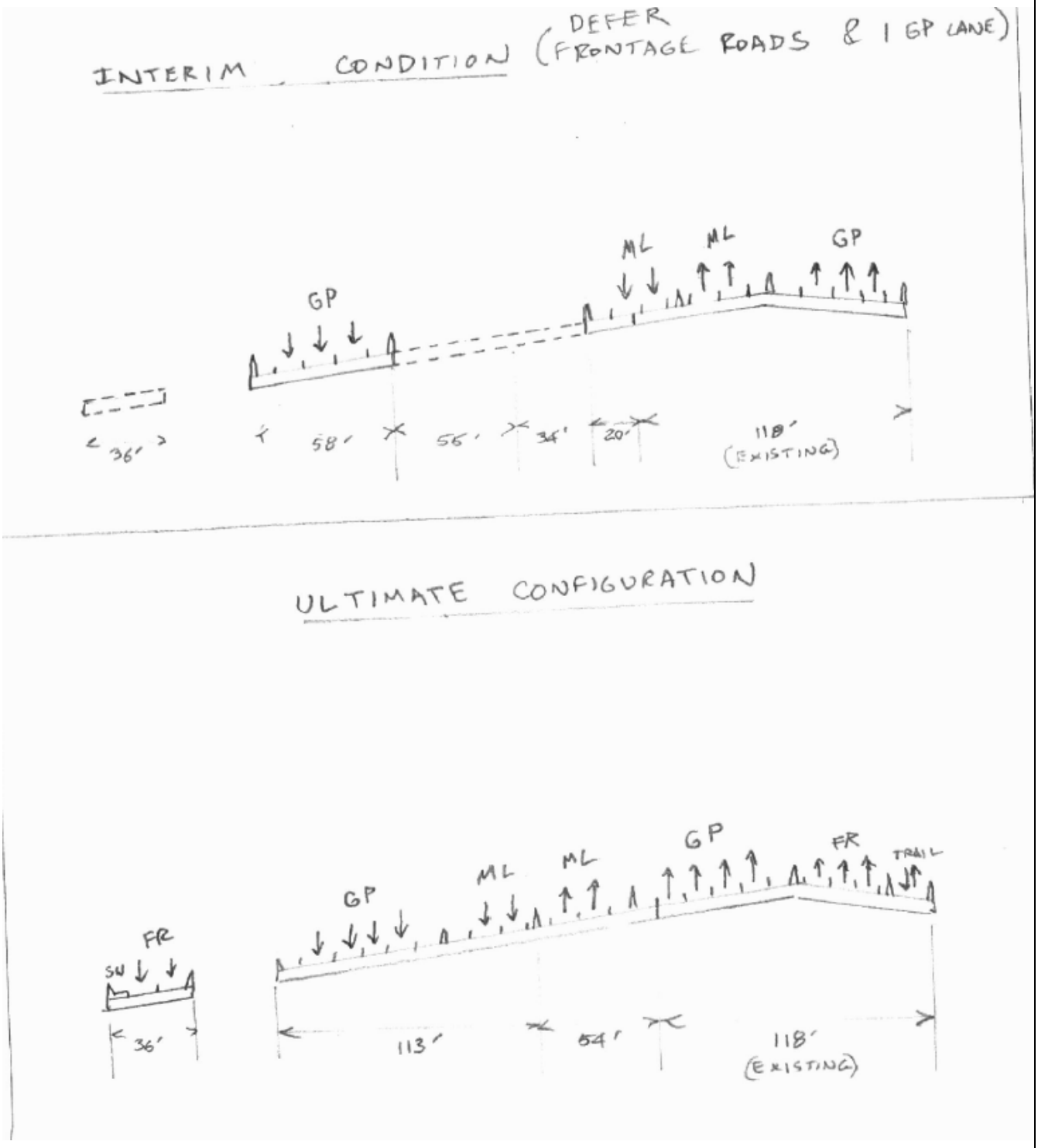
Because the quantity of bridges is being reduced, the cost of maintenance is reduced.

Original Design



PROPOSED BRIDGE TYPICAL SECTION

Proposed Alternative



PERFORMANCE *I-35E Managed Lanes Project*		TxDOT/TTA	
TITLE: Defer new frontage road construction (where feasible)		**NUMBER** 1.0 (P-3)	**PAGE NO.** 5 of 7
CRITERIA	**Performance**	**Original**	**Alternative**
REVENUE IMPACTS: Potential increase in revenue due to increased traffic at bridge (3 GP lanes).	Measure	Degree	Degree
	Rating	6	7
	Weight	18	18
	Contribution	108	126
TRAFFIC OPS - GENERAL PURPOSE LANES: Operational efficiency of GP lanes will be reduced because interim solution only provides to 3 GP lanes and a bottleneck is created at the bridge over Lake Lewisville.	Measure	Degree	Degree
	Rating	8	7
	Weight	17	17
	Contribution	136	119
TRAFFIC OPS - LOCAL: Operational efficiency of FR (local) lanes will be reduced because frontage roads over Lake Lewisville are deferred in the interim condition. Frontage roads will not be continuous.	Measure	Degree	Degree
	Rating	8	7
	Weight	12	12
	Contribution	96	84
RIGHT OF WAY IMPACTS: No apparent change.	Measure	Degree	Degree
	Rating	3	3
	Weight	10	10
	Contribution	30	30
ENVIRONMENTAL IMPACTS: Deferring impact on the lake while decreasing air quality due to additional congestion in interim condition.	Measure	Degree	Degree
	Rating	7	7
	Weight	14	14
	Contribution	98	98
STAKEHOLDER ACCEPTANCE: No impacts to stakeholder acceptance.	Measure	Degree	Degree
	Rating	7	7
	Weight	13	13
	Contribution	91	91
SCHEDULE IMPACT: Reduces time for construction.	Measure	Degree	Degree
	Rating	5	6
	Weight	6	6
	Contribution	30	36
	Measure	Degree	Degree
	Rating		
	Weight		
	Contribution	0	0
Total Performance:		589	584
Net Change in Performance (%):			-1%

Assuming can use the existing bridge over Lake Lewisville for some of the NB GP lanes and NB ML plus pedestrian walkway. (Interim condition will have 3 GP lanes (no pedestrian walkway) in each direction due to constructability of using the existing structure. The ultimate will accommodate pedestrians in the same manner as the baseline.)

Assume that COE recreation area mitigation will be deferred with deferral of FR.

Assume existing bridge has at least 20 years usable life left. (Assumed in baseline as well.)

INITIAL COSTS

I-35E Managed Lanes Project

TxDOT/TTA

TITLE: Defer new frontage road construction (where feasible)

NUMBER 1.0 (P-3)

CONSTRUCTION ELEMENT		ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
Description	**Unit**	**Quantity**	**Cost/Unit**	**Total**	**Quantity**	**Cost/Unit**	**Total**
Bridges (concrete over water) GP	SF	1,450,892	$110	$159,598,120	725,446	$110	$79,799,060
Bridges (concrete over water) FR	SF	304,360	$110	$33,479,600	0	$0	$0
Bridges (concrete over water) ML	SF	784,936	$110	$86,342,960	392,468	$110	$43,171,480
				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
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				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
Subtotal:				$279,420,680			$122,970,540
15% contigency:				$41,913,102			$18,445,581
TOTAL				$321,333,782			$141,416,121
						SAVINGS	$179,917,661

VE TEAM ALTERNATIVE REVIEW *I-35E Managed Lanes Project*	**TxDOT/TTA**
TITLE: Defer new frontage road construction (where feasible)	**NUMBER** 1.0 (P-3)

Team Member: Eva Chan

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

For interim condition, suggest to have 4 GP lanes at SB since space is sufficient

Team Member:

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member:

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member:

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member:

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member:

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*		TxDOT/TTA	
FUNCTION:	Reduce Upfront Construction Cost/Enhance Revenue	**IDEA NO.** P-5	**ALTERNATIVE NO.** 2.0
TITLE:	Defer 4th General Purpose Lane and Provide 12 ft. Outside Shoulder.		**PAGE NO.** 1 of 6

ORIGINAL CONCEPT: Construct four General Purpose (GP) lanes from north of IH 635 to US 77 (excluding the section between the PGBT and SH 121 interchanges) with 10-ft. shoulders.

ALTERNATIVE CONCEPT: Construct three GP lanes from north of IH 635 to US 77 with a 10-ft. inside shoulder and 12-ft. outside shoulder. The 12-ft. outside shoulder will ONLY be utilized as a traffic lane for peak periods when appropriate so as to not reduce Managed Lane (ML) revenue potential during off-peak periods.

ADVANTAGES:

- Reduces upfront construction costs
- Enhances revenue potential
- Provides flexibility for 4th lane capacity during peak periods by utilizing the outside shoulder (assuming FHWA concurrence).
- May increase deferral duration for 4th lane construction beyond other scenarios under evaluation because of the potential use of the 12 ft. as a travel lane during peak periods.

DISADVANTAGES:

- Impacts regional transportation plan and air quality plan
- More expensive to construct future 4th lane
- May reduce LOS and impact IAJR
- Ramp gore locations will be impacted which may impact IAJR
- Additional cost for signage/ITS
- Increased incident impacts during peak construction
- Potential political sensitivity if 4th lane not constructed as base project

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Net Present Value
Original Concept	**$** 159,000,000	**$** 0	**$** 159,000,000
Alternative Concept	**$** 0	**$** 0	**$** 0
Savings	**$** 159,000,000	**$** 0	**$** 159,000,000

Team Member:	Dan Chapman Michael Kerrigan Eva Chan	**Discipline:**	Civil Engineer Civil Engineer Civil Engineer	**PERFORMANCE:**	**+1%**

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*		TxDOT/TTA	
TITLE:	Defer 4th General Purpose Lane and Provide 12 ft. Outside Shoulder.	**ALTERNATIVE NO.** 2.0 (P-5)	**PAGE NO** 2 of 6

DISCUSSION / JUSTIFICATION:

Alternatives to defer 4th lane construction for the south and middle segments to 2030 and 2040 have already been evaluated during cost savings and revenue enhancement efforts performed after the level 2 traffic and toll revenue study. This effort showed that managed lane toll revenue could increase by not implementing the 4th lane. Cost savings for these alternatives were estimated at approximately $17 and $45 million respectively for the south and middle segments. These cost savings assumed retaining walls and bridge structures were unchanged from the base project but did reduce excavation and embankment quantities as well as other incidental quantities which were not included in this analysis.

The objective of this alternative is to further reduce upfront construction costs by eliminating the outside 10 foot of the general purpose lane bridge structures. The paving limits will be reduced by 10 ft. so that a 12 ft. wide outside shoulder is initially constructed to facilitate future utilization as a traffic lane during peak periods. The objective of providing this flexibility is to potentially delay construction of the 4th lane beyond the 2030 or 2040 scenarios already evaluated and to potentially further enhance managed lane revenue.

Delaying the 4th lane would be accomplished by eliminating either the 10 ft. wide inside or outside shoulder for the general purpose lanes included in the base project. Eliminating the inside shoulder would provide flexibility for potentially constructing a future 3rd managed lane in lieu of a 4th general purpose lane. The inside shoulder would only have to accommodate 7 slip ramp connections for the interim condition while the outside shoulder would have to accommodate 76 ramp connections. However, with the objective of further reducing upfront construction cost by reducing the general purpose bridge width initially constructed, the inside shoulder is unlikely a viable alternative. A bridge rail on the inside shoulder would be required for the interim condition. This would reduce the bridge width savings from 10 ft. to 9 ft. Leaving a 9 ft. wide gap between the managed lane bridge deck and general purpose lane bridge deck to be completed in the future is simply impracticable. The gap between the managed lanes and general purpose lanes would likely have a significant impact on traffic control.

Consequently, the alternative developed for this analysis assumes the base project outside 10 ft. shoulder is eliminated and the 4th outside general purpose lane becomes a 12 ft. wide outside shoulder. The outside shoulder accommodates an 11 ft. wide travel lane (which would require FHWA approval) with a one foot offset to edge of pavement and bridge rail for peak period operation as appropriate.

PERFORMANCE *I-35E Managed Lanes Project*	**TxDOT/TTA**		
TITLE: Defer 4th General Purpose Lane and Provide 12 ft. Outside Shoulder	**NUMBER** 2.0 (P-5)		**PAGE NO.** 3 of 6
CRITERIA	**Performance**	**Original**	**Alternative**
REVENUE IMPACTS: Based on T&R studies, deferring the 4th lane increases revenue potential. Assume adding a third ML in lieu of a 4th GP lane represents maximum potential so a value between based project and maximum is selected.	Measure	Degree	Degree
	Rating	6	8
	Weight	18	18
	Contribution	108	144
TRAFFIC OPS - GENERAL PURPOSE LANES: 4th lane capacity is provided for peak hour periods by utilizing the 12 ft. GP outside shoulder. This will not perform as efficiently as the full 4-lane section	Measure	Degree	Degree
	Rating	8	7
	Weight	17	17
	Contribution	136	119
TRAFFIC OPS - LOCAL: Assume no change from base project	Measure	Degree	Degree
	Rating	8	8
	Weight	12	12
	Contribution	96	96
RIGHT OF WAY IMPACTS: No change from base project	Measure	Degree	Degree
	Rating	3	3
	Weight	10	10
	Contribution	30	30
ENVIRONMENTAL IMPACTS: Congestion on GP lanes likely to increase which potentially impacts air quality.	Measure	Degree	Degree
	Rating	7	6
	Weight	14	14
	Contribution	98	84
STAKEHOLDER ACCEPTANCE: Some stakeholders may be sensitive to deferring the 4th lane shown in the original approved schematic; however, some may favor this concept to allow delivery of a project	Measure	Degree	Degree
	Rating	7	7
	Weight	13	13
	Contribution	91	91
SCHEDULE IMPACT: Assume no change from base project	Measure	Degree	Degree
	Rating	5	5
	Weight	6	6
	Contribution	30	30
	Measure	Degree	Degree
	Rating		
	Weight		
	Contribution	0	0
Total Performance:		589	594
Net Change in Performance (%):			1%

CALCULATIONS/ASSUMPTIONS *I-35E Managed Lanes Project*		TxDOT/TTA
TITLE: Defer 4th General Purpose Lane and Provide 12 ft. Outside Shoulder.	**NUMBER** 2.0 (P-5)	**PAGE NO.** 4 of 6

Assumptions:

- Retaining walls and excavation quantities are unchanged from the base project (embankment, top soil and seeding are increased to account for reduced general purpose lane paving section.
- Frontage road and ROW limits are unchanged from base project.
- Drainage structures and systems are not appreciably impacted.
- 400 ft. of general purpose pavement assumed to facilitate each ramp connection between frontage road and general purpose lanes.
- Additional embankment, signing, prime coat, and additional bridge approach guard rail are included in contingency. Reduction in pavement marking is not included to offset above.
- Do not include bridge over Lake Lewisville in bridge reduction calculation because of the need for storm water filtering and because the frontage road bridge deck is adjacent to general purpose lane bridge deck. Reconsider this assumption if frontage roads are eliminated from Lake Lewisville crossing.

Calculations:

- From attached Bridge_Paving spreadsheet, length of paving is 216,770 LF, length of bridge is 28,538 LF
- Reduction in paving length for ramp connections = 400 LF x 76 = 30,400 LF
- Total area of Pavement eliminated = ((216,770 – 30,400) x 10 LF)/9 = 207,078 SY
  - CEMENT TRT(34") (General Purpose) = 207,078 x 1.05 = 217,432 SY
  - CEMENT (General Purpose) = ((217,432 x 9 x 120 x 34/12)/2000) x .03 = 9,980 TONS
  - BASE COURSE (6.5") (SP-B) (General Purpose) = (6.5 x 110 x 207,078)/2000 = 74,030 TONS
  - BASE COURSE (4") (SP-D) (Gen Purpose) = (4 x 110 x 207,078)/2000 = 45,557 TONS
  - SURFACE COURSE (1.5") (PFC) (Gen Purpose) = (1.5 x 95 x 207,078)/2000 = 14,754 TONS
  - SURFACE COURSE (2") (SMA-D) (Gen Purpose) = (2 x 110 x 207,078)/2000 = 22,779 TONS
- Total area of Bridge Deck eliminated = 28,538 LF x 10 LF = 285,380 SF
- Earthwork Quantities (Reduces savings):
  - COMPOST MANUF TOPSOIL (BOS)(4") = (207,078 SY)
  - BROADCAST SEED (PERM) (URBAN) (CLAY) = (207,078 SY)
- Estimated present value increase in manage lane revenue realized by deferring the 4th lane construction to 2030 based on the Level 2 T&R study is $119 million.

INITIAL COSTS

I-35 Managed Lanes Project

TxDOT/TTA

TITLE: Defer 4th General Purpose Lane and Provide 12 ft. Outside Shoulder

NUMBER 2.0 (P-5)

PAGE NO. 5 of 6

CONSTRUCTION ELEMENT		ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
Description	**Unit**	**Quantity**	**Cost/Unit**	**Total**	**Quantity**	**Cost/Unit**	**Total**
COMPOST MANUF TOPSOIL (BOS)(4")	SY			$0	207,078	$1.00	$207,078
BROADCAST SEED (PERM) (URBAN) (CLAY)	SY			$0	207,078	$0.50	$103,539
CEMENT (General Purpose)	TON			$0	(9,980)	$115.00	($1,147,700)
CEMENT TRT(34") (General Purpose)	SY			$0	(217,432)	$11.00	($2,391,752)
BASE COURSE (6.5") (SP-B) (General Purpose)	TON			$0	(74,030)	$79.00	($5,848,370)
BASE COURSE (4") (SP-D) (Gen Purpose)	TON			$0	(45,557)	$90.00	($4,100,130)
SURFACE COURSE (1.5") (PFC) (Gen Purpose)	TON			$0	(14,754)	$68.00	($1,003,272)
SURFACE COURSE (2") (SMA-D) (Gen Purpose)	TON			$0	(22,779)	$97.00	($2,209,563)
BRIDGES (CONCRETE) (General Purpose)	SF			$0	(285,380)	$50.00	($14,269,000)
				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
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				$0			$0
				$0			$0
				$0			$0
				$0			$0
Subtotal:				$0			($30,659,170)
15% contigency:				$0			($4,598,876)
ENGINEERING COSTS (6% PS&E, 4% QA/QC, 2.5% IE)				$0			($4,407,256)
INCREASED MANAGED LANE TOLL REVENUE				$0			($119,000,000)
TOTAL						**SAVINGS**	$158,665,301

BRIDGE/PAVING LIMITS *I-35 Managed Lanes Project*					TxDOT/TTA	
TITLE: Defer 4th General Purpose Lane and Provide 12 ft. Outside Shoulder					**NUMBER** 2.0 (P-5)	**PAGE NO.** 6 of 6
BEGIN PAVING (SAT)	**BEGIN BRIDGE (STA)**	**LENGTH OF PAVEMENT (FT)**	**LENGTH OF BRIDGE (FT)**			
			LENGTH	**OVER WATER?**	**NON-WATER**	**WATER**
63000		95				
	63095		360		360	
63455		5467				
	68922		320		320	
69242		3010				
	72252		162		162	
72414		1633				
	74047		2,070		2070	
76117		4975				
	81092		325		325	
81417		5215				
	86632		301		301	
86933		5300				
	92233		358		358	
92591		1396				
	93987		520		520	
94507		35				
	94542		1,181		1181	
95723		669				
	96392		569		569	
96961		7671				
	104632		344		344	
104976		1292				
	106268		635		635	
106903		1049				
	107952		334		334	
108286		4843				
	113129		595		595	
113724		9425				
	123149		800		800	
123949		6857				
	130806		397		397	
131203		4896				
	136099		9,101	Y		9101
145200		1315				
	146515		378		378	
146893		3693				
	150586		242		242	
150828		2694				
	153522		533		533	
154055		6505				
	160560		440		440	
161000		2605				
	163605		345		345	
163950		11845				
	175795		380		380	
176175		3455				
	179630		220		220	
179850		3275				
	183125		345		345	
183470		1611				
	185081		1,380		1380	
186461		2369				
	188830		350		350	
189180						
E/IH 35W Interchange to US 380						
205525		5190				
	210715		385		385	
211100						
TOTALS:		**108385**	**23370**		**14269**	**9101**
x 2 (NB & SB):		**216770.00**			**28538.00**	

VE TEAM ALTERNATIVE REVIEW *I-35E Managed Lanes Project*	**TxDOT/TTA**
TITLE: Defer 4th General Purpose Lane and Provide 12 ft. Outside Shoulder.	**NUMBER** 2.0 (P-5)

Team Member: Bill Reichert

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Charles Riue

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

See pages 1, 2, 3 *(comments incorporated)*

Team Member: Michael Drayton

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

Include T&R impact of delaying 4th GP lane until 2030 if possible

Team Member: Jeremy McGahan

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Michael Kerrigan

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Doug Bowen

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

May not have sufficient space on shoulder in case of breakdown

VE TEAM ALTERNATIVE REVIEW *I-35E Managed Lanes Project*	**TxDOT/TTA**
TITLE: Defer 4th General Purpose Lane and Provide 12 ft. Outside Shoulder.	**NUMBER** 2.0 (P-5)

Team Member: Kim Daily

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Spenta Irani

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

There would be major ITS elements and cost involved in utilizing the ML shoulder as a lane during peak hours.

Team Member: Xiaojin (Jerry) Ji

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

Consider adding some additional operational costs for the hard shoulder as travel lane.

Team Member:

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member:

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member:

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*		**TxDOT/TTA**
FUNCTION: General/Phasing/Traffic Control	**IDEA NO.** P-7	**ALTERNATIVE NO.** 3.0
TITLE: Defer wishbones and use slip ramps instead (where applicable)		**PAGE NO.** 1 of 7

ORIGINAL CONCEPT: (Attach sketch where appropriate)

The baseline assumes that in certain places, wishbone ramps are used to carry traffic from the managed lanes to cross streets and vice versa instead of forcing managed lane traffic out of the managed lanes to cross over the GP lanes to access cross streets and exits.

ALTERNATIVE CONCEPT: (Attach sketch where appropriate)

This alternative concept assumes that access to cross streets and exits is available to managed lane traffic via slip ramps out of the managed lanes into the general purpose lane exits.

ADVANTAGES:

- Reduces upfront costs
- Simplifies construction and traffic control
- ML access flexibility
- Slip ramp allows for widening of MLs in the future

DISADVANTAGES:

- May be more to construct later
- Reduces future flexibility
- IAJR impacted
- Makes ML less attractive to users depending on location
- Adds to weaving across GP lanes

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Net Present Value
Original Concept	**$** 80,500,000	**$** 0	**$** 80,500,000
Alternative Concept	**$** 3,6287,000	**$** 0	**$** 3,6287,000
Savings	**$** 76,873,000	**$** 0	**$** 76,873,000

Team Member:	Spenta Irani, Charles Riou, Bill Reichert Kim Daily	**Discipline:**	Design Design TTA Assistant	**PERFORMANCE:**	**-2%**

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*		TxDOT/TTA	
TITLE:	Defer wishbones and use slip ramps instead (where applicable)	**ALTERNATIVE NO.** 3.0 (P-7)	**PAGE NO** 2 of 7

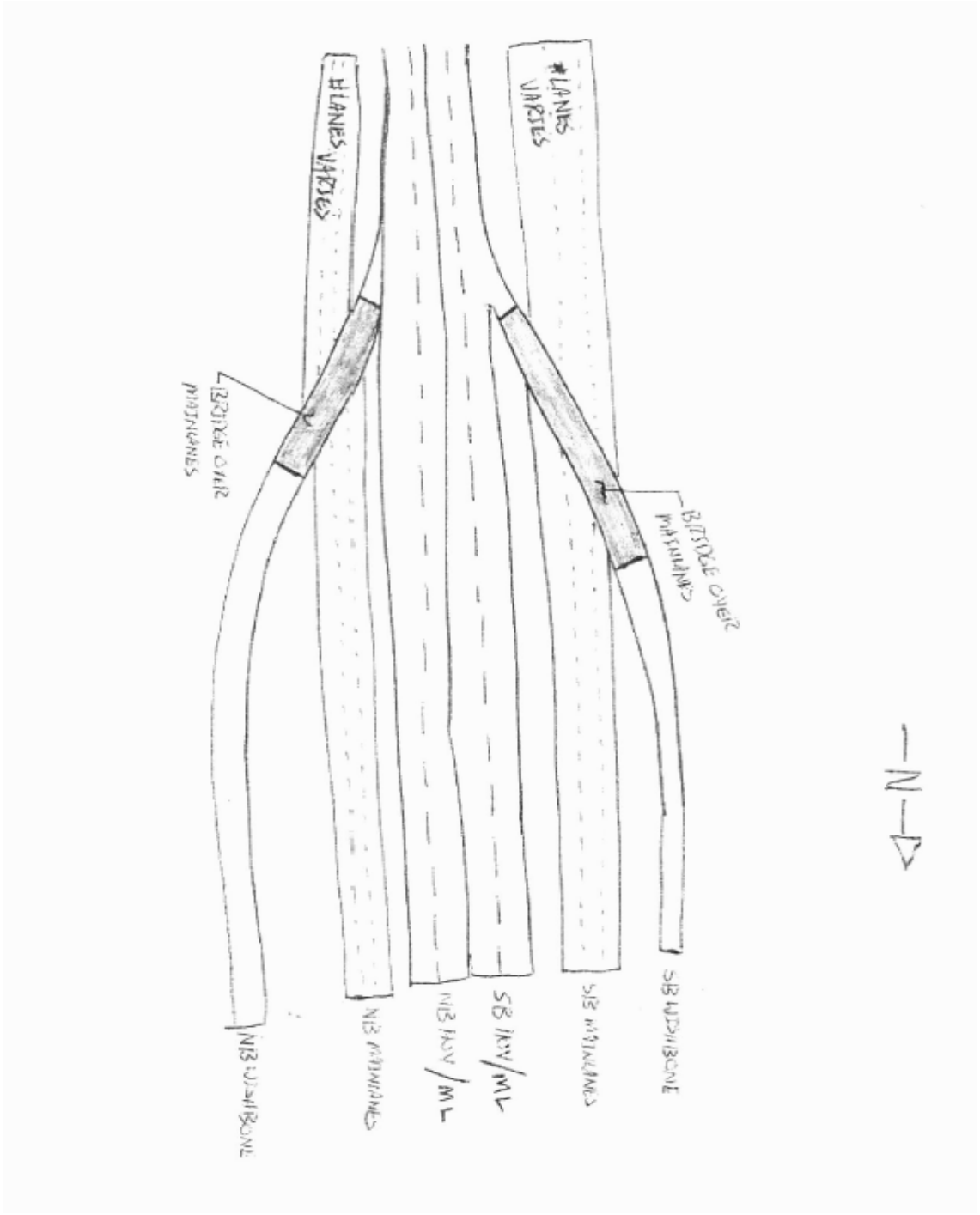
DISCUSSION / JUSTIFICATION:

One of the most expensive elements of the project is the construction of wishbones ramps which are also complicated to build over active traffic.

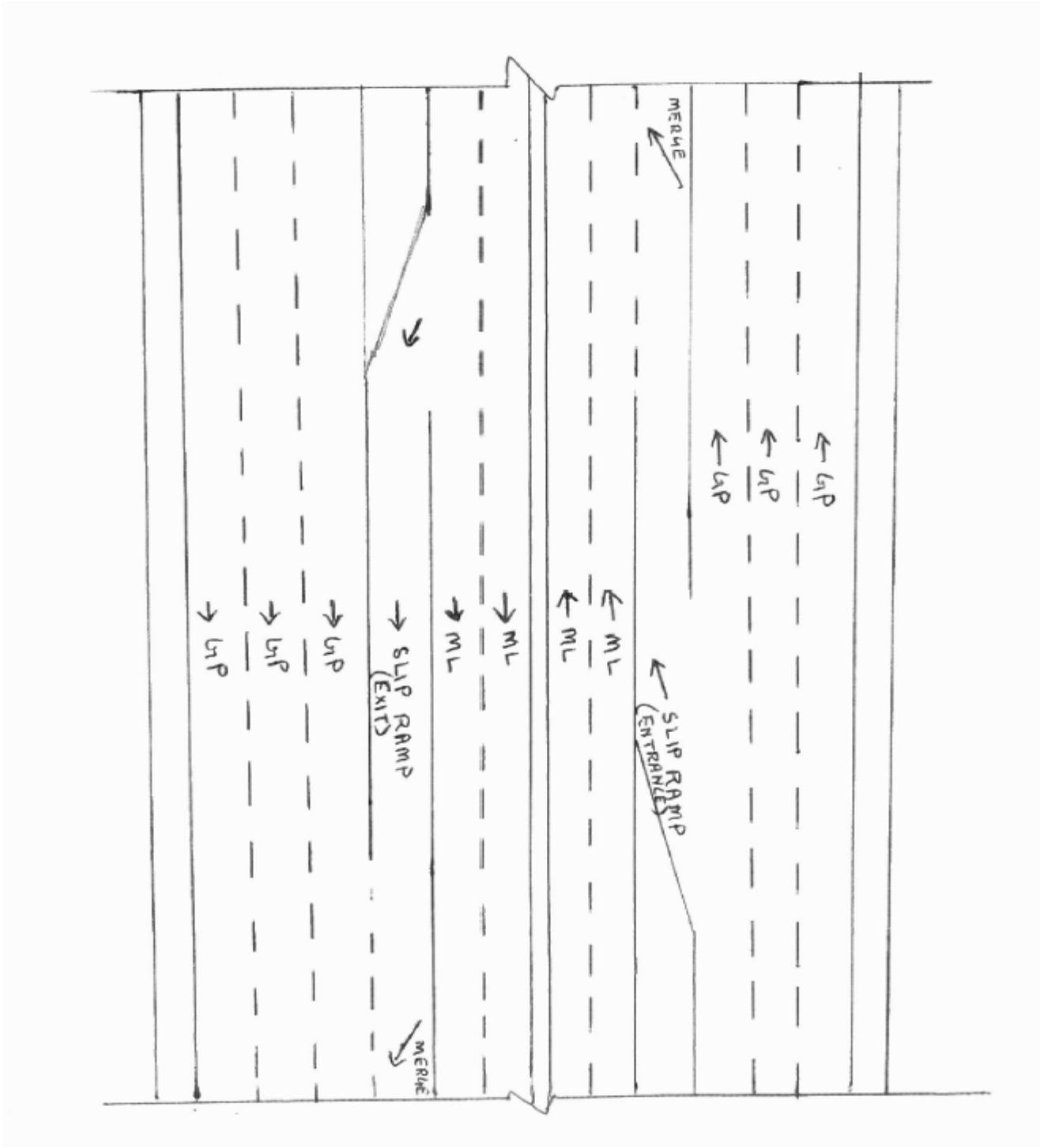
Wishbones do not allow flexibility for future access to ML. Slip ramps would allow future widening of the MLs.

Reduction in cost is a benefit.

Original Design



Proposed Alternative



PERFORMANCE *I-35E Managed Lanes Project*		**TxDOT/TTA**	
TITLE: Defer wishbones and use slip ramps instead (where applicable)		**NUMBER** 3.0 (P-7)	**PAGE NO.** 5 of 7
CRITERIA	**Performance**	**Original**	**Alternative**
REVENUE IMPACTS: Negligable.	Measure	Degree	Degree
	Rating	6	6
	Weight	18	18
	Contribution	108	108
TRAFFIC OPS - GENERAL PURPOSE LANES: Increases weaving on GP lanes but allows more access to/from ML. Allows better incident management. The barrier between GP and ML is more porous.	Measure	Degree	Degree
	Rating	8	7
	Weight	17	17
	Contribution	136	119
TRAFFIC OPS - LOCAL: Improves local circulation because direct access is not allowed. ML are not a local circulation issue.	Measure	Degree	Degree
	Rating	8	8
	Weight	12	12
	Contribution	96	96
RIGHT OF WAY IMPACTS: Not applicable.	Measure	Degree	Degree
	Rating	3	3
	Weight	10	10
	Contribution	30	30
ENVIRONMENTAL IMPACTS: Slight decrease in noise is offset by slight degradation of air quality.	Measure	Degree	Degree
	Rating	7	7
	Weight	14	14
	Contribution	98	98
STAKEHOLDER ACCEPTANCE: Not applicable.	Measure	Degree	Degree
	Rating	7	7
	Weight	13	13
	Contribution	91	91
SCHEDULE IMPACT: Easier to construct.	Measure	Degree	Degree
	Rating	5	6
	Weight	6	6
	Contribution	30	36
	Measure	Degree	Degree
	Rating		
	Weight		
	Contribution	0	0
Total Performance:		589	578
Net Change in Performance (%):			-2%

CALCULATIONS/ASSUMPTIONS *I-35E Managed Lanes Project*		TxDOT/TTA
TITLE: Defer wishbones and use slip ramps instead (where applicable)	**NUMBER** 3.0 (P-7)	**PAGE NO.** 6 of 7

Assumes that all wishbone locations can be changed to a slip ramp.

Assumes that space required for baseline wishbones allows space for slip ramps.

Assume cost for wishbone ramp based on designer calcs, same cost number used in VE Alt 10.0 (M-10).

Assumed 1000’ is sufficient for slip ramp.

Assume minimal revenue impacts.

INITIAL COSTS

I-35E Managed Lanes Project

TxDOT/TTA

TITLE: Defer wishbones and use slip ramps instead (where feasible)

NUMBER 3.0 (P-7)

CONSTRUCTION ELEMENT		**ORIGINAL CONCEPT**			**ALTERNATIVE CONCEPT**		
Description	**Unit**	**Quantity**	**Cost/Unit**	**Total**	**Quantity**	**Cost/Unit**	**Total**
Wishbone (one side)	each	14	$5,000,000	$70,000,000			$0
Slip ramps	each			$0	14	$225,333	$3,154,667
				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
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				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
Subtotal:				$70,000,000			$3,154,667
15% contigency:				$10,500,000			$473,200
TOTAL				$80,500,000			$3,627,867
						SAVINGS	$76,872,133

VE TEAM ALTERNATIVE REVIEW *I-35E Managed Lanes Project*	**TxDOT/TTA**
TITLE: Defer wishbones and use slip ramps instead (where applicable)	**NUMBER** 3.0 (P-7)

Team Member: Michael Kerrigan

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

Should indicate merge distance on drawing

Team Member:

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

Please explain why the unit cost per wishbone is $5m

Team Member: Phil Ullman

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Lucio Vasguez

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

The # of lanes do not add up. Verify.

Team Member: Mark Taylor

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

Disadvantage: uses shoulder between ML & GP for slip ramp. This may cause additional congestion on GP lanes.

Team Member: Doug Bowen

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*		TxDOT/TTA	
FUNCTION:	Early Revenue Generation	**IDEA NO.** P12/S12	**ALTERNATIVE NO.** 4.0
TITLE:	Early implementation of HOT lanes (convert existing HOV to HOT) for section between IH635 and SH121 – allowed under current legislation		**PAGE NO.** 1 of 5

ORIGINAL CONCEPT: (Attach sketch where appropriate)

Completion of Managed Lanes (HOT lanes) for the full project scope and commencement of toll revenue collection by 2017.

ALTERNATIVE CONCEPT: (Attach sketch where appropriate)

Convert the existing HOV lane to a HOT lane in each direction for the section between IH635 and SH121 (about 7 miles) and collect toll revenue before the completion of the full project scope in 2017. The HOT lanes will be operated for 6 years (between 2011 and 2016).

ADVANTAGES:

- Early revenue generation
- Relief congestion during peak hour (before project completion)
- Make good use of road space (currently the HOV lane is under utilized)
- Easy to implement
- Could be very marketable during construction

DISADVANTAGES:

- Difficult enforcement because no concrete barriers can be placed (due to space constraints)
- Duplicate toll equipment installation costs
- Creates constructability issues when ultimate construction begins
- Weaving problems from IH635 to SH121

COST SUMMARY	Initial Cost	Present Value for subsequent operation cost ("-"for income)	Net Present Value
Original Concept	**$** 17m	**$** 0m	**$** 17m
Alternative Concept	**$** 17m	**$** -9m	**$** 8m
Savings	**$** 0m	**$** 9m	**$** 9m

Team Member:	Michael Kerrigan Eva Chan Dan Chapman	**Discipline:**	Civil Engineer Civil Engineer Civil Engineer	**PERFORMANCE:**	**+3%**

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*		TxDOT/TTA	
TITLE:	Early implementation of HOT lanes (convert existing HOV to HOT) for section between IH635 and SH121 – allowed under current legislation	**ALTERNATIVE NO.** 4.0 (P-12/S-12)	**PAGE NO** 2 of 5

DISCUSSION / JUSTIFICATION:

Early implementation of HOT lanes helps to generate early revenue to support construction of the full project. The current HOV lane is under-utilized during the peak hours. Converting the HOV lanes to HOT lanes will relieve traffic congestion and generate revenue before completion of construction of the full project scope.

PERFORMANCE *I-35E Managed Lanes Project*		**TxDOT/TTA**	
TITLE: Early implementation of HOT lanes (convert existing HOV to HOT) for section between IH635 and SH121 – allowed under current legislation		**NUMBER** 4.0 (P-12)	**PAGE NO.** 3 of 5
CRITERIA	**Performance**	**Original**	**Alternative**
REVENUE IMPACTS: Generate toll revenue prior to new road opening	Measure	Degree	Degree
	Rating	6	7
	Weight	18	18
	Contribution	108	126
TRAFFIC OPS - GENERAL PURPOSE LANES: Reduce congestion during peak hour	Measure	Degree	Degree
	Rating	8	8
	Weight	17	17
	Contribution	136	136
TRAFFIC OPS - LOCAL: No effect	Measure	Degree	Degree
	Rating	8	8
	Weight	12	12
	Contribution	96	96
RIGHT OF WAY IMPACTS: No effect	Measure	Degree	Degree
	Rating	3	3
	Weight	10	10
	Contribution	30	30
ENVIRONMENTAL IMPACTS: No effect	Measure	Degree	Degree
	Rating	7	7
	Weight	14	14
	Contribution	98	98
STAKEHOLDER ACCEPTANCE: No effect	Measure	Degree	Degree
	Rating	7	7
	Weight	13	13
	Contribution	91	91
SCHEDULE IMPACT: No effect	Measure	Degree	Degree
	Rating	5	5
	Weight	6	6
	Contribution	30	30
	Measure	Degree	Degree
	Rating		
	Weight		
	Contribution	0	0
Total Performance:		589	607
Net Change in Performance (%):			3%

Cost Assumptions:

- Annual toll operation cost- $2.2m
- Total toll operation cost for 6 years = 6* 2.2m = $13.2m
- Since toll equipment will only be used for 6 years, the maintenance cost (especially Capex) is assumed to be minimal
- Total HOT lane operating cost for 6 years = $13.2m
- It is assumed that the Capital cost of the Toll Collection Equipment ($17m) is cancelled out in this calculation as it will form part of the baseline construction cost and is therefore carried in to the full scope project cost.

Revenue Assumptions:

- Revenue income for HOT lane operation between 2011 and 2016 is estimated to be $22.2m.

Year	HOT lane revenue ($m)
2011	2.8
2012	3.3
2013	3.8
2014	4.0
2015	4.1
2016	4.3
Total	22.2

- In 2010 $, early implementation of the HOT lanes contributes a surplus of $22.2m - $13.2m = $9m

INITIAL COSTS

I-35 Managed Lanes Project

TxDOT/TTA

TITLE: Early implementation of HOT lanes (convert existing HOV to HOT) for section between IH635 and SH121 – allowed under current legislation

NUMBER 4.0 (P-12)

PAGE NO. 5 of 5

CONSTRUCTION ELEMENT		ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
Description	**Unit**	**Quantity**	**Cost/Unit**	**Total**	**Quantity**	**Cost/Unit**	**Total**
Toll Equipment	Mile	7	$2,000,000	$14,000,000	7	$2,000,000	$14,000,000
Traffic signs for HOT lanes	Ea	1	$800,000	$800,000	1	$800,000	$800,000
				$0			$0
				$0			$0
				$0			$0
				$0			$0
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				$0			$0
				$0			$0
				$0			$0
Subtotal:				$14,800,000			$14,800,000
15% contigency:				$2,220,000			$2,220,000
TOTAL				$17,020,000			$17,020,000
						SAVINGS	$0

VE TEAM ALTERNATIVE REVIEW *I-35E Managed Lanes Project*	**TxDOT/TTA**
TITLE: Early Implementation of HOT lanes	**NUMBER** 4.0 (P-12/S-12)

Team Member: Michael Drayton

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Charles Riou

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

Sketches?

Team Member: Lucio Vasguez

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

There has to be some amount of construction cost to have the ML in operation.

Team Member: Phil Ullman

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Mark Taylor

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

Disadvantage: May be viewed negatively by anti-toll segment of the public

Team Member: Doug Bowen

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*		**TxDOT/TTA**	
FUNCTION:	Defer construction and ROW acquisition	**IDEA NO.** P-13	**ALTERNATIVE NO.** 5.1
TITLE:	Defer ROW acquisition and construction of northern part of middle section and north section (defer Garden Ridge North)		**PAGE NO.** 1 of 7

ORIGINAL CONCEPT: (Attach sketch where appropriate)

Acquire ROW at the start of construction of the project and build the project to full scope (i.e. 28 miles)

ALTERNATIVE CONCEPT: (Attach sketch where appropriate)

Only construct the project from the South up to Garden Ridge Blvd in the Middle segment (south of the lake, STA 1360+00) and acquire the corresponding ROW in order to save upfront construction costs. Defer ROW acquisition and road construction North of Garden Ridge Blvd (North segment + north of Middle segment) to year 2040.

ADVANTAGES:

- Reduces upfront cost significantly
- Defers cost of mitigation to COE property
- Defers maintenance costs
- Moves towards a more financially viable project

DISADVANTAGES:

- Creates hardship for current owners (urban blight)
- May cost more later to acquire ROW and to construct
- Doesn't help reduce today's congestion
- reduces revenue for middle section
- Unable to relocate utilities
- Defers development in north along corridor
- Reduces LOS north of Lake
- Reduces alternate routes for incident management

COST SUMMARY	Initial Cost	Present Value of Toll Revenue (-ve as income)	Net Present Value
Original Concept	**$** 4,003 million	**$** -764 million	**$** 3,239 million
Alternative Concept	**$** 2,151 million	**$** -435 million	**$** 1,716 million
Savings	**$** 1,852 million	**$** - 329 million	**$** 1,523 million

Team Member:	Michael Kerrigan Eva Chan Dan Chapman	**Discipline:**	Civil Engineer Civil Engineer Civil Engineer	**PERFORMANCE:** **+4%**

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*		TxDOT/TTA	
TITLE:	Defer ROW acquisition and construction of northern part of middle section and north section (defer Garden Ridge Blvd North)	**ALTERNATIVE NO.** 5.1 (P-13-1)	**PAGE NO** 2 of 7

DISCUSSION / JUSTIFICATION:

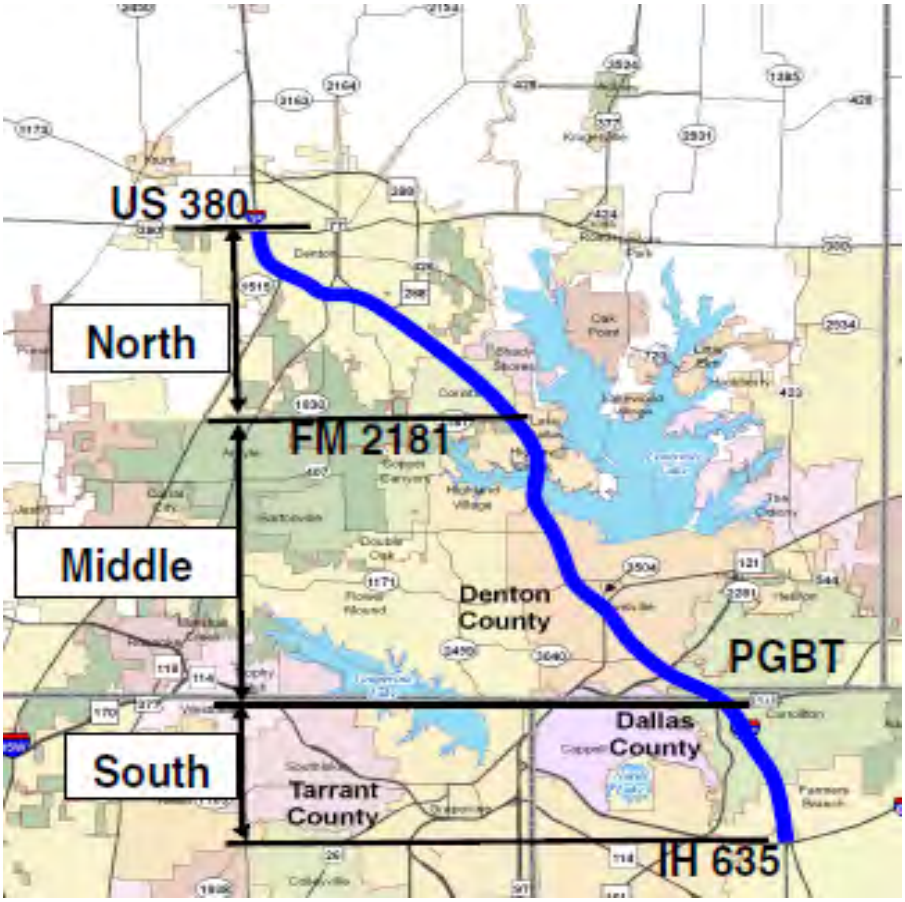
To reduce the scope to be in line with funding available today, including potential revenue generated by traffic. When extra funding is available, the remaining part of the Middle segment and all of the North section will be developed in 2040.

This alternative will potentially make a more financially viable project to begin construction in 2011.

SKETCHES *I-35E Managed Lanes Project*		TxDOT/TTA	
TITLE:	Defer ROW acquisition and construction of northern part of middle section and north section (defer Garden Ridge North)	**NUMBER** 5.1 (P-13-1)	**PAGE NO.** 3 of 7

Original Design

Construction of complete project (28 miles)



Proposed Alternative

Only acquire ROW and construction of the project up to Garden Ridge Blvd (14 miles)

PERFORMANCE *I-35E Managed Lanes Project*		**TxDOT/TTA**	
TITLE: Defer ROW acquisition and construction of northern part of middle section and north section (defer Garden Ridge North)		**NUMBER** 5.1 (P-13)	**PAGE NO.** 5 of 7
CRITERIA	**Performance**	**Original**	**Alternative**
REVENUE IMPACTS: There will be $145m reduction in revenue if the construction defer to 2040	Measure	Degree	Degree
	Rating	6	5
	Weight	18	18
	Contribution	108	90
TRAFFIC OPS - GENERAL PURPOSE LANES: Due to the deferral, congestion at north and middel segment will not be resolved in 2016	Measure	Degree	Degree
	Rating	8	7
	Weight	17	17
	Contribution	136	119
TRAFFIC OPS - LOCAL: Due to the deferral, congestion at north and middel segment will not be resolved in 2016	Measure	Degree	Degree
	Rating	8	7
	Weight	12	12
	Contribution	96	84
RIGHT OF WAY IMPACTS: Less ROW impact due to deferral	Measure	Degree	Degree
	Rating	3	6
	Weight	10	10
	Contribution	30	60
ENVIRONMENTAL IMPACTS: No change (increase in congestion, decrease in environmental impacts for construction)	Measure	Degree	Degree
	Rating	7	7
	Weight	14	14
	Contribution	98	98
STAKEHOLDER ACCEPTANCE: Towards a more feasible project	Measure	Degree	Degree
	Rating	7	9
	Weight	13	13
	Contribution	91	117
SCHEDULE IMPACT: Earlier project completion	Measure	Degree	Degree
	Rating	5	7
	Weight	6	6
	Contribution	30	42
	Measure	Degree	Degree
	Rating		
	Weight		
	Contribution	0	0
Total Performance:		589	610
Net Change in Performance (%):			4%

Cost Assumptions:

- Middle section after Garden Ridge Blvd to FM2181: deferred cost saving is $581m, including ROW acquisition cost, utility, engineering cost, PS&E, construction saving. There is an additional pavement transition cost of $15m. See spreadsheet attached for revenue projection.
- North section: deferred cost saving is $1.271 billion
- Total upfront construction cost deferred is **$1.852 billion**
- The Construction costs and savings are summarized in the table below:

	Original Concept Costs ($m)	Proposed Alternative Costs ($m)	Upfront Cost Savings ($m)
North Section	1271	0	1271
Middle Section	1901	1320	581
South Section	831	831	0
Total	**4,003**	**2,151**	**1,852**

Revenue Assumptions:

- Reduction in present value toll revenue if the construction of the road segment is deferred to 2040: $329m
- Total present value deferred cost saving to 2040 = $1852m - $329m = **$1523m**

CALCULATIONS/ASSUMPTIONS *I-35E Managed Lanes Project*		TxDOT/TTA	
TITLE:	Defer ROW acquisition and construction of northern park of middle section and north section (defer Garden Ridge Blvd North)	**NUMBER** 5.1 (P-13-1)	**PAGE NO.** 7 of 7

P13 Alternative 1 - Defer Entire North Segment and Middle Segment to South end of the Lake (Garden Ridg

REVENUE 5%

YEAR	Base Revenue Annual		Scenario Revenue Annual		Revenue Decreas Annual
	North	Middle	North	Middle	
2015	$ 3,462,402	$ 10,535,293	$ -	$ 7,901,861	$ 6,095,834
2016	$ 3,677,349	$ 11,364,860	$ -	$ 8,524,018	$ 6,518,191
2017	$ 3,905,194	$ 12,197,424	$ -	$ 9,147,890	$ 6,954,727
2018	$ 4,147,333	$ 13,789,925	$ -	$ 10,342,782	$ 7,594,476
2019	$ 4,420,728	$ 14,639,713	$ -	$ 10,979,624	$ 8,080,817
2020	$ 4,694,902	$ 16,468,223	$ -	$ 12,351,321	$ 8,811,804
2021	$ 4,960,478	$ 17,329,309	$ -	$ 12,996,836	$ 9,292,951
2022	$ 5,226,420	$ 18,174,616	$ -	$ 13,630,823	$ 9,770,214
2023	$ 5,469,787	$ 19,073,007	$ -	$ 14,304,888	$ 10,237,907
2024	$ 5,742,421	$ 19,871,394	$ -	$ 14,903,545	$ 10,710,269
2025	$ 6,122,145	$ 22,491,397	$ -	$ 16,868,789	$ 11,744,754
2026	$ 6,653,887	$ 23,437,444	$ -	$ 17,578,197	$ 12,513,133
2027	$ 7,178,128	$ 24,427,815	$ -	$ 18,320,971	$ 13,284,972
2028	$ 7,685,221	$ 25,312,272	$ -	$ 18,984,308	$ 14,013,185
2029	$ 8,179,465	$ 26,174,635	$ -	$ 19,631,174	$ 14,722,926
2030	$ 8,640,078	$ 26,912,547	$ -	$ 20,184,316	$ 15,368,309
2031	$ 8,805,610	$ 27,154,349	$ -	$ 20,365,672	$ 15,594,287
2032	$ 8,987,404	$ 27,402,344	$ -	$ 20,551,672	$ 15,838,075
2033	$ 9,137,745	$ 27,594,773	$ -	$ 20,696,242	$ 16,036,275
2034	$ 9,301,107	$ 27,823,634	$ -	$ 20,867,880	$ 16,256,861
2035	$ 9,395,825	$ 27,888,689	$ -	$ 20,916,591	$ 16,367,924
2036	$ 9,501,465	$ 27,927,205	$ -	$ 20,945,404	$ 16,483,266
2037	$ 9,580,854	$ 27,976,221	$ -	$ 20,982,166	$ 16,574,909
2038	$ 9,675,574	$ 27,981,221	$ -	$ 20,986,043	$ 16,670,752
2039	$ 9,754,781	$ 28,024,101	$ -	$ 21,018,015	$ 16,760,867
2040	$ 9,826,508	$ 28,041,790	$ -	$ 21,031,285	$ 16,837,013

VE TEAM ALTERNATIVE REVIEW *I-35E Managed Lanes Project*		TxDOT/TTA
TITLE:	Defer ROW acquisition and construction of northern part of middle section and north section (defer Garden Ridge North)	**NUMBER** 5.1 (P-13a)

Team Member: Michael Drayton

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Charles Riou

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X I have reviewed this alternative and suggest the following (or attached) changes

See page 5 *(comments incorporated)*

Team Member: Spenta Irani

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Minor typos

Team Member: Doug Bowen

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Team Member: Kim Daily

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Team Member: Bill Reichert

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VE TEAM ALTERNATIVE REVIEW *I-35E Managed Lanes Project*		TxDOT/TTA
TITLE:	Defer ROW acquisition and construction of northern part of middle section and north section (defer Garden Ridge North)	**NUMBER** 5.1 (P-13a)

Team Member: Phil Ullman

X I have reviewed this alternative and agree with it as it is written
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Team Member: Mark Taylor

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Team Member: Lucio Vasquez

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See comments *(comments incorporated)*

Team Member:

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VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*		**TxDOT/TTA**	
FUNCTION:	Defer construction and ROW acquisition	**IDEA NO.** P-13-2	**ALTERNATIVE NO.** 5.2
TITLE:	Defer ROW acquisition and construction of northern part of middle section and north section (defer Valley Ridge North)		**PAGE NO.** 1 of 7

ORIGINAL CONCEPT: (Attach sketch where appropriate)

Acquire ROW at the start of construction of the project and build the project to full scope (i.e. 28 miles)

ALTERNATIVE CONCEPT: (Attach sketch where appropriate)

Only construct the project from the South up to Valley Ridge Blvd in the Middle segment (further south of the lake, STA 1260+00) and acquire the corresponding ROW in order to save upfront construction costs. Defer ROW acquisition and road construction North of Valley Ridge Blvd (North segment + north of Middle segment) to year 2040.

ADVANTAGES:

- Reduces upfront cost significantly
- Defers cost of mitigation to COE property
- Defers maintenance costs
- Moves towards a more financially viable project

DISADVANTAGES:

- Creates hardship for current owners (urban blight)
- May cost more later to acquire ROW and to construct
- Doesn't help reduce today's congestion
- Reduces revenue for middle section
- Unable to relocate utilities
- Defers development in north along corridor
- Reduces LOS north of Lake
- Reduces alternate routes for incident management

COST SUMMARY	Initial Cost	Present Value of Toll Revenue (-ve as income)	Net Present Value
Original Concept	**$** 4,003 million	**$** -764 million	**$** 3,239 million
Alternative Concept	**$** 1,787 million	**$** -384 million	**$** 1,403 million
Savings	**$** 2,216 million	**$** -416 million	**$** 1,800 million

Team Member:	Michael Kerrigan Eva Chan Dan Chapman	**Discipline:**	Civil Engineer Civil Engineer Civil Engineer	**PERFORMANCE:** **+6%**

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*		TxDOT/TTA	
TITLE:	Defer ROW acquisition and construction of northern part of middle section and north section (defer Valley Ridge North)	**ALTERNATIVE NO.** 5.2 (P-13)	**PAGE NO** 2 of 7

DISCUSSION / JUSTIFICATION:

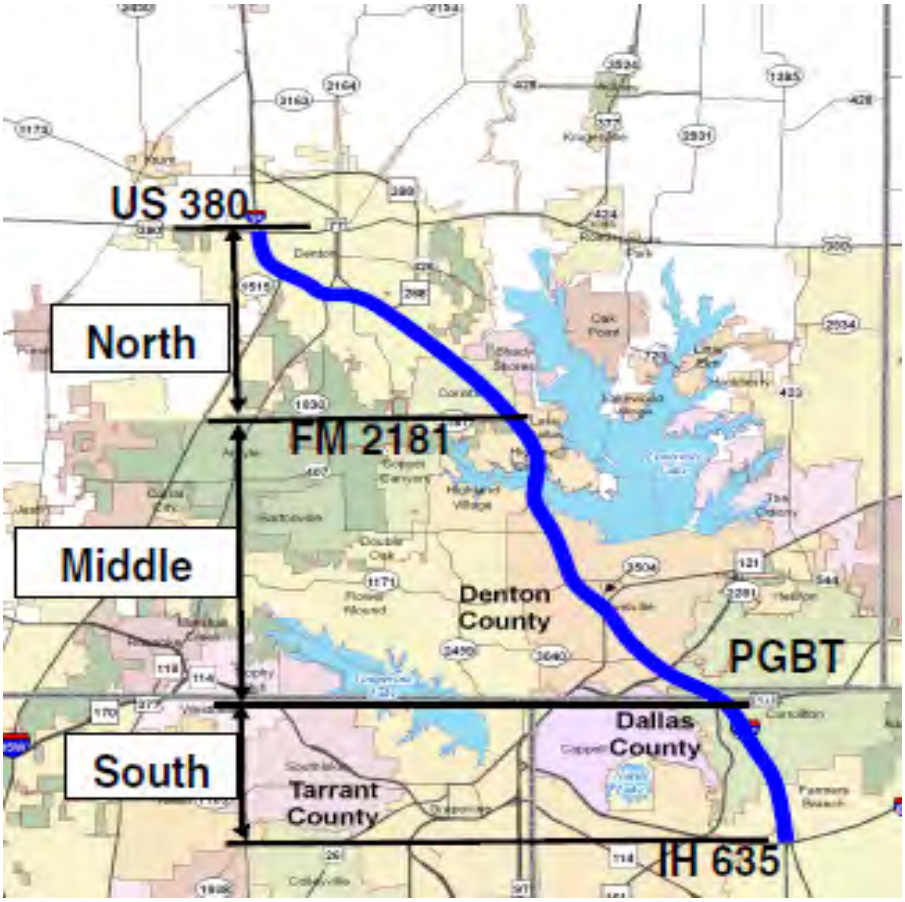
To reduce the scope to be in line with funding available today, including potential revenue generated by traffic. When extra funding is available, the remaining part of the Middle segment and all of the North section will be developed in 2040.

This alternative will potentially make a more financially viable project to begin construction in 2011.

SKETCHES *I-35E Managed Lanes Project*		TxDOT/TTA	
TITLE:	Defer ROW acquisition and construction of northern part of middle section and north section (defer Valley Ridge North)	**NUMBER** 5.2 (P-13)	**PAGE NO.** 3 of 7

Original Design

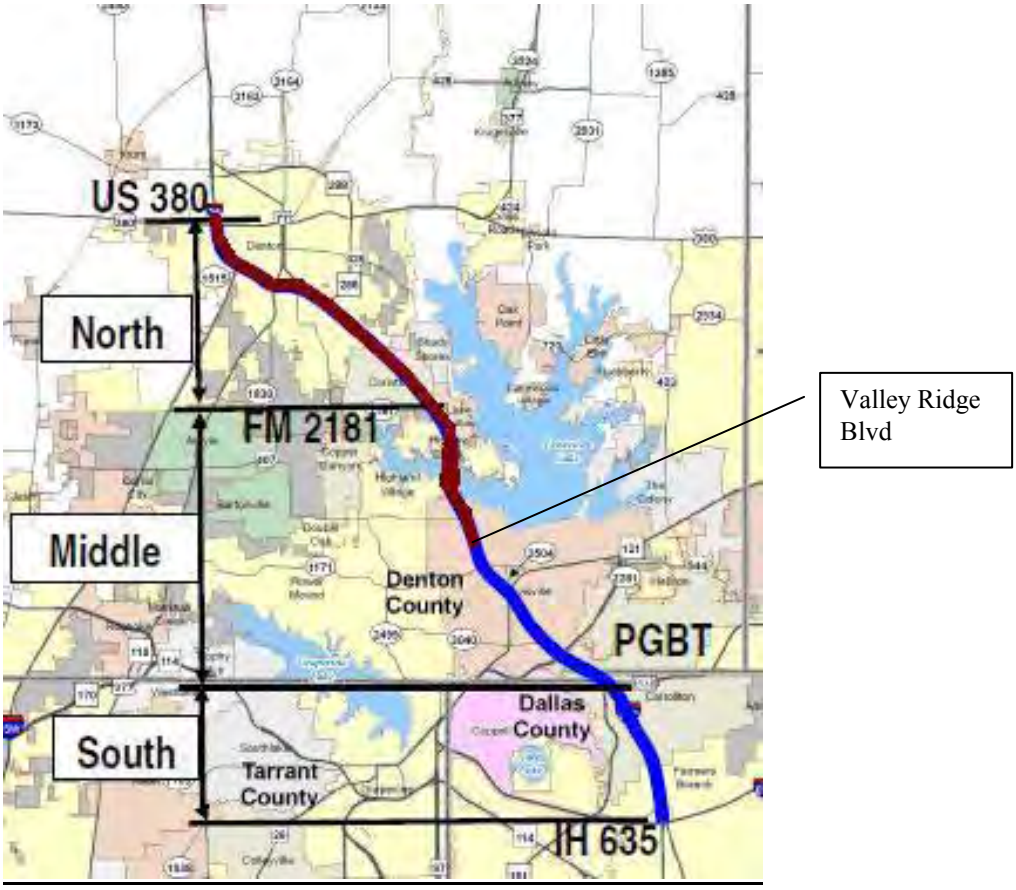
Construction of complete project (28 miles)



SKETCHES *I-35E Managed Lanes Project*		TxDOT/TTA	
TITLE:	Defer ROW acquisition and construction of northern part of middle section and north section (defer Valley Ridge North)	**NUMBER** 5.2 (P-13)	**PAGE NO.** 4 of 7

Proposed Alternative

Only acquire ROW and construction the roadway up to Valley Ridge Blvd (12 miles)



PERFORMANCE *I-35E Managed Lanes Project*		**TxDOT/TTA**	
TITLE: Defer ROW acquisition and construction of northern part of middle section and north section (defer Valley Ridge North)		**NUMBER** 5.2 (P-13)	**PAGE NO.** 5 of 7
CRITERIA	**Performance**	**Original**	**Alternative**
REVENUE IMPACTS: There will be $232m reduction in revenue if the construction defer to 2040	Measure	Degree	Degree
	Rating	6	5
	Weight	18	18
	Contribution	108	90
TRAFFIC OPS - GENERAL PURPOSE LANES: Due to the deferral, congestion at north and middel segment will not be resolved in 2016	Measure	Degree	Degree
	Rating	8	7
	Weight	17	17
	Contribution	136	119
TRAFFIC OPS - LOCAL: Due to the deferral, congestion at north and middel segment will not be resolved in 2016	Measure	Degree	Degree
	Rating	8	7
	Weight	12	12
	Contribution	96	84
RIGHT OF WAY IMPACTS: Less ROW impact due to deferral	Measure	Degree	Degree
	Rating	3	7
	Weight	10	10
	Contribution	30	70
ENVIRONMENTAL IMPACTS: No change (increase in congestion, decrease in environmental impacts for construction)	Measure	Degree	Degree
	Rating	7	7
	Weight	14	14
	Contribution	98	98
STAKEHOLDER ACCEPTANCE: Towards a more feasible project	Measure	Degree	Degree
	Rating	7	9
	Weight	13	13
	Contribution	91	117
SCHEDULE IMPACT: Earlier project completion	Measure	Degree	Degree
	Rating	5	8
	Weight	6	6
	Contribution	30	48
	Measure	Degree	Degree
	Rating		
	Weight		
	Contribution	0	0
Total Performance:		589	626
Net Change in Performance (%):			6%

Cost Assumptions:

- Middle section after Valley Ridge Blvd to FM2181: deferred cost saving is $945m, including ROW acquisition cost, utility, engineering cost, PS&E, construction saving. There is an additional pavement transition cost of $15m (see spreadsheet attached)
- North section: deferred cost saving is $1.271 billion
- Total upfront construction cost deferred is **$2.216 billion**
- The Construction costs and savings are summarized in the table below:

	Original Concept Costs ($m)	Proposed Alternative Costs ($m)	Upfront Cost Savings ($m)
North Section	1271	0	1271
Middle Section	1901	956	945
South Section	831	831	0
Total	**4,003**	**1,787**	**2,216**

Revenue Assumptions:

- Reduction in present value toll revenue if the construction of the road segment is deferred to 2040: $416m
- Total present value deferred cost saving to 2040 = $2,216m - $416m = **$1,800m**

P13 Alternative 2 - Defer Entire North Segment and Middle Segment to Valley Ridge

REVENUE

5%

YEAR	Base Revenue Annual		Scenario Revenue Annual		Revenue Reducti Annual
	North	Middle	North	Middle	
2015	$ 3,462,402	$ 10,535,293	$ -	$ 6,321,489	$ 7,676,206
2016	$ 3,677,349	$ 11,364,860	$ -	$ 6,818,916	$ 8,223,294
2017	$ 3,905,194	$ 12,197,424	$ -	$ 7,318,596	$ 8,784,021
2018	$ 4,147,333	$ 13,789,925	$ -	$ 8,273,684	$ 9,663,574
2019	$ 4,420,728	$ 14,639,713	$ -	$ 8,784,086	$ 10,276,355
2020	$ 4,694,902	$ 16,468,223	$ -	$ 9,880,934	$ 11,282,191
2021	$ 4,960,478	$ 17,329,309	$ -	$ 10,397,352	$ 11,892,435
2022	$ 5,226,420	$ 18,174,616	$ -	$ 10,904,547	$ 12,496,490
2023	$ 5,469,787	$ 19,073,007	$ -	$ 11,443,804	$ 13,098,990
2024	$ 5,742,421	$ 19,871,394	$ -	$ 11,922,634	$ 13,691,180
2025	$ 6,122,145	$ 22,491,397	$ -	$ 13,494,935	$ 15,118,608
2026	$ 6,653,887	$ 23,437,444	$ -	$ 14,062,649	$ 16,028,681
2027	$ 7,178,128	$ 24,427,815	$ -	$ 14,656,515	$ 16,949,428
2028	$ 7,685,221	$ 25,312,272	$ -	$ 15,187,280	$ 17,810,213
2029	$ 8,179,465	$ 26,174,635	$ -	$ 15,704,702	$ 18,649,398
2030	$ 8,640,078	$ 26,912,547	$ -	$ 16,147,453	$ 19,405,173
2031	$ 8,805,610	$ 27,154,349	$ -	$ 16,292,753	$ 19,667,206
2032	$ 8,987,404	$ 27,402,344	$ -	$ 16,441,270	$ 19,948,478
2033	$ 9,137,745	$ 27,594,773	$ -	$ 16,556,929	$ 20,175,589
2034	$ 9,301,107	$ 27,823,634	$ -	$ 16,694,056	$ 20,430,685
2035	$ 9,395,825	$ 27,888,689	$ -	$ 16,733,332	$ 20,551,183
2036	$ 9,501,465	$ 27,927,205	$ -	$ 16,756,323	$ 20,672,347
2037	$ 9,580,854	$ 27,976,221	$ -	$ 16,785,786	$ 20,771,289
2038	$ 9,675,574	$ 27,981,221	$ -	$ 16,788,733	$ 20,868,063
2039	$ 9,754,781	$ 28,024,101	$ -	$ 16,814,558	$ 20,964,324
2040	$ 9,826,508	$ 28,041,790	$ -	$ 16,825,074	$ 21,043,224

VE TEAM ALTERNATIVE REVIEW *I-35E Managed Lanes Project*		TxDOT/TTA
TITLE:	Defer ROW acquisition and construction of northern part of middle section and north section (defer Valley Ridge North)	**NUMBER** 5.2 (P-13b)

Team Member: Spenta Irani

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

Minor typos noted

Team Member: Charles Riou

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See page 5 *(comments incorporated)*

Team Member: Kim Daily

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Team Member: Bill Reichert

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Comments noted (*incorporated*)

Team Member: Mark Taylor

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Team Member: Phil Ullman

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VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*	TxDOT/TTA	
FUNCTION: General/Phasing/Traffic Control	**IDEA NO.** P-19	**ALTERNATIVE NO.** 6.0
TITLE: Construct elevated Managed Lanes on outside, defer construction of GP lanes, FR, and cross streets		**PAGE NO.** 1 of 7

ORIGINAL CONCEPT: (Attach sketch where appropriate)

Original concept is total reconstruction of facility with ML in the center at the same profile as GP lanes.

ALTERNATIVE CONCEPT: (Attach sketch where appropriate)

Construct elevated managed lanes on the outside of the existing GPs. Results in reduced footprint.

ADVANTAGES:

- Allows early and independent construction
- Reduces ROW costs
- Earlier revenue stream
- Reconstruction of existing General Purpose lanes, Frontage Roads, cross streets and bridges is deferred.
- Preserve existing HOV lanes (could be tolled as well, can be combined with VE Alt 4.0 (P-12)
- Easier to construct – connection, no wishbones
- Access from/to GPs would be on outside of GPs eliminating weave across 4 lanes
- ML structure could be combined with CD between PGBT and SH121.
- Allows for traffic control when GP lanes are constructed in the future

DISADVANTAGES:

- Makes access to ML less flexible
- May increase construction costs of managed lanes
- Detriment to aesthetics and noise
- Necessitate further analysis of weaving of on/off ramps – ML ramps are going to be introducing weaving with on/off ramps
- Additional ROW required for access ramps

*Cost summary does not include deferred construction costs. Includes only affected items such as ROW, rail & ML.

COST SUMMARY	Initial* Cost	Present Value Subsequent Cost	Net Present Value
Original Concept	**$** 1,556,530,544	**$** 0	**$** 1,556,530,544
Alternative Concept	**$** 1,148,543,903	**$** 0	**$** 1,148,543,903
Savings	**$** 407,986,641	**$** 0	**$** 407,986,641

Team Member:	Spenta Irani, Charles Riou, Bill Reichert, Kim Daily	**Discipline:**	Design Design TTA Assistant	**PERFORMANCE:** **-2%**

DISCUSSION / JUSTIFICATION:

The primary justification for constructing elevated managed lanes and deferring the reconstruction of general purpose, frontage roads, and cross streets allows for an early revenue stream while adding capacity and reducing the ultimate ROW requirements. Cost of project to achieve managed lanes is reduced from $4B to $1B.

By deferring the construction of the general purpose lanes, frontage roads, and cross streets the total initial capital cost requirement to construct the project is reduced due to a decrease in pavement, excavation/embankment, structures and the roadway components. The cost to reconstruct these items will most likely cost more than the cost today. There will be a permanent reduction in ROW costs due to the elevated managed lanes reducing the footprint.

Because the elevated structures can be constructed with minimal impact to the existing facility (impacts at the tie-ins) and the construction duration is significantly reduced (reduction of less roadway), the revenue stream from the managed lanes can be collected sooner than in the baseline case. Additionally, because the capacity of the general purpose lanes is not increased until the general purpose lanes, frontage roads, and cross streets are constructed at a later date (deferred), and because the volume of traffic is expected to increase over time, it can be assumed that more traffic will use the managed lanes therefore reducing the ramp-up period on the managed lanes bringing in more revenue sooner.

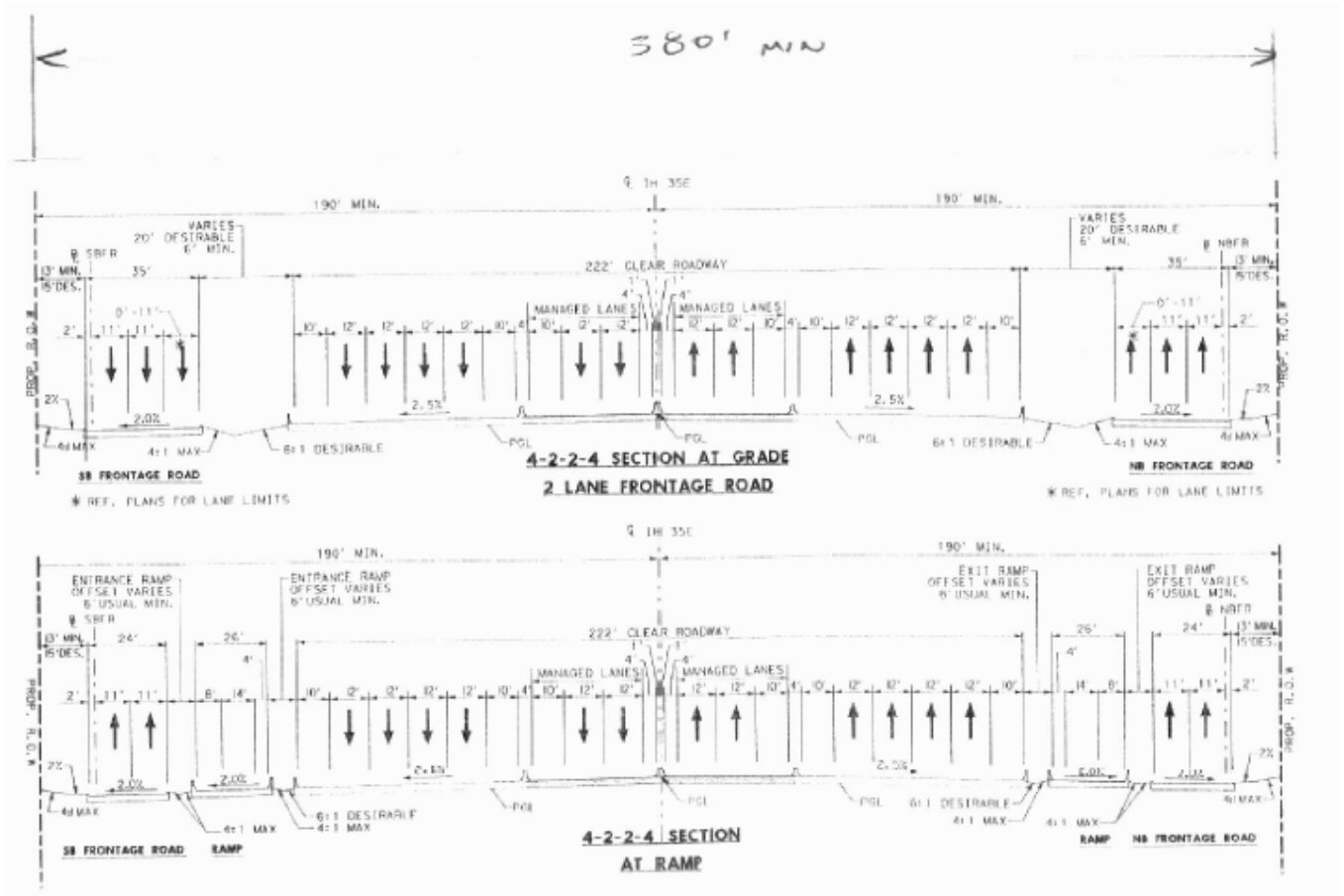
Items to consider: the impact on revenue when the general purpose lanes and frontage roads are reconstructed. The assumed increase in capital costs to reconstruct the general purpose lanes and frontage roads when required.

By deferring the reconstruction of the GP lanes to 2030, it is assumed that more traffic will use the ML. The increase in revenue resulting from this increase in ML use is approximately $11M for the North, $63M for the middle, and $45M for the South, totaling an increase in revenue of $119M.

The cost of construction for this proposal does not include the cost of deferred items.

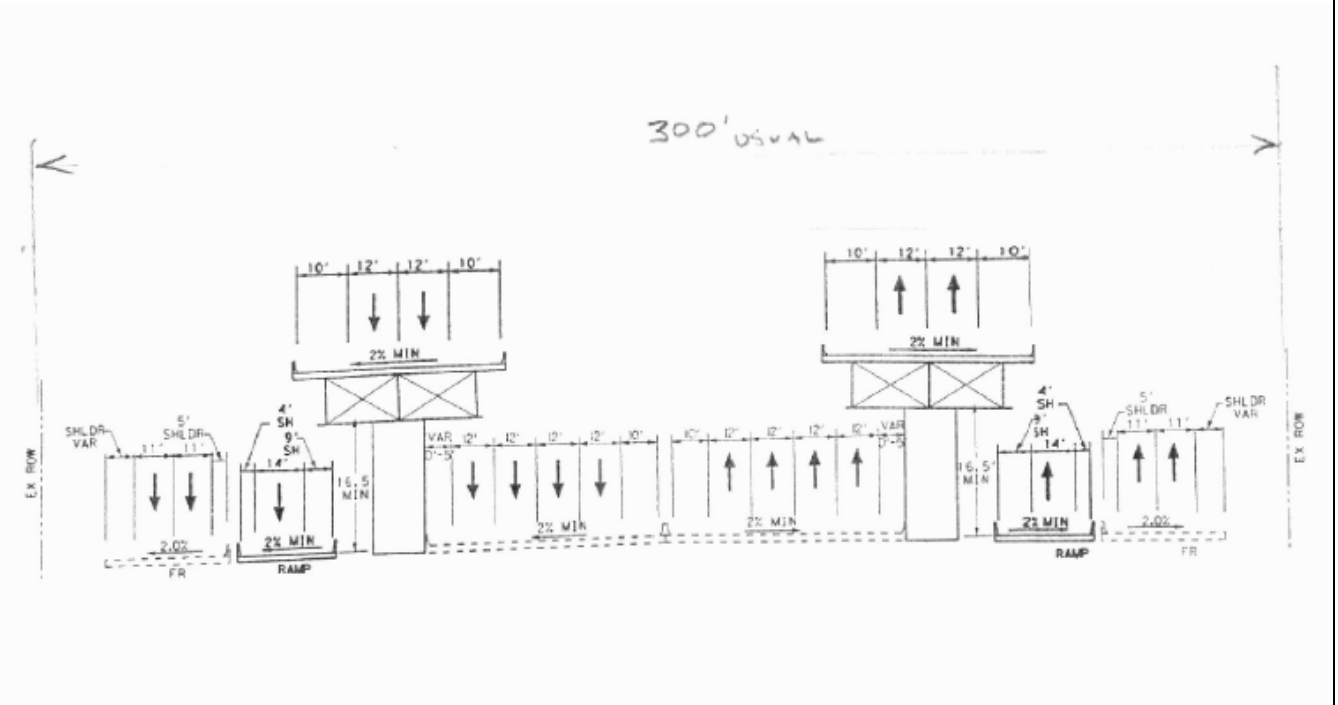
SKETCHES *I-35E Managed Lanes Project*		TxDOT/TTA	
TITLE:	Construct elevated Managed Lanes or Managed Lanes on outside, defer construction of General Purpose Lanes	**NUMBER** 6.0 (P-19)	**PAGE NO.** 3 of 7

Original Design



SKETCHES *I-35E Managed Lanes Project*		TxDOT/TTA	
TITLE:	Construct elevated Managed Lanes or Managed Lanes on outside, defer construction of General Purpose Lanes	**NUMBER** 6.0 (P-19)	**PAGE NO.** 4 of 7

Proposed Alternative



PERFORMANCE *I-35E Managed Lanes Project*		TxDOT/TTA	
TITLE: Construct elevated Managed Lanes on outside, defer construction of General Purpose Lanes		**NUMBER** 6.0 (P-19)	**PAGE NO.** 5 of 7
CRITERIA	**Performance**	**Original**	**Alternative**
REVENUE IMPACTS: Revenue increases and is realized sooner because GP capacity doesn't change.	Measure	Degree	Degree
	Rating	6	8
	Weight	18	18
	Contribution	108	144
TRAFFIC OPS - GENERAL PURPOSE LANES: Compared to the baseline, the traffic operations of the GP lanes is reduced since the GP lanes are not changed. However, volume of the traffic on the GP lanes may decrease by traffic using MLs.	Measure	Degree	Degree
	Rating	8	7
	Weight	17	17
	Contribution	136	119
TRAFFIC OPS - LOCAL: Compared to the baseline, the local traffic operations are reduced since improvements are deferred.	Measure	Degree	Degree
	Rating	8	6
	Weight	12	12
	Contribution	96	72
RIGHT OF WAY IMPACTS: Significantly less impacts.	Measure	Degree	Degree
	Rating	3	6
	Weight	10	10
	Contribution	30	60
ENVIRONMENTAL IMPACTS: More noise pollution since lanes are elevated and air quality degrades because of the deferral of added capacity.	Measure	Degree	Degree
	Rating	7	6
	Weight	14	14
	Contribution	98	84
STAKEHOLDER ACCEPTANCE: Deferral will reduce stakeholder acceptance as compared to the baseline.	Measure	Degree	Degree
	Rating	7	4
	Weight	13	13
	Contribution	91	52
SCHEDULE IMPACT: Initial construction duration is significantly less than compared to the baseline construction.	Measure	Degree	Degree
	Rating	5	8
	Weight	6	6
	Contribution	30	48
	Measure	Degree	Degree
	Rating		
	Weight		
	Contribution	0	0
Total Performance:		589	579
Net Change in Performance (%):			-2%

Assuming 77% of ROW savings where ROW is being purchased (non-COE property) based on previous ROW calculations for cost savings by TxDOT done 7/20/09.

Assume 20 year deferral of construction of general purpose lanes and frontage road lanes.

Saving upfront costs because segments of construction are deferred. Deferred costs have to consider the inflation that will take place until the project is built.

Assume access points in the proposal are the same as access points in the baseline.

Construction cost from baseline of items deferred =$373M (S)+$1,036M (M)+$597M (N) = $2B

INITIAL COSTS

I-35E Managed Lanes Project

TxDOT/TTA

TITLE: Construct elevated Managed Lanes on outside, defer construction of General Purpose Lanes	**NUMBER**	**PAGE NO.**
	6.0 (P-19)	7 of 7

CONSTRUCTION ELEMENT		**ORIGINAL CONCEPT**			**ALTERNATIVE CONCEPT**		
Description	**Unit**	**Quantity**	**Cost/Unit**	**Total**	**Quantity**	**Cost/Unit**	**Total**
Bridges (Concrete) ML (S) Proposal	/mile			$0	6	$25,000,000	$137,500,000
Bridges (Concrete) ML (M) Proposal	/mile			$0	12	$25,000,000	$302,500,000
Bridges (Concrete) ML (N) Proposal	/mile			$0	9	$25,000,000	$219,500,000
Bridges (Concrete) (Bridge over Water) ML (M) Proposal	/mile			$0	2	$29,640,000	$50,980,800
Pavement Section 72' ML (S) Baseline	SY	232,320	$78	$18,120,960			$0
Pavement Section 72' ML (M) Baseline	SY	511,104	$78	$39,866,112			$0
Pavement Section 72' ML (N) Baseline	SY	443,520	$78	$34,594,560			$0
Rail (2 sides) (S)	LF	0	$50	$0			$0
Rail (2 sides) (M)	LF	0	$50	$0			$0
Rail (2 sides) (N)	LF	152,983	$50	$7,649,150			$0
ROW (S) (Proposal Cost =23% of Baseline)	LS	100%	$323,985,151	$323,985,151	23%	$323,985,151	$74,516,585
ROW (M) (Proposal Cost =23% of Baseline)	LS	100%	$504,256,027	$504,256,027	23%	$504,256,027	$115,978,886
ROW (N) (Proposal Cost =23% of Baseline)	LS	100%	$425,032,861	$425,032,861	23%	$425,032,861	$97,757,558
				$0			$0
				$0			$0
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				$0			$0
				$0			$0
				$0			$0
Subtotal:				$1,353,504,821			$998,733,829
15% contigency:				$203,025,723			$149,810,074
TOTAL				$1,556,530,544			$1,148,543,903
						SAVINGS	$407,986,641

VE TEAM ALTERNATIVE REVIEW *I-35E Managed Lanes Project*		TxDOT/TTA
TITLE:	Construct elevated Managed Lanes on outside, defer construction of GP lanes, FR, and cross streets	**NUMBER** 6.0 (P-19/P-21)

Team Member: Michael Drayton

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

Explicit note on what costs are included in cost summary

Team Member: Phil Ullman

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

Cost of structure assumes concrete structure. Due to ramping straddle bents and steel structure doubles cost ≈ $110/SF

Team Member: Lucio Vasquez

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

May be difficult to construct at areas pts and over existing roadway

Team Member: Eva Chan

☐ I have reviewed this alternative and agree with it as it is written

X I have reviewed this alternative and suggest the following (or attached) changes

The cost savings should be $407m + $2B (deferral) = $2.4B

Team Member: Mark Taylor

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

Disadvantage: Closure of ML during ice storms, loss of revenue & functionality

Team Member:

☐ I have reviewed this alternative and agree with it as it is written

☐ I have reviewed this alternative and suggest the following (or attached) changes

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*		**TxDOT/TTA**	
FUNCTION:	Maximize Funding, Allow Construction	**IDEA NO.** P38-39	**ALTERNATIVE NO.** 7.0
TITLE:	Interim Managed Lanes in the median south of US 77 to north of FM 2181 (Swisher Rd) – defer the ultimate construction		**PAGE NO.** 1 of 7

ORIGINAL CONCEPT: The original concept improves IH 35E to a 4-2-2-4 typical section from FM 2181 (Swisher Rd) to US 77 and includes reconstruction of the frontage roads and cross street interchanges.

ALTERNATIVE CONCEPT: The alternative concept is to defer construction of the ultimate improvements from FM 2181 (Swisher Rd) to US 77 and instead construct an interim managed lane system that connects to the ultimate IH 35E managed lane system constructed south of FM 2181 (Swisher Rd).

ADVANTAGES:

- Provides capacity improvements in a segment of IH 35E that currently only has 4 total lanes.
- Provides additional revenue for the corridor.

DISADVANTAGES:

- Construction is interim and depending upon identification of funding may only be in place for a few years.
- Requires design exceptions to implement.

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Net Present Value
Original Concept	**$** 18,546,400	**$** 0	**$** 18,546,400
Alternative Concept	**$** 0	**$** 0	**$** 0
Savings	**$** 18,546,400	**$** 0	**$** 18,546,400

Team Member: Chad Gardiner	**Discipline:** Design	**PERFORMANCE:** **+8%**

DISCUSSION / JUSTIFICATION:

There is a significant funding gap to construct the ultimate IH 35E improvements. In addition, traffic and revenue studies show that construction dollars for the ultimate improvements in the North Segment generate the least amount of revenue return when compared to the South and Middle Segments. Based on these results, the North Segment is the least attractive segment within the IH 35E Corridor to be included in a PPA or CDA project.

Interim improvements could provide capacity and bottleneck improvements in the North segment until funding is identified. This VE alternative analyzed extending an interim managed lane segment into the North Segment. Looking at the existing geometry and constraints, it would be too costly to extend and interim managed lane north of US 77. Therefore, the north limit was set at US 77. Also, because the Middle Segment is considered the priority segment by TxDOT and Denton County, the north limit of the Middle Segment was set as the southern limit for the interim managed lane. These limits provide a managed lane approximately 4.6 miles long.

In order to maintain the integrity of an enclosed, tolled system, it was assumed that a fixed barrier reversible managed lane would be constructed. A concurrent system could be constructed, but it would be buffer separated with limited shoulder widths which could present significant enforcement issues. The proposed interim typical section utilizes:

- 2 – 11’ GP lanes with 10’ outside shoulders and 2’ inside shoulders
- 1 – 12’ reversible managed lane with a 10’ and 2’ shoulder
- Fixed 2’ wide concrete barriers separating the GP and reversible managed lane.

This section allows for inside widening to be utilized throughout, including at bridges and overpasses. Limited outside widening was assumed in super elevated segments. It is assumed that 8’ outside shoulders are used on the GP lanes to fit within existing spans at underpasses. The US 77 ramps would be utilized as a lane add/drop to form a transitional area at the north end of the managed lanes. Another transitional/access area was assumed at the south end to transition from the interim reversible system to the ultimate concurrent managed lanes constructed with the Middle Segment. Constructing the interim managed lane would provide capacity improvements in a segment of IH 35E that currently only has 4 total lanes. It would also provide additional revenue for the corridor.

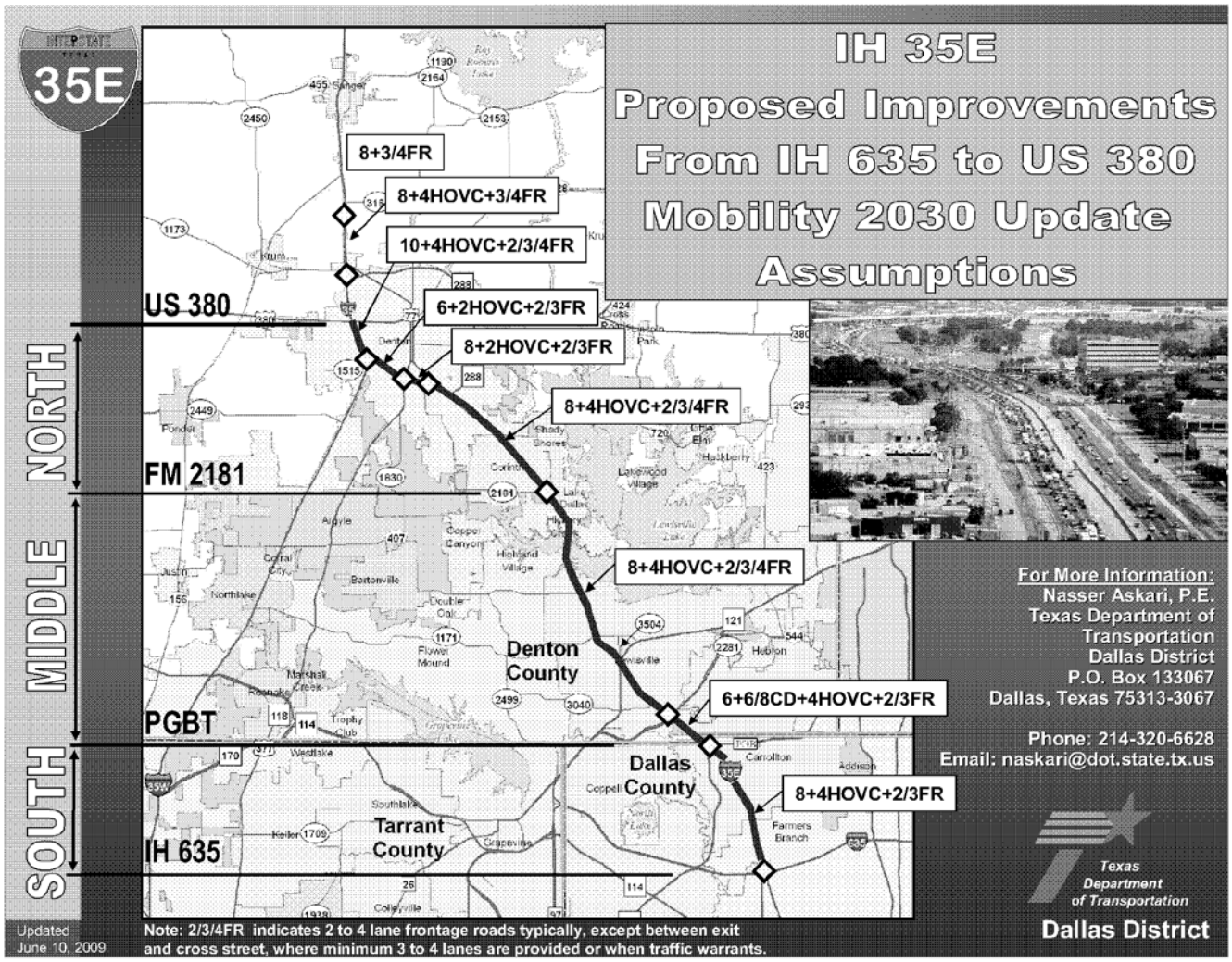
Other Opportunities to Extend the Interim Managed Lane

If the Middle Segment is initially constructed to south of Lake Lewisville with the remainder being deferred, the interim managed lane could be extended to south of Tuberville/Hundley (an additional mile) without significant cost. This segment of existing pavement has the median paved, and the only improvements needed would be restriping and barrier improvements. To extend to north of the lake would require additional inside and outside widening.

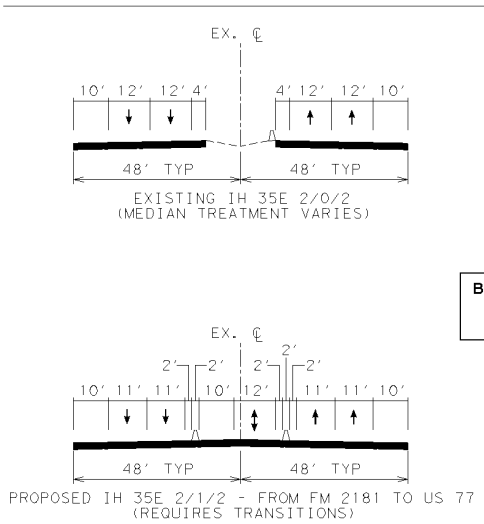
TxDOT currently has a North Early construction project for the ultimate IH 35E improvements from Loop 288 to North Texas Blvd. If construction money is identified for this segment, it could temporarily operate as reversible system and connect to the interim managed lane. A temporary conversion of the ultimate managed lane in this segment would require gates at US 77 and north of US 77.

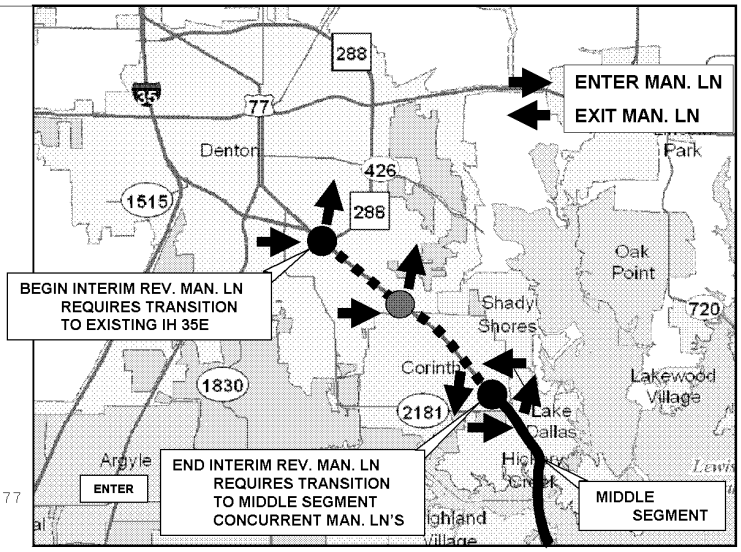
SKETCHES *I-35E Managed Lanes Project*		TxDOT/TTA	
TITLE:	Interim Managed Lanes in the median south of US 77 to north of FM 2181 (Swisher Rd) – defer the ultimate construction	**NUMBER** 7.0 (P38-39)	**PAGE NO.** 3 of 7

Original Design



Proposed Alternative





PERFORMANCE *I-35E Managed Lanes Project*	**TxDOT/TTA**		
TITLE: Interim Managed Lanes in the median south of US 77 to north of FM 2181 (Swisher Rd) – defer the ultimate construction	**NUMBER** 7.0 (P38-39)		**PAGE NO.** 5 of 7
CRITERIA	**Performance**	**Original**	**Alternative**
REVENUE IMPACTS: Extension of an interim managed lane into a deferred North Segment would generate additional revenue.	Measure	Degree	Degree
	Rating	6	7
	Weight	18	18
	Contribution	108	126
TRAFFIC OPS - GENERAL PURPOSE LANES: The managed lane would provide additional capacity. However, the reduced lane and shoulder widths could impact the GP capacity, especially during peak hours.	Measure	Degree	Degree
	Rating	8	9
	Weight	17	17
	Contribution	136	153
TRAFFIC OPS - LOCAL: No significant impact.	Measure	Degree	Degree
	Rating	8	8
	Weight	12	12
	Contribution	96	96
RIGHT OF WAY IMPACTS: No impact.	Measure	Degree	Degree
	Rating	3	3
	Weight	10	10
	Contribution	30	30
ENVIRONMENTAL IMPACTS: No apparent change.	Measure	Degree	Degree
	Rating	7	7
	Weight	14	14
	Contribution	98	98
STAKEHOLDER ACCEPTANCE: The interim capacity improvements prior to funding be identified for the North ultimate improvements would most likely be a positive for the stakeholders.	Measure	Degree	Degree
	Rating	7	8
	Weight	13	13
	Contribution	91	104
SCHEDULE IMPACT: No significant impact.	Measure	Degree	Degree
	Rating	5	5
	Weight	6	6
	Contribution	30	30
	Measure	Degree	Degree
	Rating		
	Weight		
	Contribution	0	0
Total Performance:		589	637
Net Change in Performance (%):			8%

- It was assumed that the entire Middle Segment was constructed.
- It was assumed that lane and shoulder width design exception could be granted for the interim typical section.
- Inside widening was assumed throughout with limited outside widening assumed in super elevated segments (due to existing PGL and axis of rotation).
- It is assumed that 8' outside shoulders are used on the GP lanes to fit within existing spans at underpasses.
- It is assumed that managed lane access would be provided S. of US 77, S. of Loop 288, & North of FM 2181.
- Limits of the "North Early" reversible managed lane and widening limits were determined, and quantities for these limits were measured/calculated by utilizing the proposed typical section, topographic information, and existing IH 35E record plans.

See attached estimate for cost calculations. The basis for calculating quantities:

- Calculated pavement quantities by multiplying the project length (ft) by the width (ft) of widening and converting to SY
- Earthwork quantities were developed by comparing the proposed widening pavement section to the existing typical section, and developing an average area of cut and fill per linear foot of roadway. These areas were multiplied by the length of widening and converted to cubic feet.
- Bridge widening was calculated by comparing the existing bridge widths from the record plans to the proposed typical section. It was assumed that the existing inside rails would be removed and the bridge deck and bents would be widened to the inside.
- Topographic information and the proposed typical section were utilized to quantify culvert lengthening, inlet relocations, and signage relocations.
- Guide signs and managed lane gate systems were added at the proposed reversible managed lane access locations.
- Costs for removals, striping, SWPPP, CTB, and toll enforcement were quantified from the typical section and/or project length.
- The interim pavement widening section was assumed to be 12" of cement treated subgrade, 10" base course, and 2" surface course. These items required rates not included within the original estimate.
- The ROW Prep rate was reduced to $1000/sta for the interim widening.
- Bridge widening was not included in the original estimate. A rate of $85/sf was assigned to this estimate.
- Toll access gate systems were not a part of the original estimate. They are needed for a reversible system and a unit rate of $30,000/each was assigned to this estimate.
- A reduced toll enforcement rate of $700,000/mile was used for this estimate to accurately depict the tolling system that would be constructed.
- The estimate assumes no ROW is required.

INITIAL COSTS

I-35 Managed Lanes Project

TxDOT/TTA

TITLE: Interim Managed Lanes in the median south of US 77 to north of FM 2181 (Swisher Rd) – defer the ultimate construction

NUMBER	**PAGE NO.**
7.0 (P38-39)	7 of 7

CONSTRUCTION ELEMENT		**ORIGINAL CONCEPT**			**ALTERNATIVE CONCEPT**		
Description	**Unit**	**Quantity**	**Cost/Unit**	**Total**	**Quantity**	**Cost/Unit**	**Total**
PREPARING ROW (Interim Widening)	STA	203	$1,000	$203,000			
EXCAVATION	CY	10,000	$5	$50,000			
EMBANKMENT	CY	19,000	$8	$152,000			
COMPOST MANUF TOPSOIL (BOS)(4")	SY	17,000	$1	$17,000			
BROADCAST SEED (PERM) (URBAN) (CLAY	SY	17,000	$0.50	$8,500			
CEMENT (Interim Widening)	TON	1,300	$115	$149,500			
CEMENT TRT (12") (Interim Widening)	SY	79,300	$5	$396,500			
BASE COURSE (10") (TY B) (Interim Widening)	TON	41,530	$65	$2,699,450			
SURFACE COURSE (2") (TY C) (Interim Widen	TON	8,310	$75	$623,250			
BRIDGES (CONCRETE) (Interim Widening)	SF	8,680	$85	$737,800			
CONC BOX CULV (8 FT x 4 FT) (Extend Existir	LF	40	$308	$12,320			
RC PIPE (CL III)(24 IN)	LF	150	$42	$6,300			
INLETS	EA	3	$3,500	$10,500			
WINGWALL (PW) (H=4 FT)	EA	2	$6,200	$12,400			
SET (4:1)	EA	1	$4,000	$4,000			
ALUMINUM SIGNS (TY A)	SF	48	$23	$1,104			
ALUMINUM SIGNS (TY O)	SF	2,400	$25	$60,000			
INS SM RD SN SUP	EA	3	$450	$1,350			
INS OH SN SUP (CANTILEVER) (CIRC TUBE	EA	12	$80,000	$960,000			
REMOVING CONC (ASPH)	SY	35,800	$4	$143,200			
REMOV STR (INLET)	EA	8	$495	$3,960			
SWPPP (Interim Widening)	STA	203	$4,000	$812,000			
PERM CONC TRF BAR (SGL SLP)(TY 2)	LF	53,200	$52	$2,766,400			
MTL W-BEAM GUARD FENCE	LF	3,800	$20	$76,000			
TERMINAL ANCHOR SECTION	EA	6	$620	$3,720			
MBGF TRANSITION	EA	4	$1,300	$5,200			
MBGF END TREATMENT	EA	6	$2,000	$12,000			
REFL PAV MRK TY I (W) 4" (BRK) (090 MIL)	LF	13,600	$0.35	$4,760			
REFL PAV MRK TY I (W) 4" (SLD) (090 MIL)	LF	108,100	$0.35	$37,835			
REFL PAV MRK TY I (Y) 4" (SLD) (090 MIL)	LF	54,100	$0.35	$18,935			
PAVEMENT SEALER 4"	LF	175,600	$0.10	$17,560			
REFL PAV MRKR TY II-C-R	EA	800	$4	$3,200			
PAV SURF PREP FOR MRK (4")	LF	175,600	$0.10	$17,560			
TOLL ENFORCEMENT	MILE	5	$700,000	$3,220,000			
TOLL ACCESS GATE SYSTEM	EA	6	$30,000	$180,000			
MOBILIZATION	LS	1	$1,350,000	$1,350,000			
TRAFFIC CONTROL	LS	1	$1,350,000	$1,350,000			
Subtotal:				$16,127,304			$0
15% contigency:				$2,419,096			$0
TOTAL				$18,546,400			$0
						SAVINGS	$18,546,400

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*		**TxDOT/TTA**
FUNCTION: General/Phasing/Traffic Control	**IDEA NO.** P-61	**ALTERNATIVE NO.** 8.0
TITLE: Alternative Pavement Section		**PAGE NO.** 1 of 7

ORIGINAL CONCEPT: (Attach sketch where appropriate)

The pavement section for the GPs, MLs, ramps, DCs, and CDs assumes a 48" flexible pavement section. The pavement section for the frontage roads and cross streets assumes a 34" pavement section.

ALTERNATIVE CONCEPT: (Attach sketch where appropriate)

This alternative concept assumes a reduced concrete section (34") for GPs, MLs, ramps, DCs, and CDs. The pavement section for the frontage roads and cross streets for this alternative concept assumes a 24" pavement section.

ADVANTAGES:

- Reduction in maintenance costs.
- Longer pavement life

DISADVANTAGES:

- Increase in initial upfront capital costs.
- Concrete may be more complicated to construct.
- Concrete takes longer to construct.
- Concrete is noisier.
- Geotechnical investigation required

COST SUMMARY	**Initial Cost**	**Present Value Subsequent Cost**	**Net Present Value**
Original Concept	**$** 428,035,000	**$** 2,305,000,000	**$** 2,733,000,000
Alternative Concept	**$** 510,654,000	**$** 1,640,000,000	**$** 2,150,654,000
Savings	**$** (82,619,000)	**$** 665,000,000	**$** 582,346,000

Team Member:	Spenta Irani, Charles Riou, Bill Reichert, Kim Daily	**Discipline:**	Design Design TTA Assistant	**PERFORMANCE:**	**-4%**

DISCUSSION / JUSTIFICATION:

This proposal could be considered as an alternate bid – flexible section versus concrete section. Studies undertaken for the value engineering workshop resulted in the concrete section costing more. Life cycle costs for the pavements indicate that the upfront costs would result in a lower maintenance cost over 30 years (and / or 50 years).

Lifecycle costs, in 2010 money, for 30 years are approximately:

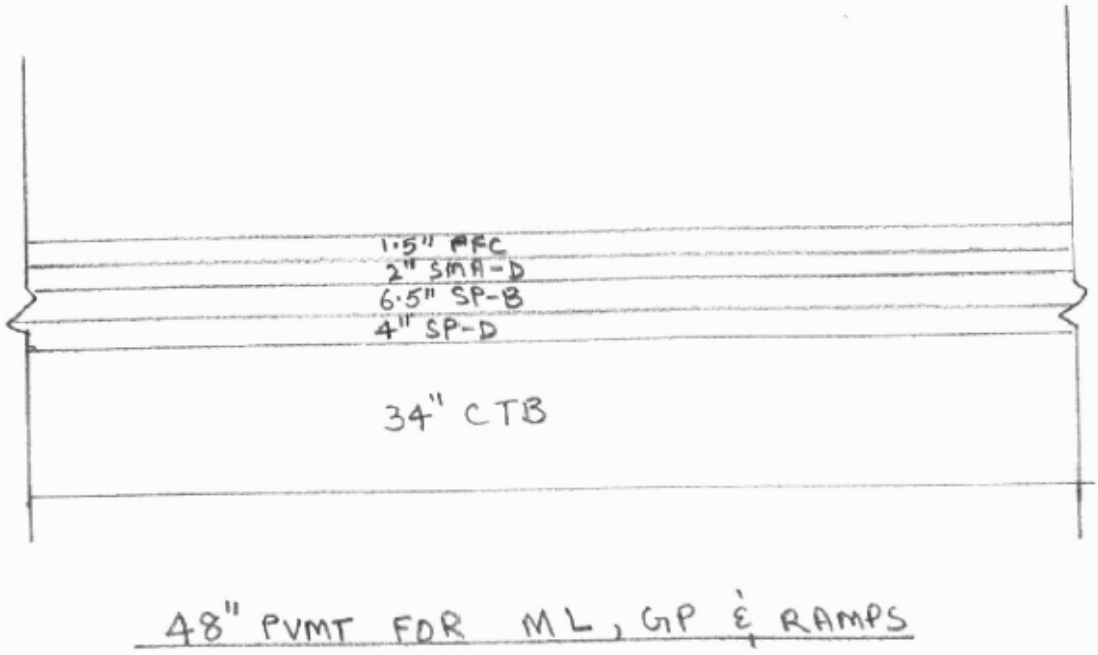
Service Life – Original (N) = $872M
Service Life – Alternative (N) = $617M

Service Life – Original (M) = $1B
Service Life – Alternative (M) = $714M

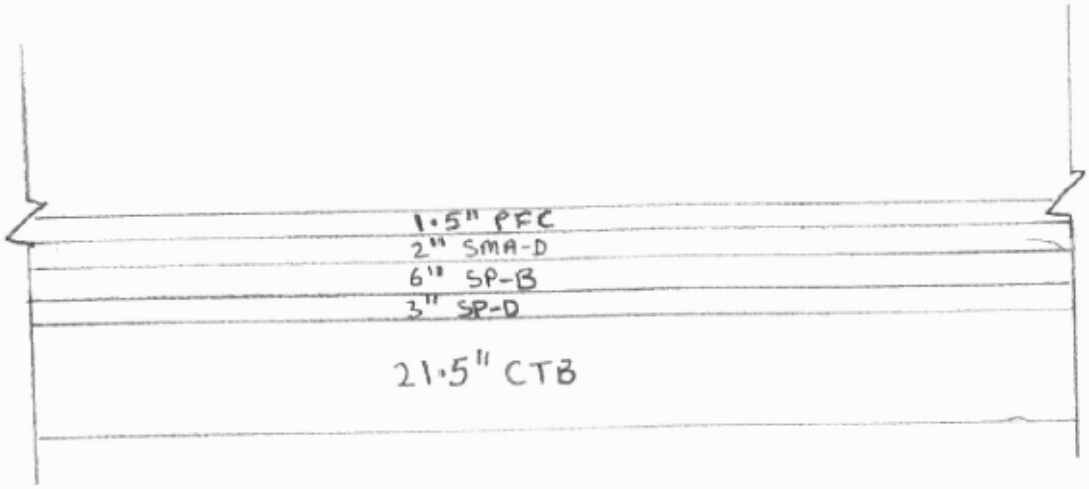
Service Life – Original (S) = $433M
Service Life – Alternative (S) = $309M

Total: Original: $2,305,000,000
Alternative: $1,640,000,000

Original Design

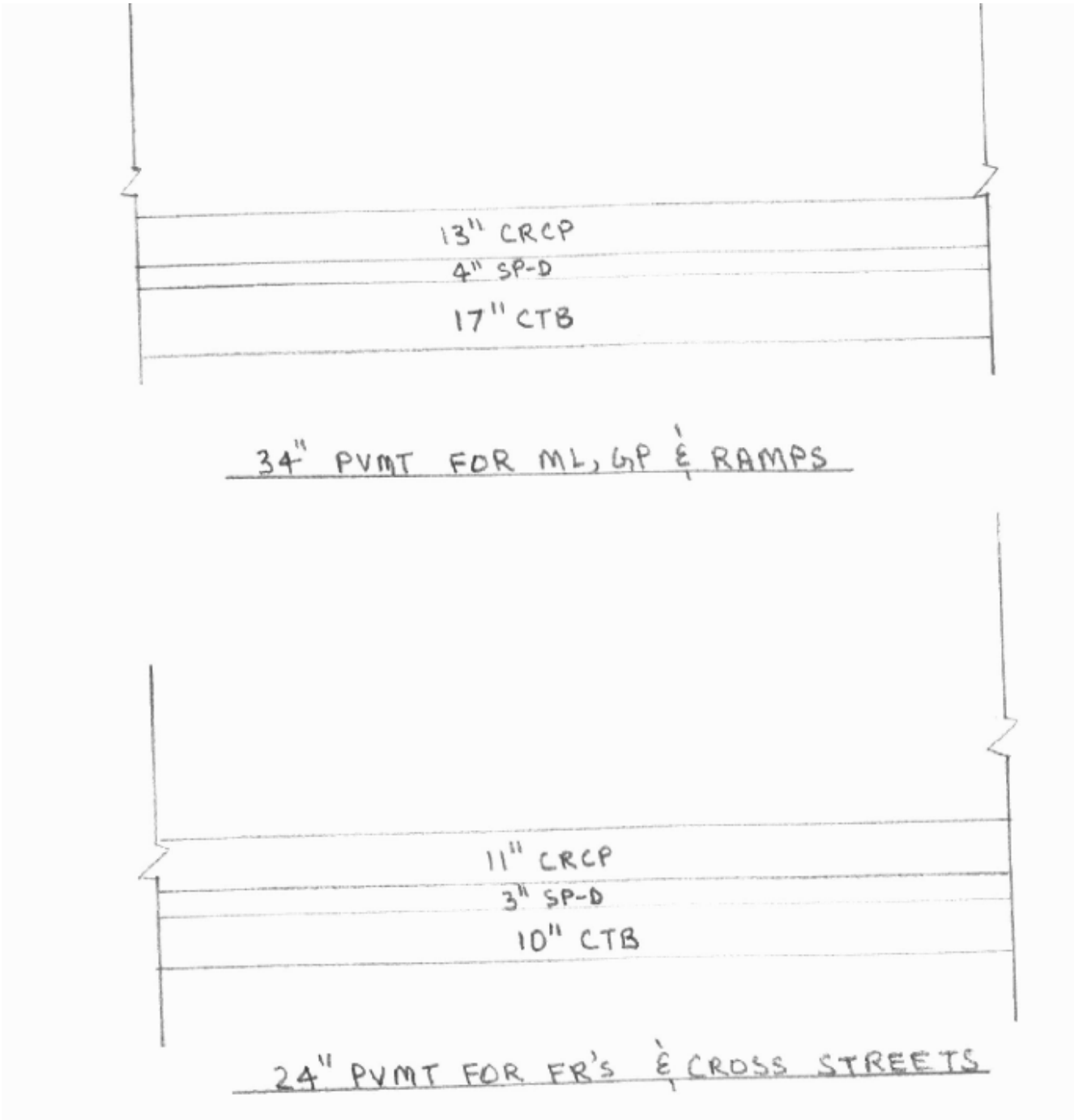


48" PVMT FOR ML, GP & RAMPS



34" PVMT FOR FR's & CROSS STREETS

Proposed Alternative



PERFORMANCE *I-35E Managed Lanes Project*		**TxDOT/TTA**	
TITLE: Alternative Pavement Section		**NUMBER** 8.0 (P-61)	**PAGE NO.** 5 of 7
CRITERIA	**Performance**	**Original**	**Alternative**
REVENUE IMPACTS: Not applicable.	Measure	Degree	Degree
	Rating	6	6
	Weight	18	18
	Contribution	108	108
TRAFFIC OPS - GENERAL PURPOSE LANES: Not applicable.	Measure	Degree	Degree
	Rating	8	8
	Weight	17	17
	Contribution	136	136
TRAFFIC OPS - LOCAL: Not applicable.	Measure	Degree	Degree
	Rating	8	8
	Weight	12	12
	Contribution	96	96
RIGHT OF WAY IMPACTS: Not applicable.	Measure	Degree	Degree
	Rating	3	3
	Weight	10	10
	Contribution	30	30
ENVIRONMENTAL IMPACTS: Noise is increased when using CRCP pavement, however, the pavement remains cooler.	Measure	Degree	Degree
	Rating	7	6
	Weight	14	14
	Contribution	98	84
STAKEHOLDER ACCEPTANCE: Not applicable.	Measure	Degree	Degree
	Rating	7	7
	Weight	13	13
	Contribution	91	91
SCHEDULE IMPACT: Takes longer to construct CRCP.	Measure	Degree	Degree
	Rating	5	3
	Weight	6	6
	Contribution	30	18
	Measure	Degree	Degree
	Rating		
	Weight		
	Contribution	0	0
Total Performance:		589	563
Net Change in Performance (%):			-4%

It is assumed that the difference in width of the CTB layer between the baseline and the proposal is negligible although the depth of CTB in the proposal is reduced.

The assumed pavement section for concrete pavement is 13" concrete pavement, 4" HMA, and 17" CTB for GPs, MLs, ramps, DCs, and CDs. The assumed pavement section for frontage roads is 11" concrete pavement, 3" HMA, and 10" CTB.

It is assumed that the savings/additional costs in excavation and embankment is equal to the length of the project times the difference in thickness of pavement sections. Assuming for this exercise that the additional embankment cost is offset equally by the reduction of excavation.

It is assumed that existing geotechnical investigations allow for this alternative pavement design.

The proposal assumes the difference in cost for the quantity difference of tack coat is negligible.

INITIAL COSTS

I-35E Managed Lanes Project

TxDOT/TTA

TITLE: Alternative Pavement Section

NUMBER	PAGE NO.
8.0 (P-61)	7 of 7

CONSTRUCTION ELEMENT		ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
Description	**Unit**	**Quantity**	**Cost/Unit**	**Total**	**Quantity**	**Cost/Unit**	**Total**
ML/GP/Ramps (S) Prime Coat Baseline	Gal	157,441	$4	$629,764			$0
ML/GP/Ramps (M) Prime Coat Baseline	Gal	289,041	$4	$1,156,164			$0
ML/GP/Ramps (N) Prime Coat Baseline	Gal	293,595	$4	$1,174,380			$0
ML/GP/Ramps (S) Cement Baseline	T	37,940	$115	$4,363,100			$0
ML/GP/Ramps (M) Cement Baseline	T	69,651	$115	$8,009,865			$0
ML/GP/Ramps (N) Cement Baseline	T	70,754	$115	$8,136,710			$0
ML/GP/Ramps (S) CTB Baseline	SY	826,575	$11	$9,092,325			$0
ML/GP/Ramps (M) CTB Baseline	SY	1,517,461	$11	$16,692,071			$0
ML/GP/Ramps (N) CTB Baseline	SY	1,541,356	$11	$16,954,916			$0
ML/GP/Ramps (S) Base Course Baseline	T	173,187	$90	$15,586,830			$0
ML/GP/Ramps (M) Base Course Baseline	T	317,945	$90	$28,615,050			$0
ML/GP/Ramps (N) Base Course Baseline	T	322,955	$90	$29,065,950			$0
ML/GP/Ramps (S) 6.5" (SP-B) Baseline	T	281,429	$79	$22,232,891			$0
ML/GP/Ramps (M) 6.5" (SP-B) Baseline	T	516,659	$79	$40,816,061			$0
ML/GP/Ramps (N) 6.5" (SP-B) Baseline	T	524,797	$79	$41,458,963			$0
ML/GP/Ramps (S) 1.5" (PFC) Baseline	T	56,088	$68	$3,813,984			$0
ML/GP/Ramps (M) 1.5" (PFC) Baseline	T	102,970	$68	$7,001,960			$0
ML/GP/Ramps (N) 1.5" (PFC) Baseline	T	104,598	$68	$7,112,664			$0
ML/GP/Ramps (S) 2" (SMA-D) Baseline	T	86,593	$97	$8,399,521			$0
ML/GP/Ramps (M) 2" (SMA-D) Baseline	T	158,973	$97	$15,420,381			$0
ML/GP/Ramps (N) 2" (SMA-D) Baseline	T	161,480	$97	$15,663,560			$0
ML/GP/Ramps (S) Cement Proposal	T			$0	18,970	$115	$2,181,550
ML/GP/Ramps (M) Cement Proposal	T			$0	34,826	$115	$4,004,933
ML/GP/Ramps (N) Cement Proposal	T			$0	35,377	$115	$4,068,355
ML/GP/Ramps (S) CTB Proposal	SY			$0	826,575	$6	$4,546,163
ML/GP/Ramps (M) CTB Proposal	SY			$0	1,517,461	$6	$8,346,036
ML/GP/Ramps (N) CTB Proposal	SY			$0	1,541,356	$6	$8,477,458
ML/GP/Ramps (S) Base Course Proposal	T			$0	173,187	$90	$15,586,830
ML/GP/Ramps (M) Base Course Proposal	T			$0	317,945	$90	$28,615,050
ML/GP/Ramps (N) Base Course Proposal	T			$0	322,955	$90	$29,065,950
ML/GP/Ramps (S) PCC Proposal	SY			$0	826,575	$55	$45,461,625
ML/GP/Ramps (M) PCC Proposal	SY			$0	1,517,461	$55	$83,460,355
ML/GP/Ramps (N) PCC Proposal	SY			$0	1,541,356	$55	$84,774,580
Frontage Rds/Cross (S) Prime Coat Baseline	Gal	61,378	$4	$245,512			$0
Frontage Rds/Cross (M) Prime Coat Baseline	Gal	146,516	$4	$586,064			$0
Frontage Rds/Cross (N) Prime Coat Baseline	Gal	127,210	$4	$508,840			$0
Frontage Rds/Cross (S) Cement Baseline	T	9,353	$115	$1,075,595			$0
Frontage Rds/Cross (M) Cement Baseline	T	22,326	$115	$2,567,490			$0
Frontage Rds/Cross (N) Cement Baseline	T	19,387	$115	$2,229,505			$0
Frontage Rds/Cross (S) CTB Baseline	SY	322,235	$11	$3,544,585			$0
Frontage Rds/Cross (M) CTB Baseline	SY	769,208	$11	$8,461,288			$0
Frontage Rds/Cross (N) CTB Baseline	SY	667,834	$11	$7,346,174			$0
Frontage Rds/Cross (S) Base Course Baseline	T	50,637	$90	$4,557,330			$0
Frontage Rds/Cross (M) Base Course Baseline	T	120,876	$90	$10,878,840			$0
Frontage Rds/Cross (N) Base Course Baseline	T	104,949	$90	$9,445,410			$0
Frontage Rds/Cross (S) Base+Surface Baseline	T	156,898	$50	$7,844,900			$0
Frontage Rds/Cross (M) Base+Surface Baseline	T	374,531	$50	$18,726,550			$0
Frontage Rds/Cross (N) Base+Surface Baseline	T	325,183	$50	$16,259,150			$0
Frontage Rds/Cross (S) Cement Proposal	T			$0	4,677	$115	$537,798
Frontage Rds/Cross (M) Cement Proposal	T			$0	11,163	$115	$1,283,745
Frontage Rds/Cross (N) Cement Proposal	T			$0	9,694	$115	$1,114,753
Frontage Rds/Cross (S) CTB Proposal	SY			$0	322,235	$6	$1,772,293
Frontage Rds/Cross (M) CTB Proposal	SY			$0	769,208	$6	$4,230,644
Frontage Rds/Cross (N) CTB Proposal	SY			$0	667,834	$6	$3,673,087
Frontage Rds/Cross (S) Base Course Proposal	T			$0	50,637	$90	$4,557,330
Frontage Rds/Cross (M) Base Course Proposal	T			$0	120,876	$90	$10,878,840
Frontage Rds/Cross (N) Base Course Proposal	T			$0	104,949	$90	$9,445,410
Frontage Rds/Cross (S) PCC Proposal	SY			$0	322,235	$50	$16,111,750
Frontage Rds/Cross (M) PCC Proposal	SY			$0	769,208	$50	$38,460,400
Frontage Rds/Cross (N) PCC Proposal	SY			$0	667,834	$50	$33,391,700
				$0			$0
				$0			$0
				$0			$0
Subtotal:				$372,204,360			$444,046,632
15% contigency:				$55,830,654			$66,606,995
TOTAL				$428,035,014			$510,653,627
						SAVINGS	($82,618,613)

VE TEAM ALTERNATIVE REVIEW *I-35E Managed Lanes Project*	**TxDOT/TTA**
TITLE: Alternative Pavement Section	**NUMBER** 8.0 (P-61)

Team Member: Michael Kerrigan

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

See comments as noted

Team Member:

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member:

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member:

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member:

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member:

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*		**TxDOT/TTA**	
FUNCTION:	Optimize maintenance strategy	**IDEA NO.** P-46	**ALTERNATIVE NO.** 9.0
TITLE:	5-year maintenance contract post construction completion, 15-year CMA post construction completion		**PAGE NO.** 1 of 4

ORIGINAL CONCEPT: (Attach sketch where appropriate)

The Concessionaire/Design-Builder is responsible for maintaining the ML for a period of 50 years. TxDOT will undertake the maintenance for GP and Frontage Roads.

ALTERNATIVE CONCEPT: (Attach sketch where appropriate)

Let 5-year maintenance contracts post construction completion of the full scope for all the lanes. This enables other contractors to bid for these maintenance services.

ADVANTAGES:

- Eliminates hand back costs associated with 50-yr concession
- Increases flexibility for TxDOT to manage maintenance contracts

DISADVANTAGES:

- Complicated contracting
- Higher administration cost by TxDOT
- Warranty period of only 2 years compared to concessionaire maintaining for the entire concession period
- CMA contains lower maintenance standards

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Net Present Value
Original Concept	**$** 0	**$** 401m	**$** 401m
Alternative Concept	**$** 0	**$** 0	**$** 0
Savings	**$** 0	**$** 401m	**$** 401m

Team Member:	Michael Kerrigan Eva Chan Dan Chapman	**Discipline:**	Civil Engineer Civil Engineer Civil Engineer	**PERFORMANCE:**	**+2%**

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*	TxDOT/TTA	
TITLE: 5-year maintenance contract post construction completion, 15-year CMA post construction completion	**ALTERNATIVE NO.** 9.0 (P-46)	**PAGE NO** 2 of 4

DISCUSSION / JUSTIFICATION:

By the time the project is procured, the legislation might not support a 50-year Concession project and therefore CMA's may be more appropriate for procurement of the maintenance activities.

With the 5-year capital maintenance agreements post construction completion, the handback provisions of a concession agreement will not be required. Instead the equivalent cost will be pushed further into the future and spent on capital maintenance under the normal improvement schedule.

PERFORMANCE *I-35E Managed Lanes Project*	TxDOT/TTA		
TITLE: 5-year maintenance contract post construction completion, 15-year CMA post construction completion	**NUMBER** 9.0 (P-46)		**PAGE NO.** 3 of 4
CRITERIA	**Performance**	**Original**	**Alternative**
REVENUE IMPACTS: No effect	Measure	Degree	Degree
	Rating	6	6
	Weight	18	18
	Contribution	108	108
TRAFFIC OPS - GENERAL PURPOSE LANES: No effect	Measure	Degree	Degree
	Rating	8	8
	Weight	17	17
	Contribution	136	136
TRAFFIC OPS - LOCAL: No effect	Measure	Degree	Degree
	Rating	8	8
	Weight	12	12
	Contribution	96	96
RIGHT OF WAY IMPACTS: No effect	Measure	Degree	Degree
	Rating	3	3
	Weight	10	10
	Contribution	30	30
ENVIRONMENTAL IMPACTS: No effect	Measure	Degree	Degree
	Rating	7	7
	Weight	14	14
	Contribution	98	98
STAKEHOLDER ACCEPTANCE: A better product can be expected. The contractor won't be responsible/ awarded for a 50-year contract.	Measure	Degree	Degree
	Rating	7	8
	Weight	13	13
	Contribution	91	104
SCHEDULE IMPACT: No effect	Measure	Degree	Degree
	Rating	5	5
	Weight	6	6
	Contribution	30	30
	Measure	Degree	Degree
	Rating		
	Weight		
	Contribution	0	0
Total Performance:		589	602
Net Change in Performance (%):			2%

Cost Assumptions:

Assume the handback costs at the end of the Concession Period are eliminated. The total amount eliminated in 2010 $ is $401m. However, this is not projected as immediate upfront construction cost savings. This is a cost saving over time and would eventually be incurred as part of normal capital maintenance activities beyond a 50yr Concession.

Handback cost saving at year 2066:

	ML ($m)	GP ($m)	FR ($m)	Total ($m)
North Section	56	85	8	149
South Section	28	43	4	75
Middle Section	68	101	9	178
			All sections	401

VE TEAM ALTERNATIVE REVIEW *I-35E Managed Lanes Project*		TxDOT/TTA
TITLE:	5-year maintenance contract post construction completion, 15-year CMA post construction completion	**NUMBER** 9.0 (P-46)

Team Member: Michael Drayton

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Charles Riou

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Bill Reichert

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

Handback costs are for DB/Concession are not TxDOT. Are you assuming a $401M reduction in cost to the project after construction?

Team Member: Kim Daily

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Doug Bowen

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Lucio Vasquez

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

This assumes we go with a D/B procurement. If TxDOT gets CDA a mouth, we will go with a concession procurement. However, for this VE exercise, the analysis is good.

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*		TxDOT/TTA	
FUNCTION:	Separate Grades, Eliminate Conflicts	**IDEA NO.** M-10	**ALTERNATIVE NO.** 10.0
TITLE:	Revise wishbone design (instead of going over, go under)		**PAGE NO.** 1 of 6

ORIGINAL CONCEPT: (Attach sketch where appropriate)

Baseline design calls for wishbone design over mainline bridges

ALTERNATIVE CONCEPT: (Attach sketch where appropriate)

Revise wishbone design to go under mainline bridges

ADVANTAGES:

- Less complicated construction
- Standard bridge on main lanes instead of large flyover
- Better main lane sight lines for adjacent properties
- More consistent main lane grades
- No straddle bents
- No steel spans

DISADVANTAGES:

- Additional main lane bridge
- Main lanes elevated (may also be an advantage)

COST SUMMARY	**Initial Cost**	**Present Value Subsequent Cost**	**Net Present Value**
Original Concept	**$** 70,000,000	**$** 0	**$** 70,000,000
Alternative Concept	**$** 40,000,000	**$** 0	**$** 40,000,000
Savings	**$** 30,000,000	**$** 0	**$** 30,000,000

Team Member:	Lucio V, Mark T, Tom H, Shane W, Doug B	**Discipline:**	Procurement, Design, Stakeholder, Design, Civil	**PERFORMANCE:**	**+8%**

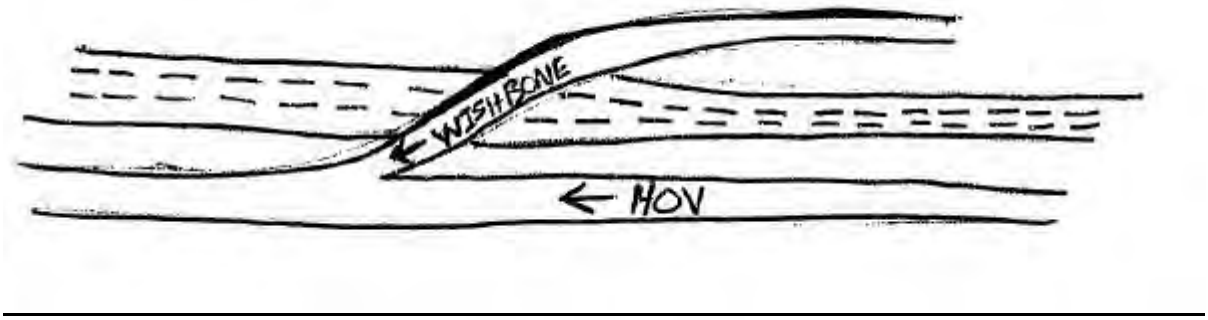
VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*	TxDOT/TTA	
TITLE: Revise wishbone design (instead of going over, go under)	**ALTERNATIVE NO.** 10.0 (M-10)	**PAGE NO** 2 of 6

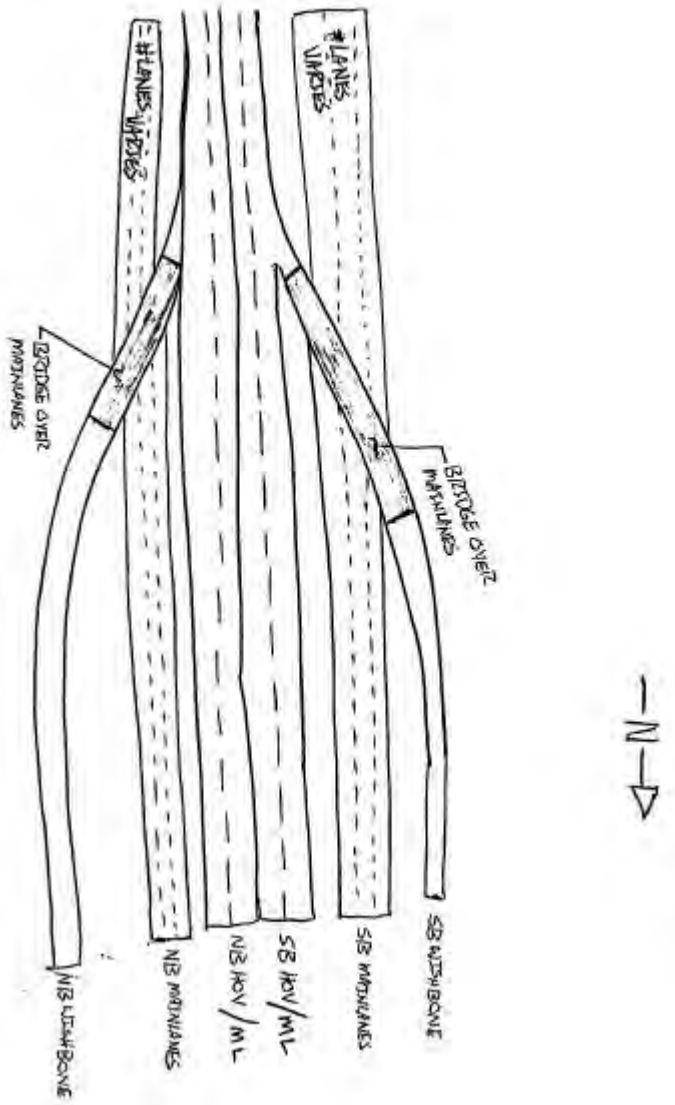
DISCUSSION / JUSTIFICATION:

Wishbone Locations	Feasible?
Between Valwood & Crosby	No
Between Beltline & Luna	Yes (move wishbone south for vertical clearance)
Between Sandy Lane & PBGT	Yes
@ FM 3040	No (3 levels)
Between FM 407 & Garden Ridge	Yes
@ Hundley	Yes
@ Mayhill	Yes

Note: Cost savings estimated at $6 million per location

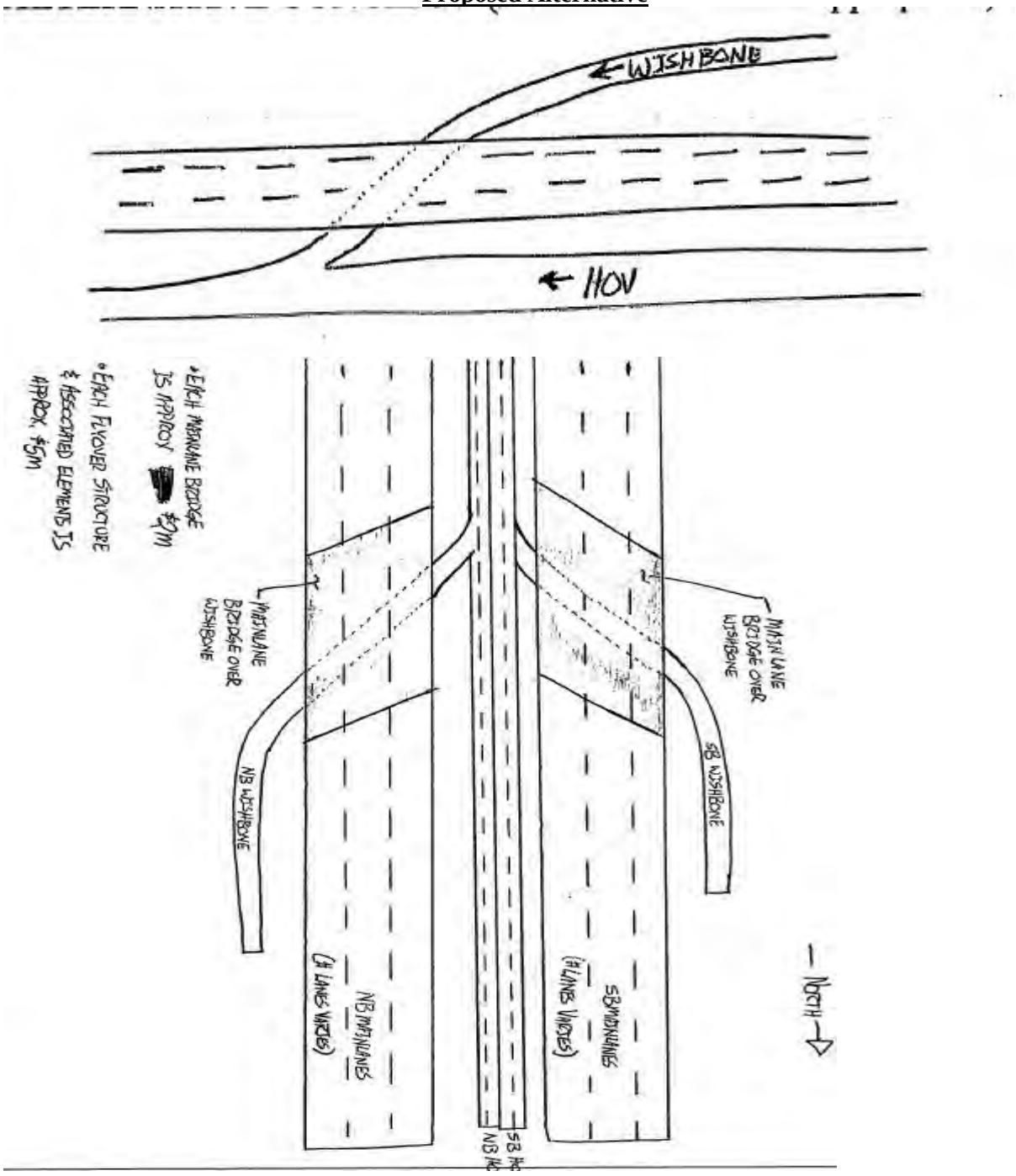
Original Design





SKETCHES *I-35E Managed Lanes Project*	TxDOT/TTA	
TITLE: Revise wishbone design (instead of going over, go under)	**NUMBER** 10.0 (M-10)	**PAGE NO.** 4 of 6

Proposed Alternative



PERFORMANCE *I-35E Managed Lanes Project*	TxDOT/TTA		
TITLE: Revise wishbone design (instead of going over, go under)	**NUMBER** 10.0 (M-10)		**PAGE NO.** 5 of 6
CRITERIA	**Performance**	**Original**	**Alternative**
REVENUE IMPACTS: No apparent change	Measure	Degree	Degree
	Rating	6	6
	Weight	18	18
	Contribution	108	108
TRAFFIC OPS - GENERAL PURPOSE LANES: No apparent change	Measure	Degree	Degree
	Rating	8	8
	Weight	17	17
	Contribution	136	136
TRAFFIC OPS - LOCAL: No apparent change	Measure	Degree	Degree
	Rating	8	8
	Weight	12	12
	Contribution	96	96
RIGHT OF WAY IMPACTS: No apparent change	Measure	Degree	Degree
	Rating	3	3
	Weight	10	10
	Contribution	30	30
ENVIRONMENTAL IMPACTS: Removal of large flyover structure.	Measure	Degree	Degree
	Rating	7	8
	Weight	14	14
	Contribution	98	112
STAKEHOLDER ACCEPTANCE: Removal of large flyover structure would result faster construction and less impact to the traveling public.	Measure	Degree	Degree
	Rating	7	8
	Weight	13	13
	Contribution	91	104
SCHEDULE IMPACT: Easier to build - provides flexibility in phasing	Measure	Degree	Degree
	Rating	5	8
	Weight	6	6
	Contribution	30	48
	Measure	Degree	Degree
	Rating		
	Weight		
	Contribution	0	0
Total Performance:		589	634
Net Change in Performance (%):			8%

Flyover Wishbones (Baseline)

Given the long span, steel beams, and straddle bents over main lane traffic, a straight forward cost estimate based on square footage will under estimate the actual cost of a flyover ramp. This is due to the additional cost of massive columns and straddle bents, along with difficulty of construction. Therefore and estimate of $10m per wishbone was used.

Main Lanes Over Wishbone Ramps (Alternate)

A basic, standard main lane bridge is built over the wishbone ramps. The ramps are woven through bridge columns so as not to impact the bent design. Costs are as follows:

1000’ of at grade wishbone ramp = (1000)(28)($7/SF) = $0.20m

1000’ of CTB x 2 sides = (2)(1000)($50/LF) = $0.10m

400’ of standard bridge ($50/sf)

5 lanes = (80)(400)(50) = $1.6m

4 lanes = (70)(400)(50) = $1.4m

3 lanes = (60)(400)(50) = $1.2m

Note: $2m per side was used to account for miscellaneous barriers, walls, etc.

VE TEAM ALTERNATIVE REVIEW *I-35E Managed Lanes Project*	**TxDOT/TTA**
TITLE: Revise Wishbone Design	**NUMBER** 10.0 (M-10)

Team Member: Michael Drayton

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

The calculation for $6m savings per wishbone is unclear

Team Member: Charles Riou

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

See comments as noted

Team Member: Spenta Irani

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

Questions on cost difference?

Team Member: Phil Ullman

X I have reviewed this alternative and agree with it as it is written

☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Eva Chan

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

Need more details on the cost estimate.

Team Member:

☐ I have reviewed this alternative and agree with it as it is written

☐ I have reviewed this alternative and suggest the following (or attached) changes

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*		TxDOT/TTA	
FUNCTION: Carry Traffic, Increase Capacity		**IDEA NO.** M-2	**ALTERNATIVE NO.** 11.0
TITLE: Remove CDs between PBGT and SH 121			**PAGE NO.** 1 of 6

ORIGINAL CONCEPT: (Attach sketch where appropriate)

Continuous CD road between PBGT and SH 121 interchanges.

ALTERNATIVE CONCEPT: (Attach sketch where appropriate)

Widen mainlanes from 3 to 5 lanes & use auxiliary lanes where needed.

ADVANTAGES:

- Simplifies 3 level interchange at FM 3040
- Could allow for future construction of CDs
- Saves about $30m

DISADVANTAGES:

- Traffic function will not be as good
  - Increased weaving
  - Diminishing returns on main lanes after exceeding 5 lanes in width
- Difficulty with existing interchange columns

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Net Present Value
Original Concept	**$** 22m	**$** 0	**$** 22m
Alternative Concept	**$** 0	**$** 0	**$** 0
Savings	**$** 22m	**$** 0	**$** 22m

Team Member: Doug Bowen	**Discipline:** Roadway Geometry	**PERFORMANCE:** **+0%**

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*	**TxDOT/TTA**
TITLE: Remove CDs between PBGT and SH 121	**ALTERNATIVE NO.** **11.0 (M-2)** / **PAGE NO** 2 of 6

DISCUSSION / JUSTIFICATION:

By removing CD roads, there is less pavement being constructed due to the merging of the 2 CD lanes onto the GP lanes. The bulk of savings is in the removal of long CD bridges (between Frankford & SH 121) being used to bridge over exit ramps & cross streets (FM 3040).

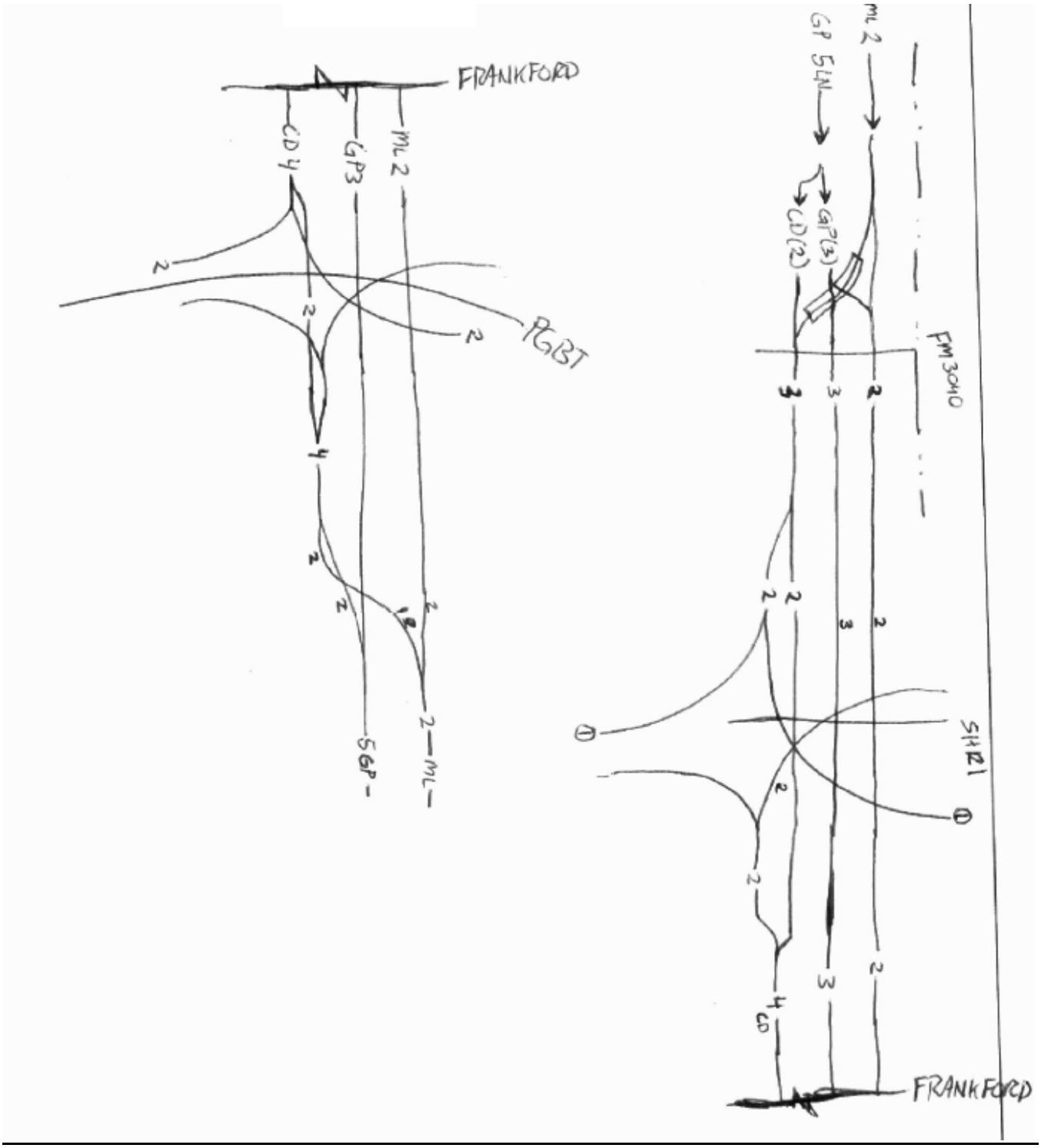
Although the main lanes are being widened, there will still be adequate width to fit CD roads in the later, when traffic necessitates and funding allows.

It also simplifies some of the connections between the managed lanes and the GP lanes & frontage road because there is one less roadway to deal with.

Wider GP lanes will also facilitate traffic control during construction, thus decreasing construction time.

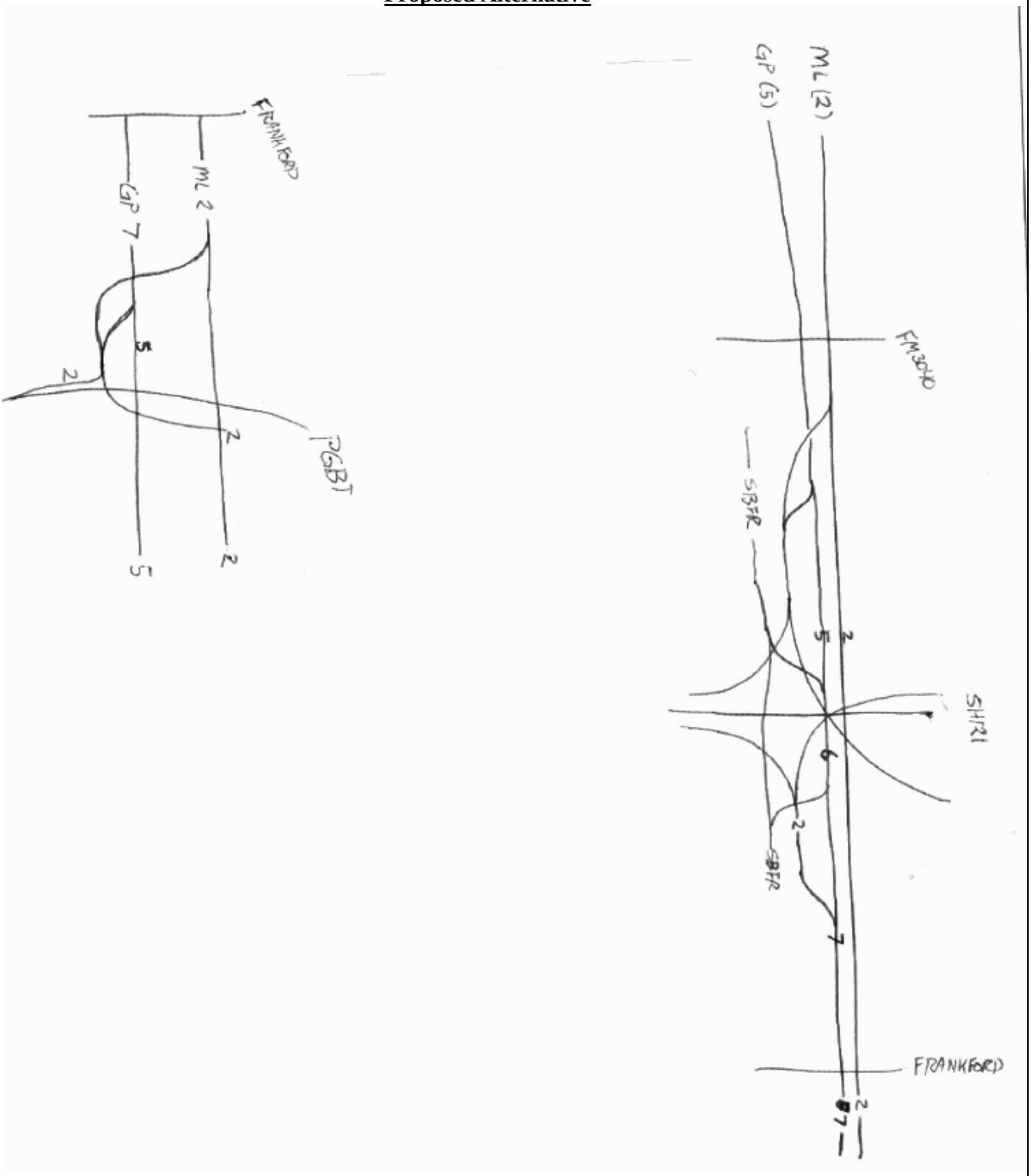
Design challenges will be ramp spacing, and avoiding columns at the existing interchanges ~ but shoulders can be reduced for "relatively short" distances, less than 2000', without requiring a design exceptions.

Original Design



SKETCHES *I-35E Managed Lanes Project*	TxDOT/TTA	
TITLE: Remove CDs between PBGT and SH 121	**NUMBER** **11.0 (M-2)**	**PAGE NO.** 4 of 6

Proposed Alternative



PERFORMANCE *I-35E Managed Lanes Project*		TxDOT/TTA	
TITLE: Remove CDs between PBGT and SH 121		**NUMBER** 11.0 (M-2)	**PAGE NO.** 5 of 6
CRITERIA	**Performance**	**Original**	**Alternative**
REVENUE IMPACTS: Tolling requires more complex software if tolls are to be captured on the CD roads due to the mixing of GP and ML traffic.	Measure	Degree	Degree
	Rating	6	6
	Weight	18	18
	Contribution	108	108
TRAFFIC OPS - GENERAL PURPOSE LANES: LOS is reduced due to a lack of separation that the CD roads provide, weaves will get worse.	Measure	Degree	Degree
	Rating	8	6
	Weight	17	17
	Contribution	136	102
TRAFFIC OPS - LOCAL: No apparent impact	Measure	Degree	Degree
	Rating	8	8
	Weight	12	12
	Contribution	96	96
RIGHT OF WAY IMPACTS: No new row.	Measure	Degree	Degree
	Rating	3	3
	Weight	10	10
	Contribution	30	30
ENVIRONMENTAL IMPACTS: Lower/fewer roadway levels at FM 3040. One wide roadway instead of 2 3 lane and 2 lane roadways.	Measure	Degree	Degree
	Rating	7	8
	Weight	14	14
	Contribution	98	112
STAKEHOLDER ACCEPTANCE: Positive ~ they don't seem to be happy about CD roads, but are willing to live with them out of traffic necessity.	Measure	Degree	Degree
	Rating	7	8
	Weight	13	13
	Contribution	91	104
SCHEDULE IMPACT: Wider GP lanes can reduce construction time due to easier traffic control.	Measure	Degree	Degree
	Rating	5	6
	Weight	6	6
	Contribution	30	36
	Measure	Degree	Degree
	Rating		
	Weight		
	Contribution	0	0
Total Performance:		589	588
Net Change in Performance (%):			0%

Additional Costs

Main lane pavement: 0.8m + 0.1m + 1.2m + 1.5m + 1.5m

Entrance Ramp @ SH 121: 0.3m

Main lane bridge: 0.6m

Main lane flyover to PBGT: 5.0m

Total additional cost: $11m

Reduced Costs

CD pavement: 0.2m + 1.0m + 0.7m + 1.7m

CD bridge: 9.2m + 1.2m + 6.5m + 1.3m

Total reduced cost: $21.8m

Net saving for SB I35E = $10.8m

Assume NB is equivalent to SB: Total net saving by eliminating CD roads between FM 3040/SH 121 and PBGT = $22m

VE TEAM ALTERNATIVE REVIEW *I-35E Managed Lanes Project*	**TxDOT/TTA**
TITLE: Remove CDs between PBGT and SH 121	**NUMBER** 11.0 (M-2)

Team Member: Kim Daily

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Bill Reichert

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Lucio Vasgez

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member:

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member:

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member:

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*		TxDOT/TTA	
FUNCTION:	Separate Grades, Eliminate Conflicts	**IDEA NO.** M-5, 7, 11, 12	**ALTERNATIVE NO.** 12.0
TITLE:	Construct Corporate, FM 407, Country Lane/S Denton, Turbeville over IH 35E		**PAGE NO.** 1 of 5

ORIGINAL CONCEPT: (Attach sketch where appropriate)

Current design calls for IH-35E over Corporate, FM 407, Country Lane/S. Denton, Turbeville.

ALTERNATIVE CONCEPT: (Attach sketch where appropriate)

Construct Corporate, FM 407, Country Lane/S Denton, Turbeville over IH 35E

ADVANTAGES:

- Simplifies construction
- Maintains existing character
- Reduces cost
- Maintains existing configuration
- Reduces time of cross street closure

DISADVANTAGES:

- Reduces adjacent development potential
- May impact to intersection capacity and cross street flow

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Net Present Value
Original Concept	**$** $48,082,710	**$** 0	**$** $48,082,710
Alternative Concept	**$** $21,088,309	**$** 0	**$** $21,088,309
Savings	**$** $26,994,401	**$** 0	**$** $26,994,401

Team Member:	Lucio V, Mark T, Tom H, Shane W, Doug B	**Discipline:**	Procurement, Design, Stakeholder, Design, Civil	**PERFORMANCE:**	-2%

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*		TxDOT/TTA	
TITLE:	Construct Corporate, FM 407, Country Lane/S Denton, Turbeville over IH 35E	**ALTERNATIVE NO.** 12.0 (M-5, 7, 11, 12)	**PAGE NO** 2 of 5

DISCUSSION / JUSTIFICATION:

The original design has I-35E cross over many cross streets. This VE concept recommends bringing those cross streets over I-35E. The average cross streets are 2-4 lanes wide, versus the I-35E with 4 MLs and 8 GP lanes. Therefore, the size of the bridge will be significantly reduced, as well as the construction complexity will be simplified. These selected locations will remain existing configurations.

PERFORMANCE *I-35E Managed Lanes Project*	**TxDOT/TTA**		
TITLE: Construct Corporate, FM 407, Country Lane/S Denton, Turbeville over IH 35E	**NUMBER** 12.0 (M-5)		**PAGE NO.** 3 of 5
CRITERIA	**Performance**	**Original**	**Alternative**
REVENUE IMPACTS: No change in revenue	Measure	Degree	Degree
	Rating	6	6
	Weight	18	18
	Contribution	108	108
TRAFFIC OPS - GENERAL PURPOSE LANES: No changes to GP lanes	Measure	Degree	Degree
	Rating	8	8
	Weight	17	17
	Contribution	136	136
TRAFFIC OPS - LOCAL: Sight distance impacts, some driveway limitations.	Measure	Degree	Degree
	Rating	8	7
	Weight	12	12
	Contribution	96	84
RIGHT OF WAY IMPACTS: Adverse right of way impacts at corners of cross streets	Measure	Degree	Degree
	Rating	3	2
	Weight	10	10
	Contribution	30	20
ENVIRONMENTAL IMPACTS: No apparent impacts	Measure	Degree	Degree
	Rating	7	7
	Weight	14	14
	Contribution	98	98
STAKEHOLDER ACCEPTANCE: Reduced construction cost favorable to stakeholders, reduced access at corners will not be favorable	Measure	Degree	Degree
	Rating	7	7
	Weight	13	13
	Contribution	91	91
SCHEDULE IMPACT: Reduced construction duration	Measure	Degree	Degree
	Rating	5	7
	Weight	6	6
	Contribution	30	42
	Measure	Degree	Degree
	Rating		
	Weight		
	Contribution	0	0
Total Performance:		589	579
Net Change in Performance (%):			-2%

CALCULATIONS/ASSUMPTIONS *I-35E Managed Lanes Project*		**TxDOT/TTA**	
TITLE:	Construct Corporate, FM 407, Country Lane/S Denton, Turbeville over IH 35E	**NUMBER** 12.0 (M-5)	**PAGE NO.** 4 of 5

Country Lane / Denton must be flipped in conjunction with Turbeville

Corporate & FM 407 existing profile grade will be held

Assumed average pavement width of 250’ for comparison purposes.

Assume ramp earthwork and retaining wall quantities are negligible

INITIAL COSTS

I-35 Managed Lanes Project

TxDOT/TTA

TITLE: Construct Corporate, FM 407, Country Lane/S Denton, Turbeville over IH 35E	**NUMBER**	**PAGE NO.**
	12.0 (M-5)	5 of 5

CONSTRUCTION ELEMENT		**ORIGINAL CONCEPT**			**ALTERNATIVE CONCEPT**		
Description	**Unit**	**Quantity**	**Cost/Unit**	**Total**	**Quantity**	**Cost/Unit**	**Total**
Corp - Bridge	SF	92,400	$50	$4,620,000	78,400	$50	$3,920,000
Corp - Embankment	CY	268,500	$8	$2,148,000	0	$8	$0
Corp - Retaining wall	SF	58,000	$75	$4,350,000	0	$75	$0
FM407 - Bridge	SF	103,750	$50	$5,187,500	66,000	$50	$3,300,000
FM407 - Embankment	CY	289,600	$8	$2,316,800	68,850	$8	$550,800
FM407 - Retaining wall	SF	62,556	$75	$4,691,700	24,200	$75	$1,815,000
CL/T - Bridge	SF	166,640	$50	$8,332,000	117,100	$50	$5,855,000
CL/T - Embankment	CY	508,444	$8	$4,067,552	83,670	$8	$669,360
CL/T - Retaining wall	SF	81,300	$75	$6,097,500	29,700	$75	$2,227,500
				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
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				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
Subtotal:				$41,811,052			$18,337,660
15% contigency:				$6,271,658			$2,750,649
TOTAL				$48,082,710			$21,088,309
						SAVINGS	$26,994,401

VE TEAM ALTERNATIVE REVIEW *I-35E Managed Lanes Project*		TxDOT/TTA
TITLE:	Construct Corporate, FM 407, Country Lane/S Denton, Turbeville over IH 35E	**NUMBER** 12.0 (M-5, 7, 11, 12)

Team Member: Dan Chapman

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

Stakeholder acceptance would be reduced from the base line

Team Member: Eva Chan

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

Comments on Discussion/Justification" section. Cost estimate should include 12.5% Engineering, QA/QC costs

Team Member: Charles Riou

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

See page 3

Team Member: Bill Reichert

☐ I have reviewed this alternative and agree with it as it is written

X I have reviewed this alternative and suggest the following (or attached) changes

Changes added to form

Team Member: Michael Drayton

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Matt MacGregor

☐ I have reviewed this alternative and agree with it as it is written

X I have reviewed this alternative and suggest the following (or attached) changes

Impact to intersection capacity. Does profile of 35E stay the same or become depressed?

VE TEAM ALTERNATIVE REVIEW *I-35E Managed Lanes Project*		**TxDOT/TTA**
TITLE:	Construct Corporate, FM 407, Country Lane/S Denton, Turbeville over IH 35E	**NUMBER** 12.0 (M-5, 7, 11, 12)

Team Member: Spenta Irani

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

Drainage along I035E will be more due to flatter slopes. Also schedule impact is not as significant for the overall project.

Team Member: Phil Ullman

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Xiaojin Jerry Ji

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Michael Kerrigan

X I have reviewed this alternative and agree with it as it is written

☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Doug Bowen

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

Intangibles – Oversize loads not impacted by height restrictions/sight distance; thus average speed is better with an overpass/more adjacent development with mainlanes over cross street

Team Member: Lucio Vasquez

☐ I have reviewed this alternative and agree with it as it is written

X I have reviewed this alternative and suggest the following (or attached) changes

What was the performance: a “-2%” or a “+2%”?

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*		TxDOT/TTA	
FUNCTION:	Span Water, Carry Traffic	**IDEA NO.** M-6	**ALTERNATIVE NO.** 13.0
TITLE:	Shorten Bridge (over water) length		**PAGE NO.** 1 of 6

ORIGINAL CONCEPT: (Attach sketch where appropriate)

Construct entire Lake Lewisville crossing on bridge.

ALTERNATIVE CONCEPT: (Attach sketch where appropriate)

Construct Lake Lewisville crossing on embankment (Causeway) with 1000' bridge at current bridge location.

ADVANTAGES:

- Reduces structure cost
- Easier to construct

DISADVANTAGES:

- Must mitigate fill within flood storage
- Reduces flexibility for future parking area under bridge
- Unknown flood / erosion impacts

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Net Present Value
Original Concept	**$** $258,915,655	**$** 0	**$** $258,915,655
Alternative Concept	**$** $88,664,296	**$** 0	**$** $88,664,296
Savings	**$** $170,251,359	**$** 0	**$** $170,251,359

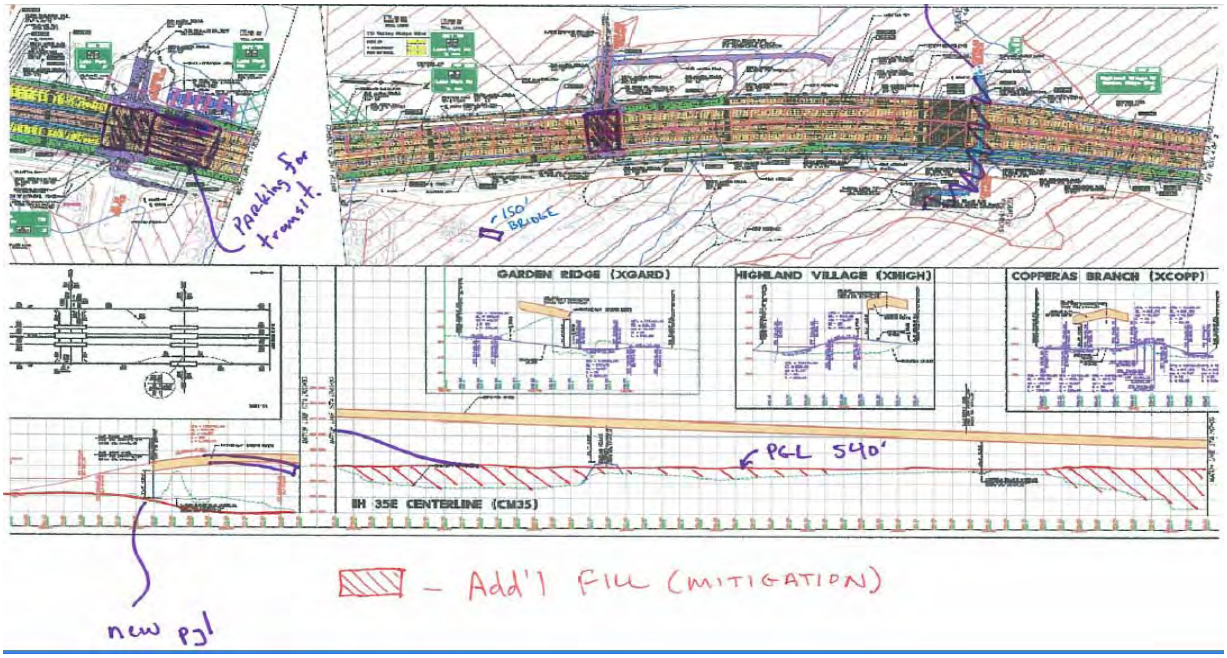
Team Member:	Lucio V, Mark T, Tom H, Shane W, Doug B	**Discipline:**	Procurement, Design, Stakeholder, Design, Civil	**PERFORMANCE:**	**+8%**

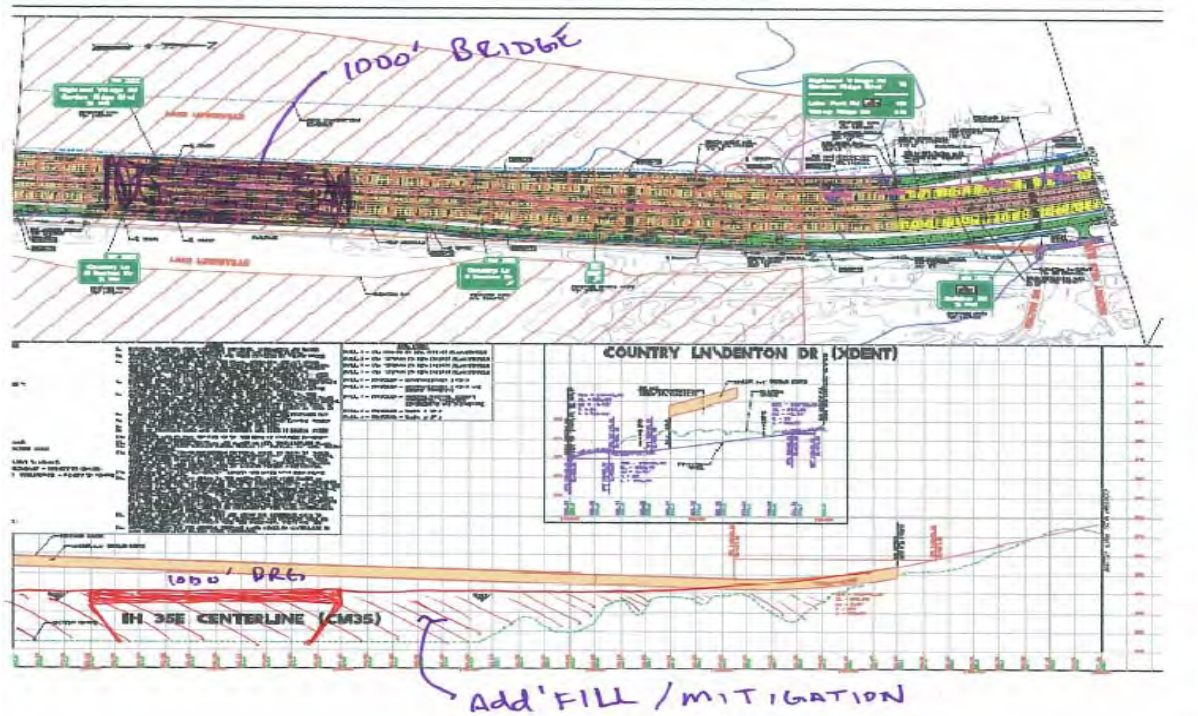
VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*	**TxDOT/TTA**	
TITLE: Shorten Bridge (over water) length	**ALTERNATIVE NO.** 13.0 (M-6)	**PAGE NO** 2 of 6

DISCUSSION / JUSTIFICATION:

The highway, in its current configuration is built on fill with a single bridge opening (1000' span). The original concept calls for a 9100' bridge spanning the entire lake. The reason for this is the avoidance of mitigation for additional fill to be placed in the lake as required by the COE. This alternative concept will require additional coordination with the COE to find a suitable location to mitigate the loss of lake capacity. Assuming mitigation is feasible, the concept will result in substantial savings in cost and construction time.

SKETCHES *I-35E Managed Lanes Project*		TxDOT/TTA	
TITLE: Shorten Bridge (over water) length		**NUMBER** 13.0 (M-6)	**PAGE NO.** 3 of 6





PERFORMANCE *I-35E Managed Lanes Project*	**TxDOT/TTA**		
TITLE: Shorten Bridge (over water) length	**NUMBER** 13.0 (M-6)		**PAGE NO.** 4 of 6
CRITERIA	**Performance**	**Original**	**Alternative**
REVENUE IMPACTS: Original lane configuration remains unchanged, no revenue impacts	Measure	Degree	Degree
	Rating	6	6
	Weight	18	18
	Contribution	108	108
TRAFFIC OPS - GENERAL PURPOSE LANES: General purpose lanes remain unchanged	Measure	Degree	Degree
	Rating	8	8
	Weight	17	17
	Contribution	136	136
TRAFFIC OPS - LOCAL: Access to park revised, but equal to original concept.	Measure	Degree	Degree
	Rating	8	8
	Weight	12	12
	Contribution	96	96
RIGHT OF WAY IMPACTS: Toe of slope for causeway will fit within proposed construction easement. No new right of way will be required	Measure	Degree	Degree
	Rating	3	3
	Weight	10	10
	Contribution	30	30
ENVIRONMENTAL IMPACTS: Increased mitigation required for additional fill in Lake Lewisville	Measure	Degree	Degree
	Rating	7	5
	Weight	14	14
	Contribution	98	70
STAKEHOLDER ACCEPTANCE: No impact to stakeholders except COE. This will require additional coordination and mitigation to be mutally agreed with COE. This may be a lenthy process we are told.	Measure	Degree	Degree
	Rating	7	5
	Weight	13	13
	Contribution	91	65
SCHEDULE IMPACT: Will reduce construction time. May increase review and approval of EA.	Measure	Degree	Degree
	Rating	5	6
	Weight	6	6
	Contribution	30	36
	Measure	Degree	Degree
	Rating		
	Weight		
	Contribution	0	0
Total Performance:		589	541
Net Change in Performance (%):			-8%

CALCULATIONS/ASSUMPTIONS *I-35E Managed Lanes Project*	**TxDOT/TTA**	
TITLE: Shorten Bridge (over water) length	**NUMBER** 13.0 (M-6)	**PAGE NO.** 5 of 6

Depth of water in lake = 20’

Intersections at Garden Ridge Blvd & Highland Village will be flipped. (cross streets over IH 35).

Copperas Branch Crossing will be eliminated, improvements will be made to park access road east of RR track.

INITIAL COSTS

I-35E Managed Lanes Project

TxDOT/TTA

TITLE: Shorten bridge (over water)

NUMBER 13.0 (M-6)

PAGE NO. 6 of 6

CONSTRUCTION ELEMENT		**ORIGINAL CONCEPT**			**ALTERNATIVE CONCEPT**		
Description	**Unit**	**Quantity**	**Cost/Unit**	**Total**	**Quantity**	**Cost/Unit**	**Total**
HV - Bridge	SF			$0	33,000	$50	$1,650,000
HV - Embankment	CY			$0	25,110	$8	$200,880
HV - Retaining Wall	SF			$0	10,000	$75	$750,000
CB - Pavement	SF	93,600	$6	$561,600			$0
CB - Embankment	CY	11,556	$8	$92,448			$0
CB - Retaining Wall	SF	26,000	$75	$1,950,000			$0
CB - Bridge (RR)	SF	2,400	$50	$120,000			$0
GR - Bridge	SF			$0	40,900	$50	$2,045,000
GR - Embankment	CY			$0	30,221	$8	$241,768
GR - Retaining Wall	SF			$0	28,000	$75	$2,100,000
CW - Embankment	CY			$0	2,854,907	$10	$28,549,070
CW - Foreshore Protection	SY			$0	60,667	$10	$606,670
CW - Pavement	SF			$0	2,502,500	$8	$20,020,000
CW - Bridge	*SF*	2,022,000	$110	$222,420,000			$0
Access Road Improvement - Bridge	***SF***			$0	7,200	$50	$360,000
Access Road Improvement - Roadway	***SY***			$0	28,800	$20	$576,000
Miscellaneous Improvement - COE	EA			$0	1	$20,000,000	$20,000,000
				$0			$0
				$0			$0
				$0			$0
				$0			$0
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				$0			$0
				$0			$0
Subtotal:				$225,144,048			$77,099,388
15% contigency:				$33,771,607			$11,564,908
TOTAL				$258,915,655			$88,664,296
						SAVINGS	$170,251,359

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*		**TxDOT/TTA**
FUNCTION: General/Phasing/Traffic Control	**IDEA NO.** M-8	**ALTERNATIVE NO.** 14.0
TITLE: Eliminate new frontage road construction over Lake Lewisville		**PAGE NO.** 1 of 5

ORIGINAL CONCEPT: (Attach sketch where appropriate)

Construct continuous frontage roads over Lake Lewisville.

ALTERNATIVE CONCEPT: (Attach sketch where appropriate)

This alternative assumes a frontage road will not be built across Lake Lewisville.

ADVANTAGES:

- Save cost (majority of bridges, most of the bridges over Lake Lewisville)
- Use of more of existing structure (bridge over lake)
- Reduces impact to COE recreation area.
- Reduces maintenance cost
- Reduces columns in flood storage area
- Increases revenue on managed lanes

DISADVANTAGES:

- Affects access to COE recreation area. (Would change mitigation and access plan.)
- Incident management flexibility is reduced.
- Access issues
- Increases congestion on general purpose lanes

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Net Present Value
Original Concept	**$** 321,334,000	**$** 0	**$** 321,334,000
Alternative Concept	**$** 141,416,000	**$** 0	**$** 141,416,000
Savings	**$** 179,918,000	**$** 0	**$** 179,918,000

Team Member:	Mark Taylor Spenta Irani, Charles Riou, Bill Reichert, Kim Daily	**Discipline:**	Design Design Design TTA Assistant	**PERFORMANCE:** **-1%**

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*	TxDOT/TTA	
TITLE: Eliminate new frontage road construction over Lake Lewisville	**ALTERNATIVE NO.** 14.0 (M-8)	**PAGE NO** 2 of 5

DISCUSSION / JUSTIFICATION:

By construction of the frontage roads where over Lake Lewisville, the initial capital costs are reduced while the level of service on the GPs and MLs are not significantly impacted. The frontage road section being investigated, in the baseline case, provides frontage road continuity and a sidewalk for pedestrians.

The managed lanes could be used for incident management.

Because the quantity of bridges is being reduced, the cost of maintenance is reduced.

PERFORMANCE *I-35E Managed Lanes Project*	**TxDOT/TTA**		
TITLE: Eliminate new frontage road construction over Lake Lewisville	**NUMBER** 14.0 (M-8)		**PAGE NO.** 3 of 5
CRITERIA	**Performance**	**Original**	**Alternative**
REVENUE IMPACTS: Potential increase in revenue due to bottlenect at bridge (3 GP lanes).	Measure	Degree	Degree
	Rating	6	7
	Weight	18	18
	Contribution	108	126
TRAFFIC OPS - GENERAL PURPOSE LANES: Operational efficiency of GP lanes will be reduced because interim solution only provides to 3 GP lanes and a bottleneck is created at the bridge over Lake Lewisville.	Measure	Degree	Degree
	Rating	8	7
	Weight	17	17
	Contribution	136	119
TRAFFIC OPS - LOCAL: Operational efficiency of FR (local) lanes will be reduced because frontage roads over Lake Lewisville are Eliminated. Frontage roads will not be continuous.	Measure	Degree	Degree
	Rating	8	7
	Weight	12	12
	Contribution	96	84
RIGHT OF WAY IMPACTS: Not applicable.	Measure	Degree	Degree
	Rating	3	3
	Weight	10	10
	Contribution	30	30
ENVIRONMENTAL IMPACTS: Decrease in air quality due to additional congestion on GP and ML.	Measure	Degree	Degree
	Rating	7	7
	Weight	14	14
	Contribution	98	98
STAKEHOLDER ACCEPTANCE: Stakeholder will view this negatively, both the City of Lewisville and COE	Measure	Degree	Degree
	Rating	7	5
	Weight	13	13
	Contribution	91	65
SCHEDULE IMPACT: Reduces time for construction.	Measure	Degree	Degree
	Rating	5	6
	Weight	6	6
	Contribution	30	36
	Measure	Degree	Degree
	Rating		
	Weight		
	Contribution	0	0
Total Performance:		589	558
Net Change in Performance (%):			-5%

CALCULATIONS/ASSUMPTIONS *I-35E Managed Lanes Project*	**TxDOT/TTA**	
TITLE: Eliminate new frontage road construction over Lake Lewisville	**NUMBER** 14.0 (M-8)	**PAGE NO.** 5 of 5

Assuming can use the existing bridge over Lake Lewisville for some of the NB GP lanes and NB ML plus pedestrian walkway. (Interim condition will have 3 GP lanes (no pedestrian walkway) in each direction due to constructability of using the existing structure. The ultimate will accommodate pedestrians in the same manner as the baseline.)

Assume that COE recreation area mitigation will be reduced with elimination of FR.

Assume existing bridge has at least 20 years usable life left. (Assumed in baseline as well.)

INITIAL COSTS

I-35E Managed Lanes Project

TxDOT/TTA

TITLE: Eliminate new frontage road construction over Lake Lewisville

NUMBER 14.0 (M-8)

CONSTRUCTION ELEMENT		ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
Description	**Unit**	**Quantity**	**Cost/Unit**	**Total**	**Quantity**	**Cost/Unit**	**Total**
Bridges (concrete over water) GP	SF	1,450,892	$110	$159,598,120	725,446	$110	$79,799,060
Bridges (concrete over water) FR	SF	304,360	$110	$33,479,600	0	$0	$0
Bridges (concrete over water) ML	SF	784,936	$110	$86,342,960	392,468	$110	$43,171,480
				$0			$0
				$0			$0
				$0			$0
				$0			$0
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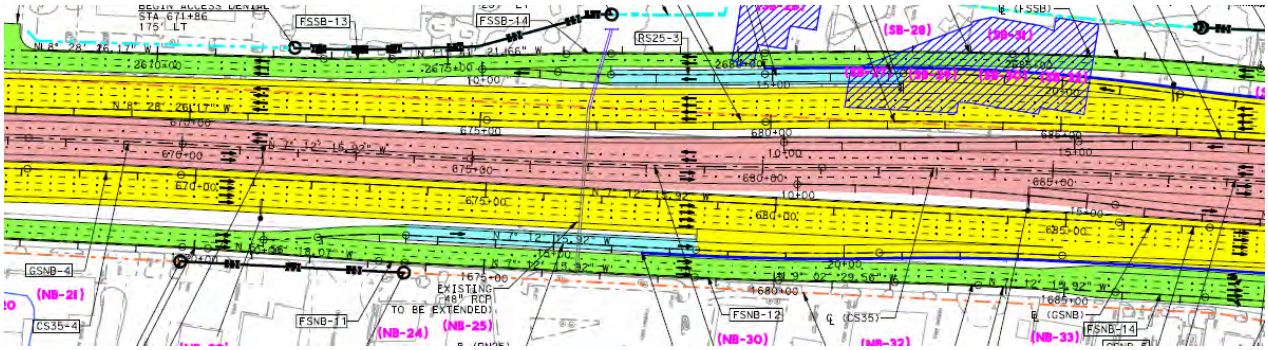
				$0			$0
				$0			$0
				$0			$0
Subtotal:				$279,420,680			$122,970,540
15% contigency:				$41,913,102			$18,445,581
TOTAL				$321,333,782			$141,416,121
						SAVINGS	$179,917,661

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*		**TxDOT/TTA**
FUNCTION: Facilitate Access	**IDEA NO.** S-13	**ALTERNATIVE NO.** 15.0
TITLE: Extend frontage road (auxiliary lanes) from ramp to ramp instead of ramp to cross street		**PAGE NO.** 1 of 5

ORIGINAL CONCEPT: (Attach sketch where appropriate)



ALTERNATIVE CONCEPT: (Attach sketch where appropriate)

Extend frontage road (auxiliary lanes) from ramp to ramp instead of ramp to cross street

ADVANTAGES:

- Reduces upfront cost by eliminating 12' lanes
- Reduces maintenance cost
- Reduces weaving distance
- May expand at a later date, if warranted

DISADVANTAGES:

- Congestion concerns
- May deviate from previous commitments to stakeholders
- Environmental assessment may need to be redone

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Net Present Value
Original Concept	$ $3,493,000	$ 0	$ $3,493,000
Alternative Concept	$ $2,329,000	$ 0	$ $2,329,000
Savings	$ $1,164,000	$ 0	$ $1,164,000

Team Member:	Mark Taylor Spenta Irani, Charles Riou, Bill Reichert, Kim Daily	**Discipline:**	Design Design Design TTA Assistant	**PERFORMANCE:**	**-8%**

DISCUSSION / JUSTIFICATION:

There are several areas in the south segment that may benefit from a reduction in the number of frontage lanes without sacrificing access.

Removing a 12' frontage road from ramp to cross-street reduces the upfront cost of the project, along with a savings in future maintenance work.

Following stations are sections that may be eliminated:

Northbound

671+00 to 686+00

785+00 to 806+00

843+00 to 866+00 (includes approx. 250 ft. of bridge)

Southbound

639+00 to 654+00

763+00 to 776+00 (includes approx. 200 ft. of bridge)

.

PERFORMANCE *I-35E Managed Lanes Project*	TxDOT/TTA		
TITLE: Extend frontage road (auxiliary lanes) from ramp to ramp instead of ramp to cross street	**NUMBER** 15.0 (S-13)		**PAGE NO.** 3 of 5
CRITERIA	**Performance**	**Original**	**Alternative**
REVENUE IMPACTS: Potential tertiary revenue impacts	Measure	Degree	Degree
	Rating	6	7
	Weight	18	18
	Contribution	108	126
TRAFFIC OPS - GENERAL PURPOSE LANES: Potential secondary impacts due to reduced weaving on frontage road.	Measure	Degree	Degree
	Rating	8	7
	Weight	17	17
	Contribution	136	119
TRAFFIC OPS - LOCAL: Direct impact to frontage road congestion	Measure	Degree	Degree
	Rating	8	6
	Weight	12	12
	Contribution	96	72
RIGHT OF WAY IMPACTS: No change in row possible due to short segments applicable (2300' max)	Measure	Degree	Degree
	Rating	3	3
	Weight	10	10
	Contribution	30	30
ENVIRONMENTAL IMPACTS: May require minor adjustments to document, does not impact overall project configuration	Measure	Degree	Degree
	Rating	7	7
	Weight	14	14
	Contribution	98	98
STAKEHOLDER ACCEPTANCE: Less desirable for local business, may create secondary congestion on local streets	Measure	Degree	Degree
	Rating	7	5
	Weight	13	13
	Contribution	91	65
SCHEDULE IMPACT: No significant change	Measure	Degree	Degree
	Rating	5	5
	Weight	6	6
	Contribution	30	30
	Measure	Degree	Degree
	Rating		
	Weight		
	Contribution	0	0
Total Performance:		589	540
Net Change in Performance (%):			-8%

CALCULATIONS/ASSUMPTIONS *I-35E Managed Lanes Project*		**TxDOT/TTA**	
TITLE:	Extend frontage road (auxiliary lanes) from ramp to ramp instead of ramp to cross street	**NUMBER** 15.0 (S-13)	**PAGE NO.** 4 of 5

Pavement cost for frontage road = $6 per sf

Assume earthwork reduction = $1.50 per sf

Used $7.50 per sf

INITIAL COSTS

I-35 Managed Lanes Project

TxDOT/TTA

TITLE: Extend frontage road (auxiliary lanes) from ramp to ramp instead of ramp to cross street

NUMBER 15.0 (S-13)

CONSTRUCTION ELEMENT		ORIGINAL CONCEPT			ALTERNATIVE CONCEPT		
Description	**Unit**	**Quantity**	**Cost/Unit**	**Total**	**Quantity**	**Cost/Unit**	**Total**
Pvmt Sta 671+00 to 686+00 (NBFR)	SF	54,000	$8	$405,000	36,000	$8	$270,000
Pvmt Sta 639+00 to 654+00 (SBFR)	SF	54,000	$8	$405,000	36,000	$8	$270,000
Pvmt Sta 785+00 to 806+00 (NBFR)	SF	75,600	$8	$567,000	50,400	$8	$378,000
Pvmt Sta 763+00 to 776+00 (SBFR)	SF	39,600	$8	$297,000	26,400	$8	$198,000
Bridge with limits of above	SF	7,200	$50	$360,000	4,800	$50	$240,000
Pvmt Sta 843+00 to 866+00	SF	73,800	$8	$553,500	49,200	$8	$369,000
Bridge with limits of above	SF	9,000	$50	$450,000	6,000	$50	$300,000
				$0			$0
				$0			$0
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				$0			$0
				$0			$0
				$0			$0
Subtotal:				$3,037,500			$2,025,000
15% contigency:				$455,625			$303,750
TOTAL				$3,493,125			$2,328,750
						SAVINGS	$1,164,375

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*	**TxDOT/TTA**	
FUNCTION: Allow Construction	**IDEA NO.** P-1	**ALTERNATIVE NO.** 16.0
TITLE: Allow purchase of ROW (by individual parcel or selected) but defer construction of north segment. If possible, lease back ROW to market when available.		**PAGE NO.** 1 of 5

ORIGINAL CONCEPT: The current plan is to acquire all the right of way (ROW) on the north segment, demolish the structures, relocate utilities and then construct new frontage roads and the full roadway cross section.

ALTERNATIVE CONCEPT: The alternative concept is to defer construction of the entire north improvements from FM 2181 to US 380 and instead just purchase the ROW needed.

ADVANTAGES:

- Defers $662.9M in construction costs until funding is available.
- Allows acquisition of ROW from property owners, especially those displaced, earlier than when full funding becomes available.
- Allows displaced property owners to lease back their properties and can remain in their home or business as long as possible.
- May generate revenue from leases, but may be a low return due to property management costs.

DISADVANTAGES:

- Does not provide any congestion relief for the north segment in the interim period.
- Requires TxDOT to become real estate property managers or hire professional property managers to maintain property and collect rents.
- Properties may still become derelict since they will eventually be demolished.

COST SUMMARY	**Initial Cost**	**Present Value Subsequent Cost**	**Net Present Value**
Original Concept	**$** 846,297,000	**$** 0	**$** 846,297,000
Alternative Concept	**$** 0	**$** 0	**$** 0
Savings	**$** 846,297,000	**$** 0	**$** 846,297,000

Team Member: Matt Craig	**Discipline:** Design	**PERFORMANCE:** **-6%**

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*		TxDOT/TTA	
TITLE:	Allow purchase of ROW (by individual parcel or selected) but defer construction of north segment.	**ALTERNATIVE NO.** 16.0 (P-1)	**PAGE NO** 2 of 5

DISCUSSION / JUSTIFICATION:

There is a significant funding gap to construct the ultimate IH 35E improvements. In addition, traffic and revenue studies show that construction dollars for the ultimate improvements in the North Segment generate the least amount of revenue return when compared to the South and Middle Segments. Based on these results, the North Segment is the least attractive segment within the IH 35E Corridor to be included in a PPA or CDA project.

Due to this limited funding and lower revenue potential, the construction of the north segment may be deferred until funding becomes available. However, once environmental clearance has been obtained, the ROW acquisition could begin as the first stage of project development.

The $425M cost for acquisition of the ROW will be about 33% of the total north segment costs. At least $663M in construction costs will be deferred. The remaining $183M in utility relocation and engineering could also be deferred for a total deferral of $846M. This is 67% of the total north segment cost of $1,271M.

PERFORMANCE *I-35E Managed Lanes Project*		TxDOT/TTA	
TITLE: Allow purchase of ROW (by individual parcel or selected) but defer construction of north segment.		**NUMBER** 16.0 (P-1)	**PAGE NO.** 3 of 5
CRITERIA	**Performance**	**Original**	**Alternative**
REVENUE IMPACTS: Although it does not generate revenue, it defers costs to a later date.	Measure	Degree	Degree
	Rating	6	7
	Weight	18	18
	Contribution	108	126
TRAFFIC OPS - GENERAL PURPOSE LANES: Deferral of reconstruction will cause the continued increase in congestion.	Measure	Degree	Degree
	Rating	8	6
	Weight	17	17
	Contribution	136	102
TRAFFIC OPS - LOCAL: Deferral of reconstruction will cause the continued and increased level of congestion, but to a lesser extent to the local cross streets and frontage roads	Measure	Degree	Degree
	Rating	8	7
	Weight	12	12
	Contribution	96	84
RIGHT OF WAY IMPACTS: No change in ROW limnits	Measure	Degree	Degree
	Rating	3	3
	Weight	10	10
	Contribution	30	30
ENVIRONMENTAL IMPACTS: No change in environmental impacts	Measure	Degree	Degree
	Rating	7	7
	Weight	14	14
	Contribution	98	98
STAKEHOLDER ACCEPTANCE: Likely to be have limited acceptance by the locals due to the lack of congestion relief. However, other stakeholders may favor this alternative which allows "a" project be delivered.	Measure	Degree	Degree
	Rating	7	7
	Weight	13	13
	Contribution	91	91
SCHEDULE IMPACT: Deferral of funding will cause delay of overall improvements. ROW acquisition would remain on schedule.	Measure	Degree	Degree
	Rating	5	4
	Weight	6	6
	Contribution	30	24
	Measure	Degree	Degree
	Rating		
	Weight		
	Contribution	0	0
Total Performance:		589	555
Net Change in Performance (%):			-6%

CALCULATIONS/ASSUMPTIONS *I-35E Managed Lanes Project*		TxDOT/TTA	
TITLE:	Allow purchase of ROW (by individual parcel or selected) but defer construction of north segment.	**NUMBER** 16.0 (P-1)	**PAGE NO.** 4 of 5

- It was assumed that design and utility relocation would not occur until funding becomes available for construction.
- Assumes the rate of construction inflation will equal the interest cost so that there is no adjustment for net present value (cost or savings) by deferring construction.

See attached estimate for cost calculations.

INITIAL COSTS

I-35 Managed Lanes Project

TxDOT/TTA

TITLE: Allow purchase of ROW (by individual parcel or selected) but defer construction of north segment.	**NUMBER**	**PAGE NO.**
	16.0 (P-1)	5 of 5

CONSTRUCTION ELEMENT		**ORIGINAL CONCEPT**			**ALTERNATIVE CONCEPT**		
Description	**Unit**	**Quantity**	**Cost/Unit**	**Total**	**Quantity**	**Cost/Unit**	**Total**
				$0			$0
Construction	LS	1	$662,940,000	$662,940,000	0		$0
Right of Way	LS	1	$425,032,861	$425,032,861	1	$425,032,861	$425,032,861
Utility Relocation	LS	1	$89,306,772	$89,306,772	0		$0
PS&E	LS	1	$45,140,000	$45,140,000	0		$0
QA/QC and IE	LS	1	$48,910,000	$48,910,000	0		$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
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				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
Subtotal:				$1,271,329,633			$425,032,861
15% contigency: (included in unit cost)				$0			$0
TOTAL				$1,271,329,633			$425,032,861
						SAVINGS	$846,296,772

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*		**TxDOT/TTA**
FUNCTION: Connect Roadways, Separate Grades	**IDEA NO.** 17.0	**ALTERNATIVE NO.** N-2, N-7
TITLE: **Flip the connection at US 77 with IH 35E at grade.**		**PAGE NO.** 1 of 7

ORIGINAL CONCEPT: (Attach sketch where appropriate)

The original design of the IH 35E / US 77 interchange has the IH 35E main lanes on structure with the US 77 highway going under the interstate and connecting using 5 ramps (2 to the managed lanes, 1 to the southbound general purpose lanes, and 2 to the frontage roads)

ALTERNATIVE CONCEPT: (Attach sketch where appropriate)

The alternative concept design of the interchange keeps IH 35E at grade and has US 77 going up and over the interstate before connecting through four ramps (2 to the managed lanes and 2 to the frontage roads). This concept allows the southbound braided ramps, just north of US 77 Interchange, to be removed. The entrance ramp in this braided ramp configuration is relocated to the south of the entering US 77 SB traffic.

ADVANTAGES:

- Lowers freeway, potentially reducing noise
- Reduces bridge structure which reduces structural cost
- Removes braided ramp on SB IH 35E, just north of the US 77 interchange
- Eliminates double gores (SB)

DISADVANTAGES:

- May cause weaving issues on frontage roads
- Impacts at least two additional residential houses
- Removes the Pennsylvania/San Jacinto & IH 35E interchange

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Net Present Value
Original Concept	**$** 23,934,000	**$** 0	**$** 23,934,000
Alternative Concept	**$** 8,605,000	**$** 0	**$** 8,605,000
Savings	**$** 15,329,000	**$** 0	**$** 15,329,000

Team Member: Jeremy McGahan	**Discipline:** Designer	**PERFORMANCE:** **-1%**

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*	**TxDOT/TTA**	
TITLE: Flip the connection at US 77 with IH 35E at grade.	**ALTERNATIVE NO.** 17.0 (N-2, N-7)	**PAGE NO** 2 of 7

DISCUSSION / JUSTIFICATION:

Flipping the connection between US 77 and IH 35E has the potential of cutting construction costs. Further development and investigation of this concept would be required. Initial review of the vertical profiles show that flipping this interchange may be possible. If possible, approximately $15 Million in structural cost could be saved. The cost comparison, for purposes in this ve study, only deduct pavement and structure costs. Much more detail in design would be required to determine the quantities of change in retaining wall, sound wall, cut & fill, as well as other items included in the construction costs. In addition to flipping this interchange, we also reconfigured the connection between the managed lanes. Both ramps were relocated to merge into the center of the managed lanes on the interstate. This would save money by keeping these two facilities on the same structure. The SB US 77 to IH 35E general purpose lanes and the SB US 77 to IH 35E frontage road ramps were also merged into a two lane ramp to the IH 35E frontage road. An entrance ramp was then added to the south. Relocating this entrance ramp to connect to the frontage road then allowed removing the entrance ramp approximately 1,000 feet to the north (part of the existing braided ramp configuration). Flipping the interchange presented in this concept would also eliminate the San Jacinto crossing of IH 35E.

A minimum of two additional residential houses would be impacted from implementing this concept. Additional ROW to the west of the interstate may be required in order to relocate the SB entrance ramp. Access along the southbound frontage road would be removed to several cross-streets; however, access could be maintained by modifying the cross-streets and cul-de-sacs.

Original Design

SKETCHES *I-35E Managed Lanes Project*		**TxDOT/TTA**
TITLE: Flip the connection at US 77 with IH 35E at grade.	**NUMBER** 17.0 (N-2, N-7)	**PAGE NO.** 4 of 7

Proposed Alternative

PERFORMANCE *I-35E Managed Lanes Project*	**TxDOT/TTA**		
TITLE: Flip the connection at US 77 with IH 35E at grade.	**NUMBER** 17.0 (N-2, N-7)		**PAGE NO.** 5 of 7
CRITERIA	**Performance**	**Original**	**Alternative**
REVENUE IMPACTS: No Revenue Impacts	Measure	Degree	Degree
	Rating	6	6
	Weight	18	18
	Contribution	108	108
TRAFFIC OPS - GENERAL PURPOSE LANES: One less ramp to the interstate, could potentially improve los along interstate	Measure	Degree	Degree
	Rating	8	8.5
	Weight	17	17
	Contribution	136	144.5
TRAFFIC OPS - LOCAL: More weaving along frontage roads, less access	Measure	Degree	Degree
	Rating	8	7.5
	Weight	12	12
	Contribution	96	90
RIGHT OF WAY IMPACTS: Could require taking a small amount of row along west row line	Measure	Degree	Degree
	Rating	3	2.5
	Weight	10	10
	Contribution	30	25
ENVIRONMENTAL IMPACTS: No change to environmental impacts	Measure	Degree	Degree
	Rating	7	7
	Weight	14	14
	Contribution	98	98
STAKEHOLDER ACCEPTANCE: Less access to neighbor hoods and development areas, could have a minor negative impact with these stakeholders	Measure	Degree	Degree
	Rating	7	6.5
	Weight	13	13
	Contribution	91	84.5
SCHEDULE IMPACT: Would be constructed quicker since there would be a lot less structure	Measure	Degree	Degree
	Rating	5	5.5
	Weight	6	6
	Contribution	30	33
	Measure	Degree	Degree
	Rating		
	Weight		
	Contribution	0	0
Total Performance:		589	583
Net Change in Performance (%):			-1%

Assumptions:

For cost comparison, only bridge structure and at grade pavement were calculated. Additional detailing would be needed to accurately estimate the changes in retaining wall, sound wall, and cut and fill estimate. A redesign of the interchange was performed in microstation and measurements of the structure and pavements were taken. The proposed bridge for each alternative was measured and a difference in the structure that would turn into pavement was then included in a cost for the alternative design.

INITIAL COSTS

I-35 Managed Lanes Project

TxDOT/TTA

TITLE: Flip the connection at US 77 with IH 35E at grade.

NUMBER	**PAGE NO.**
17.0 (N-2, N-7)	7 of 7

CONSTRUCTION ELEMENT		**ORIGINAL CONCEPT**			**ALTERNATIVE CONCEPT**		
Description	**Unit**	**Quantity**	**Cost/Unit**	**Total**	**Quantity**	**Cost/Unit**	**Total**
Concrete Bridge	SF	416,241	$50	$20,812,050	80,000	$50	$4,000,000
Steel Bridge	SF	0	$110	$0	18,830	$110	$2,071,300
Additional SP-D	Ton	0	$90	$0	6,820	$90	$613,800
Additional SMA-D	Ton	0	$97	$0	3,410	$97	$330,770
Additional Cement	Ton	0	$115	$0	945	$115	$108,675
Additional Treatment	SY	0	$11	$0	32,550	$11	$358,050
				$0			$0
				$0			$0
				$0			$0
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				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
Subtotal:				$20,812,050			$7,482,595
15% contigency:				$3,121,808			$1,122,389
TOTAL				$23,933,858			$8,604,984
						SAVINGS	$15,328,873

VE TEAM ALTERNATIVE REVIEW *I-35E Managed Lanes Project*	**TxDOT/TTA**
TITLE: Flip the connection at US 77 with IH 35E at grade	**NUMBER** 17.0 (N-2/N-7)

Team Member: Phil Ullman

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: John Nguyen

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Michael Drayton

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

Detailed costs sheet and cost summary table do not match in value. Recommend 15% contingency is also included in cost summary table.

Team Member: Bill Reichert

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

Comments as noted.

Team Member: Charles Riou

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

See pages 1 & 2

Team Member: Eva Chan

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Cost saving should be $15.3m

VE TEAM ALTERNATIVE REVIEW *I-35E Managed Lanes Project*	**TxDOT/TTA**
TITLE: Flip the connection at US 77 with IH 35E at grade	**NUMBER** 17.0 (N-2/N-7)

Team Member: Spenta Irani

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

Comments as noted.

Team Member: Doug Bowen

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

See comments

Team Member: Michael Kerrigan

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Xiaojin Jerry Ji

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

With the comments made on the sheet and comments made by others

Team Member:

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member:

☐ I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*		**TxDOT/TTA**
FUNCTION: Separate Traffic, Eliminate Conflicts	**IDEA NO.** N-3, N-8	**ALTERNATIVE NO.** 18.0
TITLE: Combine exit ramps from US 77 to IH 35E, relocate braided ramp to south		**PAGE NO.** 1 of 7

ORIGINAL CONCEPT: (Attach sketch where appropriate)

The original concept included two separate ramps from US 77 to IH 35E, one of which went to the general purpose lanes and the other went to the frontage roads. Further upstream on IH 35E, a braided ramp configuration is present on the southbound direction

ALTERNATIVE CONCEPT: (Attach sketch where appropriate)

This alternative concept would merge the two ramps from US 77 to go to the IH 35E southbound frontage road. A proposed entrance ramp to the south would then connect the frontage road to the interstate. The addition of this impact could warrant removing the entrance ramp approximately 1000 feet to the north and simply relocate it to the south.

ADVANTAGES:

- Reduction in cost
- Removes braided ramp

DISADVANTAGES:

- May cause weaving issues on frontage roads
- Potentially lead to additional row impacts

COST SUMMARY	**Initial Cost**	**Present Value Subsequent Cost**	**Net Present Value**
Original Concept	**$** 1,535,250	**$** 0	**$** 1,535,250
Alternative Concept	**$** 157,061	**$** 0	**$** 157,061
Savings	**$** 1,378,189	**$** 0	**$** 1,378,189

Team Member: Jeremy McGahan	**Discipline:** Designer	**PERFORMANCE:** **-2%**

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*		TxDOT/TTA	
TITLE:	Combine exit ramps from US 77 to IH 35E, relocate braided ramp to south	**ALTERNATIVE NO.** 18.0 (N-3, N-8)	**PAGE NO** 2 of 7

DISCUSSION / JUSTIFICATION:

This alternative concept is pretty straight forward. The concept is to merge the US 77-IH 35E general purpose and frontage road ramps to a two lane ramp to the frontage road. It then includes relocating the IH 35E entrance ramp just north of the interchange to the south to accommodate the traffic from US 77. Overall, it would basically reduce one ramp from the project. Negative impacts from this alternative concept would include potential row impacts to the west of the interstate to accommodate the ramp relocation. The concept has the potential of saving approximately $1 million in structural costs.

SKETCHES *I-35E Managed Lanes Project*		TxDOT/TTA	
TITLE:	Combine exit ramps from US 77 to IH 35E, relocate braided ramp to south	**NUMBER** 18.0 (N-3, N-8)	**PAGE NO.** 3 of 7

Original Design

SKETCHES *I-35E Managed Lanes Project*		**TxDOT/TTA**	
TITLE:	Combine exit ramps from US 77 to IH 35E, relocate braided ramp to south	**NUMBER** 18.0 (N-3, N-8)	**PAGE NO.** 4 of 7

Proposed Alternative

PERFORMANCE *I-35E Managed Lanes Project*	TxDOT/TTA		
TITLE: Combine exit ramps from US 77 to IH 35E, remove braided ramp and relocate to the south	**NUMBER** 18.0 (N-3, N-8)		**PAGE NO.** 5 of 7
CRITERIA	**Performance**	**Original**	**Alternative**
REVENUE IMPACTS:	Measure	Degree	Degree
No signficant revenue impacts	Rating	6	6
	Weight	18	18
	Contribution	108	108
TRAFFIC OPS - GENERAL PURPOSE LANES:	Measure	Degree	Degree
One less ramp on the interstate, LOS could increase	Rating	8	8.5
	Weight	17	17
	Contribution	136	144.5
TRAFFIC OPS - LOCAL:	Measure	Degree	Degree
More weaving along frontage roads, less access	Rating	8	7.5
	Weight	12	12
	Contribution	96	90
RIGHT OF WAY IMPACTS:	Measure	Degree	Degree
ROW may be needed along west side of the interstate in order to relocate braided ramp	Rating	3	2.5
	Weight	10	10
	Contribution	30	25
ENVIRONMENTAL IMPACTS:	Measure	Degree	Degree
No significant environmental impacts.	Rating	7	7
	Weight	14	14
	Contribution	98	98
STAKEHOLDER ACCEPTANCE:	Measure	Degree	Degree
Less access to neighborhoods and development locations, could have negative impact to stakeholders	Rating	7	6.5
	Weight	13	13
	Contribution	91	84.5
SCHEDULE IMPACT:	Measure	Degree	Degree
No significant schedule impacts	Rating	5	5
	Weight	6	6
	Contribution	30	30
	Measure	Degree	Degree
	Rating		
	Weight		
	Contribution	0	0
Total Performance:		589	580
Net Change in Performance (%):			-2%

Assumptions include:

Only structure and pavement costs were analyzed in the cost comparison. Additional detailing would need to be performed to determine the change in retaining walls, sound walls, cut and fill, and other construction cost items. The cost comparison basically entails removing a bridge ramp from the project and adding that same length of pavement to the at-grade frontage road.

INITIAL COSTS

I-35 Managed Lanes Project

TxDOT/TTA

TITLE: Flip the connection at US 77 with IH 35E at grade.	**NUMBER**	**PAGE NO.**
	18.0 (N-3, N-8)	7 of 7

CONSTRUCTION ELEMENT		**ORIGINAL CONCEPT**			**ALTERNATIVE CONCEPT**		
Description	**Unit**	**Quantity**	**Cost/Unit**	**Total**	**Quantity**	**Cost/Unit**	**Total**
Less Concrete Bridge	SF	26,700	$50	$1,335,000	0	$50	$0
Additional SP-D	Ton	0	$90	$0	660	$90	$59,400
Additional SMA-D	Ton	0	$97	$0	330	$97	$32,010
Additional Cement	Ton	0	$115	$0	91	$115	$10,514
Additional Treatment	SY	0	$11	$0	3,150	$11	$34,650
				$0			$0
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				$0			$0
				$0			$0
Subtotal:				$1,335,000			$136,574
15% contigency:				$200,250			$20,486
TOTAL				$1,535,250			$157,061
						SAVINGS	$1,378,189

VE TEAM ALTERNATIVE REVIEW *I-35E Managed Lanes Project*		TxDOT/TTA
TITLE:	Combine exit ramps from US 77 to IH 35E, relocate braided ramp to south	**NUMBER** 18.0 (N-3, N-8)

Team Member: Eva Chan

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Dan Chapman

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Phil Ullman

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

Weaving between Mayhill Exit and new entrance

Team Member: Michael Drayton

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Charles Riou

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

See page 4

Team Member: Bill Reichert

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

VE TEAM ALTERNATIVE REVIEW *I-35E Managed Lanes Project*		TxDOT/TTA
TITLE:	Combine exit ramps from US 77 to IH 35E, relocate braided ramp to south	**NUMBER** 18.0 (N-3, N-8)

Team Member: Kim Daily

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Spenta Irani

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Michael Kerrigan

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Doug Bowen

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Lucio Vasquez

☐ I have reviewed this alternative and agree with it as it is written
X I have reviewed this alternative and suggest the following (or attached) changes

I believe stakeholder impact would be more of a negative impact

Team Member: Mark Taylor

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*		TxDOT/TTA	
FUNCTION: Carry Traffic, Support Loads		**IDEA NO.** N-5	**ALTERNATIVE NO.** 19.0
TITLE: Push NB General Purpose lanes out at I-35W to eliminate one bridge			**PAGE NO.** 1 of 7

ORIGINAL CONCEPT: (Attach sketch where appropriate)

The original concept allows for the NB IH 35E GP lanes to overpass the NB IH 35W GP lanes. IH 35W underpasses IH 35E and merges with IH 35E on the right side. This concept treats IH 35E as the "primary" roadway. It also allows IH 35W to have an exit to Oak Street, which is an important access location to the Rayzor Ranch development north of Oak Street and east of IH 35.

ALTERNATIVE CONCEPT: (Attach sketch where appropriate)

The alternative concept pushes the NB IH 35E GP lanes easterly and allows IH 35W to merge with IH 35E on the left side (inside) of the IH 35E GP lanes. This allows the NB IH 35E GP bridge to be eliminated. It also provides an opportunity to reconfigure the NB braided ramps north of Bonnie Brae to an x-ramp configuration. This alternative concept requires eliminating the NB IH 35W exit to Oak Street.

ADVANTAGES:

- Reduces cost by eliminating the NB IH 35E GP Bridge and reconfiguring the NB IH 35E braided ramps north of Bonnie Brae to an x-ramp configuration.
- Increases the weaving distance between the IH 35E/IH 35W merge and the NB exit ramp to US 380.

DISADVANTAGES:

- Eliminates the NB IH 35W exit to Oak St, which may not be acceptable by the North Segment stakeholders.
- Does not meet driver expectation on IH 35E with the IH 35W junction on the left side.
- Potential weaving issues with relocated ramp.
- Switching the GP locations could present a new conflict between the roadways during construction.

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Net Present Value
Original Concept	$ 4,230,000	$ 0	$ 4,230,000
Alternative Concept	$ 960,000	$ 0	$ 960,000
Savings	$ 3,270,000	$ 0	$ 3,270,000

Team Member: Chad Gardiner	**Discipline:** Design	**PERFORMANCE:** -10%

VALUE ENGINEERING ALTERNATIVE *I-35E Managed Lanes Project*		TxDOT/TTA	
TITLE:	Push NB General Purpose lanes out at I-35W to eliminate one bridge	**ALTERNATIVE NO.** 19.0 (N-5)	**PAGE NO** 2 of 7

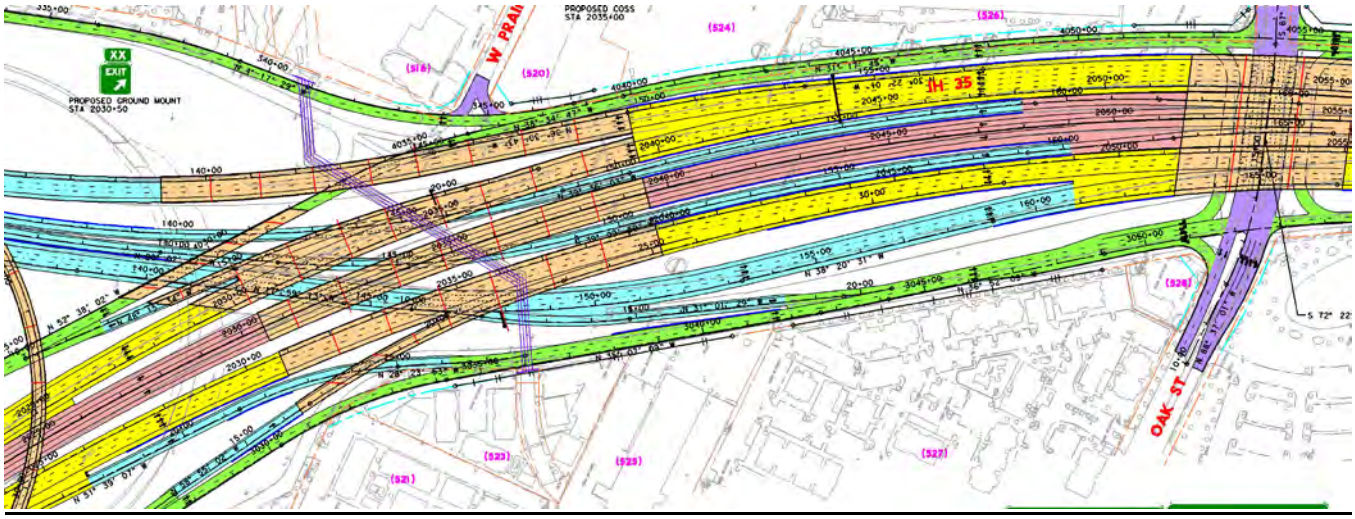
DISCUSSION / JUSTIFICATION:

The alternative concept pushes the NB IH 35E GP lanes easterly and allows IH 35W to merge with IH 35E on the left side (inside) of the IH 35E GP lanes. The alternative concept would reduce costs by reducing embankment quantities, retaining wall quantities, and eliminating 3 bridges. It would also increase the weaving distance between the IH 35E/IH 35W merge and the exit ramp to US 380 from ~1900' to ~2500'. This alternative would also allow the NB braided ramps north of Bonnie Brae to be reconfigured to an x-ramp configuration. This reconfiguration would eliminate a ramp bridge and create an ~1800' weaving segment between the Bonnie Brae entrance and US 380 exit ramps. In the original concept, the distance between these ramps is over 2500' and is not considered a weaving segment.

From a construction standpoint, the alternate design could potentially complicate phasing because it requires switching the locations of the NB lanes for IH 35E and IH 35W. The original design allows the roadways to be constructed without presenting a conflict between the two traffic streams. Depending on the final location of the merge between IH 35E & IH 35W, the alternate concept does potentially create a scenario where 4 weaving movements are located within one weaving segment (IH 35 merge / US 380 ramp and Bonnie Brae Ramp / US 380 ramp). Additional work would need to be done to finalize the merge locations and analyze the traffic impacts. Also, the alternate concept would require eliminating the IH 35W NB exit ramp to Oak Street. This exit ramp is an important access point to the City of Denton, as it provides IH 35W access to: 1) the Rayzor Ranch development north of Oak Street and east of IH 35, 2) Presbyterian Hospital of Denton, and 3) two large distributors west of IH 35 (Bennie E. Keith and Miller). Losing this access point may not be acceptable to the City of Denton and the adjacent property owners.

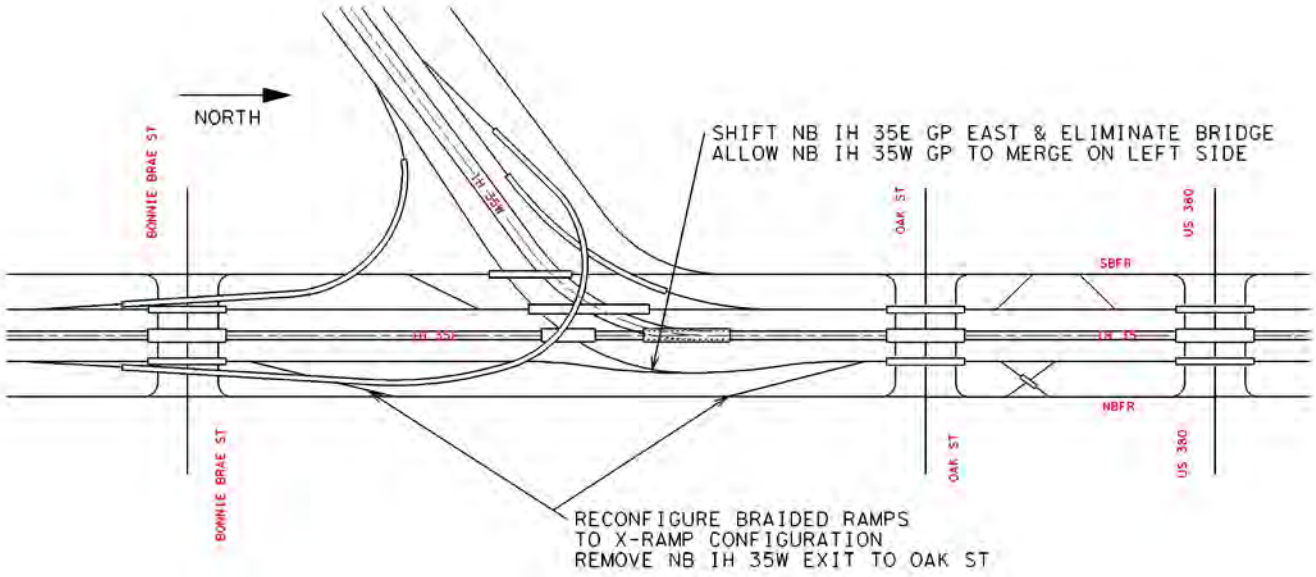
SKETCHES *I-35E Managed Lanes Project*		TxDOT/TTA	
TITLE:	Push NB General Purpose lanes out at I-35W to eliminate one bridge	**NUMBER** 19.0 (N-5)	**PAGE NO.** 3 of 7

Original Design



SKETCHES *I-35E Managed Lanes Project*		TxDOT/TTA	
TITLE:	Push NB General Purpose lanes out at I-35W to eliminate one bridge	**NUMBER** 19.0 (N-5)	**PAGE NO.** 4 of 7

Proposed Alternative



PERFORMANCE *I-35E Managed Lanes Project*	**TxDOT/TTA**		
TITLE: Push NB General Purpose lanes out at I-35W to eliminate one bridge	**NUMBER** 19.0 (N-5)		**PAGE NO.** 5 of 7
CRITERIA	**Performance**	**Original**	**Alternative**
REVENUE IMPACTS: No impact. The overall cost of the project would be slightly reduced.	Measure	Degree	Degree
	Rating	6	6
	Weight	18	18
	Contribution	108	108
TRAFFIC OPS - GENERAL PURPOSE LANES: Additional analysis would be needed to accurately determine the impact of the weaving segment and left handed merge associated with this alternative.	Measure	Degree	Degree
	Rating	8	8
	Weight	17	17
	Contribution	136	136
TRAFFIC OPS - LOCAL: Elimination of the NB IH 35W exit ramp to Oak Street would create a significant detour for traffic travelling to the southern half of the Rayzor Ranch development, Presbyterian Hospital, and distributors southwest of Oak & IH35.	Measure	Degree	Degree
	Rating	8	6
	Weight	12	12
	Contribution	96	72
RIGHT OF WAY IMPACTS: No impact.	Measure	Degree	Degree
	Rating	3	3
	Weight	10	10
	Contribution	30	30
ENVIRONMENTAL IMPACTS: No impact.	Measure	Degree	Degree
	Rating	7	7
	Weight	14	14
	Contribution	98	98
STAKEHOLDER ACCEPTANCE: Removing the NB IH 35W exit to Oak Street would not be desirable for the North Segment stakeholders.	Measure	Degree	Degree
	Rating	7	5
	Weight	13	13
	Contribution	91	65
SCHEDULE IMPACT: Removing the NB IH 35W exit to Oak Street would require going back to the stakeholders for their approval.	Measure	Degree	Degree
	Rating	5	4
	Weight	6	6
	Contribution	30	24
	Measure	Degree	Degree
	Rating		
	Weight		
	Contribution	0	0
Total Performance:		589	533
Net Change in Performance (%):			-10%

- Alternate design presents a savings of $3.27M. For cost calculations, see initial calculations spreadsheet.

- Assumed that the braided ramps could be reconfigured to an x-ramp configuration to maintain 1000' weaving on frontage roads and 1800' weaving on mainlanes between the NB entrance from Bonnie Brae and the NB exit to US 380.

- Alternate concept assumes that additional bridge would be needed at the Oak Street overpass to facilitate the NB Bonnie Brae entrance ramp taper. Assumption was made that the additional bridge needed at Oak Street is a wash with bridge needed for the entrance ramp taper in the current design.

- Alternate concept assumes that TxDOT would allow for IH 35W to merge with IH 35E on the left side.

INITIAL COSTS

I-35 Managed Lanes Project

TxDOT/TTA

TITLE: Push NB General Purpose lanes out at I-35W to eliminate one bridge

NUMBER	**PAGE NO.**
19.0 (N-5)	7 of 7

CONSTRUCTION ELEMENT		**ORIGINAL CONCEPT**			**ALTERNATIVE CONCEPT**		
Description	**Unit**	**Quantity**	**Cost/Unit**	**Total**	**Quantity**	**Cost/Unit**	**Total**
NB IH 35E GP Lanes				$0			$0
IH 35W Overpass Bridge (concrete)	sf	48,426	$50	$2,421,300			$0
Bonnie Brae Overpass Bridge (concrete)	sf			$0	9,000		$0
Excavation	cy			$0	10,600	$5	$53,000
Embankment	cy	41,100	$8	$328,800	5,000	$8	$40,000
Pavement (all items combined)	sy			$0	5,381	$78	$420,230
Ramp taper pavement now on bridge	sy	1,000	$78	$78,100			$0
NB IH 35W GP Lanes				$0			$0
Embankment	sy	10,600	$8	$84,800			$0
Pavement (all items combined)	sy	667	$78	$52,000			$0
				$0			$0
NB IH 35W Exit Ramp to Oak Street				$0			$0
Embankment	sy	2,500	$8	$20,000			$0
Pavement (all items combined)	sy	2,300	$78	$179,400			$0
				$0			$0
NB IH 35E Ent Ramp from Bonnie Brae				$0			$0
Embankment	sy			$0	26,600	$8	$212,800
Braided Ramp Bridge (concrete)	sf	10,260	$50	$513,000			$0
Pavement (all items combined)	sy			$0	1,140	$78	$88,920
				$0			$0
NB IH 35E Frontage Road				$0			$0
Pavement (all items combined)	sy			$0	240	$69	$16,570
				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
				$0			$0
NO ROW SAVINGS				$0			$0
Subtotal:				$3,677,400			$831,520
15% contigency:				$551,610			$124,728
TOTAL				$4,229,010			$956,248
						SAVINGS	$3,272,762

VE TEAM ALTERNATIVE REVIEW *I-35E Managed Lanes Project*	**TxDOT/TTA**
TITLE: Push NB General Purpose lanes out at I-35W to eliminate one bridge	**NUMBER** 19.0 (N-5)

Team Member: Michael Drayton

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Charles Riou

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Bill Reichert

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Phil Ullman

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Michael Kerrigan

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Eva Chan

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

VE TEAM ALTERNATIVE REVIEW *I-35E Managed Lanes Project*	**TxDOT/TTA**
TITLE: Push NB General Purpose lanes out at I-35W to eliminate one bridge	**NUMBER** 19.0 (N-5)

Team Member: Kim Daily

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Doug Bowen

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member: Lucio Vasquez

X I have reviewed this alternative and agree with it as it is written
☐ I have reviewed this alternative and suggest the following (or attached) changes

Team Member:

☐ I have reviewed this alternative and agree with it as it is written
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PROJECT ANALYSIS

SUMMARY OF ANALYSIS

The following value engineering tools were used to study the project:

- Project Issues
- Site Visit Observations
- Cost Model
- Function Analysis
- Performance Criteria Matrix
- Performance Rating Matrix

PROJECT ISSUES

The following project issues were identified and addressed by the VE team:

- Substantial funding gap
- Baseline improves performance significantly, compared to "no build"
- Strong stakeholder support as currently envisioned
- Key high cost items such as bridges
- Reevaluate percentages for traffic control and mobilization
- Project will be delivered through a design-build contract
- Significant ROW impacts and associated costs ~1/3 of total construction cost
- Constrained by certain design parameters, i.e. access points
- High traffic volumes impacts/impacted by construction
- Rail/transit in the same corridor
- 4th General Purpose lane reduces revenue
- Construction $s saved more significant than O&M $s saved (more important to save upfront construction costs than saving O&M costs)
- Middle section has priority because of $500M set-aside from SH121 project
- $500M set-aside carries requirements
- Assumed maximum allotment from TIFIA
- Current design adds 3-4 lane frontage roads
- Can't displace or impact lake storage
- Recreational 4f issue is primary issue in middle section
- ROW is on easement and not on fee-simple, COE property
- O&M responsibilities are split between General Purpose and Managed Lanes
- To improve operations and revenue on I-35E, improved connections at 635 required which would require additional funding
- Improved connections at 635 would also improve operations and revenue on both corridors (I-35E and 635)
- Smallest traffic volumes on north segment
- Rail line is a major constraint on the north segment
- Rail constraints on the south segment exist
- Multiple access issues in City of Denton
- Merge of I-35E and I-35W are within project limits
- Balancing future aspirations/improvements and stakeholder desires versus available funding is tricky
- Could replace wishbone ramps with slip ramps
- Wishbone versus slip ramps may not be a political issue/concern

SITE VISIT OBSERVATIONS

The following issues and concerns were listed by the VE team following the site visit:

- Lewisville Baptist Church causes constraint on middle segment
- Majority of freeway has substandard design
- Aging structures
- Rolling terrain
- ~30 dealerships along corridor (car, boat, RV)
- Serious congestion during peak hours
- One General Purpose lane drops off north of FM 2181 (from 3 to 2)
- Current HOV lanes drop off after SH121
- New stadium construction and pedestrian overpass constructed before this project
- Lots of at-grade rail crossings at cross streets
- Corridor is fairly developed
- Existing pavement is in poor condition
- Pavement types vary along length of corridor
- FM 407 interchange project was shut down (partially constructed)
- Vertical clearance issues at structures
- Quite a few overhead transmission lines crossing corridor
- Current illumination is maintenance issue
- No direct connectors to the north at SH121 to I-35E

COST MODEL

An analysis of the project cost estimates ranked, as a percentage of overall cost, all construction elements or categories which form part of the overall total project construction cost. This ranking identified the significant cost items and therefore, the *cost drivers* for the project. This ranking helped to guide the I-35E VE team in the development of ideas during the VE study.

The analysis reveals that approximately 80% of the construction cost will occur in approximately 20% of the project elements. For each segment, the rankings illustrate the following:

South Segment:

- The highest cost item, approximately 8% of the total construction cost is Mobilization which is related directly to the function *Initiate Construction.*
- The second highest cost item is Traffic Control, also representing 8% of the total cost and serving the function *Maintain Traffic, Protect Workers/Motorists.*

Middle Segment:

- The highest cost item, approximately 40% of the total construction cost, is Bridges (concrete over Lake Lewisville, both Managed and General Purpose Lanes) which is related directly to the functions *Carry Traffic* and *Span Water.*
- The second highest cost item is Mobilization, representing 8.5% of the total cost and serving the function of *Initiate Construction.*

North Segment:

- The highest cost item, approximately 9% of the total construction costs, is bridges (concrete, General Purpose Lanes) which is related directly to the functions *Carry Traffic, and Separate Grades*.
- The second highest cost item is Retaining Walls, representing 8.5% of the total construction costs, and serving the functions *Minimize ROW and Retain Earth*.

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COSTS
IH 35E FROM N OF IH 635 TO PGBT (SOUTH SEGMENT)
CSJ's: 0196-03-138, ETC.

PARETO DISTRIBUTION

ITEM	DESC CODE	DESCRIPTION	UNIT	QUANTITY	UNIT COST	SUBTOTAL	%	Accum %
500	2001	MOBILIZATION	LS	4	SEE ESTIMATE	$ 29,620,000	8.34%	8.34%
XXXX	xxxx	TRAFFIC CONTROL	LS	4	SEE ESTIMATE	$ 29,620,000	8.34%	16.69%
450	xxxx	BRIDGES (CONCRETE) (General Purpose)	SF	552,203	$ 50.00	$ 27,610,150	7.78%	24.46%
450	xxxx	BRIDGES (CONCRETE) (Ramps)	SF	421,652	$ 50.00	$ 21,082,600	5.94%	30.40%
423	2001	RETAINING WALL	SF	576,523	$ 35.00	$ 20,178,305	5.68%	36.08%
450	xxxx	BRIDGES (STEEL)	SF	140,997	$ 110.00	$ 15,509,670	4.37%	40.45%
450	xxxx	BRIDGES (CONCRETE) (Managed Lanes)	SF	296,917	$ 50.00	$ 14,845,850	4.18%	44.63%
132	2006	EMBANKMENT	CY	1,617,852	$ 8.00	$ 12,942,816	3.65%	48.28%
XXXX	xxxx	RAILROAD	LS	1	SEE ESTIMATE	$ 12,597,458	3.55%	51.83%
XXXX	xxxx	TOLL ENFORCEMENT	MILE	6	$ 2,000,000.00	$ 12,144,973	3.42%	55.25%
344	2014	BASE COURSE (6.5") (SP-B) (General Purpose)	TON	145,260	$ 79.00	$ 11,475,537	3.23%	58.48%
423	2001	RETAINING WALL (DRILLED SHAFT)	SF	151,543	$ 75.00	$ 11,365,725	3.20%	61.68%
450	xxxx	BRIDGES (CONCRETE) (Cross Streets)	SF	168,101	$ 50.00	$ 8,405,050	2.37%	64.05%
344	2119	BASE COURSE (4") (SP-D) (Gen Purpose)	TON	89,391	$ 90.00	$ 8,045,167	2.27%	66.32%
464	2011	RC PIPE (CL III)(48 IN)	LF	66,744	$ 107.00	$ 7,141,645	2.01%	68.33%
344	2014	BASE COURSE (6.5") (SP-B) (Managed Lanes)	TON	86,213	$ 79.00	$ 6,810,636	1.92%	70.25%
344	2014	BASE COURSE (6") (SP-B) (Frontage Rds)	TON	66,612	$ 79.00	$ 5,262,334	1.48%	71.73%
514	2004	PERM CONC TRF BAR (SGL SLP)(TY 2)	LF	94,700	$ 52.00	$ 4,924,400	1.39%	73.12%
344	2119	BASE COURSE (4") (SP-D) (Managed Lns)	TON	53,054	$ 90.00	$ 4,774,860	1.34%	74.46%
275	2018	CEMENT TRT(34") (General Purpose)	SY	426,638	$ 11.00	$ 4,693,014	1.32%	75.78%
104	2001	REMOVING CONC (PAV)	SY	741,057	$ 6.00	$ 4,446,342	1.25%	77.03%
346	2014	SURFACE COURSE (2") (SMA-D) (Gen Purpose)	TON	44,695	$ 97.00	$ 4,335,451	1.22%	78.26%
344	2014	BASE COURSE (6.5") (SP-B) (Ramps)	TON	49,956	$ 79.00	$ 3,946,524	1.11%	79.37%
110	2001	EXCAVATION	CY	728,364	$ 5.00	$ 3,641,920	1.03%	80.39%
464	2009	RC PIPE (CL III)(36 IN)	LF	44,496	$ 69.00	$ 3,070,240	0.86%	81.26%
344	2119	BASE COURSE (3") (SP-D) (Frontage Rds)	TON	33,306	$ 90.00	$ 2,997,532	0.84%	82.10%
105	2014	REMOVING CONC (ASPH)	SY	741,057	$ 4.00	$ 2,964,228	0.83%	82.94%
275	2018	CEMENT TRT(34") (Managed Lanes)	SY	253,213	$ 11.00	$ 2,785,347	0.78%	83.72%
344	2119	BASE COURSE (4") (SP-D) (Ramps)	TON	30,742	$ 90.00	$ 2,766,797	0.78%	84.50%
344	2014	BASE COURSE (6") (SP-B) (Cross Streets)	TON	34,662	$ 79.00	$ 2,738,266	0.77%	85.27%
465	xxxx	INLETS	EA	742	$ 3,500.00	$ 2,595,613	0.73%	86.00%
346	2014	SURFACE COURSE (2") (SMA-D) (Managed Lns)	TON	26,527	$ 97.00	$ 2,573,130	0.72%	86.73%
XXXX	xxxx	LIFT STATION	LS	1	SEE ESTIMATE	$ 2,405,239	0.68%	87.41%
275	2077	CEMENT TRT(21.5") (Frontage Roads)	SY	211,947	$ 11.00	$ 2,331,414	0.66%	88.06%
275	2001	CEMENT (General Purpose)	TON	19,583	$ 115.00	$ 2,252,007	0.63%	88.70%
346	2014	SURFACE COURSE (2") (SMA-D) (Frontage Rds)	TON	22,204	$ 97.00	$ 2,153,782	0.61%	89.30%
686	xxxx	INSTALL TRAFFIC SIGNAL (INTERSECTION)	EA	14	$ 150,000.00	$ 2,100,000	0.59%	89.89%
650	xxxx	INS OH SN SUP (CANTILEVER) (CIRC TUBE)	EA	25	$ 80,000.00	$ 2,000,000	0.56%	90.46%
531	2015	CONC SIDEWALKS (4")	SY	56,700	$ 35.00	$ 1,984,500	0.56%	91.02%
342	2006	SURFACE COURSE (1.5") (PFC) (Gen Purpose)	TON	28,950	$ 68.00	$ 1,968,626	0.55%	91.57%
275	2018	CEMENT TRT(34") (Ramps)	SY	146,724	$ 11.00	$ 1,613,965	0.45%	92.03%
450	xxxx	BRIDGES (CONCRETE) (Frontage Roads)	SF	31,628	$ 50.00	$ 1,581,400	0.45%	92.47%
100	2002	PREPARING ROW	STA	392	$ 4,000.00	$ 1,568,000	0.44%	92.91%
506	xxxx	SWPPP	STA	392	$ 4,000.00	$ 1,568,000	0.44%	93.35%
344	2119	BASE COURSE (3") (SP-D) (Cross Streets)	TON	17,331	$ 90.00	$ 1,559,783	0.44%	93.79%
464	2005	RC PIPE (CL III)(24 IN)	LF	37,080	$ 42.00	$ 1,557,368	0.44%	94.23%
346	2014	SURFACE COURSE (2") (SMA-D) (Ramps)	TON	15,371	$ 97.00	$ 1,490,996	0.42%	94.65%
610	2047	INS RD IL AM (TY SP) 48S-8-8 (.4KW)S	EA	448	$ 3,100.00	$ 1,388,800	0.39%	95.04%
275	2001	CEMENT (Managed Lanes)	TON	11,622	$ 115.00	$ 1,336,587	0.38%	95.42%
275	2077	CEMENT TRT(21.5") (Cross Streets)	SY	110,268	$ 11.00	$ 1,213,165	0.34%	95.76%
342	2006	SURFACE COURSE (1.5") (PFC) (Managed Lns)	TON	17,182	$ 68.00	$ 1,168,399	0.33%	96.09%
346	2014	SURFACE COURSE (2") (SMA-D) (Cross Streets)	TON	11,554	$ 97.00	$ 1,120,733	0.32%	96.41%
650	xxxx	INS OH SN SUP (BRIDGE) (CIRC TUBE)	EA	6	$ 180,000.00	$ 1,080,000	0.30%	96.71%
342	2006	SURFACE COURSE (1.5") (PFC) (Frontage Rds)	TON	14,382	$ 68.00	$ 977,963	0.28%	96.99%
529	2004	CONC CURB & GUTTER (TY II)	LF	75,127	$ 12.00	$ 901,521	0.25%	97.24%
275	2001	CEMENT (Ramps)	TON	6,735	$ 115.00	$ 774,483	0.22%	97.46%
618	2016	CONDT (PVC)(SCHD 40)(1 1/2")	LF	102,640	$ 7.00	$ 718,483	0.20%	97.66%
275	2001	CEMENT (Frontage Roads)	TON	6,152	$ 115.00	$ 707,452	0.20%	97.86%
342	2006	SURFACE COURSE (1.5") (PFC) (Ramps)	TON	9,956	$ 68.00	$ 677,027	0.19%	98.05%
496	2010	REMOV STR (BRIDGE 100-499 FT LENGTH)	EA	9	$ 60,000.00	$ 540,000	0.15%	98.20%
342	2006	SURFACE COURSE (1.5") (PFC) (Cross Streets)	TON	7,484	$ 68.00	$ 508,899	0.14%	98.35%
462	2007	CONC BOX CULV (5 FT x 3 FT)	LF	2,970	$ 142.00	$ 421,740	0.12%	98.47%
464	2015	RC PIPE (CL III)(72 IN)	LF	1,980	$ 200.00	$ 396,000	0.11%	98.58%
540	2002	MTL W-BEAM GUARD FENCE	LF	18,900	$ 20.00	$ 378,000	0.11%	98.68%
275	2001	CEMENT (Cross Streets)	TON	3,201	$ 115.00	$ 368,127	0.10%	98.79%
462	2010	CONC BOX CULV (6 FT x 3 FT)	LF	1,980	$ 176.00	$ 352,440	0.10%	98.89%
628	2040	ELC SRV TY A 240 / 480 100 (NS) SS (E) SP (O)	EA	77	$ 4,500.00	$ 346,861	0.10%	98.98%
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (General Purpose)	GAL	81,264	$ 4.00	$ 325,057	0.09%	99.08%
636	2003	ALUMINUM SIGNS (TY O)	SF	12,603	$ 25.00	$ 315,075	0.09%	99.16%
xxxx	xxxx	ENHANCED LANDSCAPING (per Cross Street)	EA	6	$ 40,000.00	$ 240,000	0.07%	99.23%
644	2004	INS SM RD SN SUP&ASSM TY A	EA	511	$ 450.00	$ 230,083	0.06%	99.30%
462	2006	CONC BOX CULV (5 FT x 2 FT)	LF	1,510	$ 140.00	$ 211,400	0.06%	99.36%
496	2011	REMOV STR (BRIDGE 500-999 FT LENGTH)	EA	2	$ 104,000.00	$ 208,000	0.06%	99.41%
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (Managed Lanes)	GAL	48,231	$ 4.00	$ 192,924	0.05%	99.47%
636	2001	ALUMINUM SIGNS (TY A)	SF	8,181	$ 23.00	$ 188,157	0.05%	99.52%
624	2008	GROUND BOX TY A (122311) W/APRON	EA	291	$ 616.00	$ 179,503	0.05%	99.57%

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COSTS
IH 35E FROM N OF IH 635 TO PGBT (SOUTH SEGMENT)
CSJ's: 0196-03-138, ETC.

PARETO DISTRIBUTION

ITEM	DESC CODE	DESCRIPTION	UNIT	QUANTITY	UNIT COST	SUBTOTAL	%	Accum %
462	2022	CONC BOX CULV (8 FT x 7 FT)	LF	560	$ 295.00	$ 165,200	0.05%	99.62%
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (Frontage Roads)	GAL	40,371	$ 4.00	$ 161,483	0.05%	99.66%
161	2002	COMPOST MANUF TOPSOIL (BOS)(4")	SY	158,574	$ 1.00	$ 158,574	0.04%	99.71%
610	2060	INS RD IL AM (U/P) (TY 1)(.15KW)S	EA	112	$ 1,210.00	$ 135,520	0.04%	99.75%
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (Ramps)	GAL	27,947	$ 4.00	$ 111,790	0.03%	99.78%
531	xxxx	CURB RAMPS	EA	60	$ 1,500.00	$ 90,000	0.03%	99.80%
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (Cross Streets)	GAL	21,007	$ 4.00	$ 84,029	0.02%	99.83%
666	2011	REFL PAV MRK TY I (W) 4" (SLD) (090 MIL)	LF	240,020	$ 0.35	$ 84,007	0.02%	99.85%
164	2007	BROADCAST SEED (PERM) (URBAN) (CLAY)	SY	158,574	$ 0.50	$ 79,287	0.02%	99.87%
540	2011	MBGF TRANSITION	EA	51	$ 1,300.00	$ 66,300	0.02%	99.89%
545	2001	CRASH CUSH ATTEN (INSTALL)	EA	5	$ 10,600.00	$ 53,000	0.01%	99.91%
614	2001	HI MST IL ASM (12 - 400 WATT) (ASYM) (TY A)	EA	2	$ 25,000.00	$ 50,000	0.01%	99.92%
666	2189	PAVEMENT SEALER 4"	LF	435,886	$ 0.10	$ 43,589	0.01%	99.93%
678	2001	PAV SURF PREP FOR MRK (4")	LF	435,886	$ 0.10	$ 43,589	0.01%	99.95%
666	2110	REFL PAV MRK TY I (Y) 4" (SLD) (090 MIL)	LF	106,549	$ 0.35	$ 37,292	0.01%	99.96%
666	2002	REFL PAV MRK TY I (W) 4" (BRK) (090 MIL)	LF	89,317	$ 0.35	$ 31,261	0.01%	99.97%
544	2001	MBGF END TREATMENT	EA	13	$ 2,000.00	$ 26,000	0.01%	99.97%
466	2048	WINGWALL (PW) (H=4 FT)	EA	4	$ 6,200.00	$ 24,800	0.01%	99.98%
672	2017	REFL PAV MRKR TY II-C-R	EA	6,166	$ 4.00	$ 24,663	0.01%	99.99%
636	2002	ALUMINUM SIGNS (TY G)	SF	1,124	$ 20.00	$ 22,473	0.01%	99.99%
466	2052	WINGWALL (PW) (H=8 FT)	EA	1	$ 13,980.00	$ 13,980	0.00%	100.00%
540	2005	TERMINAL ANCHOR SECTION	EA	11	$ 620.00	$ 6,820	0.00%	100.00%
467	xxxx	SET (4:1)	EA	1	$ 4,000.00	$ 4,000	0.00%	100.00%
5296	2007	NOISE WALLS	SF	0	$ 35.00	$ -		
450	xxxx	BRIDGES (CONCRETE over water) (General Purpose)	SF	0	$ 110.00	$ -		
450	xxxx	BRIDGES (CONCRETE over water) (Managed Lanes)	SF	0	$ 110.00	$ -		
450	xxxx	BRIDGES (CONCRETE over water) (Ramps)	SF	0	$ 110.00	$ -		
450	xxxx	BRIDGES (CONCRETE over water) (Frontage Roads)	SF	0	$ 110.00	$ -		
450	xxxx	BRIDGES (CONCRETE over water) (Cross Streets)	SF	0	$ 110.00	$ -		
450	xxxx	BRIDGES (CONCRETE) (Tx34 girder)	SF	0	$ 50.00	$ -		
450	2018	PEDESTRIAN RAIL (Premium added to bridge cost)	LF	0	$ 60.00	$ -		
450	2018	PEDESTRIAN RAIL (Approaches)	LF	0	$ 97.00	$ -		
450	xxxx	RAIL	LF	0	$ 50.00	$ -		
462	2001	CONC BOX CULV (3 FT x 2 FT)	LF	0	$ 110.00	$ -		
462	2003	CONC BOX CULV (4 FT x 2 FT)	LF	0	$ 110.00	$ -		
462	2004	CONC BOX CULV (4 FT x 3 FT)	LF	0	$ 124.00	$ -		
462	2015	CONC BOX CULV (7 FT x 4 FT)	LF	0	$ 239.00	$ -		
462	2017	CONC BOX CULV (7 FT x 6 FT)	LF	0	$ 266.00	$ -		
462	2019	CONC BOX CULV (8 FT x 4 FT)	LF	0	$ 308.00	$ -		
462	2024	CONC BOX CULV (9 FT x 5 FT)	LF	0	$ 340.00	$ -		
462	2030	CONC BOX CULV (10 FT x 6 FT)	LF	0	$ 368.00	$ -		
462	2032	CONC BOX CULV (10 FT x 8 FT)	LF	0	$ 400.00	$ -		
464	2010	RC PIPE (CL III)(42 IN)	LF	0	$ 85.00	$ -		
465	2005	MANHOLE	EA	0	$ 2,960.00	$ -		
465	2211	JUNCTION BOX (SPL)	EA	0	$ 27,040.00	$ -		
466	xxxx	WINGWALL (PW) (H=2 FT)	EA	0	$ 2,200.00	$ -		
466	2047	WINGWALL (PW) (H=3 FT)	EA	0	$ 5,320.00	$ -		
466	2050	WINGWALL (PW) (H=6 FT)	EA	0	$ 8,940.00	$ -		
496	2009	REMOV STR (BRIDGE 0-99 FT LENGTH)	EA	0	$ 10,200.00	$ -		
531	2004	CONC SIDEWALKS (5")	SY	0	$ 68.00	$ -		
550	2001	CHAIN LINK FENCE (INSTALL) (6') (Ped. Bridge Protection/Cove	LF	0	$ 14.00	$ -		
XXXX	xxxx	USACE PROPERTY MITIGATION TABLE	LS	0	SEE ESTIMATE	$ -		
					Subtotal:	$ 355,031,456		
					15% Contigency:	$ 53,254,718		
						$ 408,286,175		

TOTAL ESTIMATED CONSTRUCTION COST (SAY)=	$ 408,410,000
ENVIRONMENTAL MITIGATION=	$ -
RIGHT OF WAY=	$ 323,985,151
UTILITY RELOCATION =	$ 42,355,336
ENGINEERING COSTS (6% PS&E) = 6%	$ 27,060,000
ENGINEERING COSTS (4% QA/QC, 2.5% IE) = 6.5%	$ 29,320,000
TOTAL ESTIMATED COST (SAY)=	$ 831,130,487

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COSTS
IH 35E FROM N OF PGBT TO FM 2181 (MIDDLE SEGMENT)
CSJ's: 0196-03-138, ETC.

PARETO DISTRIBUTION

ITEM	DESC CODE	DESCRIPTION	UNIT	QUANTITY	UNIT COST	SUBTOTAL	%	Accum %
450	xxxx	BRIDGES (CONCRETE over water) (General Purpose)	SF	1,450,892	$ 110.00	$ 159,598,120	15.61%	15.61%
450	xxxx	BRIDGES (CONCRETE over water) (Managed Lanes)	SF	784,936	$ 110.00	$ 86,342,960	8.45%	24.06%
500	2001	MOBILIZATION	LS	4	SEE ESTIMATE	$ 85,200,000	8.34%	32.40%
XXXX	xxxx	TRAFFIC CONTROL	LS	4	SEE ESTIMATE	$ 85,200,000	8.34%	40.73%
423	2001	RETAINING WALL (DRILLED SHAFT)	SF	833,955	$ 75.00	$ 62,546,625	6.12%	46.85%
450	xxxx	BRIDGES (CONCRETE) (Ramps)	SF	1,091,553	$ 50.00	$ 54,577,650	5.34%	52.19%
450	xxxx	BRIDGES (CONCRETE) (General Purpose)	SF	946,316	$ 50.00	$ 47,315,800	4.63%	56.82%
450	xxxx	BRIDGES (CONCRETE over water) (Frontage Roads)	SF	304,360	$ 110.00	$ 33,479,600	3.28%	60.10%
450	xxxx	BRIDGES (CONCRETE) (Managed Lanes)	SF	578,425	$ 50.00	$ 28,921,250	2.83%	62.93%
XXXX	xxxx	TOLL ENFORCEMENT	MILE	12	$ 2,000,000.00	$ 24,734,848	2.42%	65.35%
344	2014	BASE COURSE (6.5") (SP-B) (General Purpose)	TON	296,795	$ 79.00	$ 23,446,798	2.29%	67.64%
450	xxxx	BRIDGES (CONCRETE) (Cross Streets)	SF	419,621	$ 50.00	$ 20,981,050	2.05%	69.69%
132	2006	EMBANKMENT	CY	2,343,253	$ 8.00	$ 18,746,104	1.83%	71.53%
450	xxxx	BRIDGES (CONCRETE) (Frontage Roads)	SF	366,468	$ 50.00	$ 18,323,400	1.79%	73.32%
344	2119	BASE COURSE (4") (SP-D) (Gen Purpose)	TON	182,643	$ 90.00	$ 16,437,872	1.61%	74.93%
464	2011	RC PIPE (CL III)(48 IN)	LF	126,216	$ 107.00	$ 13,505,112	1.32%	76.25%
344	2014	BASE COURSE (6") (SP-B) (Frontage Rds)	TON	160,721	$ 79.00	$ 12,696,968	1.24%	77.49%
110	2001	EXCAVATION	CY	2,415,113	$ 5.00	$ 12,075,565	1.18%	78.67%
344	2014	BASE COURSE (6.5") (SP-B) (Managed Lanes)	TON	143,698	$ 79.00	$ 11,352,164	1.11%	79.78%
514	2004	PERM CONC TRF BAR (SGL SLP)(TY 2)	LF	212,900	$ 52.00	$ 11,070,800	1.08%	80.87%
275	2018	CEMENT TRT(34") (General Purpose)	SY	871,705	$ 11.00	$ 9,588,759	0.94%	81.81%
104	2001	REMOVING CONC (PAV)	SY	1,482,568	$ 6.00	$ 8,895,408	0.87%	82.68%
346	2014	SURFACE COURSE (2") (SMA-D) (Gen Purpose)	TON	91,322	$ 97.00	$ 8,858,187	0.87%	83.54%
344	2119	BASE COURSE (4") (SP-D) (Managed Lns)	TON	88,430	$ 90.00	$ 7,958,674	0.78%	84.32%
450	xxxx	BRIDGES (STEEL)	SF	69,644	$ 110.00	$ 7,660,840	0.75%	85.07%
344	2119	BASE COURSE (3") (SP-D) (Frontage Rds)	TON	80,361	$ 90.00	$ 7,232,450	0.71%	85.78%
450	xxxx	BRIDGES (CONCRETE over water) (Ramps)	SF	65,282	$ 110.00	$ 7,181,020	0.70%	86.48%
5296	2007	NOISE WALLS	SF	192,571	$ 35.00	$ 6,739,993	0.66%	87.14%
344	2014	BASE COURSE (6") (SP-B) (Cross Streets)	TON	81,030	$ 79.00	$ 6,401,387	0.63%	87.77%
344	2014	BASE COURSE (6.5") (SP-B) (Ramps)	TON	76,166	$ 79.00	$ 6,017,137	0.59%	88.36%
105	2014	REMOVING CONC (ASPH)	SY	1,482,568	$ 4.00	$ 5,930,272	0.58%	88.94%
275	2077	CEMENT TRT(21.5") (Frontage Roads)	SY	511,385	$ 11.00	$ 5,625,239	0.55%	89.49%
464	2009	RC PIPE (CL III)(36 IN)	LF	78,384	$ 69.00	$ 5,408,496	0.53%	90.01%
346	2014	SURFACE COURSE (2") (SMA-D) (Frontage Rds)	TON	53,574	$ 97.00	$ 5,196,649	0.51%	90.52%
650	xxxx	INS OH SN SUP (CANTILEVER) (CIRC TUBE)	EA	62	$ 80,000.00	$ 4,960,000	0.49%	91.01%
275	2018	CEMENT TRT(34") (Managed Lanes)	SY	422,051	$ 11.00	$ 4,642,560	0.45%	91.46%
275	2001	CEMENT (General Purpose)	TON	40,011	$ 115.00	$ 4,601,297	0.45%	91.91%
465	xxxx	INLETS	EA	1,306	$ 3,500.00	$ 4,572,400	0.45%	92.36%
346	2014	SURFACE COURSE (2") (SMA-D) (Managed Lns)	TON	44,215	$ 97.00	$ 4,288,841	0.42%	92.78%
344	2119	BASE COURSE (4") (SP-D) (Ramps)	TON	46,872	$ 90.00	$ 4,218,441	0.41%	93.19%
342	2006	SURFACE COURSE (1.5") (PFC) (Gen Purpose)	TON	59,151	$ 68.00	$ 4,022,297	0.39%	93.59%
344	2119	BASE COURSE (3") (SP-D) (Cross Streets)	TON	40,515	$ 90.00	$ 3,646,360	0.36%	93.94%
686	xxxx	INSTALL TRAFFIC SIGNAL (INTERSECTION)	EA	24	$ 150,000.00	$ 3,600,000	0.35%	94.30%
531	2015	CONC SIDEWALKS (4")	SY	101,400	$ 35.00	$ 3,549,000	0.35%	94.64%
650	xxxx	INS OH SN SUP (BRIDGE) (CIRC TUBE)	EA	18	$ 180,000.00	$ 3,240,000	0.32%	94.96%
529	2004	CONC CURB & GUTTER (TY II)	LF	261,280	$ 12.00	$ 3,135,360	0.31%	95.27%
275	2077	CEMENT TRT(21.5") (Cross Streets)	SY	257,823	$ 11.00	$ 2,836,058	0.28%	95.54%
464	2005	RC PIPE (CL III)(24 IN)	LF	65,320	$ 42.00	$ 2,743,440	0.27%	95.81%
346	2014	SURFACE COURSE (2") (SMA-D) (Cross Streets)	TON	27,010	$ 97.00	$ 2,619,977	0.26%	96.07%
100	2002	PREPARING ROW	STA	653	$ 4,000.00	$ 2,612,000	0.26%	96.32%
506	xxxx	SWPPP	STA	653	$ 4,000.00	$ 2,612,000	0.26%	96.58%
610	2047	INS RD IL AM (TY SP) 48S-8-8 (.4KW)S	EA	826	$ 3,100.00	$ 2,560,600	0.25%	96.83%
275	2018	CEMENT TRT(34") (Ramps)	SY	223,705	$ 11.00	$ 2,460,757	0.24%	97.07%
XXXX	xxxx	RAILROAD	LS	1	SEE ESTIMATE	$ 2,400,000	0.23%	97.31%
342	2006	SURFACE COURSE (1.5") (PFC) (Frontage Rds)	TON	34,701	$ 68.00	$ 2,359,678	0.23%	97.54%
346	2014	SURFACE COURSE (2") (SMA-D) (Ramps)	TON	23,436	$ 97.00	$ 2,273,271	0.22%	97.76%
275	2001	CEMENT (Managed Lanes)	TON	19,372	$ 115.00	$ 2,227,796	0.22%	97.98%
342	2006	SURFACE COURSE (1.5") (PFC) (Managed Lns)	TON	28,639	$ 68.00	$ 1,947,463	0.19%	98.17%
496	2010	REMOV STR (BRIDGE 100-499 FT LENGTH)	EA	30	$ 60,000.00	$ 1,800,000	0.18%	98.34%
275	2001	CEMENT (Frontage Roads)	TON	14,843	$ 115.00	$ 1,706,940	0.17%	98.51%
618	2016	CONDT (PVC)(SCHD 40)(1 1/2")	LF	189,360	$ 7.00	$ 1,325,520	0.13%	98.64%
342	2006	SURFACE COURSE (1.5") (PFC) (Cross Streets)	TON	17,496	$ 68.00	$ 1,189,671	0.12%	98.76%
275	2001	CEMENT (Ramps)	TON	10,268	$ 115.00	$ 1,180,628	0.12%	98.87%
342	2006	SURFACE COURSE (1.5") (PFC) (Ramps)	TON	15,180	$ 68.00	$ 1,032,240	0.10%	98.97%
636	2003	ALUMINUM SIGNS (TY O)	SF	38,990	$ 25.00	$ 974,750	0.10%	99.07%
540	2002	MTL W-BEAM GUARD FENCE	LF	45,200	$ 20.00	$ 904,000	0.09%	99.16%
275	2001	CEMENT (Cross Streets)	TON	7,483	$ 115.00	$ 860,582	0.08%	99.24%
496	2011	REMOV STR (BRIDGE 500-999 FT LENGTH)	EA	7	$ 104,000.00	$ 728,000	0.07%	99.31%
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (General Purpose)	GAL	166,039	$ 4.00	$ 664,155	0.06%	99.38%
628	2040	ELC SRV TY A 240 / 480 100 (NS) SS (E) SP (O)	EA	147	$ 4,500.00	$ 662,940	0.06%	99.44%
xxxx	xxxx	ENHANCED LANDSCAPING (per Cross Street)	EA	13	$ 40,000.00	$ 520,000	0.05%	99.49%
644	2004	INS SM RD SN SUP&ASSM TY A	EA	1,133	$ 450.00	$ 509,772	0.05%	99.54%
636	2001	ALUMINUM SIGNS (TY A)	SF	18,125	$ 23.00	$ 416,880	0.04%	99.58%
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (Frontage Roads)	GAL	97,407	$ 4.00	$ 389,627	0.04%	99.62%
531	xxxx	CURB RAMPS	EA	252	$ 1,500.00	$ 378,000	0.04%	99.66%
161	2002	COMPOST MANUF TOPSOIL (BOS)(4")	SY	348,394	$ 1.00	$ 348,394	0.03%	99.69%

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COSTS
IH 35E FROM N OF PGBT TO FM 2181 (MIDDLE SEGMENT)
CSJ's: 0196-03-138, ETC.

PARETO DISTRIBUTION

ITEM	DESC CODE	DESCRIPTION	UNIT	QUANTITY	UNIT COST	SUBTOTAL	%	Accum %
624	2008	GROUND BOX TY A (122311) W/APRON	EA	545	$ 616.00	$ 335,474	0.03%	99.73%
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (Managed Lanes)	GAL	80,391	$ 4.00	$ 321,563	0.03%	99.76%
545	2001	CRASH CUSH ATTEN (INSTALL)	EA	28	$ 10,600.00	$ 296,800	0.03%	99.79%
610	2060	INS RD IL AM (U/P) (TY 1)(.15KW)S	EA	224	$ 1,210.00	$ 271,040	0.03%	99.81%
462	2024	CONC BOX CULV (9 FT x 5 FT)	LF	720	$ 340.00	$ 244,800	0.02%	99.84%
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (Cross Streets)	GAL	49,109	$ 4.00	$ 196,437	0.02%	99.86%
666	2011	REFL PAV MRK TY I (W) 4" (SLD) (090 MIL)	LF	516,332	$ 0.35	$ 180,716	0.02%	99.87%
164	2007	BROADCAST SEED (PERM) (URBAN) (CLAY)	SY	348,394	$ 0.50	$ 174,197	0.02%	99.89%
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (Ramps)	GAL	42,611	$ 4.00	$ 170,442	0.02%	99.91%
464	2010	RC PIPE (CL III)(42 IN)	LF	1,890	$ 85.00	$ 160,650	0.02%	99.92%
462	2030	CONC BOX CULV (10 FT x 6 FT)	LF	360	$ 388.00	$ 139,680	0.01%	99.94%
540	2011	MBGF TRANSITION	EA	76	$ 1,300.00	$ 98,800	0.01%	99.95%
666	2189	PAVEMENT SEALER 4"	LF	880,289	$ 0.10	$ 88,029	0.01%	99.95%
678	2001	PAV SURF PREP FOR MRK (4")	LF	880,289	$ 0.10	$ 88,029	0.01%	99.96%
666	2110	REFL PAV MRK TY I (Y) 4" (SLD) (090 MIL)	LF	229,398	$ 0.35	$ 80,289	0.01%	99.97%
544	2001	MBGF END TREATMENT	EA	28	$ 2,000.00	$ 56,000	0.01%	99.98%
614	2001	HI MST IL ASM (12 - 400 WATT) (ASYM) (TY A)	EA	2	$ 25,000.00	$ 50,000	0.00%	99.98%
666	2002	REFL PAV MRK TY I (W) 4" (BRK) (090 MIL)	LF	134,559	$ 0.35	$ 47,096	0.00%	99.99%
672	2017	REFL PAV MRKR TY II-C-R	EA	10,628	$ 4.00	$ 42,512	0.00%	99.99%
636	2002	ALUMINUM SIGNS (TY G)	SF	1,979	$ 20.00	$ 39,588	0.00%	99.99%
466	2050	WINGWALL (PW) (H=6 FT)	EA	4	$ 8,940.00	$ 35,760	0.00%	100.00%
540	2005	TERMINAL ANCHOR SECTION	EA	20	$ 620.00	$ 12,400	0.00%	100.00%
456	2048	WINGWALL (PW) (H=4 FT)	EA	1	$ 5,200.00	$ 5,200	0.00%	100.00%
467	xxxx	SET (4:1)	EA	1	$ 4,000.00	$ 4,000	0.00%	100.00%
423	2001	RETAINING WALL	SF	0	$ 35.00	$ -		
450	xxxx	BRIDGES (CONCRETE over water) (Cross Streets)	SF	0	$ 110.00	$ -		
450	xxxx	BRIDGES (CONCRETE) (Tx34 girder)	SF	0	$ 50.00	$ -		
450	2018	PEDESTRIAN RAIL (Premium added to bridge cost)	LF	0	$ 60.00	$ -		
450	2016	PEDESTRIAN RAIL (Approaches)	LF	0	$ 97.00	$ -		
450	xxxx	RAIL	LF	0	$ 50.00	$ -		
462	2001	CONC BOX CULV (3 FT x 2 FT)	LF	0	$ 110.00	$ -		
462	2003	CONC BOX CULV (4 FT x 2 FT)	LF	0	$ 110.00	$ -		
462	2004	CONC BOX CULV (4 FT x 3 FT)	LF	0	$ 124.00	$ -		
462	2006	CONC BOX CULV (5 FT x 2 FT)	LF	0	$ 140.00	$ -		
462	2007	CONC BOX CULV (5 FT x 3 FT)	LF	0	$ 142.00	$ -		
462	2010	CONC BOX CULV (6 FT x 3 FT)	LF	0	$ 178.00	$ -		
462	2015	CONC BOX CULV (7 FT x 4 FT)	LF	0	$ 239.00	$ -		
462	2017	CONC BOX CULV (7 FT x 6 FT)	LF	0	$ 266.00	$ -		
462	2019	CONC BOX CULV (8 FT x 4 FT)	LF	0	$ 308.00	$ -		
462	2022	CONC BOX CULV (8 FT x 7 FT)	LF	0	$ 295.00	$ -		
462	2032	CONC BOX CULV (10 FT x 6 FT)	LF	0	$ 400.00	$ -		
464	2015	RC PIPE (CL III)(72 IN)	LF	0	$ 200.00	$ -		
465	2005	MANHOLE	EA	0	$ 2,960.00	$ -		
465	2211	JUNCTION BOX (SPL)	EA	0	$ 27,040.00	$ -		
466	xxxx	WINGWALL (PW) (H=2 FT)	EA	0	$ 2,200.00	$ -		
466	2047	WINGWALL (PW) (H=3 FT)	EA	0	$ 5,320.00	$ -		
466	2052	WINGWALL (PW) (H=8 FT)	EA	0	$ 13,960.00	$ -		
496	2009	REMOV STR (BRIDGE 0-99 FT LENGTH)	EA	0	$ 10,200.00	$ -		
531	2004	CONC SIDEWALKS (6")	SY	0	$ 68.00	$ -		
550	2001	CHAIN LINK FENCE (INSTALL) (6') (Ped. Bridge Protection/Cove	LF	0	$ 14.00	$ -		
XXXX	xxxx	LIFT STATION	LS	0	SEE ESTIMATE	$ -		
XXXX	xxxx	USACE PROPERTY MITIGATION TABLE	LS	0	SEE ESTIMATE	$ -		
					Subtotal:	$ 1,022,109,591		
					15% Contingency:	$ 153,316,439		
					Total:	$ 1,175,426,029		
					TOTAL ESTIMATED CONSTRUCTION COST (SAY)=	$ 1,175,530,000		
					ENVIRONMENTAL MITIGATION=	$ 1,109,835		
					RIGHT OF WAY=	$ 504,256,027		
					UTILITY RELOCATION =	$ 64,781,403		
					ENGINEERING COSTS (6% PS&E) = 6%	$ 74,430,000		
					ENGINEERING COSTS (4% QA/QC, 2.5% IE) = 6.5%	$ 80,550,000		
					TOTAL ESTIMATED COST (SAY)=	$ 1,900,757,265		

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COSTS
IH 35E FROM N OF FM 2181 TO US 380 (NORTH SEGMENT)
CSJ's: 0196-03-138, ETC.

PARETO DISTRIBUTION

ITEM	DESC CODE	DESCRIPTION	UNIT	QUANTITY	UNIT COST	SUBTOTAL	%	Accum %
450	xxxx	BRIDGES (CONCRETE) (General Purpose)	SF	1,077,926	$ 50.00	$ 53,896,300	9.35%	9.35%
423	2001	RETAINING WALL	SF	1,388,500	$ 35.00	$ 48,597,500	8.43%	17.78%
500	2001	MOBILIZATION	LS	5	SEE ESTIMATE	$ 48,060,000	8.34%	26.12%
XXXX	xxxx	TRAFFIC CONTROL	LS	5	SEE ESTIMATE	$ 48,060,000	8.34%	34.46%
450	xxxx	BRIDGES (CONCRETE) (Managed Lanes)	SF	578,885	$ 50.00	$ 28,944,250	5.02%	39.48%
132	2006	EMBANKMENT	CY	3,509,500	$ 8.00	$ 28,076,000	4.87%	44.35%
344	2014	BASE COURSE (6.5") (SP-B) (General Purpose)	TON	312,433	$ 79.00	$ 24,682,207	4.28%	48.64%
XXXX	xxxx	TOLL ENFORCEMENT	MILE	11	$ 2,000,000.00	$ 22,200,000	3.85%	52.49%
344	2119	BASE COURSE (4") (SP-D) (Gen Purpose)	TON	192,267	$ 90.00	$ 17,304,030	3.00%	55.49%
450	xxxx	BRIDGES (CONCRETE) (Ramps)	SF	282,793	$ 50.00	$ 14,139,650	2.45%	57.94%
344	2014	BASE COURSE (6.5") (SP-B) (Managed Lanes)	TON	163,719	$ 79.00	$ 12,933,801	2.24%	60.19%
344	2014	BASE COURSE (6") (SP-B) (Frontage Rds)	TON	159,597	$ 79.00	$ 12,608,163	2.19%	62.38%
464	2011	RC PIPE (CL III)(48 IN)	LF	105,379	$ 107.00	$ 11,275,553	1.96%	64.33%
110	2001	EXCAVATION	CY	2,048,000	$ 5.00	$ 10,240,000	1.78%	66.11%
275	2018	CEMENT TRT(34") (General Purpose)	SY	917,634	$ 11.00	$ 10,093,974	1.75%	67.86%
514	2004	PERM CONC TRF BAR (SGL SLP)(TY 2)	LF	182,200	$ 52.00	$ 9,474,400	1.64%	69.50%
346	2014	SURFACE COURSE (2") (SMA-D) (Gen Purpose)	TON	96,135	$ 97.00	$ 9,325,095	1.62%	71.12%
344	2119	BASE COURSE (4") (SP-D) (Managed Lns)	TON	100,751	$ 90.00	$ 9,067,590	1.57%	72.70%
450	xxxx	RAIL	LF	152,983	$ 50.00	$ 7,649,150	1.33%	74.02%
344	2119	BASE COURSE (3") (SP-D) (Frontage Rds)	TON	79,800	$ 90.00	$ 7,182,000	1.25%	75.27%
450	xxxx	BRIDGES (STEEL)	SF	62,666	$ 110.00	$ 6,893,260	1.20%	76.46%
275	2077	CEMENT TRT(21.5") (Frontage Roads)	SY	507,803	$ 11.00	$ 5,585,833	0.97%	77.43%
450	xxxx	BRIDGES (CONCRETE) (Cross Streets)	SF	110,145	$ 50.00	$ 5,507,250	0.96%	78.39%
275	2018	CEMENT TRT(34") (Managed Lanes)	SY	480,849	$ 11.00	$ 5,289,339	0.92%	79.31%
346	2014	SURFACE COURSE (2") (SMA-D) (Frontage Rds)	TON	53,201	$ 97.00	$ 5,160,497	0.90%	80.20%
650	xxxx	INS OH SN SUP (CANTILEVER) (CIRC TUBE)	EA	63	$ 80,000.00	$ 5,040,000	0.87%	81.08%
346	2014	SURFACE COURSE (2") (SMA-D) (Managed Lns)	TON	50,376	$ 97.00	$ 4,886,472	0.85%	81.93%
464	2009	RC PIPE (CL III)(36 IN)	LF	70,253	$ 69.00	$ 4,847,457	0.84%	82.77%
275	2001	CEMENT (General Purpose)	TON	42,122	$ 115.00	$ 4,844,030	0.84%	83.61%
5296	2007	NOISE WALLS	SF	127,600	$ 35.00	$ 4,473,000	0.78%	84.38%
342	2006	SURFACE COURSE (1.5") (PFC) (Gen Purpose)	TON	62,269	$ 68.00	$ 4,234,292	0.73%	85.12%
465	xxxx	INLETS	EA	1,187	$ 3,500.00	$ 4,154,500	0.72%	85.84%
104	2001	REMOVING CONC (PAV)	SY	686,589	$ 6.00	$ 4,119,534	0.71%	86.55%
344	2014	BASE COURSE (6") (SP-B) (Cross Streets)	TON	50,297	$ 79.00	$ 3,973,463	0.69%	87.24%
686	xxxx	INSTALL TRAFFIC SIGNAL (INTERSECTION)	EA	26	$ 150,000.00	$ 3,900,000	0.68%	87.92%
344	2014	BASE COURSE (6.5") (SP-B) (Ramps)	TON	48,645	$ 79.00	$ 3,842,955	0.67%	88.59%
529	2004	CONC CURB & GUTTER (TY II)	LF	303,528	$ 12.00	$ 3,642,336	0.63%	89.22%
450	xxxx	BRIDGES (CONCRETE) (Frontage Roads)	SF	67,226	$ 50.00	$ 3,361,300	0.58%	89.80%
531	2015	CONC SIDEWALKS (4")	SY	92,600	$ 35.00	$ 3,241,000	0.56%	90.36%
344	2119	BASE COURSE (4") (SP-D) (Ramps)	TON	29,937	$ 90.00	$ 2,694,330	0.47%	90.83%
275	2001	CEMENT (Managed Lanes)	TON	22,073	$ 115.00	$ 2,538,395	0.44%	91.27%
610	2047	INS RD IL AM (TY SP) 48S-6-8 (.4KW)S	EA	811	$ 3,100.00	$ 2,514,100	0.44%	91.71%
464	2005	RC PIPE (CL III)(24 IN)	LF	59,043	$ 42.00	$ 2,479,806	0.43%	92.14%
506	xxxx	SWPPP	STA	600	$ 4,000.00	$ 2,400,000	0.42%	92.55%
100	2002	PREPARING ROW	STA	590	$ 4,000.00	$ 2,360,000	0.41%	92.96%
342	2006	SURFACE COURSE (1.5") (PFC) (Frontage Rds)	TON	34,460	$ 68.00	$ 2,343,280	0.41%	93.37%
650	xxxx	INS OH SN SUP (BRIDGE) (CIRC TUBE)	EA	13	$ 180,000.00	$ 2,340,000	0.41%	93.78%
344	2119	BASE COURSE (3") (SP-D) (Cross Streets)	TON	25,149	$ 90.00	$ 2,263,410	0.39%	94.17%
342	2006	SURFACE COURSE (1.5") (PFC) (Managed Lns)	TON	32,632	$ 68.00	$ 2,218,976	0.39%	94.55%
105	2014	REMOVING CONC (ASPH)	SY	499,751	$ 4.00	$ 1,999,004	0.35%	94.90%
462	2010	CONC BOX CULV (6 FT x 3 FT)	LF	9,968	$ 178.00	$ 1,774,304	0.31%	95.21%
275	2077	CEMENT TRT(21.5") (Cross Streets)	SY	160,031	$ 11.00	$ 1,760,341	0.31%	95.51%
275	2001	CEMENT (Frontage Roads)	TON	14,741	$ 115.00	$ 1,695,215	0.29%	95.81%
346	2014	SURFACE COURSE (2") (SMA-D) (Cross Streets)	TON	16,767	$ 97.00	$ 1,626,399	0.28%	96.09%
275	2018	CEMENT TRT(34") (Ramps)	SY	142,873	$ 11.00	$ 1,571,603	0.27%	96.36%
346	2014	SURFACE COURSE (2") (SMA-D) (Ramps)	TON	14,969	$ 97.00	$ 1,451,993	0.25%	96.61%
496	2010	REMOV STR (BRIDGE 100-499 FT LENGTH)	EA	24	$ 60,000.00	$ 1,440,000	0.25%	96.86%
618	2015	CONDT (PVC)(SCHD 40)(1 1/2")	LF	185,505	$ 7.00	$ 1,298,542	0.23%	97.09%
462	2019	CONC BOX CULV (8 FT x 4 FT)	LF	3,777	$ 308.00	$ 1,163,316	0.20%	97.29%
462	2017	CONC BOX CULV (7 FT x 6 FT)	LF	3,465	$ 266.00	$ 921,690	0.16%	97.45%
275	2001	CEMENT (Ramps)	TON	6,559	$ 115.00	$ 754,285	0.13%	97.58%
342	2006	SURFACE COURSE (1.5") (PFC) (Cross Streets)	TON	10,861	$ 68.00	$ 738,548	0.13%	97.71%
462	2030	CONC BOX CULV (10 FT x 6 FT)	LF	1,870	$ 388.00	$ 725,560	0.13%	97.84%
161	2002	COMPOST MANUF TOPSOIL (BOS)(4")	SY	723,177	$ 1.00	$ 723,177	0.13%	97.96%
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (General Purpose)	GAL	174,769	$ 4.00	$ 699,156	0.12%	98.08%
636	2003	ALUMINUM SIGNS (TY O)	SF	26,710	$ 25.00	$ 667,750	0.12%	98.20%
342	2006	SURFACE COURSE (1.5") (PFC) (Ramps)	TON	9,697	$ 68.00	$ 659,396	0.11%	98.31%
xxxx	xxxx	ENHANCED LANDSCAPING (per Cross Street)	EA	15	$ 40,000.00	$ 600,000	0.10%	98.42%
462	2032	CONC BOX CULV (10 FT x 8 FT)	LF	1,472	$ 400.00	$ 588,800	0.10%	98.52%
462	2015	CONC BOX CULV (7 FT x 4 FT)	LF	2,442	$ 239.00	$ 583,638	0.10%	98.62%
275	2001	CEMENT (Cross Streets)	TON	4,646	$ 115.00	$ 534,290	0.09%	98.71%
644	2004	INS SM RD SN SUP&ASSM TY A	EA	1,160	$ 450.00	$ 522,000	0.09%	98.80%
626	2040	ELC SRV TY A 240 / 480 100 (NS) SS (E) SP (O)	EA	104	$ 4,500.00	$ 468,000	0.08%	98.88%
636	2001	ALUMINUM SIGNS (TY A)	SF	18,560	$ 23.00	$ 426,880	0.07%	98.96%
450	xxxx	BRIDGES (CONCRETE) (Tx34 girder)	SF	7,900	$ 50.00	$ 395,000	0.07%	99.03%
610	2060	INS RD IL AM (U/P) (TY 1)(.15KW)S	EA	320	$ 1,210.00	$ 387,200	0.07%	99.10%

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COSTS
IH 35E FROM N OF FM 2181 TO US 380 (NORTH SEGMENT)
CSJ's: 0196-03-138, ETC.

PARETO DISTRIBUTION

ITEM	DESC CODE	DESCRIPTION	UNIT	QUANTITY	UNIT COST	SUBTOTAL	%	Accum %
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (Frontage Roads)	GAL	96,726	$ 4.00	$ 386,904	0.07%	99.16%
540	2002	MTL W-BEAM GUARD FENCE	LF	19,300	$ 20.00	$ 386,000	0.07%	99.23%
462	2007	CONC BOX CULV (5 FT x 3 FT)	LF	2,682	$ 142.00	$ 380,844	0.07%	99.30%
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (Managed Lanes)	GAL	91,591	$ 4.00	$ 366,364	0.06%	99.36%
545	2001	CRASH CUSH ATTEN (INSTALL)	EA	34	$ 10,600.00	$ 360,400	0.06%	99.42%
462	2003	CONC BOX CULV (4 FT x 2 FT)	LF	3,220	$ 110.00	$ 354,200	0.06%	99.48%
164	2007	BROADCAST SEED (PERM) (URBAN) (CLAY)	SY	704,515	$ 0.50	$ 352,258	0.06%	99.54%
465	2211	JUNCTION BOX (SPL)	EA	12	$ 27,040.00	$ 324,480	0.06%	99.60%
531	xxxx	CURB RAMPS	EA	145	$ 1,500.00	$ 217,500	0.04%	99.64%
614	2001	HI MST IL ASM (12 - 400 WATT) (ASYM) (TY A)	EA	8	$ 25,000.00	$ 200,000	0.03%	99.67%
624	2006	GROUND BOX TY A (122311) W/APRON	EA	262	$ 616.00	$ 161,392	0.03%	99.70%
666	2011	REFL PAV MRK TY I (W) 4" (SLD) (090 MIL)	LF	421,682	$ 0.35	$ 147,589	0.03%	99.73%
666	2110	REFL PAV MRK TY I (Y) 4" (SLD) (090 MIL)	LF	405,213	$ 0.35	$ 141,825	0.02%	99.75%
462	2001	CONC BOX CULV (3 FT x 2 FT)	LF	1,140	$ 110.00	$ 125,400	0.02%	99.77%
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (Cross Streets)	GAL	30,484	$ 4.00	$ 121,936	0.02%	99.79%
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (Ramps)	GAL	27,215	$ 4.00	$ 108,860	0.02%	99.81%
496	2011	REMOV STR (BRIDGE 500-999 FT LENGTH)	EA	1	$ 104,000.00	$ 104,000	0.02%	99.83%
531	2004	CONC SIDEWALKS (6")	SY	1,500	$ 68.00	$ 102,000	0.02%	99.85%
450	2018	PEDESTRIAN RAIL (Approaches)	LF	1,030	$ 97.00	$ 99,910	0.02%	99.87%
666	2189	PAVEMENT SEALER 4"	LF	994,587	$ 0.10	$ 99,459	0.02%	99.88%
678	2001	PAV SURF PREP FOR MRK (4")	LF	994,587	$ 0.10	$ 99,459	0.02%	99.90%
540	2011	MBGF TRANSITION	EA	51	$ 1,300.00	$ 66,300	0.01%	99.91%
462	2004	CONC BOX CULV (4 FT x 3 FT)	LF	474	$ 124.00	$ 58,776	0.01%	99.92%
666	2002	REFL PAV MRK TY I (W) 4" (BRK) (090 MIL)	LF	167,692	$ 0.35	$ 58,692	0.01%	99.93%
466	2047	WINGWALL (PW) (H=3 FT)	EA	11	$ 5,320.00	$ 58,520	0.01%	99.94%
466	2050	WINGWALL (PW) (H=6 FT)	EA	6	$ 8,940.00	$ 53,640	0.01%	99.95%
672	2017	REFL PAV MRKR TY II-C-R	EA	12,587	$ 4.00	$ 50,348	0.01%	99.96%
450	2018	PEDESTRIAN RAIL (Premium added to bridge cost)	LF	720	$ 60.00	$ 43,200	0.01%	99.97%
466	2048	WINGWALL (PW) (H=4 FT)	EA	6	$ 6,200.00	$ 37,200	0.01%	99.97%
636	2002	ALUMINUM SIGNS (TY G)	SF	1,775	$ 20.00	$ 35,500	0.01%	99.98%
544	2001	MBGF END TREATMENT	EA	15	$ 2,000.00	$ 30,000	0.01%	99.99%
466	2052	WINGWALL (PW) (H=8 FT)	EA	2	$ 13,980.00	$ 27,960	0.00%	99.99%
496	2009	REMOV STR (BRIDGE 0-99 FT LENGTH)	EA	2	$ 10,200.00	$ 20,400	0.00%	99.99%
550	2001	CHAIN LINK FENCE (INSTALL) (6') (Ped. Bridge Protection/Cove	LF	720	$ 14.00	$ 10,080	0.00%	100.00%
466	xxxx	WINGWALL (PW) (H=2 FT)	EA	4	$ 2,200.00	$ 8,800	0.00%	100.00%
540	2005	TERMINAL ANCHOR SECTION	EA	13	$ 620.00	$ 8,060	0.00%	100.00%
467	xxxx	SET (4:1)	EA	1	$ 4,000.00	$ 4,000	0.00%	100.00%
423	2001	RETAINING WALL (DRILLED SHAFT)	SF	0	$ 75.00	$ -		
450	xxxx	BRIDGES (CONCRETE over water) (General Purpose)	SF	0	$ 110.00	$ -		
450	xxxx	BRIDGES (CONCRETE over water) (Managed Lanes)	SF	0	$ 110.00	$ -		
450	xxxx	BRIDGES (CONCRETE over water) (Ramps)	SF	0	$ 110.00	$ -		
450	xxxx	BRIDGES (CONCRETE over water) (Frontage Roads)	SF	0	$ 110.00	$ -		
450	xxxx	BRIDGES (CONCRETE over water) (Cross Streets)	SF	0	$ 110.00	$ -		
462	2006	CONC BOX CULV (5 FT x 2 FT)	LF	0	$ 140.00	$ -		
462	2022	CONC BOX CULV (8 FT x 7 FT)	LF	0	$ 295.00	$ -		
462	2024	CONC BOX CULV (9 FT x 5 FT)	LF	0	$ 340.00	$ -		
464	2010	RC PIPE (CL III)(42 IN)	LF	0	$ 85.00	$ -		
464	2015	RC PIPE (CL III)(72 IN)	LF	0	$ 200.00	$ -		
465	2005	MANHOLE	EA	0	$ 2,960.00	$ -		
XXXX	xxxx	RAILROAD	LS	0	SEE ESTIMATE	$ -		
XXXX	xxxx	LIFT STATION	LS	0	SEE ESTIMATE	$ -		
XXXX	xxxx	USACE PROPERTY MITIGATION TABLE	LS	0	SEE ESTIMATE	$ -		
					Subtotal:	$ 576,346,819		
					15% Contingency:	$ 86,452,023		
						$ 662,798,842		
					TOTAL ESTIMATED CONSTRUCTION COST (SAY)=	$ 662,940,000		
					ENVIRONMENTAL MITIGATION=	$ -		
					RIGHT OF WAY =	$ 425,032,861		
					UTILITY RELOCATION =	$ 89,306,772		
					ENGINEERING COSTS (6% PS&E) = 6%	$ 45,140,000		
					ENGINEERING COSTS (4% QA/QC, 2.5% IE) = 6.5%	$ 48,910,000		
					TOTAL ESTIMATED COST (SAY)=	$ 1,271,329,633		

FUNCTION ANALYSIS

Function analysis results in a unique view of the study project. It transforms project elements into functions, which moves the VE team mentally away from the original design and takes it toward a functional concept of the project. Functions are defined in verb-noun statements to reduce the needs of the project to their most elemental level. Functions are categorized as Basic, Secondary, Required Secondary, Unwanted, Higher Order, and Assumed to further the analysis. Identifying the functions of the project allows a broader consideration of alternative ways to accomplish the functions.

FUNCTIONS				TxDOT
ITEM		FUNCTION		
No.	DESCRIPTION	VERB	NOUN	TYPE
	OVERALL PROJECT	Reduce	Congestion	HO
		Improve	Mobility	HO
		Upgrade/Meet	Standards	B
		Manage	Peak Traffic	HO
		Reduce	Travel Time	B
		Increase	Capacity	HO
		Improve	Air Quality	HO
		Stimulate	Economy	A
		Generate	Revenue	RS
		Improve	Local Access	B
		Create	Jobs	A
		Replace	Aging facilities	B
		Satisfy	Stakeholders	S
		Accommodate	Ped/Bike	B
		Accommodate	Recreation	RS
		Improve	Competitiveness	A
		Accommodate	Multi-modal Options	B
		Connect	Neighborhoods	B
		Acquire	ROW	U
		Induce	Traffic Demand	U
		Disrupt	Traffic (during construction)	U
	PROJECT SPECIFICS			
	Middle Segment			

Function:	Active Verb Measurable Noun	Kind:	B = Basic S = Secondary RS = Required Secondary		HO = Higher Order A = Assumed U = Unwanted		

FUNCTIONS			TxDOT	
ITEM		FUNCTION		
No.	DESCRIPTION	VERB	NOUN	TYPE
	Bridges (concrete over water) General Purpose	Carry	Traffic	B
		Span	Water	B
		Reduce	Fill	RS
		Maintain	Reservoir Storage	RS
	Bridges (concrete over water) Managed Lanes	Carry	Traffic	B
		Span	Water	B
		Reduce	Fill	RS
		Maintain	Reservoir Storage	RS
	Mobilization	Initiate	Construction	B
	Traffic Control (during construction)	Maintain	Traffic	B
		Protect	Workers/Motorists	B
		Facilitate/Allow	Construction	B
		Inform	Public	RS
		Detour	Traffic	B
	Retaining Wall	Support	Cut/Fill	B
		Minimize	ROW	B
		Minimize	Structure Length	B
	Bridges (Concrete) (ramps)	Carry	Traffic	B
		Eliminate	Conflicts	B
		Accommodate	Weaving	B
		Increase	Access (local)	B
		Enhance	Revenue	S
	Bridges (Concrete) (general purpose)	Carry	Traffic	B

Function: Active Verb, Measurable Noun

Kind: B = Basic; S = Secondary; RS = Required Secondary; HO = Higher Order; A = Assumed; U = Unwanted

FUNCTIONS			TxDOT	
ITEM		FUNCTION		
No.	DESCRIPTION	VERB	NOUN	TYPE
		Separate	Grades	B
		Eliminate	Conflicts	B
		Connect	Neighborhood	S
	Bridges (Concrete over water) Frontage Road	Connect	Frontage Roads	S
		Reduce	Congestions	S
		Manage	Incidents	B
	Bridge (Concrete) Managed Lanes	Carry	Traffic	B
		Separate	Grades	B
		Eliminate	Conflicts	B
		Enhance	Revenue	S
	Toll Collection	Collect	Tolls	B
		Manage	Traffic	B
	Pavement Section	Support	Loads	B
		Carry	Traffic	B
		Allow	Drainage	B
		Reduce	Noise	S
		Smooth	Ride-surface	S
	Bridge (concrete) (Cross Streets)	Connect	Neighborhood	B
		Accommodate	Local Access	B
		Separate	Traffic/Grades	B
		Improve	Circulations	B
	Embankment	Reduce	Structure	S
		Improve	Grades	B

Function:	**Active Verb**	**Kind:**	**B**	**=**	**Basic**	**HO**	**= Higher Order**
	Measurable Noun		**S**	**=**	**Secondary**	**A**	**= Assumed**
			RS	**=**	**Required Secondary**	**U**	**= Unwanted**

FUNCTIONS			TxDOT	
ITEM		FUNCTION		
No.	DESCRIPTION	VERB	NOUN	TYPE
		Elevate	Vert. Alignment	B
		Support	Pavement	B
		Allow	Drainage	S
	Drainage Structures	Carry	Runoff	B
		Drain	Road	B
		Prevent	Flooding	B
		Maintain	Streams	B
		Extend	Pavement Life	S
		Reduce	Bridge	S
	Excavation	Improve	Grades	B
		Lower	Vert. Alignment	B
		Reduce	Structure	S
		Allow	Drainage	RS
		Mitigate	Floodplain	RS
	Traffic Barriers	Separate	Traffic	B
		Control	Access	B
		Mitigate	Hazards	B
		Improve	Driver Confidence	A
		Channelize	Traffic/Direction	S
		Retain	Soil	S
	Noise Walls	Redirect	Noise	B
	Lift Station	Pump	Water	S
		Drain	Roadway	B

Function: Active Verb, Measurable Noun

Kind: B = Basic; S = Secondary; RS = Required Secondary; HO = Higher Order; A = Assumed; U = Unwanted

FUNCTIONS			TxDOT	
ITEM		FUNCTION		
No.	DESCRIPTION	VERB	NOUN	TYPE
	Concrete Curb & Gutter	Channelize	Traffic	B
		Channelize	Runoff	B
		Reduce	ROW	S
	Concrete Sidewalks (4")	Accommodate	Pedestrians	B
	Right of Way	Accommodate	Roadway Design	B
		Allow	Construction	B
		Reduce	Retaining walls	S
		Increase	LOS	S
		Accommodate	Utilities	B
		Control	Access	B
	Phasing	Defer	Costs	B
		Maximize	Funding	B
		Prioritize	Segments	B
		Initiate	Tolling	RS
		Improve	Construction	S
		Accommodate	ROW Acq. Schedule	B
		Accommodate	Utility Relocations	B
		Coordinate	Adjacent Projects	RS

Function:	**Active Verb**	**Kind:**	**B**	**=**	**Basic**	**HO**	**= Higher Order**
	Measurable Noun		**S**	**=**	**Secondary**	**A**	**= Assumed**
			RS	**=**	**Required Secondary**	**U**	**= Unwanted**

PERFORMANCE CRITERIA MATRIX

The evaluation criteria matrix was used to determine the key evaluative criteria for the project. The VE team listed, with the assistance of the design team and stakeholders, the possible evaluative criteria that could be used to evaluate the creative ideas. These criteria were clearly defined and entered onto a matrix and compared in pairs, asking the question: "Which one is more important to the project?" The letter code (e.g., "a") was entered into the matrix for each pair. After all pairs were discussed they were tallied and percentages calculated. The highest scoring criteria were selected for use in the Evaluation Phase of the study.

The Performance Criteria Matrix is shown below. The definitions and measurement scales for each criterion are included on the following pages.

PERFORMANCE CRITERIA MATRIX
I-35E Managed Lanes project

TxDOT

													TOTAL	%
Traffic OPS - ML	**A**	a	a/c	a	a/e	a/f	a	a	a	a			7.5	17%
Traffic OPS - Local	**B**		b/c	b	b/e	f	b	b	b	b/j			5.5	12%
Environmental Impacts	**C**			c	c/e	f	c	c	c	c			6.5	14%
Right of Way Impacts	**D**				d/e	f	d	d	d	d			4.5	10%
Stakeholder Acceptance	**E**					e/f	e	e	e	e/j			6.0	13%
Revenue Impacts	**F**						f	f	f	f			8.0	18%
Constructability	**G**							h	g/i	g/j			1.0	2%
Schedule Impact	**H**								h	h/j			2.5	6%
Maintenance OPS	**I**									i			1.5	3%
Phasing/Traffic Handling	**J**												2.0	4%
	K													0%
													45.0	1.0

a	More Important
a/b	Equal Importance

After using the Performance Criteria Matrix to select the criteria, the VE team members further refined the criteria definitions, and defined the scales to be used for each of the criteria. For this project, the performance criteria listed below were selected:

Performance Criteria	Definition	Rating Scale
General Purpose Lanes /Local Traffic Operations	A measure of the efficiency of future traffic operations as they relate directly to the mainline alignment (including on and off ramps) and local traffic	10- LOS "A"; Vol/Capacity = 0.0-0.3; Free flow-excellent operation 9 – LOS "B" Vol/Capacity = 0.31-0.48; Stable flow – very good condition 8 – LOS "C" Stable flow - good operation 7 – LOS "D" Approaching unstable flow – fair operation 6 – LOS "E" Unstable flow- poor operation 4 – LOS "F-0" Traffic congestion for 15 min to 1 hour 3 – LOS "F-1" Traffic congestion for 1 to 2 hours 2 – LOS "F-2" Traffic congestion for 2 to 3 hours 1 – LOS "F-3" Traffic congestion for more than 3 hours
Revenue Impacts	What is the level of impact to the Revenue Collection?	10- Significantly increases revenue collection 9 – 8- 7 – Somewhat increases revenue collection 6- 5 - No apparent difference to revenue collection 4- 3 – Slightly decreases revenue collection 2- 1 – Significantly decreases revenue collection
Stakeholders Acceptance	An approximation of the concept's overall acceptability to non-TxDOT stakeholders and the general public	10- Strong support by all stakeholders and the public 8 – Moderate support from some stakeholders and/or public 5 – Indifference (i.e. either a general lack of interest or no support/opposition is anticipated) 3 – Moderate opposition from some stakeholders and/or the public 1 – Strong opposition from all stakeholders and the public is anticipated

Performance Criteria	Definition	Rating Scale
ROW Impact	A measure of the amount and types of right-of-way (ROW) required.	10 – No ROW required for project 9 – 5 or fewer parcels required; none in residential or commercial use. 7 – 6-10 parcels required; none in residential or commercial use 5 – 5 or fewer residential and/or commercial parcels required 3 – 6-10 residential and/or commercial parcels required 1 – ROW difficult or impossible to obtain (e.g., Native American or military owned property)
Schedule Impacts	What is the level of impact to the project delivery schedule? (both design and construction)	10- Significantly reduces project delivery time 9 – 8- 7 – Somewhat reduces project delivery time 6- 5 - No apparent difference to project delivery time 4- 3 – Slightly delay to project delivery time 2- 1 – Significantly delay to project delivery
Environmental Impact	An approximation of the concept's overall effect on the surrounding environment. This criterion includes the following areas: • Water quality • Endangered species • Socioeconomic resources • Natural resources	10- Major improvement upon existing environment conditions 9 – Measurable improvement upon existing environmental conditions 8 – No environmental impacts 6 – Minor degradation (i.e., does not require mitigation) 4 – Moderate degradation (i.e., requires significant mitigation in one area or limited mitigation in two) 1 – Severe degradation (i.e., requires substantial mitigation in multiple areas.)

PERFORMANCE RATING MATRIX

The performance rating process has been used throughout the VE Study to measure how well the various alternatives accomplish the performance criteria for the project. While the ratings for the individual VE alternatives are included with the documentation of each alternative, this section of the report includes the documentation of the performance ratings of all alternatives combined that were developed during the VE Study.

The rationale for the ratings precedes the rating matrix for each Performance Rating Matrix developed during the VE Study. The Performance Rating Matrices included in this report document the original concepts and the Proposed Alternatives.

The following pages include:

- Performance Rating Matrix – Original Concept
- Performance Rating Matrix – Proposed Alternatives
- Performance Rating Matrix – Accepted Alternatives

PERFORMANCE MATRIX - Original Concept

I-35E Managed Lanes Project

TxDOT

Criteria	Unit of Measurement	Criteria Weight	Concept	Performance Rating 1	2	3	4	5	6	7	8	9	10	Total Performance
Revenue Impacts	Degree of Impacts	18	No Build			3								54
			Original Design						6					108
														0
														0
														0
Traffic OPS - Mainline	Degree of Impacts	17	No Build		2									34
			Original Design								8			136
														0
														0
														0
Traffic OPS - Local	Degree of Impacts	12	No Build				4							48
			Original Design								8			96
														0
														0
														0
Right of Way Impacts	Degree of Impacts	10	No Build					5						50
			Original Design			3								30
														0
														0
														0
Environmental Impacts	Degree of Impacts	14	No Build			3								42
			Original Design							7				98
														0
														0
														0
Stakeholder Acceptance	Degree of Impacts	13	No Build		2									26
			Original Design							7				91
														0
														0
														0
Schedule Impact	Degree of Impacts	6	No Build					5						30
			Original Design					5						30
														0
														0
														0

OVERALL PERFORMANCE	Total Performance	% Perf. Improve.	Total Cost	Value Index (Performance / Cost)	% Value Improvement
No Build	284	-	-	-	-
Original Concept	589	107%		#DIV/0!	

Rating Rationale – Original Design

Performance Criteria	Original Design (Baseline)
Revenue Impacts	The inclusion of Managed Lanes (ML) will generate revenue
Traffic OPS – Mainline	With 4 General Purpose (GP) lanes, the traffic operations will be improved significantly; with the option of ML, the Level of Service will be improved even more.
Traffic OPS – Local	There will be 2 to 4 lanes of frontage roads provided along the entire corridor. The local traffic will be improved significantly.
Right of Way Impacts	In order to accommodate the MLs, GPs and frontage roads, many parcels of properties will be acquired.
Environmental Impacts	The air quality will be improved and noise barriers will be installed. The overall environmental impact will be minimized.
Stakeholder Acceptance	The baseline design will improve traffic operations not only on mainlines, also local accesses. High stakeholder acceptance is expected.
Schedule Impact	This is to establish baseline, a neutral number was used.

PERFORMANCE MATRIX - VE Alternatives

I-35E Managed Lanes Project

TxDOT

Criteria	Unit of Measurement	Criteria Weight	Concept	Performance Rating 1	2	3	4	5	6	7	8	9	10	Total Performance
Revenue Impacts	Degree of Impacts	18												0
			Original Design						6					108
			Set 1					5						90
			Set 2							7				126
														0
Traffic OPS - GP Lanes	Degree of Impacts	17												0
			Original Design								8			136
			Set 1					5						85
			Set 2							7				119
														0
Traffic OPS - Local	Degree of Impacts	12												0
			Original Design								8			96
			Set 1					5						60
			Set 2								8			96
														0
Right of Way Impacts	Degree of Impacts	10												0
			Original Design			3								30
			Set 1							7				70
			Set 2			3								30
														0
Environmental Impacts	Degree of Impacts	14												0
			Original Design							7				98
			Set 1					5						70
			Set 2							7				98
														0
Stakeholder Acceptance	Degree of Impacts	13												0
			Original Design							7				91
			Set 1		2									26
			Set 2						6					78
														0
Schedule Impact	Degree of Impacts	6												0
			Original Design					5						30
			Set 1				4							24
			Set 2						6					36
														0

OVERALL PERFORMANCE	Total Performance	% Perf. Improve.	Total Cost	Value Index (Performance / Cost)	% Value Improvement
Original Concept	589	-	4000	0.15	
VE Set 1	425	-28%	1792	0.24	61%
VE Set 2	583	-1%	3372	0.17	17%

Rating Rationale – VE Alternatives Sets

Performance Criteria	VE Set 1 *Maximize Affordability of Project*	VE Set 2 *Maintain Stakeholder Acceptance*
Revenue Impacts	Revenue will be slightly impacted due to deferral of North Segment. Traffic from North Segment wouldn't be able to utilize MLs.	Revenue will be increased due to deferral of one GP lane/each direction. Early implementation of HOT lanes would also have positive effect to revenue.
Traffic OPS – Mainline	Compared to the baseline, there will be more congestion on the North Segment.	Minor degradation to the traffic operations, compared to the baseline, due to deferral of outside/inside GP lanes.
Traffic OPS – Local	Local traffic operations would have negative impacts due to the deferral of the improvements on North Segment.	No apparent change.
Right of Way Impacts	More than 1/3 of the ROW acquisitions would be deferred, significantly minimized ROW impacts.	ROW impact remains the same as the baseline.
Environmental Impacts	The air quality would not be improved in the North Segment compared to the baseline.	No apparent change compared to the baseline concept.
Stakeholder Acceptance	Due to the deferral of northern part of Middle Segment and North Segment, stakeholders from that area would have negative opinions.	Stakeholders may not favor some of the ideas in VE Set 2.
Schedule Impact	It would take longer to deliver the project due to deferral of northern part of Middle Segment and North Segment.	With interim projects and improvements, projects can be delivered even faster than the baseline concept.

PROJECT DESCRIPTION

INTRODUCTION

The I-35E Managed Lanes project is approximately 28.0 miles long and extends from US 380 in Denton County to I-635 in Dallas County, as shown in **Figure 1**. The existing corridor is a four-lane facility north of Corinth Parkway and a six-lane facility in the south with a one-lane buffer separated, concurrent HOV facility, between I-635 and SH 121 that operates daily and is never closed. A reversible ramp connecting the HOV lane through the I-635 interchange operates on weekdays only and opens in the southbound direction during the morning peak period (6:00-9:00 a.m.), and in the northbound direction during the afternoon peak period (3:30-7:00 p.m.). The I-35E corridor serves as the primary route from Denton to Dallas and the project has been divided into three segments for analysis: south, middle and north. The geographical limit of each segment is derived from the city and county limits, economic activity, geometric configurations, and the traffic characteristics particular to each segment.

The limits of the segments are provided below:

- **South Segment:** I-635 to President George Bush Turnpike (PGBT)
- **Middle Segment:** President George Bush Turnpike (PGBT) to FM 2181/Swisher Road
- **North Segment:** FM 2181/Swisher Road to US 380

PROJECT DESCRIPTION

Existing Configuration

The existing I-35E is a six-lane freeway from I-635 to Quail Run just north of the Lake Lewisville Bridge and a four-lane freeway from Quail Run to US 380. The southern portion of I-35E from I-635 to SH 121 has an interim single lane concurrent high occupancy vehicle (HOV) lane in each direction. To implement this interim HOV lane, the three general purpose lanes in each direction were reduced to a lane width of 11 feet and the inside shoulder was reconstructed to provide space for the HOV lane.

Existing Condition

The section of I-35E under consideration for this project was constructed in the late 1950's and early 1960's as part of the United States Interstate Highway System. Roadway design standards have improved greatly since its initial design and construction. The current roadway exhibits design deficiencies including: inadequate shoulder and lane widths, inadequate ramp acceleration and deceleration distances, inadequate ramp length, inadequate ramp spacing to cross streets, inadequate bridge clearance and unofficial ramps. Additionally, the limited number of existing lanes does not meet the current traffic demands and result in severe congestion. This situation is likely to get worse with future growth and increasing traffic.

Existing Mobility on I-35E

The need for the proposed project is to address the transportation congestion of the area resulting from an increase in population and the subsequent increased travel demand. The proposed project, which traverses Dallas and Denton Counties, is an essential element in the local and regional transportation

system. Within the region, I-35E functions as an interstate highway, serves as the primary north/south commuter corridor between Denton and Dallas, and also serves as a local route for trips to and from work, school, shopping, etc. As an important regional commuter route, I-35E connects the Cities of Dallas, Farmers Branch, Carrollton, Lewisville, Highland Village, Lake Dallas, Corinth, Town of Hickory Creek, and Denton as well as neighboring developing communities.

Proposed Mobility on I-35E

The area adjacent to the I- 35E corridor between Dallas and Denton is in a state of rapid growth and continues to need substantial improvements to the existing transportation system. This growth pattern necessitates substantial transportation improvements to accommodate the projected increases in traffic demand to the already insufficient regional transportation system.

The purpose of the proposed project is to address the transportation needs on the corridor by increasing capacity, reducing traffic congestion, improving mobility, and improving roadway deficiencies within the DFW metropolitan area. The project will also serve to enhance the overall regional and national transportation system.

The proposed improvements for the project include widening the general purpose lanes (free main-lanes) and upgrading the interim concurrent HOV facility by adding a barrier separated bi-directional fully operational and accessible managed lane facility.

The proposed I-35E improvements include increasing the main-lane capacity by:

- Increasing the number of general purpose lanes from six to eight between I-635 and US 377
- Increasing the number of general purpose lanes from four to six between US 377 and I-35W
- Increasing the number of general purpose lanes from four to ten between I-35W and US 380
- Adding a barrier separated bi-directional managed lane facility
    - with four lanes from I-635 to US 77
    - with two lanes from US 77 to I-35W
    - with four lanes from I-35W to US 380
- Providing access to the barrier separated bi-directional managed lane facility at major traffic demand locations such as major intersections and major developed areas along the corridor
- Modifying access to the general purpose lanes to benefit mainlane traffic by decreasing the amount of weaving interaction while maintaining accessibility and conforming to current design standards

The total overall construction cost is currently estimated at $4.0 billion. This total includes the cost of all construction activity to deliver the planned facility, environmental mitigation, right-of-way, utility relocation, and all associated planning, design, and engineering.

DOCUMENTS PROVIDED TO THE VE TEAM

The following project documents were provided to the VE team for their use during the study:

- Slideshow – I-35E Stakeholder briefing, August 2009
- Slideshow – I-35E Stakeholder Presentation, January 2010
- Slideshow – I-35E Stakeholder Presentation, July 2010

- Cost Estimates: full project scope, July 20, 2010
- I-35E managed Lanes Project – Scope Refinement, January 2010
- I-35E Managed Lanes Project – Cost Saving Measures, October 2009
- Project Schematics – South Segment, July 2010
- Project Schematics – Middle Segment, July 2010
- Project Schematics – Modified Middle Segment, July 2010
- Project Schematics – North Segment, July 2010
- Project Schematics – Connection to I-635, July 2010
- Draft Project Level 2 Traffic and Toll Report – I-35E Managed Lanes Between I-635 and US 380, October 2009, Wilbur Smith, October 2009
- Draft White Paper on I-35E Managed Lanes Traffic and Revenue Enhancement, Wilbur Smith, December 2009
- Tolling Schematics – Toll the Toll to Toll Traffic on the CD (only) [CD – Collector Distributor Road]
- Tolling Schematics – Toll the Managed Lanes Traffic and the Toll to Toll Traffic on the CD
- Tolling Schematics – I-35E Configuration between I-635 and US 380 - Toll Gantry Locations - Scenario C – 2017
- Toll Schematics – I-35E Configuration between I-635 and US 380 - Toll Gantry Locations - Scenario C – 2030
- Interstate Access Justification I-35E from I-635 (LBJ) to US 380, August 2009

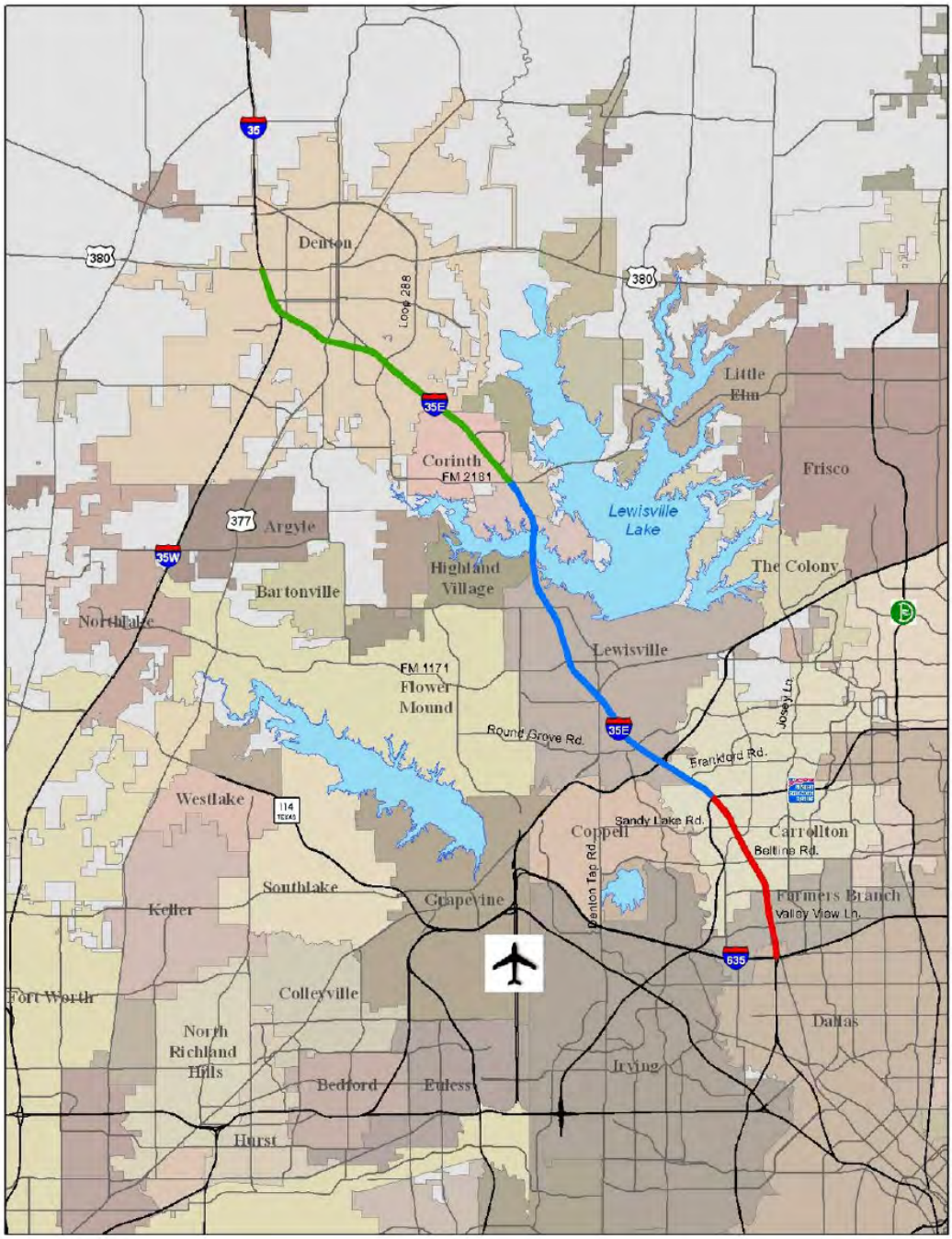
PROJECT DRAWING

Design drawing depicting project location and limits is included on the following page (Fig.1).

PROJECT COST ESTIMATES

The original project estimates are included after the project drawing.

Figure1. Project Map



Comment [D1]: Can we add a north arrow and a legend and/or big labels that show South Segment, Middle Segment, and North Segment?

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COSTS
IH 35E FROM N OF IH 635 TO PGBT (SOUTH SEGMENT)
CSJ's: 0196-03-138, ETC.

ITEM	DESC CODE	DESCRIPTION	UNIT	LOW	QUANTITY	HIGH	LOW	UNIT COST	HIGH	SUBTOTAL
EARTHWORK										
100	2002	PREPARING ROW	STA		392			$ 4,000.00		$ 1,568,000
110	2001	EXCAVATION	CY		728,384			$ 5.00		$ 3,641,920
132	2006	EMBANKMENT	CY		1,617,852			$ 8.00		$ 12,942,816
161	2002	COMPOST MANUF TOPSOIL (BOS)(4")	SY		158,574			$ 1.00		$ 158,574
164	2007	BROADCAST SEED (PERM) (URBAN) (CLAY)	SY		158,574			$ 0.50		$ 79,287
xxxx	xxxx	ENHANCED LANDSCAPING (per Cross Street)	EA		6			$ 40,000.00		$ 240,000
									CONTINGENCY (15%) =	$ 2,794,560
									EARTHWORK TOTAL (SAY) =	**$ 21,450,000**
SUBBASE & BASE										
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (General Purpose)	GAL		81,264			$ 4.00		$ 325,057
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (Managed Lanes)	GAL		48,231			$ 4.00		$ 192,924
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (Ramps)	GAL		27,947			$ 4.00		$ 111,790
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (Frontage Roads)	GAL		40,371			$ 4.00		$ 161,483
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (Cross Streets)	GAL		21,007			$ 4.00		$ 84,029
275	2001	CEMENT (General Purpose)	TON		19,583			$ 115.00		$ 2,252,007
275	2001	CEMENT (Managed Lanes)	TON		11,622			$ 115.00		$ 1,336,587
275	2001	CEMENT (Ramps)	TON		6,735			$ 115.00		$ 774,483
275	2001	CEMENT (Frontage Roads)	TON		6,152			$ 115.00		$ 707,452
275	2001	CEMENT (Cross Streets)	TON		3,201			$ 115.00		$ 368,127
275	2018	CEMENT TRT(34") (General Purpose)	SY		426,638			$ 11.00		$ 4,693,014
275	2018	CEMENT TRT(34") (Managed Lanes)	SY		253,213			$ 11.00		$ 2,785,347
275	2018	CEMENT TRT(34") (Ramps)	SY		146,724			$ 11.00		$ 1,613,965
275	2077	CEMENT TRT(21.5") (Frontage Roads)	SY		211,947			$ 11.00		$ 2,331,414
275	2077	CEMENT TRT(21.5") (Cross Streets)	SY		110,288			$ 11.00		$ 1,213,165
344	2014	BASE COURSE (6.5") (SP-B) (General Purpose)	TON		145,260			$ 79.00		$ 11,475,537
344	2014	BASE COURSE (6.5") (SP-B) (Managed Lanes)	TON		86,213			$ 79.00		$ 6,810,836
344	2014	BASE COURSE (6.5") (SP-B) (Ramps)	TON		49,956			$ 79.00		$ 3,946,528
344	2014	BASE COURSE (6") (SP-B) (Frontage Rds)	TON		66,612			$ 79.00		$ 5,262,334
344	2014	BASE COURSE (6") (SP-B) (Cross Streets)	TON		34,662			$ 79.00		$ 2,738,298
344	2119	BASE COURSE (4") (SP-D) (Gen Purpose)	TON		89,391			$ 90.00		$ 8,045,167
344	2119	BASE COURSE (4") (SP-D) (Managed Lns)	TON		53,054			$ 90.00		$ 4,774,880
344	2119	BASE COURSE (4") (SP-D) (Ramps)	TON		30,742			$ 90.00		$ 2,766,797
344	2119	BASE COURSE (3") (SP-D) (Frontage Rds)	TON		33,306			$ 90.00		$ 2,997,532
344	2119	BASE COURSE (3") (SP-D) (Cross Streets)	TON		17,331			$ 90.00		$ 1,559,783
									CONTINGENCY (15%) =	$ 10,399,278
									SUBBASE & BASE TOTAL (SAY) =	**$ 79,750,000**
PAVEMENT										
342	2006	SURFACE COURSE (1.5") (PFC) (Gen Purpose)	TON		28,950			$ 68.00		$ 1,968,628
342	2006	SURFACE COURSE (1.5") (PFC) (Managed Lns)	TON		17,182			$ 68.00		$ 1,168,399
342	2006	SURFACE COURSE (1.5") (PFC) (Ramps)	TON		9,956			$ 68.00		$ 677,027
342	2006	SURFACE COURSE (1.5") (PFC) (Frontage Rds)	TON		14,382			$ 68.00		$ 977,983
342	2006	SURFACE COURSE (1.5") (PFC) (Cross Streets)	TON		7,484			$ 68.00		$ 508,899
346	2014	SURFACE COURSE (2") (SMA-D) (Gen Purpose)	TON		44,695			$ 97.00		$ 4,336,451
346	2014	SURFACE COURSE (2") (SMA-D) (Managed Lns)	TON		26,527			$ 97.00		$ 2,573,130
346	2014	SURFACE COURSE (2") (SMA-D) (Ramps)	TON		15,371			$ 97.00		$ 1,490,996
346	2014	SURFACE COURSE (2") (SMA-D) (Frontage Rds)	TON		22,204			$ 97.00		$ 2,153,782
346	2014	SURFACE COURSE (2") (SMA-D) (Cross Streets)	TON		11,554			$ 97.00		$ 1,120,733
									CONTINGENCY (15%) =	$ 2,648,254
									PAVEMENT TOTAL (SAY) =	**$ 19,540,000**
STRUCTURES										
423	2001	RETAINING WALL	SF		576,523			$ 35.00		$ 20,178,305
423	2001	RETAINING WALL (DRILLED SHAFT)	SF		151,543			$ 75.00		$ 11,365,725
5296	2007	NOISE WALLS	SF		0			$ 35.00		$ -
450	xxxx	BRIDGES (CONCRETE) (General Purpose)	SF		552,203			$ 50.00		$ 27,610,150
450	xxxx	BRIDGES (CONCRETE) (Managed Lanes)	SF		296,917			$ 50.00		$ 14,845,850
450	xxxx	BRIDGES (CONCRETE) (Ramps)	SF		421,652			$ 50.00		$ 21,082,600
450	xxxx	BRIDGES (CONCRETE) (Frontage Roads)	SF		31,628			$ 50.00		$ 1,581,400
450	xxxx	BRIDGES (CONCRETE) (Cross Streets)	SF		168,101			$ 50.00		$ 8,405,050
450	xxxx	BRIDGES (CONCRETE over water) (General Purpose)	SF		0			$ 110.00		$ -
450	xxxx	BRIDGES (CONCRETE over water) (Managed Lanes)	SF		0			$ 110.00		$ -
450	xxxx	BRIDGES (CONCRETE over water) (Ramps)	SF		0			$ 110.00		$ -
450	xxxx	BRIDGES (CONCRETE over water) (Frontage Roads)	SF		0			$ 110.00		$ -
450	xxxx	BRIDGES (CONCRETE over water) (Cross Streets)	SF		0			$ 110.00		$ -
450	xxxx	BRIDGES (CONCRETE) (Tx34 girder)	SF		0			$ 50.00		$ -
450	xxxx	BRIDGES (STEEL)	SF		140,997			$ 110.00		$ 15,509,670
450	2018	PEDESTRIAN RAIL (Premium added to bridge cost)	LF		0			$ 60.00		$ -
450	2018	PEDESTRIAN RAIL (Approaches)	LF		0			$ 97.00		$ -
450	xxxx	RAIL	LF		0			$ 50.00		$ -
462	2001	CONC BOX CULV (3 FT x 2 FT)	LF		0			$ 110.00		$ -
462	2003	CONC BOX CULV (4 FT x 2 FT)	LF		0			$ 110.00		$ -
462	2004	CONC BOX CULV (4 FT x 3 FT)	LF		0			$ 124.00		$ -
462	2006	CONC BOX CULV (5 FT x 2 FT)	LF		1,510			$ 140.00		$ 211,400
462	2007	CONC BOX CULV (5 FT x 3 FT)	LF		2,970			$ 142.00		$ 421,740
462	2010	CONC BOX CULV (6 FT x 3 FT)	LF		1,980			$ 178.00		$ 352,440
462	2015	CONC BOX CULV (7 FT x 4 FT)	LF		0			$ 239.00		$ -
462	2017	CONC BOX CULV (7 FT x 6 FT)	LF		0			$ 286.00		$ -
462	2019	CONC BOX CULV (8 FT x 4 FT)	LF		0			$ 308.00		$ -
462	2022	CONC BOX CULV (8 FT x 7 FT)	LF		560			$ 295.00		$ 165,200
462	2024	CONC BOX CULV (9 FT x 5 FT)	LF		0			$ 340.00		$ -
462	2030	CONC BOX CULV (10 FT x 6 FT)	LF		0			$ 388.00		$ -
462	2032	CONC BOX CULV (10 FT x 8 FT)	LF		0			$ 400.00		$ -
464	2006	RC PIPE (CL III)(24 IN)	LF		37,080			$ 42.00		$ 1,557,368
464	2009	RC PIPE (CL III)(36 IN)	LF		44,496			$ 69.00		$ 3,070,240
464	2010	RC PIPE (CL III)(42 IN)	LF		0			$ 85.00		$ -
464	2011	RC PIPE (CL III)(48 IN)	LF		66,744			$ 107.00		$ 7,141,645
464	2015	RC PIPE (CL III)(72 IN)	LF		1,980			$ 200.00		$ 396,000
465	2005	MANHOLE	EA		0			$ 2,960.00		$ -
465	xxxx	INLETS	EA		742			$ 3,500.00		$ 2,595,613
465	2211	JUNCTION BOX (SPL)	EA		0			$ 27,040.00		$ -
466	xxxx	WINGWALL (PW) (H=2 FT)	EA		0			$ 2,200.00		$ -
466	2047	WINGWALL (PW) (H=3 FT)	EA		0			$ 5,320.00		$ -
466	2048	WINGWALL (PW) (H=4 FT)	EA		4			$ 6,200.00		$ 24,800
466	2050	WINGWALL (PW) (H=6 FT)	EA		0			$ 8,940.00		$ -
466	2052	WINGWALL (PW) (H=8 FT)	EA		1			$ 13,980.00		$ 13,980
467	xxxx	SET (4:1)	EA		1			$ 4,000.00		$ 4,000
									CONTINGENCY (15%) =	$ 20,479,970
									STRUCTURES TOTAL (SAY) =	**$ 157,030,000**
LIGHTING, SIGNING, MARKING, & SIGNALS										
610	2047	INS RD IL AM (TY SP) 48S-8-8 (.4KW)S	EA		448			$ 3,100.00		$ 1,388,800
610	2060	INS RD IL AM (U/P) (TY 1)(.15KW)S	EA		112			$ 1,210.00		$ 135,520
614	2001	HI MST IL ASM (12 - 400 WATT) (ASYM) (TY A)	EA		2			$ 25,000.00		$ 50,000
618	2016	CONDT (PVC)(SCHD 40)(1 1/2")	LF		102,640			$ 7.00		$ 718,483
624	2008	GROUND BOX TY A (122311) W/APRON	EA		291			$ 616.00		$ 179,503
628	2040	ELC SRV TY A 240 / 480 100 (NS) SS (E) SP (O)	EA		77			$ 4,500.00		$ 346,661

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COSTS
IH 35E FROM N OF IH 635 TO PGBT (SOUTH SEGMENT)
CSJ's: 0196-03-138, ETC.

ITEM	DESC CODE	DESCRIPTION	UNIT	LOW	QUANTITY	HIGH	LOW	UNIT COST	HIGH	SUBTOTAL
636	2001	ALUMINUM SIGNS (TY A)	SF		8,181			$ 23.00		$ 188,157
636	2002	ALUMINUM SIGNS (TY G)	SF		1,124			$ 20.00		$ 22,473
636	2003	ALUMINUM SIGNS (TY O)	SF		12,603			$ 25.00		$ 315,075
644	2004	INS SM RD SN SUP&ASSM TY A	EA		511			$ 450.00		$ 230,083
650	xxxx	INS OH SN SUP (CANTILEVER) (CIRC TUBE)	EA		25			$ 80,000.00		$ 2,000,000
650	xxxx	INS OH SN SUP (BRIDGE) (CIRC TUBE)	EA		6			$ 180,000.00		$ 1,080,000
666	2002	REFL PAV MRK TY I (W) 4" (BRK) (090 MIL)	LF		89,317			$ 0.35		$ 31,261
666	2011	REFL PAV MRK TY I (W) 4" (SLD) (090 MIL)	LF		240,020			$ 0.35		$ 84,007
666	2110	REFL PAV MRK TY I (Y) 4" (SLD) (090 MIL)	LF		106,549			$ 0.35		$ 37,292
666	2189	PAVEMENT SEALER 4"	LF		435,886			$ 0.10		$ 43,589
672	2017	REFL PAV MRKR TY II-C-R	EA		6,166			$ 4.00		$ 24,663
678	2001	PAV SURF PREP FOR MRK (4")	LF		435,886			$ 0.10		$ 43,589
686	xxxx	INSTALL TRAFFIC SIGNAL (INTERSECTION)	EA		14			$ 150,000.00		$ 2,100,000
									CONTINGENCY (15%) =	$ 1,352,903
									LIGHTING, SIGNING, MARKING, & SIGNALS TOTAL (SAY) =	$ 10,380,000
MISCELLANEOUS CONSTRUCTION										
104	2001	REMOVING CONC (PAV)	SY		741,057			$ 6.00		$ 4,446,342
105	2014	REMOVING CONC (ASPH)	SY		741,057			$ 4.00		$ 2,964,228
496	2009	REMOV STR (BRIDGE 0-99 FT LENGTH)	EA		0			$ 10,200.00		$ -
496	2010	REMOV STR (BRIDGE 100-499 FT LENGTH)	EA		9			$ 60,000.00		$ 540,000
496	2011	REMOV STR (BRIDGE 500-999 FT LENGTH)	EA		2			$ 104,000.00		$ 208,000
506	xxxx	SWPPP	STA		392			$ 4,000.00		$ 1,568,000
514	2004	PERM CONC TRF BAR (SGL SLP)(TY 2)	LF		94,700			$ 52.00		$ 4,924,400
529	2004	CONC CURB & GUTTER (TY II)	LF		75,127			$ 12.00		$ 901,521
531	xxxx	CURB RAMPS	EA		60			$ 1,500.00		$ 90,000
531	2015	CONC SIDEWALKS (4")	SY		56,700			$ 35.00		$ 1,984,500
531	2004	CONC SIDEWALKS (6")	SY		0			$ 68.00		$ -
540	2002	MTL W-BEAM GUARD FENCE	LF		18,900			$ 20.00		$ 378,000
540	2005	TERMINAL ANCHOR SECTION	EA		11			$ 620.00		$ 6,820
540	2011	MBGF TRANSITION	EA		51			$ 1,300.00		$ 66,300
544	2001	MBGF END TREATMENT	EA		13			$ 2,000.00		$ 26,000
545	2001	CRASH CUSH ATTEN (INSTALL)	EA		5			$ 10,600.00		$ 53,000
550	2001	CHAIN LINK FENCE (INSTALL) (6') (Ped. Bridge Protection/Cover	LF		0			$ 14.00		$ -
XXXX	xxxx	RAILROAD	LS		1			SEE ESTIMATE		$ 12,597,468
XXXX	xxxx	LIFT STATION	LS		1			SEE ESTIMATE		$ 2,405,239
XXXX	xxxx	USACE PROPERTY MITIGATION TABLE	LS		0			SEE ESTIMATE		$ -
XXXX	xxxx	TOLL ENFORCEMENT	MILE		6			$ 2,000,000.00		$ 12,144,973
500	2001	MOBILIZATION	LS		4			SEE ESTIMATE		$ 29,620,000
XXXX	xxxx	TRAFFIC CONTROL	LS		4			SEE ESTIMATE		$ 29,620,000
									CONTINGENCY (15%) =	$ 15,681,717
									MISCELLANEOUS CONSTRUCTION TOTAL (SAY) =	$ 120,350,000
									TOTAL ESTIMATED CONSTRUCTION COST (SAY)=	$ 406,410,000
		ENVIRONMENTAL MITIGATION =								$ -
		RIGHT OF WAY =								$ 323,985,151
		UTILITY RELOCATION =								$ 42,355,336
		ENGINEERING COSTS (6% PS&E) =	6%							$ 27,060,000
		ENGINEERING COSTS (4% QA/QC, 2.5% IE) =	6.5%							$ 29,320,000
									TOTAL ESTIMATED COST (SAY)=	$ 851,130,487

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COSTS
IH 35E FROM N OF PGBT TO FM 2181 (MIDDLE SEGMENT)
CSJ's: 0196-03-138, ETC.

ITEM	DESC CODE	DESCRIPTION	UNIT	LOW	QUANTITY	HIGH	LOW	UNIT COST	HIGH	SUBTOTAL
EARTHWORK										
100	2002	PREPARING ROW	STA		653			$ 4,000.00		$ 2,612,000
110	2001	EXCAVATION	CY		2,415,113			$ 5.00		$ 12,075,565
132	2006	EMBANKMENT	CY		2,343,263			$ 8.00		$ 18,746,104
161	2002	COMPOST MANUF TOPSOIL (BOS)(4")	SY		348,394			$ 1.00		$ 348,394
164	2007	BROADCAST SEED (PERM) (URBAN) (CLAY)	SY		348,394			$ 0.50		$ 174,197
xxxx	xxxx	ENHANCED LANDSCAPING (per Cross Street)	EA		13			$ 40,000.00		$ 520,000
									CONTINGENCY (15%) =	$ 5,171,439
									EARTHWORK TOTAL (SAY) =	**$ 39,670,000**
SUBBASE & BASE										
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (General Purpose)	GAL		166,039			$ 4.00		$ 664,156
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (Managed Lanes)	GAL		80,391			$ 4.00		$ 321,563
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (Ramps)	GAL		42,611			$ 4.00		$ 170,442
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (Frontage Roads)	GAL		97,407			$ 4.00		$ 389,627
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (Cross Streets)	GAL		49,109			$ 4.00		$ 196,437
275	2001	CEMENT (General Purpose)	TON		40,011			$ 115.00		$ 4,601,297
275	2001	CEMENT (Managed Lanes)	TON		19,372			$ 115.00		$ 2,227,796
275	2001	CEMENT (Ramps)	TON		10,268			$ 115.00		$ 1,180,828
275	2001	CEMENT (Frontage Roads)	TON		14,843			$ 115.00		$ 1,706,940
275	2001	CEMENT (Cross Streets)	TON		7,453			$ 115.00		$ 860,682
275	2018	CEMENT TRT(34") (General Purpose)	SY		871,705			$ 11.00		$ 9,588,755
275	2018	CEMENT TRT(34") (Managed Lanes)	SY		422,051			$ 11.00		$ 4,642,560
275	2018	CEMENT TRT(34") (Ramps)	SY		223,705			$ 11.00		$ 2,460,757
275	2077	CEMENT TRT(21.5") (Frontage Roads)	SY		511,365			$ 11.00		$ 5,625,239
275	2077	CEMENT TRT(21.5") (Cross Streets)	SY		257,823			$ 11.00		$ 2,836,058
344	2014	BASE COURSE (6.5") (SP-B) (General Purpose)	TON		296,795			$ 79.00		$ 23,446,795
344	2014	BASE COURSE (6.5") (SP-B) (Managed Lanes)	TON		143,598			$ 79.00		$ 11,342,164
344	2014	BASE COURSE (6.5") (SP-B) (Ramps)	TON		76,166			$ 79.00		$ 6,017,137
344	2014	BASE COURSE (6") (SP-B) (Frontage Rds)	TON		160,721			$ 79.00		$ 12,696,968
344	2014	BASE COURSE (6") (SP-B) (Cross Streets)	TON		81,030			$ 79.00		$ 6,401,387
344	2119	BASE COURSE (4") (SP-D) (Gen Purpose)	TON		182,643			$ 90.00		$ 16,437,872
344	2119	BASE COURSE (4") (SP-D) (Managed Lns)	TON		88,430			$ 90.00		$ 7,958,674
344	2119	BASE COURSE (4") (SP-D) (Ramps)	TON		46,872			$ 90.00		$ 4,218,441
344	2119	BASE COURSE (3") (SP-D) (Frontage Rds)	TON		80,361			$ 90.00		$ 7,232,450
344	2119	BASE COURSE (3") (SP-D) (Cross Streets)	TON		40,515			$ 90.00		$ 3,646,360
									CONTINGENCY (15%) =	$ 20,532,193
									SUBBASE & BASE TOTAL (SAY) =	**$ 157,430,000**
PAVEMENT										
342	2006	SURFACE COURSE (1.5") (PFC) (Gen Purpose)	TON		59,151			$ 68.00		$ 4,022,297
342	2006	SURFACE COURSE (1.5") (PFC) (Managed Lns)	TON		28,539			$ 68.00		$ 1,947,463
342	2006	SURFACE COURSE (1.5") (PFC) (Ramps)	TON		15,180			$ 68.00		$ 1,032,240
342	2006	SURFACE COURSE (1.5") (PFC) (Frontage Rds)	TON		34,701			$ 68.00		$ 2,359,678
342	2006	SURFACE COURSE (1.5") (PFC) (Cross Streets)	TON		17,495			$ 68.00		$ 1,189,671
346	2014	SURFACE COURSE (2") (SMA-D) (Gen Purpose)	TON		91,322			$ 97.00		$ 8,858,187
346	2014	SURFACE COURSE (2") (SMA-D) (Managed Lns)	TON		44,215			$ 97.00		$ 4,288,841
346	2014	SURFACE COURSE (2") (SMA-D) (Ramps)	TON		23,436			$ 97.00		$ 2,273,271
346	2014	SURFACE COURSE (2") (SMA-D) (Frontage Rds)	TON		53,574			$ 97.00		$ 5,196,649
346	2014	SURFACE COURSE (2") (SMA-D) (Cross Streets)	TON		27,010			$ 97.00		$ 2,619,977
									CONTINGENCY (15%) =	$ 5,068,241
									PAVEMENT TOTAL (SAY) =	**$ 38,870,000**
STRUCTURES										
423	2001	RETAINING WALL	SF		0			$ 35.00		$ -
423	2001	RETAINING WALL (DRILLED SHAFT)	SF		833,955			$ 75.00		$ 62,546,625
5296	2007	NOISE WALLS	SF		192,571			$ 35.00		$ 6,739,993
450	xxxx	BRIDGES (CONCRETE) (General Purpose)	SF		946,316			$ 50.00		$ 47,315,800
450	xxxx	BRIDGES (CONCRETE) (Managed Lanes)	SF		578,425			$ 50.00		$ 28,921,250
450	xxxx	BRIDGES (CONCRETE) (Ramps)	SF		1,091,553			$ 50.00		$ 54,577,650
450	xxxx	BRIDGES (CONCRETE) (Frontage Roads)	SF		366,468			$ 50.00		$ 18,323,400
450	xxxx	BRIDGES (CONCRETE) (Cross Streets)	SF		419,621			$ 50.00		$ 20,981,050
450	xxxx	BRIDGES (CONCRETE over water) (General Purpose)	SF		1,450,892			$ 110.00		$ 159,598,120
450	xxxx	BRIDGES (CONCRETE over water) (Managed Lanes)	SF		784,936			$ 110.00		$ 86,342,960
450	xxxx	BRIDGES (CONCRETE over water) (Ramps)	SF		65,282			$ 110.00		$ 7,181,020
450	xxxx	BRIDGES (CONCRETE over water) (Frontage Roads)	SF		304,360			$ 110.00		$ 33,479,600
450	xxxx	BRIDGES (CONCRETE over water) (Cross Streets)	SF		0			$ 110.00		$ -
450	xxxx	BRIDGES (CONCRETE) (Tx34 girder)	SF		0			$ 50.00		$ -
450	xxxx	BRIDGES (STEEL)	SF		69,644			$ 110.00		$ 7,660,840
450	2018	PEDESTRIAN RAIL (Premium added to bridge cost)	LF		0			$ 60.00		$ -
450	2018	PEDESTRIAN RAIL (Approaches)	LF		0			$ 97.00		$ -
450	xxxx	RAIL	LF		0			$ 50.00		$ -
462	2001	CONC BOX CULV (3 FT x 2 FT)	LF		0			$ 110.00		$ -
462	2003	CONC BOX CULV (4 FT x 2 FT)	LF		0			$ 110.00		$ -
462	2004	CONC BOX CULV (4 FT x 3 FT)	LF		0			$ 124.00		$ -
462	2006	CONC BOX CULV (5 FT x 2 FT)	LF		0			$ 140.00		$ -
462	2007	CONC BOX CULV (5 FT x 3 FT)	LF		0			$ 142.00		$ -
462	2010	CONC BOX CULV (6 FT x 3 FT)	LF		0			$ 178.00		$ -
462	2015	CONC BOX CULV (7 FT x 4 FT)	LF		0			$ 239.00		$ -
462	2017	CONC BOX CULV (7 FT x 6 FT)	LF		0			$ 266.00		$ -
462	2019	CONC BOX CULV (8 FT x 4 FT)	LF		0			$ 308.00		$ -
462	2022	CONC BOX CULV (8 FT x 7 FT)	LF		0			$ 295.00		$ -
462	2024	CONC BOX CULV (9 FT x 5 FT)	LF		720			$ 340.00		$ 244,800
462	2030	CONC BOX CULV (10 FT x 6 FT)	LF		360			$ 388.00		$ 139,680
462	2032	CONC BOX CULV (10 FT x 8 FT)	LF		0			$ 400.00		$ -
464	2005	RC PIPE (CL III)(24 IN)	LF		65,320			$ 42.00		$ 2,743,440
464	2009	RC PIPE (CL III)(36 IN)	LF		78,384			$ 69.00		$ 5,408,496
464	2010	RC PIPE (CL III)(42 IN)	LF		1,890			$ 85.00		$ 160,650
464	2011	RC PIPE (CL III)(48 IN)	LF		126,216			$ 107.00		$ 13,505,112
464	2015	RC PIPE (CL III)(72 IN)	LF		0			$ 200.00		$ -
465	2005	MANHOLE	EA		0			$ 2,960.00		$ -
465	xxxx	INLETS	EA		1,306			$ 3,500.00		$ 4,572,400
465	2211	JUNCTION BOX (SPL)	EA		0			$ 27,040.00		$ -
466	xxxx	WINGWALL (PW) (H=2 FT)	EA		0			$ 2,200.00		$ -
466	2047	WINGWALL (PW) (H=3 FT)	EA		0			$ 3,320.00		$ -
466	2048	WINGWALL (PW) (H=4 FT)	EA		1			$ 6,200.00		$ 6,200
466	2050	WINGWALL (PW) (H=6 FT)	EA		4			$ 8,940.00		$ 35,760
466	2052	WINGWALL (PW) (H=8 FT)	EA		0			$ 13,980.00		$ -
467	xxxx	SET (4:1)	EA		1			$ 4,000.00		$ 4,000
									CONTINGENCY (15%) =	$ 84,073,327
									STRUCTURES TOTAL (SAY) =	**$ 644,570,000**
LIGHTING, SIGNING, MARKING, & SIGNALS										
610	2047	INS RD IL AM (TY SP) 48S-8-S (.4KW)S	EA		826			$ 3,100.00		$ 2,560,600
610	2060	INS RD IL AM (U/P) (TY 1)(.15KW)S	EA		224			$ 1,210.00		$ 271,040
614	2001	HI MST IL ASM (12 - 400 WATT) (ASYM) (TY A)	EA		2			$ 25,000.00		$ 50,000
618	2016	CONDT (PVC)(SCHD 40)(1 1/2")	LF		189,360			$ 7.00		$ 1,325,520
624	2008	GROUND BOX TY A (122311) W/APRON	EA		545			$ 616.00		$ 335,474
628	2040	ELC SRV TY A 240 / 480 100 (NS) SS (E) SP (O)	EA		147			$ 4,500.00		$ 662,940

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COSTS
IH 35E FROM N OF PGBT TO FM 2181 (MIDDLE SEGMENT)
CSJ's: 0196-03-138, ETC.

ITEM	DESC CODE	DESCRIPTION	UNIT	LOW	QUANTITY	HIGH	LOW	UNIT COST	HIGH	SUBTOTAL
636	2001	ALUMINUM SIGNS (TY A)	SF		18,125			$ 23.00		$ 416,880
636	2002	ALUMINUM SIGNS (TY G)	SF		1,979			$ 20.00		$ 39,588
636	2003	ALUMINUM SIGNS (TY O)	SF		38,990			$ 25.00		$ 974,750
644	2004	INS SM RD SN SUP&ASSM TY A	EA		1,133			$ 450.00		$ 509,772
650	xxxx	INS OH SN SUP (CANTILEVER) (CIRC TUBE)	EA		62			$ 80,000.00		$ 4,960,000
650	xxxx	INS OH SN SUP (BRIDGE) (CIRC TUBE)	EA		18			$ 180,000.00		$ 3,240,000
666	2002	REFL PAV MRK TY I (W) 4" (BRK) (090 MIL)	LF		134,559			$ 0.35		$ 47,096
666	2011	REFL PAV MRK TY I (W) 4" (SLD) (090 MIL)	LF		516,332			$ 0.35		$ 180,716
666	2110	REFL PAV MRK TY I (Y) 4" (SLD) (090 MIL)	LF		229,398			$ 0.35		$ 80,289
666	2189	PAVEMENT SEALER 4"	LF		880,289			$ 0.10		$ 88,029
672	2017	REFL PAV MRKR TY II-C-R	EA		10,628			$ 4.00		$ 42,512
678	2001	PAV SURF PREP FOR MRK (4")	LF		880,289			$ 0.10		$ 88,029
686	xxxx	INSTALL TRAFFIC SIGNAL (INTERSECTION)	EA		24			$ 150,000.00		$ 3,600,000
									CONTINGENCY (15%) =	$ 2,920,985
									LIGHTING, SIGNING, MARKING, & SIGNALS TOTAL (SAY) =	$ 22,410,000
MISCELLANEOUS CONSTRUCTION										
104	2001	REMOVING CONC (PAV)	SY		1,482,568			$ 6.00		$ 8,895,408
105	2014	REMOVING CONC (ASPH)	SY		1,482,568			$ 4.00		$ 5,930,272
496	2009	REMOV STR (BRIDGE 0-99 FT LENGTH)	EA		0			$ 10,200.00		$ -
496	2010	REMOV STR (BRIDGE 100-499 FT LENGTH)	EA		30			$ 60,000.00		$ 1,800,000
496	2011	REMOV STR (BRIDGE 500-999 FT LENGTH)	EA		7			$ 104,000.00		$ 728,000
506	xxxx	SWPPP	STA		653			$ 4,000.00		$ 2,612,000
514	2004	PERM CONC TRF BAR (SGL SLP)(TY 2)	LF		212,900			$ 52.00		$ 11,070,800
529	2004	CONC CURB & GUTTER (TY II)	LF		261,280			$ 12.00		$ 3,135,360
531	xxxx	CURB RAMPS	EA		252			$ 1,500.00		$ 378,000
531	2015	CONC SIDEWALKS (4")	SY		101,400			$ 35.00		$ 3,549,000
531	2004	CONC SIDEWALKS (6")	SY		0			$ 68.00		$ -
540	2002	MTL W-BEAM GUARD FENCE	LF		45,200			$ 20.00		$ 904,000
540	2005	TERMINAL ANCHOR SECTION	EA		20			$ 620.00		$ 12,400
540	2011	MBGF TRANSITION	EA		76			$ 1,300.00		$ 98,800
544	2001	MBGF END TREATMENT	EA		28			$ 2,000.00		$ 56,000
545	2001	CRASH CUSH ATTEN (INSTALL)	EA		28			$ 10,600.00		$ 296,800
550	2001	CHAIN LINK FENCE (INSTALL) (6') (Ped. Bridge Protection/Cover	LF		0			$ 14.00		$ -
XXXX	xxxx	RAILROAD	LS		1			SEE ESTIMATE		$ 2,400,000
XXXX	xxxx	LIFT STATION	LS		0			SEE ESTIMATE		$ -
XXXX	xxxx	USACE PROPERTY MITIGATION TABLE	LS		0			SEE ESTIMATE		$ -
XXXX	xxxx	TOLL ENFORCEMENT	MILE		12			$ 2,000,000.00		$ 24,734,848
500	2001	MOBILIZATION	LS		4			SEE ESTIMATE		$ 85,200,000
XXXX	xxxx	TRAFFIC CONTROL	LS		4			SEE ESTIMATE		$ 85,200,000
									CONTINGENCY (15%) =	$ 35,550,253
									MISCELLANEOUS CONSTRUCTION TOTAL (SAY) =	$ 272,580,000
									TOTAL ESTIMATED CONSTRUCTION COST (SAY)=	$ 1,175,530,000
		ENVIRONMENTAL MITIGATION=								$ 1,109,835
		RIGHT OF WAY=								$ 504,256,027
		UTILITY RELOCATION =								$ 64,781,403
		ENGINEERING COSTS (6% PS&E) =	6%							$ 74,430,000
		ENGINEERING COSTS (4% QA/QC, 2.5% IE) =	6.5%							$ 80,650,000
									TOTAL ESTIMATED COST (SAY)=	$ 1,900,757,265

TXDOT DALLAS DISTRICT IH 35E CER IH 35E CORRIDOR-MIDDLE PAGE 2 OF 2

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COSTS
IH 35E FROM N OF FM 2181 TO US 380 (NORTH SEGMENT)

CSJ's: 0196-03-138, ETC.

ITEM	DESC CODE	DESCRIPTION	UNIT	LOW	QUANTITY	HIGH	LOW	UNIT COST	HIGH	SUBTOTAL
EARTHWORK										
100	2002	PREPARING ROW	STA		560			$ 4,000.00		$ 2,360,000
110	2001	EXCAVATION	CY		2,048,000			$ 5.00		$ 10,240,000
132	2006	EMBANKMENT	CY		3,509,500			$ 8.00		$ 28,076,000
161	2002	COMPOST MANUF TOPSOIL (BOS)(4")	SY		723,177			$ 1.00		$ 723,177
164	2007	BROADCAST SEED (PERM) (URBAN) (CLAY)	SY		704,515			$ 0.50		$ 352,258
xxxx	xxxx	ENHANCED LANDSCAPING (per Cross Street)	EA		15			$ 40,000.00		$ 600,000
									CONTINGENCY (15%) =	$ 6,352,715
									EARTHWORK TOTAL (SAY) =	**$ 48,720,000**
SUBBASE & BASE										
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (General Purpose)	GAL		174,789			$ 4.00		$ 699,156
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (Managed Lanes)	GAL		91,591			$ 4.00		$ 366,364
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (Ramps)	GAL		27,215			$ 4.00		$ 108,860
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (Frontage Roads)	GAL		96,726			$ 4.00		$ 386,904
310	2001	PRIME COAT (MC-30, AE-P OR SS-1) (Cross Streets)	GAL		30,484			$ 4.00		$ 121,936
275	2001	CEMENT (General Purpose)	TON		42,122			$ 115.00		$ 4,844,030
275	2001	CEMENT (Managed Lanes)	TON		22,073			$ 115.00		$ 2,538,395
275	2001	CEMENT (Ramps)	TON		6,559			$ 115.00		$ 754,285
275	2001	CEMENT (Frontage Roads)	TON		14,741			$ 115.00		$ 1,695,215
275	2001	CEMENT (Cross Streets)	TON		4,646			$ 115.00		$ 534,290
275	2018	CEMENT TRT(34") (General Purpose)	SY		917,634			$ 11.00		$ 10,093,974
275	2018	CEMENT TRT(34") (Managed Lanes)	SY		480,849			$ 11.00		$ 5,289,339
275	2018	CEMENT TRT(34") (Ramps)	SY		142,873			$ 11.00		$ 1,571,603
275	2077	CEMENT TRT(21.5") (Frontage Roads)	SY		507,803			$ 11.00		$ 5,585,833
275	2077	CEMENT TRT(21.5") (Cross Streets)	SY		160,031			$ 11.00		$ 1,760,341
344	2014	BASE COURSE (6.5") (SP-B) (General Purpose)	TON		312,433			$ 79.00		$ 24,682,207
344	2014	BASE COURSE (6.5") (SP-B) (Managed Lanes)	TON		163,719			$ 79.00		$ 12,933,601
344	2014	BASE COURSE (6.5") (SP-B) (Ramps)	TON		48,645			$ 79.00		$ 3,842,955
344	2014	BASE COURSE (6") (SP-B) (Frontage Rds)	TON		159,597			$ 79.00		$ 12,608,163
344	2014	BASE COURSE (6") (SP-B) (Cross Streets)	TON		50,297			$ 79.00		$ 3,973,463
344	2119	BASE COURSE (4") (SP-D) (Gen Purpose)	TON		192,267			$ 90.00		$ 17,304,030
344	2119	BASE COURSE (4") (SP-D) (Managed Lns)	TON		100,751			$ 90.00		$ 9,067,590
344	2119	BASE COURSE (4") (SP-D) (Ramps)	TON		29,937			$ 90.00		$ 2,694,330
344	2119	BASE COURSE (3") (SP-D) (Frontage Rds)	TON		79,800			$ 90.00		$ 7,182,000
344	2119	BASE COURSE (3") (SP-D) (Cross Streets)	TON		25,149			$ 90.00		$ 2,263,410
									CONTINGENCY (15%) =	$ 19,935,571
									SUBBASE & BASE TOTAL (SAY) =	**$ 152,870,000**
PAVEMENT										
342	2006	SURFACE COURSE (1.5") (PFC) (Gen Purpose)	TON		62,269			$ 68.00		$ 4,234,292
342	2006	SURFACE COURSE (1.5") (PFC) (Managed Lns)	TON		32,632			$ 68.00		$ 2,218,976
342	2006	SURFACE COURSE (1.5") (PFC) (Ramps)	TON		9,697			$ 68.00		$ 659,396
342	2006	SURFACE COURSE (1.5") (PFC) (Frontage Rds)	TON		34,460			$ 68.00		$ 2,343,280
342	2006	SURFACE COURSE (1.5") (PFC) (Cross Streets)	TON		10,861			$ 68.00		$ 738,548
346	2014	SURFACE COURSE (2") (SMA-D) (Gen Purpose)	TON		96,136			$ 97.00		$ 9,325,096
346	2014	SURFACE COURSE (2") (SMA-D) (Managed Lns)	TON		50,376			$ 97.00		$ 4,886,472
346	2014	SURFACE COURSE (2") (SMA-D) (Ramps)	TON		14,969			$ 97.00		$ 1,451,993
346	2014	SURFACE COURSE (2") (SMA-D) (Frontage Rds)	TON		53,201			$ 97.00		$ 5,160,497
346	2014	SURFACE COURSE (2") (SMA-D) (Cross Streets)	TON		16,767			$ 97.00		$ 1,626,399
									CONTINGENCY (15%) =	$ 4,896,742
									PAVEMENT TOTAL (SAY) =	**$ 37,560,000**
STRUCTURES										
423	2001	RETAINING WALL	SF		1,388,500			$ 35.00		$ 48,597,500
423	2001	RETAINING WALL (DRILLED SHAFT)	SF		0			$ 75.00		$ -
5296	2007	NOISE WALLS	SF		127,800			$ 35.00		$ 4,473,000
450	xxxx	BRIDGES (CONCRETE) (General Purpose)	SF		1,077,926			$ 50.00		$ 53,896,300
450	xxxx	BRIDGES (CONCRETE) (Managed Lanes)	SF		578,885			$ 50.00		$ 28,944,250
450	xxxx	BRIDGES (CONCRETE) (Ramps)	SF		282,793			$ 50.00		$ 14,139,650
450	xxxx	BRIDGES (CONCRETE) (Frontage Roads)	SF		67,226			$ 50.00		$ 3,361,300
450	xxxx	BRIDGES (CONCRETE) (Cross Streets)	SF		110,145			$ 50.00		$ 5,507,250
450	xxxx	BRIDGES (CONCRETE over water) (General Purpose)	SF		0			$ 110.00		$ -
450	xxxx	BRIDGES (CONCRETE over water) (Managed Lanes)	SF		0			$ 110.00		$ -
450	xxxx	BRIDGES (CONCRETE over water) (Ramps)	SF		0			$ 110.00		$ -
450	xxxx	BRIDGES (CONCRETE over water) (Frontage Roads)	SF		0			$ 110.00		$ -
450	xxxx	BRIDGES (CONCRETE over water) (Cross Streets)	SF		0			$ 110.00		$ -
450	xxxx	BRIDGES (CONCRETE) (Tx34 girder)	SF		7,900			$ 50.00		$ 395,000
450	xxxx	BRIDGES (STEEL)	SF		62,666			$ 110.00		$ 6,893,260
450	2018	PEDESTRIAN RAIL (Premium added to bridge cost)	LF		720			$ 60.00		$ 43,200
450	2018	PEDESTRIAN RAIL (Approaches)	LF		1,030			$ 97.00		$ 99,910
450	xxxx	RAIL	LF		152,983			$ 50.00		$ 7,649,150
462	2001	CONC BOX CULV (3 FT x 2 FT)	LF		1,140			$ 110.00		$ 125,400
462	2003	CONC BOX CULV (4 FT x 2 FT)	LF		3,220			$ 110.00		$ 354,200
462	2004	CONC BOX CULV (4 FT x 3 FT)	LF		474			$ 124.00		$ 58,776
462	2006	CONC BOX CULV (5 FT x 2 FT)	LF		0			$ 140.00		$ -
462	2007	CONC BOX CULV (5 FT x 3 FT)	LF		2,682			$ 142.00		$ 380,844
462	2010	CONC BOX CULV (6 FT x 3 FT)	LF		9,968			$ 178.00		$ 1,774,304
462	2015	CONC BOX CULV (7 FT x 4 FT)	LF		2,442			$ 239.00		$ 583,638
462	2017	CONC BOX CULV (7 FT x 6 FT)	LF		3,466			$ 266.00		$ 921,690
462	2019	CONC BOX CULV (8 FT x 4 FT)	LF		3,777			$ 308.00		$ 1,163,316
462	2022	CONC BOX CULV (8 FT x 7 FT)	LF		0			$ 295.00		$ -
462	2024	CONC BOX CULV (9 FT x 5 FT)	LF		0			$ 340.00		$ -
462	2030	CONC BOX CULV (10 FT x 6 FT)	LF		1,870			$ 388.00		$ 725,560
462	2032	CONC BOX CULV (10 FT x 8 FT)	LF		1,472			$ 400.00		$ 588,800
464	2005	RC PIPE (CL III)(24 IN)	LF		59,043			$ 42.00		$ 2,479,806
464	2009	RC PIPE (CL III)(36 IN)	LF		70,253			$ 69.00		$ 4,847,457
464	2010	RC PIPE (CL III)(42 IN)	LF		0			$ 85.00		$ -
464	2011	RC PIPE (CL III)(48 IN)	LF		105,379			$ 107.00		$ 11,275,553
464	2015	RC PIPE (CL III)(72 IN)	LF		0			$ 200.00		$ -
465	2005	MANHOLE	EA		0			$ 2,960.00		$ -
465	xxxx	INLETS	EA		1,187			$ 3,500.00		$ 4,154,500
465	2211	JUNCTION BOX (SPL)	EA		12			$ 27,040.00		$ 324,480
466	xxxx	WINGWALL (PW) (H=2 FT)	EA		4			$ 2,200.00		$ 8,800
466	2047	WINGWALL (PW) (H=3 FT)	EA		11			$ 5,320.00		$ 58,520
466	2048	WINGWALL (PW) (H=4 FT)	EA		6			$ 6,200.00		$ 37,200
466	2050	WINGWALL (PW) (H=6 FT)	EA		6			$ 8,940.00		$ 53,640
466	2052	WINGWALL (PW) (H=8 FT)	EA		2			$ 13,980.00		$ 27,960
467	xxxx	SET (4:1)	EA		1			$ 4,000.00		$ 4,000
									CONTINGENCY (15%) =	$ 30,692,232
									STRUCTURES TOTAL (SAY) =	**$ 234,570,000**
LIGHTING, SIGNING, MARKING, & SIGNALS										
610	2047	INS RD IL AM (TY SP) 48S-8-8 (4KW)S	EA		811			$ 3,100.00		$ 2,514,100
610	2060	INS RD IL AM (UP) (TY 1)(15KW)S	EA		320			$ 1,210.00		$ 387,200
614	2001	HI MST IL ASM (12 - 400 WATT) (ASYM) (TY A)	EA		8			$ 25,000.00		$ 200,000
618	2016	CONDT (PVC)(SCHD 40)(1 1/2")	LF		185,506			$ 7.00		$ 1,298,542
624	2008	GROUND BOX TY A (122311) W/APRON	EA		262			$ 616.00		$ 161,392
628	2040	ELC SRV TY A 240 / 480 100 (NS) SS (E) SP (O)	EA		104			$ 4,500.00		$ 468,000

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COSTS
IH 35E FROM N OF FM 2181 TO US 380 (NORTH SEGMENT)
CSJ's: 0196-03-138, ETC.

ITEM	DESC CODE	DESCRIPTION	UNIT	LOW	QUANTITY	HIGH	LOW	UNIT COST	HIGH	SUBTOTAL
636	2001	ALUMINUM SIGNS (TY A)	SF		18,560			$ 23.00		$ 426,880
636	2002	ALUMINUM SIGNS (TY G)	SF		1,775			$ 20.00		$ 35,500
636	2003	ALUMINUM SIGNS (TY O)	SF		26,710			$ 25.00		$ 667,750
644	2004	INS SM RD SN SUP&ASSM TY A	EA		1,160			$ 450.00		$ 522,000
650	xxxx	INS OH SN SUP (CANTILEVER) (CIRC TUBE)	EA		63			$ 80,000.00		$ 5,040,000
650	xxxx	INS OH SN SUP (BRIDGE) (CIRC TUBE)	EA		13			$ 180,000.00		$ 2,340,000
666	2002	REFL PAV MRK TY I (W) 4" (BRK) (090 MIL)	LF		167,892			$ 0.35		$ 58,692
666	2011	REFL PAV MRK TY I (W) 4" (SLD) (090 MIL)	LF		421,682			$ 0.35		$ 147,589
666	2110	REFL PAV MRK TY I (Y) 4" (SLD) (090 MIL)	LF		405,213			$ 0.35		$ 141,825
666	2189	PAVEMENT SEALER 4"	LF		994,587			$ 0.10		$ 99,459
672	2017	REFL PAV MRKR TY II-C-R	EA		12,587			$ 4.00		$ 50,348
678	2001	PAV SURF PREP FOR MRK (4")	LF		994,587			$ 0.10		$ 99,459
680	xxxx	INSTALL TRAFFIC SIGNAL (INTERSECTION)	EA		26			$ 150,000.00		$ 3,900,000
									CONTINGENCY (15%) =	$ 2,783,810
									LIGHTING, SIGNING, MARKING, & SIGNALS TOTAL (SAY) =	**$ 21,370,000**
MISCELLANEOUS CONSTRUCTION										
104	2001	REMOVING CONC (PAV)	SY		686,589			$ 6.00		$ 4,119,534
105	2014	REMOVING CONC (ASPH)	SY		499,751			$ 4.00		$ 1,999,004
496	2009	REMOV STR (BRIDGE 0-99 FT LENGTH)	EA		2			$ 10,200.00		$ 20,400
496	2010	REMOV STR (BRIDGE 100-499 FT LENGTH)	EA		24			$ 60,000.00		$ 1,440,000
496	2011	REMOV STR (BRIDGE 500-999 FT LENGTH)	EA		1			$ 104,000.00		$ 104,000
506	xxxx	SWPPP	STA		600			$ 4,000.00		$ 2,400,000
514	2004	PERM CONC TRF BAR (SGL SLP)(TY 2)	LF		182,200			$ 52.00		$ 9,474,400
529	2004	CONC CURB & GUTTER (TY II)	LF		303,528			$ 12.00		$ 3,642,336
531	xxxx	CURB RAMPS	EA		145			$ 1,500.00		$ 217,500
531	2015	CONC SIDEWALKS (4")	SY		92,600			$ 35.00		$ 3,241,000
531	2004	CONC SIDEWALKS (6")	SY		1,500			$ 68.00		$ 102,000
540	2002	MTL W-BEAM GUARD FENCE	LF		19,300			$ 20.00		$ 386,000
540	2005	TERMINAL ANCHOR SECTION	EA		13			$ 620.00		$ 8,060
540	2011	MBGF TRANSITION	EA		51			$ 1,300.00		$ 66,300
544	2001	MBGF END TREATMENT	EA		15			$ 2,000.00		$ 30,000
545	2001	CRASH CUSH ATTEN (INSTALL)	EA		34			$ 10,600.00		$ 360,400
550	2001	CHAIN LINK FENCE (INSTALL) (6') (Ped. Bridge Protection/Cover	LF		720			$ 14.00		$ 10,080
XXXX	xxxx	RAILROAD	LS		0			SEE ESTIMATE		$ -
XXXX	xxxx	LIFT STATION	LS		0			SEE ESTIMATE		$ -
XXXX	xxxx	USACE PROPERTY MITIGATION TABLE	LS		0			SEE ESTIMATE		$ -
XXXX	xxxx	TOLL ENFORCEMENT	MILE		11			$ 2,000,000.00		$ 22,200,000
500	2001	MOBILIZATION	LS		5			SEE ESTIMATE		$ 48,060,000
XXXX	xxxx	TRAFFIC CONTROL	LS		5			SEE ESTIMATE		$ 48,060,000
									CONTINGENCY (15%) =	$ 21,861,152
									MISCELLANEOUS CONSTRUCTION TOTAL (SAY) =	**$ 167,850,000**
									TOTAL ESTIMATED CONSTRUCTION COST (SAY)=	**$ 662,940,000**
		ENVIRONMENTAL MITIGATION=								$ -
		RIGHT OF WAY =								$ 425,032,861
		UTILITY RELOCATION =								$ 89,306,772
		ENGINEERING COSTS (6% PS&E) = 6%								$ 45,140,000
		ENGINEERING COSTS (4% QA/QC, 2.5% IE) = 6.5%								$ 48,910,000
									TOTAL ESTIMATED COST (SAY)=	**$ 1,271,329,633**

IDEA EVALUATION

INTRODUCTION

The creative ideas generated by the VE team are carefully evaluated and project-specific criteria are applied to each idea to assure an objective evaluation.

PERFORMANCE CRITERIA

The VE team used the paired comparison method to prioritize the seven key evaluative criteria for this project:

- Revenue Impacts
- Traffic Operations- General Purpose Lanes
- Environmental Impacts
- Stakeholder Acceptance
- Traffic Operations - Local
- Right of Way Impacts
- Schedule Impact

The team enlisted the assistance of the stakeholders and designers to develop these criteria so that the evaluation would reflect their specific requirements.

EVALUATION PROCESS

The VE team, as a group, generated and evaluated ideas on how to perform the various functions. The idea list was grouped by function. While ideas on the overall project were evaluated as a group, ideas relating to a specific technical discipline may have been evaluated by the responsible team member.

The team compared each of the ideas with the original concept for each of the key evaluative criteria to determine whether it was better, equal to, or worse than the original concept. The team reached a consensus on the ranking of the idea. High-ranked ideas would be developed further; low-ranked ones would be dropped from further consideration.

IDEA EVALUATION FORMS

All of the ideas that were generated during the creative phase using brainstorming techniques were recorded on the following Creative Ideas Evaluation forms. These ideas were discussed and the advantages and disadvantages of each were listed.

CREATIVE IDEAS EVALUATION *I-35E Managed Lane Project*			TxDOT/TTA	
No.	**IDEA DESCRIPTION (FUNCTION)**	**Advantages**	**Disadvantages**	**Rank**
GENERAL/PHASING/TRAFFIC CONTROL				
P-1	Allow purchase ROW (by individual parcel or selected) but defer construction of North Segment	• Buy ROW when it's cheaper (assumed) • Phase construction of segments when money is available • Reducing upfront cost by minimum $660M • Revenue collected may be applied later for construction • Minimize ROW impacts at construction • Utility relocation allowed to take place • Prevents undesirable development • By parcel, as it becomes available, is beneficial • TxDOT controls access	• May cost more later to construct • ROW maintenance until built out • Reduces flexibility in design • Must pay ROW costs up front • Bad PR, especially whole-sale purchase • Reduces property taxes • Undesirable land use in interim • Defers development in Denton	4

Ranking Scale:	**5-4 = Most Likely to be Developed**	**3, DS = Design Suggestion**	**1-2 = Least likely to be developed**
Evaluation Criteria:	**WD = Withdraw**	**RQ = Required**	

CREATIVE IDEAS EVALUATION *I-35E Managed Lane Project*			TxDOT/TTA	
No.	**IDEA DESCRIPTION (FUNCTION)**	**Advantages**	**Disadvantages**	**Rank**
P-1a	Defer ROW acquisition and construction of North Segment	• Reduces upfront cost by $1.3B	• Creates hardship for current owners (urban blight) • May cost more later to acquire ROW and to construct • Doesn't help reduce today's congestion • reduction in revenue for middle section • Unable to relocate utilities • Defers development in Denton along corridor	3
P-1b	Lease back ROW to market when available (combine with P-1)	• Sales tax is preserved in interim • Preserving existing land use avoiding urban blight • Additional revenue is generated from lease back fee • Reduced TxDOT maintenance	• Property taxes to local entities are reduced • Administrative burden	4
P-2	defer frontage road construction (entire length)	• Save upfront cost • Minimizes ROW acquisition	• Have to modify design to accommodate • Eliminates access points • Feasibility problems • Constricts construction • Limited application	1

Ranking Scale: **5-4 = Most Likely to be Developed** **3, DS = Design Suggestion** **1-2 = Least likely to be developed**
Evaluation Criteria: **WD = Withdraw** **RQ = Required**

CREATIVE IDEAS EVALUATION *I-35E Managed Lane Project*			TxDOT/TTA	
No.	**IDEA DESCRIPTION (FUNCTION)**	**Advantages**	**Disadvantages**	**Rank**
P-3	defer new frontage road construction (where feasible)	• Save upfront cost (pretty much all bridges) • Reduces maintenance costs • Reduces columns in flood storage area • Use more of existing structure (bridge over lake)	• Access issues • Limited application • May increase cost to construct later	4
P-4	eliminate front road construction (entire length)	• Save upfront cost	• Reduced LOS in GP • Must maintain access to park • Not politically feasible	WD
P-5	defer inside/outside GP lanes (entire length)	• Save upfront cost ~$50M • Enhances start-up revenue • Allows flexibility for future uses • Flexibility could be used for future ML instead of a GP lane	• May cost more later • Drainage • More difficult to construct • More difficult traffic control plans to construct inside lane	5
P-6	identify critical breakout/early projects	• Bottleneck reduction • Political incentive to get on board for entire project because of success in improving mobility • Traditional funding sources for breakout projects • Minimizes impacts of railroad coordination	• May not be as cost-effective • Introducing schedule risk • Probably more throw-aways	4

Ranking Scale: **5-4 = Most Likely to be Developed** **3, DS = Design Suggestion** **1-2 = Least likely to be developed**
Evaluation Criteria: **WD = Withdraw** **RQ = Required**

CREATIVE IDEAS EVALUATION *I-35E Managed Lane Project*			TxDOT/TTA	
No.	**IDEA DESCRIPTION (FUNCTION)**	**Advantages**	**Disadvantages**	**Rank**
	eliminate 4th GP lane (entire length)	• Save overall costs • Reduces ROW • Enhances start-up revenue • Reduces drainage impacts	• May reduce LOS • More politically sensitive because you're not adding GP capacity • NEPA impacts are significant – re-evaluate • IAJR impact – redo • Impacts regional transportation plan and air quality plan	3
P-7	defer wishbones and use slip ramps instead (where applicable)	• Reduces upfront costs • Increases revenue in certain location • Simplifies construction and traffic control	• May be more expensive to construct later • Adds more weaving on the GP • Makes construction more difficult to add wishbones in	4
P-8	eliminate wishbones and use slip ramps instead (where applicable)	• Reduces upfront costs • Increases revenue in certain conditions • Simplifies construction and traffic control	• Adds more weaving on the GP • Reduces future flexibility • IAJR impacted • Makes ML less attractive to users depending on location	3

Ranking Scale: **5-4 = Most Likely to be Developed** **3, DS = Design Suggestion** **1-2 = Least likely to be developed**
Evaluation Criteria: **WD = Withdraw** **RQ = Required**

CREATIVE IDEAS EVALUATION *I-35E Managed Lane Project*			TxDOT/TTA	
No.	**IDEA DESCRIPTION (FUNCTION)**	**Advantages**	**Disadvantages**	**Rank**
P-9	use rigid pavement	• Lower maintenance costs • Less urban heat • More suitable for TxDOT doing maintenance • Longer pavement life • Allow bids for alternate pavement sections	• Possibly more upfront costs • Longer construction duration • Higher noise	DS
P=9a	allow precast pavement options	• Reduces construction duration	• Increased cost	DS
P-10	use alternative materials for bridges (fiber reinforced polymers)	•	•	DS
P-11	maximize use of standard spans on bridges (geometric adjustments)	•	•	DS
P-12	early implementation of HOT lanes (convert existing HOV to HOT) – allowed under current legislation	• Generates revenue early • Could be very marketable during construction	• Duplicate toll equipment installation costs • Creates constructability issues when ultimate construction begins	5

Ranking Scale: **5-4 = Most Likely to be Developed** **3, DS = Design Suggestion** **1-2 = Least likely to be developed**
Evaluation Criteria: **WD = Withdraw** **RQ = Required**

CREATIVE IDEAS EVALUATION *I-35E Managed Lane Project*			TxDOT/TTA	
No.	**IDEA DESCRIPTION (FUNCTION)**	**Advantages**	**Disadvantages**	**Rank**
P-13	defer ROW acquisition and construction of northern part of middle section and north section (defer Garden Ridge north)	• Reduces upfront cost significantly • Defers cost of mitigation to COE property • Defers maintenance costs • Moves towards a more financially viable project	• Creates hardship for current owners (urban blight) • May cost more later to acquire ROW and to construct • Doesn't help reduce today's congestion • reduces revenue for middle section • Unable to relocate utilities • Defers development in north along corridor • Reduces LOS north of Lake • Reduces alternate routes for incident management	4
P-14	shared 10' shoulder/buffer between GP and ML	• Eliminates cost of barrier and shoulder pavement • Reduces ROW costs • Reduces maintenance costs • Reduces capital costs	• Does not serve as a breakdown lane • No positive barriers between ML and GP • Replace pylons • Could potentially increase bridge spans • Higher potential for leakage • Increase toll collection infrastructure costs • More onerous traffic management	3
P-15	reduce all lanes to 11' (used currently on Central)	• Reduces capital costs • Reduces ROW costs	• Reduces LOS equires design exception on GP	2

Ranking Scale: **5-4 = Most Likely to be Developed** **3, DS = Design Suggestion** **1-2 = Least likely to be developed**
Evaluation Criteria: **WD = Withdraw** **RQ = Required**

CREATIVE IDEAS EVALUATION *I-35E Managed Lane Project*			TxDOT/TTA	
No.	**IDEA DESCRIPTION (FUNCTION)**	**Advantages**	**Disadvantages**	**Rank**
P-16	use the shoulder as a lane during peak periods (can be combined with eliminate outside/4th GP lanes) Requires 12' shoulder	• Active traffic management • Allows for future flexibility • Reduces overall costs if eliminating GP lane	• Additional costs for signage and equipment • Creates drainage issues	4
P-17	construct 12' shoulder	•	•	WD
P-18	evaluate typical section to use more of existing profile (ML can have reverse cross slopes)	•	•	DS
P-19	construct elevated ML	• Allows early and independent construction • Reduces ROW costs • Earlier revenue stream • Make enforcement easier	• Makes ramping more difficult • May increase overall construction costs • Detriment to aesthetics and noise • Closure during snow and ice events	4
P-20	depress ML	•	• Hard to construct • Water table/drainage issues	WD
P-21	ML on outside, defer construction of GP lanes	• Allows early and independent construction • Reduces ROW costs • Earlier revenue stream • Make enforcement easier • More places for columns • Easier to construct – connection, no wishbones	• Makes ramping more difficult • May increase overall construction costs • Detriment to aesthetics and noise • Closure during snow and ice events	4

Ranking Scale: **5-4 = Most Likely to be Developed** **3, DS = Design Suggestion** **1-2 = Least likely to be developed**
Evaluation Criteria: **WD = Withdraw** **RQ = Required**

CREATIVE IDEAS EVALUATION *I-35E Managed Lane Project*			TxDOT/TTA	
No.	**IDEA DESCRIPTION (FUNCTION)**	**Advantages**	**Disadvantages**	**Rank**
P-22	eliminate barriers in sections where possible	•	•	DS
P-23	reduce design speed (from 70mph to 60mph) GP and ML	• Reduce geometrics • Reduced drainage costs • Reduced retaining wall heights • Reduced embankment costs • Allows more flexible alignment (vertical)	• More congestion or lower LOS	3
P-23a	reduce design speed on DCs (50mph to 45mph)	• Reduce geometrics • Reduced drainage costs • Reduced retaining wall heights • Reduced embankment costs • Allows more flexible alignment (vertical)	• More congestion and lower LOS	3
P-24	defer braided ramps (entire length)	• Reduce upfront structure costs • Increases LOS on GP	• Reduces LOS on frontage roads • May be more expensive to build later	2
P-25	eliminate braided ramps (entire length)	•	•	WD
P-26	stagger gores to minimize structure/ROW	• Reduction in ROW and structure costs	• Changes IAJR	DS
P-27	reduce shoulder on structures (from 10’ to less)	•	• Requires design exception	WD
P-28	close road during construction	• Reduces construction time	• Have to swim the lake	WD

Ranking Scale: **5-4 = Most Likely to be Developed** **3, DS = Design Suggestion** **1-2 = Least likely to be developed**
Evaluation Criteria: **WD = Withdraw** **RQ = Required**

CREATIVE IDEAS EVALUATION *I-35E Managed Lane Project*			TxDOT/TTA	
No.	**IDEA DESCRIPTION (FUNCTION)**	**Advantages**	**Disadvantages**	**Rank**
P-29	lock developer into fixed price at earliest stage possible	•	•	DS
P-30	close GP lanes and use ML and frontage roads during construction	•	•	WD
P-31	incentivize developer for accelerated delivery	•	•	DS
P-32	minimize green space between roadways (GPs and frontage road) – squeeze ROW	•	•	DS
P-33	sell naming rights for key structures and retaining walls	•	• Legislative issue	DS
P-34	incorporate themes into the aesthetics	•	•	DS
P-35	allow advertising along corridor freeway	•	•	WD
P-36	ask Oklahoma Casinos for contribution	•	•	DS
P-37	install digital TVs at bottlenecks and sell advertisements	•	•	WD
P-38	Interim MLs in the median up to north of Hwy 77 (from 77 to start of ultimate build)	• Early revenue • Additional capacity	• Throw away costs • Design issues at cross streets	4
P-39	Interim MLs construction combination median and shoulder/lane reduction (combine with P-38)	•	• Taking away shoulder perception	4

Ranking Scale: **5-4 = Most Likely to be Developed** **3, DS = Design Suggestion** **1-2 = Least likely to be developed**
Evaluation Criteria: **WD = Withdraw** **RQ = Required**

CREATIVE IDEAS EVALUATION *I-35E Managed Lane Project*			TxDOT/TTA	
No.	**IDEA DESCRIPTION (FUNCTION)**	**Advantages**	**Disadvantages**	**Rank**
P-40	study linear need for sidewalks and add if warranted	•	•	DS
P-41	special enhancements to pedestrian/bicycle facilities near transit facilities	•	•	DS
P-42	eliminate free right turns at signalized intersections	•	•	DS
P-43	provide protected refuge areas in median at crossings	•	•	DS
P-44	14' outside lanes or bike lanes (coordinate with local bike groups) exclusive of offset, curb and gutter	•	•	DS
P-45	Seek funding from connecting facilities (635 and SH121 and PGBT)	•	•	DS
P-46	5-year maintenance contract post construction completion, 15-year CMA post construction completion	• Assumed better quality construction • Eliminates hand back costs associated with 50-yr concession	• Complicated contracting	4
P-47	Evaluate alternatives to drilled shaft walls/wall systems	•	•	DS
P-48	re-evaluate mobilization and traffic control percentages	•	•	DS
P-49	re-evaluate unit prices	•	•	DS
P-50	investigate incentives for low emission vehicles	•	•	DS

Ranking Scale: **5-4 = Most Likely to be Developed** **3, DS = Design Suggestion** **1-2 = Least likely to be developed**
Evaluation Criteria: **WD = Withdraw** **RQ = Required**

CREATIVE IDEAS EVALUATION *I-35E Managed Lane Project*			TxDOT/TTA	
No.	**IDEA DESCRIPTION (FUNCTION)**	**Advantages**	**Disadvantages**	**Rank**
P-51	use pylons in place of barriers between ML and GP – maintain full shoulder width	• Significant cost savings • Reduce pavement width to accommodate • Allows flexibility if maintaining same pavement width • Allows maintenance breakdown spot – ease of incident management • Reduces maintenance costs • Improves drainage	• Maintain candlesticks • Potential for leakage • Reduces safety	2
P-52	utilize more existing pavement	•	•	DS
P-53	use recycled materials for fill, etc	• Reduces hauling	•	3
P-54	review ROW, identify properties that could be saved	•	•	DS
P-55	sharing of costs for tolling with NTTA	•	•	DS
P-56	use movable barriers during construction to encourage ease of construction, safety, etc and to maximize lane flow	•	•	DS
P-57	use of movable barrier in terms of permanent ML applications	•	•	DS
P-58	GP and frontage road maintenance by TxDOT and/or ML	•	•	RQ

Ranking Scale: **5-4 = Most Likely to be Developed** **3, DS = Design Suggestion** **1-2 = Least likely to be developed**
Evaluation Criteria: **WD = Withdraw** **RQ = Required**

CREATIVE IDEAS EVALUATION *I-35E Managed Lane Project*			TxDOT/TTA	
No.	**IDEA DESCRIPTION (FUNCTION)**	**Advantages**	**Disadvantages**	**Rank**
P-59	optimize geometrics to reduce ROW acquisitions	•	•	DS
P-60	utilize more of existing pavement – bring to the center, convert to ML and add GP to the outside using existing shoulder	•	•	DS
P-61	Optimize pavement design alternatives (baseline is perpetual – 48" for ramps, CD, GP, ML and 36" for frontage road)	•	•	5
MIDDLE SEGMENT				
M-1	Defer construction of bypass at Frankford Road	• Cost savings upfront	• Reduces LOS • affects local traffic	2
M-2	Combine GP and CD lanes (7 lanes total) between PGBT and SH121	• potential cost savings	• significant weaving issues introduced on the GPs • impacts IAJR	1
M-2a	Combine ML with CD lanes between PGBT and SH121 (no construction in the median)	• reduces pavement and structure costs	• re-evaluate – may or may not work geometrically	4
M-3	Reduce bridge over water (width)	• reduce structure costs	• requires design exception	WD
M-4	Develop separate CDs for SH 121 and PGBT (duplicate west of FM 3040 to east of SH 121)	•	• Will cost more • Impacts Franklin Road • Not enough room – length per AASHTO	WD

Ranking Scale: **5-4 = Most Likely to be Developed** **3, DS = Design Suggestion** **1-2 = Least likely to be developed**
Evaluation Criteria: **WD = Withdraw** **RQ = Required**

CREATIVE IDEAS EVALUATION *I-35E Managed Lane Project*			TxDOT/TTA	
No.	**IDEA DESCRIPTION (FUNCTION)**	**Advantages**	**Disadvantages**	**Rank**
M-5	Construct Corporate over I-35E	• Simplifies construction • Maintains existing character • Reduces cost (less structure)	• Reduces adjacent development potential	4
M-6	Shorten Bridge (over water) length	• Reduce structure costs significantly • Easier to construct	• Mitigate fill within flood storage	4
M-7	Construct FM 407 over I-35E	• Simplifies construction • Maintains existing character • Reduces cost (less structure)	• Reduces adjacent development potential	4
M-8	Eliminate frontage roads over at Lake	• Save significant costs • Reduces maintenance costs • Reduces columns in flood storage area • Use more of existing structure	• Access issues • Increases congestion on GP	4
M-9	Eliminate slip ramp from ML to GP at Church road	•	•	WD
M-10	Revise wishbone design (instead of going over, go under)	• Less complex structures • Fewer structures	• Lengthen GP bridges	4
M-11	Construct Country Lane/S Denton over I-35E	• Simplifies construction • Maintains existing character • Reduces cost (less structure)	• Reduces adjacent development potential	4
M-12	Construct Turbeville over I-35E	• Simplifies construction • Maintains existing character • Reduces cost (less structure)	• Reduces adjacent development potential	4

Ranking Scale: **5-4 = Most Likely to be Developed** **3, DS = Design Suggestion** **1-2 = Least likely to be developed**
Evaluation Criteria: **WD = Withdraw** **RQ = Required**

CREATIVE IDEAS EVALUATION *I-35E Managed Lane Project*			TxDOT/TTA	
No.	**IDEA DESCRIPTION (FUNCTION)**	**Advantages**	**Disadvantages**	**Rank**
M-13	Construct FM 2181 over I-35E	• Reduces cost (less structure)	• Reduces adjacent development potential • Complicates construction	2
M-14	cantilever outside lanes/frontage roads	• Reduces ROW	• Limited locations for depressing sections • Creates drainage issues	WD
M-15	Defer frontage road total lanes from 3 to 2 and/or 4 to 2	• Reduces ROW • Reduces costs	• Won't be accepted by locals	DS
M-16	defer interchange at SH121 NB DC connections	• Reduces upfront costs	• May cost more to construct later • Lose more revenue than cost of DC	WD
M-17	Sell naming rights to Lewisville Lake bridge	•	•	DS
M-18	float bridge on north and south approaches		• May cost more to construct than standard bridge	WD
M-19	access recreational area via old embankment off of Garden Ridge to eliminate new RR crossing	• Avoids a new RR crossing • May save construction time • May reduce costs	• Requires building a bridge on old embankment	DS
M-20	parking for recreation area could be under highway structure and route trail under existing roadway and rail bridges along shoreline	• Cut down less trees • No RR crossing • Reduces costs	• Emergency vehicle cannot get access	DS
M-21	reduce water crossing structures by working with COE to reduce floodway width and marsh areas/wetlands (streams)	•	•	DS

Ranking Scale: **5-4 = Most Likely to be Developed** **3, DS = Design Suggestion** **1-2 = Least likely to be developed**
Evaluation Criteria: **WD = Withdraw** **RQ = Required**

CREATIVE IDEAS EVALUATION *I-35E Managed Lane Project*			TxDOT/TTA	
No.	**IDEA DESCRIPTION (FUNCTION)**	**Advantages**	**Disadvantages**	**Rank**
		•	•	
SOUTH SEGMENT				
S-1	Eliminate 4th GP lane	• Save overall costs • Reduces ROW • Enhances start-up revenue • Reduces drainage impacts	• May reduce LOS • More politically sensitive because you're not adding GP capacity • NEPA impacts are significant – re-evaluate • IAJR impact – redo • Impacts regional transportation plan and air quality plan	3
S-2	Double decking of ML	•	•	WD
S-3	Construct Managed Lanes on viaduct	•	•	WD
S-4	Shorten wish-bone at Valwood for feeding Beltline	•	• May limit ramp access to downtown Carrollton • Not significant cost savings	2
S-5	Flip wishbone and eliminate flyovers	• Less complex structures • Fewer structures	• Lengthen GP bridges	4
S-6	Make Main W and 4th Street dead-end at I-35E frontage roads	•	•	WD

Ranking Scale: **5-4 = Most Likely to be Developed** **3, DS = Design Suggestion** **1-2 = Least likely to be developed**
Evaluation Criteria: **WD = Withdraw** **RQ = Required**

CREATIVE IDEAS EVALUATION *I-35E Managed Lane Project*			TxDOT/TTA	
No.	**IDEA DESCRIPTION (FUNCTION)**	**Advantages**	**Disadvantages**	**Rank**
S-7	Move wish-bone closer to actual exits, shorten wishbones, and shorten weaving between connections	•	•	WD
S-8	Reduce frontage road total lanes from 3 to 2 and/or 4 to 2	• Reduces ROW • Reduces costs	• Won't be accepted by locals	RQ
S-9	elevate Beltline instead of depressing to eliminate lift station	•	•	WD
S-10	deepen creek to eliminate lift station	•	•	WD
S-11	find usage for water being pumped for example irrigation or water feature	•	•	DS
S-12	convert existing HOV to ML immediately prior to project construction SEE P-?	•	•	
S-13	extend frontage road (auxiliary lanes) from ramp to ramp instead of ramp to cross street	• Lowers cost • Could reduce retaining walls • Reduce ROW	• Reduces LOS	4
S-14	optimize connections to 635 MLs and 35E MLs to enhance revenue generation	•	•	DS
NORTH SEGMENT				
N-1	Push wish-bone further north at Mayhill Road	•	•	WD
N-2	Construct San Jacinto over I-35E	• Lowers freeway resulting in less noise to receptors	• Has to work with US 77 interchange	4

Ranking Scale: **5-4 = Most Likely to be Developed** **3, DS = Design Suggestion** **1-2 = Least likely to be developed**
Evaluation Criteria: **WD = Withdraw** **RQ = Required**

CREATIVE IDEAS EVALUATION *I-35E Managed Lane Project*			TxDOT/TTA	
No.	**IDEA DESCRIPTION (FUNCTION)**	**Advantages**	**Disadvantages**	**Rank**
N-3	US 77 entering I-35E – combine SB ramps to ML and frontage road to eliminate braided ramp	• Reduces cost significantly • Removes braided ramp	• May cause weaving issues on frontage roads	4
N-4	Reduce inside shoulder width on managed lanes width on north segment	• Save interim costs on concrete	• Expensive to expand in the future • Operational difficulties	2
N-5	Push NB GP lanes out at I-35W to eliminate one bridge	• Reduces cost • Simplifies construction	• Local access issues possible	4
N-6	Reduce frontage road total lanes from 3 to 2 and/or 4 to 2	•	•	WD
N-7	flip the connection at US 77 to keep GP lanes at grade to reduce structures COMBINE WITH N-2	•	•	
N-8	combine exits and eliminate braids (current configuration based on Denton requirements) SEE OTHER	•	•	
N-9	make cross streets come in at 90 degrees where possible	•	•	DS
N-10	reversible ML (interim condition)	• revenue	• same impacts as full build	WD
N-11	end the project at US 77 (defer construction beyond) SEE OTHER	•	•	
N-12	confirm capacity and functionality of pedestrian bridge, make it expandable? Two smaller bridges?	•	•	DS

Ranking Scale: **5-4 = Most Likely to be Developed** **3, DS = Design Suggestion** **1-2 = Least likely to be developed**
Evaluation Criteria: **WD = Withdraw** **RQ = Required**

CREATIVE IDEAS EVALUATION *I-35E Managed Lane Project*			TxDOT/TTA	
No.	**IDEA DESCRIPTION (FUNCTION)**	**Advantages**	**Disadvantages**	**Rank**
N-13	make pedestrian bridge an underpass instead	•	•	WD
N-14	Investigate ROW minimizing since traffic volumes are lower	•	•	DS

Ranking Scale:	**5-4 = Most Likely to be Developed**	**3, DS = Design Suggestion**	**1-2 = Least likely to be developed**
Evaluation Criteria:	**WD = Withdraw**	**RQ = Required**	

VALUE ENGINEERING PROCESS

INTRODUCTION

The Value Engineering (VE) process involves fourteen activities needed to accomplish a VE study, organized in three parts: Preparation, VE Study, and Report. The following VE Activities Chart describes each activity; the individual tasks are summarized below.

PREPARATION

Prior to the start of the VE study, representatives from TxDOT-Dallas District, TTA CDA Program Management and VE Team Leader carried out the following three activities:

- **Initiate Study** – Identified study project, defined study goals, and prepared draft study charter.
- **Organize Study** – Conducted preparation meeting, selected team members, and finalized study charter.
- **Prepare Data** – Collected and distributed data and prepared cost models.

All of the information gathered prior to the VE Study was given to the team members for their review and use.

VE STUDY

There were ten activities carried out by the VE team during the performance of the study, organized in three segments:

Segment 1

- **Inform Team** – Receive designer presentation, develop performance criteria, and visit project site.
- **Analyze Functions** – Identify basic functions and cost drivers.
- **Create Ideas** – List a large quantity of alternative ideas and use group/individual brainstorming.
- **Evaluate Ideas** – Evaluate all ideas against performance criteria and rank all ideas.

Segment 2

- **Develop Alternatives** – Develop high-ranked ideas into VE alternatives and measure performance.

- **Critique Alternatives** – Team review of alternatives to develop and ensure team consensus and technical viability. Develop and rate recommended VE alternatives.

- **Present Alternatives** – Give interim presentation of alternatives and prepare and issue preliminary VE report.

Segment 3

- **Assess Alternatives** – Review alternatives and prepare draft implementation decisions (*TxDOT Management*).

- **Resolve Alternative** – Resolve dispositions, edit and revise alternatives, and summarize results (*TxDOT Management*).

- **Present Results** – Publish Final VE Study Report.

VE REPORT

- **Publish Results –** Prepare Final VE Report and distribute printed and electronic copies.

The VE study is complete when the report is issued as a record of the VE team's analysis and development work as well as the project development team's implementation dispositions for the alternatives.

Performance measures are integral to the VE process and are used throughout the VE Study. The following detailed discussion of the performance measures provides better clarification of how they are used within the VE process. A VE Study Activity Chart, which outlines the fourteen VE activities in more detail, follows the performance measures. The VE Study Agenda and Meeting Attendees sheet, which document the schedule and participants in the VE Study, are at the end of this section.

PROJECT PERFORMANCE MEASUREMENT

INTRODUCTION

The methodology described herein measures project value by correlating the performance of project scope and delivery to the project costs. The objective of this methodology is to prescribe a systematic, objective approach to study and optimize a project budget, schedule, and scope. This serves the transportation community by identifying a quantifiable methodology to effectively analyze and compare three project management components (scope, schedule, and budget), and measure resulting project value.

Project performance measures are an integral part of the Value Engineering (VE) methodology and consist of a set of techniques as follows:

- Identify key project (scope and delivery) performance criteria for the project
- Establish the hierarchy and impact of these criteria on the project
- Establish the baseline of the current project performance by evaluating and rating the effectiveness of the current design concepts
- Identify the change in performance of alternative project concepts generated by the study
- Measure the aggregate effect of alternative concepts relative to the baseline project's performance as a measure of overall value improvement

It is important that the project performance criteria be well defined and agreed to by the VE team members at the start of the study as they are used throughout the study to identify, evaluate, and document alternatives. Project scope performance improvements are also one of the critical quantifiable results of a VE study. All subsequent references to "project scope and delivery performance" will be abbreviated to "performance".

The primary goal of value engineering is to improve project value. A simple way to think of value in terms of an equation is as follows:

$$\text{Value} = \frac{\text{Project Performance (Scope \& Delivery)}}{\text{Project Cost}}$$

Value engineering has traditionally been perceived as an effective means for reducing project costs. This paradigm only addresses one part of the value equation, often at the expense of overlooking the role that VE can play to improve project performance. Project costs are fairly easy to quantify and compare through traditional estimating techniques. Performance is not so easily quantifiable.

A unique methodology using a variety of techniques aimed at identifying, defining, and quantifying performance is used. Once this has been accomplished, the interrelationship between cost and performance can be quantified and compared in terms of how they contribute to overall value.

The direct and active involvement of the project's stakeholders is at the core of this process. The VE Team Leader will lead team members through the methodology, using the power of the process to distill subjective thought into an objective language that everyone can relate to and understand. The dialog that develops forms the basis for the VE team's understanding of the performance requirements of the project and to what degree the current design concept is meeting those requirements. From this baseline, the VE team can focus on developing alternative concepts that will quantify both performance and cost and contribute to overall project value.

The approach to project performance yields the following benefits:

- Builds consensus among project stakeholders (especially those holding conflicting views)
- Develops a better understanding of a project's goals and objectives
- Develops a baseline understanding of how the project is meeting performance goals and objectives
- Identifies areas where project performance can be improved through the VE process
- Develops a better understanding of a VE alternative's effect on project performance
- Develops an understanding of the relationship between performance and cost in determining value
- Uses value as the true measurement for the basis of selecting the right project or design concept
- Provides decision makers with a means of comparing costs and performance (i.e., costs vs. benefits) in a way that can assist them in making better decisions

METHODOLOGY

The application of performance methodology consists of the following steps:

1. Define the major performance criteria
2. Determine the relative importance of the criteria
3. Establish the performance "baseline" for the original design
4. Evaluate the performance of the VE alternative concepts
5. Compare the performance rating of alternative concepts to the "baseline" project.

Assumptions

Before embarking on the details of this methodology some assumptions need to be identified:

- An evaluation of the creative ideas (ideas generated during the brainstorming, creative sessions-not to be confused with VE alternative concepts described in Step 4) is done between Step 3 and 4. The idea evaluation process remains true to the "value" approach of measuring performance and costs; however, due to the time constraints, the idea evaluation is a qualitative form of evaluating ideas, as opposed to the quantitative procedures done in the other steps.

- The methodology described in the following steps assumes the project functions are well established. Project functions are "the what" the project delivers to its users and stakeholders; a good reference for the project functions can be found in the environmental document's purpose and need statement. Project functions are generally well defined prior to the start of the VE Study. In the event that project functions have been substantially modified, the methodology must begin anew from the beginning (Step 1).

Step 1 – Determine the Major Performance Criteria

The VE Team Leader will initially request that representatives from TxDOT identify performance criteria that they feel are essential to meeting the overall need and purpose of the project. Usually four to eight criteria are selected. It is important that all potential criteria be thoroughly discussed. The information that comes out of this discussion will be valuable to both the VE team and TxDOT. It is important that the criteria be discretely defined, and they must be quantifiable in some form. By quantifiable, it is meant that a useable scale must be delineated with values given on a scale of 1 to 10. A "1" indicates poor value while a "10" indicates excellent value. Every effort should be made to make the ratings as objective as possible.

Step 2 – Determine the Relative Importance of the Criteria

Once the group has agreed upon the project's performance criteria, the next step is to determine their relative importance in relation to each other. This is accomplished through the use of an evaluative tool termed in this paper as the "Performance Criteria Matrix." This matrix compares the performance criteria in pairs, asking the question: "Which one is more important to the project?" A letter code (e.g., "a") is entered into the matrix for each pair identifying which of the two is more important. If a pair of criteria is considered to be essentially equal importance, both letters (e.g., "a/b") are entered into the appropriate box. This, however, should be discouraged, as it has been found that in practice a tie usually indicates that the pairs have not been adequately discussed. When all pairs have been discussed, the number of "votes" for each is tallied and percentages (which will be used as weighted multipliers later in the process) are calculated. It is not uncommon for one criterion to not receive any "votes". If this occurs, the criterion is given a token "vote", as it made the list in the first place and should be given some degree of importance.

It is important for the VE Team Leader to remind the group that as they evaluate each pair of criteria they should think of performance trade-offs in hypothetical terms as they relate to the project's overall need and purpose. The team should also be reminded that these performance criteria will be used to evaluate the merits of alternative concepts generated during the course of the VE Study. As such, the group should keep an open mind and base their evaluation on what is possible rather than what exists in terms of the current design concept.

Step 3 – Establish the Performance "Baseline" for the Original Design

The next step in the process is to evaluate how well the original design is addressing the project's performance criteria. This step establishes a "baseline" against which the VE alternative concepts can be compared. The Performance Rating Matrix is used to assist the VE team in determining the performance ratings for the original design concept. Representatives from the VE team next begin assigning a 1 to 10 rating for each criterion, using the definitions and scales developed in Step 1.

Once the 1 to 10 rating for the various criteria have been established, their total performance should be calculated by multiplying the criteria's weight (which was developed in Step 2) by its rating. Once the total performance for each criterion has been determined, the original design's total performance can be calculated by adding all of the scores for the criteria. The concept's total performance will be somewhere between 100 and 1,000 points. A concept scoring 1,000 would represent a hypothetically "perfect" design concept, with all performance criteria being addressed to their theoretical maximum. This numerical expression of the original design's performance forms the "baseline" against which all alternative concepts will be compared.

Step 4 – Evaluate the Performance of the VE Alternative Concepts

Once the performance baseline has been established for the original design concept, it can be used to help the VE team develop performance ratings for individual VE alternative concepts as they are developed during the course of the VE Study. The Performance Measures form is used to capture this information. This form allows a side-by-side comparison of the original design and VE alternative concepts to be performed.

It is important to consider the alternative concept's impact on the entire project, rather than on discrete components, when developing performance ratings for the alternative concept.

Step 5 – Compare the Performance Ratings of Alternative Concepts to the "Baseline" Project

The last step in the process completes the Performance Rating Matrix that was initially begun to develop the performance ratings for the original design concept. The VE team totals the VE alternatives, as a "set", to provide the decision makers a clear picture of how the alternatives fit together into possible solutions. This "set" of VE alternatives is rated and compared against the original concept. The performance ratings developed for the VE alternative set are entered into the matrix and the summary portion of the Performance Rating Matrix is completed. The summary provides details on net changes to cost, performance, and value using the following calculations.

- % Performance Improvement = Δ Performance VE Alt. Set / Total Performance Original Concept
- Value Index = Total Performance / Total Cost (in Millions)
- % Value Improvement = Δ Value Index VE Alt. Set / Value Index Original Concept

The Performance Rating Matrix shows the numerical change for each performance measure and alternative set. The Total Performance is calculated by multiplying the criteria weight by the performance rating for each performance measure of either the original concept or VE set.

CONCLUSION

The development and integration of performance measurements into the value methodology employed on VE studies has improved the effectiveness of the VE Program as applied to projects by providing a reliable, integrated method of measuring performance and, consequently, value. This in turn has allowed the program to more easily discuss disposition of the alternatives, justify alternatives with cost increases, apply value engineering more effectively to projects in the earlier stages of project development, and to better capture input from participating project stakeholders.

The application of performance measurements within a VE Study neither supplants nor reduces the authority of the Project Development Team from developing, analyzing, and refining the project scope issue contained in the above two major categories. The intent of the project (scope) performance measurements within the context of a VE Study is for the VE team to address the relevant project scope issues. These may help the Project Development Team, but they do not supplant their role as the final decision makers on the project scope.

Value Engineering Study Activity Chart

PREPARATION

INITIATE STUDY — 1
- Identify study project
- Identify study roles and responsibilities
- Define study goals
- Select team leader

ORGANIZE STUDY — 2
- Conduct preparation meeting
- Select team members and advisors
- Identify stakeholders, decision-makers
- Identify data collection
- Select study dates
- Determine study logistics

PREPARE DATA — 3
- Collect and distribute data
- Develop construction cost models

VE STUDY

Segment 1

INFORM TEAM — 4
- Review study activities and confirm reviewers
- Present design concept
- Present stakeholders' interests
- Review project issues and objective
- Develop key functions and performance criteria
- Visit project site

ANALYZE FUNCTIONS — 5
- Analyze project data
- Expand project functions
- Determine functional cost drivers

CREATE IDEAS — 6
- Focus on functions
- List all ideas
- Apply creativity and innovation techniques

EVALUATE IDEAS — 7
- Apply key performance criteria
- Rate each idea
- List advantages and disadvantages
- Rank all ideas
- Assign alternatives for development

Segment 2

DEVELOP ALTERNATIVES — 8
- Develop alternative concepts
- Prepare sketches and calculations
- Measure performance
- Estimate costs, Life Cycle Costing (LCC) benefits/costs, if applicable

CRITIQUE ALTERNATIVES — 9
- VE Alternatives Team Consensus Review

PRESENT ALTERNATIVES* — 10
- Present findings
- Document feedback
- Confirm pending reviews
- Prepare preliminary report

**Informal presentation of study findings*

Segment 3

ASSESS ALTERNATIVES* — 11
- Review preliminary report
- Assess alternatives for project acceptance
- Prepare draft implementation dispositions

**Activities performed by Project Development Team (PDT) and Stakeholders*

RESOLVE ALTERNATIVES — 12
- Review implementation dispositions
- Resolve implementation actions with decision -makers and stakeholders
- Edit alternatives
- Revisit rejected alternatives, if needed

PRESENT RESULTS* — 13
- Present results
- Obtain management approval on implemented alternatives
- Summarize performance, cost, and value improvements

**Preferred presentation- formal*

REPORT

PUBLISH RESULTS — 14
- Document process and study results
- Incorporate all comments and implementation actions
- Distribute printed report
- Distribute electronic report to TxDOT

VE STUDY AGENDA

Monday, August 16, 2010

Information Phase

9:00-9:05	Introductions (All)
9:05-9:45	Brief overview of the VE Process (*Martin Hsu, Team Leader*)
9:45-10:30	Project Overview (*Project Manager and Engineers*)
10:30-11:00	Stakeholder Issues (All)
11:00-12:00	Function Identification, Performance Criteria Development, Rating of Baseline (All)
12:00-1:00	Lunch
1:00-5:00	Site Visit **(VE Team members only)**

Tuesday, August 17, 2010

9:00-9:30	Recap of First Day/Additional Information Review
9:30-11:00	Review/Discussion of Baseline Cost Estimate

Function Analysis Phase

11:00-12:00	Function Analysis/*Fast Diagram*
12:00-1:00	Lunch
1:00-2:00	Function Analysis/Fast Diagram (continued)

Creative/Speculation Phase

2:00-5:00	Team Brainstorming

Wednesday, August 18, 2010

8:00-10:00	Team Brainstorming (Continued)

Evaluation Phase

10:00-12:00	Evaluation of Ideas
12:00-1:00	Lunch
1:00-4:00	Evaluation of Ideas, Team Assignments for Development
4:00-5:00	Review Alternative Development Process

Monday, August 23, 2010

Development Phase

8:00-9:00	Review of VE Alternatives Meeting (Reality Check)
9:00-10:00	Review/Distribution of Handouts and VE Alternative Forms
10:00-12:00	Alternative Development
12:00-1:00	Lunch
1:00-5:00	Alternative Development

Tuesday, August 24, 2010

8:00-12:00	Alternative Development
12:00-1:00	Lunch
1:00-3:30	Finalize VE Alternative Development
3:30-5:00	Finalize Team Review of VE Alternatives

Wednesday, August 25, 2010

Presentation Phase

8:00-10:15	Group Review, prepare for Presentation
10:15-12:30	**Presentation of VE Alternatives to Management and Stakeholders**

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