Texas State Highway (SH) 183 Dallas County, Texas

Cost Estimate Review
April 2011

TABLE OF CONTENTS:

EXECUTIVE SUMMARY

The Federal Highway Administration (FHWA), and the Texas Department of Transportation (TxDOT) conducted a workshop to review the cost and schedule estimates for the Texas State Highway 183 (SH 183) Project in Dallas County, Texas, at the Dallas District office of the Texas Department of Transportation in Mesquite, Texas between April 25 and April 27, 2011. The objectives of the review were to verify the accuracy and reasonableness of the current TxDOT total cost estimate and schedule and to develop a probability range for the cost estimate that represents the Project's current stage of development.

Significant results of the review:

- The TxDOT estimate of $1.096 billion was revised during the review. The revised baseline estimate became $1.391 billion.

- Based on the review, the total escalated range of costs for this project is between $1.389 billion and $1.474 billion with an 80% confidence.

- The revised baseline estimate of $1.391 billion is at a confidence level of about 15%. The 70% confidence level equates to a $1.448 billion cost estimate which is normally considered the minimum level.

- The most significant risk for the total project is the project schedule. Authorization to implement this project using a Public-Private Partnership is awaiting action in the state legislature as of this writing. Without this authorization, there is no identified funding for the project. The review team assumed that authorization was achieved. Should this authorization fail, the impact of a 10 year delay possible to achieve alternative financing was modeled to understand the impact of such a delay.

Chapter 1 - Review Summary

Introduction:

The FHWA Texas Division Office, the Texas Department of Transportation (TxDOT), and the Project Consultants (Halff, Civil Associates and Bridgefarmer) conducted a workshop to review the cost and schedule estimates for the Texas State Highway 183 (SH 183) Project. This Team met at the Dallas District office of the Texas Department of Transportation in Mesquite, Texas from April 25 through April 27, 2011, to conduct the review.

The objectives of the review were to verify the accuracy and reasonableness of the current TxDOT total cost estimate and schedule and to develop a probability range for the cost estimate that represents the Project's current stage of design. This document summarizes and reports the results of this review.

The Review Team's methodology was to develop an understanding of the Project scope, current cost and schedule estimates, and status. The Review Team reviewed current relevant documents and current reports on the Project, and the TxDOT Project Team members presented their approach to developing the Project scope and costs for different elements of the Project.

The Appendix of this Report includes the Review Team's close-out presentation developed on April 27, 2011.

Basis of Review:

The "Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users" (SAFETEA-LU) (Pub.L. 109-59, 119 Stat. 1144) requires the financial plan for all Federal-aid projects with an estimated total cost of $500,000,000 or more to be approved by the Secretary (i.e. FHWA) based on reasonable assumptions. The $500,000,000 threshold includes all costs (PE, CN, R/W, UT, CE, etc.). The FHWA has interpreted reasonable assumptions to be a risk based analysis. Financial plans are also required for projects that have an estimated total project cost between $100-$500 Million and those financial plans are subject to review at the discretion of the FHWA Division Office. The cost estimate reviews are required to provide the risk based assessment of the estimate and are used in the approval of the financial plan.

Project Background:

The SH 183 project is the proposed reconstruction and improvement to a 9 mile section of routes SH 183, in Dallas County, Texas. The SH 183 project runs along SH 183 from SH 161 to IH 35E in Dallas County. A Location Map is presented on the next page.

The proposed improvements consist of the construction of four tolled managed lanes (2 in each direction), reconstruction and widening of the existing mainlanes and frontage roads. The SH 183 project meets the North Tarrant Expressway (NTE) Segment 2E

project on the west end, the Loop 12/SH 114 project at their interchange, and Project Pegasus at IH 35E on the east end. The costs associated with the NTE project, the interchange of SH 183 with Loop 12/SH 114 and SH 183 with IH 35E are not included in this estimate as there are considered part of the adjacent projects. The environmental clearance for this project is provided by an Environmental Assessment (EA) which received a Finding of No Significant Impact (FONSI) in 2004. Due to changes in project scope and the time elapsed since the FONSI; a reevaluation of the EA is currently underway. This cost estimate review is based on the projected costs associated with the proposed build alternative as expressed in the reevaluation document.

Estimate Adjustments:

TxDOT provided a cost estimate for the Project at the beginning of the workshop. During the workshop, several adjustments were made to the estimate.

- Added Expended Right of Way costs - $120.5 m
- Added Expended Preliminary Engineering costs - $15.0 m
- Added Noise Wall and Frontage Road Project (under construction) - $7.2 m
- Added Landscaping and Aesthetics – ½% of construction - $3.4 m
- Added construction cost for project design details not included in the estimate at 3% of construction - $20.6 m
- Added ITS costs at 1% of construction - $6.9 m
- Added Cost of PPP procurement - $4,000,000
- Traffic Signal Unit Cost was reduced to $85,000
- Signing Unit Cost was reduced to $6000
- Contingency was reduced from 20% to 15% to account for separating out the above noted costs for landscaping, aesthetics, ITS and miscellaneous design details which were originally included in the 20% rate - $34.4 m reduction

These revisions resulted in a TxDOT year 2011 total cost estimate increase from $1.096 billion to $1.228 billion for the entire Project.

The time frame for implementation of this project is based upon the North Central Texas Council of Governments Mobility 2030 Long Range Transportation Plan (MTP). The 2035 MTP is being implemented at this time, but the project schedule has not changed. The current short range Transportation Improvement Plan (2010- 2014) does not identify any funding for this project. The current MTP shows that the anticipated construction schedule is completed before 2020 and was used as the basis for escalation.

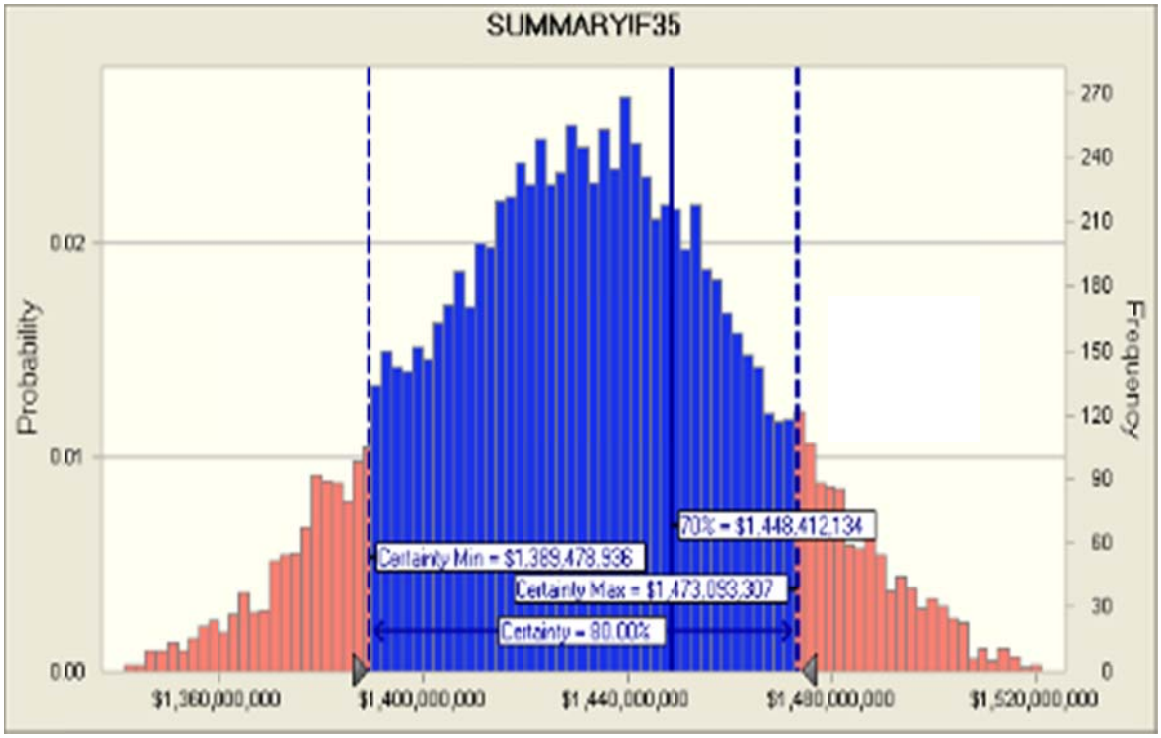
To express the estimate as a range, threats and opportunities were developed. The workshop review team selected assumption curves that best modeled the cost impacts and probabilities based on the uncertainty associated with those threats and opportunities. The assumption curves were incorporated into a Monte Carlo program that developed forecast curves that represent a cost estimate range for the Project. This simulation was performed on the adjusted estimate. Appendix A contains the Crystal Ball® Probability Analysis report generated by the team during the review.

The following are the results of the simulation for the Project. The certainty in the chart (shown using the blue or darker shaded area) represents the likelihood that the total cost for the cost identified will be at or below the maximum value, based on the threats, opportunities and uncertainties modeled during the review. The certainty shown is based on the uncertainty of the inputs used to derive the estimate. As such, it should be noted that risks such as extreme inflation, the impact of world events, or other unforeseen circumstances were not considered in the review.

For the SH 183 project, expended TxDOT costs for design and other work were not included in the escalation calculation and were added in after all the other costs were escalated. The years of escalation for construction were based on the midpoint of the estimated construction schedule.

Costs Summary:

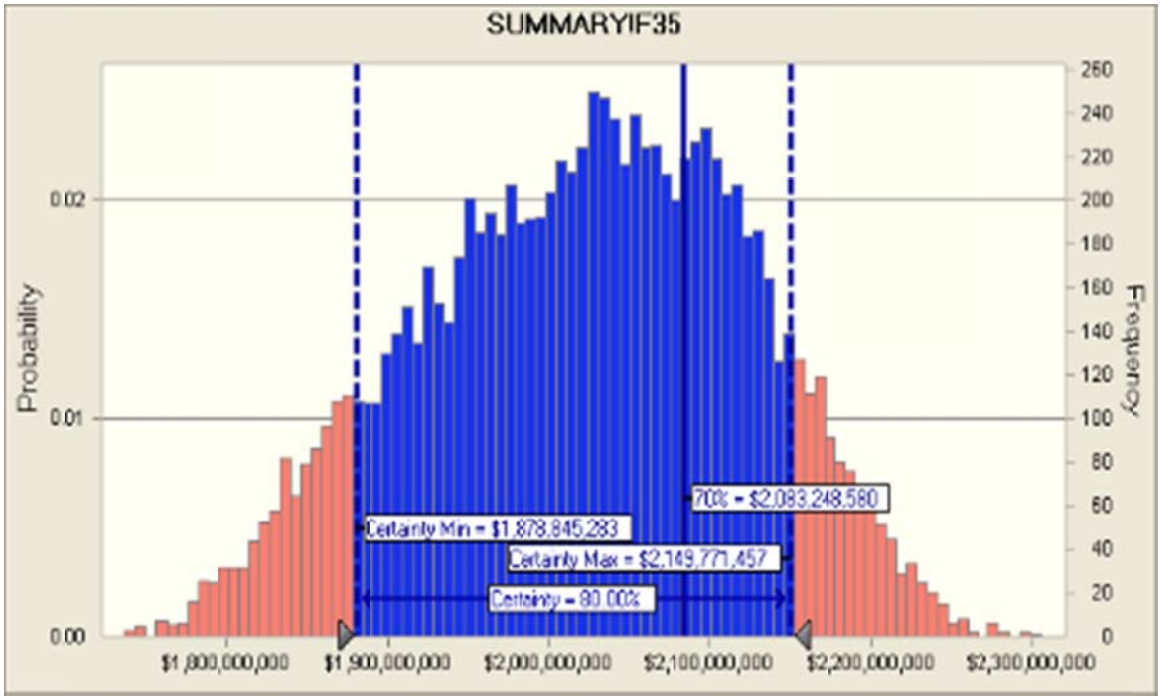
The review teams' revised estimate of $1.391 billion (YOE dollars) represents about a 15% level of confidence. This level of confidence is due to the use of unescalated dollars in the base estimate, uncertainty modeled in the escalation rate added to the estimate, the years of escalation used, and the 44 assumption curves that were input based on the opportunities and threats identified by the review team. There are two ways of interpreting the chart below. Looking at the dark blue line drawn vertically to the right of center on the chart, it shows that with a 70% confidence the total project cost will be less than $1.448 billion. Another interpretation can be made looking at the blue shaded area. It represents that the total project will cost between $1.389 billion and $1.473 billion with an 80% confidence level.



Listed below is a summary of confidence levels along with the Total Project Cost estimates (year of expenditure):

Confidence Levels for	Updated Estimate (year of expenditure)
20%	$1.403 billion
50%	$1.432 billion
70%	$1.448 billion
80%	$1.459 billion
90%	$1.473 billion

Since this project is dependent on authorization action by the state legislature, analysis of a possible ten year delay in project implementation was modeled. To perform this model, the project was still assumed to be constructed in a single phase with the year of implementation extended to 2030. The chart below represents the results of that model run. The 70% cost and 80% range is plotted on the chart.

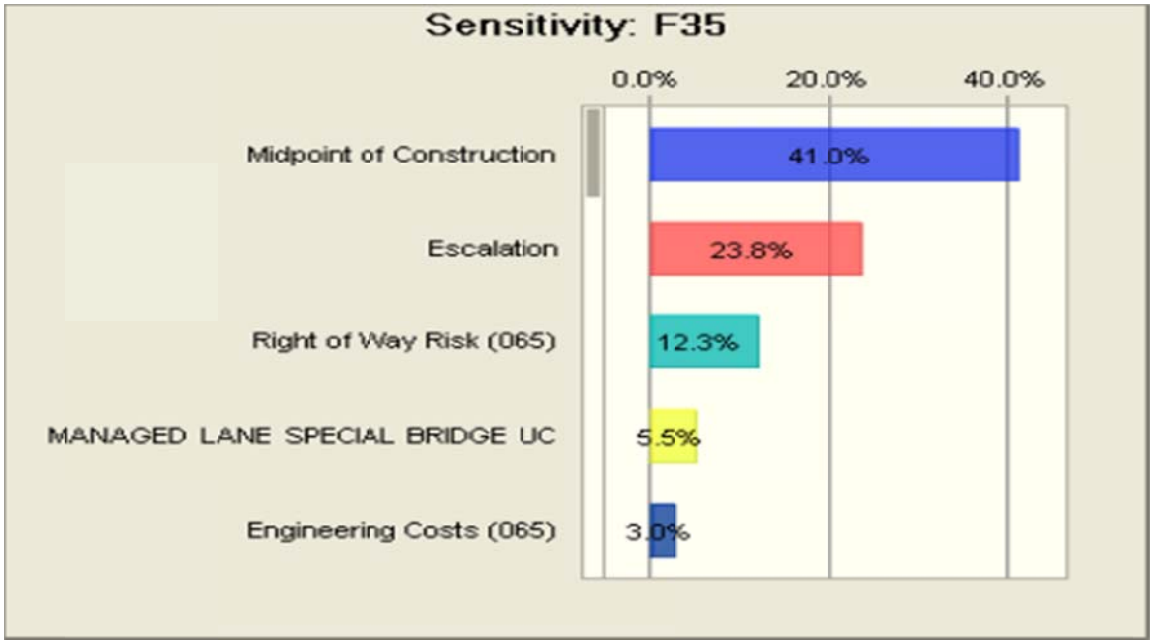


Listed below is a summary of confidence levels along with the delayed project estimates (year of expenditure):

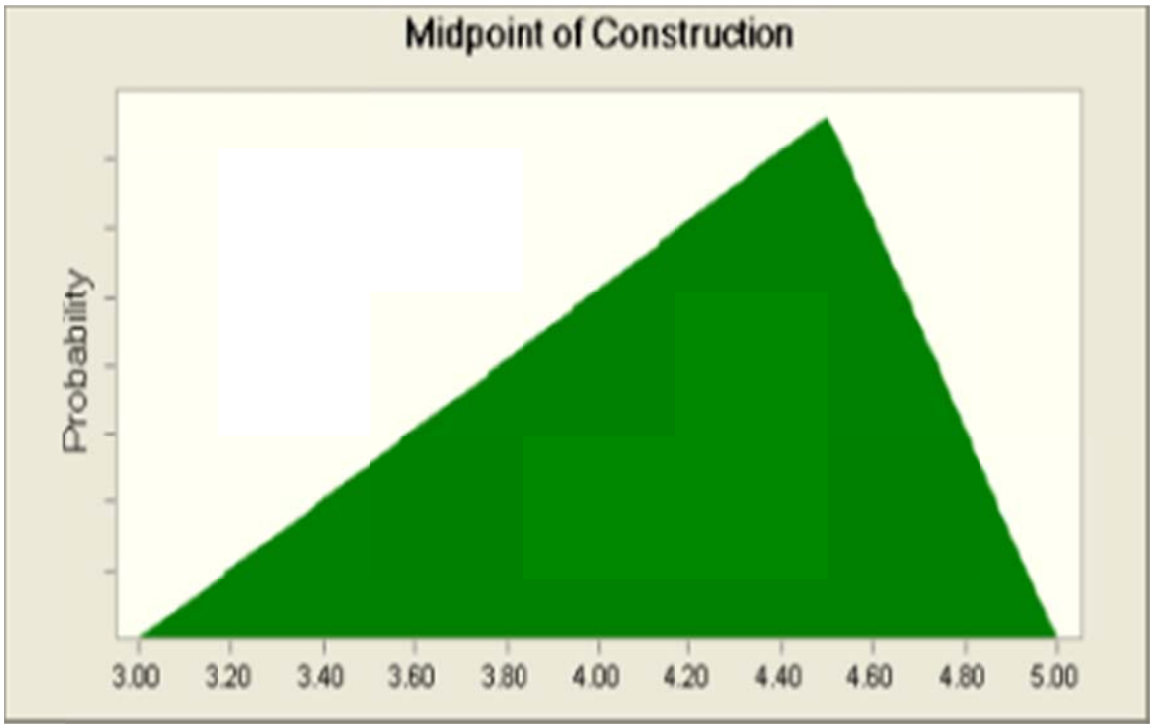
Confidence Levels for	Updated Estimate (year of expenditure)
20%	$1.928 billion
50%	$2.027 billion
70%	$2.083 billion
80%	$2.112 billion
90%	$2.150 billion

Sensitivity Analysis:

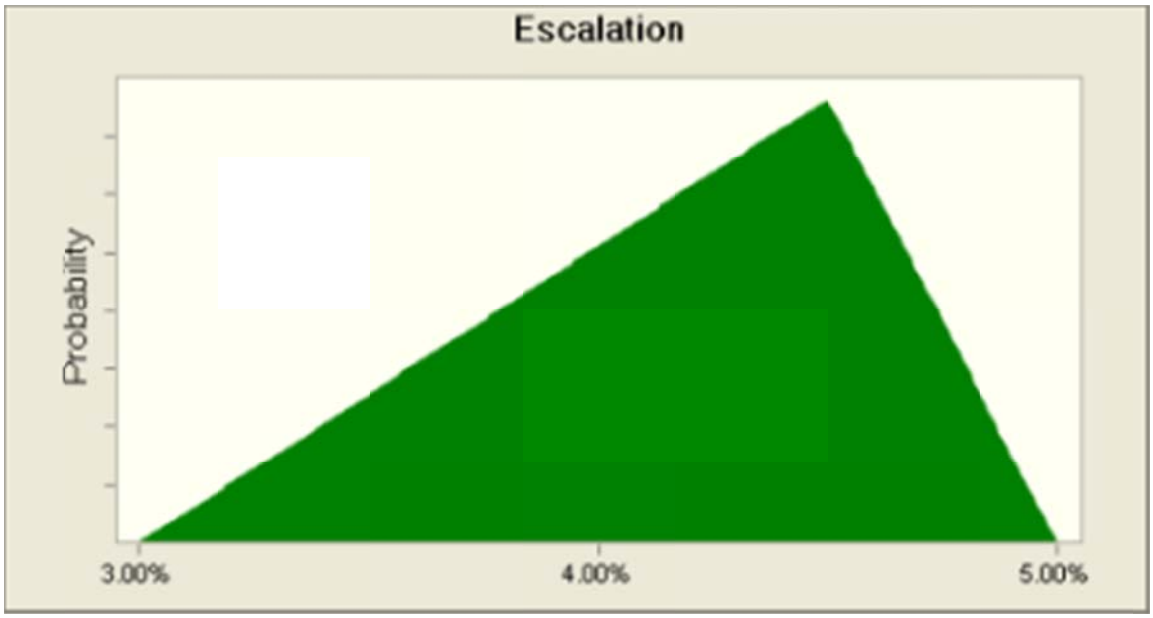
Returning to the original project schedule, the following chart shows how the variation of the cost estimate components impacts the variation of the total cost estimate for the Project. Those inputs at the top of the graph have greater impact on the variation of the total Project costs while those at the bottom have less impact.



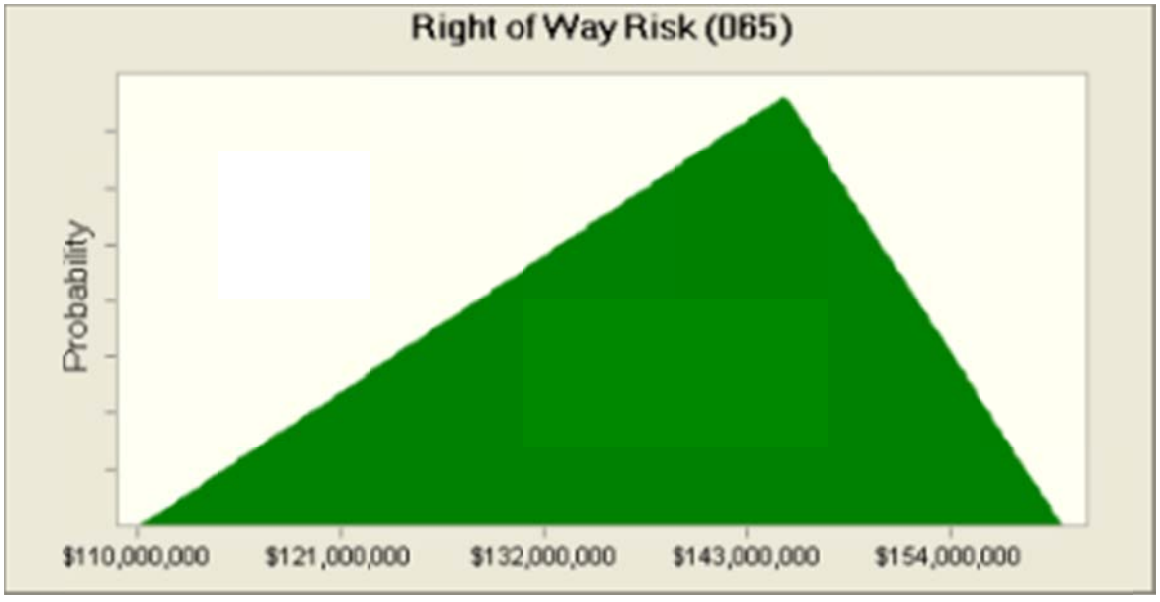
Midpoint of Construction – The uncertainty modeled in this assumption accounts for 41% of the total project cost variance. The assumption curve used was a triangular distribution with a most likely midpoint of construction in 4.5 years, a minimum of 3 years and a maximum of 5 years.



Escalation – The uncertainty modeled in this assumption accounts for 24% of the total project cost variance. The assumption curve used was a triangular distribution with a most likely inflation rate of 4.5%, a minimum of 3.0% and a maximum of 5.0%.



Right of Way cost in the West (065) portion of the project – The uncertainty modeled in this assumption accounts for 12% of the total project cost variance. The assumption curve used was a triangular distribution with a most likely ROW cost of $145 million, a minimum of $110 million and a maximum of $160 million.



Risk (Threats and Opportunities) Summary:

During the course of the workshop the Review Team identified the following risks (threats and opportunities):

RISKS (THREATS):

Lack of Identified Funding – This project is awaiting Public-Private Partnership authority from the Texas legislature. While the entire project is shown in the current long range transportation plan, funding has not been identified for the project.

USACE 408 Permit Required – The process necessary to obtained the require Corps of Engineers 408 permit is data intensive and time consuming. The Corps of Engineers will require a full set of construction drawings in the permit area (the Trinity River Floodway). The permit process could take a year to complete. Other parts of the project, however, can be constructed during this timeframe.

Right of Way Concerns – Acquisition of right-of-way is ongoing, as funds become available. Several concerns were noted with this process. There are still many outstanding parcels left to acquire. Delays in their acquisition could delay parts of this project. Also, condemnation awards have been higher in the Dallas area recently, which could impact the final acquisition costs. In the Irving hospital area, there is a helipad in proximity to this project which requires coordination with the Federal Aviation Administration. And finally, there is an Exxon/Mobile tank farm within the project limits which has access issues which will need to be resolved.

Utility Relocations – The potential exists for some high cost utility relocations to be required. The full scope of utility relocations have not been determined.

Outdoor Advertising – Within the City of Dallas, there are a large number of billboards along the project corridor which will be impacted by this project.

Increasing Oil Prices – Continuing increases in oil prices have impacts on fuel and material prices.

Multiple Major Projects in the Area – This projects proximity to several other major projects (including IH 635/LBJ Freeway, North Tarrant Expressway, and DFW Connector) could impact the availability of labor (including DBE subcontractors) and materials.

Areas of Clay Soils – This area of Dallas has pockets of clay soils. The geotechnical analysis for this projects design is still underway and these areas have not all been identified. These clay soils could impact the pavement design and may require a deeper excavation and base material course or potentially a different pavement design.

Bicycle and Pedestrian Accommodation – Changes in requirements in the bike/ped accommodation are causing the need to adjust the project design.

Environmental Document Reviews – The reevaluation of the environmental document for this project is not yet complete.

RISKS (OPPORTUNITIES):
Ongoing Right-of-Way Acquisition – Right-of-way acquisition has been ongoing, as funds become available. Approximately 60% of the necessary ROW has been acquired to date. This process will continue.

Public-Private Partnership Advantages – Legislative approval of PPP authority for this project will speed project delivery, take advantage of lower interest rates and shift the risks associated with utility relocations to the developer.

Review Recommendations:

During the workshop, the Review Team developed the following recommendations for implementation:

- Incorporate results into the Financial Plan and Project Management Plan.
- Communicate in terms of Total Project Costs
- Develop a plan to manage threats and opportunities

Next Steps:

These follow-up actions were developed at the end of the workshop:

- FHWA will prepare a draft report documenting review findings for review and comment within 30 days.
- After receipt of comments, FHWA will prepare the final report within 30 days.

Chapter 2 - Review Methodology

Review Team:

The Project Review Team was developed with the intent of having individuals with a strong knowledge of the Project and/or of major project work and expertise in specific disciplines of the Project. This Review Team participated together throughout the workshop, and individuals with specific project expertise briefed the Review Team on that portion of the Project estimate development process, including the development of the Project cost estimate quantities, unit prices, assumptions, opportunities and risks.

The Team was comprised of the following members:

- FHWA Staff
  - Ted West, TX Division Office
  - Brett Jackson, TX Division Office
  - Anita Wilson, TX Division Office

- TxDOT Staff
  - Nasser Askari, Dallas District
  - Murray Allen, Dallas District
  - Tony Payberah, Dallas District
  - Matthew MacGregor, Dallas District
  - Adnan Elsaad, Dallas District
  - Melanie Young, Dallas District
  - Kojo Mensah, Dallas District
  - Travis Henderson, Dallas District

- Civil Associates
  - Naser Abusaad

- Bridgefarmer
  - Azad Shahriar

- Halff
  - Chad Gardiner
  - Matt Craig

Documents Reviewed:

Documents provided by TxDOT to the Review Team prior to and during the workshop were:

- TxDOT Cost Estimate
- TxDOT Project Overview Presentation
- Project Schedule
- Project Layout and Maps

Review Process:

- Project Team input
    - FHWA, TxDOT and Consultants
- Methodology
    - Understanding the scope of the Project
    - Stage of design and date of estimates
    - Evaluating any scope not included in detailed estimates
    - Considering the Risks and Opportunities for various items
    - Discussing and reviewing the projected Schedule, Inflation Rates and Contingencies
    - Compiling the Total Project Estimates (Design, Construction, ROW, Utilities, Contingencies, Inflation, etc.)
- Risks (Threat and Opportunities) Analysis
    - Focused on major cost items
    - Evaluated Project risks
    - Identified Project opportunities
    - Applied probability curves
- Performed Monte Carlo modeling of potential cost outcomes to determine probabilities
- Basis of Review:
    - Not an independent estimate
    - Review based on the current Project estimate as presented during the workshop
    - Potential schedule impacts due to inter-contract relationships were considered, but not quantified in analysis

Chapter 3 – Probability Analysis

The objective of the probability analysis during the workshop was to determine the Review Team's confidence level in the current values being produced for the estimate. The results of this probability analysis could then be used to determine if the risk/contingency factors in the estimate are reasonable.

The Review Team discussed each work package and major component, including the current estimate, scope, schedule, risks and opportunities. Based on this review, probability curves were selected for each of the major line items in the project estimates, considering the probability that the final bid or contract value would be within a certain range of the current estimate. Next, forecast curves were generated from the random sampling (10,000 iterations) of the input probability curves previously defined by the Review Team. This type of analysis provided a statistical level of certainty that the variation of the forecast distribution curve reflected the underlying variation of the cost inputs as determined by the Review Team.

The resulting forecast curves were then analyzed to provide information on the confidence level in the Project cost estimates and remaining budgets.

The Review Team used a statistical software tool called Crystal Ball® in order to establish a sense of perspective on the cost expectations for the Project. This software selection is an add-in program for use with the Excel™ spreadsheet program and it permitted the application of Monte Carlo simulation technology to analyze key components of current cost estimates prepared by the project delivery team. As is the case with many real-world problems involving elements of uncertainty, the analysis of the variables is much too complex to be solved by strict analytical methods. There are simply too many combinations of input values to calculate every possible result. In the case of this workshop cost model, the Monte Carlo simulation supplied random numbers for selected cells identified as "assumption cells", with these random numbers falling within the range of real-life possibilities defined by the study team. Each set of these

random numbers is essential input to a "what-if" scenario. In this case, each scenario outcome represents a possible outcome from an expected real-world bidding and construction cycle. The model is recalculated for each scenario many times and builds a final forecast probability curve that reflects the combined uncertainty of the assumption cells on the model's output. This plotted probability curve provides a range that can be expected for a final project cost, with degrees of certainty to model the potential final outcome.

The outcome depicted in this final probability curve is typically stated in the following manner: "There is a 90% (or whatever percentage depicted) degree of certainty that the construction cost will be in a range from $x to $y, provided that our understandings and related assumptions do not change significantly between now and the end of construction." In order for this to work correctly the Review Team must supply the program with the probable range of construction costs for each assumption cell in the spreadsheet, and must supply an indicative characterization for the probability spread for each of these cells. This shows up in the form of probability distribution curves. The triangular probability curves are commonly used when relying on expert opinion. In the case of this workshop, the Review Team utilized a triangular probability distribution for the vast majority of assumption cells. The probability assumption curves shown in the following sections depict how the Team considered modeling the major cost elements for this Project. Based on these assumption curves, the Monte Carlo analysis would select a random number for each of these curves and sum each random selection for the resulting probabilities. The probability assumption curves shown in this section are only those items that have a significant impact on the results of the analysis. The Appendix includes an Excel™ file of the probability assumption curves used for the Project estimate.

Appendix A - *Crystal Ball Probability Analysis:*

SH 183 Crystal Ball Report.xlsx

Appendix B - *Workshop Close-out Presentation:*

SH 183 CER Closeout.ppt

Appendix C - *Sign-in Sheets:*

SH 183 CER Signin Sheets.pdf