

# CMGC Design Phase State Report

For

## I-15; Dixie Drive Interchange

Project No.

S-I15-1(84)6

PIN No. 7755



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For

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Of

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## Purpose

The purpose of the State CMGC Design Phase report is to discuss how the contractor's input during design led to improved constructability, effective risk management, and savings through innovation. This report will discuss some performance measures that the state has established in order to compare the project's cost and schedule to the open market. The information in this report was obtained by interviewing key personnel from UDOT, the designer, and the contractor. Additional information was gathered from design meeting records, and bid documents.

## Project Overview

The Dixie Drive Interchange Request for Proposals gave the following physical description of the project:

The Utah Department of Transportation (UDOT) in conjunction with St. George City plan to construct a new interchange on I-15 at approximately milepost 5 in St. George. The proposed interchange will provide access from I-15 to Dixie Drive, and Convention Center Drive. It will also alleviate a significant portion of the congestion at the Bluff Street Interchange. This project is needed because the existing Bluff Street Interchange lacks the capacity to handle the future traffic demands in the area.

The new interchange will include five new bridges; two new bridges for ramps over the Santa Clara River, two bridges for I-15 mainline over Santa Clara River, and one bridge for the interchange structure. The project will also include two other minor structures; one over Convention Center Drive on the east side of I-15, and one pedestrian structure under Dixie Drive to maintain the existing trail system. Auxiliary lanes will be used between the Bluff Street Interchange and the new Dixie Drive Interchange to prevent traffic from merging onto I-15 mainline traffic between the two interchanges. All traffic merging onto I-15 mainline will do so north of the Bluff Street Interchange or south of the new Dixie Drive Interchange.

The Project was released in 4 formal design packages, or phases. There was also an early release package for the girders to be used on the Mainline I-15 structures. Phase I covered the construction of Mainline I-15. Phase II covered the eastern half of the project. Phase III covered the rough grading of the golf course. Phase IV covered the western half of the project. The detailed work required for each phase is listed below.

## Phase I:

- MOT required for package
- Construct mainline I-15 Northbound and Southbound
- Construct/move trail head and construct a temporary/permanent parking area
- Construct I-15 Northbound and Southbound bridges over Santa Clara
- Relocate/construct utilities for Package I and any others that can be completed in this package

## Phase II:

- MOT required for package
- Construct Ramp A
- Construct Ramp B and bridge
- Construct MSE walls and Dixie Drive on east side of I-15
- Construct C/D roads
- Construct Ramp E and F at Bluff Street
- Construct Convention Center Drive
- Finish trail head if required
- Place sleeves in fills for SPI bridge
- Relocate/construct utilities for Package II and any others that can be completed in this package

## Phase III:

- Construct rough grading of golf course not completed in City package

## Phase IV:

- MOT required for package
- Construct Ramp C and bridge
- Construct Ramp D
- Construct MSE walls and Dixie Drive on west side of I-15
- Construct C/D Roads
- Construct Ramp G and H at Bluff Street
- Construct surface streets
- Construct SPI bridge
- Relocate/construct utilities for Package IV and any others that can be completed in this package

The Dixie Drive Interchange Request for Proposals identified the following project goals in order of importance:

- Maintain two lanes of traffic in both directions on I-15 at all times throughout the project.
- Maintain the current functionality of the Bluff St. Interchange during construction.
- Maintain the traffic flow on Dixie Drive and Indian Hills Road.
- Apply innovative solutions to stay within the budget.
- Minimize the impact of construction activities on the adjacent golf course.
- Meet all flood plain requirements and coordinate with other government agencies.
- Maintain safe access to the trail on the east side of I-15, and provide no fewer parking spaces for trail users than currently exist.
- Achieve project completion by Fall of 2011.

The project goals reveal that there were many potential conflicts with outside parties, and that minimizing the projects impact to the surrounding area was a high priority. As this report will show, CMGC gave the project a better ability to avoid conflicts while also upholding a high level of service to the travelling public, and a tight construction schedule.

In the design finalization meeting, the team expressed some frustration of UDOT's focus of project priorities. The primary focus by the Department was schedule, the team then focused their efforts on a timely delivery which began to raise project costs and Right of Way conflicts. Then the Department changed its focus from schedule to cost due to limited funding. Finally, the focus was changed back to schedule. This change of focus was difficult for the design team because the focus is the basis by which innovations are evaluated. There is a delicate balance between schedule and cost that must be maintained regardless of delivery method. Though the shifting of owner's focus was difficult for the team, CMGC does allow the owner to more readily change their focus during design. This versatility may be a benefit but can reduce the effectiveness of the team if not handled properly.

## Design Costs

Washington County Constructors (WCC), a joint venture of Ralph L. Wadsworth and Granite Construction, was selected on September 2, 2009 as the CMGC contractor for all four phases of the project. Horrocks Engineers acted as the designers and Stanton Constructability performed the Independent Cost Estimates for the project (ICE).

Table 1 CMGC Design Fees

<b>Designer’s Fee</b>	\$5,020,695.00
<b>CMGC Design Fee</b>	\$712,755.90
<b>ICE Preparer’s Fee</b>	\$185,605.36
<b>Total Design Costs</b>	\$5,919,056.26
<b>CMGC % of Total</b>	12.0%

## Bid Prices

Table 2 Cost Breakdown of Phases Compared to Engineer's Estimate and ICE

<b>Project Number</b>	<b>Engineer’s Estimate (EE)</b>	<b>Independent Cost Estimate (ICE)</b>	<b>Final Bid</b>	<b>% Difference of EE</b>	<b>% Difference of ICE</b>
S-I15-1(88)5	\$1,104,000.00	\$1,041,348.00	\$808,640.00	-26.75%	-22.35%
S-I15-1(89)5	\$16,913,610.42	\$17,956,320.20	\$17,938,444.11	6.06%	-0.10%
S-I15-1(90)5	\$19,562,037.83	\$20,567,323.24	\$20,990,331.66	7.30%	2.06%
S-I15-1(91)5	\$11,806,466.40	\$12,469,307.25	\$12,812,036.36	8.52%	2.75%
S-I15-1(96)5	\$3,371,700.00	\$3,722,711.90	\$3,640,020.27	7.96%	-2.22%
<b>Totals</b>	<b>\$52,757,814.65</b>	<b>\$55,757,010.59</b>	<b>\$56,189,472.40</b>	<b>6.50%</b>	<b>0.78%</b>

## Applicability of the CMGC Process

The following section discusses the influence that the CMGC process had on the design of the Dixie Drive Interchange project. CMGC allowed the contractor to review plans before they were completed, recommend innovations, and investigate solutions to problems faced during design. The contractor's input led to several innovations that will be discussed below. These innovations prompted improvements in design and constructability, while also reducing costs, and optimizing the construction schedule.

## Innovative Process

The project used an innovation matrix to identify and track innovations. The matrix recorded the status of each innovation proposed on the project. It served as a single reference point for potential solutions to constructability issues, opportunities to simplify the design, and savings estimated for design alternatives. Once an alternative was proposed, the project management team assigned the appropriate party to investigate the possibility of including it in the plans. After this investigation each innovation was then included into the plans, or dismissed based on the recommendation of the responsible party.

## Innovations Used

Table 3 Key Innovations of Dixie Drive (see Appendix B for Complete List)

ID	Issue	Innovation	Savings	Schedule Impact (days)
1	MOT phasing	Integrate cut lines with MOT phasing to preserve as much of the I-15 section as possible.	\$ 1,000,000.00	0
2	MOT - Traffic Plans - City Streets	Build new Dixie Drive before re-constructing Hilton & connectors	\$ 150,000.00	180
3	Mainline MOT	All traffic on N.B. or S.B. with phasing	\$ 180,000.00	0
4	Partial depth vs. full depth panels	Partial depth panel recommended for constructability and over-all quality	\$ 875,000.00	0
5	Bridge ABC methods	Analysis of various ABC methods. Precast bent cap at SPUI	\$ -	7
6	Girder acquisition	Installation coupled with supply of girders in M&P to eliminate sales tax	\$ 70,000.00	0
7	SPMT Bridge move	SPMT move not recommended. Adds time and additional cost.	\$ 2,100,000.00	14
8	Pile instead of drilled shafts	As a cost saving measure pile/stone columns used instead of drilled shafts	\$ 1,300,000.00	0
9	Drilled shaft length reduction	shorten shafts as actual conditions are realized	\$ 43,000.00	0
10	Scour protection along Dixie Drive	Sheet pile wall recommended over a rip rap option. Cost and material availability.	\$ 540,000.00	70
<b>Estimated Value</b>			<b>\$ 6,258,000.00</b>	<b>271</b>

The Table 3 highlights 10 innovations that were proposed on the Dixie Drive Interchange project. The estimated cost savings of these innovations is estimated at over \$6.2 million. The key innovations discussed herein are focused mainly on the team’s approach to MOT and the structural design.

### **Mobilization of Traffic Innovations**

As with most transportation construction projects on the interstate system, the Dixie Drive project was very sensitive to the mobilization of traffic during construction. The RFP from the Department dictated the use of Accelerated Bridge Construction (ABC) but left the contractors the opportunity to identify MOT innovations in their proposals. Once the design team met to discuss the various options it was determined that the new intersection could be built in place and that traffic could be routed to both sides of the interstate and thereby meet the traffic impacts allowed in the RFP. However, the existing bridge would have to be demolished and reconstructed in a piecewise fashion. The cut lines for demolition were coordinated with the phasing of the project to ensure that a minimal amount of the original pavement was removed. Finally it was determined that by manipulating the construction schedule it was beneficial to begin the modifications on Dixie Drive prior to constructing the other collector streets. This allowed them to use Dixie Drive to reduce traffic impacts on the Hilton collector streets. Because of the input from designers and contractors, the team was able to tailor the construction process to meet the intent of the RFP, minimize traffic delays and ultimately save over \$1.3 million. These innovations were closely tied to the changes made in structural design to achieve even more savings.

### **Structural Innovations**

Part of the ABC techniques suggested in the RFP was the use of bridge mobilization. The team worked to analyze the impacts of mobilizing the bridge and when coupled with the MOT innovations they determined that mobilizing the bridge would cost more than \$2 million with little benefit to the traveling public and large impacts on ROW acquisitions. Once all items were considered they decided not to mobilize the bridge, however other practices frequently used in ABC were implemented. These innovations included: Early procurement of girders, use of partial depth precast panels for the bridge deck, and foundation requirement evaluation.

The team recognized that by adjusting the Measurement and Payment descriptions and coupling the price of installation with the procurement of materials they could ensure that the supplier would perform the installation. This reduced the amount of sales taxes that would be levied on the project. They also discussed the complexities of precast panels for the bridge deck versus the use of precast partial panels with a concrete overly. Because the MOT had been sufficiently addressed the time savings of using full depth panels became a liability because of

constructability issues. It was determined that partial depth panels would result in a better overall finish and be less expensive.

Sequencing the design and the construction of different phases of the project enabled the team to see how the project budget was performing with the design practices. During the later design stages the budget became an issue of concern for the team. In an effort to save the project money, the final phases of construction utilized H piles rather than drilled shafts to save a substantial amount of money. Furthermore, after drilling the first shafts design and bid in the earlier phases of work, the team became aware of the true performance of the subsoil on site which enabled them to reduce the depths of the drilled shafts that were already let in the contract. All of these structural innovations accounted for more than \$4.3 million in project savings.

### **Other Innovations**

The original design concept specified the use of riprap to provide bank stabilization along the river east of the bridges. Once the construction schedule began to take shape the team realized that the required riprap would not be available during their construction window. To meet the supply schedule the work would need to be performed during the golfing season. In order to minimize the economic impacts of lost revenue to the city, the team evaluated different alternatives to bank stabilization. They determined that the use of sheet piles could be implemented to achieve bank stabilization at a reduced cost when compared to riprap. This re-evaluation and change in materials resulted in an overall savings of more than \$0.5 million.

For a complete list of all innovations incorporated by the design team please refer to Appendix B. Total savings of all listed innovations was estimated over \$15.6 million. Also many of the innovations led to time savings compared to the original project described in the RFP.

**Impact to Schedule**

Table 4 below shows the dates for design, and construction milestones on this project.

**Table 4 Project Milestones**

<b>Project Schedule Milestones</b>	<b>Action</b>
09/02/09 - 19/29/10	Pre-Construction - CMGC Design
09/02/09	NTP
09/03/10 - 04/07/10	Design Package B - Mainline I-15
09/03/10 - 04/07/10	Design Package B - Golf Course
04/28/10	Bid Design Package B
09/03/09 - 06/30/10	Design Package C - SPUI, East Side, Early West Side
08/03/10	Bid Design Package C
08/31/10	NTP - Package C
09/03/09 - 08/31/09	Design Package D - West Side
10/01/10	Bid Design Package D
10/29/10	NTP - Package D
04/29/10 - 08/30/10	Procurement - Package A - Early Release Packages
07/01/10 - 04/06/11	Procurement - Procurement Phase
05/03/10 - 1/11/11	Construction Package B - Golf Course
06/01/10 - 12/07/11	Construction Package B - Mainline I-15, Trailhead Relocations, Crossovers
08/31/10 - 07/20/11	Construction Package C - NB Ramps & CD, East Side Items
08/31/10 - 05/09/11	Construction Package C - Accelerated West Side Items
01/18/11 - 12/14/11	Construction Package D - SPUI, SB Ramps & CD, West Side Items
10/29/10 - 08/02/11	Construction Package D - Surface Streets

The project schedule went through some expansion, and contraction as design proceeded. For this reason the overall effect of the CMGC process on the schedule is a matter of some debate. Compared to the original proposal the schedule did expand, but so did the scope. While both the scope and schedule expanded, they did not increase in equal proportions. The team feels that the expansion of scope outpaced the schedule increase.

One issue that did cause problems with the schedule early on in the design process was a lack of communication during selection. The contractor was not aware, when originally proposing their construction schedule, that much of the design was still incomplete. They had assumed that the project was ready for work to begin immediately, when in actuality there was a seven-month design period between contractor selection, and the start of construction. The contractor was able to recover the seven-month delay through innovations, and project phasing. This put the team back on pace to meet the accelerated schedule they promised. This was achieved even after the scope extensions were then.

### Impact to Design

The Contractor's presence during design allowed the team to pursue options that led to cost, and schedule savings. Without using the CMGC delivery method the team would not have been able to optimize construction sequencing in order to take advantage of specific opportunities. This is best shown by the way that the team was able to negotiate with the city of St. George to reduce the impact of construction activities near the golf course.

The golf course is a large source of revenue for the city. Planned construction activities were going to require a closure of the golf course at some point during the project. With the contractor's help, the team was able to negotiate with the city in order to close the golf course during the low period of the city's revenue, and dovetail that with construction efforts in order to minimize the impact to the city. This avoided a situation of compensating the city for lost revenue.

### Risk

The team assessed risks similar to how they addressed innovations. They compiled a risk matrix as determined through ongoing team discussions. The matrix was used to track the status of various risks, and their mitigation strategies. The Risk Matrix also tracked the reduction of risk as design proceeded. To determine the cost of risk and the savings associated with their mitigated efforts the team assigned risk factors to each risk element based on the team's background experience. When the team identified a new risk they provided an estimate of the dollar amount that the risk would cost the project, or the number of days that the risk would delay the project. On the Risk Matrix these figures are referred to as the "Total Possible Risk," and "Schedule Risk in Days." After the team developed a viable mitigation plan for each risk, they recorded the "Mitigation Cost Savings," the dollar amount of risk eliminated through mitigation, and the total cost of the mitigation strategy. The dollar value of any remaining risk was recorded, and the team estimated the probability of the risk occurring. Using the probability and the dollar value of each given risk, the team determined the necessary contingency values that the Department set aside. This contingency value was recorded on the matrix under the column "Total to Risk Pool." The entire Risk Matrix is included in Appendix C

The team estimated that the total possible risk on this project was approximately \$21.3 Million. Through the design process the team was able to directly eliminate \$10.67 Million in recognized risk costs. Elimination in risk was achieved by changing the current design or project assumptions to avoid the identified risk. Of the remaining risk costs the team was able to reduce their costs by developing mitigation strategies. These mitigations reduced the possible impact of risk on the project by another \$3.4 Million, leaving approximately \$7.5 Million of possible risk outstanding. Approximately \$4.1 Million of the remaining risk was accepted by the

team as further mitigation would not yield any savings. These costs were recognized as true costs to the project, accepted by design and budgeted accordingly.

The team addressed the remaining risks one-by-one to determine if they might be avoided. They identified \$3.4 Million that had some probability of occurring. To prepare sufficient contingency funds, the team multiplied the potential cost of these risks by their probability of occurrence. As a result, the final contingency fund totaled \$755,000. This amount was held aside by the project manager to address the risks as they occur.

## Analysis of Performance

### Price

During the CMGC selection process the Department asked each proposer to provide the unit prices of selected bid items to help determine a pricing component of the proposers. By comparing the pricing of the selected bid items to the state average pricing values at the time of selection, the Department hoped to establish a goal for pricing at award. Table 7 shows the comparison of bid items at selection with the ratio of proposal pricing to state average pricing. It was anticipated that the project pricing for the selected contractor would be approximately equal to the state average pricing model. However, as was mentioned earlier, due to a miscommunication during the selection process the contractor thought that the design was mostly done and that construction could proceed immediately upon award. In reality the design proceeded on for 7 more months. During this time they were able to recommend changes to the design that benefited the public. However, as can be seen in Table 5, the actual bid quantities and item descriptions changed drastically indicating that the originally selected bid items used for comparison during selection were not comparable to the final design.

**Table 5 Comparison of Winning Proposal’s Price Estimate with the Final Bid Prices**

Description	RFP Quantity	Unit	Winning Proposal Unit Price	Unit Price Average as of 05-29-2008 to 05-28-2009*	Anticipated Price Ratio <sup>2</sup>	Awarded Bid Quantities	Awarded Bid Unit Price <sup>1</sup>
Precast Concrete Panel	100150	sq ft	\$46.14	\$32.69	<b>0.989</b>	2142	\$123.29
Borrow	320000	Cu yd	\$9.94	\$8.77		61616	\$9.94
PCCP 9 inches thick <sup>4</sup>	141696	Sq Yd	\$38.47	\$39.56		292	\$98.21
HMA 3/4 inch	74126	Ton	\$63.24	\$87.18		41234	\$70.49
Traffic Control	1	Lump	\$606,271.95	\$611,301.18		4	\$340,772.50
Notes:							
1. Prices were averaged from all 4 bid openings and weighted based on the quantity provided							
2. This is the anticipated ratio of the state average costs based on pricing provided at selection							
3. Where state average prices were not available, the average of all proposers was used as a basis of comparison							
4. Actual PCCP provided was 11.5 inches thick rather than 9 shown here							

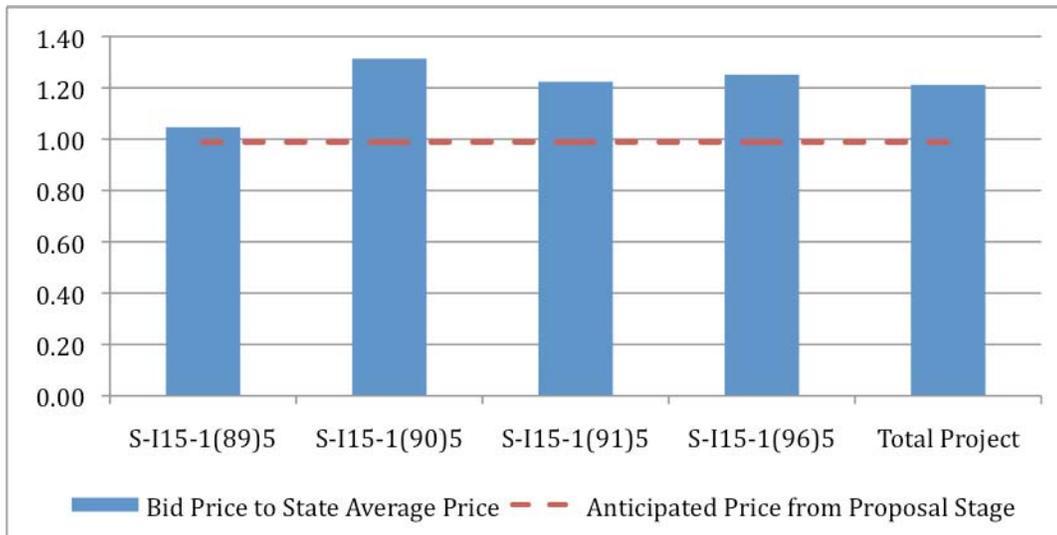
Table 8 shows the pricing of each phase compared to the state average pricing model showing that the project price was higher than the state average goal established during selection. However, when compared to the actual Engineer’s Estimate and the ICE (see Table 2 above), the pricing for the project was very competitive for the work based on current market prices and verified production rates.

Table 6 Pricing Performance at Bid Opening -

Phase	Pins	State Average Price (Matched items)	Bid Price (of items that match)	Bid Price to State Average Price
S-I15-1(88)5	8304	NA	NA	NA
S-I15-1(89)5	8308	\$5,724,031.26	\$5,988,912.58	1.05
S-I15-1(90)5	8529	\$8,236,945.33	\$10,822,968.25	1.31
S-I15-1(91)5	8530	\$4,956,701.92	\$6,065,728.28	1.22
S-I15-1(96)5	8949	\$1,181,335.67	\$1,478,371.95	1.25
Total Project		\$20,099,014.18	\$24,355,981.06	1.21
Percent of project cost that had comparable bid items:				43.3%

Figure 1 is a graphical representation of the data presented in Table 6 above.

Figure 1 Ratio of Bid Prices to State Averages and Anticipated Price from Contractor Proposal



### Blind Bid Opening

The Dixie Drive project conducted an experimental Blind Bid Opening (BBO) for primary work in Phase II prior to its actual bid opening. The theory behind the BBO is to allow the team time to investigate the current pricing of the project and discuss with the contractor any pricing discrepancies prior to the actual bid opening. This is done by having the contractor submit pricing information from a bid list prepared by the designer. An Engineer’s Estimate is also provided. The Independent Cost Estimator also prepares an estimate from the same bid list but instead of divulging the price of each bid item they identify which bid items are priced 10% higher than their estimate. Of the 35 bid items in the BBO, 30 of them could be traced to an

equivalent bid item in the final bid (for a complete list of BBO compared please see Appendix D). Of the 30 bid items compared, 27 of them were identified by the ICE as being over the 10% ICE limit. Of these 27 items only 2 of them did not have a lower price in the actual bid opening. In fact it is estimated that the bid price was reduced by \$1.78 Million because of the BBO process.

However, the BBO process was not utilized in later phases because the initial BBO bid list was not complete. The BBO bid list represented roughly \$12 Million of scope. The actual bid list had almost three times as many bid items as the BBO and represented close to \$18 Million of scope. Because of the large discrepancy in actual costs the team did not continue to use the BBO process for following phases.

### Schedule

Figure 2 Anticipated Construction Phase Schedule

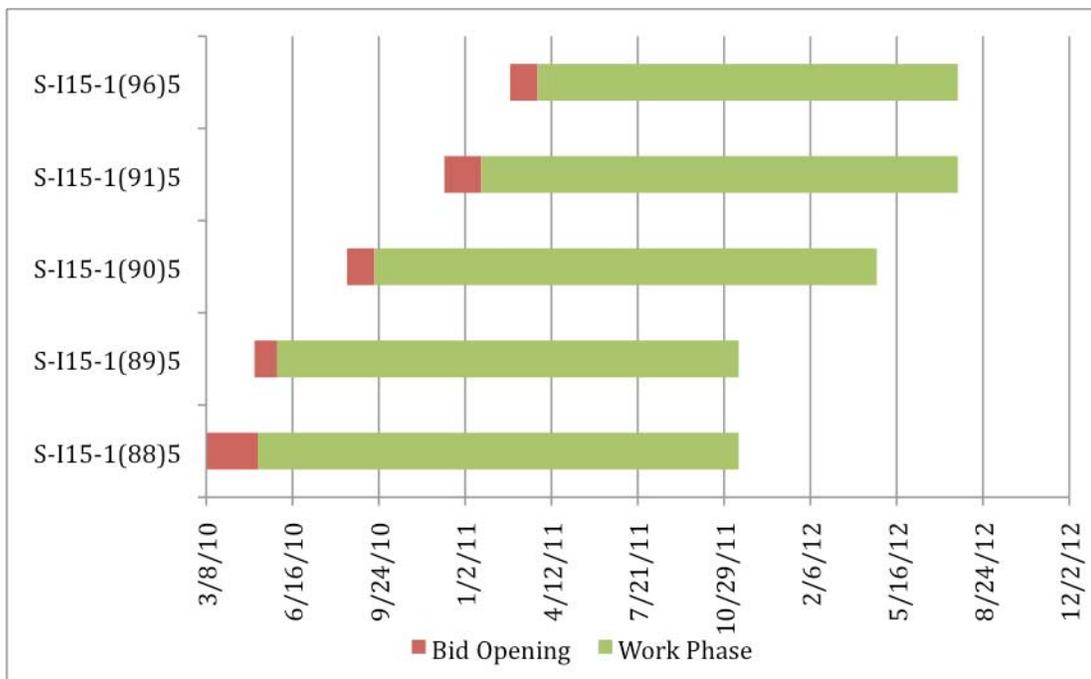


Figure 2 shows the phasing of the contracts that made up the Dixie Drive project. The design team was able to move forward with construction as each phase was completed allowing the team to save a year in the total delivery process. Phasing of the project’s construction had many benefits besides the overall estimated reduction in time. As the team discussed the complexities of the project they became aware of undesirable risks and impacts that would have potentially resulted in many claims to the Department. First long lead structural bridge items were ordered in advance to be available when work was to proceed. Then the work around the golf course was coordinated with the winter season. Right of Way agreements and the duration of obtaining ownership of properties dictated how different sections of the project would be

sequenced. Also another consideration was the management of MOT for the entire project. Through the flexibility of phasing these complexities were addressed so that the overall delivery of the project from design through construction was scheduled and phased to achieve a more time effective delivery. Overall the team felt that project scheduling and phasing was a huge benefit to getting the project delivered a year earlier than if it had been delivered with any other contracting method.

## Environmental Stewardship

This project included a number of commitments that restricted work during certain times of the year. One of the commitments involved the Southwest Willow Flycatcher, which is a small bird on the Federal Endangered Species list. The project area included some of the Flycatcher's habitat, and for that reason certain construction activities were not allowed during the animal's mating season. There were also numerous archaeological sites in the project area. To address these environmental issues, the Contractor provided helpful advice about what work could be performed during particular construction windows, and agreed to obtain pre-clearance before conducting heavy construction activities.

## Lessons Learned

In a final team interview and follow up interviews with key personnel are included in Appendix A. During these interviews the following items were specifically identified as Lessons Learned:

- On large and complicated projects, the CMGC process provided a team that could address issues more effectively to ensure that the project was complete.
- Initially the team felt that separating the project into different phases was more costly, however, once the team began working to meet the deadlines imposed on them the phasing of the project became very important to how decisions were made.
- ROW was a problem. This was because of the schedule-driven nature of the project. This did not allow sufficient time for ROW, and Utility clearances.
- The CMGC process is very sensitive to changes in the owner's expectations or focus. All members of the team felt that outside influences were imposed on them that hindered their focus on the project. The team recommended that upper management from all of the organizations (Owner, Designer, and Contractor) need to be involved in setting the project goals to avoid a change of focus during the project.
- When projects become budget driven the designer may be placed under more pressure to reduce standards to meet the budget constraints. This is not possible.
- The average bid model for selection should be modified. It would be best, on a project by project basis, to have the Contractor provide the lowest cost he can. (NOTE: The average bid model mentioned here is the reference to UDOT's policy to rank pricing based on the average and not the low bid, this is done so the contractor does not "buy" a project). It might be useful to have the Contractor bid their margin, mobilization, and

traffic control, because these are all typically the most nebulous factors on any given project. Having proposers competitively bid on some, or all of these items, would remove some of the vagueness in the Contractor's pricing.

- Regarding negotiation during bid openings: It seemed that the Contractor's margin was too high, but we are not in a position to negotiate for a better price. We simply have an opportunity to accept or reject their bid. It is only if we see an error we have an opportunity to request that the Contractor correct the error. But this is much different, and much more limiting, than being able to say we want a better price on an item or else we are not going to award the project.

## Conclusion

The Dixie Drive project faced many challenges from both schedule and budget constraints. The team felt that the project was a success due to partnering efforts of the team to work together through many of these challenges. It is estimated that the project saved \$15.6 Million in innovations developed and recorded by the team. Furthermore, the team either reduced or eliminated an additional \$14 Million through their risk mitigation efforts. Despite these claims in cost savings, the project suffered from delays due to right of way negotiations, and project focus. Comparisons of price against state averages suggest that the overall unit prices were higher than anticipated; however, these prices were investigated and ratified by both the Engineer's Estimate and an Independent Cost Estimator. Some pricing control was evident through the preliminary Blind Bid Opening process. Due to some discrepancy in overall budget pricing the BBO process was not used on later phases. Curiously, one of the frustrations expressed by the Project Management team may have been avoided with the use of the BBO process in later phases.

## APPENDIX A- Interview Notes

Rudy Alder, Tamerah Maxwell, Trond Pederson, Jessy Poole

### Design

What benefits did you see in design because of contractor participation?

- Dixie Drive wouldn't have been able to set such an aggressive schedule, or save as much money, if it were not delivered using CMGC.
- CMGC allowed the team to negotiate with the city in order to close the golf course during the low period of the city's revenue, and dovetail that with construction efforts in order to minimize the impact to the city. This avoided a situation in which the Department would have had to compensate the city for lost revenue, which is how traditional projects handle this sort of conflict.

What challenges came up during design?

- The team was able to prioritize ROW acquisition, but sometimes CMGC accelerates the construction schedule to a point that the people responsible for acquiring ROW are often put under excess pressure. In this case, though, we were able to track the ROW acquisition as it related to the Contractor's construction schedule. This allowed us to have weekly meetings with the Contractor to mitigate the impacts of ROW clearances that would not be acquired in time for construction.
- The schedule driven design causes problems such as the additional ROW costs that arose on this project. These costs left the team unable to complete the project
- The problem comes from the fact that even when the limitation of operations is established before advertising the project it is difficult for the ROW people to get all clearances on time.
- Some of the challenges with design were related to the difficulty of running a schedule-driven CMGC design process.
- When you are in a schedule driven environment the best thing to do is evaluate proposed solutions against the cost model in order to determine whether or not there is enough money in the budget to pursue that solution.
- On this project the ROW escalation costs put the project \$7M upside down, and the project needed to cut that \$7M from other areas, through

innovation, in order to balance the budget.

- The Contractor provided a cost matrix that allowed the team to view projected costs of quantities that the designers were showing on the plans.

What risks did you help to identify during design?

- See matrix

How did the team identify, evaluate, and track project risk?

- The team used a matrix that tracked the investigation of contractor suggestions, listed issues, and projected the cost, as well as schedule, benefits of each suggestion. Refer to it for specific examples.

Which contractor suggestions helped reduce risk and control costs?

- The Contractor provided a cost matrix that allowed the team to view projected costs of quantities that the designers were showing on the plans. Refer to it for specific examples.

What is the expected cost savings produced by contractor’s suggestions?

- There is a matrix that gives estimates for the savings of things like negotiating the golf course closing.

### Innovations

What innovations were used to reduce cost?

- See Matrix

What innovations were used to reduce schedule?

- See Matrix

What innovations were used to reduce impacts to the public?

- The Contractor came up with a plan to keep two lanes of I-15 traffic open during the entire length of the project without the need for a costly SPMT move.

### Constructability

How was

- The Contractor improved constructability on almost every aspect of

constructability improved by involvement of the contractor in design?

the project because of the congested and complex nature of the project area.

- There were some things included in the project that were overly driven by quality. For example, we included sheet pile for the rip-rap protection, even though this may not have been necessary.

## Schedule

Was the construction schedule shortened or lengthened? How do you know? By how much?

- The schedule went back and forth, with extensions, and cut-backs. The overall effect on the schedule depends on how you measure it. The scope of work grew beyond what was originally proposed, and the construction schedule also lengthened. However, the schedule did not grow commensurately with the extension of the scope.
- The Contractor was not aware, when originally proposing their schedule, that much of the design was not completed. They assumed they would be able to begin work immediately, but in fact there was a 7 month delay between Contractor selection, and the start of construction.
- The Contractor was able to make up the 7 month delay. This put them back on pace to meet the accelerated schedule that the promised, but because of the scope extensions the project schedule ultimately matched the original proposal. In short, the project is now designed to include a larger scope of work within the originally planned time limits.

## Environmental Stewardship

How did bringing the contractor on early alleviate environmental concerns?

- This project included a number of environmental commitments that restricted work during certain times of the year. Thanks to the Contractor's involvement we were able to mitigate schedule delays by looking into what work could be accomplished during particular construction windows.

## Lessons Learned

What did you learn in this CMGC process?

- In the proposal stage, we need to make it clear that the Contractor should not put hard and fast dates without having the full scope of the project realized.

Was there anything you would change during the RFP portion of the project?

- The average bid model for selection should be modified. It would be best, on a project by project basis, to have the Contractor provide the lowest cost he can. It should then be the responsibility of the selection team to ascertain that the Contractor's proposal price is realistic.
- It might be useful to have the Contractor bid their margin,

mobilization, and traffic control, because these are all typically the most nebulous factors on any given project. Having proposers competitively bid on some, or all of these items, would remove some of the vagueness in the Contractor's pricing.

- Regarding negotiation during bid openings: It seemed that the Contractor's margin was too high, but we are not in a position to negotiate for a better price. We simple have an opportunity to accept or reject their bid. It is only if we see an error we have an opportunity to request that the Contractor correct the error. But this is much different, and much more limiting, than being able to say we want a better price on an item or else we are not going to award the

What is your opinion of the value of CMGC?

- I am much more in favor of the process after going through it on this project.

## Dixie Drive Interchange Design Phase Group Interview – March 2011

**Participants:**

Reuel Alder - UDOT

Dallas Wall - WCEC

Dana Meier - UDOT

Larry Reasch – Horrocks

Contractor and Estimators

**1. Phasing****A. How did phasing help the project proceed?**

- There were 5 project phases (A-E).
- The best person to talk to about this is Gary.
- Without phasing it would have delayed the completion of the project by about a year.
- While we were under construction we were able to obtain a lot of positive feedback that informed design elements on later packages.
- This project had many unknowns, and if it were a DB, or DBB project it would have been fraught with claims.
- In construction we were able to absorb the time of certain complications because when we encountered a ROW challenge or some other challenge we were able to roll it into a later design package. As a result we nearly have a complete handle on the job. We would not have had such a handle on the project without the CMGC process, and phasing.

**B. What was the logic behind phasing the project?**

- There was a golf course that had to be rebuilt, and we had to establish construction windows that would allow for that work to proceed.
- It also had to do with early procurement of bridge beams.
- The design phasing proceeded in the same order as the construction sequence. This allowed us to develop an overall project schedule, and sequence it in a manner that would comply with the EAA, and other agreements.
- The phasing also corresponded to natural and logical construction segments as they tied into mainline I-15.
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C. Did phasing the project save overall delivery time of the project? How much?

- Yes, it saved about a year.

D. Knowing what you know now, how would you have changed the phasing?

- The five packages were a good way to proceed, but it does depend on your goal. In this case we developed the phasing based on a schedule driven goal. The particular approach we took to phasing addressed this goal very well.
- Some of the elements had to be moved from one phase to another, but I don't think that we could have foreseen the need for those moves, and place them into other phases from the start.
- There were some difficulties related to the expectations that were set at the outset of the project. When we looked at the initial proposal we thought that the project would proceed more quickly. It seemed that the contractor, designer, and UDOT all had different expectations about the schedule at the beginning of the project, which is why schedule became such an urgent matter during design.
- Some of these problems about early expectations will hopefully be resolved by some changes UDOT is making to the CMGC process. For example, the RFP will now caution the contractor not to give a hard date for completion in their proposal, unless the Department explicitly asks for it. Another modification to the process involves having the team commit to a particular set of goals before releasing the RFP. Hopefully this will avoid fluctuation between goals during design. This fluctuation caused a problem on DDI, as the goal shifted from schedule, to cost, and back to schedule.
- The expectations changed with the wind on this project, which led to many difficulties.
- From a designer's perspective, phasing the project does increase design costs. We have to staff heavier to put out completed bid packages while also conducting ongoing design of other packages. On this project we tried to set the phasing the best we knew how when the job started. There were just a few conflicts that could not have been foreseen when we began, but in general the approach we took to phasing was the only way to do it based on the conditions we had to work within.
- Design costs are up, as well as construction costs, but we do know what our costs will be. If we had gone with a different delivery method we would likely experience a lot of cost changes after award.
- The savings produced through the enhanced VE can offset the additional design costs. For example, the scour wall alone cut out approximately \$1.5M. Overall on the job we VE'd almost \$7M out of the job, which easily offsets the added design costs.

## 2. Design

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A. Was the contractor brought on too soon in the process? How was he beneficial during the early stages of design?

- This project brought the contractor in much sooner than other CMGC projects have in the past.
- The contractor benefitted by learning that they had to be careful with cost/time estimates because they were based on information that was very preliminary. That was frustrating, because contractors are used to putting out estimates that are based on more information, and much more accurate.
- Still, the contractor was absolutely not brought in too soon. Without the contractor's presence we would never have been able to collaborate with third parties, such as the city, to figure out how to make this project successful.
- This was one of the most complex project underway in the entire state, which suggests that it was vital to have the contractor present.
- In this case it was good to have the contractor present early. On something like a greenfield project, where there is a fixed ROW, and so forth, the contractor may not be able to provide as much value. Yet again, though, to get much benefit from a contractor being involved this early you need to set very clear goals and expectations early on.

B. What would you have done to improve the contractor's participation?

- Clear expectations and clearly defined goals. Also a clear explanation of what the contractor's role will be.
- CMGC should not be a schedule-driven design project. Meaning, that the design should not be under a hastened schedule.
- This project went through a futile exercise in reducing, and then expanding the schedule.
- CMGC is a design-intensive process, yet contractors are used to pushing schedules. That is why it is important to ensure that the design schedule is not pushed. In DB, you pay for the contractor to take on risk, and push a design schedule.
- However, if you know schedule is a priority going into the design you can effectively phase a project to meet an aggressive schedule.
- Because the team was directed to focus on schedule they were caught off-guard by a sudden challenge with ROW acquisition that put them over budget. The team was then criticized for not being prepared, and directed to focus on cost. Then after the team brought the project back within budget they were directed, once again, to focus on schedule.

C. What measures of budget control were used by the team?

- Once we were able to establish some firm estimates of project cost the team was able to identify opportunities for savings.

- This project was exceptional. There were \$22M in scope increases on what was initially a \$78M dollar budget. Somehow the team was able to cover those increases under the original budget.
- The contractor developed an original \$48.2 M construction cost estimate. Then we encountered about \$22M of unexpected costs.
- There was a lot of VE, and innovations that led to budget control. There was no need to sacrifice any scope, other than the SMA. We also reduced Dixie Drive from 7 lanes, to 5 earlier than expected.

D. How was the design schedule impacted by the CMGC process?

- It was extended, but we got a tremendous benefit out of the extra time spent because of the problems we will avoid in the field.
- Typically there are more design iterations in the CMGC process. So it certainly takes more design effort, and time with CMGC, but the product of that design is much better.
- Owners also perceive a longer design process with CMGC. That extra time ends up resulting in phasing, constructability, accurate cost modeling, and other advantages.
- Because decisions, errors, and delays are avoided in the field there is an overall reduction in project schedule.
- The value of the additional design time and cost is ultimately confirmed by the reduction in change orders. On this project we are holding an extremely low contingency, but Eric Wells has gone before the Transportation Commission and stated that he is confident that this project can be delivered without exceeding the contingency.

3. **Contract Bidding**

A. How was the bidding process perceived by the team?

- The contractor felt that they spent more time and effort on their estimates than the ICE, or Engineer because any estimating errors come out of the contractor's pocket. (1 Hour to go).
- Some of the contractor's bid numbers were actual subcontractor quotes. The contractor was aware of which items were going to cause disagreements. This is because the ICE doesn't have to build the project. This means that the ICE can take a bid from a subcontractor who is going out of business next week and plug it into his bid. The contractor cannot. For example, on package B several of the subs that bid the pipe are out of business now. What this means is that sometime the subs will include quotes that are not from reliable sources. The contractor does not have that luxury, and must put due diligence into their bids.

- There is a great deal of risk and contingency that disappears through the process, which offsets the increased unit costs seen on some items.
- 80% of this project is GMP.
- The bidding process overall went very well, and many of the bids were accelerated. Because of how familiar the contractor was with the project they could begin working on estimates before packages were advertised. Overall there is only about a 1% difference between the contractor and the ICE.
- It went very well. Although at the first bid opening was very terse.

B. What were the problems identified by the team with pricing?

- One troubling thing was that the team developed cost models, and then the contractor pricing consistently came in above those cost models. This applied to unit prices, and total packages.
- The cost models were not updated as diligently as the actual bids. This was mainly because of how schedule driven the design was. By the time the team reached 90% plans they were busy working on the final estimate, so that it could be prepared by the time 100% plans were complete, and the designers did not have time to spend developing a cost model in the interim.
- Cost modeling information lagged behind actual estimates. Because of how much effort the team is putting into compressing the design schedule the cost model ultimately was based on 60% plans, while the team was working on estimates and bids for 90-100% plans.
- One of the odd things about the pricing process was that the team worked together to solve design problems, and develop cost models and estimates, and then went their separate ways to develop final estimates without making sure that all parties were up to date on quantities and the like. This lack in communication may have been avoided if there had been more time during design.
- The cost model approach was adequate, but the main flaw was the crunched schedule on this project. Also, there is always going to be some dissonance between the contractor and ICE because the ICE does not have to build the project. In one case the ICE could not defend their numbers when they claimed that they could reduce project cost by an additional \$1.5M.
- It would be good if it were possible to develop a more accurate cost model earlier in the process in order to drive decisions at a project level.
- The first cost models were generated by meeting with each design lead once they reached 60% quantities, and then the PM applied their contingency. The cost model then depends on the Engineer's confidence in their numbers.
- ROW doubled. There were a lot of non-construction costs that expanded greatly on this project.
- The cost model did not contain any contingency for unknowns. It was a very tight estimate that was based on insufficient information. Ultimately this made the bid, which was risk-based, look bad. In this case risk was not built into

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individual items, but instead carried at the bottom as an overall contingency which was quickly eaten up by escalating ROW costs.

~~C. How were these problems resolved?~~

D. How were the blind bid openings a benefit to the project?

- Absolutely. It does not necessarily help the contractor a lot, but it does help the ICE by giving them an opportunity to go over M&P, and to really flesh out differences between estimates.
- There was only one BBO per package. One is sufficient when you have the items well defined. It may be possible to enhance the value of a BBO by having more items included in it.
- It was an advantage on the first package, but in some cases the bid items were so similar that there may have not been a benefit.

#### 4. Risk

A. How did the Risk process reduce necessary contingency funds? How much?

- The person in charge of tracking risk was Scott.
- The Risk matrix allowed the team to reduce risks. Accepted values on the matrix mean that that cost was put into the project, and the cost was absorbed. A lot of items disappeared because the team was able to put them into the estimate as a certain cost.
- Scour wall had a total possible risk of \$5.4. The Accepted risk was the amount bid in package B. The rest of the risk was then dismissed.
- The Mitigation Savings shown on the matrix corresponds to costs that were saved based on something in the design that reduced the cost of an item.
- The actual amount saved due to innovation is the total possible risk cost, minus the accepted risk cost.
- The final contingency was around \$300K.

B. How was the design changed due to the risk analysis?

- As the team identified risk they either accepted the risk, or adapted the design to eliminate the risk.

C. How did the contractor's view of risk enhance the team's decisions?

- The team could not have addressed risk in this way without the contractor.

- Each team member does do their own risk assessment. The risk matrix that we have been referring to is the one that was developed by the contractor.
- The contractor is the right party to keep the risk matrix because eventually they are the ones who are going to have to price the risk.
- If the contractor is able to mitigate the risk prior to it becomes possible to have projects with 80% GMP items, and hence very little risk.

D. Was funding set aside to address issues that were better handled during construction (planned change orders)?

- Some projects have handled risks by identifying risks, then setting aside money to be used to fund a change order at the time during construction when the risk can be addressed. This project did not do that because they had the luxury of deferring those risks to a later design package.

**(note: discussion of innovations was skipped due to time constraint)**

## 5. Lessons Learned

A. What worked well (what helped the project)?

- The biggest thing is that on a complicated job there are three separate entities that bring experience and skill to the project. This is a unique and effective marriage for solving the challenges on a complex project. In this case all parties were needed to resolves issues.
- Looking back, in the beginning it appeared that separating the project into packages would cost UDOT a lot of money. However, all parties felt confident that they can deliver the prices that were bid on the project with minimal contingency. Other delivery methods would not have created this opportunity.
- One huge benefit was that the contractor was able to start work on some aspects before all design was complete. This allowed the team to foresee problems, and solve them ahead of time. Early procurement also produced substantial benefits. For example, this project required a lot of steel, and prices on steel have recently increased.

B. What did not work well (what hindered the project)?

- ROW was a problem. This was because of the schedule-driven nature of the project. This did not allow sufficient time for ROW, and Utility clearances. You need to have design well enough defined that it can produce legal documents concerning ROW and Utility conflicts. When you are still doing design work and putting packages out you cannot make offers on areas of conflict. This is

especially a problem with signed relocations and purchases. For example, package B had a completion date of April 23rd, and the team proceeded toward that date knowing that ROW could not be cleared by that time. Ultimately this pushed the schedule out, and cost the project money, as well as time.

- ROW ended up pushing the project schedule out.
- The issue with the CMGC process is the change of owner direction and expectations mid-process. This created hysteria.
- The resolution to this is for UDOT to take responsibility for offering better communication between the PM's, and Department management's expectations.
- The contractor performed very well. The one thing they could have done better was the same as what the Department could have done better. It had to do with outside managers influencing the project in a way that complicated things for the project team. The top managers must define goals clearly from the outset so that changes in direction do not happen once the project is underway. All parties must buy into the project goals by the time the design contract is awarded. Top managers on both sides should be involved, give input, and buy-in at the time of the kick-off meeting.
- Designers and contractors must understand each other better. They have some basic standards and procedures that sometimes conflict. This sometimes leads to the designer feeling pressure to lower standards in order to reduce costs. This can lead to tense situations, but that tension can be alleviated by understanding one another. Overall, the designer feels that the process must not result in cut standards.

**Appendix B - Innovation Matrix**

RFI	Date	Issue	Team Innovations / Recommendations	Constructability Issues (Minimize future change orders)	Project Cost Savings	Schedule Savings In Days
1	1/11/2010	Conventional vs. con-span bridge over Convention Dr.	Conventional bridge recommended to minimize utility conflicts. Avoid gas line relocation	Con-span not possible over H.P. gas line	\$0	80-100
2	1/11/2010	Bridge Type Selection	Recommended early release Utah Bulb Tee girder procurement package due to new form type procurement time	Based on availability	\$0	60 Days
3	1/11/2010	Bridge Freeboard	Lower profiles to reduce project cost		\$125,000	0 Days
4	1/11/2010	Bridge ABC methods	Analysis of various ABC methods. Precast bent cap at SPUI			7 Days
4a		SPMT Bridge move	SPMT move not recommended. Adds time and additional cost.	Eliminates use of Dixie Center parking lot & impact	\$2,100,000	14 Days
5	1/13/2010	Asbestos contamination	Design to avoid asbestos. Have contractor on stand-by.			
6	10/28/2009	Use of material generated from CLOMR grading for Dixie Dr. fills	Recommended soil testing. Estimated 75% of excavated material usable in Dixie Dr. fills.	Prepared fill area in package C to use package B excavations	\$225,000	0 Days
7		I-15 super-elevation	Designed to match existing elevations avoiding overall elevation increases to project	Received design wavier	\$1,200,000	0 Days
8	1/13/2010	CBR values of on-site material vs. import	Granular borrow recommended vs. thicker pavement section		\$25,000	0 Days
9	1/13/2010	Mill / Overlay I-15	Protects const. joints long-term & provided a "finished" appearance.	Eliminates longitudinal const. joints in wheel paths per UDOT specifications.	\$0	0 Days
10		Rock excavation	Rock ex bid item. Eliminate unneeded risk to cost model.			
11	1/18/2010	Steel diaphragms on mainline bridges	Time savings		\$0	18 Days
12	2/3/2010	Gas line @ Convention Dr.	Expose, support and monitor recommended over relocate.	Schedule risk minimized	\$40,000	45 Days
13	12/9/2009	Partial depth vs. full depth panels	Partial depth panel recommended for constructability and over-all quality		\$875,000	0 Days
14	2/9/2010	Lateral spread mitigation. What standards?	Cut recommended mitigation by 40% with changing criteria. Removed mitigation on Convention Dr, east and west MSE walls.		\$640,000	60 Days
15		Concrete vs. cable barrier	cable barrier selected to match existing. Cost savings		\$125,000	0 Days
16		Hilton Drive Culvert design flows	After careful analysis reduced needed capacity by 25% (500 CFS)		\$250,000	
17		Detention ponds in the 100 year flood plain	UDOT allowance through design wavier. Saved 1 acre of ROW		\$600,000	0 Days
20	12/9/2009	Integrate trail with Hilton Drive box culvert	Reduce amount of ROW needed	Provided constructability while minimizing ROW acquisition	\$63,000	0 Days
22	12/9/2009	Hilton Drive Culvert - Precast vs. C.I.P	C.I.P. recommended		\$80,000	0 Days
26		Wetlands	Reclassify wetland jurisdiction. Allowing for early construction			75 Days
28		Storm discharge points	By careful analysis and outside the box thinking, minimized unnecessary pipe		\$10,000	
31	12/23/2009	Storm drain pipe stub @ phase lines	Pipe type recommended to allow extension through phase lines	Not constructible to go back to box	\$0	0 Days
32	12/16/2009	Storm drain trunk line location	Additional longitudinal pipe is less expensive than I-15 crossings	Reduced I-15 crossings	\$35,000	0 Days
2a			Concrete selected over steel.		\$788,000	60 Days
33-	12/9/2009	Hilton Drive Culvert (Structure type)	Option A selected based on cost and construction schedule		\$200,000 - \$900,000	0 Days

RFI	Date	Issue	Team Innovations / Recommendations	Constructability Issues (Minimize future change orders)	Project Cost Savings	Schedule Savings In Days
34						
9a		Micro-surface vs. SMA overlay	Micro-surfacing provides finished at significantly reduced cost		\$200,000	0 Days
	2/2/2010	Scour protection along Dixie Drive	Sheet pile wall recommended over a rip rap option. Cost and material availability.	Unable to do within golf course window	\$540,000	70 Days
	12/16/2009	Sewer alignment with Hilton Dr. Box Culvert	Alignment recommended to eliminate jack & bore		\$250,000	30 Days
36	2/24/2010	Sewer proximity to MSE Wall/ flooding risk	Sewer alignment mover to western edge of Hilton Drive channel	Only constructible option		
	In proposal	Mainline MOT	All traffic on N.B. or S.B. with phasing	Meets RFP requirements / Minimizes temp pavement. Increases safety to public and workers	\$180,000	0 Days
	1/26/2010	MOT - Traffic Plans - City Streets	Build new Dixie Drive before re-constructing Hilton & connectors	Utilizes Dixie Dr to minimize traffic impacts to city streets	\$150,000	180 Days
	1/21/2010	Project Phasing (Severable packages)	Re-evaluated phasing packages (A-D)			
	2/3/2010	Scour mitigation under I-15 during bird window	Cascading rip rap launch	Allow construction during critical bird window	\$0	120 Days
	12/9/2009	Pedestrian/drainage culvert settlement under Dixie Dr.	Pour finish floor/approach slabs after settlement	Schedule does not allow for removal of borrow material after settlement	\$20,000	30 Days
	2/3/2010	Golf course sewer line relocate	Recommended sewer line from Tonaquint to east through golf course	Very difficult to construct under existing Dixie Dr. bridge	\$0	0 Days
	In proposal	Use of precast substructure elements	Precast elements recommended	Minimized exposure in river	\$0	21 Days
	2/17/2010	Girder acquisition	Installation coupled with supply of girders in M&P to eliminate sales tax		\$70,000	0 Days
	2/24/2010	Over Excavation	Over ex bid item. Eliminate unneeded risk to cost model.			
	12/16/2009	Fill slopes at NB off ramp	Added slopes to eliminate additional MSE walls		\$150,000	
		Phase 1 golf course construction	Early release package given to city to prevent start-up delays			
38	2/26/2010	Billboard on UDOT property. Lease expires in Dec. 2010. Potential relocation and lease buy-out savings	Construction cannot wait until Dec. 2010 without dramatically affecting our CPM schedule and required completion date.		(Relocation and lease buy-out)	*
41	3/10/2010	Hilton Drive lining protection	Option 4 is the most cost effective. (See RFI)		Adds \$200,000, but option B is most economical by 80K	0
	3/24/2010	Lateral spread mitigation. Specify depths	Specify maximum depths of mitigation, allows GMP, minimizes change orders	Subcontractors will bid substantial risk into unknowns		
	2/15/2010	Cost of Traffic Control	Use permanent barrier as for MOT before permanent installation		\$200,000	0
	3/15/2010	Having MSE panel available when they are needed	Break out contract with MSE supplier between design and supply.		\$0	45
	1/15/2010	Cost savings on storm drain work.	Reduce storm drain pipe and crossing I-15 by using Hilton Drive channel for an outlet with a hooded cover		\$20,000	0
	12/12/2009	MOT phasing	Integrate cut lines with MOT phasing to preserve as much of the I-15 section as possible.		\$1,000,000	0
	6/15/2010	Ramp F slope retainage	Soil nail wall	Only viable alternative	\$0	0
	7/7/2010	Archeologist monitoring excavation	Total clearance achieved before mass excavation	Avoided major work stoppage	\$55,000 as of 8-24	0
	8/4/2010	Surcharge	Use UTB for Surcharge		\$100,000	8
	6/30/2010	Sewer Settlement @ Dixie Drive	Design to avoid pre-loading	Schedule Savings		45

RFI	Date	Issue	Team Innovations / Recommendations	Constructability Issues (Minimize future change orders)	Project Cost Savings	Schedule Savings In Days
	7/1/2010	Temporary ATMS	Designed route for temporary ATMS until permanent can be installed			
	7/1/2010	ATMS HUB Building	Use of Previously owned		\$50,000	
	8/9/2010	Signs and Micro surfacing	Consolidated all signs and Micro surfacing to package D	Minimizes MOB Cost and economy of scale pricing		
	5/3/2010	Insurance	Use of Private insurance vs. using OCIP	Saves 2% of Construction Cost	\$1,000,000	
INNOVATIONS TO CUT BUDGET PRIOR TO PACKAGE D ADVERTISEMENT						
	9/15/2010	Pile instead of drilled shafts	As a cost saving measure pile/stone columns used instead of drilled shafts		\$1,300,000	
	9/15/2010	Change SMA to HMA	SMA not necessary with the micro surfacing	Micro surface with cover striping scars and rumble strips in wrong location	\$400,000	
	9/15/2010	Eliminate sound wall	Sound wall is not necessary until the ultimate build out of I-15		\$100,000	
	9/15/2010	Have city direct contract for restroom & gazebo	City of St George has building inspectors and can administer this contract	Awkward for UDOT and heavy civil construction	\$30-50,000	
	9/15/2010	Blackridge Alignment	Re-align to save ROW costs and construction costs	City approval negotiated	\$300,000	
	9/15/2010	Ford property ROW land swap	Re-alignment allowed savings to ROW acquisitions at Ford Dealership	City and owner approvals negotiated	\$600,000	
	9/15/2010	Indian Hills Connection	Re-alignment allowed savings to ROW acquisitions and construction costs	City approval negotiated	\$540,000	
	9/15/2010	Over-excavation	Reduce unnecessary over-excavation (inspector discretion)	inspector discretion. precedence established in field	\$50,000	
	9/15/2010	Landscape	Delete unnecessary items until project completion within budget was realized	any remaining contingency to be used as project completion	\$1,000,000	
	9/15/2010	Moment Slabs	Eliminate unnecessary slabs	re design to facilitate	\$25,000	
	11/15/2010	ATMS realignment	Place conduit in parapet for fiber eliminating bore	approval from TOC	\$15,000	
	9/29/2010	Stone column penetration	Clear area of large boulders prior to stone column application	Avoid damage to equipment/ avoiding claim	\$25-60,000	
	1/10/2011	Drilled shaft length reduction	shorten shafts as actual conditions are realized	project savings	\$43,000	
	1/10/2100	Shot crete Wall (Bluff Street)	Contractor to design and construct	Contractor assumes risk but schedule does not slip	\$64,500	
					\$15,658,500	

**Appendix C - Risk Matrix**

#	Risk	Total Possible Risk	Schedule Risk In Days	Risk Mitigation Plan	Mitigation Cost Savings	Eliminated	Accepted	Total Possible To Risk Pool	Percent Probability	Cost Model Risk Pool
<b>1</b>	<b>ROADWAY / DRAINAGE / FLOODWAY</b>									<b>\$0</b>
a	Scour protection under mainline I-15 and along Dixie Dr. (North bank)	\$5,400,000	100 Days	Use sheet pile rather than rip rap scour protection (Reduce Schedule Risk by 70 days)	\$540,000	\$1,660,000	\$3,200,000	\$0	100%	\$0
a.1	Scour protection along south bank of Santa Clara	\$3,000,000	60 Days		\$1,350,000	\$1,392,000	\$258,000	\$0	100%	\$0
b	Braided Ramps	\$3,000,000	90 Days		\$0	\$3,000,000		\$0	0%	\$0
c	Asbestos (Indian Hills and connectors)	\$50,000	20 Days	Avoid asbestos with design. Have certified contractor on stand-by	\$0			\$50,000	0%	\$0
d	MOT to accommodate SPUI Bridge Move	\$50,000		Alternate MOT puts workers closer to live traffic. Base MOT is the safest	\$0	\$50,000		\$0	0%	\$0
e	Type of MSE walls (single vs. 2 stage)	\$0		Use single stage walls based on Geotech recommendations	\$0	\$0	\$0	\$0	0%	\$0
f	Proximity of Dixie Dr. to businesses	\$150,000	10 Days	Possible sound walls or added landscaping	\$0			\$150,000	5%	\$7,500
g	Archeological sites	\$75,000	60 Days	Continue coordination efforts with State agencies	\$0			\$75,000	5%	\$3,750
h	Mill and overlay I-15	\$300,000		Micro-surface I-15 instead of a full SMA overlay	\$200,000	\$0	\$100,000	\$0	0%	\$0
i	Excavated materials unsuitable for fills	\$300,000		Remove unsuitable materials and purchase new.	\$0	\$240,000	\$60,000	\$0	0%	\$0
j	Dumpsite / Haul distances	\$10,000		Determine suitable dumpsite.		\$10,000		\$0	0%	\$0
k	Misc. asphalt repairs	\$10,000		Plan work to eliminate unnecessary repairs				\$10,000	50%	\$5,000
l	Hilton Dr. Flood Channel: Box type	\$0	Included	Option A selected	\$0	\$0	\$0	\$0	0%	\$0
m	Rock cut on mainline I-15	\$50,000		Increased quantity of rock ex 3-4000 CY				\$50,000	75%	\$37,500
i	Obliterate road - M&P Item							\$0		\$0
n	HMA tie ins at Convention center/Ford unaddressed in estimate	\$5,000		tie ins need to take place quantities missed				\$5,000	75%	\$3,750
o	Quantity changes to existing model	\$400,000		Landscape items, Electrical items, overhead as schedule slips				\$400,000	75%	\$300,000
<b>2</b>	<b>STRUCTURES / GEOTECHNICAL</b>							\$0		<b>\$0</b>
a	Liquefaction/lateral spread near bridges and under walls	\$2,000,000	60 Days	Geotech / Designer recommendations	\$800,000	\$720,000	\$480,000	\$0	90%	\$0
b	ABC impacts to cost and schedule - Mainline	\$200,000		Mainline I-15 bridges will use precast bent caps to reduce cure time and cut schedule. Partial depth precast deck panels will be used when possible.	\$200,000	\$0	\$0	\$0	0%	\$0

#	Risk	Total Possible Risk	Schedule Risk In Days	Risk Mitigation Plan	Mitigation Cost Savings	Eliminated	Accepted	Total Possible To Risk Pool	Percent Probability	Cost Model Risk Pool
c	Overhead Sign Structures - Size, location	\$1,000,000		Sign for current conditions with use of roadside signs as needed. Final solution is leaning toward additional sign structures. Final determination of I-15 signing needed by 2/10/10 in order to not cause schedule delays.	\$0	\$0	\$0	\$1,000,000	0%	\$0
d	Concrete Form Lead Time and Acquisition of Girders	\$0	60 Days	Early girder package. UDOT requirement sent out to state in memo, 12/10	\$0	\$0	\$0	\$0	0%	\$0
e	Pedestrian Culvert Settlement and Construction Phasing	\$250,000		Recommended using surcharge to remove settlement and/or deep foundations. Box barrel will be constructed at elevation to allow for anticipated settlement. Aprons will be constructed after settlement.	\$250,000	\$0	\$0	\$250,000	3%	\$6,250
	MSE wall / backfill requirements	\$50,000		Free draining requirements in spec do not meet electro-chemical requirements requested by UDOT directed to change material				\$50,000	75%	\$37,500
f	SPI Move	\$3,500,000		Analysis of ABC Methods Memo Dated 01/05/10 Use Dixie Center Parking For Staging Area		\$3,500,000	\$0	\$0	0%	\$0
g	Sign Structure Foundation Conflict with Drainage Culvert	\$40,000		Add barrier transition or change sign structure to cantilever. Adjust sign position to limit impact.	\$20,000	\$0	\$0	\$20,000	50%	\$10,000
h	TC/MOT user costs associated with final phasing	\$0		See RFI 4				\$0		\$0
j	Definition of Rock Excavation -M&P Item							\$0		\$0
k	Need to add Temporary Wall item in M&P							\$0		\$0
l	Existing H-Pile conflict with Drilled Shafts	\$25,000		issue realized absorbed by contractor				\$25,000	0%	\$0
m	Hayward Baker claim changing conditions	\$40,000		Issue has been escalated for consideration originally denied				\$40,000	50%	\$20,000
n	MSE wall added square footage	\$125,000	60 Days	UDOT has directed to proceed with new calculations/				\$125,000	75%	\$93,750
<b>3</b>	<b>UTILITIES</b>							\$0		<b>\$0</b>
a	Power lines & poles over I-15 & along Convention Dr.		60 Days	Re-align power over I-15. New poles required				\$0		\$0
b	H.P. gas & sewer along Convention Dr.	\$50,000		Expose and support during settlement. Move west abutment 30'. Continue coordination efforts with utility companies	\$40,000			\$10,000	100%	\$10,000
c	Tonaquint bridge utilities	\$10,000		Continue working with utility companies. May need to protect in place				\$10,000	0%	\$0
d	Consequential utility damages	\$50,000						\$50,000	25%	\$12,500
d	Utility subcontractors		30 Days	Coordinate and work closely with subs to eliminate risk and schedule delays				\$0		\$0

#	Risk	Total Possible Risk	Schedule Risk In Days	Risk Mitigation Plan	Mitigation Cost Savings	Eliminated	Accepted	Total Possible To Risk Pool	Percent Probability	Cost Model Risk Pool
e	ATMS on east side of I-15	\$0	0 Days	Bore under Santa Clara. Coordinate with utility company to eliminate schedule risks.				\$0		\$0
f	Asbestos covered utilities	\$50,000	30 Days	Have contractor on stand-by. Have mitigation plan in place				\$50,000	25%	\$12,500
g	Utilities in CLOMR grading area	\$0	0 Days	Mitigated through design				\$0	0%	\$0
h	Misc. utility conflicts	\$25,000	10 Days	Make the unknowns, known. Identify all utilities				\$25,000	10%	\$2,500
j								\$0		\$0
i								\$0		\$0
j								\$0		\$0
<b>4</b>	<b>MISC. ITEMS</b>							\$0		<b>\$0</b>
a	Misc. legal fees & lawsuits	\$250,000	0 Days					\$250,000	3%	\$7,500
b	Insurance deductibles	\$40,000	0 Days					\$40,000	25%	\$10,000
c	Property damage & protection	\$20,000	0 Days					\$20,000	25%	\$5,000
d	Permits. 404, DWQ,	\$100,000	30 Days			\$100,000		\$0	100%	\$0
e	Weather/Flooding	\$250,000	10 Days					\$250,000	50%	\$125,000
g	South West Willow Fly Catcher		90 Days	Mitigated through scheduling				\$0		\$0
i	ROW Acquisition Delays (Package B)	\$400,000	120 Days	ROW delays incurred thus far absorbed in schedule				\$400,000	5%	\$20,000
	Incidentals	\$50,000		fencing, landscaping, minor repairs				\$50,000	50%	\$25,000
		\$21,325,000			\$3,400,000	\$10,672,000	\$4,098,000	\$3,405,000		\$755,000.00

\* does not reflect additional and unknown PE, CE and ROW costs

**Appendix D - Blind Bid Opening Comparison**

**Blind Bid Opening Phase II - Conducted on March 22, 2010**

DESCRIPTION	UNIT	BBO			Over 10% of ICE	Final Bid			> 25% Quantity Increase?	Did Price Go Down
		Quantity	Unit Price	Price		Quantity	Unit Price	Price		
Mobilization	lump	1	\$ 2,790,000.00	\$ 2,790,000.00	Yes	1	\$ 2,294,000.00	\$ 2,294,000.00		Yes
Public Information Services	lump	1	\$ 115,000.00	\$ 115,000.00	Yes	1	\$ 152,390.00	\$ 152,390.00		No
Traffic Control	lump	1	\$ 1,240,000.00	\$ 1,240,000.00	Yes	1	\$ 633,570.00	\$ 633,570.00		Yes
Maintenance of Traffic - Crossovers	lump	1	\$ 575,000.00	\$ 575,000.00	No	1	\$ 843,380.00	\$ 843,380.00		No
Environmental Control Supervisor	lump	1	\$ 34,000.00	\$ 34,000.00	Yes	1	\$ 29,170.00	\$ 29,170.00		Yes
Granular Borrow (Est. Lump Qty. 19,184 Cu Yd)	cu yd	19184	\$ 25.00	\$ 479,600.00	Yes	18033	\$ 20.86	\$ 376,160.00		Yes
Obliterate Road (Est. Lump Qty. 3,356 Sq Yd)	sq yd	3356	\$ 2.50	\$ 8,390.00	Yes	3356	\$ 5.06	\$ 16,970.00		Yes
Roadway Excavation (Est. Lump Qty. 63,563 Cu Yd)	cu yd	63563	\$ 9.00	\$ 572,067.00	Yes	62891	\$ 9.25	\$ 582,010.00		Yes
Rock Excavation	cu yd	5044	\$ 12.30	\$ 62,041.20	Yes	5000	\$ 12.10	\$ 60,500.00		Yes
12 inch Approach Slab Drain, Class C, corrugated	ft	37	\$ 85.50	\$ 3,163.50	Yes	36	\$ 33.40	\$ 1,202.40		Yes
18 inch Concrete Pipe, Irrigation/Storm Drain, Class C	ft	811	\$ 35.00	\$ 28,385.00	Yes	429	\$ 28.10	\$ 12,054.90		Yes
24 inch Concrete Pipe, Irrigation/Storm Drain, Class C	ft	6791	\$ 38.00	\$ 258,058.00	Yes	5762	\$ 29.90	\$ 172,283.80		Yes
36 inch Concrete Pipe, Irrigation/Storm Drain, Class C	ft	523	\$ 51.00	\$ 26,673.00	Yes	522	\$ 53.10	\$ 27,718.20		Yes
Culvert End Section 18 inch	each	3	\$ 400.00	\$ 1,200.00	Yes	1	\$ 383.00	\$ 383.00		Yes
Culvert End Section 24 inch	each	2	\$ 700.00	\$ 1,400.00	Yes	4	\$ 452.00	\$ 1,808.00	Yes	Yes
4' Manhole	each	4	\$ 2,525.00	\$ 10,100.00	Yes	3	\$ 2,162.00	\$ 6,486.00		Yes
5' Manhole	each	2	\$ 2,605.00	\$ 5,210.00	Yes	4	\$ 2,467.00	\$ 9,868.00	Yes	Yes
6' Manhole	each	1	\$ 4,000.00	\$ 4,000.00	Yes	1	\$ 4,578.00	\$ 4,578.00		No
Catch Basin-CB9	each	46	\$ 2,965.00	\$ 136,390.00	No	41	\$ 2,655.00	\$ 108,855.00		Yes
Untreated Base Course (Est. Lump Qty. 12,374 Cu Yd)	cu yd	12374	\$ 30.00	\$ 371,220.00	Yes	12803	\$ 31.29	\$ 400,640.00		Yes
SMA (Stone Matrix Asphalt) - 1/2 Inch (Plan Quantity)	ton	3,327	\$ 120.00	\$ 399,240.00	Yes	3084	\$ 107.00	\$ 329,988.00		Yes
HMA - 3/4 Inch (Plan Quantity)	ton	22,160	\$ 82.50	\$ 1,828,200.00	Yes	20861	\$ 70.10	\$ 1,462,356.10		Yes
Precast Concrete Full Barrier (New Jersey Shape)	ft	9,513	\$ 64.50	\$ 613,588.50	Yes	9478	\$ 48.60	\$ 460,630.80		Yes
Temporary Retaining Walls	lump	1	\$ 164,500.00	\$ 164,500.00	Yes	1	\$ 124,450.00	\$ 124,450.00		Yes

Structural Concrete (Est. Lump Qty: 2260 cu yd)	cu yd	2,260	\$ 625.66	\$ 1,414,000.00	No	2265	\$ 516.77	\$ 1,170,480.00	Yes
Remove Bridge (Tonaquint Drive) (Est. Lump Qty. 1 Each)	each	1	\$ 42,000.00	\$ 42,000.00	Yes	1	\$ 26,790.00	\$ 26,790.00	Yes
Golf Course Excavation (Est. Lump Qty. 63,415 Cu Yd)	cu yd	1	\$ 348,783.00	\$ 348,783.00	No	1	\$ 213,530.00	\$ 213,530.00	Yes
12" Hdpe Sewer Pipe	ft	772	\$ 127.30	\$ 98,275.60	Yes	400	\$ 86.30	\$ 34,520.00	Yes
5' Sewer Manhole	each	8	\$ 3,940.00	\$ 31,520.00	Yes	8	\$ 4,025.00	\$ 32,200.00	Yes
Strip and Stockpile Topsoil (Plan Quantity)	sq yd	76,667	\$ 0.60	\$ 46,000.20	Yes	29737	\$ 1.55	\$ 46,092.35	Yes
<b>Total</b>				\$ 11,708,005.00				\$ 9,635,064.55	

Total number of BBO Items: 35  
 Comparable Bid Items from Bid: 30  
 Number of items that were Above Limit and Unit Price did not Reduce: 2  
 Sum of BBO unit prices at Bid Quantities \$ 11,410,392.02  
 Estimated Savings due to BBO Discussions: \$ 1,775,327.47