

# CMGC Process Report – Construction Phase

## Riverdale Road

Project No.  
SP-0026(4)0-A  
SP-0026(4)0-B  
SP-0026(4)0  
S-0026(10)2

PIN No. 6867, 6868, 2495, and 7447

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## Project Overview

UDOT's Request for Proposals described the Riverdale Road Project as follows:

Utah State Road 26 is a principal urban arterial which begins at SR 126 (1900 West) in Roy and continues northeast through the cities of Roy, Riverdale, South Ogden and Ogden to US-89 (Washington Blvd.) in Ogden. The purpose of this project is to improve mobility, enhance safety, correct roadway deficiencies, and replace the I-15 and I-84 bridges. The project limits extend from 1900 West to Washington Boulevard, approximately 3.7 miles. The existing conditions of the pavement section in conjunction with the need for an additional travel lane in each direction has warranted the reconstruction of Riverdale Road. In addition the I-15 and I-84 bridges are also at the end of their respective service life and will need to be replaced to accommodate the proposed travel lane sections. The project also requires geometric upgrades such as dual turn movements at selected intersections with replacement of all traffic signals along the corridor. Retaining walls are proposed at selected locations primarily at the I-15 and I-84 bridge locations and restriping of the entire project.

The project was complete in four phases, which correspond to the four project numbers seen on the cover of this report. Phase I, SP-0026(4)0-A, covered early procurement of long-lead materials. Phase II, SP-0026(4)0-B, covered utility coordination, clearing and grubbing, construction of retaining walls, and setting of the piles. Phase III, SP-0026(4)0, covered roadway construction from I-15 to 550 West. Phase IV, S-0026(4)0, covered the remaining roadway, from 550 West to Chimes Avenue.

## Construction Costs

Because this project took place in an urban setting, the selection team anticipated that the project costs would be higher than State average values. This was seen in the high ratio of select bid item prices to State averages. Although these prices were high compared to State averages, they were close to the Independent Cost Estimate (ICE). For further discussion of the bid prices see the *CMGC Process Report – Design Riverdale Road*.

The total contracted amount for the work done on Riverdale Road was \$60,001,136.70. However, during design some issues were identified that would impact the bid price. Because the full impacts of these issues would not be identified until construction started, these issues were knowingly removed from the bid list and the team agreed to address them as change orders during construction. These “Planned Change Orders” accounted for an additional \$12,480,306.45 in project costs. For a complete analysis of the construction costs, and change orders, see the section of this report titled "Analysis of Performance Measures."

Table 1 Total Construction Costs - Riverdale Road SP-0026(4)0-A; SP-0026(4)0-B; SP-0026(4)0; S-0026(10)2

<b>Riverdale Road</b>					
	<b>SP-0026(4)0-A</b>	<b>SP-0026(4)0-B</b>	<b>SP-0026(4)0</b>	<b>S-0026(10)2</b>	<b>Total</b>
Original Contract	\$2,549,341.30	\$10,778,168.40	\$26,273,979.00	\$20,399,648.00	\$60,001,136.70
Planned Change Orders	\$0.00	\$3,563,500.81	\$5,293,445.70	\$3,632,102.96	\$12,489,049.47
Unplanned Change Orders	\$0.00	\$38,921.12	\$450,876.72	\$714,093.23	\$1,203,891.07
Overruns/Under runs	\$66,175.89	-\$3,923,469.39	-\$3,467,261.20	\$2,750,264.85	-\$4,574,289.85
Incentives/Disincentives	\$0.00	\$35,081.48	\$188,509.64	\$551,669.48	\$775,260.60
Bituminous/Fuel Adjustments	\$31,991.31	\$35,355.95	\$25,330.63	\$0.00	\$92,677.89
<b>Total</b>	<b>\$2,647,508.50</b>	<b>\$10,527,558.37</b>	<b>\$28,764,880.49</b>	<b>\$28,047,778.52</b>	<b>\$69,987,725.88</b>

## Project Goals

UDOT determined that success of this project required a balance of the following outcomes:

- Completion of project phases I, II, and III on or before October 31, 2009 thereby minimizing the impact on commercial entities prior to the holiday shopping season;
- A high level of public satisfaction amongst business and property owners, motorists, and other stakeholders; and
- Completion of the project within the project budget.

Key project elements affecting the balance of these goals included the high potential for utility conflicts, the need to provide access to businesses, and the limited margin of error in the construction schedule.

The team selected Granite as the Contractor in spite of the fact that they had submitted the highest pricing proposal (See appendix D and E of the Proposal). Although they had the highest price, they were selected because they showed the most potential to maintain high public satisfaction, and complete the project by the specified deadline. It is not common to choose schedule over cost, but in this case the project's impact to the local economy was closely linked to the construction schedule.

The project had an impact on many retail stores, and, without accelerating, the scheduled construction threatened to lag into the holiday shopping season. Reducing user costs by completing construction in time for the holiday shopping season was expected to offset the increased bid cost. The team used a strategic construction phasing plan that minimized delays, and placed a priority on critical construction activities that would have an impact on area retailers. As a result, all of the first three phases received final acceptance on or before September 17, 2009: well ahead of the October deadline. See the Performance Measures section of this report for a complete discussion of how well this project addressed the aforementioned goals.

## Applicability of the CMGC Process

The Design Phase report for the Riverdale Road project identified the following characteristics that qualified it for the use of the CMGC delivery method. These characteristics included:

- A. Design and Constructability Issues
- B. Opportunities for Innovation
- C. A High Concentration of Utility and ROW Risks

#### D. Schedule Constraints

This Construction Phase report will now examine how well the CMGC process helped to address these characteristics throughout construction.

### **Design and Constructability**

The Contractor's involvement during design improved the constructability of the project by reducing the complexity of key project elements, such as drainage, and structures. The Contractor proposed simplifying the drainage system by running a single trunk line down the center of the road. As construction proceeded, this modification enabled the Contractor to tie in many existing drainage systems, rather than installing something entirely new. To simplify the structures the Contractor recommended using post-tensioning rather than rebar splices. This led to a more constructible product by easing the tolerances for rebar placement. The Contractor reported that the modifications to the drainage system saved the project \$600,000.00, and that the modification to the structure design saved the project \$41,000.00. For a complete description of the savings that the Contractor's design input brought to the project, see the section titled "Innovations."

### **Project Schedule**

As Stated in the Project Overview, schedule was the critical factor on this project. The section titled "Performance Measures" will compare the dates of key project milestones to their scheduled deadlines. This section will focus on the strategy that the team employed to meet an efficient construction schedule that was sensitive to the goals of the project.

In order to meet the goal of providing open access to traffic during the peak of the shopping season, construction was phased. The first three phases were required to be completed by October 31, 2009. The early project phases were directed toward getting sensitive utility work underway early, so as not to delay final project delivery. All of the first three phases were completed ahead of schedule: Phase I achieved substantial completion on May 12, 2009; Phase II, and Phase III achieved substantial completion on May 15, 2009. This accelerated schedule was kept due to the fact that, during construction, the Contractor was able to swiftly move from the completion of one phase, to the start of another phase.

Once the key elements of the project were completed by the required date, the project team looked at expanding the scope of work to include widening of Riverdale Road from Chimes View Boulevard to Washington Street in Ogden Utah. Traditionally this would have been accomplished by adding another phase of work to the contract. However, the project team felt that the project would be better served by adding the work via UDOT's standard change order process instead of going through process of

another bid opening. Change order #9 was created for an estimated \$5,451,501.74 for the additional scope of work. An additional 97 working days was also added to the project schedule for the additional work (See change order #15).

Some specific measures that the team took to optimize the construction schedule included integrating local utility work into Granite's Traffic Control Plan (TCP), releasing an early construction package for the procurement of long-lead items, and eliminating the bid letting process. All of these measures were possible because this project was delivered using the CMGC process.

Because the early phases were all completed ahead of schedule, it is safe to say that the early procurement strategy was effective.

### Innovations

During design the team proposed many innovations. The Contractor tracked, and provided cost estimates for implementation of the innovations during construction as shown in Table 2 below. The greatest cost-saving innovation on this project was the thinning of the pavement section. The estimated savings were \$1,600,000.00 because the thinner section allowed the Contractor to avoid large quantities of roadway excavation, and granular borrow. The thinner pavement section also allowed the project to avoid numerous utility relocations. Utility relocations commonly cause a great expense to projects, and they are very time-consuming to coordinate. Because the exact savings for avoiding relocations are not know, this project is only reporting a savings of \$1,600,000.00 for the thinner pavement section, although the actual savings are higher.

Quantities are available for the utility cost savings that one innovation produced. The Contractor estimated that the project saved \$270,000.00 by having local utilities work within the Contractor's traffic control scheme. The savings comes from avoiding redundant efforts. The project needed to integrate work by three local utility companies. Each of these companies was expected to have approximately three months, or ninety days, of work on the project. The estimated cost for allowing the utility companies to provide their own traffic control was \$1,000.00 per day. The total estimated savings can be explained by the following equation:

$$90 \text{ (days)} \times 3 \text{ (utilities)} \times \$1,000.00 \text{ (dollars per day)} = \$270,000.00 \text{ (savings)}$$

**Table 2 Innovations Approved by Team During Design**

Innovation	Implemented?	Estimate Savings	Comments
Thin Pavement Section	Y	1,600,000.00	Thinning the pavement section reduced quantities of roadway excavation, and granular borrow.
Traffic Control for Utilities	Y	\$270,000.00	Having local utilities work within Granite’s Traffic Control Plan (TCP) avoided redundant costs.
Utility Location and Avoidance	Y	\$20,000.00	Relocating utilities on plans to avoid conflicts
South/North Slope Repair	Y	\$100,000.00	Drainage repairs to the South/North cut slope were eliminated from original contract scope.
Post Tensioning	Y	\$41,000.00	Design of the structural concrete, and the post-tensioning for that item, were modified.
Drainage	Y	\$600,000.00	This savings was produced by taking advantage of many existing drainage systems.
Retaining Wall Design Modification	Y	\$39,398.00	Cast in place concrete wall segment replaced with gravity concrete block walls.
<b>Total</b>		<b>\$2,670,398.00</b>	

Similar to traffic control, the project placed central control of the waterline/utility loops in the hands of the Contractor. The Contractor was allowed to conduct surveys on all utilities. Based on the

information they gathered, the Contractor was able to place all utilities in a manner that avoided looping them. This produced an estimated savings between \$20,000.00, and \$50,000.00.

The project originally called for costly drainage repairs to the North and South cut wall slopes. During design the team was able to remove the South wall from the project scope. The Contractor estimated that deleting the work would produce a savings of approximately \$100,000.00. The results of construction showed that the cost to repair the North slope was \$107,000.00, which indicates that the Contractor's estimate of the savings was accurate, or perhaps even slightly low.

Finally, during design the contractor was concerned about the impacts to the access of one of the local businesses and began gathering information for a gravity retaining wall section to replace the cast in place walls shown on the plans. Once all information was available the conflicting retaining wall was replaced via change order and resulted in a net reimbursement of over \$39,000 (see final phase Change Order #3).

The total savings for the innovations discussed in this section, as well as the two innovations mentioned in the "Design and Constructability" section of this report, amount to roughly \$2,670,398.00. This savings represents approximately 4% of the total project cost, which indicates that innovations added significant value to this project.

## Risk

The most significant way that CMGC enabled this project to control risk was by putting the team in a position to develop a proactive strategy to address the unknown quantity of unsuitable sub-grade. During design the Contractor recognized that the plans grossly underestimated the amount of soft spot, trench, and geogrid repairs. The plans showed unsuitable sub-grade on only 10% of the project area, whereas the Contractor knew they were likely to encounter unsuitable sub-grades under approximately 75% of the project area.

The Contractor took the initiative to point out that the plans did not accurately quantify the amount of unsuitable material that would be encountered during excavation. To deal with the uncertainty the team released the plans using the original bid quantities and prices as place holders, agreeing that the actual bid price would be validated via the change order process once a total quantity was determined. Rather than having the Contractor or UDOT carry the burden of risk associated with the bid item, the team acted together to ensure that the project's needs were met and all members were treated fairly.

The results of construction show that this strategy did reduce the cost of this particular risk. On Phase III, the original unit prices for soft spot repair, and trench repair were \$94/Cu. Yd., and \$118/Cu. Yd.,

respectively. The final unit prices that were used were \$65/Cu. Yd. for soft spot repair, and \$85/Cu. Yd. for trench repair. This reduction in unit price was due to large quantity overruns. Current State standards enable the State and the Contractor to negotiate a more reasonable unit price for major bid items (See Standard Specifications 00725.1.9). Despite the fact that soft spot repair was not a major bid item, and did not truly qualify for re-negotiation, Granite reduced the unit costs because it was part of the risk mitigation plan discussed during design. By reducing the unit prices the team saved over \$600,000 on Phase III construction alone. If the team had not agreed to the procedure to control risks on the sub grades the savings would have instead been an added cost born solely by the Department.

**Table 3 Savings Due to Agreed Unit Cost Decrease for Unsuitable Material in Phase III**

<b>SP-0026(4)0 <sup>1</sup></b>		
	<b>Trench Material</b>	<b>Subgrade Material</b>
Original Quantity (cu yd):	25	50
Contract Unit Price:	\$94.00	\$118.00
Actual Quantity (cu yd):	2583	16287
Contracted Payment:	\$242,802.00	\$1,921,866.00
Adjusted Unit Price:	\$65.00	\$85.00
Actual Payment:	\$167,895.00	\$1,384,395.00
Savings:	\$74,907.00	\$537,471.00
<b>Material Savings:</b>	<b>\$612,378.00</b>	
Notes:		
1 - Change Order 2 - Bid items 65 and 66		

During the final phase of construction the quantities were better defined based on what was seen in the previous phase. Therefore no price adjustments were necessary. The unit price was set at \$72 per cubic yard during the bid opening process of phase four.

Another risk that the state was able to mitigate included the cost of bonding for subcontractors. This cost was removed from the overall burden of the general contractor at bidding and actual numbers were utilized for reimbursement (see final phase Change Order #8).

### **Benefit to the Public**

As Stated in the Project Overview, the effect that construction activities had on the travelling public was a preeminent concern on the Riverdale Road project. Area businesses benefitted greatly thanks to Contractor's efforts to maintain some level of customer access throughout the duration of the project. The Contractor also honored the commitment to complete the second and third phases of the project in time for the busy holiday shopping season. Reducing the project's impact required extensive planning, and the capacity to make modifications instantaneously in order to provide better service. On this project CMGC provided that capacity, which led team members to the conclusion that CMGC is the ideal contracting method to preserve UDOT's public image on an urban reconstruction project.

### **Budget Analysis**

The previous section explained how the project reduced overall costs by implementing innovations, and controlling risk. In, addition, the project met its overall goal of maintaining a high level of favor with the public--especially local businesses. The purpose of the "Budget Analysis" section is to verify that the benefits described in earlier sections were not achieved by inflating costs in other areas. This following section evaluates the overall project cost in comparison to certain metrics that the State has established.

### **Contractor's Influence to Cost Control**

During the CMGC Design Process, the Contractor's role is to provide design review, constructability recommendations, innovation suggestions, and verification of the cost of risk. Table 2 suggests that through these measures the Contractor helped save the project \$2,611,000.00 through innovations. The Risk section of this report showed that the Contractor help the project avoid \$612,000.00 in additional costs due to excavation. This shows that the Contractor's direct input led to at least \$3,223,000.00 in overall savings.

### **Were Contractor's Prices Fair and Reasonable**

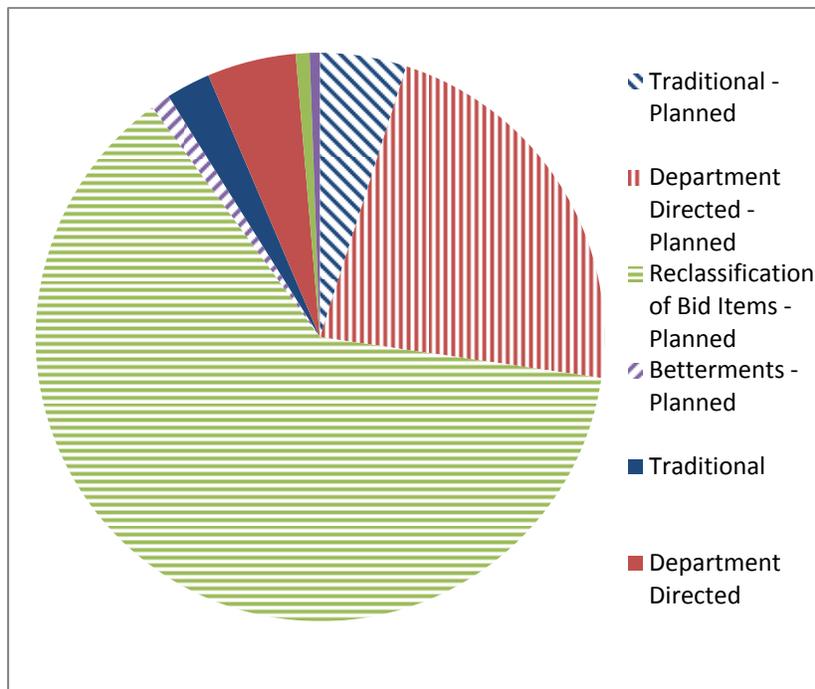
The bid prices were compared with an Independent Cost Estimate (ICE) in accordance with accepted policy at UDOT. The difference between the original bid and the ICE was -1.5% for all 4 phases of work, indicating that the prices were reasonable for the work performed. For further discussion of project pricing performance see the companion report *CMGC Design Phase State Report for Riverdale Road*.

## Change Orders

The Riverdale Road project included two types of change orders: planned, and unplanned. Unplanned change orders refer to change orders that are required due to unforeseen site conditions or errors during design. Planned change orders refer to change orders concerning issues that were recognized in design, but were not assigned specific production rates and quantities until construction. This allowed the team to wait until more information was available before proceeding or adding scope to the project due to additional budget. These change orders were planned because their funding was set aside for construction, and not included in the original bid amount. By addressing certain issues through planned change orders the team was able to manage the project more efficiently.

From investigating the previous 5 years of UDOT’s closed projects, the average cost of change orders for Design Bid Build methods is 12.7% of the total construction cost. Since planned change orders are part of the CMGC project delivery process, they are not considered in this analysis. Referring to Table 1 in this report, we see that unplanned change orders totaled \$1,212,634.07, and the total construction cost was \$69,987,725.86, which equates to roughly 1.73%.

Table 4 on the following pages shows all of the change orders for this project, and indicates whether each change order was planned, or unplanned. This information is also shown in Figure 1. Large numbers of change orders were applied by the Department to facilitate the management of the design.



The final phase of work (S-0026(10)2) had the largest number of change orders of all the other contracts. The team felt this was due primarily to the change of project goals. At the onset of the project the team’s stated focus was more on quality and public benefits. However, during the final phase the team was directed to focus more on cost and schedule.

Figure 1 Type of Change Orders for Riverdale Road

Table 4 Change Orders for Riverdale Road

PROJECT	Change Order Number	Description	Amount Anticipated <sup>3</sup>	Amount Paid <sup>4</sup>				Planned <sup>1</sup>	Unplanned <sup>2</sup>	Responsible Party
				Traditional Change of Work on Site	Department Directed Change (scope creep)	Reclassification of Bid Items	Betterment for the Local Interest (cost sharing may be applicable)			
SP-0026(4)0-A	1	MEASUREMENT AND PAYMENT LANGUAGE CHANGES	\$0.00			\$0.00		X	PROJECT ENGINEER	
SP-0026(4)0-B	1	REMOVE MOBILIZATION FROM AUTO CALC	\$0.00			\$1,309,274.20		X	PROJECT ENGINEER	
SP-0026(4)0-B	2	GROUND WATER MITIGATION, NORTH CUT SLOPE REPAIR	\$107,529.00	\$107,529.00				X	DESIGN (UDOT/CONSULTANT)	
SP-0026(4)0-B	3	QUEST MANHOLE MATERIALS	\$1,956.61	\$1,956.61				X	UTILITIES	
SP-0026(4)0-B	4	REPLACEMENT OF REMOVED IRRIGATION SYSTEM	\$6,000.62	\$6,000.62				X	PROJECT ENGINEER	
SP-0026(4)0-B	5	REPLACEMENT OF SS MH AND CHANGE IN M&P LANGUAGE	\$23,130.01	\$23,130.01				X	CONTRACTOR	
SP-0026(4)0-B	6	POTHOLE PATCHING	\$7,833.88		\$7,833.88			X	PROJECT ENGINEER	
SP-0026(4)0-B	7	SCOPE CHANGES TO BE PAID BY INVOICE	-\$570,905.39			\$2,146,697.61		X	PROJECT MANAGER	
SP-0026(4)0-B	8	TIME EXTENSION OF B CONTRACT TO MATCH MAIN CONTRACT	-\$7,749.06			\$0.00		X	CONSULTANT	
SP-0026(4)0	1	SCOPE CHANGES	\$0.00			\$108,531.22		X	PROJECT MANAGER	
SP-0026(4)0	2	REMOVE AND REPLACE UNSUITABLE MATERIAL MOD	\$155,408.82			\$1,571,626.68		X	TRAFFIC	
SP-0026(4)0	3	REMOVE MOBILIZATION FROM AUTO CALC	\$0.00			\$3,565,766.66		X	PROJECT ENGINEER	
SP-0026(4)0	4	RAMP B AND RAMP D TEMPORARY CONSTRUCTION	\$156,052.36	\$156,052.36				X	PROJECT MANAGER	
SP-0026(4)0	5	EXTRA WORK	\$92,869.31	\$83,597.54				X	CONTRACTOR	
SP-0026(4)0	6	MILL AND OVERLAY	\$194,468.00		\$194,468.00			X	PROJECT MANAGER	
SP-0026(4)0	7	STAMPED CONCRETE AT CHILIS RESTAURANT / HMA SPEC MODIFICATION	\$64,279.96	\$64,279.96				X	CONTRACTOR	
S-0026(10)2	1	CHANGES TO MEASUREMENT AND PAYMENT, DWGS & SPECIAL PROVISIONS	\$0.00	\$0.00				X	CONTRACTOR	
S-0026(10)2	2	ADD POLYMER OVERLAY TYPE 1 TO BR. C-966 OVER I-84 32,810 SF	\$255,093.20		\$257,487.44			X	PROJECT MANAGER	
S-0026(10)2	3	CONDUIT AT RIVERDAL, QUICK CRETE, SIGN RELOC & GRAVITY WALL	-\$5,842.00	\$358,721.01				X	CONTRACTOR	
S-0026(10)2	4	HAZMAT WORK & COMMERCIAL SIGN MODS	\$44,900.00	\$44,900.00				X	CONTRACTOR	
S-0026(10)2	5	ELECTRICAL WORK FOR ROCKY MTN POWER AND MISC POWER RELOCATION	\$26,138.00			\$26,138.00		X	CONTRACTOR	
S-0026(10)2	6	BURCH CREEK REPAIR AND BIG 5 SIGN RELOCATION	\$29,037.00	\$29,037.00				X	CONTRACTOR	
S-0026(10)2	7	ADD AUXILIARY LANE BETWEEN I-84 AND 1500 W ON SB RIVERDALE RD	\$88,272.00		\$88,272.00			X	PROJECT MANAGER	
S-0026(10)2	8	SUBCONTRACTOR BOND COSTS	\$51,988.77	\$51,988.77				X	PROJECT MANAGER	
S-0026(10)2	9	PHASE 3 CONSTRUCTION FROM CHIMES VIEW DR TO WASHINGTON	\$5,451,501.74		\$2,803,956.50			X	PROJECT MANAGER	
S-0026(10)2	10	SO OGDEN CITY SEWER & WATERLINE (NON PARTICIPATING)	\$56,839.74			\$56,839.74		X	UTILITIES	
S-0026(10)2	11	CANCELLED		\$0.00						
S-0026(10)2	12	RIVERDALE CITY SEWER AND WATERLINE (NON-PARTICIPATING)	\$0.00			\$94,366.50		X	UTILITIES	
S-0026(10)2	13	BARRIER REPLACEMENT	\$52,504.00		\$52,504.00			X	PROJECT MANAGER	
S-0026(10)2	14	SPECIFICATION CHANGE-HMA STABILIZATION COURSE	\$0.00	\$0.00				X	CONTRACTOR	
S-0026(10)2	15	TIME ADJUSTMENT FOR CHANGE ORDER NO. 9 (NO COST)	\$0.00	\$0.00				X	PROJECT MANAGER	
S-0026(10)2	16	CANCELLED	\$0.00	\$0.00						
S-0026(10)2	17	RIVERDALE VIADUCT APP SLAB REPAIR (FIBERCRETE)	\$44,378.00		\$43,420.10			X	MAINTENANCE	
S-0026(10)2	18	BUILDING DEMOLITION ON PARCEL #103 "U&I FURNITURE"	\$8,743.00		\$8,743.00			X	RIGHT-OF-WAY	
S-0026(10)2	19	RIVERDALE ROAD LANE GAIN FROM 1500 WEST TO I-15	\$285,167.48		\$221,809.29			X	PROJECT MANAGER	
S-0026(10)2	20	MICRO SURFACING / MILL AND FILL FROM APPROX I-84 TO 190	\$120,039.45		\$83,834.11			X	PROJECT MANAGER	
S-0026(10)2	21	KEYSTONE WALLS AT BURGER KING AND PANDA EXPRESS	\$23,159.00	\$23,159.00				X	CONSULTANT	
S-0026(10)2	22	ADDITIONAL QWEST DUCT BANK CONDUITS	\$52,259.00			\$52,259.00		X	PROJECT MANAGER	
S-0026(10)2	23	UNDERDRAIN INSTALLATION	\$18,212.00	\$18,212.00				X	PROJECT MANAGER	
S-0026(10)2	24	I-84 SPUJ JOINT REPAIR	\$35,075.00	\$35,075.00				X	PROJECT MANAGER	
S-0026(10)2	25	KNIGHTS ROOF DRAIN, 37TH ST SEWER TIE IN, WATERLINE DESIGN - STILL UNDER ADVISEMENT	\$15,688.00	\$15,688.00				X	PROJECT MANAGER	
S-0026(10)2	26	QUESTAR UTILITY RELOCATION ASSISTANCE	\$7,571.00	\$7,571.00				X	CONTRACTOR	
S-0026(10)2	27	SOUTH OGDEN CITY BETTERMENT AGREEMENT ADJUSTMENT	-\$27,785.27			-\$27,785.27		X	PROJECT MANAGER	
<b>Total</b>			<b>\$6,863,813.23</b>	<b>\$1,026,897.88</b>	<b>\$3,762,328.32</b>	<b>\$8,701,896.37</b>	<b>\$201,817.97</b>	=	<b>\$13,692,940.54</b>	
<b>Total for Planned Change Orders</b>			<b>\$5,666,409.24</b>	<b>\$674,291.14</b>	<b>\$3,070,186.94</b>	<b>\$8,593,365.15</b>	<b>\$151,206.24</b>	=	<b>\$12,489,049.47</b>	
<b>Total for Unplanned Change Orders</b>			<b>\$1,197,403.99</b>	<b>\$352,606.74</b>	<b>\$692,141.38</b>	<b>\$108,531.22</b>	<b>\$50,611.73</b>	=	<b>\$1,203,891.07</b>	
*Notes:										
1. Planned change orders are project items that were recognized during the design and planning stages and were either planned on being addressed in the field or drawings were prepared with alternatives.										
2. Unplanned change orders are project items that were first realized during construction.										
3. Anticipated Amount is the value of the change order as entered into PDBS, Amount Paid is the amount that UDOT paid for items that the change order addressed. Refunds of original bid items are calculated as Underruns										
4. Significant differences between Amount Anticipated and Amount Paid are due to reclassification of bid items thereby crediting the original amounts back as overruns (see below).										

### Overruns and Underruns and Change Orders

Investigating change orders alone is deceptive. This is due to the fact that many times during construction the project team will remove quantities from the bid item list and replace them with similar items of different quantities and unit prices. UDOT typically does this if the bid item as described in the original contract does not fully represent the conditions on site. When bid items are redefined the result is a bid item underrun, and an increased change order amount. For this reason it is often preferred that change orders and overrun/underruns are viewed jointly in order to get an accurate view of the change in project cost during construction.

Investigating Design Bid Build (DBB) projects during the same 5 year period of historical data shows that the average overrun/underrun for those projects is -3.3%. Subtracting the 3.3% underrun from the 12.4% average change order seen over that span equates to a total contract change of 9.4% from the original bid amount. Table 5 indicates that the unforeseen conditions onsite were significantly reduced as compared to the traditional methods of DBB. This resulted in a -5.6% total contract change from the original bid amount.

**Table 5 Overruns/Under runs and Change Orders per the Original Bid Amount**

	<b>Overruns/Under runs as Percent of Original Bid</b>	<b>Unplanned Change Orders as Percent of the Original Bid</b>	<b>Total Change to Construction Bid</b>
<b>SP-0026(4)0-A</b>	2.6%	0.0%	2.6%
<b>SP-0026(4)0-B</b>	-36.4%	0.4%	-36.0%
<b>SP-0026(4)0</b>	-13.2%	1.7%	-11.5%
<b>S-0026(10)2</b>	13.5%	3.5%	17.0%
<b>Total</b>	<b>-7.6%</b>	<b>2.0%</b>	<b>-5.6%</b>
<b>Sample Urban Design Bid Build Project</b>			
<b>STP-LC05(17)</b>	2.0%	17.7%	<b>19.7%</b>
<b>CM-0039(12)4</b>	1.0%	6.3	<b>7.3%</b>
5 year average Design Bid Build	-3.30%	12.74%	<b>9.4%</b>
*5 year average based on 2005 through 3rd quarter of 2009			

Comparing Riverdale Road to another urban type reconstruction project indicates that such projects are especially complex in nature, and perform more poorly than State averages suggest. Project STP-LC05(17) (design bid build project, new urban roadway in Logan Utah) carried a 2% overrun, and 17.7% change orders. The 19.7% cost increase on STP-LC05(17) may suggest that, although the pricing on Riverdale Road was higher than State averages, the CMGC process allowed the team to produce savings as a result of better design coordination. A similar project

in Ogden, Utah was the pavement rehabilitation and intersection improvements on SR-39 from Wall Avenue to I-15. This project 6.3% change orders and 1 % overruns for a total change of 7.3%.

### **Cost Comparison of ICE and Final Cost**

The Independent Cost Estimate (ICE) is an engineering estimate provided by a third party of estimators trained in the construction industry. Obtaining an ICE enables the project team to have detailed discussions of project budget, while maintaining independence of pricing during the bid openings. The ICE is determined based on actual bid item element costs, and accounts for production rates, as well as site-specific conditions. It does not consider contract cost adjustments like change orders and overruns.

Figure 5 illustrates the final cost of the project compared to the original ICE bid projections. Scope Increase refers to the planned change orders that were identified during design, but were not added to the construction budget until after the bid was approved (see Change Order Section Above). The EE, and ICE did not provide estimates for the work included in the scope increase. The red bar in Figure 5 represents the Contractor's bid on the original scope of work. The Contractor's bid was \$900,000 below the ICE, and \$1,500,000 above the EE. Unplanned change orders, overruns, and other costs brought the cost of the original scope approximately \$1.9 Million (or 3.1%) above the ICE, and approximately \$4.3 Million (or 7.5%) above the EE.

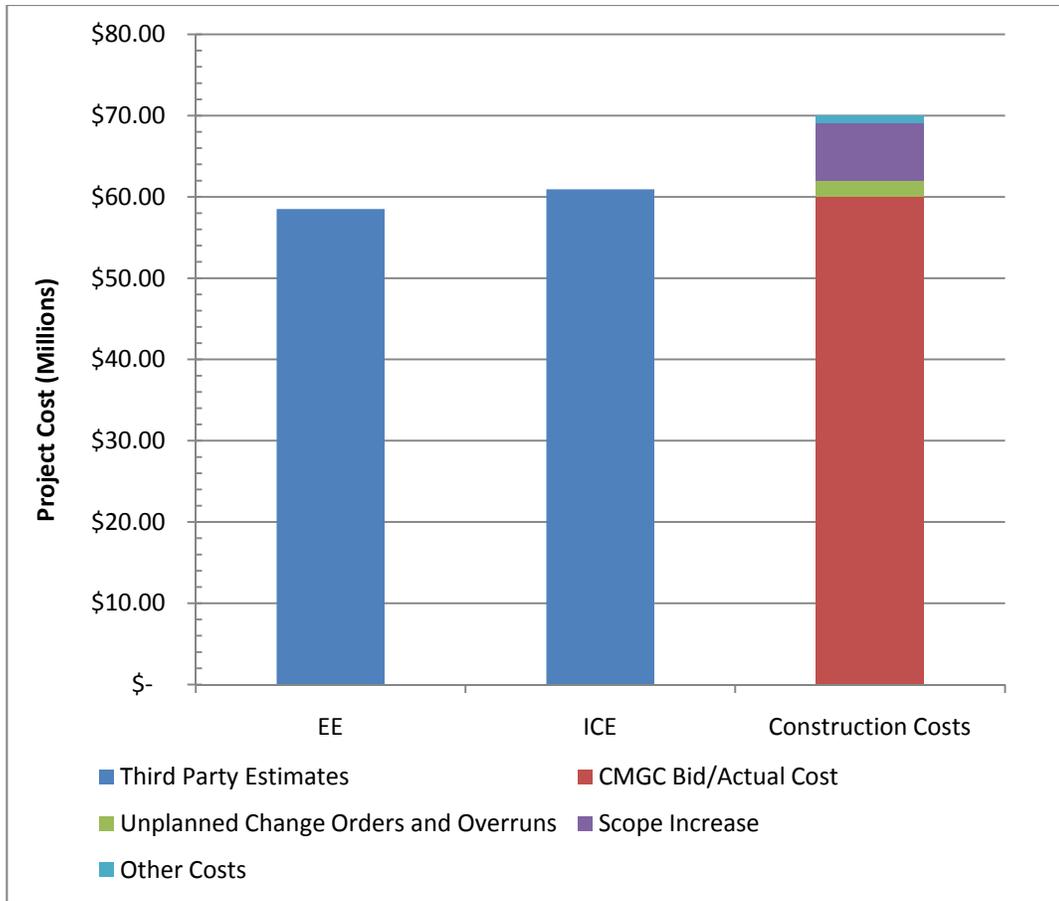


Figure 5 Projected Costs versus Final Costs

Because the project had already been awarded, the Department did not obtain cost estimates for the planned change orders. Instead, the cost of the planned change orders, like all change orders, were validated in accordance with UDOT policy 08B-10. When adding the planned change orders, the overall cost of the project was roughly \$10.9 million (or 14.9%) more than the projected bid estimate of the ICE.

## Delivery Process and Timeline

The total time to complete the project was 1045 days from the bid opening of Phase I, to the substantial completion of Phase IV. Phases I through III were the key phases of work that impacted the commercial sector, and were subject to the October 31, 2009 deadline. Phase IV had less of an impact on the commercial sector, and could be completed at a later date.

Figure 6 shows the project delivery timeline by phases. The green bars show the total days worked on each phase, from the NTP date to the substantial completion date. The purple bars show the number of additional days that could have been taken according to the number of working days granted in the contract (including time adjustments for change orders).

The team estimated that by using CMGC the Riverdale Road project saved approximately 3 months on the critical construction phases. Traditional delivery methods would not have enabled the earthwork in Phase I to get underway before the designs for the other three phases were complete. On this project the team was able to begin the earthwork and utilities coordination approximately 150 days before the total design of Phase III was complete. If Riverdale Road had been a design bid build project, some of that 150 day savings would have been offset by a more compressed design schedule. This is why the project team estimates that the actual time savings more conservatively, at three months, rather than taking credit for the entire 150 days, or five months. It is important to note that the first three phases on this project achieved substantial completion by mid-May, 2009, which is more than five months ahead of the October 31 deadline.

The estimate that the project saved between three and five months is not represented in the figure below. When looking at Phase II alone it would appear that the project saved 215 days, or roughly seven months. This is misleading, however, because Phase II was originally scheduled for 180 days. During construction the team determined that the critical path was the due date of Phase III. Therefore as part of change order #8 of Phase II (SP-0026(4)0-B) the time for construction was adjusted to match the deadline of Phase III (see Table 4 of this report). This means that the 215 days left unused on Phase II do not represent time saved on the project; they represent working days that were held in contingency, and not ultimately needed.

The fact that the first three phases were completed well before the October 31 deadline indicate that this project was able to meet its scheduling goals. Phasing of the project is an instrumental part of the CMGC process, and in this case it allowed the Department to ensure that the project proceeds on a schedule that is beneficial to the public. Phase IV was added at the end of the project and includes the large scope extension via change order. Some additional time savings could have been achieved if Phase IV was anticipated from the beginning of the project.

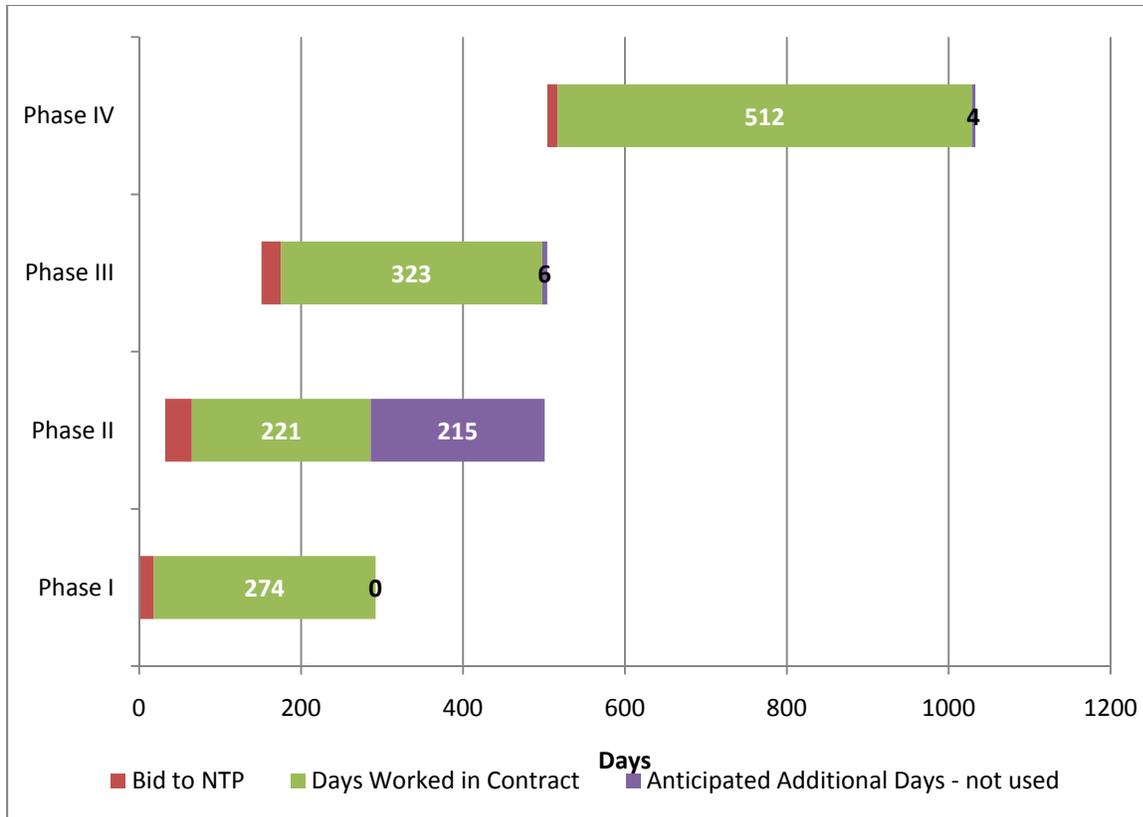


Figure 2 - Timeline for Riverdale Road (all Phases)

### Conclusion

When revisiting the principle goal Stated at the outset of this report, we see that the Riverdale Road project did achieve a great deal of success. Because this project took place in an urban commercial center the Department's priority was to avoid disruptions to the holiday shopping season. The team employed a construction phasing strategy to avoid delays, and get construction underway as swiftly as possible. Thanks to this strategy, all three of the critical phases achieved substantial completion approximately five months ahead of schedule, and three months faster than they could have been delivered under traditional methods.

Another highlight of the project was the successful implementation of cost-saving innovations. By making modifications to the original design, the team was able to incorporate Contractor suggestions that ultimately saved the project \$2,611,000.00. The team was also able to renegotiate the unit prices of unsuitable sub-grade materials in order to protect the Department from \$612,000.00 in added costs. These unique approaches to applying innovations, and controlling risk, were made possible through the CMGC process.

Some of the State average pricing data provides additional evidence that CMGC led to better use of the project budget. Comparing the Riverdale Road project to the 5-year averages for traditional projects reveals that Riverdale Road experience approximately 1/3 of the typical cost increase due to change orders and overruns. While the bid item prices for Riverdale Road were high compared to State averages, they were close to the ICE, which indicates that higher prices were expected. This expectation came from the fact that Riverdale Road was a major urban area reconstruction project. Such projects are typically more expensive.

The project team was highly satisfied with the CMGC process. They felt that Because of the versatility and efficiency of the contract, modifications could be made instantaneously to provide better service. As a result, the team recommended that on a complex, urban reconstruct project the CMGC delivery method should be seriously considered as a way to keep UDOT's public currency intact.

## APPENDIX A – Personal Interview Notes

### CMGC Interview Questions

UDOT Project Manager- Randy Jefferies  
 Contractor Project Manager – Bryan Griffith  
 Resident Engineer – Larry Migliaccio PB

#### Project Description: Riverdale Road

#### Constructability

<p>How was constructability improved by involvement of the Contractor in design?</p>	<p>Being involved with the design allowed the Contractor to have input into all aspects of the design. In the CMGC process the final design decisions are made by the owner, but the Contractor review and input allows open discussions on any concerns or questions the Contractor has significantly alleviating field problems. This was particularly useful in developing the details for the pre-cast structure. Location of water line was optimized.</p>
<p>How did ideas incorporated by the Contractor into the design to overcome constructability issues get followed through in the field?</p>	<p>Contract phasing was identified and incorporated into plan set.</p>

#### Project Schedule

<p>Was the construction schedule shortened by the design effort? By how much?</p>	<ul style="list-style-type: none"> <li>The construction schedule was shortened through the design and contracting process by at least 3 months. By working closely with the DOT and designer, the Contractor was able to start work quicker, get answers in a timely manner and eliminating the bid letting process saved at least 3 months on the whole project.</li> </ul>
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#### Risk

<p>How did the team identify, evaluate, and track project</p>	<ul style="list-style-type: none"> <li>Early and often risk was evaluated. Potential risks were listed and tracked. The lowest cost price was given to the DOT with no contingency built in. This adds more paperwork in change orders,</li> </ul>
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risk?	however the State pays only for services provided.
Which Contractor suggestions helped you to reduce risk and control cost?	<ul style="list-style-type: none"> <li>Remove and Replace unsuitable subgrade was only 10% of the total area. We knew there would be at least 75%. We increased the quantity and were able to work efficiently with better productions. This reduced the cost significantly.</li> </ul>

### Change Orders

What was the total cost of Change Orders?	<ul style="list-style-type: none"> <li>About 6.6 million</li> </ul>
What change orders were unexpected and occurred because of design oversights or unseen risk and what is the dollar value of these change orders?	<ul style="list-style-type: none"> <li>\$85,000.00 worth of unexpected changed orders. All of this came from either utility conflicts or hazardous materials found onsite.</li> </ul>
What change orders were anticipated and occurred to meet design or scope and what is the dollar value of these change orders?	<ul style="list-style-type: none"> <li>\$6,565,000.00 of change orders were additional scope outside of the original project limits or potential changes known at bid time.</li> </ul>
How did having a Contractor involved in design help to reduce change orders?	<ul style="list-style-type: none"> <li>There was a better understanding of project intent before construction started. Therefore, we did not have a misinterpretation of plans and specs. Everyone knew exactly what was required.</li> </ul>
How did you negotiate change orders?	<ul style="list-style-type: none"> <li>Change Orders were either bid before work started or for high priority cases, cost was tracked and then submitted with a set mark up.</li> </ul>

### Environmental Stewardship

How did bringing the Contractor on early alleviate	<ul style="list-style-type: none"> <li>There were very few environmental concerns for the project as this was in a previously established roadway.</li> </ul>
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environmental concerns?	
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**Benefits to Public**

How did the public benefit from the CM/GC process?	<ul style="list-style-type: none"> <li>The public was the biggest benefactor to the CMGC process. Because of the versatility and efficiency of the contract, modifications could be made instantaneously to provide better service. On an urban reconstruct there should be only one contracting method to keep UDOT’s public currency intact. CMGC.</li> </ul>
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**Lessons Learned**

What did you learn in the CM/GC process?	<ul style="list-style-type: none"> <li>If pricing is going to be considered during the evaluations make sure that it is very clear on what is to be included. For example is overhead project overhead, company overhead, division overhead. Also, consider that the items of work being priced may change significantly during design or not even apply at all. If this is the case then the price evaluation for the items that effect the Contractor selection may not even be constructed during the project if alternate designs are used.</li> </ul>

**General Notes/Other Items**

How would you rate the CMGC process now that the project is completed?	<ul style="list-style-type: none"> <li>The process has evolved into a 9 of 10. The DOT is getting a very competitive price and an extremely competent Contractor. There is less risk of a “black eye” to the DOT in the CMGC format. High Profile/Urban Reconstructs/Accelerated Schedule/Unique Design projects should be handled through a Contractor the DOT can trust and CMGC is a great way to facilitate that.</li> </ul>
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