CMGC Construction Phase - State Report

For

I-80; State St to 1300 E

S-80-3(152)121

S-80-3(153)121

SP-80-3(68)121

PIN No. 4303, 6838, 6839

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Purpose

The purpose of this report is to summarize how the contractor's involvement in design impacted the construction phase of the I-80; State St to 1300 E project. The report will address the results of innovations introduced in design, how the planning for risk was implemented, and the impacts of design on schedule, cost, quality and constructability. All of these aspects will result in impacts to the public and the achievement of the Utah Department of Transportation directives:

- Take Care of What We Have
- Make the System Work Better
- Improve Safety
- Increase Capacity

This report is a companion report to the CMGC Design Phase report published previously. Together they describe the impact that the CMGC process had on the I-80; State St to 1300 E project.

Project Innovations

Key innovations focused on project goals of minimizing schedule and saving money. Goals were achieved by focusing efforts on the following six categories:

- Technical innovation of remote bridge construction and mobilization were tested.
- Design efficiencies were enhanced through alternative suggestions that enhanced constructability or saved money. These alternatives were evaluated by the designers and UDOT managers to ensure that quality and anticipated standards were maintained.
- Utility innovations focused on resolving project scope and the timely performance of work by utility contractors. The team focused on making the projects scope meet the needs of the utility companies or coordinating acceptable alternatives to the utility company's requirements.
- Alternative materials were investigated to insure their use on the project. Alternative material's suitability was tested and validated in order to incorporate its use rather than following standard practices of disposal.

- Methodologies of construction were utilized to minimize the impact of right of way requirements.
- Public impact was the priority in the MOT plan. Once the accelerated delivery became the most pressing goal to the project, the MOT was designed to meet that goal.

By achieving these goals of enhanced design efficiency, minimizing impacts to existing utilities, validating the use of alternative materials, and minimizing impacts of the right of way, the CMGC team saved millions of dollars and shaved a year off of the delivery time. All of these efforts resulting in approximately $4 million of direct savings and $122 million in savings to drivers on I-80. A breakdown of the money saved can be seen in Appendix C (User Cost Estimates) and Appendix D (CMGC Estimated Innovation Savings)

The most dramatic innovation introduced during the I-80 reconstruction project was the mobilization of bridges. By building 7 bridge structures off site and moving them into place the interruption of traffic per bridge was minimized from months to mere hours. The actual cost to mobilize a bridge was over $1.1 million per structure. However, this portion of the project helped to meet the accelerated schedule and expanded the knowledge and experience of contractors, designers and UDOT officials. The information and experience gained has since been transferred to various other projects throughout the state. This project has placed UDOT as a frontrunner of innovative roadway construction nationwide. The introduction of this innovative process was achieved through the collaborative efforts that CMGC affords.

Innovation~~s~~ Categories
• Enhanced Design Efficiency • Bridge Structure Mobilization • Utility Conflict Resolution • Material Reuse or Alternatives • Minimization of Right of Way • MOT Optimization for Project Schedule

Efficient design focused on saving money and time by proposing alternatives to irrigation and landscaping, minimizing environmental requirements, and reconstructing existing catch basins. The original irrigation and landscaping design specified very expensive components and required extensive utility connections of power and water. By minimizing these connections and proposing reasonable alternatives significant savings were achieved. This minimization approach was used again as the contractor's certified Environmental Control Specialists walked the site with UDOT officials to minimize the runoff controls measures shown in the original design. Finally, the contractor avoided replacing 22 catch basins by reconstructing them on site. These efforts of efficient design allowed the team to save project money.

Utility conflicts were the main obstacle addressed by the CMGC team. Massive adjustments to the utility corridor were anticipated at the beginning of the project. Many of the utility companies simply could not react to the accelerated schedule to move their utilities out of the construction zone. The team focused on adjusting roadway alignment, protecting utilities in place, providing alternative sources of supply, and replacement of pipelines using insitu methods rather than reinstalling them. All of these innovations were negotiated directly with the utilities to ensure their approval prior to construction. Keeping good relationships with the utility companies became one of the most important lessons learned during the project. These efforts overcame a major difficulty facing the project schedule.

Creative sourcing of materials was a key innovation to help reduce the project cost. Recycling of materials or the use of non standard materials became an important tool to reduce costs and save time. All materials were checked and tested to ensure their suitability prior to use on the project. Concrete was crushed and mixed with other materials to meet gradation requirements. Expensive man made water barriers were replaced with natural clay. Granular borrow was recycled from the staging yards. Overhead sign structures marked for removal were sampled, measured, and tested for suitability of reuse. All of these efforts helped to avoid additional costs by using what was already available rather than disposal of used materials.

Right of way is always expensive and time consuming. However, two properties were acquired by the state with the intention of demolition. Due to the construction methods used the properties were salvaged and resold by the state. Through the team's efforts some of the expense of right of way was reabsorbed by the state.

The largest cost savings due to innovations is the user costs saved by the commuters traveling I-80. During construction the project utilized a barrier that could be moved between lanes allowing 3 lanes of traffic open in the direction of high traffic and 2 lanes for the opposite direction. Also, by completing the project 1 year early the capacity of I-80 is now 5 lanes open in both directions yielding no delays to users. For estimating purposes, 6 months of the additional construction would have allowed 2 lanes in both directions and then 3 lanes for the remaining 6 months (most probable scenario as discussed with John Montoya). The total estimated savings of these MOT innovations is equivalent to the entire project cost (see user cost analysis totals in Appendix C).

One innovation that cost money but saved the project an estimated 2 months was the addition of an intermediate crossover at 700 East. Though the cost was estimated at $175,000, its installation helped maintain full lanes of traffic and shifted the critical path of construction. Like many of the other innovations listed above, the primary purpose was to get the 3 year project done in the two year time frame.

The innovations associated with the I-80 reconstruction project were vital in achieving the project goals. Through their implementation the project time was reduced and savings were substantial.

Risks

Risk assessment and mitigation played a major role in the mobilization of bridges. Prior to moving the first bridge into place it was witnessed that the carrying beam began to fail. The move was canceled so the issue could be remedied. The team met with upper level management of UDOT and an extensive list was prepared of all feasible risks associated with the moving process. Though risk was considered prior to these moves, a formalized checklist of issues was generated and checked only after the first bridge move. The team realized that a formalized risk matrix was important to defend the teams decisions when viewed by persons not associated with the project. It became a standard procedure to review the risk list in a formal meeting and also on site prior to mobilizing any bridges. Assessment and mitigation of risk is an important part of all technical innovations. The I-80 reconstruction project helped standardize the risky process of bridge mobilization.

Analysis of Performance

CMGC projects are analyzed based on their ability to meet the original goals regarding cost and schedule. The I-80 reconstruction project's substantial completion date was December 14, 2009. Its anticipated completion date was the end of 2009. The project was completed within two years and met the accelerated schedule that was imposed by UDOT. Table 3 shows the total cost of the project including all charges to the project.

Planned change orders were utilized to segment the construction during design. A planned change order is project scope not included in the original bid due to lacking information. The team is aware that additional charges will be assessed to complete the project scope. For analysis purposes planned change orders are considered part of the project original cost and not considered as change orders in the traditional sense.

At first glance the accelerated schedule had an adverse effect on CMGC capability to reduce change orders. Accelerating the schedule reduces the design team's capacity to review and evaluate alternative measure and investigation of site conditions during design. However, much of this evaluation and investigation happened during construction. By shifting the design team's efforts to the construction phase of the project, the budget impacts are manifested differently. Change orders rise as the design on the plans are modified during construction. At the same

time, the original bid items are abandoned for the wiser design presented in the change orders which results in large underruns of the contract bid items. By adding the change orders and underruns together the resultant bid impact is an 8.5% increase of the original bid. By comparison, the 5 year state average Design Bid Build projects are showing a 9.4% increase. Even with a schedule that could not have been achieved by any other delivery method, CMGC showed a capacity to reduce the budget impacts typically experienced by the state.

Table 3 – Total Project Construction Costs

	SP-80-3(68)121	S-80-3(152)121	S-80-3(153)121	
	Phase I	**Phase 2**	**Phase 3**	**Total**
Original Bid	$6,050,431.66	$92,830,570.48	$3,976,395.03	$102,857,397.17
Planned Change Order [1]	$10,602,045.90	$3,767,188.46	$0.00	$14,369,234.36
Standard Change Order	$2,888,600.50	$17,157,005.29	$57,010.43	$20,102,616.22
Percent of Bid	47.74%	18.48%	1.43%	19.54%
Bid Item Overrun	($2,475,337.66)	($8,700,922.40)	($152,849.09)	($11,329,109.15)
Percent of Bid	-40.91%	-9.37%	-3.84%	-11.01%
Other Costs [2]	$36,003.09	$544,653.81	($16,432.49)	$564,224.41
Total	**$17,101,743.49**	**$105,598,495.64**	**$3,864,123.88**	**$126,564,363.01**

Notes: (According to PDBS as of April 8, 2010)

1. Planned change orders are portions of the project that were realized during design but insufficient information was known at the time to move forward. The contract was let knowing that the changes would be implemented when more information was made available to the team. Change order process was utilized to phase the project.

2. Other Costs include: Incentives/disincentives, Bituminous/Fuel adjustments, OCIP costs, Price Adjustments, Utilities, and Liquidated Damages (project and DBE).

Price Comparison

In order to uniformly evaluate pricing of CMGC projects the UDOT developed a ratio of comparison for Total Project Costs to the "Projected Cost of the Project and is represented in Equation 1 below. The Projected Cost of the project is the cost based on the state average unit prices and the average impact of change orders and overruns. A discussion of how the projected cost is determined is outlined in Appendix B.

$$R_{PC} = \frac{Tc}{Pc}$$

Equation 1 – Ratio of Project Cost to Projected Cost

A value of R_{PC} above 1 suggests that the project was overpriced when compared to state average pricing data. A value less than 1 suggests that the project costs were reasonable. The R_{PC} for this project was 0.81.

The project performance of the I-80; State St to 1300 E achieved the project goal of a two year project schedule. Much of the success achieved can be attributed to the innovations presented in design and implemented in construction to save money and reduce the project schedule. Pricing was fair and reasonable and provided a competitive value for the state of Utah.

Lessons Learned

- Project was completed at least one year earlier then could have been possible with any other delivery method (John Montoya).
- CMGC did not eliminate change orders. CMGC helped with constructability-related change orders, but on unforeseen conditions, CMGC can't really help. An example is the soft spots in the road base. The best you can hope for is good partnering so the contractor is reasonable in negotiating change orders (John Montoya)
- Early release packages were a mistake, in terms of cost, because you lose your ability to negotiate. You need to allow enough time to "cut and run" if necessary. Schedule driven projects are not capable of achieving significant cost savings. (John Montoya).
- Improved geotechnical exploration before construction would have reduced change orders for soft spots in the soils (Wayne Bowden).
- Keep your relationships strong with the utilities (Wayne Bowden).
- It may have been better to have involved a contractor or sub contractor that specializes in 'dirt' in the design. This may have resulted in fewer change orders related to fill (Brian Atkinson)
- When project goals change during design the efficacy of the CMGC team is jeopardized (Larry Reasch)
- Formally tracking risks is important so the team can defend its decisions to persons not directly associated with the project (Larry Reasch)
- Contractor does not fully comprehend the design efforts that are done to keep the project moving (Larry Reasch)
- To fully realize the potential of CMGC, it must be viewed as a team approach to design and construction (Larry Reasch).

Conclusion

On December 14, 2009 the I-80; State Street to 1300 E project entered substantial completion. Upon completion this project became one of the most daring and exciting projects accomplished by UDOT. This excitement was due to the accelerated schedule that included 15 bridge replacements and the widening of I-80 from 3 lanes in each direction to 5 lanes. The project schedule was reduced from 3 years to 2 years, requiring innovative solutions throughout the project to ensure its delivery time.

Ralph L. Wadsworth was selected to perform the work based on qualifications and the lowest proposal price of any of the contractors. The pricing from the proposal was reflected in the major phase II work that included 90% of the work and the mobilization of 7 bridges. Through the collaborative efforts encouraged in CMGC the project was completed at the accelerated pace. This feat could not have been achieved by any other delivery method. Due to the lessons learned during the project, bridge mobilization has become an effective tool that UDOT has transferred to other projects. This project set a new milestone in UDOT's history of roadway construction.

Appendix A - Interview Notes

CMGC Interview Questions

UDOT Project Manager- John Montoya
Design Project Manager – Larry Reasch
Contractor Project Manager – Wayne Bowden

Project Description:	**I-80; State Street to 1300 East**
Pin:	4303, 6838, 6839
Project Phase:	Construction
Actual construction cost:	**$126,564,363.01 (as of April 2010)**
Notice to proceed date:	3-13-2008
Substantial Completion date:	12-14-2009 (Phase II)

Constructability

How was constructability improved by involvement of the contractor in design?	• This project couldn't have been done using any other method under the time and budget constraints, mostly because of the innovations of the bridges (John Montoya). • The design was built around the particular methods of the contractor (John Montoya). • The ABC would have been nearly impossible without contractor participation, particularly in understanding the equipment and processes involved (Brian Atkinson). • The contractor understood early on that the surcharges would be critical path. To work around this, they recommended early widening, which saved an entire construction season (Brian Atkinson). • The contractor assisted with utility relocations, lightweight fill, box culverts, ROW, and various other items. • Contractor met weekly with utility companies to help ensure that utility claims and State agreements were addressed during construction.(Wayne Bowden).
How did ideas incorporated by the contractor into the design to overcome constructability issues get followed	• Some design was basically turned over to the contractor based on their means and methods (John Montoya). • The contractor was invaluable during the ABC process, and took charge of the scheduling (Brian Atkinson). • In some cases designs that were provided were reviewed by the contractor to for evaluation and alternatives were

through in the field?	proposed to the project team. (Wayne Bowden)

Project Schedule

Was the construction schedule shortened by the design effort? By how much?	• It was also quicker than Design Build because we would have lost close to 3 months in procurement processes with design build methods (John Montoya). • The surcharge times could have added significantly to the schedule. However, the temporary widening solution provided by the Contractor saved a full construction season by allowing for early work on surcharges (Brian Atkinson). • Many of the innovations used were required to meet the project's accelerated schedule (Wayne Bowden)

Risk

How did the team identify, evaluate, and track project risk?	• After the failure of the carrier beam on the first bridge, the team created a matrix of risks that was used as a checklist prior to all subsequent bridge moves. This checklist was reviewed in a meeting and on site prior to each bridge mobilization (Larry Reasch)

Change Orders

What was the total cost of Change Orders?	• $34,471,850.58 as of April 2010
What change orders were unexpected and occurred because of design oversights or unseen risk and what is the dollar value of these change orders?	• $20,102,616.22 the remaining amount was for change orders that were used to enable the project to move forward until unknowns were made available.
What change orders were anticipated and occurred to meet design or	• $14,369,234.36

scope and what is the dollar value of these change orders?	
How did having a contractor involved in design help to reduce change orders?	• Many times we did not seek compensation for changes to scope that were contingent on our recommendations during design. Because we had a stake in the project we did not feel comfortable asking for additional funding (Wayne Bowden).
How did you negotiate change orders?	• When changes had to occur during construction, the change orders were negotiated based on costs and overhead because we did not feel comfortable trying to negotiate extended overhead and other issues due to our partnership in design (Wayne Bowden). • With every change in scope, I reviewed the bids by the suppliers and subcontractors and sent them back for reduced prices (Wayne Bowden).

Benefits to Public

How did the public benefit from the CM/GC process?	• Project was completed in two years rather than 3 (John Montoya) • User cost savings due to movable barriers and ABC construction resulted in substantial user cost savings. (John Montoya) • Utility modifications were simplified resulting to lower costs than replacement (Wayne Bowden). • Recycling of approved sign structures saved funding and reduced landfill (Wayne Bowden). • ABC process of bridge mobilization has become a standardized method in other delivery methods.

Lessons Learned

What did you learn in the CM/GC process?	• There should be more UDOT staff on the project to watch out for UDOT interests (John Montoya). • With a project this big ($139M), it puts tremendous pressure on the contractor to maximize profits (John

	Montoya). • Early release packages were a mistake, in terms of cost, because you lose your ability to negotiate. You need to allow enough time to “cut and run” if necessary. Schedule driven projects are not capable of achieving significant cost savings. (John Montoya). • Improved geotechnical exploration before construction would have reduced change orders for soft spots in the soils (Wayne Bowden). • It may have been better to have involved a contractor or sub contractor that specializes in ‘dirt’ in the design. This may have resulted in fewer dirt change orders (Brian Atkinson). • Keep your relationships strong with the utilities (Wayne Bowden). • When project goals change during design the efficacy of the CMGC team is jeopardized (Larry Reasch) • Formally tracking risks is important so the team can defend its decisions to persons not associated with the project (Larry Reasch) • Contractor does not fully comprehend the design efforts that are done to keep the project moving (Larry Reasch) • To fully realize the potential of CMGC, it must be viewed as a team approach to design and construction (Larry Reasch).

Appendix B – Price Comparison

Equation 1 shown in the report is a ratio of Total Project Cost to Projected Cost. The Total project cost is the bid price plus the change orders (including planned change orders) and overruns determined from the PDBS overrun status report for the project. It should be noted that the "other costs" shown in table are not included as they typically do not account for a significant amount.

Total Cost = Bid + Planned Change Orders + Change Orders + Overruns/Underruns (See Table 3 for values) Equation #2

TC = $102,857,397.17 + $14,369,234.36 + $20,102,616.22 + (-$11,329,109.15)

= $126,000,138.60

The Projected Cost is determined by taking the bid price (BP) and multiplying it by the inverse of the silver standard ratio (SSR) (see the Design Phase Report for I-80; State St to 1300 E, Figure 1). This estimates the Projected Bid Price (PBP) assuming state average unit prices. It assumes that the unmatched bid items follow the same pricing pattern as the matched bid items. For this project the silver standard ratio is 0.72. This ratio is the ratio of bid items to the matched state average cost items. (See Appendix B of the Design Phase Report for I-80; State St to 1300 E). The PBP become the basis for calculating the change orders and bid item overruns anticipated due to state average estimates. Over the last five years (2005 through last quarter of 2009) UDOT's change orders have averaged 12.7 % of the bid price and overruns of -3.3% of the bid price. By totaling these three values the Projected Cost (Pc) is determined.

PBP = BP x (1/SSR) Equation # 3

PC = PBP + (PBP x 0.127) + (PBP x -0.033)

or

PC = PBP x (1 + 0.127 – 0.033)

or

PC = PBP x 1.094

Substituting from Equation #3

PC=(BP/0.72) x 1.094

PC= $102,857,397.17 /0.72) x 1.094

PC = $156,286,100.70

The Ratio of Total Cost to Projected Cost is simply TC/PC

RTC = $126,000,138.60 / $156,286,100.70

RTC = 0.81

Appendix C – User Cost Estimates

Having 3 lanes open to traffic versus 2 lanes:

	3 lanes on I-80	**2 lanes on I-80**	**Difference**
VMT*	46,732,600	46,719,700	-12,900
VHT_AM	234,069	234,401	332
VHT_MD	394,064	394,411	347
VHT_PM	376,772	377,937	1,165
VHT_EVE	254,564	254,565	1
VHT_DY	1,259,469	1,261,314	1,845
	Calculations	Notes	
Daily cost of time	$46,240.77	VHT_DY * weighted ave. cost per hour	
Daily mileage cost	$7,095.00	VMT difference *IRS mileage rate	
Total Daily Cost	$53,335.77	Sum of Daily time and Daily mileage costs	
Total Weekly Cost	**$ 293,346.76**	Total Daily costs * 5.5 days	
	Assumptions:		
	Box Trucks	5%	
	18-wheelers	5%	
	Passenger Vehicles	90%	
	vehicle occupancy	1.25	passengers per vehicle
	cost of time	$15.47	per person per hour
	Box trucks	$51.06	per vehicle hour
	18-wheelers	$102.12	per vehicle hour
	weighted average cost	$25.06	per hour
	IRS Mileage Rate	$0.55	
**VMT is vehicle miles traveled per day, VHT is vehicle hours traveled*			

Please note that this figure substantiates the claim stated in the RFP, “A recent study was completed which showed that reducing the number of lanes along I-80 to two lanes in each direction for a nine month period created user delays between $10 and $15 million dollars”. The actual project lasted approximately 90 weeks and resulted in $26,402,208.

Results- 2 lanes - versus no delays (5 lanes)

Near State Street	Peak Dir AM	Peak Dir PM	Saturday	
fuel loss	$10,407.24	$25,863.95	$2,977.61	
value of time	$158,090.76	$392,827.45	$45,240.17	
total cost	**$168,498.00**	**$418,691.40**	**$48,217.78**	
total delay	6308.5	15675.5	1805.3	veh-hours
total person delay	7380.9	18340.3	2112.2	person hours
max delay per veh	33.6	76.1	10.4	min/veh
ave delay per veh	17.3	35.3	5.5	min/veh
	Cost Per Week:	$2,984,165		
	Project Duration:	6	months	
	Number of Weeks:	26		
	Total Cost:	**$77,528,601**		

Results- 3 lanes - versus no delays (5 lanes)

Near State Street	Peak Dir AM	Peak Dir PM	Saturday	
fuel loss	$1,254.77	$7,435.81	$ -	
value of time	$19,080.17	$112,952.41	$ -	
total cost	**$20,334.94**	**$120,388.22**	**$ -**	
total delay	761.4	4507.3	0	veh-hours
total person delay	890.8	5273.5	0	person hours
max delay per veh	8.1	25.5	0	min/veh
ave delay per veh	3.7	13.8	0	min/veh
	Cost Per Week:	$703,616		
	Project Duration:	6	months	
	Number of Weeks:	26		
	Total Cost:	**$18,279,938**		

Total savings: $26,402,208 + $77,528,601 + $18,279,938 = $122,209,747

Or $122 million

Appendix D – CMGC Estimated Innovation Savings

The following innovations were implemented by the design team which consisted of UDOT, Horrocks, and Ralph L. Wadsworth. In many cases the contractor suggested these modifications to design in an attempt to save project budget and schedule. Horrocks and UDOT had the responsibility to determine if the changes impaired the quality of the project and prepare the acceptable designs required for implementation. Estimated savings of money and time were provided by the contractor and, where possible, verified via the bid items.

Duration savings shown are anticipated schedule extensions that would have been required to achieve the work if the innovation was not implemented. Since all items were not on the critical path, overall duration savings would be less than the total of all items shown.

Bridge Abutment Realignment

I-80 team changed the orientation of the abutments and bridge lengths to avoid the relocation of major power poles and underground utilities which inhibited the use of overhead equipment required for bridge installation.

- Money savings: $450,000.
- Duration savings: 3 months.

Qwest Utility Hub in Freeway Alignment

Major utility hub was located within the freeway alignment including multiple communication lines by Qwest. Qwest was consulted and they estimated that to relocate all of the lines impacted would cost over $1,000,000. The team proposed that the utility hub be encased in vaults to allow physical access and for inspection and protection from construction activities overhead. Qwest agreed.

- Money Savings: $1,000,000.
- Duration savings: 3 months.

Soft Spot Repair with Recycled Materials

Contractor proposed using site recycled materials (removed Portland cement concrete pavement PCCP) for the soft spot repair instead of importing material from pits outside the project. This would save in hauling and disposal costs. Proposed recycled materials were processed on site and tested to meet UDOT's standards prior to placement.

- Money Savings: $400,000
- Duration savings: None

Rocky Mountain Power Influence on Schedule

Contractor negotiated with Rocky Mountain Power (RMP) to minimize costs and schedule impacts associated with maintaining power to citizens at 900 East, 890 East, 600 East, 500 East

and 300 East. To avoid the chance of power outages RMP requires that work be done in low power use seasons (non summer months and the month of December). Traditionally this would require that the work to move the power poles in conflict would be done outside the high use season. Instead the contractor suggested using shut out switches and rerouted power around the poles that needed to be moved so that work could proceed in accordance with the schedule's requirements.

- Money savings: $250,000
- Duration savings: 3 months

State Street Phasing/Moveable Barrier

Prior to the traffic switch from the EB lanes to the WB lanes it was determined that the State Street Bridge would not accommodate 6 lanes of traffic. This required the team to keep the moveable barrier and switch traffic morning and night. The process would add time delays and costs to the project. The contractor proposed widening the center section of the State Street Bridge to allow 6 lanes of traffic thus avoiding the delay. This was also done on the 1300 East structure.

- Money savings: $100,000
- Duration savings: 1 month

Intermediate Crossover

Team designed and constructed a crossover after 700 E to enable construction to begin in late October, 2 months ahead of schedule. This impacted the project by alleviating the critical path of construction. The crossover actually cost the contractor an estimated $175,000 but the contractor deemed the tradeoff for 2 months time worth the cost.

- Money savings: None
- Duration savings: 2 months

Clay vs. Geomembrane

The shop drawings for the RECON block walls called for a layer of impermeable clay to be installed on top of the backfill behind the walls. The specification of the clay blanket was man-made and very expensive with long lead times. Since the vast majority of the walls were installed under the bridge decks where they would not be exposed to the runoff, this design seemed excessive. After coordinating with RECON the requirement was changed to a geomembrane which was less expensive.

- Money savings: $40,000
- Duration savings: 1 month

Drainage

Original scope required the entire trunkline to be replaced, the team negotiated with cities to allow a slip line system to be used on the trunkline. Design was modified to tie into the existing system.

- Money savings: $400,000
- Duration savings: 4 months

Environmental Control Supervisor Requirements

Original plans called for approximately 19,000 linear feet of silt fence. The contractor's ECS met with UDOT's Landscape Architects and walked the site verifying where silt fence was really required and tailoring the environmental design to each element on the project. This reduced the fence length of 6000 feet along with optimizing other required efforts. These efforts resulted in the underruns on Silt Fence, Drop inlet barrier, pipe inlet barrier, and ECS bid items. These were verified on the final pay estimate (contractor claimed $30,000 in savings; actual underruns saved almost $72,000).

- Money savings: $72,000
- Duration savings: 10 days

Parcels Returned to UDOT

Through alternative methods of construction of the MSE and noise-walls, two parcels were protected in place and were re-sold returning money back to the department. These parcels were originally identified for demolition and landscaping. One lot was a single family dwelling unit and the other was a four-plex apartment building.

- Money savings: $400,000
- Duration savings: 1 month

1300 E Granular Borrow Recycled

Team proposed the use of recycled material from the bridge staging yards as fill for the mainline saving import costs. The material was cleaned and re-sampled to verify compliance with the specifications.

- Money savings: $75,000
- Duration savings: None

Waterline at 2400 South

The design teams negotiated with the municipalities to line the 12" waterline verses replacing the existing pipe. If the pipe line was replaced, multiple other utility loops and drainage relocations would have required replacement also.

- Money savings: $50,000

- Duration savings: 1.5 months

Pipe Bursting at Robert Avenue

The design team negotiated with the municipalities to use pipe bursting technology instead of relocating the drainage line and avoided conflicts with other utility services.

- Money savings: $50,000
- Duration savings: 1.5 months

Overhead Sign Structure Reuse

Rather than disposal of the existing sigh structures, each sign structure removed was salvaged, tested and verified to see if it met the existing specifications. Parts that met the requirements were reused on the roadway. This claim was verified from the overrun/underrun quantity analysis (savings may have been as high as $370,000)

- Money Savings: $315,000
- Duration savings: NONE

Catch Basins

The contractor proposed to the design team that 22 catch basins be reconstructed rather than replacing with new catch basins. This accounted for the overrun of reconstruct catch basins in bid item.

- Money savings: $150,000
- Duration savings: 2 months

Lightweight Fill Material

Lightweight slag from Nephi was used for fill material to protect utilities. This was performed at 500 East and 300 East (major Qwest line in Highland) and for a 30 inch waterline for SLC. Use of fill mitigated the risk of damaging utilities in place.

- Money savings: NONE
- Duration savings: NONE

Irrigation and Landscape Design Adjustments

Preliminary design utilized expensive components and required multiple service connections at each bridge. The contractor proposed a design using less expensive components and only required one power and water connection at each bridge. This was recognized as one of the most painful processes of the project.

Money savings: $250,000

Duration savings: 2 months

Total Money Savings Estimated: $4,000,000
Duration Savings: 25 months