

Dotsero Colorado River Bridge Replacement Project Alternative Evaluation Process March 8, 2012

The Colorado Department of Transportation is completing the design phase of the Dotsero Colorado River “green” bridge replacement project. The bridge is located on the I-70 Frontage Road over the Colorado River in Dotsero. The existing structure, built in 1935, needs replacement because it is functionally and structurally obsolete. This bridge is scheduled to be replaced by spring 2014 through the Colorado Bridge Enterprise.

CDOT committed to follow a Context Sensitive Solutions (CSS) approach to this project, engaging agencies and other stakeholders in a collaborative decision-making process that respects the physical, social, and environmental context of the project. A Project Leadership Team (PLT), a collaborative stakeholder team that leads the process and ensures decision making is consistent with CSS, was formed for this project. Members of the PLT represent federal, state and local interests.

The PLT met on September 14, 2011 and developed a context statement and critical success factors for the project, built on the interests and objectives of the PLT members. CDOT held a public open house on September 28, 2011. The focus of the meeting was to discuss the context and critical success factors for the project and concerns about the project. CDOT presented initial alignment options for comment. A survey was provided to participants and was posted on the CDOT project website to solicit additional input.

Context Statement

The context statement guides how the project fits within the physical, social, and environmental context. The context statement for the Dotsero Colorado River Bridge Project is:

US 6 at Dotsero serves as a hub for a wide array of recreational uses, including river sports, hunting, bicycling, hiking, fishing, and numerous camps upstream along the Colorado River. Dotsero represents a gateway into and out of Eagle County, Glenwood Canyon and the Flat Tops Wilderness. The interchange with I-70 and the Colorado River Road provides critical access for commerce, residents, ranches, recreation, emergency response and truck parking and an alternate route to communities north of I-70. Dotsero is steeped in Colorado history as a winter camp for the Utes, an important link in the expansion of the railroad, and multiple generations of western slope ranching.

Critical Success Factors

Input from the stakeholders, Project Leadership Team, Technical Team, and project staff provided the basis for critical success factors to be considered to address the project context and desired outcomes.

- Meet FHWA and CDOT design and safety standards

- Do not preclude future improvements to interchange
- Minimize environmental impacts
- Accommodate all users, including bicycles and pedestrians
- Accommodate emergency access during and after construction
- Minimize disruptions during construction
- Accommodate river access in partnership with Eagle County
- Maintain traffic during construction
- Meet schedule and budget

In addition to the critical success factors, stakeholders, the PLT and project staff identified issues to consider in evaluating alternatives:

- Glenwood Canyon design features
- Gateway to Eagle County
- Access for truckers using incident parking area
- Logging and gravel operations
- Historic features: existing bridge, US 6, town site, cemetery, railroad, ranches, Ute winter grounds
- Environmental impacts: river, wetlands, riparian, water quality, fisheries, chub, wildlife and linkage interference,
- Sight distance limitations at Cotton Lane and US 6
- Archeology and paleontology
- Active volcano flow near Ski Lake

The critical success factors provide the basis for evaluating alternatives and options for replacing the Dotsero Colorado River Bridge. The specific issues were incorporated into the evaluation process for the roadway alignment as considerations for the critical success factors, shown in Table 1 below.

Evaluating Alignment Alternatives

An initial list of alternatives was considered for the reconstruction of the Dotsero bridge. Options included maintaining the current bridge alignment or shifting the alignment; realignment of the intersection with Colorado River Road and the use of roundabouts at that intersection.

The Technical Team considered the construction impacts of maintaining the current alignment and determined that the most effective alignment would shift the bridge and roadway to the south, toward I-70. Specific considerations for this option included:

- Least construction impacts
- Lowest cost
- Within the existing right-of-way
- Minimal utility impacts

- Minimal disruptions to the traveling public

At the intersection of US 6 and Colorado River Road, two alternatives were evaluated, a 2-way stop control and a roundabout. Table 1 shows how the critical success factors were applied to the intersection options and to the bridge alternatives.

Table 1: Application of Critical Success Factors to Intersection Alternatives

Critical Success Factor	Measurement	Considerations
Meet CDOT design standards	Best, better, good ● ●○ ○	Address existing deficiencies
Accommodate the 100-year flows	Best, better, good ● ●○ ○	FEMA flood data and 2011 observations, 4' of freeboard
Minimize environmental impacts	Best, better, good ● ●○ ○	Avoid, minimize, mitigate environmental impacts (permanent & temporary structures)
Minimize impacts to affected homeowners	Best, better, good ● ●○ ○	Rights-of-way and easements Construction impacts Alignment changes
Provide for safe access for properties in the vicinity of the bridge	Best, better, good ● ●○ ○	Maintain or improve access and sight-distance at driveway accesses
Maintain traffic during construction	Best, better, good ● ●○ ○	Work zone speed Construction duration
Meet schedule and budget	Best, better, good ● ●○ ○	Cost Construction completion

The Project Leadership Team and Technical Team reviewed the intersection options and determined that a roundabout would address sight distance issues while improving the potential safety of the intersection. Other advantages of a roundabout at this site include:

- A long-term safety improvement for the intersection
- Flexibility in adapting to the new alignment of the frontage road
- Allow trucks entering WB I-70 to leave the intersection at about 10mph to 15mph, giving trucks a head start for acceleration on the short WB on-ramp
- The roundabout splitter island offers a pedestrian refuge and better sight distance for pedestrians using the planned trail connection

Additional funding has been identified to allow the construction of a roundabout as part of this project.

Intersection Alternatives	Critical Success Factors										Comments
	1 - Meet FHWA and CDOT design and safety standards	2 - Do not preclude future improvements to interchange	3 - Minimize environmental impacts	4 - Accommodate all users, including bicycles and pedestrians	5 - Accommodate river access in partnership with Eagle County	6 - Accommodate emergency access during and after construction	7 - Minimize disruptions during construction	8 - Maintain traffic during construction	9 - Meet schedule and budget	10 - Maximize constructability	
	CONSIDERATIONS										
	<ul style="list-style-type: none"> - FHWA and CDOT Design Standards - CSS Design Guidance and sustainability principles - Random parking, access and operations, sight distance 	<ul style="list-style-type: none"> - Reconfiguration of split diamond interchange 	<ul style="list-style-type: none"> - Avoid, minimize, mitigate environmental impacts - River, wetlands, riparian, water quality, fisheries, chub wildlife and LIZs, archeology, paleontology historic 	<ul style="list-style-type: none"> - Recreation trail for pedestrians and bicyclists, crossing locations and operations 	<ul style="list-style-type: none"> - Coordination with Eagle County river access plan, Cotton Lane intersection alignment and sight distance 	<ul style="list-style-type: none"> - Access, coordination with response agencies 	<ul style="list-style-type: none"> - Closures, timing, schedule, access, phasing 	<ul style="list-style-type: none"> - Trucks, logging and gravel operations, maintain two lanes, bikes and pedestrian access 	<ul style="list-style-type: none"> - Cost - Construction completion 	<ul style="list-style-type: none"> - Construction risk - Construction safety, timing, phasing 	
Roundabout Intersection	●	⦿	⦿	⦿	NA	○	○	○	○	○	<ul style="list-style-type: none"> - Improved safety - Improved truck access to I-70 ramp - Reduced emissions
Two Way Stop Intersection	⦿	○	○	○	NA	⦿	⦿	⦿	⦿	⦿	<ul style="list-style-type: none"> - Minimizes disruption and traffic impacts to Colorado River Road - Lower cost - Simpler construction

Evaluating Bridge Structure Alternatives

An initial list of alternative bridge structures was considered for the Dotsero bridge replacement, including one, two, three, and four span configurations. Clear spans of the river were identified as preferred in the I-70 aesthetics guidance, but the clear span option was determined to be too deep relative to the vertical distance between the water and the bridge superstructure and too costly. The two span configuration would have a pier centered in the bridge and in the Colorado River channel. Three span options provided the widest variety of span configurations for the site with a wide variety of structure types possible. The location of the piers could be placed in a manner to align them with the downstream piers and /or with the natural features of the river.

The Technical Team and project staff worked to ensure that the design options considered the context statement and were evaluated against the critical success factors. These measures were applied to the viable structure types, as shown in next table and were presented to the Technical Team to recommend a bridge structure. The recommended structure is a three span bridge based on Option C in the table below. The span configuration was adjusted to a 143 foot center span with 87 foot end span on the west and 120 foot end span on east. The proposed structure represents the best fit for the project's critical success factors, as shown in the following table, and minimizes impacts to the Colorado River. The simple span, continuous tub girder structure is commonly built and has few constructability issues. This structure represents one of the lowest cost options, minimizes risks and constructability issues and incorporates considerations from the CSS aesthetic guidance.

Bridge Alternatives	Critical Success Factors										Comments
	1 - Meet FHWA and CDOT design and safety standards	2 - Do not preclude future improvements to interchange	3 - Minimize environmental impacts	4 - Accommodate all users, including bicycles and pedestrians	5 - Accommodate river access in partnership with Eagle County	6 - Accommodate emergency access during and after construction	7 - Minimize disruptions during construction	8 - Maintain traffic during construction	9 - Meet schedule and budget	10 – Maximize constructability	
	CONSIDERATIONS										
	- FHWA and CDOT Design Standards - CSS Design Guidance and sustainability principles - Random parking, access and operations, sight distance	- Reconfiguration of split diamond interchange	- Avoid, minimize, mitigate environmental impacts - River, wetlands, riparian, water quality, fisheries, chub wildlife and LIZs, archeology, paleontology, historic	- Recreation trail for pedestrians and bicyclists, crossing locations and operations	- Coordination with Eagle County river access parcel plan, Cotton Lane intersection alignment and sight distance	- Access, coordination with response agencies	- Closures, timing, schedule, access, phasing	- Trucks, logging and gravel operations, maintain two lanes, bikes and pedestrian access	- Cost - Construction completion	- Construction risk - Construction safety, timing, phasing	
3-SPAN BT72, SIMPLE MADE CONTINUOUS Center Span 140' End Spans 105' Option B											- Not as open as possible - Doesn't frame the river - Uses Bulb-Ts - Piers in the river - Short center span/channel - Cost efficient - Standard construction
3-SPAN CONCRETE U72 Center Span 140' End Spans 105' Option C											- Uses U-shaped girders - Piers in the river - Short center span/channel - Cost efficient - Standard construction

<p>3-SPAN SPLICED BT84</p> <p>Center Span 200' End Spans 75'</p> <p>Option D</p>											<ul style="list-style-type: none"> - More open span - Uses Bulb-Ts - Less impact on the river - Long center span/channel - Post tension required for longer span - Increased risk with splice
<p>3-SPAN VARIABLE DEPTH STEEL ANCHORED END SPAN</p> <p>Center Span 210' End Span 70'</p> <p>Option G</p>											<ul style="list-style-type: none"> - Most consistent with CSS guidance - Less impact on the river - Long center span/channel - Most expensive - Material and erection risks

CSS Design Criteria Considerations

The I-70 Mountain Corridor Context Sensitive Solutions guidance was considered as one of the critical success factors. The CSS guidance includes both design criteria for engineering and aesthetic guidance. The criteria, as well as the stated objective of each criterion, were applied to the structure options. Three criteria are not met in the proposed design and the rationale for each is provided below.

- *Utilize closed end abutment designs which have a minimum vertical height of 8' as described in the Design Criteria.*

In order to keep the roadway grades safe as they approach the intersection with Colorado River Road west of the bridge, the west abutment could not meet this criteria without cutting into the existing berm of the river. The berm is continuous upstream of the existing bridge through the I-70 bridges and changes to the geometry of the berm, such as placing the abutment in front of it, could present hydraulic issues. It was recommended to use an integral abutment with an exposed face of 2 feet at the west abutment. Closed end U-shaped wingwalls can and will be incorporated.

- *Incorporate thoughtful and deliberate shadow patterns on super structures and abutments. The overhang of the bridge deck should be equal to 2/3 the height of the girder to produce the desired shadow on the superstructure.*

The proposed overhang is approximately 10 inches larger than the maximum allowed by the CDOT Bridge Design Manual. When overhangs exceed the requirements, the CDOT Bridge Design Manual states, "These overhang criteria may be exceeded with the approval of the Staff Bridge Engineer." Therefore an exception is necessary for being short of the overhang requirements for CSS and requires Staff Bridge Engineer approval for being longer than CDOT Staff Bridge requirements.

- *Avoid locating piers in a stream or river where scour could occur.*

To avoid placing piers in the river, the bridge would need to span 250 +/- feet for normal flows, 310 +/- feet to span the 100 year flow. The bridge would have one of the largest single spans in the state and could not be spanned by conventional girder systems. Bridge types that could be used for clear spans of these lengths include anchored end spans, arches, and trusses. These are not commonly constructed in Colorado and would pose a significant increase in the project budget, likely two to four times the cost of a conventional girder bridge. The existing US 6 over the Colorado River bridge is a three span bridge with two piers in the river. The adjacent existing I-70 bridges are four span bridges, each with three piers located in the river. It was recommended to use a three span bridge with two piers in the river.