



L O R I S

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*Mastering the Art of
Engineering Structures
and Infrastructures*

June 7, 2011

Mr. Jim Schmidt

City of Boulder
Open Space & Mountain Parks
P.O. Box 791
Boulder, CO 80306

Reference: **SH119 Trail Extension to Tunnel #1**
Feasibility Report

Dear Jim:

Loris and Associates has performed a conceptual study to determine a preferred alignment and conceptual cost estimate to extend the existing trail from its current terminus to Tunnel #1. Alternate alignment options and associated costs were also evaluated. We believe there is a definite Preferred Alignment from a user enjoyment disposition, provided easements can be obtained. The Preferred Alignment also appears to be the most cost effective alignment, although the cost differentials of the various alignment alternatives are not significant. Our conceptual cost estimate for the preferred alignment is \$5.4M.

Please refer to the attached plans for a plan view of the preferred and various alternate alignment options. Five basic trail typical sections apply to the various alignments throughout the study reach as described below. For each typical section type, we have developed a linear foot unit cost and tabulated applicable section lengths.

Section #1 – Typical Trail: A 10' wide crusher fines trail with 3:1 sideslopes. Unit cost = \$160/lf.

Section #2 – Bridge Span: A typical prefabricated bridge span with a 10' clear width and treated timber deck. Unit cost = \$1600/lf.

Section #3 – Underpass: A 4-sided CBC, 14' wide x 8' minimum height. Unit cost = \$4300/lf.

Section #4 – Rock Cut: 10' concrete trail adjacent to rock excavation. Unit cost = \$900/lf.

Section 4A – Rock Cut with Barrier: Alternate rock cut section which would reduce the rock cut excavation at the expense of adding a barrier. The feasibility of this alternate section will depend on the profile grade, a more detailed quantities estimate, and a possible exception of a compromised trail width thru this stretch; all of which are beyond the limitations of this report.

Section #5 – Soil Nail: 10' concrete trail cut into the SH119 embankment. Unit cost = \$1000/lf.

Section #5A – Guardrail Type 7, Style CE Concrete Barrier: 10' concrete trail utilizing the CDOT Guardrail Type 7, Style CE Barrier to provide a limited cut. There are portions of Section #5 applicability where a limited bench exists and this section may be applicable. This guardrail type would provide up to 3' of retainage. A more detailed topographic survey will be required to determine the limits of this section.

Section #6 – Shared Use Path: This section is specific to the Alps Boulder Canyon Inn drive. The existing drive is 10', which is just enough for a single vehicle traveling in one direction. The inclusion of two directional pedestrian and bicycle traffic with no modifications to the drive may cause considerable user conflict. It should also be noted that the sight distance is limited and downhill traveling cyclists may be moving at high speeds regardless of signage. The proposed section therefore consists of rebuilding the drive to consist of a 16' wide shared use vehicular drive with a dedicated 6' lane for downhill bike/pedestrian traffic and a 10' shared lane for uphill bike/pedestrian/vehicular traffic. The existing masonry and landscaping would be heavily impacted, but we believe the reconstruction could be performed in a manner that is agreeable to all parties. Unit cost = \$825/lf.

Preferred Alignment Narrative: The Preferred Alignment consists of extending the trail along the current informal path between Boulder Creek and SH119 to where the informal path ends. From this point, an 85' bridge span is recommended to clear the area where only a steep slope exists between Boulder Creek and SH119. This bridge span would lead directly into an underpass below SH119. The underpass would be on a skewed alignment with respect to SH119 and daylight in the open area north of SH119, near an existing culvert inlet. The recommended underpass dimensions are 8' minimum inside height by 14' inside width. Because the trail profile grade will likely be below the culvert invert elevation, this culvert will need to be modified or reconstructed, possibly incorporated into the pedestrian underpass itself.

The trail would then continue thru the open area to where a rock outcrop exists immediately adjacent to the road. A significant rock cut is required thru this stretch to place the trail and separation barrier. To minimize the amount of rock cut thru this stretch, it may be possible to build the trail above the separation barrier, as was done further down the canyon. But because the trail will already be climbing sharply out of the underpass, and because existing grade must be maintained at the Alps Boulder Canyon Inn entrance immediately uphill, the ability to elevate the trail thru this stretch is limited.

The trail would then utilize the existing Alps Boulder Canyon Inn drive. This drive is only a single lane access. Considerable conflict may exist if modifications to this drive are not made. From the entrance to the parking lot, we recommend removing and reconstructing portions of the existing landscaping and retaining walls in order to increase the drive width and facilitate a shared use path. The existing drive is 10' wide with landscaping and retaining walls on both sides. Assuming a 2' shoulder

adjacent to SH119, a 2' separation barrier and removal of landscaping, a total shared path width of 16' appears possible while maintaining the existing entry and overall functionality. At the beginning of the parking lot, the road begins to separate from the drive. At this point, the trail could then divorce from the drive and be placed between it and SH119, or the drive could be widened to continue a shared use access.

The trail would then cross the Alps Boulder Canyon Inn drive exit and enter a flat area north of a wetland drainage basin. It would then cross Chapman Drive, and continue along the flat area to the existing underpass immediately north of the Red Lion Inn. The existing cattle crossing underpass is very restrictive at about 4' wide by 7' tall and since the existing alignment is not ideal, we recommend replacing it. The recommended replacement underpass would be 8' minimum height by 14' inside width and would be skewed to SH119 to better facilitate better sight lines and longer curve radii in and out of the underpass. The trail would then utilize the bench between Boulder Creek and SH119. A switchback spur to access the Red Lion Inn is also recommended at this location.

The trail would then continue along this bench to the end of the flat area just east of Private Residence #2. The preferred alignment would then include a pedestrian bridge over Boulder Creek onto this property, continue as close as practical to the creek to the western end of the property, then bridge back over the creek. This landing area which contains a gaging station, several old picnic benches and historical monuments provides an excellent opportunity for trailhead parking and/or park area. The trail would then continue west along the revegetated bench. At the end of the bench, it would then continue on a built-up bench to the hydro-electric plant. We also recommend an underpass be provided to access the Betasso Link Trail. The link from the underpass and Betaso Link Trail will be very topographically challenged; however, since Betasso Link Trail is a hiking/mountain biking trail, the underpass link may incorporate a very steep grade, stairs and a sharp turning radius as necessary. It is important to note that this preferred alignment requires an easement from the Private Residence #2, located at 38148 Boulder Canyon Drive. If this easement cannot be acquired, an alternate alignment will be necessary.

Alternate Alignment Narrative: There are many alternate alignment possibilities through various portions of the trail. These various alternatives are not recommended from a cost and user enjoyment perspective, but may prove to be the only options available should shared land use agreements be unattainable, or other mitigating circumstances arise.

Alternate 1: This option is presented as a means of avoiding the shared use path at the Alps Boulder Canyon Inn. It would start where the first pedestrian bridge of the preferred alignment is located and would begin with a pedestrian bridge over Boulder Creek onto the Private Residence #1 property. It would then continue as close as practical to the creek to where an existing waterline crosses the creek. The trail would also cross the creek at this location and utilize an existing bench to its terminus. A particularly difficult length of trail would then ensue, consisting of either a soil nail or micropile A-frame wall cut into the SH119 embankment; a soldier pile wall to build up the embankment, or a series of bridge spans. We

believe the soil nail wall to be the most practical of these sections at this time, although more information will be required with respect to site survey, utilities and geotechnical conditions before a final wall selection can be made. Within portions of this length, a limited bench width exists behind the guardrail. Replacing the existing standard Guardrail Type 3 with Guardrail Type 7 (Style CE) may provide enough retainage to construct the trail in these areas and would be the preferred section to those listed above if and where it is geometrically feasible to construct. The trail would continue through this difficult stretch until it could bridge over the creek to the Red Lion property. It would then continue thru the property as close as practical to the creek, utilize the Red Lion bridge to cross the creek again, then continue along the Preferred Alignment.

Alternate 1A: The trail section cut into the SH 119 embankment is very expensive and not user friendly. Accordingly, the Alternate 1A alignment crosses into the Red Lion property as soon as practical. If this property agreement cannot be obtained, Alternate 1A would consist of continuing the trail along the difficult embankment cut. The trail would preferably go beneath the Red Lion entrance bridge and then return to the preferred alignment. The presence of the steep channel embankment at the bridge and required headroom may make this underpass particularly difficult.

Alternate 1B: At the Red Lion Bridge, the channel is constricted and the embankment slope is steep. It may be more feasible to continue the soil nail embankment cut section all the way up to the Red Lion entrance, then return to the preferred alignment.

Alternate 2: This modest alignment alternate presents itself at the very beginning of the project. It consists of commencing the trail along the existing private driveway, and could either bridge over the creek to the preferred alignment, or continue along this property along Alternate 1. This alternate offers little advantage to the preferred alignment in and of itself, unless it is desired to avoid the shared use drive further along the trail at the Alps Boulder Canyon Inn.

Alternate 3: West of the Red Lion, a property exists along the preferred alignment. Beyond this property is a water gaging station and the hydro-electric plant, whereas the Betasso Link Trail exists on the opposite side of the road. Placing the trail on the north side of the road would alleviate these issues, but would necessitate long stretches of significant rock cut, and would be at an undesirable proximity to the SH119.

Alternate 4: If the preferred alignment is desired, but a property agreement cannot be reached with the Private Residence #2 just west of the Red Lion, the soil nail embankment cut section would need to be utilized. It should be noted that the entrance bridge to this property is in critical condition, having already experienced an apparent partial scour failure at its north abutment. It may be beneficial to both parties to replace the bridge in exchange for a trail easement. The replacement bridge could also serve as the trail crossing as depicted as Alternate 4A on the plans.

We hope this information is of assistance in your considerations for this existing trail connection. Please feel free to contact us should you have any questions regarding this material.

Sincerely,

The Office of
Loris and Associates, Inc.

A handwritten signature in black ink, appearing to read "Dan Beltzer".

Dan Beltzer, P.E.
Project Manager

Reviewed by,

A handwritten signature in black ink, appearing to read "Peter J. Loris".

Peter J. Loris, P.E.
Principal