DRAFT VALUE ANALYSIS STUDY

National Park Service
U.S. Department of the Interior

Federal Highway Administration
U.S. Department of Transportation
North Carolina
Department of Transportation

Blue Ridge Parkway
North Carolina

REPLACEMENT OF BLUE RIDGE PARKWAY BRIDGE OVER INTERSTATE 26

Federal Project Number– NC_ST_BLRI_I26_NEPA
PMIS 221876

Value Analysis (VA) and Choosing-by-Advantages (CBA) Study

May 2016

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VALUE ANALYSIS AND CHOOSING-BY-ADVANTAGES STUDY

DECEMBER 15-17, 2015

BLUE RIDGE PARKWAY

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FOREWORD

This Value Analysis Report presents the recommendations of the Value Analysis Study for the Replacement of the Blue Ridge Parkway Bridge over Interstate 26 (federal project number NC_ST_BLRI_I26_NEPA) conducted on December 15-17, 2015 at the Blue Ridge Parkway headquarters in Asheville, North Carolina.

This is to certify that the Value Analysis Study was led by the undersigned Value Analysis Study Facilitator and was conducted in accordance with the Federal Highway Administration, National Park Service, and North Carolina Department of Transportation value engineering analysis principles and guidelines.

John W. Hoesterey
Value Analysis Study Facilitator
JWH Environmental Consulting LLC
Littleton, Colorado

EXECUTIVE SUMMARY

SUMMARY DESCRIPTION OF THE PROJECT

The North Carolina Department of Transportation (NCDOT) has been approved to widen I-26 from four to eight lanes from Hendersonville NC, to Interstate 40 in Asheville, NC. This widening requires that the existing Blue Ridge Parkway Bridge over I-26 must be reconstructed. The abutments and piers of this existing bridge would restrict lane widening beneath.

The parkway bridge must accommodate the following I-26 parameters: Existing width is 84.5'; Edge of travel lane to edge of travel lane existing width is 63.75'; Proposed width is 146' for the ultimate future 10 lane build out edge of travel to edge of travel; Proposed width is 90.5' on both sides of centerline of required clear span for ultimate 10 lane section.

All government stakeholders have agreed that the existing bridge must be removed and replaced with a new bridge, designed for widening I-26 up to 10 lanes. The National Park Service (NPS) and the Federal Highway Administration, Eastern Federal Lands Highway Division (EFLHD) identified several new alignment alternatives, as well as the existing alignment, for evaluation. Retrofitting the bridge will also be evaluated. Schematic design options for the bridge and alternative realignment of the parkway will be prepared by the government. In a memorandum of agreement (MOA), the Federal Highway Administration, Eastern Federal Lands Highway Division (EFLHD) has been contracted to provide conceptual designs for the new bridge.

STUDY OBJECTIVES

The objectives of the value analysis study were to identify opportunities to increase value or reduce cost, and to identify a preferred bridge alignment and bridge type.

SUMMARY OF RECOMMENDATIONS

The value analysis (VA) study team relied on the initial bridge type and alignment schematic design alternatives developed by EFLHD to foster discussion of opportunities to improve the performance and the value of the project. These were fully evaluated in the Evaluation Phase of the study. Following full evaluation of the project alternative candidates, a preferred alternative was recommended by the VA team.

Design Alternatives

Four bridge alignments and three bridge types were initially considered for the Blue Ridge Parkway bridge over I-26. The bridge type options and alignment alternatives are described below. The VA team also considered two options for bridge railings: the Kansas Corral rail and the Caltrans Type 80 rail. Note that in the location study area, for discussion purposes, I-26 is considered to run north and south and the Blue Ridge Parkway Design Alternatives run east and west.

<u>Bridge-type Options</u>

- Post-Tensioned Concrete Box Girder (segmental construction, precast or cast-in-place)
- Steel Plate Girder
- Retrofit the existing bridge with a steel arch (applies only to alternative 7)

<u>Alignment Alternatives</u>

The alternative numbers presented below were retained from the 2015 NPS report *Blue Ridge Parkway Bridge over Interstate 26: Conceptual Alternatives, Impact Topics Considered,*

Environmental Consequences, and VA/CBA Study Factors. The report evaluated seven alternative bridge alignments and dismissed two (alternatives 2 and 3). The VA team started with retained alternatives 1, 4, 5 and 7. Alternative 7 retained the existing road and bridge alignment and consisted of either retrofitting the existing bridge or constructing either a new concrete segmental bridge or steel girder bridge. As discussed in the Evaluation section below, the VA team selected a two-step decision process in which the first step would evaluate and select a preferred road and bridge alignment and the second step would evaluate and select a preferred bridge type.

Alternative 1. The roadway would be realigned to the north (or Asheville) side of the existing bridge, and consist of approximately 2,300 ft. of roadway realignment with the bridge being on a curve with a radius of 1,530 ft. Because of its single sweeping curve, it would also be the longest bridge alternative. The bridge would be lengthened to 715 feet (concrete box girder)/835 feet (steel girder), and would require a 2-foot curve widening of the bridge.

Alternative 4. The roadway would be realigned to the south (or Hendersonville) side of the existing bridge, and would consist of approximately 3,015 ft. of roadway realignment with the bridge being on a curve with a radius of 1,075 ft. The new bridge will have an approximate length of 605 feet (concrete box girder)/705 feet (steel girder) and will require 2 ft. of widening on the bridge. Note: following the VA, the vertical and horizontal alignments of alternative 4 were revised. The revised alternative does not alter the evaluation and is presented in the report.

Alternative 5. The parkway for this alternative would be realigned to the south side of the existing bridge, and would consist of approximately 3,255 ft. of roadway realignment with the bridge being on a curve with a radius of 1,510 ft. The approach curve radius to the bridge would be substandard (565 ft.) and would require 10% superelevation and 3 ft. of roadway widening. The new bridge would have an approximate length of 605 feet (concrete box girder)/705 feet (steel girder) and would require a 2-foot curve-widening on the bridge.

Alternative 7. The bridge would either be replaced with a new bridge at its current location, or would be retrofitted with a steel or concrete arch constructed beneath the existing bridge deck. The insertion of an arch would allow for the piers closest to I-26 to be removed. A new bridge would have a 1091-foot radius curve and 3-foot of curve widening on the bridge. The bridge length would be 605 feet (concrete box girder)/705 feet (steel girder)/512 feet (retrofit).

Under alternatives 1, 4, and 5, the existing bridge would remain in service during construction. Alternative 7 would require closure of a portion of the parkway and a construction detour.

Construction and Life Cycle Cost Estimates

Initial design construction and life cycle cost estimates are presented below. A detailed construction and life cycle cost estimate for each bridge type is presented in Appendix B.

Initial Design Construction and Life Cycle Costs

Alignment and Bridge Type Alternatives	Construction Cost (Alignment and Bridge)	Total Life Cycle Cost (Bridge only)
Alternative 1 - Concrete Segmental	$21,000,000	$19,326,597
Alternative 1 - Steel Girder	$23,300,000	$22,159,535
Alternative 4 - Concrete Segmental	$19,200,000	$16,237,008
Alternative 4 - Steel Girder	$21,300,000	$18,883,779

Initial Design Construction and Life Cycle Costs (Continued)

Alignment and Bridge Type Alternatives	Construction Cost (Alignment and Bridge)	Total Life Cycle Cost (Bridge only)
Alternative 5 - Concrete Segmental	$18,700,000	$16,237,008
Alternative 5 - Steel Girder	$20,900,000	$18,937,779
Alternative 7 - Concrete Segmental	$17,000,000	$16,237,008
Alternative 7 - Steel Girder	$19,300,000	$18,937,779
Alternative 7 - Retrofit	$16,600,000	$24,845,339

Summary of Alternatives Evaluation

The alignment alternatives were evaluated first using a process called Choosing by Advantages (CBA), where decisions are based on the relative importance of advantages between alternatives. The evaluation involves the identification of the attributes or characteristics of each alternative relative to the evaluation factors, a determination of the advantages for each alternative within each evaluation factor, and then the weighing of importance of each advantage. The following summarizes the results of the evaluation and the scoring of the alignment alternatives.

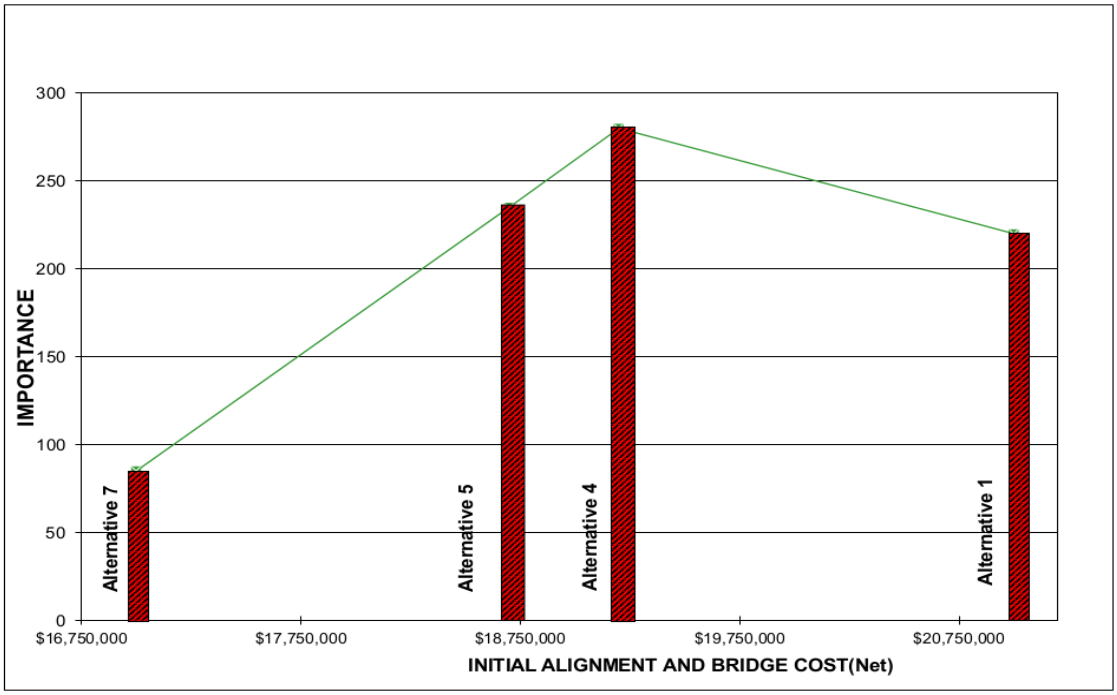
Summary of Advantage Scores

Factor	Alt 1	Alt 4	Alt 5	Alt 7
1. Optimize Health, Safety, and Welfare	55	90	45	
2. Maintain or Improve Natural Resources	25			40
3. Maintain or Improve Cultural Resources		20	20	45
4. Maintain or Improve Visitor Experience	70	100	100	
5. Optimize Operations and Maintenance	70	70	70	
Total	**220**	**280**	**235**	**85**

Alternative 4 alignment has the greatest total advantage. It would have the least impact on visitor experience and would provide the greatest safety and operation and maintenance efficiency by avoiding a detour. It, as well as with alternatives 1 and 5, would have greater effect on cultural and natural resources than alternative 7, however, initial consultation with the SHPO and field surveys of natural and archeological resource indicate that the impacts would be slight and/or could be mitigated. Alternative alignment 5 has somewhat less advantage than alternative 4 because of the sharpness of curves in the alignment and superelevation of the bridge. This was further evaluated by the VA team.

Recommended Preferred Alternative

Costs and advantages of the alternatives were evaluated to determine a preferred alignment. Alternatives 4 and 5 were considered first. They both provide considerable advantage over alternative 7 and with an increased cost that is much less than alternative 1. Alternative 4 provides greater total advantage than alternative 5, but would cost somewhat more. The VA team conducted an additional side-by-side evaluation of the two alternatives to further refine the evaluation. Alternative 4 has safety advantages compared with alternative 5, as discussed in the initial evaluation. The two alternatives were further compared by 1) the ability to adjust alignment grades to tie into the bridge, 2) the degree of the new alignment's departure from the existing parkway alignment, and 3) constructability based on topography. For all factors, alternative 4 would be preferred. Based on this evaluation, alternative 4 is the recommended alignment.



Total Advantage Score and Total Initial Cost

Bridge type - Following the selection of the preferred alignment, an evaluation and selection of the preferred bridge type was conducted. Four factors were considered, 1) Optimize operations and maintenance, 2) Construction duration, 3) Construction impacts to I-26, and 4) Sustainability. In all factors a concrete segmental bridge has greater advantage than a steel girder bridge and at a lower cost. The concrete segmental bridge is the preferred bridge type.

Bridge railing - The VA team evaluated the performance of two bridge railing options: Caltrans Type 80 and Kansas Corral rail. The evaluation was based on five evaluation factors: 1) Screening visibility of I-26, 2) Ability to divert drainage, 3) Aesthetics, 4) Ability to integrate stone guard walls, and 5) Ability to integrate hand rails. In all five factors, the Caltrans Type 80 rail was preferred and is recommended as the preferred railing type.

In addition, to the two bridge railing options, a suicide deterrent fencing add-on was considered, but was dismissed due to compliance concerns including negative visual effects and other cultural resource effects.

Additional Topic and Design Recommendations

The following items were discussed during the VA workshop and recommendations developed.

Mountains-to-Sea Trail – The VA team affirmed the parkway study recommendation. This would be considered a Section 4(f) mitigation. The trail would be realigned to parkway left at MP392. This would avoid the need for a pedestrian road crossing at or under the bridge to access the sidewalk (i.e. the trail would be on the same side of the bridge at both the west and east ends of the bridge). Construction of trailhead parking at mile post (MP) 392 would be under a separate project and not under the NCDOT bridge replacement project.

Guard walls - Stone guard walls using Georgia granite are recommended and would be consistent with other parkway bridge approaches. Georgia granite facing should continue onto the abutments.

Additional design recommendations

- Install interior inspection lighting (concrete box).
- Install a vandalism prevention/remote sensing and monitoring system.

CONTENTS

VALUE ANALYSIS STUDY

INTRODUCTION AND BACKGROUND

The North Carolina Department of Transportation (NCDOT) has been approved to widen I-26 from four to eight lanes from Hendersonville NC, to Interstate 40 in Asheville, NC. This widening requires that the existing Blue Ridge Parkway Bridge over I-26 be reconstructed. The abutments and piers of this existing bridge would restrict lane widening beneath.

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All government stakeholders have agreed that the existing bridge must be removed and replaced with a new bridge, designed for widening I-26 up to 10 lanes. The National Park Service (NPS) and the Federal Highway Administration, Eastern Federal Lands Highway Administration (EFLHD) identified several new alignment alternatives, as well as the existing alignment, for evaluation. Retrofitting the bridge will also be evaluated. Schematic design options for the bridge and alternative realignment of the parkway will be prepared by the government. In a memorandum of agreement (MOA), EFLHD has been contracted to provide conceptual designs for the new bridge. The existing bridge (Figure 1) identification and description is as follows:

- Bridge total length is 512.3 feet, with a width of 35.2 feet, with a curb to curb width of 28 feet.
- The bridge has 7 spans and the longest span is 95 feet. The bridge superstructure consists of steel plate girders with cast-in-place concrete deck. The driving surface is concrete.
- Piers 3, 4, & 5 are founded on rock, and piers 1, 2, 6 and both abutments are founded on steel piles.
- The existing railing consists of a concrete parapet wall with single tubular railing.
- The bridge has a vertical clearance above I-26 of approximately 100 feet.
- The bridge was designed for an H15 loading.

The preferred alternative recommended by this VA study (alternative 4), has been included as the preferred alternative in the preliminary EIS being prepared by NCDOT.

Value Analysis Study Objectives

The objectives of the value analysis study were to identify opportunities to increase value or reduce cost, and to assist in identifying a preferred bridge alignment and bridge type.

PHASE I – INFORMATION

Initial Design Alternatives

Four bridge alignments (Figures 2 through 5) and three bridge types (Figures 6 through 11) were initially considered for the Blue Ridge Parkway bridge over I-26. The bridge type options and alignment alternatives are described below. The VA team also considered two options for bridge railings as described below. Note that in the location study area, for discussion purposes, I-26 is considered to run north and south and the Blue Ridge Parkway Design Alternatives run east and west.

Bridge-type Options

- Post-Tensioned Concrete Box Girder (segmental construction)
- Steel Plate Girder
- Retrofit the existing bridge with a steel arch (applies only to alternative 7)

PHOTOGRAPHS
I-26 BRIDGE

STRUCTURE NO. 5140-124P
INSPECTION DATE: 8/6/13

PHOTO #1 - LOOKING SOUTHBOUND TOWARD CHEROKEE

PHOTO #2 - WEST SIDE

Figure 1: Existing Bridge (from 2015 Inspection Report)

Alignment Alternatives

The alternative numbers presented below were retained from the 2015 NPS report *Blue Ridge Parkway Bridge over Interstate 26: Conceptual Alternatives, Impact Topics Considered, Environmental Consequences, and VA/CBA Study Factors.* The report evaluated seven alternative

bridge alignments and dismissed two (alternatives 2 and 3). The VA team started with retained alternatives 1 and 4 and combined alternatives 6 and 7. Both alternatives 6 and 7 retained the existing road alignment. They differed with alternative 6 retrofitting the existing bridge and alternative 7 constructing either a new concrete segmental bridge or steel girder bridge. As discussed in the Evaluation section below, the VA team selected a two-step decision process in which the first step would evaluate and select a preferred road and bridge alignment and the second step would evaluate and select a preferred bridge type.

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Alternative 5. The parkway for this alternative would be realigned to the south side of the existing bridge, and would consist of approximately 3,255 ft. of roadway realignment with the bridge being on a curve with a radius of 1,510 ft. The approach curve radius to the bridge would be substandard (565 ft.) and would require 10% superelevation and 3 ft. of roadway widening. The new bridge would have an approximate length of 605 feet (concrete box girder)/705 feet (steel girder) and would require a 2-foot curve-widening on the bridge (Figure 4).

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Under alternatives 1, 4, and 5, the existing bridge would remain in service during construction. Alternative 7 would require closure of a portion of the parkway and a construction detour.

Alignment and Bridge Type Construction and Life Cycle Cost Estimates

Initial design construction and life cycle cost estimates are presented in Table 1. A complete construction and life cycle cost estimate for each bridge type is presented in Appendix B.

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Table 1: Initial Design Construction and Life Cycle Costs (continued)

Alignment and Bridge Type Alternatives	Construction Cost (Alignment and Bridge)	Total Life Cycle Cost (Bridge only)
Alternative 5 - Concrete Segmental	$18,700,000	$16,237,008
Alternative 5 - Steel Girder	$20,900,000	$18,937,779
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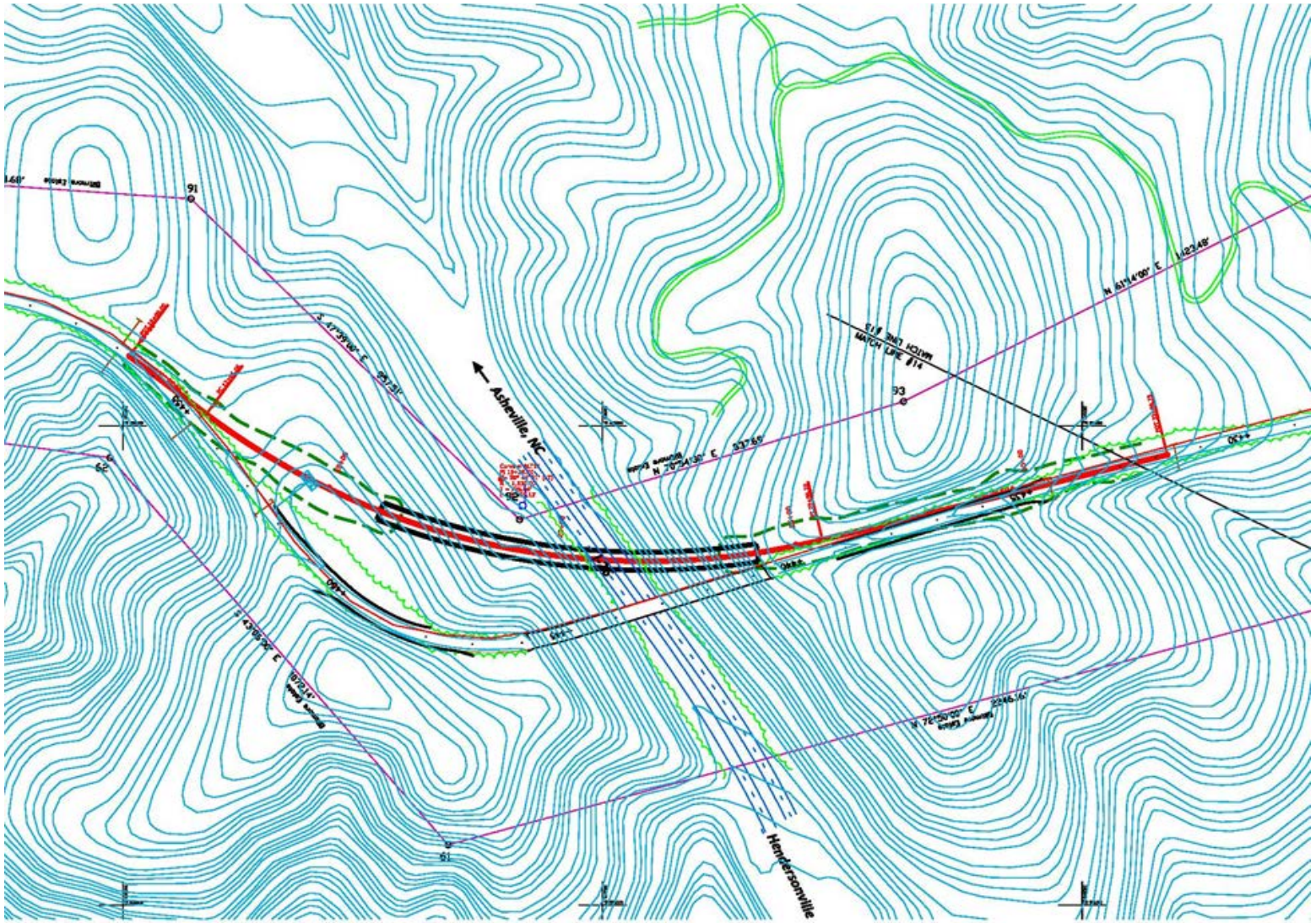


Figure 2: Alignment 1

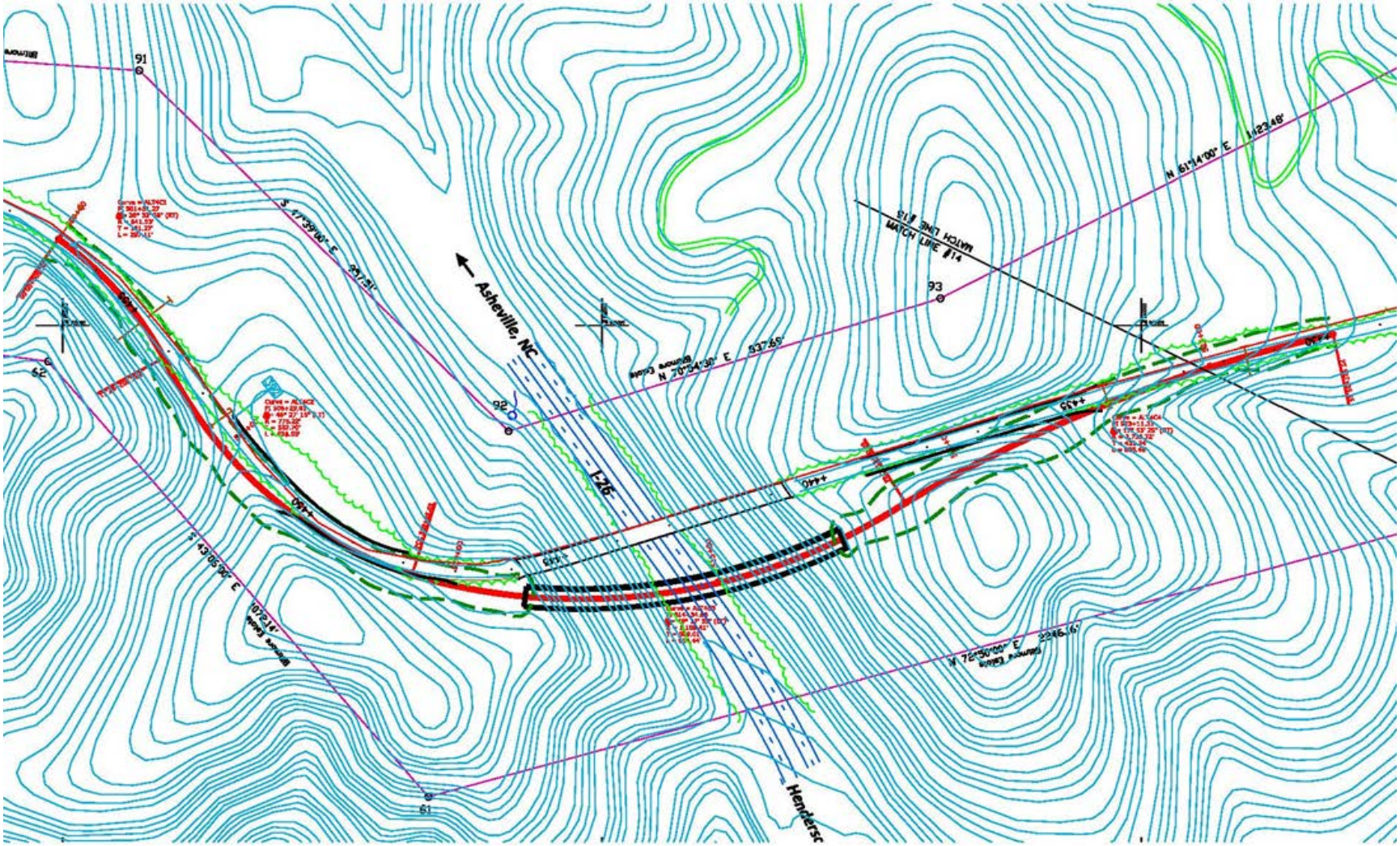


Figure 3: Alignment 4

Figure 4: Alignment 5

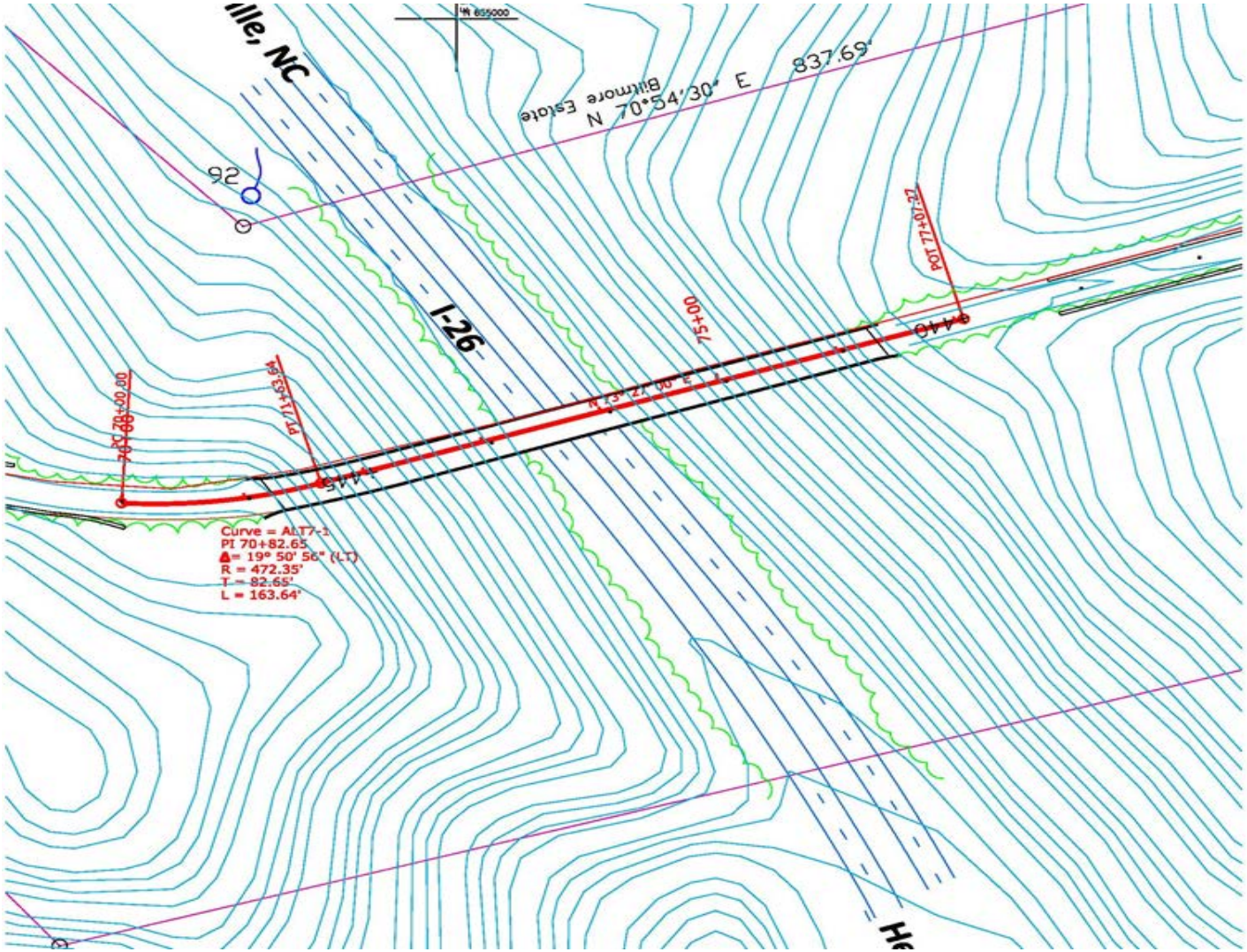


Figure 5: Alignment 7

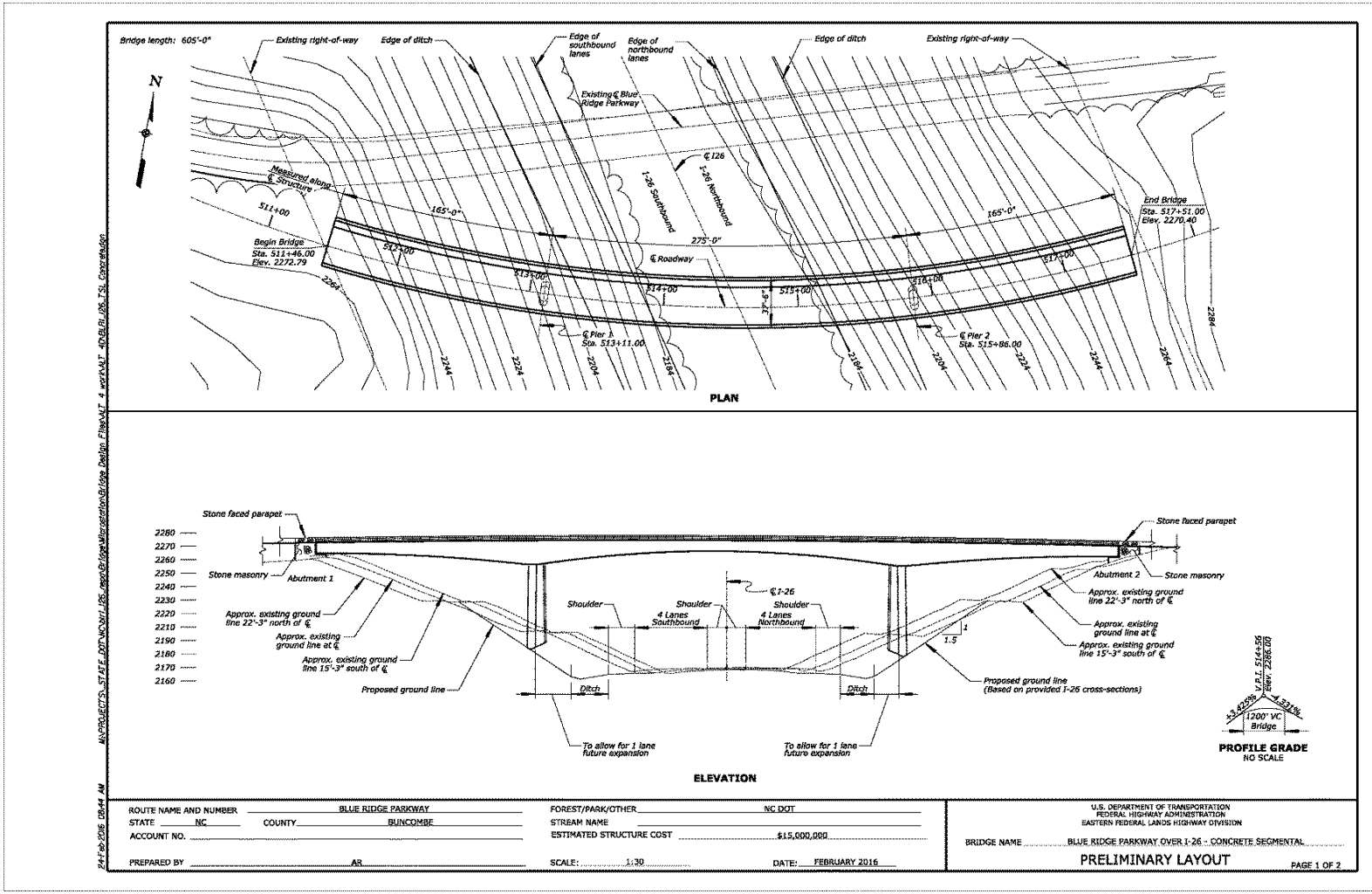


Figure 6: Plan and Elevation – Concrete Segmental Bridge

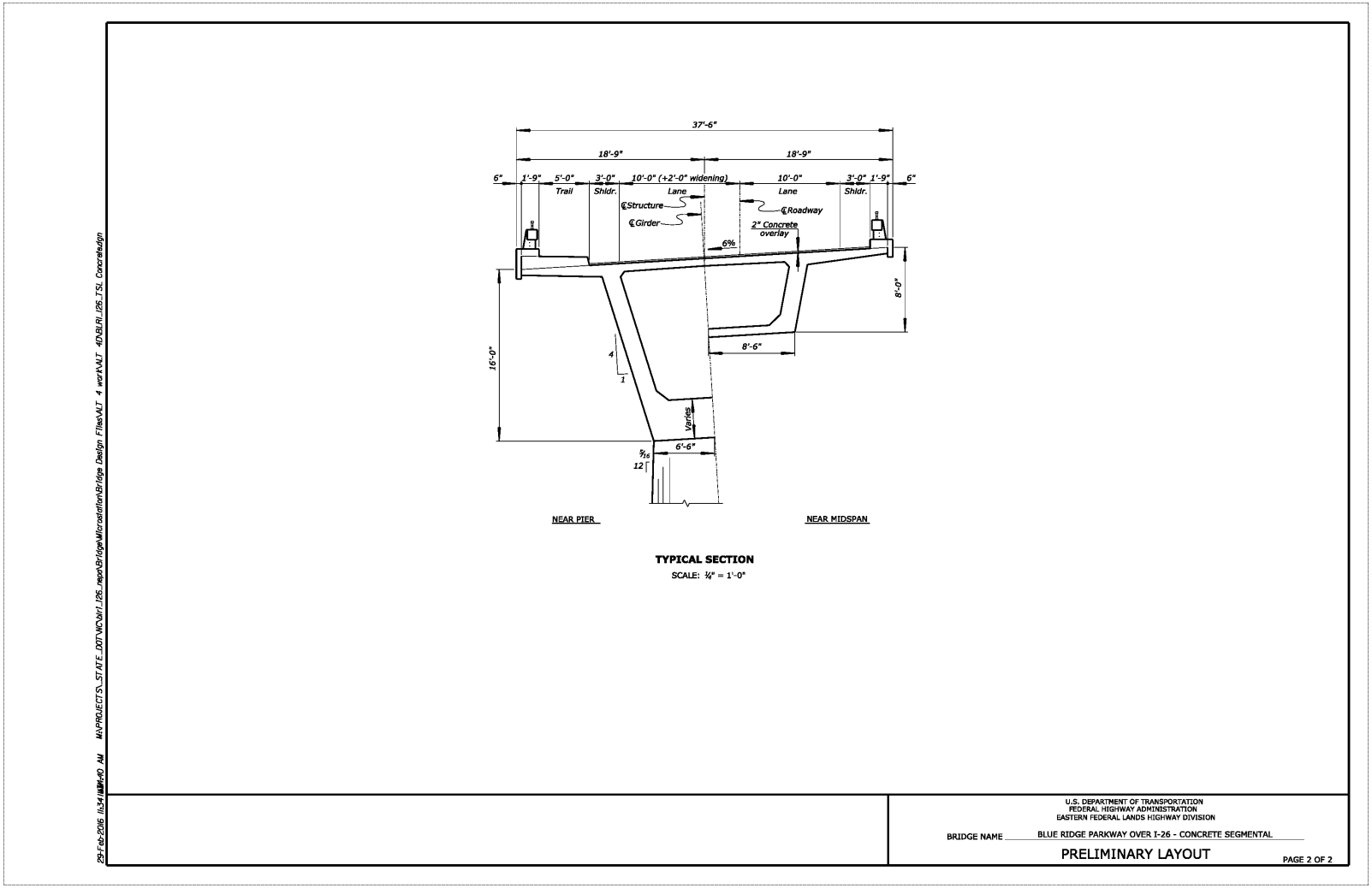


Figure 7: Section – Concrete Segmental Bridge

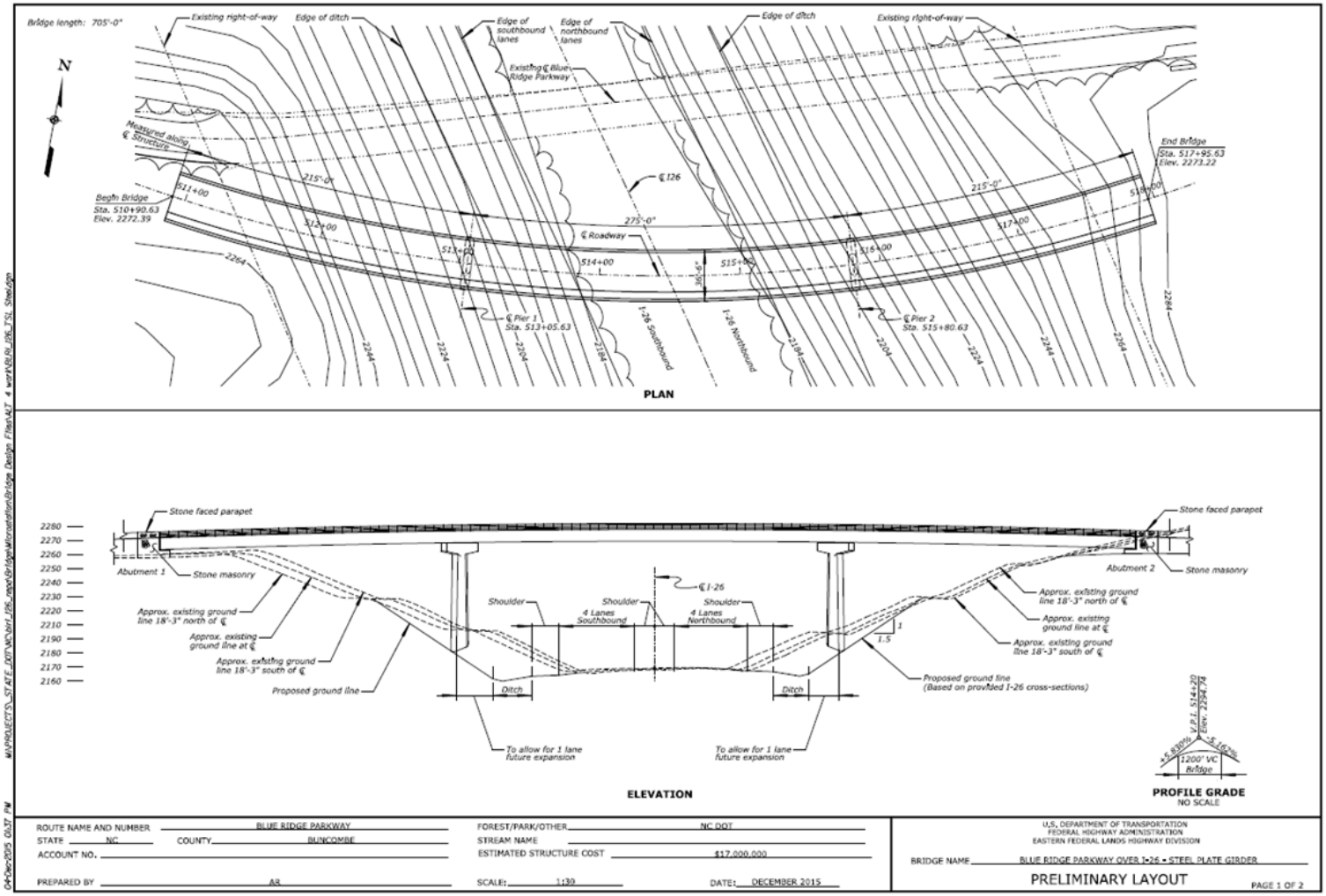


Figure 8: Plan and Elevation – Steel Girder Bridge

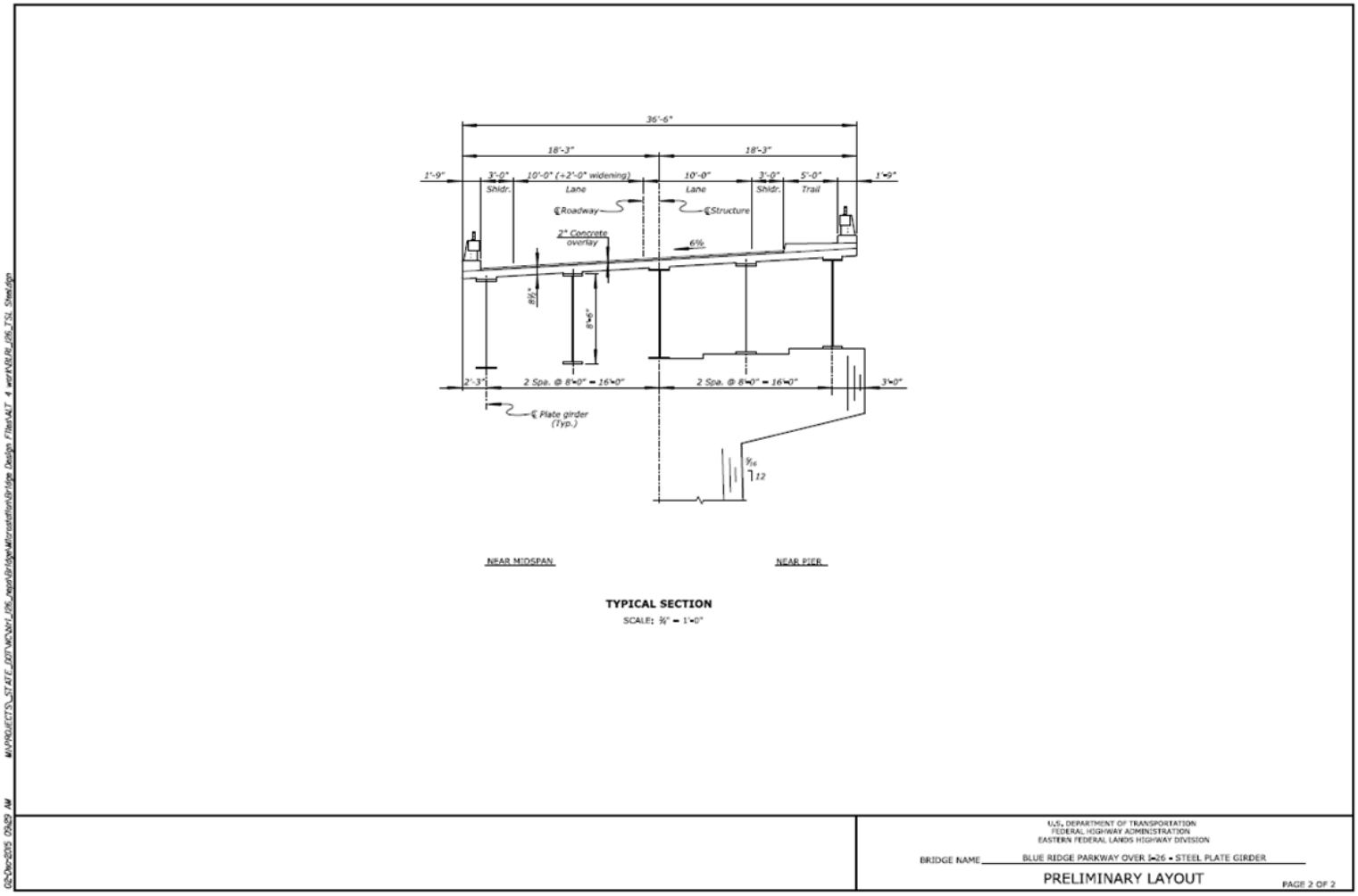


Figure 9: Section – Steel Girder Bridge

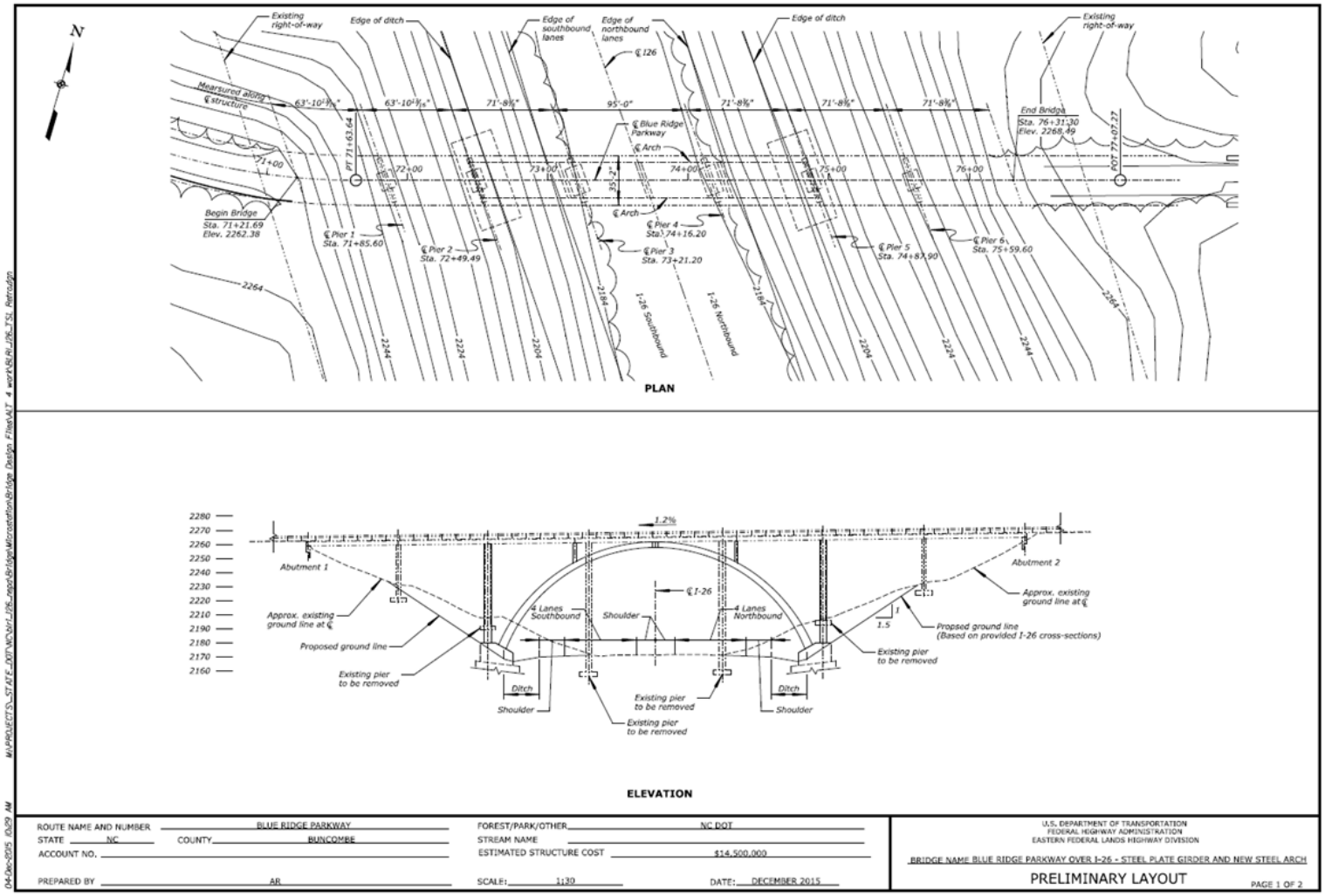


Figure 10: Plan and Elevation – Retrofit Bridge

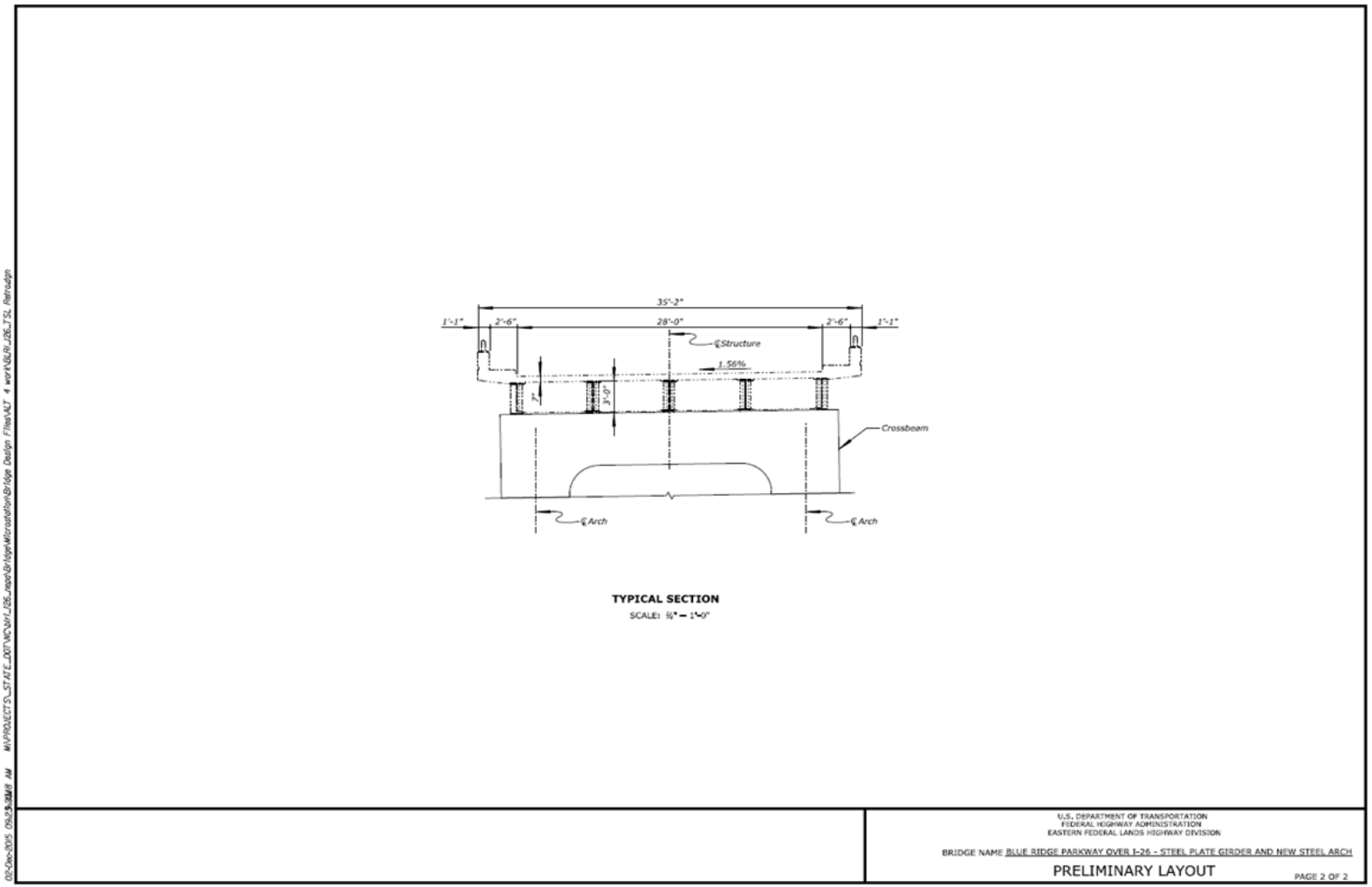


Figure 11: Section – Retrofit Bridge

Bridge Railing Options

Two railing designs were evaluated that meet crash test standards and meet cultural compliance and aesthetic criteria. The Kansas Coral railing system and the Caltrans Type 80 railing were considered by the VA team and are shown in figures 12 and 13. Both are 32-inch high concrete railings. A handrail, single or double tubular aluminum or steel railing, could be mounted on either railing system.

The Kansas Corral rail system is 32 inches in height and must be mounted with either a single or double tubular aluminum railing to provide the minimal 42-inch pedestrian safe vertical height requirement.

The Caltrans Type 80 railing is mounted with a square steel handrail system to give the railing system an overall height of 42 inches to make it pedestrian safe. Spaces within the railing and below the handrail are fitted with steel rods to limit vertical spaces to less than 6 inches in height. This railing system could also be mounted with the single or double tubular railing system.

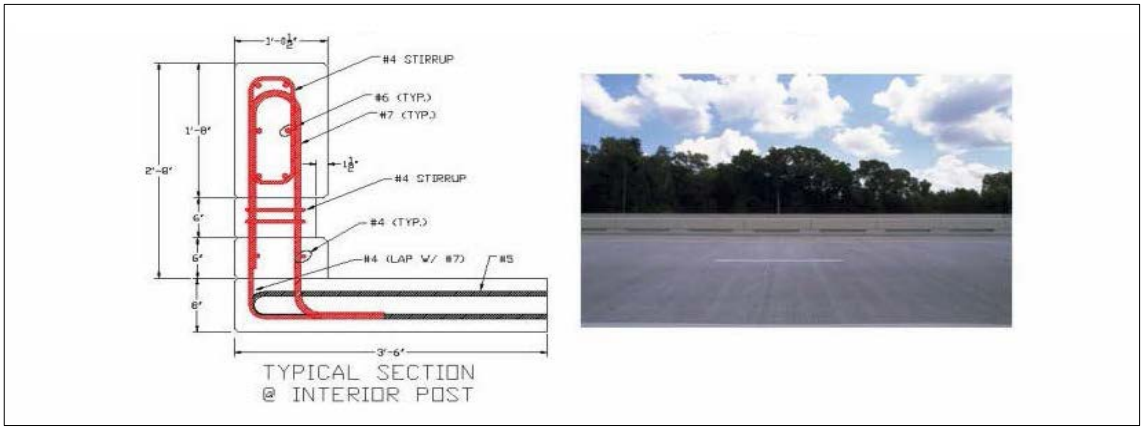


Figure 12. Kansas Corral Rail

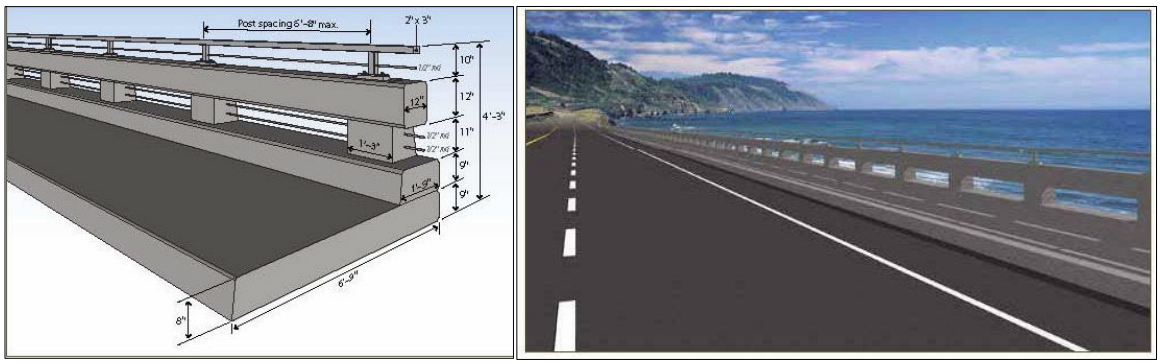


Figure 13. Caltrans Type 80 Rail

Existing Environment

The following is excerpted from *Blue Ridge Parkway Bridge over Interstate 26: Conceptual Alternatives, Impact Topics Considered, Environmental Consequences, and VA/CBA Study Factors, NPS.*

Vegetation

Most of the Blue Ridge Parkway is covered with forests. The study area is comprised of Montane Oak- Hickory Forest. Montane oak-hickory forests contain a mixture of oak species (often white oak dominates).

Invasive Species: Exotic and/or invasive species of concern in the project area include Chinese privet, Japanese honeysuckle, Japanese stilt grass, multiflora rose, and Oriental bittersweet. The disturbance associated with the realignment could increase the potential for the introduction of invasive species.

Table 2. Area of Vegetation Disturbance

Alternative	Clearing (acres)
1	1.7
4	4.0
5	4.0
7	0.5

Wildlife

By virtue of the production of vast quantities of acorns, hickory nuts, and a wide variety of soft mast associates, the wildlife food production capacity of oak forests is immense. Coupled with the sheer amount of this habitat, these oak forests are one of the most important habitats of the region to a significant variety wildlife species.

The Blue Ridge Parkway has no records of federally-listed species being present in the study area, with the exception of the northern long-eared bat. Northern long-eared bat surveys and consultation with U.S. Fish and Wildlife Service would be completed. Avoidance and minimization measures would be implemented to reduce impacts to the northern long-eared bat. One of the measures would likely be that tree clearing would occur while the bats are dormant, between November 1 and May 15.

Geologic Resources and Soils

Soils in the project area are comprised primarily of Clifton sandy loam and Evard-Cowee complex of varying slopes. In order to realign the bridge approaches and construct a new bridge across the parkway, grading would be necessary given the hilly topography. Areas of cut and fill would be needed to flatten the roadway grades. Balancing of the cuts and fills would allow for excavated material to be utilized as fill material on site. This would reduce the need for fill material to be imported from off-site or reduce the amount of excavated material to be disposed of off-site, depending on the volumes required.

Table 3. Volume of Soil Disturbance

Alternative	Volume of Cut/Fill (cubic yards)
1	9,800
4	42,000
5	38,000
7	200

Historic Structures

The bridge carrying the Blue Ridge Parkway is a contributing resource within the parkway, which is a resource previously determined eligible for the National Register of Historic Places (NRHP). Under all of the built alternatives, the bridge carrying Blue Ridge Parkway over I-26 would be demolished and replaced with a new structure. This would result in an adverse effect determination under Section 106 of the National Historic Preservation Act. A memorandum of agreement would be developed and executed to resolve the adverse effect. Favorable consultation has been initiated with the North Carolina State Historic Preservation Officer (NCSHPO).

Archeological Resources

A pedestrian survey of the Blue Ridge Parkway bridge replacement APE was completed by the NPS. No known archeological sites would be impacted. The build alternatives would have no impact on archeological resources.

Cultural Landscapes

The Blue Ridge Parkway motor road corridor is the centerpiece of a 469-mile long designed historic cultural landscape that stretches from Virginia to North Carolina. The Blue Ridge Parkway is a nationally significant cultural resource, and meets the eligibility criteria for designation as a National Historic Landmark. Realignment of the parkway motor road must be carefully considered to minimize impacts to the cultural landscape and the unique visual character of the designed landscape. The entire parkway motor road is listed on the parkway's cultural landscape inventory.

Realignment of the parkway motor road would alter the topography, vegetation, road alignment, and circulation patterns. This would be the first significant realignment of the parkway that exceeds a distance beyond the length of a new bridge. However, no historic views or vistas are visible from vehicles being driven along the Blue Ridge Parkway in the project area.

The design of the new bridge to replace the existing bridge must retain the landscape design characteristics of material use, aesthetics, workmanship, and alignment setting of the bridges built after the World War II Era. Steel girder or concrete box girder construction would meet these criteria.

Table 4. Bridge and Alignment Lengths

Alternative	Approximate Length of Bridge (feet)	Length of Realignment (feet)
1	835	2,300
4	705	3,200
5	705	3,260
7	705	Not Applicable

Visual Resources

Outstanding scenery is a key resource and important visitor experience along the Blue Ridge Parkway. The Blue Ridge Parkway crosses over I-26 but does not have direct access with I-26. Impacts to visual resources in the project area can result from the following:

- Duration and extent of the view to the I-26 widening from the new bridge and along the bridge approaches. This impact is directly related to the length of the new bridge, the extent of grading along bridge approaches that would open views to I-26 and the potential to reestablish view screening reforestation along the bridge approaches.

- The new bridge would be visible to drivers on I-26 and should be recognized as being appropriate and compatible and blend with the historic design of the Blue Ridge Parkway. To be considered appropriate and compatible the bridge type should be historically correct to the post World War II bridge construction types that have already been constructed on the Parkway.

- The bridge should be aesthetically pleasing and historically compatible from the perspective of visitors traveling on the parkway. The appearance of the bridge deck, railing design and the positioning of the bridge to lie lightly within the surrounding landscape are important impacting considerations.

Visitor Use & Experience

The Blue Ridge Parkway corridor landscape is comprised of over 80,000 acres of land and features 24 separate visitor use and recreation areas. The Blue Ridge Parkway receives an annual average of 18,210,827 recreational visitors (based on 1986-2005 data). Enjoyment of park resources and values by the people of the United States is part of the fundamental purpose of all national parks (2006 Management Policies).

The proposed action would have the potential to impact visitor experience by altering the driving experience of the Blue Ridge Parkway. This would include the impact of construction detours that would delay and disrupt a continuous parkway driving experience.

Mountains-to-Sea Trail

The Mountains-to-Sea Trail stretches from Clingman's Dome in the Great Smoky Mountains National Park to Jockey's Ridge State Park by the Atlantic Ocean. The mainline distance is 935 miles. The segments of Mountains-to-Sea Trail along the Blue Ridge Parkway were designated as National Recreation Trail in 2005. The frequently used trail is located within the project area corridor and would be indirectly impacted by the project.

Issues and Constraints

Project issues and constraints were discussed as part of the information phase and throughout the study proceedings. The following were identified as relevant to the objectives of the value analysis study.

Bats – There are two bat species that would require mitigating actions. If Indiana bats are present, nighttime work (between dusk and dawn) would only be allowed during bridge removal activities and installation of new piers and segments. If other nighttime work is needed, park natural resource staff shall be consulted to determine if further mitigations are necessary. Surveys have indicated that Northern long-eared bats are in the project area and avoidance and minimization measures would be implemented to reduce potential impacts. One measure would be to only

allow tree cutting between November 1 and May 15, while the bats are dormant; no tree cutting would be allowed during the nesting season.

Minimize/avoid parkway closures - Realignment of a portion of the motor road could be completed while the existing bridge and approaches remain open to traffic, with the exception of Alternative 7. Closure of the parkway during the visitor season, May 1 through October 31, would not be permitted; however, temporary or nighttime closures of the parkway with a signed detour may be allowed.

If the bridge is reconstructed or replaced on the existing alignment (Alternative 7), a detour would be necessary. It is estimated that the build alternatives would have a construction duration of two years. While the I-26 bridge is closed, gates or barriers would be placed just north of the intersection of SR 191 at MP 393.6 and just south of the intersection of US Hwy 25 at MP 388.8. The signed detour would begin at the intersection of I-74 (MP 384.7), continue west along I-40 to the intersection of SR 191 and return to the parkway at MP 393.6. This detour would add approximately 20 minutes of driving time. This would disrupt the parkway visitor experience, would be an unacceptable route for bicyclists to follow, and have substantial adverse impact on park and concessioner operations, including emergency response.

Minimize/avoid impacts to or closures of I-26 - Designs requiring the delivery of, lifting, and placing of bridge segments or construction of additional piers in the center of I-26 that would require closure or significant reductions in interstate capacity would not be allowed. Short-term closures (e.g. nighttime) would be the maximum allowed. To minimize impacts the construction period and sequence for the new bridge should be coordinated with widening activities on I-26.

Mountains-to-Sea Trail – Hikers must use the bridge as part of the trail and no designated pull-out or overlook exists at the location of the bridge. The parkway would provide signage and a detour to guide trail users out of the active construction area and into safe locations. Construction would disrupt use of the trail, although the alternatives that realign the parkway and keep the existing bridge open would have minor impact because initial clearing that could impact the trail would be of short duration and during a time of low probable usage (i.e. winter). Trail closure within the parkway right of way should be avoided. The new bridge would include a five-foot-wide concrete walkway to provide a safe and permanent crossing of the bridge for MST hikers and other pedestrians.

Section 106 Consultation – As presented above, the Blue Ridge Parkway is a nationally significant cultural resource, and meets the eligibility criteria for designation as a National Historic Landmark. The entire parkway motor road is listed on the parkway's cultural landscape inventory, and the bridge is contributing to cultural landscape. Contextual design that retains the landscape design characteristics of material use, aesthetics, workmanship, and alignment setting will be an important NCSHPO consultation consideration. Section 106 consultation has been initiated with the NCSHPO that could result in a memorandum of agreement to resolve the adverse effect of a new alignment and bridge.

Section 4(f) resources and evaluation - The Blue Ridge Parkway and Mountains-to-Sea Trail meet the criteria for protection under Section 4(f) and are addressed in FHWA's draft Section 4(f) evaluation.

The draft evaluation concludes that there is no prudent or feasible alternative to the reconstruction or replacement of the parkway bridge. All of the I-26 widening build alternatives would result in a use of the Blue Ridge Parkway and Mountains-to-Sea Trail section 4(f) properties. The piers of the existing Blue Ridge Parkway bridge across I-26 are located immediately adjacent to the existing travel lanes, so any widening of I-26 would require their relocation and hence, a Section

4(f) use of the Blue Ridge Parkway and the Mountains-to-Sea Trail which follows the Blue Ridge Parkway across I-26.

Alternatives to avoid the potential impacts to the Blue Ridge Parkway and Mountains-to-Sea Trail were considered and included: the No-Build Alternative, the Mass Transit Alternative and the Transportation System and Demand Management Alternatives. I-26 bisects the Blue Ridge Parkway and Mountains-to-Sea Trail; an avoidance alternative to realign I-26 to a location that would accommodate the widening while avoiding both the Blue Ridge Parkway and Mountains-to-Sea Trail is not feasible. The other alternatives were evaluated and determined to not meet the purpose and need for the project.

The 4(f) analysis will incorporate the preferred alternative recommended by this value analysis process as discussed further in the Recommendations section.

Dismissal of Alternative 7, Retrofit

Prior to the full evaluation of the alternatives, the VA discussed the feasibility of retrofitting the existing bridge in-place under alternative 7.

The retrofit option would have a very high life cycle cost. Initial construction costs would be somewhat less than the other alternatives, however, due to the age of the bridge full bridge replacement would be required within 20 years. Over the full 75-year service life used in the life cycle cost analysis, this would result in up to a 50 percent increase in total life cycle cost compared with other alternatives (Table 1).

There are no construction advantages over a new bridge on the alternative alignments. Installation of the arch segments would require significant construction activity from I-26 to deliver and raise materials. This could require unacceptably long closures and impacts on I-26.

The ends of the arches would unacceptably have to be aligned within the drainage ditches of the I-26 widening, and would only provide clearance for 8 lanes, not the required 10 lanes as mandated

There may be some cultural resource advantage to maintaining the existing alignment and elements of the existing bridge. The addition of an arch, however, would alter the character of the parkway bridge as viewed from I-26.

For these reasons, the VA dismissed the retrofit option from further consideration. If alternative 7 was selected as the preferred alignment, only a new concrete segmental or steel girder bridge would be considered.

Stakeholders

In an effort to understand the context for this project, the study team developed a list of project "stakeholders", persons or groups (Table 5) with an active interest in the making of project decisions or the outcome of such decisions.

Table 5: Stakeholders

Stakeholder	Interest
The public – commuters on the parkway	No travel and commuting delays, safety, keep the road open
The public – I-26 users	No additional travel delays, safety
Parkway visitors	No travel delays, safety, keep the road open, high quality views and resources, convenience, minimum construction duration
Local businesses	No impact on tourism and revenue
Bicyclists	No detours, safety including railings on the bridge
Hikers	No detours, safety, keep the Mountains-to-Sea Trail open, accommodate trail use during construction
National Park Service and Blue Ridge Parkway	Continuity of operations, maintain emergency response capability, maintainability of the bridge and roadway, inspectability of the bridge, low risk (structural redundancy), parkway aesthetics, effective traffic management
North Carolina Department of Transportation	Maintain traffic flow on I-26, safety, a wider interstate highway, cost-effective solutions
NC State Historic Preservation Officer	Aesthetics, mitigation and minimization of adverse impacts to cultural resources
U.S. Fish and Wildlife Service	Consultation for Northern Long-Eared Bat (NLEB)
Federal Lands Highway National Bridge Inspection Program	Inspectability, maintainability
Environmental groups	NLEB protection, parkway aesthetics, compliance with regulations
Adjacent land owners	Access to the parkway, keep the road open, minimize construction duration, minimize impacts to adjacent lands
Tribal Historic Preservation Officers	Consultation
Pisgah Inn parkway concession operation	Consultation

Functional Analysis

A functional analysis was developed for the project identifying the key functional objectives and elements. Table 6 presents the primary functions that the project should meet for each component of the bridge structure. Using the functional analysis the study team validated the general project program and the areas of focus for the VA.

Table 6: Functional Analysis

Component Description	Function		
	Verb	**Noun**	**Kind***
Bridge Superstructure	Support	Deck	B
	Transfer	Load	B
	Span	Space	B
	Distribute	Load	B
	Preserve	Aesthetics	S
Bridge Deck	Carry	Load	B
	Span	Space	B
	Shed	Water	S
	Define	Travel Way	S
	Distribute	Load	S
	Accommodate	Motorized Traffic	S
	Accommodate	M-t-S Trail Hikers	S
	Accommodate	Bicyclists	S
Abutment	Support	Superstructure	B
	Retain	Backfill	B
	Transfer	Load	B
	Manage	Drainage	S
Piers	Transfer	Load	B
	Support	Deck	B
Curbs and Walkways	Contain	Traffic	B
	Separate	Users	B
	Ensure	Safe Travel	B
	Direct	Drainage	B
Alignment	Approach	Bridge	B
	Create	Sight Distance	B
	Ensure	Safety	B
	Facilitate	Construction	S
	Minimize	Resource Disturbance	S
	Preserve	Cultural Landscape	S
Railings	Ensure	Safety	B
	Discourage	Suicides	S
	Preserve	Aesthetics	S

Table 6: Functional Analysis (continued)

Component Description	Function		
	Verb	**Noun**	**Kind***
Excavation and Fill	Support	Load	B
	Limit	Settlement	B
	Enable	Drainage	B
	Support	Vegetation	B
	Balance	Volumes	B

***B** = Basic Function*
S = Secondary Function

PHASE II - CREATIVITY

Using the initial design alternatives and following discussion of each, the VA team brainstormed potential new approaches for the project. Based on a discussion of pros and cons, alternatives were either dismissed from further consideration, identified for more in-depth evaluation due to their potential to improve total value, or recommended for development in the next design stages (design recommendation).

The results of this step were then carried into the Evaluation Phase in which alternatives were evaluated for the advantages that they offered.

Brainstorm Focus Areas

The improvement options that resulted from brainstorming were discussed and the pros and cons of each option were rapidly evaluated. The following table presents the results of the VA team's rapid evaluation.

Table 7: Brainstorm Options and Evaluation

Option	Pros	Cons
Accelerated bridge construction such as slide-in construction. **CONSIDER FURTHER IF ALT. 7 SELECTED**	▪ Shortened construction duration. ▪ Improved quality control. ▪ Reduced user costs such as impacts to I-26 and parkway users. ▪ Could avoid parkway detours in Alternative 7.	▪ Potential additional costs. ▪ Logistics may be difficult due to heights above I-26. ▪ Would apply primarily to Alternative 7. ▪ Could not likely be done without short-term closures of I-26. ▪ Methods such as slide-in construction would impact the parkway for more than one winter period (the maximum acceptable timeframe for disruption of parkway traffic).

Table 7: Brainstorm Options and Evaluation (continued)

Option	Pros	Cons
Weathering steel. **HOLD FOR CONSIDERATION IF STEEL GIRDER SELECTED**	▪ Lower life-cycle cost. ▪ Avoids logistics of painting a steel girder bridge.	▪ Could generate stains on piers and slope paving. ▪ Would be inconsistent with existing parkway steel bridges. ▪ Some painting would still be needed.
Constant depth segmental concrete bridge/Multi-span with an additional pier in the median of I-26. **REJECT**	▪ More consistent with existing parkway concrete bridges. ▪ May have minor consultation benefits. ▪ Easier to pre-cast. ▪ Easier to launch.	▪ Bridge may be too long without an extra span and center pier in the median of I-26. ▪ Unacceptable closures of I-26 may be needed to construct a center pier. ▪ Unacceptable effects on I-26 traffic safety. ▪ Additional cost.
Add a bike lane. **REJECT**	▪ Would improve safety and experience for bicyclists crossing the bridge.	▪ There are no other bike lanes on the parkway. ▪ Park policy and the GMP direct the sharing the parkway motor road by all users including bicyclists.
Add a barrier wall and multi-use path to the bridge deck. **REJECT**	▪ Might improve safety and experience for bicyclists and pedestrians crossing the bridge.	▪ There are no other multi-use paths on the parkway. ▪ Current bridge design incorporates an appropriate sidewalk for pedestrians. ▪ Park policy directs sharing the road by all users.
Provide a marked, at-grade pedestrian crossing for the Mountains-to-Sea Trail. **REJECT**	▪ Might improve safety and experience for pedestrians crossing the parkway to access the sidewalk on the new bridge.	▪ There are no other marked pedestrian crossings on the parkway. ▪ A marked crossing would impact the cultural landscape of the parkway.
Provide a pedestrian crossing under the new bridge for the Mountains-to-Sea Trail. **RETAIN (note: unnecessary if next brainstorm item is implemented)**	▪ Might improve safety and experience for pedestrians crossing the parkway to access the sidewalk on the new bridge.	▪ Additional cost to construct a trail crossing under the bridge. ▪ Would increase access to abutments and increase opportunities for graffiti.

Table 7: Brainstorm Options and Evaluation (continued)

Option	Pros	Cons
Realign the Mountains-to-Sea Trail at mile post 392.1 to parkway left. **RETAIN**	▪ Would align the trail to the sidewalk side of the bridge. ▪ Would avoid the need for a pedestrian crossing close to the bridge. ▪ Would create a safer pedestrian crossing. ▪ Would avoid construction of an under-bridge crossing and avoid the opportunities for vandalism/graffiti on abutments (see Vandalism Prevention below).	▪ Additional cost for trail construction.
Install suicide fence. **REJECT**	▪ Would deter suicides.	▪ Adverse aesthetics. ▪ Options are available such as signage with a hotline number. ▪ May be minimally effective. ▪ No other parkway bridge has one. ▪ Virginia SHPO has denied this approach.
Vandalism prevention. **DESIGN RECOMMENDATION**	Vandalism reduction and prevention could be facilitated by: ▪ Not constructing a trail crossing under the bridge. ▪ Discouraging access to abutments (grading, vegetative screening, etc.). ▪ Minimizing the height and surface area of abutments. ▪ Installing remote monitoring (i.e. cameras).	▪ Cameras would have upfront & long terms maintenance costs ▪ Equipment could be subject to vandalism..

Table 7: Brainstorm Options and Evaluation (continued)

Option	Pros	Cons
Install exterior bridge lighting. **REJECT**	▪ Would provide lighted walkway and improved safety.	▪ Dark sky impacts. ▪ Impacts to historic structure and cultural landscape. ▪ Inconsistent with other existing parkway bridges.
Install interior inspection lighting (concrete box). **DESIGN RECOMMENDATION**	▪ Would facilitate inspections. ▪ Expected to be a standard component of a concrete segmental bridge design.	▪ None.
Install a remote sensing and monitoring system. **DESIGN RECOMMENDATION**	▪ Would enable monitoring for vandalism prevention. ▪ Would enable monitoring of adverse bridge conditions.	▪ None.
Modify the alignment of I-26 to accommodate the existing bridge piers (i.e., additional right-of-way widening). **REJECT**	▪ Would avoid the need to replace the bridge at this time. ▪ Reduced cost.	▪ Piers and barrier walls would split the I-26 lanes. ▪ Preliminary design considered this and there is not enough room. ▪ There would be additional adverse impacts to adjacent properties (e.g. Biltmore Estate).
Construct a new bridge one lane at a time. **REJECT**	▪ Would avoid full disruption of service on the existing bridge. ▪ Would avoid the need for detours.	▪ Would reduce the parkway to one lane during construction. ▪ Would create safety issues for bicyclists and pedestrians. ▪ Would create significant traffic delays and adverse impacts to visitor experience and park and concessioner operations. ▪ No real advantage to a detour.

PHASE III - EVALUATION

The alternatives were evaluated using a process called Choosing by Advantages (CBA), where decisions are based on the importance of advantages between alternatives. The evaluation involves the identification of the attributes or characteristics of each alternative relative to the evaluation factors (Table 8), a determination of the advantages for each alternative within each evaluation factor, and then the weighing of importance of each advantage (Table 9).

The alternative with the greatest advantage were identified in each factor. The paramount advantage across factors was determined and assigned a weight of 100. Remaining advantages were rated on the same scale. Construction and life cycle costs are compared with total advantage for all alternatives. Recommendations are based on a balance of cost and advantage.

The evaluation table (Table 9) presents various types of information. Attributes of an alternative are shown above the dotted line in the table. The alternative with the least importance with in a factor is indicated by underlining the attributes of the alternative. Advantage rankings between alternatives and total advantage are shown below the dotted line.

Evaluation Factors

As the first task of the evaluation phase, factors were developed and discussed that would be used to evaluate the alternatives. The factors reflect elements of the alternatives where there are performance differences and are important for the deciding agencies. Variables were defined and described to tailor the evaluation factors to the needs of this project.

Table 8: Evaluation Factors

Factor 1 - Optimizes public health and safety, welfare of employees and the public.
Alignment ▪ Superelevations - Public traffic safety to automobile, motor cycles, bicyclists, and pedestrians on the bridge and to bridge approaches. ▪ Sight line distances - Horizontal curve alignment. ▪ Detour - Need for a construction detour off of the parkway and onto local nonparkway roads. ▪ Length of the bridge - Amount of time users could be exposed to icy conditions.
Factor 2 - Maintain or improve natural resources
Alignment ▪ Area of disturbance - Effects of construction disturbance or altering site features due to grading requirements, area of clearing. ▪ Volume of soil excavated – Alteration of soils and soil biology.

Table 8: Evaluation Factors (continued)

Factor 3 – Maintain or improve cultural resources
Alignment ▪ Length of parkway realignment - Effect of significant realignment of the Parkway which is an historic resource. ▪ Degree of departure of new alignment from the current alignment - Impact to cultural landscape and viewsheds.
Factor 4 – Maintain or improve visitor experience
Alignment ▪ Drivability – Smoothest of roadway curves. ▪ Bridge length – Length of time viewing I-26. ▪ Detour – Need for detours off of the parkway during construction. Delays for visitors. ▪ Construction duration – amount of time that visitors would be exposed to construction activity.
Factor 5 – Optimizes operations and maintenance efficiency
Alignment ▪ Effects on park operations from detours and traffic management Bridge ▪ Long term serviceability of the bridge – painting, deck repair and maintenance. ▪ Logistical complexity required to maintain bridge – number of bearings; inspection methods.
Factor 6 - Construction factors
Bridge ▪ Construction duration. ▪ Construction-related impacts to I-26. ▪ Construction-related impacts to the parkway.
Factor 7 – Sustainability
Bridge ▪ Energy required for fabrication of bridge materials and components.

Determining Advantage of the Alternatives for Each Factor

The complete results of the CBA evaluation are displayed in Table 9. The following presents the process and summarizes the key findings of the VA team.

For each factor, the VA team discussed the subfactors shown in Table 8 and ranked the alternatives from least preferred to best performing within the subfactor. Totaling the ranks for all subfactors enabled the team to:

1. Identify the least preferred alternative within each factor (shown as underlined text in Table 9).
2. Identify the ordinal ranking of all alternatives within each factor.

The VA team then determined whether each alternative's advantage within a factor fell closer to the least preferred or to the best performing alternative. This resulted in a scale that is displayed following the discussion of each factor below.

Factor 1 – Optimizes public health and safety, welfare of employees and the public - Alternative 4 was the best performing alignment for the health and safety of employees and the public. Roadway geometry would produce flatter curves with better sight distance and be safer in icy conditions than Alternative 7. The realignment would not require a detour during construction of the new bridge and would result in safer traffic conditions than Alternative 7. Alternative 7 would have the least preferred effect on safety. Its superelevation, tightest curves, and necessary detour would be the least safe set of conditions for parkway users. Alternatives 1 and 5 would have somewhat less safety advantage than alternative 4 because of longer bridge length (less safe in icy conditions) and greater bridge superelevations, respectively.

7	5	1	4
Least Preferred			Best Performing

Factor 2 – Maintain or improve natural resources - Alternative 7 would have the least impact on natural resources with no realignment of the parkway needed. A small area would be disturbed to construct the bridge. Alternatives 4 and 5 would require the greatest area of disturbance (4 acres) and amount of soil excavated (38,000 cubic yards). Alternative 1 would have greater disturbance of natural resources than alternative 7, but less than alternatives 4 and 5.

4/5	1	7
Least Preferred		Best Performing

Factor 3 – Maintain or improve cultural resources - Alternative 7 would have the least impact because there would be no realignment of the parkway and the least impact on the cultural landscape of the parkway. It would have the least potential disturbance of archeological resources. Alternative 1 would be the least preferred because it would require the longest realigned area (archeological impact) and have the greatest departure from the existing parkway alignment (cultural landscape impact). Alternative 4 and 5 would have greater potential impact than alternative 7 and less than alternative 1. It was noted during the evaluation, however, that all alignments have been surveyed and cleared for the presence of archeological resources. The uncovering of resources during construction is still possible but the likelihood is expected to be low. This resulted in assigning less importance of archeological impacts during the evaluation.

1	4/5	7
Least Preferred		Best Performing

Factor 4 – Maintain or improve visitor experience – Alternatives 4 and 5 would have the least impact on visitor experience. The curves in these alignments would be the smoothest and easiest to navigate (similar to alternative 1). Bridge lengths would be short and would have the most limited views of I-26. Construction impacts would be limited with the shortest construction periods and there would be no construction detours to disrupt visitor travel. Alternative 7 would be the least preferred primarily because visitors would have to detour from the parkway during construction and the period of construction would be the longest. Alternative 1 would have somewhat less advantage than alternatives 4 and 5. It would have the longest bridge with a longer period of visibility of I-26, and a somewhat longer construction period.

7	1	4/5
Least Preferred		Best Performing

Factor 5 – Optimizes operations and maintenance efficiency – Alternatives 1, 4, and 5 would all be preferred over alternative 7. These alternatives would avoid the need for a detour during construction and would have much greater advantage compared to alternative 7. There would be no impact on park and concessioner operations from a construction detour off of the parkway. There would be no impact on the movement of materials and staff, emergency response, or program functions such as interpretation.

7	1/4/5
Least Preferred	Best Performing

Scoring the Alternatives

The advantage that each alternative had over the least preferred alternative within a factor was scored on a scale of 0 - 100. The VA team determined that the greatest advantage was achieved in Factor 4– Maintain or Improve Visitor Experience with alternative alignments 4 and 5. This was primarily because the new alignments would avoid disruptions to traffic patterns and experience caused by a construction detour. The resulting bridges on these alignments would be shorter than alternative alignment 1 with shorter duration views of I-26, and the overall construction duration would be less. These alternatives were given a score of 100 (the paramount advantage within Table 9) for their advantage to visitor experience compared with the other alternatives.

The advantages of the best performing alternative in the other four factors were then scored in comparison to the paramount advantage discussed for alternatives 4 and 5 advantage for visitor experience. As shown in Table 9, other large advantages were achieved by the safety advantage of smoother curves and superelevation in alternative 4.

The advantages of the remaining alternatives in each factor were scored proportionally based on the relative performance determined by the VA team and graphically shown above on each scale.

The totals of all advantage scores for each alternative are shown at the bottom of Table 9 and summarized in Table 10.

Table 9: Bridge Alignment CBA Evaluation

Factor	Alignment Alternative 1		Alignment Alternative 4		Alignment Alternative 5		Alignment Alternative 7 Existing Bridge Alignment	
Factor 1 – Optimize Health, Safety, and Welfare of Employees and the Public								
	Attributes		**Attributes**		**Attributes**		**Attributes**	
Superelevation	• Acceptable superelevation – 6.8 percent	+	• Superelevation – 7.0 percent	+	• Superelevation – 10 percent – exceeds desired.		• Superelevation – 1.5 percent - inadequate	
Sight Distance	• Flattest curve	++	• Flatter curve	+	• Flatter curve	+	• Sharpest curve	
Need for a detour	• No detour	+	• No detour	+	• No detour	+	• Detour needed for duration of construction	
I-26 traffic control	• Minimal traffic control	+	• Minimal traffic control	+	• Minimal traffic control	+	• Substantial traffic control	
Length	• 715/835 feet		• 605/705 feet	+	• 605/705 feet	+	• 605/705 /512 feet	++
Importance of Advantages	**50**		**90**		**45**			
Factor 2 - Maintain or Improve Condition of Natural Resources								
Area disturbed	• Acres disturbed – 1.7 acres	+	• Acres disturbed – 4.0 acres		• Acres disturbed – 4.0 acres		• Acres disturbed – 0.5 acre (includes staging)	++
Volume of soil excavated	• Volume of Soil Disturbed - 9.8K cubic yards	+	• Volume of Soil Disturbed – 42K cubic yards		• Volume of Soil Disturbed – 38K cubic yards		• Volume of Soil Disturbed – 200 cubic yards	++
Importance of Advantages	**25**						**40**	
Factor 3 - Maintain or Improve Condition of Cultural Resources								
Length of realignment	• New alignment of parkway segment – 2300 ft.	+	• New alignment of parkway segment – 3200 ft.		• New alignment of parkway segment – 3260 ft.		• No new alignment of parkway	++
Degree of departure of new alignment from the current alignment	• Most departure		• Least departure	+	• Least departure	+	• No departure	++
Importance of Advantages			**20**		**20**		**45**	
Factor 4 – Maintain or Improve Visitor Experience								
Drivability	• Smoother curve	+	• Smoother curve	+	• Smoother curve	+	• Sharpest curve	
Bridge length	• Longest bridge length and view of I-26		• Shortest bridge length and view of I-26	+	• Shortest bridge length and view of I-26	+	• Shortest bridge length and view of I-26	+
Need for a detour	• No construction detour	+	• No construction detour	+	• No construction detour	+	• Construction detour needed	
Construction duration	• Less than 7. Greater than 4 and 5	+	• Shortest construction duration	++	• Shortest construction duration	++	• Longest construction duration	
Importance of Advantages	**70**		**100**		**100**			
Factor 5 - Optimize Operations and Maintenance Efficiency								
Impacts on operations and management from a detour	• No detours	+	• No detours	+	• No detours		• Detours required	
Importance of Advantages			**70**		**70**			
TOTAL ADVANTAGE	**220**		**280**		**235**		**85**	

Summary of Alternatives Scoring

Alternative alignment 4 has the greatest total advantage. It would have the least impact on visitor experience, and would provide the greatest safety and operation and maintenance efficiency by avoiding a detour. It, as with alternatives 1 and 5, would have greater adverse effect on cultural and natural resources than alternative 7, however, initial consultation with the SHPO and field surveys of natural and archeological resource indicate that the impacts would be slight and/or could be mitigated. Alternative alignment 5 has somewhat less advantage than alternative 4 because of the sharpness of curves in the alignment and superelevation of the bridge. This was further discussed by the VA team as presented below.

Table 10: Summary of Advantage Scores

Factor	Alt 1	Alt 4	Alt 5	Alt 7
Optimize Health, Safety, and Welfare	55	90	45	
Maintain or Improve Natural Resources	25			40
Maintain or Improve Cultural Resources		20	20	45
Maintain or Improve Visitor Experience	70	100	100	
Optimize Operations and Maintenance	70	70	70	
Total	**220**	**280**	**235**	**85**

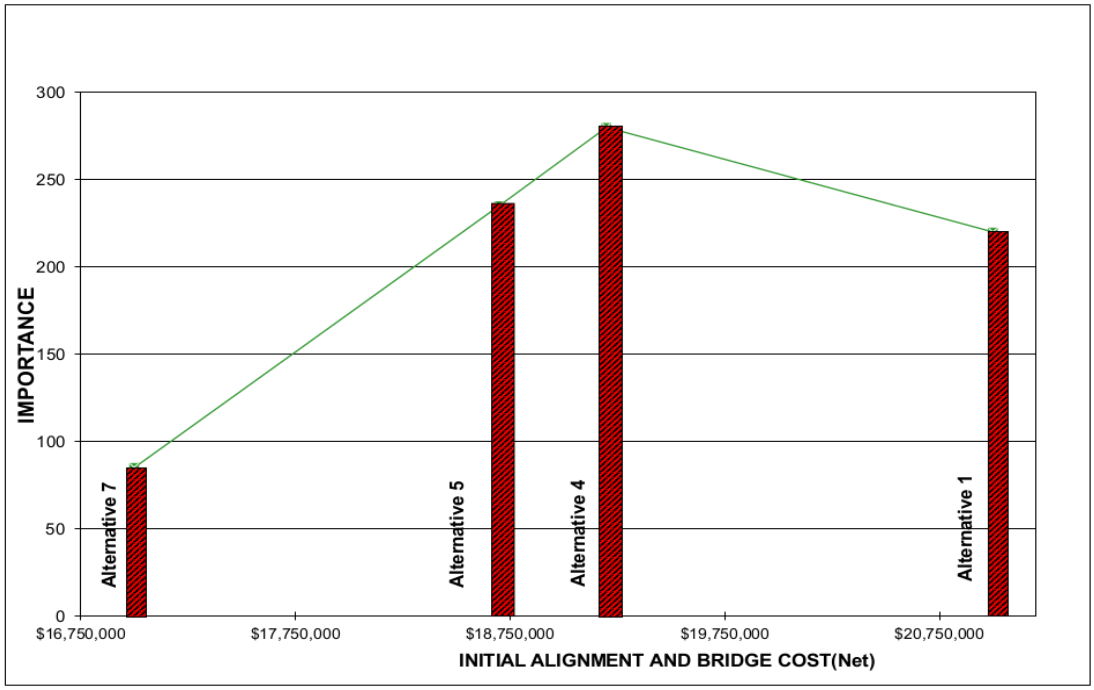


Figure 14. Total Advantage Score and Total Initial Cost

Recommended Preferred Alignment Alternative

Alternatives 4 and 5s' costs and advantages were compared further to determine a preferred. They both provide considerable advantage over alternative 7, and both cost much less than alternative 1. Alternative 4 provides greater total advantage than alternative 5, but would cost somewhat more (Figure 14). Alternative 4 has safety advantages compared with alternative 5, as discussed in the initial evaluation. The VA team conducted an additional side-by-side evaluation of the two alternatives as shown in Table 11 to further refine the evaluation The two alternatives were further compared by 1) the ability to adjust alignment grades to tie into the bridge, 2) the degree of the new alignment's departure from the existing parkway alignment, and 3) constructability based on topography. For all factors, alternative 4 would be preferred. Based on this evaluation, alignment alternative 4 is the recommended alignment.

Following the VA workshop, EFLHD refined the vertical and horizontal alignments of alternative 4. The refined TS&Ls were presented above in Figures 6 and 7. The revised preliminary plan and profile is also presented in Appendix C.

Table 11: Evaluation of Alternatives 4 and 5

Factor	Alternative 4	Alternative 5
Ability to adjust grades for tie-in to the bridge	Easiest to adjust grades.	More difficult grades.
	Best	**Least Preferred**
Departure from existing parkway alignment	Smallest departure from existing parkway alignment.	Greater departure from existing parkway alignment.
	Best	**Least Preferred**
Constructability	Topography more conducive for grading.	North end of alignment constrained by hillside.
	Best	**Least Preferred**
	RECOMMENDED	

Recommended Preferred Bridge Type

The VA team conducted a separate evaluation to determine the preferred bridge type that would be constructed on the preferred alternative alignment 4. A simplified Choosing by Advantages process was used. As discussed above, the evaluation factors that were determined to be relevant to the selection of a bridge type were:

- Optimize operations and maintenance efficiency
  - Long term serviceability of the bridge – painting, deck repair, and maintenance.
  - Logistical complexity required to maintain the bridge – number of bearings and inspection methods (e.g. snoopers).
- Construction factors
  - Construction duration.
  - Construction-related impacts to I-26.
  - Construction-related impacts to the parkway (no difference, factor was dismissed).

- Sustainability -Energy required for fabrication of bridge materials and components.

In all factors a concrete segmental bridge has greater advantage than a steel girder bridge and at a lower cost (Table 12). The concrete segmental bridge is the preferred bridge type.

Table 12: Bridge Type Evaluation

Factor	Steel Girder Bridge	Concrete Segmental Bridge
Optimize operations and maintenance efficiency	• Painting would be required. • More bearings to maintain. • Would have a concrete deck requiring maintenance separate for superstructure. • Harder bridge to inspect – multiple ribs; more complex snooper operations.	• No painting needed. • Fewer bearings to maintain. • Deck would be part of box and not require separate maintenance. • Easier to inspect – interior access to box girders; more simple snooper operations.
	Least preferred	**Best**
Construction duration	• Longer construction period	• Shorter construction period (if pre-cast; not for slip form)
Construction-related impacts to I-26	• Short-term closures of I-26 would be needed for materials delivery. • More debris shield needed to protect I-26.	• Closures could be avoided with lane shifts to deliver materials. • No or less debris shielding would be required.
	Least preferred	**Best**
Sustainability	• Least sustainable materials. • Somewhat lower life expectancy.	• Most sustainable material. Less energy required to fabricate. • Somewhat better life expectancy.
	Least preferred	**Best**
Cost	**$2M more than concrete bridge**	**$2M less than steel bridge**

Bridge Railing Decision

The VA team evaluated the performance of two bridge railing options: Caltrans Type 80 rail and Kansas Corral rail. The evaluation was based on five evaluation factors:

- Screening visibility of I-26
- Ability to divert drainage
- Aesthetics
- Ability to integrate stone guard walls
- Ability to integrate hand rails

Table 13: Bridge Rail Evaluation

Factor	Caltrans Type 80	Kansas Corral Rail
Screening visibility of I-26	Best screening of views of I-26 while crossing the bridge.	I-26 more visible while crossing the bridge.
	Best	**Least preferred**
Ability to divert drainage	Raised foundation prevents drainage onto I-26.	No raised foundation. Would not prevent drainage onto I-26.
	Best	**Least preferred**

Table 13: Bridge Rail Evaluation (continued)

Factor	Caltrans Type 80	Kansas Corral Rail
Aesthetics	Less visually massive.	More visually massive.
	Best	**Least preferred**
Ability to integrate stone guard wall	Better ability to integrate a stone guard wall.	More difficult to integrate a stone guard wall.
	Best	**Least preferred**
Ability to integrate hand rail on sidewalk side	Easier to integrate a hand railing.	More difficult to incorporate a hand railing.
	Best	**Least preferred**
Cost	Similar to Kansas Corral rail.	Similar to Caltrans Type 80.
	RECOMMENDED	

Design recommendation – The Caltrans Type 80 rail is the recommended bridge railing design. The final design should adjust the railing heights on both sides of the bridge to account for the superelevation and to maintain a balanced appearance for users approaching the bridge. However, the design adjustments must maintain the crash ratings.

Mountains-to-Sea Trail

The VA team was asked to consider the conceptual design developed by the parkway for amenities associated with the Mountains-to-Sea Trail at mile post (MP) 392.1 and to offer a final recommendation. This location would be in close proximity to the bridge before the trail traverses the bridge.

The parkway is completing a comprehensive study of the Asheville commuter zone and Mountains-to-Sea Trail access (Figure 15). This study is an analysis of existing gravel pull-off areas that are heavily used by hikers and bicyclists as parking facilities along the parkway. This includes a study for construction of new and restoration of existing gravel pull-off parking areas within the vicinity of the existing I-26 bridge.

Actions at MP 392.1 would include grading and constructing an asphalt-paved parking area on west side of parkway. The location for parking area would provide safe sight distances for motorist to and from parking area. The parking area would provide space for up to 8 vehicles. The adjoining social trails would be improved to provide official trail connections.

The VA team affirmed that the conceptual design would be a benefit to Mountains-to-Sea Trail users, improve safety, and provide section 4(f) and section 106 mitigation opportunities.

Design recommendation - Consider ways to realign the trail to parkway left at MP392. This would avoid the need for a pedestrian road crossing at or under the bridge to access the sidewalk (i.e. the trail would be on the same side of the bridge at both the west and east ends of the bridge). A preliminary relocation plan in the project vicinity is presented in Appendix D. Construction of trailhead parking at mile post (MP) 392 would be under a separate project and not under the NCDOT bridge replacement project.

Guard Walls

The VA team discussed design considerations for guard walls approaching the bridge. This was discussed in the context the Caltrans Type 80 preferred railing type. It was noted in the evaluation of the Caltrans Type 80 that stone guard walls could be readily integrated with the railing design.

Design recommendation - Stone guard walls using Georgia granite are recommended and would be consistent with other parkway bridge approaches. Georgia granite facing should continue onto the abutments.

Draft Section 4(f) Evaluation of the Preferred Alternative and Measures to Minimize Harm

The draft Section 4(f) evaluation prepared by FHWA considers the recommended preferred alternative 4. Pursuant to 23 CFR 774.3(c), if the avoidance analysis determines that there is no feasible and prudent avoidance alternative, then only the alternative that causes the least overall harm to the Section 4(f) property may be approved. All of the action alternatives considered were evaluated to determine which alternatives would cause the least overall harm to the Section 4(f) property. The preferred alternative would improve conditions for the Blue Ridge Parkway and Mountains-to-Sea Trail from an operational perspective resulting in the least overall harm to Section 4(f) resources. The Preferred Alternative includes all possible planning to minimize harm (as defined in 23 CFR 774.17), and after balancing all of the different aspects of this project, there is no "feasible and prudent avoidance alternative", as defined in 23 CFR 774.17.

In addition to replacing the bridge on a new alignment to avoid the construction detour impacts, additional measures to minimize harm would include:

- Construction dust and noise reduction through standard Best Management Practices. Every practicable effort would be made to minimize the dust and noise during construction through the use of standard Best Management Practices (e.g., watering, covering of soil piles), and standard accepted noise reduction measures (e.g., maintaining tune of equipment, limited work hours).
- Aesthetic design of the bridge.
- Safer accommodation of the Mountains-to-Sea Trail on the replacement bridge.
- New parking area for the Mountains-to-Sea Trail.
- Provisions of the Section 106 Memorandum of Agreement (MOA). The MOA would be completed and executed prior to the Record of Decision.
- Mitigation measures for any actions which might affect the Threatened Northern Long-eared Bat.

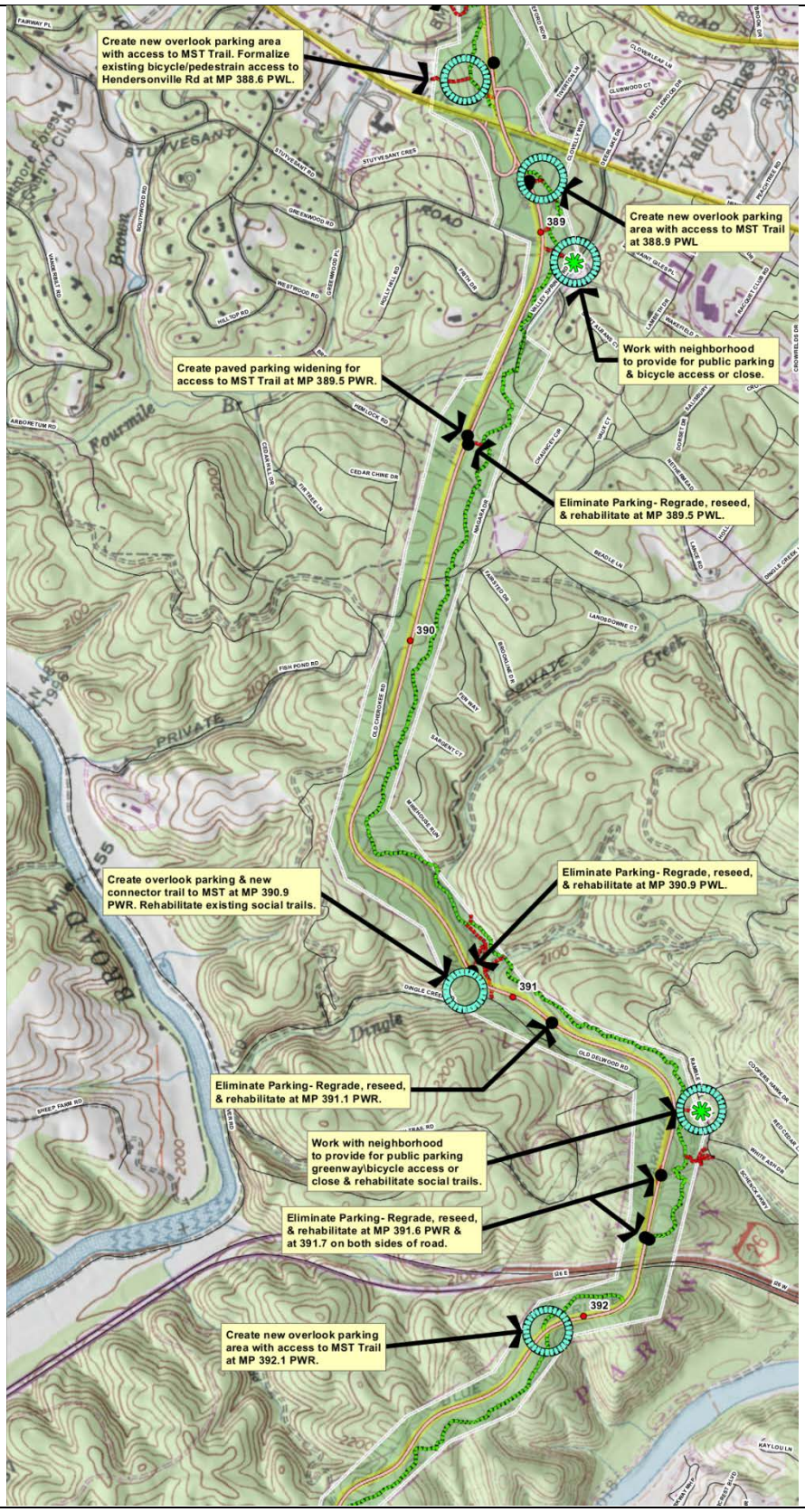


Figure 15. Asheville Corridor Access Map and MP 392.1 Site

APPENDIX A - Workshop Agenda and Participant List

VALUE ANALYSIS (VA/CBA) FOR THE REPLACEMENT OF THE BLUE RIDGE PARKWAY BRIDGE OVER INTERSTATE 26

Federal Project Number– NC_ST_BLRI_I26_NEPA

December 15-17, 2015

AGENDA

Meeting Location: Blue Ridge Parkway headquarters conference room, Asheville, North Carolina, 28803

Study Team Leader/Facilitator: *John Hoesterey, JWH Environmental Consulting, (303)906-8987*

FHWA COR: *Yanina Kirtley, Eastern Federal Lands Highway Division, (571) 434-1556*

Tuesday, December 15

8:30 a.m. Meet at BLRI headquarters for a field review of the project ..... VA Team
The bridge alternatives will be reviewed and discussed in the field. Come prepared with appropriate field attire.

12:00 **LUNCH**

1:00 p.m. Meet at BLRI headquarters conference room to begin the workshop ..... VA Team
Welcome & Opening Remarks ..... FHWA/NPS
Team Member Introductions (for anyone not on field visit) ..... Facilitator/VA Team
Objectives of Workshop / Schedule ..... Facilitator

1:30 **PHASE I – INFORMATION**
The goal for this phase is for the team to develop a clear understanding of the project through review of base information and an analysis of costs and functions.

. Executive summary, project background, purpose/need, key issues, schematic design alternatives, alternatives considered but dismissed ..... FHWA
Planning constraints, assumptions, and special project criteria ..... Facilitator/VA Team
Stakeholders Analysis ..... Facilitator/VA Team

2:30 **BREAK**

2:45 **PHASE II – FUNCTIONAL ANALYSIS**
Functional areas where significant cost savings or improvement in value can be expected will be identified for further study.

Functional Analysis ..... Facilitator/Team
Cost Modeling ..... Facilitator/Team
Life Cycle Cost Analysis (overview/elements contributing to LCC differences) ..... JMT
Identification of areas of focus for VA study ..... Facilitator/Team

3:45 **PHASE III – CREATIVITY**

The VA team will brainstorm options to improve the range of alternatives, if any. This process involves the development of ideas without judgment at this point. This may result in modifications to the initial alternatives or the introduction of a new alternative.

Brainstorming options to improve range of the alternatives ..... Team
Discuss and screen options for further evaluation ..... Team
Develop options, as needed, to provide necessary detail ..... Team

Close for Day: *Approximately 4:30 PM*

Wednesday, December 16

8:30 **PHASE III – CREATIVITY (continue)**

Complete options development, as needed, to provide necessary detail ..... Team

10:00 **PHASE IV –EVALUATION**

The initial alternatives will be evaluated using the Choosing by Advantages (CBA) method. Through CBA, the VA team will determine the relative advantages of each alternative for the decision factors identified by the team. This will allow the team to recommend a preferred alternative that provides the best advantage and cost performance.

BREAK AS NEEDED

CBA overview ..... Facilitator
Review and finalize CBA evaluation factors ..... Team
Bridge TS&L - Start alternatives evaluation using CBA ..... Team

12:00 **LUNCH**

2:00 **PHASE IV – EVALUATION (Continued)**

Bridge TS&L - Complete alternatives evaluation using CBA ..... Team
Bridge Rail Options - Start alternatives evaluation using CBA ..... Team

Close for Day: *Approximately 4:30 PM*

Thursday, December 17

8:30 **PHASE IV – EVALUATION (continued)**
Bridge Rail Options – Complete alternatives evaluation using CBA ..... Team

11:00 **PHASE V – DEVELOPMENT**
Additional items that need final development and/or resolution will be discussed and recommendations made.

Review of topics to resolve ..... Team
Evaluation and development of recommendations ..... Team/Workgroups
Next steps in project ..... Team

12:00 **LUNCH**

1:00 **PHASE VII - RECOMMENDATIONS AND PRESENTATION**
This phase consists of recording the value study recommendations and presenting the recommended proposals to the decision-makers. Opportunities for and impediments to implementation may be identified.

Cost estimate revisions, if necessary ..... Team
Run spreadsheet and importance-to-cost graph ..... Team
Document/review VA team recommendations ..... Team
Prep for briefing to present VA findings..... Team

2:30 **BREAK**

3:00 **PHASE VII - RECOMMENDATIONS AND PRESENTATION (Continued)**

Presentation and close-out with management, non-core team members, and key staff

Study Closes: *Approximately 4:30pm*

STUDY TEAM MEMBERS	ORGANIZATION	ATTENDANCE		
		12/15	12/16	12/17
Mounir Abouzakhm	FHWA/EFLHD	•	•	•
Wael Arafat	NC DOT	•	•	•
Mitch Batuzich	FHWA/NC DIV	•	•	•
Beth Byrd	NPS/BLRI	•	•	•
Fred Braerman	JMT	•	•	•
George Choubah	FHWA/EFLHD	•	•	•
Kurt Dowden	FHWA/EFLHD			Final Present
Earl Dubin	FHWA/NC DIV	•	•	•
Nathan Epling	NPS/BLRI	•	•	•
Jennifer Harris	HNTB	•	•	•
Larry Hultquist	NPS/DSC	•	•	•
Yanina Kirtley	FHWA/EFLHD	•	•	•
Lisa Landers	FHWA/EFLHD			Final Present
Jim Martin	FHWA/NC DIV	•	•	•
Mike Molling	NPS/BLRI	•	•	•
Suzette Molling	NPS/BLRI	•	•	•
Kevin Moore	NC DOT	•	•	•
Andy Otten	NPS/DSC	•	•	•
Rich Pakhchanian	FHWA/EFLHD	•	•	•
Jim Prevost	JMT	•	•	•
Matt Shiplet	FHWA/EFLHD	•	•	•
Alan Teikari	FHWA/EFLHD			Final Present
Rick Tipton	NC DOT	•	•	•
Kevin Tyler	NPS/DSC	•	•	•
Jack Van Dop	FHWA/EFLHD	•	•	•
Clayton Wellman	FHWA/EFLHD	•	•	•
Mark Woods	NPS/BLRI			Final Present
Craig Yow	NPS/BLRI	•	•	•

APPENDIX B: CONSTRUCTION AND LIFE CYCLE COST ESTIMATES

Preliminary Estimate for BLRI I-26 Bridge (concrete box) ALT# 1

Item	Quantity	Unit	Unit Price		Amount
Mobilization (8%)	All	Lpsm	1,555,000.00	$	1,555,000
Construction Survey And Staking (1.5%)	All	Lpsm	283,000.00	$	283,000
Contractor Testing (1.5%)	All	Lpsm	283,000.00	$	283,000
Design Contingency (20%)	All	Lpsm	3,144,000.00	$	3,144,000
Soil Erosion Control (5%)	All	Lpsm	32,000.00	$	32,000
Clearing And Grubbing	1.7	Acre	17,000.00	$	28,900
Removal Of Pavement, Asphalt	5300	Sqyd	6.45	$	34,185
Roadway Excavation	9800	Cuyd	22.00	$	215,600
Aggregate Base Grading C Or D	1730	Ton	41.00	$	70,930
Aggregate-Topsoil Course	225	Ton	47.00	$	10,575
Asphalt Concrete Pavement, Gyratory Mix, 3/8-Inch Nominal	325	Ton	190.00	$	61,750
Asphalt Concrete Pavement, Gyratory Mix, 3/4-Inch Nominal	555	Ton	160.00	$	88,800
Stone Masonry Guardwall	200	Lnft	420.00	$	84,000
Furnishing And Placing Topsoil	370	Cuyd	47.00	$	17,390
Turf Establishment	2.8	Acre	3,800.00	$	10,640
Temporary Traffic Control	All	Lpsm	40,000.00	$	40,000
Field Office	1	Each	22,000.00	$	22,000
Concrete Box Girder Bridge	All	Lpsm	15,000,000.00	$	15,000,000
			Total =	**$**	**21,000,000**

Preliminary Estimate for BLRI I-26 Bridge (steel girder) ALT #1

Item	Quantity	Unit	Unit Price		Amount
Mobilization (8%)	All	Lpsm	1,719,000.00	$	1,719,000
Construction Survey And Staking (1.5%)	All	Lpsm	313,000.00	$	313,000
Contractor Testing (1.5%)	All	Lpsm	313,000.00	$	313,000
Design Contingency (20%)	All	Lpsm	3,477,000.00	$	3,477,000
Soil Erosion Control (5%)	All	Lpsm	32,000.00	$	32,000
Clearing And Grubbing	1.7	Acre	17,000.00	$	28,900
Removal Of Pavement, Asphalt	5300	Sqyd	6.45	$	34,185
Roadway Excavation	9800	Cuyd	22.00	$	215,600
Aggregate Base Grading C Or D	1730	Ton	41.00	$	70,930
Aggregate-Topsoil Course	225	Ton	47.00	$	10,575
Asphalt Concrete Pavement, Gyratory Mix, 3/8-Inch Nominal	325	Ton	190.00	$	61,750
Asphalt Concrete Pavement, Gyratory Mix, 3/4-Inch Nominal	555	Ton	160.00	$	88,800
Stone Masonry Guardwall	200	Lnft	420.00	$	84,000
Furnishing And Placing Topsoil	370	Cuyd	47.00	$	17,390
Turf Establishment	2.8	Acre	3,800.00	$	10,640
Temporary Traffic Control	All	Lpsm	40,000.00	$	40,000
Field Office	1	Each	22,000.00	$	22,000
Steel Plate Girder Bridge	All	Lpsm	16,665,000.00	$	16,665,000
			Total =	**$**	**23,300,000**

Preliminary Estimate for BLRI I-26 Bridge (concrete box) ALT #4

Item	Quantity	Unit	Unit Price		Amount
Mobilization (8%)	All	Lpsm	1,418,000.00	$	1,418,000
Construction Survey And Staking (1.5%)	All	Lpsm	259,000.00	$	259,000
Contractor Testing (1.5%)	All	Lpsm	259,000.00	$	259,000
Design Contingency (20%)	All	Lpsm	2,867,000.00	$	2,867,000
Soil Erosion Control (5%)	All	Lpsm	88,000.00	$	88,000
Clearing And Grubbing	4.2	Acre	5,300.00	$	22,260
Removal Of Pavement, Asphalt	5000	Sqyd	6.45	$	32,250
Roadway Excavation	42000	Cuyd	19.00	$	798,000
Pavement Markings	12000	Lnft	1.50	$	18,000
Aggregate Base Grading C Or D	2200	Ton	33.00	$	72,600
Aggregate-Topsoil Course	400	Ton	41.00	$	16,400
Asphalt Concrete Pavement, Gyratory Mix, 3/8-Inch Nominal	925	Ton	190.00	$	175,750
Asphalt Concrete Pavement, Gyratory Mix, 3/4-Inch Nominal	1900	Ton	160.00	$	304,000
Guardrail System SBTA	1300	Lnft	50.00	$	65,000
Stone Masonry Guardwall	210	Lnft	420.00	$	88,200
Furnishing And Placing Topsoil	1200	Cuyd	47.00	$	56,400
Turf Establishment	12000	Sqyd	3.00	$	36,000
Temporary Traffic Control	All	Lpsm	40,000.00	$	40,000
Field Office	1	Each	22,000.00	$	22,000
Concrete Box Girder Bridge	All	Lpsm	12,500,000.00	$	12,500,000
			Total =	**$**	**19,200,000**

Preliminary Estimate for BLRI I-26 Bridge (steel girder) ALT #4

Item	Quantity	Unit	Unit Price		Amount
Mobilization (8%)	All	Lpsm	1,574,000.00	$	1,574,000
Construction Survey And Staking (1.5%)	All	Lpsm	287,000.00	$	287,000
Contractor Testing (1.5%)	All	Lpsm	287,000.00	$	287,000
Design Contingency (20%)	All	Lpsm	3,184,000.00	$	3,184,000
Soil Erosion Control (5%)	All	Lpsm	86,000.00	$	86,000
Clearing And Grubbing	4.2	Acre	5,300.00	$	22,260
Removal Of Pavement, Asphalt	5000	Sqyd	6.45	$	32,250
Roadway Excavation	42000	Cuyd	19.00	$	798,000
Pavement Markings	12000	Lnft	1.50	$	18,000
Aggregate Base Grading C Or D	2200	Ton	33.00	$	72,600
Aggregate-Topsoil Course	400	Ton	41.00	$	16,400
Asphalt Concrete Pavement, Gyratory Mix, 3/8-Inch Nominal	925	Ton	190.00	$	175,750
Asphalt Concrete Pavement, Gyratory Mix, 3/4-Inch Nominal	1900	Ton	160.00	$	304,000
Guardrail System SBTA	1300	Lnft	50.00	$	65,000
Stone Masonry Guardwall	210	Lnft	420.00	$	88,200
Furnishing And Placing Topsoil	1200	Cuyd	47.00	$	56,400
Temporary Traffic Control	All	Lpsm	40,000.00	$	40,000
Field Office	1	Each	22,000.00	$	22,000
Steel Plate Girder Bridge	All	Lpsm	14,120,000.00	$	14,120,000
			Total =	**$**	**21,300,000**

Preliminary Estimate for BLRI I-26 Bridge (concrete box) ALT #5

Item	Quantity	Unit	Unit Price		Amount
Mobilization (8%)	All	Lpsm	1,383,000.00	$	1,383,000
Construction Survey And Staking (1.5%)	All	Lpsm	252,000.00	$	252,000
Contractor Testing (1.5%)	All	Lpsm	252,000.00	$	252,000
Design Contingency (20%)	All	Lpsm	2,797,000.00	$	2,797,000
Soil Erosion Control	All	Lpsm	68,000.00	$	68,000
Clearing And Grubbing	4.0	Acre	5,300.00	$	21,200
Removal Of Pavement, Asphalt	7200	Sqyd	6.45	$	46,440
Roadway Excavation	38000	Cuyd	19.00	$	722,000
Aggregate Base Grading C Or D	3180	Ton	33.00	$	104,940
Aggregate-Topsoil Course	400	Ton	41.00	$	16,400
Asphalt Concrete Pavement, Gyratory Mix, 3/8-Inch Nominal	600	Ton	190.00	$	114,000
Asphalt Concrete Pavement, Gyratory Mix, 3/4-Inch Nominal	1025	Ton	160.00	$	164,000
Stone Masonry Guardwall	200	Lnft	420.00	$	84,000
Furnishing And Placing Topsoil	1170	Cuyd	47.00	$	54,990
Turf Establishment	5.8	Acre	3,800.00	$	22,040
Temporary Traffic Control	All	Lpsm	40,000.00	$	40,000
Field Office	1	Each	22,000.00	$	22,000
Concrete Box Girder Bridge	All	Lpsm	12,500,000.00	$	12,500,000
			Total =	**$**	**18,700,000**

Preliminary Estimate for BLRI I-26 Bridge (steel) ALT #5

Item	Quantity	Unit	Unit Price		Amount
Mobilization (8%)	All	Lpsm	1,547,000.00	$	1,547,000
Construction Survey And Staking (1.5%)	All	Lpsm	282,000.00	$	282,000
Contractor Testing (1.5%)	All	Lpsm	282,000.00	$	282,000
Design Contingency (20%)	All	Lpsm	3,129,000.00	$	3,129,000
Soil Erosion Control	All	Lpsm	68,000.00	$	68,000
Clearing And Grubbing	4.0	Acre	5,300.00	$	21,200
Removal Of Pavement, Asphalt	7200	Sqyd	6.45	$	46,440
Roadway Excavation	38000	Cuyd	19.00	$	722,000
Aggregate Base Grading C Or D	3180	Ton	33.00	$	104,940
Aggregate-Topsoil Course	350	Ton	41.00	$	14,350
Asphalt Concrete Pavement, Gyratory Mix, 3/8-Inch Nominal	600	Ton	190.00	$	114,000
Asphalt Concrete Pavement, Gyratory Mix, 3/4-Inch Nominal	1025	Ton	160.00	$	164,000
Stone Masonry Guardwall	200	Lnft	420.00	$	84,000
Furnishing And Placing Topsoil	1170	Cuyd	47.00	$	54,990
Turf Establishment	5.8	Acre	3,800.00	$	22,040
Temporary Traffic Control	All	Lpsm	40,000.00	$	40,000
Field Office	1	Each	22,000.00	$	22,000
Steel Plate Girder Bridge	All	Lpsm	14,165,000.00	$	14,165,000
			Total =	**$**	**20,900,000**

Preliminary Estimate for BLRI I-26 Bridge (concrete box) ALT #7

Item	Quantity	Unit	Unit Price		Amount
Mobilization (8%)	All	Lpsm	1,259,000.00	$	1,259,000
Construction Survey And Staking (1.5%)	All	Lpsm	230,000.00	$	230,000
Contractor Testing (1.5%)	All	Lpsm	230,000.00	$	230,000
Design Contingency (20%)	All	Lpsm	2,547,000.00	$	2,547,000
Soil Erosion Control (5%)	All	Lpsm	11,000.00	$	11,000
Clearing And Grubbing	0.2	Acre	5,300.00	$	1,060
Removal Of Pavement, Asphalt	500	Sqyd	6.45	$	3,225
Roadway Excavation	200	Cuyd	19.00	$	3,800
Aggregate Base Grading C Or D	155	Ton	33.00	$	5,115
Aggregate-Topsoil Course	10	Ton	41.00	$	410
Asphalt Concrete Pavement, Gyratory Mix, 3/8-Inch Nominal	7	Ton	190.00	$	1,330
Asphalt Concrete Pavement, Gyratory Mix, 3/4-Inch Nominal	17	Ton	160.00	$	2,720
Stone Masonry Guardwall	200	Lnft	420.00	$	84,000
Furnishing And Placing Topsoil	100	Cuyd	47.00	$	4,700
Turf Establishment	0.2	Acre	3,800.00	$	760
Temporary Traffic Control	All	Lpsm	90,000.00	$	90,000
Field Office	1	Each	22,000.00	$	22,000
Concrete Box Girder Bridge	All	Lpsm	12,500,000.00	$	12,500,000
			Total =	**$**	**17,000,000**

Preliminary Estimate for BLRI I-26 Bridge (steel) ALT #7

Item	Quantity	Unit	Unit Price		Amount
Mobilization (8%)	All	Lpsm	1,424,000.00	$	1,424,000
Construction Survey And Staking (1.5%)	All	Lpsm	260,000.00	$	260,000
Contractor Testing (1.5%)	All	Lpsm	260,000.00	$	260,000
Design Contingency (20%)	All	Lpsm	2,880,000.00	$	2,880,000
Soil Erosion Control (5%)	All	Lpsm	11,000.00	$	11,000
Clearing And Grubbing	0.2	Acre	5,300.00	$	1,060
Removal Of Pavement, Asphalt	500	Sqyd	6.45	$	3,225
Roadway Excavation	200	Cuyd	19.00	$	3,800
Aggregate Base Grading C Or D	155	Ton	33.00	$	5,115
Aggregate-Topsoil Course	10	Ton	41.00	$	410
Asphalt Concrete Pavement, Gyratory Mix, 3/8-Inch Nominal	7	Ton	190.00	$	1,330
Asphalt Concrete Pavement, Gyratory Mix, 3/4-Inch Nominal	17	Ton	160.00	$	2,720
Stone Masonry Guardwall	200	Lnft	420.00	$	84,000
Furnishing And Placing Topsoil	100	Cuyd	47.00	$	4,700
Turf Establishment	0.2	Acre	3,800.00	$	760
Temporary Traffic Control	All	Lpsm	90,000.00	$	90,000
Field Office	1	Each	22,000.00	$	22,000
Steel Plate Girder Bridge	All	Lpsm	14,165,000.00	$	14,165,000
			Total =	**$**	**19,300,000**

Preliminary Estimate for BLRI I-26 Bridge (retrofit) ALT #7

Item	Quantity	Unit	Unit Price		Amount
Mobilization (8%)	All	Lpsm	1,229,000.00	$	1,229,000
Construction Survey And Staking (1.5%)	All	Lpsm	224,000.00	$	224,000
Contractor Testing (1.5%)	All	Lpsm	224,000.00	$	224,000
Design Contingency (20%)	All	Lpsm	2,486,000.00	$	2,486,000
Soil Erosion Control (5%)	All	Lpsm	19,000.00	$	19,000
Clearing And Grubbing	0.2	Acre	5,300.00	$	1,060
Removal Of Pavement, Asphalt	500	Sqyd	6.45	$	3,225
Roadway Excavation	200	Cuyd	19.00	$	3,800
Aggregate Base Grading C Or D	155	Ton	33.00	$	5,115
Aggregate-Topsoil Course	10	Ton	41.00	$	410
Asphalt Concrete Pavement, Gyratory Mix, 3/8-Inch Nominal	7	Ton	190.00	$	1,330
Asphalt Concrete Pavement, Gyratory Mix, 3/4-Inch Nominal	17	Ton	160.00	$	2,720
Stone Masonry Guardwall	200	Lnft	420.00	$	84,000
Furnishing And Placing Topsoil	100	Cuyd	47.00	$	4,700
Turf Establishment	0.2	Acre	3,800.00	$	760
Temporary Traffic Control	All	Lpsm	250,000.00	$	250,000
Field Office	1	Each	22,000.00	$	22,000
Steel Plate Girder Bridge	All	Lpsm	12,030,000.00	$	12,030,000
			Total =	**$**	**16,600,000**

BRIDGE LIFE CYCLE COST ANALYSIS
BLUE RIDGE PARKWAY BRIDGE

ALTERNATIVE 1: Concrete Segmental Bridge

75 year Service Life = Planning Horizon

Code:
= Begin/End Service
= Minor Maintenance
= Moderate Restoration
= Major Rehabilitation

DATE	YEAR (n)	MAINTENANCE ACTIVITY	QTY	UNIT	UNIT. COST	EXTENDED EST. COST	PV FACTOR	PV
2016	0	New Construction	1	LS	$18,000,000	$18,000,000	1.00	$18,000,000
2026	10	Bearing Maintenance	8	EA	$1,500	$12,000	0.83	$9,941
2026	10	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.83	$4,660
2036	20	Bridge Deck, Milling and Overlay	2225	SY	$100	$222,500	0.69	$152,703
2036	20	Bearing, Maintenance	8	EA	$1,500	$12,000	0.69	$8,236
2036	20	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.69	$3,860
2046	30	Bearing, Maintenance	8	EA	$1,500	$12,000	0.57	$6,823
2046	30	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.57	$3,198
2046	30	Substructure Concrete Patching Repair	1143	SY	$150	$171,450	0.57	$97,479
2056	40	Bridge Deck, Milling and Overlay	2225	SY	$100	$222,500	0.47	$104,800
2056	40	Bearing, Maintenance	8	EA	$1,500	$12,000	0.47	$5,652
2056	40	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.47	$2,649
2066	50	Bearing Replacement	8	EA	$11,000	$88,000	0.39	$34,338
2066	50	Expansion Joint, Replacement	75	LF	$2,500	$187,500	0.39	$73,163
2066	50	Future Post Tensioning	236364	LB	$5	$1,181,820	0.39	$461,150
2076	60	Bridge Deck Milling and Overlay	2225	SY	$100	$222,500	0.32	$71,925
2076	60	Bearing, Maintenance	8	EA	$1,500	$12,000	0.32	$3,879
2076	60	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.32	$1,818
2076	60	Substructure Concrete Patching Repair	657	SF	$150	$98,550	0.32	$31,857
2086	70	Bearing, Maintenance	8	EA	$1,500	$12,000	0.27	$3,214
2086	70	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.27	$1,506
2091	75	Terminal Cost (= Demolition - Salvage)	1	LS	$1,000,000	$1,000,000	0.24	$243,745
							TOTAL	***$19,326,597***

Present Value Factor

PV = 1/(1 + DR) ^n = 1/(1.019)^n

Assumptions:

1) Real Discount Rate*: 1.9%

DR = 1.9%

BRIDGE LIFE CYCLE COST ANALYSIS
BLUE RIDGE PARKWAY BRIDGE

ALTERNATIVE 1: Welded Steel Plate Girder Bridge

75 year Service Life = Planning Horizon

Code:
= Begin/End Service
= Minor Maintenance
= Moderate Restoration
= Major Rehabilitation

DATE	YEAR (n)	MAINTENANCE ACTIVITY	QTY	UNIT	UNIT COST	EXTENDED EST. COST	PV FACTOR	PV
2016	0	New Construction	1	LS	$19,998,000	$19,998,000	1.00	$19,998,000
2026	10	Bearing Maintenance	20	EA	$1,500	$30,000	0.83	$24,853
2026	10	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.83	$4,660
2036	20	Bridge Deck, Milling and Overlay	2598	SY	$100	$259,800	0.69	$178,302
2036	20	Bearing, Maintenance	20	EA	$1,500	$30,000	0.69	$20,589
2036	20	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.69	$3,860
2046	30	Paint Structural Steel, Touchup	29921	SF	$12	$359,052	0.57	$204,142
2046	30	Bearing, Maintenance	20	EA	$1,500	$30,000	0.57	$17,057
2046	30	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.57	$3,198
2046	30	Substructure Concrete Patching Repair	1143	SY	$150	$171,450	0.57	$97,479
2056	40	Bridge Deck, Replacement	829	CY	$1,665	$1,380,285	0.47	$650,132
2056	40	Bearing, Maintenance	20	EA	$1,500	$30,000	0.47	$14,130
2056	40	Expansion Joint, Replacement	75	LF	$2,500	$187,500	0.47	$88,315
2066	50	Paint Structural Steel, Full Repaint	89763	SF	$12	$1,077,156	0.39	$420,310
2066	50	Bearing Replacement	20	EA	$11,000	$220,000	0.39	$85,845
2066	50	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.39	$2,195
2076	60	Bridge Deck Milling and Overlay	2598	SY	$100	$259,800	0.32	$83,982
2076	60	Bearing, Maintenance	20	EA	$1,500	$30,000	0.32	$9,698
2076	60	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.32	$1,818
2076	60	Substructure Concrete Patching Repair	1143	SY	$150	$171,450	0.32	$55,423
2086	70	Bearing, Maintenance	20	EA	$1,500	$30,000	0.27	$8,034
2086	70	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.27	$1,506
2091	75	Terminal Cost (= Demolition - Salvage)	1	LS	$763,121	$763,121	0.24	$186,007
							TOTAL	***$22,159,535***

Present Value Factor

PV = 1/(1 + DR) ^n = 1/(1.019)^n

Assumptions:

1) Real Discount Rate*: 1.9%

DR = 1.9%

BRIDGE LIFE CYCLE COST ANALYSIS
BLUE RIDGE PARKWAY BRIDGE

ALTERNATIVE 4: Concrete Segmental Bridge

75 year Service Life = Planning Horizon

Code:
= Begin/End Service
= Minor Maintenance
= Moderate Restoration
= Major Rehabilitation

DATE	YEAR (n)	MAINTENANCE ACTIVITY	QTY	UNIT	UNIT. COST	EXTENDED EST. COST	PV FACTOR	PV
2016	0	New Construction	1	LS	$15,000,000	$15,000,000	1.00	$15,000,000
2026	10	Bearing Maintenance	8	EA	$1,500	$12,000	0.83	$9,941
2026	10	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.83	$4,660
2036	20	Bridge Deck, Milling and Overlay	1883	SY	$100	$188,300	0.69	$129,231
2036	20	Bearing, Maintenance	8	EA	$1,500	$12,000	0.69	$8,236
2036	20	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.69	$3,860
2046	30	Bearing, Maintenance	8	EA	$1,500	$12,000	0.57	$6,823
2046	30	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.57	$3,198
2046	30	Substructure Concrete Patching Repair	1206	SY	$150	$180,900	0.57	$102,852
2056	40	Bridge Deck, Milling and Overlay	1883	SY	$100	$188,300	0.47	$88,692
2056	40	Bearing, Maintenance	8	EA	$1,500	$12,000	0.47	$5,652
2056	40	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.47	$2,649
2066	50	Bearing Replacement	8	EA	$11,000	$88,000	0.39	$34,338
2066	50	Expansion Joint, Replacement	75	LF	$2,500	$187,500	0.39	$73,163
2066	50	Future Post Tensioning	200000	LB	$5	$1,000,000	0.39	$390,203
2076	60	Bridge Deck Milling and Overlay	1883	SY	$100	$188,300	0.32	$60,869
2076	60	Bearing, Maintenance	8	EA	$1,500	$12,000	0.32	$3,879
2076	60	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.32	$1,818
2076	60	Substructure Concrete Patching Repair	1206	SF	$150	$180,900	0.32	$58,477
2086	70	Bearing, Maintenance	8	EA	$1,500	$12,000	0.27	$3,214
2086	70	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.27	$1,506
2091	75	Terminal Cost (= Demolition - Salvage)	1	LS	$1,000,000	$1,000,000	0.24	$243,745
							TOTAL	***$16,237,008***

Present Value Factor

PV = 1/(1 + DR) ^n = 1/(1.019)^n

Assumptions:

1) Real Discount Rate*: 1.9%

DR = 1.9%

* = Based on Office of Management and Budget, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs, Appendix C, OMB Circular A-94, Washington, D.C., February, 2014

BRIDGE LIFE CYCLE COST ANALYSIS
BLUE RIDGE PARKWAY BRIDGE

ALTERNATIVE 4: Welded Steel Plate Girder Bridge

75 year Service Life = Planning Horizon

Code:
= Begin/End Service
= Minor Maintenance
= Moderate Restoration
= Major Rehabilitation

DATE	YEAR (n)	MAINTENANCE ACTIVITY	QTY	UNIT	UNIT COST	EXTENDED EST. COST	PV FACTOR	PV
2016	0	New Construction	1	LS	$16,944,000	$16,944,000	1.00	$16,944,000
2026	10	Bearing Maintenance	20	EA	$1,500	$30,000	0.83	$24,853
2026	10	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.83	$4,660
2036	20	Bridge Deck, Milling and Overlay	2194	SY	$100	$219,400	0.69	$150,575
2036	20	Bearing, Maintenance	20	EA	$1,500	$30,000	0.69	$20,589
2036	20	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.69	$3,860
2046	30	Paint Structural Steel, Touchup	25263	SF	$12	$303,152	0.57	$172,359
2046	30	Bearing, Maintenance	20	EA	$1,500	$30,000	0.57	$17,057
2046	30	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.57	$3,198
2046	30	Substructure Concrete Patching Repair	1206	SY	$150	$180,900	0.57	$102,852
2056	40	Bridge Deck, Replacement	700	CY	$1,665	$1,165,500	0.47	$548,965
2056	40	Bearing, Maintenance	20	EA	$1,500	$30,000	0.47	$14,130
2056	40	Expansion Joint, Replacement	75	LF	$2,500	$187,500	0.47	$88,315
2066	50	Paint Structural Steel, Full Repaint	75788	SF	$12	$909,456	0.39	$354,873
2066	50	Bearing Replacement	20	EA	$11,000	$220,000	0.39	$85,845
2066	50	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.39	$2,195
2076	60	Bridge Deck Milling and Overlay	2194	SY	$100	$219,400	0.32	$70,923
2076	60	Bearing, Maintenance	20	EA	$1,500	$30,000	0.32	$9,698
2076	60	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.32	$1,818
2076	60	Substructure Concrete Patching Repair	1206	SY	$150	$180,900	0.32	$58,477
2086	70	Bearing, Maintenance	20	EA	$1,500	$30,000	0.27	$8,034
2086	70	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.27	$1,506
2091	75	Terminal Cost (= Demolition - Salvage)	1	LS	$800,000	$800,000	0.24	$194,996
							TOTAL	***$18,883,779***

Present Value Factor

PV = 1/(1 + DR) ^n = 1/(1.019)^n

Assumptions:

1) Real Discount Rate*: 1.9%

DR = 1.9%

* = Based on Office of Management and Budget, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs, Appendix C, OMB Circular A-94, Washington, D.C., February, 2014

BRIDGE LIFE CYCLE COST ANALYSIS
BLUE RIDGE PARKWAY BRIDGE

ALTERNATIVE 5: Concrete Segmental Bridge

75 year Service Life = Planning Horizon

Code:
= Begin/End Service
= Minor Maintenance
= Moderate Restoration
= Major Rehabilitation

DATE	YEAR (n)	MAINTENANCE ACTIVITY	QTY	UNIT	UNIT. COST	EXTENDED EST. COST	PV FACTOR	PV
2016	0	New Construction	1	LS	$15,000,000	$15,000,000	1.00	$15,000,000
2026	10	Bearing Maintenance	8	EA	$1,500	$12,000	0.83	$9,941
2026	10	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.83	$4,660
2036	20	Bridge Deck, Milling and Overlay	1883	SY	$100	$188,300	0.69	$129,231
2036	20	Bearing, Maintenance	8	EA	$1,500	$12,000	0.69	$8,236
2036	20	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.69	$3,860
2046	30	Bearing, Maintenance	8	EA	$1,500	$12,000	0.57	$6,823
2046	30	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.57	$3,198
2046	30	Substructure Concrete Patching Repair	1206	SY	$150	$180,900	0.57	$102,852
2056	40	Bridge Deck, Milling and Overlay	1883	SY	$100	$188,300	0.47	$88,692
2056	40	Bearing, Maintenance	8	EA	$1,500	$12,000	0.47	$5,652
2056	40	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.47	$2,649
2066	50	Bearing Replacement	8	EA	$11,000	$88,000	0.39	$34,338
2066	50	Expansion Joint, Replacement	75	LF	$2,500	$187,500	0.39	$73,163
2066	50	Future Post Tensioning	200000	LB	$5	$1,000,000	0.39	$390,203
2076	60	Bridge Deck Milling and Overlay	1883	SY	$100	$188,300	0.32	$60,869
2076	60	Bearing, Maintenance	8	EA	$1,500	$12,000	0.32	$3,879
2076	60	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.32	$1,818
2076	60	Substructure Concrete Patching Repair	1206	SF	$150	$180,900	0.32	$58,477
2086	70	Bearing, Maintenance	8	EA	$1,500	$12,000	0.27	$3,214
2086	70	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.27	$1,506
2091	75	Terminal Cost (= Demolition - Salvage)	1	LS	$1,000,000	$1,000,000	0.24	$243,745
							TOTAL	***$16,237,008***

Present Value Factor

PV = 1/(1 + DR) ^n = 1/(1.019)^n

Assumptions:

1) Real Discount Rate*: 1.9%

DR = 1.9%

* = Based on Office of Management and Budget, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs, Appendix C, OMB Circular A-94, Washington, D.C., February, 2014

BRIDGE LIFE CYCLE COST ANALYSIS
BLUE RIDGE PARKWAY BRIDGE

ALTERNATIVE 5: Welded Steel Plate Girder Bridge

75 year Service Life = Planning Horizon

Code:
= Begin/End Service
= Minor Maintenance
= Moderate Restoration
= Major Rehabilitation

DATE	YEAR (n)	MAINTENANCE ACTIVITY	QTY	UNIT	UNIT COST	EXTENDED EST. COST	PV FACTOR	PV
2016	0	New Construction	1	LS	$16,998,000	$16,998,000	1.00	$16,998,000
2026	10	Bearing Maintenance	20	EA	$1,500	$30,000	0.83	$24,853
2026	10	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.83	$4,660
2036	20	Bridge Deck, Milling and Overlay	2194	SY	$100	$219,400	0.69	$150,575
2036	20	Bearing, Maintenance	20	EA	$1,500	$30,000	0.69	$20,589
2036	20	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.69	$3,860
2046	30	Paint Structural Steel, Touchup	25263	SF	$12	$303,152	0.57	$172,359
2046	30	Bearing, Maintenance	20	EA	$1,500	$30,000	0.57	$17,057
2046	30	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.57	$3,198
2046	30	Substructure Concrete Patching Repair	1206	SY	$150	$180,900	0.57	$102,852
2056	40	Bridge Deck, Replacement	700	CY	$1,665	$1,165,500	0.47	$548,965
2056	40	Bearing, Maintenance	20	EA	$1,500	$30,000	0.47	$14,130
2056	40	Expansion Joint, Replacement	75	LF	$2,500	$187,500	0.47	$88,315
2066	50	Paint Structural Steel, Full Repaint	75788	SF	$12	$909,456	0.39	$354,873
2066	50	Bearing Replacement	20	EA	$11,000	$220,000	0.39	$85,845
2066	50	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.39	$2,195
2076	60	Bridge Deck Milling and Overlay	2194	SY	$100	$219,400	0.32	$70,923
2076	60	Bearing, Maintenance	20	EA	$1,500	$30,000	0.32	$9,698
2076	60	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.32	$1,818
2076	60	Substructure Concrete Patching Repair	1206	SY	$150	$180,900	0.32	$58,477
2086	70	Bearing, Maintenance	20	EA	$1,500	$30,000	0.27	$8,034
2086	70	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.27	$1,506
2091	75	Terminal Cost (= Demolition - Salvage)	1	LS	$800,000	$800,000	0.24	$194,996
							TOTAL	***$18,937,779***

Present Value Factor

PV = 1/(1 + DR) ^n = 1/(1.019)^n

Assumptions:
1) Real Discount Rate*: 1.9%

DR = 1.9%

* = Based on Office of Management and Budget, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs, Appendix C, OMB Circular A-94, Washington, D.C., February, 2014

BRIDGE LIFE CYCLE COST ANALYSIS
BLUE RIDGE PARKWAY BRIDGE

ALTERNATIVE 7: Concrete Segmental Bridge

75 year Service Life = Planning Horizon

Code:
= Begin/End Service
= Minor Maintenance
= Moderate Restoration
= Major Rehabilitation

DATE	YEAR (n)	MAINTENANCE ACTIVITY	QTY	UNIT	UNIT. COST	EXTENDED EST. COST	PV FACTOR	PV
2016	0	New Construction	1	LS	$15,000,000	$15,000,000	1.00	$15,000,000
2026	10	Bearing Maintenance	8	EA	$1,500	$12,000	0.83	$9,941
2026	10	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.83	$4,660
2036	20	Bridge Deck, Milling and Overlay	1883	SY	$100	$188,300	0.69	$129,231
2036	20	Bearing, Maintenance	8	EA	$1,500	$12,000	0.69	$8,236
2036	20	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.69	$3,860
2046	30	Bearing, Maintenance	8	EA	$1,500	$12,000	0.57	$6,823
2046	30	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.57	$3,198
2046	30	Substructure Concrete Patching Repair	1206	SY	$150	$180,900	0.57	$102,852
2056	40	Bridge Deck, Milling and Overlay	1883	SY	$100	$188,300	0.47	$88,692
2056	40	Bearing, Maintenance	8	EA	$1,500	$12,000	0.47	$5,652
2056	40	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.47	$2,649
2066	50	Bearing Replacement	8	EA	$11,000	$88,000	0.39	$34,338
2066	50	Expansion Joint, Replacement	75	LF	$2,500	$187,500	0.39	$73,163
2066	50	Future Post Tensioning	200000	LB	$5	$1,000,000	0.39	$390,203
2076	60	Bridge Deck Milling and Overlay	1883	SY	$100	$188,300	0.32	$60,869
2076	60	Bearing, Maintenance	8	EA	$1,500	$12,000	0.32	$3,879
2076	60	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.32	$1,818
2076	60	Substructure Concrete Patching Repair	1206	SF	$150	$180,900	0.32	$58,477
2086	70	Bearing, Maintenance	8	EA	$1,500	$12,000	0.27	$3,214
2086	70	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.27	$1,506
2091	75	Terminal Cost (= Demolition - Salvage)	1	LS	$1,000,000	$1,000,000	0.24	$243,745
							TOTAL	***$16,237,008***

Present Value Factor

PV = 1/(1 + DR) ^n = 1/(1.019)^n

Assumptions:

1) Real Discount Rate*: 1.9%

DR = 1.9%

* = Based on Office of Management and Budget, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs, Appendix C, OMB Circular A-94, Washington, D.C., February, 2014

BRIDGE LIFE CYCLE COST ANALYSIS
BLUE RIDGE PARKWAY BRIDGE

ALTERNATIVE 7: Welded Steel Plate Girder Bridge

75 year Service Life = Planning Horizon

Code:
= Begin/End Service
= Minor Maintenance
= Moderate Restoration
= Major Rehabilitation

DATE	YEAR (n)	MAINTENANCE ACTIVITY	QTY	UNIT	UNIT COST	EXTENDED EST. COST	PV FACTOR	PV
2016	0	New Construction	1	LS	$16,998,000	$16,998,000	1.00	$16,998,000
2026	10	Bearing Maintenance	20	EA	$1,500	$30,000	0.83	$24,853
2026	10	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.83	$4,660
2036	20	Bridge Deck, Milling and Overlay	2194	SY	$100	$219,400	0.69	$150,575
2036	20	Bearing, Maintenance	20	EA	$1,500	$30,000	0.69	$20,589
2036	20	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.69	$3,860
2046	30	Paint Structural Steel, Touchup	25263	SF	$12	$303,152	0.57	$172,359
2046	30	Bearing, Maintenance	20	EA	$1,500	$30,000	0.57	$17,057
2046	30	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.57	$3,198
2046	30	Substructure Concrete Patching Repair	1206	SY	$150	$180,900	0.57	$102,852
2056	40	Bridge Deck, Replacement	700	CY	$1,665	$1,165,500	0.47	$548,965
2056	40	Bearing, Maintenance	20	EA	$1,500	$30,000	0.47	$14,130
2056	40	Expansion Joint, Replacement	75	LF	$2,500	$187,500	0.47	$88,315
2066	50	Paint Structural Steel, Full Repaint	75788	SF	$12	$909,456	0.39	$354,873
2066	50	Bearing Replacement	20	EA	$11,000	$220,000	0.39	$85,845
2066	50	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.39	$2,195
2076	60	Bridge Deck Milling and Overlay	2194	SY	$100	$219,400	0.32	$70,923
2076	60	Bearing, Maintenance	20	EA	$1,500	$30,000	0.32	$9,698
2076	60	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.32	$1,818
2076	60	Substructure Concrete Patching Repair	1206	SY	$150	$180,900	0.32	$58,477
2086	70	Bearing, Maintenance	20	EA	$1,500	$30,000	0.27	$8,034
2086	70	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.27	$1,506
2091	75	Terminal Cost (= Demolition - Salvage)	1	LS	$800,000	$800,000	0.24	$194,996
							TOTAL	***$18,937,779***

Present Value Factor

PV = 1/(1 + DR) ^n = 1/(1.019)^n

Assumptions:

1) Real Discount Rate*: 1.9%

DR = 1.9%

* = Based on Office of Management and Budget, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs, Appendix C, OMB Circular A-94, Washington, D.C., February, 2014

BRIDGE LIFE CYCLE COST ANALYSIS
BLUE RIDGE PARKWAY BRIDGE

ALTERNATIVE 7: Retrofit (Steel Arch)

75 year Service Life = Planning Horizon

Code:
= Begin/End Service
= Minor Maintenance
= Moderate Restoration
= Major Rehabilitation

DATE	YEAR (n)	MAINTENANCE ACTIVITY	QTY	UNIT	UNIT COST	EXTENDED EST. COST	PV FACTOR	PV
2016	0	New Construction	1	LS	$14,436,000	$14,436,000	1.00	$14,436,000
2026	10	Bearing Maintenance	25	EA	$1,500	$37,500	0.83	$31,066
2026	10	Expansion & Contraction Joint, Maintenance	210	LF	$75	$15,750	0.83	$13,048
2036	20	Bridge Replacement (Concrete box on existing alignment)	1	LS	$15,000,000	$15,000,000	0.69	$10,294,555
2046	30	Bearing Maintenance	8	EA	$1,500	$12,000	0.57	$6,823
2046	30	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.57	$3,198
2056	40	Bridge Deck, Milling and Overlay	1883	SY	$100	$188,300	0.47	$88,692
2056	40	Bearing, Maintenance	8	EA	$1,500	$12,000	0.47	$5,652
2056	40	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.47	$2,649
2066	50	Bearing, Maintenance	8	EA	$1,500	$12,000	0.39	$4,682
2066	50	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.39	$2,195
2066	50	Substructure Concrete Patching Repair	1206	SY	$150	$180,900	0.39	$70,588
2076	60	Bridge Deck, Milling and Overlay	1883	SY	$100	$188,300	0.32	$60,869
2076	60	Bearing, Maintenance	8	EA	$1,500	$12,000	0.32	$3,879
2076	60	Expansion Joint, Maintenance	75	LF	$75	$5,625	0.32	$1,818
2086	70	Bearing Replacement	8	EA	$11,000	$88,000	0.27	$23,566
2086	70	Expansion Joint, Replacement	75	LF	$2,500	$187,500	0.27	$50,212
2086	70	Future Post Tensioning	200000	LB	$5	$1,000,000	0.27	$267,798
2091	75	Residual Value (Credit for 20 years of service life)	1	LS	-$2,141,383	-$2,141,383	0.24	-$521,952
							TOTAL	***$24,845,339***

Present Value Factor

PV = 1/(1 + DR) ^n = 1/(1.019)^n

Assumptions:

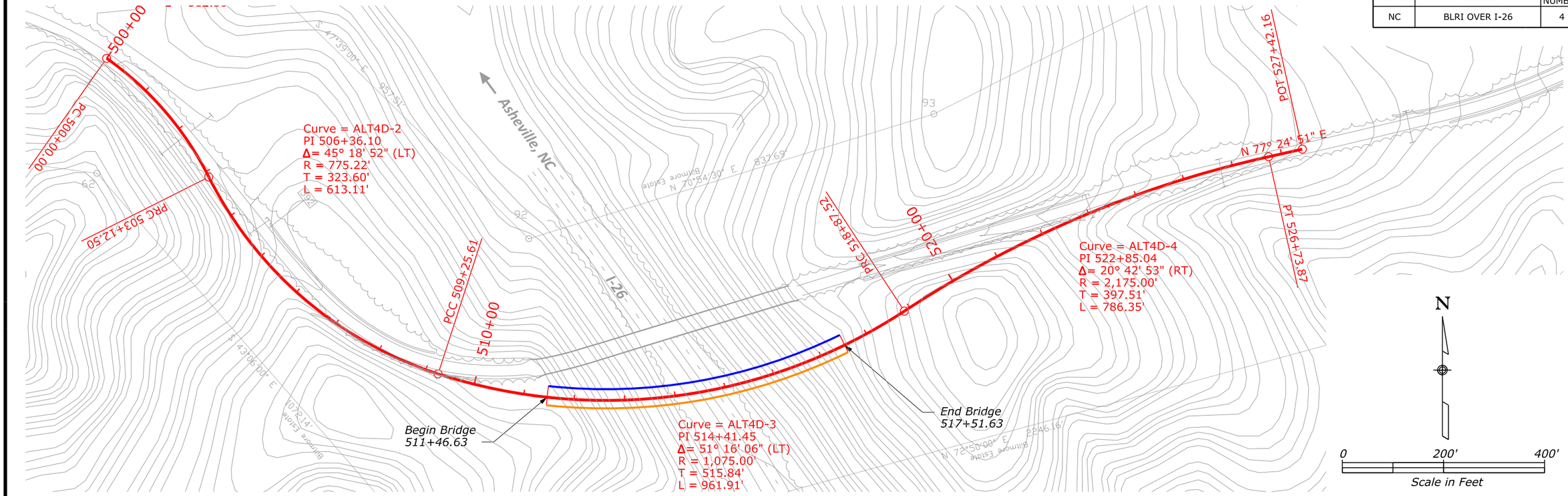
1) Real Discount Rate*: 1.9%

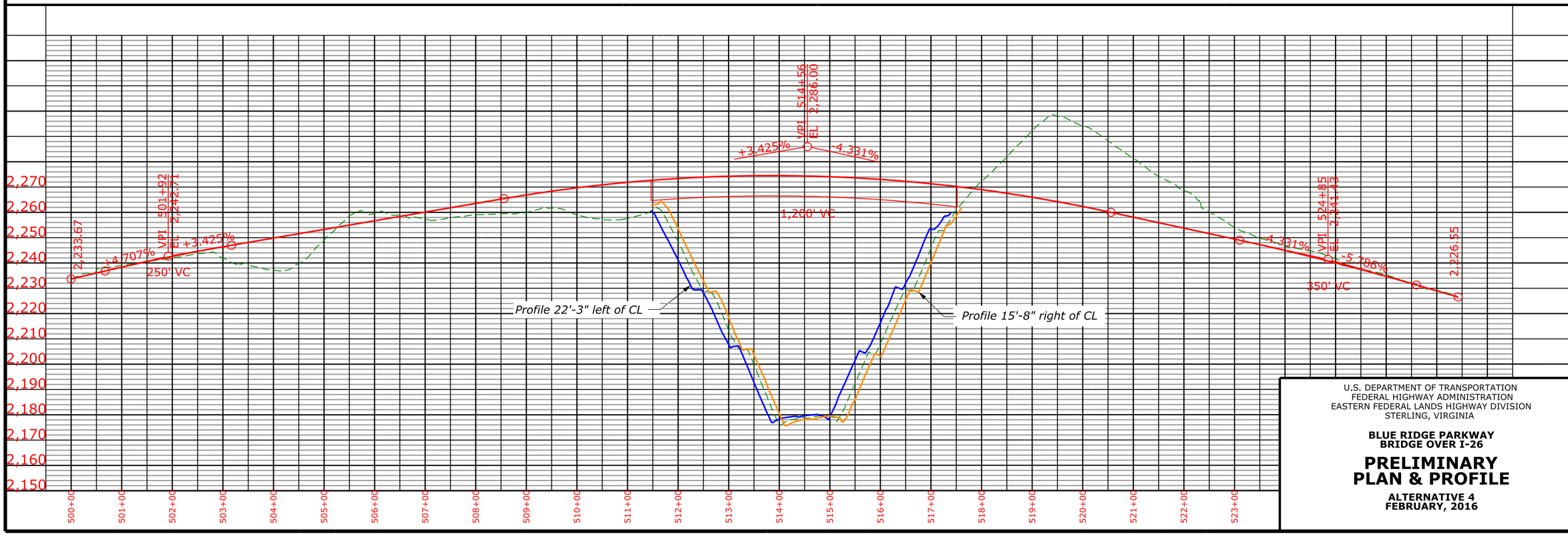
DR = 1.9%

* = Based on Office of Management and Budget, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs, Appendix C, OMB Circular A-94, Washington, D.C., February, 2014

APPENDIX C: PRELIMINARY PLAN AND PROFILE FOR ALTERNATIVE 4 ALIGNMENT

STATE	PROJECT	SHEET NUMBER
NC	BLRI OVER I-26	4





U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
EASTERN FEDERAL LANDS HIGHWAY DIVISION
STERLING, VIRGINIA

BLUE RIDGE PARKWAY
BRIDGE OVER I-26

PRELIMINARY PLAN & PROFILE

ALTERNATIVE 4
FEBRUARY, 2016

APPENDIX D: MOUNTAIN-TO-SEA TRAIL PRELIMINARY RELOCATION PLAN

Blue Ridge Parkway Over I-26

Relocation of the
Mountains -To-Sea-Trail

March 2016

Relocated Mountains-To-Sea Trail

Existing Mountains-To-Sea Trail

Asheville, NC

Cross Here To New Trail Section?

New Parking Area?

Sidewalk On This Side

Existing Mountains-To-Sea Trail

Alt #4

Existing Trail Profile

Existing MST Trail Profile

Cut Slope from Roadway Cross Section

Relocated Trail Profile

Relocated MST Trail Profile

Cut Slope from Roadway
Cross Section