Bitterroot River-W of Missoula

Bridge Type, Size and Location (TSL) Report

BR 9032(65)
UPN 6296

Missoula County
October 24, 2016

Contents

1 Introduction 1
1.1 General 1
1.2 Existing Bridge 1
1.3 Maclay Bridge Planning Study 2
2 Project Design Criteria 3
2.1 Roadway Design Standards 3
2.2 Bridge Design Standards 5
2.3 Bicycle and Pedestrian Facilities 6
2.4 Hydraulics 7
2.5 Bridge Deck Drainage 8
2.6 Right of Way 8
2.7 Geotechnical 9
2.8 Aesthetics 9
2.9 Construction Staging 10
2.10 Utilities 10
3 Bridge & Roadway Alternate Evaluation 11
3.1 Alignment Alternatives 11
3.2 Bridge Alternatives 12
3.2.1 Bridge Alternate 1A 14
3.2.2 Bridge Alternate 1B 14
3.2.3 Bridge Alternate 1C 15
3.2.4 Bridge Alternate 2A 16
3.2.5 Bridge Alternate 2B 16
3.2.6 Bridge Alternate 2C 17
3.2.7 Bridge Alternate 2D 17
3.2.8 Bridge Alternate 2E 18
3.3 Bridge Substructure 19
3.4 Bridge Alternate Cost Summary 19
3.5 Conclusion 21

Tables

Table 2-1. Missoula County Road Design Considerations 3
Table 2-2. Bridge Foundation Alternatives........ 9
Table 3-1. Bridge Alternates 13
Table 3-2. Bridge Alternate 1A Summary 14
Table 3-3. Bridge Alternate 1B Summary 15
Table 3-4. Bridge Alternate 2A Summary 16
Table 3-5. Bridge Alternate 2B Summary 16
Table 3-6. Bridge Alternate 2C Summary 17
Table 3-7. Bridge Alternate 2D Summary 18
Table 3-8. Bridge Alternate 2E Summary 18
Table 3-9. Estimated Construction Cost Summary........ 20

Figures

Figure 1-1. Site Map........ 1
Figure 2-1. MDT Roadway Classifications near Proposed Bridge Site 3
Figure 2-2. Bridge Typical Section Alternate w/ Sidewalks 4
Figure 2-3. Bridge Typical Section Alternate w/ Shared Use Path 5
Figure 2-4. Bridge Typical Section Alternate w/o Dedicated Walkways 5
Figure 2-5. City of Missoula Parks & Trails Map........ 6
Figure 2-6. Floodplain 7
Figure 2-7. Potential Utility Conflicts near West Approach........ 10
Figure 3-1. Roadway Alignment Options 11
Figure 3-2. Selected Roadway Alignment Options 12

Appendices

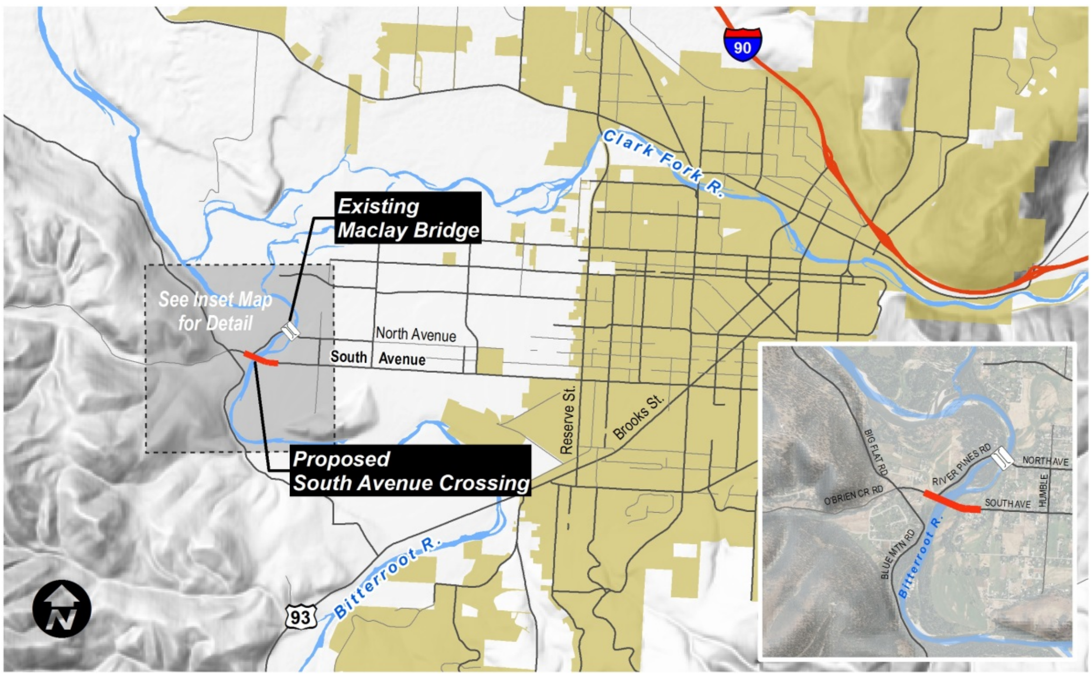
Appendix – A: Bridge Alternative Preliminary Layouts
Appendix – B: Cost Estimates

1 Introduction

1.1 General

This project involves the construction of a new bridge over the Bitterroot River to connect the terminus of South Avenue located on the east side of the river to River Pines Road located on the west side of the river. The project scope also includes roadway reconstruction at the new bridge approaches on River Pines Road and South Avenue. The current project limits extend between the intersection of Blue Heron Lane and River Pines Road on the west side of the river, to the intersection of Hanson Drive and South Avenue on the east side of the river. The project is located in Missoula County, outside the city limits of Missoula.

Figure 1-1. Site Map



The purpose of this Bridge Type, Size and Location (TSL) Report is to document the project design criteria, identify possible bridge alternatives, and provide recommendations on the preferred bridge alternate that will advance into final design.

1.2 Existing Bridge

The existing Maclay Bridge is located on North Avenue approximately 2200-ft downstream of the proposed South Avenue Bridge crossing. The existing bridge includes a 180-ft steel through truss main span, a 39.25-ft pony truss span, and two 61.2-ft pre-stressed concrete T-beam approach spans. The eastern approach spans are supported on precast concrete pile foundations. The truss spans are supported on cast-in-place concrete wall piers. Based on the existing bridge plans, the substructure for the truss spans may be supported on timber piling at the west abutment and intermediate piers.

The bridge is currently posted at 11-tons, limiting the ability of school buses and fire trucks to cross the bridge without some restrictions. One of the original truss spans was washed out during a flood event after the bridge was first constructed in 1935. The T-beam approach spans were constructed in 1965 to replace another span(s) that were washed out in a subsequent flood event. Additional information on the existing bridge from the MDT Bridge Inspection Report is listed below.

Bridge Inventory No.	L32101000+01001
Route	Off System
Year Built	1935 reconstructed in 1964
Length	346’
Deck Roadway Width	14-ft (single lane)
Out to Out Deck Width	16-ft
Sufficiency Rating	27.3
Posting	11-tons

The bridge is functionally obsolete due to inadequate roadway width and substandard roadway approach curves and is eligible to receive funding for replacement. Rehabilitating the existing bridge is not a practical alternate because rehabilitation or retrofitting the existing structure would not correct the substandard roadway width across the structure.

1.3 Maclay Bridge Planning Study

In 1994, an Environmental Assessment (EA) was completed for a new bridge over the Bitterroot River at the extension of South Avenue. A Finding of No Significant Impact (FONSI) on the 1994 EA was never issued by the Federal Highway Administration (FHWA) and a project was never advanced at the request of Missoula County due to a lack of funding. In 2002, Missoula County nominated the project to receive funding from the Montana Department of Transportation’s (MDT) Off System Bridge Program. Since then, the project has risen in priority for the County and MDT.

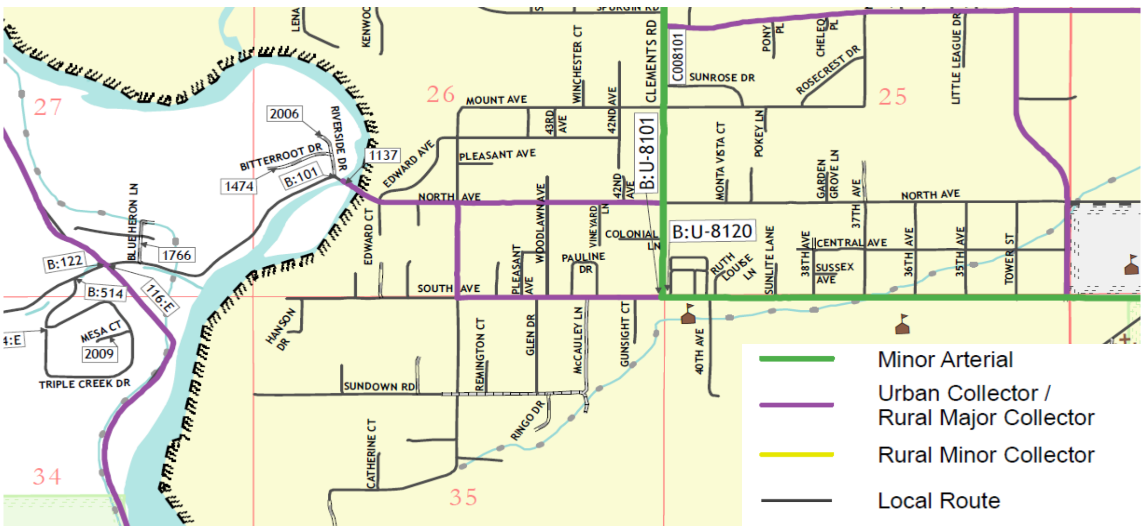
With funding and technical assistance from MDT, a pre National Environmental Policy Act (NEPA)/Montana Environmental Policy Act (MEPA) planning study was initiated at the request of Missoula County Commissioners. The purpose of the study was to identify project needs and objectives, conduct public outreach, coordinate with stakeholders, and identify project alternatives that reasonably address the project issues. The results of this work are published in *the Final Maclay Bridge Planning Study, March 22, 2013*. On April 17, 2013 the Missoula County Commissioners voted to continue with project development for the Planning Study Preferred Alternative which includes a new bridge over the Bitterroot River at the extension of South Avenue.

2 Project Design Criteria

2.1 Roadway Design Standards

South Avenue is currently designated as a Local Road from the existing west terminus to the intersection with Humble Road. From Humble Road to the intersection with Clements Road, South Avenue is classified as an Urban Collector. Eastward from Clements road, South Avenue is classified as a Minor Arterial. The existing connection to River Pines Road over the Bitterroot River is located on North Avenue which is currently classified as an Urban Collector.

Figure 2-1. MDT Roadway Classifications near Proposed Bridge Site



Source: MDT

Upon connecting the South Avenue to River Pines Road, the segment between the eastern bridge end and Humble Road will likely be reclassified as an Urban Collector. Requirements for an MDT system Urban Collector compare closely to Missoula County Standards for a Minor Collector. Therefore, the new bridge and roadway approaches will be designed to meet the minimum requirements for a Minor Collector as listed in Table 6.1 of the Missoula County Public Works Manual, revised 2010.

Table 2-1. Missoula County Road Design Considerations

Design Parameter	Road Classification			
	Local	Minor Collector	Collector or Commercial	Arterial
Design Speed (mph)	25-35	25-35	25-45	35-55
Max Vertical Grade (%)	10	8	6	6
Min Horizontal Curve Radius (ft)	150	200	525	900
Surface Width (ft)	24-32	32	44	44

Source: Missoula County Public Works Manual, 2010

Based on the projected traffic volumes (DHV > 400) a 40-ft bridge roadway width would be appropriate per MDT Bridge Design Standards and Missoula County Road Construction Standards. However, the roadway design criteria may also be determined based on the local context and existing approach roadway geometry. There have been some concerns expressed by local residents on controlling speeds on South Avenue after the new bridge is constructed. Despite the posted speed limit, higher speeds could be expected on a wider bridge. Missoula County does not have published design standards for bridges. According to MDT bridge design standards, the minimum roadway width is 28-ft for an off-system bridge which includes two 12-ft lanes and 2-ft shoulders on each side of the roadway. Given the length of the bridge, and consideration to snow removal in the winter, a wider shoulder seems appropriate. Therefore, the bridge roadway width will match the approach roadway at 32-ft minimum measured from face to face of traffic barrier.

The bridge may also accommodate future expansion of the trail network along South Avenue. Where possible, the roadway vertical grades will be limited to 5% for compliance with the American Disability Act (ADA). Whether to accommodate sidewalks on each side of the bridge, provide a single shared use path on one side, or allow use of the shoulder for bicycles and pedestrians is undetermined at this time. Additional discussion on bicycle and pedestrian accommodations is included in Section 2.3.

The existing posted speed limit on River Pines Road is 35mph, and 25mph near the end of South Avenue. East of the project limits between Humble Road and Clements Road, South Avenue has a posted speed limit of 30 mph. Between Clements Road and Reserve Street, South Avenue is posted for 35 mph. The posted speed limit for this project is undetermined at this time, however, a design speed of 35mph is currently proposed. A higher design speed may be warranted given the future route designation. However, designing the project for a higher design speed could impact existing development within the project limits.

For the purpose of determining the roadway footprint and estimating construction cost, the total bridge width measured from edge of slab to edge of slab is assumed at an even 43-ft. Additional cost can be expected depending on the accommodations provided for bicycles and pedestrians. However, the final bridge width and accommodations for bicycles/pedestrians will not impact selection of a preferred bridge alternate.

Possible bridge typical sections are shown in the figures below.

Figure 2-2. Bridge Typical Section Alternate w/ Sidewalks

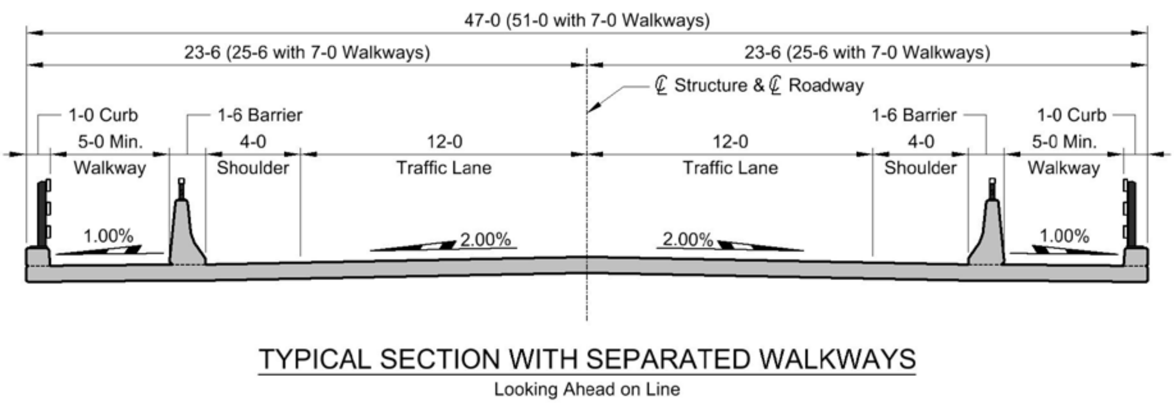


Figure 2-3. Bridge Typical Section Alternate w/ Shared Use Path

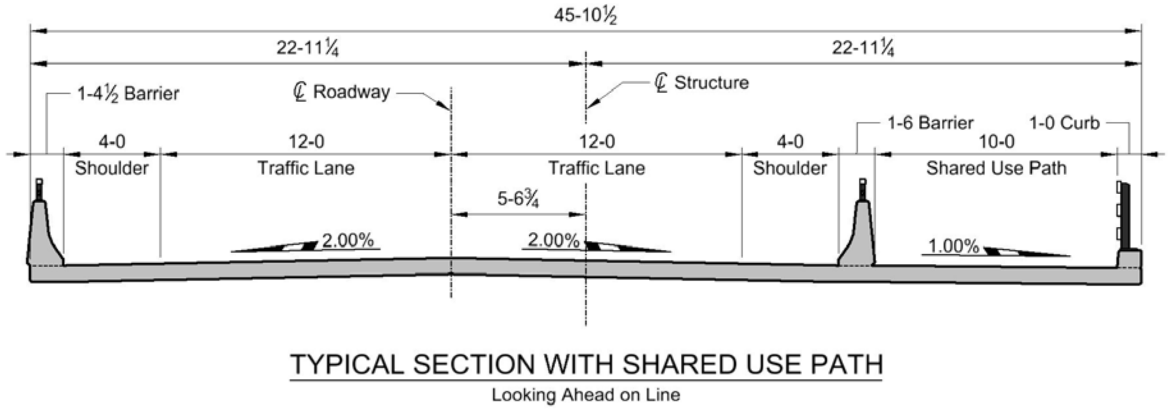
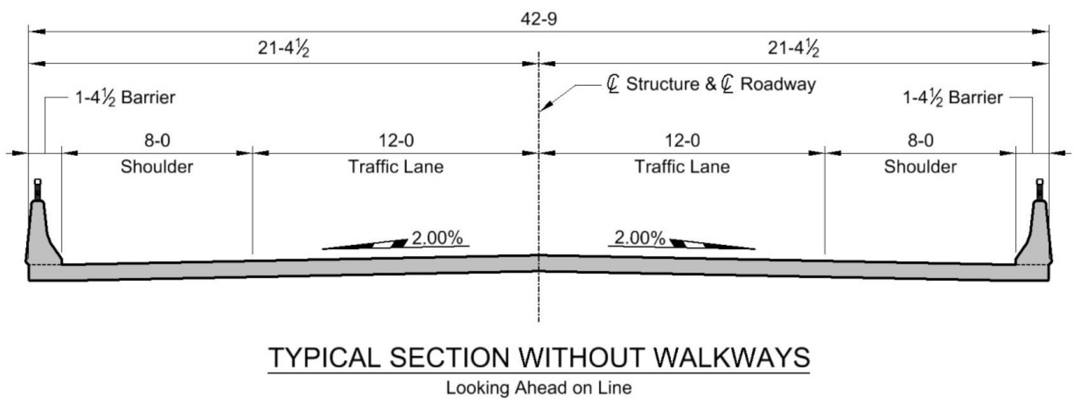


Figure 2-4. Bridge Typical Section Alternate w/o Dedicated Walkways



The existing paved width on River Pines Road and South Avenue near the proposed bridge ends is approximately 22-ft. The roadway approach on each end of the bridge will transition to the existing roadway such that the taper rates conform to the appropriate standards.

2.2 Bridge Design Standards

Missoula County does not have specific bridge design standards. Therefore the new bridge will be designed to meet AASHTO and MDT standards. Specifically, the following standards and specifications apply:

- Montana Structures Manual
- AASHTO LRFD Bridge Design Specifications, 7th Edition with 2015 Interims
- AASHTO Guide Specifications for LRFD Seismic Bridge Design, 2nd Edition
- Montana Standard Specifications for Road and Bridge Construction, 2014

The following seismic design data determined in accordance with the AASHTO Specifications will be used for the final bridge design:

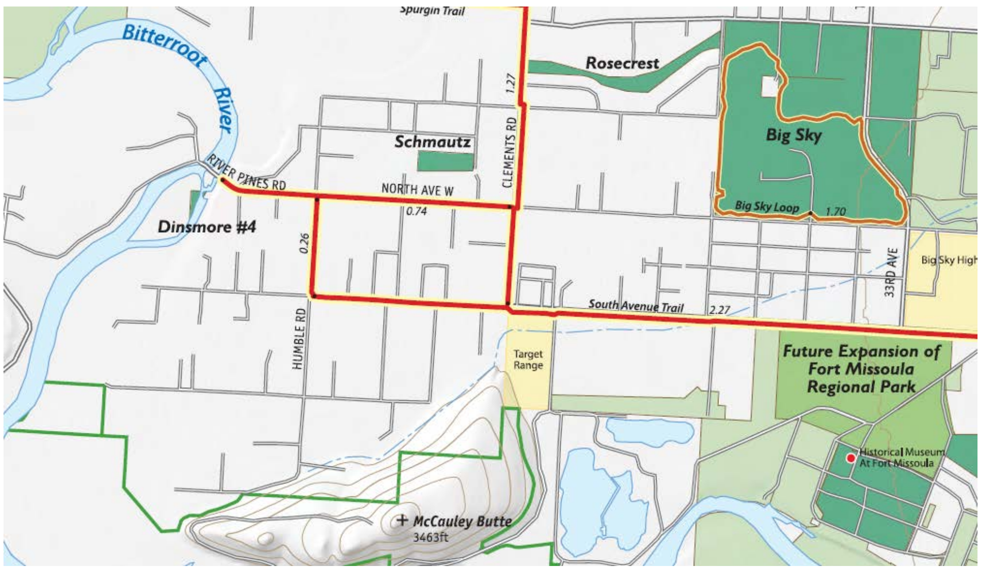
- Approximate Return Period = 1000 year
- Peak Ground Acceleration (PGA) = 0.131g
- Site Class D
- Effective Peak Ground Acceleration, A_s = 0.202g

- Design Spectral Acceleration Coefficient (0.2s period), S_{DS} = 0.488
- Design Spectral Acceleration Coefficient (1.0s period), S_{D1} = 0.235
- Seismic Zone 2 (SDC = B per Guide Specification)
- Importance Category = Other

2.3 Bicycle and Pedestrian Facilities

The new bridge may provide accommodations for future expansion of sidewalks or the existing South Avenue Trail. The existing South Avenue Trail is located on the south side of the street and ends at Humble Road.

Figure 2-5. City of Missoula Parks & Trails Map



Source: City of Missoula

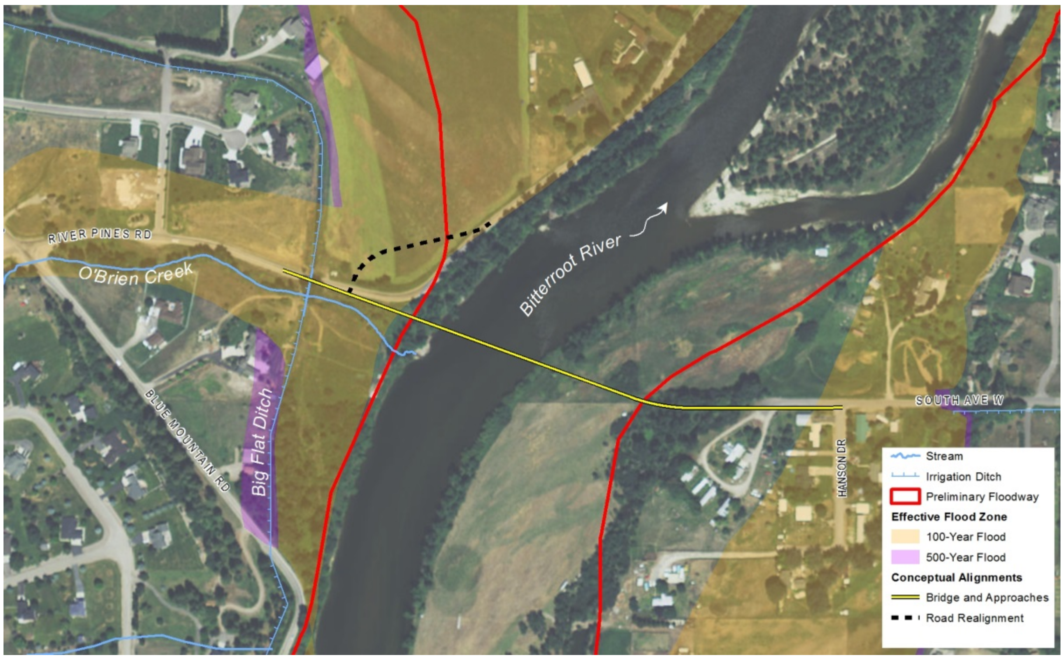
Options to provide a shared use path on one side of the structure or provide a sidewalk on each side of the structure will be considered. Per the Missoula County Public Works Manual, Section 10, the minimum sidewalk width is 5-ft for a residential area. A 7-ft sidewalk would be appropriate considering a Collector classification for the roadway. Considering the South Avenue Trail as a core trail network, a shared use path width on the bridge should be 8ft-10ft minimum per Table 10.1 of the Missoula County Public Works Manual. The AASHTO Guide for the Development of Bicycle Facilities, 2012, recommends a 10-ft minimum width for shared use paths.

The final typical section will be determined with consideration to public input on bicycle and pedestrian accommodations. For the purpose of developing bridge alternatives and associated construction cost, the width of the bridge from edge to edge of deck is assumed at 43'-0" (rounded up from 42'-9"). The actual bridge width may change based on final decisions on the provided accommodations for bicycles and pedestrians. Refer to Appendix A for bridge typical sections and possible options for accommodating bicycles and pedestrians.

2.4 Hydraulics

The new bridge will span the Bitterroot River roughly 2200-ft upstream of the existing Maclay Bridge. The river floodway and floodplain are approximately 720-ft and 2100-ft wide respectively at the proposed bridge site. The floodplain and floodway are illustrated below.

Figure 2-6. Floodplain



River Pines Road and the west end of South Avenue are currently located within the mapped floodplain at the project site. Additionally, there are several homes that are constructed within the floodplain at the west end of South Avenue. Bridge options that span over the floodplain would eliminate access to some of the existing homes on South Avenue. Therefore, spanning the entire floodplain is not a practical option. The new bridge ends will be located at the floodway boundary with some roadway approach fill in the floodplain in order to connect to the existing approach roadways and perpetuate access to existing properties. The new crossing will be designed such that a no-rise scenario is maintained within the river floodway per Montana floodplain regulations. The roadway approaches will be overtopped during flood events.

Missoula County Floodplain regulations also require 2-ft of freeboard between the bridge low chord and the 100-year flood event. The bridge profile grade will be developed such that the low chord is at least 2-ft above the design flood event and to allow adequate clearance for boaters during normal flows.

Intermediate piers within the river channel will likely be required. Although bridge options that clear span the active channel have been considered, they come at significantly higher cost compared to bridge alternatives with intermediate piers in the active river channel.

Preliminary hydraulic models have been run for the various bridge alternates included in this study. Although there are slight variations in the base flood elevations depending on the provided bridge opening, each of the alternates provide an acceptable hydraulic opening with the abutments located at the floodway boundary. The Final Hydraulics Report will include final hydraulic design information for the preferred bridge alternate that is selected upon completion of this work. Preliminary hydraulic design information is summarized below:

Preliminary Stream Data

Drift:	Moderate
Ice:	Light
2-year Stage (Q2):	3111.9-ft
Base Flood Stage (Q100):	3115.6-ft

The characterization of Drift and Ice is taken from the Location Hydraulics Study Report completed by MDT. Excavation of the east overbank will be required in the immediate vicinity of the new bridge to mitigate the rise in flood elevation due to the addition of fill into the floodplain. Refer to the preliminary bridge layouts in Appendix A for approximate limits of excavation.

Refer to the Preliminary Hydraulics Report for additional information.

2.5 Bridge Deck Drainage

Storm water drainage from the bridge deck will be captured at the shoulders and conveyed toward the bridge ends. To the extent practical, discharge of storm water into the active river channel will be avoided. However, discharge onto the riverbank may be necessary in order to limit storm water spread widths from encroaching into the travel lanes. The frequency of downspouts on the bridge deck will be based on the width of deck, profile grade, and location of curbs or traffic barriers.

A closed drainage system on the bridge to avoid any storm water discharge onto the floodplain is not practical. A closed drainage system would require frequent maintenance to clear debris and to repair locations that have ruptured due to freezing in the winter.

Input from resource agencies will be gathered during development of the bridge design. However, at this point, storm water discharge from the bridge deck onto the river banks is assumed to be acceptable.

2.6 Right of Way

The existing right of way along South Avenue is generally 60-ft wide up to the existing cul-de-sac at the west end of the road. An 80-ft wide strip of county right of way extends westward from the end of South Avenue to the Bitterroot River.

The existing right of way width on River Pines Road is generally 60-ft. There is an 80-ft wide public easement that extends from River Pines Road to the river that runs roughly parallel to O'Brien Creek.

New right of way acquisition and temporary construction permits will be required for the project.

2.7 Geotechnical

Geotechnical borings have been collected near the proposed bridge abutments to assist in developing preliminary foundation recommendations. Refer to the Preliminary Geotechnical and Materials Report prepared by Tetra Tech. Additional borings at the proposed pier locations along with final geotechnical recommendations are forthcoming.

Possible bridge foundation types include drilled shafts or driven pipe piles. Considering impacts to the river, drilled shafts may be the preferred foundation type for the intermediate piers since they reduce or possibly eliminate the need for cofferdams and are less vulnerable to scour compared to other foundation types. A summary of advantages and disadvantages of foundation types is listed below.

Table 2-2. Bridge Foundation Alternatives

Foundation Type	Advantages	Disadvantages
Driven Steel Piling	• Local Contractor familiarity • More redundant compared to drilled shafts • Lower cost	• Requires cofferdams • More vulnerable to scour than drilled shafts • Piles may deflect while being driven or reach refusal prior to reaching the required embedment
Spread Footings	Not a practical alternative due to the vulnerability to scour at the intermediate piers	
Drilled Shafts	• Less intrusive on the river • Cofferdams may not be required • Less vulnerable to scour	• Required specialized equipment/expertise to construct • Difficult to correct for obstructions or errors that may occur during construction

Additional recommendations will be provided by the geotechnical engineer as the project progresses. A detailed design for the bridge foundations will not be complete until the preferred bridge alternate is selected.

2.8 Aesthetics

The appearance of the bridge will be important and public input on the bridge aesthetic features is a requirement for development of this project per the agreement between MDT and the County.

The bridge will be visible to adjacent home owners and to boaters or other recreationalists along the river. Some typical cost effective options that improve the appearance of the bridge are listed below.

- Textured concrete at the abutments and piers
- Structural enhancements such as haunched girders
- Architectural pedestrian railing
- Colors schemes that blend with the natural surroundings and/or accent lighting
- Decorative pilasters at the bridge ends

A more detailed evaluation of architectural treatments will be performed once the bridge type and span configuration are determined. Public input on aesthetic treatments will be captured prior to finalizing the design.

2.9 Construction Staging

Traffic will be maintained at the current North Avenue crossing at Maclay Bridge during construction. Some temporary closures to River Pines Road in the vicinity of the west approach roadway and west bridge abutment may be necessary during construction; however home owner access will be maintained during construction activities. The existing Maclay Bridge will be removed after the new South Avenue Bridge is constructed and opened to traffic.

Construction of the South Avenue Bridge project will require at least one full construction season to complete. Lead times for bridge material fabrication, in particular steel superstructure elements, should be considered in determining the project bid dates.

2.10 Utilities

A detailed evaluation of utility impacts has not been performed at this time. It appears that several utilities may be in conflict at the west roadway approach depending on the selected alignment.

Figure 2-7. Potential Utility Conflicts near West Approach

Source: Google Maps

A natural gas line, fiber optic line, and telephone line are attached to the existing Maclay Bridge and will need to be relocated prior to demolition of the bridge. Coordination with utility companies to determine utility locations near the proposed bridge site and options to protect in place or relocate will be necessary during final design. At this time, utility impacts are not a controlling factor in selecting the preferred bridge alternative.

3 Bridge & Roadway Alternate Evaluation

3.1 Alignment Alternatives

Several alignments have been considered and are illustrated in the figure below.

Figure 3-1. Roadway Alignment Options

Roadway Alignment A provides the most direct connection between South Avenue and River Pines Road but was eliminated from further consideration due to the proximity to O'Brien Creek. Montana Fish, Wildlife and Parks (FWP) has expressed concerns with the potential impacts to O'Brien Creek and have indicated that the project maintain a 50-ft to 100-ft no-disturbance buffer between the confluence of the creek and the Bitterroot River. Road and bridge construction work for Alignment B is proposed to be outside of the requested buffer. Therefore, Alignment B has been advanced as the most direct connection between South Avenue and River Pines Road that avoids significant impacts to O'Brien Creek.

Alignment C includes gradual curves on either end of the bridge to aid in controlling speeds and to increase the distance from O'Brien Creek. Alignment C also crosses the river at a reduced skew compared to Alignment B which could reduce the total length of bridge. Alignment C has been advanced for further consideration.

Alignment D and E were developed such that the bridge crossing would be perpendicular to the river which eliminates skew and provides the shortest span length over the active channel. Although Alignment E has the advantage of reducing property impacts on the west side of the river, it was eliminated because of the T-intersection with River Pines Road. Given the vertical grade needed on River Pines Road and the 90° corner, this option does not provide adequate sight distance, and is inefficient considering the projected 2-way traffic volumes. After developing some preliminary bridge span arrangements on Alignment D, it became apparent that there was no cost advantage compared to Alignment C which requires less roadway work. Therefore, Alignment D was eliminated.

Alignment B and Alignment C were advanced for further consideration in developing bridge alternatives and were renamed to Alignment 1 and Alignment 2 respectively.

Figure 3-2. Selected Roadway Alignment Options

During a flood event, the high water will overtop the existing South Avenue roadway from its current west terminus to approximately 600-ft east. To minimize impacts to the existing floodplain, and adequately convey high river flows, the new approach roadway grade should closely match the existing roadway elevation near the end of South Avenue. This will perpetuate overtopping of the roadway during a flood event. In addition, matching the existing South Avenue grade will also avoid significant impacts to the existing roadway approaches. If the profile grade were raised at the east bridge approach, there would be an increase in the backwater elevation, impacts to the existing flood plain limits, and impacts to existing property access. Therefore, to the extent possible, the east bridge approach will closely match the existing roadway grade.

In general, the roadway profile grade was set to provide adequate freeboard over the design flood event, provide clearance for boaters during normal flows, and to fit the existing roadway grades. Where possible, the maximum vertical roadway approach grades were limited at 5%, which is the maximum grade to comply with ADA requirements.

3.2 Bridge Alternatives

The bridge alternates presented in this report were developed to best meet the site-specific design requirements discussed in Section 2. In general, intermediate pier construction can be more complex and costly for a river crossings compared to a bridge constructed over dry land. The additional cost to provide longer spans can sometimes be offset by reduced substructure costs and impacts to the river. For this project, intermediate pier locations were determined for each bridge alternate with consideration to the following items:

- River hydraulics
- Impacts to O'Brien Creek
- Potential impacts to recreational use of the river
- Structurally efficient bridge span lengths

- Symmetrical span arrangement for aesthetics
- Constructability

Bridge superstructures comprised of steel I-girder shapes are cost effective and common to local contractors. Steel box girders are also viable superstructure alternatives for this site, but cost more compared to I-girders and with no apparent structural advantage. Intermediate piers in the active channel are required to maintain practical span lengths for girder bridge types. The use of uncoated weathering steel has been the predominate choice in Montana due to the initial and long term cost advantage compared to painted steel. In general, weathering steel is appropriate where adequate freeboard is maintained over normal water flows and the steel is not subject to a corrosive environment. Therefore, uncoated weathering steel I-girders are assumed for all steel girder bridge alternates.

Conventional prestressed concrete girder superstructures have shorter span length capability and additional piers would be required compared to using steel girders. Spliced, post-tensioned, concrete I-girders allow for greater span lengths than conventional prestressed girders. However, that bridge type would require temporary shoring in the river to support the girders prior to completing the splice and would likely cost at least as much as a steel plate girder bridge with the same span lengths. Similarly, a concrete box girder bridge (segmental or cast in place) can accommodate long spans, but requires specialized construction and results in higher cost compared to a steel plate girder bridge. Therefore, concrete bridge alternatives have been eliminated as practical options for this site.

Bridge superstructure types such as a tied arch or truss can span the active river channel without the need for intermediate piers. However, these structure types cost significantly more than the more conventional I-girder bridge types.

There are numerous span configurations and bridge options that can be considered. However, the following bridge alternatives best fit the project site, comply with the project specific criteria, and provide a comprehensive range of structure types to evaluate.

Table 3-1. Bridge Alternates

Bridge Alternate	Roadway Alignment	Span Configuration	Description
1A	Alignment #1	240’-241’-133’-132’ = 746’	Longer span steel plate girder on tangent alignment
1B	Alignment #1	166’-207’-207’-166’ = 746’	Balanced steel plate girder bridge on tangent alignment
1C	Alignment #1	166’-207’-167’-103.5’-102.5’ = 746’	Three span plate girder with pre-stressed beam approach spans
2A	Alignment #2	225-226-92-91-91 = 725’	Similar to Alternate 1A but on Alignment #2
2B	Alignment #2	160.5’-202’-202-‘160.5’ = 725’	Similar to Alternate 1B but on Alignment #2
2C	Alignment #2	226’-227’-91’-91-‘90’ = 725’	Two span steel truss with plate girder approach spans

Table 3-1. Bridge Alternates

Bridge Alternate	Roadway Alignment	Span Configuration	Description
2D	Alignment #2	226'-227'-91'-91-'90' = 725'	Two span tied arch with plate girder approach spans
2E	Alignment #2	451'-92'-91'-91' = 725'	Long span tied arch or truss with plate girder approach spans

Preliminary layouts for each of the bridge alternates are included in Appendix A.

3.2.1 Bridge Alternate 1A

Bridge Alternate 1A consists of two, two span continuous welded steel plate girder superstructures. The larger two span structure spans over the active river channel with the shorter structure extending over the floodway to the east. A single pier is centered on the existing channel which provides a large separation from O'Brien Creek and accommodates recreational navigation along the river banks. The entire bridge is located on a tangent alignment.

Table 3-2. Bridge Alternate 1A Summary

Bridge Details	
Total Bridge Length:	746'
Span Configuration:	240' - 241' – 133' - 132'
Superstructure Type:	Welded Steel Plate Girder
Estimated Construction Cost:	$7,330,000 (Base Cost, See §3.4)
Possible Advantages:	• Only one pier in the active river channel • Haunched main span girder provides structural economy and possible aesthetic preference • Tangent alignment
Possible Disadvantages:	• Girder dimensions may preclude local fabrication • Skew requires additional analysis and detailing for cross frames • Additional expansion joint between two superstructure systems
Other Information:	• Constant depth girder design could increase cost for the two span structure over the main channel

3.2.2 Bridge Alternate 1B

Bridge Alternate 1B is a four span continuous welded steel plate girder bridge. The piers are located to provide structurally balanced span lengths and to avoid the center of the existing channel. The balanced span configuration allows for a cost effective superstructure design and possibly more desirable visual appearance compared to unbalanced spans. The entire bridge is located on a tangent alignment.

Table 3-3. Bridge Alternate 1B Summary

Bridge Details	
Total Bridge Length:	746’
Span Configuration:	166’ - 207’ - 207’ - 166’
Superstructure Type:	Welded Steel Plate Girder
Estimated Construction Cost:	$6,790,000 (Base Cost, See §3.4)
Possible Advantages:	• Balanced span configuration • Girder depth within local fabricator capabilities • Tangent alignment • Within 1% of the low cost alternative
Possible Disadvantages:	• Two piers in the active river channel
Other Information:	• Cost estimate is based on constant depth girder. Girders could be haunched for aesthetics with added cost.

3.2.3 Bridge Alternate 1C

This alternate was added for consideration per the request of the Montana Department of Transportation. Alternate 1C consists of two superstructure types: a three span continuous welded steel plate girder superstructure and a two span prestressed concrete MTS beam superstructure. Similar to Alternate 1B, the river piers are located to provide structurally balanced steel span lengths and to avoid the center of the existing channel. The spans over the eastern floodplain are composed of prestressed concrete beams with an additional pier compared to Alternate 1B. The entire bridge is located on a tangent alignment.

Table 3-4. Bridge Alternate 1C Summary

Bridge Details	
Total Bridge Length:	746’
Span Configuration:	166’ - 207’ - 167’ – 103.5’ – 103.5'
Superstructure Type:	Welded Steel Plate Girder and Prestressed Beam
Estimated Construction Cost:	$6,850,000 (Base Cost, See §3.4)
Possible Advantages:	• Balanced span configuration • Girder depth within local fabricator capabilities • Tangent alignment • Within 1% of the low cost alternative
Possible Disadvantages:	• Two piers in the active river channel • Additional expansion joint between two superstructures • Visual discontinuity between superstructure types - aesthetics
Other Information:	• Cost estimate is based on constant depth girder. Girders could be haunched for aesthetics with added cost.

3.2.4 Bridge Alternate 2A

Bridge Alternate 2A is a five span structure with two steel plate girder units. The main unit spans over the existing channel and a shorter three span steel girder east approach over the floodway. This alternate is similar to Alternate 1A, but on roadway Alignment #2 and with shorter, more economical main spans. The eastern approach spans would be located on a horizontally curved alignment.

Table 3-5. Bridge Alternate 2A Summary

Bridge Details	
Total Bridge Length:	725’
Span Configuration:	225’ - 226’ - 92’ - 91’ - 91’
Superstructure Type:	Welded Steel Plate Girder
Estimated Construction Cost:	$7,130,000 (Base Cost, See §3.4)
Possible Advantages:	• Only one intermediate pier in the active river channel • Haunched main span girder provide structural economy and potential aesthetic preference • Lower roadway profile compare to 1A
Possible Disadvantages:	• Girder dimensions may preclude local fabrication • Additional expansion joint between two superstructures • Curved alignment on east end of bridge
Other Information:	• Constant depth girder design could increase cost for the 2-span system over the main channel • One pier could be eliminated at the east approach with a profile grade raise and a deeper 2-span girder system

3.2.5 Bridge Alternate 2B

Bridge Alternate 2B is a four span steel plate girder with balanced span lengths. This alternate is similar to Alternate 1B, but on roadway Alignment #2. The piers are located to provide structurally balanced span lengths and to avoid the center zone of the existing channel. The eastern most span would be located on a horizontally curved alignment.

Table 3-6. Bridge Alternate 2B Summary

Bridge Details	
Total Bridge Length:	725’
Span Configuration:	160.5’ – 202’ – 202’ – 160.5’
Superstructure Type:	Welded Steel Plate Girder
Estimated Construction Cost:	$6,750,000 (Base Cost, See §3.4)
Possible Advantages:	• Balanced span configuration • Girder depth within local fabricator capabilities • Low cost alternate
Possible Disadvantages:	• Two piers in the active river channel • Curved alignment on the east

Table 3-6. Bridge Alternate 2B Summary

Bridge Details	
Other Information:	• Cost is based on constant depth girder option. Girders could be haunched for aesthetics with added cost.

3.2.6 Bridge Alternate 2C

Bridge Alternate 2C is similar to Alternate 2A but with steel trusses serving as the main spans over the active channel and steel girder approach spans over the floodway on the east side of the river. The purpose of this alternate was to develop an option that fits the context of the existing Maclay Bridge. The steel trusses would include a protective coating at least in the areas that would be exposed roadway spray containing deicing chemical. The eastern approach span would be located on a curved alignment.

Table 3-7. Bridge Alternate 2C Summary

Bridge Details	
Total Bridge Length:	725’
Span Configuration:	226’ – 227’ – 91’ – 91’ – 90’
Superstructure Type:	Steel Truss and Welded Steel Plate Girder
Estimated Construction Cost:	$10,500,000 (Base Cost, See §3.4)
Possible Advantages:	• Relatively shallow superstructure could accommodate lower roadway profile grade • Through trusses are visually similar to the Maclay bridge
Possible Disadvantages:	• Truss spans do not accommodate future widening • Curved alignment on east end of bridge • Additional expansion joint between two superstructures • Trusses may require protective coating system • Trusses require Fracture Critical Members • Higher cost alternate
Other Information:	• Truss spans could possibly be supplier designed with a reduced roadway width.

3.2.7 Bridge Alternate 2D

Bridge Alternate 2D is similar to Alternate 2C but with tied arch spans over the active channel. This alternate was developed based on interest expressed in the project working group regarding a tied arch structure. The tied arch spans cannot be practically constructed on a skew. Therefore the piers are oriented normal to the alignment. Alternatively, roadway Alignment D or E discussed in §3.1 could be used to avoid piers that are misaligned with the direction of river flow. If this alternate moves forward, additional consideration should be given to Roadway Alignment D or E. Similar to the truss spans in Alternate 2C, the main span steel would be painted to protect against roadway spray containing deicing chemical. The eastern approach spans would consist of steel girders and require a curved alignment over the floodway.

Table 3-8. Bridge Alternate 2D Summary

Bridge Details	
Total Bridge Length:	725’
Span Configuration:	226’ – 227’ – 91’ – 91’ – 90’
Superstructure Type:	Tied Arch and Welded Steel Plate Girder
Estimated Construction Cost:	$12,060,000 (Base Cost, See §3.4)
Possible Advantages:	• Relatively shallow superstructure could accommodate a lower roadway profile grade • Aesthetics
Possible Disadvantages:	• Bridge type does not accommodate future widening • Curved alignment on east end of bridge • Piers misaligned to river flow • Arch spans may require protective coating system • Additional expansion joint between two superstructures • Arch requires Fracture Critical Members • Higher cost alternate
Other Information:	• Roadway Alignment D or E would better align the piers with the direction of flow and should be reconsidered if this alternate advances.

3.2.8 Bridge Alternate 2E

Bridge Alternate 2E was developed as an option that clear spans the active channel. Two options with similar costs were considered for the main span: A tied arch and a steel truss. The tied arch spans cannot be practically constructed on a skew. Therefore the piers are oriented normal to the alignment. Alternatively, Roadway Alignment D or E discussed in §3.1 could be used to avoid piers that are misaligned with the direction of river flow. The main span steel elements would be painted to protect against roadway spray containing deicing chemical. The eastern approach spans would consist of steel girders and require a curved alignment over the floodway.

Table 3-9. Bridge Alternate 2E Summary

Bridge Details	
Total Bridge Length:	725’
Span Configuration:	451’ – 92’ – 91’ – 91’
Superstructure Type:	Steel Truss/Arch and Steel Plate Girder
Estimated Construction Cost:	$16,220,000 (Base Cost, See §3.4)
Possible Advantages:	• Eliminates construction in active channel • Shallow superstructure could accommodate a lower roadway profile grade • Aesthetics

Table 3-9. Bridge Alternate 2E Summary

Bridge Details	
Possible Disadvantages:	• Curved alignment on east end of bridge • Piers misaligned to river flow • Protective coating system • Fracture Critical Members with special inspection requirements. • Additional expansion joint between two superstructures • Highest cost alternative
Other Information:	• Roadway Alignment D or E should be reconsidered if a clear span option is advanced.

3.3 Bridge Substructure

For the purpose of this study, drilled shafts are assumed to be the preferred foundation type for all bridge alternatives included in this report. The diameter and length of embedment has been estimated to determine concept level costs. Although foundation cost is a significant component of the overall bridge cost, the foundation type should not have a significant impact on the relative cost difference between bridge alternates. Final geotechnical recommendations, selection of a foundation type, and bridge substructure design will follow selection of the preferred bridge alternate.

3.4 Bridge Alternate Cost Summary

A cost summary of the bridge alternates is included in the table below. The costs were based on MDT bid tabulations from past projects and applied to the estimated quantities for each of the bridge alternates. Where appropriate the unit prices were adjusted based on judgment to reflect the specific characteristics of this project.

Table 3-10. Estimated Construction Cost Summary

Estimated Cost	Bridge Alternate							
	1A	1B	1C	2A	2B	2C	2D	2E
Base Bridge Cost (2016 dollars)	$7,330,000	$6,790,000	$6,850,000	$7,130,000	$6,750,000	$10,500,000	$12,060,000	$16,220,000
Base Bridge Cost per Square Foot	$228	$211	$213	$228	$216	$336	$386	$519
Remove Structure	$300,000	$300,000	$300,000	$300,000	$300,000	$300,000	$300,000	$300,000
Roadway Approach Cost	$335,000	$335,000	$335,000	$360,000	$360,000	$360,000	$360,000	$360,000
Mobilization (18%) including work bridge	$1,643,700	$1,546,500	$1,557,300	$1,612,200	$1,543,800	$2,218,800	$2,499,600	$3,248,400
Subtotal	**$9,608,700**	**$8,971,500**	**$9,042,300**	**$9,402,200**	**$8,953,800**	**$13,378,800**	**$15,219,600**	**$20,128,400**
Contingencies (20%)	$1,921,740	$1,794,300	$1,808,460	$1,880,440	$1,790,760	$2,675,760	$3,043,920	$4,025,680
Construction Engineering (15%)	$1,729,566	$1,614,870	$1,627,614	$1,692,396	$1,611,684	$2,408,184	$2,739,528	$3,623,112
Inflation to 2018 (3% per year)	$807,534	$753,983	$759,933	$790,180	$752,495	$1,124,381	$1,279,086	$1,691,631
Total Est. Cost	**$14,067,540**	**$13,134,653**	**$13,238,307**	**$13,765,216**	**$13,108,739**	**$19,587,125**	**$22,282,134**	**$29,468,823**

3.5 Conclusion

Bridge Alternate 1B is cost effective, structurally efficient, and is the recommended option for this site. Alternate 1A is also a valid alternative with a similar cost and offers the advantage of one fewer piers in the active channel. However, the hydraulic performance of Alternate 1B is nearly identical to Alternate 1A, and the total number of piers is the same for either option. Since Alternate 1B provides adequate hydraulic performance and is more structurally efficient, it is recommended over Alternate 1A.

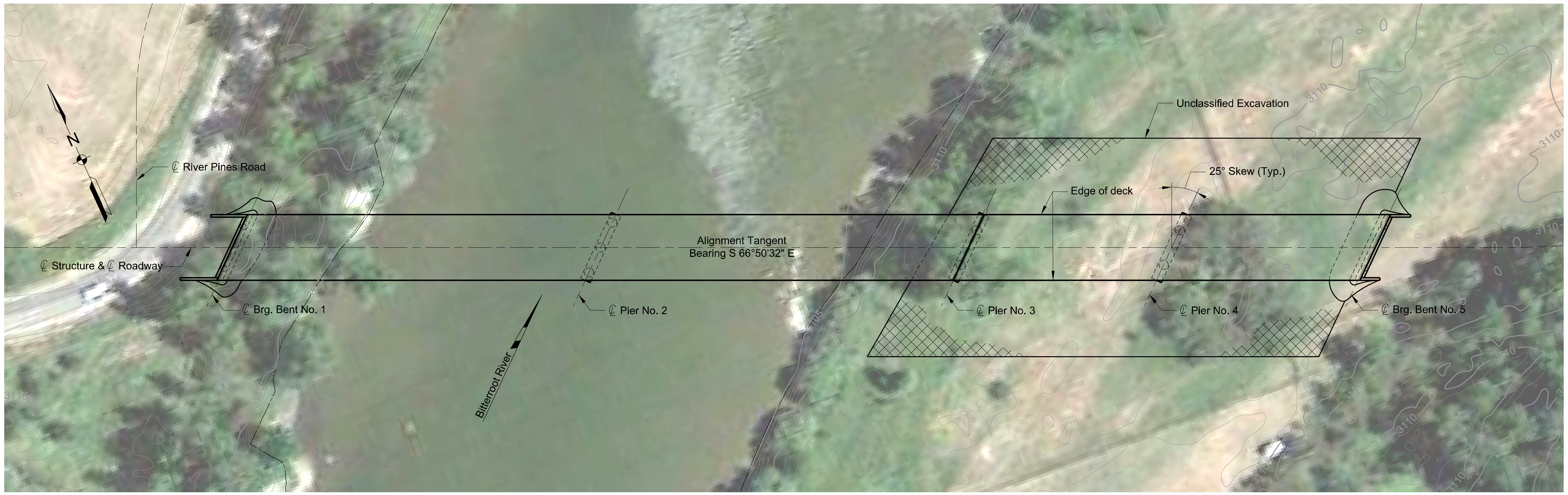
Bridge Alternate 1C utilizes a combination of welded plate girders to span the main river channel and simple span MTS Prestressed beams to span the eastern floodplain. The alternate is cost competitive. However, compared to Alternate 1B, Alternate 1C requires an additional pier, will require an additional expansion joint, and in profile does not provide a uniform appearance which is undesirable considering aesthetics. For these reasons, Alternate 1C is not recommended over Alternate 1B.

Bridge Alternates 2A and 2B are nearly identical to Alternates 1A and 1B respectively, but have a reduced total bridge length due the roadway alignment. The biggest disadvantage of Alternates 2A and 2B is that the horizontal curve at the eastern approach extends onto the bridge. The horizontal curve would likely require designing the bridge deck to transition from a normal crown to a super elevation, which is not uncommon, but increases the complexity of both design and construction. An additional consideration is that this alignment requires drivers to negotiate a curve on a potentially icy bridge deck during the winter. For these reasons, Alternates 2A and 2B are not recommended over Alternates 1A and 1B.

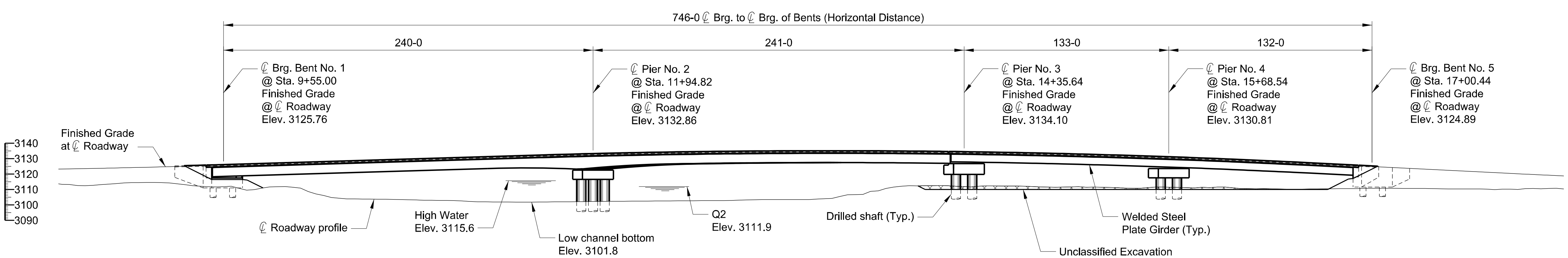
Bridge Alternates 2C, 2D and 2E all utilize a combination of welded plate girders to span the floodway to the east and long span structures, trusses or tied arches over the main river channel. These alternates do provide benefits such as minimizing, or eliminating, work in the existing channel and minimizing superstructure depth. However, these bridge alternates cost significantly more than the girder superstructure alternatives. The limited benefits do not justify the increased costs and for this reason Bridge Alternates 2C, 2D, and 2E are not recommended.

Appendix – A

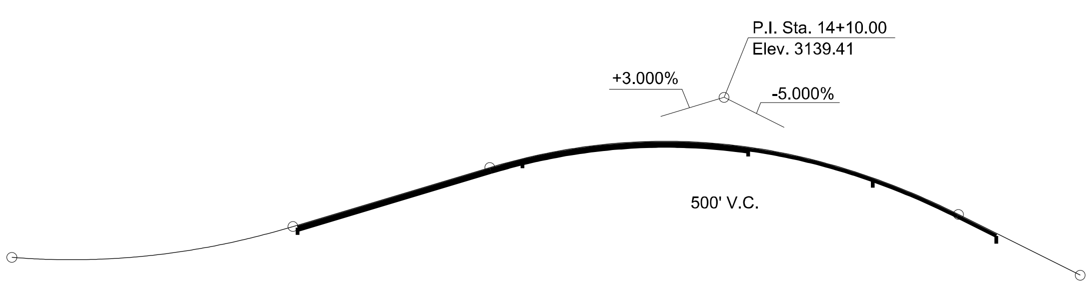
Preliminary Bridge Layouts



PLAN



ELEVATION



PROFILE GRADE

No Scale

HDR

PRELIMINARY

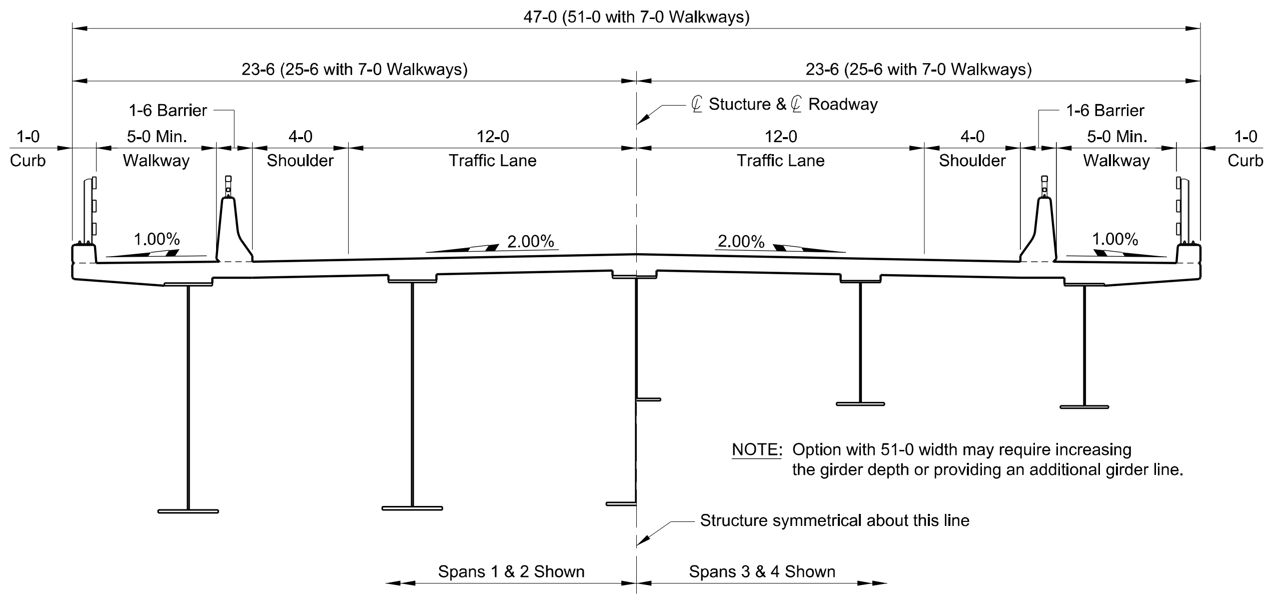
MC

SOUTH AVENUE BRIDGE
OVER BITTERROOT RIVER
TYPE SIZE AND LOCATION STUDY

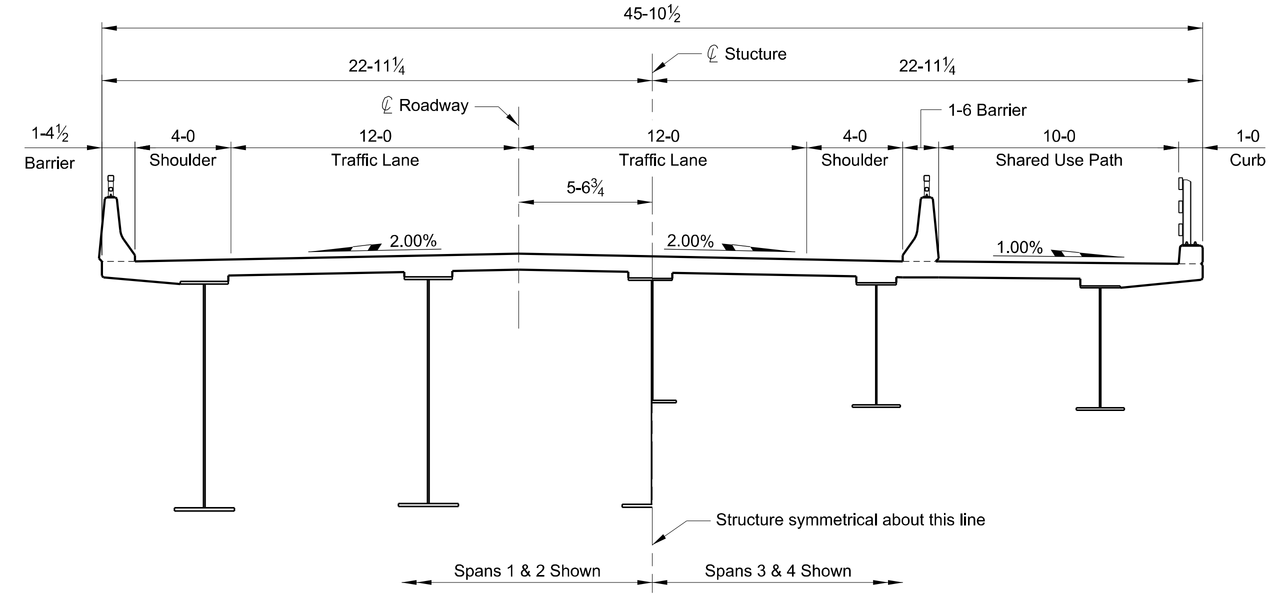
ALTERNATE 1A PLAN & ELEVATION

JULY 2016

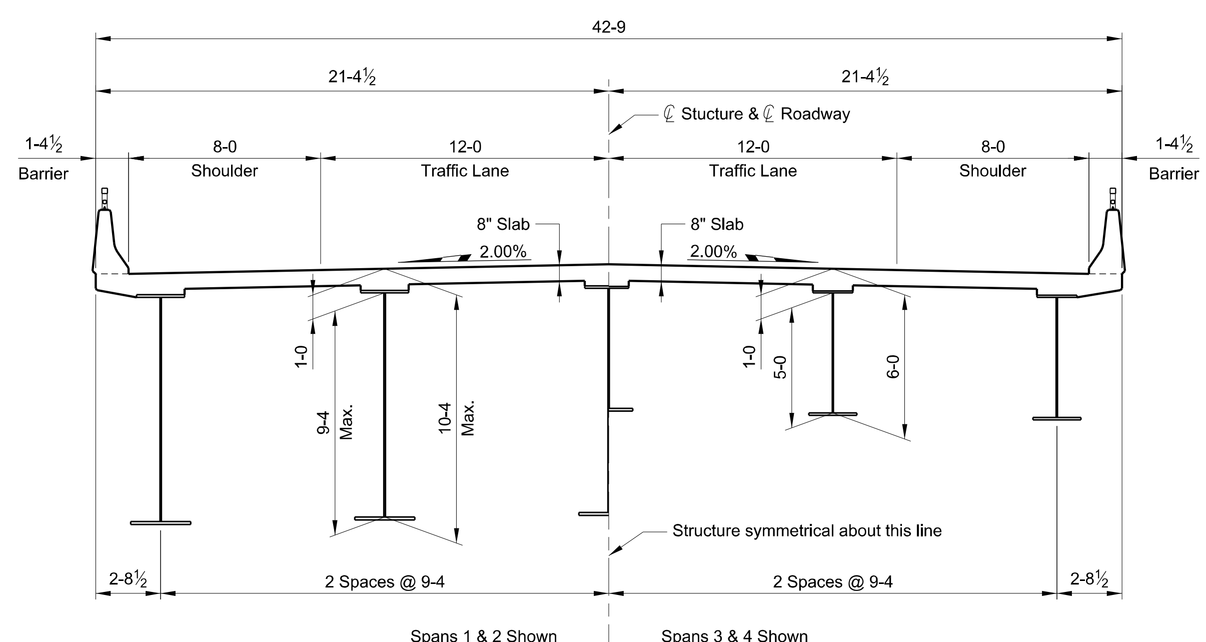
Scale 1" = 80'-0"



SECTION WITH SEPARATED WALKWAYS
(Looking Ahead on Line)



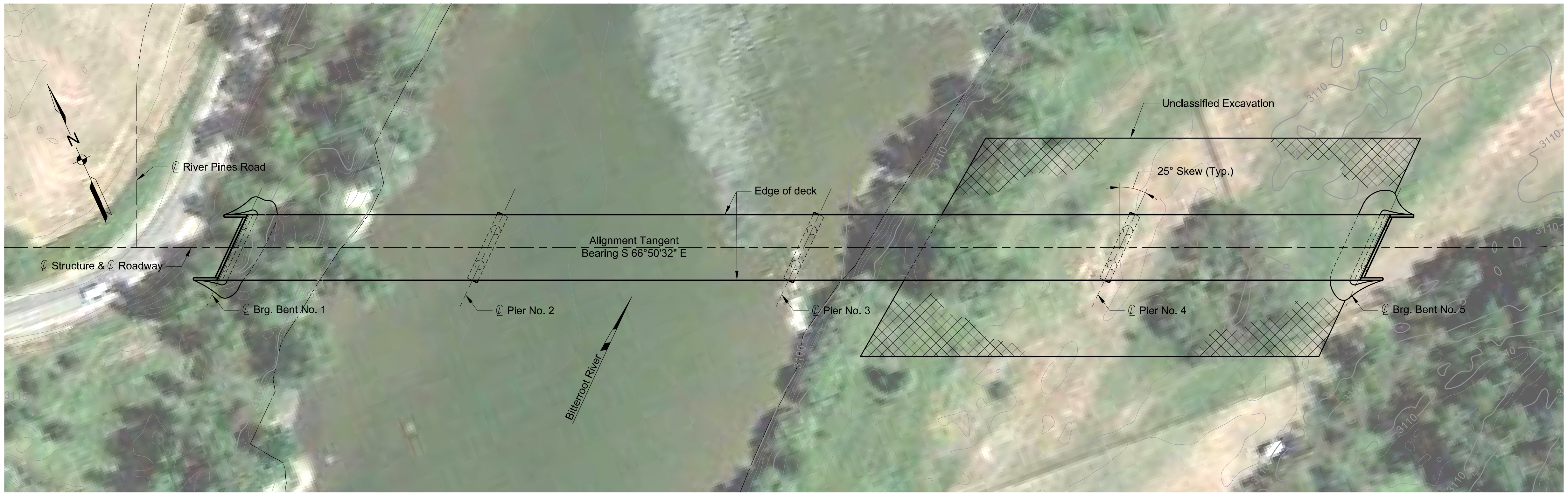
SECTION WITH SHARED USE PATH
(Looking Ahead on Line)



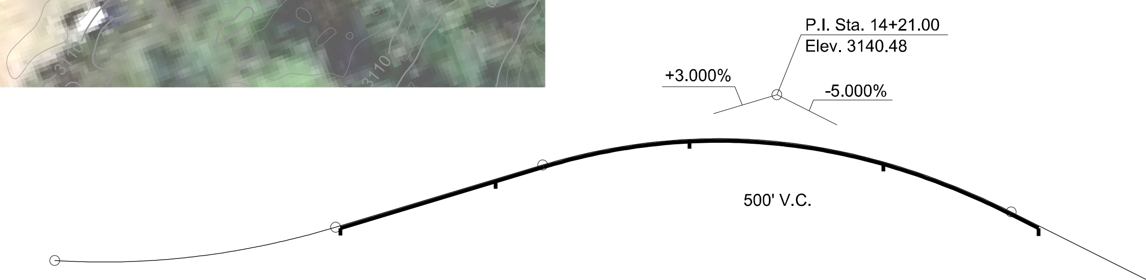
SECTION
(Looking Ahead on Line)

SOUTH AVENUE BRIDGE
OVER BITTERROOT RIVER
TYPE SIZE AND LOCATION STUDY
ALTERNATE 1A DECK OPTIONS
JULY 2016
Scale ⅛" = 1'-0"

PRELIMINARY

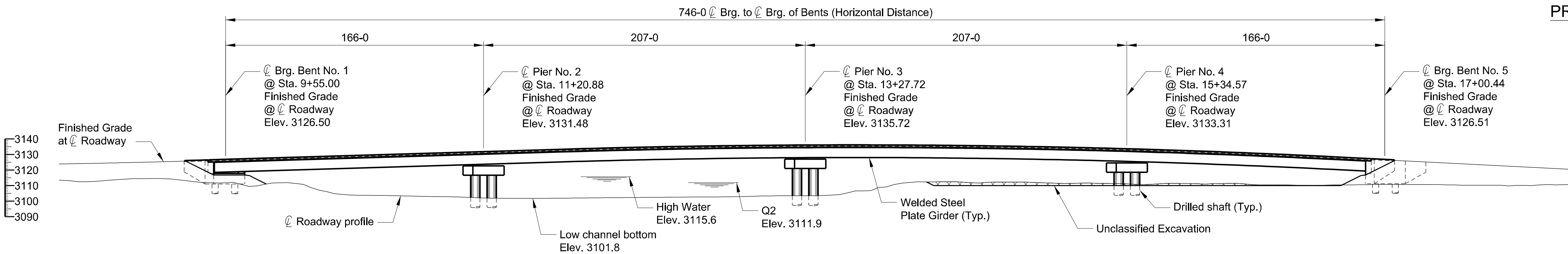


PLAN

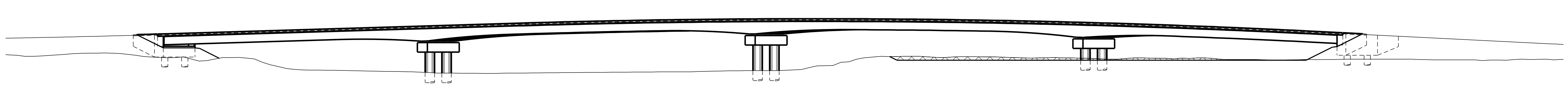


PROFILE GRADE

No Scale



ELEVATION



ELEVATION - HAUNCHED GIRDER OPTION

HDR

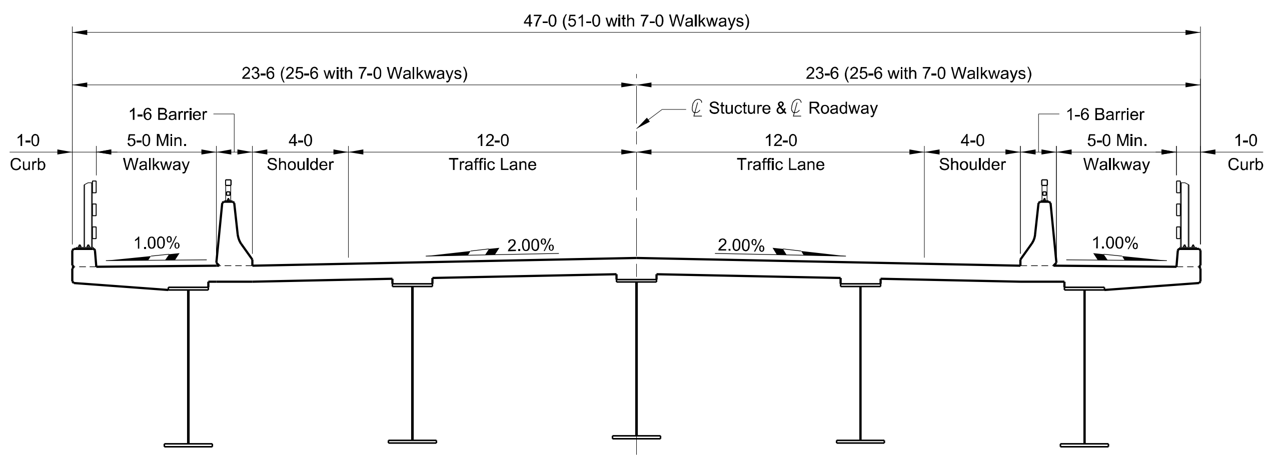
PRELIMINARY

SOUTH AVENUE BRIDGE
OVER BITTERROOT RIVER
TYPE SIZE AND LOCATION STUDY

ALTERNATE 1B PLAN & ELEVATION

JULY 2016

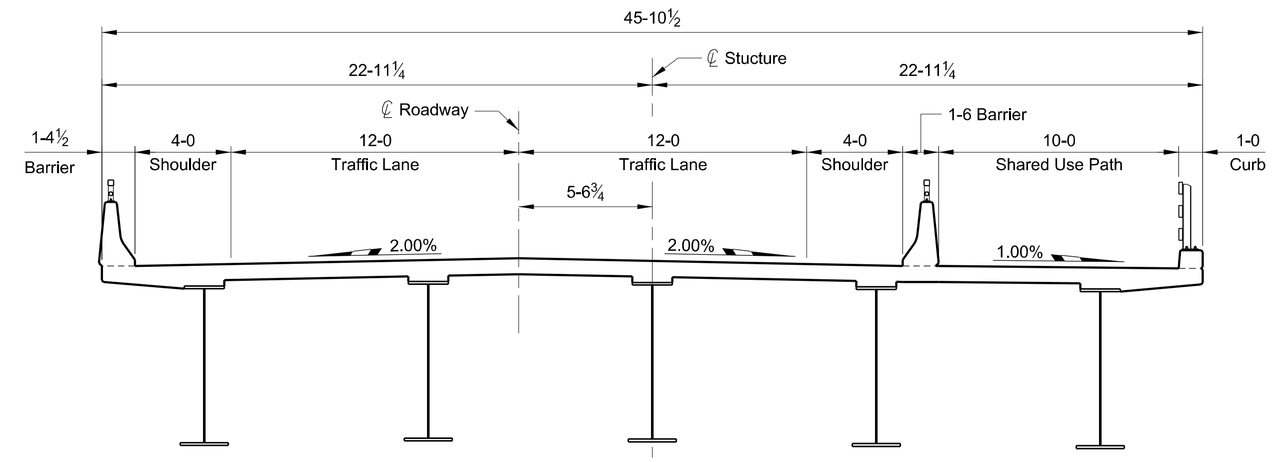
Scale 1" = 80'-0"



NOTE: Option with 51-0 width may require increasing the girder depth or providing an additional girder line.

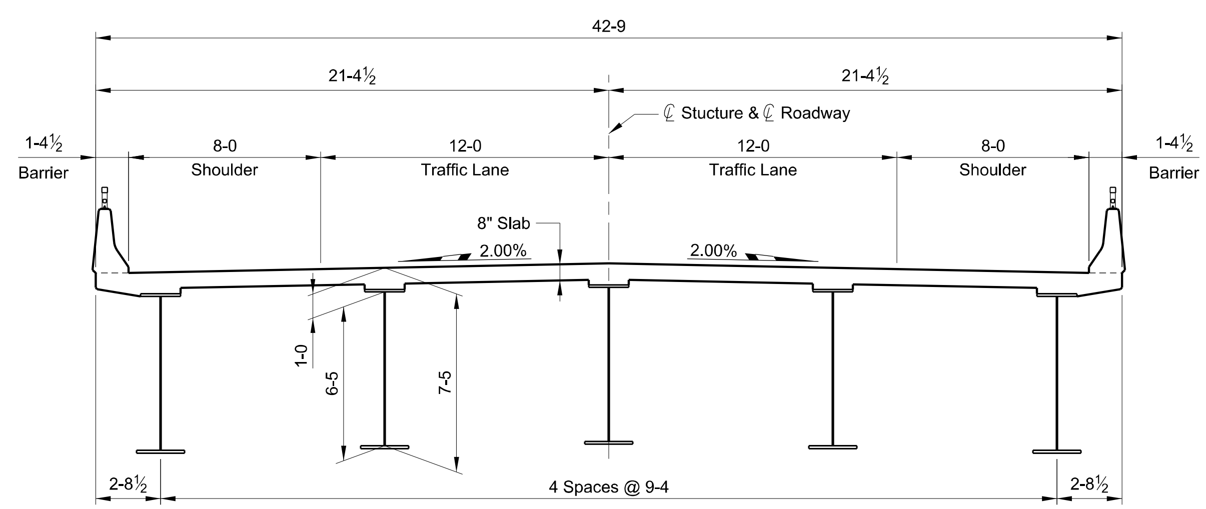
SECTION WITH SEPARATED WALKWAYS

(Looking Ahead on Line)



SECTION WITH SHARED USE PATH

(Looking Ahead on Line)



SECTION

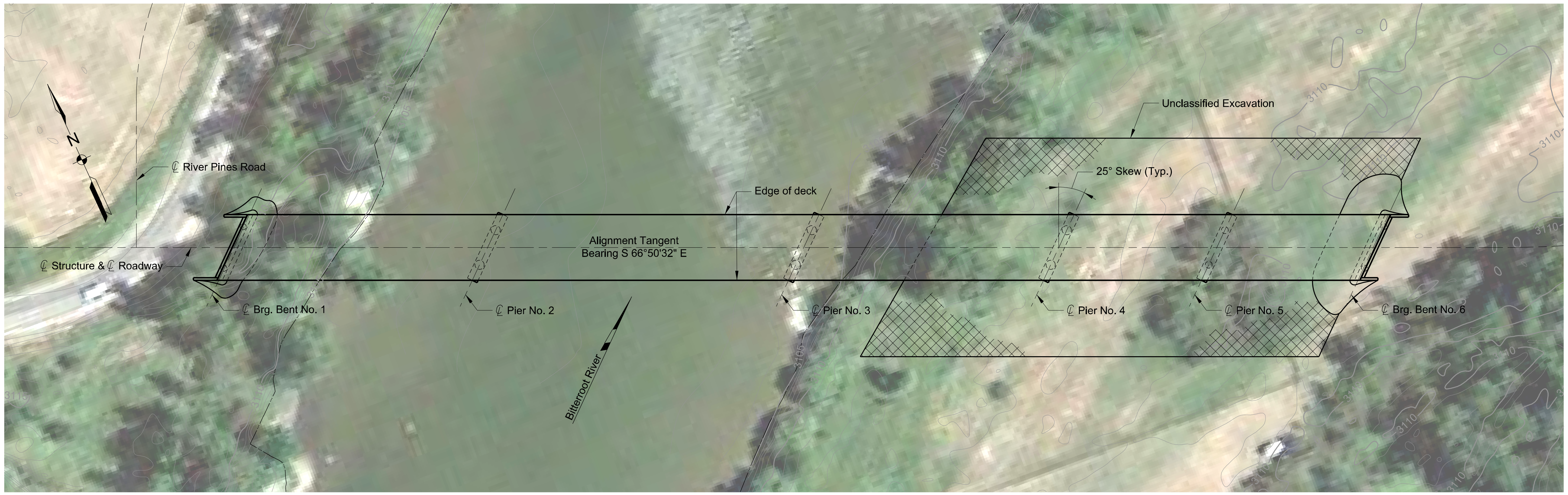
(Looking Ahead on Line)

SOUTH AVENUE BRIDGE
OVER BITTERROOT RIVER
TYPE SIZE AND LOCATION STUDY

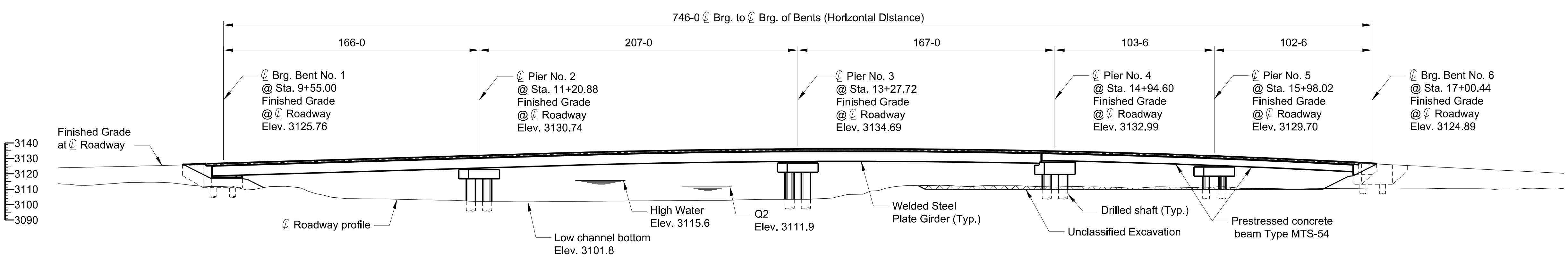
ALTERNATE 1B DECK OPTIONS

JULY 2016

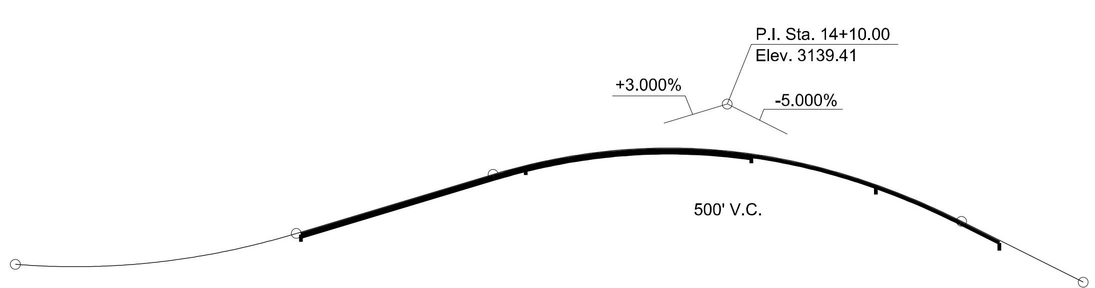
Scale ⅛" = 1'-0"



PLAN



ELEVATION



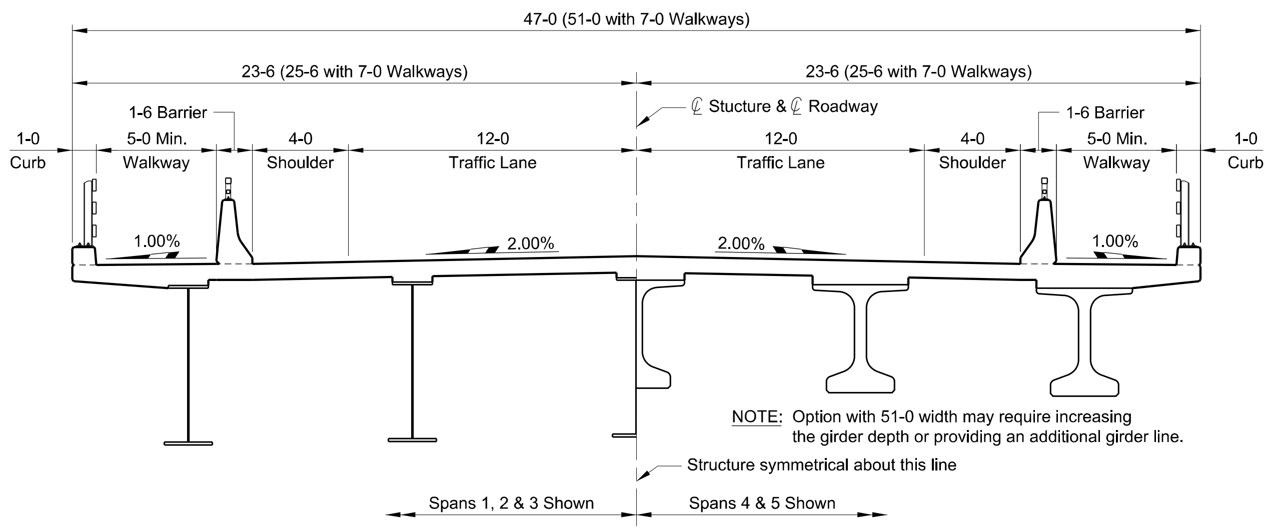
PROFILE GRADE
No Scale

HDR

PRELIMINARY

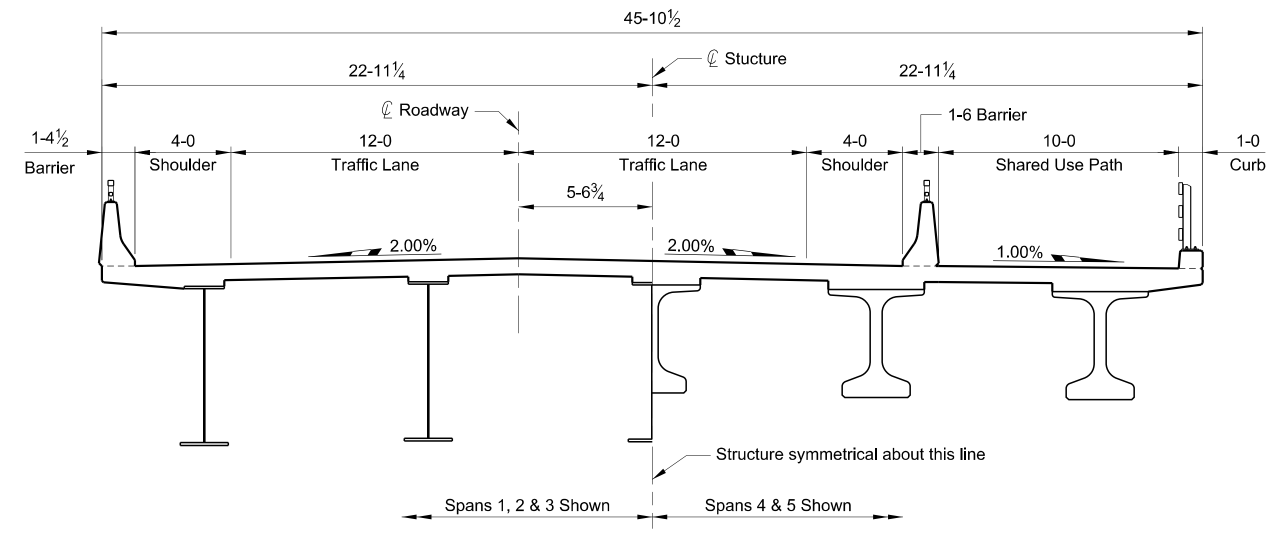
MC

SOUTH AVENUE BRIDGE
OVER BITTERROOT RIVER
TYPE SIZE AND LOCATION STUDY
ALTERNATE 1C PLAN & ELEVATION
OCTOBER 2016
Scale 1" = 80'-0"



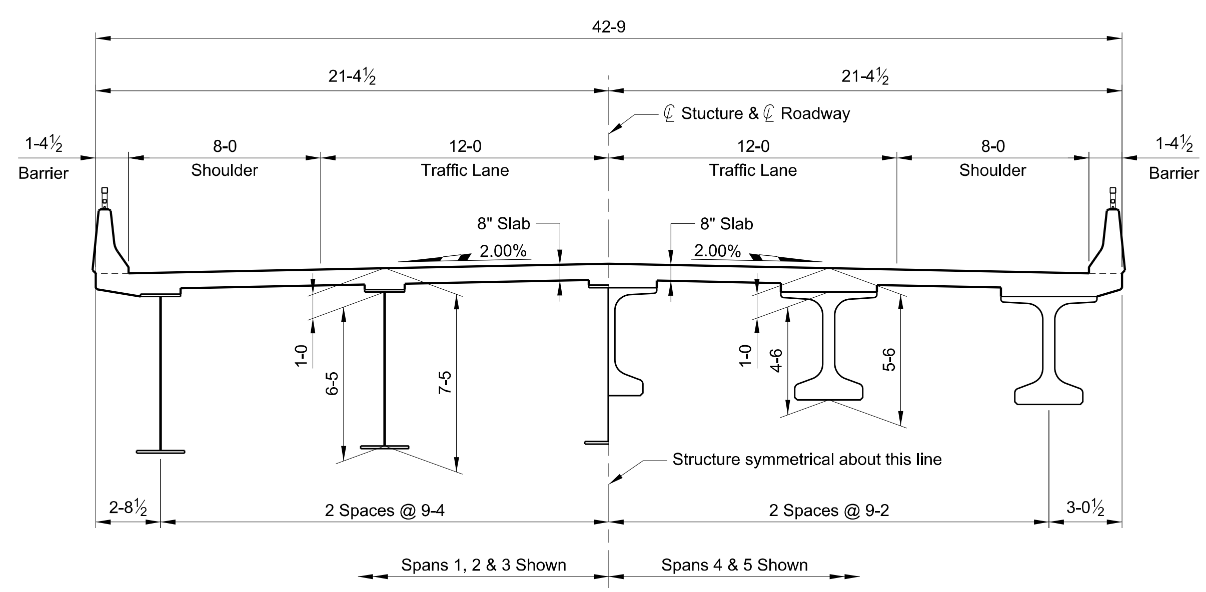
SECTION WITH SEPARATED WALKWAYS

(Looking Ahead on Line)



SECTION WITH SHARED USE PATH

(Looking Ahead on Line)



SECTION

(Looking Ahead on Line)

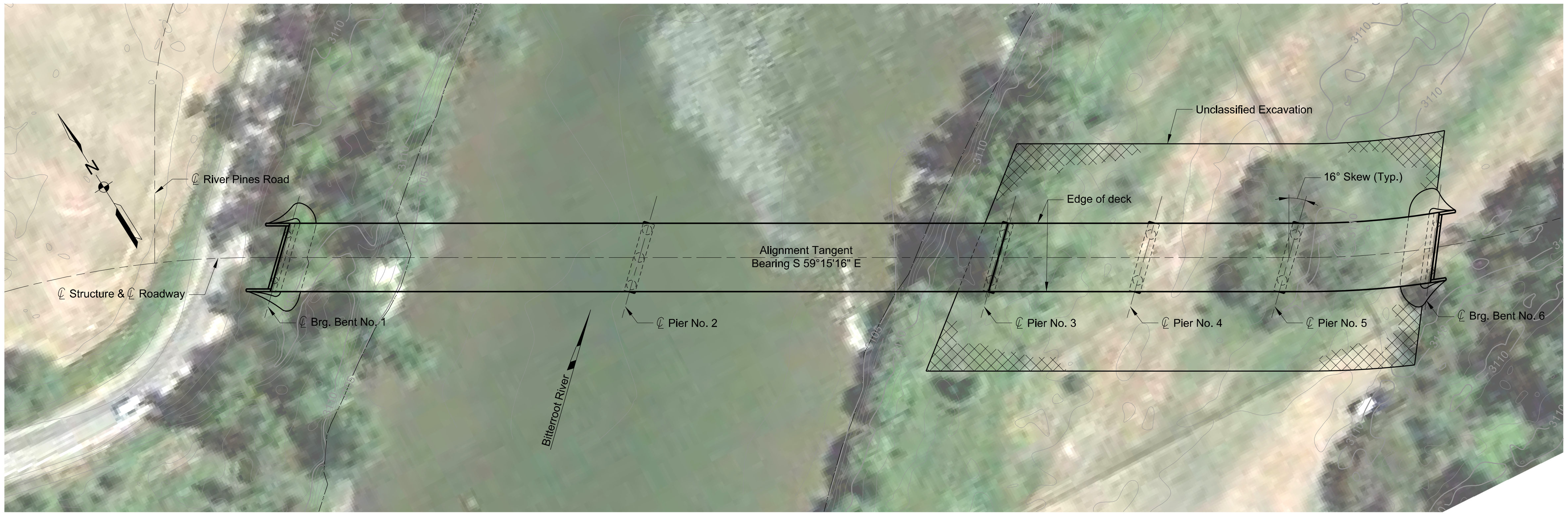
SOUTH AVENUE BRIDGE
OVER BITTERROOT RIVER
TYPE SIZE AND LOCATION STUDY

ALTERNATE 1C DECK OPTIONS

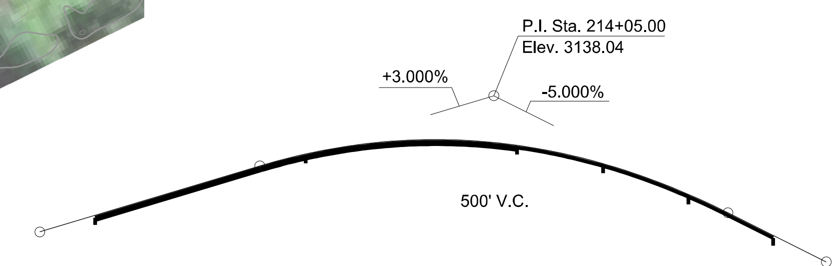
OCTOBER 2016

Scale ⅛" = 1'-0"

PRELIMINARY

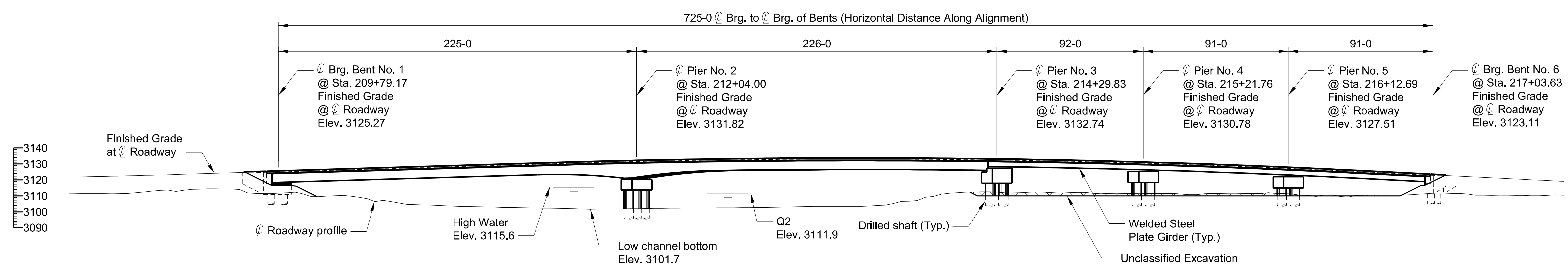


PLAN



PROFILE GRADE

No Scale



ELEVATION

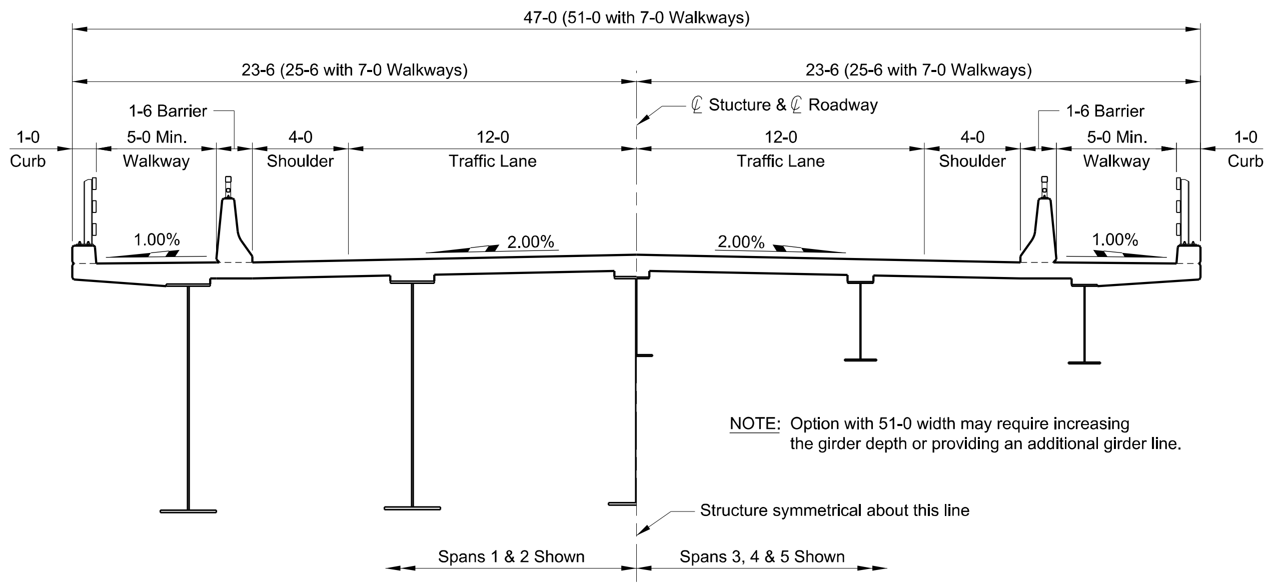
SOUTH AVENUE BRIDGE
OVER BITTERROOT RIVER
TYPE SIZE AND LOCATION STUDY

ALTERNATE 2A PLAN & ELEVATION

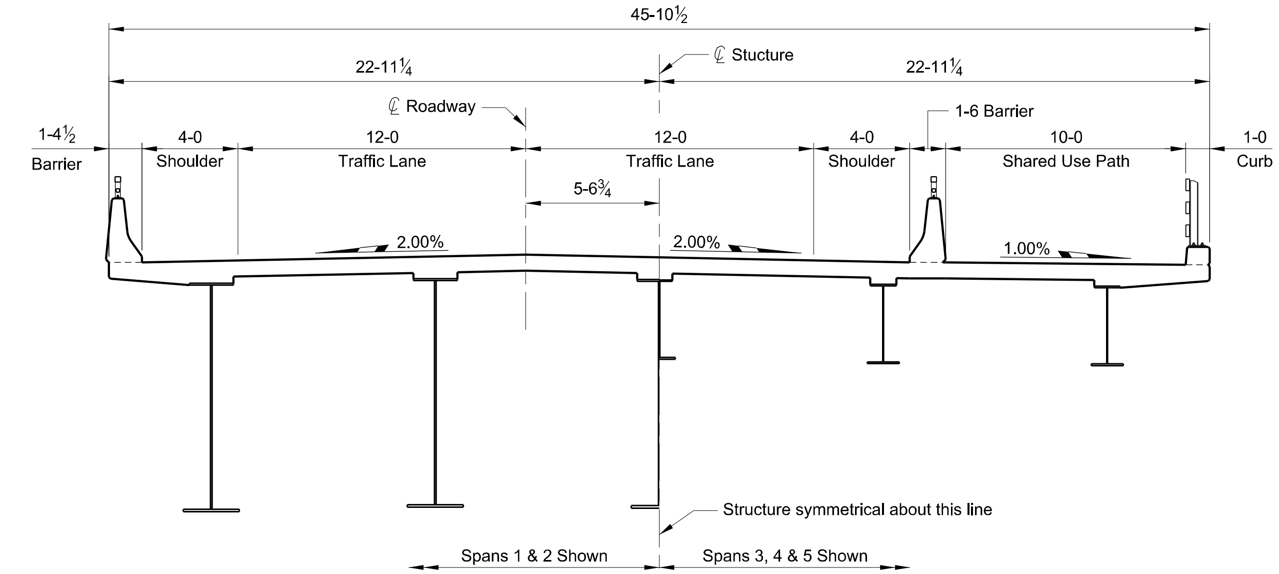
JULY 2016

Scale 1" = 80'-0"

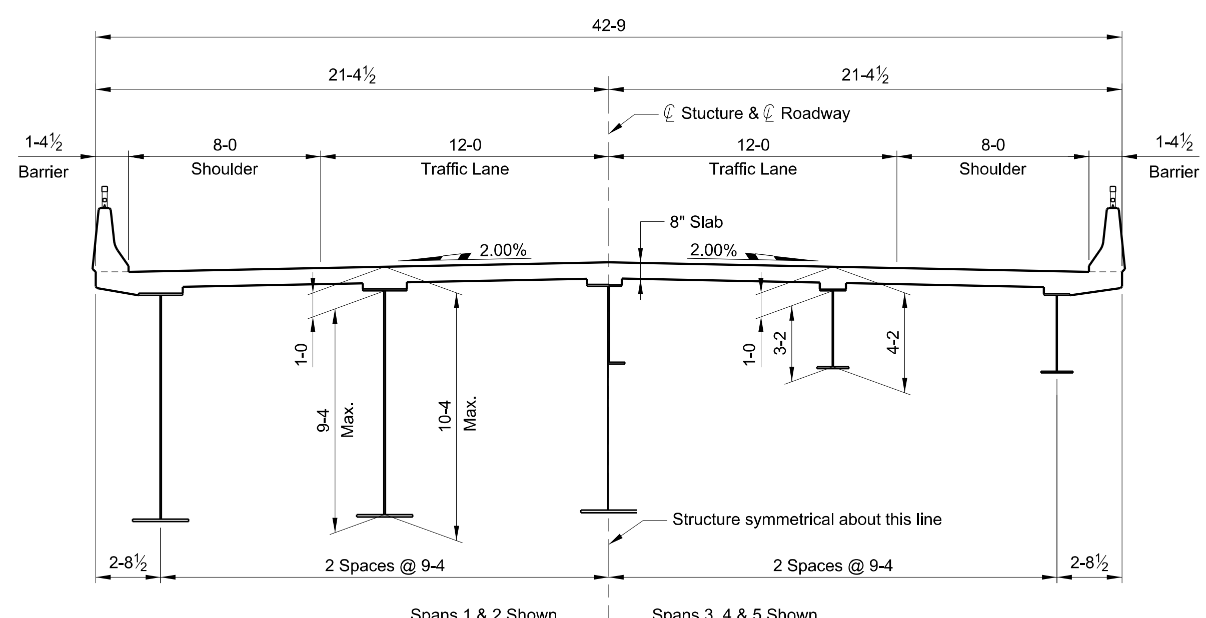
PRELIMINARY



SECTION WITH SEPARATED WALKWAYS
(Looking Ahead on Line)



SECTION WITH SHARED USE PATH
(Looking Ahead on Line)



SECTION
(Looking Ahead on Line)

HDR

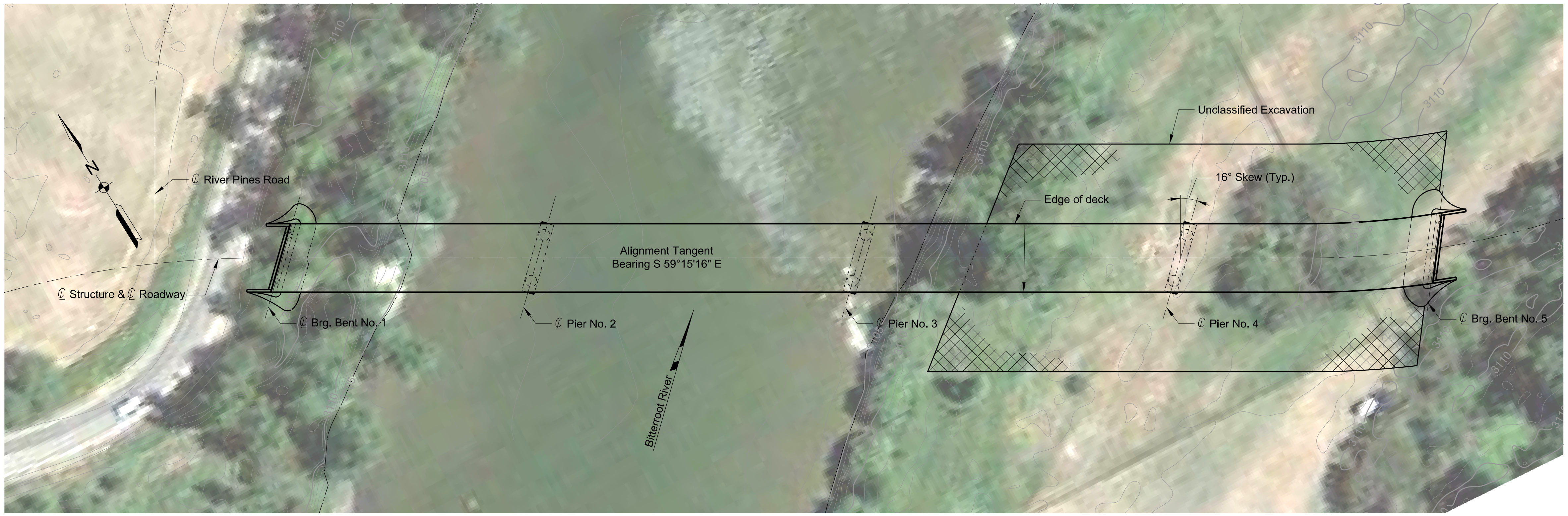
PRELIMINARY

SOUTH AVENUE BRIDGE
OVER BITTERROOT RIVER
TYPE SIZE AND LOCATION STUDY

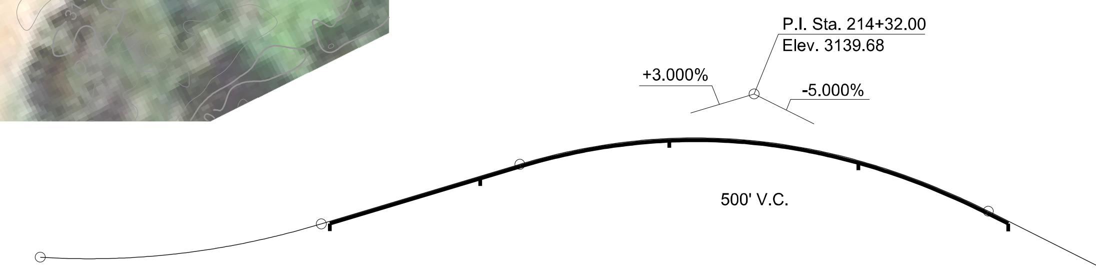
ALTERNATE 2A DECK OPTIONS

JULY 2016

Scale ⅛" = 1'-0"

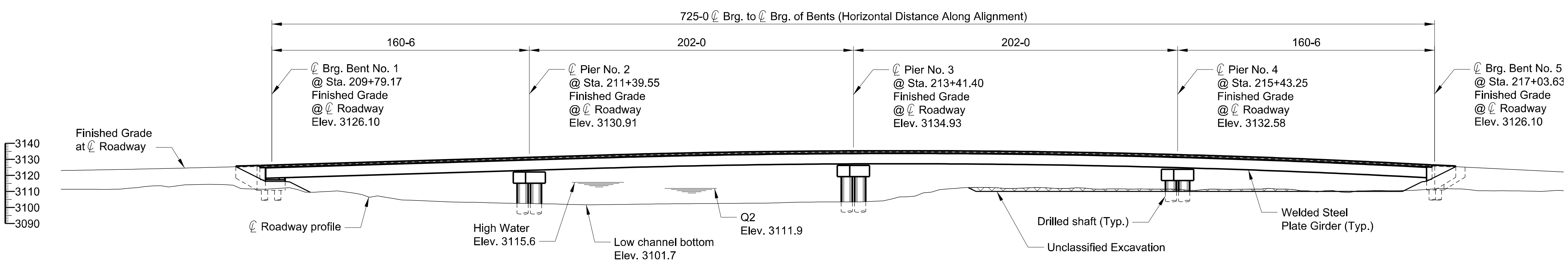


PLAN

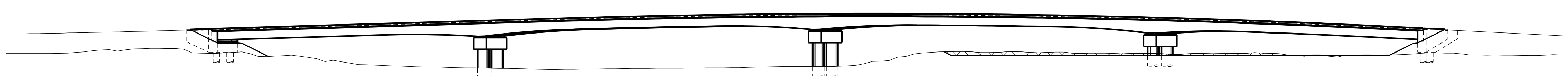


PROFILE GRADE

No Scale



ELEVATION



ELEVATION - HAUNCHED GIRDER OPTION

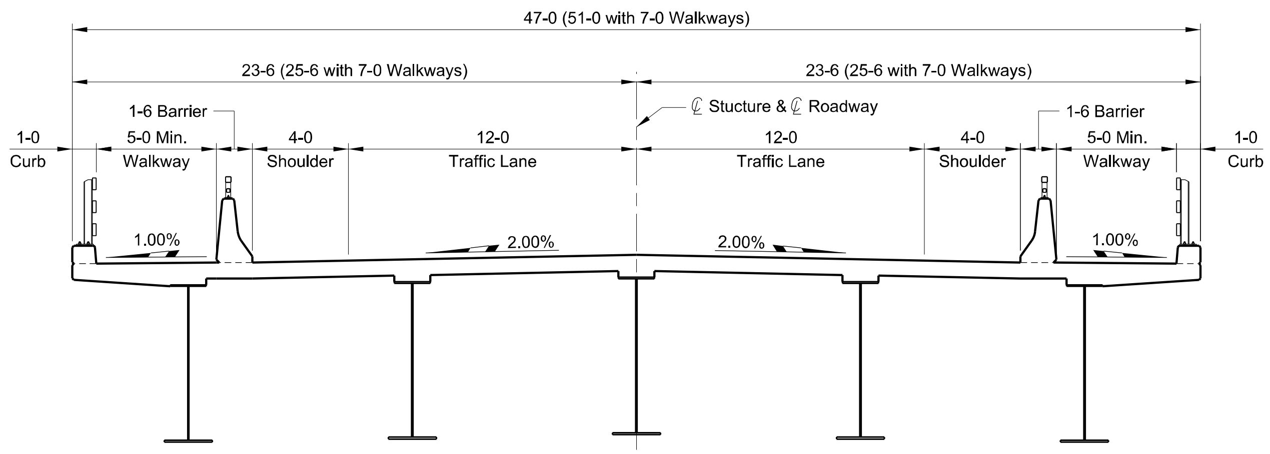
SOUTH AVENUE BRIDGE
OVER BITTERROOT RIVER
TYPE SIZE AND LOCATION STUDY

ALTERNATE 2B PLAN & ELEVATION

JULY 2016

Scale 1" = 80'-0"

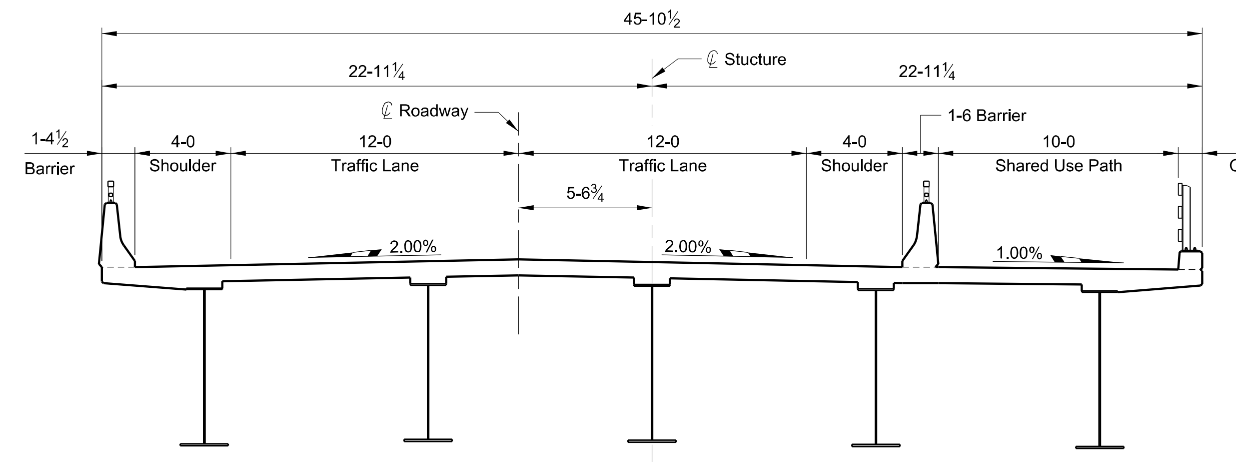
PRELIMINARY



NOTE: Option with 51-0 width may require increasing the girder depth or providing an additional girder line.

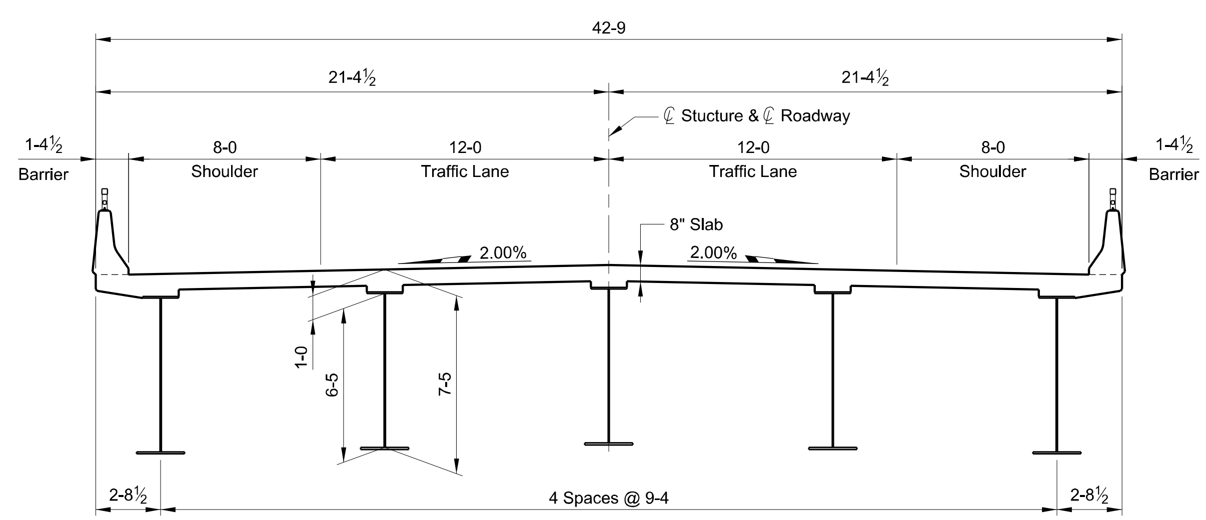
SECTION WITH SEPARATED WALKWAYS

(Looking Ahead on Line)



SECTION WITH SHARED USE PATH

(Looking Ahead on Line)



SECTION

(Looking Ahead on Line)

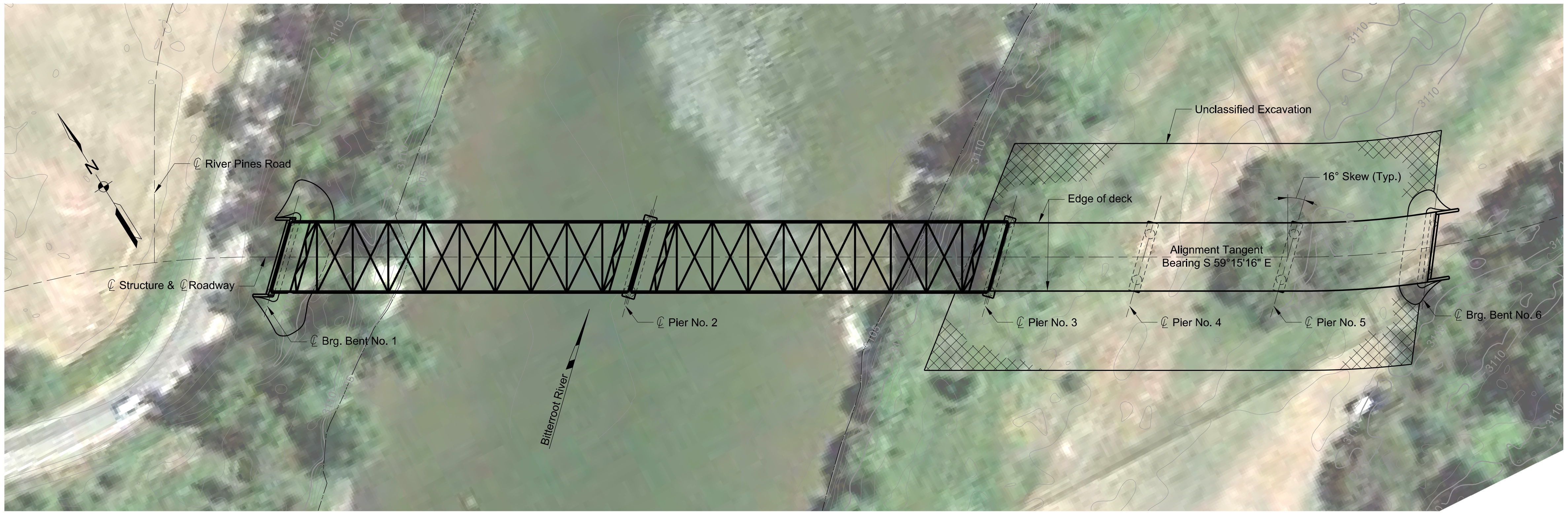
SOUTH AVENUE BRIDGE
OVER BITTERROOT RIVER
TYPE SIZE AND LOCATION STUDY

ALTERNATE 2B DECK OPTIONS

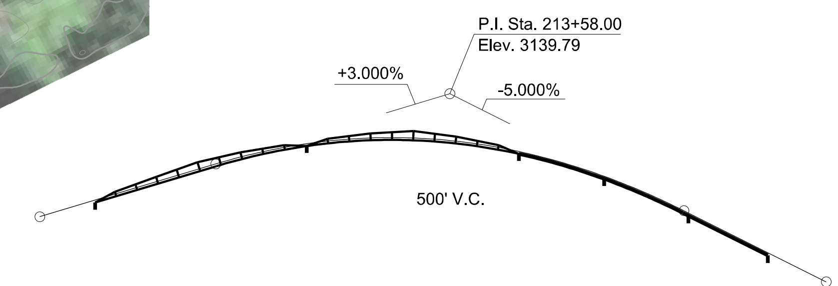
JULY 2016

Scale ⅛" = 1'-0"

PRELIMINARY

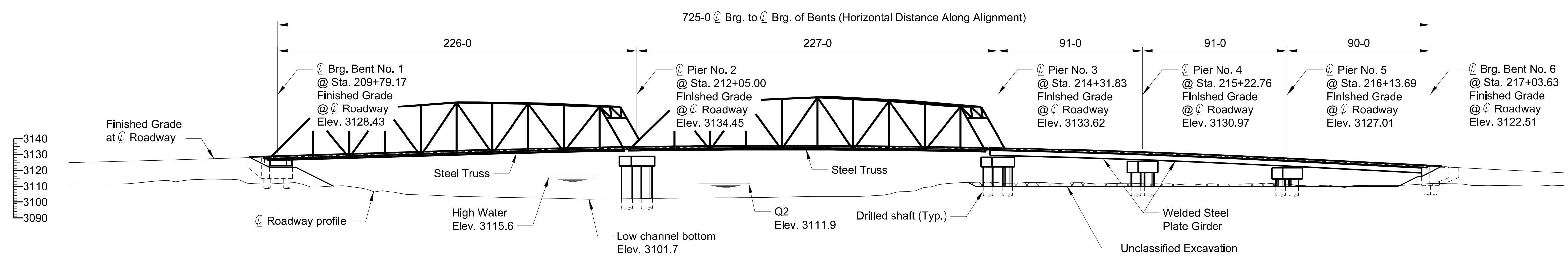


PLAN



PROFILE GRADE

No Scale



ELEVATION

HDR

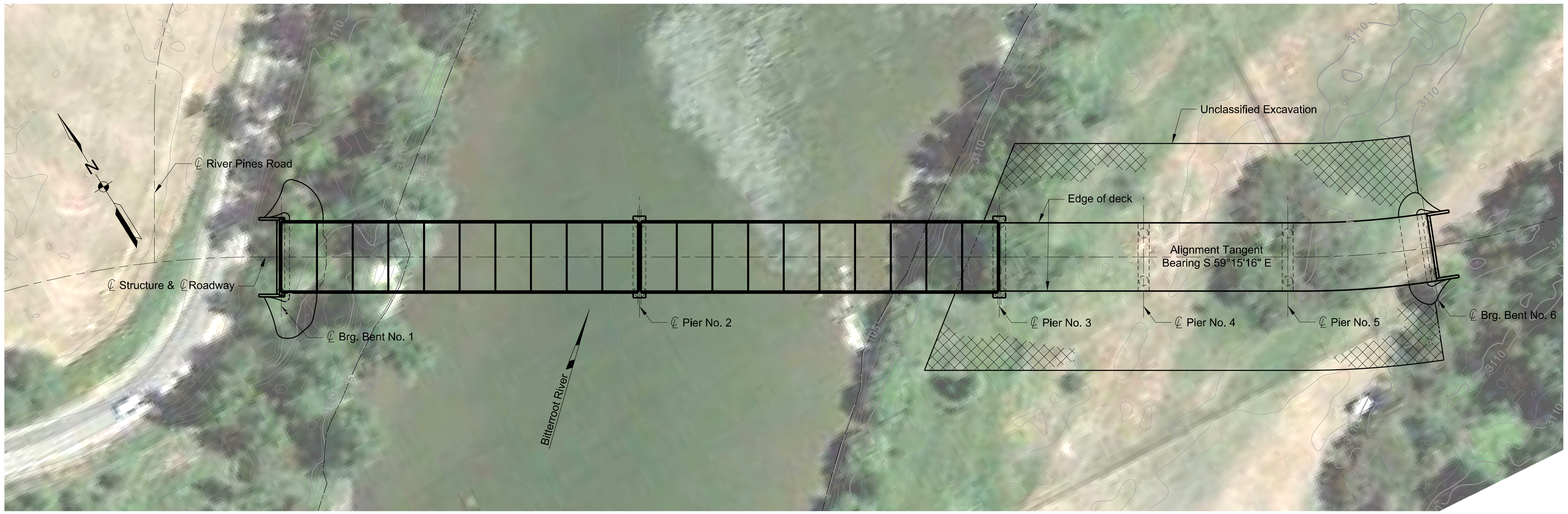
PRELIMINARY

MC

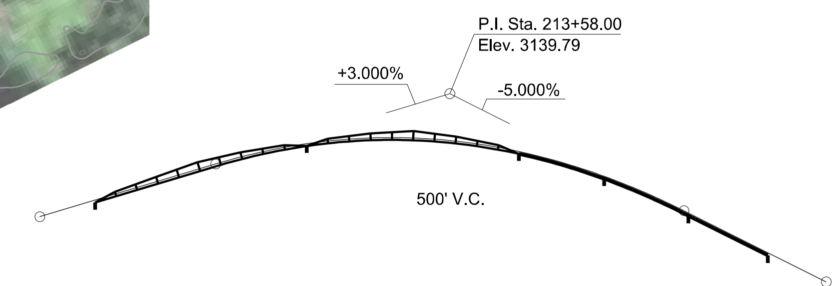
SOUTH AVENUE BRIDGE
OVER BITTERROOT RIVER
TYPE SIZE AND LOCATION STUDY

ALTERNATE 2C PLAN & ELEVATION

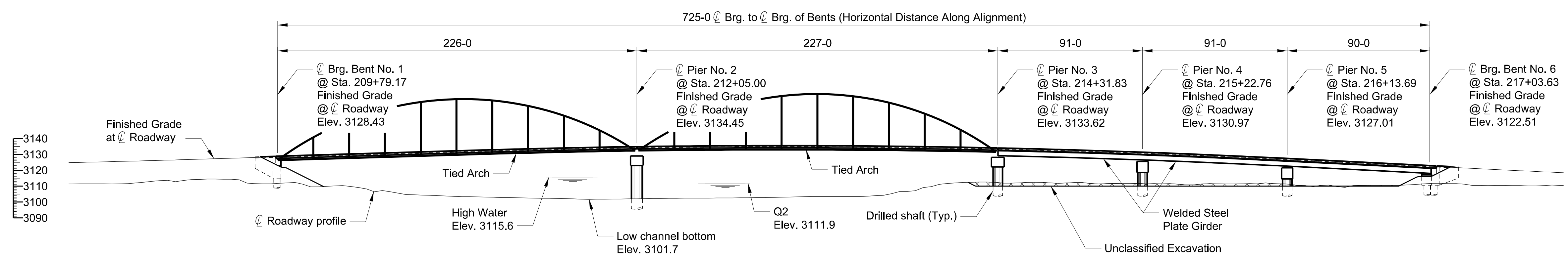
JULY 2016
Scale 1" = 80'-0"



PLAN



PROFILE GRADE
No Scale



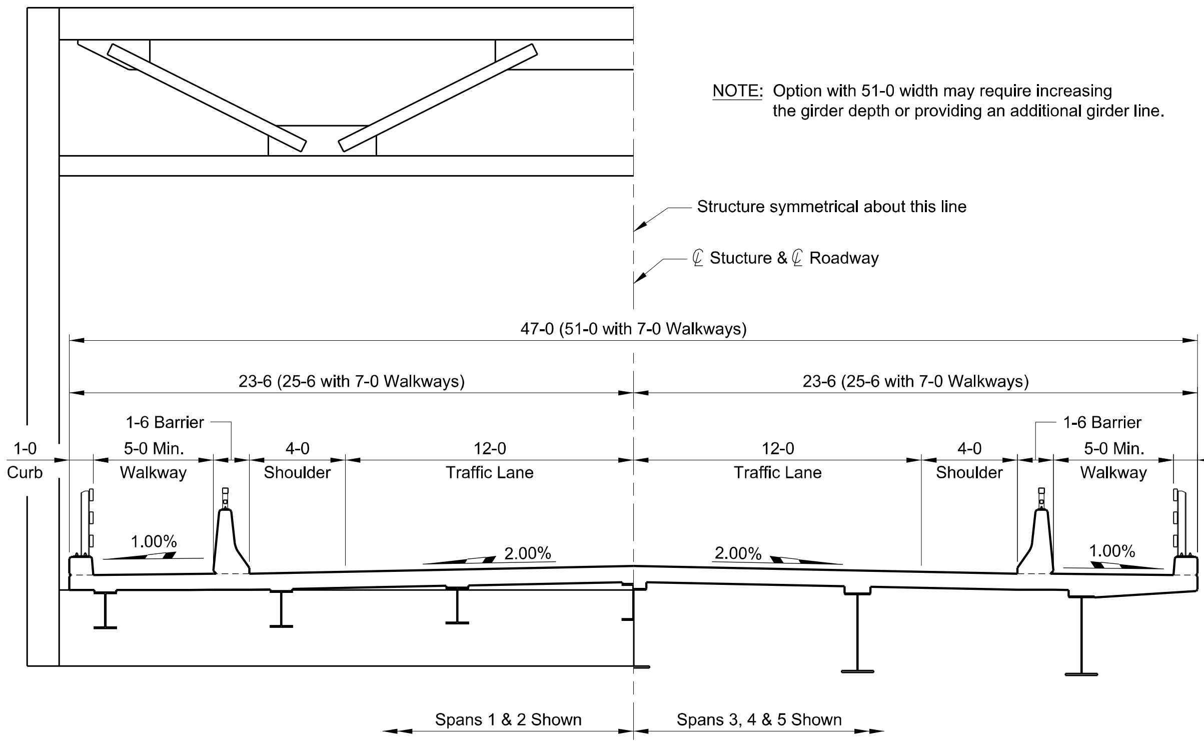
ELEVATION

SOUTH AVENUE BRIDGE
OVER BITTERROOT RIVER
TYPE SIZE AND LOCATION STUDY

ALTERNATE 2D PLAN & ELEVATION

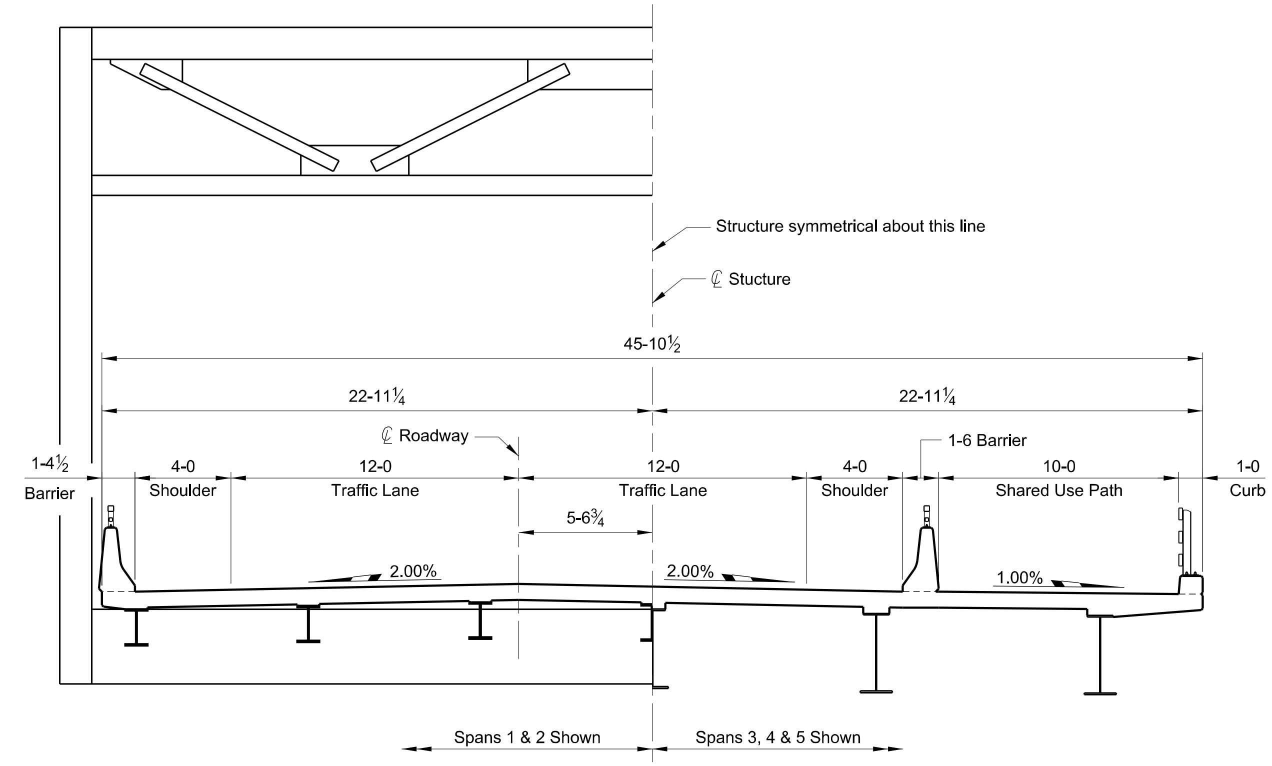
JULY 2016
Scale 1" = 80'-0"

PRELIMINARY



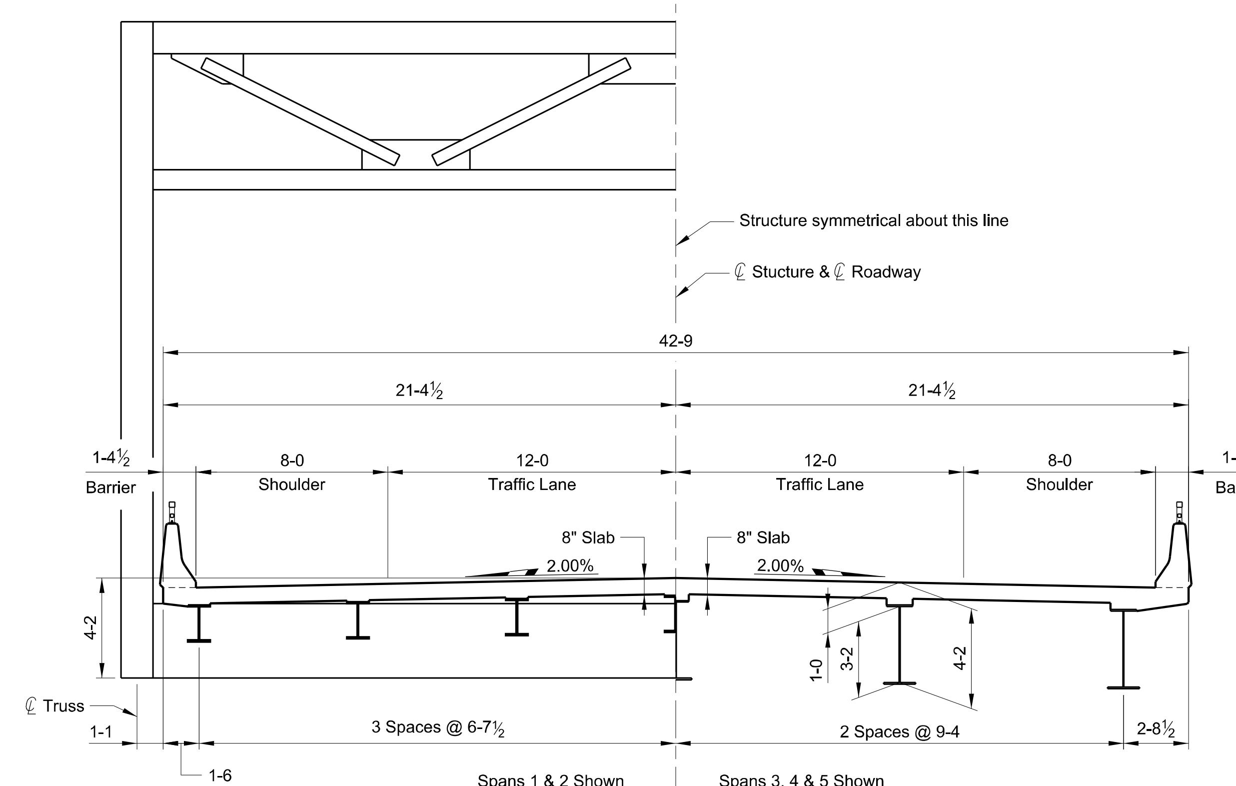
SECTION WITH SEPARATED WALKWAYS

(Looking Ahead on Line)
(Option 2C shown, Option 2D similar)



SECTION WITH SHARED USE PATH

(Looking Ahead on Line)
(Option 2C shown, Option 2D similar)



SECTION

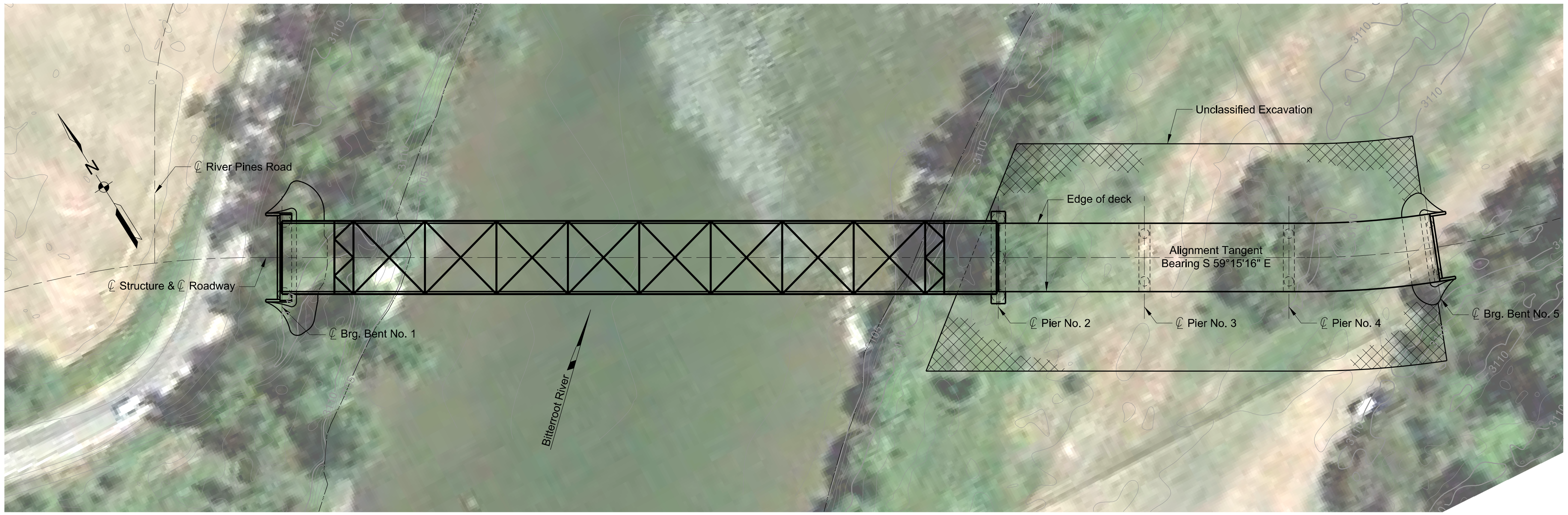
(Looking Ahead on Line)
(Option 2C shown, Option 2D similar)

PRELIMINARY

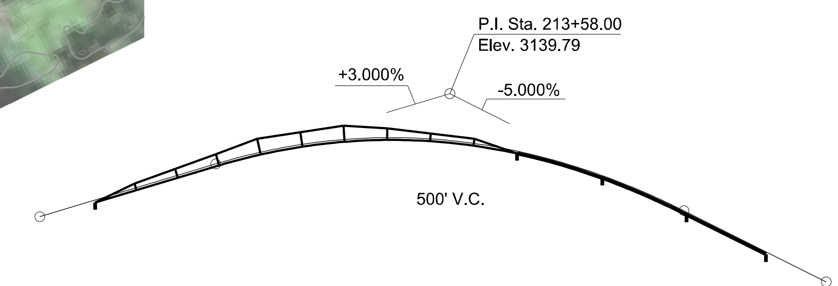
SOUTH AVENUE BRIDGE
OVER BITTERROOT RIVER
TYPE SIZE AND LOCATION STUDY

ALTERNATE 2C & 2D DECK OPTIONS

JULY 2016
Scale ⅛" = 1'-0"

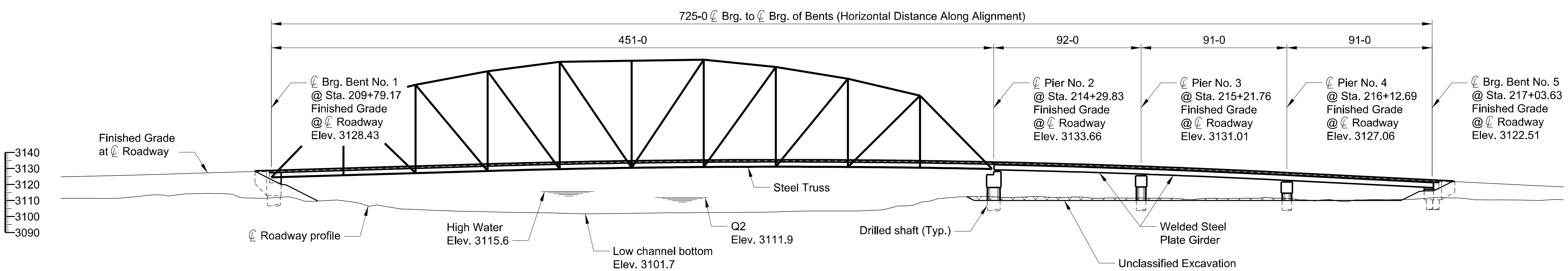


PLAN

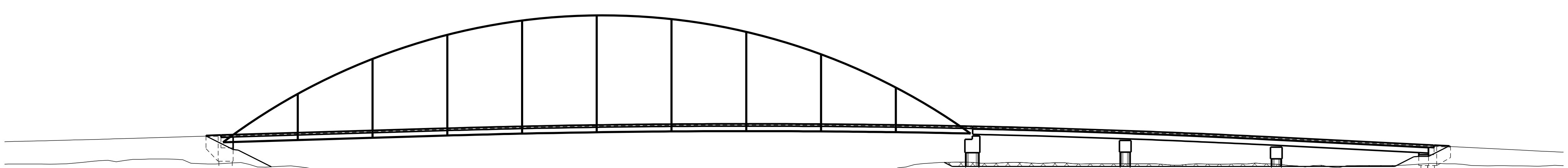


PROFILE GRADE

No Scale



ELEVATION



ELEVATION - TIED ARCH MAIN SPAN OPTION

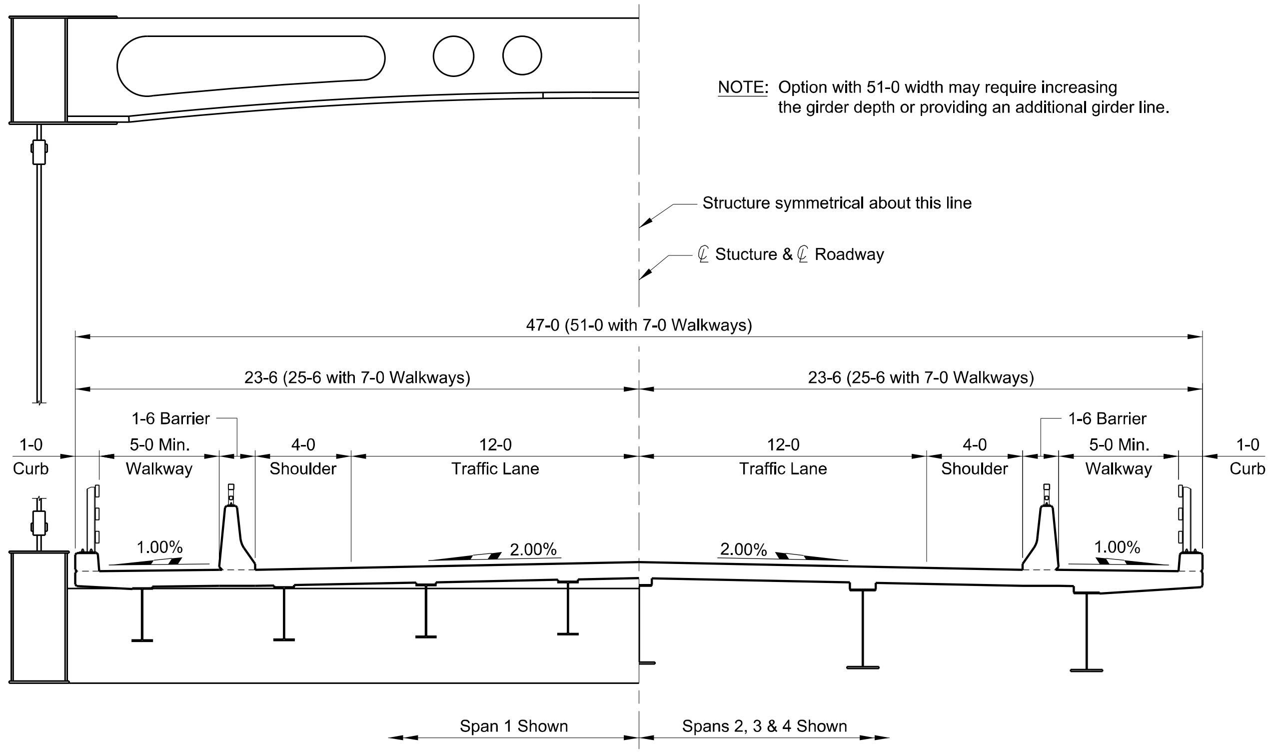
SOUTH AVENUE BRIDGE
OVER BITTERROOT RIVER
TYPE SIZE AND LOCATION STUDY

ALTERNATE 2E PLAN & ELEVATION

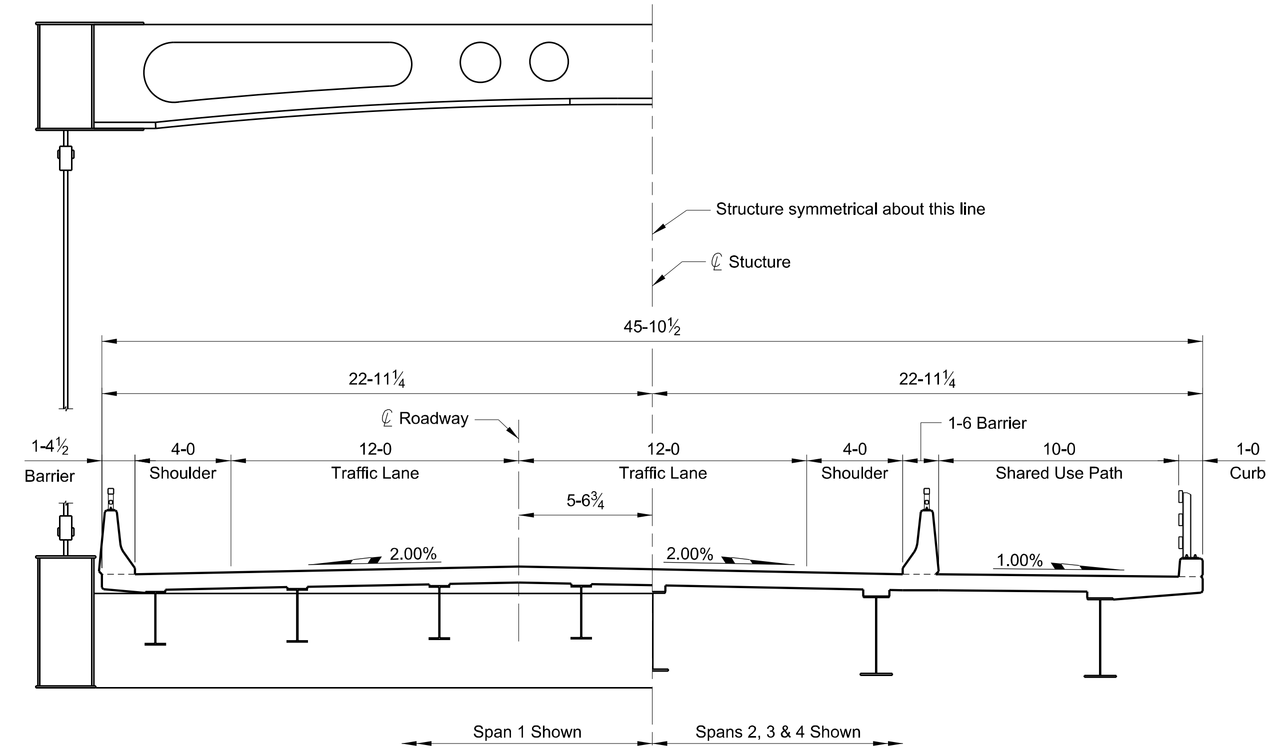
JULY 2016
Scale 1" = 80'-0"

HDR

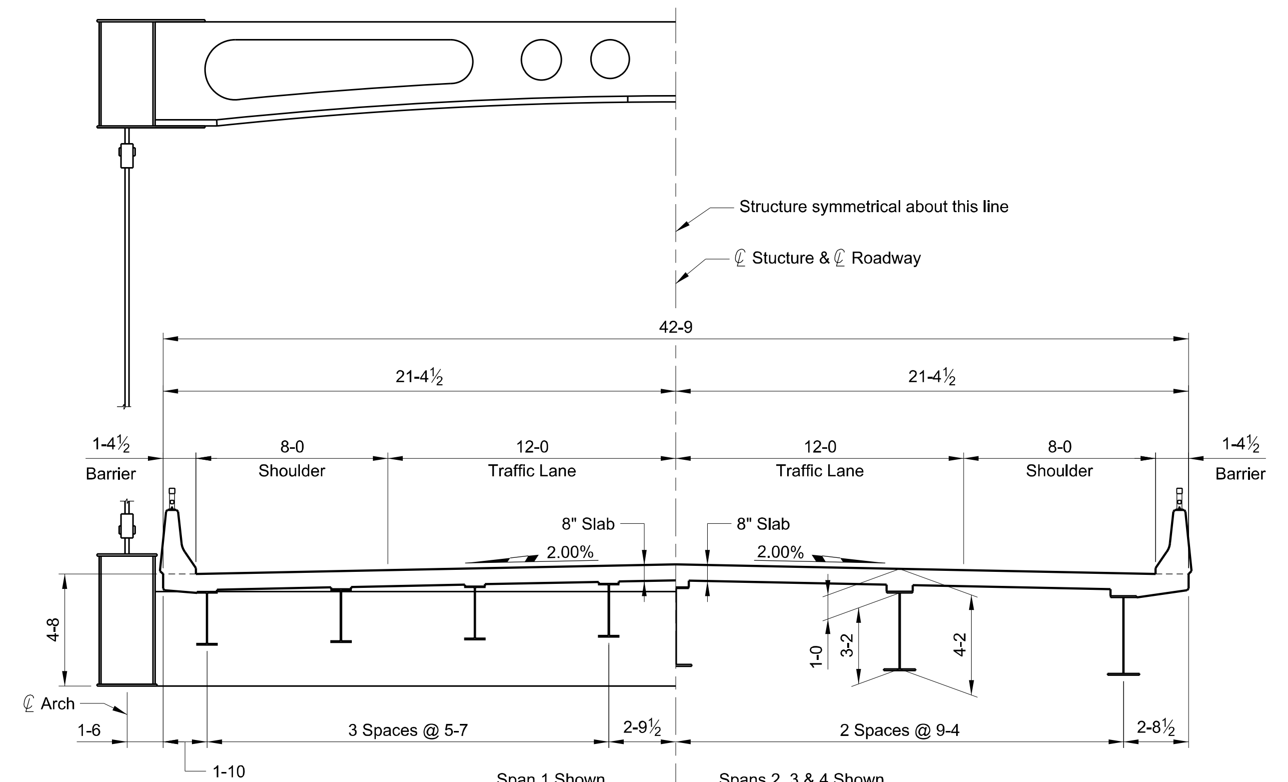
PRELIMINARY



SECTION WITH SEPARATED WALKWAYS
(Looking Ahead on Line)
(Tied Arch Option Shown)



SECTION WITH SHARED USE PATH
(Looking Ahead on Line)
(Tied Arch Option Shown)



SECTION
(Looking Ahead on Line)
(Tied Arch Option Shown)

PRELIMINARY

SOUTH AVENUE BRIDGE
OVER BITTERROOT RIVER
TYPE SIZE AND LOCATION STUDY
ALTERNATE 2E DECK OPTIONS
JULY 2016
Scale ⅛" = 1'-0"

Appendix – B

Bridge Alternate Cost Summary

Missoula County

Prepared By:

HDR

Preliminary Construction Cost Estimate for South Avenue over Bitterroot River in Missoula

Alternates 1 &2 Cost Comparison

Spans: Varies

Project Number: BR 9032(65)

Job No.	251333-123		
Computed	BKC	Date	6/17/2016
Checked	CCA	Date	6/20/2016
Sheet No.	1	Of	1

DECK WIDTH 43.0 FT (OUT TO OUT)
DECK EXT. 9.0 IN (BEYOND ABUTMENT CL OF BEARING)

ALTERNATE	SPAN DESCRIPTION	UNIT COST	C/C ABUT. BRG'S	TOTAL LENGTH	AREA	BRIDGE COST*
1A	*240-240' Plate Girder &132'-132' PL Gir Spans*	$228/SF	746.0 FT	747.5 FT	32142.5 SF	$7,330,000
1B	*166'-207'-207'-166' Plate Girder Spans*	$211/SF	746.0 FT	747.5 FT	32142.5 SF	$6,790,000
1C	*166'-207'-166' Plate Gir. 103.5'-103.5' MTS Beams*	$213/SF	746.0 FT	747.5 FT	32142.5 SF	$6,850,000
2A	*2-225' Plate Girder &91'-91'-91 PL Gir Spans*	$228/SF	725.0 FT	726.5 FT	31239.5 SF	$7,130,000
2B	*160.5'-202'-202'-160.5' Plate Girder Spans*	$216/SF	725.0 FT	726.5 FT	31239.5 SF	$6,750,000
2C	*2-225' Truss Spans &90'-91'-90' PL Gir Spans*	$336/SF	725.0 FT	726.5 FT	31239.5 SF	$10,500,000
2D	*2-225' Tied Arch Spans &90'-91'-90' PL Gir Spans*	$386/SF	725.0 FT	726.5 FT	31239.5 SF	$12,060,000
2E	*1-450' Truss Span & 91'-91'-91' PL Gir Spans*	$519/SF	725.0 FT	726.5 FT	31239.5 SF	$16,220,000
2E	*1-450' Tied Arch & 91'-91'-91' PL Gir Spans*	$519/SF	725.0 FT	726.5 FT	31239.5 SF	$16,220,000

**Values rounded up to nearest $10,000*

Missoula County

Prepared By: HDR

Preliminary Construction Cost Estimate for South Avenue over Bitterroot River in Missoula

Alternate 1A: Welded Steel Plate Girders

Spans: 250 ft - 251 ft - 121 ft - 120 ft = 742 ft

Project Number: BR 9032(65)

Job No.	251333-123		
Computed	**BKC**	Date	**6/17/2016**
Checked	**CCA**	Date	**6/20/2016**
Sheet No.	**1**	Of	**1**

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
551 020 035	*CONCRETE - CLASS STRUCTURE*	CY	643	$705	$453,199
551 020 107	*CONCRETE - CLASS DECK*	CY	926	$650	$602,176
551 020 166	*CONCRETE - CLASS DRILLED SHAFT*	CY	1021	$300	$306,174
552 010 140	*TRANSVERSE DECK GROOVING*	SY	2327	$5.00	$11,634
552 011 010	*EXPANSION JOINT STRIP SEAL*	FT	142	$400	$56,934
555 010 100	*REINFORCING STEEL*	LB	68978	$1.05	$72,427
555 010 200	*REINFORCING STEEL - EPOXY COATED*	LB	373117	$1.10	$410,429
555 010 400	*REINFORCING STEEL - SEISMIC*	LB	293237	$1.50	$439,856
556 010 011	*STRUCTURAL STEEL - GIRDER*	LS	1	$3,111,885	$3,111,885
557 010 105	*PEDESTRIAN RAIL*	FT	1544	$225	$347,360
557 010 110	*HAND RAIL*	FT	1496	$100	$149,582
558 000 140	*DRILLED SHAFT - 4.0 FT*	FT	255	$435	$110,925
558 000 170	*DRILLED SHAFT - 6.0 FT*	FT	360	$1,250	$450,000
558 000 180	*DRILLED SHAFT - 7.0 FT*	FT	285	$1,500	$427,500
558 001 100	*DRILLED SHAFT CASING - 6.0 FT*	FT	120	$500	$60,000
558 001 140	*DRILLED SHAFT CASING - 7.0 FT*	FT	90	$750	$67,500
565 000 010	*ELASTOMERIC BEARING DEVICES*	EA	10	$5,000	$50,000
565 000 020	*ELASTOMERIC BEARING DEVICES - PTFE*	EA	20	$3,500	$70,000
606 011 106	*BARRIER RAIL - CAST IN PLACE - BR*	FT	1496	$80	$119,666

ESTIMATED BASE CONSTRUCTION COST **$7,317,247**

Estimated Cost per Deck Plan Area = $228

Deck Plan Area (Per Bridge)= 43.00 FT x 747.91 FT 32160 FT2

Structural Steel Girder Cost = 1646500 LB x $1.89 $3,111,885

Missoula County

Prepared By: HDR

Preliminary Construction Cost Estimate for South Avenue over Bitterroot River in Missoula

Alternate 1B: Welded Steel Plate Girders

Spans: 160 ft - 200 ft - 200 ft - 160 ft = 720 ft

Project Number: BR 9032(65)

Job No.	251333-123		
Computed	**JDS**	Date	**6/10/2016**
Checked	**CCA**	Date	**6/13/2016**
Sheet No.	**1**	Of	**1**

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
551 020 035	*CONCRETE - CLASS STRUCTURE*	CY	668	$705	$470,874
551 020 107	*CONCRETE - CLASS DECK*	CY	875	$650	$569,053
551 020 166	*CONCRETE - CLASS DRILLED SHAFT*	CY	1079	$300	$323,846
552 010 140	*TRANSVERSE DECK GROOVING*	SY	2247	$5.00	$11,237
552 011 020	*EXPANSION JOINT MODULAR*	FT	95	$850	$80,657
555 010 100	*REINFORCING STEEL*	LB	70000	$1.05	$73,500
555 010 200	*REINFORCING STEEL - EPOXY COATED*	LB	361263	$1.10	$397,390
555 010 400	*REINFORCING STEEL - SEISMIC*	LB	308356	$1.50	$462,534
556 010 011	*STRUCTURAL STEEL - GIRDER*	LS	1	$2,227,665	$2,227,665
557 010 105	*PEDESTRIAN RAIL*	FT	1509	$225	$339,467
557 010 110	*HAND RAIL*	FT	1445	$100	$144,474
558 000 140	*DRILLED SHAFT - 4.0 FT*	FT	390	$435	$169,650
558 000 180	*DRILLED SHAFT - 7.0 FT*	FT	630	$1,500	$945,000
558 001 140	*DRILLED SHAFT CASING - 7.0 FT*	FT	180	$750	$135,000
565 000 010	*ELASTOMERIC BEARING DEVICES*	EA	5	$5,000	$25,000
565 000 020	*ELASTOMERIC BEARING DEVICES - PTFE*	EA	20	$3,500	$70,000
606 011 106	*BARRIER RAIL - CAST IN PLACE - BR*	FT	1445	$80	$115,579

ESTIMATED BASE CONSTRUCTION COST **$6,560,926**

Estimated Cost per Deck Plan Area = $211

Deck Plan Area (Per Bridge)=	*43.00 FT*	*x*	*722.37 FT*		*31062 FT2*
Structural Steel Girder Cost =	*1350100 LB*	*x*	*$1.65*		*$2,227,665*

Missoula County

Prepared By: HDR

Preliminary Construction Cost Estimate for South Avenue over Bitterroot River in Missoula

Alternate 1C: Welded Steel Plate Girders River, MTS-54 Approach

Spans: 166 ft - 207 ft - 167 ft - 103.5 ft - 102.5 ft = 746 ft

Project Number: BR 9032(65)

Job No.	251333-123		
Computed	**BKC**	Date	**10/11/2016**
Checked	**PCJ**	Date	**10/17/2016**
Sheet No.	**1**	Of	**1**

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
551 020 035	*CONCRETE - CLASS STRUCTURE*	CY	744	$705	$524,237
551 020 107	*CONCRETE - CLASS DECK*	CY	935	$650	$607,687
551 020 166	*CONCRETE - CLASS DRILLED SHAFT*	CY	1191	$300	$357,422
552 010 140	*TRANSVERSE DECK GROOVING*	SY	2326	$5.00	$11,629
552 011 010	*EXPANSION JOINT STRIP SEAL*	FT	142	$400	$56,934
553 010 155	*PRESTRESSED BEAM - TYPE MTS-54*	FT	1040	$375	$390,000
555 010 100	*REINFORCING STEEL*	LB	90717	$1.05	$95,253
555 010 200	*REINFORCING STEEL - EPOXY COATED*	LB	377293	$1.10	$415,023
555 010 400	*REINFORCING STEEL - SEISMIC*	LB	337745	$1.50	$506,618
556 010 011	*STRUCTURAL STEEL - GIRDER*	LS	1	$1,756,425	$1,756,425
557 010 105	*PEDESTRIAN RAIL*	FT	1559	$225	$350,823
557 010 110	*HAND RAIL*	FT	1495	$100	$149,521
558 000 140	*DRILLED SHAFT - 4.0 FT*	FT	390	$435	$169,650
558 000 150	*DRILLED SHAFT - 4.5 FT*	FT	190	$600	$114,000
558 000 180	*DRILLED SHAFT - 7.0 FT*	FT	630	$1,500	$945,000
	DRILLED SHAFT CASING - 4.5 FT	FT	60	$450	$27,000
558 001 140	*DRILLED SHAFT CASING - 7.0 FT*	FT	180	$750	$135,000
565 000 010	*ELASTOMERIC BEARING DEVICES*	EA	10	$5,000	$50,000
565 000 020	*ELASTOMERIC BEARING DEVICES - PTFE*	EA	20	$3,500	$70,000
606 011 106	*BARRIER RAIL - CAST IN PLACE - BR*	FT	1495	$80	$119,617

ESTIMATED BASE CONSTRUCTION COST **$6,851,839**

Estimated Cost per Deck Plan Area = $213

Deck Plan Area (Per Bridge)= 43.00 FT x 747.50 FT 32143 FT2

Structural Steel Girder Cost = 1064500 LB x $1.65 $1,756,425

Missoula County	Prepared By: HDR
Preliminary Construction Cost Estimate for South Avenue over Bitterroot River in Missoula	Job No. 251333-123
Alternate 2A: Welded Steel Plate Girders	Computed BKC, Date 6/13/2016
Spans: 225 ft - 226 ft - 91 ft - 90 ft - 85.167 ft = 717.167 ft	Checked CCA, Date 6/13/2016
Project Number: BR 9032(65)	Sheet No. 1 Of 1

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
551 020 035	*CONCRETE - CLASS STRUCTURE*	CY	646	$705	$455,430
551 020 107	*CONCRETE - CLASS DECK*	CY	886	$650	$575,900
551 020 166	*CONCRETE - CLASS DRILLED SHAFT*	CY	1038	$300	$311,400
552 010 140	*TRANSVERSE DECK GROOVING*	SY	2244	$5.00	$11,220
552 011 010	*EXPANSION JOINT STRIP SEAL*	FT	135	$400	$54,000
555 010 100	*REINFORCING STEEL*	LB	88109	$1.05	$92,514
555 010 200	*REINFORCING STEEL - EPOXY COATED*	LB	356537	$1.10	$392,191
555 010 400	*REINFORCING STEEL - SEISMIC*	LB	281982	$1.50	$422,973
556 010 011	*STRUCTURAL STEEL - GIRDER*	LS	1	$2,677,135	$2,677,135
557 010 105	*PEDESTRIAN RAIL*	FT	1514	$225	$340,650
557 010 110	*HAND RAIL*	FT	1442	$100	$144,200
558 000 140	*DRILLED SHAFT - 4.0 FT*	FT	340	$435	$147,900
558 000 170	*DRILLED SHAFT - 6.0 FT*	FT	840	$1,250	$1,050,000
558 001 100	*DRILLED SHAFT CASING - 6.0 FT*	FT	270	$500	$135,000
565 000 010	*ELASTOMERIC BEARING DEVICES*	EA	10	$5,000	$50,000
565 000 020	*ELASTOMERIC BEARING DEVICES - PTFE*	EA	25	$3,500	$87,500
605 000 030	*BARRIER RAIL - CAST IN PLACE - BR*	FT	1442	$80	$115,360

ESTIMATED BASE CONSTRUCTION COST **$7,063,373**

Estimated Cost per Deck Plan Area =		*$228*
Deck Plan Area (Per Bridge)=	*43.00 FT x 720.98 FT*	*31002 FT2*
Structural Steel Girder Cost=	*1447100 LB x $1.85*	*$2,677,135*

Missoula County

Preliminary Construction Cost Estimate for South Avenue over Bitterroot River in Missoula

Alternate 2B: Welded Steel Plate Girders

Spans: 160 ft - 200 ft - 200 ft - 160 ft = 720 ft

Project Number: BR 9032(65)

Prepared By: HDR

Job No.	251333-123		
Computed	**BKC**	Date	**6/13/2016**
Checked	**CCA**	Date	**6/13/2016**
Sheet No.	**1**	Of	**1**

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
551 020 035	*CONCRETE - CLASS STRUCTURE*	CY	639	$705	$450,495
551 020 107	*CONCRETE - CLASS DECK*	CY	873	$650	$567,450
551 020 166	*CONCRETE - CLASS DRILLED SHAFT*	CY	1080	$300	$324,000
552 010 140	*TRANSVERSE DECK GROOVING*	SY	2248	$5.00	$11,240
552 011 020	*EXPANSION JOINT - MODULAR*	FT	90	$850	$76,500
555 010 100	*REINFORCING STEEL*	LB	70000	$1.05	$73,500
555 010 200	*REINFORCING STEEL - EPOXY COATED*	LB	353859	$1.10	$389,245
555 010 400	*REINFORCING STEEL - SEISMIC*	LB	307466	$1.50	$461,199
556 010 011	*STRUCTURAL STEEL - GIRDER*	LS	1	$2,403,178	$2,403,178
557 010 105	*PEDESTRIAN RAIL*	FT	1509	$225	$339,525
557 010 110	*HAND RAIL*	FT	1445	$100	$144,500
558 000 140	*DRILLED SHAFT - 4.0 FT*	FT	390	$435	$169,650
558 000 170	*DRILLED SHAFT - 7.0 FT*	FT	630	$1,500	$945,000
558 001 100	*DRILLED SHAFT CASING - 7.0 FT*	FT	180	$750	$135,000
565 000 010	*ELASTOMERIC BEARING DEVICES*	EA	5	$5,000	$25,000
565 000 020	*ELASTOMERIC BEARING DEVICES - PTFE*	EA	20	$3,500	$70,000
605 000 030	*BARRIER RAIL - CAST IN PLACE - BR*	FT	1445	$80	$115,600

ESTIMATED BASE CONSTRUCTION COST **$6,701,082**

Estimated Cost per Deck Plan Area =		*$216*
Deck Plan Area (Per Bridge)=	*43.00 FT x 722.37 FT*	*31062 FT2*
Structural Steel Girder Cost=	*1350100 LB x $1.78*	*$2,403,178*

Missoula County

Prepared By: HDR

Preliminary Construction Cost Estimate for South Avenue over Bitterroot River in Missoula

Alternate 2C: Through Truss and Welded Steel Plate Girders

Spans: 225 ft - 226 ft - 91 ft - 90 ft - 85.167 ft = 717.167 ft

Project Number: BR 9032(65)

Job No.	251333-123		
Computed	BKC	Date	6/13/2016
Checked	CCA	Date	6/13/2016
Sheet No.	1	Of	1

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
551 020 035	*CONCRETE - CLASS STRUCTURE*	CY	744	$705	$524,520
551 020 107	*CONCRETE - CLASS DECK*	CY	853	$650	$554,450
551 020 166	*CONCRETE - CLASS DRILLED SHAFT*	CY	981	$300	$294,300
552 010 140	*TRANSVERSE DECK GROOVING*	SY	2244	$5.00	$11,220
552 011 010	*EXPANSION JOINT STRIP SEAL*	FT	135	$400	$54,000
555 010 100	*REINFORCING STEEL*	LB	96442	$1.05	$101,264
555 010 200	*REINFORCING STEEL - EPOXY COATED*	LB	349463	$1.10	$384,409
555 010 400	*REINFORCING STEEL - SEISMIC*	LB	280693	$1.50	$421,040
556 010 011	*STRUCTURAL STEEL - GIRDER*	LS	1	$474,710	$474,710
557 010 105	*PEDESTRIAN RAIL*	FT	1490	$225	$335,250
557 010 110	*HAND RAIL*	FT	1442	$100	$144,200
558 000 140	*DRILLED SHAFT - 4.0 FT*	FT	340	$435	$147,900
558 000 170	*DRILLED SHAFT - 6.0 FT*	FT	540	$1,250	$675,000
558 000 180	*DRILLED SHAFT - 7.0 FT*	FT	180	$1,500	$270,000
558 001 100	*DRILLED SHAFT CASING - 6.0 FT*	FT	180	$500	$90,000
558 001 140	*DRILLED SHAFT CASING - 7.0 FT*	FT	60	$750	$45,000
565 000 010	*ELASTOMERIC BEARING DEVICES*	EA	5	$5,000	$25,000
565 000 020	*ELASTOMERIC BEARING DEVICES - PTFE*	EA	15	$3,500	$52,500
605 000 030	*BARRIER RAIL - CAST IN PLACE - BR*	FT	1442	$80	$115,360
	225' PREFABRICATED THROUGH TRUSS	LS	2	$2,850,000	$5,700,000

ESTIMATED BASE CONSTRUCTION COST **$10,420,123**

Estimated Cost per Deck Plan Area = $336

Deck Plan Area (Per Bridge)=	*43.00 FT x 720.98 FT*	*31002 FT2*
Structural Steel Girder Cost=	*256600 LB x $1.85*	*$474,710*

Missoula County

Prepared By: HDR

Preliminary Construction Cost Estimate for South Avenue over Bitterroot River in Missoula

Alternate 2D: Tied Arches and Welded Steel Plate Girders

Spans: 225 ft - 226 ft - 91 ft - 90 ft - 85.167 ft = 717.167 ft

Project Number: BR 9032(65)

Job No.	251333-123		
Computed	**BKC**	Date	**6/13/2016**
Checked	**CCA**	Date	**6/13/2016**
Sheet No.	**1**	Of	**1**

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
551 020 035	*CONCRETE - CLASS STRUCTURE*	CY	744	$705	$524,520
551 020 107	*CONCRETE - CLASS DECK*	CY	853	$650	$554,450
551 020 166	*CONCRETE - CLASS DRILLED SHAFT*	CY	981	$300	$294,300
552 010 140	*TRANSVERSE DECK GROOVING*	SY	2244	$5.00	$11,220
552 011 010	*EXPANSION JOINT STRIP SEAL*	FT	135	$400	$54,000
555 010 100	*REINFORCING STEEL*	LB	96442	$1.05	$101,264
555 010 200	*REINFORCING STEEL - EPOXY COATED*	LB	349463	$1.10	$384,409
555 010 400	*REINFORCING STEEL - SEISMIC*	LB	280693	$1.50	$421,040
556 010 011	*STRUCTURAL STEEL - GIRDER*	LS	1	$474,710	$474,710
557 010 105	*PEDESTRIAN RAIL*	FT	1490	$225	$335,250
557 010 110	*HAND RAIL*	FT	1442	$100	$144,200
558 000 140	*DRILLED SHAFT - 4.0 FT*	FT	340	$435	$147,900
558 000 170	*DRILLED SHAFT - 6.0 FT*	FT	540	$1,250	$675,000
558 000 180	*DRILLED SHAFT - 7.0 FT*	FT	180	$1,500	$270,000
558 001 100	*DRILLED SHAFT CASING - 6.0 FT*	FT	180	$500	$90,000
558 001 140	*DRILLED SHAFT CASING - 7.0 FT*	FT	60	$750	$45,000
565 000 010	*ELASTOMERIC BEARING DEVICES*	EA	5	$5,000	$25,000
565 000 020	*ELASTOMERIC BEARING DEVICES - PTFE*	EA	15	$3,500	$52,500
605 000 030	*BARRIER RAIL - CAST IN PLACE - BR*	FT	1442	$80	$115,360
	225' TIED ARCH	SF	19350	$375	$7,256,250

ESTIMATED BASE CONSTRUCTION COST	**$11,976,373**

Estimated Cost per Deck Plan Area = $386

Deck Plan Area (Per Bridge)=	*43.00 FT x 720.98 FT*	*31002 FT2*
Structural Steel Girder Cost=	*256600 LB x $1.85*	*$474,710*

Missoula County

Prepared By: HDR

Preliminary Construction Cost Estimate for South Avenue over Bitterroot River in Missoula

Alternate 2E: Through Truss/Tied Arch & Welded Steel Plate Gir.'s

Spans: 451 ft - 91 ft - 90 ft - 85.167 ft = 717.167 ft

Project Number: BR 9032(65)

Job No.	251333-123		
Computed	BKC	Date	6/13/2016
Checked	CCA	Date	6/13/2016
Sheet No.	1	Of	1

ITEM NO.	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
551 020 035	*CONCRETE - CLASS STRUCTURE*	CY	488	$705	$344,040
551 020 107	*CONCRETE - CLASS DECK*	CY	318	$650	$206,700
551 020 166	*CONCRETE - CLASS DRILLED SHAFT*	CY	896	$300	$268,800
552 010 140	*TRANSVERSE DECK GROOVING*	SY	831	$5.00	$4,155
552 011 010	*EXPANSION JOINT STRIP SEAL*	FT	86	$400	$34,400
555 010 100	*REINFORCING STEEL*	LB	79019	$1.05	$82,970
555 010 200	*REINFORCING STEEL - EPOXY COATED*	LB	135192	$1.10	$148,711
555 010 400	*REINFORCING STEEL - SEISMIC*	LB	241670	$1.50	$362,505
556 010 011	*STRUCTURAL STEEL - GIRDER*	LS	1	$474,710	$474,710
557 010 105	*PEDESTRIAN RAIL*	FT	583	$225	$131,175
557 010 110	*HAND RAIL*	FT	535	$100	$53,500
558 000 140	*DRILLED SHAFT - 4.0 FT*	FT	140	$435	$60,900
558 000 170	*DRILLED SHAFT - 6.0 FT*	FT	340	$1,250	$425,000
558 000 200	*DRILLED SHAFT - 8.0 FT*	FT	255	$1,750	$446,250
558 001 100	*DRILLED SHAFT CASING - 6.0 FT*	FT	120	$500	$60,000
558 001 180	*DRILLED SHAFT CASING - 8.0 FT*	FT	90	$1,000	$90,000
565 000 010	*ELASTOMERIC BEARING DEVICES*	EA	5	$5,000	$25,000
565 000 020	*ELASTOMERIC BEARING DEVICES - PTFE*	EA	15	$3,500	$52,500
605 000 030	*BARRIER RAIL - CAST IN PLACE - BR*	FT	535	$80	$42,800
	450' Long Span Through Truss or Tied Arch	SF	19350	$660	$12,771,000

ESTIMATED BASE CONSTRUCTION COST $16,085,116

Estimated Cost per Deck Plan Area = $519

Deck Plan Area = 43.00 FT x 720.98 FT 31002 FT2

Structural Steel Girder Cost= 256600 LB x $1.85 $474,710

700 SW Higgins Avenue
Suite 200
Missoula, MT 59803-1489
406.532.2200

hdrinc.com