BRIDGE REHABILITATION / REPLACEMENT ALTERNATIVES STUDY REPORT

Route 19 over Current River and Spring Valley (Project No. J9P3305)

Bridges No. G0804 and J0420

October 2019

Prepared for:
Missouri Department of Transportation

November 27, 2019

Attn: Mr. Pete Berry, P.E.
Transportation Project Manager
Southeast District
Missouri Department of Transportation
2675 North Main Street
Sikeston, MO 63801

RE: Route 19 Bridge Rehabilitation / Replacement Concept Study Report
Project No. J9P3305
Structures No. G0804 and J0420
Rte. 19 over the Current River and Spring Valley

Dear Mr. Berry:

In accordance with our agreement approved on July 8, 2019, we are submitting this final report of findings for the study of options to rehabilitate or replace the historic concrete arch bridges carrying Route 19 over the Current River and Spring Valley in Shannon County, Missouri and within the Ozark National Scenic Riverways.

This report presents the results of the alternatives studied for alignment, profile and structure type at each site. The appendices of this report contain a report of the site investigation performed and the substructure materials sampling and testing completed as part of the project. Also included are the materials presented at the design charrette on September 19, 2019 and a report summarizing the findings of the charrette.

If you should have any questions please feel free to call.

Sincerely,

HDR Engineering, Inc.

Kurt Gribble

Kurt Gribble, P.E.
Project Manager

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1 Executive Summary

This report documents the analysis of conceptual alternatives studied to rehabilitate or replace the bridges carrying Route 19 over the Current River and Spring Valley in Shannon County, Missouri, within the Ozark National Scenic Riverways. The results of the field investigations and the structural analysis are presented and incorporated into the consideration of each of the identified alternatives at each bridge. This report presents the benefits and challenges of each of the alternatives studied but does not recommend an alternative for further development. The selection of the preferred alternative is left to the following Environmental Assessment project that is expected to begin shortly after this report is finalized.

Preliminary study limitations and preferences were gathered during preparation for the project and include alternatives to replace the bridges on and off alignment as well as to rehabilitate each bridge. This information was supplemented with a field investigation that observed the general condition of the bridges and included on-site material testing and concrete sampling for further laboratory testing. The field investigations were limited to portions of the structures accessible from the ground and no access equipment was used. The field observations reported many areas of spalls and delaminations of the existing concrete that would need to be repaired or replaced if a rehabilitation is selected. The on-site and laboratory materials testing concluded that chloride ion contamination high enough to induce corrosion was present in many of the areas tested. The report of materials testing also noted that field testing and samples were limited to areas away from the portions of the bridge likely to contain high levels of chloride ion contamination, specifically the mid-spans of the arches near the roadway surface. If rehabilitation is selected, a comprehensive corrosion mitigation plan should be undertaken and include the use of embedded galvanic anodes.

Alignment alternatives considered included offset temporary bridges to maintain the existing alignments as well as new permanent alignments shifted away from the existing roadway. Bridge alternatives considered at each site include rehabilitation and widening of the existing structure and replacement either on alignment or offset with either a similar concrete arch structure or a haunched steel plate girder structure. The alignment and bridge analysis showed that all alternatives considered are viable. The rehabilitation option considered for the Current River Bridge would mostly obscure the existing bridge behind the widened structure. The rehabilitation of the bridge over Spring Valley would only save the existing concrete arches (not the approach spans) and would not fully support an HS20 design live load but would provide a calculated posting load of 44 tons which exceeds the posting requirements. Options to replace the concrete arch spans will generally have greater cost and impact on the streambed during construction while girder bridge options generally have lower costs and streambed impacts. Depending of the alternative selected, the cost to rehabilitate or replace the bridge over the Current River varies from $6,700,000 to $12,700,000. The cost to rehabilitate or replace the bridge over Spring Valley varies from $5,800,000 to $7,800,000. The estimated costs include the construction of the bridge and roadway and do not include the cost of right of way acquisition, engineering or possible utility relocations.

2 General Information

The existing bridge over the Current River (G0804) was constructed in 1924 and the bridge over Spring Valley (J0420) was constructed in 1930 and are within the limits of the Ozark National Scenic Riverways dedicated in 1972. Together with the bridge over Sinking Creek, which was not included in this study, these bridges make up the Three Bridges Historic District. A pedestrian and utility bridge constructed in the 1970's is downstream of the Current River Bridge and is not included in the Historic District. The Current River Bridge has been identified as being eligible for the National Register of Historic Places and the Spring Valley Bridge is possibly eligible for the register. Route 19 is the primary north-south route through this part of the state and serves a variety of stakeholders. Rehabilitation and replacement options for each bridge were studied while considering the variety of stakeholder requirements and preferences. Options to replace the bridges on and off alignment are included in the study as well as off alignment temporary shoofly bridges. Figure 2-2 shows many of the challenges in this study.

2.1 Existing Bridge Description

Bridge G0804 over Current River

Bridge G0804 carries Route 19 over the Current River north of Round Spring. The bridge is 602 feet long carrying an 18 foot roadway which has been reduced to a single lane due to the condition of the supporting cantilever brackets. The bridge is square to the alignment, comprised of five continuous spans of filled spandrel arches and two filled abutment houses. The abutment houses are each 34 feet long. The three main arches are each 130 feet long and the end arches are each 60 feet long. The five arch spans are separated by four piers with six foot wide pilasters. The arch ring in each span is 14 feet wide with cantilever brackets supporting the roadway and bridge barrier. See Figure 2-3 thru Figure 2-5 for the general configuration of the existing bridge. All pier foundations are unreinforced concrete footings socketed into bedrock. The foundations at the abutment houses are spread footings on rock. The roadway over the bridge is supported directly on the fill of the arches and abutment houses. Each pilaster contains a decorative relief for most of the exposed height and the remaining exposed concrete shows a relief of the form boards used in construction. The bridge rail is a continuous concrete curb except at the joints in the spandrel walls. A concrete top rail supported on concrete pickets completes the rail in the bridge spans. Decorative posts are included in the bridge rail at each pier and at each end of the abutment houses.

The current bridge condition ratings from the last available official inspection on December 13, 2018 indicate the bridge is in fair condition with a rating of 5 for the deck, superstructure and substructure. A site visit to the bridge identified areas of spalling, delamination and cracking in the concrete. Rain water was observed seeping from the joints between the spandrel walls and through the drain holes near each pier. See Appendix B for the complete report of the field site visit including photographs. During the site visit, limited testing and sampling of the existing concrete was performed. The results of the concrete tests indicate some of the arch concrete is saturated with freeze / thaw damage and chloride ion concentrations high enough to initiate corrosion in the embedded reinforcing steel which could result in additional spalling. Testing was limited to portions of the bridge that could be reached from the ground and did not collect samples from the areas likely to have higher concentrations of chloride ions. Testing indicates remediation of the existing concrete would be needed to keep the concrete in service and should be included in any rehabilitation. See Appendix C for the complete report of material sampling and testing.

Bridge J0420 over Spring Valley

Bridge J0420 carries Route 19 over Spring Valley, just south of Round Spring. The bridge is almost 523 feet long carrying two traffic lanes on a 20 foot wide roadway. The bridge is skewed 45 degrees to the alignment and is comprised of eight simple spans, including an open spandrel arch main span and seven concrete deck girder approach spans. The main arch span is 155 feet long and the approach spans vary between approximately 51 feet and 54 feet. The approach spans are supported on two girders with a curved haunched shape and intermediate floorbeams and cantilevers supporting the deck and barrier rail. The main span is two concrete arches supporting rectangular concrete columns and cap beams. See Figure 2-6 thru Figure 2-8 for the general configuration of the existing bridge. The bridge configuration offers two lines of support which precludes the option of a phased rehabilitation that includes removal of the concrete deck. The bridge rail is composed of an intermittent concrete curb and a concrete rail supported on concrete pickets. Larger decorative posts are included at each pier, abutment and at the 1/3 points of the arch span.

The current bridge condition ratings from the last available official inspection on December 13, 2018 indicate the bridge is in fair to poor condition with a rating of 4 for the deck, 5 for the superstructure and 6 for the substructure. Site visits to the bridge identified areas of spalling, delamination and cracking. The overhang portions of the deck below the curb perforations are particularly deteriorated with exposed reinforcing in several locations. See Appendix B for the complete report of the field site visit including photographs. During the site visit, limited testing and sampling of the existing concrete was performed. The results of the concrete tests indicate chloride ion concentrations high enough to initiate corrosion in the embedded reinforcing steel in 2 of the 6 locations tested. Testing was limited to portions of the bridge that could be reached from the ground and did not collect samples from the worst concrete areas observed in the deck and overhang brackets. Testing indicates remediation of the existing concrete would be needed to keep the bridge in service and should be included in any rehabilitation. See Appendix C for the complete report of material sampling and testing.

Additional Bridges Considered

While it is not included in this study Bridge A8295 over Sinking Creek is included in the historic district. This bridge is over 364 feet long carrying two curving lanes on a straight bridge with a 31 foot wide roadway. The superstructure consists of three spans of weathering steel plate girders haunched to mimic the previous arch shape and each span is approximately 120 feet. The bridge is supported on square concrete column intermediate bents with web walls and formliners. The bridge rail is a vertical concrete barrier with a structural steel tube rail.

In addition to the highway structures already mentioned this study took into account the existing pedestrian and utility bridge downstream of the Current River Bridge. The bridge is owned and operated by the National Park Service (NPS) and no plans were available during the study. The pedestrian bridge is founded on wall piers that mimic the arrangement of the adjacent highway bridge. The piers support two parallel flange steel plate girders with a timber deck and steel handrail. The center of the pedestrian bridge is offset approximately 50 feet from the center of the highway bridge as measured in the aerial image gathered from Google Earth and corrected for distortion. The underside of the pedestrian bridge carries up to ten utility lines. NPS has confirmed the bridge carries a water supply line, a sewer line, communication lines and park service electric lines. It appears two of the utility lines supply lights installed in the handrail posts. NPS also indicated the bridge carries commercial three-phase service for the local electric utility.

2.2 Location Map and Aerial Photograph

Figure 2-1. Location Map

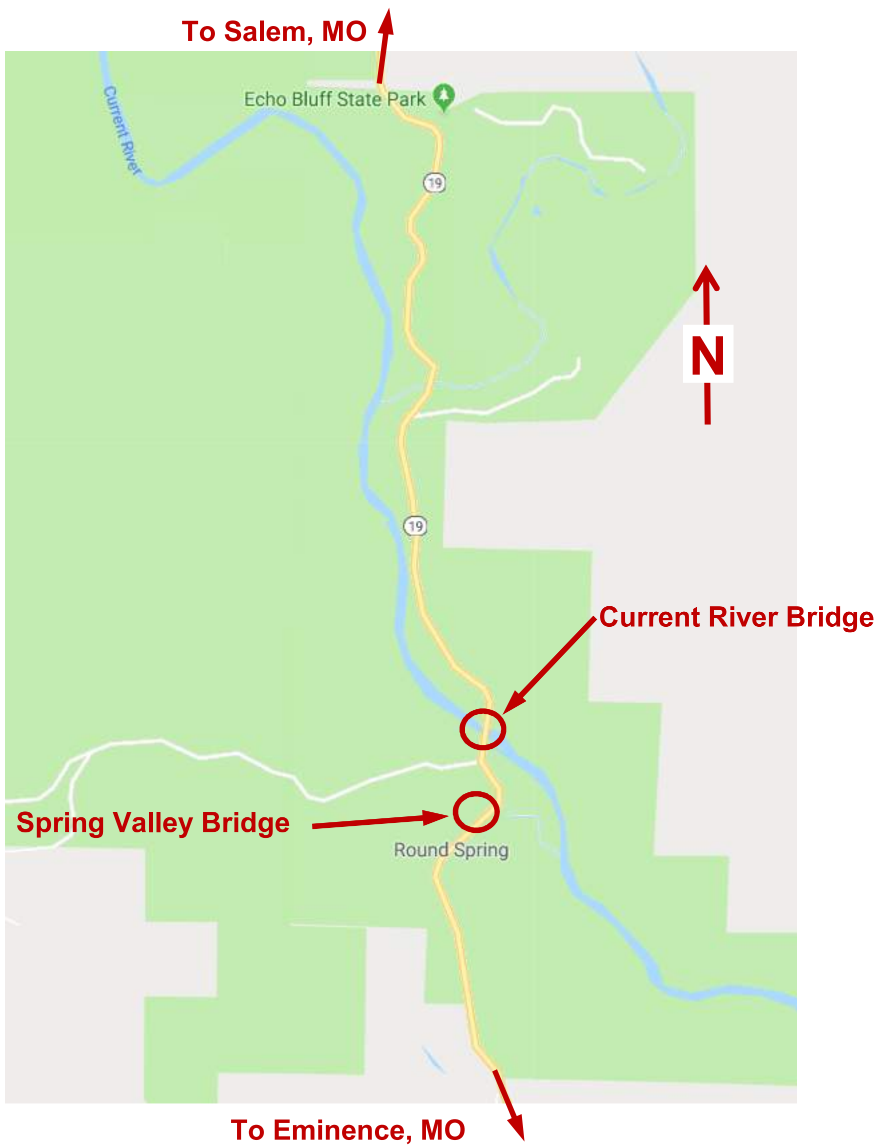
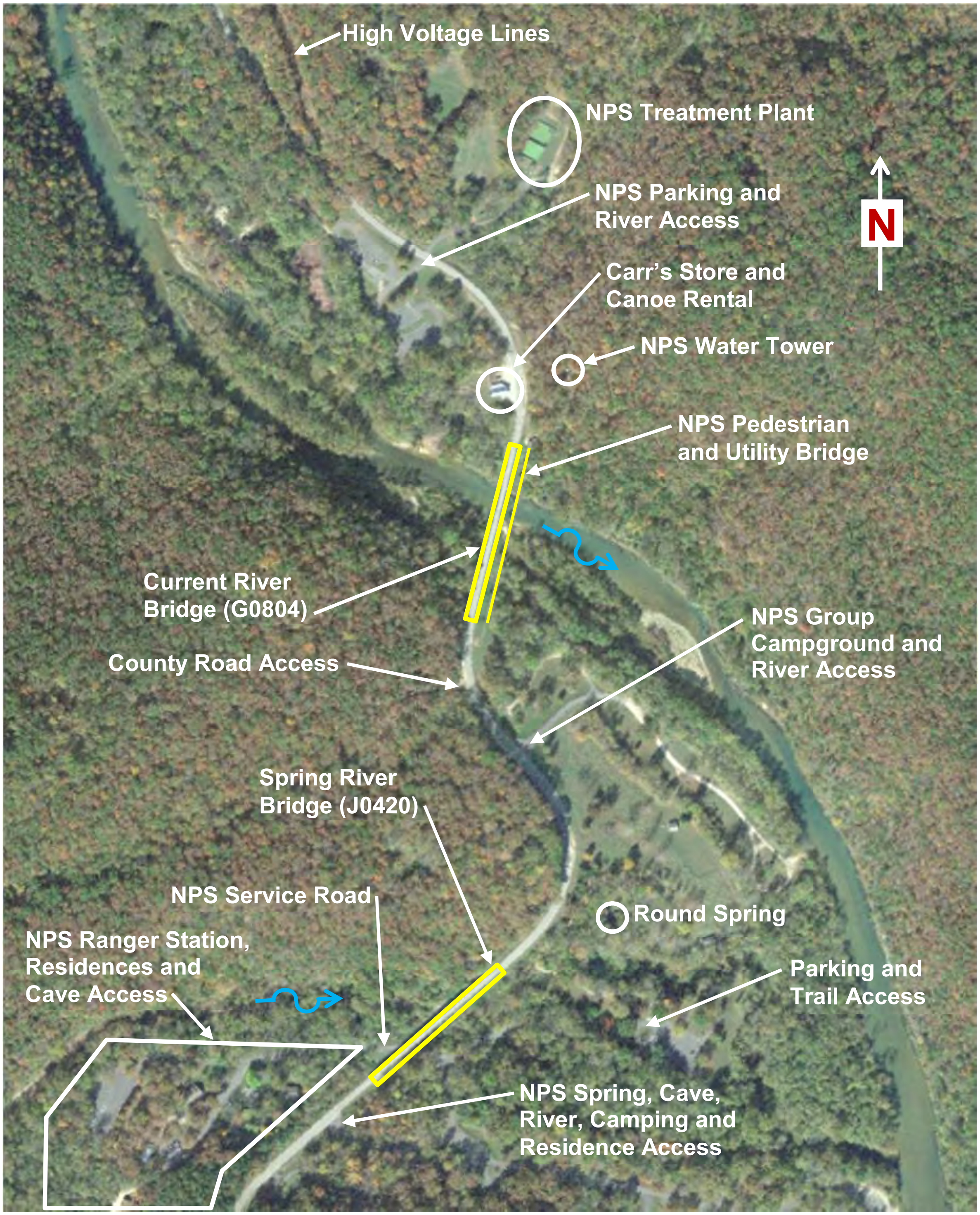


Figure 2-2. Aerial Photo of Route 19 through the Study Area



2.3 Configuration of Existing Bridges

The figures below were taken from the original construction plans and represent the basic configuration for each bridge. The complete set of original construction plans are available.

Figure 2-3. Current River Bridge (G0804) General Elevation

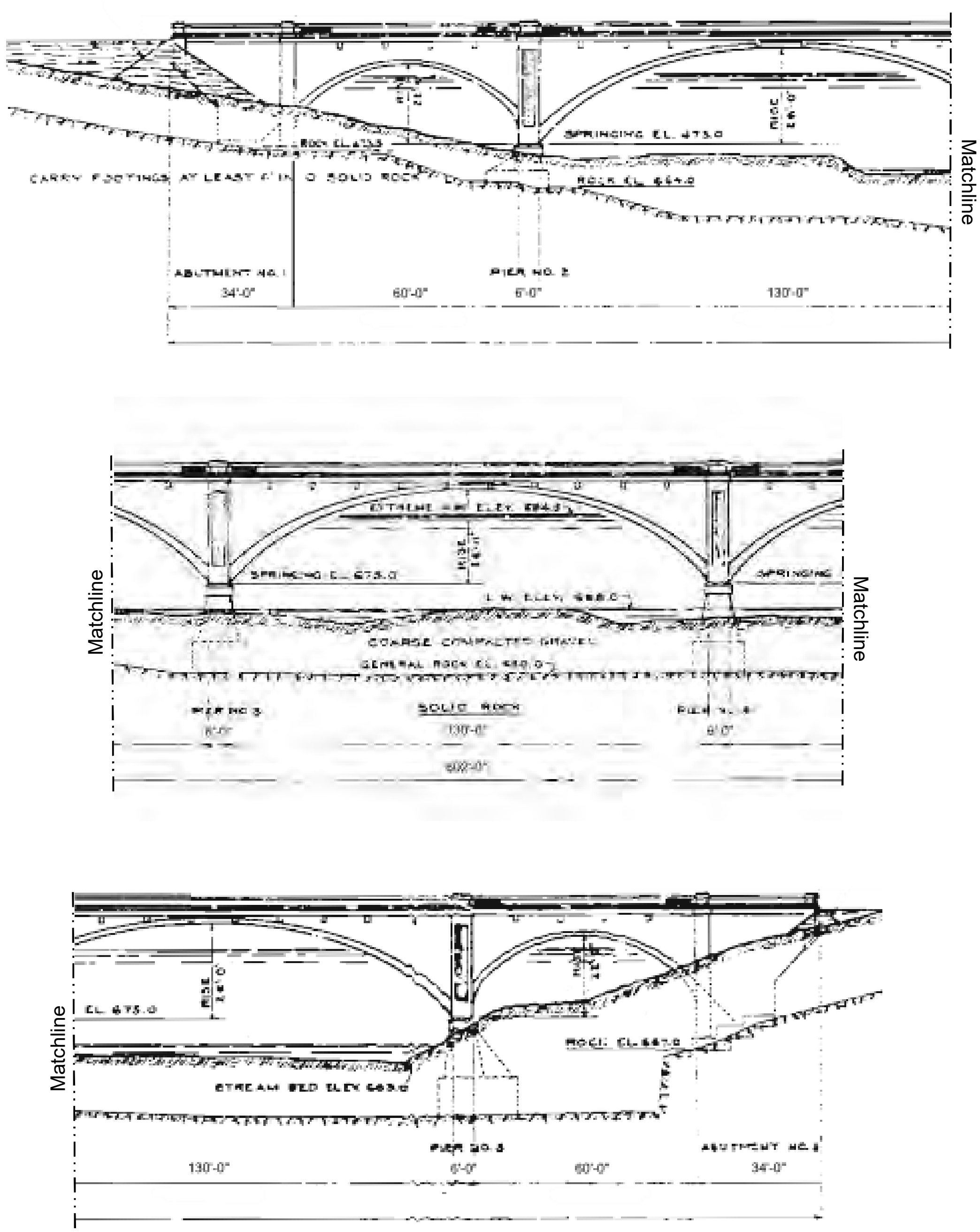


Figure 2-4. Current River Bridge (G0804) Typical Section through Arch Spans

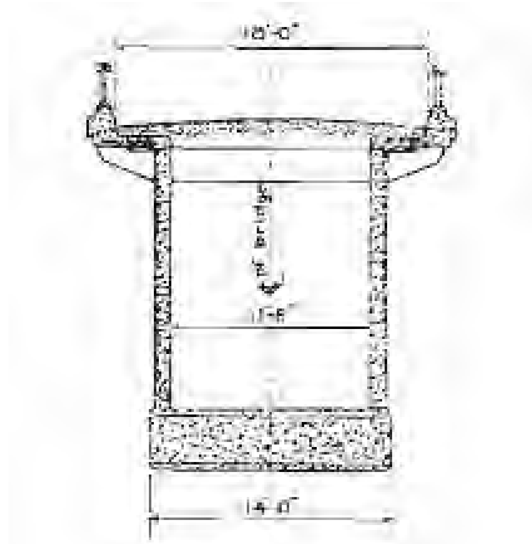


Figure 2-5. Current River Bridge (G0804) Typical Section through Filled Abutment Houses

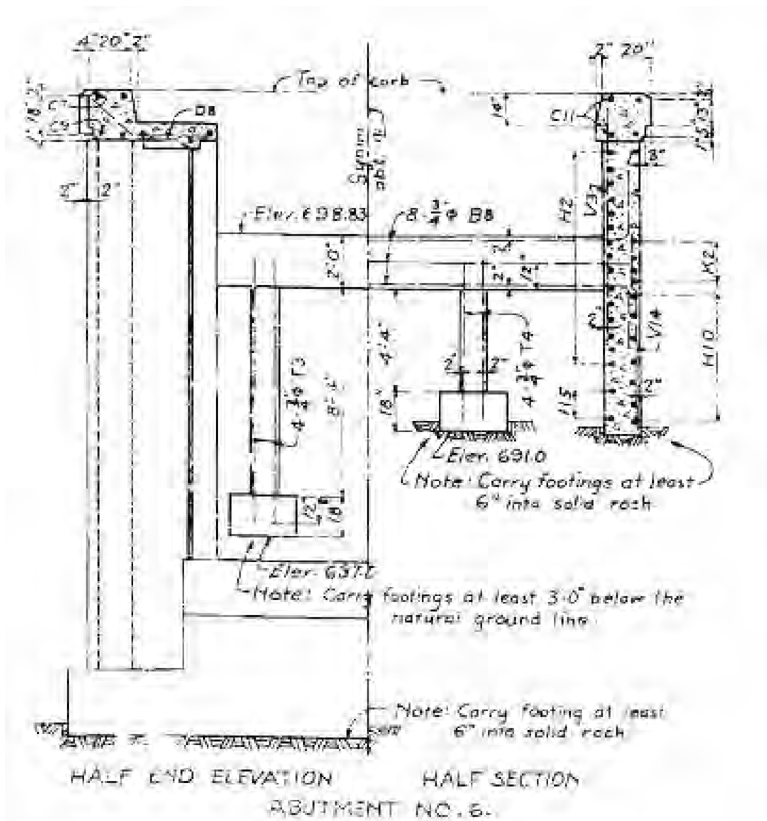


Figure 2-6. Spring Valley Bridge (J0420) General Elevation and Plan

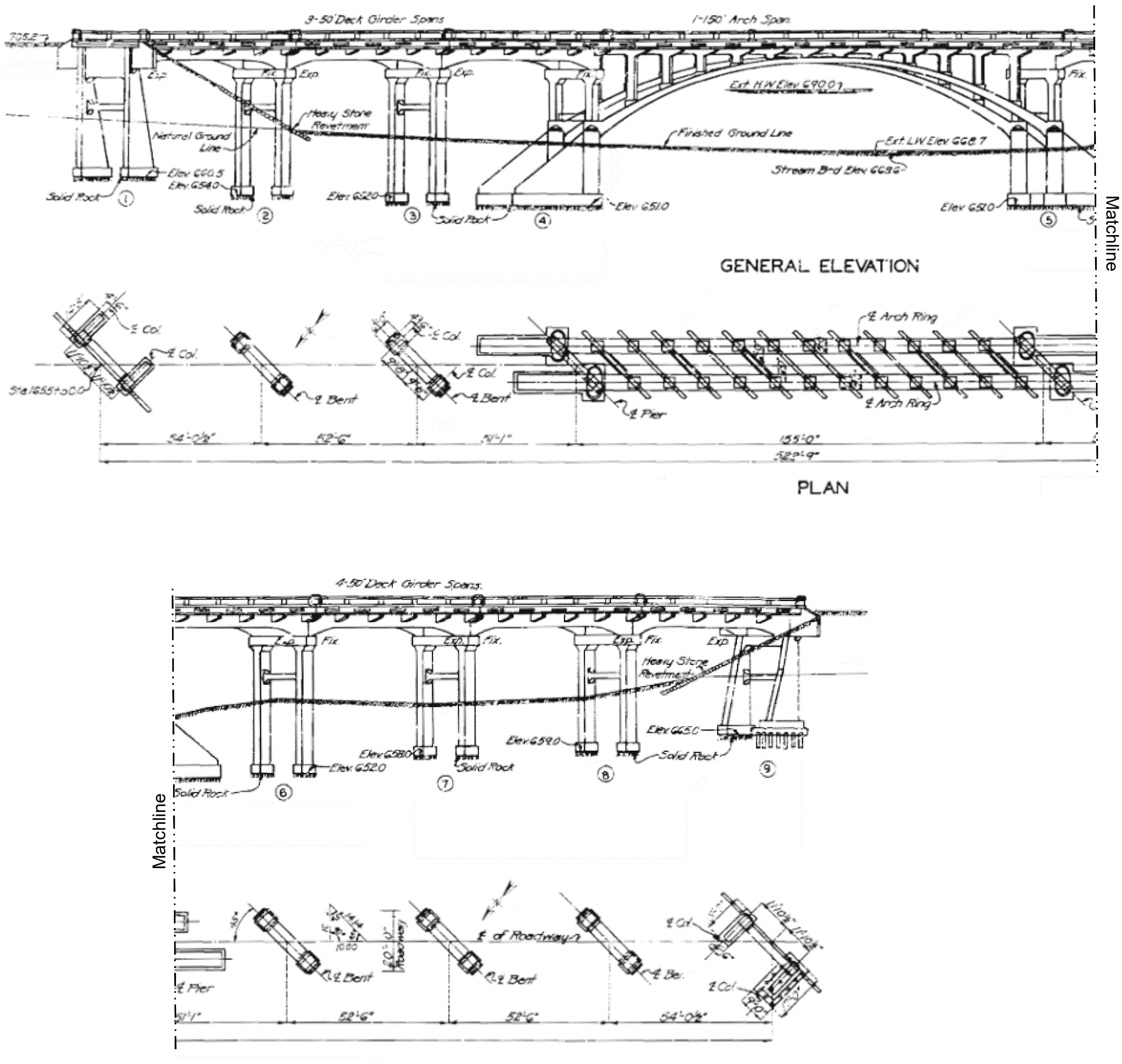


Figure 2-7. Spring Valley Bridge (J0420) Typical Section through Approach Spans

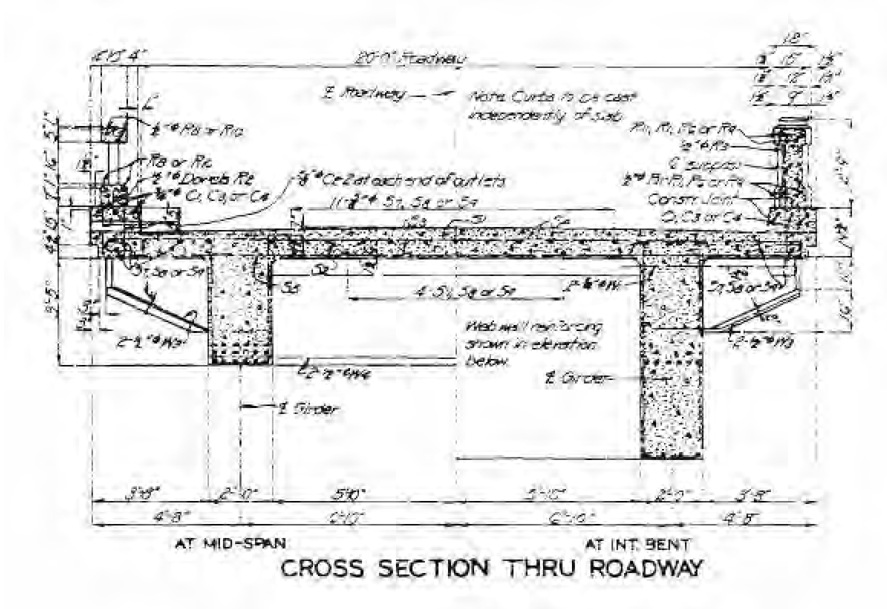
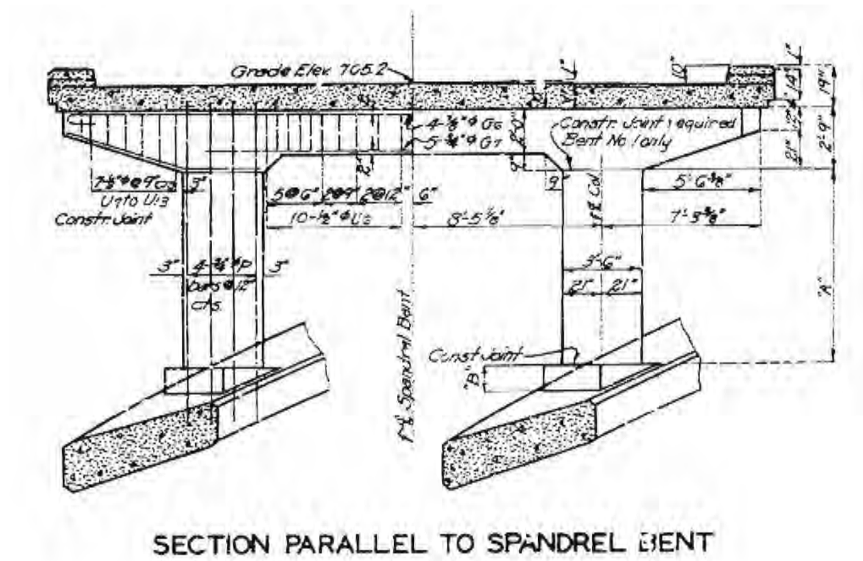


Figure 2-8. Spring Valley Bridge (J0420) Typical Section through Arch Span



2.4 Concept Study Limitations

This study was performed using limited data collected in the field and other available information. Additional information was gathered from various stakeholders during the design charrette. The limitations noted below were not addressed in this study and should be included in any future work on this project.

Alignments and profiles were developed from a limited topographic survey. Vehicle mounted LiDAR was used to gather information along the roadway surface and the adjacent features. Beyond the limits of the LiDAR surface the survey was supplemented with a one meter digital elevation model that was created by the US Geological Survey in 2017. The limits of the study were established to be approximately one quarter of a mile north of the Current River Bridge and one third of a mile south of the Spring Valley Bridge. These limits captured the roadway curves past each bridge and identified various access points. Further refinement of a selected alignment will require a more extensive survey of the area.

The existing conditions of each bridge were determined by reviewing available inspection reports and supplemented with a limited field investigation that did not include access equipment. Specifically, no access to the upper portions of either bridge was possible including the floorbeams or the midpoints of the arches. Field testing and material sampling of the existing concrete was similarly limited to portions of the bridge that could be accessed from the ground. The results of the limited testing was extrapolated to the remainder of the structure. The complete testing report is included in Appendix C and includes the observation that concrete higher on the structures is likely to contain elevated levels of chloride ion contamination. Prior to a rehabilitation project for either bridge, a more extensive investigation of the condition of the portions of each bridge to be included in a rehabilitated structure should be completed to verify the condition of the concrete closest to the roadway surface or plans should include replacement of concrete expected to be deteriorated. A rehabilitation of the bridge over the Current River should include plans to temporarily close the road and perform a partial pavement removal to access the buried arch concrete that cannot be inspected using traditional inspection methods.

The hydraulic adequacy of the existing structures is based on the design high water elevations presented in the existing plans as well as field observations of the structures during their nearly 100 year life. The existing plans for the Current River Bridge show 6.5 feet of freeboard to the extreme high water elevation. The recurrence interval of this elevation is unknown but is assumed to be 100 years. Field observations report that frequent high water events occur at the Current River crossing. The existing plans for the Spring Valley Bridge show 9.1 feet of freeboard to the extreme high water elevation. The recurrence interval here is also unknown and assumed to be 100 years. The spring runoff feeding the creek through Spring Valley does not produce enough flow to reach the extreme water elevation noted. The drainage area feeding the creek through the valley also does not appear large enough to create the design elevation. It is likely the extreme high water elevation at Spring Valley is due to backwater from the Current River. Bridge alternatives were developed to match or improve the waterway opening provided today. The adequacy of the waterway opening compared to current engineering policy was not investigated. Also not considered were temporary conditions, either shoofly bridges or permanent offset bridges, with foundations that do not align with the existing bridges resulting in a temporary reduction of the waterway opening. Both temporary and permanent conditions should be considered during further refinement of the project.

Utilities are known to be carried on the pedestrian / utility structure immediately downstream of the Current River Bridge. Past the bridge on both ends the utilities are buried and no utility locates were included in this study. Based on information from NPS personnel, water supply and sewer treatment facilities are located north of the Current River Bridge but the route of the buried utilities is not included in the current survey. NPS personnel did identify a utility corridor near Spring Valley east of the road and roughly parallel. Several of the options for the Current River Bridge will require relocation of the existing utilities. NPS personnel expressed a willingness to relocate the utilities, possibly by directional boring under the river, but no alternate utility corridor was identified in this study. If a temporary bridge converted to a permanent pedestrian bridge or a phased girder bridge replacement is selected, the existing utilities could be moved to the new structure in lieu of boring under the river to reduce project costs.

3 Study Issues Identified

3.1 Project Limitations and Requirements

Based on conversations with various stakeholders before and during the design charrette the following project requirements and limitations were identified:

- Route 19 must remain open to traffic at all times in some fashion. It is the primary north / south route through this part of the state and the potential detour route around a closure is excessive and cannot be tolerated. This route serves several local industries including logging and tourism and connects a NPS ranger station to the remainder of the Ozark National Scenic Riverways.
- Any proposed design must meet the current EPG and AASHTO standards for highway design and safety features. Included in these standard requirements are vertical and horizontal curve limitations for site distance, roadway superelevation requirements and travel lane and shoulder width. Design exceptions are possible but should be considered sparingly and their acceptance is not guaranteed.
- Any proposed design must meet the current EPG and AASHTO standards for bridge design or rating requirements if a rehabilitation is considered. Design exceptions may be possible however most structural design is driven by safety requirements and design exceptions will likely not be granted.
- Carr’s Store and Canoe Rental on the northwest corner of the Current River Bridge must not be disturbed and access must be maintained in some fashion. The location of this store limits the consideration of a temporary or permanent bridge offset to the west at the Current River.
- No impact is allowed to Round Spring which is east of Route 19 between the Current River and Spring Valley bridges. The location of the spring limits consideration of a temporary or permanent alignment that is offset to the east at Spring Valley.
- The Round Spring Cave, NPS ranger station and NPS residences are accessed by an NPS service road beneath the existing Spring Valley Bridge. Access to this area must be maintained. Limited road closures for demolition or construction activities could be tolerated but will require close coordination with NPS.
- The utilities carried on the existing pedestrian bridge must remain in service. If relocation of the utilities is needed, limited outages to make new connections could be tolerated.
- An allowance must be made for river traffic on the Current River to traverse the project site during the majority of construction. Limited closure of the river may be

possible but will require close coordination with NPS including advanced notification to river outfitters and the general public.

- The entrance to the NPS river access point on the north bank of the Current River must remain open. Similarly, the entrance to the NPS campgrounds and river access points south of the Current River must also remain open.
- Traffic must be maintained at the county road intersection with Route 19 south of the Current River Bridge.

3.2 Constructability Concerns

The existing pedestrian bridge downstream of the bridge over the Current River may limit the construction envelope for an offset temporary or permanent bridge. A phased replacement option for the Current River Bridge is presented in Alternative 6 but may be difficult to construct with the pedestrian bridge in place. The pedestrian bridge carries several utilities that are buried beyond the bridge limits. Options to locate a temporary or permanent bridge downstream of the existing pedestrian bridge will require the roadway to cross the buried utilities on both sides of the river. The existing utility lines are likely not designed for the weight of vehicular traffic and are likely not buried deep enough to negate the effect of traffic. It may be possible to expose the existing utilities to sleeve them and reinforce the crossings, but this includes additional project risk and cost.

The horizontal curves used in the proposed alignments are generally flatter and the roadway cross slope varies to include the correct superelevation for the curve radius. In addition, traveled way widening for the curves approaching the bridges have been accounted for in the roadway design. These curve superelevation and widening transitions will extend onto the Current River Bridge and require a change of bridge configuration. Additionally, the new roadway will require stable side slopes that may extend beyond the existing right-of-way. To limit the impact of these side slopes, retaining walls or reinforced steepened slopes will be needed south of Spring Valley to avoid impacting the NPS buildings and rock benching will likely be needed north of the Current River to avoid impacting the NPS water storage tank. Depending on the alternative selected, excavation on the east side of the highway north of the Current River, especially rock benching, has the possibility to impact the buried utilities crossing this area.

Both bridge sites have relatively shallow bedrock, but the bedrock is not at the surface and will require cofferdams if spread footings are constructed. Shallow cofferdams for excavations that extend to rock will be difficult to construct and will likely require drilling of structural steel piles to support the cofferdam walls. Installation of the cofferdams will increase the area of impact on the streambed. At the bridge over Spring Valley, the stream has migrated to the north and is now adjacent to the existing arch thrust block. The current placement of the stream would make it difficult to replace the arch span in its current location and a shift to the north is presented in the alternatives considered.

Bridge construction, especially removal of the existing bridges, will have a temporary adverse impact on the use of the park and will require coordination with NPS. Construction activities at the Current River site could affect boaters on the river and special removal methods such as bracing the arch span over the main channel may be needed to limit the impact. The existing fill inside the Current River Bridge will also require special removal to avoid depositing the material directly into the river. Similarly, construction and demolition activities for the Spring Valley Bridge over the NPS service road will require coordination and may require special methods to limit the impact to access under the bridge.

3.3 Hydraulic Uncertainties

Hydrologic and hydraulic modeling was not included in the scope of work for either bridge site. The Design High Water elevations noted on the as-built plans were considered valid for the purposes of this study. The proposed bridge openings were set to match or exceed the existing openings to maintain similar hydraulic performance. The flow velocity through each bridge opening is unknown and therefore the expected local and contraction scour is unknown. The proposed permanent bridge configurations use drilled shafts socketed into rock or mass footings on rock similar to the existing bridges which would withstand most scour conditions. The stream though Spring Valley has migrated to the north since the construction of the existing bridge causing a shift in the channel for the ordinary high water. The current stream location is adjacent to the existing arch footing and thrust block.

3.4 Subsurface Concerns

This region of the state is known to have karstic bed rock conditions. The Round Spring Cave entrance is west of the existing Spring Valley Bridge and the extents of the cave are not known at the time of this study. NPS personnel may have a shape file of the cave limits available for review during following portions of the project. The extents of the known cave may limit the use of driven piles or drilled shafts and should be considered during project approach selection.

3.5 Cultural and Environmental Considerations

A known archeological site has been identified near Carr’s Store and additional archeological sites may be in the area. The known archeological site should not be disturbed. The bridges in this study along with the bridge over Sinking Creek make up the Three Bridges Historic District and the bridge over the Current River is eligible for the National Register of Historic Places and the bridge over Spring Valley is possibly eligible for the register. This designation will need to be considered during the evaluation of the rehabilitation options considered.

Construction of temporary and permanent bridges or rehabilitations will disturb the bridge surroundings. The streambed is considered environmentally sensitive and disturbance of large rocks will be detrimental to sensitive aquatic life. Six protected species have been identified in Shannon County including Gray Bat, Indiana Bat, Northern Long-eared Bat, Red-cockaded Woodpecker, Ozark Hellbender and Virginia Sneezeweed. The area around the project site is known to contain critical habitat for the Indiana Bat and may contain critical habitat for other species. Additional work by the US Fish and Wildlife Service may be requested as the project progresses. The impacts of multiple bridges in the channel should be avoided if possible and the reduction of bridge foundations within the ordinary stream banks should be considered. The selected alternative should minimize impacts to the adjacent river bluffs and streambed.

The use of the Current River for boating and fishing is a legitimate use of the river and construction activities that restrict river access should be avoided. Navigation along the river should be maintained to the maximum extent possible. The selected project should avoid the acquisition of park land for highway right-of-way if possible.

3.6 Aesthetic Considerations

The existing arch profile of the bridge over the Current River can be viewed from the north approach roadway as the road descends and curves onto the bridge presenting a dramatic view of the existing structure. The elevation of the arched bridge can be viewed by boaters on the river as well as from Carr's Store and adjacent river access area. The existing bridge is a filled arch and therefore has a heavy, massive appearance. In addition to the general aesthetic of the filled arched bridge, the Current River Bridge contains some specific architectural elements including a geometric relief on the upstream and downstream face of each pilaster between the arches, an open spindle bridge rail with heavy posts and a curving approach barrier at the bridge ends.

The existing open spandrel arch bridge over Spring Valley can be viewed from the NPS service road leading to the ranger station and Round Spring Cave. The bridge can also be viewed from the parking lot and trail to Round Spring. The existing bridge presents a slender open arch and the offset arch placement due to the 45 degree skew adds visual complexity to the elevation view of the bridge. The spans approaching the arch have a curved bottom flange adding visual interest as the bridge crosses the NPS service road. Additional architectural elements include small decorative features at the tops of both thrust blocks and an open spindle rail with heavy posts.

4 Conceptual Alternatives Studied

The general description of the alternatives considered are presented below. Descriptions of specific sub-alternatives are also included. Descriptions of the alignments and profiles as well as the bridge types and configurations considered are included in the following sections. Details of the alignments, profiles and bridge configurations can be seen in Appendix A. Prior to the design charrette, Alternatives 3 and 4 were subdivided to include a possible retrofit of the existing highway bridge for reuse as a pedestrian crossing. These options would only be possible if the NPS was willing to take ownership of the bridge after construction. During the design charrette it was made clear that the NPS was not willing to take ownership of the existing bridge and further consideration of these options was halted and those options are not included in the final study report.

Alternatives 1 and 2 at the Current River that stay on alignment can use either a two lane or a single lane temporary bridge. The alternatives with a two lane temporary bridge are designated with an "A" suffix while the single lane alternatives use a "B" suffix. Additionally, the two lane temporary bridge can be placed on two different alignments show in the details as Option 1 which removes the existing pedestrian bridge and Option 2 located downstream of the pedestrian bridge. Similarly, the offset alignment Alternatives 3 & 4 can be placed on two different alignments and Option 1 removes the existing pedestrian bridge while Option 2 is located downstream of the pedestrian bridge. The Current River Bridge rehabilitation shown in Alternative 5 considers only a two lane temporary bridge, the suffixes “A” and “B” are shown for differing construction sequences as described in Section 6.6. The alternatives at Spring Valley that include either a new or rehabilitated concrete arch main span could be built with either concrete girder approach spans or haunched steel plate girder approach spans. The concrete girder approach span alternatives include an “A” suffix while the haunched steel plate girder approach spans use a “B” suffix.

Alternative 1 – In-Kind Bridge Replacement on Alignment

This alternative would carry traffic on a temporary bridge on an offset alignment. The existing highway bridges would be replaced with similar but wider structures in their existing locations. Temporary roadway alignments would be designed for speeds as low as 20 MPH. Permanent roadway work would be minimized with this alternative but it would require construction of two bridges at each site.

Current River Alternative 1A – Option 1 includes a two lane temporary bridge in place of the existing pedestrian bridge and Alternative 1A – Option 2 includes a two lane temporary bridge downstream of the pedestrian bridge. Current River Alternative 1B includes a single lane temporary bridge in place of the existing pedestrian bridge to be converted to a permanent mixed use path (MUP) at the completion of the project. Spring Valley Alternative 1A includes new concrete girder approach spans while Alternative 1B includes haunched steel plate girder approach spans.

Alternative 2 – Girder Bridge Replacement on Alignment

This alternative is similar to Alternative 1 but would replace the existing bridge with a new, wider haunched steel girder bridge instead of a bridge similar to the existing concrete arch structure.

Current River Alternative 2A – Option 1 includes a two lane temporary bridge in place of the existing pedestrian bridge and Alternative 2A – Option 2 includes a two lane temporary bridge downstream of the pedestrian bridge. Current River Alternative 2B includes a single lane temporary bridge in place of the existing pedestrian bridge to be converted to a permanent mixed use path at the completion of the project.

Alternative 3 – In-Kind Bridge Replacement on Offset Alignment

This alternative would carry traffic on the existing bridge while a new bridge similar to the existing bridge but wider is constructed on an offset alignment. Speed limits as low as 35 MPH would be allowed, but other roadway design standards would not be reduced for this option since traffic would not be carried on a temporary roadway. This option would create the greatest amount of roadway work and impact on the area surrounding the bridges but it would only require construction of one bridge at each site.

Spring Valley Alternative 3A includes new concrete girder approach spans while Alternative 3B includes haunched steel plate girder approach spans.

Alternative 4 – Girder Bridge Replacement on Offset Alignment

This alternative is similar to Alternative 3 but would replace the existing bridge with a new haunched steel girder bridge instead of a bridge similar to the existing concrete arch structure. Continuous steel girders are assumed for all spans so no suffix modifiers are included at Spring Valley.

Alternative 5 – Rehabilitation of Existing Bridges

At the Current River, there are two options to this alternative. Alternative 5A would be a phased rehabilitation and widening of the existing bridge that would carry the current single lane of traffic on the existing or widened structure and therefore would not require a temporary bridge. In a multi-phase rehabilitation most of the existing bridge fill could not be removed limiting the ability to perform an inspection and a complete rehabilitation of the existing concrete. Similar to Alterative 1A, Alternative 5B would carry traffic on a two lane temporary bridge on an offset alignment. The existing highway bridge would be rehabilitated to correct deterioration and widened to account for current highway design criteria. Temporary roadway alignments would be designed for speeds as low as 20 MPH. A single phase of rehabilitation with the traffic shifted to a temporary bridge would permit the removal of the existing bridge fill allowing for inspection and rehabilitation of the buried components of the existing bridge. In both options, permanent roadway work would be minimized with this alternative but it may require construction of a temporary bridge and a substantial remediation and modification project that is likely to have impacts in the streambed similar to the construction of a new bridge. A rehabilitated bridge over the Current River would result in a new concrete deck that would receive a condition rating of 8 while the superstructure and substructure would be rehabilitated to a condition rating of at least 6 and likely 7 depending on the extent of the rehabilitation selected.

The configuration of the bridge over Spring Valley provides only two lines of support (either concrete girders or arches) over the length of the structure. This configuration does not allow for a phased rehabilitation and only a single phase rehabilitation is presented. Similar to Alternative 1, a temporary bridge on an offset alignment will be required but permanent roadway work will be minimized. The rehabilitation of the existing bridge would create impacts to the surroundings similar to the construction of a new bridge. Spring Valley Alternative 5A includes new concrete girder approach spans while Alternative 5B includes haunched steel plate girder approach spans. Similar to the Current River Bridge, a rehabilitation of the bridge over Spring Valley would result in a new concrete deck that would receive a condition rating of 8 while the superstructure and substructure would be rehabilitated to a condition rating of at least 6 and likely 7 depending on the extent of the rehabilitation selected.

Alternative 6 – Phased In-Kind Replacement of Existing Bridge

This alternative only applies to the bridge over the Current River, the bridge over Spring Valley cannot be replaced in phases. A phased replacement with a new concrete arch structure could be built resulting in a slight offset of the permanent alignment. This alternative would carry traffic on either the existing bridge or the widened bridge and would not require a temporary bridge. Permanent roadway work would be greater than the on alignment options but less than a fully offset bridge. Bridge costs would increase due to the phased construction, but a temporary bridge is not needed.

Alternative 7 – Phased Girder Bridge Replacement of Existing Bridge

Similar to Alternative 6, this alternative also only applies to the bridge over the Current River. A phased replacement with a girder bridge could be built resulting in a slight offset of the permanent alignment. This alternative would carry traffic on either the existing bridge or the widened bridge and would not require a temporary bridge. Permanent roadway work would be greater than the on alignment options but less than a fully offset bridge. Bridge costs would increase due to the phased construction, but a temporary bridge is not needed.

Study Alternatives Summary

The following tables summarize the various aspects of the studied alternatives for each site.

Table 4-1. Current River Studied Alternatives Summary

Alternative Studied	On Alignment	Offset Alignment	New Concrete Filled Arch Bridge	New Haunched Steel Girder Bridge	Rehab. Bridge	Phased Construction	2-Lane Temp. Bridge	1-Lane Temp. Bridge	Temp. Bridge near Exist.	Temp Bridge Downstream of Ped.	Remove Ped. Bridge
Alternative 1A, Option 1	X		X				X		X		X
Alternative 1A, Option 2	X		X				X			X	
Alternative 1B	X		X					X			X
Alternative 2A, Option 1	X			X			X		X		X
Alternative 2A, Option 2	X			X			X			X	
Alternative 2B	X			X				X			X
Alternative 3, Option 1		X	X								X
Alternative 3, Option 2		X	X								
Alternative 4, Option 1		X		X							X
Alternative 4, Option 2		X		X							
Alternative 5A	X				X	X					
Alternative 5B, Option 1	X				X		X		X		X
Alternative 5B, Option 2	X				X		X			X	
Alternative 6		X	X			X					
Alternative 7		X		X		X					

Table 4-2. Spring Valley Studied Alternatives Summary

Alternative Studied	On Alignment	Offset Alignment	New Concrete Spandrel Arch Bridge	New Haunched Steel Girder Bridge	Rehab. Bridge	Concrete Girder Approach Spans	Haunched Steel Girder Approach Spans	2-Lane Temp. Bridge
Alternative 1A	X		X			X		X
Alternative 1B	X		X				X	X
Alternative 2	X			X				X
Alternative 3A		X	X			X		
Alternative 3B		X	X				X	
Alternative 4		X		X				
Alternative 5A	X				X	X		X
Alternative 5B	X				X		X	X

5 Alignment Alternatives Studied

All offset alignments over the Current River, both temporary and permanent, contain a shift to the east of the existing highway or downstream of the existing bridge. The proximity of Carr's Store and a known archeological site west of the highway limits the ability to shift the alignment to the west and was not further considered in this study. Similarly, all offset alignments over Spring Valley, both temporary and permanent, contain a shift to the west of the existing highway or upstream of the existing bridge. Round Spring is located east of the highway and just north of the existing Spring Valley Bridge and limits the ability to shift the alignment east and was not considered further in this study. Additionally, all new temporary or permanent alignments offset from the existing roadway will require clearing the land and will impact trees and vegetation in the area. Restoration of the area after construction can be included in the project but will take several years to match the existing condition.

5.1 Existing Roadway Conditions

The existing Route 19 highway is a two-lane rural highway classified as a Minor Arterial. The existing highway has two 11 foot lanes with 2 foot shoulders. Current traffic volume along Route 19 through the study area is approximately 400 AADT, with approximately 15% trucks. The highway has a posted speed limit of 45 MPH through the study area. There are four horizontal curves located within the study area. Two of the curves have approximately 450-foot radii, one curve has a radius of approximately 400-feet and the northernmost curve has a radius of approximately 500 feet. None of these existing horizontal curves meet the design criteria for 45 MPH. In addition, no warning signs of an approaching sharp curve with advisory speed plaques are in place in advance of any of the curves. The curves meet horizontal design speed criteria for 40 MPH. Crash data was not analyzed for this concept study, but should be taken into consideration during the next phase of the project.

5.2 General Roadway Design Parameters

Given the rural and scenic nature of the study area and the popularity of recreation near Round Spring, it was determined that maintaining a posted speed limit of 45 MPH through the study area after rehabilitation or replacement of the bridges was warranted. The use of temporary shooflys would maintain the existing horizontal curves along Route 19. Alternatives that shift the roadway to an offset alignment have improved geometrics by slightly increased radii where obtainable, but the radii were not increased enough to raise the design speed to 45 MPH. It is recommended that advanced warning signs for approaching curves with advisory speed plaques be added before the four curves in the study area. Vertical curves for the offset alignments have also been designed to meet the existing 40 MPH design speed.

Temporary shoofly alignments were generally designed to meet a 25 MPH design speed. Because these are temporary alignments, superelevation on the horizontal curves was not provided. Most of the shoofly horizontal curves have a minimum radius of 350-feet, except for the two curves on the north side of Current River for the downstream alignment alternative.

The minimum roadway width set for the project is 26 feet, including the roadway over the rehabilitated or replaced bridges. The curves before and after the Current River Bridge are reversed creating an “S” shape with travel way widening needed on the inside of both curves. The width transition for both curves will extend onto bridge requiring additional bridge deck width beyond the 26 foot minimum. To avoid opposite hand flared spans at each end of the Current River, the roadway width over the bridge has been set to 28 feet throughout. The curves near the bridge over Spring Valley are further away and the travel way width transitions do not impact the bridge. The design roadway width of 26 feet is adequate over the Spring Valley Bridge.

The stated purpose of the study is to examine the various alternatives for rehabilitating or replacing the existing bridges. It is not the intent of the project to substantially improve the roadway geometrics through the study corridor and the proposed design parameters reflect the general approach of maintaining the current level of service. This approach will create a project that improves the safety of the route while maintaining the character of the roadway through the culturally sensitive region. The design parameters used may require design exceptions during future phases of the project. Possible design exceptions include design speed, horizontal and vertical curve geometry and shoulder width as well as design spread for bridge drainage due to narrow roadway.

5.3 Current River - Temporary Shoofly with Pedestrian Bridge Removal (Alternatives 1, 2 & 5)

This alignment alternative consists of a temporary shoofly located approximately 45 feet east of the existing Current River Bridge centerline which would provide approximately six feet of separation between the widened bridge and temporary bridge. Because of this shoofly location, the existing pedestrian bridge would need to be removed which would result in no pedestrian crossing during reconstruction or rehabilitation of the Current River Bridge. In addition, the removal of the pedestrian bridge would require relocation of the existing utilities located below the bridge deck prior to construction. Two alignment options were evaluated for a temporary bridge across the Current River that removes the pedestrian bridge. The first alignment is for a two-lane bridge and is depicted in Figure A-1. The second alignment is for a single lane bridge to temporarily carry both directions of traffic and is depicted in Figure A-3. Traffic over the single lane structure will be controlled by temporary traffic signals on either end of the bridge to alternate between northbound and southbound traffic. After completion of the new highway bridge, the narrower single-lane bridge would be converted to a permanent pedestrian crossing allowing the alignment for the single lane alternative to be approximately 10 feet closer to the existing bridge. See Section 6.1 for more discussion on the bridge aspects of the temporary bridge.

The shoofly alignment would be constructed with 400-foot minimum radius curves. On the north side of the river, reverse curves or an S-curve would shift traffic from existing Route 19 to the shoofly alignment. On the south side of the river, a single curve would connect the temporary shoofly with Route 19 which would provide for more area at the south end of the existing Current River Bridge for construction staging and/or storage

5.4 Current River - Temporary Shoofly Downstream of Pedestrian Bridge (Alternatives 1, 2 & 5)

Another alignment option can be seen in Figure A-2 consisting of a temporary shoofly located approximately 80 feet east of the existing bridge centerline. This shoofly location is downstream of the existing pedestrian bridge and may avoid removal of the pedestrian bridge and the attached utilities. The pedestrian bridge may remain in service throughout the construction of the Current River Bridge but it will be on the west side of the temporary roadway and an allowance will be needed to safely move trail users across Route 19 at both ends. The temporary bridge across the Current River could be constructed as either a two-lane temporary bridge or a single-lane bridge controlled by traffic signals on either end allowing alternating traffic to cross the bridge. Only the two-lane option is presented in this study report. See Section 6.1 for more discussion on the bridge aspects of the temporary bridge.

The shoofly alignment would be constructed with north side reverse curves and a south side single curve similar to the Current River Temporary Shoofly with Pedestrian Bridge Removal options, except this option would have smaller 200-foot radius curves on the north side to minimize the roadway impacts to the areas along Route 19. Even with sharper curves, the impacts to the areas along Route 19 would increase compared to the options that remove the pedestrian bridge since there would be more lateral shifting of Route 19 traffic from the existing alignment to the temporary shoofly alignment.

5.5 Current River - New Offset Bridge with Pedestrian Bridge Removal (Alternatives 3 & 4)

This alignment alternative can be seen in Figure A-4 and consists of a new offset alignment located approximately 35 feet east of the existing bridge centerline which would provide approximately 10 feet of separation between the existing bridge and new bridge. The new alignment would be a permanent shift allowing the existing Current River Bridge to carry traffic while the new bridge is constructed. The new alignment location would require the removal of the existing pedestrian bridge and result in no pedestrian crossing during reconstruction of the Current River Bridge. The removal of the pedestrian bridge would require relocation of the existing utilities located below the bridge deck prior to construction. Since this alternative has a new mainline alignment, new flatter curves with shoulder widening and transitions would be constructed for both of the curves along the alignment. The new Current River Bridge would be widened to account for this additional roadway width and the curve transitions near the bridge ends would be extended onto the bridge. With the removal of the existing pedestrian bridge, a 10-foot mixed use path would be included on the east side of the new bridge. See Sections 6.4 and 6.5 for more discussion on the bridge aspects of the new bridge.

5.6 Current River - New Offset Bridge Downstream of Pedestrian Bridge (Alternatives 3 & 4)

Similar to the Current River Temporary Shoofly Downstream of Pedestrian Bridge option, this alternative would consist of a new mainline alignment located approximately 80 feet east of the existing bridge centerline and can be seen in Figure A-5. The new alignment would be a permanent shift allowing the existing Current River Bridge to carry traffic while the new bridge is constructed. Similar to the alignment options that remove the pedestrian bridge, a new mainline alignment further downstream would use flatter curves with shoulder widening and transitions would be constructed for the curves on both sides of the river. The new Current River Bridge would be widened to account for this additional roadway width and the curve transitions near the bridge ends would be extended onto the bridge. Sections 6.4 and 6.5 for more information on the bridge aspects of the new bridge.

As compared to the Current River New Offset Bridge with Pedestrian Bridge Removal option, this alternative would result in additional impacts to the areas along Route 19 due to increase lateral shifting of traffic from the existing alignment to the new permanent alignment. The impacts will be greatest on the east side of the highway north of the river. Construction limits for the proposed alignment extend into a significant portion of the hillside when 3:1 side slopes are assumed possibly impacting the NPS utilities and specifically the water storage tank. No geotechnical investigation was performed for this study but rock stable enough to support an open face is expected in the hillside. If further analysis confirms the existence of rock the impact of the alignment shift could be reduced.

5.7 Current River - Phased New Bridge near Existing Alignment (Alternatives 6 & 7)

This alignment alternative can be seen in Figure A-6 and consists of a new alignment offset approximately 20 feet east of the existing bridge centerline. The permanent alignment shift would allow for the phased construction of a new bridge. The existing bridge would be used for one-lane traffic while the new bridge is being constructed. Since this alternative has a new mainline alignment, new flatter curves with shoulder widening and transitions would be constructed on both sides of the river. The new Current River Bridge would be widened to account for this additional roadway width and curve transitions that extend onto the bridge would be included. Section 6.7 has more detailed discussion on the aspects of the new bridge.

5.8 Spring Valley - Temporary Shoofly Upstream (Alternatives 1, 2 & 5)

The alignment alternative shown in Figure A-7 presents a temporary shoofly located approximately 35 feet west of the centerline of the existing Spring Valley Bridge and would provide approximately 10 feet of separation between the existing bridge and temporary bridge. The temporary bridge across the Spring Valley could be constructed as either a standard two-lane temporary bridge or a single-lane bridge controlled by traffic signals at each end allowing alternating traffic to cross the bridge. Either temporary bridge option would be constructed from standard MoDOT temporary spans which have to be installed level limiting the ability to lower the profile and reduce bridge length. Only the two-lane bridge option is presented in this report. See Section 7.1 for more discussion on the bridge aspects of the temporary bridge.

The shoofly alignment would be constructed with 300-foot minimum radius curves. On the south side of the valley, reverse curves or S-curve would shift traffic from existing Route 19 to the shoofly alignment. On the north side of the valley, a single curve would connect the temporary shoofly with Route 19 and provide more area at the north end of the existing Spring Valley Bridge for construction staging and/or storage. The existing NPS access onto Route 19 at the south end of the Spring Valley Bridge would be extended to connect with the temporary shoofly. A shoofly alignment would not impact the existing NPS buildings.

5.9 Spring Valley – New Offset Bridge Upstream (Alternatives 3 & 4)

A new permanent alignment offset approximately 35 feet west of the existing bridge centerline is presented in Figure A-8 and would provide approximately 10 feet of separation between the existing bridge and new bridge. The new alignment would be a permanent shift and would allow traffic to be maintained on the existing Spring Valley Bridge while the new bridge is constructed. Since this alternative has a new mainline alignment, new flatter curves with shoulder widening and transitions would be constructed on each side of the valley. The new Spring Valley Bridge would be widened to account for the additional roadway width but the travel way transitions do not extend onto the bridge limiting the new roadway width over the bridge to 26 feet instead of 28 feet required over the Current River. Details of the new offset bridges are included in Sections 7.4 and 7.5.

The alignment shifted west toward the existing NPS buildings would require a retaining wall or a reinforced side slope steepened to 2:1 to avoid impacts to NPS buildings. If a retaining wall were constructed, it would be approximately 300 feet long and vary in height from approximately five to seven feet. If a reinforced side slope is selected along the west side it would extend from the south end of the Spring Valley Bridge approximately 400 feet past the southernmost NPS building. Either option of a retaining wall or a reinforced side slope will alter the appearance of the roadway embankment adjacent to the NPS facility.

6 Current River Bridge Alternatives Studied

The final configuration of the bridge over the Current River needs to include a 28 foot wide roadway and many alternatives include a 10 foot wide mixed use path. For the alternatives where replacement of the pedestrian bridge is included, the mixed use path is generally in the overall width of a single bridge. Alternatives 1B and 2B include consideration of using a single lane temporary bridge that is converted to a mixed use path at completion of the project. The roadway width is required due to the approach roadway curves adjacent to the ends of the bridge. The existing bridge cross slope is normally crowned, but the roadway over the bridge will need to accommodate the necessary superelevation transitions that will extend onto the bridge.

All alternatives assume the design high water noted on the as built plans is close to the value that will come from a detailed hydraulic model. The hydrology and hydraulics modelling is beyond the scope of this conceptual study and is not included. Bridge lengths and roadway profiles have been established similar to the existing bridge but may be reduced if detailed hydraulic modeling shows a reduced bridge opening to be adequate for storm water conveyance.

If a replacement option is selected, removal of the existing structure will be more difficult than an ordinary bridge. The demolition of the structure will need to happen in reverse sequence to the method of construction with the surfacing removed to allow extraction of the fill working out from the center of each span to maintain balanced loading on the arches. Arch fill material should be removed from the site and not deposited in the river. Removal of the spandrel walls, counterforts and tie beams could be done with conventional methods but explosive charges should be considered to allow the arch concrete to collapse onto a prepared rock blanket or temporary causeway in the channel. If the nearby cave system or other formations in the area preclude the use of explosive charges, temporary supports and bracing will be needed to safely remove the arch concrete. Foundation elements away from the stream could be removed to the standard limit of two feet below the groundline. Consideration should be given to additional removal of the foundations in the channel to avoid future scour events that would expose the foundation remnants and pose a possible hazard to river traffic. These challenges to the removal of the bridge were considered in the cost estimates presented in this report.

Normal flows on the Current River and frequent high water events require the use of substantial temporary works in the stream. Construction in the river will require a causeway with piping to convey the stream flow while allowing construction activities. An allowance must be made to maintain river traffic during construction. Removal of the existing bridge may require a surface that allows equipment access and also allows for either explosive or braced removal of the arch concrete. Temporary access roads will be needed to the river level from both river banks. Additionally, Route 19 has several roadway curves north and south of the project which could limit the length of field pieces that can be efficiently delivered to the site. Field pieces longer than 130 feet should be investigated to determine if shoulder widening or other roadway improvements are needed for delivery.

6.1 Current River - Temporary Bridge

Most of the on alignment rehabilitation or replacement alternatives considered would carry traffic on a temporary structure while construction is underway. Existing temporary spans owned by MoDOT are configured for 40 foot span lengths supported by steel cap beams on driven HP piles. Because of roadway geometry requirements and to limit the impact of the temporary roadway on the surrounding area, the temporary profile will nearly match the existing bridge. This profile will produce foundation heights that exceed the limitations of exposed driven piles leading to a more robust temporary substructure than is standard for MoDOT owned temporary bridges. Two column concrete bents supported on drilled shafts are anticipated to support the temporary spans. This substructure type has the additional benefit of providing adequate lateral resistance during the frequent high water events on the Current River. Due to the cost of the concrete substructure and additional challenges with bent placement within the river, longer temporary spans of prestressed concrete NU-girders supporting open grid decking was evaluated and precludes the use of the standard temporary spans in MoDOT’s inventory. NU-girders are recommended due to having reasonable span lengths for this application and a sufficiently large top flange to attach the temporary decking. Additional cost considerations have been included in the estimate to require the precast manufacturer to thicken the top flange such that coil tie inserts or J-bolts can be installed to attach the decking.

An additional option was considered for Alternatives 1B and 2B to build a single lane bridge to temporarily carry traffic over the Current River during reconstruction of the highway bridge. This bridge would be converted to a pedestrian bridge after the new highway bridge is reopened. This option may be able to carry the existing utilities if the single lane temporary bridge is built while the pedestrian bridge remains in service. This option produces cost savings for the project by eliminating the waste of a temporary bridge but will result in two structures at the crossing. It is unknown if the NPS would be willing to take ownership of the bridge after it is converted to pedestrian use or if maintenance would remain MoDOT’s responsibility. The cost estimate for the single lane temporary bridge includes haunched steel plate girders with a concrete deck in place of the open steel grid deck. The unit cost of the single lane bridge is higher than the two lane temporary bridge since both designs use two column bents. This option is shown for Alternative 1B and 2B however including a girder bridge adjacent to a new arch structure may not create the aesthetic conditions desired at this location. If a single lane filled concrete arch bridge would be desired to match the highway bridge selected a corresponding cost increase should be expected.

6.2 Current River - Replacement In-Kind on Alignment

The first alternative considered to cross the Current River is a new bridge that matches the general shape and span arrangement of the existing bridge. The three main filled arch spans would be recreated in a bridge with a wider roadway. If the temporary bridge in place of the pedestrian bridge is selected, an allowance for a mixed use path should be included in the new bridge width. The end span arches and the filled abutment houses would be replaced by single spans of concrete girder bridge. The filled arch span would still have a floating roadway surface supported on the arch fill but it will be tied to the arch near the center of the segment and strip seal type expansion joints will be placed at the ends. To avoid the problem of salted roadway drainage running into the fill soil and through the openings of the bridge seen in the existing structure, Type A curbs will be placed along the edges of the roadway to the west and the edge of the pedestrian walkway to the east. These curbs will allow the collection of roadway drainage and direct it to a bridge drainage system that will be contained inside the arch fill and directed to a discharge through the arch rib below. A system that collects drainage and directs it to the ends of the bridge is possible but would require either raising the grade of the roadway or lowering the curve of the arches to accommodate the collection piping.

In this option the proposed piers would be founded on deep spread footings similar to the existing bridge. The span arrangement was matched so that cofferdams necessary to construct the new bridge could also be used to remove the existing foundations. An option to support the new bridge on a pile cap footing founded on drilled shafts is also possible. The proposed bridge arrangement can be seen in Figure A-10. In addition to matching the general shape and span arrangement of the existing bridge the aesthetic relief on the sides of the pilasters above the piers will be recreated. Similar to the existing bridge, cantilever brackets would be used to support the bridge roadway and barrier. The cantilever brackets can be shaped to match the stepped bottom flange of the existing brackets and the curved shape of the pier pilasters thereby mimicking the look of the existing bridge.

The primary benefit of this alternative is to match the aesthetic condition of the existing bridge. This option would create a bridge with a massive, heavy appearance similar to the existing bridge. One of the drawbacks of this alternative is that it would put back in place a type of bridge that cannot be fully inspected because a portion of the primary support member is buried under the arch fill. While the proposed roadway drainage collection system should remove the primary source of corrosion from the new arch the lack of accessibility would recreate the current situation and introduce risk into the life cycle expectations of a new bridge. An option to improve the situation would be to build a faux filled arch bridge where the roadway was actually supported on spandrel columns and cap beams but spandrel walls were added to create the massive, heavy appearance. This option would need to include access portals to the interior of the arch to allow for future inspection and maintenance. Detailed consideration of this option, including cost estimates, is not included in this study.

6.3 Current River - Girder Bridge Replacement on Alignment

Another alternative studied is to replace the existing bridge with a new bridge comprised of haunched steel plate girders on concrete substructures. Several span arrangements were studied to allow placement of new bridge foundations that avoid complete removal of the existing bridge foundations. The five span option presented in Figure A-11 and Figure A-12 was developed to maintain a similar overall bridge length. This bridge length exceeds the recommended length for the use of integral end bents and strip seal type expansion joints will be necessary. Since a girder bridge would not have the flow restrictions of a filled arch span a refined hydraulic model may allow for a shorter bridge and corresponding cost savings.

A parabolically haunched steel plate girder is presented in the bridge elevation in Figure A-11. Concrete girder and steel girder bridge options were considered during the study. While a concrete girder bridge would be the most cost effective structure at this location this option was not well received during the design charrette and therefore is not presented in this report and is not reflected in the final cost estimates presented. Five spans of haunched steel plate girders were selected to mimic the number of spans of the existing bridge and mimic the arch shape resulting in a context sensitive design. This structure type also matches the bridge over Sinking Creek and would maintain the bridge characteristics in other crossing along the corridor. A concrete girder structure would more closely match the material of the existing bridge, but haunched precast beams are not practical and the formwork for cast-in-place concrete girder spans would rival the cost and impact of a new concrete arch bridge and therefore was not considered.

The substructure of a new girder span bridge would consist of concrete columns and cap beams with web walls between the columns to avoid catching drift that is carried down the river. The concrete columns would be supported on drilled shafts socketed into rock. To match the aesthetics of the bridge over Sinking Creek, square columns were considered and a formliner allowance on the columns and web walls was included in the cost estimates. The use of square columns founded on round drilled shafts results in higher cost estimates due to the use of larger drilled shafts and rock sockets. As rock is approximately 15 feet deep over the bridge site drilled shaft foundations are preferred and will limit the impact on the streambed by avoiding large open excavations.

6.4 Current River - Replace In-Kind on Offset Alignment

A new filled concrete arch bridge offset from the existing bridge would have the same span arrangement as a bridge built on the existing alignment. Matching the existing span arrangement will recreate the look and hydraulic performance of the existing bridge. Figure A-13 shows a bridge elevation that matches the arrangement of the existing bridge with an alignment that places the new bridge very close to the existing bridge and would require removal of the pedestrian bridge. The other alignment option would place the new bridge downstream of the existing pedestrian bridge. A similar bridge elevation would be expected at each crossing option.

6.5 Current River - Girder Bridge Replacement on Offset Alignment

A new open span girder bridge built on an offset alignment is expected to be similar to the option on the existing alignment presented in Section 6.3. Greater flexibility of span arrangements would be realized when the need to avoid the existing bridge foundations is removed. A five span bridge with substructure aligned with the existing bridge would reduce the temporary hydraulic impact on the project. The offset alignments and profiles analyzed for this study would result in similar bridge lengths compared to the option on the existing alignment. Aesthetic considerations similar to those mentioned in Section 6.3 should be made.

6.6 Current River - Rehabilitation and Widening of Existing Bridge

A report of the material condition and life expectancy was prepared by KPFF Consulting Engineers and is included in Appendix C. Based on the results of material testing performed on samples taken from the existing bridge, the potential for corrosion in the arch concrete is high. While widespread delamination and spalling of the main arch concrete has not been recorded, some localized deterioration has occurred. Due to the configuration of the existing bridge, samples of the concrete on the interior of the arch were not possible and it is likely that chloride ion concentrations on the interior arch surface are higher than those sampled on the exterior surface. The KPFF report notes the concrete sampled is not from the areas closer to the roadway and near the midpoint of the arch where the worst conditions would be expected. If the selected alternative is to rehabilitate and widen the existing bridge a comprehensive corrosion mitigation program should be included. Such a mitigation program would include removal and replacement of deteriorated concrete and inclusion of embedded galvanic anodes to counter the corrosive effects of the chloride ion contamination. It should also be noted that the embedded anodes available to industry today have a life expectancy of approximately 30 years which may not meet the needs of the project or would require additional rehabilitation in the future. In addition to the concrete material testing, the existing structure was analyzed to determine its ability to carry current highway design loads. That analysis showed the bridge to adequately carry an HS20 live load in its current configuration or as part of a widened bridge.

Two rehabilitation plans were considered. Alternative 5A is a phased rehabilitation that keeps one lane of traffic on the existing structure or the new widened structure. The potential phasing is shown in Figure A-14. This option would include temporary repairs to the existing deteriorated cantilevers so that a single lane of traffic could be carried close to the existing west rail. Using temporary shoring to support the existing roadway fill the east cantilevers, bridge rail and bridge deck extension would be removed. The arch ring would be widened enough to support a full lane of traffic on the west side which would then carry the traffic while the east side was widened to accommodate the current roadway design width. Figure A-14 shows a final configuration that meets all the minimum width requirements but that would not allow for removal of the existing arch fill to perform additional inspection and repair. This option is included in the cost estimates presented in the report. A bridge that was built a couple feet wider than necessary could be configured to allow removal of the existing arch fill but that option is not presented in the figures. It should be noted that the unknown condition of the top of the arch ring and the buried counterforts and tie beams represents a significant risk to the project. If the first couple stages of the rehabilitation are complete and then significant deterioration is found on the existing bridge to remain in place project cost overruns due to a more substantial rehabilitation program and project time extensions would occur.

Alternative 5B would be a single phase rehabilitation where traffic would be carried on a temporary bridge. The final configuration of this alternative would be similar to the phased rehabilitation presented in Figure A-14 and a separate figure is not presented. The primary benefit of this alternative is the ability remove the arch fill and inspect the arch concrete prior to beginning other work to widen the bridge. Since the fill most saturated with chloride ions is likely to be near the top, removal of the top three feet of fill may be enough to inspect the critical concrete areas and determine if more inspection or rehabilitation is needed. The primary drawback of this alternative is the need to build a temporary structure. While it is not presented in the cost estimates, a project similar to Alternative 1B with a single lane temporary bridge converted to a pedestrian bridge could be considered. This option would reduce the bridge widening and is only feasible with the single phase rehabilitation.

6.7 Current River - Phased Bridge Replacement near Existing Alignment

The final option considered to replace the bridge over the Current River is a phased replacement on a slight offset alignment which was discussed during the design charrette and has been added to this report. The staging for this phased replacement can be seen in Figure A-15. In this alternative a new partial width bridge would be constructed downstream of the existing bridge. Analysis shows this partial bridge would likely fit between the existing highway bridge and the pedestrian bridge but the clearance to the existing structures would be less than preferred. This would involve a roadway alignment shift of approximately 20 feet. The space constraint to build the new bridge and the side slope extensions of the shifted and widened bridge may require additions of retaining walls to avoid impacts to the existing pedestrian bridge. This alternative could be pursued with either a new concrete arch structure (Alternative 6) or a new haunched steel plate girder structure (Alternative 7).

7 Spring Valley Bridge Alternatives Studied

The final configuration of the bridge over Spring Valley should include a 26 foot wide roadway with no allowance for pedestrian use. A 26 foot wide roadway is the minimum roadway width acceptable to MoDOT for this project given the traffic makeup and expected roadway geometry. No pedestrian facility exists adjacent to the highway bridge over Spring Valley and no need for a pedestrian facility is anticipated. Trail traffic from the Current River Bridge can proceed over land and use other crossings during normal stream flow.

Similar to the bridge over the Current River, all alternatives assumed the design high water noted on the as built plans is close to the value that will come from a detailed hydraulic model. The hydrology and hydraulics modelling is beyond the scope of this conceptual study and is not included. Bridge lengths and roadway profiles have been established similar to the existing bridge but may be reduced if detailed hydraulic modeling shows a reduced bridge opening to be adequate for storm water conveyance. The design high water noted on the as built plans is likely the result of backwater from the Current River. If this is the case, it may be possible to shorten the bridge and reduce project costs but a shortened bridge would have to include additional roadway fill in the valley. Additional roadway fill in the valley would not pose an engineering challenge but may not be acceptable to other stakeholders.

The existing bridge is set on a 45 degree right advance skew but a 30 degree skew appears to align better with the valley and the majority of stream flows while creating a bridge with less tendency to try to “walk” off its bearings requiring less maintenance over the life of the structure. All new bridge options are set at 30 degree right advance skew to accommodate the current stream alignment and provide adequate clearance to the NPS service road.

The stream has migrated to the north and created a scour hole near the north arch thrust block (Bent 4 in Figure 2-6). All span arrangements considered should keep piers out of the main channel if possible and avoid the scour hole to allow free flow of the stream. All span arrangements must also provide at least 14'-6" of vertical clearance to the NPS service road to meet MoDOT EPG requirements. A substructure layout that avoids the clear zone of the service road is preferred but the roadway could be protected if a span arrangement encroaches on the clear zone but provides other benefits.

If a replacement option is selected, removal of the existing structure will be more difficult than an ordinary bridge but does not have the complication of arch fill as noted in the bridge over the Current River. The majority of the bridge can be removed with traditional methods. Due to the proximity of Round Spring and the Round Spring Cave removing the arch concrete with explosive charges may not be allowed and a shored and braced removal should be expected. Removal of the approach span over the NPS service road will require close coordination as this road provides the only access to NPS residences on the west side of the bridge. While the stream through Spring Valley does not carry boaters, it is a well visited area and consideration should be given to foundation removals beyond the standard two feet below ground. Additional scour or stream migration in the area could expose partially removed foundations and the presence of the north arch thrust block may continue to contribute to the existing scour hole.

Access to the area below the Spring Valley Bridge can be made using existing park service roads and extensive temporary access roads are not expected. A low water crossing to construct portions of the bridge north of the stream may be needed. This low water crossing may also be needed to install piling and place portions of the temporary bridge if an alternative with a temporary bridge is selected.

All foundation options for a temporary or permanent bridge should take into account the adjacent Round Spring Cave system. Further design of bridge options at this location should be coordinated with the NPS and checked against the cave shape file they are preparing.

7.1 Spring Valley - Temporary Bridge

Due to the two-girder bridge configuration over Spring Valley all of the on alignment rehabilitation or replacement options will rely on a temporary bridge. It is our understanding that MoDOT has 9 standard temporary bridge spans in inventory in Willow Springs, which is near the project and 12 more available at other locations. The temporary bridge at Spring Valley has been configured to utilize 11 of these 40-foot long standard spans and a 110-foot long Mabey truss span already owned by MoDOT. The Mabey truss span (or an equivalent rental span) is needed due to the alignment of the NPS service road that must remain open.

The span over the service road could be shortened if it is determined that a temporary single lane service road is acceptable. If a longer temporary span is needed a couple extra provisions will be required. The Mabey truss span is 28 feet wide while the standard temporary spans utilize a 24 foot roadway. Temporary thrie beam guardrail that aligns with the guardrail on the standard temporary spans will need to be attached to the decking in the truss span. Additionally, the NPS service road will need to be protected from debris that could fall through the open grate decking used on temporary spans.

The standard temporary spans include steel cap beams designed to be supported on 14 inch steel HP piles. Since the temporary profile must remain close to the existing, the temporary bents will need to be approximately 33 feet tall. Due to the height of the intermediate bents required, it is anticipated that steel CIP pipe piles or similarly stout piles will be required and 16 inch CIP piles have been assumed in the cost estimates. The use of these larger piles will likely require fabrication of custom steel cap beams which is reflected in the cost estimates. The overburden at this site is approximately 10 to 15 feet which is too shallow to create stable foundations with driven piles. Piles prebored through the overburden and five feet into the bedrock have been assumed. Temporary shoring towers were considered but rejected due to the possibility of inundation during high water events destabilizing the towers or the tower foundations.

An option exists at this site to use a single lane temporary bridge signalized on each end to alternate traffic. This configuration would remove the center portion of the standard MoDOT temporary spans and connect the two side sections at the middle of the temporary lane. A longer temporary span similar to the Mabey span will still be needed over the NPS service road but thrie beam guardrail could be attached to the steel grid decking in line with the guardrail on the standard spans. This option will require new steel cap beams, but that cost is already included due to the expected use of 16 inch CIP pipe piles. Omitting the center section of the standard temporary spans would reduce cost of the piling and prebore as well as reducing the cost of transporting, erecting and eventually removing the spans.

7.2 Spring Valley - Replace In-Kind on Alignment

The first alternative considered to cross Spring Valley is a new bridge that matches the existing open spandrel arch shape of the main span and uses prestressed concrete NU girders for the approach spans. The arch span would match the shape and size of the existing main span but the arches would be spaced slightly further apart to account for the wider roadway carried over the bridge. The arch span would also be shifted so that both new thrust blocks would be north of the existing thrust blocks and thus moving the new arch foundations away from the meandering streambed and the scour hole adjacent to the existing north footing. Strip seal type expansion devices will be used at each end of the arch span and bridge drains will be placed in the deck and the drainage collected in pipes behind the approach girders where possible. The drainage collection system through the arch span may not be hidden.

The approach spans are sized to miss the existing foundations and provide additional clearance to the NPS service road. NU-girders are recommended to provide reasonable span lengths needed, especially on the north approach span. If the differing appearance is acceptable standard MoDOT shape girders could be used on the south approach. The concrete girder approach span option is presented as Alternative 1A. In place of concrete girder approach spans, haunched steel plate girders could be used to add visual interest and create a curved bottom flange reminiscent of the curved bottom flange of the existing approach girders. Haunched steel plate girder approach spans are presented as Alternative 1B but no separate figure is included.

Since the arch foundations will be replaced, longer spans adjacent to the arch are possible as the additional load can be accounted for in the design. The arch thrust blocks and footings will match the existing construction and will each require a large cofferdam. The intermediate bents will be similar to the girder bridge options and will consist of square columns with web walls and formliner allowance supported on drilled shafts and rock sockets to avoid additional open excavations in the streambed.

7.3 Spring Valley - Girder Bridge Replacement on Alignment

Similar to the bridge over the Current River, an open span girder bridge was also studied to cross Spring Valley. Several span arrangements were studied and the four span (135'-152'-152'-110') bridge presented in Figure A-18 and Figure A-19 avoids the existing bridge foundations and the migrated stream through the valley. This span arrangement represents an efficient balance of superstructure and substructure investment. The maximum span lengths of 152 feet compare favorably to the 155 foot arch span of the existing bridge. This structure would also provide adequate vertical clearance over the NPS service road and horizontal clearance would exceed the existing but may still require guardrail protection. This bridge length exceeds the recommended values for using integral end bents and non-integral bents with strip seal type expansion devices are recommended. An open span bridge comprised of concrete girders was also considered and would be the most cost efficient structure but is not presented in this report as that concept does not meet the criteria developed during the design charrette.

The existing arch thrust blocks are very large and occupy a significant portion of the longitudinal section. Finding a span arrangement that avoids the existing substructure while creating a bridge that balanced superstructure and substructure cost results in the most efficient structure. Additional bridge configurations with three span and five span arrangements were also considered but the four span structure presented represents the most efficient configuration.

While the number of spans for this girder bridge would be greatly reduced compared to the existing bridge, the parabolically haunched steel girders would mimic the arch shape of the main span as well and the curved bottom flange of the existing approach spans. Similar to the bridge over the Current River, square column substructure with web walls with formliner supported on drilled shafts would be used to avoid issues with stream debris accumulation and generally match the characteristics of the bridge over Sinking Creek. Rock is approximately 20 feet below the surface and drilled shaft foundations are the preferred foundation option to avoid large open excavations in the streambed.

7.4 Spring Valley - Replace In-Kind on Offset Alignment

A new concrete arch bridge on an alignment offset to the west would be very similar to the bridge described to be rebuilt on alignment in Section 7.2. The bridge presented in Figure A-20 uses the same span arrangements and other configurations as the bridge presented previously. Without the constraints of the existing foundations a more efficient span arrangement may be found but a more refined survey including the limits of the existing scour hole would be needed to fine tune the bridge geometry. Similarly, without the conflict of the existing abutments it may be possible to pull in the ends of the bridge and reduce the project cost. The requirement to span the existing NPS service road will still need to be met. The offset alignment options considered would require the use of temporary shoring of the existing roadway embankment during the construction of the new bridge.

7.5 Spring Valley - Girder Bridge Replacement on Offset Alignment

A new open span bridge built on an offset alignment adjacent to the existing bridge is expected to be similar to the option on the existing alignment presented in Section 7.3. An offset alignment would remove the span arrangement constraints of the existing foundations. A four or five span structure will still be the most effective and a bridge skew of 30 degrees right advance would still be the best fit for the current stream flows. The offset alignments and profiles considered for this study would result in similar bridge lengths. The need to avoid the existing abutment foundations would be removed and a shorter bridge is possible. If the offset alignment option is selected consideration should be given to a refined analysis of the bridge to determine if integral end bents are feasible, thus removing a future maintenance consideration. Aesthetic considerations similar to those mentioned in Section 7.3 should be used.

7.6 Spring Valley - Rehabilitation and Widening of Existing Bridge

The material condition and life expectancy report prepared by KPFF shows the concrete sampled from the bridge over Spring Valley to include chloride ion contamination at levels that could initiate corrosion. Similar to the notes included for the Current River bridge the material sampled was not taken from areas of the bridge expected to have the worst contamination and higher levels of chloride ions should be expected in those areas closest to the deck. As described below most of the other concrete in the bridge would need to be replaced so the concrete of greatest concern is in the arch and the arch footings. Spalls and delaminations are visible in the arch concrete indicating deterioration with corrosion of reinforcing steel is occurring. This is the concrete closest to the deck and is expected to be the most contaminated. If a rehabilitation option is selected, a vigorous corrosion mitigation program should be expected to include removal and replacement of deteriorated concrete with the inclusion of embedded galvanic anodes. As noted previously the anodes have an expected life of approximately 30 years.

Our site visit and review of the inspection reports indicate significant deterioration of the deck concrete. The perforated curb portion of the existing bridge rail allows over the side drainage which is flowing along the underside of the deck causing corrosion. Any rehabilitation will need to remove the deck concrete. Removal of the deck through the arch span may be possible but removal of the deck concrete in the approach spans is not. The approach spans are constructed of two girder cast in place concrete “T” girders where the deck is part of the primary support element and can’t be replaced independently of the girders unlike a modern girder bridge. The deck cannot be removed without destabilizing the girder and a single girder cannot be removed without destabilizing the span. This results in the need to remove the superstructure, deck and barrier in the approach spans as part of any rehabilitation effort. The existing approach span substructure has several areas of spalled concrete and would require wider cap beams to accommodate the new bridge width. The existing approach span columns have reinforcing steel embedded into the unreinforced concrete footings. Any part of the bridge to remain would have to be evaluated for inclusion in the final structure and the wider roadway will cause additional overturning loads from Live Load that the unreinforced footings wouldn't be able to withstand. Therefore, complete replacement of the approach spans (superstructure and substructure) is recommended for any rehabilitation.

New approach span substructure should be similar to other girder options mentioned elsewhere: square concrete columns with web walls supported on drilled shafts and rock sockets. It is possible to rebuild the approach span girders to match the shape of the girder in the existing bridge, but it would require the girders to be cast-in-place using extensive formwork supported from the ground. This formwork would be extensive enough to restrict the use of the NPS service road and was not considered further. Similar to Alternative 1 and 3, if a rehabilitation of the bridge is considered, new prestressed concrete or haunched steel plate girder spans should be used.

To widen the bridge the existing cap beams supported by the spandrel columns above the arch will need to be lengthened. The cap beams are integral with the existing spandrel columns and the columns have areas of deterioration. Replacement of the cap beams and columns is recommended to carry the additional load from the increased roadway width. New cap beams will need to be wider than existing and constructed from higher strength reinforcing steel in common use today.

The existing arches were analyzed to determine their ability to carry current highway design loads. A wider roadway will allow either arch to see a greater lane fraction of the applied live load than the current bridge. This increased lane fraction results in an HS20 loading requiring 111% of the available capacity of the arch which is unacceptable. Next, a 3S2 designated rating truck was considered and resulted in a live load that needed 95% of the available operating capacity to support the applied load considering load factors applicable to operating conditions. MoDOT's written policy is to post bridges at 86% of the operating rating. Performance of these calculations found the bridge posting load would be 44 Tons based on the capacity of the arches and assuming the new portions of the bridge do not control the rating. This value exceeds the required posting limit and a rehabilitated bridge would not need to be posted for the given rating trucks.

A bridge rehabilitation would have to accept the existing concrete arches not supporting the full HS20 design load and would also need to accept a possible reduced service life of the structure as the anodes are consumed and the possibility of corrosion of the arch concrete returns.

8 Bridge Rail Alternatives Considered

The bridge rails at both sites are a significant part of the character of the existing bridges. The bridge rail is the portion of the bridge most readily observed by the traveling public and a change of bridge rail is considered an impact to the historic nature of the bridge.

Unfortunately, the rail on both bridges fails to meet current standards for crash worthiness and general safety. Options to replace the bridge rails are presented below.

Existing Bridge Rails

The existing rail for the bridge over the Current River is a continuous concrete curb and rail supported on concrete spindles. The concrete curb was originally 7” above the roadway surface but subsequent overlays have nearly buried the entire curb. The rail height is 36 inches above the curb for most of the bridge length reaching 39 inches tall at the posts at each pier. The front of the rail and the typical condition can be seen in Figure 8-1. The back of the rail and a typical post can be seen in Figure 8-2.

The existing rail on the bridge over the Spring Valley is similar to the rail over the Current River except the curb is not continuous and allows roadway drainage to flow over the side of the deck. The height of the intermittent curb is 9” above the deck. The rail height is 30 inches above the curb with posts at various points along the bridge reaching 33 inches tall. A view of the curb, rail and a post can be seen in Figure 8-3.

Figure 8-1. Existing Current River Bridge Rail – Front Face

Figure 8-2. Existing Current River Bridge Rail – Back Face with Post

Figure 8-3. Existing Spring Valley Bridge Rail – Front Face

Standard MoDOT Type D Barrier Curb

One option for the replacement of the bridge rail is the MoDOT Type D barrier curb. This is a 42 inch tall concrete barrier with a single sloping front face. It is the standard barrier curb used on most new construction in the state at this time. The height of this barrier combined with the solid face will limit the sight of the traveling public. The appearance of this barrier curb is a departure in form compared to the existing rail. A formliner pattern can be applied to the back side of this barrier only. This barrier curb is the least cost option considered for this project at approximately $105 per linear foot if formliner is not used. A typical view of this type of barrier can be seen in Figure 8-4.

Figure 8-4. MoDOT Type D Concrete Barrier Curb

Photo from Google Earth.

Vertical Concrete Barrier and Steel Tube Rail

This bridge rail option consists of a 24 inch tall concrete barrier with an 18 inch tall single steel tube rail bolted to the top. This barrier is in place on the bridge carrying Route 19 over Sinking Creek. The overall height of the barrier / railing is 42 inches, but the open rail allows improved site lines from the bridge. The appearance of this barrier curb is a departure from the existing rail but matches the other bridge in the historic district on this route. A formliner pattern can be applied to the back side of this barrier only and a broken fin type pattern was used on the bridge over Sinking Creek. The average bid for this barrier and rail in January 2017 was $190 per linear foot plus the cost of formliner. This rail was used in the cost estimates shown in Section 9 and a unit cost of $200 per linear foot for the concrete barrier and rail combination was assumed. Views of this type of barrier in place on the bridge over Sinking Creek can be seen in Figure 8-5 and Figure 8-6.

Figure 8-5. Vertical Concrete Barrier and Steel Tube Rail – Front Face

Figure 8-6. Vertical Concrete Barrier and Steel Tube Rail – Back Face

Concrete Corral Rail and Steel Rail

This bridge rail option consists of a 32 inch tall concrete barrier with a solid top rail and recessed lower portion. This rail is based on the Kansas DOT Corral Rail. The concrete barrier can be topped with a decorative or structural steel rail. This barrier is in use on the bridge carrying Route 19 over the Missouri River in Hermann, MO. The height of the concrete barrier would limit site lines from the bridge but not as severely as the standard MoDOT Type D barrier curb. A formliner pattern can be applied to the back side of this barrier and to the front side in the recessed portion only; the solid top rail cannot have formliner. The bids for this barrier and rail in August 2015 varied considerably. The winning bid for the combined barrier and rail was $180 per linear foot not including formliner and is estimated to cost approximately $230 per linear foot in 2019. A view of this type of barrier on the bridge in Hermann, MO can be seen in Figure 8-7.

Figure 8-7. Corral Rail and Steel Rail

Photo from Google Earth.

Open Concrete Curb and Rail with Concrete Posts

This bridge rail option is a 42 inch tall concrete barrier with a solid curb and top rail and includes a 6 inch wide “window” every 18 inches. The barrier height and thickness can be increased at points of interest to create the look of posts. This barrier is in use on the bridge carrying Route 76 over Lake Taneycomo in Branson, MO which was also a historic arch structure. The height of the concrete barrier could limit site lines from the bridge but the windows will allow a similar view as the existing bridge rail. The appearance of this rail is the closest to the existing rail of the options considered during this study. The average bid for this barrier in October 2009 was $185 per linear foot and is estimated to cost approximately $240 per linear foot in 2019. Views of this type of barrier on the bridge in Branson, MO can be seen in Figure 8-8 and Figure 8-9.

Figure 8-8. Open Concrete Curb and Rail with Concrete Posts – Front Face

Photo from Google Earth.

Figure 8-9. Open Concrete Curb and Rail with Concrete Posts – Back Face

Photo from Google Earth.

Historic Replacement Rail Developed by Oregon DOT

Recently, the Oregon DOT replaced some historic rail on a bridge in the Columbia River Highway District using a “stealth” rail. The rail consisted of a structural steel rail connected to the bridge deck surrounded by a precast concrete shell formed to mimic the shape of the existing bridge rail. The rail they utilized met design standards for safety and was designed for a TL-4 loading but was not crash tested. To remove snag hazards in the original bridge rail configuration, various shadow lines were included in the new rail and a continuous curb was included along the bottom to increase safety. ODOT is in the process of having their stealth rail design crash tested at a research facility in Texas. A “stealth” rail configuration similar to the existing bridge rail could be designed for this project. The thin spindles of the existing bridge rails may limit the effectiveness of this approach. The cost of this rail option was not available during preparation of this report but is expected to exceed the other options considered. Views of the stealth rail used by ODOT can be seen in Figure 8-10 and Figure 8-11.

Figure 8-10. Oregon DOT Stealth Rail Installation

Photo from Oregon DOT.

Figure 8-11. Oregon DOT Stealth Rail Complete-In-Place

Photo from Oregon DOT.

9 Alternatives Cost Analysis

Cost estimates were developed for the full suite of alternatives described above at both bridge sites. All cost estimates were developed based on fiscal year 2019 prices. Prices should be adjusted to the fiscal year of expected construction. Some alternatives will require the acquisition of new permanent right-of-way and others will require construction easements. The land surrounding both project sites is part of the Ozark National Scenic Riverways and new right-of-way will involve acquisition of park land. Assessing the value of this land or the value for temporary use and necessary remediation of the land or for an in-kind swap of park land for existing state right-of-way is beyond the scope of this study and no right-of-way costs are included in the cost estimates.

Several of the options considered include removal of the existing pedestrian bridge downstream of the Current River Bridge which will require relocation of the existing utilities.

We have assumed the eight utilities believed to be attached to the pedestrian bridge could be carried under the river in five separate directional bores. The borings will likely vary in size and we have assumed the following borings: 10 inch HDPE Sewer Line; 8 inch HPDE water line; 6 inch HDPE communication line with innerducts; 4 inch HDPE for local NPS power lines; 12 inch HDPE power transmission line with innerducts. As much of this work will be through rock we have determined an average cost of $220 per linear foot for each boring. The existing river crossing is just over 600 feet long so we have assumed each directional bore to be 800 feet resulting in an estimated boring cost of $880,000. An additional $200,000 is estimated to place new utility lines through the bores and connect to the existing services. This information is presented to give a general scope of the expected project cost but is not included in the following cost estimates as it is based on several assumptions. Identification of the utilities and refinement of the estimated relocation cost will require additional work and is beyond the scope of this study.

Roadway costs were estimated based on square footage of the new or temporary roadway to be constructed with consideration given to the amount and type of earthwork that would be needed. The roadway portion of the estimates were also checked for reasonableness in regards to the expected maintenance of traffic for each option considered. Due to the preliminary nature of the roadway estimates during this study phase of the project a contingency factor of 25% was included.

At the Current River crossing, the option to place either a temporary bridge or permanent bridge on an offset alignment downstream of the pedestrian bridge results in the least roadway costs even though the deviation from the existing alignment is greater than the options which remove the pedestrian bridge. The hillside topography on the northeast corner is location of most of the cut quantities. The alignment options closer to the existing alignment tie into the existing alignment further from the existing bridge and locate the revised curve closer to the hillside topography in the northeast corner resulting in additional cut quantities compared to other options. The alignment options downstream of the pedestrian bridge reduce the cut into the hillside by moving the curve away from the hillside and offer more balanced cut and fill.

Bridge costs were estimated by developing a layout for each option considered, estimating various quantities and applying accepted unit costs. From the calculated bridge costs, unit costs per square foot of bridge plan area were developed and checked for reasonableness. Since a more detailed cost estimate was developed for the bridge alternatives, no contingency factor has been included. The bridge costs presented below assume the vertical concrete barrier with steel tube rail will be selected for use on the final structure. The cost estimates should be updated if a different barrier is selected. None of the cost estimates presented below account for a new bridge option using all concrete girders. A bridge constructed of all concrete girders will be the least cost option at both sites, however this option does not address the many other aesthetic and cultural concerns for the corridor expressed during the design charrette and no cost estimate for that option is included.

9.1 Cost Estimate Summary

A summary of the cost estimates for each alternative are presented below. A breakdown of the costs for each alternative including a summary of the details and options considered can be found in Section 9.2. Costs are presented for each site independently so that the best solution for each site can be determined. The selected project at each site could be performed together or separately based on available funding. Some savings may be obtained by combining work at each site into a single project, but that savings is not expected to affect the general magnitude of these cost estimates.

Table 9-1. Current River Bridge Cost Analysis Summary

Alterative Description	Estimated Cost	Cost Ranking
Alt 1A: Option 1,New Concrete Filled Arch Bridge on Alignment, Two-Lane Temporary Bridge, Ped. Bridge Removed	$12,700,000	1
Alt 1A: Option 2,New Concrete Filled Arch Bridge on Alignment, Two-Lane Temporary Bridge, Ped. Bridge Remains	$10,200,000	5
Alt 1B: New Concrete Filled Arch Bridge on Alignment, One-Lane Temporary Bridge Converted to Ped. Bridge	$10,400,000	4 (tie)
Alt 2A: Option 1, New Haunched Steel Plate Girder Bridge on Alignment, Two-Lane Temporary Bridge, Ped. Bridge Removed	$9,100,000	7
Alt 2A: Option 2, New Haunched Steel Plate Girder Bridge on Alignment, Two-Lane Temporary Bridge, Ped. Bridge Remains	$7,700,000	11
Alt 2B: New Haunched Steel Plate Girder Bridge on Alignment, One-Lane Temporary Bridge Converted to Ped. Bridge	$7,900,000	10
Alt 3: Option 1, New Concrete Filled Arch Bridge on Offset Alignment, Ped. Bridge Removed	$10,800,000	3
Alt 3: Option 2, New Concrete Filled Arch Bridge on Offset Alignment, Ped. Bridge Remains	$11,000,000	2
Alt 4: Option 1, New Haunched Steel Plate Girder Bridge on Offset Alignment, Ped. Bridge Removed	$7,200,000	13
Alt 4: Option 2, New Haunched Steel Plate Girder Bridge on Offset Alignment, Ped. Bridge Remains	$7,400,000	12
Alt 5A: Phased Rehabilitation of Existing Bridge with No Temporary Bridge	$8,600,000	8
Alt 5B: Option 1, Single Phase Rehabilitation of Existing Bridge, Two-Lane Temporary Bridge, Ped. Bridge Removed	$10,400,000	4 (tie)
Alt 5B: Option 2, Single Phase Rehabilitation of Existing Bridge, Two-Lane Temporary Bridge, Ped. Bridge Remains	$8,400,000	9
Alt 6: Phased Replacement of Existing Bridge with New Concrete Filled Arch Structure	$9,600,000	6
Alt 7: Phased Replacement of Existing Bridge with New Haunched Steel Plate Girder Structure	$6,600,000	14

Table 9-2. Spring River Bridge Cost Analysis Summary

Alterative Description	Estimated Cost	Cost Ranking
Alt 1A: New Concrete Spandrel Arch Bridge on Alignment, Concrete Girder Approach Spans, Two-Lane Temporary Bridge	$7,300,000	3
Alt 1B: New Concrete Spandrel Arch Bridge on Alignment, Haunched Steel Plate Girder Approach Spans, Two-Lane Temporary Bridge	$7,800,000	1
Alt 2: New Haunched Steel Plate Girder Bridge on Alignment, Two-Lane Temporary Bridge	$6,200,000	7
Alt 3A: New Concrete Spandrel Arch Bridge on Offset Alignment, Concrete Girder Approach Spans	$6,800,000	5
Alt 3B: New Concrete Spandrel Arch Bridge on Offset Alignment, Haunched Steel Plate Girder Approach Spans	$7,400,000	2
Alt 4: New Haunched Steel Plate Girder Bridge on Offset Alignment	$5,700,000	8
Alt 5A: Rehabilitation of Existing Bridge, Concrete Girder Approach Spans, Two-Lane Temporary Bridge	$6,500,000	6
Alt 5B: Rehabilitation of Existing Bridge, Haunched Steel Plate Girder Approach Spans, Two-Lane Temporary Bridge	$7,000,000	4

9.2 Cost Estimate Details for each Alternative

Current River – Alternative 1A, Option 1

Replace existing bridge with a new concrete filled arch structure on existing alignment. Traffic to be carried on a two lane temporary shoofly bridge that includes removal of the existing pedestrian bridge.

Table 9-3. Current River Bridge Cost Analysis – Alternative 1A, Option 1

Item	Unit Cost per Sq. Ft.	Cost
Pedestrian Bridge Removal (Assumed 10' x 605')	$15	$90,000
Temporary Bridge (Assumed 26' x 616')	$132	$2,110,000
Remove Existing Bridge (21' x 602')	$25	$310,000
New Concrete Filled Arch Bridge (Assumed 41' x 612')	$317	$7,950,000
Roadway Work	--	$980,000
Mobilization (Assumed 11% of project)	11%	$1,260,000
Total Cost	--	**$12,700,000**

Current River – Alternative 1A, Option 2

Replace existing bridge with a new concrete filled arch structure on existing alignment. Traffic to be carried on a two lane temporary shoofly bridge downstream of the existing pedestrian bridge and does not remove the existing pedestrian bridge.

Table 9-4. Current River Bridge Cost Analysis – Alternative 1A, Option 2

Item	Unit Cost per Sq. Ft.	Cost
Temporary Bridge (Assumed 26’ x 616’)	$132	$2,110,000
Remove Existing Bridge (21’ x 602’)	$25	$310,000
New Concrete Filled Arch Bridge (Assumed 30’ x 612’)	$317	$5,820,000
Roadway Work	--	$900,000
Mobilization (Assumed 11% of project)	11%	$1,010,000
Total Cost	--	**$10,150,000**

Current River – Alternative 1B

Replace existing bridge with a new concrete filled arch structure on existing alignment that matches the current span arrangement. Traffic to be carried on a single lane temporary shoofly bridge that becomes the permanent pedestrian bridge after construction. Temporary traffic bridge estimated as a haunched steel plate girder bridge with aesthetic considerations since it will become permanent.

Table 9-5. Current River Bridge Cost Analysis – Alternative 1B

Item	Unit Cost per Sq. Ft.	Cost
Pedestrian Bridge Removal (Assumed 10’ x 605’)	$15	$90,000
Temporary Bridge (Assumed 14’ x 616’)	$258	$2,220,000
Remove Existing Bridge (21’ x 602’)	$25	$310,000
New Concrete Filled Arch Bridge (Assumed 30’ x 612’)	$317	$5,820,000
Roadway Work	--	$900,000
Mobilization (Assumed 11% of project)	11%	$1,030,000
Total Cost	--	**$10,370,000**

Current River – Alternative 2A, Option 1

Replace existing bridge with a new haunched steel girder structure on existing alignment that matches the current span arrangement. Traffic to be carried on a two lane temporary shoofly bridge that includes removal of the existing pedestrian bridge.

Table 9-6. Current River Bridge Cost Analysis – Alternative 2A, Option 1

Item	Unit Cost per Sq. Ft.	Cost
Pedestrian Bridge Removal (Assumed 10’ x 605’)	$15	$90,000
Temporary Bridge (Assumed 26’ x 616’)	$132	$2,110,000
Remove Existing Bridge (21’ x 602’)	$25	$310,000
New Steel Girder Bridge (Assumed 41’ x 612’)	$188	$4,720,000
Roadway Work	--	$980,000
Mobilization (Assumed 11% of project)	11%	$900,000
Total Cost	--	**$9,110,000**

Current River – Alternative 2A, Option 2

Replace existing bridge with a new haunched steel girder structure on existing alignment that matches the current span arrangement. Traffic to be carried on a two lane temporary shoofly bridge downstream of the existing pedestrian bridge and does not remove the existing pedestrian bridge.

Table 9-7. Current River Bridge Cost Analysis – Alternative 2A, Option 2

Item	Unit Cost per Sq. Ft.	Cost
Temporary Bridge (Assumed 26’ x 616’)	$132	$2,110,000
Remove Existing Bridge (21’ x 602’)	$25	$310,000
New Steel Girder Bridge (Assumed 30’ x 612’)	$193	$3,540,000
Roadway Work	--	$900,000
Mobilization (Assumed 11% of project)	11%	$760,000
Total Cost	--	**$7,620,000**

Current River – Alternative 2B

Replace existing bridge with a new haunched steel girder structure on existing alignment that matches the current span arrangement. Traffic to be carried on a single lane temporary shoofly bridge that becomes the permanent pedestrian bridge after construction. Temporary traffic bridge estimated as a haunched steel plate girder bridge with aesthetic considerations since it will become permanent.

Table 9-8. Current River Bridge Cost Analysis – Alternative 2B

Item	Unit Cost per Sq. Ft.	Cost
Pedestrian Bridge Removal (Assumed 10' x 605')	$15	$90,000
Temporary Bridge (Assumed 14' x 616')	$258	$2,220,000
Remove Existing Bridge (21' x 602')	$25	$310,000
New Steel Girder Bridge (Assumed 30' x 612')	$193	$3,540,000
Roadway Work	--	$900,000
Mobilization (Assumed 11% of project)	11%	$780,000
Total Cost	--	**$7,840,000**

Current River – Alternative 3, Option 1

Replace existing bridge with a new concrete filled arch structure on an offset alignment that matches current span arrangement and includes removal of the existing pedestrian bridge. Traffic to be maintained on the existing bridge during construction.

Table 9-9. Current River Bridge Cost Analysis – Alternative 3, Option 1

Item	Unit Cost per Sq. Ft.	Cost
Pedestrian Bridge Removal (Assumed 10' x 605')	$15	$90,000
New Concrete Filled Arch Bridge (Assumed 41' x 612')	$317	$7,950,000
Remove Existing Bridge (21' x 602')	$25	$310,000
Roadway Work	--	$1,350,000
Mobilization (Assumed 11% of project)	11%	$1,070,000
Total Cost	--	**$10,770,000**

Current River – Alternative 3, Option 2

Replace existing bridge with a new concrete filled arch structure on an offset alignment downstream of the existing pedestrian bridge that matches current span arrangement. Traffic to be maintained on the existing bridge during construction and the existing pedestrian bridge to remain in place.

Table 9-10. Current River Bridge Cost Analysis – Alternative 3, Option 2

Item	Unit Cost per Sq. Ft.	Cost
New Concrete Filled Arch Bridge (Assumed 41' x 612')	$317	$7,950,000
Remove Existing Bridge (21' x 602')	$25	$310,000
Roadway Work	--	$1,630,000
Mobilization (Assumed 11% of project)	11%	$1,090,000
Total Cost	--	**$10,980,000**

Current River – Alternative 4, Option 1

Replace existing bridge with a new haunched steel girder structure on an offset alignment that matches current span arrangement and includes removal of the existing pedestrian bridge. Traffic to be maintained on the existing bridge during construction.

Table 9-11. Current River Bridge Cost Analysis – Alternative 4, Option 1

Item	Unit Cost per Sq. Ft.	Cost
Pedestrian Bridge Removal (Assumed 10' x 605')	$15	$90,000
New Steel Girder Bridge (Assumed 41' x 612')	$188	$4,720,000
Remove Existing Bridge (21' x 602')	$25	$310,000
Roadway Work	--	$1,350,000
Mobilization (Assumed 11% of project)	11%	$710,000
Total Cost	--	**$7,180,000**

Current River – Alternative 4, Option 2

Replace existing bridge with a new haunched steel girder structure on an offset alignment downstream of the existing pedestrian bridge that matches current span arrangement. Traffic to be maintained on the existing bridge during construction and the existing pedestrian bridge to remain in place.

Table 9-12. Current River Bridge Cost Analysis – Alternative 4, Option 2

Item	Unit Cost per Sq. Ft.	Cost
New Steel Girder Bridge (Assumed 41' x 612')	$188	$4,720,000
Remove Existing Bridge (21' x 602')	$25	$310,000
Roadway Work	--	$1,630,000
Mobilization (Assumed 11% of project)	11%	$730,000
Total Cost	--	**$7,390,000**

Current River – Alternative 5A

Perform a phased rehabilitation and widening of the existing bridge. Phased bridge rehabilitation is assumed to include a 20% cost premium. Final alignment to match the existing alignment. Single lane of traffic to be maintained on the existing or widened structure. A mixed use path is included in the widened bridge, but existing pedestrian bridge to remain in place.

Table 9-13. Current River Bridge Cost Analysis – Alternative 5A

Item	Unit Cost per Sq. Ft.	Cost
Rehabilitate and Widen Concrete Filled Arch Bridge (Assumed 41' x 602')	$302	$7,440,000
Roadway Work	--	$230,000
Mobilization (Assumed 11% of project)	11%	$850,000
Total Cost	--	**$8,520,000**

Current River – Alternative 5B, Option 1

Perform a non-phased rehabilitation and widening of the existing bridge. Final alignment to match the existing alignment. Traffic to be carried on a two lane temporary shoofly bridge that includes removal of the existing pedestrian bridge.

Table 9-14. Current River Bridge Cost Analysis – Alternative 5B, Option 1

Item	Unit Cost per Sq. Ft.	Cost
Pedestrian Bridge Removal (Assumed 10' x 605')	$15	$90,000
Temporary Bridge (Assumed 26' x 616')	$132	$2,110,000
Rehabilitate and Widen Concrete Filled Arch Bridge (Assumed 41' x 602')	$252	$6,200,000
Roadway Work	--	$980,000
Mobilization (Assumed 11% of project)	11%	$1,030,000
Total Cost	--	**$10,410,000**

Current River – Alternative 5B, Option 2

Perform a non-phased rehabilitation and widening of the existing bridge. Final alignment to match the existing alignment. Traffic to be carried on a two lane temporary shoofly bridge downstream of the existing pedestrian bridge and does not remove the existing pedestrian bridge.

Table 9-15. Current River Bridge Cost Analysis – Alternative 5B, Option 2

Item	Unit Cost per Sq. Ft.	Cost
Temporary Bridge (Assumed 26' x 616')	$132	$2,110,000
Rehabilitate and Widen Concrete Filled Arch Bridge (Assumed 30' x 602')	$252	$4,550,000
Roadway Work	--	$900,000
Mobilization (Assumed 11% of project)	11%	$830,000
Total Cost	--	**$8,390,000**

Current River – Alternative 6

Perform a phased replacement of the existing bridge with a new concrete filled arch structure that matches the existing span arrangement. Phased bridge rehabilitation assumed to include a 20% cost premium. Final alignment to be moderately offset of the existing alignment. Single lane of traffic to be maintained on the existing or new structure.

Table 9-16. Current River Bridge Cost Analysis – Alternative 6

Item	Unit Cost per Sq. Ft.	Cost
New Concrete Filled Arch Bridge (Assumed 30' x 612')	$380	$6,980,000
Remove Existing Bridge (21' x 602')	$25	$310,000
MSE Walls (Assumed 8'x100' and 8'x75')	$55	$80,000
Roadway Work	--	$1,220,000
Mobilization (Assumed 11% of project)	11%	$950,000
Total Cost	--	**$9,540,000**

Current River – Alternative 7

Perform a phased replacement the existing bridge with a new steel girder structure that matches the existing span arrangement. Phased bridge rehabilitation assumed to include a 20% cost premium. Final alignment to be moderately offset of the existing alignment. Single lane of traffic to be maintained on the existing or new structure.

Table 9-17. Current River Bridge Cost Analysis – Alternative 7

Item	Unit Cost per Sq. Ft.	Cost
New Steel Girder Bridge (Assumed 30' x 612')	$232	$4,260,000
Remove Existing Bridge (21' x 602')	$25	$310,000
MSE Walls (Assumed 8'x100' and 8'x75')	$55	$80,000
Roadway Work	--	$1,220,000
Mobilization (Assumed 11% of project)	11%	$650,000
Total Cost	--	**$6,520,000**

Spring Valley – Alternative 1A

Replace existing bridge with a new concrete spandrel arch structure with concrete girder approach spans on existing alignment. Traffic to be carried on a temporary shoofly bridge composed of temporary spans owned by MoDOT.

Table 9-18. Spring Valley Bridge Cost Analysis – Alternative 1A

Item	Unit Cost per Sq. Ft.	Cost
Temporary Bridge (Assumed 26' x 550')	$102	$1,460,000
Remove Existing Bridge (23' x 523')	$20	$240,000
New Concrete Spandrel Arch Bridge (Assumed 28' x 545')	$263	$4,010,000
Roadway Work	--	$800,000
Mobilization (Assumed 11% of project)	11%	$720,000
Total Cost	--	**$7,230,000**

Spring Valley – Alternative 1B

Replace existing bridge with a new concrete spandrel arch structure with haunched steel girder approach spans on existing alignment. Traffic to be carried on a temporary shoofly bridge composed of temporary spans owned by MoDOT.

Table 9-19. Spring Valley Bridge Cost Analysis – Alternative 1B

Item	Unit Cost per Sq. Ft.	Cost
Temporary Bridge (Assumed 26' x 550')	$102	$1,460,000
Remove Existing Bridge (23' x 523')	$20	$240,000
New Concrete Spandrel Arch Bridge (Assumed 28' x 545')	$294	$4,490,000
Roadway Work	--	$800,000
Mobilization (Assumed 11% of project)	11%	$770,000
Total Cost	--	**$7,760,000**

Spring Valley – Alternative 2

Replace existing bridge with a new haunched steel girder structure on existing alignment. Traffic to be carried on a temporary shoofly bridge composed of temporary spans owned by MoDOT.

Table 9-20. Spring Valley Bridge Cost Analysis – Alternative 2

Item	Unit Cost per Sq. Ft.	Cost
Temporary Bridge (Assumed 26' x 550')	$102	$1,460,000
Remove Existing Bridge (23' x 523')	$20	$240,000
New Steel Girder Bridge (Assumed 28' x 545')	$199	$3,040,000
Roadway Work	--	$800,000
Mobilization (Assumed 11% of project)	11%	$610,000
Total Cost	--	**$6,150,000**

Spring Valley – Alternative 3A

Replace existing bridge with a new concrete spandrel arch structure with concrete girder approach spans on an offset alignment. Traffic to be maintained on the existing bridge during construction.

Table 9-21. Spring Valley Bridge Cost Analysis – Alternative 3A

Item	Unit Cost per Sq. Ft.	Cost
New Concrete Spandrel Arch Bridge (Assumed 28' x 545')	$263	$4,010,000
Remove Existing Bridge (23' x 523')	$20	$240,000
Roadway Work	--	$1,890,000
Mobilization (Assumed 11% of project)	11%	$680,000
Total Cost	--	**$6,820,000**

Spring Valley – Alternative 3B

Replace existing bridge with a new concrete spandrel arch structure with haunched steel girder approach spans on an offset alignment. Traffic to be maintained on the existing bridge during construction.

Table 9-22. Spring Valley Bridge Cost Analysis – Alternative 3B

Item	Unit Cost per Sq. Ft.	Cost
New Concrete Spandrel Arch Bridge (Assumed 28’ x 545’)	$294	$4,490,000
Remove Existing Bridge (23’ x 523’)	$20	$240,000
Roadway Work	--	$1,890,000
Mobilization (Assumed 11% of project)	11%	$730,000
Total Cost	--	**$7,350,000**

Spring Valley – Alternative 4

Replace existing bridge with a new haunched steel girder structure on an offset alignment. Traffic to be maintained on the existing bridge during construction.

Table 9-23. Spring Valley Bridge Cost Analysis – Alternative 4

Item	Unit Cost per Sq. Ft.	Cost
New Steel Girder Bridge (Assumed 28’ x 545’)	$199	$3,040,000
Remove Existing Bridge (23’ x 523’)	$20	$240,000
Roadway Work	--	$1,890,000
Mobilization (Assumed 11% of project)	11%	$570,000
Total Cost	--	**$5,740,000**

Spring Valley – Alternative 5A

Rehabilitate and widen the existing spandrel arch span; replace the approach spans with new concrete girder spans. Final alignment to match the existing alignment. Traffic to be carried on a temporary shoofly bridge composed of temporary spans owned by MoDOT.

Table 9-24. Spring Valley Bridge Cost Analysis – Alternative 5A

Item	Unit Cost per Sq. Ft.	Cost
Temporary Bridge (Assumed 26' x 550')	$102	$1,460,000
Rehabilitate Concrete Spandrel Arch Bridge (Assumed 28' x 540')	$238	$3,600,000
Roadway Work	--	$800,000
Mobilization (Assumed 11% of project)	11%	$650,000
Total Cost	--	**$6,510,000**

Spring Valley – Alternative 5B

Rehabilitate and widen the existing spandrel arch span; replace the approach spans with new haunched steel girder spans. Final alignment to match the existing alignment. Traffic to be carried on a temporary shoofly bridge composed of temporary spans owned by MoDOT.

Table 9-25. Spring Valley Bridge Cost Analysis – Alternative 5B

Item	Unit Cost per Sq. Ft.	Cost
Temporary Bridge (Assumed 26' x 550')	$102	$1,460,000
Rehabilitate Concrete Spandrel Arch Bridge (Assumed 28' x 540')	$265	$4,010,000
Roadway Work	--	$800,000
Mobilization (Assumed 11% of project)	11%	$690,000
Total Cost	--	**$6,960,000**

10 Studied Alternatives Performance Summary

The following tables list the advantages and disadvantages identified for the various alternatives and options studied for this report. The estimated cost of the alternatives studied is included and cost estimates were ranked from most expensive to least expensive. 15 alternatives were studied to cross the Current River and the costs are ranked from 1 (highest) to 14 (lowest) with a tie in 4th place. The alternatives ranked 11 through 14 vary by approximately $1,000,000 and are considered to have an advantage over the remaining alternatives. Eight alternatives were studied to cross Spring Valley and the costs are ranked from 1 (highest) to 8 (lowest). The variance is about $2,000,000 the alternatives ranked 5 to 8 are considered to have an advantage over the others. The selected bridge rail could be used on any of the alternatives and is not included in the performance tables.

Table 10-1. Current River – Alternative 1A, Option 1 Performance

New Concrete Filled Arch Bridge on Alignment, Two-Lane Temporary Bridge, Existing Pedestrian Bridge Removed.

Advantages	Disadvantages
Matches form of existing bridge.	Cost rank of alternatives studied = 1.
Less permanent roadway work.	Builds two bridges in the channel.
Replaces the original two-lane bridge during construction.	Extensive formwork in the channel.
Final configuration is a single bridge over the channel.	The cost of the temp. bridge is wasted.
	Ped. bridge must be removed prior to construction.
	New bridge has limited inspection access similar to existing.

Table 10-2. Current River – Alternative 1A, Option 2 Performance

New Concrete Filled Arch Bridge on Alignment, Two-Lane Temporary Bridge, Existing Pedestrian Bridge Remains.

Advantages	Disadvantages
Matches form of existing bridge.	Cost rank of alternatives studied = 5.
Less permanent roadway work.	Builds two bridges in the channel.
Replaces the original two-lane bridge during construction.	Extensive formwork in the channel.
Final configuration is a single bridge over the channel.	The cost of the temp. bridge is wasted.
Ped. bridge may remain in place during construction.	Pedestrian use of existing ped. bridge is practically limited during construction.
Utilities may remain in place during construction.	New bridge has limited inspection access similar to existing.

Table 10-3. Current River – Alternative 1B Performance

New Concrete Filled Arch Bridge on Alignment, One-Lane Temporary Bridge Converted to Pedestrian Bridge, Existing Pedestrian Bridge Removed.

Advantages	Disadvantages
Matches form of existing bridge.	Cost rank of alternatives studied = 4.
Less permanent roadway work.	Builds two bridges in the channel.
Cost of temp. bridge is not wasted.	Extensive formwork in the channel.
	Keeps single lane bridge throughout construction.
	Ped. bridge must be removed prior to construction.
	Final configuration is two bridges over the channel.
	New bridge has limited inspection access similar to existing.

Table 10-4. Current River – Alternative 2A, Option 1 Performance

New Haunched Steel Plate Girder Bridge on Alignment, Two-Lane Temporary Bridge, Existing Pedestrian Bridge Removed.

Advantages	Disadvantages
New bridge matches look of Sinking Creek.	New bridge looks different than existing.
Less permanent roadway work.	Cost rank of alternatives studied = 7.
Uses a two-lane bridge during construction.	Builds two bridges in the channel.
Final configuration is a single bridge over the channel.	The cost of the temp. bridge is wasted
Less formwork in the channel.	Ped. bridge must be removed prior to construction.
New bridge has more inspection access similar to existing.	

Table 10-5. Current River – Alternative 2A, Option 2 Performance

New Haunched Steel Plate Girder Bridge on Alignment, Two-Lane Temporary Bridge, Existing Pedestrian Bridge Remains.

Advantages	Disadvantages
New bridge matches look of Sinking Creek.	New bridge looks different than existing.
Cost rank of alternatives studied = 11.	Builds two bridges in the channel.
Less permanent roadway work.	The cost of the temp. bridge is wasted
Uses a two-lane bridge during construction.	Pedestrian use of existing ped. bridge is practically limited during construction.
Final configuration is a single bridge over the channel.	
Less formwork in the channel.	
Ped. bridge may remain in place during construction.	
Utilities may remain in place during construction.	
New bridge has more inspection access similar to existing.	

Table 10-6. Current River – Alternative 2B Performance

New Haunched Steel Plate Girder Bridge on Alignment, One-Lane Temporary Bridge, Existing Pedestrian Bridge Removed.

Advantages	Disadvantages
New bridge matches look of Sinking Creek.	New bridge looks different than existing.
Less permanent roadway work.	Cost rank of alternatives studied = 10.
Cost of temp. bridge is not wasted.	Keeps single lane bridge throughout construction.
Less formwork in the channel.	Ped. bridge must be removed prior to construction.
New bridge has more inspection access similar to existing.	Final configuration is two bridges over the channel.

Table 10-7. Current River – Alternative 3, Option 1 Performance

New Concrete Filled Arch Bridge on Offset Alignment, Existing Pedestrian Bridge Removed.

Advantages	Disadvantages
Matches form of existing bridge.	Cost rank of alternatives studied = 3.
Builds one bridge in the channel	Ped. bridge must be removed prior to construction.
No temp. bridge is built, avoiding wasted money.	Extensive formwork in the channel.
	More permanent roadway work.
	Keeps single lane of traffic on exist. bridge during construction.
	New bridge has limited inspection access similar to existing.

Table 10-8. Current River – Alternative 3, Option 2 Performance

New Concrete Filled Arch Bridge on Offset Alignment, Existing Pedestrian Bridge Remains.

Advantages	Disadvantages
Matches form of existing bridge.	Cost rank of alternatives studied = 2.
Builds one bridge in the channel	Extensive formwork in the channel.
No temp. bridge is built, avoiding wasted money.	More permanent roadway work.
Ped. bridge may remain in place during construction.	Keeps single lane of traffic on exist. bridge during construction.
Utilities may remain in place during construction.	New bridge has limited inspection access similar to existing.
	Pedestrian use of existing ped. bridge is practically limited during construction.

Table 10-9. Current River – Alternative 4, Option 1 Performance

New Haunched Steel Plate Girder Bridge on Offset Alignment, Existing Pedestrian Bridge Removed.

Advantages	Disadvantages
New bridge matches look of Sinking Creek.	New bridge looks different than existing.
Cost rank of alternatives studied = 13.	Ped. bridge must be removed prior to construction.
No temp. bridge is built, avoiding wasted money.	More permanent roadway work.
Builds one bridge in the channel	Keeps single lane of traffic on exist. bridge during construction.
Less formwork in the channel.	
New bridge has more inspection access similar to existing.	

Table 10-10. Current River – Alternative 4, Option 2 Performance

New Haunched Steel Plate Girder Bridge on Offset Alignment, Existing Pedestrian Bridge Remains.

Advantages	Disadvantages
New bridge matches look of Sinking Creek.	New bridge looks different than existing.
Cost rank of alternatives studied = 12.	More permanent roadway work.
No temp. bridge is built, avoiding wasted money.	Keeps single lane of traffic on exist. bridge during construction.
Builds one bridge in the channel.	Pedestrian use of existing ped. bridge is practically limited during construction.
Less formwork in the channel.	
Ped. bridge may remain in place during construction.	
Utilities may remain in place during construction.	
New bridge has more inspection access similar to existing.	

Table 10-11. Current River – Alternative 5A Performance

Phased Rehabilitation of Existing Bridge with No Temporary Bridge, Existing Pedestrian Bridge Remains.

Advantages	Disadvantages
Matches form of existing bridge.	Cost rank of alternatives studied = 8.
No temp. bridge is built, avoiding wasted money.	Extensive formwork in the channel.
Single bridge in channel in final configuration.	Keeps single lane of traffic on exist. bridge during construction.
Ped. bridge may remain in place during construction.	Builds on both sides of exist. bridge.
Utilities may remain in place during construction.	Two year construction project.
Less permanent roadway work.	Remediated concrete of existing bridge is buried in the structure, possibly requiring further rehabilitation in the future.
	Final bridge has limited inspection access similar to existing.
	Remediated concrete will require embedded galvanic anodes that have a life expectancy of approximately 30 years.

Table 10-12. Current River – Alternative 5B, Option 1 Performance

Single Phase Rehabilitation of Existing Bridge, Two-Lane Temporary Bridge, Existing Pedestrian Bridge Removed.

Advantages	Disadvantages
Matches form of existing bridge.	Cost rank of alternatives studied = 4.
Uses a two-lane bridge during construction.	Extensive formwork in the channel.
Single bridge in channel in final configuration.	The cost of the temp. bridge is wasted.
Less permanent roadway work.	Builds two bridges in the channel.
Ped. bridge may remain in place during construction.	Builds on both sides of exist. bridge.
Utilities may remain in place during construction.	Remediated concrete of existing bridge is buried in the structure, possibly requiring further rehabilitation in the future.
	Final bridge has limited inspection access similar to existing.
	Remediated concrete will require embedded galvanic anodes that have a life expectancy of approximately 30 years.

Table 10-13. Current River – Alternative 5B, Option 2 Performance

Single Phase Rehabilitation of Existing Bridge, Two-Lane Temporary Bridge, Existing Pedestrian Bridge Remains.

Advantages	Disadvantages
Matches form of existing bridge.	Cost rank of alternatives studied = 9.
Uses a two-lane bridge during construction.	Extensive formwork in the channel.
Single bridge in channel in final configuration.	The cost of the temp. bridge is wasted.
Less permanent roadway work.	Builds two bridges in the channel.
	Builds on both sides of exist. bridge.
	Remediated concrete of existing bridge is buried in the structure, possibly requiring further rehabilitation in the future.
	Final bridge has limited inspection access similar to existing.
	Remediated concrete will require embedded galvanic anodes that have a life expectancy of approximately 30 years.
	Pedestrian use of existing ped. bridge is practically limited during construction.

Table 10-14. Current River – Alternative 6 Performance

Phased Replacement of Existing Bridge with New Concrete Filled Arch Structure, Existing Pedestrian Bridge May Remain.

Advantages	Disadvantages
Matches form of existing bridge.	Cost rank of alternatives studied = 6.
No temp. bridge is built, avoiding wasted money.	Extensive formwork in the channel.
Single bridge in channel in final configuration.	Keeps single lane of traffic on exist. bridge or new bridge during construction.
Moderate amount of permanent roadway work.	Two year construction project.
Ped. bridge may remain in place during construction.	Final bridge has limited inspection access similar to existing.
Utilities may remain in place during construction.	

Table 10-15. Current River – Alternative 7 Performance

Phased Replacement of Existing Bridge with New Haunched Steel Plate Girder Structure, Existing Pedestrian Bridge May Remain.

Advantages	Disadvantages
New bridge matches look of Sinking Creek.	New bridge looks different than existing.
Cost rank of alternatives studied = 14.	Keeps single lane of traffic on exist. bridge or new bridge during construction.
No temp. bridge is built, avoiding wasted money.	Two year construction project.
Single bridge in channel in final configuration.	
Moderate amount of permanent roadway work.	
Less formwork in the channel.	
Ped. bridge may remain in place during construction.	
Utilities may remain in place during construction.	

Table 10-16. Spring Valley – Alternative 1A Performance

New Concrete Spandrel Arch Bridge on Alignment, Two-Lane Temporary Bridge, Concrete Girder Approach Spans.

Advantages	Disadvantages
New bridge maintains open spandrel arch.	Cost rank of alternatives studied = 3.
Less permanent roadway work. Avoids retaining walls or reinforced slopes.	Builds two bridges in the channel.
Concrete approach spans match existing approach span material.	Extensive formwork in the channel.
	The cost of the temp. bridge is wasted.
	Concrete approach spans do not have similar shape as the existing.

Table 10-17. Spring Valley – Alternative 1B Performance

New Concrete Spandrel Arch Bridge on Alignment, Two-Lane Temporary Bridge, Haunched Steel Plate Girder Approach Spans.

Advantages	Disadvantages
New bridge maintains open spandrel arch.	Cost rank of alternatives studied = 1.
Less permanent roadway work. Avoids retaining walls or reinforced slopes.	Builds two bridges in the channel.
Steel girder approach spans mimic the curved shape of the existing spans.	Extensive formwork in the channel.
	The cost of the temp. bridge is wasted.
	Steel girder approach spans are a different material and will have a different appearance than the existing approach spans.

Table 10-18. Spring Valley – Alternative 2 Performance

New Haunched Steel Plate Girder Bridge on Alignment, Two-Lane Temporary Bridge.

Advantages	Disadvantages
New bridge matches look of Sinking Creek.	New bridge looks different than existing.
Cost rank of alternatives studied = 7.	Builds two bridges in the channel.
Less permanent roadway work. Avoids retaining walls or reinforced slopes.	The cost of the temp. bridge is wasted.
Steel girder spans mimic the curved shape of the existing spans.	

Table 10-19. Spring Valley – Alternative 3A Performance

New Concrete Spandrel Arch Bridge on Offset Alignment, Concrete Girder Approach Spans.

Advantages	Disadvantages
New bridge maintains open spandrel arch.	More permanent roadway work.
Cost rank of alternatives studied = 5.	May need retaining walls or reinforced slope.
Builds one bridge in the channel.	Extensive formwork in the channel.
No temp. bridge is built, avoiding wasted money.	Concrete approach spans do not have similar shape as the existing.
Concrete approach spans match existing approach span material.	

Table 10-20. Spring Valley – Alternative 3B Performance

New Concrete Spandrel Arch Bridge on Offset Alignment, Haunched Steel Plate Girder Approach Spans.

Advantages	Disadvantages
New bridge maintains open spandrel arch.	Cost rank of alternatives studied = 2.
Builds one bridge in the channel.	More permanent roadway work.
No temp. bridge is built, avoiding wasted money.	May need retaining walls or reinforced slope.
Steel girder approach spans mimic the curved shape of the existing spans.	Extensive formwork in the channel.
	Steel girder approach spans are a different material and will have a different appearance than the existing approach spans.

Table 10-21. Spring Valley – Alternative 4 Performance

New Haunched Steel Plate Girder Bridge on Offset Alignment.

Advantages	Disadvantages
New bridge matches look of Sinking Creek.	New bridge looks different than existing.
Cost rank of alternatives studied = 8.	More permanent roadway work.
Builds one bridge in the channel.	May need retaining walls or reinforced slope.
No temp. bridge is built, avoiding wasted money.	Extensive formwork in the channel.
Steel girder spans mimic the curved shape of the existing spans.	

Table 10-22. Spring Valley – Alternative 5A Performance

Rehabilitate Concrete Spandrel Arch Bridge on Alignment, Two-Lane Temporary Bridge, Concrete Girder Approach Spans.

Advantages	Disadvantages
Rehabilitated bridge maintains existing open spandrel arch.	Builds two bridges in the channel.
Cost rank of alternatives studied = 6.	The cost of the temp. bridge is wasted.
Less permanent roadway work. Avoids retaining walls or reinforced slopes.	Concrete approach spans do not have similar shape as the existing.
Concrete approach spans match existing approach span material.	Keeps remediated concrete of existing bridge, possibly requiring further rehabilitation in the future.
Avoids extensive formwork in the channel.	Remediated concrete will require embedded galvanic anodes that have a life expectancy of approximately 30 years.
	Cannot carry design loading, but will not require posting.

Table 10-23. Spring Valley – Alternative 5B Performance

Rehabilitate Concrete Spandrel Arch Bridge on Alignment, Two-Lane Temporary Bridge, Haunched Steel Plate Girder Approach Spans.

Advantages	Disadvantages
Rehabilitated bridge maintains existing open spandrel arch.	Cost rank of alternatives studied = 4.
Less permanent roadway work. Avoids retaining walls or reinforced slopes.	Builds two bridges in the channel.
Steel girder approach spans mimic the curved shape of the existing spans.	The cost of the temp. bridge is wasted.
Avoids extensive formwork in the channel.	Steel girder approach spans are a different material and will have a different appearance than the existing approach spans.
	Keeps remediated concrete of existing bridge, possibly requiring further rehabilitation in the future.
	Remediated concrete will require embedded galvanic anodes that have a life expectancy of approximately 30 years.
	Cannot carry design loading, but will not require posting.

Appendix A. Supporting Figures

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Curve 1 Data	
PI	100+14.86
PC	100+00.00
PT	100+29.71
Δ	4°15'21.35" (LT)
D	14°19'26.20"
L	29.71'
T	14.86'
R	400.00'

Curve 2 Data	
PI	102+26.82
PC	100+69.71
PT	103+69.11
Δ	42°53'09.21" (RT)
D	14°19'26.20"
L	299.40'
T	157.10'
R	400.00'

Curve 3 Data	
PI	112+20.85
PC	110+81.81
PT	113+46.51
Δ	43°19'55.13" (LT)
D	16°22'12.80"
L	264.70'
T	139.04'
R	350.00'

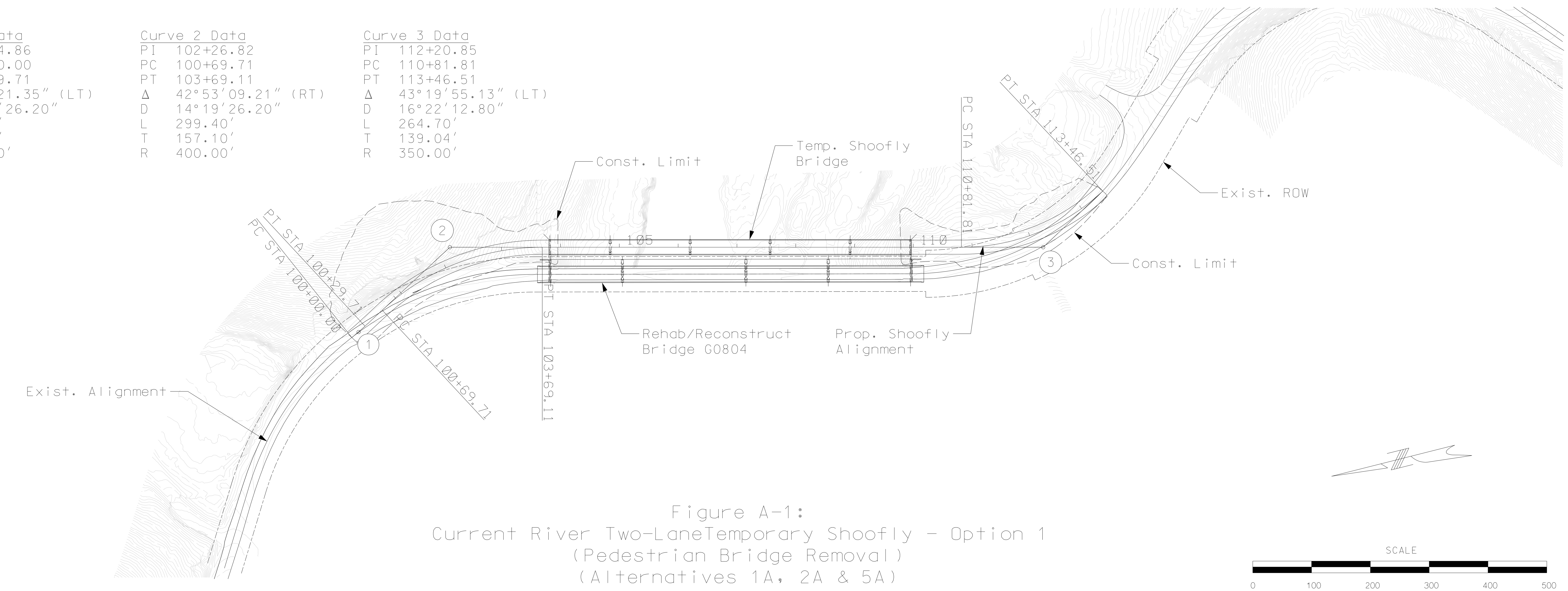
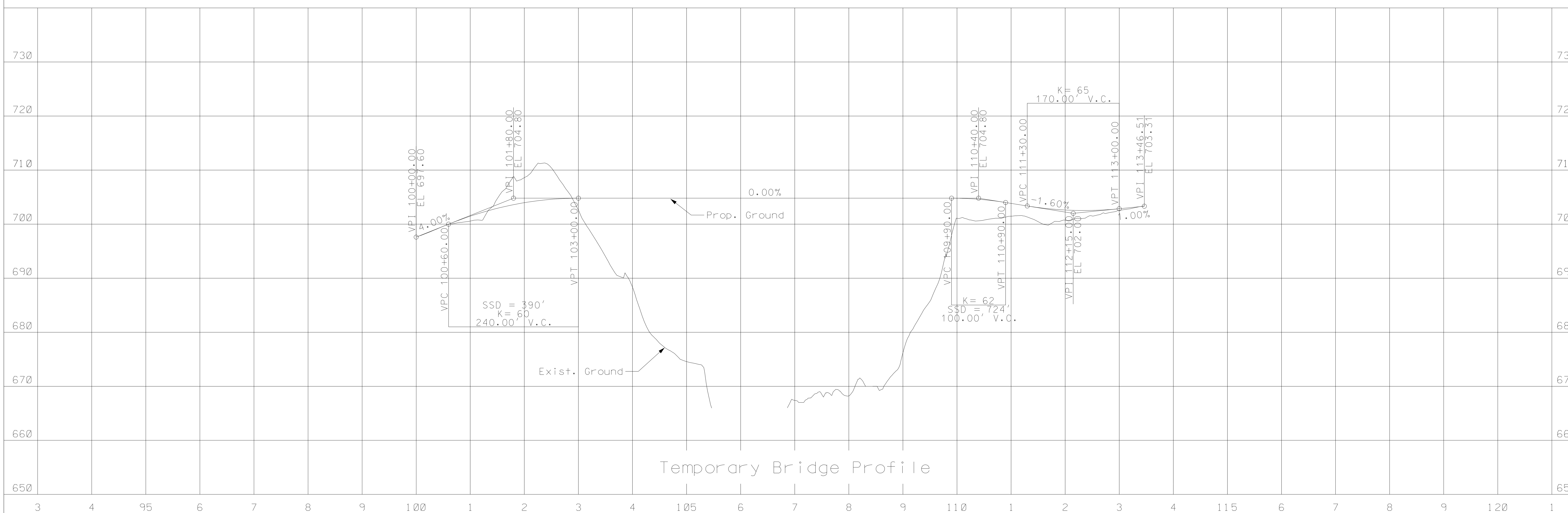


Figure A-1:
Current River Two-LaneTemporary Shoofly - Option 1
(Pedestrian Bridge Removal)
(Alternatives 1A, 2A & 5A)



NOT FOR CONSTRUCTION

DATE PREPARED	
10/21/2019	
ROUTE 19	STATE MO
DISTRICT SE	SHEET NO. A.1
COUNTY SHANNON	
JOB NO. J9P3305	
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO. CURRENT RIVER	

DESCRIPTION

DATE

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

MoDOT

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

HDR

HDR Engineering, Inc.
10450 Holmes Rd
Suite 600
Kansas City, MO 64131
816-360-2700
Certificate of Authority: 000856

Curve 1 Data	
PI	300+44.30
PC	300+00.00
PT	300+87.20
Δ	24°58'51.46" (LT)
D	28°38'52.40"
L	87.20'
T	44.30'
R	200.00'

Curve 2 Data	
PI	301+75.92
PC	300+87.20
PT	302+54.20
Δ	47°50'31.11" (RT)
D	28°38'52.40"
L	167.00'
T	88.72'
R	200.00'

Curve 3 Data	
PI	311+34.14
PC	309+68.14
PT	312+78.14
Δ	50°44'51.69" (LT)
D	16°22'12.80"
L	310.00'
T	166.00'
R	350.00'

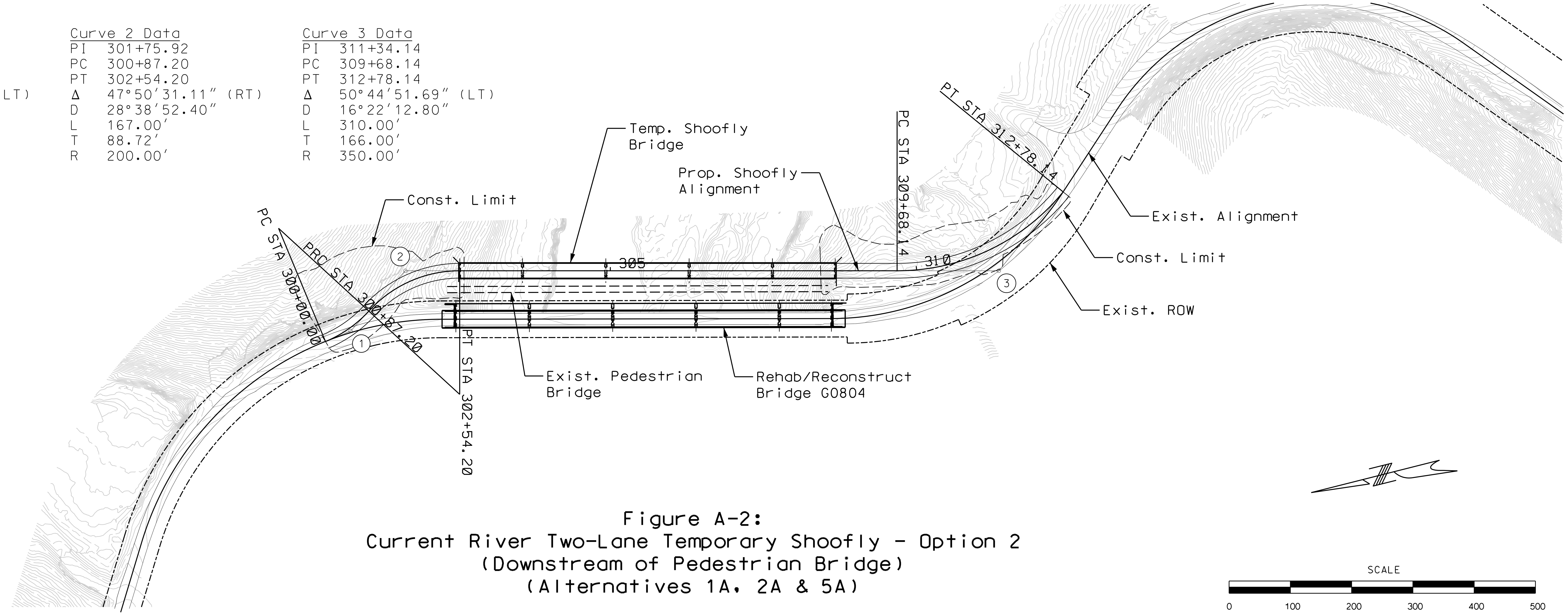
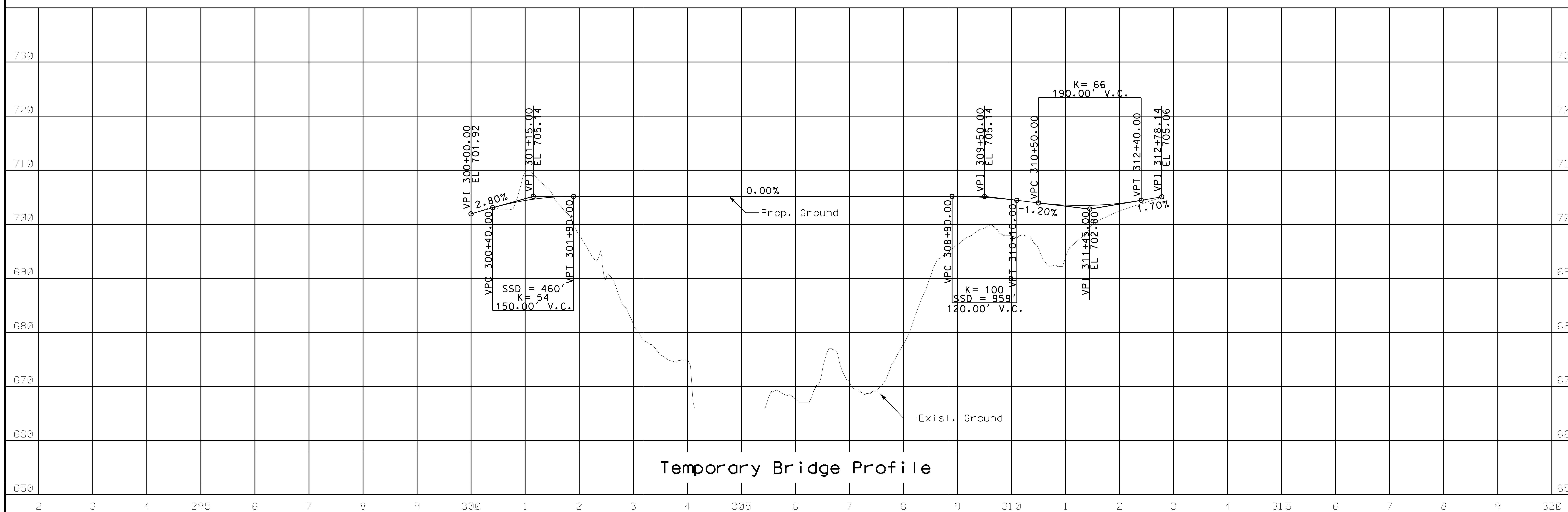


Figure A-2:
Current River Two-Lane Temporary Shoofly - Option 2
(Downstream of Pedestrian Bridge)
(Alternatives 1A, 2A & 5A)



Temporary Bridge Profile

NOT FOR CONSTRUCTION

DATE PREPARED	
10/21/2019	
ROUTE 19	STATE MO
DISTRICT SE	SHEET NO. A.2
COUNTY SHANNON	
JOB NO. J9P3305	
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO. CURRENT RIVER	

DATE	DESCRIPTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

MoDOT

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

HDR

HDR Engineering, Inc.
10450 Holmes Rd
Suite 600
Kansas City, MO 64131
816-360-2700
Certificate of Authority: 000856

Curve 1 Data	
PI	200+20.47
PC	200+00.00
PT	200+40.91
Δ	5°51'36.15" (LT)
D	14°19'26.20"
L	40.91'
T	20.47'
R	400.00'

Curve 2 Data	
PI	201+87.23
PC	200+47.03
PT	203+16.72
Δ	38°37'48.89" (RT)
D	14°19'26.20"
L	269.69'
T	140.20'
R	400.00'

Curve 3 Data	
PI	211+46.88
PC	210+16.28
PT	212+66.28
Δ	40°55'32.00" (LT)
D	16°22'12.80"
L	250.00'
T	130.60'
R	350.00'

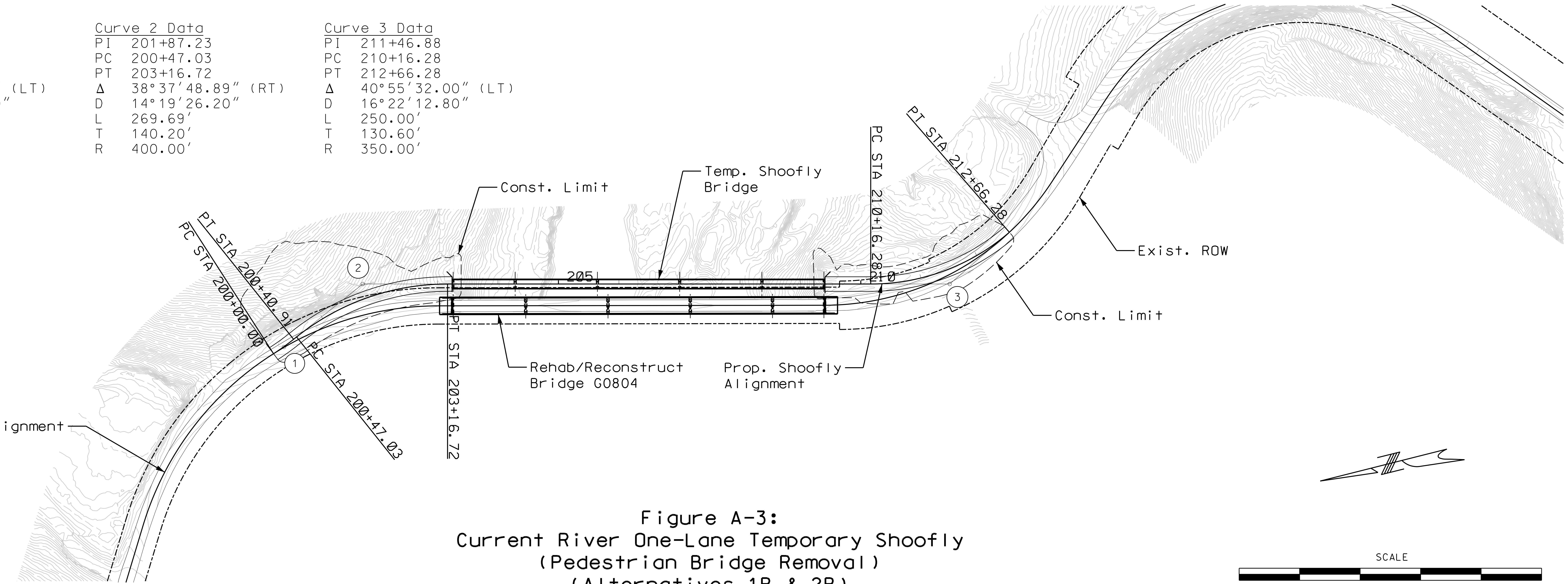
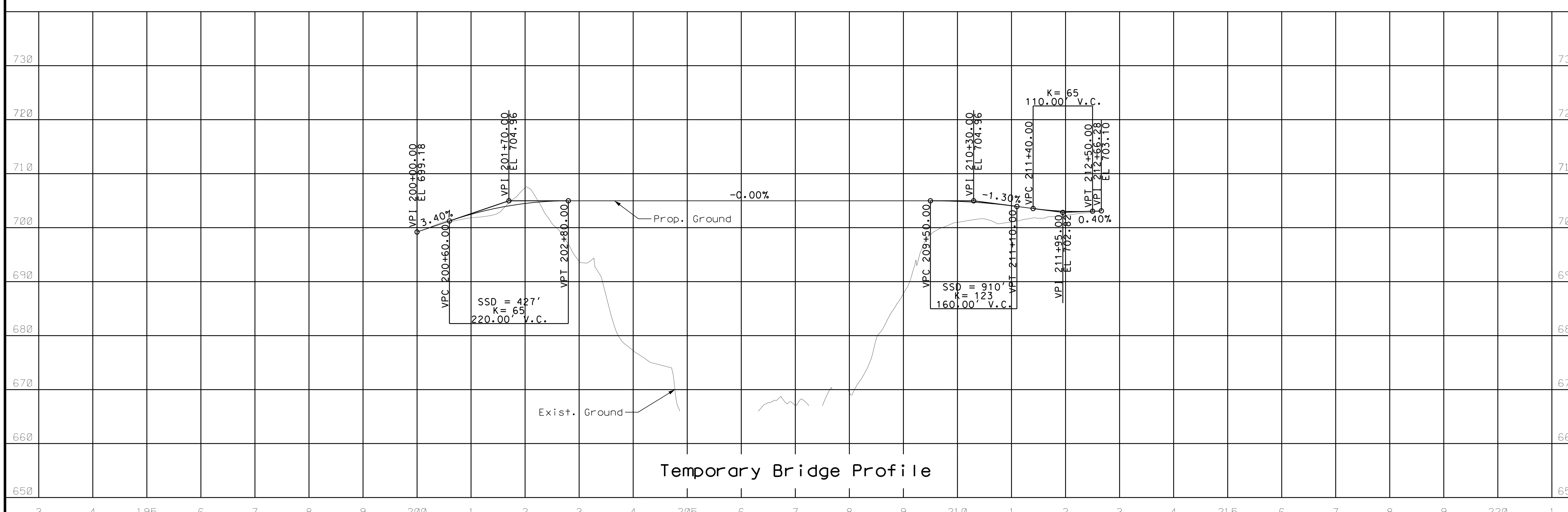


Figure A-3:
Current River One-Lane Temporary Shoofly
(Pedestrian Bridge Removal)
(Alternatives 1B & 2B)



Temporary Bridge Profile

NOT FOR CONSTRUCTION

DATE PREPARED	10/21/2019
ROUTE	19
STATE	MO
DISTRICT	SE
SHEET NO.	A.3
COUNTY	SHANNON
JOB NO.	J9P3305
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	CURRENT RIVER

DESCRIPTION | DATE

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
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HDR Engineering, Inc.
10450 Holmes Rd
Suite 600
Kansas City, MO 64131
816-360-2700
Certificate of Authority: 000856

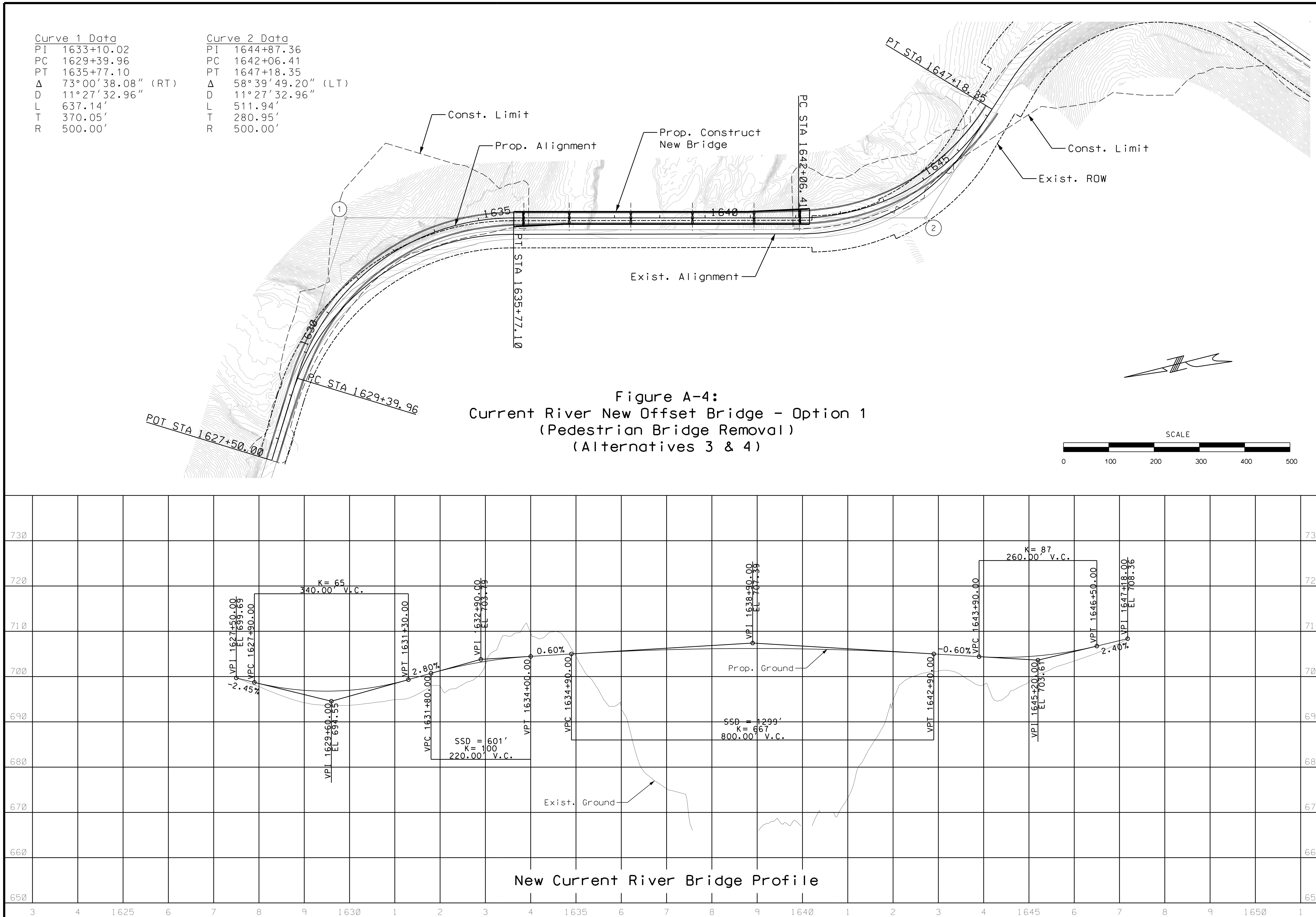

Figure A-4:
Current River New Offset Bridge - Option 1
(Pedestrian Bridge Removal)
(Alternatives 3 & 4)

NOT FOR CONSTRUCTION

DATE PREPARED	10/21/2019
ROUTE	19
STATE	MO
DISTRICT	SE
SHEET NO.	A.4
COUNTY	SHANNON
JOB NO.	J9P3305
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	CURRENT RIVER

DATE | DESCRIPTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
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Curve 1 Data	
PI	1633+54.31
PC	1629+82.87
PT	1636+21.80
Δ	73°12′57.85″ (RT)
D	11°27′32.96″
L	638.93′
T	371.44′
R	500.00′

Curve 2 Data	
PI	1645+33.95
PC	1642+96.72
PT	1647+32.46
Δ	56°13′47.20″ (LT)
D	12°54′16.04″
L	435.74′
T	237.22′
R	444.00′

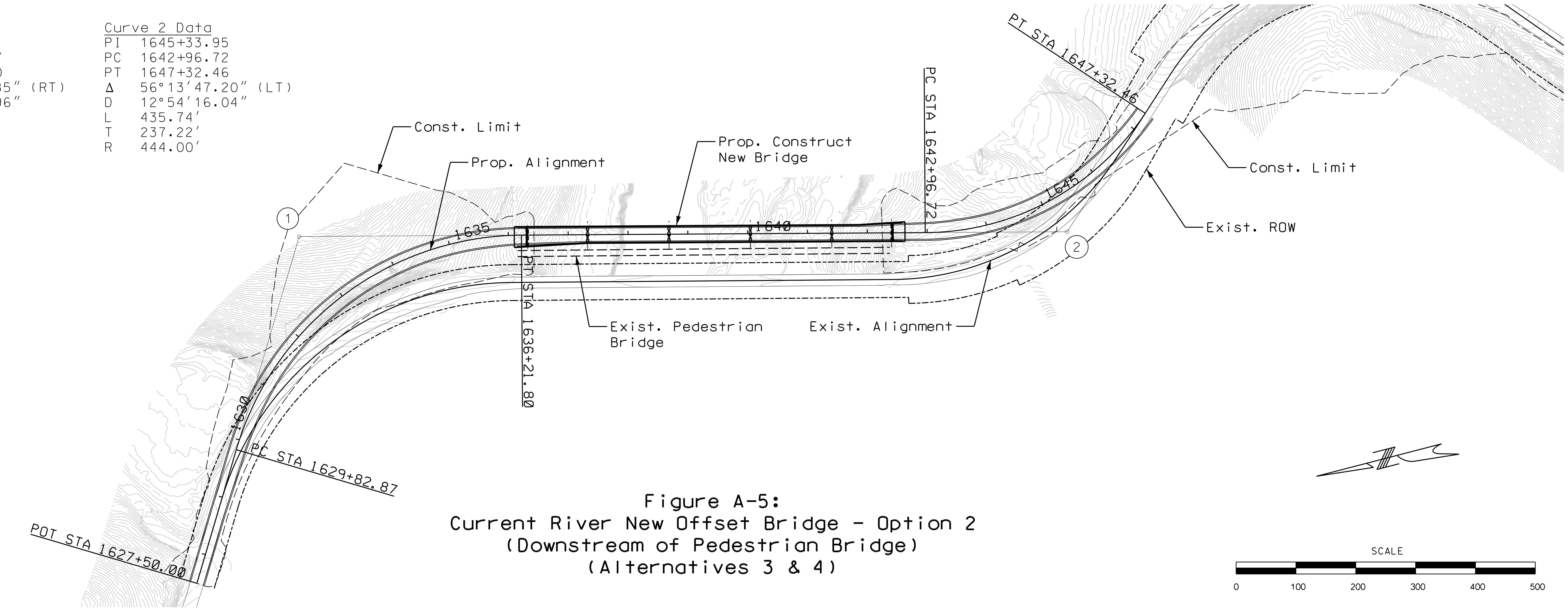
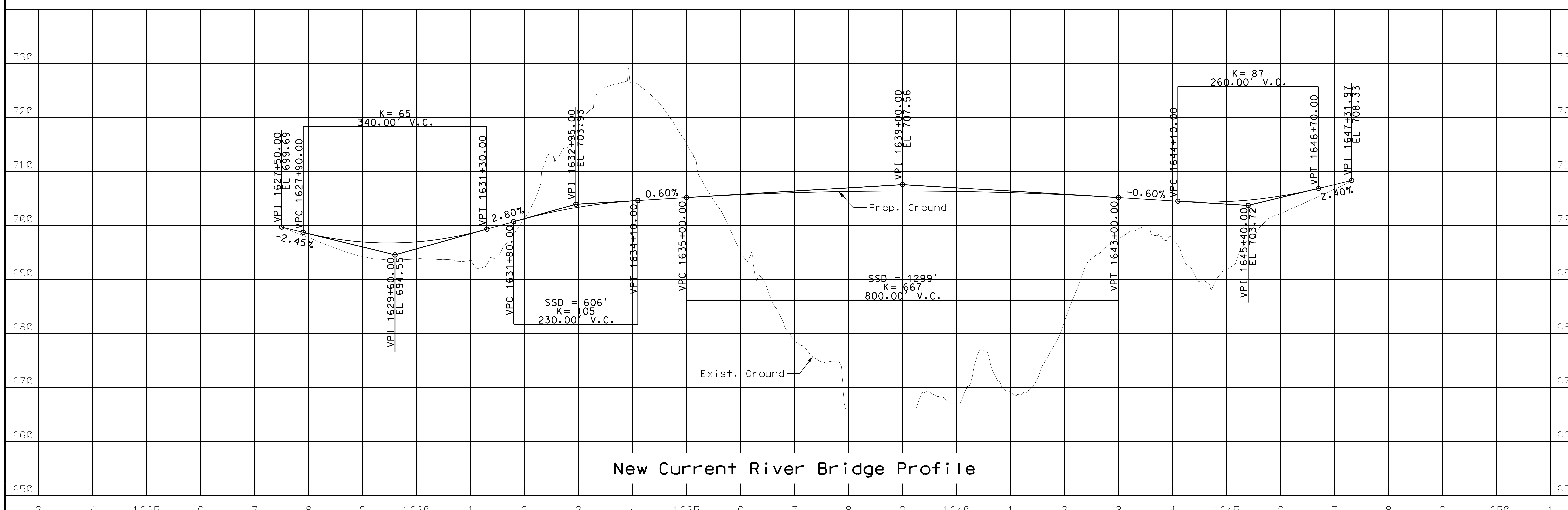


Figure A-5:
Current River New Offset Bridge - Option 2
(Downstream of Pedestrian Bridge)
(Alternatives 3 & 4)



New Current River Bridge Profile

NOT FOR CONSTRUCTION

DATE PREPARED	
10/21/2019	
ROUTE 19	STATE MO
DISTRICT SE	SHEET NO. A.5
COUNTY SHANNON	
JOB NO. J9P3305	
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO. CURRENT RIVER	

DATE | DESCRIPTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
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105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

HDR Engineering, Inc.
10450 Holmes Rd
Suite 600
Kansas City, MO 64131
816-360-2700
Certificate of Authority: 000856

Curve 1 Data	
PI	1632+83.59
PC	1629+12.79
PT	1635+50.89
Δ	73°07'16.92" (RT)
D	11°27'32.96"
L	638.10'
T	370.80'
R	500.00'

Curve 2 Data	
PI	1644+55.45
PC	1641+47.50
PT	1647+08.96
Δ	58°29'19.43" (LT)
D	10°25'02.69"
L	561.45'
T	307.94'
R	550.00'

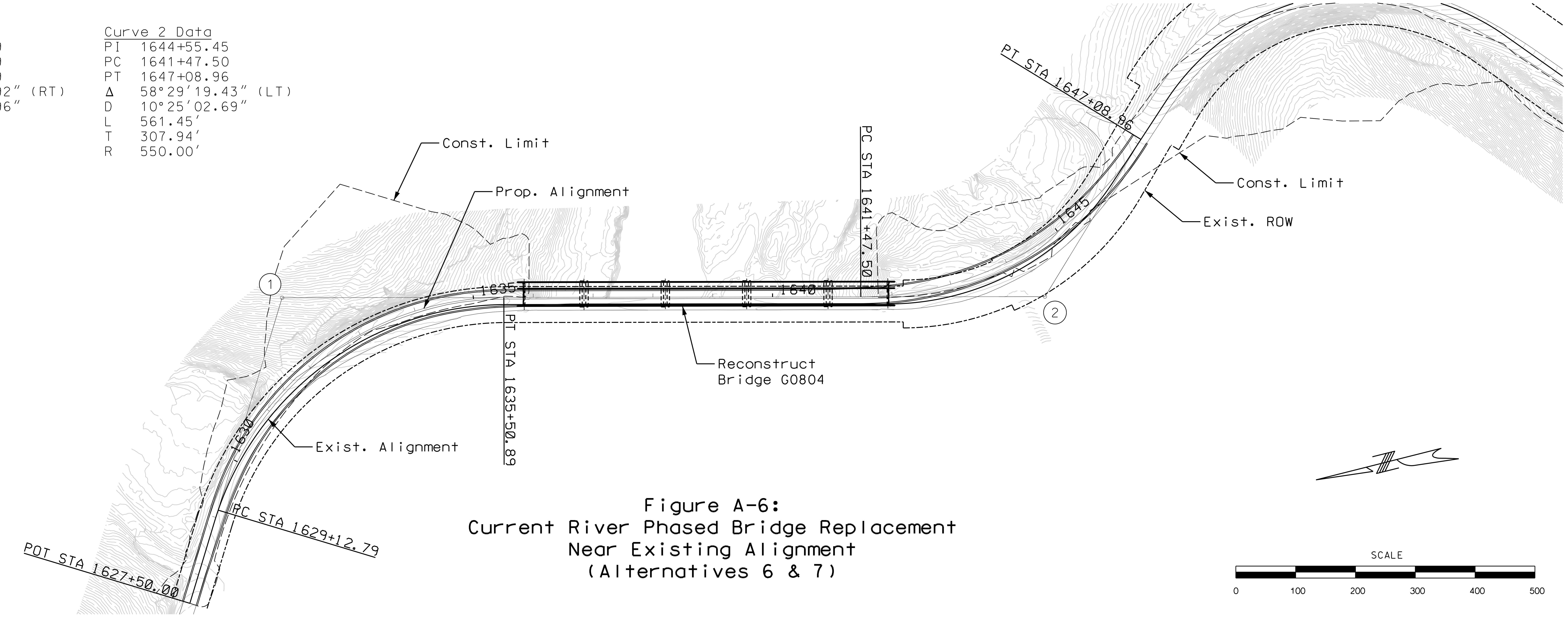
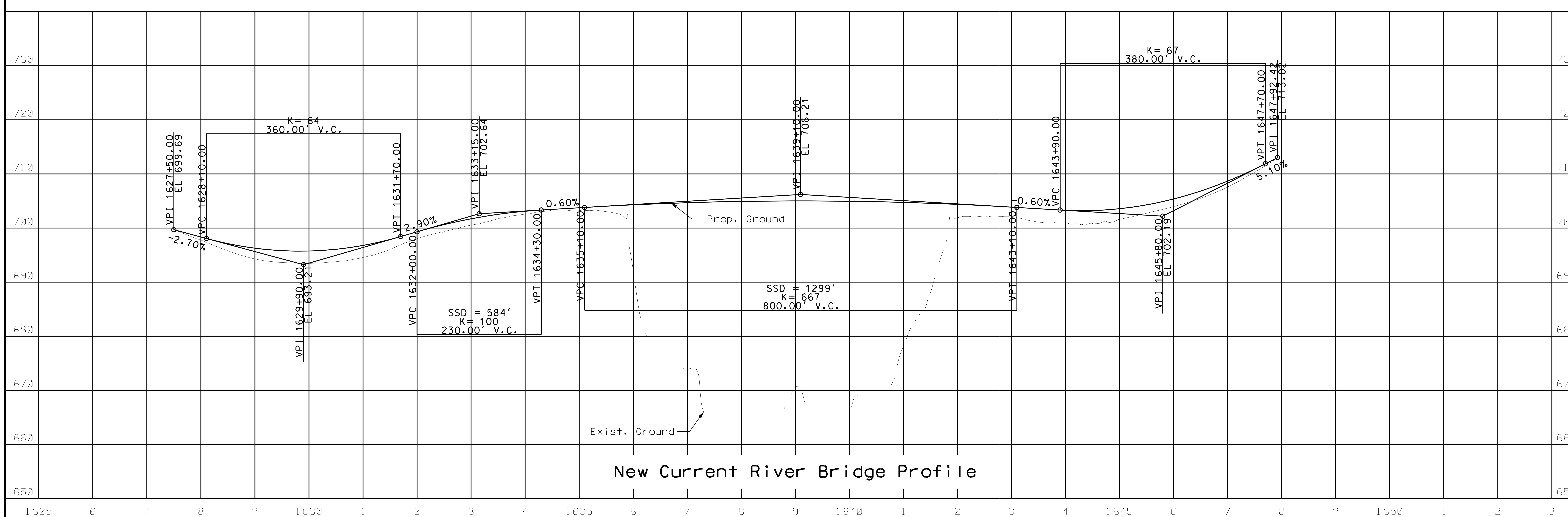


Figure A-6:
Current River Phased Bridge Replacement
Near Existing Alignment
(Alternatives 6 & 7)



New Current River Bridge Profile

NOT FOR CONSTRUCTION

DATE PREPARED	
10/21/2019	
ROUTE 19	STATE MO
DISTRICT SE	SHEET NO. A.6
COUNTY SHANNON	
JOB NO. J9P3305	
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO. CURRENT RIVER	

DATE | DESCRIPTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
MoDOT
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

HDR
HDR Engineering, Inc.
10450 Holmes Rd
Suite 600
Kansas City, MO 64131
816-360-2700
Certificate of Authority: 000856

Curve 1 Data	
PI	401+44.50
PC	400+00.00
PT	402+69.33
Δ	51°26′16.86″ (RT)
D	19°05′54.94″
L	269.33′
T	144.50′
R	300.00′

Curve 2 Data	
PI	411+75.85
PC	411+25.58
PT	412+25.58
Δ	14°19′26.20″ (LT)
D	14°19′26.20″
L	100.00′
T	50.26′
R	400.00′

Curve 3 Data	
PI	413+21.21
PC	412+70.58
PT	413+71.30
Δ	14°25′33.72″ (RT)
D	14°19′26.20″
L	100.71′
T	50.62′
R	400.00′

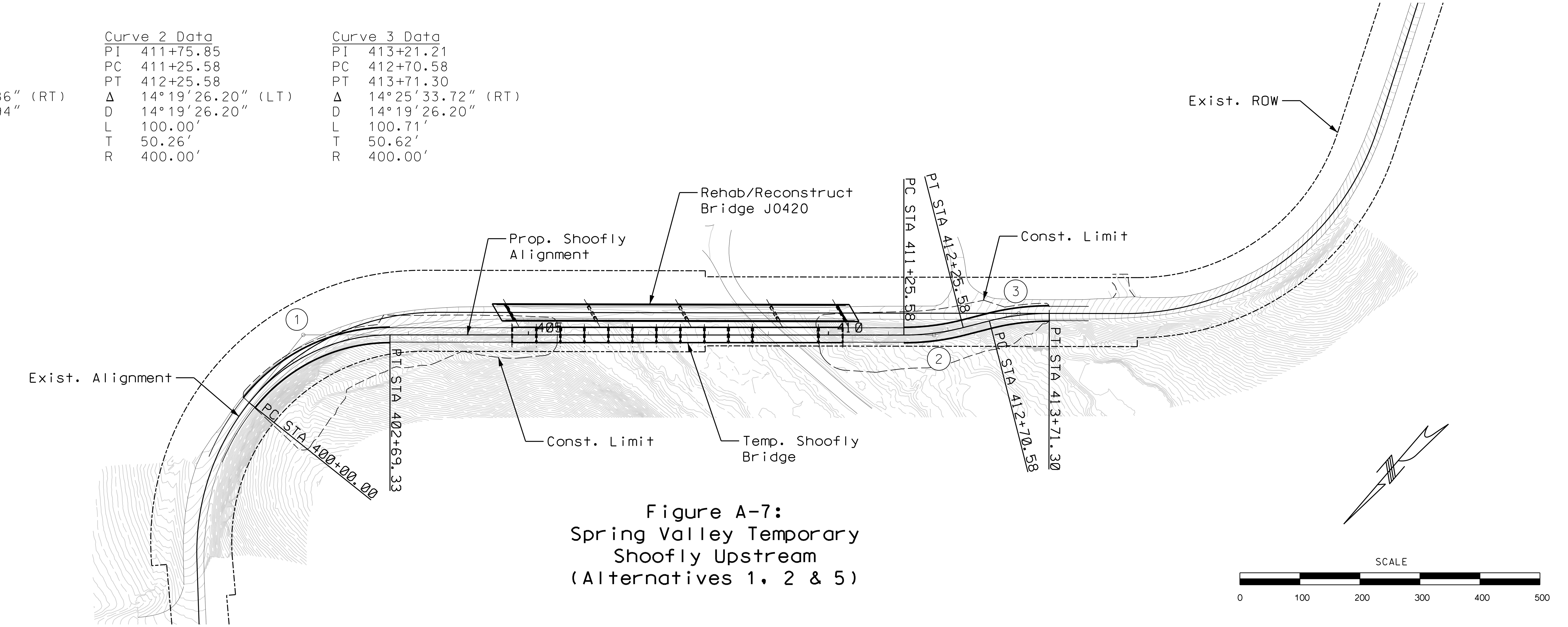
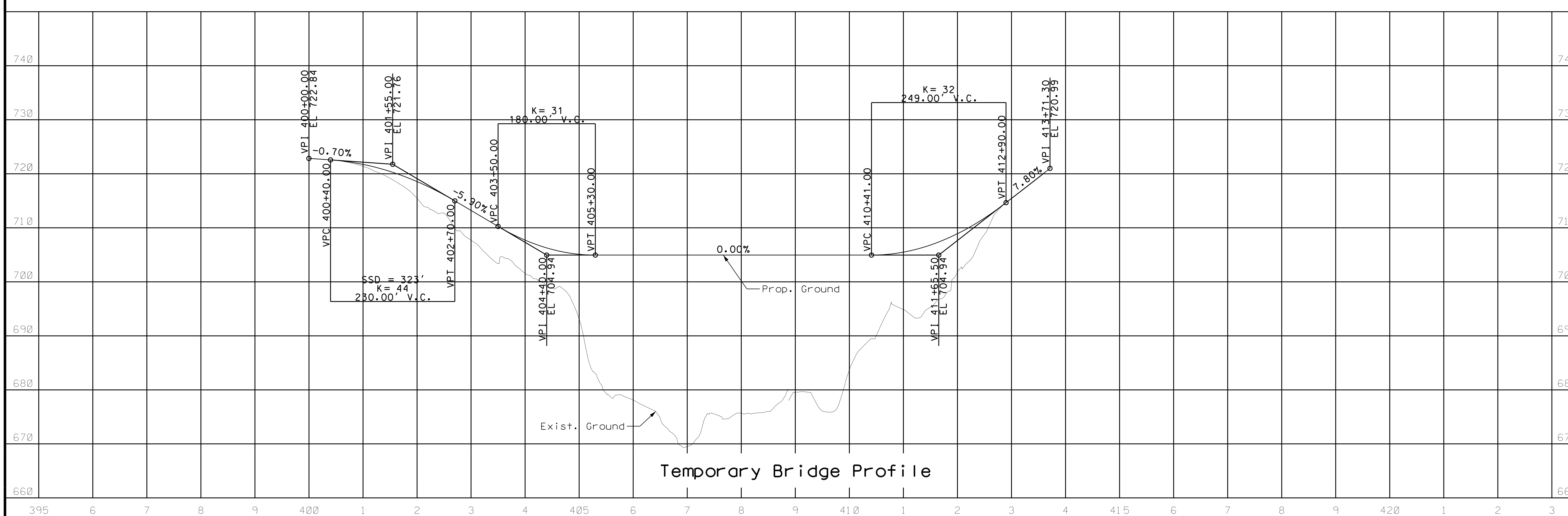


Figure A-7:
Spring Valley Temporary
Shoofly Upstream
(Alternatives 1, 2 & 5)



Temporary Bridge Profile

NOT FOR CONSTRUCTION

DATE PREPARED	
10/21/2019	
ROUTE 19	STATE MO
DISTRICT SE	SHEET NO. A.7
COUNTY SHANNON	
JOB NO. J9P3305	
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO. SPRING VALLEY	

DESCRIPTION

DATE

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

HDR Engineering, Inc.
10450 Holmes Rd
Suite 600
Kansas City, MO 64131
816-360-2700
Certificate of Authority: 000856

Curve 1 Data	
PI	1704+55.15
PC	1700+00.00
PT	1707+11.97
Δ	90°39′05.00″ (RT)
D	12°43′56.62″
L	711.97′
T	455.15′
R	450.00′

Curve 2 Data	
PI	1720+93.62
PC	1717+51.56
PT	1723+51.56
Δ	68°45′17.77″ (LT)
D	11°27′32.96″
L	600′
T	342.07′
R	500.00′

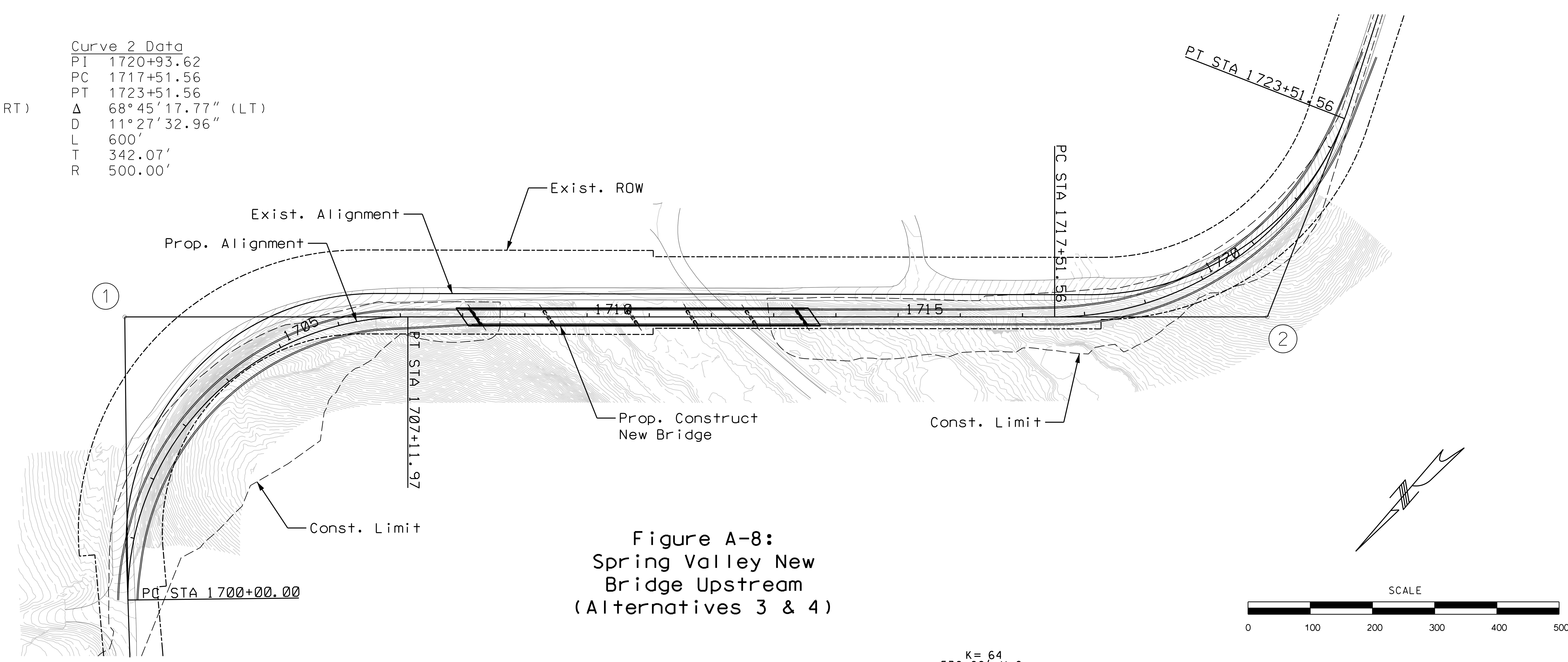
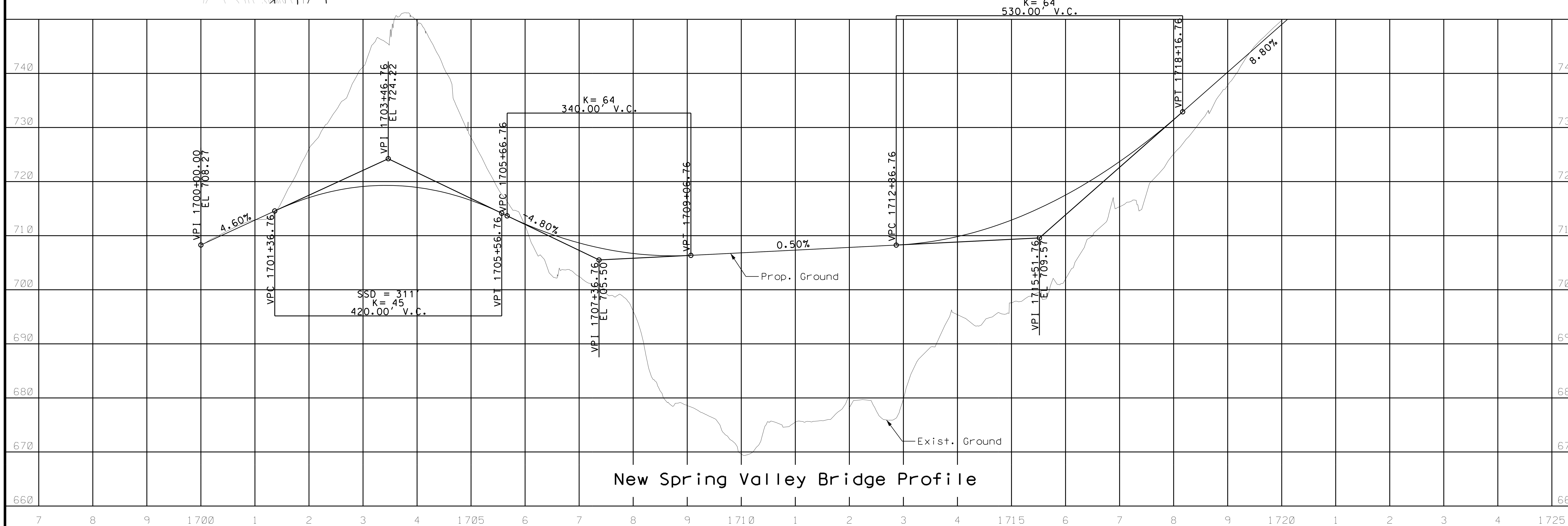


Figure A-8:
Spring Valley New
Bridge Upstream
(Alternatives 3 & 4)



New Spring Valley Bridge Profile

NOT FOR CONSTRUCTION

DATE PREPARED	
10/21/2019	
ROUTE 19	STATE MO
DISTRICT SE	SHEET NO. A.8
COUNTY SHANNON	
JOB NO. J9P3305	
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO. SPRING VALLEY	

DESCRIPTION

DATE

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

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105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

HDR

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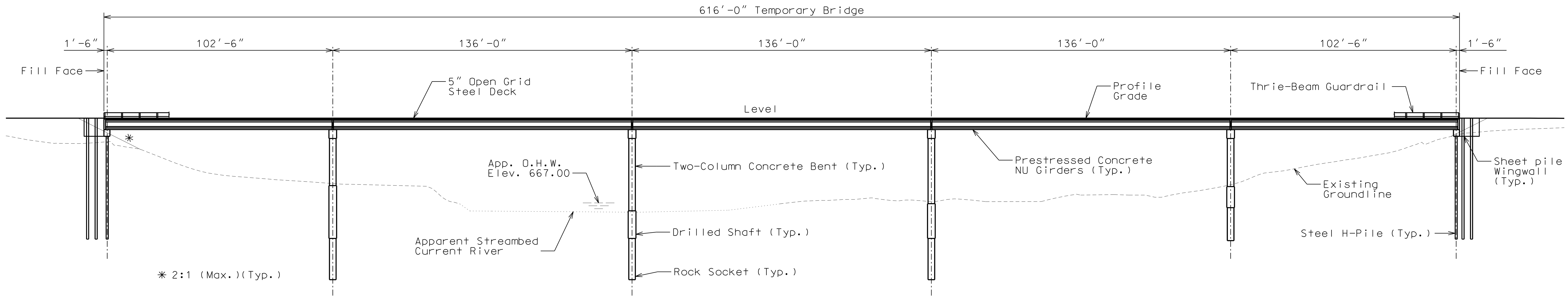
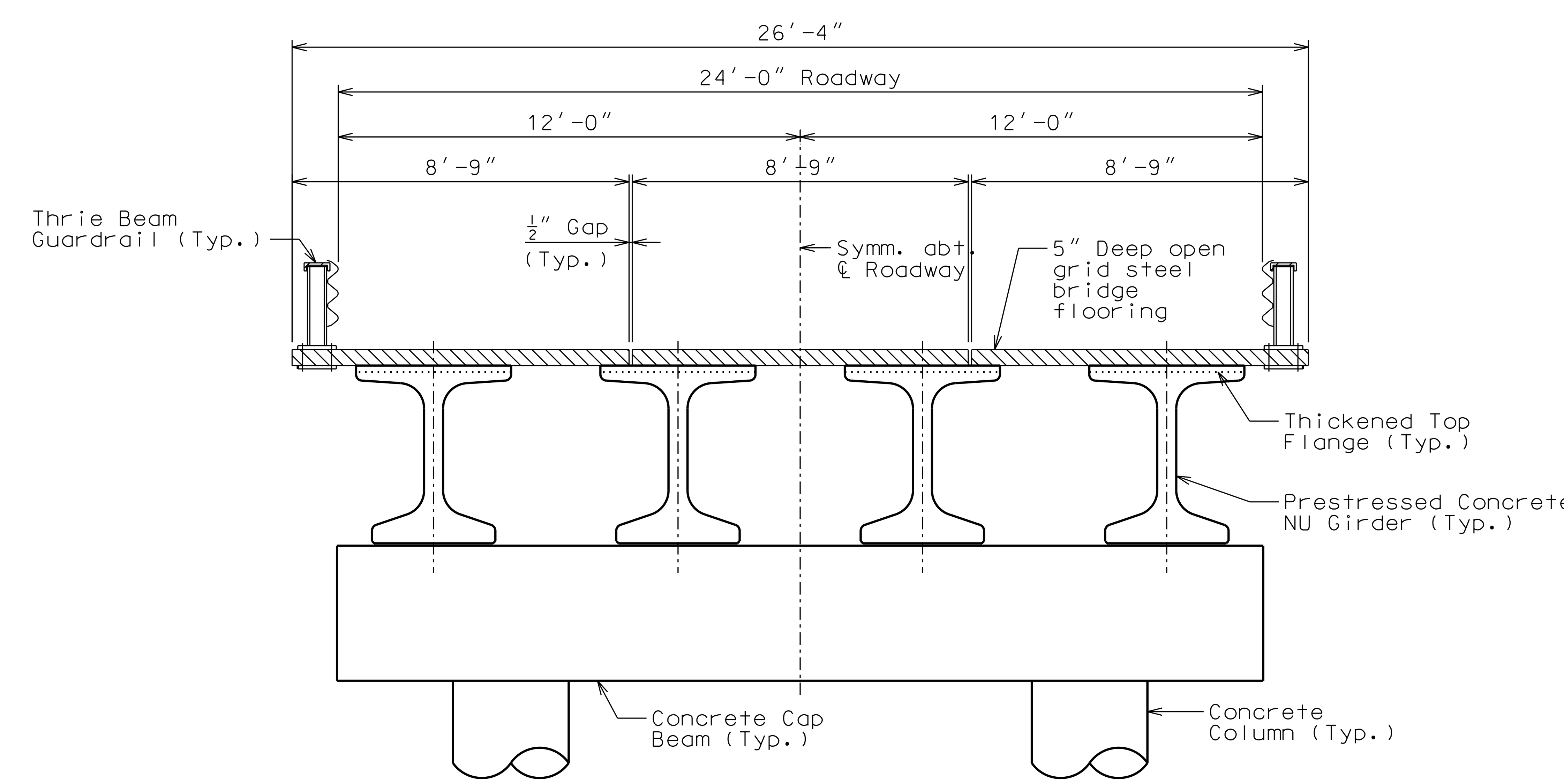
10450 Holmes Rd
Suite 600
Kansas City, MO 64131
816-360-2700
Certificate of Authority: 000856



GENERAL ELEVATION



TEMPORARY ROUTE 19 BRIDGE
PROP. TYP. SECTION @ INT. BENT

Figure A-9: Current River - Temporary Bridge Elevation and Section

Note: This drawing is not to scale. Follow dimensions.

NOT FOR CONSTRUCTION

DATE PREPARED 10/20/2019	
ROUTE 19	STATE MO
DISTRICT BR	SHEET NO. A.9
COUNTY SHANNON	
JOB NO. J9P3305	
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO. CURRENT RIVER	

DESCRIPTION

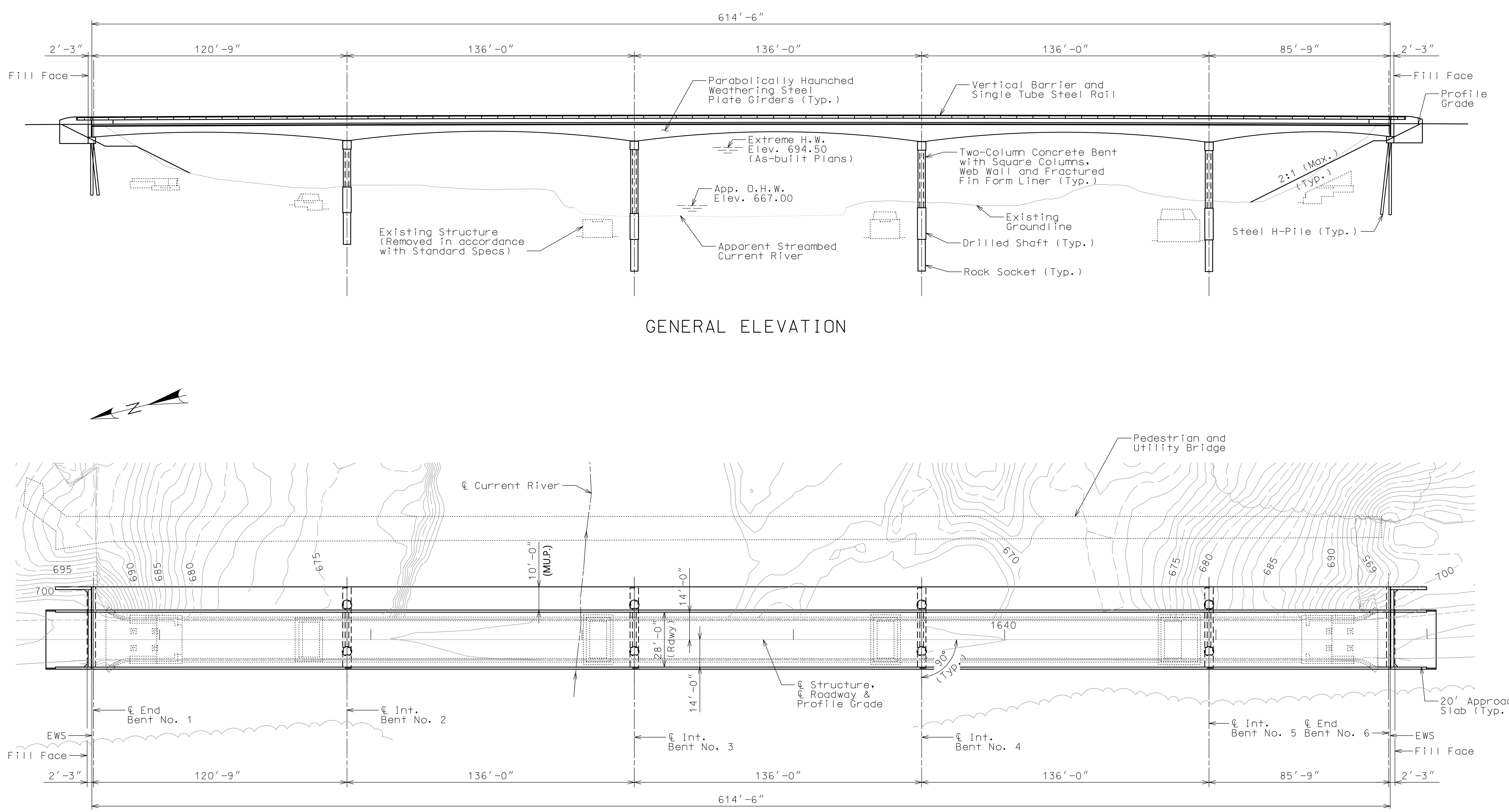
DATE

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

olsson
7301 WEST 133RD STREET
OVERLAND PARK, KS 66213
CERTIFICATE OF
AUTHORITY NO. 001592

Figure A-10: Current River - Replacement In-Kind on Alignment Plan and Elevation

Note: This drawing is not to scale. Follow dimensions.



Note: A bridge replacement that includes a mixed use path is shown. The roadway portion of the highway only bridge included in Alternate 2A, Option 2 would be similar.

Figure A-11: Current River - Girder Bridge Replacement on Alignment Plan and Elevation

Note: This drawing is not to scale. Follow dimensions.

NOT FOR CONSTRUCTION

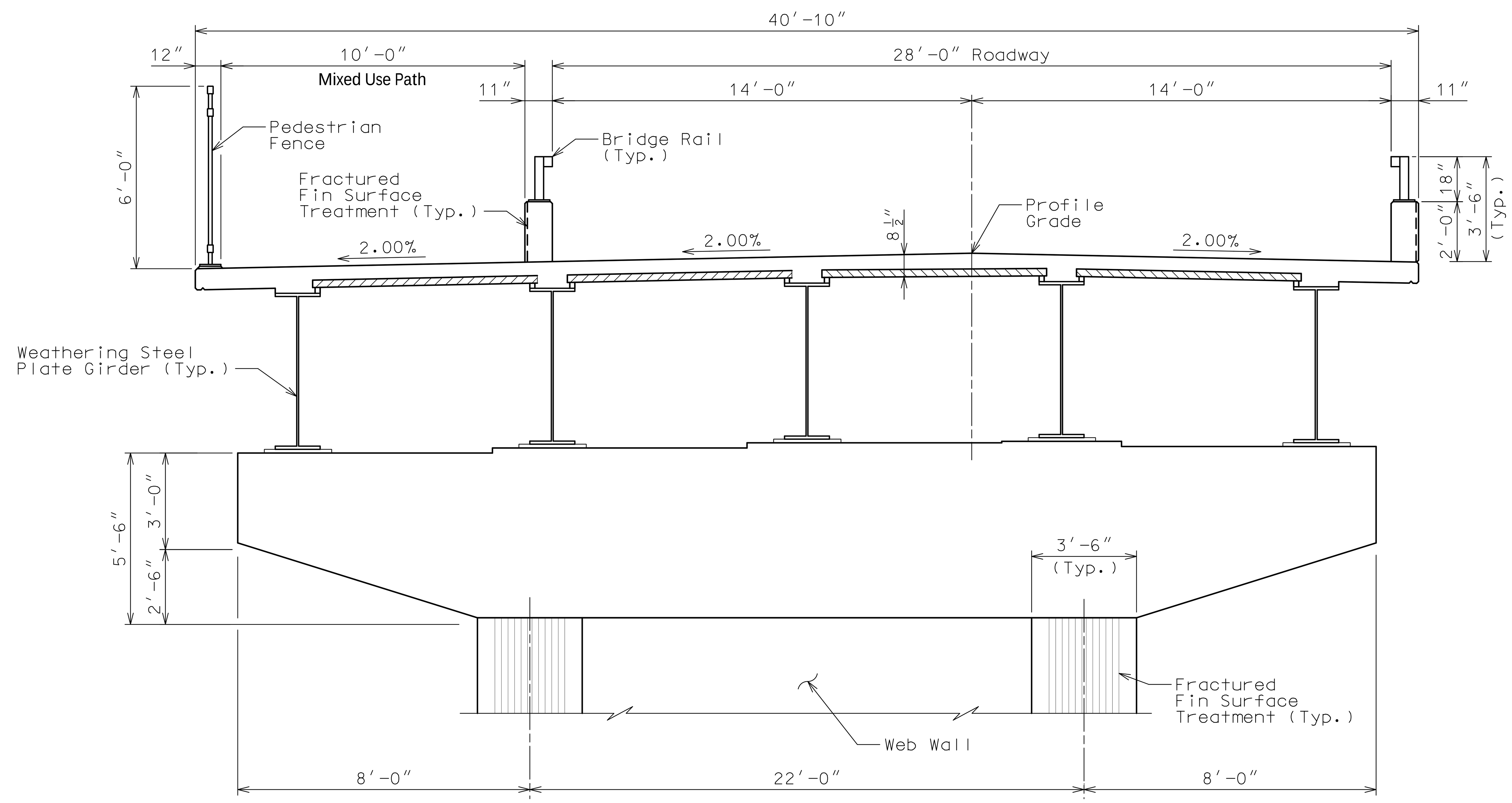
DATE PREPARED	10/21/2019
ROUTE	19
STATE	MO
DISTRICT	BR
SHEET NO.	A.11
COUNTY	SHANNON
JOB NO.	J9P3305
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	CURRENT RIVER

DATE	DESCRIPTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

olsson
7301 WEST 133RD STREET
OVERLAND PARK, KS 66213
CERTIFICATE OF AUTHORITY NO. 001592



ROUTE 19 BRIDGE OVER CURRENT RIVER
PROP. TYP. SECTION @ INT. BENT

Figure A-12: Current River - Girder Bridge Replacement Typical Section

Note: This drawing is not to scale. Follow dimensions.

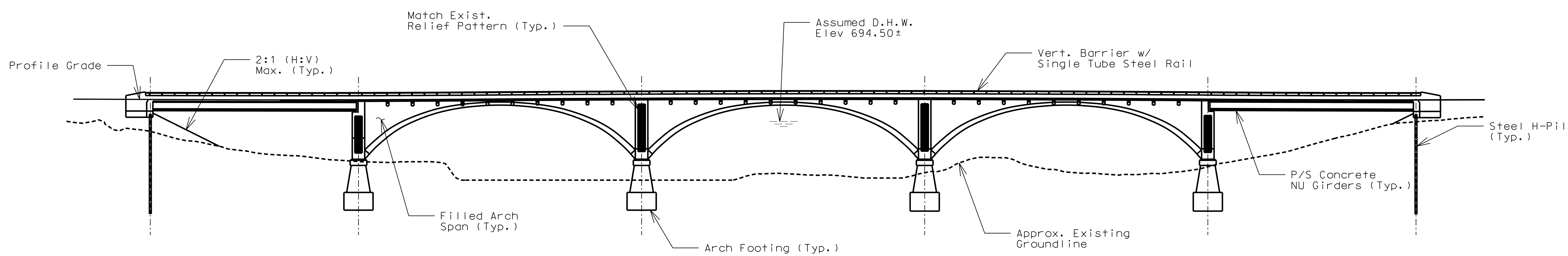
NOT FOR CONSTRUCTION

DATE PREPARED	10/21/2019
ROUTE	19
STATE	MO
DISTRICT	BR
SHEET NO.	A.12
COUNTY	SHANNON
JOB NO.	J9P3305
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	CURRENT RIVER

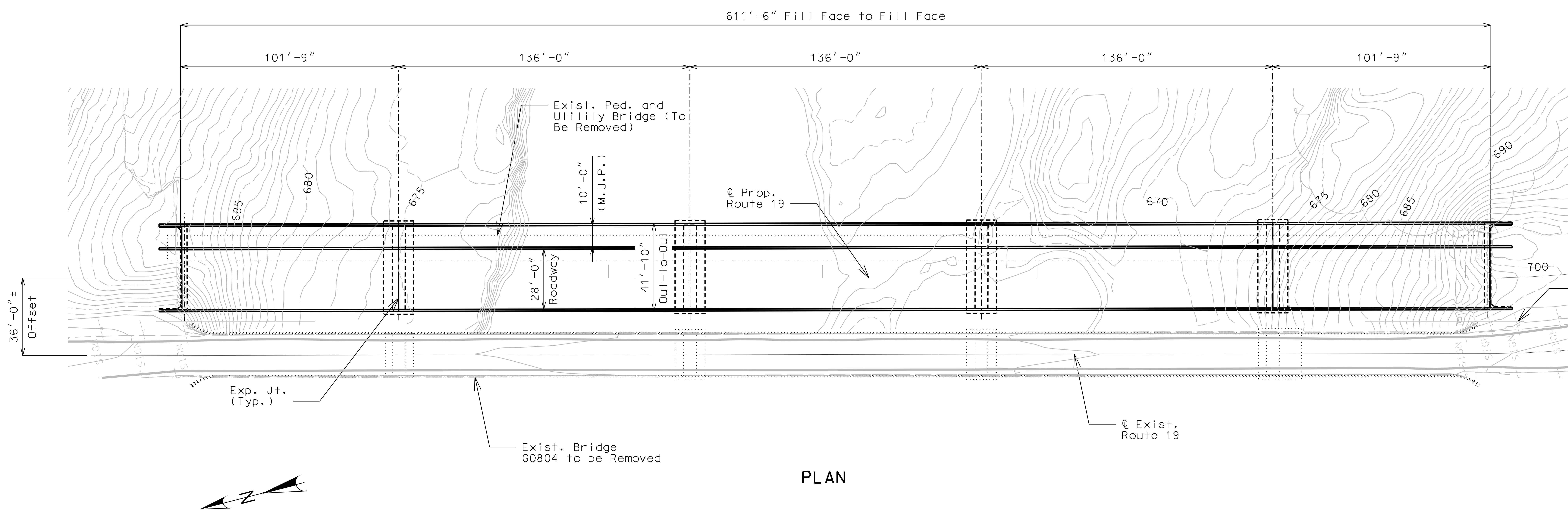
DESCRIPTION
DATE

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
MoDOT
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

olsson
7301 WEST 133RD STREET
OVERLAND PARK, KS 66213
CERTIFICATE OF
AUTHORITY NO. 001592



ELEVATION



PLAN

Figure A-13: Current River - Replacement In-Kind on Offset Alignment Plan and Elevation

Note: This drawing is not to scale. Follow dimensions.

NOT FOR CONSTRUCTION

DATE PREPARED	11/19/2019
ROUTE	19
STATE	MO
DISTRICT	BR
SHEET NO.	A.13
COUNTY	SHANNON
JOB NO.	J9P3305
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	CURRENT RIVER

DATE	DESCRIPTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
MoDOT
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

HDR Engineering, Inc.
4435 Main Street
Suite 1000
Kansas City, MO 64111-1856
816-360-2700
Certificate of Authority: 000856

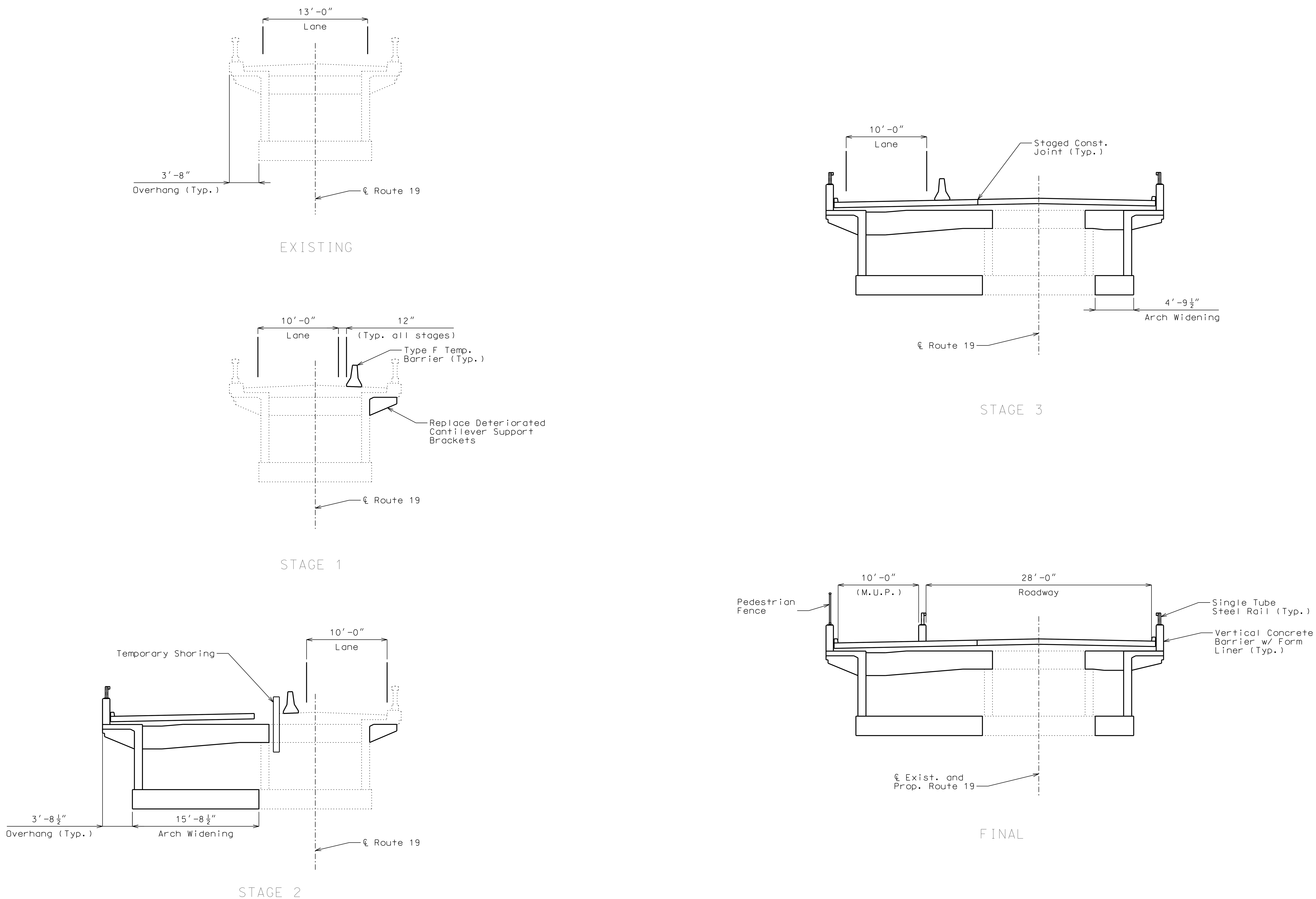


Figure A-14: Current River - Rehabilitation and Widening of Existing Bridge Phasing

Note: This drawing is not to scale. Follow dimensions.

NOT FOR CONSTRUCTION

DATE PREPARED	
10/21/2019	
ROUTE: 19	STATE: MO
DISTRICT: BR	SHEET NO.: A.14
COUNTY: SHANNON	
JOB NO.: J9P3305	
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.: CURRENT RIVER	

DATE	DESCRIPTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
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105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

HDR Engineering, Inc.
4435 Main Street
Suite 1000
Kansas City, MO 64111-1856
816-360-2700
Certificate of Authority: 000856

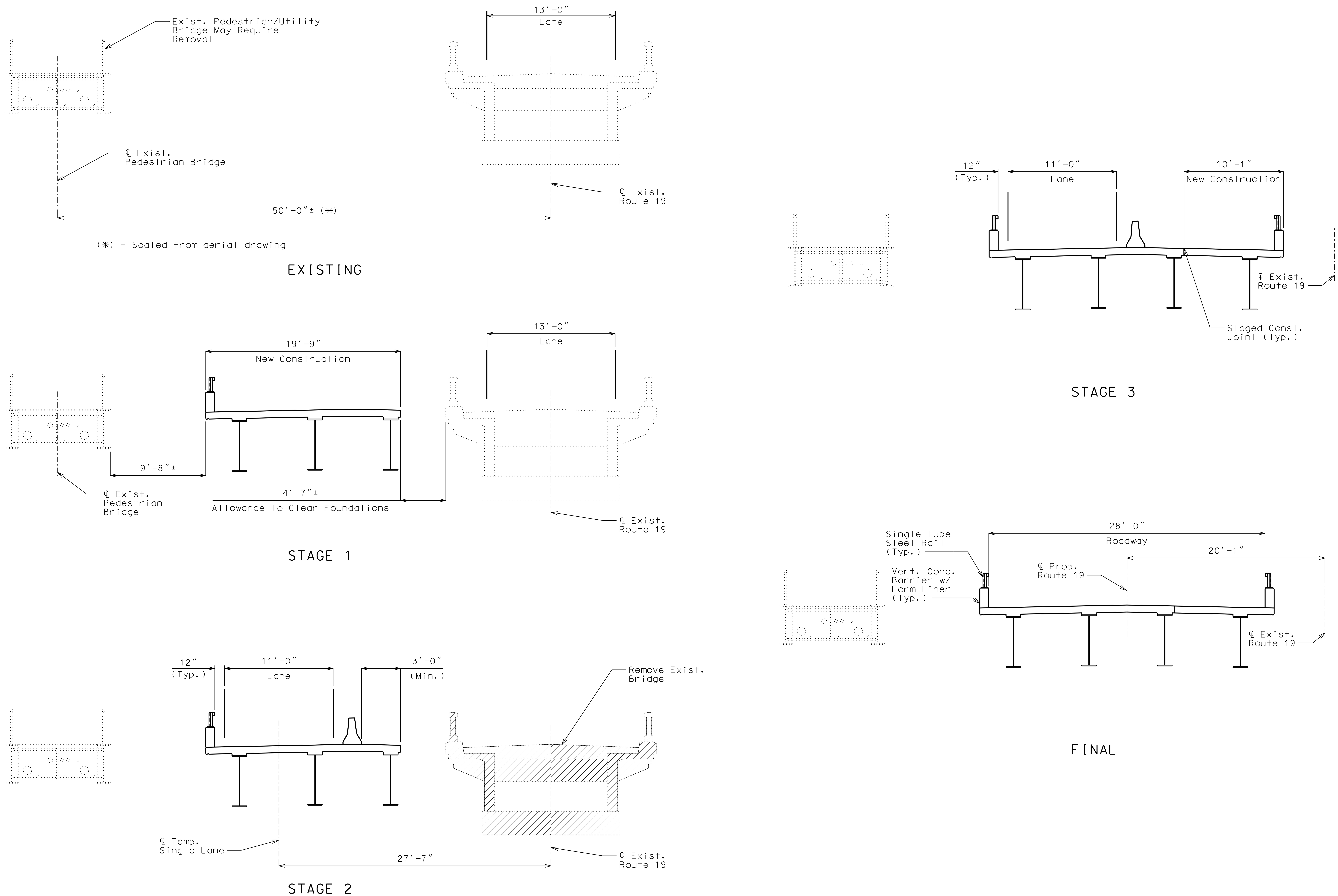

Figure A-15: Current River - Phased Replacement Near Existing Alignment

Note: This drawing is not to scale. Follow dimensions.

NOT FOR CONSTRUCTION

DATE PREPARED	11/26/2019
ROUTE 19	STATE MO
DISTRICT BR	SHEET NO. A.15
COUNTY	SHANNON
JOB NO.	J9P3305
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	CURRENT RIVER

DESCRIPTION | DATE

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
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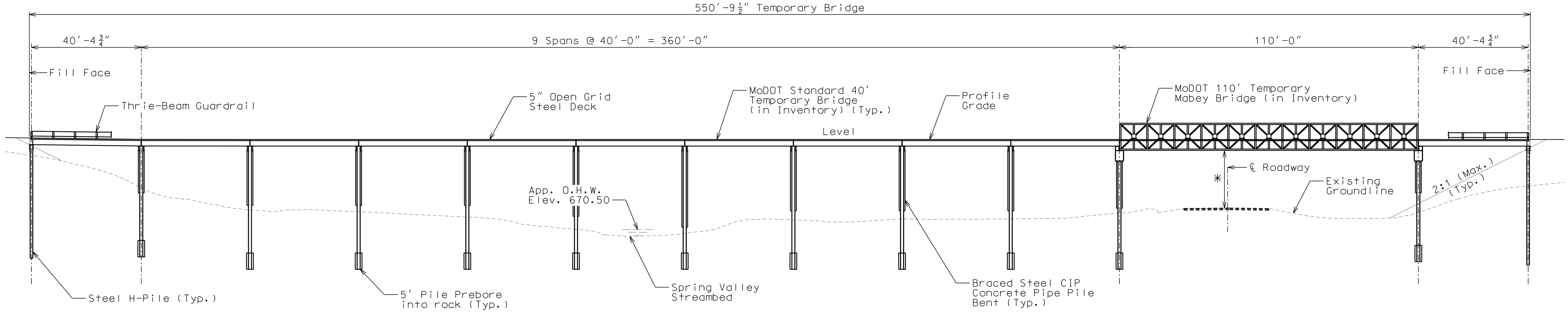
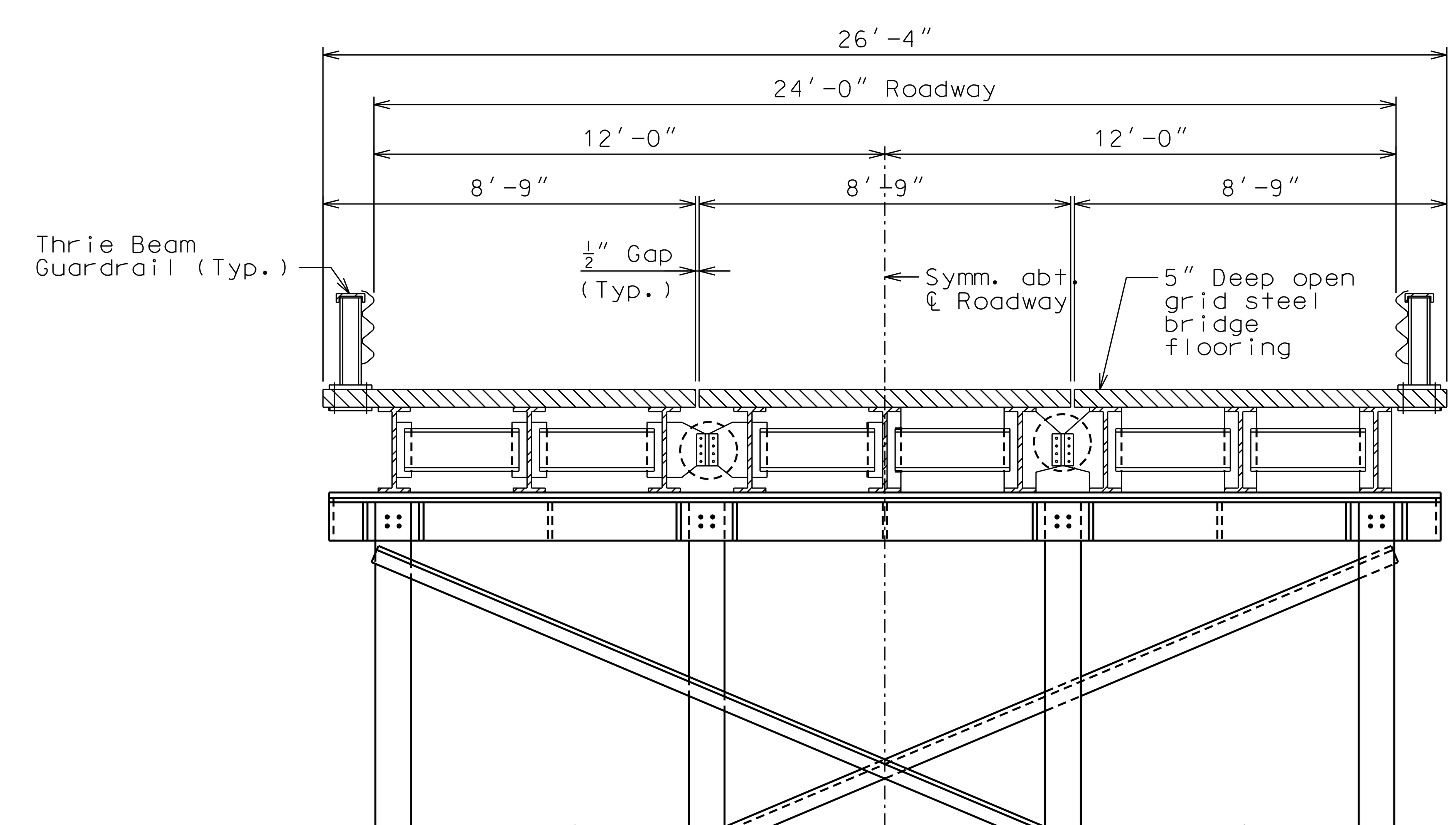
Suite 1000
Kansas City, MO 64111-1856
816-360-2700
Certificate of Authority: 000856



GENERAL ELEVATION



TEMPORARY ROUTE 19 BRIDGE
PROP. TYP. SECTION @ INT. BENT

Figure A-16: Spring Valley - Temporary Bridge Elevation and Section

Note: This drawing is not to scale. Follow dimensions.

NOT FOR CONSTRUCTION

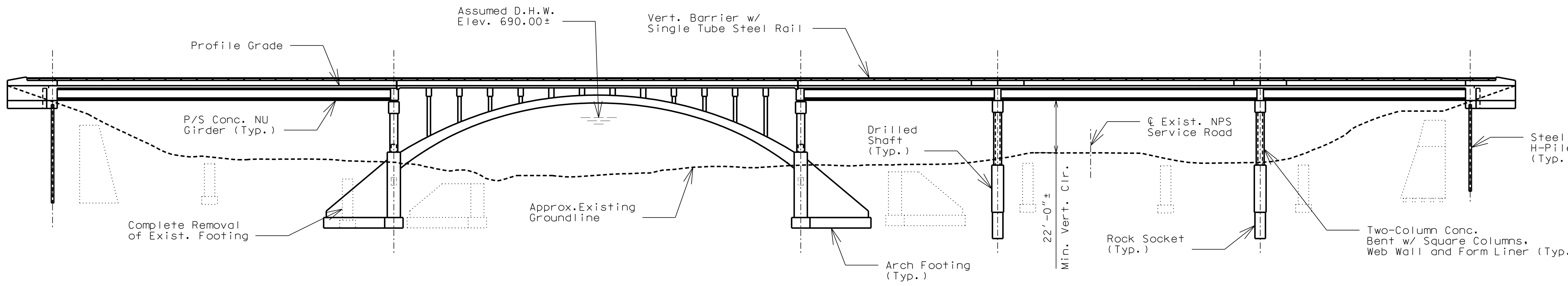
DATE PREPARED 10/20/2019	
ROUTE 19	STATE MO
DISTRICT BR	SHEET NO. A.16
COUNTY SHANNON	
JOB NO. J9P3305	
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO. SPRING VALLEY	

DESCRIPTION

DATE

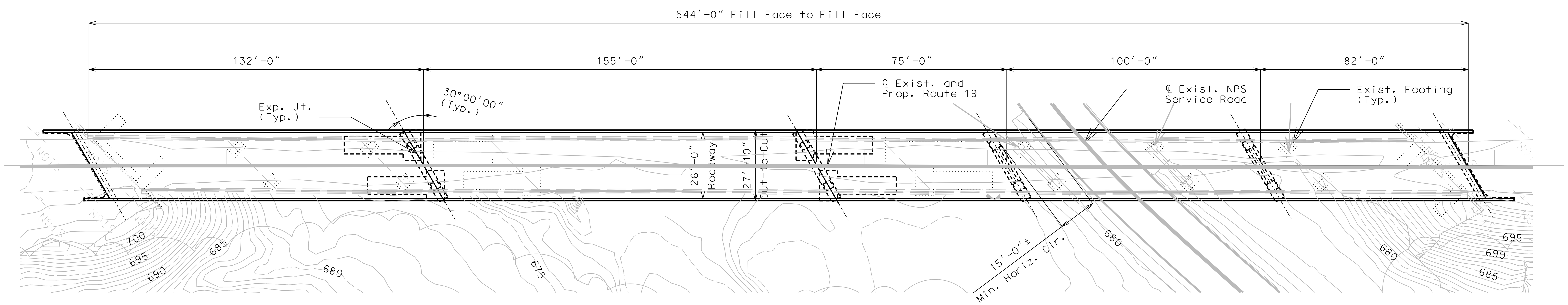
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

olsson
7301 WEST 133RD STREET
OVERLAND PARK, KS 66213
CERTIFICATE OF
AUTHORITY NO. 001592



ELEVATION

Note:
Prestressed concrete girder approach spans are shown.
Haunched steel plate girder spans are also possible
but are not shown.



PLAN

Note:
Minimum vertical and horizontal clearances shown are
estimated based on limited survey data.

Figure A-17: Spring Valley - Replacement In-Kind on Alignment Plan and Elevation

Note: This drawing is not to scale. Follow dimensions.

NOT FOR CONSTRUCTION

DATE PREPARED	
11/19/2019	
ROUTE 19	STATE MO
DISTRICT BR	SHEET NO. A.17
COUNTY SHANNON	
JOB NO. J9P3305	
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO. SPRING VALLEY	

DATE	DESCRIPTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
MoDOT
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

HDR
HDR Engineering, Inc.
4435 Main Street
Suite 1000
Kansas City, MO 64111-1856
816-360-2700
Certificate of Authority: 000856

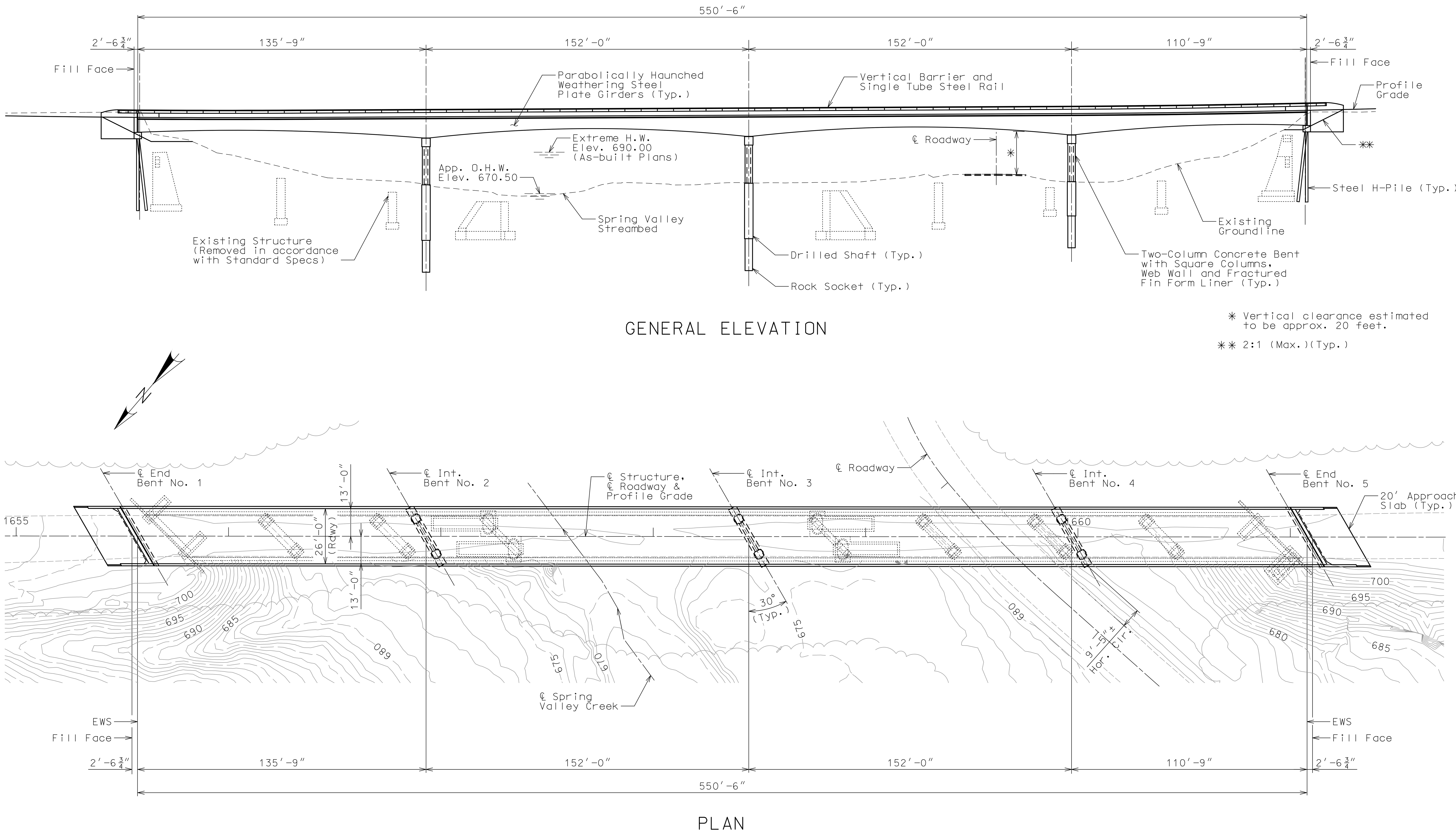


Figure A-18: Spring Valley - Girder Bridge Replacement on Alignment Plan and Elevation

Note: This drawing is not to scale. Follow dimensions.

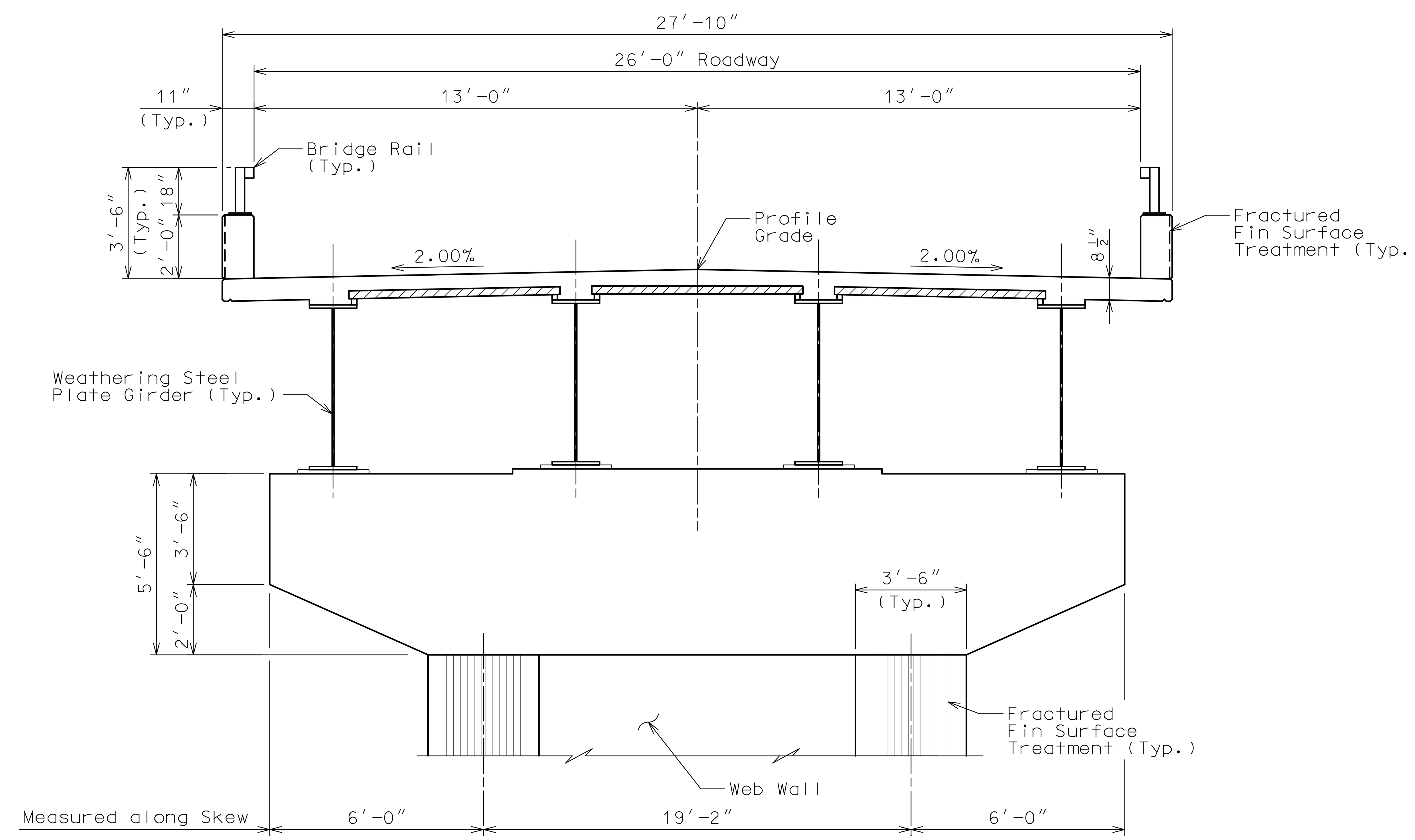
NOT FOR CONSTRUCTION

DATE PREPARED 10/21/2019	
ROUTE 19	STATE MO
DISTRICT BR	SHEET NO. A.18
COUNTY SHANNON	
JOB NO. J9P3305	
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO. SPRING VALLEY	

DATE	DESCRIPTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
MoDOT
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

olsson
7301 WEST 133RD STREET
OVERLAND PARK, KS 66213
CERTIFICATE OF AUTHORITY NO. 001592



ROUTE 19 BRIDGE OVER SPRING VALLEY
PROP. TYP. SECTION @ INT. BENT

Figure A-19: Spring Valley - Girder Bridge Replacement Typical Section

Note: This drawing is not to scale. Follow dimensions.

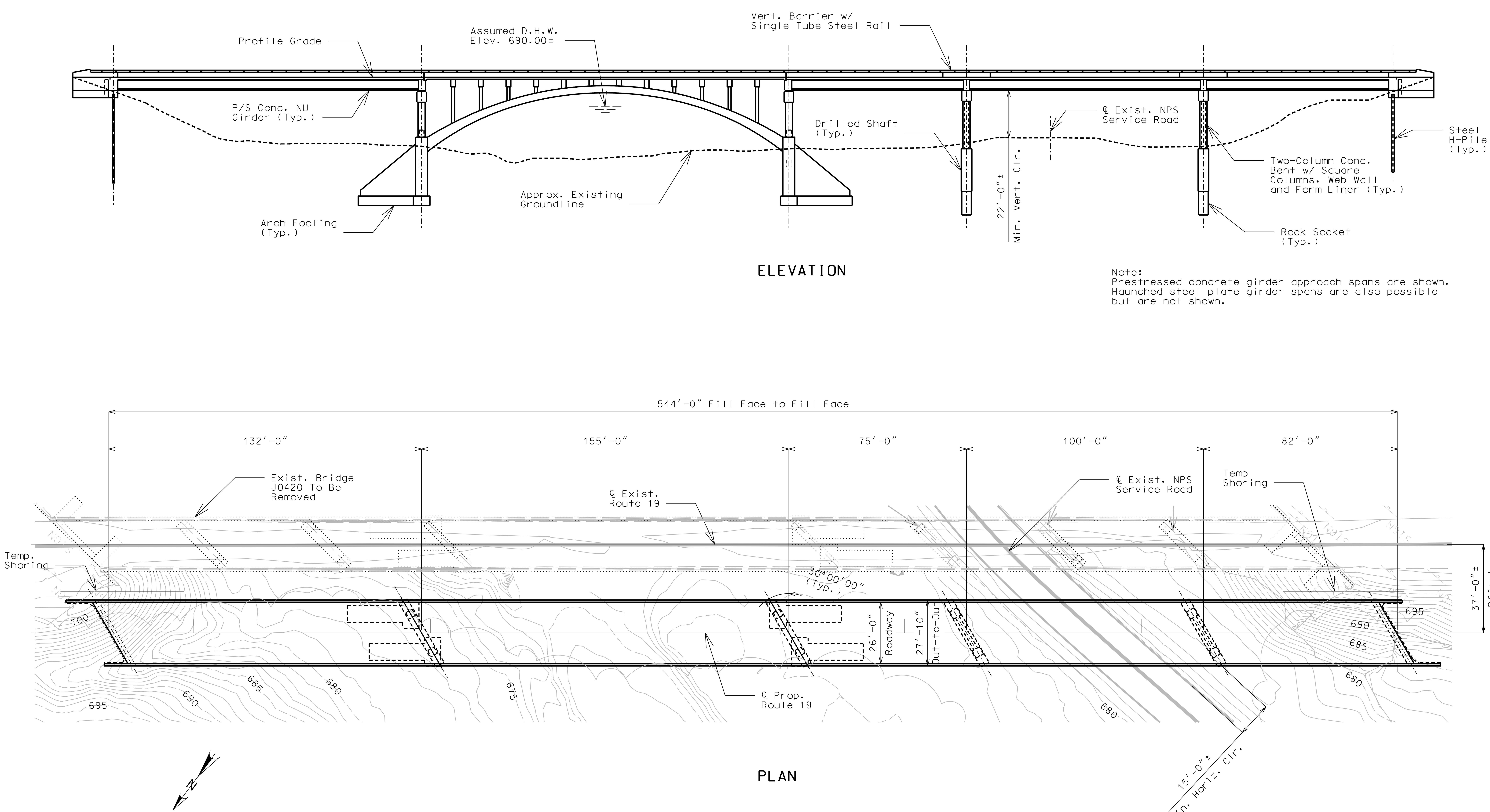
NOT FOR CONSTRUCTION

DATE PREPARED	10/21/2019
ROUTE	19
STATE	MO
DISTRICT	BR
SHEET NO.	A.19
COUNTY	SHANNON
JOB NO.	J9P3305
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	SPRING VALLEY

DATE	DESCRIPTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

olsson
7301 WEST 133RD STREET
OVERLAND PARK, KS 66213
CERTIFICATE OF AUTHORITY NO. 001592



Note:
Prestressed concrete girder approach spans are shown. Haunched steel plate girder spans are also possible but are not shown.

Note:
Minimum vertical and horizontal clearances shown are estimated based on limited survey data.

Figure A-20: Spring Valley - Replacement In-Kind on Offset Alignment Plan and Elevation

Note: This drawing is not to scale. Follow dimensions.

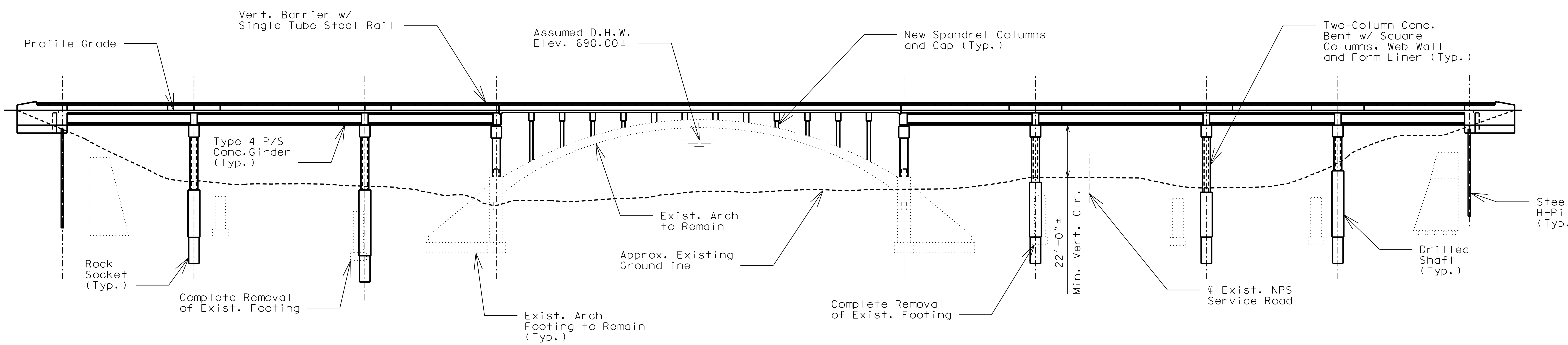
NOT FOR CONSTRUCTION

DATE PREPARED	11/19/2019
ROUTE	19
STATE	MO
DISTRICT	BR
SHEET NO.	A.20
COUNTY	SHANNON
JOB NO.	J9P3305
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	SPRING VALLEY

DATE | DESCRIPTION

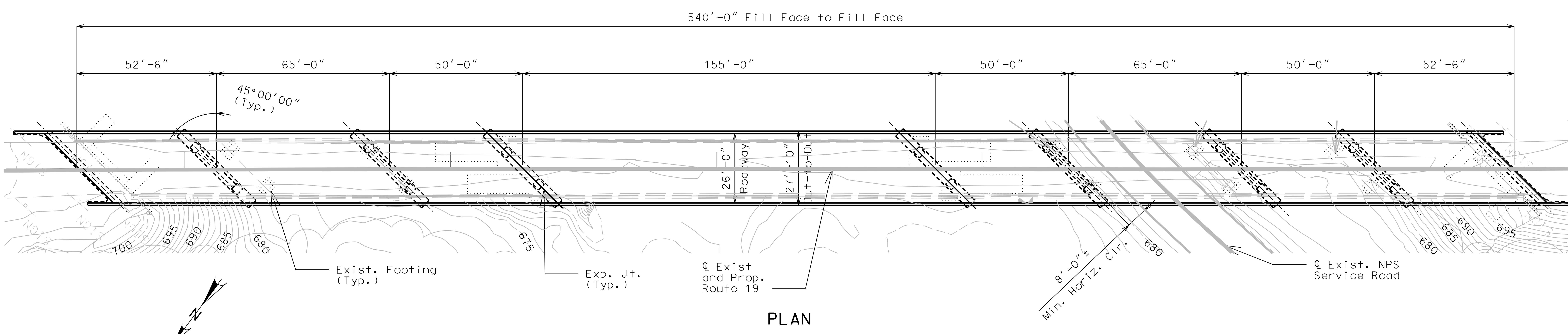
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
MoDOT
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

HDR Engineering, Inc.
4435 Main Street
Suite 1000
Kansas City, MO 64111-1856
816-360-2700
Certificate of Authority: 000856



ELEVATION

Note:
Prestressed concrete girder approach spans are shown. Haunched steel plate girder spans are also possible but are not shown.



PLAN

Note:
Minimum vertical and horizontal clearances shown are estimated based on limited survey data.

Figure A-21: Spring Valley - Rehabilitation and Widening of Existing Bridge Plan and Elevation

Note: This drawing is not to scale. Follow dimensions.

NOT FOR CONSTRUCTION

DATE PREPARED	11/19/2019
ROUTE	19
STATE	MO
DISTRICT	BR
SHEET NO.	A.21
COUNTY	SHANNON
JOB NO.	J9P3305
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	SPRING VALLEY

DATE	DESCRIPTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

105 WEST CAPITOL
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816-360-2700
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Appendix B. Field Investigation Report

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Route 19 over Current River (Br. G0804)
Rehabilitation / Replacement Concept Study
Report of Field Investigation

MoDOT Project No.: J9P3305

Prepared by:
HDR Engineering, Inc.

Site Work:
August 6 - 7, 2019

Table of Contents

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General Information

The scope of this field investigation was to gather information on the existing bridge sufficient to be used to estimate remaining life, repair needs, and rehabilitation costs. The information was gather visually from the ground, the roadway and the adjacent pedestrian bridge. Binoculars were used intermittently as deemed appropriate to obtain more detailed information readily attainable. The scope of work was set to be conducted in a one-day site visit.

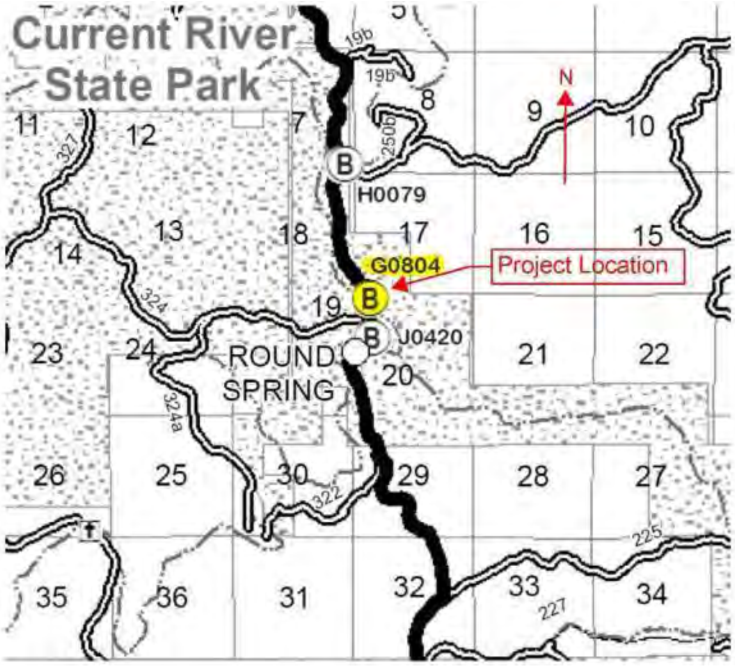
The field investigation was performed August 6th, 2019 and August 7th, 2019 by a field crew consisting of Brian Zeiger, PE with HDR Engineering, Inc. and Terry Stowell with Olsson Associates. The bridge was accessed on foot from the north approach, via a local access road under the north end span, and from the south approach. No equipment was used for access. The bridge was open to traffic at all times for this field investigation.

As a condition of the overall scope of the project it was assumed that the bridge will need a new deck for all options and therefore the deck was excluded from the investigation. General photos of the deck and rail were included for information only.

Bridge Description

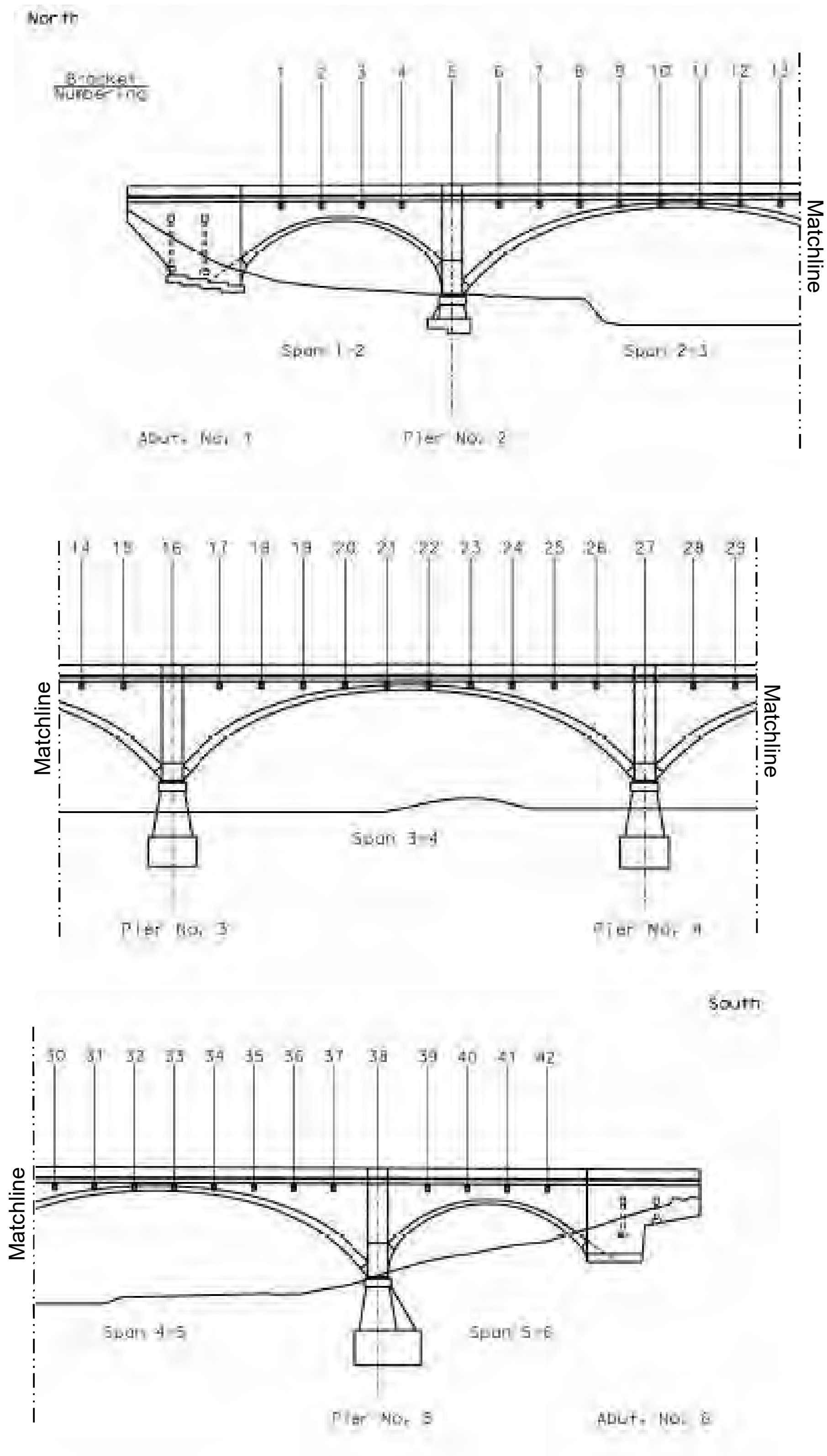
The bridge over the Current River (G0804) was built in 1924, has (60'-130'-130'-130'-60') filled arch spans with 34' filled deep abutments. The bridge has ratings of deck -5, superstructure-5 substructure-6, and has an 18' roadway. The bridge is posted for centerline only. Several of the overhang supports have significant deterioration. The deck between the arch walls is supported by the fill between the arch walls. The bridge is over the Current River within the National Park. There are trails, canoe rental businesses and canoe access to the river close by. There is a pedestrian / utility bridge located just downstream and parallel to G0804. The overall bridge elevation is shown looking southwest in the following photograph.

Elevation of Bridge

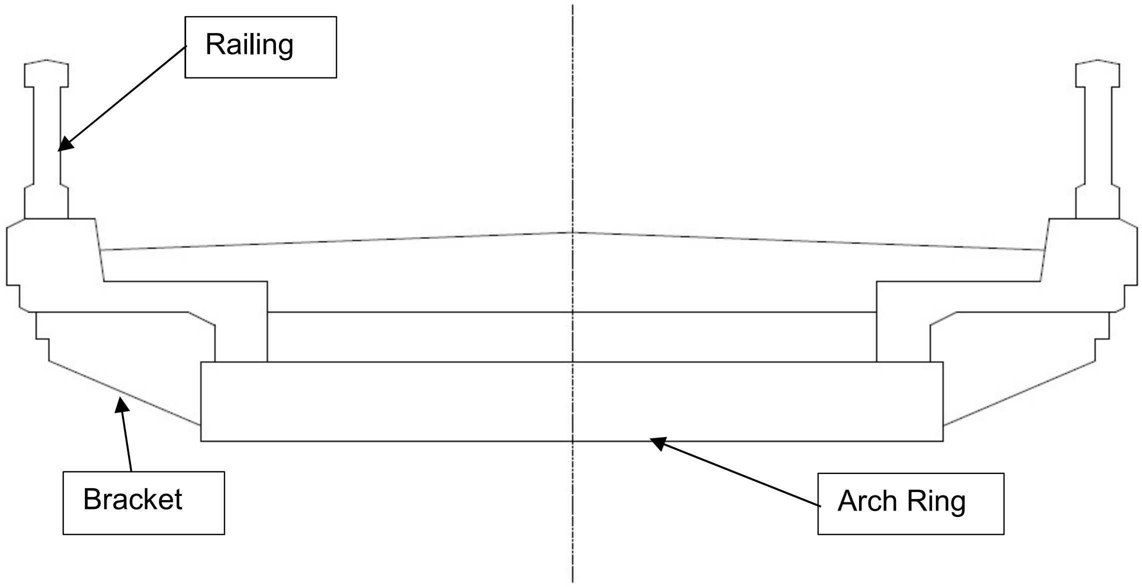


Location Map

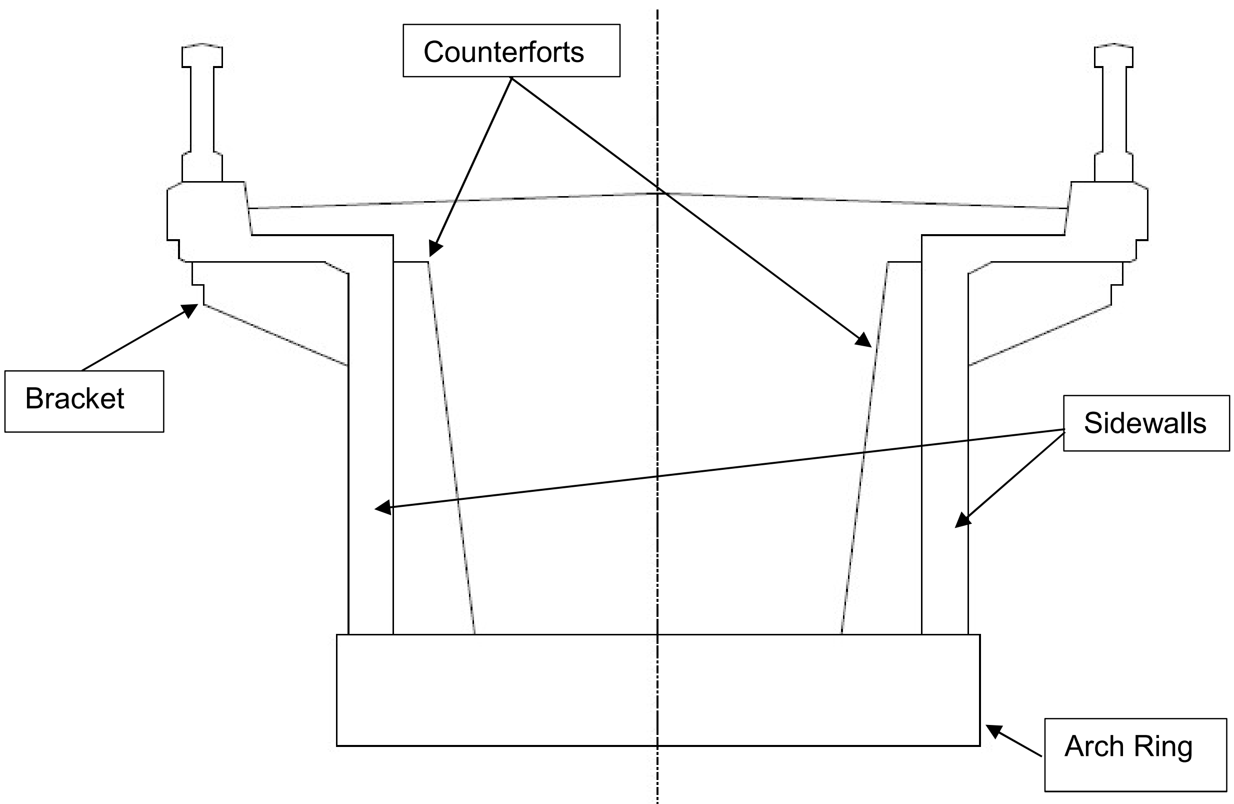
Aerial Photograph



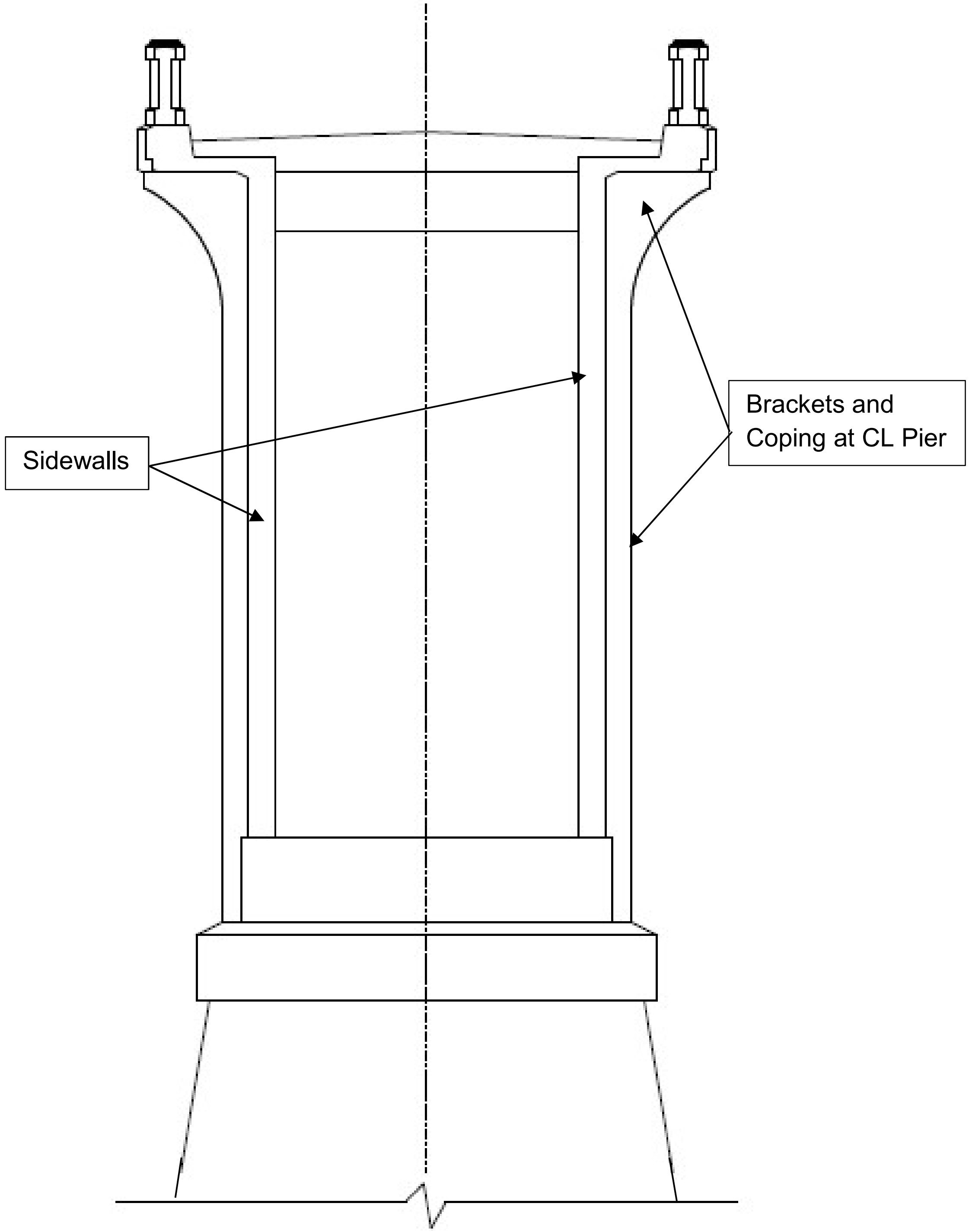
Elevation of Bridge
(Abutment, pier and bracket numbering shown)



Typical Section at Midspan of Arch



Typical Section at Counterforted Sidewall



Typical Section at Pier

Results of Field Investigation

Deck and Barrier

The scope of services for this project listed the project condition that the deck and barrier would be replaced under any of the rehabilitation scenarios developed for this project. The deck and barriers were therefore excluded from analysis during the site visit. However, a cursory observation was made for informational purposes. The following photographs show various areas of collision damage and deflection of the rails, the cracking of the asphalt wearing surface of the roadway and small deck spalls that were observed during the site visit.

Collision Damage to the Railing

Condition of Wearing Surface

Deck Spall

Superstructure

The superstructure of the bridge consists of five spans of filled spandrel arches. The fill material is from local sources with drains and drainage materials installed at the bases of the arch rings at the piers. The side walls have joints at the bracket locations and are either cantilevered walls or have counterforts install for support. Refer back to the typical sections for views of these details.

In general the arches are in good condition with areas of spalling and staining, primarily from leakage at the vertical joints in the sidewalls and the brackets. This leakage appears to be due in large part to the failure of the joint material between sections of the sidewall. The brackets supporting the deck cantilevers are heavily deteriorated throughout the structure. Several locations exhibit loss of up to 40% of the bracket area under the deck. Heavy spalling with exposed reinforcing steel is also prevalent.

One additional observation on the superstructure was the differential lateral movement between the sidewall sections. The section of sidewall over the pier that extends to each joint is either connected from side to side with a floor beam or there are counterforts on the pier side of the joint. The wall that is on the opposite side of the joint is not likewise supported and appears to have deflected outward on the order of ¾” per side. This results in a face of barrier dimension approximate 1 ½” wider than over the pier.

The following photographs represent examples of these superstructure observations.

Spalling and Staining on Arch Ring

Leakage from Sidewall Joints

Heavy Deterioration with Loss of Bracket Support Area

Differential Alignment of Barrier at Joints Adjacent to Pier

Substructure

The substructure elements are in generally fair condition. There are areas of scaling, staining, and deterioration on most substructure members. No obvious signs of settlement were observed. The abutments generally exhibit the spalling cracking and delamination on the outstanding corners and adjacent to the vertical joints. The piers exhibit the same types of deterioration and additionally scaling on the piers was observed and indications of scour holes at piers 3 and 4. The following photographs highlight the typical deterioration of the substructure elements.

Typical Spalling at Abutment Corners

Cracking and Delamination at Abutments

Scaling Along Pier Foundations

Spalling on Pier Surfaces

Scour Hole at Pier 3

Scour Hole at Pier 4

Summary

The bridge is in generally fair condition with consistent areas of deterioration throughout the elements. Most of this deterioration is due to poor drainage of the fill material and failure of the expansion joint filler in the vertical joints of the brackets and sidewalls.

Recommendations

Based on the observations of this site visit, rehabilitation of this structure should include the following items:

- Replacement of the barrier and the wearing surface.
- Improvement of the drainage system for the arch fill material.
- Replacement of the joint filler in the sidewalls.
- Repair or replacement of the numerous deteriorated brackets.
- Concrete repair and possible chloride remediation at deteriorated concrete areas and areas of high chloride levels in walls, piers and arches.
- Fill and protection of the observed scour holes

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Missouri Department of Transportation

STRUCTURAL REHABILITATION CHECKLIST

Bridge No.: G0804 | **Job No.:** J9P3305

Route: MO 19 | **Over:** Current River

County: Shannon | **Date of Field Check:** August 6, 2019

*** * * Please include photographs for all items that apply. * * ***

1 OVERLAY

* **Type of existing overlay:** ☐ None ☑ Asphalt ☐ Low Slump ☐ Silica Fume ☐ Latex ☐ Epoxy ☐ Other: ____

* **Existing overlay thickness:** 5-7 "   * **Year overlay was applied:** 2010 ☐ Unknown

* **% of overlay repaired or patched:** ____ %   * **Replace overlay:** ☐ Yes ☐ No

* **Notes:** Asphalt wearing surface width along concrete cantilever curb of 4' on each side and earth fill in center.

Picture # Pic: 001

2A DECK REPAIRS

(Deck repair quantities are required even if a Deck Test request has been ordered for this structure.)

* **Half-sole repairs:** ____ sq. ft.
(round up to the nearest 50 sq. ft.)

* **Full-depth repairs:** ____ sq. ft.
(round up to the nearest 25 sq. ft.)

* **Slab edge repairs:** ____ lin. ft.
(covers the outer 4" of the slab edge)

* **Superstructure repair (Unformed):** ____ sq. ft.
(covers the remaining slab cantilever beyond the outer 4")

* **Clean & seal slab edge:** ____ lin. ft.
(in lieu of edge repairs)

* **Cantilever replacement:** 1204 lin. ft.

* **Total surface hydro demolition bridge deck:** ☐ Yes ☑ No
(half-sole and full depth repair quantities still required)

* **Full deck replacement (redeck):** ☑ Yes ☐ No ☐ Optional

* **Superstructure replacement:** ☐ Yes ☐ No ☑ Optional

* **Deck repairs with voided tube replacement:** ☐ Yes ☑ No
(if applicable)
____ sq. ft.

* **Full bridge replacement:** ☐ Yes ☐ No ☑ Optional
(Deck repair quantities required for cost comparison of alternatives)

* **How were the quantities obtained?** ☑ Visual ☑ Bridge Inspection Report ☐ Sounded ☐ Other ____

* **Notes:** ____

Picture #

2B

DECK REPAIRS CONT.

*** ISSUES \ PROBLEMS WITH PRECAST PRESTRESSED DECK PANELS**

Spans	At Panel Jt.	Btwn (mid) Panel Jt.	Location in Span: End		Mid		End	Deterioration: Type	Deterioration: Amount	Describe
____	☐	☐	☐	☐	☐	☐	☐	____	sq. ft.	____
____	☐	☐	☐	☐	☐	☐	☐	____	sq. ft.	____
____	☐	☐	☐	☐	☐	☐	☐	____	sq. ft.	____
____	☐	☐	☐	☐	☐	☐	☐	____	sq. ft.	____
____	☐	☐	☐	☐	☐	☐	☐	____	sq. ft.	____
____	☐	☐	☐	☐	☐	☐	☐	____	sq. ft.	____

* **Notes:** ______________________________

(Deterioration may include water saturation, efflorescence, rust staining, cracking, spalling, exposed steel, disintegration of panel edges at joints, etc. Typically observed at or near panel joints. The location and "Type" of deterioration should be recorded.)

Picture #

3

APPROACH SLABS

* **Is there a bridge approach slab in place?** ☐ Yes ☑ No * **Type:** ☐ Concrete ☐ Asphalt ☐ Other ____

* **Is there a rdwy. approach pavement in place?** ☑ Yes ☐ No * **Type:** ☐ Concrete ☑ Asphalt ☐ Other ____

* **Is the approach slab sinking at the end bent?** ☑ N/A ☐ Yes ☐ No ____

* **Are repairs needed to the bridge approach slab driving surface?** ☐ Yes ☑ No ____
(Typically a roadway item but will be reported to district on the Bridge Memorandum.)

* **Notes:** ______________________________

Picture #

4

SLAB DRAINS

* **Is the drainage system working adequately?** ☐ Yes ☑ No

* **Recommendations:** Provide drains during rehabilitation or replacement of existing bridge.

* **Notes:** No deck drains in place.

Picture # Pic: 002

5

CURBS & RAILS

* **Existing curb (left side):** ☐ Safety Barrier Curb ☐ Curb/parapet ☐ Blockouts ☐ Thrie Beam ☑ Baluster ☐ Steel Channel
  ☐ Other ______ ☐ Handrail ☐ Fence ______
  * Does curb need repair ☑ Yes ☐ No
  * Curb repair 602 lin. ft.
  * Remove hand rail ☐ Yes ☑ No
  * Add curb blockout ☐ Yes ☑ No

* **Existing curb (right side):** ☐ Safety Barrier Curb ☐ Curb/parapet ☐ Blockouts ☐ Thrie Beam ☑ Baluster ☐ Steel Channel
  ☐ Other ______ ☐ Handrail ☐ Fence ______
  * Does curb need repair ☑ Yes ☐ No
  * Curb repair 602 lin. ft.
  * Remove hand rail ☐ Yes ☑ No
  * Add curb blockout ☐ Yes ☑ No

* **Existing median curb:** Type: N/A Width ______ " Height ______ "
  * Does curb need repair ☐ Yes ☑ No
  * Curb repair ______ lin. ft.

* **Approach rail attachment:** ☑ None ☐ Not attached ☐ 4 Hole ☐ 5 Hole ☐ Turn-down ☐ Other ______

* **If the existing handrails will be removed, does the local maintenance supervisor wish to keep them?** ☐ Yes ☑ No

Storage address: *location:* ______
address: ______
city: ______ *state:* ______ *zip:* ______

* **Notes:** Total of 1204 lin. ft. of concrete baluster bridge rail.

Picture # Pic: 003, 004

6

EXPANSION DEVICES

Bent	Type	Recommendations			Gap Left	Gap Right	Temperature & Other Info
		USE-IN-PLACE	REPAIR	REPLACE			
		☐	☐	☐	"	"	
		☐	☐	☐	"	"	
		☐	☐	☐	"	"	
		☐	☐	☐	"	"	
		☐	☐	☐	"	"	
		☐	☐	☐	"	"	

* Notes: N/A

Picture #

7

BEARINGS

Bent	Coating		Recommendations						Notes (indicate which bearings at each bent)
	CLEAN & OVERCOAT	BLAST CLEAN & RECOAT	USE-IN-PLACE	REPAIR	RESET	REPLACE	MAKE END BENT SLIDING SLAB	MAKE END BENT INTEGRAL	
	☐	☐	☐	☐	☐	☐	☐	☐	
	☐	☐	☐	☐	☐	☐	☐	☐	
	☐	☐	☐	☐	☐	☐	☐	☐	
	☐	☐	☐	☐	☐	☐	☐	☐	
	☐	☐	☐	☐	☐	☐	☐	☐	
	☐	☐	☐	☐	☐	☐	☐	☐	

* Notes: N/A

Picture # (Provide Pictures of Each Bearing)

8

COATING SYSTEM (PAINT)

* **Existing coating system:** N/A ☐ green ☐ gray ☐ other ____

* **Date last coated:** ____

* **Is existing coating peeling?** ☐ Yes (Overcoat is not an option) ☐ No

* **Coating recommendation:**

☐ Blast clean & recoat all steel

☐ Clean & overcoat all steel

☐ Blast clean & recoat only at joint locations

☐ Blast & recoat at joint locations and clean & overcoat all other steel

Note: Pull off test required for overcoat (Calcium Sulfonate) option. Bridge Division will request pull off tests.

* Notes: N/A

Picture #

9

SUPERSTRUCTURE REPAIRS

(Repairs needed not previously stated.)

Concrete Slab Superstructure or Girder: *(above the bearings)*

(Example: Deck solid slabs, voided slabs, box girder, deck girders & prestressed girders)

Steel: *(Example: Beams, stringers, girders, diaphragms, cross-frames, misc. steel)*

Member *(Check all that apply) (Attach pictures)*					Describe & Locate
	☐ Section Loss	%	☐ Cracks	in.	
	☐ Section Loss	%	☐ Cracks	in.	
	☐ Section Loss	%	☐ Cracks	in.	
	☐ Section Loss	%	☐ Cracks	in.	

Notes: **The HDR field investigation report describes typical deterioration found. Further anlaysis has shown that areas that could be considered Superstructure will be encased behind new construction during a rehabilitation due to needed widening.**

Picture # **Pic: 005, 006**

10

SUBSTRUCTURE REPAIR

Bent	Formed Repair	Unformed Repair	Seal Concrete Beam Cap Bts.	Coat Exposed Pile @ Int. Pile Cap Bts.	Describe (Beam, Backwall, Wing, etc.)
1	110 sq. ft.	sq. ft.	☐ Yes ☐ No	☐ Yes ☐ No	
2	170 sq. ft.	sq. ft.	☐ Yes ☐ No	☐ Yes ☐ No	
3	130 sq. ft.	sq. ft.	☐ Yes ☐ No	☐ Yes ☐ No	
4	190 sq. ft.	sq. ft.	☐ Yes ☐ No	☐ Yes ☐ No	
5	140 sq. ft.	sq. ft.	☐ Yes ☐ No	☐ Yes ☐ No	
6	110 sq. ft.	sq. ft.	☐ Yes ☐ No	☐ Yes ☐ No	

* **Does the structure need graffiti protection?** ☑ No ☐ Bottom 8' of Concrete ☐ End Bents ☐ Other

* **Notes:**

Picture # **Pic: 007, 008, 009**

11

SIGNS, SIGNALS &/OR LIGHTING ATTACHED TO STRUCTURE

* **Are there signs attached directly to this structure?** ☐ Yes ☑ No quantity ____ location ____
* **Describe proposed work to be done to signs.** ____
* **Are there signals attached directly to this structure?** ☐ Yes ☑ No quantity ____ location ____
* **Describe proposed work to be done to signals.** ____
* **Is there aviation lighting attached to this structure?** ☐ Yes ☑ No ☐ N/A ☐ Red ____ *qnty.* ☐ Green ____ *qnty.*
* **Is there navigational lighting attached to this structure?** ☐ Yes ☑ No ☐ N/A ☐ Red ____ *qnty.* ☐ Green ____ *qnty.*
* **Is there roadway lighting attached to this structure?** ☐ Yes ☑ No ☐ N/A
* **Describe proposed work to be done to lighting.** ____
* **Notes:** ____

Picture #

12

UTILITIES ATTACHED TO STRUCTURE

Type			Qty.	Size	Owner	Condition			
☐ Conduit	☐ Pipeline	☐ Other				☐ Repaint	☐ Repair	☐ Replace	☐ Remove
☐ Conduit	☐ Pipeline	☐ Other				☐ Repaint	☐ Repair	☐ Replace	☐ Remove
☐ Conduit	☐ Pipeline	☐ Other				☐ Repaint	☐ Repair	☐ Replace	☐ Remove
☐ Conduit	☐ Pipeline	☐ Other				☐ Repaint	☐ Repair	☐ Replace	☐ Remove

* **Notes:** **Utilities on adjacent ped bridge.**

Picture # **Pic: 010**

13

CATHODIC PROTECTION SYSTEM

* **Is there a cathodic system on this structure?** ☐ Yes ☑ No ☐ Remove ☐ Do not alter ☐ Abandon in place (grooved system)

* **Is it on and working?** ☐ Yes ☐ No ☐ Unknown

* **Notes:**

Picture #

14

CHANNEL ALIGNMENT, SLOPE PROTECTION & SCOUR

* **Is channel aligned to bridge opening?** ☑ Yes ☐ No Describe

* **Is drift a continual problem?** ☑ Yes ☐ No Describe & Locate **High water drift on south bank affecting pier 4**

* **Is erosion a problem?** ☑ Yes ☐ No Describe & Locate **Erosion around substructure units on South bank**

* **Describe slope protection in place.** **Little of original slope protection in place around Abutment 6**

* **Scour**

At Footing	At Piling	Depth	Bent	Recommendation
☑	☐	Est 8'	4	
☑	☐		3	See MoDOT UW Insp. Report Dated 07/26/2016

* **Describe needed work.** **Remove drift up and down stream. Level elevation under bridge. Fill scour holes with type II rip rap**

Picture # **Pic: 011, 012**

15

TRAFFIC LANES

* **Number of lanes striped:** on structure 1 under structure 0

* **Shoulder width:** ☑ None on structure 4 ft. *(left)* 4 ft. *(right)* under structure 0 ft *(left)* 0 ft *(right)*

* **Sidewalk widths:** on structure 0 ft *(left)* 0 ft *(right)* under structure 0 ft *(left)* 0 ft *(right)*

* **Median width:** on structure 0 under structure 0

* **Proposed improvements for lanes/shoulders/sidewalks:**

Picture # **Pic: 013**

16

GENERAL AREA CONDITIONS

* **Primary area:** ☑ Commercial ☐ Industrial ☐ Residential ☐ Agricultural ☐ Military ☑ Other **Nat Waterway Park**

* **Posted speed limit on structure:** **35** mph

* **Posted load on structure:** ______ tons @ ______ mph ☐ NA
  Single Unit: ______ tons @ ______ mph ☐ NA
  Semi (tractor/trailer): ______ tons @ ______ mph ☐ NA

* **Are both signs in place?** ☐ Yes ☐ No

* **Do pedestrians and/or bicyclists regularly use this structure?** ☐ Yes ☐ No ☑ Undetermined

* **Notes:** **Posted at S-4. Ped bridge adjacent to structure** **Posted as single lane centerline use only.**

Picture # **Pic: 014, 015**

17

MAINTENANCE

* **What work has been done to this structure that may not be reflected on existing bridge plans?**

Depth of roadway overlay surface along CL bridge

Picture #

18

ADDITIONAL FIELD NOTES

Picture #

19

STAGING / DETOUR

* **Traffic Control:** ☐ Close structure ☐ Stage construction on structure ☐ Cross over traffic to adjacent structure ☐ Detour

☑ Other option **Build an offset alignment or staged construction on structure.**

* **Define probable detour route.** **Detour estimate at 55+ miles.**

20

PERSONS ASSISTING WITH CHECKLIST

Name Brian Zeiger, PE	Title Senior Bridge Engineer, HDR Engineering	Ph. (913) 302 - 8931
Name Terry Stowell	Title CA Field Operations, Olsson Assoc.	Ph. (816) 604 - 9888
Name	Title	Ph. ( ) -
Name	Title	Ph. ( ) -
Name	Title	Ph. ( ) -

21

REQUIRED SIGNATURES

I have reviewed the information on this checklist and believe it to be as accurate as possible.

Name ______________________ **Date** __________

Transportation Project Manager

Name ______________________ **Date** __________

District Bridge Engineer

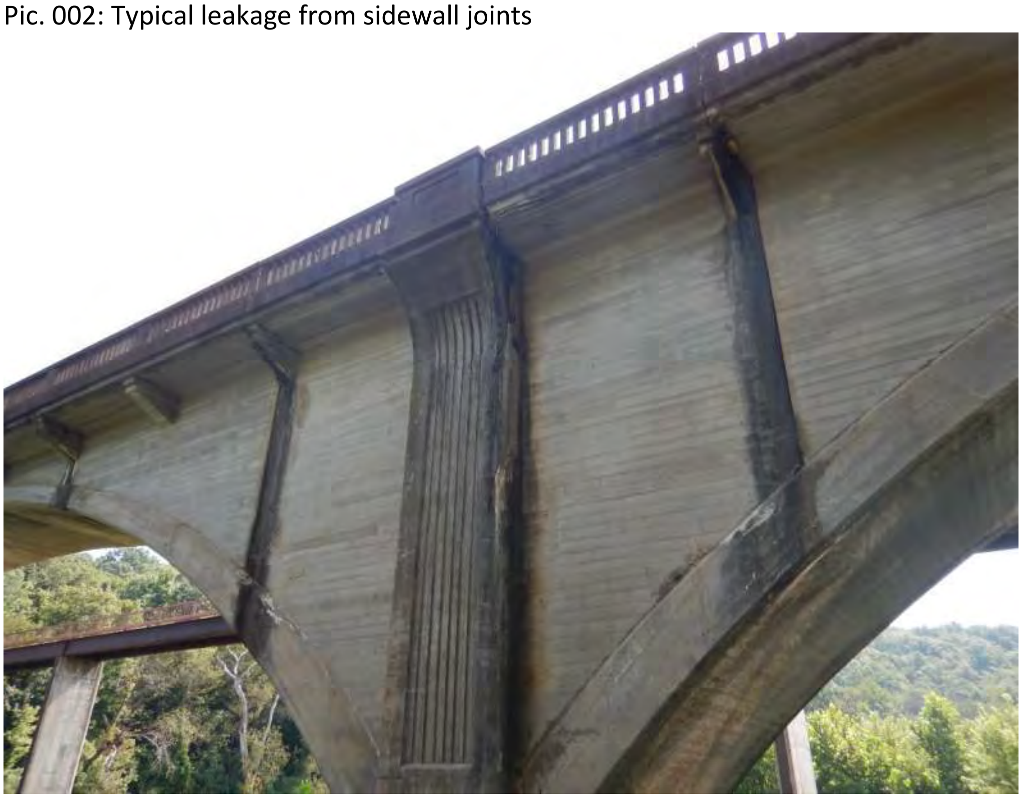
The structural rehabilitation checklist indicates how the bridge is functioning and aging.

All deterioration should be noted, even if it is known that the work will not be completed under the proposed project.

Send **NEW** Structural Rehabilitation Checklist by email
To: "Bridge Survey Processor"
Cc: Structural Project Manager or Structural Resource Manager

Pic. 001: Typical view of pavement, north end shown.

Pic. 002: Typical leakage from sidewall joints



Pic. 003: West barrier, Span (2-3)

Pic. 004: West barrier, Span (4-5)

Pic. 005: Spalling along corner of arch ring, Span (4-5) east face

Pic. 006: Spalling along corner of arch ring, Span (4-5) east face

Pic. 007: Cracking and delamination, Abutment 1 west side

Pic. 008: Spalled and deteriorated concrete, Pier 3 west face

Pic. 009: Spalling and delamination on pilaster, Pier 2 east side

Pic. 010: Utilities on adjacent pedestrian / utility crossing

Pic. 011: Scour hole at Pier 3

Pic. 012: Scour hole at Pier 4

Pic. 013: Roadway over bridge looking north

Pic. 014: Pedestrian / utility crossing east of highway, looking south

Pic. 015: Reduction to single lane with yield sign, south end of bridge

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Route 19 over Spring Valley (Br. J0420)

Rehabilitation / Replacement Concept Study

Report of Field Investigation

MoDOT Project No.: J9P3305

Prepared by:

HDR Engineering, Inc.

Site Work:

August 7, 2019

Table of Contents

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General Information

The scope of this field investigation was to gather information on the existing bridge sufficient to be used to estimate remaining life, repair needs, and rehabilitation costs. The information was gathered visually from the ground and the roadway. Binoculars were used intermittently as deemed appropriate to obtain more detailed information readily attainable. The scope of work was set to be conducted in a one-day site visit.

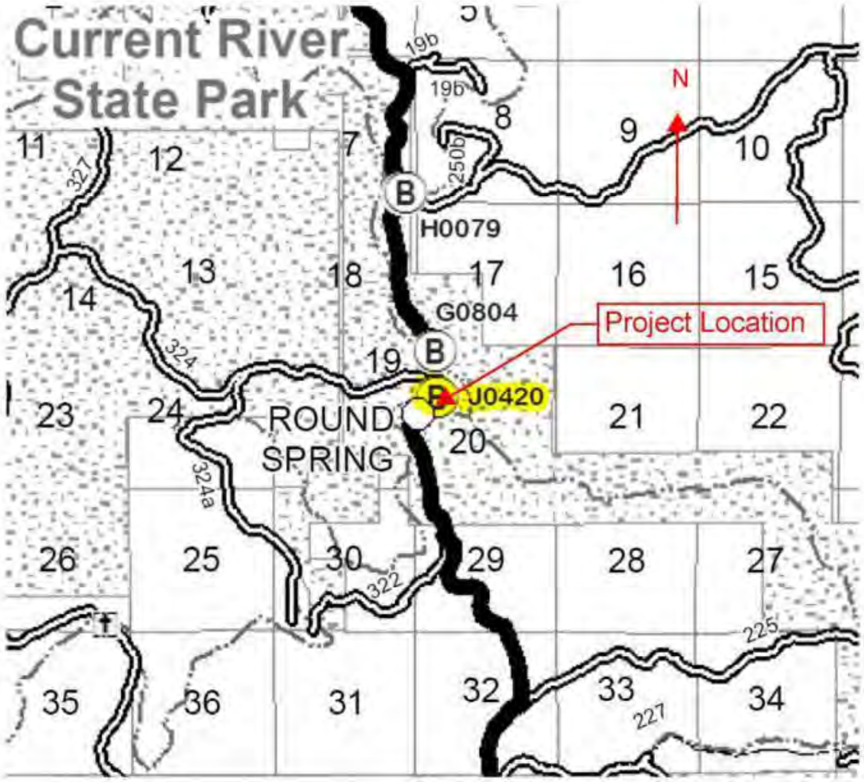
The field investigation was performed August 7th, 2019 by a field crew consisting of Brian Zeiger, PE with HDR Engineering, Inc. and Terry Stowell with Olsson Associates. The bridge was accessed on foot from the north approach, via a local park access road under the south approach span, and from the south approach. No equipment was used for access. The bridge was open to traffic at all times for this field investigation.

As a condition of the overall scope of the project it was assumed that the bridge will need a new deck for all options and therefore the deck was excluded from the investigation. General photos of the deck and rail were included for information only.

Bridge Description

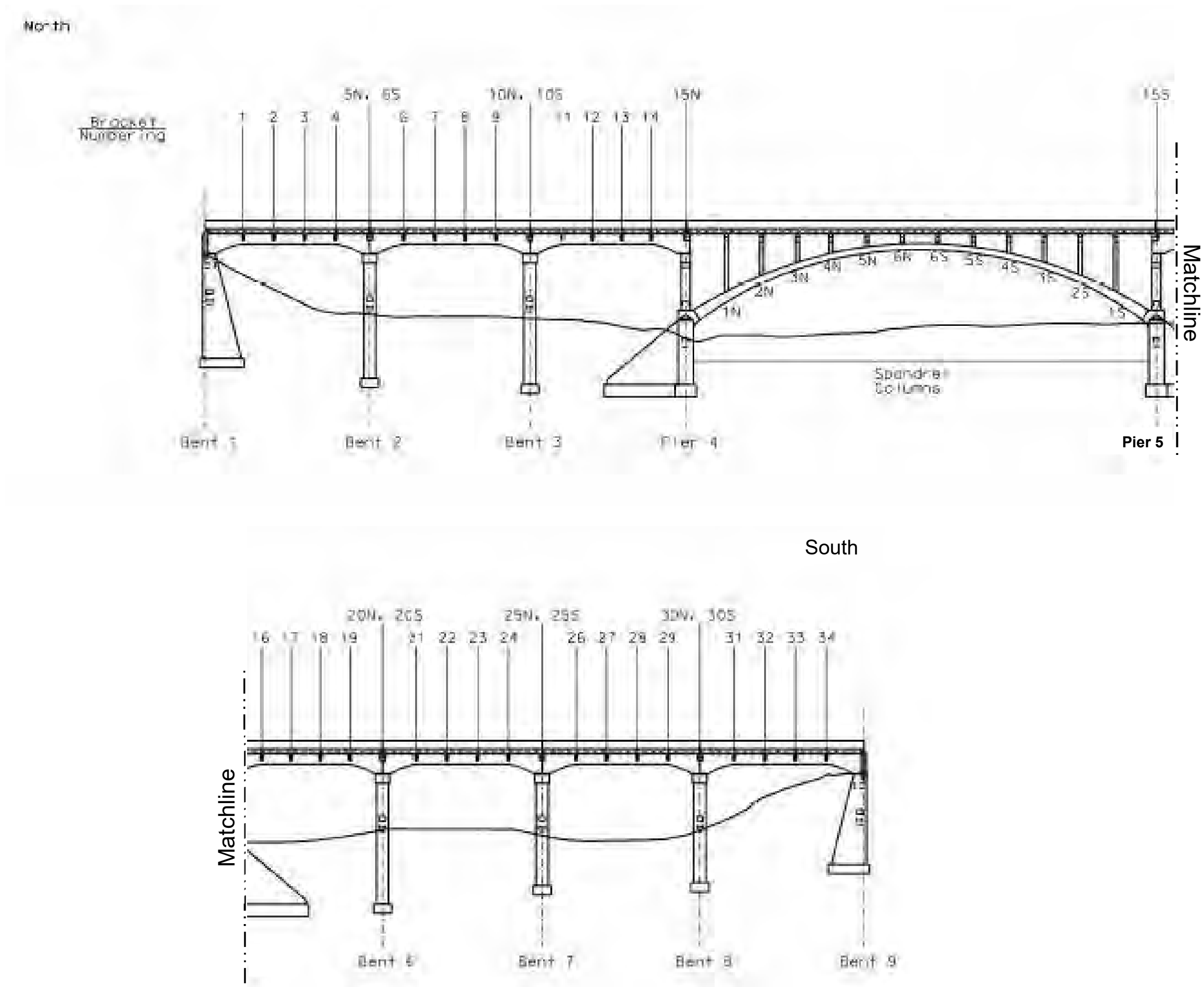
The bridge over Spring Valley (J0420) was built in 1930, is 523 feet long and has 7- 52' arch deck girder approach spans (3 on one end and 4 on the other) with a 155' spandrel arch main span. The bridge has ratings of deck – 4, superstructure – 5 and substructure – 6, and has a 20' roadway. The bridge is not posted. The deck is in poor condition. The bridge goes over and next to campgrounds, park service buildings, roads, springs, caves and trails.

Elevation of Bridge

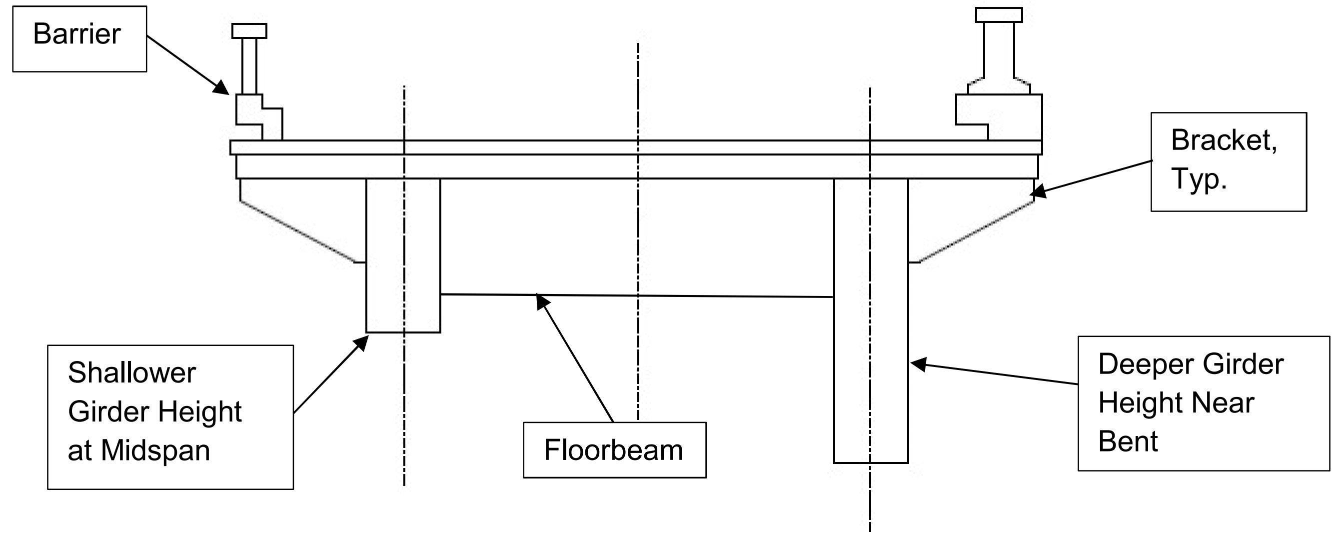


Location Map

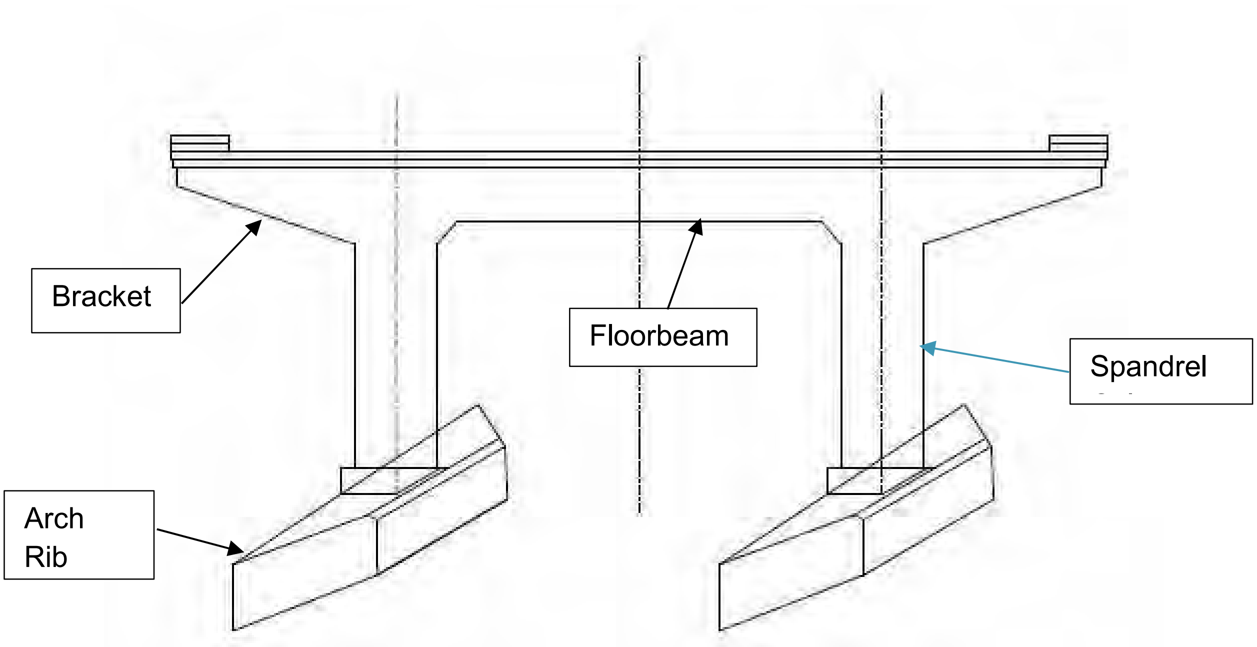
Aerial Photograph



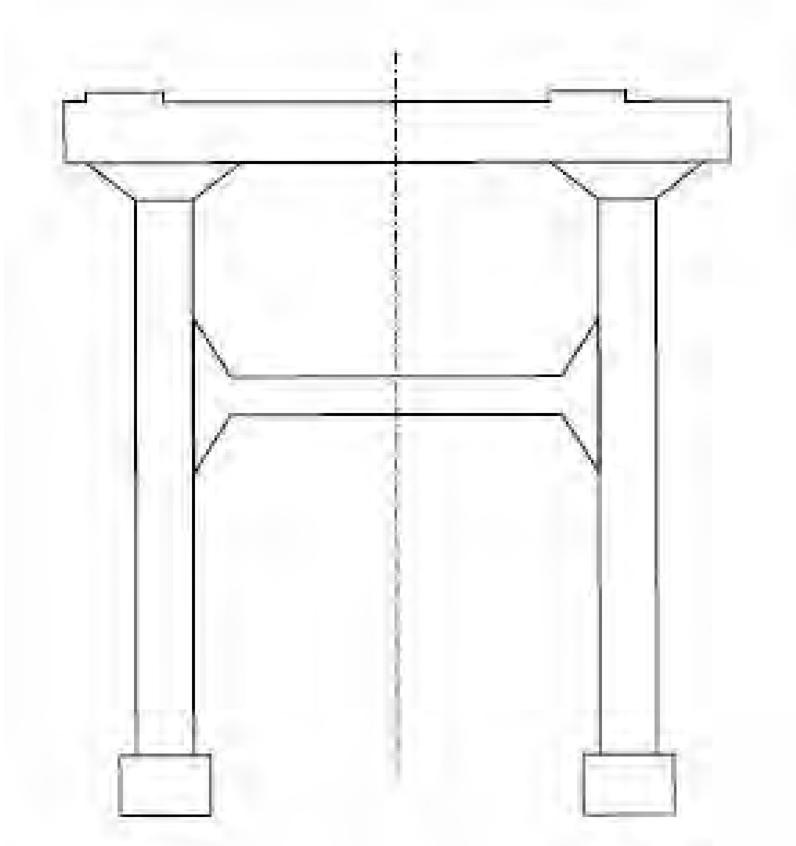
Elevation of Bridge
(Bent, spandrel column and bracket numbering shown)



Typical Section – Girder Spans



Typical Section Through Arch Span
(Perpendicular to Spandrel Bent)



Typical Elevation of Intermediate Bent

Results of Field Investigation

Deck and Barrier

The scope of services for this project listed the project condition that the deck and barrier would be replaced under any of the rehabilitation scenarios developed for this project. The deck and barriers were therefore excluded from analysis during the site visit. However, a cursory observation was made for informational purposes. The following photographs show various areas of collision damage and deflection of the rails, the spalling of the asphalt wearing surface of the roadway, heavy deterioration at the deck drains, and overall views of the wearing surface and deck expansion joints.

Collision Damage to the Railing


Condition of Wearing Surface


Heavy Deterioration of the Deck at Existing Drains

Typical Slab Expansion Joint

Superstructure

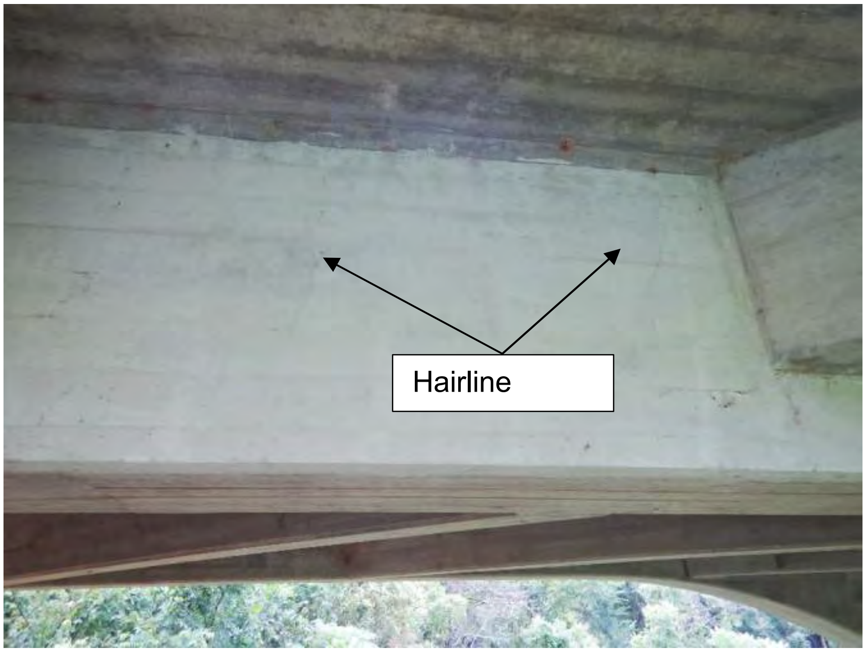
The superstructure of the bridge consists of three units. Unit 1 is three spans of concrete girders with floorbeams, Unit 2 is an open spandrel arch span and Unit 3 is four spans of concrete girders with floorbeams. The arch span includes multiple spandrel bents composed of columns, cap beams and overhang brackets. Refer back to the typical sections for views of these details.

In general the concrete girders of Units 1 and 3 and the arch ribs of Unit 2 are in good condition with areas of spalling, hairline cracking, delamination and staining, primarily from drainage from the deck. The brackets supporting the deck cantilevers are deteriorated throughout the structure.

The arch spandrel columns and cap beams exhibit several areas of spalling, cracking and delamination. Additionally there is some drift caught up on the west arch rib at the north end of the span indicating inundation of this area during a high flow event. There is also spalling with exposed rebar on several locations of the arch lateral bracing.

The bridge is on a 45 degree skew and is exhibiting lateral movement of the girders relative to the substructure due to the sharp skew. Previous retrofit projects have included the installation of brackets to keep the girders in line with the bearings. The girders are tight against these brackets. At Bent 9 there appears to have been an attempt to raise the east girder and realign the upper bearing plate with the girder. A jacking block had been added to the girder to facilitate this modification.

The following photographs represent examples of these superstructure observations.



Typical Hairline Cracks in Girders

Typical Delamination on Girders


Typical Deterioration of Brackets


Typical Girder Restraint Bracket

East Girder at Bent 9

Deterioration of Floorbeams at Intermediate Bents

Spalling and Delamination of Arch Ribs

Drift in Structure

Typical Deterioration on Spandrel Columns

Typical Deterioration on Spandrel Capbeams

Lateral Bracing Between the Arch Ribs

Substructure

The substructure elements are in generally fair condition. There are areas of scaling, staining, and deterioration on most substructure members. No obvious signs of settlement were observed. The abutments generally exhibit the spalling cracking and delamination on the backwalls and wings. The intermediate bents have numerous areas of cracking with spalling and exposed reinforcing steel. The following photographs highlight the typical deterioration of the substructure elements.

Typical Spalling at Abutment

Deterioration of Intermediate Bent Columns

Deterioration of Intermediate Bent Cap Beams

Summary

The bridge is in generally fair condition with consistent areas of deterioration throughout the elements. Most of this deterioration is due to drainage from the open curb drains of the deck allowing drainage to fall on the superstructure and substructure members

Recommendations

Based on the observations of this site visit, rehabilitation of this structure should include the following items:

- Replacement of the deck, barrier and the wearing surface. Replacement of the deck will require replacement of the concrete deck girders and possibly the floorbeams over the spandrel arch.
- Include a drainage system in the rehabilitation or replacement.
- Repair or replace of the numerous deteriorated brackets.
- Repair the numerous areas of cracking, spalling and delamination in the superstructure and substructure.
- Concrete repair and possible chloride remediation at deteriorated concrete areas and areas of high chloride levels.
- Stabilization of the lateral displacement of the girders due to the 45 degree skew.
- Fill observed scour hole and provide protection for the pier.

Missouri Department of Transportation

STRUCTURAL REHABILITATION CHECKLIST

Bridge No.: J0420 | **Job No.:** J9P3305

Route: MO 19 | **Over:** Spring Valley

County: Shannon | **Date of Field Check:** August 7, 2019

*** * * Please include photographs for all items that apply. * * ***

1

OVERLAY

* **Type of existing overlay:** ☐ None ☑ Asphalt ☐ Low Slump ☐ Silica Fume ☐ Latex ☐ Epoxy ☐ Other: ______

* **Existing overlay thickness:** 1" "   * **Year overlay was applied:** 2010 ☐ Unknown

* **% of overlay repaired or patched:** ______ %   * **Replace overlay:** ☐ Yes ☐ No

* **Notes:** Deck replacement incorporated into rehab

Picture # Pic: 001

2A

DECK REPAIRS

(Deck repair quantities are required even if a Deck Test request has been ordered for this structure.)

* **Half-sole repairs:** ______ sq. ft.
(round up to the nearest 50 sq. ft.)

* **Full-depth repairs:** ______ sq. ft.
(round up to the nearest 25 sq. ft.)

* **Slab edge repairs:** ______ lin. ft.
(covers the outer 4" of the slab edge)

* **Superstructure repair (Unformed):** ______ sq. ft.
(covers the remaining slab cantilever beyond the outer 4")

* **Clean & seal slab edge:** ______ lin. ft.
(in lieu of edge repairs)

* **Cantilever replacement:** ______ lin. ft.

* **Total surface hydro demolition bridge deck:** ☐ Yes ☐ No
(half-sole and full depth repair quantities still required)

* **Full deck replacement (redeck):** ☑ Yes ☐ No ☐ Optional

* **Superstructure replacement:** ☐ Yes ☐ No ☑ Optional

* **Deck repairs with voided tube replacement:** ☐ Yes ☐ No
(if applicable)
______ sq. ft.

* **Full bridge replacement:** ☐ Yes ☐ No ☑ Optional
(Deck repair quantities required for cost comparison of alternatives)

* **How were the quantities obtained?** ☐ Visual ☐ Bridge Inspection Report ☐ Sounded ☐ Other ______

* **Notes:** Deck replacement incorporated into rehab

Picture # Pic: 002

2B

DECK REPAIRS CONT.

*** ISSUES \ PROBLEMS WITH PRECAST PRESTRESSED DECK PANELS**

Spans	**At Panel Jt.**	**Btwn (mid) Panel Jt.**	**Location in Span** End		Mid		End	**Deterioration** Type	Amount	**Describe**
______	☐	☐	☐	☐	☐	☑	☐	______	sq. ft.	______
______	☐	☐	☐	☐	☐	☐	☐	______	sq. ft.	______
______	☐	☐	☐	☐	☐	☐	☐	______	sq. ft.	______
______	☐	☐	☐	☐	☐	☐	☐	______	sq. ft.	______
______	☐	☐	☐	☐	☐	☐	☐	______	sq. ft.	______
______	☐	☐	☐	☐	☐	☐	☐	______	sq. ft.	______

* **Notes:** N/A

(Deterioration may include water saturation, efflorescence, rust staining, cracking, spalling, exposed steel, disintegration of panel edges at joints, etc. Typically observed at or near panel joints. The location and "Type" of deterioration should be recorded.)

Picture #

3

APPROACH SLABS

* **Is there a bridge approach slab in place?** ☐ Yes ☑ No * **Type:** ☐ Concrete ☐ Asphalt ☐ Other ______

* **Is there a rdwy. approach pavement in place?** ☑ Yes ☐ No * **Type:** ☐ Concrete ☑ Asphalt ☐ Other ______

* **Is the approach slab sinking at the end bent?** ☑ N/A ☐ Yes ☐ No ______

* **Are repairs needed to the bridge approach slab driving surface?** ☐ Yes ☑ No ______
(Typically a roadway item but will be reported to district on the Bridge Memorandum.)

* **Notes:** ______

Picture #

4

SLAB DRAINS

* **Is the drainage system working adequately?** ☐ Yes ☑ No

* **Recommendations:** Provide drains during rehabilitation or replacement of existing bridge.

* **Notes:**

Picture # Pic: 002

5

CURBS & RAILS

* **Existing curb (left side):** ☐ Safety Barrier Curb ☐ Curb/parapet ☐ Blockouts ☐ Thrie Beam ☑ Baluster ☐ Steel Channel ☐ Other ☐ Handrail ☐ Fence
  * Does curb need repair ☑ Yes ☐ No
  * Curb repair ____ lin. ft.
  * Remove hand rail ☐ Yes ☑ No
  * Add curb blockout ☐ Yes ☑ No

* **Existing curb (right side):** ☐ Safety Barrier Curb ☐ Curb/parapet ☐ Blockouts ☐ Thrie Beam ☑ Baluster ☐ Steel Channel ☐ Other ☐ Handrail ☐ Fence
  * Does curb need repair ☑ Yes ☐ No
  * Curb repair ____ lin. ft.
  * Remove hand rail ☐ Yes ☑ No
  * Add curb blockout ☐ Yes ☑ No

* **Existing median curb:** Type: N/A Width ____ " Height ____ "
  * Does curb need repair ☐ Yes ☑ No
  * Curb repair ____ lin. ft.

* **Approach rail attachment:** ☑ None ☐ Not attached ☐ 4 Hole ☐ 5 Hole ☐ Turn-down ☐ Other

* **If the existing handrails will be removed, does the local maintenance supervisor wish to keep them?** ☐ Yes ☑ No

Storage address: *location:*

address:

city: *state:* *zip:*

* **Notes:** Barrier replacement incorporated into rehab

Picture # Pic: 003

6

EXPANSION DEVICES

Bent	Type	Recommendations: USE-IN-PLACE	REPAIR	REPLACE	Gap Left	Gap Right	Temperature & Other Info
		☐	☐	☐	"	"	
		☐	☐	☐	"	"	
		☐	☐	☐	"	"	
		☐	☐	☐	"	"	
		☐	☐	☐	"	"	
		☐	☐	☐	"	"	

* Notes: Expansion gaps have been overlaid with aspalt

Picture # Pic: 001

7

BEARINGS

Bent	Coating: CLEAN & OVERCOAT	BLAST CLEAN & RECOAT	Recommendations: USE-IN-PLACE	REPAIR	RESET	REPLACE	MAKE END BENT SLIDING SLAB	MAKE END BENT INTEGRAL	Notes (indicate which bearings at each bent)
	☐	☐	☐	☐	☐	☐	☐	☐	
	☐	☐	☐	☐	☐	☐	☐	☐	
	☐	☐	☐	☐	☐	☐	☐	☐	
	☐	☐	☐	☐	☐	☐	☐	☐	
	☐	☐	☐	☐	☐	☐	☐	☐	
	☐	☐	☐	☐	☐	☐	☐	☐	

* Notes: N/A

Picture # (Provide Pictures of Each Bearing)

8

COATING SYSTEM (PAINT)

* **Existing coating system:** N/A ☐ green ☐ gray ☐ other ______

* **Date last coated:** ______

* **Is existing coating peeling?** ☐ Yes (Overcoat is not an option) ☐ No

* **Coating recommendation:**

☐ Blast clean & recoat all steel

☐ Clean & overcoat all steel

☐ Blast clean & recoat only at joint locations

☐ Blast & recoat at joint locations and clean & overcoat all other steel

Note: Pull off test required for overcoat (Calcium Sulfonate) option. Bridge Division will request pull off tests.

* Notes: N/A

Picture #

9

SUPERSTRUCTURE REPAIRS

(Repairs needed not previously stated.)

Concrete Slab Superstructure or Girder: *(above the bearings)*

(Example: Deck solid slabs, voided slabs, box girder, deck girders & prestressed girders)

Steel: *(Example: Beams, stringers, girders, diaphragms, cross-frames, misc. steel)*

Member *(Check all that apply) (Attach pictures)*					**Describe & Locate**
	☐	Section Loss	%	☐ Cracks	in.
	☐	Section Loss	%	☐ Cracks	in.
	☐	Section Loss	%	☐ Cracks	in.
	☐	Section Loss	%	☐ Cracks	in.

Notes: **The HDR field investigation report describes typical deterioration found. Further anlaysis has shown that a widening and rehabilitation will need to replace the superstructure.**

Picture # **Pic: 004, 005, 006, 007, 008, 009**

10

SUBSTRUCTURE REPAIR

Bent	Formed Repair	Unformed Repair	Seal Concrete Beam Cap Bts.	Coat Exposed Pile @ Int. Pile Cap Bts.	Describe (Beam, Backwall, Wing, etc.)
	sq. ft.	sq. ft.	☐ Yes ☐ No	☐ Yes ☐ No	
	sq. ft.	sq. ft.	☐ Yes ☐ No	☐ Yes ☐ No	
	sq. ft.	sq. ft.	☐ Yes ☐ No	☐ Yes ☐ No	
	sq. ft.	sq. ft.	☐ Yes ☐ No	☐ Yes ☐ No	
	sq. ft.	sq. ft.	☐ Yes ☐ No	☐ Yes ☐ No	

* **Does the structure need graffiti protection?** ☑ No ☐ Bottom 8' of Concrete ☐ End Bents ☐ Other

* **Notes:** **The HDR field investigation report describes typical deterioration found. A rehabilitation will replace all substructure except the arch footings.**

Picture # **Pic: 010, 011**

11

SIGNS, SIGNALS &/OR LIGHTING ATTACHED TO STRUCTURE

* **Are there signs attached directly to this structure?** ☐ Yes ☑ No quantity ____ location ________
* **Describe proposed work to be done to signs.** ________
* **Are there signals attached directly to this structure?** ☐ Yes ☑ No quantity ____ location ________
* **Describe proposed work to be done to signals.** ________
* **Is there aviation lighting attached to this structure?** ☐ Yes ☑ No ☐ N/A ☐ Red ____ (qnty.) ☐ Green ____ (qnty.)
* **Is there navigational lighting attached to this structure?** ☐ Yes ☑ No ☐ N/A ☐ Red ____ (qnty.) ☐ Green ____ (qnty.)
* **Is there roadway lighting attached to this structure?** ☐ Yes ☑ No ☐ N/A
* **Describe proposed work to be done to lighting.** ________
* **Notes:** ________

Picture #

12

UTILITIES ATTACHED TO STRUCTURE

Type			Qty.	Size	Owner	Condition			
☐ Conduit	☐ Pipeline	☐ Other				☐ Repaint	☐ Repair	☐ Replace	☐ Remove
☐ Conduit	☐ Pipeline	☐ Other				☐ Repaint	☐ Repair	☐ Replace	☐ Remove
☐ Conduit	☐ Pipeline	☐ Other				☐ Repaint	☐ Repair	☐ Replace	☐ Remove
☐ Conduit	☐ Pipeline	☐ Other				☐ Repaint	☐ Repair	☐ Replace	☐ Remove

* **Notes:** None

Picture #

13

CATHODIC PROTECTION SYSTEM

* **Is there a cathodic system on this structure?** ☐ Yes ☑ No ☐ Remove ☐ Do not alter ☐ Abandon in place (grooved system)

* **Is it on and working?** ☐ Yes ☐ No ☐ Unknown

* **Notes:**

Picture #

14

CHANNEL ALIGNMENT, SLOPE PROTECTION & SCOUR

* **Is channel aligned to bridge opening?** ☑ Yes ☐ No Describe

* **Is drift a continual problem?** ☑ Yes ☐ No Describe & Locate **High water drift on pier 4**

* **Is erosion a problem?** ☑ Yes ☐ No Describe & Locate **Erosion under substructure tie beams on units 1 and 9.**

* **Describe slope protection in place.** **Missing heavy stone on banks under bridge**

* **Scour**	**At Footing**	**At Piling**	**Depth**	**Bent**	**Recommendation**
	☐	☐	**Est 3'**	**4**	
	☐	☐		**5**	

* **Describe needed work.** **Stabilize scour holes at Pier 4 with type II rip rap**

Picture # **Pic: 012**

15

TRAFFIC LANES

* **Number of lanes striped:** on structure **2** under structure **2**

* **Shoulder width:** ☑ None on structure **0 ft.** *(left)* **0 ft.** *(right)* under structure **0 ft** *(left)* **0 ft** *(right)*

* **Sidewalk widths:** on structure **0 ft** *(left)* **0 ft** *(right)* under structure **0 ft** *(left)* **0 ft** *(right)*

* **Median width:** on structure **0** under structure **0**

* **Proposed improvements for lanes/shoulders/sidewalks:**

Picture # **Pic: 013**

16

GENERAL AREA CONDITIONS

* **Primary area:** ☑ Commercial ☐ Industrial ☐ Residential ☐ Agricultural ☐ Military ☑ Other Nat Waterway Park

* **Posted speed limit on structure:** 35 mph

* **Posted load on structure:** ______ tons @ ______ mph ☐ NA

Single Unit: ______ tons @ ______ mph ☐ NA

Semi (tractor/trailer): ______ tons @ ______ mph ☐ NA

* **Are both signs in place?** ☐ Yes ☐ No

* **Do pedestrians and/or bicyclists regularly use this structure?** ☐ Yes ☐ No ☑ Undetermined

* **Notes:** ______

Picture #

17

MAINTENANCE

* **What work has been done to this structure that may not be reflected on existing bridge plans?** ______

Picture #

18

ADDITIONAL FIELD NOTES

Picture #

19

STAGING / DETOUR

* **Traffic Control:** ☐ Close structure ☐ Stage construction on structure ☐ Cross over traffic to adjacent structure ☐ Detour

☑ Other option **Build an offset alignment or use temporary bridge.**

* **Define probable detour route.** **Detour estimate at 55+ miles.**

20

PERSONS ASSISTING WITH CHECKLIST

Name	**Brian Zeiger, PE**	Title	**Senior Bridge Engineer, HDR Engineering**	Ph.	(**913**) **302** - **8931**
Name	**Terry Stowell**	Title	**CA Field Operations, Olsson Assoc.**	Ph.	(**816**) **604** - **9888**
Name		Title		Ph.	( ) -
Name		Title		Ph.	( ) -
Name		Title		Ph.	( ) -

21

REQUIRED SIGNATURES

I have reviewed the information on this checklist and believe it to be as accurate as possible.

Name ____________________ **Date** ____________

Transportation Project Manager

Name ____________________ **Date** ____________

District Bridge Engineer

The structural rehabilitation checklist indicates how the bridge is functioning and aging.

All deterioration should be noted, even if it is known that the work will not be completed under the proposed project.

Send **NEW** Structural Rehabilitation Checklist by email
To: "Bridge Survey Processor"
Cc: Structural Project Manager or Structural Resource Manager

Pic. 001: Typical view of surface over bridge deck

Pic. 002: Typical deck condition below curb openings

Pic. 003: Bridge barrier rail with misalignment

Pic. 004: Hairline cracks in girder, Span)1-2) west girder shown

Pic. 005: Deterioration of cap beam cantilever

Pic. 006: Typical deterioration of spandrel capbeams

Pic. 007: Spalling near center of arch rib, east rib

Pic. 008: Spalling of arch rib, west rib near south thrust block

Pic. 009: Typical deterioration of spandrel column

Pic. 010: Vertical cracking in column, Bent 3 shown

Pic. 011: Spalling and cracking on column, Bent 6 shown

Pic. 012: Scour hole at Pier 4

Pic. 013: Roadway over bridge looking north

Appendix C. Substructure Evaluation and Remaining Life Report

(Complete report prepared by KPFF Consulting Engineers including Appendixes A thru D)

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Substructure Evaluation

Route 19 Bridges over Current River and Spring Valley

MoDOT Structure Nos.: G0804 / J0420

Inspection Report

October 2019

kpff Consulting Engineers

Inspection Report

October 2019

Prepared for:

HDR Engineering, Inc.
10450 Holmes Road
Kansas City, MO 64131

Prepared by:

KPFF Consulting Engineers
1560 Sherman Avenue, Suite 1020
Evanston, IL 60201
(847) 859-7790
KPFF Job No. 10041900532

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Executive Summary

As part of the Shannon County, Route 19 Arch Bridge Rehabilitation Study Project, KPFF Consulting Engineers, Inc. (KPFF) was retained by HDR Engineering, Inc. to perform an evaluation of the concrete materials of the Route 19 bridges over Spring Valley and Current River, in Shannon County, MO. Field work was completed August 6 and 7, 2019.

Our evaluation work included limited, hands-on inspection, with hammer sounding of accessible portions of the bridges, Non-Destructive Testing (NDT) including half-cell potential testing in select areas and representative impulse radar scans, and materials sampling and testing. Due to project constraints, inspections were limited to arch abutments and other areas accessible by foot.

Route 19 over Current River, Bridge No. G0804

The concrete at the Current River Bridge is in fair to poor condition, with widespread deteriorated concrete, including cracking, and spalling along the vertical corners of the piers and abutments and moderate cracking and spalling along the edges of the arches. Additionally, petrographic evaluation of two cores taken from the edges of the arches in spans 2 and 5 indicated significant, internal, freeze-thaw damage. Freeze-thaw damage is typically associated with saturated, non-air entrained concrete and is likely due to the poor drainage of the earth fill above the arch.

Chloride levels in the cores taken from the edges of the arch were also high, exceeding corrosion initiation thresholds at depths greater than 5-inches, indicating that chlorides may be carried by drainage in the earth fill. Although there were no observations of chloride induced corrosion damage, half-cell potential measurements indicate that corrosion is likely in 2 of six locations tested and possible in 3 other locations.

The combination of freeze-thaw damage due to saturated conditions and elevated chloride levels represent a significant durability issue. The arches are likely nearing the end of their service life and significant rehabilitation will required if this concrete is to remain in service. Although testing was limited to the lower arches, similar deterioration is likely present in the fascia walls.

Rehabilitation options could include removal and replacement of chloride contaminated concrete as well as spalled and delaminated concrete, epoxy injection of cracks, installation of transverse ties perpendicular to the arch surface, and or implementation of cathodic protection. Additionally, removal of earth fill and sealing the top surface of the arches and inside surfaces of the walls will reduce future freeze-thaw damage.

Route 19 over Spring Valley, Bridge No. J0420

The Spring Valley Bridge concrete is in good to fair condition with isolated areas of deterioration, including cracks, delaminations and spalls with exposed reinforcement. Deterioration is more prevalent in the pier columns.

Although deterioration is isolated, future durability of the concrete is a concern, because measured chloride ion content exceeds corrosion initiation thresholds at the depth of the reinforcement in two out of three locations sampled and half cell potential measurements indicate that corrosion is likely in 2 out of 6 locations tested. Additionally, petrographic evaluation indicated that concrete carbonation depths are approaching the average measured cover thickness of the pier columns

To enhance the durability of these elements, limited rehabilitation, including installation of passive cathodic protection, removal and replacement of chloride contaminated concrete; sealing the concrete surface; and/or limiting exposure to deicing solutions by eliminating the open transverse superstructure joints is recommended. However, it should be noted that testing was very limited and additional testing and modeling are required to better establish remaining service life of the bridge. It is possible that chloride levels are higher in pier cap beams and portions of the arches at higher elevation and closer to the underside of the deck and associated run-off of deicing solutions.

Table of Contents

List of Tables

Appendices

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1. Background

KPFF Consulting Engineers, Inc. (KPFF) was retained by HDR Engineering, Inc. (HDR) for the evaluation of the concrete substructures of the Route 19 Bridges over Spring Valley and the Current River, in Shannon County, MO as part of the Missouri Department of Transportation (MoDOT) Route 19 Arch Bridge Rehabilitation Study Project.

The Route 19 Bridge over the Current River, shown in Photo 1, was originally constructed in 1924. The 5 span, filled spandrel arch structure has a length of 602 ft, comprised of three 130 ft arch spans, flanked on either end by 60 ft arch spans. An 18 ft wide roadway is carried across the bridge.

The Route 19 Bridge over Spring Valley, shown in Photo 5, was originally constructed in 1930. The bridge is 523 ft long with a 20 ft wide deck, carrying two lanes of traffic. The 150 foot main span is supported by a two rib open spandrel arch with 3 concrete deck girder approach spans to the north of the main span and 4 to the south. The approach spans are supported by reinforced concrete piers.

2. Scope of Work

The objective of our work was to investigate the concrete materials, including durability evaluation. Our work was limited to portions of the bridges accessible by foot, with a single day available at each bridge.

KPFF's scope of work included:

1. Representative radar scans of accessible areas to determine reinforcement cover depth variation.
2. Half-cell potential testing in select areas to determine corrosion potential levels.
3. Concrete material sampling and testing, as detailed below. A total of 7 cores were collected from the bridges and the following testing was performed on the samples:
   a. Concrete strength testing to verify concrete strength.
   b. Petrographic examination to evaluate overall concrete quality and determine air content, w/c ratio, depth of carbonation, and to identify micro-cracking and/or potential aggregate reactivity.
   c. Water-soluble chloride content testing to determine chloride content profiles.

3. Field Evaluation

3.1 SUMMARY

The field testing and concrete material sampling occurred on August 6th and 7th, 2019. Weather was seasonally hot and humid, with some passing rain over the inspection period. Access was by foot to the bottoms of the arches and arch abutments and bottoms of the pier columns.

In general the arches and piers of the Current River bridge are in fair condition with moderate cracking and spalling along the vertical corners of the pier pilasters and abutments and moderate cracking and spalling along the edges of the arches, see photo 2. Significant leakage was observed from the vertical joints in the fascia walls and the drains located near the base of the arches, as shown in Photos 3 and 4.

The arches and piers of the Spring Valley Bridge (SVB) are in good condition, with isolated areas of delaminated concrete and limited cracking observed in the pier columns, Photo 6

3.2 NON-DESTRUCTIVE TESTING

3.2.1 Ground-Penetrating Radar

The Ground-Penetrating Radar (GPR) method was used to conduct a concrete cover survey of steel reinforcement. The GPR technique employs high-frequency electromagnetic energy waves for rapidly and continuously assessing a variety of characteristics of concrete structures. The principle of operation is based on reflection of electromagnetic waves from varying dielectric constant boundaries in the material being probed.

A contacting transducer (antenna) transmits and receives radar signals. High-frequency, short pulse electromagnetic energy is transmitted into the element under test. Each transmitted pulse travels through the material, and is partially reflected when it encounters a change in dielectric constant. The receiving section of the transducer detects reflected pulses. The location and depth of the dielectric constant boundary is evaluated by using recorded transit time from start of pulse to reception of reflected pulse and the velocity of wave propagation. Boundary depth is proportional to transit time. Since concrete to air, water, and/or backfill interfaces are electronically detected by the instrument as dielectric constant boundaries, the Impulse Radar method is capable of assessing a variety of reinforced concrete, masonry, and environmental characteristics. The Impulse Radar equipment is self-contained, compact, and portable. The system consists of the main radar unit and antenna in a single unit. All data is stored in the main radar unit, for future processing. GPR is widely accepted as a reliable and rapid means for detecting rebar position and measuring approximate concrete cover depth.

Test locations were selected to capture a representative sampling of as-built reinforcement position and depth and generally included primary and secondary reinforcement of arches, columns, and pier pilasters. GPR measurements were calibrated on exposed bars throughout.

Statistical data, including number of bars, maximum cover, minimum cover, and average cover, were tabulated for each bridge, and these are summarized in Tables 3-1 and 3-2. The orientation of the reinforcing steel documented in a given scan is orthogonal to the direction of the scan.

Plan-specified cover for each set of bars is also shown in Tables 3-1 and 3-2. In general, the average cover was approximately 2-inches, in general agreement with plan-specified cover.

Table 3-1: Summary of Concrete Cover Data, Route 19 over Current River

Element	Bar Direct.	No. Scans	No. Bars Meas.	Average Cover (in.)	Min. Cover (in.)	Max. Cover (in.)	Plan Cover (in.)
Short Span Arch (Bottom)	Longitudinal	4	56	1.95	1.14	3.78	2
Long Span Arch (Bottom)	Longitudinal	4	70	2.37	1.54	3.82	2
Arch (Bottom)	Transverse	6	14	2.76	1.69	5.08	
Pier Pilaster	Vertical	3	37	4.27	2.83	5.39	4

Table 3-2: Summary of Concrete Cover Data, Route 19 over Spring Valley

Element	Bar Direct.	No. Scans	No. Bars Meas.	Average Cover (in.)	Min. Cover (in.)	Max. Cover (in.)	Plan Cover (in.)
Arch	Longitudinal	7	82	1.72	0.51	3.11	2
	Transverse	3	8	2.85	1.77	3.66	
Pier Column	Vertical	6	15	2.22	0.71	3.23	2
	Horizontal	6	27	1.33	0.59	2.52	

3.2.2 Half-cell Potential Measurements

Half-cell potential measurements using a copper/copper sulfate reference half-cell were performed in accordance with ASTM C876-09, “Standard Test Method for Half-Cell Potentials of Uncoated Reinforcing Steel in Concrete.” Measurements were taken at select locations throughout both bridges, as shown in Photo 7.

Corrosion, which is an electrochemical process, occurs in concrete when oxygen and moisture are present. The actual corrosion is an exchange of energy within different sections of the uncoated reinforcing steel. The relative energy levels can be determined in relation to a reference electrode with a stable electrochemical potential. By connecting a high impedance voltmeter between the reinforcing steel and a reference electrode placed on the concrete surface, a measurement can be made for the half-cell potential at the location of the reference cell. This then is a measurement of the probability of corrosion activity in the steel in the vicinity of the reference cell. The reference cell is copper in a copper/sulphate solution. By taking half-cell potential measurements a fixed distance apart, a grid of half-cell potentials can be quickly made, and therefore areas delineated with a high probability of corrosion of the reinforcing steel. It should be noted that factors like cover depth, moisture content, concrete resistivity, location of the reference electrode during testing, and chloride concentration of the concrete, among other factors, may influence results.

The appendix of the ASTM standard indicates that if the electrical potential values obtained are more positive than 200mV, there is a greater than 90 percent probability that no corrosion of the steel reinforcement is occurring. If potential measurements are in the range of -200 to -350 mV, corrosion activity of the reinforcing steel in that area is uncertain. If the potential measurements are more negative than -350mV, there is a greater than 90 percent probability that corrosion is occurring.

In general, the readings indicate a range of potential for corrosion of the pier reinforcement throughout the bridges, with areas of increased potential noted in Table 3-3. Half-cell results are presented in Appendix B.

Table 3-3: Summary of Half cell potential measurements

Bridge	Location	Approximate Area	Condition
Current River	Bottom surface arch, Span 1 at Abutment 1	8 ft x 14 ft	Corrosion likely on outer 1/3's of surface, along edge of arch
	Bottom surface arch, Span 2 at Pier 2	8 ft x 14 ft	Corrosion not likely over east half of surface, possible over west half
	West face, Pier 2 Pilaster	6 ft by 6 ft	Corrosion likely
	Bottom surface arch, Span 5 at Pier 5	8 ft x 14 ft	Corrosion not likely
	East face, Abutment 6	7 ft x 5 ft	Corrosion possible over half of surface
	North face, East side of arch, Abutment 6	6 ft x 4 ft	Corrosion possible over half of surface
Spring Valley	Top surface, West arch at Pier 5	10 ft x 5 ft	Corrosion not likely
	South and East face, East Column, Pier 6	7 ft x 2.5 ft and 7 ft x 4 ft	Corrosion not likely
	South and West face, West Column, Pier 6	7 ft x 2.5 ft and 7 ft x 4 ft	Corrosion not likely
	West face, West Column, Pier 7	7 ft x 4 ft	Corrosion not likely
	West face, East Column, Pier 7	7 ft x 4 ft	Corrosion likely
	North and West face, West Column, Pier 8	7 ft x 2.5 ft and 7 ft x 4 ft	Corrosion likely

3.3 CONCRETE MATERIAL SAMPLING

A total of seven, 4-inch diameter cores were removed from the bridges. Cores were extracted using a standard water-cooled core drill, as shown in Photo 8. Sample locations and observations are summarized in Table 3-4 below.

Table 3-4: Concrete Core Sample Summary

Bridge	Core ID	Location	Exposure	Notes
Current River	CR-1	Edge of Arch, Span 2 at Pier 2	West	Several Delaminations in Core and Core hole
	CR-2	Pier 2	East	No Delaminations
	CR-3	Arch Bottom, Span 1 at Abut 1	South	No delaminations
	CR-4	Edge of arch, Span 5 at Abut 6	East	Several Delaminations in Core and Core hole
Spring Valley	SV-1	West Column, Pier 6	West	No Delaminations
	SV-2	West Arch at Pier 5	East	No Delaminations
	SV-3	East Arch Abut. at Pier 5	South	No Delaminations

KPFF provided onsite supervision during coring operations, including determination of core locations, onsite inspection, and documentation of core samples and sample locations. Coring was completed by Coring and Cutting - Springfield. All core holes were filled using a pre-bagged grout mix.

4. Materials Testing and Evaluation

Laboratory testing of concrete core samples was performed by Universal Construction Testing (UCT) to evaluate compressive strength and chloride ion concentrations in the concrete. Additionally, petrographic examination was performed to evaluate general concrete quality and document the properties of the material. The following sections detail the testing methods and results.

4.1 COMPRESSIVE STRENGTH TESTING

Compressive strength testing was performed on four 4-inch-nominal-diameter concrete core samples, in accordance with ASTM C-42, "Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete." Cores were tested in the air-dry condition.

Compressive strengths are shown in Table 4-1 below. The full test report is included in Appendix D.

Table 4-1: Summary of Concrete Compressive Strength Test Results

Bridge	Core ID	Member Type	Measured Compressive Strength, f'c (psi)
Current River	CR-2	Pier	8470
	CR-3	Arch	4050
Spring Valley	SV-1	Column	8230
	SV-2	Arch	4820

4.2 CHLORIDE ION CONCENTRATION TESTING

Water-soluble chloride ion concentration testing was performed on a total of 30 samples, obtained from 6 cores.

Water-soluble (available) chloride content test results were used to evaluate the chloride levels in the concrete at various depths measured from the exposed surface. Testing was performed in accordance with AASHTO T260-97 (2001), "Sampling and Testing for Chloride Ion in Concrete and Concrete Raw Materials." A summary of the test results is included in Table 4-2 below. Individual laboratory test results are included in Appendix D. Chloride ion concentration test results are reported as percentage of the total sample weight and include both paste and aggregate.

Table 4-2: Summary of Chloride Content Profiles

Bridge	Sample ID	Member	Face	Water Soluble Chloride Ion Content[1] (% by weight of sample)				
				Depth 0-1 in.	Depth 1-2 in.	Depth 2-3 in.	Depth 3-4 in.	Depth 4-5 in.
Current River	CR-1	Arch	West	**0.099**	**0.083**	**0.062**	**0.056**	**0.046**
	CR-2	Pier	East	**0.041**	**0.004**	**0.003**	**0.003**	**0.002**
	CR-4	Arch	East	**0.063**	**0.063**	**0.046**	**0.035**	**0.028**
Spring Valley	SV-1	W. Column	West	**0.035**	**0.012**	**0.003**	**0.003**	**0.003**
	SV-2	W. Arch	East	**0.094**	**0.054**	**0.025**	**0.005**	**0.003**
	SV-3	E. Arch Abut	South	**0.141**	**0.097**	**0.086**	**0.055**	**0.013**

[1] Values displayed in red exceed corrosion initiation threshold, 0.024% by weight of sample.

General observations about these test results include the following:

- Higher concentrations of chloride ions near the surface of the concrete and a decreasing gradient of the chloride content with depth of sample indicate that the concrete has been exposed to an external source of chlorides.
- Chloride levels are high, exceeding corrosion initiation threshold to depths of 1 inch at all locations and up to 5 inches at some locations.
- High Chloride levels at depths exceeding 5-inches for cores CR-1 and CR-4 may be a result of delamination cracks in these locations.
- Elevated chloride levels represent a significant durability issue.

4.3 PETROGRAPHIC EXAMINATION

Petrographic examination was performed on a total of 3 cores, shown in Table 4-3, in accordance with ASTM C856-04 "Standard Practice for Petrographic Examination of Hardened Concrete." This procedure evaluates the overall concrete quality, air content, w/c ratio, and depth of carbonation and identifies micro-cracking and/or potential aggregate reactivity. The complete petrographic report is included in Appendix D.

Table 4-3: Summary of Petrographic Analysis

Bridge	Core ID	General Condition	Carbonation Depth (mm)	Estimated W/C	Air Content (%)
Current River	CR-1	Heavily Fractured	5	0.35 to 0.45	2 to 3%
	CR-4	Heavily Fractured	12	0.35 to 0.45	2 to 3%
Spring Valley	SV-3	Good	33	0.35 to 0.45	3 to 4%

Findings of the petrographic examination include the following:

- Aggregates are sound and stable with no evidence of ASR, AAR, or other aggregate reactivity. Aggregates are well graded with no evidence of segregation.
- Concrete is not air-entrained with entrapped air content between 2 and 4%.
- Carbonation depths ranged from 5 to 12 mm in the current river bridge and up to 33 mm in the Spring Valley Bridge.
- Cement paste was hard with good paste to aggregate bond in all cores. Water to cement ratio is estimated at 0.35 to 0.45 for all three cores. No supplemental cementitious materials, such as fly-ash, were observed. Cement content is estimated at 5 to 6 bags per cubic yard.
- Cores CR-1 and CR-4 exhibited significant fractures, oriented sub-parallel to the core surface. Fractures pass both through and around aggregate particles. Cracking was consistent with freeze-thaw damage in concrete with saturated service exposure.

5. Discussion of Inspection Findings

In general, compressive strength testing and petrographic examination indicate that the concrete is generally fair quality with damage consistent with concrete in service for nearly 100 years. Given the overall quality of the concrete, service life of the piers is controlled by a combination of chloride-induced corrosion of embedded reinforcement, carbonation, and freeze-thaw damage.

5.1 CURRENT RIVER BRIDGE

The concrete at the Current River Bridge is in fair to poor condition with significant internal, freeze-thaw damage observed.

The earth fill within the concrete arches is likely saturated, resulting in saturation of the concrete in the arches. This saturated condition has resulted in freeze-thaw damage to the non-air-entrained concrete in the arches that will continue. Although this damage may be limited to the lower portion of the arches, additional testing would be required to verify.

Additionally, chloride contents are also high, exceeding corrosion initiation thresholds at depths greater than 5 inches in two out of three locations tested. These high chloride levels will result in corrosion of reinforcement and ongoing deterioration.

The combination of freeze-thaw damage due to saturated conditions and elevated chloride levels represent a significant durability issue for this bridge. The arches are likely near the end of their service life and significant rehabilitation will required if this concrete is to remain in service. Although testing was limited to the arches, similar deterioration is likely present in the fascia walls.

Rehabilitation options could include removal and replacement of chloride contaminated concrete as well as spalled and delaminated concrete, epoxy injection of cracks, installation of transverse ties perpendicular to the arch surface, and or implementation of passive cathodic protection. Additionally, removal of earth fill and sealing the top surface of the arches and inside surfaces of the walls will reduce future freeze-thaw damage.

5.2 SPRING VALLEY BRIDGE

In general, the Spring Valley Bridge concrete is in good to fair condition, with isolated areas of delaminated and spalled concrete, and with some minor areas of exposed rebar in the piers. The arches and arch abutments were in good condition with no damage noted.

Average measured cover on the arches was in close agreement with the 2-inch minimum specified by the plans. Average measured cover on the pier columns was more shallow, with many bars measuring less than 1.5 inches. Cover is a concern, as carbonation depth was measured at just over 1-1/4 inch. Additionally, chloride contents exceeded the corrosion initiation thresholds at depths exceeding 2-inches in 2 out of the three locations tested.

Half-cell potential measurements indicated a 90 percent probability that corrosion is occurring in 33% of 6 locations evaluated.

Although damage was isolated, the combination of relatively shallow cover and high chloride content are a durability concern that may limit remaining service life of the concrete. Additional testing and service life modeling is necessary to better establish likely remaining service life. It should also be noted that concrete sampling and test locations were limited to areas close to the ground. It is anticipated that corrosion is more severe in areas closer to the underside of the deck, especially near joints, due to higher chloride exposure from deicing solutions. These areas include pier cap beams and the center portions of the arch.

To enhance the durability of these elements, limited rehabilitation, including installation of passive cathodic protection, removal and replacement of chloride contaminated concrete; sealing the concrete surface; and/or limiting exposure to deicing solutions by eliminating the open transverse superstructure joints is recommended.

Appendix A

Photo Log

List of Photos

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Photo 1: Current River Bridge, Downstream Fascia, looking south

Photo 2: CRB, Typical spalling and deterioration along vertical corners of pier and edge of arch, West Face, pier 2 shown.

Photo 3: CRB, Typical Leakage from vertical joints in fascia walls

Photo 4: CRB, Typical leakage from drains at base of arch

Photo 5: Spring Valley Bridge, East Fascia, looking north

Photo 6: SVB, Typical Cracking and exposed reinforcement,
Pier 7, North Face, east column and Pier 6, East Face, east column shown


Photo 7: Half Cell Potential Testing


Photo 8: Concrete Coring

Appendix B

Half-Cell Potential Test Results

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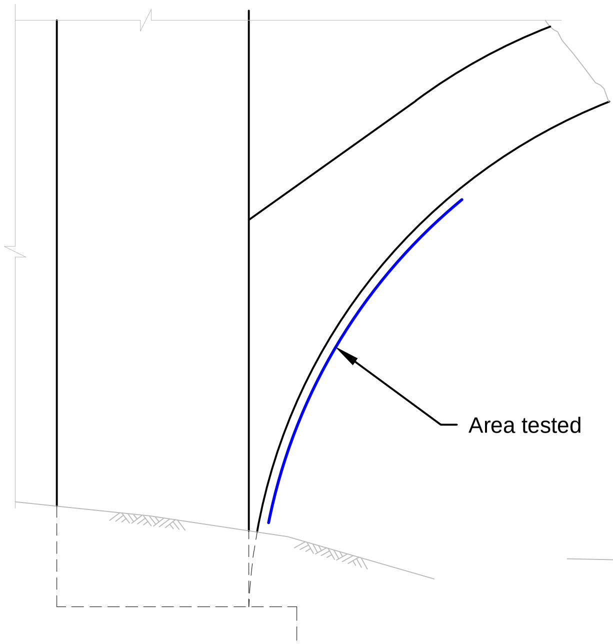
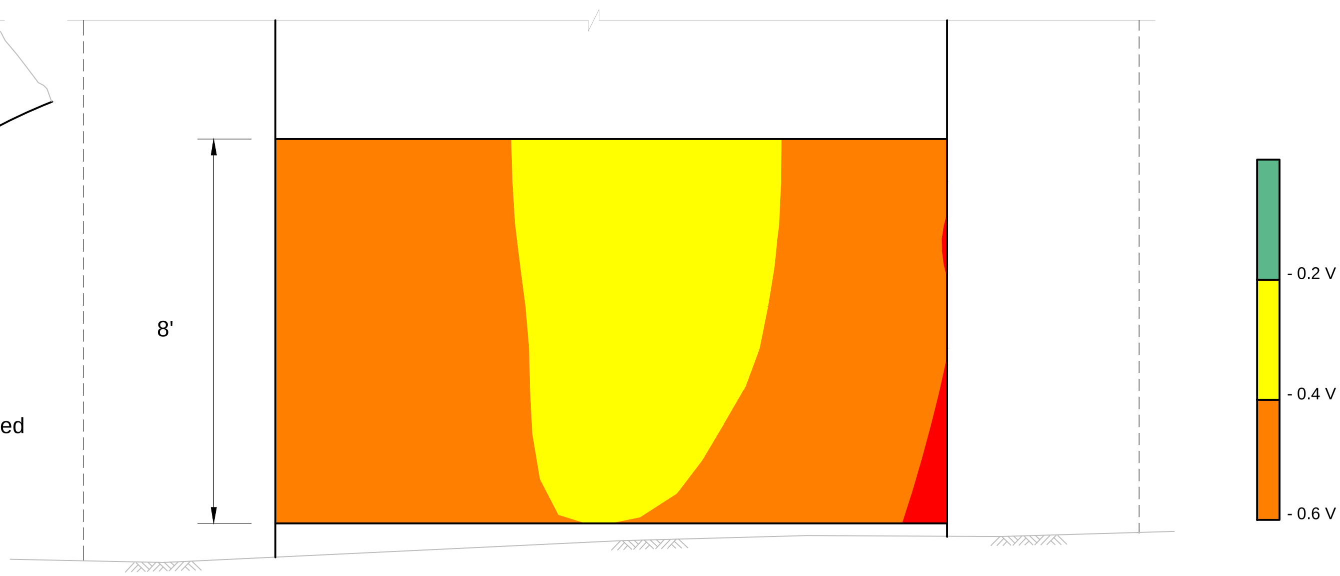


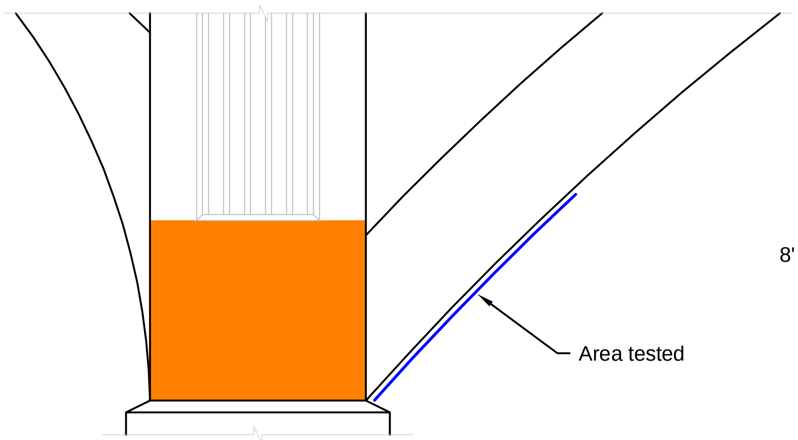
Abut. 1
Partial West Elevation



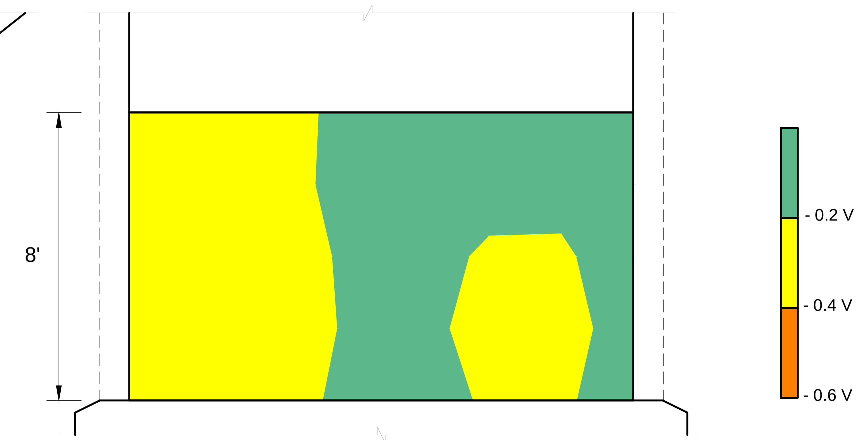
South Face, Under Arch

Route 16 Bridges, Current River Bridge	
Half Cell Potential Test Results	
by: MI	ckd: CAL
Date: Sept. 2019	
KPFF Proj: 10041900532	

kpff Consulting Engineers

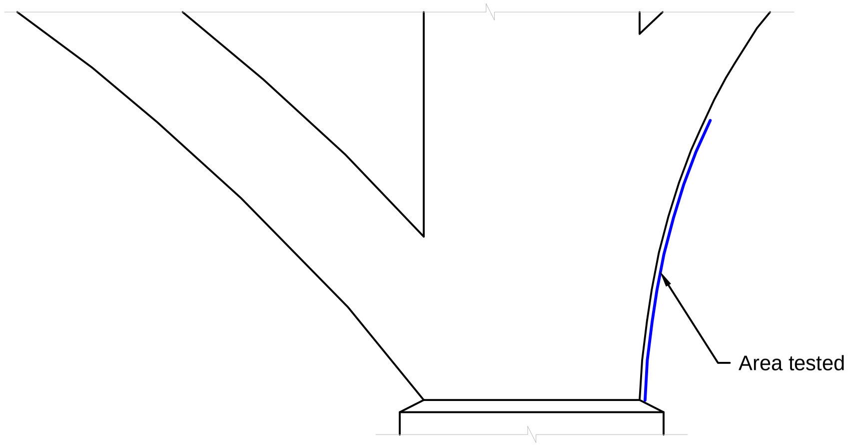


Pier2
Partial West Elevation

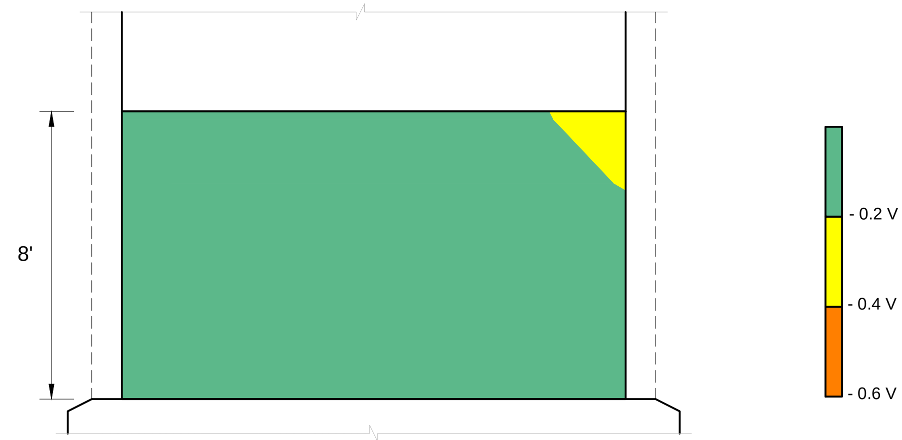


South Face, Under Arch

Route 16 Bridges, Current River Bridge	
Half Cell Potential Test Results	
by: MI	ckd: CAL
Date: Sept. 2019	
KPFF Proj: 10041900532	

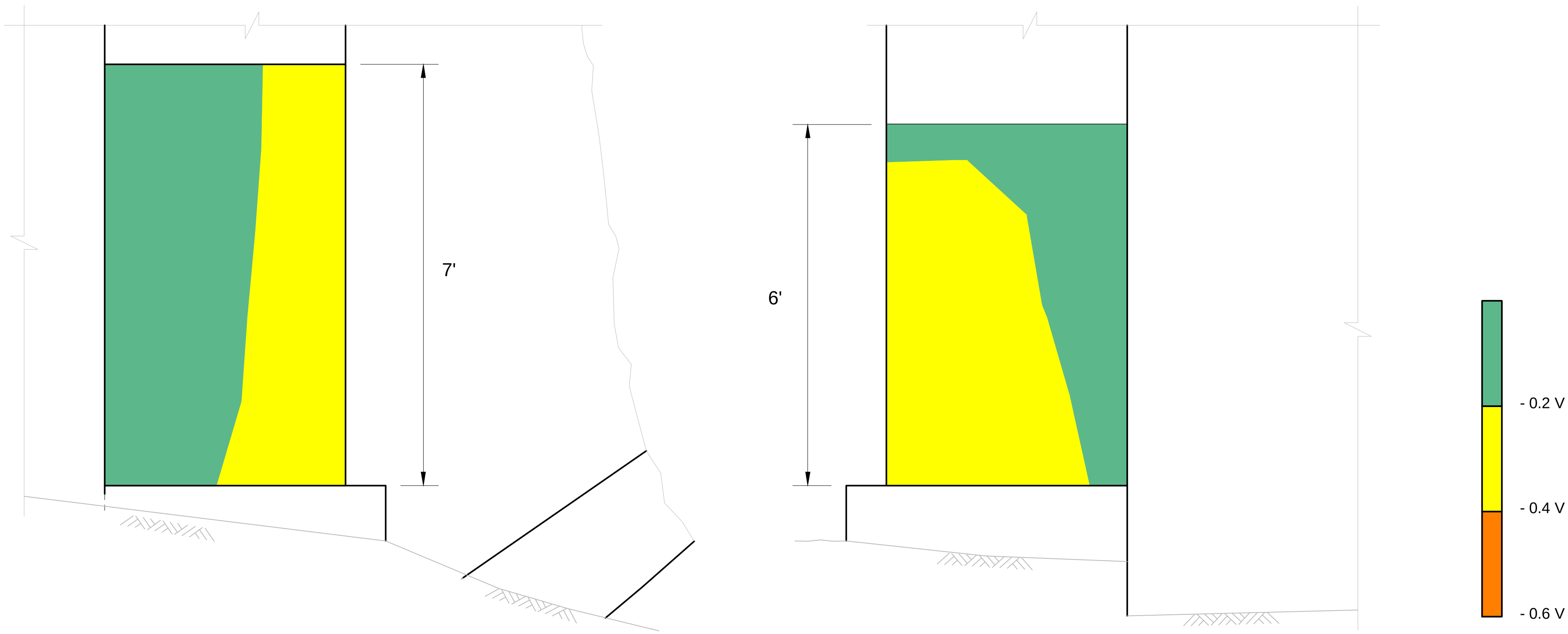


Pier 5
Partial West Elevation



South Face, Under Arch

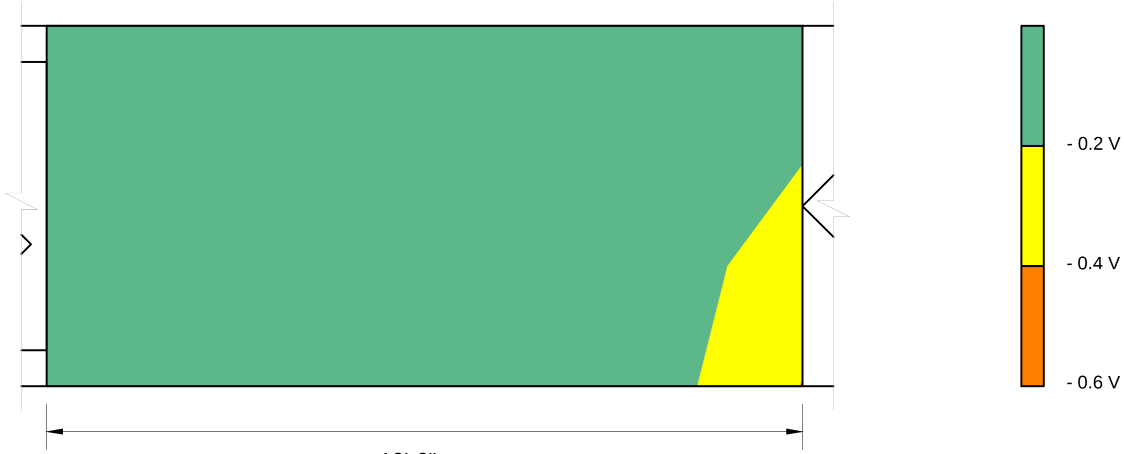
Route 16 Bridges, Current River Bridge	
Half Cell Potential Test Results	
by: MI	ckd: CAL
Date: Sept. 2019	
KPFF Proj: 10041900532	



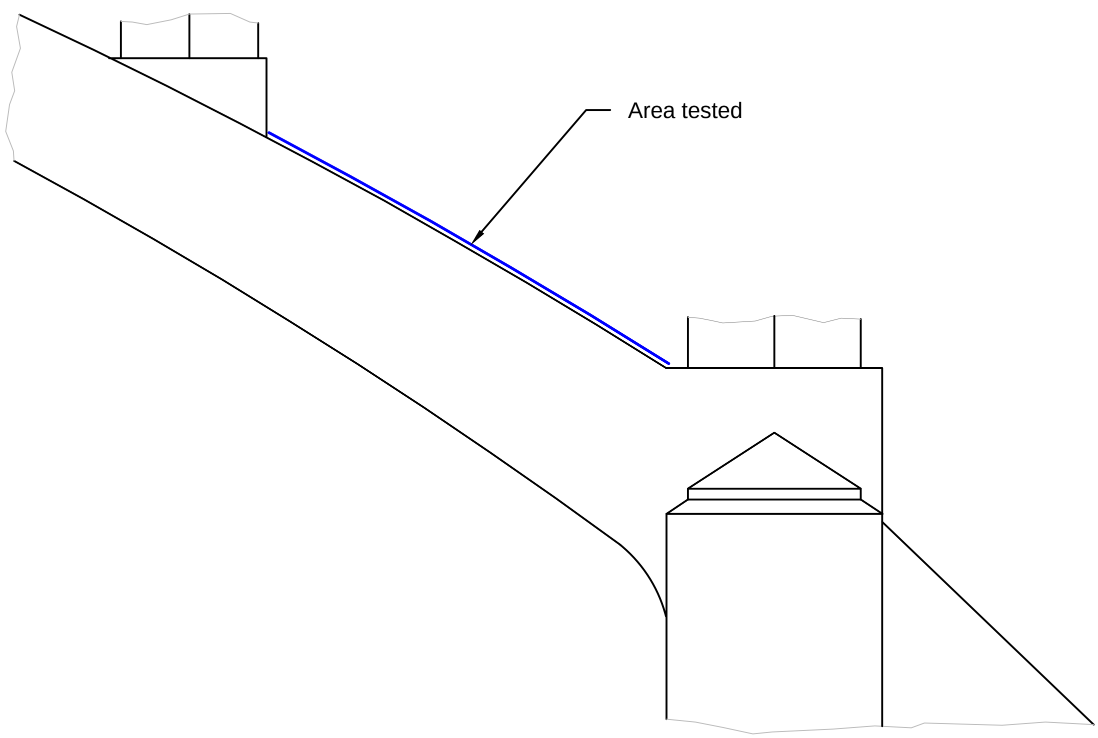
Abut. 6, East Face

Abut. 6, North Face

Route 16 Bridges, Current River Bridge	
Half Cell Potential Test Results	
by: MI	ckd: CAL
Date: Sept. 2019	
KPFF Proj: 10041900532	

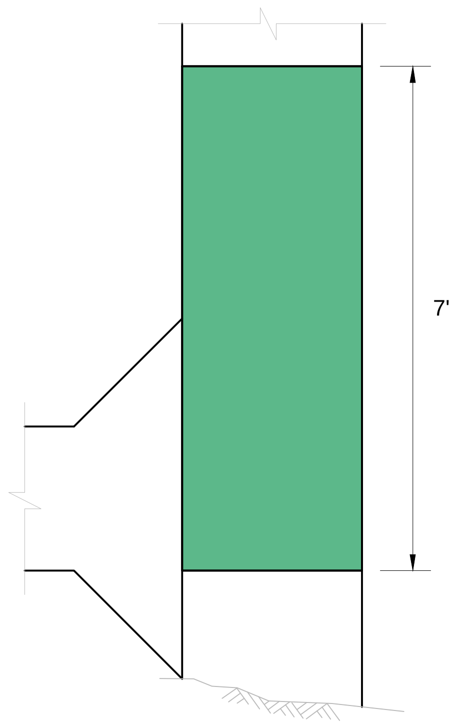


Top Surface of Arch

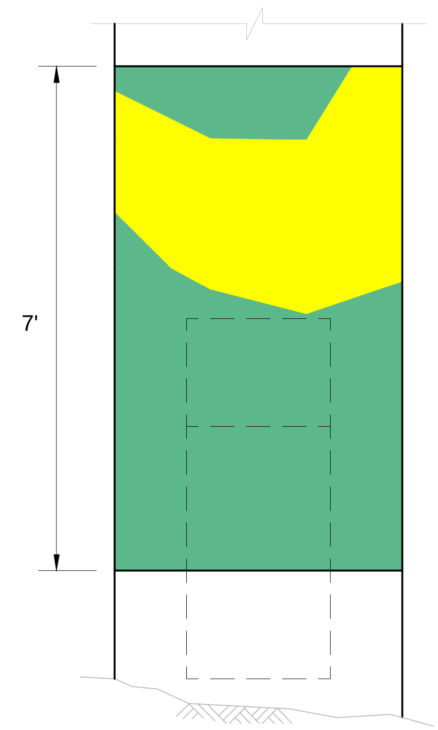


West Arch @ Pier 5
Partial West Elevation

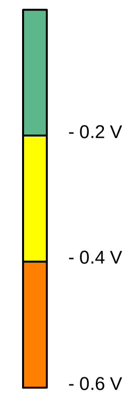
Route 16 Bridges, Spring Valley Bridge		
Half Cell Potential Test Results		
by: MI	ckd: CAL	kpff Consulting Engineers
Date: Sept. 2019		
KPFF Proj: 10041900532		



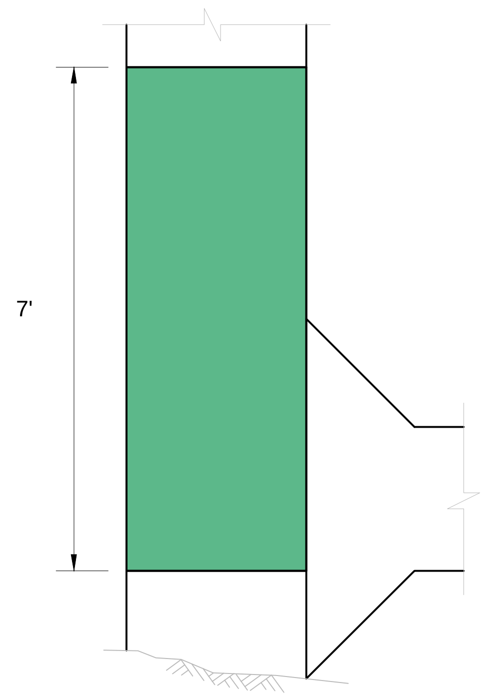
Pier 6, East Column
South Face



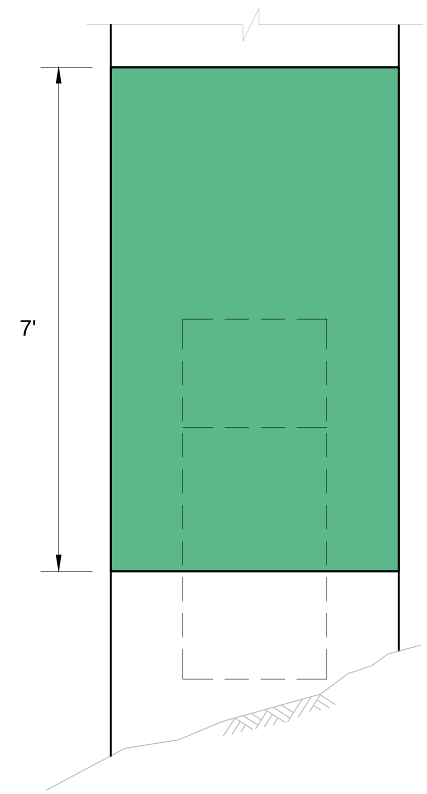
Pier 6 , East Column
East Face



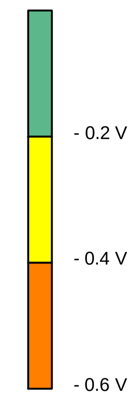
Route 16 Bridges, Spring Valley Bridge	
Half Cell Potential Test Results	
by: MI	ckd: CAL
Date: Sept. 2019	
KPFF Proj: 10041900532	



Pier 6, West Column
South Face



Pier 6, West Column
West Face



Route 16 Bridges, Spring Valley Bridge	
Half Cell Potential Test Results	
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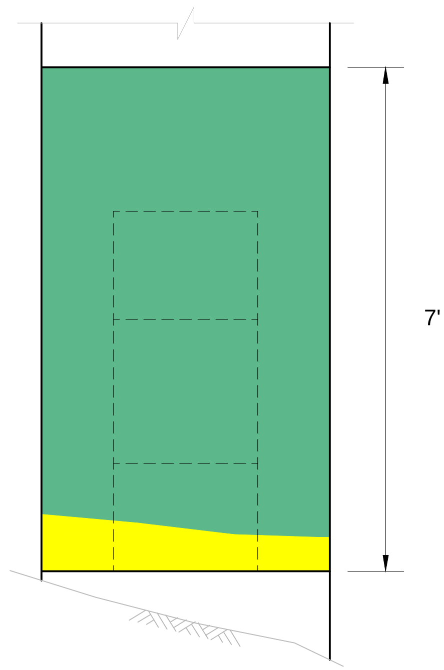
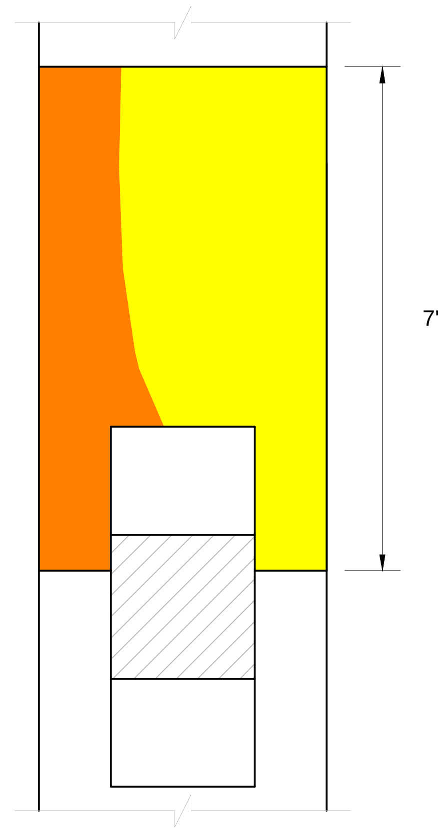
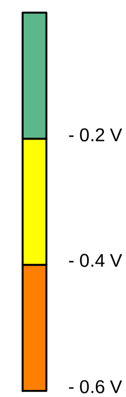
Date: Sept. 2019	
KPFF Proj: 10041900532	



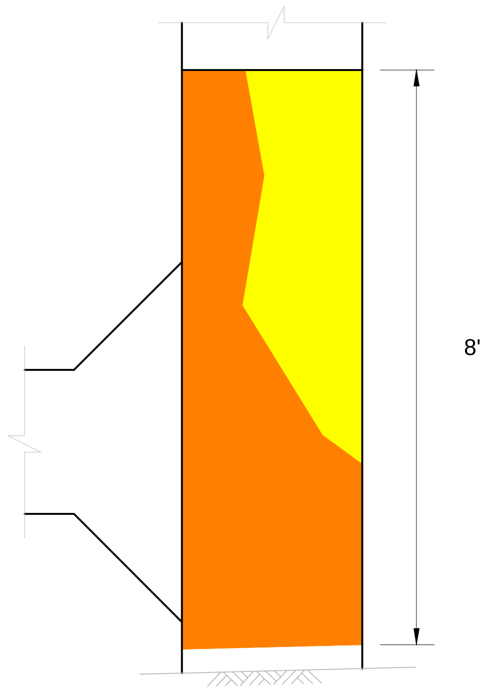
Pier 7, West Column
West Face



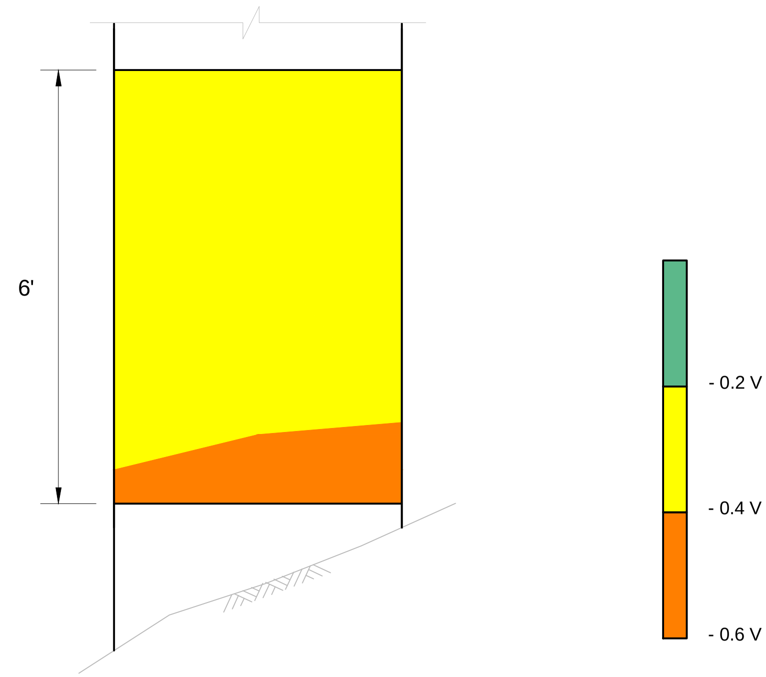
Pier 7, East Column
West Face



Route 16 Bridges, Spring Valley Bridge		
Half Cell Potential Test Results		
by: MI	ckd: CAL	
Date: Sept. 2019		
KPFF Proj: 10041900532		



Pier 8, West Column
North Face



Pier 8, West Column
West Face

Route 16 Bridges, Spring Valley Bridge	
Half Cell Potential Test Results	
by: MI	ckd: CAL
Date: Sept. 2019	
KPFF Proj: 10041900532	

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Appendix C

Concrete Material Sampling

Core CR-1

- Edge of Arch, Span B @ Pier 2
- West Exposure
- 4 x 10, extracted in two pieces
- Several delaminations noted in core and core hole
- Cracks through and around aggregate with cracks in aggregate

Testing

- Petrographic Examination
- Water soluble chloride, 0 to 5-in depths in 1-inch increments

Core CR-2:

- East Face of Pier 2
- 4 x 10
- No delaminations noted
- Some cracking in Aggregates

Testing

- Compressive Strength?
- Water soluble chloride, 0 to 5-in depths in 1-inch increments

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Core CR-3:

- Underside of Arch, Span A @ Abutment 1, near center of bridge
- South Exposure, under bridge
- 4 x 10
- No delaminations noted
- Some cracking in Aggregates

Testing

- Compressive Strength?

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Core CR-4

- Edge of Arch, Span A @ Abut. 6
- East Exposure
- Drilled 4 x 10, extracted length ~ 7 inch.
- Several delaminations noted in core and core hole
- Cracks through and around aggregate with cracks in aggregate

Testing

- Petrographic Examination
- Water soluble chloride, 0 to 5-in depths in 1-inch increments

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Core SV-1

- Pier 6, West Column, West Face
- 4 x 10
- No delaminations noted

Testing

- Compressive Strength?
- Water soluble chloride, 0 to 5-in depths in 1-inch increments

Core SV-2

- West Arch @ Pier 5, East Face
- 4 x 10
- No delaminations noted

Testing

- Compressive Strength?
- Water soluble chloride, 0 to 5-in depths in 1-inch increments

Core SV-3

- East Arch Abutment @ Pier 5, South Face
- 4 x 10
- No delaminations noted

Testing

- Petrographic Examination
- Water soluble chloride, 0 to 5-in depths in 1-inch increments

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Appendix D

Materials Test Reports

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Mr. Chris Ligozio
Senior Engineer – Bridges and Infrastructure
KPFF
140 A Metro Park
Rochester, NY 14623

chris.ligozio@kpff.com
PH: 585.465.5092

Re: Laboratory Studies of Concrete Core Samples
Route 19 Bridges
Winona, Missouri
KPFF Project No. 10041900532

Dear Mr. Ligozio:

Universal Construction Testing, Ltd. (UCT) has completed laboratory studies of seven (7) concrete core samples excised by others from the referenced project and delivered to our laboratories on September 9, 2019.

The cores were reportedly taken from a century-old arch bridge in Missouri. Four (4) core samples were tested for compression strength, six (6) core samples were analyzed chemically for chloride ion content profile, and three (3) core samples were subjected to petrographic examination as directed by you. The purpose of the testing was to evaluate the concrete properties and to determine the general quality, serviceability characteristics, and to identify if any, the presence of deleterious materials.

Table 1 – Sample Identification and Test Program

Sample ID	Location in the Structure	Compressive Strength (ASTM C42)	Chloride Content Analysis (ASTM C1218)	Petrographic Examination (ASTM C856)
CR-1	Arch Edge, Span B at Pier 2	--	X	X
CR-2	East Face of Pier 2	X	X	--
CR-3	Arch Underside Span A at Abut. 6	X	--	--
CR-4	Arch Edge, Span A, Abut. 6	--	X	X
SV-1	Pier 6, West Face of West Column	X	X	--
SV-2	West Arch, East Face of Pier 5	X	X	--
SV-3	East Arch Abut., South Face of Pier 5	--	X	X

SUMMARY OF FINDINGS

Compressive Strength: The compressive strength of the concrete represented by the designated cores is in the 4,000-8,000-psi range.

Chloride Content Analysis: According to the American Concrete Institute, 0.15% maximum water-soluble chloride content expressed by weight of cement is the suggested threshold to minimize the risk of chloride-induced corrosion in conventionally reinforced concrete.

The results of the chemical analysis are shown in Table 3 below.

The chloride content profile of the samples analyzed suggests an external source of chloride ingress, such as deicing salts.

Petrographic Examination: The concrete represented by all the cores is well consolidated. The concrete in Cores CR-1 and CR-4 is heavily fractured with fractures oriented sub-parallel to the outer surface of each core.

The coarse aggregate is fairly well graded and has a 1.25-in. (32-mm) maximum size. The coarse aggregate is natural gravel composed primarily of chert with minor amounts of sandstone and dolomite. The fine aggregate is a calcareous and siliceous natural sand, which is uniformly dispersed in a hardened Portland-cement based paste matrix.

The paste in all three cores is moderately well bond to aggregate, hard, and dense. Freshly fractured surfaces have a dull to subvitreous luster.
The cement paste is carbonated to a depth of approximately 0.20 to 1.30-in. (5 to 33-mm) below the outer surfaces of Cores CR-1, Cr-4, and SV-3.

Cement paste properties reported above are used to interpret the estimated water-to-cement ratio. The water-to-cement ratio is estimated to be in the range of *0.35 to 0.45* in all three cores.

The concrete of the three cores is not intentionally air-entrained, based on the lack of small, spherical air-voids, with an estimated entrapped air-content between **2.0 to 4.0%**.

Multiple cracks are present in the outer sections of Cores CR-1 and CR-4 and pass through and around aggregate particles.

There is no evidence of alkali-aggregate reaction associated with the aggregate.

Discussion

The cores are not air-entrained, as air-entrained admixtures were not discovered until about 20 or more years after this concrete was cast. Therefore, the samples contain low estimated air contents, significantly lower than the 4% recommended by ACI 318 for air-entrained concrete to protect against freeze-thaw damage.

The lack of an intentionally developed air-void system imparted by intentional air-entrainment has rendered this concrete highly susceptible to freeze-thaw damage. Cracking oriented subparallel to the outer surface of the concrete and in the outer regions of the concrete members in cores CR-1 and CR-4 is characteristic of bulk freeze-thaw damage that usually occurs in a non-air-entrained concrete subjected to saturated service exposure. Therefore, bulk freeze-thaw damage is the most likely cause of the cracking in Core CR-1 and CR-4.

LABORATORY STUDIES

Compressive Strength: The compression testing was performed in general accordance with applicable provisions of ASTM Standard C42 - *Standard Test Method for Obtaining and Testing Drilled Cores of Concrete*. Refer to Table 2 below for the results of compression testing. Samples were tested in an air-dry condition.

Table 2 - Compressive Strength Test Results

Core ID	Tested Height L (in)	Diam. D (in)	L/D Ratio K	Total Load (lbs.)	Uncorrected Compressive Strength (psi)	**Corrected Compressive Strength (psi)**
CR-2	7.46	3.73	2.00 / 1.00	92,470	8,470	**8,470**
CR-3	7.46	3.73	2.00 / 1.00	45,240	4,050	**4,050**
SV-1	7.45	3.73	2.00 / 1.00	89,840	8,230	**8,230**
SV-2	7.46	3.73	2.00 / 1.00	52,610	4,820	**4,820**
Remarks: The cores were tested in air-dry conditions.						

Chloride Content Analysis was performed in accordance with the applicable provisions of ASTM Standard C1218 - *Standard Test Method for Water-Soluble Chloride in Mortar and Concrete*. Refer to Table 3 below for the summary of the results obtained.

Table 3 - Results of Chloride Content Analysis

Core ID	**Level Tested from Top**	**Chloride (CL^-) Content**		
		CL^- by weight of concrete (PPM)*	CL^- by weight of concrete (%)	**CL^- by weight of cement (%) ***
CR-1	0 to 1 in. (0-25 mm)	990	0.099	**0.64**
	1 to 2 in. (25-51 mm)	830	0.083	**0.54**
	2 to 3 in. (51-76 mm)	620	0.062	**0.40**
	3 to 4 in. (77-100 mm)	560	0.056	**0.37**
	4 to 5 in. (100-125 mm)	460	0.046	**0.30**
CR-2	0 to 1 in. (0-25 mm)	410	0.041	**0.27**
	1 to 2 in. (25-51 mm)	40	0.004	**0.03**
	2 to 3 in. (51-76 mm)	30	0.003	**0.02**
	3 to 4 in. (77-100 mm)	30	0.003	**0.02**
	4 to 5 in. (100-125 mm)	20	0.002	**0.01**
CR-4	0 to 1 in. (0-25 mm)	630	0.063	**0.41**
	1 to 2 in. (25-51 mm)	630	0.063	**0.41**
	2 to 3 in. (51-76 mm)	460	0.046	**0.30**
	3 to 4 in. (77-100 mm)	350	0.035	**0.23**
	4 to 5 in. (100-125 mm)	280	0.028	**0.18**
SV-1	0 to 1 in. (0-25 mm)	350	0.035	**0.23**
	1 to 2 in. (25-51 mm)	120	0.012	**0.08**
	2 to 3 in. (51-76 mm)	30	0.003	**0.02**
	3 to 4 in. (77-100 mm)	30	0.003	**0.02**
	4 to 5 in. (100-125 mm)	30	0.003	**0.02**
SV-2	0 to 1 in. (0-25 mm)	940	0.094	**0.61**
	1 to 2 in. (25-51 mm)	540	0.054	**0.35**
	2 to 3 in. (51-76 mm)	250	0.025	**0.16**
	3 to 4 in. (77-100 mm)	50	0.005	**0.04**
	4 to 5 in. (100-125 mm)	30	0.003	**0.02**

Table 3 - Results of Chloride Content Analysis (Cont'd).

Core ID	**Level Tested from Top**	**Chloride (CL^-) Content**		
		CL^- by weight of concrete (PPM)*	CL^- by weight of concrete (%)	**CL^- by weight of cement (%) ***
SV-3	0 to 1 in. (0-25 mm)	1410	0.141	**0.92**
	1 to 2 in. (25-51 mm)	970	0.097	**0.63**
	2 to 3 in. (51-76 mm)	860	0.086	**0.56**
	3 to 4 in. (77-100 mm)	550	0.055	**0.36**
	4 to 5 in. (100-125 mm)	130	0.013	**0.09**
Remarks: *) Assumed cement content 600 lbs./cu.yd. and U.W. = 3900 pcy.				

PETROGRAPHIC EXAMINATION

CR-1 (Pier 2 Arch)

General

The core is 3.75-in. (95-mm) in diameter, 9.25-in. (235-mm) long and represents a partial member thickness (Figure 1). The outer surface has a smooth imprint of a formed surface (Figure 1). The inner surface is an irregular fracture surface (Figure 1). The concrete is well consolidated and shows no signs of segregation.

Figure 1: *Top:* **Core CR-1 (outer surface oriented to the left).** *Bottom:* **Outer (left) and inner (right) surfaces of the Core CR-1.**

Cracks

Multiple, interlaced cracks, oriented subparallel to the outer surface of the core, are present through the length of the core and have a range of widths from 0.1 to 6.0 mm. The cracks pass around and through aggregate particles. Cracks are depicted in Figure 2 below (red arrows).

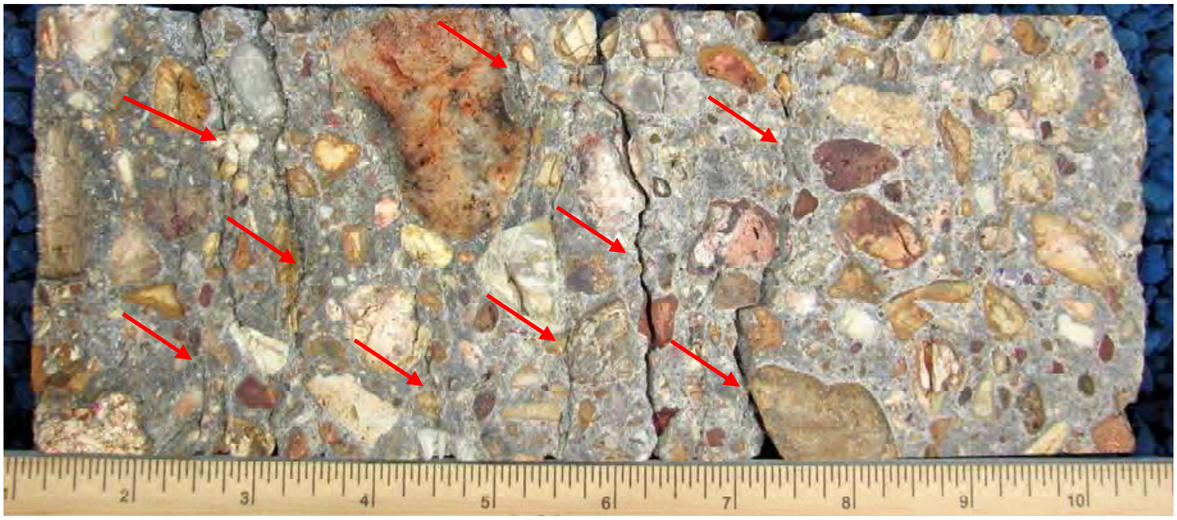

Figure 2: Photograph showing the cracks in Core CR-1. The outer surface is to the left. Scale in inches.

Unit Weight

The unit weight of the concrete sample, as received, is approximately **143.0 lbs./cf**.

Air Content

The concrete has an estimated air content between **2.0 and 3.0%.**

Carbonation

The depth of paste carbonation, measured from the outer surface of the core is approximately 5-mm (0.20-in.).

Reinforcement

Reinforcement is not present in the core.

Water-to-Cement Ratio

The water-to-cement ratio is estimated to be between 0.35 and 0.45.

Paste-Aggregate Bond

The paste-aggregate bond is moderately tight throughout the core, as fractures created in the laboratory pass through and around coarse aggregate particles.

Paste

The cement paste is dark gray, dense, and hard. Freshly fractured surfaces have a dull to subvitreous luster.

Aggregate

The aggregate is fairly well graded and uniformly distributed. There is no evidence of deleterious alkali-aggregate reactions.

The coarse aggregate consists of natural gravel composed primarily of chert with minor amounts of sandstone and dolomite with a 1.25-in. (32-mm) top size. The coarse aggregate particles are rounded to subangular with a blocky to elongate sphericity.

The fine aggregate is natural sand composed primarily of quartz, limestone, feldspar, sandstone and other minerals and rocks. Individual sand grains are subrounded and range from elongated to blocky shape.

Core Sample CR-4 (Abutment 6 Arch)

General

The core is 3.75-in. (95-mm) in diameter, 7.5-in. (191-mm) long and represents a partial member thickness (Figure 3). The outer surface has a smooth imprint of a formed surface (Figure 3). The inner surface is an irregular fracture surface (Figure 3). The concrete is well consolidated and shows no signs of segregation.

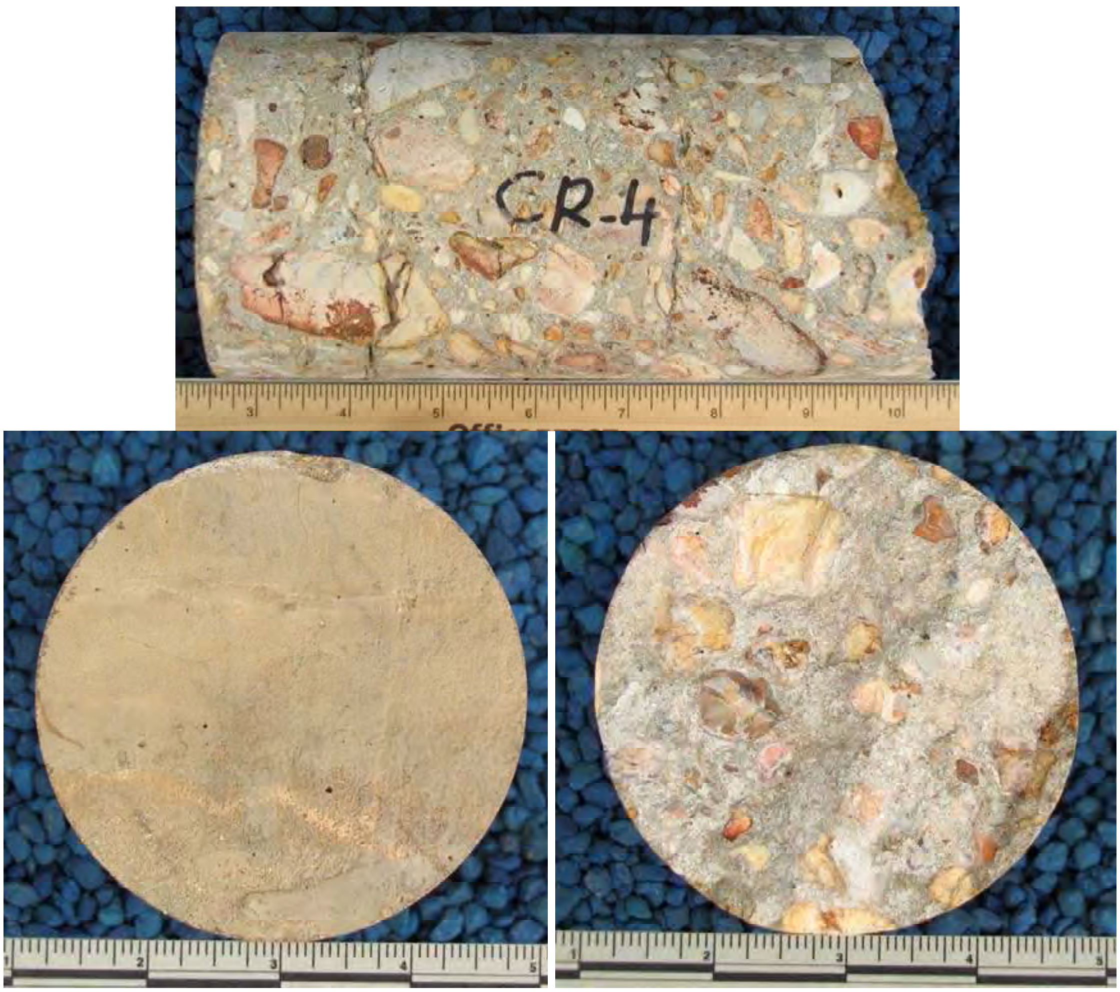

Figure 3: *Top:* **Core CR-4 (outer surface oriented to the left).** *Bottom:* **Outer (left) and inner (right) surfaces of Core CR-4.**

Cracks

Multiple, interlaced cracks, oriented subparallel to the outer surface of the core, are present through the length of the core and have a range of widths from 0.1 to 1.0-mm. The cracks pass around and through aggregate particles. Cracks are depicted in Figure 4 below (red arrows).

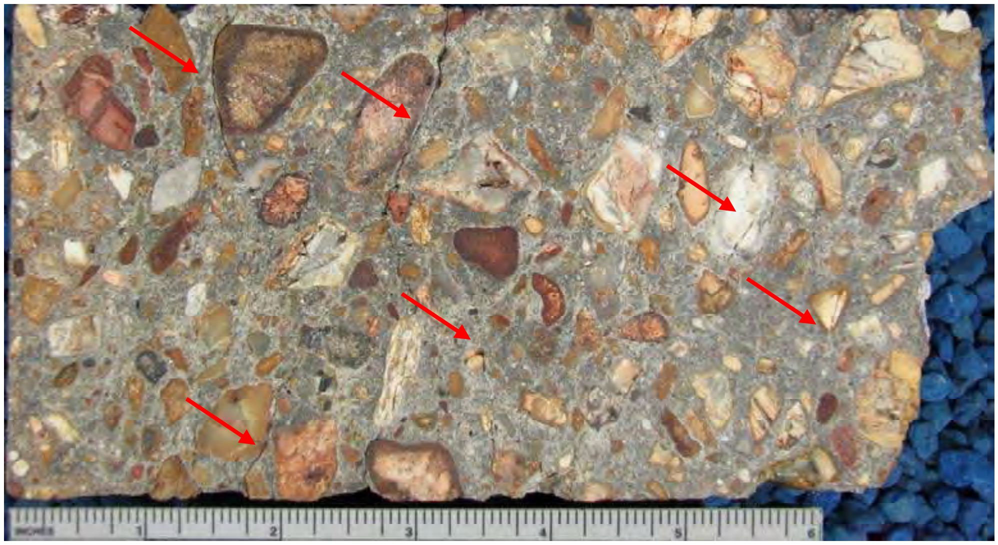

Figure 4: Photograph showing the cracks in Core CR-4. The outer surface is to the left. Scale in inches.

Unit Weight

The unit weight of the concrete sample, as received, is approximately **144.0 lbs./cf**.

Air Content

The concrete has an estimated air content between **2.0 and 3.0%.** Figure 5 is a photomicrograph depicting the low air content.

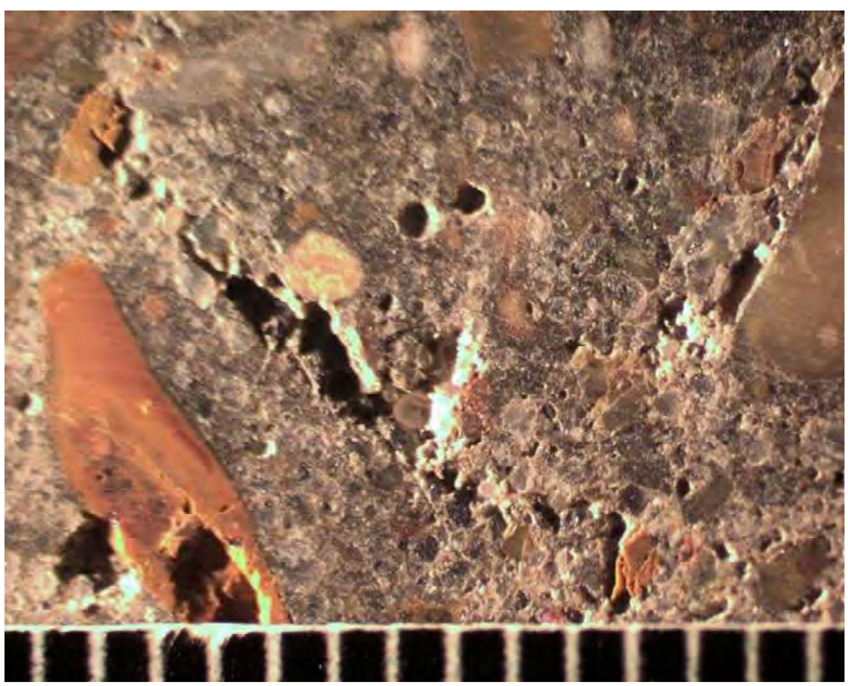

Figure 5: Photomicrograph showing the low air content in Sample CR-4. Scale in millimeters.

Carbonation

Depth of paste carbonation, measured from the top surface of the core, is approximately 12-mm (0.47-in).

Reinforcement

Reinforcement is not present in the core.

Water-to-Cement Ratio

The water-to-cement ratio is estimated to be between 0.35 and 0.45.

Paste-Aggregate Bond

The paste-aggregate bond is moderately tight throughout the core, as fractures created in the laboratory pass through and around coarse aggregate particles.

Paste

The cement paste is dark gray, dense, and hard. Freshly fractured surfaces have a dull to subvitreous luster.

Aggregate

The aggregate is fairly well graded and uniformly distributed. There is no evidence of deleterious alkali-aggregate reactions.

The coarse aggregate consists of natural gravel composed primarily of chert with minor amounts of sandstone and dolomite with a 1.25-in. (32-mm) top size. The coarse aggregate particles are rounded to subangular with a blocky to elongate sphericity.

The fine aggregate is natural sand composed primarily of quartz, limestone, feldspar, sandstone and other minerals and rocks. Individual sand grains are subrounded and range from elongated to blocky shape.

Core Sample SV-3 (South Face of Pier 5)

General

The core is 3.7-in. (95-mm) in diameter, 10.0-in. (254-mm) long and represents a partial member thickness (Figure 6). The outer surface has a smooth imprint of a formed surface (Figure 6). The inner surface is an irregular fracture surface (Figure 6). The concrete is well consolidated and shows no signs of segregation (Figure 7).

Figure 6: *Top:* **Core SV-3 (outer surface oriented to the left).** *Bottom:* **Outer (left) and inner (right) surfaces of Core SV-3.**

Cracks

No cracks or microcracks are present in the core, as shown in Figure 7 below.

Figure 7: Photograph showing the good condition of Core SV-3. The outer surface is to the left. Scale in inches.

Unit Weight

The unit weight of the concrete sample, as received, is approximately **143.0 lbs./cf**.

Air Content

The concrete has an estimated air content between **3.0 and 4.0%.**

Carbonation

Depth of paste carbonation, measured from the top surface of the core, is approximately 33-mm (1.3-in).

Reinforcement

Reinforcement is not present in the core.

Water-to-Cement Ratio

The water-to-cement ratio is estimated to be between 0.35 and 0.45.

Paste-Aggregate Bond

The paste-aggregate bond is moderately tight throughout the core, as fractures created in the laboratory pass through and around coarse aggregate particles.

Paste

The cement paste is gray, dense, and hard. Freshly fractured surfaces have a dull to subvitreous luster.

Aggregate

The aggregate is fairly well graded and uniformly distributed. The aggregate appears sound. There is no evidence of deleterious alkali-aggregate reactions.

The coarse aggregate consists of natural gravel composed primarily of chert with minor amounts of sandstone and dolomite with a 1.25-inch (32-mm) top size. The coarse aggregate particles are round to subangular with a blocky to elongate sphericity.

The fine aggregate is natural sand composed primarily of quartz, limestone, feldspar, sandstone and other minerals and rocks. Individual sand grains are subrounded and range from elongated to blocky shape.

****

We appreciate the opportunity to be of continued service to you. Should you have any questions or require additional information, please feel free to contact us at your convenience.

Sincerely yours,
Universal Construction Testing, Ltd.

Mitchell McCarthy
Junior Petrographer

Elena I. Emerson
Operations Manager

Reviewed by James W. Schmitt, P.G (IL, IN, WI).

Sample(s) will be discarded after ninety (90) days unless another disposition is requested by you.

Appendix D. Options Charrette Report

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Route 19 at Current River and Spring Valley
Rehab Study of Bridges J0420 and G0804
Design Charrette

Final Report

Prepared by:

HDR Engineering, Inc.

Workshop Date:

September 19, 2019

Report Date:

October 7, 2019

Table of Contents

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Executive Summary

Introduction

This report summarizes the events of a design charrette workshop conducted for the Missouri State Department of Transportation (MoDOT) and facilitated by HDR Engineering, Inc. The subject of the workshop was the evaluation of concept-level options for two arch bridge structures on Route 19 over the Current River (G-804A) and Spring Creek (J-420) in the Mark Twain National Forest in Shannon County, Missouri. The workshop was conducted September 19, 2019 in Round Spring, Missouri.

Representatives from the National Park Service and Shannon County participated in a one-day workshop with a team of MoDOT representatives. HDR provided technical subject matter experts on roadway and bridge design as well as a facilitator for the workshop.

Project Overview

MoDOT has two aesthetic and historical arch bridge structures on Route 19 over the Current River (G0804) and Spring Creek (J0420) in the Mark Twain National Forest in Shannon County that are in fair to poor condition. The structures carrying Route 19 through the Ozark National Scenic Riverways are of 1920's vintage reinforced concrete construction. Attractive arch spans command a visitor's attention when the bridges come into view. Filled arches (G0804), skewed arches (J0420), open structural framing, haunched girders and distinctive cantilever brackets supporting the deck slab contribute to the character of the structures.

Both structures are exhibiting signs of increased deterioration and have been rated in poor or fair condition by recent bridge inspections. The existing roadway width is a limiting component of both structures. Wider vehicles such as trucks, busses, recreational vehicles, and those pulling trailers have difficulty crossing the bridge against opposing traffic. G0804 is signed and striped for single-lane traffic.

HDR has been hired by MoDOT to perform a study to identify viable alternatives that will be included in a forthcoming environmental study of the bridges.

Workshop Objectives

The objective of the design charrette workshop was to solicit and incorporate stakeholder and submit matter expert input early in the alternative development process. The workshop was also tasked with developing key functional and performance criteria that could be used to evaluate the current set of construction options relative to which offers the best overall value in terms of performance, cost, schedule and risk. From this analysis, the team was asked to recommend improvements to the concepts which will be included in the forthcoming environmental study.

Key Project Issues

The items listed below are the key drivers, constraints, or issues being addressed by the project and considered during this study to evaluate the various options.

- The Current River Bridge has deck, superstructure, and substructure ratings of 5 – Fair Condition based on the last inspection report dated April, 2019. The Spring Valley Bridge has a 4 – Poor Condition rating for the deck, a 5 – Fair Condition rating for the superstructure, and a 6 – Satisfactory Condition rating for the substructure. The Spring Valley Bridge is considered to be in worse condition. Both bridges will continue to deteriorate requiring additional maintenance until rehab or reconstruction options are completed.
- All construction alternatives need to consider safety and operational improvements from a standard-width roadway.
- Route 19 is a primary north-south roadway in the area. Detour options are limited and would require significant out-of-way travel times. Construction alternatives must maintain a minimum of one lane of traffic at all times.
- Float trips on the rivers are a common occurrence. Construction alternatives will need to consider recreational activity impacts and the ability to maintain river traffic during construction.
- Any construction alternatives need to consider the natural environment, cultural value, and visual aesthetics of the historic bridges.
- The existing pedestrian bridge adjacent to the Current River Bridge accommodates numerous public and private utilities which will need to be maintained throughout construction. Alternatives that impact the pedestrian bridge will need to consider relocation of the utilities. The pedestrian bridge also provides bike/ped access across the Current River. All construction alternatives must provide dedicated pedestrian accommodation and consider the temporary impacts to maintaining pedestrian access.

Conceptual Alternatives

Prior to the workshop, MoDOT provided the following conceptual alternatives:

1. Replace-in-kind on alignment with traffic on temporary bridges.
2. Girder bridge replacement on alignment with traffic on temporary bridges.
3. Girder bridge on offset alignment with traffic maintained on existing alignment.
    a. Without reuse of existing bridge G0804 for pedestrian use.
    b. With reuse of existing bridge G0804 for pedestrian use.
4. Concrete arch on offset alignment with traffic maintained on existing alignment.
    a. Without reuse of existing bridge G0804 for pedestrian use.
    b. With reuse of existing bridge G0804 for pedestrian use.
5. Rehabilitation of existing bridges with traffic on temporary bridges.

Alternative Evaluation Methodology

During the course of the workshop, a number of analytical tools and techniques were applied to develop a better understanding of the conceptual alternatives. A major component of this analysis was the application of Value Metrics which seeks to assess the elements of cost, performance, time, and risk as they relate to the total value presented by a set of options. As part of the Value Metrics process, the stakeholder representatives identified a number of Performance Requirements, defined as the essential, non-discretionary aspects of the project, and Performance Attributes, those aspects of a project's scope that may possess a range of potential values. These were used throughout the workshop to communicate stakeholder priorities and as a format for evaluation of the conceptual alternatives. Key Performance Requirements include the MoDOT Highway Design and Bridge Design Standards, Applicable Environmental Processes and Reviews, Maintaining minimum roadway operations and access points during construction, Accommodating pedestrian/bike access, and Maintaining river traffic operations during construction. The key performance attributes identified for the analysis are listed in the table, "Performance Attributes."

Performance Attributes
Aesthetics
Maintainability
Construction Impacts
Environmental Impacts

Table 1- Major Performance Attributes

Workshop Results

A number of potential alternatives were pre-screened due to conflicts with the identified performance requirements. Once a conceptual alternative was confirmed viable from meeting all performance requirements, it was evaluated using the performance attributes noted in the table above. The results of the performance evaluation are provided in the *Alternatives Evaluation* section of this report.

The following are some of the key lessons learned and take-aways that were captured as a result of the workshop:

- There is a significant interest in maintaining the appearance and character of the existing structures in the parkland setting.
- Identified a modification to Alterative 5 that considers staged rehab construction of the Current River Bridge that maintains one-lane traffic in lieu of a temporary bridge.
- Identified an additional conceptual alternative that rehabs the Current River Bridge with an over-widened section and replacement or rehabilitation of Spring Valley Bridge.
- The existing pedestrian bridge is in need of maintenance. The National Park Service would support removal of the existing pedestrian bridge as long as utility service could be maintained. The National Park Service indicated that it would not be interested in taking

ownership of the existing Current River Bridge for use as a pedestrian bridge given the maintenance implications.

- Bridge railing options were identified and evaluated. All bridge railing options can be accommodated by any construction alternative.
- MoDOT may consider modifying the design criteria relative to the operating vehicle vs. the standard design vehicle.
- The National Park Service indicated a preference for upgraded fencing on the pedestrian walkways in lieu of standard chainlink.
- The National Park Service indicated a preference to be a cooperating agency for the project.

HDR wishes to express its appreciation to the MoDOT, NPS, and County personnel that participated on this workshop and for the excellent support they provided.

Project Information

Background

The Missouri Department of Transportation (MoDOT), like State Departments of Transportation throughout the nation, is faced with the task of addressing an aging transportation infrastructure. Many of today's highways and bridges were constructed during the Great Depression and shortly after World War II. For more than a half century, MoDOT has maintained these facilities ensuring public access to fast and reliable travel and providing Missouri with the means to conduct commerce throughout the State and beyond. As these facilities have aged, costs associated with maintaining them have grown considerably. Many of these facilities require major rehabilitation to bring them up to standards necessary to meet today's travel demands and safety requirements. Bridges of this era are exceeding their design life potentially putting travelers and the State's economy at risk were they to fail. Now, after nearly 100 years, these facilities have served the traveling public well beyond the number years for which they were designed.

Project Description

MoDOT has two aesthetic and historical arch bridge structures on Route 19 over the Current River (G0804) and Spring Creek (J0420) in the Mark Twain National Forest in Shannon County that are in poor condition. The structures carrying Route 19 through the Ozark National Scenic Riverways are of 1920's vintage reinforced concrete construction. Attractive arch spans command a visitor's attention when the bridges come into view. Skewed arches, open structural framing, haunched girders and distinctive cantilever brackets supporting the deck slab contribute to the character of the structures.

MoDOT is currently planning on initiating an environmental study to evaluate options to either rehabilitate or replace both bridges. Currently, there are no less than five potential options under consideration. Due to the resource intensive nature of performing environmental studies, it was decided that preliminary conceptual development was needed to develop information on the options that would be included in the forthcoming environmental study.

Bridge G0804 over Current River

Bridge G0804 spans the Current River and was constructed in 1924 as noted on a plaque near the north abutment. The original construction plans indicate the bridge has five spans with an overall bridge length of 602 ft. from fill face to fill face of abutments. The three center spans are 136 ft. filled concrete arches, with one 14 ft. wide arch rib per span. The two 63 ft. end spans are also filled concrete arch spans. The 21'-4" wide bridge carries an 18 ft. clear roadway. Roadway paving is supported on the earth and gravel fill contained within the arch spans.

All reinforced concrete piers and abutments are founded on spread footings keyed into rock. Deep abutments are 34 ft. long, hollow cell, filled type with internal cross beams supporting side walls.

Bridge G0804 is signed as a one-lane bridge, but no traffic control or signals are currently provided.

A pedestrian/utility bridge parallels the existing bridge approximately 50 ft. east of Bridge G0804. A convenience store is located on the west side of Rte. 19, approximately 180 ft. north of the north end of the bridge. A large camping and picnic area is located west of the bridge, on the north side of the Current River and east of the bridge, south of the Current River. The intersection of Route 19/County Road 324 is located approximately 200 ft. south of the bridge.

Elevation View – Looking Southeast

Roadway – Looking South

Bridge J0420 over Spring Valley

Original construction plans for the existing bridge over Spring Valley are dated 1930. The bridge is skewed at 45 degrees, right advance. Consisting of eight spans, the overall bridge length is 522.75 ft. from fill face to fill face of abutments. The center span is a 155 ft. open spandrel concrete arch, with the two arch ribs staggered to accommodate the large skew. The three approach spans from the north and four approach spans from the south are of cast-in-place concrete girder construction. The deck slab is cast monolithically with the floor beams in the arch span and the two girder system in the approach spans. The 23 ft. wide bridge carries a 20 ft. clear roadway.

Both reinforced concrete piers supporting the arch span are founded on rock, utilizing spread footings embedded at least 18 inches into solid rock. Framed bents on spread footings are embedded at least 6 inches into rock. Abutments are spill-thru type with deep counterforts. The north abutment is supported on two spread footings. South abutment support is provided by a spread footing on the east side, and a timber pile supported footing on the west. The 25 ft. long timber piles extend below the adjacent rock elevation of the eastern footing, most likely due to a sink hole, cavern or drastic change in bedrock elevation.

The 20 ft. roadway width is a limiting component of the structure. Currently, wider vehicles such as trucks, busses, recreational vehicles, and those pulling trailers have difficulty crossing the bridge against opposing traffic. Also, the bridge is posted for 34 tons.

Round Spring is approximately 380 ft. north and 140 ft. east of the north end of the bridge (along Rte 19). Park ranger headquarters, including several buildings, is located southwest of the existing bridge. Access to the headquarters and Round Spring Cave is via a roadway under the existing Rte. 19 bridge. The closest park building is approximately 230 ft. south of the bridge and 100 ft. west of Rte. 19. A low water crossing, carrying vehicular traffic to the Round Spring parking area is located 140 ft. downstream of the Rte. 19 bridge. The intersection of the campground and Spring access roadway is located approximately 200 ft. south of the bridge.

Elevation View – Looking Northeast

Span Over Park Road – Looking East

Conceptual Alternatives

Prior to the workshop, MoDOT provided the following conceptual alternatives to be considered and evaluated:

1. Replace-in-kind on alignment with traffic on temporary bridges.
2. Girder bridge replacement on alignment with traffic on temporary bridges.
3. Girder bridge on offset alignment with traffic maintained on existing alignment.
    a. Without reuse of existing bridge G0804 for pedestrian use.
    b. With reuse of existing bridge G0804 for pedestrian use.
4. Concrete arch on offset alignment with traffic maintained on existing alignment.
    a. Without reuse of existing bridge G0804 for pedestrian use.
    b. With reuse of existing bridge G0804 for pedestrian use.
5. Rehabilitation of existing bridges with traffic on temporary bridges.

Alternative Features

Alternative 1, 2 and 5 - Reconstruct/Rehab existing bridge with temporary alignments connected to mainline Rte. 19 via temp shoo-flys

- Current River crossing
    - Option 1 –
        - Temp alignment – approx. 45’ east of existing bridge centerline
        - Temp bridge requires removal of existing ped bridge. No ped crossing during construction. Utility impacts on existing ped bridge.
        - Temp bridge provides two 12’ traffic lanes
        - New reconstructed/rehab bridge built with 10’ walkway/mixed use path
    - Option 2 –
        - Temp alignment – approx. 80’ east of existing bridge centerline
        - Existing ped bridge remains in place
        - Temp bridge provides two 12’ traffic lanes
    - Option 3 –
        - Temp alignment – approx. 35’ east of existing bridge centerline
        - Temp bridge requires removal of existing ped bridge. No ped crossing during construction. Utility impacts on existing ped bridge.
        - Temp bridge provides one 12’ traffic lane. Traffic is signal controlled
        - Temp bridge is used for ped bridge after construction
    - Option 4 –
        - No temp alignment – use existing bridge for one lane traffic. Traffic is signaled controlled.
        - Will require multiple traffic shifts on existing bridge to reconstruct/rehab existing bridge
        - Existing ped bridge remains in place
- Spring Valley crossing
    - One option for all alternatives
        - Temp alignment – approx. 35’ west of existing bridge centerline
        - No impacts to Park access

- No impacts to NPS buildings
- Will impact multiple trees on west side of existing bridge

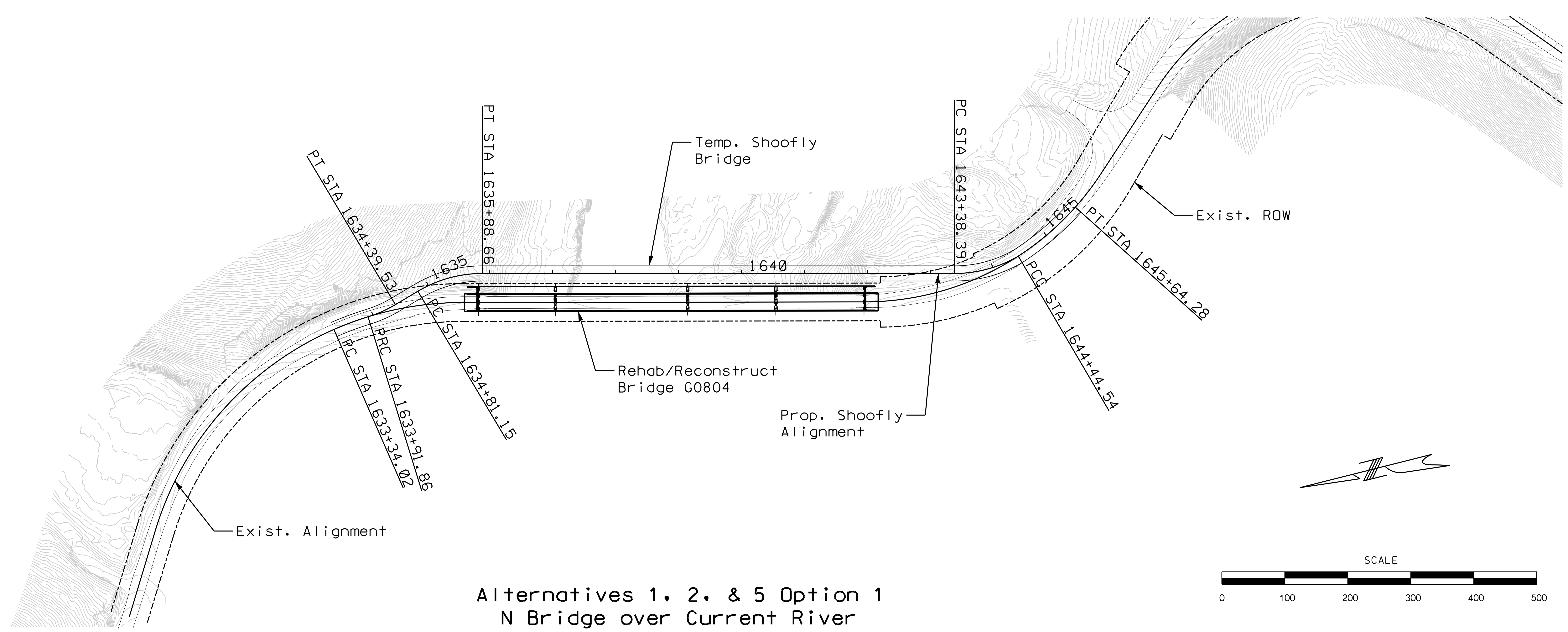
- General
  - Shoo-fly alignments – 225' minimum radius; no superelevation; maintains minimum 10' separation from bridge/approach slab construction

Alternative 3a & 4a – Offset alignment (without reuse of existing bridge for pedestrian use)

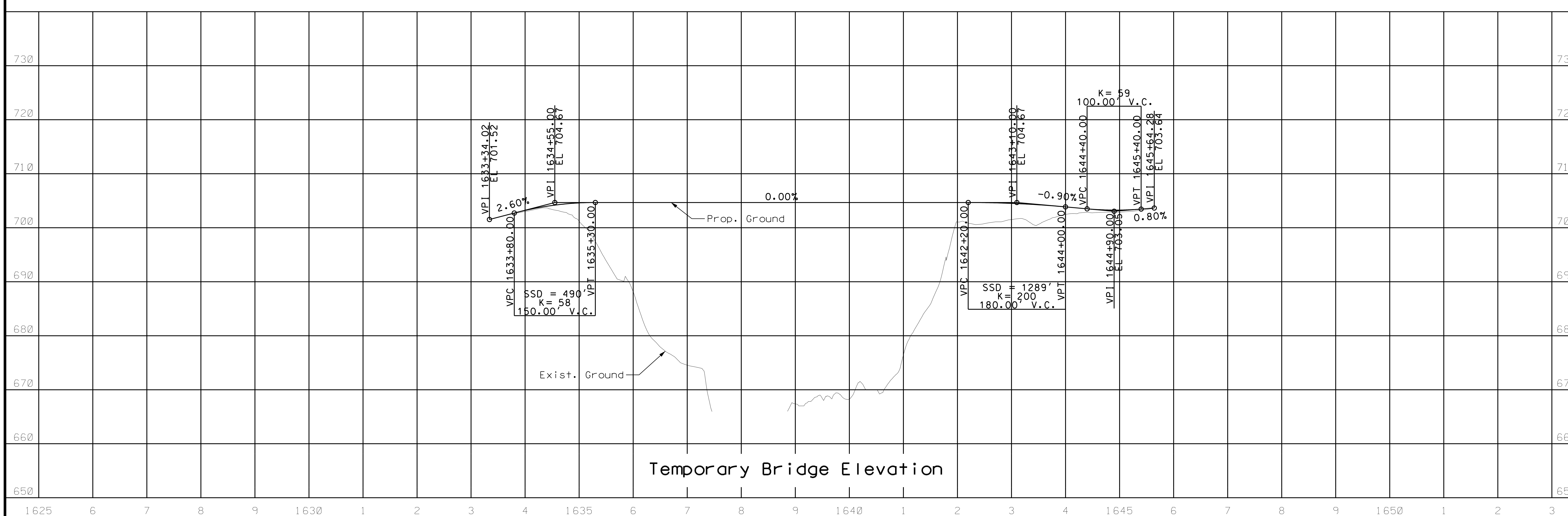
- Current River Crossing
  - Option 1 –
    - Final alignment – approx. 80' east of existing bridge centerline
    - Existing ped bridge remains in place
    - More roadway impacts – increased costs
  - Option 2 –
    - Final alignment – approx. 35' east of existing bridge centerline
    - Requires removal of existing ped bridge. No ped crossing during construction. Utility impacts on existing ped bridge.
    - New reconstructed/rehab bridge built with 10' walkway/mixed use path
- Spring Valley crossing
  - One option for all offset alignment alternatives (including 3a1/4a1, 3a2/4a2, and 3b/4b)
    - Final alignment – approx. 35' west of existing bridge centerline
    - Will require retaining wall or steepened fill slope to avoid impacting NPS buildings

Alternative 3b & 4b – Offset alignment (with reuse of existing bridge for pedestrian use)

- Current River Crossing
  - One option for 3b/4b
    - Final alignment – approx. 35' east of existing bridge centerline
    - Requires removal of existing ped bridge. No ped crossing during construction. Utility impacts on existing ped bridge.



Alternatives 1, 2, & 5 Option 1
N Bridge over Current River



Temporary Bridge Elevation

"THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT."

DATE PREPARED	10/1/2019
ROUTE	19
STATE	MO
DISTRICT	SE
SHEET NO.	1
COUNTY	SHANNON
JOB NO.	J9P3305
CONTRACT ID.	.
PROJECT NO.	.
BRIDGE NO.	.

DATE	DESCRIPTION
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MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

MoDOT
105 WEST CAPITOL
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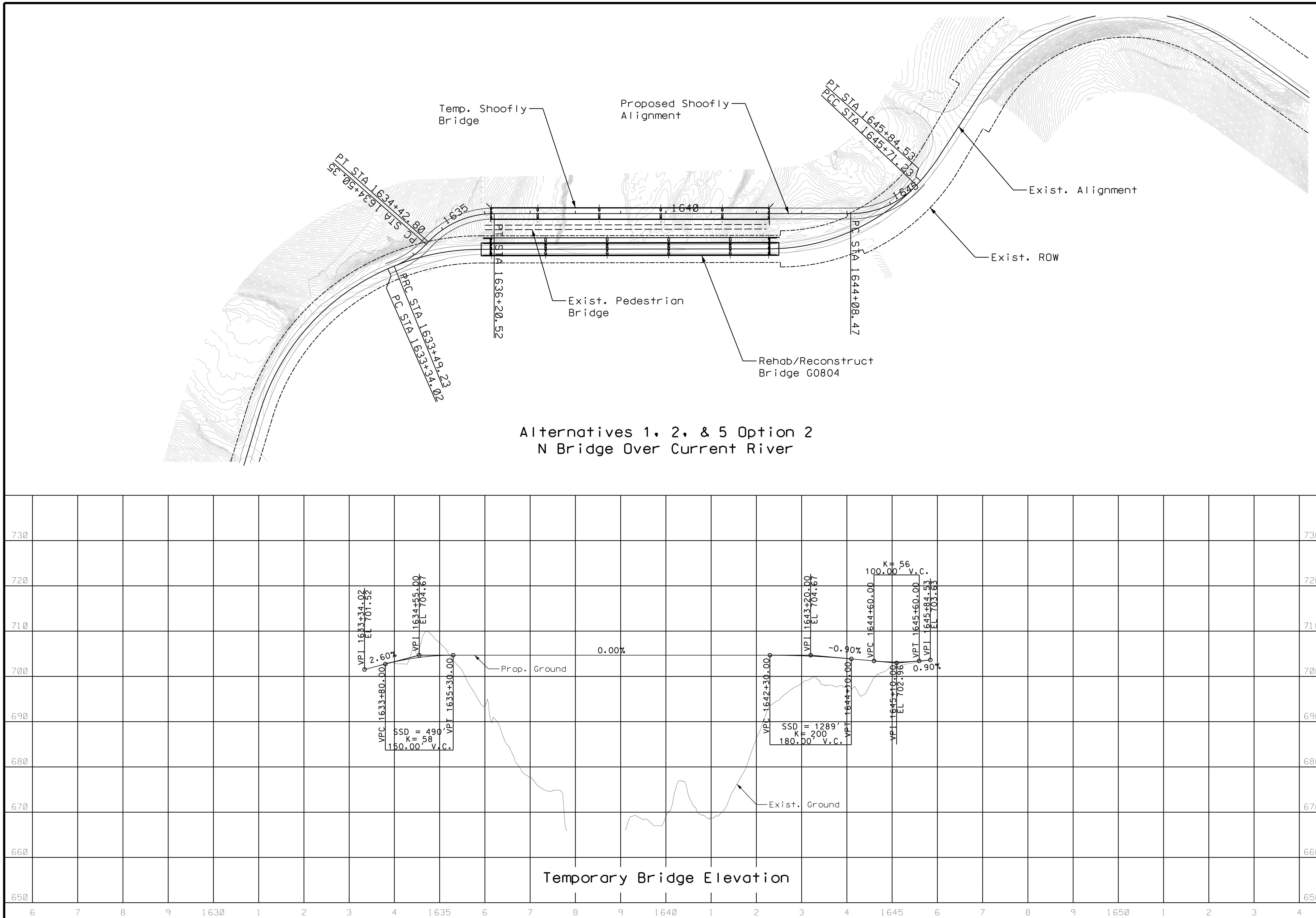

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10/1/2019	
ROUTE 19	STATE MO
DISTRICT SE	SHEET NO. 2
COUNTY SHANNON	
JOB NO. J9P3305	
CONTRACT ID. .	
PROJECT NO.	
BRIDGE NO. .	

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MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

HDR Engineering, Inc.
10450 Holmes Rd
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Kansas City, MO 64131
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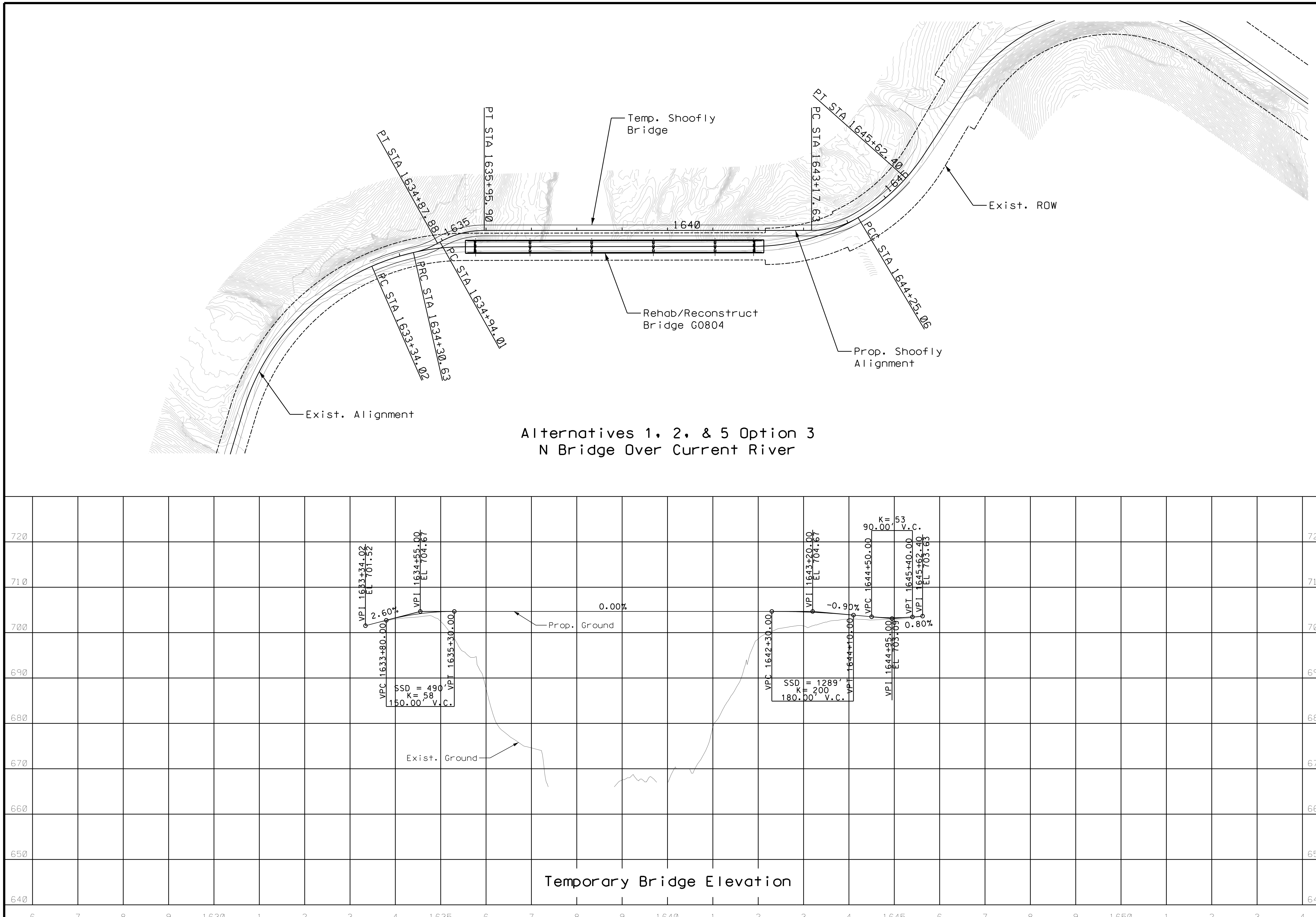

Alternatives 1, 2, & 5 Option 3
N Bridge Over Current River

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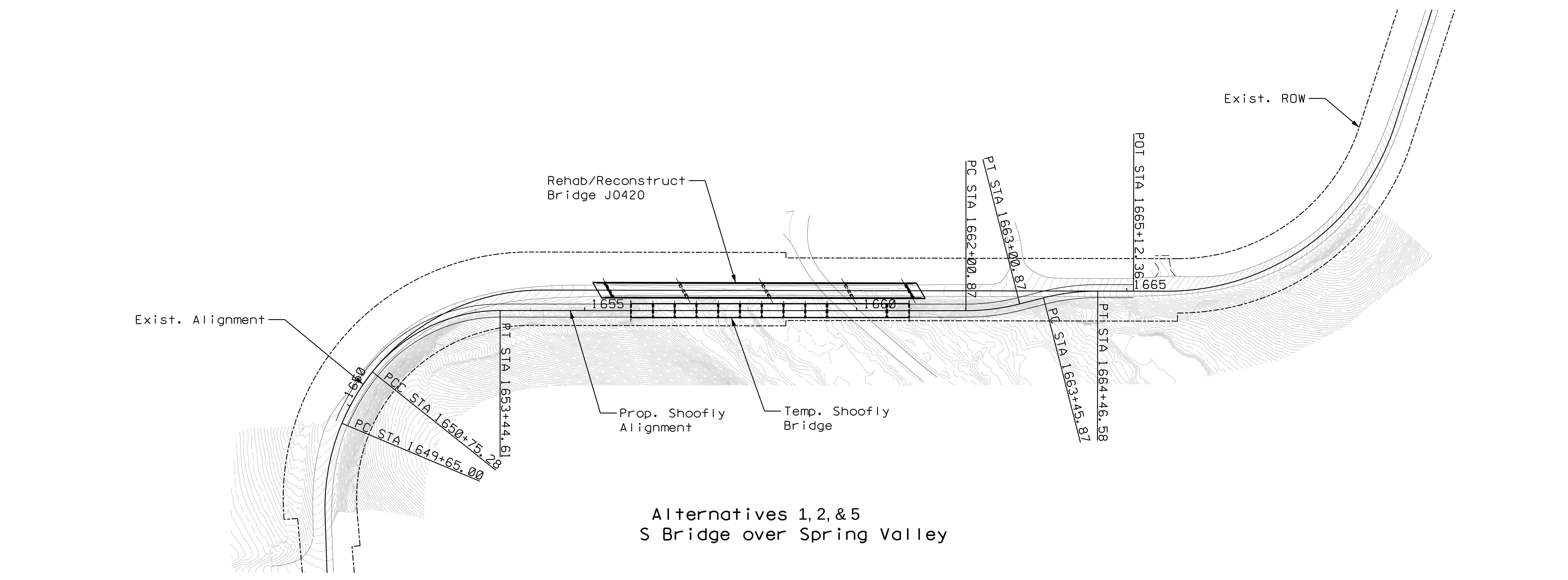
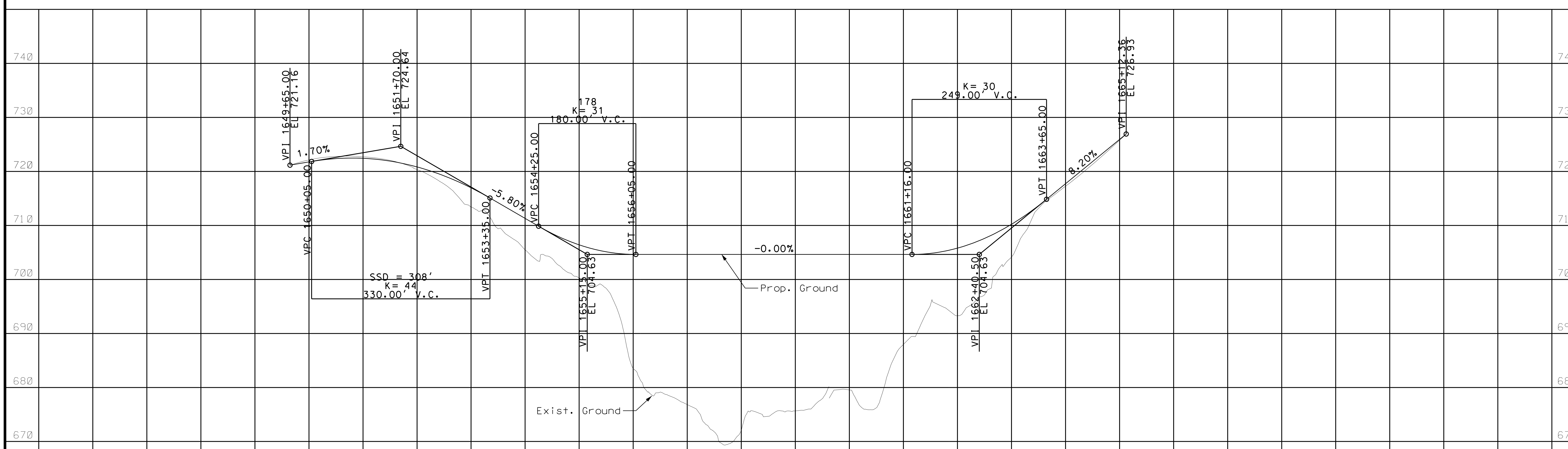


Alternatives 1, 2, & 5
S Bridge over Spring Valley



Temporary Bridge Elevation

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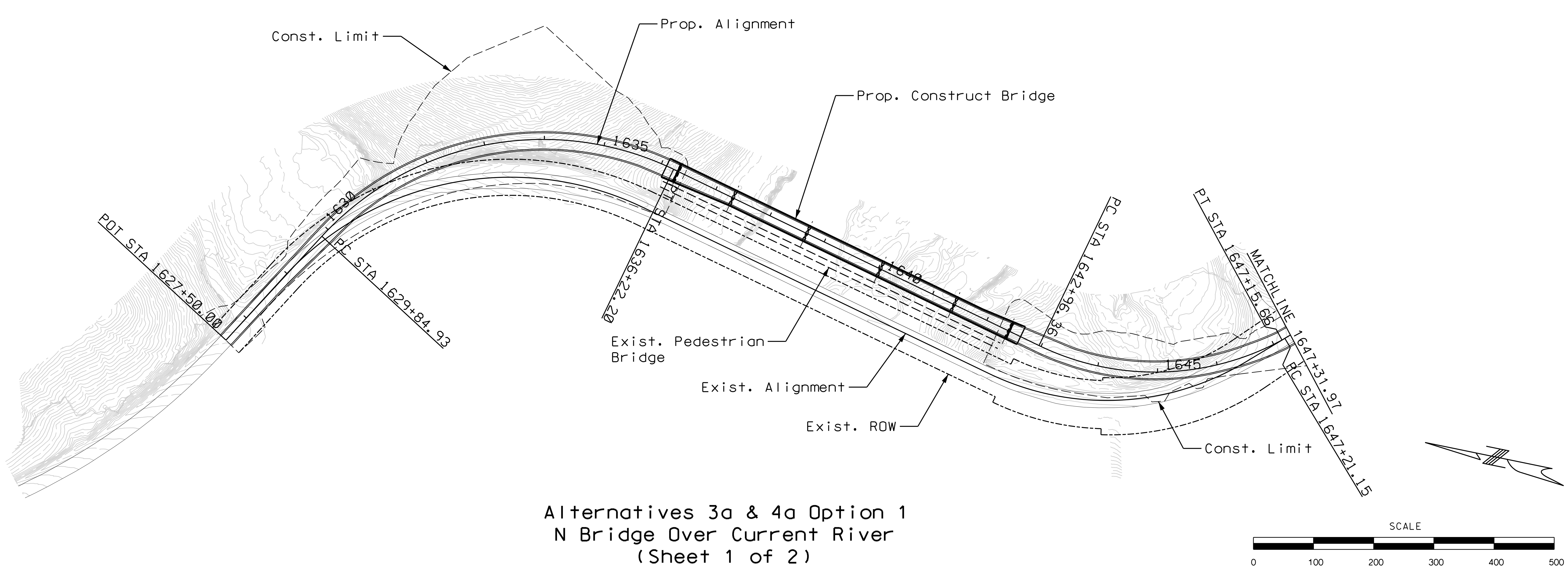
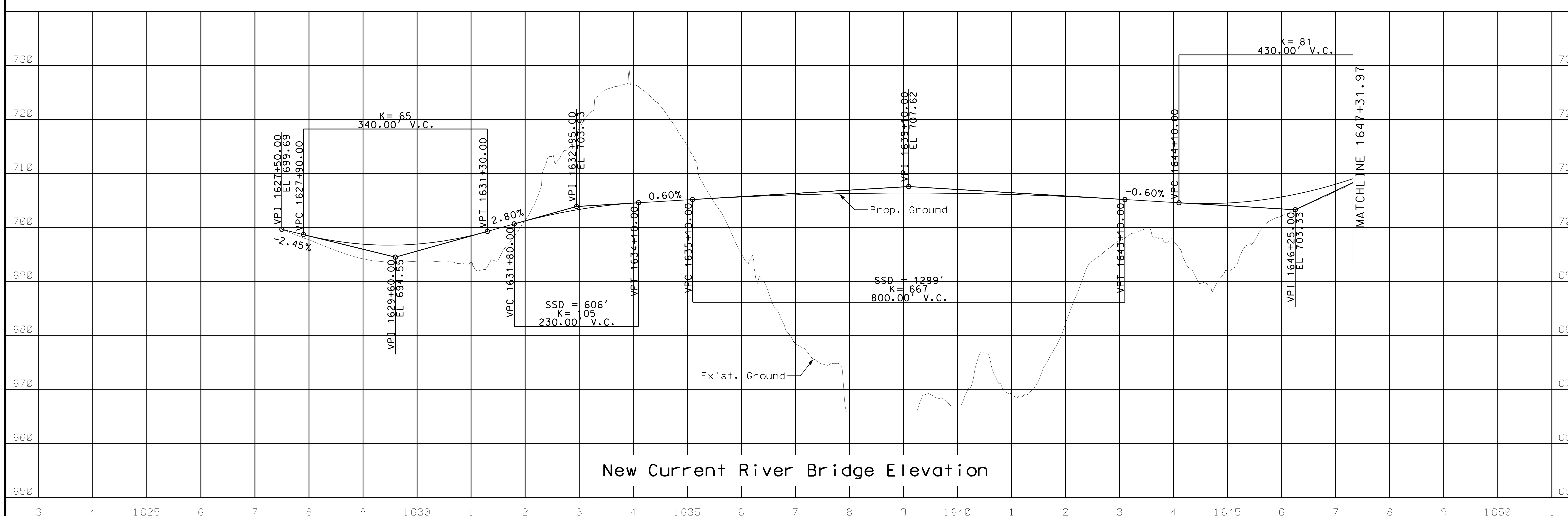


Alternatives 3a & 4a Option 1
N Bridge Over Current River
(Sheet 1 of 2)



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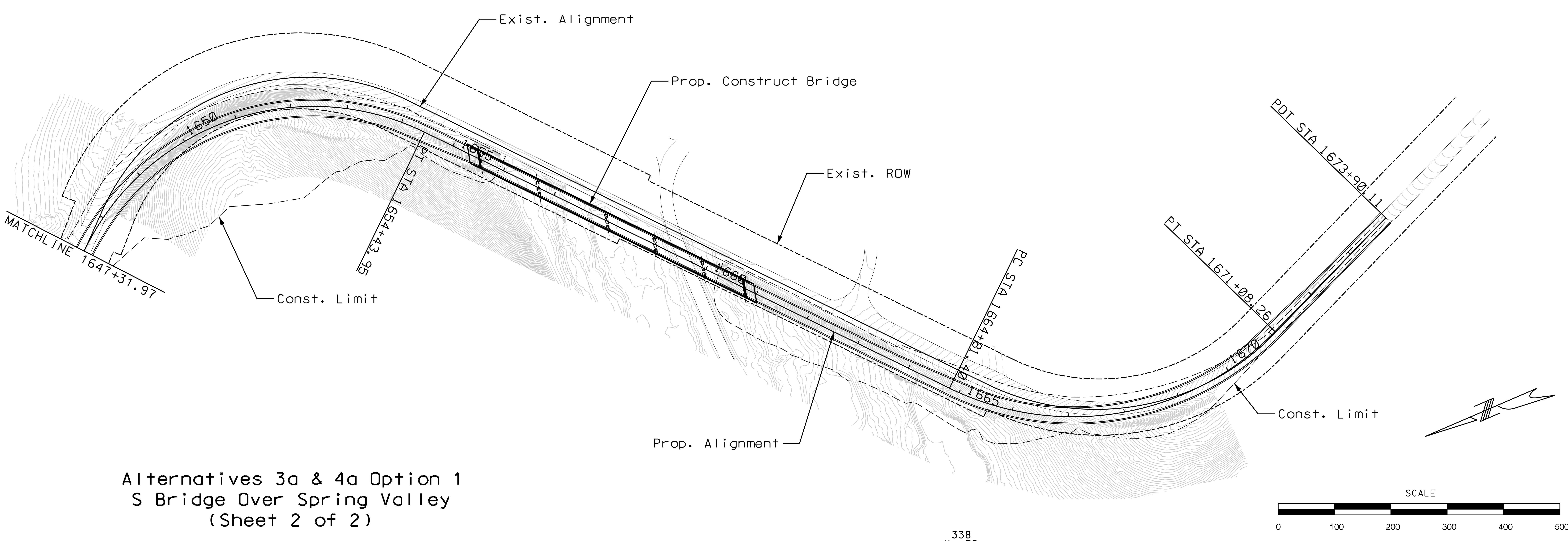
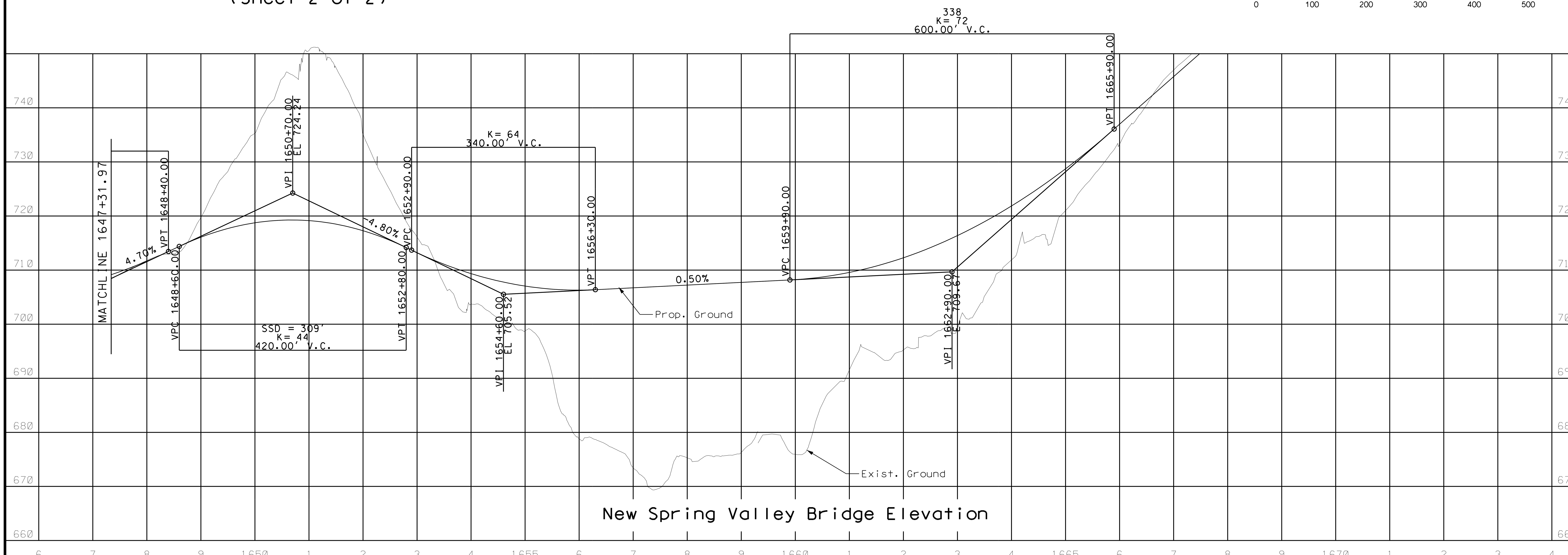
Alternatives 3a & 4a Option 1
S Bridge Over Spring Valley
(Sheet 2 of 2)





New Spring Valley Bridge Elevation

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DATE PREPARED	
10/1/2019	
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DISTRICT SE	SHEET NO. 6
COUNTY SHANNON	
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MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

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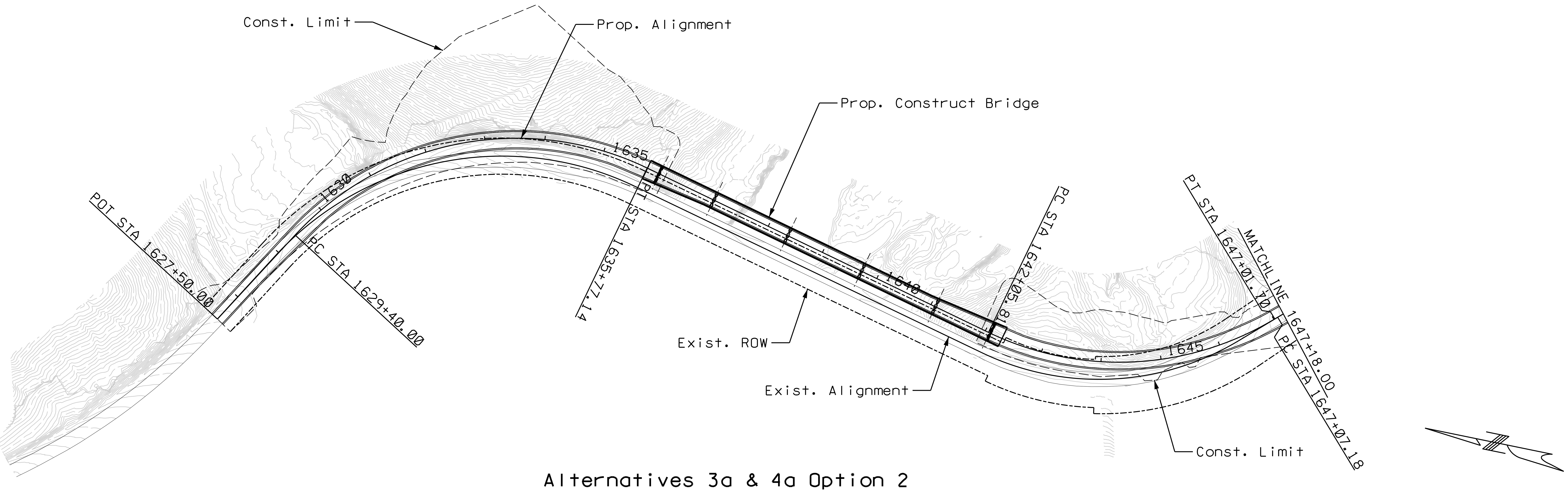
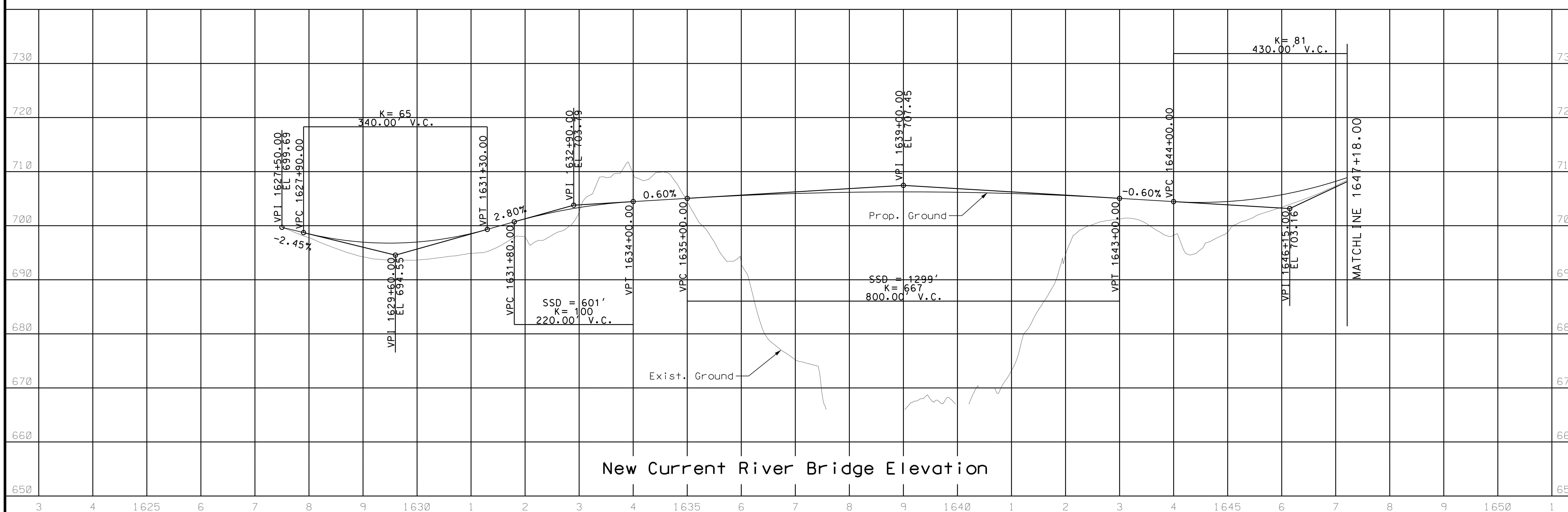


Alternatives 3a & 4a Option 2
Alternatives 3b & 4b
N Bridge Over Current River
(Sheet 1 of 2)



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ROUTE 19	STATE MO
DISTRICT SE	SHEET NO. 7
COUNTY SHANNON	
JOB NO. J9P3305	
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BRIDGE NO. .	

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MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
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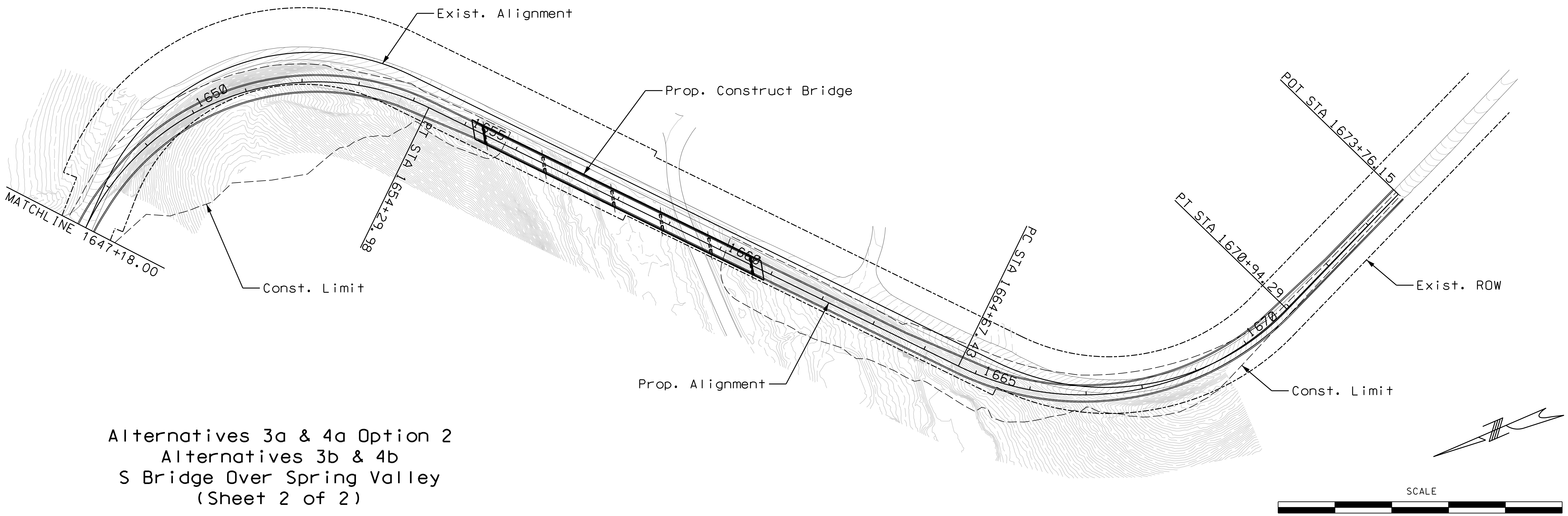
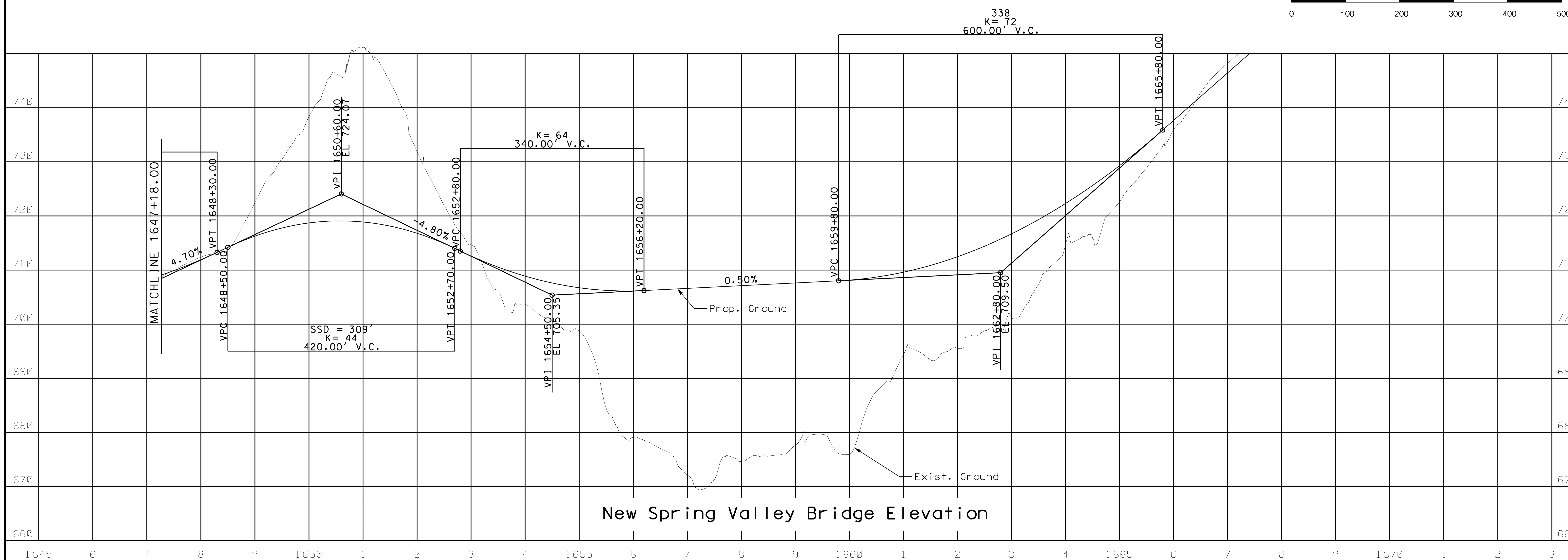


Alternatives 3a & 4a Option 2
Alternatives 3b & 4b
S Bridge Over Spring Valley
(Sheet 2 of 2)



New Spring Valley Bridge Elevation

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10/1/2019	
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DISTRICT: SE	SHEET NO.: 8
COUNTY: SHANNON	
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BRIDGE NO.: .	

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MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
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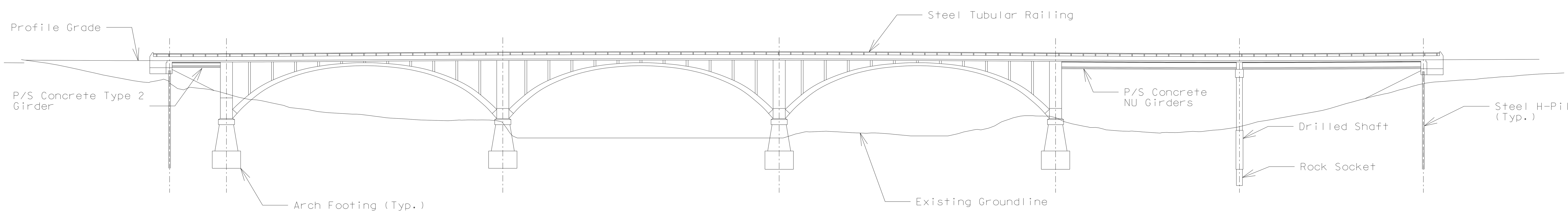
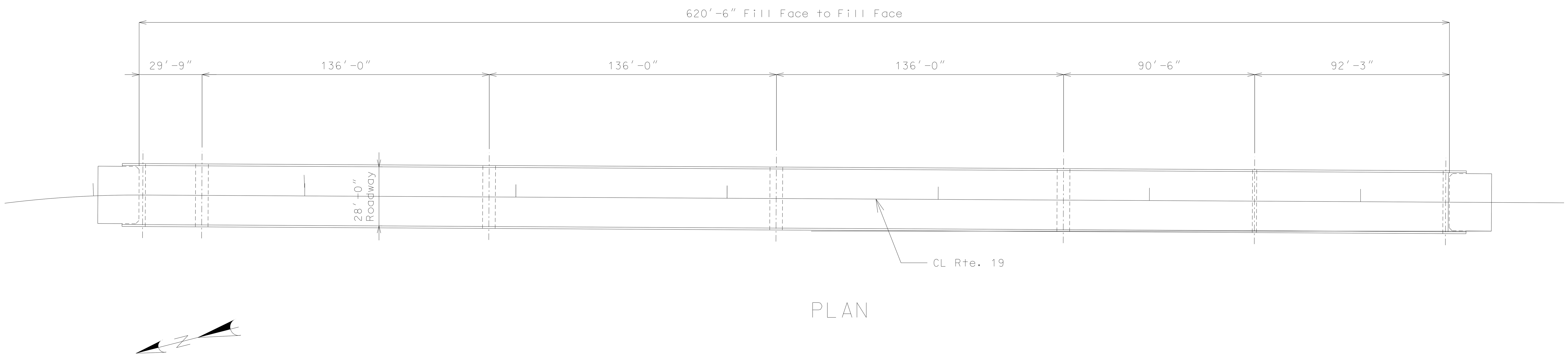


ELEVATION



PLAN

CURRENT RIVER - REPLACE IN KIND ON OFFSET ALIGNMENT OPTION

GENERAL PLAN AND ELEVATION

Note: This drawing is not to scale. Follow dimensions.

Sheet No. of

DATE PREPARED	9/18/2019
ROUTE	19
STATE	MO
DISTRICT	BR
SHEET NO.	9
COUNTY	SHANNON
JOB NO.	J9P3305
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	

DATE	DESCRIPTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
MoDOT
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JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

HDR
HDR Engineering, Inc.
4435 Main Street
Suite 1000
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816-360-2700
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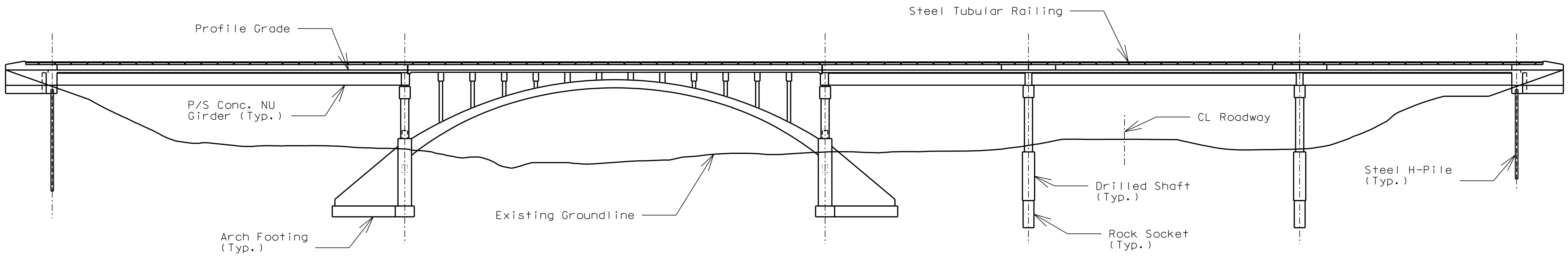
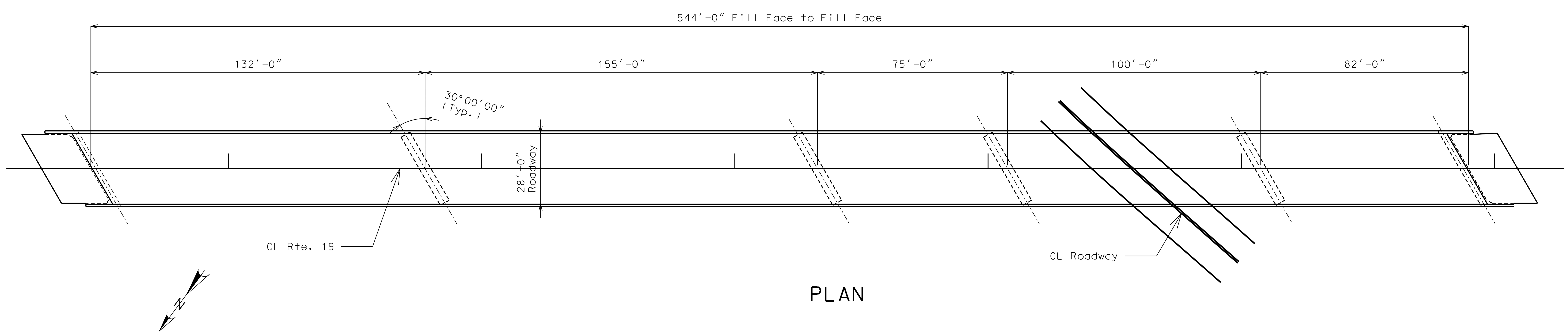


ELEVATION



PLAN

SPRING VALLEY - REPLACE IN KIND ON OFFSET ALIGNMENT OPTION

GENERAL PLAN AND ELEVATION

Note: This drawing is not to scale. Follow dimensions.

Sheet No. of

DATE PREPARED	9/18/2019
ROUTE	19
STATE	MO
DISTRICT	BR
SHEET NO.	10
COUNTY	SHANNON
JOB NO.	J9P3305
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	

DESCRIPTION | DATE

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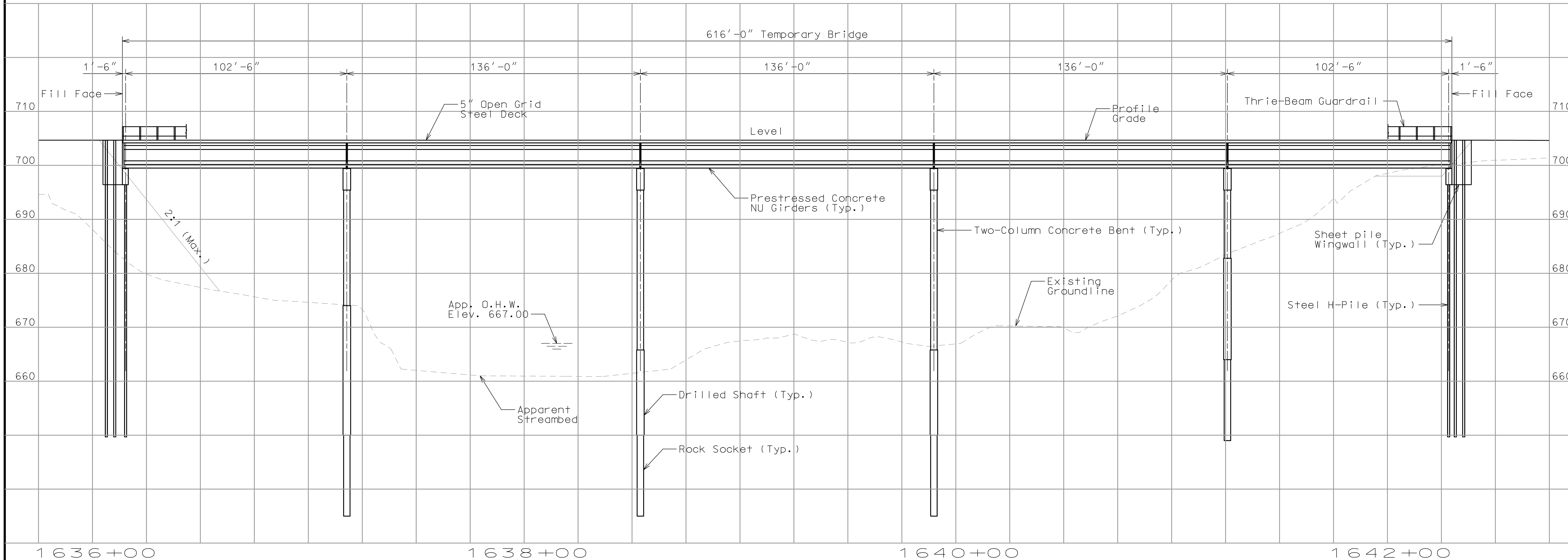
ROUTE 19 ℄ TEMPORARY ROADWAY PROFILE

- - - - - EXISTING GROUNDLINE



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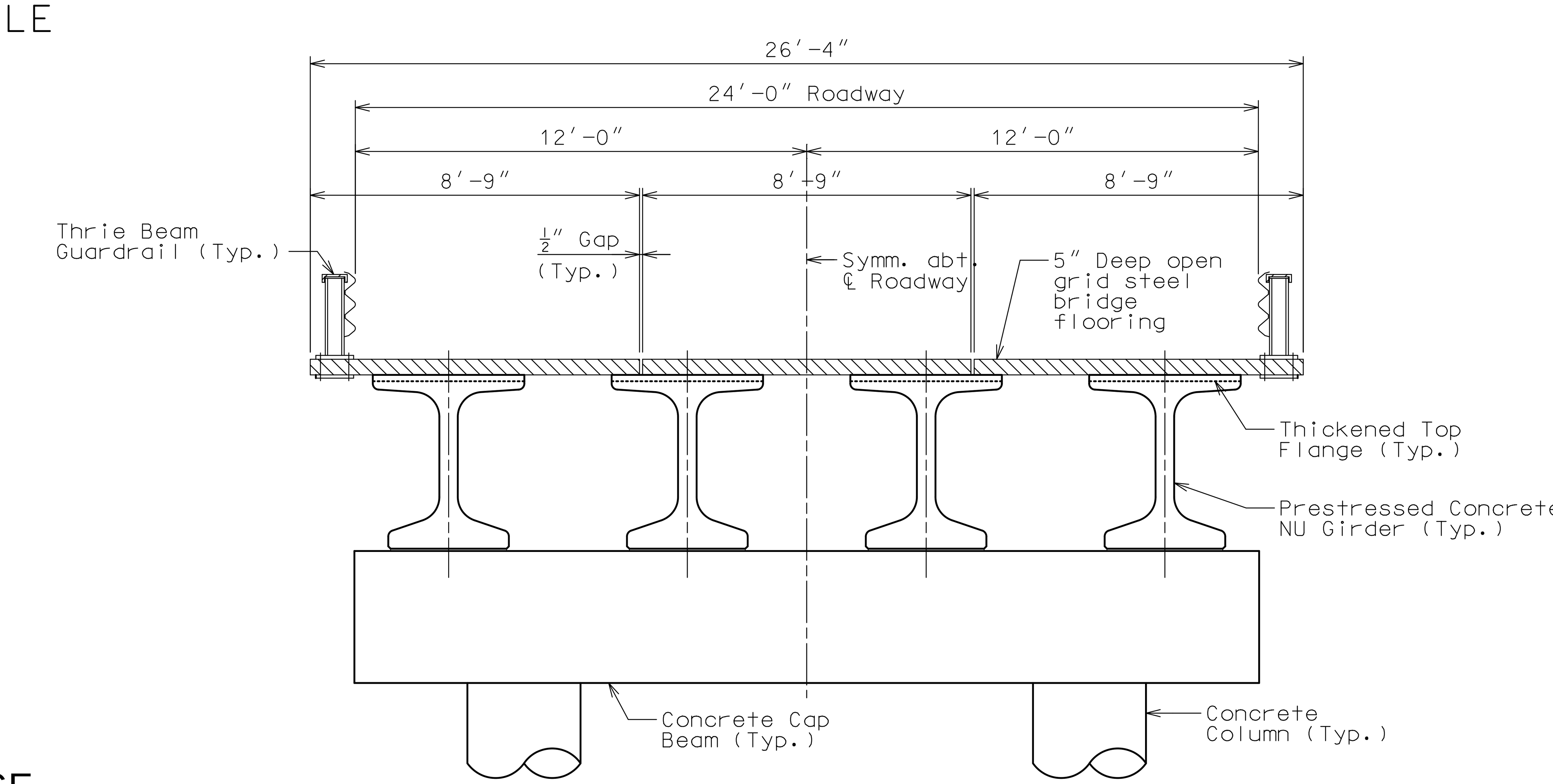

TEMPORARY ROUTE 19 BRIDGE
PROP. TYP. SECTION @ INT. BENT

CURRENT RIVER - TEMPORARY BRIDGE

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 1 of 1

NOT FOR CONSTRUCTION

DATE PREPARED 9/17/2019	
ROUTE 19	STATE MO
DISTRICT BR	SHEET NO. 11
COUNTY SHANNON	
JOB NO. J9P3305	
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO. TEMP. BR.	

DATE | DESCRIPTION

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
MoDOT
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

olsson
7301 WEST 133RD STREET
OVERLAND PARK, KS 66213
CERTIFICATE OF
AUTHORITY NO. 001592

REV.

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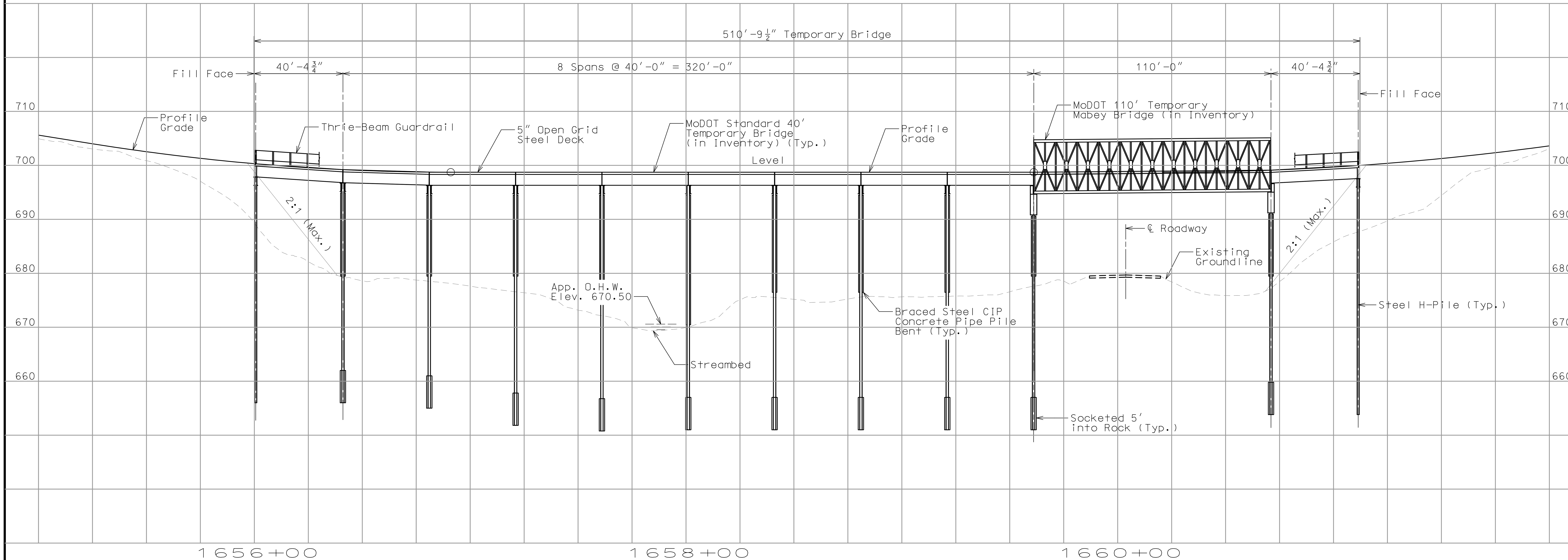
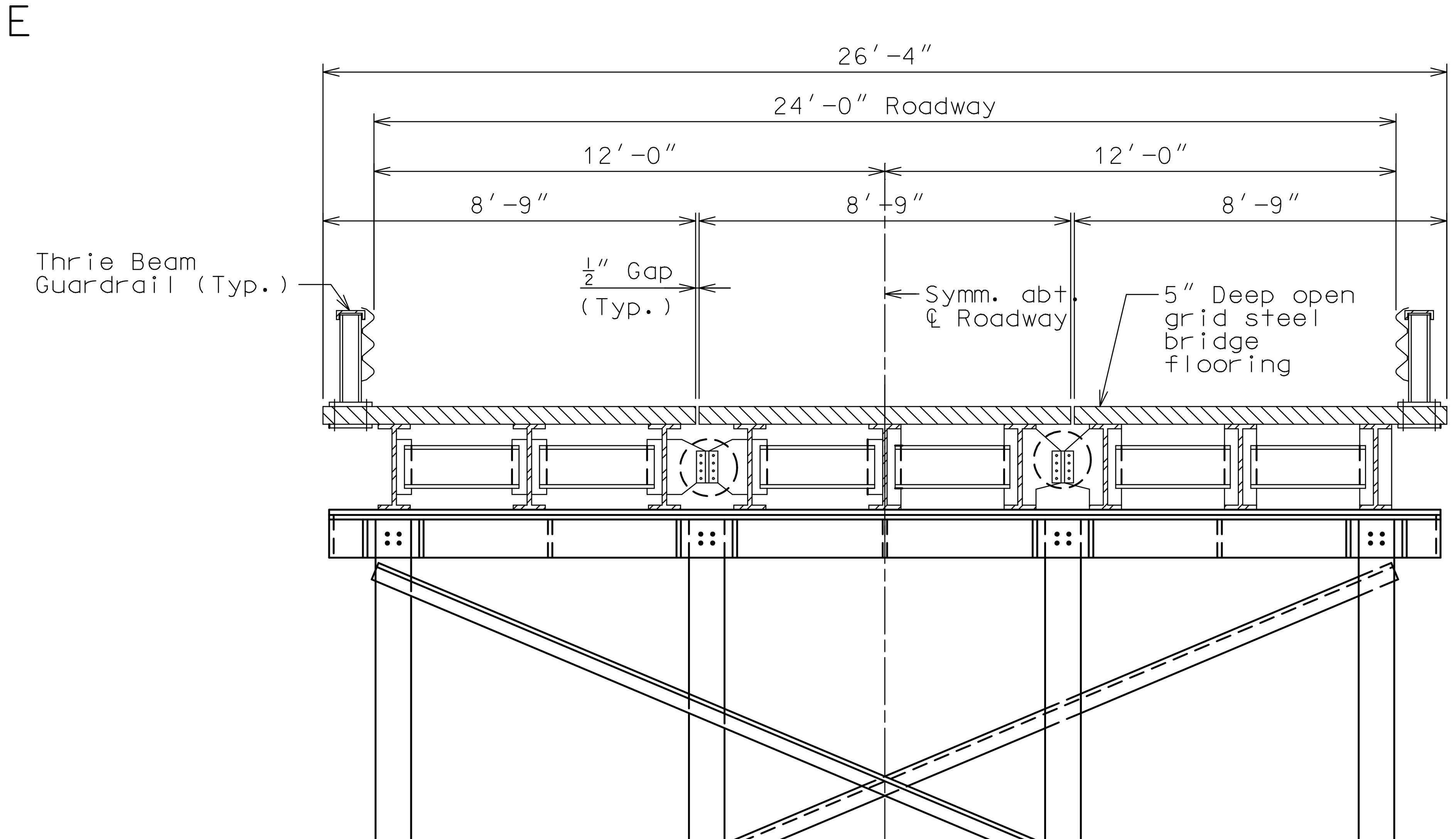
ROUTE 19 ℄ TEMPORARY ROADWAY PROFILE

EXISTING GROUNDLINE



PROFILE



TEMPORARY ROUTE 19 BRIDGE
PROP. TYP. SECTION @ INT. BENT

SPRING VALLEY - TEMPORARY BRIDGE

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 1 of 1

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DATE PREPARED 9/17/2019	
ROUTE 19	STATE MO
DISTRICT BR	SHEET NO. 12
COUNTY SHANNON	
JOB NO. J9P3305	
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO. TEMP. BR.	

DATE | DESCRIPTION

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7301 WEST 133RD STREET
OVERLAND PARK, KS 66213
CERTIFICATE OF AUTHORITY NO. 001592

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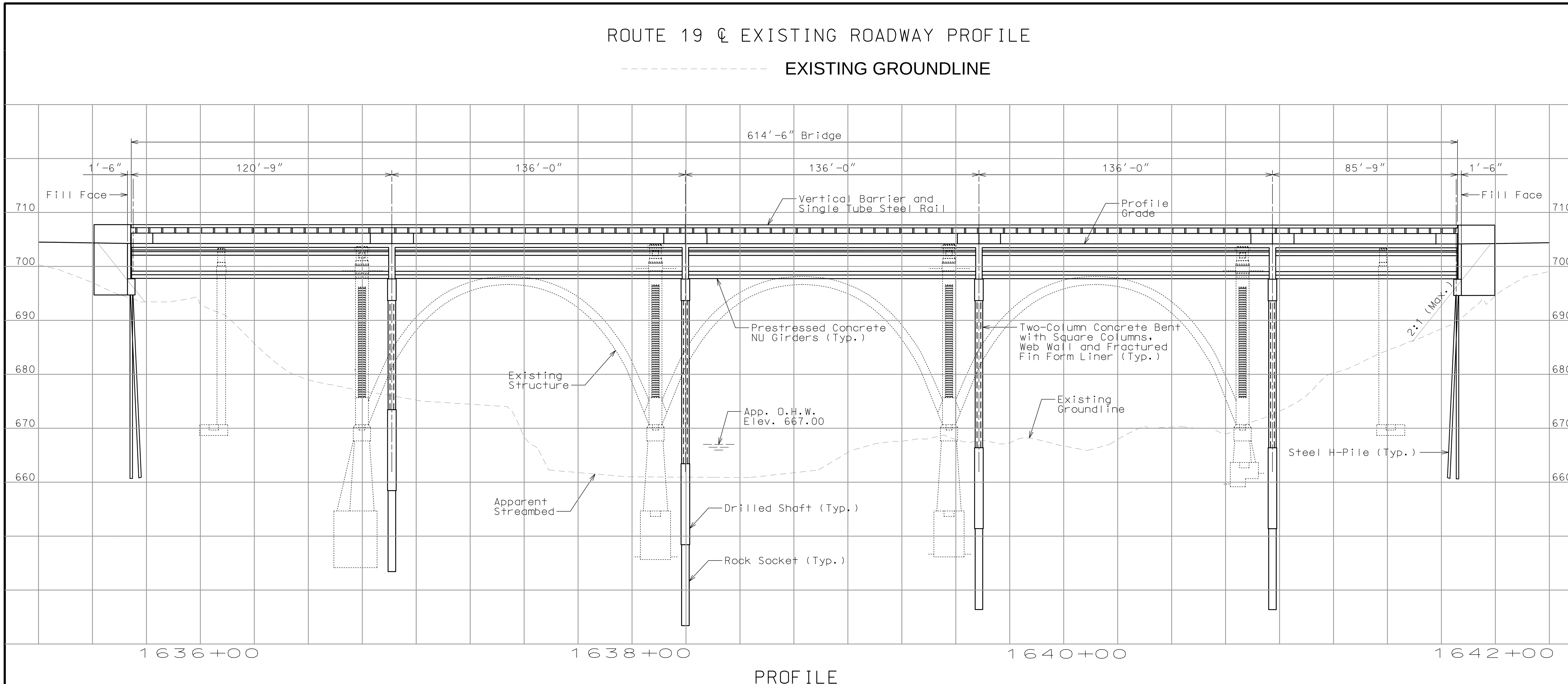

A new girder bridge option would likely use parabolically haunched steel plate girders similar to those over Sinking Creek instead of the concrete girders as shown.

CURRENT RIVER - GIRDER BRIDGE REPLACEMENT OPTION

Note: This drawing is not to scale. Follow dimensions.

Sheet No. 1 of 1

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DATE PREPARED	9/18/2019
ROUTE	19
STATE	MO
DISTRICT	BR
SHEET NO.	13
COUNTY	SHANNON
JOB NO.	J9P3305
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	BRIDGE

DATE	DESCRIPTION

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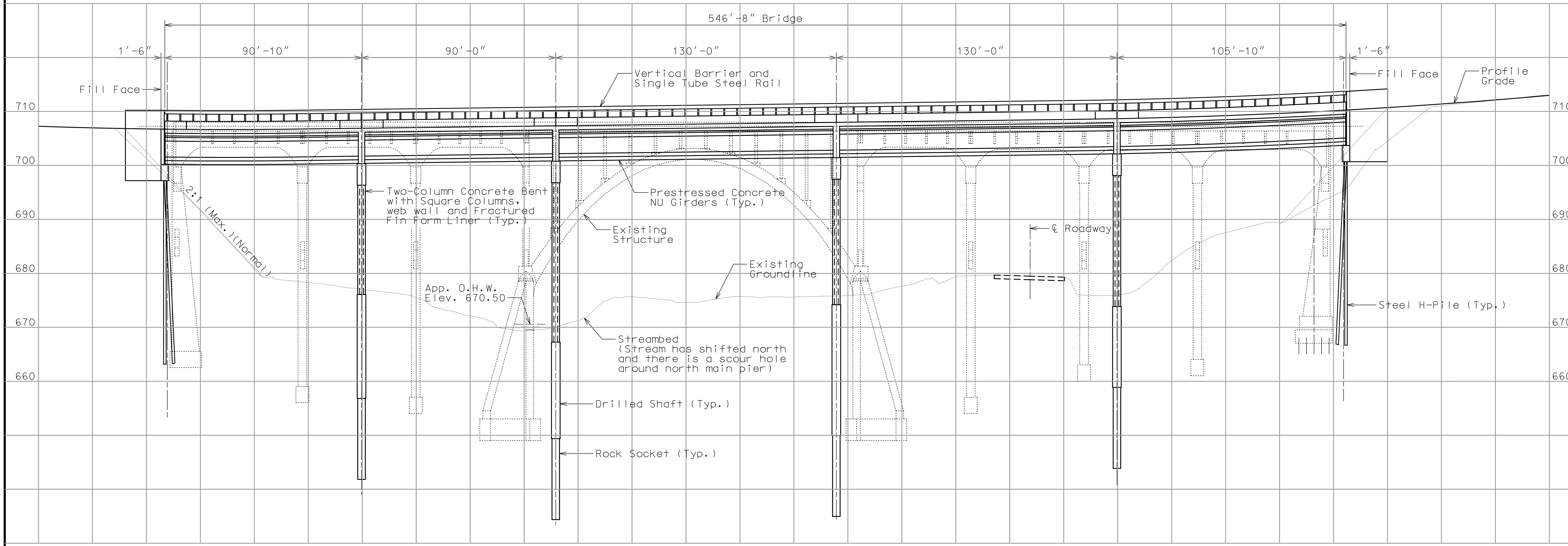
ROUTE 19 ℄ EXISTING ROADWAY PROFILE

EXISTING GROUNDLINE



PROFILE

A new girder bridge option would likely use parabolically haunched steel plate girders similar to those over Sinking Creek instead of the concrete girders as shown.

SPRING VALLEY - GIRDER BRIDGE REPLACEMENT OPTION

Note: This drawing is not to scale. Follow dimensions.

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ROUTE 19	STATE MO
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COUNTY SHANNON	
JOB NO. J9P3305	
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO. BRIDGE	

DESCRIPTION

DATE

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CERTIFICATE OF AUTHORITY NO. 001592

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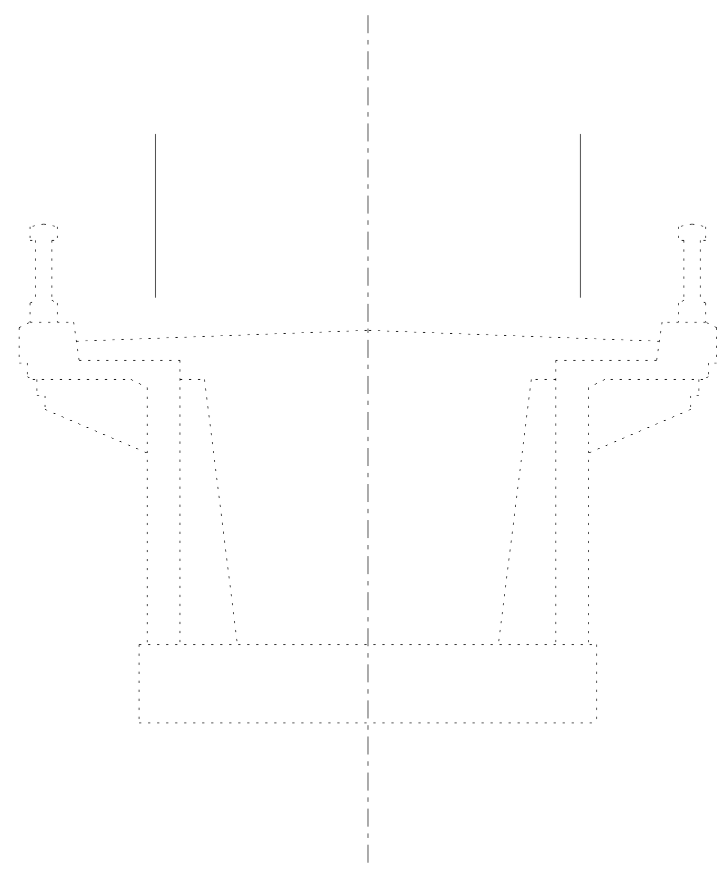

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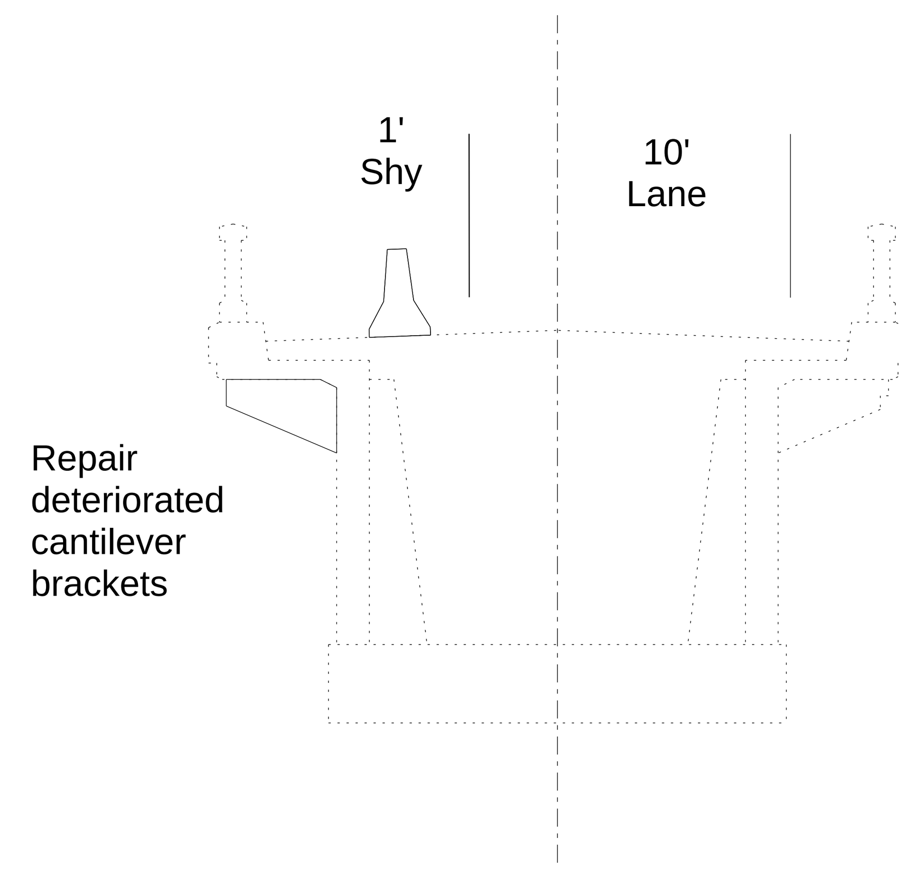

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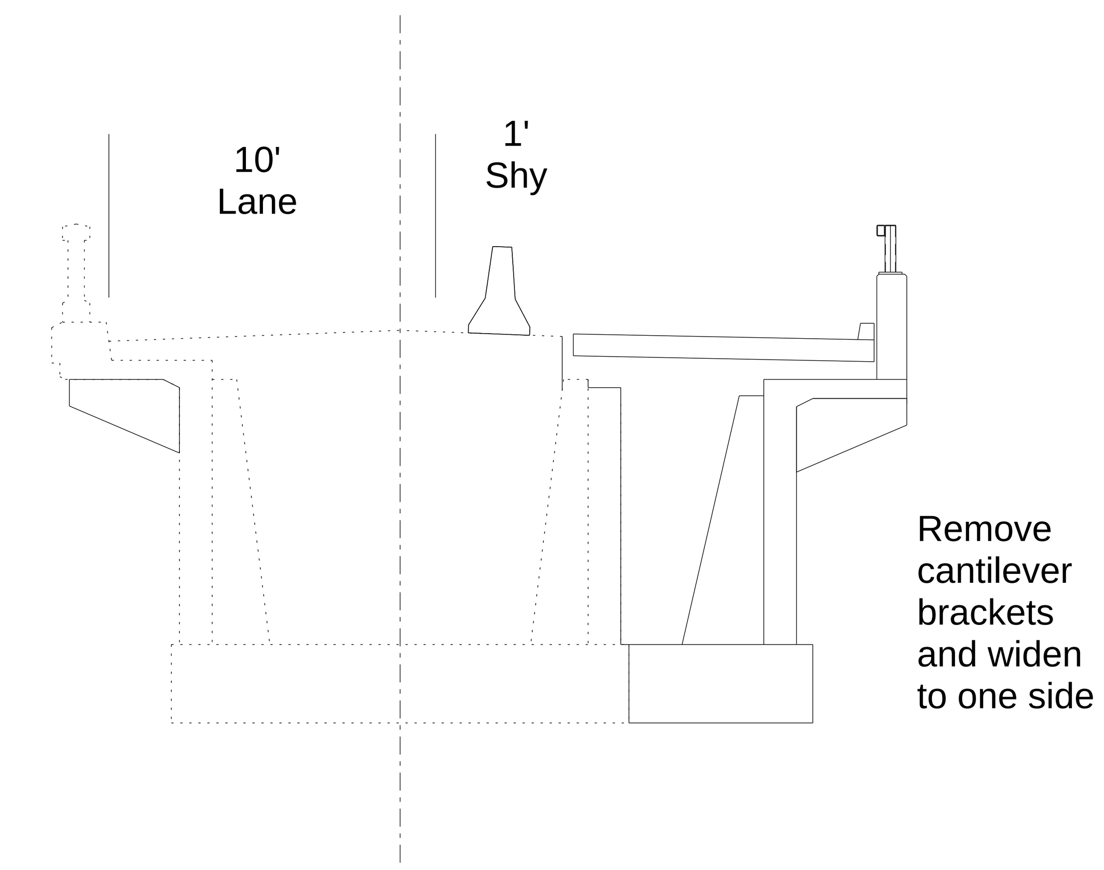

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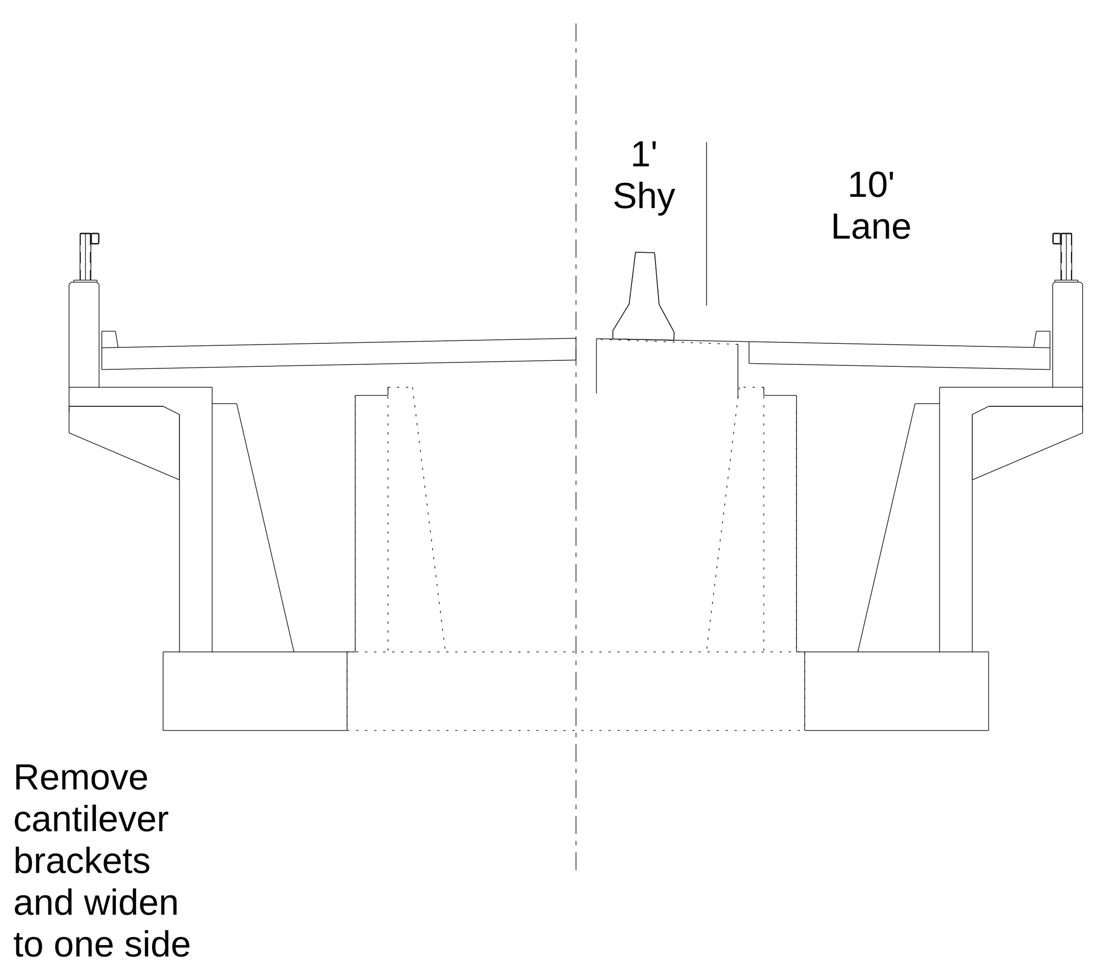

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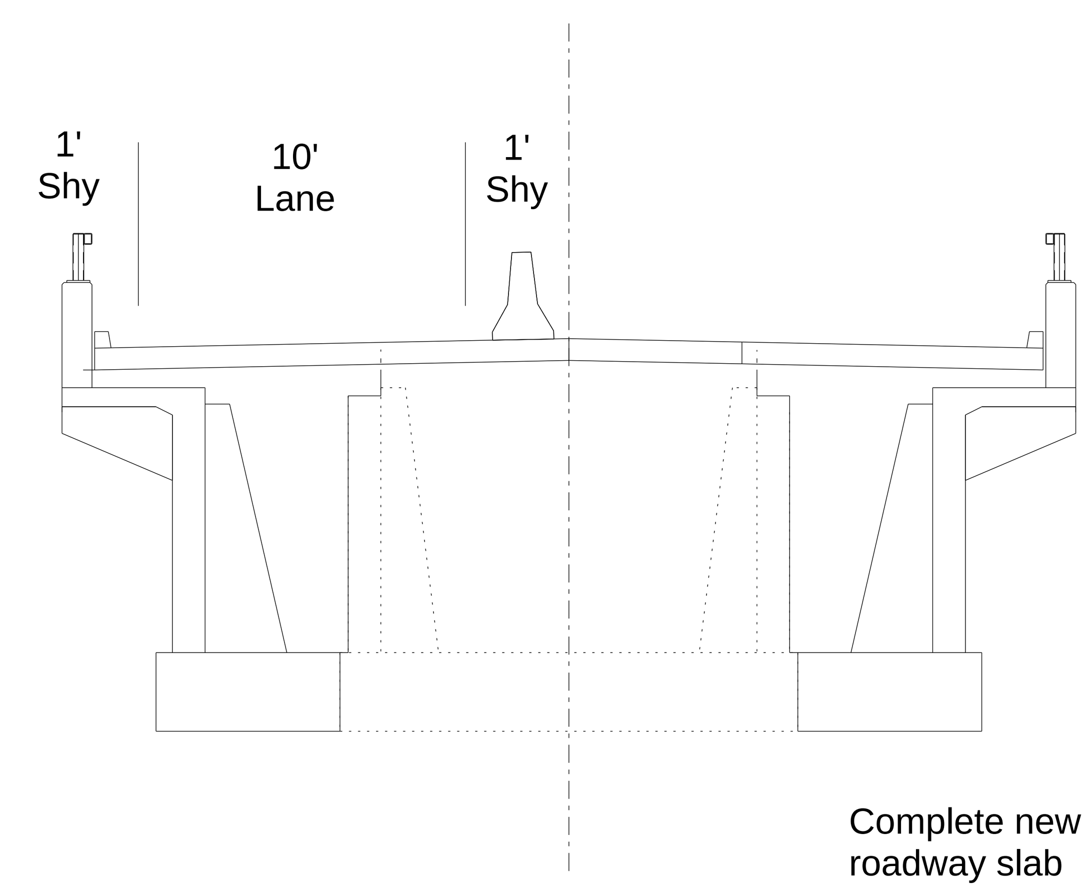

PHASE 4

CURRENT RIVER - PROPOSED REHABILITATION PHASING

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DATE PREPARED	9/18/2019
ROUTE	19
STATE	MO
DISTRICT	BR
SHEET NO.	15
COUNTY	SHANNON
JOB NO.	J9P3305
CONTRACT ID.	
PROJECT NO.	
BRIDGE NO.	

DESCRIPTION

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Route 19 - Alternative Descriptions

Alternative	Option	Existing Bridge				Ped Bridge		Temp Shoofly Bridge			New Bridge		
		Rehab/Reconst. Exist Bridge	Remove Exist Bridge	Use Exist Bridge G0804 for Ped	Add 10' Sidewalk to Exist Bridge	Keep Exist Ped Bridge	Remove Exist Ped Bridge	Use Temp Shoofly Bridge	Use Temp Bridge for Ped After	# Lanes on Temp Shoofly Bridge	Build New Bridge	Add 10' Sidewalk to New Bridge	# Lanes on New Bridge
1, 2, & 5	1N	X			X		X	X		2			
	2N	X				X		X		2			
	3N	X					X	X	X	1			
	S	X						X		2			
3a & 4a	1		X			X					X		2
	2		X				X				X	X	2
3b & 4b	1			X			X				X		2

Cost Summary

Concept Alternatives - Revised

No. 1 - $17.0M - $20.9M

No. 2 - $13.1M - $15.4M

No. 3 - $13.2M - $13.4M

No. 4 - $18.2M - $18.8M

No. 5 - $15.9M - $17.7M

Alternatives Evaluation

The workshop used a performance analysis process to evaluate the conceptual alternatives being considered. The techniques are based on the use of Value Metrics, which is predicated on the logic that value and good value decisions are based on the interrelationship between cost, performance, time and risk.

Value Metrics

Value Metrics is a decision making process that leverages a powerful multi-attribute utility theory (MAUT) known as the Analytic Hierarchy Process (AHP). Stated simply, AHP breaks down complex decisions that include varied and disparate attributes into a series of smaller, pairwise comparisons utilizing a common ratio scale. From this structure, straightforward mathematical priorities may be derived that reflect relative degrees of preference for a set of alternatives.

In making value comparisons, four essential elements must be factored. These include cost, performance, time and risk. Value Metrics provides a standardized means of identifying, defining, evaluating, and measuring performance. Value Metrics can improve group decision making by:

- Building consensus among project stakeholders
- Better informing decision makers regarding differing perspectives
- Making subjective judgments, and their strength of conviction, explicit
- Reducing bias that leads to suboptimal decisions
- Developing a better understanding of a decision's goals and objectives and identifying and aligning decision criteria to them that will result in the desired outcomes
- Developing a deeper understanding of the relationship between performance, cost, time and risk in determining value
- Using value as the basis for making decisions

Value Metrics provides a standardized means of identifying, defining, evaluating, and measuring performance. Performance is quantified in terms of how well a set of attributes contribute to the overall functional purpose of a given project.

The basic equation used for calculating value is:

$$Value = \frac{Performance}{Cost + Time}$$

In other words, value is equivalent to the relationship of the resources needed to provide a certain level of performance for a given function. Performance is defined as a set of requirements and attributes of a project's scope that are pertinent to the project's need and purpose. Participant responses are elicited for a series of paired comparisons in which the performance of alternatives are compared, with consideration of the project need and purpose, while taking into account the relative intensity of preference of one criterion over another.

The following pages describe the steps in the Value Metrics process and evaluation of the conceptual alternatives.

Define Performance Requirements

Any concept that fails to meet the project's performance requirements, regardless of whether it was developed during the project's design process or during the course of the workshop, cannot be considered as a viable solution. It should be noted that in some cases, a performance requirement may also represent the minimum acceptable level of a performance attribute. The following performance requirements were identified for this project.

Table 2 Performance Requirements

Performance Requirement	Description
Highway Design Standards	Project must meet MoDOT's most recent highway standards unless a deviation is approved. Provide minimum 26' roadway width and curve widening per MoDOT's Engineering Policy Guide.
Structural Design Standards	Any structure in the project must comply with current structural design standards.
Bridge Service Life	Any new bridge must be designed to meet minimum service life standards.
Environmental Review Process	Any concept considered must comply with applicable environmental laws and be compatible with the environmental review process.
Maintenance of Traffic	A minimum of one travel lane must be maintained throughout construction. Temporary full roadway closures may be permitted on a limited basis.
Pedestrian Facilities	All scenarios must accommodate pedestrian/bike access with a 10' wide pedestrian/mixed use walkway. Existing Current River bridge will not be accepted by NPS for use as pedestrian bridge.
Utility Impacts	Maintain utility service throughout construction
Carr's Canoe Rental Store	Maintain service and access to Carr's Store throughout construction
River Operation	Ability to maintain operation of river traffic throughout construction. Minor short-term closures and off-season closures could be considered.
Maintain Access Points	A number of access points must be maintained throughout construction. These include access to park service facilities adjacent to Spring Valley Bridge, the Round Spring campgrounds, and park service facilities north of the Current River Bridge.

Define Performance Attributes

Performance attributes represent those aspects of a project's scope that may possess a range of potential values while meeting the project's need and purpose. The following are example performance attributes for transportation-focused projects.

Mainline Operations

The Mainline Operations performance attribute is defined as an assessment of traffic operations on the mainline facilities within the project limits. Operational considerations include level of service relative to the 20-year traffic projections, as well as geometric considerations such as design speed, sight distance, lane widths, and shoulder widths.

The workshop participants determined that, although mainline operations are important, when all of the highway and structural design standard requirements are met, all construction alternatives provide the same level of performance for this attribute.

Aesthetics

An assessment of the permanent visual impacts of the project and ability to maintain visual appeal similar to the existing. This attribute also considers how well it responds to the site, surrounding environment, and the locale.

Maintainability

The performance attribute Maintainability is defined as an assessment of the long-term maintainability of the transportation facility(s). Maintenance considerations include the following factors:

- Overall Durability: Longevity (i.e. service life) and ability to maintain a good state of repair for pavements, structures, and other facility systems.
- Ease of Maintenance Efforts over the Service Life
- Accessibility and Safety Considerations for Maintenance Personnel

Construction Impacts

This performance attribute is defined by an assessment of the construction impacts for the project. These are temporary impacts only observed during the construction phase of the project. Construction impacts should consider the following components:

- Temporary Public Impacts: A measure of the construction effects on the traveling public including ease of traffic management. Also includes impacts to recreational usage during construction.
- Temporary Environmental Impacts: A measure of impacts to the surrounding community in terms of air, noise, vibrations, dust, and water quality.
- Constructability: The relative ease of constructing the proposed facility in term of availability of materials, availability of labor, and complexity of construction operations (such as stage construction complexity, lane restrictions and specialized construction methods).

Environmental Impacts

Defined as an approximation of the concept's overall permanent effects on the natural environment as well as impacts to cultural, recreational, and historic resources. Also considered under this attribute are the following:

- Impacts to Wetlands and Woodlands:
- Impacts to Vegetation
- Impacts to Wildlife habitat and linkages
- Impacts to Surface Water and Watercourses
- Impacts to Drainage and Hydraulic Issues

Prioritize Performance Attributes

The performance attributes of a project are seldom of equal importance. Therefore, a systematic approach must be utilized in order to determine their relative importance in meeting the project's need and purpose.

Once the performance attributes were defined, the stakeholders prioritized them based on their relative importance to the project. The performance attributes were systematically compared in pairs, asking the question: "An improvement to which attribute will provide the greatest benefit relative to the project's need and purpose?" Participants were then asked to indicate their priorities and the relative intensities of their preferences. The chart below provides the results of this analysis and includes the complete breakdown of the priorities, expressed as a percentage of the whole.

Performance Attributes Criteria Matrix

Paired Comparison

					Total points	% of Total
Aesthetics	A	A	A	A/D	3.5	33.3%
Maintainability		B	B	D	2.5	23.8%
Construction Impacts			C	D	1.0	9.5%
Environmental Impacts				D	3.5	33.3%
				Total	10.5	100.0%

Without emphasis on preference

A = A is of greater importance

A/B = A and B are of equal importance

Figure 1 Paired Comparison Matrix

Evaluate Performance of Conceptual Alternatives

The workshop participants prepared performance assessments of each of the Conceptual Alternatives and the rationale for how the alternative performed for each attribute was recorded.

ALTERNATIVE NO. 1 ***Replace-in-kind on alignment***
PERFORMANCE MEASURES **Attributes and Rating Rationale**
Aesthetics • Replacement of existing bridge with concrete arch spans. • Widening of bridge would have minor impacts to side slopes (varies by options of temporary bridge offset alignment). • Option 1 and 3 remove the existing pedestrian bridge. Option 2 retains existing pedestrian bridge. Preference is to remove existing pedestrian bridge and accommodate pedestrian access on new bridge.
Maintainability • Replaces existing bridge with new concrete arch span bridge. • Open spandrel option would facilitate access for inspections.
Construction Impacts • Option 1 and 3 eliminate pedestrian access during construction. Option 2 maintains pedestrian access. • Concrete arch extends construction time resulting in extended time of impacts. • Temporary bridge requires footings in the channels. • Larger overall footprint for temporary bridge construction and multiple impacts to channel. • Increased amount of falsework in the channel to support concrete arch construction increases river traffic impacts and environmental footprint. • Provides two lanes for traffic during construction (depending upon width of temporary bridge option).
Environmental Impacts • Replaces existing historic bridges with new bridges, but attempts to match current type. • Temporary bridge foundations may impact natural habitat (varies by options of temporary bridge offset alignment). • Temporary bridge would require minor impacts to side slopes (varies by options of temporary offset). • Ground disturbance for temporary bridge may impact unknown archeological sites (varies by options of temporary bridge offset alignment).

ALTERNATIVE NO. 2 Girder bridge replacement on current alignment
PERFORMANCE MEASURES **Attributes and Rating Rationale**
Aesthetics • Replacement of existing bridge with girder bridge. • Widening of bridge would have minor impacts to side slopes (varies by options of temporary bridge offset alignment). • Option 1 and 3 remove the existing pedestrian bridge. Option 2 retains existing pedestrian bridge. Preference is to remove existing pedestrian bridge and accommodate pedestrian access on new bridge.
Maintainability • Replaces existing bridge with new girder bridge. • Girder bridge would facilitate access for inspections. • Girder bridge has increased redundancy of structural support. • Girder structure reduces obstructions to channel flow.
Construction Impacts • Option 1 and 3 eliminate pedestrian access during construction. Option 2 maintains pedestrian access. • Girder bridge can be built in one construction season which limits total time of impacts. • Temporary bridge requires footings in the channels. • Larger overall footprint for temporary bridge construction and multiple impacts to channel. • Reduced amount of falsework in channel lessens river traffic impacts • Provides two lanes for traffic during construction (depending upon width of temporary bridge option).
Environmental Impacts • Replaces existing historic bridges with new girder bridges (more adverse impacts to historic district). • Temporary bridge foundations may impact natural habitat (varies by options of temporary bridge offset alignment). • Temporary bridge would require minor impacts to side slopes (varies by options of temporary offset). • Ground disturbance for temporary bridge may impact unknown archeological sites (varies by options of temporary bridge offset alignment). • Potential for reduced footings and columns in channel.

ALTERNATIVE NO. 3 Girder bridge on offset alignment
PERFORMANCE MEASURES **Attributes and Rating Rationale**
Aesthetics • Replacement of existing arch bridge with girder bridge. • Significant impacts to side slopes and ROW to accommodate permanent offset alignment. • 3A Option 1: Removes existing Current River bridge, but existing pedestrian bridges remains. • 3A Option 2: Removes existing Current River and pedestrian bridges. • 3B: Retains existing Current River bridge for pedestrian use.
Maintainability • Replaces existing bridge with new bridge. • Girder bridge would facilitate access for inspections. • Girder bridge has increased redundancy of structural support. • 3A Option 1: Removes existing Current River bridge but existing pedestrian bridge remains. NPS would continue ownership of existing pedestrian bridge. • 3A Option 2: Removes existing Current River and pedestrian bridges. Preference is to remove deteriorating structures. • 3B: Existing Current River bridge remains for pedestrian traffic, but will require periodic maintenance. • Girder structure reduces obstructions to channel flow.
Construction Impacts • Girder bridge can be built in one construction season which limits total time of impacts. • Limits in-channel work to one new bridge construction. • Reduced amount of falsework in channel. • May eliminate pedestrian access during construction (varies by option of alignment offset).
Environmental Impacts • Significant side slope and ROW impacts to accommodate permanent alignment offset). • Greatest adverse impact to Three Bridges Historic District and Section 4F impacts. • Increased ground disturbance outside existing ROW may impact unknown archeological sites and karst topography (varies by options of offset alignment).

ALTERNATIVE NO. 4 *Concrete Arch on offset alignment*
PERFORMANCE MEASURES **Attributes and Rating Rationale**
Aesthetics • Replacement of existing arch bridge with concrete arch bridge. • Significant impacts to side slopes and ROW to accommodate permanent offset alignment. • 4A Option 1: Removes existing Current River bridge, but existing pedestrian bridges remains. • 4A Option 2: Removes existing Current River and pedestrian bridges. • 4B: Retains existing Current River bridge for pedestrian use.
Maintainability • Replaces existing bridge with new concrete arch span bridge. • Open spandrel option would facilitate access for inspections. • 4A Option 1: Removes existing Current River bridge but existing pedestrian bridge remains. NPS would continue ownership of existing pedestrian bridge. Preference is to remove deteriorating structures. • 4A Option 2: Removes existing Current River and pedestrian bridges. Preference is to remove deteriorating structures. • 4B: Existing Current River bridge remains for pedestrian traffic, but will require periodic maintenance.
Construction Impacts • Concrete arch extends construction time resulting in extended time of impacts. • Increased amount of falsework in the channel to support concrete arch construction increases river traffic impacts and environmental footprint. • May eliminate pedestrian access during construction (varies by option of alignment offset).
Environmental Impacts • Significant side slope and ROW impacts to accommodate permanent alignment offset). • Highway realignment results in significant adverse impact to Three Bridges Historic District and Section 4F impacts. • Increased ground disturbance outside existing ROW may impact unknown archeological sites and karst topography (varies by options of offset alignment).

ALTERNATIVE NO. 5 ***Rehabilitation of existing bridges (Temporary Bridge for Spring Valley, Staged Construction of Current River)***
PERFORMANCE MEASURES **Attributes and Rating Rationale**
Aesthetics • Matches existing aesthetics (structure type, side slopes, pedestrian bridge). • Maintains existing pedestrian bridge. • No impacts to side slopes at Current River. • Side slope impacts at Spring Valley for temporary bridge. • Majority of Spring Valley bridge is replaced. Arch and thrust blocks remain, but not visible.
Maintainability • Retains existing concrete bridge within widened new structure. • Eliminates ability to inspect portions of structure. • Reduced total life of rehabbed structure (vs. new structure).
Construction Impacts • Limits traffic to one signal-controlled lane during construction. • Narrow one-lane widths during select stages. • Concrete arch extends construction time resulting in extended time of impacts. • Increased amount of falsework in the channel to support concrete arch increases river traffic impacts and environmental footprint. • Provides two lanes for traffic during construction (depending upon width of temporary bridge option).
Environmental Impacts • Least amount of environmental disturbance. • Temporary bridge at Spring Valley would require minor impacts to side slopes. • Temporary bridge foundations at Spring Valley may impact natural habitat. • Ground disturbance for temporary bridge at Spring Valley may impact unknown archaeological sites.
Risk • Potential for increased deterioration discovered during construction.

ALTERNATIVE NO. 6 ***Over-widened rehabilitation of Current River Bridge, Staged Construction of Current River, Temporary Bridge for Spring Valley*** ***Option A: Girder Bridge*** ***Option B: Concrete Arch Bridge***
PERFORMANCE MEASURES **Attributes and Rating Rationale**
Aesthetics • Matches existing aesthetics depending upon structure type option. • Removes existing pedestrian bridge. • No impacts to side slopes at Current River. • Side slope impacts at Spring Valley for temporary bridge.
Maintainability • Retains existing concrete bridge within widened new structure. • Removes existing pedestrian bridge. • Girder option reduces obstructions to channel flow.
Construction Impacts • Limits traffic to one signal-controlled lane during construction. • Narrow one-lane widths during select stages. • Eliminates pedestrian access during construction. • Concrete arch option extends construction time resulting in extended time of impacts. • Increased amount of falsework in the channel to support concrete arch option increases river traffic impacts and environmental footprint.
Environmental Impacts • Least amount of environmental disturbance. • Girder option would result in adverse affects to Historic District. • Temporary bridge at Spring Valley would require minor impacts to side slopes. • Removes existing pedestrian bridge from channel reduces flow obstructions. • Temporary bridge foundations at Spring Valley may impact natural habitat. • Ground disturbance for temporary bridge at Spring Valley may impact unknown archaeological sites.

Evaluate Performance of Bridge Railing Alternatives

ALTERNATIVE NO. 1 *Parapet and Steel Rail*
PERFORMANCE MEASURES **Attributes and Rating Rationale**
Aesthetics • Matches Sinking Creek railing and Texas County Road 17 railing. • Does not match aesthetics of existing bridge railing. • Promotes visibility from roadway to surrounding area.
Maintainability • Steel feature may require some maintenance.
Construction Impacts • Relatively simpler and faster to construct.
Environmental Impacts • N/A
Risk • Very likely to be acceptable under new bridge rail criteria.

ALTERNATIVE NO. 2 *Open Concrete Rail*
PERFORMANCE MEASURES **Attributes and Rating Rationale**
Aesthetics • Closest match to existing bridge railing. • Height of railing and picket spacing reduces visibility to surrounding.
Maintainability • More susceptible to damage after vehicle strikes. • Patch repair less likely to match original. • Increased surface area subject to deterioration.
Construction Impacts • Specialty construction of elements may increase construction complexity and time.
Environmental Impacts • N/A
Risk • May be subject to acceptability limitations under new criteria.

ALTERNATIVE NO. 3 *Concrete Corral Rail with Steel Rail*
PERFORMANCE MEASURES **Attributes and Rating Rationale**
Aesthetics • Restricts viewsheds from structure • Allows use of form liner for lower portion to enhance aesthetics. • Does not match aesthetics of existing bridge railing or Sinking Creek.
Maintainability • Solid concrete is less susceptible to damage from vehicle strikes. • Steel elements may require periodic maintenance.
Construction Impacts • Relatively simpler and faster to construct than open concrete rail.
Environmental Impacts • N/A

ALTERNATIVE NO. 4 *Type D Concrete Parapet Wall*
PERFORMANCE MEASURES **Attributes and Rating Rationale**
Aesthetics • Does not match aesthetics of existing bridge railing or Sinking Creek. • Limits visibility from roadway to surrounding area. • Form liner could be applied to exterior.
Maintainability • Solid concrete is less susceptible to damage from vehicle strikes. • No steel elements to maintain.
Construction Impacts • Easiest construction effort and time.
Environmental Impacts • N/A
Risk • Most likely to be acceptable under new bridge rail criteria.

Appendix

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Workshop Agenda

Date: Thursday, September 19, 2019
Location: NPS Maintenance Facility at Round Spring

08:00 AM	**Charrette Kick-off** • Safety Minute • Introductions • Workshop objectives	**All Participants**
08:15 AM	**Charrette Process Overview** • An instructional presentation on the charrette processes and their application to the project	**Facilitator**
8:30 AM	**Project Overview** • Pre-Workshop Investigation Results • Design Drivers and Constraints • Conceptual Alternatives Presentation	**HDR Design Team**
10:00 AM	**Break**	
10:15 AM	**Project Analysis / Value Metrics** • Function Analysis / Discuss Purpose and Need • Performance Requirements and Attributes • Performance Attribute Prioritization	**All Participants**
12:00 PM	**Lunch Break**	
1:00 PM	**Conceptual Alternative Evaluation** • Evaluate Conceptual Alternatives based on predetermined criteria	**All Participants**
3:00	**Brainstorming Ideas** • Brainstorm alternative ways to address project issues • Brainstorm additional conceptual alternatives	**All Participants**
4:30 PM	**Adjourn**	

Workshop Attendees

Workshop Attendees
Route 19 at Current River and Spring Valley, Rehab Study of Bridges A-420 J-804
Shannon County, MO

NAME	ORGANIZATION	POSITION/DISCIPLINE	TELEPHONE	CELL	E-MAIL
Pete Berry	MoDOT	Project Manager	417-469-6242		Chris.Berry@modot.mo.gov
Stacy McMillan	MoDOT	Structural Liaison Engineer			Stacy.McMillan@modot.mo.gov
Karen Daniels	MoDOT	Historic Preservation	573-526-7346	573-508-2208	Karen.daniels@modot.mo.gov
Richard Moore	MoDOT	Environmental	573-526-2909		Richard.moore@modot.mo.gov
Elquin Auala	MoDOT	Area Engineer	417-469-6286	417-252-7816	Elquin.auala@modot.mo.gov
Eric Daniels	NPS Ozark National Scenic Riverway	Chief of Resource Management	573-996-6605	573-323-4868	Eric_daniels@nps.gov
Jeff Cowen	Shannon County		417-247-1234		jeffcowen@yahoo.com
Kurt Gribble	HDR	Project Manager	573-886-8934		Kurt.Gribble@hdrinc.com
Mark Watson	HDR	VE Facilitator		816-206-0067	Mark.watson@hdrinc.com
John Buttenob	HDR	Roadway Design	801-743-7817	801-913-3346	john.Buttenob@hdrinc.com

Workshop Attendees

Route 19 at Current River and Spring Valley, Rehab Study of Bridges A-420 J-804

Shannon County, MO

NAME	ORGANIZATION	POSITION/DISCIPLINE	TELEPHONE	CELL	E-MAIL
David Barrett	HDR	Bridge Design	816-360-2752		David.Barrett@hdrinc.com
Rick Halbert	NPS Ozark National Scenic Riverway	Chief of Maintenance	573-323-4913		Richard_halbert@nps.gov
Russ Runge	NPS Ozark National Scenic Riverway	Deputy Superintendent	573-323-4861		Russell_runge@nps.gov
Tom Haney	NPS Ozark National Scenic Riverway	Upper Current Water/Wastewater			Tom_Haney@nps.gov
Steven Williams	NPS Ozark National Scenic Riverway	Upper Current Supervisor	573-323-8100	573-300-5460	Steven_l_williams@nps.gov
Victoria Grant	NPS Ozark National Scenic Riverway	Natural Resource Manager	573-323-4903		Victoria_grant@nps.gov
Jessica Fry	NPS Ozark National Scenic Riverway	Museum Specialist, Park 106 Coordinator	573-323-8047		Jessica_fry@nps.gov
Dena Matteson	NPS Ozark National Scenic Riverway	Chief of Interpretation, Public Info Officer	573-323-4814		Dena_matteson@nps.gov
Dave Tobey	NPS	Round Spring District Superintendent	573-323-8093		Dave_tobey@nps.gov
Mike Meinkath	MoDOT	Historic Preservation	573-526-35993		Michael.meikath@modot.mo.gov

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Appendix E. Bridge and Roadway Estimates

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Current River Bridge

Alternative 1A, Option 1 – Cost Estimate

G0804 Replacement - Filled Arch Option (No phasing)

Bridge Length =	612	Ft.	Skew =	0	degrees
New Bridge Width =	40.83	Ft.	New Arch Width =	35	Ft.
Cantilever Width =	4.583	Ft.	Side Wall Area (DGN) =	1060	ft^2
Pier 2 Width =	40.5	ft.	New Side Wall Thk =	12	in.
Pier 2 Length =	13	ft.	Arch End Area (130' Span) =	290	ft^2
Pier 3&4 Width =	43.5	ft.	Pier 2 Area =	165	ft^2
Pier 3&4 Length =	14	ft.	Pier 3 & 4 Area =	300	ft^2
Pier 5 Width =	43.5	ft.	Pier 5 Area =	450	ft^2
Pier 5 Length =	20	ft.	# Girders (End Spans) =	5	
End Span Lengths (NU53) =	102	ft.	Wing Length =	15	ft.

Item	Quantity		Unit Cost	Estimated Cost
Arch Backfill				
(202-60.40)	3890	Cu. Yd.	$25	$97,250
		Filled Arch - Assume 33' wide fill x side wall area (measured in CAD)		
Class 1 Excavation				
(206-10.00)	2530	Cu. Yd.	$50	$126,500
	Abut. Excav. Depth =	5	ft.	
	Pier 2 Excav. Depth =	12	ft.	
	Pier 3 & 4 Excav. Depth =	17	ft.	
	Pier 5 Excav. Depth =	27	ft.	
Cofferdams				
(206-60.02)	1	Lump Sum	$1,000,000	$1,000,000
		Assume $250,000 each		
Ornamental Pedestrian Fence				
(607-99.03)	612	LF.	$160	$97,920
Galvanized Structural Steel Pile (12")				
(702-12.12)	324	LF.	$75	$24,300
	Approx. Pile Length (EB 1) =	24	ft	
	Approx. Pile Length (EB 6) =	30	ft	
	# Piles/End Bent =	6		
Dynamic Pile Testing				
(702-50.01)	2	Ea.	$2,500	$5,000
Pile Point Reinforcement				
(702-70.00)	12	Ea.	$125	$1,500
Class B Concrete (Substructure)				
(703-20.03)	2,460	Cu. Yd.	$900	$2,214,000
		Include side walls, 6'x12" pilasters and support brackets w/ foundations		
		Include new floorbeam braces (10 per span - 15"x27"x33')		
Class B-2 Concrete (Arch)				
(703-20.03)	1130	Cu. Yd.	$2,000	$2,260,000
		Use end areas from DGN file and multiply by 35' wide arch		
Slab on Filled Arch				
(703-42.14)	1860	Sq. Yd.	$200	$372,000
Barrier Curb				
(703-42.15)	1290	LF.	$95	$122,550
Slab on Concrete NU-Girder				
(703-42.15)	930	Sq. Yd.	$315	$292,950

Form Liners				
(703-46.20)	400	Sq. Yd.	$100	$40,000
		Back of Barrierss and new Pilasters at piers (approx. 5' wide x 25' tall)		
NU 53, Prestressed Concrete NU-Girder				
(705-60.23)	1010	LF.	$240	$242,400
Reinforcing Steel				
(706-10.60)	489,300	Lb.	$1.40	$685,020
		Assume 130# per CY of concrete for Substr. 150# for the Arch concrete		
Steel Intermediate Diaphragm (NU Girder)				
(712-33.01)	16	Ea.	$1,000	$16,000
		Two in each end span per bay		
Slab Drain				
(712-36.10)	84	Ea.	$500	$42,000
		Assume new VC on bridge to help drainage. Spa. @ 15' across bridge		
Drainage System on Structure				
(712-99.01)	1	Lump Sum	$80,000	$80,000
Misc. Bridge Rail				
(712-99.03)	1290	LF.	$110	$141,900
Vertical Drain at End Bent				
(715-10.01)	2	Ea.	$3,060	$6,120
		Assume $45/ft. Roadway width + 2 wings		
Laminated Neoprene Bearing (Tapered)				
(716-10.03)	10	Ea.	$375	$3,750
Laminated Neoprene Bearing Assembly				
(716-20.00)	10	Ea.	$2,000	$20,000
Strip Seal Expansion Joint System				
(717-20.01)	90	LF.	$400	$36,000

Total New Bridge Cost =	**$7,927,200**	**Unit Cost =**	**$317 / Sq. Ft.**

Not including approach slab

CONCEPT STUDY - OPINION OF PROBABLE CONSTRUCTION COSTS
ROUTE 19 ARCH BRIDGES REHAB STUDY
HDR

DESCRIPTION: Route 19 two-lane minor rural highway. Project limits assume construction of shoofly along Route 19 from Sta. 100+00 to Sta. 113+47 across Current River. Estimate does not include costs for bridges.

Figure A-1: Alternative 1A,2A, 5B North Option 1 - Temp Shoofly Bridge; Remove Ped Bridge

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST	COMMENT
MOBILIZATION AND TRAFFIC CONTROL					
TEMPORARY TRAFFIC CONTROL	LS	1	$35,000	$35,000	assumes flagging, temp barrier, signs, etc
TEMPORARY PAVING	SY	1984	$55	$109,141	8" asphalt; 6" aggregate base
EROSION CONTROL					
EROSION CONTROL	LS	1	$20,000	$20,000	
ROADWORK					
REMOVAL OF IMPROVEMENTS	LS	1	$15,000	$15,000	
CLEARING AND GRUBBING	ACRE	3	$7,000	$21,000	
EXCAVATION - CLASS A	CY	8539	$8	$64,041	Assumes 2/3 cut volume is Class A
EXCAVATION - CLASS C	CY	4269	$20	$85,388	Assumes 1/3 cut volume is Class C
EMBANKMENT IN PLACE	CY	3411	$12	$40,935	
DRAINAGE AND SEWERS					
DRAINAGE	LS	1	$20,000	$20,000	
BRIDGES					
BRIDGE DEMOLITION	LS				See Bridge Costs
ROUTE 19 OVER CURRENT RIVER	LS				See Bridge Costs
TEMPORARY CAUSEWAY	LS	1	$250,000	$250,000	
TEMPORARY SHORING	LS	1	$50,000	$50,000	
PAVEMENT					
ROUTE 19 RECONSTRUCTION	SY	146	$55	$8,033	8" asphalt; Type 5 aggregate base (6")
PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES					
GUARDRAIL, MGS	FOOT	300	$20	$6,000	
GUARDRAIL, BRIDGE APPROACH TRANSITION SECTION	EACH	4	$3,000	$12,000	
GUARDRAIL, TYPE A CRASHWORTHY END TERMINAL (MASH)	EACH	4	$2,500	$10,000	
PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS					
SIGNING AND STRIPING	LS	1	$10,000	$10,000	
OTHER					
SEEDING AND MULCHING	LS	1	$15,000	$15,000	
BID ITEMS SUBTOTAL				**$771,537**	
CONSTRUCTION SURVEYING	LS			$10,000.00	
CONTINGENCIES	LS		25%	$195,384.20	
TOTAL CONSTRUCTION COST				**$976,921**	

ENGINEER'S ESTIMATE - CONCEPTUAL CONSTRUCTION COST

olsson

Client: MoDOT **Date:** 9/16/2019
Project: J9P3305: Rte 19 Arch Bridges Rehab. Study
Project Number: 019-2126 **By:** GCL
Description: Current River Bridge - Temporary Bridge (24' Rdwy)
(102.5'-136'-136'-136'-102.5')

These Costs do not include PE, RW, Permitting, Inspection Costs. Unit Prices are FY 2020.

BID FORM #	MODOT BID ITEM #	DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
BRIDGE CONSTRUCTION BID ITEMS						
1	2160500	Removal of Bridges (Temp Structure)	1	L.S.	$160,160	$160,160
2	7011107	Drilled Shafts (4 Ft. 6 In. Dia.)	160.0	Lin. Ft.	$900	$144,000
3	7011206	Rock Sockets (4 Ft. 0 In. Dia.)	160.0	Lin. Ft.	$950	$152,000
4	7011300	Video Camera Inspection	8.0	Each	$225	$1,800
5	7011400	Foundation Inspection Holes	360.0	Lin. Ft.	$130	$46,800
6	7011600	Sonic Logging Testing	8.0	Each	$2,000	$16,000
7	7021212	Galvanized Structural Steel Piles (12 In.)	990.0	Lin. Ft.	$80	$79,200
8	7027000	Pile Point Reinforcement	18.0	Each	$125	$2,250
9	7032003	Class B Concrete (Substructure)	173.3	Cu. Yd.	$750	$129,955
10	7056024	NU 63 (1600), Prestressed Concrete NU-Girder	2452.0	Lin. Ft.	$300	$735,600
11	7061060	Reinforcing Steel (Bridges)	17516	Lbs	$1.20	$21,019
12	7121160	Steel Grid Floor (Open)	16221.1	Sq. Ft.	$20	$324,423
13	7134000	Bridge Guardrail (Thrie Beam)	1232.0	Lin. Ft.	$240	$295,680
14	7161003	Laminated Neoprene Bearing Pad (Tapered)	30.0	Each	$400	$12,000
					Sub-Total (A) =	**$2,120,890**
				Price/Sq. Ft. (Bridge Items) =		*$132*

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Current River Bridge

Alternative 1A, Option 2 – Cost Estimate

Project:	MoDOT Rte. 19 Concepts	Computed:	JDM	Date:	9/18/2019
Subject:	G0804 Replacement	Checked:	DGB	Date:	10/2/2019
Task:	Concept Cost Estimate	Page:		of:	ESTIMATE
Job #:		No:			

G0804 Replacement - Filled Arch Option (No phasing)

Bridge Length =	612	Ft.	Skew =	0	degrees
New Bridge Width =	40.83	Ft.	New Arch Width =	35	Ft.
Cantilever Width =	4.583	Ft.	Side Wall Area (DGN) =	1060	ft^2
Pier 2 Width =	40.5	ft.	New Side Wall Thk =	12	in.
Pier 2 Length =	13	ft.	Arch End Area (130' Span) =	290	ft^2
Pier 3&4 Width =	43.5	ft.	Pier 2 Area =	165	ft^2
Pier 3&4 Length =	14	ft.	Pier 3 & 4 Area =	300	ft^2
Pier 5 Width =	43.5	ft.	Pier 5 Area =	450	ft^2
Pier 5 Length =	20	ft.	# Girders (End Spans) =	5	
End Span Lengths (NU53) =	102	ft.	Wing Length =	15	ft.

Item	Quantity		Unit Cost	Estimated Cost
Arch Backfill				
(202-60.40)	3890	Cu. Yd.	$25	$97,250
		Filled Arch - Assume 33' wide fill x side wall area (measured in CAD)		
Class 1 Excavation				
(206-10.00)	2530	Cu. Yd.	$50	$126,500
	Abut. Excav. Depth =	5	ft.	
	Pier 2 Excav. Depth =	12	ft.	
	Pier 3 & 4 Excav. Depth =	17	ft.	
	Pier 5 Excav. Depth =	27	ft.	
Cofferdams				
(206-60.02)	1	Lump Sum	$1,000,000	$1,000,000
		Assume $250,000 each		
Ornamental Pedestrian Fence				
(607-99.03)	612	LF.	$160	$97,920
Galvanized Structural Steel Pile (12")				
(702-12.12)	324	LF.	$75	$24,300
	Approx. Pile Length (EB 1) =	24	ft	
	Approx. Pile Length (EB 6) =	30	ft	
	# Piles/End Bent =	6		
Dynamic Pile Testing				
(702-50.01)	2	Ea.	$2,500	$5,000
Pile Point Reinforcement				
(702-70.00)	12	Ea.	$125	$1,500
Class B Concrete (Substructure)				
(703-20.03)	2,460	Cu. Yd.	$900	$2,214,000
		Include side walls, 6'x12" pilasters and support brackets w/ foundations		
		Include new floorbeam braces (10 per span - 15"x27"x33')		
Class B-2 Concrete (Arch)				
(703-20.03)	1130	Cu. Yd.	$2,000	$2,260,000
		Use end areas from DGN file and multiply by 35' wide arch		
Slab on Filled Arch				
(703-42.14)	1860	Sq. Yd.	$200	$372,000
Barrier Curb				
(703-42.15)	1290	LF.	$95	$122,550
Slab on Concrete NU-Girder				
(703-42.15)	930	Sq. Yd.	$315	$292,950

Form Liners				
(703-46.20)	400	Sq. Yd.	$100	$40,000
		Back of Barrierss and new Pilasters at piers (approx. 5' wide x 25' tall)		
NU 53, Prestressed Concrete NU-Girder				
(705-60.23)	1010	LF.	$240	$242,400
Reinforcing Steel				
(706-10.60)	489,300	Lb.	$1.40	$685,020
		Assume 130# per CY of concrete for Substr. 150# for the Arch concrete		
Steel Intermediate Diaphragm (NU Girder)				
(712-33.01)	16	Ea.	$1,000	$16,000
		Two in each end span per bay		
Slab Drain				
(712-36.10)	84	Ea.	$500	$42,000
		Assume new VC on bridge to help drainage. Spa. @ 15' across bridge		
Drainage System on Structure				
(712-99.01)	1	Lump Sum	$80,000	$80,000
Misc. Bridge Rail				
(712-99.03)	1290	LF.	$110	$141,900
Vertical Drain at End Bent				
(715-10.01)	2	Ea.	$3,060	$6,120
		Assume $45/ft. Roadway width + 2 wings		
Laminated Neoprene Bearing (Tapered)				
(716-10.03)	10	Ea.	$375	$3,750
Laminated Neoprene Bearing Assembly				
(716-20.00)	10	Ea.	$2,000	$20,000
Strip Seal Expansion Joint System				
(717-20.01)	90	LF.	$400	$36,000

Total New Bridge Cost =	**$7,927,200**	**Unit Cost =**	**$317 / Sq. Ft.**

Not including approach slab

CONCEPT STUDY - OPINION OF PROBABLE CONSTRUCTION COSTS
ROUTE 19 ARCH BRIDGES REHAB STUDY
HDR

DESCRIPTION: Route 19 two-lane minor rural highway. Project limits assume construction of shoofly along Route 19 from Sta. 300+00 to Sta. 312+78 across Current River. Estimate does not include costs for bridges.

Figure A-2: Alternative 1A,2A,5B North Option 2 - Temp Shoofly Bridge Downstream of Ped Bridge

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST	COMMENT
MOBILIZATION AND TRAFFIC CONTROL					
TEMPORARY TRAFFIC CONTROL	LS	1	$35,000	$35,000	assumes flagging, temp barrier, signs, etc
TEMPORARY PAVING	SY	1801	$55	$99,051	8" asphalt; 6" aggregate base
EROSION CONTROL					
EROSION CONTROL	LS	1	$20,000	$20,000	
ROADWORK					
REMOVAL OF IMPROVEMENTS	LS	1	$15,000	$15,000	
CLEARING AND GRUBBING	ACRE	2	$7,000	$14,000	
EXCAVATION - CLASS A	CY	2961	$8	$22,204	Assumes 2/3 cut volume is Class A
EXCAVATION - CLASS C	CY	1480	$20	$29,605	Assumes 1/3 cut volume is Class C
EMBANKMENT IN PLACE	CY	7332	$12	$87,981	
BORROW	CY	2891	$2	$5,782	
DRAINAGE AND SEWERS					
DRAINAGE	LS	1	$20,000	$20,000	
BRIDGES					
BRIDGE DEMOLITION	LS				See Bridge Costs
ROUTE 19 OVER CURRENT RIVER	LS				See Bridge Costs
TEMPORARY CAUSEWAY	LS	1	$250,000	$250,000	
TEMPORARY SHORING	LS	1	$50,000	$50,000	
PAVEMENT					
ROUTE 19 RECONSTRUCTION	SY	146	$55	$8,033	8" asphalt; Type 5 aggregate base (6")
PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES					
GUARDRAIL, MGS	FOOT	300	$20	$6,000	
GUARDRAIL, BRIDGE APPROACH TRANSITION SECTION	EACH	4	$3,000	$12,000	
GUARDRAIL, TYPE A CRASHWORTHY END TERMINAL (MASH)	EACH	4	$2,500	$10,000	
PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS					
SIGNING AND STRIPING	LS	1	$10,000	$10,000	
OTHER					
SEEDING AND MULCHING	LS	1	$15,000	$15,000	
BID ITEMS SUBTOTAL				**$709,656**	
CONSTRUCTION SURVEYING	LS			$10,000.00	
CONTINGENCIES	LS		25%	$179,914.01	
TOTAL CONSTRUCTION COST				**$899,570**	

ENGINEER'S ESTIMATE - CONCEPTUAL CONSTRUCTION COST

olsson

Client: MoDOT **Date:** 9/16/2019
Project: J9P3305: Rte 19 Arch Bridges Rehab. Study
Project Number: 019-2126 **By:** GCL
Description: Current River Bridge - Temporary Bridge (24' Rdwy)
(102.5'-136'-136'-136'-102.5')

These Costs do not include PE, RW, Permitting, Inspection Costs. Unit Prices are FY 2020.

BID FORM #	MODOT BID ITEM #	DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
BRIDGE CONSTRUCTION BID ITEMS						
1	2160500	Removal of Bridges (Temp Structure)	1	L.S.	$160,160	$160,160
2	7011107	Drilled Shafts (4 Ft. 6 In. Dia.)	160.0	Lin. Ft.	$900	$144,000
3	7011206	Rock Sockets (4 Ft. 0 In. Dia.)	160.0	Lin. Ft.	$950	$152,000
4	7011300	Video Camera Inspection	8.0	Each	$225	$1,800
5	7011400	Foundation Inspection Holes	360.0	Lin. Ft.	$130	$46,800
6	7011600	Sonic Logging Testing	8.0	Each	$2,000	$16,000
7	7021212	Galvanized Structural Steel Piles (12 In.)	990.0	Lin. Ft.	$80	$79,200
8	7027000	Pile Point Reinforcement	18.0	Each	$125	$2,250
9	7032003	Class B Concrete (Substructure)	173.3	Cu. Yd.	$750	$129,955
10	7056024	NU 63 (1600), Prestressed Concrete NU-Girder	2452.0	Lin. Ft.	$300	$735,600
11	7061060	Reinforcing Steel (Bridges)	17516	Lbs	$1.20	$21,019
12	7121160	Steel Grid Floor (Open)	16221.1	Sq. Ft.	$20	$324,423
13	7134000	Bridge Guardrail (Thrie Beam)	1232.0	Lin. Ft.	$240	$295,680
14	7161003	Laminated Neoprene Bearing Pad (Tapered)	30.0	Each	$400	$12,000
					Sub-Total (A) =	**$2,120,890**
				Price/Sq. Ft. (Bridge Items) =		*$132*

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Current River Bridge

Alternative 1B – Cost Estimate

G0804 Replacement - Filled Arch Option (No phasing)

Bridge Length =	612	Ft.	Skew =	0	degrees
New Bridge Width =	40.83	Ft.	New Arch Width =	35	Ft.
Cantilever Width =	4.583	Ft.	Side Wall Area (DGN) =	1060	ft^2
Pier 2 Width =	40.5	ft.	New Side Wall Thk =	12	in.
Pier 2 Length =	13	ft.	Arch End Area (130' Span) =	290	ft^2
Pier 3&4 Width =	43.5	ft.	Pier 2 Area =	165	ft^2
Pier 3&4 Length =	14	ft.	Pier 3 & 4 Area =	300	ft^2
Pier 5 Width =	43.5	ft.	Pier 5 Area =	450	ft^2
Pier 5 Length =	20	ft.	# Girders (End Spans) =	5	
End Span Lengths (NU53) =	102	ft.	Wing Length =	15	ft.

Item	Quantity		Unit Cost	Estimated Cost
Arch Backfill				
(202-60.40)	3890	Cu. Yd.	$25	$97,250
		Filled Arch - Assume 33' wide fill x side wall area (measured in CAD)		
Class 1 Excavation				
(206-10.00)	2530	Cu. Yd.	$50	$126,500
	Abut. Excav. Depth =	5	ft.	
	Pier 2 Excav. Depth =	12	ft.	
	Pier 3 & 4 Excav. Depth =	17	ft.	
	Pier 5 Excav. Depth =	27	ft.	
Cofferdams				
(206-60.02)	1	Lump Sum	$1,000,000	$1,000,000
		Assume $250,000 each		
Ornamental Pedestrian Fence				
(607-99.03)	612	LF.	$160	$97,920
Galvanized Structural Steel Pile (12")				
(702-12.12)	324	LF.	$75	$24,300
	Approx. Pile Length (EB 1) =	24	ft	
	Approx. Pile Length (EB 6) =	30	ft	
	# Piles/End Bent =	6		
Dynamic Pile Testing				
(702-50.01)	2	Ea.	$2,500	$5,000
Pile Point Reinforcement				
(702-70.00)	12	Ea.	$125	$1,500
Class B Concrete (Substructure)				
(703-20.03)	2,460	Cu. Yd.	$900	$2,214,000
		Include side walls, 6'x12" pilasters and support brackets w/ foundations		
		Include new floorbeam braces (10 per span - 15"x27"x33')		
Class B-2 Concrete (Arch)				
(703-20.03)	1130	Cu. Yd.	$2,000	$2,260,000
		Use end areas from DGN file and multiply by 35' wide arch		
Slab on Filled Arch				
(703-42.14)	1860	Sq. Yd.	$200	$372,000
Barrier Curb				
(703-42.15)	1290	LF.	$95	$122,550
Slab on Concrete NU-Girder				
(703-42.15)	930	Sq. Yd.	$315	$292,950

Project:	MoDOT Rte. 19 Concepts	Computed:	JDM	Date:	9/18/2019
Subject:	G0804 Replacement	Checked:	DGB	Date:	10/2/2019
Task:	Concept Cost Estimate	Page:		of:	ESTIMATE
Job #:		No:			

Item	Quantity	Unit	Unit Price	Cost
Form Liners				
(703-46.20)	400	Sq. Yd.	$100	$40,000
		Back of Barrierss and new Pilasters at piers (approx. 5' wide x 25' tall)		
NU 53, Prestressed Concrete NU-Girder				
(705-60.23)	1010	LF.	$240	$242,400
Reinforcing Steel				
(706-10.60)	489,300	Lb.	$1.40	$685,020
		Assume 130# per CY of concrete for Substr. 150# for the Arch concrete		
Steel Intermediate Diaphragm (NU Girder)				
(712-33.01)	16	Ea.	$1,000	$16,000
		Two in each end span per bay		
Slab Drain				
(712-36.10)	84	Ea.	$500	$42,000
		Assume new VC on bridge to help drainage. Spa. @ 15' across bridge		
Drainage System on Structure				
(712-99.01)	1	Lump Sum	$80,000	$80,000
Misc. Bridge Rail				
(712-99.03)	1290	LF.	$110	$141,900
Vertical Drain at End Bent				
(715-10.01)	2	Ea.	$3,060	$6,120
		Assume $45/ft. Roadway width + 2 wings		
Laminated Neoprene Bearing (Tapered)				
(716-10.03)	10	Ea.	$375	$3,750
Laminated Neoprene Bearing Assembly				
(716-20.00)	10	Ea.	$2,000	$20,000
Strip Seal Expansion Joint System				
(717-20.01)	90	LF.	$400	$36,000

Total New Bridge Cost =	**$7,927,200**	**Unit Cost =**	**$317 / Sq. Ft.**

Not including approach slab

CONCEPT STUDY - OPINION OF PROBABLE CONSTRUCTION COSTS
ROUTE 19 ARCH BRIDGES REHAB STUDY
HDR

DESCRIPTION: Route 19 two-lane minor rural highway. Project limits assume construction of shoofly along Route 19 from Sta. 200+00 to Sta. 212+66 across Current River. Estimate does not include costs for bridges.

Figure A-3: Alternative 1B and 2B North - New Bridge; Remove Ped Bridge; Single-lane temp shoo-fly bridge

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST	COMMENT
MOBILIZATION AND TRAFFIC CONTROL					
TEMPORARY TRAFFIC CONTROL	LS	1	$35,000	$35,000	assumes flagging, temp barrier, signs, etc
WORK ZONE TRAFFIC SIGNAL SYSTEM	EACH	1	$12,000	$12,000	alternating traffic across bridge
TEMPORARY PAVING	SY	1758	$55	$96,685	8" asphalt; 6" aggregate base
EROSION CONTROL					
EROSION CONTROL	LS	1	$20,000	$20,000	
ROADWORK					
REMOVAL OF IMPROVEMENTS	LS	1	$15,000	$15,000	
CLEARING AND GRUBBING	ACRE	2	$7,000	$14,000	
EXCAVATION - CLASS A	CY	5876	$8	$44,072	Assumes 2/3 cut volume is Class A
EXCAVATION - CLASS C	CY	2938	$20	$58,762	Assumes 1/3 cut volume is Class C
EMBANKMENT IN PLACE	CY	2991	$12	$35,892	
BORROW	CY		$2		
DRAINAGE AND SEWERS					
DRAINAGE	LS	1	$20,000	$20,000	
BRIDGES					
BRIDGE DEMOLITION	LS				See Bridge Costs
ROUTE 19 OVER CURRENT RIVER	LS				See Bridge Costs
TEMPORARY CAUSEWAY	LS	1	$250,000	$250,000	
TEMPORARY SHORING	LS	1	$50,000	$50,000	
PAVEMENT					
ROUTE 19 RECONSTRUCTION	SY	146	$55	$8,033	8" asphalt; Type 5 aggregate base (6")
PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES					
GUARDRAIL, MGS	FOOT	300	$20	$6,000	
GUARDRAIL, BRIDGE APPROACH TRANSITION SECTION	EACH	4	$3,000	$12,000	
GUARDRAIL, TYPE A CRASHWORTHY END TERMINAL (MASH)	EACH	4	$2,500	$10,000	
PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS					
SIGNING AND STRIPING	LS	1	$10,000	$10,000	
OTHER					
SEEDING AND MULCHING	LS	1	$15,000	$15,000	
BID ITEMS SUBTOTAL				**$712,445**	
CONSTRUCTION SURVEYING	LS			$10,000.00	
CONTINGENCIES	LS		25%	$180,611.13	
TOTAL CONSTRUCTION COST				**$903,056**	

ENGINEER'S ESTIMATE - CONCEPTUAL CONSTRUCTION COST

Client: MoDOT **Date:** 9/12/2019
Project: J9P3305: Rte 19 Arch Bridges Rehab. Study
Project Number: 019-2126 **By:** GCL
Description: Current River Bridge - Replace on Existing Alignment
Br. Option (102'-136'-136'-136'-102') Pl. Girder (W/ Peds)

These Costs do not include PE, RW, Permitting, Inspection Costs. Unit Prices are FY 2020.

BID FORM #	MODOT BID ITEM #	DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
BRIDGE CONSTRUCTION BID ITEMS						
1	2061000	Class I Excavation	1128	Cu. Yd.	$50	$56,408
2	6079903	(72 In.) Pedestrian Fence (Structures)	1300.0	Lin. Ft.	$160	$208,000
3	7011107	Drilled Shafts (6 Ft. 0 In. Dia.)	142.0	Lin. Ft.	$1,200	$170,400
4	7011206	Rock Sockets (5 Ft. 6 In. Dia.)	160.0	Lin. Ft.	$900	$144,000
5	7011300	Video Camera Inspection	8.0	Each	$650	$5,200
6	7011400	Foundation Inspection Holes	240.0	Lin. Ft.	$130	$31,200
7	7011600	Sonic Logging Testing	8.0	Each	$2,000	$16,000
8	7021212	Galvanized Structural Steel Piles (12 In.)	420.0	Lin. Ft.	$80	$33,600
9	7027000	Pile Point Reinforcement	6.0	Each	$125	$750
10	7026000	Pre-Bore for Piling	270.0	Lin. Ft.	$150	$40,500
11	7032003	Class B Concrete (Substructure)	272.4	Cu. Yd.	$850	$231,553
12	7034212	Slab on Steel	1088.0	Sq. Yd.	$275	$299,200
13	7034620	Form Liners	604.4	Sq. Yd.	$100	$60,444
14	7039903	Misc. Barrier Curb	1298.0	Lin. Ft.	$100	$129,800
15	7061060	Reinforcing Steel (Bridges)	64020	Lbs	$1.40	$89,628
16	7121122	Fab. Structural LA Steel (Plate Girder) A709, Gr 50W	408349	Lbs	$1.75	$714,611
17	7123610	Slab Drain	1.0	L.S.	$120,000	$120,000
18	7129903	Misc. Bridge Rail (One Tube Structural Steel)	1298.0	Lin. Ft.	$100	$129,800
19	7151001	Vertical Drain at End Bents	2.0	Each	$1,000	$2,000
20	7162000	Laminated Neoprene Bearing Pad Assembly	12.0	Each	$2,100	$25,200
21	7172001	Strip Seal Expansion Joint System	32	Lin. Ft.	$425	$13,600
					Sub-Total (A) =	**$2,521,893**
				Price/Sq. Ft. (Bridge Items) =		*$258*

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Current River Bridge

Alternative 2A, Option 1 – Cost Estimate

ENGINEER'S ESTIMATE - CONCEPTUAL CONSTRUCTION COST

olsson

Client: MoDOT **Date:** 9/12/2019
Project: J9P3305: Rte 19 Arch Bridges Rehab. Study
Project Number: 019-2126 **By:** GCL
Description: Current River Bridge - Replace on Existing Alignment
Br. Option (102'-136'-136'-136'-102') Pl. Girder (W/ Peds)

These Costs do not include PE, RW, Permitting, Inspection Costs. Unit Prices are FY 2020.

BID FORM #	MODOT BID ITEM #	DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
BRIDGE CONSTRUCTION BID ITEMS						
1	2061000	Class I Excavation	1266	Cu. Yd.	$50	$63,282
2	5031010A	Bridge Approach Slab (Major Road)	136.3	Sq. Yd.	$250	$34,074
3	6079903	(72 In.) Pedestrian Fence (Structures)	650.0	Lin. Ft.	$160	$104,000
4	7011107	Drilled Shafts (6 Ft. 0 In. Dia.)	213.0	Lin. Ft.	$1,200	$255,600
5	7011206	Rock Sockets (5 Ft. 6 In. Dia.)	240.0	Lin. Ft.	$900	$216,000
6	7011300	Video Camera Inspection	12.0	Each	$650	$7,800
7	7011400	Foundation Inspection Holes	360.0	Lin. Ft.	$130	$46,800
8	7011600	Sonic Logging Testing	12.0	Each	$2,000	$24,000
9	7021212	Galvanized Structural Steel Piles (12 In.)	980.0	Lin. Ft.	$80	$78,400
10	7027000	Pile Point Reinforcement	14.0	Each	$125	$1,750
11	7026000	Pre-Bore for Piling	630.0	Lin. Ft.	$150	$94,500
12	7032003	Class B Concrete (Substructure)	514.1	Cu. Yd.	$850	$437,022
13	7034212	Slab on Steel	2776.7	Sq. Yd.	$275	$763,583
14	7034620	Form Liners	1137.8	Sq. Yd.	$100	$113,778
15	7039903	Misc. Barrier Curb	1298.0	Lin. Ft.	$100	$129,800
16	7061060	Reinforcing Steel (Bridges)	107202	Lbs	$1.40	$150,083
17	7121122	Fab. Structural LA Steel (Plate Girder) A709, Gr 50W	1045000	Lbs	$1.75	$1,828,750
18	7123610	Slab Drain	1.0	L.S.	$120,000	$120,000
19	7129903	Misc. Bridge Rail (One Tube Structural Steel)	1298.0	Lin. Ft.	$100	$129,800
20	7151001	Vertical Drain at End Bents	2.0	Each	$3,500	$7,000
21	7162000	Laminated Neoprene Bearing Pad Assembly	30.0	Each	$2,100	$63,000
22	7172001	Strip Seal Expansion Joint System	89	Lin. Ft.	$425	$37,970
					Sub-Total (A) =	**$4,706,991**
				Price/Sq. Ft. (Bridge Items) =		*$188*

CONCEPT STUDY - OPINION OF PROBABLE CONSTRUCTION COSTS
ROUTE 19 ARCH BRIDGES REHAB STUDY
HDR

DESCRIPTION: Route 19 two-lane minor rural highway. Project limits assume construction of shoofly along Route 19 from Sta. 100+00 to Sta. 113+47 across Current River. Estimate does not include costs for bridges.

Figure A-1: Alternative 1A,2A, 5B North Option 1 - Temp Shoofly Bridge; Remove Ped Bridge

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST	COMMENT
MOBILIZATION AND TRAFFIC CONTROL					
TEMPORARY TRAFFIC CONTROL	LS	1	$35,000	$35,000	assumes flagging, temp barrier, signs, etc
TEMPORARY PAVING	SY	1984	$55	$109,141	8" asphalt; 6" aggregate base
EROSION CONTROL					
EROSION CONTROL	LS	1	$20,000	$20,000	
ROADWORK					
REMOVAL OF IMPROVEMENTS	LS	1	$15,000	$15,000	
CLEARING AND GRUBBING	ACRE	3	$7,000	$21,000	
EXCAVATION - CLASS A	CY	8539	$8	$64,041	Assumes 2/3 cut volume is Class A
EXCAVATION - CLASS C	CY	4269	$20	$85,388	Assumes 1/3 cut volume is Class C
EMBANKMENT IN PLACE	CY	3411	$12	$40,935	
DRAINAGE AND SEWERS					
DRAINAGE	LS	1	$20,000	$20,000	
BRIDGES					
BRIDGE DEMOLITION	LS				See Bridge Costs
ROUTE 19 OVER CURRENT RIVER	LS				See Bridge Costs
TEMPORARY CAUSEWAY	LS	1	$250,000	$250,000	
TEMPORARY SHORING	LS	1	$50,000	$50,000	
PAVEMENT					
ROUTE 19 RECONSTRUCTION	SY	146	$55	$8,033	8" asphalt; Type 5 aggregate base (6")
PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES					
GUARDRAIL, MGS	FOOT	300	$20	$6,000	
GUARDRAIL, BRIDGE APPROACH TRANSITION SECTION	EACH	4	$3,000	$12,000	
GUARDRAIL, TYPE A CRASHWORTHY END TERMINAL (MASH)	EACH	4	$2,500	$10,000	
PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS					
SIGNING AND STRIPING	LS	1	$10,000	$10,000	
OTHER					
SEEDING AND MULCHING	LS	1	$15,000	$15,000	
BID ITEMS SUBTOTAL				**$771,537**	
CONSTRUCTION SURVEYING	LS			$10,000.00	
CONTINGENCIES	LS		25%	$195,384.20	
TOTAL CONSTRUCTION COST				**$976,921**	

ENGINEER'S ESTIMATE - CONCEPTUAL CONSTRUCTION COST

olsson

Client: MoDOT **Date:** 9/16/2019
Project: J9P3305: Rte 19 Arch Bridges Rehab. Study
Project Number: 019-2126 **By:** GCL
Description: Current River Bridge - Temporary Bridge (24' Rdwy)
(102.5'-136'-136'-136'-102.5')

These Costs do not include PE, RW, Permitting, Inspection Costs. Unit Prices are FY 2020.

BID FORM #	MODOT BID ITEM #	DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
BRIDGE CONSTRUCTION BID ITEMS						
1	2160500	Removal of Bridges (Temp Structure)	1	L.S.	$160,160	$160,160
2	7011107	Drilled Shafts (4 Ft. 6 In. Dia.)	160.0	Lin. Ft.	$900	$144,000
3	7011206	Rock Sockets (4 Ft. 0 In. Dia.)	160.0	Lin. Ft.	$950	$152,000
4	7011300	Video Camera Inspection	8.0	Each	$225	$1,800
5	7011400	Foundation Inspection Holes	360.0	Lin. Ft.	$130	$46,800
6	7011600	Sonic Logging Testing	8.0	Each	$2,000	$16,000
7	7021212	Galvanized Structural Steel Piles (12 In.)	990.0	Lin. Ft.	$80	$79,200
8	7027000	Pile Point Reinforcement	18.0	Each	$125	$2,250
9	7032003	Class B Concrete (Substructure)	173.3	Cu. Yd.	$750	$129,955
10	7056024	NU 63 (1600), Prestressed Concrete NU-Girder	2452.0	Lin. Ft.	$300	$735,600
11	7061060	Reinforcing Steel (Bridges)	17516	Lbs	$1.20	$21,019
12	7121160	Steel Grid Floor (Open)	16221.1	Sq. Ft.	$20	$324,423
13	7134000	Bridge Guardrail (Thrie Beam)	1232.0	Lin. Ft.	$240	$295,680
14	7161003	Laminated Neoprene Bearing Pad (Tapered)	30.0	Each	$400	$12,000
					Sub-Total (A) =	**$2,120,890**
				Price/Sq. Ft. (Bridge Items) =		*$132*

Current River Bridge

Alternative 2A, Option 2 – Cost Estimate

ENGINEER'S ESTIMATE - CONCEPTUAL CONSTRUCTION COST

olsson

Client: MoDOT **Date:** 9/12/2019
Project: J9P3305: Rte 19 Arch Bridges Rehab. Study
Project Number: 019-2126 **By:** GCL
Description: Current River Bridge - Replace on Existing Alignment
Br. Option (102'-136'-136'-136'-102') Pl. Girder (w/o Peds)

These Costs do not include PE, RW, Permitting, Inspection Costs. Unit Prices are FY 2020.

BID FORM #	MODOT BID ITEM #	DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
BRIDGE CONSTRUCTION BID ITEMS						
1	2061000	Class I Excavation	1204	Cu. Yd.	$50	$60,200
2	5031010A	Bridge Approach Slab (Major Road)	136.3	Sq. Yd.	$250	$34,074
3	7011107	Drilled Shafts (6 Ft. 0 In. Dia.)	142.0	Lin. Ft.	$1,200	$170,400
4	7011206	Rock Sockets (5 Ft. 6 In. Dia.)	160.0	Lin. Ft.	$900	$144,000
5	7011300	Video Camera Inspection	8.0	Each	$650	$5,200
6	7011400	Foundation Inspection Holes	240.0	Lin. Ft.	$130	$31,200
7	7011600	Sonic Logging Testing	8.0	Each	$2,000	$16,000
8	7021212	Galvanized Structural Steel Piles (12 In.)	700.0	Lin. Ft.	$80	$56,000
9	7027000	Pile Point Reinforcement	10.0	Each	$125	$1,250
10	7026000	Pre-Bore for Piling	450.0	Lin. Ft.	$150	$67,500
11	7032003	Class B Concrete (Substructure)	350.2	Cu. Yd.	$850	$297,664
12	7034212	Slab on Steel	2028.6	Sq. Yd.	$275	$557,877
13	7034620	Form Liners	835.6	Sq. Yd.	$100	$83,556
14	7039903	Misc. Barrier Curb	1298.0	Lin. Ft.	$100	$129,800
15	7061060	Reinforcing Steel (Bridges)	73353	Lbs	$1.40	$102,694
16	7121122	Fab. Structural LA Steel (Plate Girder) A709, Gr 50W	816698	Lbs	$1.75	$1,429,222
17	7123610	Slab Drain	1.0	L.S.	$120,000	$120,000
18	7129903	Misc. Bridge Rail (One Tube Structural Steel)	1298.0	Lin. Ft.	$100	$129,800
19	7151001	Vertical Drain at End Bents	2.0	Each	$2,000	$4,000
20	7162000	Laminated Neoprene Bearing Pad Assembly	24.0	Each	$2,100	$50,400
21	7172001	Strip Seal Expansion Joint System	67	Lin. Ft.	$425	$28,620
					Sub-Total (A) =	**$3,519,456**
				Price/Sq. Ft. (Bridge Items) =		*$193*

CONCEPT STUDY - OPINION OF PROBABLE CONSTRUCTION COSTS
ROUTE 19 ARCH BRIDGES REHAB STUDY
HDR

DESCRIPTION: Route 19 two-lane minor rural highway. Project limits assume construction of shoofly along Route 19 from Sta. 300+00 to Sta. 312+78 across Current River. Estimate does not include costs for bridges.

Figure A-2: Alternative 1A,2A,5B North Option 2 - Temp Shoofly Bridge Downstream of Ped Bridge

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST	COMMENT
MOBILIZATION AND TRAFFIC CONTROL					
TEMPORARY TRAFFIC CONTROL	LS	1	$35,000	$35,000	assumes flagging, temp barrier, signs, etc
TEMPORARY PAVING	SY	1801	$55	$99,051	8" asphalt; 6" aggregate base
EROSION CONTROL					
EROSION CONTROL	LS	1	$20,000	$20,000	
ROADWORK					
REMOVAL OF IMPROVEMENTS	LS	1	$15,000	$15,000	
CLEARING AND GRUBBING	ACRE	2	$7,000	$14,000	
EXCAVATION - CLASS A	CY	2961	$8	$22,204	Assumes 2/3 cut volume is Class A
EXCAVATION - CLASS C	CY	1480	$20	$29,605	Assumes 1/3 cut volume is Class C
EMBANKMENT IN PLACE	CY	7332	$12	$87,981	
BORROW	CY	2891	$2	$5,782	
DRAINAGE AND SEWERS					
DRAINAGE	LS	1	$20,000	$20,000	
BRIDGES					
BRIDGE DEMOLITION	LS				See Bridge Costs
ROUTE 19 OVER CURRENT RIVER	LS				See Bridge Costs
TEMPORARY CAUSEWAY	LS	1	$250,000	$250,000	
TEMPORARY SHORING	LS	1	$50,000	$50,000	
PAVEMENT					
ROUTE 19 RECONSTRUCTION	SY	146	$55	$8,033	8" asphalt; Type 5 aggregate base (6")
PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES					
GUARDRAIL, MGS	FOOT	300	$20	$6,000	
GUARDRAIL, BRIDGE APPROACH TRANSITION SECTION	EACH	4	$3,000	$12,000	
GUARDRAIL, TYPE A CRASHWORTHY END TERMINAL (MASH)	EACH	4	$2,500	$10,000	
PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS					
SIGNING AND STRIPING	LS	1	$10,000	$10,000	
OTHER					
SEEDING AND MULCHING	LS	1	$15,000	$15,000	
BID ITEMS SUBTOTAL				**$709,656**	
CONSTRUCTION SURVEYING	LS			$10,000.00	
CONTINGENCIES	LS		25%	$179,914.01	
TOTAL CONSTRUCTION COST				**$899,570**	

ENGINEER'S ESTIMATE - CONCEPTUAL CONSTRUCTION COST

olsson

Client:	MoDOT	**Date:**	9/16/2019
Project:	J9P3305: Rte 19 Arch Bridges Rehab. Study		
Project Number:	019-2126	**By:**	GCL
Description:	Current River Bridge - Temporary Bridge (24' Rdwy)		
	(102.5'-136'-136'-136'-102.5')		

These Costs do not include PE, RW, Permitting, Inspection Costs. Unit Prices are FY 2020.

BID FORM #	MODOT BID ITEM #	DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
BRIDGE CONSTRUCTION BID ITEMS						
1	2160500	Removal of Bridges (Temp Structure)	1	L.S.	$160,160	$160,160
2	7011107	Drilled Shafts (4 Ft. 6 In. Dia.)	160.0	Lin. Ft.	$900	$144,000
3	7011206	Rock Sockets (4 Ft. 0 In. Dia.)	160.0	Lin. Ft.	$950	$152,000
4	7011300	Video Camera Inspection	8.0	Each	$225	$1,800
5	7011400	Foundation Inspection Holes	360.0	Lin. Ft.	$130	$46,800
6	7011600	Sonic Logging Testing	8.0	Each	$2,000	$16,000
7	7021212	Galvanized Structural Steel Piles (12 In.)	990.0	Lin. Ft.	$80	$79,200
8	7027000	Pile Point Reinforcement	18.0	Each	$125	$2,250
9	7032003	Class B Concrete (Substructure)	173.3	Cu. Yd.	$750	$129,955
10	7056024	NU 63 (1600), Prestressed Concrete NU-Girder	2452.0	Lin. Ft.	$300	$735,600
11	7061060	Reinforcing Steel (Bridges)	17516	Lbs	$1.20	$21,019
12	7121160	Steel Grid Floor (Open)	16221.1	Sq. Ft.	$20	$324,423
13	7134000	Bridge Guardrail (Thrie Beam)	1232.0	Lin. Ft.	$240	$295,680
14	7161003	Laminated Neoprene Bearing Pad (Tapered)	30.0	Each	$400	$12,000
					Sub-Total (A) =	**$2,120,890**
				Price/Sq. Ft. (Bridge Items) =		*$132*

Current River Bridge

Alternative 2B – Cost Estimate

ENGINEER'S ESTIMATE - CONCEPTUAL CONSTRUCTION COST

olsson

Client: MoDOT **Date:** 9/12/2019
Project: J9P3305: Rte 19 Arch Bridges Rehab. Study
Project Number: 019-2126 **By:** GCL
Description: Current River Bridge - Replace on Existing Alignment
Br. Option (102'-136'-136'-136'-102') Pl. Girder (w/o Peds)

These Costs do not include PE, RW, Permitting, Inspection Costs. Unit Prices are FY 2020.

BID FORM #	MODOT BID ITEM #	DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
BRIDGE CONSTRUCTION BID ITEMS						
1	2061000	Class I Excavation	1204	Cu. Yd.	$50	$60,200
2	5031010A	Bridge Approach Slab (Major Road)	136.3	Sq. Yd.	$250	$34,074
3	7011107	Drilled Shafts (6 Ft. 0 In. Dia.)	142.0	Lin. Ft.	$1,200	$170,400
4	7011206	Rock Sockets (5 Ft. 6 In. Dia.)	160.0	Lin. Ft.	$900	$144,000
5	7011300	Video Camera Inspection	8.0	Each	$650	$5,200
6	7011400	Foundation Inspection Holes	240.0	Lin. Ft.	$130	$31,200
7	7011600	Sonic Logging Testing	8.0	Each	$2,000	$16,000
8	7021212	Galvanized Structural Steel Piles (12 In.)	700.0	Lin. Ft.	$80	$56,000
9	7027000	Pile Point Reinforcement	10.0	Each	$125	$1,250
10	7026000	Pre-Bore for Piling	450.0	Lin. Ft.	$150	$67,500
11	7032003	Class B Concrete (Substructure)	350.2	Cu. Yd.	$850	$297,664
12	7034212	Slab on Steel	2028.6	Sq. Yd.	$275	$557,877
13	7034620	Form Liners	835.6	Sq. Yd.	$100	$83,556
14	7039903	Misc. Barrier Curb	1298.0	Lin. Ft.	$100	$129,800
15	7061060	Reinforcing Steel (Bridges)	73353	Lbs	$1.40	$102,694
16	7121122	Fab. Structural LA Steel (Plate Girder) A709, Gr 50W	816698	Lbs	$1.75	$1,429,222
17	7123610	Slab Drain	1.0	L.S.	$120,000	$120,000
18	7129903	Misc. Bridge Rail (One Tube Structural Steel)	1298.0	Lin. Ft.	$100	$129,800
19	7151001	Vertical Drain at End Bents	2.0	Each	$2,000	$4,000
20	7162000	Laminated Neoprene Bearing Pad Assembly	24.0	Each	$2,100	$50,400
21	7172001	Strip Seal Expansion Joint System	67	Lin. Ft.	$425	$28,620
					Sub-Total (A) =	**$3,519,456**
				Price/Sq. Ft. (Bridge Items) =		*$193*

CONCEPT STUDY - OPINION OF PROBABLE CONSTRUCTION COSTS
ROUTE 19 ARCH BRIDGES REHAB STUDY
HDR

DESCRIPTION: Route 19 two-lane minor rural highway. Project limits assume construction of shoofly along Route 19 from Sta. 200+00 to Sta. 212+66 across Current River. Estimate does not include costs for bridges.

Figure A-3: Alternative 1B and 2B North - New Bridge; Remove Ped Bridge; Single-lane temp shoo-fly bridge

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST	COMMENT
MOBILIZATION AND TRAFFIC CONTROL					
TEMPORARY TRAFFIC CONTROL	LS	1	$35,000	$35,000	assumes flagging, temp barrier, signs, etc
WORK ZONE TRAFFIC SIGNAL SYSTEM	EACH	1	$12,000	$12,000	alternating traffic across bridge
TEMPORARY PAVING	SY	1758	$55	$96,685	8" asphalt; 6" aggregate base
EROSION CONTROL					
EROSION CONTROL	LS	1	$20,000	$20,000	
ROADWORK					
REMOVAL OF IMPROVEMENTS	LS	1	$15,000	$15,000	
CLEARING AND GRUBBING	ACRE	2	$7,000	$14,000	
EXCAVATION - CLASS A	CY	5876	$8	$44,072	Assumes 2/3 cut volume is Class A
EXCAVATION - CLASS C	CY	2938	$20	$58,762	Assumes 1/3 cut volume is Class C
EMBANKMENT IN PLACE	CY	2991	$12	$35,892	
BORROW	CY		$2		
DRAINAGE AND SEWERS					
DRAINAGE	LS	1	$20,000	$20,000	
BRIDGES					
BRIDGE DEMOLITION	LS				See Bridge Costs
ROUTE 19 OVER CURRENT RIVER	LS				See Bridge Costs
TEMPORARY CAUSEWAY	LS	1	$250,000	$250,000	
TEMPORARY SHORING	LS	1	$50,000	$50,000	
PAVEMENT					
ROUTE 19 RECONSTRUCTION	SY	146	$55	$8,033	8" asphalt; Type 5 aggregate base (6")
PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES					
GUARDRAIL, MGS	FOOT	300	$20	$6,000	
GUARDRAIL, BRIDGE APPROACH TRANSITION SECTION	EACH	4	$3,000	$12,000	
GUARDRAIL, TYPE A CRASHWORTHY END TERMINAL (MASH)	EACH	4	$2,500	$10,000	
PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS					
SIGNING AND STRIPING	LS	1	$10,000	$10,000	
OTHER					
SEEDING AND MULCHING	LS	1	$15,000	$15,000	
BID ITEMS SUBTOTAL				**$712,445**	
CONSTRUCTION SURVEYING	LS			$10,000.00	
CONTINGENCIES	LS		25%	$180,611.13	
TOTAL CONSTRUCTION COST				**$903,056**	

ENGINEER'S ESTIMATE - CONCEPTUAL CONSTRUCTION COST

olsson

Client: MoDOT **Date:** 9/12/2019
Project: J9P3305: Rte 19 Arch Bridges Rehab. Study
Project Number: 019-2126 **By:** GCL
Description: Current River Bridge - Replace on Existing Alignment
Br. Option (102'-136'-136'-136'-102') Pl. Girder (W/ Peds)

These Costs do not include PE, RW, Permitting, Inspection Costs. Unit Prices are FY 2020.

BID FORM #	MODOT BID ITEM #	DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
BRIDGE CONSTRUCTION BID ITEMS						
1	2061000	Class I Excavation	1128	Cu. Yd.	$50	$56,408
2	6079903	(72 In.) Pedestrian Fence (Structures)	1300.0	Lin. Ft.	$160	$208,000
3	7011107	Drilled Shafts (6 Ft. 0 In. Dia.)	142.0	Lin. Ft.	$1,200	$170,400
4	7011206	Rock Sockets (5 Ft. 6 In. Dia.)	160.0	Lin. Ft.	$900	$144,000
5	7011300	Video Camera Inspection	8.0	Each	$650	$5,200
6	7011400	Foundation Inspection Holes	240.0	Lin. Ft.	$130	$31,200
7	7011600	Sonic Logging Testing	8.0	Each	$2,000	$16,000
8	7021212	Galvanized Structural Steel Piles (12 In.)	420.0	Lin. Ft.	$80	$33,600
9	7027000	Pile Point Reinforcement	6.0	Each	$125	$750
10	7026000	Pre-Bore for Piling	270.0	Lin. Ft.	$150	$40,500
11	7032003	Class B Concrete (Substructure)	272.4	Cu. Yd.	$850	$231,553
12	7034212	Slab on Steel	1088.0	Sq. Yd.	$275	$299,200
13	7034620	Form Liners	604.4	Sq. Yd.	$100	$60,444
14	7039903	Misc. Barrier Curb	1298.0	Lin. Ft.	$100	$129,800
15	7061060	Reinforcing Steel (Bridges)	64020	Lbs	$1.40	$89,628
16	7121122	Fab. Structural LA Steel (Plate Girder) A709, Gr 50W	408349	Lbs	$1.75	$714,611
17	7123610	Slab Drain	1.0	L.S.	$120,000	$120,000
18	7129903	Misc. Bridge Rail (One Tube Structural Steel)	1298.0	Lin. Ft.	$100	$129,800
19	7151001	Vertical Drain at End Bents	2.0	Each	$1,000	$2,000
20	7162000	Laminated Neoprene Bearing Pad Assembly	12.0	Each	$2,100	$25,200
21	7172001	Strip Seal Expansion Joint System	32	Lin. Ft.	$425	$13,600
					Sub-Total (A) =	**$2,521,893**
				Price/Sq. Ft. (Bridge Items) =		*$258*

Current River Bridge

Alternative 3, Option 1 – Cost Estimate

Project:	MoDOT Rte. 19 Concepts	Computed:	JDM	Date:	9/18/2019
Subject:	G0804 Replacement	Checked:	DGB	Date:	10/2/2019
Task:	Concept Cost Estimate	Page:		of:	ESTIMATE
Job #:		No:			

G0804 Replacement - Filled Arch Option (No phasing)

Bridge Length =	612	Ft.	Skew =	0	degrees
New Bridge Width =	40.83	Ft.	New Arch Width =	35	Ft.
Cantilever Width =	4.583	Ft.	Side Wall Area (DGN) =	1060	ft^2
Pier 2 Width =	40.5	ft.	New Side Wall Thk =	12	in.
Pier 2 Length =	13	ft.	Arch End Area (130' Span) =	290	ft^2
Pier 3&4 Width =	43.5	ft.	Pier 2 Area =	165	ft^2
Pier 3&4 Length =	14	ft.	Pier 3 & 4 Area =	300	ft^2
Pier 5 Width =	43.5	ft.	Pier 5 Area =	450	ft^2
Pier 5 Length =	20	ft.	# Girders (End Spans) =	5	
End Span Lengths (NU53) =	102	ft.	Wing Length =	15	ft.

Item	Quantity		Unit Cost	Estimated Cost
Arch Backfill				
(202-60.40)	3890	Cu. Yd.	$25	$97,250
		Filled Arch - Assume 33' wide fill x side wall area (measured in CAD)		
Class 1 Excavation				
(206-10.00)	2530	Cu. Yd.	$50	$126,500
	Abut. Excav. Depth =	5	ft.	
	Pier 2 Excav. Depth =	12	ft.	
	Pier 3 & 4 Excav. Depth =	17	ft.	
	Pier 5 Excav. Depth =	27	ft.	
Cofferdams				
(206-60.02)	1	Lump Sum	$1,000,000	$1,000,000
		Assume $250,000 each		
Ornamental Pedestrian Fence				
(607-99.03)	612	LF.	$160	$97,920
Galvanized Structural Steel Pile (12")				
(702-12.12)	324	LF.	$75	$24,300
	Approx. Pile Length (EB 1) =	24	ft	
	Approx. Pile Length (EB 6) =	30	ft	
	# Piles/End Bent =	6		
Dynamic Pile Testing				
(702-50.01)	2	Ea.	$2,500	$5,000
Pile Point Reinforcement				
(702-70.00)	12	Ea.	$125	$1,500
Class B Concrete (Substructure)				
(703-20.03)	2,460	Cu. Yd.	$900	$2,214,000
		Include side walls, 6'x12" pilasters and support brackets w/ foundations		
		Include new floorbeam braces (10 per span - 15"x27"x33')		
Class B-2 Concrete (Arch)				
(703-20.03)	1130	Cu. Yd.	$2,000	$2,260,000
		Use end areas from DGN file and multiply by 35' wide arch		
Slab on Filled Arch				
(703-42.14)	1860	Sq. Yd.	$200	$372,000
Barrier Curb				
(703-42.15)	1290	LF.	$95	$122,550
Slab on Concrete NU-Girder				
(703-42.15)	930	Sq. Yd.	$315	$292,950

Form Liners				
(703-46.20)	400	Sq. Yd.	$100	$40,000
		Back of Barrierss and new Pilasters at piers (approx. 5' wide x 25' tall)		
NU 53, Prestressed Concrete NU-Girder				
(705-60.23)	1010	LF.	$240	$242,400
Reinforcing Steel				
(706-10.60)	489,300	Lb.	$1.40	$685,020
		Assume 130# per CY of concrete for Substr. 150# for the Arch concrete		
Steel Intermediate Diaphragm (NU Girder)				
(712-33.01)	16	Ea.	$1,000	$16,000
		Two in each end span per bay		
Slab Drain				
(712-36.10)	84	Ea.	$500	$42,000
		Assume new VC on bridge to help drainage. Spa. @ 15' across bridge		
Drainage System on Structure				
(712-99.01)	1	Lump Sum	$80,000	$80,000
Misc. Bridge Rail				
(712-99.03)	1290	LF.	$110	$141,900
Vertical Drain at End Bent				
(715-10.01)	2	Ea.	$3,060	$6,120
		Assume $45/ft. Roadway width + 2 wings		
Laminated Neoprene Bearing (Tapered)				
(716-10.03)	10	Ea.	$375	$3,750
Laminated Neoprene Bearing Assembly				
(716-20.00)	10	Ea.	$2,000	$20,000
Strip Seal Expansion Joint System				
(717-20.01)	90	LF.	$400	$36,000

Total New Bridge Cost =	$7,927,200	Unit Cost =	$317 / Sq. Ft.

Not including approach slab

CONCEPT STUDY - OPINION OF PROBABLE CONSTRUCTION COSTS
ROUTE 19 ARCH BRIDGES REHAB STUDY
HDR

DESCRIPTION: Route 19 two-lane minor rural highway. Project limits assume reconstruction of Route 19 from Sta. 1627+50 to Sta. 1647+18 across Current River. Estimate does not include costs for bridges.

Figure A-4: Alternatives 3 and 4 North Option 1 - New Bridge on Offset alignment; Remove Ped Bridge

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST	COMMENT
MOBILIZATION AND TRAFFIC CONTROL					
TEMPORARY TRAFFIC CONTROL	LS	1	$50,000	$50,000	assumes flagging, temp barrier, signs, etc
EROSION CONTROL					
EROSION CONTROL	LS	1	$25,000	$25,000	
ROADWORK					
REMOVAL OF SURFACINGS	SY	8000	$3	$24,000	
REMOVAL OF IMPROVEMENTS	LS	1	$25,000	$25,000	
CLEARING AND GRUBBING	ACRE	5	$7,000	$35,000	
EXCAVATION - CLASS A	CY	8613	$8	$64,597	Assumes 2/3 cut volume is Class A
EXCAVATION - CLASS C	CY	4306	$20	$86,130	Assumes 1/3 cut volume is Class C
EMBANKMENT IN PLACE	CY	9725	$12	$116,695	
DRAINAGE AND SEWERS					
DRAINAGE	LS	1	$50,000	$50,000	
BRIDGES					
BRIDGE DEMOLITION	LS				See Bridge Costs
ROUTE 19 OVER CURRENT RIVER	LS				See Bridge Costs
TEMPORARY CAUSEWAY	LS	1	$250,000	$250,000	
PAVEMENT					
DRIVEWAY RECONSTRUCTION	EACH	2	$10,000	$20,000	
ROUTE 19 RECONSTRUCTION	SY	4564	$55	$251,003	8" asphalt; Type 5 aggregate base (6")
PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES					
GUARDRAIL, MGS	FOOT	300	$20	$6,000	
GUARDRAIL, BRIDGE APPROACH TRANSITION SECTION	EACH	4	$3,000	$12,000	
GUARDRAIL, TYPE A CRASHWORTHY END TERMINAL (MASH)	EACH	4	$2,500	$10,000	
PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS					
SIGNING AND STRIPING	LS	1	$25,000	$25,000	
OTHER					
SEEDING AND MULCHING	LS	1	$15,000	$15,000	
BID ITEMS SUBTOTAL				**$1,065,425**	
CONSTRUCTION SURVEYING	LS		1%	$10,654	
CONTINGENCIES	LS		25%	$269,020	
TOTAL CONSTRUCTION COST				**$1,345,099**	

Current River Bridge

Alternative 3, Option 2 – Cost Estimate

Project:	MoDOT Rte. 19 Concepts	Computed:	JDM	Date:	9/18/2019
Subject:	G0804 Replacement	Checked:	DGB	Date:	10/2/2019
Task:	Concept Cost Estimate	Page:		of:	ESTIMATE
Job #:		No:			

G0804 Replacement - Filled Arch Option (No phasing)

Bridge Length =	612	Ft.	Skew =	0	degrees
New Bridge Width =	40.83	Ft.	New Arch Width =	35	Ft.
Cantilever Width =	4.583	Ft.	Side Wall Area (DGN) =	1060	ft^2
Pier 2 Width =	40.5	ft.	New Side Wall Thk =	12	in.
Pier 2 Length =	13	ft.	Arch End Area (130' Span) =	290	ft^2
Pier 3&4 Width =	43.5	ft.	Pier 2 Area =	165	ft^2
Pier 3&4 Length =	14	ft.	Pier 3 & 4 Area =	300	ft^2
Pier 5 Width =	43.5	ft.	Pier 5 Area =	450	ft^2
Pier 5 Length =	20	ft.	# Girders (End Spans) =	5	
End Span Lengths (NU53) =	102	ft.	Wing Length =	15	ft.

Item	Quantity		Unit Cost	Estimated Cost
Arch Backfill				
(202-60.40)	3890	Cu. Yd.	$25	$97,250
		Filled Arch - Assume 33' wide fill x side wall area (measured in CAD)		
Class 1 Excavation				
(206-10.00)	2530	Cu. Yd.	$50	$126,500
	Abut. Excav. Depth =	5 ft.		
	Pier 2 Excav. Depth =	12 ft.		
	Pier 3 & 4 Excav. Depth =	17 ft.		
	Pier 5 Excav. Depth =	27 ft.		
Cofferdams				
(206-60.02)	1	Lump Sum	$1,000,000	$1,000,000
		Assume $250,000 each		
Ornamental Pedestrian Fence				
(607-99.03)	612	LF.	$160	$97,920
Galvanized Structural Steel Pile (12")				
(702-12.12)	324	LF.	$75	$24,300
	Approx. Pile Length (EB 1) =	24 ft		
	Approx. Pile Length (EB 6) =	30 ft		
	# Piles/End Bent =	6		
Dynamic Pile Testing				
(702-50.01)	2	Ea.	$2,500	$5,000
Pile Point Reinforcement				
(702-70.00)	12	Ea.	$125	$1,500
Class B Concrete (Substructure)				
(703-20.03)	2,460	Cu. Yd.	$900	$2,214,000
		Include side walls, 6'x12" pilasters and support brackets w/ foundations		
		Include new floorbeam braces (10 per span - 15"x27"x33')		
Class B-2 Concrete (Arch)				
(703-20.03)	1130	Cu. Yd.	$2,000	$2,260,000
		Use end areas from DGN file and multiply by 35' wide arch		
Slab on Filled Arch				
(703-42.14)	1860	Sq. Yd.	$200	$372,000
Barrier Curb				
(703-42.15)	1290	LF.	$95	$122,550
Slab on Concrete NU-Girder				
(703-42.15)	930	Sq. Yd.	$315	$292,950

Project:	MoDOT Rte. 19 Concepts	Computed:	JDM	Date:	9/18/2019
Subject:	G0804 Replacement	Checked:	DGB	Date:	10/2/2019
Task:	Concept Cost Estimate	Page:		of:	ESTIMATE
Job #:		No:			

Form Liners				
(703-46.20)	400	Sq. Yd.	$100	$40,000
		Back of Barrierss and new Pilasters at piers (approx. 5' wide x 25' tall)		
NU 53, Prestressed Concrete NU-Girder				
(705-60.23)	1010	LF.	$240	$242,400
Reinforcing Steel				
(706-10.60)	489,300	Lb.	$1.40	$685,020
		Assume 130# per CY of concrete for Substr. 150# for the Arch concrete		
Steel Intermediate Diaphragm (NU Girder)				
(712-33.01)	16	Ea.	$1,000	$16,000
		Two in each end span per bay		
Slab Drain				
(712-36.10)	84	Ea.	$500	$42,000
		Assume new VC on bridge to help drainage. Spa. @ 15' across bridge		
Drainage System on Structure				
(712-99.01)	1	Lump Sum	$80,000	$80,000
Misc. Bridge Rail				
(712-99.03)	1290	LF.	$110	$141,900
Vertical Drain at End Bent				
(715-10.01)	2	Ea.	$3,060	$6,120
		Assume $45/ft. Roadway width + 2 wings		
Laminated Neoprene Bearing (Tapered)				
(716-10.03)	10	Ea.	$375	$3,750
Laminated Neoprene Bearing Assembly				
(716-20.00)	10	Ea.	$2,000	$20,000
Strip Seal Expansion Joint System				
(717-20.01)	90	LF.	$400	$36,000

Total New Bridge Cost =	$7,927,200	Unit Cost =	$317 / Sq. Ft.

Not including approach slab

CONCEPT STUDY - OPINION OF PROBABLE CONSTRUCTION COSTS
ROUTE 19 ARCH BRIDGES REHAB STUDY
HDR

DESCRIPTION: Route 19 two-lane minor rural highway. Project limits assume reconstruction of Route 19 from Sta. 1627+50 to Sta. 1647+32 across Current River. Estimate does not include costs for bridges.

Figure A- 5: Alternatives 3 and 4 North Option 2 - New Bridge on Offset alignment; Ped Bridge Remains

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST	COMMENT
MOBILIZATION AND TRAFFIC CONTROL					
TEMPORARY TRAFFIC CONTROL	LS	1	$50,000	$50,000	assumes flagging, temp barrier, signs, etc
EROSION CONTROL					
EROSION CONTROL	LS	1	$25,000	$25,000	
ROADWORK					
REMOVAL OF SURFACINGS	SY	8000	$3	$24,000	
REMOVAL OF IMPROVEMENTS	LS	1	$25,000	$25,000	
CLEARING AND GRUBBING	ACRE	5	$7,000	$35,000	
EXCAVATION - CLASS A	CY	19136	$8	$143,523	Assumes 2/3 cut volume is Class A
EXCAVATION - CLASS C	CY	9568	$20	$191,364	Assumes 1/3 cut volume is Class C
EMBANKMENT IN PLACE	CY	12950	$12	$155,397	
DRAINAGE AND SEWERS					
DRAINAGE	LS	1	$50,000	$50,000	
BRIDGES					
BRIDGE DEMOLITION	LS				See Bridge Costs
ROUTE 19 OVER CURRENT RIVER	LS				See Bridge Costs
TEMPORARY CAUSEWAY	LS	1	$250,000	$250,000	
PAVEMENT					
DRIVEWAY RECONSTRUCTION	EACH	2	$10,000	$20,000	
ROUTE 19 RECONSTRUCTION	SY	4631	$55	$254,730	8" asphalt; Type 5 aggregate base (6")
PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES					
GUARDRAIL, MGS	FOOT	300	$20	$6,000	
GUARDRAIL, BRIDGE APPROACH TRANSITION SECTION	EACH	4	$3,000	$12,000	
GUARDRAIL, TYPE A CRASHWORTHY END TERMINAL (MASH)	EACH	4	$2,500	$10,000	
PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS					
SIGNING AND STRIPING	LS	1	$25,000	$25,000	
OTHER					
SEEDING AND MULCHING	LS	1	$15,000	$15,000	
BID ITEMS SUBTOTAL				**$1,292,015**	
CONSTRUCTION SURVEYING	LS		1%	$12,920	
CONTINGENCIES	LS		25%	$326,234	
TOTAL CONSTRUCTION COST				**$1,631,169**	

Current River Bridge

Alternative 4, Option 1 – Cost Estimate

ENGINEER'S ESTIMATE - CONCEPTUAL CONSTRUCTION COST

olsson

Client: MoDOT **Date:** 9/12/2019
Project: J9P3305: Rte 19 Arch Bridges Rehab. Study
Project Number: 019-2126 **By:** GCL
Description: Current River Bridge - Replace on Existing Alignment
Br. Option (102'-136'-136'-136'-102') Pl. Girder (W/ Peds)

These Costs do not include PE, RW, Permitting, Inspection Costs. Unit Prices are FY 2020.

BID FORM #	MODOT BID ITEM #	DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
BRIDGE CONSTRUCTION BID ITEMS						
1	2061000	Class I Excavation	1266	Cu. Yd.	$50	$63,282
2	5031010A	Bridge Approach Slab (Major Road)	136.3	Sq. Yd.	$250	$34,074
3	6079903	(72 In.) Pedestrian Fence (Structures)	650.0	Lin. Ft.	$160	$104,000
4	7011107	Drilled Shafts (6 Ft. 0 In. Dia.)	213.0	Lin. Ft.	$1,200	$255,600
5	7011206	Rock Sockets (5 Ft. 6 In. Dia.)	240.0	Lin. Ft.	$900	$216,000
6	7011300	Video Camera Inspection	12.0	Each	$650	$7,800
7	7011400	Foundation Inspection Holes	360.0	Lin. Ft.	$130	$46,800
8	7011600	Sonic Logging Testing	12.0	Each	$2,000	$24,000
9	7021212	Galvanized Structural Steel Piles (12 In.)	980.0	Lin. Ft.	$80	$78,400
10	7027000	Pile Point Reinforcement	14.0	Each	$125	$1,750
11	7026000	Pre-Bore for Piling	630.0	Lin. Ft.	$150	$94,500
12	7032003	Class B Concrete (Substructure)	514.1	Cu. Yd.	$850	$437,022
13	7034212	Slab on Steel	2776.7	Sq. Yd.	$275	$763,583
14	7034620	Form Liners	1137.8	Sq. Yd.	$100	$113,778
15	7039903	Misc. Barrier Curb	1298.0	Lin. Ft.	$100	$129,800
16	7061060	Reinforcing Steel (Bridges)	107202	Lbs	$1.40	$150,083
17	7121122	Fab. Structural LA Steel (Plate Girder) A709, Gr 50W	1045000	Lbs	$1.75	$1,828,750
18	7123610	Slab Drain	1.0	L.S.	$120,000	$120,000
19	7129903	Misc. Bridge Rail (One Tube Structural Steel)	1298.0	Lin. Ft.	$100	$129,800
20	7151001	Vertical Drain at End Bents	2.0	Each	$3,500	$7,000
21	7162000	Laminated Neoprene Bearing Pad Assembly	30.0	Each	$2,100	$63,000
22	7172001	Strip Seal Expansion Joint System	89	Lin. Ft.	$425	$37,970
					Sub-Total (A) =	**$4,706,991**
				Price/Sq. Ft. (Bridge Items) =		*$188*

CONCEPT STUDY - OPINION OF PROBABLE CONSTRUCTION COSTS
ROUTE 19 ARCH BRIDGES REHAB STUDY
HDR

DESCRIPTION: Route 19 two-lane minor rural highway. Project limits assume reconstruction of Route 19 from Sta. 1627+50 to Sta. 1647+18 across Current River. Estimate does not include costs for bridges.

Figure A-4: Alternatives 3 and 4 North Option 1 - New Bridge on Offset alignment; Remove Ped Bridge

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST	COMMENT
MOBILIZATION AND TRAFFIC CONTROL					
TEMPORARY TRAFFIC CONTROL	LS	1	$50,000	$50,000	assumes flagging, temp barrier, signs, etc
EROSION CONTROL					
EROSION CONTROL	LS	1	$25,000	$25,000	
ROADWORK					
REMOVAL OF SURFACINGS	SY	8000	$3	$24,000	
REMOVAL OF IMPROVEMENTS	LS	1	$25,000	$25,000	
CLEARING AND GRUBBING	ACRE	5	$7,000	$35,000	
EXCAVATION - CLASS A	CY	8613	$8	$64,597	Assumes 2/3 cut volume is Class A
EXCAVATION - CLASS C	CY	4306	$20	$86,130	Assumes 1/3 cut volume is Class C
EMBANKMENT IN PLACE	CY	9725	$12	$116,695	
DRAINAGE AND SEWERS					
DRAINAGE	LS	1	$50,000	$50,000	
BRIDGES					
BRIDGE DEMOLITION	LS				See Bridge Costs
ROUTE 19 OVER CURRENT RIVER	LS				See Bridge Costs
TEMPORARY CAUSEWAY	LS	1	$250,000	$250,000	
PAVEMENT					
DRIVEWAY RECONSTRUCTION	EACH	2	$10,000	$20,000	
ROUTE 19 RECONSTRUCTION	SY	4564	$55	$251,003	8" asphalt; Type 5 aggregate base (6")
PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES					
GUARDRAIL, MGS	FOOT	300	$20	$6,000	
GUARDRAIL, BRIDGE APPROACH TRANSITION SECTION	EACH	4	$3,000	$12,000	
GUARDRAIL, TYPE A CRASHWORTHY END TERMINAL (MASH)	EACH	4	$2,500	$10,000	
PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS					
SIGNING AND STRIPING	LS	1	$25,000	$25,000	
OTHER					
SEEDING AND MULCHING	LS	1	$15,000	$15,000	
BID ITEMS SUBTOTAL				**$1,065,425**	
CONSTRUCTION SURVEYING	LS		1%	$10,654	
CONTINGENCIES	LS		25%	$269,020	
TOTAL CONSTRUCTION COST				**$1,345,099**	

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Current River Bridge

Alternative 4, Option 2 – Cost Estimate

ENGINEER'S ESTIMATE - CONCEPTUAL CONSTRUCTION COST

Client: MoDOT **Date:** 9/12/2019
Project: J9P3305: Rte 19 Arch Bridges Rehab. Study
Project Number: 019-2126 **By:** GCL
Description: Current River Bridge - Replace on Existing Alignment
Br. Option (102'-136'-136'-136'-102') Pl. Girder (W/ Peds)

These Costs do not include PE, RW, Permitting, Inspection Costs. Unit Prices are FY 2020.

BID FORM #	MODOT BID ITEM #	DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
BRIDGE CONSTRUCTION BID ITEMS						
1	2061000	Class I Excavation	1266	Cu. Yd.	$50	$63,282
2	5031010A	Bridge Approach Slab (Major Road)	136.3	Sq. Yd.	$250	$34,074
3	6079903	(72 In.) Pedestrian Fence (Structures)	650.0	Lin. Ft.	$160	$104,000
4	7011107	Drilled Shafts (6 Ft. 0 In. Dia.)	213.0	Lin. Ft.	$1,200	$255,600
5	7011206	Rock Sockets (5 Ft. 6 In. Dia.)	240.0	Lin. Ft.	$900	$216,000
6	7011300	Video Camera Inspection	12.0	Each	$650	$7,800
7	7011400	Foundation Inspection Holes	360.0	Lin. Ft.	$130	$46,800
8	7011600	Sonic Logging Testing	12.0	Each	$2,000	$24,000
9	7021212	Galvanized Structural Steel Piles (12 In.)	980.0	Lin. Ft.	$80	$78,400
10	7027000	Pile Point Reinforcement	14.0	Each	$125	$1,750
11	7026000	Pre-Bore for Piling	630.0	Lin. Ft.	$150	$94,500
12	7032003	Class B Concrete (Substructure)	514.1	Cu. Yd.	$850	$437,022
13	7034212	Slab on Steel	2776.7	Sq. Yd.	$275	$763,583
14	7034620	Form Liners	1137.8	Sq. Yd.	$100	$113,778
15	7039903	Misc. Barrier Curb	1298.0	Lin. Ft.	$100	$129,800
16	7061060	Reinforcing Steel (Bridges)	107202	Lbs	$1.40	$150,083
17	7121122	Fab. Structural LA Steel (Plate Girder) A709, Gr 50W	1045000	Lbs	$1.75	$1,828,750
18	7123610	Slab Drain	1.0	L.S.	$120,000	$120,000
19	7129903	Misc. Bridge Rail (One Tube Structural Steel)	1298.0	Lin. Ft.	$100	$129,800
20	7151001	Vertical Drain at End Bents	2.0	Each	$3,500	$7,000
21	7162000	Laminated Neoprene Bearing Pad Assembly	30.0	Each	$2,100	$63,000
22	7172001	Strip Seal Expansion Joint System	89	Lin. Ft.	$425	$37,970
					Sub-Total (A) =	**$4,706,991**
				Price/Sq. Ft. (Bridge Items) =		*$188*

CONCEPT STUDY - OPINION OF PROBABLE CONSTRUCTION COSTS
ROUTE 19 ARCH BRIDGES REHAB STUDY
HDR

DESCRIPTION: Route 19 two-lane minor rural highway. Project limits assume reconstruction of Route 19 from Sta. 1627+50 to Sta. 1647+32 across Current River. Estimate does not include costs for bridges.

Figure A- 5: Alternatives 3 and 4 North Option 2 - New Bridge on Offset alignment; Ped Bridge Remains

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST	COMMENT
MOBILIZATION AND TRAFFIC CONTROL					
TEMPORARY TRAFFIC CONTROL	LS	1	$50,000	$50,000	assumes flagging, temp barrier, signs, etc
EROSION CONTROL					
EROSION CONTROL	LS	1	$25,000	$25,000	
ROADWORK					
REMOVAL OF SURFACINGS	SY	8000	$3	$24,000	
REMOVAL OF IMPROVEMENTS	LS	1	$25,000	$25,000	
CLEARING AND GRUBBING	ACRE	5	$7,000	$35,000	
EXCAVATION - CLASS A	CY	19136	$8	$143,523	Assumes 2/3 cut volume is Class A
EXCAVATION - CLASS C	CY	9568	$20	$191,364	Assumes 1/3 cut volume is Class C
EMBANKMENT IN PLACE	CY	12950	$12	$155,397	
DRAINAGE AND SEWERS					
DRAINAGE	LS	1	$50,000	$50,000	
BRIDGES					
BRIDGE DEMOLITION	LS				See Bridge Costs
ROUTE 19 OVER CURRENT RIVER	LS				See Bridge Costs
TEMPORARY CAUSEWAY	LS	1	$250,000	$250,000	
PAVEMENT					
DRIVEWAY RECONSTRUCTION	EACH	2	$10,000	$20,000	
ROUTE 19 RECONSTRUCTION	SY	4631	$55	$254,730	8" asphalt; Type 5 aggregate base (6")
PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES					
GUARDRAIL, MGS	FOOT	300	$20	$6,000	
GUARDRAIL, BRIDGE APPROACH TRANSITION SECTION	EACH	4	$3,000	$12,000	
GUARDRAIL, TYPE A CRASHWORTHY END TERMINAL (MASH)	EACH	4	$2,500	$10,000	
PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS					
SIGNING AND STRIPING	LS	1	$25,000	$25,000	
OTHER					
SEEDING AND MULCHING	LS	1	$15,000	$15,000	
BID ITEMS SUBTOTAL				**$1,292,015**	
CONSTRUCTION SURVEYING	LS		1%	$12,920	
CONTINGENCIES	LS		25%	$326,234	
TOTAL CONSTRUCTION COST				**$1,631,169**	

Current River Bridge

Alternative 5A – Cost Estimate

G0804 Rehab - Filled Arch Option (Phased/Non-phased Construction)

Bridge Length =	602	Ft.	Skew =	0	deg	
Exist. Bridge Width =	21.67	Ft.	21.67	Ft. along skew		
New Bridge Width =	40.83	Ft.				
Cantilever Width =	4.583	Ft.	Existing Arch Width =	14	Ft.	
Widening =	19.16	Ft.	New Arch Width =	35	Ft.	
Average Abutment Length =	23.5	ft.	Arch Ring Arc Length (60') =	65	Ft	
Abut. Footing Width =	3.5	ft.	Arch Ring Arc Length (130') =	140	Ft	
Pier 2 Width =	20.5	ft.	130' Side Wall Area (DGN) =	1060	ft^2	
Pier 2 Length =	13	ft.	60' Side Wall Area (DGN) =	990	ft^2	
Pier 3&4 Width =	23.5	ft.	New Side Wall Thk =	12	in.	
Pier 3&4 Length =	14	ft.	Arch Ring End Area (60' Span) =	110	ft^2	
Pier 5 Width =	23.5	ft.	Arch Ring End Area (130' Span) =	290	ft^2	
Pier 5 Length =	20	ft.	Pier 2 Area =	165	ft^2	
			Pier 3 & 4 Area =	300	ft^2	
			Pier 5 Area =	450	ft^2	

Item	Quantity		Unit Cost	Estimated Cost
Arch Backfill				
(202-60.40)	3830	Cu. Yd.	$25	$95,750
		Filled Arch - Assume 10' wide fill added each side x Avg. Side Wall Height		
Class 1 Excavation				
(206-10.00)	1800	Cu. Yd.	$50	$90,000
	Abut. Excav. Depth =	15	ft.	
	Pier 2 Excav. Depth =	12	ft.	
	Pier 3 & 4 Excav. Depth =	17	ft.	
	Pier 5 Excav. Depth =	27	ft.	
Cofferdams				
(206-60.02)	1	Lump Sum	$1,000,000	$1,000,000
		Include all piers in same pay item		
Removal of Existing Bridge Decks - Non. Comp.				
(216-25.00)	5,518	Sq. Ft.	$9.00	$49,661
		Remove slab cantilevers both sides		
Partial Removal of Exist. Bridge Deck				
(216-99.01)	49.0	Cu. Yd.	$1,000	$49,000
		Remove slab cantilever support brackets. Say 16" deep by 15" wide. *Also remove pilasters at piers (assume average 20' tall. 6' x 12")*		
Ornamental Pedestrian Fence				
(607-99.03)	602	LF.	$160	$96,320
Class B Concrete (Substructure)				
(703-20.03)	1,510	Cu. Yd.	$900	$1,359,000
		Include side walls and support brackets w/ foundations *Add 4.5' wide new cantilevers (7" thick). Add new OH brackets. 76 total* *bracket locations (2*(2*4+3*10)) = 76. Pier Areas measured from DGN* *Add new 6' wide x 12" thick x 20' (average) high pilasters at piers.*		
Class B-2 Concrete (Arch)				
(703-20.03)	850	Cu. Yd.	$2,000	$1,700,000
		Use end areas from DGN file and multiply by 15' widening		
Slab on Filled Arch				
(703-42.14)	2740	Sq. Yd.	$200	$548,000
Barrier Curb				
(703-42.15)	1210	LF.	$95	$114,950

Item	Quantity	Unit	Unit Price	Cost
Form Liners (703-46.20)	380	Sq. Yd.	$100	$38,000
		Back of Barrier Curbs and new Pilasters at piers (approx. 5' wide x 25' tall)		
Substructure Repair (Formed) (704-01.01)	940	Sq. Ft.	$135	$126,900
		Assume 5% of arch surface area needs repair. Assume 500 SF more for side walls and tie beams		
Embedded Galvanic Anodes (704-99.01)	2000	Ea.	$100	$200,000
Reinforcing Steel (Bridges) (706-10.60)	331,350	Lb.	$1.40	$463,890
		Assume 135# per CY of concrete for Substr. 150# for the Arch concrete		
Slab Drain (712-36.10)	90	Ea.	$500	$45,000
Drainage System on Structure (712-99.01)	1	Lump Sum	$80,000	$80,000
Misc. Bridge Rail (712-99.03)	1210	LF.	$110	$133,100
Strip Seal (717-20.02)	90	LF.	$100	$9,000

Total Bridge Cost =	**$6,198,600**	**Unit Cost =**	**$252 / Sq. Ft.**

*** - without phasing**

Phasing Premium =	**$1,239,720**	*Assume 20%*

Total Bridge Cost =	**$7,438,320**	**Unit Cost =**	**$303 / Sq. Ft.**

*** - with phasing**

CONCEPT STUDY - OPINION OF PROBABLE CONSTRUCTION COSTS
ROUTE 19 ARCH BRIDGES REHAB STUDY
HDR

DESCRIPTION: Route 19 two-lane minor rural highway. No construction of shoofly or offset alignment. Estimate does not include costs for bridges.

Figure A-1: Alternative 5A North - Phased Traffic Control

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST	COMMENT
MOBILIZATION AND TRAFFIC CONTROL					
TEMPORARY TRAFFIC CONTROL	LS	1	$100,000	$100,000	assumes flagging, temp barrier, signs, etc
WORK ZONE TRAFFIC SIGNAL SYSTEM	EACH	1	$12,000	$12,000	alternating traffic across bridge
EROSION CONTROL					
EROSION CONTROL	LS		$20,000		
ROADWORK					
REMOVAL OF IMPROVEMENTS	LS	1	$15,000	$15,000	
ASPHALT PAVEMENT SAW CUTTING	FOOT		$1		
CLEARING AND GRUBBING	ACRE		$7,000		
EXCAVATION - CLASS A	CY		$8		
EXCAVATION - CLASS C	CY		$20		
EMBANKMENT IN PLACE	CY		$12		
DRAINAGE AND SEWERS					
DRAINAGE	LS		$20,000		
BRIDGES					
BRIDGE DEMOLITION	LS				See Bridge Costs
ROUTE 19 OVER CURRENT RIVER	LS				See Bridge Costs
TEMPORARY CAUSEWAY	LS		$250,000		
TEMPORARY SHORING	LS		$50,000		
PAVEMENT					
ROUTE 19 RECONSTRUCTION	SY	146	$55	$8,033	8" asphalt; Type 5 aggregate base (6")
PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES					
GUARDRAIL, MGS	FOOT	300	$20	$6,000	
GUARDRAIL, BRIDGE APPROACH TRANSITION SECTION	EACH	4	$3,000	$12,000	
GUARDRAIL, TYPE A CRASHWORTHY END TERMINAL (MASH)	EACH	4	$2,500	$10,000	
PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS					
SIGNING AND STRIPING	LS	1	$10,000	$10,000	
OTHER					
SEEDING AND MULCHING	LS		$15,000		
BID ITEMS SUBTOTAL				**$173,033**	
CONSTRUCTION SURVEYING	LS			$5,000.00	
CONTINGENCIES	LS		25%	$44,508.17	
TOTAL CONSTRUCTION COST				**$222,541**	

Current River Bridge

Alternative 5B, Option 1 – Cost Estimate

Project:	MoDOT Rte. 19 Concepts	Computed:	JDM	Date:	9/18/2019
Subject:	G0804 Rehab	Checked:	DGB	Date:	10/2/2019
Task:	Prelim. Cost Estimate	Page:	1	of:	ESTIMATE
Job #:		No:			

G0804 Rehab - Filled Arch Option (Phased/Non-phased Construction)

Bridge Length =	602	Ft.	Skew =	0	deg
Exist. Bridge Width =	21.67	Ft.	21.67	Ft. along skew	
New Bridge Width =	40.83	Ft.			
Cantilever Width =	4.583	Ft.	Existing Arch Width =	14	Ft.
Widening =	19.16	Ft.	New Arch Width =	35	Ft.
Average Abutment Length =	23.5	ft.	Arch Ring Arc Length (60') =	65	Ft
Abut. Footing Width =	3.5	ft.	Arch Ring Arc Length (130') =	140	Ft
Pier 2 Width =	20.5	ft.	130' Side Wall Area (DGN) =	1060	ft²
Pier 2 Length =	13	ft.	60' Side Wall Area (DGN) =	990	ft²
Pier 3&4 Width =	23.5	ft.	New Side Wall Thk =	12	in.
Pier 3&4 Length =	14	ft.	Arch Ring End Area (60' Span) =	110	ft²
Pier 5 Width =	23.5	ft.	Arch Ring End Area (130' Span) =	290	ft²
Pier 5 Length =	20	ft.	Pier 2 Area =	165	ft²
			Pier 3 & 4 Area =	300	ft²
			Pier 5 Area =	450	ft²

Item	Quantity		Unit Cost	Estimated Cost
Arch Backfill				
(202-60.40)	3830	Cu. Yd.	$25	$95,750
		Filled Arch - Assume 10' wide fill added each side x Avg. Side Wall Height		
Class 1 Excavation				
(206-10.00)	1800	Cu. Yd.	$50	$90,000
	Abut. Excav. Depth =	15	ft.	
	Pier 2 Excav. Depth =	12	ft.	
	Pier 3 & 4 Excav. Depth =	17	ft.	
	Pier 5 Excav. Depth =	27	ft.	
Cofferdams				
(206-60.02)	1	Lump Sum	$1,000,000	$1,000,000
		Include all piers in same pay item		
Removal of Existing Bridge Decks - Non. Comp.				
(216-25.00)	5,518	Sq. Ft.	$9.00	$49,661
		Remove slab cantilevers both sides		
Partial Removal of Exist. Bridge Deck				
(216-99.01)	49.0	Cu. Yd.	$1,000	$49,000
		Remove slab cantilever support brackets. Say 16" deep by 15" wide. *Also remove pilasters at piers (assume average 20' tall. 6' x 12")*		
Ornamental Pedestrian Fence				
(607-99.03)	602	LF.	$160	$96,320
Class B Concrete (Substructure)				
(703-20.03)	1,510	Cu. Yd.	$900	$1,359,000
		Include side walls and support brackets w/ foundations *Add 4.5' wide new cantilevers (7" thick). Add new OH brackets. 76 total* *bracket locations (2*(2*4+3*10)) = 76. Pier Areas measured from DGN* *Add new 6' wide x 12" thick x 20' (average) high pilasters at piers.*		
Class B-2 Concrete (Arch)				
(703-20.03)	850	Cu. Yd.	$2,000	$1,700,000
		Use end areas from DGN file and multiply by 15' widening		
Slab on Filled Arch				
(703-42.14)	2740	Sq. Yd.	$200	$548,000
Barrier Curb				
(703-42.15)	1210	LF.	$95	$114,950

Project:	MoDOT Rte. 19 Concepts	Computed:	JDM	Date:	9/18/2019
Subject:	G0804 Rehab	Checked:	DGB	Date:	10/2/2019
Task:	Prelim. Cost Estimate	Page:	1	of:	ESTIMATE
Job #:		No:			

Form Liners				
(703-46.20)	380	Sq. Yd.	$100	$38,000
		Back of Barrier Curbs and new Pilasters at piers (approx. 5' wide x 25' tall)		
Substructure Repair (Formed)				
(704-01.01)	940	Sq. Ft.	$135	$126,900
		Assume 5% of arch surface area needs repair. Assume 500 SF more for side walls and tie beams		
Embedded Galvanic Anodes				
(704-99.01)	2000	Ea.	$100	$200,000
Reinforcing Steel (Bridges)				
(706-10.60)	331,350	Lb.	$1.40	$463,890
		Assume 135# per CY of concrete for Substr. 150# for the Arch concrete		
Slab Drain				
(712-36.10)	90	Ea.	$500	$45,000
Drainage System on Structure				
(712-99.01)	1	Lump Sum	$80,000	$80,000
Misc. Bridge Rail				
(712-99.03)	1210	LF.	$110	$133,100
Strip Seal				
(717-20.02)	90	LF.	$100	$9,000

Total Bridge Cost =	**$6,198,600**	**Unit Cost =**	**$252 / Sq. Ft.**

*** - without phasing**

Phasing Premium =	**$1,239,720**	*Assume 20%*

Total Bridge Cost =	**$7,438,320**	**Unit Cost =**	**$303 / Sq. Ft.**

*** - with phasing**

CONCEPT STUDY - OPINION OF PROBABLE CONSTRUCTION COSTS
ROUTE 19 ARCH BRIDGES REHAB STUDY
HDR

DESCRIPTION: Route 19 two-lane minor rural highway. Project limits assume construction of shoofly along Route 19 from Sta. 100+00 to Sta. 113+47 across Current River. Estimate does not include costs for bridges.

Figure A-1: Alternative 1A,2A, 5B North Option 1 - Temp Shoofly Bridge; Remove Ped Bridge

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST	COMMENT
MOBILIZATION AND TRAFFIC CONTROL					
TEMPORARY TRAFFIC CONTROL	LS	1	$35,000	$35,000	assumes flagging, temp barrier, signs, etc
TEMPORARY PAVING	SY	1984	$55	$109,141	8" asphalt; 6" aggregate base
EROSION CONTROL					
EROSION CONTROL	LS	1	$20,000	$20,000	
ROADWORK					
REMOVAL OF IMPROVEMENTS	LS	1	$15,000	$15,000	
CLEARING AND GRUBBING	ACRE	3	$7,000	$21,000	
EXCAVATION - CLASS A	CY	8539	$8	$64,041	Assumes 2/3 cut volume is Class A
EXCAVATION - CLASS C	CY	4269	$20	$85,388	Assumes 1/3 cut volume is Class C
EMBANKMENT IN PLACE	CY	3411	$12	$40,935	
DRAINAGE AND SEWERS					
DRAINAGE	LS	1	$20,000	$20,000	
BRIDGES					
BRIDGE DEMOLITION	LS				See Bridge Costs
ROUTE 19 OVER CURRENT RIVER	LS				See Bridge Costs
TEMPORARY CAUSEWAY	LS	1	$250,000	$250,000	
TEMPORARY SHORING	LS	1	$50,000	$50,000	
PAVEMENT					
ROUTE 19 RECONSTRUCTION	SY	146	$55	$8,033	8" asphalt; Type 5 aggregate base (6")
PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES					
GUARDRAIL, MGS	FOOT	300	$20	$6,000	
GUARDRAIL, BRIDGE APPROACH TRANSITION SECTION	EACH	4	$3,000	$12,000	
GUARDRAIL, TYPE A CRASHWORTHY END TERMINAL (MASH)	EACH	4	$2,500	$10,000	
PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS					
SIGNING AND STRIPING	LS	1	$10,000	$10,000	
OTHER					
SEEDING AND MULCHING	LS	1	$15,000	$15,000	
BID ITEMS SUBTOTAL				**$771,537**	
CONSTRUCTION SURVEYING	LS			$10,000.00	
CONTINGENCIES	LS		25%	$195,384.20	
TOTAL CONSTRUCTION COST				**$976,921**	

Current River Bridge

Alternative 5B, Option 2 – Cost Estimate

Project:	MoDOT Rte. 19 Concepts	Computed:	JDM	Date:	9/18/2019
Subject:	G0804 Rehab	Checked:	DGB	Date:	10/2/2019
Task:	Prelim. Cost Estimate	Page:	1	of:	ESTIMATE
Job #:		No:			

G0804 Rehab - Filled Arch Option (Phased/Non-phased Construction)

Bridge Length =	602	Ft.	Skew =	0	deg
Exist. Bridge Width =	21.67	Ft.	21.67	Ft. along skew	
New Bridge Width =	40.83	Ft.			
Cantilever Width =	4.583	Ft.	Existing Arch Width =	14	Ft.
Widening =	19.16	Ft.	New Arch Width =	35	Ft.
Average Abutment Length =	23.5	ft.	Arch Ring Arc Length (60') =	65	Ft
Abut. Footing Width =	3.5	ft.	Arch Ring Arc Length (130') =	140	Ft
Pier 2 Width =	20.5	ft.	130' Side Wall Area (DGN) =	1060	ft^2
Pier 2 Length =	13	ft.	60' Side Wall Area (DGN) =	990	ft^2
Pier 3&4 Width =	23.5	ft.	New Side Wall Thk =	12	in.
Pier 3&4 Length =	14	ft.	Arch Ring End Area (60' Span) =	110	ft^2
Pier 5 Width =	23.5	ft.	Arch Ring End Area (130' Span) =	290	ft^2
Pier 5 Length =	20	ft.	Pier 2 Area =	165	ft^2
			Pier 3 & 4 Area =	300	ft^2
			Pier 5 Area =	450	ft^2

Item	Quantity		Unit Cost	Estimated Cost
Arch Backfill				
(202-60.40)	3830	Cu. Yd.	$25	$95,750
		Filled Arch - Assume 10' wide fill added each side x Avg. Side Wall Height		
Class 1 Excavation				
(206-10.00)	1800	Cu. Yd.	$50	$90,000
	Abut. Excav. Depth =	15 ft.		
	Pier 2 Excav. Depth =	12 ft.		
	Pier 3 & 4 Excav. Depth =	17 ft.		
	Pier 5 Excav. Depth =	27 ft.		
Cofferdams				
(206-60.02)	1	Lump Sum	$1,000,000	$1,000,000
		Include all piers in same pay item		
Removal of Existing Bridge Decks - Non. Comp.				
(216-25.00)	5,518	Sq. Ft.	$9.00	$49,661
		Remove slab cantilevers both sides		
Partial Removal of Exist. Bridge Deck				
(216-99.01)	49.0	Cu. Yd.	$1,000	$49,000
		Remove slab cantilever support brackets. Say 16" deep by 15" wide. *Also remove pilasters at piers (assume average 20' tall. 6' x 12")*		
Ornamental Pedestrian Fence				
(607-99.03)	602	LF.	$160	$96,320
Class B Concrete (Substructure)				
(703-20.03)	1,510	Cu. Yd.	$900	$1,359,000
		Include side walls and support brackets w/ foundations *Add 4.5' wide new cantilevers (7" thick). Add new OH brackets. 76 total* *bracket locations (2*(2*4+3*10)) = 76. Pier Areas measured from DGN* *Add new 6' wide x 12" thick x 20' (average) high pilasters at piers.*		
Class B-2 Concrete (Arch)				
(703-20.03)	850	Cu. Yd.	$2,000	$1,700,000
		Use end areas from DGN file and multiply by 15' widening		
Slab on Filled Arch				
(703-42.14)	2740	Sq. Yd.	$200	$548,000
Barrier Curb				
(703-42.15)	1210	LF.	$95	$114,950

Form Liners				
(703-46.20)	380	Sq. Yd.	$100	$38,000
		Back of Barrier Curbs and new Pilasters at piers (approx. 5' wide x 25' tall)		
Substructure Repair (Formed)				
(704-01.01)	940	Sq. Ft.	$135	$126,900
		Assume 5% of arch surface area needs repair. Assume 500 SF more for side walls and tie beams		
Embedded Galvanic Anodes				
(704-99.01)	2000	Ea.	$100	$200,000
Reinforcing Steel (Bridges)				
(706-10.60)	331,350	Lb.	$1.40	$463,890
		Assume 135# per CY of concrete for Substr. 150# for the Arch concrete		
Slab Drain				
(712-36.10)	90	Ea.	$500	$45,000
Drainage System on Structure				
(712-99.01)	1	Lump Sum	$80,000	$80,000
Misc. Bridge Rail				
(712-99.03)	1210	LF.	$110	$133,100
Strip Seal				
(717-20.02)	90	LF.	$100	$9,000

Total Bridge Cost =	**$6,198,600**	**Unit Cost =**	**$252 / Sq. Ft.**

*** - without phasing**

Phasing Premium =	**$1,239,720**	*Assume 20%*

Total Bridge Cost =	**$7,438,320**	**Unit Cost =**	**$303 / Sq. Ft.**

*** - with phasing**

CONCEPT STUDY - OPINION OF PROBABLE CONSTRUCTION COSTS
ROUTE 19 ARCH BRIDGES REHAB STUDY
HDR

DESCRIPTION: Route 19 two-lane minor rural highway. Project limits assume construction of shoofly along Route 19 from Sta. 300+00 to Sta. 312+78 across Current River. Estimate does not include costs for bridges.

Figure A-2: Alternative 1A,2A,5B North Option 2 - Temp Shoofly Bridge Downstream of Ped Bridge

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST	COMMENT
MOBILIZATION AND TRAFFIC CONTROL					
TEMPORARY TRAFFIC CONTROL	LS	1	$35,000	$35,000	assumes flagging, temp barrier, signs, etc
TEMPORARY PAVING	SY	1801	$55	$99,051	8" asphalt; 6" aggregate base
EROSION CONTROL					
EROSION CONTROL	LS	1	$20,000	$20,000	
ROADWORK					
REMOVAL OF IMPROVEMENTS	LS	1	$15,000	$15,000	
CLEARING AND GRUBBING	ACRE	2	$7,000	$14,000	
EXCAVATION - CLASS A	CY	2961	$8	$22,204	Assumes 2/3 cut volume is Class A
EXCAVATION - CLASS C	CY	1480	$20	$29,605	Assumes 1/3 cut volume is Class C
EMBANKMENT IN PLACE	CY	7332	$12	$87,981	
BORROW	CY	2891	$2	$5,782	
DRAINAGE AND SEWERS					
DRAINAGE	LS	1	$20,000	$20,000	
BRIDGES					
BRIDGE DEMOLITION	LS				See Bridge Costs
ROUTE 19 OVER CURRENT RIVER	LS				See Bridge Costs
TEMPORARY CAUSEWAY	LS	1	$250,000	$250,000	
TEMPORARY SHORING	LS	1	$50,000	$50,000	
PAVEMENT					
ROUTE 19 RECONSTRUCTION	SY	146	$55	$8,033	8" asphalt; Type 5 aggregate base (6")
PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES					
GUARDRAIL, MGS	FOOT	300	$20	$6,000	
GUARDRAIL, BRIDGE APPROACH TRANSITION SECTION	EACH	4	$3,000	$12,000	
GUARDRAIL, TYPE A CRASHWORTHY END TERMINAL (MASH)	EACH	4	$2,500	$10,000	
PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS					
SIGNING AND STRIPING	LS	1	$10,000	$10,000	
OTHER					
SEEDING AND MULCHING	LS	1	$15,000	$15,000	
BID ITEMS SUBTOTAL				**$709,656**	
CONSTRUCTION SURVEYING	LS			$10,000.00	
CONTINGENCIES	LS		25%	$179,914.01	
TOTAL CONSTRUCTION COST				**$899,570**	

Current River Bridge

Alternative 6 – Cost Estimate

Project:	MoDOT Rte. 19 Concepts	Computed:	JDM	Date:	9/18/2019
Subject:	G0804 Replacement	Checked:	DGB	Date:	10/2/2019
Task:	Concept Cost Estimate	Page:		of:	ESTIMATE
Job #:		No:			

G0804 Replacement - Filled Arch Option (Phased Construction)

Bridge Length =	612	Ft.	Skew =	0	degrees
New Bridge Width =	40.83	Ft.	New Arch Width =	35	Ft.
Cantilever Width =	4.583	Ft.	Side Wall Area (DGN) =	1060	ft^2
Pier 2 Width =	40.5	ft.	New Side Wall Thk =	12	in.
Pier 2 Length =	13	ft.	Arch End Area (130' Span) =	290	ft^2
Pier 3&4 Width =	43.5	ft.	Pier 2 Area =	165	ft^2
Pier 3&4 Length =	14	ft.	Pier 3 & 4 Area =	300	ft^2
Pier 5 Width =	43.5	ft.	Pier 5 Area =	450	ft^2
Pier 5 Length =	20	ft.			
End Span Lengths (NU53) =	102	ft.	# Girders (End Spans) =	5	
Wing Length =	15	ft.			

Item	Quantity		Unit Cost	Estimated Cost
Arch Backfill				
(202-60.40)	3890	Cu. Yd.	$25	$97,250
		Filled Arch - Assume 33' wide fill x side wall area (measured in CAD)		
Class 1 Excavation				
(206-10.00)	2530	Cu. Yd.	$50	$126,500
		Abut. Excav. Depth = 5 ft.		
		Pier 2 Excav. Depth = 12 ft.		
		Pier 3 & 4 Excav. Depth = 17 ft.		
		Pier 5 Excav. Depth = 27 ft.		
Cofferdams				
(206-60.02)	1	Lump Sum	$1,000,000	$1,000,000
		Assume $250,000 each		
Ornamental Pedestrian Fence				
(607-99.03)	612	LF.	$160	$97,920
Galvanized Structural Steel Pile (12")				
(702-12.12)	324	LF.	$75	$24,300
		Approx. Pile Length (EB 1) = 24 ft		
		Approx. Pile Length (EB 6) = 30 ft		
		# Piles/End Bent = 6		
Pile Point Reinforcement				
(702-70.00)	12	Ea.	$125	$1,500
Class B Concrete (Substructure)				
(703-20.03)	2,460	Cu. Yd.	$900	$2,214,000
		Include side walls, 6'x12" pilasters and support brackets w/ foundations		
		Include new floorbeam braces (10 per span - 15"x27"x33')		
Class B-2 Concrete (Arch)				
(703-20.03)	1130	Cu. Yd.	$2,000	$2,260,000
		Use end areas from DGN file and multiply by 35' wide arch		
Slab on Filled Arch				
(703-42.14)	1860	Sq. Yd.	$200	$372,000
Barrier Curb				
(703-42.15)	1290	LF.	$95	$122,550

Slab on Concrete NU-Girder				
(703-42.15)	930	Sq. Yd.	$315	$292,950
Form Liners				
(703-46.20)	400	Sq. Yd.	$100	$40,000
		Back of Barriers and new Pilasters at piers (approx. 5' wide x 25' tall)		
NU 53, Prestressed Concrete NU-Girder				
(705-60.23)	1010	LF.	$240	$242,400
Reinforcing Steel				
(706-10.60)	489,300	Lb.	$1.40	$685,020
		Assume 130# per CY of concrete for Substr. 150# for the Arch concrete		
Steel Intermediate Diaphragm (NU Girder)				
(712-33.01)	16	Ea.	$1,000	$16,000
		Two in each end span per bay		
Slab Drain				
(712-36.10)	84	Ea.	$500	$42,000
		Assume new VC on bridge to help drainage. Spa. @ 15' across bridge		
Drainage System on Structure				
(712-99.01)	1	Lump Sum	$80,000	$80,000
Misc. Bridge Rail				
(712-99.03)	1290	LF.	$110	$141,900
Vertical Drain at End Bent				
(715-10.01)	2	Ea.	$3,060	$6,120
		Assume $45/ft. Roadway width + 2 wings		
Laminated Neoprene Bearing (Tapered)				
(716-10.03)	10	Ea.	$375	$3,750
Laminated Neoprene Bearing Assembly				
(716-20.00)	10	Ea.	$2,000	$20,000
Strip Seal Expansion Joint System				
(717-20.01)	90	LF.	$400	$36,000

Total New Bridge Cost =	**$7,922,200**	**Unit Cost =**	**$317 / Sq. Ft.**

Not including phasing premium

Phasing Premium =	**$1,584,440**	*Assume 20%*

TOTAL COST =	**$9,506,640**	**Unit Cost =**	**$380 / Sq. Ft.**

Including phasing premium

CONCEPT STUDY - OPINION OF PROBABLE CONSTRUCTION COSTS
ROUTE 19 ARCH BRIDGES REHAB STUDY
HDR

DESCRIPTION: Route 19 two-lane minor rural highway. Project limits assume reconstruction of Route 19 from Sta. 1627+50 to Sta. 1647+09 across Current River. Estimate does not include costs for bridges.

Figure A-6: Alternative 6 and 7 North - Slight alignment shift; Remove Ped Bridge

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST	COMMENT
MOBILIZATION AND TRAFFIC CONTROL					
TEMPORARY TRAFFIC CONTROL	LS	1	$50,000	$50,000	assumes flagging, temp barrier, signs, etc
EROSION CONTROL					
EROSION CONTROL	LS	1	$25,000	$25,000	
ROADWORK					
REMOVAL OF SURFACINGS	SY	8000	$3	$24,000	
REMOVAL OF IMPROVEMENTS	LS	1	$25,000	$25,000	
CLEARING AND GRUBBING	ACRE	5	$7,000	$35,000	
EXCAVATION - CLASS A	CY	5994	$8	$44,953	Assumes 2/3 cut volume is Class A
EXCAVATION - CLASS C	CY	2997	$20	$59,937	Assumes 1/3 cut volume is Class C
EMBANKMENT IN PLACE	CY	5562	$12	$66,741	
DRAINAGE AND SEWERS					
DRAINAGE	LS	1	$50,000	$50,000	
BRIDGES					
BRIDGE DEMOLITION	LS				See Bridge Costs
ROUTE 19 OVER CURRENT RIVER	LS				See Bridge Costs
TEMPORARY CAUSEWAY	LS	1	$250,000	$250,000	
PAVEMENT					
DRIVEWAY RECONSTRUCTION	EACH	2	$10,000	$20,000	
ROUTE 19 RECONSTRUCTION	SY	4522	$55	$248,706	8" asphalt; Type 5 aggregate base (6")
PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES					
GUARDRAIL, MGS	FOOT	300	$20	$6,000	incl. Sta. 1660+50 to Sta. 1666+50; west side
GUARDRAIL, BRIDGE APPROACH TRANSITION SECTION	EACH	4	$3,000	$12,000	
GUARDRAIL, TYPE A CRASHWORTHY END TERMINAL (MASH)	EACH	4	$2,500	$10,000	
PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS					
SIGNING AND STRIPING	LS	1	$25,000	$25,000	
OTHER					
SEEDING AND MULCHING	LS	1	$15,000	$15,000	
BID ITEMS SUBTOTAL				**$967,337**	
CONSTRUCTION SURVEYING	LS		1%	$9,673.37	
CONTINGENCIES	LS		25%	$244,252.64	
TOTAL CONSTRUCTION COST				**$1,221,263**	

Current River Bridge

Alternative 7 – Cost Estimate

ENGINEER'S ESTIMATE - CONCEPTUAL CONSTRUCTION COST

olsson

Client: MoDOT **Date:** 9/12/2019
Project: J9P3305: Rte 19 Arch Bridges Rehab. Study
Project Number: 019-2126 **By:** GCL
Description: Current River Bridge - Replace on Existing Alignment
Br. Option (102'-136'-136'-136'-102') Pl. Girder (w/o Peds)

These Costs do not include PE, RW, Permitting, Inspection Costs. Unit Prices are FY 2020.

BID FORM #	MODOT BID ITEM #	DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
BRIDGE CONSTRUCTION BID ITEMS						
1	2061000	Class I Excavation	1204	Cu. Yd.	$50	$60,200
2	5031010A	Bridge Approach Slab (Major Road)	136.3	Sq. Yd.	$250	$34,074
3	7011107	Drilled Shafts (6 Ft. 0 In. Dia.)	142.0	Lin. Ft.	$1,200	$170,400
4	7011206	Rock Sockets (5 Ft. 6 In. Dia.)	160.0	Lin. Ft.	$900	$144,000
5	7011300	Video Camera Inspection	8.0	Each	$650	$5,200
6	7011400	Foundation Inspection Holes	240.0	Lin. Ft.	$130	$31,200
7	7011600	Sonic Logging Testing	8.0	Each	$2,000	$16,000
8	7021212	Galvanized Structural Steel Piles (12 In.)	700.0	Lin. Ft.	$80	$56,000
9	7027000	Pile Point Reinforcement	10.0	Each	$125	$1,250
10	7026000	Pre-Bore for Piling	450.0	Lin. Ft.	$150	$67,500
11	7032003	Class B Concrete (Substructure)	350.2	Cu. Yd.	$850	$297,664
12	7034212	Slab on Steel	2028.6	Sq. Yd.	$275	$557,877
13	7034620	Form Liners	835.6	Sq. Yd.	$100	$83,556
14	7039903	Misc. Barrier Curb	1298.0	Lin. Ft.	$100	$129,800
15	7061060	Reinforcing Steel (Bridges)	73353	Lbs	$1.40	$102,694
16	7121122	Fab. Structural LA Steel (Plate Girder) A709, Gr 50W	816698	Lbs	$1.75	$1,429,222
17	7123610	Slab Drain	1.0	L.S.	$120,000	$120,000
18	7129903	Misc. Bridge Rail (One Tube Structural Steel)	1298.0	Lin. Ft.	$100	$129,800
19	7151001	Vertical Drain at End Bents	2.0	Each	$2,000	$4,000
20	7162000	Laminated Neoprene Bearing Pad Assembly	24.0	Each	$2,100	$50,400
21	7172001	Strip Seal Expansion Joint System	67	Lin. Ft.	$425	$28,620
					Sub-Total (A) =	**$3,519,456**
				Price/Sq. Ft. (Bridge Items) =		*$193*

Staging Premium = 20%	$703,891
Sub-Total (B)	$703,891
Total (A+B)	$4,223,347
Price / sq.ft. (Bridge Items)	$232

CONCEPT STUDY - OPINION OF PROBABLE CONSTRUCTION COSTS
ROUTE 19 ARCH BRIDGES REHAB STUDY
HDR

DESCRIPTION: Route 19 two-lane minor rural highway. Project limits assume reconstruction of Route 19 from Sta. 1627+50 to Sta. 1647+09 across Current River. Estimate does not include costs for bridges.

Figure A-6: Alternative 6 and 7 North - Slight alignment shift; Remove Ped Bridge

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST	COMMENT
MOBILIZATION AND TRAFFIC CONTROL					
TEMPORARY TRAFFIC CONTROL	LS	1	$50,000	$50,000	assumes flagging, temp barrier, signs, etc
EROSION CONTROL					
EROSION CONTROL	LS	1	$25,000	$25,000	
ROADWORK					
REMOVAL OF SURFACINGS	SY	8000	$3	$24,000	
REMOVAL OF IMPROVEMENTS	LS	1	$25,000	$25,000	
CLEARING AND GRUBBING	ACRE	5	$7,000	$35,000	
EXCAVATION - CLASS A	CY	5994	$8	$44,953	Assumes 2/3 cut volume is Class A
EXCAVATION - CLASS C	CY	2997	$20	$59,937	Assumes 1/3 cut volume is Class C
EMBANKMENT IN PLACE	CY	5562	$12	$66,741	
DRAINAGE AND SEWERS					
DRAINAGE	LS	1	$50,000	$50,000	
BRIDGES					
BRIDGE DEMOLITION	LS				See Bridge Costs
ROUTE 19 OVER CURRENT RIVER	LS				See Bridge Costs
TEMPORARY CAUSEWAY	LS	1	$250,000	$250,000	
PAVEMENT					
DRIVEWAY RECONSTRUCTION	EACH	2	$10,000	$20,000	
ROUTE 19 RECONSTRUCTION	SY	4522	$55	$248,706	8" asphalt; Type 5 aggregate base (6")
PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES					
GUARDRAIL, MGS	FOOT	300	$20	$6,000	incl. Sta. 1660+50 to Sta. 1666+50; west side
GUARDRAIL, BRIDGE APPROACH TRANSITION SECTION	EACH	4	$3,000	$12,000	
GUARDRAIL, TYPE A CRASHWORTHY END TERMINAL (MASH)	EACH	4	$2,500	$10,000	
PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS					
SIGNING AND STRIPING	LS	1	$25,000	$25,000	
OTHER					
SEEDING AND MULCHING	LS	1	$15,000	$15,000	
BID ITEMS SUBTOTAL				**$967,337**	
CONSTRUCTION SURVEYING	LS		1%	$9,673.37	
CONTINGENCIES	LS		25%	$244,252.64	
TOTAL CONSTRUCTION COST				**$1,221,263**	

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Spring Valley Bridge

Alternative 1A – Cost Estimate

Project:	MoDOT Rte. 19 Concepts	Computed:	DGB	Date:	9/16/2019
Subject:	J0420 Replacement	Checked:	JDM	Date:	9/25/2019
Task:	Prelim. Cost Estimate	Page:	1	of:	ESTIMATE
Job #:		No:			

J0420 Replacement - In Kind - On Alignment (Concrete Approaches)

New Bridge Length = 540 ft
New Bridge Width = 28 ft

Item	Quantity		Unit Cost	Estimated Cost
Class 1 Excavation				
(206-10.00)	120	Cu. Yd.	$50	$6,000
Class 2 Excavation				
(206-20.00)	1795	Cu. Yd.	$60	$107,700
Cofferdams				
(206-60.02)	1	Lump Sum	$500,000	$500,000
Bridge Approach Slab (Minor Road)				
(503-10.11A)	116	Sq. Yd.	$215	$24,940
Drilled Shaft (6'-0" Dia.)				
(701-11.06)	87	LF	$1,200	$104,400
Rock Socket (5'-6" Dia.)				
(701-12.06)	32	LF	$900	$28,800
Video Camera Inspection				
(701-13.00)	4	Ea.	$650	$2,600
Foundation Inspection Hole				
(701-14.00)	72	LF	$120	$8,640
Sonic Logging Testing				
(701-16.00)	4	Ea.	$2,000	$8,000
Galvanized Structural Steel Pile (12")				
(702-12.12)	497	LF	$75	$37,275
Dynamic Pile Testing				
(702-50.01)	2	Ea.	$5,000	$10,000
Pile Point Reinforcement				
(702-70.00)	14	Ea.	$125	$1,750
Class B Concrete (Substructure)				
(703-20.03)	780	Cu. Yd.	$900	$702,000
		Includes thrust blocks and new pier/end bent concrete		
Class B-2 Concrete (Spandrel Columns)				
(703-20.03)	152	Cu. Yd.	$1,000	$152,000
Class B-2 Concrete (Arch)				
(703-20.03)	220	Cu. Yd.	$2,000	$440,000
Slab on Concrete NU Girder				
(703-42.14)	1223	Sq. Yd.	$320	$391,360

Project:	MoDOT Rte. 19 Concepts	Computed:	DGB	Date:	9/16/2019
Subject:	J0420 Replacement	Checked:	JDM	Date:	9/25/2019
Task:	Prelim. Cost Estimate	Page:	1	of:	ESTIMATE
Job #:		No:			

Slab on Concrete Spandrel Arch (703-42.14)	475	Sq. Yd.	$350	$166,250
Barrier Curb (703-42.15)	1155	LF	$95	$109,725
Form Liners (703-46.20)	494	Sq. Yd.	$100	$49,400
NU 53, Prestressed Concrete NU-Girder (705-60.23)	1568	LF	$250	$392,000
Reinforcing Steel (Epoxy Coated) (706-10.00)	386,314	Lb. *Assume 130#/CY for substr concrete and 150#/CY of arch concrete*	$1.40	$540,839
Steel Int. Diaphragms for P/S Conc. NU Girder (712-33.01)	18	Ea.	$1,000	$18,000
Slab Drain (712-36.10)	108	Ea.	$340	$36,720
Misc. Bridge Rail (712-99.03)	1155	LF	$110	$127,050
Vertical Drain at End Bents (715-10.01)	2	Ea.	$2,500	$5,000
Laminated Neoprene Bearing Pad (716-10.02)	24	Ea.	$260	$6,240
Laminated Neoprene Bearing Pad Assembly (716-20.00)	8	Ea.	$2,200	$17,600
Strip Seal (717-20.02)	62	LF	$100	$6,200

Total Bridge Cost =	**$4,000,500**	**Unit Cost =**	**$263 / Sq. Ft.**

Not including bridge approach slab

CONCEPT STUDY - OPINION OF PROBABLE CONSTRUCTION COSTS
ROUTE 19 ARCH BRIDGES REHAB STUDY
HDR

DESCRIPTION: Route 19 two-lane minor rural highway. Project limits assume construction of shoofly along Route 19 from Sta. 400+00 to Sta. 413+71 across Spring Valley. Estimate does not include costs for bridges.

Figure A-7: Alternatives 1A,1B,2,5A,5B South - Shoofly Bridge Upstream

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST	COMMENT
MOBILIZATION AND TRAFFIC CONTROL					
TEMPORARY TRAFFIC CONTROL	LS	1	$35,000	$35,000	assumes flagging, temp barrier, signs, etc
TEMPORARY PAVING	SY	2733	$55	$150,332	8" asphalt; 6" aggregate base
EROSION CONTROL					
EROSION CONTROL	LS	1	$25,000	$25,000	
ROADWORK					
REMOVAL OF IMPROVEMENTS	LS	1	$15,000	$15,000	
CLEARING AND GRUBBING	ACRE	3	$7,000	$21,000	
EXCAVATION - CLASS A	CY	4391	$8	$32,932	Assumes 2/3 cut volume is Class A
EXCAVATION - CLASS C	CY	2195	$20	$43,909	Assumes 1/3 cut volume is Class C
EMBANKMENT IN PLACE	CY	9680	$12	$116,166	
BORROW	CY	3094	$2	$6,188	
DRAINAGE AND SEWERS					
DRAINAGE	LS	1	$20,000	$20,000	
BRIDGES					
BRIDGE DEMOLITION	LS				See Bridge Costs
ROUTE 19 OVER SPRING VALLEY	LS				See Bridge Costs
TEMPORARY SHORING	LS	1	$100,000	$100,000	
PAVEMENT					
ROUTE 19 RECONSTRUCTION	SY	145	$55	$7,962	8" asphalt; Type 5 aggregate base (6")
ROTUE 19 TIE-IN MILL/OVERLAY	SY		$25		2" thickness
PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES					
GUARDRAIL, MGS	FOOT	300	$20	$6,000	
GUARDRAIL, BRIDGE APPROACH TRANSITION SECTION	EACH	4	$3,000	$12,000	
GUARDRAIL, TYPE A CRASHWORTHY END TERMINAL (MASH)	EACH	4	$2,500	$10,000	
PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS					
SIGNING AND STRIPING	LS	1	$10,000	$10,000	
OTHER					
SEEDING AND MULCHING	LS	1	$15,000	$15,000	
BID ITEMS SUBTOTAL				**$626,488**	
CONSTRUCTION SURVEYING	LS			$10,000.00	
CONTINGENCIES	LS		25%	$159,122.07	
TOTAL CONSTRUCTION COST				**$795,610**	

ENGINEER'S ESTIMATE - CONCEPTUAL CONSTRUCTION COST

olsson

Client: MoDOT **Date:** 9/16/2019
Project: J9P3305: Rte 19 Arch Bridges Rehab. Study
Project Number: 019-2126 **By:** GCL
Description: Spring Valley Bridge - Temporary Bridge (24' Rdwy)
(40' - 110' - 10 @ 40')

These Costs do not include PE, RW, Permitting, Inspection Costs. Unit Prices are FY 2020.

BID FORM #	MODOT BID ITEM #	DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
BRIDGE CONSTRUCTION BID ITEMS						
1	2160500	Removal of Bridges (Temp Structure)	1	L.S.	$65,825	$65,825
2	7021214	Galvanized Structural Steel Piles (14 in)	611.8	Lin. Ft.	$75	$45,885
3	7021316	Galvanized Cast-in-Place Concrete Piles (16 in)	2635.6	Lin. Ft.	$125	$329,450
4	7026000	Pre-bore for Piling	1238.0	Lin. Ft.	$110	$136,180
5	7032003	Class B Concrete (Substructure)	23.1	Cu. Yd.	$850	$19,644
6	7061060	Reinforcing Steel (Bridges)	2774	Lbs	$1.20	$3,329
7	7121000	Fabricated Structural Carbon Steel (Misc)	75000	Lbs	$3.50	$262,500
8	7181020	Transporting and Erecting Superstructure (10 - 40' Spans)	1	L.S.	$375,000	$375,000
9	7181020A	Transporting and Erecting Superstructure (1 - 110' Span)	1	L.S.	$50,000	$50,000
10	7181030	Removing and Storing Superstructure (10 - 40' Spans)	1	L.S.	$165,000	$165,000
11	7181030A	Removing and Storing Superstructure (1 - 110' Span)	1	L.S.	$20,000	$20,000
					Sub-Total (A) =	**$1,472,813**
			Price/Sq. Ft. (Bridge Items) =			*$102*

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Spring Valley Bridge

Alternative 1B – Cost Estimate

Project:	MoDOT Rte. 19 Concepts	Computed:	DGB	Date:	9/16/2019
Subject:	J0420 Replacement	Checked:	JDM	Date:	10/10/2019
Task:	Prelim. Cost Estimate	Page:	1	of:	ESTIMATE
Job #:		No:			

J0420 Replacement - In Kind - On Alignment (Steel PL Girder Approaches)

New Bridge Length = 540 ft
New Bridge Width = 28 ft

Item	Quantity		Unit Cost	Estimated Cost
Class 1 Excavation (206-10.00)	120	Cu. Yd.	$50	$6,000
Class 2 Excavation (206-20.00)	1795	Cu. Yd.	$60	$107,700
Cofferdams (206-60.02)	1	Lump Sum	$500,000	$500,000
Bridge Approach Slab (Minor Road) (503-10.11A)	107	Sq. Yd.	$215	$23,005
Drilled Shaft (6'-0" Dia.) (701-11.10)	87	LF	$1,200	$104,400
Rock Socket (5'-6" Dia.) (701-12.09)	32	LF	$900	$28,800
Video Camera Inspection (701-13.00)	4	Ea.	$650	$2,600
Foundation Inspection Hole (701-14.00)	72	LF	$120	$8,640
Sonic Logging Testing (701-16.00)	4	Ea.	$2,000	$8,000
Galvanized Structural Steel Pile (12") (702-12.12)	497	LF	$75	$37,275
Dynamic Pile Testing (702-50.01)	2	Ea.	$5,000	$10,000
Pile Point Reinforcement (702-70.00)	14	Ea.	$125	$1,750
Class B Concrete (Substructure) (703-20.03)	780	Cu. Yd. *Includes thrust blocks and new pier/end bent concrete*	$900	$702,000
Class B-2 Concrete (Spandrel Columns) (703-20.03)	152	Cu. Yd.	$1,000	$152,000
Class B-2 Concrete (Arch) (703-20.03)	220	Cu. Yd.	$2,000	$440,000
Slab on Steel (703-42.12)	1223	Sq. Yd.	$275	$336,325

Project:	MoDOT Rte. 19 Concepts	Computed:	DGB	Date:	9/16/2019
Subject:	J0420 Replacement	Checked:	JDM	Date:	10/10/2019
Task:	Prelim. Cost Estimate	Page:	1	of:	ESTIMATE
Job #:		No:			

Slab on Concrete Spandrel Arch (703-42.14)	475	Sq. Yd.	$350	$166,250
Barrier Curb (703-42.15)	1155	LF	$95	$109,725
Form Liners (703-46.20)	494	Sq. Yd.	$100	$49,400
Reinforcing Steel (Epoxy Coated) (706-10.00)	386,314	Lb.	$1.40	$540,839
Fabricated Structural Steel (Plate Girder) 712-11.22	473,132	Lb.	$1.75	$827,981
		Assume 130#/CY for substr concrete and 150#/CY of arch concrete		
Slab Drain (712-36.10)	108	Ea.	$340	$36,720
Drainage System on Structure (712-99.01)	1	Lump Sum	$80,000	$80,000
Misc. Bridge Rail (712-99.03)	1155	LF	$110	$127,050
Vertical Drain at End Bents (715-10.01)	2	Ea.	$2,500	$5,000
Laminated Neoprene Bearing Pad Assembly (716-20.00)	16	Ea.	$2,200	$35,200
Strip Seal Expansion Joint System (717-20.01)	62	LF	$425	$26,350

Total Bridge Cost =	**$4,473,000**	**Unit Cost =**	**$294 / Sq. Ft.**

CONCEPT STUDY - OPINION OF PROBABLE CONSTRUCTION COSTS
ROUTE 19 ARCH BRIDGES REHAB STUDY
HDR

DESCRIPTION: Route 19 two-lane minor rural highway. Project limits assume construction of shoofly along Route 19 from Sta. 400+00 to Sta. 413+71 across Spring Valley. Estimate does not include costs for bridges.

Figure A-7: Alternatives 1A,1B,2,5A,5B South - Shoofly Bridge Upstream

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST	COMMENT
MOBILIZATION AND TRAFFIC CONTROL					
TEMPORARY TRAFFIC CONTROL	LS	1	$35,000	$35,000	assumes flagging, temp barrier, signs, etc
TEMPORARY PAVING	SY	2733	$55	$150,332	8" asphalt; 6" aggregate base
EROSION CONTROL					
EROSION CONTROL	LS	1	$25,000	$25,000	
ROADWORK					
REMOVAL OF IMPROVEMENTS	LS	1	$15,000	$15,000	
CLEARING AND GRUBBING	ACRE	3	$7,000	$21,000	
EXCAVATION - CLASS A	CY	4391	$8	$32,932	Assumes 2/3 cut volume is Class A
EXCAVATION - CLASS C	CY	2195	$20	$43,909	Assumes 1/3 cut volume is Class C
EMBANKMENT IN PLACE	CY	9680	$12	$116,166	
BORROW	CY	3094	$2	$6,188	
DRAINAGE AND SEWERS					
DRAINAGE	LS	1	$20,000	$20,000	
BRIDGES					
BRIDGE DEMOLITION	LS				See Bridge Costs
ROUTE 19 OVER SPRING VALLEY	LS				See Bridge Costs
TEMPORARY SHORING	LS	1	$100,000	$100,000	
PAVEMENT					
ROUTE 19 RECONSTRUCTION	SY	145	$55	$7,962	8" asphalt; Type 5 aggregate base (6")
ROTUE 19 TIE-IN MILL/OVERLAY	SY		$25		2" thickness
PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES					
GUARDRAIL, MGS	FOOT	300	$20	$6,000	
GUARDRAIL, BRIDGE APPROACH TRANSITION SECTION	EACH	4	$3,000	$12,000	
GUARDRAIL, TYPE A CRASHWORTHY END TERMINAL (MASH)	EACH	4	$2,500	$10,000	
PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS					
SIGNING AND STRIPING	LS	1	$10,000	$10,000	
OTHER					
SEEDING AND MULCHING	LS	1	$15,000	$15,000	
BID ITEMS SUBTOTAL				**$626,488**	
CONSTRUCTION SURVEYING	LS			$10,000.00	
CONTINGENCIES	LS		25%	$159,122.07	
TOTAL CONSTRUCTION COST				**$795,610**	

ENGINEER'S ESTIMATE - CONCEPTUAL CONSTRUCTION COST

olsson

Client: MoDOT **Date:** 9/16/2019
Project: J9P3305: Rte 19 Arch Bridges Rehab. Study
Project Number: 019-2126 **By:** GCL
Description: Spring Valley Bridge - Temporary Bridge (24' Rdwy)
(40' - 110' - 10 @ 40')

These Costs do not include PE, RW, Permitting, Inspection Costs. Unit Prices are FY 2020.

BID FORM #	MODOT BID ITEM #	DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
BRIDGE CONSTRUCTION BID ITEMS						
1	2160500	Removal of Bridges (Temp Structure)	1	L.S.	$65,825	$65,825
2	7021214	Galvanized Structural Steel Piles (14 in)	611.8	Lin. Ft.	$75	$45,885
3	7021316	Galvanized Cast-in-Place Concrete Piles (16 in)	2635.6	Lin. Ft.	$125	$329,450
4	7026000	Pre-bore for Piling	1238.0	Lin. Ft.	$110	$136,180
5	7032003	Class B Concrete (Substructure)	23.1	Cu. Yd.	$850	$19,644
6	7061060	Reinforcing Steel (Bridges)	2774	Lbs	$1.20	$3,329
7	7121000	Fabricated Structural Carbon Steel (Misc)	75000	Lbs	$3.50	$262,500
8	7181020	Transporting and Erecting Superstructure (10 - 40' Spans)	1	L.S.	$375,000	$375,000
9	7181020A	Transporting and Erecting Superstructure (1 - 110' Span)	1	L.S.	$50,000	$50,000
10	7181030	Removing and Storing Superstructure (10 - 40' Spans)	1	L.S.	$165,000	$165,000
11	7181030A	Removing and Storing Superstructure (1 - 110' Span)	1	L.S.	$20,000	$20,000
					Sub-Total (A) =	**$1,472,813**
					Price/Sq. Ft. (Bridge Items) =	*$102*

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Spring Valley Bridge

Alternative 2 – Cost Estimate

ENGINEER'S ESTIMATE - CONCEPTUAL CONSTRUCTION COST

olsson

Client: MoDOT **Date:** 9/12/2019
Project: J9P3305: Rte 19 Arch Bridges Rehab. Study
Project Number: 019-2126 **By:** GCL
Description: Spring Valley Bridge - Replace on Existing Alignment
Alt #2 - Br. Option 2 (136'-152'-152'-111') Pl. Girder

These Costs do not include PE, RW, Permitting, Inspection Costs. Unit Prices are FY 2020.

BID FORM #	MODOT BID ITEM #	DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
BRIDGE CONSTRUCTION BID ITEMS						
1	2061000	Class I Excavation	1242	Cu. Yd.	$50	$62,097
2	5031010A	Bridge Approach Slab (Major Road)	118.5	Sq. Yd.	$250	$29,630
3	7011107	Drilled Shafts (6 Ft. 0 In. Dia.)	102.0	Lin. Ft.	$1,200	$122,400
4	7011206	Rock Sockets (5 Ft. 6 In. Dia.)	120.0	Lin. Ft.	$900	$108,000
5	7011300	Video Camera Inspection	6.0	Each	$650	$3,900
6	7011400	Foundation Inspection Holes	180.0	Lin. Ft.	$130	$23,400
7	7011600	Sonic Logging Testing	6.0	Each	$2,000	$12,000
8	7021212	Galvanized Structural Steel Piles (12 In.)	990.0	Lin. Ft.	$80	$79,200
9	7027000	Pile Point Reinforcement	18.0	Each	$125	$2,250
10	7032003	Class B Concrete (Substructure)	261.6	Cu. Yd.	$850	$222,392
11	7034212	Slab on Steel	1690.1	Sq. Yd.	$275	$464,772
12	7034620	Form Liners	566.0	Sq. Yd.	$100	$56,600
13	7039903	Misc. Barrier Curb	1164.0	Lin. Ft.	$100	$116,400
14	7061060	Reinforcing Steel (Bridges)	51899	Lbs	$1.40	$72,659
15	7121122	Fab. Structural LA Steel (Plate Girder) A709, Gr 50W	761743	Lbs	$1.75	$1,333,050
16	7123610	Slab Drain	1.0	L.S.	$120,000	$120,000
17	7129903	Misc. Bridge Rail (One Tube Structural Steel)	1164.0	Lin. Ft.	$100	$116,400
18	7151001	Vertical Drain at End Bents	2.0	Each	$3,500	$7,000
19	7162000	Laminated Neoprene Bearing Pad Assembly	20.0	Each	$2,100	$42,000
20	7172001	Strip Seal Expansion Joint System	63	Lin. Ft.	$425	$26,920
					Sub-Total (A) =	**$3,021,069**
				Price/Sq. Ft. (Bridge Items) =		*$199*

CONCEPT STUDY - OPINION OF PROBABLE CONSTRUCTION COSTS
ROUTE 19 ARCH BRIDGES REHAB STUDY
HDR

DESCRIPTION: Route 19 two-lane minor rural highway. Project limits assume construction of shoofly along Route 19 from Sta. 400+00 to Sta. 413+71 across Spring Valley. Estimate does not include costs for bridges.

Figure A-7: Alternatives 1A,1B,2,5A,5B South - Shoofly Bridge Upstream

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST	COMMENT
MOBILIZATION AND TRAFFIC CONTROL					
TEMPORARY TRAFFIC CONTROL	LS	1	$35,000	$35,000	assumes flagging, temp barrier, signs, etc
TEMPORARY PAVING	SY	2733	$55	$150,332	8" asphalt; 6" aggregate base
EROSION CONTROL					
EROSION CONTROL	LS	1	$25,000	$25,000	
ROADWORK					
REMOVAL OF IMPROVEMENTS	LS	1	$15,000	$15,000	
CLEARING AND GRUBBING	ACRE	3	$7,000	$21,000	
EXCAVATION - CLASS A	CY	4391	$8	$32,932	Assumes 2/3 cut volume is Class A
EXCAVATION - CLASS C	CY	2195	$20	$43,909	Assumes 1/3 cut volume is Class C
EMBANKMENT IN PLACE	CY	9680	$12	$116,166	
BORROW	CY	3094	$2	$6,188	
DRAINAGE AND SEWERS					
DRAINAGE	LS	1	$20,000	$20,000	
BRIDGES					
BRIDGE DEMOLITION	LS				See Bridge Costs
ROUTE 19 OVER SPRING VALLEY	LS				See Bridge Costs
TEMPORARY SHORING	LS	1	$100,000	$100,000	
PAVEMENT					
ROUTE 19 RECONSTRUCTION	SY	145	$55	$7,962	8" asphalt; Type 5 aggregate base (6")
ROTUE 19 TIE-IN MILL/OVERLAY	SY		$25		2" thickness
PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES					
GUARDRAIL, MGS	FOOT	300	$20	$6,000	
GUARDRAIL, BRIDGE APPROACH TRANSITION SECTION	EACH	4	$3,000	$12,000	
GUARDRAIL, TYPE A CRASHWORTHY END TERMINAL (MASH)	EACH	4	$2,500	$10,000	
PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS					
SIGNING AND STRIPING	LS	1	$10,000	$10,000	
OTHER					
SEEDING AND MULCHING	LS	1	$15,000	$15,000	
BID ITEMS SUBTOTAL				**$626,488**	
CONSTRUCTION SURVEYING	LS			$10,000.00	
CONTINGENCIES	LS		25%	$159,122.07	
TOTAL CONSTRUCTION COST				**$795,610**	

ENGINEER'S ESTIMATE - CONCEPTUAL CONSTRUCTION COST

olsson

Client: MoDOT **Date:** 9/16/2019
Project: J9P3305: Rte 19 Arch Bridges Rehab. Study
Project Number: 019-2126 **By:** GCL
Description: Spring Valley Bridge - Temporary Bridge (24' Rdwy)
(40' - 110' - 10 @ 40')

These Costs do not include PE, RW, Permitting, Inspection Costs. Unit Prices are FY 2020.

BID FORM #	MODOT BID ITEM #	DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
BRIDGE CONSTRUCTION BID ITEMS						
1	2160500	Removal of Bridges (Temp Structure)	1	L.S.	$65,825	$65,825
2	7021214	Galvanized Structural Steel Piles (14 in)	611.8	Lin. Ft.	$75	$45,885
3	7021316	Galvanized Cast-in-Place Concrete Piles (16 in)	2635.6	Lin. Ft.	$125	$329,450
4	7026000	Pre-bore for Piling	1238.0	Lin. Ft.	$110	$136,180
5	7032003	Class B Concrete (Substructure)	23.1	Cu. Yd.	$850	$19,644
6	7061060	Reinforcing Steel (Bridges)	2774	Lbs	$1.20	$3,329
7	7121000	Fabricated Structural Carbon Steel (Misc)	75000	Lbs	$3.50	$262,500
8	7181020	Transporting and Erecting Superstructure (10 - 40' Spans)	1	L.S.	$375,000	$375,000
9	7181020A	Transporting and Erecting Superstructure (1 - 110' Span)	1	L.S.	$50,000	$50,000
10	7181030	Removing and Storing Superstructure (10 - 40' Spans)	1	L.S.	$165,000	$165,000
11	7181030A	Removing and Storing Superstructure (1 - 110' Span)	1	L.S.	$20,000	$20,000
					Sub-Total (A) =	**$1,472,813**
			Price/Sq. Ft. (Bridge Items) =			*$102*

Spring Valley Bridge

Alternative 3A – Cost Estimate

Project:	MoDOT Rte. 19 Concepts	Computed:	DGB	Date:	9/16/2019
Subject:	J0420 Replacement	Checked:	JDM	Date:	9/25/2019
Task:	Prelim. Cost Estimate	Page:	1	of:	ESTIMATE
Job #:		No:			

J0420 Replacement - In Kind - On Alignment (Concrete Approaches)

New Bridge Length = 540 ft
New Bridge Width = 28 ft

Item	Quantity		Unit Cost	Estimated Cost
Class 1 Excavation				
(206-10.00)	120	Cu. Yd.	$50	$6,000
Class 2 Excavation				
(206-20.00)	1795	Cu. Yd.	$60	$107,700
Cofferdams				
(206-60.02)	1	Lump Sum	$500,000	$500,000
Bridge Approach Slab (Minor Road)				
(503-10.11A)	116	Sq. Yd.	$215	$24,940
Drilled Shaft (6'-0" Dia.)				
(701-11.06)	87	LF	$1,200	$104,400
Rock Socket (5'-6" Dia.)				
(701-12.06)	32	LF	$900	$28,800
Video Camera Inspection				
(701-13.00)	4	Ea.	$650	$2,600
Foundation Inspection Hole				
(701-14.00)	72	LF	$120	$8,640
Sonic Logging Testing				
(701-16.00)	4	Ea.	$2,000	$8,000
Galvanized Structural Steel Pile (12")				
(702-12.12)	497	LF	$75	$37,275
Dynamic Pile Testing				
(702-50.01)	2	Ea.	$5,000	$10,000
Pile Point Reinforcement				
(702-70.00)	14	Ea.	$125	$1,750
Class B Concrete (Substructure)				
(703-20.03)	780	Cu. Yd.	$900	$702,000
		Includes thrust blocks and new pier/end bent concrete		
Class B-2 Concrete (Spandrel Columns)				
(703-20.03)	152	Cu. Yd.	$1,000	$152,000
Class B-2 Concrete (Arch)				
(703-20.03)	220	Cu. Yd.	$2,000	$440,000
Slab on Concrete NU Girder				
(703-42.14)	1223	Sq. Yd.	$320	$391,360

Project:	MoDOT Rte. 19 Concepts	Computed:	DGB	Date:	9/16/2019
Subject:	J0420 Replacement	Checked:	JDM	Date:	9/25/2019
Task:	Prelim. Cost Estimate	Page:	1	of:	ESTIMATE
Job #:		No:			

Item	Quantity	Unit	Unit Price	Cost
Slab on Concrete Spandrel Arch (703-42.14)	475	Sq. Yd.	$350	$166,250
Barrier Curb (703-42.15)	1155	LF	$95	$109,725
Form Liners (703-46.20)	494	Sq. Yd.	$100	$49,400
NU 53, Prestressed Concrete NU-Girder (705-60.23)	1568	LF	$250	$392,000
Reinforcing Steel (Epoxy Coated) (706-10.00)	386,314	Lb.	$1.40	$540,839
		Assume 130#/CY for substr concrete and 150#/CY of arch concrete		
Steel Int. Diaphragms for P/S Conc. NU Girder (712-33.01)	18	Ea.	$1,000	$18,000
Slab Drain (712-36.10)	108	Ea.	$340	$36,720
Misc. Bridge Rail (712-99.03)	1155	LF	$110	$127,050
Vertical Drain at End Bents (715-10.01)	2	Ea.	$2,500	$5,000
Laminated Neoprene Bearing Pad (716-10.02)	24	Ea.	$260	$6,240
Laminated Neoprene Bearing Pad Assembly (716-20.00)	8	Ea.	$2,200	$17,600
Strip Seal (717-20.02)	62	LF	$100	$6,200

Total Bridge Cost =	**$4,000,500**	**Unit Cost =**	**$263 / Sq. Ft.**

Not including bridge approach slab

CONCEPT STUDY - OPINION OF PROBABLE CONSTRUCTION COSTS
ROUTE 19 ARCH BRIDGES REHAB STUDY
HDR

DESCRIPTION: Route 19 two-lane minor rural highway. Project limits assume reconstruction of Route 19 from Sta. 1700+00 to Sta. 1723+51 across Spring Valley. Estimate does not include costs for bridges.

Figure A-8: Alternatives 3A, 3B, & 4 South - New Bridge Upstream

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST	COMMENT
MOBILIZATION AND TRAFFIC CONTROL					
TEMPORARY TRAFFIC CONTROL	LS	1	$50,000	$50,000	assumes flagging, temp barrier, signs, etc
EROSION CONTROL					
EROSION CONTROL	LS	1	$25,000	$25,000	
ROADWORK					
REMOVAL OF SURFACINGS	SY	8000	$3	$24,000	
REMOVAL OF IMPROVEMENTS	LS	1	$25,000	$25,000	
CLEARING AND GRUBBING	ACRE	5	$7,000	$35,000	
EXCAVATION - CLASS A	CY	32682	$8	$245,118	Assumes 2/3 cut volume is Class A
EXCAVATION - CLASS C	CY	16341	$20	$326,823	Assumes 1/3 cut volume is Class C
EMBANKMENT IN PLACE	CY	20239	$12	$242,867	
DRAINAGE AND SEWERS					
DRAINAGE	LS	1	$50,000	$50,000	
BRIDGES					
BRIDGE DEMOLITION	LS				See Bridge Costs
ROUTE 19 OVER SPRING VALLEY	LS				See Bridge Costs
TEMPORARY CAUSEWAY	LS		$250,000		
PAVEMENT					
DRIVEWAY RECONSTRUCTION	EACH	4	$10,000	$40,000	
ROUTE 19 RECONSTRUCTION	SY	6438	$55	$354,096	8" asphalt; Type 5 aggregate base (6")
PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES					
GUARDRAIL, MGS	FOOT	825	$20	$16,500	incl. Sta. 1660+50 to Sta. 1666+50; west side
GUARDRAIL, BRIDGE APPROACH TRANSITION SECTION	EACH	4	$3,000	$12,000	
GUARDRAIL, TYPE A CRASHWORTHY END TERMINAL (MASH)	EACH	4	$2,500	$10,000	
PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS					
SIGNING AND STRIPING	LS	1	$25,000	$25,000	
OTHER					
SEEDING AND MULCHING	LS	1	$15,000	$15,000	
BID ITEMS SUBTOTAL				**$1,496,403**	
CONSTRUCTION SURVEYING	LS		1%	$14,964.03	
CONTINGENCIES	LS		25%	$377,841.84	
TOTAL CONSTRUCTION COST				**$1,889,209**	

Spring Valley Bridge

Alternative 3B – Cost Estimate

Project:	MoDOT Rte. 19 Concepts	Computed:	DGB	Date:	9/16/2019
Subject:	J0420 Replacement	Checked:	JDM	Date:	10/10/2019
Task:	Prelim. Cost Estimate	Page:	1	of:	ESTIMATE
Job #:		No:			

J0420 Replacement - In Kind - On Alignment (Steel PL Girder Approaches)

New Bridge Length = 540 ft
New Bridge Width = 28 ft

Item	Quantity		Unit Cost	Estimated Cost
Class 1 Excavation (206-10.00)	120	Cu. Yd.	$50	$6,000
Class 2 Excavation (206-20.00)	1795	Cu. Yd.	$60	$107,700
Cofferdams (206-60.02)	1	Lump Sum	$500,000	$500,000
Bridge Approach Slab (Minor Road) (503-10.11A)	107	Sq. Yd.	$215	$23,005
Drilled Shaft (6'-0" Dia.) (701-11.10)	87	LF	$1,200	$104,400
Rock Socket (5'-6" Dia.) (701-12.09)	32	LF	$900	$28,800
Video Camera Inspection (701-13.00)	4	Ea.	$650	$2,600
Foundation Inspection Hole (701-14.00)	72	LF	$120	$8,640
Sonic Logging Testing (701-16.00)	4	Ea.	$2,000	$8,000
Galvanized Structural Steel Pile (12") (702-12.12)	497	LF	$75	$37,275
Dynamic Pile Testing (702-50.01)	2	Ea.	$5,000	$10,000
Pile Point Reinforcement (702-70.00)	14	Ea.	$125	$1,750
Class B Concrete (Substructure) (703-20.03)	780	Cu. Yd. *Includes thrust blocks and new pier/end bent concrete*	$900	$702,000
Class B-2 Concrete (Spandrel Columns) (703-20.03)	152	Cu. Yd.	$1,000	$152,000
Class B-2 Concrete (Arch) (703-20.03)	220	Cu. Yd.	$2,000	$440,000
Slab on Steel (703-42.12)	1223	Sq. Yd.	$275	$336,325

Slab on Concrete Spandrel Arch (703-42.14)	475	Sq. Yd.	$350	$166,250
Barrier Curb (703-42.15)	1155	LF	$95	$109,725
Form Liners (703-46.20)	494	Sq. Yd.	$100	$49,400
Reinforcing Steel (Epoxy Coated) (706-10.00)	386,314	Lb.	$1.40	$540,839
Fabricated Structural Steel (Plate Girder) 712-11.22	473,132	Lb.	$1.75	$827,981
		Assume 130#/CY for substr concrete and 150#/CY of arch concrete		
Slab Drain (712-36.10)	108	Ea.	$340	$36,720
Drainage System on Structure (712-99.01)	1	Lump Sum	$80,000	$80,000
Misc. Bridge Rail (712-99.03)	1155	LF	$110	$127,050
Vertical Drain at End Bents (715-10.01)	2	Ea.	$2,500	$5,000
Laminated Neoprene Bearing Pad Assembly (716-20.00)	16	Ea.	$2,200	$35,200
Strip Seal Expansion Joint System (717-20.01)	62	LF	$425	$26,350

Total Bridge Cost =	**$4,473,000**	**Unit Cost =**	**$294 / Sq. Ft.**

CONCEPT STUDY - OPINION OF PROBABLE CONSTRUCTION COSTS
ROUTE 19 ARCH BRIDGES REHAB STUDY
HDR

DESCRIPTION: Route 19 two-lane minor rural highway. Project limits assume reconstruction of Route 19 from Sta. 1700+00 to Sta. 1723+51 across Spring Valley. Estimate does not include costs for bridges.

Figure A-8: Alternatives 3A, 3B, & 4 South - New Bridge Upstream

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST	COMMENT
MOBILIZATION AND TRAFFIC CONTROL					
TEMPORARY TRAFFIC CONTROL	LS	1	$50,000	$50,000	assumes flagging, temp barrier, signs, etc
EROSION CONTROL					
EROSION CONTROL	LS	1	$25,000	$25,000	
ROADWORK					
REMOVAL OF SURFACINGS	SY	8000	$3	$24,000	
REMOVAL OF IMPROVEMENTS	LS	1	$25,000	$25,000	
CLEARING AND GRUBBING	ACRE	5	$7,000	$35,000	
EXCAVATION - CLASS A	CY	32682	$8	$245,118	Assumes 2/3 cut volume is Class A
EXCAVATION - CLASS C	CY	16341	$20	$326,823	Assumes 1/3 cut volume is Class C
EMBANKMENT IN PLACE	CY	20239	$12	$242,867	
DRAINAGE AND SEWERS					
DRAINAGE	LS	1	$50,000	$50,000	
BRIDGES					
BRIDGE DEMOLITION	LS				See Bridge Costs
ROUTE 19 OVER SPRING VALLEY	LS				See Bridge Costs
TEMPORARY CAUSEWAY	LS		$250,000		
PAVEMENT					
DRIVEWAY RECONSTRUCTION	EACH	4	$10,000	$40,000	
ROUTE 19 RECONSTRUCTION	SY	6438	$55	$354,096	8" asphalt; Type 5 aggregate base (6")
PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES					
GUARDRAIL, MGS	FOOT	825	$20	$16,500	incl. Sta. 1660+50 to Sta. 1666+50; west side
GUARDRAIL, BRIDGE APPROACH TRANSITION SECTION	EACH	4	$3,000	$12,000	
GUARDRAIL, TYPE A CRASHWORTHY END TERMINAL (MASH)	EACH	4	$2,500	$10,000	
PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS					
SIGNING AND STRIPING	LS	1	$25,000	$25,000	
OTHER					
SEEDING AND MULCHING	LS	1	$15,000	$15,000	
BID ITEMS SUBTOTAL				**$1,496,403**	
CONSTRUCTION SURVEYING	LS		1%	$14,964.03	
CONTINGENCIES	LS		25%	$377,841.84	
TOTAL CONSTRUCTION COST				**$1,889,209**	

Spring Valley Bridge

Alternative 4 – Cost Estimate

ENGINEER'S ESTIMATE - CONCEPTUAL CONSTRUCTION COST

olsson

Client: MoDOT **Date:** 9/12/2019
Project: J9P3305: Rte 19 Arch Bridges Rehab. Study
Project Number: 019-2126 **By:** GCL
Description: Spring Valley Bridge - Replace on Existing Alignment
Alt #2 - Br. Option 2 (136'-152'-152'-111') Pl. Girder

These Costs do not include PE, RW, Permitting, Inspection Costs. Unit Prices are FY 2020.

BID FORM #	MODOT BID ITEM #	DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
BRIDGE CONSTRUCTION BID ITEMS						
1	2061000	Class I Excavation	1242	Cu. Yd.	$50	$62,097
2	5031010A	Bridge Approach Slab (Major Road)	118.5	Sq. Yd.	$250	$29,630
3	7011107	Drilled Shafts (6 Ft. 0 In. Dia.)	102.0	Lin. Ft.	$1,200	$122,400
4	7011206	Rock Sockets (5 Ft. 6 In. Dia.)	120.0	Lin. Ft.	$900	$108,000
5	7011300	Video Camera Inspection	6.0	Each	$650	$3,900
6	7011400	Foundation Inspection Holes	180.0	Lin. Ft.	$130	$23,400
7	7011600	Sonic Logging Testing	6.0	Each	$2,000	$12,000
8	7021212	Galvanized Structural Steel Piles (12 In.)	990.0	Lin. Ft.	$80	$79,200
9	7027000	Pile Point Reinforcement	18.0	Each	$125	$2,250
10	7032003	Class B Concrete (Substructure)	261.6	Cu. Yd.	$850	$222,392
11	7034212	Slab on Steel	1690.1	Sq. Yd.	$275	$464,772
12	7034620	Form Liners	566.0	Sq. Yd.	$100	$56,600
13	7039903	Misc. Barrier Curb	1164.0	Lin. Ft.	$100	$116,400
14	7061060	Reinforcing Steel (Bridges)	51899	Lbs	$1.40	$72,659
15	7121122	Fab. Structural LA Steel (Plate Girder) A709, Gr 50W	761743	Lbs	$1.75	$1,333,050
16	7123610	Slab Drain	1.0	L.S.	$120,000	$120,000
17	7129903	Misc. Bridge Rail (One Tube Structural Steel)	1164.0	Lin. Ft.	$100	$116,400
18	7151001	Vertical Drain at End Bents	2.0	Each	$3,500	$7,000
19	7162000	Laminated Neoprene Bearing Pad Assembly	20.0	Each	$2,100	$42,000
20	7172001	Strip Seal Expansion Joint System	63	Lin. Ft.	$425	$26,920
					Sub-Total (A) =	**$3,021,069**
				Price/Sq. Ft. (Bridge Items) =		*$199*

CONCEPT STUDY - OPINION OF PROBABLE CONSTRUCTION COSTS
ROUTE 19 ARCH BRIDGES REHAB STUDY
HDR

DESCRIPTION: Route 19 two-lane minor rural highway. Project limits assume reconstruction of Route 19 from Sta. 1700+00 to Sta. 1723+51 across Spring Valley. Estimate does not include costs for bridges.

Figure A-8: Alternatives 3A, 3B, & 4 South - New Bridge Upstream

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST	COMMENT
MOBILIZATION AND TRAFFIC CONTROL					
TEMPORARY TRAFFIC CONTROL	LS	1	$50,000	$50,000	assumes flagging, temp barrier, signs, etc
EROSION CONTROL					
EROSION CONTROL	LS	1	$25,000	$25,000	
ROADWORK					
REMOVAL OF SURFACINGS	SY	8000	$3	$24,000	
REMOVAL OF IMPROVEMENTS	LS	1	$25,000	$25,000	
CLEARING AND GRUBBING	ACRE	5	$7,000	$35,000	
EXCAVATION - CLASS A	CY	32682	$8	$245,118	Assumes 2/3 cut volume is Class A
EXCAVATION - CLASS C	CY	16341	$20	$326,823	Assumes 1/3 cut volume is Class C
EMBANKMENT IN PLACE	CY	20239	$12	$242,867	
DRAINAGE AND SEWERS					
DRAINAGE	LS	1	$50,000	$50,000	
BRIDGES					
BRIDGE DEMOLITION	LS				See Bridge Costs
ROUTE 19 OVER SPRING VALLEY	LS				See Bridge Costs
TEMPORARY CAUSEWAY	LS		$250,000		
PAVEMENT					
DRIVEWAY RECONSTRUCTION	EACH	4	$10,000	$40,000	
ROUTE 19 RECONSTRUCTION	SY	6438	$55	$354,096	8" asphalt; Type 5 aggregate base (6")
PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES					
GUARDRAIL, MGS	FOOT	825	$20	$16,500	incl. Sta. 1660+50 to Sta. 1666+50; west side
GUARDRAIL, BRIDGE APPROACH TRANSITION SECTION	EACH	4	$3,000	$12,000	
GUARDRAIL, TYPE A CRASHWORTHY END TERMINAL (MASH)	EACH	4	$2,500	$10,000	
PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS					
SIGNING AND STRIPING	LS	1	$25,000	$25,000	
OTHER					
SEEDING AND MULCHING	LS	1	$15,000	$15,000	
BID ITEMS SUBTOTAL				**$1,496,403**	
CONSTRUCTION SURVEYING	LS		1%	$14,964.03	
CONTINGENCIES	LS		25%	$377,841.84	
TOTAL CONSTRUCTION COST				**$1,889,209**	

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Spring Valley Bridge

Alternative 5A – Cost Estimate

Project:	MoDOT Rte. 19 Concepts	Computed:	DGB	Date:	9/16/2019
Subject:	J0420 Rehab	Checked:	JDM	Date:	9/25/2019
Task:	Prelim. Cost Estimate	Page:	1	of:	ESTIMATE
Job #:		No:			

J0420 Rehab (New concrete approach spans; retain existing arch)

New Bridge Length = 540 ft
New Bridge Width = 28 ft
Arch Span Length = 155 ft

Item	Quantity				Unit Cost		Estimated Cost
Class 1 Excavation							
(206-10.00)	120	Cu. Yd.			$50		$6,000
Removal of Bridge (Approaches)							
(216-05.00)	1	Lump Sum			$180,435		$180,435
Bridge Approach Slab (Minor Road)							
(503-10.11A)	120	Sq. Yd.			$215		$25,800
Drilled Shaft (5'-0" Dia.)							
(701-11.06)	214	LF			$1,100		$235,400
	Bent 2 Length =	23	Ft.				
	Bent 3 Length =	25	Ft.				
	Bent 6 Length =	26	Ft.				
	Bent 7 Length =	17	Ft.				
	Bent 8 Length =	16	Ft.				
Rock Socket (4'-6" Dia.)							
(701-12.06)	150	LF			$800		$120,000
		Assume all are 8'-0" Long					
Video Camera Inspection							
(701-13.00)	10	Ea.			$650		$6,500
Foundation Inspection Hole							
(701-14.00)	250	LF			$120		$30,000
Sonic Logging Testing							
(701-16.00)	10	Ea.			$2,000		$20,000
Galvanized Structural Steel Pile (12")							
(702-12.12)	497	LF			$75		$37,275
Dynamic Pile Testing							
(702-50.01)	2	Ea.			$5,000		$10,000
Pile Point Reinforcement							
(702-70.00)	14	Ea.			$125		$1,750
Class B Concrete (Substructure)							
(703-20.03)	356	Cu. Yd.			$900		$320,400
	Column Size =	3	Ft.	X	3	Ft.	
	Cap Length =	40	Ft.				
	Cap Size =	4	Ft.	X	4.5	Ft.	
	Column Height =	20	Ft.		*(Approx. Average)*		
	Web Wall thickness =	1.75	Ft.				

Project:	MoDOT Rte. 19 Concepts	Computed:	DGB	Date:	9/16/2019
Subject:	J0420 Rehab	Checked:	JDM	Date:	9/25/2019
Task:	Prelim. Cost Estimate	Page:	1	of:	ESTIMATE
Job #:		No:			

Class B-2 Concrete (Spandrel Columns) (703-20.03)	152	Cu. Yd. *Including Spandrel Caps*	$1,000	$152,000
Slab on Concrete I Girder (703-42.14)	1200	Sq. Yd.	$320	$384,000
Slab on Concrete Spandrel Arch (703-42.14)	490	Sq. Yd.	$350	$171,500
Barrier Curb (703-42.15)	1155	LF	$95	$109,725
Form Liners (703-46.20)	541	Sq. Yd.	$100	$54,100
Substructure Repair (Formed) (704-01.01)	233	Sq. Ft.	$130	$30,290
Embedded Galvanic Anodes (704-99.01)	600	Ea.	$100	$60,000
Type 4, Prestressed Concrete I-Girder (705-60.02)	1532	LF	$190	$291,080
Reinforcing Steel (Epoxy Coated) (706-10.00)	753,600	Lb.	$1.40	$1,055,040
Steel Int. Diaphragms for P/S Conc. I-Girder (712-33.01)	21	Ea.	$800	$16,800
Drainage System on Structure (712-99.01)	1	Lump Sum	$120,000	$120,000
Misc. Bridge Rail (712-99.03)	1155	LF	$110	$127,050
Vertical Drain at End Bents (715-10.01)	2	Ea.	$2,500	$5,000
Laminated Neoprene Bearing Pad (716-10.02)	48	Ea.	$260	$12,480
Laminated Neoprene Bearing Pad Assembly (716-20.00)	8	Ea.	$2,200	$17,600
Strip Seal (717-20.02)	76	LF	$400	$30,400

Total Bridge Cost =	**$3,630,600**	**Unit Cost =**	**$238 / Sq. Ft.**

Not including bridge approach slab

CONCEPT STUDY - OPINION OF PROBABLE CONSTRUCTION COSTS
ROUTE 19 ARCH BRIDGES REHAB STUDY
HDR

DESCRIPTION: Route 19 two-lane minor rural highway. Project limits assume construction of shoofly along Route 19 from Sta. 400+00 to Sta. 413+71 across Spring Valley. Estimate does not include costs for bridges.

Figure A-7: Alternatives 1A,1B,2,5A,5B South - Shoofly Bridge Upstream

ITEM	UNIT	QUANTITY	UNIT COST	ITEM COST	COMMENT
MOBILIZATION AND TRAFFIC CONTROL					
TEMPORARY TRAFFIC CONTROL	LS	1	$35,000	$35,000	assumes flagging, temp barrier, signs, etc
TEMPORARY PAVING	SY	2733	$55	$150,332	8" asphalt; 6" aggregate base
EROSION CONTROL					
EROSION CONTROL	LS	1	$25,000	$25,000	
ROADWORK					
REMOVAL OF IMPROVEMENTS	LS	1	$15,000	$15,000	
CLEARING AND GRUBBING	ACRE	3	$7,000	$21,000	
EXCAVATION - CLASS A	CY	4391	$8	$32,932	Assumes 2/3 cut volume is Class A
EXCAVATION - CLASS C	CY	2195	$20	$43,909	Assumes 1/3 cut volume is Class C
EMBANKMENT IN PLACE	CY	9680	$12	$116,166	
BORROW	CY	3094	$2	$6,188	
DRAINAGE AND SEWERS					
DRAINAGE	LS	1	$20,000	$20,000	
BRIDGES					
BRIDGE DEMOLITION	LS				See Bridge Costs
ROUTE 19 OVER SPRING VALLEY	LS				See Bridge Costs
TEMPORARY SHORING	LS	1	$100,000	$100,000	
PAVEMENT					
ROUTE 19 RECONSTRUCTION	SY	145	$55	$7,962	8" asphalt; Type 5 aggregate base (6")
ROTUE 19 TIE-IN MILL/OVERLAY	SY		$25		2" thickness
PERMANENT TRAFFIC SAFETY AND GUIDANCE DEVICES					
GUARDRAIL, MGS	FOOT	300	$20	$6,000	
GUARDRAIL, BRIDGE APPROACH TRANSITION SECTION	EACH	4	$3,000	$12,000	
GUARDRAIL, TYPE A CRASHWORTHY END TERMINAL (MASH)	EACH	4	$2,500	$10,000	
PERMANENT TRAFFIC CONTROL AND ILLUMINATION SYSTEMS					
SIGNING AND STRIPING	LS	1	$10,000	$10,000	
OTHER					
SEEDING AND MULCHING	LS	1	$15,000	$15,000	
BID ITEMS SUBTOTAL				**$626,488**	
CONSTRUCTION SURVEYING	LS			$10,000.00	
CONTINGENCIES	LS		25%	$159,122.07	
TOTAL CONSTRUCTION COST				**$795,610**	

ENGINEER'S ESTIMATE - CONCEPTUAL CONSTRUCTION COST

olsson

Client: MoDOT **Date:** 9/16/2019
Project: J9P3305: Rte 19 Arch Bridges Rehab. Study
Project Number: 019-2126 **By:** GCL
Description: Spring Valley Bridge - Temporary Bridge (24' Rdwy)
(40' - 110' - 10 @ 40')

These Costs do not include PE, RW, Permitting, Inspection Costs. Unit Prices are FY 2020.

BID FORM #	MODOT BID ITEM #	DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST
BRIDGE CONSTRUCTION BID ITEMS						
1	2160500	Removal of Bridges (Temp Structure)	1	L.S.	$65,825	$65,825
2	7021214	Galvanized Structural Steel Piles (14 in)	611.8	Lin. Ft.	$75	$45,885
3	7021316	Galvanized Cast-in-Place Concrete Piles (16 in)	2635.6	Lin. Ft.	$125	$329,450
4	7026000	Pre-bore for Piling	1238.0	Lin. Ft.	$110	$136,180
5	7032003	Class B Concrete (Substructure)	23.1	Cu. Yd.	$850	$19,644
6	7061060	Reinforcing Steel (Bridges)	2774	Lbs	$1.20	$3,329
7	7121000	Fabricated Structural Carbon Steel (Misc)	75000	Lbs	$3.50	$262,500
8	7181020	Transporting and Erecting Superstructure (10 - 40' Spans)	1	L.S.	$375,000	$375,000
9	7181020A	Transporting and Erecting Superstructure (1 - 110' Span)	1	L.S.	$50,000	$50,000
10	7181030	Removing and Storing Superstructure (10 - 40' Spans)	1	L.S.	$165,000	$165,000
11	7181030A	Removing and Storing Superstructure (1 - 110' Span)	1	L.S.	$20,000	$20,000
					Sub-Total (A) =	**$1,472,813**
			Price/Sq. Ft. (Bridge Items) =			*$102*

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Spring Valley Bridge

Alternative 5B – Cost Estimate

Project:	MoDOT Rte. 19 Concepts	Computed:	DGB	Date:	9/16/2019
Subject:	J0420 Rehab	Checked:	JDM	Date:	9/25/2019
Task:	Prelim. Cost Estimate	Page:	1	of:	ESTIMATE
Job #:		No:			

J0420 Rehab (New steel plate girder approach spans; retain existing arch)

New Bridge Length = 540 ft
New Bridge Width = 28 ft
Arch Span Length = 155 ft

Item	Quantity				Unit Cost		Estimated Cost
Class 1 Excavation							
(206-10.00)	120	Cu. Yd.			$50		$6,000
Removal of Bridge (Approaches)							
(216-05.00)	1	Lump Sum			$180,435		$180,435
Bridge Approach Slab (Minor Road)							
(503-10.11A)	120	Sq. Yd.			$215		$25,800
Drilled Shaft (5'-0" Dia.)							
(701-11.06)	214	LF			$1,100		$235,400
	Bent 2 Length =	23	Ft.				
	Bent 3 Length =	25	Ft.				
	Bent 6 Length =	26	Ft.				
	Bent 7 Length =	17	Ft.				
	Bent 8 Length =	16	Ft.				
Rock Socket (4'-6" Dia.)							
(701-12.06)	150	LF			$800		$120,000
		Assume all are 8'-0" Long					
Video Camera Inspection							
(701-13.00)	10	Ea.			$650		$6,500
Foundation Inspection Hole							
(701-14.00)	250	LF			$120		$30,000
Sonic Logging Testing							
(701-16.00)	10	Ea.			$2,000		$20,000
Galvanized Structural Steel Pile (12")							
(702-12.12)	497	LF			$75		$37,275
Dynamic Pile Testing							
(702-50.01)	2	Ea.			$5,000		$10,000
Pile Point Reinforcement							
(702-70.00)	14	Ea.			$125		$1,750
Class B Concrete (Substructure)							
(703-20.03)	356	Cu. Yd.			$900		$320,400
	Column Size =	3	Ft.	X	3	Ft.	
	Cap Length =	40	Ft.				
	Cap Size =	4	Ft.	X	4.5	Ft.	
	Column Height =	20	Ft.		*(Approx. Average)*		
	Web Wall thickness =	1.75	Ft.				

Project:	MoDOT Rte. 19 Concepts	Computed:	DGB	Date:	9/16/2019
Subject:	J0420 Rehab	Checked:	JDM	Date:	9/25/2019
Task:	Prelim. Cost Estimate	Page:	1	of:	ESTIMATE
Job #:		No:			

Item	Quantity	Unit	Unit Price	Cost
Class B-2 Concrete (Spandrel Columns) (703-20.03)	152	Cu. Yd. *Including Spandrel Caps*	$1,000	$152,000
Slab on Steel (703-42.12)	1200	Sq. Yd.	$275	$330,000
Slab on Concrete Spandrel Arch (703-42.14)	490	Sq. Yd.	$350	$171,500
Barrier Curb (703-42.15)	1155	LF	$95	$109,725
Form Liners (703-46.20)	541	Sq. Yd.	$100	$54,100
Substructure Repair (Formed) (704-01.01)	233	Sq. Ft.	$130	$30,290
Embedded Galvanic Anodes (704-99.01)	600	Ea.	$100	$60,000
Fabricated Structural Steel (Plate Girder) 712-11.22	420,360	Lb.	$1.75	$735,629
Reinforcing Steel (Epoxy Coated) (706-10.00)	753,600	Lb.	$1.40	$1,055,040
Drainage System on Structure (712-99.01)	1	Lump Sum	$120,000	$120,000
Misc. Bridge Rail (712-99.03)	1155	LF	$110	$127,050
Vertical Drain at End Bents (715-10.01)	2	Ea.	$2,500	$5,000
Laminated Neoprene Bearing Pad (716-10.02)	0	Ea.	$260	$0
Laminated Neoprene Bearing Pad Assembly (716-20.00)	28	Ea.	$2,200	$61,600
Strip Seal Expansion Joint System (717-20.01)	76	LF	$400	$30,400

Total Bridge Cost =	**$4,035,900**	**Unit Cost =**	**$265 / Sq. Ft.**

CONCEPT STUDY - OPINION OF PROBABLE CONSTRUCTION COSTS
ROUTE 19 ARCH BRIDGES REHAB STUDY
HDR

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