JACOBS

Alternatives Report

Route 19 over Interstate 70

MoDOT Project No.: J2P3090

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Northeast District

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Executive Summary

Route 19 is a two-lane minor arterial rural highway crossing I-70 near New Florence, MO with a conventional diamond interchange providing access to and from I-70. The Route 19 overpass provides a vital link connecting nearby businesses and residents as well as historic Hermann and the Katy Trail to the south of I-70 and Montgomery City and Mark Twain Lake north of I-70. The objective of this report is to provide alternatives that will maintain this connection during and after construction as well as developing alternatives that will facilitate traffic now and in the future.

Existing traffic operations were evaluated as well as traffic operations for all alternatives for the Design Year 2041. The future construction of a proposed Truck Stop in the southeast quadrant of the interchange was included for traffic modeling.

Topographical survey was collected in early 2019 for this study corridor. The survey information was used in the development of the design alternatives.

Conceptual design alternatives were presented to the MoDOT Project Team during multiple Design Concept Workshops performed on April 30, 2019, July 25, 2019 and October 1, 2019. Feedback from those meetings has been incorporated into the final recommended alternative.

The development of Route 19 design alternatives focused on constructing a new bridge, providing a structure length that would span a future widening of I-70 to 6 lanes, and improving the ramp terminal and outer road intersections. Major features of the design alternatives that were further analyzed are described below.

Option 1 (see Appendix A for figure)

- Realignment of Route 19 bridge west of existing Route 19 bridge.
- WB I-70 on/off ramp terminals and Booneslick Road intersection with Route 19 combined into a 6-leg roundabout.
- EB I-70 on/off ramp terminals and Tree Farm Road/South Outer Road intersection with Route 19 combined into a 6-leg roundabout.
- 36 ft roadway to provide two thru traffic lanes required on the new bridge.

Option 2 (see Appendix A for figure)

- Realignment of Route 19 bridge west of existing Route 19 bridge.
- Construction of a roundabout at the intersection of Tree Farm Road/South Outer Road and Route 19.
- Reconstruction of the signalized intersection of Booneslick Road and Route 19.
- 56 ft roadway to provide two thru traffic lanes and a center turn lane required on the new bridge.

Option 5 (see Appendix A for figure)

- Realignment of Route 19 bridge west of existing Route 19 bridge, minimizing the skew angle between Route 19 and I-70.

- Construction of an elliptical 5-leg roundabout south of proposed Route 19 bridge incorporating EB on/off ramps, Tree Farm Road/South Outer Road (West), and Route 19.
- Reconstruction of the signalized intersection of Booneslick Road and Route 19.
- Reconstruction of EB off-ramp
- Construction of new intersection for Tree Farm Road/South Outer Road (East) to Route 19.
- 48 ft roadway to provide two thru traffic lanes and a center turn lane required on the new bridge.

Option 7 (see Appendix A for figure)

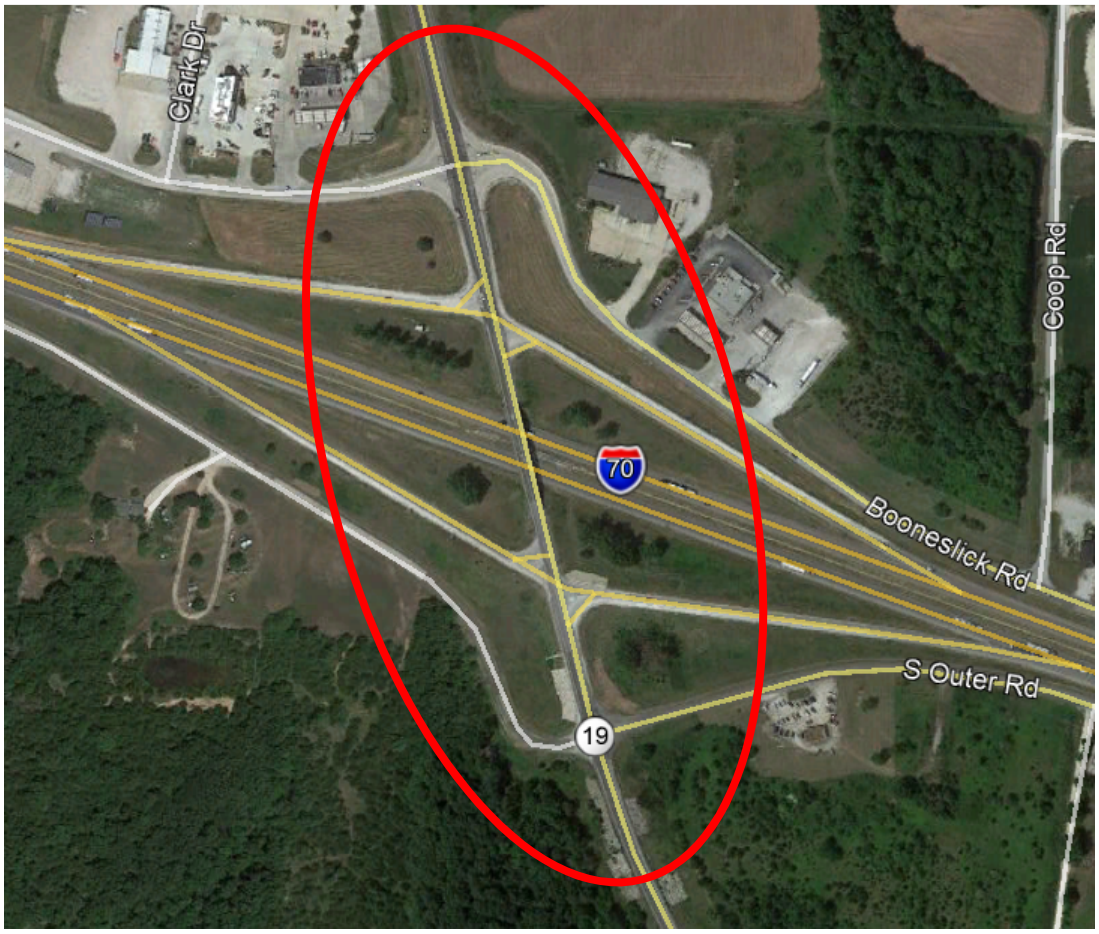
- Realignment of Route 19 bridge west of existing Route 19 bridge.
- Reconstruction of the interchange ramps and outer roads per EPG Access Management guidelines.
- 48 ft roadway to provide two thru traffic lanes and a center turn lane required on the new bridge.
- Recommendation of the *Improve I-70* Second Tier Environmental Impact Statement completed in December 2005 (ROD 2006).

Introduction

Study Area

The study corridor for this report includes approximately 0.50 miles of Route 19 and includes the diamond interchange with I-70 as well as outer road connections at Booneslick Road and Tree Farm Road/South Outer Road (see Figure 1). The corridor is located in south-central Montgomery County.

Figure 1 – Project Study Area



Data and Methodology

The project team met with MoDOT Project representatives regarding initial scoping of the project August 7, 2018. Once the project initiated, a team call on April 11, 2019 confirmed additional details. A Traffic Memorandum summarizing project assumptions and existing conditions was submitted to MoDOT and finalized May 31, 2019; this memo is attached to this document as Appendix D.

Background

Currently, traffic operations within the study area are very positive with ratings of LOS A and B at all intersections and individual movements in both the AM and PM peak hours of weekday operations. The existing operations were determined via a Traffic Impact Study for a "Love's Travel Stop" (April 24, 2018) proposed for the southeast quadrant of the interchange. This study also determined that a dedicated southbound left-turn lane approaching the eastbound I-70 ramps terminal intersection is warranted based on existing volumes. With regard to the future development, the only recommended improvement was a southbound left-turn lane for the intersection with Tree Farm Road/South Outer Road.

The proposed Travel Stop was incorporated into future projections for the study corridor for the Construction Year (2021) timeframe. In addition, a similar development to be potentially developed in the southwest corner of the interchange was added for the Design Year (2041) projections. Analysis of the future network volumes found that operations remained at an acceptable level through the Construction Year (2021) but could be expected to deteriorate by the Design Year 2041 with the additional development – specifically at the Tree Farm Road/South Outer Road intersection and the I-70 Ramps terminal intersections. The future No-Build analyses are also presented in the Traffic Memorandum (May 31, 2019) attached as Appendix D.

Alternatives Development

In April, a meeting was held to discuss six different alternatives. A seventh alternative was suggested after the meeting. The six alternatives presented, and the seventh alternative were:

- Option 1 – Offset alignment with dual 6-leg roundabouts at outer roads and ramps
- Option 2 – Offset alignment with traditional ramp terminal and outer road intersections
- Option 3 – Intersection and bridge replacement on existing alignment
- Option 4 – Offset alignment with traditional ramp terminal intersections and dual 4-leg roundabouts at outer roads
- Option 5 – Offset alignment with minimized skew angle, traditional ramp terminal and outer road intersections north of I-70 and an elliptical roundabout at the intersection with Tree Farm Road/South Outer Road and the ramps south of I-70
- Option 6 – Teardrop roundabout construction
- Option 7 – Offset alignment with ramp and outer road connections per MoDOT Access Management plan

During the April meeting, Option 3 was eliminated due to the long-term closures of Route 19 required for construction on existing alignment. Additionally, Option 6 was eliminated due to concerns with accommodating all traffic movements that the area requires along with the possibility of needing a wider structure. Options 2 and 4 were combined to maintain as much of the existing intersection at Booneslick Road as possible. Thus, a new Option 2 was established that builds a new bridge offset to the existing bridge and maintains a traditional signalized intersection at Booneslick Road and Route 19 and a proposed roundabout at Tree Farm Road/South Outer Road and Route 19. Furthermore, Option 7 was added with relocated outer roads and ramp terminals matching a previously completed Environmental Impact Study of the I-70 corridor.

Alternatives were developed that are consistent with both MoDOT's *Engineering Policy Guide (EPG*) and the American Association of State Highway and Transportation Officials' (AASHTO) *A Policy on Geometric Design of Highways and Streets.* Appendix A shows detailed conceptual layouts of the alternatives that were further analyzed.

None of the alternatives evaluated include bicycle or pedestrian facilities. This determination was made early in the process of defining alternatives and is based on the absence of bicycle or pedestrian (bike/ped) facilities at the existing interchange, no current demand for those facilities, and the development forecast for the interchange area. The interchange area is a primary traffic generator for vehicle stops during travels on I-70 and Route 19. Although new gas and convenience centers are proposed for the interchange, no new generators of bike/ped traffic are anticipated given the rural nature of the project. The nearest population center, New Florence, is about a mile to the northeast via Route 19. Existing Route 19 paved shoulders can be utilized to offer bicycle facilities and connectivity to the Katy Trail; however, the shoulder width narrows south of the project limits. Should future demands change for bicycle/pedestrian facilities, any of the defined alternatives can be modified in the future.

Option 1 – Route 19 Realignment to the West with New Dual 6-leg Roundabouts

Appendix A-Option 1 Exhibit shows the conceptual layout. Major features of Option 1 include:

- Realignment of Route 19 bridge west of existing Route 19 bridge.
- WB I-70 on/off ramp terminals and Booneslick Road intersection with Route 19 combined into a 6-leg roundabout.
- EB I-70 on/off ramp terminals and Tree Farm Road/South Outer Road intersection with Route 19 combined into a 6-leg roundabout.
- 36 ft roadway to provide two thru traffic lanes required on the new bridge.

Benefits

The dual 6-leg roundabouts eliminate the need for traffic signals as well as the maintenance costs associated with them. Additionally, combining the ramp terminal intersections with the outer road intersections into a roundabout eliminates the proximity of two separate intersections. Dual roundabout construction eliminates the need for a center turn lane across the bridge, thus allowing for the narrowest roadway width across the bridge of all the options, 36 ft.

Eliminating intersections and incorporating them into roundabouts provides for safer corridor for the traveling public and decreases the probability of crashes.

Furthermore, option 1 requires the least amount of right-of-way to be acquired.

Disadvantages

Introducing roundabouts would disrupt the current tangent alignment of Route 19 and slow traffic that wants to pass through on Route 19. Additionally, 6-leg roundabouts would be unfamiliar to local drivers. To help familiarize drivers with the new traffic movements, additional signage would be required.

The geometric configuration required for a 6-leg roundabout increases the overall footprint of Route 19. The increased footprint requires more earthwork and pavement to incorporate the free-flowing traffic movements.

Option 2 – Route 19 Realignment to the West with Signalized Intersection and new 4-leg Roundabout

Appendix A-Option 2 Exhibit shows the conceptual layout. Major features of Option 2 include:

- Realignment of Route 19 bridge west of existing Route 19 bridge.
- Construction of a roundabout at the intersection of Tree Farm Road/South Outer Road and Route 19.
- Reconstruction of the signalized intersection of Booneslick Road and Route 19.
- 56 ft roadway to provide two thru traffic lanes and a center turn lane required on the new bridge. Increased bridge width to provide for sight distance related to turn movements

Benefits

This alternative would reconstruct the existing signalized intersection at Booneslick Road and Route 19 and construct a new 4-leg roundabout at Tree Farm Road/South Outer Road and Route 19. The existing ramp terminals would be reconstructed and would be very similar to existing conditions. This alternative would be most familiar to drivers. The 4-leg roundabout would be new to local traffic, but it is the most common roundabout drivers experience.

This alternative would require the least amount of grading and earthwork and would be the quickest to construct, resulting in less disturbance to traffic.

Disadvantages

The skew of the ramp terminal intersections and Route 19 create sight distance issues for drivers trying to see around the bridge parapet. To allow for adequate sight distance the bridge shoulders were increased to 10', creating an overall roadway width across the bridge of 56'. Additionally, with this option, ramp terminal intersections and outer road intersections would remain very close together. This could lead to traffic issues in the future if signals are required at the ramp terminals due to an increased ADT.

Option 5 – Route 19 Realignment to the West with Signalized Intersection and new 5-leg Elliptical Roundabout

Appendix A-Option 5 Exhibit shows the conceptual layout. Major features of Option 5 include:

- Realignment of Route 19 bridge west of existing Route 19 bridge, minimizing the bridge skew.
- Construction of an elliptical 5-leg roundabout south of proposed Route 19 bridge incorporating EB on/off ramps, Tree Farm Road/South Outer Road, and Route 19.
- Reconstruction of the signalized intersection of Booneslick Road and Route 19.
- Reconstruction of EB off-ramp
- Construction of new intersection for Tree Farm Road/South Outer Road (East) to Route 19.
- 48 ft roadway to provide two thru traffic lanes and a center turn lane required on the new bridge.

Benefits

This alternative realigns Route 19 over I-70 to the west of the existing bridge and minimizes the bridge skew. The reduced skew angle yields the shortest and least costly bridge of all options. Additionally, the skew reduction of the Route 19 alignment over I-70 allows the ramp terminals for WB I-70 to intersect Route 19 near 90 degrees.

The elliptical roundabout eliminates the EB I-70 ramp terminal intersection and reduces the speed of traffic, decreasing the probability and severity of crashes.

Disadvantages

This alternative would alter the existing alignment of Route 19 the most and create a “jog” in the North/South traffic movements along Route 19. Furthermore, the proximity of the roundabout to the proposed bridge would necessitate a retaining wall at the south abutment of the bridge along EB I-70.

The existing ground elevations at the proposed roundabout would require approximately 25’ of fill resulting in a large amount of earthwork and grading. This large amount of earthwork would likely require an extended closure of the EB I-70 off-ramp and Tree Farm Road/South Outer Road during construction, west of Route 19.

The roundabout and raised ramp profile south of I-70 require a significant amount of added right-of-way acquisition.

Option 7 – Route 19 Realignment to the West with Access Management Outer Road Configurations

Appendix A-Option 7 Exhibit shows the conceptual layout. Major features of Option 7 include:

- Realignment of Route 19 bridge west of existing Route 19 bridge.
- Reconstruction of the interchange ramps and outer roads per EPG Access Management guidelines.
- 48 ft roadway to provide two thru traffic lanes and a center turn lane required on the new bridge.
- Recommendation of the *Improve I-70* Second Tier Environmental Impact Statement completed in December 2005 (ROD 2006).

Benefits

This alternative realigns Route 19 over I-70 to the west of the existing bridge. New ramp terminals and outer road connections are constructed per MoDOT EPG to comply with Access Management guidelines.

Disadvantages

This alternative would require a large amount of ROW to be purchased and the complete realignment of the outer road system. Extensive removals and clearing and grubbing would be required. The new alignment of the outer roads would position them behind the existing business currently located in the Northeast and Northwest quadrants of the interchange. Furthermore, this option would have the largest construction footprint and would be more than double the cost of the other options.

Alternatives Analysis

Further analyzing the different options focused on the constructability of each option as well as providing an acceptable level of service for all traffic movements and assessing the general qualitative safety impacts to the corridor in the construction (2021) and design (2041) years. The results of the traffic operational analysis are shown in the tables within Appendix B. It is desirable to maintain traffic on the existing Route 19 alignment as long as possible while construction is on-going and limit any Route 19, ramp, or outer road closures that will be required to complete construction. Further analysis of each option is provided below:

Option 1

Constructability

The proposed alignment of Route 19 would allow the new bridge to be constructed off-line while maintaining traffic on existing Route 19. While the new bridge is being constructed, half of the proposed roundabouts could be constructed, and additional build-up of earthwork could be

completed where required. Once the bridge is completed, short term closures could be utilized to connect the bridge to the half-completed roundabouts. Traffic could then be shifted to the new bridge and half-completed roundabouts while the other half of the roundabouts are completed. To minimize the length of some construction phases, the temporary closure of various ramps and outer roads may occur.

Traffic Analysis

Both roundabouts can be expected to operate at acceptable LOS through the Design Year (2041): the south roundabout is projected to operate at LOS A/B and the north roundabout at LOS B/C in forecast years 2021/2041. The generally high levels of operation could be expected to provide some room for additional unforeseen growth.

Safety

Regarding safety, roundabouts reduce the number of conflict points at an intersection; combining two intersections into one roundabout at each end of the corridor would enhance these effects and could be expected to improve the safety of the corridor. In addition, the roundabouts would be expected to reduce overall speeds within the corridor. A period of adjustment would be anticipated for local drivers to become accustomed to navigating the roundabouts.

A conceptual safety analysis for no build, Option 1 and Option 2 was performed using the Highway Safety Manual (HSM) *Predictive Method for Rural Two-Lane, Two-Way Roads Analysis Spreadsheet*. The results shown in the table below indicate that Option 1 offers the greatest reduction in total and all types of crashes, although both Options 1 and 2 offer over 40% reduction in predicted crashes over the no build alternative.

Scenario (2041 Design Year)	Predicted Average Crash Frequency (crashes/year)		
	Total	Fatal & Injury	PDO
No Build	18.321	7.607	10.714
Option 1	9.377	3.571	5.806
Option 2	10.832	4.379	6.453

The full HSM Evaluation Summary is located in Appendix G.

Bridge

Five bridge configurations were considered for Option 1. All five options provide a 36 ft roadway to accommodate two through lanes on Route 19. The roundabouts used with Option 1 do not require a center turn lane thus allowing a narrower structure compared to the other options. The cost estimates and bridge plan sheets are located in Appendix C and E, respectively. The bridge cost estimates include two roadway adjustments related to bridge length and structure depth. The base roadway estimate uses the structure length and depth from Option 1E. A cost adjustment is included with Options 1A, 1B, 1C and 1D to account for the change to a different bridge length or deeper superstructure.

The cost estimates assume drilled shaft foundations at the intermediate bents based upon the as-built structure plans and available soil data. During final design the subsurface investigation will determine if pile cap foundations are feasible. Additional information is needed to determine the drivability and length of H-piles. If feasible, pile foundations could offer cost savings compared to the assumed drilled shafts.

Bridge Option 1A uses MSE walls placed directly behind I-70 shoulder barriers to create the shortest bridge length. Bridge Option 1B uses MSE walls placed 30 ft clear of the nearest I-70 traffic lane to provide a clear zone and room for open channel drainage in front of the MSE Walls. Bridge Option 1C is a four-span configuration with spill slopes at the end bents to eliminate the MSE walls while providing a shallow structure depth. Bridge Options 1D (steel) and 1E (concrete) are two-span structures with spill slopes at the end bents to eliminate MSE walls while providing a two-span structure.

Bridge Option	1A	1B	1C	1D	1E
Bridge Width	38'-8"				
Roadway	36' (2-12' Lanes, 2-6' Shoulders, 2-16" Type D Barriers)				
Skew Angle	34°-35'-10"				
Span Configuration	84.25'-84.25'	104.25'-104.25'	57'-80'-80'-57'	137'-137'	137'-137'
Bridge Length	172'-9"	212'-9"	278'-3"	278'-3"	278'-3"
MSE Walls	At Each End Bent	At Each End Bent	None	None	None
Superstructure	4-NU35 8.5" deck PS deck panels	4-NU53 8.5" deck PS deck panels	4-NU35 8.5" deck PS deck panels	4-Painted Steel Plate Girders (54" web) 9.5" deck Steel SIP Forms	5-NU70 9.5" deck PS deck panels
Structure Depth	4'-3"	5'-10"	4'-3"	6'-3"	7'-6"
Expansion Joints	None				
End Bents	Integral with Galvanized Steel Piles				
Intermediate Bents	3-column bents founded on Drilled Shafts with Rock Sockets				
Benefits	Shallow depth. Shortest bridge. Lowest cost.	MSE Walls beyond clear zone. Open channel I-70 drainage.	Shallow depth. No MSE Walls. Improved sight lines. Open channel I-70 drainage.	No MSE Walls. Open I-70 Template. Lightweight. Improved sight lines. Open channel I-70 drainage.	No MSE Walls. Open I-70 Template. Improved sight lines. Open channel I-70 drainage.
Disadvantages	MSE Walls against I-70 Shoulder. I-70 Drainage thru MSE Wall. MSE Wall Maintenance.	Deeper structure. Longer bridge. MSE Wall Maintenance.	More intermediate bents.	Highest initial cost. High maintenance costs.	Deep Structure.
Cost with 20% Contingency	$1,558,211	$1,695,879	$1,980,087	$2,222,448	$1,677,823
% of Low Cost	100%	108.8%	127.1%	142.6%	107.7%

Bridge Options 1A, 1B and 1E are similar regarding the estimated construction costs. Bridge Option 1E is the preferred bridge configuration for Option 1. The primary benefit of Option 1E is the open I-70 template beneath the bridge which provides improved sight lines and allows for additional future expansion of I-70. Additionally, Option 1E has no MSE Walls to maintain and therefore no risk of wall damage from vehicle impact. Bridge Option 1A is not desirable due to increased maintenance caused by the risk of vehicle impact and the drainage included within the wall.

Environmental Considerations

A Conceptual Level Request for Environmental Services (RES) was completed on 6-11-2019 and is included with this document as Appendix F.

Potential Impacts are summarized below:

Farmland Impact
The Farmland Protection Policy Act will apply if any right of way or permanent easements are required outside of the New Florence city limits.

Floodplain/Regulatory Floodway
There are no impacts to floodplain or regulatory floodway with Option 1.

Stormwater/Water Quality
The project is outside the TW4 area.

FEMA/SEMA Buyout
According to the TMS FEMA buyout layer, there are no buyout sites in the vicinity of the project area.

Socioeconomic Impact
New right of way and easements will be subject to the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. Commercial and/or residential displacements will require further assessment to determine if there are any potential impacts to low-income and minority residents and business owners.

Threatened & Endangered Species
The following species listed in the Endangered Species Act Species List may be present in the project area: Running Buffalo Clover; Gray, Indiana and Northern Long-eared bats.

The potential existence of suitable bat roost trees for Option 1 may require compliance with the following conditions.

- Informal Rangewide Programmatic Agreement – Clearing of suitable bat habitat within 100-feet of an existing road (gravel or paved, including shoulders) shall be completed between November 1 to March 31. No mitigation required.

- Formal Rangewide Programmatic Agreement – Clearing of suitable bat habitat within 100-feet to 300-feet of an existing road shall be completed between November 1 to March 31. Clearing of suitable habitat between 100-feet to 300-feet is considered to have an adverse effect on bats; therefore, mitigation is required for the amount of suitable habitat cleared between 100-feet to 300-feet. The mitigation amount and ratio would be determined during the project development phase.

- Suitable habitat clearing beyond 300-foot from an existing road does not qualify under the established Programmatic Agreements. Mitigation will be required. The mitigation amount and ratio would be determined during the project development phase.

Migratory Birds
The existing bridge is a slab structure not conducive to nesting for migratory birds. No nests evident based on Google Earth street level imagery (7/2018).

Hazardous Waste Impact
The project location was reviewed utilizing the MDNR Interactive E-Start Map for the following types of sites: Superfund sites, Federal Facilities sites, Resource Conservation and Recovery Act Corrective Action sites, Brownfield/Voluntary Cleanup Program sites Brownfield Assessments, and Petroleum and Hazardous Substance Storage Tank Facilities. No such sites were found within the project area. Although the potential to encounter wastes from sites unknown to MoDOT should be a consideration, any previously unknown sites that are found during construction of the project will be handled in accordance with current laws and regulations.

Wetland Impact
There do not appear to be any impacts to streams or wetlands with Option 1 and no 404 permit would be required.

Noise Impact
Option 1 would likely be a Type III project and would not require a noise analysis.

Cultural Resources
The area around the Route 19/I-70 interchange encompassing all the options was included in several previous cultural resources surveys. There is one small and seemingly NRHP non-eligible site in the southwest quadrant southwest of the current outer road intersection with Route 19 that would require further evaluation. There are no other known archaeological concerns at this interchange.

Public Land Impact (Section 4f/6f)
There are no documented Section 4(f) or Section 6(f) resources in the vicinity of the project area. The nearest resource, the Danville Conservation Area (MDC) is about 2.5 miles southeast of the project area. However, the project should not restrict access to this resource. There are no impacts to public recreational lands with any of the options.

Existing Utilities

The following existing utilities responded to the locate tickets submitted to Missouri One Call:

- Ameren Missouri Electric
- ATT Distribution
- ATT Transmission
- Centurylink Fiber
- Charter Communications
- City of New Florence Muni Gas
- Kingdom Telephone
- MoDOT Northeast District
- MoDOT St. Louis District
- New Florence Telephone

Based on utilities marked in the field, there are potential conflicts with the following:

- MoDOT
- New Florence Telephone
- Centurylink Fiber
- Water line of unknown ownership
- Kingdom Telephone
- Centurylink Fiber
- ATT Transmission

The potential impacts to these utilities are similar between Options 1, 2 and 5.

Option 2

Constructability

The proposed alignment of Route 19 would allow the new bridge to be constructed off-line while maintaining traffic on existing Route 19. While the new bridge is being constructed, a temporary connection of Tree Farm Road/South Outer Road and Route 19 could be established to allow for construction of the majority of the roundabout. North of I-70, staging will have to be utilized at the Booneslick Road and Route 19 intersection. It is anticipated this option would require the least amount of temporary closures during construction.

Traffic Analysis

An initial traffic analysis investigated various traffic control options at the intersection with Tree Farm Road/South Outer Road. The evaluation determined that all-way stop control (AWSC) would result in LOS D for both the AM and PM including a LOS E at one approach. Similarly, a signalized intersection would operate at acceptable levels overall, but with a single approach at unacceptable levels during one peak period. It was determined that the intersection and all approaches would continue to operate at a high level of service (LOS B) in the design year with a roundabout. The intersection of Booneslick Road would remain in its existing configuration and under signalized control.

Because this alternative (relatively) mirrors the existing geometry, the traffic analysis additionally investigated alternatives for improving the future operations for the I-70 Ramp Terminal intersections as both intersections are expected to have either the ramp approach (eastbound ramps) or overall intersection (westbound ramps) at an unacceptable LOS during both peak hours by the Design Year (2041). It should be noted, however, that both ramps are expected to operate acceptably at the Construction Year (2021) and would be anticipated to deteriorate with the additional development forecasted by 2041. This investigation (included within the analysis results for Option 2) determined that a first step would be to add a dedicated (channelized) right-turn lane on the ramps. Therefore, this geometric change was incorporated into the future design plans where applicable. With additional development, however, this improvement alone may not maintain an acceptable LOS at the westbound ramp terminals. Therefore, it was determined that enhanced operational control via AWSC could achieve acceptable operations and be incorporated when necessary to achieve acceptable LOS. The tables in Appendix B note when

additional lanes and/or revised traffic control were incorporated into an alternative. For Option 2, additional lanes and AWSC at the ramp terminal intersections were necessary to achieve acceptable LOS.

Safety

Roundabouts have shown to improve intersection safety by reducing the number of conflict points at an intersection. These impacts would be less dramatic in Option 2 (vs. Option 1) but the potential to reduce the number of crashes and the speeds at the south end of the corridor exists.

A conceptual safety analysis was performed on the no build, Option 1 and Option 2. See discussion under Option 1 for details and Appendix G for the full HSM Evaluation Summary.

Bridge

Five bridge configurations were considered for Option 2. All five options provide a 56 ft roadway to accommodate two through lanes and a center turn lane on Route 19. A wider bridge is required to provide adequate sight distance for the turn movements at the I-70 ramps. This requirement results in the Option 2 structure being the widest structure compared to the other options. The cost estimates and bridge plan sheets are located in Appendix C and E, respectively. The bridge cost estimates include two roadway adjustments related to bridge length and structure depth. The base roadway estimate uses the structure length and depth from Option 2C. A cost adjustment is included with Options 2A, 2B, 2D and 2E to account for the change to a different bridge length or deeper superstructure.

The cost estimates assume drilled shaft foundations at the intermediate bents based upon the as-built structure plans and available soil data. During final design the subsurface investigation will determine if pile cap foundations are feasible. Additional information is needed to determine the drivability and length of H-piles. If feasible, pile foundations could offer cost savings compared to the assumed drilled shafts.

Bridge Option 2A uses MSE walls placed directly behind I-70 shoulder barriers to create the shortest bridge length. Bridge Option 2B uses MSE walls placed 30 ft clear of the nearest I-70 traffic lane to provide a clear zone and room for open channel drainage in front of the MSE Walls. Bridge Option 2C is a four-span configuration with spill slopes at the end bents to eliminate the MSE walls while providing a shallow structure depth. Bridge Options 2D (steel) and 2E (concrete) are two-span structures with spill slopes at the end bents to eliminate MSE walls while providing a two-span structure.

Bridge Option	2A	2B	2C	2D	2E
Bridge Width	58’-8”				
Roadway	56’ (2-12’ Lanes, 1-12’ Turn Lane, 2-10’ Shoulders, 2-16” Type D Barriers)				
Skew Angle	33°-31’-03”				
Span Configuration	83’-83’	103’-103’	57’-80’-80’-57’	137’-137’	137’-137’
Bridge Length	170’-2.5”	210’-2.5”	278’-2.5”	278’-2.5”	278’-2.5”
MSE Walls	At Each End Bent	At Each End Bent	None	None	None
Superstructure	6-NU35 8.5” deck PS deck panels	6-NU53 8.5” deck PS deck panels	6-NU35 8.5” deck PS deck panels	6-Painted Steel Plate Girders (54” web) 9.5” deck Steel SIP Forms	7-NU70 9.5” deck PS deck panels
Structure Depth	4’-5”	6’-0”	4’-5”	6’-7”	7’-8”
Expansion Joints	None				
End Bents	Integral with Galvanized Steel Piles				
Intermediate Bents	4-column bents founded on Drilled Shafts with Rock Sockets				
Benefits	Shallow depth. Shortest bridge. Lowest cost.	MSE Walls beyond clear zone. Open channel I-70 drainage.	Shallow depth. No MSE Walls. Improved sight lines. Open channel I-70 drainage.	No MSE Walls. Open I-70 Template. Lightweight. Improved sight lines. Open channel I-70 drainage.	No MSE Walls. Open I-70 Template. Improved sight lines. Open channel I-70 drainage.
Disadvantages	MSE Walls against I-70 Shoulder. I-70 Drainage thru MSE Wall. MSE Wall Maintenance.	Deeper structure. MSE Wall Maintenance.	More intermediate bents.	Highest initial cost. High maintenance costs.	Deep Structure.
Cost with 20% Contingency	$2,095,021	$2,416,477	$2,701,928	$3,443,803	$2,702,602
% of Low Cost	100%	115.3%	129.0%	164.4%	129.0%

Bridge Option 2A is the lowest estimated cost but is not the preferred option due to increased maintenance caused by the risk of vehicle impact and the drainage included within the MSE wall. Options 2C and 2E are nearly the same costs. Option 2C is preferable to Option 2E due to the profile raise which will reach into the existing intersections and complicate construction. Additionally, if pile foundations prove feasible, the cost of Option 2C will drop more than that of

Option 2E due to the number of intermediate bent foundations. Option 2B is less expensive than Option 2C based upon the estimated roadway cost differences in the bridge estimates. The bridge estimated roadway costs are slightly different than the detailed roadway estimates due to the items computed using percentages. This report includes itemized total project costs for Options 2B and 2C. Looking at those estimates, the total project costs for Options 2B and 2C are very close. Option 2C provides a more open template on I-70 which improves sight lines. Additionally, Option 2C eliminates maintenance risks associated with the MSE wall and potential vehicular impact. Therefore, Option 2C is considered the preferred structure for Option 2.

Environmental Considerations

The Conceptual Level Request for Environmental Services (RES) completed on 6-11-2019 revealed the Option 2 environmental considerations are the same as Option 1. See category descriptions listed under Option 1 and the full RES document in Appendix F.

Existing Utilities

The utility impacts for Option 2 are similar to Option 1. See discussion under Option 1 for utility information.

Option 5

Constructability

The proposed alignment of Route 19 would allow the new bridge to be constructed off-line while maintaining traffic on existing Route 19. However, this option would require an extended closure of the EB I-70 off ramp and Tree Farm Road/South Outer Road, west of Route 19, while the new elliptical roundabout is constructed. Staging would be utilized North of I-70 to reconstruct the WB I-70 ramp terminals and the Booneslick Road and Route 19 intersection.

Traffic Analysis

This option would revise the existing study corridor, most notably with the interruption of Tree Farm Road/South Outer Road between the roundabout and a new intersection. The new intersection would be created east of the proposed roundabout on Route 19 at Tree Farm Road/South Outer Road (Route 19 would connect those two nodes). The intersection with Booneslick Road would be reconstructed with the same geometry and signalized control. Tables 1 and 2 within Appendix B reflect the additional intersection for this Option. The five-legged roundabout operates at LOS C or better through Design Year (2041) and the new (TWSC) intersection at Tree Farm Road/South Outer Road (East) operates at LOS A through 2041.

Per the analysis of the future ramp terminal intersections discussed under Option 2, the geometry for this Option included at the Westbound I-70 Ramp terminal intersection a left-turn lane for the northbound approach, a right-turn lane for the westbound approach, and AWSC.

Safety

This option would also be expected to reduce speeds and the potential for intersection crashes with the incorporation of a roundabout. However, the atypical roundabout shape and realignment of Route 19 and Tree Farm Road/South Outer Road may incur additional adjustment time for drivers. Although the roundabout merges the Eastbound I-70 Ramp terminal intersection and Tree Farm Road/South Outer Road (west of Route 19), it introduces a new intersection at Tree Farm Road/South Outer Road (east of Route 19) and Route 19, so the number of intersections is not reduced overall as with Option 1.

Bridge

Three bridge configurations were considered for Option 5. All three options provide a 48 ft roadway to accommodate two through lanes and a center turn lane on Route 19. The cost estimates and bridge plan sheets are located in Appendix C and E, respectively. The bridge cost estimates include two roadway adjustments related to bridge length and structure depth. The base roadway estimate uses the structure length and depth from Option 5A. A cost adjustment is included with Options 5B and 5C to account for the change to a different bridge length or deeper superstructure.

The cost estimates assume drilled shaft foundations at the intermediate bents based upon the as-built structure plans and available soil data. During final design the subsurface investigation will determine if pile cap foundations are feasible. Additional information is needed to determine the drivability and length of H-piles. If feasible, pile foundations could offer cost savings compared to the assumed drilled shafts.

Bridge Option 5A uses MSE walls placed directly behind I-70 shoulder barriers to create the shortest bridge length. Bridge Option 5B uses MSE walls placed 30 ft clear of the nearest I-70 traffic lane to provide a clear zone and room for open channel drainage in front of the MSE Walls. Bridge Option 5C is a three-span configuration with spill slopes at the north end bent and an MSE wall at the south end bent. All Option 5 bridge configurations use an MSE wall at the south end bent because the ramp profile will be raised significantly. The wall is required due to insufficient space to use spill slopes along the raised ramp.

Bridge Option	5A	5B	5C
Bridge Width	50’-8”		
Roadway	48’ (2-12’ Lanes, 1-12’ Turn Lane, 2-6’ Shoulders, 2-16” Type D Barriers)		
Skew Angle	4°-03’-03”		
Span Configuration	70’-70’	86’-86’	64’-70’-70’
Bridge Length	143’-6”	175’-6”	207’-6”
MSE Walls	At Each End Bent	At Each End Bent	At South End Bent
Superstructure	5-NU35 8.5” deck PS deck panels	5-NU43 8.5” deck PS deck panels	5-NU35 8.5” deck PS deck panels
Structure Depth	4’-4”	5’-0”	4’-4”
Expansion Joints	None		
End Bents	Integral with Galvanized Steel Piles		

Bridge Option	5A	5B	5C
Intermediate Bents	3-column bents founded on Drilled Shafts with Rock Sockets		
Benefits	Shallow depth. Shortest bridge. Lowest cost.	MSE Walls beyond clear zone. Open channel I-70 drainage.	Shallow depth. No MSE Wall at north end. Open channel I-70 drainage.
Disadvantages	MSE Walls against I-70 Shoulder. I-70 Drainage thru MSE Wall.	Deeper structure.	Longest bridge. More intermediate bents.
Cost with 20% Contingency	$1,460,211	$1,554,695	$1,685,686
% of Low Cost	100%	106.3%	116.7%

Bridge Option 5B is the recommended bridge configuration for Option 5. The primary benefits of Option 5B are the wider I-70 template, the reduced risk of MSE Wall maintenance due to vehicular impact and the open channel drainage in front of the walls. Bridge Option 5A is the lowest estimated cost but is not the preferred option due to increased maintenance caused by the risk of vehicle impact and the drainage included within the wall.

Environmental Considerations

The Conceptual Level Request for Environmental Services (RES) completed on 6-11-2019 revealed the Option 5 environmental considerations are the same as Option 1. See category descriptions listed under Option 1 and the full RES document in Appendix F.

Existing Utilities

The utility impacts for Option 5 are similar to Option 1. See discussion under Option 1 for utility information.

Option 7

Constructability

The proposed alignment of Route 19 would allow the new bridge to be constructed off-line while maintaining traffic on existing Route 19. Furthermore, all ramps and outer roads are relocated which allows the existing system to remain open while most of the construction is completed. However, this option has a much larger footprint than any other option and would likely take much longer to construct.

Traffic Analysis

An interesting outcome of this proposed geometry is that, with additional separation, the intersections operate at somewhat higher LOS than in the No-Build scenario. Most notably, the intersection of Booneslick Road/North Outer Road could be expected to function at an acceptable

LOS through the Design Year (2041) under AWSC – eliminating a signal from the corridor (assuming the inclusion of northbound and southbound auxiliary turn lanes).

Safety

Option 7 would be expected to have the least impacts to corridor safety. The reduction in lanes, conversion to stop control, and increased approach distances could be expected to improve safety slightly at the Booneslick Road/North Outer Road intersection. Similarly approach distances would increase for the Tree Farm Road/South Outer Road intersection. Little else would change geometrically versus the existing corridor.

Bridge

Five bridge configurations were considered for Option 7. All five options provide a 48 ft roadway to accommodate two through lanes and a center turn lane on Route 19. The cost estimates and bridge plan sheets are located in Appendix C and E, respectively. The bridge cost estimates include two roadway adjustments related to bridge length and structure depth. The base roadway estimate uses the structure length and depth from Option 7C. A cost adjustment is included with Options 7A, 7B, 7D and 7E to account for the change to a different bridge length or deeper superstructure.

The cost estimates assume drilled shaft foundations at the intermediate bents based upon the as-built structure plans and available soil data. During final design the subsurface investigation will determine if pile cap foundations are feasible. Additional information is needed to determine the drivability and length of H-piles. If feasible, pile foundations could offer cost savings compared to the assumed drilled shafts.

Bridge Option 7A uses MSE walls placed directly behind I-70 shoulder barriers to create the shortest bridge length. Bridge Option 7B uses MSE walls placed 30 ft clear of the nearest I-70 traffic lane to provide a clear zone and room for open channel drainage in front of the MSE Walls. Bridge Option 7C is a four-span configuration with spill slopes at the end bents to eliminate the MSE walls while providing a shallow structure depth. Bridge Options 7D (steel) and 7E (concrete) are two-span structures with spill slopes at the end bents to eliminate MSE walls while providing a two-span structure.

Bridge Option	7A	7B	7C	7D	7E
Bridge Width	50’-8”				
Roadway	48’ (2-12’ Lanes, 1-12’ Turn Lane, 2-6’ Shoulders, 2-16” Type D Barriers)				
Skew Angle	28°-17’-53”				
Span Configuration	78.75’-78.75’	97.5’-97.5’	57’-80’-80’-57’	137’-137’	137’-137’
Bridge Length	161’-5.75”	198’-11.75”	277’-11.75”	277’-11.75”	277’-11.75”
MSE Walls	At Each End Bent	At Each End Bent	None	None	None

Bridge Option	7A	7B	7C	7D	7E
Superstructure	5-NU35 8.5" deck PS deck panels	5-NU43 8.5" deck PS deck panels	5-NU35 8.5" deck PS deck panels	5-Painted Steel Plate Girders (60" web) 9.5" deck Steel SIP Forms	6-NU70 9.5" deck PS deck panels
Structure Depth	4'-4"	5'-0"	4'-4"	7'-0"	7'-7"
Expansion Joints	None				
End Bents	Integral with Galvanized Steel Piles				
Intermediate Bents	3-column bents founded on Drilled Shafts with Rock Sockets				
Benefits	Shallow depth. Shortest bridge. Lowest cost.	MSE Walls beyond clear zone. Open channel I-70 drainage.	Shallow depth. No MSE Walls. Improved sight lines. Open channel I-70 drainage.	No MSE Walls. Open I-70 Template. Lightweight. Improved sight lines. Open channel I-70 drainage.	No MSE Walls. Open I-70 Template. Improved sight lines. Open channel I-70 drainage.
Disadvantages	MSE Walls against I-70 Shoulder. I-70 Drainage thru MSE Wall. MSE Wall Maintenance.	Deeper structure. MSE Wall Maintenance.	More intermediate bents.	Highest initial cost. High maintenance costs.	Deep Structure.
Cost with 20% Contingency	$1,788,323	$1,898,930	$2,261,067	$2,958,620	$2,282,657
% of Low Cost	100%	106.2%	126.4%	165.4%	127.6%

Bridge Option 7B is the recommended bridge configuration for Option 7. The primary benefits of Option 7B are the low cost combined with a wider I-70 template, the reduced risk of MSE Wall maintenance due to vehicular impact and the open channel drainage in front of the walls. Bridge Option 7A is the lowest estimated cost but is not the preferred option due to increased maintenance caused by the risk of vehicle impact and the drainage included within the wall.

Environmental Considerations

A Conceptual Level Request for Environmental Services (RES) was completed on 6-11-2019 and is included with this document as Appendix F.

Potential Impacts are summarized below:

Farmland Impact
The Farmland Protection Policy Act will apply if any right of way or permanent easements are required outside of the New Florence city limits.

Floodplain/Regulatory Floodway
Option 7 could encroach upon the Zone A 100-year floodplain of Smith Branch, located east of Route 19, at Coop Road and I-70. Based on the type of work and right of way impacts, a floodplain development permit from SEMA may be required. There are no areas of regulatory floodway within any of the options.

Stormwater/Water Quality
The project is outside the TW4 area.

FEMA/SEMA Buyout
According to the TMS FEMA buyout layer, there are no buyout sites in the vicinity of the project area.

Socioeconomic Impact
New right of way and easements will be subject to the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. Commercial and/or residential displacements will require further assessment to determine if there are any potential impacts to low-income and minority residents and business owners.

Threatened & Endangered Species
The following species listed in the Endangered Species Act Species List may be present in the project area: Running Buffalo Clover; Gray, Indiana and Northern Long-eared bats.

The potential presence of Running Buffalo Clover along Smith Branch is possible for Option 7. No records in the project area indicate its presence; however, a field check along Smith Branch will be necessary for Option 7.

Due to the significantly higher amounts of tree clearing required for Option 7, mitigation for tree clearing is anticipated. The potential existence of suitable bat roost trees for Option 7 will require compliance with the following conditions.

- Informal Rangewide Programmatic Agreement – Clearing of suitable bat habitat within 100-feet of an existing road (gravel or paved, including shoulders) shall be completed between November 1 to March 31. No mitigation required.
- Formal Rangewide Programmatic Agreement – Clearing of suitable bat habitat within 100-feet to 300-feet of an existing road shall be completed between November 1 to March 31. Clearing of suitable habitat between 100-feet to 300-feet is considered to have an adverse effect on bats; therefore, mitigation is required for the amount of suitable habitat cleared between 100-feet to 300-feet. The mitigation amount and ratio would be determined during the project development phase.

- Suitable habitat clearing beyond 300-foot from an existing road does not qualify under the established Programmatic Agreements. Mitigation will be required. The mitigation amount and ratio would be determined during the project development phase.

Wetland Impacts

Option 7 will impact Smith Branch and a mapped emergent wetland in the northwest quadrant of the option. A field check will be required to determine if the wetland is jurisdictional. A Section 404 permit will be necessary to address stream and wetland impacts.

Noise Impact

Depending on the improvements, this option may meet the criteria of a Type I project, which requires a noise study. It is unlikely there will be impacts since the study area doesn't appear to have noise sensitive receptors.

Cultural Resources

The area around the Route 19/I-70 interchange encompassing all the options was included in several previous cultural resources surveys. There is one small and seemingly NRHP non-eligible site in the southwest quadrant southwest of the current outer road intersection with Route 19 that would require further evaluation. There are no other known archaeological concerns at this interchange.

Existing Utilities

See Option 1 for discussion regarding utility impacts. Option 7 extends beyond the utility locates conducted for the project analysis. Additional utility impacts are anticipated for Option 7, but the extent of the impacts are unknown outside the immediate interchange area.

Estimated Cost

The estimated costs for the four alternatives are tabulated in Appendix C. Right-of-way cost estimates were provided for Option 1 and Option 2. These estimates were used to approximate a cost for Option 5 and Option 7 to provide a similar comparison in the table below. Table 1 is a summary of the estimated total project cost in 2019 dollars.

Table 1. Total Estimated Project Costs

<table>
<tr><th>Alternate</th><th>Option 1 with Bridge 1E</th><th>Option 2 with Bridge 2C</th><th>Option 5 with Bridge 5B</th><th>Option 7 with Bridge 7B</th></tr>
<tr><td>Total Estimated Project Cost (2019 USD)</td><td>$9,715,800</td><td>$9,779,300</td><td>$9,448,300</td><td>$25,670,900</td></tr>
<tr><td>% of Low Cost</td><td>102.8%</td><td>103.5%</td><td>100.0%</td><td>271.7%</td></tr>
<tr><td>LOS AM/PM 2021 (2041) Intersection with Route 19</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Tree Farm Road</td><td rowspan="2">A/A (B/B) Roundabout</td><td>A/A (B/B) Roundabout</td><td rowspan="2">B/A (C/C) Roundabout</td><td>B/B (C/B) AWSC</td></tr>
<tr><td>Eastbound Ramps</td><td>A/A (C/B) Ramp SC/AWSC</td><td>A/A (C/B) TWSC</td></tr>
<tr><td>Westbound Ramps</td><td rowspan="2">B/B (C/C) Roundabout</td><td>A/A (B/C) Ramp SC/AWSC</td><td>A/A (B/C) AWSC</td><td>A/A (B/C) TWSC</td></tr>
<tr><td>Booneslick Road</td><td>A/B (B/B) Signalized</td><td>A/B (B/B) Signalized</td><td>B/C (B/C) TWSC (AWSC)</td></tr>
</table>

Recommendation

Based on the evaluation of the options discussed in this report, the Core Team selected Option 1 with Bridge 1E as the recommended option for this location.

Option 1 was selected due to the safety improvements it provides, the projected long-term operational performance, and reduced maintenance due to the removal of the existing signal and narrower bridge width.

Bridge Option 1E is the selected bridge configuration. The primary benefit is the open I-70 template beneath the bridge which provides improved sight lines, open channel drainage, and allows for future expansion of I-70. Additionally, Option 1E has no MSE Walls to maintain and therefore no risk of wall damage from vehicle impact.

Appendix A

Alternatives Exhibits

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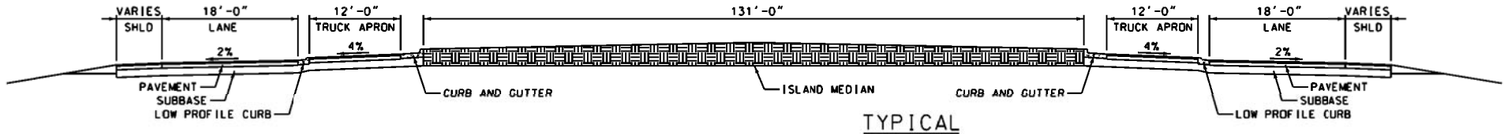

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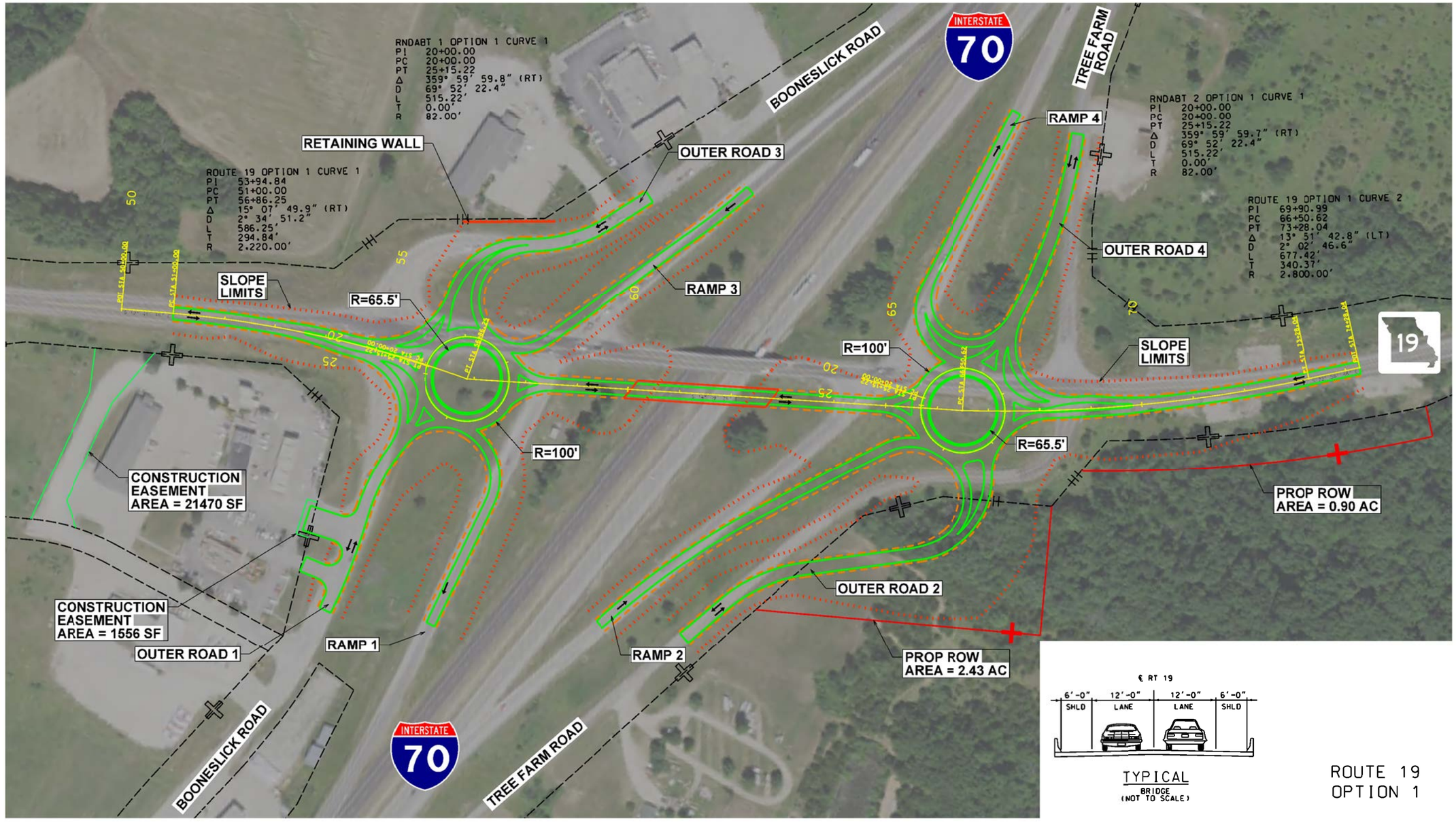

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ROUTE 19
OPTION 1

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09-JAN-2020

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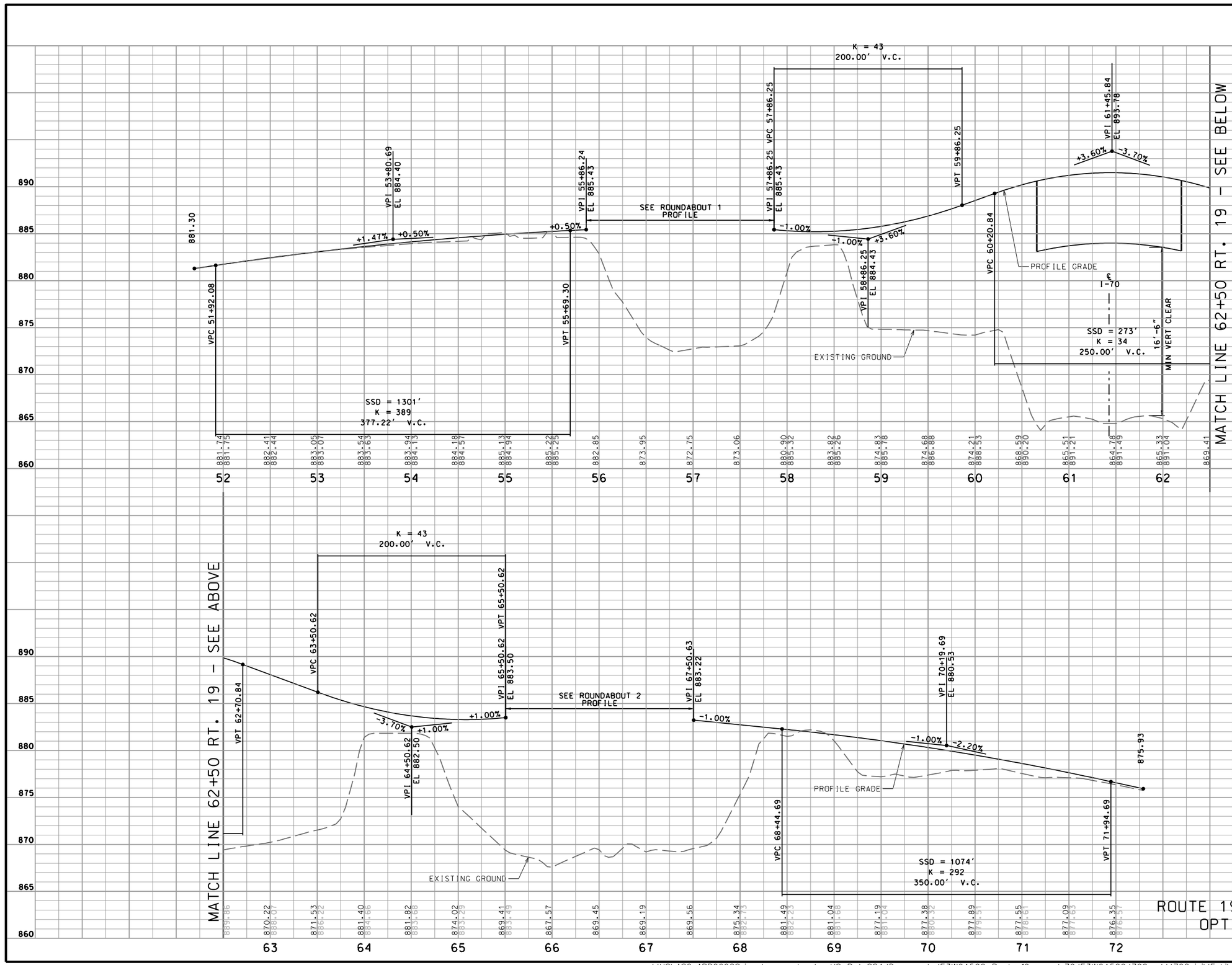

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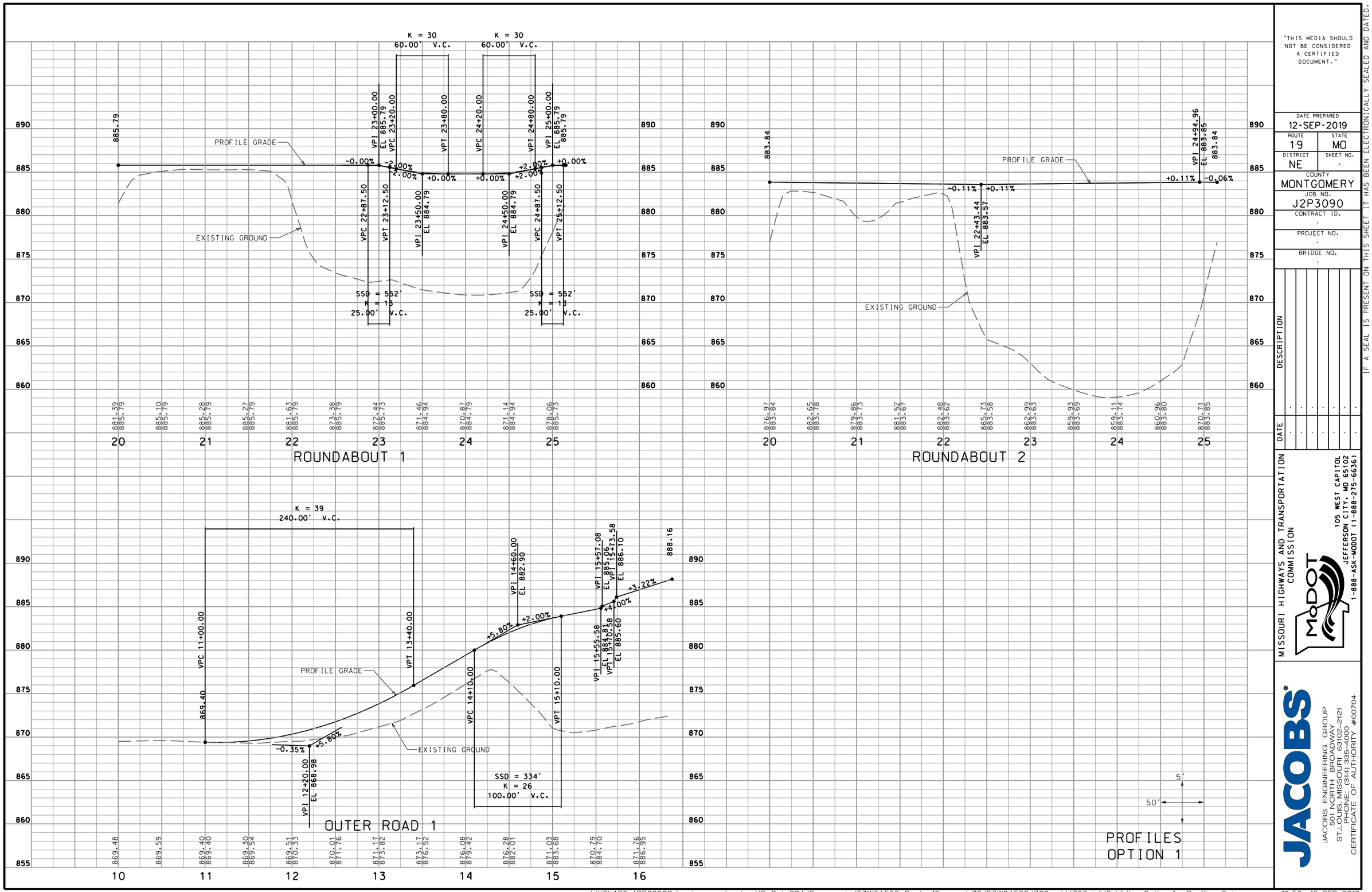

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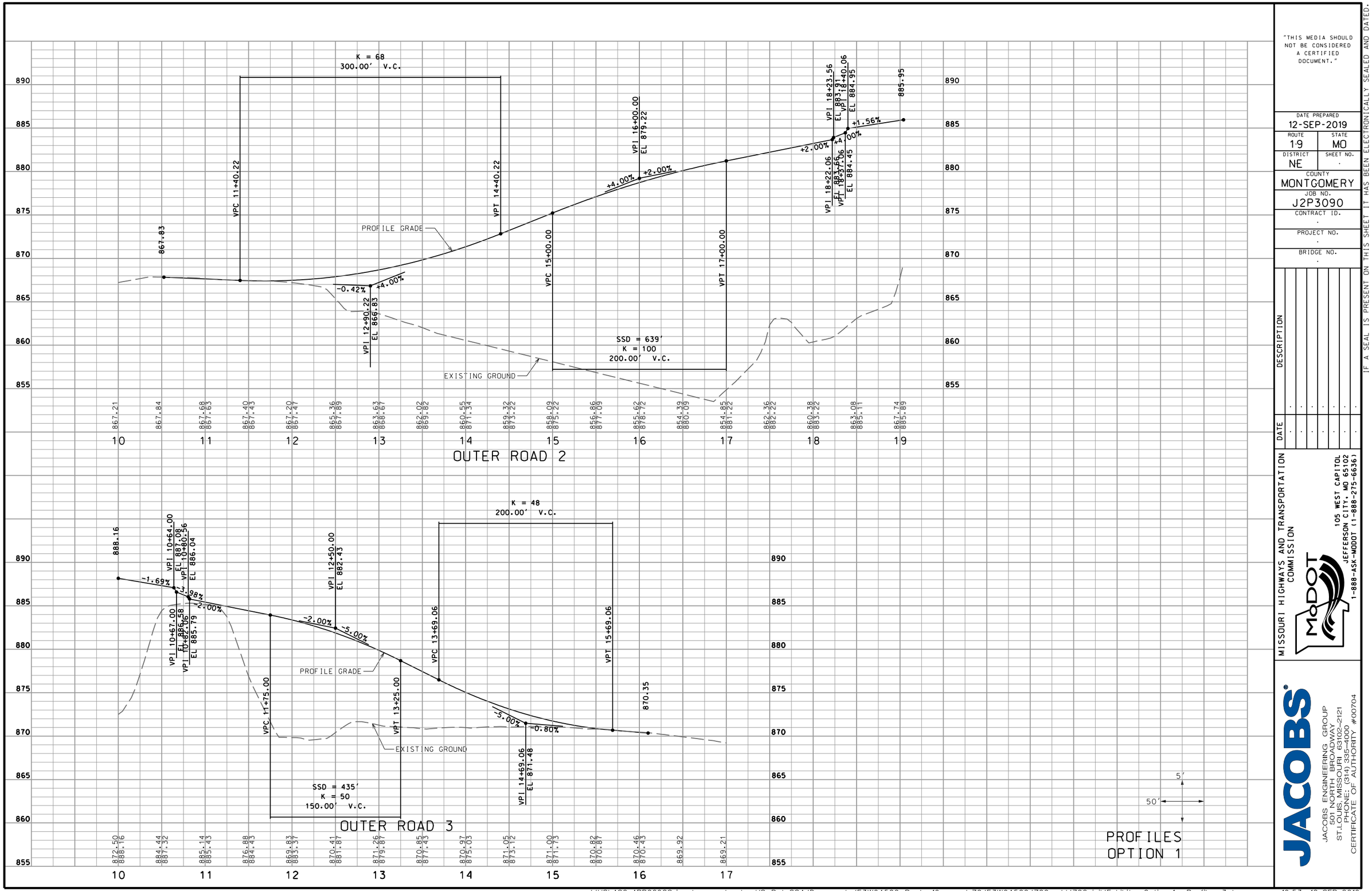

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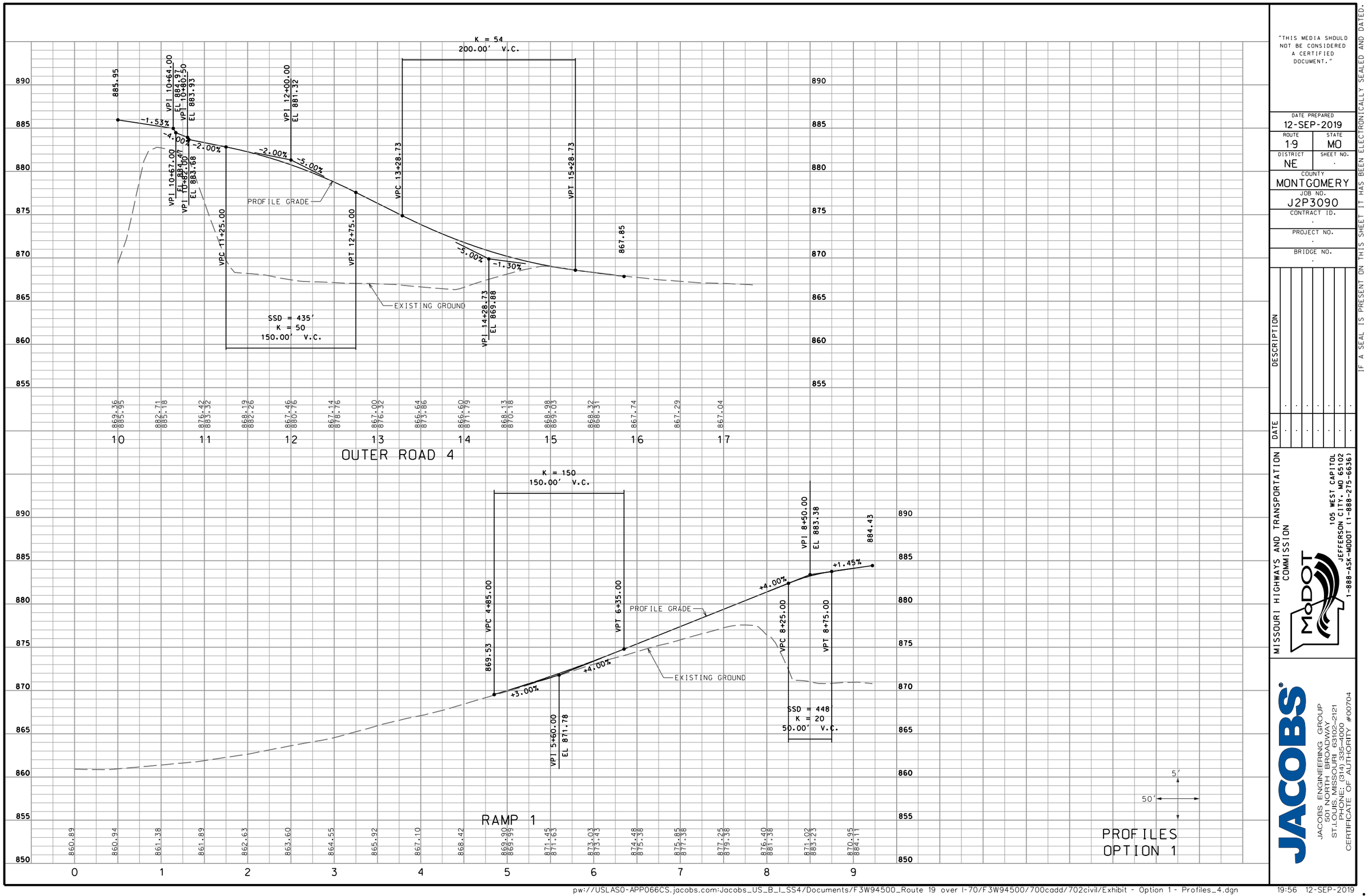

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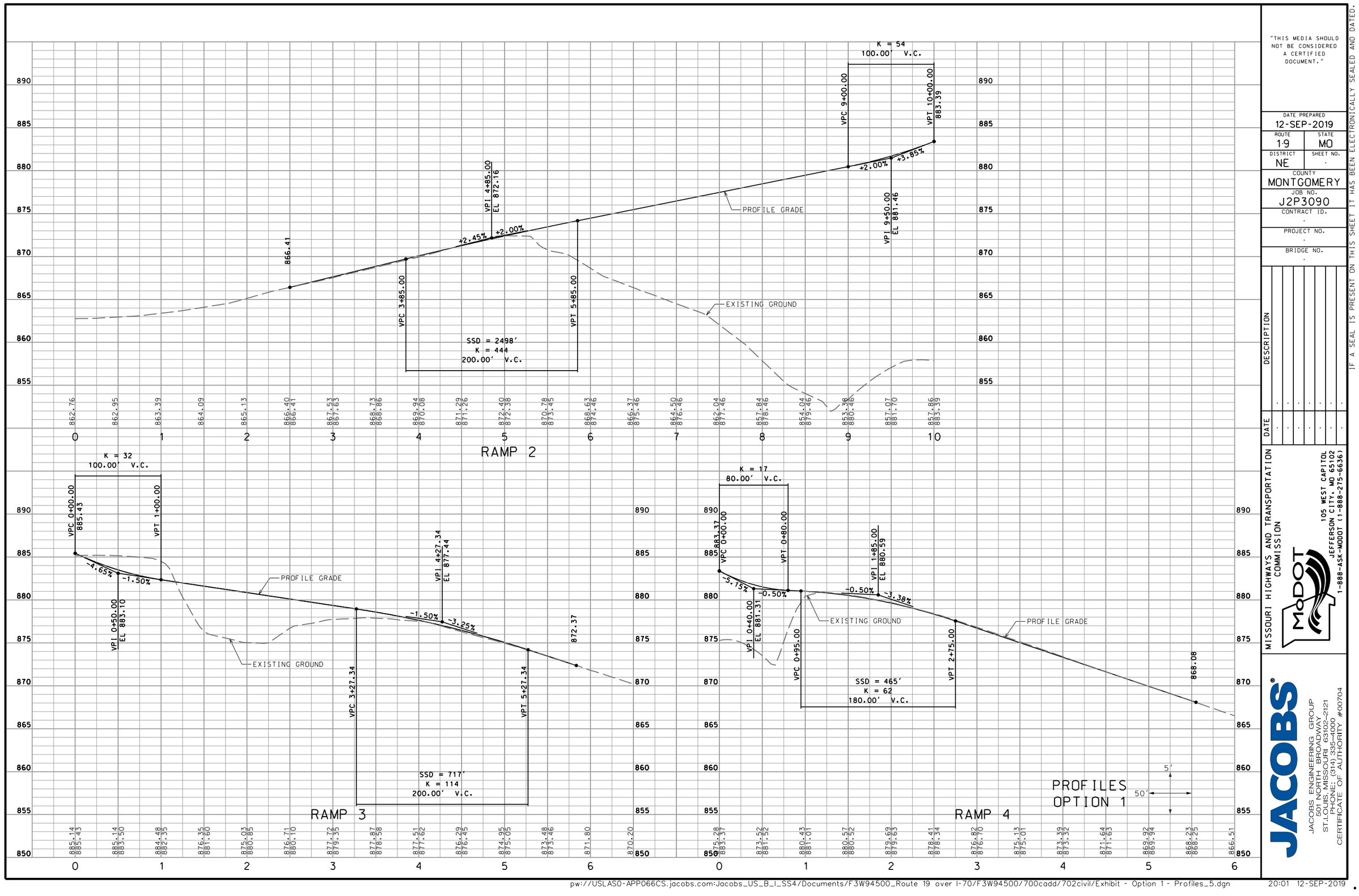

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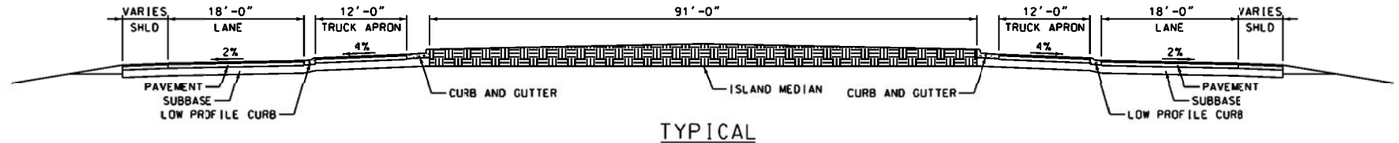

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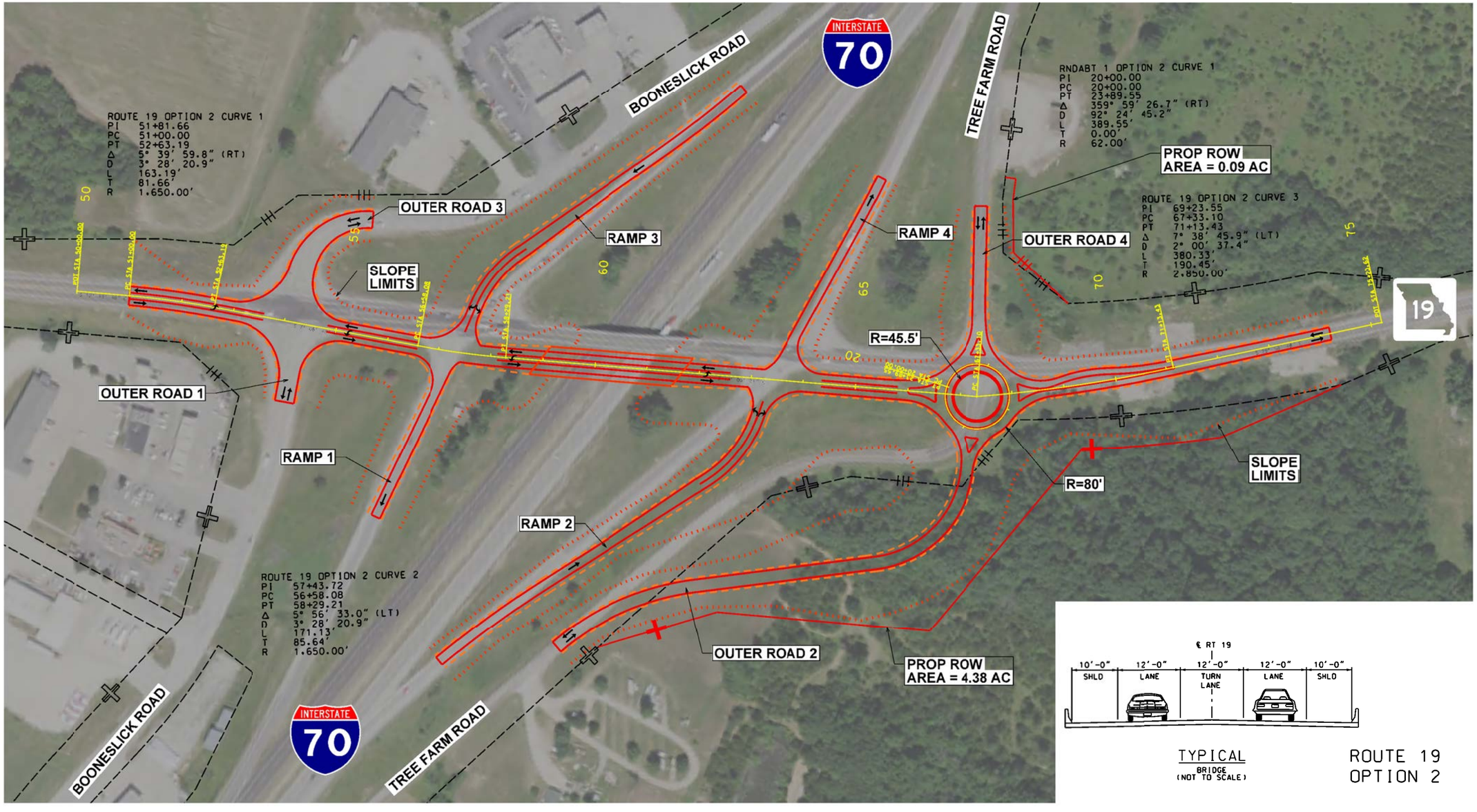

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ROUTE 19
OPTION 2

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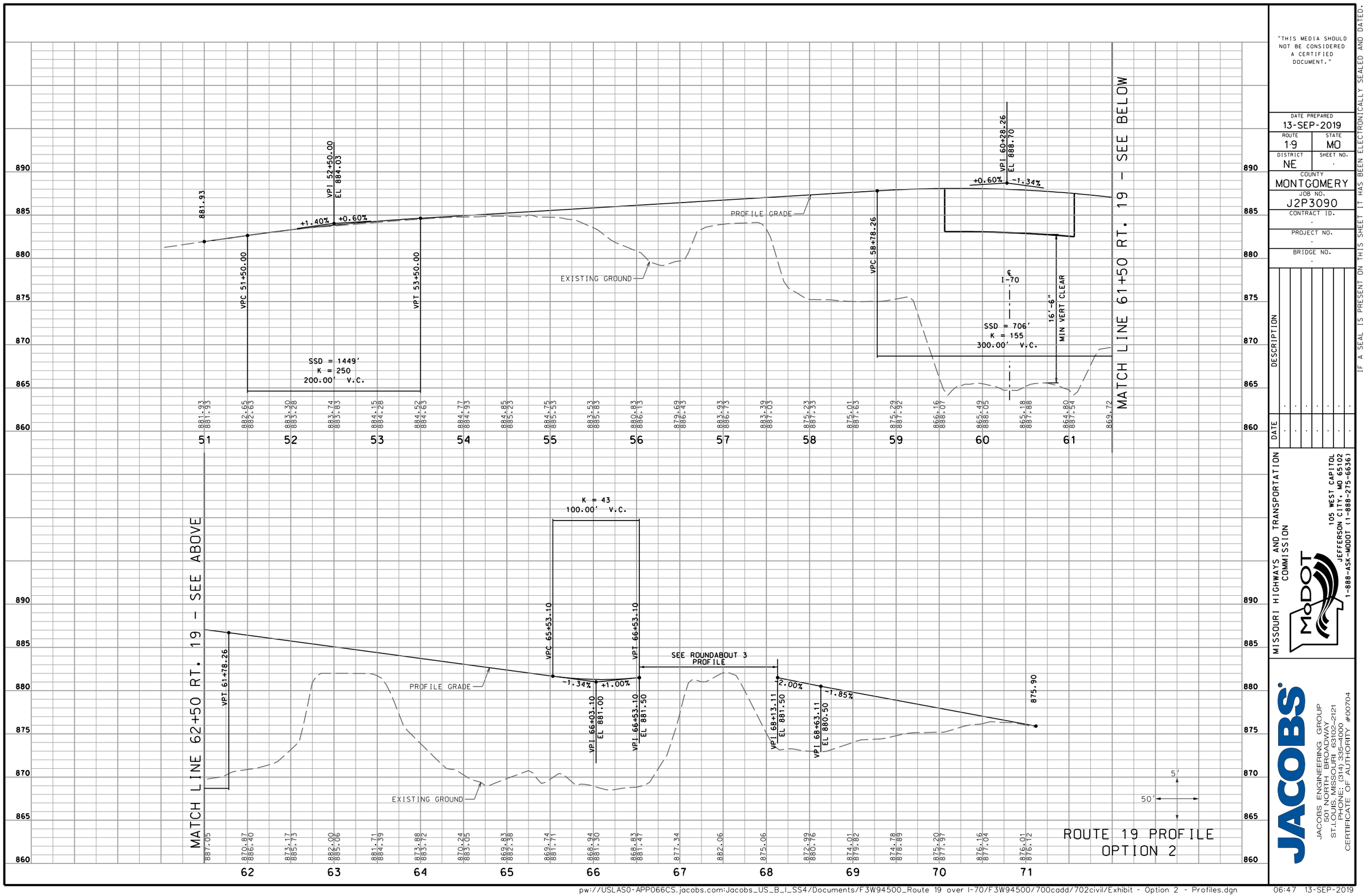

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CONTRACT ID.
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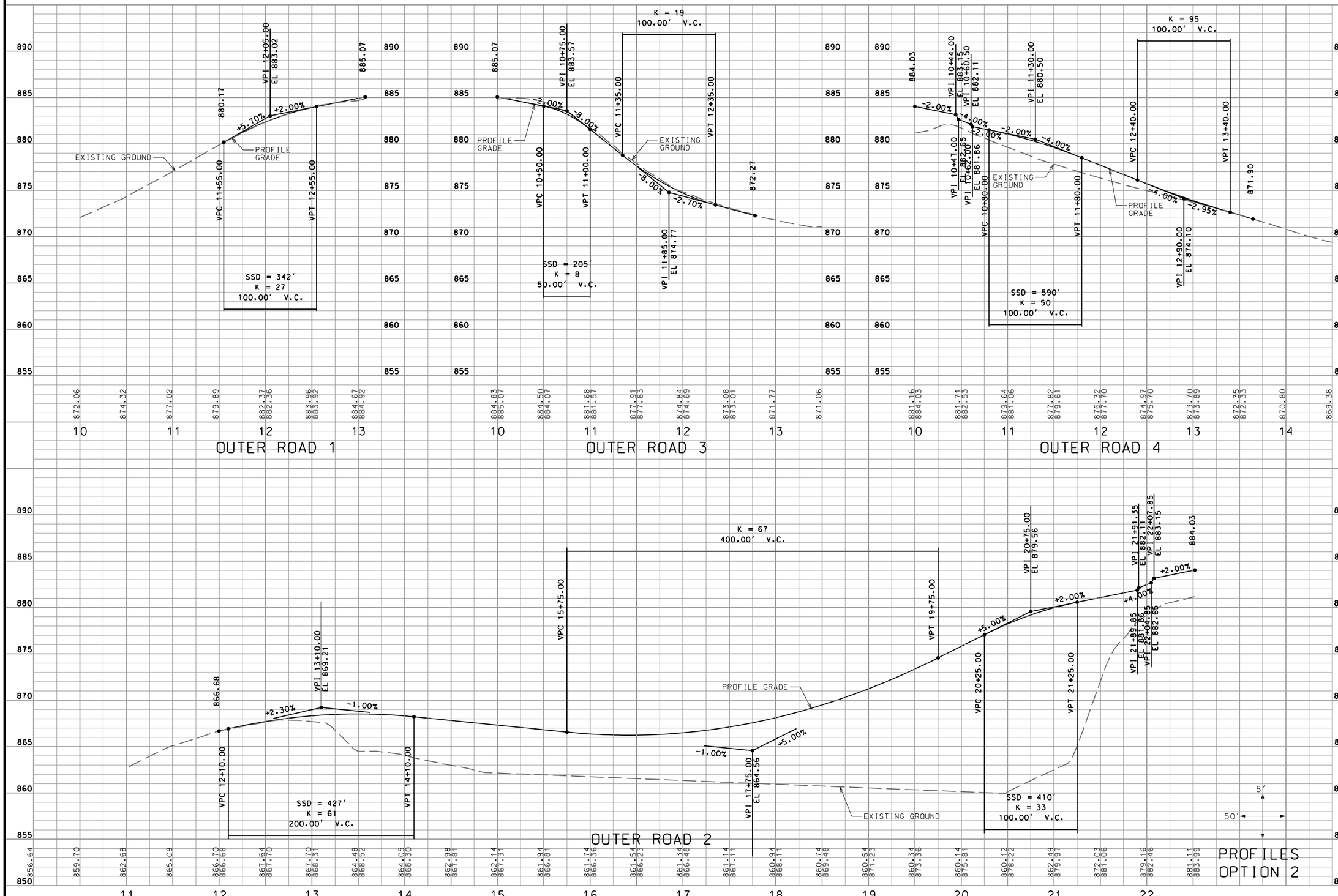

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13-SEP-2019

ROUTE	STATE
19	MO
DISTRICT	SHEET NO.
NE	.

COUNTY
MONTGOMERY

JOB NO.
J2P3090

CONTRACT ID.
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PROJECT NO.
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BRIDGE NO.
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105 WEST CAPITOL
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JACOBS

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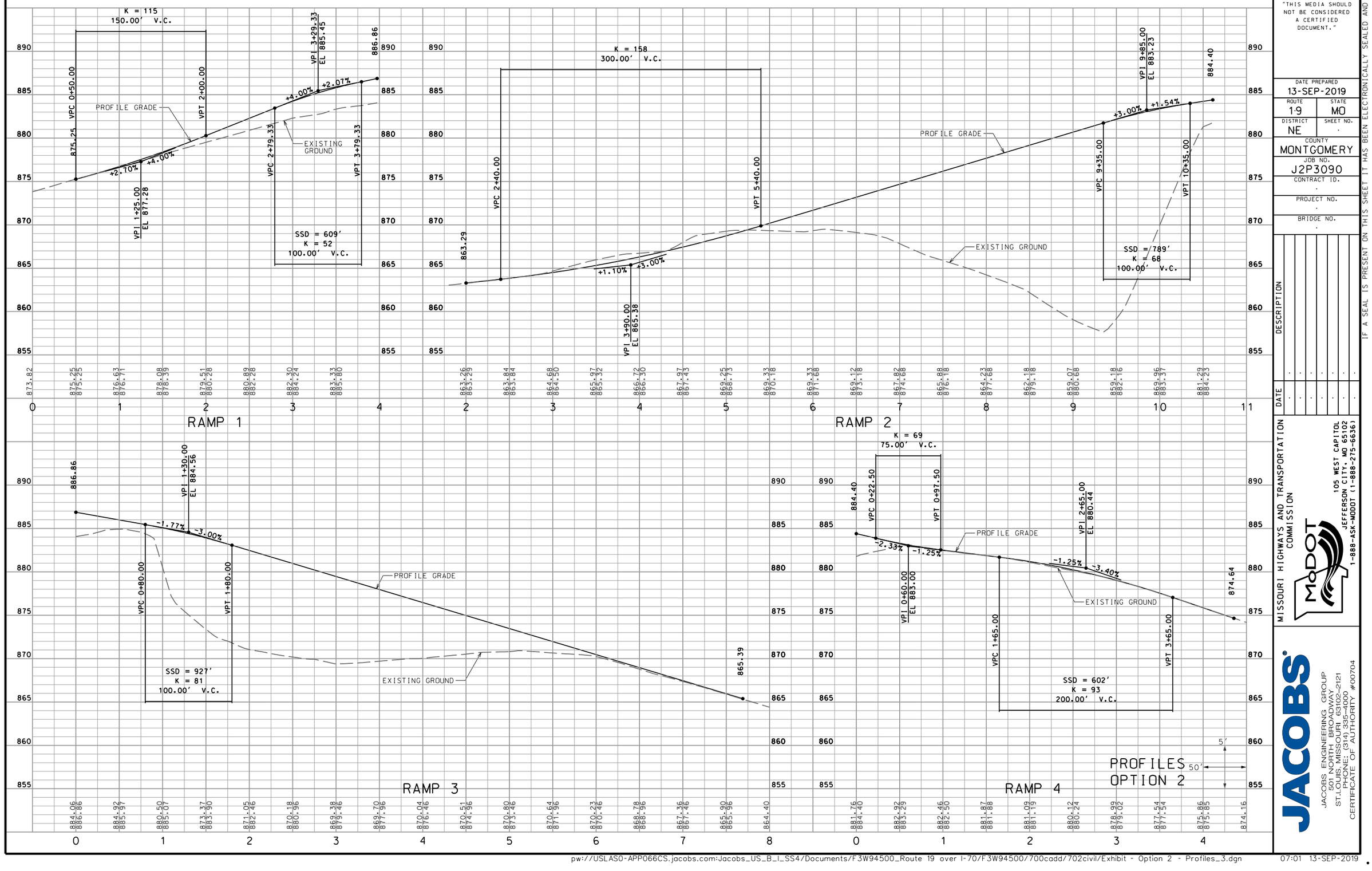

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13-SEP-2019

ROUTE	STATE
19	MO
DISTRICT	SHEET NO.
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COUNTY
MONTGOMERY

JOB NO.
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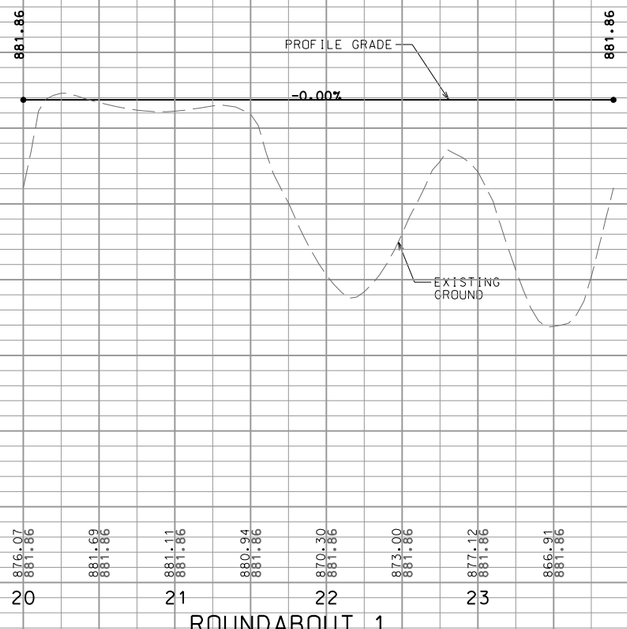

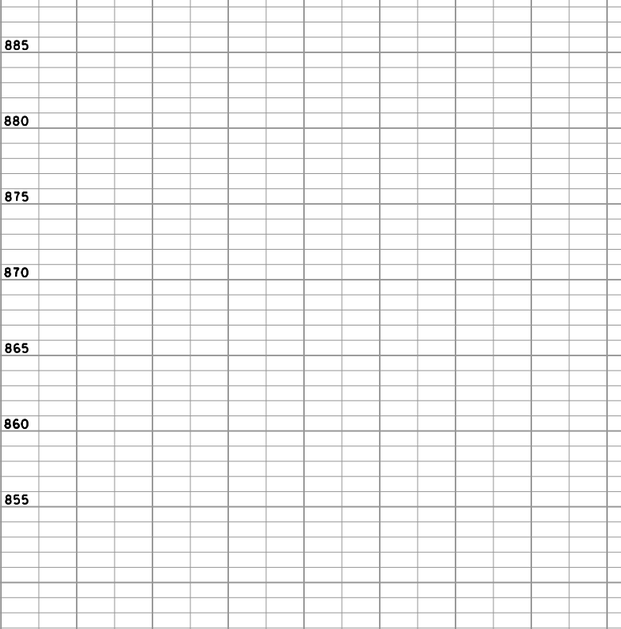

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DATE PREPARED
13-SEP-2019

ROUTE	STATE
19	MO
DISTRICT	SHEET NO.
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COUNTY
MONTGOMERY

JOB NO.
J2P3090

CONTRACT ID.
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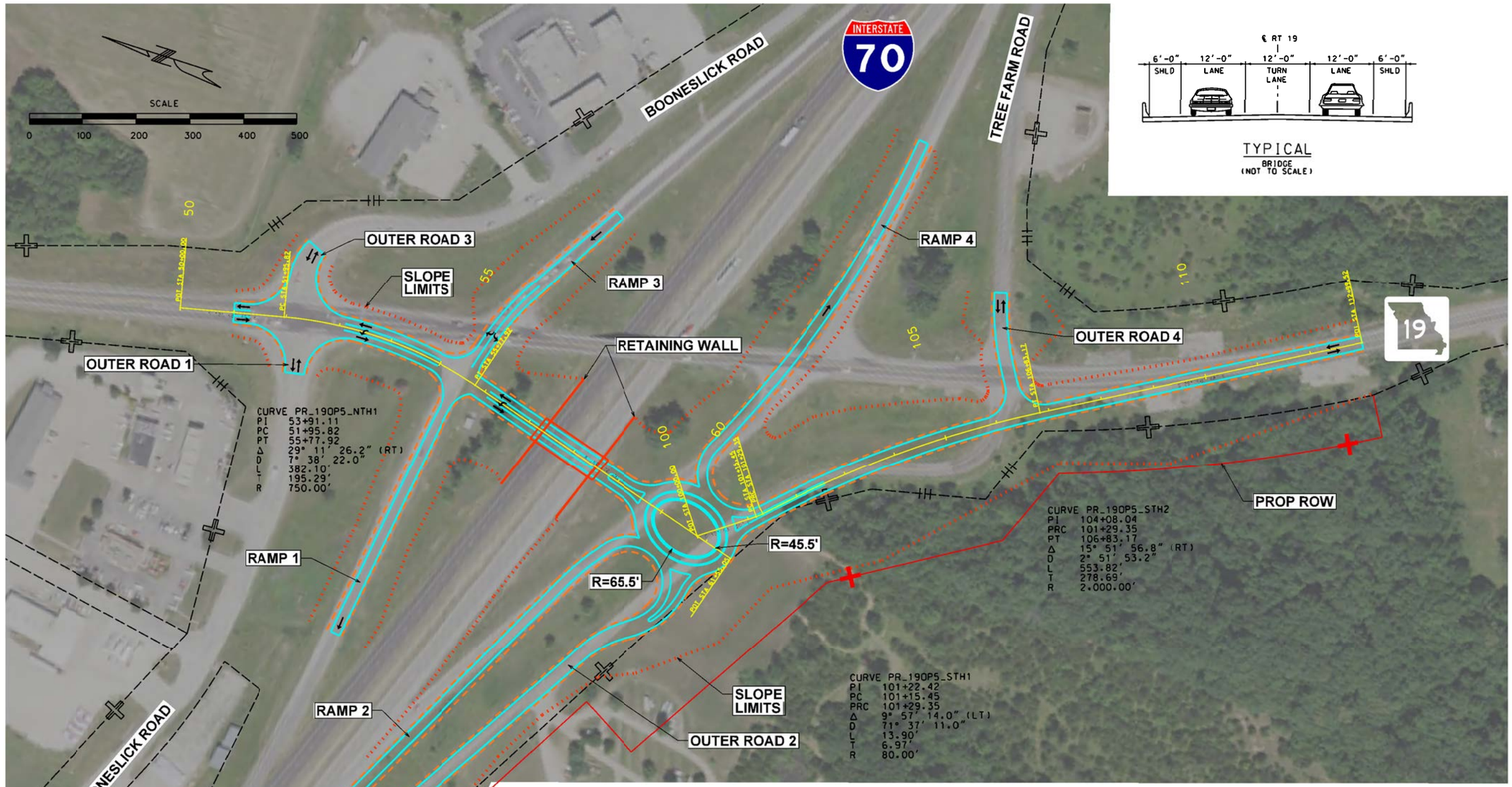
PROFILES
OPTION 2



ROUTE 19
OPTION 5

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DATE PREPARED: 09-JAN-2020
ROUTE: 19 | STATE: MO
DISTRICT: NE | SHEET NO.:
COUNTY: MONTGOMERY
JOB NO.: J2P3090
CONTRACT ID.:
PROJECT NO.:
BRIDGE NO.:

DATE	DESCRIPTION
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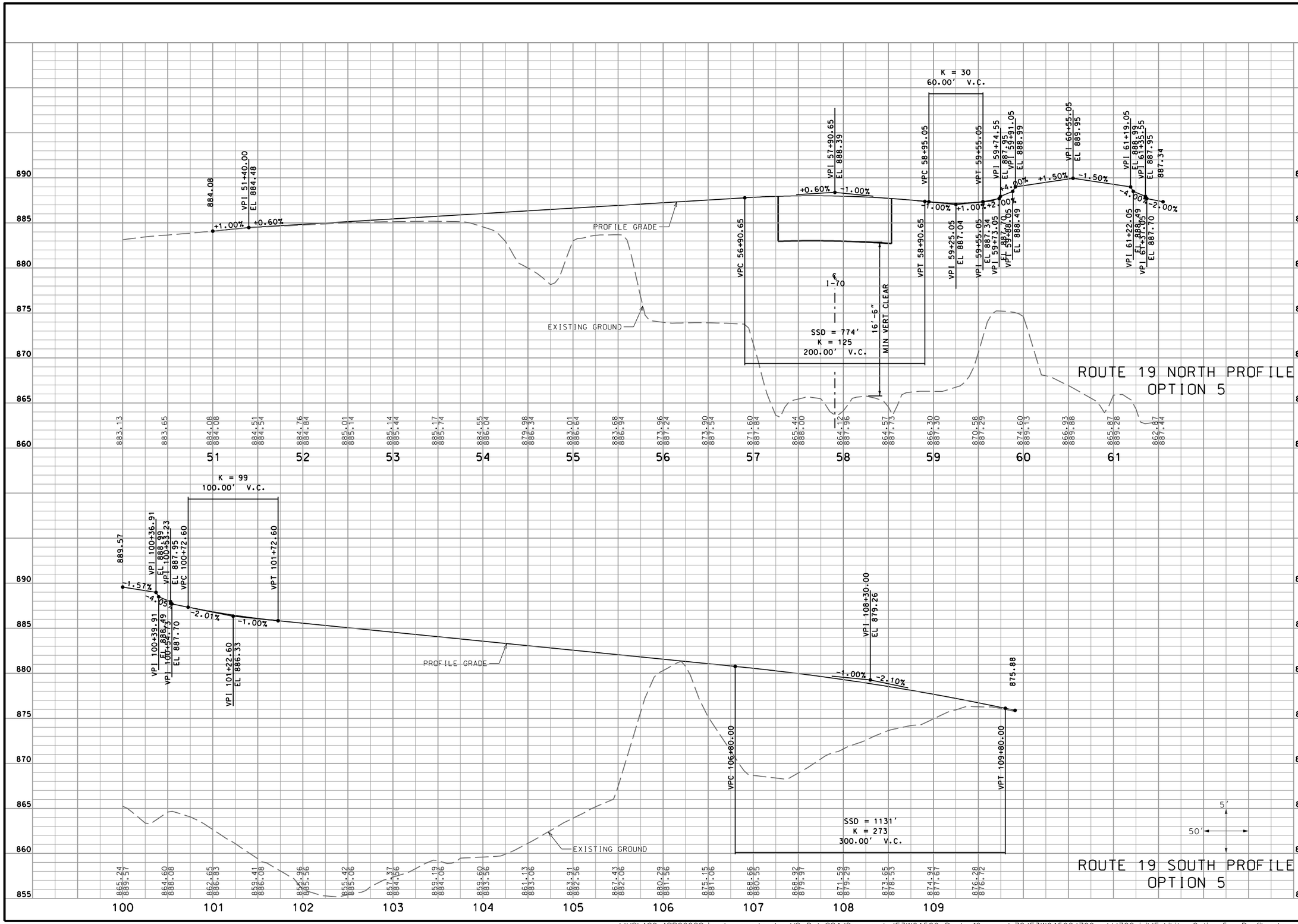

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DATE PREPARED
13-SEP-2019

ROUTE	STATE
19	MO
DISTRICT	SHEET NO.
NE	.

COUNTY
MONTGOMERY

JOB NO.
J2P3090

CONTRACT ID.
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PROJECT NO.
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BRIDGE NO.
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DATE	DESCRIPTION
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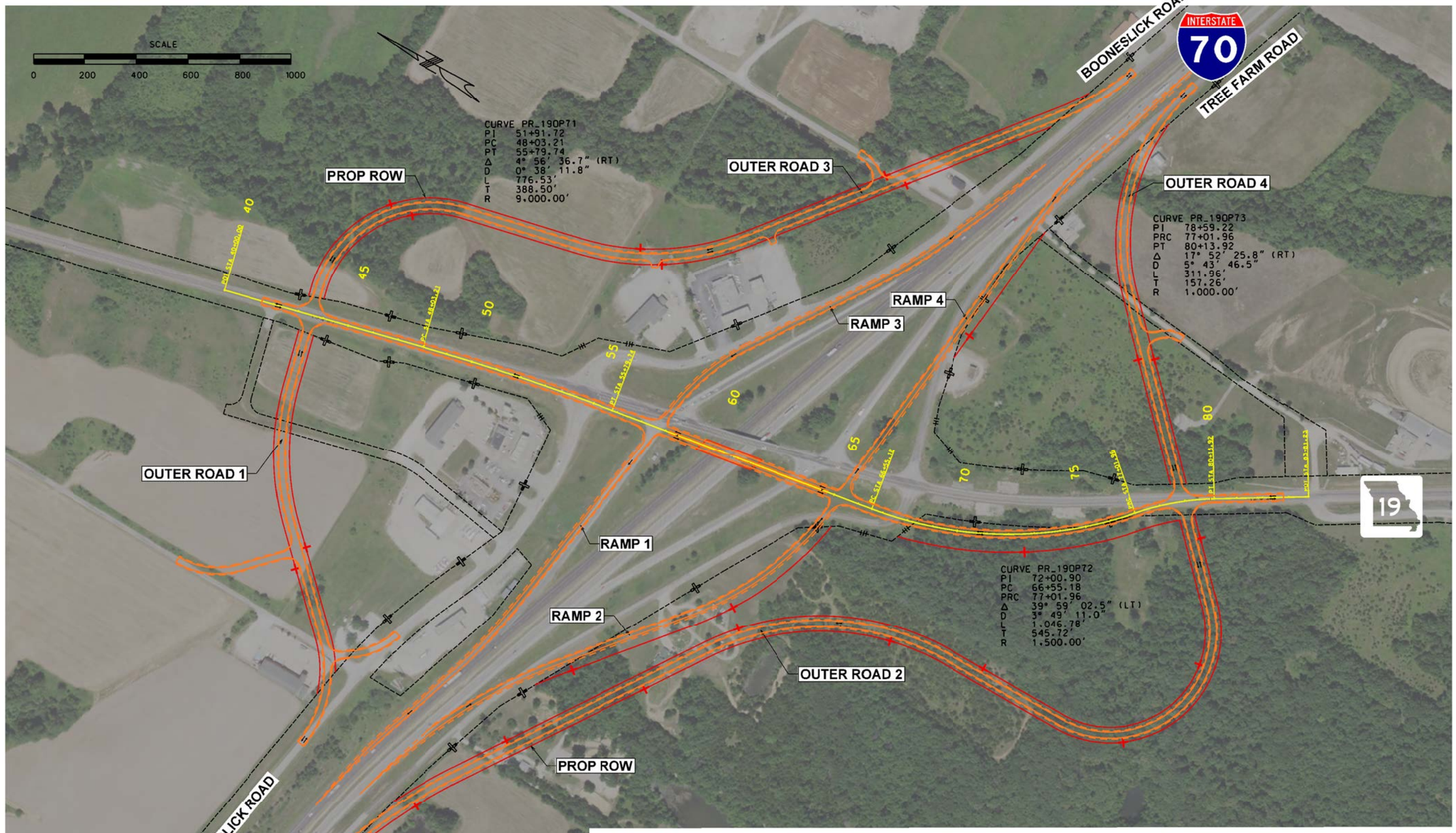
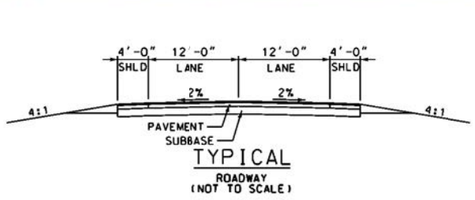
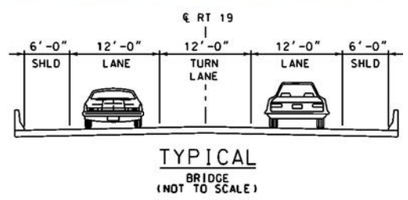




TYPICAL
ROADWAY
(NOT TO SCALE)



TYPICAL
BRIDGE
(NOT TO SCALE)

ROUTE 19
OPTION 7

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DATE PREPARED
09-JAN-2020

ROUTE 19 | STATE MO
DISTRICT NE | SHEET NO. .

COUNTY
MONTGOMERY

JOB NO.
J2P3090

CONTRACT ID.
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PROJECT NO.
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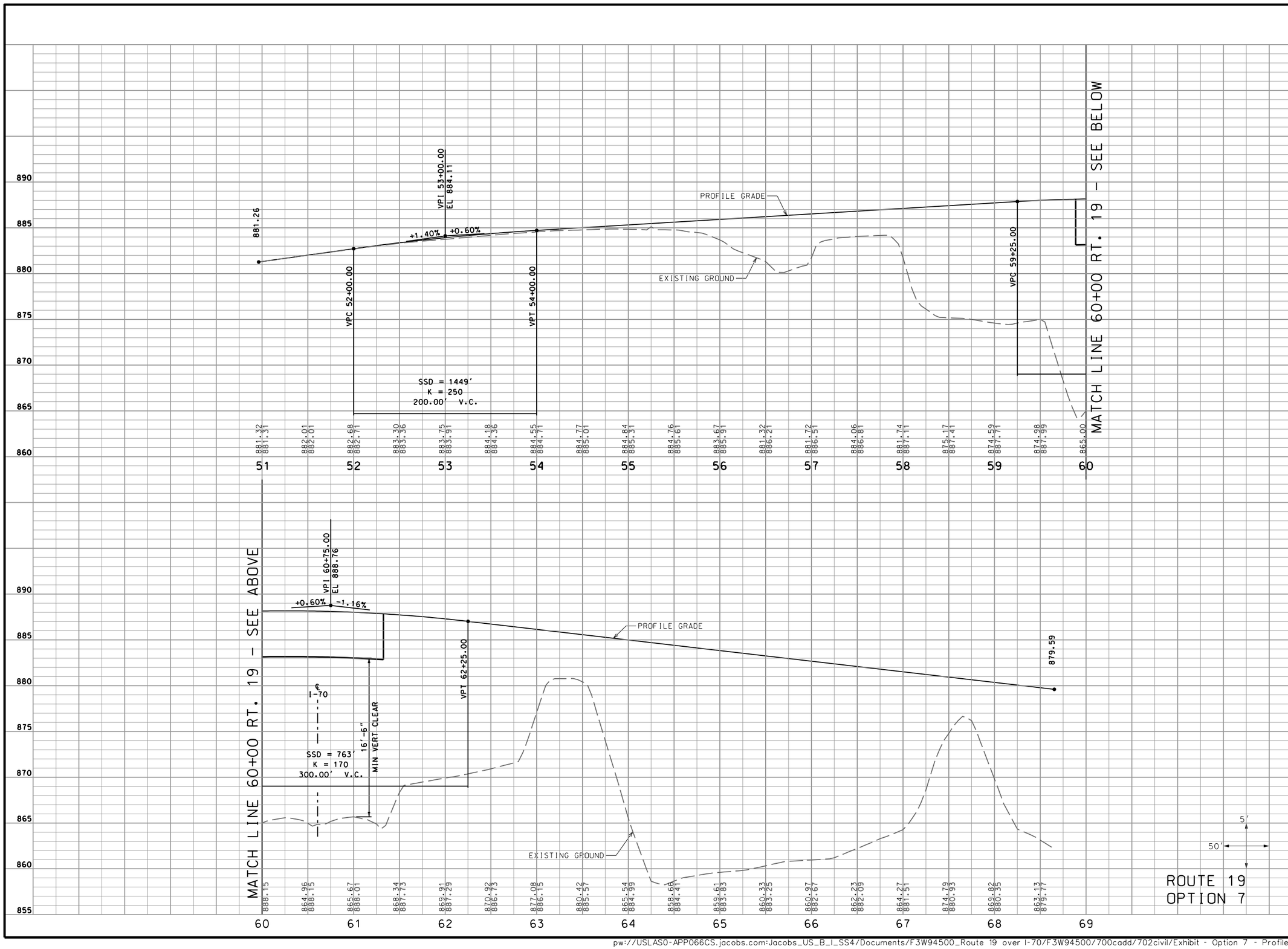

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13-SEP-2019

ROUTE	STATE
19	MO
DISTRICT	SHEET NO.
NE	.

COUNTY
MONTGOMERY

JOB NO.
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CONTRACT ID.
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PROJECT NO.
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BRIDGE NO.
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DATE	DESCRIPTION
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Appendix B

Operational Traffic Analysis

Appendix B: Table 1 – Conceptual Options Comparison: Anticipated Design Year (2021) Operating Conditions

Intersection/Movement	*No-Build*		*Option 1 – Two Roundabouts: North & South*		*Option 2 – Tree Farm Rd. Roundabout (only)*		*Option 5 – South Elliptical Roundabout + 2-lane & AWSC WB Ramp*		*Option 7 – EIS: SOR & NOR AWSC*	
	AM Peak Hour (with new SBL @ SOR)	*PM Peak Hour (with new SBL @ SOR)*	*AM Peak Hour*	*PM Peak Hour*	*AM Peak Hour*	*PM Peak Hour*	*AM Peak Hour*	*PM Peak Hour*	*AM Peak Hour*	*PM Peak Hour*
Tree Farm Rd/SOR at (relocated) Route 19 (twsc) – *this intersection added in Option 5 only*										
Westbound Tree Farm Rd. Approach							C (15.1) 65′	C (18.9) 95′		
Northbound Route 19 Approach							Free Flow	Free Flow		
Southbound Route 19 Approach							A (6.3) 15′	A (5.2) 15′		
Overall Intersection							**A (8.7)**	**A (9.8)**		
MO Route 19 at Tree Farm Road (twsc: No-Build; awsc: Option 7 – noted that twsc achieves acceptable LOS for all movements)										
Eastbound Tree Farm Road Approach	D (25.9) 10′	D (31.2) 10′	A (5.5) 5′	A (6.1) 5′	A (5.3) 5′	A (5.6) 0′	A (6.4) 5′	A (7.0) 5′	A (9.2)	A (9.5)
Westbound Tree Farm Road Approach	C (15.7) 70′	C (19.9) 105′	A (10.0) 35′	A (9.8) 30′	A (9.5) 30′	A (8.8) 25′	-	-	B (13.9)	C (16.6)
Northbound MO Route 19 Approach	A (0.1) 0′	A (0.2) 0′	A (7.4) 20′	A (7.6) 25′	A (7.2) 20′	A (7.5) 20′	B (12.2) 50′	B (11.4) 45′	B (10.8)	B (11.2)
Southbound MO Route 19 Approach	A (5.7) 15′ SBL	A (4.4) 15′ SBL	-	-	A (8.5) 35′	A (9.1) 40′	A (8.5) 40′	A (8.8) 60′	B (11.3)	B (12.0)
Overall Intersection	**A (9.2)**	**B (10.3)**	**-**	**-**	**A (8.5)**	**A (8.5)**	**B (10.1)**	**A (9.8)**	**B (12.2)**	**B (13.6)**
MO Route 19 at I-70 Eastbound Ramp Terminals (twsc)										
Eastbound I-70 Exit Ramp Approach	C (17.4) 35′	C (20.3) 40′	A (7.8) 20′	A (8.3) 20′	C (17.4) 35′	C (20.3) 40′	A (9.4) 20′	A (10.0) 20′	C (17.4) 35′	C (20.3) 40′
Northbound MO Route 19 Approach	Free Flow	Free Flow	-	-	Free Flow	Free Flow	-	-	Free Flow	Free Flow
Southbound MO Route 19 Approach	A (4.5) 10′	A (5.0) 15′	A (6.8) 40′	A (6.9) 55′	A (3.8) 10′L	A (4.2) 15′L	-	-	A (3.8) 10′	A (4.2) 15′L
Overall Intersection	**A (4.7)**	**A (5.7)**	**A (7.9)**	**A (7.8)**	**A (4.4)**	**A (5.3)**	**-**	**-**	**A (4.4)**	**A (5.3)**
MO Route 19 at I-70 Westbound Ramp Terminals (twsc)										
Westbound I-70 Exit Ramp Approach	C (18.7) 80′	C (24.6) 115′	B (13.9) 75′	B (12.3) 70′	C (18.7) 80′	C (24.6) 115′	C (18.7) 80′	C (24.6) 115′	C (18.8) 80′	D (25.4) 120′
Northbound MO Route 19 Approach	A (3.1) 5′	A (3.2) 5′	A (8.5) 30′	A (7.5) 30′	A (2.7) 5′L	A (2.6) 5′L	A (3.1) 5′	A (3.2) 5′	A (2.7) 5′L	A (2.7) 5′L
Southbound MO Route 19 Approach	Free Flow	Free Flow	-	-	Free Flow	Free Flow	Free Flow	Free Flow	Free Flow	Free Flow
Overall Intersection	**A (7.5)**	**A (8.1)**	**-**	**-**	**A (7.4)**	**A (8.0)**	**A (7.5)**	**A (8.1)**	**A (7.4)**	**A (8.2)**
MO Route 19 at Booneslick Road (signalized: No-Build, Option 2, Option 5; awsc: Option 7 – noted that twsc achieves acceptable LOS for all movements)										
Eastbound Booneslick Rd. Approach	A (9.7) 40′	B (11.7) 40′	B (10.1) 25′	A (9.5) 25′	A (9.7) 40′	B (11.7) 40′	A (9.7) 40′	B (11.7) 40′	B (10.7)	B (12.2)
Westbound Booneslick Rd. Approach	B (13.6) 50′	C (21.0) 65′	A (9.6) 15′	A (8.7) 15′	B (13.6) 50′	C (21.0) 65′	B (13.6) 50′	C (21.0) 65′	B (10.4)	B (11.6)
Northbound MO Route 19 Approach	A (6.5) 115′	A (7.0) 95′	-	-	A (6.5) 115′	A (7.0) 95′	A (6.5) 115′	A (7.0) 95′	C (15.7)	C (20.0)
Southbound MO Route 19 Approach	B (11.7) 90′	B (15.0) 130′	B (10.8) 25′	B (13.2) 75′	B (11.7) 90′	B (15.0) 130′	B (11.7) 90′	B (15.0) 130′	B (11.4)	C (20.6)
Overall Intersection	**A (9.2)**	**B (12.1)**	**B (10.9)**	**B (10.8)**	**A (9.2)**	**B (12.1)**	**A (9.2)**	**B (12.1)**	**B (13.1)**	**C (18.3)**

X (XX.X) XXX′: Level of Service (avg. veh delay in sec/veh) 95th Percentile Queue Length in feet

Appendix B: Table 2 – Conceptual Options Comparison: Anticipated Design Year (2041) Operating Conditions

Intersection/Movement	*No-Build*		*Option 1 – Two Roundabouts: North & South*		*Option 2 – Tree Farm Rd. Roundabout (only) + 2-lane & AWSC Ramps*		*Option 5 – South Elliptical Roundabout + 2-lane & AWSC WB Ramp*		*Option 7 – EIS: SOR & NOR AWSC + 2-lane & AWSC Ramps*	
	AM Peak Hour (with SBL & AWSC @ SOR)	*PM Peak Hour (with SBL & AWSC @ SOR)*	*AM Peak Hour*	*PM Peak Hour*	*AM Peak Hour*	*PM Peak Hour*	*AM Peak Hour*	*PM Peak Hour*	*AM Peak Hour*	*PM Peak Hour*
Tree Farm Rd/SOR at (relocated) Route 19 (twsc) – *this intersection added in Option 5 only*										
Westbound Tree Farm Rd. Approach							C (18.0) 90′	C (17.1) 65′		
Northbound Route 19 Approach							Free Flow	Free Flow		
Southbound Route 19 Approach							A (6.2) 15′	A (5.3) 15′		
Overall Intersection							**A (9.6)**	**A (7.5)**		
MO Route 19 at Tree Farm Road (awsc: No-Build, Option 7); EBR and WBR auxiliary lanes added for Option 7										
Eastbound Tree Farm Road Approach	D (33.4)	C (19.6)	B (14.8) 55′	C (15.8) 45′	B (13.3) 40′	B (12.3) 30′	C (17.8) 60′	C (21.2) 55′	D (28.3)	B (12.4)
Westbound Tree Farm Road Approach	D (31.9)	E (37.0)	C (17.4) 75′	C (15.4) 50′	C (15.6) 65′	B (12.5) 35′	-	-	C (22.9)	A (8.1)
Northbound MO Route 19 Approach	C (19.3)	C (18.0)	B (12.0) 35′	B (12.6) 45′	B (11.2) 30′	B (10.6) 30′	C (24.8) 165′	C (23.4) 140′	C (18.9)	B (11.9)
Southbound MO Route 19 Approach	C (19.8)	D (26.0)	-	-	B (14.9) 75′	B (13.9) 80′	B (13.6) 75′	C (16.9) 110′	C (18.8)	B (14.4)
Overall Intersection	**D (26.4)**	**D (27.1)**	**-**	**-**	**B (14.1)**	**B (12.7)**	**C (18.2)**	**C (19.9)**	**C (22.3)**	**B (11.9)**
MO Route 19 at I-70 Eastbound Ramp Terminals (twsc: No-Build; awsc: Option 2, Option 7); SBL added for Options 2 & 7										
Eastbound I-70 Exit Ramp Approach	E (35.1) 115′	E (38.8) 105′	B (13.6) 40′	B (14.6) 50′	A (7.8)	A (7.8)	C (18.0) 50′	C (22.0) 70′	A (7.8)	A (7.8)
Northbound MO Route 19 Approach	Free Flow	Free Flow	-	-	D (30.5)	C (16.1)	-	-	D (30.5)	C (16.1)
Southbound MO Route 19 Approach	A (4.4) 15′	A (5.0) 20′	A (9.8) 70′	B (10.2) 90′	B (12.6)	B (12.6)	-	-	B (12.6)	B (12.6)
Overall Intersection	**A (7.8)**	**A (8.4)**	**B (12.9)**	**B (12.7)**	**C (19.8)**	**B (13.1)**	**-**	**-**	**C (19.8)**	**B (13.1)**
MO Route 19 at I-70 Westbound Ramp Terminals (twsc: No-Build; awsc: Option 2, Option 5, Option 7); NBL added for Options 2, 5 & 7										
Westbound I-70 Exit Ramp Approach	F (123.2) 390′	F (259.7) 570′	D (34.5) 230′	D (32.6) 220′	A (9.6)	A (9.7)	A (9.6)	A (9.8)	A (9.6)	A (9.7)
Northbound MO Route 19 Approach	A (4.5) 15′	A (4.9) 15′	B (12.0) 55′	B (11.7) 65′	B (11.8)	B (11.9)	B (11.8)	B (12.3)	B (11.8)	B (11.9)
Southbound MO Route 19 Approach	Free Flow	Free Flow	-	-	C (15.7)	D (32.1)	C (15.7)	C (23.1)	C (15.7)	D (32.1)
Overall Intersection	**E (44.5)**	**F (79.0)**	**-**	**-**	**B (12.3)**	**C (19.8)**	**B (12.3)**	**C (15.5)**	**B (12.3)**	**C (19.8)**
MO Route 19 at Booneslick Road (signalized: No-Build, Option 2, Option 5; awsc: Option 7); NBR AND SBR auxiliary lanes added for Option 7										
Eastbound Booneslick Rd. Approach	B (11.5) 45′	B (12.3) 45′	C (16.1) 40′	B (14.6) 40′	B (11.5) 45′	B (12.3) 45′	B (11.5) 45′	B (12.3) 45′	B (11.6)	B (13.3)
Westbound Booneslick Rd. Approach	B (15.7) 55′	C (23.5) 70′	B (14.6) 25′	B (13.7) 25′	B (15.7) 55′	C (23.5) 70′	B (15.7) 55′	C (23.5) 70′	B (11.1)	B (12.3)
Northbound MO Route 19 Approach	A (7.9) 145′	A (7.4) 120′	-	-	A (7.9) 145′	A (7.5) 130′	A (7.9) 145′	A (7.4) 120′	C (17.7)	C (24.5)
Southbound MO Route 19 Approach	B (13.4) 115′	B (18.0) 175′	C (20.3) 90′	D (30.3) 190′	B (13.4) 115′	B (18.0) 175′	B (13.4) 115′	B (18.0) 175′	B (12.5)	C (21.0)
Overall Intersection	**B (10.8)**	**B (13.7)**	**C (21.2)**	**C (22.7)**	**B (10.8)**	**B (13.7)**	**B (10.8)**	**B (13.7)**	**B (14.6)**	**C (20.4)**

X (XX.X) XXX′: Level of Service (avg. veh delay in sec/veh) 95th Percentile Queue Length in feet

Appendix B: Table 3 – Option 2 Conceptual Alternatives Comparison: Anticipated Design Year (2021) Operating Conditions

Intersection/Movement	*No-Build*		*BUILD 1 – SOR Signal*		*BUILD 2 – SOR Roundabout*	
	AM Peak Hr. with SBL @ SOR	*PM Peak Hr. with SBL @ SOR*	*AM Peak Hr.*	*PM Peak Hr.*	*AM Peak Hr.*	*PM Peak Hr.*
MO Route 19 at Tree Farm Road *(Build signal = semi-actuated, uncoordinated to be conservative)*						
Eastbound Tree Farm Road Approach	D (25.9) 10′	D (31.2) 10′	A (9.1) 5′	A (8.3) 10′	A (5.3) 5′	A (5.6) 0′
Westbound Tree Farm Road Approach	C (15.7) 70′	C (19.9) 105′	B (11.0) 15′	B (12.1) 0′	A (9.5) 30′	A (8.8) 25′
Northbound MO Route 19 Approach	A (0.1) 0′	A (0.2) 0′	A (6.2) 40′	A (6.5) 50′	A (7.2) 20′	A (7.5) 20′
Southbound MO Route 19 Approach	A (5.7) 15′ SBL	A (4.4) 15′ SBL	A (9.7) 70′L	B (10.2) 65′L	A (8.5) 35′	A (9.1) 40′
Overall Intersection	**A (9.2)**	**B (10.3)**	**A (9.5)**	**B (10.3)**	**A (8.5)**	**A (8.5)**
MO Route 19 at I-70 Eastbound Ramp Terminals (twsc); SBL added for Build 3 & 4						
Eastbound I-70 Exit Ramp Approach	C (17.4) 35′	C (20.3) 40′	C (17.4) 35′	C (20.3) 40′	C (17.4) 35′	C (20.3) 40′
Northbound MO Route 19 Approach	Free Flow	Free Flow	Free Flow	Free Flow	Free Flow	Free Flow
Southbound MO Route 19 Approach	A (4.5) 10′	A (5.0) 15′	A (3.8) 10′L	A (4.2) 15′L	A (3.8) 10′L	A (4.2) 15′L
Overall Intersection	**A (4.7)**	**A (5.7)**	**A (4.4)**	**A (5.3)**	**A (4.4)**	**A (5.3)**
MO Route 19 at I-70 Westbound Ramp Terminals (twsc); NBL added for Build 3 & 4						
Westbound I-70 Exit Ramp Approach	C (18.7) 80′	C (24.6) 115′	C (18.7) 80′	C (24.6) 115′	C (18.7) 80′	C (24.6) 115′
Northbound MO Route 19 Approach	A (3.1) 5′	A (3.2) 7′	A (2.7) 5′L	A (2.6) 5′L	A (2.7) 5′L	A (2.6) 5′L
Southbound MO Route 19 Approach	Free Flow	Free Flow	Free Flow	Free Flow	Free Flow	Free Flow
Overall Intersection	**A (7.5)**	**A (8.1)**	**A (7.4)**	**A (8.0)**	**A (7.4)**	**A (8.0)**
MO Route 19 at Booneslick Road (signalized)						
Eastbound Booneslick Rd. Approach	A (9.7) 40′	B (11.7) 40′	A (9.7) 40′	B (11.7) 40′	A (9.7) 40′	B (11.7) 40′
Westbound Booneslick Rd. Approach	B (13.6) 50′	C (21.0) 65′	B (13.6) 50′	C (21.0) 65′	B (13.6) 50′	C (21.0) 65′
Northbound MO Route 19 Approach	A (6.5) 115′	A (7.0) 95′	A (6.5) 115′	A (7.0) 95′	A (6.5) 115′	A (7.0) 95′
Southbound MO Route 19 Approach	B (11.7) 90′	B (15.0) 130′	B (11.7) 90′	B (15.0) 130′	B (11.7) 90′	B (15.0) 130′
Overall Intersection	**A (9.2)**	**B (12.1)**	**A (9.2)**	**B (12.1)**	**A (9.2)**	**B (12.1)**

X (XX.X) XXX′: Level of Service (avg. veh delay in sec/veh) 95th Percentile Queue Length in feet; #: volume exceeds capacity

Appendix B: Table 4 - Option 2 Conceptual Alternatives Comparison: Anticipated Design Year (2041) Operating Conditions

Intersection/Movement	*No-Build*		*BUILD 1 – SOR Signal*		*BUILD 2 – SOR Roundabout*		*BUILD 3 – SOR RAB +2-lane Ramps*		*BUILD 4 – SOR RAB +2-lane & AWSC Ramps*	
	AM Peak Hr. with SBL & AWSC @ SOR	*PM Peak Hr. with SBL & AWSC @ SOR*	*AM Peak Hr.*	*PM Peak Hr.*	*AM Peak Hr.*	*PM Peak Hr.*	*AM Peak Hr.*	*PM Peak Hr.*	*AM Peak Hr.*	*PM Peak Hr.*
MO Route 19 at Tree Farm Road *(Build signal = semi-actuated, uncoordinated to be conservative)*										
Eastbound Tree Farm Road Approach	D (33.4)	C (19.6)	E (55.3) 90′	D (44.8) 100′#	B (13.3) 40′	B (12.3) 30′	B (13.3) 40′	B (12.3) 30′	B (13.3) 40′	B (12.3) 30′
Westbound Tree Farm Road Approach	D (31.9)	E (37.0)	A (5.3) 10′	A (9.2) 0′	C (15.6) 65′	B (12.5) 35′	C (15.6) 65′	B (12.5) 35′	C (15.6) 65′	B (12.5) 35′
Northbound MO Route 19 Approach	C (19.3)	C (18.0)	B (16.4) 80′	A (9.8) 65′	B (11.2) 30′	B (10.6) 30′	B (11.2) 30′	B (10.6) 30′	B (11.2) 30′	B (10.6) 30′
Southbound MO Route 19 Approach	C (19.8)	D (26.0)	B (18.5) 135′L#	B (12.5) 65′	B (14.9) 75′	B (13.9) 80′	B (14.9) 75′	B (13.9) 80′	B (14.9) 75′	B (13.9) 80′
Overall Intersection	**D (26.4)**	**D (27.1)**	**C (23.8)**	**B (15.9)**	**B (14.1)**	**B (12.7)**	**B (14.1)**	**B (12.7)**	**B (14.1)**	**B (12.7)**
MO Route 19 at I-70 Eastbound Ramp Terminals (twsc); SBL added for Build 3 & 4										
Eastbound I-70 Exit Ramp Approach	E (35.1) 115′	E (38.8) 105′	E (35.1) 115′	E (38.8) 105′	E (35.1) 115′	E (38.8) 105′	C (21.4) 50′	D (25.2) 55′	B (10.9)	A (7.8)
Northbound MO Route 19 Approach	Free Flow	Free Flow	Free Flow	Free Flow	Free Flow	Free Flow	Free Flow	Free Flow	D (30.5)	C (16.1)
Southbound MO Route 19 Approach	A (4.4) 15′	A (5.0) 20′	A (3.3) 15′L	A (3.7) 20′	A (3.3) 15′	A (3.7) 20′	A (3.3) 15′L	A (3.7) 20′	B (12.6)	B (12.6)
Overall Intersection	**A (7.8)**	**A (8.4)**	**A (7.3)**	**A (7.8)**	**A (7.3)**	**A (7.8)**	**A (5.0)**	**A (5.7)**	**C (19.8)**	**B (13.1)**
MO Route 19 at I-70 Westbound Ramp Terminals (twsc); NBL added for Build 3 & 4										
Westbound I-70 Exit Ramp Approach	F (123.2) 390′	F (259.7) 570′	F (123.2) 390′	F (259.7) 570′	F (123.2) 390′	F (259.7) 570′	E (38.6) 210′	F (150.1) 435′	B (13.2)	A (9.7)
Northbound MO Route 19 Approach	A (4.5) 15′	A (4.9) 15′	A (3.6) 15′	A (3.8) 15′L	A (3.6) 15′	A (3.8) 15′	A (3.6) 15′L	A (3.8) 15′L	B (11.8)	B (11.9)
Southbound MO Route 19 Approach	Free Flow	Free Flow	Free Flow	Free Flow	Free Flow	Free Flow	Free Flow	Free Flow	C (15.7)	D (32.1)
Overall Intersection	**E (44.5)**	**F (79.0)**	**E (44.2)**	**F (78.7)**	**E (44.2)**	**F (78.7)**	**B (14.7)**	**E (45.9)**	**B (12.3)**	**C (19.8)**
MO Route 19 at Booneslick Road (signalized)										
Eastbound Booneslick Rd. Approach	B (11.5) 45′	B (12.3) 45′	B (11.5) 45′	B (12.3) 45′	B (11.5) 45′	B (12.3) 45′	B (11.5) 45′	B (12.3) 45′	B (11.5) 45′	B (12.3) 45′
Westbound Booneslick Rd. Approach	B (15.7) 55′	C (23.5) 70′	B (15.7) 55′	C (23.5) 70′	B (15.7) 55′	C (23.5) 70′	B (15.7) 55′	C (23.5) 70′	B (15.7) 55′	C (23.5) 70′
Northbound MO Route 19 Approach	A (7.9) 145′	A (7.4) 120′	A (7.9) 145′	A (7.4) 120′	A (7.9) 145′	A (7.4) 120′	A (7.9) 145′	A (7.4) 120′	A (7.9) 145′	A (7.5) 130′
Southbound MO Route 19 Approach	B (13.4) 115′	B (18.0) 175′	B (13.4) 115′	B (18.0) 175′	B (13.4) 115′	B (18.0) 175′	B (13.4) 115′	B (18.0) 175′	B (13.4) 115′	B (18.0) 175′
Overall Intersection	**B (10.8)**	**B (13.7)**	**B (10.8)**	**B (13.7)**	**B (10.8)**	**B (13.7)**	**B (10.8)**	**B (13.7)**	**B (10.8)**	**B (13.7)**

X (XX.X) XXX′: Level of Service (avg. veh delay in sec/veh) 95th Percentile Queue Length in feet; #: volume exceeds capacity

Appendix C

Cost Estimate

Facility: **Rt 19 over I-70**

Project: **J2P3090**

Date: **September 13, 2019**

Type of Estimate: **Conceptual Design Alternatives**

Category						Rt 19 Option 1 *Dual 6-leg Roundabouts with Bridge Option E*		Rt 19 Option 2 *Signalized Intersection with Roundabout and Bridge Option B*		Rt 19 Option 2 *Signalized Intersection with Roundabout and Bridge Option C*		Rt 19 Option 5 *Signalized Intersection with Perpendicular Bridge and Oval Roundabout Bridge Option B*		Rt 19 Option 7 *Relocated Outer Roads Bridge Option B*		
ROADWAY	**Item**	**Unit**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Item**	**Unit**	**Cost/Unit**	**Number of Units**	**TOTAL COST**
	Removal of Improvements	LS	$135,000	1.0	$135,000	$135,000	1.0	$135,000	$135,000	1.0	$135,000	$135,000	1.0	$135,000	Removal of Improvements	LS	$500,000	1.0	$500,000
	Excavation	C.Y.	$6	8200.0	$49,200	$6	8600.0	$51,600	$6	8500.0	$51,000	$6	3000.0	$18,000	Clearing and Grubbing	Acre	$4,000	19.3	$77,200
	Fill														**New 2 Lane (Minor)**				
	Compacting Embankment	C.Y.	$2	31000.0	$62,000	$2	25750.0	$51,500	$2	25000.0	$50,000	$2	27000.0	$54,000	Grading & Drainage	Mile	$617,000	3.0	$1,851,000
	Embankment in Place (Borrow)	C.Y.	$10	156000.0	$1,560,000	$10	113250.0	$1,132,500	$10	109500.0	$1,095,000	$10	169000.0	$1,690,000	**Interchange Ramps**				
	Subgrade Treatment	Lane Mile	$75,000	0.5	$37,500	$75,000	0.5	$37,500	$75,000	0.5	$37,500	$75,000	0.5	$37,500	Grading & Drainage	Each	$1,366,000	4.0	$5,464,000
	Roadway Subtotal				$1,843,700			$1,408,100			$1,368,500			$1,934,500	**Roadway Subtotal**				$7,892,200
DRAINAGE	**Item**	**Unit**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Item**	**Unit**	**Cost/Unit**	**Number of Units**	**TOTAL COST**
	Drainage System	LS	$50,000	1.0	$50,000	$30,000	1.0	$30,000	$30,000	1.0	$30,000	$75,000	1.0	$75,000	Drainage System				
	Drainage Subtotal				$50,000			$30,000			$30,000			$75,000	(Cost included in lane mile estimate)				
PAVEMENT	**Item**	**Unit**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Item**	**Unit**	**Cost/Unit**	**Number of Units**	**TOTAL COST**
	New/Reconstruction Pavement														**New 2 Lane (Minor)**				
	Pavement	SY	$75	21155.0	$1,586,700	$75	20181.9	$1,513,700	$75	19909.9	$1,493,300	$75	19102.8	$1,432,800					
	Shoulder	SY	$45	7382.8	$332,300	$45	6747.3	$303,700	$45	6644.4	$299,000	$45	7107.2	$319,900	Base & Surface	Mile	$619,000	3.0	$1,857,000
	Base	SY	$10	28537.8	$285,400	$10	26929.2	$269,300	$10	26554.3	$265,600	$10	26210.0	$262,100	**Interchange Ramps**				
	Raised Median	SY	$54	2016.8	$109,000	$54	558.6	$30,200	$54	558.6	$30,200	$54	415.0	$22,500	Base & Surface	Each	$846,000	4.0	$3,384,000
	Curb and Gutter	LF	$27	4809.0	$129,900	$27	1680.0	$45,400	$27	1680.0	$45,400	$27	1579.0	$42,700					
	Pavement Subtotal				$2,443,300			$2,162,300			$2,133,500			$2,080,000	**Pavement Subtotal**				$5,241,000
TRAFFIC SIGNAL	**Item**	**Unit**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Item**	**Unit**	**Cost/Unit**	**Number of Units**	**TOTAL COST**
	Traffic Signal	Each	$250,000	0.0	$0	$250,000	1.0	$250,000	$250,000	1.0	$250,000	$250,000	1.0	$250,000					
	Traffic Signal Subtotal				$0			$250,000			$250,000			$250,000	**Traffic Control Subtotal**				
RETAINING WALLS (Non-Bridge)	**Item**	**Unit**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Item**	**Unit**	**Cost/Unit**	**Number of Units**	**TOTAL COST**
	Retaining Wall - MSE	S.F.	$65	1000.0	$65,000	$65		$0	$65		$0	$65		$0					
	Retaining Wall Subtotal				$65,000			$0			$0			$0	**Retaining Wall Subtotal**				
BRIDGES	**Item**	**Unit**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Item**	**Unit**	**Cost/Unit**	**Number of Units**	**TOTAL COST**
	New Structures		Option E			Option B			Option C										
	RT 19 over I-70	Each	$1,398,185	1.0	$1,398,200	$1,867,931	1.0	$1,868,000	$2,251,607	1.0	$2,251,700	$1,424,708	1.0	$1,424,800	Bridge	Each	$1,651,244	1.0	$1,651,300
	Structure Subtotal				$1,398,200			$1,868,000			$2,251,700			$1,424,800	**Structure Subtotal**				$1,651,300
OTHER	**Item**	**Unit**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Cost/Unit**	**Number of Units**	**TOTAL COST**	**Item**	**Unit**	**Cost/Unit**	**Number of Units**	**TOTAL COST**
	Right-of-way	AC		3.3	$876,100		4.5	$960,800		4.5	$960,800	**	4.6	$975,000	Right-of-Way	AC	**	19.3	$4,342,500
	Utility Adjustments	Each	$500,000	1.0	$500,000	$500,000	1.0	$500,000	$500,000	1.0	$500,000	$500,000	1.0	$500,000	Utility Adjustments	Each	$500,000	1.0	$500,000
	Environmental Mitigation	$/AC	$6,200	3.3	$20,500	$6,200	4.5	$27,900	$6,200	4.5	$27,900	$6,200	4.6	$28,600	Environmental Mitigation	$/AC	$6,200	19.3	$119,700
	Other Subtotal				$1,396,600			$1,488,700			$1,488,700			$1,503,600	**Other Subtotal**				$4,962,200
	Subtotal of Above Costs				$7,196,800			$7,207,100			$7,522,400			$7,267,900	**Subtotal of Above Costs**				$19,746,700
	Maintenance of Traffic		10%		$719,700	5%		$360,400	5%		$376,200	5%		$363,400	**Maintenance of Traffic**	5%			$987,400
	Mobilization		5%		$359,900	5%		$360,400	5%		$376,200	5%		$363,400	**Mobilization**	5%			$987,400
	Design Contingency		20%		$1,439,400	20%		$1,441,500	20%		$1,504,500	20%		$1,453,600	**Design Contingency**	20%			$3,949,400
	TOTAL CONSTRUCTION BUDGET COST				**$9,715,800**			**$9,369,400**			**$9,779,300**			**$9,448,300**	**TOTAL CONSTRUCTION BUDGET COST**				**$25,670,900**

**ROW cost estimated per Options 1 & 2

**ROW cost estimated per Options 1 & 2

JACOBS

Estimated Quantities and Costs for Route 19 over I-70 Job: J2P3090				Option 1A 2-Span (concrete) with MSE Walls on Shoulder		Option 1B 2-Span (concrete) with MSE Walls behind Ditch		Option 1C 4-Span (Concrete) with Spill Slopes		Option 1D 2-Span (Steel) with Spill Slopes		Option 1E 2-Span (Concrete) with Spill Slopes	
Item No	Item	Unit	Unit Price	Estimated Quantity	Estimated Cost	Estimated Quantity	Estimated Cost	Estimated Quantity	Estimated Cost	Estimated Quantity	Estimated Cost	Estimated Quantity	Estimated Cost
206-10.00	cu. yard	Class 1 Excavation	$40.00	165	$6,600.00	200	$8,000.00	165	$6,600.00	190	$7,600.00	235	$9,400.00
216-05.00	lump sum	Removal of Bridges	$15.00		$117,016.25		$117,016.25		$117,016.25		$117,016.25		$117,016.25
503-10.10A	sq. yard	Bridge Approach Slab (Major Road)	$250.00	164	$41,000.00	164	$41,000.00	164	$41,000.00	164	$41,000.00	164	$41,000.00
701-11.07	linear foot	Drilled Shafts (4 ft. 6 in. Dia)	$900.00	54.0	$48,600.00	54.0	$48,600.00	162.0	$145,800.00	54.0	$48,600.00	54.0	$48,600.00
701-12.06	linear foot	Rock Sockets (4 ft. 0 in. Dia.)	$1,500.00	42.0	$63,000.00	42.0	$63,000.00	126.0	$189,000.00	42.0	$63,000.00	42.0	$63,000.00
701-13.00	each	Video Camera Inspection	$1,000.00	3	$3,000.00	3	$3,000.00	9	$9,000.00	3	$3,000.00	3	$3,000.00
701-14.00	linear foot	Foundation Inspection Holes	$150.00	72.0	$10,800.00	72.0	$10,800.00	216.0	$32,400.00	72.0	$10,800.00	72.0	$10,800.00
701-16.00	each	Sonic Logging Testing	$3,000.00	3	$9,000.00	3	$9,000.00	9	$27,000.00	3	$9,000.00	3	$9,000.00
702-12.12	linear foot	Galvanized Structural Steel Piles (12 in.)	$70.00	540	$37,800.00	540	$37,800.00	540	$37,800.00	540	$37,800.00	540	$37,800.00
702-70.00	each	Pile Point Reinforcement	$125.00	12	$1,500.00	12	$1,500.00	12	$1,500.00	12	$1,500.00	12	$1,500.00
703-20.03	cu. yard	Class B Concrete (Substructure)	$850.00	94.5	$80,325.00	94.5	$80,325.00	192.2	$163,370.00	94.5	$80,325.00	94.5	$80,325.00
703-42.12	sq. yard	Slab on Steel	$400.00		$0.00		$0.00		$0.00	1195	$478,000.00		$0.00
703-42.19A	linear foot	Barrier Curb (Type D)	$90.00	406	$36,540.00	486	$43,740.00	617	$55,530.00	617	$55,530.00	617	$55,530.00
703-42.21	sq. yard	Slab on Concrete NU-Girder	$380.00	742	$281,960.00	914	$347,320.00	1195	$454,100.00		$0.00	1195	$454,100.00
705-60.21	linear foot	NU 35, Prestressed Concrete NU-Girder	$250.00	674	$168,500.00	0	$0.00	1091	$272,750.00	0	$0.00	0	$0.00
705-60.22	linear foot	NU 43, Prestressed Concrete NU-Girder	$270.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00
705-60.23	linear foot	NU 53, Prestressed Concrete NU-Girder	$280.00	0	$0.00	834	$233,520.00	0	$0.00	0	$0.00	0	$0.00
705-60.25	linear foot	NU 70, Prestressed Concrete NU-Girder	$290.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1370	$397,300.00
706-10.60	pound	Reinforcing Steel (Bridges)	$1.25	10270	$12,837.50	10270	$12,837.50	30810	$38,512.50	10270	$12,837.50	10270	$12,837.50
710-10.00	pound	Reinforcing Steel (Epoxy Coated)	$1.40	9780	$13,692.00	9780	$13,692.00	29330	$41,062.00	9780	$13,692.00	9780	$13,692.00
711-02.00	lump sum	Protective Coating - Concrete Bents and Piers (Epoxy)			$1,884.96		$1,884.96		$5,654.87		$1,884.96		$1,884.96
711-03.00	lump sum	Concrete and Masonry Protection System			$4,818.00		$4,818.00		$0.00		$0.00		$0.00
711-04.00	lump sum	Sacrificial Graffiti Protection System			$4,818.00		$4,818.00		$0.00		$0.00		$0.00
712-11.21	pound	Fabricated Structural Low Alloy Steel (Plate Girder) A709 Grade 50	$1.70	0	$0.00	0	$0.00	0	$0.00	458410	$779,297.00	0	$0.00
712-33.01	each	Steel Intermediate Diaphragms for P/S Concrete Girders	$1,000.00	0	$0.00	12	$12,000.00	0	$0.00	0	$0.00	16	$16,000.00
712-36.10	each	Slab Drain	$600.00	12	$7,200.00	16	$9,600.00	20	$12,000.00	20	$12,000.00	20	$12,000.00
712-53.65A	sq. foot	Intermediate Field Coat (System G)	$3.20	0	$0.00	0	$0.00	0	$0.00	15000	$48,000.00	0	$0.00
712-53.70A	sq. foot	Finish Field Coat (System G)	$3.20	0	$0.00	0	$0.00	0	$0.00	8300	$26,560.00	0	$0.00
715-10.01	each	Vertical Drain at End Bents	$3,500.00	2	$7,000.00	2	$7,000.00	2	$7,000.00	2	$7,000.00	2	$7,000.00
716-10.00	each	Plain Neoprene Bearing Pad	$300.00	8	$2,400.00	8	$2,400.00	8	$2,400.00	0	$0.00	0	$0.00
716-10.02	each	Laminated Neoprene Bearing Pad	$400.00	8	$3,200.00	8	$3,200.00	24	$9,600.00	12	$4,800.00	16	$6,400.00
720-10.00	sq. foot	Mechanically Stabilized Earth Wall Systems	$55.00	4818	$264,990.00	4818	$264,990.00	0	$0.00	0	$0.00	0	$0.00
720-13.00	each	Pipe Pile Spacers	$1,000.00	12	$12,000.00	12	$12,000.00	0	$0.00	0	$0.00	0	$0.00
		TOTAL			**$1,240,481.71**		**$1,393,861.71**		**$1,669,095.62**		**$1,859,242.71**		**$1,398,185.71**
		Bridge Demolition			$117,016.25		$117,016.25		$117,016.25		$117,016.25		$117,016.25
		MSE Walls			$274,626.00		$274,626.00		$0.00		$0.00		$0.00
		Total Bridge Construction Items			$848,839.46		$1,002,219.46		$1,552,079.37		$1,742,226.46		$1,281,169.46
		deck area sq ft			6678		8226		10755		10755		10755
		Bridge Items Cost Per sq ft of Deck			$127.11		$121.84		$144.31		$161.99		$119.12
		Roadway Cost Adjustment for Bridge Length			$ 101,600.00		$ 37,600.00		$ -		$ -		$ -
		Roadway Cost Adjustment for Profile Raise			$ (43,572.83)		$ (18,229.42)		$ (19,023.12)		$ (7,202.61)		$ -
		Total with Roadway Adjustment			**$1,298,508.88**		**$1,413,232.29**		**$1,650,072.50**		**$1,852,040.09**		**$1,398,185.71**
		20% Contingency			$259,701.78		$282,646.46		$330,014.50		$370,408.02		$279,637.14
		Total with Contingency			**$1,558,210.66**		**$1,695,878.74**		**$1,980,087.00**		**$2,222,448.11**		**$1,677,822.85**
		Percent of Low Cost			100.0%		108.8%		127.1%		142.6%		107.7%

Note: Roadway cost adjustments are based upon roadway base estimate for Option 1E.

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Estimated Quantities and Costs for Route 19 over I-70 Job: J2P3090				Option 2A 2-Span (concrete) with MSE Walls on Shoulder		Option 2B 2-Span (concrete) with MSE Walls behind Ditch		Option 2C 4-Span (Concrete) with Spill Slopes		Option 2D 2-Span (Steel) with Spill Slopes		Option 2E 2-Span (Concrete) with Spill Slopes	
Item No	Item	Unit	Unit Price	Estimated Quantity	Estimated Cost	Estimated Quantity	Estimated Cost	Estimated Quantity	Estimated Cost	Estimated Quantity	Estimated Cost	Estimated Quantity	Estimated Cost
206-10.00	cu. yard	Class 1 Excavation	$40.00	245	$9,800.00	300	$12,000.00	245	$9,800.00	280	$11,200.00	350	$14,000.00
216-05.00	lump sum	Removal of Bridges	$15.00		$117,016.25		$117,016.25		$117,016.25		$117,016.25		$117,016.25
503-10.10A	sq. yard	Bridge Approach Slab (Major Road)	$250.00	253	$63,250.00	253	$63,250.00	253	$63,250.00	253	$63,250.00	253	$63,250.00
701-11.07	linear foot	Drilled Shafts (4 ft. 6 in. Dia)	$900.00	72.0	$64,800.00	72.0	$64,800.00	216.0	$194,400.00	72.0	$64,800.00	72.0	$64,800.00
701-12.06	linear foot	Rock Sockets (4 ft. 0 in. Dia.)	$1,500.00	42.0	$63,000.00	42.0	$63,000.00	126.0	$189,000.00	42.0	$63,000.00	42.0	$63,000.00
701-13.00	each	Video Camera Inspection	$1,000.00	3	$3,000.00	3	$3,000.00	9	$9,000.00	3	$3,000.00	3	$3,000.00
701-14.00	linear foot	Foundation Inspection Holes	$150.00	72.0	$10,800.00	72.0	$10,800.00	216.0	$32,400.00	72.0	$10,800.00	72.0	$10,800.00
701-16.00	each	Sonic Logging Testing	$3,000.00	3	$9,000.00	3	$9,000.00	9	$27,000.00	3	$9,000.00	3	$9,000.00
702-12.12	linear foot	Galvanized Structural Steel Piles (12 in.)	$70.00	900	$63,000.00	900	$63,000.00	900	$63,000.00	900	$63,000.00	900	$63,000.00
702-70.00	each	Pile Point Reinforcement	$125.00	20	$2,500.00	20	$2,500.00	20	$2,500.00	20	$2,500.00	20	$2,500.00
703-20.03	cu. yard	Class B Concrete (Substructure)	$850.00	136.7	$116,195.00	136.7	$116,195.00	280.8	$238,680.00	136.7	$116,195.00	136.7	$116,195.00
703-42.12	sq. yard	Slab on Steel	$400.00		$0.00		$0.00		$0.00	1814	$725,600.00		$0.00
703-42.19A	linear foot	Barrier Curb (Type D)	$90.00	400	$36,000.00	480	$43,200.00	616	$55,440.00	616	$55,440.00	616	$55,440.00
703-42.21	sq. yard	Slab on Concrete NU-Girder	$380.00	1110	$421,800.00	1370	$520,600.00	1814	$689,320.00		$0.00	1814	$689,320.00
705-60.21	linear foot	NU 35, Prestressed Concrete NU-Girder	$250.00	996	$249,000.00	0	$0.00	1637	$409,250.00	0	$0.00	0	$0.00
705-60.22	linear foot	NU 43, Prestressed Concrete NU-Girder	$270.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00
705-60.23	linear foot	NU 53, Prestressed Concrete NU-Girder	$280.00	0	$0.00	1236	$346,080.00	0	$0.00	0	$0.00	0	$0.00
705-60.25	linear foot	NU 70, Prestressed Concrete NU-Girder	$290.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1918	$556,220.00
706-10.60	pound	Reinforcing Steel (Bridges)	$1.25	12390	$15,487.50	12390	$15,487.50	37180	$46,475.00	12390	$15,487.50	12390	$15,487.50
710-10.00	pound	Reinforcing Steel (Epoxy Coated)	$1.40	14410	$20,174.00	14410	$20,174.00	43240	$60,536.00	14410	$20,174.00	14410	$20,174.00
711-02.00	lump sum	Protective Coating - Concrete Bents and Piers (Epoxy)			$2,513.27		$2,513.27		$7,539.82		$2,513.27		$2,513.27
711-03.00	lump sum	Concrete and Masonry Protection System			$5,795.00		$5,795.00		$0.00		$2,513.27		$0.00
711-04.00	lump sum	Sacrificial Graffiti Protection System			$5,795.00		$5,795.00		$0.00		$2,513.27		$0.00
712-11.21	pound	Fabricated Structural Low Alloy Steel (Plate Girder) A709 Grade 50	$1.70	0	$0.00	0	$0.00	0	$0.00	700050	$1,190,085.00	0	$0.00
712-33.01	each	Steel Intermediate Diaphragms for P/S Concrete Girders	$1,000.00	0	$0.00	20	$20,000.00	0	$0.00	0	$0.00	24	$24,000.00
712-36.10	each	Slab Drain	$600.00	12	$7,200.00	16	$9,600.00	20	$12,000.00	20	$12,000.00	20	$12,000.00
712-53.65A	sq. foot	Intermediate Field Coat (System G)	$3.20	0	$0.00	0	$0.00	0	$0.00	22700	$72,640.00	0	$0.00
712-53.70A	sq. foot	Finish Field Coat (System G)	$3.20	0	$0.00	0	$0.00	0	$0.00	12500	$40,000.00	0	$0.00
715-10.01	each	Vertical Drain at End Bents	$3,500.00	2	$7,000.00	2	$7,000.00	2	$7,000.00	2	$7,000.00	2	$7,000.00
716-10.00	each	Plain Neoprene Bearing Pad	$300.00	12	$3,600.00	12	$3,600.00	12	$3,600.00	0	$0.00	0	$0.00
716-10.02	each	Laminated Neoprene Bearing Pad	$400.00	12	$4,800.00	12	$4,800.00	36	$14,400.00	18	$7,200.00	28	$11,200.00
720-10.00	sq. foot	Mechanically Stabilized Earth Wall Systems	$55.00	5795	$318,725.00	5795	$318,725.00	0	$0.00	0	$0.00	0	$0.00
720-13.00	each	Pipe Pile Spacers	$1,000.00	20	$20,000.00	20	$20,000.00	0	$0.00	0	$0.00	0	$0.00
		TOTAL			**$1,640,251.02**		**$1,867,931.02**		**$2,251,607.07**		**$2,676,927.57**		**$1,919,916.02**
		Bridge Demolition			$117,016.25		$117,016.25		$117,016.25		$117,016.25		$117,016.25
		MSE Walls			$330,315.00		$330,315.00		$0.00		$5,026.55		$0.00
		Total Bridge Construction Items			$1,192,919.77		$1,420,599.77		$2,134,590.82		$2,554,884.77		$1,802,899.77
		deck area sq ft			9990		12330		16326		16326		16326
		Bridge Items Cost Per sq ft of Deck			$119.41		$115.21		$130.75		$156.49		$110.43
		Roadway Cost Adjustment for Bridge Length			$ 105,600.00		$ 41,600.00		$ -		$ -		$ -
		Roadway Cost Adjustment for Profile Raise			$ -		$ 104,200.00		$ -		$ 192,908.18		$ 332,252.53
		Total with Roadway Adjustment			**$1,745,851.02**		**$2,013,731.02**		**$2,251,607.07**		**$2,869,835.75**		**$2,252,168.55**
		20% Contingency			$349,170.20		$402,746.20		$450,321.41		$573,967.15		$450,433.71
		Total with Contingency			**$2,095,021.23**		**$2,416,477.23**		**$2,701,928.49**		**$3,443,802.91**		**$2,702,602.26**
		Percent of Low Cost			100.0%		115.3%		129.0%		164.4%		129.0%

Note: Roadway cost adjustments are based upon roadway base estimate for Option 2C.

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Estimated Quantities and Costs for Route 19 over I-70 Job: J2P3090				Option 5A 2-Span (concrete) with MSE Walls on Shoulder		Option 5B 2-Span (concrete) with MSE Walls behind Ditch		Option 5C 3-Span (Concrete) with Spill Slope North Side and MSE Wall South Side	
Item No	**Item**	**Unit**	**Unit Price**	**Estimated Quantity**	**Estimated Cost**	**Estimated Quantity**	**Estimated Cost**	**Estimated Quantity**	**Estimated Cost**
206-10.00	cu. yard	Class 1 Excavation	$40.00	215	$8,600.00	235	$9,400.00	215	$8,600.00
216-05.00	lump sum	Removal of Bridges	$15.00		$117,016.25		$117,016.25		$117,016.25
503-10.10A	sq. yard	Bridge Approach Slab (Major Road)	$250.00	218	$54,500.00	218	$54,500.00	218	$54,500.00
701-11.07	linear foot	Drilled Shafts (4 ft. 6 in. Dia)	$900.00	54.0	$48,600.00	54.0	$48,600.00	108.0	$97,200.00
701-12.06	linear foot	Rock Sockets (4 ft. 0 in. Dia.)	$1,500.00	42.0	$63,000.00	42.0	$63,000.00	84.0	$126,000.00
701-13.00	each	Video Camera Inspection	$1,000.00	3	$3,000.00	3	$3,000.00	6	$6,000.00
701-14.00	linear foot	Foundation Inspection Holes	$150.00	72.0	$10,800.00	72.0	$10,800.00	144.0	$21,600.00
701-16.00	each	Sonic Logging Testing	$3,000.00	3	$9,000.00	3	$9,000.00	6	$18,000.00
702-12.12	linear foot	Galvanized Structural Steel Piles (12 in.)	$70.00	900	$63,000.00	900	$63,000.00	900	$63,000.00
702-70.00	each	Pile Point Reinforcement	$125.00	20	$2,500.00	20	$2,500.00	20	$2,500.00
703-20.03	cu. yard	Class B Concrete (Substructure)	$850.00	89.9	$76,415.00	89.9	$76,415.00	131.5	$111,775.00
703-42.12	sq. yard	Slab on Steel	$400.00		$0.00		$0.00		$0.00
703-42.19A	linear foot	Barrier Curb (Type D)	$90.00	335	$30,150.00	399	$35,910.00	463	$41,670.00
703-42.21	sq. yard	Slab on Concrete NU-Girder	$380.00	808	$307,040.00	988	$375,440.00	1168	$443,840.00
705-60.21	linear foot	NU 35, Prestressed Concrete NU-Girder	$250.00	700	$175,000.00	0	$0.00	1014	$253,500.00
705-60.22	linear foot	NU 43, Prestressed Concrete NU-Girder	$270.00	0	$0.00	860	$232,200.00	0	$0.00
705-60.23	linear foot	NU 53, Prestressed Concrete NU-Girder	$280.00	0	$0.00	0	$0.00	0	$0.00
705-60.25	linear foot	NU 70, Prestressed Concrete NU-Girder	$290.00	0	$0.00	0	$0.00	0	$0.00
706-10.60	pound	Reinforcing Steel (Bridges)	$1.25	10270	$12,837.50	10270	$12,837.50	20540	$25,675.00
710-10.00	pound	Reinforcing Steel (Epoxy Coated)	$1.40	8320	$11,648.00	8320	$11,648.00	16640	$23,296.00
711-02.00	lump sum	Protective Coating - Concrete Bents and Piers (Epoxy)			$1,413.72		$1,413.72		$2,827.43
711-03.00	lump sum	Concrete and Masonry Protection System			$5,404.00		$5,404.00		$2,702.00
711-04.00	lump sum	Sacrificial Graffiti Protection System			$5,404.00		$5,404.00		$2,702.00
712-11.21	pound	Fabricated Structural Low Alloy Steel (Plate Girder) A709 Grade 50	$1.70	0	$0.00	0	$0.00	0	$0.00
712-33.01	each	Steel Intermediate Diaphragms for P/S Concrete Girders	$1,000.00	0	$0.00	0	$0.00	0	$0.00
712-36.10	each	Slab Drain	$600.00	10	$6,000.00	12	$7,200.00	14	$8,400.00
712-53.65A	sq. foot	Intermediate Field Coat (System G)	$3.20	0	$0.00	0	$0.00	0	$0.00
712-53.70A	sq. foot	Finish Field Coat (System G)	$3.20	0	$0.00	0	$0.00	0	$0.00
715-10.01	each	Vertical Drain at End Bents	$3,500.00	2	$7,000.00	2	$7,000.00	2	$7,000.00
716-10.00	each	Plain Neoprene Bearing Pad	$300.00	10	$3,000.00	10	$3,000.00	10	$3,000.00
716-10.02	each	Laminated Neoprene Bearing Pad	$400.00	10	$4,000.00	10	$4,000.00	20	$8,000.00
720-10.00	sq. foot	Mechanically Stabilized Earth Wall Systems	$55.00	5404	$297,220.00	5404	$297,220.00	2702	$148,610.00
720-13.00	each	Pipe Pile Spacers	$1,000.00	20	$20,000.00	20	$20,000.00	10	$10,000.00
		TOTAL			**$1,342,548.47**		**$1,475,908.47**		**$1,607,413.68**
		Bridge Demolition			$117,016.25		$117,016.25		$117,016.25
		MSE Walls			$308,028.00		$308,028.00		$154,014.00
		Total Bridge Construction Items			$917,504.22		$1,050,864.22		$1,336,383.43
		deck area sq ft			7272		8892		10512
		Bridge Items Cost Per sq ft of Deck			$126.17		$118.18		$127.13
		Roadway Cost Adjustment for Bridge Length			$ -		$ (51,200.00)		$ (102,400.00)
		Roadway Cost Adjustment for Profile Raise			$ -		$ -		$ -
		Total with Roadway Adjustment			**$1,342,548.47**		**$1,424,708.47**		**$1,505,013.68**
		15% Contingency			$201,382.27		$213,706.27		$225,752.05
		Total with Contingency			**$1,543,930.74**		**$1,638,414.74**		**$1,730,765.74**
		Percent of Low Cost			100.0%		106.1%		112.1%

Note: Roadway cost adjustments are based upon roadway base estimate for Option 5A.

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Estimated Quantities and Costs for Route 19 over I-70 Job: J2P3090				Option 7A 2-Span (concrete) with MSE Walls on Shoulder		Option 7B 2-Span (concrete) with MSE Walls behind Ditch		Option 7C 4-Span (Concrete) with Spill Slopes		Option 7D 2-Span (Steel) with Spill Slopes		Option 7E 2-Span (Concrete) with Spill Slopes	
Item No	Item	Unit	Unit Price	Estimated Quantity	Estimated Cost	Estimated Quantity	Estimated Cost	Estimated Quantity	Estimated Cost	Estimated Quantity	Estimated Cost	Estimated Quantity	Estimated Cost
206-10.00	cu. yard	Class 1 Excavation	$40.00	215	$8,600.00	260	$10,400.00	215	$8,600.00	245	$9,800.00	305	$12,200.00
216-05.00	lump sum	Removal of Bridges	$15.00		$117,016.25		$117,016.25		$117,016.25		$117,016.25		$117,016.25
503-10.10A	sq. yard	Bridge Approach Slab (Major Road)	$250.00	218	$54,500.00	218	$54,500.00	218	$54,500.00	218	$54,500.00	218	$54,500.00
701-11.07	linear foot	Drilled Shafts (4 ft. 6 in. Dia)	$900.00	54.0	$48,600.00	54.0	$48,600.00	162.0	$145,800.00	54.0	$48,600.00	54.0	$48,600.00
701-12.06	linear foot	Rock Sockets (4 ft. 0 in. Dia.)	$1,500.00	42.0	$63,000.00	42.0	$63,000.00	126.0	$189,000.00	42.0	$63,000.00	42.0	$63,000.00
701-13.00	each	Video Camera Inspection	$1,000.00	3	$3,000.00	3	$3,000.00	9	$9,000.00	3	$3,000.00	3	$3,000.00
701-14.00	linear foot	Foundation Inspection Holes	$150.00	72.0	$10,800.00	72.0	$10,800.00	216.0	$32,400.00	72.0	$10,800.00	72.0	$10,800.00
701-16.00	each	Sonic Logging Testing	$3,000.00	3	$9,000.00	3	$9,000.00	9	$27,000.00	3	$9,000.00	3	$9,000.00
702-12.12	linear foot	Galvanized Structural Steel Piles (12 in.)	$70.00	900	$63,000.00	900	$63,000.00	900	$63,000.00	900	$63,000.00	900	$63,000.00
702-70.00	each	Pile Point Reinforcement	$125.00	20	$2,500.00	20	$2,500.00	20	$2,500.00	20	$2,500.00	20	$2,500.00
703-20.03	cu. yard	Class B Concrete (Substructure)	$850.00	115.9	$98,515.00	115.9	$98,515.00	233.6	$198,560.00	115.9	$98,515.00	115.9	$98,515.00
703-42.12	sq. yard	Slab on Steel	$400.00		$0.00		$0.00		$0.00	1565	$626,000.00		$0.00
703-42.19A	linear foot	Barrier Curb (Type D)	$90.00	383	$34,470.00	458	$41,220.00	616	$55,440.00	616	$55,440.00	616	$55,440.00
703-42.21	sq. yard	Slab on Concrete NU-Girder	$380.00	909	$345,420.00	1120	$425,600.00	1565	$594,700.00		$0.00	1565	$594,700.00
705-60.21	linear foot	NU 35, Prestressed Concrete NU-Girder	$250.00	788	$197,000.00	0	$0.00	1364	$341,000.00	0	$0.00	0	$0.00
705-60.22	linear foot	NU 43, Prestressed Concrete NU-Girder	$270.00	0	$0.00	975	$263,250.00	0	$0.00	0	$0.00	0	$0.00
705-60.23	linear foot	NU 53, Prestressed Concrete NU-Girder	$280.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00
705-60.25	linear foot	NU 70, Prestressed Concrete NU-Girder	$290.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	1644	$476,760.00
706-10.60	pound	Reinforcing Steel (Bridges)	$1.25	10270	$12,837.50	10270	$12,837.50	30810	$38,512.50	10270	$12,837.50	10270	$12,837.50
710-10.00	pound	Reinforcing Steel (Epoxy Coated)	$1.40	11780	$16,492.00	11780	$16,492.00	35330	$49,462.00	11780	$16,492.00	11780	$16,492.00
711-02.00	lump sum	Protective Coating - Concrete Bents and Piers (Epoxy)			$1,884.96		$1,884.96		$5,654.87		$1,884.96		$1,884.96
711-03.00	lump sum	Concrete and Masonry Protection System			$5,404.00		$5,404.00		$0.00		$0.00		$0.00
711-04.00	lump sum	Sacrificial Graffiti Protection System			$5,404.00		$5,404.00		$0.00		$0.00		$0.00
712-11.21	pound	Fabricated Structural Low Alloy Steel (Plate Girder) A709 Grade 50	$1.70	0	$0.00	0	$0.00	0	$0.00	605280	$1,028,976.00	0	$0.00
712-33.01	each	Steel Intermediate Diaphragms for P/S Concrete Girders	$1,000.00	0	$0.00	0	$0.00	0	$0.00	0	$0.00	20	$20,000.00
712-36.10	each	Slab Drain	$600.00	12	$7,200.00	14	$8,400.00	20	$12,000.00	20	$12,000.00	20	$12,000.00
712-53.65A	sq. foot	Intermediate Field Coat (System G)	$3.20	0	$0.00	0	$0.00	0	$0.00	20100	$64,320.00	0	$0.00
712-53.70A	sq. foot	Finish Field Coat (System G)	$3.20	0	$0.00	0	$0.00	0	$0.00	11000	$35,200.00	0	$0.00
715-10.01	each	Vertical Drain at End Bents	$3,500.00	2	$7,000.00	2	$7,000.00	2	$7,000.00	2	$7,000.00	2	$7,000.00
716-10.00	each	Plain Neoprene Bearing Pad	$300.00	10	$3,000.00	10	$3,000.00	10	$3,000.00	0	$0.00	0	$0.00
716-10.02	each	Laminated Neoprene Bearing Pad	$400.00	10	$4,000.00	10	$4,000.00	30	$12,000.00	15	$6,000.00	24	$9,600.00
720-10.00	sq. foot	Mechanically Stabilized Earth Wall Systems	$55.00	5404	$297,220.00	5404	$297,220.00	0	$0.00	0	$0.00	0	$0.00
720-13.00	each	Pipe Pile Spacers	$1,000.00	20	$20,000.00	20	$20,000.00	0	$0.00	0	$0.00	0	$0.00
		TOTAL			**$1,435,863.71**		**$1,592,043.71**		**$1,966,145.62**		**$2,345,881.71**		**$1,688,845.71**
		Bridge Demolition			$117,016.25		$117,016.25		$117,016.25		$117,016.25		$117,016.25
		MSE Walls			$308,028.00		$308,028.00		$0.00		$0.00		$0.00
		Total Bridge Construction Items			$1,010,819.46		$1,166,999.46		$1,849,129.37		$2,228,865.46		$1,571,829.46
		deck area sq ft			8181		10080		14085		14085		14085
		Bridge Items Cost Per sq ft of Deck			$123.56		$115.77		$131.28		$158.24		$111.60
		Roadway Cost Adjustment for Bridge Length			$ 119,200.00		$ 59,200.00		$ -		$ -		$ -
		Roadway Cost Adjustment for Profile Raise			$ -		$ -		$ -		$ 226,831.72		$ 296,073.13
		Total with Roadway Adjustment			**$1,555,063.71**		**$1,651,243.71**		**$1,966,145.62**		**$2,572,713.42**		**$1,984,918.83**
		15% Contingency			$233,259.56		$247,686.56		$294,921.84		$385,907.01		$297,737.83
		Total with Contingency			**$1,788,323.26**		**$1,898,930.26**		**$2,261,067.46**		**$2,958,620.43**		**$2,282,656.66**
		Percent of Low Cost			100.0%		106.2%		126.4%		165.4%		127.6%

Note: Roadway cost adjustments are based upon roadway base estimate for Option 7C.

Appendix D

Traffic Memorandum

MEMORANDUM

Date: May 31, 2019

To: MoDOT
From: Carrie A. Falkenrath, PE, PTOE, PTP, RSP

Subject: Technical Memorandum for Traffic Impact Study

Project: MO Route 19 over Interstate-70
T^2 Project No: 2018-07
Jacobs Project No: F3W94500-S19-0002
MoDOT Project No: J2P3090

T^2 Traffic & Transportation is working with Jacobs Engineering Group to complete a Bridge Replacement Study for MoDOT Bridge A-0986 carrying MO Route 19 over Interstate 70 in Montgomery, County, MO, and associated interchange and outer road modifications. The project team met with MoDOT Project representatives regarding initial scoping of the project August 7, 2018. Once the project initiated, a team call on April 11, 2019 confirmed additional details. This memorandum serves to document the assumptions defined during those two project meetings, the existing conditions within the project corridor, and the build analysis methodologies to be documented in the final project report.

Study Area

The project is located in New Florence, Missouri, as shown in **Figure 1**. Missouri Route 19 runs north-south though the western portion of the City and Interstate 70 passes through the City southwest of its downtown area. The study corridor, shown in **Figure 2**, is Missouri Route 19 at the I-70 interchange, including its intersections at the eastbound and westbound ramp terminals, Tree Farm Road (south outer road), and Booneslick Road (north outer road).

Existing Conditions

EXISTING ROAD NETWORK

MO Route 19 is a two-lane minor arterial owned and maintained by the Missouri Department of Transportation (MoDOT). There is one northbound and one southbound lane through the study area. The posted speed is 45 mph for traffic approaching outer roads and 55 mph for traffic departing the study corridor. The lanes are approximately 11-feet wide with varying shoulder widths throughout the corridor.

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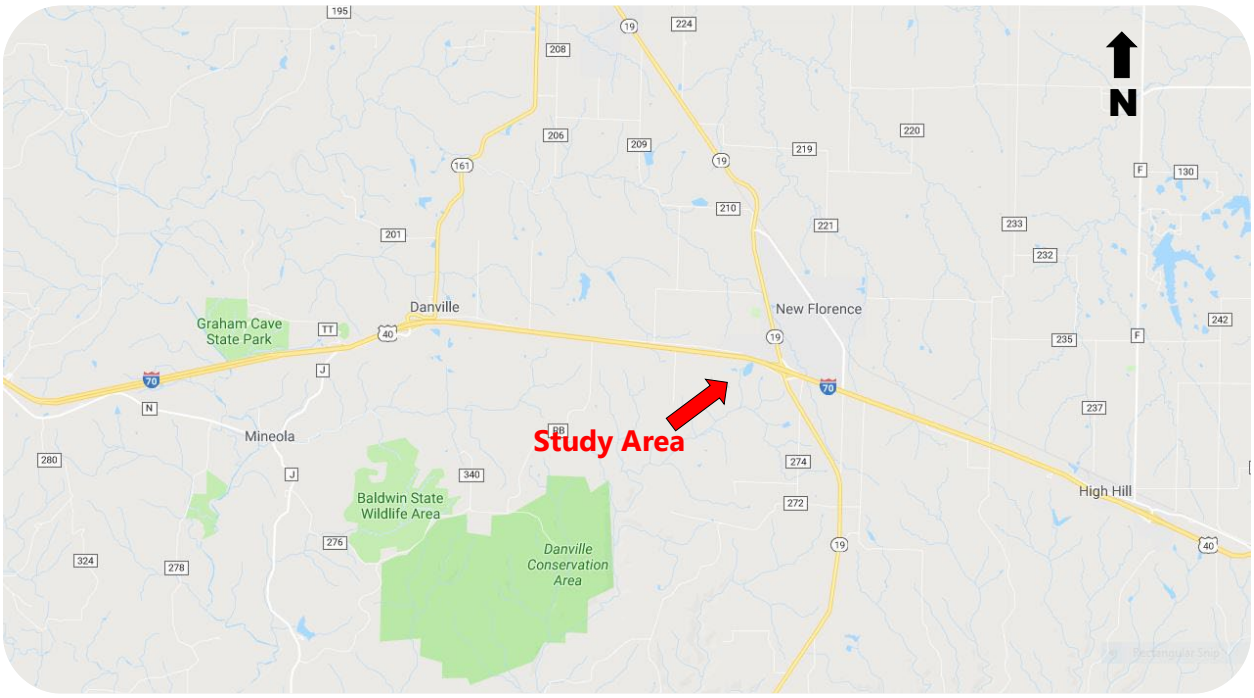

Figure 1: Project Area

Figure 2: Study Corridor

The intersection at Booneslick Road is signalized and incorporates left-and right-turn lanes of varying storage lengths. The Route 19 north- and southbound approaches consist of a left-turn lane, thru lane, and right-turn lane. The Booneslick Road east- and westbound approaches both include a shared left-turn/thru lane and a right-turn lane. The signal phasing utilizes protected plus permissive phasing for the Route 19 approaches and permissive (only) phasing for the Booneslick Road approaches.

Interstate 70 passes under Route 19 at their junction. I-70 is currently a four-lane divided facility (two lanes eastbound and two lanes westbound). The interchange is a diamond-configuration with single-lane access ramps terminating at two-way stop-controlled (TWSC) intersections.

Tree Farm Road (south outer road) is a two-lane roadway that parallels I-70, also under MoDOT's jurisdiction. The road is approximately 24-feet wide west of Route 19, and 22-feet wide to its east. The Tree Farm Road approaches to Route 19 are stop-controlled (with the main road uncontrolled). The posted speed limit is 55 mph throughout the project area.

Booneslick Road (north outer road) is also a two-lane roadway owned and maintained by MoDOT. The facility also parallels I-70 but is separated by a greater distance than the south outer road with some development between the two in the northwest quadrant of the interchange. The road is approximately 24-feet wide (outside of its signalized intersection with Route 19) and the posted speed limit is 35 mph.

EXISTING TRAFFIC VOLUMES

The existing traffic volumes were provided by MoDOT from counts collected on Thursday, November 30, 2017 between 6:00 AM and 6:00 PM at the study intersections. Based on that data, the weekday peak hour periods within the study corridor were determined to be 7:15 – 8:15 AM and 4:00 – 5:00 PM. The peak hour volumes are shown in **Figure 3** (AM) and **Figure 4** (PM).

Table 1: Existing Truck Percentages

	AM		*PM*	
Roadway	**Northbound or Westbound**	**Southbound or Eastbound**	**Northbound or Westbound**	**Southbound or Eastbound**
MO Route 19	25%	20%	10%	5%
Tree Farm Road	40%	25%	15%	10%
Booneslick Road	15%	20%	5%	5%
I-70 Ramps	15%	20%	5%	15%

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Figure 3: Existing AM Peak Hour Volumes

Figure 4: Existing PM Peak Hour Volumes

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EXISTING SYNCHRO ANALYSIS

Synchro models for the existing study corridor were provided by MoDOT to the project team on September 24, 2018. The models were created for a previous study and MoDOT confirmed they incorporated the most recent existing traffic volume data and signal timings (at Route 19 and Booneslick Rd.). **Table 2** summarizes the results of the Synchro analyses - the calculated existing levels of service (LOS) and average delays during the weekday AM and PM peak hours.

Table 2 – Operating Conditions of Existing Study Intersections

Intersection/Movement	*Weekday AM Peak Hour*	*Weekday PM Peak Hour*
MO Route 19 at Tree Farm Road (twsc)		
Eastbound Tree Farm Road Approach	B (10.8) 5′	B (11.1) 5′
Westbound Tree Farm Road Approach	A (9.9) 5′	A (9.9) 5′
Northbound MO Route 19 Approach	A (0.1) 0′	A (0.2) 0′
Southbound MO Route 19 Approach	A (0.5) 0′	A (0.5) 5′
Overall Intersection	**A (2.1)**	**A (1.6)**
MO Route 19 at I-70 Eastbound Ramp Terminals (twsc)		
Eastbound I-70 Exit Ramp Approach	B (14.5) 15′	C (16.4) 25′
Northbound MO Route 19 Approach	Free Flow	Free Flow
Southbound MO Route 19 Approach	A (5.5) 10′	A (5.5) 15′
Overall Intersection	**A (4.8)**	**A (5.7)**
MO Route 19 at I-70 Westbound Ramp Terminals (twsc)		
Westbound I-70 Exit Ramp Approach	B (11.4) 35′	B (12.6) 40′
Northbound MO Route 19 Approach	A (1.0) 5′	A (1.2) 5′
Southbound MO Route 19 Approach	Free Flow	Free Flow
Overall Intersection	**A (4.3)**	**A (3.9)**
MO Route 19 at Booneslick Road (signalized)		
Eastbound Booneslick Rd. Approach	A (9.1) 35′	B (11.4) 40′
Westbound Booneslick Rd. Approach	B (12.7) 45′	C (20.1) 65′
Northbound MO Route 19 Approach	A (6.3) 95′	A (6.9) 85′
Southbound MO Route 19 Approach	B (11.4) 70′	B (14.0) 110′
Overall Intersection	**A (8.9)**	**B (11.5)**

X (XX.X) XXX′: Level of Service (avg. veh delay in sec/veh) 95th Percentile Queue Length in feet

As shown in Table 2, all but one of the study intersections operate at LOS A during both the AM and PM peak hours – the exception is Route 19 at Booneslick Rd. during the evening peak (LOS B). In addition, all of the approaches generally operate at high levels of service during both peak hours with only two approaches operating at a LOS C during the PM peak: the eastbound I-70 exit ramp and the westbound Booneslick Road approach.

It is noted that Synchro version 9 (used for this project) utilizes the methodologies of the Highway Capacity Manual (HCM), 2000 release. However, beginning with Synchro v8, the software incorporates an analysis module based on the methodologies of the HCM 2010, which includes significant changes requiring more intense calculations in some aspects. Through discussions with MoDOT staff, the decision was made to utilize the standard Synchro v9 analysis results (rather than output from the HCM 2010 module) to be consistent with previous modeling in the project area and because the results are, generally, more conservative.

Volume Forecasts

In order to evaluate the future operations of the existing interchange (and alternative design options) an effort was made to forecast the 20-year volumes at the interchange. These forecasts are based on a combination of an annual average ("background") growth in traffic and additional trips generated from potential new development.

BACKGROUND TRAFFIC GROWTH

Through coordination with the MoDOT project team (April 11, 2019), it was determined that the annual average growth rate in the study area is 0.5% per year.

FUTURE DEVELOPMENT VOLUMES

In regard to potential future development, there is currently a proposal to develop a "Travel Stop" in the southeast quadrant of the existing intersection. MoDOT anticipates a similar development proposal for the southwest quadrant, as well. Therefore, the projected Construction Year (2021) traffic volumes incorporate a 13,000-square-foot Truck Stop located on Tree Farm Road east of Route 19. The Design Year (2041) projected volumes incorporate an additional Truck Stop of the same size on Tree Farm Road west of Route 19. Although there is some potential for development and/or redevelopment in the north quadrants of the intersection, MoDOT feels the impacts will be significantly less than the new development to the south.

For consistency, the future development volumes utilized for this forecast reflect those determined by a previous Traffic Impact Study prepared (*"Proposed Love's Travel Stop – Traffic Impact Study" April 24, 2018*). Following industry standards, the study utilized the recommended methodologies within the ITE Trip Generation Manual. The trip generation forecast for this development is reproduced in **Table 3**. The site projections were based on the data for Land Use: 950 – Truck Stop. It was estimated that trucks would account for approximately 50% of future site trips (established by historical truck data from other facilities). Furthermore, approximately 75% of the future site trips would be not be new trips to the area, but vehicles diverted from I-70 (80% of the diverted trips) and Route 19 (20% of the diverted trips).

Table 3: Trip Generation for Proposed Truck Stop
("Proposed Love's Travel Stop – Traffic Impact Study"; April 24, 2018)

ITE Land Use	Size	Daily Trips	AM Peak Hour			PM Peak Hour		
			In	Out	Total	In	Out	Total
950: Truck Stop	13,278 sf	6,050	175	175	350	160	140	300
Estimated Truck Volume (50%)		3,025	85	85	170	80	70	150
Estimated Passenger Vehicles (50%)		3,025	90	90	180	80	70	150
Diverted/Pass-By Trips (75%)		***4,535***	***130***	***130***	***260***	***110***	***110***	***220***
Total New Trips		**1,515**	**45**	**45**	**90**	**50**	**30**	**80**

The estimated site traffic was then assigned routes to and from the site based on an estimated "directional distribution". The estimated pass-by trips were assigned routes that reflected the existing travel patterns on Route 19 in the current study corridor. The resulting trip distribution is shown below in Table 4. Again, for consistency, this distribution was utilized for the development traffic incorporated into the Year 2021 and Year 2041 future volumes for this study.

Table 4: Future Trip Distribution Assumptions
("Proposed Love's Travel Stop – Traffic Impact Study"; April 24, 2018)

ITE Land Use	Size	Daily Trips	AM Peak Hour			PM Peak Hour		
			In	Out	Total	In	Out	Total
950: Truck Stop	13,278 sf	6,050	175	175	350	160	140	300
Estimated Truck Volume (50%)		3,025	85	85	170	80	70	150
Estimated Passenger Vehicles (50%)		3,025	90	90	180	80	70	150
Diverted/Pass-By Trips (75%)		***4,535***	***130***	***130***	***260***	***110***	***110***	***220***
Total New Trips		**1,515**	**45**	**45**	**90**	**50**	**30**	**80**

The average annual background growth and future development volumes were added to the existing volumes to arrive at the future projected volumes for the Construction Year (2021) and Design Year (2014). The resulting projected 2021 volumes are shown in **Figure 5** (AM) and **Figure 6** (PM), and the projected 2014 volumes are shown in **Figure 7** (AM) and **Figure 8** (PM). It should be noted that potential addition of two truck-stop-type developments has a significant impact on the truck percentages within the study corridor, as shown below in **Table 5**.

Table 5: Projected 2041 Truck Percentages

Roadway	*AM*		*PM*	
	Northbound or Westbound	**Southbound or Eastbound**	**Northbound or Westbound**	**Southbound or Eastbound**
MO Route 19	40%	40%	30%	30%
Tree Farm Road	45%	45%	45%	45%
Booneslick Road	15%	20%	5%	5%
I-70 Ramps	30%	40%	20%	30%

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Figure 5: Projected Construction Year (2021) AM Peak Hour Volumes

Figure 6: Projected Construction Year (2021) PM Peak Hour Volumes

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Figure 7: Projected Design Year (2041) AM Peak Hour Volumes

Figure 8: Projected Design Year (2041) PM Peak Hour Volumes

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No-Build Synchro Analyses

In order to determine the potential impacts of design alternatives, the operations of the future "No-Build" networks are calculated utilizing SYNCHRO software. The existing AM and PM peak hour models discussed previously were modified to reflect the projected future volumes for both the Construction (2021) and Design (2041) year scenario. Through discussions with MoDOT, it was confirmed that a southbound-left-turn lane is anticipated to be needed at the Tree Farm Road (South Outer Road) intersection during the construction of the proposed travel stop in the southeast quadrant of the interchange. Therefore, both the Construction Year (2021) and Design Year (2041) no-build scenarios include this geometric change as a second analyses. The results of the No-Build analyses are shown in **Table 6** (2021) and **Table 7** (2041).

Table 6 – Anticipated Construction Year (2021) No-Build Operating Conditions

Intersection/Movement	*Weekday AM Peak Hour*	*Weekday PM Peak Hour*	*Weekday AM Peak Hr. with SBL @ SOR*	*Weekday PM Peak Hr. with SBL @ SOR*
MO Route 19 at Tree Farm Road (twsc)				
Eastbound Tree Farm Road Approach	D (25.9) 10′	D (31.2) 10′	D (25.9) 10′	D (31.2) 10′
Westbound Tree Farm Road Approach	C (15.7) 70′	C (19.9) 105′	C (15.7) 70′	C (19.9) 105′
Northbound MO Route 19 Approach	A (0.1) 0′	A (0.2) 0′	A (0.1) 0′	A (0.2) 0′
Southbound MO Route 19 Approach	A (6.2) 15′	A (5.2) 15′	A (5.7) 15′ SBL	A (4.4) 15′ SBL
Overall Intersection	**A (9.3)**	**B (10.6)**	**A (9.2)**	**B (10.3)**
MO Route 19 at I-70 Eastbound Ramp Terminals (twsc)				
Eastbound I-70 Exit Ramp Approach	C (17.4) 35′	C (20.3) 40′	C (17.4) 35′	C (20.3) 40′
Northbound MO Route 19 Approach	Free Flow	Free Flow	Free Flow	Free Flow
Southbound MO Route 19 Approach	A (4.5) 10′	A (5.0) 15′	A (4.5) 10′	A (5.0) 15′
Overall Intersection	**A (4.7)**	**A (5.7)**	**A (4.7)**	**A (5.7)**
MO Route 19 at I-70 Westbound Ramp Terminals (twsc)				
Westbound I-70 Exit Ramp Approach	C (18.7) 80′	C (24.6) 115′	C (18.7) 80′	C (24.6) 115′
Northbound MO Route 19 Approach	A (3.1) 5′	A (3.2) 7′	A (3.1) 5′	A (3.2) 7′
Southbound MO Route 19 Approach	Free Flow	Free Flow	Free Flow	Free Flow
Overall Intersection	**A (7.5)**	**A (8.1)**	**A (7.5)**	**A (8.1)**
MO Route 19 at Booneslick Road (signalized)				
Eastbound Booneslick Rd. Approach	A (9.7) 40′	B (11.7) 40′	A (9.7) 40′	B (11.7) 40′
Westbound Booneslick Rd. Approach	B (13.6) 50′	C (21.0) 65′	B (13.6) 50′	C (21.0) 65′
Northbound MO Route 19 Approach	A (6.5) 115′	A (7.0) 95′	A (6.5) 115′	A (7.0) 95′
Southbound MO Route 19 Approach	B (11.7) 90′	B (15.0) 130′	B (11.7) 90′	B (15.0) 130′
Overall Intersection	**A (9.2)**	**B (12.1)**	**A (9.2)**	**B (12.1)**

X (XX.X) XXX′: Level of Service (avg. veh delay in sec/veh) 95th Percentile Queue Length in feet

An additional geometric change was required for the Design Year (2041) No-Build scenario. Due to the projected increased traffic at Route 19 and Tree Farm Road, the intersection is anticipated to be critically over-capacity. Therefore, the intersection was modified to reflect all-way stop control (AWSC) to provide a minimum change that would increase capacity by providing much-needed gaps for traffic on the eastbound and westbound legs of that intersection. The operational analysis results in **Table 7** reflect this change.

Table 7 – Anticipated Design Year (2041) No-Build Operating Conditions

Intersection/Movement	*Weekday AM Peak Hour*	*Weekday PM Peak Hour*	*AM Peak Hr. with 4-way & SBL @ SOR*	*PM Peak Hr. with 4-way & SBL @ SOR*
MO Route 19 at Tree Farm Road (AWSC)*				
Eastbound Tree Farm Road Approach	E (41.0)	C (20.1)	D (33.4)	C (19.6)
Westbound Tree Farm Road Approach	E (40.0)	E (39.7)	D (31.9)	E (37.0)
Northbound MO Route 19 Approach	C (21.2)	C (18.0)	C (19.3)	C (18.0)
Southbound MO Route 19 Approach	F (78.2)	F (129.2)	C (19.8)	D (26.0)
Overall Intersection	**E (49.8)**	**F (70.5)**	**D (26.4)**	**D (27.1)**
MO Route 19 at I-70 Eastbound Ramp Terminals (twsc)				
Eastbound I-70 Exit Ramp Approach	E (35.1) 115′	E (38.8) 106′	E (35.1) 115′	E (38.8) 106′
Northbound MO Route 19 Approach	Free Flow	Free Flow	Free Flow	Free Flow
Southbound MO Route 19 Approach	A (4.4) 15′	A (5.0) 20′	A (4.4) 15′	A (5.0) 20′
Overall Intersection	**A (7.8)**	**A (8.4)**	**A (7.8)**	**A (8.4)**
MO Route 19 at I-70 Westbound Ramp Terminals (twsc)				
Westbound I-70 Exit Ramp Approach	F (123.2) 390′	F (259.7) 570′	F (123.2) 390′	F (259.7) 570′
Northbound MO Route 19 Approach	A (4.5) 15′	A (4.9) 15′	A (4.5) 15′	A (4.9) 15′
Southbound MO Route 19 Approach	Free Flow	Free Flow	Free Flow	Free Flow
Overall Intersection	**E (44.5)**	**F (79.0)**	**E (44.5)**	**F (79.0)**
MO Route 19 at Booneslick Road (signalized)				
Eastbound Booneslick Rd. Approach	B (11.5) 45′	B (12.3) 45′	B (11.5) 45′	B (12.3) 45′
Westbound Booneslick Rd. Approach	B (15.7) 55′	C (23.5) 70′	B (15.7) 55′	C (23.5) 70′
Northbound MO Route 19 Approach	A (7.9) 145′	A (7.4) 120′	A (7.9) 145′	A (7.4) 120′
Southbound MO Route 19 Approach	B (13.4) 115′	B (18.0) 175′	B (13.4) 115′	B (18.0) 175′
Overall Intersection	**B (10.8)**	**B (13.7)**	**B (10.8)**	**B (13.7)**

X (XX.X) XXX′: Level of Service (avg. veh delay in sec/veh) 95th Percentile Queue Length in feet

The project team appreciates your review of the preliminary study data. Please contact me at your convenience with any comments or questions on this information. I can be reached via email at carrie@tsquaredtt.com or phone at 314.375.3748.

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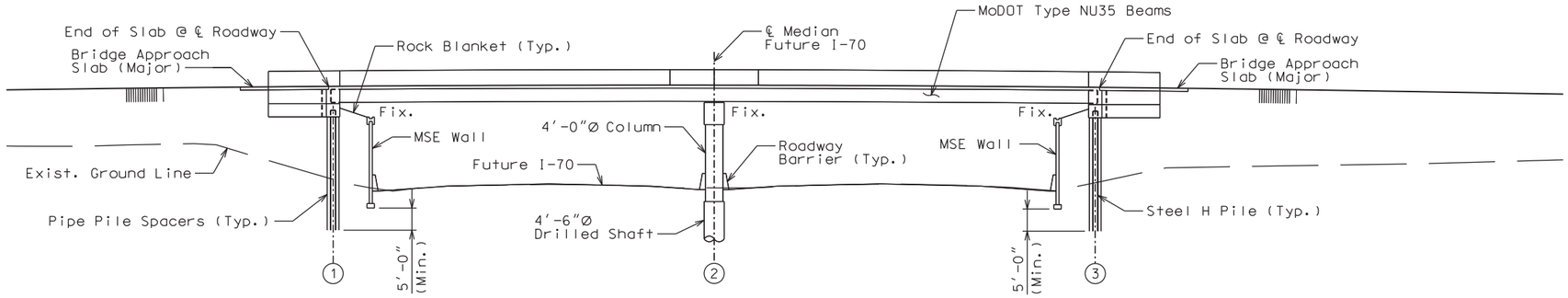
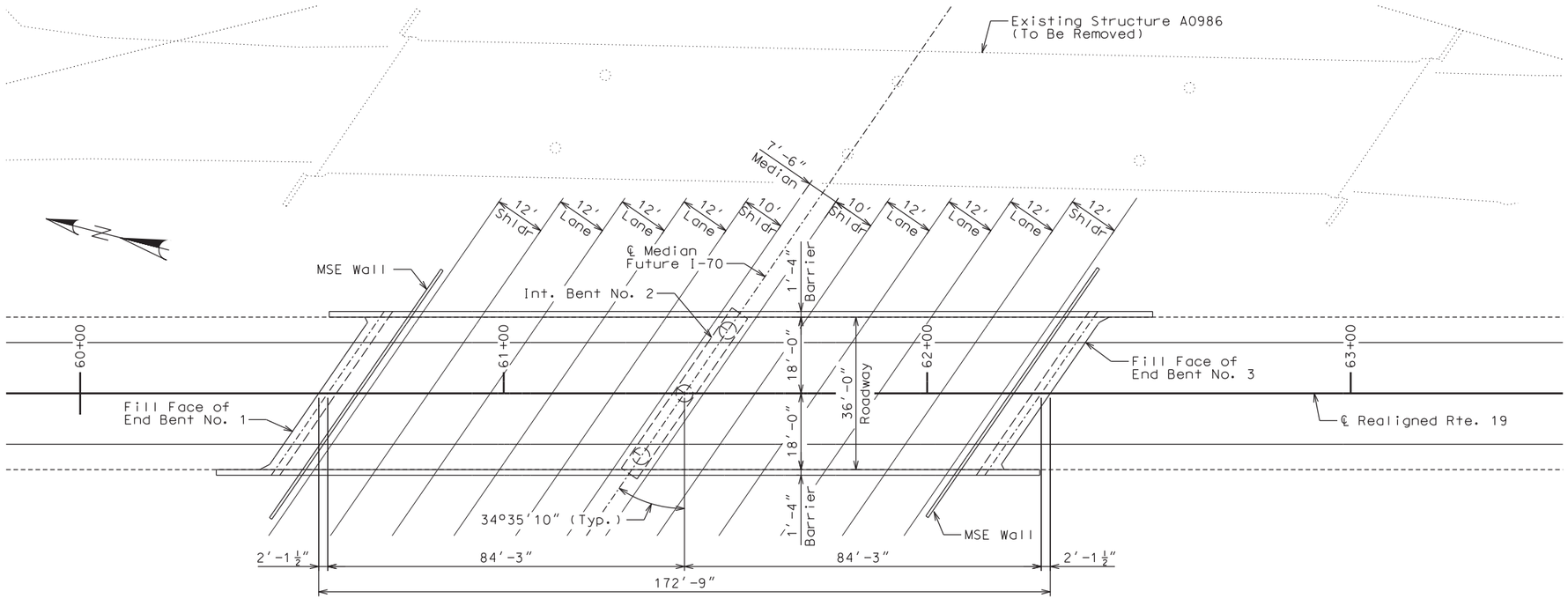
Appendix E

Bridge Type Plans

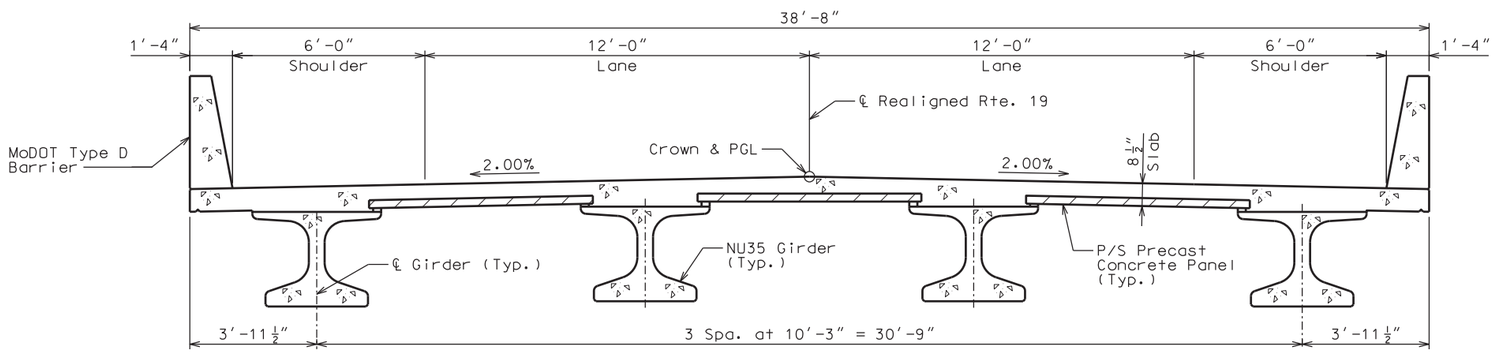
(84.25'-84.25') PRESTRESSED CONCRETE NU35 GIRDER SPANS



ELEVATION



PLAN



TYPICAL SECTION

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

BRIDGE: ROUTE 19 OVER I-70
OPTION 1A

Detailed July 2019
Checked July 2019

FOR INFORMATION ONLY, NOT FOR CONSTRUCTION

DATE PREPARED
$DATE$

ROUTE	STATE
RTE 19	MO
DISTRICT	SHEET NO.
BR	.

COUNTY
MONTGOMERY

JOB NO.
J2P3090

CONTRACT ID.
.

PROJECT NO.
.

BRIDGE NO.
.

DESCRIPTION	DATE
.	.

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JEFFERSON CITY, MO 65102
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JACOBS

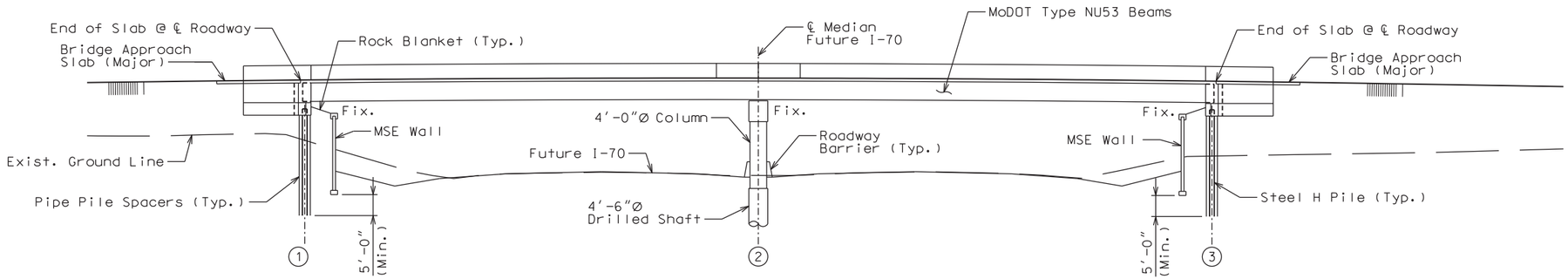
JACOBS ENGINEERING GROUP
501 NORTH BROADWAY
ST. LOUIS, MISSOURI 63102-2121
PHONE: (314) 335-4000
CERTIFICATE OF AUTHORITY
#00704

IF A SEAL IS PRESENT ON THIS SHEET, IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

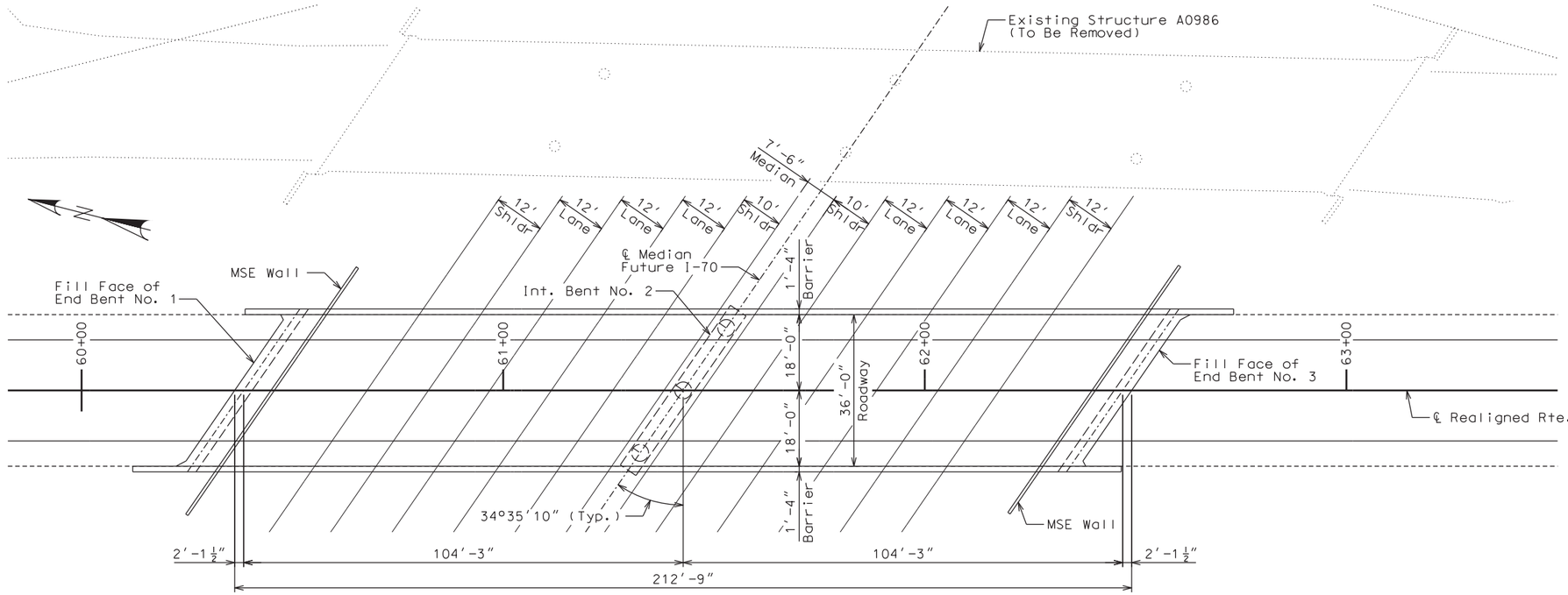
REV.

$FILE$ $TIME$ $DATE$

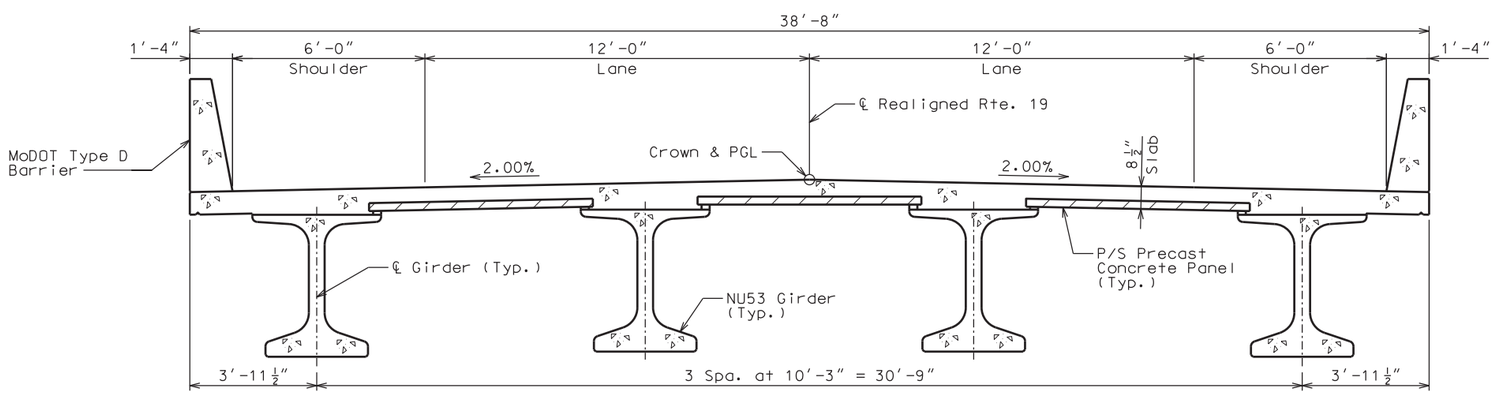
(104.25'-104.25') PRESTRESSED CONCRETE NU53 GIRDER SPANS



ELEVATION



PLAN



TYPICAL SECTION

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

BRIDGE: ROUTE 19 OVER I-70
OPTION 1B

Detailed July 2019
Checked July 2019

FOR INFORMATION ONLY, NOT FOR CONSTRUCTION

DATE PREPARED
$DATE$

ROUTE	STATE
RTE 19	MO
DISTRICT	SHEET NO.
BR	.

COUNTY: MONTGOMERY
JOB NO.: J2P3090
CONTRACT ID.: .
PROJECT NO.: .
BRIDGE NO.: .

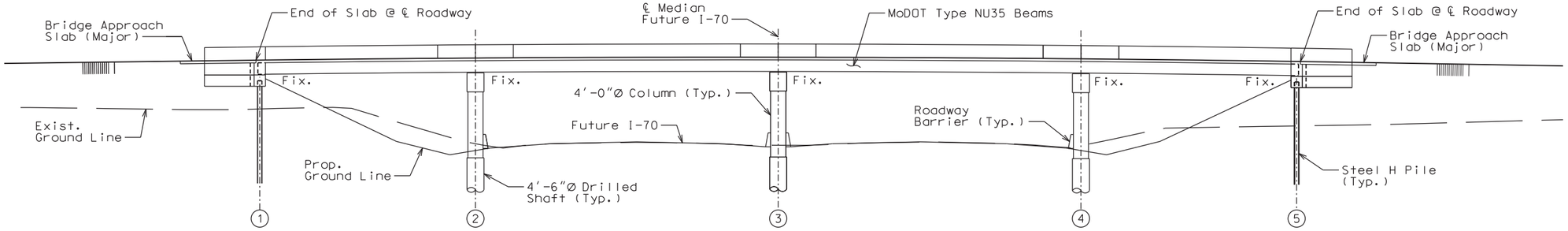
DESCRIPTION	DATE
.	.

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

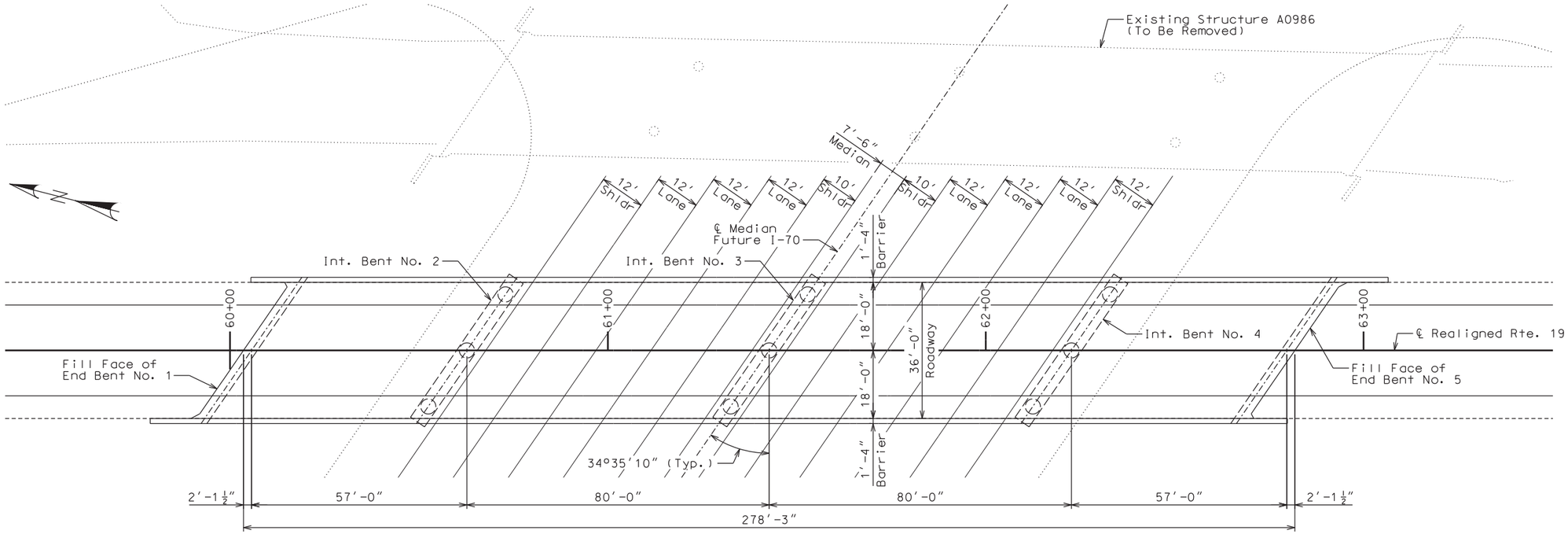
JACOBS
JACOBS ENGINEERING GROUP
501 NORTH BROADWAY
ST. LOUIS, MISSOURI 63102-2121
PHONE: (314) 335-4000
CERTIFICATE OF AUTHORITY #007041

IF A SEAL IS PRESENT ON THIS SHEET, IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

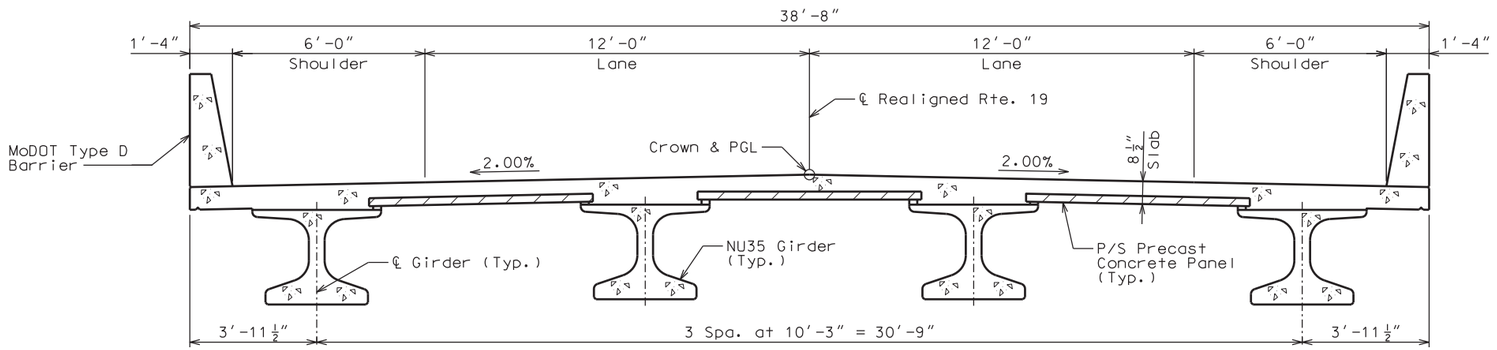
(57'-80'-80'-57') PRESTRESSED CONCRETE NU35 GIRDER SPANS



ELEVATION



PLAN



TYPICAL SECTION

Detailed July 2019
Checked July 2019

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

BRIDGE: ROUTE 19 OVER I-70
OPTION 1C

FOR INFORMATION ONLY, NOT FOR CONSTRUCTION

DATE PREPARED
$DATE$

ROUTE	STATE
RTE 19	MO
DISTRICT	SHEET NO.
BR	.

COUNTY
MONTGOMERY

JOB NO.
J2P3090

CONTRACT ID.
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PROJECT NO.
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BRIDGE NO.
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DESCRIPTION	DATE
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MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

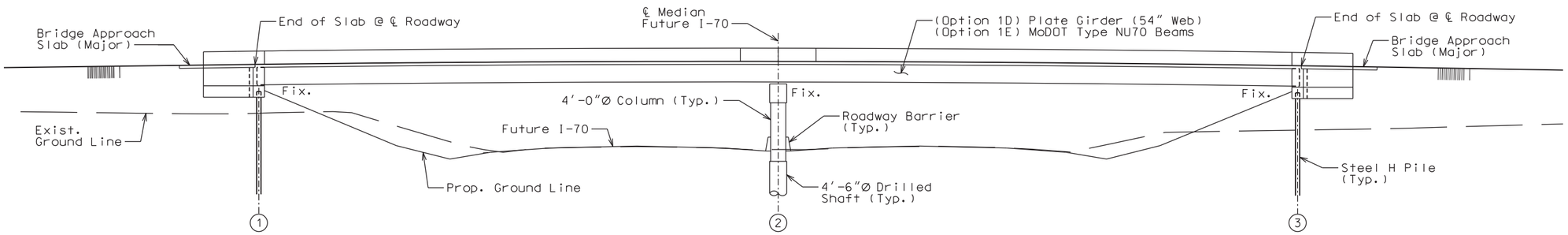
JACOBS
JACOBS ENGINEERING GROUP
501 NORTH BROADWAY
ST LOUIS, MISSOURI 63102-2121
PHONE: (314) 335-4000
CERTIFICATE OF AUTHORITY #000104

IF A SEAL IS PRESENT ON THIS SHEET, IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

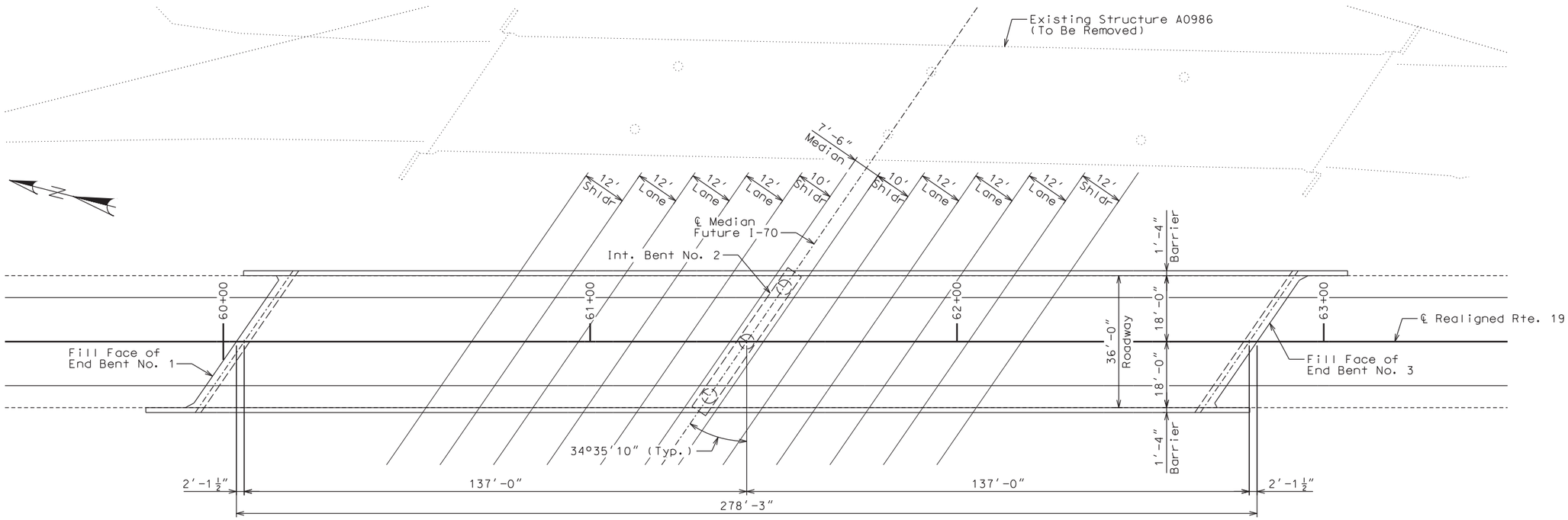
REV.

$FILE$ $TIME$ $DATE$

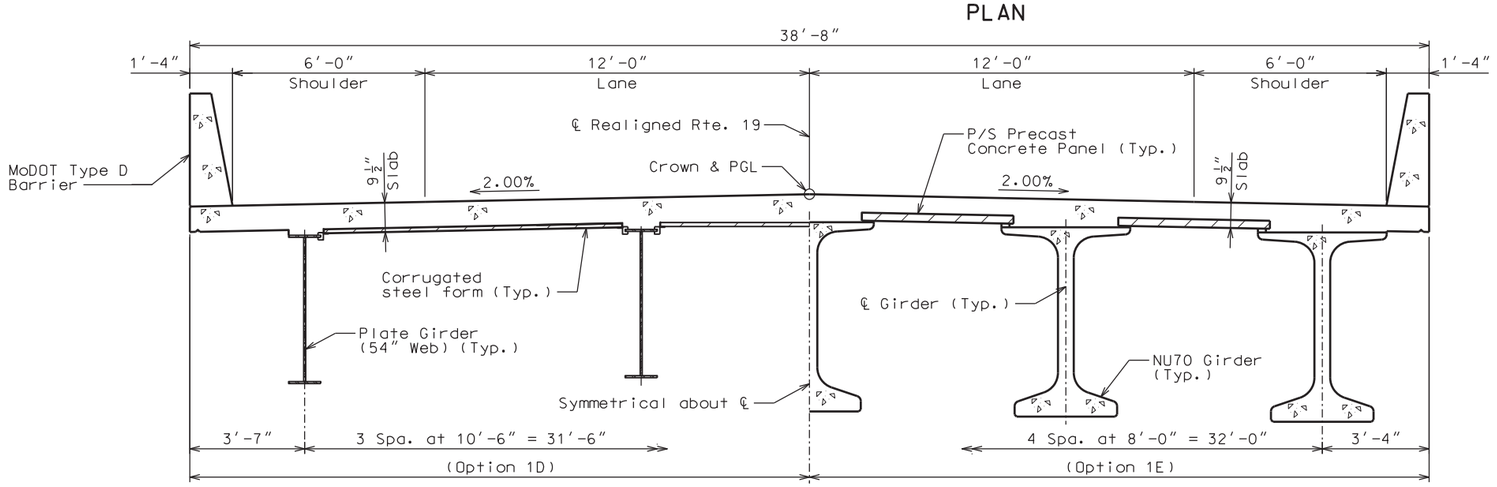
(OPTION 1D) (137'-137') COMPOSITE PLATE GIRDER SPANS
(OPTION 1E) (137'-137') PRESTRESSED CONCRETE NU70 GIRDER SPANS



ELEVATION



PLAN



TYPICAL SECTION

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

BRIDGE: ROUTE 19 OVER I-70
OPTION 1D & OPTION 1E

Detailed July 2019
Checked July 2019

FOR INFORMATION ONLY, NOT FOR CONSTRUCTION

DATE PREPARED
$DATE$

ROUTE	STATE
RTE 19	MO
DISTRICT	SHEET NO.
BR	.

COUNTY
MONTGOMERY

JOB NO.
J2P3090

CONTRACT ID.
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PROJECT NO.
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BRIDGE NO.
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DESCRIPTION	DATE
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MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

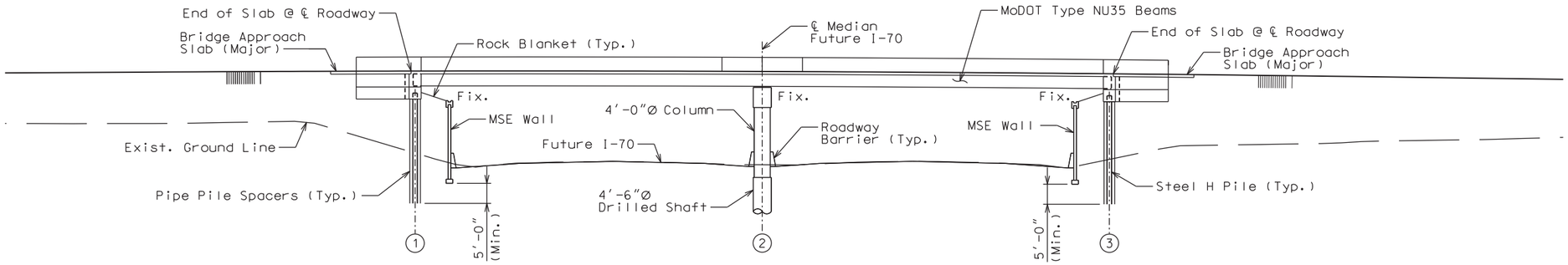
JACOBS
JACOBS ENGINEERING GROUP
501 NORTH BROADWAY
ST. LOUIS, MISSOURI 63102-2121
PHONE: (314) 335-4000
CERTIFICATE OF AUTHORITY #00704

IF A SEAL IS PRESENT ON THIS SHEET, IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

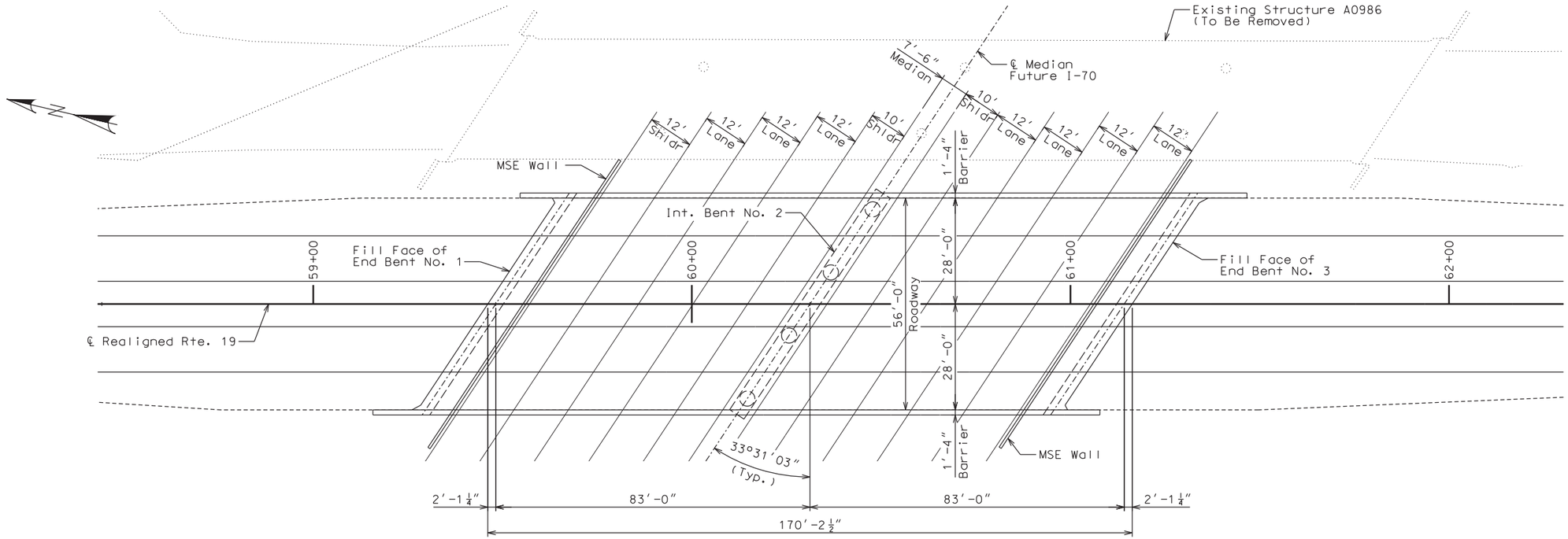
REV.

$FILE$ $TIME$ $DATE$

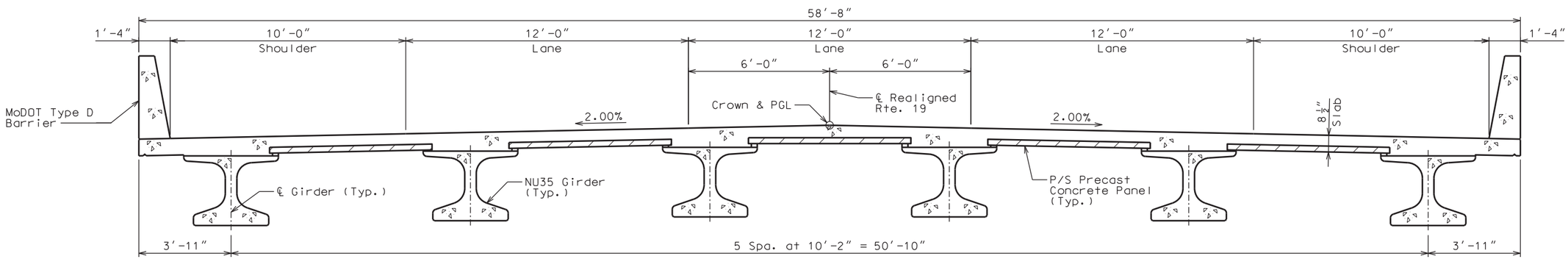
(83'-83') PRESTRESSED CONCRETE NU35 GIRDER SPANS



ELEVATION



PLAN



TYPICAL SECTION

Detailed July 2019
Checked July 2019

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

BRIDGE: ROUTE 19 OVER I-70
OPTION 2A

FOR INFORMATION ONLY, NOT FOR CONSTRUCTION

DATE PREPARED: $DATE$

ROUTE	STATE
RTE 19	MO
DISTRICT	SHEET NO.
BR	.

COUNTY: MONTGOMERY
JOB NO.: J2P3090
CONTRACT ID.: .
PROJECT NO.: .
BRIDGE NO.: .

DESCRIPTION	DATE
.	.

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

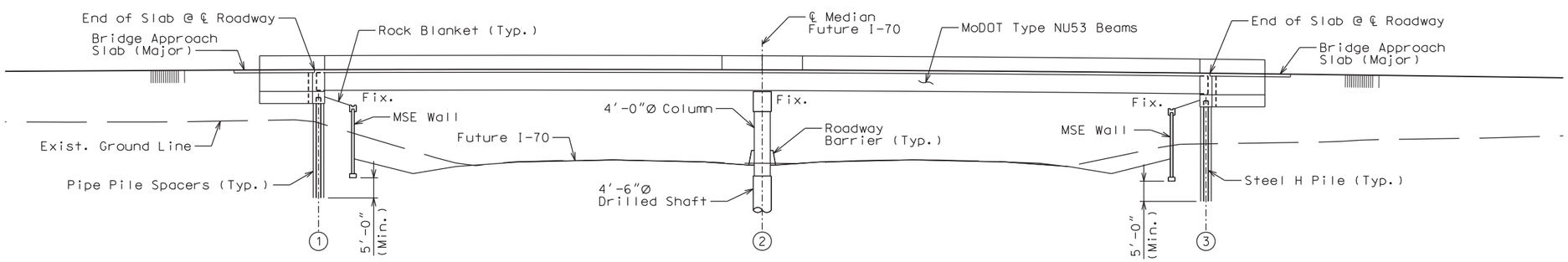
JACOBS ENGINEERING GROUP
501 NORTH BROADWAY
ST. LOUIS, MISSOURI 63102-2121
PHONE: (314) 335-4000
CERTIFICATE OF AUTHORITY #00754

IF A SEAL IS PRESENT ON THIS SHEET, IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

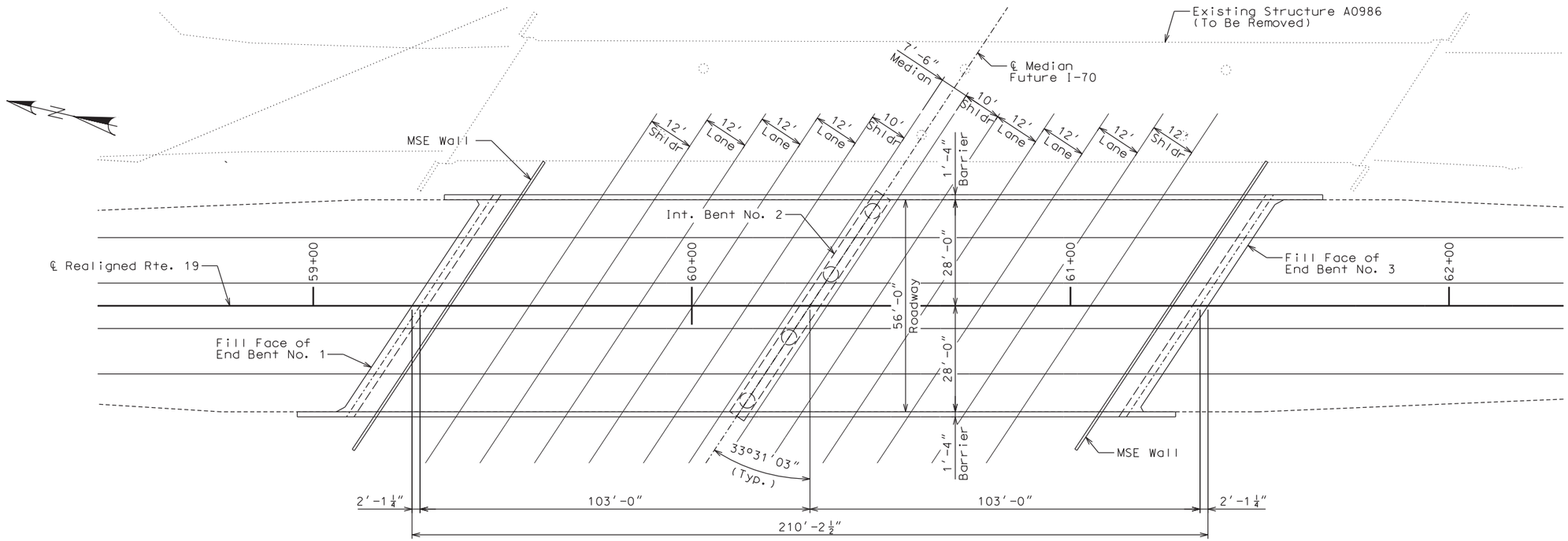
REV.

$FILE$ $TIME$ $DATE$

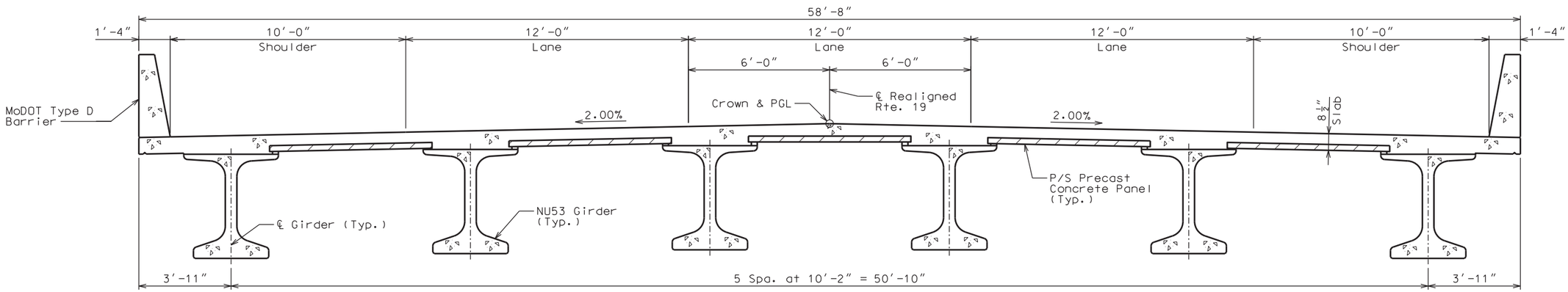
(103'-103') PRESTRESSED CONCRETE NU53 GIRDER SPANS



ELEVATION



PLAN



TYPICAL SECTION

Detailed July 2019
Checked July 2019

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

BRIDGE: ROUTE 19 OVER I-70
OPTION 2B

FOR INFORMATION ONLY, NOT FOR CONSTRUCTION

DATE PREPARED
$DATE$

ROUTE	STATE
RTE 19	MO
DISTRICT	SHEET NO.
BR	.

COUNTY
MONTGOMERY

JOB NO.
J2P3090

CONTRACT ID.
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PROJECT NO.
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BRIDGE NO.
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DESCRIPTION	DATE
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MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

105 WEST CAPITOL
JEFFERSON CITY, MO 65102
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JACOBS
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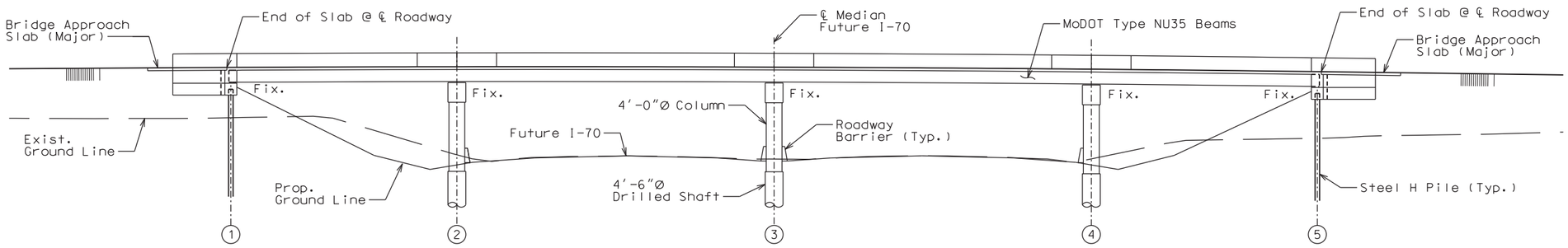
ST. LOUIS, MISSOURI 63102-2121
PHONE: (314) 335-4000
CERTIFICATE OF AUTHORITY
#00704

IF A SEAL IS PRESENT ON THIS SHEET, IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

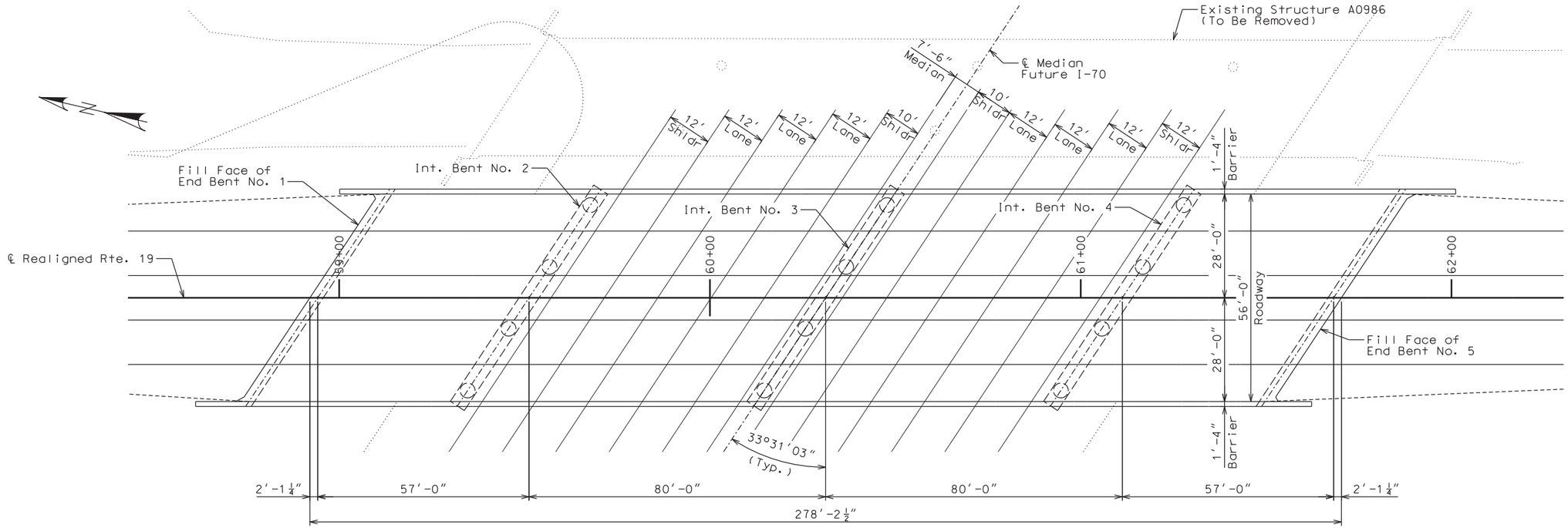
REV.

$FILE$ $TIME$ $DATE$

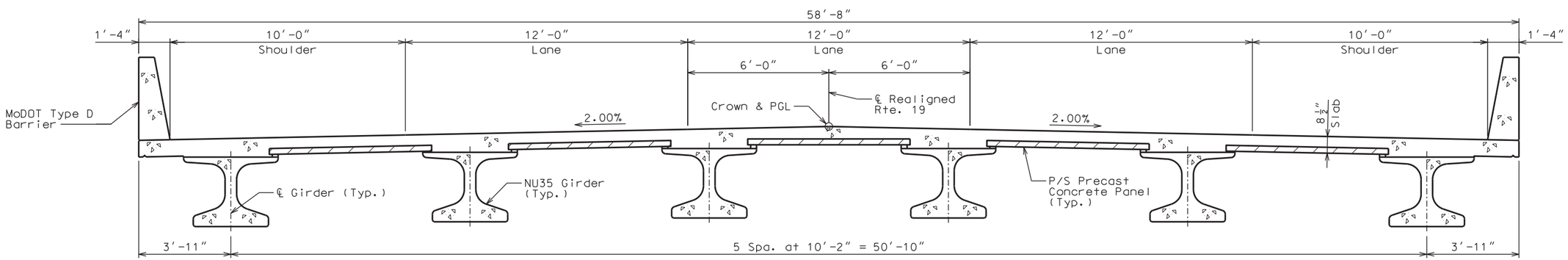
(57'-80'-80'-57') PRESTRESSED CONCRETE NU35 GIRDER SPANS



ELEVATION



PLAN



TYPICAL SECTION

BRIDGE: ROUTE 19 OVER I-70 OPTION 2C

Detailed July 2019
Checked July 2019

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

FOR INFORMATION ONLY, NOT FOR CONSTRUCTION

DATE PREPARED: $DATE$

ROUTE	STATE
RTE 19	MO
DISTRICT	SHEET NO.
BR	.

COUNTY: MONTGOMERY
JOB NO.: J2P3090
CONTRACT ID.: .
PROJECT NO.: .
BRIDGE NO.: .

DESCRIPTION	DATE
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I.F. A SEAL IS PRESENT ON THIS SHEET, IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

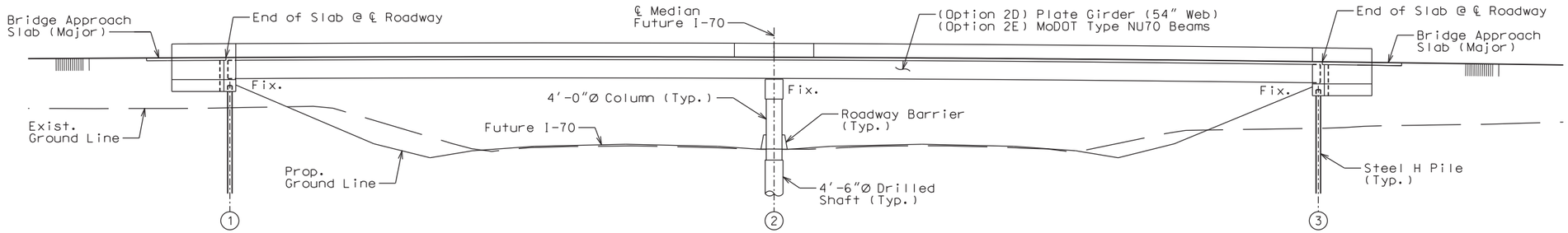
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

JACOBS ENGINEERING GROUP
501 NORTH BROADWAY
ST. LOUIS, MISSOURI 63102-2121
PHONE: (314) 335-4000
FAX: (314) 335-4001
CERTIFICATE OF AUTHORITY #00704

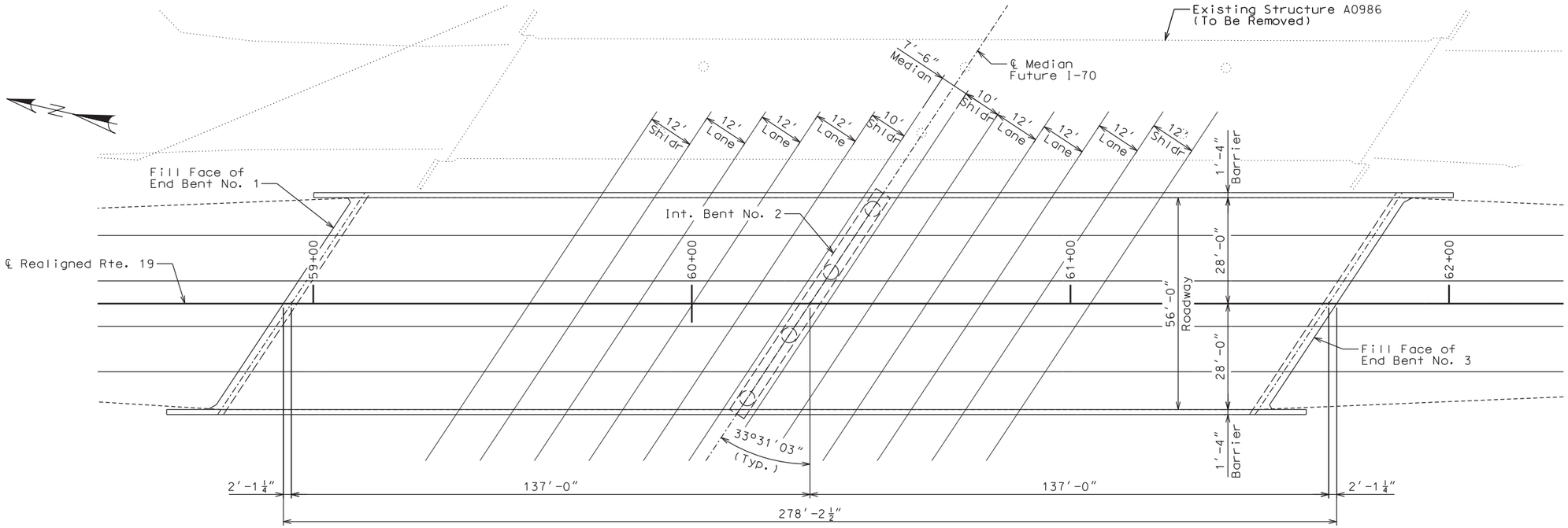
REV.

$FILE$ $TIME$ $DATE$

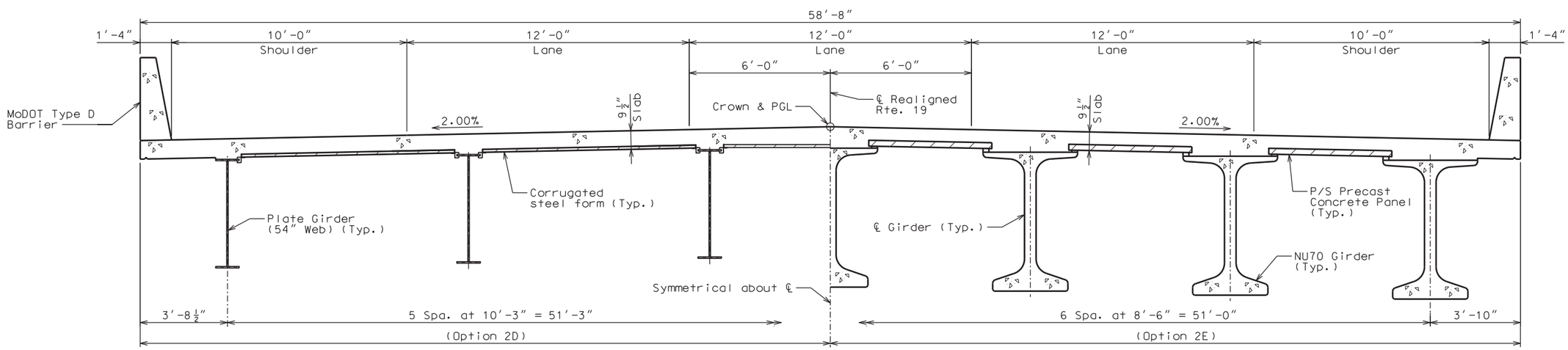
(OPTION 2D) (137'-137') COMPOSITE PLATE GIRDER SPANS
(OPTION 2E) (137'-137') PRESTRESSED CONCRETE NU70 GIRDER SPANS



ELEVATION



PLAN



TYPICAL SECTION

BRIDGE: ROUTE 19 OVER I-70
OPTION 2D & OPTION 2E

Detailed July 2019
Checked July 2019

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

FOR INFORMATION ONLY, NOT FOR CONSTRUCTION

DATE PREPARED: $DATE$

ROUTE	STATE
RTE 19	MO
DISTRICT	SHEET NO.
BR	.

COUNTY: MONTGOMERY
JOB NO.: J2P3090
CONTRACT ID.: .
PROJECT NO.: .
BRIDGE NO.: .

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

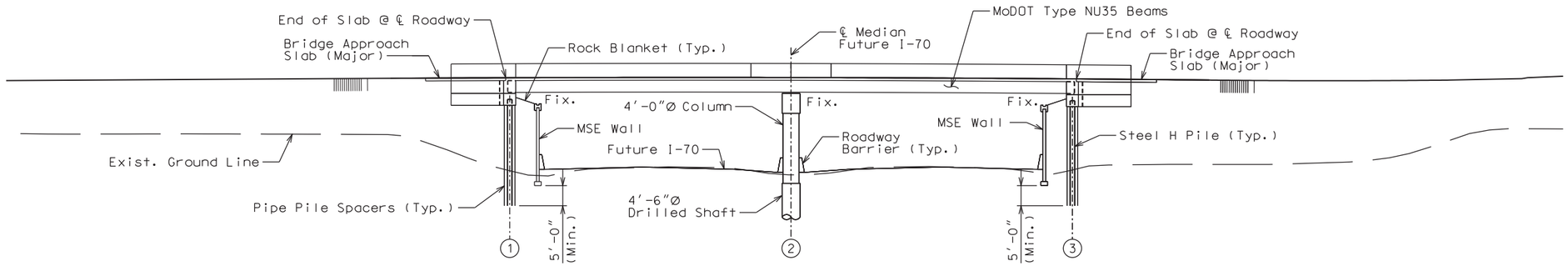
JACOBS
JACOBS ENGINEERING GROUP
501 NORTH BROADWAY
ST. LOUIS, MISSOURI 63102-2121
PHONE: (314) 335-4000
MISSOURI CERTIFICATE OF AUTHORITY
CERTIFICATE #00704

I.F. A SEAL IS PRESENT ON THIS SHEET, IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

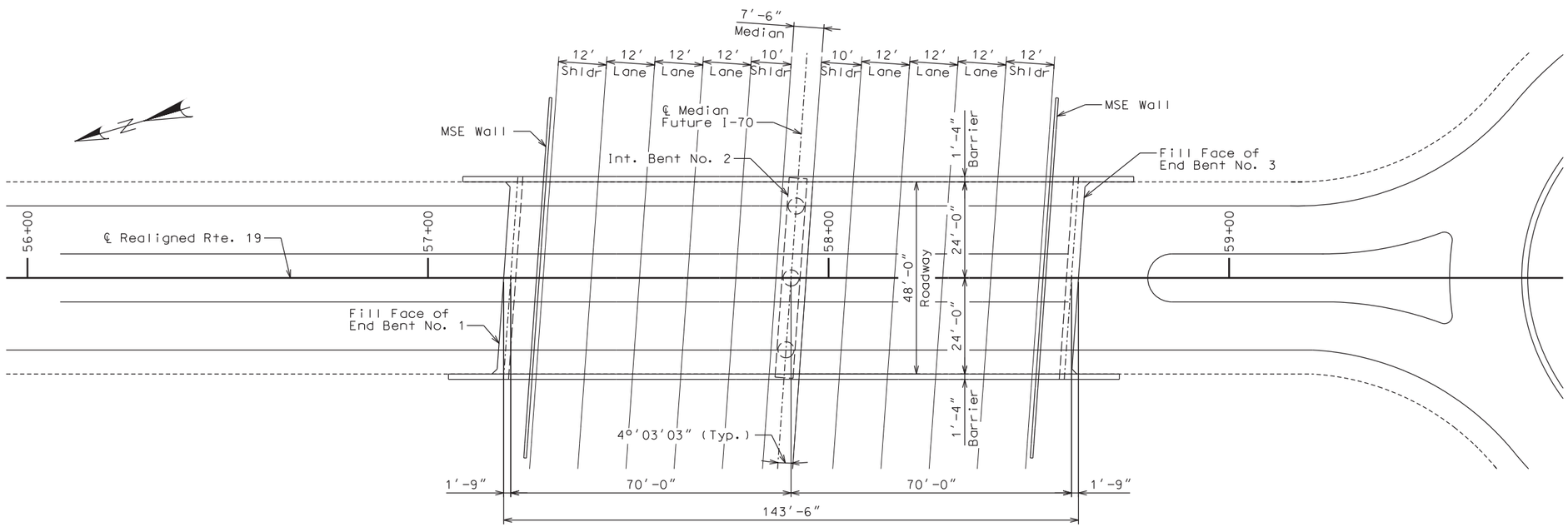
REV.

$FILE$ $TIME$ $DATE$

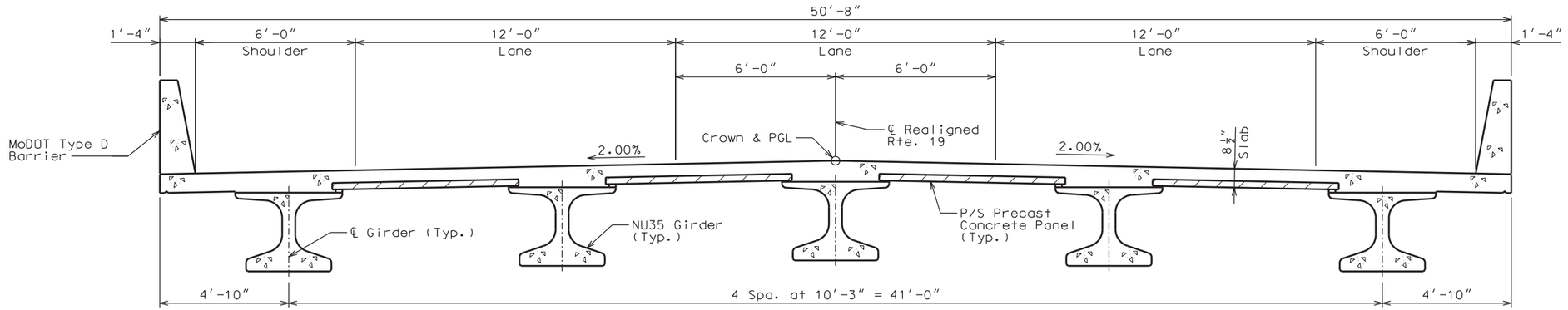
(70'-70') PRESTRESSED CONCRETE NU35 GIRDER SPANS



ELEVATION



PLAN



TYPICAL SECTION

Detailed July 2019
Checked July 2019

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

BRIDGE: ROUTE 19 OVER I-70
OPTION 5A

FOR INFORMATION ONLY, NOT FOR CONSTRUCTION

DATE PREPARED: $DATE$
ROUTE: RTE 19 | STATE: MO
DISTRICT: BR | SHEET NO.: .
COUNTY: MONTGOMERY
JOB NO.: J2P3090
CONTRACT ID.: .
PROJECT NO.: .
BRIDGE NO.: .

DESCRIPTION / DATE

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

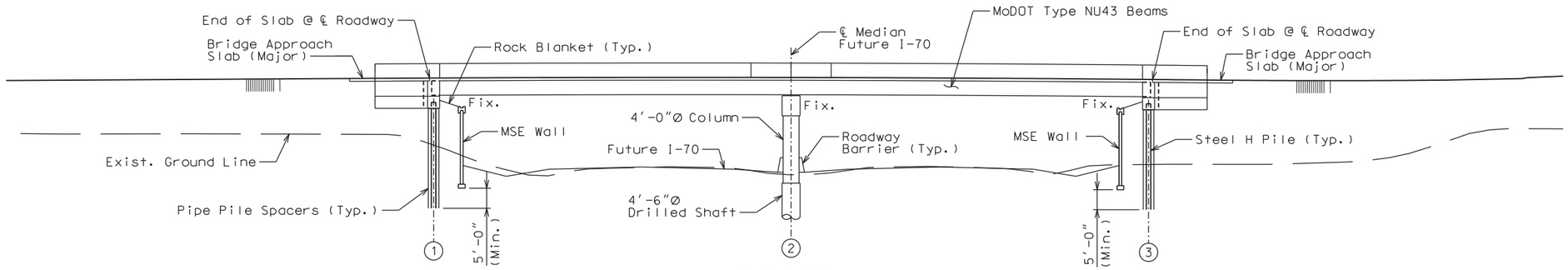
JACOBS ENGINEERING GROUP
501 NORTH BROADWAY
ST. LOUIS, MISSOURI 63102-2121
PHONE: (314) 335-4000
FAX: (314) 335-4001
CERTIFICATE OF AUTHORITY #00704

I.F. A SEAL IS PRESENT ON THIS SHEET, IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

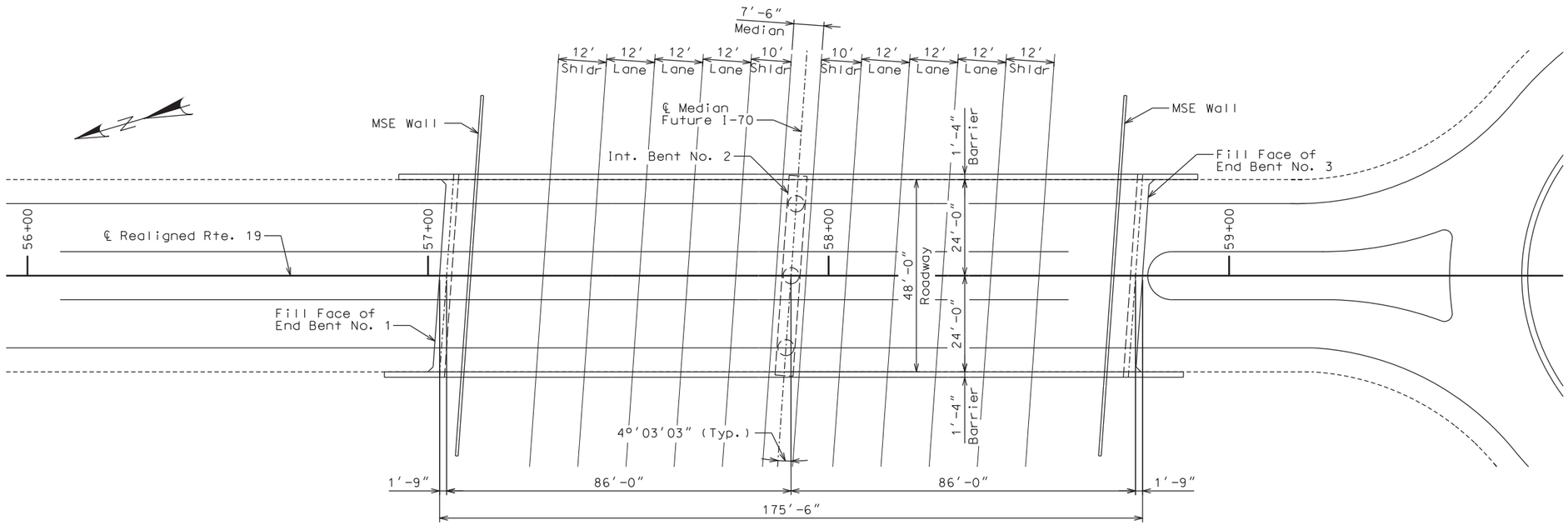
REV.

$FILE$ $TIME$ $DATE$

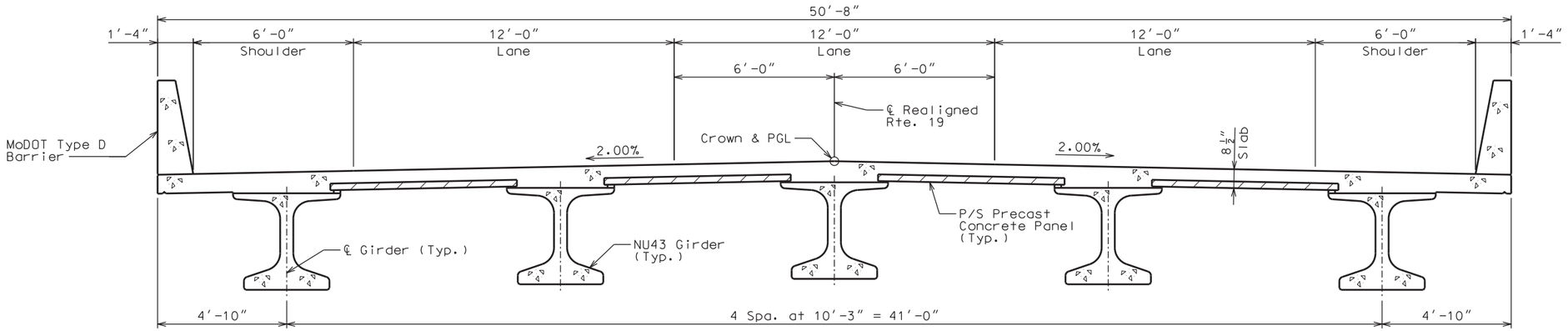
(86'-86') PRESTRESSED CONCRETE NU43 GIRDER SPANS



ELEVATION



PLAN



TYPICAL SECTION

BRIDGE: ROUTE 19 OVER I-70
OPTION 5B

Detailed July 2019
Checked July 2019

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

FOR INFORMATION ONLY. NOT FOR CONSTRUCTION

DATE PREPARED: $DATE$

ROUTE	STATE
RTE 19	MO
DISTRICT	SHEET NO.
BR	.

COUNTY: MONTGOMERY
JOB NO.: J2P3090
CONTRACT ID.: .
PROJECT NO.: .
BRIDGE NO.: .

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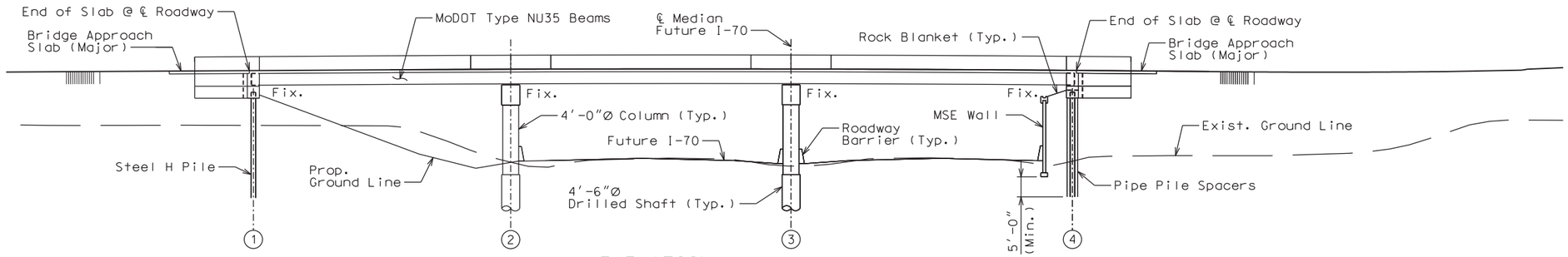
MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
105 WEST CAPITOL
JEFFERSON CITY, MO 65102
1-888-ASK-MODOT (1-888-275-6636)

JACOBS ENGINEERING GROUP
501 NORTH BROADWAY
ST. LOUIS, MISSOURI 63102-2121
PHONE: (314) 335-4000
CERTIFICATE OF AUTHORITY #00704

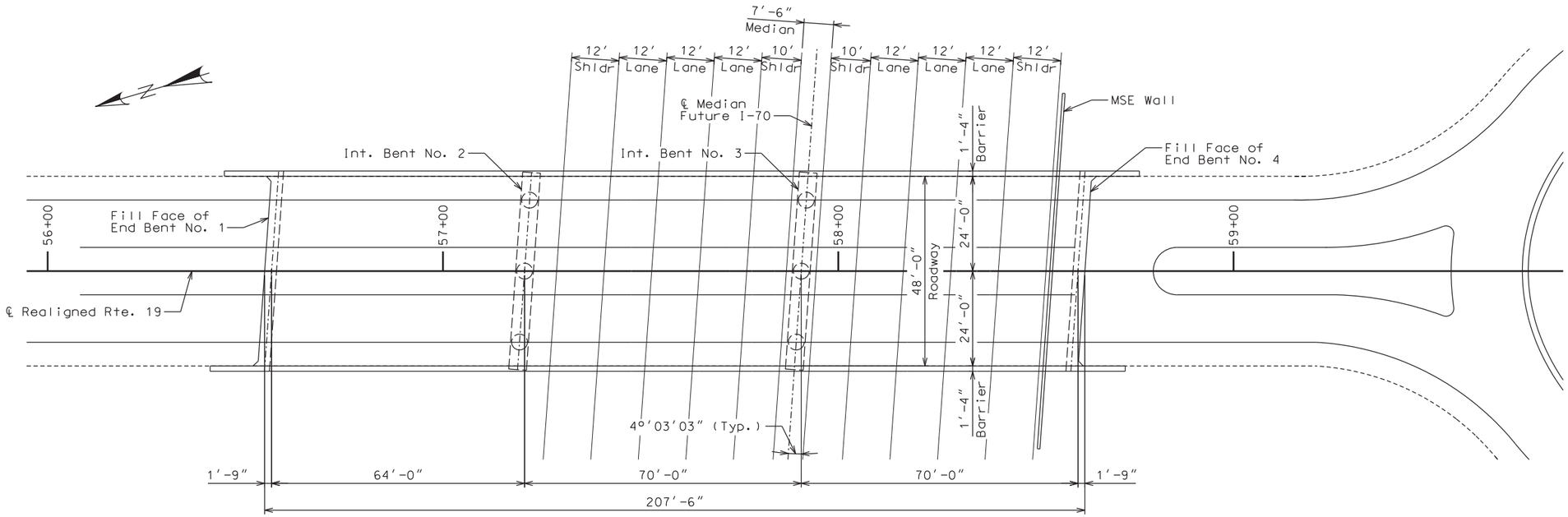
I.F. A SEAL IS PRESENT ON THIS SHEET, IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

$FILE$ $TIME$ $DATE$ REV.

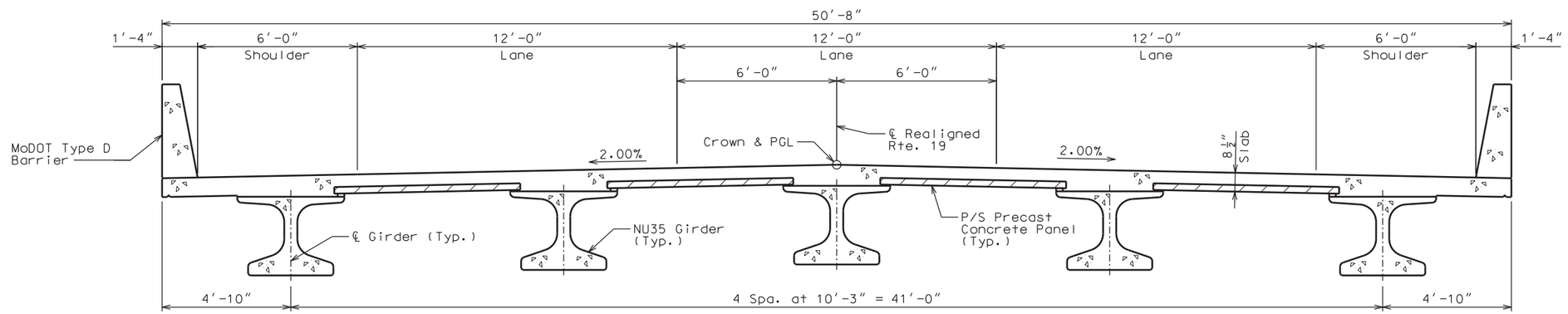
(64'-70'-70') PRESTRESSED CONCRETE NU35 GIRDER SPANS



ELEVATION



PLAN



TYPICAL SECTION

Detailed July 2019
Checked July 2019

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

BRIDGE: ROUTE 19 OVER I-70
OPTION 5C

FOR INFORMATION ONLY, NOT FOR CONSTRUCTION

DATE PREPARED
$DATE$

ROUTE	STATE
RTE 19	MO
DISTRICT	SHEET NO.
BR	.

COUNTY
MONTGOMERY

JOB NO.
J2P3090

CONTRACT ID.
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PROJECT NO.
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BRIDGE NO.
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DESCRIPTION	DATE
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MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION

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

JACOBS
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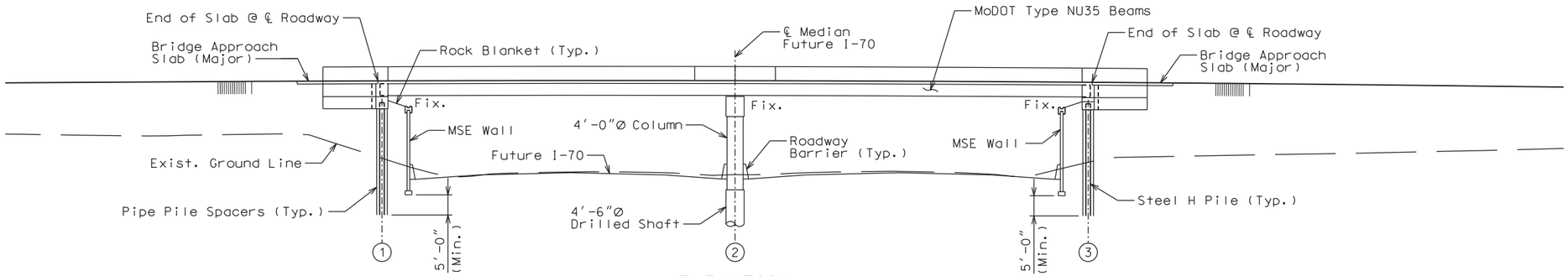
501 NORTH BROADWAY
ST. LOUIS, MISSOURI 63102-2121
PHONE: (314) 335-4000
CERTIFICATE OF AUTHORITY #001004

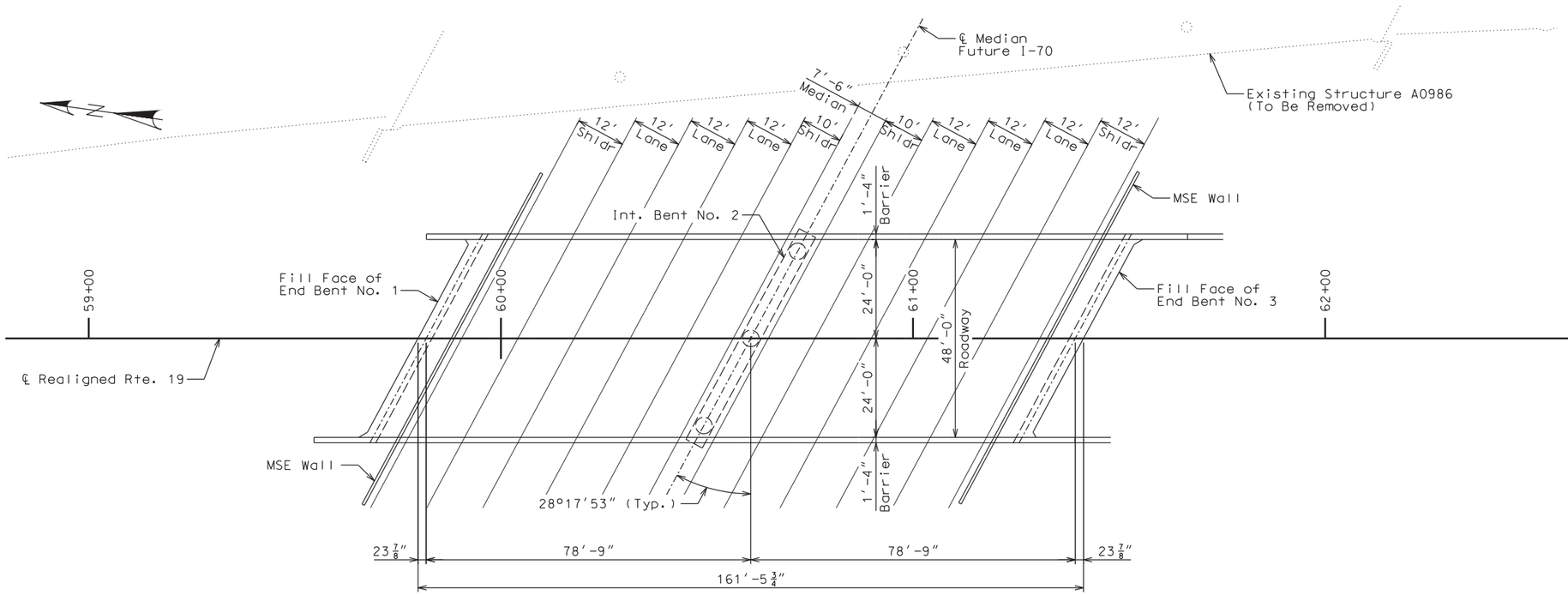
I.F. A SEAL IS PRESENT ON THIS SHEET, IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

$FILE$ $TIME$ $DATE$ REV.

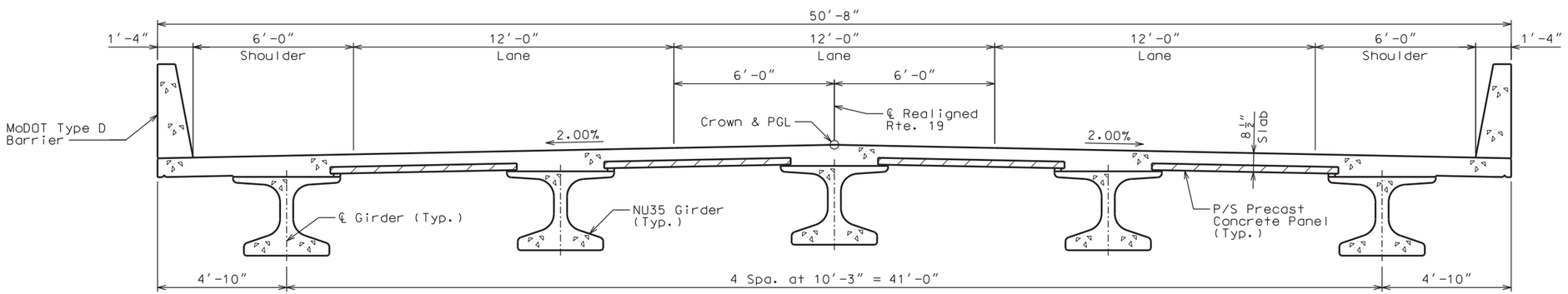
(78.75'-78.75') PRESTRESSED CONCRETE NU35 GIRDER SPANS



ELEVATION



PLAN



TYPICAL SECTION

Detailed July 2019
Checked July 2019

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

BRIDGE: ROUTE 19 OVER I-70
OPTION 7A

FOR INFORMATION ONLY, NOT FOR CONSTRUCTION

DATE PREPARED
$DATE$

ROUTE: RTE 19
STATE: MO
DISTRICT: BR
SHEET NO.: .
COUNTY: MONTGOMERY
JOB NO.: J2P3090
CONTRACT ID.: .
PROJECT NO.: .
BRIDGE NO.: .

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

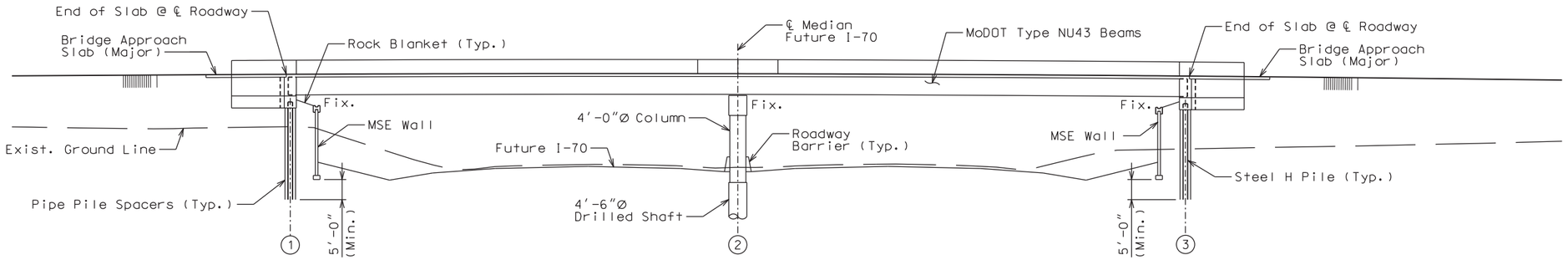
JACOBS
JACOBS ENGINEERING GROUP
501 NORTH BROADWAY
ST LOUIS, MISSOURI 63102-2121
PHONE: (314) 335-4000
MO CERTIFICATE OF AUTHORITY #000104

I.F. A SEAL IS PRESENT ON THIS SHEET, IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

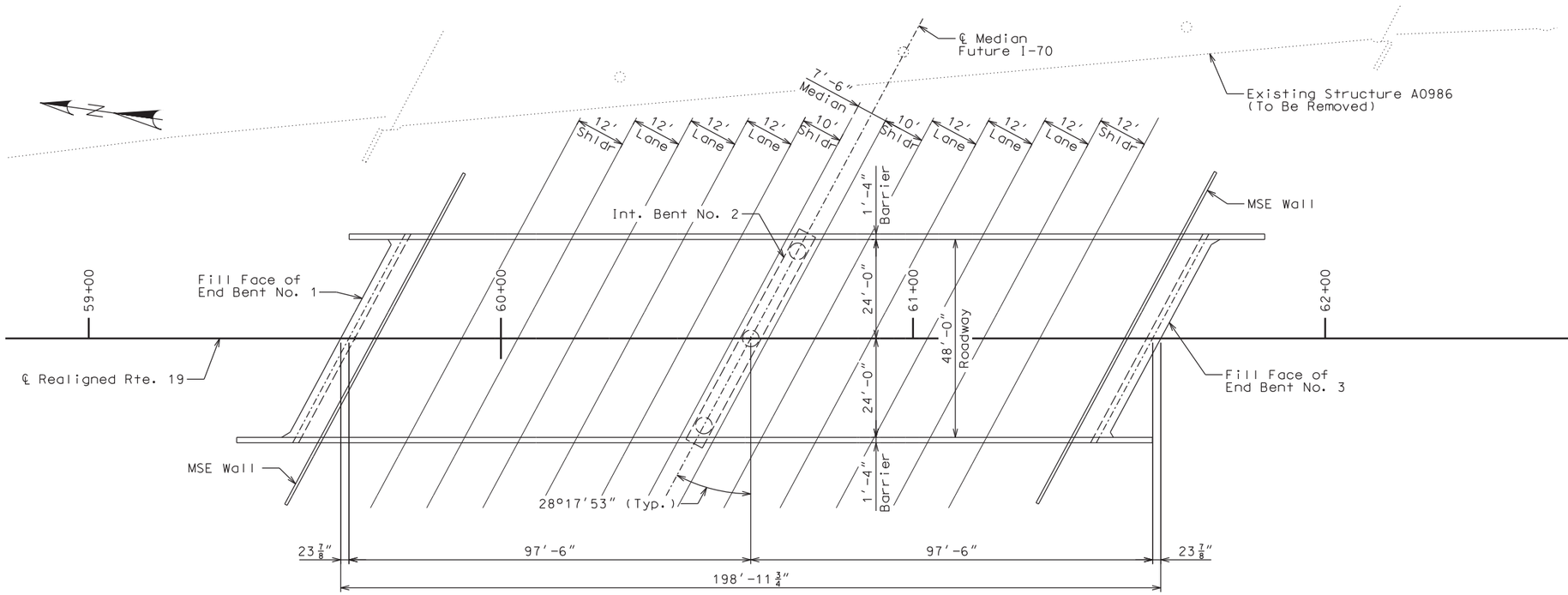
REV.

$FILE$ $TIME$ $DATE$

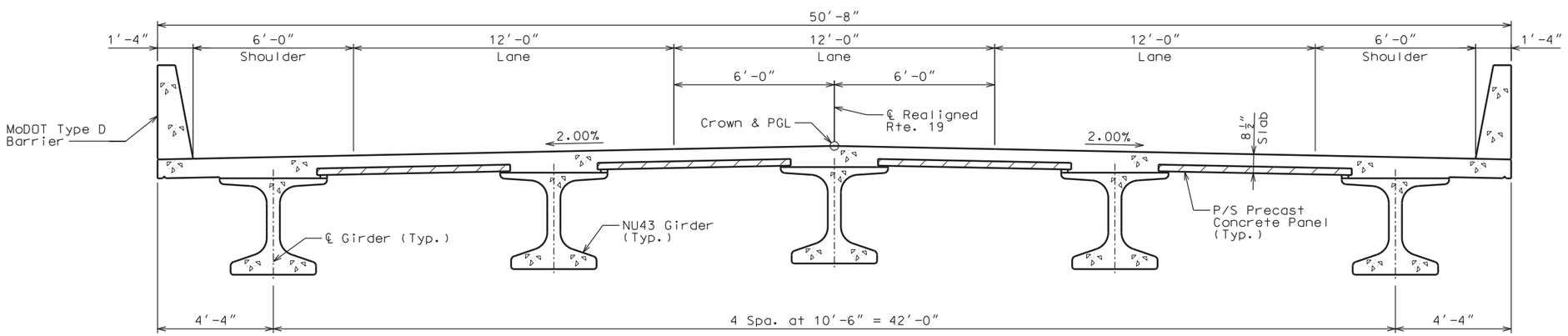
(97.5'-97.5') PRESTRESSED CONCRETE NU43 GIRDER SPANS



ELEVATION



PLAN



TYPICAL SECTION

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

BRIDGE: ROUTE 19 OVER I-70
OPTION 7B

Detailed July 2019
Checked July 2019

FOR INFORMATION ONLY. NOT FOR CONSTRUCTION

DATE PREPARED: $DATE$

ROUTE	STATE
RTE 19	MO
DISTRICT	SHEET NO.
BR	.

COUNTY: MONTGOMERY
JOB NO.: J2P3090
CONTRACT ID.: .
PROJECT NO.: .
BRIDGE NO.: .

DESCRIPTION	DATE
.	.

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

JACOBS
JACOBS ENGINEERING GROUP
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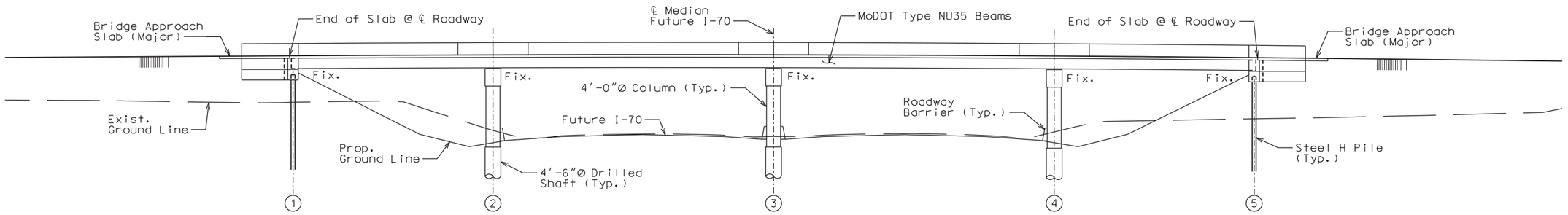
ST. LOUIS, MISSOURI 63102-2121
PHONE: (314) 335-4000
FAX: (314) 335-4001
CERTIFICATE OF AUTHORITY #000104

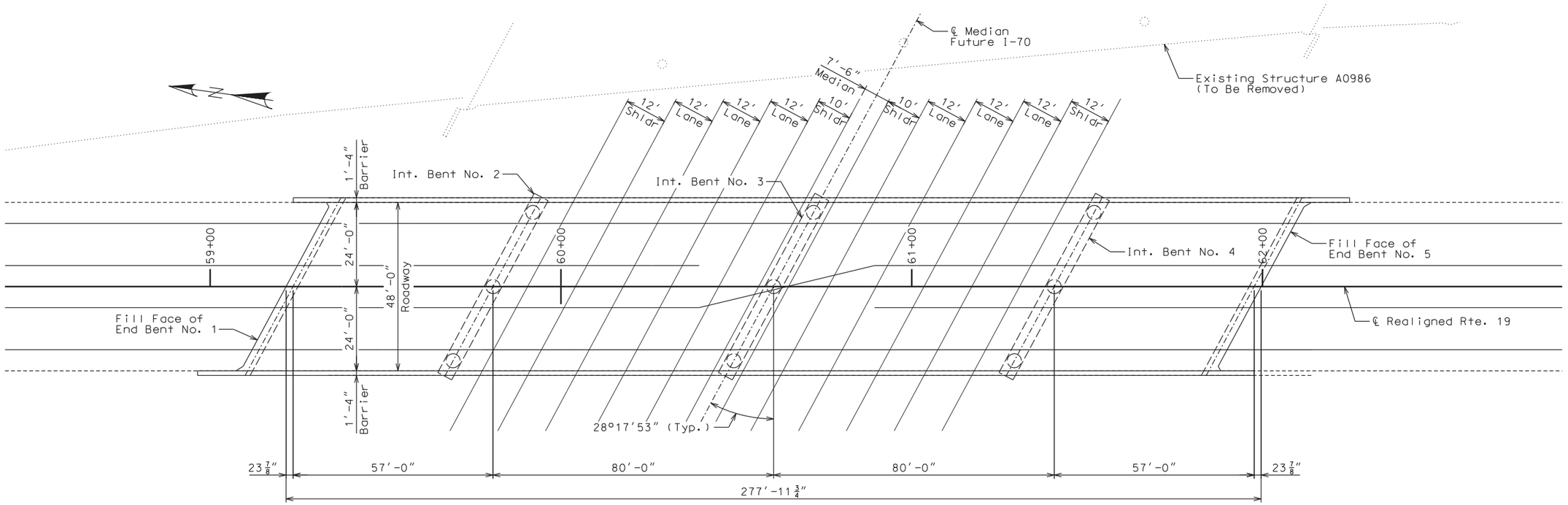
I.F. A SEAL IS PRESENT ON THIS SHEET, IT HAS BEEN ELECTRONICALLY SEALED AND DATED.

$FILE$ $TIME$ $DATE$ REV.

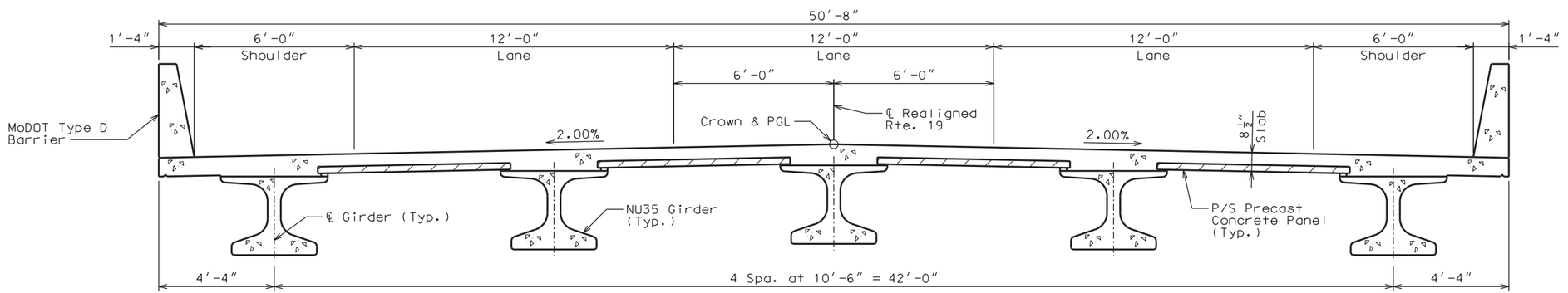
(57'-80'-80'-57') PRESTRESSED CONCRETE NU35 GIRDER SPANS



ELEVATION



PLAN



TYPICAL SECTION

Detailed July 2019
Checked July 2019

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

BRIDGE: ROUTE 19 OVER I-70
OPTION 7C

FOR INFORMATION ONLY, NOT FOR CONSTRUCTION

DATE PREPARED
$DATE$

ROUTE: RTE 19
STATE: MO
DISTRICT: BR
SHEET NO.: .
COUNTY: MONTGOMERY
JOB NO.: J2P3090
CONTRACT ID.: .
PROJECT NO.: .
BRIDGE NO.: .

DESCRIPTION	DATE
.	.

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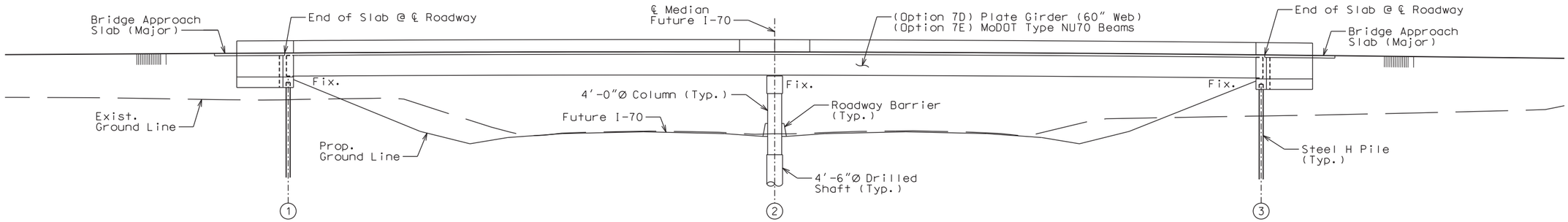
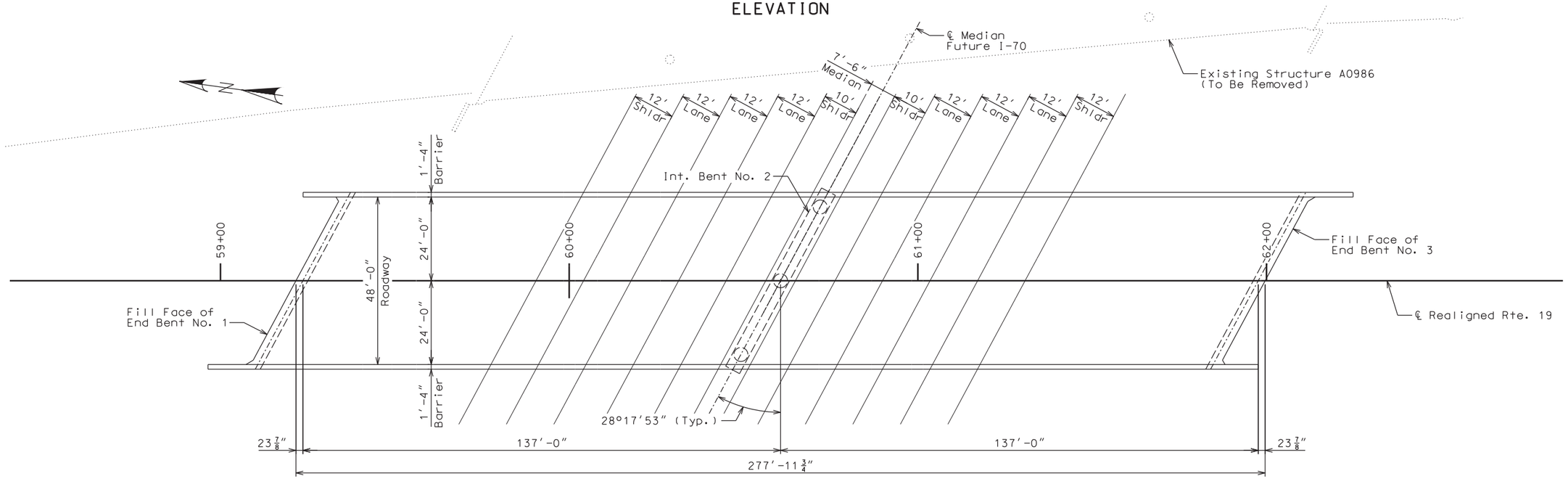
CERTIFICATE OF AUTHORITY #000104

$FILE$ $TIME$ $DATE$ REV.

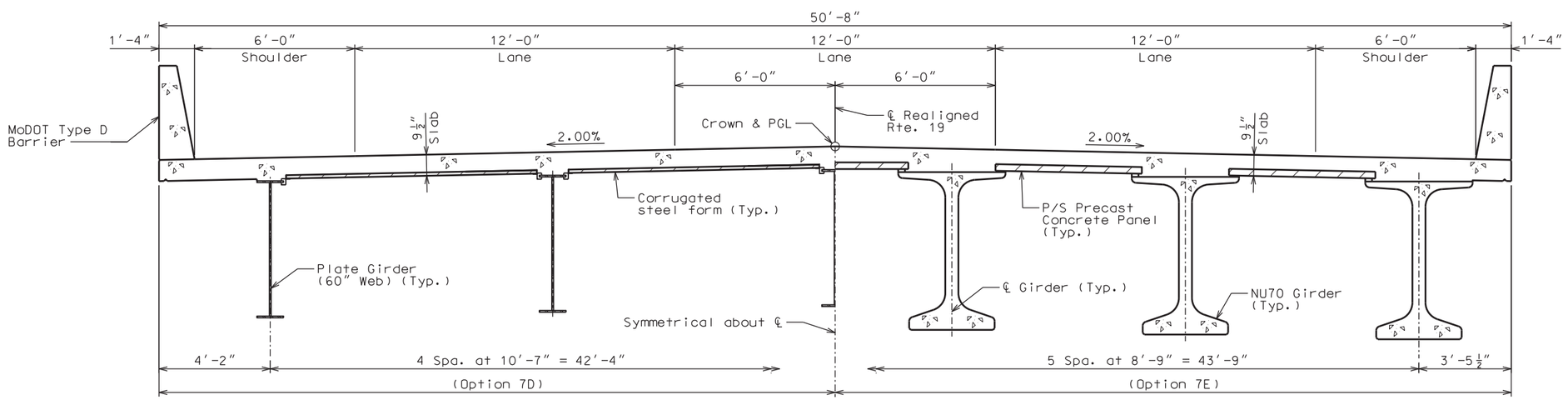
(OPTION 7D) (137'-137') COMPOSITE PLATE GIRDER SPANS
(OPTION 7E) (137'-137') PRESTRESSED CONCRETE NU70 GIRDER SPANS



ELEVATION



PLAN



TYPICAL SECTION

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

Detailed July 2019
Checked July 2019

BRIDGE: ROUTE 19 OVER I-70
OPTION 7D & OPTION 7E

FOR INFORMATION ONLY. NOT FOR CONSTRUCTION

DATE PREPARED: $DATE$
ROUTE: RTE 19
STATE: MO
DISTRICT: BR
SHEET NO.: .
COUNTY: MONTGOMERY
JOB NO.: J2P3090
CONTRACT ID.: .
PROJECT NO.: .
BRIDGE NO.: .

DESCRIPTION | DATE

MISSOURI HIGHWAYS AND TRANSPORTATION COMMISSION
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REV.

$FILE$ $TIME$ $DATE$

Appendix F

Request for Environmental Services

This RES has been completed, only administrators may edit this document now, they will contact you if any information changes.

Date Completed: 06/11/2019
Completed By: Charlotte Drinkard

Request for Environmental Services
Form#:2019-05-01290

Project Information

Stage:	Location/Conceptual			Previous RES(s):	No RES Selected
Job Number (w/o 'J'):	2P3090	District:	Northeast	County:	Montgomery
TIP Number:				Rte/Street:	MO 19
Letting Date:				PS&E Due Date:	
Location:	over I-70 near New Florence.				
TMS Project Description - termini (no stations):	Scoping for bridge improvements over I-70 near New Florence. Project involves bridge A0986.				
Describe RES project improvements in full detail:	A conceptual report is being prepared for the replacement of bridge A0986 on Montgomery 19 over I-70 near New Florence. Several options are being reviewed in order to make a final selection for the project. Please identify potential environmental issues for each option. Please note, the right of way amounts and tree clearing vary with each option; however, the RES form required a number for submittal. I inserted generic numbers in these fields.				

These users will receive a notification when Environmental Services completes the current stage, the person who created this form as well as the person who submits it will also receive notification.

Project Manager:	Kimberly Trainor - 573-248-2576	TP Designer:	Toshia Drebes - 573-406-6543
District Contact:	None selected	District Contact:	None selected
Date Desired:	06/15/2019	Submit Date:	05/16/2019
Desired A-Date:			
Created By:	Kimberly Trainor - (5/16/2019 3:15:54 PM) - 573-248-2576	Submitted By:	Kimberly Trainor - (5/16/2019 12:00:00 AM) - 573-248-2576

Program Year:

Preliminary Engineering:	2019	Right of Way:	N/A
Construction:	N/A		

Has the district documented that the project has: 1. Independent utility, 2. Logical termini, and 3. Does not restrict consideration of alternatives for other reasonably foreseeable transportation improvements?: (●) Yes ( ) No

Changes to project since last RES submittal? If yes, explain: No

[ ] Design/Build [ ] Alternate Technical Concepts

[ ] Project breakout from previous or larger project? *If checked explain:*

Acres - From all sources (e.g. donated from public or private entities):

Additional R/W:	2	**Temp Easement:**	0	**Permanent Easement:**	0
ROW may be needed, but, not yet determined?	Yes			Acres of Tree Clearing:	1 acres

Is ANY Federally-owned land impacted by the project? ○ Yes ◉ No

Land Disturbance / Stormwater:

Will project involve 1 acre of land disturbance: ○ Yes ○ No ○ Unknown

Projects with one acre or greater land disturbance activities must comply with the Land Disturbance Permit requirements.

Define project type (see definitions below): ○ New Development ○ Redevelopment ○ Maintenance

New Development - Projects (with land disturbance greater than or equal to 1 acre) that are constructed where there was previously no transportation facility.
Redevelopment - Non-maintenance work performed to or on an existing public transportation facility which provides for an increased number of thru lanes of travel unless the work can be accomodated without increasing the width of the existing pavement. Widening of an existing road that does not result in an additional thru lane does not constitute redevelopment. Widening to add shoulders does not constitute a thru lane unless the total widening is greater than or equal to 10 feet.
Maintenance - Projects that do not meet the criteria of redevelopment or new development.

Number of Displacements(do not include partial takes that do not displace):

Residential:	○ Yes ◉ No			Commercial:	○ Yes ◉ No
No. of People:		Residences:		No. of Employees:	Businesses:

Public Hearing/Meeting Information:

Average Daily Traffic:

ADT Construction Year:	5000	ADT Design Year:	

Traffic Impacts:

Road Closure Planned:	○ Yes ◉ No	Bridge Closure Planned:	○ Yes ◉ No

Detour Info (including use of local roads): Depending upon each option, there may be minor closure periods for connecting roadway segments prior to completing the bridge.

Days/Months Closed:

Bicycle / Pedestrian Consideration

Pedestrian facilities considered:	Yes	Bicycle facilities considered:	Yes

National Flood Insurance Program (NFIP) and Hydraulic Design Data:

☐ Project is in a FEMA-identified zone "subject to 100-year flooding": *If so, what zone?:*

Project is in a FEMA-defined "floodway": No

☐ Project involves land purchased through FEMA Hazard Mitigation Grant Program (Flood buyout property)

If checked, give details:

☐ Is highway improvement located within 4 miles of an existing airport?

Known Concerns: Provide information you have about these resources that you have observed in the area.

Parkland:	
Wetland/404 Permit:	
Land Disturbance / Stormwater:	
Farmland:	
Threatened & Endangered Species:	
Migratory Birds: Are there birds nesting on the structure?	Unknown,
Hazardous Waste:	
Cultural Resources:	
District Comments:	

Project Attachments:

NOTE: If making updates to an attachment, please use a different filename than the original.
The combined size of attachments in one upload must be less than 100MB

Attachments:

- ✖ J2P3090_Option_7.pdf
- ✖ J2P3090_Option_1_Revised.pdf
- ✖ J2P3090_Option_2_Revised.pdf
- ✖ J2P3090_Option_2A.pdf
- ✖ J2P3090_Option_5.pdf

Required Information to be attached for each RES stage:

- ***Loc/Concp.:*** *Location map (county map) & topographic map or aerial photo showing project limits – pre-plan sheets or other preliminary map showing alternatives, if available*
- ***Prel. Plan:*** *Prel. Plan sheets*
- ***R/W:*** *R/W Plan sheets*
- ***Final Design:*** *Final Plans [Location map (county map) & topographic map or aerial photo showing project limits if this is first RES submittal*

RES Environmental Screenings

Farmland Impact

Status Information: Status Changed By: Jo Dent — Clearance Date: — ○ N/A ◉ Pending ○ Cleared

Environmental Response: If any of the options require new right of way or permanent easements outside of New Florence city limits, the Farmland Protection Policy Act will apply requiring completion of a farmland evaluation in coordination with the NRCS. The NRCS has 30 days to respond upon receipt of project information.

Environmental Action: Continue to assess the need for a farmland evaluation as more information is provided from the district.

District Action: As it becomes known, provide right of way and easement amounts and locations to the environmental specialist for determining the need for a farmland evaluation.

Attachments:

☑ Farmland Impact Submitted - *Mark submitted when this review is ready to be sent to district staff.*

Last Updated: Jo Dent - 6/4/2019 9:10:20 AM

Floodplain/Regulatory Floodway

Status Information: Status Changed By: Jo Dent — Clearance Date: — ○ N/A ◉ Pending ○ Cleared

Environmental Response: According to the attached FEMA Firmette map, Option 7 (as labeled on the RES; the plan sheet indicates Option 6) could encroach upon Zone A 100-year floodplain of Smith Branch east of Route 19, at Coop Road and I-70. Based on the type of work that could occur in the floodplain and whether new right of way is needed at this location, a floodplain development permit from SEMA may be required. There are no areas of regulatory floodwa in and around the various option footprints.

Environmental Action: Continue to assess the need for a floodplain development permit from SEMA as more information is provided by the district.

District Action: Once established, submit detailed work description and new right of way and easement amounts to the environmental specialist to determine the need for a floodplain development permit from SEMA.

Attachments:

✖FEMA-Firmette_Smith-Branch_100-year.pdf

☑ Floodplain/Regulatory Floodway Submitted - *Mark submitted when this review is ready to be sent to district staff.*

Last Updated: Jo Dent - 6/10/2019 10:39:22 AM

Land Disturbance / Stormwater

Status Information: Status Changed By: Chris Shulse — Clearance Date: — ◉ N/A ○ Pending ○ Cleared

Environmental Response: The project is outside the TS4 area.

Environmental Action: None

District Action: None

TS4 Area: ○ Yes ○ No ○ Partial — Is the project in a TMDL watershed? ○ Yes ○ No

Attachments:

☑ Land Disturbance / Stormwater Submitted - *Mark submitted when this review is ready to be sent to district staff.*

Last Updated: Christopher Shulse - 6/6/2019 7:45:23 AM

FEMA/SEMA Buyout

Status Information: Status Changed By: Jo Dent — Clearance Date: — ◉ N/A ○ Pending ○ Cleared

Environmental Response: According to the TMS FEMA buyout layer, there are no buyout sites in the vicinity of the project area for any of the options. No impacts to buyout sites.

Environmental Action: None

District Action: None

Attachments:

☑ FEMA/SEMA Buyout Submitted - *Mark submitted when this review is ready to be sent to district staff.*

Last Updated: Jo Dent - 5/17/2019 2:05:42 PM

Socioeconomic Impact

Status Information: Status Changed By: Jo Dent | N/A | Pending | Cleared | Comment Date: 06/10/2019

Environmental Response: If any option chosen requires new right of way and/or easements, they would be subject to the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended. If commercial and/or residential displacement should be needed, further assessment would be warranted to determine any potential impacts to low-income and minority residents and businesses owners. Traffic impacts will need to be explained for any of the options, including road closures, detours routes and lengths, approximate timeline for construction, and how and when the public would be notified. Any public involvement documentation (meetings, press releases, letters, sign-in sheets, meeting minutes, etc.) would need to be provided to the environmental specialist, including any known controversies, public comments, and MoDOT responses.

Environmental Action: Continue to assess impacts as more information is provided by the district.

District Action: Provide additional information and documentation to the environmental specialist as discussed above.

Attachments:

☑ Socioeconomic Impact Submitted - *Mark submitted when this review is ready to be sent to district staff.*

Last Updated: Jo Dent - 6/10/2019 10:18:08 AM

Threatened & Endangered Species

Status Information: Status Changed By: Chris Shulse | No Effect | Pending | Cleared | Clearance Date:

Environmental Response: Consultation Code: 03E14000-2019-SLI-1604 May 16, 2019 Endangered Species Act Species List: Running Buffalo clover; Gray, Indiana, and Northern Long-eared bats. Running buffalo clover occurs in the transitional area between grassland and forest in areas with light disturbance. It can be found along streams. Although there are no records in the project area according to the MDC Heritage Database (April 2019) a field check along Smith Branch would be necessary with Option 7. The listed bat species roost in caves and mines during the winter. Indiana and northern long-eared bats roost in suitable trees during the summer. There are no caves or mines in the project area according to the MSS Cave Database (April 2019). Habitat assessments for suitable roost trees would be necessary for all options, but Option 7 would likely require formal consultation with USFWS and possible mitigation for tree clearing. This could result in longer clearance timelines. A JSP for winter tree clearing is possible with any of the options involving clearing, but is highly likely with Option 7. Presence/absence surveys may also be necessary for Option 7. Although all three bat species occasionally roost on bridges, the current structure is a slab and appears unlikely to serve as a roost.

Environmental Action: Re-evaluate.

District Action: See above.

Attachments:

✖ Official_Species_List_2P3090.pdf

☑ Threatened & Endangered Species Submitted - *Mark submitted when this review is ready to be sent to district staff.*

Last Updated: Christopher Shulse - 6/6/2019 8:07:26 AM

Migratory Birds

Status Information: Status Changed By: Chris Shulse | N/A | Pending | Cleared | Clearance Date: 06/06/2019

Environmental Response: The existing bridge is a slab structure and not conducive to nesting for migratory birds. No nests are evident in Google Earth street level imagery (7/2018). No JSP necessary.

Environmental Action: None

District Action: None

Attachments:

☑ Migratory Birds Submitted - *Mark submitted when this review is ready to be sent to district staff.*

Last Updated: Christopher Shulse - 6/6/2019 7:59:34 AM

Hazardous Waste Impact

Status Information:	Status Changed By:		Clearance Date:
	Kevin Kelly	○ N/A ○ Pending ◉ Cleared	05/29/2019

Environmental Response: The site location was reviewed utilizing the MDNR Interactive E-Start Map. The map contains information about the following types of sites: Superfund sites, Federal Facilities sites, Resource Conservation and Recovery Act Corrective Action sites, Brownfields/Voluntary Cleanup Program sites, Brownfield Assessments, and Petroleum and Hazardous Substance Storage Tank Facilities. No such sites were found within the project area. The potential to encounter wastes from sites unknown to MoDOT should always be a consideration. Any previously unknown sites that are found during project construction will be handled in accordance with Federal and State Laws and Regulations.

Environmental Action: None

District Action: Demolition or renovation of bridges requires asbestos inspection, notification and demolition notice to DNR. The District will need to submit a request for asbestos and painted concrete inspection to MoDOT's Chemical Laboratory. The information needed is outlined in Section 127.8.1.3.1 of the EPG. In regards to demolition notification, the Contractor (or MoDOT) is required to notify DNR 10-days in advance of all bridge demolitions. It is recommended that Section 202.40.1.1 Notification of Demolition paragraph be included in the contract documents to highlight this requirement.

Attachments:

☑ Hazardous Waste Impact Submitted - *Mark submitted when this review is ready to be sent to district staff.*

Last Updated: Kevin Kelly - 5/29/2019 2:12:03 PM

Wetland Impact (Section 404/401)

Status Information:	Status Changed By:		Clearance Date:
	Chris Shulse	○ N/A ◉ Pending ○ Cleared	

Environmental Response: Option 7 would impact Smith Branch on the east side of the project and would also impact a mapped emergent wetland in the NW quadrant of the project. The wetland may not be jurisdictional but a field check would be necessary. A Section 404 permit would be necessary for impacts. It is possible that mitigation for both streams and wetlands could be necessary with Option 7. The other options do not appear to impact any streams or wetlands and no permit would be required.

Environmental Action: Re-evaluate.

District Action: See above.

Wetland Permit Information:	404 Permit Number	Permit Submitted	Permit Received
	Permit Expiration	Compliance Certification Sent	Compliance Certification Received

Attachments:

☑ Wetland Impact Submitted - *Mark submitted when this review is ready to be sent to district staff.*

Last Updated: Christopher Shulse - 6/6/2019 7:57:07 AM

Noise Impact

Status Information:	Status Changed By:		Clearance Date:
	Matt Burcham	○ N/A ◉ Pending ○ Cleared	

Environmental Response: Depending upon the option's improvements the project may meet the criteria of a Type I project. Options 5 and 7 would qualify as Type I and require a noise study. It is unlikely there will be impacts since the study area doesn't appear to have noise sensitive receptors. The other options are Type III candidates which would not require a noise analysis.

Environmental Action: Determine if chosen option is Type I, then proceed from that determination.

District Action: Inform of chosen option to build.

Attachments:

☑ Noise Impact Submitted - *Mark submitted when this review is ready to be sent to district staff.*

Last Updated: Matthew Burcham - 6/4/2019 12:58:43 PM

Cultural Resources Impact (Section 106)

Status Information: (●) Pending ( ) Cleared ( ) ROW Cleared

Status Changed By: Russell Weisman

Clearance Date:

A Date Cleared:

Environmental Action: The area around the Route 19/70 interchange encompassing all the options was included in several previous cultural resources surveys. One small and seemingly NRHP non-eligible site (23MT1460) has been identified SW of the current outer rd intersections with Route 19 in the SW quadrant. There are no other known archaeological concerns at this interchange

District Action:

Attachments:

[ ] Adverse Effect or Conditional No Adverse Effect

[x] Cultural Resources Impact Submitted - *Mark submitted when this review is ready to be sent to district staff.*

Last Updated: Russell Weisman - 6/5/2019 10:08:30 AM

Public Land Impact (Section 4f/6f)

Status Information:

Status Changed By: Jo Dent

Clearance Date:

(●) N/A ( ) Pending ( ) Cleared

Environmental Response: According to Google Earth imagery and ArcMap public lands layers, there are no Section 4(f) or Section 6(f) resources in the vicinity of the project area for any of the options. Danville Conservation Area (MDC) is the nearest resource, approximately 2.5 miles southeast of the project area, off of Route RB. However, the project should not restrict access to this resource. No impacts to public recreational lands.

Environmental Action: None

District Action: None

Attachments:

[x] Based on the review of the project location and description noted above, there are no identified 4(f) or 6(f) resources affected that would preclude the setting of an A-date.

Checked by: Jo Dent on 05/17/2019

[x] Public Land Impact Submitted - *Mark submitted when this review is ready to be sent to district staff.*

Last Updated: Jo Dent - 5/17/2019 2:30:07 PM

Other

Status Information:

Clearance Date:

( ) N/A (●) Pending ( ) Cleared

Environmental Response:

District Action:

Attachments:

[ ] Other Screening Submitted - *Mark submitted when this review is ready to be sent to district staff.*

Last Updated: Unsaved

NEPA Classification

NEPA Right-Of-Way Permission:	Pending	as determined or approved by:	
NEPA Approval/Proceed to A-date Request:		Re-evaluation Date:	
		Final Design Complete:	
NEPA Classification:			
This project qualifies for the programmatic categorical exclusion under Item#:		All Environmental Issues Cleared:	
Comments To District:	A re-evaluation of the SIU7 for the I-70 corridor will be required.		

Attachments:

Last Submitted: 06/11/2019 by Charlotte Drinkard

Appendix G

HSM Evaluation Summary

MEMORANDUM

Date: August 19, 2019

To: Christina Sfreddo, Jacobs
From: Carrie A. Falkenrath

Subject: Predictive HSM Analysis Summary

Project: MO Route 19 over I-70
Jacobs Project No.: F3W94500-S19-0002
T² Job No: 18-07

Per the CORE team meeting and subsequent direction from MoDOT, I have completed a conceptual safety analysis of two of the proposed alternatives for the MO Route 19 over I-70 project. This analysis utilized HSM methodologies, specifically the *Predictive Method for Rural Two-Lane, Two-Way Roads Analysis Spreadsheet*. Because recent crash data was not available, a predictive analysis was performed for comparison purposes only. Per MoDOT's direction, Options 1 and 2 were evaluated with the No Build option (for contrast).

The results are tabulated below in **Table 1**, and summaries from the spreadsheets are attached. In summary, both corridor design Options will offer fewer crashes than the No Build alternative, reductions over 40% are projected. Furthermore, there are fewer crashes predicted for the two roundabouts in Option 1 vs. the four intersections in Option 2.

Table 1: HSM Predictive Analysis Results

Scenario (2041 Design Year)	**Predicted Average Crash Frequency (crashes/year)**		
	Total	Fatal & Injury	PDO
No Build	**18.321**	7.607	10.714
Option 1	**9.377**	3.571	5.806
Option 2	**10.832**	4.379	6.453

The reduction in future crashes can be attributed to the additional turn lanes and roundabout added in Option 1 and the roundabout conversions in Option 2. It should be noted that the Crash Modification Factor (CMF) for turn lanes is built into the spreadsheet, but for roundabouts is selected by the analyst. For Option 2, CMF ID 229 ("Convert intersection with minor-road stop

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control to a modern roundabout") with a CRF of 0.29 was utilized for the proposed roundabout at Tree Farm Road/South Outer Road. This CMF has been approved and used in multiple previous projects for MoDOT. For Option 1, CMF ID 9445 ("Convert to interchange roundabouts with either a single RAB or a pair, 1-lane") with a CRF of 0.756 was used. I felt this CMF was more applicable to the proposed design as well as more conservative.

Analysis results printed from the HSM spreadsheets are attached in the following pages.

NO BUILD OPTION

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Worksheet 3A -- Predicted and Observed Crashes by Severity and Site Type Using the Site-Specific EB Method

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Site type	**Predicted average crash frequency (crashes/year)**			**Observed crashes,** $N_{observed}$ (crashes/year)	**Overdispersion Parameter, k**	**Weighted adjustment, w**	**Expected average crash frequency,**
	$N_{predicted}$ (TOTAL)	$N_{predicted}$ (FI)	$N_{predicted}$ (PDO)			Equation A-5 from Part C Appendix	Equation A-4 from Part C Appendix
ROADWAY SEGMENTS							
Segment 1							
Segment 2							
Segment 3						1.000	0.0
Segment 4						1.000	0.0
Segment 5						1.000	0.0
Segment 6						1.000	0.0
Segment 7						1.000	0.0
Segment 8						1.000	0.0
INTERSECTIONS							
Intersection 1	3.193	1.376	1.817		0.240	0.566	1.8
Intersection 2	5.092	2.194	2.897		0.240	0.450	2.3
Intersection 3	6.856	2.955	3.901		0.240	0.378	2.6
Intersection 4	3.180	1.081	2.099		0.110	0.741	2.4
Intersection 5						1.000	0.0
Intersection 6						1.000	0.0
Intersection 7						1.000	0.0
Intersection 8						1.000	0.0
COMBINED (sum of column)	18.321	7.607	10.714	0	--	--	9.0

Worksheet 3B -- Site-Specific EB Method Summary Results

(1)	(2)	(3)
Crash severity level	$N_{predicted}$	$N_{expected}$
Total	$(2)_{COMB}$ from Worksheet 3A	$(8)_{COMB}$ from Worksheet 3A
	18.321	9.0
Fatal and Injury (FI)	$(3)_{COMB}$ from Worksheet 3A	$(3)_{TOTAL} * (2)_{FI} / (2)_{TOTAL}$
	7.607	3.8
Property Damage Only (PDO)	$(4)_{COMB}$ from Worksheet 3A	$(3)_{TOTAL} * (2)_{PDO} / (2)_{TOTAL}$
	10.714	5.3

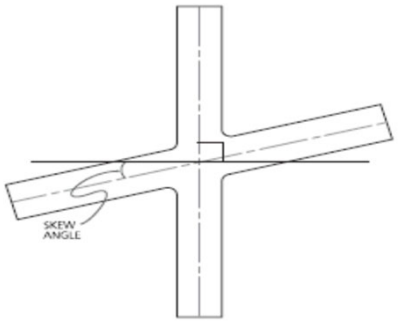
Worksheet 2A -- General Information and Input Data for Rural Two-Lane Two-Way Roadway Intersections

General Information		Location Information	
Analyst	CAF	Roadway	MO Route 19
Agency or Company	T2	Intersection	Route 19 at Tree Farm Road/SOR
Date Performed	08/08/19	Jurisdiction	Montgomery County, MO
		Analysis Year	2041

Input Data				Base Conditions	Site Conditions	
Intersection type (3ST, 4ST, 4SG)				--	4ST	
$AADT_{major}$ (veh/day)	$AADT_{MAX}$ =	14,700	(veh/day)	--	6,000	AADT OK
$AADT_{minor}$ (veh/day)	$AADT_{MAX}$ =	3,500	(veh/day)	--	3,220	AADT OK
Intersection skew angle (degrees) [If 4ST, does skew differ for minor legs?]		No		0	Skew for Leg 1 (All): 0	Skew for Leg 2 (4ST only): 0
Number of signalized or uncontrolled approaches with a left-turn lane (0, 1, 2, 3, 4)				0	1	
Number of signalized or uncontrolled approaches with a right-turn lane (0, 1, 2, 3, 4)				0	0	
Intersection lighting (present/not present)				Not Present	Present	
Calibration Factor, C_i				1.00	1.00	

Unsignalized four-leg (stop control on minor-road approaches)

Skew Intersection:



Worksheet 2B -- Crash Modification Factors for Rural Two-Lane Two-Way Roadway Intersections

(1) CMF for Intersection Skew Angle CMF_{1i} from Equations 10-22 or 10-23	(2) CMF for Left-Turn Lanes CMF_{2i} from Table 10-13	(3) CMF for Right-Turn Lanes CMF_{3i} from Table 10-14	(4) CMF for Lighting CMF_{4i} from Equation 10-24	(5) Combined CMF CMF_{COMB} (1)*(2)*(3)*(4)
1.00	0.72	1.00	0.91	0.65

Worksheet 2C -- Intersection Crashes for Rural Two-Lane Two-Way Roadway Intersections

(1) Crash Severity Level	(2) $N_{spf\ 3ST,\ 4ST\ or\ 4SG}$ from Equations 10-8, 10-9, or 10-10	(3) Overdispersion Parameter, k from Section 10.6.2	(4) Crash Severity Distribution from Table 10-5	(5) $N_{spf\ 3ST,\ 4ST\ or\ 4SG}$ by Severity Distribution $(2)_{TOTAL}$ * (4)	(6) Combined CMFs from (5) of Worksheet 2B	(7) Calibration Factor, C_i	(8) Predicted average crash frequency, $N_{predicted\ int}$ (5)*(6)*(7)
Total	4.888	0.24	1.000	4.888	0.65	1.00	3.193
Fatal and Injury (FI)	--	--	0.431	2.107	0.65	1.00	1.376
Property Damage Only (PDO)	--	--	0.569	2.781	0.65	1.00	1.817

Worksheet 2D -- Crashes by Severity Level and Collision Type for Rural Two-Lane Two-Way Road Intersections

(1) Collision Type	(2) Proportion of Collision Type(TOTAL) from Table 10-6	(3) $N_{predicted\ int\ (TOTAL)}$ (crashes/year) $(8)_{TOTAL}$ from Worksheet 2C	(4) Proportion of Collision Type(FI) from Table 10-6	(5) $N_{predicted\ int\ (FI)}$ (crashes/year) $(8)_{FI}$ from Worksheet 2C	(6) Proportion of Collision Type(PDO) from Table 10-6	(7) $N_{predicted\ int\ (PDO)}$ (crashes/year) $(8)_{PDO}$ from Worksheet 2C
Total	1.000	3.193	1.000	1.376	1.000	1.817
		(2)x(3)TOTAL		(4)x(5)FI		(6)x(7)PDO
SINGLE-VEHICLE						
Collision with animal	0.010	0.032	0.006	0.008	0.014	0.025
Collision with bicycle	0.001	0.003	0.001	0.001	0.001	0.002
Collision with pedestrian	0.001	0.003	0.001	0.001	0.001	0.002
Overturned	0.005	0.016	0.006	0.008	0.004	0.007
Ran off road	0.122	0.390	0.094	0.129	0.144	0.262
Other single-vehicle collision	0.008	0.026	0.004	0.006	0.010	0.018
Total single-vehicle crashes	0.147	0.469	0.112	0.154	0.174	0.316
MULTIPLE-VEHICLE						
Angle collision	0.431	1.376	0.532	0.732	0.354	0.643
Head-on collision	0.040	0.128	0.060	0.083	0.025	0.045
Rear-end collision	0.242	0.773	0.210	0.289	0.266	0.483
Sideswipe collision	0.101	0.322	0.044	0.061	0.144	0.262
Other multiple-vehicle collision	0.039	0.125	0.042	0.058	0.037	0.067
Total multiple-vehicle crashes	0.853	2.724	0.888	1.222	0.826	1.501

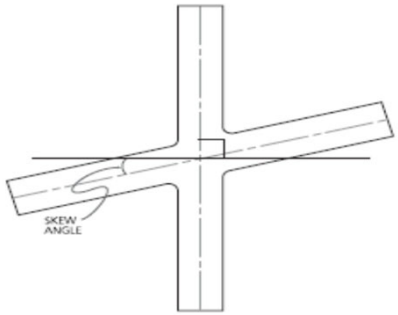
Worksheet 2E -- Summary Results for Rural Two-Lane Two-Way Road Intersections

(1) Crash severity level	(2) Crash Severity Distribution (proportion) (4) from Worksheet 2C	(3) Predicted average crash frequency (crashes / year) (8) from Worksheet 2C
Total	1.000	3.2
Fatal and Injury (FI)	0.431	1.4
Property Damage Only (PDO)	0.569	1.8

Worksheet 2A -- General Information and Input Data for Rural Two-Lane Two-Way Roadway Intersections

General Information		Location Information	
Analyst	CAF	Roadway	MO Route 19
Agency or Company	T2	Intersection	Route 19 at I-70 EB Ramp Terminals
Date Performed	08/08/19	Jurisdiction	Montgomery County, MO
		Analysis Year	2041

Input Data				Base Conditions	Site Conditions				
Intersection type (3ST, 4ST, 4SG)				--	4ST				Unsignalized four-leg (stop control on minor-road approaches)
$AADT_{major}$ (veh/day)	$AADT_{MAX}$ =	14,700	(veh/day)	--	9,100			AADT OK	
$AADT_{minor}$ (veh/day)	$AADT_{MAX}$ =	3,500	(veh/day)	--	1,800			AADT OK	
Intersection skew angle (degrees)	[If 4ST, does skew differ for minor legs?]		No	0	Skew for Leg 1 (All):	45	Skew for Leg 2 (4ST only):	30	Skew Intersection:
Number of signalized or uncontrolled approaches with a left-turn lane (0, 1, 2, 3, 4)				0	0				
Number of signalized or uncontrolled approaches with a right-turn lane (0, 1, 2, 3, 4)				0	0				
Intersection lighting (present/not present)				Not Present	Present				
Calibration Factor, C_i				1.00	1.00				



Worksheet 2B -- Crash Modification Factors for Rural Two-Lane Two-Way Roadway Intersections

(1) CMF for Intersection Skew Angle CMF_{1i} from Equations 10-22 or 10-23	(2) CMF for Left-Turn Lanes CMF_{2i} from Table 10-13	(3) CMF for Right-Turn Lanes CMF_{3i} from Table 10-14	(4) CMF for Lighting CMF_{4i} from Equation 10-24	(5) Combined CMF CMF_{COMB} (1)*(2)*(3)*(4)
1.28	1.00	1.00	0.91	1.16

Worksheet 2C -- Intersection Crashes for Rural Two-Lane Two-Way Roadway Intersections

(1) Crash Severity Level	(2) $N_{spf\ 3ST,\ 4ST\ or\ 4SG}$ from Equations 10-8, 10-9, or 10-10	(3) Overdispersion Parameter, k from Section 10.6.2	(4) Crash Severity Distribution from Table 10-5	(5) $N_{spf\ 3ST,\ 4ST\ or\ 4SG}$ by Severity Distribution $(2)_{TOTAL}$ * (4)	(6) Combined CMFs from (5) of Worksheet 2B	(7) Calibration Factor, C_i	(8) Predicted average crash frequency, $N_{predicted\ int}$ (5)*(6)*(7)
Total	4.401	0.24	1.000	4.401	1.16	1.00	5.092
Fatal and Injury (FI)	--	--	0.431	1.897	1.16	1.00	2.194
Property Damage Only (PDO)	--	--	0.569	2.504	1.16	1.00	2.897

Worksheet 2D -- Crashes by Severity Level and Collision Type for Rural Two-Lane Two-Way Road Intersections

(1) Collision Type	(2) Proportion of Collision $Type_{(TOTAL)}$ from Table 10-6	(3) $N_{predicted\ int\ (TOTAL)}$ (crashes/year) $(8)_{TOTAL}$ from Worksheet 2C	(4) Proportion of Collision $Type_{(FI)}$ from Table 10-6	(5) $N_{predicted\ int\ (FI)}$ (crashes/year) $(8)_{FI}$ from Worksheet 2C	(6) Proportion of $Type_{(PDO)}$ from Table 10-6	(7) $N_{predicted\ int\ (PDO)}$ (crashes/year) $(8)_{PDO}$ from Worksheet 2C
Total	1.000	5.092	1.000	2.194	1.000	2.897
		(2)x(3)$_{TOTAL}$		(4)x(5)$_{FI}$		(6)x(7)$_{PDO}$
SINGLE-VEHICLE						
Collision with animal	0.010	0.051	0.006	0.013	0.014	0.041
Collision with bicycle	0.001	0.005	0.001	0.002	0.001	0.003
Collision with pedestrian	0.001	0.005	0.001	0.002	0.001	0.003
Overturned	0.005	0.025	0.006	0.013	0.004	0.012
Ran off road	0.122	0.621	0.094	0.206	0.144	0.417
Other single-vehicle collision	0.008	0.041	0.004	0.009	0.010	0.029
Total single-vehicle crashes	0.147	0.748	0.112	0.246	0.174	0.504
MULTIPLE-VEHICLE						
Angle collision	0.431	2.194	0.532	1.167	0.354	1.026
Head-on collision	0.040	0.204	0.060	0.132	0.025	0.072
Rear-end collision	0.242	1.232	0.210	0.461	0.266	0.771
Sideswipe collision	0.101	0.514	0.044	0.097	0.144	0.417
Other multiple-vehicle collision	0.039	0.199	0.042	0.092	0.037	0.107
Total multiple-vehicle crashes	0.853	4.343	0.888	1.949	0.826	2.393

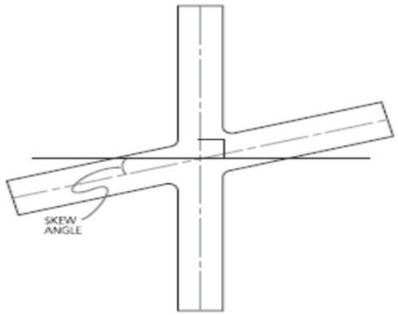
Worksheet 2E -- Summary Results for Rural Two-Lane Two-Way Road Intersections

(1) Crash severity level	(2) Crash Severity Distribution (proportion) (4) from Worksheet 2C	(3) Predicted average crash frequency (crashes / year) (8) from Worksheet 2C
Total	1.000	5.1
Fatal and Injury (FI)	0.431	2.2
Property Damage Only (PDO)	0.569	2.9

Worksheet 2A -- General Information and Input Data for Rural Two-Lane Two-Way Roadway Intersections

General Information		Location Information	
Analyst	CAF	Roadway	MO Route 19
Agency or Company	T2	Intersection	Route 19 at I-70 WB Ramp Terminals
Date Performed	08/08/19	Jurisdiction	Montgomery County, MO
		Analysis Year	2041

Input Data				Base Conditions	Site Conditions				
Intersection type (3ST, 4ST, 4SG)				--	4ST				Unsignalized four-leg (stop control on minor-road approaches)
$AADT_{major}$ (veh/day)	$AADT_{MAX}$ =	14,700	(veh/day)	--	7,600			AADT OK	
$AADT_{minor}$ (veh/day)	$AADT_{MAX}$ =	3,500	(veh/day)	--	3,500			AADT OK	
Intersection skew angle (degrees)	[If 4ST, does skew differ for minor legs?]		No	0	Skew for Leg 1 (All):	45	Skew for Leg 2 (4ST only):	30	Skew Intersection:
Number of signalized or uncontrolled approaches with a left-turn lane (0, 1, 2, 3, 4)				0	0				
Number of signalized or uncontrolled approaches with a right-turn lane (0, 1, 2, 3, 4)				0	0				
Intersection lighting (present/not present)				Not Present	Present				
Calibration Factor, C_i				1.00	1.00				



Worksheet 2B -- Crash Modification Factors for Rural Two-Lane Two-Way Roadway Intersections

(1) CMF for Intersection Skew Angle CMF_{1i} from Equations 10-22 or 10-23	(2) CMF for Left-Turn Lanes CMF_{2i} from Table 10-13	(3) CMF for Right-Turn Lanes CMF_{3i} from Table 10-14	(4) CMF for Lighting CMF_{4i} from Equation 10-24	(5) Combined CMF CMF_{COMB} (1)*(2)*(3)*(4)
1.28	1.00	1.00	0.91	1.16

Worksheet 2C -- Intersection Crashes for Rural Two-Lane Two-Way Roadway Intersections

(1) Crash Severity Level	(2) $N_{spf\ 3ST,\ 4ST\ or\ 4SG}$ from Equations 10-8, 10-9, or 10-10	(3) Overdispersion Parameter, k from Section 10.6.2	(4) Crash Severity Distribution from Table 10-5	(5) $N_{spf\ 3ST,\ 4ST\ or\ 4SG}$ by Severity Distribution $(2)_{TOTAL}$ * (4)	(6) Combined CMFs from (5) of Worksheet 2B	(7) Calibration Factor, C_i	(8) Predicted average crash frequency, $N_{predicted\ int}$ (5)*(6)*(7)
Total	5.927	0.24	1.000	5.927	1.16	1.00	6.856
Fatal and Injury (FI)	--	--	0.431	2.554	1.16	1.00	2.955
Property Damage Only (PDO)	--	--	0.569	3.372	1.16	1.00	3.901

Worksheet 2D -- Crashes by Severity Level and Collision Type for Rural Two-Lane Two-Way Road Intersections

(1) Collision Type	(2) Proportion of Collision $Type_{(TOTAL)}$ from Table 10-6	(3) $N_{predicted\ int\ (TOTAL)}$ (crashes/year) $(8)_{TOTAL}$ from Worksheet 2C	(4) Proportion of Collision $Type_{(FI)}$ from Table 10-6	(5) $N_{predicted\ int\ (FI)}$ (crashes/year) $(8)_{FI}$ from Worksheet 2C	(6) Proportion of Collision $Type_{(PDO)}$ from Table 10-6	(7) $N_{predicted\ int\ (PDO)}$ (crashes/year) $(8)_{PDO}$ from Worksheet 2C
Total	1.000	6.856	1.000	2.955	1.000	3.901
		(2)x(3)$_{TOTAL}$		(4)x(5)$_{FI}$		(6)x(7)$_{PDO}$
SINGLE-VEHICLE						
Collision with animal	0.010	0.069	0.006	0.018	0.014	0.055
Collision with bicycle	0.001	0.007	0.001	0.003	0.001	0.004
Collision with pedestrian	0.001	0.007	0.001	0.003	0.001	0.004
Overturned	0.005	0.034	0.006	0.018	0.004	0.016
Ran off road	0.122	0.836	0.094	0.278	0.144	0.562
Other single-vehicle collision	0.008	0.055	0.004	0.012	0.010	0.039
Total single-vehicle crashes	0.147	1.008	0.112	0.331	0.174	0.679
MULTIPLE-VEHICLE						
Angle collision	0.431	2.955	0.532	1.572	0.354	1.381
Head-on collision	0.040	0.274	0.060	0.177	0.025	0.098
Rear-end collision	0.242	1.659	0.210	0.621	0.266	1.038
Sideswipe collision	0.101	0.692	0.044	0.130	0.144	0.562
Other multiple-vehicle collision	0.039	0.267	0.042	0.124	0.037	0.144
Total multiple-vehicle crashes	0.853	5.848	0.888	2.624	0.826	3.222

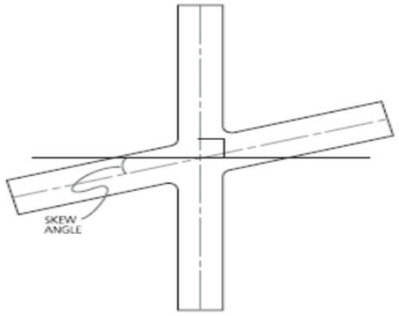
Worksheet 2E -- Summary Results for Rural Two-Lane Two-Way Road Intersections

(1) Crash severity level	(2) Crash Severity Distribution (proportion) (4) from Worksheet 2C	(3) Predicted average crash frequency (crashes / year) (8) from Worksheet 2C
Total	1.000	6.9
Fatal and Injury (FI)	0.431	3.0
Property Damage Only (PDO)	0.569	3.9

Worksheet 2A -- General Information and Input Data for Rural Two-Lane Two-Way Roadway Intersections

General Information		Location Information	
Analyst	CAF	Roadway	MO Route 19
Agency or Company	T2	Intersection	Route 19 at Booneslick Rd/NOR
Date Performed	08/08/19	Jurisdiction	Montgomery County, MO
		Analysis Year	2041

Input Data				Base Conditions	Site Conditions				
Intersection type (3ST, 4ST, 4SG)				--	4SG				Signalized four-leg
$AADT_{major}$ (veh/day)	$AADT_{MAX}$ =	25,200	(veh/day)	--	8,000			AADT OK	
$AADT_{minor}$ (veh/day)	$AADT_{MAX}$ =	12,500	(veh/day)	--	2,600			AADT OK	
Intersection skew angle (degrees) [If 4ST, does skew differ for minor legs?]			Yes	0	Skew for Leg 1 (All):	10	Skew for Leg 2 (4ST only):	0	Skew Intersection:
Number of signalized or uncontrolled approaches with a left-turn lane (0, 1, 2, 3, 4)				0	2				
Number of signalized or uncontrolled approaches with a right-turn lane (0, 1, 2, 3, 4)				0	4				
Intersection lighting (present/not present)				Not Present	Present				
Calibration Factor, C_i				1.00	1.00				



Worksheet 2B -- Crash Modification Factors for Rural Two-Lane Two-Way Roadway Intersections

(1) CMF for Intersection Skew Angle CMF_{1i} from Equations 10-22 or 10-23	(2) CMF for Left-Turn Lanes CMF_{2i} from Table 10-13	(3) CMF for Right-Turn Lanes CMF_{3i} from Table 10-14	(4) CMF for Lighting CMF_{4i} from Equation 10-24	(5) Combined CMF CMF_{COMB} (1)*(2)*(3)*(4)
1.00	0.67	0.85	0.89	0.51

Worksheet 2C -- Intersection Crashes for Rural Two-Lane Two-Way Roadway Intersections

(1) Crash Severity Level	(2) $N_{spf\ 3ST,\ 4ST\ or\ 4SG}$ from Equations 10-8, 10-9, or 10-10	(3) Overdispersion Parameter, k from Section 10.6.2	(4) Crash Severity Distribution from Table 10-5	(5) $N_{spf\ 3ST,\ 4ST\ or\ 4SG}$ by Severity Distribution $(2)_{TOTAL}$ * (4)	(6) Combined CMFs from (5) of Worksheet 2B	(7) Calibration Factor, C_i	(8) Predicted average crash frequency, $N_{predicted\ int}$ (5)*(6)*(7)
Total	6.265	0.11	1.000	6.265	0.51	1.00	3.180
Fatal and Injury (FI)	--	--	0.340	2.130	0.51	1.00	1.081
Property Damage Only (PDO)	--	--	0.660	4.135	0.51	1.00	2.099

Worksheet 2D -- Crashes by Severity Level and Collision Type for Rural Two-Lane Two-Way Road Intersections

(1) Collision Type	(2) Proportion of Collision $Type_{(TOTAL)}$ from Table 10-6	(3) $N_{predicted\ int\ (TOTAL)}$ (crashes/year) $(8)_{TOTAL}$ from Worksheet 2C	(4) Proportion of $Collision\ Type_{(FI)}$ from Table 10-6	(5) $N_{predicted\ int\ (FI)}$ (crashes/year) $(8)_{FI}$ from Worksheet 2C	(6) Proportion of $Collision\ Type_{(PDO)}$ from Table 10-6	(7) $N_{predicted\ int\ (PDO)}$ (crashes/year) $(8)_{PDO}$ from Worksheet 2C
Total	1.000	3.180	1.000	1.081	1.000	2.099
		(2)x(3)$_{TOTAL}$		(4)x(5)$_{FI}$		(6)x(7)$_{PDO}$
SINGLE-VEHICLE						
Collision with animal	0.002	0.006	0.000	0.000	0.003	0.006
Collision with bicycle	0.001	0.003	0.001	0.001	0.001	0.002
Collision with pedestrian	0.001	0.003	0.001	0.001	0.001	0.002
Overturned	0.003	0.010	0.003	0.003	0.003	0.006
Ran off road	0.064	0.204	0.032	0.035	0.081	0.170
Other single-vehicle collision	0.005	0.016	0.003	0.003	0.018	0.038
Total single-vehicle crashes	0.076	0.242	0.040	0.043	0.107	0.225
MULTIPLE-VEHICLE						
Angle collision	0.274	0.871	0.336	0.363	0.242	0.508
Head-on collision	0.054	0.172	0.080	0.086	0.040	0.084
Rear-end collision	0.426	1.355	0.403	0.436	0.438	0.919
Sideswipe collision	0.118	0.375	0.051	0.055	0.153	0.321
Other multiple-vehicle collision	0.052	0.165	0.090	0.097	0.020	0.042
Total multiple-vehicle crashes	0.924	2.938	0.960	1.038	0.893	1.874

Worksheet 2E -- Summary Results for Rural Two-Lane Two-Way Road Intersections

(1) Crash severity level	(2) Crash Severity Distribution (proportion) (4) from Worksheet 2C	(3) Predicted average crash frequency (crashes / year) (8) from Worksheet 2C
Total	1.000	3.2
Fatal and Injury (FI)	0.340	1.1
Property Damage Only (PDO)	0.660	2.1

OPTION 1

(Two Roundabouts)

226 CENTRAL AVENUE
ST. LOUIS, MO 63119
314.375.3748
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Worksheet 3A -- Predicted and Observed Crashes by Severity and Site Type Using the Site-Specific EB Method

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Site type	**Predicted average crash frequency (crashes/year)**			**Observed crashes,** $N_{observed}$ (crashes/year)	**Overdispersion Parameter, k**	**Weighted adjustment, w**	**Expected average crash frequency,**
	$N_{predicted}$ (TOTAL)	$N_{predicted}$ (FI)	$N_{predicted}$ (PDO)			Equation A-5 from Part C Appendix	Equation A-4 from Part C Appendix
ROADWAY SEGMENTS							
Segment 1							
Segment 2							
Segment 3						1.000	0.0
Segment 4						1.000	0.0
Segment 5						1.000	0.0
Segment 6						1.000	0.0
Segment 7						1.000	0.0
Segment 8						1.000	0.0
INTERSECTIONS							
Intersection 1	4.203	1.811	2.391		0.240	0.498	2.1
Intersection 2						1.000	0.0
Intersection 3						1.000	0.0
Intersection 4	5.174	1.759	3.415		0.110	0.637	3.3
Intersection 5						1.000	0.0
Intersection 6						1.000	0.0
Intersection 7						1.000	0.0
Intersection 8						1.000	0.0
COMBINED (sum of column)	9.377	3.571	5.806	0	--	--	5.4

Worksheet 3B -- Site-Specific EB Method Summary Results

(1)	(2)	(3)
Crash severity level	$N_{predicted}$	$N_{expected}$
Total	$(2)_{COMB}$ from Worksheet 3A	$(8)_{COMB}$ from Worksheet 3A
	9.377	5.4
Fatal and Injury (FI)	$(3)_{COMB}$ from Worksheet 3A	$(3)_{TOTAL} * (2)_{FI} / (2)_{TOTAL}$
	3.571	2.1
Property Damage Only (PDO)	$(4)_{COMB}$ from Worksheet 3A	$(3)_{TOTAL} * (2)_{PDO} / (2)_{TOTAL}$
	5.806	3.3

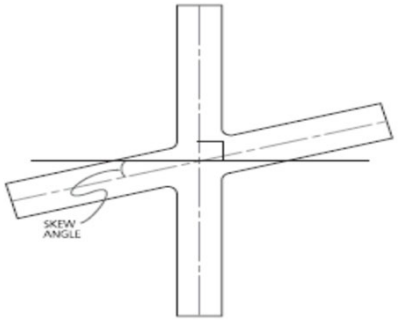
Worksheet 2A -- General Information and Input Data for Rural Two-Lane Two-Way Roadway Intersections

General Information		Location Information	
Analyst	CAF	Roadway	MO Route 19
Agency or Company	T2	Intersection	Route 19 at Tree Farm Road/SOR
Date Performed	08/08/19	Jurisdiction	Montgomery County, MO
		Analysis Year	2041

Input Data				Base Conditions	Site Conditions	
Intersection type (3ST, 4ST, 4SG)				--	4ST	
$AADT_{major}$ (veh/day)	$AADT_{MAX}$ =	14,700	(veh/day)	--	8,800	AADT OK
$AADT_{minor}$ (veh/day)	$AADT_{MAX}$ =	3,500	(veh/day)	--	3,200	AADT OK
Intersection skew angle (degrees) [If 4ST, does skew differ for minor legs?]		No		0	Skew for Leg 1 (All): 0	Skew for Leg 2 (4ST only): 0
Number of signalized or uncontrolled approaches with a left-turn lane (0, 1, 2, 3, 4)				0	0	
Number of signalized or uncontrolled approaches with a right-turn lane (0, 1, 2, 3, 4)				0	0	
Intersection lighting (present/not present)				Not Present	Present	
Calibration Factor, C_i				1.00	1.00	

Unsignalized four-leg (stop control on minor-road approaches)

Skew Intersection:



Worksheet 2B -- Crash Modification Factors for Rural Two-Lane Two-Way Roadway Intersections

(1) CMF for Intersection Skew Angle CMF_{1i} from Equations 10-22 or 10-23	(2) CMF for Left-Turn Lanes CMF_{2i} from Table 10-13	(3) CMF for Right-Turn Lanes CMF_{3i} from Table 10-14	(4) CMF for Lighting CMF_{4i} from Equation 10-24	(5) Combined CMF CMF_{COMB} (1)*(2)*(3)*(4)*(5)
1.00	1.00	1.00	0.91	**0.69**

Worksheet 2C -- Intersection Crashes for Rural Two-Lane Two-Way Roadway Intersections

(1) Crash Severity Level	(2) $N_{spf\ 3ST,\ 4ST\ or\ 4SG}$ from Equations 10-8, 10-9, or 10-10	(3) Overdispersion Parameter, k from Section 10.6.2	(4) Crash Severity Distribution from Table 10-5	(5) $N_{spf\ 3ST,\ 4ST\ or\ 4SG}$ by Severity Distribution $(2)_{TOTAL}$ * (4)	(6) Combined CMFs from (5) of Worksheet 2B	(7) Calibration Factor, C_i	(8) Predicted average crash frequency, $N_{predicted\ int}$ (5)*(6)*(7)
Total	6.127	0.24	1.000	6.127	0.69	1.00	4.203
Fatal and Injury (FI)	--	--	0.431	2.641	0.69	1.00	1.811
Property Damage Only (PDO)	--	--	0.569	3.486	0.69	1.00	2.391

Worksheet 2D -- Crashes by Severity Level and Collision Type for Rural Two-Lane Two-Way Road Intersections

(1) Collision Type	(2) Proportion of Collision Type(TOTAL) from Table 10-6	(3) $N_{predicted\ int\ (TOTAL)}$ (crashes/year) $(8)_{TOTAL}$ from Worksheet 2C	(4) Proportion of Collision Type(FI) from Table 10-6	(5) $N_{predicted\ int\ (FI)}$ (crashes/year) $(8)_{FI}$ from Worksheet 2C	(6) Proportion of Collision Type(PDO) from Table 10-6	(7) $N_{predicted\ int\ (PDO)}$ (crashes/year) $(8)_{PDO}$ from Worksheet 2C
Total	1.000	4.203	1.000	1.811	1.000	2.391
		(2)x(3)$_{TOTAL}$		(4)x(5)$_{FI}$		(6)x(7)$_{PDO}$
SINGLE-VEHICLE						
Collision with animal	0.010	0.042	0.006	0.011	0.014	0.033
Collision with bicycle	0.001	0.004	0.001	0.002	0.001	0.002
Collision with pedestrian	0.001	0.004	0.001	0.002	0.001	0.002
Overturned	0.005	0.021	0.006	0.011	0.004	0.010
Ran off road	0.122	0.513	0.094	0.170	0.144	0.344
Other single-vehicle collision	0.008	0.034	0.004	0.007	0.010	0.024
Total single-vehicle crashes	0.147	0.618	0.112	0.203	0.174	0.416
MULTIPLE-VEHICLE						
Angle collision	0.431	1.811	0.532	0.964	0.354	0.847
Head-on collision	0.040	0.168	0.060	0.109	0.025	0.060
Rear-end collision	0.242	1.017	0.210	0.380	0.266	0.636
Sideswipe collision	0.101	0.424	0.044	0.080	0.144	0.344
Other multiple-vehicle collision	0.039	0.164	0.042	0.076	0.037	0.088
Total multiple-vehicle crashes	0.853	3.585	0.888	1.609	0.826	1.975

				(5)
CMF ID:	**CMF ID:**	**CMF ID:**		**CMF ID:**
		9440		**9445**
Value	Value	Value		Value
		1.066		0.756
$N_{expected}$				$N_{expected}$
0.00	**0.00**	**4.45**		**3.16**
0.00	**0.00**	**1.09**		**0.77**
0.00	**0.00**	**3.36**		**2.38**
		Convert to interchange roundabouts with either a single RAB or a pair; *1-2 lanes		Convert to interchange roundabouts with either a single RAB or a pair; *1-lane

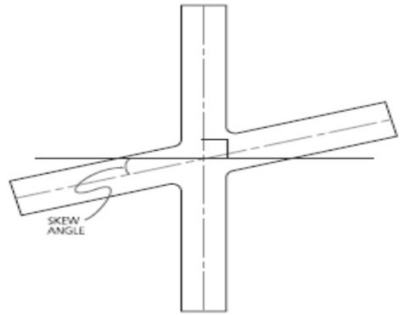
Worksheet 2E -- Summary Results for Rural Two-Lane Two-Way Road Intersections

(1) Crash severity level	(2) Crash Severity Distribution (proportion) (4) from Worksheet 2C	(3) Predicted average crash frequency (crashes / year) (8) from Worksheet 2C
Total	1.000	4.2
Fatal and Injury (FI)	0.431	1.8
Property Damage Only (PDO)	0.569	2.4

Worksheet 2A -- General Information and Input Data for Rural Two-Lane Two-Way Roadway Intersections

General Information		Location Information	
Analyst	CAF	Roadway	MO Route 19
Agency or Company	T2	Intersection	Route 19 at Booneslick Rd/NOR
Date Performed	08/08/19	Jurisdiction	Montgomery County, MO
		Analysis Year	2041

Input Data				Base Conditions	Site Conditions				
Intersection type (3ST, 4ST, 4SG)				--	4SG				Signalized four-leg
$AADT_{major}$ (veh/day)	$AADT_{MAX}$ =	25,200	(veh/day)	--	11,230			AADT OK	
$AADT_{minor}$ (veh/day)	$AADT_{MAX}$ =	12,500	(veh/day)	--	2,600			AADT OK	
Intersection skew angle (degrees)	[If 4ST, does skew differ for minor legs?]		No	0	Skew for Leg 1 (All):	0	Skew for Leg 2 (4ST only):	0	Skew Intersection:
Number of signalized or uncontrolled approaches with a left-turn lane (0, 1, 2, 3, 4)				0	0				
Number of signalized or uncontrolled approaches with a right-turn lane (0, 1, 2, 3, 4)				0	0				
Intersection lighting (present/not present)				Not Present	Present				
Calibration Factor, C_i				1.00	1.00				



Worksheet 2B -- Crash Modification Factors for Rural Two-Lane Two-Way Roadway Intersections

(1) CMF for Intersection Skew Angle CMF_{1i} from Equations 10-22 or 10-23	(2) CMF for Left-Turn Lanes CMF_{2i} from Table 10-13	(3) CMF for Right-Turn Lanes CMF_{3i} from Table 10-14	(4) CMF for Lighting CMF_{4i} from Equation 10-24	(5) Combined CMF CMF_{COMB} (1)*(2)*(3)*(4)*(5)
1.00	1.00	1.00	0.89	**0.67**

Worksheet 2C -- Intersection Crashes for Rural Two-Lane Two-Way Roadway Intersections

(1) Crash Severity Level	(2) $N_{spf\ 3ST,\ 4ST\ or\ 4SG}$ from Equations 10-8, 10-9, or 10-10	(3) Overdispersion Parameter, k from Section 10.6.2	(4) Crash Severity Distribution from Table 10-5	(5) $N_{spf\ 3ST,\ 4ST\ or\ 4SG}$ by Severity Distribution $(2)_{TOTAL}$ * (4)	(6) Combined CMFs from (5) of Worksheet 2B	(7) Calibration Factor, C_i	(8) Predicted average crash frequency, $N_{predicted\ int}$ (5)*(6)*(7)
Total	7.679	0.11	1.000	7.679	0.67	1.00	5.174
Fatal and Injury (FI)	--	--	0.340	2.611	0.67	1.00	1.759
Property Damage Only (PDO)	--	--	0.660	5.068	0.67	1.00	3.415

Worksheet 2D -- Crashes by Severity Level and Collision Type for Rural Two-Lane Two-Way Road Intersections

(1) Collision Type	(2) Proportion of Collision $Type_{(TOTAL)}$ from Table 10-6	(3) $N_{predicted\ int\ (TOTAL)}$ (crashes/year) $(8)_{TOTAL}$ from Worksheet 2C	(4) Proportion of Collision $Type_{(FI)}$ from Table 10-6	(5) $N_{predicted\ int\ (FI)}$ (crashes/year) $(8)_{FI}$ from Worksheet 2C	(6) Proportion of Collision $Type_{(PDO)}$ from Table 10-6	(7) $N_{predicted\ int\ (PDO)}$ (crashes/year) $(8)_{PDO}$ from Worksheet 2C
Total	1.000	5.174	1.000	1.759	1.000	3.415
		(2)x(3)$_{TOTAL}$		(4)x(5)$_{FI}$		(6)x(7)$_{PDO}$
SINGLE-VEHICLE						
Collision with animal	0.002	0.010	0.000	0.000	0.003	0.010
Collision with bicycle	0.001	0.005	0.001	0.002	0.001	0.003
Collision with pedestrian	0.001	0.005	0.001	0.002	0.001	0.003
Overturned	0.003	0.016	0.003	0.005	0.003	0.010
Ran off road	0.064	0.331	0.032	0.056	0.081	0.277
Other single-vehicle collision	0.005	0.026	0.003	0.005	0.018	0.061
Total single-vehicle crashes	0.076	0.393	0.040	0.070	0.107	0.365
MULTIPLE-VEHICLE						
Angle collision	0.274	1.418	0.336	0.591	0.242	0.826
Head-on collision	0.054	0.279	0.080	0.141	0.040	0.137
Rear-end collision	0.426	2.204	0.403	0.709	0.438	1.496
Sideswipe collision	0.118	0.611	0.051	0.090	0.153	0.522
Other multiple-vehicle collision	0.052	0.269	0.090	0.158	0.020	0.068
Total multiple-vehicle crashes	0.924	4.781	0.960	1.689	0.893	3.050

(5)

CMF ID:	CMF ID:	CMF ID: 9440	CMF ID: 9445
Value	Value	Value 1.066	Value 0.756
$N_{expected}$ 0.00	0.00	4.45	3.16
0.00	0.00	1.09	0.77
0.00	0.00	3.36	2.38
		Convert to interchange roundabouts with either a single RAB or a pair; *1-2 lanes	Convert to interchange roundabouts with either a single RAB or a pair; *1-lane

Worksheet 2E -- Summary Results for Rural Two-Lane Two-Way Road Intersections

(1) Crash severity level	(2) Crash Severity Distribution (proportion) (4) from Worksheet 2C	(3) Predicted average crash frequency (crashes / year) (8) from Worksheet 2C
Total	1.000	5.2
Fatal and Injury (FI)	0.340	1.8
Property Damage Only (PDO)	0.660	3.4

OPTION 2

(Roundabout at Tree Farm Road/SOR)

226 CENTRAL AVENUE
ST. LOUIS, MO 63119
314.375.3748
WWW.TQUAREDTT.COM

Worksheet 3A -- Predicted and Observed Crashes by Severity and Site Type Using the Site-Specific EB Method

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Site type	**Predicted average crash frequency (crashes/year)**			**Observed crashes,** $N_{observed}$ (crashes/year)	**Overdispersion Parameter, k**	**Weighted adjustment, w**	**Expected average crash frequency,**
	$N_{predicted}$ (TOTAL)	$N_{predicted}$ (FI)	$N_{predicted}$ (PDO)			Equation A-5 from Part C Appendix	Equation A-4 from Part C Appendix
ROADWAY SEGMENTS							
Segment 1							
Segment 2							
Segment 3						1.000	0.0
Segment 4						1.000	0.0
Segment 5						1.000	0.0
Segment 6						1.000	0.0
Segment 7						1.000	0.0
Segment 8						1.000	0.0
INTERSECTIONS							
Intersection 1	1.286	0.554	0.732		0.240	0.764	1.0
Intersection 2	2.713	1.169	1.544		0.240	0.606	1.6
Intersection 3	3.653	1.574	2.079		0.240	0.533	1.9
Intersection 4	3.180	1.081	2.099		0.110	0.741	2.4
Intersection 5						1.000	0.0
Intersection 6						1.000	0.0
Intersection 7						1.000	0.0
Intersection 8						1.000	0.0
COMBINED (sum of column)	10.832	4.379	6.453	0	--	--	6.9

Worksheet 3B -- Site-Specific EB Method Summary Results

(1)	(2)	(3)
Crash severity level	$N_{predicted}$	$N_{expected}$
Total	$(2)_{COMB}$ from Worksheet 3A	$(8)_{COMB}$ from Worksheet 3A
	10.832	6.9
Fatal and Injury (FI)	$(3)_{COMB}$ from Worksheet 3A	$(3)_{TOTAL} * (2)_{FI} / (2)_{TOTAL}$
	4.379	2.8
Property Damage Only (PDO)	$(4)_{COMB}$ from Worksheet 3A	$(3)_{TOTAL} * (2)_{PDO} / (2)_{TOTAL}$
	6.453	4.1

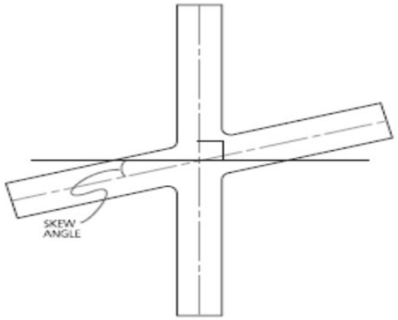
Worksheet 2A -- General Information and Input Data for Rural Two-Lane Two-Way Roadway Intersections

General Information		Location Information	
Analyst	CAF	Roadway	MO Route 19
Agency or Company	T2	Intersection	Route 19 at Tree Farm Road/SOR
Date Performed	08/08/19	Jurisdiction	Montgomery County, MO
		Analysis Year	2041

Input Data				Base Conditions	Site Conditions			
Intersection type (3ST, 4ST, 4SG)				--	4ST			
$AADT_{major}$ (veh/day)	$AADT_{MAX}$ =	14,700	(veh/day)	--	6,000	AADT OK		
$AADT_{minor}$ (veh/day)	$AADT_{MAX}$ =	3,500	(veh/day)	--	3,220	AADT OK		
Intersection skew angle (degrees) [If 4ST, does skew differ for minor legs?]		No		0	Skew for Leg 1 (All):	0	Skew for Leg 2 (4ST only):	0
Number of signalized or uncontrolled approaches with a left-turn lane (0, 1, 2, 3, 4)				0	0			
Number of signalized or uncontrolled approaches with a right-turn lane (0, 1, 2, 3, 4)				0	0			
Intersection lighting (present/not present)				Not Present	Present			
Calibration Factor, C_i				1.00	1.00			

Unsignalized four-leg (stop control on minor-road approaches)

Skew Intersection:



Worksheet 2B -- Crash Modification Factors for Rural Two-Lane Two-Way Roadway Intersections

(1) CMF for Intersection Skew Angle CMF_{1i} from Equations 10-22 or 10-23	(2) CMF for Left-Turn Lanes CMF_{2i} from Table 10-13	(3) CMF for Right-Turn Lanes CMF_{3i} from Table 10-14	(4) CMF for Lighting CMF_{4i} from Equation 10-24	(5) Combined CMF CMF_{COMB} (1)*(2)*(3)*(4)*(5)
1.00	1.00	1.00	0.91	0.26

Worksheet 2C -- Intersection Crashes for Rural Two-Lane Two-Way Roadway Intersections

(1) Crash Severity Level	(2) $N_{spf\ 3ST,\ 4ST\ or\ 4SG}$ from Equations 10-8, 10-9, or 10-10	(3) Overdispersion Parameter, k from Section 10.6.2	(4) Crash Severity Distribution from Table 10-5	(5) $N_{spf\ 3ST,\ 4ST\ or\ 4SG}$ by Severity Distribution $(2)_{TOTAL}$ * (4)	(6) Combined CMFs from (5) of Worksheet 2B	(7) Calibration Factor, C_i	(8) Predicted average crash frequency, $N_{predicted\ int}$ (5)*(6)*(7)
Total	4.888	0.24	1.000	4.888	0.26	1.00	1.286
Fatal and Injury (FI)	--	--	0.431	2.107	0.26	1.00	0.554
Property Damage Only (PDO)	--	--	0.569	2.781	0.26	1.00	0.732

Worksheet 2D -- Crashes by Severity Level and Collision Type for Rural Two-Lane Two-Way Road Intersections

(1) Collision Type	(2) Proportion of Collision Type(TOTAL) from Table 10-6	(3) $N_{predicted\ int\ (TOTAL)}$ (crashes/year) $(8)_{TOTAL}$ from Worksheet 2C	(4) Proportion of Collision Type(FI) from Table 10-6	(5) $N_{predicted\ int\ (FI)}$ (crashes/year) $(8)_{FI}$ from Worksheet 2C	(6) Proportion of Collision Type(PDO) from Table 10-6	(7) $N_{predicted\ int\ (PDO)}$ (crashes/year) $(8)_{PDO}$ from Worksheet 2C
Total	1.000	1.286	1.000	0.554	1.000	0.732
		(2)x(3)TOTAL		(4)x(5)FI		(6)x(7)PDO
SINGLE-VEHICLE						
Collision with animal	0.010	0.013	0.006	0.003	0.014	0.010
Collision with bicycle	0.001	0.001	0.001	0.001	0.001	0.001
Collision with pedestrian	0.001	0.001	0.001	0.001	0.001	0.001
Overturned	0.005	0.006	0.006	0.003	0.004	0.003
Ran off road	0.122	0.157	0.094	0.052	0.144	0.105
Other single-vehicle collision	0.008	0.010	0.004	0.002	0.010	0.007
Total single-vehicle crashes	0.147	0.189	0.112	0.062	0.174	0.127
MULTIPLE-VEHICLE						
Angle collision	0.431	0.554	0.532	0.295	0.354	0.259
Head-on collision	0.040	0.051	0.060	0.033	0.025	0.018
Rear-end collision	0.242	0.311	0.210	0.116	0.266	0.195
Sideswipe collision	0.101	0.130	0.044	0.024	0.144	0.105
Other multiple-vehicle collision	0.039	0.050	0.042	0.023	0.037	0.027
Total multiple-vehicle crashes	0.853	1.097	0.888	0.492	0.826	0.604

(5)

CMF ID: 5229	CMF ID: 4930	CMF ID: 4697	CMF ID: 229
Value 0.659	Value 0.751	Value 0.32	Value 0.29
$N_{expected}$ 2.75	3.14	1.34	$N_{expected}$ 1.21
0.67	0.77	0.33	0.30
2.08	2.37	1.01	0.91
Convert Intersection into high-speed roundabout	Conversion of TWSC intersection into single or multi-lane roundabout	Convert high-speed rural intersection (4-leg) to roundabout	Convert intersection with minor-road stop control to modern roundabout

Worksheet 2E -- Summary Results for Rural Two-Lane Two-Way Road Intersections

(1) Crash severity level	(2) Crash Severity Distribution (proportion) (4) from Worksheet 2C	(3) Predicted average crash frequency (crashes / year) (8) from Worksheet 2C
Total	1.000	1.3
Fatal and Injury (FI)	0.431	0.6
Property Damage Only (PDO)	0.569	0.7

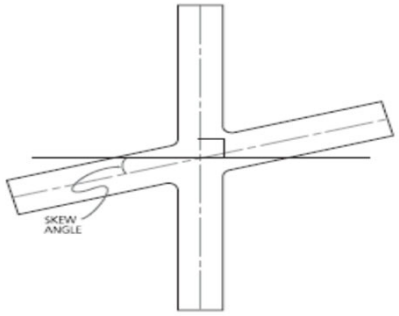
Worksheet 2A -- General Information and Input Data for Rural Two-Lane Two-Way Roadway Intersections

General Information		Location Information	
Analyst	CAF	Roadway	MO Route 19
Agency or Company	T2	Intersection	Route 19 at I-70 EB Ramp Terminals
Date Performed	08/08/19	Jurisdiction	Montgomery County, MO
		Analysis Year	2041

Input Data				Base Conditions	Site Conditions			
Intersection type (3ST, 4ST, 4SG)				--	4ST			
$AADT_{major}$ (veh/day)	$AADT_{MAX}$ =	14,700	(veh/day)	--	9,100	AADT OK		
$AADT_{minor}$ (veh/day)	$AADT_{MAX}$ =	3,500	(veh/day)	--	1,800	AADT OK		
Intersection skew angle (degrees) [If 4ST, does skew differ for minor legs?]		No		0	Skew for Leg 1 (All):	45	Skew for Leg 2 (4ST only):	30
Number of signalized or uncontrolled approaches with a left-turn lane (0, 1, 2, 3, 4)				0	1			
Number of signalized or uncontrolled approaches with a right-turn lane (0, 1, 2, 3, 4)				0	2			
Intersection lighting (present/not present)				Not Present	Present			
Calibration Factor, C_i				1.00	1.00			

Unsignalized four-leg (stop control on minor-road approaches)

Skew Intersection:



Worksheet 2B -- Crash Modification Factors for Rural Two-Lane Two-Way Roadway Intersections

(1) CMF for Intersection Skew Angle CMF_{1i} from Equations 10-22 or 10-23	(2) CMF for Left-Turn Lanes CMF_{2i} from Table 10-13	(3) CMF for Right-Turn Lanes CMF_{3i} from Table 10-14	(4) CMF for Lighting CMF_{4i} from Equation 10-24	(5) Combined CMF CMF_{COMB} (1)*(2)*(3)*(4)
1.28	0.72	0.74	0.91	0.62

Worksheet 2C -- Intersection Crashes for Rural Two-Lane Two-Way Roadway Intersections

(1) Crash Severity Level	(2) $N_{spf\ 3ST,\ 4ST\ or\ 4SG}$ from Equations 10-8, 10-9, or 10-10	(3) Overdispersion Parameter, k from Section 10.6.2	(4) Crash Severity Distribution from Table 10-5	(5) $N_{spf\ 3ST,\ 4ST\ or\ 4SG}$ by Severity Distribution $(2)_{TOTAL}$ * (4)	(6) Combined CMFs from (5) of Worksheet 2B	(7) Calibration Factor, C_i	(8) Predicted average crash frequency, $N_{predicted\ int}$ (5)*(6)*(7)
Total	4.401	0.24	1.000	4.401	0.62	1.00	2.713
Fatal and Injury (FI)	--	--	0.431	1.897	0.62	1.00	1.169
Property Damage Only (PDO)	--	--	0.569	2.504	0.62	1.00	1.544

Worksheet 2D -- Crashes by Severity Level and Collision Type for Rural Two-Lane Two-Way Road Intersections

(1) Collision Type	(2) Proportion of Collision $Type_{(TOTAL)}$ from Table 10-6	(3) $N_{predicted\ int\ (TOTAL)}$ (crashes/year) $(8)_{TOTAL}$ from Worksheet 2C	(4) Proportion of $Type_{(FI)}$ from Table 10-6	(5) $N_{predicted\ int\ (FI)}$ (crashes/year) $(8)_{FI}$ from Worksheet 2C	(6) Proportion of $Type_{(PDO)}$ from Table 10-6	(7) $N_{predicted\ int\ (PDO)}$ (crashes/year) $(8)_{PDO}$ from Worksheet 2C
Total	1.000	2.713	1.000	1.169	1.000	1.544
		(2)x(3)$_{TOTAL}$		(4)x(5)$_{FI}$		(6)x(7)$_{PDO}$
SINGLE-VEHICLE						
Collision with animal	0.010	0.027	0.006	0.007	0.014	0.022
Collision with bicycle	0.001	0.003	0.001	0.001	0.001	0.002
Collision with pedestrian	0.001	0.003	0.001	0.001	0.001	0.002
Overturned	0.005	0.014	0.006	0.007	0.004	0.006
Ran off road	0.122	0.331	0.094	0.110	0.144	0.222
Other single-vehicle collision	0.008	0.022	0.004	0.005	0.010	0.015
Total single-vehicle crashes	0.147	0.399	0.112	0.131	0.174	0.269
MULTIPLE-VEHICLE						
Angle collision	0.431	1.169	0.532	0.622	0.354	0.546
Head-on collision	0.040	0.109	0.060	0.070	0.025	0.039
Rear-end collision	0.242	0.657	0.210	0.246	0.266	0.411
Sideswipe collision	0.101	0.274	0.044	0.051	0.144	0.222
Other multiple-vehicle collision	0.039	0.106	0.042	0.049	0.037	0.057
Total multiple-vehicle crashes	0.853	2.314	0.888	1.038	0.826	1.275

Worksheet 2E -- Summary Results for Rural Two-Lane Two-Way Road Intersections

(1) Crash severity level	(2) Crash Severity Distribution (proportion) (4) from Worksheet 2C	(3) Predicted average crash frequency (crashes / year) (8) from Worksheet 2C
Total	1.000	2.7
Fatal and Injury (FI)	0.431	1.2
Property Damage Only (PDO)	0.569	1.5

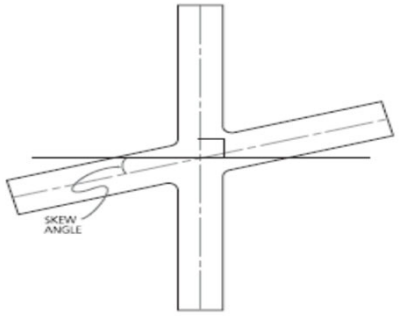
Worksheet 2A -- General Information and Input Data for Rural Two-Lane Two-Way Roadway Intersections

General Information		Location Information	
Analyst	CAF	Roadway	MO Route 19
Agency or Company	T2	Intersection	Route 19 at I-70 WB Ramp Terminals
Date Performed	08/08/19	Jurisdiction	Montgomery County, MO
		Analysis Year	2041

Input Data				Base Conditions	Site Conditions			
Intersection type (3ST, 4ST, 4SG)				--	4ST			
$AADT_{major}$ (veh/day)	$AADT_{MAX}$ =	14,700	(veh/day)	--	7,600	AADT OK		
$AADT_{minor}$ (veh/day)	$AADT_{MAX}$ =	3,500	(veh/day)	--	3,500	AADT OK		
Intersection skew angle (degrees) [If 4ST, does skew differ for minor legs?]		No		0	Skew for Leg 1 (All):	45	Skew for Leg 2 (4ST only):	30
Number of signalized or uncontrolled approaches with a left-turn lane (0, 1, 2, 3, 4)				0	1			
Number of signalized or uncontrolled approaches with a right-turn lane (0, 1, 2, 3, 4)				0	2			
Intersection lighting (present/not present)				Not Present	Present			
Calibration Factor, C_i				1.00	1.00			

Unsignalized four-leg (stop control on minor-road approaches)

Skew Intersection:



Worksheet 2B -- Crash Modification Factors for Rural Two-Lane Two-Way Roadway Intersections

(1) CMF for Intersection Skew Angle CMF_{1i} from Equations 10-22 or 10-23	(2) CMF for Left-Turn Lanes CMF_{2i} from Table 10-13	(3) CMF for Right-Turn Lanes CMF_{3i} from Table 10-14	(4) CMF for Lighting CMF_{4i} from Equation 10-24	(5) Combined CMF CMF_{COMB} (1)*(2)*(3)*(4)
1.28	0.72	0.74	0.91	0.62

Worksheet 2C -- Intersection Crashes for Rural Two-Lane Two-Way Roadway Intersections

(1) Crash Severity Level	(2) $N_{spf\ 3ST,\ 4ST\ or\ 4SG}$ from Equations 10-8, 10-9, or 10-10	(3) Overdispersion Parameter, k from Section 10.6.2	(4) Crash Severity Distribution from Table 10-5	(5) $N_{spf\ 3ST,\ 4ST\ or\ 4SG}$ by Severity Distribution $(2)_{TOTAL}$ * (4)	(6) Combined CMFs from (5) of Worksheet 2B	(7) Calibration Factor, C_i	(8) Predicted average crash frequency, $N_{predicted\ int}$ (5)*(6)*(7)
Total	5.927	0.24	1.000	5.927	0.62	1.00	3.653
Fatal and Injury (FI)	--	--	0.431	2.554	0.62	1.00	1.574
Property Damage Only (PDO)	--	--	0.569	3.372	0.62	1.00	2.079

Worksheet 2D -- Crashes by Severity Level and Collision Type for Rural Two-Lane Two-Way Road Intersections

(1) Collision Type	(2) Proportion of Collision $Type_{(TOTAL)}$ from Table 10-6	(3) $N_{predicted\ int\ (TOTAL)}$ (crashes/year) $(8)_{TOTAL}$ from Worksheet 2C	(4) Proportion of $Collision\ Type_{(FI)}$ from Table 10-6	(5) $N_{predicted\ int\ (FI)}$ (crashes/year) $(8)_{FI}$ from Worksheet 2C	(6) Proportion of $Collision\ Type_{(PDO)}$ from Table 10-6	(7) $N_{predicted\ int\ (PDO)}$ (crashes/year) $(8)_{PDO}$ from Worksheet 2C
Total	1.000	3.653	1.000	1.574	1.000	2.079
		(2)x(3)$_{TOTAL}$		(4)x(5)$_{FI}$		(6)x(7)$_{PDO}$
SINGLE-VEHICLE						
Collision with animal	0.010	0.037	0.006	0.009	0.014	0.029
Collision with bicycle	0.001	0.004	0.001	0.002	0.001	0.002
Collision with pedestrian	0.001	0.004	0.001	0.002	0.001	0.002
Overturned	0.005	0.018	0.006	0.009	0.004	0.008
Ran off road	0.122	0.446	0.094	0.148	0.144	0.299
Other single-vehicle collision	0.008	0.029	0.004	0.006	0.010	0.021
Total single-vehicle crashes	0.147	0.537	0.112	0.176	0.174	0.362
MULTIPLE-VEHICLE						
Angle collision	0.431	1.574	0.532	0.838	0.354	0.736
Head-on collision	0.040	0.146	0.060	0.094	0.025	0.052
Rear-end collision	0.242	0.884	0.210	0.331	0.266	0.553
Sideswipe collision	0.101	0.369	0.044	0.069	0.144	0.299
Other multiple-vehicle collision	0.039	0.142	0.042	0.066	0.037	0.077
Total multiple-vehicle crashes	0.853	3.116	0.888	1.398	0.826	1.717

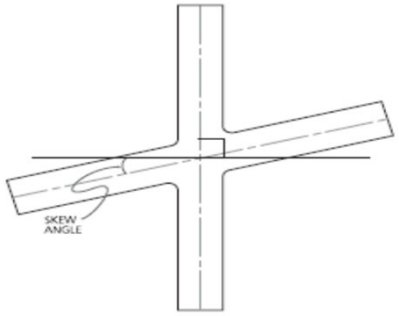
Worksheet 2E -- Summary Results for Rural Two-Lane Two-Way Road Intersections

(1) Crash severity level	(2) Crash Severity Distribution (proportion) (4) from Worksheet 2C	(3) Predicted average crash frequency (crashes / year) (8) from Worksheet 2C
Total	1.000	3.7
Fatal and Injury (FI)	0.431	1.6
Property Damage Only (PDO)	0.569	2.1

Worksheet 2A -- General Information and Input Data for Rural Two-Lane Two-Way Roadway Intersections

General Information		Location Information	
Analyst	CAF	Roadway	MO Route 19
Agency or Company	T2	Intersection	Route 19 at Booneslick Rd/NOR
Date Performed	08/08/19	Jurisdiction	Montgomery County, MO
		Analysis Year	2041

Input Data				Base Conditions	Site Conditions				
Intersection type (3ST, 4ST, 4SG)				--	4SG				Signalized four-leg
$AADT_{major}$ (veh/day)	$AADT_{MAX}$ =	25,200	(veh/day)	--	8,000			AADT OK	
$AADT_{minor}$ (veh/day)	$AADT_{MAX}$ =	12,500	(veh/day)	--	2,600			AADT OK	
Intersection skew angle (degrees) [If 4ST, does skew differ for minor legs?]			Yes	0	Skew for Leg 1 (All):	10	Skew for Leg 2 (4ST only):	0	Skew Intersection:
Number of signalized or uncontrolled approaches with a left-turn lane (0, 1, 2, 3, 4)				0	2				
Number of signalized or uncontrolled approaches with a right-turn lane (0, 1, 2, 3, 4)				0	4				
Intersection lighting (present/not present)				Not Present	Present				
Calibration Factor, C_i				1.00	1.00				



Worksheet 2B -- Crash Modification Factors for Rural Two-Lane Two-Way Roadway Intersections

(1) CMF for Intersection Skew Angle CMF_{1i} from Equations 10-22 or 10-23	(2) CMF for Left-Turn Lanes CMF_{2i} from Table 10-13	(3) CMF for Right-Turn Lanes CMF_{3i} from Table 10-14	(4) CMF for Lighting CMF_{4i} from Equation 10-24	(5) Combined CMF CMF_{COMB} (1)*(2)*(3)*(4)
1.00	0.67	0.85	0.89	0.51

Worksheet 2C -- Intersection Crashes for Rural Two-Lane Two-Way Roadway Intersections

(1) Crash Severity Level	(2) $N_{spf\ 3ST,\ 4ST\ or\ 4SG}$ from Equations 10-8, 10-9, or 10-10	(3) Overdispersion Parameter, k from Section 10.6.2	(4) Crash Severity Distribution from Table 10-5	(5) $N_{spf\ 3ST,\ 4ST\ or\ 4SG}$ by Severity Distribution $(2)_{TOTAL}$ * (4)	(6) Combined CMFs from (5) of Worksheet 2B	(7) Calibration Factor, C_i	(8) Predicted average crash frequency, $N_{predicted\ int}$ (5)*(6)*(7)
Total	6.265	0.11	1.000	6.265	0.51	1.00	3.180
Fatal and Injury (FI)	--	--	0.340	2.130	0.51	1.00	1.081
Property Damage Only (PDO)	--	--	0.660	4.135	0.51	1.00	2.099

Worksheet 2D -- Crashes by Severity Level and Collision Type for Rural Two-Lane Two-Way Road Intersections

(1) Collision Type	(2) Proportion of Collision $Type_{(TOTAL)}$ from Table 10-6	(3) $N_{predicted\ int\ (TOTAL)}$ (crashes/year) $(8)_{TOTAL}$ from Worksheet 2C	(4) Proportion of $Collision\ Type_{(FI)}$ from Table 10-6	(5) $N_{predicted\ int\ (FI)}$ (crashes/year) $(8)_{FI}$ from Worksheet 2C	(6) Proportion of $Collision\ Type_{(PDO)}$ from Table 10-6	(7) $N_{predicted\ int\ (PDO)}$ (crashes/year) $(8)_{PDO}$ from Worksheet 2C
Total	1.000	3.180	1.000	1.081	1.000	2.099
		(2)x(3)$_{TOTAL}$		(4)x(5)$_{FI}$		(6)x(7)$_{PDO}$
SINGLE-VEHICLE						
Collision with animal	0.002	0.006	0.000	0.000	0.003	0.006
Collision with bicycle	0.001	0.003	0.001	0.001	0.001	0.002
Collision with pedestrian	0.001	0.003	0.001	0.001	0.001	0.002
Overturned	0.003	0.010	0.003	0.003	0.003	0.006
Ran off road	0.064	0.204	0.032	0.035	0.081	0.170
Other single-vehicle collision	0.005	0.016	0.003	0.003	0.018	0.038
Total single-vehicle crashes	0.076	0.242	0.040	0.043	0.107	0.225
MULTIPLE-VEHICLE						
Angle collision	0.274	0.871	0.336	0.363	0.242	0.508
Head-on collision	0.054	0.172	0.080	0.086	0.040	0.084
Rear-end collision	0.426	1.355	0.403	0.436	0.438	0.919
Sideswipe collision	0.118	0.375	0.051	0.055	0.153	0.321
Other multiple-vehicle collision	0.052	0.165	0.090	0.097	0.020	0.042
Total multiple-vehicle crashes	0.924	2.938	0.960	1.038	0.893	1.874

Worksheet 2E -- Summary Results for Rural Two-Lane Two-Way Road Intersections

(1) Crash severity level	(2) Crash Severity Distribution (proportion) (4) from Worksheet 2C	(3) Predicted average crash frequency (crashes / year) (8) from Worksheet 2C
Total	1.000	3.2
Fatal and Injury (FI)	0.340	1.1
Property Damage Only (PDO)	0.660	2.1