FINAL REPORT:
Biological Assessment
Impacts to *Epioblasma triquetra* as a Result of Bridge Construction Activities in the North Fork Hughes River

Cairo Bridge Replacement

Ritchie County, WV

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1.0 Introduction

The purpose of this Biological Assessment (BA) is to review the construction and demolition plans for the Cairo Bridge project and determine whether the actions associated with replacement will affect the federally endangered species *Epioblasma triquetra* (snuffbox). This BA is prepared in accordance with legal requirements set forth under Section 7 of the Endangered Species Act (ESA) (16 U.S.C. 1536[c]). The Action Area addressed in this BA includes the Direct Impact Area, the Indirect Impact Area, as well as upland project limits (Figure 1-1). The Direct Impact Area extends approximately 35 m (115 ft.) upstream to approximately 10 m (33 ft.) downstream of the existing bridge centerline, and includes the demolition footprint of the existing bridge, construction footprint of the proposed bridge, construction/demolition footprint of the temporary detour bridge, footprint of temporary rock causeways, and 5 m (16 ft.) upstream and riverward and 10 m (33 ft.) downstream buffers. The Indirect Impact Area extends approximately 100 m (328 ft.) downstream of the Direct Impact Area. The new bridge piers will be constructed out of the ordinary high water (no instream piers), but some construction and demolition activity would occur in the North Fork Hughes River. Since freshwater unionid mussels occur in this reach of the North Fork Hughes River and *E. triquetra* populations are known to occur upstream and downstream of the Action Area, *E. triquetra* could potentially occur in the Action Area.

Due to its advanced age, structural deficiencies, narrow lanes, and limited vertical clearance, the existing bridge does not meet current transportation requirements or design standards. The existing conditions restrict truck traffic and hinder substantial local economic development. Therefore, a new bridge over the North Fork Hughes River is necessary.

This BA describes bridge construction and demolition locations and distribution of unionid mussels within this section of the North Fork Hughes River, and the potential effects these activities may have on unionids. Also described are conservation measures that will be implemented to avoid and minimize impacts.

Under Section 7 of the ESA, federal agencies are required to consider two main issues with respect to a threatened or endangered species: 1) whether the proposed action is likely to jeopardize the continued existence of the species; and 2) whether the proposed action would destroy or adversely modify designated critical habitat for that species. If an endangered species is present and may be affected, formal consultation is required.

Unionid surveys within the project area were performed by Ecological Specialists, Inc. August 13-14, 2015. The 2015 survey found 49 live unionids of 8 species. Preliminary meetings with U.S. Fish and Wildlife Service (USFWS) and West Virginia Division of Natural Resources (WVDNR) to discuss construction alternatives and conservation measures were initiated November 2015 (Table 1-1). As *E. triquetra* is known to occur upstream and downstream of the Project Area and that there is a high probability that *E. triquetra* occurs in the Project Area, formal consultation is requested for the Cairo Bridge project.

2.0 Project Description

The purpose of this project is to replace the existing bridge over the North Fork Hughes River with a replacement that meets current design standards to effectively serve the transportation needs of tourists, residents, industry, and emergency vehicles. The existing bridge is structurally deficient, does not meet current design standards, and is at the end of its useful life. Closure of the existing bridge without constructing a replacement would result in a 45 km (28 mile) detour, burdening commercial, industrial, and residential traffic.

Project elements that could affect freshwater mussels in the North Fork Hughes River include any actions that would affect freshwater mussel habitat; specifically, local hydraulic conditions, substrate constituents or stability, water and sediment quality, current velocity, depth, and host fish occurrence. This would include any construction/demolition of in-stream structures, in-stream operation of construction equipment, as well as upland disturbances.

2.1 Design and Alternatives of Project Features

The alternative courses of action considered for this project include a no-build option and five build options: 1) demolition of existing bridge, and construction of a new single-span bridge on the existing alignment (Alternative 1A), 2) demolition of existing bridge, and construction of a new three-span bridge on the existing alignment (Alternative 1B), 3) demolition of existing bridge, and construction of a new single-span bridge on a new alignment upstream of existing alignment (Alternative 2A), 4) demolition of existing bridge, and construction of new three-span bridge on a new alignment upstream of existing alignment (Alternative 2B), and 5) rehabilitation of existing bridge using an upstream temporary detour bridge (Alternative 3; Figure 2-1). Alternatives 1A, 1B and 3 require a 130 ft. long, two-span temporary bridge upstream of the existing bridge to maintain traffic during demolition of the existing span and construction of the new span. Traffic would be maintained on the existing structure during construction of the new span for Alternatives 2A and 2B. Demolition of the existing bridge would be similar across all alternatives: the truss would be cut with explosives and lifted out of the river. Explosives or jackhammers would remove the existing piers. Machinery would be used to remove concrete and other debris from the river. Demolition and debris removal is expected to take approximately 25 days.

Due to the deteriorated condition of the existing bridge the no-build alternative would result in eventual closure, eliminating this route of WV Route 31. The structure would continue to deteriorate until complete replacement becomes unavoidable. Therefore, a no-build option would not satisfy the project objectives and no further investigation on this option was performed.

During the Field Review Submission, engineers examined the feasibility of dismantling the existing structure and erecting girders without impacting the stream. After review and discussion, it was concluded that the risks inherent with the complex demolition and construction plans associated with these unconventional methods is not warranted for this site. These risks, which could still include inadvertent damage to the natural resource would be more than a responsible contractor would assume and would be reflected in an increased construction cost. Therefore, instream impacts due to construction/demolition activities are associated with this project.

Construction Alternative 1A entails construction of a new single-span bridge on the existing alignment (see Figure 2-1). Traffic would be maintained on a temporary bridge approximately 35 m (115 ft.) upstream of the existing span. Construction of this temporary bridge would require a temporary in-stream causeway extending from the south bank to the location of the temporary bridge pier. This construction option would offer a new crossing of the North Fork Hughes River that meets traffic requirements. This single-span alternative has less substructure and bridge deck area to maintain in the future and provide the most open channel for flood debris. Temporary rock causeways on each bank would be constructed leaving the center of the channel open. These causeways would allow crane and equipment to access each side for normal demolition and erection procedures.

Construction Alternative 1B entails construction of a new three-span bridge on the existing alignment (see Figure 2-1). Traffic would be maintained on a temporary bridge approximately 35 m (115 ft.) upstream of the existing span. Construction of this temporary bridge would require a temporary in-stream causeway extending from the south bank to the location of the temporary bridge pier. The three-span design of this alternative would be the most feasible to erect and therefore this design has the least cost and least impact of traffic during construction. Temporary rock causeways on each bank would be constructed leaving the center of the channel open. These causeways would allow crane and equipment to access each side for normal demolition and erection procedures.

Construction Alternative 2A entails construction of a new single-span bridge on a new bridge alignment approximately 15 m (49 ft.) upstream of the existing bridge (see Figure 2-1). Traffic would be maintained on the existing structure during construction. Similarly to Alternative 1A, the single-span design has less substructure and bridge deck area to maintain in the future and provides the most open channel for flood debris. Temporary shoring would be required on the south approach during the phased construction of the abutment wingwalls where they conflict with the existing structure. Temporary rock causeways on each bank would be constructed leaving the center of the channel open. These causeways would allow crane and equipment to access each side for normal demolition and erection procedures.

Construction Alternative 2B entails construction of a new three-span bridge on a new bridge alignment approximately 15 m (49 ft.) upstream of the existing bridge (see Figure 2-1). Traffic would be maintained on the existing structure during construction. Similarly to Alternative 2A, temporary shoring would be required on the south approach during the phased construction of the abutment wingwalls, where they conflict with the existing structure. Temporary rock causeways on each bank would be constructed leaving the center of the channel open. These causeways would allow crane and equipment to access each side for normal demolition and erection procedures.

Construction Alternative 3 entails the rehabilitation of the existing structure (see Figure 2-1). Traffic would be maintained on a temporary bridge approximately 35 m (115 ft.) upstream of the existing span. Temporary rock causeways on each bank would be constructed leaving the center of the channel open. These causeways would allow crane and equipment to access each side for normal demolition and erection procedures. However, this Alternative would not provide any additional lane width on the existing structure; therefore this option provides less safety for two lane, two-way traffic. This alternative would also result in significant, ongoing maintenance costs as compared to other alternatives. As this alternative would provide only a short-term structural solution and maintain substandard lane width that restricts use by truck traffic and hinders substantial economic development, this alternative does not meet the purpose and need of the project. Additionally, recent inspections detected significant destress in the deck, strings, and lower chord of the truss. Analysis of rehabilitation measures concluded that rehabilitation of the bridge in the deformed condition of the lower chord is not practical or recommended.

In-stream impacts differ among alternatives. Alternative 3 would have the least in-stream impact, as all construction would occur above ordinary high water and the existing bridge would be rehabilitated. Alternatives 2A and 2B would have moderate in-stream impacts, as causeways extending from both banks at the existing structure would be constructed and in-stream impacts associated with the existing bridge would occur. Alternatives 1A and 1B would have the most in-stream impacts among all alternatives, as in addition to impacts associated with Alternatives 2A and 2B, a temporary rock causeway extending from the south bank to the temporary detour bridge pier. This temporary in-stream pier would remain in place until the temporary detour bridge is removed.

While Alternatives 1A, 1B, 2A, and 2B all meet the project's purpose and needs, WVDOH determined that constructing Alternative 1B is the most desirable alternative, as it fulfills the need for a modern crossing of the North Fork Hughes River, reduces impacts on traffic, and does not rely on the existing structure to maintain traffic. The advanced deterioration of the existing bridge indicates that it will be unlikely to maintain traffic through the construction of a replacement bridge. As such, Alternatives 2A and 2B were considered less feasible, as both of these alternatives utilize the existing bridge to maintain traffic. While Alternative 1B is the preferred alternative, Alternative 1A may be utilized pending the final bridge design. There will be no difference in the in-stream impacts between Alternative 1A and Alternative 1B, only in the number of piers constructed above ordinary high water. As Alternative 1B is the preferred alternative, this BA addresses impacts associated with this alternative.

2.2 Preferred Alternative 1B

Alternative 1B consists of constructing a new three-span bridge on the existing alignment. The new structure consists of spans of 20.7 m (68 ft.), 37.2 m (122 ft.), and 20.7 m (68 ft.), totaling 78.6 m (258 ft.) in length. The new structure would provide 2, 3.4 m (11 ft.) lanes, with 2, 1.2 m (4 ft.) shoulders and 1, 1.7 m (5.6 ft.) sidewalk and other structures for a total bridge width of 10.9 m (35.8 ft.). Additionally, significant approach roadway work, removal of the existing structure, and construction of a 39.6 m (130 ft.) two-span temporary bridge approximately 35 m (115 ft.) upstream of the existing span would be required.

Construction of the proposed roadway would require both clearing trees and placing fill at the approaches. The stream banks at the proposed structure would be graded to a 2:1 slope at the abutments, both of which would help provide more uniform stream banks throughout the project area. All work done within the streambed would be during low flow conditions. Clearing of trees would be needed along the stream banks. The Area of Direct Impact would encompass a total of 52.5 linear m (172.2 linear ft.) along the left descending bank and a total of 54.3 linear m (178.1 linear ft.) along the right descending bank. The riparian zone was fully vegetated and harbored plant life generally associated with riparian corridors, with typical streamside species such as sycamore (*Platanus sp*.), maple (*Acer sp*.), cottonwood (*Populus sp*.), willow (*Salix sp*.), and various woody shrubs. Large trees were more common in the upstream portion of the riparian zone. Emergent vegetation such as water willow (*Justicia americana*) was present along the banks. Silt fencing, turbidity curtains, and additional erosion control measures would be used on both banks to prevent siltation within the North Fork Hughes River.

Construction will consist of five phases, and will be completed in two construction seasons over 422 days. Phase 1 will include the construction of a temporary in-stream causeway extending from the south bank to the location of the temporary bridge pier upstream of the existing bridge. It is assumed the temporary pier will be constructed of driven steel piles and will not require a cofferdam. The causeway will be used to place the pier and for crane positioning during erection of the temporary bridge girders. Once the temporary bridge is erected, the causeway will be removed. Included in Phase 1 is the implementation of temporary traffic control measures, installation of erosion and sediment controls, utility relocations, installation of construction entrances, and installation of the temporary detour roadway. Phase 1 is anticipated to last 55 calendar days.

Phase 2 will include the installation of in-stream temporary causeways extending from both banks just upstream of the existing bridge. The center of the channel will remain open. Demolition of the bridge will be done by setting charges along critical locations. In-stream clean up of the fallen debris will be accessed from the causeway. This causeway will remain in place after the bridge demolition to be used for crane placement during erection of the proposed bridge girders in Phase 3. Phase 2 is anticipated to last 25 days.

Phase 3 will include the construction of the proposed bridge on the same alignment as the existing bridge. Piers and abutments will be constructed out of the ordinary high water and no cofferdams are anticipated. Structural girders will be set on the bridge abutments and piers and steel decking will be installed. The causeway will be in place for the 282 days required to complete Phase 3 through the muskellunge spawning season. Phase 3 is anticipated to last 282 days.

Phase 4 will begin once the muskellunge spawning season ends. The remaining portions of the causeway will be removed and concrete decking and rails, approach structures, and guard rails will be installed. Phase 4 is anticipated to last 45 days.

Phase 5 will begin after the new bridge is open to traffic. A temporary causeway from the south bank to the location of the temporary bridge pier (installed during Phase 1) will be reconstructed. The temporary bridge will be removed with cranes working from the causeway. Once the bridge is removed, the causeway will be removed, concluding in-stream work on this project. Phase 5 is anticipated to last 25 days.

As temporary rock causeways will be in place through the 422 day duration of the project, causeways may be subjected to chronic and/or acute high water events. Therefore, there is a slight risk of a causeway 'wash-out'. A causeway 'wash-out' contingency plan will be addressed in a USFWS-approved Erosion and Sediment Pollution Control Plan.

2.3 Project Timeline and Schedule

Replacement of the existing bridge will consist of five phases and will require approximately 422 calendar days to complete (Figure 2-2). Construction is expected to occur across two construction seasons, and is anticipated to begin July 1, 2018.

2.4 Project Location

The project area is located in the North Fork Hughes River, in the area occupied by the existing WV Route 31 crossing and areas immediately upstream and downstream, Ritchie County, West Virginia (Action Area). The Direct Impact Area associated with the preferred alternative (Alternative 1B) extends approximately 35 m (115 ft.) upstream to 10 m (33 ft.) downstream of the existing bridge, and includes the demolition footprint of the existing bridge, construction footprint of the proposed bridge, construction/demolition footprint of the temporary detour bridge, footprint of temporary rock causeways, and 5 m (16 ft.) upstream and riverward and 10 m (33 ft.) downstream buffers (approximately 1,037 m^2 (11,162 ft^2); Figure 2-3). This includes any areas traversed by machinery during construction and post-demolition debris removal. The Direct Impact Area will be simultaneously treated as the Salvage Zone, from which mussels would be removed prior to construction and demolition activities.

The Indirect Impact Area spans bank to bank and extends approximately 100 m (328 ft.) downstream of the Direct Impact Area (approximately 1,411 m^2 (15,188 ft^2); Figure 2-3). These areas may be affected by increased turbidity and increased sedimentation emanating from demolition and construction activities within the Direct Impact Area.

Upland Areas where construction, equipment staging, and refueling are likely to occur are also included in the Action Area (see Figure 1-1).

2.5 Conservation Measures

The design of the new bridge crossing is such that environmental impacts would be minimized to the maximum possible extent. The new bridge would use a three-span design, and would have no in-stream structures. The new bridge would be built without drains to prevent any spills from entering the river; runoff on the new bridge would be filtered through a grassy swale prior to discharge into the river. A USFWS-approved Erosion and Sediment Pollution Control Plan would be developed prior to the start of construction. Silt fencing, turbidity curtains, and additional erosion control measures would be implemented during construction and demolition activities to prevent siltation within the North Fork Hughes River. Immediately after earth disturbance activities cease, the disturbed areas would be stabilized through the planting of 450 stems/acre of willows and native seeding. Non-native seeding such as winter wheat may also be used.

The project's timeline has been developed with aquatic fauna in mind. Construction activities would avoid the early spring muskellunge spawning season (April 1 to June 30). Demolition of the existing bridge would be postponed until a period of low water (August, September, October) to reduce siltation to downstream unionids.

As construction of the temporary detour bridge, demolition of the existing bridge, and construction of the proposed bridge may affect unionid mussels, unionids inhabiting the Direct Impact Area (Salvage Zone) would need to be relocated within 1 year of the start of construction. As construction is expected to begin during the spring of the construction year, unionids would be relocated the previous fall during low-water conditions. As a temporary causeway will need to be re-constructed to remove the temporary bridge pier during the final phase of the project (days 397 – 422), and since more than 1 year will have passed since the original relocation effort, a second relocation effort from the footprint of the causeway will be required prior to causeway re-construction. The relocation will be conducted according to a WVDNR and USFWS approved Relocation Plan; the Relocation Plan is outlined below:

> Relocation of mussels within the Salvage Zone will be accomplished by dividing the area into cells, not exceeding 100 m^2. Initially, each cell will be qualitatively searched at an effort of 0.5 minutes/m^2. A second pass will be made through each cell at the same search effort, and additional passes will be conducted until 2 or fewer mussels or less than 5% of the original number collected are recovered on the final pass. All live individuals recovered from the Salvage Zone will be identified to species, aged (external annuli), measured (length in mm), and sexed (for sexually dimorphic species). Individuals of endangered species will be assigned a unique identification number (shellfish tag), while individuals of common species will receive a colored mark or other non-unique indicator. Recovered individuals will be held in mesh collection bags, in flowing water, out of direct sunlight until they can be transported to a Recipient Site; total retention time of recovered individuals will not exceed 1 hour, and individuals will be hand-placed into the substrate at a Recipient Site.
>
> Prior to the relocation effort, a Recipient Site will be identified. An area upstream of the Salvage Zone that was investigated during the initial survey harbors an existing unionid community and will be used to receive non-listed individuals. All T&E species collected during the relocation will be transferred to WVDNR and placed at a downstream Recipient Site located approximately 2.5 km downstream of the project area currently utilized as a permanent monitoring site (J. Clayton, WVDNR, pers. comm.).
>
> The upstream Recipient Site will be delineated through a series of timed qualitative searches. Searches will be 5 minutes in duration and will consist of biologists visually searching the stream bottom while fanning and/or

disturbing the top layer of substrate. The minimum search effort for delineation of the site will be 1 person-hour, and searches will continue until at least 6 samples are collected with no additional species. The extent of the site will be recorded with GPS. All live individuals collected during delineation searches will be identified to species and classified as adult or juvenile. Data from delineation searches will be used to create a species richness curve. In addition to timed qualitative searches, a minimum of 20, 0.25 m^2 whole-substrate quantitative samples (quadrats) will be excavated to estimate density of mussels within the newly delineated concentration. All live individuals collected in quantitative samples will be identified to species, aged (external annuli), measured (length in mm), and sexed (for sexually dimorphic species).

If this site contains similar or better habitat than the Salvage Zone, harbors a similar unionid community, and can accept individuals relocated from the Salvage Zone without increasing density by more than 25%, this area will be utilized as a Recipient Site. Non-listed unionid species will be hand-placed evenly throughout the Recipient Site.

Relocation efforts prior to the temporary causeway re-construction will follow the above methods and will be coordinated with WVDNR and USFWS. Unionids will be removed from the footprint of the causeway with a 5 m upstream buffer and 10 m downstream buffer.

Recolonization will be assessed through monitoring of the Salvage Zone 1, 3, and 5 years post-construction. To determine effects of bridge construction and unionid recolonization within the Salvage Zone, 4-10 m x 10 m cells will be selected within the Salvage Zone and will be delineated based on the cells used for the initial relocation. Within each cell, 10-0.25 m^2 quantitative quadrat samples will be excavated to determine density, species composition, and to increase probability of finding juvenile (≤5 years old) unionids that may have recolonized the area. Quantitative samples will be distributed within each cell based on a three random start methodology, and each sample will be excavated to a depth of approximately 15 cm. All live unionids will be measured (length in mm) and aged (external annuli count). Fresh dead shells (with or without tissue, nacre shiny, valves still intact, periostracum present; likely dead less than one year) will be counted and noted as juveniles (≤5 years old) or adults (> 5 years old). Weathered dead shells (no tissue, nacre chalky, valves may or may not be intact, periostracum present; likely dead more than one year) and subfossil shells (entire shell chalky, valves not intact, no periostracum; dead many years to decades) will be noted as present. Live unionids will be returned to the river near their collection point. At each sample point, a GPS position will be recorded and depth (m) and substrate composition (visual and tactile estimate by diver) will be recorded. In addition, each cell will be qualitatively searched by 12, 5-minute qualitative spot dives to determine species composition and increase the probability of collecting all species present within each cell. At the conclusion of each sample, live unionids will be identified to species, identified as juveniles or adults, and counted. Fresh dead, weathered dead, and subfossil shells will be treated as in quantitative samples. Live unionids will be returned to the river near their collection point. A GPS position, depth, and substrate composition will be recorded at the start of each sample. At least one individual of each species will be photographed. This effort will be repeated during the 3 and 5 year monitoring events to compare density, catch per unit effort (CPUE), and species composition to document recolonization of the Salvage Zone.

3.0 Environmental Setting and Biological Resources

No mussel surveys had been conducted within the Action Area prior to 2015; however, surveys conducted elsewhere in the North Fork Hughes River accounted for 26 unionid species, including *E. triquetra* (Table 3-1). A pre-project unionid survey of the North Fork Hughes River from approximately 110 m (361 ft.) upstream to approximately 150 m (492 ft.) downstream of the existing Cairo Bridge centerline was conducted in August 2015; although construction plans had not yet been finalized, the entirety of the Direct and Indirect Impact areas were included in this survey (Figure 3-1). The 2015 survey identified 8 live unionid species (Table 3-2). Species richness was moderate but density within the Salvage Zone (0.89 (±0.81) live unionids/m^2) exceeded expectations based on semi-quantitative samples, suggesting that undetected unionids may be buried deep within the substrate throughout the study area and potential exists for additional species to occur in the Direct and Indirect Impact Areas (Figure 3-2). Although *E. triquetra* was not found during the 2015 survey, its presence cannot be ruled out.

3.1 Unionid Characteristics

Unionid characteristics are based on the 2015 pre-project survey, which followed West Virginia Mussel Survey Protocols (Clayton et al., 2015) for Group 2 streams (small to medium sized streams where endangered species are expected). A combination of semi-quantitative and qualitative sampling methods was used during the survey (ESI, 2015). Survey effort is presented in Appendix B.

Eight (8) live species were found in the 2015 survey area. Two (2) additional species, *Lampsilis cardium* and *Strophitus undulatus* were present as weathered dead shells. *Fusconaia flava* was the dominant species (n=14), followed by *Amblema plicata* (n=11), *Lampsilis siliquoidea* (n=6), and *Ptychobranchus fasciolaris* (n=6). Semi-quantitative catch per unit effort (CPUE) averaged 1.1 live unionids/hr. Unionids were collected throughout the study area in substrate of sand, gravel, cobble, and boulder (Figure 3-3).

Depths within the Direct Impact Area varied; depths were shallow (0.0 – 0.2 m) at the downstream end near the existing Cairo Bridge where a gravel bar split the channel into two shallow run/riffle complexes, and deeper (>1.1 m) at the upstream end where a pool was present (Figure 3-4). Substrate within the Direct Impact Area was primarily gravel and sand, with some boulder, clay, and detritus present (Figure 3-5).

Only 4 live individuals (n=3 in semi-quantitative samples, n=1 in quantitative samples) were collected from the Direct Impact Area (Table 3-3). One (1) individual was collected in quantitative samples under the bridge (*A. plicata*) while the 3 individuals collected in semi-quantitative samples (*A. plicata*, *L. siliquoidea*, and *P. fasciolaris*) were collected upstream of the bridge in a pool (see Figure 3-3). No federally endangered species were observed in the Direct Impact Area.

Similarly to the Direct Impact Area, substrate within the Indirect Impact Area consisted of sand, gravel, cobble, and boulder (see Figure 3-5). The majority of individuals found in the 2015 survey were in this heterogeneous substrate (see

Figure 3-3 and Figure 3-5). Depths within the Indirect Impact area ranged from 0.3 m to >1.1 m, with the greatest depths observed along the right descending bank downstream of the existing bridge (see Figure 3-4).

Twenty-seven (27) live unionids of 7 species were collected from the Indirect Impact Area (see Table 3-3). While individuals were generally present throughout the Indirect Impact Area, 2 areas, one at the upstream end of the Indirect Impact Area and one halfway down along the left descending bank, yielded a majority of the mussels collected (see Figure 3-3). *Fusconaia flava* (n=9) was the most commonly collected species, followed by *A. plicata* (n=5), *L. siliquoidea* (n=3), *Obovaria subrotunda* (n=3), and *P. fasciolaris* (n=3).

3.2 Ongoing Activities

No known activities are currently affecting unionid communities or their habitat immediately within the Action Area.

4.0 Species Considered

North America's unionid fauna is the most diverse in the world, and consists of nearly 300 nominal species (Williams et al., 1993; Turgeon et al., 1998). This diverse group of sedentary filter feeding animals is an important ecological component of many benthic communities where they play important roles in particle dynamics, nutrient cycling, and sediment mixing (Ricciardi et al., 1998; Vaughn and Hakenkamp, 2001). However, pollution, modification of riverine systems, and the introduction of exotic species have resulted in the decline of many unionid species. Approximately 10% of North American unionid species are already presumed to be extinct, and approximately two-thirds of the species are threatened by environmental degradation, making this North America’s most imperiled faunal group (Ricciardi et al., 1998; Haag and Williams, 2014).

While not collected in the Action Area, the federally endangered *E. triquetra* is known to occur within the North Fork Hughes River approximately 2.5 km downstream of the project area. Because most unionid species have similar habitat requirements and impacts to most unionid species would be similar, only this species was addressed in this BA.

4.1 Snuffbox (*Epioblasma triquetra*)

Epioblasma triquetra was federally listed as an endangered species February 14, 2012 (77 FR 8632 8665) and thus, is designated as critically imperiled in every state where it is known to occur. The following description, habitat requirements and distribution information for *E. triquetra* is taken from USFWS Final Rule: Determination of Endangered Status for the Rayed Bean and Snuffbox Mussels Throughout Their Ranges (USFWS, 2012):

“The snuffbox is a small- to medium- sized mussel, with males reaching up to 2.8 in (7.0 cm) in length (Cummings and Mayer 1992, p. 162; Parmalee and Bogan 1998, p. 108). The maximum length of females is about 1.8 in (4.5 cm) (Parmalee and Bogan 1998, p. 108). The shape of the shell is somewhat triangular (females), oblong, or ovate (males), with the valves solid, thick, and very inflated. The beaks are located somewhat anterior of the middle, and are swollen, turned forward and inward, and extended above the hingeline (Cummings and Mayer 1992, p. 162). Beak sculpture consists of three or four faint, double-looped bars (Cummings and Mayer 1992, p. 162; Parmalee and Bogan 1998, p. 108). The anterior end of the shell is rounded, and the posterior end is truncated, highly so in females. The posterior ridge is prominent, being high and rounded, while the posterior slope is widely flattened. The posterior ridge and slope in females is covered with fine ridges and grooves, and the posterioventral shell edge is finely toothed (Cummings and Mayer 1992, p. 162). When females are viewed from a dorsal or ventral perspective, the convergence of the two valves on the posterior slope is nearly straight due to being highly inflated. This gives the female snuffbox a unique, broadly lanceolate or cordate perspective when viewed at the substrate and water column interface (Ortmann 1919, p. 329; Van der Schalie 1932, p. 104). The ventral margin is slightly rounded in males and nearly straight in females. Females have recurved denticles (downward curved tooth-like structures) on the posterior shell margin that aid in holding host fish (Barnhart 2008, p. 1). The periostracum (external shell surface) is generally smooth and yellowish or yellowish-green in young individuals, becoming darker with age. Green, squarish, triangular, or chevron- shaped marks cover the umbone (the inflated area of the shell along the dorsal margin), but become poorly delineated stripes with age. Internally, the left valve has two high, thin, triangular, emarginate pseudocardinal teeth (the front tooth being thinner than the back tooth) and two short, strong, slightly curved, and finely striated lateral teeth. The right valve has a high, triangular pseudocardinal tooth with a single short, erect, and heavy lateral tooth. The interdentum (a flattened area between the pseudocardinal and lateral teeth) is absent, and the beak cavity is wide and deep. The color of the nacre is white, often with a silvery luster, and a gray-blue or gray-green tinge in the beak cavity. The soft anatomy was described by Oesch (1984, pp. 233–234) and Williams et al. (2008, p. 282). Key characters useful for distinguishing the snuffbox from other species include its unique color pattern, shape (especially in females), and high degree of inflation" (USFWS, 2012).

"(The snuffbox) is thought to be a long-term brooder (bradytictic); snuffbox brood glochidia from September to May (Ortmann 1912, p. 355; 1919, p. 327). *Epioblasma* spp. are unique in that they "capture" their hosts. Hosts are attracted by a brightly colored mantle in the gaping shell. When a fish investigates, the female snaps her valves shut, trapping the hosts' head and expelling glochidia while holding the host captive (Barnhart et al., 2008). Recent investigations into the life history of *E. triquetra* show that several darter and sculpin species successfully served as hosts. Juvenile snuffbox have successfully transformed on logperch (*Percina caprodes*), blackside darter (*P. maculata*), rainbow darter (*E, caeruleum*), Iowa darter (*E. exile*), blackspotted topminnow (*Fundulus olivaceous*), mottled sculpin (*Cottus bairdi*), banded sculpin (*C. carolinae*), Ozark sculpin (*C. hypselurus*), largemouth bass (*Micropterus salmoides*), and brook stickleback (*Culaea inconstans*) in laboratory tests (Sherman 1994, p. 17; Yeager and Saylor 1995, p. 3; Hillegass and Hove 1997, p. 25; Barnhart et al. 1998, p. 34; Hove et al. 2000, p. 30; Mulcrone 2004, pp. 100–103)" (USFWS, 2012).

"The snuffbox is found in small- to medium-sized creeks, to larger rivers, and in lakes (Cummings and Mayer 1992, p. 162; Parmalee and Bogan 1998, p. 108). The species occurs in swift currents of riffles and shoals and wave- washed shores of lakes over gravel and sand with occasional cobble and boulders. Individuals generally burrow deep into the substrate, except when spawning or attempting to attract a host (Parmalee and Bogan 1998, p. 108)" (USFWS, 2012).

"The snuffbox historically occurred in 210 streams and lakes in 18 States and 1 Canadian province: Alabama, Arkansas, Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Mississippi, Missouri, New York, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and Wisconsin; and Ontario, Canada. The major watersheds of historical streams and lakes of occurrence include the upper Great Lakes sub-basin (Lake Michigan drainage), lower Great Lakes sub-basin (Lakes Huron, Erie, and Ontario drainages), upper Mississippi River sub- basin, lower Missouri River system, Ohio River system, Cumberland River system, Tennessee River system, lower Mississippi River sub-basin, and White River system" (USFWS, 2012).

"Extant populations of the snuffbox are known from 79 streams in 14 States and 1 Canadian province: Alabama (Tennessee River, Paint Rock River, and Elk River), Arkansas (Buffalo River, Spring River, and Strawberry River), Illinois (Kankakee River and Embarras River), Indiana (Pigeon River, Salamonie River, Tippecanoe River, Sugar Creek, Buck Creek, Muscatatuck River, and Graham Creek), Kentucky (Tygarts Creek, Kinniconick Creek, Licking River, Slate Creek, Middle Fork Kentucky River, Red Bird River, Red River, Rolling Fork Salt River, Green River, and Buck Creek), Michigan (Grand River, Flat River, Maple River, Pine River, Belle River, Clinton River, Huron River, Davis Creek, South Ore Creek, and Portage River), Minnesota (Mississippi River, St. Croix River), Missouri (Meramec River, Bourbeuse River, St. Francis River, and Black River), Ohio (Grand River, Ohio River, Muskingum River, Walhonding River, Killbuck Creek, Olentangy River, Big Darby Creek, Little Darby Creek, Salt Creek, Scioto Brush Creek, South Fork Scioto Brush Creek, Little Miami River, and Stillwater River), Pennsylvania (Allegheny River, French Creek, West Branch French Creek, Le Boeuf Creek, Woodcock Creek, Muddy Creek, Conneaut Outlet, Little Mahoning Creek, Shenango River, and Little Shenango River), Tennessee (Clinch River, Powell River, Elk River, and Duck River), Virginia (Clinch River and Powell River), West Virginia (Ohio River, Middle Island Creek, McElroy Creek, Little Kanawha River, Hughes River, North Fork Hughes River, and Elk River), and Wisconsin (St. Croix River, Wolf River, Embarrass River, Little Wolf River, and Willow Creek); and Ontario, Canada (Ausable River and Sydenham River). It is probable that the species persists in some of the 132 streams or lakes where it is now considered extirpated (Butler 2007, p. 16); however, if extant, these populations are likely to be small and not viable" (USFWS, 2012).

Epioblasma triquetra is known to occur in the North Fork Hughes River (J. Clayton, WVDNR, pers. comm.). Although no individuals were found in the Salvage Zone, density of live unionids within the Salvage Zone exceeded expectations based on semi-quantitative samples, suggesting that undetected unionids may be buried deep within the substrate. Despite not collecting *E. triquetra*, based on the density estimated from quantitative samples and suitable unionid habitat, *E. triquetra* could occur in the Project Area and could be impacted during construction and demolition activities.

5.0 Effects of Proposed Action

5.1 Unionid Community

The proposed project may result in take of federally listed mussel species as defined in federal law and guidance, however it would not result in jeopardy to the continued existence or recovery of listed mussel species and take would be minimized though conservation measures.

While a USFWS-approved Erosion and Sediment Pollution Control Plan would be developed and implemented, the removal of mature vegetation and undergrowth and replacement with smaller plants may lead to a temporary increase in erosion and sedimentation along stream banks.

The existing bridge is a single-span truss supported by two wall-type abutments. The piers and abutments for the proposed bridge would be located out of ordinary high water, which should avoid the need for cofferdams or dewatering. While the proposed three-span bridge would not require in-stream piers, temporary rock causeways for equipment access on both banks of the river will be required. The causeways would be constructed such that the center of the channel would remain open. The proposed temporary detour bridge associated with this Alternative would require an in-stream pier.

Aspects of the project that could directly affect freshwater mussels include:

- Operation of heavy equipment within the river, which could crush any unionids on the substrate;
- Construction of causeways in the river, which could bury/crush unionids;
- Construction and demolition of the temporary detour bridge and the associated in-stream pier, which could crush/bury unionids; and
- Demolition of the existing bridge, which could crush any unionids on the substrate.

The Salvage Zone is 1,037 m^2 (11,162 ft^2) and extends approximately 35 m (115 ft.) upstream to 10 m (33 ft.) downstream of the existing bridge, and includes the demolition footprint of the existing bridge, construction footprint of the proposed bridge, construction/demolition footprint of the temporary detour bridge, footprint of temporary rock causeways, and 5 m (16 ft.) upstream and riverward and 10 m (33 ft.) downstream buffers. Substrate within the Salvage Zone was a heterogonous mix of sand, gravel, cobble, and boulder, but few unionids were collected. Using density estimates from the 2015 survey, a maximum estimate of 1,780 individuals could inhabit the Salvage Zone. *Epioblasma triquetra* was not found in the Action Area, and if present, would be at a low frequency. It is also likely less abundant than the 2 species found as shells (*L. cardium* and *S. undulatus*). Using the regression formula generated from the species accumulation curve ($y=1.9614\ln(x)+0.6164$; see Figure 3-2), the 9^{th} live species should be found with the collection of 72 individuals (frequency of 1.4%). Applying this frequency to the number of unionids expected in the Direct Impact Area (105 to 1,780), approximately 1 to 25 *E. triquetra* might occur in the Direct Impact Area associated with Alternative 1B (Table 5-1). As Alternatives 1A and 1B both require a temporary detour bridge and differ only in the number of shore-based piers, the number of unionids impacted by these Alternatives are the same (see Table 5-2).

Differences between Alternatives 2A and 2B include the number of shore-based piers, but differ from Alternatives 1A and 1B in that no temporary detour bridge is required. This reduction in construction footprint, and thus Direct Impact Area results in a slight decrease in the number of unionids expected in the Direct Impact Area (80 to 1,345) and the number of *E. triquetra* that may occur in the Direct Impact Area (1 to 19; see Table 5-2).

Aspects of the project that could indirectly affect freshwater mussels include temporary increases in turbidity and siltation within the Salvage Zone and Indirect Impact Area during construction and demolition. Water with high levels of suspended solids and turbidity can negatively impact mussel populations. The magnitude of the impact resulting from sedimentation depends upon the duration of the exposure. Mussels are adapted to short term (acute) events such as spring floods. Long term or chronic increases in sedimentation can interfere in growth, feeding, and reproduction (Stansbery, 1970), decrease water volume pumped by the mussel (Loosanoff and Tommers, 1948) and increase time spent with their shells closed (Ellis, 1936). Unionids are filter feeders, drawing in food and oxygen by pumping water across their gills. Feeding and respiration becomes less efficient in highly turbid water, requiring extra energy to process the water (Aldridge et al., 1987). More energy will be spent on gill clearing and the production of pseudo feces to eliminate inedible material. Increases in turbidity can also affect mussel filtration by diluting organic particle concentration with suspended inorganic materials, thus reducing the efficiency of feeding and food assimilation (Bartell et al., 2003). The energy spent on managing excess sediment is allocated away from growth or reproduction (Marking and Bills, 1979; Watters, 1995; Brim Box and Mossa, 1999; Bartell et al., 2003). Juvenile mussels may be particularly sensitive to sedimentation. The newly metamorphosed young can be smothered by the deposition of sediment. In addition, interstitial spaces between river substrate have been found to be critical habitat for young unionids. Increased sedimentation reduces juvenile habitat by clogging interstitial spaces (Brim Box and Mossa, 1999).

The Indirect Impact Area is approximately 1,411 m^2 (15,188 ft^2) and extends 100 m (328 ft.) downstream of the Salvage Zone. Substrate within the Indirect Impact Area generally consisted of a heterogeneous mix of sand, gravel, cobble, and boulder. The Indirect Impact Area harbored the majority of unionids collected during the 2015 survey. Density estimates from the 2015 survey suggest a minimum of 130 individuals and a maximum of 2,415 individuals occur in the Indirect Impact Area and may be affected by increased turbidity and sedimentation associated with construction and demolition activities (see Table 5-1). If *E. triquetra* comprise an estimated 1.4% of the mussel community in the Indirect Impact Area, a maximum estimate of 34 *E. triquetra* individuals may be affected by these secondary impacts.

The primary conservation measure used to minimize effects on unionids will be a systematic relocation of individuals within the Salvage Zone. The Salvage Zone offers suitable unionid habitat, and the number of individuals currently inhabiting this area is expected to be low. While no relocation effort is capable of removing every individual, a pre-construction systematic relocation should be sufficient to detect the majority of individuals within the Salvage Zone and move them to an area outside of the project's impacts. As construction is expected to begin during the spring of the construction year, unionids would be relocated the previous fall during low-water conditions. A temporary causeway will need to be re-constructed to remove the temporary bridge pier during the final phase of the project (days 397 – 422), and since more than 1 year will have passed since the original relocation effort, a second relocation effort from the footprint of the causeway will be required prior to causeway re-construction

Relocation of mussels within the Salvage Zone will be accomplished by dividing the area into cells, not to exceed 100 m^2. Initially, each cell will be qualitatively searched at an effort of 0.5 minutes/m^2. A second pass will be made through each cell at the same search effort, and additional passes will be conducted until 2 or fewer mussels or less than 5% of the original number collected are recovered on the final pass. All live individuals recovered from the action area will be identified to species, aged (external annuli), measured (length in mm), and sexed (for sexually dimorphic species); individuals of endangered species will be assigned a unique identification number (shellfish tag), while individuals of common species will receive a colored mark or other non-unique indicator. Recovered individuals will be held in mesh collection bags, in flowing water, out of direct sunlight until they can be transported to the Recipient Site; total retention time of recovered individuals will not exceed 1 hour, and individuals will be hand-placed into the substrate at a Recipient Site.

Prior to the relocation effort, a Recipient Site will be identified. An area upstream of the Salvage Zone that was investigated during the initial survey harbors an existing unionid community and will be used to receive non-listed individuals. All T&E species collected during the relocation will be transferred to WVDNR and placed at a downstream Recipient Site located approximately 2.5 km downstream of the project area currently utilized as a permanent monitoring site (J. Clayton, WVDNR, pers. comm.).

The upstream Recipient Site will be delineated through a series of timed qualitative searches. Searches will be 5 minutes in duration and will consist of biologists visually searching the stream bottom while fanning and/or disturbing the top layer of substrate. The minimum search effort for delineation of the site will be 1 person-hour, and searches will continue until at least 6 samples are collected with no additional species. The extent of the site will be recorded with GPS. All live individuals collected during delineation searches will be identified to species and classified as adult or juvenile. Data from delineation searches will be used to create a species richness curve. In addition to timed qualitative searches, a minimum of 20, 0.25 m^2 whole-substrate quantitative samples (quadrats) will be excavated to estimate density of mussels within the newly delineated concentration. All live individuals collected in quantitative samples will be identified to species, aged (external annuli), measured (length in mm), and sexed (for sexually dimorphic species).

If this site contains similar or better habitat than the Salvage Zone, harbors a similar unionid community, and can accept individuals relocated from the Salvage Zone without increasing density by more than 25%, this area will be utilized as a Recipient Site. Non-listed unionid species will be hand-placed evenly throughout the Recipient Site.

Relocation efforts prior to the temporary causeway re-construction will follow the above methods and will be coordinated with WVDNR and USFWS. Unionids will be removed from the footprint of the causeway with a 5 m upstream buffer and 10 m downstream buffer.

Recolonization will be assessed through monitoring of the Salvage Zone 1, 3, and 5 years post-construction. To determine effects of bridge construction and unionid recolonization within the Salvage Zone, 4-10 m x 10 m cells will be selected within the Salvage Zone and will be delineated based on the cells used for the initial relocation. Within each cell, 10-0.25 m^2 quantitative quadrat samples will be excavated to determine density, species composition, and to increase probability of finding juvenile (≤5 years old) unionids that may have recolonized the area. Quantitative samples will be distributed within each cell based on a three random start methodology, and each sample will be excavated to a depth of approximately 15 cm. All live unionids will be measured (length in mm) and aged (external annuli count). Fresh dead shells (with or without tissue, nacre shiny, valves still intact, periostracum present; likely dead less than one year) will be counted and noted as juveniles (≤5 years old) or adults (> 5 years old). Weathered dead shells (no tissue, nacre chalky, valves may or may not be intact, periostracum present; likely dead more than one year) and subfossil shells (entire shell chalky, valves not intact, no periostracum; dead many years to decades) will be noted as present. Live unionids will be returned to the river near their collection point. At each sample point, a GPS position will be recorded and depth (m) and substrate composition (visual and tactile estimate by diver) will be recorded. In addition, each cell will be qualitatively searched by 12, 5-minute qualitative spot dives to determine species composition and increase the probability of collecting all species present within each cell. At the conclusion of each sample, live unionids will be identified to species, identified as juveniles or adults, and counted. Fresh dead, weathered dead, and subfossil shells will be treated as in quantitative samples. Live unionids will be returned to the river near their collection point. A GPS position, depth, and substrate composition will be recorded at the start of each sample. At least one individual of each species will be photographed. This effort will be repeated during the 3 and 5 year monitoring events to compare density, catch per unit effort (CPUE), and species composition to document recolonization of the Salvage Zone.

5.2 Cumulative Effects

Non-federal actions that may reasonably be expected to occur within the North Fork Hughes River watershed during the lifespan of the proposed bridge may include commercial, residential, and industrial development. As the existing bridge is structurally deficient and restricts truck traffic, the proposed bridge, which will meet current design standards, may attract heavier vehicle traffic, and thus, development within the watershed. While the existing bridge may limit the types of trucks and materials being transported, it is not a current barrier to oil and gas development within the region and the construction of the proposed bridge should not result in a significant increase in these activities. Natural gas exploration and extraction currently exists within this part of West Virginia, and future natural gas development may occur in the North Fork Hughes River watershed.

6.0 Conclusion and Determination of Effects

The proposed project may result in “take” of federally listed mussel species as defined in federal law and guidance, however it would not result in jeopardy to the continued existence or recovery of listed mussel species and “take” would be minimized though conservation measures.

6.1 Snuffbox (*Epioblasma triquetra*)

During a 2015 pre-project survey, density of live unionids within the Salvage Zone exceeded expectations based on semi-quantitative samples, suggesting that undetected unionids may be buried deep within the substrate throughout the Direct Impact Area and Indirect Impact Area. Despite not collecting *E. triquetra*, based on the density estimated from quantitative samples and suitable unionid habitat, *E. triquetra* could occur in the Direct Impact Area.

While the Indirect Impact Area harbors a moderately dense unionid concentration that may include *E. triquetra*, indirect impacts associated with construction and demolition activities would be restricted to temporary (acute) increases in turbidity and sedimentation. These should not exceed conditions experienced during the normal hydrological cycle and would be minimized by restricting construction and demolition activities to low flow conditions. However, *E. triquetra* feeding could be reduced during temporary increases in sedimentation and/or turbidity resulting in “harassment”. Up to 34 *E. triquetra* could occur in Indirect Impact Areas and be “harassed” during the demolition process.

The Salvage Zone harbors similar habitat and a similar unionid community to that of the Indirect Impact Area. Using density estimates from the 2015 survey, a maximum estimate of 1,780 unionids may inhabit the Salvage Zone associated with Alternative 1B. If *E. triquetra* comprises 1.4% of the unionid community, ≤25 *E. triquetra* individuals may be directly affected by bridge replacement.

The current conservation measures (erosion and sediment control and relocation of unionids prior to construction) should reduce negative effects to this species from bridge construction activity. The overall “take” of *E. triquetra* from direct and indirect effects should not exceed 59 individuals.

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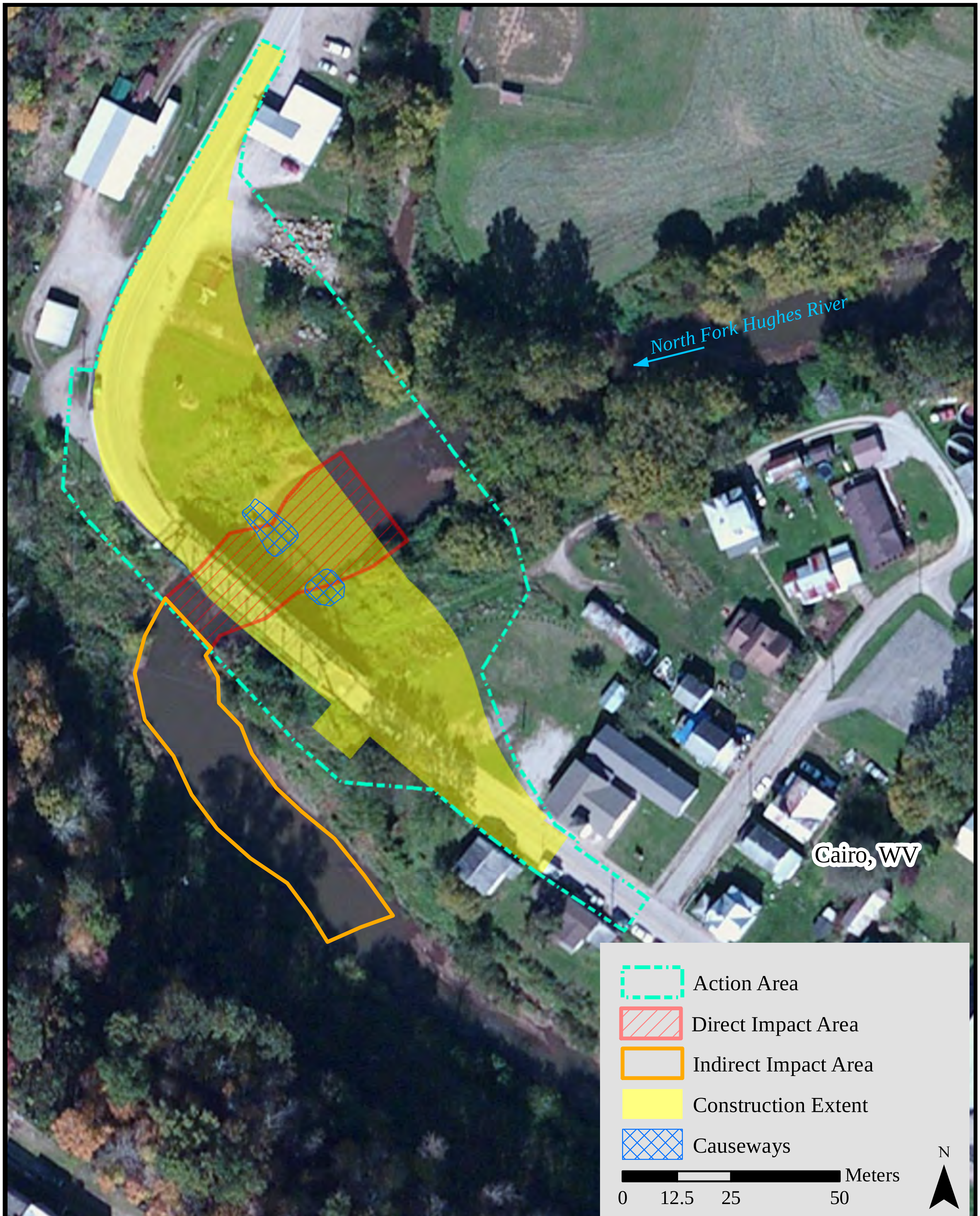

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Figure 1-1. Action Area at Cairo Bridge crossing, Ritchie County, WV

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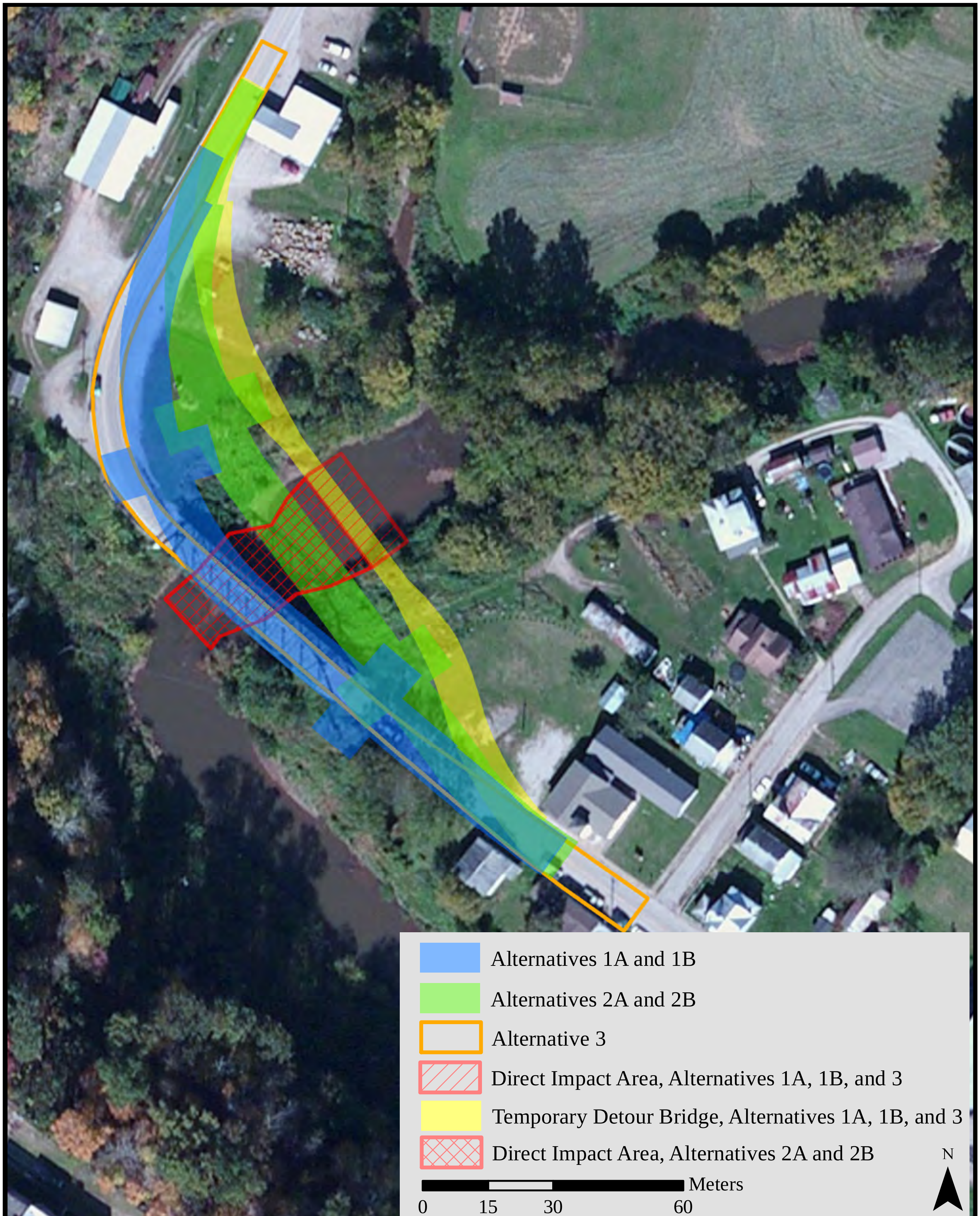

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Figure 2-1. Construction alternatives and respective Direct Impact Areas for Cairo Bridge crossing, Ritchie County, WV.

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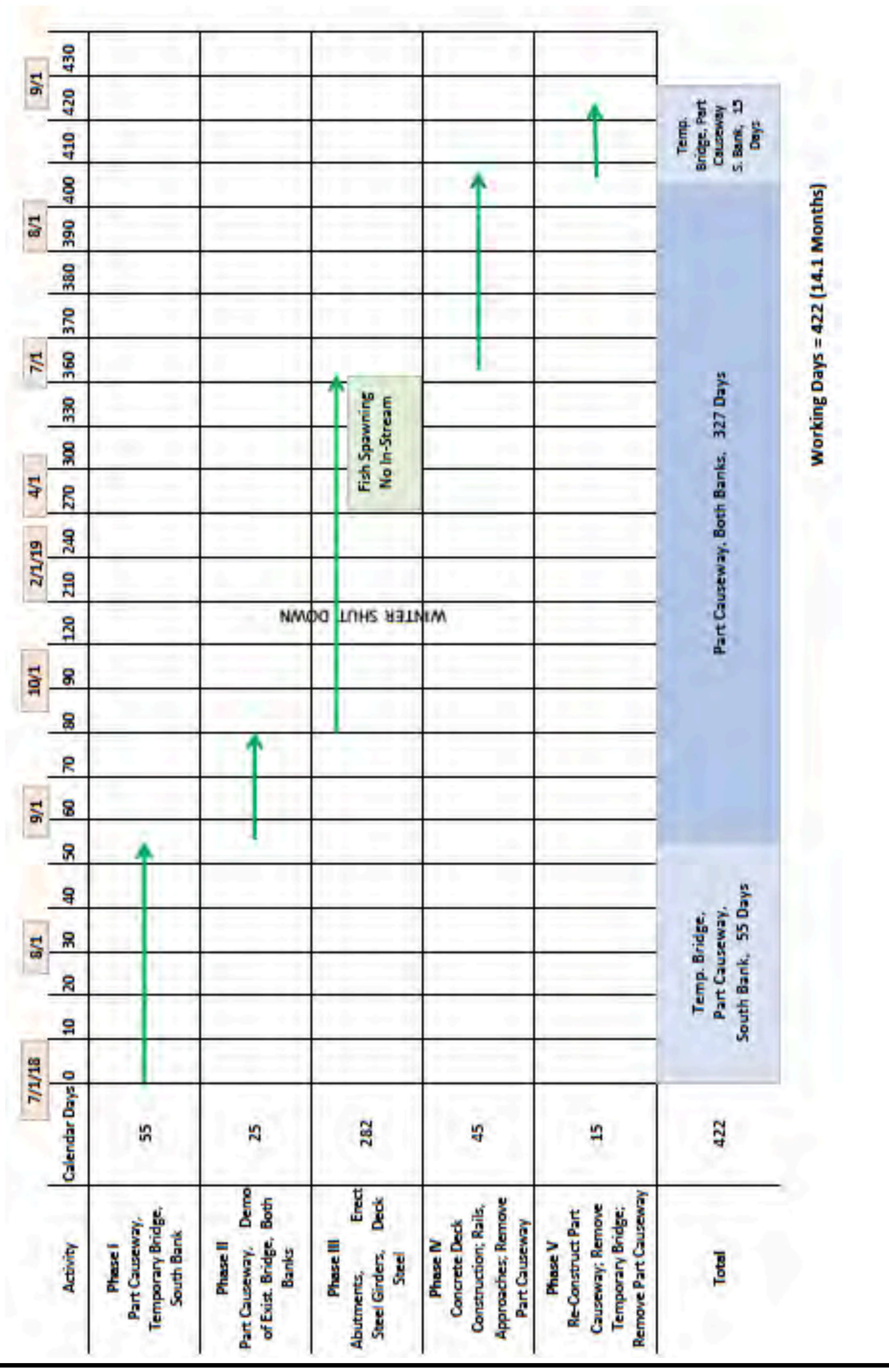

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Figure 2-2. Construction timeline for Cairo Bridge crossing, Ritchie County, WV.

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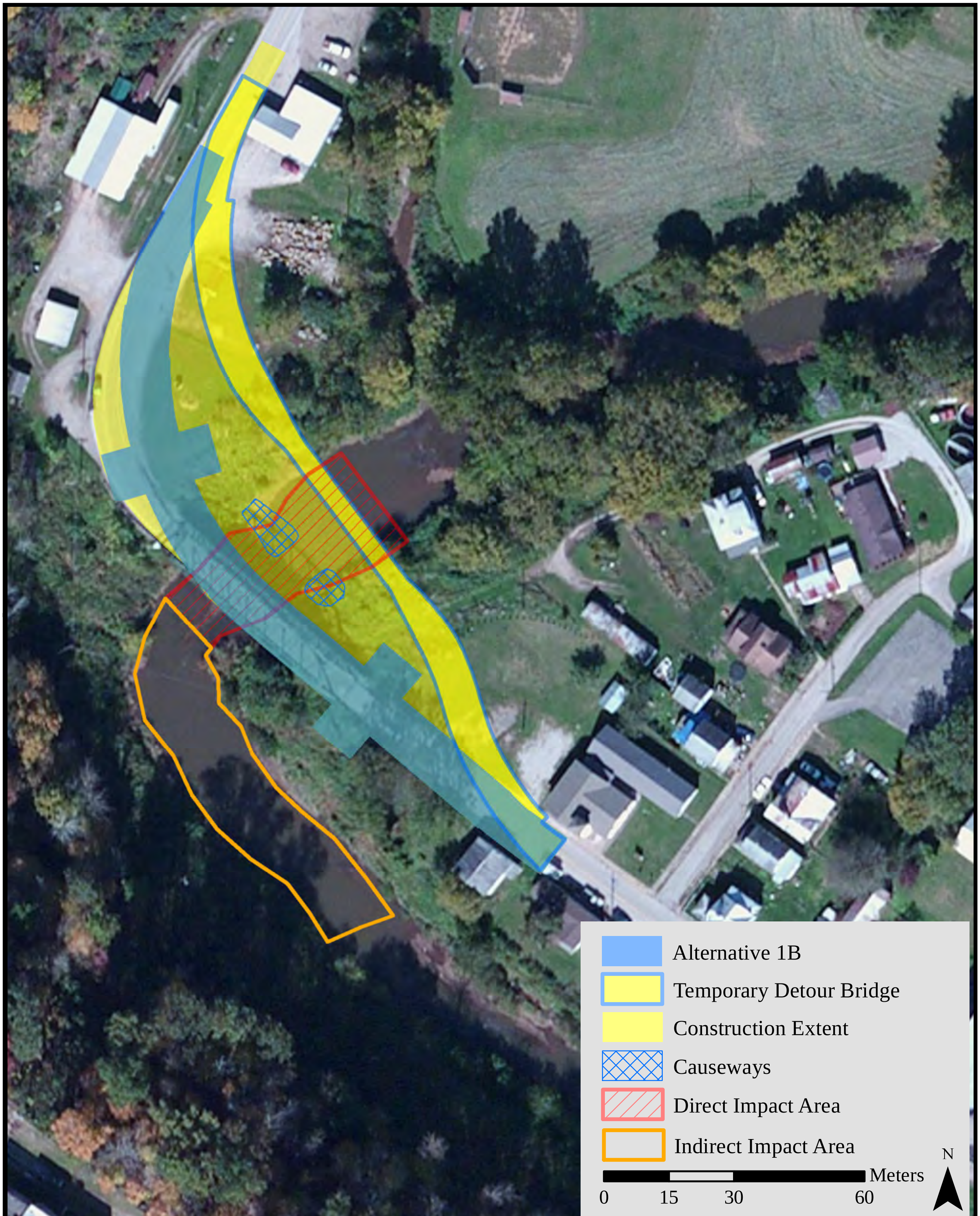

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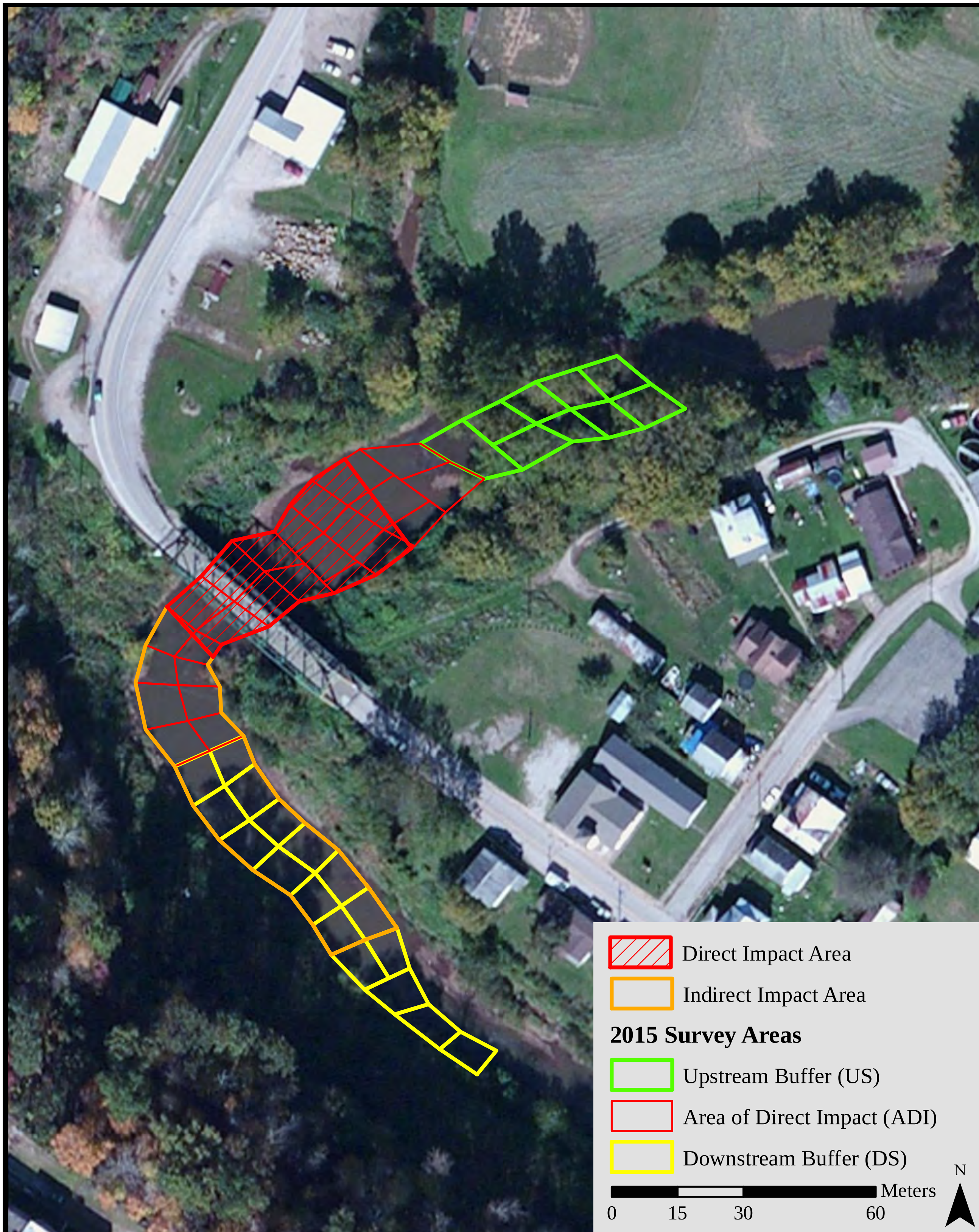
Figure 2-3. Direct and Indirect Impact Areas, Alternative 1B, Cairo Bridge crossing, Ritchie County, WV.

ESI



ECOLOGICAL SPECIALISTS, INC.	Figure 3-1. Direct and Indirect Impact Areas, Alternative 1B, in relation to 2015 Survey Areas, Cairo Bridge crossing, Ritchie County, WV.	ESI

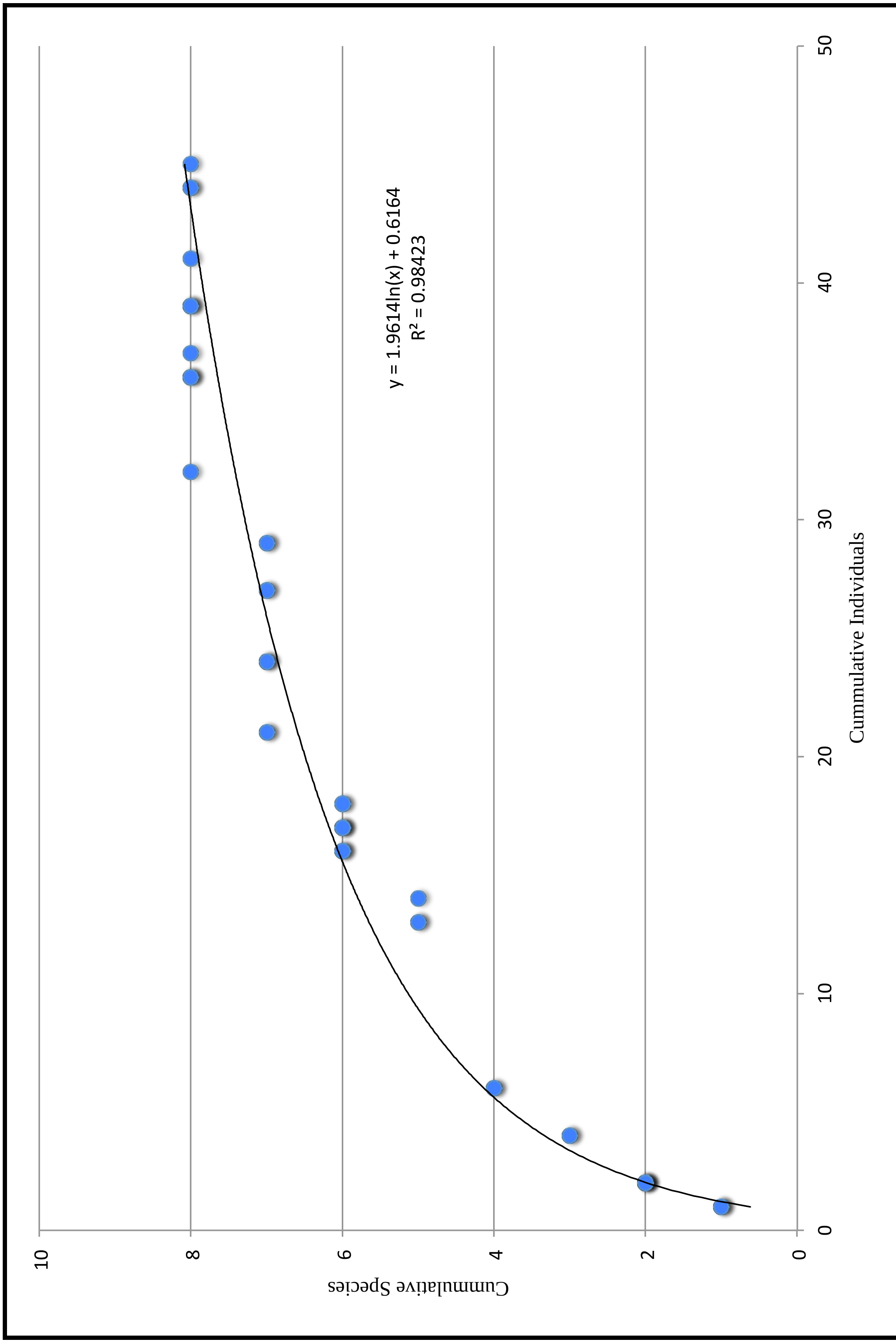
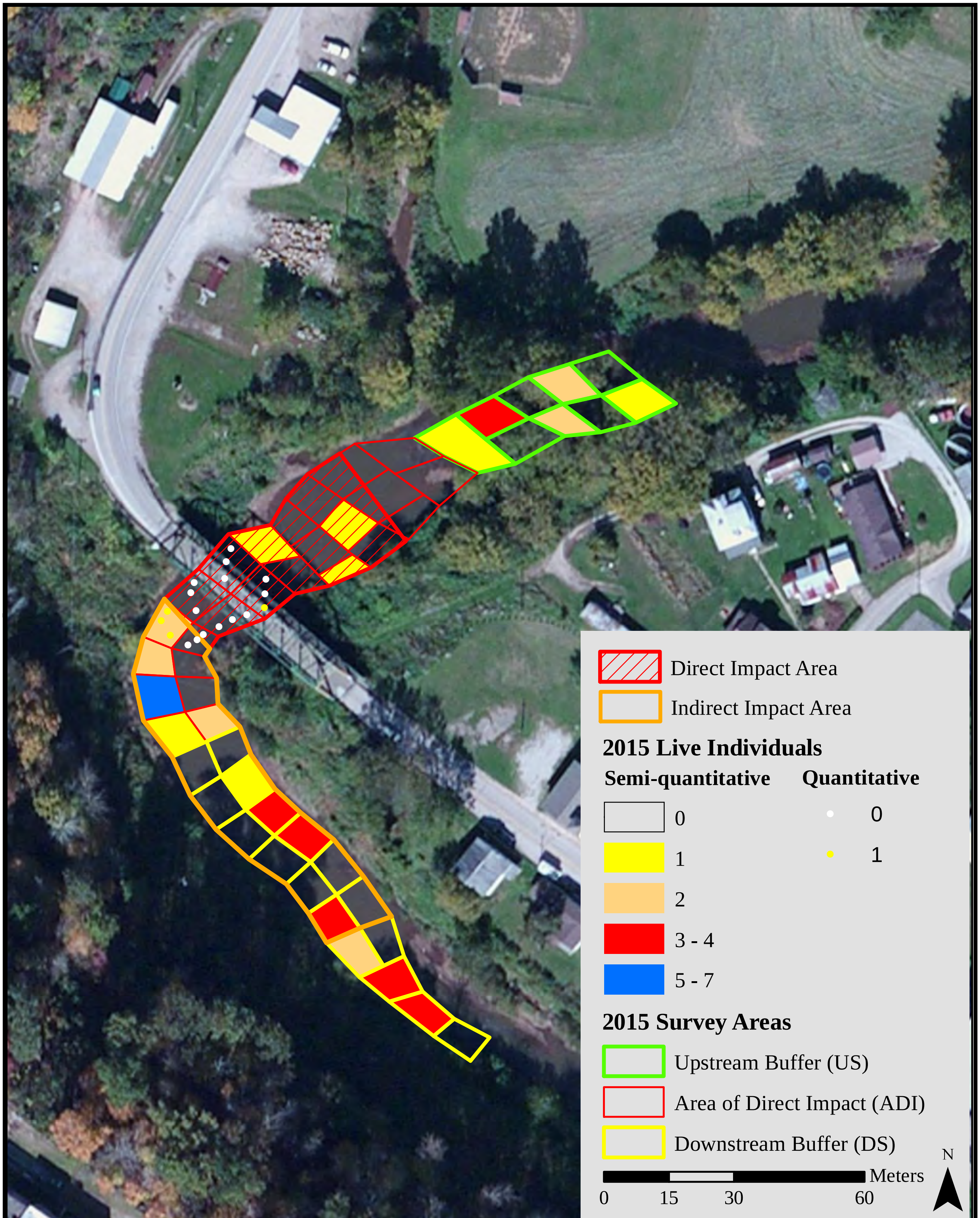


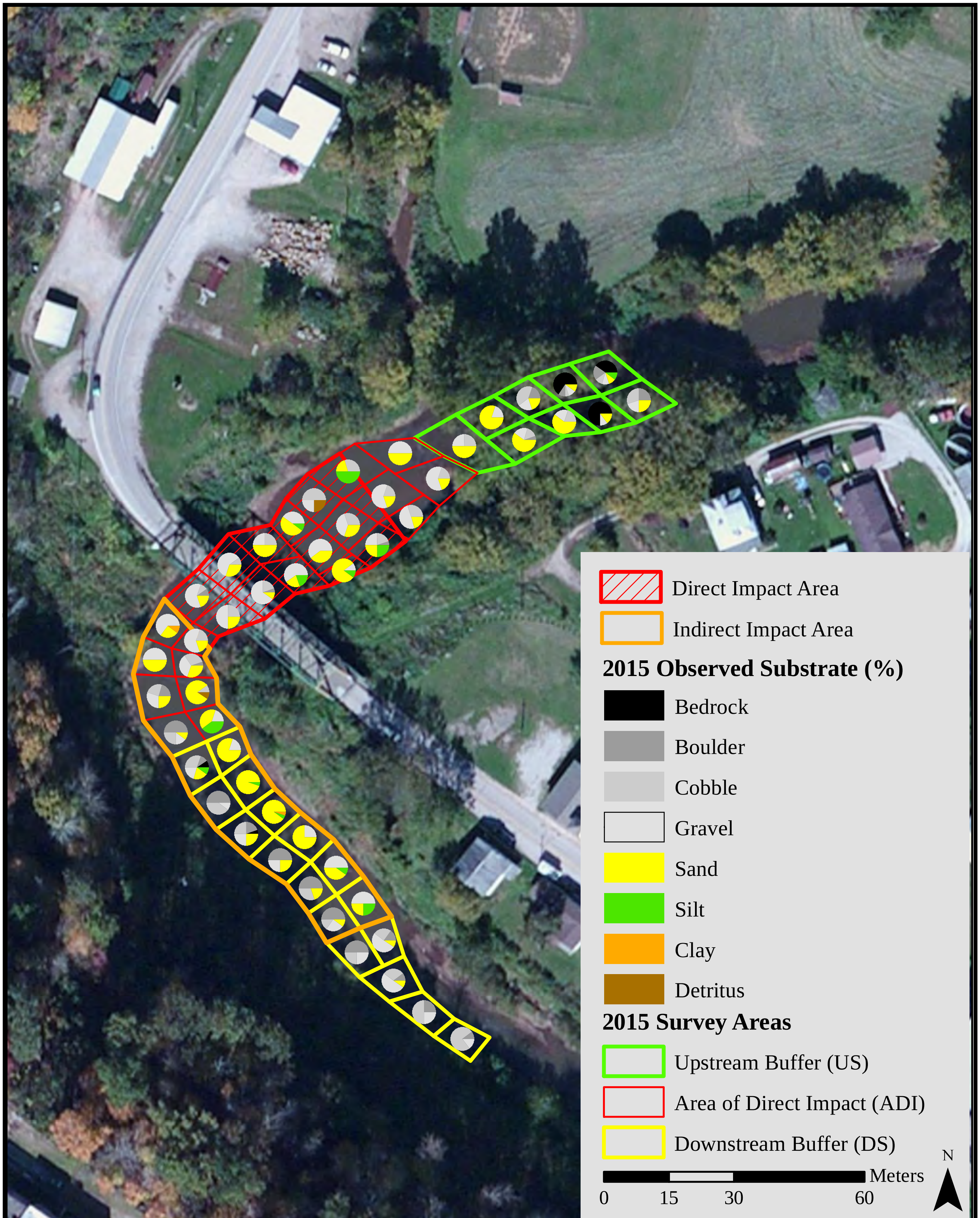
Figure 3-2. Species accumulation curve, Cairo Bridge, North Fork Hughes River, August 2015.

ECOLOGICAL SPECIALISTS, INC.



ECOLOGICAL SPECIALISTS, INC.	Figure 3-3. Live unionids collected in Direct and Indirect Impact Areas, Alternative 1B, during the 2015 survey, Cairo Bridge crossing, Ritchie County, WV.	ESI

ECOLOGICAL SPECIALISTS, INC.	Figure 3-4. Depths in Direct and Indirect Impact Areas, Alternative 1B, during the 2015 survey, Cairo Bridge crossing, Ritchie County, WV.	ESI



ECOLOGICAL SPECIALISTS, INC.	Figure 3-5. Substrate in Direct and Indirect Impact Areas, Alternative1B, during the 2015 survey, Cairo Bridge crossing, Ritchie County, WV.	ESI

Table 1-1. Cairo Bridge consultation history, November 2015 - February 2017.

Date	Participants[1]	Meeting Description
11.3.15	USFWS WVDNR WVDOH FHWA ESI	2015 unionid survey results presented and discussed High number of species with low number of overall mussels found Known *E. triquetra* locations upstream and downstream of project area Very high probability of *E. triquetra* found during relocation Formal consultation required due to high probablity of *E. triquetra* in project area
2.22.17	USFWS WVDNR WVDOH ESI	Discussed edits/comments to Draft BA Alternative 1B is preferred alternative, but Alternative 1A may be used (no difference in in-stream impacts) Alternatives 2A and 2B not feasible; existing bridge deteriorating at such a rate that it may not be structurally able to maintain traffic as needed in these alternatives Construction duration is expected over 2 construction seasons (2018 - 2019) Second unionid relocation effort needed when temporary causeway re-constructed to remove temporary bridge pier in 2019 Need to incorporate a recolonization monitoring plan into BA Endangered unionids collected during relocation will be placed downstream by WVDNR; common unionids will be placed upstream of bridge in areas of suitable unionid habitat Need to incorporate a causeway wash-out contigency plan into BA

[1]USFWS = U.S. Fish and Wildlife Service, WVDNR = West Virginia Division of Natural Resources, WVDOH = West Virginia Division of Highways, FHWA = Federal Highway Administration, ESI = Ecological Specialists, Inc.

Table 3-1. Unionid species reported from the North Fork Hughes River, West Virginia

Species	Status[1]	Jenkinson 1978[2]	ESI 1993	Miller and Payne 2000	ESI 2001	WVDNR 2012[3]	ESI 2015
Amblemini							
Amblema plicata		–	x	x	–	x	x
Pleurobemini							
Elliptio crassidens		–	–	x	–	–	–
Elliptio dilatata		x	x	x	x	x	x
Fusconaia flava		x	x	x	–	x	x
Fusconaia subrotunda		–	FD	x	WD	x	–
Pleurobema sintoxia		–	x	x	–	–	–
Quadrulini							
Quadrula p. pustulosa		–	x	–	–	x	–
Quadrula quadrula		–	x	x	–	x	–
Tritogonia verrucosa		–	x	x	–	x	x
Lampsilini							
Actinonaias ligamentina		–	–	–	–	x	–
Epioblasma triquetra	FE	–	x	x	FD	x	–
Lampsilis cardium		x	x	x	WD	x	WD
Lampsilis siliquoidea		x	x	x	x	x	x
Leptodea fragilis		–	x	x	WD	x	–
Obovaria subrotunda		x	x	x	WD	x	x
Potamilus alatus		–	x	x	x	x	–
Ptychobranchus fasciolaris		x	x	x	–	x	x
Toxolasma parvus		–	FD	x	–	–	–
Villosa iris		x	x	x	–	–	x
Anodontini							
Anodontoides ferussacianus		–	x	–	–	–	–
Lasmigona c. complanata		–	–	–	–	x	–
Lasmigona costata		x	x	x	WD	x	–
Pyganodon grandis		x	x	–	–	x	–
Simpsonaias ambigua		x	–	–	–	–	–
Strophitus undulatus		x	x	x	–	x	WD
Utterbackia imbecillis		–	x	–	–	–	–
No. Species		11	22	19	9	19	10
No. Live Species		11	20	19	3	19	8

X = Live, FD = Fresh Dead, WD = Weathered Dead
[1]FE = Federally Endangered (USFWS, 2017)
[2]Ohio State Museum:1978:002
[3]J. Clayton,WVDNR, pers. comm., 2015

Table 3-2. Species composition by method and area, Cairo Bridge, North Fork Hughes River, August 2015.

	Semi-Quantitative								Quantitative	
	Upstream Buffer		Area of Direct Impact		Downstream Buffer		Total		Salvage Area	
	No. Live	%	No. Live	%	No. Live	%	No. Live	%	No. Live	%
Amblemini										
Amblema plicata	4	44.4	6	35.3	WD	–	10	22.2	1	25.0
Pleurobemini										
Elliptio dilatata	–	–	–	–	2	10.5	2	4.4	WD	–
Fusconaia flava	2	22.2	4	23.5	6	31.6	12	26.7	2	50.0
Quadrulini										
Tritogonia verrucosa	1	11.1	1	5.9	1	5.3	3	6.7	–	–
Lampsilini										
Lampsilis cardium	–	–	WD	–	–	–	–	–	–	–
Lampsilis siliquoidea	FD	–	2	11.8	4	21.1	6	13.3	–	–
Obovaria subrotunda	2	22.2	1	5.9	2	10.5	5	11.1	–	–
Ptychobranchus fasciolaris	–	–	3	17.6	2	10.5	5	11.1	1	25.0
Villosa iris	–	–	–	–	2	10.5	2	4.4	–	–
Anodontini										
Strophitus undulatus	–	–	WD	–	–	–	–	–	–	–
Total No. Live	9	100.0	17	100.0	19	100.0	45	100.0	4	100.0
No. Live Species	4		6		7		8		3	
Effort (min)	450		1075		850		2375			
CPUE (no. live/hour)	1.2		0.9		1.3		1.1			
Density (no./m^2) ±2SE									0.9 (±0.8)	
Recruitment (% ≤5 years old)									100.0	
Mortality (% FD)									0.0	

FD = Fresh Dead, WD = Weathered Dead

Table 3-3. Individuals collected from Direct and Indirect Impact Area during 2015 survey, Cairo Bridge, North Fork Hughes River.

		Direct Impact Area	Indirect Impact Area
Tribe	Species	No. Live	No. Live
Amblemini	*Amblema plicata*	2	5
Pleurobemini	*Fusconaia flava*	-	9
Quadrulini	*Tritogonia verrucosa*	-	2
Lampsilini	*Lampsilis siliquoidea*	1	3
	Obovaria subrotunda	-	3
	Ptychobranchus fasciolaris	1	3
	Villosa iris	-	2
	No. Live	4	27
	No. Live Species	3	7

Table 5-1. Estimated number of Direct and Indirect Impact Area inhabitants impacted by Cairo Bridge project, Alternative 1B, based on 2015 survey results.

Direct Impact Area (Salvage Zone): 1037 m^2
Indirect Impact Area: 1411 m^2
2015 Total Estimated Density: 0.89 ± 0.81 unionids / m^2
Minimum Density: 0.08 unionids / m^2
Maximum Density: 1.70 unionids / m^2

			Direct Impact Area		Indirect Impact Area	
Tribe	Species	Relative Abundance (%) in 2015 Survey	Number of Individuals Impacted Minimum Estimate[1]	Number of Individuals Impacted Maximum Estimate[2]	Number of Individuals Impacted Minimum Estimate[3]	Number of Individuals Impacted Maximum Estimate[4]
Amblemini	*Amblema plicata*	22.4	20	395	30	540
Pleurobemini	*Elliptio dilatata*	4.1	5	75	5	100
	Fusconaia flava	28.6	25	505	35	690
Quadrulini	*Tritogonia verrucosa*	6.1	10	110	10	150
Lampsilini	*Lampsilis siliquoidea*	12.2	15	220	15	295
	Obovaria subrotunda	10.2	10	180	15	245
	Ptychobranchus fasciolaris	12.2	15	220	15	295
	Villosa iris	4.1	5	75	5	100
	Total		**105**	**1780**	**130**	**2415**
Lampsilini	*Epioblasma triquetra*	1.4 [5]	1	25	2	34

[1]Direct Impact Area in m^2 x Minimum Density Estimate x Relative Abundance (rounded up to the nearest 5)
[2]Direct Impact Area in m^2 x Maximum Density Estimate x Relative Abundance (rounded up to the nearest 5)
[3]Indirect Impact Area in m^2 x Minimum Density Estimate x Relative Abundance (rounded up to the nearest 5)
[4]Indirect Impact Area in m^2 x Maximum Density Estimate x Relative Abundance (rounded up to the nearest 5)
[5]Estimated from species accumulation curve regression y=1.9614ln(x)+0.6164 (rounded to the nearest 5)

Table 5-2. Comparison of Direct and Indirect Impact Area inhabitants impacted by Cairo Bridge project by Alternative, based on 2015 survey results.

Alternatives 1A, 1B, and 3
Direct Impact Area (Salvage Zone): 1037 m^2
Indirect Impact Area: 1411 m^2

Alternatives 2A and 2B
Direct Impact Area (Salvage Zone): 780 m^2
Indirect Impact Area: 1411 m^2

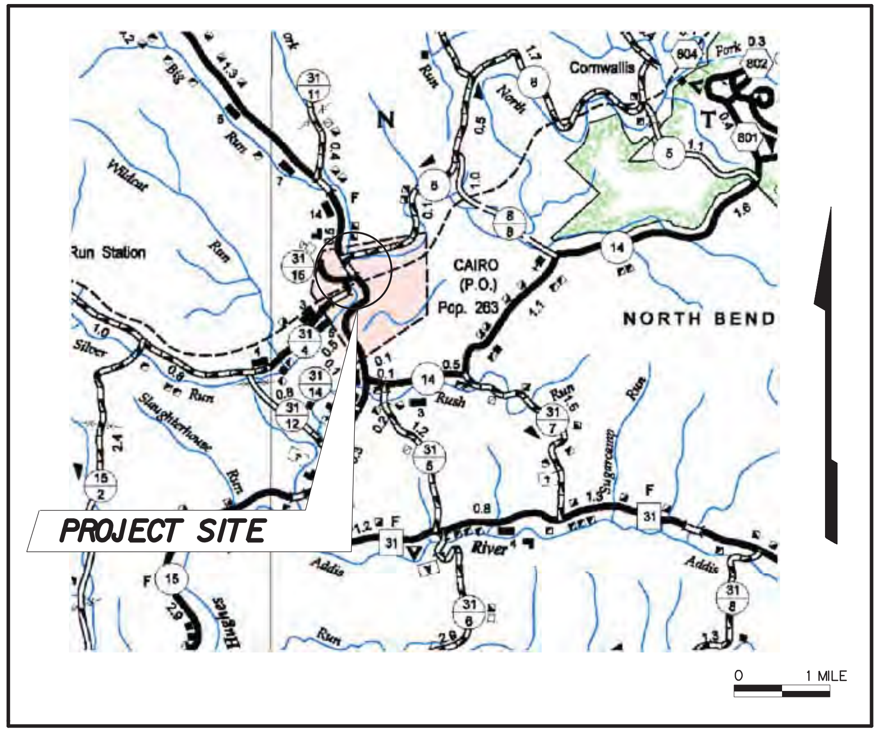
2015 Total Estimated Density: 0.89 ± 0.81 unionids / m^2
Minimum Density: 0.08 unionids / m^2
Maximum Density: 1.70 unionids / m^2

			Direct Impact Area		Indirect Impact Area	
Tribe	Species	Relative Abundance (%) in 2015 Survey	Number of Individuals Impacted Minimum Estimate[1]	Number of Individuals Impacted Maximum Estimate[2]	Number of Individuals Impacted Minimum Estimate[3]	Number of Individuals Impacted Maximum Estimate[4]
Alternatives 1A, 1B, and 3						
Amblemini	*Amblema plicata*	22.4	20	395	30	540
Pleurobemini	*Elliptio dilatata*	4.1	5	75	5	100
	Fusconaia flava	28.6	25	505	35	690
Quadrulini	*Tritogonia verrucosa*	6.1	10	110	10	150
Lampsilini	*Lampsilis siliquoidea*	12.2	15	220	15	295
	Obovaria subrotunda	10.2	10	180	15	245
	Ptychobranchus fasciolaris	12.2	15	220	15	295
	Villosa iris	4.1	5	75	5	100
	Total		**105**	**1780**	**130**	**2415**
Lampsilini	*Epioblasma triquetra*	1.4 [5]	1	25	2	34
Alternatives 2A and 2B						
Amblemini	*Amblema plicata*	22.4	15	300	30	540
Pleurobemini	*Elliptio dilatata*	4.1	5	55	5	100
	Fusconaia flava	28.6	20	380	35	690
Quadrulini	*Tritogonia verrucosa*	6.1	5	85	10	150
Lampsilini	*Lampsilis siliquoidea*	12.2	10	165	15	295
	Obovaria subrotunda	10.2	10	140	15	245
	Ptychobranchus fasciolaris	12.2	10	165	15	295
	Villosa iris	4.1	5	55	5	100
	Total		**80**	**1345**	**130**	**2415**
Lampsilini	*Epioblasma triquetra*	1.4 [5]	1	19	2	34

[1]Direct Impact Area in m^2 x Minimum Density Estimate x Relative Abundance (rounded up to the nearest 5)
[2]Direct Impact Area in m^2 x Maximum Density Estimate x Relative Abundance (rounded up to the nearest 5)
[3]Indirect Impact Area in m^2 x Minimum Density Estimate x Relative Abundance (rounded up to the nearest 5)
[4]Indirect Impact Area in m^2 x Maximum Density Estimate x Relative Abundance (rounded up to the nearest 5)
[5]Estimated from species accumulation curve regression y=1.9614ln(x)+0.6164 (rounded to the nearest 5)

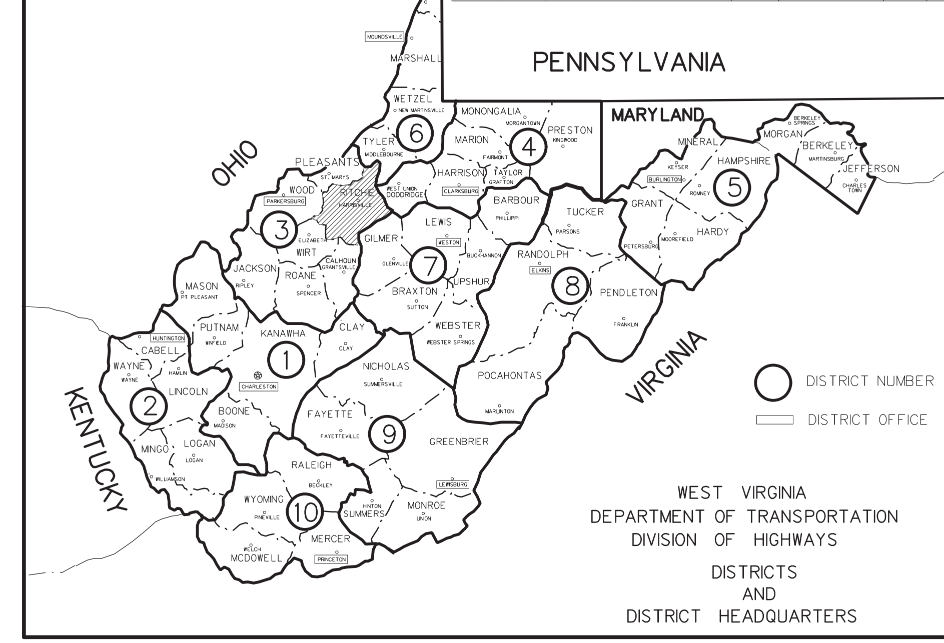
Appendix A. Construction Plans.

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W. V.	3	S343-31-9.82 00	STP-0031-(037) D	2018	RITCHIE	E1	E87



WEST VIRGINIA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
PLANS FOR CONSTRUCTION
OF
STATE HIGHWAY
FEDERAL PROJECT NO. STP-0031 (037) D
STATE PROJECT NO. S343-31-9.82 00
WV ROUTE 31 / MAIN STREET
TOWN OF CAIRO
RITCHIE COUNTY

CAIRO BRIDGE DESIGN STUDY



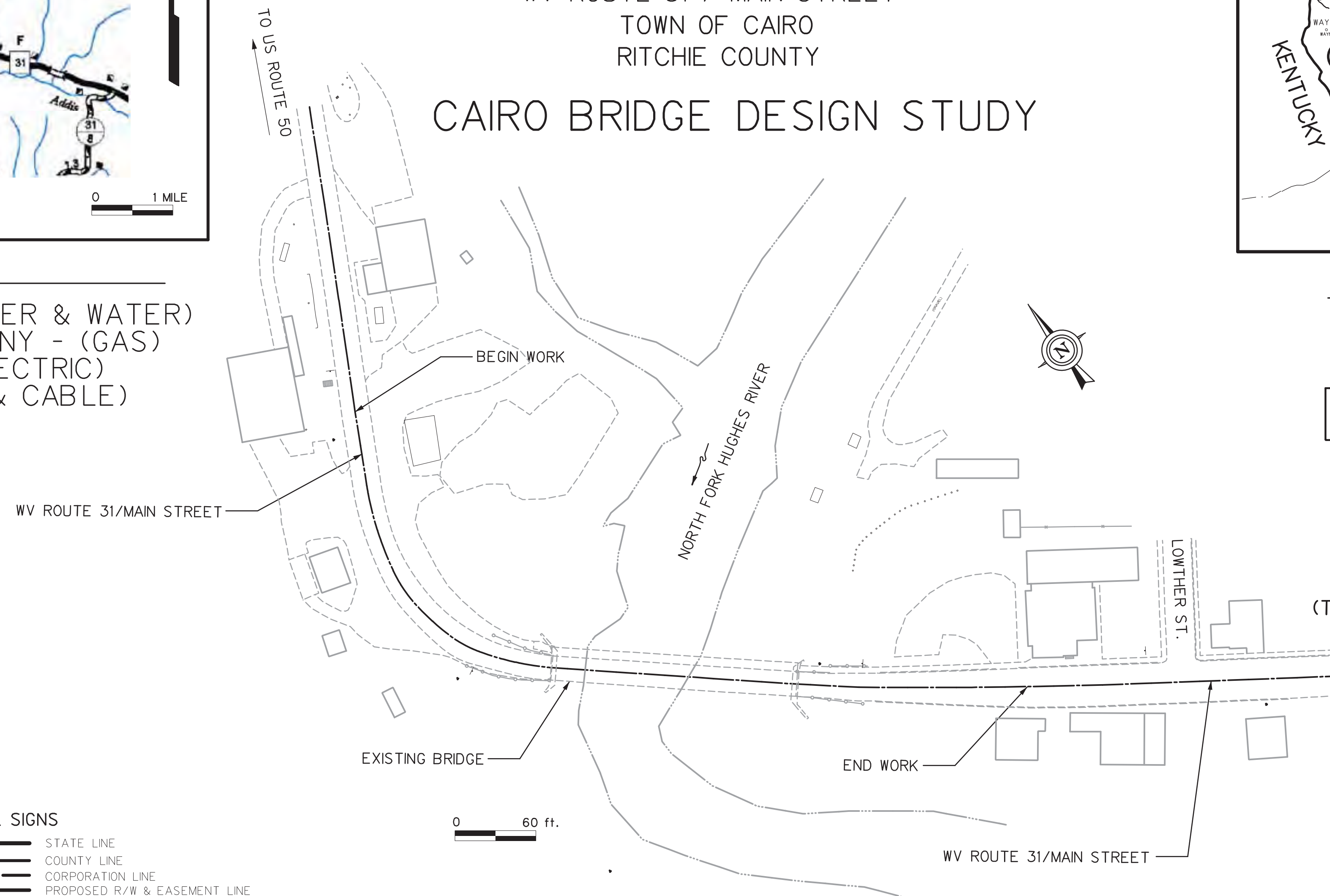
UTILITIES

TOWN OF CAIRO - (SANITARY SEWER & WATER)
CONSUMER GAS UTILITY COMPANY - (GAS)
FIRST ENERGY CORP - (ELECTRIC)
ARMSTRONG - (TELEPHONE & CABLE)

TYPE OF CONSTRUCTION

DESIGN STUDY OFFICE REVIEW

PRELIMINARY NOT FOR CONSTRUCTION



PLANS PREPARED BY
BURGESS & NIPLE, INC.
PARKERSBURG, WV

SIGNED.......................................DATE:.................WV REG. P.E.............

SCALES

PLAN HOR. 0 20 ft.

PROFILE VERT. 0 5 ft. HOR. 0 20 ft.

DESIGN DESIGNATION

A . D . T (2013 -)
A . D . T (2033 -)
D . H . V. "
D . "
T . "
V . "

CONVENTIONAL SIGNS

STATE LINE
COUNTY LINE
CORPORATION LINE
PROPOSED R/W & EASEMENT LINE
EXISTING R/W LINE
PROPERTY LINE
EXISTING FENCE
PROPOSED FENCE
EDGE OF STREAM
PROPOSED GUARD RAIL
EXISTING GUARD RAIL
RAILROAD
SEWER LINE
GAS LINE
WATER LINE
TELEPHONE LINE
UNDERGROUND TELEPHONE
ELECTRIC LINE
TELEPHONE POLE
POWER POLE
COMBINED POWER AND TELEPHONE POLE
TREE
SHRUB
RIGHT OF WAY MARKER

INDEX TO SHEETS

NO.	DESCRIPTION
1	TITLE SHEET
E2	EXISTING TYPICAL SECTIONS
E3	PROPOSED TYPICAL SECTIONS
E4-E7	PROPERTY MAP AND OWNERSHIP INDEX
E8-E24	ALTERNATIVE 1A
E25-E82	ALTERNATIVE 1B
E41-E56	ALTERNATIVE 2A
E57-E69	ALTERNATIVE 2B
E70-E77	ALTERNATIVE 3
E78-E87	TEMPORARY DETOUR

REVISION NUMBER	SHEET NUMBER	REVISIONS	DATE	BY

.... 2016
I HEREBY CERTIFY THAT THIS IS A CORRECT COPY OF THE PLANS OF PROJECT S343-31-9.82 00, STP-0031 (037) D

.... EXECUTIVE SECRETARY

RECOMMENDED .... PROJECT MANAGER

RECOMMENDED FOR APPROVAL .... STATE HIGHWAY ENGINEER

APPROVED .... COMMISSIONER OF HIGHWAYS

PROJECT NO. S343-31-9.82 00, STP-0031 (037) D

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
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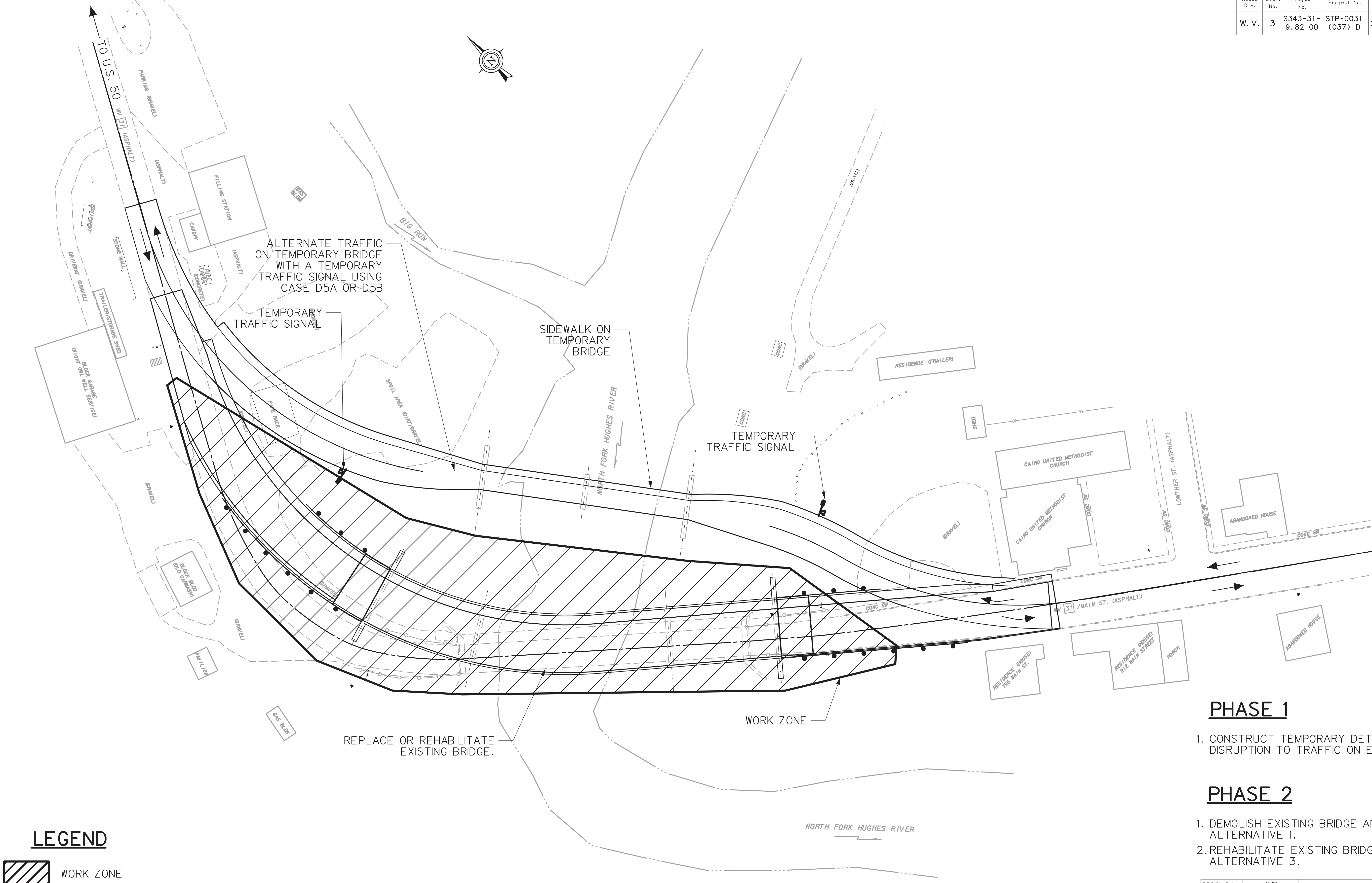

PHASE 1

1. CONSTRUCT TEMPORARY DETOUR WITHOUT DISRUPTION TO TRAFFIC ON EXISTING ROUTE.

PHASE 2

1. DEMOLISH EXISTING BRIDGE AND REPLACE FOR ALTERNATIVE 1.
2. REHABILITATE EXISTING BRIDGE FOR ALTERNATIVE 3.

LEGEND

WORK ZONE

TRAFFIC FLOW

SCALE : 0 30 ft.

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

DESIGN BY:	JMB
DRAWN BY:	JMC
CHECKED BY:	MML
DATE:	3/16

BURGESS & NIPLE
Engineers ■ Environmental Scientists ■ Planners
PARKERSBURG, WV

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

TEMPORARY TRAFFIC CONTROL PLAN
ALTERNATIVES 1 & 3

J04C23C03-PLAN.e

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
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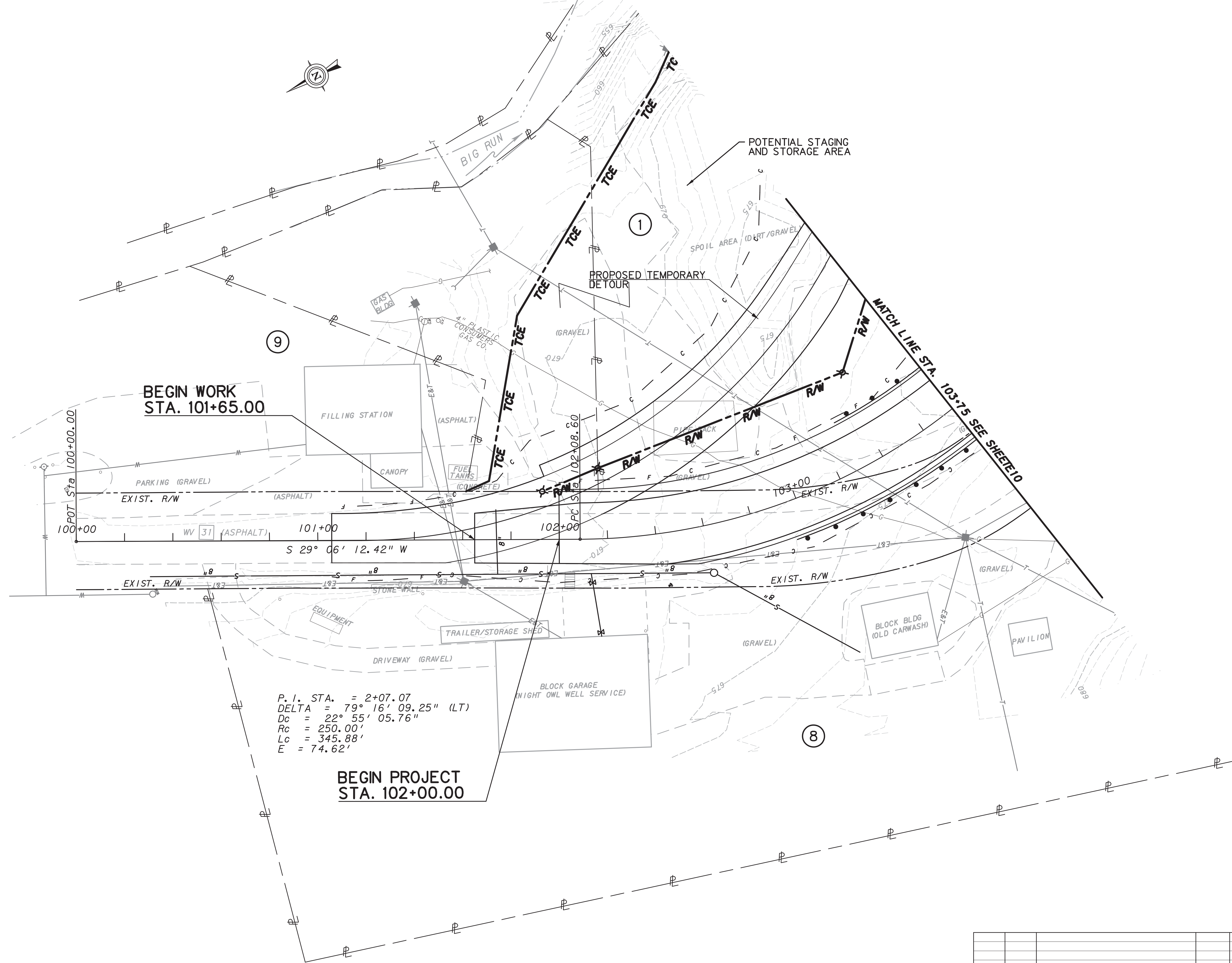

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REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

DESIGN BY:	JMC
DRAWN BY:	JMB
CHECKED BY:	MWL
DATE:	2/16

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PARKERSBURG, WV

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

PLAN SHEET
ALTERNATIVE 1A

J04C23C03-PLAN.e

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
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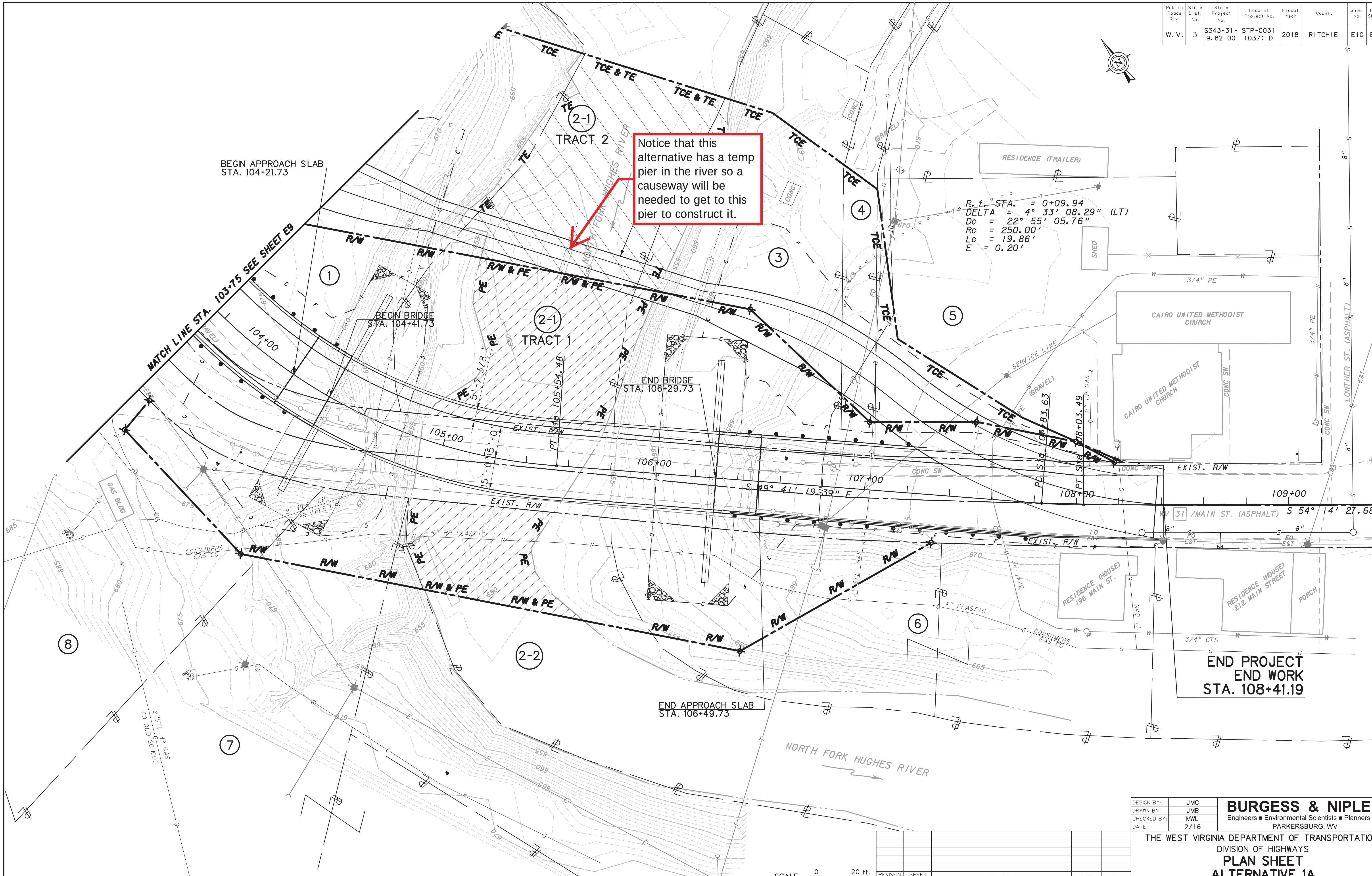

DESIGN BY: JMC
DRAWN BY: JMB
CHECKED BY: MML
DATE: 2/16

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REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
PLAN SHEET
ALTERNATIVE 1A

J04C23C03-PLAN.e

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
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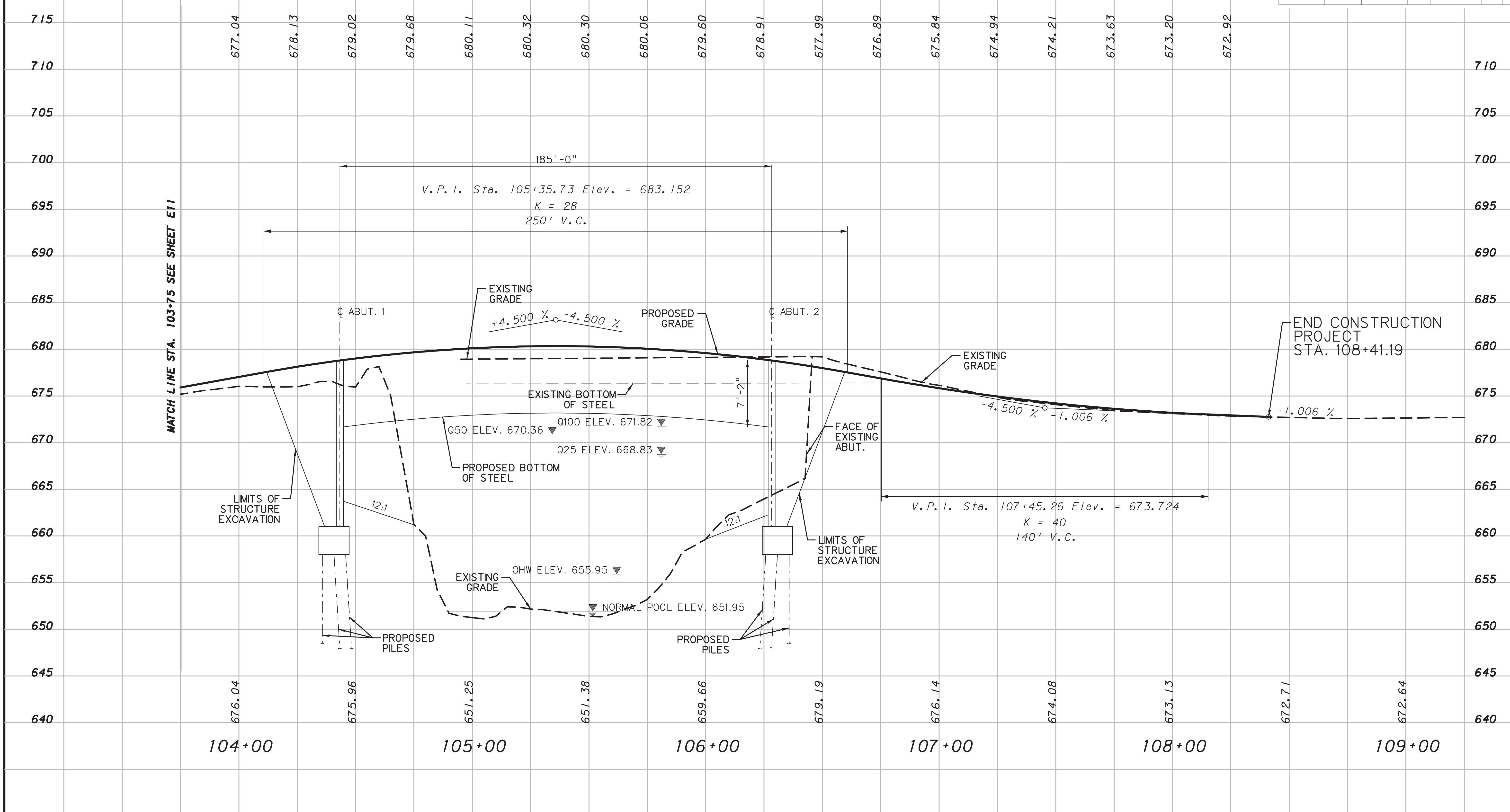

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REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

DESIGN BY:	JMC
DRAWN BY:	JMC
CHECKED BY:	MWL
DATE:	2/16

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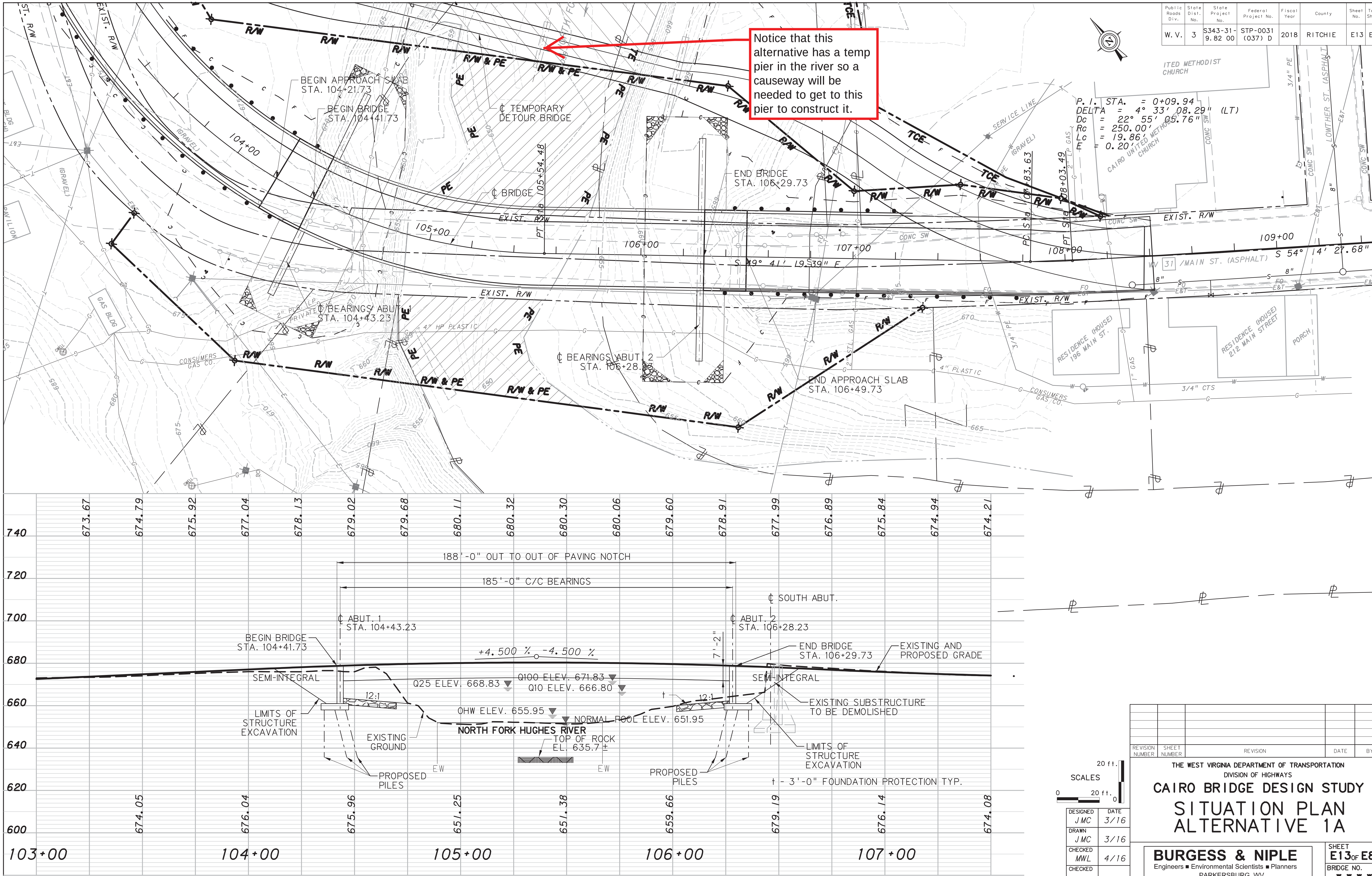
PARKERSBURG, WV

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

ALTERNATE 1A PROFILE

J04C30C03-PROFILE



Notice that this alternative has a temp pier in the river so a causeway will be needed to get to this pier to construct it.

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W. V.	3	S343-31-9.82 00	STP-0031 (037) D	2018	RITCHIE	E13	E87

SCALES 20 ft. 0 20 ft.

DESIGNED	DATE
JMC	3/16
DRAWN	
JMC	3/16
CHECKED	
MWL	4/16
CHECKED	

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

CAIRO BRIDGE DESIGN STUDY

SITUATION PLAN
ALTERNATIVE 1A

BURGESS & NIPLE
Engineers ■ Environmental Scientists ■ Planners
PARKERSBURG, WV

SHEET E13 OF E87
BRIDGE NO. ✱✱✱✱

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
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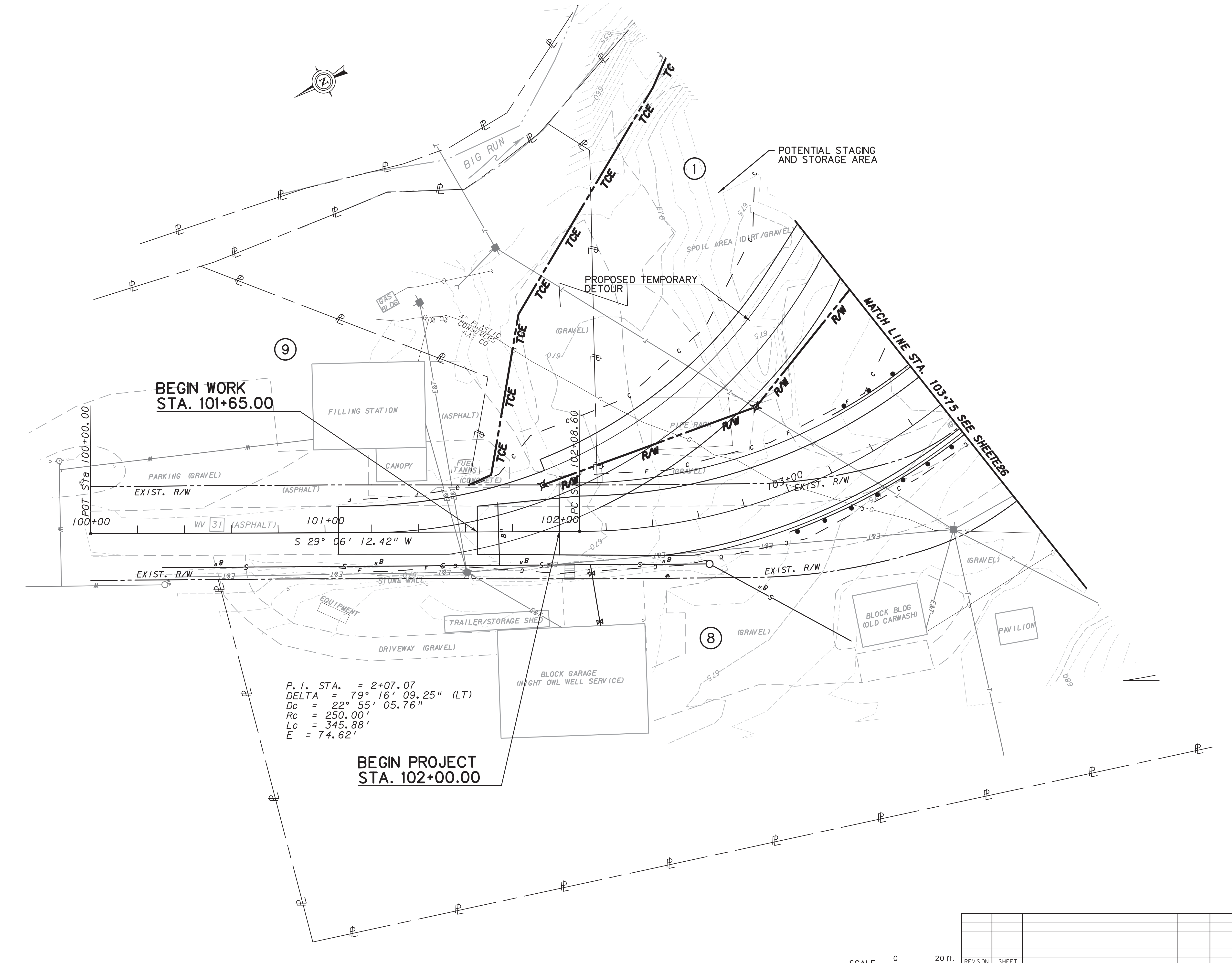

DESIGN BY:	JMC
DRAWN BY:	JMB
CHECKED BY:	MWL
DATE:	2/16

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PARKERSBURG, WV

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
PLAN SHEET
ALTERNATIVE 1B

J04C23C03-PLAN e

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
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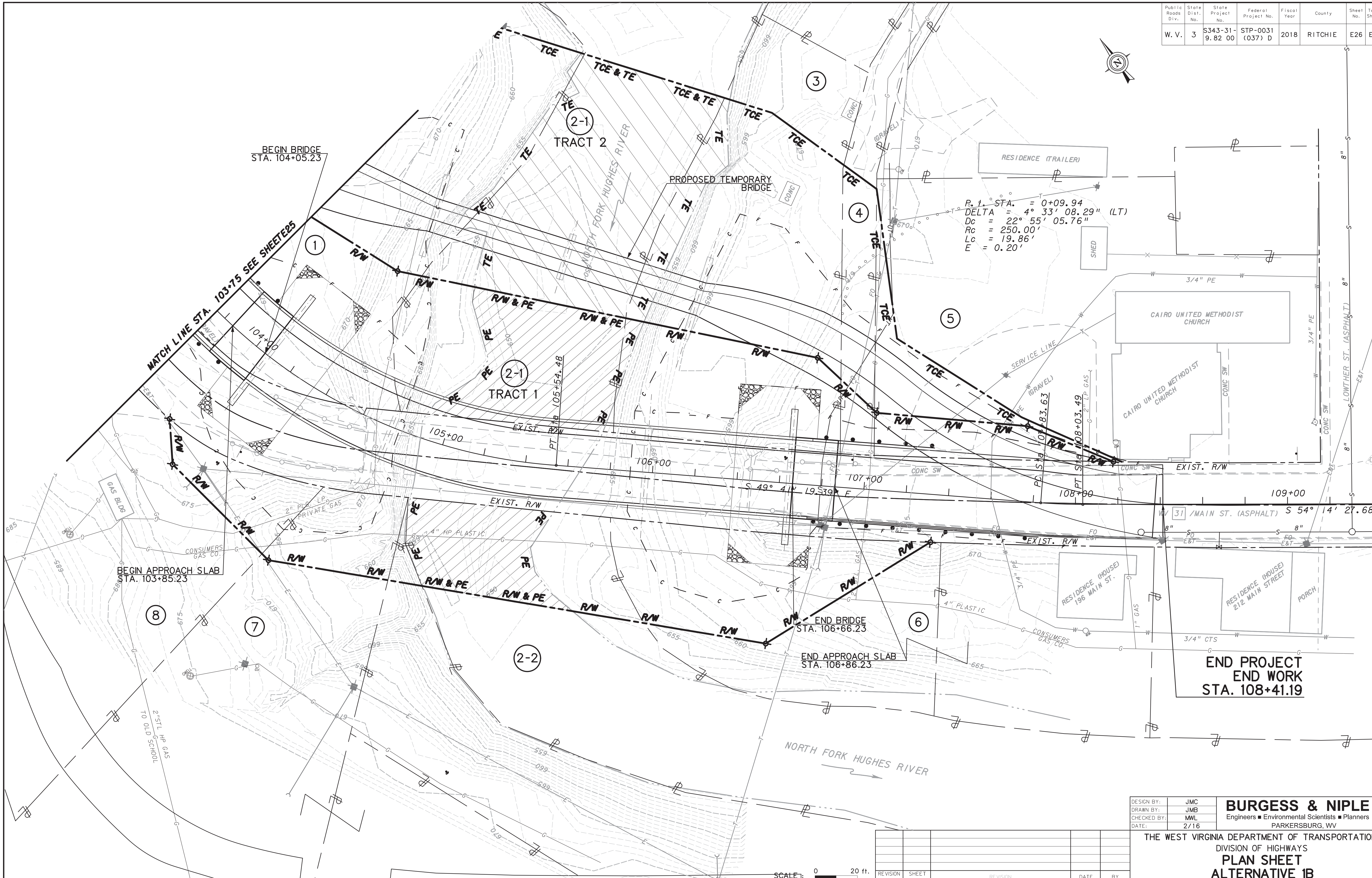

DESIGN BY:	JMC
DRAWN BY:	JMB
CHECKED BY:	MML
DATE:	2/16

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REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
PLAN SHEET
ALTERNATIVE 1B

J04C23C03-PLAN.e

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
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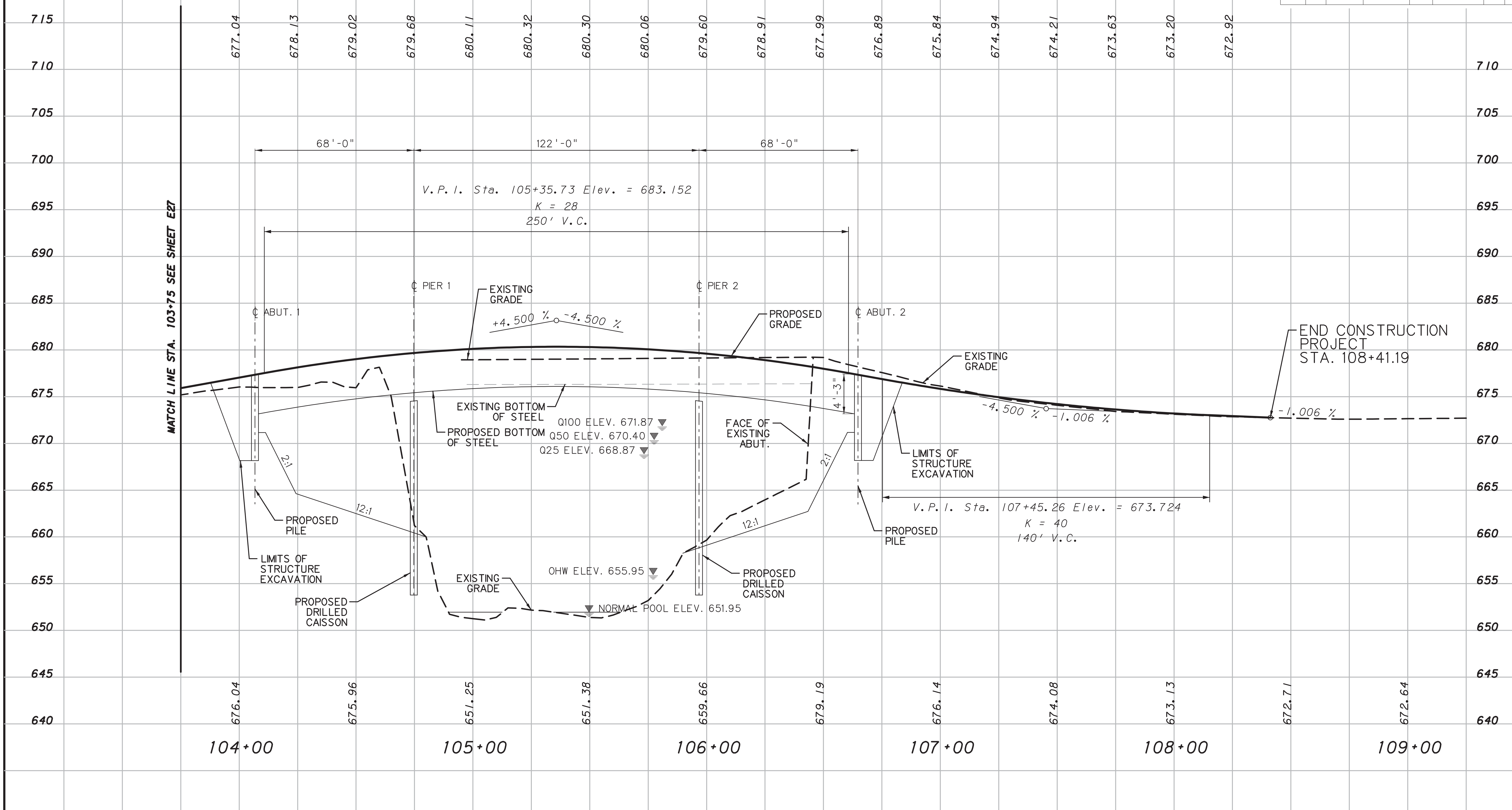

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REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

DESIGN BY:	JMC
DRAWN BY:	JMC
CHECKED BY:	MWL
DATE:	2/16

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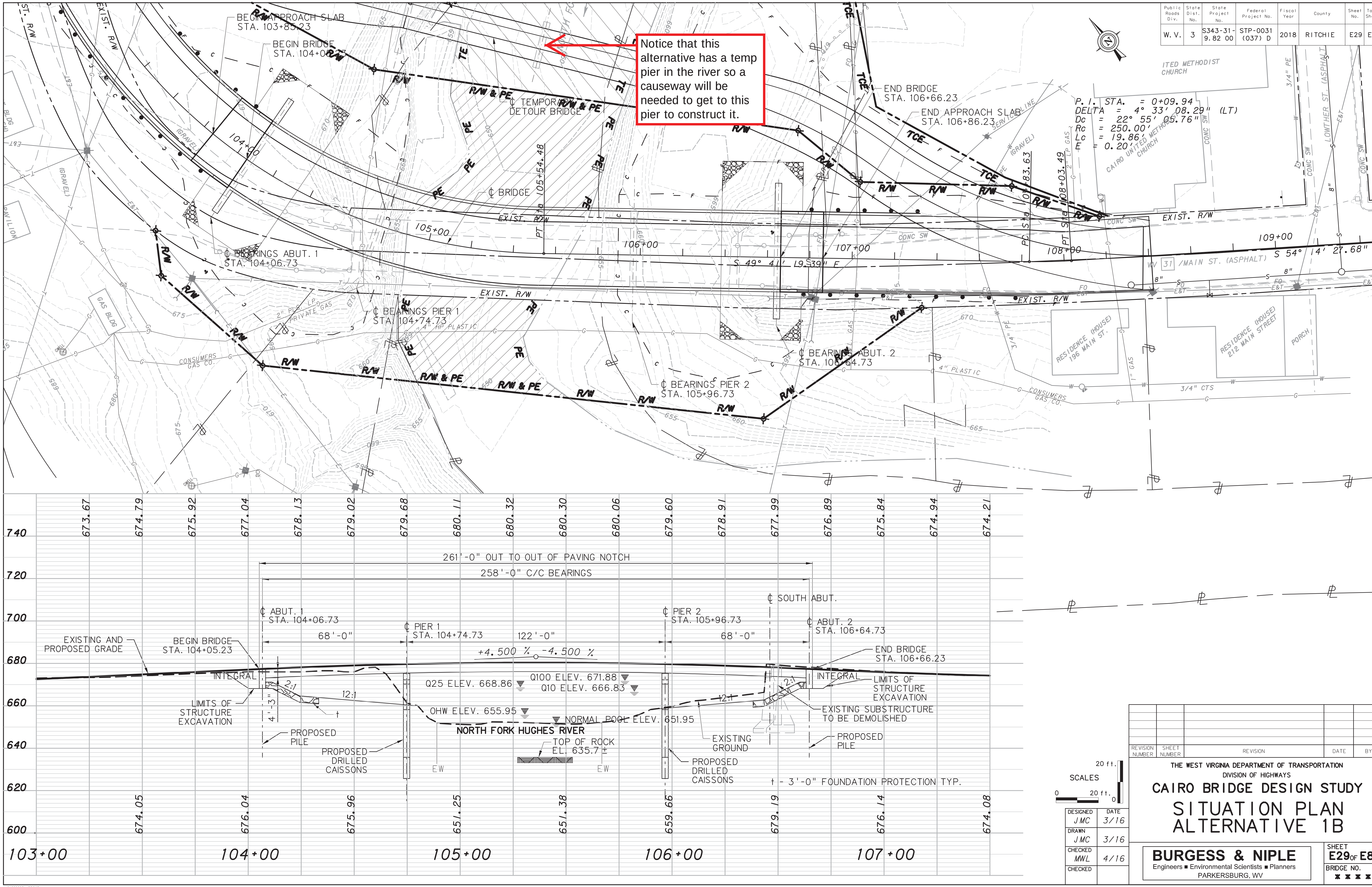
THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

ALTERNATE 1B PROFILE

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W. V.	3	S343-31-9.82 00	STP-0031 (037) D	2018	RITCHIE	E29	E87

Notice that this alternative has a temp pier in the river so a causeway will be needed to get to this pier to construct it.



SCALES 20 ft. 0 20 ft. 0

DESIGNED	DATE
JMC	3/16
DRAWN	
JMC	3/16
CHECKED	
MWL	4/16
CHECKED	

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

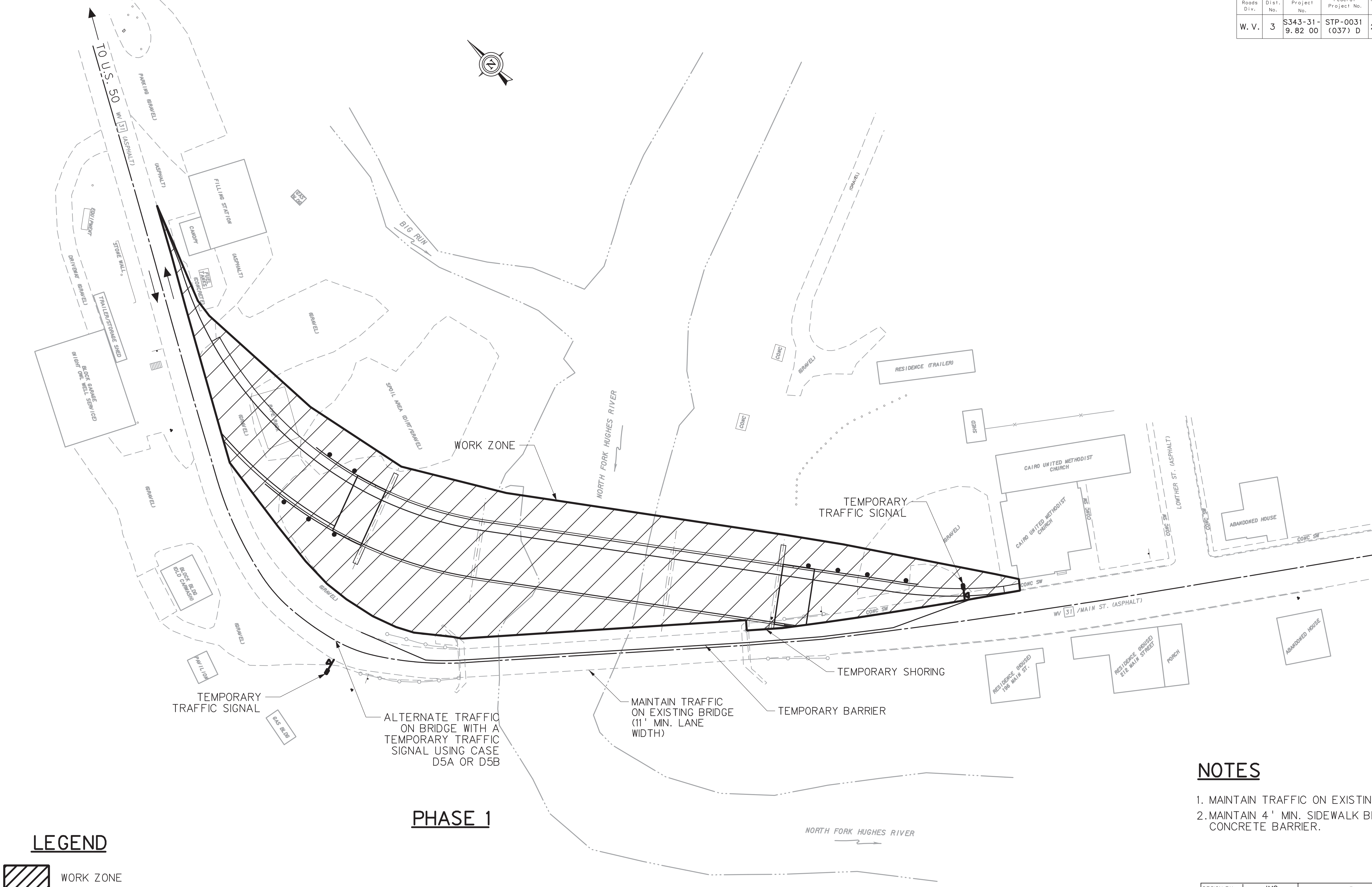
CAIRO BRIDGE DESIGN STUDY

SITUATION PLAN ALTERNATIVE 1B

BURGESS & NIPLE
Engineers ■ Environmental Scientists ■ Planners
PARKERSBURG, WV

SHEET E29 OF E87
BRIDGE NO. ××××

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W. V.	3	S343-31-9.82 00	STP-0031 (037) D	2018	RITCHIE	E41	E87



PHASE 1

LEGEND

WORK ZONE

TRAFFIC FLOW

NOTES

1. MAINTAIN TRAFFIC ON EXISTING WV 31/MAIN ST.
2. MAINTAIN 4' MIN. SIDEWALK BEHIND TEMPORARY CONCRETE BARRIER.

SCALE : 0 30 ft.

DESIGN BY:	JMC
DRAWN BY:	JMC
CHECKED BY:	MML
DATE:	3/16

BURGESS & NIPLE
Engineers ■ Environmental Scientists ■ Planners
PARKERSBURG, WV

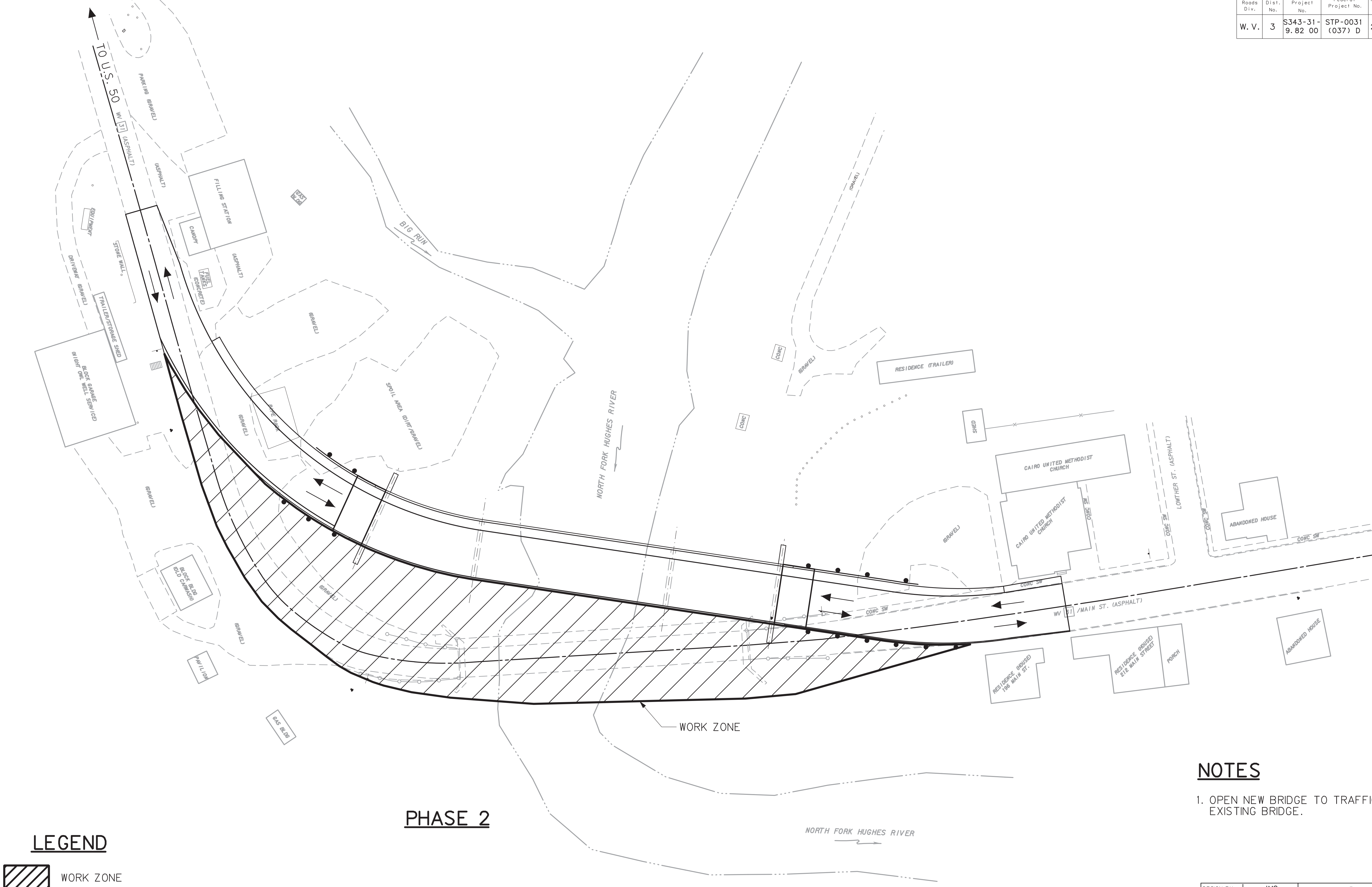
REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

TEMPORARY TRAFFIC CONTROL PLAN
ALTERNATIVE 2 - PHASE 1

J04C23C03-PLAN.e

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W. V.	3	S343-31-9.82 00	STP-0031 (037) D	2018	RITCHIE	E42	E87



PHASE 2

NOTES

1. OPEN NEW BRIDGE TO TRAFFIC AND DEMOLISH EXISTING BRIDGE.

LEGEND

WORK ZONE

TRAFFIC FLOW

SCALE : 0 30 ft.

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

DESIGN BY:	JMC
DRAWN BY:	JMC
CHECKED BY:	MML
DATE:	3/16

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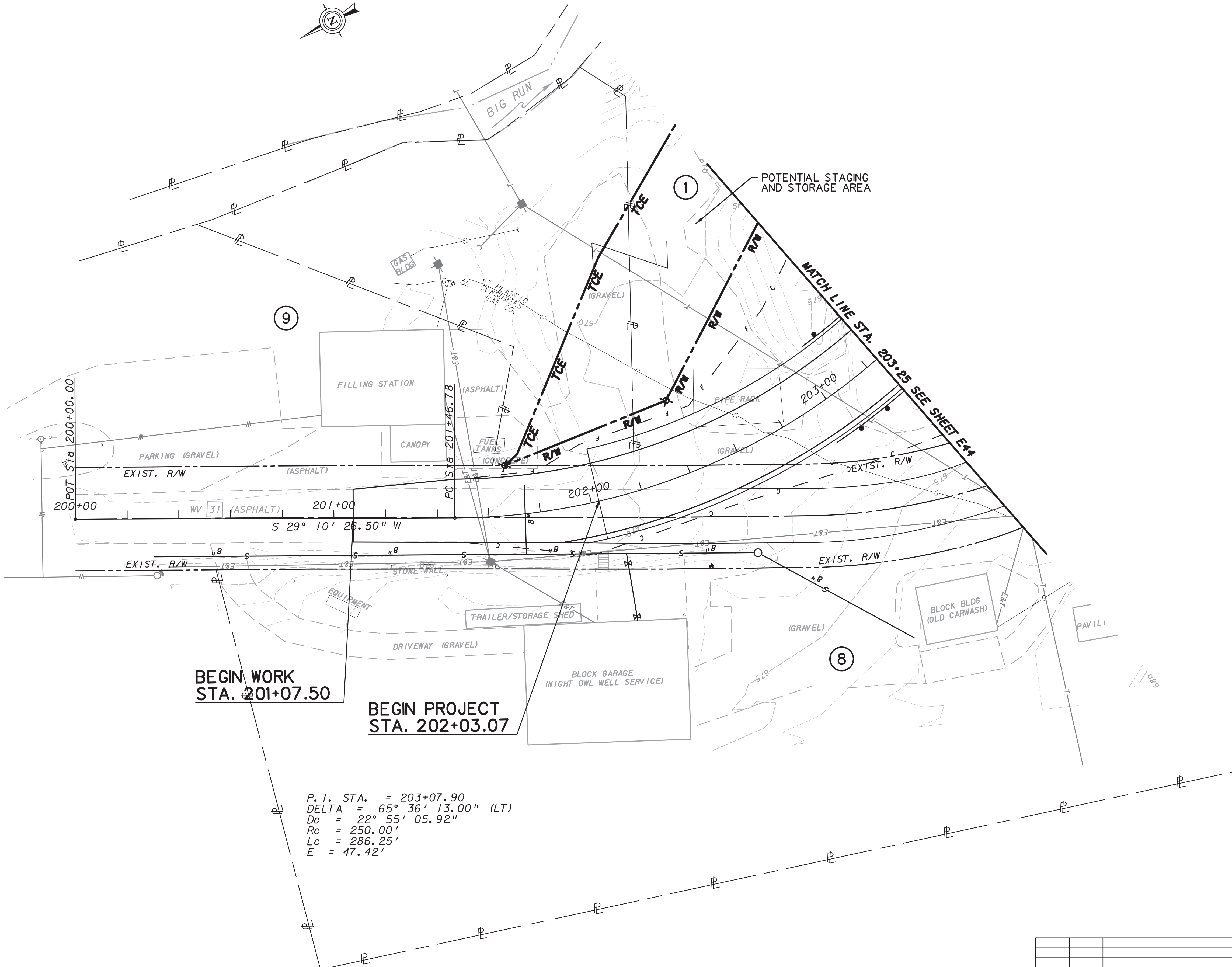
Engineers ■ Environmental Scientists ■ Planners
PARKERSBURG, WV

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

TEMPORARY TRAFFIC CONTROL PLAN
ALTERNATIVE 2 - PHASE 2

J04C23C03-PLAN e

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W. V.	3	S343-31-9.82 00	STP-0031 (037) D	2018	RITCHIE	E43	E87



SCALE : 0 20 ft.

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

DESIGN BY:	JMC
DRAWN BY:	JMB
CHECKED BY:	MWL
DATE:	2/16

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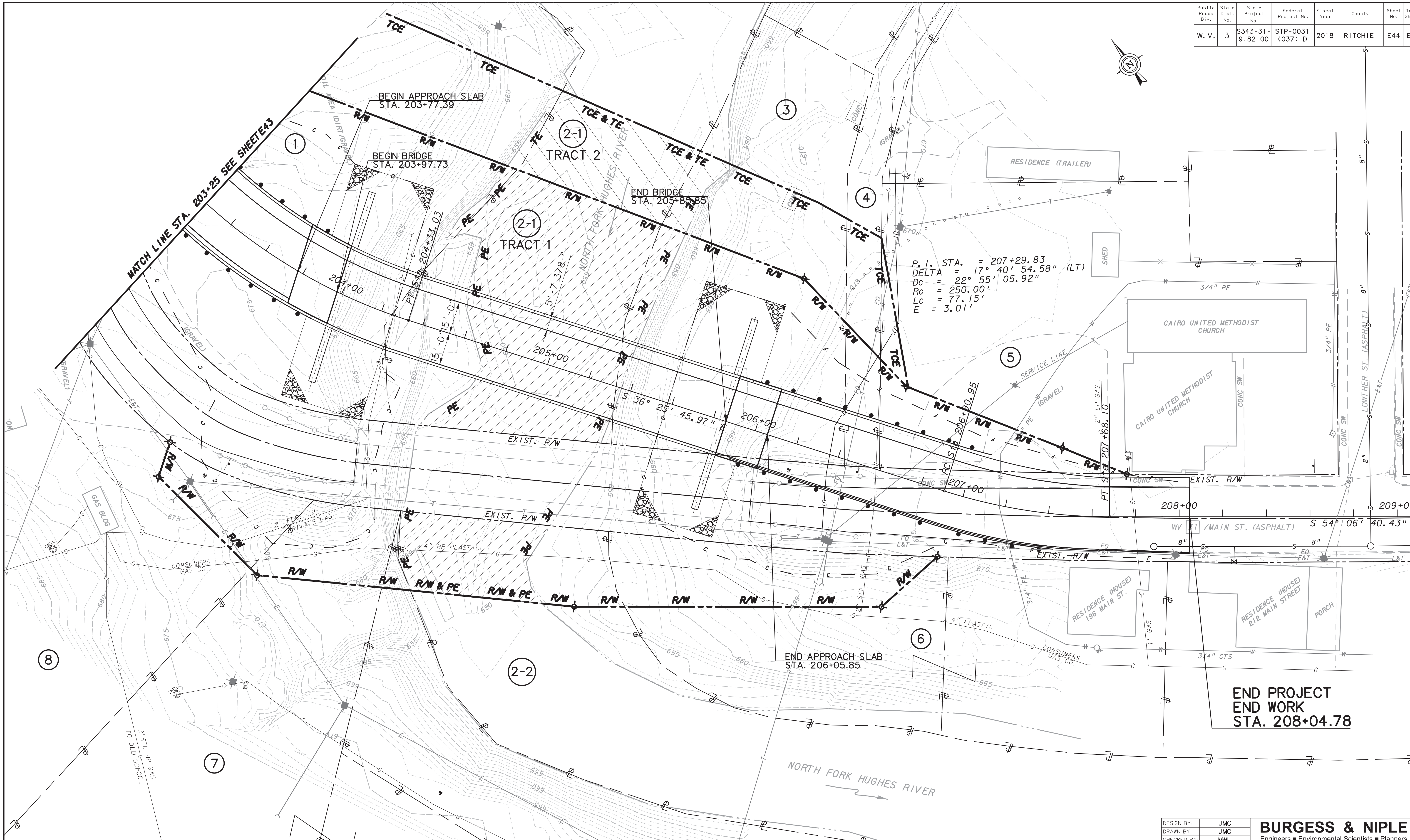
PARKERSBURG, WV

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

PLAN SHEET
ALTERNATIVE 2A

J04C23C03-PLAN.e

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W.V.	3	S343-31-9.82 00	STP-0031 (037) D	2018	RITCHIE	E44	E87



SCALE : 0 20 ft.

DESIGN BY:	JMC
DRAWN BY:	JMC
CHECKED BY:	MWL
DATE:	2/16

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PARKERSBURG, WV

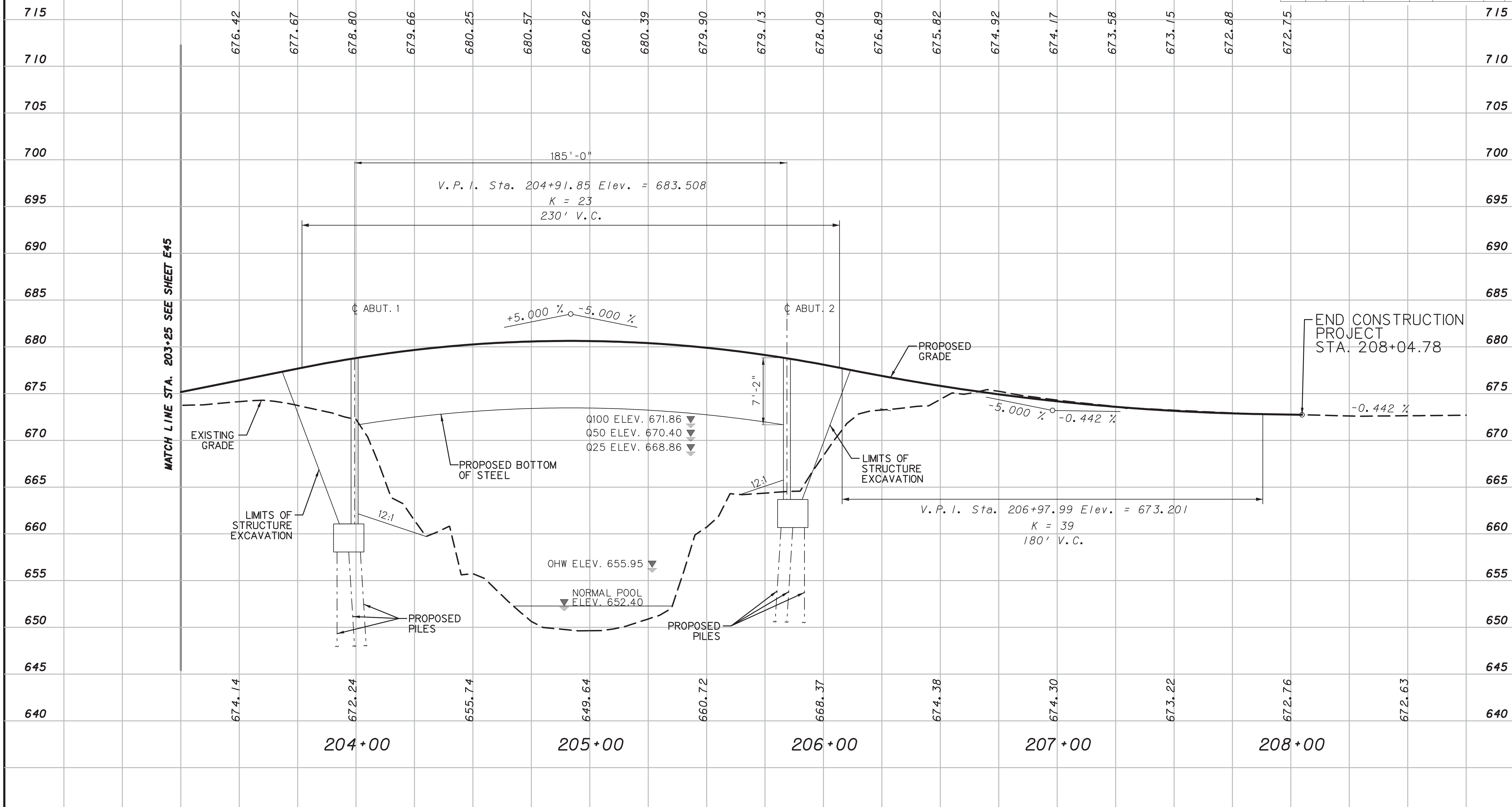
REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

PLAN SHEET
ALTERNATIVE 2A

J04C23C03-PLAN.e

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W. V.	3	S343-31-9.82 00	STP-0031 (037) D	2018	RITCHIE	E46	E87



SCALE : 0 20 ft.

5 ft.
0

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

DESIGN BY:	JMC
DRAWN BY:	JMC
CHECKED BY:	MWL
DATE:	2/16

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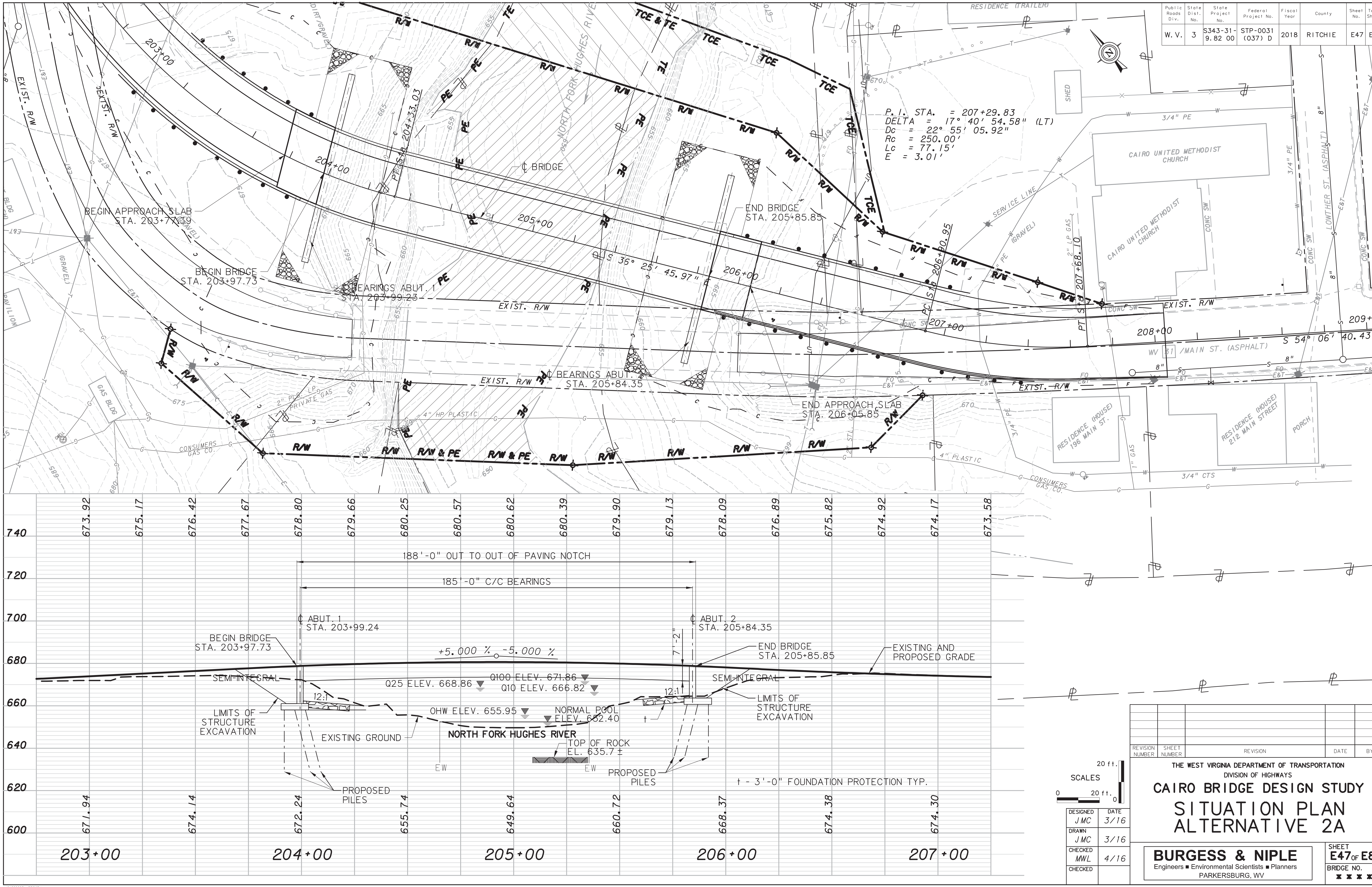
PARKERSBURG, WV

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

ALTERNATE 2A PROFILE

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W. V.	3	S343-31-9.82 00	STP-0031 (037) D	2018	RITCHIE	E47	E87



SCALES 20 ft.

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

CAIRO BRIDGE DESIGN STUDY

SITUATION PLAN ALTERNATIVE 2A

DESIGNED	JMC	3/16
DRAWN	JMC	3/16
CHECKED	MWL	4/16
CHECKED		

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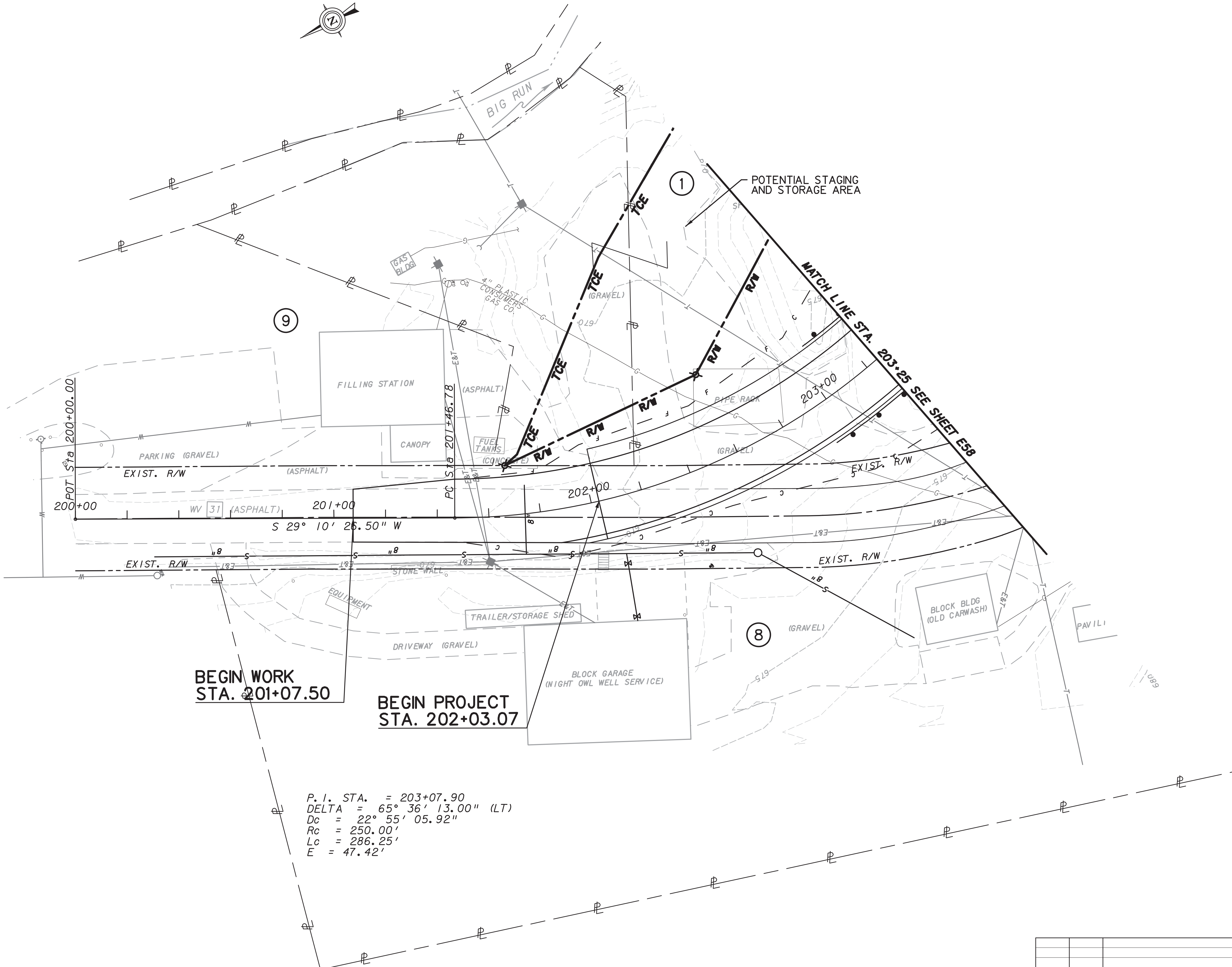
Engineers ■ Environmental Scientists ■ Planners
PARKERSBURG, WV

SHEET E47 OF E87
BRIDGE NO. ✖✖✖✖

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W. V.	3	S343-31-9.82 00	STP-0031 (037) D	2018	RITCHIE	E57	E87



SCALE : 0 20 ft.

DESIGN BY:	JMC
DRAWN BY:	JMB
CHECKED BY:	MWL
DATE:	2/16

BURGESS & NIPLE
Engineers ■ Environmental Scientists ■ Planners
PARKERSBURG, WV

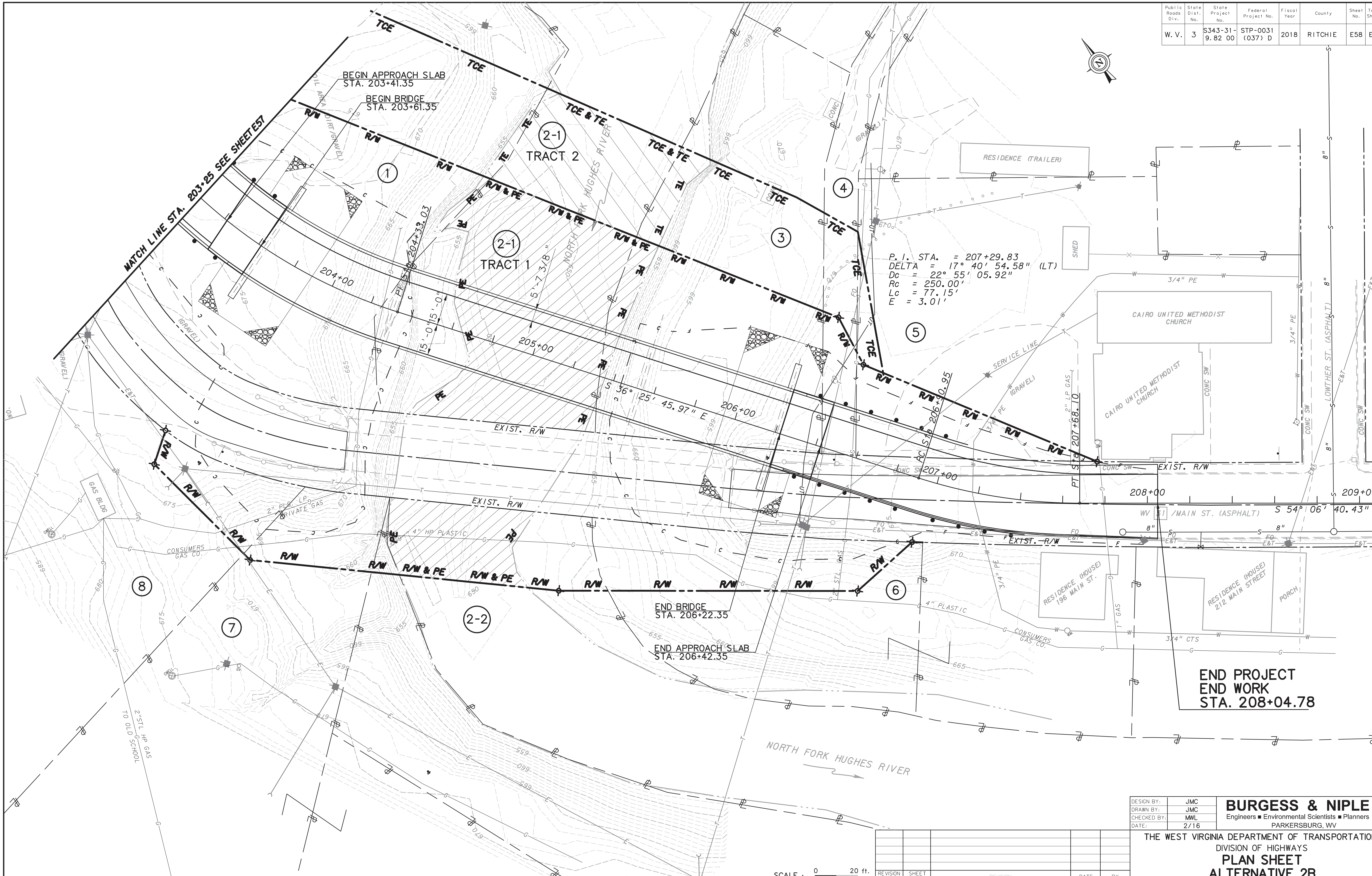
REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

PLAN SHEET
ALTERNATIVE 2B

J04C23C03-PLAN e

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W. V.	3	S343-31-9.82 00	STP-0031 (037) D	2018	RITCHIE	E58	E87



DESIGN BY:	JMC
DRAWN BY:	JMC
CHECKED BY:	MWL
DATE:	2/16

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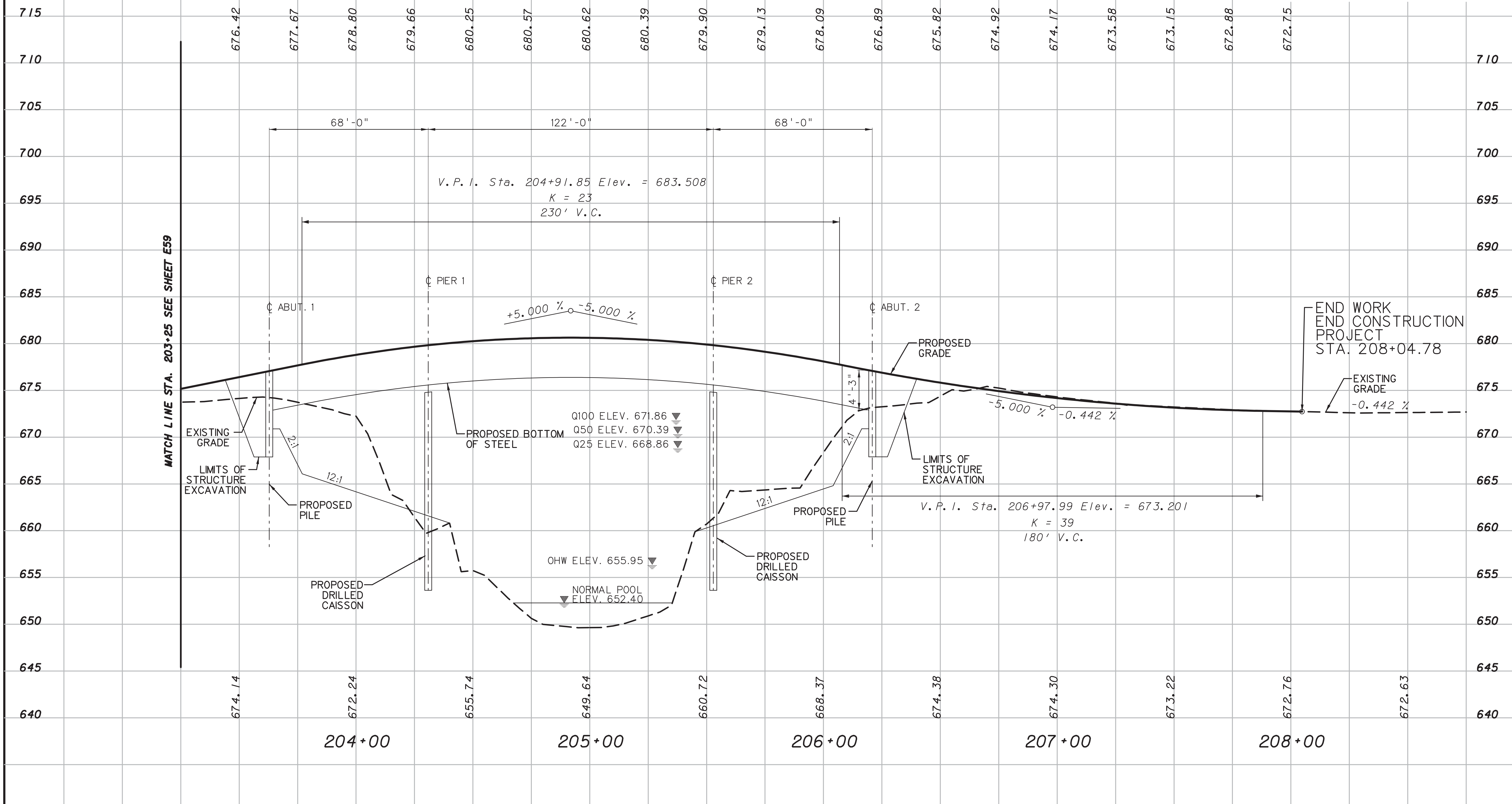
PARKERSBURG, WV

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
PLAN SHEET
ALTERNATIVE 2B

J04C23C03-PLAN.e

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W. V.	3	S343-31-9.82 00	STP-0031 (037) D	2018	RITCHIE	E60	E87



SCALE : 0 20 ft.

5 ft.
0

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

DESIGN BY:	JMC
DRAWN BY:	JMC
CHECKED BY:	MWL
DATE:	2/16

BURGESS & NIPLE

Engineers ■ Environmental Scientists ■ Planners

PARKERSBURG, WV

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION

DIVISION OF HIGHWAYS

ALTERNATE 2B PROFILE

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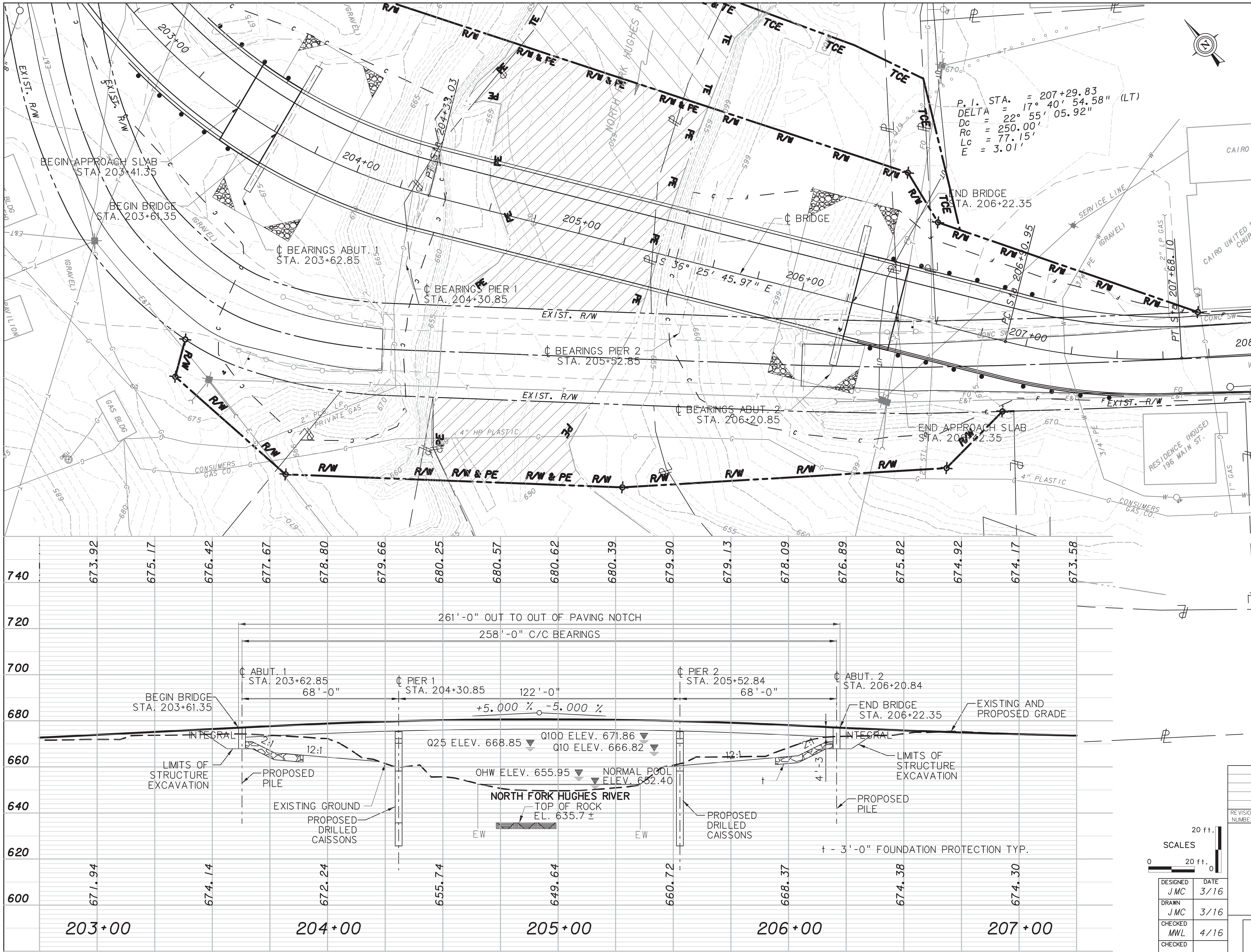
Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W. V.	3	S343-31-9.82 00	STP-0031 (037) D	2018	RITCHIE	E61	E87



SCALES 20 ft. 0 20 ft. 0

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

CAIRO BRIDGE DESIGN STUDY

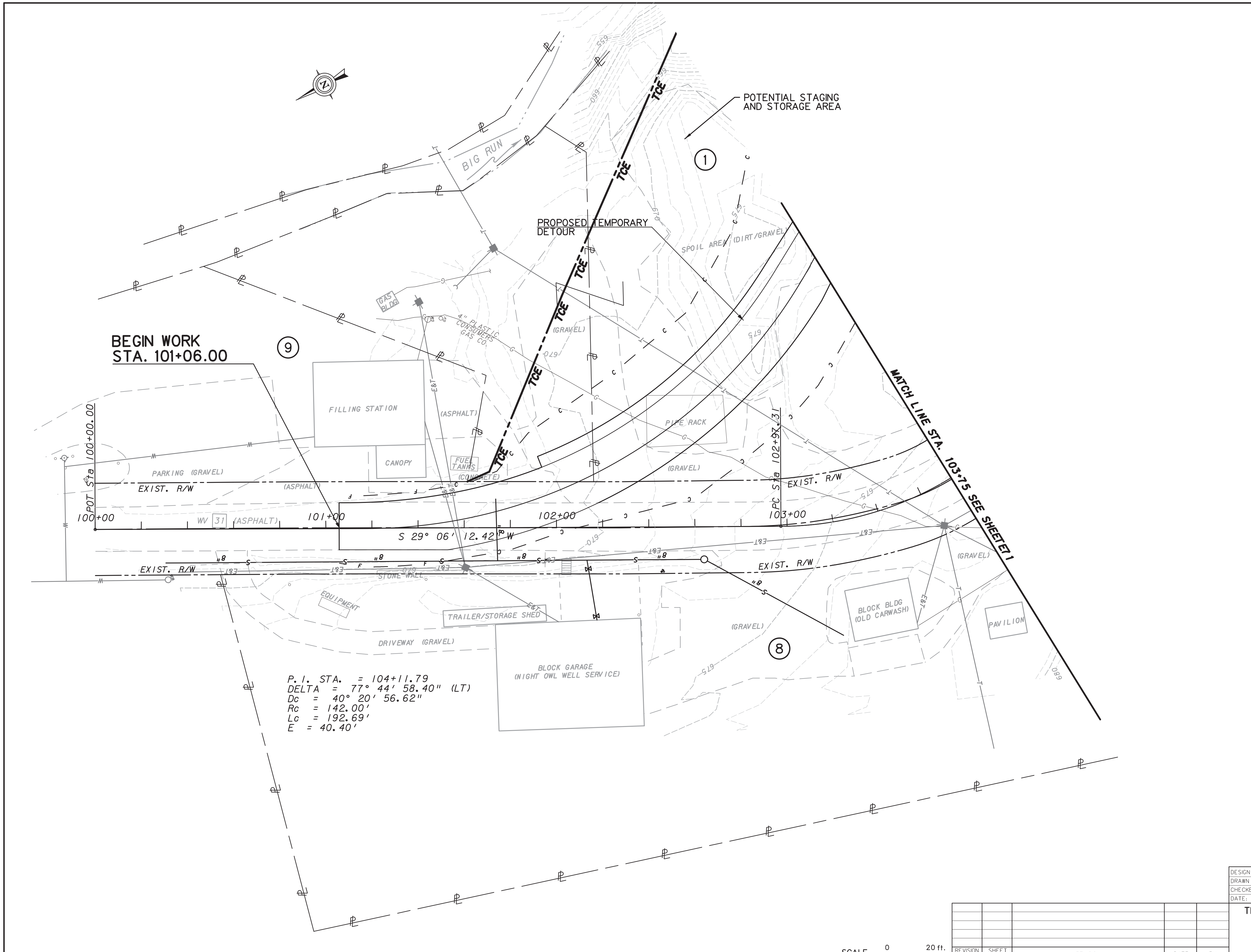
SITUATION PLAN ALTERNATIVE 2B

DESIGNED	JMC	3/16
DRAWN	JMC	3/16
CHECKED	MWL	4/16
CHECKED		

BURGESS & NIPLE
Engineers ■ Environmental Scientists ■ Planners
PARKERSBURG, WV

SHEET E61 OF E87
BRIDGE NO. ＊＊＊＊

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W. V.	3	S343-31-9.82 00	STP-0031 (037) D	2018	RITCHIE	E70	E87



DESIGN BY:	JMC
DRAWN BY:	JMC
CHECKED BY:	MWL
DATE:	2/16

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PARKERSBURG, WV

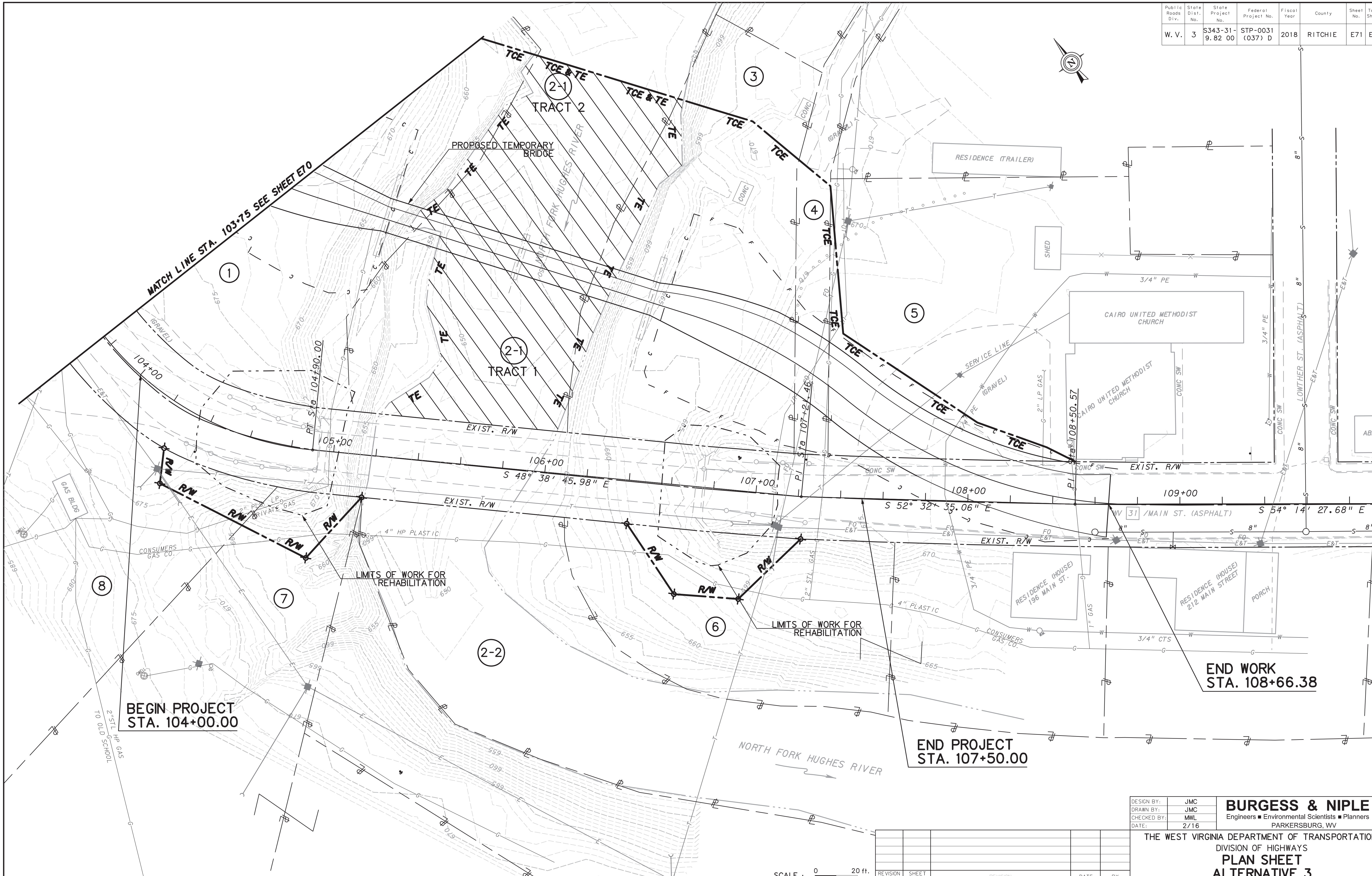
REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

PLAN SHEET
ALTERNATIVE 3

J04C23C03-PLAN.e

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W. V.	3	S343-31-9.82 00	STP-0031 (037) D	2018	RITCHIE	E71	E87



DESIGN BY:	JMC
DRAWN BY:	JMC
CHECKED BY:	MML
DATE:	2/16

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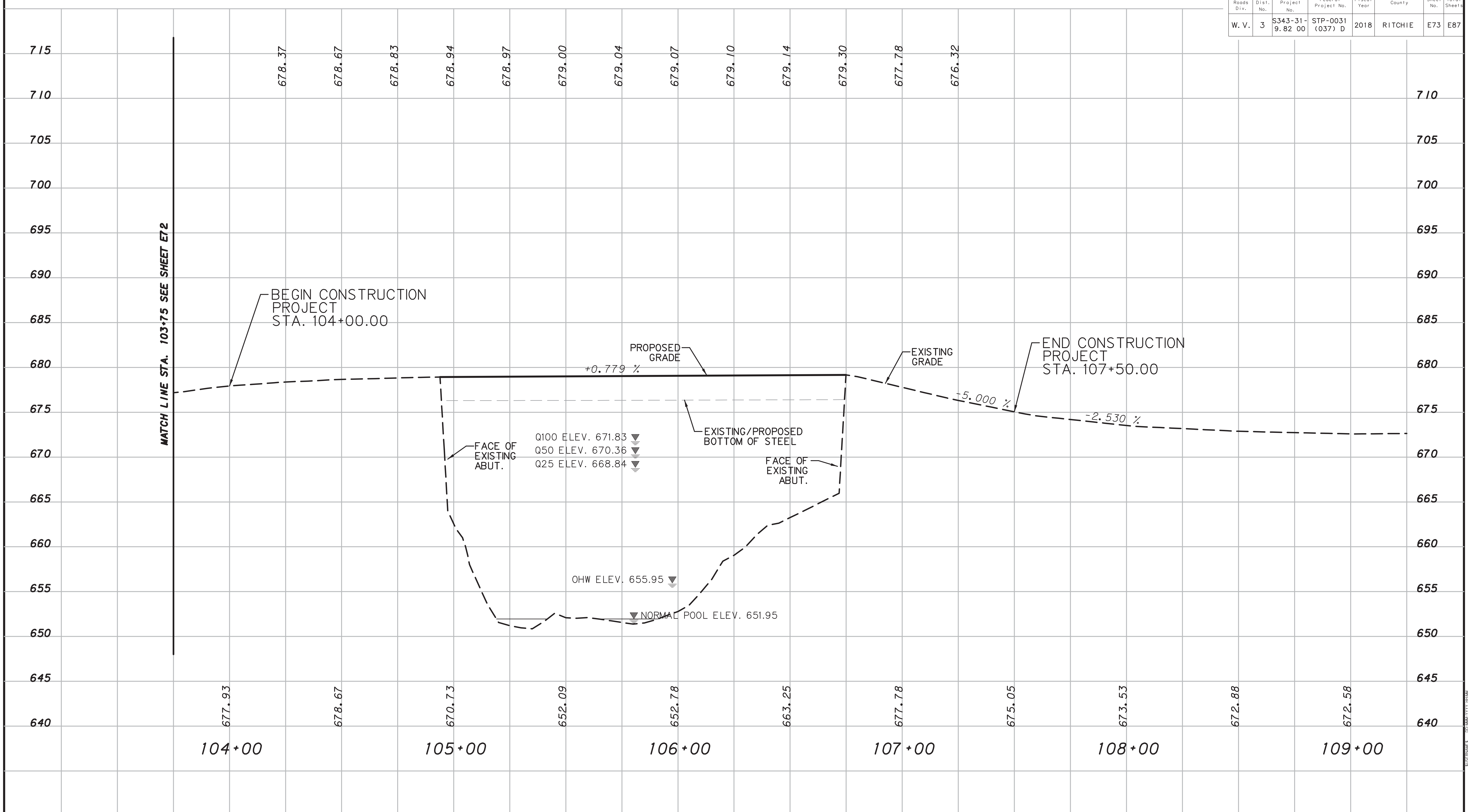
PARKERSBURG, WV

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
PLAN SHEET
ALTERNATIVE 3

J04C23C03-PLAN.e

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W. V.	3	S343-31-9.82 00	STP-0031 (037) D	2018	RITCHIE	E73	E87



SCALE : 0 20 ft.

5 ft. 0

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

DESIGN BY:	JMC
DRAWN BY:	JMC
CHECKED BY:	MWL
DATE:	2/16

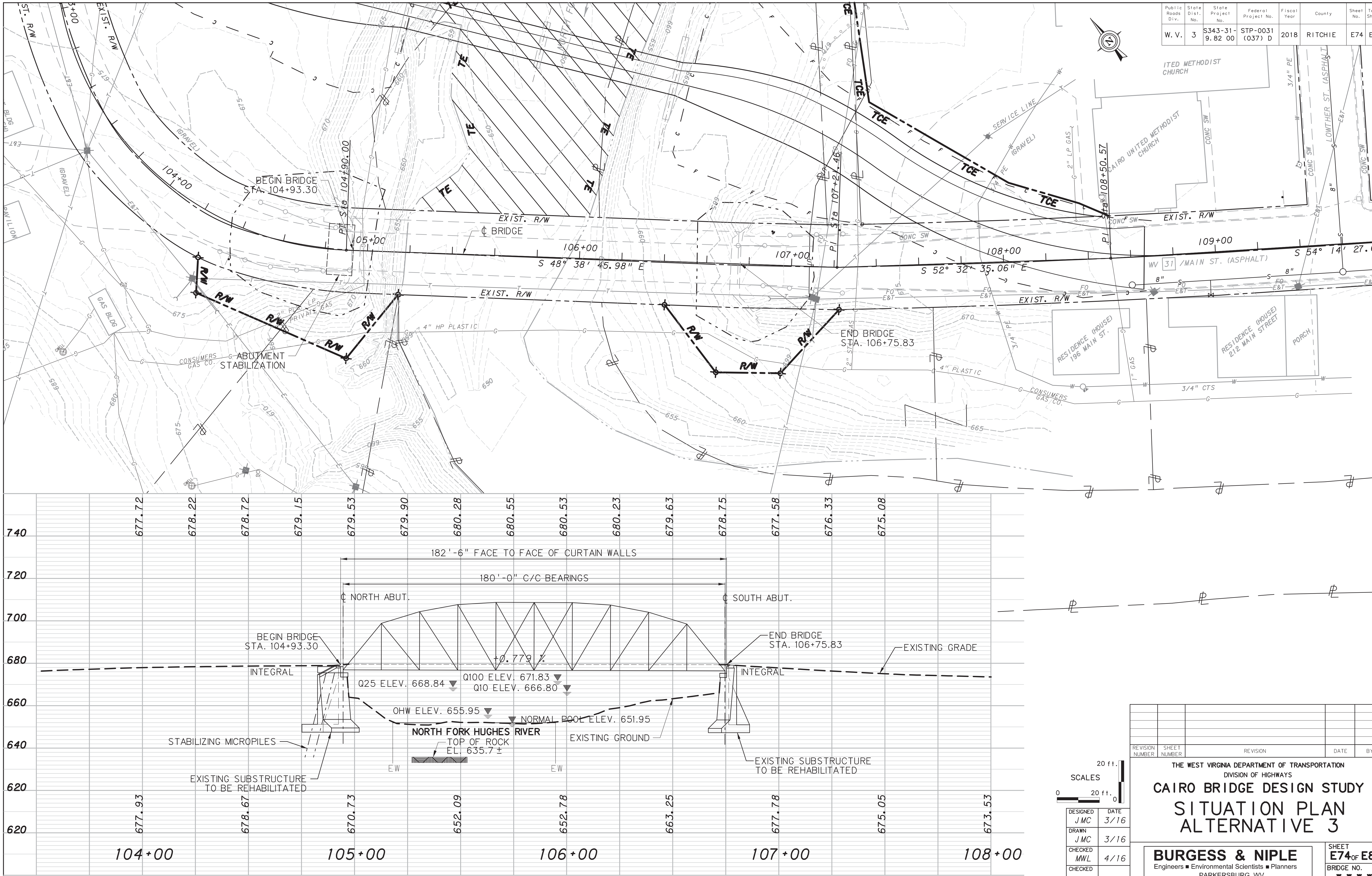
BURGESS & NIPLE
Engineers ■ Environmental Scientists ■ Planners
PARKERSBURG, WV

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

ALTERNATE 3 PROFILE (EXISTING)

J04C30C03-PROFILE

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W. V.	3	S343-31-9.82 00	STP-0031 (037) D	2018	RITCHIE	E74	E87



REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

SCALES
20 ft.
0 20 ft.

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

CAIRO BRIDGE DESIGN STUDY

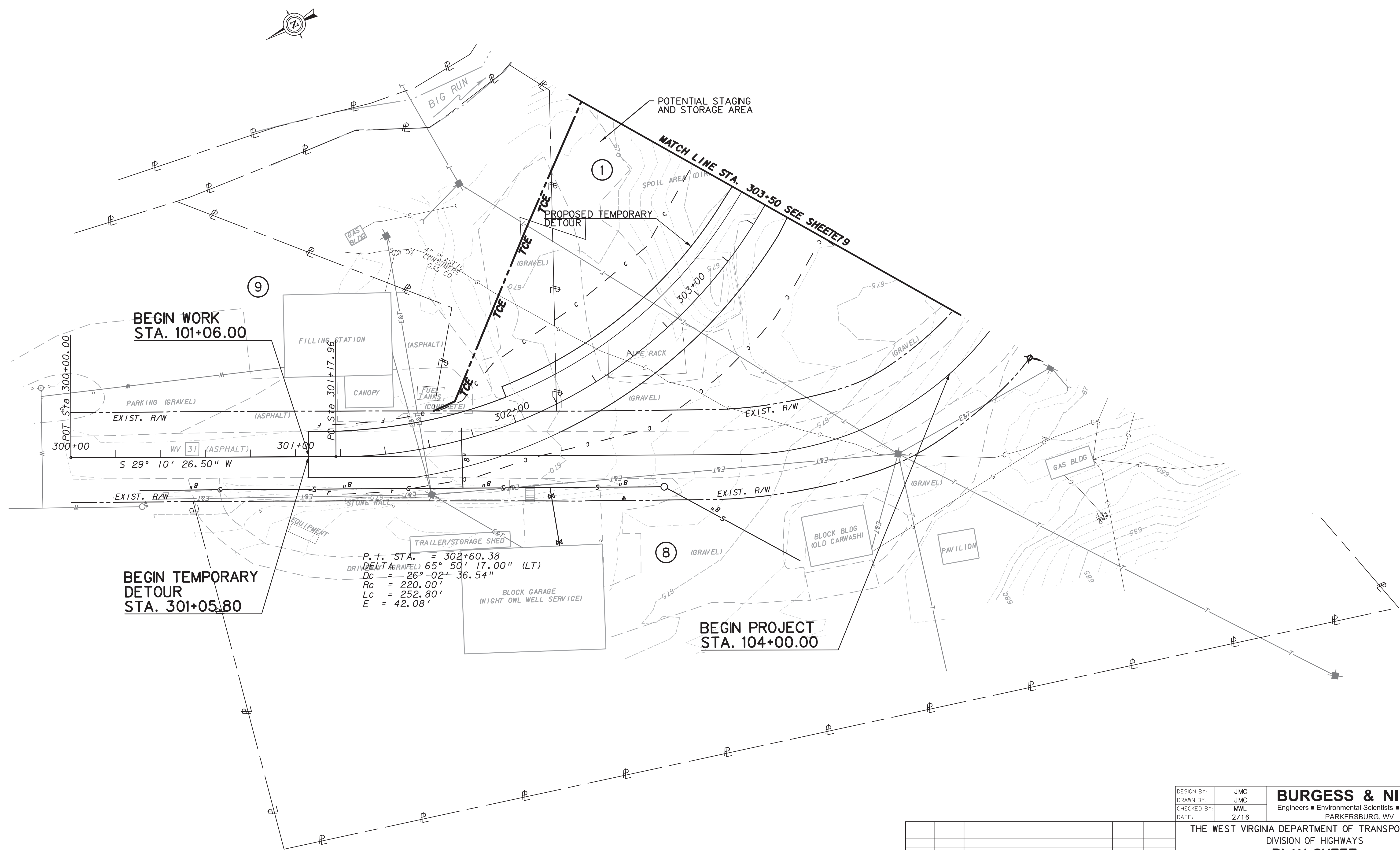
SITUATION PLAN ALTERNATIVE 3

DESIGNED	JMC	3/16
DRAWN	JMC	3/16
CHECKED	MWL	4/16
CHECKED		

BURGESS & NIPLE
Engineers ■ Environmental Scientists ■ Planners
PARKERSBURG, WV

SHEET E74 OF E87
BRIDGE NO. ✱✱✱✱

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W. V.	3	S343-31-9.82 00	STP-0031 (037) D	2018	RITCHIE	E78	E87



SCALE : 0 20 ft.

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

DESIGN BY:	JMC
DRAWN BY:	JMC
CHECKED BY:	MWL
DATE:	2/16

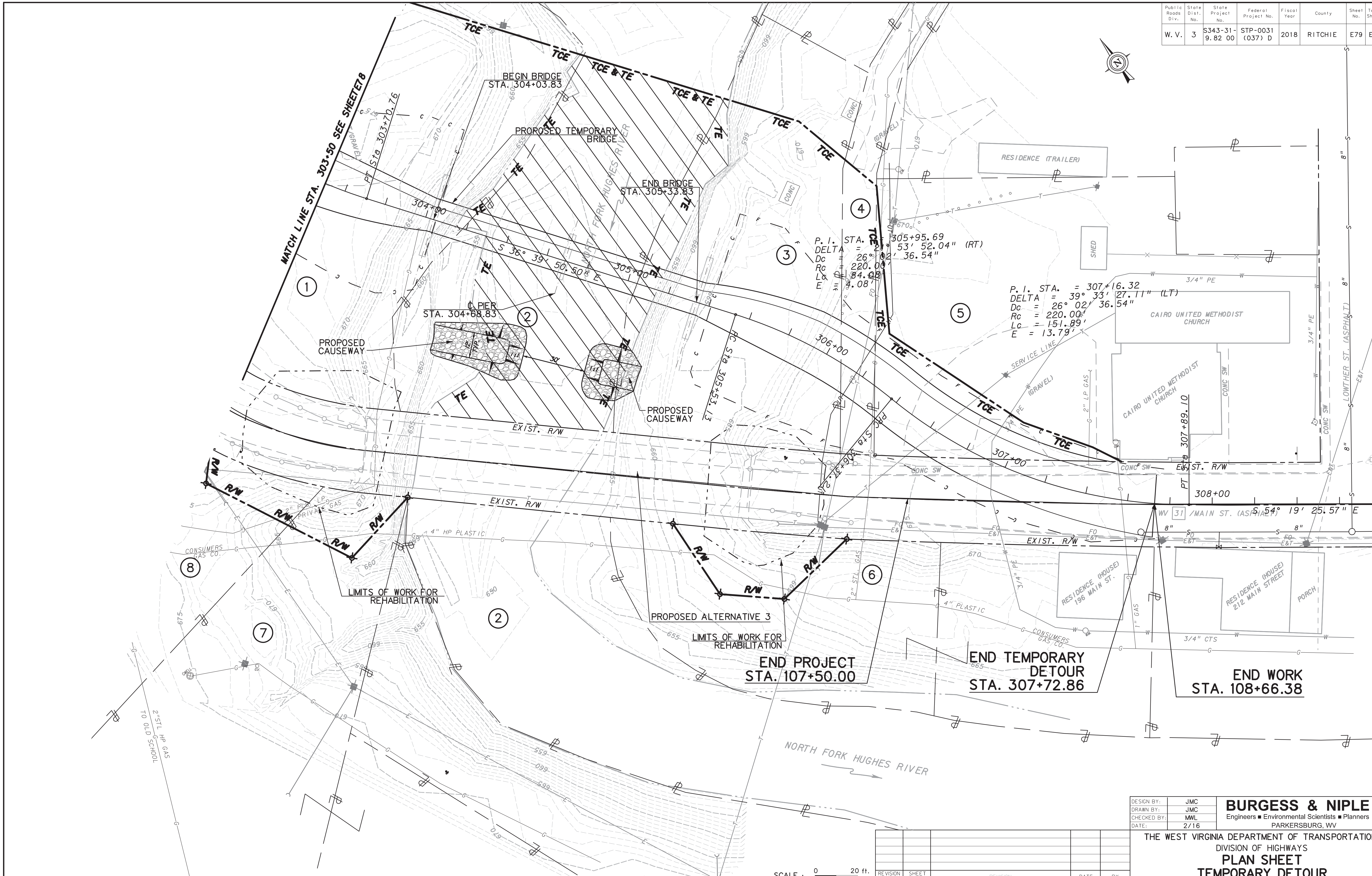
BURGESS & NIPLE
Engineers ■ Environmental Scientists ■ Planners
PARKERSBURG, WV

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

PLAN SHEET
TEMPORARY DETOUR

J04C23C03-PLAN e

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W. V.	3	S343-31-9.82 00	STP-0031 (037) D	2018	RITCHIE	E79	E87



SCALE : 0 20 ft.

DESIGN BY:	JMC
DRAWN BY:	JMC
CHECKED BY:	MML
DATE:	2/16

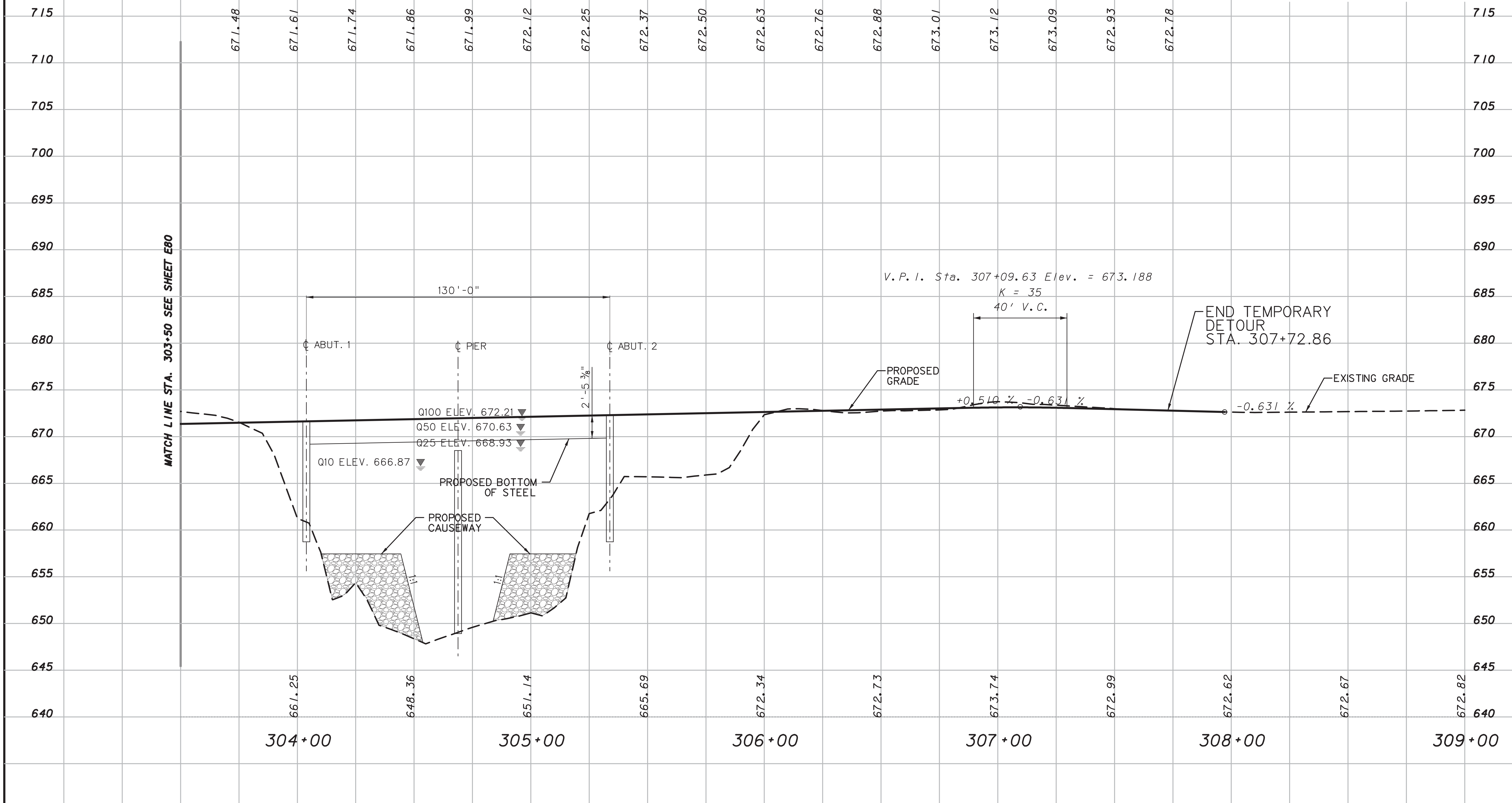
BURGESS & NIPLE
Engineers ■ Environmental Scientists ■ Planners
PARKERSBURG, WV

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
PLAN SHEET
TEMPORARY DETOUR

J04C23C03-PLAN.e

Public Roads Div.	State Dist. No.	State Project No.	Federal Project No.	Fiscal Year	County	Sheet No.	Total Sheets
W. V.	3	S343-31-9.82 00	STP-0031 (037) D	2018	RITCHIE	E81	E87



SCALE : 0 20 ft.
5 ft. 0

REVISION NUMBER	SHEET NUMBER	REVISION	DATE	BY

DESIGN BY:	JMC
DRAWN BY:	JMC
CHECKED BY:	MWL
DATE:	3/16

BURGESS & NIPLE
Engineers ■ Environmental Scientists ■ Planners
PARKERSBURG, WV

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

ALTERNATES 1 & 3 PROFILE
TEMPORARY DETOUR BRIDGE

J04C30C03-PROFILE.c

Appendix B. Unionid survey effort at Cairo Bridge, North Fork Hughes River, August 2015.

Appendix B. Unionid survey effort at Cairo Bridge, North Fork Hughes River, August 2015.

Area[1]	Semi-quantitative Cells No.	Semi-quantitative Cells Area (m^2)	Semi-quantitative Cells Total (m^2)	Quantitative No.	Quantitative Area (m^2)
US Buffer	9	60 - 100	900	-	-
ADI	25	40 - 100	2080	18	4.5
DS Buffer	17	60 - 80	1370	-	-
Total	51	40 - 100	4350	18	4.5

[1]US=Upstream, ADI=Area of direct impact, DS=Downstream

United States Department of the Interior

FISH AND WILDLIFE SERVICE
West Virginia Field Office
694 Beverly Pike
Elkins, West Virginia 26241

June 15, 2017

Mr. Jason Workman
Federal Highway Administration
700 Washington Street, East
Charleston, West Virginia 25301

Re: West Virginia Division of Highways, Cairo Bridge Replacement and Demolition Project, Ritchie County, West Virginia (FWS File #2016-F-0137)

Dear Mr. Workman:

This letter acknowledges the U.S. Fish and Wildlife Service's (Service) receipt of your May 22, 2017, package providing information needed to initiate formal section 7 consultation under the Endangered Species Act (ESA) (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*) for the proposed replacement and demolition of Cairo Bridge over the North Fork Hughes River in Ritchie County, West Virginia. Formal consultation was requested for one federally endangered species, the snuffbox mussel (*Epioblasma triquetra*).

Formal consultation is initiated on the date that the Service receives a federal agency's initiation request and all relevant data has been provided to the action agency pursuant to section 7 of the ESA. Section 7 allows the Service up to 90 days to conclude formal consultation with your agency and an additional 45 days to prepare our Biological Opinion (BO), unless we mutually agree to an extension. While additional coordination may be required to address specific project details, the Service has received all the information required to initiate consultation. Therefore, based on an initiation date of May 22, 2017, we expect to provide you with our BO on or before October 4, 2017.

The Service will continue to coordinate with your office throughout the formal consultation process, and appreciates the cooperative efforts that you and your staff have provided to address these issues. If you have any questions regarding this letter, please contact Ms. Liz Stout of my staff at (304) 636-6586, Ext. 15, or at the letterhead address.

Sincerely,

John E. Schmidt
Field Supervisor

U.S. Department
of Transportation
Federal Highway
Administration

West Virginia Division

154 Court Street
Charleston, West Virginia 25301
Phone (304) 347-5928
Fax (304) 347-5103

October 3, 2017

IN REPLY REFER TO:
Federal Project STP-0031(037)D
State Project S343-31-9.82 00
Cairo Bridge Replacement
Ritchie County
Section 7 – Biological Opinion

John Schmidt
Field Supervisor
U.S. Fish and Wildlife Service
West Virginia Field Office
694 Beverly Pike
Elkins, West Virginia 26241

Dear Mr. Schmidt:

The Federal Highway Administration (FHWA), in cooperation with the West Virginia Division of Highways, has completed review of the final biological opinion (BO), transmitted by email on September 28, 2017, for the above referenced project. We have no further comments on the document and agree to implement the reasonable and prudent measures.

To conclude Section 7 consultation on this project, FHWA requests that the U.S. Fish and Wildlife confirm our acceptance of the final BO. If you have any questions concerning this matter, please contact Alison Rogers at (304) 347-5436 or via email at alison.rogers@dot.gov.

Sincerely yours,

Jason E. Workman
Director, Program Development

U.S. Department
of Transportation
**Federal Highway
Administration**

West Virginia Division

154 Court Street
Charleston, West Virginia 25301
Phone (304) 347-5928
Fax (304) 347-5103

October 3, 2017

IN REPLY REFER TO:
Federal Project STP-0031(037)D
State Project S343-31-9.82 00
Cairo Bridge Replacement
Ritchie County
Section 7 – Biological Opinion

R.J. Scites, P.E.
Director, Engineering Division
West Virginia Division of Highways
Charleston, West Virginia 25305

Dear Mr. Scites:

Please find enclosed a copy of the U. S. Fish and Wildlife Services' Final Biological Opinion (BO) for the above referenced project. Our acceptance of the BO concludes the Endangered Species Act (ESA) Section 7 Formal Consultation process. Should you have any questions regarding the enclosed information, please contact me at (304) 347-5436 or via email at alison.rogers@dot.gov.

Sincerely yours,

Jason Workman
Director, Program Development

United States Department of the Interior

FISH AND WILDLIFE SERVICE

West Virginia Field Office
694 Beverly Pike
Elkins, West Virginia 26241

September 28, 2017

Mr. Jason Workman
Federal Highway Administration
700 Washington Street, East
Charleston, West Virginia 25301

Re: West Virginia Division of Highways, Cairo Bridge Replacement Project, Ritchie County, West Virginia

Dear Mr. Workman:

The U.S. Fish and Wildlife Service (Service) has reviewed the Federal Highway Administration (FHWA) and West Virginia Division of Highways (WVDOH) project plans and Biological Assessment (BA) for the proposed Cairo Bridge replacement project located in Ritchie County, West Virginia. This bridge crosses the North Fork Hughes River which is known to contain the federally endangered snuffbox mussel (*Epioblasma triquetra*). Your letter, dated May 22, 2017, requested we initiate formal consultation pursuant to section 7 of the Endangered Species Act (ESA; 87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*). The Service concurs with your determination that proposed activity may affect and is likely to adversely affect the snuffbox. This document represents the Service's biological opinion (BO) on the effects of the proposed action on this species.

CONSULTATION HISTORY

Service biologists met with representatives from FHWA, WVDOH, West Virginia Division of Natural Resources (WVDNR), and Ecological Specialists, Inc. (ESI) numerous times either in person or by phone to discuss project design plans, mussel survey results, project alternatives, and the consultation planning process. The BA for the proposed action was received on May 22, 2017. Additional key events in the consultation history are as follows:

Date	Reviewers	Description
08/13-14/2015	ESI	Mussel and habitat survey of the project area was completed by ESI
11/03/2015	Service, WVDNR, WVDOH, FHWA, ESI	Meeting to discuss mussel survey results
02/22/2017	Service, WVDNR, WVDOH, ESI	Meeting to discuss the draft BA
06/15/2017	Service	Formal consultation initiated

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The purpose of this project is to replace the existing Cairo Bridge over the North Fork Hughes River with a new bridge that meets current design standards to effectively serve the transportation needs of tourists, residents, industry, and emergency vehicles. The existing bridge is structurally deficient, does not meet current design standards, and is at the end of its useful life. Closure of the existing bridge without constructing a replacement would result in a 45 km (28 mile) detour, burdening commercial, industrial, and residential traffic. Therefore, the objective of this project is to construct a new bridge that meets current condition, rating, and design standards that will minimize disturbance to mussels, mussel habitat, and the riparian zone.

Due to the rapid deterioration of the current structure, the preferred alternative (Alternative 1B) is to construct a temporary bridge 35 meters upstream for traffic to utilize and construct a new bridge on the existing bridge alignment. This construction option would offer a new crossing of the North Fork Hughes River that meets traffic requirements. The project will require a Nationwide Permit 3 from the U.S. Army Corps of Engineers

CONSTRUCTION PLANS

The proposed bridge project over the North Fork Hughes River is located on WV Route 31 in Ritchie County, West Virginia. The North Fork Hughes River is a 55-mile tributary of the Hughes River which flows into the Little Kanawha River which then flows into the Ohio River. The location of the proposed action is shown in Figure 1.

Figure 1. Cairo Bridge replacement project action area

The WVDOH proposes to replace the Cairo Bridge with a new three-span structure on the existing alignment. A temporary two-span bridge 35 meters upstream will service traffic while the old bridge is demolished and the new bridge is constructed.

Construction will consist of five phases, is anticipated to begin on July 1, 2018, and will be completed in two construction seasons over 422 days. Phase 1 will include the construction of a single temporary in-stream causeway extending from the south bank to the location of the temporary bridge pier upstream of the existing bridge. It is assumed the temporary pier will be constructed of driven steel piles and will not require a cofferdam. The causeway will be used to install the pier and to position the crane during erection of the temporary bridge girders. Once the temporary bridge is erected, this causeway will be removed. Included in Phase 1 is the implementation of temporary traffic control measures, installation of erosion and sediment controls, relocation of utilities s, installation of construction entrances, and installation of the temporary detour bridge and roadway. Phase 1 is anticipated to last 55 calendar days.

Phase 2 will include the installation of a pair in-stream temporary causeways extending from both banks just upstream of the existing bridge. The center of the channel will remain open. Then the existing bridge will be demolished by setting charges along critical locations. In-stream cleanup of the fallen debris will be accessed from the causeway and no equipment will enter the stream. These causeways will remain in place after the bridge demolition to be used for crane placement during erection of the proposed bridge girders in Phase 3. Phase 2 is anticipated to last 25 days.

Phase 3 will include the construction of the proposed bridge on the same alignment as the existing bridge. Two piers and abutments will be constructed out of the ordinary high water and no cofferdams are anticipated. Structural girders will be set on the bridge abutments and piers and steel decking will be installed. The causeways installed during Phase II will be in place for the 282 days required to complete Phase 3 through the fish spawning season as defined by the WVDNR (April 1 – June 30). Phase 3 is anticipated to last 282 days.

Phase 4 will begin once the fish spawning season ends. The remaining portions of the causeway will be removed and concrete decking and rails, approach structures, and guard rails will be installed. Phase 4 is anticipated to last 45 days.

Phase 5 will begin after the new bridge is open to traffic. A temporary causeway from the south bank to the location of the temporary bridge pier (installed during Phase 1) will be reconstructed. The temporary bridge will be removed with cranes working from the causeway. Once the bridge is removed, the causeway will be removed, concluding in-stream work on this project. Phase 5 is anticipated to last 25 days.

Conservation Measures
Conservation measures are those actions taken to benefit or promote the recovery of the species and that are included as an integral portion of the proposed action. These actions will be taken by the Federal agency or the applicant and serve to minimize or compensate for project effects on the species under review. The FHWA and WVDOH have committed to completing the following conservation measures, as more fully detailed on pages 6 – 9 of the BA:

1. All piers for the new bridge will be constructed outside of the stream channel above ordinary high water and all drainage from the bridge will be filtered through grassy swales before entering the North Fork Hughes River.
2. Temporary rock causeways will be installed outside of the fish spawning season and will leave the center of the channel open to allow for fish passage for the duration of the project.
3. Staging areas for equipment where fueling and vehicle maintenance will take place will be located away from streams to avoid impacts to riparian areas and receiving waters. All potential toxic substances will be stored within these staging areas as will all accumulated debris and construction waste.
4. Prior construction, the project impact area will be rigorously searched for both listed and non-listed freshwater mussels per the mussel salvage plan as described in the BA, and all freshwater mussels will be relocated from the areas of impact to the salvage area. A temporary causeway will need to be re-constructed to remove the temporary bridge pier during the final phase of the project (days 397 – 422), and since more than one year will have passed since the original relocation effort, a second relocation effort from the footprint of the causeway will be conducted prior to causeway re-construction.
5. Post-construction monitoring at the project location will include habitat and depth monitoring one year, three years, and five years following construction.
6. In-stream work will be conducted outside of the fish spawning season, which overlaps with the breeding season for snuffbox mussels.
7. The existing bridge will be demolished and removed during a period of low water (August, September, October) to minimize siltation and sedimentation of mussel habitat.
8. Controlled demolition techniques will be used to limit scattering of bridge debris when the existing structure is removed.
9. Immediately after earth disturbance activities cease, disturbed areas will be stabilized by planting 450 willow stems per acre and native seeding. Non-native seeding such as winter wheat may also be used.
10. A Service-approved Erosion and Sediment Pollution Control Plan will be utilized. This plan will be provided to the Service for review and approval prior to any ground disturbing activities.
11. Because the temporary rock causeways will be in place through the 422 day duration of the project they may be subjected to chronic and/or acute high water events. Therefore, there is a slight risk of a causeway 'wash-out'. A causeway 'wash-out' contingency plan will be included in a Service-approved Erosion and Sediment Pollution Control Plan.

Alternatives Evaluated
The WVDOH and FHWA considered five build options and a no-build option in order to fulfill the project purpose and objectives an avoid and minimize impacts to freshwater mussels. The five build options included:

1. demolition of existing bridge, and construction of a new single-span bridge on the existing alignment (Alternative 1A),
2. demolition of existing bridge, and construction of a new three-span bridge on the existing alignment (Alternative 1B),

3. demolition of existing bridge, and construction of a new single-span bridge on a new alignment upstream of existing alignment (Alternative 2A),
4. demolition of existing bridge, and construction of new three-span bridge on a new alignment upstream of existing alignment (Alternative 2B), and
5. rehabilitation of existing bridge using an upstream temporary detour bridge (Alternative 3).

Alternatives 1A, 1B and 3 would require a 36.9-meter two-span temporary bridge 35 meters upstream of the existing bridge to maintain traffic during demolition of the existing span and construction of the new span. Traffic would be maintained on the existing structure during construction of the new span for Alternatives 2A and 2B. Demolition of the existing bridge would be similar across all alternatives: the truss would be cut with explosives and lifted out of the river. Explosives or jackhammers would remove the existing piers. Machinery would be used to lift and remove concrete and other debris from the river. Demolition and debris removal is expected to take approximately 25 days. Figure 2 shows the location of the examined alternatives.

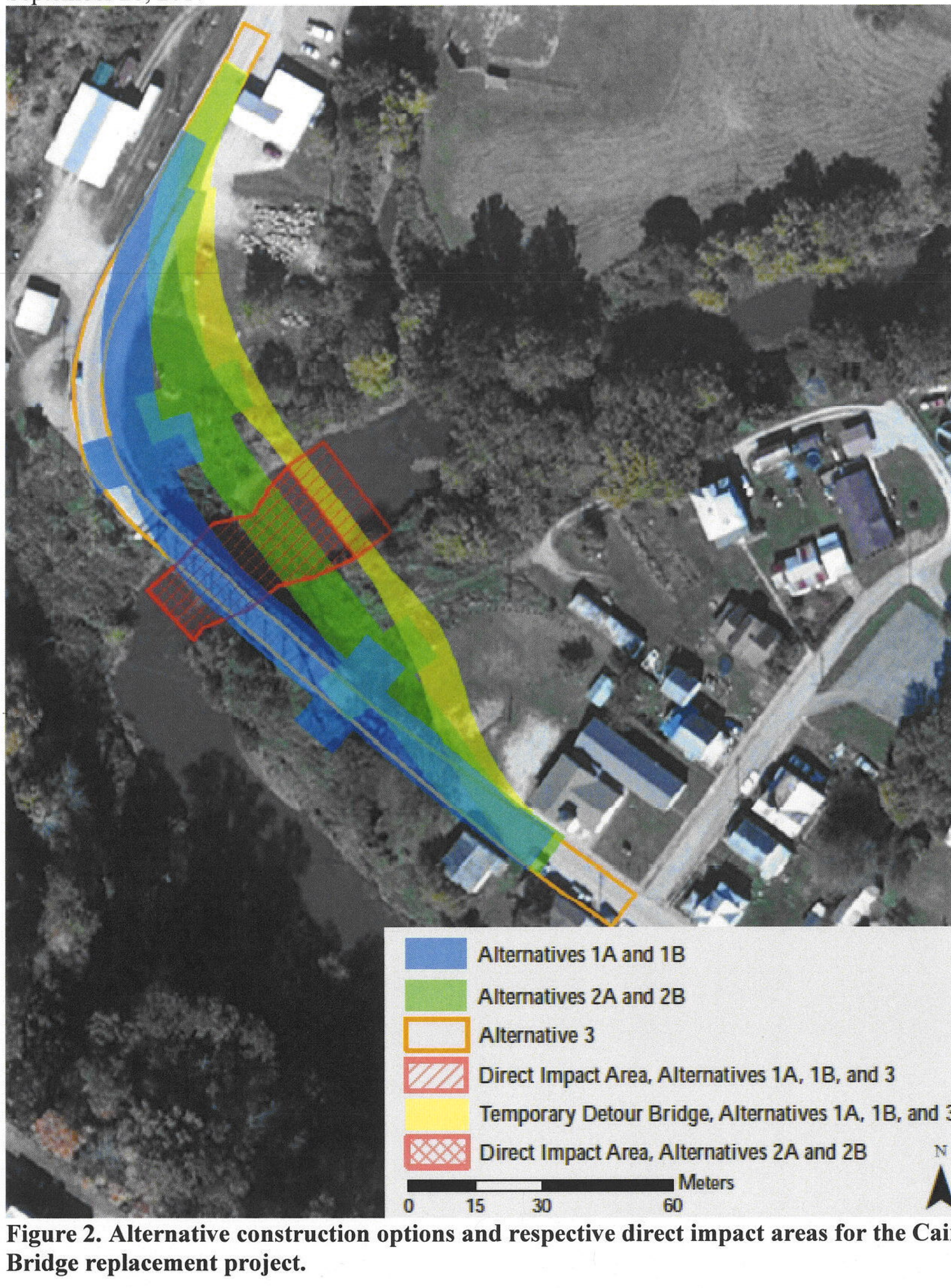


Figure 2. Alternative construction options and respective direct impact areas for the Cairo Bridge replacement project.

Due to the deteriorated condition of the existing bridge, implementing the no-build alternative would result in eventual closure, eliminating this portion of WV Route 31. The structure would continue to deteriorate until complete replacement becomes unavoidable. Therefore, a no-build option would not satisfy the project objectives; no further investigation on this option was performed.

Construction Alternative 1A entails construction of a new single-span bridge on the existing alignment (Figure 2). Traffic would be maintained on a temporary bridge approximately 35 meters upstream of the existing span. Construction of this temporary bridge would require a temporary in-stream causeway extending from the south bank to the location of the temporary bridge pier. This construction option would offer a new crossing of the North Fork Hughes River that meets traffic requirements. This single-span alternative has less substructure and bridge deck area to maintain in the future and provides the most open channel for flood debris. Temporary rock causeways on each bank would be constructed leaving the center of the channel open. These causeways would allow crane and equipment to access each side for normal demolition and erection procedures.

Construction Alternative 1B entails construction of a new three-span bridge on the existing alignment (Figure 2). Traffic would be maintained on a temporary bridge approximately 35 meters upstream of the existing span. Construction of this temporary bridge would require a temporary in-stream causeway extending from the south bank to the location of the temporary bridge pier. The three-span design of this alternative would be the most feasible to erect and therefore this design has the least cost and least impact of traffic during construction. Temporary rock causeways on each bank would be constructed leaving the center of the channel open. These causeways would allow crane and equipment to access each side for normal demolition and erection procedures.

Construction Alternative 2A entails construction of a new single-span bridge on a new bridge alignment approximately 15 meters upstream of the existing bridge (Figure 2). Traffic would be maintained on the existing structure during construction. Similarly to Alternative 1A, the single-span design has less substructure and bridge deck area to maintain in the future and provides the most open channel for flood debris. Temporary shoring would be required on the south approach during the phased construction of the abutment wingwalls where they conflict with the existing structure. Temporary rock causeways on each bank would be constructed leaving the center of the channel open. These causeways would allow crane and equipment to access each side for normal demolition and erection procedures.

Construction Alternative 2B entails construction of a new three-span bridge on a new bridge alignment approximately 15 meters upstream of the existing bridge (Figure 2). Traffic would be maintained on the existing structure during construction. Similarly to Alternative 2A, temporary shoring would be required on the south approach during the phased construction of the abutment wingwalls, where they conflict with the existing structure. Temporary rock causeways on each bank would be constructed leaving the center of the channel open. These causeways would allow crane and equipment to access each side for normal demolition and erection procedures.

Construction Alternative 3 entails the rehabilitation of the existing structure (Figure 2). Traffic would be maintained on a temporary bridge approximately 35 meters upstream of the existing span. Temporary rock causeways on each bank would be constructed leaving the center of the channel open. These causeways would allow crane and equipment to access each side for normal demolition and erection procedures. However, this alternative would not provide any additional lane width on the existing structure; therefore, this option provides less safety for two-lane, two-way traffic. This alternative would also result in significant, ongoing maintenance costs as compared to other alternatives. As this alternative would provide only a short-term structural solution and maintain substandard lane width that restricts use by truck traffic and hinders substantial economic development, this alternative does not meet the purpose and need of the project. Additionally, recent inspections detected significant destress in the deck, strings, and lower chord of the truss. Analysis of rehabilitation measures concluded that rehabilitation of the bridge in the deformed condition of the lower chord is not practical or recommended.

In-stream impacts differ among alternatives. Alternative 3 would have the least in-stream impact, as all construction would occur above ordinary high water and the existing bridge would be rehabilitated. Alternatives 2A and 2B would have moderate in-stream impacts, as causeways extending from both banks at the existing structure would be constructed and in-stream impacts associated with the existing bridge would occur. Alternatives 1A and 1B would have the most in-stream impacts among all alternatives due to the temporary rock causeway extending from the south bank to the temporary detour bridge pier. This temporary in-stream pier would remain in place until the temporary detour bridge is removed.

Engineers examined the feasibility of dismantling the existing structure and erecting girders without impacting the stream. After review and discussion, it was concluded that the risks inherent with the complex demolition and construction plans associated with these unconventional methods is not warranted for this site. These risks, which could still include inadvertent damage to the natural resource, would be more than a responsible contractor would assume and would be reflected in an increased construction cost. Therefore, in-stream impacts due to construction and demolition activities are associated with this project.

While Alternatives 1A, 1B, 2A, and 2B all meet the project's purpose and needs, the WVDOH determined that constructing Alternative 1B is the most desirable alternative, as it fulfills the need for a modern crossing of the North Fork Hughes River, reduces impacts on traffic, and does not rely on the existing structure to maintain traffic. While Alternative 1B is one of the most environmentally damaging alternatives, the advanced deterioration of the existing bridge indicates that it will be unlikely to maintain traffic through the construction of a replacement bridge; utilizing the existing structure longer than necessary will be a safety risk. As such, Alternatives 2A and 2B were considered less feasible, as both of these alternatives utilize the existing bridge to maintain traffic. While Alternative 1B is the preferred alternative, Alternative 1A may be utilized pending the final bridge design. There will be no difference in the in-stream impacts between Alternative 1A and Alternative 1B, only in the number of piers constructed above ordinary high water.

Alternative 1B (Figure 3) consists of constructing a new three-span bridge on the existing alignment. The new structure consists of spans of 20.7 meters, 37.2 meters, and 20.7 meters, totaling 78.6 meters in length. The new structure would provide two 3.4-meter lanes, with two

1.2-meter shoulders and one 1.7-meter sidewalk for a total bridge width of 10.9 meters. Additionally, significant approach roadway work, removal of the existing structure, and construction of a 39.6 meter two-span temporary bridge approximately 35 meters upstream of the existing span would be required.

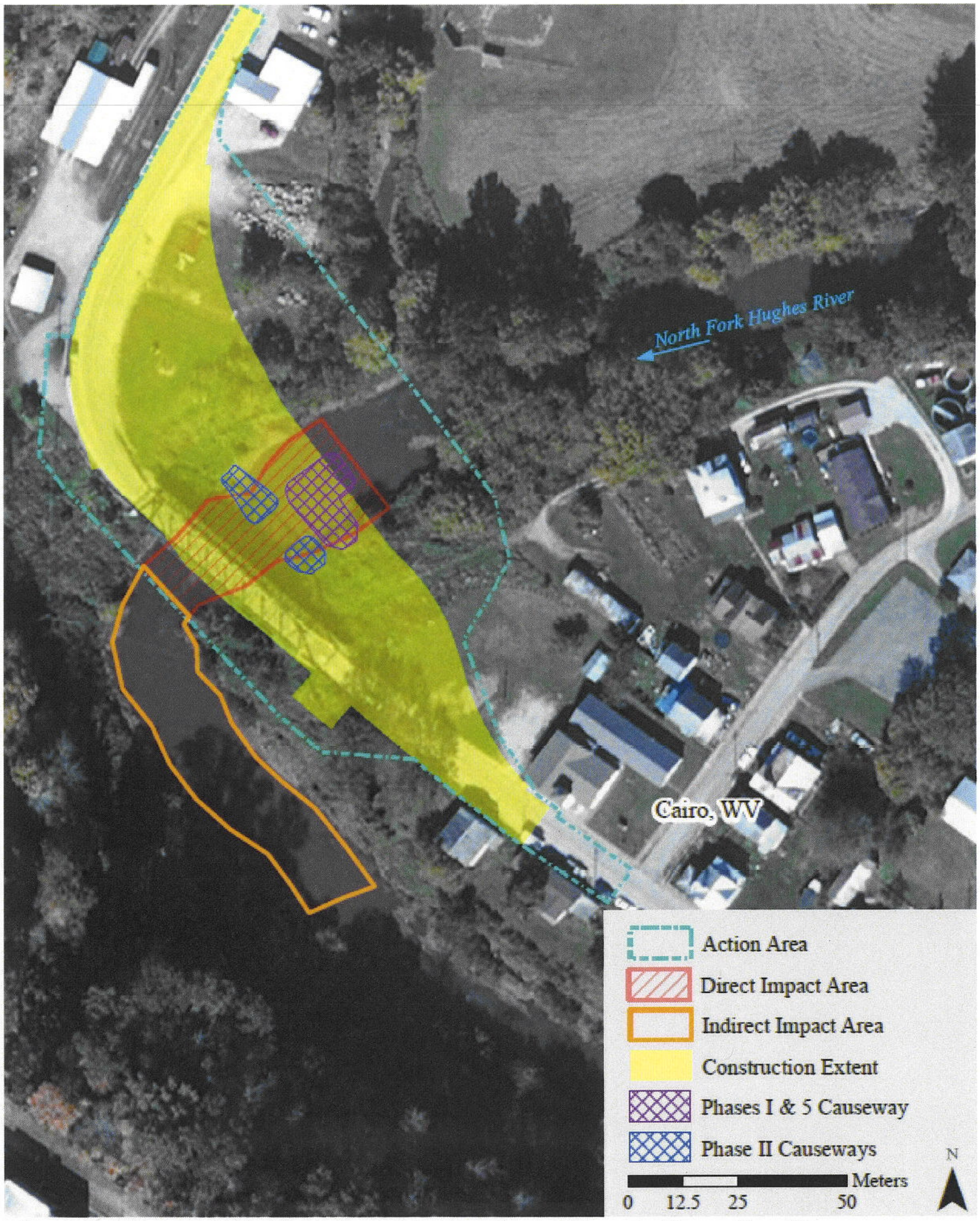


Figure 3. Direct and indirect impact areas for preferred alternative 1B

Construction of the proposed roadway would require both clearing trees and placing fill at the approaches. The stream banks at the proposed structure would be graded to a 2:1 slope at the abutments, both of which would help provide more uniform stream banks throughout the project area. All work done within the streambed would be during low flow conditions. Clearing of trees would be needed along the stream banks. The direct impact area encompasses a total of 52.5 linear meters along the left descending bank and a total of 54.3 linear meters along the right descending bank. The riparian zone is fully vegetated and harbors typical streamside species such as sycamore (*Platanus sp.*), maple (*Acer sp.*), cottonwood (*Populus sp.*), willow (*Salix sp.*), and various woody shrubs. Large trees are more common in the upstream portion of the riparian zone. Emergent vegetation such as water willow (*Justicia americana*) is present along the banks.

Action Area

The action area is defined as all areas to be affected directly or indirectly by the Federal action, including all interrelated and interdependent effects and not merely the immediate area involved in the action. Therefore, for the purposes of this BO, the action area includes all areas affected by construction of the proposed action including the direct and indirect impact areas.

The direct impact area extends approximately 35 meters upstream to 10 meters downstream of the existing bridge and includes the demolition footprint of the existing bridge, the construction footprint of the proposed bridge, the construction/demolition footprint of the temporary detour bridge, and the footprint of temporary rock causeways. This area totals approximately 1,037 square meters and also includes any areas traversed by machinery during construction and post-demolition debris removal. The indirect impact area spans bank to bank and extends an additional 100 meters downstream of the direct impact area and totals approximately 1,411 square meters. Upland areas where construction, equipment staging, and refueling are likely to occur are also included in the action area.

STATUS OF THE SPECIES

Snuffbox

Species Description

The snuffbox is a small to medium-sized mussel that reaches at least 8.8 centimeters in length. Sexual dimorphism is pronounced with males achieving greater shell lengths. The shape of the shell is somewhat triangular (females), oblong, or ovate (males) with the valves solid, thick, and very inflated (Parmalee and Bogan, 1998). The shell is generally smooth and yellowish or yellowish-green in young individuals, becoming darker with age. Green squarish, triangular, or chevron-shaped marks cover the umbone but become poorly delineated stripes with age (Parmalee and Bogan, 1998).

Life History

As with many mussels, the life history of the snuffbox is not well documented. However, like other mussels, adult snuffbox are suspension feeders, siphoning phytoplankton, diatoms, and other microorganisms from the water column (Allen, 1921; Fuller, 1974). Newly-metamorphosed juvenile mussels employ foot (pedal) feeding for the first several months, and use either pedal-sweep feeding or pedal-locomotory feeding (Reid *et al.*, 1992). Adult snuffbox are usually deeply burrowed into substrate, showing only the truncated posterior slope (Parmalee and Bogon, 1998). This makes the species particularly difficult to locate during surveys.

The snuffbox, like and most unionid mussels, has separate sexes. Males expel sperm into the water column, which are drawn in by females through their incurrent siphons. Within the mussel, fertilization takes place in the suprabranchial chambers above the gills, and the resulting zygotes develop into specialized larvae termed glochidia within the gills. The snuffbox utilizes a specialized portion of its outer gills as a marsupium for its developing glochidia (Service, 2007).

The snuffbox is bradytictic or a long-term brooder (Ortmann, 1912, 1919). The glochidia are brooded from September to May (Ortmann, 1912, 1919; Baker, 1928). In Virginia, spawning and fertilization occurred from mid-July to August when water levels were low, facilitating sperm transfer to female mussels (Zale and Neves, 1982). In Michigan, glochidial release (from drift samples) began on 17 May (water temperature = 62° Fahrenheit [F]), peaked on 11 June (74° F), and ended by 15 July (84° F) (Sherman, 1994).

Documented hosts for juvenile snuffbox include the logperch (*Percina caprodes*), blackside darter (*P. maculata*), rainbow darter (*Etheostoma caeruleum*), Iowa darter (*E. exile*), blackspotted topminnow (*Fundulus olivaceous*), mottled sculpin (*Cottus bairdi*), banded sculpin (*C. carolinae*), Ozark sculpin (*C. hypselurus*), largemouth bass (*Micropterus salmoides*), and brook stickleback (*Culaea inconstans*) (Service, 2007). Logperch is widely considered to be the best host for the snuffbox (Sherman, 1994; McNichols and Mackie, 2004; Sherman and Mulcrone, 2004). Hornyhead chub (*Nocomis biguttatus*) is also a potential host (Sherman, 1994).

The snuffbox and certain congeners employ a unique behavior to attract and infest host fish. Gravid females lie at the substrate surface with their valves widely agape. Foraging darters, which probe among stones or flip stones in the case of the logperch, may poke their snout or head into the gape of a snuffbox and elicit a "snapping" behavior. The female mussel holds the fish with recurved denticles on the posterior edge of the valves. Once "caught," the mussel uses her specialized spongy, inflatable mantle margins (cymapallia) to make a gasket seal around the fishes' snout, and pumps her glochidia into the host's buccal cavity with rhythmic pulses (Jones, 2004; Barnhart, 2005). Glochidia generally spend from two to six weeks as parasites, with the duration of encystment being dependent on the species and water temperature (Zimmerman and Neves, 2002). Newly-metamorphosed juveniles drop off to begin a free-living existence on the stream bottom, and will die if they settle in unsuitable habitat (Isely, 1911).

<u>Habitat</u>

The habitat requirements of the snuffbox are summarized from Parmalee and Bogan (1998). The snuffbox is found in small to medium-sized creeks, to larger rivers and in lakes. It occurs in swift currents of riffles and shoals and wave-washed lakeshores over gravel and sand with occasional cobble and boulders, and generally burrows deep into the substrate except when spawning or attracting a host.

<u>Population Dynamics</u>

Longevity information for the snuffbox is scant although specimens between 20 and 23 years have been documented (Service, 2007).The age at sexual maturity, which is unknown for this species, is highly variable among and within species (ranging from 0-9 years) (Haag and Staton, 2003), and may be sex dependent (Smith, 1979). As with many mussel species, the snuffbox is long-lived and probably has low juvenile survival rates. The snuffbox like other mussels is susceptible to permanent, temporary, and intermittent forms of environmental degradation, and reduced populations may take several decades to recover, even if no further degradation occurs.

Reasons for Decline and Continued Threats

The chief causes of the decline of mussels in general and the snuffbox specifically include impoundments, channelization, chemical contaminants, mining, sedimentation, and developmental activities (Neves, 1991, 1993; Williams *et al.,* 1993; Richter *et al.*, 1997; Neves *et al.*, 1997; Watters, 2000). The vast majority of mussel declines in the Mississippi River and Great Lakes basins are the result of habitat loss and degradation (Stansbery, 1971; Neves, 1993). In Middle Island Creek, continued threats to mussel populations include mining, oil and gas development, local discharges of untreated domestic sewage, and water withdrawals. In addition to direct habitat degradation, the strong correlation between populations of the snuffbox and its host fish (logperch) suggests that snuffbox are also vulnerable to fish host declines attributed to degraded habitats (Mulcrone, 2004).

Historical population losses due to impoundments have probably contributed more to the decline and imperilment of the snuffbox than any other single factor. Dams interrupt most of a river's ecological processes by eliminating productive riffle and shoal habitats; modifying flood pulses; controlling impounded water elevations; altering water flow, sediments, nutrients, and energy inputs and outputs; increasing depth; decreasing habitat heterogeneity; decreasing stability due to subsequent sedimentation; blocking host fish passage; and isolating mussel populations from fish hosts (Williams *et al.*, 1992; Yeager, 1993; Neves *et al.*, 1997; Khym and Layzer, 2000; Watters, 2000). Snuffbox streams of all sizes have been impounded leaving only isolated patches of suitable habitat. The snuffbox does not occur in reservoirs lacking riverine characteristics and it is unable to successfully reproduce and recruit under reservoir conditions. It rarely persists in large rivers with dams (e.g., Ohio River) and then only in sections retaining riverine characteristics (generally tailwaters). In addition to damming, dredging and channelization activities have profoundly altered riverine habitats nationwide and have detrimental effects on mussel populations (Service, 2007).

Contaminants contained in point and non-point discharges can degrade water and substrate quality and adversely impact mussel populations. Although chemical spills and other point sources of contaminants may directly result in mussel mortality, widespread decreases in density and diversity may result in part from the subtle, pervasive effects of chronic, low-level contamination (Naimo, 1995). Mussels are very intolerant of heavy metals (Keller and Zam, 1991, Havlik and Marking, 1987), and even at low levels, certain heavy metals may inhibit glochidial attachment to fish hosts (Huebner and Pynnönen, 1992). Among pollutants, ammonia warrants priority attention for its effects on mussels. It has been shown to be lethal to both juveniles and glochidia at low concentrations (Service, 2007). The snuffbox is "apparently... unable to survive even minimal amounts of organic pollution or chemical waste" (Bogan and Parmalee, 1983).

Sedimentation has been implicated in the decline of mussel populations nationwide and is a threat to snuffbox; it can reduce feeding and respiratory efficiency by clogging gills, disrupt metabolic processes, reduce growth rates, limit burrowing activity, and physically smother mussels (Service, 2012). Additionally, studies indicate that excessive sediment level impacts are sublethal with detrimental effects not immediately apparent (Service, 2012). Physical habitat can also be impacted by sedimentation effects through alteration of suspended and bed material loads, and bed sediment composition associated with increased sediment production and run-off; clogged interstitial habitats and reduced interstitial flow rates and dissolved oxygen levels; changed channels in form, position, and degree of stability; altered depth or width-depth ratio that affects light penetration and flow regime; aggraded (filling) or degraded (scouring) channels; and changed channel positions that dewater mussel beds (Service, 2012). Interstitial spaces in the substrate provide essential habitat for juvenile mussels. When they are clogged, interstitial flow rates and spaces may become reduced (Brim Box and Mossa, 1999), thus reducing juvenile habitat availability.

Developmental activities may impact streams and their mussel fauna where adequate streamside buffers are not maintained and erosion from impacted land is allowed to enter streams (Brainwood et al., 2006). Types of development may include highway construction, parking lots, building construction, general infrastructure (e.g., utilities, sewer systems), and recreation facilities. Factors impacting snuffbox populations in urban and suburban areas include sedimentation, toxic effluents, domestic sewage, road salts, and general runoff. Impervious surfaces are detrimental to mussel habitat by altering various hydrological factors, including: increased volumes of flow, annual flow rates, peak flows and duration, and temperature; decreased base flow; and changes in sediment loadings (Service, 2012). These factors result in flooding, erosion, channel widening, altered streambeds, channel instability, riparian and in-stream habitat loss, and loss of fish populations (Service, 2012). As little as 10 percent of a watershed being impervious can cause channel instability and a host of other stream habitat effects (Booth, 1991, Booth and Reinelt, 1993). Impervious surfaces may reduce sediment input into streams but result in channel instability by accelerating stormwater runoff, which increases bank erosion and bed scouring (Brim Box and Mossa, 1999). Hydrological variability influences the distribution of mussels in streams, with distinct communities associated with hydrologically flashy and hydrologically stable streams (Di Maio and Corkum, 1995). Recruitment is also significantly reduced in high discharge years (Howard and Cuffey, 2006). Most snuffbox streams have been impacted by general developmental activities and increased impervious surface levels (Service, 2012).

All snuffbox streams are crossed by bridges and roads. Effects from these structures were reviewed by Wheeler et al. (2005). Categories of impacts include primary effects (construction), secondary effects (post-construction), and indirect effects (development associated with highway presence) (Angermeier et al., 2004). Culverts act as barriers to fish passage (Wheeler et al., 2005), particularly by increasing flow velocity (Warren and Pardew, 1998). Stream channels become destabilized when culverted or improperly bridged by interrupting the transport of woody debris, substrate, and water (Wheeler et al., 2005). Anthropogenic activities can lower water tables, making snuffbox and other mussel populations susceptible to depressed flow levels. Water withdrawals for irrigation, municipal, and industrial water supplies are an increasing concern. We anticipate water withdrawals and potential stream dewatering to be a threat to snuffbox in the foreseeable future.

Status and Distribution

Historically, the snuffbox was widespread and occurred in portions of the Great Lakes and Mississippi River basins. However, the species now occurs in less than 40 percent of its original range (Roe, 2002). Extant snuffbox populations exist in 79 streams in 14 states, and one Canadian province (77 FR 8632-8665). Within West Virginia, the snuffbox is known historically from the Ohio River; Little Kanawha River and its tributaries North Fork Hughes River, South Fork Hughes River, Hughes River, Henrys Fork, Cedar Creek, Leading Creek and West Fork Little Kanawha River; Middle Island Creek and its tributaries McElroy Creek and Meathouse Fork; Hackers Creek, West Fork River and Dunkard Creek within the Monongahela River Watershed; and the Elk River (Clayton, J. WVDNR, personal comm.). However, extant populations only occur within the Little Kanawha River and its tributaries North Fork Hughes River, South Fork Hughes River, Hughes River; Middle Island Creek and its tributaries McElroy Creek and Meathouse Fork; and the Elk River (Clayton, J. WVDNR, personal comm.). In Middle Island Creek, the snuffbox is found throughout Tyler and Pleasants Counties.

September 2009, a golden-algae bloom caused by high aquatic mineral and salt content from a mine discharge resulted in a large fish and mussel kill at Dunkard Creek, Monongalia County, West Virginia. The WVDNR reported one hundred percent mortality for fourteen species of mussels within Dunkard Creek (Jernejcic and Wellman, 2009). As a result of this kill, the snuffbox may have been extirpated from Dunkard Creek or the population may have become inviable. However, efforts to restore fish and mussel populations within this watershed are underway.

Review of Endangered Species Information

The snuffbox was listed as endangered on February 14, 2012, in the *Federal Register* (77 FR 8632-8665). No critical habitat for the snuffbox has been designated. The State of West Virginia does not have formal threatened and endangered species legislation. However, West Virginia tracks the status of the snuffbox as a State-rare species (S2), and lists all mussels as a "no-take" species in the State, meaning that a State permit is required for any mussel collection.

Since the species was proposed for listing, 11 Federal actions have taken place or are proposed that have adversely affected the snuffbox (Table 2). The Service determined that these actions would not jeopardize the continued existence of the snuffbox, and estimated incidental take for each action. The incidental take of snuffbox was estimated to be 1,146 individuals that would be directly killed, harmed or harassed, plus an unquantified number of animals indirectly affected by each action.

Table 2: Previous biological opinions authorizing incidental take of the snuffbox mussel

Project Name, State	Estimated Incidental Take (direct take)	Number salvaged	Year	Project Status
Gassaway Bridge, WV	5	-	2010	Complete
Ironton-Russel Bridge, OH	6	-	2011	Complete
PennDOT Bridge Program	691	-	2011-2016	Ongoing
Mead Avenue, PA	55	18	2012	Ongoing
Race Street	83	65	2013	Ongoing
Carlton	40	20	2013	Ongoing
Hunter Station, PA	103	-	2013	Ongoing
West Milton Dam Removal, OH	10	-	2014	Complete
North Fork Hughes Dam Repair, WV	8	-	2015	Complete
Shiloh Bridge, WV	64	6	2015	Complete
Camp Creek Bridge, WV	81	-	2015	Ongoing
West Fork Dam Removals	43	0	2015	Complete
Wells Bridge Replacement, WV	45	-	2017	Ongoing

Rangewide Conservation Needs of the Species

According to the listing rule for the snuffbox (Service, 2012), extant snuffbox populations should continue to be protected with Federal and State laws and regulations that address the species' habitat. The rule also states that the overall conservation status of the snuffbox would improve if more extant populations could be maintained at viable levels and if historical populations were reintroduced. Middle Island Creek is listed as an extant population of snuffbox in the rule (77 FR 8632-8665). Additionally, the rule calls for pollution reduction in snuffbox drainages; reduction of sand and gravel mining in snuffbox habitat; creation of a prioritization scheme for stream protection; securing stakeholder support for management actions; the restoration of significant levels of snuffbox habitat; and additional research and monitoring efforts to examine the status, life history, and potential threats to this species (77 FR 8632-8665).

A recovery plan for the snuffbox has not been developed yet, but a recovery outline was completed in 2012 (Service, 2012). According to this outline, there are a high degree of threats to the snuffbox that are primarily a result of habitat loss and degradation due to impoundments, channelization, chemical contaminants, mining, and sedimentation. Recovery potential is considered low because these threats will require long-term management and will be difficult to alleviate. The ultimate goal of the recovery effort is to ensure the long-term survival of the snuffbox by controlling and reducing threats to an extent that populations can be self-sustaining.

Although subject to change, full recovery of the snuffbox is currently envisioned as follows: viable populations will persist throughout the species' historical range in sufficiently managed and protected habitats. Threats to the species, primarily modification and destruction of river and stream habitat from localized and watershed impacts, will be sufficiently abated. Populations will be maintained to provide sufficient representation, resiliency, and redundancy to ensure the high probability of survival for the foreseeable future.

The recovery outline for snuffbox lists the following recovery actions for the species range-wide, in addition to protection of known populations and habitat (Service, 2012).

1. Monitor the status of the species throughout its range.

2. Conduct basic research to determine the life history characteristics of the snuffbox and integrate results into management and recovery actions for the species.

3. Develop a reintroduction and augmentation plan for each species and assess the feasibility of augmenting existing populations and reintroducing these species into restored habitats in their historic range.

4. Protect habitat integrity and quality of river segments that currently support or could support these species. Encourage and support community based watershed stewardship planning and action.

5. Develop and implement programs to educate the public on the need and benefits of ecosystem management, and involve the public in watershed stewardship and conservation efforts for the snuffbox.

6. Utilize section 7(a)(1) and 7(a)(2) of the Endangered Species Act as mechanisms for conservation of the snuffbox.

ENVIRONMENTAL BASELINE

Status of the Species in the Action Area
Surveys within the action area were conducted from August 13 through 14, 2015. This survey covered a total length of 260 meters and included a distance approximately 110 meters above the centerline of the existing bridge and extended approximately 150 meters downstream from the centerline of the existing structure. The survey documented 49 total individual mussels representing eight live species. Two additional species were present as weathered dead shells. No live or dead snuffbox were found during this effort.

Depths within the direct impact area varied; depths were shallow (0.0 – 0.2 m) at the downstream end near the existing Cairo Bridge where a gravel bar split the channel into two shallow run/riffle complexes, and deeper (>1.1 m) at the upstream end where a pool was present (Figure 4). Depths within the indirect impact area ranged from 0.3 m to >1.1 m, with the greatest depths observed along the right descending bank downstream of the existing bridge (Figure 4).

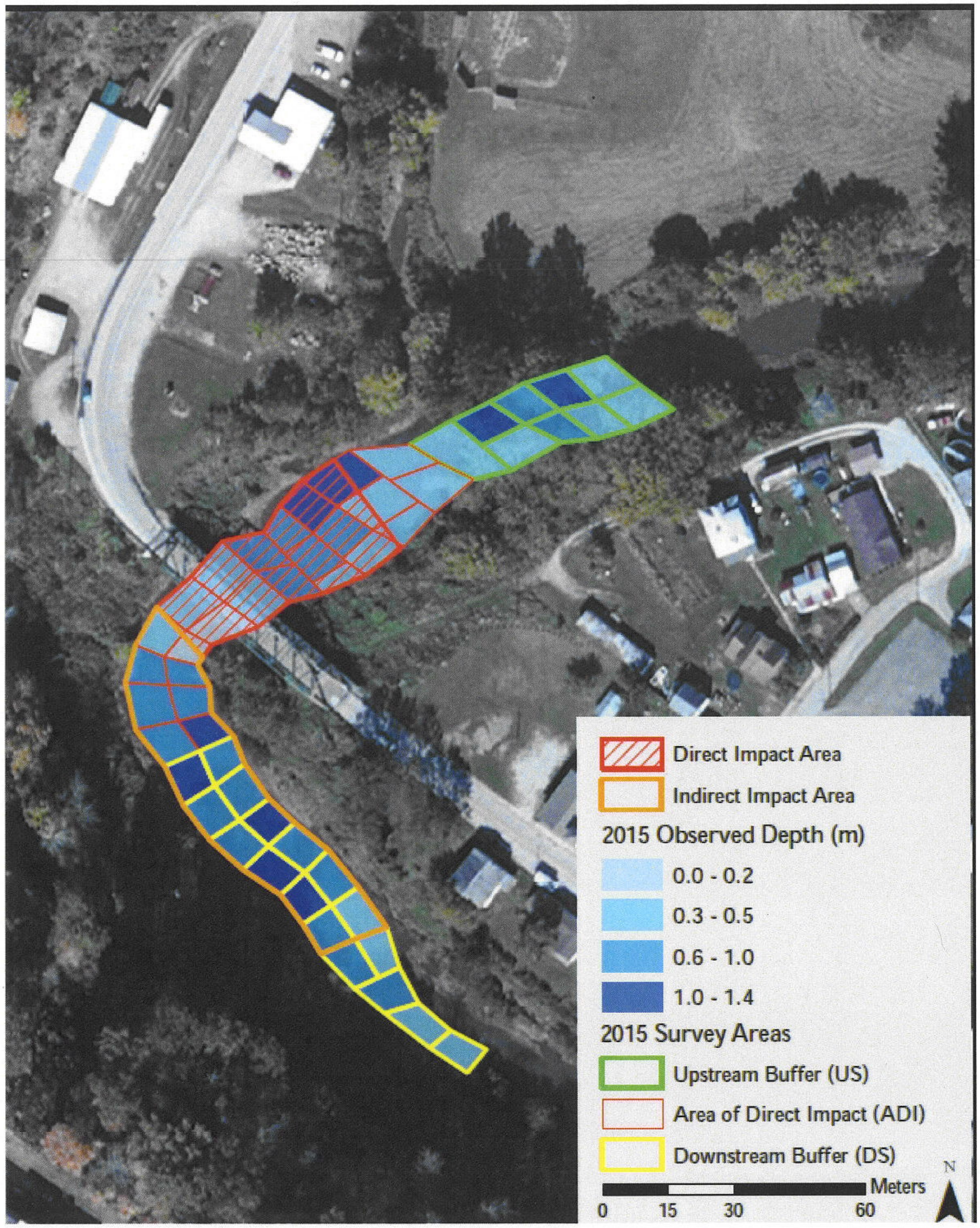


Figure 4. Depths observed within the action area

Substrate within the direct impact area was primarily gravel and sand, with some boulder, clay, and detritus present (Figure 5). Only four live mussels were collected from the direct impact area. One individual was collected in quantitative samples under the bridge while the three individuals collected in semi-quantitative samples were collected upstream of the bridge in a pool. The majority of individuals found in the 2015 survey were in this heterogeneous substrate (Figure 6).

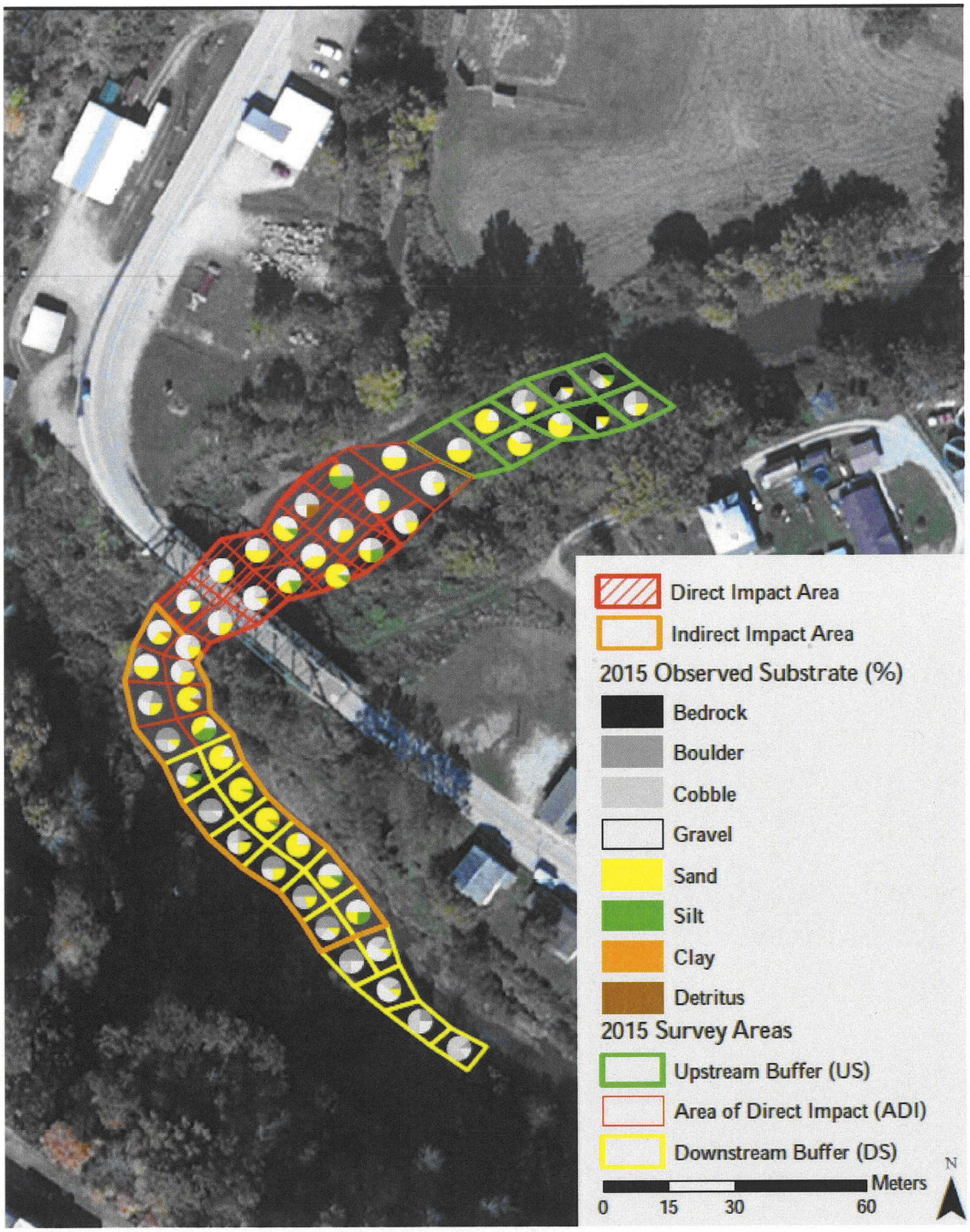


Figure 5. Substrate observed within the action area

The indirect impact area consisted of sand, gravel, cobble, and boulder. Twenty-seven live mussels of seven species were collected from the indirect impact. While individuals were generally present throughout the indirect impact area, two areas, one at the upstream end of the indirect impact area and one halfway down along the left descending bank, yielded a majority of the mussels. Species richness was moderate, but density within the direct impact zone where mussels will be salvaged exceeded expectations based on semi-quantitative samples, suggesting that undetected mussels may be buried deep within the substrate throughout the study area and potential exists for additional species to occur in the direct and indirect impact areas. Although snuffbox was not found during the 2015 survey, its presence cannot be ruled out because it is known to be present in close proximity to the action area (as described below) and snuffbox are often found buried beneath the substrate and are difficult to locate (Buchanan 1980, Ortmann 1919).

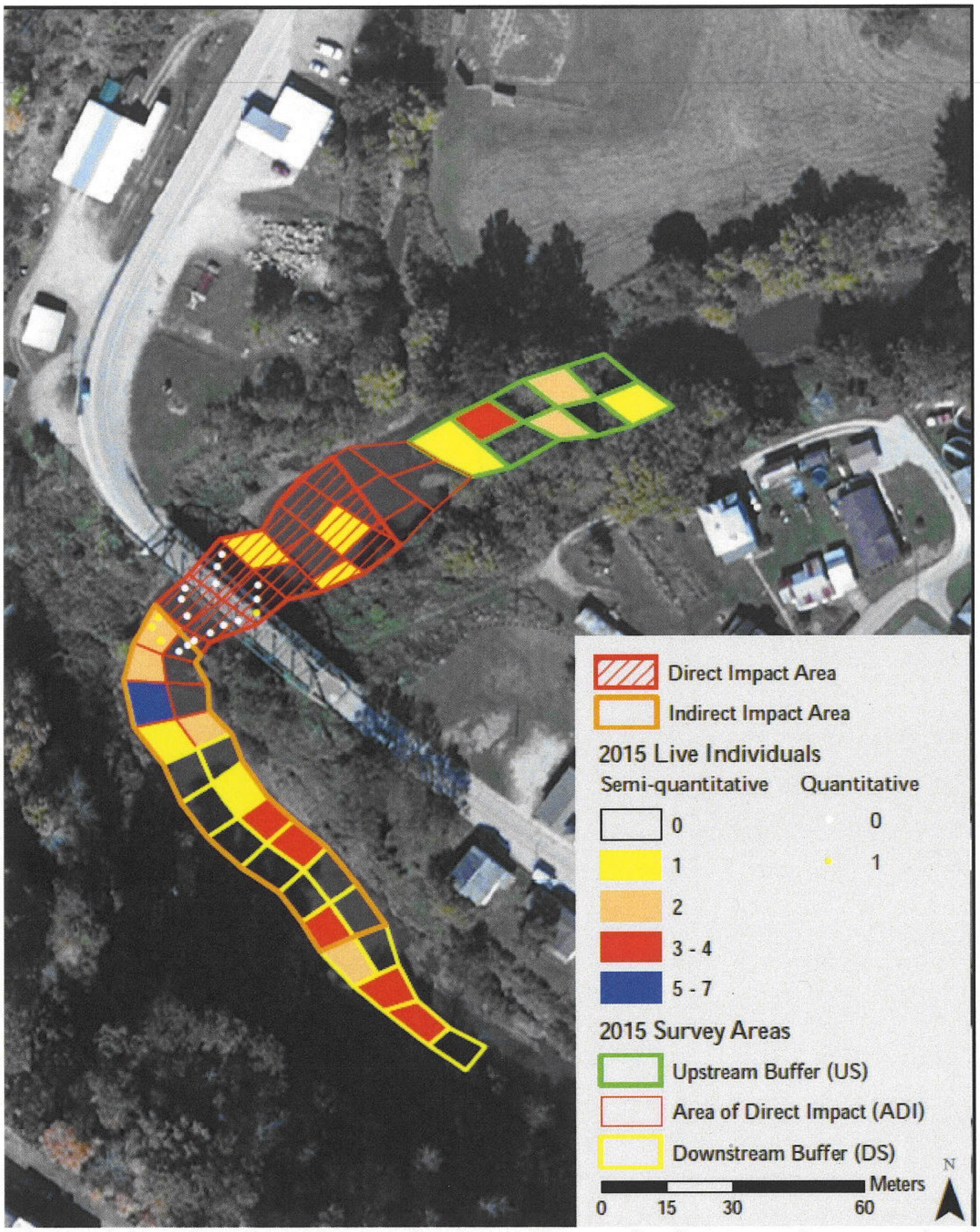


Figure 6. Results of semi-quantitative and quantitative mussel surveys in the action area

<u>North Fork Hughes River Populations</u>

The North Fork Hughes River begins in northern Ritchie County and travels approximately 88.5 km (55 miles) southwest until it meets the South Fork Hughes River to become the Hughes

River. Twenty-one different mussel beds are known to exist throughout the North Fork Hughes River. Of these, eleven have recorded the presence of snuffbox or relic shells of snuffbox since 1981. The closest known snuffbox bed is 2.8 kilometers downstream of the project area.

Other Factors Affecting the Species in the Action Area

The action area is currently affected by traditional oil and gas drilling activities in addition to newer oil and gas activities that involve water withdrawals and horizontally fracked Marcellus shale wells. The water withdrawals have been suspected of affecting aquatic life during low flow conditions by causing more fluctuation in water levels which sometimes leads to the dewatering of mussel beds. Sedimentation and erosion from the supporting infrastructure for Marcellus shale gas developments is having a heavy impact on streams in this area. Bank stability is also a problem, often a result of poor land use practices.

The action area is 11.3 kilometers (7 miles) downstream of the North Fork Hughes Dam. Construction of this dam began in1998, and was completed in 2002. In 2005, the river bank below the dam began to show signs of erosion and instability. While this instability has led to erosion that has caused sediment to enter the river which has affected snuffbox habitat and populations in that area, significant effects due to this are not expected 11.3 kilometers downstream in the action area.

Conservation Needs of the Species in the Action Area

Similar to the rangewide conservation needs of the species, the conservation needs of the species within the action area center around reducing existing threats, avoiding new threats, and allowing the populations to continue to expand and recover so that they have increased viability and resiliency. Within the action area this includes: limiting the amount, duration, and severity of direct disturbances to suitable habitat; minimizing the direct loss of existing individuals; ensuring that suitable substrates are not degraded or lost from direct disturbances; allowing water quality to improve by avoiding and minimizing new sources of water quality degradation from increased sedimentation; ensuring that reproduction and recruitment are not impaired; conducting efforts to augment existing populations; and establishing monitoring programs to track population and habitat conditions. When evaluating the effects of the action, we will consider whether the proposed action has incorporated measures to address the conservation needs of the species in the action area.

EFFECTS OF THE ACTION

Regulations define effects of the action as the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with the action that will be added to the environmental baseline. Direct effects of the proposed action include direct mussel disturbance, direct habitat disturbance, sedimentation, hydrologic changes, streambank disturbance, and potential spills and toxic discharges. Indirect effects are defined as those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. While some of the direct effects of project construction may be short-term and temporary, indirect adverse effects from disturbance of the mussels and their habitat, and increased sedimentation can occur or persist for some time post-construction.

Indirect effects include effects on the reproduction of mussels in the area, and lost mussel density and abundance until such time that mussels recolonize the area. The Service anticipates that the following effects will occur as a result of the proposed action.

Direct Mussel Disturbance

Mussels present within the direct impact area, including those within area of the proposed causeway and the area of bridge demolition, as well as mussels present in substrates adjacent to these areas, may be crushed, smothered, dislodged, or killed during construction. Those mussels not killed or injured during this process may still suffer death, injury, or increased predation risk if they are unable to right themselves and re-burrow into suitable habitat. It is estimated that mussels may be smothered and killed within the area from the temporary bridge to the downstream edge of the existing structure. Based on these dimensions, it is estimated that all mussels with in a 1,037 square meter area will be affected by direct construction impacts.

WVDOH has minimized the potential for directly crushing, smothering, or killing mussels by selecting the proposed bridge replacement alternative that avoids the largest concentration of mussels, positioning the causeway in such a manner that it can be utilized for both construction and demolition, surveying the area and relocating any mussels found prior to construction, and conducting post-construction monitoring to ensure no unanticipated mussel mortality occurs. These measures combine to both reduce the potential number of mussels that will be exposed to project effects, and also reduce the severity of effects that will be experienced by the remaining individual mussels, since mortality associated with relocation is significantly less than mortality associated with direct crushing.

Relocations will be conducted by surveying the area that will be most significantly affected by project construction and relocating all individual mussels that are found into an upstream area of the North Fork Hughes River that should not be affected by the project. Due to the selected construction alternative that requires a temporary upstream bridge with an in-stream pier, a temporary causeway will need to be re-constructed to remove the temporary bridge pier during the final phase of the project (days 397 – 422). Because more than one year will have passed since the original relocation effort, a second relocation effort from the footprint of the causeway will be conducted prior to causeway re-construction. The upstream and downstream buffer distances for mussel relocations are based on the recommendations in Clayton et al. (2016).

Based on previous experiences with relocation efforts in West Virginia, it is estimated that relocations may find approximately 60 percent of the mussels in typical mussel habitat such as sand and gravel (EnviroScience Inc., 2013, 2004, 2002, 2001; Clayton, J. WVDNR, personal comm.). Some individuals may not be detected and would be crushed or killed by construction of the causeway. Because they are small and difficult to locate, juvenile mussels are less likely to be located during surveys and thus may have an increased risk of being crushed, killed, or smothered. This could result in the disproportionate loss of younger individuals and could alter the age-class distribution of the population. In addition, because the snuffbox is usually found entirely buried in the substrate or with only the posterior slope exposed to view (Buchanan 1980, Ortmann 1919), they are more difficult to locate during surveys than other species and thus may have an increased risk of being crushed, killed, or smothered.

While relocation will result in the reduction of direct take, and will thus significantly minimize adverse effects, there can also be some adverse effects associated with relocations. When conducted properly, relocations can be an effective tool to minimize mussel mortality. Studies have documented survival of up to 99 percent of relocated mussels after one year (Cope *et al.*, 2003). However, handling and relocation of mussels can also cause direct mortality, or stress to mussels resulting in reduced growth and reproduction (Cope and Waller, 2006, Dunn *et al.*, 1999; Strayer and Smith, 2003). The rate of survival during relocations and handling is influenced by water and air temperatures, handling and transport methods, and substrate suitability in relocation area. Most relocation projects are conducted from July to September when reproductive stress is relatively low and metabolic rates are sufficient for active reburrowing in the substrate (Cope and Waller, 2006). Relocations conducted during active reproduction periods or during low temperatures when metabolic rates are low will likely result in increased mortality and reduced reproductive success. For example, one relocation project conducted during fall with rapidly declining temperatures resulted in greater than 30 percent mortality for most relocated species (Dunn *et al.*, 1999).

The mussel relocations for this project will precede project construction and will take place within one year of construction. Mussels gathered throughout the salvage area will be collected in such a way that spatial location and relative density of mussels can be recorded. Non-federally listed salvaged mussels will then be translocated to the nearest optimal upstream habitat that harbors an existing mussel community; federally listed mussels that are salvaged will be transferred to the WVDNR and placed at a permanent monitoring site 2.5 kilometers downstream. A report describing the salvage and translocation results will be provided to the WVDNR and the Service.

<u>Direct Habitat Disturbance</u>
In addition to directly disturbing mussels within the action area, the project will disrupt and alter mussel habitat in the action area. As described above, habitat within the causeway area and the bridge demolition area will be directly disturbed. These activities could change substrate composition or compaction in and around the construction area and make it less suitable for mussels to live and burrow in. As described above, a total of 1,037 square meters of habitat may be affected from these types of effects.

Direct impacts to substrates will occur where causeways will be constructed, where bridge demolition will take place, and along streambanks. These disturbances will likely result in some sedimentation to the stream, however, the disturbance will be limited in duration and will be minimized through erosion and sedimentation control measures outlined in the BA.

FWHA and WVDOH have incorporated a number of conservation measures into the project that should minimize the extent and significance of the direct habitat disturbance. These measures include: use of clean rock fill that will be completely removed post-construction, locating the causeways so that they may serve a dual purpose for construction of the new bridge and demolition of the old structure, and construction of the causeways in such a way that the center of the river channel is always open for fish passage. Post-construction monitoring will include habitat and depth monitoring one year, three years, and five years following construction. As a result of the incorporation of these conservation measures, we expect that duration and scope of habitat degradation as a result of direct disturbance will be limited, and that the directly disturbed portions of the site will likely provide some level of suitable mussel habitat post-construction. No permanent loss of habitat is anticipated.

Hydrologic Effects

The presence of the temporary causeway in the stream during construction activities could potentially result in local hydrologic modifications to the river. The greatest potential for substrate scour and deposition would occur in association with construction and removal of the causeways, as well as from the presence of the causeways during construction, especially during high flows. These modifications could include transport of suspended debris from the causeway that would directly impact mussels and mussel habitat downstream.

Sediment and silt will also be resuspended due to project-related scouring. Deposition of silt and sediment generated from the project or that is already suspended in the water column is most likely to occur in those areas where project-related hydrological modifications reduce the water's capability to carry sediments (*i.e.*, decreased water velocity). This is particularly likely to occur (1) upstream of the causeways where flow is restricted, causing water to pool behind the causeways, and (2) immediately downstream of the causeways, where flow has not yet redistributed across the river channel and sediments scoured from the causeway openings are likely to redeposit.

Long-term alteration in habitat quality may occur within the action area of the Cairo Bridge. A Hydrologic Engineering Centers River Analysis System (HEC-RAS) was completed to examine the changes in flow under the existing and proposed new conditions at the river crossing. Under the various flows modeled for existing and new conditions, water velocity changes were negligible and in the temporary condition changes were not substantial. Additionally, impacts to mussel habitat should be limited to the footprint of the causeways, the area below the bridge demolition, and the area of the temporary bridge pier that will be in the middle of the river. While HEC-RAS can only grossly predict velocity changes that are likely to influence mussel habitat (i.e., near-bed velocities), we do not anticipate large changes to result since new piers will be placed above the ordinary high water mark of the stream. The riverbed configuration will doubtless change due to the new alignment, and in turn, shifts will occur for specific deposition and scour locations and mussel habitat. However, these shifts should be minimal. It is not possible to predict the extent of these changes based on the modeling available, but based on the information provided, we anticipate that the area of mussel habitat and overall river bed stability should be similar to what currently exists. The FHWA and WVDOH have established a habitat monitoring plan that will occur one year prior to construction and one, three, and five years following construction. This monitoring will measure depth and particle size along transects and will help quantify any potential effects that have occurred from the alteration of the hydrology within the action area.

The overall risk of hydraulic modification from the project and to mussel populations and habitat is considered very low. Hydrologic flow changes and sedimentation will be temporary and do not pose long term risks to the mussel populations within the action area. No permanent changes to the current habitat availability and condition in the North Fork Hughes River as a result of this bridge replacement project are anticipated.

Streambank Disturbance

Streambank disturbance and loss of riparian vegetation can affect the physical and biological processes of streams (Pusey and Arthington, 2003). Healthy, functioning, riparian areas are essential to maintaining water and habitat quality in streams, and streams are adversely affected when riparian vegetation is removed (Urgenson, 2006). Loss of streambank vegetation can cause increased water temperatures and changes in light regimes, that can affect dissolved oxygen levels, and the health, fitness, and survival of benthic invertebrates like mussels, as well as their fish hosts (Urgenson, 2006). Removal of riparian vegetation and disturbance to the streambanks can also increase streambank erosion, increase sedimentation in streams, and alter channel morphology.

Invasive, nonnative plants associated with riparian areas, such as Japanese knotweed (*Fallopia japonica*), have the potential to adversely affect mussel populations in the North Fork Hughes River. Japanese knotweed is a species native to eastern Asia that was introduced in the United States as an ornamental landscape plant (Barney, 2006). The species forms dense, monotypic stands that exclude native vegetation (Urgenson, 2006). Once introduced into an area, it spreads rapidly through riparian areas as flood waters carry root and stem fragments downstream and these fragments then regenerate to form new populations (Urgenson, 2006). Japanese knotweed is difficult to control and eradicate. Effective eradication requires many years of focused efforts, and often populations are discovered downstream before 100 percent mortality is achieved in the treated area (Urgenson, 2006).

Streambanks dominated by Japanese knotweed populations are less stable and more prone to erosion because Japanese knotweed has shallower roots compared to native riparian trees and woody shrubs. Because Japanese knotweed dies back in winter, it also leaves streambanks more exposed to erosive forces (Urgenson, 2006). Thus, knotweed can increase streambank erosion, increase sedimentation in streams, and alter channel morphology. In addition, riparian areas dominated by Japanese knotweed change the natural composition of leaf litter entering the stream. This affects nutrient cycling and organic matter inputs into the aquatic food web, and can have long-lasting effects on micro-habitat conditions and aquatic life of affected stream systems (Urgenson, 2006). Japanese knotweed is very tolerant of many soil types and is thus easily spread to new areas; project-related activities (vehicles traveling to and from the site) risk spreading Japanese knotweed.

The proposed action will result in the temporary disturbance to 52.5 linear meters along the left descending bank and a total of 54.3 linear meters along the right descending bank. The current riparian zone is fully vegetated with typical streamside species such as sycamore, maple, cottonwood, willow), and various woody shrubs. Large trees are more common in the upstream portion of the riparian zone. Emergent vegetation such as water willow is present along the banks.

In order to minimize the effects of streambank disturbance, silt fencing, turbidity curtains, and additional erosion control measures will be used on both banks to prevent siltation within the North Fork Hughes River. Immediately after earth disturbance activities cease, the disturbed areas will be stabilized through the planting of 450 stems/acre of willows and native seeding.

Non-native seeding such as winter wheat may also be used. Additionally, the contractor will develop an erosion and sedimentation control plan and best management practices that to be reviewed by the Service for approval prior to ground disturbing activities.

As a result of the minimal amount of disturbed streambank, the conservation measures included to reduce erosion to immediately restore the vegetation and grade of the streambanks post-construction, and the erosion and sedimentation control plan, we anticipate overall project effects from the streambank disturbance and loss of existing riparian vegetation will be minor.

Spills and Toxic Discharges

There is a potential for spills or releases of oil, fuel, or other toxic contaminants to occur during project construction. These products could leak from construction equipment, broken fuel or hydraulic lines, storage tanks, or other items used on site. Conducting regular inspection of equipment on the causeway will help identify and control possible leakage of toxic materials. Petroleum and oil-based products can kill or impair adult or young mussels or their fish hosts, as well as adversely affect the reproduction of these species.

Contractors who will be conducting this work will provide a spill prevention and control plan and project best management practices to the Service for review prior to beginning any on-site activities. This plan will be used to ensure that spills and discharges are unlikely to occur, and that measures that will be taken to immediately control and contain any spills that do occur. As a result of the implementation of this plan, we anticipate that the potential for spills or chemical discharges should be insignificant. If significant spills or toxic discharges do occur, this shall constitute new information that was not considered in this BO.

Sedimentation

Mussels will also be affected by increased sedimentation generated during disturbance of the substrate from the installation of the causeway, demolition of the bridge, and from disturbance of the riverbanks. Both deposited and suspended sediment can negatively affect the survival and fitness of freshwater mussels. Effects of sedimentation include mortality, reduced physiological function, and depressed rates of growth, reproduction, and recruitment (Henley *et al.*, 2000).

High levels of suspended sediments cause mussels to reduce water filtration rates and have reduced dietary absorption efficiencies which can cause sub-lethal effects on growth and reproduction, or starvation with long-term exposure. Mussels will close their valves during periods of heavy siltation to avoid irritation and clogging of feeding structures (Loar *et al.*, 1980). Mussel gills can become overwhelmed with excessive suspended sediment, causing a mussel to either reduce its water and food intake rate or close altogether. Mussels exposed to greater than 600 mg/l of suspended sediments for 9 days showed decreases in metabolic rates and feeding impairment (Aldridge *et al.*, 1987). Excessive siltation also degrades water and substrate quality. High levels of suspended sediments will reduce dissolved oxygen levels in the water, while heavy sediment deposition will fill interstitial spaces in the substrates, both of which can suffocate mussels particularly if sufficient accumulation occurs (Ellis, 1936, Marking and Bills, 1980). Some mussel species showed significant mortality when exposed to less than 0.64 centimeters of deposited sediment (Ellis, 1936, Henley *et al.*, 2000). Young mussels who feed in interstitial waters and whose siphons cannot extend far above the substrate may be particularly susceptible to these types of effects. Additionally, mussel shell erosion rates can increase significantly due to the scouring effect of increased suspended sand and larger size particles, and the displacement of larger substrates which serve as refugia from high flows. Finally, increased turbidity due to sedimentation may impede sight-feeding host fishes and disrupt attractant mechanisms mussels use to lure fish hosts (Hartfield and Hartfield, 1996).

It is difficult to determine how far downstream these types of effects will occur, what level of excess sedimentation will be generated by the project, or how long these effects will persist. Factors such as stream channel morphology, flow rates during and post-construction, the composition of excavated sediments, and the effectiveness of sediment and erosion control measures, can affect the duration and severity of in-stream sedimentation. Sedimentation and increased turbidity from causeway construction work could cause deleterious effects to mussels downstream of the project area.

FHWA and WVDOH have incorporated a number of conservation measures into the project that should minimize the extent and duration of sedimentation that will occur within the action area and areas downstream. These measures include: use of clean rock fill for the causeway, locating the causeway so that it may serve a dual purpose for construction of the new bridge and demolition of the old structure, constructing the causeway so that the center of the river channel is always open to flows, placement of the demolished bridge pieces onto the causeway for removal, and locating staging areas in upland areas away from receiving waters that are protected through sedimentation and erosion control best management practices.

Reproductive Effects

The proposed action could adversely affect mussel reproduction. Stress caused by mussels being displaced from their habitat or increased sedimentation could impact reproduction by causing mussels to abort their glochidia before they are mature (77 FR 14914). The proposed action could also affect the transport of sperm making them less viable, impair the rate that mussels siphon water and thus reduce their intake of sperm, cause host fish to avoid the area so that they are not present when mussels release their glochidia, or impair the ability of the fish host to detect lures and conglutinates that mimic prey items so that host fish are less likely to become infested with glochidia. The type and extent of these potential effects will depend on the timing of construction. For long-term brooders like the snuffbox, construction in May through June when snuffbox are ready to release mature glochidia could reduce the rate that fish hosts come in contact with the species and therefore the rate that glochidia successfully encyst on fish hosts, while construction in July to August could reduce the rate of sperm intake and the successful maturation of glochidia in adult female mussels. Construction in fall and winter could cause the mussels to abort glochidia or release them earlier than would normally occur. Because so little is known about the timing and triggers for each stage of reproduction for these endangered mussels, these timeframes are only approximations based on currently available information. Flow rates and water temperatures may also affect the timing of reproduction each year.

FHWA and WVDOH propose to conduct in-stream construction for 422 days; a partial causeway will be in place throughout. No in-stream work will be conducted from April 1 to June 30. The center of the channel will remain open throughout construction and will not block fish host passage. During late summer or early fall prior to in-stream activities, the area will be rigorously searched for mussels in accordance with the mussel salvage plan; these mussels will be moved to an upstream location. A temporary causeway will need to be re-constructed to remove the temporary bridge pier during the final phase of the project (days 397 – 422), and since more than one year will have passed since the original relocation effort, a second relocation effort from the footprint of the causeway will be conducted prior to causeway re-construction. Mussels that are stressed from injury, handling during relocations, habitat disturbance, and sedimentation may also divert more of their resources towards physical recovery and away from reproduction, and these mussels would thus have reduced reproductive output the following year. These two factors could result in lost reproductive potential of the affected mussels for the next year, and a reduction in numbers of young mussels of that year-class present in the population of the action area.

Mussel Recolonization and Recovery

It is not known how long it will take for endangered mussels to recolonize the area affected by this proposed action. In one experiment where mussels were removed from small areas of a mussel bed, mussels had recolonized the removal plots, although not to pre-removal density, within 2.5 years (Young and Williams, 1983). Deposition of juvenile mussels by fish was found to be the most important mode of recolonization, whereas active movement and passive transfer were less important. This suggests that if suitable habitat conditions and fish hosts are present, and reproducing source populations are reasonably close, mussels can recolonize areas. However, in that study, mussels were only removed from small areas, habitat disturbance was limited, and mussel mortality associated with in-stream construction did not occur. As a result, it will likely take more than 2.5 years for mussels to recolonize the action area to pre-construction densities.

Factors that may affect the rate and success of mussel recolonization include the presence and abundance of other reproducing source populations nearby, the presence of suitable substrates post-construction, how long it takes for host fish to begin reusing the area, and whether water quality and flows are conducive to successful reproduction in the years subsequent to construction.

However, population numbers in the area are low, which reduces the overall amount of reproduction that may occur in the action area. In addition, as discussed above, reproduction and recruitment of juveniles into the population is likely to be reduced post-construction because 1) construction could affect the reproductive success of mussels remaining in and downstream of the bridge replacement project, 2) juvenile mussels are less likely to be found during relocation and are thus more likely to be crushed and killed during construction, and 3) young mussels are particularly susceptible to the effects of sedimentation. These factors could reduce the overall rate of recolonization in the area, and could have continuing effects on the age distribution of the mussel population in the action area resulting in a population with a larger percentage of older, less reproductively-active individuals.

For this project, we expect that the affected area will continue to have suitable substrates post-construction and that there will be no permanent loss of suitable habitat. This should increase the probability that mussels will recolonize the area relatively quickly. Post-construction monitoring will include habitat and depth monitoring one year, three years, and five years following construction. The results of this monitoring will help validate these assumptions about habitat recovery.

FHWA and WVDOH propose to conduct in-stream construction prior to the fish spawning season and will work from the causeways and the shore during the spawning season. None of the in-stream structures will extend across the entire river, so fish host passage for migration and spawning will not be blocked during construction. Negative impacts to mussels that may be releasing sperm and glochidia at this time will not occur as fish host species will still be present in the area. Additionally, hydrologic flow changes and sedimentation will be temporary and do not pose long term risks to the mussel populations within the action area. No permanent changes to the current habitat availability and condition in the North Fork Hughes River as a result of this bridge replacement project are anticipated and water quality and flow conducive to successful reproduction will exist post-construction.

Cumulative Effects
Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. While the Service is not aware of any specific proposed projects scheduled to occur immediately within the action area, it is currently being affected by a variety of actions and activities such as oil and gas development and water withdrawals as described in the "Other Factors Affecting the Species in the Action Area" section above. Multiple oil and gas wells, pipelines, and water impoundments are under construction within the watershed. These activities often result in increased sedimentation and erosion to waterways due to a large quantity of earth disturbing activities.

Summary of Effects
The proposed action could have a number of types of adverse effects on individual snuffbox present in the action area. Direct effects of the proposed action include direct mussel disturbance, direct habitat disturbance, hydrologic effects, sedimentation, streambank disturbance, and potential spills.

We estimate that a total of 1,037 square meters of habitat will be affected by the causeways, temporary bridge pier, and demolition of the existing bridge. Mussels present within this area may be crushed, smothered, dislodged, or killed during construction of the new bridge and removal of the old bridge. Surveys will be conducted within this area prior to construction, and all mussels found will be relocated to an unaffected area upstream. However, relocations are not 100 percent effective and any individuals not detected would still be crushed, killed, or smothered. Juvenile mussels are less likely to be located during surveys and thus may have an increased risk of being crushed and could alter the age-class distribution of the population. Relocated mussels may experience some mortality or stress resulting in reduced growth and reproduction. However, measures have been developed to minimize mortality and stress from relocation. Relocation efforts should significantly reduce the number of mussels that will be exposed to project effects, and also reduce the severity of effects that will be experienced by the remaining individual mussels because mortality associated with relocation is significantly less than mortality associated with direct crushing.

Mussels may also be impacted by hydrologic effects from the installation of the causeways for construction and the demolition of the old bridge. However, it is anticipated that the area of mussel habitat and overall river bed stability should achieve a similar condition to what currently exists post-construction.

Mussels within the action area may also be adversely affected by sedimentation in the form of both increased suspended and deposited sediments. Effects of sedimentation include degraded water and substrate quality, mussel mortality, reduced physiological function, and depressed rates of growth, reproduction, and recruitment. Increases in suspended sediments will likely persist a few days post construction, whereas increased deposited sediments may persist for a few months post-construction until high flows wash them away. However, as a result of the incorporated conservation measures, we anticipate that project effects to sedimentation will be minimal.

As a result of the conservation measures incorporated into the project, we anticipate overall project effects from streambank disturbance and loss of existing riparian vegetation will be minor. We also anticipate that the potential for spills or chemical discharges should be insignificant. If significant spills or toxic discharges do occur, this shall constitute new information that was not considered in this BO.

Indirect effects include effects on the reproduction of mussels in the area, and lost mussel density and abundance until such time that mussels recolonize the area. We expect that there could be reduced reproductive output of mussels within the action area for at least one year post-construction, and a reduction in numbers of young mussels present in the population of the action area, resulting in a population with a larger percentage of older, less reproductively-active individuals. We further expect that while federally endangered mussels will recolonize the area eventually, it will likely take more than 2.5 years for mussels to recolonize the action area to pre-construction densities.

Cumulative effects from oil and gas developments and associated water withdrawals may occur in the area, although they are unquantifiable.

Based on the effects analysis described above, we have determined that the proposed action has incorporated conservation measures into the project that address the following conservation needs of the species in the action area: minimizing the direct loss of existing individuals; and establishing a monitoring schedule to track population and habitat conditions.

CONCLUSION

After evaluating the effects of the action, we must then determine if the proposed action will jeopardize the continued existence of the species. Jeopardize means to engage in an action that reasonably would be expected, directly or indirectly, to appreciably reduce the likelihood of survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species. This is evaluated first by determining the effects to individuals within the action area (in combination with baseline conditions), and then evaluating the significance of those individual effects to the reproduction, numbers, and distribution of the population that they are a part of. If there is an appreciable effect to any one factor at the population-level, then the analysis is extended to determine whether there are appreciable effects range-wide, or to the recovery unit, if recovery units have been designated. Actions that have met or addressed the conservation needs of the species in the action area, and thus are not expected to appreciably reduce the reproduction, numbers, and distribution within the action area, are not likely to jeopardize the species.

Conservation measures have been incorporated into the proposed action that will substantially reduce the scope and significance of all the types of effects described in the Effects of the Action section above. As a result, the number of individual snuffbox that will be affected is low, and the majority of mussels affected will be subjected to sub-lethal effects. An appreciable loss of numbers within the action area is not anticipated. There will be no permanent loss of available habitat, but there will be a loss of mussel density and abundance within the directly disturbed area. However, due to the relatively small length of habitat that will be affected and the expected continued habitat suitability, it is expected that mussels will recolonize the area within a few years. There should therefore be no appreciable loss of distribution in the action area. Some reduction in reproduction and loss of young mussels within the action area is anticipated as a result of direct and indirect effects of the action. The loss in reproductive potential will only affect a limited number of individuals. In the absence of additional disturbances, or habitat or water quality degradation in the future, the reduction in reproduction and recruitment should be temporary and relatively short-term when considering the reproductive life-span of the mussels.

The Cairo Bridge replacement project will both directly and indirectly affect populations of snuffbox within the North Fork Hughes River. However, the Service concludes that the effects of the proposed project will be limited by the inclusion of conservation measures such as: 1) salvaging and relocating of mussels prior to project implementation; 2) reducing the footprint of the project by lifting the bridge debris out of the water; and 3) locating areas of the most direct impact (bridge drop and construction of causeways) in areas of low mussel density. The Service also concludes that the effects of this project, including hydrologic flow changes and sedimentation, will be temporary and do not pose long term risks to the mussel populations within the action area. There will be no permanent changes to the current habitat availability/condition in the North Fork Hughes River as a result of this bridge replacement project. Because of the temporary nature of this project, and the adequacy of the conservation measures, the Service believes that the snuffbox mussel will likely continue to persist within the action area and that habitat quality within the action area will likely recover over time.

After reviewing the current status of the snuffbox mussel, the environmental baseline of the action area, and the effects of the proposed bridge replacement project, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the snuffbox mussel. No critical habitat has been designated for this species therefore, none will be affected.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA, prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the FHWA and the WVDOH and any other action agency, applicant or agent, as appropriate, for the exemption of section 7(o)(2) to apply. The FHWA and the WVDOH, and any other action agency, have a continuing duty to regulate the activity covered by this Incidental Take Statement. If the FHWA and the WVDOH, or other action agency should (1) fail to assume and implement the terms and conditions, or (2) fail to require all parties associated with this action, including any contractors, to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added to any permit, authorization, contract or funding document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the FHWA and the WVDOH, and any other action agency, must report the progress of the action and its impact on the species to the Service as specified in the Incidental Take Statement [50 CFR 402.14(i)(3)].

AMOUNT OR EXTENT OF TAKE

The Service anticipates that take in the form of killing, harm, and harassment (as defined in 50 CFR §17.3) will occur as a result of the proposed action. We anticipate that may potentially be taken during implementation of the Cairo bridge replacement project through direct mortality, injury, and stress. Direct impacts (mortality) to these species are expected in a 1,037 square meter area. Additional temporary, indirect impacts including stress from sedimentation, temporary hydrologic changes, substrate disturbance, and fish host disruption may also occur. It is expected that these indirect impacts will be confined to an area of approximately 1,411 square meters and extends 100 meters downstream.

Mussels within the footprint of the construction may be crushed, smothered, dislodged, or killed if not found and translocated during the pre-construction survey. Relocated mussels may experience some direct mortality and stress as a result of the translocation effort. Mussels located downstream of the footprint of construction may experience direct mortality, injury, stress, and reproductive impairment as a result of in-stream sedimentation and disturbance of streambanks. These events could also result in harm to glocidial life stages of the mussels or to populations of host fish.

Substrate within the direct impact area was a heterogonous mix of sand, gravel, cobble, and boulder, but few mussels were collected. Using density estimates from the 2015 survey, a maximum estimate of 1,780 individual freshwater mussels of all species could inhabit the direct impact area. Snuffbox were not found in the action area, and if present, would be at a low frequency. It is also likely less abundant than the two species found only as shells (*L. cardium* and *S. undulatus*). Using the regression formula generated from the species accumulation curve (y=1.9614ln(x)+0.6164; Figure 7), the ninth live species should be found with the collection of 72 individuals (frequency of 1.4%). Applying this frequency to the number of mussels expected in the direct impact area (105 to 1,780), approximately 1 to 25 snuffbox might occur in the direct impact area associated with Alternative 1B (page 37 of the BA). As Alternatives 1A and 1B both require a temporary detour bridge and differ only in the number of shore-based piers, the number of mussels impacted by these Alternatives are the same (page 38 of the BA).

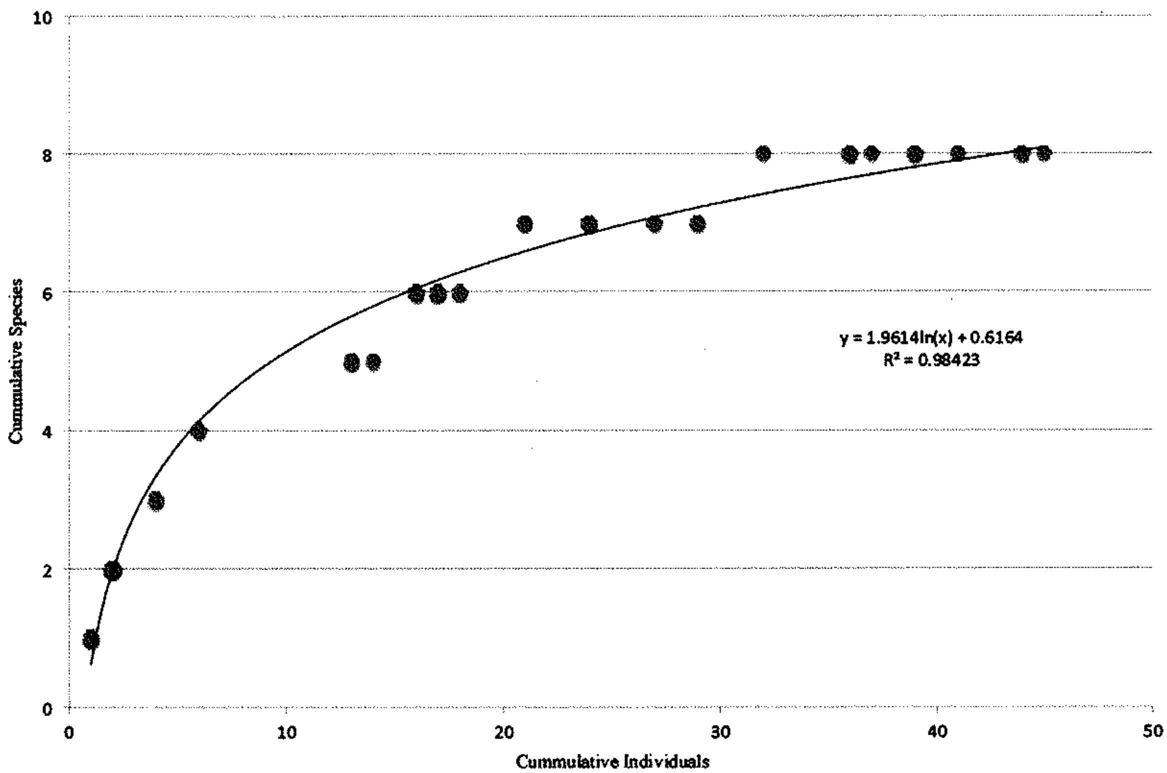


Figure 7. Species accumulation curve

Alternatives 1A and 1B do not require a temporary detour bridge. This reduction in construction footprint, and thus direct impact area results in a slight decrease in the number of mussels expected in the direct impact area (80 to 1,345) and the number of snuffbox that may occur in the direct impact area (1 to 19; see page 38 of the BA).

The indirect impact area is approximately 1,411 square meters and extends 100 meters downstream of the direct impact area. Substrate within the indirect impact area generally consisted of a heterogeneous mix of sand, gravel, cobble, and boulder. The indirect impact area harbored the majority of mussels collected during the 2015 survey. Density estimates from the 2015 survey suggest a minimum of 130 individuals and a maximum of 2,415 individual freshwater mussels of all species may occur in the indirect impact area and may be affected by increased turbidity and sedimentation associated with construction and demolition activities (page 37 of the BA). If snuffbox mussels comprise an estimated 1.4% of the mussel community in the indirect impact area, a maximum estimate of 34 snuffbox individuals may be affected by these secondary impacts.

The current conservation measures (erosion and sediment control and relocation of mussels prior to construction) should reduce negative effects to this species from bridge construction activity. The overall "take" of snuffbox from direct and indirect impacts should not exceed 59 individuals.

These estimated levels of take are based on the proposed project design, assumptions regarding the effectiveness of erosion and sedimentation control and spill control plans, and full implementation of the conservation measures. We note that the actual level of incidental take will be difficult to detect and quantify for the following reasons: 1) as indicated by the results of the mussel surveys within the project action area, these species are present in small, and possibly undetectable numbers; 2) individuals (juveniles and adults) are typically buried in the substrate, making them difficult to locate; 3) finding dead or injured specimens is unlikely; and 4) sub-lethal effects such as stress, reduced fitness, and decreased reproductive success are difficult to measure and detect in the field.

However, implementation of the terms and conditions associated with the reasonable and prudent measures will reduce the impact of the potential for incidental take. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The FHWA and the WVDOH must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

REASONABLE AND PRUDENT MEASURES and TERMS AND CONDITIONS

The Service believes the following reasonable and prudent measures (RPMs) are necessary and appropriate to minimize incidental take of snuffbox mussels. In order to be exempt from the prohibitions of section 9 of the ESA, the FHWA and the WVDOH, any other action agency, applicant or agent, must comply with the following terms and conditions which implement the RPMs and outline reporting/monitoring requirements. These terms and conditions are non-discretionary. Each RPM is listed in italics, followed by numbered terms and conditions that implement each RPM.

RPM 1: Minimize direct impacts to mussel populations through mussel relocation and conduct monitoring to track incidental take.

1.1 Prior to any in-stream activities, the project impact area shall be searched for freshwater mussels and all native mussels found shall be relocated as outlined in the mussel salvage plan in the BA. Personnel conducting the salvage and holding of snuffbox shall obtain a State Collecting Permit from the WVDNR. The Service's West Virginia Field Office (WVFO) shall be notified two weeks prior to beginning salvage operations.

1.2 A report documenting the salvage effort shall be prepared and submitted to the Service's WVFO and the WVDNR within six months of completion of the salvage. The report shall include an introduction, methods section, results section, conclusion and/or summary, and any relevant supplementary information (*e.g.*, names and qualifications of surveyors). The methods section shall detail protocols used for surveying, handling, and transporting mussels. The results section shall include the total number of individuals of each mussel species collected; date collected; water and air temperatures; river stage; total number of live and dead snuffbox mussels collected; condition, size and approximate age of live snuffbox; data regarding non-endangered mussels; and maps or figures showing the salvage area relative to project features (causeways, old bridge, etc).

1.3 The FHWA and WVDOH shall monitor and report the direct mortality of mussels resulting from the implementation of this project subsequent to the removal of the bridge. They shall notify the Service's Office of Law Enforcement in Elkins, WV within 24 hours should any endangered or threatened species be found dead or injured as a direct or indirect result of the implementation of this project. This notification shall include the date, time, and location of the carcass, and any other pertinent information. Snuffbox that are accidentally killed, or that are moribund or freshly-dead and contain soft tissues, shall be preserved according to standard museum practices, properly identified or indexed (date of collection, complete scientific and common name, latitude and longitude of collection site, description of collection site), and submitted to WVDNR for deposition.

1.4 The FWHA and WVDOH shall monitor and report the survival of relocated mussels as stated in the BA. These monitoring efforts will take place one year, three years, and five years post-construction. Copies of yearly reports shall be provided to the Service's WVFO and WVDNR by December 31 of the year the monitoring is completed.

RPM 2: Minimize direct impacts to mussel populations through reducing the project footprint and in-stream activities.

2.1 Any in-stream work conducted in association with this project shall take place outside of fish spawning period of April 1 – June 30.

2.2 The causeway shall be constructed so that the center of the river channel always remains open for fish passage (9.1 meters between the two causeways).

2.3 After the bridge span is dropped into the river, the FWHA and WVDOH or their contractors shall remove all bridge materials and construction debris by lifting them from the river bed. No material or equipment shall be dragged across or through the river bed. This will reduce the footprint of direct impacts to the area directly under the existing bridge span. Contract plans shall contain written language restricting activities to remain within designated areas. The permits from the Corps and the WVDEP shall also restrict work to these areas. If the contractor attempts to do work in areas that are not approved through this BO or permits with the Corps and WVDEP, construction shall cease until reinitiation of consultation is completed.

2.4 The direct footprint of the project's causeway and any culverts shall not exceed 1,037 square meters and shall use clean rock fill that will be completely removed post-construction.

2.5 The FHWA and the WVDOH or their contractors shall not place additional fill in the river beyond what has been described above.

RPM 3: Conduct habitat and depth monitoring to assess any impacts to the riverbed.

3.1 At least 60 days prior to initiating any construction activities, the FHWA and the WVDOH shall develop a habitat monitoring plan to assess the impacts of this project. The survey area of the monitoring plan shall be sufficient to assess the extent of upstream and downstream effects resulting from the project. The plan shall be submitted to the Service for review and concurrence.

3.2 The FHWA and the WVDOH or their contractors shall conduct habitat and depth monitoring in accordance with the Service approved plan within one year prior to construction.

3.3 The FHWA and the WVDOH shall provide the WVFO and the WVDNR with habitat monitoring reports one year, three years, and five years following construction.

3.4 The FHWA and the WVDOH shall provide the WVFO and the WVDNR with a written final report describing the cumulative effects of this project on the stream-bed habitat the North Fork Hughes River and the ability of the site to recover post-construction. This final habitat report shall be provided no later than 18 months after the completion of the project.

RPM 4: Minimize direct and indirect impacts to mussels by using best management practices for erosion and sedimentation.

4.1 The FHWA and the WVDOH or their contractors shall locate all staging areas for construction vehicles and equipment on appropriate work pads located away from any receiving waters of the North Fork Hughes River and shall avoid impacts to riparian vegetation.

4.2 No more than 52.5 linear meters along the left descending bank and 54.3 linear meters along the right descending bank shall be disturbed during construction.

4.3 The FHWA and the WVDOH or their contractors shall mulch and re-seed any disturbed areas within this project site with native vegetation to prevent erosion of these areas into the North Fork Hughes River. In particular, they shall recontour riverbanks and stabilize the soils using native vegetation including live stakes to prevent erosion of these areas that includes native species at a density of 450 woody stems per acre upon initial planting.

4.4 An erosion and sedimentation control and maintenance plan shall be provided to the Service for review and concurrence prior to any ground disturbing activities take place. This plan shall include information on the types of controls to be used throughout the various phases of the project, a maintenance and monitoring schedule for the controls, and information on restoration measures for the site post-construction. At a minimum this plan shall include the following measures to ensure that streambank disturbance will be minimal, that erosion and sedimentation from streambank disturbances will be controlled and minimized, and that riparian habitat will be restored using native woody and herbaceous vegetation: installation of super silt fence and compost filter sock, use of sediment sumps, seeding and mulching of exposed soils within 24 hours, daily inspection and immediate repair of any control features found to be nonfunctioning or in disrepair, reinstallation of any devices that were removed in order to perform work during the day, development of an emergency plan that defines procedures and contacts for unexpected events such as the washout of a causeway, containment spill, or evacuation of equipment from the stream due to high water events, and post-construction restoration/stabilization of stream banks with a permanent erosion control matting filled with a fiber bonded hydro mulch. Design drawings delineating areas to be seeded and areas where permanent erosion control matting may be installed will be submitted to the Service for final approval prior to installation.

RPM 5: Minimize indirect impacts to mussels by using best management practices for the control of invasive species.

5.1 The FHWA and the WVDOH or their contractors shall only use clean rock for the construction of the crane pads and shall remove these materials, along with the gabions and rock fill, from the river following project completion.

5.2 The FHWA and the WVDOH or their contractors shall inspect all construction vehicles and equipment for the presence of invasive species and shall wash/clean this equipment using best management practices before use at the site.

RPM 6: Minimize direct and indirect impacts to mussels by using best management practices for protection of water quality at the site.

6.1 The FHWA and the WVDOH or their contractors shall only fuel and maintain vehicles or equipment within a containment site with adequate buffering (berms, vegetation, etc.) from any receiving waters of the North Fork Hughes River.

6.2 . Construction equipment used on the causeways will be power washed to remove any m contaminants prior to arriving at the project site.

6.3 The FHWA and the WVDOH or their contractors shall inspect construction vehicles and equipment used at the site on a daily basis for leaks of potentially toxic materials including fuels, lubricants, oils, etc. Any fluids found during these inspections shall be immediately contained in accordance with applicable regulations, and the equipment shall be repaired prior to further use on the site.

6.4 The FHWA and the WVDOH or their contractors shall store all potentially toxic substances (fuels, paints, solvents, lubricants, etc.) within a containment area with adequate buffering (berms, vegetation, distance, etc.) from any receiving waters of the North Fork Hughes River.

6.5 The FHWA and the WVDOH or their contractors shall immediately report any unpermitted discharge of any potentially toxic substance to the Service and the West Virginia Department of Environmental Protection upon discovery.

6.6 While this project is in progress, the FHWA and the WVDOH or their contractors shall store construction debris and waste in a stockpile with adequate buffering capacity from any receiving waters of the North Fork Hughes River. At the completion of this project, they shall permanently remove all bridge material and construction debris from the site.

6.7 While this project is in progress, the FHWA and the WVDOH or their contractors shall have a spill containment kit present on site.

RPM 7: Minimize direct and indirect impacts to mussels by informing potential construction companies of the presence of federally endangered species and the site and the requirements of this biological opinion.

7.1 During the bidding process, FHWA and WVDOH shall notify all prospective project contractors of the presence of federally endangered species in the project area <u>and</u> the special provisions necessary to protect them, including the reasonable and prudent measures listed in this document. The successful contractor(s) shall be instructed on the importance of the natural resources in the project area and the need to ensure proper implementation of the required erosion and sedimentation controls, invasive species prevention measures, and spill avoidance/remediation practices.

7.2 The FHWA and WVDOH shall include the following conditions (language) in all construction and demolition contracts awarded for project implementation:

i. Federally endangered species are present in the action area and there is a risk of unauthorized take (ESA section 9 violation) if the attached Terms and Conditions of the Service's biological opinion are not closely followed.

ii. Best Management Practices for erosion and sedimentation control shall be in place before, during, and after any work is conducted.

iii. Contractors shall monitor the action area daily when the site is active and not stabilized, and as soon as possible following severe storms or ice flows when the site is inactive and/or otherwise stabilized, to ensure the erosion and sedimentation control and spill avoidance practices are implemented and effective. Action shall be taken as soon possible to correct malfunctioning erosion and sedimentation control practices.

7.3 The FHWA and the WVDOH shall include a payment incentive/disincentive special provision within the contract documents to encourage contractors to limit the number of days of in-stream work.

CONSERVATION RECOMMENDATIONS

Section 7(a) (1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The Service has identified the following actions which, if undertaken by WVDOH and/or FHWA, would further the conservation and assist in the recovery of the snuffbox:

1. Provide funding to the WVDNR or other facilities to support activities to determine captive husbandry techniques suitable for propagation and augmentation of snuffbox populations within the North Fork Hughes River watershed.

2. Perform a systematic assessment of roads within the North Fork Hughes River watershed to identify sources of sedimentation and fish passage blockages and prioritize restoration of these areas.

3. Create guidelines for road construction activities performed by the oil and gas industry within the North Fork Hughes River watershed that will help minimize erosion and sedimentation impacts to waterways that contain federally listed freshwater mussels. The Service will work with the WVDOH in the development of these guidelines.

REINITIATION NOTICE

This concludes formal consultation on the action outlined in FHWA's request. You may ask the Service to confirm this draft BO as a final BO on the prospective action. The request must be in writing. If the Service confirms this as the final BO on the project, no further section 7 consultation will be necessary except if any reinitiation criteria are met. As required by 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat is designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such a take must cease, pending reinitiation.

The Service appreciates the opportunity to work with FWHA and WVDOH in fulfilling our mutual responsibilities under the ESA. If you have any questions regarding this letter, please contact Ms. Liz Stout of my staff at (304) 636-6586 ext. 15, or at the letterhead address.

Sincerely,

for

John E. Schmidt
Field Supervisor

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