Detailed Alternatives Analysis for the AGSM Bridge Replacement Environmental Assessment

Preface

The following report details the analysis of alternatives for the PFC Abraham G. Sams Memorial (AGSM) Bridge Replacement Project. It describes the development of the range of alternatives considered and the selection of a Preferred Alternative for carrying through the Environmental Assessment, prepared in accordance with the National Environmental Policy Act (NEPA).

As of December 22, 2014, the process detailed herein is very similar to the analysis presented to the U.S. Fish and Wildlife Service (USFWS) in the Biological Assessment submitted on November 17, 2014 as part of the ongoing coordination required by Section 7 of the Endangered Species Act of 1973. However, specific information on the locations of high quality habitat and where endangered species were found has been omitted from this report because of the public nature of the Environmental Assessment and the need to protect the species. Correspondence with USFWS has included that additional information.

Figures referenced throughout this text are presented at the end of the report.

Project Description

The West Virginia Division of Highways (WVDOH), in cooperation with the Federal Highway Administration (FHWA), has considered a wide range of alternatives for replacing the PFC Abraham G. Sams Memorial Bridge (AGSM Bridge), also known as the Camp Creek Truss Bridge. This bridge carries Clay County Route 4/5 (CR 4/5) over the Elk River. Views within the Project Area are shown in Figure 1.

Project Need

The replacement of the AGSM Bridge is necessitated by its current condition. The AGSM Bridge was constructed in 1925 and renovated in 1978. The bridge was found not to be eligible for listing on the National Register of Historic Places by the State Historic Preservation officer by letter August 18, 2006. The 300-foot long structure consists of one simple 150-foot span steel through truss and two simple 75-foot span steel pony trusses, founded on two reinforced concrete abutments and two in-stream concrete piers. It is comprised of two principal components: the piers, which are the main supports founded on ground below the river mud; and the truss superstructure, which carries the traffic across the piers. The AGSM Bridge is 15' 9" wide, providing one lane of traffic.

Based on the findings of a bridge inspection performed by WVDOH in 2000, the existing bridge was found to have a sufficiency rating of 40.1 out of 100[1]. The 2012 inspection found "fracture critical" locations where, if a break occurs, the bridge fails. The bridge piers exhibit cracking and spalling, and various pieces of the truss display substantial loss, with rusting and holes. The bridge and an example of its rusted pin locations are shown in Figure 1.

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[1] The sufficiency rating formula provides a method of evaluating highway bridge data by calculating four separate factors to obtain a numeric value which is indicative of bridge sufficiency to remain in service. The result of this method is a percentage in which 100 percent would represent an entirely sufficient bridge and zero percent would represent an entirely insufficient or deficient bridge. The formula considers the structural adequacy; functional obsolescence and level of service; and essentiality for public use. FHWA. 2011. "Bridge Preservation Guide."

A 2012 traffic study estimated that 450 vehicles per day cross the bridge and that this level will increase to 600 by 2032. Deterioration of the AGSM Bridge has warranted the placement of increasingly strict weight limits for vehicles using the bridge, and, after the 2012 bridge inspection, a 7-ton limit was put into effect. These restrictions hamper the flow of services (e.g., first responders, EMS, and fire departments) and day to day travel for local residents. Eventually, deterioration will likely result in the closing of the AGSM Bridge, necessitating detours. The next nearest bridge over the Elk River is more than 6 miles away along narrow, winding roads. The detour for a traveler to Clay requires a total of 16 additional miles of travel.

In summary, the Project Area has the following needs related to the AGSM Bridge:

- Avoidance of permanent bridge closure.
- Improved safety of the bridge, through such measures as providing a two-lane bridge with wider shoulders.
- Maintained or improved service of the bridge, through such measures as avoiding additional weight limits or removing the weight limit.

Project Purpose

Based on the needs discussed in the previous section, a project purpose has been developed. The purpose of the project is to replace the existing AGSM Bridge so that the replacement meets current design standards to efficiently and effectively serve the transportation needs of first responders (e.g., fire trucks, ambulances, and hazardous materials response vehicles), through travelers, and the residents of the nearby community.

Analysis of Project Alternatives

Early Alternatives and Mussel Studies

In 2001, WVDOH produced a Bridge Replacement Study for the project, examining the No Build Alternative and three different Build Alternatives. As part of the project scoping, resource agencies were consulted and a mussel survey was conducted in the Project Area river bed. In the 2001 mussel survey, 17 species of mussels were found, including the federally listed endangered pink mucket (*Lampsilis abrupta*).

As presented in the November 13, 2014 Biological Assessment for the Project, the following paragraphs summarize protections for endangered species and mussels in West Virginia:

> "The purpose of the Endangered Species Act (ESA) of 1973 is to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved (Section 2(B)). Congress further declared that all Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of the purposes of the ESA (Section 2(c)(1)). The term conserve means "…the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary" (Section 3(3)). To this end, Section 9 of the ESA sets forth specific prohibitions related to the "take" of a listed species as defined in the statute and regulation. The 'take' prohibition applies to all 'persons,' including federal, state, and local agencies; corporations, businesses, and individuals, regardless of project funding sources or applicable permit requirements. Section 11 provides for civil and criminal penalties for violations of the 'take' prohibitions. Section 7 establishes procedures for interagency cooperation to assist federal agencies in meeting the purposes of ESA, while Section 10 allows for certain exceptions to the 'take' prohibitions.

> "Although West Virginia does not have state threatened and endangered species legislation, freshwater mussels are considered a 'no take' species within the state. West Virginia does maintain a list of state rare, threatened, and endangered species. In order to obtain project clearance for in-stream projects where mussels may be present, the West Virginia Department of Natural Resources (WVDNR) requires that mussel surveys and, if avoidance cannot be implemented, translocations be performed. If the WVDNR concurs with the project biological assessment, they will issue a permit that will allow for the salvage and relocation of listed and non-listed mussels; mussels cannot be moved without this authorization."

In addition, Section 7 of the ESA sets forth guidelines for consultation with the USFWS. Section 7 informal consultation proceeded in the early to mid-2000's, and WVDOH conducted an additional mussel survey in 2006. Again with this survey, 17 species of mussels were found, including the federally listed endangered pink mucket. Both USFWS and WVDNR responded to WVDOH with concerns for impacts the project may have on the mussels. The alternatives analysis was examined again, using avoidance and minimization of impacts to the mussels as a priority. As described in the following sections, this included consideration for a Build Alternative farther away from the existing location than previously considered, as well as creative mechanisms for removing the existing bridge.

Basic Alternative Options

Prior to analysis of specific locations and construction alternatives, WVDOH considered more basic project options:

- No Build Alternative
- Rehabilitate the Bridge
- Leave the Bridge in Place (and Build Elsewhere)
- Remove Bridge (and Re-Build in Place or Build Elsewhere)

Each of these general options was assessed to find whether or not it can fulfill the purpose and need of the project and whether or not it can avoid impacts to the mussels.

Alternative locations are discussed later in this analysis.

➢ No Build Alternative

This alternative considered if the bridge was not replaced or rehabilitated, but repaired until it reached the end of its service life and then closed. With this alternative, travelers would need to use a detour of an additional 16 miles. This alternative did not meet the project need and would result in significant hardship for local residents and other users by eliminating a vital access to goods and services, including emergency services. Eventually the bridge would deteriorate to a point where it would collapse under its own weight or need to be removed. Also, scour and log jam issues with the existing piers would continue to progress, resulting in potentially significant uncontrolled impacts to aquatic species. As a result of this analysis, the no build alternative was dropped as a viable option, but it is carried forward in the Environmental Assessment as a basis for the comparison of other alternatives, as required by NEPA.

➢ Rehabilitation

Investigations found that rehabilitation cannot eliminate the functional deficiencies of the bridge, and, therefore, cannot address the project's purpose and need.

In addition, with this alternative:

- The weight limit cannot be eliminated.
- There is only minimal extension of the service life, requiring continual detailed inspections and maintenance activities.
- At least one of the existing piers has scour issues that require in-stream work.

Therefore, this alternative was not carried forward.

➢ Bridge Left in Place and New Bridge Built Elsewhere

Because this alternative includes building a new bridge, presumably to the necessary design standards, this alternative would fulfill the project purpose and need. WVDOH investigated whether or not this alternative could also offer avoidance of the mussels.

With the deteriorating state of the structure, the existing bridge and piers will collapse into the river if left alone. Falling structure would harm mussels and habitat more than it would with the benefit of controlled dismantling.

In addition to the impact to the mussels, this alternative is unacceptable because of safety and floodplain impacts. Currently, the existing bridge and a small adjacent community are located within the 100-year floodplain of the Elk River, constrained within a narrow valley. Unpredictable and uncontrolled collapse of the bridge poses safety concerns to people using the river or bridge for recreation or travel. Hydraulic and hydrologic studies show that leaving the existing bridge piers in combination with a new bridge would increase the 100-year flood elevation. As shown in Figure 2, the existing 100-year floodplain already inundates the banks, and any increase is unacceptable.

Therefore, the option of leaving the bridge in place (either the whole bridge or just the piers) was not carried forward for further analysis.

➢ Bridge Removed and New Bridge Built

Again, because this alternative includes building a new bridge, presumably to the necessary design standards, this alternative would fulfill the project purpose and need. WVDOH investigated whether or not this alternative could also offer avoidance of the mussels.

WVDOH studied various methods for removing the bridge, a task which was consistently found to create more aquatic impacts than the construction of a new bridge because of the existing structure's size, weight, structural instability, and poor site access.

It was determined the side spans can be removed with minimal disturbance in the river; however, the middle span requires substantial disturbance in the river. WVDOH studied the possibility of using shallow work barges to remove the middle span, but they would bottom-out on the mussel habitat. A large crane is needed to remove the middle span, and this poses several challenges. The crane cannot be transported to the southeastern bank because of narrow, curved roads. On the northwestern bank, use of the large crane necessitates the construction of an enlarged causeway into the river to hold the crane and a platform along the bank to hold the removed middle span. A schematic depiction of this scenario is provided in Figure 3.

In addition to these challenges, removing the middle span with a large crane poses a particular risk of bridge debris collapse into the river because of structural instability. The swinging and twisting motion would stress the fracture critical pin locations (see example in Figure 1). Therefore, to avoid the risk of uncontrolled collapse and impacts from

the use of the large crane, it was determined that the middle span must be dropped into the river and removed by smaller crane.

Because of the impacts associated with removing the existing bridge, this alternative cannot avoid impacts to the mussels regardless of the avoidance measures taken with locating and constructing a new bridge. Therefore, it was determined that there was no practicable alternative available that would avoid all impacts to unionid mussels, including the federally endangered pink mucket, and analysis proceeded to determine the least damaging new bridge alternative.

Construction Alternatives

Different construction alternatives were considered for a new bridge, including single-span, two-span and three-span arrangements. Hydraulic and hydrologic analysis was conducted to determine the resultant flood elevations with different scenarios. A single-span bridge could offer the best opportunity to avoid mussel impacts. However, a single-span bridge would require such a large girder that floodwaters would be blocked by the structure, thus raising the 100-year flood elevation, which is unacceptable. This was also found to be the case with the two-span bridge option.

H & H analysis indicated that an 85 ft – 150 ft – 85 ft three-span arrangement will not increase the 100-year flood elevation. In addition, with this arrangement, new bridge piers that may be located in the vicinity of the existing bridge will be farther away from suitable habitat than the existing piers. Suitable habitat areas are defined as including Very High, High, and Marginal habitat areas and excluding Low/Marginal habitat areas. This new span arrangement will have the piers located approximately 10 feet to the southeast of existing locations, with the northwestern pier deeper in the river and farther from the northwestern mussel beds, and the southeastern pier outside of the river's normal pool and farther from the southeastern mussel beds.

Location Alternatives

Because an infinite number of locations could be assessed, alternatives were narrowed based on the mussel habitat, roadway location, topography, and residential layout. Far downstream alternatives were eliminated because of lack of an existing roadway to tie into on the south side of the river. Therefore, general locations, relative to the existing bridge, under consideration included:

- Existing location,
- Far upstream,
- Immediate upstream, and
- Immediate downstream.

The alternatives studied at these locations and described in the following sections are depicted in Figure 4.

- Existing Location: Alternatives 1A and Alternative 1B

A variety of options for a new bridge at the existing location were considered. To avoid some of the in-stream work from building in the existing location, consideration was given to replacing just the superstructure atop the existing piers; however, the piers do not have the structural integrity to support the new superstructure and design loads. To avoid having to detour traffic 16 miles with the next river crossing, a temporary bridge in line with the existing road and adjacent to the existing bridge location was considered (Alternative 1A). However, a single-span temporary bridge was found to be cost-prohibitive, and placing an additional pier or piers in the river for a temporary bridge would substantially impact mussels and mussel habitat greater than the new bridge construction alone.

The remaining alternative under consideration for the existing location is Alternative 1B (Figure 4). Alternative 1B consists of replacing the entire bridge in place. This alternative does not require any residential relocations (Table 1).

Alternative 1B does not include a temporary bridge for traffic maintenance during construction. Instead, this alternative employs Accelerated Bridge Construction to shorten the time required for the detour. The span arrangement was optimized to three spans of 85 ft-150 ft-85 ft, which does not raise the flood elevation. Additionally, this arrangement places the piers outside the suitable mussel habitat that lies in the vicinity of the existing bridge. However, this alternative requires that the existing bridge be demolished prior to new construction. Because of the size and limited stability of the bridge's middle span, this process requires dropping the middle span into the river to remove it.

Alternative 1B was analyzed for impact to mussels and suitable habitat. Temporary impact to suitable mussel habitat totals approximately 7,300 sq ft, and overall temporary impact to the streambed totals 9,020 sq ft (Table 1). These impacts are due to the area of causeway required in the river to both construct the new bridge and demolish the existing bridge.

- Far Upstream from Existing Bridge: Alternative 4

Any location upstream of the mussel beds would have the same reduction in direct impact from construction, provided no new mussel beds were found. However, the specific upstream location was selected based on the configuration of the neighborhood and an existing roadway, Scenic River Road (CR 4/6). This alternative is called Alternative 4 and lies approximately 600 feet upstream of the existing bridge (Figure 4). Alternative 4 turns away from the alignment with Scenic River Road to cross the river at a gap between a residence and the Burke Memorial United Methodist Church. Mussel surveys confirmed no direct impacts to suitable mussel habitat will occur with construction of a new bridge at this location. Alternative 4 also has an optimized span arrangement of 85 ft-150 ft-85 ft, which does not raise the flood elevation. This alternative requires one (1) residential relocation as well as property from five (5) other residences and the church (Table 1).

Alternative 4 employs the existing bridge for traffic maintenance during construction. After the new bridge is constructed, the existing bridge is demolished. Because of the size and limited stability of the bridge's middle span, this process requires dropping the middle span into the river to remove it.

Alternative 4 was analyzed for impact to mussels and suitable habitat. Although no threatened or endangered mussels or suitable mussel habitat are known to exist at the location of Alternative 4, mussels are still being impacted with this alternative during the demolition of the existing bridge. Alternative 4 has the same impacts to suitable habitat areas as bridge removal alone; however, there is substantially more stream area disturbed because of the upstream project area for the new bridge. Temporary impact to suitable mussel habitat totals 6,640 sq ft, and overall temporary impact to the streambed totals 17,040 sq ft (Table 1).

- Immediate Upstream from Existing Bridge: Alternative 3

Alternative 3 places a new bridge approximately 20 feet upstream of the existing bridge (Figure 4). Again, this alternative has an optimized span arrangement of 85 ft-150 ft-85 ft, which does not raise the flood elevation. Additionally, this arrangement places the piers outside the suitable mussel habitat that lies in the vicinity of the existing bridge. Alternative 3 employs the existing bridge for traffic maintenance during construction. After the new bridge is constructed, the existing bridge is demolished. This alternative requires one (1) residential relocation (Table 1).

During development of this alternative, WVDOH found opportunity to reduce the demolition impacts. Because of its proximity to the existing bridge, the new bridge at this location can be used as a platform for the middle span. Instead of dropping the middle span into the river, the middle span can be lifted in a controlled manner, with a crane positioned on one of the pads used for the new bridge construction, and then placed onto the new adjacent superstructure. From there, the middle span can be dismantled and removed. Therefore, Alternative 3 offers the chance for considerably less in-stream disturbance than Alternative 4.

Alternative 3 was analyzed for impact to mussels and suitable habitat. Temporary impact to suitable mussel habitat totals 3,620 sq ft, and overall temporary impact to the streambed totals 8,650 sq ft (Table 1).

- Immediate Downstream from Existing Bridge: Alternative 2C

Alternative 3 places a new bridge approximately 20 feet upstream of the existing bridge (Figure 4). As with the other Build Alternatives, this alternative has an optimized span arrangement of 85 ft-150 ft-85 ft, which does not raise the flood elevation, and, this arrangement places the piers outside the suitable mussel habitat that lies in the vicinity. As with Alternatives 4 and 3, Alternative 2C employs the existing bridge for traffic maintenance during construction. After the new bridge is constructed, the existing bridge is demolished. This alternative does not require any residential relocations, and property from two (2) residences will be required (Table 1).

As with Alternative 3, Alternative 2C's proximity to the existing bridge allows the new bridge to be used as a staging platform for the middle span, thus reducing mussel impacts during demolition. Instead of dropping the middle span into the river, the middle span can be lifted in a controlled manner, with a crane positioned on one of the pads used for the new bridge construction, and then placed onto the new adjacent superstructure. From there, the middle span can be dismantled and removed. Therefore, Alternative 2C also presents the opportunity for considerably less in-stream disturbance than Alternative 4.

Alternative 2C was analyzed for impact to mussels and suitable habitat. Temporary impact to suitable mussel habitat totals 2,180 sq ft, and overall temporary impact to the streambed totals 8,070 sq ft, (Table 1). In addition, with Alternative 2C the causeway configuration can avoid all impacts to highly suitable and very highly suitable habitat areas.

Table 1: Comparison of Build Alternative Impacts

Alternative	Location	ROW Requirements	Cost (Million Dollars)	Temporary Impact to All Suitable* Habitat (sq ft)	Total Temporary Impact in Streambed (sq ft)	Estimated # of Mussels Impacted
Alternative 1B	existing location	0	$3.7	7,300	9,020	2,174
Alternative 4	upstream	1 residence; property from 5 other residences and 1 church	$5.0	6,640	15,650	2,169
Alternative 3	immediately upstream	1 residence	$3.5	3,620	8,650	510
Alternative 2C	immediately downstream	0; property from 2 residences	$3.4	2,180	8,070	16

*These areas include Very High, High, and Marginal habitat areas and exclude Low/Marginal habitat areas.

Preferred Alternative Selection

Based on a review of all the alternatives, Alternative 2C was selected as the Preferred Alternative. Alternative 2C presented the best option to minimize impacts to Threatened and Endangered mussel habitat while still meeting the purpose and need of the project. This alternative had the fewest impacts to mussels, the smallest impact to suitable habitat, and the least amount of overall streambed impact. In a letter dated May 2014, USFWS concurred with the selection of Alternative 2C as the alternative that best minimized impact to mussel habitat. Preferred Alternative 2C is shown in Figure 5.

Figure 1: Project area elements. Left = View of the AGSM Bridge from the north. Top Right = Neighborhood to the southeast of the bridge, including County Route 4/5, homes, a church, and an inactive railbed (visible on the right). Bottom Right =. One of the bridge's many pin locations, where one element's failure would cause the bridge to collapse.

Figure 2: Depiction of flooding in Project Area. Left - Plan view above Project Area, with existing bridge shown in gray and blue lines indicating the breadth of 100-year floodwaters. Right - Profile cross-section view, looking downstream, at River Station 1739, approximately 600 feet upstream of the existing bridge. Blue indicates 100-year floodwaters, which inundate the banks, including CR 4, CR 4/5 (the bridge itself), and CR 4/6.

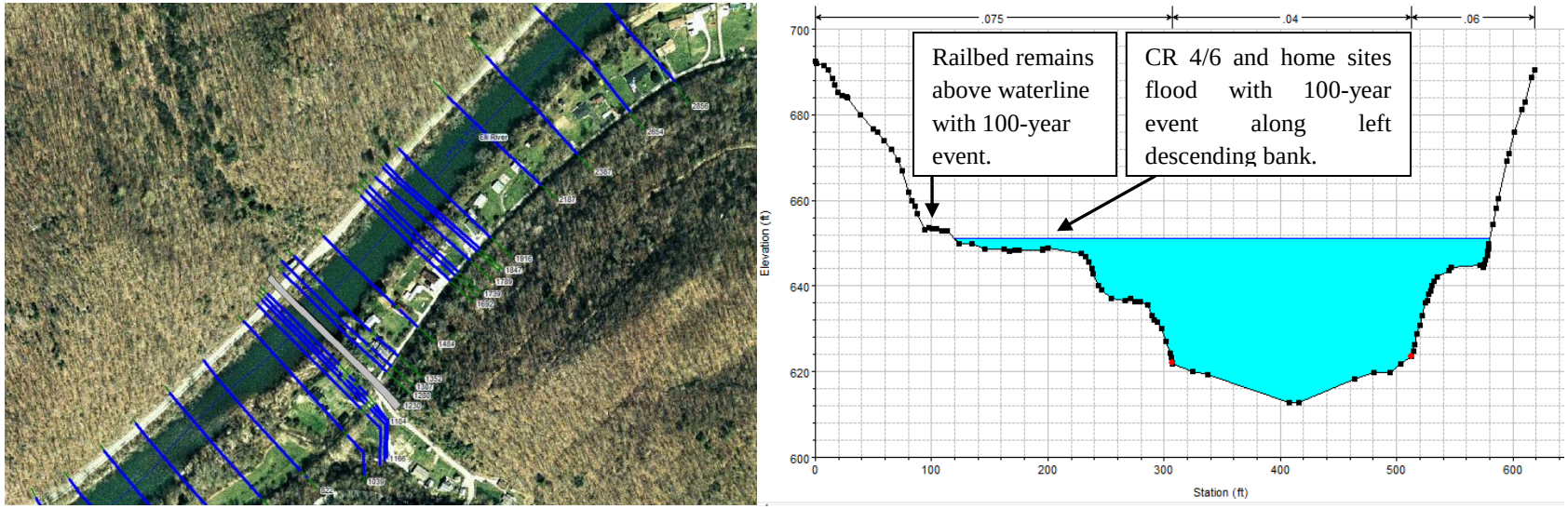

Figure 3: Depiction of removal of middle span. a. (top) Existing bridge from upstream after removal of the side spans. The middle span is being removed by a large crane on the northern side of the Elk River. The area in orange is the new causeway area required for the large crane. This would be in addition to the causeway required just for the smaller cranes to remove the side spans. b. (bottom) Plan view of removing the middle span with a single large crane. This shows the additional causeway and the area on the bank for setting down the truss.

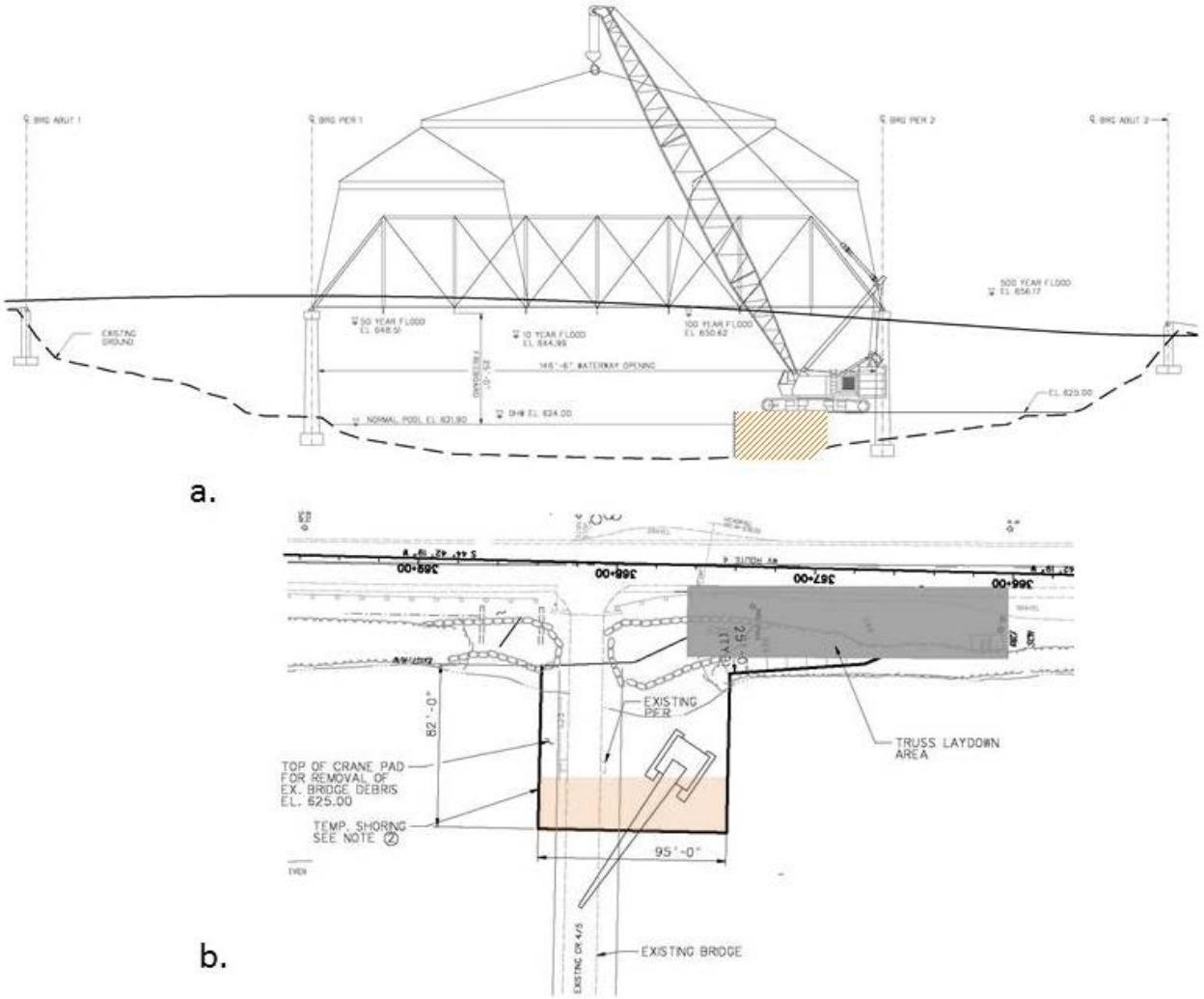

Figure 4: Build Alternatives

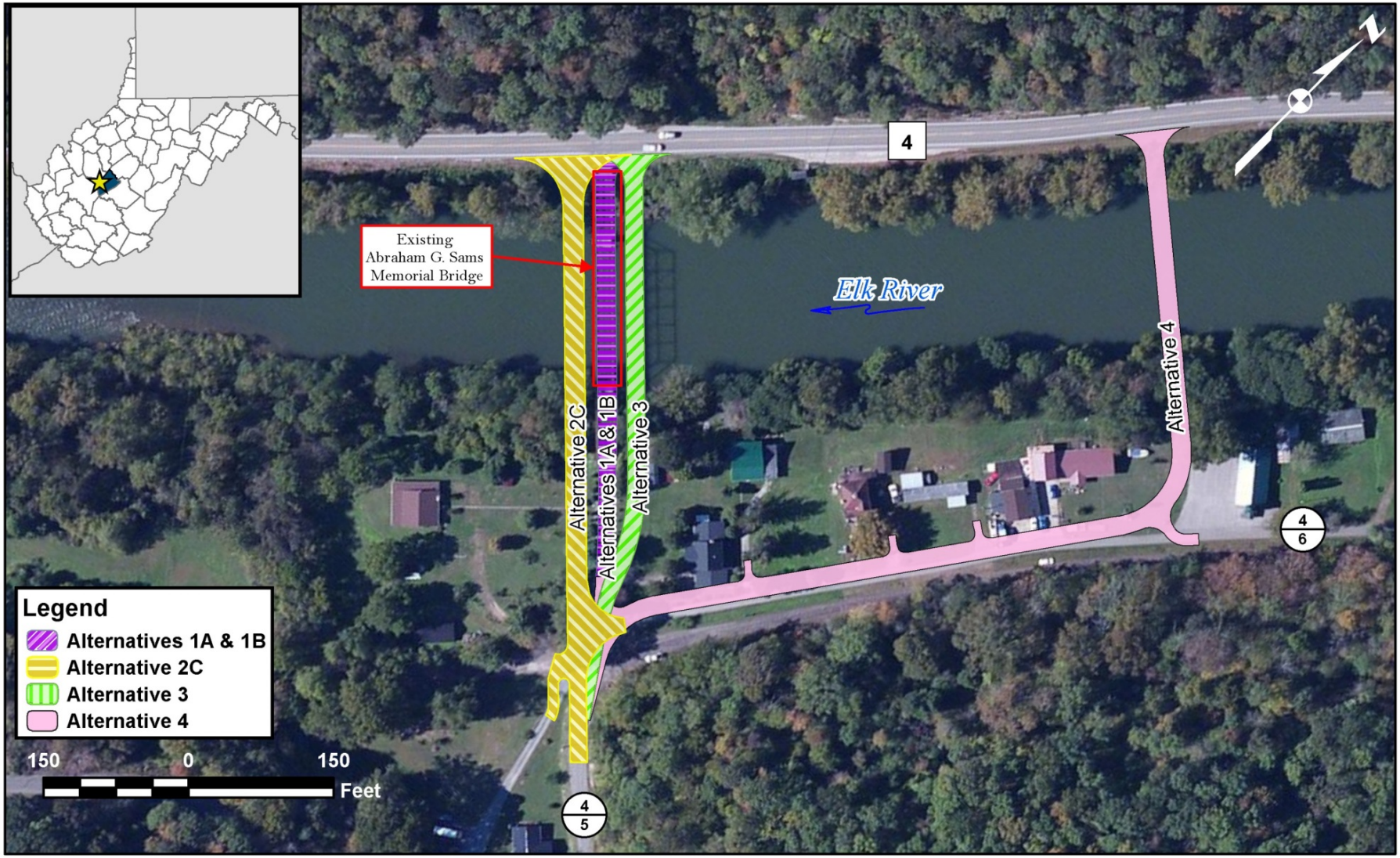

Figure 5: Preferred Alternative