Design Support Report for Programmatic Section 4(f) Alternatives Analysis

U.S. Highway 60 Bridge Over Horse Creek

Afton, Ottawa County

Job Piece No.: 31715(05)

NBI Bridge No.: 05017
Structure No.: 5806 0256 X

Prepared for
Federal Highway Administration

and

Oklahoma Department of Transportation

Prepared by
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   (April 6, 2015)

B  Project Location Map

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F  Preliminary Plans for Bridge and Approaches, US 60 over Horse
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1. Introduction

According to Section 4(f) regulations (23 CFR 774), the Federal Highway Administration (FHWA) may not approve an action that uses publicly owned parks, recreation areas, wildlife and waterfowl refuges, or historic sites, including historic bridges, when there is a feasible and prudent alternative to the action. Actions that “use” a historic bridge are those that result in the demolition or removal of the structure or that reconstruct it to such an extent that the character-defining features that give it historic significance are eliminated or substantially impaired. As established by the Programmatic Section 4(f) Evaluation for Historic Bridges, a limited number of avoidance alternatives must be evaluated and rejected before the FHWA can approve an action that uses a historic bridge. The purpose of this report is to present the alternatives analysis for the U.S. Highway (US) 60 Bridge over Horse Creek to enable the FHWA and the Oklahoma Department of Transportation (ODOT) to assess the feasibility and prudence of the alternatives.

To prepare this report, a Mead & Hunt, Inc. (Mead & Hunt) qualified professional historian and professional structural engineer conducted a site visit to the bridge on April 20, 2016; reviewed bridge inspection reports, bridge plans, and other documents related to the bridge; and participated in conference calls with representatives from ODOT and the design consultant.

Constructed in 1936, the US 60 Bridge over Horse Creek is listed in the National Register of Historic Places (NRHP) under Criterion A: Transportation. The bridge is significant as a unique example of the need to accommodate pedestrians in a time when the automobile was becoming the dominant mode of transportation. The 143-foot-long steel I-beam bridge is known locally as “the side-walk” bridge for its double reinforced-concrete walkway design. The sidewalks and associated railings are the key elements of the US 60 Bridge that represent its significance and therefore are its character-defining features.

The remainder of this report is organized to present a description of the bridge and its existing conditions, identify the proposed project’s purpose and need, and discuss the analysis of three primary avoidance alternatives. The three primary alternatives under consideration in this document are:

1. Do nothing;
2. Rehabilitate the historic bridge for continued vehicular service for two-way traffic; and
3. Construct a structure on new location without adversely affecting the historic bridge’s integrity.

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3 National Register of Historic Places, Horse Creek Bridge, Afton, Ottawa County, Oklahoma. National Register #95000040.
Alternative 3 identified above is subdivided into three options:

- **Option A** – Retain the historic bridge in vehicular service as half of a one-way couplet.

- **Option B1** – Retain the historic bridge as a monument with a new bridge constructed on an offset highway alignment.

- **Option B2** – Retain the historic bridge as a non-motorized vehicle/pedestrian/bicycle facility with a new bridge constructed on an offset highway alignment.

The American Association of State Highway and Transportation Officials (AASHTO)'s *A Policy on Geometric Design of Highways and Streets 2011* (AASHTO Green Book) was used to complete the alternatives analysis in accordance with FHWA and ODOT guidelines for the Design Support for Section 4(f) Analysis for Historic Bridges.
2. Existing Conditions

This section addresses the existing condition of the US 60 Bridge, including a description of the structure and its setting. Two primary considerations in this section for the US 60 Bridge are structural deficiency and functional obsolescence. A discussion of the bridge’s current sufficiency rating, which is determined during each bridge inspection, is also presented to provide a framework for understanding the bridge’s structural deficiency and functional obsolescence. The latest ODOT Bridge Inspection Report, based on an inspection performed on April 6, 2015, is included in Appendix A.

A. Description

The US 60 Bridge over Horse Creek is located in ODOT Division 8, in the northeast area of the city of Afton, Ottawa County, Oklahoma, 2.6 miles north of the Delaware County Line (see Appendix B for a project location map). Residential and commercial properties are located to the west of the bridge on both sides of US 60.

The US 60 Bridge over Horse Creek is a three-span structure with an overall length of approximately 143 feet, as measured from the back of the abutments. The bridge consists of one 60-foot-long and two 40-foot-long steel I-beam spans, with a cast-in-place reinforced-concrete deck providing a 24-foot clear roadway for two lanes of traffic and two 5-foot-wide sidewalks, one on each side of the roadway. The bridge has reinforced-concrete railings on each side of the sidewalks, for a total of four railings. The bridge is skewed at a 45-degree angle with the waterway.

The steel I-beam spans are supported on two cast-in-place reinforced-concrete abutments (each with two cast-in-place reinforced-concrete wingwalls) and on two cast-in-place reinforced-concrete piers with concrete web walls between concrete columns. The foundations for the abutments and piers are supported on limestone bedrock. See Appendix C for photographs of the bridge and Appendix D for select original plans for this bridge.

The bridge was originally designed for an AASHTO H 20 (20-ton truck) live load. The bridge is not load posted/weight restricted. The bridge inspection report (April 2015) indicates that this bridge was last load rated on August 1, 2006, using the Load Factor (LF)-Ton inventory rating method. The results of that rating indicate a Posting of 5: At/Above Legal Loads.

US 60 at the project site is classified as a rural minor arterial highway. The highway is not on the National Highway System and is not part of a national truck route. The 2016 average annual daily traffic (AADT) on the bridge is 7,000 vehicles; the projected 2036 AADT is 11,200 vehicles. The truck percentage as a measure of AADT is approximately 23 percent. The posted speed limit at the bridge location is 35 miles per hour (mph) and increases to 45 mph east of the bridge. There have been several crashes at this bridge in recent years, as evidenced by repairs to three sections of the concrete bridge railings. These crashes appear to have been single vehicle collisions with the concrete railings, as documented in ODOT’s Collision Analysis Report for the period January 2004 to December 2006.
Several items impact the hydraulics of Horse Creek. An active railroad bridge is located approximately 650 feet upstream (north) of the existing bridge. In addition, there are remnants of the old Route 66 Bridge and abandoned highway fill to the north of the existing bridge. The old concrete west abutment remains surrounded with vegetation. Portions of two concrete pier foundations remain in the waterway. These old substructure remnants and highway fill appear to partially obstruct the Horse Creek waterway flow.

B. Current bridge sufficiency rating

The bridge’s current sufficiency rating is 29.9 out of a possible 100 points. The sufficiency rating measures a bridge’s capability to remain in vehicular service, based on a mathematical formula incorporating condition ratings, load capacity, roadway and structure geometrics, traffic counts, presence of suitable detour routes, and other bridge inspection factors. A bridge with a sufficiency rating of 80 or less is eligible for federal bridge rehabilitation funding. A bridge with a sufficiency rating of 50 or less is eligible for federal bridge replacement funding.

The bridge is structurally deficient (SD) and functionally obsolete (FO) with the following National Bridge Inventory (NBI) ratings on a scale of 9 = Excellent Condition to 0 = Failed Condition as shown in Table 1, in accordance with the current Bridge Inspection Report (April 2015) (see Appendix A). This report will be referred to herein after as “Bridge Inspection Report.”

<table>
<thead>
<tr>
<th>Item</th>
<th>Current Rating (April 2015)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NBI Item 58 (Deck)</td>
<td>3 = Serious</td>
</tr>
<tr>
<td>NBI Item 59 (Superstructure)</td>
<td>4 = Poor</td>
</tr>
<tr>
<td>NBI Item 60 (Substructure)</td>
<td>5 = Fair</td>
</tr>
<tr>
<td>NBI Item 61 (Channel)</td>
<td>7 = Minor Damage</td>
</tr>
<tr>
<td>Overall Sufficiency Rating</td>
<td>29.9 (SD, FO)</td>
</tr>
</tbody>
</table>

C. Structural deficiencies and condition

Bridges are considered structurally deficient if significant load-carrying elements are found to be in poor condition due to deterioration and/or damage. Structural deficiency is numerically defined as a bridge component (deck, superstructure, or substructure) having an NBI general condition rating of 4 (poor condition) or less. The concrete deck for this bridge has a rating of 3, and the superstructure has a rating of 4. Based on the Bridge Inspection Report and field verification, the structural deficiencies and conditions are listed below according to NBI item, along with the condition state for individual elements.

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4 According to the Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges, "Rating 3 - Serious Condition" means that structural elements show loss of section, deterioration, spalling or scour having seriously affected primary structural components. Local failures are possible.

5 NBI element-level inspection condition state for individual components of a bridge are defined as follows: 1 = Good; 2 = Fair; 3 = Poor; 4 = Severe; and 5 = (undefined, but is critical or imminent failure).
Section 2
Existing Conditions

- NBI Item 36A-Bridge Rail, Item 36B-Rail Transition, Item 36C-Approach Rail, and Item 36D-Approach Rail Ends: These items rate as 0-Substandard. The concrete railings between the roadway and the sidewalks do meet current crash rating test level (TL) standards.\(^6\) The concrete railings on the outside of the sidewalks do not meet current geometric and safety requirements for overall height and for minimum clear opening dimensions between elements of the railing. There is no approach railing to the bridge, nor are there any approach railing ends.

- NBI Item 58 – Deck (3, serious condition): The entire reinforced-concrete deck is rated in Condition State 3 – Poor. The concrete deck has many cracks, patched areas, spalls, and impending potholes with exposed reinforcing steel bars. Joints in the concrete deck have completely failed and are allowing water and debris to drip onto the steel beams and steel diaphragms below the joints. The deck was observed to be pumping or bouncing on the steel beams when traffic passed over. This is because the concrete deck is not physically attached to the steel beams. The reinforced-concrete sidewalks are in fair condition without any potholes or spalled areas. The longitudinal joints between the sidewalks and the bridge railings are unsealed, allowing water to drip on the steel beams below.

- NBI Item 59 – Superstructure (4, poor condition): The steel beams that support the roadway concrete deck and concrete sidewalks are in Condition State 2 – Fair. The paint system has failed in approximately 25 percent of the surface area of the steel beams, primarily at the ends over the bearings. Minor deterioration of the steel was observed at the ends of the beams; several of the beams have supplemental steel sections welded to them on the bottom flanges at the ends. Steel diaphragms between the beams over the piers and abutments have failed. Many of the steel diaphragms have completely deteriorated with total loss of section; several of the most deteriorated diaphragms have been removed. Steel bearings for the beams have complete paint failure and moderate loss of section.

- NBI Item 60 – Substructure (5, fair condition): The reinforced-concrete piers and abutments are in Condition State 2 – Fair. The west abutment and east abutment have minor spalls and cracks with exposed reinforcing steel; several of the cracks have efflorescence. Other than very minor spalling on top of the concrete caps, the reinforced-concrete piers did not exhibit structural deficiencies.

- NBI Item 61 – Channel and Channel Protection (7 = minor damage): The north embankment for the west abutment is protected with riprap consisting of chunks of concrete and large segments of asphalt. This protection appears to be stable, with only a few chunks dislodged and resting in the waterway. The north embankment of the east abutment is protected with segments of asphalt and layers of crushed asphalt. This protection appears to be stable. Plans for the original bridge construction indicate that stone riprap was provided at each of these locations.

\(^6\) TL 3 for speeds less than 50 mph with approach guardrail or TL 4 for speeds less than 50 mph without approach guardrail.
Section 2
Existing Conditions

- NBI Item 71 – Waterway Adequacy (7, above minimum): The bridge crosses over Horse Creek at a 45-degree skew angle. The westerly portion of the river channel under the westerly span of the bridge has filled itself in over the years, and is currently a blockage to the full hydraulic opening through the bridge. The main water channel passes under the center span of the bridge for low flow events. At the time of the site visit, water was flowing only in the channel under the center span, and this was after a moderate rain event the night before. A hydraulic analysis and summary for this bridge was completed assuming a waterway opening equivalent to that which existed when the bridge was originally constructed (see Appendix E). The hydraulic analysis indicated that this bridge is able to pass the 100 year flood frequency event without overtopping the roadway. The hydraulic summary also indicates that the roadway would overtop during a 255-year frequency event.

- NBI Item 72 – Approach Roadway (8, equals desirable criteria): The asphalt roadway approaches at each end of the bridge are in good condition. The shoulders are not paved.

- NBI Item 113 – Scour Rating (8, stable above footing): The foundations of the substructure units were not visible during the field visit. Original design plans indicate that foundations are supported on bedrock.

D. Functionally obsolete

Bridges are considered functionally obsolete when the deck geometry, load carrying capacity (comparison of the original design load to the current legal loads), clearance, or approach roadway alignment do not meet current design criteria. In general, functionally obsolete means that the bridge was built to standards that are no longer used today.

This bridge, designed for an AASHTO H-20 (20-ton truck) live load, meets current load criteria. However, this bridge is considered functionally obsolete because its clear roadway width and approach roadway width do not meet current criteria for the current and projected AADT.

The bridge’s clear roadway width of 24 feet does not meet current criteria. The bridge has two 12-foot-wide lanes with no outside shoulders. Current roadway design standards outline that the minimum clear roadway width across a bridge with two-way traffic is 40 feet (two 12-foot traffic lanes and two 8-foot shoulders) for an arterial functional class and an AADT greater than 2,000 vehicles per day.

The width of the roadway at each end of the bridge is also substandard. Current roadway design standards are for two 12-foot-wide traffic lanes with 8-foot-wide shoulders at each end of the bridge for a roadway with an arterial functional classification. The horizontal alignment and vertical profile geometry of the roadway approaches at each end of the bridge are acceptable. West of the bridge, US 60 passes through Afton on a tangent alignment with a posted speed limit of 35 mph. East of the bridge, US 60 has a horizontal curve with a posted speed limit of 45 mph.

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3. Purpose and Need

The project need describes the transportation deficiency. It is the foundation of the entire decision-making process. The need provides information to support the purpose and explains why the project is needed.

The need for the project is as follows:

- The existing bridge over Horse Creek is structurally deficient.
- The existing bridge is functionally obsolete and is of substandard width.
- The existing bridge rails do not meet full-scale crash criteria.

The project purpose defines the problem to be solved. Defining the purpose is necessary to determine the range of alternatives that will be considered.

The purpose of this project is as follows:

- Provide a structurally sound bridge over Horse Creek.
- Preserve Historic Route 66 and the Route 66 National Scenic Byway as a tourist destination in Oklahoma.
4. Alternative Analysis

This section addresses the alternatives that are required to be considered for the Programmatic Section 4(f) Evaluation for Historic Bridges. Each alternative is assessed for its ability to meet project purpose and need, and to avoid effects to the character-defining features that give the bridge its historic significance.

A. Alternative 1 – Do nothing

Alternative 1 would leave the existing structure in place, without bypass, rehabilitation, or replacement. Under this alternative, there would be no use of the Section 4(f) property since character-defining features that make the bridge significant would not be removed or substantially altered.

Previous cyclical or routine maintenance activities have been minimal and limited to activities like annual water-washing of the bridge deck and sidewalks. The bridge is currently on a 24-month inspection schedule. Condition-based maintenance activities have included repairing damaged concrete railing sections due to vehicular impact.

Under this alternative the bridge would be left in place and the structural and functional deficiencies discussed earlier in this evaluation would remain unresolved and potentially lead to unacceptable safety hazards for the traveling public. Efforts to correct the structural deficiencies of the bridge are beyond what is considered routine maintenance. No increased costs associated with routine maintenance or inspections are anticipated under this alternative. Routine maintenance would continue at existing levels and inspections would continue according to their current frequency.

With this alternative, the bridge will continue to deteriorate and may need to be load posted at some time. Such load posting would require heavy trucks to use alternate routes.

The “Do Nothing” alternative would avoid use of the historic bridge as a Section 4(f) property and have the least impact on the historic integrity of the bridge, at least in the short term. However, if left untreated, the existing structural deficiencies will worsen and develop into more significant defects. The existing functional inadequacies related to roadway width and substandard non-crash tested railings would also remain unaddressed. This alternative would not meet the project purpose and need because it would not provide a structurally sound bridge. It does not correct the structurally deficient and functionally obsolete bridge. In the near term, this alternative would meet the project purpose to preserve Historic Route 66 and the Route 66 National Scenic Byway as a tourist destination in Oklahoma. However, in the long term, the lack of rehabilitation and maintenance of the historic bridge would result in its continued deterioration and could lead to eventual failure. Failure and removal of the bridge would remove a historic element from Route 66.

B. Alternative 2 – Rehabilitation

This alternative would rehabilitate the existing bridge to be in conformance with current design standards and to continue vehicular service for two-way traffic. This alternative would leave the existing bridge in place and continue to allow two-way traffic on the structure. The structure would be widened on both
sides to meet current roadway design criteria: a 24-foot-wide roadway with 8-foot shoulders on each side, for a clear roadway width of 40 feet, with or without sidewalks.

To rehabilitate the structure for continued vehicular use, the following work would need to be undertaken:

- Construct temporary bypass roadway (shoofly) with culvert pipes on the south side of the existing road.
- Detour traffic to the temporary bypass roadway (shoofly).
- Remove the four lines of concrete railings, two lines on each side of the roadway.
- Remove both concrete sidewalks.
- Remove the existing, original, 8-inch, non-composite, cast-in-place, reinforced-concrete deck.
- Remove the two exterior steel beams that support the outer edges of the sidewalks.
- Remove steel diaphragms.
- Remove the two reinforced-concrete wingwalls at each abutment.
- Modify each abutment to match the desired bridge beam and deck geometry.
- Modify top of wingwalls to match revised bridge deck geometry.
- Modify top of each pier to match the desired bridge beam geometry.
- Remove, clean, and paint, then reinstall, existing bearings at ends of existing six interior steel beams.
- Clean and paint the existing steel beams. This operation will require containment of material and old paint from the cleaning and painting operations.
- Add two lines of steel beams, one line each side of the bridge, with new bearings. These new beams would be fully painted before shipment to the project site. These new steel beams would also have stud shear connectors that would project into the new concrete deck.
- Erect new steel diaphragms between steel beams, and connect with high-strength bolts.
- Weld new stud shear connectors to the top flanges of the existing steel beams so that the new concrete deck will act compositely with the steel beams.
- Construct new cast-in-place reinforced-concrete deck with epoxy coated rebars. This would include construction of sealed expansion joints over the substructure units.

- Construct new crash-tested concrete railings (Texas Type T66 or ODOT Std TR4-2) on the outside edges of the bridge to meet TL 3 standard. The railing can be matched in material but no standard crash-tested railing matches the historic railing in appearance.

- Patch spalled areas of the faces of both abutments.

- Dredge the creek channel under the westerly span of the bridge and restore the waterway opening through the entire bridge to its originally constructed condition.

- Add supplemental stone riprap on the north side of the west abutment and the north side of the east abutment.

- Construct new roadway segments on each side of the bridge, and transition to match the existing roadway.

- Construct approach guardrail with transitions according to current design standards on each end of the bridge.

- Paint pavement markings (lane line striping) on the bridge and the roadway approaches.

- Switch traffic back to the original roadway, and remove the temporary bypass.

The estimated cost of this alternative is $2,440,347. The estimated cost includes the following:

- Right-of-way acquisition and utility relocation costs: $312,900.

- Roadway costs, including temporary shoofly detour: $1,174,860.

- Bridge rehabilitation costs: $952,587.  

This alternative would remedy most of the existing functional and structural deficiencies in the bridge’s substructure and superstructure. The rehabilitation would accomplish the following:

- Remedy the deterioration in the concrete deck and deck expansion joints.

- Alleviate the deteriorated condition of the steel beams, bearings, and diaphragms.

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7 The rehabilitation costs do not include a sidewalk as part of the widening and assume an ODOT Std TR4-2 railing.
• Resolve the deteriorated condition of the paint system.

• Provide a crash-tested railing that meets current crash testing test level TL 3(TL) criteria.

• Improve the waterway opening and hydraulics through the bridge to nearly its original condition.

• Correct deficiencies leading to functional obsolescence by widening the bridge to current roadway standards.

The hydraulic analysis performed (see Appendix E) indicates that the existing bridge can pass the 255-year storm event without overtopping the roadway. This analysis is based on the assumption that the westerly portion of the water channel is dredged to provide the waterway opening similar to that when the bridge was constructed. After the rehabilitation is completed, this bridge is expected to continue to serve in its present capacity for 25 to 30 years or longer with proper maintenance, stabilization, and preservation activities.

This rehabilitation alternative would meet the project purpose and need to provide a structurally sound bridge since it will correct the structurally deficient and functionally obsolete bridge and provide new railings that meet full-scale crash criteria. This alternative would also meet the project purpose to preserve Historic Route 66 and the Route 66 National Scenic Byway as a tourist destination in Oklahoma. This alternative does impact character-defining features and remove historic fabric of the bridge, including the removal of four original concrete railings and the elimination of the sidewalks. These changes to the bridge may decrease this bridge’s appeal as a particular tourist destination; however, changes to one structure along the approximately 400-mile corridor would not diminish the ability of the overall route to serve as a tourist destination. This alternative would not avoid the use of the bridge as a Section 4(f) property since the rehabilitation would diminish the structure’s historic integrity.

C. Alternative 3 – Build on new location without using historic bridge

Alternative 3 involves the construction of a new bridge and various options for the historic bridge. For the three options in Alternative 3, consideration of the location of the new bridge included an assessment of local constraints. Engineers working on preliminary design options for a new bridge assessed the orientation of a new bridge on both the north (upstream) and south (downstream) sides of the historic bridge. This analysis determined that constructing a new bridge on the south side would result in greater impacts to wetlands and private property; a new bridge located north of the existing structure would minimize these impacts. Also, a new bridge located north of the existing structure would provide better geometric alignment of the highway at the curve at the east end of the project, and minimize right-of-way acquisition at both the west and east ends of the project. (Preliminary plans are included in Appendix F.)
The new bridge and roadway relocation would require approximately 1.47 acres of additional right-of-way. This is estimated to result in impacts to 11 properties: seven properties would be infringed upon (acquiring property) and an additional four properties would be affected (temporary construction easements).

With the construction of a new bridge, a hydraulic analyses would need to be conducted with both bridges in place, to determine the adequacy of the waterway opening through both bridges. This analysis would be based on the assumption that the westerly portion of the water channel through the existing bridge is dredged to provide the waterway opening similar to that when the bridge was constructed. Such hydraulic analysis is beyond the scope of this report.

(1) **Option A – Retain the historic bridge in vehicular service as one half of a one-way couplet**

Alternative 3, Option A consists of constructing a new bridge adjacent to the historic bridge and using each structure to carry one lane of one-way traffic plus shoulders in a single direction. The centerline of the new US 60 alignment would be 50 feet north of the existing centerline, resulting in a clearance of approximately 10 feet between the edges of the bridges. The width of the new bridge would be constructed to accommodate one 24-foot-wide traffic lane plus two 8-foot shoulders, for a total clear roadway width of 40 feet. If necessary in the future, the new bridge could carry two-way traffic with two 12-foot traffic lanes with 8-foot shoulders, should the historic bridge be taken out of service. Under this alternative, the historic bridge would be left in place and would carry one lane of one-way traffic in the opposite direction.

Rehabilitation of the existing bridge as half of a one-way couplet would require the following repairs:

- Construct a new bridge to the north of the existing bridge, located so there would be 2 feet clear distance between the outside edge of the new bridge and the outside edge of the existing bridge. The new bridge would be 240 feet long, with spans of 70, 100, and 70 feet, and have Type IV precast prestressed concrete girders with a cast-in-place reinforced-concrete deck. New cast-in-place reinforced-concrete abutments and piers would be constructed for the new bridge substructure. This new bridge would have a 40-foot clear roadway width and crash-tested barrier railings on each side, without sidewalks. Traffic would continue to operate on the existing bridge while the new bridge is constructed. This bridge would be designed as described above to accommodate two lanes of traffic with shoulders in the future, should the existing bridge need to be removed.

- Construct new US 60 roadway approaches on each side of the new bridge, with roadway width of 24 feet for two 12-foot traffic lanes, plus 8-foot shoulders on each side. Tie this new road to the existing road on each side of the bridge, using 45 mph as the design criteria for geometric alignment.
• Construct signage and pavement markings for the roadway split on approaches at each end of the bridges.

• Switch two-way US 60 traffic to the new bridge after the new roadway approaches are constructed.

• Perform the following work on the existing bridge; the bridge would retain its existing width, but the sidewalks and railings would be removed, and a wider roadway deck would be constructed. The clear roadway width would be approximately 36 feet, which is wide enough for one 12-foot traffic lane plus 8-foot shoulders on each side, plus an allowance for extra width to accommodate the steel I-beam framing:
  
  o Remove the four lines of concrete railings, two lines on each side of the roadway.
  
  o Remove both concrete sidewalks.
  
  o Remove the existing, original, 8-inch, non-composite, reinforced-concrete deck.
  
  o Remove the two exterior steel beams that support the outer edges of the sidewalks. Also remove all bearings for these steel beams.
  
  o Remove all steel diaphragms.
  
  o Remove the north reinforced-concrete wingwall at each abutment; retain the south wingwalls.
  
  o Modify each abutment to receive one new line of exterior steel beams on each side of the bridge, and revise geometry to match new deck.
  
  o Modify top of existing concrete wingwalls on the south side of each abutment; construct a concrete closure wall at each abutment between the existing bridge and the new bridge.
  
  o Modify each pier cap to receive one new line of exterior steel beams on each side of the bridge.
  
  o Remove, clean, and paint, then reinstall, existing bearings at ends of existing six interior steel beams.
  
  o Clean and paint the existing steel beams. This operation will require containment of material and old paint from the cleaning and painting operations.
  
  o Add two lines of steel beams, one line each side of the bridge, with new bearings. These new beams would be fully painted before shipment to the
project site. These new steel beams would also have stud shear connectors which would project into the new concrete deck.

- Erect new steel diaphragms between all steel beams, and connect with high-strength bolts.
- Weld stud shear connectors to the top flanges of the existing steel beams so the new concrete deck will act compositely with the steel beams.
- Construct new cast-in-placed reinforced-concrete deck with epoxy coated rebars. This would include construction of sealed expansion joints over the substructure units.
- Construct new crash-tested concrete railings (Texas Type T66 or ODOT Std TR4-2) on the outside edges of the bridge to meet TL 3 standard. The railing can be matched in material but no standard crash-tested railing matches the historic railing in appearance.
- Patch spalled areas of the faces of both abutments.
- Dredge the creek channel under the westerly span of the bridge and restore the waterway opening through the entire bridge to its originally constructed condition.
- Reconstruct US 60 roadway approaches at each end of the bridge.
- Construct approach guardrail with transitions according to current design standards.
- Paint pavement markings (lane line striping) on the bridge and the roadway approaches.
- Switch eastbound US 60 traffic back to the original roadway, and keep westbound US 60 traffic on the new bridge.

The total cost for this alternative is estimated at $4,891,438 and includes the following:

- Right-of-way acquisition and utility relocation costs: $1,300,000.
- Roadway costs: $1,110,660.
- Bridge rehabilitation costs: $955,155.8
- New bridge costs: $1,525,623.

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8 The rehabilitation costs do not include a sidewalk as part of the widening and assume an ODOT Std TR4-2 railing.
With the construction of a new vehicular bridge, this alternative meets the project’s purpose and need to provide a structurally sound bridge. Rehabilitation of the historic bridge as a one-way couplet also addresses the purpose and need to provide a structurally sound bridge since it will correct the structurally deficient and functionally obsolete bridge and provide new railings that meet full-scale crash criteria. After the rehabilitation is completed, this bridge is expected to continue to serve similar to its present capacity for 25 to 30 years or longer with proper maintenance, stabilization, and preservation activities.

This alternative would also meet the project purpose to preserve Historic Route 66 and the Route 66 National Scenic Byway as a tourist destination in Oklahoma. This alternative impacts character-defining features and removes historic fabric of the bridge, including the four original concrete railings and the elimination of the sidewalks. These changes may decrease this bridge’s appeal as a particular tourist destination; however, changes to one structure along the approximately 400-mile corridor would not diminish the ability of the overall route to serve as a tourist destination. This alternative would not avoid the use of the bridge as a Section 4(f) property since the rehabilitation of the bridge as a one-way couplet would impact the structure’s historic integrity.

(2) Option B1 – Retain the historic bridge as a monument

This alternative would construct a new structure that would carry two-way traffic parallel to the existing bridge. The new structure and associated US 60 roadway realignment would be as described in Alternative 3, Option A above, but would carry two-way traffic rather than one-way traffic. The new structure would meet current design criteria with a clear roadway width of 40 feet and would require additional right-of-way costs and utility relocation costs as described for Option A. The historic bridge would remain in use until the construction of the new bridge is complete. Once the new bridge is open, traffic would be diverted onto the new bridge and the historic bridge would be left in place as a monument. The road at each end of the historic bridge would be obliterated with the grade restored to its original condition. The bridge ends would also be barricaded to prevent access by traffic, non-motorized vehicles, pedestrians, and bicyclists. Rehabilitation work would be limited to removing the north wingwalls at each abutment, constructing a concrete closure wall between the existing bridge and the new bridge, resealing the joints in the existing concrete deck, and dredging the creek channel under the westerly span of the bridge to its originally constructed condition. Under this alternative, periodic inspection of the historic bridge would be required to monitor the bridge’s condition, as is currently done on a bi-annual basis.

The total cost of constructing a new bridge and leaving the historic bridge in place as a monument is estimated at $3,962,805, which is broken down as follows:

- Right-of-Way Acquisition and Utility Relocation Costs: $1,300,000.
- Roadway Costs: $1,027,200.

---

9 Construction of the new bridge would require additional hydraulic studies to determine potential impacts to the river, in terms of hydraulic capacity with two bridges in place.
Section 4
Alternative Analysis

- Bridge Rehabilitation Costs: $109,982.
- New Bridge Costs: $1,525,623.

With the construction of a new vehicular bridge, this alternative meets the project purpose and need to provide a structurally sound bridge.\(^{10}\) However, in the long term the lack of rehabilitation and maintenance of the historic bridge may equate to an adverse effect to its historic integrity since the superstructure elements and substructure would likely continue to deteriorate and could lead to eventual failure. It is estimated that this bridge could serve as a monument for 30 to 40 years or longer with proper maintenance and preservation activities.

This alternative would also meet the project purpose to preserve Historic Route 66 and the Route 66 National Scenic Byway as a tourist destination in Oklahoma. The bridge would remain in place as a monument adjacent to the new bridge allowing it to continue to serve as a visible element of the history of Route 66. However, in the long term the lack of rehabilitation and maintenance of the historic bridge would result in its continued deterioration and could lead to eventual failure. Failure and removal of the bridge would remove a historic element from Route 66. The construction of a new bridge next to the historic bridge would not diminish the integrity of the overall route as a tourist destination.

This alternative does not impact the bridge’s character-defining features and does not remove historic fabric. This alternative avoids use of the bridge as a Section 4(f) property since its historic integrity would be retained.

(3) Option B2 – Retain the historic bridge as a non-motorized vehicle/pedestrian/bicycle facility

This alternative would construct a new structure of the same type described in Alternative 3, Option B1 above, that would handle both directions of traffic and would be located parallel to, and upstream (north) of, the existing bridge. The new structure would meet current design criteria with a clear roadway width of 40 feet and would require additional right-of-way acquisition costs and utility relocation costs as described for Alternative 3, Option A. The historic bridge would remain in use during construction of the new bridge. Once the new bridge was opened, traffic would be diverted to the new bridge and the historic bridge would be rehabilitated and left in place for pedestrians, bicyclists, and non-motorized vehicles. The existing roadway approaches at each end of the historic bridge would be retained to accommodate pedestrians and bicyclists. A barrier would be constructed at each end of the historic bridge to allow pedestrians and bicyclists through but prevent vehicular access to the bridge.

As a non-motorized vehicle/pedestrian/bicycle bridge, the historic bridge would not carry vehicular traffic. The bridge would need to be load rated for the desired current pedestrian live loading of 95 pounds per square foot of bridge deck area, with appropriate reduction factors based on the

\(^{10}\) Construction of the new bridge would require additional hydraulic studies to determine potential impacts to the river, in terms of hydraulic capacity with two bridges in place.
area of the deck. It is expected that the historic bridge would have sufficient strength to handle this pedestrian live loading, although some rehabilitation work would be necessary, including:

- Patch spalled concrete in bridge deck, estimated at 40 percent of the total deck surface. Overlay entire bridge deck with a 2-inch-thick, non-shrink, concrete overlay. This work includes replacing all of the deck expansion joints between the spans with new sealed expansion joints.
- Replace all steel diaphragms between the existing steel beams with new, painted steel diaphragms connected with high-strength bolts.
- Clean and paint entire steel superstructure. This includes all steel beams and bearings.
- Remove wingwalls at north side of each abutment, and construct a concrete closure wall between the existing bridge and the new bridge.
- Patch spalled concrete surfaces in the faces of the abutments and wingwalls.
- Dredge the creek channel under the westerly span of the bridge and restore the waterway opening through the entire bridge to its originally constructed condition.

The existing four lines of bridge railings would remain in place without modification. The railings adjacent to the roadway do not meet current crash impact load standards. The exterior railings on the outside edges of the sidewalk do not meet current criteria for height and maximum clear openings. The top of the top railing is 39.5 inches above the sidewalk surface; current criteria is 42-inch-high railings. The clear opening between the two lines of horizontal railings is approximately 8 inches. Current criteria outlines that openings must not allow a 4-inch-diameter sphere to pass through the lower portion of a railing and a 6-inch-diameter sphere to pass through the upper portion of the railing. Since no work is being proposed to the existing railings for this lower use option for the bridge, the railings do not need to be modified to meet current standards.

The total cost of constructing a new bridge and leaving the historic bridge in place as a non-motorized vehicle/pedestrian/bicycle bridge is estimated at $4,548,083, which is broken down as follows:

- Right-of-way acquisition and utility relocation costs: $1,300,000.
- Roadway costs: $1,091,400.
- Bridge rehabilitation costs: $631,060.
- New bridge costs: $1,525,623.
With the construction of a new vehicular bridge, this alternative meets the project purpose and need to provide a structurally sound bridge. Rehabilitation of the historic bridge for pedestrians, bicycles, and non-motorized vehicles addresses the need to correct a structurally deficient and functionally obsolete bridge. While this bridge is located on the outskirts of Afton, there is generally no need to provide pedestrian, bicycle, or non-motorized vehicle access across Horse Creek, and there are no trails in the vicinity with which to connect.

This alternative would also meet the project purpose to preserve Historic Route 66 and the Route 66 National Scenic Byway as a tourist destination in Oklahoma. The bridge would remain in place for pedestrians, bicycles, and non-motorized vehicles, allowing it to continue as a visible element of the history of Route 66. The construction of a new bridge next to the historic bridge would not diminish the integrity of the overall route as a tourist destination.

This alternative does not impact the bridge’s character-defining features and does not remove historic fabric. This alternative avoids use of the bridge as a Section 4(f) property since its historic integrity would be retained. It is estimated that this bridge could function as a non-motorized pedestrian/bicycle facility for 30 to 40 years or longer with proper periodic maintenance, stabilization, and preservation activities.

\[\text{\footnotesize\textsuperscript{11}\ Construction of the new bridge would require additional hydraulic studies to determine potential impacts to the river, in terms of hydraulic capacity with two bridges in place.}\]
5. Summary of Findings

Table 2 summarizes the analysis of three primary alternatives (Alternative 3 subdivided into three options). Detailed cost estimates for each alternative, except the No Build alternative, are also included below. ODOT and the FHWA will use this analysis to assess the feasibility and prudence of avoidance alternatives.
Table 2. Summary of alternative analysis

<table>
<thead>
<tr>
<th>Avoidance Alternative</th>
<th>Meets Need and Purpose for the Project?</th>
<th>Costs</th>
<th>Preliminary understanding of Social, Economic, Environmental Impacts?</th>
<th>Section 4(f) use?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Construction ($)</td>
<td>ROW &amp; Utility Relocation Costs ($)</td>
<td>Total cost ($)</td>
</tr>
<tr>
<td>1. No-Build.</td>
<td>No, does not address structural deficiencies or functional inadequacies and does not provide a structurally sound bridge.</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>2. Rehabilitation Alternative for continued 2-way vehicle use.</td>
<td>Yes, rehabilitation addresses structural and functional inadequacies and provides a structurally sound bridge. Also preserves Historic Route 66 and the Route 66 National Scenic Byway as a tourist destination in Oklahoma.</td>
<td>$2,127,447</td>
<td>$312,900</td>
<td>$2,440,347</td>
</tr>
<tr>
<td>3A. Retain historic bridge in vehicular service as one half of one-way couplet; construct new bridge parallel to existing bridge with two lanes of traffic and shoulders.</td>
<td>Yes, addresses structural and functional inadequacies of historic bridge and paired with a new bridge provides a structurally sound bridge. Also preserves Historic Route 66 and the Route 66 National Scenic Byway as a tourist destination in Oklahoma.</td>
<td>$3,591,438</td>
<td>$1,300,000</td>
<td>$4,891,438</td>
</tr>
<tr>
<td>3B1. Retain historic bridge as a monument; construct new bridge parallel to existing bridge with two lanes of traffic and shoulders.</td>
<td>Yes, with new structure a structurally sound bridge is provided. Also preserves Historic Route 66 and the Route 66 National Scenic Byway as a tourist destination in Oklahoma.</td>
<td>$2,662,805</td>
<td>$1,300,000</td>
<td>$3,962,805</td>
</tr>
<tr>
<td>3B2. Retain historic bridge as a non-motorized pedestrian or bicycle facility; construct new bridge parallel to existing bridge with two lanes of traffic and shoulders.</td>
<td>Yes, with new structure a structurally sound bridge is provided. Structural deficiencies and functional inadequacies of historic bridge would be addressed in rehabilitation for non-motorized use. Also preserves Historic Route 66 and the Route 66 National Scenic Byway as a tourist destination in Oklahoma.</td>
<td>$3,248,083</td>
<td>$1,300,000</td>
<td>$4,548,083</td>
</tr>
</tbody>
</table>
Opinions of Probable Construction Costs

The opinions of probable construction costs provided herein are presented in third quarter 2016 dollars. These costs were developed by using data previously prepared by others, such as preliminary plans for a proposed new bridge and associated roadway work, bridge inspection reports and hydraulic analysis reports, and site investigations conducted by Mead & Hunt. They were developed without a detailed hands-on bridge inspection or completion of preliminary design for the rehabilitation of the existing historic bridge for the alternatives considered. The estimated costs represent an opinion based on related experience and background knowledge of historic unit prices and comparable work performed on other structures. The opinions of cost are intended to provide a programming level of estimated cost. These costs will require refinement and may require adjustments as further analysis is completed in determining the course of action for future improvements to the structure. A 20% contingency and 7% mobilization allowance have been included in the cost estimates. No administrative or engineering costs have been included.

Darrell J. Berry, PE
Oklahoma PE 26371

Date 8/26/2016
# ALTERNATIVE 2-REHABILITATION OF EXISTING BRIDGE

**August 26, 2016**

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>ITEM</th>
<th>UNITS</th>
<th>QUANTITY</th>
<th>UNIT COST</th>
<th>TOTAL ESTIMATE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>RIGHT-OF-WAY ACQUISITION &amp; UTILITY RELOCATION COSTS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>RIGHT-OF-WAY ACQUISITION COSTS</td>
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<td>UTILITY RELOCATION COSTS</td>
<td>LUMP SUM</td>
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<td>$237,000</td>
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<tr>
<td></td>
<td><strong>ESTIMATED ROW &amp; UTILITY COSTS</strong></td>
<td></td>
<td></td>
<td></td>
<td>$312,900</td>
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<td></td>
<td><strong>ROADWAY COSTS</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>MOBILIZATION @ 7%</td>
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<td>$76,860</td>
<td>$76,860</td>
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<td>1</td>
<td>TEMPORARY DETOUR (SHOOFLY TO SOUTH) WITH TEMPORARY BRIDGE</td>
<td>LUMP SUM</td>
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<td>$500,000</td>
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<td>2</td>
<td>APPROACH ROADWAY WORK FOR TRANSITIONS EACH END OF EXISTING BRIDGE</td>
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<td>$400,000</td>
<td>$400,000</td>
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<tr>
<td>2</td>
<td>GUARDRAIL ON ROADWAY APPROACHES TO BRIDGE, 4 QUADRANTS</td>
<td>LUMP SUM</td>
<td>1</td>
<td>$15,000</td>
<td>$15,000</td>
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<tr>
<td></td>
<td>20% CONTINGENCY</td>
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<td><strong>ESTIMATED ROADWAY COSTS</strong></td>
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<td></td>
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<tr>
<td></td>
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<td>NEW STRUCTURAL STEEL BEAMS, STUD SHEAR CONNECTORS, DIAPHRAGMS, BOLTS</td>
<td>LB</td>
<td>43,000</td>
<td>$3</td>
<td>$129,000</td>
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<td>3</td>
<td>STUD SHEAR CONNECTORS WELDED TO EXISTING STEEL BEAMS</td>
<td>EACH</td>
<td>1,692</td>
<td>$5</td>
<td>$8,460</td>
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<td>4</td>
<td>CLEAN AND PAINT EXISTING STEEL BEAMS &amp; BEARINGS (INCL CONTAINMENT)</td>
<td>LUMP SUM</td>
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<td>$250,000</td>
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<td>CAST-IN-PLACE REINFORCED CONCRETE DECK WITH EPOXY COATED REBARS</td>
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<td>155</td>
<td>$1,200</td>
<td>$186,000</td>
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<td>$125</td>
<td>$36,250</td>
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<td>MODIFY BEARING SEATS ON PIERS AND ABUTMENTS</td>
<td>LUMP SUM</td>
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<td>$10,000</td>
<td>$10,000</td>
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<tr>
<td>8</td>
<td>PATCH SPALLED CONCRETE AND EPOXY INJECT CRACKS FOR ABUTMENTS &amp; WINGS</td>
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<td>1</td>
<td>$25,000</td>
<td>$25,000</td>
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<tr>
<td>9</td>
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<tr>
<td>10</td>
<td>ADD LARGE STONE RIPRAP NORTH OF EACH ABUTMENT</td>
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<td>100</td>
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<td>11</td>
<td>4-INCH EPOXY PAINT LINES, BRIDGE AND ROADWAY</td>
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<td>$1</td>
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</tr>
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<tr>
<td></td>
<td><strong>ALTERNATIVE TOTAL COSTS</strong></td>
<td></td>
<td></td>
<td></td>
<td>$2,440,347</td>
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### ALTERNATIVE 3 OPTION A-RETAIN HISTORIC BRIDGE IN VEHICULAR SERVICE AS ONE HALF OF A ONE-WAY COUPLER; CONSTRUCT NEW BRIDGE PARALLEL TO EXISTING BRIDGE

**August 26, 2016**

#### RIGHT-OF-WAY ACQUISITION & UTILITY RELOCATION COSTS

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>ITEM</th>
<th>UNIT</th>
<th>QUANTITY</th>
<th>UNIT COST</th>
<th>TOTAL ESTIMATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RIGHT-OF WAY ACQUISITION COSTS</td>
<td>LUMP SUM</td>
<td>1</td>
<td>$1,000,000</td>
<td>$1,000,000</td>
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<tr>
<td>2</td>
<td>UTILITY RELOCATION COSTS</td>
<td>LUMP SUM</td>
<td>1</td>
<td>$300,000</td>
<td>$300,000</td>
</tr>
</tbody>
</table>

**ESTIMATED ROW & UTILITY COSTS $1,300,000**

#### ROADWAY COSTS

- MOBILIZATION @ 7%
  - LUMP SUM 1 $72,660 $72,660
- EARTHWORK FOR NEW ROAD AND APPROACHES FOR EXISTING ROAD AT BRIDGE
  - LUMP SUM 1 $350,000 $350,000
- 2-LANE ROADWAY WITH SHOULDERS ON NEW ALIGNMENT & RECONSTRUCT APPROACH ROADWAYS TO EXISTING BRIDGE
  - LUMP SUM 1 $500,000 $500,000
- INSTALL GUARDRAIL ON ROADWAY APPROACHES TO EXISTING BRIDGE, 4 QUADRANTS
  - LUMP SUM 1 $15,000 $15,000
- 20% CONTINGENCY
  - LUMP SUM 1 $173,000 $173,000

**ESTIMATED ROADWAY COSTS $1,110,660**

#### BRIDGE REHABILITATION COSTS

- MOBILIZATION @ 7%
  - LUMP SUM 1 $62,487 $62,487
- DEMOLITION OF RAILINGS, SIDEWALKS, DECK, 2 LINES OF BEAMS & ALL STEEL DIAPHRAGMS, & 2 WINGWALLS
  - LUMP SUM 1 $80,000 $80,000
- NEW STRUCTURAL STEEL BEAMS, STUD SHEAR CONNECTORS, DIAPHRAGMS, BOLTS
  - LB 43000 $3 $129,000
- STUD SHEAR CONNECTORS WELDED TO EXISTING STEEL BEAMS
  - EACH 1692 $5 $8,460
- CLEAN AND PAINT EXISTING STEEL BEAMS & BEARINGS (INCL CONTAINMENT)
  - CY 140 $1,200 $168,000
- CAST-IN-PLACE REINFORCED CONCRETE DECK WITH EPOXY COATED REBARS
  - EACH 2500 $125 $362,500
- NEW OK STD. TR 4-2 RAILING
  - LF 290 $125 $36,250
- MODIFY BEARING SEATS ON PIERS AND ABUTMENTS
  - LUMP SUM 1 $10,000 $10,000
- PATCH SPALED CONCRETE AND EPOXY INJECT CRACKS FOR ABUTMENTS & WINGS
  - LUMP SUM 1 $25,000 $25,000
- CONSTRUCT CONCRETE CLOSURE WALLS AT EACH ABUTMENT
  - EACH 2 $10,000 $20,000
- DREDGE CREEK CHANNEL
  - LUMP SUM 1 $15,000 $15,000
- 4-INCH EPOXY PAINT LINES, EXISTING BRIDGE AND EXISTING ROADWAY
  - LF 2180 $1 $2,180
- 20% CONTINGENCY
  - LUMP SUM 1 $148,778 $148,778

**ESTIMATED BRIDGE REHABILITATION COSTS $955,155**

#### NEW BRIDGE COSTS

- MOBILIZATION @ 7%
  - LUMP SUM 1 $99,807 $99,807
- 3 SPAN (70-100-70) TYPE IV PRECAST PRESTRESSED CONCRETE GIRDER BRIDGE
  - SQ FT 10332 $115 $1,188,180
- 20% CONTINGENCY
  - LUMP SUM 1 $237,636 $237,636

**ESTIMATED NEW BRIDGE COSTS $1,525,623**

**ALTERNATIVE TOTAL COSTS $4,891,438**
### ALTERNATIVE 3 OPTION B1-RETAIN HISTORIC BRIDGE AS A MONUMENT; CONSTRUCT NEW BRIDGE PARALLEL TO EXISTING BRIDGE WITH 2-LANES OF TRAFFIC

August 26, 2016

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>ITEM</th>
<th>UNIT</th>
<th>QUANTITY</th>
<th>UNIT COST</th>
<th>TOTAL ESTIMATE</th>
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<tbody>
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<td>2</td>
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<td>$1,300,000</td>
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<td></td>
<td>MOBILIZATION @ 7%</td>
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<td>1</td>
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<td>2-LANE ROADWAY WITH SHOULDERS ON NEW ALIGNMENT</td>
<td>LUMP SUM</td>
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<td>$450,000</td>
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<tr>
<td>20% CONTINGENCY</td>
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<td></td>
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<td>MOBILIZATION @ 7%</td>
<td>LUMP SUM</td>
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<td>1</td>
<td>OBLITERATE OLD ROAD PAVEMENT EACH END OF BRIDGE</td>
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<td>CONSTRUCT PERMANENT BARRICADES EACH END OF BRIDGE</td>
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<td>2</td>
<td>$2,500</td>
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<td>REMOVE NORTH WINGWALLS AT EACH ABUTMENT</td>
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<td>4</td>
<td>CONSTRUCT CONCRETE CLOSURE WALLS AT EACH ABUTMENT</td>
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<tr>
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<td>RESEAL JOINTS IN EXISTING BRIDGE DECK</td>
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<tr>
<td>6</td>
<td>DREDGE CREEK CHANNEL</td>
<td>LUMP SUM</td>
<td>1</td>
<td>$15,000</td>
<td>$15,000</td>
</tr>
<tr>
<td>20% CONTINGENCY</td>
<td></td>
<td>LUMP SUM</td>
<td>1</td>
<td>$17,320</td>
<td>$17,320</td>
</tr>
<tr>
<td></td>
<td><strong>ESTIMATED BRIDGE REHABILITATION COSTS</strong></td>
<td></td>
<td></td>
<td></td>
<td>$109,982</td>
</tr>
<tr>
<td></td>
<td>MOBILIZATION @ 7%</td>
<td>LUMP SUM</td>
<td>1</td>
<td>$99,807</td>
<td>$99,807</td>
</tr>
<tr>
<td>1</td>
<td>3 SPAN (70-100-70) TYPE IV PRECAST PRESTRESSED CONCRETE GIRDER BRIDGE</td>
<td>SQ FT</td>
<td>10332</td>
<td>$115</td>
<td>$1,188,180</td>
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<tr>
<td>20% CONTINGENCY</td>
<td></td>
<td>LUMP SUM</td>
<td>1</td>
<td>$237,636</td>
<td>$237,636</td>
</tr>
<tr>
<td></td>
<td><strong>ESTIMATED NEW BRIDGE COSTS</strong></td>
<td></td>
<td></td>
<td></td>
<td>$1,525,623</td>
</tr>
<tr>
<td></td>
<td><strong>ALTERNATIVE TOTAL COSTS</strong></td>
<td></td>
<td></td>
<td></td>
<td>$3,962,805</td>
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</tbody>
</table>
### ALTERNATIVE 3 OPTION B2-RETAIN HISTORIC BRIDGE AS A NON-MOTORIZED PEDESTRIAN OR BICYCLE FACILITY; CONSTRUCT NEW BRIDGE PARALLEL TO EXISTING BRIDGE WITH 2-LANES OF TRAFFIC

**August 26, 2016**

**Estimation of Quantities and Costs**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item Description</th>
<th>Unit</th>
<th>Quantity</th>
<th>Unit Cost</th>
<th>Total Estimate</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Right-of-Way Acquisition Costs</td>
<td>Lump Sum</td>
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<td>$1,000,000</td>
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<tr>
<td>2</td>
<td>Utility Relocation Costs</td>
<td>Lump Sum</td>
<td>1</td>
<td>$300,000</td>
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**Estimated ROW & Utility Costs**

$1,300,000

**Mobilization @ 7%**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
<th>Quantity</th>
<th>Unit Cost</th>
<th>Total Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Earthwork for New Road</td>
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<td>1</td>
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<tr>
<td>2</td>
<td>2-Lane Roadway with Shoulders on New Alignment &amp; Modify Existing Road as a Trail to Existing Bridge</td>
<td>Lump Sum</td>
<td>1</td>
<td>$350,000</td>
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<tr>
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<td>20% Contingency</td>
<td>Lump Sum</td>
<td>1</td>
<td>$170,000</td>
<td>$170,000</td>
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**Estimated ROW & Utility Costs**

$1,091,400

**Bridge Rehabilitation Costs**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Unit</th>
<th>Quantity</th>
<th>Unit Cost</th>
<th>Total Estimate</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Patch Spalled Concrete in Bridge Deck</td>
<td>Sq Ft</td>
<td>1344</td>
<td>$20</td>
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<tr>
<td>2</td>
<td>Construct New 2-Inch Concrete Overlay</td>
<td>Sq Ft</td>
<td>3360</td>
<td>$20</td>
<td>$67,200</td>
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<tr>
<td>3</td>
<td>Construct New Deck Expansion Joints</td>
<td>Each</td>
<td>4</td>
<td>$10,000</td>
<td>$40,000</td>
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<tr>
<td>4</td>
<td>Remove and Replace All Steel Diaphragms with Painted Steel Members</td>
<td>Lb</td>
<td>9600</td>
<td>$3</td>
<td>$28,800</td>
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<tr>
<td>5</td>
<td>Clean and Paint Existing Steel Beams &amp; Bearings (Incl Containment)</td>
<td>Lump Sum</td>
<td>1</td>
<td>$250,000</td>
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<tr>
<td>6</td>
<td>Remove North Wingwalls at Each Abutment</td>
<td>Lump Sum</td>
<td>1</td>
<td>$15,000</td>
<td>$15,000</td>
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<tr>
<td>7</td>
<td>Construct Concrete Closure Walls at Each Abutment</td>
<td>Each</td>
<td>2</td>
<td>$10,000</td>
<td>$20,000</td>
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<tr>
<td>8</td>
<td>Patch Spalled Concrete and Epoxy Inject Cracks for Abutments &amp; Wings</td>
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<tr>
<td>9</td>
<td>Dredge Creek Channel</td>
<td>Lump Sum</td>
<td>1</td>
<td>$15,000</td>
<td>$15,000</td>
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<tr>
<td>10</td>
<td>Construct Concrete Filled Bollards at Each End of Bridge</td>
<td>Each</td>
<td>12</td>
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**Estimated Bridge Rehabilitation Costs**

$631,060

**New Bridge Costs**

<table>
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<th>Item</th>
<th>Description</th>
<th>Unit</th>
<th>Quantity</th>
<th>Unit Cost</th>
<th>Total Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3 Span (70-100-70) Type IV Precast Prestressed Concrete Girder Bridge</td>
<td>Sq Ft</td>
<td>10332</td>
<td>$115</td>
<td>$1,188,180</td>
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<tr>
<td></td>
<td>20% Contingency</td>
<td>Lump Sum</td>
<td>1</td>
<td>$237,636</td>
<td>$237,636</td>
</tr>
</tbody>
</table>

**Estimated New Bridge Costs**

$1,525,623

**Alternative Total Costs**

$4,548,083
US 60 Horse Creek Bridge

Cost estimates:

per ODOT 9/25/16:
- programmed project costs: only
  - Construction: $1,733,154
  - Right-of-way: $75,905
  - Utilities: $237,000
  TOTAL: $2,046,059, say $2,046,000

(does not include design engineering or construction engineering, not ODOT administrative costs)

Cost estimates use 20% contingency, and 7.0% mobilization

Assumptions:
1) Remove existing bridge
2) Construct new bridge on existing alignment
3) Temporary detour road with large culvert pipes through temporary bridge

(Note: Benham Estimate
9/19/16 Construction
$3,141,853, provided backup calculations)

New bridge per Leidos plans:
- Length = 246' (spans 73' 100'-73')
- Width = 42'
- Type IV P.C. Beams w/ 40' clear roadway, skew 45° RF, TR4 concrete rail.

\[ \text{Approx. bridge cost: } 246' \times 42' = 10,332 \text{ D} \times \frac{115}{\circ} \times \frac{120}{\circ} = 1,188,180 \]

Effective unit cost w/ 20% contingency and 7% mobilization:
\[ \frac{115}{\circ} \times 1.20 \times 107 = 147,660 \]

WS DOT Bridge Manual:
- end of 2015:
  - $145,000
- use this w/ 20% contingency

Per Benham (Leidos) Preliminary Design Report Oct 12, 2010:

Option 3: New bridge and roadway construction an offset alignment to the north, full 6% superelevation across the bridge.
1.47 AC, 7 properties infringed, 4 properties affected.

R/W Acquisitions: $477,200
Utility Relocations: $298,700
Roadway: $279,000
Earthwork: $306,880
Bridge: $1,251,680
Detour (shoofly): $260,400

Total = $3,864,780

\[ (202' \times 42' \times 138/\circ) \text{ maybe high, even from Oct. 2010} \]
Alternative 2 - Rehabilitation of existing bridge

Existing bridge is 143' long, 24' clear roadway, two 5'-0" sidewalks, 4 lines of concrete railing, total width out-to-out is 38'-10"

per Preliminary Plan and Field Review Meeting March 20, 2016 plans by Leidos: (and from programmed costs)

R/W Acquisitions: $75,900 (includes temp. constr. easements)

Utility Relocations: $237,000

Subtotal: $312,900

Temporary Detour (shoofly) = $260,400, round to $350,000; (2010)

Roadway Work for Transitions at each end of bridge, allow: $170,000, round to $215,000

(includes guardrail) earthwork: allow $100,000

Subtotal = $315,000

Demolition of 4 bridge railings, concrete sidewalks, bridge deck, 2 lines of steel beams, allow...

$75,000

2 lines of steel beams, plus diaphragms & bolts

($27x94) 2 x (40' + 40') x 94' = 15,040$  

($36x150) 2 x 60' x 150' = 18,000$

$6 x 4 x 5' x 33.9' = 4,100$

$6 x 2 x 8' x 33.9' = 3,500$

Misc. Allow = 2,000

Total = $42,440 $ x $3.00/lb = $129,000

For unit price, include fabricated steel, welded stud shear connectors, primed and fully painted. Includes bearings + anchor bolts, and erection
Reinforced concrete deck, 8-inches thick with epoxy coated rebars:

\[
\frac{145' \times 42' \times 0.667'}{27} = 150.4 \text{ CY}
\]

Round to 155 CY

\#1,200 \times \$1,200 = \$186,000

Use \$1,200/CY to include formwork and epoxy coated rebars; also includes expansion joints.

Stud shear connectors add to existing 30 lines of steel I-beams, welded per row:

27'1.5" 40'1.5" 27'1.5"

\(40' + 60' + 40' \times (27 + 40 + 27) \times 3 = 1,642 \text{ ea.} \)

\(\frac{2 \times \$3.50}{+ 1.50} = \frac{\$8,500}{\$5.00 \text{ ea.}}\)

Clean and paint existing steel beams and bearings (near white finish); includes containment and environmental protection

1 LS = \$250,000

New OK Std. TR4-2 Railing:

145' \times 2 = 290 LF @ \$125/\text{LF} = \$36,250

Modify bearing seats on piers and abutments for new lines of beams:

1 LS = \$10,000

Patch spalled concrete on abutments, and seal cracks w/epoxy injection:

1 LS = \$25

Dredge creek channel, esp. under West span:

1 LS = \$15,000

Add stone riprap north of ea. abutment:

\[2 \times 50 \text{ CY} = 100 \text{ CY} \times \$50/\text{CY} = \$5,000\]
Pavement marking (striping):
4"-inch double yellow centerline, white edge lines:
\[ 4 \times (200' + 145' + 200') = 2,180 \text{ LF} \times \$1.00/\text{LF} = \$2,180 \]

Alternative 3 - Option A (new bridge on northerly alignment):

- ROW Acquisition Costs:
  2010 Report had \$977,200 → use \$1,000,000

- Utility Relocation Costs:
  2010 Report had \$298,700 → use \$300,000

- Earthwork for New Road:
  2010 Report had \$306,880 → use \$350,000

- 2-Lane Roadway w/Shadows:
  2010 Report had \$270,000 → use \$285,000 (used to match B & H estimate data)

- Guardrail at approaches to existing bridge:
  150' x 4 guads. = 600 LF \times \$25.00 = \$15,000

- Demolition: railings, sidewalks, deck, 2 lines of beams, plus 2 wingwalls → use \$80,000
  (\$5,000 more than Alt.2)

- New Structural steel (see Alt.2):
  \[ 43,000 \times \$100/\text{lf} = \$4,300,000 \]

- Stud shear connectors welded to existing beams (see Alt.2):
  \[ 1,692 \text{ ea.} \times \$5 = \$8,460 \]

- Clean & paint existing steel (see Alt.2) → \$250,000

- Cast-in-place reinforced concrete deck:
  \[ \frac{45' \times 38' \times 0.607}{27} = 136.1 \text{ cy} \text{ round to } 140 \text{ CY} \times \$1,200 = \$168,000 \]
New OK Std. TR4-2 Rail (see Alt.2) 290 Lf x $125 = $36,250
- Modify bearing seats on piers & abutments for new lines of beams (see Alt.2) Allow LS = $10,000
- Patch spalled concrete on abutments and seal cracks w/ epoxy injection (see Alt.2) Allow LS = $25,000
- Construct concrete closure walls at each abutment between new & existing bridge: 2 Ea. x $10,000 = $20,000
- Dredge Channel (see Alt.2) Allow LS = $15,000 2,180 Lf x $1.00/Lf = $2,180
- Pavement marking (see Alt.2) 115' 180 LF x $100/SF = $48,900 (see Sheet 10f5)
  
Alternative 3 - Option B-1 - Monument
- Items same as Alt.3 - Option A, except as follows:
  - Obliterate old road pavement ea. end of bridge: Allow LS = $30,000
  - Construct permanent barricades at ends: 2 Ea x $2,500 = $5,000
  - Remove north wing walls ea. abutment: Allow LS = $15,000
  - Reseal (not replace) joints in deck: 40' x 4 : 160 Lf x $10 = $1,600

Alternative 3 - Option B-2 - Ped/Bike Bridge
- Items same as Alt.3 - Option A, except as follows:
  - Patch spalled concrete in bridge deck: 40% x (140' x 24') = 1,344 SF x $20 = $26,880
  - Construct 2-Inch Concrete Overlay: 3,360 SF x $20 = $67,200
  - Construct new deck expansion joints: 4 Ea x $10,000 = $40,000
  - Remove and replace steel diaphragms: 9,600 lb x $3.00 = $28,800
  - Construct concrete filled bollards at each end of bridge: 2 x 6 = 12 Ea x $300 = $3,600
Works Cited

Federal Highway Administration and Oklahoma Department of Transportation. “Design Support for
Section 4(f) Analysis for Historic Bridges.” 25 March 2013 (updated). Available at

Federal Highway Administration, Office of Planning, Environment, and Realty, Project Development and

Federal Highway Administration. Recording and Coding Guide for the Structure Inventory and Appraisal

National Register of Historic Places, Horse Creek Bridge, Afton, Ottawa County, Oklahoma. National
Register #95000040.
## Bridge Inspection Report

**NBI No.: 05017**  
**Structure No.: 5806 0256 X**  
**Local ID: 1**  
**Suff. Rating:** 29.9  
**Health Index:** 59.7

### Description:
- **State:** Oklahoma  
- **SHD District:** Division 8  
- **County Code:** OTTAWA  
- **Place Code:** AFJON  
- **Admin. Area:** Unknown

### IDENTIFICATION
1. **Route Delineation:**  
   - 40'-60'-40' 1-BM. SPANS W/TH 2-9 SIDEWALKS SK. 45 DEG.  
   - 2. **State/Province:** OKLAHOMA  
   - 3. **Route No.:** 00060

### DETOUR LENGTH:
- **Year of Future ADT:** 02

### SUBSTANDARD:
- **Open, no restriction:** N
- **Not on NHS:** N
- **U.S. 60:** 00060
- **Length:** 19.9 mi

### STRUCTURE TYPE AND MATERIALS
- **Main Span Material and Design Type:** Steel  
- **Approach Span Material and Design Type:** Stringer/Girder

### AGE AND SERVICE
- **Year Built:** 1936  
- **Year Reconstructed:** Unknown
- **Lanes on:** 2  
- **Lanes Under:** 0  
- **ADT:** 6500

### GEOMETRIC DATA
- **Deck Area:** 5.5757 sq. ft
- **Median:** 0
- **Width:** 45
- **Vertical Flare:** N/0

### NAVIGATION DATA
- ** skew:** 0
- **Vertical Clearance:** H

### LOAD RATING AND POSTING
- **Bridge Cost:** $1,089,056
- **Roadway Cost:** $1,796,942
- **Total Cost:** $3,049,356
- **Type of Work:** 1
- **Approach Rating:** Y
- **Bridge Length:** 0
- **Type of Service on:** 5
- **Type of Service under:** 5

### PROPOSED UPGRADES
- **Bridge Inspection Report:** 258. Plans w/ found. are in file at ODOT

### APPRAISAL
- **Cost:** $3,049,356
- **Condition:** 5 Substandard
- **Rating:** 40

### Sampling:
- **Max. Measured Clearance:** 5 Waterway
- **Horse Creek:** 60.0 ft
- **River:** 143.0 ft
- **Flowline/High Water:** 24 ft
- **Flowline Notes:** Monitor 3 ft downstream of Approach

### APPROXIMATE MILEMARK
- **Milepost:** 3.65

### OBSERVATIONS
- **Weather:** CLOUDY
- **Water Quality:** Excellent

### APPRAISAL
- **Rating:** 4
- **Score:** 86
- **Date:** 8/1/2006

### PROPOSED IMPROVEMENTS
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### OBSERVATIONS
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- **Water Quality:** Excellent

### PROPOSED IMPROVEMENTS
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- **Approach Rating:** Y
- **Bridge Length:** 0
- **Type of Service on:** 5
- **Type of Service under:** 5
## Bridge Inspection Report

**OKLAHOMA DEPARTMENT OF TRANSPORTATION - Health Index:** 59.7

**NBI No.:** 05017  **Structure No.:** 5806 0256 X  **Local ID:** -1

**Invoice No.:** -1  **Inspection Date:** 4/6/2015  **Reported By:** UFD8003  **Agency:**

### Structure / Inspection Notes

**FX:** SEVERAL DIAPHRAGMS SEVERE SECTION LOSS & SEVERAL COMPLETELY DETERIATED.

### Additional Elements

#### Element Notes (Include Size and Location of Deterioration)

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<th>Description</th>
<th>Un.</th>
<th>Qty.</th>
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<th>% 1</th>
<th>Qty.St. 2</th>
<th>% 2</th>
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<th>% 3</th>
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<th>% 4</th>
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<tr>
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<td>0 %</td>
<td>0 %</td>
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<tr>
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<tr>
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<td>210</td>
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<td>79</td>
<td>100 %</td>
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<tr>
<td>215</td>
<td>Reinforced Conc Abutment</td>
<td>(LF)</td>
<td>112</td>
<td>0 %</td>
<td>108</td>
<td>96 %</td>
<td>4 %</td>
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<tr>
<td>234</td>
<td>Reinforced Conc Cap</td>
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<td>98 %</td>
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<td>187</td>
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<td>0 %</td>
<td>187</td>
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<td>0 %</td>
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<td>311</td>
<td>Moveable Bearing (roller, sliding, etc.)</td>
<td>(EA)</td>
<td>14</td>
<td>0 %</td>
<td>12</td>
<td>86 %</td>
<td>0 %</td>
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<tr>
<td>859</td>
<td>Soffit of Concrete Decks and Slabs</td>
<td>(EA)</td>
<td>1</td>
<td>0 %</td>
<td>1</td>
<td>100 %</td>
<td>0 %</td>
<td>0 %</td>
<td>0 %</td>
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<td>865</td>
<td>Steel Open Girder/Beam End (5 Ft.)</td>
<td>(LF)</td>
<td>210</td>
<td>0 %</td>
<td>60</td>
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<td>963</td>
<td>Steel Section Loss</td>
<td>(EA)</td>
<td>1</td>
<td>0 %</td>
<td>1</td>
<td>100 %</td>
<td>0 %</td>
<td>0 %</td>
<td>0 %</td>
<td>0 %</td>
<td></td>
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</tbody>
</table>

### Element Notes (Include Size and Location of Deterioration)

- **FX:** Several Patched areas, spalls & Impending potholes w/ exposed rebar. Note: Deck makes chatter noise upon impact.
- **FX:** E.ABUT. MODERATE DIAG. CRACKS W/ EFFLORESCENCE S.E.COR. AND W.ABUT SPALLS W/ EXPOSED REBAR & CRACKS W/ EFFLOR.
- **FX:** BEARINGS HAVE MODERATE to HEAVY CORROSION.
- **FX:** BEARINGS HAVE MODERATE to HEAVY CORROSION.
- **FX:** PAINT FAILED @ BM.ENDS.
- **FX:** SOFFIT FALSEWORK, SEVERAL SPALLS REBAR EXPOSED, CRACKS WITH EFFLOR. THROUGHOUT.
- **FX:** BEAM ENDS HAVE MODERATE SECTION LOSS. NOTE: ENDS HAVE WELDED ANGLES.
- **FX:** MOD. DECK CRACKS.
- **FX:** SECTION LOSS AT BEAM ENDS AND BEARINGS.

### Channel Profile

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<th>7</th>
<th>8</th>
<th>9</th>
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<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
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<td>Baseline</td>
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<td>-1.0</td>
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<tr>
<td>Event</td>
<td>Flowline</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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</tbody>
</table>
Appendix B. Project Location Map
Begin 24273(04) at Section Line (Main Street) Afton

End 24273(04) at Section Line

Project Location Map
US 60 Bridge over Horse Creek
Appendix C.  Photographs (April 2016)
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Photo 1. US 60 west roadway approach to the bridge, looking east.

Photo 2. South side of bridge; note sanitary sewer manhole and drainage swale.
Photo 3. South side of Span 2 and Pier 2; unknown vertical pipe attached to bridge.

Photo 4. East abutment, south wingwall, cracking and spalling with efflorescence.
Photo 5. Underside of bridge deck at west abutment; note severely deteriorated steel diaphragm, spalled concrete deck with exposed rebar, and failed deck joint.

Photo 6. Underside of bridge deck at Pier 1; note severely deteriorated steel diaphragm, spalled concrete deck with exposed rebar, and failed deck joint.
Photo 7. West end of bridge, south side at end of sidewalk, showing concrete railings.

Photo 8. Condition of bridge deck, looking east from west end of bridge; note patched concrete, potholes, and failed deck joints.
Photo 9. Failed joint between bridge deck and roadway at west end of bridge.

Photo 10. Horse Creek waterway channel under westerly span of bridge; note sediment and soil buildup, reducing waterway opening.
Photo 11. View looking upstream (north) of Horse Creek from north side of bridge.

Photo 12. Repaired concrete bridge railing; note color and texture of repaired section compared to original railing.
Photo 13. Repaired concrete railing post; note color and texture of repaired post compared to original post.

Photo 14. Underside of bridge deck at east abutment; note plywood used to form underside of concrete patch in deck; also note supplemental steel support under steel diaphragm.
Photo 15. US 60 east roadway approach to the bridge, looking west.

Photo 16. Condition of bridge deck at east abutment, south side; note patched and potholed concrete and failed deck joint.
Photo 17. View looking downstream (south) of Horse Creek from south side of bridge.
Appendix D. 1935 Design Plans for U.S. Highway 60 and Horse Creek Bridge (Select Sheets)
### SUMMARY OF GRADING QUANTITIES

<table>
<thead>
<tr>
<th>Station</th>
<th>Elev.</th>
<th>C.V.</th>
<th>%</th>
<th>Volume</th>
<th>Road</th>
<th>Drain</th>
<th>Cut Off</th>
<th>Fill</th>
<th>10'</th>
<th>15'</th>
<th>20'</th>
<th>25'</th>
<th>30'</th>
<th>40'</th>
<th>50'</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.0</td>
<td>0.0</td>
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<td>0.0</td>
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</tbody>
</table>

**Total**

**SUMMARY OF DRAINAGE STRUCTURES**

<table>
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<th>Description</th>
<th>Details</th>
<th>C.V.</th>
<th>%</th>
<th>Volume</th>
<th>Road</th>
<th>Drain</th>
<th>Cut Off</th>
<th>Fill</th>
<th>10'</th>
<th>15'</th>
<th>20'</th>
<th>25'</th>
<th>30'</th>
<th>40'</th>
<th>50'</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>Bridge</td>
<td>Steel</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
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<td>0.0</td>
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<td>0.0</td>
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</table>

**Construction Note:**

The crown shall be located to a uniform surface conforming to the proposed section shown on the plans and the existing grade line prior to laying town.

The proposed bridge shall be designed on the basis of the uniform type of soil used (USCS soil type). The bridge shall be designed to conform to the proposed section shown on the plans.

**Summary of Pay Quantities:**

<table>
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<tr>
<th>Description</th>
<th>Volume</th>
<th>Rate</th>
<th>Amount</th>
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<tbody>
<tr>
<td>Bridge</td>
<td>0.0</td>
<td>0.0</td>
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*Based on 30 ft per 1000 C.Y. of Embankment*

**Typical Chat Section 84°-0 RDY.**

### Typical Chat Section 84°-0 RDY.
Profile of Proposed Sewer Line, Natural Ground & Roadway Fill Over Sewer.

Proposed Sewer to be on a 0.025% Grade.
Appendix E. Hydraulic Analysis, 2016
Project No. BRFY-158B(119)  
JP # 24273(04)  

US 60 over Horse Creek  
NBIS # 05017  

Hydraulic Summary  
Total Drainage Area = 22.70 sq. mi  
Controlled Drainage Area = 0.00 sq. mi  
Effective Drainage Area = 22.70 sq. mi  

Existing Structure:  
42'-60"-42" I Beams, Skewed 45°  
C/L Station 344+94  
NBIS # 05017  
L = 142 ft  
Q \text{OT} \approx Q_{255}  
Low Bm Elev = 781.10  
Rdyw \text{OT} Elev = 780.82  
Rdyw \text{OT} Sta = 339+36  

Proposed Structure:  
70'-100'-70' Type IV PC Beam, Skewed 45°  
C/L Station 344+94  
L = 245.5 ft  
Q \text{OT} \approx Q_{OT-Q500}  
Low Bm Elev = 780.00  
Rdyw \text{OT} Elev = 780.82  
Rdyw \text{OT} Sta = 339+36  

Detour Structure:  
3-108" RCPs  
C/L Station 2346+11  
Slope = 0.003 ft/ft  
Q \text{OT} \approx Q_{223}  
Inlet Elev = 765.45  
Detour \text{OT} Elev = 775.72  
Detour \text{OT} Sta = 2345+89  

<table>
<thead>
<tr>
<th>Freq.</th>
<th>Q (cfs)</th>
<th>CHW (ft)</th>
<th>V (fps)</th>
<th>Contraction Scour (ft)</th>
<th>Pier Scour (ft)</th>
<th>Total Scour (ft)</th>
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<td>2</td>
<td>1700</td>
<td>773.90</td>
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<tr>
<td>5</td>
<td>3150</td>
<td>775.55</td>
<td>5.79</td>
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<td>25</td>
<td>6590</td>
<td>778.18</td>
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<td>8300</td>
<td>779.40</td>
<td>11.16</td>
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<td>15100</td>
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<td>1820</td>
<td>775.72</td>
<td>10.23</td>
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Notes:  
1. According to the Geotechnical Engineering Report, the depth to bedrock is 10.58 feet. Therefore, the scour will probably not extend as deep as predicted.

**Hydraulic Design is in compliance with**  
"Federal Aid Policy Guide 23 CFR 650, Subpart A"
<table>
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**Computed Water Surface Elevations (FT)**

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<th>Discharges (CFS)</th>
<th>Velocity (FPS)</th>
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<td><strong>Open Channel</strong></td>
<td><strong>Existing</strong></td>
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<tr>
<td>Low Beam (ft)</td>
<td>Backwater</td>
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<tr>
<td>Q2 = 1,700</td>
<td>773.72</td>
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<td>Q5 = 3,150</td>
<td>775.30</td>
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<td>Q10 = 4,470</td>
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<td>Q25 = 6,590</td>
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<td>Q50 = 8,300</td>
<td>778.70</td>
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<tr>
<td>Q100 = 10,000</td>
<td>779.67</td>
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<tr>
<td>Q500 = 15,100</td>
<td>782.29</td>
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</tbody>
</table>

- **Overtopping Elev (ft) =** 780.82
- **Overtopping Elev (ft) =** 780.82
- **Overtopping Elev (ft) =**
- **Overtopping Q (cfs) =** 11,975
- **Overtopping Q (cfs) = OT>Q500**
- **Overtopping Freq (yr) =** 255
Typical Flowline Profile

Horse Creek Flowline

EXISTING BRIDGE
Q STA: 344+93.76
42'-60'-42' 1-BEAM SPANS.
SKEW 45° RF
24° 0" CLR RDY W/2-18" SC
& 5 SIDEWALKS
TOTAL LENGTH = 144.00'
LOW BEAM ELEV = 781.10
RDWY OT STA 339+36.38
RDWY OT ELEV = 780.82

EXIST. BRIDGE

PROPOSED BRIDGE A
Q STA: 344+93.76
70'-100'-70' TYPE IV PC BM SPANS.
SKEW 45° RF
40'-0" CLR RDY.
TOTAL LENGTH = 245.52'
LOW BEAM ELEV = 780.00
RDWY OT STA 339+36.38
RDWY OT ELEV = 780.82

Slope 0.018%
GUARDRAIL DETAIL

STA 342+14.35 TO STA 342+20.60 LT. (OPPOSITE HAND)
STA 342+14.35 TO STA 342+20.60 RT.
STA 342+14.35 TO STA 342+20.60 LT. (OPPOSITE HAND)
STA 342+14.35 TO STA 342+20.60 RT.
STORM WATER MANAGEMENT PLAN

SITE DESCRIPTION

SOIL STABILIZATION PRACTICES:

- Temporary Seeding
- Permanent Seeding, Spraying or Seeding
- Vegetative Mulching
- Soil Retention Blanket
- Preservation of Existing Vegetation

NOTE: Temporary erosion control methods must be used on all disturbed areas where construction activities have ceased for over 14 days. Methods used will be as shown on plans, or as directed by the Engineer.

SUGGESTED SEQUENCE OF EROSION CONTROL ACTIVITIES:

1) Prior to initiating soil disturbing activities, the contractor will install all perimeter temporary sediment controls specified.
2) Strip, Stockpile and Stabilize Topsoil.
3) Clean and Grub only in necessary areas, preserving as much native vegetation as possible.
4) Install and Maintain temporary sediment items with construction operations as practical.
5) If directed by the Engineer, plant temporary seeding.
6) Replace salvaged topsoil and devices when an acceptable vegetative cover at least 70% has been attained.
7) As site conditions warrant, the contractor may choose to modify the type or arrangement of specified practices to improve their effectiveness as approved by the Engineer.
8) The contractor will maintain a log of the dates of major soil disturbance activities, and also the dates of installation of erosion control measures.

OFFSITE AREA TO BE DISTURBED:

- For contractor use
- Maximum acres to be disturbed at any one time: 50
- For contractor use

NAME OF RECEIVING WATERS: HORSE CREEK

GENERAL NOTES:

- Proper management and disposal of construction waste material is required by the contractor.
- Materials include stockpiles, surplus, debris, and all other products from the construction process. Practices include disposal, proper management and cleanup measures. Controls and practices will meet the requirements of all federal, state and local agencies.

HAZARDOUS MATERIALS:

- Proper management and disposal of hazardous waste material is required. The contractor is responsible for performing all responsibilities of OQEC, Water Quality Division, September 13, 2012.

GUIDELINES:

- Prevention of soil erosion, containment of hazardous materials, and the interception of these pollutants before leaving the construction site are the best practices for controlling storm water pollution.

THE CONTRACTOR SHALL ALSO BE RESPONSIBLE FOR THE FOLLOWING:

- Maintenance and Inspection:
  - All erosion and sediment controls will be maintained in good working order from the beginning of construction until an acceptable vegetative cover is established.
  - Inspection by the contractor and any necessary repairs shall be performed once every 7 calendar days and within 24 hours after any storm event greater than 0.5 inches as recorded by a non-freezing rain gauge located on site. Potentially erodible areas, drainageways, and other areas, devices, construction entrances and exits along with erosion and sediment control locations are examples of sites that need to be inspected.

- Waste Materials:
  - Proper management and disposal of construction waste material is required by the contractor. Materials include stockpiles, surplus, debris, and all other products from the construction process. Practices include disposal, proper management and cleanup measures. Controls and practices will meet the requirements of all federal, state and local agencies.

- General Notes:
  - Storm water pollution prevention plan (SWPPP) is required to comply with the Oklahoma pollution discharge elimination system (OPDES) regulations. This plan is initiated during the design phase, confirmed in pre-work meetings and available on site. The plan must be kept current with updated amendments during the progression of the project. All contractor off-site operations associated with the project must be documented in the SWPPP. This includes, but is not limited to, borrow pits, waste roads, disposal sites, asphalt/concrete plants, etc.
  - The basic goal of storm water management is to improve water quality by reducing pollutants in storm water discharges. Runoff from construction sites has the potential for pollution due to exposed soils and the presence of hazardous materials used in the construction process. The prevention of soil erosion, containment of hazardous materials, and the interception of these pollutants before leaving the construction site are the best practices for controlling storm water pollution.

- The following sections of the 2009 ODOT Standard Specifications should be noted:
  - 103.05 Bonding Requirements
  - 104.0 Final Cleaning Up
  - 104.12 Contractor's Responsibility for Work
  - 104.13 Environmental Protection
  - 106.08 Storage and Handling of Material
  - 107.01 Laws, Rules and Regulations to Be Observed
  - 107.20 Storm Water Management
  - 220 Management of Erosion, Sedimentation and Storm Water Pollution Prevention and Control

- Temporary Sediment Control

- In addition: GIDQ General Permit (EKIP10) for storm water discharges from construction activities within the state of Oklahoma. ODEQ, Water Quality Division, September 13, 2012.

NOTES:

- No disturbed area to one project outfall exceeds 5 acres.
Permanent Slope Protection

Special Roadway Ditch

Top of Cut Rounding

Top of Slope Rounding

Rounding Detail

Elevations as shown on P & P sheets and cross sections.

Widths as shown on plans.

Grade to this line.

1:4 Backslope

Backfill material w/sod or TBSC (refer to typicals)

5' Salvaged Topsoil

Intersection of cut and/or fill slopes with ground line to be rounded as part of finishing operations. Rounding shall be 5' min. for smaller cuts and fills to 15' max. for larger cuts and fills or as designated by the Engineer. Cost of rounding to be included in price bid for other items of work.

5' Min. for small cuts and fills to 15' max. for larger cuts and fills.
PHASE 1

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<th>CONSTRUCTION</th>
<th>TRAFFIC</th>
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<td>Detour</td>
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<td>Bridge A</td>
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PHASE 2

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<tr>
<td>Bridge A</td>
<td>Construct</td>
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</tbody>
</table>

LEGEND

- CONSTRUCTION
- TEMPORARY CONSTRUCTION
- COMPLETED CONSTRUCTION
- COMPLETED TEMPORARY CONSTRUCTION
- TEMPORARY CONSTRUCTION REMOVAL

US 60 DETOUR

PHASE 1

PHASE 2

US 60 DETOUR
PHASE 3

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</tr>
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<tr>
<td>Hi: 30</td>
<td>Construct/gap shoulder, guardrail, median and fence.</td>
<td>On designated US 60</td>
</tr>
<tr>
<td>Detour</td>
<td>Remove</td>
<td></td>
</tr>
<tr>
<td>Bridge A</td>
<td>No construction</td>
<td></td>
</tr>
</tbody>
</table>

LEGEND

- [diagram elements]

OKLAHOMA DEPARTMENT OF TRANSPORTATION

Preliminary Plan Field Review Meeting
MARCH 2016
HALF SECTION AT END DIAPHRAGMS

TYPICAL SECTION THRU STRUCTURE

HALF SECTION AT INTERMEDIATE DIAPHRAGMS

DIAPHRAGM BOLT NOTES

1. STRUCTURAL STEEL FOR DIAPHRAGM BOLTS AND PLATE WASHERS SHALL CONFORM TO ASTM A325 (ASTM A325) GRADE 50 STEEL. TESTING NOT REQUIRED. A #12 REINFORCING BAR CONFORMING TO ASTM A615 GRADE 60, 8 FOOT LENGTHS, SHALL BE SUBMITTED FOR THE DIAPHRAGM BOLTS AT NO ADDITIONAL COST TO THE DEPT. HER NUTS SHALL CONFORM TO ASTM M27 (ASTM A563).

2. PAINT EXPOSED DIAPHRAGM BOLT, PLATE WASHER AND HEX NUT WITH TWO (2) COATS OF ZINC-RICH PAINT (6 MIL MINIMUM THICKNESS) TO CONFORM TO AASHTO M31. GRADE 60, 8 FOOT LENGTHS, SHALL BE SUBMITTED FOR THE DIAPHRAGM BOLTS AT NO ADDITIONAL COST TO THE DEPT. HER NUTS SHALL CONFORM TO ASTM M27 (ASTM A563).

3. TREAT SURFACES INDICATED BY HEAVY LINE AND HATCH WITH WATER REPELLENT.

NOTE: PLAN QUANTITIES FOR CLASS AA CONCRETE INCLUDE BEAM HAUNCHES. THE ACTUAL HAUNCH HEIGHT FOR PAYMENT. THE ENGINEER WILL NOT MEASURE THEORETICAL HAUNCH HEIGHT AT THE CENTERLINE OF THE BEAMS AND SUBMIT TO THE ENGINEER FOR APPROVAL. THE ENGINEER WILL NOT MEASURE THEORETICAL HAUNCH HEIGHT FOR PAYMENT.

NOTE: WATER REPELLENT TO BE INCLUDED IN CONTRACT UNIT PRICE FOR STRUCTURAL STEEL.