Revised DRAFT FOR REVIEW

MUS-CR66-0005, PID No. 101730
BRIDGE OVER MUSKINGUM RIVER
STRUCTURE TYPE STUDY

Dated: September 2019

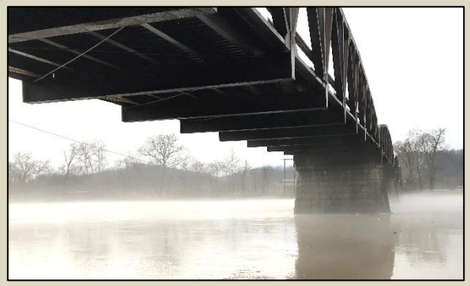
Prepared For:

Muskingum County
ENGINEER'S OFFICE

155 Rehl Road
Zanesville, Ohio 43701
Phone - 740-454-0155
Fax - 740-455-7180

Mark J. Eicher, P.E., P.S. - Muskingum County Engineer

Engineer@mceo.org



Prepared By:

ADR & ASSOCIATES, LTD.

ADR & Associates, Ltd.
88 West Church Street
Newark, Ohio 43055
(740) 345-1921

TABLE OF CONTENTS

PREFACE

This document was prepared in August 2019.

Prepared For:

Muskingum County ENGINEER'S OFFICE
155 Rehl Road
Zanesville, Ohio 43701
Phone - 740-454-0155
Fax - 740-455-7180
Mark J. Eicher, P.E., P.S. - Muskingum County Engineer
Engineer@mceo.org

Prepared By:

ADR & Associates, Ltd.
88 West Church Street
Newark, Ohio 43055
(740) 345-1921

Justin Hartfield, PE Date

EXECUTIVE SUMMARY

ADR & Associates, Ltd. (ADR) has prepared this MRS-CR66-0005 (Gaysport Bridge) Structure Type Study for the Muskingum County Engineer's Office. This report is one component of the Preliminary Engineering Process for this project.

The purpose of the MUS-CR66-00.05, PID No. 101730 project is to replace the structurally deficient existing bridge superstructure on the Gaysport bridge (C.R. 66 a.k.a. North Street) over the Muskingum River (SFN 6031307) using the existing bridge substructures. This structure type study evaluates the project site to determine the best bridge superstructure replacement alternative.

The roadway horizontal and vertical alignment are intended to be maintained or slightly improved over the existing conditions. The replacement bridge superstructure low chord was not lowered below the existing bridge low chord elevation so there will be no adverse impacts to the 100-year storm elevation (Base Flood Elevation). The bridge will have a vertical profile set to accommodate 25 MPH two-lane, two-way traffic. There is some room to adjust the profile down thereby improving the profile.

Traffic will need to be detoured for construction because it is not practical or cost effective to reconstruct the bridge part width, to construct a replacement bridge in a new location, or to construct a temporary bridge. Maintaining marine traffic or closing to marine traffic will be dependent on the process for the demolition of the existing superstructure and the construction of the proposed superstructure.

Since the existing substructure was determined to be reused by the Muskingum County Engineer, no alternative evaluation of the substructure was necessary.

The following replacement superstructures were considered.

- Doing nothing (No-Build)
- Four truss spans with rolled steel beam approach spans with a width of 20 feet f/f rail
- Four truss spans with rolled steel beam approach spans with a width of 24 feet f/f rail
- Four steel plate girder spans with rolled steel beam approach spans with a width of 20 feet f/f rail
- Four steel plate girder spans with rolled steel beam approach spans with a width of 24 feet f/f rail
- Prestressed concrete I-beams

The recommended preferred replacement superstructure alternative is to use four lines of galvanized rolled steel beams for spans 1, 2 & 7 and four lines of galvanized constant depth steel plate girders for spans 3 through 6 with 24 feet wide face/face rail reinforced concrete deck with TST railing and over the side drainage. The steel plate girders are proposed to have a depth of between 50" to 52" with an 8.5" composite concrete deck and 2" haunches that will not decrease the low chord elevation of the bridge.

The substructure abutments and piers will have caps replaced with reinforced concrete and new bearings. Abutments will be semi-integral with new approach slabs. Link slab joints are proposed between spans 2 & 3 and between spans 6 & 7. Barges with cranes will be more cost effective and of lower risk than constructing a causeway to demolish the existing bridge superstructure and portions of the substructure and to construct the proposed bridge superstructure.

The preliminary estimated construction cost for the recommended preferred alternative is $5.98 million.

INTRODUCTION

GENERAL PROJECT DESCRIPTION

The purpose of the MUS-CR66-00.05, PID No. 101730 project is to replace the structurally deficient existing bridge superstructure on the Gaysport bridge over the Muskingum River (SFN 6031307) using the existing bridge substructures. This structure type study evaluates the project site to determine the best bridge superstructure replacement alternative.

PROJECT BACKGROUND

The Muskingum County Engineer employed ADR & Associates, Ltd. (ADR) to provide a structure type study to replace the superstructure for the existing bridge structure on County Road 66 over the Muskingum River.

Based on bridge inspections performed by the Muskingum County Engineer's Office, the Muskingum County Engineer made the determination that the existing bridge superstructure needed to be replaced and that the existing bridge substructure could be salvaged. Therefore, alternatives that require removing and relocating the bridge or permanently closing and removing the bridge are not considered.

The existing bridge has been signalized to allow only one-lane of two-way traffic on the bridge.

SCOPE OF SERVICES FOR THE STRUCTURE TYPE STUDY

ADR's scope of services includes:

- Performing a structure type study per Section 201 of the Bridge Design Manual (BDM).
- Salvaging and reusing the existing substructure except that the pier and abutment caps are to be specified to be replaced and preliminarily designed as appropriate for each alternative.
- Evaluating and preliminarily developing the following superstructure type alternatives:
  - No build
  - Four truss spans with rolled steel beam approach spans with a width of 20 feet f/f rail
  - Four truss spans with rolled steel beam approach spans with a width of 24 feet f/f rail
  - Four steel plate girder spans with rolled steel beam approach spans with a width of 20 feet f/f rail
  - Four steel plate girder spans with rolled steel beam approach spans with a width of 24 feet f/f rail
  - Prestressed concrete I-beams
- Using TST bridge railing with over the over the side drainage in lieu of using concrete parapets.
- Specifying the bridge spans are to be numbered from west to east.
- Using continuous rolled steel beams for bridge spans 1-2.
- Using simple rolled steel beams for bridge span 7.
- Analyzing and providing preliminary designs for:
  - Continuous rolled beams, spans 1 & 2
  - Continuous plate girders, spans 3 thru 6
  - Simple rolled beam, span 7
- Using the criteria for deflection as specified in AASHTO LRFD Bridge Design Manual Specifications 2.5.2.6.2. The optional span-to-depth ratios specified in AASHTO LRFD Bridge Design Specifications 2.5.2.6.3 will not be used.
- Determining the anticipated cost of the new bearings for the construction cost estimates. The design of the bearings will be deferred to when the preferred alternative is further developed.
- Developing the following for each feasible alternative advanced for consideration:
  - Preliminary site plan
  - Preliminary plan and profile
  - Preliminary engineer's estimate of probable construction costs
- Requesting hydraulic analysis data from FEMA. If the data is available in a format compatible with HEC-RAS, a preliminary analysis will be performed for the feasible alternatives.
- Designing each feasible alternative to maintain the navigable channel height.
- Determining the need and cost of a causeway into the river to construct the replacement bridge superstructure and identifying feasible alternatives to the causeway.
- Proposing only the minimum roadway approach work needed to accommodate the feasible bridge superstructure replacement alternatives and restore the roadway to two-lane, two-way traffic.
- Investigating whether to accommodate replacing utilities on the replacement bridge superstructure or require the utilities currently on the bridge to relocate. In coordination with the Muskingum County Engineer, the affected utilities will be contacted for their input.
- Closing the bridge and detouring traffic during construction. Maintenance of Traffic design and details will be prepared during development of the preferred alternative.
- Comparing considered feasible superstructure replacement alternatives and recommending a preferred superstructure replacement alternative.

SERVICES NOT INCLUDED

The following services that have not been scoped to be included in this study and are deferred to after the selection of the preferred alternative:

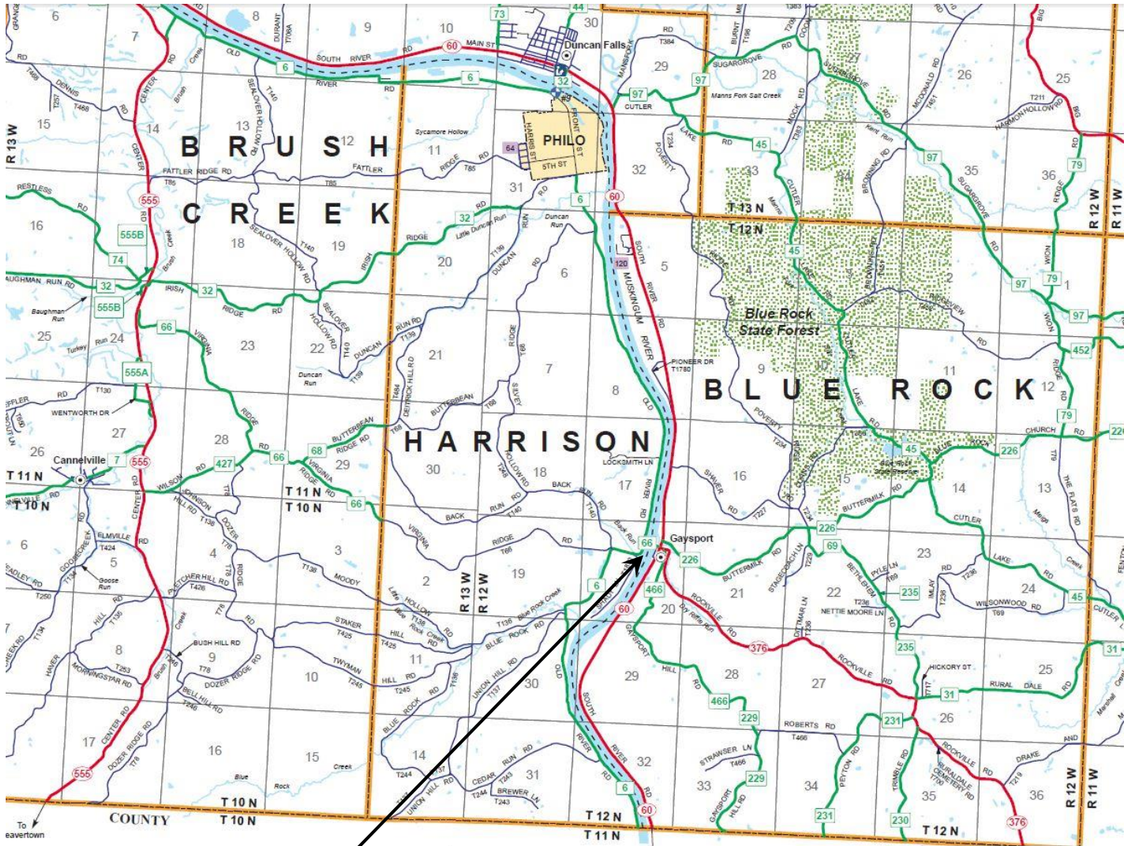
- Environmental investigations, clearance, or permitting
- Asbestos investigations
- Surveying
- Utility relocation
- Determination of existing property ownerships and existing easements
- Existing and proposed right-of-way determinations
- Construction plans and specifications
- Geotechnical investigations
- Public involvement
- Structural inspections
- Analysis of substructure
- Testing
- Another agency coordination

LOCATION

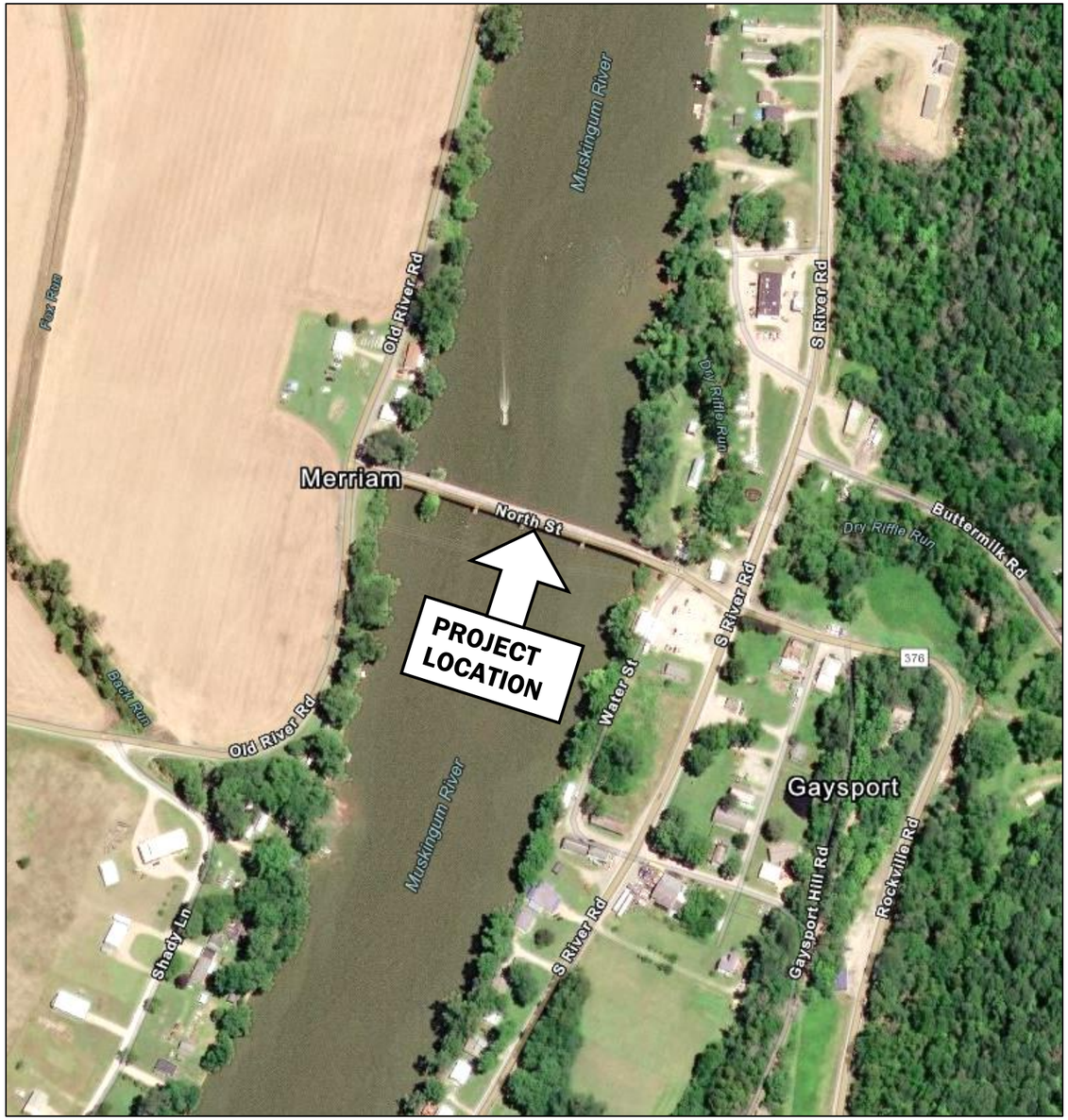
The Gaysport bridge is in the County of Muskingum and the State of Ohio. It is located along Muskingum County Road No. 66 (C.R. 66 a.k.a. North Street) over the Muskingum River connecting S.R. 60 at the unincorporated Village of Gaysport in the Township of Blue Rock on the east side of the river to Muskingum County Road No. 6 (C.R. 6) on the west side of the river in Harrison Township. The bridge is also located within the jurisdiction of ODOT District 5.

Latitude: 39°48'14.18" (39.80394°) Longitude: -81°53'36.26" (-81.89306°)

PROJECT VICINITY MAP



PROJECT LOCATION MAP



EXISTING CONDITIONS

The following are general descriptions of the existing conditions at the bridge site.

EXISTING ROADWAY DESCRIPTION

Existing County Road 66 (North Street) is a river crossing roadway that connects C.R. 6 (Old River Road) to the west to the intersection of S.R. 60 (S. River Road) with S.R. 376 (Rockville Road) to the east at a distance of approximately 0.17 mile across the Muskingum River.

The pavement surface is asphalt concrete with an unknown thickness and unknown base other than as shown on the record plans.

The existing right-of-way width is shown as being 50 feet in width at the bridge and varies in width at the adjacent intersections according to Muskingum County GIS. The actual R/W widths will need to be determined and verified as the project is further developed.

The existing roadway was intended to have two-lane traffic with two 10 feet wide lanes. It appears that the paved shoulders are a minimum of 2 feet wide. However, due to the condition of the bridge superstructure, the bridge has been signalized to allow only one-lane two-way traffic.

EXISTING TRAFFIC DATA

- ADT (2015): 2,917
- ADTT (2015): 218
- Directional Distribution: Unknown

EXISTING BRIDGE DESCRIPTION

The existing bridge is known as the “Gaysport Bridge” further identified as the MUS-CR66-00.05 (SFN 6031307) bridge over the Muskingum River.

EXISTING STRUCTURE DATA

- Spans: Seven spans (60.93’, 140.17’, 140.17’, 109.67’, 102.33’, 71.38’, 59.83’)
- Total Length: 684 ft. (688 ft. per bridge inventory report)
- Ohio % Legal Load: 35%
- Design Speed: Less than 25 mph
- Superstructure Type: Simple steel beam approach spans with four pony truss mid spans
- Abutment Type: Concrete capped sandstone
- Pier Type: Concrete capped sandstone
- Roadway Width: 24’-0” face to face rail
- Skew: None
- Loading: Unknown
- Approach Slabs: None
- Wearing Surface: Asphalt
- Date Constructed: 1955, Modified 1971 & 2001
- Navigation channel is Span 4 with a width of 103.77’+/-

AVAILABLE RECORD PLANS AND RECORD INFORMATION

The following record plans and information were used to develop this structure type study.

- Reconstruction and Repair of Gaysport Bridge and Approaches over Muskingum River, dated June 1955.
- Proposed New Bridge over Muskingum River at Gaysport, dated Jan. 1970.
- 684’ Seven Span Bridge, County Road 66, 24’ Roadway Width, Gaysport Bridge, dated July 2001.
- Ohio Department of Transportation Bridge Inventory Report
- Ohio Department of Transportation Bridge Inspection Report

DESIGN CONSIDERATIONS

The design philosophy for this bridge was to replace the bridge superstructure on the existing substructure except for replacing the substructure pier and abutment caps.

The replacement bridge structure and associated roadway improvements are designed in accordance with the Ohio Department of Transportation (ODOT) Location and Design Manuals (issued July 2019), the ODOT Bridge Design Manual 2019 (issued July 2019), and the AASHTO LRFD Bridge Design Specifications, 8th Edition. AASHTO LRFD HL-93 truck (or lane load) are the design live loadings, and a 60 psf future wearing surface, placed out-to-out deck, is used for the future dead load on the structure.

ROADWAY

The roadway geometrics and typical section were developed referencing L&D Vol. 1 as well as per Muskingum County Engineer criteria.

ROADWAY DESIGN CRITERIA

- Highway Classification: Rural Collector
- Legal Speed: Unposted and Signal Controlled
- Design Speed: <25 MPH Existing and 25 MPH Proposed
- ADT (2015): 2,917
- ADTT (2015): 218
- ADT (2035): To be determined upon further project development
- ADT (2035): To be determined upon further project development
- Directional Distribution: To be determined upon further project development

PROPOSED HORIZONTAL ALIGNMENT

The proposed horizontal alignment of C.R. 66 (North Street) is on a tangent alignment beginning at the westerly end of C.R. 66 at the intersection with C.R. 6 (North River Road) and extending across 7 bridge spans to a curve to the right having a degree of curve of 19°11'17" and 15.73' west of the easterly bridge limit. The horizontal alignment of C.R. 66 terminates at the intersection with S.R. 60. The proposed horizontal alignment of the proposed bridge follows the horizontal alignment of the existing bridge.

PROPOSED VERTICAL ALIGNMENT

The proposed profile grade will provide a crest vertical curve over the Muskingum River like the existing bridge. The proposed design speed is 25 MPH which is a slight improvement over the existing conditions. The intersections located in close proximity of the bridge at both ends of the bridge and required bridge clearances over the Muskingum River limit increasing the design speed of the roadway over the bridge.

PEDESTRIAN SIDEWALKS

There are no pedestrian destination or origin points located west of the bridge and the existing bridge has no walks, therefore, no walks are proposed for the replacement bridge superstructure.

MAINTENANCE OF TRAFFIC

ROADWAY TRAFFIC:

Traffic will need to be detoured for construction because it is not practical or cost effective to reconstruct the bridge part width, to construct a replacement bridge in a new location, or construct a temporary bridge. It is 5 miles to the Philo bridge over the Muskingum River to the north (upstream) and 12.6 miles to the McConnelsville bridge to the south (downstream).

MARINE TRAFFIC:

The maintenance of marine traffic will be determined as the project further develops. Maintaining marine traffic or closing to marine traffic will be dependent on the process for the demolition of the existing superstructure and the construction of the proposed superstructure.

BRIDGE DECK AND ROADWAY DRAINAGE

As directed by the Muskingum County Engineer the proposed drainage for the bridge will be over the side drainage.

The approach roadway drainage will be open ditch.

PROPOSED STRUCTURE

PROPOSED STRUCTURE DATA

- Spans: Seven spans
- Superstructure Type: Steel beam and plate girder
- Abutment Type: Reinforced concrete capped stone
- Pier Type: Reinforced concrete capped stone
- Roadway Width: 24' face to face rail
- Skew: None
- Loading: HL-93 with 0.06 KSF future wearing surface
- Approach Slabs: 25' long (AS-1-15)
- Wearing Surface: 1" monolithic concrete

PROPOSED BRIDGE TRANSVERSE SECTION

The proposed bridge transverse section for the 24 feet wide face/face rail alternatives will consist of two 10'-0" wide lanes with 2'-0" shoulders on each side. The proposed approach roadways will approximate the existing conditions.

The proposed bridge transverse section for the 20 feet wide face/face rail alternatives will consist of two 9'-0" wide lanes with 1'-0" shoulders on each side. The proposed approach roadways will approximate the existing conditions by transitioning the 9'-0" wide lanes to the 10 feet wide existing approach lanes.

CLEARANCES

The Muskingum River is designated as a navigable waterway within the specific reach of the river that includes the location of the Gaysport bridge. Preliminary coordination with the United States Coast Guard is ongoing. Past coordination has included telephone discussions.

Based on prior work completed on the MUS-CR32-0.00 (Philo Bridge) project, the following clearances are proposed for the Gaysport bridge.

MINIMUM VERTICAL NAVIGATIONAL CHANNEL CLEARANCE

The minimum vertical navigational channel clearance is 28 feet above the normal pool elevation defined to be at elevation 660.41 and located within the navigational channel.

MINIMUM HORIZONTAL NAVIGATIONAL CHANNEL CLEARANCE

The minimum horizontal navigational channel clearance is 76 feet of clearance provided from face to face of the piers in the navigation channel. Since the existing piers are intended to remain, the horizonal clearance will remain as existing.

STREAM HYDRAULICS

Muskingum River hydraulic data was acquired from the Muskingum County Engineer's Office and additional data was requested from FEMA.

The data received from the Muskingum County Engineer's Office was for portions of the Muskingum River located north of Gaysport and it did not encompass data that could be used to study the Gaysport bridge superstructure replacement.

The initial stream data received from FEMA was not current HEC-RAS data. Based on subsequent requests to FEMA for additional available hydraulic data, additional data was obtained for tributaries to the Muskingum River, but not for the Muskingum River.

ADR & Associates, Ltd. (ADR) attempted to create a duplicative effective model based on the hydraulic outputs obtained from FEMA. The data was keyed into HEC-RAS, but a model that checked within the required tolerances was not generated (within 6 inches of the existing model). Therefore, a stream profile was established based on existing published data.

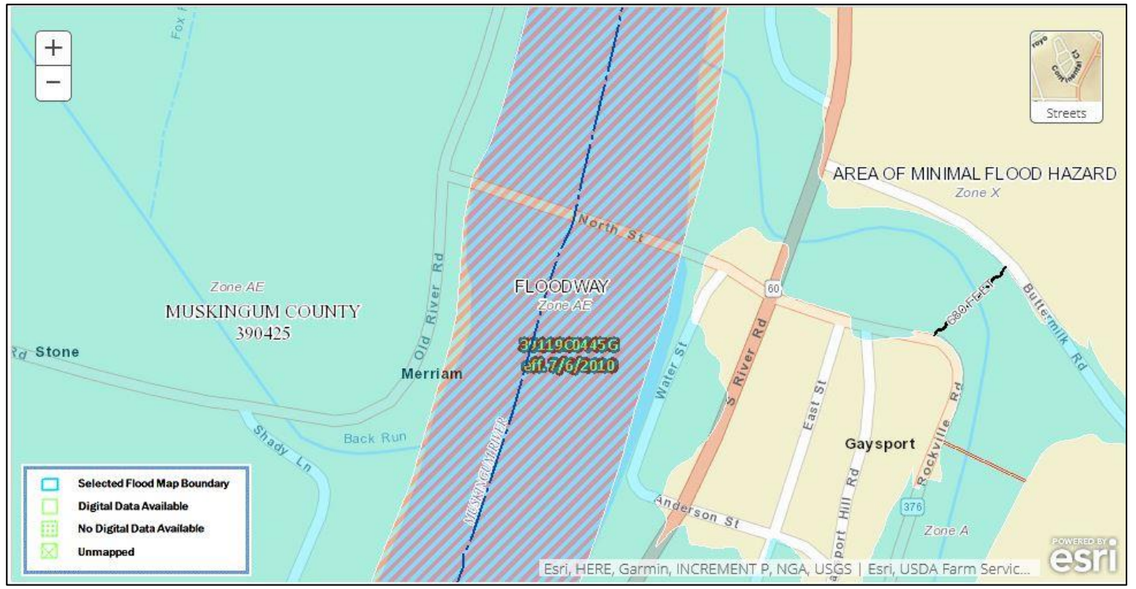
The replacement bridge superstructure low chord was not lowered below the existing bridge low chord elevation so there will be no adverse impacts to the 100-year storm elevation (Base Flood Elevation).

AVAILABLE STREAM DATA

- The bridge site is located within the Muskingum River watershed.
- The 1913 Flood Elevation is noted at 683.00 on 1970 plans.
- The river pool elevation is noted as 661.11 USCE (1929 Datum) or 660.41 (1988 Datum).
- The base flood (100-year) elevation is 679.50+/- (1988 Datum).
- The following are based on Ohio StreamStats (https://streamstats.usgs.gov/ss/):
  - Drainage Area: 7350 square miles
  - Peak Flood, 10-Year: 89,400 cfs
  - Peak Flood, 100-Year: 145,000 cfs
  - Highest Mean Monthly Flow: Occurs in March at 13,600 cfs
- FEMA stream data varies from Ohio StreamStats

DESIGN FREQUENCY

As per the ODOT Location and Design Manual Volume 2 Section 1004.2 and as referenced in the 2019 Bridge Design Manual, Section 203.2, the proposed bridge structure will be designed for a 25-year design flood frequency and the 100-year flood frequency will be checked for compliance with federal regulations.



FLOOD ZONE

The bridge and approach roadway are in Zone AE per FEMA FIRM Map 39119C0445G dated 7/6/2010. The Base Flood Elevation (BFE) and floodway have been determined and depicted on the FIRM. An existing hydraulic model is available from FEMA. The 100-year discharge found in the FEMA model was used for the analysis.

A No-Rise condition is preferred if construction is performed within the floodway. Construction within the FEMA Zone AE will require coordination with the Local Floodplain Coordinator. For Muskingum County, the Designated Floodplain Administrator (DFPA) is the Chief Building Official, Jason R. Baughman, PE, Floodplain Administrator, 22 North 5th Street, Zanesville, OH 43701, (740) 455-7905.

STRUCTURE CONSIDERATIONS

PROPOSED STRUCTURE

The project involves replacing the existing deteriorated bridge superstructure on existing substructure with new reinforced concrete caps on the existing piers and abutments. Since the existing substructure was determined to be reused by the Muskingum County Engineer, no alternative evaluation of the substructure was necessary. The following replacement superstructures were considered.

- Doing nothing (No-Build)
- Four truss spans with rolled steel beam approach spans with a width of 20 feet f/f rail
- Four truss spans with rolled steel beam approach spans with a width of 24 feet f/f rail
- Four steel plate girder spans with rolled steel beam approach spans with a width of 20 feet f/f rail
- Four steel plate girder spans with rolled steel beam approach spans with a width of 24 feet f/f rail
- Prestressed concrete I-beams

NO-BUILD ALTERNATIVE

While the No-Build Alternative is the least expensive of the alternatives considered, it does not meet the purpose and need of the project and is dismissed from further consideration.

The No-Build Alternative will result in the complete closure of the existing bridge to traffic within the next few years. The existing superstructure has experienced significant deterioration with substantial section loss observed on connections and stringers. The bridge load limit has been reduced to 35% of legal load. Traffic has been reduced from two-lane, two-way traffic to one-lane, two-way traffic with signalization on the bridge. Due to the length of the bridge the one-lane two-way traffic with signalization has increased traffic wait times. Closing the bridge to traffic will result in traffic needing to cross the river either 5 miles upstream to the north at Philo/Duncan Falls or 13 miles downstream at McConnelsville/Malta.

PRESTRESSED CONCRETE I-BEAMS ALTERNATIVE

The use of prestressed concrete I-beams was considered and dismissed from further consideration. The prestressed concrete I-beams were dismissed because constructing a new superstructure with prestressed concrete I-beams would result in a significant increase to the superstructure dead load. The existing substructure is being reused and it was not designed for the substantial additional loading. Additionally, access to the site with the long prestressed concrete I-beams would be problematic and costly. Setting the prestressed concrete I-beams would require a crane larger than required to set the girders and rolled beams for a steel superstructure thereby increasing the erection costs for the prestressed concrete I-beams alternative.

APPROACH SPANS (SPANS 1, 2 & 7) ALTERNATIVE

While other alternatives were considered, the recommended preferred alternative for the bridge approach spans 1, 2 & 7 are to use rolled steel beams with four beam lines. Rolled steel beams are recommended because the approach spans are shorter than the middle spans allowing for the more economical steel rolled beams. The rolled steel beams are proposed to be continuous in approach spans 1 & 2 and in a simple span configuration for span 7. Rolled beams can used in conjunction with either plate girders or trusses for the middle spans.

A joint will be required on piers 2 and 6. A link slab could be used to prevent debris from entering the joint and keep the joint clean. New pier caps will be required to accommodate the proposed rolled steel beams. Existing substructure concrete caps should be removed down to the sandstone and rebuilt to the proposed beam seat. A semi-integral design is recommended on the piers and abutments per a slightly modified version of ODOT standard construction drawing SICD-1-96 Semi-Integral Construction Details for Steel Beam and Girder Bridges on Rigid Abutments. A semi-integral abutment diaphragm is recommended per ODOT SICD-2-14 Semi-Integral Abutment Diaphragm Guide.

20 FEET WIDE TRUSS (SPANS 3 THRU 6) ALTERNATIVE

This alternative utilizes four middle truss spans with rolled steel beam approach spans with a width of 20 feet f/f rail. This truss alternative will be less than the cost of the 24 feet wide truss alternative and comparable to the 24 feet wide steel plate girder alternative. However, the superstructure lane widths for this alternative would be significantly less than the 24 feet wide options and the existing bridge lane widths. Additionally, truss superstructures are considered fracture critical. Section 209.12 of the 2019 BDM states ***"The use of fracture critical members is strongly discouraged"***. Fracture critical superstructure require additional maintenance and expensive inspection when compared with the steel plate girder alternative.

Since the there are no significant cost savings when compared to the 24 feet wide steel plate girder, and fracture critical superstructures are discouraged by ODOT, this alternative is not recommended for additional consideration and project development.

24 FEET WIDE TRUSS (SPANS 3 THRU 6) ALTERNATIVE

This alternative utilizes four middle truss spans with rolled steel beam approach spans with a width of 24 feet f/f rail. This truss alternative will be more costly than the comparable 24' wide steel plate girder alternative. Additionally, truss superstructures are considered fracture critical. Section 209.12 of the 2019 BDM states ***"The use of fracture critical members is strongly discouraged"***. Fracture critical superstructure require additional maintenance and expensive inspection when compared with the steel plate girder alternative. For these reasons, this alternative is not recommended for additional consideration and project development.

ROLLED BEAM (SPANS 3 THRU 6) ALTERNATIVE

The four middle spans are too long for rolled steel beams, therefore this alternative is dismissed from further consideration.

20 FEET WIDE STEEL PLATE GIRDERS (SPANS 3 THRU 6) ALTERNATIVE

This alternative considers four continuous steel plate girder middle spans with rolled steel beam approach spans with a width of 20 feet f/f rail. This results in middle span costs being less than the other middle span options under consideration. However, the superstructure lane widths for this alternative would be significantly less than the 24 feet wide options and the existing bridge lane widths. For these reasons, this alternative is not recommended for additional consideration and project development.

24 FEET WIDE STEEL PLATE GIRDERS (SPANS 3 THRU 6) ALTERNATIVE

This alternative considers four continuous constant depth steel plate girder middle spans with rolled steel beam approach spans with a width of 24 feet f/f rail. This alternative is less expensive than the 24 feet wide truss alternative, maintains a 24 feet wide f/f rail width and is not fracture critical.

This alternative is recommended for additional consideration and project development.

PROPOSED BRIDGE DESIGN FEATURES

PROPOSED RAILING

The Muskingum County Engineer desires to use Twin Steel Tube (TST) bridge railing.

Per ODOT BDM Section 304.3.3, the TST railing configuration was developed as a replacement to the Deep Beam Bridge Guardrail system on projects requiring a higher NCHRP acceptance level. The TST bridge railing is for use over rural stream crossings on two (2) lane routes with an ADTT in one direction less than 2500 where the finished deck surface is less than 25 feet above the normal water surface elevation or final ground line. The system shall not be used on an overpass structure.

While the bridge is over 25 feet above the normal water surface, the TST is justifiable because the:

- existing bridge does not have concrete parapets,
- TST will be an improvement over the existing conditions,
- ADTT is significantly less than 2500,
- TST will be lighter than concrete parapets,
- TST will better accommodate over the side drainage,
- And the Muskingum County Engineer will be the maintaining agency.

GALVANIZED STRUCTURAL STEEL

All structural steel should be galvanized. The Muskingum County Engineer desires to use galvanized structural steel over weathering steel even though additional splices may be required for the galvanizing of girders. Painting structural steel requires additional maintenance throughout the lifespan of the structure.

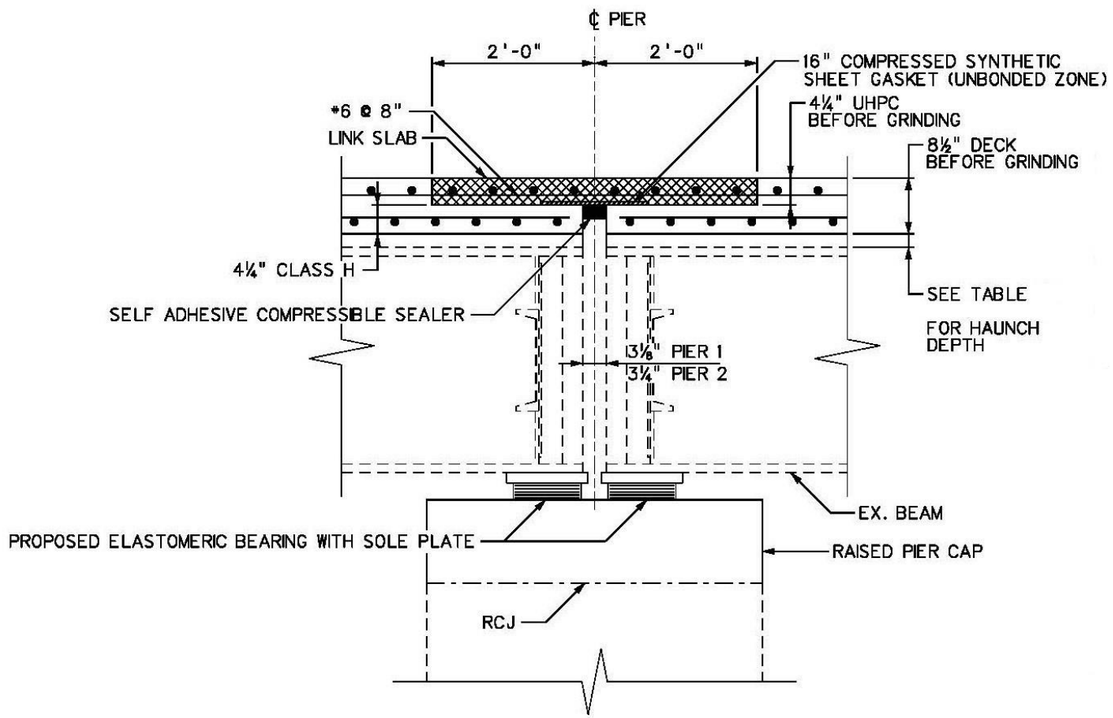
PROPOSED JOINTS

Expansion joint options were investigated for the two intermediate joint locations where the rolled beam and girder share a pier. A strip seal expansion joint and link slabs were investigated as two alternatives.

The preliminary costs of using link slabs is less than a strip seal expansion joint (approximately $6000). The link slabs will also eliminate the maintenance issues that a strip seal can have (such as leaking seal, armor damaged by snowplows, etc.).

There will be a joint over piers 2 and 6. Spans 1 & 2 and 3 thru 6 will be continuous. Span 7 is a simple span. A joint will be required between spans 2 & 3 and between spans 6 & 7.

A link slab joint detail that has been recently used in West Virginia and other states is recommended for this project. The link slab joint will keep the beam seat dry and material out of the joint. Following is an example of the link slab joint detail.



PROPOSED JOINT SECTION

UTILITIES ON BRIDGE

The determination whether to require utilities to relocate or to be allowed on the replacement bridge superstructure will be determine as the project is further developed and utility coordination occurs.

There is an existing utility line on the bridge. The line appears to be telephone. During the construction the line will require relocation. South of the structure there is overhead electric and telephone. These lines may limit cranes to being able to operate only on the north side of the bridge. Coordination with the utilities will be required to determine if relocation of the overhead lines is necessary.

CAUSEWAY VERSES BARGES

CAUSEWAY

Due to the length of the four main spans, a causeway or barges will be required to demolish the existing bridge superstructure and portions of the substructure and to construct the proposed bridge superstructure.

A causeway will require environmental permitting since significant fill will be necessary below ordinary high water. It is estimated that the causeway will need to be 50' +/- wide at the top to accommodate cranes and outriggers. Assuming 1:1 embankment slopes, the base of the causeway will need to be 80' to 100' wide. This would result in a large amount of fill to be placed and subsequently removed. Causeways have a risk of overtopping if the design storm is exceeded. This additional cost would be borne by the owner. This is not recommended method due to high cost and risk.

BARGES

Barges with cranes will be more cost effective and of lower risk than a causeway. Barges may require acquisition of temporary right-of-way for cranes and material to be loaded onto the barge. Permitting may be required to work below the ordinary high-water mark to construct a suitable area for loading and unloading. However, the impacts would be significantly less than a causeway. Based on conversations with contractors, the cost of removing the existing superstructure and constructing the new superstructure with barges is estimated to be approximately $2,000,000.

CORROSION PROTECTION – STEEL GIRDERS

There are three primary options that exist for protection against corrosion of steel girders. They are:

- Painted Steel
- Galvanized Steel
- Weathering Steel

The ODOT Bridge Design Manual (BDM) Section 302.4.1.5 serves as a guide in selecting corrosion control systems.

PAINTED STEEL

Painted steel is a common corrosion protection method used in the State of Ohio. The main drawback of a paint protection system is that it will need to be sand blasted and repainted periodically in order to continually protect the superstructure steel from corrosion. Sand blasting and repainting is complicated because of containment requirements and is expensive because the bridge transverses a relatively large waterway, the Muskingum River.

GALVANIZED STEEL

Hot dip galvanizing provides an excellent long-lasting corrosion protection system which is anticipated to be relatively maintenance free throughout the life of the galvanized coating which is approximately 100 years. Galvanized steel is often used on smaller bridges where beam/girder units can be easily hot-dipped. Generally structural steel members would need to be relatively short, approximately 55 feet or less, for hot-dipped galvanizing, but longer lengths can be galvanized. Therefore, the longer bridge spans may need to be fabricated with approximately twice as many members or sections as would typically be designed. This will increase the number of field splices and the cost of construction.

WEATHERING STEEL

Weathering steel can provide an excellent long-lasting corrosion protection system when used in the appropriate atmospheric circumstances. Typically, weathering steel performs well on bridges which are not exposed to a highly corrosive environment and which are not continuously exposed to long term moisture conditions. Adequate air flow is needed to provide a drying ventilation condition below the bridge. This would allow the girders to remain relatively dry and ensure that the steel will form a stable rust-like appearance when exposed to elements for a long period of time. The net effect is that the steel creates a brown patina coating which guards against future corrosion.

CORROSION PROTECTION LIFESPAN

A structure with a lower up-front cost which requires significant recurring maintenance may prove to be less economical than a structure with a higher up-front cost and little to no recurring maintenance. Additionally, a structure with high up-front costs and a long service life may prove to be more economical than a structure with lower up-front costs and a shorter service life.

Potential maintenance items include:

- Deck replacement: 40 years
- Sealing of concrete: 5 years
- Structural steel painting (painted steel alternative only): 30 years

A number of factors go into affecting the lifespan of the structure including the effect of corrosive elements in the environment, the type of corrosion protection system used, and the as-built thickness of the corrosion protections systems. A review of available information indicates the following lifespans for each beam/girder type with the associated maintenance work:

- Prestressed concrete I-beams: 75 years, with facia girder sealing every 5 years
- Weathering steel girders: 75 years, with little to no maintenance
- Galvanized steel girders: 100 years, with little to no maintenance

The value of a structure whose lifespan extends far into the future is hard to accurately quantify. Predicting the operational and loading needs of a structure 50 years into the future is typically not accurate.

CORROSION PROTECTION CONCLUSION

The girders for the Gaysport bridge are considered to be in a relatively non-corrosive environment except when road salts (deicing salts) find their way to the girders below the deck through a leaky deck and deck joints. While the beams are relatively high above the Muskingum River allowing for adequate air flow, there is fog and moisture associated with the river. Over the side drainage would allow road salts to blow onto the girders.

While having a higher initial cost, galvanized steel is recommended because it will not require maintenance, will better allow for over the side drainage, and avoids rust staining of the new substructure pier and abutment caps.

GIRDER WEB THICKNESS

Increasing the web thickness of steel plate girders facilitates easier construction when the girders are erected. A thicker web will help prevent the girders from buckling under their own weight prior to attaching cross frames. A thicker web will minimize, and may eliminate, the amount of temporary bracing required during construction.

A thicker web will increase the lifespan of the steel plate girder. Once the galvanizing has deteriorated the underlying steel will have an addition sacrificial thickness that can deteriorate without adversely affecting the superstructure thereby increasing lifespan.

The steel plate girders proposed for the replacement bridge superstructure are 48 inches by 5/8 inch. The steel plate girder web can be increased by 1/4 inch for a total web thickness of 7/8 inch without requiring the redesign of the steel plate girder flanges. The estimated cost of increasing the web thickness is $120,969 based on the following calculation.

493.75' long girders x (0.25" additional web thickness ÷ 12"/ft.) x 4' girder height x 4 girders x 490 lbs./cu. Ft. x $1.50 per lbs. = $120,969

SUMMARY OF CONSTRUCTION COSTS

CONSTRUCTION COST COMPARISONS

A preliminary estimate of probable construction costs based on 2019 costs was developed for each considered alternative and summarized as follows.

TRUSS REPLACEMENT COSTS

According to the Muskingum County Engineer's Office (MCEO) on Aug. 26, 2019, the estimated cost to replace the existing truss spans with galvanized truss superstructures having a 24' wide f/f rail concrete deck and TST railing is $5,320,000. This cost is to replace truss spans 3 thru 6 only, including new pier caps. This does not include costs to replace the steel beam spans 1, 2 & 7, abutments, or approach work.

According to the Muskingum County Engineer's Office (MCEO) on Aug. 27, 2019, the estimated cost to replace the existing truss spans with galvanized truss superstructures having a 20' wide f/f rail concrete deck and TST railing is $4,400,000. This cost is to replace truss spans 3 thru 6 only, including new pier caps. This does not include costs to replace the steel beam spans 1, 2 & 7, abutments, or approach work.

APPROACH SPANS ROLLED STEEL BEAMS, 20' WIDE, SPANS 1, 2 & 7, COSTS

Approximate construction cost is $1.398 million. See Appendix.

APPROACH SPANS ROLLED STEEL BEAMS, 24' WIDE, SPANS 1, 2 & 7, COSTS

Approximate construction cost is $1.446 million. See Appendix.

STEEL PLATE GIRDER, 20' WIDE, SPANS 3 THRU 6, COSTS

Approximate construction cost is $4.296 million. See Appendix.

STEEL PLATE GIRDER, 24' WIDE, SPANS 3 THRU 6, COSTS

Approximate construction cost is $4.527 million. See Appendix.

COST COMPARISON SUMMARY

Truss Alternative, 20' Wide: $1.398 Million + $4.400 Million = **$5.798 Million**

Truss Alternative, 24' Wide: $1.446 Million + $5.320 Million = **$6.766 Million**

Steel Plate Girder Alternative: 20' Wide: $1.398 Million + $4.296 Million = **$5.694 Million**

Steel Plate Girder Alternative: 24' Wide: $1.446 Million + $4.527 Million = **$5.973 Million**

LIFE CYCLE COSTS

Life cycle costs are generated by combining the initial construction costs with the future maintenance costs to calculate the anticipated cost of the alternatives over the life of the bridge.

For this study, life cycle costs are calculated on today's dollars and with a negligible discount rate.

For actual performance, it is noted that increasing traffic and damage would result in rehabilitation timing decreases. Meaning that the same standard fix can't last the same time frame as the previous fix.

The time horizon for the life cycle cost analysis:

- Equal for all alternatives under consideration
- Is not the same as the design life
- Is set long enough in include at least one major rehabilitation
- Long enough to distinguish cost differences

For reasons previously stated, painting of structurally steel has been excluded from additional consideration and life cycle cost analysis.

BREAKDOWN OF LIFE CYCLE COSTS

The following tables show the life cycle costs for sealing, deck and inspection for a 75-year life cycle.

STRUCTURE TYPE	SEALING Life Cycle Cost		
	Frequency (Years)	Cost	Total
Galvanized Beams	15	$9,800	$39,200
Weathering Beams		$9,800	$39,200
Truss		$4,694	$18,776

STRUCTURE TYPE	DECK Life Cycle Cost *		
	Frequency (Years)	Cost	Total
Galvanized Beams	40	$943,117	$943,117
Weathering Beams		$943,117	$943,117
Truss	20	$508,499	1,525,498

* Deck cost for truss includes superstructure rehabilitation.

STRUCTURE TYPE	INSPECTION Life Cycle Cost		
	Frequency (Years)	Cost	Total
Galvanized Beams	1	$1,500	$112,500
Weathering Beams		$1,500	$112,500
Truss		$5,000	$375,000

SUMMARY OF LIFE CYCLE COSTS

The following table shows the life cycle costs for the shown beam types for a 75-year life cycle.

STRUCTURE TYPE	Life Cycle Cost	Superstructure Replacement Initial Construction Cost
Galvanized Beams	$7,058,106	$5,972,289
Weathering Beams	$6,610,672	$5,524,855
Truss	$8,684,910	$6,765,636

CONCLUSIONS AND RECOMMENDATIONS

RECOMMENDED PREFERRED ALTERNATIVE

The recommended preferred replacement superstructure alternative is to use four beam lines of galvanized rolled steel beams for spans 1, 2 & 7 and galvanized steel plate constant depth girder for spans 3 through 6 with 24 feet wide face/face rail reinforced concrete deck with TST railing and over the side drainage. The steel plate girders are proposed to have a depth of between 50” to 52” with an 8.5” composite concrete deck and 2” haunches. There are also four steel plate girder beam lines.

The total superstructure depth will be 60.5” to 62.5”. Span lengths are 102’-3”, 110’, 140’-3”, and 140’-3” for spans 3 through 5.

The bridge will have a vertical profile set to accommodate 25 MPH two-lane, two-way traffic that will not decrease the low chord elevation of the bridge. There is some room to adjust the profile downward to improve the profile.

The substructure abutments and piers will have caps replaced with reinforced concrete and new bearings. Abutments will be semi-integral with new approach slabs. Link slab joints are proposed between spans 2 & 3 and between spans 6 & 7.

Barges with cranes will be more cost effective and of lower risk than constructing a causeway to demolish the existing bridge superstructure and portions of the substructure, and to construct the proposed bridge superstructure.

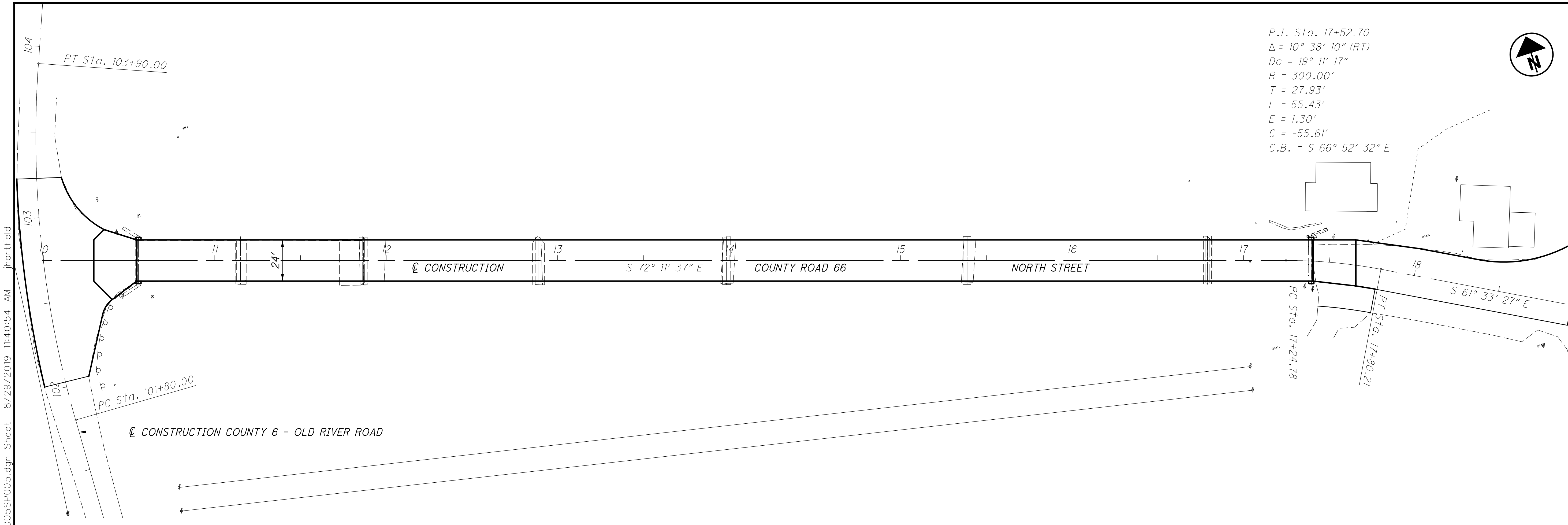
APPENDIX

APPENDIX A: PRELIMINARY PLANS

APPENDIX B: COST ESTIMATES

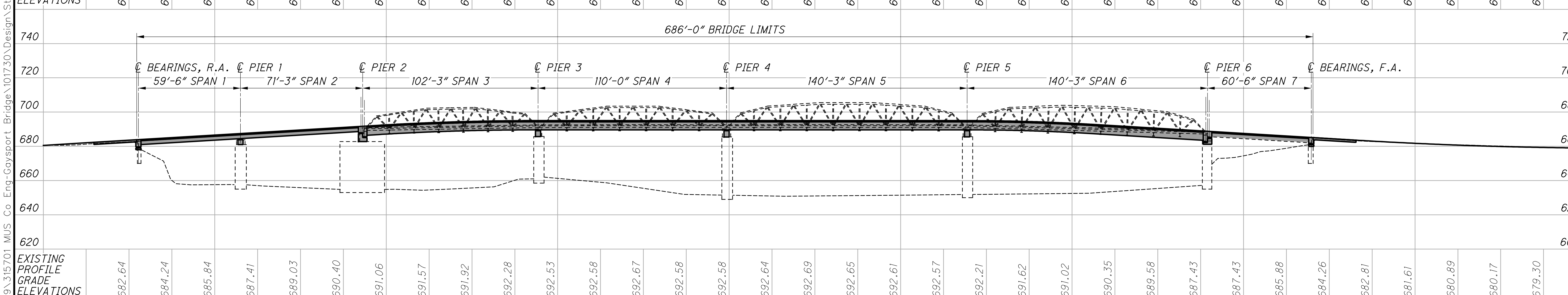
APPENDIX C: HYDRAULIC DATA

APPENDIX D: EXISTING PLANS



PLAN

PROPOSED PROFILE GRADE ELEVATIONS	683.55	685.05	686.55	688.05	689.55	691.05	692.54	693.77	694.57	694.96	695.00	695.00	695.00	695.00	695.00	695.00	695.00	695.00	695.00	695.00	694.95	694.47	693.47	692.02	690.52	689.02	687.52	686.02	684.52	683.04	681.75	680.71	679.90	679.34
EXISTING PROFILE GRADE ELEVATIONS	682.64	684.24	685.84	687.41	689.03	690.40	691.06	691.57	691.92	692.28	692.53	692.58	692.67	692.58	692.58	692.64	692.69	692.65	692.61	692.57	692.21	691.62	691.02	690.35	689.58	687.43	687.43	685.88	684.26	682.81	681.61	680.89	680.17	679.30



PROFILE ALONG ℄ CONSTRUCTION

P:\ADR\2019.315701 MUS Co Eng-Gaysport Bridge\101730\Design\Structures\MUS066_0050C\Sheets\066_0005SP005.dgn Sheet 8/29/2019 11:40:54 AM jhartfield

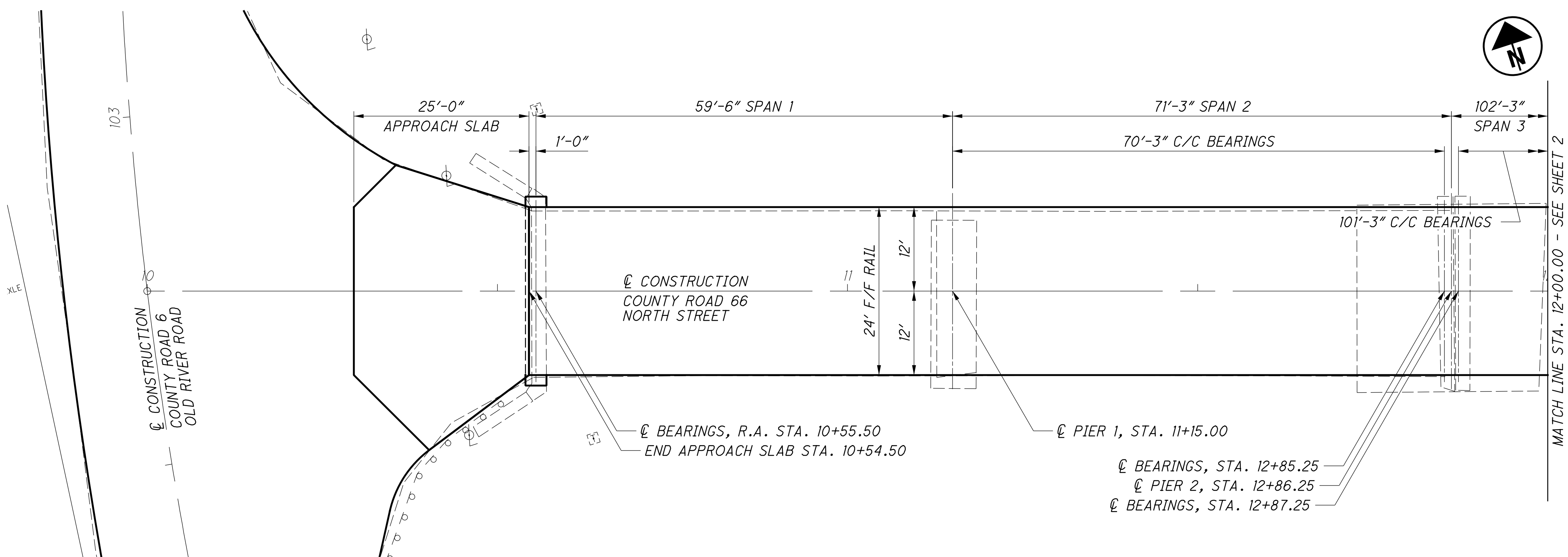
DESIGN AGENCY: ADR
Newark Office: 88 West Church Street, Newark, OH 43055, (740) 345-1921 (ph), (740) 345-4994 (fax), www.adrinnovation.com

REVIEWED: -- | DATE: --
STRUCTURE FILE NUMBER: 6031307
DRAWN: JTH | REVISED: --
DESIGNED: -- | CHECKED: --

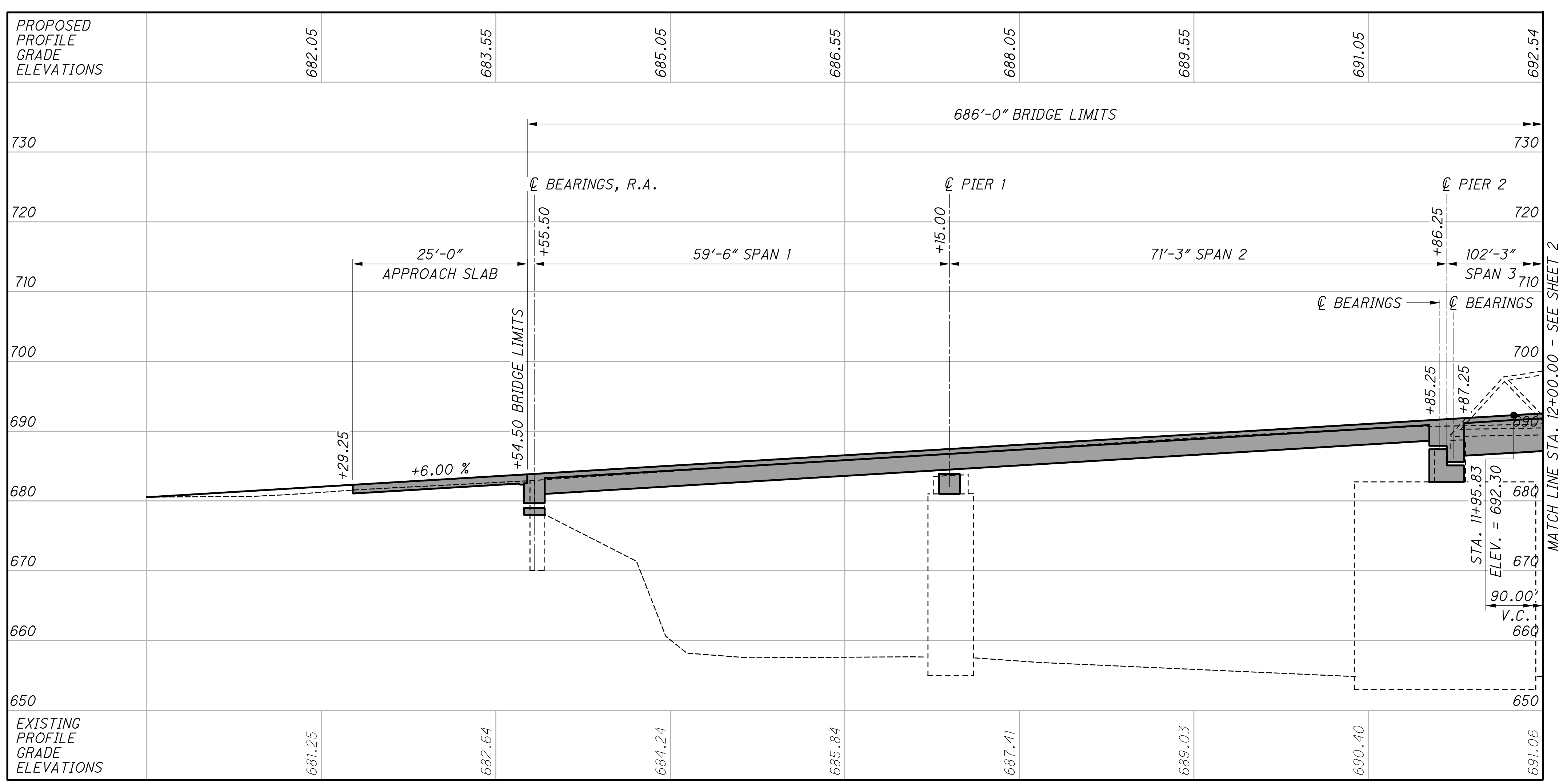
MUSKINGUM COUNTY
STA. 10+04.50
STA. 17+40.50

SITE PLAN
BRIDGE NO. MUS-CR66-0005
OVER MUSKINGUM RIVER

MUS-CR66-0005
PID No. 101730



PLAN



PROFILE ALONG ℄ CONSTRUCTION

TRAFFIC DATA

DESIGN TRAFFIC:

2015 ADT = 2,917 2015 ADTT = 218

2035 ADT = _____ 2035 ADTT = ___

DIRECTIONAL DISTRIBUTION = UNKNOWN

HYDRAULIC DATA

DRAINAGE AREA = 7,341 SQUARE MILES

Q (100) = 77,700 CFS BASED ON FEMA FLOOD INSURANCE STUDY 39119CV00B AUGUST 15, 2017

STRUCTURE CLEARS THE 100 YEAR DESIGN HW BY ___ FEET

SPAN CONFIGURATION

SPANS 1 & 2 - CONTINUOUS ROLLED BEAM WITH COMPOSITE DECK

SPANS 3 - 6 - CONTINUOUS PLATE GIRDER WITH COMPOSITE DECK

SPAN 7 - SIMPLE ROLLED BEAM WITH COMPOSITE DECK

EXISTING STRUCTURE

TYPE: SEVEN SPAN STRUCTURE WITH SIMPLE STEEL BEAM APPROACH SPANS AND TRUSSES WITH ASPHALT WEARING SURFACE ON SANDSTONE ABUTMENTS AND PIERS.

SPANS: 59'±, 71'-3"±, 102'-3"±, 110'±, 140'-3"±, 140'-3"±, 59'±

ROADWAY: 24'-0"± F/F RAIL

LOADING: UNKNOWN

SKEW: NONE

APPROACH SLABS: NONE

ALIGNMENT: TANGENT WITH HORIZONTAL CURVE AT FORWARD ABUTMENT

CROWN: VARIES

STRUCTURAL FILE NUMBER: 6031307

DATE BUILT: UNKNOWN (SUPERSTRUCTURE REPLACEMENT 1971 WITH REHABILITATION IN 2001)

DISPOSITION: SUPERSTRUCTURE TO BE REPLACED

PROPOSED STRUCTURE

TYPE: SEVEN SPAN STEEL BEAM AND PLATE GIRDER WITH COMPOSITE REINFORCED DECK ON EXISTING STANDSTONE ABUTMENTS AND PIERS

SPANS: 59'-6", 71'-3", 102'-3", 110'-0", 140'-3", 140'-3", 60'-6"

ROADWAY: 24'-0" F/F RAIL

LOADING: HL-93 WITH 0.06 KSF FUTURE WEARING SURFACE

SKEW: NONE

APPROACH SLABS: 25' LONG (AS-1-15)

WEARING SURFACE: 1" MONOLITHIC CONCRETE

ALIGNMENT: TANGENT WITH HORIZ. CURVE AT FORWARD ABUTMENT

CROWN: 0.016 FT/FT

COORDINATES: LATITUDE 39°48'15"

LONGITUDE 81°53'40"

DESIGN AGENCY: ADR

STRUCTURE FILE NUMBER 6031307

DESIGNED --- CHECKED --- DRAWN JTH REVIEWED --- DATE --- REVISED ---

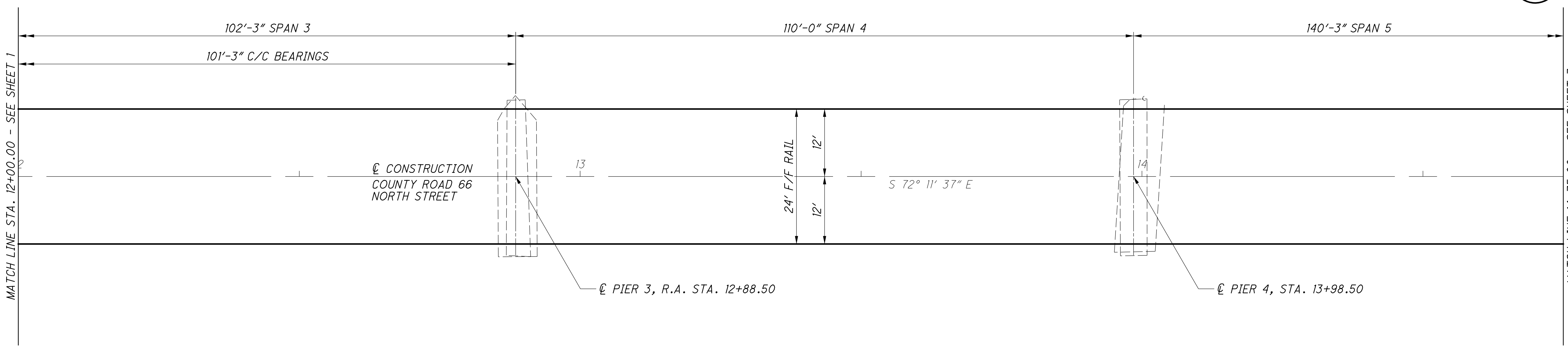
MUSKINGUM COUNTY STA. 10+04.50 STA. 17+40.50

SITE PLAN

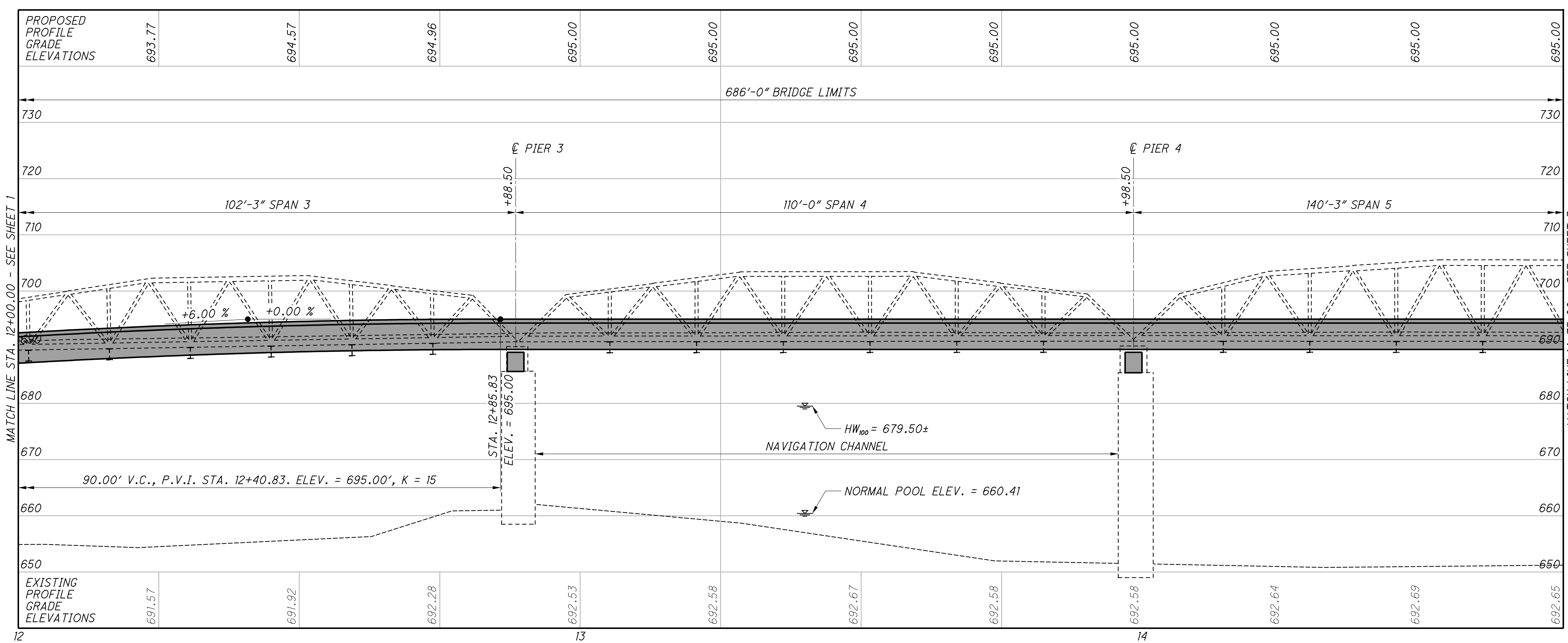
BRIDGE NO. MUS-CR66-0005 OVER MUSKINGUM RIVER

MUS-CR66-0005

PID No. 101730



PLAN



PROFILE ALONG ℄ CONSTRUCTION

DESIGN AGENCY: ADR

DESIGNED	DRAWN	REVIEWED	DATE
---	JTH	---	--------
CHECKED	REVISED	STRUCTURE FILE NUMBER	
---		6031307	

MUSKINGUM COUNTY
STA. 10+04.50
STA. 17+40.50

SITE PLAN

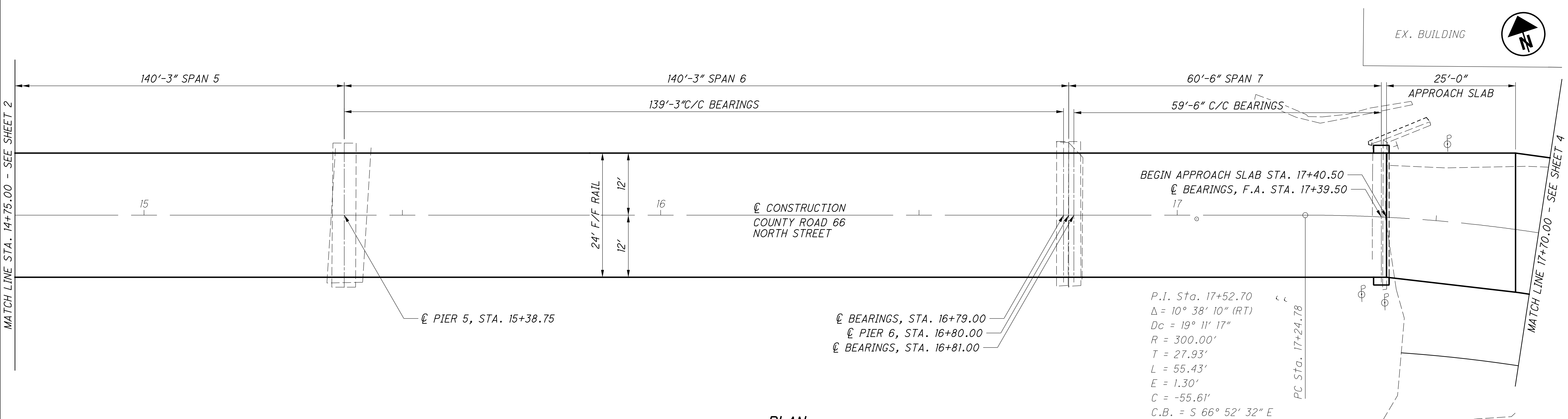
BRIDGE NO. MUS-CR66-0005
OVER MUSKINGUM RIVER

MUS-CR66-0005

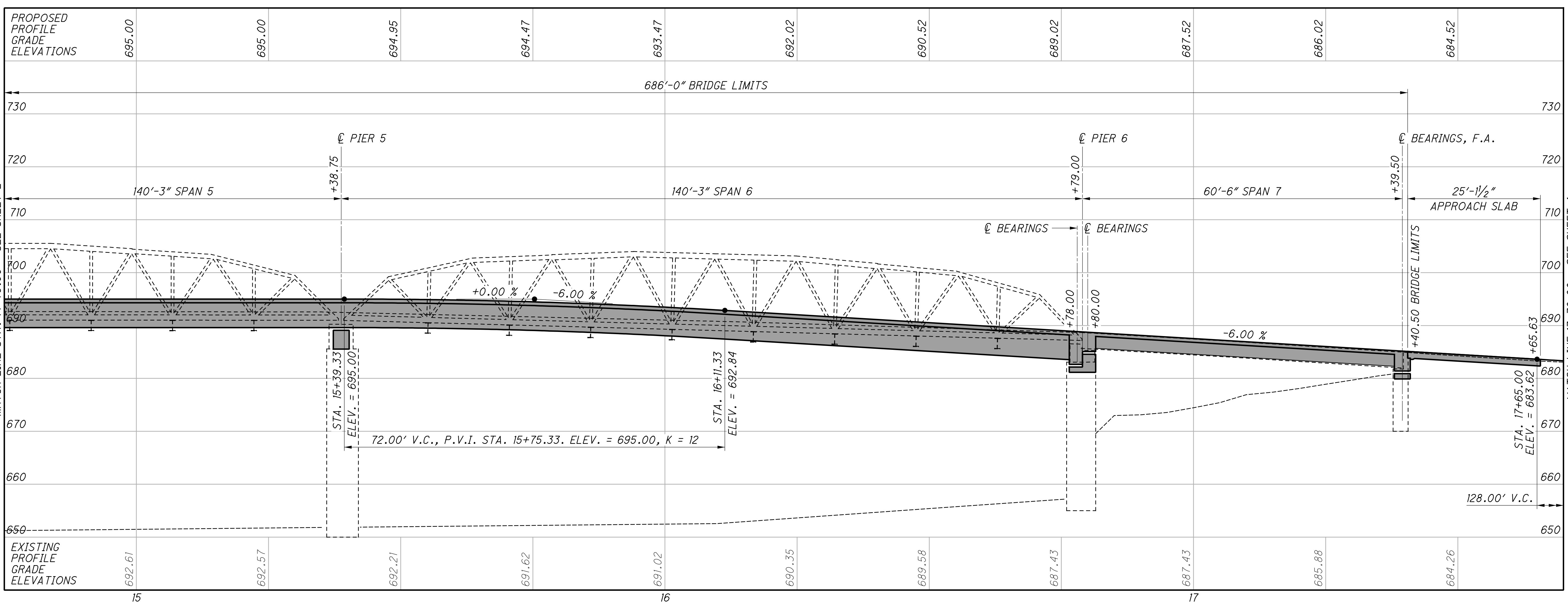
PID No. 101730

3 / 7

P:\ADR\2019\315701 MUS Co Eng-Gaysport Bridge\101730\Design\Structures\MUS066_0050C\Sheets\066_0005SP002.dgn Sheet 8/29/2019 11:41:17 AM jhortfield



PLAN



PROFILE ALONG ℄ CONSTRUCTION

DESIGN AGENCY: ADR

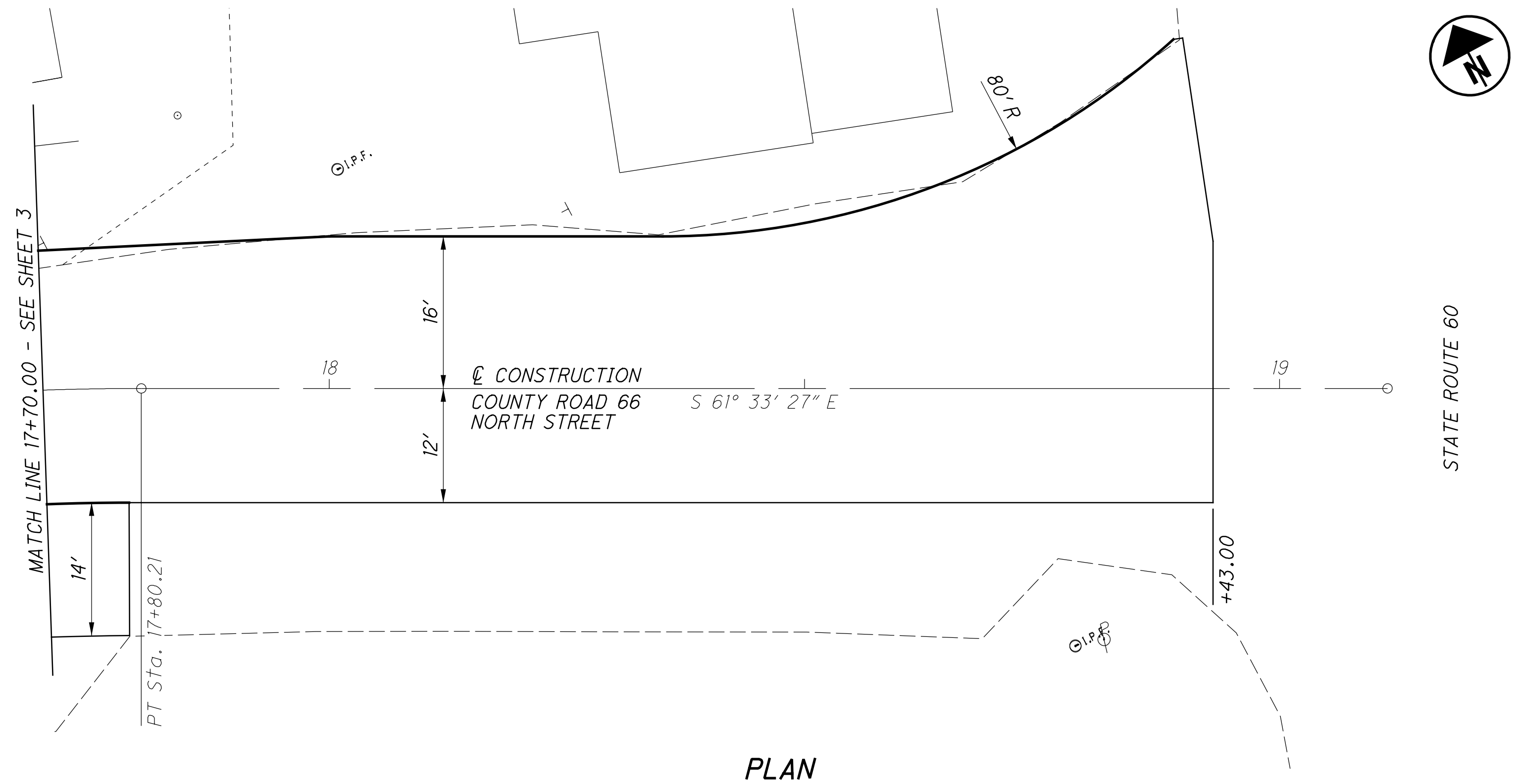
DESIGNED	CHECKED	DRAWN	REVISED	REVIEWED	DATE	STRUCTURE FILE NUMBER
---	---	JTH	---	---	---	6031307

MUSKINGUM COUNTY
STA. 10+04.50
STA. 17+40.50

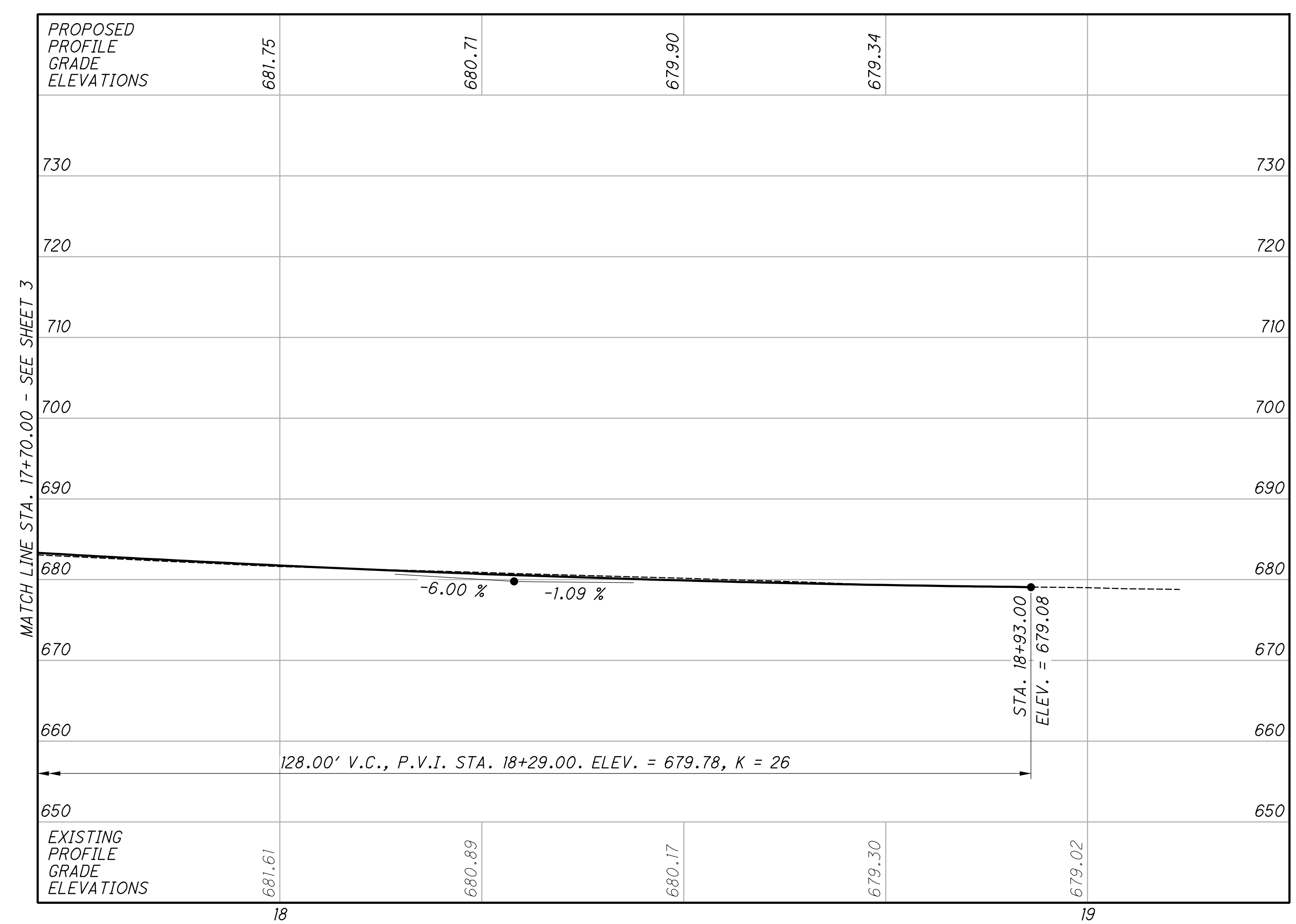
SITE PLAN
BRIDGE NO. MUS-CR66-0005
OVER MUSKINGUM RIVER

MUS-CR66-0005
PID No. 101730

4 / 7



PLAN



PROFILE ALONG ℄ CONSTRUCTION

P:\ADR\2019\315701 MUS Co Eng-Gaysport Bridge\101730\Design\Structures\MUS066_0050C\Sheets\066_0005SP004.dgn Sheet 8/29/2019 11:41:39 AM jhartfield

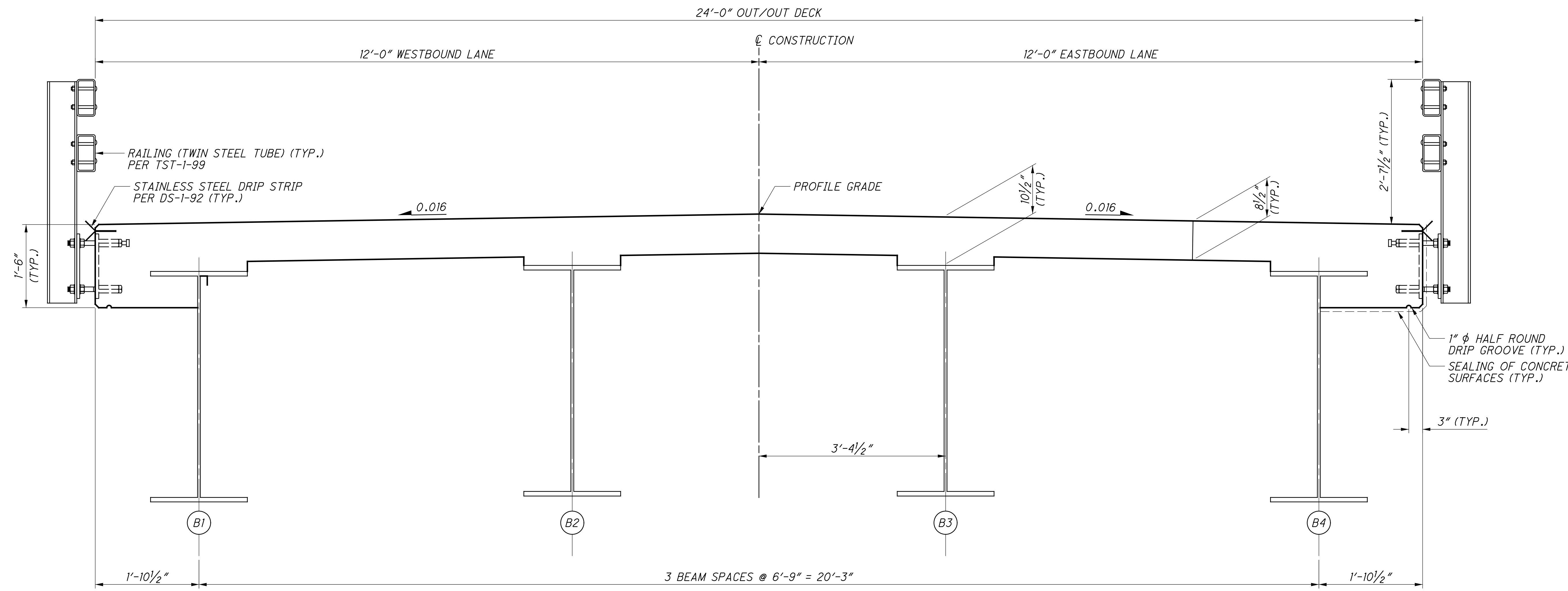
DESIGN AGENCY
ADR

DESIGNED	DRAWN	REVIEWED	DATE
---	JTH	---	---
CHECKED	REVISED	STRUCTURE FILE NUMBER	
---		6031307	

MUSKINGUM COUNTY
STA. 10+04.50
STA. 17+40.50

SITE PLAN
BRIDGE NO. MUS-CR66-0005
OVER MUSKINGUM RIVER

MUS-CR66-0005
PID No. 101730



TRANSVERSE SECTION

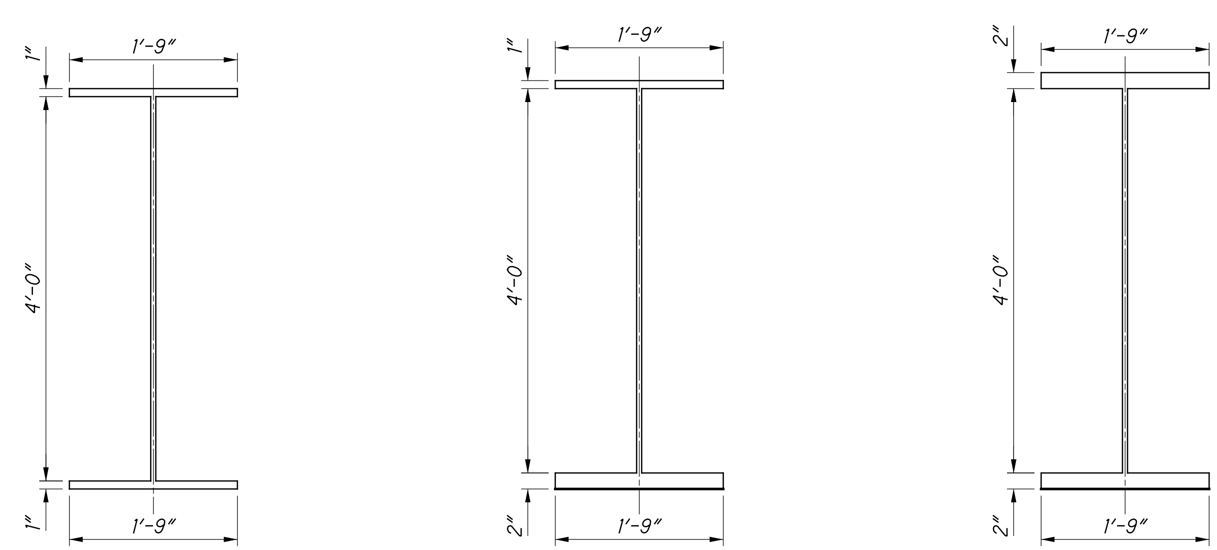


PLATE GIRDER SECTIONS

DESIGN AGENCY

ADR & ASSOCIATES, LTD.

Newark Office:
88 West Church Street
Newark, OH 43055
(740) 345-1921 (ph)
(740) 345-4994 (fax)
www.adrinnovation.com

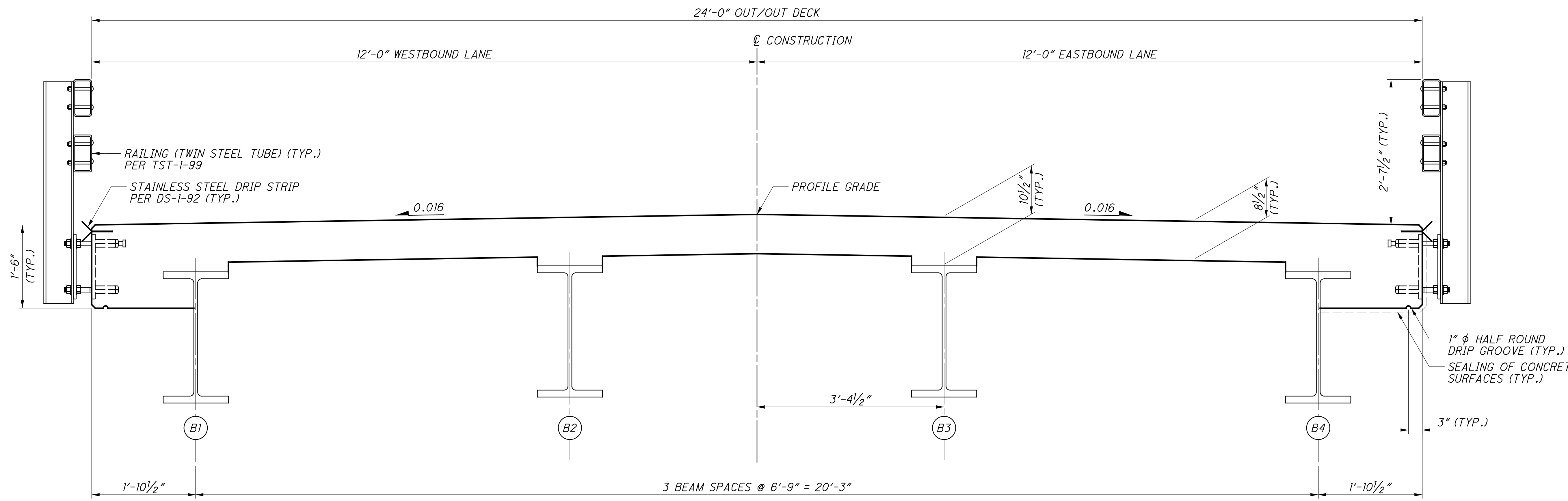
DESIGNED JTH	DRAWN JTH	REVIEWED RBK	DATE 2-14-19
CHECKED BCK	REVISED —	STRUCTURE FILE NUMBER 6130594	

TRANSVERSE SECTION - PLATE GIRDER SECTIONS

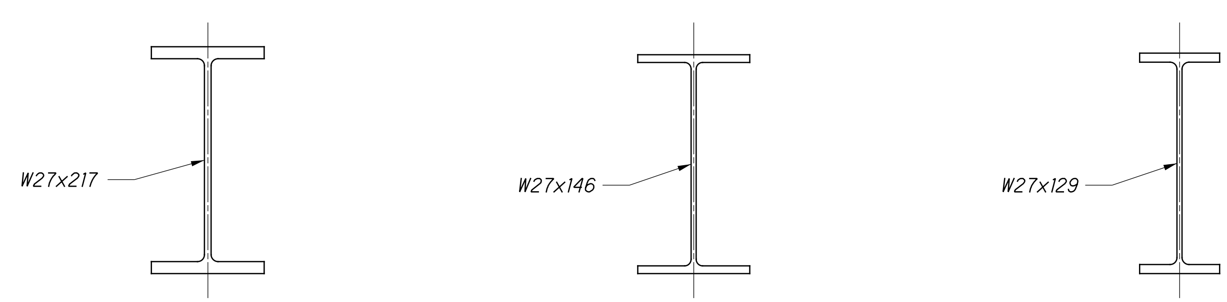
BRIDGE NO. MUS-CR66-0005
OVER EAST FORK DUCK CREEK

MUS-CR66-0005
PID No. 101730

6 / 7



TRANSVERSE SECTION



ROLLED BEAM SECTIONS

DESIGN AGENCY ADR

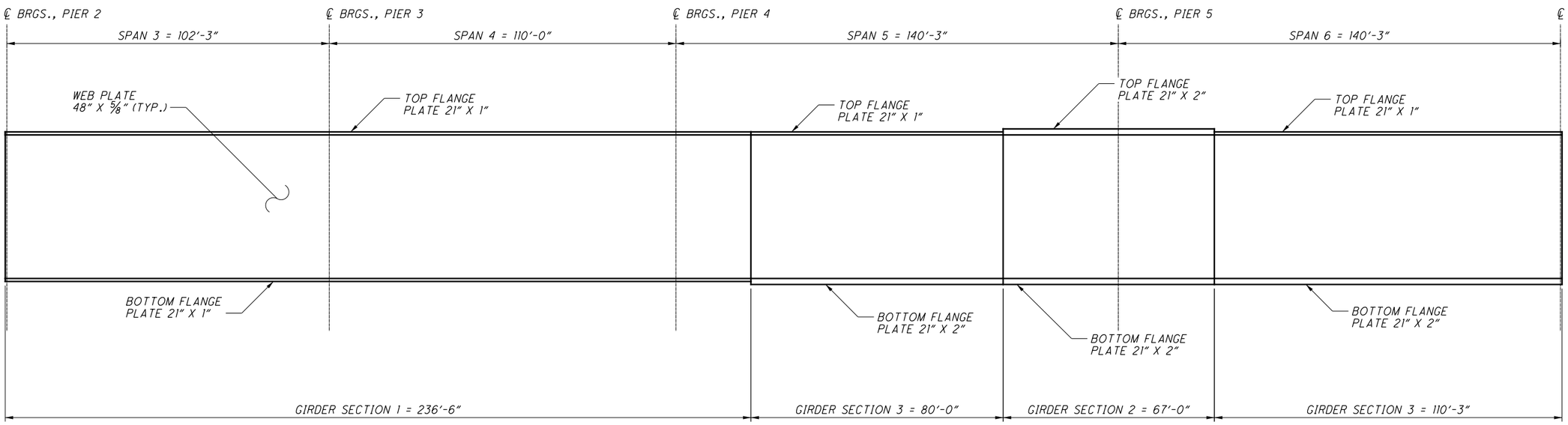
DESIGNED	CHECKED	DRAWN	REVISED	REVIEWED	DATE	STRUCTURE FILE NUMBER
JTH	BCK	JTH		RBK	2-14-19	6130594

TRANSVERSE SECTION - ROLLED BEAM SECTIONS
BRIDGE NO. MUS-CR66-0005
OVER MUSKINGUM RIVER

MUS-CR66-0005
PID No. 101730

7/7

P:\ADR\2019\315701 MUS Co Eng-Gaysport Bridge\101730\Design\Structures\MUS066_0050C\Sheets\066_0005ST002.dgn Sheet 8/29/2019 11:40:44 AM jhartfield



P:\ODT\MP\0110_MUS-CR66_0005\101730\Design\Structures\MUS066_0005C\Sheets\BEAM ELEVATION.dgn Sheet 8/1/2019 9:14:54 AM CMT006

DESIGN AGENCY

DESIGNED	DRAWN	REVIEWED	DATE
MTJ	MTJ	XXX	XXX
CHECKED	REVISED	STRUCTURE FILE NUMBER	
AMR		XXX	

GIRDER ELEVATION

BRIDGE NO. MUS-CR66-0005
OVER MUSKINGUM RIVER

MUS-CR66-0005

PID No. 101730

0 / 0

0
0

Estimate

Estimated Cost:$1,165,101.65

Contingency: 20.00%

Estimated Total: $1,398,121.98

Spans 1,2,7 & Approach Work (20' F/F)

Base Date: 08/20/19

Spec Year: 19

Unit System: E

Work Type: BRIDGE REHABILITATION

Highway Type:

Urban/Rural Type: RURAL CLASS

Season: SUMMER

County: MUSKINGUM

Latitude of Midpoint: 394814

Longitude of Midpoint: 815336

District: 05

Federal/State Project Number:

Prepared by Damon Fulk

Line #	Item Number / Description / *Supplemental Description*	Quantity	Units	Unit Price	Extension
Group 0100:					
0006	202E23500 WEARING COURSE REMOVED	1,829.000	SY	$5.01587	$9,174.03
0007	202E23000 PAVEMENT REMOVED	510.000	SY	$14.89737	$7,597.66
0008	203E10000 EXCAVATION	25.000	CY	$33.05942	$826.49
0009	203E20000 EMBANKMENT	25.000	CY	$31.00139	$775.03
0010	304E20000 AGGREGATE BASE	184.000	CY	$95.55089	$17,581.36
0011	301E46000 ASPHALT CONCRETE BASE, PG64-22	157.000	CY	$181.21869	$28,451.33
0012	441E10000 ASPHALT CONCRETE SURFACE COURSE, TYPE 1, (446), PG64-22	33.000	CY	$181.05222	$5,974.72
0013	441E10200 ASPHALT CONCRETE INTERMEDIATE COURSE, TYPE 2, (446)	46.000	CY	$180.00000	$8,280.00
0037	644E00104 EDGE LINE, 6"	0.340	MILE	$2,629.74596	$894.11
0038	644E00300 CENTER LINE	0.170	MILE	$6,462.30090	$1,098.59
0039	644E00500 STOP LINE	20.000	FT	$8.83998	$176.80
				Total for Group 0100:	$80,830.12
Group 1900:					
0014	202E11000 STRUCTURE REMOVED	1.000	LS	$100,000.00000	$100,000.00
0015	503E21300 UNCLASSIFIED EXCAVATION	1.000	LS	$5,000.00000	$5,000.00
0016	509E10000 EPOXY COATED REINFORCING STEEL	32,900.000	LB	$1.00000	$32,900.00

Line #	Item Number	Description / *Supplemental Description*	Quantity	Units	Unit Price	Extension
0017	511E21522	CLASS QC2 CONCRETE WITH QC/QA, SUPERSTRUCTURE	162.000	CY	$796.83118	$129,086.65
0018	511E50210	CLASS QC1 CONCRETE, SUBSTRUCTURE	11.000	CY	$1,431.71836	$15,748.90
0019	512E10000	SEALING OF CONCRETE SURFACES	130.000	SY	$18.68300	$2,428.79
0020	513E10220	STRUCTURAL STEEL MEMBERS, LEVEL 1	31,153.000	LB	$1.50000	$46,729.50
0021	513E10240	STRUCTURAL STEEL MEMBERS, LEVEL 2	103,697.000	LB	$1.50000	$155,545.50
0022	513E20000	WELDED STUD SHEAR CONNECTORS	3,084.000	EACH	$3.11676	$9,612.09
0023	516E14600	STRUCTURAL JOINT OR JOINT SEALER, MISC.:	40.000	FT	$300.00000	$12,000.00
0024	516E44200	ELASTOMERIC BEARING WITH INTERNAL LAMINATES AND LOAD PLATE (NEOPRENE)	20.000	EACH	$200.00000	$4,000.00
0026	517E70000	RAILING (TWIN STEEL TUBE)	382.500	FT	$124.69023	$47,694.01
0027	518E21200	POROUS BACKFILL WITH GEOTEXTILE FABRIC	22.000	CY	$104.34588	$2,295.61
0028	518E40000	6" PERFORATED CORRUGATED PLASTIC PIPE	40.000	FT	$9.19862	$367.94
0029	518E40012	6" NON-PERFORATED CORRUGATED PLASTIC PIPE	120.000	FT	$10.70539	$1,284.65
0030	526E25000	REINFORCED CONCRETE APPROACH SLABS (T=15")	136.000	SY	$218.00268	$29,648.36
0031	601E32104	ROCK CHANNEL PROTECTION, TYPE B WITH GEOTEXTILE FABRIC	78.000	CY	$114.26724	$8,912.84
0032	846E00110	POLYMER MODIFIED ASPHALT EXPANSION JOINT SYSTEM	28.000	CF	$357.73906	$10,016.69
0033	513E95020	STRUCTURAL STEEL, MISC.:	1.000	LS	$100,000.00000	$100,000.00

Line #	Item Number	Description / *Supplemental Description*	Quantity	Units	Unit Price	Extension
		Bridge Erection - Spans 1, 2, 7				

Total for Group 1900:$713,271.53

Group 1901:

Line #	Item Number	Description	Quantity	Units	Unit Price	Extension
0034	614E11000	MAINTAINING TRAFFIC	1.000	LS	$10,000.00000	$10,000.00
0035	624E10000	MOBILIZATION	1.000	LS	$350,000.00000	$350,000.00
0036	623E10000	CONSTRUCTION LAYOUT STAKES AND SURVEYING	1.000	LS	$11,000.00000	$11,000.00

Total for Group 1901:$371,000.00

Estimate

Estimated Cost:$1,204,696.26

Contingency: 20.00%

Estimated Total: $1,445,635.51

Spans 1,2,7 & Approach Work (24' F/F)

Base Date: 08/20/19

Spec Year: 19

Unit System: E

Work Type: BRIDGE REHABILITATION

Highway Type:

Urban/Rural Type: RURAL CLASS

Season: SUMMER

County: MUSKINGUM

Latitude of Midpoint: 394814

Longitude of Midpoint: 815336

District: 05

Federal/State Project Number:

Prepared by Damon Fulk

Line #	Item Number / Description / *Supplemental Description*	Quantity	Units	Unit Price	Extension
Group 0100:					
0006	202E23500 WEARING COURSE REMOVED	1,829.000	SY	$5.01587	$9,174.03
0007	202E23000 PAVEMENT REMOVED	510.000	SY	$14.89737	$7,597.66
0008	203E10000 EXCAVATION	25.000	CY	$33.05942	$826.49
0009	203E20000 EMBANKMENT	25.000	CY	$31.00139	$775.03
0010	304E20000 AGGREGATE BASE	184.000	CY	$95.55089	$17,581.36
0011	301E46000 ASPHALT CONCRETE BASE, PG64-22	157.000	CY	$181.21869	$28,451.33
0012	441E10000 ASPHALT CONCRETE SURFACE COURSE, TYPE 1, (446), PG64-22	33.000	CY	$181.05222	$5,974.72
0013	441E10200 ASPHALT CONCRETE INTERMEDIATE COURSE, TYPE 2, (446)	46.000	CY	$180.00000	$8,280.00
0037	644E00104 EDGE LINE, 6"	0.340	MILE	$2,629.74596	$894.11
0038	644E00300 CENTER LINE	0.170	MILE	$6,462.30090	$1,098.59
0039	644E00500 STOP LINE	20.000	FT	$8.83998	$176.80
				Total for Group 0100:	$80,830.12
Group 1900:					
0014	202E11000 STRUCTURE REMOVED	1.000	LS	$100,000.00000	$100,000.00
0015	503E21300 UNCLASSIFIED EXCAVATION	1.000	LS	$5,000.00000	$5,000.00
0016	509E10000 EPOXY COATED REINFORCING STEEL	39,805.000	LB	$1.00000	$39,805.00

Estimate:

Line #	Item Number	Quantity	Units	Unit Price	Extension
	Description				
	Supplemental Description				
0017	511E21522	170.000	CY	$789.71448	$134,251.46
	CLASS QC2 CONCRETE WITH QC/QA, SUPERSTRUCTURE				
0018	511E50210	13.000	CY	$1,325.02451	$17,225.32
	CLASS QC1 CONCRETE, SUBSTRUCTURE				
0019	512E10000	145.000	SY	$18.41114	$2,669.62
	SEALING OF CONCRETE SURFACES				
0020	513E10220	33,863.000	LB	$1.50000	$50,794.50
	STRUCTURAL STEEL MEMBERS, LEVEL 1				
0021	513E10240	112,714.000	LB	$1.50000	$169,071.00
	STRUCTURAL STEEL MEMBERS, LEVEL 2				
0022	513E20000	3,084.000	EACH	$3.11676	$9,612.09
	WELDED STUD SHEAR CONNECTORS				
0023	516E14600	48.000	FT	$300.00000	$14,400.00
	STRUCTURAL JOINT OR JOINT SEALER, MISC.:				
0024	516E44200	20.000	EACH	$200.00000	$4,000.00
	ELASTOMERIC BEARING WITH INTERNAL LAMINATES AND LOAD PLATE (NEOPRENE)				
0026	517E70000	382.500	FT	$124.69023	$47,694.01
	RAILING (TWIN STEEL TUBE)				
0027	518E21200	25.000	CY	$101.93788	$2,548.45
	POROUS BACKFILL WITH GEOTEXTILE FABRIC				
0028	518E40000	48.000	FT	$8.43135	$404.70
	6" PERFORATED CORRUGATED PLASTIC PIPE				
0029	518E40012	120.000	FT	$10.70539	$1,284.65
	6" NON-PERFORATED CORRUGATED PLASTIC PIPE				
0030	526E25000	161.000	SY	$213.88850	$34,436.05
	REINFORCED CONCRETE APPROACH SLABS (T=15")				
0031	601E32104	78.000	CY	$114.26724	$8,912.84
	ROCK CHANNEL PROTECTION, TYPE B WITH GEOTEXTILE FABRIC				
0032	846E00110	31.000	CF	$346.98213	$10,756.45
	POLYMER MODIFIED ASPHALT EXPANSION JOINT SYSTEM				
0033	513E95020	1.000	LS	$100,000.00000	$100,000.00
	STRUCTURAL STEEL, MISC.:				

Estimate:

Line #	Item Number	Quantity	Units	Unit Price	Extension
	Description				
	Supplemental Description				
	Bridge Erection - Spans 1, 2, 7				

Total for Group 1900:$752,866.14

Group 1901:

0034	614E11000	1.000	LS	$10,000.00000	$10,000.00
	MAINTAINING TRAFFIC				
0035	623E10000	1.000	LS	$11,000.00000	$11,000.00
	CONSTRUCTION LAYOUT STAKES AND SURVEYING				
0036	624E10000	1.000	LS	$350,000.00000	$350,000.00
	MOBILIZATION				

Total for Group 1901:$371,000.00

Estimate

Estimated Cost:$3,579,799.17

Contingency: 20.00%

Estimated Total: $4,295,759.00

Girder - Spans 3,4,5,6 - 20' F/F

Base Date: 08/20/19

Spec Year: 19

Unit System: E

Work Type: BRIDGE REHABILITATION

Highway Type:

Urban/Rural Type: RURAL CLASS

Season: SUMMER

County: MUSKINGUM

Latitude of Midpoint: 394814

Longitude of Midpoint: 815336

District: 05

Federal/State Project Number:

Prepared by Damon Fulk

Estimate:

Line #	Item Number / Description / *Supplemental Description*	Quantity	Units	Unit Price	Extension
Group 1900:					
0014	202E11000 STRUCTURE REMOVED	1.000	LS	$1,000,000.00000	$1,000,000.00
0015	509E10000 EPOXY COATED REINFORCING STEEL	82,743.000	LB	$1.00000	$82,743.00
0016	511E21522 CLASS QC2 CONCRETE WITH QC/QA, SUPERSTRUCTURE	320.000	CY	$702.00910	$224,642.91
0017	511E50210 CLASS QC1 CONCRETE, SUBSTRUCTURE	24.000	CY	$997.20645	$23,932.95
0018	512E10000 SEALING OF CONCRETE SURFACES	432.000	SY	$15.90154	$6,869.47
0021	513E10280 STRUCTURAL STEEL MEMBERS, LEVEL 4	544,888.000	LB	$2.00000	$1,089,776.00
0022	513E20000 WELDED STUD SHEAR CONNECTORS	7,908.000	EACH	$3.11676	$24,647.34
0024	516E44200 ELASTOMERIC BEARING WITH INTERNAL LAMINATES AND LOAD PLATE (NEOPRENE)	20.000	EACH	$200.00000	$4,000.00
0025	517E70000 RAILING (TWIN STEEL TUBE)	985.500	FT	$125.00000	$123,187.50
0032	513E95020 STRUCTURAL STEEL, MISC.: Bridge Erection Using Barges and Cranes	1.000	LS	$1,000,000.00000	$1,000,000.00

Total for Group 1900:$3,579,799.17

Estimate

Estimated Cost:$3,772,210.90

Contingency: 20.00%

Estimated Total: $4,526,653.08

Girder Spans 3,4,5,6 - 24' F/F

Base Date: 08/20/19

Spec Year: 19

Unit System: E

Work Type: BRIDGE REHABILITATION

Highway Type:

Urban/Rural Type: RURAL CLASS

Season: SUMMER

County: MUSKINGUM

Latitude of Midpoint: 394814

Longitude of Midpoint: 815336

District: 05

Federal/State Project Number:

Prepared by Damon Fulk

Estimate:

Line #	Item Number / Description / *Supplemental Description*	Quantity	Units	Unit Price	Extension
Group 1900:					
0014	202E11000 STRUCTURE REMOVED	1.000	LS	$1,000,000.00000	$1,000,000.00
0015	509E10000 EPOXY COATED REINFORCING STEEL	95,493.000	LB	$1.00000	$95,493.00
0016	511E21522 CLASS QC2 CONCRETE WITH QC/QA, SUPERSTRUCTURE	371.000	CY	$682.95075	$253,374.73
0017	511E50210 CLASS QC1 CONCRETE, SUBSTRUCTURE	28.000	CY	$928.43027	$25,996.05
0018	512E10000 SEALING OF CONCRETE SURFACES	451.000	SY	$15.80994	$7,130.28
0021	513E10280 STRUCTURAL STEEL MEMBERS, LEVEL 4	619,191.000	LB	$2.00000	$1,238,382.00
0022	513E20000 WELDED STUD SHEAR CONNECTORS	7,908.000	EACH	$3.11676	$24,647.34
0024	516E44200 ELASTOMERIC BEARING WITH INTERNAL LAMINATES AND LOAD PLATE (NEOPRENE)	20.000	EACH	$200.00000	$4,000.00
0025	517E70000 RAILING (TWIN STEEL TUBE)	985.500	FT	$125.00000	$123,187.50
0032	513E95020 STRUCTURAL STEEL, MISC.: Bridge Erection Using Barges and Cranes	1.000	LS	$1,000,000.00000	$1,000,000.00

Total for Group 1900:$3,772,210.90

FLOODING SOURCE		FLOODWAY				1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	WIDTH REDUCED FROM PRIOR STUDY (FEET)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
MUSKINGUM RIVER									
A	60.6	354	12276	6.3	61	676.3	676.3	677.3	1.0
B	62.2	1065	21121	3.7		678.1	678.1	679.1	1.0
C	64.7	420	13152	5.9		680.7	680.7	681.7	1.0
D	66.7	500	15919	4.9	70	682.5	682.5	683.5	1.0
E	68.6	810	22901	3.2		684.5	684.5	685.5	1.0
F	70.7	540	14760	5.0		686.3	686.3	687.3	1.0
G	72.7	487	14369	5.1	73	688.3	688.3	689.3	1.0
H	74.6	485	13862	5.3		690.3	690.3	691.3	1.0
I	75.1	481	13377	5.1		690.3	690.3	691.3	1.0
J	80.1	561	14595	4.4		699.3	699.3	700.3	1.0
K	82.9	445	10786	6.0		703.3	703.3	704.3	1.0
L	86.0	370	9130	7.1		708.3	708.3	709.3	1.0
M	89.1	1155	16338	3.9		713.8	713.8	714.8	1.0
N	91.8	450	10618	6.1		717.4	717.4	718.4	1.0
O	93.1	653	14071	4.6		718.5	718.5	719.5	1.0
P	94.5	3778	32601	1.9		720.9	720.9	721.9	1.0
Q	97.9	2883	22032	2.9		725.8	725.8	726.8	1.0
R	100.5	1800	25895	2.5		729.4	729.4	730.4	1.0

BRIDGE LOCATION

[1]Miles above confluence with Ohio River

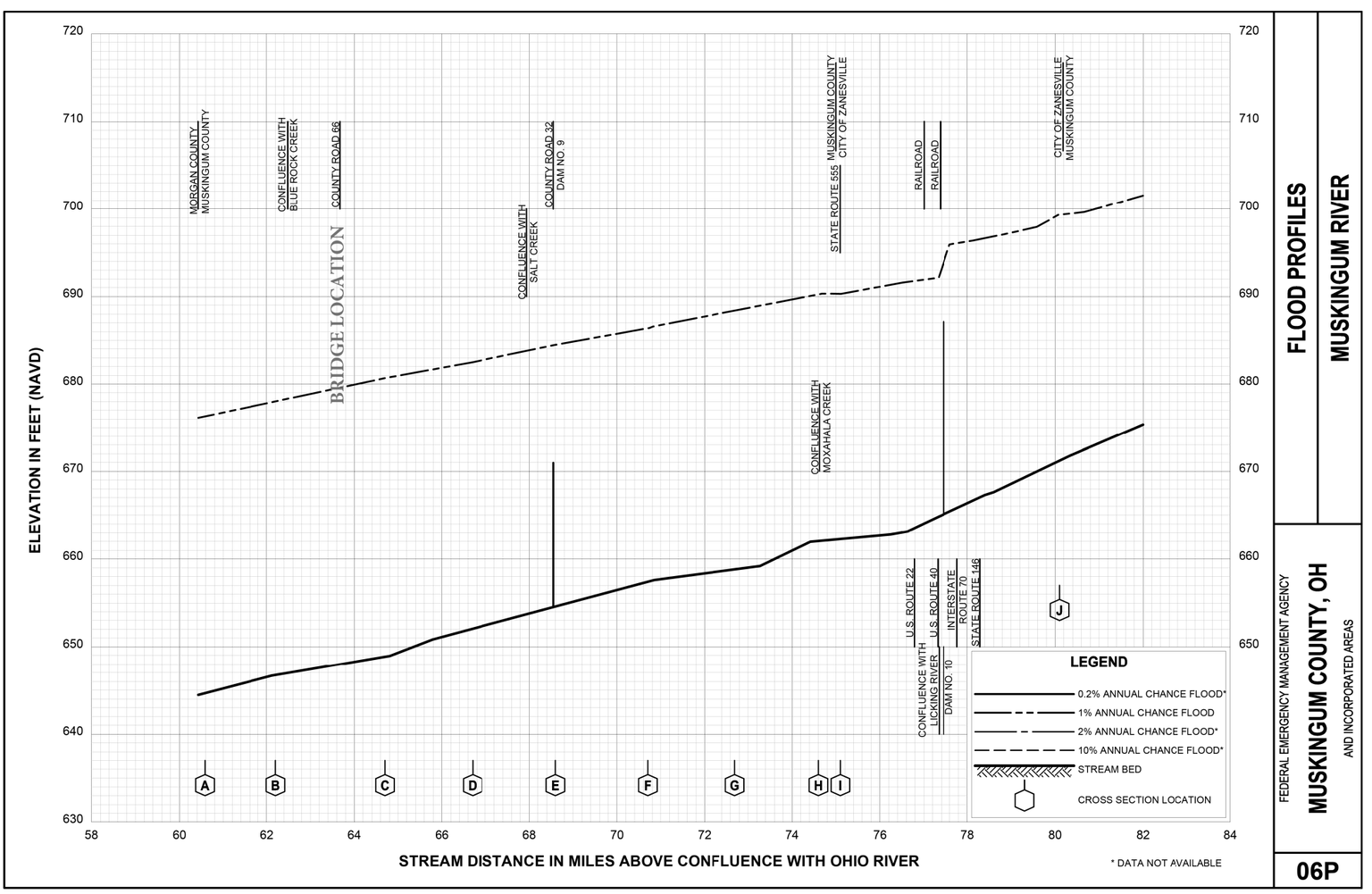
TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

MUSKINGUM COUNTY, OH
AND INCORPORATED AREAS

FLOODWAY DATA

MUSKINGUM RIVER



FLOOD PROFILES

MUSKINGUM RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MUSKINGUM COUNTY, OH

AND INCORPORATED AREAS

06P

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Ohio State Plane South zone 3201 (FIPSZONE 3402). The **horizontal datum** was NAD83. Differences in datum, spheroid, projection or state plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242**, or visit its website at http://www.ngs.noaa.gov/.

Base Map information shown on this FIRM was derived from the Muskingum County GIS Office from photography dated 2002 or later.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

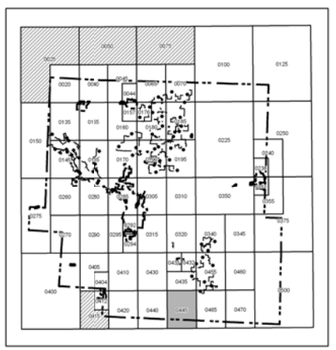
Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1-800-358-9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study report, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1-800-358-9620 and its website at http://msc.fema.gov/.

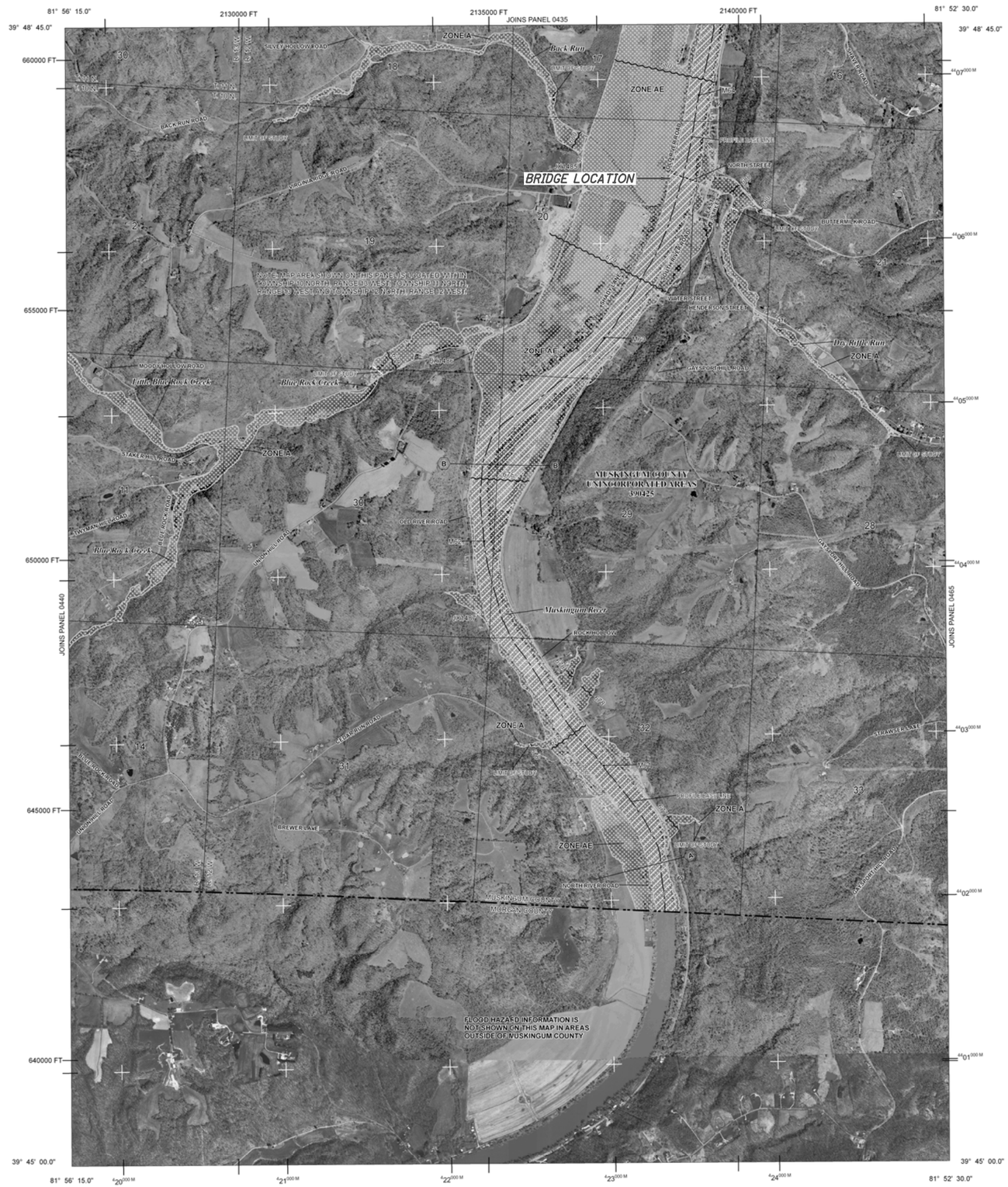
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip/.

The **profile base lines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile base line**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

PANEL INDEX



Panel Not Printed



LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100 year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard may include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Area of special flood hazard formerly protected from the 1% annual chance flood event by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood event by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Bse Flood Elevations determined

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside of the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Food Hazard Areas.

- 1% annual chance floodplain boundary
- 0.2% annual chance floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 10) — Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- A — A — Cross section line
- 23 — 23 — Transect line
- Bridge
- Culvert
- 85° 03' 45.0", 41° 24' 22.5" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
- 4187000 M — 1000-meter Universal Transverse Mercator grid values, zone 17
- 2250000 FT — 5000-foot grid ticks: Ohio State Plane South Coordinate System, 5001 zone (FIPSZONE 3402) Lambert Conformal Conic projection
- KA0015 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
July 6, 2010

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'
500 0 1000 2000 FEET
300 0 300 600 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0445G

FIRM
FLOOD INSURANCE RATE MAP
MUSKINGUM COUNTY, OHIO
AND INCORPORATED AREAS

PANEL 445 OF 500
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MUSKINGUM COUNTY	390425	0445	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
39119C0445G
EFFECTIVE DATE
JULY 6, 2010

Federal Emergency Management Agency