A photograph of a stone arch culvert. The structure is built with large, light-colored stone blocks. A dark, corrugated metal pipe is visible through the arch opening. The culvert is situated in a grassy embankment, and the water level is low, reflecting the structure. The background shows a grassy field and some trees.

Rehabilitation of Stone Arch Culverts Henry County US 24 and State Route 424

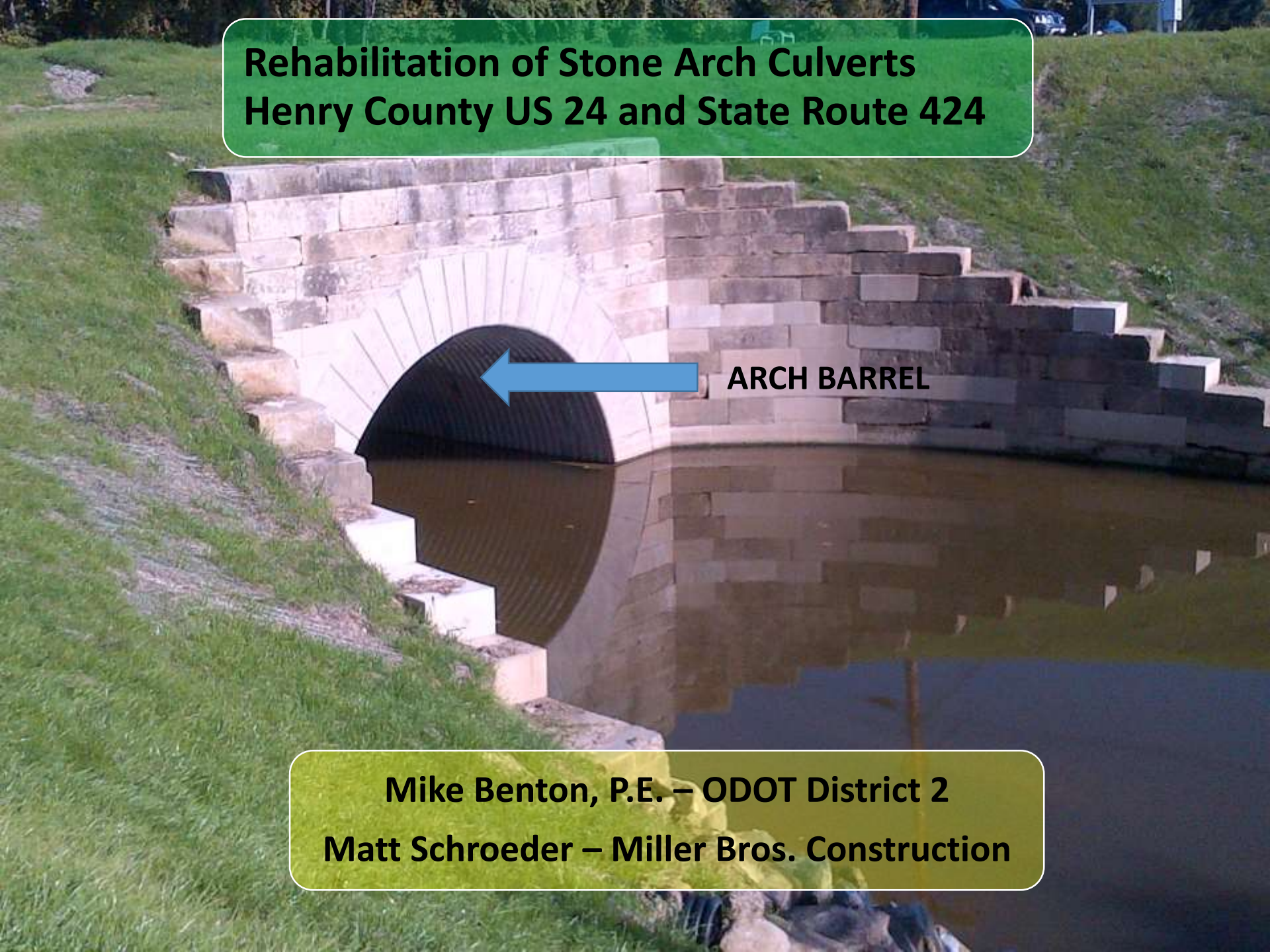
Mike Benton, P.E. – ODOT District 2
Matt Schroeder – Miller Bros. Construction

Rehabilitation of Stone Arch Culverts Henry County US 24 and State Route 424

 **ARCH RING**

**Mike Benton, P.E. – ODOT District 2
Matt Schroeder – Miller Bros. Construction**

Rehabilitation of Stone Arch Culverts Henry County US 24 and State Route 424



ARCH BARREL

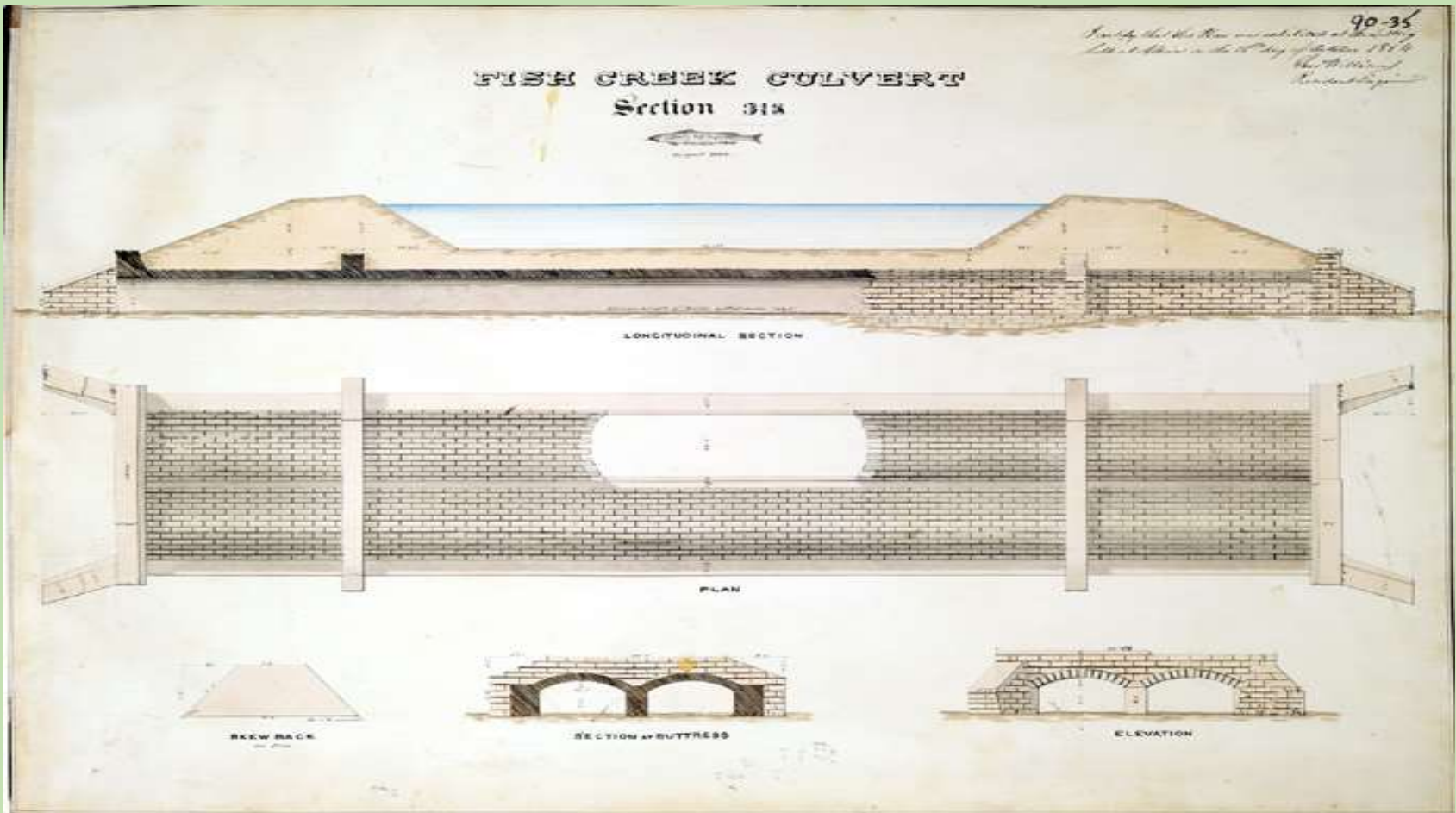
**Mike Benton, P.E. – ODOT District 2
Matt Schroeder – Miller Bros. Construction**

ODOT PID 88197 Scope

- Rehabilitate 8 stone arch culverts as part of former US 24 Abandonment
- Meet ODNR and State Historical Preservation Office (SHPO) expectations
- Meet Henry County Engineer's expectations
- Meet Napoleon's expectations

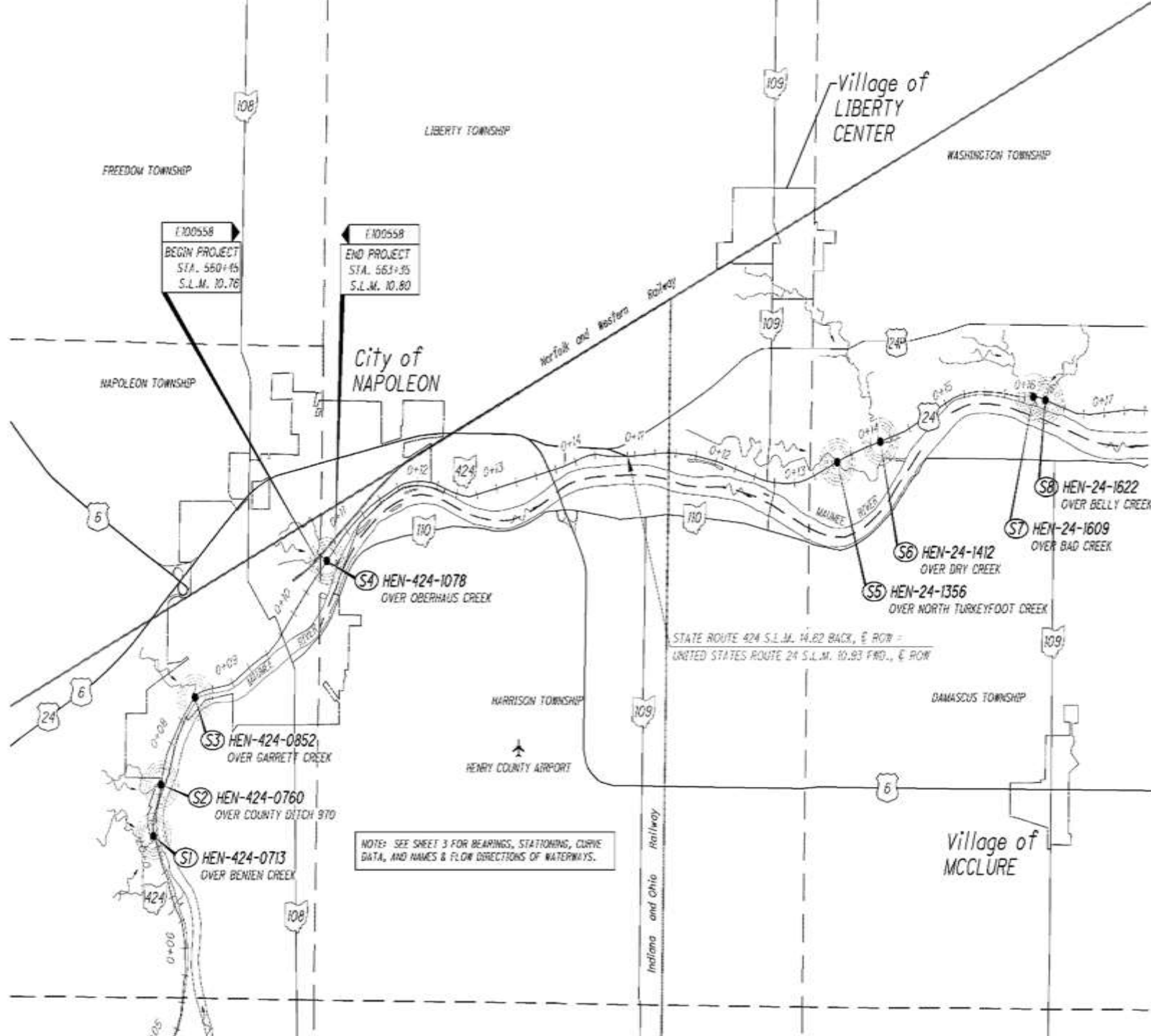
History

- Stone Arches originally constructed in mid-1800's
- Served as aqueducts under Miami and Erie Canal



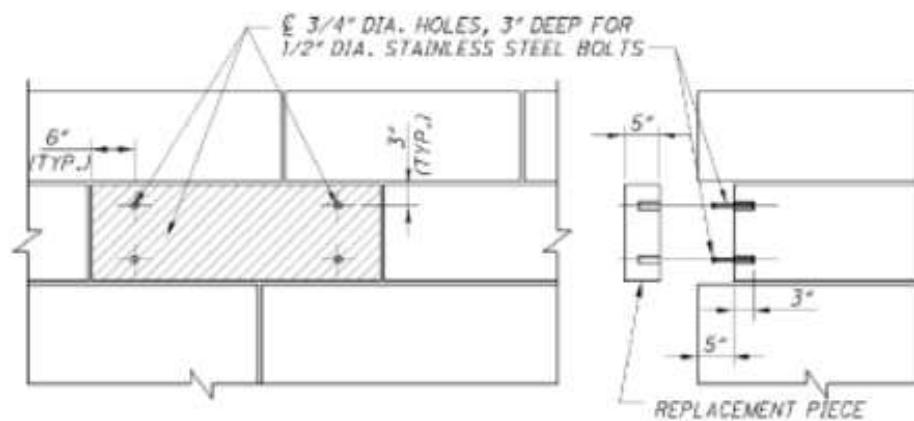
CHALLENGES

- Several differing site conditions, most notably existing foundation
- Amount of replacement block needed grossly underestimated
- Arch Ring repairs thicker than estimated
- In-Stream work restrictions: Jan.1 – Jun.30
- High water events
- One site required road closure within Napoleon;
Route to Hospital

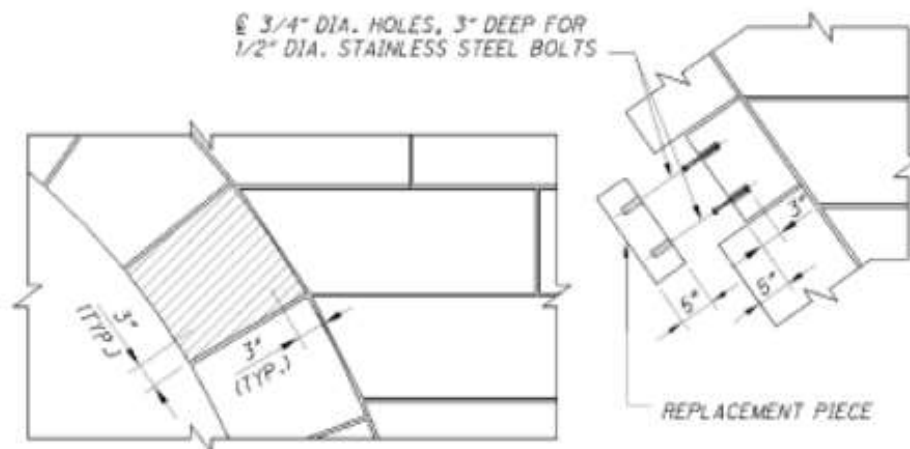


Site Specific Scopes: S1, S2, S6, S8

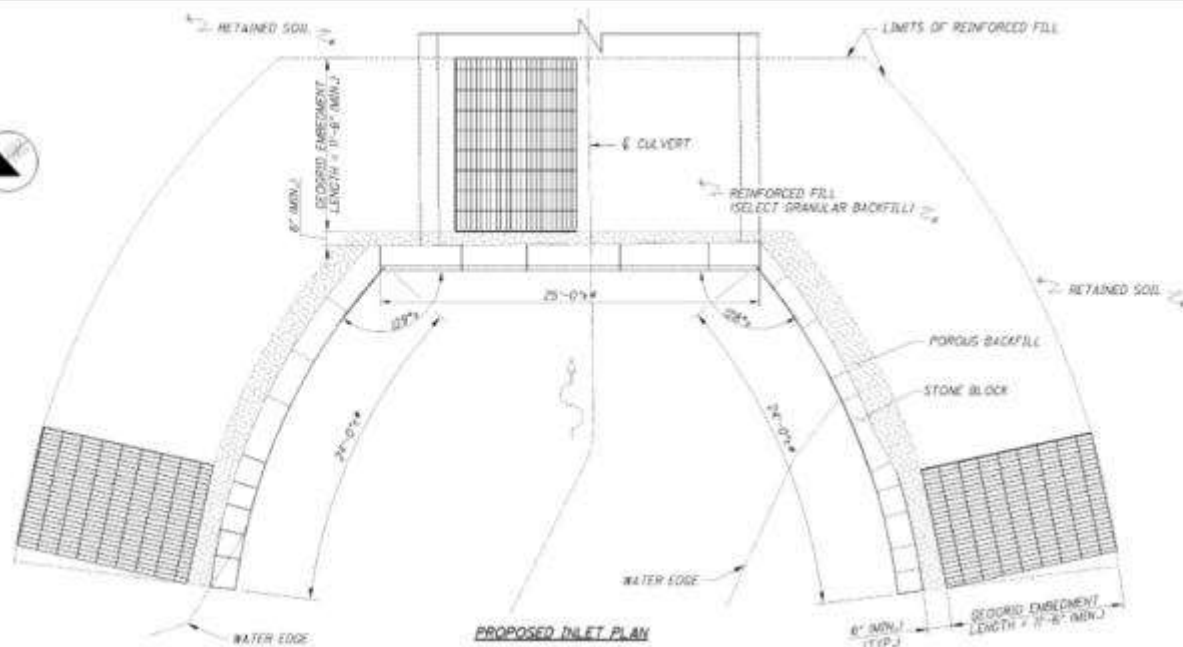
- Excavate down and remove inlet wingwalls/headwall block
- Arch ring repair
- Replace limestone block as necessary and reconstruct
- Install wire wall MSE system for backfill behind wingwalls/headwalls



REPAIR OF ERODED STONE FACING



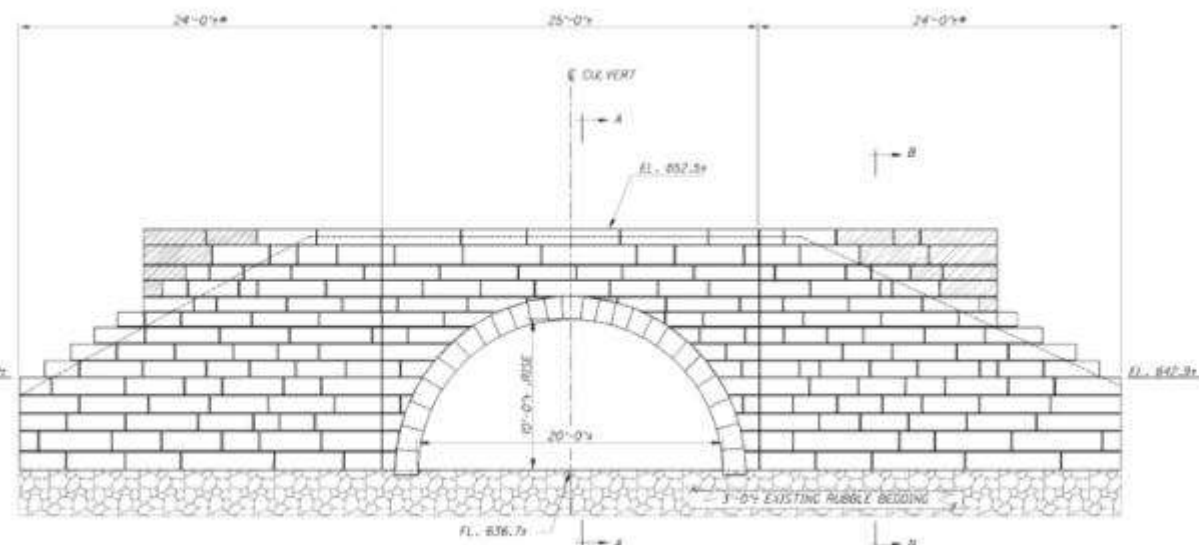
REPAIR OF ARCH RING



PROPOSED INLET PLAN

NOTES:

1. WINDMILL STONE BLOCK PATTERN BELOW THE EXISTING GROUND SHALL BE FIELD VERIFIED BY THE CONTRACTOR.
2. THE RECONSTRUCTED STONE WINDMILLS SHALL MATCH CLOSELY THE EXISTING STONE BLOCK PATTERN.
3. FOR SECTIONS A-A & B-B, SEE SHEET 102B.



PROPOSED INLET ELEVATION (DEVELOPED VIEW)

* - MEASURED ALONG FRONT FACE OF WALL.

LEGEND:

-  = GEORG
-  = EXISTING RUBBLE BEDDING
-  = POPULUS BACKFILL
-  = OPTIONAL
-  = CLASS C CONCRETE

DIMENSIONS

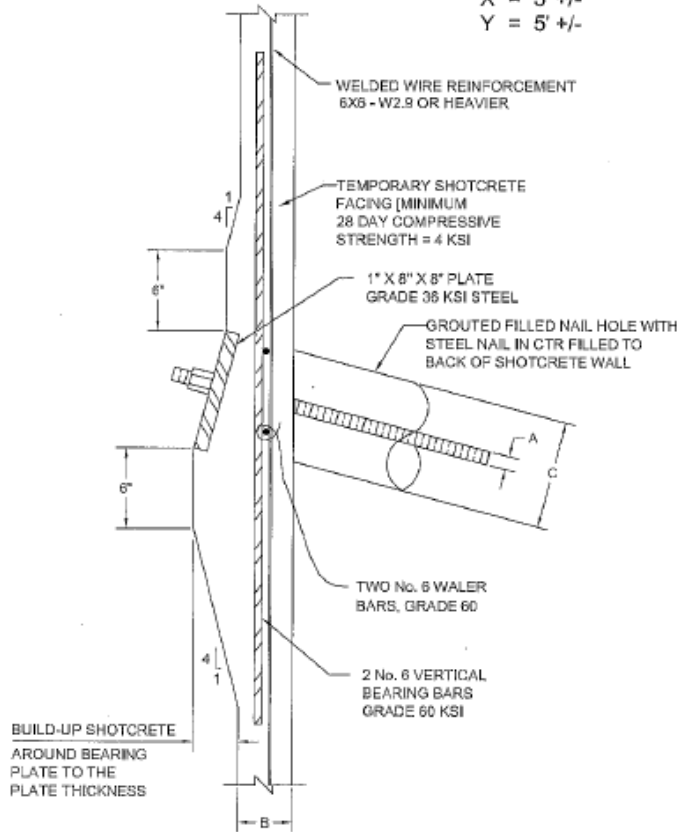
A = 1.0"

B = 4" +/-

C = 6" +

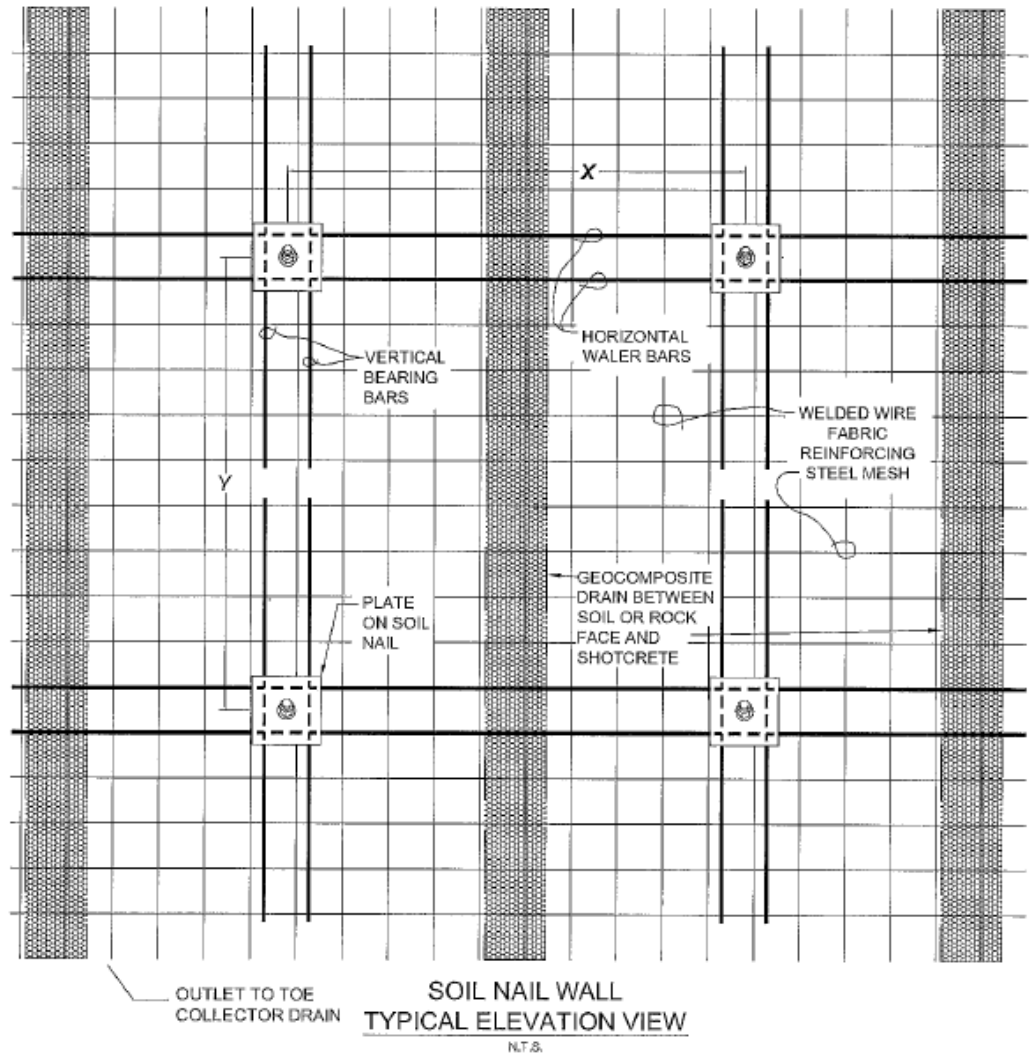
X = 5' +/-

Y = 5' +/-



TEMPORARY WALL
BEARING PLATE CONNECTION
DETAILS PROFILE

N.T.S.



SOIL NAIL WALL
TYPICAL ELEVATION VIEW

N.T.S.



DESIGNED BY:

Geotech Engineering, Inc.
GIA, Geotechnical and Structural
1414 Elmwood Avenue N.E.
Akron, Ohio 44316
(330) 748-4469

512 Proj. No. 13130

07/11/2013



8/13/2013 9:56

S1 Benien Creek Before



S1 Benien Creek After



S2 Co. Ditch 970 Before



S2 Co. Ditch 970 After



S6 Dry Creek Before



3/14/2013 13:48

S6 Dry Creek After



S8 Belly Creek Before



3/20/2013 10:43

S8 Belly Creek After



Site Specific Scopes: S3

- Replace Inlet Reinforced Concrete Headwalls/Wingwalls

Actual Work: S3

- Replace Inlet Reinforced Concrete Headwalls/Wingwalls
- Re-line Outer 20' of Barrel with Corrugated Metal Arch

S3 Garret Creek Before



S3 Garret Creek Re-Line



S3 Garret Creek After



Site Specific Scopes: S7

- Repair Eroded Stone Facing
- Reset Misaligned Blocks

Actual Work: S7

- Excavate down and remove inlet/outlet wingwalls/headwall block
- Arch ring repair
- Replace block as necessary and reconstruct

S7 Bad Creek Inlet Before



3/20/2013 10:22

S7 Bad Creek Inlet After



S7 Bad Creek Outlet Before



3/20/2013 10:31

S7 Bad Creek Outlet After



Site Specific Scope: S4 Oberhaus Creek

- Dewater work area.
- Disassemble existing stone block headwalls, wingwalls and arch. Catalogue and reference good blocks and replace damaged or missing blocks then reassemble.
- Existing waterline relocation.
- Existing sanitary sewer relocation.
- Incidental storm sewer work.
- Replace road and pavement.

Masonry Subcontractor

- Harry S. Peterson
- Requirements: Minimum 5 Years Experience in Masonry Construction for Historic Preservation
- Shall Employ Skilled Masons and Helpers
- Utilized Limestone and Concrete Block

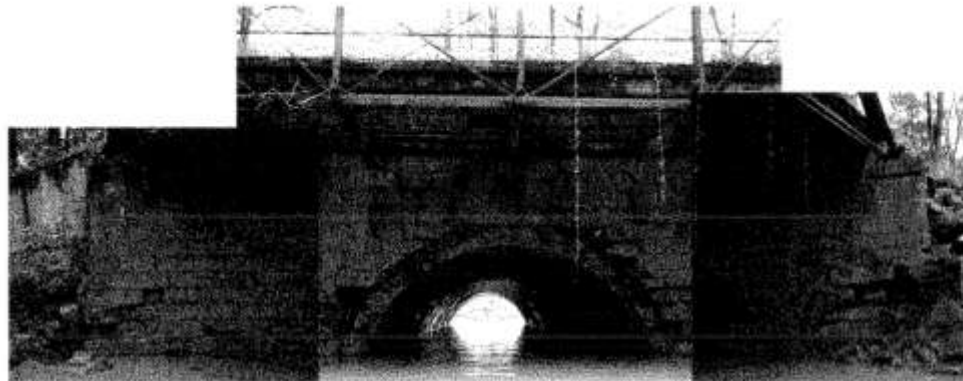
'Houston..... we have a problem'

Plans indicated the blocks were sitting on 2' of stone base. Once the work area was dewatered it was discovered that the entire structure (headwalls, wingwalls and arch) are sitting on large wooded timbers. At that point ODOT was notified of change of existing conditions and work was suspended until an alternate plan was developed. The existing timbers were tested and the results indicated that they were in good condition.

Actual Work: S4 Oberhaus Creek

- Install 18'x7'8" CMP arch liner inside existing arch.
 - Liner sat on CIP footings placed on top of existing timbers.
 - Footings were doweled into existing blocks.
 - Liner was assembled outside the arch and pulled into place with steel cable block & tackle and dozer.
 - Void between the existing arch and liner was filled with LSM. Special procedure so as not to damage the liner
- Pour a new CIP arch ring to match the previous.
- Install wire MSE walls.
- Remove and reassemble headwalls & wingwalls.

Original Plan Sheet



EXISTING INLET ELEVATION (DEVELOPED VIEW)



EXISTING OUTLET ELEVATION (DEVELOPED VIEW)

SEQUENCE OF CONSTRUCTION:

- (1) Dewatering - BEFORE THE RECONSTRUCTION WORK COMMENCES, THE TWO ENDS OF THE STONE ARCH CULVERTS ARE TO BE "DAMMED". THE NORMAL CHANNEL FLOW SHALL BE "ROUTED" THROUGH A CONDUIT BY PUMPING.
- (2) UNCLASSIFIED EXCAVATION, AS PER PLAN - THE DISMANTLING OF THE EXISTING STONE BLOCKS OF THE INLET HEADWALL AND WINGWALLS SHALL BE PERFORMED CONCURRENTLY WITH THE REQUIRED EXCAVATION OF THE EXISTING ROADWAY AND EMBANKMENT INCLUDING TREE REMOVAL. HEAVY EQUIPMENT THAT HAS THE POTENTIAL TO CAUSE DAMAGE TO THE EXISTING STONE ARCH BARREL SHALL NOT BE PERMITTED TO LOCATE DIRECTLY OVER THE CULVERT. THE EXCAVATED MATERIAL, WHICH HAS HIGH ORGANIC CONTENT, SHALL BE DISPOSED OF OFF SITE.
- (3) DISMANTLING THE EXISTING STONE ARCH STRUCTURE - ALL EXISTING HEADWALL AND WINGWALL STONE BLOCKS, AND THOSE OF THE EXISTING ARCH BARREL, ARE TO BE CAREFULLY DISMANTLED DOWN TO THE "RUBBLE BEDDING" AND STORED INSIDE THE DESIGNATED CONTRACTOR STAGING AREA. DETERIORATED OR DAMAGED STONE BLOCKS SHALL BE REPLACED WITH NEW LIMESTONE BLOCKS MEETING SPECIFICATION FOR MATERIALS SET FORTH IN THE GENERAL STRUCTURE NOTES ON SHEET [2/2].
- (4) RECONSTRUCTION OF THE EXISTING ARCH BARREL - THE RECONSTRUCTED ARCH BARREL SHALL BE COMPOSED OF THE EXISTING NATURAL STONE BLOCKS PER THE PLAN AND ELEVATION VIEWS SHOWN ON THE PLANS. NO MORTAR IS ALLOWED. IT SHALL ALSO HAVE THE SAME SPAN (20 FEET) AND RISE (10 FEET), AS WELL AS THE SAME ARCH RING DESIGN PATTERN AT THE TWO ENDS, AS THE EXISTING. REPLACE ALL DAMAGED OR DETERIORATED NATURAL STONE BLOCKS WITH NEW CONCRETE STONE BLOCKS SUPPLIED BY AN ODOT-APPROVED SUPPLIER. THE LONGITUDINAL LENGTH OF THE RECONSTRUCTED STONE ARCH CULVERT ON EITHER SIDE OF THE RIGHT OF WAY CENTERLINE SHALL BE AS INDICATED ON THE PLANS. SHOP DRAWINGS FOR THE BRACINGS USED TO RECONSTRUCT THE ARCH BARREL SHALL BE PREPARED BY AN ODOT REGISTERED PROFESSIONAL ENGINEER, AND SUBMITTED TO THE DISTRICT FOR APPROVAL AT LEAST 14 DAYS PRIOR TO THE ARCH BARREL RECONSTRUCTION.
- (5) RECONSTRUCTION OF THE EXISTING HEADWALLS AND WINGWALLS - THE RECONSTRUCTED HEADWALLS AND WINGWALLS AT BOTH INLET AND OUTLET ENDS SHALL BE COMPOSED OF THE EXISTING NATURAL STONE BLOCKS PER THE PLAN AND ELEVATION VIEWS SHOWN ON THE PLANS. NO MORTAR IS ALLOWED. REPLACE ALL DAMAGED OR DETERIORATED NATURAL STONE BLOCKS WITH NEW CONCRETE STONE BLOCKS SUPPLIED BY AN ODOT-APPROVED SUPPLIER.
- (6) BACKFILLING - THE BACKFILL MATERIAL SHALL BE PER CMS ITEM 203. THE MAXIMUM LIFT FOR EACH BACKFILL SHALL NOT BE MORE THAN 12". THE BACKFILL OVER THE STONE ARCH BARREL SHALL BE COMPACTED WITH HAND-OPERATED COMPACTOR.
- (7) EXCAVATION BRACING - SEE ITEM 803, COFFERDAMS AND EXCAVATION BRACING, AS PER PLAN NOTE ON SHEET [2/2].
- (8) EXISTING STORM PIPES - THE THREE STORM PIPES THAT ARE CURRENTLY DRAINING OVER THE WINGWALLS AT THE OUTLET (SEE PHOTO ON LEFT AND RIGHT) SHALL BE ROUTED TO DRAINAGE AT THE ENDS OF THE RECONSTRUCTED WINGWALLS.

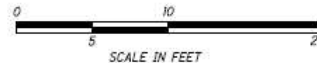
NOTE:

SEE GENERAL STRUCTURE NOTES FOR ADDITIONAL REQUIREMENTS.

Revised Plan Sheet



EXISTING INLET ELEVATION (DEVELOPED VIEW)



EXISTING OUTLET ELEVATION (DEVELOPED VIEW)



- (3) DISMANTLING THE EXISTING STONE ARCH HEADWALLS AND WINGWALLS - ALL EXISTING HEADWALL AND WINGWALL STONE BLOCKS ARE TO BE CAREFULLY DISMANTLED DOWN TO THE TIMBER MATTING AND STORED INSIDE THE DESIGNATED CONTRACTOR STAGING AREA. DETERIORATED OR DAMAGED STONE BLOCKS SHALL BE REPLACED WITH NEW LIMESTONE BLOCKS MEETING SPECIFICATION FOR MATERIALS SET FORTH IN THE GENERAL STRUCTURES NOTES ON SHEET 2/11.
- (4) CONSTRUCTION OF THE MULTI-PLATE ARCH - CONSTRUCTION OF THE MULTI-PLATE ARCH SHALL INCLUDE CONSTRUCTION OF CONCRETE FOOTINGS BEARING ON THE TIMBER MATS AS SHOWN ON PLAN SHEET 5A/11, ERECTION OF THE STEEL, MULTI- PLATE ARCH, INSTALLATION OF WEEPHOLES, AND GROUTING OF THE REMAINING GAP BETWEEN THE PROPOSED MULTI-PLATE ARCH AND THE EXISTING STONE ARCH.

SEQUENCE OF CONSTRUCTION:

- (1) DEWATERING - BEFORE THE RECONSTRUCTION WORK COMMENCES, THE TWO ENDS OF THE STONE ARCH CULVERTS ARE TO BE "DAMMED". THE NORMAL CHANNEL FLOW SHALL BE ROUTED THROUGH A CONDUIT BY PUMPING.
- (2) UNCLASSIFIED EXCAVATION, AS PER PLAN - THE DISMANTLING OF THE EXISTING STONE BLOCKS OF THE INLET HEADWALL AND WINGWALLS SHALL BE PERFORMED CONCURRENTLY WITH THE REQUIRED EXCAVATION OF THE EXISTING ROADWAY AND EMBANKMENT INCLUDING TREE REMOVAL. HEAVY EQUIPMENT THAT HAS THE POTENTIAL TO CAUSE DAMAGE TO THE EXISTING STONE ARCH BARREL SHALL NOT BE PERMITTED TO LOCATE DIRECTLY OVER THE CULVERT. THE EXCAVATED MATERIAL, WHICH HAS HIGH ORGANIC CONTENT, SHALL BE DISPOSED OF OFF SITE.
- (3) DISMANTLING THE EXISTING STONE ARCH STRUCTURE - ALL EXISTING HEADWALL AND WINGWALL STONE BLOCKS, AND THOSE OF THE EXISTING ARCH BARREL, ARE TO BE CAREFULLY DISMANTLED DOWN TO THE RUBBLE BEDDING AND STORED INSIDE THE DESIGNATED CONTRACTOR STAGING AREA. DETERIORATED OR DAMAGED STONE BLOCKS SHALL BE REPLACED WITH NEW LIMESTONE BLOCKS MEETING SPECIFICATION FOR MATERIALS SET FORTH IN THE GENERAL STRUCTURE NOTES ON SHEET 2/11.
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- (6) BACKFILLING - THE BACKFILL MATERIAL SHALL BE PER CMS ITEM 203. THE MAXIMUM LIFT FOR EACH BACKFILL SHALL NOT BE MORE THAN 12". THE BACKFILL OVER THE STONE ARCH BARREL SHALL BE COMPACTED WITH HAND-OPERATED COMPACTOR.
- (7) EXCAVATION BRACING - SEE ITEM 503, COFFEEDAMS AND EXCAVATION BRACING, AS PER PLAN NOTE ON SHEET 2/21.
- (8) EXISTING STORM PIPES - THE THREE STORM PIPES THAT ARE CURRENTLY DRAINING OVER THE WINGWALLS AT THE OUTLET (SEE PHOTO ON LEFT AND RIGHT) SHALL BE ROUTED TO DRAINAGE AT THE ENDS OF THE RECONSTRUCTED WINGWALLS.

NOTE:

SEE GENERAL STRUCTURE NOTES FOR ADDITIONAL REQUIREMENTS.

11-01-2013 DLZ CULVERT REVISIONS

1

COLUMBUS ENGINEERING
CONSULTANTS, INC.
100 N. HIGHWAY 100
COLUMBUS, OH 43240-1000

DATE: 01/12
BY: JLM
CHECKED: JLM
THICK LINE: JLM
35031700

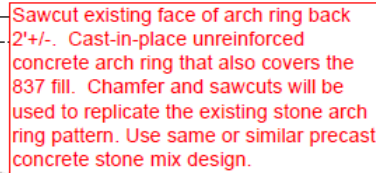
SCALE: 1"=10'-0"

EXISTING INLET & OUTLET VIEWS
BRIDGE NO. HEN-424-1078
S.R. 424 OVER CHEROKEE CREEK

HEN-24/424 STONE ARCHES
P.D. NO. 88197

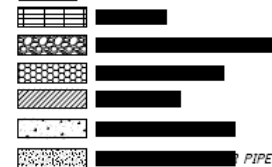
5 / 11

36
129



1. WINGWALL STONE BLOCK PATTERN BELOW THE EXISTING GROUND SHALL BE FIELD VERIFIED BY THE CONTRACTOR.
2. THE RECONSTRUCTED STONE WINGWALLS SHALL MATCH CLOSELY THE EXISTING STONE BLOCK PATTERN.

4. PRIOR TO BACKFILL FOR LINER PIPE HARDENING, FORM GROOVES AT THE EXPOSED ENDS TO CLOSELY MATCH THE EXISTING STONE ARCH RING PATTERNS.



Weep holes will be drilled thru the liner grout to the rock.



S4 Outlet before

S4 Cofferdam set & site dewatered



S4 Timbers



S4 Timbers





S4 Excavation

S4 CMP Liner installation



S4 Complete



Actual Work: S5 Turkeyfoot Creek

- Original Work Non-Performed; Re-added to contract due to success of S4 work
- Install 32'8"x13'3" CMP arch liner inside existing arch.
 - Liner sat on CIP footings placed on top of existing timbers.
 - Footings were doweled into existing blocks.
 - Liner was assembled outside the arch and pulled into place with steel cable block & tackle and dozer.
 - Void between the existing arch and liner was filled with LSM. Special procedure so as not to damage the liner
- Pour a new CIP arch ring to match the previous.
- Install wire MSE walls.
- Remove and reassemble headwalls & wingwalls.

S5 Before



3/14/2013 13:23



S5 CMP Liner installation

S5 Cast-in-place Arch Ring



S5 Complete



Turkeyfoot Creek at its worst



- Work Start: 3/26/2013; Original Completion: 1/1/2014; Actual Work Complete: 5/28/2015
- Bid Cost = \$5,247,539.88
- Current Cost = \$8,947,402.25
- Exceptional partnering and cooperation between ODOT, Contractors, Henry County, City of Napoleon
- Questions????

Mike Benton, ODOT:

Michael.Benton@dot.ohio.gov

Matt Schroeder, Miller Bros. Construction:

Mattschroeder@mbcholdings.com