Final
Basis of Design and Work Plan
for the Sand Creek Culvert Replacement
at the Open Demolition Area #2 Crossing
(RVAAP-004-R-01 Open Demolition Area #2 MRS)
Military Munitions Response Program

Former Ravenna Army Ammunition Plant, Camp Ravenna
Portage and Trumbull Counties, Ohio

Contract No. W912QR-12-D-0004
Delivery Order No. 0003

Prepared for:

U.S. Army Corps of Engineers
Louisville District
600 Dr. Martin Luther King, Jr. Place, Room 821
Louisville, Kentucky 40202-2267

Prepared by:

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September 16, 2016

REPORT DOCUMENTATION PAGE

Form Approved
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1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
16-09-2016	Final	From 12/21/2015 to 09/16/2016

4. TITLE AND SUBTITLE

Basis of Design and Work Plan
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Former Ravenna Army Ammunition Plant, Camp Ravenna
Portage and Trumbull Counties, Ohio

5a. CONTRACT NUMBER
W912QR-12-D-0004, DO No. 0003

5b. GRANT NUMBER
N/A

5c. PROGRAM ELEMENT NUMBER
N/A

6. AUTHOR(S)
Tetra Tech, Inc.

5d. PROJECT NUMBER
N/A

5e. TASK NUMBER
N/A

5f. WORK UNIT NUMBER
N/A

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

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8. PERFORMING ORGANIZATION REPORT NUMBER
N/A

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10. SPONSOR/MONITOR'S ACRONYM(S)
ARNG-ILE

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
N/A

12. DISTRIBUTION/AVAILABILITY STATEMENT
Reference Distribution Page

13. SUPPLEMENTARY NOTES
None

14. ABSTRACT

This Basis of Design and Work Plan for the Sand Creek Culvert Replacement covers the current conditions at the site, activities associated with the culvert replacement - a proposed culvert replacement, foundation design, and associated calculations.

15. SUBJECT TERMS
Work Plan, Basis of Design, Sand Creek Culvert Replacement, Open Demolition Area 2 crossing, George Road, Ravenna Army Ammunition Plant, Camp Ravenna

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Scott Nesbit
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Ohio Environmental Protection Agency

John R. Kasich, Governor
Mary Taylor, Lt. Governor
Craig W. Butler, Director

July 27, 2016

Re: US Army Ravenna Ammunition Plt RVAAP Remediation Response
Project records
Remedial Response
Portage County
267000859089

Mr. Mark Leeper, P.G., MBA
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ARNG-ILE-CR
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Subject: Review of the "Basis of Design and Work Plan for the Sand Creek Culvert Replacement at the Open Demolition Area #2 Crossing, RVAAP-004-R-01," Dated July 8, 2016 (Work Activity No. 267-000859-089)

Dear Mr. Leeper:

The Ohio Environmental Protection Agency (Ohio EPA), Northeast District Office (NEDO), Division of Environmental Response and Revitalization (DERR) has received and reviewed the "Basis of Design and Work Plan for the Sand Creek Culvert Replacement at the Open Demolition Area #2 Crossing, RVAAP-004-R-01," dated July 8, 2016. This document, received by Ohio EPA's NEDO on July 12, 2016, was prepared for the U.S. Army Corps of Engineers (USACE) Louisville District, by Tetra Tech, Inc.

This document was reviewed by personnel from Ohio EPA's DERR, pursuant to the Director's Findings and Orders. Ohio EPA has no comments; therefore, the document may be finalized. If you have any questions or concerns, please do not hesitate to contact me at (330)963-1235.

Sincerely,

Nicholas Roope
Site Coordinator
Division of Environmental Response and Revitalization

NP/nvr

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CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

Tetra Tech, Inc. has completed the preparation of this Final Basis of Design and Work Plan as part of the Sand Creek Culvert Replacement at the Open Demolition Area 2 Crossing at the former Ravenna Army Ammunition Plant (RVAAP)/Camp Ravenna. Notice is hereby given that a technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project. During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of technical assumptions; methods, procedures, and materials to be used; conformity to Ohio Army National Guard specifications; and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing USACE policy.

Scott Nesbit
Project Manager

9/13/16
Date

Robert Davis
Independent Technical Review Team Leader

9/13/16
Date

Final
Basis of Design and Work Plan for the Sand Creek Culvert Replacement at the Open Demolition Area #2 Crossing RVAAP-004-R-01

Former Ravenna Army Ammunition Plant, Camp Ravenna
Portage and Trumbull Counties, Ohio

Prepared for:
United States Army Corps of Engineers
Louisville District

Prepared by:
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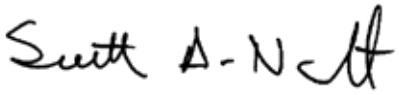
Multiple Award Remediation Contract
Contract No. W912QR-12-D-0004
Delivery Order No. 0003

September 16, 2016

PREPARED UNDER THE SUPERVISION OF & APPROVED FOR SUBMITTAL BY:



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ARNG-ILE-CR	Army National Guard - Installation Logistics Environmental – Cleanup Restoration
ARNG	Camp Ravenna = Army National Guard – Camp Ravenna Joint Military Training Center
OHARNG	Ohio Army National Guard Camp Ravenna Joint Military Training Center
REIMS	Ravenna Environmental Information Management System
AR	Administrative Record
USACE	United States Army Corps of Engineers

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ACRONYMS AND ABBREVIATIONS

ARNG	Army National Guard
bgs	below ground surface
Camp Ravenna	Camp Ravenna Joint Military Training Center
Contech	Contech Engineered Solutions LLC
ESS	Explosives Safety Submission
km	kilometer
MEC	munitions and explosives of concern
MMRP	Military Munitions Response Program
MPPEH	material presenting a potential explosive hazard
ODA2	Open Demolition Area 2
ODOT	Ohio Department of Transportation
OHARNG	Ohio Army National Guard
PCN	Pre-construction Notification
PWS	Performance Work Statement
USACE	United States Army Corps of Engineers
SSHP	Site Safety and Health Plan
WBG	Winklepeck Burning Grounds

EXECUTIVE SUMMARY

The Open Demolition Area 2 (ODA2) access road, located at Camp Ravenna Joint Military Training Center (Camp Ravenna) provides a surface for travel over the Sand Creek culvert. The existing culvert consists of two independent circular culverts with a combined capacity insufficient for the flow rates generated during high precipitation events. The ODA2 access road has experienced erosion as a result of overtopping of the Sand Creek culverts and corrective action is necessary.

The objectives and scope of work to be performed at RVAAP-004-R-01 (Contract No. W912QR-12-D-0004, Delivery Order No. 0003) include: 1) the slope stabilization at Rocket Ridge, 2) removal and replacement of the culvert located where Sand Creek crosses the ODA2 access road, and 3) removal of existing munitions from the culvert area. This document will focus on 2) removal and replacement of the culvert located where Sand Creek crosses the ODA2 access road, and it includes the design of the proposed replacement culvert and its associated foundation.

1.0 PROJECT DESCRIPTION

This document provides the basis of design for the replacement of the Sand Creek Culvert at the Open Demolition Area 2 (ODA2) access road crossing located at RVAAP-004-R-01 in Camp Ravenna Joint Military Training Center (Camp Ravenna), Ravenna, Ohio. The culvert location is shown on Figure 1-1. The culvert replacement action involves the removal of the two existing pipe culverts and replacement with an arched culvert. The replacement culvert design is based on the following design criteria:

- The replacement culvert shall be a concrete, three-sided, arched culvert with wing walls;
- A concrete pad with a minimum vehicle load rating of HS20 shall be placed over the culvert to allow vehicle passage;
- The concrete pad shall be a single lane crossing with a 14-foot travel way and 2-foot shoulders; and
- The culvert shall be designed to pass the peak flow rate for the 100-year flood event without overtopping the road.

The culvert replacement has been prepared as required by the Performance Work Statement (PWS), and will be performed in accordance with Site Safety and Health Plan (SSHP).

1.1 BACKGROUND

The Sand Creek culvert in ODA2 occupies approximately 300 square feet in the south-central part of Camp Ravenna. The culvert extends approximately 10 feet underneath the ODA2 access road from the west to the east. It consists of two independent culverts each with a diameter of 5 feet separated by approximately 4 feet. The entrance of the culvert is flanked by stacked, stone slabs on either side. The culverts are currently covered by approximately 4 feet of soil. The approximate location of the Sand Creek culvert is shown on Figure 1-1. Overtopping of the culverts during high flow rate events has created visible erosion of the ODA2 access road crossing north of Sand Creek. A photographic log of the conditions observed during a site visit on November 4, 2015 has been provided in Appendix A.

In general, the culvert entrance and exit are surrounded by vegetation in various locations flanking the culvert. Sand Creek generally flows west to east and is bordered by embankments to the north and south of varying height. Immediately downstream of the culvert is a small plunge pool. Soil samples collected by Specpro, Inc. in 2002 from borings downstream of the culvert indicate silty clay to approximately 5 feet below ground surface (bgs) underlain by varying amounts of sand and gravel to approximately 15 feet bgs where the borings concluded. These boring logs have been provided as Appendix B.

Munitions and explosives of concern (MEC) items have been observed within the backfill utilized for the culvert. Anecdotal evidence suggests Material Presenting a Potential Explosive Hazard (MPPEH) may have been inadvertently placed in the backfill over the culvert during roadway repair following a flood event. The Army National Guard (ARNG) determined that the culvert should be removed and replaced.

1.2 PROJECT OBJECTIVES

This project is one of three components described in the RVAAP-05 Winklepeck Burning Grounds (WBG) PWS. The RVAAP-05 WBG scope of work consists of implementation of the remedial design for WBG, stabilization of the slope at Rocket Ridge, and removal and replacement of the Sand Creek culvert at the ODA2 access road crossing. The primary objective of the Sand Creek culvert replacement is to preserve the integrity of the ODA2 access road and to address any MEC or MPPEH previously used as backfill for the culvert.

1.3 PERMITTING

Tetra Tech has developed and submitted the relevant and required permits and notifications including a pre-construction notification (PCN) for Nationwide Permit #3 in the name of Ohio Army National Guard (OHARNG) to the United States Army Corps of Engineers (USACE). A PCN is required under Nationwide Permit #3, and the appropriate application has been provided in Appendix C.

1.4 DOCUMENT ORGANIZATION

This document is organized as follows:

- Section 1.0 provides a description of the project, site history, physical setting, and organization of this document.
- Section 2.0 provides a description of the project activities, MPPEH removal, and site restoration.
- Section 3.0 provides a description of the recommended design, basis of design, and design analysis report.

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DRAWN BY: J. ENGLISH	DATE: 01/06/16	SAND CREEK CULVERT WORK AREA CAMP RAVENNA RAVENNA, OHIO	CONTRACT NUMBER: W912QR-12-D-0004
CHECKED BY: T. RILEY	DATE: 01/07/16		APPROVED BY: ___ DATE: ___
REVISED BY:	DATE:		APPROVED BY: ___ DATE: ___
SCALE: AS NOTED			FIGURE NO.: 1-1 REV: 0

2.0 PROJECT ACTIVITIES

2.1 CULVERT REPLACEMENT

Prior to culvert removal operations, the adjacent wetlands areas indicated on Figure 2-1 will be staked and clearly marked to avoid disturbance. Additionally, silt fences and rock check dams will be installed to control sediment during construction, and these erosion and sediment controls will be maintained in effective operation conditions. Staging areas for the equipment, fill materials, and support operations are located on the south side of Sand Creek as indicated on the staging map provided as Figure 2-2. The proposed activities will occur within Sand Creek, and will neither impact any navigational opportunities nor the movement of aquatic species.

The project at Sand Creek will be occurring in FEMA floodplain area 39133C0180D. Per the 100-year floodplain map dated August 18, 2009, the activities will take place within 100-year floodplain. The completed project will not create new obstructions within the floodplain and will not impact flow within the floodplain.

The area will be prepared for excavation through vegetation removal with chain saws, brush hog, wood chipper and excavator. The culvert replacement action involves the excavation and removal of two, adjacent, 5-foot diameter culverts running underneath the ODA2 access road. An excavator will be used to remove the rock, soil, and the existing pipe culverts from the work area. A front end loader or skid-steer loader will place the materials adjacent to the work area or load it onto trucks for removal.

The soil removed during excavation will be stockpiled to the southeast of the culvert. It is estimated that approximately 110 cubic yards of material including gravel and soil will be need to be excavated to remove the existing culverts. Excavated soil will be reused in the construction of the new culvert if it meets geotechnical requirements and is demonstrated to be free of MPPEH and MEC. The existing soil is assumed to be reusable unless it is deemed highly organic or peaty by visual inspection. Prior to reuse, visual inspection and magnetometer surveys will be conducted on backfill to ensure it is suitable for reuse.

During the removal of the existing culverts, the flow of the stream will neither be interrupted nor relocated. Prior to removal of the existing culverts a pump, bypass lines, and sandbags will be installed to maintain continuous flow of the creek and enable construction of the footers. Work in Sand Creek will maintain water flow by including a temporary sump with a pump to route water over or around the construction area. Approximately 35 cubic yards of sandbags will also be used to prevent water from entering active construction zones while the footers are being constructed, and the sandbags will be removed from the stream channel once the culvert replacement activities are complete. For the duration of the project, there will be no discharges to surrounding wetlands, and wetlands will be staked and clearly marked to avoid disturbance.

Approximately 20 cubic yards of Ohio Department of Transportation (ODOT) Type D (4 inch to 12 inch diameter) riprap will be placed over the 400 square feet below the culvert in the stream bed prior to installation of the culvert and will be used to armor the stream bed and culvert walls. An excavator or crane will be used to set the precast concrete arch culvert in the prepared area of Sand Creek. The arched culvert and its associated headwalls and wing walls will then be installed according to the installation drawings in Appendix E. Backfill will then be placed over the culvert and proof rolled with a static, 6-ton roller for 3 passes. Following completion a concrete pad will be constructed as discussed in Sections 2.2 and 3.2.4, and affected areas will be restored as discussed in Section 2.4.

Any refueling of the equipment will be done away from Sand Creek. Tarps or similar materials will be placed underneath the equipment and a “catch can” will be used to prevent any fuel or lubricants from reaching the ground. A spill kit will be located onsite in the event of a spill. Camp Ravenna Range Control will be immediately notified if a spill occurs.

2.2 CONCRETE PAD

A concrete pad will be paved over the culvert overburden in order to facilitate a vehicle load rating of HS20. The pad design and justification is further discussed in Section 3.2.4. Concrete trucks and concrete finishing equipment will be used for any concrete work.

2.3 MPPEH REMOVAL

MEC items have been observed within the backfill utilized for the culvert. Anecdotal evidence suggests MPPEH may have been inadvertently placed in the backfill over the culvert during roadway repair following a flood event. Although the Sand Creek culvert has been assessed as low-probability for containing MEC-related items, if MEC items are encountered which cause the site status to change, the USACE Baltimore Military Munitions Response Program (MMRP) Design District will prepare an Explosives Safety Submission (ESS) that covers work on the site. The excavated soil from the Sand Creek culvert removal will be visually inspected and surveyed by a magnetometer to verify the soils are free of MEC and MPPEH. Munitions debris and scrap metal will be disposed of by recycling. The Contractor will document the transport and transfer of the munitions debris and scrap metal using proper waste tracking procedures. It is not expected that demolition will be required.

If MEC is found during the visual inspection and surveying of the soil it will be removed from the soil and demolition/detonation of the MEC will be processed in the Buried Explosion Module at ODA2. A Type II portable magazine will be used to hold MEC/MPPEH items discovered during screening operations until disposal is planned. If the item is determined unsafe to move the item will be treated at the culvert using Blow in Place procedures.

Tetra Tech will use the procedures identified in the Department of Defense Explosive Safety Board approved ESS to be developed by USACE Baltimore District to conduct the MEC demolition operations. Tetra Tech explosive ordnance disposal technicians are Department of Transportation certified to transport explosives within a military installation and will transport the explosives to the Buried Explosion Module at ODA2 in accordance with Camp Ravenna Requirements. Large munition debris fragments, other debris, and ferrous and non-ferrous metals will be recycled after it is inspected and certified that it is free of explosive hazards.

2.4 SITE RESTORATION

A preconstruction visual survey was performed to document initial conditions at the culvert on March 8, 2016 by Campbell & Associates, Inc. The preconstruction land survey of the existing

ground elevation was conducted at the culvert to establish existing grade for site restoration and has been provided as Figure 2-3. Following the construction of the culvert foundation, the stream bed will be armored with approximately 20 cubic yards of riprap per ODOT Type D specifications by an excavator. Once the culvert has been installed the riprap will be redistributed such that the culvert walls are adequately protected. During construction, some vegetation and small trees may be removed. Following completion, affected areas will be restored and reseeded using the Camp Ravenna approved seed mix to reduce the potential for erosion. Equipment such as a front end loader, dozer, skid-steer loader, compactor, and hydroseeder may be used for backfill and restoration of the area surrounding the culvert. The proposed site plan has been provided as Figure 2-4.

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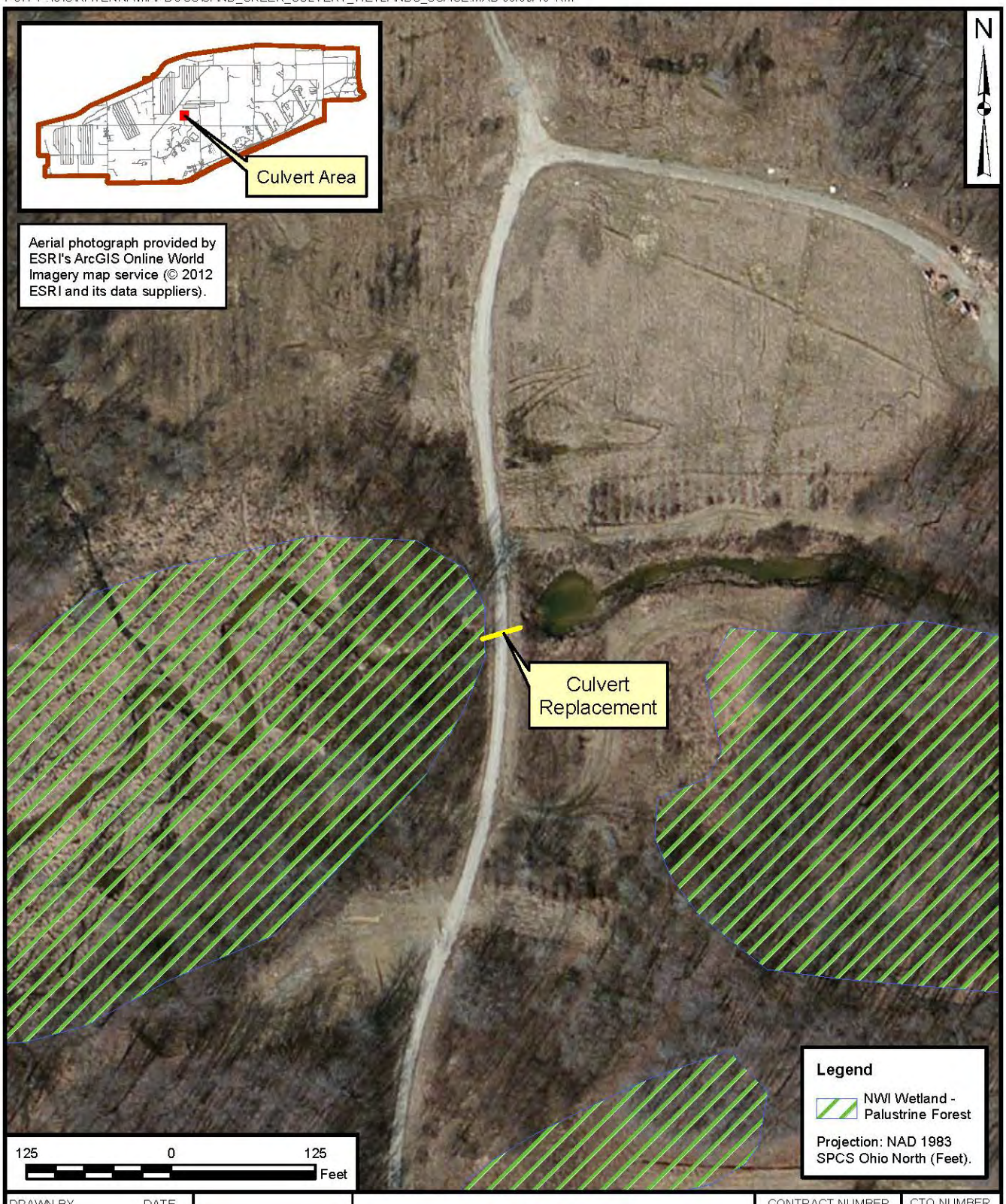

DRAWN BY: J. ENGLISH	DATE: 04/25/16	WETLANDS DELINEATION MAP CAMP RAVENNA RAVENNA, OHIO	CONTRACT NUMBER: W912QR-12-D-0004
CHECKED BY: T. RILEY	DATE: 05/09/16		CTO NUMBER: —
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CONTRACT NUMBER W912QR-12-D-0004

APPROVED BY — DATE —

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FIGURE NO. 2-2

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SAND CREEK CULVERT STAGING AREA
CAMP RAVENNA
RAVENNA, OHIO

DRAWN BY J. ENGLISH DATE 06/01/16

CHECKED BY G. HEALY DATE 06/15/16

REVISED BY — DATE —

SCALE AS NOTED

NOTES:

1. TOPOGRAPHIC MAPPING FROM CAMPBELL & ASSOCIATES, INC. DRAWING TITLED "TOPOGRPAHIC SURVEY", DATED MARCH 2016.
2. HORIZONTAL DATUM: OHIO STATE PLANE COORDINATE SYSTEM, NAD 83, NORTH ZONE
3. VERTICAL DATUM: NAVD 88
4. BENCHMARK: TOP OF IDENTIFICATION DISC FOR MONITORING WELL "DA2MW-107". ELEVATION: 1039.96 (NAVD88).

LEGEND:

- 1035 — EXISTING 5' CONTOUR
- EXISTING 1' CONTOUR
- EXISTING TREE
- EXISTING CULVERT
- MW — EXISTING MONITORING WELL
- EXISTING STONE WALL
- EXISTING NWI WETLAND

BENCHMARK
MONITORING WELL
DISC IN CONCRETE
EL.: 1039.96

MW MONITORING WELL
DA2MW-107
N: 560479.241
E: 2354924.096
EL.: 1040.03

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0 10 20
SCALE IN FEET

US Army Corps of Engineers

U.S. ARMY CORPS OF ENGINEERS, LOUISVILLE DISTRICT
600 DR. MARTIN LUTHER KING JR. PLACE, ROOM 821
LOUISVILLE, KENTUCKY 40202-2267

REVISIONS			
NO.	BY	DATE	REMARKS

CAMP RAVENNA
RAVENNA, OHIO

SAND CREEK CULVERT

SAND CREEK CULVERT SURVEY

DATE:	4/15/16
PROJECT NO.:	112IC05958
DESIGNED BY:	GH
DRAWN BY:	BH
CHECKED BY:	SN

SHEET 1 OF 2-3

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NOTES:

1. TOPOGRAPHIC MAPPING FROM CAMPBELL & ASSOCIATES, INC. DRAWING TITLED "TOPOGRPAHIC SURVEY", DATED MARCH 2016.
2. HORIZONTAL DATUM: OHIO STATE PLANE COORDINATE SYSTEM, NAD 83, NORTH ZONE
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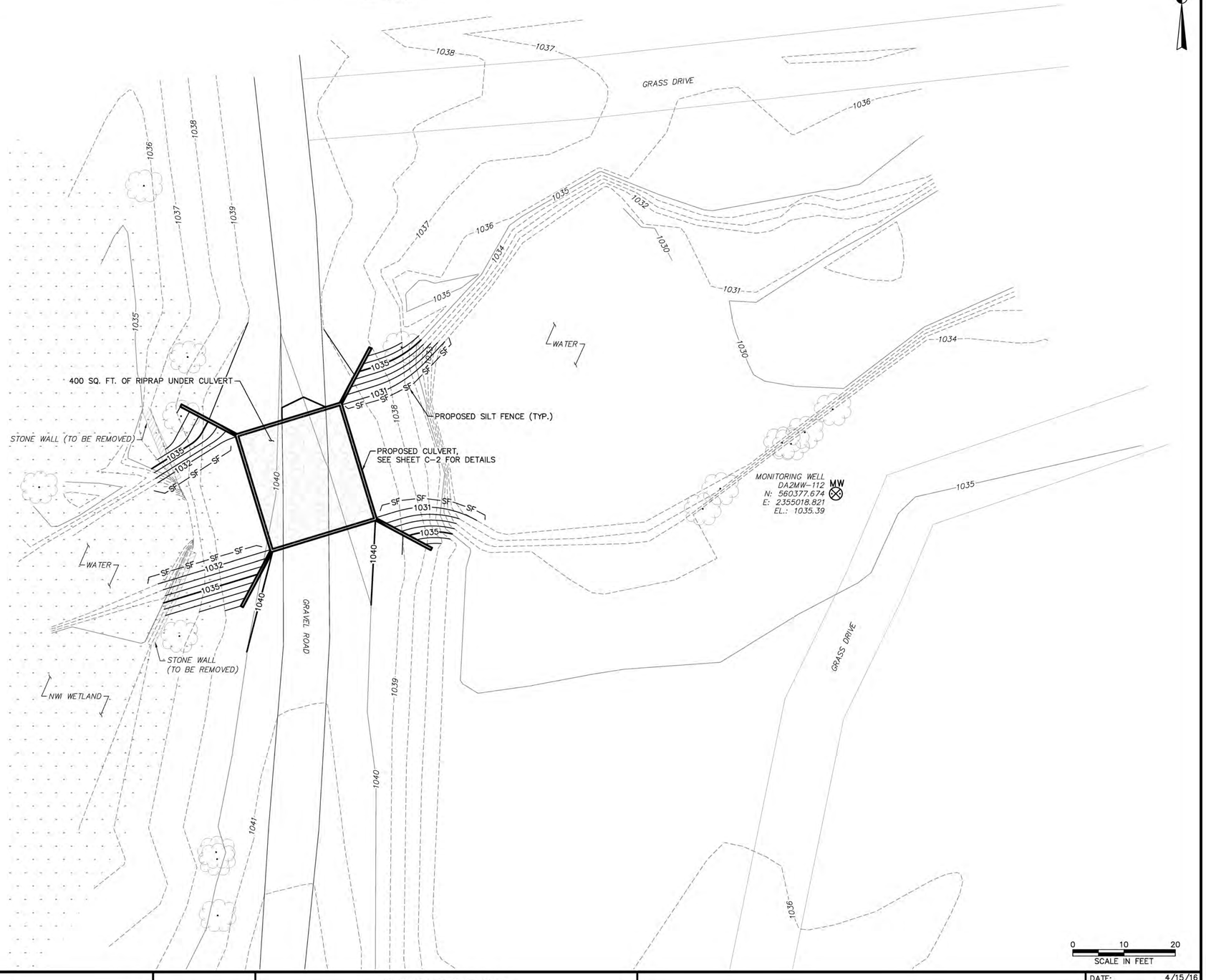
LEGEND:

- 1035 — EXISTING 5' CONTOUR
- EXISTING 1' CONTOUR
- EXISTING TREE
- EXISTING CULVERT
- MW — EXISTING MONITORING WELL
- EXISTING STONE WALL
- EXISTING NWI WETLAND
- PROPOSED CULVERT
- 1035 — PROPOSED 5' CONTOUR
- PROPOSED 1' CONTOUR
- SF — SF — PROPOSED SILT FENCE
- PROPOSED RIRPAP

BENCHMARK MONITORING WELL DISC IN CONCRETE EL.: 1039.96

MW MONITORING WELL DA2MW-107 N: 560479.241 E: 2354924.096 EL.: 1040.03



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600 DR. MARTIN LUTHER KING JR. PLACE, ROOM 821
LOUISVILLE, KENTUCKY 40202-2267

REVISIONS			
NO.	BY	DATE	REMARKS

CAMP RAVENNA
RAVENNA, OHIO

SAND CREEK CULVERT

PROPOSED SITE PLAN

DATE:	4/15/16
PROJECT NO.:	112IC05958
DESIGNED BY:	GH
DRAWN BY:	BH
CHECKED BY:	SN

SHEET 1 OF –

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3.0 BASIS OF DESIGN/DESIGN ANALYSIS

3.1 REPLACEMENT CULVERT DESCRIPTION

The replacement culvert design is based on the following design criteria:

- The replacement culvert shall be a concrete, three-sided, arched culvert with wing walls;
- A concrete pad with a minimum vehicle load rating of HS20 shall be placed over the culvert to allow vehicle passage;
- The concrete pad shall be a single lane crossing with a 14-foot travel way and 2-foot shoulders; and
- The culvert shall be designed to pass the peak flow rate for the 100-year flood event without overtopping the road.

3.2 BASIS OF DESIGN

The process by which the culvert design was generated and verified involved a hydraulic analysis which was submitted with the OHARNG's design specifications to Contech for procurement of a replacement culvert design. Design documents developed by Contech pertaining to the culvert and foundation have been provided as Appendix E. The design was evaluated by Tetra Tech, Inc. to ensure it met the design constraints while maintaining structural integrity.

3.2.1 StreamStats Watershed Delineation

A hydraulic analysis was performed to delineate the watershed of the culvert, determine the peak flow entering the culvert, and the cross-sectional area required to pass the peak flow. StreamStats, a USGS application for determining streamflow statistics, was used to generate the watershed corresponding to the Sand Creek Culvert and determine the peak flow through the culvert during a 100-year storm. The output files derived from the StreamStats evaluation have been provided in Appendix D. The watershed for the Sand Creek Culvert covers approximately 3.69 square miles. The peak flow rate during a 100-year storm is 695 cubic feet per second at the head of the culvert.

3.2.2 Foundation Design

A Load Factor Design for bridge foundations was used to produce a foundation for the proposed culvert. The bearing capacity was conservatively assumed to be 2,500 pounds per square foot due to the lack of recent soil borings directly adjacent to the culvert. The design accounts for loads from the culvert, overburden, a concrete pad, and an HS20 live load. Based on these design conditions a foundation with a width of 6 feet and thickness of 2 feet is proposed. The bottom of footer would be installed 3 feet 3 inches below the stream surface. Due to the lack of subsurface soils information, a lean concrete subfooter may need to be created if the soils are deemed incapable of supporting the design bearing capacity. The footer shell will be provided by Contech in the form of an EXPRESS Foundation. The shell will be cast in place with concrete after installation of the EXPRESS Foundation segments.

3.2.3 Prefabricated Culvert Design

Contech was contacted for the provision of a prefabricated arch culvert capable of passing the peak flow. Dimensions for the replacement culvert were selected based upon culvert capacity curves provided by Contech. These dimensions along with the design requirements listed in the PWS and subsequent attachments were provided to Contech for the design of the arched culvert. Contech suggested a CON/SPAN O-Series culvert for Sand Creek. The proposed replacement culvert will be 8 inches thick, 21 feet wide at the base, 24 feet long, and approximately 7 feet tall at its highest point. Wing walls will flank the entry and exit at 45 degree angles and will be 12 feet long. This design assumes a maximum soil coverage of 2 feet above the center of the culvert, a vehicle load rating of HS20, and concrete pad 6 inches thick.

3.2.4 Concrete Pad Design

The concrete pad will be 20 feet long and 18 feet wide at minimum per PWS requirements. Welded-wire fabric will be used to reinforce the concrete. The thickness of the pad was determined using the design chart for rigid pavements provided in Appendix F. Given that the ODA2 access road is a secondary road (p_t=2.0), the concrete is expected to have a working stress of approximately 440 psi, and the modulus of subgrade reaction can conservatively be assumed to be 150 pounds per cubic inch, with 50 daily equivalent 18-kip single-axle load applications a slab thickness of approximately 6 inches would be required. The concrete pad will be underlain by 4

inches of aggregate equivalent to American Association of State Highway and Transportation #57 stone. A geogrid will be installed beneath the aggregate to provide reinforcement for soils under tension.

3.3 DESIGN ANALYSIS

Contech submitted the proposed designs for the foundation and culvert to Tetra Tech for review. The results of Contech's calculations were reviewed for inaccuracies before being determined acceptable for further use. Boring logs (Appendix B) and the site survey were used to determine the approximate soil conditions at the culvert location. Based on these conditions, Contech's bearing capacity assumption was deemed adequate.

4.0 REFERENCES

Das, B. M., 1984. Principles of Foundation Engineering, PWS Engineering.

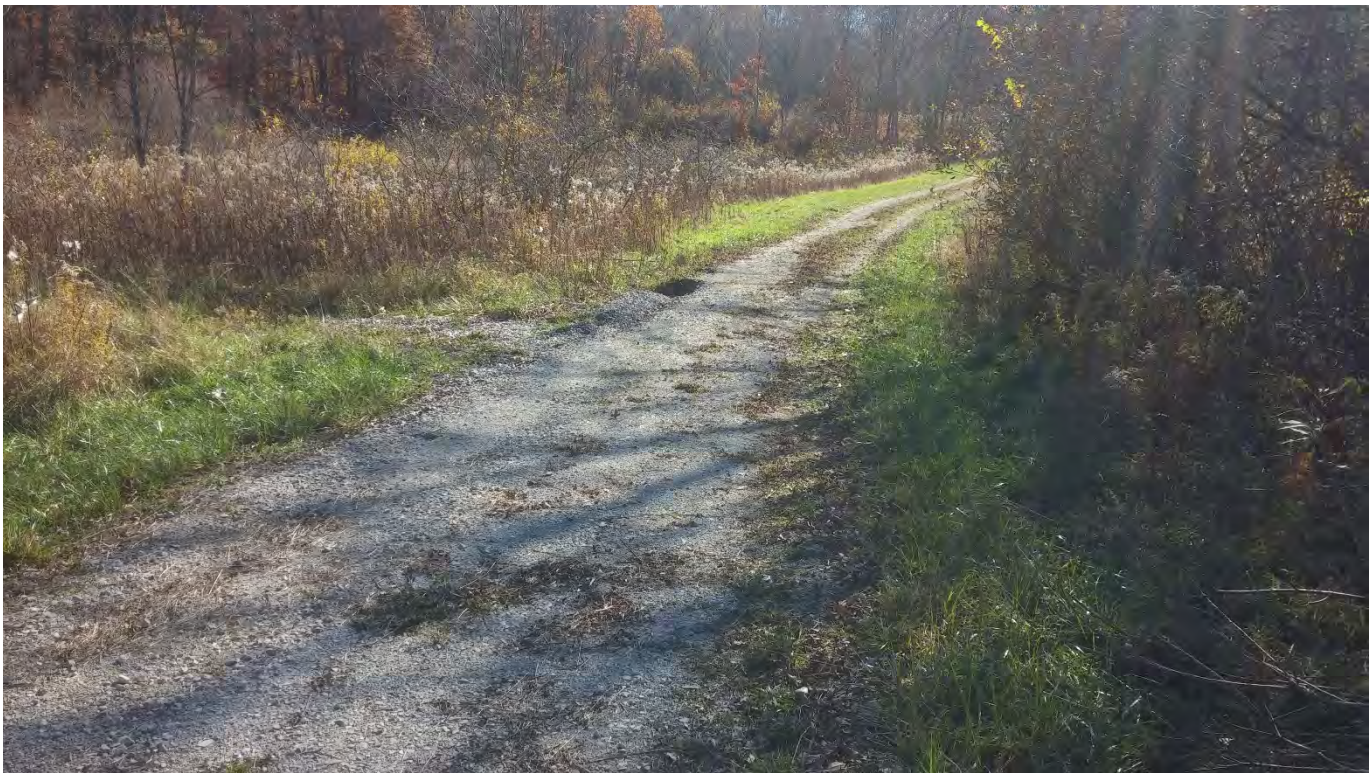
USACE Louisville District, 2015. Performance Work Statement for the Soil Removal Action at RVAAP-05 Winklepeck Burning Grounds (WBG), Former Ravenna Army Ammunition Plant (RVAAP) Restoration Program, Camp Ravenna, Portage and Trumbull Counties, Ohio. June 25.

Tetra Tech, Inc., 2015. Draft Work Plan Soil Removal Action at RVAAP-05 Winklepeck Burning Grounds, Camp Ravenna, Ohio. November.

Yoder, E. J., Witczak, M. W., 1975. Principles of Pavement Design, Second Edition, John Wiley & Sons, Inc.

APPENDIX A

PHOTOGRAPHIC LOG



Facing South-southeast – Erosion on George Road, ODA2 access road

Facing East – Plunge pool at culvert outlet

Facing East – Sand Creek culvert entrance

Facing East – Closeup of southern Sand Creek pipe culvert

Facing East-southeast – Stone slab wing walls

Facing Northeast – Northern Sand Creek pipe culvert covered by debris

Facing Northeast – Plunge pool at outlet of Sand Creek culvert looking downstream

Facing Northwest – Outlet of Sand Creek pipe culverts looking upstream

Facing West-northwest – Outlet of Sand Creek pipe culverts

Facing West-southwest – Outlet of Sand Creek pipe culverts

Facing West-southwest – Outlet of Sand Creek pipe culverts

Facing West – Outlet of Sand Creek pipe culverts

Facing West-northwest – Erosion path

APPENDIX B

BORING LOGS

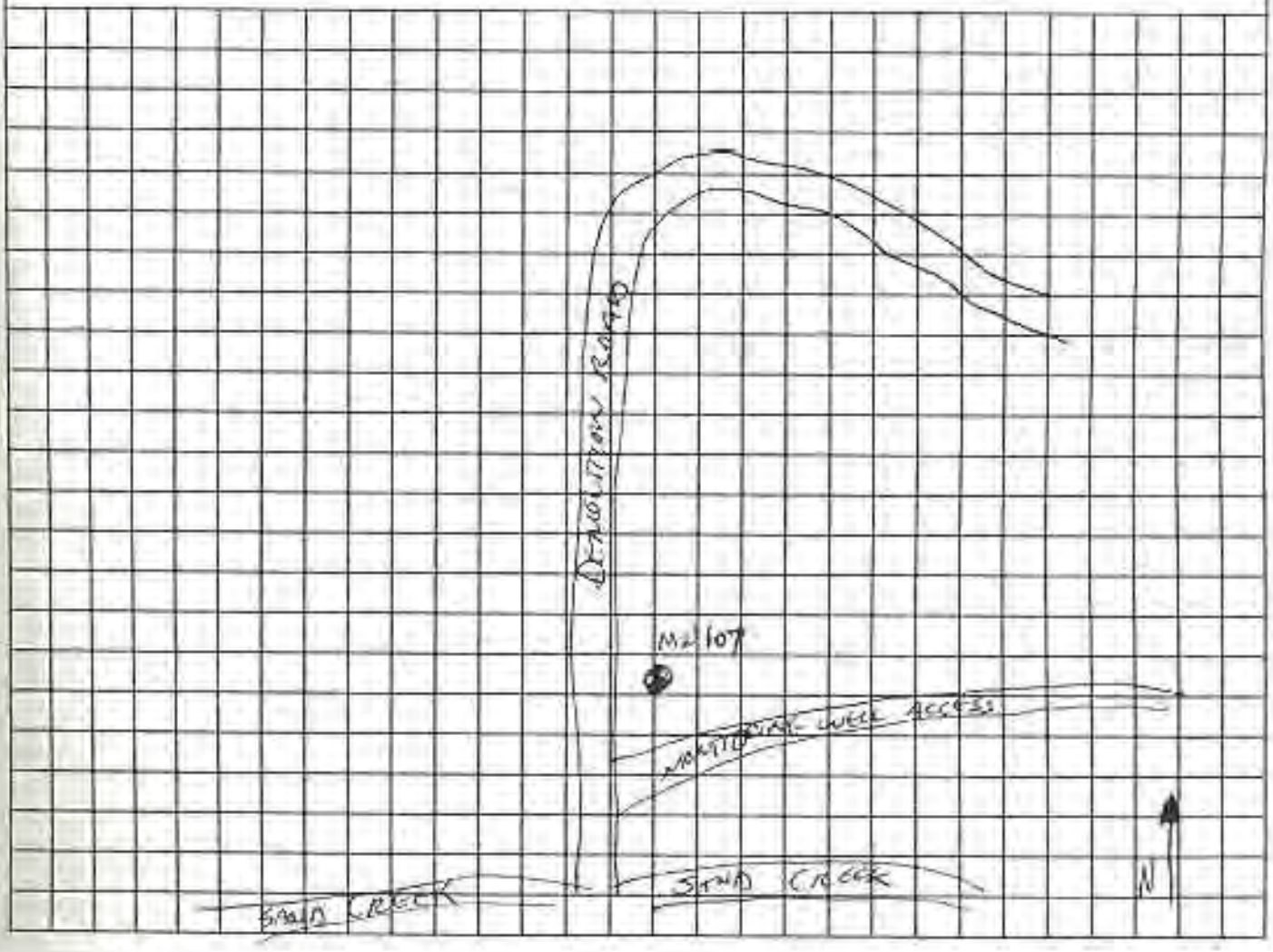
HTRW DRILLING LOG

1. COMPANY NAME: SPEC PRO INC	2. DRILL SUBCONTRACTOR: TOITEST, INC	HOLE NUMBER: MW107
	DISTRICT: LOUISVILLE	SHEET 1 of 3

3. PROJECT: DEMO AREA 2 PHASE II RI	4. LOCATION: DEMO AREA 2
5. NAME OF DRILLER: Bob Gallihue	6. MANUFACTURER'S DESIGNATION OF DRILL: CME 75
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: CME MODEL 75 USING 4-1/4" Hollow Stem Augers; 2" x 2" ID Split Spoon Samplers; 2"x3" ID Shelby Tube	8. HOLE LOCATION: SEE MAP BELOW
	9. SURFACE ELEVATION: 1039.18
	10. DATE STARTED: 07-18-02 — 11. DATE COMPLETED: 07-18-02
12. OVERBURDEN THICKNESS: 12.0'	15. DEPTH GROUNDWATER ENCOUNTERED: 9.0'
13. DEPTH DRILLED INTO ROCK: Augered to 15' - Approx 3' in Shale	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 7.67 — 24 hours
14. TOTAL DEPTH OF HOLE: 15'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):

18. GEOTECHNICAL SAMPLES: 10-12', 12-14'	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES				
20. SAMPLES FOR CHEMICAL ANALYSIS: 0-2', 2-4'	VOC	METALS ✓	OTHER (SPECIFY): Explosives	OTHER (SPECIFY):	OTHER (SPECIFY):	21. TOTAL CORE RECOVERY: %	
22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL ✓	OTHER (SPECIFY):	23. SIGNATURE OF INSPECTOR: [signature]			

LOCATION SKETCH/COMMENTS — SCALE: NOT TO SCALE



HTRW DRILLING LOG

DAZ

HOLE NUMBER 107

PROJECT: DAZ AHZ RI Rudder | INSPECTOR: Sal Caulin | SHEET 2 OF 3

ELEV. (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	HEADSPACE SCREENING RESULTS	GEOTECH SAMPLE OR CORE BOX	ANALYTICAL SAMPLE NO. (F)	REMARKS (G)
		yellowish brown 10YR 5/4 silty clay with gravel, some organics very loose to 1.7 ft stiff at 1.7, with increasing clay content, CL			Sample 820 0819	Blow count 8, 10, 12, 12 Recovery 2/2 some large rock/slag and roots time 0955
		as above clay 10YR 4/4 dark yellow brown with fine gravel, stiff, trace of organics with red mineral stains, moist CL			Sample 821 0920	Blow count 5, 5, 4, 4 Recovery 1.7/2 time 1003
		as above, moist, soft slightly plastic, with a trace of gray mottles. CL				BC 1, 2, 3, 3 Recovery 1.6/2 time 1008
		as above, CL				BC 1, 2, 3, 4 Recovery 1.6/2 time 1015
		dark gray 10YR 4/1, soft, plastic clay CL gray 10YR 5/2 fine to medium grained with a trace of fine to medium gravel; wet, loose. 5Ft SC Increasing large gravel some red mottles				BC- 5, 6, 8, 9 Recovery - 1.3/2 saturated at 9' time 1019

HTRW DRILLING LOG

DAZ

HOLE NUMBER 107

PROJECT: DAZ PAZ RI RI/FS

INSPECTOR: SMcCauslin

SHEET 3 OF 3

ELEV (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	HEADSPACE SCREENING RESULTS	GEOTECH SAMPLE OR CORE BOX	ANALYTICAL SAMPLE NO (E)	REMARKS (G)
	11	Wet From the end, gray clay w/ gravel CL		Shelby tube		Blow count - N/A Recovery - full
	12	Weathered shale, wet at end of Shelby tube		Shelby tube		time 1040 Recovery 1.1'
	13					time 1120
	14		Bt 2.69 FID			Auger to 15' to set well
	15	Bottom of Hole SMcCauslin				
	16					
	17					
	18					09-12-02
	19					
	20					

MONITORING WELL INSTALLATION LOG

PROJECT NAME: Ravenna Demolition Area 2 Phase II RI DELIVERY ORDER: 0003

MONITORING WELL ID: DA2 MW 107

INSTALLATION START: DATE: 07-18-02 TIME: 1126

INSTALLATION FINISH: DATE: 7-18-02 TIME: 1153

ANNULAR SPACE MATERIALS INVENTORY:

GRANULAR FILTER PACK: TYPE: Global #7 SAND QUANTITY: 4 - 50 Lb BAGS

BENTONITE SEAL: TYPE: Volclay 3/8" pellets QUANTITY: 1 - 50 Lb Bucket

GROUT: TYPE: CEMENT/BENTONITE QUANTITY: 47 Lbs

DESCRIPTION OF WELL SCREEN:

SLOT SIZE (inches): .010 SLOT CONFIGURATION: Machine Cut

OUTSIDE DIAMETER: 2.375" NOMINAL INSIDE DIAMETER: 2.0"

SCHEDULE/THICKNESS: SCH 40 COMPOSITION: PVC

MANUFACTURER: Johnson

TYPE OF MATERIAL BETWEEN BOTTOM OF BORING AND SCREEN: Global #7 SAND

DESCRIPTION OF WELL CASING:

OUTSIDE DIAMETER: 2.375" NOMINAL INSIDE DIAMETER 2.0"

SCHEDULE/THICKNESS: SCH 40 COMPOSITION: PVC

MANUFACTURER: Johnson

JOINT DESIGN AND COMPOSITION: Threaded PVC

CENTRALIZERS DESIGN AND COMPOSITION: NONE USED

DESCRIPTION OF PROTECTIVE CASING:

NOMINAL INSIDE DIAMETER: 5.0" COMPOSITION: STEEL

SPECIAL PROBLEMS ENCOUNTERED DURING WELL CONSTRUCTION AND THEIR RESOLUTION:

None

Was all well screen and casing material used for construction free of foreign matter (e.g. adhesive tape, labels, soil, grease, etc.)? YES [X] NO [ ]

Was all well screen and casing material used for construction free of unsecured couplings, ruptures, and other physical breakage and/or defects? YES [X] NO [ ]

Is deformation or bending of the installed well screen and casing minimized to the point of allowing the insertion and retrieval of a 1.0-inch bailer throughout the entire length of the complete well? YES [X] NO [ ]

QUANTITY OF APPROVED WATER USED FOR FILTER PACK EMPLACEMENT: _____

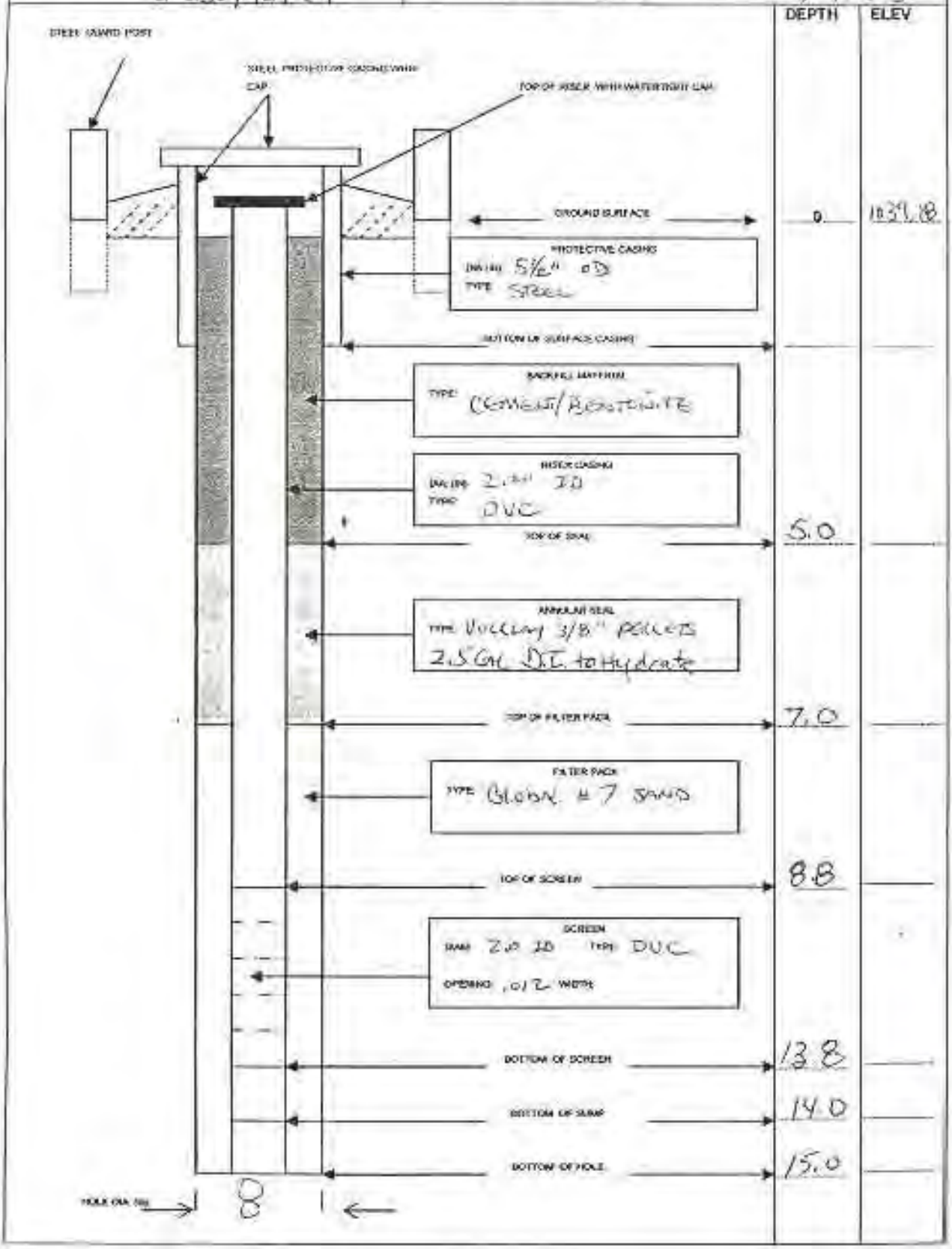
RECORDED BY: _____ 7/18/02 QA CHECK BY: _____

(Signature and Date) (Signature and Date)

MONITORING WELL CONSTRUCTION DIAGRAM

PROJECT NAME: Ravenna Demolition Area 2 Phase II RI **DELIVERY ORDER NO:** 0003

WELL NUMBER: DA2-MW107	**BEGIN:** 07-18-02	**END:** 07-18-02
COORDINATES: N. 560~~8~~480.04 E: 2354924.29	**REFERENCE POINT:** TOC	**ELEVATION:** 1041.63



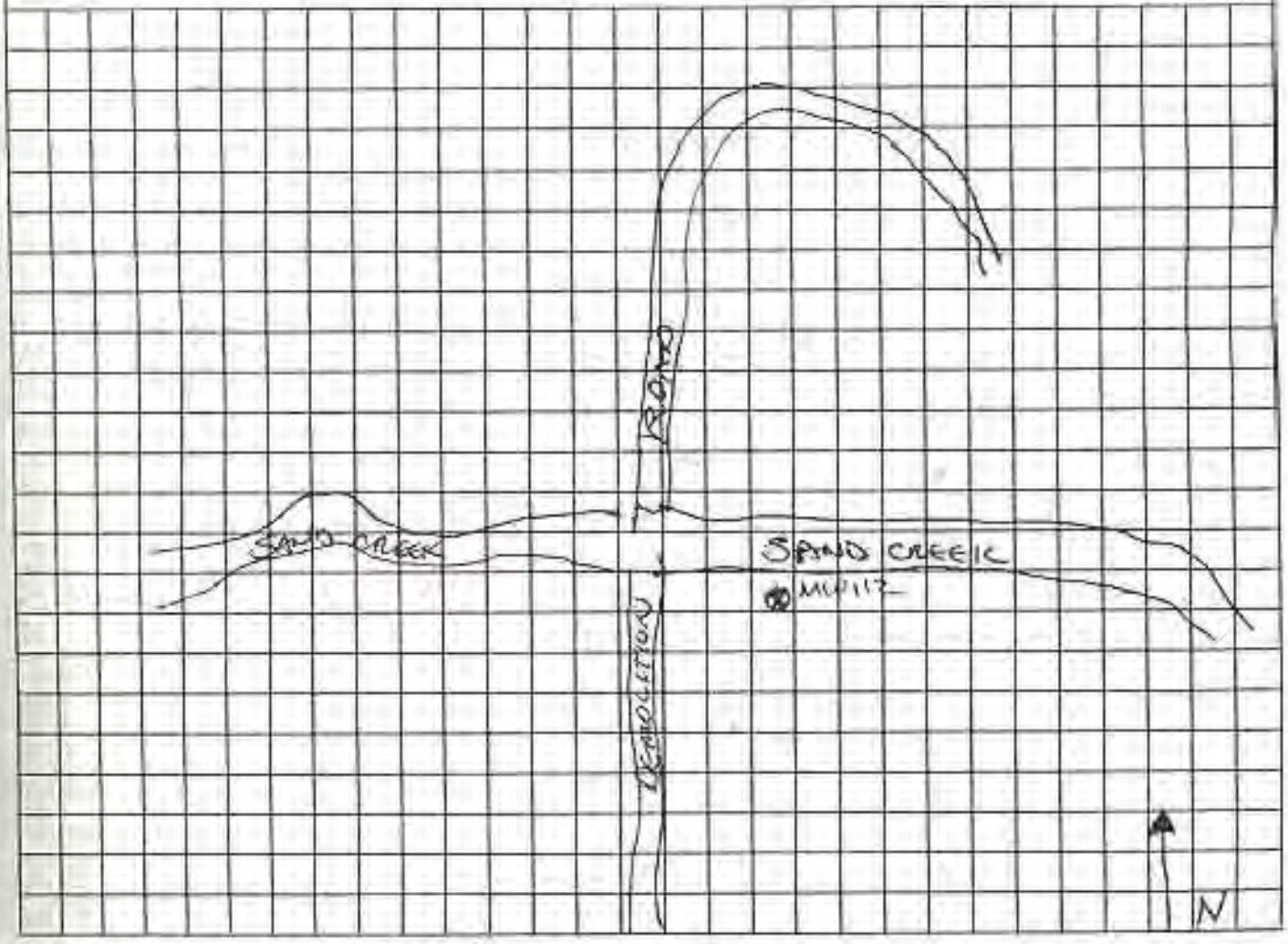
HTRW DRILLING LOG

1. COMPANY NAME: SPECPRO, INC	2. DRILL SUBCONTRACTOR: TOLTEST, INC	DISTRICT: Louisville; HOLE NUMBER: MW112; SHEET 1 of 3

3. PROJECT: DEMO AREA 2. PHASE II. RI	4. LOCATION: DEMO AREA 2
5. NAME OF DRILLER: Robert Miller, Toltest, Inc	6. MANUFACTURER'S DESIGNATION OF DRILL: CME 75
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: CME MODEL 75 with 4-1/4" Hollow Stem augers. 2' x 2" Split Spoons.	8. HOLE LOCATION: SEE MAP BELOW
	9. SURFACE ELEVATION: 1034.87
	10. DATE STARTED: 07-23-02; 11. DATE COMPLETED: 07-23-02
12. OVERBURDEN THICKNESS: 15'	15. DEPTH GROUNDWATER ENCOUNTERED: 6'
13. DEPTH DRILLED INTO ROCK: N/A	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 3.78 48 hours
14. TOTAL DEPTH OF HOLE: 15'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES			
20. SAMPLES FOR CHEMICAL ANALYSIS: 0-2, 2-4'	VOC:	METALS: ✓	OTHER (SPECIFY): Explosives	OTHER (SPECIFY):	OTHER (SPECIFY):	21. TOTAL CORE RECOVERY: %
22. DISPOSITION OF HOLE	BACKFILLED:	MONITORING WELL: ✓	OTHER (SPECIFY):	23. SIGNATURE OF INSPECTOR: [signature]		

LOCATION SKETCH/COMMENTS — SCALE: NOT TO SCALE



HTRW DRILLING LOG

PROJECT: DAZ PH2 RI KWAP | INSPECTOR: S McCause | HOLE NUMBER: 112 | SHEET 2 OF 3

ELEV (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	HEADSPACE SCREENING RESULTS	GEOTECH SAMPLE OR CORE BOX	ANALYTICAL SAMPLE NO. (F)	REMARKS (G)
		dark brown 10YR 3/3 Clay silt, 15% fine gravel, with a trace of roots, ML grades into a dark brown silty clay, moist, soft, non plastic, increasing coarse gravel with depth, mineral staining. CL			0-2' #839 -	BC 4,3,4,3 Recovery 1.3/2 Time: 1345
					~~2-4~~ ~~839~~	BC 4,3,3,3 Recovery - NONE Large cobble in hole. Augered to 4ft. No Sample. Time: 1350
		dark grayish brown 10yr 4/1, poorly sorted sand with 20% gravel fine to coarse. Trace of clay, wet, loose SP			4-6' #840	BC: 3,3,6,7 Recovery: .7/2 Time: 1400
		as above, saturated, with increasing gravel to 50% GC				BC 6,7,8,9 Recovery: .5/2 time: -1405
		as above saturated GC				BC 3,5,6,8 Recovery 1/2 Time 1410

193

HTRW DRILLING LOG

HOLE NUMBER 112

PROJECT: DA2 OH2 RJ RAAP | INSPECTOR SMcCann | SHEET 2 OF 3

ELEV (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	HEADSPACE SCREENING RESULTS	GEOTECH SAMPLE OR CORE BOX	ANALYTICAL SAMPLE NO. (E)	REMARKS (G)
		As above to 11' SP BC				BC 3,5,8,10 Recovery 1.2/2
	11	Very dark gray 10YR3/1 weathered Shale, MOIST ~~firm~~ med. stiff, finely laminated				time 1416
	12	As Above to 14'				BC 3,5,8,9 Recovery 1.2/2
	13					time 1423
	14					
	15	Bottom of Hole 15.0' SMcCann				
	16					
	17					
	18					
	19					

MONITORING WELL INSTALLATION LOG

PROJECT NAME: Ravenna Demolition Area 2 Phase II RI DELIVERY ORDER: 0003

MONITORING WELL ID: DA2 MW 112

INSTALLATION START: DATE 07-23-02 TIME 1513

INSTALLATION FINISH: DATE 07-23-02 TIME 1610

ANNULAR SPACE MATERIALS INVENTORY:

GRANULAR FILTER PACK: TYPE: Global #7 Sand QUANTITY: 3.5 - 50 Lb Bags

BENTONITE SEAL: TYPE: Volclay 3/8" pellets QUANTITY: 1 - 50 Lb Bucket

GROUT: TYPE: Cement/Bentonite QUANTITY: 49 Lbs

DESCRIPTION OF WELL SCREEN:

SLOT SIZE (inches): .010 SLOT CONFIGURATION: Machine Cut

OUTSIDE DIAMETER: 2.375" NOMINAL INSIDE DIAMETER: 2.0"

SCHEDULE/THICKNESS: Sch 40 COMPOSITION: PVC

MANUFACTURER: Johnson

TYPE OF MATERIAL BETWEEN BOTTOM OF BORING AND SCREEN: _____

DESCRIPTION OF WELL CASING:

OUTSIDE DIAMETER: 2.375" NOMINAL INSIDE DIAMETER: 2.0"

SCHEDULE/THICKNESS: Sch 40 COMPOSITION: PVC

MANUFACTURER: Johnson

JOINT DESIGN AND COMPOSITION: Threaded

CENTRALIZERS DESIGN AND COMPOSITION: N/A

DESCRIPTION OF PROTECTIVE CASING:

NOMINAL INSIDE DIAMETER: 5.0" COMPOSITION: STEEL

SPECIAL PROBLEMS ENCOUNTERED DURING WELL CONSTRUCTION AND THEIR RESOLUTION:

None

Was all well screen and casing material used for construction free of foreign matter (e.g. adhesive tape, labels, soil, grease, etc.)? YES [X] NO [ ]

Was all well screen and casing material used for construction free of unsecured couplings, ruptures, and other physical breakage and/or defects? YES [X] NO [ ]

Is deformation or bending of the installed well screen and casing minimized to the point of allowing the insertion and retrieval of a 1 0-inch bailer throughout the entire length of the complete well? YES [X] NO [ ]

QUANTITY OF APPROVED WATER USED FOR FILTER PACK EMPLACEMENT: _____

RECORDED BY: SM Chuck 7-23-02 QA CHECK BY: _____

(Signature and Date) (Signature and Date)

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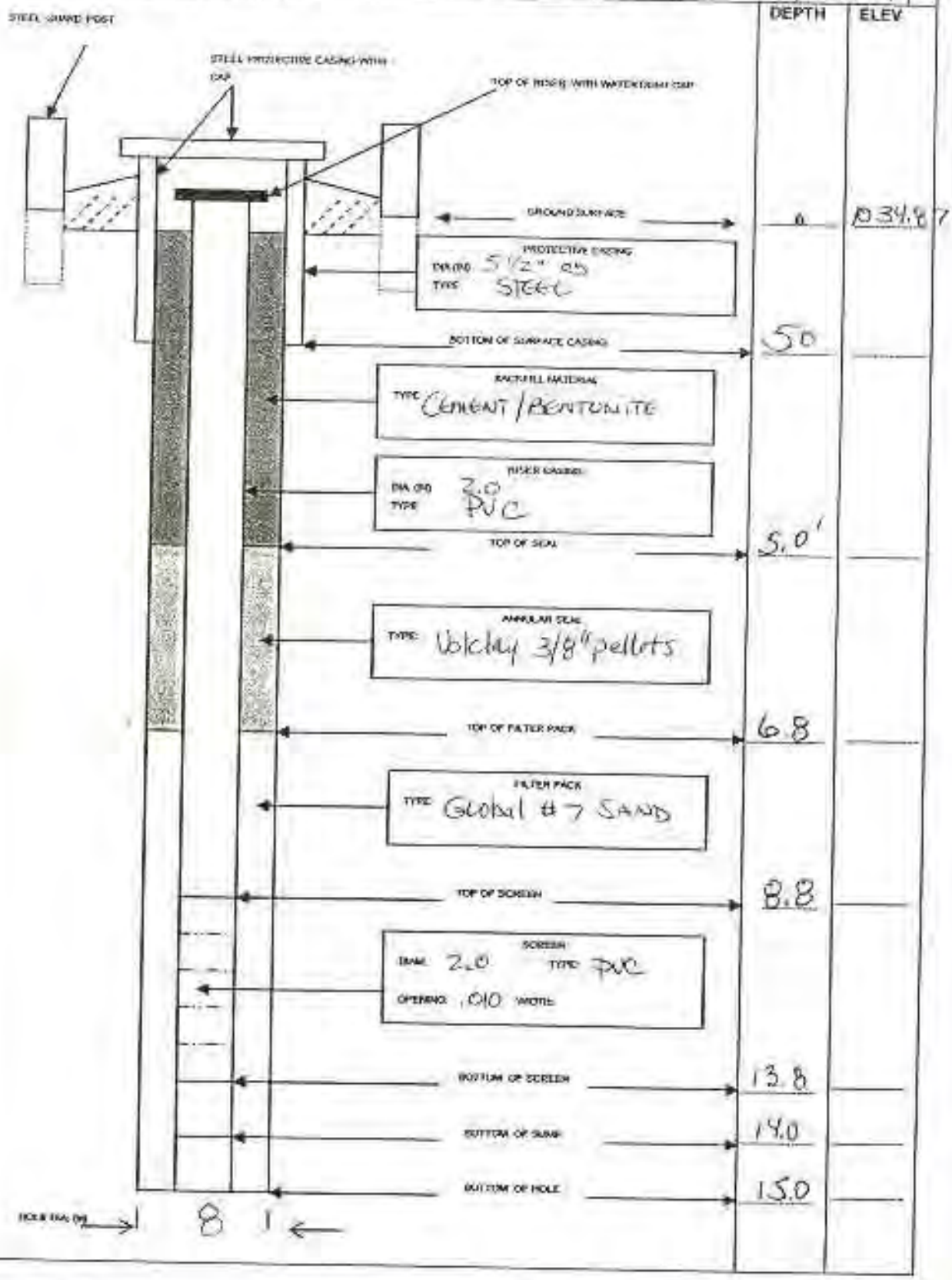
MONITORING WELL CONSTRUCTION DIAGRAM

PROJECT NAME: Ravenna Demolition Area 2 Phase II RI DELIVERY ORDER NO: 0003

WELL NUMBER: DA2MW01I2 BEGIN: 07-23-02 END: 07-23-02

COORDINATES: N: 560378.35 E: 2355818.98 REFERENCE POINT: TOC ELEVATION: 1037.44



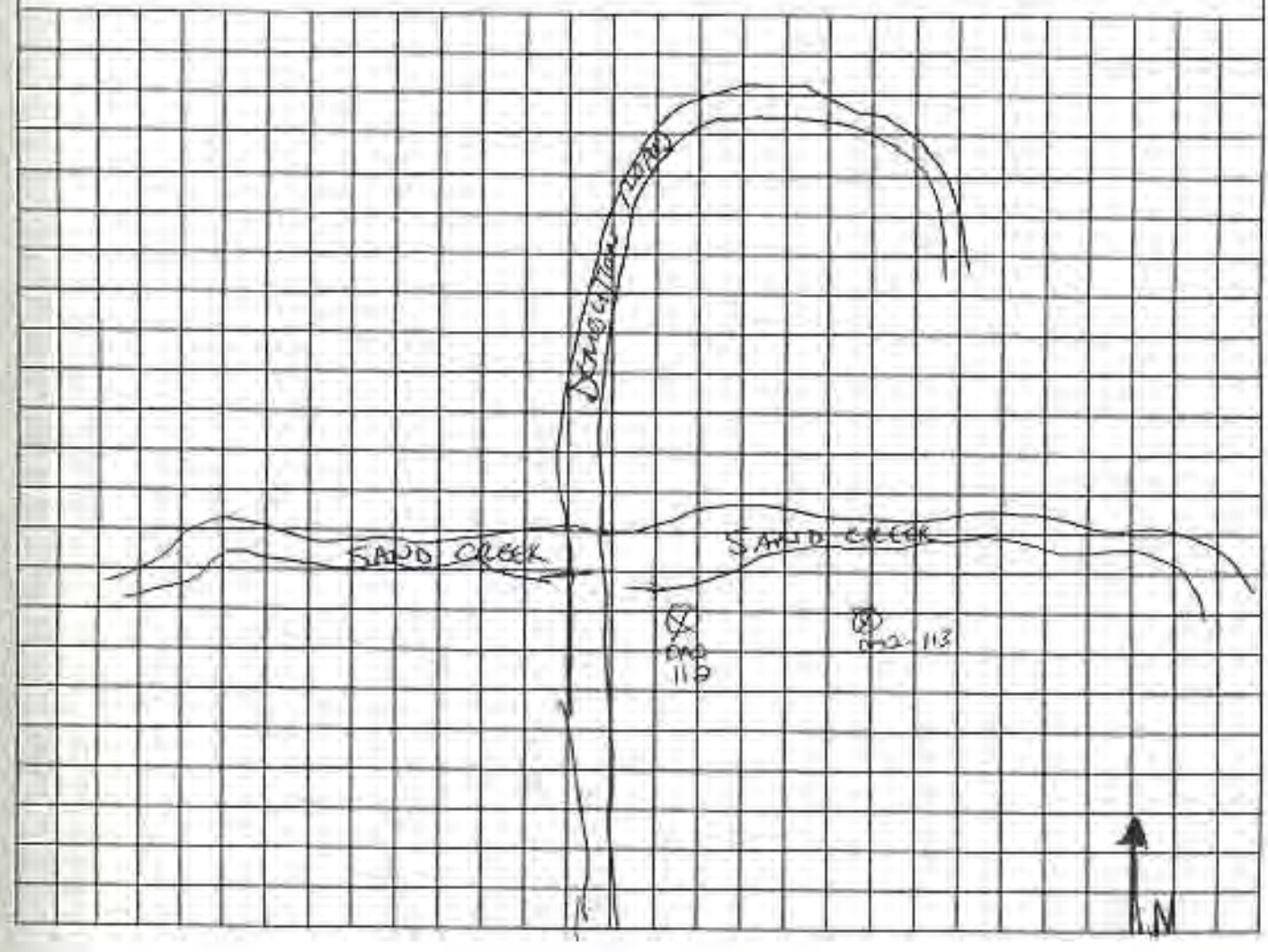
HTRW DRILLING LOG

1. COMPANY NAME: SPECPRO, INC.	2. DRILL SUBCONTRACTOR: TOLTEST, INC	HOLE NUMBER: 113
		SHEET 1 OF 3

3. PROJECT: DEMO AREA 2 PHASE II RI	4. LOCATION: DEMO AREA 2
5. NAME OF DRILLER: Bob Gollihue TOLTEST	6. MANUFACTURER'S DESIGNATION OF DRILL: CME 75
7. SIZE AND TYPE OF BIT (OR) AND SAMPLING EQUIPMENT: CME MODEL 75 with 4-1/4" hollow stem auger; 2" x 2' Split Spoons	8. HOLE LOCATION: SEE MAP BELOW
	9. SURFACE ELEVATION: 1034.51
	10. DATE STARTED: 07-23-02 / 11. DATE COMPLETED: 07-23-02
12. OVERBURDEN THICKNESS: 14.0'	15. DEPTH GROUNDWATER ENCOUNTERED: 6.9'
13. DEPTH DRILLED INTO ROCK: N/A	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 4.88 48 hours
14. TOTAL DEPTH OF HOLE: 14.0'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES			
20. SAMPLES FOR CHEMICAL ANALYSIS: G-21, 2-41	VOC	METALS: ✓	OTHER (SPECIFY): Explosives	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY: %
22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR: [signature]		

LOCATION SKETCH/COMMENTS — SCALE: NOT TO SCALE



2/2

HTRW DRILLING LOG

PROJECT: DAZ PHL RI RJAAF | INSPECTOR: [signature] | HOLE NUMBER: 113 | SHEET 2 OF 3

ELEV. (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	HEADSPACE SCREENING RESULTS	GEOTECH SAMPLE OR CORE BOX	ANALYTICAL SAMPLE NO. (F)	REMARKS (G)
		Dk yellowish brown 10YR 4/4 silty clay w trace fine gravel, roots, dry, soft CL			0-2' 0843	Blow count: 2,1,1,3
	1	Dark Brown 10YR 3/3 silt, well sorted, with a trace of organics, grading to a dark yellowish brown 10YR 4/5 ML				Recovery: 1.5/2
	2					time: 0834
		yellowish brown 10YR 5/4 clay silt, moist, trace of gray mottling, soft. ML			2-4' 0844	BC 3,3,5,5,
	3	yellowish brown 10YR 5/6 sand, trace of fine gravel, coarse to increasing gravel w/ depth, loose, wet SP				Recovery 1.9/2
	4	silty clay with coarse gravel dark yellowish brown 10YR 5/8, moist, plastic CL				time 0837
		dark yellowish brown 10YR 4/6 fine sand with gravel, trace of clay, poorly sorted ~30% gravel, moist. SP				BC: 5,6,8,10
	5					Recovery: 1.9/2
	6					time: 0846
		as above to 6.8, wet SP				BC: 11,18,14,19
	7	gray 10YR 6/1, sand & gravel, wet SP				Recovery: 1.8/2
		dark yellowish brown sand 10YR 4/6 50% gravel, wet SP				
	8	dark gray 10YR 6/1, 10% coarse sand with gravel, loose, wet GC				time: 0855
		Dark gray 10YR 4/1, sand and gravel poorly sorted, wet, loose, GC				BC: 7,8,10,11
	9					Recovery: 1.7/2
						time: 0903

HTRW DRILLING LOG

HOLE NUMBER 113

PROJECT: DAC AAC RI RWAP | INSPECTOR SMcCord | SHEET 3 OF 3

ELEV (A)	DEPTH (B)	DESCRIPTION OF MATERIALS (C)	HEADSPACE SCREENING RESULTS	GEOTECH SAMPLE OR CORE BOX	ANALYTICAL SAMPLE NO (E)	REMARKS (G)
	11	as above to 11.5 Ft. GC				BC: 9,11,9,9 Recovery: 2/2
	12	Very dark gray 10yr 3/1 Clay, moist, medium stiff, slightly plastic as above to 12.6 ft. CL				time: 0906
	13	Very dark gray 10yr 3/1 weathered shale, moist, stiff				BC: 5,7,12,14 Recovery: 1.5/2
	14	Bottom of Hole @ 14.0'	SMcCord			time: 0910
	15					
	16					
	17					
	18					
	19					
	20					

MONITORING WELL INSTALLATION LOG

PROJECT NAME: Ravenna Demolition Area 2 Phase II RI **DELIVERY ORDER:** 0003

MONITORING WELL ID: DA2MW-113

INSTALLATION START: DATE: 07-23-02 TIME: 1122

INSTALLATION FINISH: DATE: 07-23-02 TIME: 1148

ANNULAR SPACE MATERIALS INVENTORY:

GRANULAR FILTER PACK: TYPE: Global #7 SAND QUANTITY: 3-50 Lb Bags

BENTONITE SEAL: TYPE: Volclay 3/8" pellets QUANTITY: 1-50 Lb Bucket

GROUT: TYPE: CEMENT / BENTONITE QUANTITY: 49 Lbs

DESCRIPTION OF WELL SCREEN:

SLOT SIZE (inches): .010 SLOT CONFIGURATION: Machine Cut

OUTSIDE DIAMETER: 2.375" NOMINAL INSIDE DIAMETER: 2.0"

SCHEDULE/THICKNESS: Sch 40 COMPOSITION: PVC

MANUFACTURER: Johnson

TYPE OF MATERIAL BETWEEN BOTTOM OF BORING AND SCREEN: Global #7 SAND

DESCRIPTION OF WELL CASING:

OUTSIDE DIAMETER: 2.375" NOMINAL INSIDE DIAMETER: 2.0"

SCHEDULE/THICKNESS: Sch 40 COMPOSITION: PVC

MANUFACTURER: Johnson

JOINT DESIGN AND COMPOSITION: Threaded PVC

CENTRALIZERS DESIGN AND COMPOSITION: None used

DESCRIPTION OF PROTECTIVE CASING:

NOMINAL INSIDE DIAMETER: 5.0" COMPOSITION: Steel

SPECIAL PROBLEMS ENCOUNTERED DURING WELL CONSTRUCTION AND THEIR RESOLUTION:

Heaving sand at 6.5'. Pellets on top, from 6.5' to 3 feet bgs

Was all well screen and casing material used for construction free of foreign matter (e.g. adhesive tape, labels, soil, grease, etc.)? YES [X] NO [ ]

Was all well screen and casing material used for construction free of unsecured couplings, ruptures, and other physical breakage and/or defects? YES [X] NO [ ]

Is deformation or bending of the installed well screen and casing minimized to the point of allowing the insertion and retrieval of a 1.0-inch bailer throughout the entire length of the complete well? YES [X] NO [ ]

QUANTITY OF APPROVED WATER USED FOR FILTER PACK EMPLACEMENT: _____

RECORDED BY: SM Clark 7-23-02 QA CHECK BY: _____

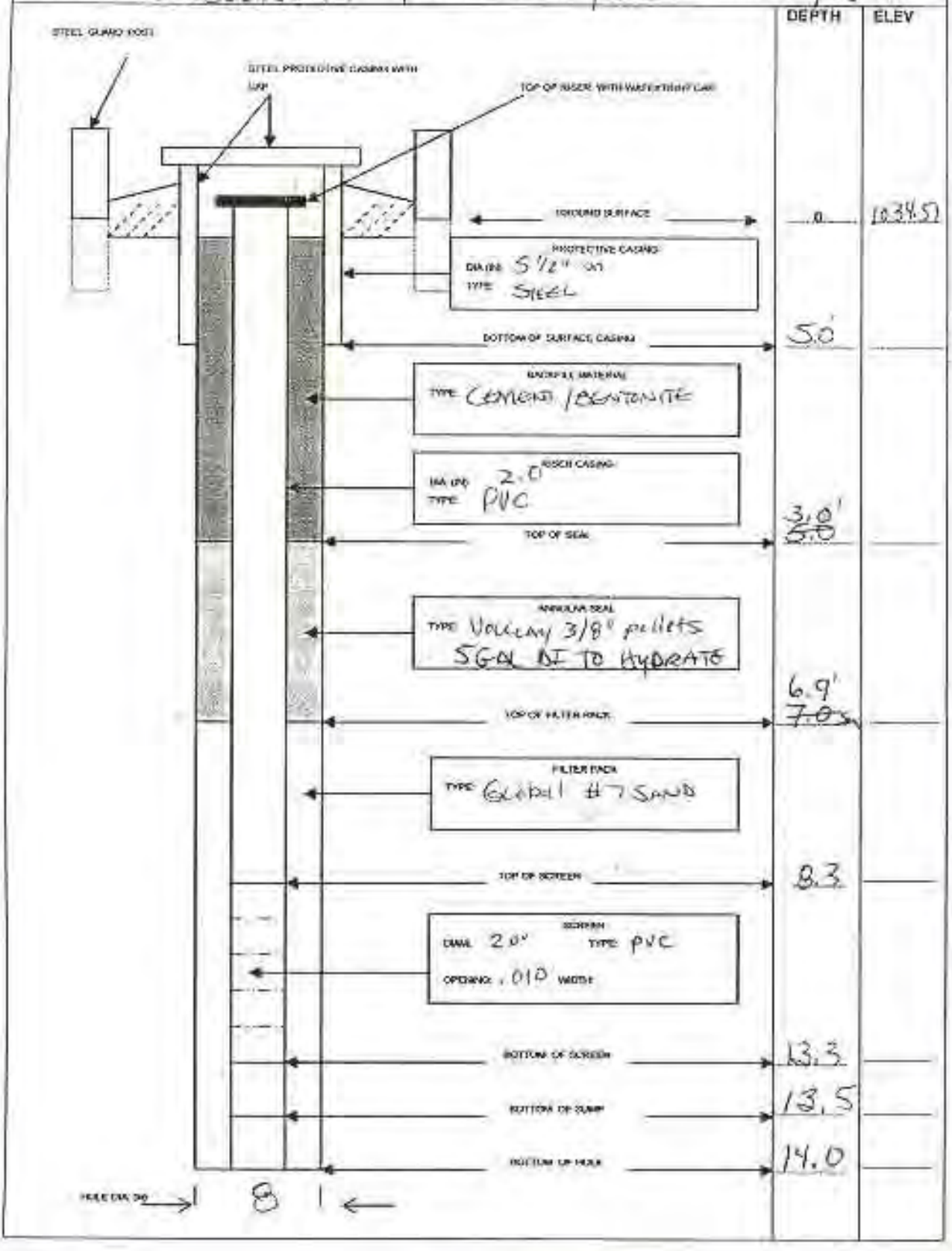
(Signature and Date) (Signature and Date)

219

MONITORING WELL CONSTRUCTION DIAGRAM

PROJECT NAME: Ravenna Demolition Area 2 Phase II RI **DELIVERY ORDER NO:** 0003

WELL NUMBER: DA2 MW 113	**BEGIN:** 07-23-02	**END:** 07-23-02
COORDINATES: N: 560394.81 E 2355153.13	**REFERENCE POINT:** TOC	**ELEVATION:** 1037.11



APPENDIX C

PERMITTING

U.S. ARMY CORPS OF ENGINEERS

APPLICATION FOR DEPARTMENT OF THE ARMY PERMIT

33 CFR 325. The proponent agency is CECW-CO-R.

Form Approved - OMB No. 0710-0003 Expires: 30-SEPTEMBER-2015

Public reporting for this collection of information is estimated to average 11 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of the collection of information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters, Executive Services and Communications Directorate, Information Management Division and to the Office of Management and Budget, Paperwork Reduction Project (0710-0003). Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. Please DO NOT RETURN your form to either of those addresses. Completed applications must be submitted to the District Engineer having jurisdiction over the location of the proposed activity.

PRIVACY ACT STATEMENT

Authorities: Rivers and Harbors Act, Section 10, 33 USC 403; Clean Water Act, Section 404, 33 USC 1344; Marine Protection, Research, and Sanctuaries Act, Section 103, 33 USC 1413; Regulatory Programs of the Corps of Engineers; Final Rule 33 CFR 320-332. Principal Purpose: Information provided on this form will be used in evaluating the application for a permit. Routine Uses: This information may be shared with the Department of Justice and other federal, state, and local government agencies, and the public and may be made available as part of a public notice as required by Federal law. Submission of requested information is voluntary, however, if information is not provided the permit application cannot be evaluated nor can a permit be issued. One set of original drawings or good reproducible copies which show the location and character of the proposed activity must be attached to this application (see sample drawings and/or instructions) and be submitted to the District Engineer having jurisdiction over the location of the proposed activity. An application that is not completed in full will be returned.

(ITEMS 1 THRU 4 TO BE FILLED BY THE CORPS)

1. APPLICATION NO.	2. FIELD OFFICE CODE	3. DATE RECEIVED	4. DATE APPLICATION COMPLETE

(ITEMS BELOW TO BE FILLED BY APPLICANT)

5. APPLICANT'S NAME	8. AUTHORIZED AGENT'S NAME AND TITLE (agent is not required)
First - Timothy Middle - Michael Last - Morgan	First - Scott Middle - Last - Nesbit
Company - Adjutant General's Department	Company - Tetra Tech, Inc.
E-mail Address - timothy.m.morgan.nfg@mail.mil	E-mail Address - Scott.Nesbit@tetratech.com
6. APPLICANT'S ADDRESS:	**9. AGENT'S ADDRESS:**
Address- 1438 State Route 534 SW	Address- 661 Andersen Drive, Foster Plaza 7
City - Newton Falls State - OH Zip - 44444 Country - US	City - Pittsburgh State - PA Zip - 15220 Country - USA
7. APPLICANT'S PHONE NOs. w/AREA CODE	**10. AGENTS PHONE NOs. w/AREA CODE**
a. Residence b. Business c. Fax	a. Residence b. Business c. Fax
(614) 336-6568	(412) 921-7134

STATEMENT OF AUTHORIZATION

11. I hereby authorize, Tetra Tech to act in my behalf as my agent in the processing of this application and to furnish, upon request, supplemental information in support of this permit application.

SIGNATURE OF APPLICANT — DATE: 2016-06-09

NAME, LOCATION, AND DESCRIPTION OF PROJECT OR ACTIVITY

12. PROJECT NAME OR TITLE (see instructions)

Sand Creek Culvert Replacement at the Open Demolition Area #2 Crossing

13. NAME OF WATERBODY, IF KNOWN (if applicable)	14. PROJECT STREET ADDRESS (if applicable)
Sand Creek	Address ODA2 Access Road (CRJMTC)
15. LOCATION OF PROJECT Latitude: °N 41°11'46.6" Longitude: °W 81°05'44.9"	City - Ravenna (Paris Twp) State- OH Zip- 44266

16. OTHER LOCATION DESCRIPTIONS, IF KNOWN (see instructions)

State Tax Parcel ID Municipality

Section - Township - Paris Range -

17. DIRECTIONS TO THE SITE

From the City of Ravenna, drive onto State Route 59 headed east. State Route 59 will merge with State Route 5 (Ravenna Warren Road) continuing to head east. After being on State Route 5 for approximately 8 miles, turn left at the entrance to the OHARNG Camp Ravenna Joint Military Training Center. Head straight onto George Road. Turn left onto Newton Falls Road and turn right at the second turnoff from Newton Falls Road. The Sand Creek crossing is approximately 2,000 feet down this road.

18. Nature of Activity (Description of project, include all features)

The culvert replacement action involves the excavation and removal of two, adjacent, 5-foot diameter culverts running underneath the Open Demolition Area 2 access road. The replacement culvert will meet criteria specified by the OHARNG including a concrete, three-sided, arched culvert design; wing walls at the entry and exit; a concrete pad on the road surface capable of supporting a vehicle load rating of HS20; concrete pad minimum width of 14 feet with 2-foot shoulders; and the ability to pass the peak flow rate for the 100-year flood event without overtopping the road. Prior to removal of the existing culverts, a pump, bypass lines, and sandbags (to block 1/2 at a time) will be installed to maintain continuous flow of the creek and enable placement of the footers. Work in Sand Creek will maintain water flow by including a temporary sump with a pump to route water over or around the construction area and by only blocking 1/2 of the stream at a time. Sandbags will also be used to prevent water from entering active construction zones while the footers are being placed. (Continued in Block 20)

19. Project Purpose (Describe the reason or purpose of the project, see instructions)

The ultimate purpose of the project is to preserve the integrity of the Open Demolition Area 2 access road and remove existing munitions from the culvert area. The existing culverts are insufficient in supporting peak 100-year flow conditions resulting in overtopping of the culverts and erosion of the road. This project intends to install an open-bottom, concrete, arched culvert (with wing walls) capable of supporting peak 100-year flow conditions as well as a vehicle load rating of HS20. Existing munitions items within the culvert backfill will be removed and properly disposed as part of the project.

USE BLOCKS 20-23 IF DREDGED AND/OR FILL MATERIAL IS TO BE DISCHARGED

20. Reason(s) for Discharge

There will be no discharges to wetlands for the duration of this project. After the culvert is replaced, ODOT Type D rip rap (4 inch to 12 inch diameter) will be placed in the stream to armor the banks. Sandbags will be placed temporarily in the stream bed during construction activities to divert flow (1/2 of the stream at a time).

(Continued from Block 18) Adjacent wetlands shall be staked and clearly marked to avoid disturbance.
The stream bed will be restored to original elevations. The stream bed beneath the culvert (approximately 400 square feet) will be armored with Ohio Department of Transportation Type D riprap (4-inch to 12-inch rock diameter). Following completion, affected areas will be reseeded using the Camp Ravenna approved seed mix.

21. Type(s) of Material Being Discharged and the Amount of Each Type in Cubic Yards:

Type Amount in Cubic Yards	Type Amount in Cubic Yards	Type Amount in Cubic Yards
20 cubic yards rip rap	25 cubic yards sand bags (temporary)	

22. Surface Area in Acres of Wetlands or Other Waters Filled (see instructions)

Acres There will be no filling of wetlands.
or
Linear Feet

23. Description of Avoidance, Minimization, and Compensation (see instructions)

Silt fencing will be installed prior to commencing work along the stream bank and spoil piles. Adjacent wetlands shall be clearly marked so they can be avoided. NWI wetlands shown on maps are not an accurate representation of wetland locations. Project will be within the footprint of the original culvert and wetlands can be avoided. Impact to stream flow will be minimized by maintaining flow throughout the project by only blocking off 1/2 of the stream at a time.

24. Is Any Portion of the Work Already Complete? ☐ Yes ☒ No IF YES, DESCRIBE THE COMPLETED WORK

25. Addresses of Adjoining Property Owners, Lessees, Etc., Whose Property Adjoins the Waterbody (if more than can be entered here, please attach a supplemental list)

a. Address-

City - State - Zip -

b. Address-

City - State - Zip -

c. Address-

City - State - Zip -

d. Address-

City - State - Zip -

e. Address-

City - State - Zip -

26. List of Other Certificates or Approvals/Denials received from other Federal, State, or Local Agencies for Work Described in This Application.

AGENCY	TYPE APPROVAL*	IDENTIFICATION NUMBER	DATE APPLIED	DATE APPROVED	DATE DENIED

* Would include but is not restricted to zoning, building, and flood plain permits

27. Application is hereby made for permit or permits to authorize the work described in this application. I certify that this information in this application is complete and accurate. I further certify that I possess the authority to undertake the work described herein or am acting as the duly authorized agent of the applicant.

9 June 2016
SIGNATURE OF APPLICANT DATE

scott.nesbit@tetratech.com
Digitally signed by: scott.nesbit@tetratech.com
DN: CN = scott.nesbit@tetratech.com
Date: 2016.06.09 14:08:19 -05'00'
SIGNATURE OF AGENT

9 June 2016
DATE

The Application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in block 11 has been filled out and signed.

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency of the United States knowingly and willfully falsifies, conceals, or covers up any trick, scheme, or disguises a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statements or entry, shall be fined not more than $10,000 or imprisoned not more than five years or both.

20 June 2016

2200 Williams S. Moorehead Federal Building
1000 Liberty Avenue
Pittsburgh, PA 15222-2186
Attn: Mike Fodsey

Re: Sand Creek Culvert Replacement Project at the Open Demolition Area #2 (RVAAP-004-R-01) Stream Crossing, Ravenna Army Ammunition Plant (RVAAP) Restoration Program, Camp Ravenna Joint Military Training Center (Camp Ravenna), Portage and Trumbull Counties, Ohio – Supplemental Information for Nationwide Permit Pre-Construction Notification

Dear Mr. Fodsey:

This Nationwide Permit Pre-Construction Notification application and supplemental information is provided to document that the proposed project meets the conditions of the Nationwide Permit (NWP) #3. Camp Ravenna is replacing two existing pipe culverts with a single arched culvert and restoring natural flow of Sand Creek at the Open Demolition Area (ODA) #2 stream crossing as part of the RVAAP restoration program. The project requires the removal of the two existing culverts, installation of the replacement culvert, and restoration of the project area. This letter provides supplemental information to ENG Form 4345 Application for Department of the Army Permit and addresses general conditions not discussed within the application.

General Condition 1 – Navigation
The proposed activities will occur within Sand Creek within Camp Ravenna. Camp Ravenna has restricted access and Sand Creek has minimal navigational opportunity. As such, there will be no impact to the navigation of existing waterways.

General Condition 2 – Aquatic Life Movements
The permanent crossing will be suitably culverted to sustain movement of aquatic species.

General Condition 6 – Suitable Material
Soil removed from the existing culvert area will be used as backfill. Reused material will be verified clean prior to reuse by means of visual inspection, magnetometer survey, and sampling.

General Condition 8 – Adverse Effects from Impoundments
Prior to removal of either culvert, a pump, bypass lines, and sandbags will be installed to maintain continuous flow of the creek and enable placement of the footers (1/2 of the stream channel will be blocked with sandbags to maintain flow). The existing culverts will then be removed and the new three-sided culvert will be installed and water will be able to flow freely along the natural stream bed. Removal of the existing culverts and installation of the new culvert will not adversely affect or impound the stream.

General Condition 9 – Management of Water Flows

The proposed activity in Sand Creek will maintain water flow by including a temporary sump with a pump to route water over or around the construction area. Additionally, sandbags (covering half of the stream channel at a time) will also be installed to divert flow around the portions of the stream that are part of active construction. The pre-construction course, condition, and location of Sand Creek will be maintained. The weather will be monitored and work will not take place when rain and potential storms are in the forecast.

General Condition 10 – Fills Within 100-Year Floodplains

The project at Sand Creek will be occurring in FEMA floodplain area 39133C0180D. Per the 100-Year floodplain map dated August 18, 2009, the activities will take place within a 100-year floodplain. The completed project will not create new obstructions within the floodplain and will not impact flow within the floodplain. See attached floodplain map in Attachment A.

General Condition 11 – Equipment

Preparing the area for excavation, vegetation removal will occur with chain saws, brush hog, wood chipper and excavator. An excavator will be used to remove the rock, soil, and the existing pipe culverts from the work area. Front-end loader/skid steer will place the materials adjacent to the work area or loaded on to trucks for removal. Pumps and sandbags will be used as needed to keep the work area free from water. Upon installation of the culvert foundation, approximately 400 square feet of riprap will be placed in the stream bed under where the arched culvert will be installed. An excavator or crane will be used to set the precast concrete arch culvert in the prepared area of Sand Creek. Following culvert installation, a loader, dozer, skid steer, compactor, hydro seeder are some of the equipment types to be used for backfill and restoration of the area. For any concrete work, concrete truck and concrete finishing equipment will be used. Any re-fueling of the equipment will be done away from the creek. Tarps or similar materials will be placed underneath the equipment and a "catch can" will be used to prevent any fuel or lubricants from reaching the ground. A spill kit will be located onsite in the event of a spill. Camp Ravenna Range Control will be immediately notified if a spill occurs. Please see attached site staging diagram in Attachment C.

General Condition 12 – Soil Erosion and Sediment Control

Soil erosion and sediment controls will be used and maintained in effective operating condition during construction and all exposed soils as well as any work below the ordinary high water mark will be permanently stabilized. Best management practices, including a silt fence downstream of the construction area and rock check dams will be used to control sediment during construction. In addition, work will be scheduled/staged to coincide with periods of low-flow or no-flow.

General Condition 13 – Removal of Temporary Fills

Sandbags used for stream diversion will be removed from the stream channel once culvert replacement activities are complete. The stream bed beneath the culvert will be anchored with approximately 400 square feet of rip rap. The stream bed will be returned to its natural state and disturbed areas will be re-vegetated.

General Condition 17 – Tribal Rights

The proposed activities will not infringe on tribal rights and will not impair tribal rights including reserved water rights and treaty fishing and hunting rights.

In 2006, the OHARNG consulted with 55 federally recognized Tribes regarding the development of an Environmental Assessment for a proposed Engineer School at Camp Ravenna and the associated archaeological survey. The archaeological survey completed in association with the EA encompasses several areas near the project areas. Tribes interested in the results of the archaeological survey did not express an interest in the sites identified during the survey. However, several tribes did request being contacted in the event of an inadvertent discovery during any ground disturbing activities. In addition, the OHARNG regularly consults with 13 federally recognized Tribes regarding archaeological surveys and projects at Camp Ravenna. Draft archaeological surveys completed at Camp Ravenna are sent to these 13 tribes for comment and review. No concerns have been expressed regarding the surveys. The OHARNG has established a good working relationship with tribes that have ancestral ties to OHARNG owned properties. Consultation with tribes has shown that the greatest interest is the inadvertent discovery of human remains or NAGPRA related items and results of archaeological surveys. In the event of an inadvertent discovery of human remains or funerary items, the OHARNG will follow *Procedures for Inadvertent Discovery of Cultural Materials at Camp Ravenna Joint Military Training Center*. These procedures were taken from Standard Operating Procedure #6 of the OHARNG Integrated Cultural Resources Management Plan and modified specifically for Camp Ravenna.

General Condition 18 – Endangered Species

Camp Ravenna has implemented National Guard procedures for compliance with the Endangered Species Act (ESA) for the project. The US Fish and Wildlife Service (USFWS) is a cooperating agency along with the Ohio Department of Natural resources (ODNR) in the Camp Ravenna Integrated Natural Resources Plan. The agencies have a long standing positive working relationship. Below is a list of the potential and known species on Camp Ravenna and a brief description of ESA compliance.

Federally listed species known to occur in Portage County, Ohio, provided by the US Fish and Wildlife Service (USFWS) Ecological Services Field Offices in Columbus, Ohio, include the endangered Indiana bat (*Myotis sodalis*), the endangered Mitchell's satyr butterfly *(Neonympha mitchellii mitchellii*), the threatened northern monkshood *(Aconitum noveboracense*), the threatened northern long-eared bat (*Myotis septentrionalis*), and the candidate eastern massasauga (*Sistruruscatenatus catenatus*). The bald eagle (*Haliaeetus leucocephalus*), is also listed as a species of concern.

Intensive biological surveys have been conducted at Camp Ravenna that include all the above listed species. The surveys have demonstrated the absence of the Indiana bat, the northern monkshood, Mitchells' satyr butterfly, and the eastern massasauga. There is habitat for the Indiana bat and some limited potential habitat for the eastern massasauga. Even so, these species are not present at Camp Ravenna. Surveys have confirmed the presence of the northern long-eared bat (NLEB).

The OHARNG conducted a Biological Evaluation (BE) of the NLEB at Camp Ravenna in 2015. The BE identified all activities at Camp Ravenna and evaluated their potential impacts on the NLEB and identified management activities and limitations that will be implemented to protect the bat. The USFWS accepted the BE as informal consultation on 12 May 2015. As long as the OHARNG operates within the limitations identified in the BE, project-specific coordination with the USFWS concerning the NLEB is not required. The limitation to fell trees 3 inches in diameter and greater after 30 September and before 1 April is applicable to this project.

Due to lack of species presence, lack of designated critical habitat at Camp Ravenna and because the tree cutting period restriction identified in our BE will be implemented, there will be no effect on any federally listed species by the proposed action. Please note that trees within the project area were felled during the week of 28 March 2016, prior to the 1 April deadline.

ESA compliance has been documented by the Camp Ravenna Environmental Office in a project-specific Memorandum for Record (MFR), provided in Attachment B.

General Condition 19 – Migratory Bird and Bald and Golden Eagle Permits

The amount of ground and vegetation to be disturbed is very minimal and will be restored to pre-construction conditions. The project will not impact migratory birds. There is a Bald Eagle nest at Camp Ravenna approximately one mile southwest of the proposed activity. The proposed activity will not impact the nest.

General Condition 20 – Historic Properties

The immediate project area has not been surveyed for cultural resources due to the fact that it is located in an area of concern are part of the RVAAP restoration program. Walk overs and digging in this area is a potential hazard, therefore surveys have not been completed. However, several surveys have been completed around the project area over the last several years. Six archaeological surveys were completed between 2004 and 2015 in the area surrounding the project area. There are twenty-three archaeological sites identified during these 6 surveys in the area surrounding the project area. Four of these sites meet the eligibility criteria for listing in the National Register of Historic Places (NRHP) and require further investigation. The remaining nineteen sites do not meet the criteria and no further investigations are necessary. The Ohio Historic Preservation Office concurred with the OHARNG determinations regarding the eligibility of these sites. The four eligible sites are between 1,500 to 3,000 feet from the project area. There is no potential for the proposed project to disturb any of these sites. This information has been documented in a project-specific Memorandum for Record, provided in Attachment B.

Based on Camp Ravenna's review of cultural resources as documented in the MFR, project activities will not impact any known cultural resources.

General Condition 21 – Discovery of Previously Unknown Remains and Artifacts

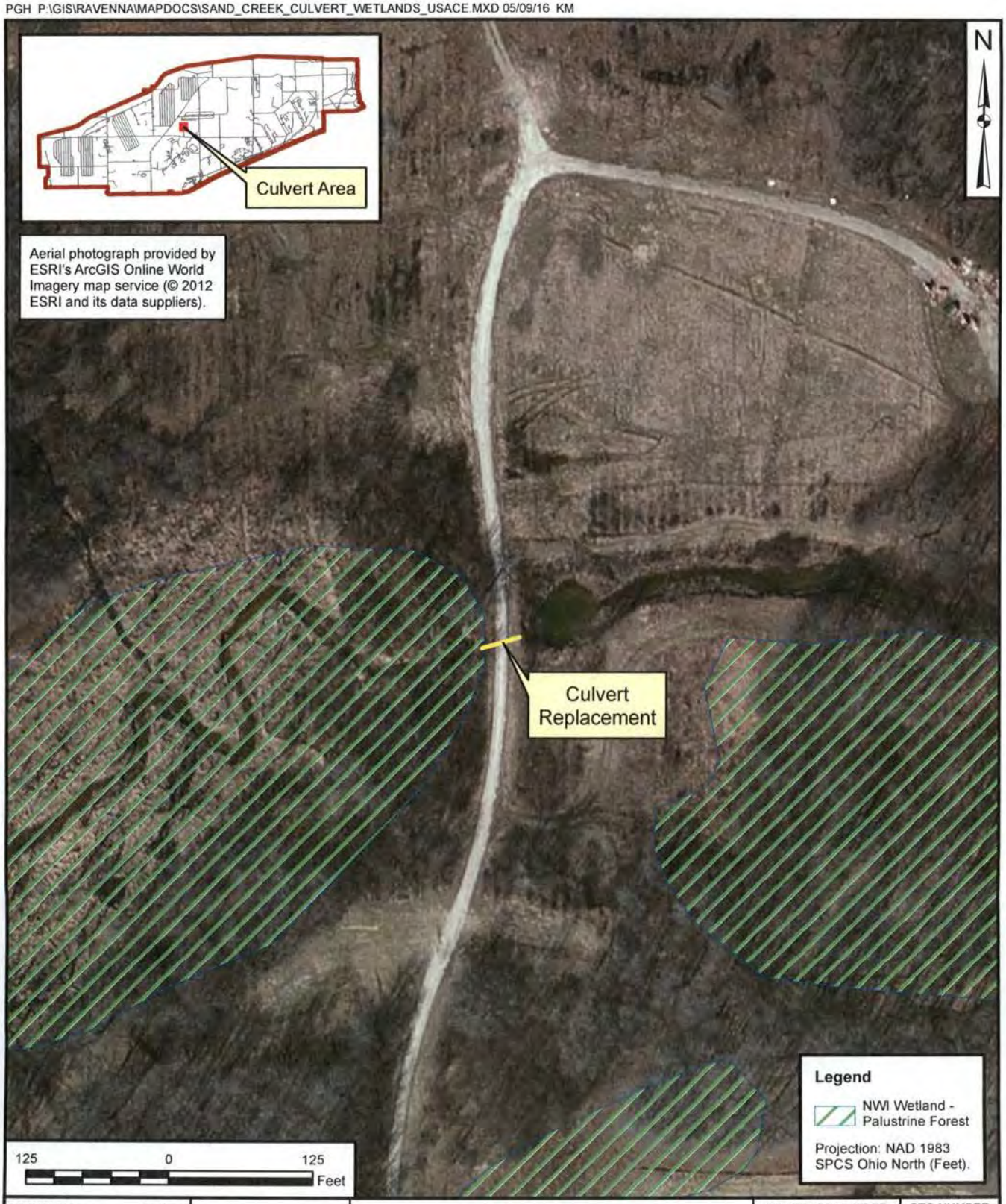
In the event of an inadvertent discovery of human remains or funerary items, the OHARNG and the contractor will follow *Procedures for Inadvertent Discovery of Cultural Materials at Camp Ravenna Joint Military Training Center*. These procedures were taken from Standard Operating Procedure #6 of the OHARNG Integrated Cultural Resources Management Plan and modified specifically for Camp Ravenna.

Figures

PGH P:\GIS\RAVENNA\MAPDOCS\SAND_CREEK_CULVERT_JAN2016.MXD 01/07/16 JEE

DRAWN BY	DATE		SAND CREEK CULVERT WORK AREA CAMP RAVENNA RAVENNA, OHIO	CONTRACT NUMBER	CTO NUMBER
J. ENGLISH	01/06/16				
CHECKED BY	DATE			APPROVED BY	DATE
T. RILEY	01/07/16				
REVISED BY	DATE			APPROVED BY	DATE
				FIGURE NO. 1	REV 0
SCALE AS NOTED					

PGH P:\GIS\RAVENNA\MAPDOCS\SAND_CREEK_CULVERT_WETLANDS_USACE.MXD 05/09/16 KM



DRAWN BY	DATE		SAND CREEK CULVERT REPLACEMENT CAMP RAVENNA RAVENNA, OHIO	CONTRACT NUMBER	CTO NUMBER
J. ENGLISH	04/25/16				
CHECKED BY	DATE			APPROVED BY	DATE
T. RILEY	05/09/16				
REVISED BY	DATE			APPROVED BY	DATE
SCALE AS NOTED				FIGURE NO. 2-2	REV 0

BASIS OF BEARINGS

THE BASIS FOR BEARINGS FOR THIS SURVEY IS GRID NORTH OF THE OHIO STATE PLANE COORDINATE SYSTEM, NORTH ZONE, NAD88 (2011).

BENCH MARK - BM

TOP OF IDENTIFICATION DISC FOR MONITORING WELL "DA2MW-107".

ELEVATION = 1039.96 (NAVD88)

LEGEND

- EXISTING MONITORING WELL
- TREE
- EX. CONTOURS
- EX. SPOT ELEVATION

I HEREBY DECLARE THAT THIS DRAWING IS AN ACCURATE DEPICTION OF ACTUAL FIELD CONDITIONS AS OF THE DATE OF THIS SURVEY.

JAMES P. YURKSCHATT REG. NO. 7809 — DATE 03/08/2016

JAMES P. YURKSCHATT
CAMPBELL & ASSOCIATES, INC.

STATE OF OHIO
JAMES P. YURKSCHATT
7809
REGISTERED SURVEYOR

Topographic Survey

Camp Ravenna
Sand Creek Culvert

CAMPBELL & ASSOCIATES, INC.
Land Surveying
(330) 945-4117
www.campbellsurvey.com
3485 Fortuna Drive Suite 100 Akron, Ohio 44312

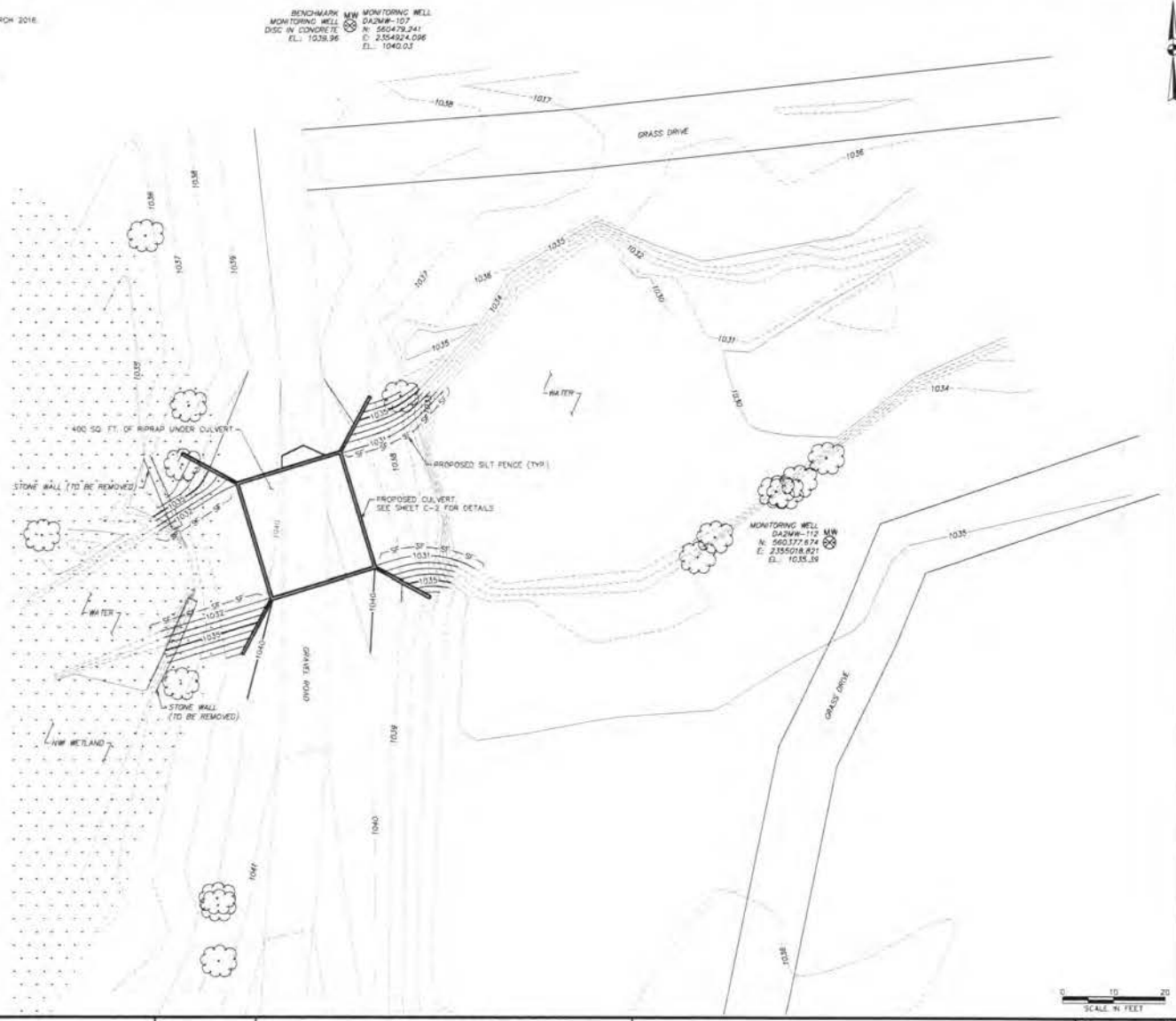
Date:	March 2016
By:	DLG
Scale:	1"= 20'
Job:	20160041
Sheet	1 of 1

NOTES:

1. TOPOGRAPHIC MAPPING FROM CAMPBELL & ASSOCIATES, INC. DRAWING TITLED "TOPOGRAPHIC SURVEY", DATED MARCH 2016.
2. HORIZONTAL DATUM: OHIO STATE PLANE COORDINATE SYSTEM, NAD 83, NORTH ZONE
3. VERTICAL DATUM: NAVD 88
4. BENCHMARK: TOP OF IDENTIFICATION DISC FOR MONITORING WELL "DA2MW-107". ELEVATION: 1039.96 (NAVD88).

LEGEND:

- 1035 — EXISTING 5' CONTOUR
- EXISTING 1' CONTOUR
- EXISTING TREE
- EXISTING CULVERT
- MW EXISTING MONITORING WELL
- EXISTING STONE WALL
- EXISTING NW WETLAND
- PROPOSED CULVERT
- 1035 — PROPOSED 5' CONTOUR
- PROPOSED 1' CONTOUR
- SF — SF — PROPOSED SILT FENCE
- PROPOSED RIPRAP



TETRA TECH

www.tetratech.com

661 ANDERSEN DRIVE – FOSTER PLAZA 7
PITTSBURGH, PA 15220
T: (412) 921-7090 | F: (412) 921-4040

REVISIONS			
NO.	BY	DATE	REMARKS

CAMP RAVENNA
RAVENNA, OHIO

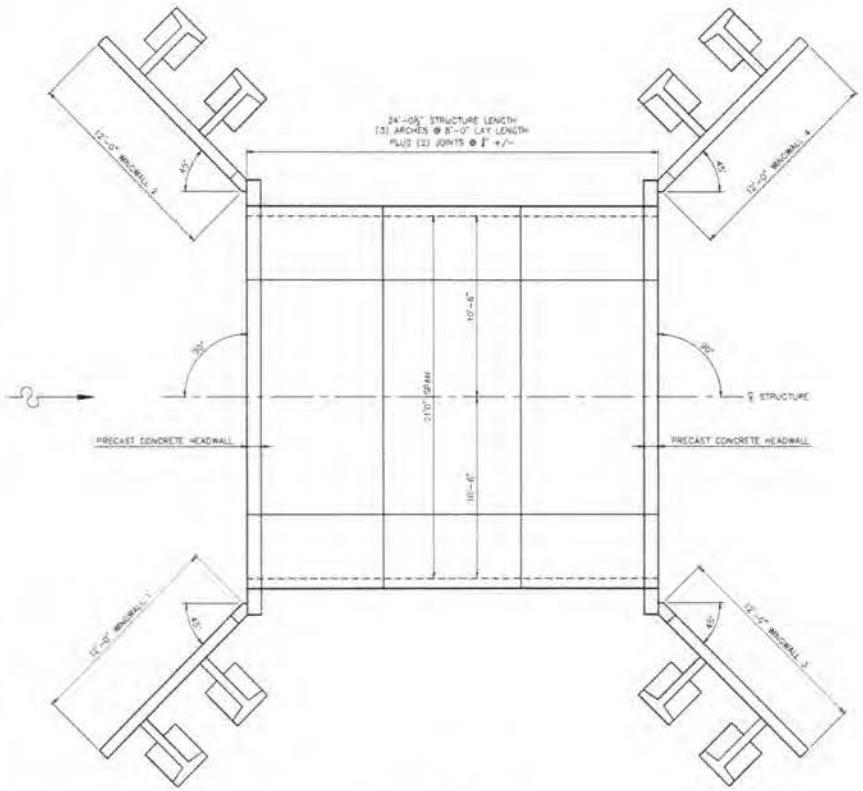
SAND CREEK CULVERT

PROPOSED SITE PLAN

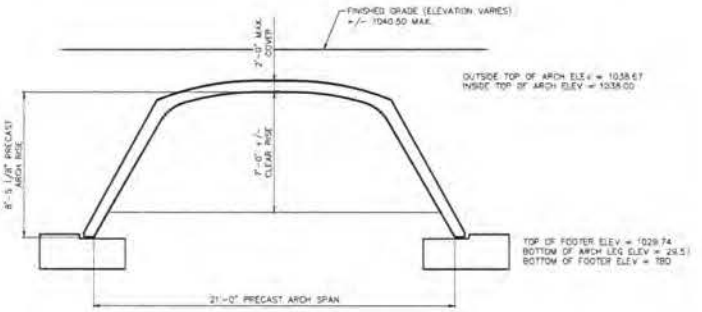
DATE:	4/15/16
PROJECT NO.:	112/05958
DESIGNED BY:	CH
DRAWN BY:	BH
CHECKED BY:	SN

C-1

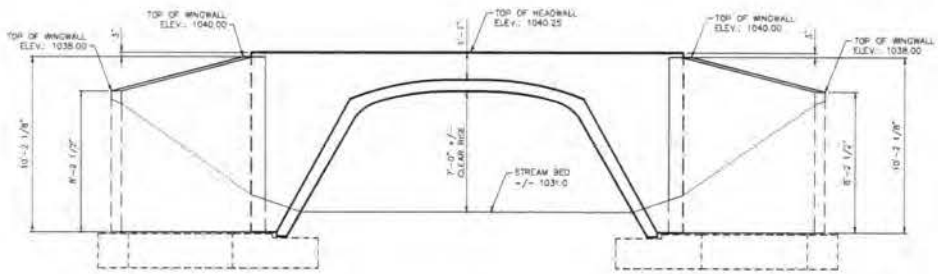
SHEET 1 OF –



BRIDGE PLAN
NOT TO SCALE



TYPICAL BRIDGE SECTION
NOT TO SCALE



TYPICAL END ELEVATION
NOT TO SCALE

TETRA TECH
www.tetratech.com
661 ANDERSEN DRIVE – FOSTER PLAZA 7
PITTSBURGH, PA 15220
T: (412) 921-7090 | F: (412) 921-4040

REVISIONS			
NO.	BY	DATE	REMARKS

CAMP RAVENNA
RAVENNA, OHIO

SAND CREEK CULVERT

CULVERT DETAILS

DATE:	4/15/16
PROJECT NO.:	113C05958
DESIGNED BY:	GH
DRAWN BY:	BH
CHECKED BY:	SN
COMPANY TETRA TECH NO.:	C-2
SHEET	2 OF –

Attachment A

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 North zone 4976 (FIPSZONE 3401). 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 Portage County GIS Department at a scale of 1:200 from photography dated 2005 and from USGS digital orthophoto quadrangles at a scale of 1:12,000 dated 1998 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.

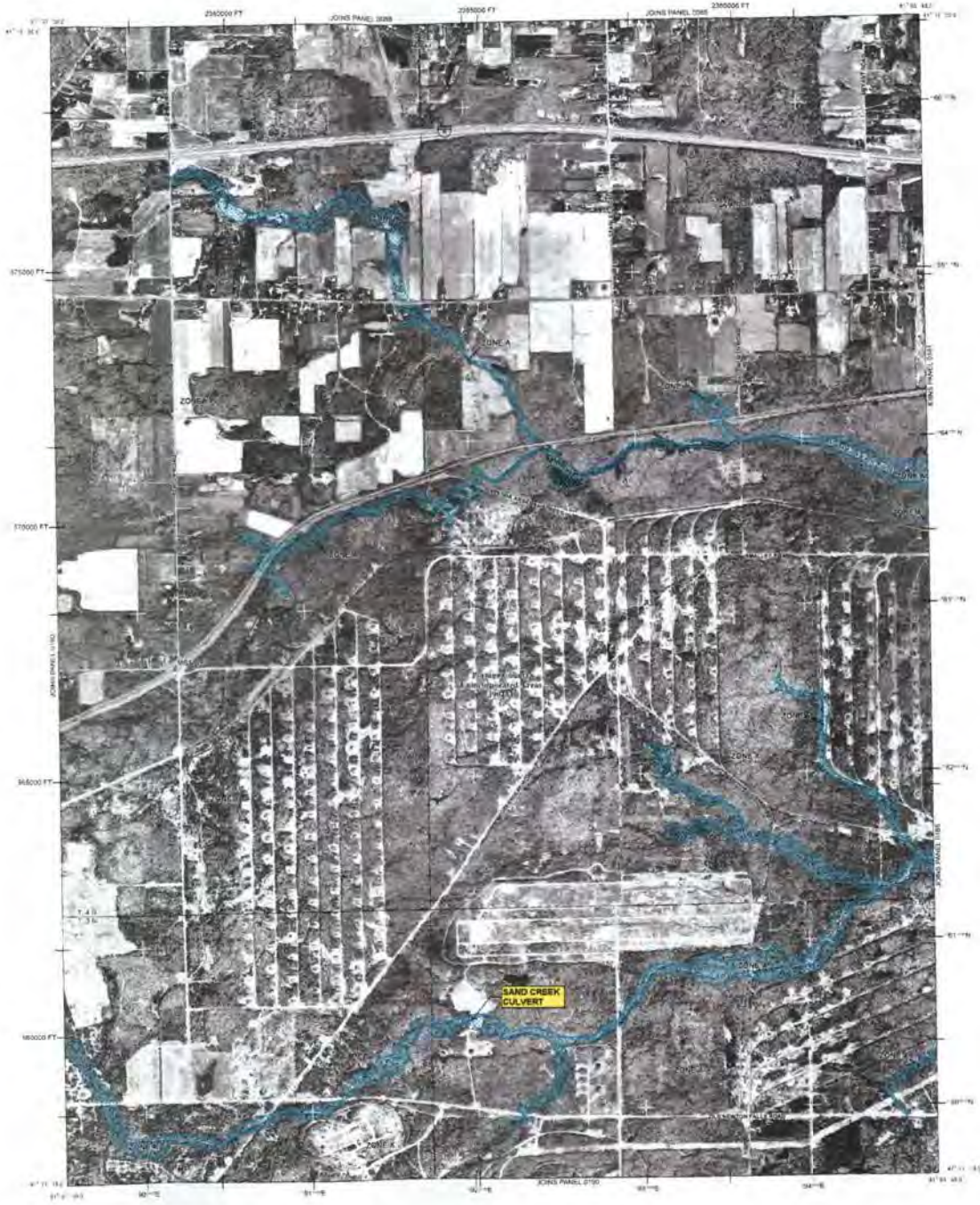
Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which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



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); Base 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 Flood 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*
Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

Cross section line
Transect line
Geographic coordinates, referenced to the North American Datum of 1983 (NAD 83), Western hemisphere
Universal Transverse Mercator grid values, zone 17
5000-foot grid ticks: Ohio State Plane North Coordinate System, NAD 1983 (FIPSZONE 3401), Lambert Conformal Conic
Bench mark (see explanation in Notes to Users section of this FIRM panel)
River mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTY-WIDE FLOOD INSURANCE RATE MAP
AUGUST 18, 2009

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.

SCALE
MAP SCALE 1" = 1000'
0 500 1000 FEET
0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0180D

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

PANEL 180 OF 400
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:
COMMUNITY — NUMBER — PANEL — SUFFIX

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
39133C0180D
EFFECTIVE DATE
AUGUST 18, 2009

Federal Emergency Management Agency

Attachment B

ADJUTANT GENERAL'S DEPARTMENT
CAMP RAVENNA JOINT MILITARTY TRAINING CENTER
1438 State Route 534 SW
Newton Falls, OH 44444

NGOH-IMR-ENV 3 February 2016

MEMORANDUM FOR RECORD

SUBJECT: Endangered Species Act (ESA) Section 7 Consultation for the Remedial Action (RA) at the Winklepeck Burning Grounds (WBG) Area of Concern (AOC) and Culvert Replacement and Bank Stabilization at Open Demolition Area #2 (ODA#2) Munition Response Site (MRS) at Camp Ravenna Joint Military Training Center (CRJMTC) as part of the Ravenna Army Ammunition Plant (RVAAP) Restoration Program

1. The Army National Guard (ARNG)/Ohio Army National Guard (OHARNG) has contracted Tetra Tech to complete a Remedial Action at the Winklepeck Burning Grounds (WBG) AOC (RVAAP-05) and a culvert replacement and bank stabilization at the Open Demolition Area # 2 (ODA2) MRS (RVAAP-004-R-01) as part of the RVAAP Restoration Program. The AOC and MRS are located on the central portion of CRJMTC within Portage County, Ohio.

2. The work at WBG will include excavation of 5,250 cubic yards of soil to remove poly aromatic hydrocarbon (PAH) contamination at Pad 61/61A, 2, 4, 6-trinitrotoluene (TNT) contamination at Pad 38, and TNT and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), contamination at Pads 66 and 67 in subsurface soil (depths of 2 feet and 10 feet below ground surface) to achieve Industrial use. Work will also include screening of soils for munitions and explosives of concern (MEC).

3. The work at ODA2 will include replacement of an existing culvert on the ODA2 access road that runs through the central portion of the MRS and bank stabilization at Rocket Ridge on the eastern portion of the MRS. The culvert replacement project will occur within the central portion of ODA2 where Sand Creek crosses the ODA2 access road. The existing two circular culverts will be replaced with a prefabricated concrete, three-sided arched culvert with wing walls and a 20 foot by 18 foot concrete pad. The existing culvert is being replaced to help with overtopping from flood events and to remove munitions items from the existing backfill that was used to secure the culvert in place. The flow of the stream will neither be interrupted nor relocated during the replacement activities. A Preconstruction Notification (PCN) under Nationwide Permit #3 will be submitted. Existing soil removed from the culvert area will be screened for munitions and used for backfill (if proven clean) or properly disposed. Ground disturbance and a minor amount of vegetation removal will occur within the existing footprint of the culvert. The bank stabilization project will be conducted at Rocket Ridge within ODA2 and will consist of boulder placement within Sand Creek and tree planting (mix of Northern Red Oak and Red Maple) on Rocket Ridge to help with stream bank erosion issues. Minor ground disturbance will occur due to the planting of trees and placement of boulders. No vegetation removal is anticipated as part of the bank stabilization activities. Work will also include screening of soils for munitions and explosives of concern (MEC).

4. This culvert removal and replacement project involves removing up to six small diameter trees and shrubby vegetation in order for the contractor to access the project sites. Because this

project involves potential impacts to the habitat of the Endangered Indiana bat (*Myotis sodalis*) and the federally threatened Northern Long-Eared Bat (*Myotis septentrionalis*), this MFR addresses measures taken to complete this proposed action in accordance with US Fish and Wildlife Service (USFWS) protocols for bat (*Myotis* sp.) management. For this reason, necessary tree cutting will only take place between 1 OCT and 31 MAR.

5. Approximately six small diameter pole-size trees measuring 3 – 10 inches DBH will need to be removed by the contractor in order to remove and replace Sand Creek culvert. The species of trees to be removed include, three green ash (*Faxinus pennsylvanica*), one American elm (*Ulmus americana*), one black cherry (*Prunus serotina*), and one black willow (*Salix nigra*). Tree felling for this project is expected to take place in March 2016 and take no more than one day to complete.

6. The following listed species provided by the US Fish and Wildlife Service Ecological Services Field Office in Columbus, Ohio, are known to occur in Portage County, Ohio. The presence of general habitat within the project area and federally designated critical habitat within the project area and federally designated critical habitat at CRJMTC has also been included.

Common Name	Scientific Name	Federal Status	Habitat within Project Area	Critical Habitat at Camp Ravenna	Determination
Indiana Bat	*Myotis sodalis*	E	Yes	No	No Effect
Mitchell's Satyr Butterfly	*Neonympha mitchelllii mitchellii*	E	No	No	No Effect
Northern Monkshood	*Aconitum noveboracense*	T	No	No	No Effect
Northern Long-Eared Bat	*Myotis septentrionalis*	T	Yes	No	May Affect, Not Likely to Adversely Affect
Eastern Massasauga	*Sistrurus catenatus catenatus*	PT	No	No	No Effect

E = Endangered
T = Threatened
PT = Proposed Threatened

7. Intensive biological surveys have been conducted at CRJMTC for all of the above listed species. In accordance with the CRJMTC Integrated Natural Resources Management Plan (INRMP), bat surveys are conducted on five-year cycles in coordination with the USFWS. To date, five base-wide bat surveys have been conducted at CRJMTC (Tawse, 1999; Davey Resource Group, 2002; Duffey & Brack, 2005; and Johnson, 2010). The current survey which

is still ongoing was begun in July 2015 by EnviroScience, Inc. Habitat suitable for the Threatened Northern Long-eared Bat (NLEB) does exist at CRJMTC as does habitat for the Endangered Indiana bat which to date, has not been found on site. During the 2010 bat survey, before White-Nose Syndrome had been found in Ohio, a total of 29 NLEBs were captured in mist nets. In early August 2015, a single post-lactating adult female NLEB was captured in a mist net and radio tracked back to a roost tree where it spent the night. The 2015-2016 base-wide bat survey is scheduled to resume in early June 2016.

8. Despite the OHARNG's best effort to verify all bat species present at CRJMTC, a list that now contains six species but does not include the Federally Endangered Indiana bat, it was agreed to by the USFWS at the INRMP Review for Operation & Effect meeting on 19 December 2012 that since the Indiana bat does not occur at CRJMTC, no activities at CRJMTC can impact a species that is not present.

9. A young, healthy butternut (*Juglans cinerea*) was found growing on the south side of Sand Creek and on the west side of ODA#2 Rd. This tree measures approximately four inches in diameter, is free of butternut-canker, and is growing next to a larger red maple (*Acer rubrum*). Butternut is listed as a Federal Species of Concern by the USFWS. A species of this informal designation has no legal status or protection under the ESA but rather is considered a watch-list species which is why a concerted effort should be made to avoid harming such species. This tree was marked with pink flagging on 1 FEB 2016 so the contractor will know which particular tree to avoid impacting above and below ground.

10. Based on the above review, the verbal acceptance given to the OHARNG by the USFWS on 19 December 2012 at the Camp Ravenna INRMP review for O&E, the absence of federally designated critical habitat at CRJMTC, and the fact that tree cutting will take place between 1 October – 31 March in accordance with the Camp Ravenna NLEB Informal Conference agreed to by the USFWS on 12 MAY 2015, the OHARNG has determined that implementation of this action "**may affect, not likely to adversely affect**" the NLEB with no additional coordination necessary with the USFWS because seasonal cutting restrictions outlined in said BE are being followed. For all other federally listed species under the ESA present in Portage County, the OHARNG has concluded "**no effect**" will occur as a result of this action.

11. The POC for this action is Mr. Brian Riley, Natural Resources Program Manager, at 614-336-4564 or by email at brian.p.riley17.nfg@mail.mil.

//////////BPR//////////
Brian P. Riley
Natural Resources Manager
OHARNG

CC: CRJMTC file
Ms. Kathryn Tait

Attachment

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
4625 Morse Road, Suite 104
Columbus, Ohio 43230
(614) 416-8993 / FAX (614) 416-8994

Federally Listed Species by Ohio Counties
October 2015

COUNTY	SPECIES
ADAMS	Indiana bat (E), northern long-eared bat (T), running buffalo clover (E), fanshell (E), rayed bean (E), pink mucket pearly mussel (E), sheepnose (E), snuffbox (E), timber rattlesnake (SC), bald eagle (SC)
ALLEN	Indiana bat (E), northern long-eared bat (T), bald eagle (SC)
ASHLAND	Indiana bat (E), northern long-eared bat (T), eastern hellbender (SC), bald eagle (SC)
ASHTABULA	Indiana bat (E), northern long-eared bat (T), Kirtland's warbler (E), piping plover (E), clubshell (E), snuffbox (E), rufa red knot (T), eastern massasauga (PT), bald eagle (SC)
ATHENS	Indiana bat (E), northern long-eared bat (T), American burying beetle (E), fanshell (E), sheepnose (E), pink mucket pearly mussel (E), snuffbox (E), timber rattlesnake (SC), bald eagle (SC)
AUGLAIZE	Indiana bat (E), northern long-eared bat (T), bald eagle (SC)
BELMONT	Indiana bat (E), northern long-eared bat (T), eastern hellbender (SC), bald eagle (SC)
BROWN	Indiana bat (E), northern long-eared bat (T), running buffalo clover (E), fanshell (E), pink mucket pearly mussel (E), rayed bean (E), sheepnose (E), snuffbox (E), bald eagle (SC)
BUTLER	Indiana bat (E), northern long-eared bat (T), rayed bean (E), bald eagle (SC)
CARROLL	Indiana bat (E), northern long-eared bat (T), bald eagle (SC)
CHAMPAIGN	Indiana bat (E), northern long-eared bat (T), eastern massasauga (PT), bald eagle (SC)
CLARK	Indiana bat (E), northern long-eared bat (T), rayed bean (E), eastern prairie fringed orchid (T), eastern massasauga (PT), bald eagle (SC)
CLERMONT	Indiana bat (E), northern long-eared bat (T), running buffalo clover (E), fanshell (E), pink mucket pearly mussel (E), rayed bean (E), sheepnose (E), snuffbox (E), bald eagle (SC)
CLINTON	Indiana bat (E), northern long-eared bat (T), eastern massasauga (PT), bald eagle (SC)
COLUMBIANA	Indiana bat (E), northern long-eared bat (T), eastern massasauga (PT), eastern hellbender (SC), bald eagle (SC)
COSHOCTON	Indiana bat (E), northern long-eared bat (T), clubshell (E), fanshell (E), rayed bean (E), purple cat's paw pearly mussel (E), sheepnose (E), snuffbox (E), rabbitsfoot (T/CH), eastern hellbender (SC), bald eagle (SC)
CRAWFORD	Indiana bat (E), northern long-eared bat (T), eastern massasauga (PT), bald eagle (SC)

CUYAHOGA	Indiana bat (E), northern long-eared bat (T), Kirtland's warbler (E), piping plover (E), rufa red knot (T), bald eagle (SC)
DARKE	Indiana bat (E), northern long-eared bat (T), rayed bean (E), bald eagle (SC)
DEFIANCE	Indiana bat (E), northern long-eared bat (T), clubshell (E), northern riffleshell (E), white cat's paw pearly mussel (E), rayed bean (E), copperbelly water snake (T), bald eagle (SC)
DELAWARE	Indiana bat (E), northern long-eared bat (T), rayed bean (E), snuffbox (E), bald eagle (SC)
ERIE	Indiana bat (E), northern long-eared bat (T), Kirtland's warbler (E), piping plover (E/CH), Lakeside daisy (T), rufa red knot (T), eastern massasauga (PT), Lake Erie watersnake (SC), bald eagle (SC)
FAIRFIELD	Indiana bat (E), northern long-eared bat (T), eastern massasauga (PT), bald eagle (SC)
FAYETTE	Indiana bat (E), northern long-eared bat (T), eastern massasauga (PT), bald eagle (SC)
FRANKLIN	Indiana bat (E), northern long-eared bat (T), Scioto madtom (E), clubshell (E), northern riffleshell (E), rayed bean (E), snuffbox (E), rabbitsfoot (T), bald eagle (SC)
FULTON	Indiana bat (E), northern long-eared bat (T), rayed bean (E), bald eagle (SC)
GALLIA	Indiana bat (E), northern long-eared bat (T), fanshell (E), pink mucket pearly mussel (E), sheepnose (E), snuffbox (E), timber rattlesnake (SC), bald eagle (SC)
GEAUGA	Indiana bat (E), northern long-eared bat (T), bald eagle (SC)
GREENE	Indiana bat (E), northern long-eared bat (T), clubshell (E), rayed bean (E), snuffbox (E), eastern massasauga (PT), bald eagle (SC)
GUERNSEY	Indiana bat (E), northern long-eared bat (T), bald eagle (SC)
HAMILTON	Indiana bat (E), northern long-eared bat (T), running buffalo clover (E), fanshell (E), pink mucket pearly mussel (E), rayed bean (E), sheepnose (E), snuffbox (E), bald eagle (SC)
HANCOCK	Indiana bat (E), northern long-eared bat (T), clubshell (E), rayed bean (E), bald eagle (SC)
HARDIN	Indiana bat (E), northern long-eared bat (T), clubshell (E), rayed bean (E), copperbelly water snake (T), eastern massasauga (PT), bald eagle (SC)
HARRISON	Indiana bat (E), northern long-eared bat (T), bald eagle (SC)
HENRY	Indiana bat (E), northern long-eared bat (T), bald eagle (SC)
HIGHLAND	Indiana bat (E), northern long-eared bat (T), timber rattlesnake (SC), bald eagle (SC)
HOCKING	Indiana bat (E), northern long-eared bat (T), American burying beetle (E), running buffalo clover (E), northern monkshood (T), small whorled pogonia (T), timber rattlesnake (SC), bald eagle (SC)
HOLMES	Indiana bat (E), northern long-eared bat (T), eastern prairie fringed orchid (T), eastern hellbender (SC), bald eagle (SC)
HURON	Indiana bat (E), northern long-eared bat (T), eastern massasauga (PT), bald eagle (SC)
JACKSON	Indiana bat (E), northern long-eared bat (T), running buffalo clover (E), timber rattlesnake (SC), bald eagle (SC)

JEFFERSON	Indiana bat (E), northern long-eared bat (T), eastern hellbender (SC), bald eagle (SC)
KNOX	Indiana bat (E), northern long-eared bat (T), eastern hellbender (SC), bald eagle (SC)
LAKE	Indiana bat (E), northern long-eared bat (T), Kirtland's warbler (E), piping plover (E/CH), snuffbox (E), rufa red knot (T), bald eagle (SC)
LAWRENCE	Indiana bat (E), northern long-eared bat (T), running buffalo clover (E), fanshell (E), pink mucket pearly mussel (E), sheepnose (E), snuffbox (E), timber rattlesnake (SC), bald eagle (SC)
LICKING	Indiana bat (E), northern long-eared bat (T), eastern massasauga (PT), bald eagle (SC)
LOGAN	Indiana bat (E), northern long-eared bat (T), rayed bean (E), eastern massasauga (PT), bald eagle (SC)
LORAIN	Indiana bat (E), northern long-eared bat (T), Kirtland's warbler (E), piping plover (E), rufa red knot (T), bald eagle (SC)
LUCAS	Indiana bat (E), northern long-eared bat (T), Karner blue butterfly (E), Kirtland's warbler (E), piping plover (E), rayed bean (E), eastern prairie fringed orchid (T), rufa red knot (T), eastern massasauga (PT), bald eagle (SC)
MADISON	Indiana bat (E), northern long-eared bat (T), Scioto madtom (E), clubshell (E), northern riffleshell (E), rayed bean (E), snuffbox (E), rabbitsfoot (T/CH), bald eagle (SC)
MAHONING	Indiana bat (E), northern long-eared bat (T), eastern massasauga (PT), bald eagle (SC)
MARION	Indiana bat (E), northern long-eared bat (T), rayed bean (E), eastern massasauga (PT), bald eagle (SC)
MEDINA	Indiana bat (E), northern long-eared bat (T), bald eagle (SC)
MEIGS	Indiana bat (E), northern long-eared bat (T), fanshell (E), pink mucket pearly mussel (E), sheepnose (E), snuffbox (E), bald eagle (SC)
MERCER	Indiana bat (E), northern long-eared bat (T), bald eagle (SC)
MIAMI	Indiana bat (E), northern long-eared bat (T), rayed bean (E), snuffbox (E), bald eagle (SC)
MONROE	Indiana bat (E), northern long-eared bat (T), eastern hellbender (SC), bald eagle (SC)
MONTGOMERY	Indiana bat (E), northern long-eared bat (T), rayed bean (E), snuffbox (E), eastern massasauga (PT), bald eagle (SC)
MORGAN	Indiana bat (E), northern long-eared bat (T), American burying beetle (E), fanshell (E), pink mucket pearly mussel (E), sheepnose (E), snuffbox (E), bald eagle (SC)
MORROW	Indiana bat (E), northern long-eared bat (T), bald eagle (SC)
MUSKINGUM	Indiana bat (E), northern long-eared bat (T), fanshell (E), sheepnose (E), snuffbox (E), rabbitsfoot (T), eastern hellbender (SC), bald eagle (SC)
NOBLE	Indiana bat (E), northern long-eared bat (T), bald eagle (SC)
OTTAWA	Indiana bat (E), northern long-eared bat (T), Kirtland's warbler (E), piping plover (E), eastern prairie fringed orchid (T), Lakeside daisy (T), rufa red knot (T), eastern massasauga (PT), Lake Erie watersnake (SC), bald eagle (SC)
PAULDING	Indiana bat (E), northern long-eared bat (T), bald eagle (SC)

PERRY	Indiana bat (E), northern long-eared bat (T), American burying beetle (E), bald eagle (SC)
PICKAWAY	Indiana bat (E), northern long-eared bat (T), Scioto madtom (E), clubshell (E), northern riffleshell (E), rayed bean (E), snuffbox (E), rabbitsfoot (T), bald eagle (SC)
PIKE	Indiana bat (E), northern long-eared bat (T), clubshell (E), northern riffleshell (E), rayed bean (E), timber rattlesnake (SC), bald eagle (SC)
PORTAGE	Indiana bat (E), northern long-eared bat (T), Mitchell's satyr (E), northern monkshood (T), eastern massasauga (PT), bald eagle (SC)
PREBLE	Indiana bat (E), northern long-eared bat (T), eastern massasauga (PT), bald eagle (SC)
PUTNAM	Indiana bat (E), northern long-eared bat (T), bald eagle (SC)
RICHLAND	Indiana bat (E), northern long-eared bat (T), eastern massasauga (PT), eastern hellbender (SC), bald eagle (SC)
ROSS	Indiana bat (E), northern long-eared bat (T), running buffalo clover (E), clubshell (E), northern riffleshell (E), rayed bean (E), snuffbox (E), eastern hellbender (SC), timber rattlesnake (SC), bald eagle (SC)
SANDUSKY	Indiana bat (E), northern long-eared bat (T), Kirtland's warbler (E), piping plover (E), eastern prairie fringed orchid (T), rufa red knot (T), eastern massasauga (PT), bald eagle (SC)
SCIOTO	Indiana bat (E), northern long-eared bat (T), running buffalo clover (E), clubshell (E), fanshell (E), northern riffleshell (E), pink mucket pearly mussel (E), rayed bean (E), sheepnose (E), snuffbox (E), small whorled pogonia (T), Virginia spiraea (T), eastern hellbender (SC), timber rattlesnake (SC), bald eagle (SC)
SENECA	Indiana bat (E), northern long-eared bat (T), bald eagle (SC)
SHELBY	Indiana bat (E), northern long-eared bat (T), rayed bean (E), bald eagle (SC)
STARK	Indiana bat (E), northern long-eared bat (T), bald eagle (SC)
SUMMIT	Indiana bat (E), northern long-eared bat (T), northern monkshood (T), bald eagle (SC)
TRUMBULL	Indiana bat (E), northern long-eared bat (T), clubshell (E), eastern massasauga (PT), bald eagle (SC), eastern hellbender (SC)
TUSCARAWAS	Indiana bat (E), northern long-eared bat (T), eastern hellbender (SC), bald eagle (SC)
UNION	Indiana bat (E), northern long-eared bat (T), Scioto madtom (E), clubshell (E), northern riffleshell (E), rayed bean (E), snuffbox (E), rabbitsfoot (T/CH), bald eagle (SC)
VAN WERT	Indiana bat (E), northern long-eared bat (T), bald eagle (SC)
VINTON	Indiana bat (E), northern long-eared bat (T), running buffalo clover (E), American burying beetle (E), eastern hellbender (SC), timber rattlesnake (SC), bald eagle (SC)
WARREN	Indiana bat (E), northern long-eared bat (T), running buffalo clover (E), rayed bean (E), eastern massasauga (PT), bald eagle (SC)

WASHINGTON	Indiana bat (E), northern long-eared bat (T), fanshell (E), pink mucket pearly mussel (E), sheepnose (E), snuffbox (E), eastern hellbender (SC), timber rattlesnake (SC), bald eagle (SC)
WAYNE	Indiana bat (E), northern long-eared bat (T), eastern prairie fringed orchid (T), eastern massasauga (PT), bald eagle (SC)
WILLIAMS	Indiana bat (E), northern long-eared bat (T), clubshell (E), northern riffleshell (E), rayed bean (E), white cat's paw pearly mussel (E), rabbitsfoot (T/CH), copperbelly water snake (T), bald eagle (SC)
WOOD	Indiana bat (E), northern long-eared bat (T), bald eagle (SC)
WYANDOT	Indiana bat (E), northern long-eared bat (T), rayed bean (E), eastern massasauga (PT), bald eagle (SC)

IMPORTANT NOTE: This list reflects data available as of October 2015, and will change as new data become available. For this reason, searches for listed species should not necessarily be limited to the counties noted above. Any decisions in that regard should be made only after calling the USFWS (614/416-8993) for guidance.

E = Endangered
T = Threatened
C = Candidate
SC = Species of Concern
CH = Critical Habitat
P = Proposed (T/E/CH)

STATE OF OHIO
ADJUTANT GENERAL'S DEPARTMENT
2825 West Dublin Granville Road
Columbus, Ohio 43235-2789

NGOH-IMR-ENV 11 September 2015

MEMORANDUM FOR RECORD

SUBJECT: National Historic Preservation Act Compliance for the Remedial Action (RA) at the Winklepeck Burning Grounds Area of Concern (AOC) and Culvert Removal and Replacement and Bank Stabilization at Open Demolition Area #2 Munition Response Site (MRS) at Camp Ravenna Joint Military Training Center (CRJMTC) as part of the Ravenna Army Ammunition Plant (RVAAP) Restoration Program

1. The Army National Guard (ARNG)/Ohio Army National Guard (OHARNG) has contracted Tetra Tech to complete a Remedial Action at the Winklepeck Burning Grounds (WBG) AOC (RVAAP-05) and a culvert removal and replacement and bank stabilization at the Open Demolition Area # 2 (ODA2) MRS (RVAAP-004-R-01) as part of the RVAAP Restoration Program. The AOC and MRS are located on the central portion of CRJMTC within Portage County, Ohio. The work at WBG will include excavation of 5,250 cubic yards of soil to remove poly aromatic hydrocarbon (PAH) contamination at Pad 61/61A, 2, 4, 6-trinitrotoluene (TNT) contamination at Pad 38, and TNT and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), contamination at Pads 66 and 67 in subsurface soil (depths of 2 feet and 10 feet below ground surface) to achieve Industrial use. The work at ODA2 will include removal and replacement of an existing culvert on the ODA2 access road that runs through the central portion of the MRS and bank stabilization at Rocket Ridge on the eastern portion of the MRS. Work at both sites will also include screening of soils for munitions and explosives of concern (MEC).

2. The immediate project areas covered in this MFR have not been surveyed for cultural resources due to the fact that these are areas of concern are part of the RVAAP restoration program. Walk overs and digging in these areas is a potential hazard, therefore surveys have not been completed in these areas. However, several surveys have been completed around the project areas over the last several years. Six archaeological surveys were completed between 2004 and 2015 in the areas surrounding the project areas. There are twenty-three archaeological sites identified during these 6 surveys in the areas surrounding the project areas. Four of these sites meet the eligibility criteria for listing in the National Register of Historic Places (NRHP) and require further investigation. The remaining nineteen sites do not meet the criteria and no further investigations are necessary. The Ohio Historic Preservation Office concurred with the OHARNG determinations regarding the eligibility of these sites. The four eligible sites are between 1,500 to 3,000 feet from the project areas. There is no potential for the proposed projects to disturb any of these sites.

3. In 2006, the OHARNG consulted with 55 federally recognized Tribes regarding the development of an Environmental Assessment for a proposed Engineer School at CRJMTC and the associated archaeological survey. The archaeological survey completed in association with the EA encompasses several areas near the project areas. Tribes interested in the results of the archaeological survey did not express an interest in the sites identified during the survey.

However, several tribes did request being contacted in the event of an inadvertent discovery during any ground disturbing activities. In addition, the OHARNG regularly consults with 13 federally recognized Tribes regarding archaeological surveys and projects at CRJMTC. Draft archaeological surveys completed at CRJMTC are sent to these 13 tribes for comment and review. No concerns have been expressed regarding the surveys. The OHARNG has established a good working relationship with tribes that have ancestral ties to OHARNG owned properties. Consultation with tribes has shown that the greatest interest is the inadvertent discovery of human remains or NAGPRA related items and results of archaeological surveys. In the event of an inadvertent discovery of human remains or funerary items, the OHARNG will follow *Procedures for Inadvertent Discovery of Cultural Materials at Camp Ravenna Joint Military Training Center*. These procedures were taken from Standard Operating Procedure #6 of the OHARNG Integrated Cultural Resources Management Plan and modified specifically for CRJMTC.

4. There are no known historic properties present within the Area of Potential Effects; therefore the OHARNG makes the determination that no historic properties will be affected by the Winklepeck Remedial Action and culvert removal and replacement and bank stabilization at ODA2. Copies of pertinent correspondence with the OHPO and Tribes are available upon request from the OHARNG Cultural Resources Manager. Any questions or concerns regarding Cultural Resources for CRJMTC should be directed to the undersigned at (614) 336-6569 or via e-mail at kimberly.s.ludt.nfg@mail.mil.

//////S//////
KIMBERLY S. LUDT
OHARNG Cultural Resources Manager

Attachment C

PGH P:\GIS\RAVENNA\MAPDOCS\SAND_CREEK_STAGING_AREA_JUN2016.MXD 06/15/16 JEE

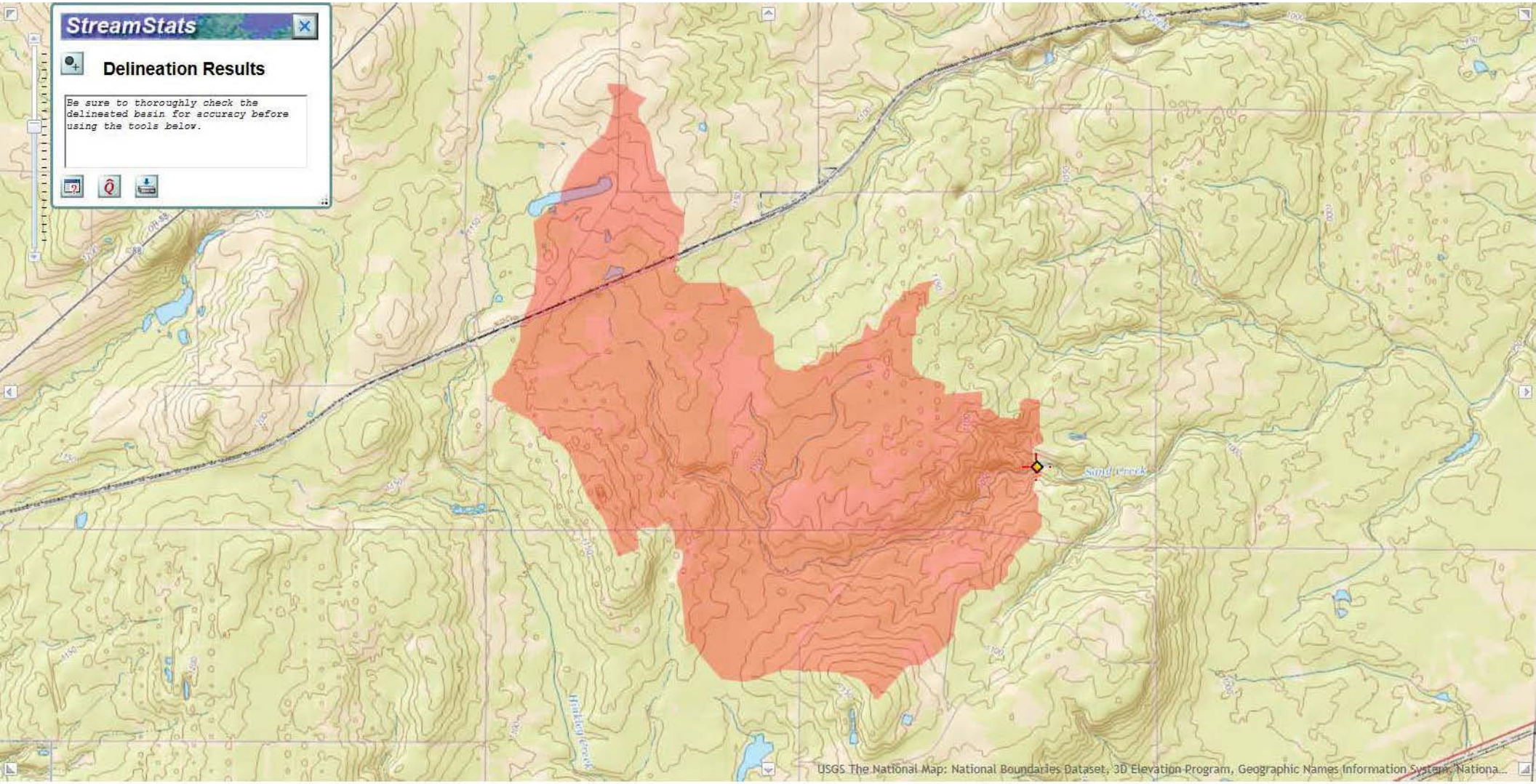
SAND CREEK CULVERT STAGING AREA
CAMP RAVENNA
RAVENNA, OHIO

CONTRACT NUMBER		CTO NUMBER	
APPROVED BY	DATE		
APPROVED BY	DATE		
FIGURE NO. 6		REV 0	

DRAWN BY	DATE	SCALE:	
J. ENGLISH	06/01/16	AS NOTED	
CHECKED BY	DATE		
G. HEALY	06/15/16		
REVISED BY	DATE		

APPENDIX D

STREAMSTATS OUTPUT


StreamStats
Delineation Results
Be sure to thoroughly check the delineated basin for accuracy before using the tools below.
Sand Creek
USGS The National Map: National Boundaries Dataset, 3D Elevation Program, Geographic Names Information System, Nationa...

StreamStats Version 3.0

Flow Statistics Ungaged Site Report

Date: Tues Dec 8, 2015 1:57:13 PM GMT-5
Study Area: Ohio
NAD 1983 Latitude: 41.1963 (41 11 47)
NAD 1983 Longitude: -81.0961 (-81 05 46)
Drainage Area: 3.69 mi2

Peak Flows Basin Characteristics			
100% Peak Flow Full Model (3.69 mi2)			
Parameter	**Value**	**Regression Equation Valid Range**	
		Min	**Max**
Drainage Area (square miles)	3.69	0.01	7422
Ohio Region C Indicator 1 if in C else 0 (dimensionless)	0	0	1
Ohio Region A Indicator 1 if in A else 0 (dimensionless)	1	0	1
Stream Slope 10 and 85 Longest Flow Path (feet per mi)	29.7	1.53	674
Percent Storage from NLCD1992 (percent)	6.67	0	25.8

Low Flows Basin Characteristics			
100% Low Flow Region A 2012 5138 (3.69 mi2)			
Parameter	**Value**	**Regression Equation Valid Range**	
		Min	**Max**
Drainage Area (square miles)	3.69	1	1250
Streamflow Variability Index from Grid (dimensionless)	0.59	0.24	1.12

Probability of Zero Flow Basin Characteristics			
100% P zero Flow 2012 5138 (3.69 mi2)			
Parameter	**Value**	**Regression Equation Valid Range**	
		Min	**Max**
Drainage Area (square miles)	3.69	1	1250
Streamflow Variability Index from Grid (dimensionless)	0.59	0.24	1.12

Mean and Percentile Basin Characteristics			
Y coordinate (latitude) of the centroid_ in decimal degrees=41.1980			
100% Low Flow LatLE 41.2 wri02 4068 (3.69 mi2)			
Parameter	**Value**	**Regression Equation Valid Range**	
		Min	**Max**
Drainage Area (square miles)	3.69	0.12	7422
Percent Forest (percent)	67	0	99.1
Percent Storage from NLCD1992 (percent)	6.67	0	19
Mean Annual Precipitation (inches)	36.6	34	43.2
Streamflow Variability Index from Grid (dimensionless)	0.59	0.25	1.13
Latitude of Basin Centroid (decimal degrees)	41.1980	38.68	41.2
Longitude of Basin Centroid (decimal degrees)	81.1216	80.53	84.6

Peak Flows Statistics						
Statistic	Value	Unit	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
					Min	Max
PK2	209	ft3/s	37	2.1	105	418
PK5	334	ft3/s	35	3.3	174	644
PK10	422	ft3/s	34	4.4	219	814
PK25	532	ft3/s	35	5.9	270	1050
PK50	613	ft3/s	37	6.8	303	1240
PK100	695	ft3/s	38	7.5	333	1450
PK500	882	ft3/s	42	8.6	391	1990

http://pubs.usgs.gov/sir/2006/5312/ (http://pubs.usgs.gov/sir/2006/5312/)
Koltun_ G.F._ Kula_ S.P._ and Puskas_ B.M._ 2006_ A Streamflow Statistics (StreamStats) Web Application for Ohio: U.S. Geological Survey Scientific Investigations Report 2006-5312_ 62 p.

Low Flows Statistics						
Statistic	Value	Unit	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
					Min	Max
M1D10Y	0.0346	ft3/s	53			
M7D10Y	0.0458	ft3/s	40			
M30D10Y	0.0749	ft3/s	36			
M90D10Y	0.13	ft3/s	30			
D80	0.29	ft3/s	29			

#http://pubs.usgs.gov/sir/2012/5138/#
Koltun_ G.F._ and Kula_ S.P._ 2013_ Methods for estimating selected low-flow statistics and development of annual flow-duration statistics for Ohio: U.S. Geological Survey Scientific Investigations Report 2012-5138_ 195 p.

Probability of Zero Flow Statistics						
Statistic	Value	Unit	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
					Min	Max
PROB 1DAY	0.0452	dim				
PROB 7DAY	0.0201	dim				
PROB 30DAY	0.000935	dim				

#http://pubs.usgs.gov/sir/2012/5138/#
Koltun_ G.F._ and Kula_ S.P._ 2013_ Methods for estimating selected low-flow statistics and development of annual flow-duration statistics for Ohio: U.S. Geological Survey Scientific Investigations Report 2012-5138_ 195 p.

Mean and Percentile Statistics						
Statistic	Value	Unit	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
					Min	Max
Q1	5.72	ft3/s	17			
Q2	6.46	ft3/s	12			

Q3	7.43	ft3/s	14			
Q4	6.71	ft3/s	11			
Q5	3.98	ft3/s	20			
Q6	2.51	ft3/s	27			
Q7	1.41	ft3/s	28			
Q8	0.99	ft3/s	37			
Q9	0.71	ft3/s	44			
QA	3.75	ft3/s	11			
Q10	0.72	ft3/s	51			
Q11	1.71	ft3/s	38			
Q12	3.84	ft3/s	22			
QAH	0.59	ft3/s	66			
FPS25	0.76	ft3/s	29			
FPS50	1.97	ft3/s	40			
FPS75	4.79	ft3/s	48			

http://oh.water.usgs.gov/reports/wrir/wrir02-4068.pdf (http://oh.water.usgs.gov/reports/wrir/wrir02-4068.pdf)
Koltun_G. F._and Whitehead_M. T._2002_Techniques for Estimating Selected Streamflow Characteristics of Rural_Unregulated Streams in Ohio: U. S. Geological Survey Water-Resources Investigations Report 02-4068_50 p

StreamStats Version 3.0

Basin Characteristics Ungaged Site Report

Date: Tues Dec 8, 2015 2:00:28 PM GMT-5
Study Area: Ohio
NAD 1983 Latitude: 41.1963 (41 11 47)
NAD 1983 Longitude: -81.0961 (-81 05 46)

Label	Value	Units	Definition
OHREGA	1	dimensionless	Ohio Region A Indicator
OHREGC	0	dimensionless	Ohio Region C Indicator
DRNAREA	3.69	square miles	Area that drains to a point on a stream
LAT_CENT	41.198	decimal degrees	Latitude of Basin Centroid
CSL1085LFP	undefined	feet per mi	Change in elevation divided by length between points 10 and 85 percent of distance along the longest flow path to the basin divide, LFP from 2D grid
LONG_CENT	81.1216	decimal degrees	Longitude Basin Centroid
PRECIP	36.6	inches	Mean Annual Precipitation
STREAM_VARG	0.59	dimensionless	Streamflow variability index as defined in WRIR 02-4068, computed from regional grid
FOREST	100	percent	Percentage of area covered by forest
LC92STOR	0	percent	Percentage of water bodies and wetlands determined from the NLCD
LC11IMP	0	percent	Percentage of impervious area determined from NLCD 2011 impervious dataset
LC11DEV	0	percent	Percentage of land-use from NLCD 2011 classes 21-24

APPENDIX E

CONTECH CULVERT DESIGN

CON/SPAN O-SERIES

updated 10/15/15

LFD BRIDGE FOUNDATION CALCULATIONS

JOB #: 539111
NAME: Camp Ravenna - 2500 psf option
DATE: 20-Jun-16
BY:

Note: Engineer of record shall be responsible for the accuracy of these calculations.

BRIDGE DATA:

Bridge type =	O-Series		
Manual Reactions =	yes	Shape ID =	221
		cover, at structure center =	2.00 ft, max
		bridge span =	21 ft
		bridge rise =	8.4 ft
		live load =	HS20

LOADS:

vertical load (dead load), per leg, RvDL	8.5 k/f
vertical load (dead + live load), per leg, RvDL+LL	11.3 k/f
horizontal load (dead load), per leg, RhDL	1.6 k/f
horizontal load (dead + live load), per leg, RhDL+LL	3.0 k/f

FOOTING DESIGN

bearing material =	soil	
overburden depth, dF =	3.00 ft	
net allowable bearing pressure, qa =	2500 psf	
gross allowable bearing pressure =	2860 psf	
Include soil over heel to reduce footing bending =	yes	
trial footing width, b =	5.50 ft	
footing width (B) =	6.00 ft	
footing offset, o =	10.00 in	
toe width (Wt) =	1.88 ft	
heel width (Wh) =	3.54 ft	
footing depth, D =	2.00 ft	
keyway depth (kd) =	3.0 in	
depth of fill @ inside footing (Df) =	0.00 ft	

BEARING PRESSURES AND ECCENTRICITY:

total vertical load (ΣFv) =	16.37 k	
total moment (ΣM) =	49.52 k-ft/f	
moment arm, L = ΣM/ΣFv =	3.03 ft	(from toe)
eccentricity,e = L-B/2 =	0.03 ft	within middle 1/3 of B, OK
gross bearing pressure @ toe (q toe) =	2659 psf	< gross allowable, OK
gross bearing pressure @ heel (q heel) =	2798 psf	< gross allowable, OK

SUMMARY OF STABILITY AFTER CONSTRUCTION: (see pg.3 for details)

FS Overturning =	38.9	> 2.0, OK
FS Sliding =	3.3	> 1.5, OK

SOIL PROPERTIES:

soil unit weight (γs) =	120 pcf
internal friction angle (ϕ) =	32 degrees
angle of wall friction (δ) =	24 degrees
earth pressure =	at-rest
at-rest pressure coefficient (Ko) =	0.47
maximum passive pressure coefficient (Kpmax) =	1.5
maximum friction coefficient (fmax) =	0.35

REINFORCED CONCRETE PROPERTIES:

concrete unit weight (γc) =	150 pcf
concrete strength (f'c) =	4000 psi
reinforcing steel strength (fy) =	60000 psi

VERTICAL FORCES: (after construction)

The vertical and horizontal reactions are obtained from the CON/SPAN reaction charts, which were developed using many test runs of the finite-element program CANDE. A portion of the backfill adjacent to the CON/SPAN is included in

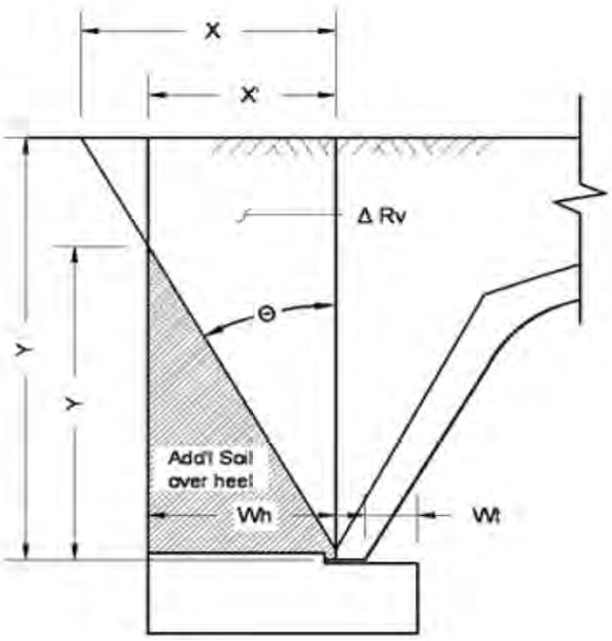
many test runs of the finite element program CANDE. A portion of the backfill adjacent to the culvert is included in the vertical reaction from CANDE due to negative soil arching (friction against the culvert). The remaining backfill adjacent to the culvert is included in the soil over the heel.

Soil over heel not included in CANDE vertical reaction:

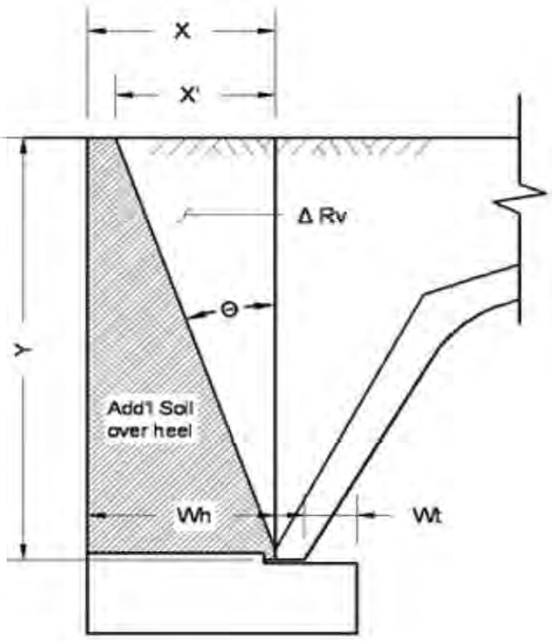
CANDE dead load Rv = 8,500 lbs
Rv' = precast unit + soil above = 7,095 lbs
ΔRv = Rv - Rv' = 1,405 lbs
y = 11.09 ft
x = 2.11 ft

θ = 10.77 degrees
x' = Wh = 3.54 ft
add'l soil = 3,310 lbs
centroid = 4.68 ft (from toe)

Case 2 applies



CASE 1



CASE 2

Note: Positive moments are taken counter-clockwise about toe

Description	Force	Moment Arm	Moment
culvert vertical reaction (Rv) =	11.30 k/f	2.17 ft	24.48 k-ft/f
footing weight (Pf) =	1.76 k/f	3.00 ft	5.28 k-ft/f
weight of soil over heel (Ph), see diagram =	3.31 k/f	4.68 ft	15.50 k-ft/f
weight over toe =	0.00 k/f	0.94 ft	0.00 k-ft/f
ΣFv =	16.37 k/f		45.26 k-ft/f

HORIZONTAL FORCES: (after construction)

Note: Positive forces are to the right (toward the toe). Negative forces are to the left (toward the heel).

Determine AT-REST or PASSIVE condition behind footing:

Zt = 10.93 ft
Zf = 12.93 ft
at-rest pressures:
p1 = K γs Zt = 616 psf
p3 = K γs Zf = 729 psf

culvert horizontal reaction (Rh) = -3.04 k/f
at-rest pressure force (Po) = 1.35 k/f
calculated friction coefficient, fs = (Rh+Po)/ΣRv = 0.10 <= fsmax
actual friction force, Ff = fs ΣRv = 1.69 k/f
Ffmax = fmax ΣRv = 5.73 k/f

Po + Ffmax >= Rh **AT-REST**

Passive pressure behind footing: (Used for FS SLIDING calculation)

calculated passive pressure coefficient (Kp) = 0.47 <= Kpmax

passive pressures:
p1 = Kp γs Zt = 616 psf
p3 = Kp γs Zf = 729 psf

Pp = 1/2(p1+p3)(H+D)/1000 = 1.35 k
moment arm = 1/3(H+D)(p3+2*p1)/(p1+p3) = 0.97 ft
p1max = Kpmax γs Zt = 1967 psf
p3max = Kpmax γs Zf = 2327 psf

Ppmax = 1/2(p1max+p3max)(H+D)/1000 = 4.29 k

Passive pressure inside:

calculated passive press. coeff. (Kpf) = 0.00 <= Kpmax
max. passive force (Pf max) = 0.00 k
actual resultant passive force (Pf) = 0.00 k
moment arm = 0.00 ft

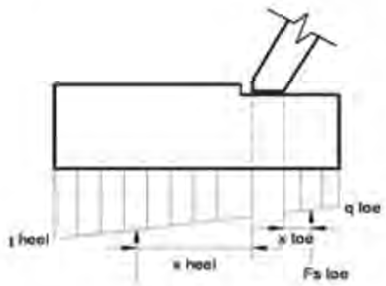
Description	Force	Moment Arm	Moment
culvert horizontal reaction (Rh) =	-3.04 k/f	1.83 ft	5.57 k-ft/f
at-rest pressure force (Po) =	1.35 k/f	0.97 ft	-1.31 k-ft/f
passive pressure in front of footing (Pf) =	0.00 k/f	0.00 ft	0.00 k-ft/f
friction force (Ff) =	1.69 k/f	0.00 ft	0.00 k-ft/f
ΣFh =	0.00 k/f		4.27 k-ft/f

CHECK STABILITY: (after construction)

ΣM_R = 50.83
ΣM_D = 1.31
FS Overturning = $\Sigma M_R/\Sigma M_D$ = 38.9 > 1.5, OK

ΣF_R = 10.02 k/f
ΣF_D = 3.04 k/f
FS Sliding = $\Sigma F_R/\Sigma F_D$ = 3.3 > 1.5, OK

FOOTING UNREINFORCED BENDING CHECK:



q @ inside footing = 2702 psf
q @ outside footing = 2716 psf
Fs toe = 5.03 k/f
Fs heel = 9.76 k/f
x toe = 0.93 ft
x heel = 1.78 ft
$M_{s\ toe}$ = 4.70 ft-k/ft
$M_{s\ heel}$ = 9.03 ft-k/ft heel bending controls
y = 10.50 in
I = 9261 in^4
σt_{allow} = 100 psi
σt_{actual} = 123 psi reinforcement required

FOOTING REINFORCEMENT: (BENDING, FACTORED LOADS)

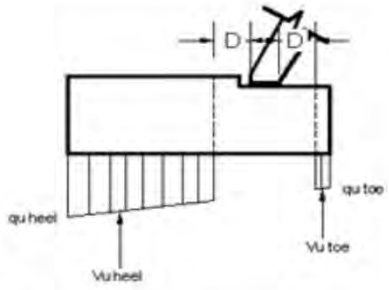
live load percentage of Rv = 19%
weighted load factor for ultimate bearing pressures = 1.42
qu toe = 3763 psf
qu heel = 3959 psf
qu @ inside footing = 3824 psf
qu @ outside footing = 3843 psf
Fu toe = 7.11 k/f
Fu heel = 13.82 k/f
x toe = 0.93 ft
x heel = 1.78 ft
$M_{u\ toe}$ = 6.65 ft-k/ft
$M_{u\ heel}$ = 13.74 ft-k/ft heel bending controls

Design reinforcement:

M_u = 13.74 ft-k/ft
$1.2M_{cr}$ = 41.84 ft-k/ft

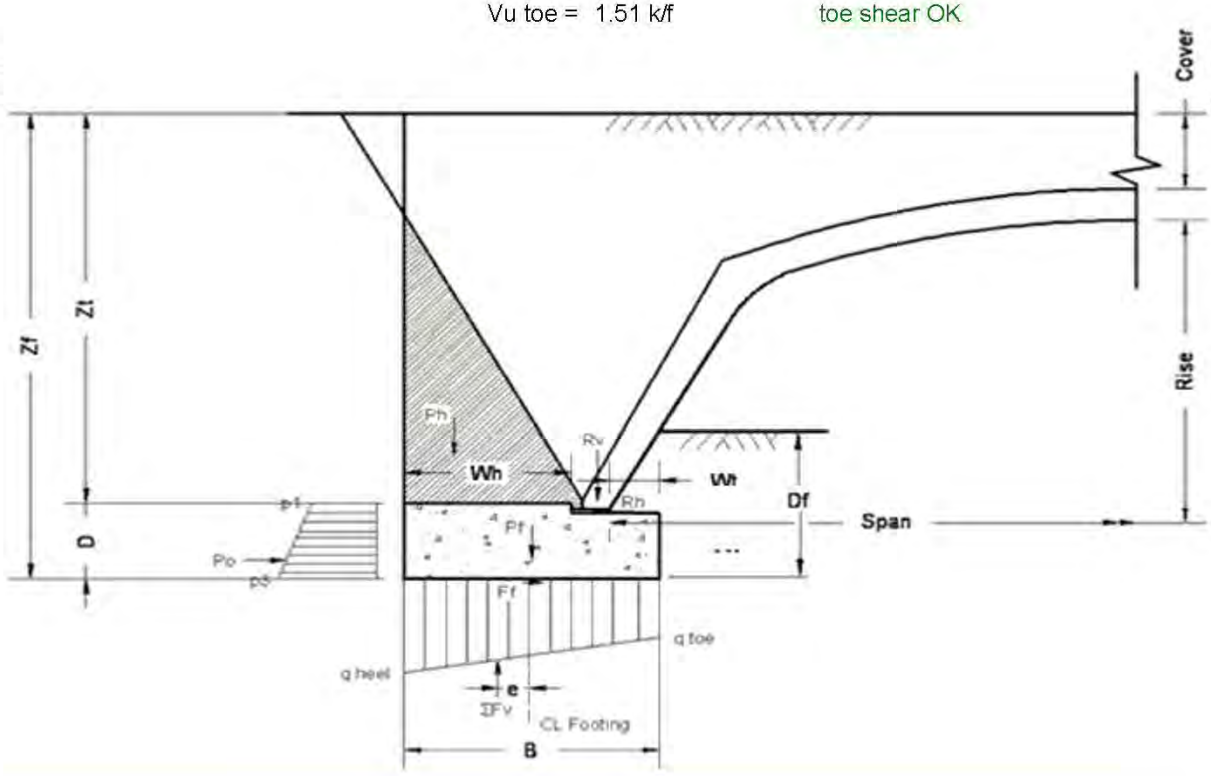
$(4/3)M_u$ =	18.31 ft-k/ft	controls, per AASHTO 8.17.1
design moment =	18.31 ft-k/ft	
rebar clear cover =	3.0 in	
d =	17.69 in	
m =	17.65	
R_u =	65 psi	
ρ =	0.0011	
ρ_{min} =	0.0011	
ρ_{max} =	0.0214	
$As_{req'd}$ =	0.23 in^2/ft	
As_{actual} =	0.31 in^2/ft	
ϕM_n =	24.11 k-ft/f	OK
Horizontal bars :		#5 @ 12 in
Longitudinal bars :		#6 @ 12 in

CHECK SHEAR IN FOOTING:



qu @ d from inside of arch leg =	3776 psf	
qu @ d from outside of arch leg =	3892 psf	
ϕVc =	22.82 k/f	
Vu toe =	1.51 k/f	toe shear OK

CALCU



CAMP RAVENNA
SAND CREEK CULVERT
PORTAGE COUNTY
CAMP RAVENNA, OHIO

NOTES

GENERAL NOTES:

1. THIS BRIDGE HAS BEEN DESIGNED FOR GENERAL SITE CONDITIONS. THE PROJECT ENGINEER SHALL BE RESPONSIBLE FOR THE STRUCTURE'S SUITABILITY TO THE EXISTING SITE CONDITIONS AND FOR THE HYDRAULIC EVALUATION – INCLUDING SCOUR AND CONFIRMATION OF SOIL CONDITIONS.
2. PRIOR TO CONSTRUCTION, CONTRACTOR MUST VERIFY ALL ELEVATIONS SHOWN THROUGH THE ENGINEER.
3. ONLY CONTECH ENGINEERED SOLUTIONS LLC, THE CON/SPAN® APPROVED PRECASTER IN OHIO MAY PROVIDE THE STRUCTURE DESIGNED IN ACCORDANCE WITH THESE PLANS.
4. THE USE OF ANOTHER PRECAST STRUCTURE WITH THE DESIGN ASSUMPTIONS USED FOR THE CON/SPAN® STRUCTURE MAY LEAD TO SERIOUS DESIGN ERRORS. USE OF ANY OTHER PRECAST STRUCTURE WITH THIS DESIGN AND DRAWINGS VOIDS ANY CERTIFICATION OF THIS DESIGN AND WARRANTY. CONTECH ENGINEERED SOLUTIONS LLC ASSUMES NO LIABILITY FOR DESIGN OF ANY ALTERNATE OR SIMILAR TYPE STRUCTURES.
5. ALTERNATE STRUCTURES MAY BE CONSIDERED, PROVIDED THAT DRAWINGS AND CALCULATIONS SIGNED AND SEALED BY A PROFESSIONAL ENGINEER, REGISTERED IN THE STATE OF OHIO, EMPLOYED BY THE PRECAST CONCRETE BRIDGE SUPPLIER, ARE SUBMITTED TO THE ENGINEER 2 WEEKS PRIOR TO THE BID DATE FOR REVIEW AND APPROVAL.
6. ALTERNATE STRUCTURES MAY BE CONSIDERED, PROVIDED THAT THE ALTERNATE DESIGN DOES NOT REDUCE THE HYDRAULIC OPENING OF THE STRUCTURE AS SHOWN ON THE DRAWINGS. AT A MINIMUM THE ALTERNATE STRUCTURE MUST PROVIDE THE SAME OR LARGER SPAN AND RISE AS THE STRUCTURE SHOWN ON THE DRAWINGS.
7. THE PRECAST ARCH SUPPLIER MUST ATTEND THE PRE-BID MEETING, IF ONE IS HELD.
8. SUPPLIER OF PROPOSED ALTERNATES TO A CON/SPAN® BRIDGE SYSTEM MUST SUBMIT AT LEAST TWO (2) INDEPENDENTLY VERIFIED FULL SCALE LOAD TESTS THAT CONFIRM THE PROPOSED DESIGN METHODOLOGY OF THE THREE SIDED/ARCH STRUCTURE(S). THE PROPOSED ALTERNATE, UPON SATISFACTORY CONFIRMATION OF DESIGN METHODOLOGY, MAY BE CONSIDERED AN ACCEPTABLE ALTERNATE.
9. PROPOSED ALTERNATE STRUCTURES MAY BE CONSIDERED, PROVIDED THAT THE PRECAST CONCRETE BRIDGE STRUCTURES ARE PROVIDED BY A SUPPLIER THAT HAS A MINIMUM OF TWO (2) REGISTERED PROFESSIONAL ENGINEERS ON STAFF THAT ARE DEDICATED TO THE DESIGN OF THESE TYPES OF STRUCTURES. SUPPLIER MUST PROVIDE THESE NAMES, P.E. LICENSE NUMBERS AND DATES OF HIRE AT TIME OF ALTERNATE SUBMITTAL.

DESIGN DATA

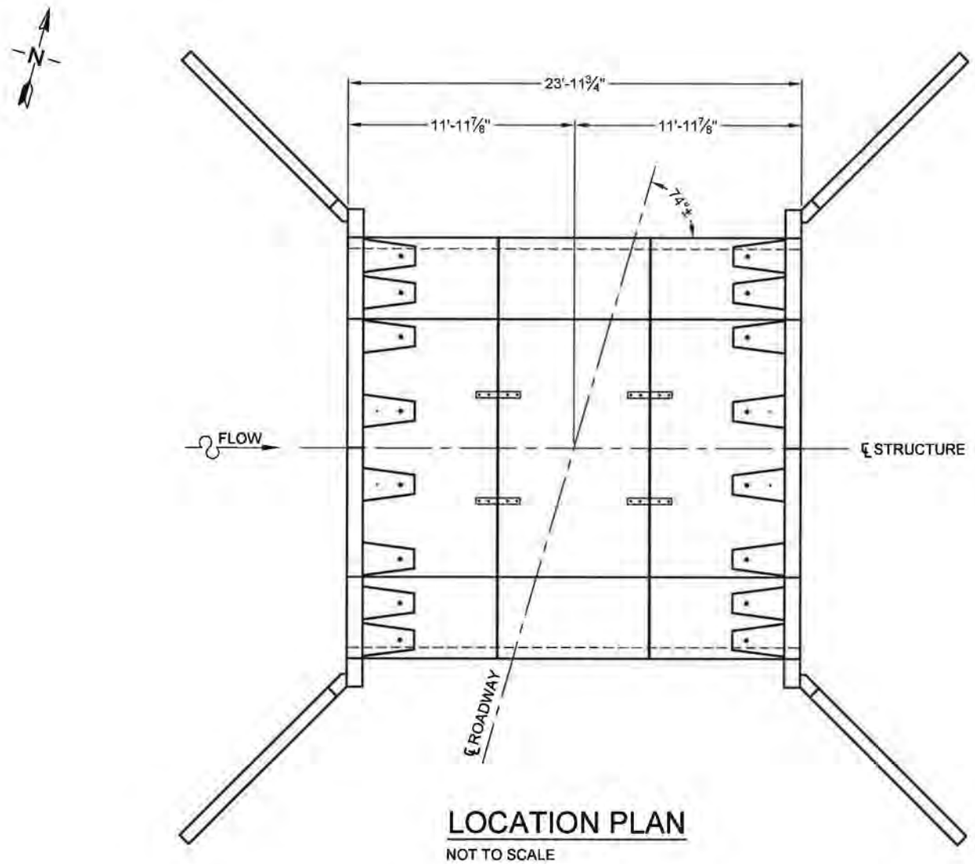
DESIGN LOADING:
- BRIDGE UNITS: HS20
- HEADWALLS: EARTH PRESSURE + LIVE LOAD SURCHARGE
- WINGWALLS: EARTH PRESSURE + LIVE LOAD SURCHARGE

DESIGN FILL HEIGHT: 1'-0" MIN. TO 2'-0" MAX.
FROM TOP OF CROWN TO TOP OF PAVEMENT.
DESIGN METHOD: LOAD FACTOR PER AASHTO SPECIFICATION
ASSUMED NET ALLOWABLE SOIL BEARING PRESSURE: 2500 PSF*

*AT THE TIME OF DESIGN, A GEOTECHNICAL REPORT FOR THE PROJECT SITE WAS NOT AVAILABLE. IT IS THE PROJECT ENGINEER'S, OWNER'S AND/OR THE CONTRACTOR'S RESPONSIBILITY TO VERIFY THAT THE ACTUAL SITE CONDITIONS AT THE TIME OF CONSTRUCTION ARE CONSISTENT WITH THE ASSUMED ALLOWABLE SOIL BEARING PRESSURE WITH A GEOTECHNICAL INVESTIGATION FROM A QUALIFIED GEOTECHNICAL ENGINEER.

MATERIALS

PRECAST UNITS SHALL BE CONSTRUCTED AND INSTALLED IN ACCORDANCE WITH CON/SPAN® SPECIFICATIONS. CONCRETE FOR FOOTINGS SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4000 PSI. REINFORCING STEEL FOR FOOTINGS SHALL CONFORM TO ASTM A615 OR A996-GRADE 60.



LOCATION PLAN
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CON/SPAN® -SERIES EXPRESS™ Foundations
CONTRACT DRAWING

CAMP RAVENNA
SAND CREEK CULVERT
PORTAGE COUNTY
CAMP RAVENNA, OHIO

PROJECT No.	SEQ. No.	DATE
539111	010	7/13/2016
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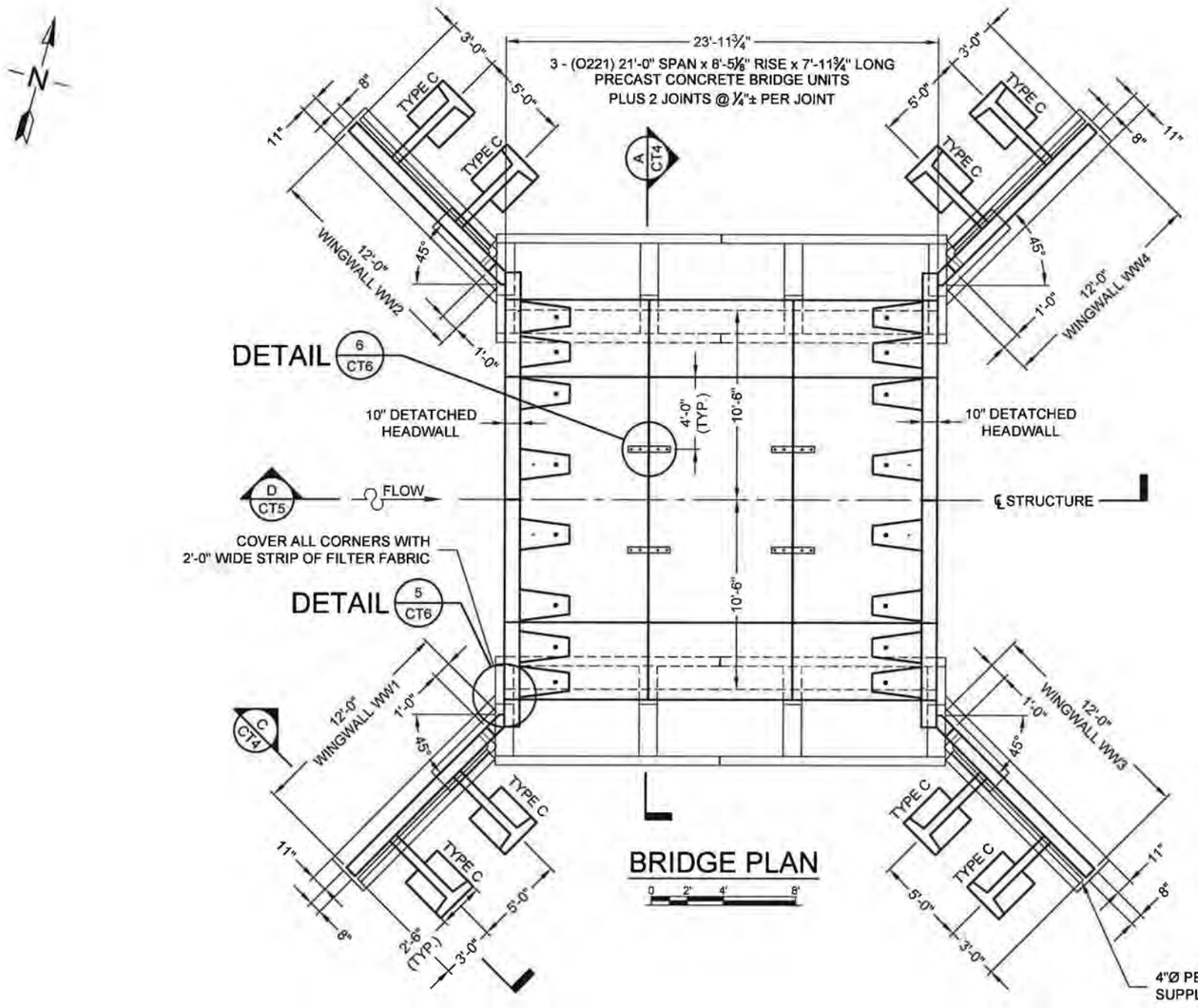
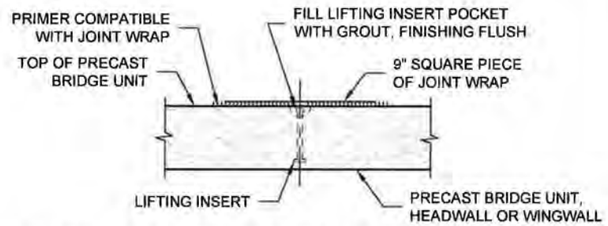
CHECKED: RKC	APPROVED: PAC	
SHEET NO.: CT1 OF CT8		





TYPICAL LIFT INSERT SEALING DETAIL

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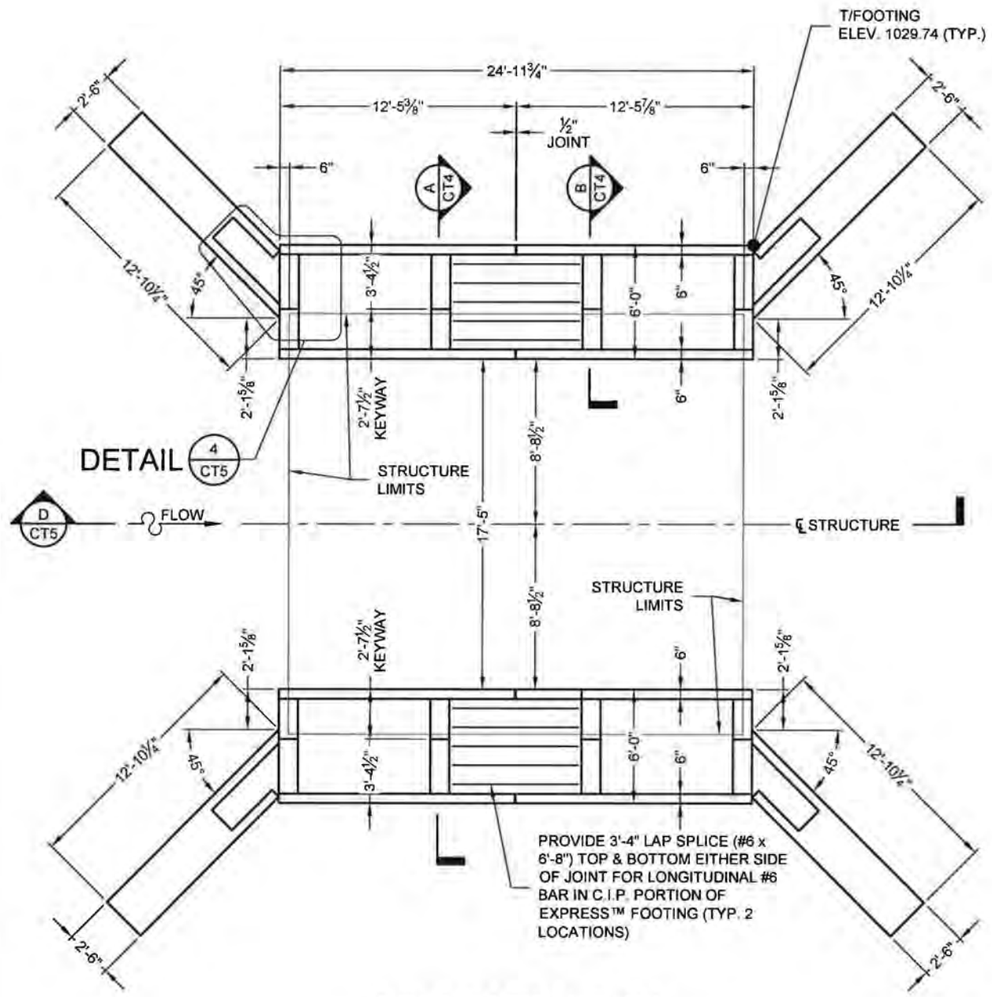
PRECAST REINFORCED CONCRETE EXPRESS™ FOUNDATION NOTES:

1. PRECAST FOUNDATION UNITS SHALL BE CONSTRUCTED AND INSTALLED IN ACCORDANCE WITH SPECIFICATIONS FOR MANUFACTURE AND INSTALLATION OF CON/SPAN BRIDGE SYSTEMS.
2. PRECAST AND CAST-IN-PLACE CONCRETE FOR EXPRESS FOUNDATIONS SHALL HAVE A MINIMUM 28-DAY COMPRESSIVE STRENGTH OF 4000 PSI. REINFORCING STEEL FOR FOUNDATIONS SHALL CONFORM TO ASTM A615 OR A996, GRADE 60.
3. PRECAST FOUNDATION UNITS SHALL BE SET ON A MINIMUM 4-INCH THICK BASE LAYER OF COMPACTED GRANULAR MATERIAL THE FULL WIDTH OF THE FOUNDATION.
4. COMPACTED BACKFILL MATERIAL MUST BE PLACED UP TO THE TOP OF THE PRECAST FOUNDATION UNITS ON BOTH SIDES PRIOR TO PLACING CAST-IN-PLACE CONCRETE PORTION OF FOUNDATIONS.
5. CONCRETE SURFACES WHICH CAST-IN-PLACE CONCRETE WILL BE PLACED AGAINST SHALL BE CLEAN, FREE OF LAITANCE, DIRT, STANDING WATER AND ANY OTHER MATERIAL THAT MAY IMPAIR THE BOND BETWEEN THE PRECAST CONCRETE AND CAST-IN-PLACE CONCRETE.
6. CAST-IN-PLACE CONCRETE MIX USED TO FILL FOUNDATION SHALL BE ABLE TO FLOW INTO ARCH SHIM SPACE OR NON-SHRINK GROUT SHALL BE PLACED UNDER ARCH UNIT LEG AT FOUNDATION CROSS MEMBERS PRIOR TO PLACEMENT OF CAST-IN-PLACE PORTION OF FOUNDATION.
7. IF THE AMBIENT TEMPERATURE AT THE TIME OF PLACEMENT OF CAST-IN-PLACE CONCRETE IS ABOVE 90°F OR EXPECTED TO GO BELOW 35°F DURING THE CURE PERIOD, THE CONTRACTOR SHALL FOLLOW THE REQUIREMENTS OF THE LATEST EDITION OF THE AASHTO LRFD BRIDGE CONSTRUCTION SPECIFICATIONS, SECTION 8.6.2 HOT WEATHER PROTECTION OR SECTION 8.6.4 COLD WEATHER PROTECTION.
8. IF PRECAST ARCH UNITS ARE TO BE ERECTED ON PRECAST FOUNDATION UNITS PRIOR TO PLACEMENT OF CAST-IN-PLACE CONCRETE, THE CABLE TIES/RODS (SHIPPED WITH LONG-SPAN STRUCTURES) MUST REMAIN IN PLACE AND MAY NOT BE REMOVED UNTIL CAST-IN-PLACE CONCRETE HAS REACHED A MINIMUM COMPRESSIVE STRENGTH OF 2000 PSI.
9. IF CABLE TIES/RODS (SHIPPED WITH LONG-SPAN STRUCTURES) MUST BE REMOVED PRIOR TO SETTING OF ARCH UNITS, CAST-IN-PLACE CONCRETE PORTION OF FOUNDATIONS MUST BE PLACED AND ALLOWED TO REACH A MINIMUM COMPRESSIVE STRENGTH OF 2000 PSI BEFORE PLACEMENT OF PRECAST ARCH UNITS, HEADWALLS AND WINGWALLS. CONTRACTOR MUST FOLLOW SPECIFICATION SECTION 13.4 AND NOTIFY CONTECH ENGINEER PRIOR TO REMOVING CABLES TIES/RODS.
10. IF CAST-IN-PLACE CONCRETE PORTION OF FOUNDATION IS TO BE PLACED PRIOR TO SETTING OF ARCH UNITS, HEADWALLS OR WINGWALLS, CAST-IN-PLACE CONCRETE SHALL REACH A MINIMUM COMPRESSIVE STRENGTH OF 2000 PSI BEFORE PRECAST ARCH UNITS, HEADWALLS AND WINGWALLS ARE SET.
11. FOUNDATION CONCRETE SHALL REACH ITS FULL DESIGN STRENGTH BEFORE BACKFILLING OF ARCH UNITS MAY COMMENCE.



FOUNDATION PLAN

0 2' 4' 8'

CAST IN PLACE CONCRETE VOLUME: 17.47 CUBIC YARDS CONCRETE VOLUME IS ACTUAL REQUIRED AMOUNT AND SHOULD BE INCREASED FOR ANTICIPATED LEAKAGE, WASTE, ETC.

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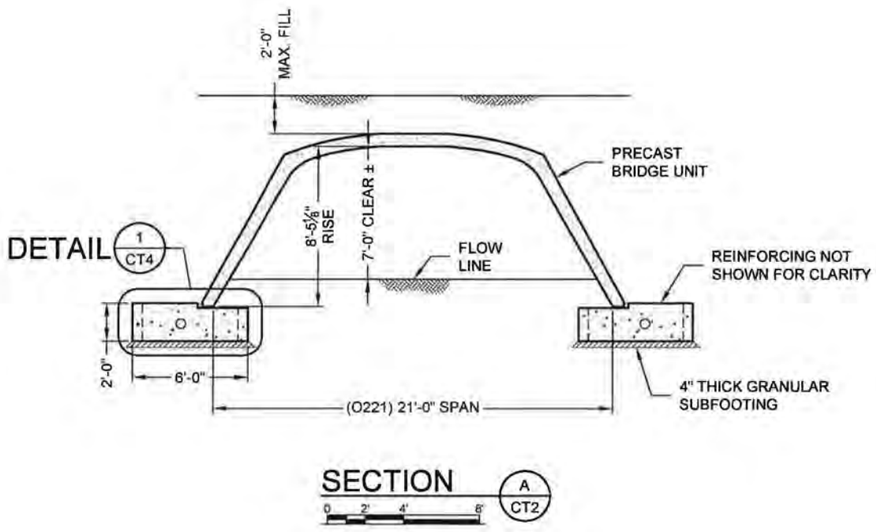
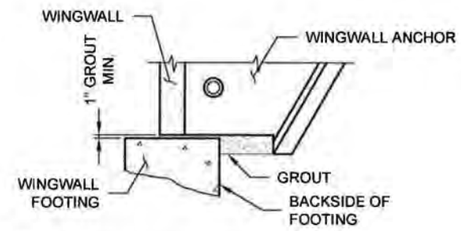


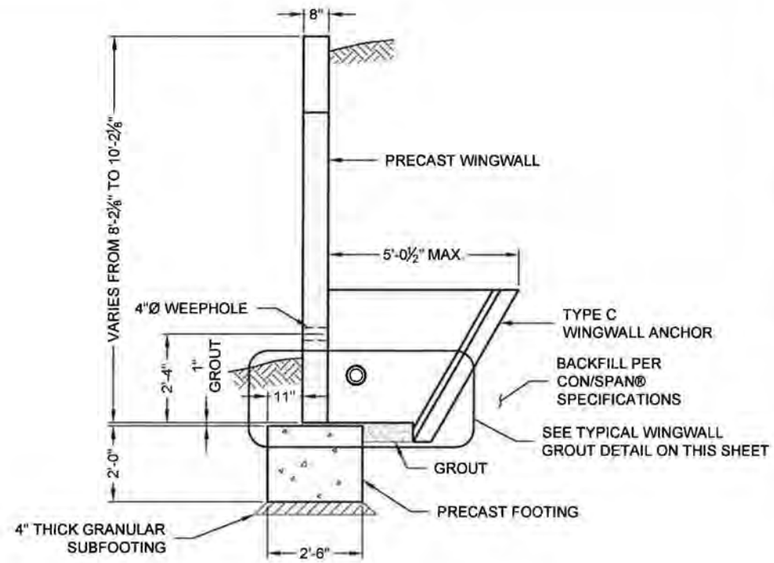
SECTION A CT2



NOTES:
- MINIMUM 1" GROUT UNDER WINGWALL LEG & ANCHOR STEM.
- AREA BETWEEN WINGWALL FOOTING AND WINGWALL ANCHOR SHALL BE GROUTED SOLID BEFORE BACKFILL.
- FORM BACKSIDE OF FOOTING TO DIMENSIONS SHOWN ON FOUNDATION PLAN.

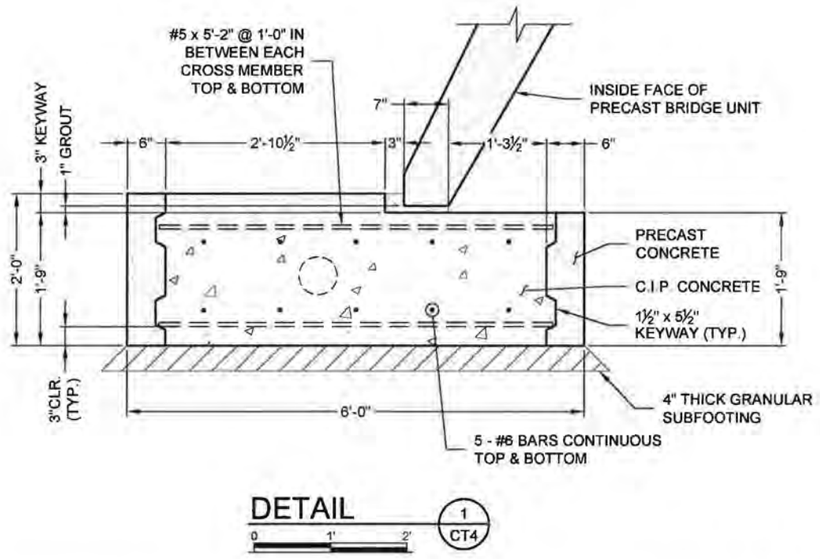
TYPICAL WINGWALL GROUT DETAIL

NOT TO SCALE



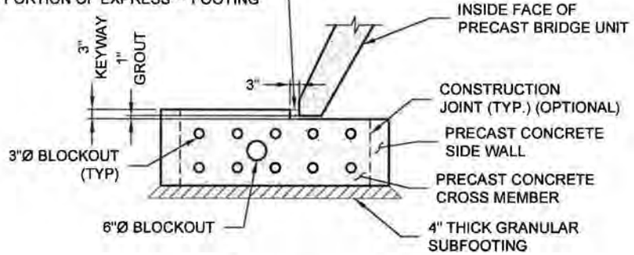
SECTION C CT2

NOTE: A MINIMUM BEARING CAPACITY OF 2500 PSF TO BE CONFIRMED IN FIELD BY OTHERS.



DETAIL 1 CT4

CONCRETE MIX USED TO FILL EXPRESS™ FOOTING MUST BE ABLE TO BE WORKED UNDER ARCH SHIM SPACE, OR NON SHRINK GROUT USED UNDER ARCH LEG PRIOR TO POURING CIP PORTION OF EXPRESS™ FOOTING



SECTION B CT3

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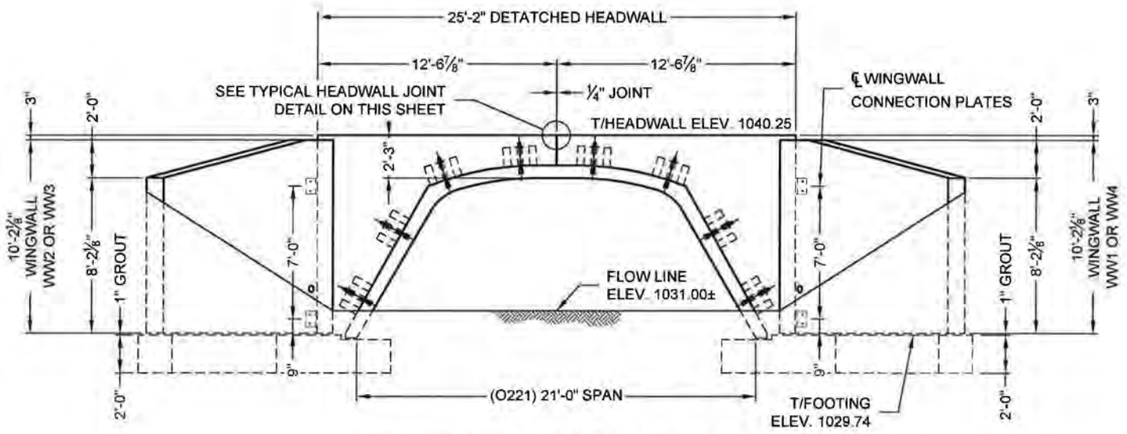
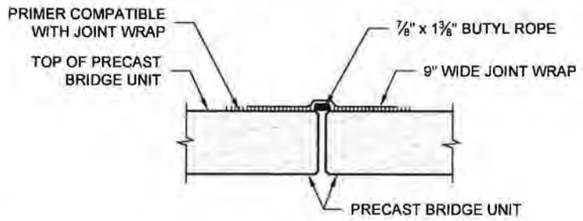


TYPICAL END ELEVATION

0 2' 4' 8'



TYPICAL JOINT SEAL DETAIL

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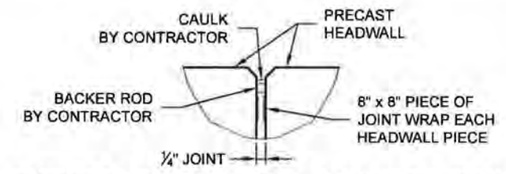
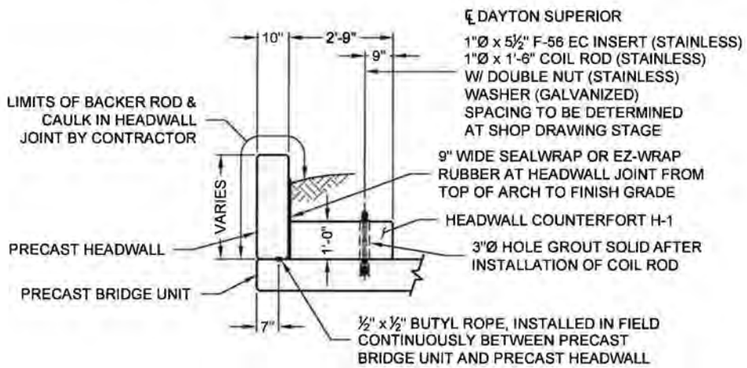


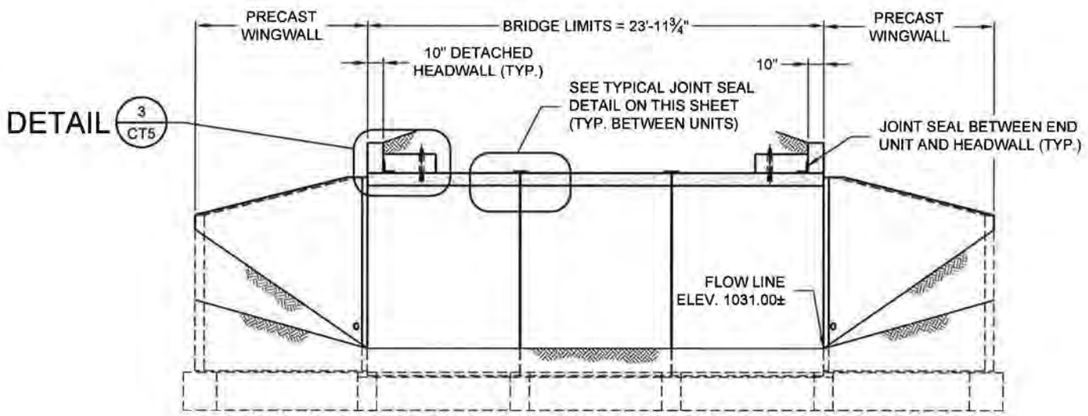
TYPICAL HEADWALL JOINT DETAIL

NOT TO SCALE



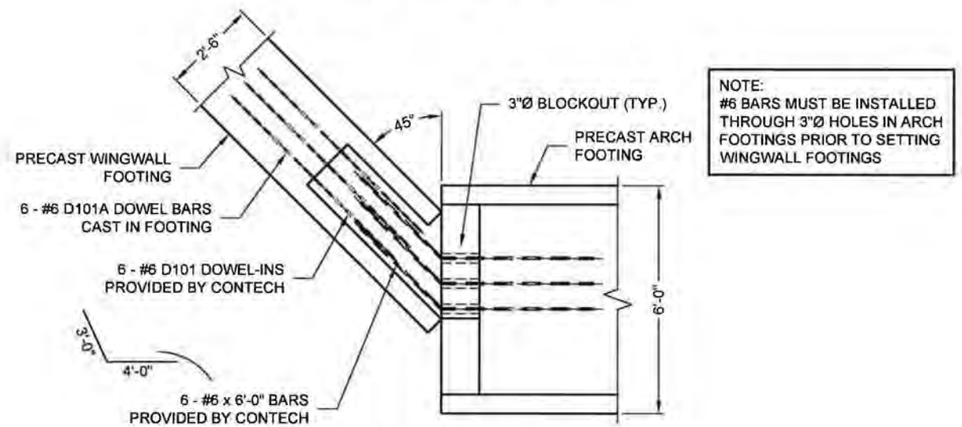
DETAIL 3 CT5

0 1' 2' 4'



SECTION D CT2

0 2' 4' 8'



NOTE:
#6 BARS MUST BE INSTALLED THROUGH 3"Ø HOLES IN ARCH FOOTINGS PRIOR TO SETTING WINGWALL FOOTINGS

DETAIL 4 CT3

0 1' 2' 4'

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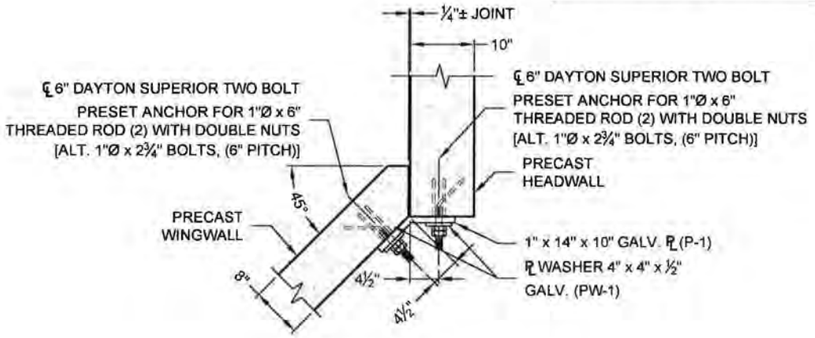
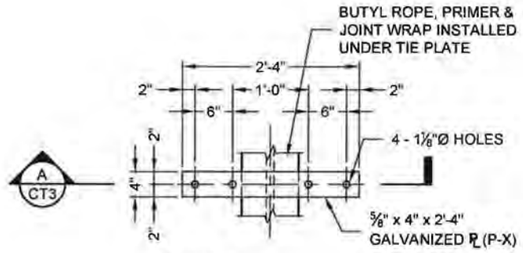
NOTE:
CONNECTION ℄'S (P-1) MUST BE POSITIONED WITH SMALL Ø HOLES TOWARD PRECAST HEADWALL



DETAIL @ HEADWALL (5 / CT2)

0 1' 2'



DETAIL (# / CT2)
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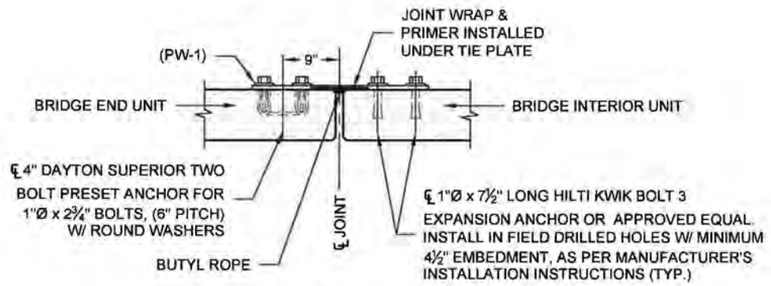

SECTION (A / CT2)
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SPECIFICATIONS FOR MANUFACTURE AND INSTALLATION OF CON/SPAN® O-SERIES BRIDGE SYSTEMS

1. DESCRIPTION
   1.1. TYPE - THIS WORK SHALL CONSIST OF FURNISHING AND CONSTRUCTING A CON/SPAN® O-SERIES BRIDGE SYSTEM IN ACCORDANCE WITH THESE SPECIFICATIONS AND IN REASONABLY CLOSE CONFORMITY WITH THE LINES, GRADES, DESIGN AND DIMENSIONS SHOWN ON THE PLANS OR AS ESTABLISHED BY THE ENGINEER. IN SITUATIONS WHERE TWO OR MORE SPECIFICATIONS APPLY TO THIS WORK, THE MOST STRINGENT REQUIREMENTS SHALL GOVERN.
   1.2. DESIGNATION - PRECAST REINFORCED CONCRETE CON/SPAN® O-SERIES BRIDGE UNITS MANUFACTURED IN ACCORDANCE WITH THIS SPECIFICATION SHALL BE DESIGNATED BY SPAN AND RISE. PRECAST REINFORCED CONCRETE WINGWALLS AND HEADWALLS MANUFACTURED IN ACCORDANCE WITH THIS SPECIFICATION SHALL BE DESIGNATED BY LENGTH, HEIGHT, AND DEFLECTION ANGLE. PRECAST REINFORCED CONCRETE EXPRESS™ FOUNDATION UNITS MANUFACTURED IN ACCORDANCE WITH THIS SPECIFICATION SHALL BE DESIGNATED BY LENGTH, HEIGHT AND WIDTH.

2. DESIGN
   2.1. SPECIFICATIONS - THE PRECAST ELEMENTS ARE DESIGNED IN ACCORDANCE WITH THE "STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES" 17TH EDITION, ADOPTED BY THE AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS, 2002. A MINIMUM OF ONE FOOT OF COVER ABOVE THE CROWN OF THE BRIDGE UNITS IS REQUIRED IN THE INSTALLED CONDITION. (UNLESS NOTED OTHERWISE ON THE SHOP DRAWINGS AND DESIGNED ACCORDINGLY.)

3. MATERIALS
   3.1. CONCRETE - THE CONCRETE FOR THE PRECAST ELEMENTS SHALL BE AIR-ENTRAINED WHEN INSTALLED IN AREAS SUBJECT TO FREEZE-THAW CONDITIONS, COMPOSED OF PORTLAND CEMENT, FINE AND COARSE AGGREGATES, ADMIXTURES AND WATER. AIR-ENTRAINED CONCRETE SHALL CONTAIN 6 ± 2 PERCENT AIR. THE AIR- ENTRAINING ADMIXTURE SHALL CONFORM TO AASHTO M154. THE MINIMUM CONCRETE COMPRESSIVE STRENGTH SHALL BE AS SHOWN ON THE SHOP DRAWINGS.
      3.1.1. PORTLAND CEMENT - SHALL CONFORM TO THE REQUIREMENTS OF ASTM SPECIFICATIONS C150-TYPE I, TYPE II, OR TYPE III CEMENT.
      3.1.2. COARSE AGGREGATE - SHALL CONSIST OF STONE HAVING A MAXIMUM SIZE OF 1 INCH. AGGREGATE SHALL MEET REQUIREMENTS FOR ASTM C33.
      3.1.3. WATER REDUCING ADMIXTURE - THE MANUFACTURER MAY SUBMIT, FOR APPROVAL BY THE ENGINEER, A WATER-REDUCING ADMIXTURE FOR THE PURPOSE OF INCREASING WORKABILITY AND REDUCING THE WATER REQUIREMENT FOR THE CONCRETE.
      3.1.4. CALCIUM CHLORIDE - THE ADDITION TO THE MIX OF CALCIUM CHLORIDE OR ADMIXTURES CONTAINING CALCIUM CHLORIDE WILL NOT BE PERMITTED.
      3.1.5. MIXTURE - THE AGGREGATES, CEMENT AND WATER SHALL BE PROPORTIONED AND MIXED IN A BATCH MIXER TO PRODUCE A HOMOGENEOUS CONCRETE MEETING THE STRENGTH REQUIREMENTS OF THIS SPECIFICATION. THE PROPORTION OF PORTLAND CEMENT IN THE MIXTURE SHALL NOT BE LESS THAN 564 POUNDS (6 SACKS) PER CUBIC YARD OF CONCRETE.
   3.2. STEEL REINFORCEMENT
      3.2.1. THE MINIMUM STEEL YIELD STRENGTH SHALL BE 60,000 PSI. UNLESS OTHERWISE NOTED ON THE SHOP DRAWINGS.
      3.2.2. ALL REINFORCING STEEL FOR THE PRECAST ELEMENTS SHALL BE FABRICATED AND PLACED IN ACCORDANCE WITH THE DETAILED SHOP DRAWINGS SUBMITTED BY THE MANUFACTURER.
      3.2.3. REINFORCEMENT SHALL CONSIST OF WELDED WIRE REINFORCING CONFORMING TO ASTM SPECIFICATION A 1064, OR DEFORMED BILLET STEEL BARS CONFORMING TO ASTM SPECIFICATION A 615, GRADE 60. LONGITUDINAL DISTRIBUTION REINFORCEMENT MAY CONSIST OF WELDED WIRE FABRIC OR DEFORMED BILLET-STEEL BARS.
   3.3. STEEL HARDWARE
      3.3.1. BOLTS AND THREADED RODS FOR WINGWALL CONNECTIONS SHALL CONFORM TO ASTM A 307. NUTS SHALL CONFORM TO AASHTO M292 (ASTM A194) GRADE 2H. ALL BOLTS, THREADED RODS AND NUTS USED IN WINGWALL CONNECTIONS SHALL BE MECHANICALLY ZINC COATED IN ACCORDANCE WITH ASTM B695 CLASS 50.
      3.3.2. STRUCTURAL STEEL FOR WINGWALL CONNECTION PLATES AND PLATE WASHERS SHALL CONFORM TO AASHTO M 270 (ASTM A 709) GRADE 36 AND SHALL BE HOT DIP GALVANIZED AS PER AASHTO M111 (ASTM A123).
      3.3.3. INSERTS FOR WINGWALLS SHALL BE 1" DIAMETER TWO-BOLT PRESET WINGWALL ANCHORS AS MANUFACTURED BY DAYTON SUPERIOR CONCRETE ACCESSORIES, MIAMISBURG, OHIO, (800) 745-3700 AND SHALL BE MECHANICALLY ZINC COATED IN ACCORDANCE WITH ASTM B695 CLASS 50.
      3.3.4. FERRULE LOOP INSERTS SHALL BE F-64 FERRULE LOOP INSERTS AS MANUFACTURED BY DAYTON SUPERIOR CONCRETE ACCESSORIES, MIAMISBURG, OHIO, (800) 745-3700.
      3.3.5. HOOK BOLTS USED IN ATTACHED HEADWALL CONNECTIONS SHALL BE ASTM A307.
      3.3.6. INSERTS FOR DETACHED HEADWALL CONNECTIONS SHALL BE AISI TYPE 304 STAINLESS STEEL, EXPANDED COIL INSERTS AS MANUFACTURED BY DAYTON SUPERIOR CONCRETE ACCESSORIES, MIAMISBURG, OHIO, (800) 745-3700. COIL RODS AND NUTS USED IN HEADWALL CONNECTIONS SHALL BE AISI TYPE 304 STAINLESS STEEL. WASHERS USED IN HEADWALL CONNECTIONS SHALL BE EITHER AISI TYPE 304 STAINLESS STEEL PLATE WASHERS OR AASHTO M270 (ASTM A709) GRADE 36 PLATE WASHERS HOT DIP GALVANIZED AS PER AASHTO M111 (ASTM A123).
      3.3.7. MECHANICAL SPLICES OF REINFORCING BARS SHALL BE MADE USING THE DOWEL BAR SPLICER SYSTEM AS MANUFACTURED BY DAYTON SUPERIOR CONCRETE ACCESSORIES, MIAMISBURG, OHIO, (800) 745-3700, AND SHALL CONSIST OF THE DOWEL BAR SPLICER (DB-SAE) AND DOWEL-IN (DI).

4. MANUFACTURE OF PRECAST ELEMENTS - SUBJECT TO THE PROVISIONS OF SECTION 5, BELOW, THE PRECAST ELEMENT DIMENSION AND REINFORCEMENT DETAILS SHALL BE AS PRESCRIBED IN THE PLAN AND SHOP DRAWINGS PROVIDED BY THE MANUFACTURER.
   4.1. FORMS - THE FORMS USED IN MANUFACTURE SHALL BE SUFFICIENTLY RIGID AND ACCURATE TO MAINTAIN THE REQUIRED PRECAST ELEMENT DIMENSIONS WITHIN THE PERMISSIBLE VARIATIONS GIVEN IN SECTION 5 OF THESE SPECIFICATIONS. ALL CASTING SURFACES SHALL BE OF A SMOOTH MATERIAL.
   4.2. PLACEMENT OF REINFORCEMENT
      4.2.1. PLACEMENT OF REINFORCEMENT IN PRECAST BRIDGE UNITS - THE COVER OF CONCRETE OVER THE OUTSIDE CIRCUMFERENTIAL REINFORCEMENT SHALL BE 2" MINIMUM. THE COVER OF CONCRETE OVER THE INSIDE CIRCUMFERENTIAL REINFORCEMENT SHALL BE 1½" MINIMUM, UNLESS OTHERWISE NOTED ON THE SHOP DRAWINGS. THE CLEAR DISTANCE OF THE END CIRCUMFERENTIAL WIRES SHALL NOT BE LESS THAN 1" NOR MORE THAN 2" FROM THE ENDS OF EACH SECTION. REINFORCEMENT SHALL BE ASSEMBLED UTILIZING SINGLE OR MULTIPLE LAYERS OF WELDED WIRE FABRIC (NOT TO EXCEED 3 LAYERS), SUPPLEMENTED WITH A SINGLE LAYER OF DEFORMED BILLET-STEEL BARS, WHEN NECESSARY. WELDED WIRE FABRIC SHALL BE COMPOSED OF CIRCUMFERENTIAL AND LONGITUDINAL WIRES MEETING THE SPACING REQUIREMENTS OF 4.3, BELOW, AND SHALL CONTAIN SUFFICIENT LONGITUDINAL WIRES EXTENDING THROUGH THE BRIDGE UNIT TO MAINTAIN THE SHAPE AND POSITION OF THE REINFORCEMENT. LONGITUDINAL DISTRIBUTION REINFORCEMENT MAY BE WELDED WIRE FABRIC OR DEFORMED BILLET-STEEL BARS AND SHALL MEET THE SPACING REQUIREMENTS OF 4.3, BELOW. THE ENDS OF THE LONGITUDINAL DISTRIBUTION REINFORCEMENT SHALL BE NOT MORE THAN 3" AND NOT LESS THAN 1½" FROM THE ENDS OF THE BRIDGE UNIT.
      4.2.2. BENDING OF REINFORCEMENT FOR PRECAST BRIDGE UNITS - THE OUTSIDE AND INSIDE CIRCUMFERENTIAL REINFORCING STEEL FOR THE CORNERS OF THE BRIDGE SHALL BE BENT TO SUCH AN ANGLE THAT IS APPROXIMATELY EQUAL TO THE CONFIGURATION OF THE BRIDGE'S OUTSIDE CORNER.
      4.2.3. PLACEMENT OF REINFORCEMENT FOR PRECAST WINGWALLS AND HEADWALLS - THE COVER OF CONCRETE OVER THE LONGITUDINAL AND TRANSVERSE REINFORCEMENT SHALL BE 2" MINIMUM. THE CLEAR DISTANCE FROM THE END OF EACH PRECAST ELEMENT TO THE END OF REINFORCING STEEL SHALL NOT BE LESS THAN 1½" NOR MORE THAN 3". REINFORCEMENT SHALL BE ASSEMBLED UTILIZING A SINGLE LAYER OF WELDED WIRE FABRIC, OR A SINGLE LAYER OF DEFORMED BILLET-STEEL BARS. WELDED WIRE FABRIC SHALL BE COMPOSED OF TRANSVERSE AND LONGITUDINAL WIRES MEETING THE SPACING REQUIREMENTS OF 4.3, BELOW, AND SHALL CONTAIN SUFFICIENT LONGITUDINAL WIRES EXTENDING THROUGH THE ELEMENT TO MAINTAIN THE SHAPE AND POSITION OF THE REINFORCEMENT. LONGITUDINAL REINFORCEMENT MAY BE WELDED WIRE FABRIC OR DEFORMED BILLET-STEEL BARS AND SHALL MEET THE SPACING REQUIREMENTS OF 4.3, BELOW.
      4.2.4. PLACEMENT OF REINFORCEMENT FOR PRECAST FOUNDATION UNITS - THE COVER OF CONCRETE OVER THE BOTTOM REINFORCEMENT SHALL BE 3 INCHES MINIMUM. THE COVER OF CONCRETE FOR ALL OTHER REINFORCEMENT SHALL BE 2 INCHES MINIMUM. THE CLEAR DISTANCE FROM THE END OF EACH PRECAST ELEMENT TO THE END OF REINFORCING STEEL SHALL NOT BE LESS THAN 2 INCHES NOR MORE THAN 3 INCHES. REINFORCEMENT SHALL BE ASSEMBLED UTILIZING A SINGLE LAYER OF WELDED WIRE FABRIC OR A SINGLE LAYER OF DEFOREMED BILLET-STEEL BARS. WELDED WIRE FABRIC SHALL BE COMPOSED OF TRANSVERSE AND LONGITUDINAL WIRES MEETING THE SPACING REQUIREMENTS OF 4.3, BELOW, AND SHALL CONTAIN SUFFICIENT LONGITUDINAL WIRES EXTENDING THROUGH THE ELEMENT TO MAINTAIN THE SHAPE AND POSITION OF THE REINFORCEMENT. LONGITUDINAL REINFORCEMENT MAY BE WELDED WIRE FABRIC OR DEFORMED BILLET-STEEL BARS AND SHALL MEET THE SPACING REQUIREMENTS OF 4.3, BELOW.
   4.3. LAPS, WELDS, SPACING
      4.3.1. LAPS, WELDS, AND SPACING FOR PRECAST BRIDGE UNITS - TENSION SPLICES IN THE CIRCUMFERENTIAL REINFORCEMENT SHALL BE MADE BY LAPPING. LAPS MAY BE TACK WELDED TOGETHER FOR ASSEMBLY PURPOSES. FOR SMOOTH WELDED WIRE FABRIC, THE OVERLAP SHALL MEET THE REQUIREMENTS OF AASHTO 5.11.2.5.2 AND 5.11.6.2. FOR DEFORMED WELDED WIRE FABRIC, THE OVERLAP SHALL MEET THE REQUIREMENTS OF AASHTO 5.11.2.5.1 AND 5.11.6.1. THE OVERLAP OF WELDED WIRE FABRIC SHALL BE MEASURED BETWEEN THE OUTER-MOST LONGITUDINAL WIRES OF EACH FABRIC SHEET. FOR DEFORMED BILLET-STEEL BARS, THE OVERLAP SHALL MEET THE REQUIREMENTS OF AASHTO 5.11.2.1 FOR SPLICES OTHER THAN TENSION SPLICES. THE OVERLAP SHALL BE A MINIMUM OF 1'-0" FOR WELDED WIRE FABRIC OR DEFORMED BILLET-STEEL BARS. THE SPACING CENTER TO CENTER OF THE CIRCUMFERENTIAL WIRES IN A WIRE FABRIC SHEET SHALL BE NOT LESS THAN 2" NOR MORE THAN 4". THE SPACING CENTER TO CENTER OF THE LONGITUDINAL WIRES SHALL NOT BE MORE THAN 8". THE SPACING CENTER TO CENTER OF THE LONGITUDINAL DISTRIBUTION STEEL FOR EITHER LINE OF REINFORCING IN THE TOP SLAB SHALL BE NOT MORE THAN 1'-4".
      4.3.2. LAPS, WELDS, AND SPACING FOR PRECAST WINGWALLS, HEADWALLS AND FOUNDATIONS - SPLICES IN THE REINFORCEMENT SHALL BE MADE BY LAPPING. LAPS MAY BE TACK WELDED TOGETHER FOR ASSEMBLY PURPOSES. FOR SMOOTH WELDED WIRE FABRIC, THE OVERLAP SHALL MEET THE REQUIREMENTS OF AASHTO 5.11.2.5.2 AND 5.11.6.2. FOR DEFORMED WELDED WIRE FABRIC, THE OVERLAP SHALL MEET THE REQUIREMENTS OF AASHTO 5.11.2.5.1 AND 5.11.6.1. FOR DEFORMED BILLET-STEEL BARS, THE OVERLAP SHALL MEET THE REQUIREMENTS OF AASHTO 5.11.2.1. THE SPACING CENTER-TO-CENTER OF THE WIRES IN A WIRE FABRIC SHEET SHALL BE NOT LESS THAN 2" NOR MORE THAN 8".
   4.4. CURING - THE PRECAST CONCRETE ELEMENTS SHALL BE CURED FOR A SUFFICIENT LENGTH OF TIME SO THAT THE CONCRETE WILL DEVELOP THE SPECIFIED COMPRESSIVE STRENGTH IN 28 DAYS OR LESS. ANY ONE OF THE FOLLOWING METHODS OF CURING OR COMBINATIONS THERE OF SHALL BE USED.
      4.4.1. STEAM CURING - THE PRECAST ELEMENTS MAY BE LOW-PRESSURE STEAM CURED BY A SYSTEM THAT WILL MAINTAIN A MOIST ATMOSPHERE.
      4.4.2. WATER CURING - THE PRECAST ELEMENTS MAY BE WATER CURED BY ANY METHOD THAT WILL KEEP THE SECTIONS MOIST.
      4.4.3. MEMBRANE CURING - A SEALING MEMBRANE CONFORMING TO THE REQUIREMENTS OF ASTM SPECIFICATION C309 MAY BE APPLIED AND SHALL BE LEFT INTACT UNTIL THE REQUIRED CONCRETE COMPRESSIVE STRENGTH IS ATTAINED. THE CONCRETE TEMPERATURE AT THE TIME OF APPLICATION SHALL BE WITHIN +/- 10 DEGREES F OF THE ATMOSPHERIC TEMPERATURE. ALL SURFACES SHALL BE KEPT MOIST PRIOR TO THE APPLICATION OF THE COMPOUNDS AND SHALL BE DAMP WHEN THE COMPOUND IS APPLIED.
   4.5. STORAGE, HANDLING & DELIVERY
      4.5.1. STORAGE – PRECAST CONCRETE BRIDGE ELEMENTS SHALL BE LIFT NOT BENT AND STORED IN "AS-CAST" POSITION. PRECAST CONCRETE HEADWALL AND WINGWALL UNITS ARE CAST, STORED AND SHIPPED IN A FLAT POSITION. THE PRECAST ELEMENTS SHALL BE STORED IN SUCH A MANNER TO PREVENT CRACKING OR DAMAGE. STORE ELEMENTS USING TIMBER SUPPORTS AS APPROPRIATE. THE UNITS SHALL NOT BE MOVED UNTIL THE CONCRETE COMPRESSIVE STRENGTH HAS REACHED A MINIMUM OF 2500 PSI, AND THEY SHALL NOT BE STORED IN AN UPRIGHT POSITION.
      4.5.2. HANDLING - HANDLING DEVICES SHALL BE PERMITTED IN EACH PRECAST ELEMENT FOR THE PURPOSE OF HANDLING AND SETTING. SPREADER BEAMS MAY BE REQUIRED FOR THE LIFTING OF PRECAST CONCRETE BRIDGE ELEMENTS TO PRECLUDE DAMAGE FROM BENDING OR TORSION FORCES.
      4.5.3. DELIVERY - PRECAST CONCRETE ELEMENTS MUST NOT BE SHIPPED UNTIL THE CONCRETE HAS ATTAINED THE SPECIFIED DESIGN COMPRESSIVE STRENGTH, OR AS DIRECTED BY THE DESIGN ENGINEER. PRECAST CONCRETE ELEMENTS MAY BE UNLOADED AND PLACED ON THE GROUND AT THE SITE UNTIL INSTALLED. STORE ELEMENTS USING TIMBER SUPPORTS AS APPROPRIATE.
   4.6. QUALITY ASSURANCE - THE PRECASTER SHALL DEMONSTRATE ADHERENCE TO THE STANDARDS SET FORTH IN THE NPCA QUALITY CONTROL MANUAL. THE PRECASTER SHALL MEET EITHER SECTION 4.6.1 OR 4.6.2
      4.6.1. CERTIFICATION - THE PRECASTER SHALL BE CERTIFIED BY THE PRECAST/PRESTRESSED CONCRETE INSTITUTE PLANT CERTIFICATION PROGRAM OR THE NATIONAL PRECAST CONCRETE ASSOCIATION'S PLANT CERTIFICATION PROGRAM PRIOR TO AND DURING PRODUCTION OF THE PRODUCTS COVERED BY THIS SPECIFICATION.
      4.6.2. QUALIFICATIONS, TESTING AND INSPECTION
         4.6.2.1. THE PRECASTER SHALL HAVE BEEN IN THE BUSINESS OF PRODUCING PRECAST CONCRETE PRODUCTS SIMILAR TO THOSE SPECIFIED FOR A MINIMUM OF THREE YEARS. HE SHALL MAINTAIN A PERMANENT QUALITY CONTROL DEPARTMENT OR RETAIN AN INDEPENDENT TESTING AGENCY ON A CONTINUING BASIS. THE AGENCY SHALL ISSUE A REPORT, CERTIFIED BY A LICENSED ENGINEER, DETAILING THE ABILITY OF THE PRECASTER TO PRODUCE QUALITY PRODUCTS CONSISTENT WITH INDUSTRY STANDARDS.
         4.6.2.2. THE PRECASTER SHALL SHOW THAT THE FOLLOWING TESTS ARE PERFORMED IN ACCORDANCE WITH THE ASTM STANDARDS INDICATED. TESTS SHALL BE PERFORMED AS INDICATED IN SECTION 6 OF THESE SPECIFICATIONS.
            4.6.2.2.1. AIR CONTENT: C231 OR C173
            4.6.2.2.2. COMPRESSIVE STRENGTH: C31,C39,C497
         4.6.2.3. THE PRECASTER SHALL PROVIDE DOCUMENTATION DEMONSTRATING COMPLIANCE WITH THIS SECTION TO CONTECH® ENGINEERED SOLUTIONS AT REGULAR INTERVALS OR UPON REQUEST.
         4.6.2.4. THE OWNER MAY PLACE AN INSPECTOR IN THE PLANT WHEN THE PRODUCTS COVERED BY THIS SPECIFICATION ARE BEING MANUFACTURED.
      4.6.3. DOCUMENTATION - THE PRECASTER SHALL SUBMIT PRECAST PRODUCTION REPORTS TO CONTECH® ENGINEERED SOLUTIONS AS REQUIRED.

5. PERMISSIBLE VARIATIONS
   5.1. BRIDGE UNITS
      5.1.1. INTERNAL DIMENSIONS - THE INTERNAL DIMENSION SHALL VARY NOT MORE THAN 1% FROM THE DESIGN DIMENSIONS NOR MORE THAN 1½" WHICHEVER IS LESS.
      5.1.2. SLAB AND WALL THICKNESS - THE SLAB AND WALL THICKNESS SHALL NOT BE LESS THAN THAT SHOWN IN THE DESIGN BY MORE THAN ½". A THICKNESS MORE THAN THAT REQUIRED IN THE DESIGN SHALL NOT BE CAUSE FOR REJECTION.
      5.1.3. LENGTH OF OPPOSITE SURFACES - VARIATIONS IN LAYING LENGTHS OF TWO OPPOSITE SURFACES OF THE BRIDGE UNIT SHALL NOT BE MORE THAN ½" IN ANY SECTION, EXCEPT WHERE BEVELED ENDS FOR LAYING OF CURVES ARE SPECIFIED BY THE PURCHASER.
      5.1.4. LENGTH OF SECTION - THE UNDERRUN IN LENGTH OF A SECTION SHALL NOT BE MORE THAN ½" IN ANY BRIDGE UNIT.
      5.1.5. POSITION OF REINFORCEMENT - THE MAXIMUM VARIATION IN POSITION OF THE REINFORCEMENT SHALL BE ± ½" IN NO CASE SHALL THE COVER OVER THE REINFORCEMENT BE LESS THAN 1½" FOR THE OUTSIDE CIRCUMFERENTIAL STEEL OR BE LESS THAN 1" FOR THE INSIDE CIRCUMFERENTIAL STEEL AS MEASURED TO THE EXTERNAL OR INTERNAL SURFACE OF THE BRIDGE. THESE TOLERANCES OR COVER REQUIREMENTS DO NOT APPLY TO MATING SURFACES OF THE JOINTS.
      5.1.6. AREA OF REINFORCEMENT - THE AREAS OF STEEL REINFORCEMENT SHALL BE THE DESIGN STEEL AREAS AS SHOWN IN THE MANUFACTURER'S SHOP DRAWINGS. STEEL AREAS GREATER THAN THOSE REQUIRED SHALL NOT BE CAUSE FOR REJECTION. THE PERMISSIBLE VARIATION IN DIAMETER OF ANY REINFORCEMENT SHALL CONFORM TO THE TOLERANCES PRESCRIBED IN THE ASTM SPECIFICATION FOR THAT TYPE OF REINFORCEMENT.
   5.2. WINGWALLS & HEADWALLS
      5.2.1. WALL THICKNESS - THE WALL THICKNESS SHALL NOT VARY FROM THAT SHOWN IN THE DESIGN BY MORE THAN ½".
      5.2.2. LENGTH/HEIGHT OF WALL SECTIONS - THE LENGTH AND HEIGHT OF THE WALL SHALL NOT VARY FROM THAT SHOWN IN THE DESIGN BY MORE THAN ½".
      5.2.3. POSITION OF REINFORCEMENT - THE MAXIMUM VARIATION IN THE POSITION OF THE REINFORCEMENT SHALL BE ± ½" IN NO CASE SHALL THE COVER OVER THE REINFORCEMENT BE LESS THAN ½".
      5.2.4. SIZE OF REINFORCEMENT - THE PERMISSIBLE VARIATION IN DIAMETER OF ANY REINFORCING SHALL CONFORM TO THE TOLERANCES PRESCRIBED IN THE ASTM SPECIFICATION FOR THAT TYPE OF REINFORCING. STEEL AREA GREATER THAN THAT REQUIRED SHALL NOT BE CAUSE FOR REJECTION.
   5.3. FOUNDATION UNITS
      5.3.1. WALL THICKNESS - THE WALL THICKNESS SHALL NOT VARY FROM THAT SHOWN IN THE DESIGN BY MORE THAN ½".
      5.3.2. LENGTH/ HEIGHT/WIDTH OF FOUNDATION SECTIONS - THE LENGTH, HEIGHT AND WIDTH OF THE FOUNDATION UNITS SHALL NOT VARY FROM THAT SHOWN IN THE DESIGN BY MORE THAN ½".
      5.3.3. POSITION OF REINFORCEMENT - THE MAXIMUM VARIATION IN THE POSITION OF THE REINFORCEMENT SHALL BE ± ½" IN NO CASE SHALL THE COVER OVER THE REINFORCEMENT BE LESS THAN 1½".
      5.3.4. SIZE OF REINFORCEMENT - THE PERMISSIBLE VARIATION IN DIAMETER OF ANY REINFORCING SHALL CONFORM TO THE TOLERANCES PRESCRIBED IN THE ASTM SPECIFICATION FOR THAT TYPE OF REINFORCING. STEEL AREA GREATER THAN THAT REQUIRED SHALL NOT BE CAUSE FOR REJECTION.

6. TESTING/ INSPECTION
   6.1. TESTING
      6.1.1. TYPE OF TEST SPECIMEN - CONCRETE COMPRESSIVE STRENGTH SHALL BE DETERMINED FROM COMPRESSION TESTS MADE ON CYLINDERS OR CORES. FOR CYLINDER TESTING, A MINIMUM OF 4 CYLINDERS SHALL BE TAKEN FOR EACH BRIDGE ELEMENT. EACH ELEMENT SHALL BE CONSIDERED SEPARATELY FOR THE PURPOSE OF TESTING AND ACCEPTANCE.
      6.1.2. COMPRESSION TESTING - CYLINDERS SHALL BE MADE AND TESTED AS PRESCRIBED BY THE ASTM C39 SPECIFICATION. CYLINDERS SHALL BE CURED IN THE SAME ENVIRONMENT AS THE BRIDGE ELEMENTS. CORES SHALL BE OBTAINED AND TESTED FOR COMPRESSIVE STRENGTH IN ACCORDANCE WITH THE PROVISIONS OF THE ASTM C42 SPECIFICATION.
      6.1.3. ACCEPTABILITY OF CYLINDER TESTS - WHEN THE AVERAGE COMPRESSIVE STRENGTH OF ALL CYLINDERS TESTED IS EQUAL TO OR GREATER THAN THE DESIGN COMPRESSIVE STRENGTH, AND NOT MORE THAN 10% OF THE CYLINDERS TESTED HAVE A COMPRESSIVE STRENGTH LESS THAN THE DESIGN CONCRETE STRENGTH, AND NO CYLINDER TESTED HAS A COMPRESSIVE STRENGTH LESS THAN 80% OF THE DESIGN COMPRESSIVE STRENGTH, THEN THE ELEMENT SHALL BE ACCEPTED. WHEN THE COMPRESSIVE STRENGTH OF THE CYLINDERS TESTED DOES NOT CONFORM TO THESE ACCEPTANCE CRITERIA, THE ACCEPTABILITY OF THE ELEMENT MAY BE DETERMINED AS DESCRIBED IN SECTION 6.1.4, BELOW.
      6.1.4. ACCEPTABILITY OF CORE TESTS - THE COMPRESSIVE STRENGTH OF THE CONCRETE IN A BRIDGE ELEMENT IS ACCEPTABLE WHEN THE AVERAGE CORE TEST STRENGTH IS EQUAL TO OR GREATER THAN THE DESIGN CONCRETE STRENGTH. WHEN THE COMPRESSIVE STRENGTH OF A CORE TESTED IS LESS THAN THE DESIGN CONCRETE STRENGTH, THE PRECAST ELEMENT FROM WHICH THAT CORE WAS TAKEN MAY BE RE-CORED. WHEN THE COMPRESSIVE STRENGTH OF THE RE-CORE IS EQUAL TO OR GREATER THAN THE DESIGN CONCRETE STRENGTH, THE COMPRESSIVE STRENGTH OF THE CONCRETE IN THAT BRIDGE ELEMENT IS ACCEPTABLE.
         6.1.4.1. WHEN THE COMPRESSIVE STRENGTH OF ANY RECORE IS LESS THAN THE DESIGN CONCRETE STRENGTH, THE PRECAST ELEMENT FROM WHICH THAT CORE WAS TAKEN SHALL BE REJECTED.
         6.1.4.2. PLUGGING CORE HOLES - THE CORE HOLES SHALL BE PLUGGED AND SEALED BY THE MANUFACTURER IN A MANNER SUCH THAT THE ELEMENTS WILL MEET ALL OF THE TEST REQUIREMENTS OF THIS SPECIFICATION. PRECAST ELEMENTS SO SEALED SHALL BE CONSIDERED SATISFACTORY FOR USE.
         6.1.4.3. TEST EQUIPMENT - EVERY MANUFACTURER FURNISHING PRECAST ELEMENTS UNDER THIS SPECIFICATION SHALL FURNISH ALL FACILITIES AND PERSONNEL NECESSARY TO CARRY OUT THE TEST REQUIRED.
   6.2. INSPECTION - THE QUALITY OF MATERIALS, THE PROCESS OF MANUFACTURE, AND THE FINISHED PRECAST ELEMENTS SHALL BE SUBJECT TO INSPECTION BY THE PURCHASER.

7. JOINTS
   THE BRIDGE UNITS SHALL BE PRODUCED WITH FLAT BUTT ENDS. THE ENDS OF THE BRIDGE UNITS SHALL BE SUCH THAT WHEN THE SECTIONS ARE LAID TOGETHER THEY WILL MAKE A CONTINUOUS LINE WITH A SMOOTH INTERIOR FREE OF APPRECIABLE IRREGULARITIES, ALL COMPATIBLE WITH THE PERMISSIBLE VARIATIONS IN SECTION 5, ABOVE. THE JOINT WIDTH BETWEEN ADJACENT PRECAST UNITS SHALL NOT EXCEED ¾".

8. WORKMANSHIP/ FINISH
   THE BRIDGE UNITS, WINGWALLS, HEADWALLS AND FOUNDATION UNITS SHALL BE SUBSTANTIALLY FREE OF FRACTURES. THE ENDS OF THE BRIDGE UNITS SHALL BE NORMAL TO THE WALLS AND CENTERLINE OF THE BRIDGE SECTION, WITHIN THE LIMITS OF THE VARIATIONS GIVEN IN SECTION 5, ABOVE, EXCEPT WHERE BEVELED ENDS ARE SPECIFIED. THE FACES OF THE WINGWALLS AND HEADWALLS SHALL BE PARALLEL TO EACH OTHER, WITHIN THE LIMITS OF VARIATIONS GIVEN IN SECTION 5, ABOVE. THE SURFACE OF THE PRECAST ELEMENTS SHALL BE A SMOOTH STEEL FORM OR TROWELED SURFACE. TRAPPED AIR POCKETS CAUSING SURFACE DEFECTS SHALL BE CONSIDERED AS PART OF A SMOOTH, STEEL FORM FINISH.

9. REPAIRS
   PRECAST ELEMENTS MAY BE REPAIRED, IF NECESSARY, BECAUSE OF IMPERFECTIONS IN MANUFACTURE OR HANDLING DAMAGE AND WILL BE ACCEPTABLE IF, IN THE OPINION OF THE PURCHASER, THE REPAIRS ARE SOUND, PROPERLY FINISHED AND CURED, AND THE REPAIRED SECTION CONFORMS TO THE REQUIREMENTS OF THIS SPECIFICATION.

10. REJECTION
    THE PRECAST ELEMENTS SHALL BE SUBJECT TO REJECTION ON ACCOUNT OF ANY OF THE SPECIFICATION REQUIREMENTS. INDIVIDUAL PRECAST ELEMENTS MAY BE REJECTED BECAUSE OF ANY OF THE FOLLOWING.
    10.1 FRACTURES OR CRACKS PASSING THROUGH THE WALL, EXCEPT FOR A SINGLE END CRACK THAT DOES NOT EXCEED ONE HALF THE THICKNESS OF THE WALL.
    10.2 DEFECTS THAT INDICATE PROPORTIONING, MIXING, AND MOLDING NOT IN COMPLIANCE WITH SECTION 4 OF THESE SPECIFICATIONS.
    10.3 HONEYCOMBED OR OPEN TEXTURE.
    10.4 DAMAGED ENDS, WHERE SUCH DAMAGE WOULD PREVENT MAKING A SATISFACTORY JOINT.

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CON/SPAN® O-SERIES® EXPRESS™ Foundations
CONTRACT DRAWING

CAMP RAVENNA
SAND CREEK CULVERT
PORTAGE COUNTY
CAMP RAVENNA, OHIO

PROJECT No.:	SEQ. No.:	DATE:
539111	010	7/13/2016
DESIGNED: CMS	DRAWN: JEM	
CHECKED: RKC	APPROVED: PAC	
SHEET NO.: CT7 OF CT8		

SPECIFICATIONS FOR MANUFACTURE AND INSTALLATION OF CON/SPAN® O-SERIES BRIDGE SYSTEMS (CONT'D)

11. MARKING
EACH BRIDGE UNIT SHALL BE CLEARLY MARKED BY WATERPROOF PAINT. THE FOLLOWING SHALL BE SHOWN ON THE INSIDE OF THE VERTICAL LEG OF THE BRIDGE SECTION:
BRIDGE SPAN x BRIDGE RISE
DATE OF MANUFACTURE
NAME OR TRADEMARK OF THE MANUFACTURER

12. INSTALLATION PREPARATION
TO ENSURE CORRECT INSTALLATION OF THE PRECAST CONCRETE BRIDGE SYSTEM, CARE AND CAUTION MUST BE EXERCISED IN FORMING THE SUPPORT AREAS FOR BRIDGE UNITS, HEADWALL, AND WINGWALL ELEMENTS. EXERCISING SPECIAL CARE WILL FACILITATE THE RAPID INSTALLATION OF THE PRECAST COMPONENTS.

12.1. FOOTINGS
DO NOT OVER EXCAVATE FOUNDATIONS UNLESS DIRECTED BY SITE SOIL ENGINEER TO REMOVE UNSUITABLE SOIL.

THE SITE SOILS ENGINEER SHALL CERTIFY THAT THE BEARING CAPACITY MEETS OR EXCEEDS THE FOOTING DESIGN REQUIREMENTS, PRIOR TO THE CONTRACTOR POURING OF THE FOOTINGS.

THE BRIDGE UNITS AND WINGWALLS SHALL BE INSTALLED ON EITHER PRECAST OR CAST-IN-PLACE CONCRETE FOOTINGS. THE SIZE AND ELEVATION OF THE FOOTINGS SHALL BE AS DESIGNED BY THE ENGINEER. A KEYWAY SHALL BE FORMED IN THE TOP SURFACE OF THE BRIDGE FOOTING AS SPECIFIED ON THE PLANS. NO KEYWAY IS REQUIRED IN THE WINGWALL FOOTINGS, UNLESS OTHERWISE SPECIFIED ON THE PLANS.

THE FOOTINGS SHALL BE GIVEN A SMOOTH FLOAT FINISH AND SHALL REACH A COMPRESSIVE STRENGTH OF 2,000 PSI BEFORE PLACEMENT OF THE BRIDGE AND WINGWALL ELEMENTS. BACKFILLING SHALL NOT BEGIN UNTIL THE FOOTING HAS REACHED THE FULL DESIGN COMPRESSIVE STRENGTH.

THE FOOTING SURFACE SHALL BE CONSTRUCTED IN ACCORDANCE WITH GRADES SHOWN ON THE PLANS. WHEN TESTED WITH A 10'-0" STRAIGHT EDGE, THE SURFACE SHALL NOT VARY MORE THAN ¼" IN 10'-0".

IF A PRECAST CONCRETE FOOTING IS USED, THE CONTRACTOR SHALL PREPARE A 4" THICK BASE LAYER OF COMPACTED GRANULAR MATERIAL THE FULL WIDTH OF THE FOOTING PRIOR TO PLACING THE PRECAST FOOTING.

THE FOUNDATIONS FOR PRECAST CONCRETE BRIDGE ELEMENTS AND WINGWALLS MUST BE CONNECTED BY REINFORCEMENT TO FORM ONE MONOLITHIC BODY. EXPANSION JOINTS SHALL NOT BE USED.

THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE CONSTRUCTION OF THE FOUNDATIONS PER THE PLANS AND SPECIFICATIONS.

13. INSTALLATION
13.1. GENERAL - THE INSTALLATION OF THE PRECAST CONCRETE ELEMENTS SHALL BE AS EXPLAINED IN THE PUBLICATION CON/SPAN BRIDGE SYSTEMS INSTALLATION HANDBOOK.

13.1.1. LIFTING - IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO ENSURE THAT A CRANE OF THE CORRECT LIFTING CAPACITY IS AVAILABLE TO HANDLE THE PRECAST CONCRETE UNITS. THIS CAN BE ACCOMPLISHED BY USING THE WEIGHTS GIVEN FOR THE PRECAST CONCRETE COMPONENTS AND BY DETERMINING THE LIFTING REACH FOR EACH CRANE UNIT. SITE CONDITIONS MUST BE CHECKED WELL IN ADVANCE OF SHIPPING TO ENSURE PROPER CRANE LOCATION AND TO AVOID ANY LIFTING RESTRICTIONS. THE LIFT ANCHORS OR HOLES PROVIDED IN EACH UNIT ARE THE ONLY MEANS TO BE USED TO LIFT THE ELEMENTS. THE PRECAST CONCRETE ELEMENTS MUST NOT BE SUPPORTED OR RAISED BY OTHER MEANS THAN THOSE GIVEN IN THE MANUALS AND DRAWINGS WITHOUT WRITTEN APPROVAL FROM CONTECH® ENGINEERED SOLUTIONS.

13.1.2. CONSTRUCTION EQUIPMENT WEIGHT RESTRICTIONS - IN NO CASE SHALL EQUIPMENT OPERATING IN EXCESS OF THE DESIGN LOAD (HS20 OR HS25) BE PERMITTED OVER THE BRIDGE UNITS UNLESS APPROVED BY CONTECH® ENGINEERED SOLUTIONS.

13.1.2.1. IN THE IMMEDIATE AREA OF THE BRIDGE UNITS, THE FOLLOWING RESTRICTIONS FOR THE USE OF HEAVY CONSTRUCTION MACHINERY DURING BACKFILLING OPERATIONS APPLY:

- NO CONSTRUCTION EQUIPMENT SHALL CROSS THE BARE PRECAST CONCRETE BRIDGE UNIT.
- AFTER THE COMPACTED FILL LEVEL HAS REACHED A MINIMUM OF 4" OVER THE CROWN OF THE BRIDGE, CONSTRUCTION EQUIPMENT WITH A WEIGHT OF LESS THAN 10 TONS MAY CROSS THE BRIDGE.
- AFTER THE COMPACTED FILL LEVEL HAS REACHED A MINIMUM OF 1'-0" OVER THE CROWN OF THE BRIDGE, CONSTRUCTION EQUIPMENT WITH A WEIGHT OF LESS THAN 30 TONS MAY CROSS THE BRIDGE.
- AFTER THE COMPACTED FILL LEVEL HAS REACHED THE DESIGN COVER, OR 2'-0" MINIMUM, OVER THE CROWN OF THE PRECAST CONCRETE BRIDGE, CONSTRUCTION EQUIPMENT WITHIN THE DESIGN LOAD LIMITS FOR THE ROAD MAY CROSS THE PRECAST CONCRETE BRIDGE.

13.2. LEVELING PAD/SHIMS - THE BRIDGE UNITS AND WINGWALLS SHALL BE SET ON HARDBOARD SHIMS CONFORMING TO ASTM D1037 OR PLASTIC SHIMS (DAYTON SUPERIOR P-80, P-81 OR APPROVED EQUAL) MEASURING 5" x 5", MINIMUM, UNLESS SHOWN OTHERWISE ON THE PLANS. A MINIMUM GAP OF ½" SHALL BE PROVIDED BETWEEN THE FOOTING AND THE BOTTOM OF THE BRIDGE'S VERTICAL LEGS OR THE BOTTOM OF THE WINGWALL. ALSO, A SUPPLY OF ½", ¼" AND ⅛" THICK HARDBOARD OR PLASTIC SHIMS FOR VARIOUS SHIMMING PURPOSES SHALL BE ON SITE.

13.3. PLACEMENT OF BRIDGE UNITS - THE BRIDGE UNITS SHALL BE PLACED AS SHOWN ON THE ENGINEER'S PLAN DRAWINGS. SPECIAL CARE SHALL BE TAKEN IN SETTING THE ELEMENTS TO THE TRUE LINE AND GRADE. THE JOINT WIDTH BETWEEN ADJACENT PRECAST UNITS SHALL NOT EXCEED ¾".

13.4. IT IS THE CONTRACTOR'S RESPONSIBILITY TO MAINTAIN THE STRUCTURE SPAN DURING ALL PHASES OF INSTALLATION. DUE TO THE ARCH SHAPE, BRIDGE ELEMENTS WILL TEND TO SPREAD UNDER SELF-WEIGHT. IT IS IMPERATIVE THAT ANY LATERAL SPREADING OF THE BRIDGE ELEMENTS BE AVOIDED DURING AND AFTER THEIR PLACEMENT. GENERALLY, HORIZONTAL CABLE TIES OR TIE RODS ARE SHIPPED IN THE LARGER BRIDGE ELEMENTS TO ASSIST IN PREVENTING THIS SPREADING. CABLE TIES/TIE RODS SHALL NOT BE REMOVED UNTILL BRIDGE UNITS ARE GROUTED AND GROUT HAS CURED. IT IS RECOMMENDED THAT TEMPORARY HARDWOOD BLOCKS BE USED IN CONJUNCTION WITH THE CABLE TIES/TIE RODS TO MAINTAIN SPAN. IF, HOWEVER, DUE TO SITE RESTRICTIONS, THESE CABLE TIES/TIE RODS MUST BE REMOVED PRIOR TO PLACEMENT OF THE BRIDGE ELEMANTS, THE CONTRACTOR MUST NOTIFY CONTECH (MANUFACTURER) AND REQUEST A SUGGESTED INSTALLATION PROCEDURE.

IN ADDITION, IF THE CABLE TIES/TIE RODS MUST BE REMOVED PRIOR TO SETTING ARCH UNITS, THE FOLLOWING QUALITY CONTROL PROCEDURE MUST BE FOLLOWED:
1) FIND "MEASURED SPAN" UPON ARCH UNIT'S DELIVERY TO SITE, PRIOR TO LIFTING FROM TRUCK AND REMOVING CABLE TIES/TIE RODS. "MEASURED SPAN" SHALL BE THE AVERAGE OF (3) SPAN MEASUREMENTS ALONG THE LAY LENGTH OF THE ARCH UNIT.
2) AFTER SETTING OF BRIDGE UNIT ON THE FOUNDATION, VERIFY THE SPAN. THIS "INSTALLED SPAN MEASUREMENT" SHALL NOT EXCEED THE MAXIMUM OF:
A) THE NOMINAL SPAN +½" OR
B) THE "MEASURED SPAN"
IF THE "INSTALLED SPAN MEASUREMENT" EXCEEDS THIS AMOUNT, THE ARCH UNIT SHALL BE LIFTED AND RE-SET UNTIL THE "INSTALLED SPAN MEASUREMENT" MEETS THE LIMITS.

13.5. PLACEMENT OF WINGWALLS, HEADWALLS AND FOUNDATION UNITS - THE WINGWALLS, HEADWALLS AND FOUNDATIONS SHALL BE PLACED AS SHOWN ON THE PLAN DRAWINGS. SPECIAL CARE SHALL BE TAKEN IN SETTING THE ELEMENTS TO THE TRUE LINE AND GRADE.

13.6. WATERPROOFING/JOINT PROTECTION AND SUBSURFACE DRAINAGE

13.6.1. EXTERNAL PROTECTION OF JOINTS - THE BUTT JOINT MADE BY TWO ADJOINING BRIDGE UNITS SHALL BE COVERED WITH A 7⅞" x 1'-3" PREFORMED BITUMINOUS JOINT SEALANT AND A MINIMUM OF A 9" WIDE JOINT WRAP. THE SURFACE SHALL BE FREE OF DIRT BEFORE APPLYING THE JOINT MATERIAL. A PRIMER COMPATIBLE WITH THE JOINT WRAP TO BE USED SHALL BE APPLIED FOR A MINIMUM WIDTH OF 9" ON EACH SIDE OF THE JOINT. THE EXTERNAL WRAP SHALL BE CS212 BY CONCRETE SEALANTS INC., EZ-WRAP RUBBER BY PRESS-SEAL GASKET CORPORATION, SEAL WRAP BY MAR MAC MANUFACTURING CO. INC. OR APPROVED EQUAL. THE JOINT SHALL BE COVERED CONTINUOUSLY FROM THE BOTTOM OF ONE BRIDGE SECTION LEG, ACROSS THE TOP OF THE BRIDGE AND TO THE OPPOSITE BRIDGE SECTION LEG. ANY LAPS THAT RESULT IN THE JOINT WRAP SHALL BE A MINIMUM OF 6" LONG WITH THE OVERLAP RUNNING DOWNHILL.

13.6.2. IN ADDITION TO THE JOINTS BETWEEN BRIDGE UNITS, THE JOINT BETWEEN THE END BRIDGE UNIT AND THE HEADWALL SHALL ALSO BE SEALED AS DESCRIBED ABOVE. IF PRECAST WINGWALLS ARE USED, THE JOINT BETWEEN THE END BRIDGE UNIT AND THE WINGWALL SHALL BE SEALED WITH A 2'-0" STRIP OF FILTER FABRIC. ALSO, IF LIFT HOLES ARE FORMED IN THE BRIDGE UNITS, THEY SHALL BE PRIMED AND COVERED WITH A 9" x 9" SQUARE OF JOINT WRAP.

13.6.3. DURING THE BACKFILLING OPERATION, CARE SHALL BE TAKEN TO KEEP THE JOINT WRAP IN ITS PROPER LOCATION OVER THE JOINT.

13.6.4. SUBSOIL DRAINAGE SHALL BE AS DIRECTED BY THE ENGINEER.

13.7. GROUTING

13.7.1. GROUTING SHALL NOT BE PERFORMED WHEN TEMPERATURES ARE EXPECTED TO GO BELOW 35° FOR A PERIOD OF 72 HOURS. FILL THE BRIDGE-FOUNDATION KEYWAY WITH CEMENT GROUT (PORTLAND CEMENT AND WATER OR CEMENT MORTAR COMPOSED OF PORTLAND CEMENT, SAND AND WATER) WITH A MINIMUM 28-DAY COMPRESSIVE STRENGTH OF 3000 PSI. VIBRATE AS REQUIRED TO ENSURE THAT THE ENTIRE KEY AROUND THE BRIDGE ELEMENT IS COMPLETELY FILLED. IF BRIDGE ELEMENTS HAVE BEEN SET WITH TEMPORARY TIES (CABLES, BARS, ETC.) GROUT MUST ATTAIN A MINIMUM COMPRESSIVE STRENGTH OF 1500 PSI BEFORE TIES MAY BE REMOVED.

13.7.2. ALL GROUT SHALL HAVE A MAXIMUM AGGREGATE SIZE OF ¼".

13.7.3. LIFTING AND ERECTION ANCHOR RECESSES SHALL BE FILLED WITH GROUT.

13.7.4. AFTER GROUT HAS REACHED ITS DESIGN STRENGTH THE TEMPORARY HARDWOOD WEDGES SHALL BE REMOVED AND THEIR HOLES FILLED WITH GROUT.

13.8. BACKFILL

13.8.1. DO NOT PERFORM BACKFILLING DURING WET OR FREEZING WEATHER.

13.8.2. NO BACKFILL SHALL BE PLACED AGAINST ANY STRUCTURAL ELEMENTS UNTIL THEY HAVE BEEN APPROVED BY THE ENGINEER.

13.8.3. BACKFILL SHALL BE CONSIDERED AS ALL REPLACED EXCAVATION AND NEW EMBANKMENT ADJACENT TO THE PRECAST CONCRETE ELEMENTS. THE PROJECT CONSTRUCTION AND MATERIAL SPECIFICATIONS, WHICH INCLUDE THE SPECIFICATIONS FOR EXCAVATION FOR STRUCTURES AND ROADWAY EXCAVATION AND EMBANKMENT CONSTRUCTION, SHALL APPLY EXCEPT AS MODIFIED IN THIS SECTION.

13.8.4. BACKFILL ZONES:

- IN-SITU SOIL
- ZONE A: CONSTRUCTED EMBANKMENT OR OVERFILL
- ZONE B: FILL THAT IS DIRECTLY ASSOCIATED WITH PRECAST CONCRETE BRIDGE INSTALLATION.
- ZONE C: ROAD STRUCTURE.

13.8.5. REQUIRED BACKFILL PROPERTIES

13.8.5.1. IN-SITU SOIL - NATURAL GROUND IS TO BE SUFFICIENTLY STABLE TO ALLOW EFFECTIVE SUPPORT TO THE PRECAST CONCRETE BRIDGE UNITS. AS A GUIDE, THE EXISTING NATURAL GROUND SHOULD BE OF SIMILAR QUALITY AND DENSITY TO ZONE B MATERIAL FOR MINIMUM LATERAL DIMENSION OF ONE BRIDGE SPAN OUTSIDE OF THE BRIDGE FOOTING.

13.8.5.2. ZONE A - ZONE A REQUIRES FILL MATERIAL WITH SPECIFICATIONS AND COMPACTING PROCEDURES EQUAL TO THAT FOR NORMAL ROAD EMBANKMENTS.

13.8.5.3. ZONE B - GENERALLY, SOILS SHALL BE REASONABLY FREE OF ORGANIC MATTER, AND, NEAR CONCRETE SURFACES, FREE OF STONES LARGER THAN 3" IN DIAMETER. SEE CHARTS FOR DETAILED DESCRIPTIONS OF ACCEPTABLE SOILS.

13.8.5.4. ZONE C - ZONE C IS THE ROAD SECTION OF GRAVEL, ASPHALT OR CONCRETE BUILT IN COMPLIANCE WITH LOCAL ENGINEERING PRACTICES.

13.8.5.5. GEOTECHNICAL ENGINEER SHALL REVIEW GRADATIONS OF ALL INTERFACING MATERIALS AND, IF NECESSARY, RECOMMEND GEOTEXTILE FILTER FABRIC (PROVIDED BY CONTRACTOR)

13.8.6. PLACING AND COMPACTING BACKFILL
DUMPING FOR BACKFILLING IS NOT ALLOWED ANY NEARER THAN 3'-0" FROM THE BRIDGE LEG.

THE FILL MUST BE PLACED AND COMPACTED IN LAYERS NOT EXCEEDING 8". THE MAXIMUM DIFFERENCE IN THE SURFACE LEVELS OF THE FILL ON OPPOSITE SIDES OF THE BRIDGE MUST NOT EXCEED 2'-0".

THE FILL BEHIND WINGWALLS MUST BE PLACED AT THE SAME TIME AS THAT OF THE BRIDGE FILL. IT MUST BE PLACED IN PROGRESSIVELY PLACED HORIZONTAL LAYERS NOT EXCEEDING 8" PER LAYER.

THE BACKFILL OF ZONE B SHALL BE COMPACTED TO A MINIMUM DENSITY OF 95% OF THE STANDARD PROCTOR, AS REQUIRED BY AASHTO T-99.

SOIL WITHIN 1'-0" OF CONCRETE SURFACES SHALL BE HAND-COMPACTED. ELSEWHERE, USE OF ROLLERS IS ACCEPTABLE. IF VIBRATING ROLLER-COMPACTORS ARE USED, THEY SHALL NOT BE STARTED OR STOPPED WITHIN ZONE B AND THE VIBRATION FREQUENCY SHOULD BE AT LEAST 30 REVOLUTIONS PER SECOND.

THE BACKFILL MATERIAL AND COMPACTING BEHIND WINGWALLS SHALL SATISFY THE CRITERIA FOR THE BRIDGE BACKFILL, ZONE B.

BACKFILL AGAINST A WATERPROOFED SURFACE SHALL BE PLACED CAREFULLY TO AVOID DAMAGE TO THE WATERPROOFING MATERIAL.

13.8.7. BRIDGE UNITS
FOR FILL HEIGHTS OVER 12 FEET (AS MEASURED FROM TOP CROWN OF BRIDGE TO FINISHED GRADE), NO BACKFILLING MAY BEGIN UNTIL A BACKFILL COMPACTION TESTING PLAN HAS BEEN COORDINATED WITH AND APPROVED BY CONTECH® ENGINEERED SOLUTIONS.

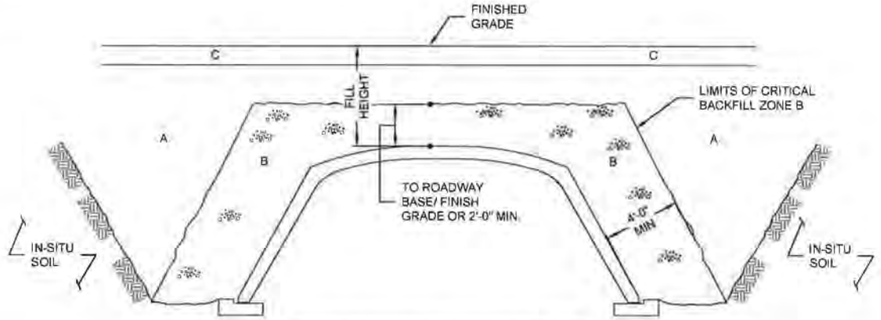
13.8.8. WINGWALLS
BACKFILL IN FRONT OF WINGWALLS SHALL BE CARRIED TO GROUND LINES SHOWN IN THE PLANS.

13.8.9. MONITORING
THE CONTRACTOR SHALL CHECK SETTLEMENTS AND HORIZONTAL DISPLACEMENT OF FOUNDATION TO ENSURE THAT THEY ARE WITHIN THE ALLOWABLE LIMIT PROVIDED BY THE ENGINEER. THESE MEASUREMENTS SHOULD GIVE AN INDICATION OF THE SETTLEMENTS AND DEFORMATIONS ALONG THE LENGTH OF THE FOUNDATIONS.

THE FIRST MEASUREMENT SHOULD TAKE PLACE AFTER THE ERECTION OF ALL PRECAST BRIDGE SYSTEM ELEMENTS. A SECOND AFTER COMPLETION OF BACKFILLING, AND A THIRD BEFORE OPENING OF THE BRIDGE TO TRAFFIC. FURTHER MEASUREMENTS MAY BE MADE ACCORDING TO LOCAL CONDITIONS.

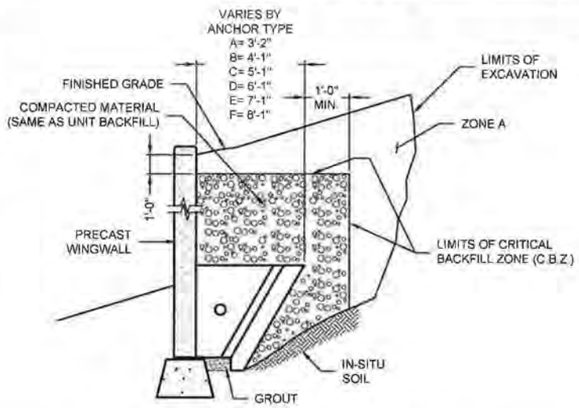
ACCEPTABLE SOILS FOR USE IN ZONE B BACKFILL

TYPICAL USCS MATERIALS	AASHTO GROUP	AASHTO SUBGROUP	PERCENT PASSING US SIEVE NO.			CHARACTER OF FRACTION PASSING NO. 40 SIEVE		SOIL DESRIPTION
			#10	#40	#200	LIQUID LIMIT	PLASTICITY INDEX	
GW, GP, SP	A1	A-1a	50 MAX	30 MAX	15 MAX		6 MAX	LARGELY GRAVEL BUT CAN INCLUDE SAND AND FINES
GM, SW, SP, SM		A-1b		50 MAX	25 MAX		6 MAX	GRAVELLY SAND OR GRADED SAND, MAY INCLUDE FINES
GM, SM, ML, SP, GP	A2	A-2-4			35 MAX	40 MAX	10 MAX	SANDS, GRAVELS WITH LOW-PLASTICITY SILT FINES
SC, GC, GM		A-2-5			35 MAX	41 MIN	10 MAX	SANDS, GRAVELS WITH PLASTIC SILT FINES
SP, SM, SW	A3			51 MIN	10 MAX		NON-PLASTIC	FINE SANDS
ML, SM, SC	A4				36 MIN	40 MAX	10 MAX	LOW-COMPRESSIBILTY SILTS

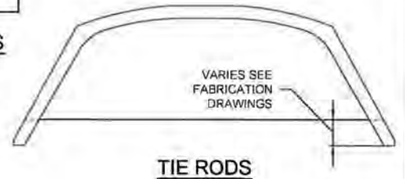


SPAN	FILL HEIGHT	ACCEPTABLE MATERIAL INSIDE ZONE B
≤ 24'-0"	≥ 12'-0"	A1, A3
≤ 24'-0"	< 12'-0"	A1, A2, A3, A4
> 24'-0"	ALL	A1, A3

BACKFILL REQUIREMENTS



WALL BACKFILL REQUIREMENTS



TIE RODS

MARK	DATE	REVISION DESCRIPTION	BY

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CON/SPAN® O-SERIES EXPRESS Foundations
CONTRACT DRAWING

CAMP RAVENNA
SAND CREEK CULVERT
PORTAGE COUNTY
CAMP RAVENNA, OHIO

PROJECT No.:	SEQ. No.:	DATE:
539111	010	7/13/2016
DESIGNED: CMS	DRAWN: JEM	
CHECKED: RKC	APPROVED: PAC	
SHEET NO.: CT8 OF CT8		

I:\MERLIN\PROJECTS\ACTIVE\539100\539111\539111-10-CON_SPAN_O_SERIES\DRAWINGS\CONTRACT\PRE-539111-010-CO-CON-C.DWG 7/13/2016 2:43 PM

APPENDIX F

CONCRETE PAD DESIGN

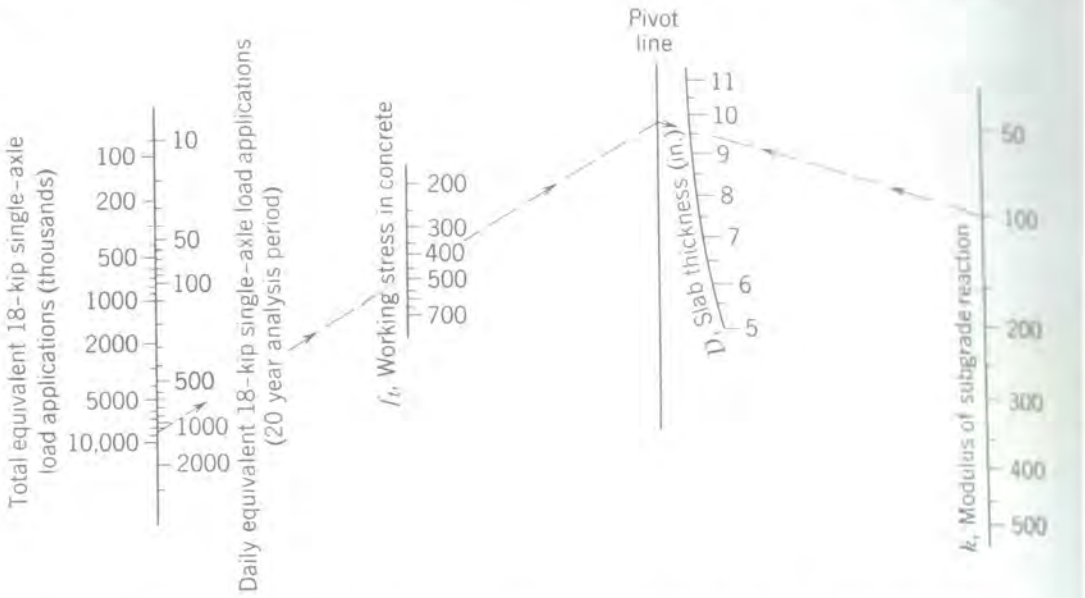


Figure 17.4. Design chart for rigid pavements, $p_t = 2.0$. (From AASHO Interim Guide.)

strate the sensitivity of the factors. It can be seen that the method is sensitive to traffic and quite sensitive to the strength of the concrete itself. The modulus of subgrade reaction has a relatively minor effect. These data are for comparative purposes and must be viewed with some caution, since experience has shown that the unknowns of variability (Chapter 13), and the tenuous methods of estimating traffic (Chapter 4) many times completely override all other considerations.

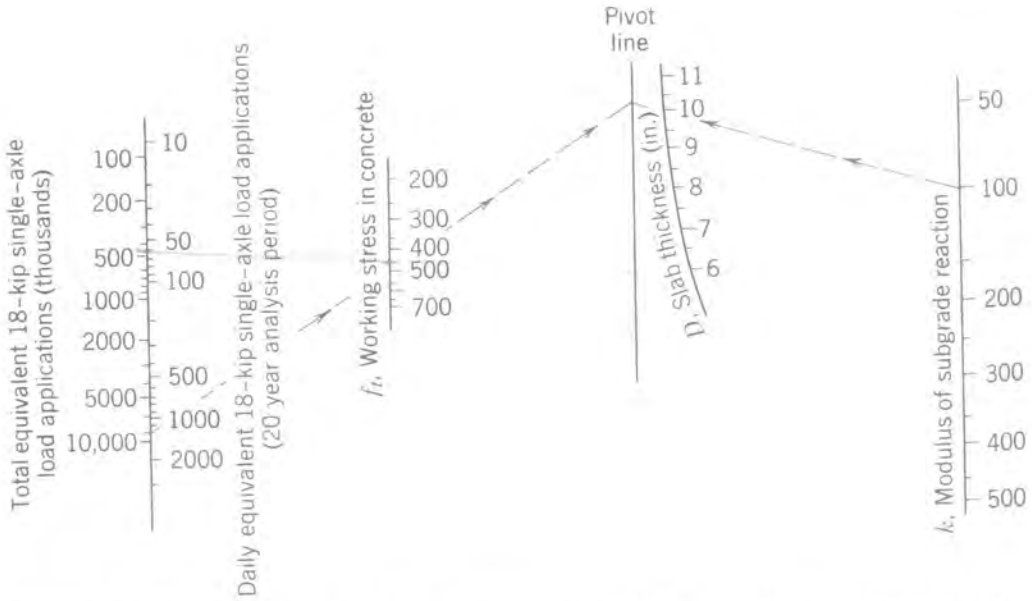


Figure 17.5. Design chart for rigid pavements, $p_t = 2.5$. (From AASHO Interim Guide.)

APPENDIX G

PROJECT FORMS

TETRA TECH

PREPARATORY PHASE CHECKLIST

(CONTINUED ON SECOND PAGE)

SPEC SECTION	DATE
Enter Spec. Section # Here	

CONTRACT NO	DEFINABLE FEATURE OF WORK	SCHEDULE ACT NO.	INDEX #

PERSONNEL PRESENT

GOVERNMENT REP NOTIFIED ____ HOURS IN ADVANCE YES ☐ NO ☐

NAME	POSITION	COMPANY/GOVERNMENT

SUBMITTALS

REVIEW SUBMITTALS AND/OR SUBMTTAL REGISTER. HAVE ALL SUBMITTALS BEEN APPROVED? YES ☐ NO ☐

IF NO, WHAT ITEMS HAVE NOT BEEN SUBMITTED? _____

ARE ALL MATERALS ON HAND? YES ☐ NO ☐

IF NO, WHAT ITEMS ARE MISSING? _____

CHECK APPROVED SUBMITTALS AGAINST DELIVERED MATERIAL (THIS SHOULD BE DONE AS MATERIAL ARRIVES.)

COMMENTS: _____

MATERIAL STORAGE

ARE MATERIALS STORED PROPERLY? YES ☐ NO ☐

IF NO, WHAT ACTION IS TAKEN? _____

SPECIFICATIONS

REVIEW EACH PARAGRAPH OF SPECIFICATIONS. _____

DISCUSS PROCEDURE FOR ACCOMPLISHING THE WORK. _____

CLARIFY ANY DIFFERENCES. _____

PRELIMINARY WORK & PERMITS

ENSURE PRELIMINARY WORK IS CORRECT AND PERMITS ARE ON FILE.

IF NOT, WHAT ACTION IS TAKEN? _____

TESTING	IDENTIFY TEST TO BE PERFORMED, FREQUENCY, AND BY WHOM.
	WHEN REQUIRED?
	WHERE REQUIRED?
	REVIEW TESTING PLAN.
	HAS TEST FACILITIES BEEN APPROVED?
SAFETY	ACTIVITY HAZARD ANALYSIS APPROVED? YES ☐ NO ☐ REVIEW APPLICABLE PORTION OF EM385-1-1.
MEETING COMMENTS	USACE/COR COMMENTS DURING MEETING.
OTHER ITEMS OR REMARKS	OTHER ITEMS OR REMARKS:

QC MANAGER DATE

TETRA TECH

INITIAL PHASE CHECKLIST

		SPEC SECTION	DATE
CONTRACT NO	DEFINABLE FEATURE OF WORK	SCHEDULE ACT NO.	INDEX #

PERSONNEL PRESENT

GOVERNMENT REP NOTIFIED ___ HOURS IN ADVANCE YES ☐ NO ☐

NAME	POSITION	COMPANY/GOVERNMENT

PROCEDURE COMPLIANCE

IDENTIFY FULL COMPLIANCE WITH PROCEDURES IDENTIFIED AT PREPARATORY. COORDINATE PLANS, SPECIFICATIONS, AND SUBMITTALS.

COMMENTS:

PRELIMINARY WORK

ENSURE PRELIMINARY WORK IS COMPLETE AND CORRECT. IF NOT, WHAT ACTION IS TAKEN?

WORKMANSHIP

ESTABLISH LEVEL OF WORKMANSHIP.

WHERE IS WORK LOCATED?

IS SAMPLE PANEL REQUIRED? YES ☐ NO ☐

WILL THE INITIAL WORK BE CONSIDERED AS A SAMPLE? YES ☐ NO ☐

(IF YES, MAINTAIN IN PRESENT CONDITION AS LONG AS POSSIBLE AND DESCRIBE LOCATION OF SAMPLE)

RESOLUTION

RESOLVE ANY DIFFERENCES.

COMMENTS:

CHECK SAFETY

REVIEW JOB CONDITIONS USING EM 385-1-1 AND JOB HAZARD ANALYSIS.

COMMENTS:

OTHER

OTHER ITEMS OR REMARKS:

QC MANAGER DATE

TETRA TECH

DAILY ACTIVITY REPORT (DAR)

Project No.:	Project Title:	Date:	
		Year:	
Task		Day:	

Personnel Summary

TETRA TECH
661 Anderson Drive
Pittsburgh, PA 15220
412.921.7090
412.921.4040 FAX

Tetra Tech NUS, Inc.	Init.	Name	Hrs.	Visitors	Init.	Status
Project Manager:						
Field Operations Leader						
Site Safety & Health						
Site Safety & Health				USACE	Init.	Status
Field Operations Leader			10.5			

EQUIPMENT USED

Description of Work Performed, Problems Encountered and Resolutions:

Time	Description of Work

Comments:	Trucking Totals: Today Cumulative
--	
Temperature Range: $\frac{^0F}{^0F}$	
Weather Conditions:	Field Operations Supervisor Signature

TETRA TECH

EQUIPMENT & PRODUCTION REPORT

Project No.:	Project Title:		Date:	0-Jan
0		0	Year:	0
Task 0		0	Day:	-

E&S CONTROL

Tetra Tech Personnel on Site

Employee	Init.	Hrs. Worked		Cuml. Hours Worked		
TOTALS						

Subcontractor Personnel on Site

Employee/Company	Init.	Hrs. Worked		Cuml. Hours Worked		
TOTALS						

Material Quantities Installed

Description	Unit	Daily Qty	Previous Total	Cumulative Total

Earthwork Quantities Installed

Description	Unit	Daily Qty	Previous Total	Cumulative Total

TETRA TECH

DAILY QUALITY CONTROL REPORT

(ATTACH ADDITIONAL SHEETS IF NECESSARY)

DATE Enter (DD/MMM/YY)

REPORT NO

PHASE	CONTRACT NO	CONTRACT TITLE

PREPARATORY

WAS PREPARATORY PHASE WORK PERFORMED TODAY? YES ☐ NO ☐

IF YES, FILL OUT AND ATTACH SUPPLEMENTAL PREPARATORY PHASE CHECKLIST.

Schedule Activity No.	Definable Feature of Work	Index #

INITIAL

WAS INITIAL PHASE WORK PERFORMED TODAY? YES ☐ NO ☐

IF YES, FILL OUT AND ATTACH INITIAL PHASE CHECKLIST

Schedule Activity No.	Definable Feature of Work	Index #

FOLLOW-UP

WORK COMPLIES WITH CONTRACT AS APPROVED DURING INITIAL PHASE? YES ☐ NO ☐

WORK COMPLIES WITH SAFETY REQUIREMENTS? YES ☐ NO ☐

Schedule Activity No.	Description of Work, Testing Performed & By Whom, Definable Feature of Work, Specification Section, Location and List of Personnel Present

REWORK ITEMS IDENTIFIED TODAY (NOT CORRECTED BY CLOSE OF BUSINESS)

Schedule Activity No.	Description

REWORK ITEMS CORRECTED TODAY (FROM REWORK ITEMS LIST)

Schedule Activity No.	Description

REMARKS (Also Explain Any Follow-Up Phase Checklist Item From Above That Was Answered "NO"), Manuf. Rep On-Site, etc.

Schedule Activity No.	Description

On behalf of the contractor, I certify that this report is complete and correct and equipment and material used and work performed during this reporting period is in compliance with the contract drawings and specifications to the best of my knowledge except as noted in this report.

AUTHORIZED QC MANAGER AT SITE DATE

GOVERNMENT QUALITY ASSURANCE REPORT

QUALITY ASSURANCE REPRESENTATIVE'S REMARKS AND/OR EXCEPTIONS TO THE REPORT

Schedule Activity No.	Description

GOVERNMENT QUALITY ASSURANCE MANAGER DATE

Scrap Metal Removal Summary Table

TETRA TECH

ORIGIN:		
DATE	**# of TRUCK LOADS**	**DAILY VOLUME/WEIGHT**
WEEKLY TOTAL		
WEEKLY TOTAL		
WEEKLY TOTAL		
WEEKLY TOTAL		
WEEKLY TOTAL		
WEEKLY TOTAL		
GRAND TOTAL TO DATE		

Waste Manifest	Manifest Doc. No.	Date
3. Generator's Name and Address		4. Generator's Phone
5. Designated Facility Name and Address		6. Facility's Phone

7. Waste Description	Total Qty	Unit Wt/Vol
a.		
b.		

8. Transporter Company Name	9. Transporter Truck ID	10. Transporter Name	11. Transporter's Phone

12. Transporter Acknowledgement of Receipt of Materials			
Transporter Signature	Month	Day	Year

Waste Manifest	Manifest Doc. No.	Date
3. Generator's Name and Address		4. Generator's Phone
5. Designated Facility Name and Address		6. Facility's Phone

7. Waste Description	Total Qty	Unit Wt/Vol
a.		
b.		

8. Transporter Company Name	9. Transporter Truck ID	10. Transporter Name	11. Transporter's Phone

12. Transporter Acknowledgement of Receipt of Materials			
Transporter Signature	Month	Day	Year

FIRST RESPONDER SPILL/RELEASE RESPONSE ACTIONS

Units or contractors performing training or other operations at Camp Ravenna shall be responsible for adhering to the provisions identified in the Camp Ravenna Integrated Contingency Plans (ICP). A copy of the ICP may be obtained from the Camp Ravenna Environmental Supervisor. Following discovery of a spill (any size), the procedures outlined below shall be executed where applicable:

1. **If necessary, initiate evacuation of the immediate area.**
2. **Notify Camp Ravenna Range Control via two-way radio or by calling (614) 336-6041, and report information contained on the "First Responder Reporting Form" if it is known or can reasonably be determined. This form has been copied on the opposite side of this page. If Range Control cannot be reached, contact a Camp Ravenna OSC (listed below).**
3. **Stop spill flow when possible without undue risk of personal injury.**
4. **If trained, contain the spill using available spill response equipment or techniques.**
5. **Make spill scene OFF LIMITS to unauthorized personnel.**
6. **Restrict all sources of ignition when flammable substances are involved.**
7. **Report to the OSC upon his/her arrival to the scene.**
8. **Turn in a completed copy of the Camp Ravenna First Responder Form to Camp Ravenna Range Control for ALL releases, even ones cleaned up by the reporter.**

TELEPHONE NUMBER

When Camp Ravenna Range Control is not available, the Camp Ravenna OSC must to be contacted by the discoverer/first responder following a release if it is in water, at or above a reportable quantity (25 gallons or more of POL), a hazardous or extremely hazardous substance, a hazardous waste, or involves fire, explosion, or is otherwise a major incident.

NAME	JOB TITLE	OFFICE	24 HOUR
Camp Ravenna Range Control	Operations and Training	(614)336-6041	(614) 202-5783
Tim Morgan (Primary OSC)	Environmental Supervisor	(614)336-6568	(330)322-7098
Katie Tait	Environmental Specialist	(614)336-6136	Contact Alternate
CPT Mike Yates	Range Operations	(614)336-6193	(330) 819-5038
MAJ Richard Saphore	Logistics Officer	(614)336-6790	(614) 593-1654
LTC Ed Meade	Garrison Commander	(614)336-6560	(614)307-0493
Joint Forces Command (Alternate POC)	OHARNG Emergency Center	(888)637-9053	(888)637-9053

Off-site (from Camp Ravenna area code 614 phones)

Portage County Fire Department (Portage Dispatch) 9-1-330 296-6486
Portage County Sheriff 9-1-330-296-5100
Trumbull County Fire Department and Sheriff (Trumbull Dispatch) 9-1-330-675-2730

SEE REVERSE FOR FIRST RESPONDER REPORTING FORM

FIRST RESPONDER REPORTING FORM

(Print all information)

Collect as much of the information on the top half of this form as possible before making initial notification. Complete the top and bottom of the form before turning in to Camp Ravenna.

Name of individual reporting spill: _____

When did the spill occur (Date and Time)? _____

Spill Location (Building or area name / number, indoors or out; if vehicle involved, type and bumper number):

_____

What was spilled? _____ **How much was spilled?** _____

Rate at which material is currently spilling. _____

Extent of spill travel? _____

Did the spill reach water (ditch, creek, stream, pond, well head) _____

Number of injured personnel and type injuries, if applicable. _____

Do you need the Fire Department to respond to protect life, property, and environment? _____

Unit: _____ **State:** _____ **Report Date & Time:** _____

On Scene Coordinator Name and Grade: _____ **Phone:** _____

How did the spill occur (be specific). _____

_____

What remedial action was taken? _____

_____

Was soil and absorbent material generated? _____ **How much?** _____

What is the location of the soil and absorbents? _____

Was the Environmental Office contacted (yes or No, date and time)? _____

Who did you talk to in the Environmental Office? _____

Was the site cleared by the Env. Office (Yes or No, date and time)? _____

Who cleared the site (name and grade, date and time)? _____

Initial information is critical. Get as much information as you can, but don't hesitate to make the initial notification if a spill is moving or worsening rapidly!

This form must be completed for all releases and turned-in to Camp Ravenna Range Control within 24 hours.

APPENDIX H

COMMENT RESOLUTION TABLE

Comment Resolution Table

Installation: Camp Ravenna/Former RVAAP
Document: Preliminary Draft Basis of Design and Work Plan for the Sand Creek Culvert Replacement at ODA2 Stream Crossing
Reviewer(s): Katie Tait, Environmental Specialist, OHARNG, (614)336-6136 or kathryn.s.tait.nfg@mail.mil
Date: 25 January 2016

Cmt. No.	Page or Sheet	Comment	Recommendation	Response
1	Document Distribution List	The reviewer is listed as Sue Netzly Watkins. The Ohio EPA reviewer for this project (culvert replacement and bank stabilization) may be Drew Kocher. Drew has been reviewing all of the project work at ODA2 and will be reviewing the bank stabilization for Rocket Ridge. Need to check with the Ohio EPA.		Drew Kocher no longer works with the Ohio EPA. We will address the submittal to Nick Roope.
2	General – For Cover Page and Executive Summary and Project Description	Please reference the RVAAP # on the cover, in the Executive Summary and in the Project Description. Should be RVAAP-004-R-01		The RVAAP number has been added to the cover page.
3	Pg ES-1, Line 2	"The Open Demolition Area 2 (ODA2) access Road, also known as George Road, located at …" The ODA2 access road is not the same as George Road. Please reference as ODA2 access road.		Revised to refer to "ODA2 access road".
4	Section 1.3 Permitting	This section indicates that a PCN may be required and that it is provided in Appendix C. Based on the provisions in NWP 3, a PCN is required for this project. Please present it as such. Please note that as part of the qualification under NWP 3, the PCN must demonstrate compliance set forth in Section C Nationwide Permit General Conditions which include things such as proving that there are no impacts to Endangered Species, Cultural/Archaeological Resources, 100 year flood plains etc. This needs to be provided in your PCN document and reviewed by the OHARNG prior to submittal to the USACE. This information is not currently provided in the PCN. Please provide a complete PCN for review. If you need example, we may be able to provide one as we have completed PCNs for culvert replacement projects at Camp Ravenna.		Text revised to indicate a PCN is required and has been submitted. The full, completed application has been provided in Appendix C and this is indicated in the text.

Comment Resolution Table

Installation: Camp Ravenna/Former RVAAP
Document: Preliminary Draft Basis of Design and Work Plan for the Sand Creek Culvert Replacement at ODA2 Stream Crossing
Reviewer(s): Katie Tait, Environmental Specialist, OHARNG, (614)336-6136 or kathryn.s.tait.nfg@mail.mil
Date: 25 January 2016

		Please note that the OHARNG will draft a Memorandum for Record for both cultural and natural resources which reviews and documents any cultural or natural resources and makes an effect determination. Our initial review indicates that there will be no impact. You will be able to use these as part of your PCN. We can help with input for the PCN but the meat of it should be provided by you. Check out Section C and include the associated information.		
5	Section 2.1 Culvert Replacement	"… armoring of the channel and banks with rip rap as needed…" This is not enough information. We need to know how much rip rap will be installed (length) and size of rip rap to be used. Suggest providing a better description and an aerial plan view of what the view will be of the restored area (showing extent of rip rap, seeding, new culvert etc).		Ohio Department of Transportation Type D riprap (4" to 12" diameter; average 6") will be used. The proposed site plan (Figure 2-4) indicates the extent of riprap coverage.
6	Pg 2-1, Line 9	"The soil removed during excavation will be reused in the construction of the new culvert if they meet geotechnical requirements and are demonstrated to be free of MPPEH and MEC by screening and sifting or another method approved by the ANG and Ohio Army National Guard (OHARNG" How will you prove that the soil is clean and acceptable for reuse? Will you sample it? Must be determined to be clean prior to reuse. ANG should be changed to ARNG.		The existing soil is assumed to be appropriate for reuse, but will be visually inspected and surveyed by magnetometer for MEC/MPPEH. Visual characterization will be used to ensure the soil is not overly organic or peaty.
7	Pg 2-1, Line 22	"…has been assessed as low probability assessment…" Where did this determination come from? A Probability Assessment conducted for the overall MRS in May 2015 by Baltimore USACE indicated that the culvert falls in a high probability area. Please clarify.		From the June 26, 2015, Performance Work Statement (pg 10): "The culvert replacement work has also been assessed as low-probability, at this time. If MEC items are encountered which cause the site status to change, USACE-NAB will prepare an ESS."
8	Pg 2-1, Line 24	"…prepared an Explosives Safety Submission (ESS) that covers the work on the site." Please note that the ESS for		The text has been revised to indicate that "USACE Baltimore…will prepare an ESS…" if

Comment Resolution Table

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Date: 25 January 2016

		ODA2 is specific to the TCRA that will be conducted at ODA2. It does not specifically call out the culvert replacement work.		MEC items are encountered.
9	Pg 2-1, Line 27	"The excavated soil from the Sand Creek culvert removal will be transported to the screening and sifting area for the WBG soil removal action to remove potential MEC/MPPEH." **1**. What will happen to the MEC/MPPEH once screened? Will it be handled as scrap metal? Will it require demolition at ODA2 in the BEM? If demolition is required, how will it be handled? Need to indicate. **2**. All wastes need to be tracked including scrap metal. **3**. If demolition is required, there are certain procedures that are required to demo at ODA2. Will this fall under the management of the WBG Supplements or the ODA2 TCRA Work Plan? Need to determine and describe. **4**. This methodology needs to be reviewed and discussed with the Ohio EPA. In the past, the Ohio EPA has not been accepting of moving contaminated dirt from one AOC to another AOC even if it is being screened. Additionally, they need to be aware that the soil is being moved from ODA2 to WBG and then being put back in place at ODA2 and the munitions will be handled at WBG (screened and scrapped) or ODA2 (if demo needed). We need to see how this fits into the management of MEC under the Findings and Orders and under this new process of using the BEM. Since we are transferring between 2 sites, we need to have their buy-in and acceptance on how it is being handled.		1. Yes, it will be handled as scrap metal and tracked via the waste manifest form in Appendix G. The text has been revised to indicate procedures for handling if demolition is required. 2. A waste tracking form has been added in Appendix G. 3. Demolition will fall under the management of the WBG Supplements. 4. Soils will not be moved from the site to WBG. All soils will be visually inspected and surveyed by magnetometer in the soils stockpile located southeast of the culvert (Figure 2-2).
10	General	Overall on this project will you be following the general guidelines that we have for environmental projects at Camp Ravenna? Such as the ICP/First Responder Form for Spills; the Camp Ravenna Waste Guidelines for waste etc. Please clarify.		We will follow general guidelines for environmental projects, and a first responder form has been included in Appendix G.
11	Site	Will any vegetation be removed as part of this project? If		We will operate within the window for felling

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	Restoration	yes, how will it be handled? Please note there is a cutting restriction due to the Northern Long Eared Bat. Indicates that areas will be reseeded. Will you be reseeding with the approved Camp Ravenna seed mix? Please indicate.		trees, and we will reseed using the approved Camp Ravenna seed mix. The text has been revised to indicate this.
12	General	Will you be working from the north or the south side of the culvert? Will you need any areas for equipment staging?		We will be working from the South, and the staging area will be immediately southwest of the culvert. The text has been revised to indicate this and Figure 2-2 has been provided to indicate the staging area.
13	Appendix C Permitting	Please see prior comment about providing a complete PCN document. Applicants name should be changed to Tim Morgan, Ohio Army National Guard, timothy.m.morgan.nfg@mail.mil Directions to the site (Box 17) are incorrect and need revised. Revise to state: "From the City of Ravenna, drive onto State Route 59 headed east. State Route 59 will merge with State Route 5 (Ravenna Warren Road) continuing to head east. After being on State Route 5 for approximately 8 miles, turn left at the entrance to the OHARNG Camp Ravenna Joint Military Training Center. Head straight onto George Road. Turn left onto Newton Falls Road and turn right at the second turnoff from Newton Falls Road. The Sand Creek crossing is approximately 2,000 feet down this road."		The PCN has been revised, submitted, and approved.
14	General – Purpose of Project	The document notes that the purpose of the project is to preserve the integrity of the ODA2 access road. You need to also note that the purpose is to address any MEC or MPPEH used as backfill for the culvert (this is why we are doing the culvert replacement as part of the restoration program).		The text has been updated to indicate the additional objective.

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Gail Harris				
1		The site nomenclature is not used in the title of the Cover Page. Is the site associated with the IRP or MMRP program? Without the correct nomenclature (RVAAP-004-R-01 Open Demolition Area #2 MRS) I cannot catalog it correctly. Also the address under the title should read as 'Former Ravenna Army Ammunition Plant, Camp Ravenna, Portage and Trumbull Counties, Ohio.'		The site nomenclature has been included. The site is an MMRP. The address has been changed to be in accordance with the comment.
2		The Cover Page does not display the full date as required by the Submission Format Guidelines (SFG) in Appendix B.		The cover page has been changed to be in accordance with SFG Appendix B.
3		The submission does not display the correct order of front documentation as required by the SFG (Section 3.0 Submission Stage - Preliminary Draft Document, sub-section 3.1.2 Organizing the Components).		Additional front documentation has been added and rearranged for the Draft submission.
4		The Standard Form 298 displays the Report Date as being January 15, 2016 while the CD Label displays the date as being January 21, 2016. Which is the correct date?		January 21st, 2016 is the correct date.
5		A Compliance Checklist was not included in the submission delivery as required by SFG, (Section 2.0 Global Requirements for All Documents, Sub-section 2.2.7 Compliance Checklist). Note: A Compliance Checklist is available for contractors to download in REIMS under the Format Guidelines Menu.		A compliance checklist has been generated and will be included in future documents.
6		Although Preliminary Drafts are not required to pass section 508 accessibility it is good to run a full check to see if there are any problems which will need to be addressed before creating the next generation of a draft. I found the following errors in the accessibility report: a. Page Content i. Tagged Content - Failed, 1136 Elements ii. Tab order - Failed, 13 pages iii. Character encoding - Failed, 12 words (this cannot		Subsequent drafts will pass the Section 508 accessibility checks.

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		be fixed in Adobe only in the native or source file) b. Alternate Text i. Figures alternate text - Failed, 102 figures ii. Other elements alternate text - Failed, 72 elements c. Tables i. Headers - Failed, 6 elements ii. Summary - Failed, 12 elements d. Headings i. Appropriate nesting - Failed, 2 elements All accessibility errors will need to be corrected before submitted the draft version. All the Character encoding errors are associated with the bridge plan drawing. One solution is to scan and OCR the image and another is to ensure the developer uses standard character encoding in his drawings and make sure the drawing software's PDF converter is up to date.		
7		What I need now from the contractor is the correct date (either January 15th or 21st) by revising the SF 298 and the Cover Page showing the full (correct) date, the site nomenclature and address (see comments 1, 2 & 4) and re-burning the CDs with the correct date on the label. I will also need two (2) revised hard copy Cover Pages.		The cover page and CDs have been updated to reflect that January 21st is the correct date.