Bioengineering Bank Stabilization for Roadway Protection (*Martz-Paullin Road Case Study*)

Chuck Petty, WCEO
Joel Thrash, Cardno

County Engineers Association of Ohio (CEAO)
2016 Stormwater Management and Drainage Conference
March 15, 2016

Presentation Outline

OUTLINE

- ✓ Pre Project Conditions
- ✓ Design and Cost Alternatives
- ✓ Project Funding
- ✓ Design and Permitting Strategy
- ✓ Construction Observations and Lessons Learned

- ✓ Applicability to other infrastructure projects adjacent to streams
- ✓ Changes in NWP Permitting for roadway projects

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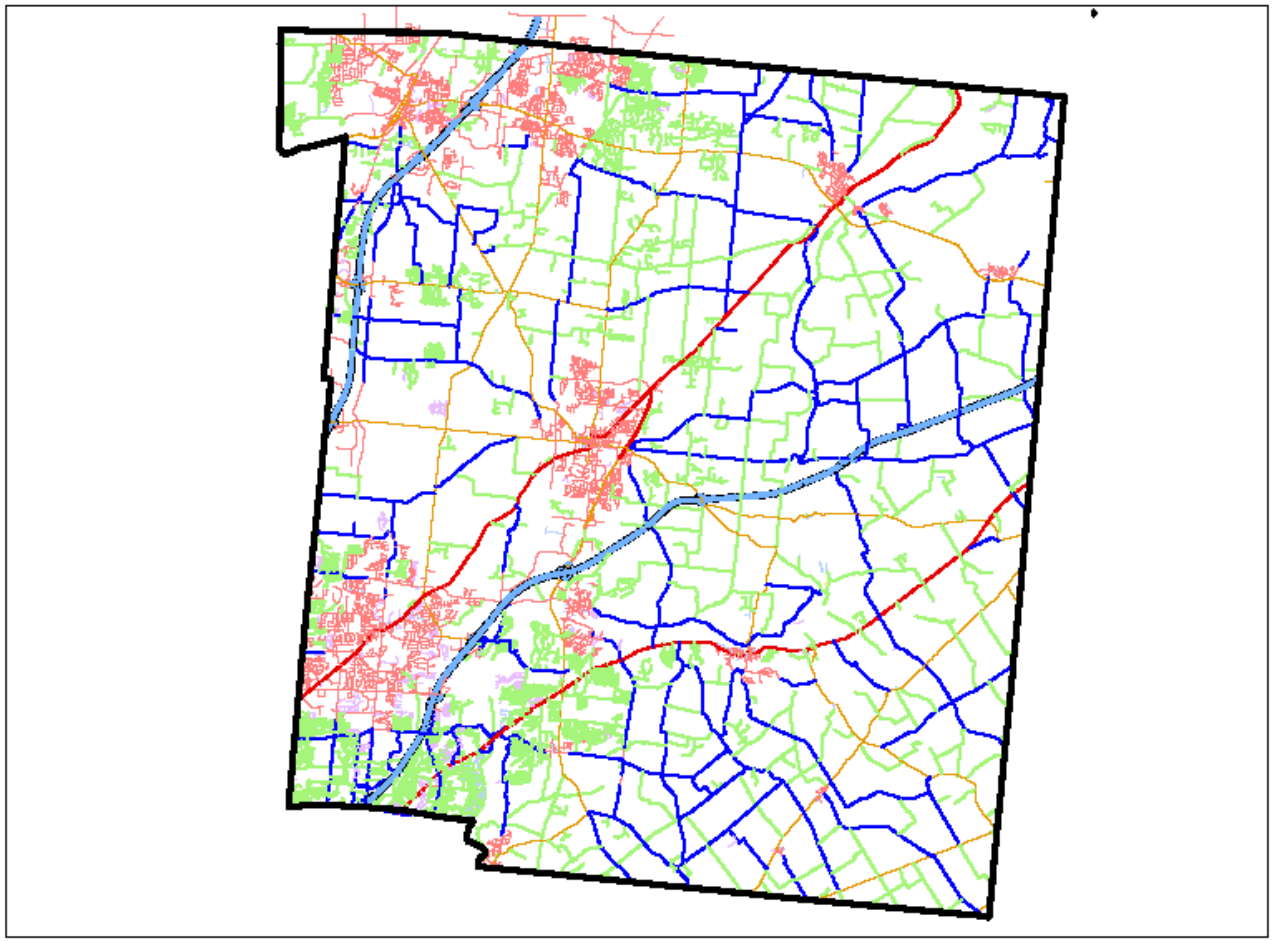
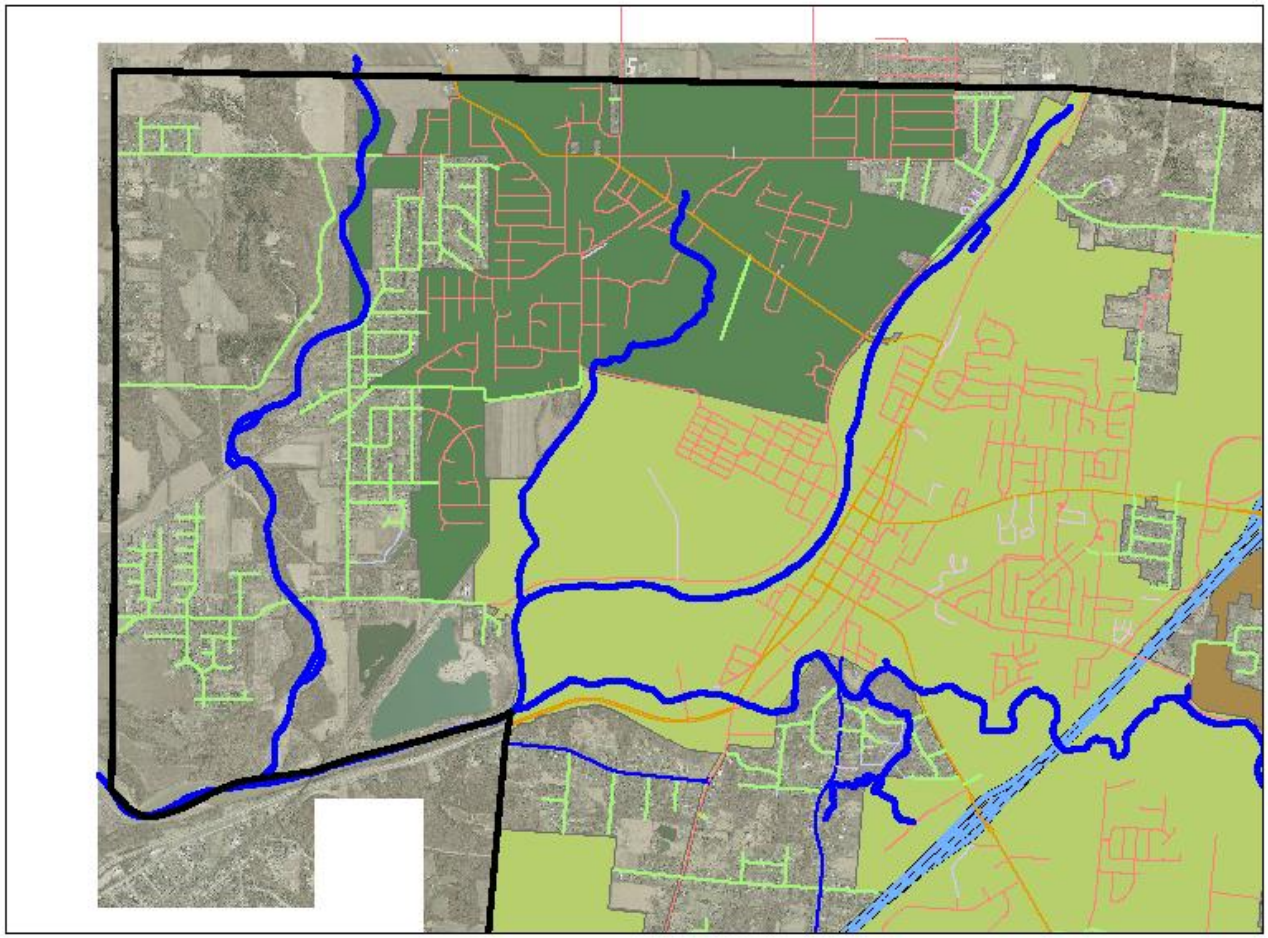
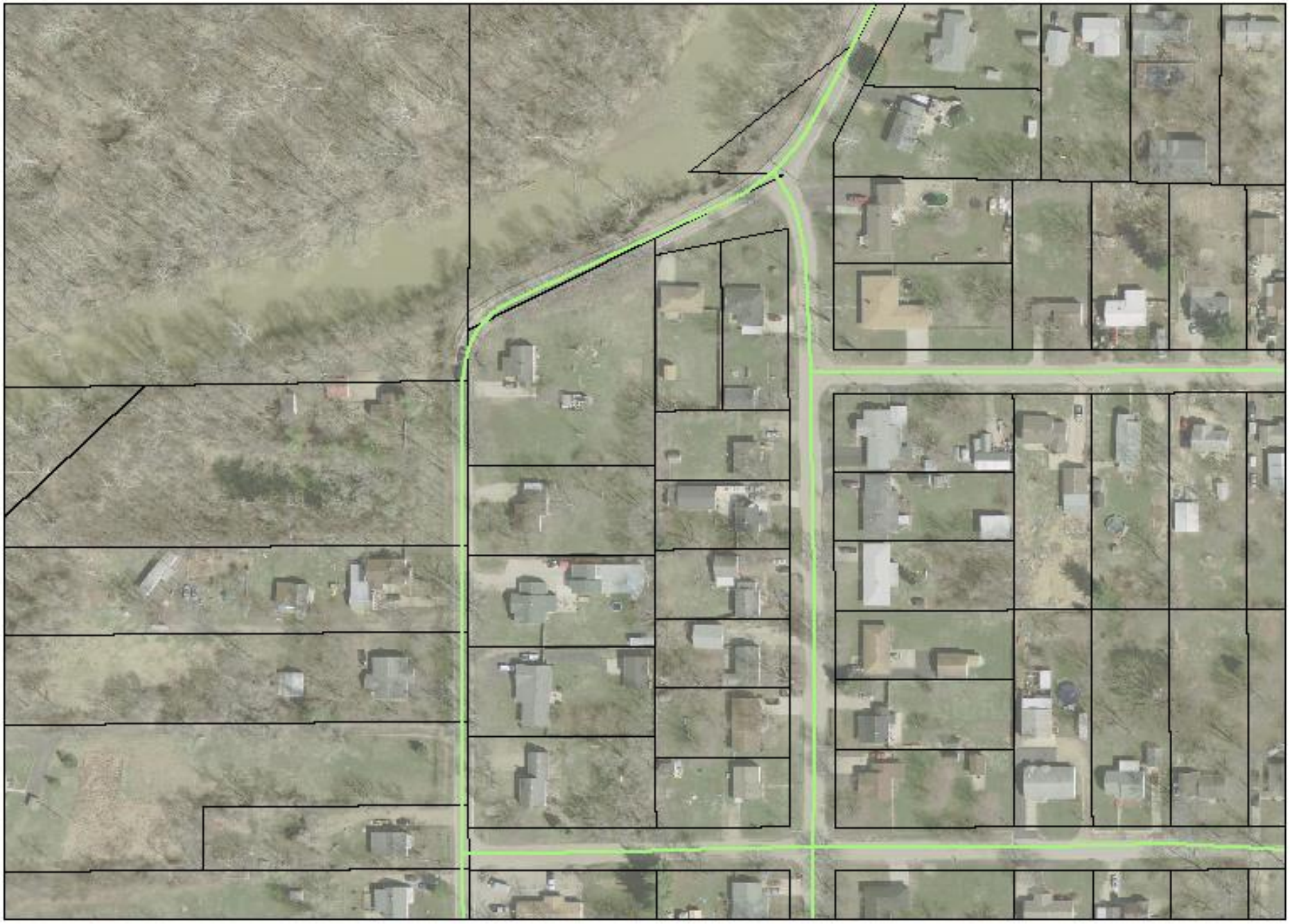
Monroe
Fayette
Pickaway
Morgan
Butler
Warren
Clinton
Hocking
Washington
Ross
Athens
Hamilton
Clermont
Highland
Vinton
Pike
Meigs
Jackson
Brown
Adams
Scioto
Gallia
Lawrence








2011

2014

April 9, 2014

April 9, 2014

TIMELINE

FIRST REPORT	SPRING 2012
SECOND REPORT	SPRING 2013
THIRD REPORT	MARCH 2014
TERRACON CONTRACT	APRIL 2014
SURVEY	APRIL 2014
DRILLING	MAY 2014
TERRACON REPORT	JULY 2014

REV.	DATE	BY	DESCRIPTION

PLAN VIEW

MARTZ-PAULIN ROAD SCOUR ELEVATION

WARREN COUNTY ENGINEER'S OFFICE

FRANKLIN, WARREN COUNTY OHIO

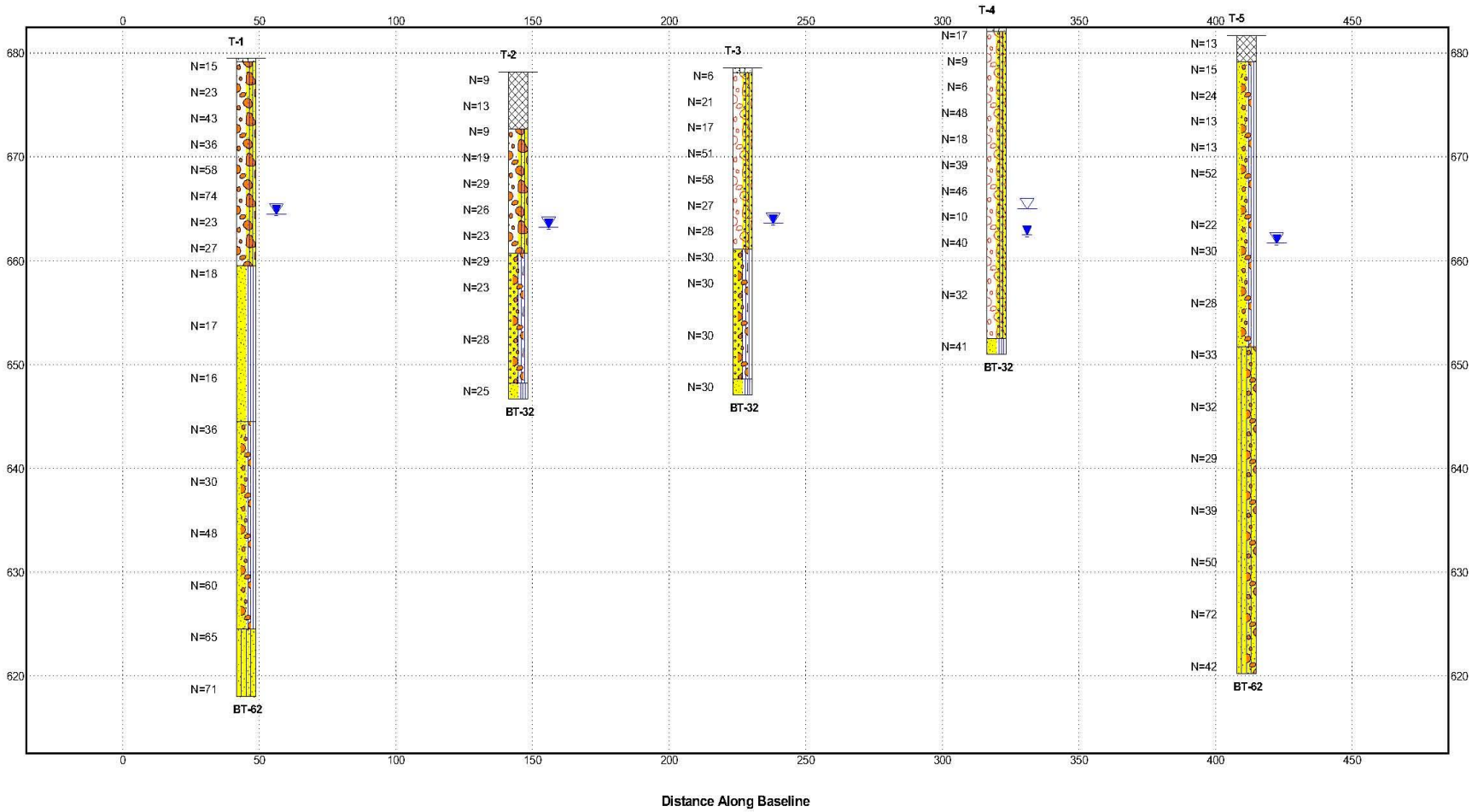
Terracon
Consulting Engineers and Scientists
611 LUNKEN PARK DRIVE CINCINNATI, OHIO 45226
PH. (513) 321-5816 FAX. (513) 321-4340

EXHIBIT A-10

DESIGNED BY:	RMG
DRAWN BY:	KM
APP'VD. BY:	GDW
SCALE:	1"=30'
DATE:	07/05/2014
JOB NO:	N1145123
ACAD NO.:	WCE EXS.DWG
SHEET NO.:	A-10

E

W



Explanation

T-1 — Borehole Number

Moisture Content — %w — LL PL — Liquid and Plastic Limits

Sampling (See Generic Notes) — Borehole Lithology

AR / BT — Borehole Termination Type

Water Level Reading at time of drilling.

Water Level Reading after drilling.

Topsoil

Fill (made ground)

Poorly-graded Gravel with silt and sand

USCS Well-graded Sand with Silt

Poorly-graded Sand with Clay (or silty clay)

Well-graded Gravel with silt and sand

Poorly-graded Sand with Clay (or silty clay)

Silty Sand with gravel

Silty Sand

NOTES:

See Exhibit for orientation of soil profile.
See General Notes in Appendix for symbols and soil classifications.
Soils profile provided for illustration purposes only.
Soils between borings may differ
AR - Auger Refusal
BT - Boring Termination

Project Manager: GCW	Project No.: N1145123
Drawn by: RMG	Scale: 1"=10' vertical
Approved by: GCW	File Name: fence
Date: 8/26/2014	

Terracon
611 Lunken Park Drive
Cincinnati, Ohio
PH. 513-321-5816 FAX. 513-321-0294

SUBSURFACE PROFILE

MARTZ-PAULIN ROAD SCOUR EVALUATION
MARTZ-PAULIN ROAD
FRANKLIN, OHIO

EXHIBIT

A-9

TIMELINE

MORE SURVEY	JULY 2014
CARDNO CONTRACT	AUGUST 2014
CARDNO DESIGN	OCT 2014
PCN TO USACOE	DEC 2014
USACOE PERMIT	JAN 2015
STORM	MARCH 2015

March 16, 2015

March 16, 2015

March 16, 2015

March 17, 2015

TIMELINE

ROAD CLOSED	MARCH 2015
CDBG FUNDING	MARCH 2015
BAT HABITAT REMOVED	MARCH 2015
BID DATE SET	JUNE 2015
RE-BID DATE SET	AUGUST 2015
CONSTRUCTION	SEPT 2015

COSTS

ENGINEERING	$ 50,000
TERRACON	25%
CARDNO	65%
SURVEY	10%
CONSTRUCTION	$181,000
TOTAL	$231,000

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FUNDING

WCEO	$ 50,000
CDBG	$ 148,000
OPWC	$ 33,000
TOTAL	$ 231,000

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Design Goals and Objectives

PROJECT GOAL

To rehabilitate approximately 275 linear feet of eroded stream bank along Twin Creek in order to cost effectively re-open Martz-Paullin Road while protecting the long term stability of the road.

PROJECT OBJECTIVES

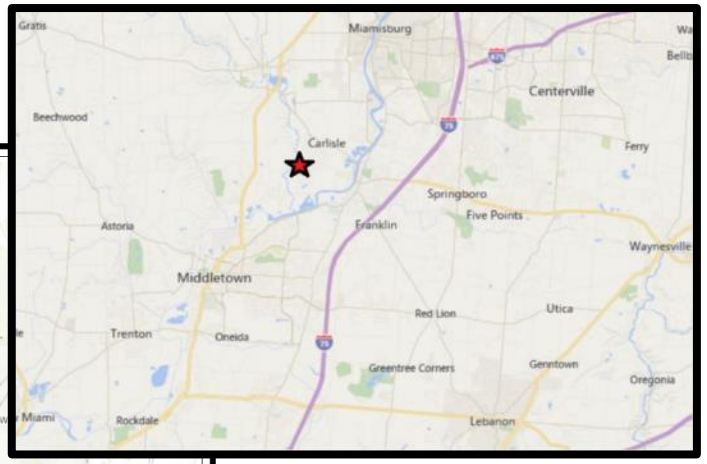
- ✓ Obtain regulatory permits (NEPA Exempt, Non-ODOT funded)
- ✓ Rehabilitate geomorphic features within project area using bioengineering techniques
- ✓ Maintain structural integrity of Martz-Paullin Rd
- ✓ Reduce sheer stress on eroded banks
- ✓ Reduce sediment loading
- ✓ Improve riparian buffer habitat
- ✓ Educate public on alternative bank restoration practices

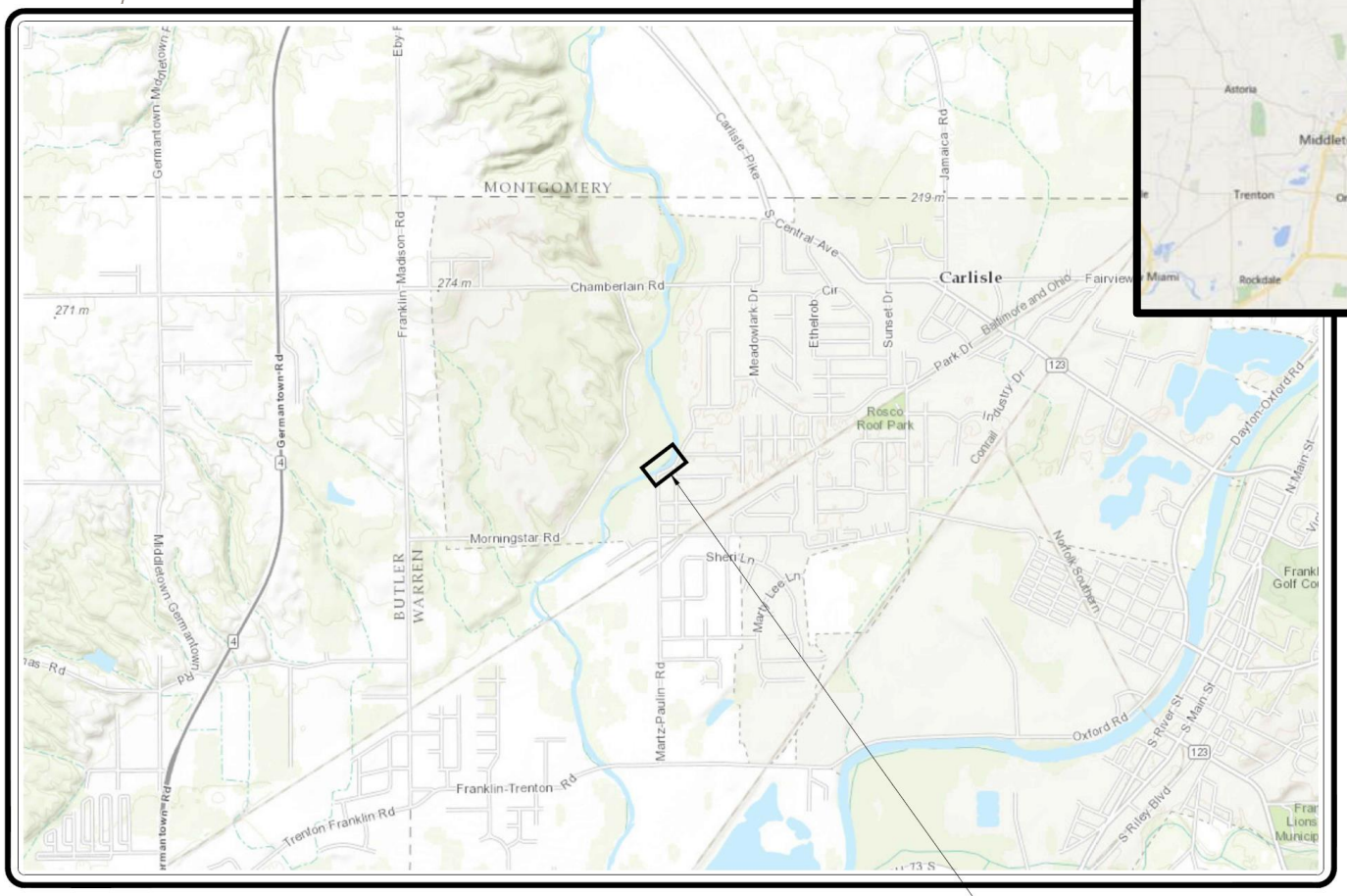
Project Challenges

Design and Permitting Challenges

- ✓ Existing Soils and Alluvial Properties
- ✓ Existing Road Location / RoW Issues
- ✓ Shear Stresses
- ✓ Permitting Thresholds
- ✓ Seasonal "In-Stream" Restrictions
  - ✓ Mussels
  - ✓ IN and NLE Bat Habitat
  - ✓ Fish Spawning
- ✓ Construction Access / Right of Way Access
- ✓ MCD and Protected Property (Opposite bank)
- ✓ Funding
- ✓ Ownership and Maintenance

Project Location





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Pre-Project Aerial Photograph (2013)

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Waterway Permitting and Design Considerations for Infrastructure Improvement Projects

General Project Sequence

- Project Planning and Development
- Ecological, Natural Resource and Cultural Assessments
- Regulatory Permitting
- Engineering and Design
- Construction
- Compliance and Monitoring

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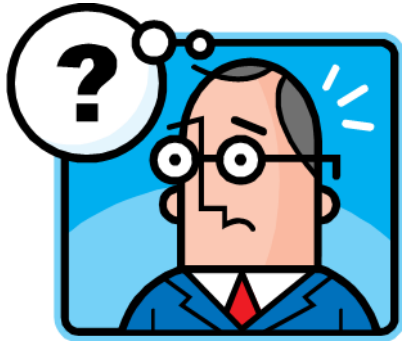
Regulatory Approvals

REGULATORY APPROVALS FOR WORK IN "REGULATED WATERS"

- ✓ Corps of Engineers (CWA, §404)
- ✓ Ohio EPA (CWA, § 401)
- ✓ OHPO (NHPA, Section 106)
- ✓ USFWS (ESA, Section 7)
- ✓ Ohio EPA NPDES - CGP (CWA §404)

- ✓ Floodplain Permits
- ✓ National Park Service (WSRA, Section 7a)
- ✓ ODNR Scenic Rivers (ORC §1547.82)
- ✓ ODNR / CZMA

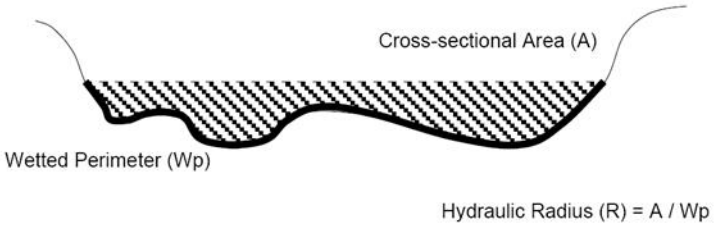


Design Vitals

- ✓ Mean Bankfull Width (*Bw*)= 62.5 ft (Elev. = 665.75)
- ✓ Mean Cross Sectional Area (*A*)= 425 ft^2
- ✓ Mean Wetted Perimeter (*Wp*) = 80 ft
- ✓ Hydraulic Radius (*R*) = 5.14 – 5.56 ft
- ✓ Channel Slope (*S*) = .0038 (0.4%)
- ✓ Sheer Stress (τ = 195 N/m2, 5 lbs/Sf)

- ✓ Regulatory OHWM = Elevation 665.0
- ✓ Radius of Curvature (Rc) = 245 LF

- ✓ Rock Toe Depth: 2 - 3 feet to Thalweg
- ✓ Post Restoration Slope 1.75 : 1
- ✓ Native Bioengineering Materials



$$\tau = \rho \times g \times R \times S$$

where:

τ = Shear Stress (N)

ρ = Density of Water (1000 kg m^{-3})

g = Acceleration due to gravity (9.8 m s^{-2})

R = Hydraulic Radius

S = Surface Water Slope

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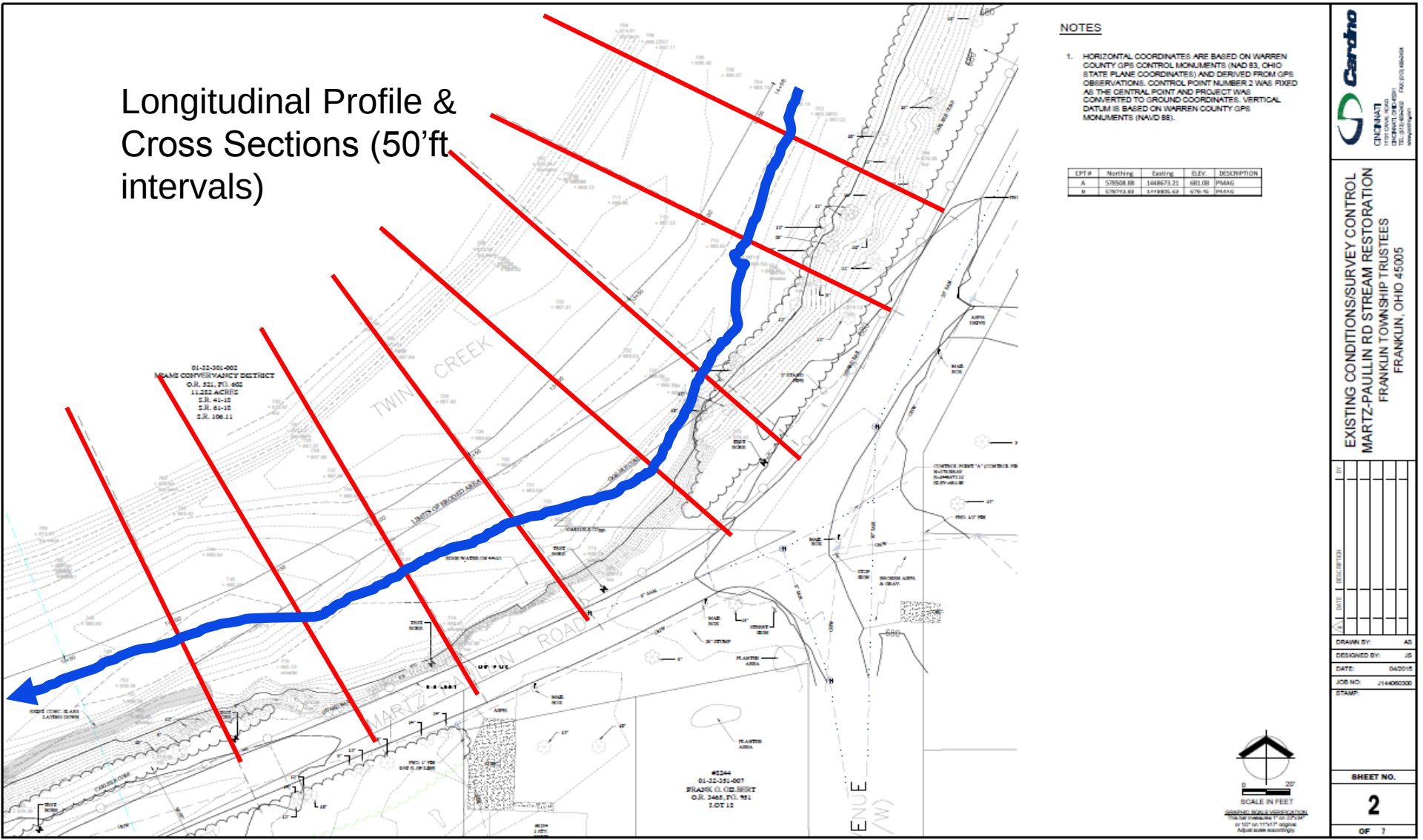
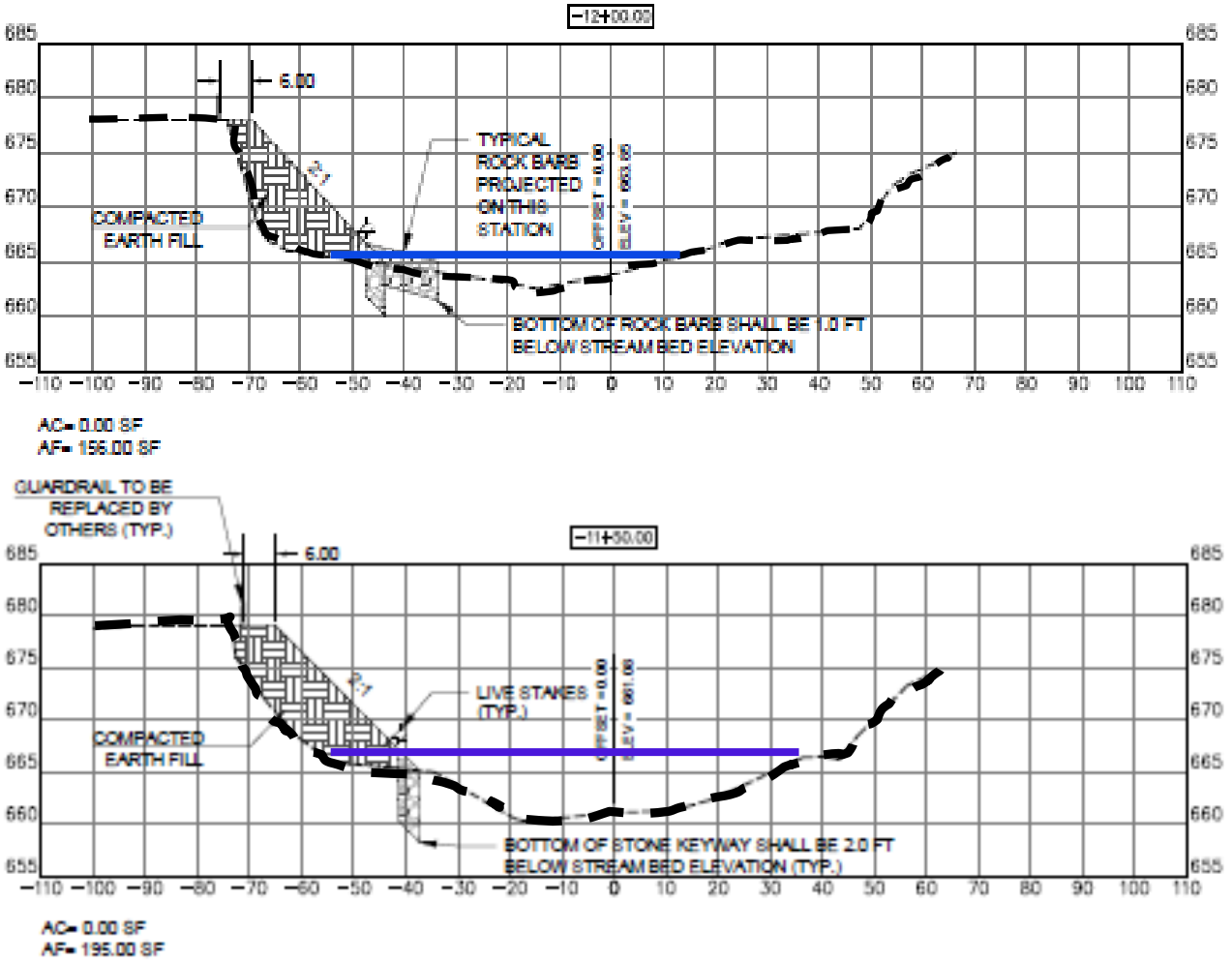
Pre Project Stream Surveys

Longitudinal Profile & Cross Sections (50’ft intervals)



Cross Sections (12+00 – 11+50)



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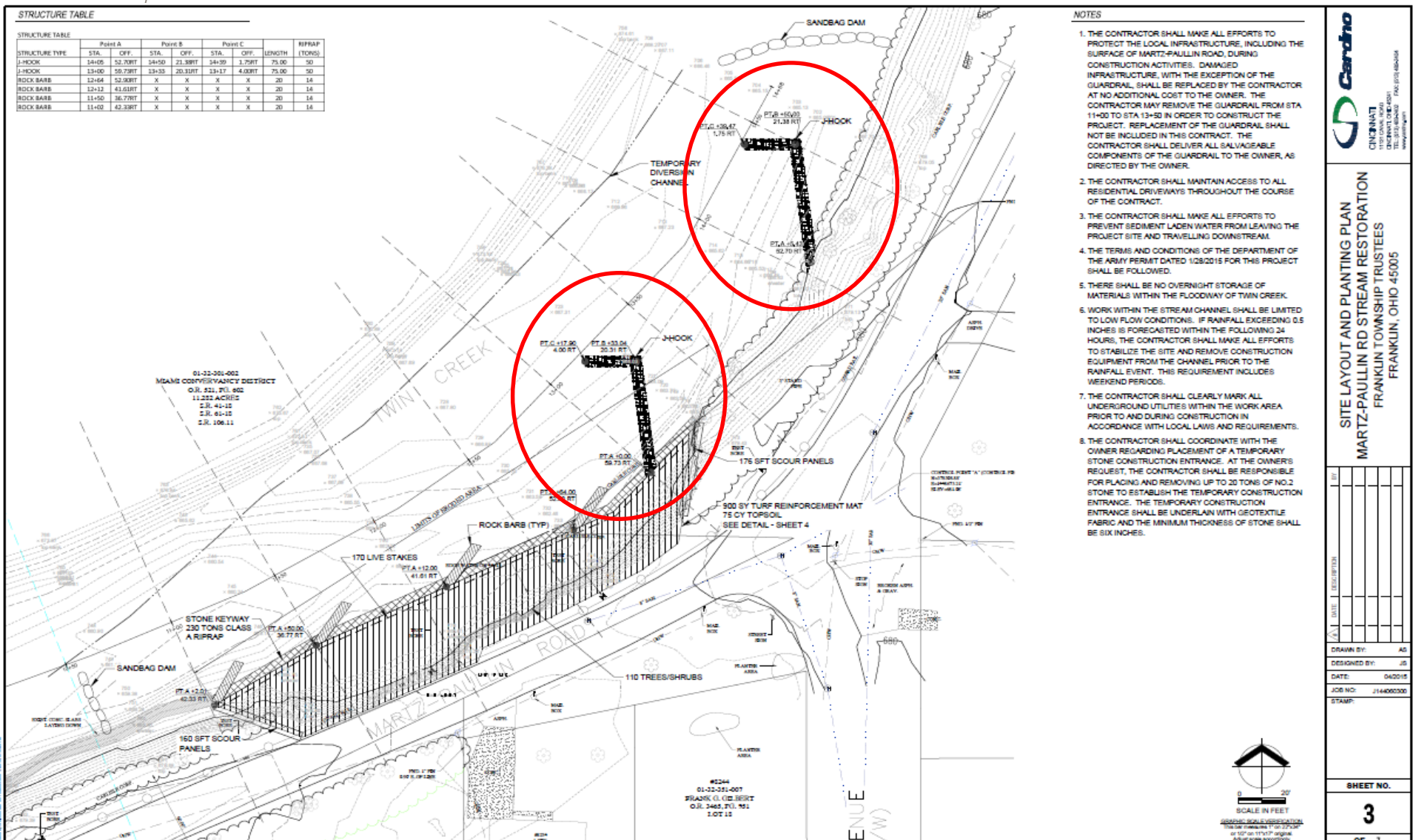
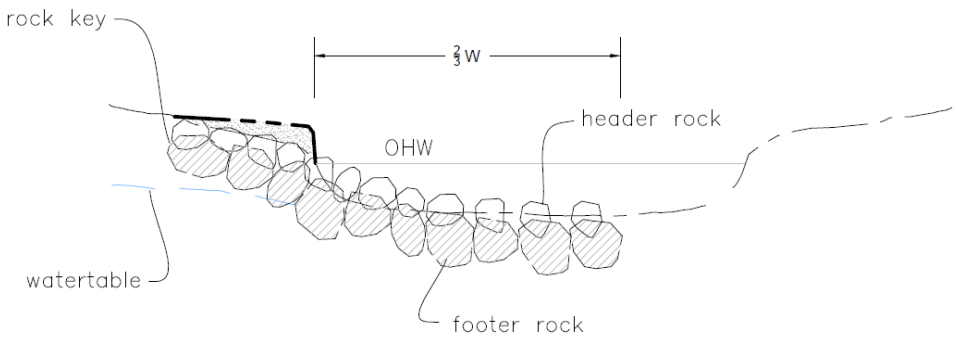
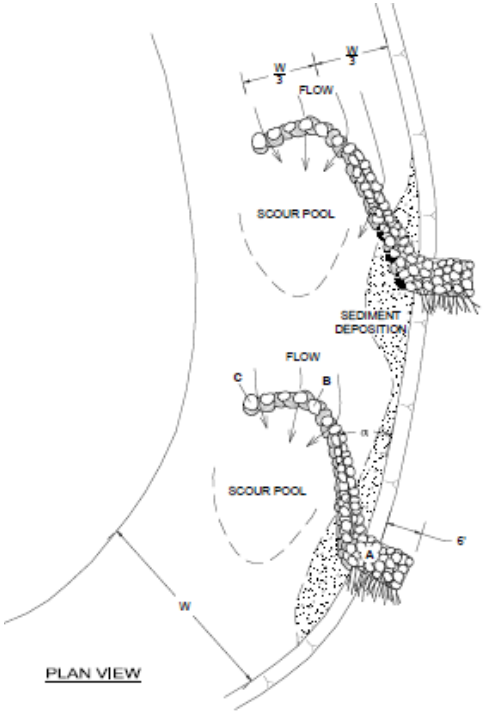
Proposed Conditions (J-Hooks)



In-Stream Structures (J-Hooks)



SECTION VIEW



PLAN VIEW

OK VANE DETAIL - TYPICAL

J-HOOK VANE AND STREAM BARB NOTES:

1. J-hook vane/stream barb structures shall be installed at periods of near or at low flow. Installation shall not occur during or immediately following periods of heavy precipitation.
2. J-hook structures shall be keyed into the stream banks or installed stone revetment at specified locations.
3. A footer trench shall be excavated within the streambed to a minimum depth of 1.5 feet.
4. Unless specified otherwise, the central crest of the J-hook structure shall protrude upstream into the channel at an angle approximately equal to 25 degrees from the bank tangent point at the specified location.
5. Unless specified otherwise, stream barbs shall be keyed into the stream bank at a height equal to the bankfull elevation and decrease in elevation along the J-hook/barb crest at a slope of approximately 2-7%.
6. Structures shall be installed under supervision of Project designer.
7. Any modifications or amendments to construction plans shall be approved by the Project Designer.

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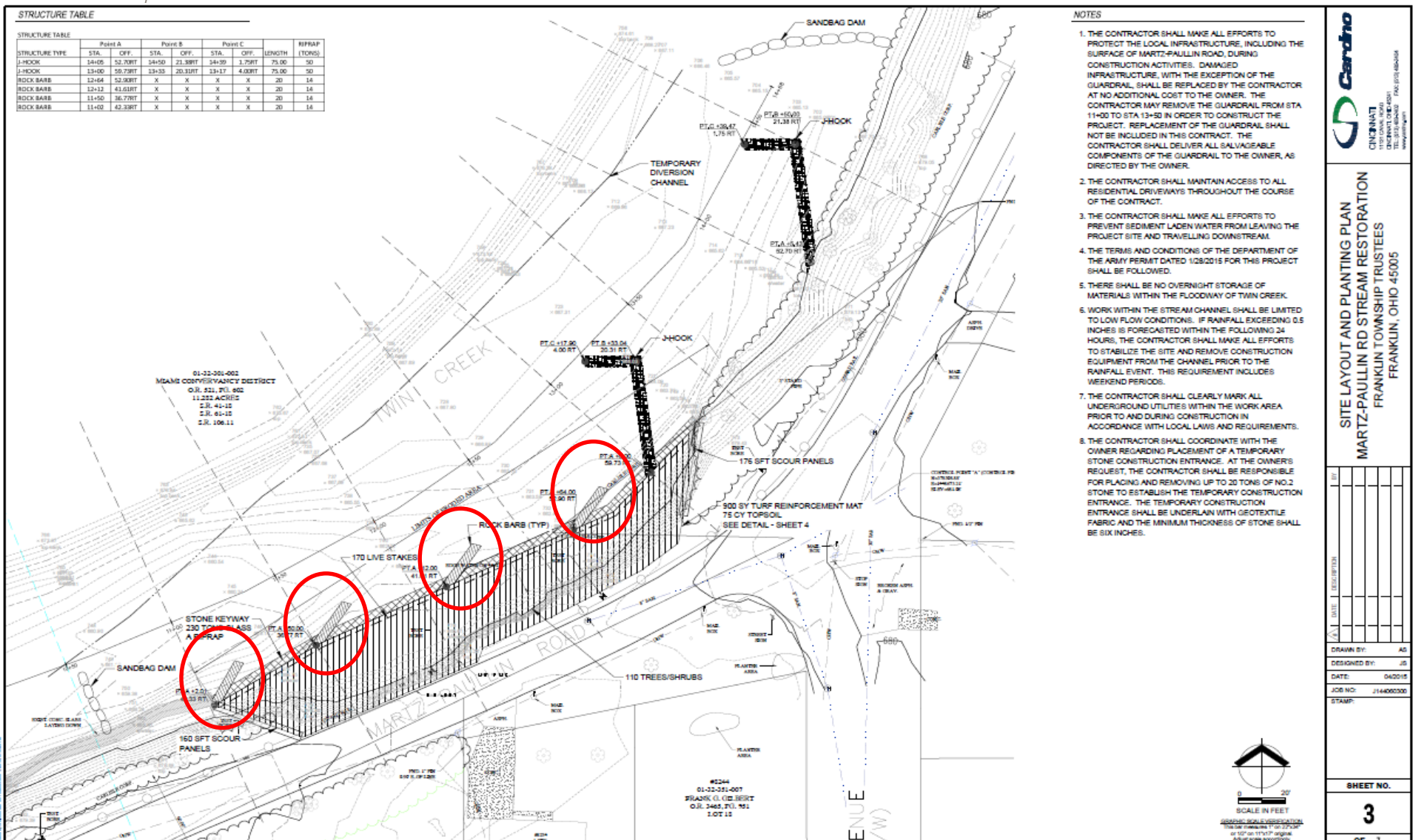
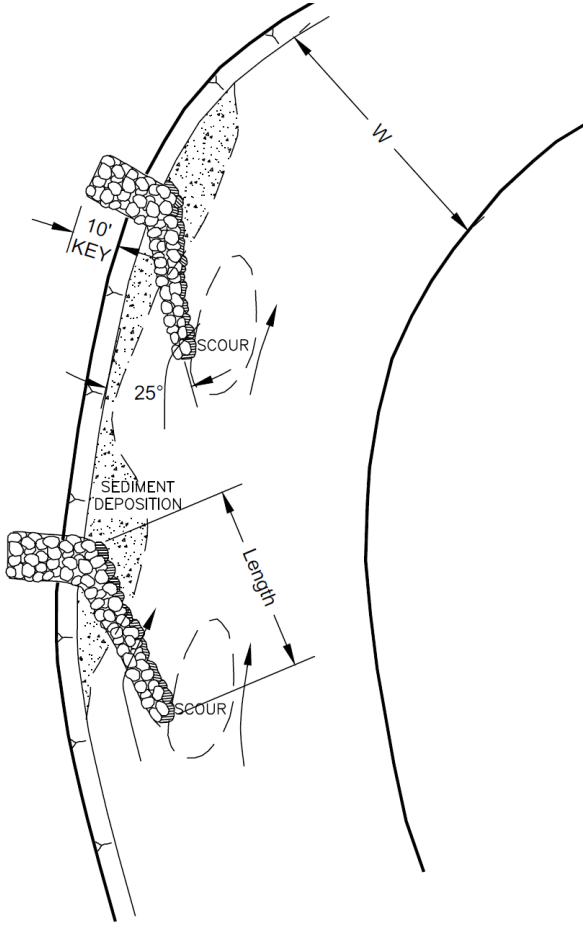
Twin Creek
Martz-Paulin Rd
Sue Ave
Google

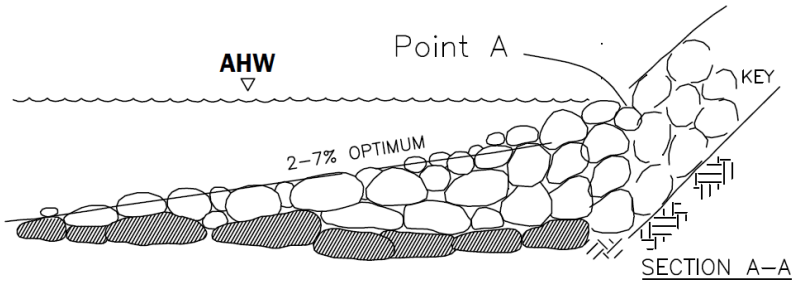
Proposed Conditions (Rock Barbs)



In-Stream Structures (Rock Barbs)



PLAN VIEW



TYPICAL STREAM BARB BANK KEY DETAIL

NOT TO SCALE

TYPICAL STREAM BARB DETAIL

NOT TO SCALE

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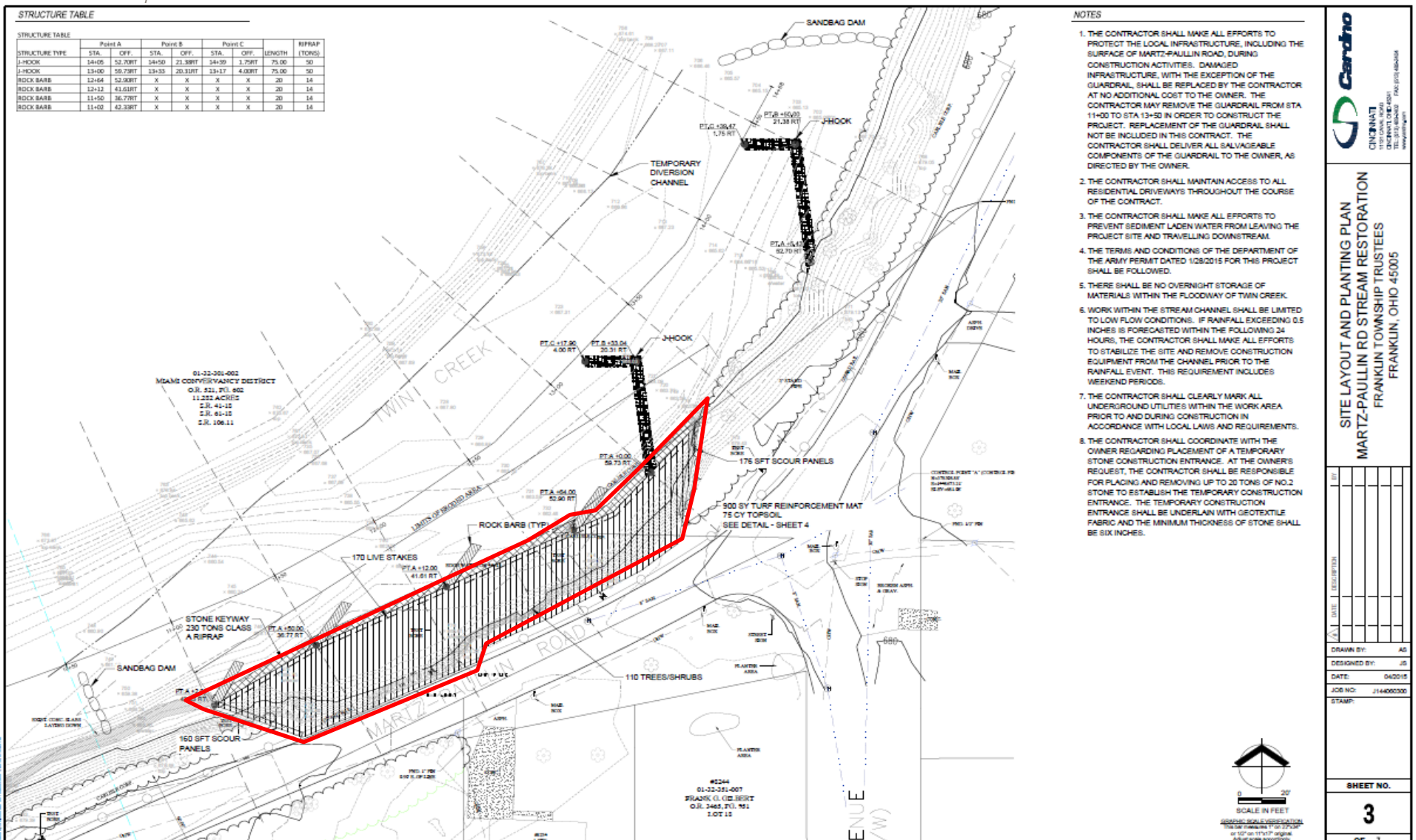
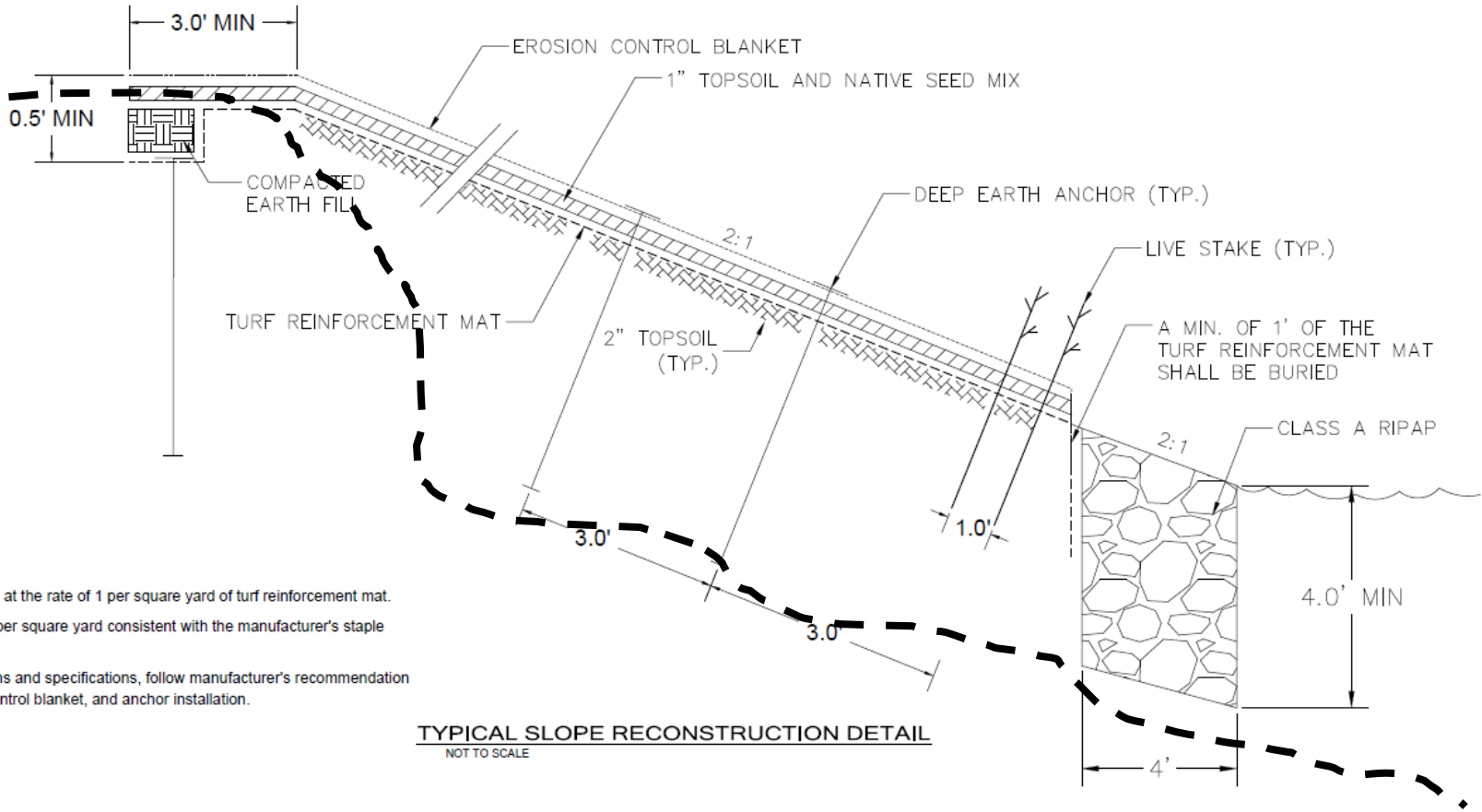
17/03/2016

Proposed Conditions (Bank Reconstruction)





TYPICAL SLOPE RECONSTRUCTION DETAIL

NOT TO SCALE

ANCHOR NOTES:

1. Deep earth anchors shall be installed at the rate of 1 per square yard of turf reinforcement mat.
2. Install 18" Geopins at the rate of 3.6 per square yard consistent with the manufacturer's staple pattern "E".
3. Unless otherwise directed on the plans and specifications, follow manufacturer's recommendation for turf reinforcement mat, erosion control blanket, and anchor installation.

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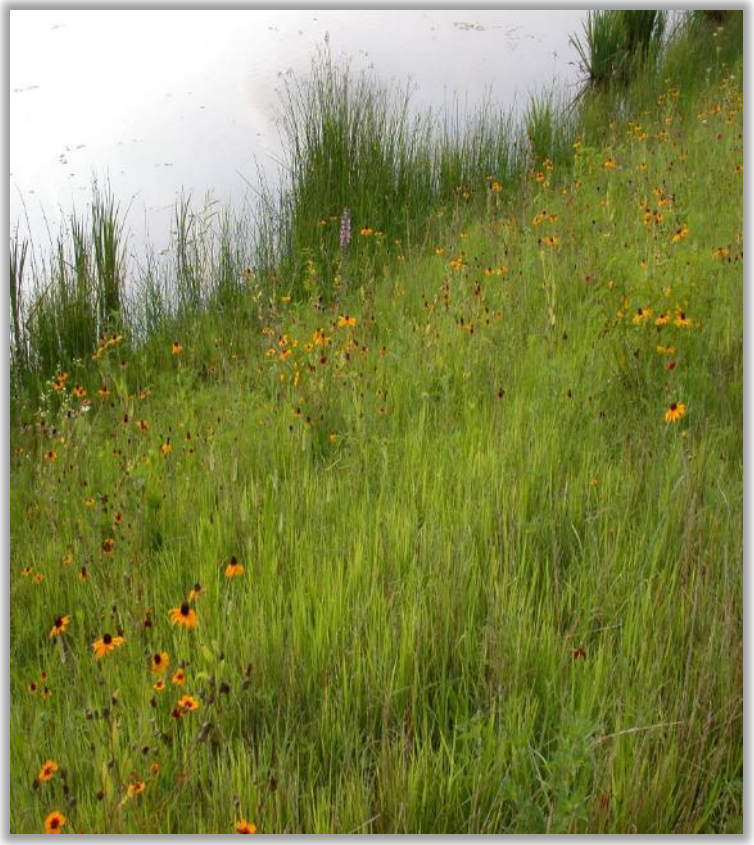
Native Seeding – Slope Stabilization Mix

Native Slope Stabilization Seed Mix		
Botanical Name	Common Name	Pure Live Seed Ounces/Acre
Permanent Mix		
Andropogon gerardii	Big Bluestem	48.00
Bouteloua curtipendula	Side-Oats Grama	16.00
Carex spp.	Prairie Sedge Mix	4.00
Elymus canadensis	Canada Wild Rye	32.00
Elymus virginicus	Virginia Wild Rye	24.00
Panicum virgatum	Switch Grass	12.00
Schizachyrium scoparium	Little Bluestem	32.00
Sorghastrum nutans	Indian Grass	32.00
	Sub-Total	200.00
Temporary Mix:		
Avena sativa	Common Oat	512.00
Lolium multiflorum	Annual Rye	240.00
	Sub-Total	752.00
	Total Ounces/Acre	952.00
	Total Pounds/Acre	59.50



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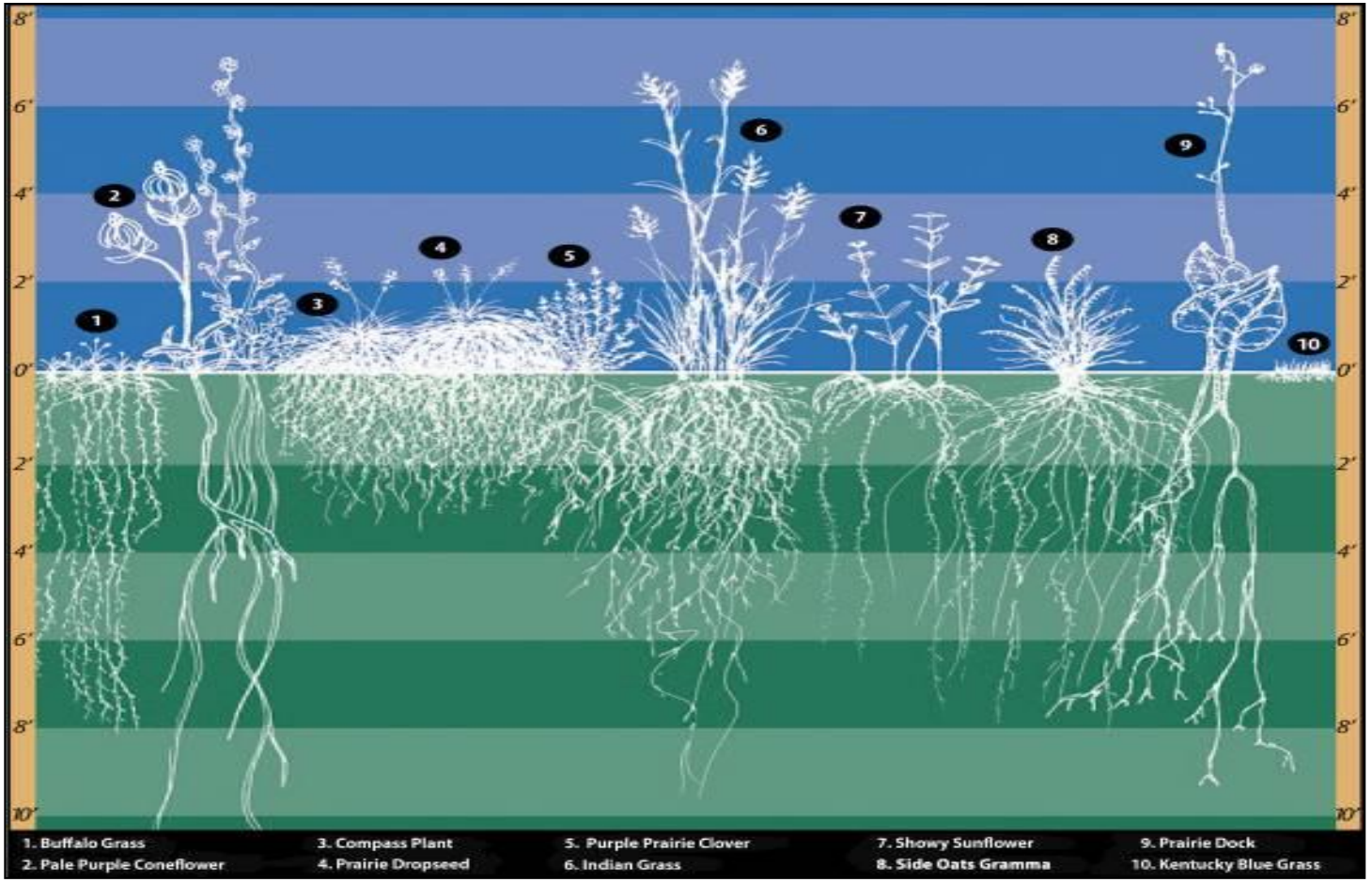

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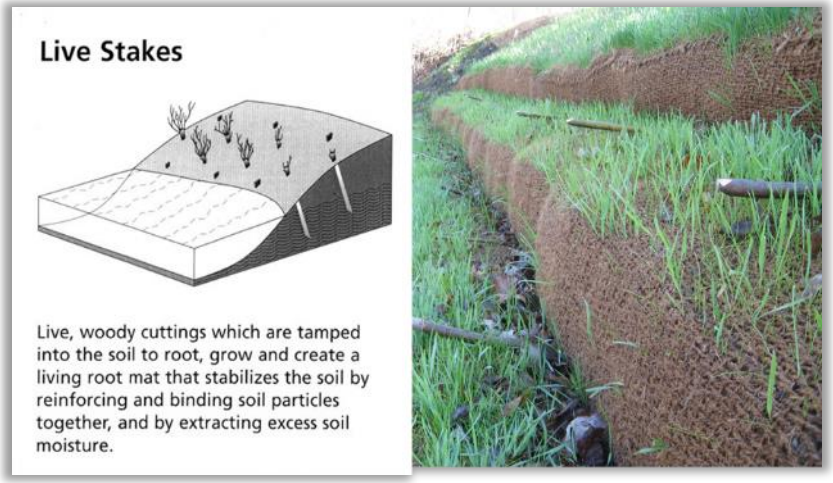
Bioengineering Materials – Live Stakes

Bare Root Planting List	
Scientific Name	Common Name
Amelanchier laevis	Smooth Serviceberry
Asimina triloba	Pawpaw
Cercis canadensis	Redbud
Cornus florida	Flowering Dogwood
Cornus racemosa	Gray Dogwood
Corylus americana	American Hazelnut
Hamamelis virginiana	Witch Hazel
Ilex verticillata	Winterberry
Lindera benzoin	Spicebush
Physocarpus opulifolius	Ninebark
Salix exigua	Sandbar Willow
Sambucus canadensis	Elderberry
Viburnum prunifolium	Black Haw

Live Stake Planting List	
Scientific Name	Common Name
Cornus sp.	dogwood
Ilex verticillata	Winterberry
Salix sp.	willow
Sambucus canadensis	Elderberry



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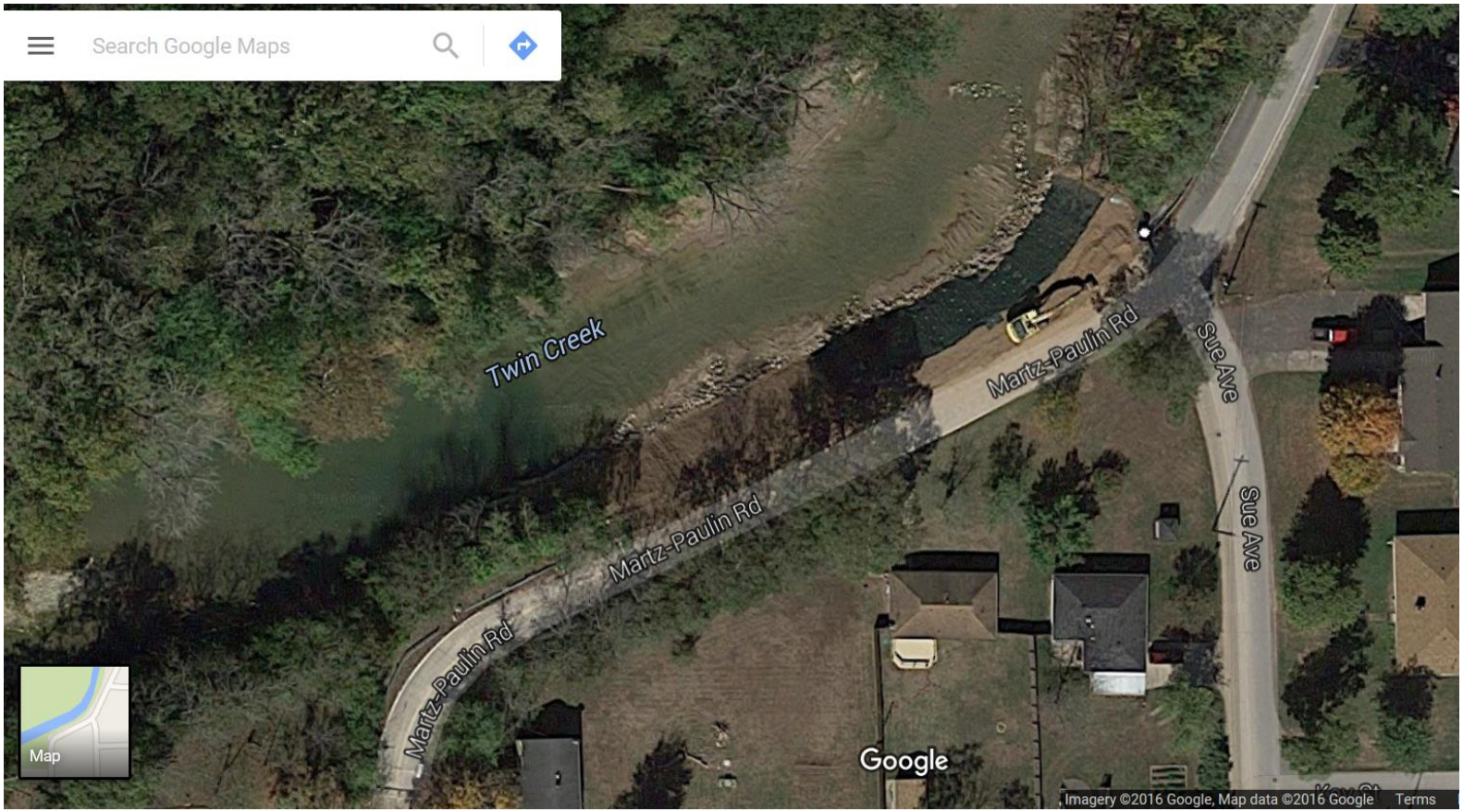
Bioengineering Materials – Brush Layering

Bioengineering – Soil Encapsulated Lifts

Construction Implementation



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Channel Diversion

Pump Around and Construction Access

Key Trench, Rock Toe and Barb Installation

Key Trench and Barb Installation

Slope Reconstruction

Slope Reconstruction

Slope Reconstruction

Turf Reinforcement Mat (Pyramat) Installation

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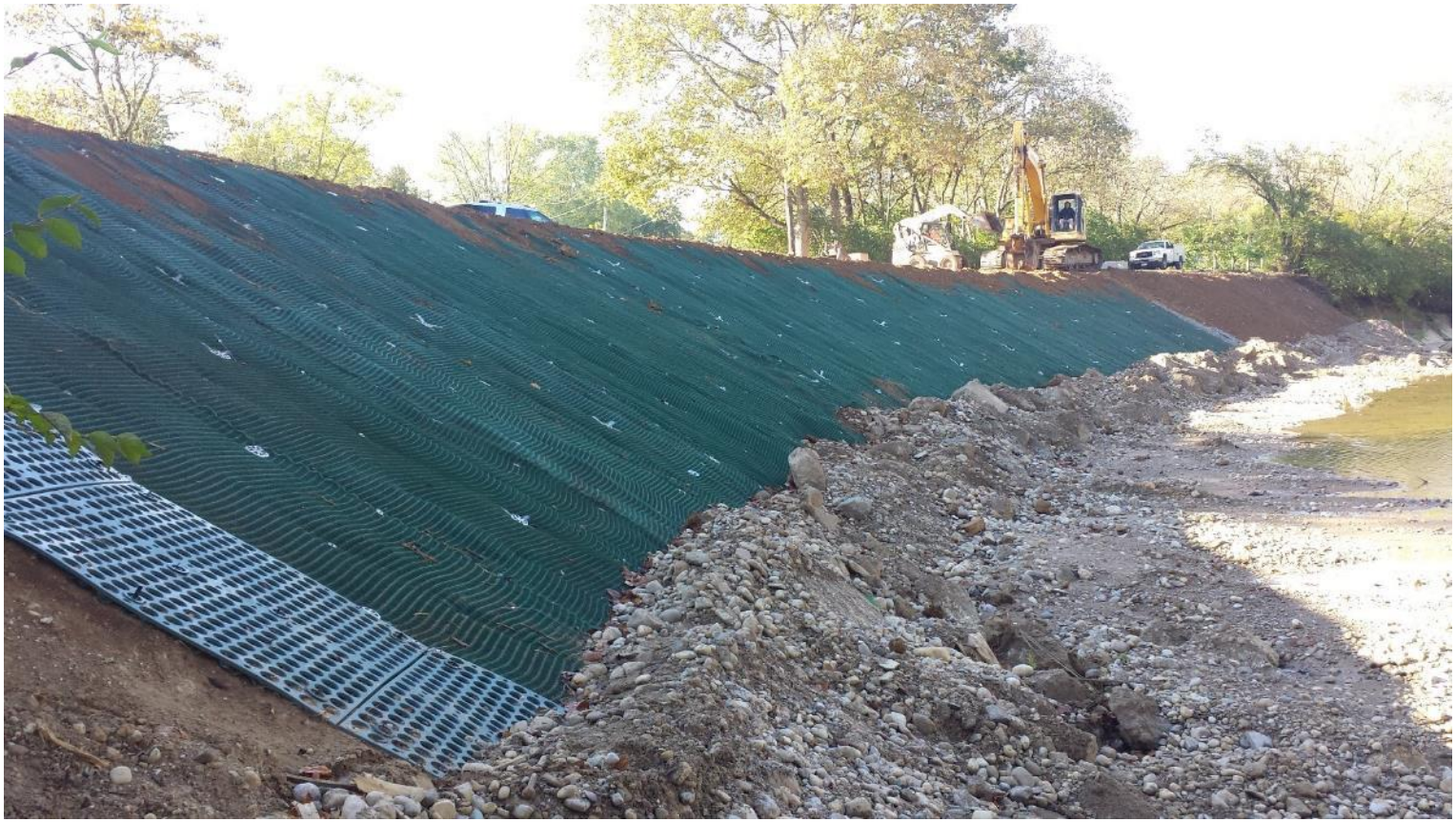
Deep Earth Anchor Installation

Scour Stop and Pyramat Installation



Top Soil Addition- During

Top Soil Addition- After

Erosion Control Blanket Installation

Post Installation

Post Installation – 3 Mon

Waterway Permitting and Design Considerations for Infrastructure Improvement Projects

Ecological Assessments and Surveys

- Wetland Determination and Delineations
- Stream Assessments
- Rare, Threatened, and Endangered (RTE) Species Surveys
- Habitat Assessments
- Cultural and Historic Resource Evaluations
- Stormwater Pollution Prevention Planning (SWPPP)
- National Environmental Policy Act (NEPA) studies, and reporting

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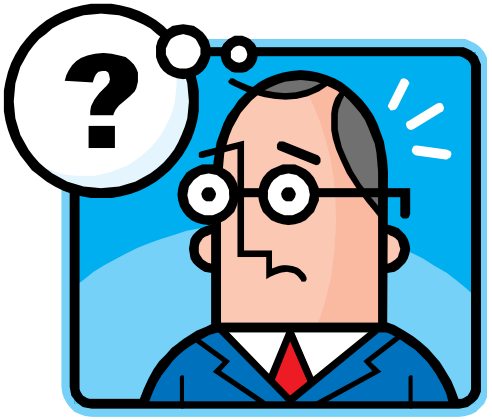
Waterway Permitting and Design Considerations for Infrastructure Improvement Projects

Permitting

- Wetlands (jurisdictional and isolated)
- Waterways and streams
- Coastal, dune, and high risk erosion areas
- Cultural resources
- Soil erosion and sedimentation control
- Stormwater management
- Inland lakes
- Floodway and floodplain
- Rare, threatened, and endangered species
- Wetland and protected species mitigation
- State and National Scenic Rivers
- Coastal Zone Management
- Wetland and protected species mitigation



Waterway Permitting and Design Considerations for Infrastructure Improvement Projects

Determining the Critical Path

For most infrastructure improvements, the critical path is determined by the highest level and type of permit required. The majority of all other permits will roll under or have a “federal nexus” to the lead permitting agency.

For most linear projects (roads, storm / sanitary sewers, and pipelines); this will be one of the following:

U.S. Army Corps of Engineers – Clean Water Act – Section 404

U.S. Army Corps of Engineers – Rivers and Harbors Act – Section 10

Federal Highway Administration (FHWA)

Federal Energy Regulatory Commission (FERC)

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U.S. Army Corps of Engineers – Clean Water Act, Section §404 Permit

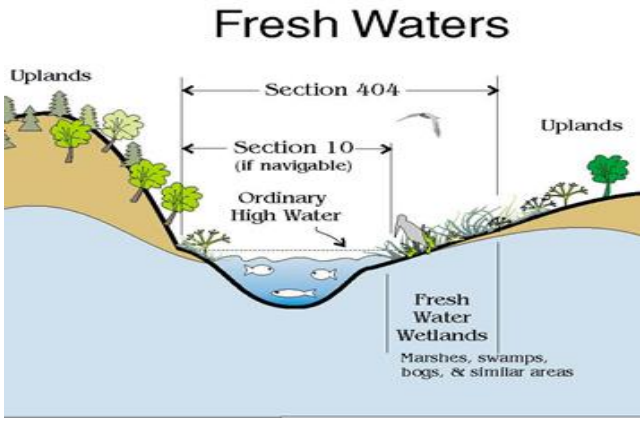
Required For:

Impacts to Jurisdictional “Waters of the U.S.” The placement of fill in jurisdictional wetland and/or streams below the plane of the **ordinary high water mark (OHWM)**

Types of Permits:

Nationwide General Permits (NWPs)

Individual Permits (IPs)



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Ordinary High Water Mark (OHWM) Determination

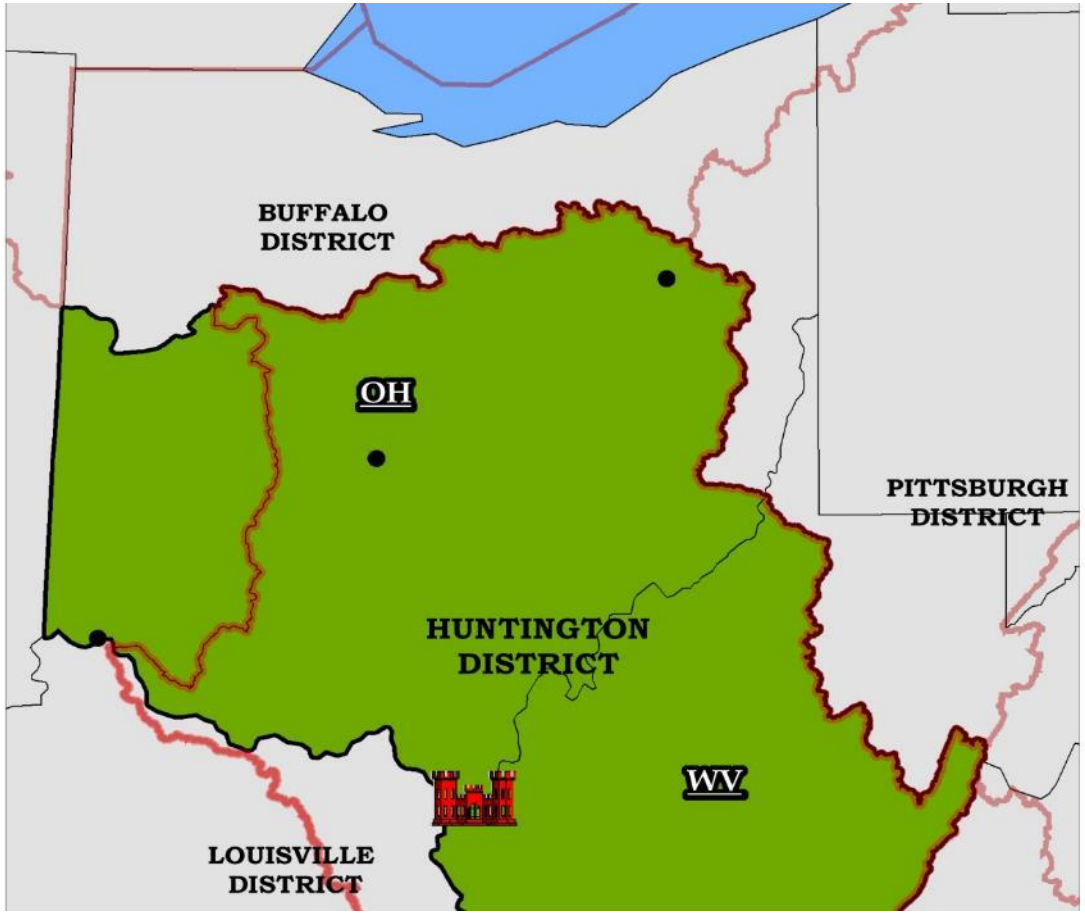
Impacts to Jurisdictional "Waters of the U.S."

- The placement of fill in jurisdictional wetland and/or streams below the plane of the **ordinary high water mark (OHWM)** requires a Section 404 permit

U.S. Army Corps of Engineers – Clean Water Act, Section §404 Permit

Ohio Corps Districts

Huntington District (Lead)
Buffalo District
Pittsburgh District



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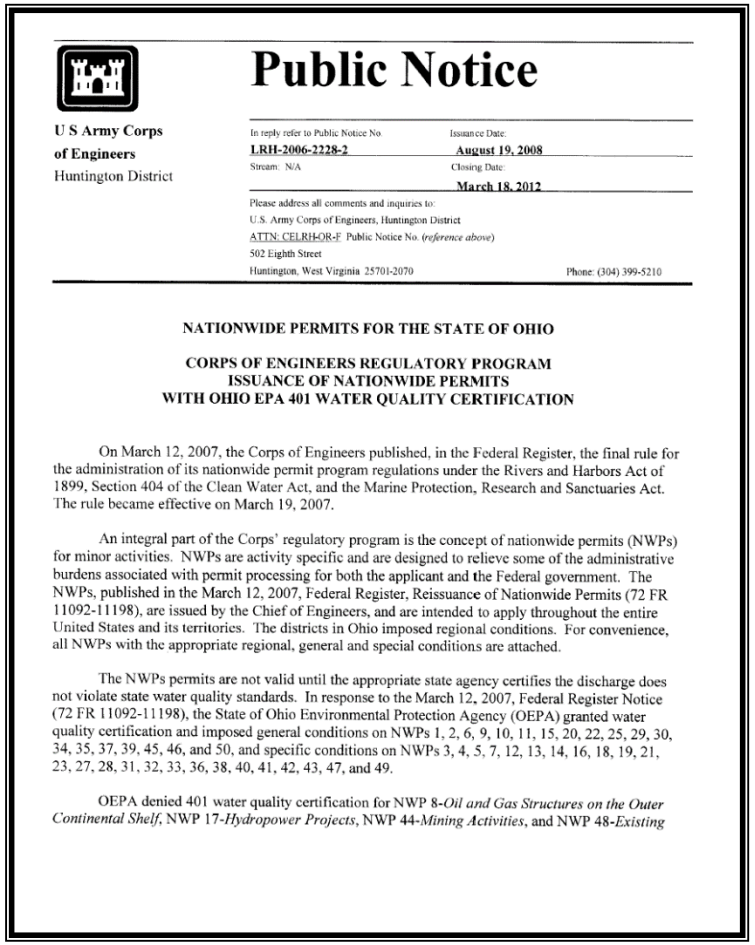
U.S. Army Corps of Engineers – Section §404 Permits Nationwide General Permits

- General Permits with *typically* expedited approvals (60-90 days)
- A total of 52 specifically activities authorized in the State of Ohio
  - **NWP 3 – Maintenance**
  - **NWP 12 – Utility Lines**
  - **NWP 13 – Bank Stabilization**
  - **NWP 14 – Transportation**
  - **NWP 27 – Aquatic Habitat Restoration**
  - NWP 29 – Residential Developments
  - NWP 31 – Flood Control Facilities
  - NWP 39 – Commercial Developments
  - NWP 41 – Drainage Ditches
  - NWP 43 – Stormwater Management Facilities
- Determine the project purpose and need for permit applicability



Public Notice

U S Army Corps of Engineers
Huntington District

In reply refer to Public Notice No.
LRH-2006-2228-2
Stream: N/A

Issuance Date:
August 19, 2008
Closing Date:
March 18, 2012

Please address all comments and inquiries to:
U.S. Army Corps of Engineers, Huntington District
ATTN: CELRH-OR-F Public Notice No. *(reference above)*
502 Eighth Street
Huntington, West Virginia 25701-2070
Phone: (304) 399-5210

NATIONWIDE PERMITS FOR THE STATE OF OHIO

CORPS OF ENGINEERS REGULATORY PROGRAM
ISSUANCE OF NATIONWIDE PERMITS
WITH OHIO EPA 401 WATER QUALITY CERTIFICATION

On March 12, 2007, the Corps of Engineers published, in the Federal Register, the final rule for the administration of its nationwide permit program regulations under the Rivers and Harbors Act of 1899, Section 404 of the Clean Water Act, and the Marine Protection, Research and Sanctuaries Act. The rule became effective on March 19, 2007.

An integral part of the Corps' regulatory program is the concept of nationwide permits (NWPs) for minor activities. NWPs are activity specific and are designed to relieve some of the administrative burdens associated with permit processing for both the applicant and the Federal government. The NWPs, published in the March 12, 2007, Federal Register, Reissuance of Nationwide Permits (72 FR 11092-11198), are issued by the Chief of Engineers, and are intended to apply throughout the entire United States and its territories. The districts in Ohio imposed regional conditions. For convenience, all NWPs with the appropriate regional, general and special conditions are attached.

The NWPs permits are not valid until the appropriate state agency certifies the discharge does not violate state water quality standards. In response to the March 12, 2007, Federal Register Notice (72 FR 11092-11198), the State of Ohio Environmental Protection Agency (OEPA) granted water quality certification and imposed general conditions on NWPs 1, 2, 6, 9, 10, 11, 15, 20, 22, 25, 29, 30, 34, 35, 37, 39, 45, 46, and 50, and specific conditions on NWPs 3, 4, 5, 7, 12, 13, 14, 16, 18, 19, 21, 23, 27, 28, 31, 32, 33, 36, 38, 40, 41, 42, 43, 47, and 49.

OEPA denied 401 water quality certification for NWP 8-*Oil and Gas Structures on the Outer Continental Shelf*, NWP 17-*Hydropower Projects*, NWP 44-*Mining Activities*, and NWP 48-*Existing*

U.S. Army Corps of Engineers – Section §404 Permits Nationwide General Permits

- Notification Requirements
  - Some always require notification: ex. NWP 12, 29, 39
  - Some have conditional notification: ex. NWP 14, 27, 41
  - Some may not require notification: ex. NWP 3, 20

- Notification Typically Includes:
  - Pre Construction Notification (PCN)
  - Regulated Waters Delineation
  - Demonstrate Impacts below *De Minimis* Thresholds
    - Ex. 300 LF for perennial, intermittent and ephemeral streams
    - Ex. ½ acre for wetlands
  - Pre- and Post – Construction Cross Sections
  - Federal Nexus Coordination
  - Regional and State Specific Conditions
    - Ex. Ohio EPA 401 Water Quality Certifications

U.S. Army Corps of Engineers – Section §404 Permits Individual Permits

- Individual Permits with *typical* approvals (8-12 months)
- Typical for Impacts that:
  - Exceed 300 LF of Stream Bed
  - Exceed ½ acre of Jurisdictional Wetlands
  - Occur in Outstanding State Waters
- Requires a NEPA-based alternatives analysis
- Requires Corps to complete a CDD (decision document).
- Evaluates the project's broader socio-economic impact, including all feasible alternative
- Public Notice / Public Hearing
- Requires Compensatory Mitigation
- Determine whether project has "independent utility" or meets requirements of a "single and complete project"

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U.S. Army Corps of Engineers – Section §404 Permits Nationwide General Permits

- Potential Federal and State Nexus Permits/Approvals:
  - U.S. Army Corps of Engineer's – Rivers and Harbor's Act – Section 10
  - **U.S. Fish & Wildlife Service – Endangered Species Act - Section 7(a)**
  - National Park Service - Wild and Scenic Rivers Act – Section 7
  - FEMA – Flood Protection
  - **Ohio Historic Preservation Office (OHPO) – National Historic Preservation Act (NHRP) – Section 106**
  - **Ohio EPA – Clean Water Act – Section 401 Water Quality Certification**
  - **Ohio EPA – Isolated Wetland Permits**
  - ODNR – Coastal Zone Management Coordination
  - ODNR – State Scenic Rivers
  - Ohio EPA – NPDES

U.S. Army Corps of Engineers – Section §404 Permits Nationwide General Permits

Big Changes Coming?

****DRAFT DATE 10/26/2015****

The Chief of Engineers
HQUSACE
Attn: CECW-OR
Washington, D.C. 20314-1000

Re: All Counties, Cities and Townships in Ohio
Modification of Grants of Clean Water Act section 401 water quality certifications and replaces the certifications issued on March 30, 2012 and April 19, 2012
Authorization of discharge of dredged or fill material to various waters of the State for the following nationwide permits as published in the February 21, 2012, *Federal Register* (Volume 77, Number 34)
Ohio EPA ID Numbers 113742 and 123911

NWP Modifications

NWP # 4, 6, 7, 12, 13, 14, 15, 16, 18, 21, 22, 23, 25, 29, 30, 33, 34, 36, 37, 38, 39, 40, 41, 42, 43, 45, 49, 50, 51,	**Revision** – The new stream eligibility conditions have replaced the stream aquatic life use designation and antidegradation category conditions for all NWP where those conditions currently exist.
NWP # 3, 4, 5, 6, 7, 12, 14, 29, 33, 39, 40,	**Revision** – The existing culvert and culvert extension condition was revised for all NWP where this condition currently exists. The inclusion of the language "new culvert" was confusing and often misinterpreted. This portion of the condition has been removed.
NWP # 5, 31	**Deletion** –The stream conditions were removed from the NWP for Scientific Measurement Devices and Maintenance of Existing Flood Control Facilities.
NWP # 4, 5, 6, 7, 13, 14, 15, 16, 18, 21, 22, 23, 25, 29, 30, 31, 33, 34, 36, 39, 40, 41, 42, 43, 45, 49, 50, 51	**Deletion** –The 300 or 500 linear foot threshold was removed from all NWP where the condition currently exists in order to more closely align the 401 WQC with the NWP and to avoid duplicative conditions where they already exist. The Corps already includes a 300 linear foot threshold for NWP # 12, 14, 21, 27, 29, 39, 40, 42, 43, 50, 51 and a 500 linear foot threshold for NWP # 13.

Nationwide Permits – GRANTED 401 Certification

Why is a 401 Water Quality Certification required?

- Section 401 of the Clean Water Act requires that each state certify that the proposed actions will not violate state water quality standards. Ohio EPA is the regulatory agency charged with this responsibility.
- Ohio EPA issued the 401 WQC for the NWPs on March 30, 2012, (non-coal NWPs) and April 19, 2012 (coal NWPs).

Ohio Environmental Protection Agency

Modifications to 2012-17 Nationwide Permits

Why modify the 401 WQC for Nationwide Permits now?

- During the last two years, Ohio EPA determined that the following changes were necessary:
  - Revise language for consistency (both with Corps requirements and in the document from NWP to NWP);
  - Correct typographical errors;
  - Update stream eligibility requirements;
  - Clarify and provide guidelines and structure to the Director's Authorization process; and
  - Combine the 401 WQC for coal and non-coal NWPs into one 401 WQC document.
- Time between the final issuance of the modification and certification of the new NWPs in 2017 allows for the new processes to be evaluated and changed, if necessary.

Ohio Environmental Protection Agency

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Stream Eligibility

Stream Eligibility Condition

- Ohio EPA developed a GIS-based approach that defines stream eligibility under the 401 WQC for the NWPs.
- Approach takes advantage of our robust data on high quality waters and minimizes need for individual stream assessments.
- **Objective:** To protect known "high quality waters," which are defined as coldwater*, exceptional warmwater, seasonal salmonid aquatic life uses, superior high quality waters, or outstanding state waters (upper antidegradation tiers) *and those water bodies that support them*.

*Map includes only those CWH streams having documented cold water fish

Ohio Environmental Protection Agency

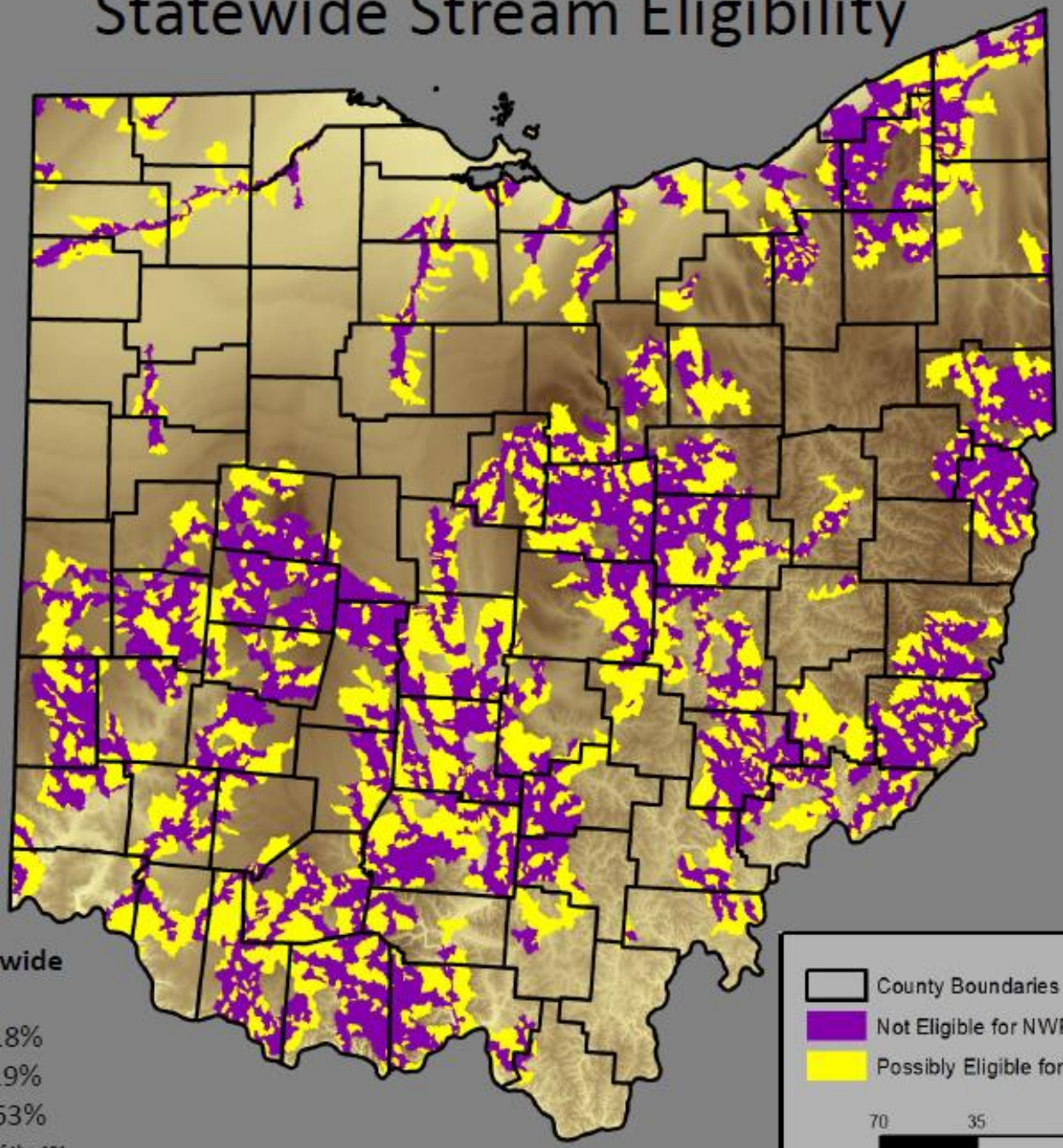
Stream Eligibility (continued)

Stream Eligibility Condition

- Map shows watersheds falling within one of the following three areas:
  - Eligible for 401 coverage under NWP (no further information needed);
  - Possibly eligible (with further information); and
  - Ineligible for 401 coverage under NWPs.

Ohio Environmental Protection Agency

Statewide Stream Eligibility



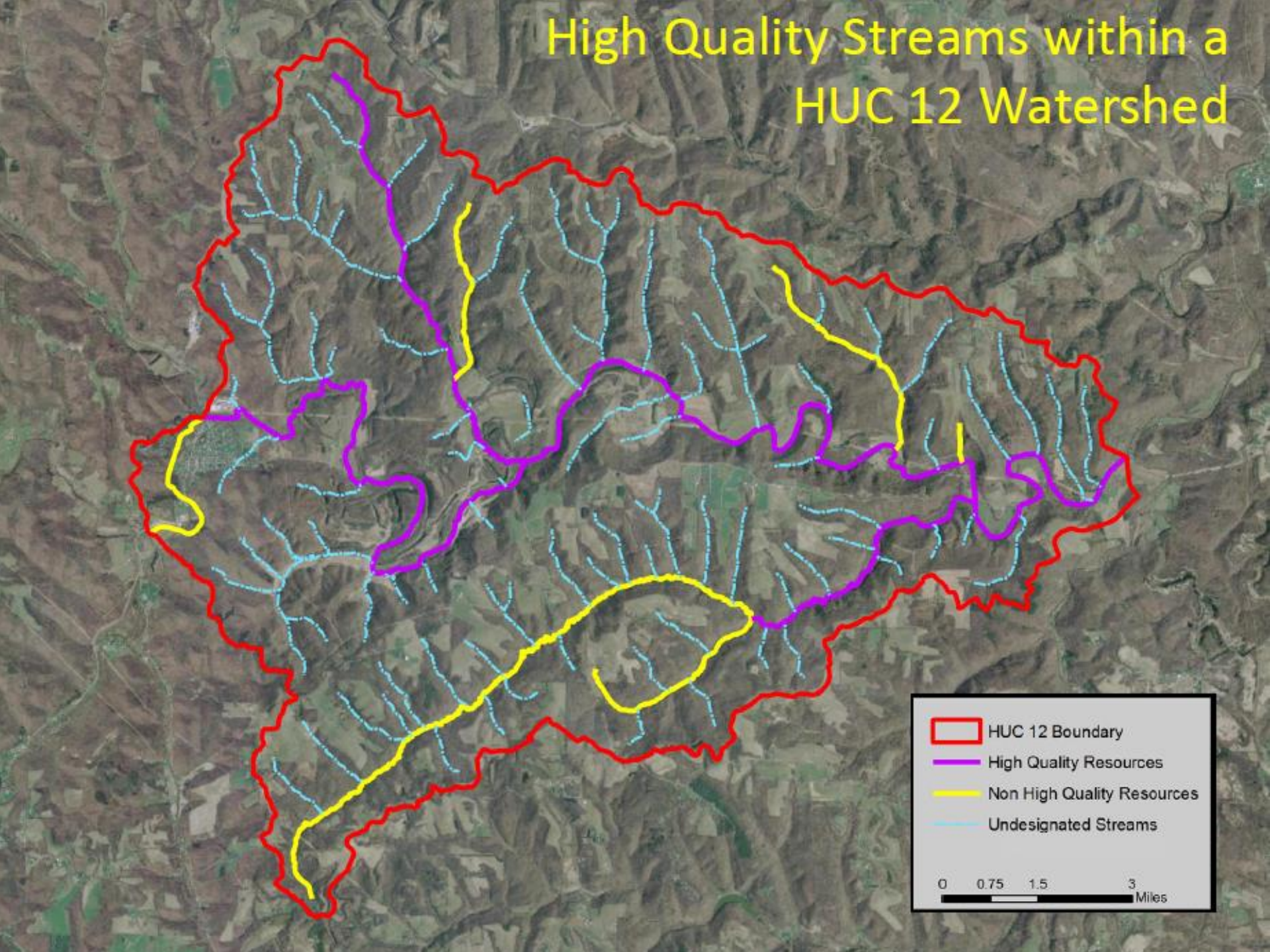
* Based on most recent update of existing use (designated in rule and assessed) statewide GIS layer (2015).

Approximate Statewide Eligibility Statistics

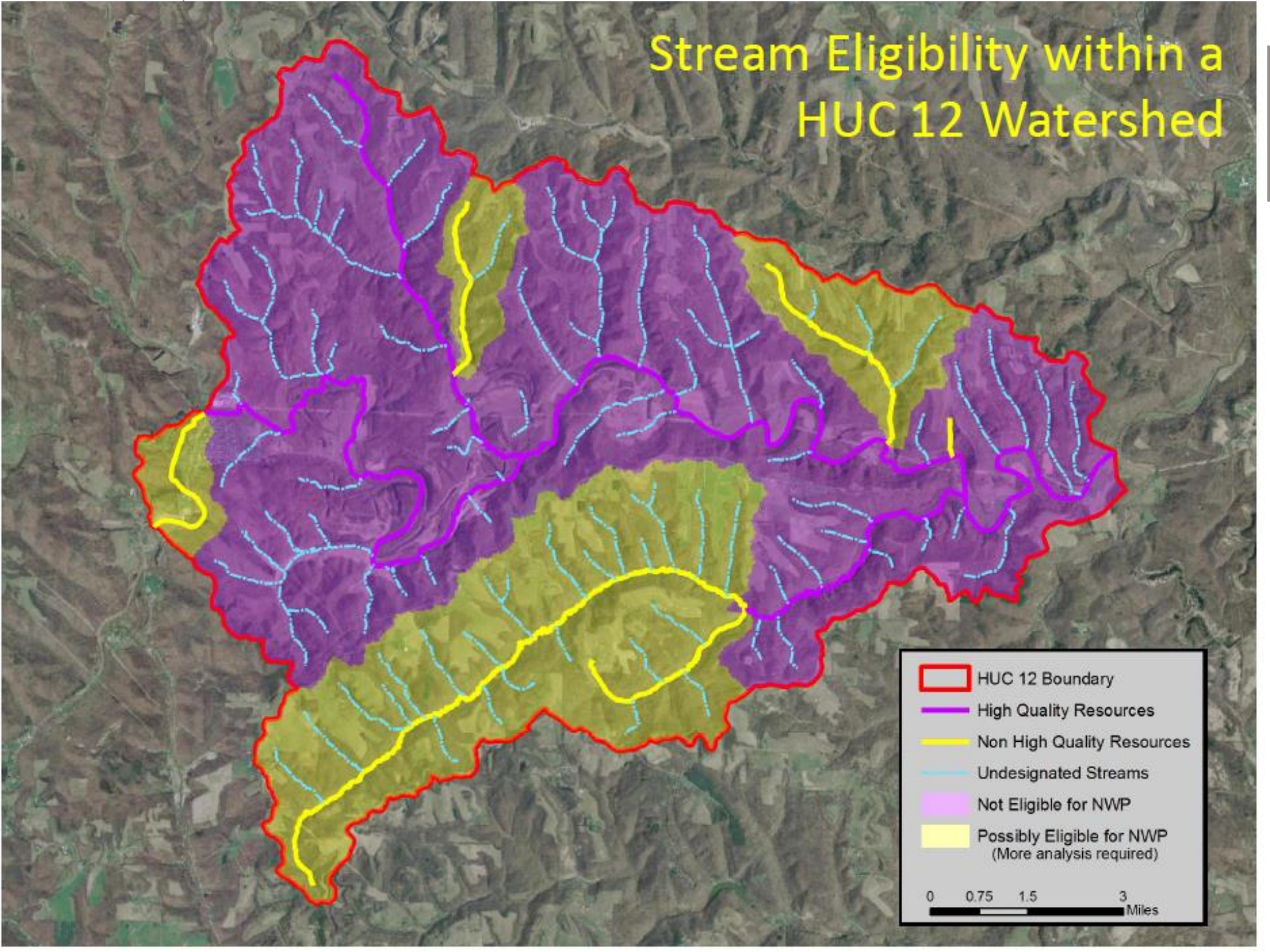
Not eligible = 18%
Possibly eligible = 19%
Eligible* = 63%

*Given that all other conditions of the 401 WQC for the NWPs are satisfied.

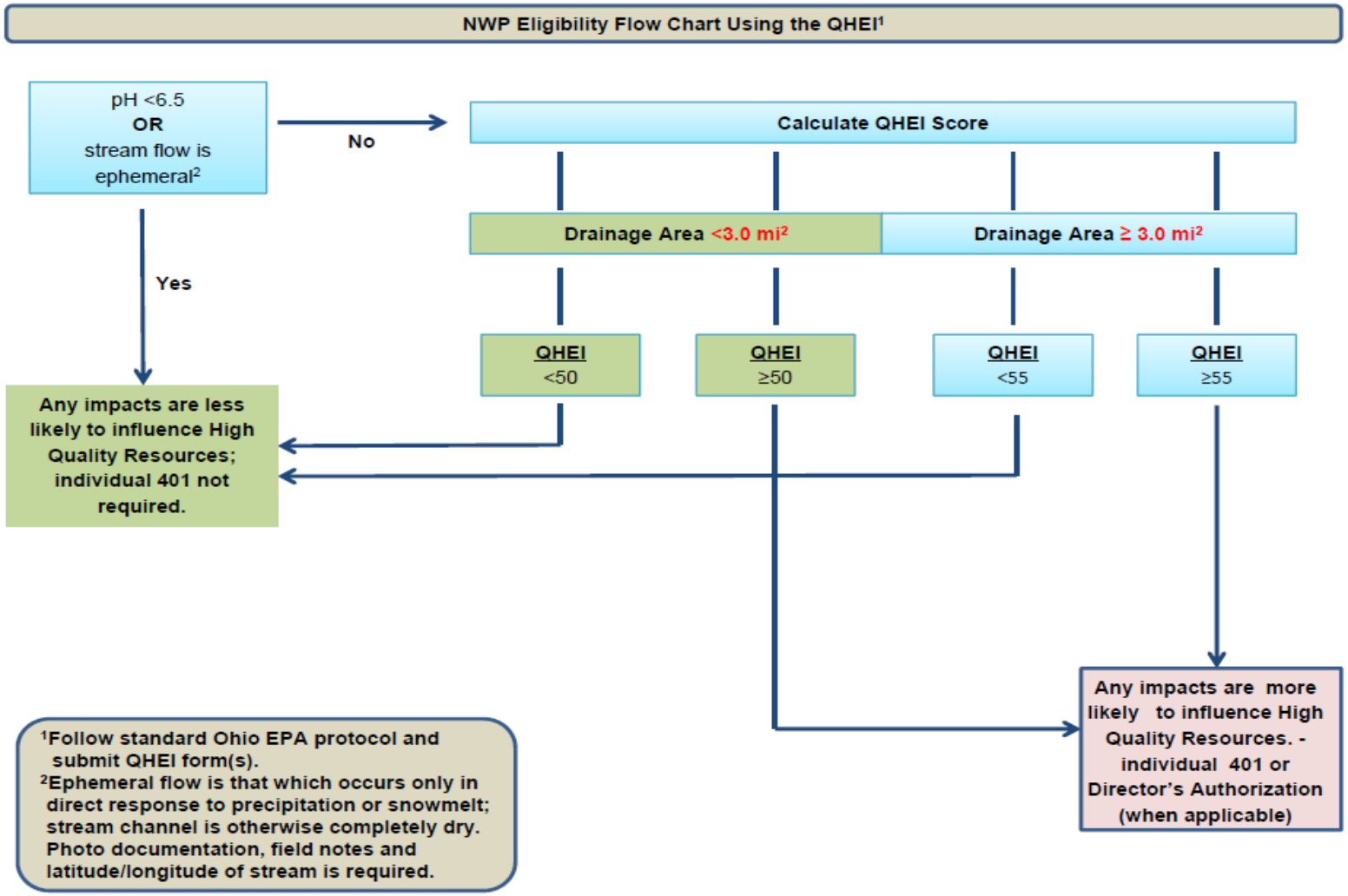
High Quality Streams within a HUC 12 Watershed



Stream Eligibility within a HUC 12 Watershed



NWP Eligibility Flow Chart (using QHEI)



Possible Scenarios (CEAO Members)

- **Culvert Replacements (NWP 3 (a) and (b)**
- **Culvert Extensions (NWP 3 (a))**
- **Bridge Crossings (NWP 14)**
- **In Line Detention / Regional Stormwater Basins (NWP 43 / NWP 31)**
- **Road Widening Projects (NWP 14)**
- **Stream Restoration (NWP 27)**
- **Storm Sewer Installations (NWP 12 / NWP 14)**
- **Bank Stabilization (NWP 13)**
- **Drainage Ditches (NWP 41)**

Questions:

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