A New Bridge over Big Darby Creek – Balancing Environmental Impacts with Long-Term Cost Effectiveness

PIC-CR22-6.58 [Scioto Darby Road]

KORDA
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TranSystems
S&ME
ENGINEERING INTEGRITY.
PRIME AE®

Project Team

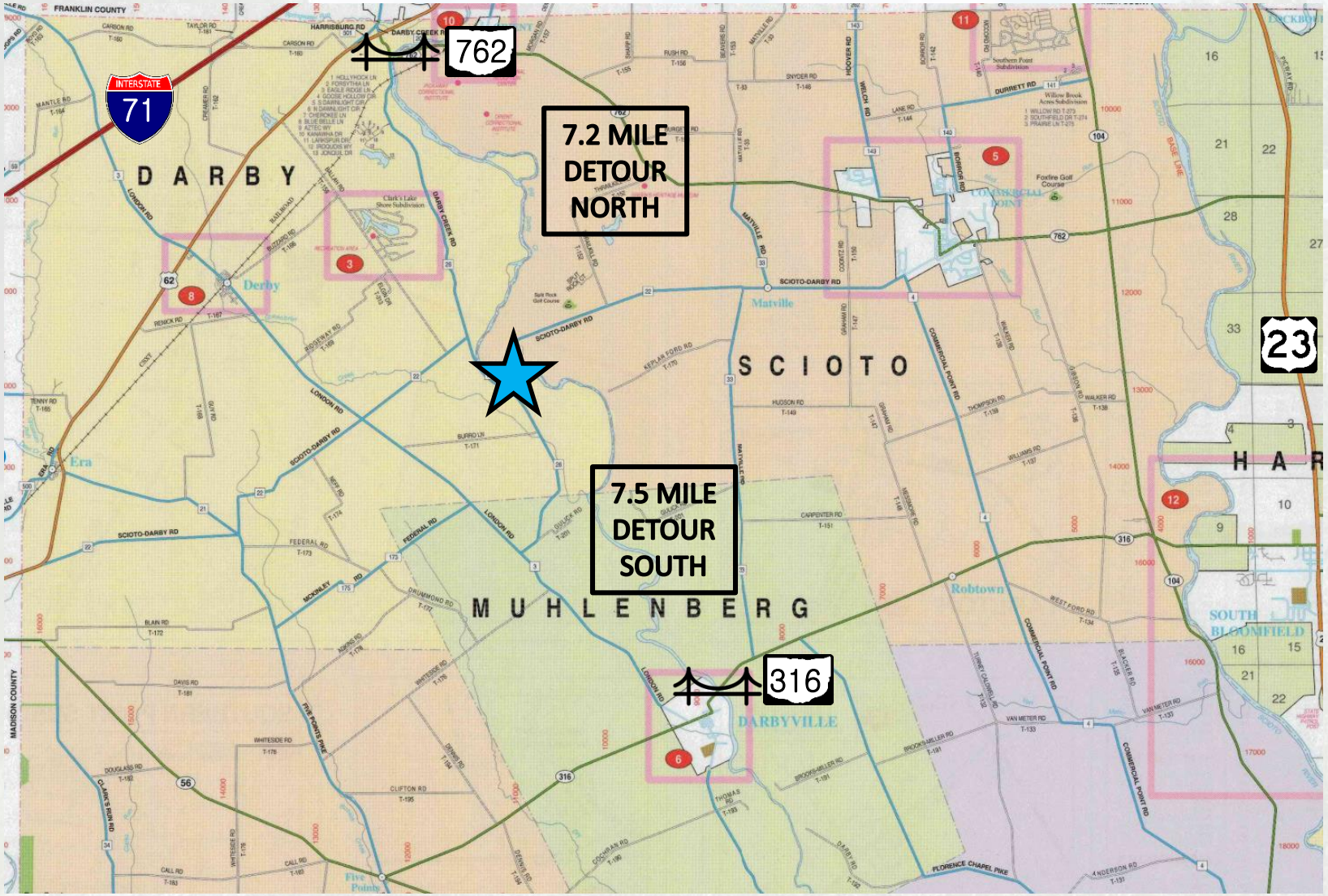
Owner
- Pickaway County Engineer (Local Let LPA)

Design Team
- Korda/Nemeth Engineering, Inc. (Prime Consultant)
- TranSystems Corp. (Environmental Subconsultant)
- S&ME, Inc. (Geotechnical Subconsultant)

Construction
- Prime AE Group (Construction Inspection/Administration)
- Eagle Bridge Company (Contractor)

Funding/Review
- ODOT District 6

Project Location



Background & History

"Gantz Bridge"

- Constructed in 1910
- Two-span Pratt Truss
  - Not historic
- 255' Long, 17.3' Width
- Closed to traffic in March, 2014
  - Deteriorated floor beams
- ADT = 303 vpd (2011)
- 1 of 2 County bridges over Big Darby (Florence Bridge/TR127, c.a. 1912 – closed in 2016)

Project Goals

County Perspective

- Cost effective, “ordinary” construction
- Low maintenance, especially over Big Darby Creek
  - Work near Scenic Rivers increasingly difficult
  - Avoid future painting of steel girders
- Increase safety – wider structure, realigned roadway
- Aesthetics – County desire and environmental commitment
  - Similar aesthetic to other recent long-span County bridges

Scioto River Crossing

Existing Conditions

CR26 -Darby Creek Rd.

Dc = 25°, DS~15 mph

CR22 – Scioto-Darby Rd.

Single, 17’ lane

11.4%

+ 3 vertical curves, DS ≤ 31 mph

Dc = 34°, Site Distance 125’, DS~15 mph

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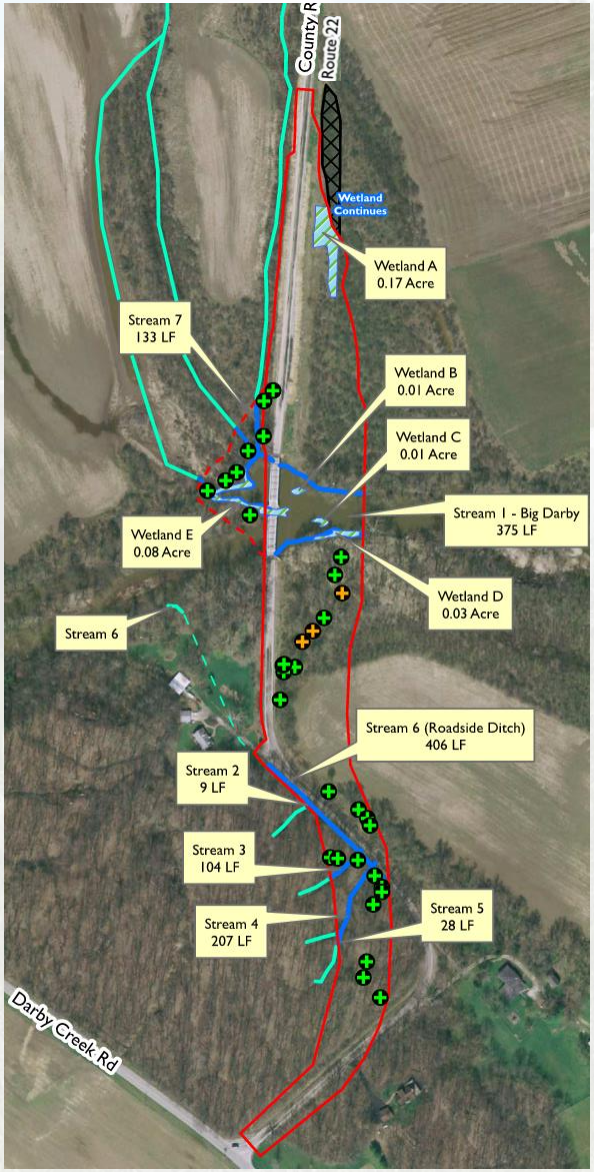
Preliminary Engineering

Environmental Resources Overview

- Big Darby Creek
- 8 other jurisdictional streams
- 5 wetlands
- Bat roost trees
- Maternity roost trees



Early Stakeholder Meetings

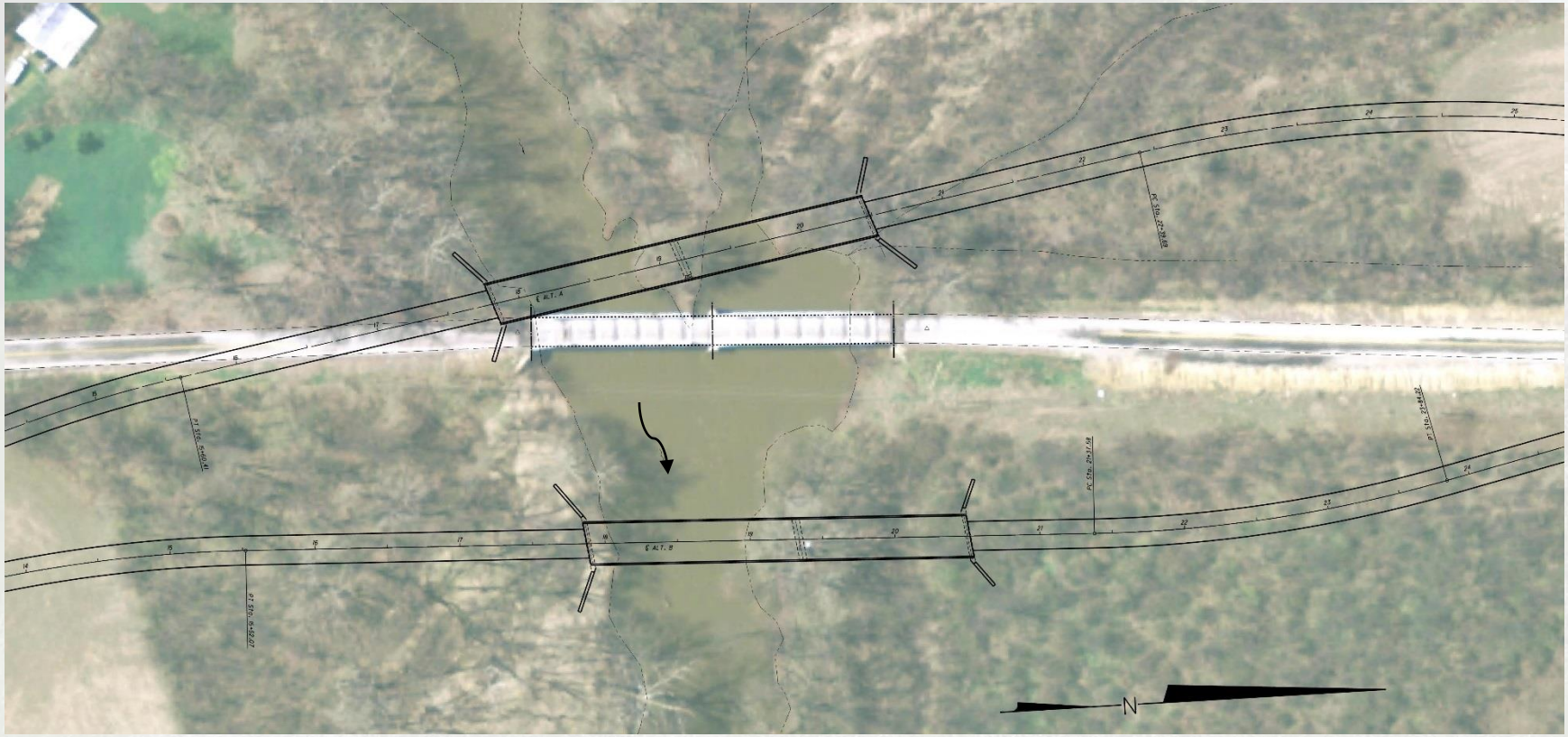
Environmental is key

- Pre-scope meetings with ODOT & agencies
- Numerous on-site meetings
- Weighing each agency's environmental concerns
  - U.S. Fish & Wildlife Service (USFWS)
  - ODNR Scenic Rivers
  - National Park Service (NPS)
  - U.S. Army Corps of Engineers (USACE)
  - Ohio EPA – 401 Permits
  - ODNR Waterway Permits
  - Ohio EPA – Big Darby Stormwater Permit
  - The Nature Conservancy (TNC)*
  - OSU Ecology Dept.* – Re-introducing mussels upstream
- Field verify OHWM
- **Minimize piers in Big Darby Creek for "natural free flow"**
- **Minimize temporary Big Darby impacts (causeway)**
- **Minimize permanent impacts to other tributaries**
- **Minimize Bat tree impacts**

Preliminary Concepts

Minimize stream impacts

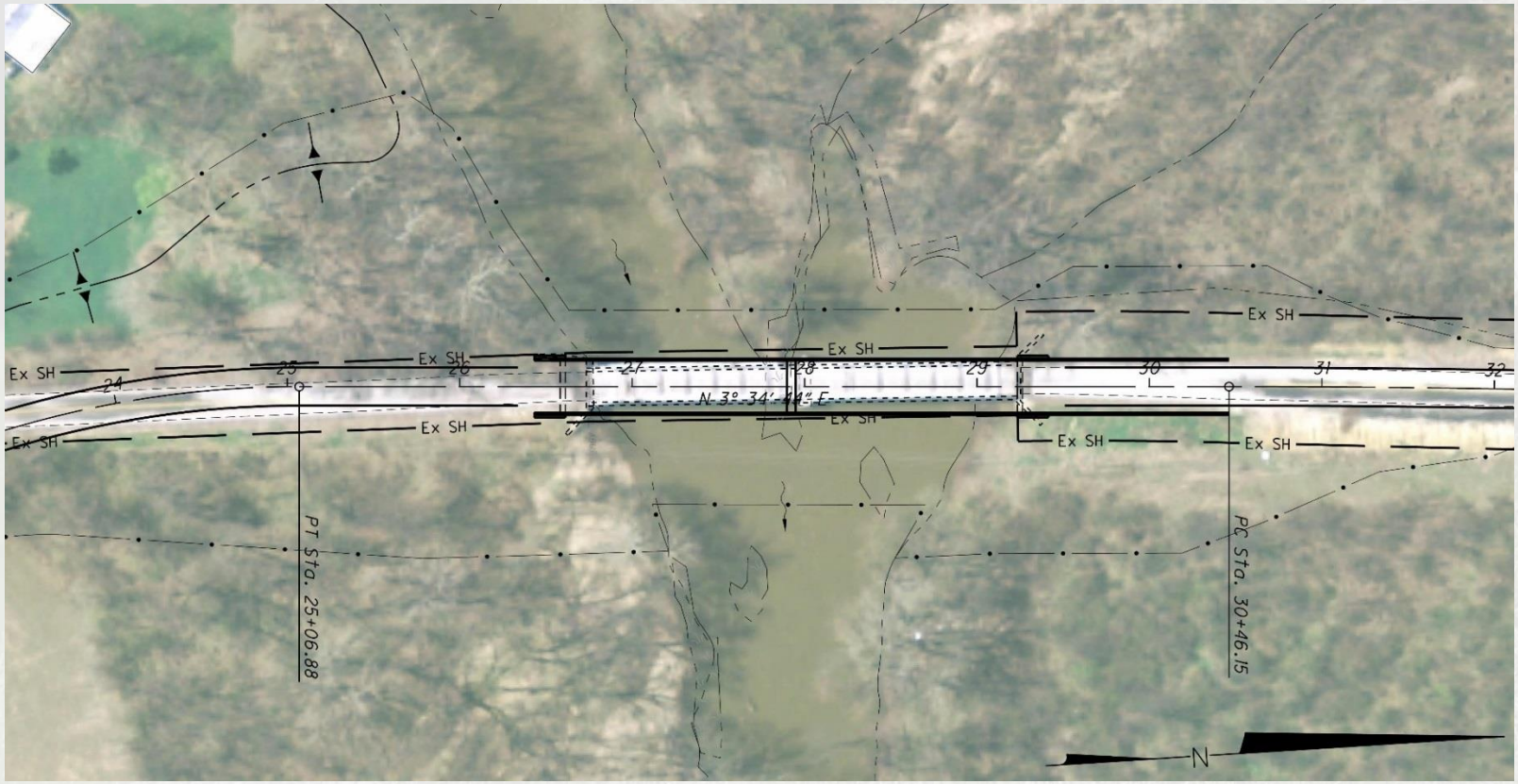
- Alternative A – Relocate west (upstream)
- Alternative B – Relocate east (downstream)



Preliminary Concepts

Minimize stream impacts

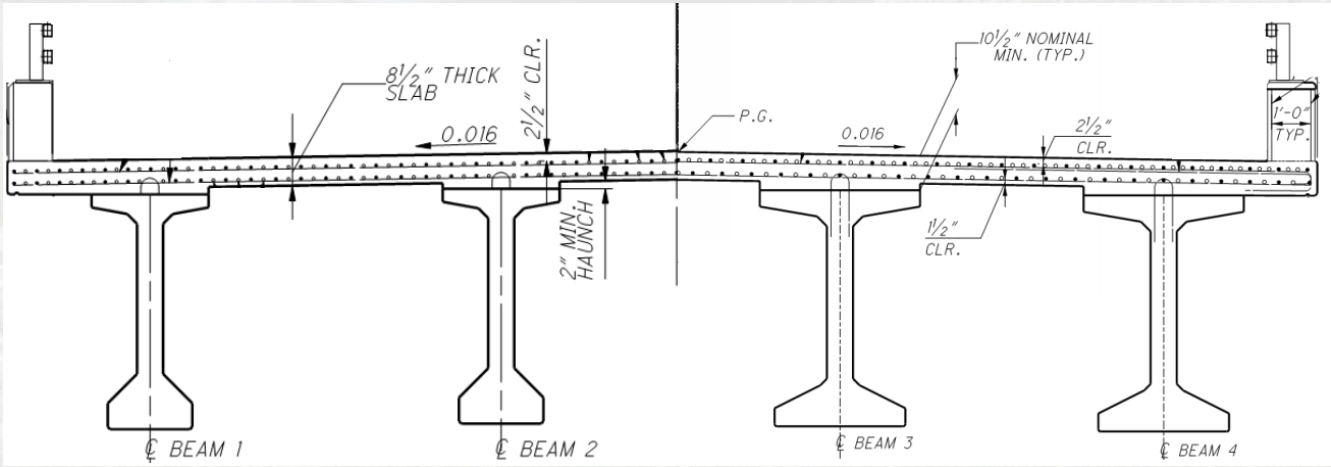
- Alternative C1 & C2 – Existing Alignment(s) (came in late, at request of agencies)
  - Profile rise 6’



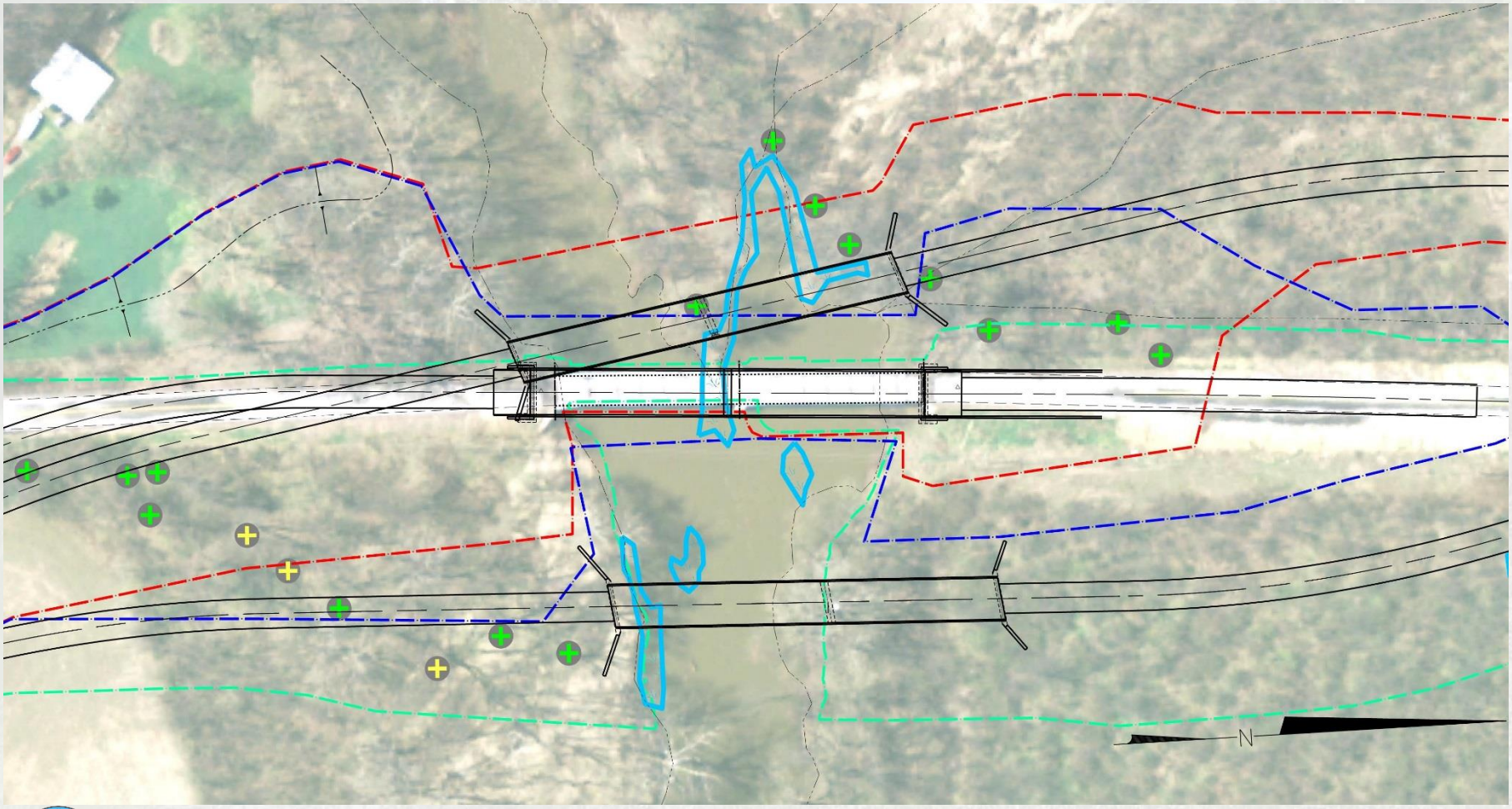
Preliminary Engineering

Feasible Structure Types

- Cost effective, “standard” bridge types
- If on new alignment, make concrete I-beams feasible
- Steel girders vs. concrete I-beams
  - Similar initial costs
  - Steel life cycle costs +15%
  - Future painting over Big Darby Creek
- Wide flange I-beams vs. standard – 20% more strands
- River span – cost effective with no causeway?



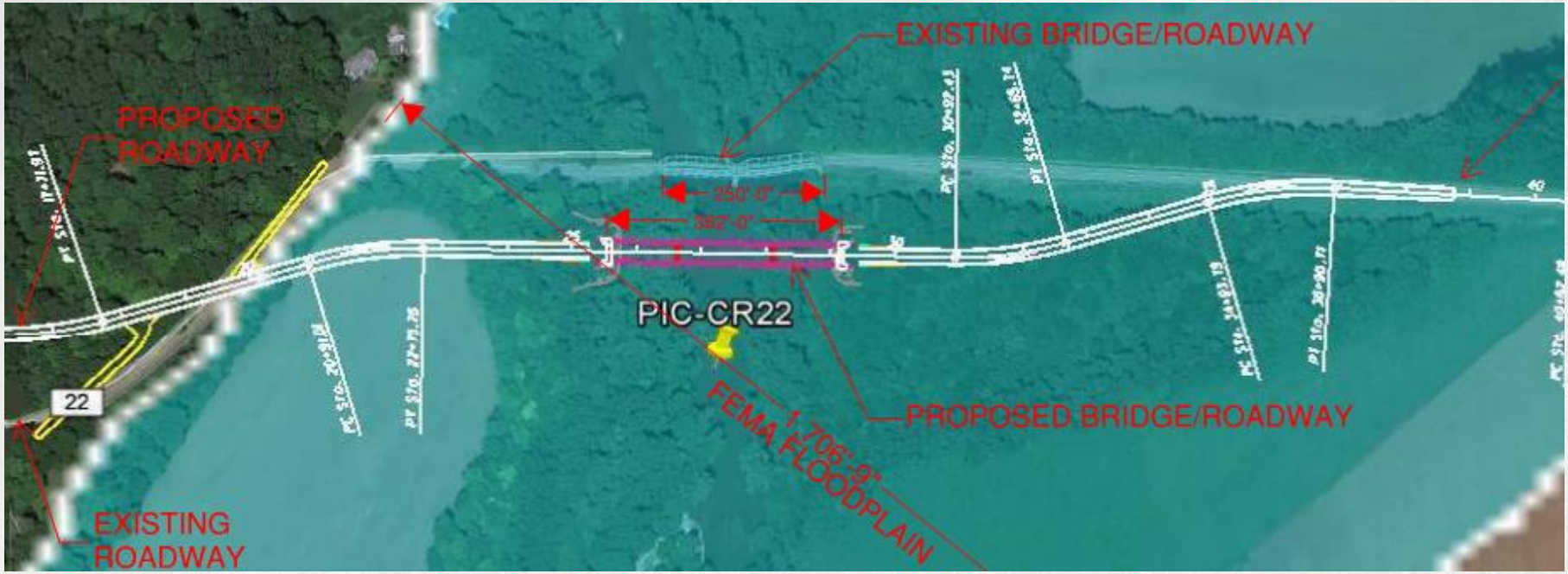
Bridge – Environmental Impact Evaluation



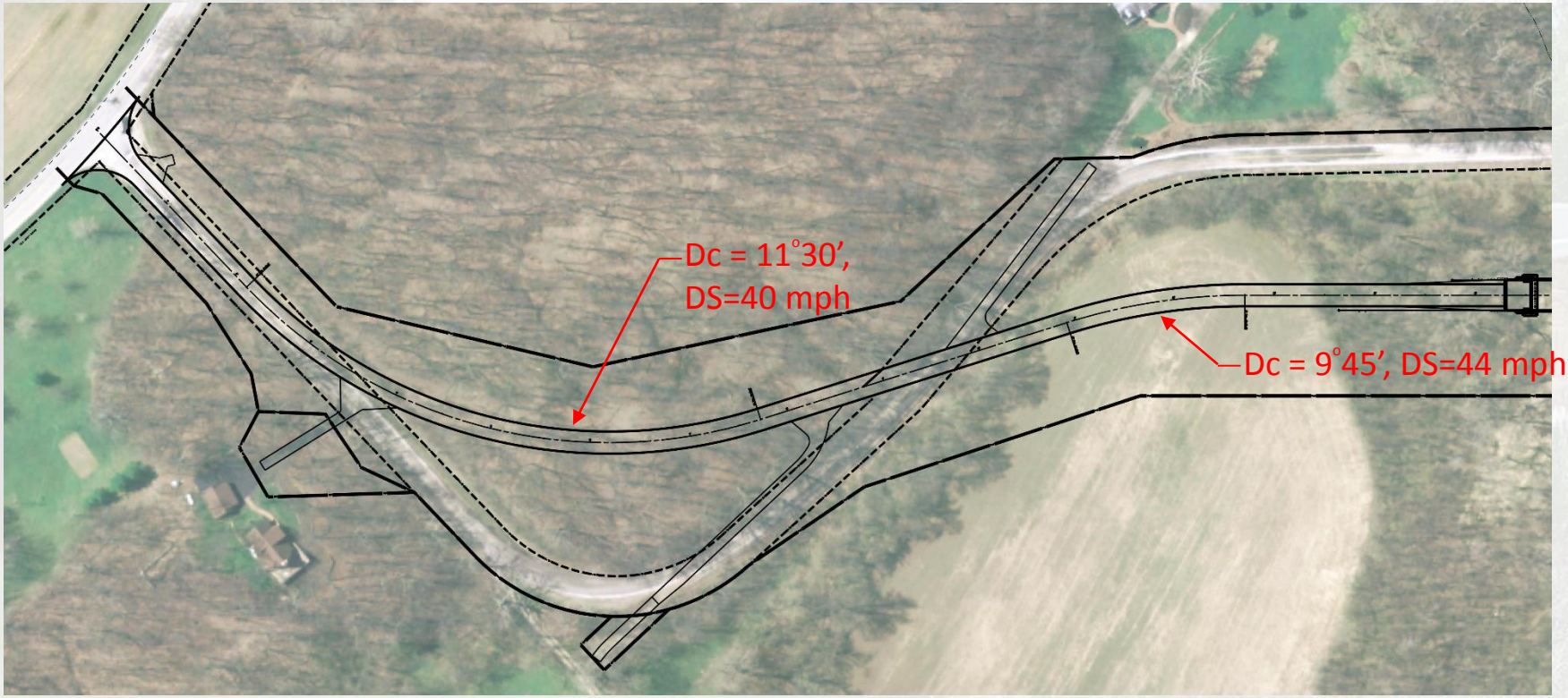
Preliminary Engineering

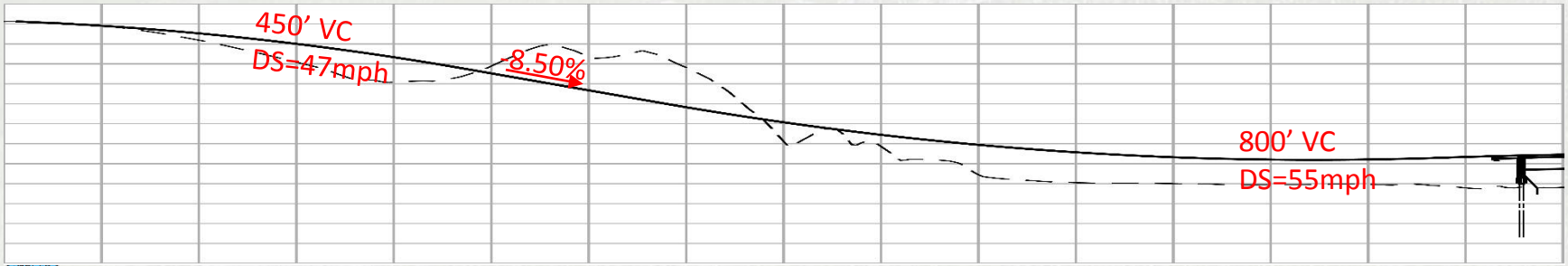
Hydraulic Considerations

- EX. 2 spans over water vs. PR. 1 span over water + 2 over floodplain
- Open up rear span
- Unregulated “dike”
- HEC-RAS streambed velocity analysis for mussel shear stress



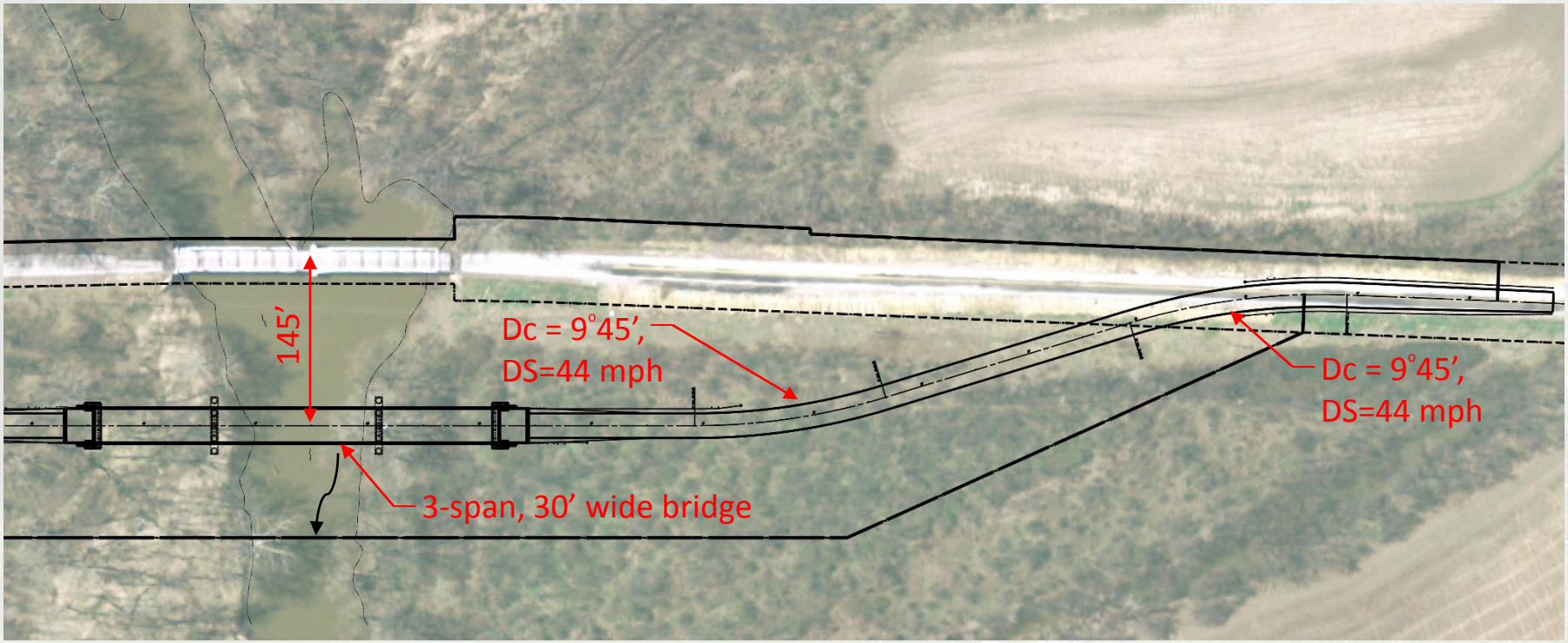
Preliminary Engineering





(add labels, merits, etc)

Preliminary Engineering



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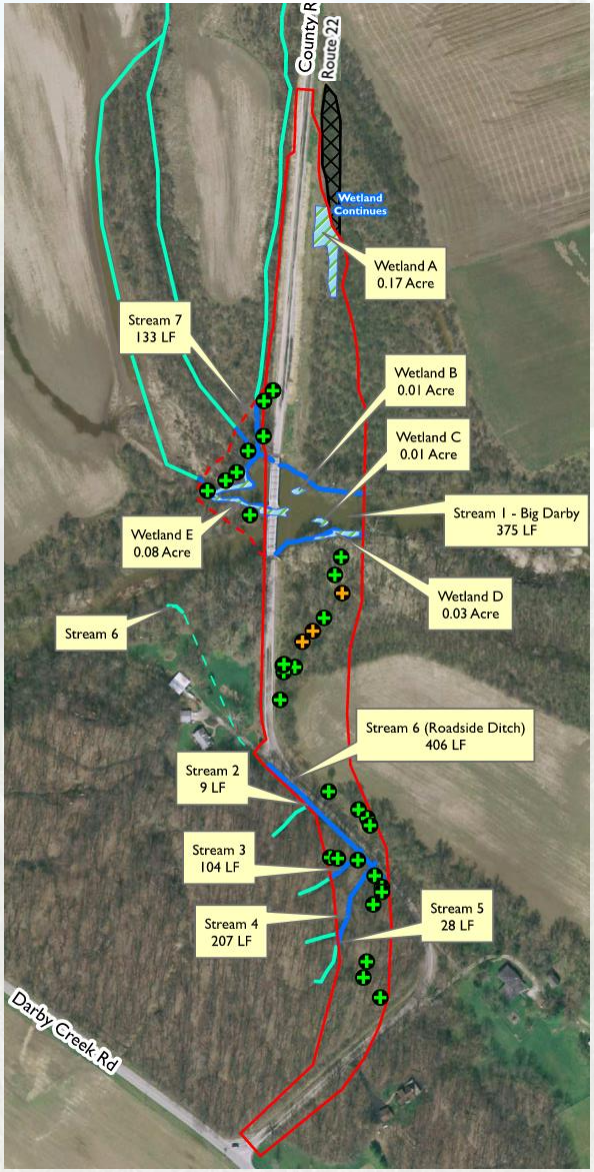
Environmental Overview

Environmental Resources Overview

- Big Darby Creek is listed as a State and National Scenic River
- Three (3) state listed fish and 12 state (4 federal) listed mussels were presumed present.
- In addition to Big Darby Creek, five (5) headwater streams and two (2) road ditches which capture streams were impacted.
  - 523 linear feet of temporary stream impacts
  - 774 linear feet of permanent stream impacts
  - Mitigated off-site
- Five wetlands impacted
  - 0.13 acres of temporary wetland impacts
  - 0.17 acres of permanent wetland impacts
  - Mitigated off-site
- 5.96 acres of bat habitat impacted
  - Required 17 acres of mitigation (3:1 ratio)



Environmental Impacts

Mitigation Requirements

- Primary
  - 17.14 acres of bat habitat.
  - Required for USFWS approval
- Secondary
  - Once USFWS approved, need to get concurrence:
    - ODNR State Scenic River
    - National Park Service-Federal Scenic Rivers
    - Ohio EPA (401 and stormwater)
    - USACE
- Project mitigation multiple agency collaboration

Environmental Impacts

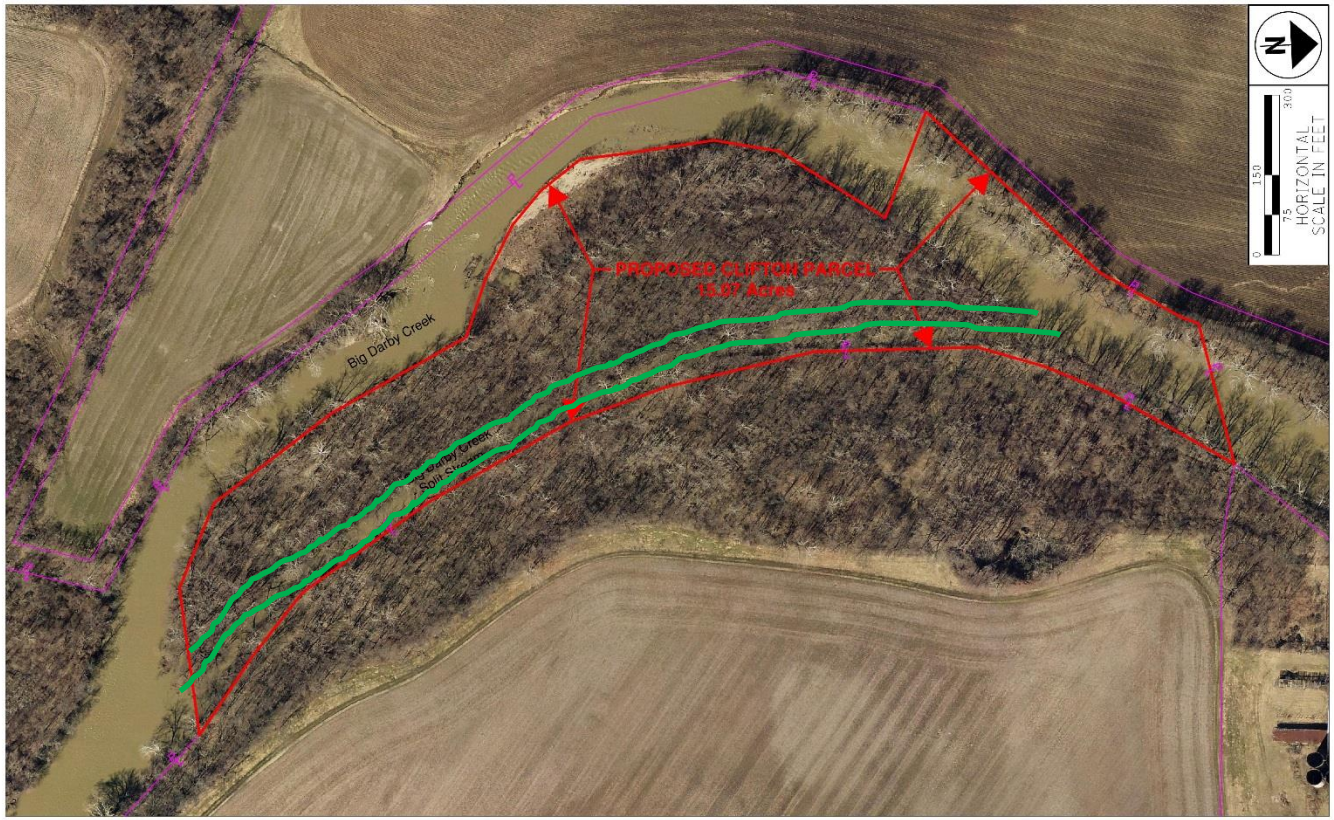
Mitigation Alternatives

- 15 Acre conservation easement
- The Nature Conservancy – south side of project
- Gulick Parcel – northwest of project, OEPA issues
- Beaver Parcel – northeast of project
- Clifton Parcel - downstream
- Very restrictive conservation language. Competition.
- Chicken or egg?

Environmental Impacts

Final Pickaway County Mitigation Area (PCMA)

- Clifton Parcel - ~7 river miles downstream
- Owned by County, maintained by Pickaway County Park District
- 15.09 ac
- Big Darby Creek streambanks
- Overflow channel



Environmental Path Forward

Environmental Path Forward

- Bat Mitigation became critical path to Environmental Clearance
  - The proposed mitigation protected and preserved a total 17.14 acres of riparian/wetland habitat along Big Darby Creek in perpetuity
  - Includes 2.05 acres of the existing County Road 22 right of way – re-vegetate
- The Pickaway County Mitigation Area (PCMA/Clifton Parcel)
  - 15.09 acre riparian habitat located within the active channel and the active floodplain of the Big Darby Creek.
  - Predominately wooded riparian island adjacent to Big Darby Creek and separated from the mainland by a high-flow channel.
  - A small portion of the property extends across the Darby and includes a strip of wooded floodplain on the west bank of the Big Darby Creek.

Environmental Impacts

Pickaway County Mitigation Area (Clifton Parcel)

- Environmental details
  - The entire 15.09 acres of the PCMA was considered a special aquatic site.
  - Includes varied wetland habitats, vernal pools, intermittent high flow stream channels, and bottomland riverine forests.
  - Possesses the special ecological characteristics of productivity, habitat, and wildlife protection along this State and National River.
  - Preservation of these lands will provide significant ecological benefit to the watershed of the State Scenic Big Darby Creek by:
    - Providing flood control by slowing and absorbing flood waters, resulting in reduced flood damage, reduced stream bank erosion and increased groundwater storage.
    - Providing valuable habitat for threatened and endangered species, including Indiana and Northern Long-eared bats, Fawnsfoot, Loggerhead Shrike, Northern Riffle Shell, Ohio Pigtoe, Elephant Ear, Snuffbox, Drummond's Aster and six species of concern to the USFWS and/or ODNR.

Environmental Impacts

Waterway Permits

- Due to the overall project impacts identified in the Stage 3 plans, the need for a Section 401 Water Quality Certification and the fact that a 404 Pre-construction Notification and an 404 Individual Permit require the same permit application it was determined by Transystems and Pickaway County to prepare a combined Section 404/401 permit application.
- Final Submittal November, 2015
- “Administratively Complete” - January, 2016
- 404 Permit approved by USACE - February, 2016
- Public Hearing - April, 2016
- 401 Permit approved by OEPA - May, 2016

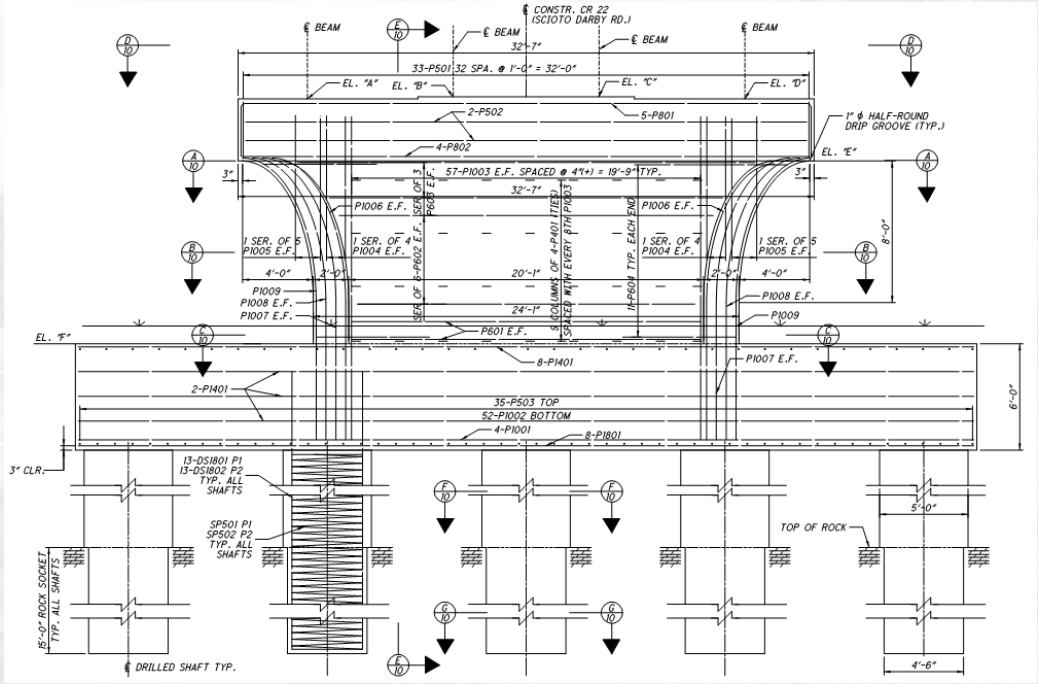
Bridge Design

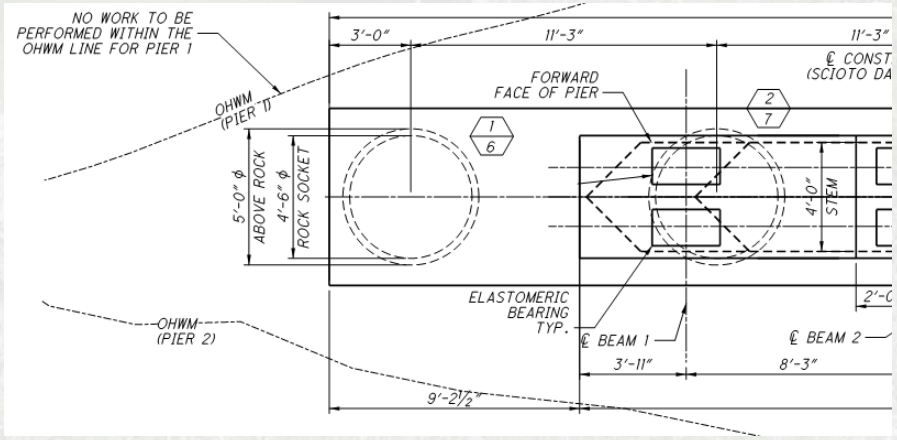
Piers

- Aesthetic
- Modified wall type vs. twin tapered columns
- Shafts in-line vs. rectangular layout
  - OHWM constraint
- 54” rock socket
  - Limit size & cost
- Designed for complete scour of overburden (~15’)

Abutments

- Abutments – Turn back on H-piles to rock

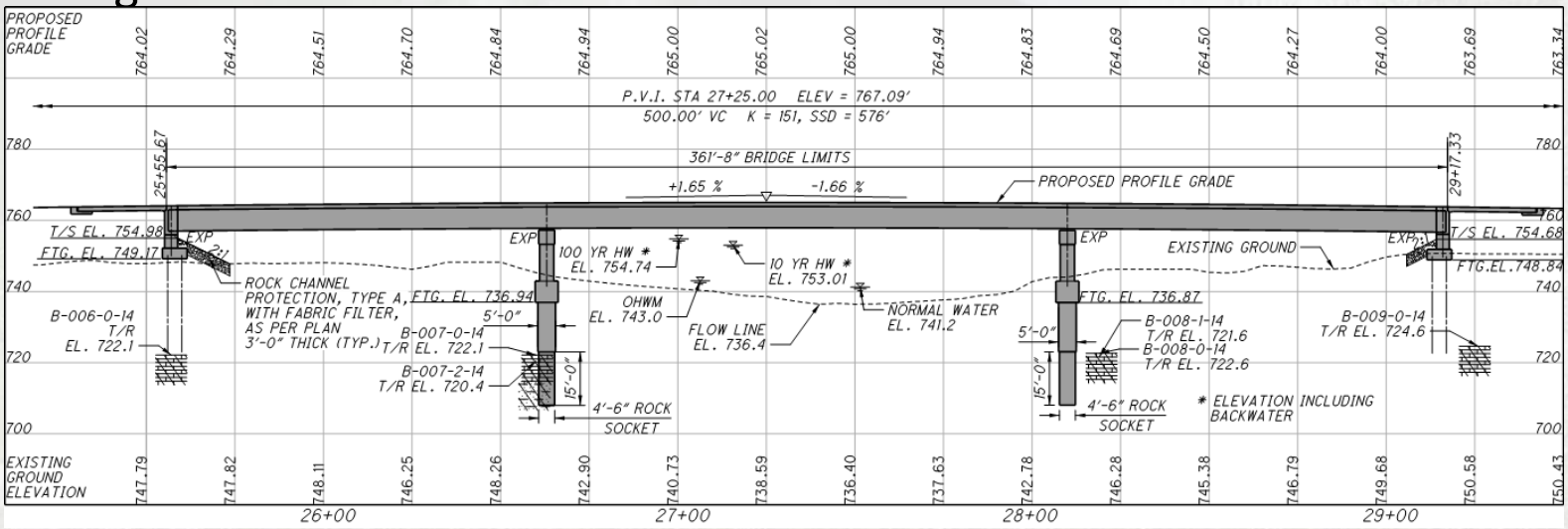




Bridge Design

Concrete I-Beams

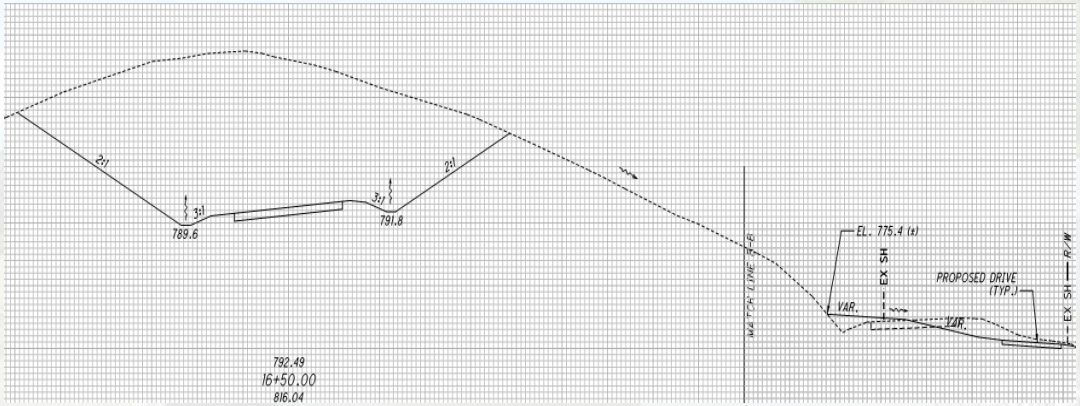
- 147’ center span (106’-147’-106’ = 362’), 30’ T/T Parapet
- Wide-flange I-beams - Pre-approval with ODOT and Prestress Association
  - 20% more strands
  - Later became ODOT standard
- More stable during transport & erection
- Additional vertical reinforcement in anchorage zones for bursting & confinement
- High strength concrete



Design Details

Roadway Considerations

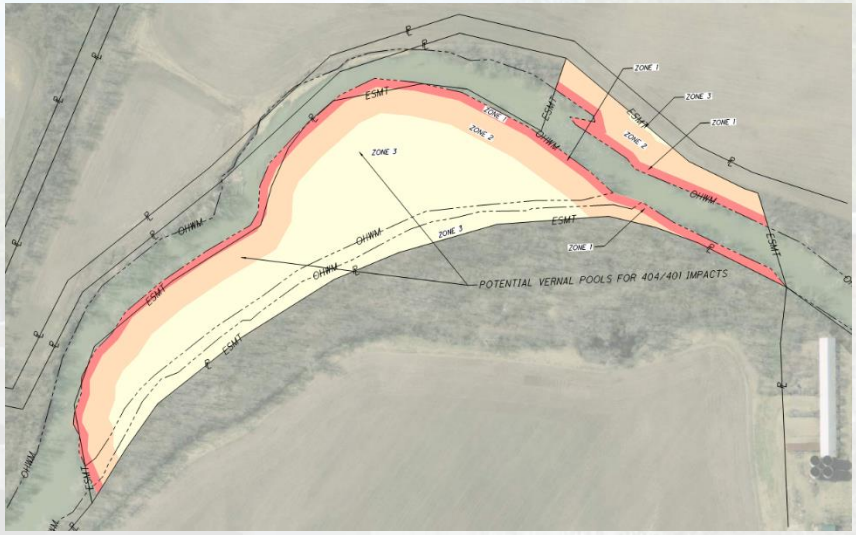
- Cut/fills ~ 30 ft
- Save trees
- Preserve “levee”
- Drives – up to 320’ long, 20’ fill

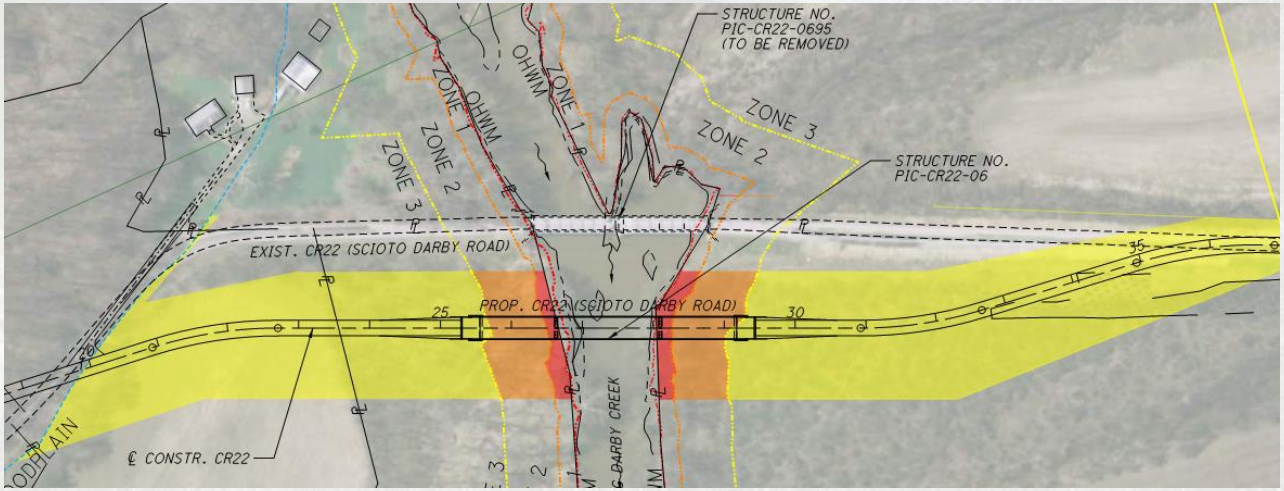


Stormwater

Ohio EPA Big Darby Permit

- Water Quality - filter strips & biofilters (on-site)
- Riparian Setbacks
  - 6.19 acres impacted
  - 13.44 acres mitigation required
  - 2.12 acres mitigated (on-site)
  - 5.0 ac. excess mitigation zones 1+2 (PCMA)
- Groundwater Recharge – <u>negotiate</u>
  - Create more groundwater recharge potential
  - On-site = 72%. PCMA = 0%. 28% deficit.
  - Excess riparian mitigation
  - Stream protection (3750’ Big Darby, 4000’ overflow)
  - Wetland recharge > permit allows (brush/woods)
  - Conservation corridor





Bidding & Construction

COST COMPARISON				
	PE Study	Final Estimate	Avg. Bid	Low Bid
Roadway	$ 1,838,966	$ 1,954,722	$ 1,862,207	$ 1,857,235
Bridge	$ 2,109,641	$ 2,469,065	$ 2,560,441	$ 2,221,764
TOTAL	$ 3,948,607	$ 4,423,787	$ 4,422,648	$ 4,078,999

Cost Summary

- Increased engineers estimate as site constraints developed:
  - Single prestresser, large shafts, large cranes, anxiety of environmental limelight, stormwater/SWPPP anxiety.
  - Had to be open by winter
  - Bids due March 29, 2016 – before 401 permit public hearing
- 5 bidders range from $4,079,000 to $4,765,222
- Awarded to Eagle Bridge Company
  - Contract awarded April 5, 2016 (final 401 permit May 9, 2016)

Bidding & Construction

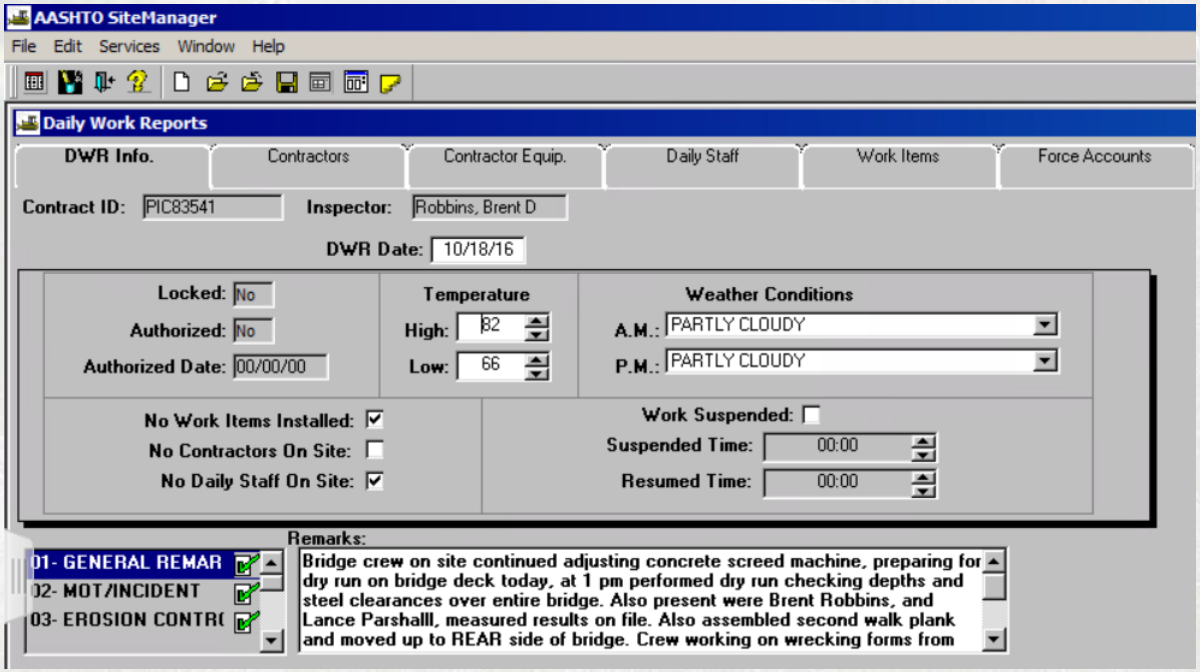
Construction Inspection/Administration

- PRIME AE was selected to perform:
  - Contract Administration
  - Construction Inspection
  - Materials Testing
- Project Manager – Joe Warino, PE
- Field Engineer – Brent Robbins, PE
- Project Inspection – Lance Parshall
- CM/CI estimate was $440K (roughly 10% of Construction Cost)
- Final Cost was approximately $355K

Bidding & Construction

Construction Inspection/Administration

- Project was set up for E-Filing
- Project documents were uploaded directly onto the ODOT D6 Construction Sharepoint site
  - District Audits
- This was the first LPA project in the state to use the ODOT Site Manager CMS.
  - ODOT Project Documentation
  - PBOM



Bidding & Construction

Project Issues

- Differing Site Conditions claim for bedrock hardness
  - Boring logs used
  - ODOT Central Office
- Issue with concrete strength in poured drilled shafts.
  - 4500 psi spec strength
  - Multiple Cylinders broke below 4000 psi
  - Lowest Break 2987 psi

Bidding & Construction

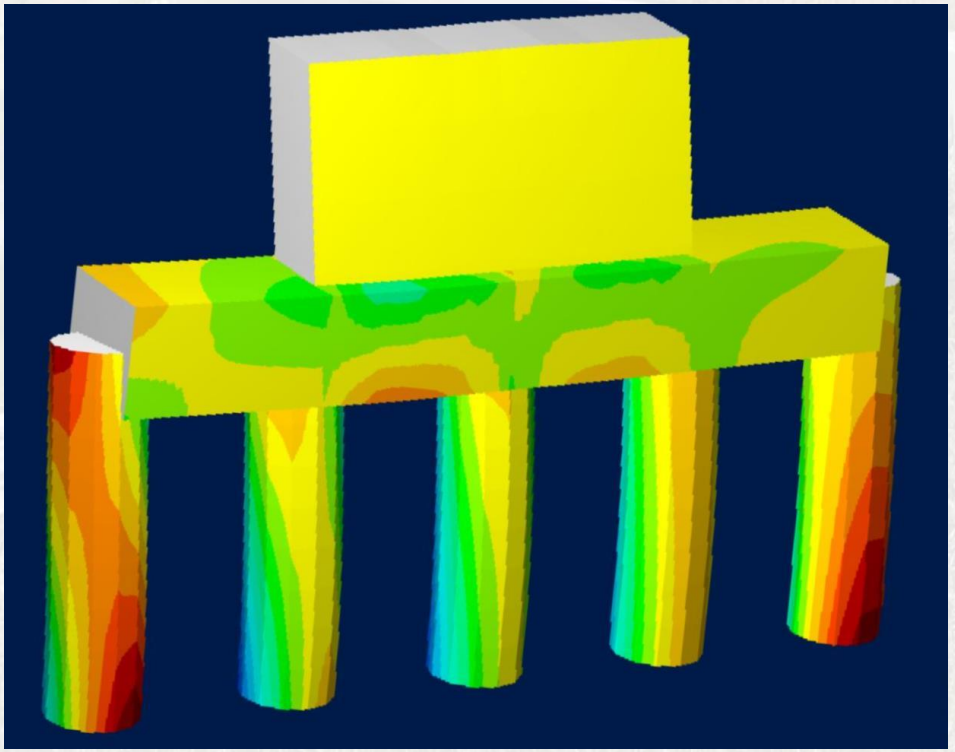
Drilled Shaft Concrete Resolution

- Drilled shafts concrete design strength = 4000 psi (4500 psi spec)
- 28-day breaks = 2987 psi. Assume 10% increase = 3300-3400 psi
  - Aligns with 56-day break of 3339 psi
  - Adjacent shafts were different pours
- Finite element, rigid frame re-analysis with shafts, footing, piers
  - Distribute loads equally among 5 shafts (BDM & RCPier), or,
  - Tributary loading (finite element)
- 54” shafts sized for friction resistance – shear in shafts ✅
- Reinforcement based on lateral capacity - deflection/moments ✅
- Development length of #18 bars
  - Minimum of 3293 psi required – ✅ (<u>just barely</u> vs. 3339)
- Nearest Failure Mode = Scour + Longitudinal Forces (Temp. + Braking + Stream Limit State)

Bidding & Construction

Drilled Shaft Concrete Resolution

- Agreed upon penalty for low strength concrete
  - Design team re-analysis
  - Material deducts for reduced strength
  - Future bridge inspection/monitoring costs by County



Completion

Construction Summary

- Start construction – May 10, 2016
- Opened to traffic – December 2, 2016
- Final completion – May 31, 2017 (stain, seal, landscaping)
- Final construction costs $3,990,000 (vs. $4,079,000 bid)
- Minimal involvement from environmental agencies

Lessons Learned

Lessons learned during planning, design, environmental, construction, etc.

- Early coordination with agencies - develop relationship
- Constant dialog and feedback
- Rely on team expertise to interpret agency's priorities and propose a project & plan that is most "approvable"
- Keep adjacent landowners/stakeholders updated to gain buy-in

Photos

Photos

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Photos

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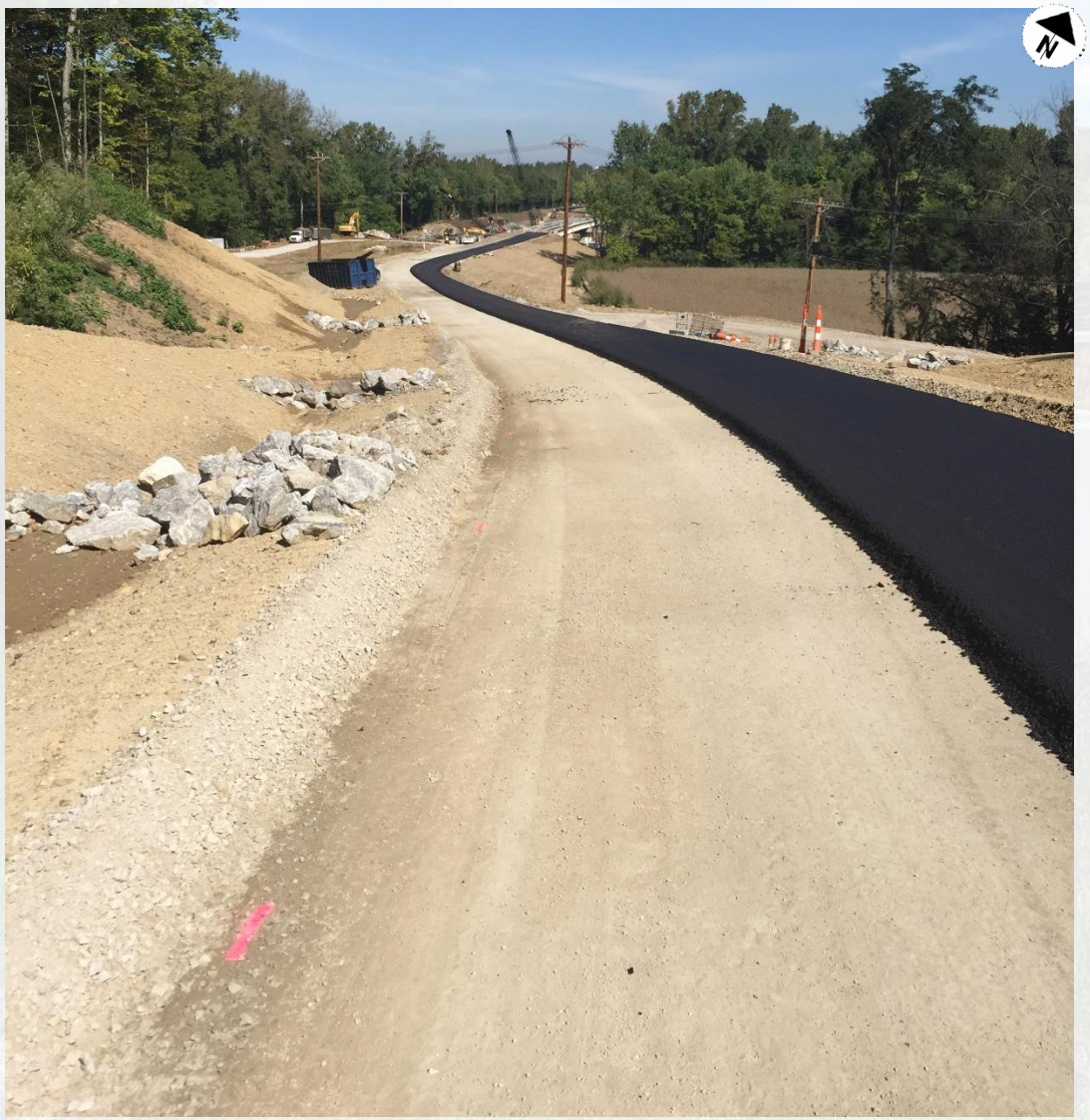

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Grand Opening

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Questions?