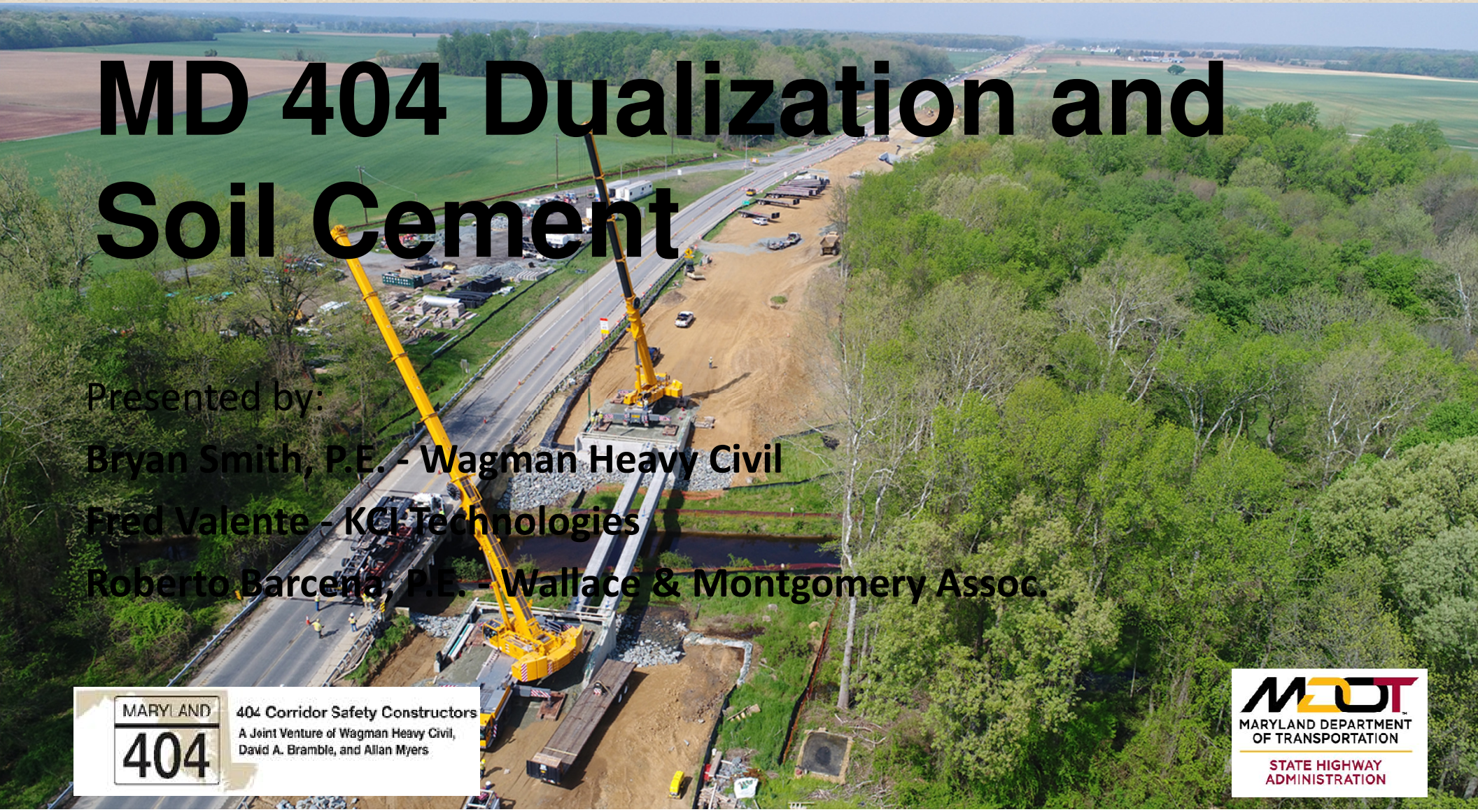
MD 404 Dualization and Soil Cement



Presented by:

Bryan Smith, P.E. - Wagman Heavy Civil

Fred Valente - KCI Technologies

Roberto Barcena, P.E. - Wallace & Montgomery Assoc.

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404 Corridor Safety Constructors

A Joint Venture of Wagman Heavy Civil, David A. Bramble, and Allan Myers

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STATE HIGHWAY ADMINISTRATION

Agenda

- Project Overview – Bryan Smith (Contractor, Wagman Heavy Civil)
  - Overview with Challenges and Keys to Project Success
  - Project Update
  - Drone Flyover

- Soil Cement QC Challenges - Fred Valente (Owner, MD SHA)
  - Maryland Testing Criteria
  - Soil Cement Application

- Soil Cement and Pavement Design - Roberto Barcena (Designer, Wallace Montgomery)
  - Pavement Design and ATC Overview
  - Soil Cement Design

MD 404 Project Overview

Bryan Smith, P.E. – Wagman Heavy Civil

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Project Details

- Owner: MD SHA
- Location: Queen Anne Area, Md.
- Scope of Work: Design-Build Project to Widen and Rehabilitate MD 404
- Contract Value: $104,997,777.77
- Notice to Proceed: 6/7/16
- Substantial Completion: 11/21/17

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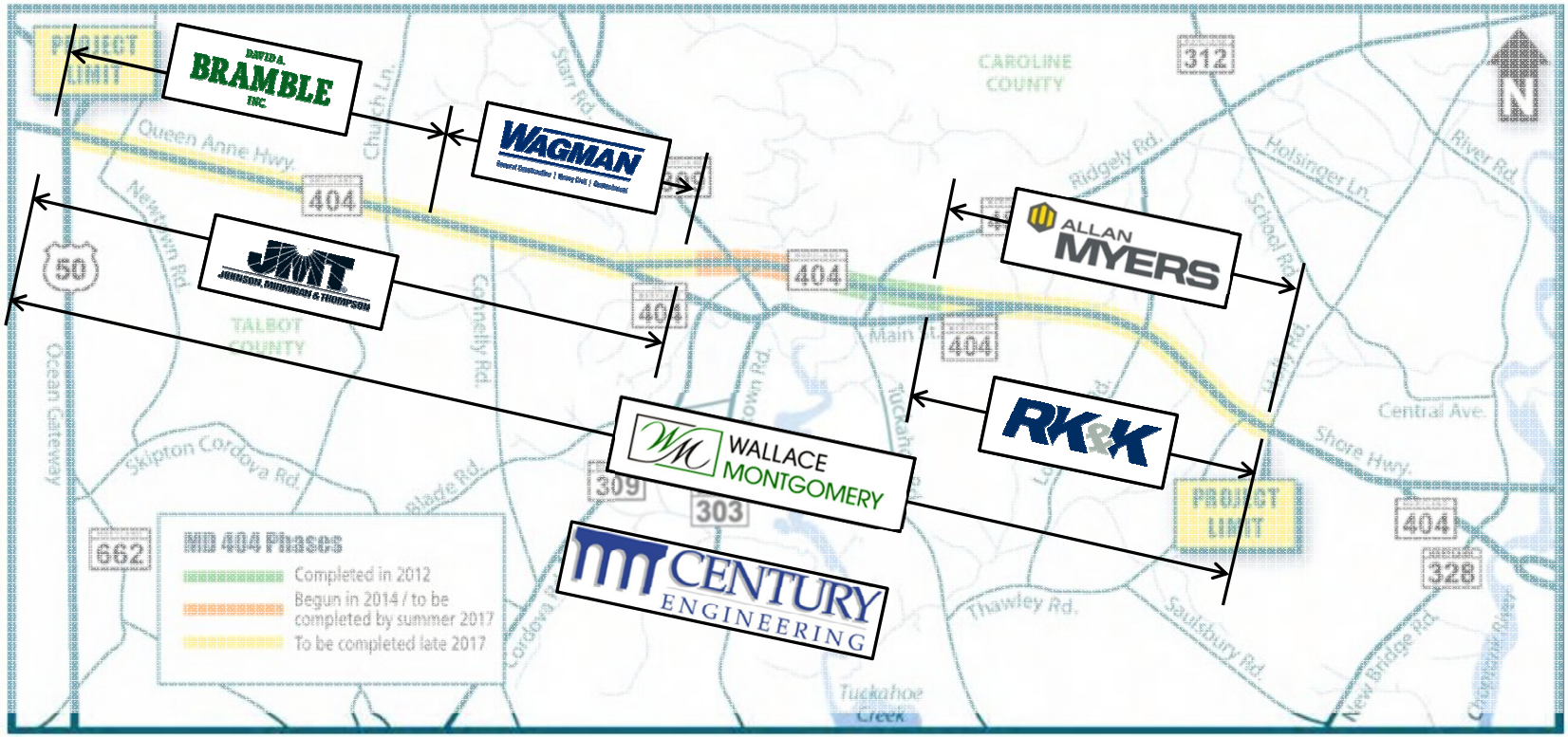
404 Project Team



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Project Goals

- Schedule – Fully open 4 lanes to traffic and substantially complete construction by Thanksgiving 2017
- Cost – Deliver a cost efficient project at or below budget
- Safety – Safe roadway with ZERO fatalities and serious injuries during and after construction
- Customer Satisfaction – Receive 100% satisfaction from travelers along MD 404
- Mobility – Minimize delay during construction and after construction

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Traffic

- 23,000 vehicles per day
  - Summer/18,000 typical
- 16% Trucks

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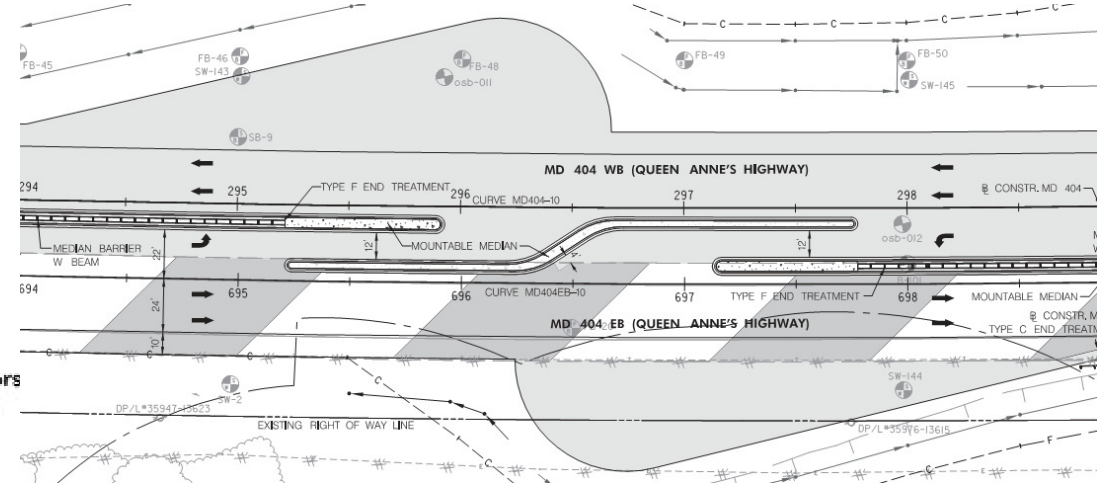
Roadway Features

- 9 Miles of New WB Roadway
- 1 Bridge
- 31 Intersections
- 400,000 CY Cut, 325,000 CY Fill
- 22 Miles of Guardrail
- 101K LF of Silt Fence
- 220K TN of Asphalt
- 300K SY of GAB Base
- 274K SY of Soil Cement
- 1.5M LF of Pavement Marking



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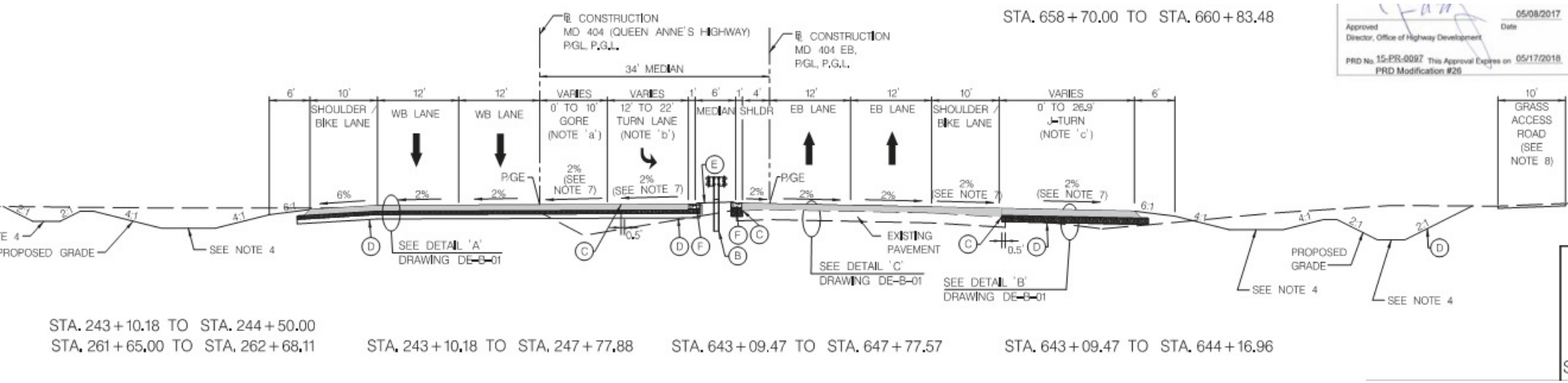
Westbound Eastbound



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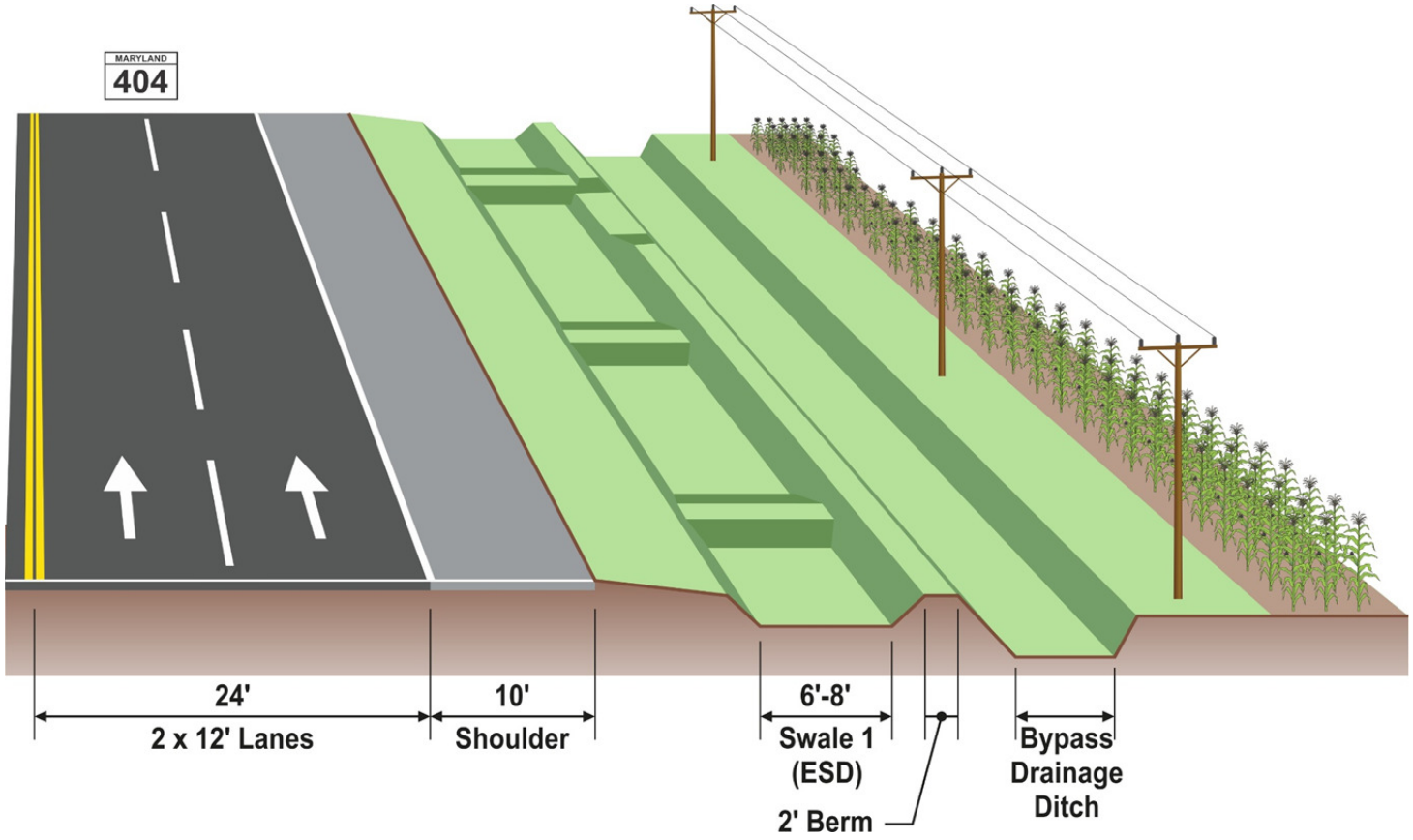

"Double Ditches"

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Drainage Features

- SWM Facilities
  - SWM Swales = 84,350 LF (16 Miles)
    - 110 Grass Swales
    - 145 Wet Swales
    - 25 Bioswales
  - 6 Box Culverts
  - 20K LF of RCP Pipe
  - 140 Drainage Structures
  - 19 - Major Pipe Road Crossings

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Environmental Challenges

- 17 WUS (Waters of the US) Stream Crossings
- Norwich Creek Stream Restrictions November 16 to June 30
- Extensive Environmental Quality Assurance Program and E&S Construction team
- 20 Acre Grading Units per Watershed

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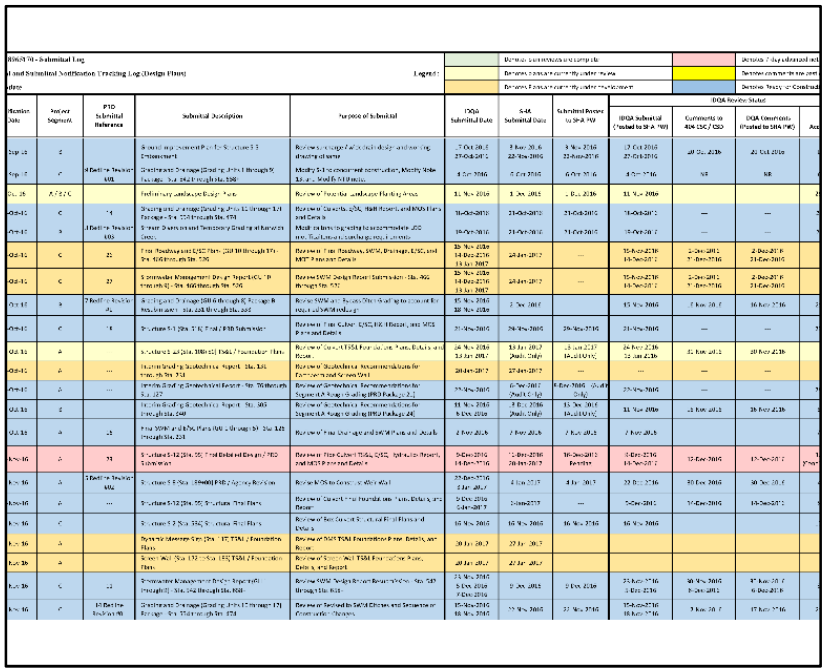
Design Challenges

- 280+ Design Submissions
- Plan review by IDQA (Century), SHA PRD, MDE, HHD
- Included 29 Plan Packages with Multiple Redlines
  - 8 Mass Grading Packages
  - 4 Final Design Packages
  - 17 other packages for culvert installation, surcharge, etc.



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Major Construction Challenges

- Aggressive Schedule- majority of construction completed in 12 months
- Sheer volume of work
- QA/QC- Soil Cement (Fred will cover)

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Keys to Project Success

- Partnering
  - Bi-weekly Progress/Partnering Meetings ensured key player involvement and accountability
- Coordination
  - Weekly Joint Venture management and constructability meetings with DB Team
- Performance
  - All team members including SHA, Engineering Partners, JV Partners, and Subcontractors contributed to the delivery of the project

Project Status

- Notice to Proceed: 6/7/16
- Substantial Completion: 11/21/17
- Substantial Completion Bonus: $5,000,000
- Contract Completion: 7/31/18

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Drone Flyover

- September 2017, two months prior to substantial completion

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Soil Cement QC Challenges

Fred Valente - KCI Technologies

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MD 404 Soil Cement Overview

- Pavement Section included 8” Soil Cement base
- Segments A&B used majority in-situ materials
- Segment C used majority offsite borrow materials
- Lab Testing by DBT to establish required cement content based on varying materials

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Soil Cement QC Challenges

Keeping up with production:

- 225,000 SY of Soil Cement (7000 TNS of Cement)
- Peak Production of 2,200 SY/day (multiple crews)
- Two testing sheds needed due to traffic and multiple soil cement operations

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Soil Cement QC Challenges

- Acceptance Criteria:
  - Maryland OMT requires unconfined compressive strength pills for acceptance
  - PCA does not recommend unconfined compressive strength tests based on molded specimens due to inconsistency of sampling and pill breaks
  - Solution to establish QC Plan, which assured proper mix and also perform additional proof rolling prior to GAB placement

Soil Cement QC Challenges

- Acceptance Criteria:
  - 404 Team had Soil Cement Base Course NOT Cement Modified Subgrade
  - Cement Modified Subgrade is more typical application in Maryland with strength requirement of 300 PSI
  - Soil Cement Base Course not typical with 450 PSI strength
  - First big project in Maryland with this application requiring higher strength acceptance

Soil Cement QC Challenges

- QC Work Plan provided additional verification tests:
  - 3rd Party provided additional Quality Assurance testing (moisture, compaction, cement content, etc.)
  - Key was to ensure product in field matched previously established Lab Verification Testing
  - Due to schedule and inconsistent testing, contractor went with 8% content although lower contents (5-6%) were approved in verification testing

Soil Cement QC Challenges

- Compaction & Moisture:
  - Proof rolling subgrade?
  - Varying in-situ onsite materials used
  - 1 Point Compaction test required to choose from family of curves
  - Assure within 2% of optimum moisture content for proper compaction AND to verify cement is activated (multiple moisture checks)

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Soil Cement QC Challenges

- Compressive Strength Results:
  - Moisture vs Strength
  - Appears Moisture range did not affect strength
  - Overall pill breaks were very inconsistent

MARYLAND STATE HIGHWAY ADMINISTRATION
SOIL CEMENT COMPRESSIVE STRENGTH LOG

Contract: AW8965170
FAP No: AC -NHPP-300-1(53)N

MD 404 DUALIZATION

DATE	PILL NUMBERS	SEG	CEMENT %	MOISTURE %	STATION	BREAK DATE	AGE	BREAK RESULTS (PSI)
05/04/17	2A	A	8	13.6	126+50	05/11/17	7	560
05/04/17	2B	A	8	13.6	126+50	05/18/17	14	585
05/04/17	2C	A	8	13.6	126+50	06/01/17	28	
05/08/17	3A	A	8	13.0	123+30	05/15/17	7	482
05/08/17	3B	A	8	13.0	123+30	05/22/17	14	
05/08/17	3C	A	8	13.0	123+30	06/05/17	28	
05/08/17	4A	A	8	12.9	121+90	05/15/17	7	263
05/08/17	4B	A	8	12.9	121+90	05/22/17	14	413
05/08/17	4C	A	8	12.9	121+90	06/05/17	28	
05/08/17	5A	A	8	13.1	120+00	05/15/17	7	422
05/08/17	5B	A	8	13.1	120+00	05/22/17	14	631
05/08/17	5C	A	8	13.1	120+00	06/05/17	28	
05/08/17	6A	A	8	8.9	118+50	05/15/17	7	319
05/08/17	6B	A	8	8.9	118+50	05/22/17	14	181
05/08/17	6C	A	8	8.9	118+50	06/05/17	28	
05/08/17	7A	A	8	12.0	117+30	05/15/17	7	730
05/08/17	7B	A	8	12.0	117+30	05/22/17	14	
05/08/17	7C	A	8	12.0	117+30	06/05/17	28	
05/09/17	8A	A	8	10.5	115+70	05/16/17	7	774
05/09/17	8B	A	8	10.5	115+70	05/23/17	14	
05/09/17	8C	A	8	10.5	115+70	06/06/17	28	
05/09/17	9A	A	8	11.0	110+80	05/16/17	7	395
05/09/17	9B	A	8	11.0	110+80	05/23/17	14	
05/09/17	9C	A	8	11.0	110+80	06/06/17	28	

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Soil Cement and Pavement Design

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Pavement Design Requirements

- Pavement Sections for Highway Elements Provided in Request For Proposal (RFP)
- Design-Build Team able to develop Alternative Technical Concepts (ATCs)
  - Pavement Design Criteria:
    - AASHTO 93
    - MDOT SHA Pavement Design Guide
    - MDOT SHA Specifications for Construction and Materials

Soil Cement Definition

- Soil treated with a small proportion of Portland Cement with the objective of improving properties (American Concrete Institute)
- The amount of cement added to the soil is less than that required to produce a hardened mass, but is enough to improve the engineering properties of a soil example
  - Lowers Plasticity Index
  - Improves Bearing Capacity

Soil Cement Definition (in MDOT SHA Design)

- Soil Cement as part of:
  - Subgrade Improvement (Cement Modified Subgrade)
  - Part of the Pavement Sections (Soil Cement)

Soil Cement Mix Design

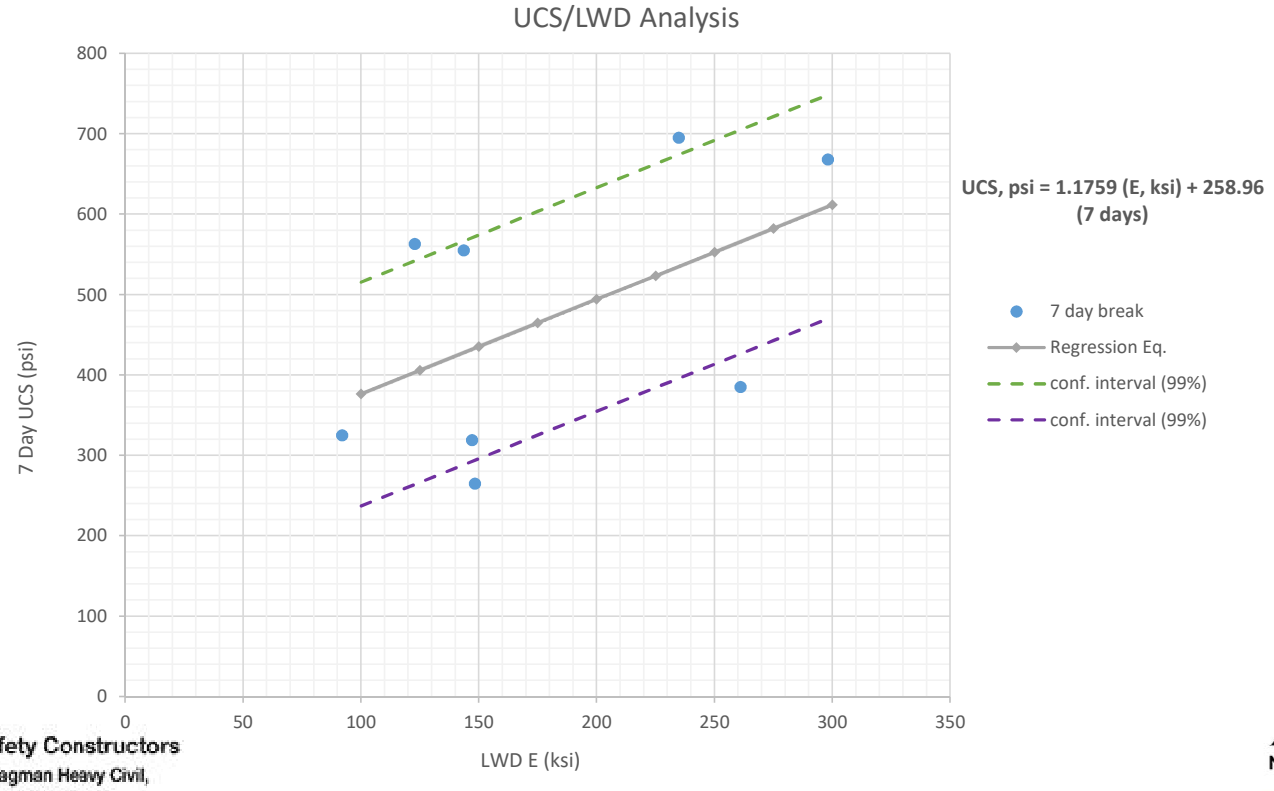
- MDOT SHA Specifications for Construction and Materials
- Portland Cement Association Soil Cement Lab Handbook
  - Submission of soil samples at least 45 days before placing soil cement
  - Identifying soil sources and sampling
  - Soil classification (A-1-a, A-1-b, A-3, A-2-4)
  - Determination of Optimum Moisture Content

Soil Cement Mix Design

- Determination of Cement Content
  - Trial of Cement Percentages (Seed value +2% ,-2% increments)
  - Strength: Unconfined Compressive Strength (UCS) : 450 psi (7 days cure)
- Durability
  - Freeze-Thaw Cycles (12 cycles, 14% loss maximum)
- Structural Layer Coefficient
  - SN = 0.20

Proposed Field Verification

- Light Weight Deflectometer (field) Vs UCS



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