I-295/I-76/Route 42 Direct Connection

Camden County

NJAPA

March 15, 2021

Presented by:

Chris Baldwin, PE – Dewberry

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I-295/I-76/Route 42 Direct Connection
Camden County

Presentation Outline

- Project Overview
- Contract Breakout
- Geotechnical Factors
- Pavement Condition, Analysis, and Recommendations
- Underdrains and Internal Drainage
- Stone Matrix Asphalt
- Questions

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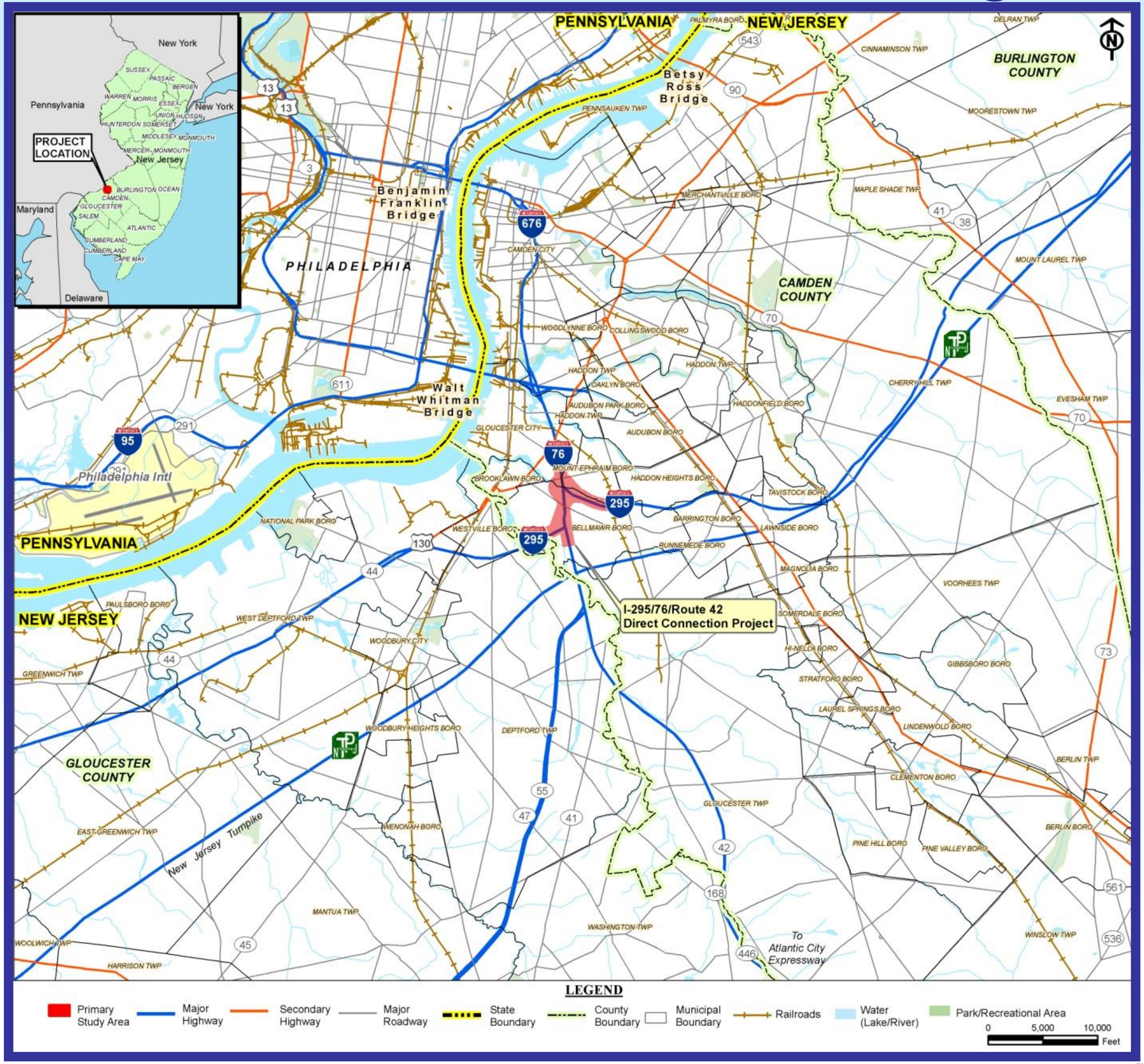
Regional Map



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Project Location and Constraints

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Project Purpose and Need

- Purpose: Relieve the bottleneck through the interchange by constructing a direct connection for I-295 mainline
- Improvements will reduce congestion and traffic weaves, and enhance traffic operations and safety.
- Resilient pavement box that will support the high volume of heavy vehicles on a daily basis and reduce the pavement maintenance schedule

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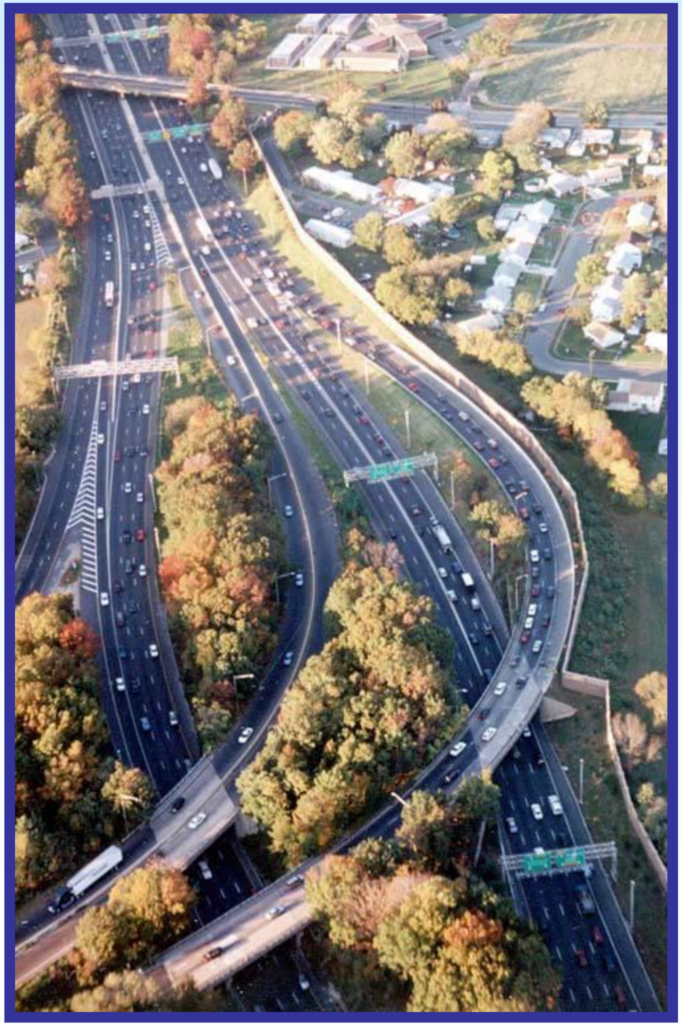
Pre-2013 Interchange Issues

- High Traffic volumes exceeding 392,000 vehicles per day
- High percentage of heavy vehicles
- High accident rates
- Through traffic weaving movements
- Aging and deteriorating pavement



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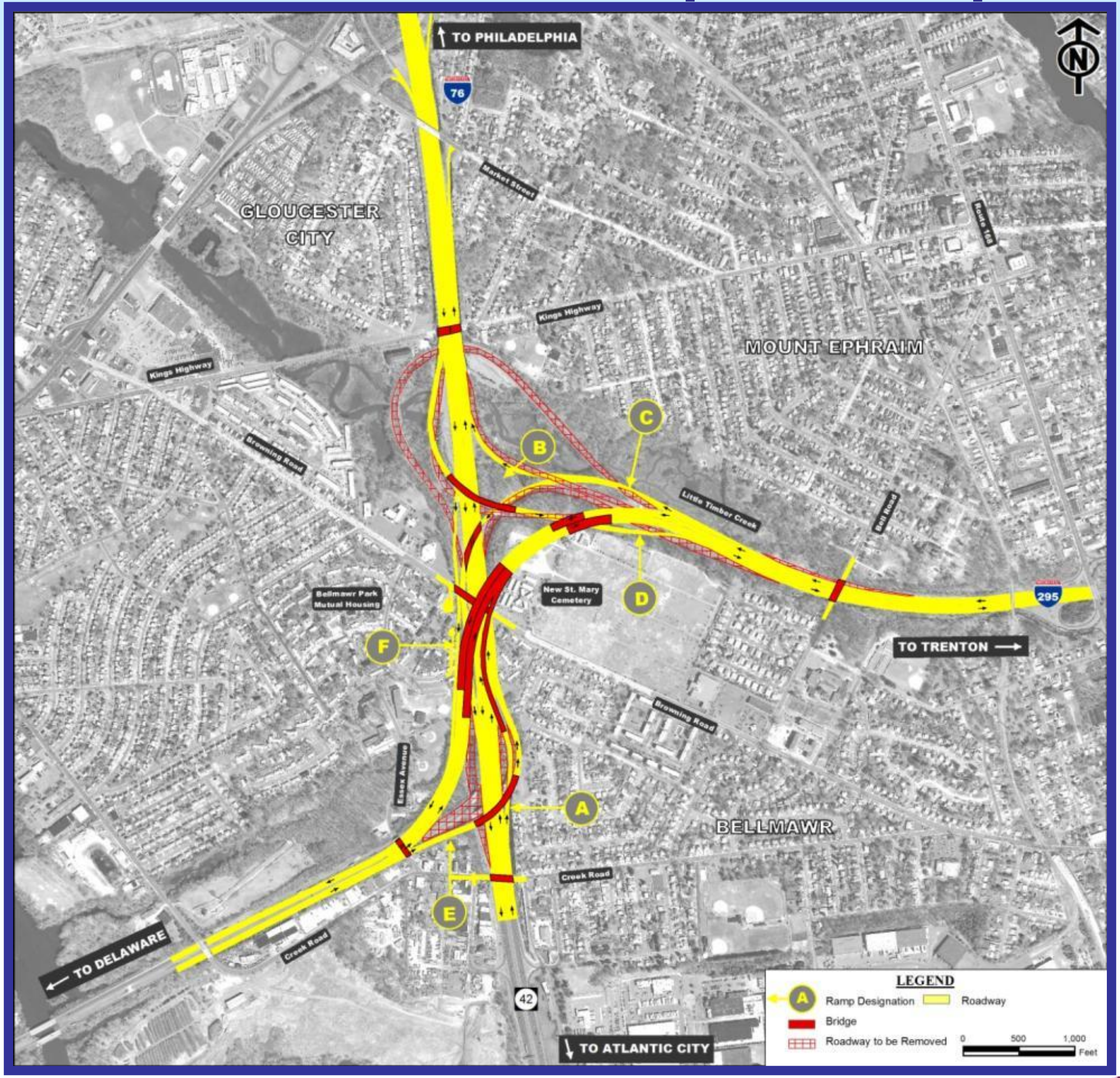
Proposed Improvements



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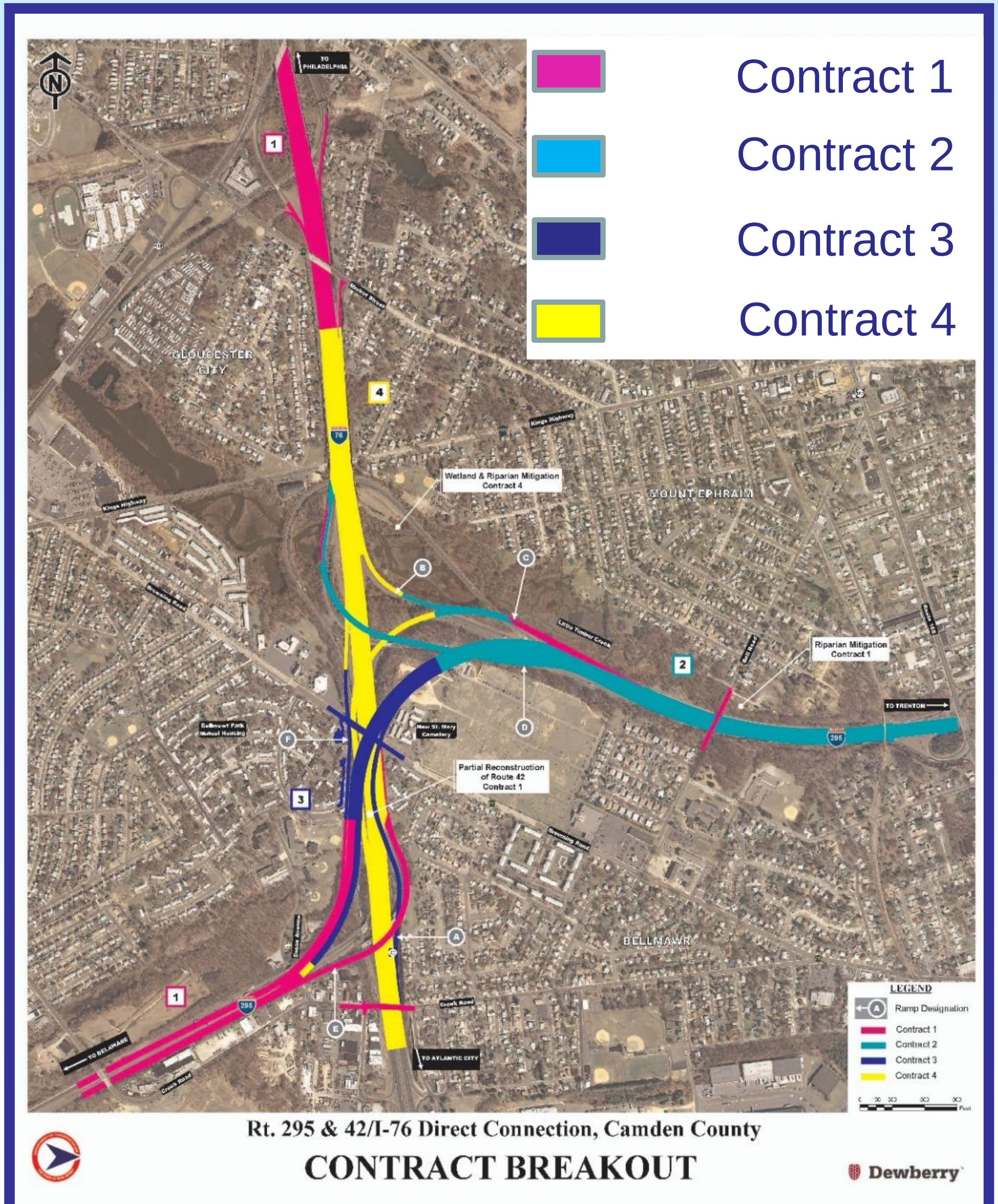
Design Considerations

- MPT / Maintain # of traffic lanes
- Tight work zones
- Material placement and compaction
- Groundwater / Seepage
- Settlement / Soil conditions
- Coordination between contracts



Contract Breakout

Contract Breakout Criteria

- Less than $200 million
- Minimize overlap and potential for delays

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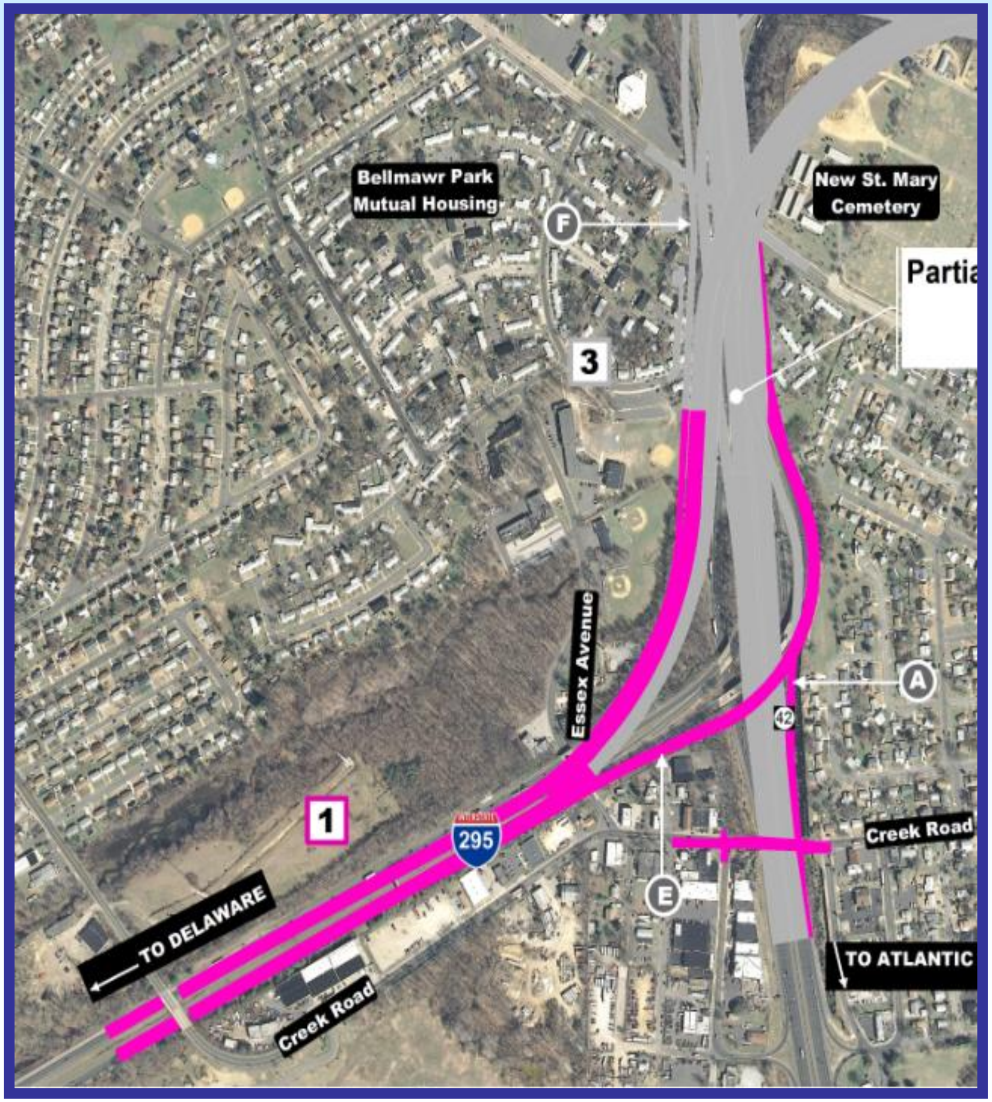
Contract 1
Awarded PKF Mark-III Inc.
$159.9 Million

Start Construction
February 2013

Completed
November 2016

Contract 1 - South and West of Browning Rd



I-295 Corridor (Creek Rd to Essex Ave)

- Essex Ave Bridge
- I-295 SB and Wall 19
- Ramp E Bridge / Wall 15
- Walls 13/14 along I-295 NB and Ramp E

Route 42 Corridor (Leaf Ave to Browning Rd)

- Interim Ramp A
- Wall 16/17/Ramp A Pier Columns along Route 42/Fir Place
- Creek Rd Bridge
- Traffic signals on Creek Rd at Edgewood & Harding Avenues
- 60” pipe jacking under Route 42

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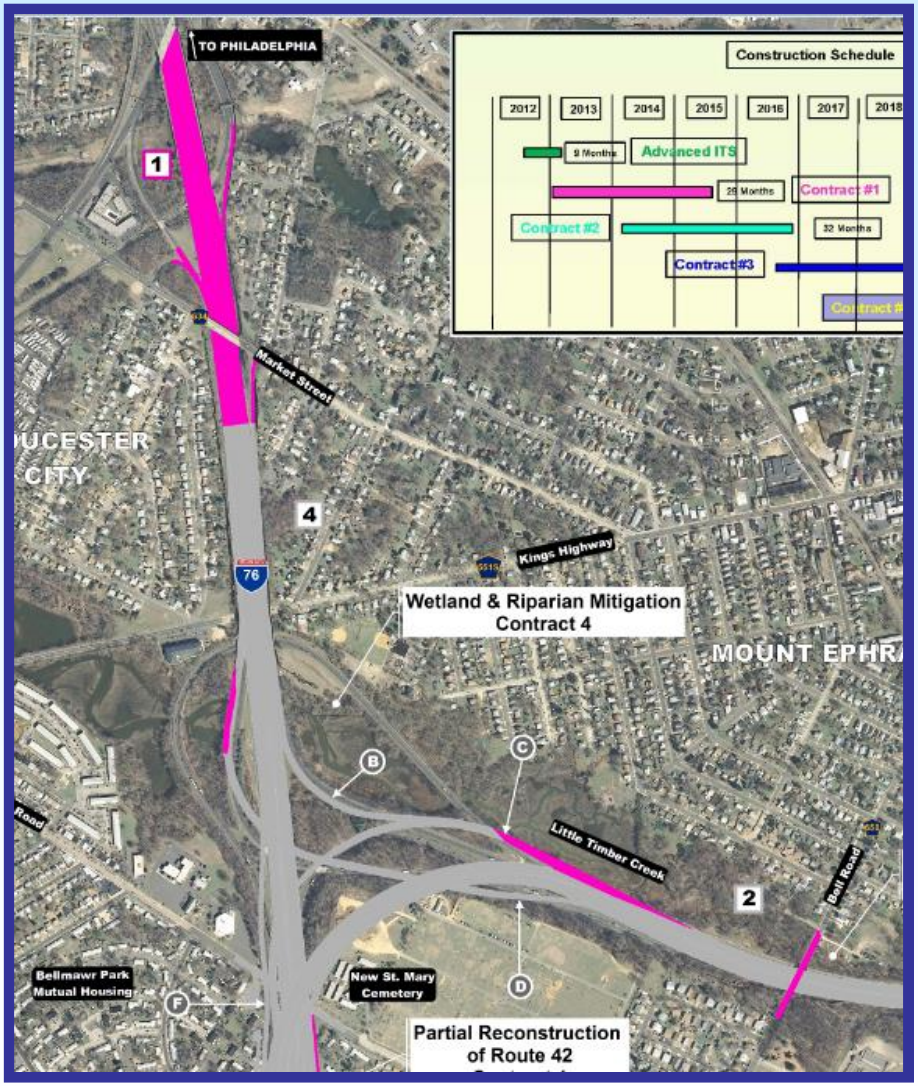
Contract 1 - North and East of Browning Rd



I-76 Corridor

- Lower I-76 at Market Street
- Wall 11 at Ramp D

Work along I-76 completed using:

- ❑ Accelerated construction
- ❑ Weekend closures of Market St and Route 130 SB Ramps

I-295 Corridor

- Bell Rd Bridge
- Wall 8 along Little Timber Creek

- ❑ Sign structures (18)
- ❑ Noise Walls (2)

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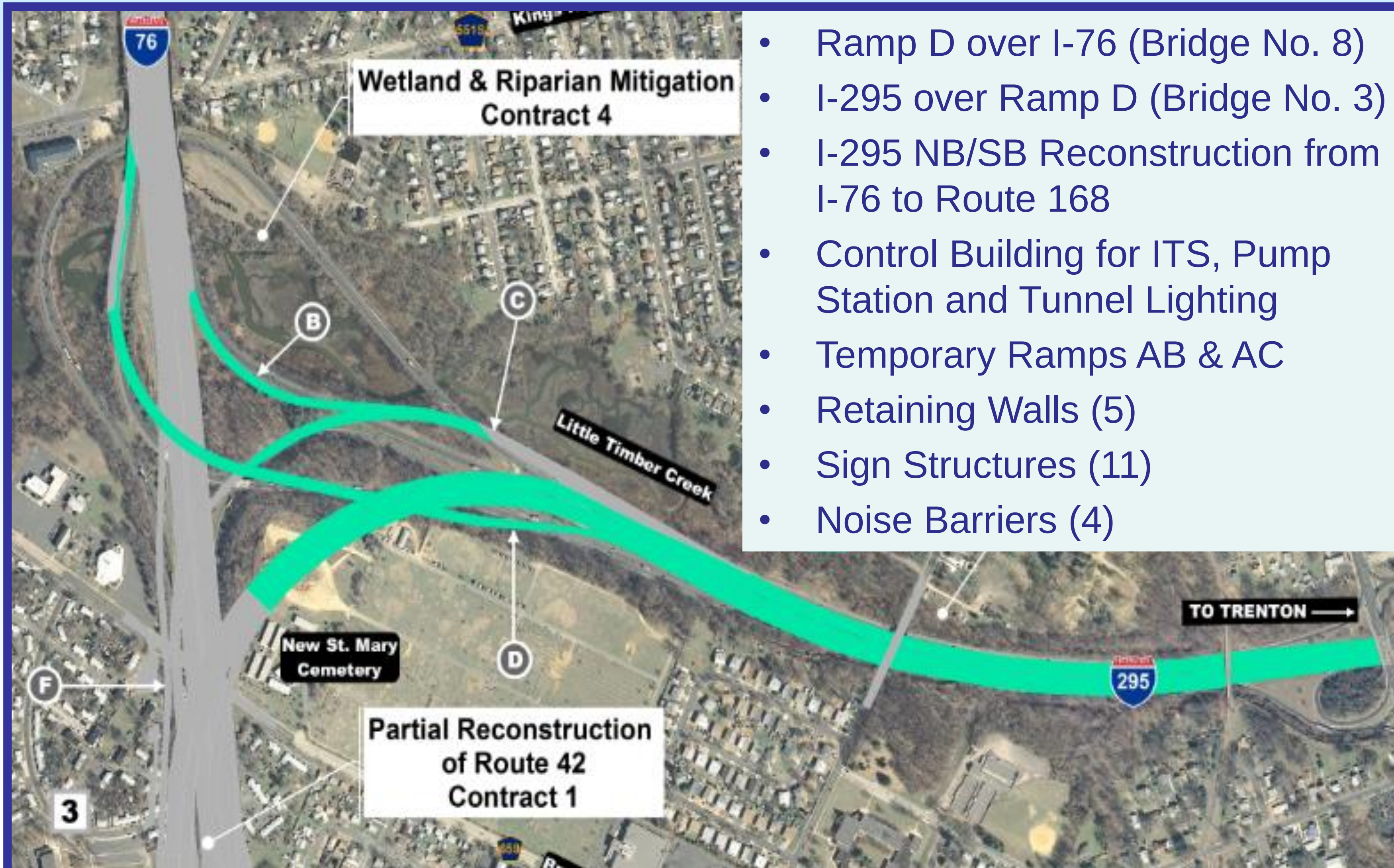
Contract 2
Awarded to Conti Enterprises, Inc.
$152.6 Million

Start Construction
June 2014

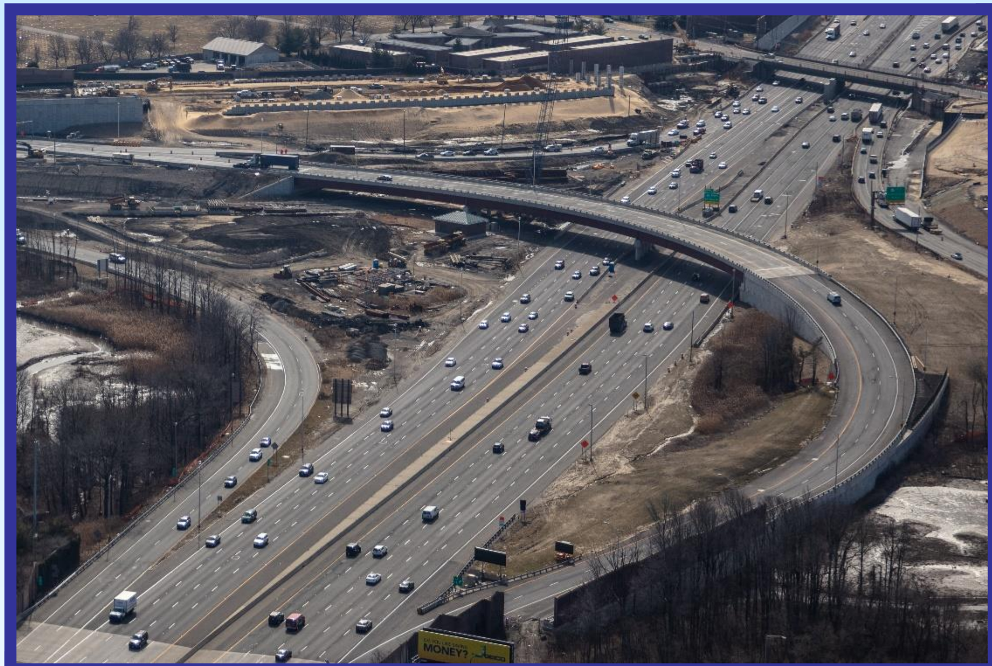
Completed
November 2019

Contract 2 – I-76 to Route 168



- Ramp D over I-76 (Bridge No. 8)
- I-295 over Ramp D (Bridge No. 3)
- I-295 NB/SB Reconstruction from I-76 to Route 168
- Control Building for ITS, Pump Station and Tunnel Lighting
- Temporary Ramps AB & AC
- Retaining Walls (5)
- Sign Structures (11)
- Noise Barriers (4)

Contract 2 – Ramp D



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Contract 3
Awarded to South State, Inc.
$192.1 Million

Start Construction
March 2017

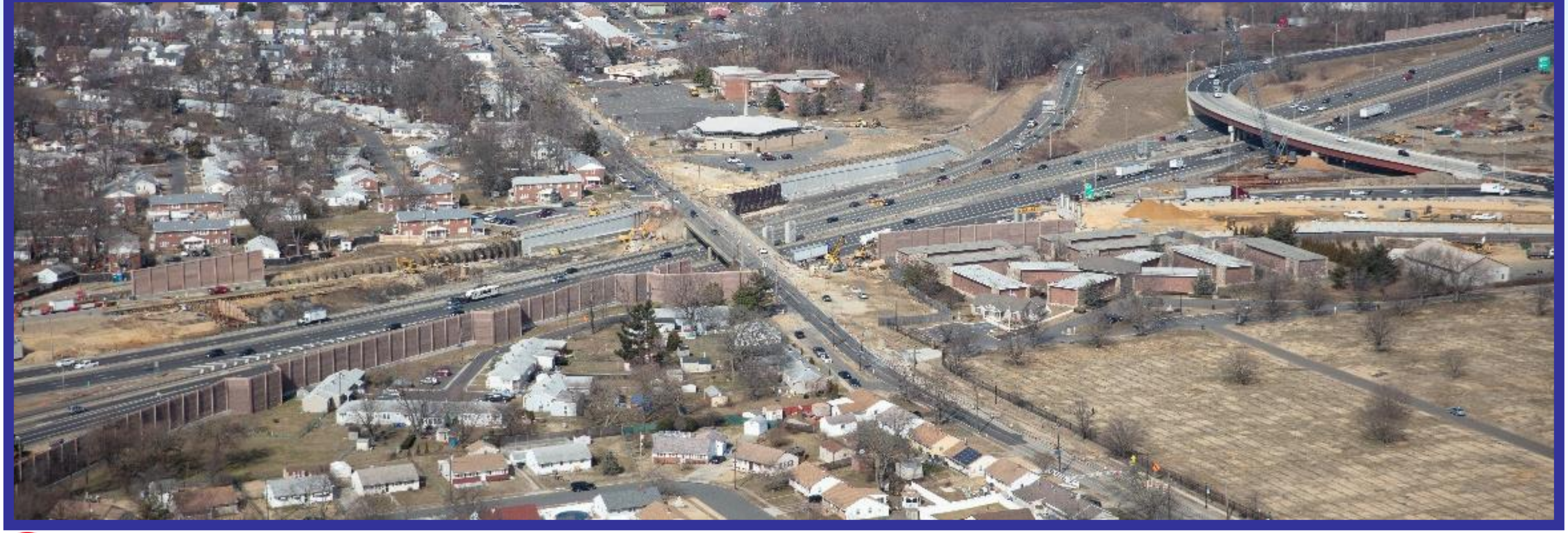
Anticipated Completion
December 2022

Contract 3

- I-295 NB/SB Bridges
  - SB opens with 2 lanes
  - Al Jo's curve changes to just a ramp to Route 42 SB
- Complete Wall 19 along ballfields

- Retaining Walls (10)
- New Ramp A Bridge opens with one lane
  - Interim Ramp A Removed
- BPMHC Relocations
- Temporary Browning Road Bridge
- Browning Road Bridge
- Sanitary pump station
- Noise Walls (4)

Contract 3 – I-295



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Contract 4 – Final Design 2020

Construction
Fall 2021

Anticipated Completion
Winter 2025

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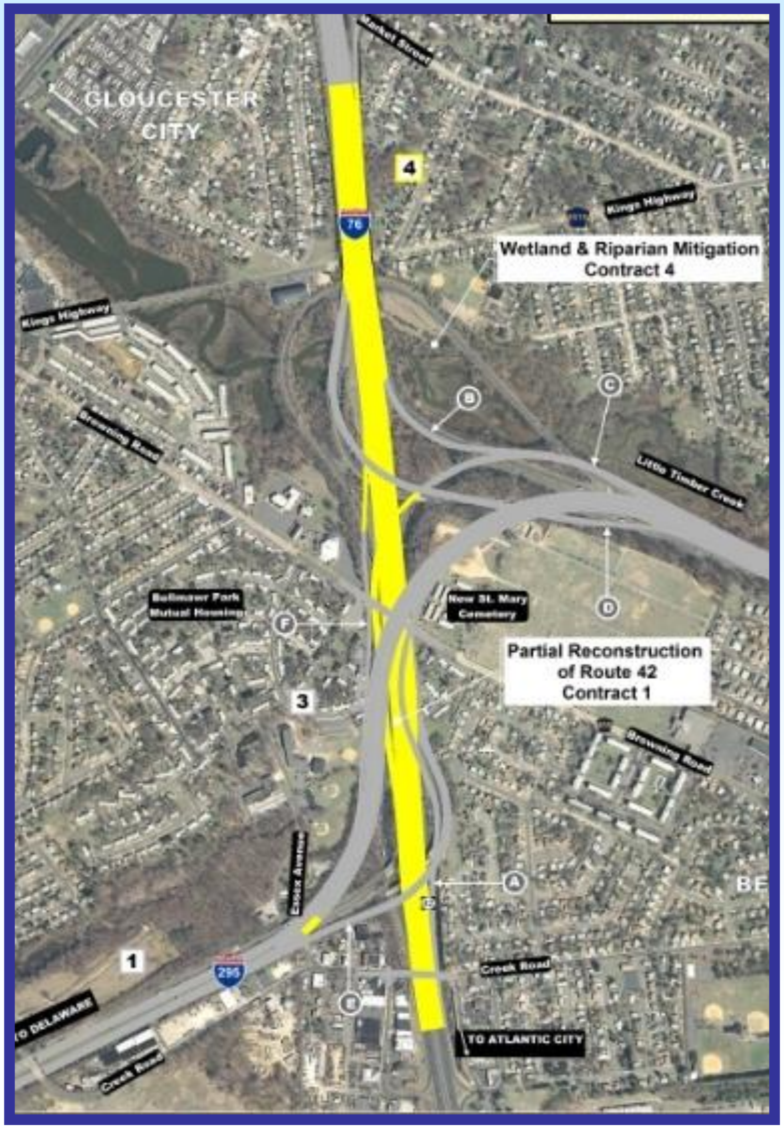
Contract 4

- Complete I-76/Route 42
- New Ramp F (I-76 EB to I-295 SB) opens eliminates the existing left hand exit
- New I-295 NB opens – express lanes eliminated
- New Ramp C (I-295 SB to Route 42 SB) covered roadway opens
- Remove Al-Jo's Curve



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Contract 4 – Ramp B & Ramp C

Contract 4 – Removal of Al Joe's Curve

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Contract 4 – Route 42/I-76

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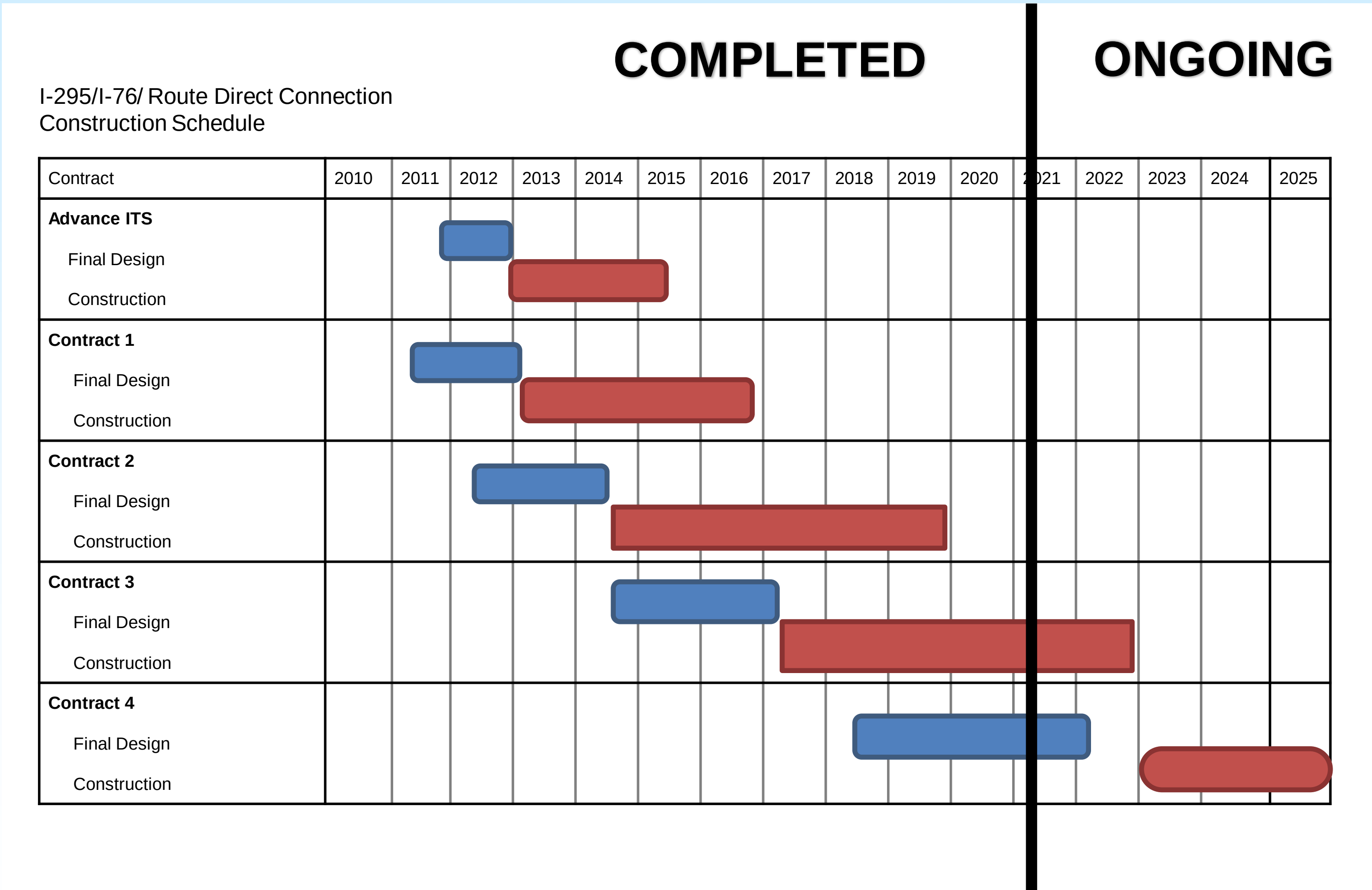
Construction Schedule



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Geotechnical Factors

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Subsurface Investigation

- 2005 Preliminary investigation of 10 borings
- 2009 Full investigation of 700 borings and 25 pavement cores
- Since 2010 Supplemental borings and pavement cores taken as needed
- Boring depths range from 15 ft to 180 ft
- Subsurface profiles generally consist of medium dense sand overlying soft to hard cohesive soils

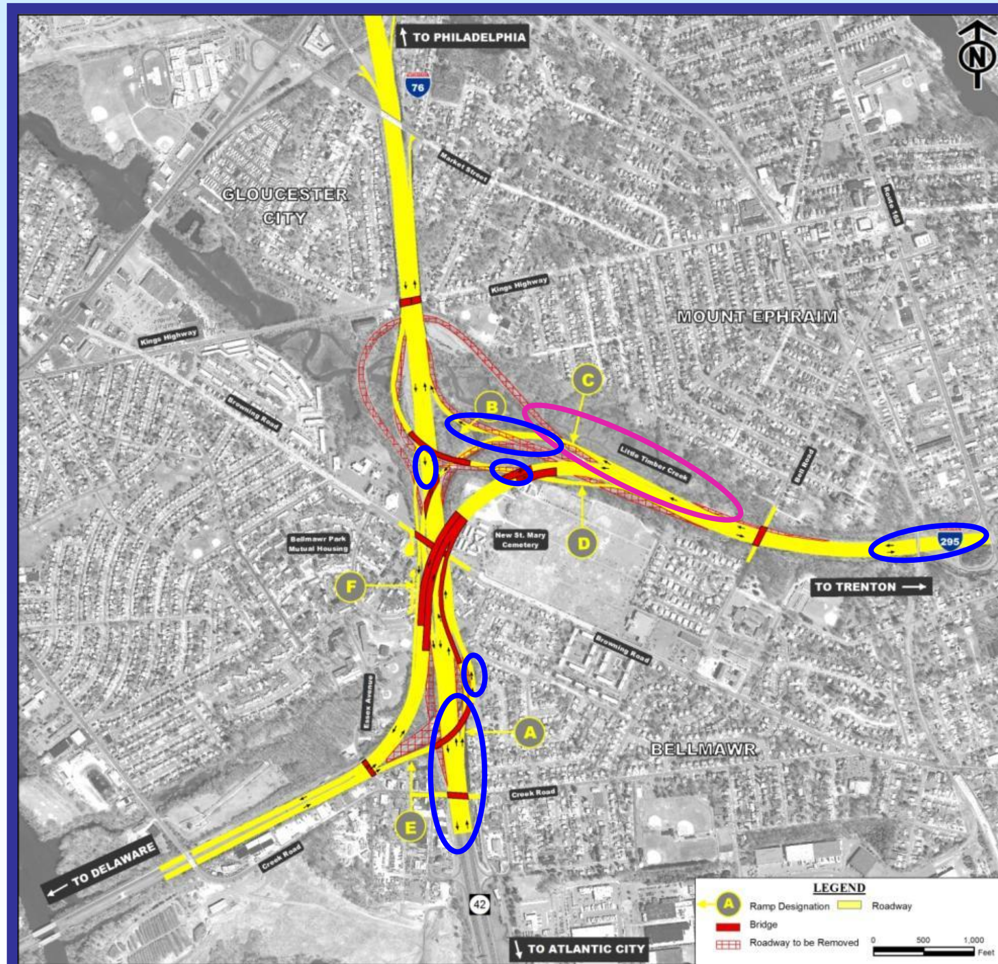
Subsurface Investigation

Impacts on Pavement Design:

- How to provide roadway support that will be built on embankments that are constructed on settlement prone soft clay?
- How to manage potential groundwater seepage in roadway built in areas with shallow groundwater table?
- How to provide a dry roadway built below groundwater table?

Subsurface Investigation

- Identified problem areas with weak soils such as Little Timber Creek
- Installed numerous monitoring wells to establish baseline groundwater level and areas of shallow groundwater in relation to final elevations
- Ramp C profile in a cut section and will be built below groundwater table in Contract 4



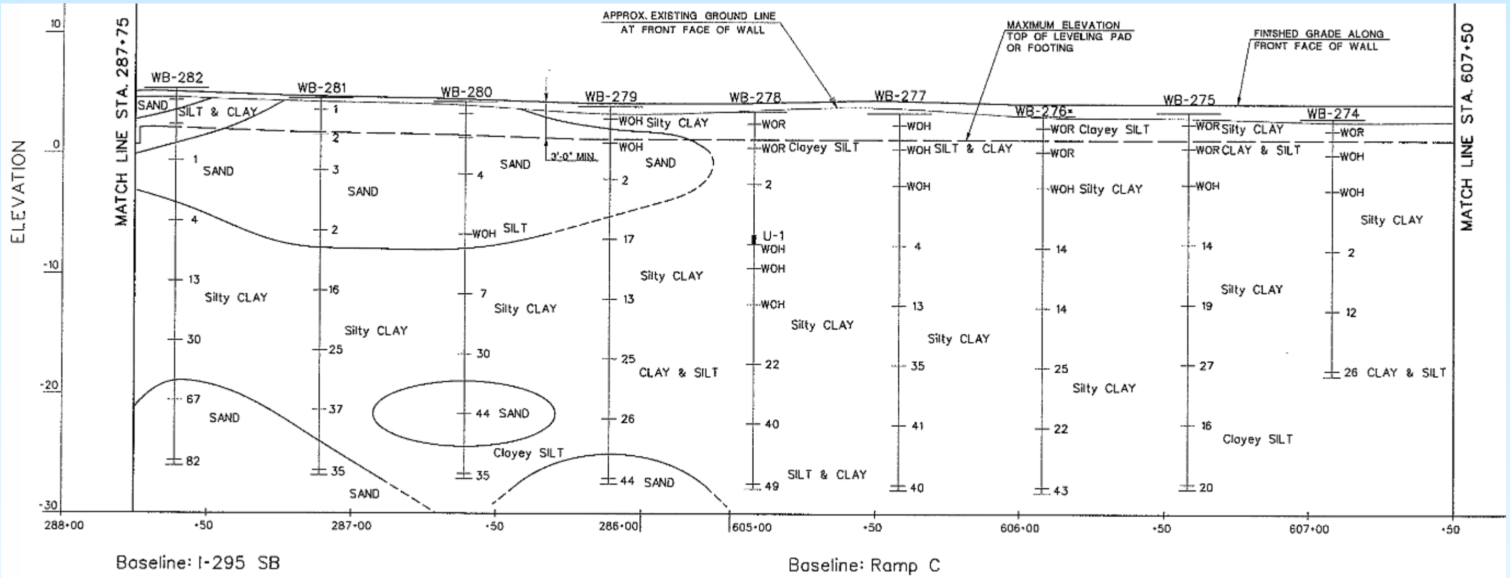
Adverse Conditions - Perched Groundwater Condition

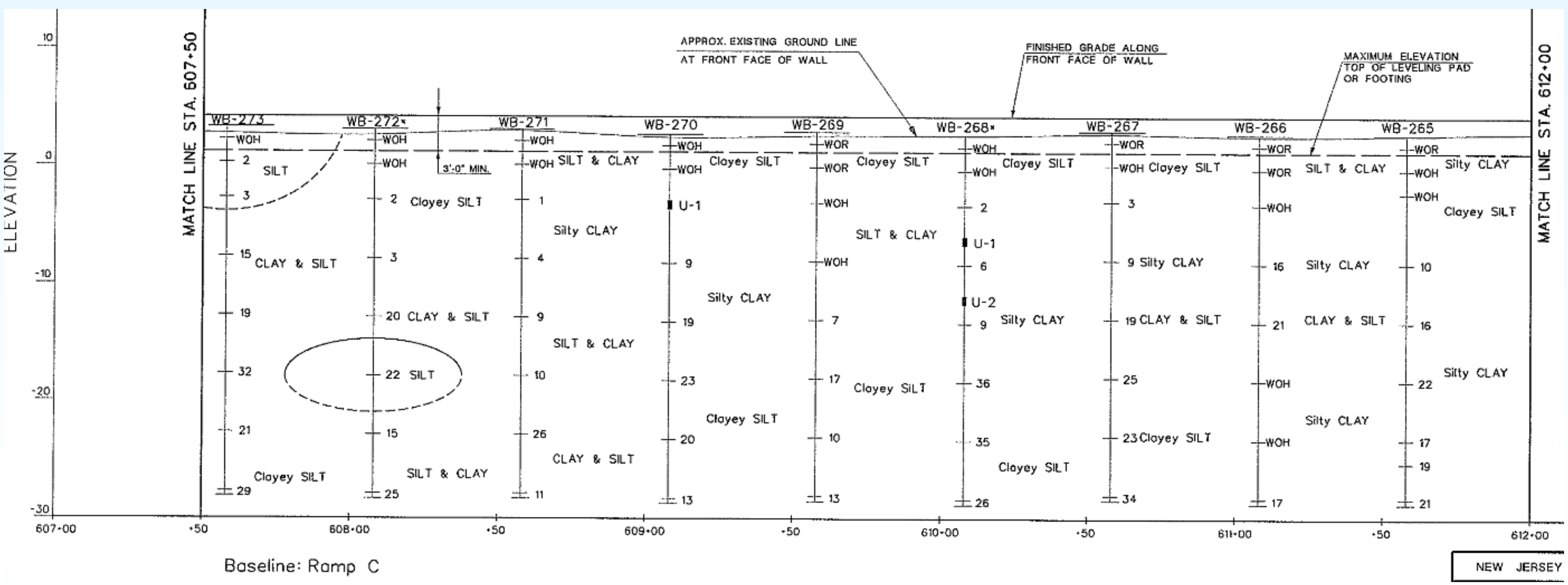
Slope Seepage

Soil Stratification (Sand over Clay) dipping into cut slope

Seasonal Seepage along sand-clay interface after rough grading

Geologic Profile





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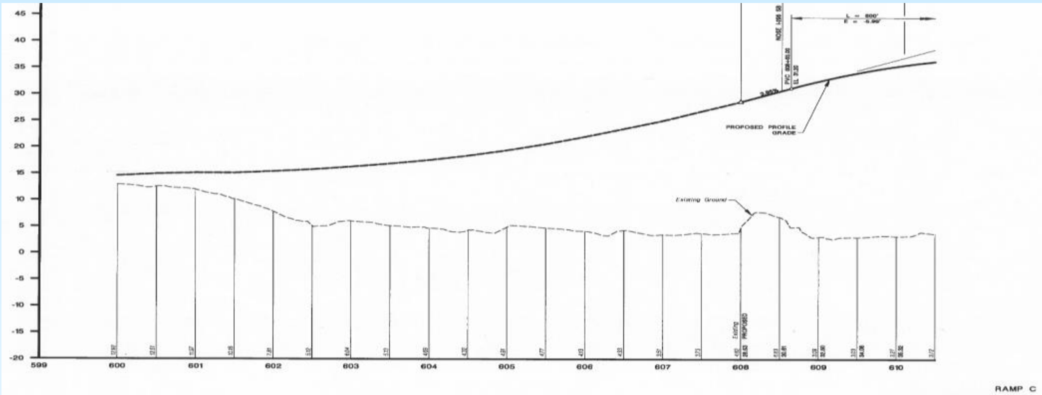
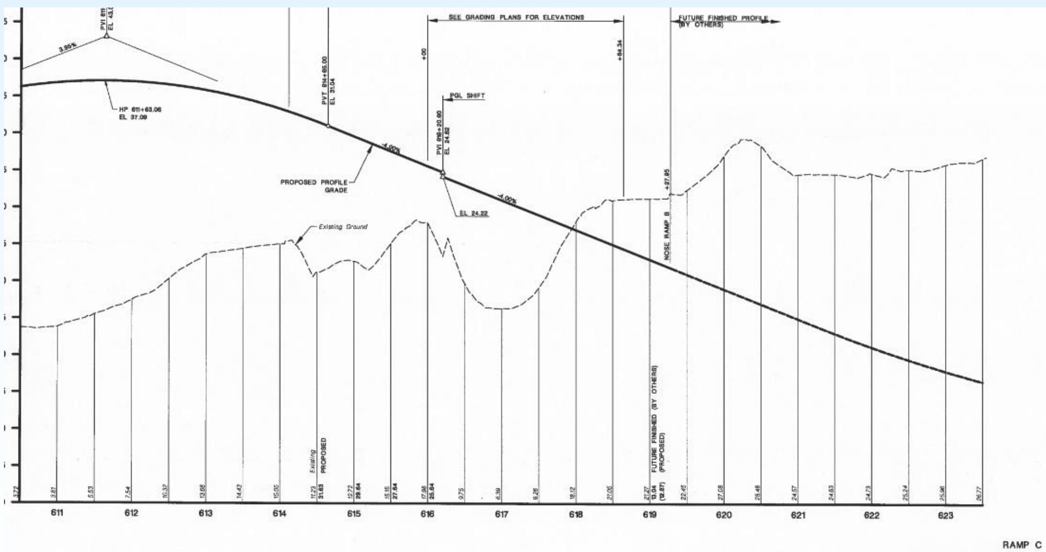
Ramp C Profile





- Grade raised by as much as 30 ft and cut as much as 25 ft
- How to build embankment without settlement to handle new pavement and roadway loading
- Ground improvement using load transfer mats and rigid grout columns
- Bypasses surficial weak soil to more competent underlying layers

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Pavement Conditions, Analysis, and Recommendations

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Existing Pavement Conditions

- Generated existing conditions via available as-built information and pavement core data
  - ✓ 2009 I-295 Gloucester/Camden Rehabilitation
  - ✓ 1996 I-76
  - ✓ 1957 Bell Road
  - ✓ 1955 Browning Road and Creek Road
- Roadway sections consist of both full depth HMA and composite sections
- Local roads consist of approximately 4-8 in. HMA. Highways range from 10-16 in. HMA. All pavement boxes include some form of compacted, granular subbase

Existing Pavement Conditions

- Pavement Core records included in Contract Documents
- Cores show variable thickness of HMA and sections of composite pavement on local roadways and highways

DATE STARTED: 9-15-2009 DATE COMPLETED: 9-17-2009

CORE NUMBER	PC-21	PC-22	PC-23	PC-24	PC-25
ROUTE	Creek Rd	Essex Ave	Victory Drive	Browning Road	Kings Hwy
DIRECTION (N, E, S, W)	EB	SB	EB	WB	WB
MILE POST (MP or Station)	827+25	804+60	921+50 (Ramp F BL)	847+90	869+20
LANE NO. (Left to Right)	1	1	1	1	1
SHOULDER (Inside or Outside)	-	-	-	-	-
HOLE DIAMETER (Inches)	4"	4"	4"	4"	4"
TOTAL CORE DEPTH (Inches)	5"	4"	7"	10"	9"
CORE DRILLED TO	7" crushed stone over c-f Sand	6" Crushed stone over c-f Sand	Gravel subbase	c-f Sand subbase	c-f Sand subbase
SURFACE TYPE (AC/PC)	AC	AC	AC	AC	PC
AC THICKNESS (Inches)	5"	4"	7"	2"	-
PC THICKNESS (Inches)	-	-	-	8.5"	9"

* Lane 1 is the left lane in the direction of travel.

Existing Pavement Conditions

- Pavement Core records included in Contract Documents
- Cores show variable thickness of HMA and sections of composite pavement on local roadways and highways

DATE STARTED: 9-15-2009 DATE COMPLETED: 9-23-2009

CORE NUMBER	PC-16	PC-17	PC-18	PC-19	PC-20
ROUTE	I-76 Local	I-76 Express	I-76 Express	I-76 Local	I-76 Express
DIRECTION (N, E, S, W)	WB	WB	WB	WB	WB
MILE POST (MP or Station)	121+00	128+00	138+00	140+00	145+00
LANE NO. (Left to Right)	-	-	-	1	-
SHOULDER (Inside or Outside)	Outside	Outside (right)	Outside (right)	-	Inside (right)
HOLE DIAMETER (Inches)	4"	4"	4"	4"	4"
TOTAL CORE DEPTH (Inches)	13"	12"	12"	13"	11"
CORE DRILLED TO	Gravel subbase	Gravel subbase	c Gravel subbase	Sand subbase	Sand subbase
SURFACE TYPE (AC/PC)	AC	AC	AC	AC	AC
AC THICKNESS (Inches)	13"	12"	12"	4"	11"
PC THICKNESS (Inches)	-	-	-	9" - Rebar	-

* Lane 1 is the left lane in the direction of travel.

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Pavement Cross Section

Pavement Design and Recommendations

- Considered adjacent rehab project on 295 NB/SB to the immediate north and south of 295 Direct Connection project limits

- Pavement Design data, ADT, and truck percentages provided by NJDOT in 2009 for I-295, Route 42 and I-76

- Directional distributions provided by NJDOT via traffic counts

- Consider the soil conditions and groundwater conditions from the subsurface investigation

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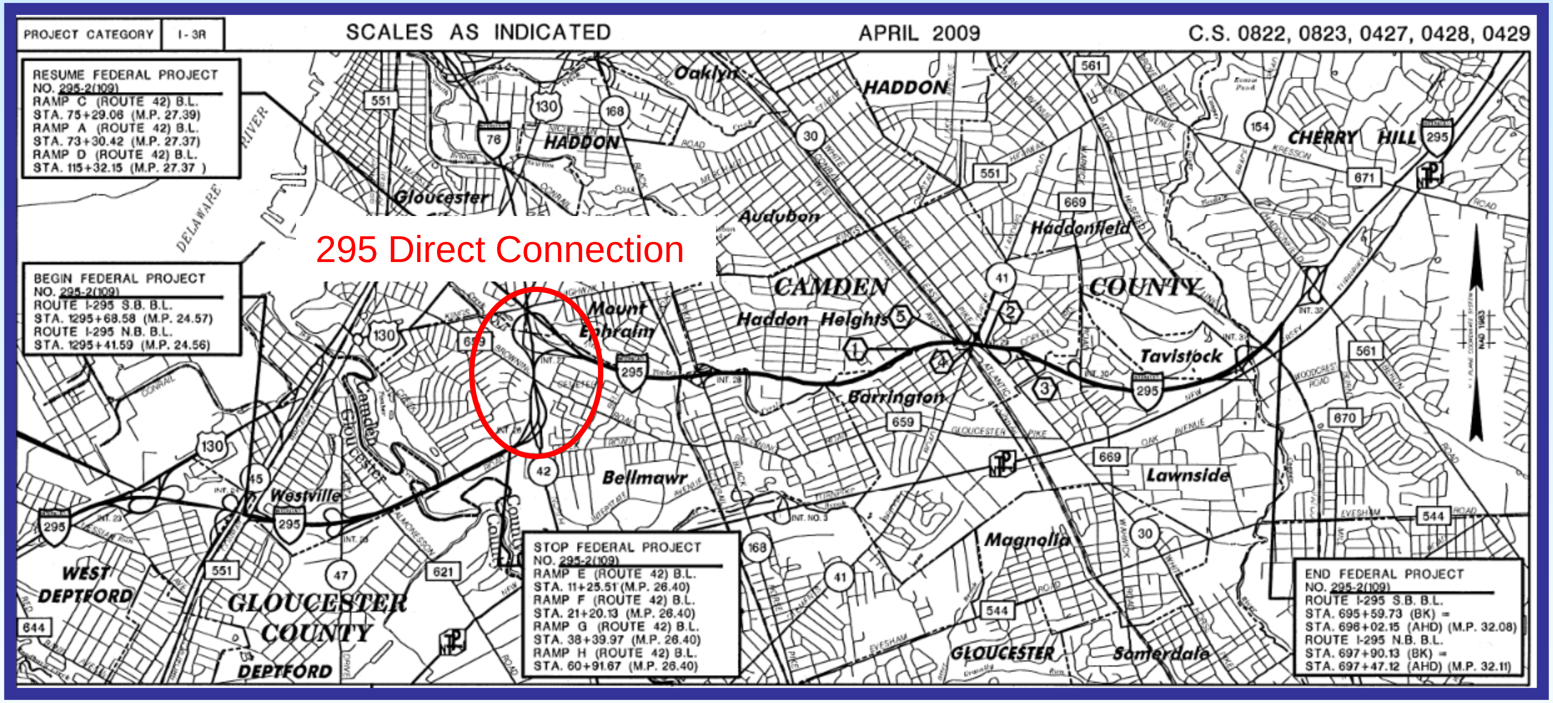
Pavement Design and Recommendations

295 Gloucester/Camden Rehabilitation Contract No. 024003720



- New pavement proposed up to the boundary of the I-295 limits
- Integrated the new pavement box with the I-295 portion of the Direct Connection Project

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Pavement Design and Recommendations

- Pavement Analysis performed with DARWIN Pavement Design System, v. 2.01 and 1993 AASHTO Guide for the Design of Pavement Structures

- 30 year design life for sections of new pavement and 20 year design life in areas for milling and paving. Less rigid requirements of mill/pave to allow for greater use of existing pavement

- Initially HMA 12.5M76 Surface course was recommended but later revised to Stone Matrix Asphalt Surface 12.5M Course as a more durable option

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Design Data

I-295 MP 26.03 – MP 28.06

PAVEMENT DESIGN DATA

2009 ADT (one way)	=	71,920 VPD
2017 ADT (one way)	=	82,340 VPD
2045 ADT (one way)	=	131,480 VPD
2045 Heavy Truck % in 24 hours	=	10%
2045 Total Truck % in 24 hours	=	16%

I-76 MP 0.00 – MP 1.15

PAVEMENT DESIGN DATA

2009 ADT (one way)	=	83,755 VPD
2017 ADT (one way)	=	95,920 VPD
2045 ADT (one way)	=	154,205 VPD
2045 Heavy Truck % in 24 hours	=	4%
2045 Total Truck % in 24 hours	=	12%

Route 42 Sections 13 & 14 MP 13.82 – MP 14.28

PAVEMENT DESIGN DATA

2009 ADT (one way)	=	73,685 VPD
2017 ADT (one way)	=	88,320 VPD
2045 ADT (one way)	=	166,485 VPD
2045 Heavy Truck % in 24 hours	=	4%
2045 Total Truck % in 24 hours	=	8%

- Data provided by NJDOT in 2009 for I-295, Route 42, and I-76

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DARWIN Design

I-295 MP 26.03 – MP 28.06

- New pavement for 30 year design life

Flexible Structural Design Module Data

18-kip ESALs Over Initial Performance Period:	91,907,335
Initial Serviceability:	4
Terminal Serviceability:	2.5
Reliability Level (%):	95
Overall Standard Deviation:	.44
Roadbed Soil Resilient Modulus (PSI):	5,500
Stage Construction:	1
Calculated Design Structural Number:	7.93

Specified Layer Design

Layer	Material Description	Struct. Coef. (Ai)	Drain. Coef. (Mi)	Thickness (Di) (in)	Width (ft)	Calculated SN
1	SMA12.5H76	.44	1	2	-	.88
2	HMA19M76	.44	1	3	-	1.32
3	HMA25M64	.4	1	7.5	-	3.00
4	Asphalt Stabilized Drainage C	.44	1	4	-	1.76
5	Dense Graded Aggregate	.14	1	10	-	1.40
Total	-	-	-	26.50	-	8.36

Rigorous ESAL Calculation

Performance Period (years):	30
Two-Way Daily Traffic (ADT):	159,007
Number of Lanes In Design Direction:	4
Percent of All Trucks In Design Lane (%):	50
Percent Trucks In Design Direction (%):	51
Growth:	Compound

Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/truck)	Annual % Growth in Truck Factor	Accumulated 18K ESALs over Performance Period
2	84	1.688	.0006	.5	312,298
4	6	1.688	.327	.5	12,157,317
6	10	1.688	1.282	.5	79,437,720
Total	100.00	-	-	-	91,907,335

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DARWIN Design

I-76 MP 0.00 – MP 1.15/Route 42 Sections MP 13.82 – MP 14.28

- New pavement for 30 year design life

Flexible Structural Design Module Data

18-kip ESALs Over Initial Performance Period:	65,951,425
Initial Serviceability:	4.2
Terminal Serviceability:	3
Reliability Level (%):	95
Overall Standard Deviation:	.44
Roadbed Soil Resilient Modulus (PSI):	5,500
Stage Construction:	1
Calculated Design Structural Number:	8.13

Specified Layer Design

Layer	Material Description	Struct. Coef. (Ai)	Drain. Coef. (Mi)	Thickness (Di) (in)	Width (ft)	Calculated SN
1	SMA 12.5 Surface	.44	1	2	-	.88
2	HMA 19M76 Interm.	.44	1	4	-	1.76
3	HMA 25M64 Base	.4	1	10	-	4.00
4	DGA	.14	1.25	8	-	1.40
5	Subbase, Design I-3	.08	1.25	8	-	.80
Total	-	-	-	32.00	-	8.84

Rigorous ESAL Calculation

Performance Period (years):	30
Two-Way Daily Traffic (ADT):	185,444
Number of Lanes In Design Direction:	5
Percent of All Trucks In Design Lane (%):	50
Percent Trucks In Design Direction (%):	58
Growth:	Compound

Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/truck)	Annual % Growth in Truck Factor	Accumulated 18K ESALs over Performance Period
2	88	1.71	.0006	.5	435,454
4	8	1.71	.311	.5	20,519,101
6	4	1.71	1.364	.5	44,996,871
Total	100.00	-	-	-	65,951,425

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Typical Sections

Common NJDOT Standard pavement items

PROPOSED MATERIALS	
ITEM NO.	DESCRIPTION
202021P	REMOVAL OF PAVEMENT
203041P	GEOTEXTILE, ROADWAY STABILIZATION
301006P	SUBBASE
302042P	DENSE-GRADED AGGREGATE BASE COURSE, 8" THICK
302045P	DENSE-GRADED AGGREGATE BASE COURSE, 10" THICK
303003M	ASPHALT-STABILIZED DRAINAGE COURSE
401009P	HMA MILLING, 3" OR LESS
401060M	HOT MIX ASPHALT 12.5 M 76 SURFACE COURSE
401090M	HOT MIX ASPHALT 19 M 76 INTERMEDIATE COURSE
401099M	HOT MIX ASPHALT 25 M 64 BASE COURSE
404006M	STONE MATRIX ASPHALT 12.5 MM SURFACE COURSE
601417P	UNDERDRAIN, TYPE X
607018P	9" x 16" CONCRETE VERTICAL CURB

- ASDC, SMA, Underdrains all are utilized to address project specific concerns
  - ✓ Prevent water damage to pavement and underlying soils
  - ✓ Extend the life of the riding surface due to high number of ESALs

Pavement Construction Concerns

- Significant amount of construction staging limiting work zones and access for paving equipment
- Maintaining roadway grades and profiles during transitional/temporary pavement periods
- Limited access restricts normal paving operations and requires use of material transfer vehicles or smaller paving equipment
- Existing roadway conditions that were in poor condition required rehabilitated prior to use and shifting of traffic.
- Shoulders used as a temporary lane were investigated and upgraded as needed to ensure the pavement section is adequate to support traffic

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Material Transfer

- Adjacent construction operations caused a portion of the edge of the HMA to crack/settle
- Emergency paving with limited access had to performed

Project Details - Paving

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Pavement Quantities

ITEM	UNIT	CONTRACT 1	CONTRACT 2	CONTRACT 3
HMA Milling (various depths)	SY	200,000	48,000	135,000
HMA Surface Course	T	28,000	28,000	26,500
HMA Intermediate Course	T	50,000	45,000	22,000
HMA Base Course	T	70,000	85,000	35,000
Asphalt Stabilized Base Course	T	5,600	15,000	300
Dense Graded Aggregrate	SY	150,000	180,000	80,000
Underdrains (various types)	LF	20,000	18,000	8,500

Contract 4

- In Final Design so quantities still being developed – paving will include entire interchange
- Construction of “Boat Section” for new Ramp C
- Resurfacing with Stone Matrix Asphalt as final riding surface

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Underdrains and Internal Drainage

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Groundwater and Moisture

- Shallow groundwater conditions and overland drainage required the use of underdrains to prevent water seepage into the subbase and pavement box which can threaten the longevity of the pavement
- Water is one of the most difficult potential damage source to prevent or control
- Water reduces the shear strength of the soil which can result in a weakened subbase and long term damage to the pavement
- Moisture within the pavement can degrade the bonding between layers, as well as erode the other materials within the pavement (PCC or HMA)
- Seasonal fluctuations of groundwater need to be considered to prepare for a worst case scenario

Subbase and Subgrade Performance

- Weak subbase either through poor construction pratices or water damage can manifest itself in a variety of pavement damage
  - Rutting of subgrade and unbound layers
  - Potholes
  - Surficial cracking (fatigue, longitudinal, transverse)
  - Stripping of asphalt
  - Essentially any type of pavement failure
  - However, the listed failure types are not limited to a weak subbase/subgrade as the only cause. Numerous load cycles, material quality, construction of the pavement, weather conditions, etc… can all contribute

- Think of the subbase/subgrade as the foundation of the roadway. A weak foundation limits the performance of the supported structure/roadway, regardless of the quality of the materials used

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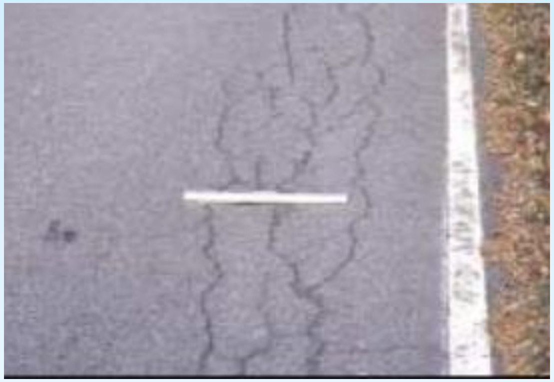
Common HMA Distresses

- All photos were taken from FHWA-HRT-013-092 Distress Identification Manual



Moderate fatigue cracking

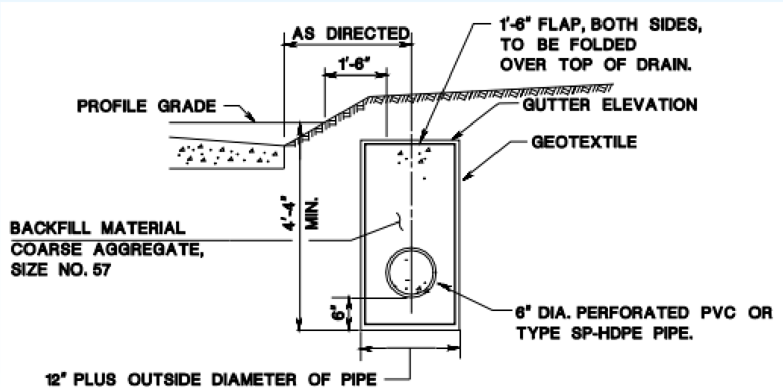
Deteriorating pothole

Rutting

Reflective cracking
(HMA overlay on PCC)

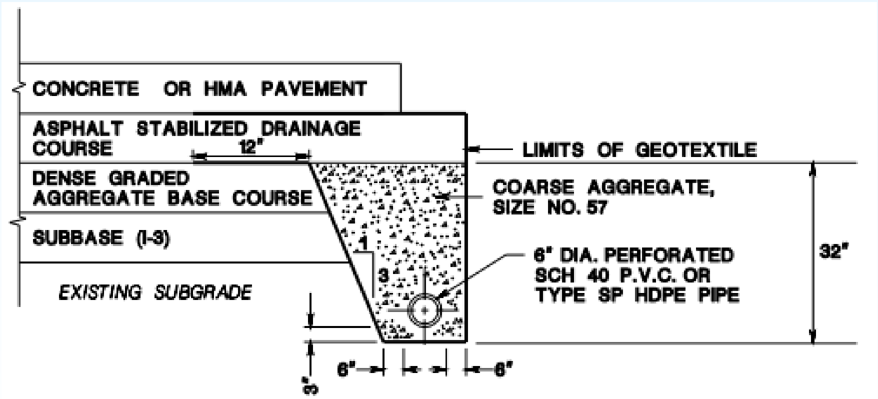
Underdrains

- Underdrains are proposed in several areas:
  - ❑ Low side of roadway in superelevation
  - ❑ Both sides of roadway in normal sections where overland drainage is directed toward a roadway
  - ❑ Roadway low points within project limits
  - ❑ Roadway at or near groundwater levels
  - ❑ Standard DOT Detail CD 601-1.1 Underdrain Type F
  - ❑ Standard DOT Detail CD 601-1.2 Underdrain Type X
  - ❑ Type X used in areas where Asphalt-Stabilized Drainage Course is constructed



UNDERDRAIN TYPE F

CD-601-1.1



UNDERDRAIN TYPE X

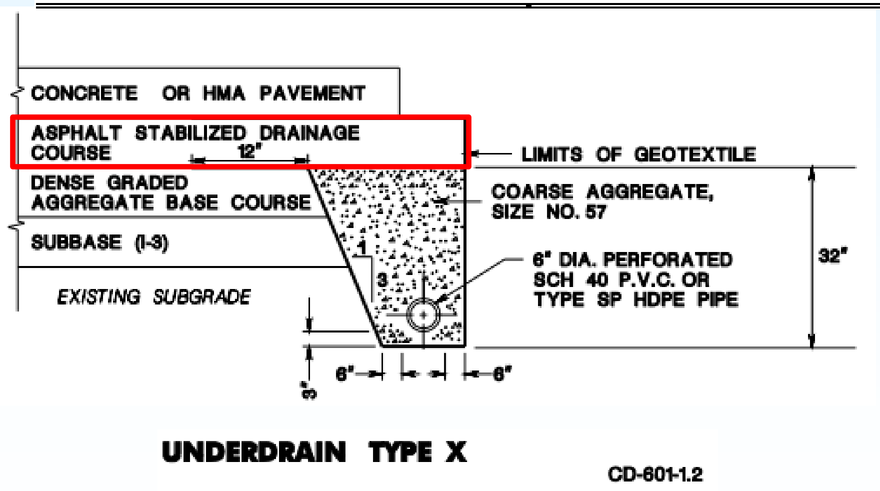
CD-601-1.2

Asphalt Stabilized Drainage Course (ASDC)

- ASDC used in conjunction with underdrains to improve internal drainage to prevent water damage, particularly in areas susceptible to capillary action
  - ❑ NJDOT Standard Road and Bridge Specifications Section 302 and 902.06.
    - ✓ ASDC does not get tack coat!

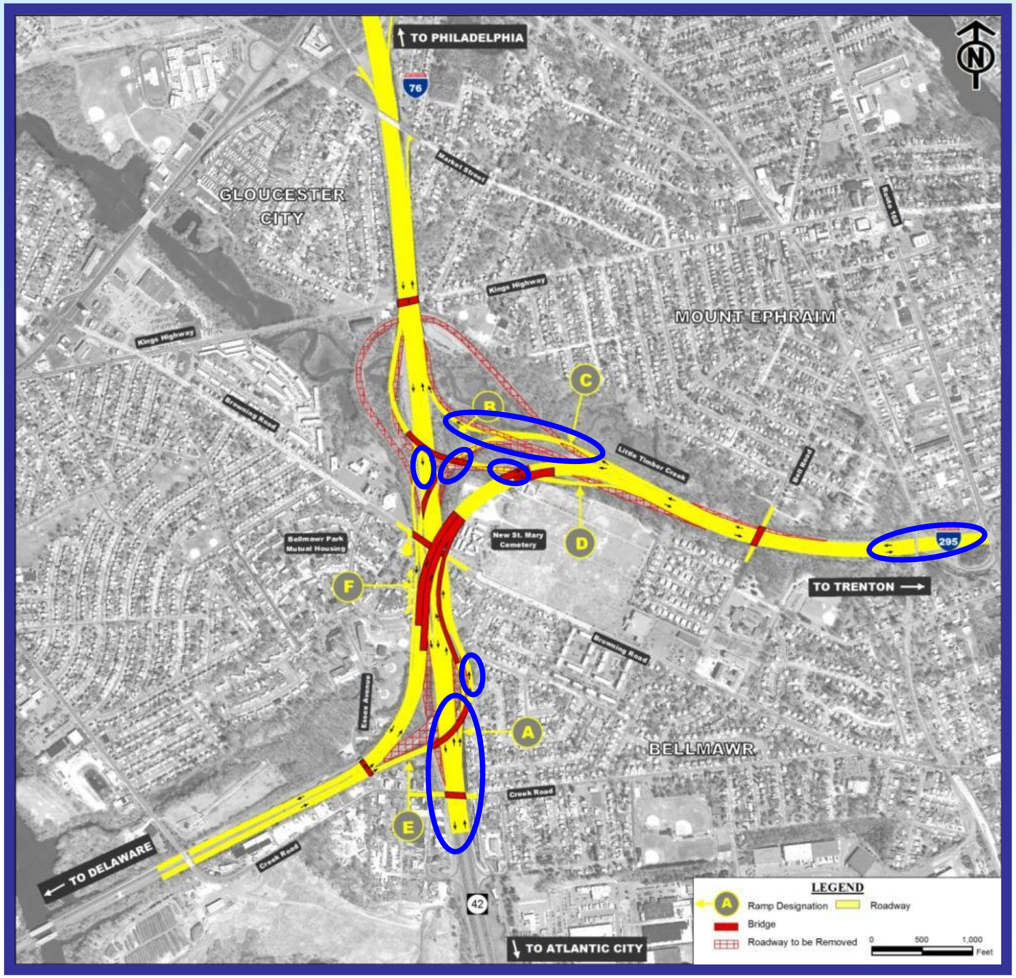
Table 902.06.01-1 Gradation Requirements and Tolerances for ASDC

Production Tolerance (Variation From JMF)	Sieve Size	JMF (Percent Passing)
–	1"	100
±1.0	3/4"	95 – 100
±3.0	1/2"	85 – 100
±6.0	3/8"	60 – 90
±2.0	No. 4	15 – 25
±2.0	No. 8	2 – 10
±1.0	No. 200	2 – 5



Underdrain Locations

- Approximate areas where underdrains required



I-295/I-76/Route 42
Direct Connection
Camden County

Stone Matrix Asphalt

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Development and History

- Originated in Europe, came to US in early 1990s. First project on I-94 near Waukesha, Wisconsin in 1991
- NJ used SMA on limited projects prior to 2008. Since 2008 SMA has been used more frequently with very good results
- Provides high rut resistance through aggregate shape and size, as well as a rich asphalt binder and additives
- Increasingly popular with state agencies but is more expensive. Higher cost offset by increased life expectancy of pavement

National and State Specifications

- AASHTO R46 / AASHTO M325.
- NJDOT Asphalts Section 404 and Materials Section 902.05
- Most standard requirements for HMA also apply to SMA
- However, SMA does have some restrictions
  - ✓ No paving operations under 50°F. HMA is restricted to 32°F
  - ✓ Due to rich binder mix excessive vibratory compacting should be avoided to prevent bleeding
  - ✓ Rollers should be kept close to the paver. A second roller in static mode can be used if the pavers are not close to the paving machine
  - ✓ Paving operations can also be slowed down to maintain a close distance between roller and paver

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NJDOT HMA Specification

Table 902.02.03-1 HMA Mixtures Nominal Maximum Size of Aggregate – Grading of Total Aggregate												
Sieve Size	Nominal Maximum Aggregate Size – Control Point (Percent Passing)											
	37.5 mm		25 mm		19 mm		12.5 mm		9.5 mm		4.75 mm	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
2"	100	–	–	–	–	–	–	–	–	–	–	–
1 1/2"	90	100	100	–	–	–	–	–	–	–	–	–
1"	–	90	90	100	100	–	–	–	–	–	–	–
3/4"	–	–	–	90	90	100	100	–	–	–	–	–
1/2"	–	–	–	–	–	90	90	100	100	–	100	–
3/8"	–	–	–	–	–	–	–	90	90	100	95	100
No. 4	–	–	–	–	–	–	–	–	–	90	90	100
No. 8	15	41	19	45	23	49	28	58	32	67	–	–
No. 16	–	–	–	–	–	–	–	–	–	–	30	60
No. 200	0	6	1	7	2	8	2	10	2	10	6	12

Table 902.02.03-3 HMA Requirements for Design										
Compaction Levels	Required Density (% of Theoretical Max. Specific Gravity)		Voids in Mineral Aggregate (VMA), % (minimum)						Voids Filled With Asphalt (VFA)[1] %	Dust-to-Binder Ratio
			Nominal Max. Aggregate Size, mm							
	@N_{des}[2]	@N_{max}	37.5	25.0	19.0	12.5	9.5	4.75		
L	96.0	≤ 98.0	11.0	12.0	13.0	14.0	15.0	16.0	70 – 80	0.6 – 1.2
M	96.0	≤ 98.0	11.0	12.0	13.0	14.0	15.0	16.0	65 – 78	0.6 – 1.2

1. For 37.5 mm nominal maximum size mixtures, the specified lower limit of the VFA is 64 percent for all design traffic levels.
2. As determined from the values for the maximum specific gravity of the mix and the bulk specific gravity of the compacted mixture. Maximum specific gravity of the mix is determined according to AASHTO T 209. Bulk specific gravity of the compacted mixture is determined according to AASHTO T 166. For verification, specimens must be between 95.0 and 97.0 percent of maximum specific gravity at N_{des}.

For mix designs that include RAP or GBSM, also include the following based on the weight of the total mixture:

1. Percentage of RAP or GBSM.
2. Percentage of asphalt binder in the RAP or GBSM.
3. Percentage of new asphalt binder.
4. Total percentage of asphalt binder.
5. Percentage of each type of virgin aggregate.

NJDOT SMA Specification

Table 902.05.02-1 SMA Specification Band (% Passing) Nominal-Maximum Aggregate Size

Production Control Tolerances from JMF[1]	Sieve Size	19 mm % Passing	12.5 mm % Passing	9.5 mm % Passing
0%	1"	100	100	100
±2%	3/4"	90 – 100	100	100
±5%	1/2"	50 – 88	90 – 100	100
±5%	3/8"	25 – 60	50 – 80	70 – 95
±3%	No. 4	20 – 28	20 – 35	30 – 50
±2%	No. 8	16 – 24	16 – 24	20 – 30
±4%	No. 16	–	–	0 – 21
±3%	No. 30	–	–	0 – 18
±3%	No. 50	–	–	0 – 15
±2%	No. 200	8.0 – 11.0	8.0 – 11.0	8.0 – 12.0
–	Coarse Aggregate Fraction	Portion Retained on No. 4 Sieve	Portion retained on No. 4 Sieve	Portion retained on No. 8 Sieve
–	Minimum Lift Thickness	2 inches	1 1/2 inch	1 inch

1. Production tolerances may fall outside of the wide band gradation limits.

Table 902.05.02-2 SMA Mixtures Volumetrics for Design and Plant Production

Property	Production Control Tolerances	Requirement
Air Voids	±1%	3.5%
Voids in Mineral Aggregate (VMA)	–	17.0% minimum
VCA_{mix}	–	Less than VCA_{dry}
Draindown @ production temperature	–	0.30% maximum
Asphalt Binder Content (AASHTO T 308)[1]	±0.40%	6% minimum
Tensile Strength Ratio (AASHTO T 283)	–	80% minimum

1. Asphalt binder content may not be lower than the minimum after the production tolerance is applied.

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SMA Specifications

- SMA <u>cannot</u> include the following materials per NJDOT specification but does not necessarily mean other state agencies do not permit the use of these materials in some form of reduced percentage in comparison to HMA
  - ✓ Reclaimed Asphalt Pavement (RAP)
  - ✓ Crushed Recycled Container Glass (CRCG)
  - ✓ Ground Bituminous Shingle Material (GBSM)
  - ✓ Remediated Petroleum Contaminated Soil Aggregate (RPCSA)

- Higher percentage of Voids in Mineral Aggregate (VMA) for SMA resulting in a more effective asphalt content
  - ✓ $VMA = V_{effective\ asphalt} + V_{air}$

- HMA Sieve size vs SMA sieve
  - ✓ Due to aggregate requirements for SMA the 3/8", #4, and #8 have much lower % passing than standard HMA

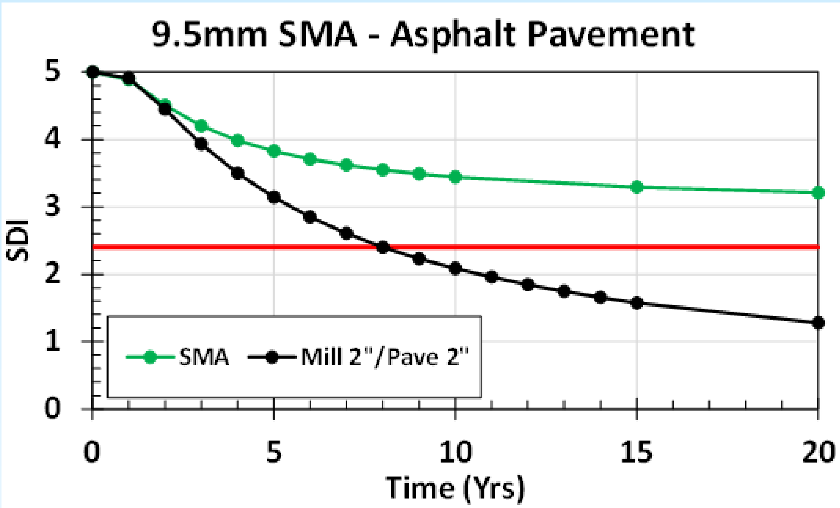
SMA Performance

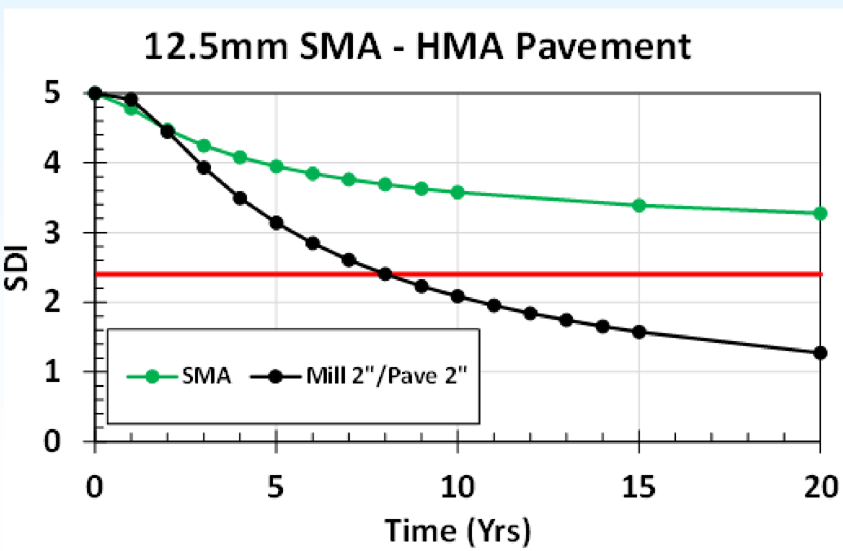
- SMA provides significant long term improvement over HMA relying on stone to stone contact and efficient asphalt binder contact
- DOT Project Managers and Resident Engineers have had positive experiences on numerous projects and expect the use of SMA to increase on state projects.
- In 2019 approximately 130,000 Tons of SMA was used on state projects according to NJDOT Pavement Group

SMA Performance Study in New Jersey

- Study by Dr. Thomas Bennert, Ph.D. from Rutgers University and the Center for Advanced Infrastructure and Transportation (CAIT)
- NJDOT Pavement Management System (PMS) data extracted from 2007 to 2019 and includes approximately 100 SMA pavement sections using the following criteria
  - ✓ Minimum of 3 years of performance
  - ✓ 9.5 mm and 12.5 mm nominal aggregate sizes
  - ✓ Flexible and composite overlays
  - ✓ Performance compared to mill 2 ”/pave 2” HMA
- Surface Distress Index (SDI) used to evaluate pavement life.
  - ✓ SDI < 2.4 trigger for pavement rehabilitation

SMA Field Performance - Flexible





- Pavement distress curve shows SMA should outperform HMA by 10+ yrs
- I-295/42/76 will have a SMA overlay during the final Contract 4 phase

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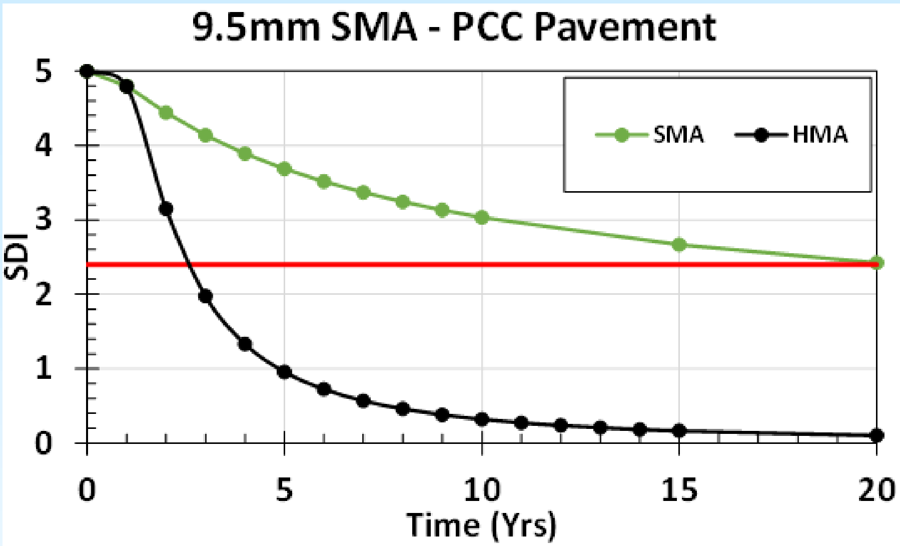
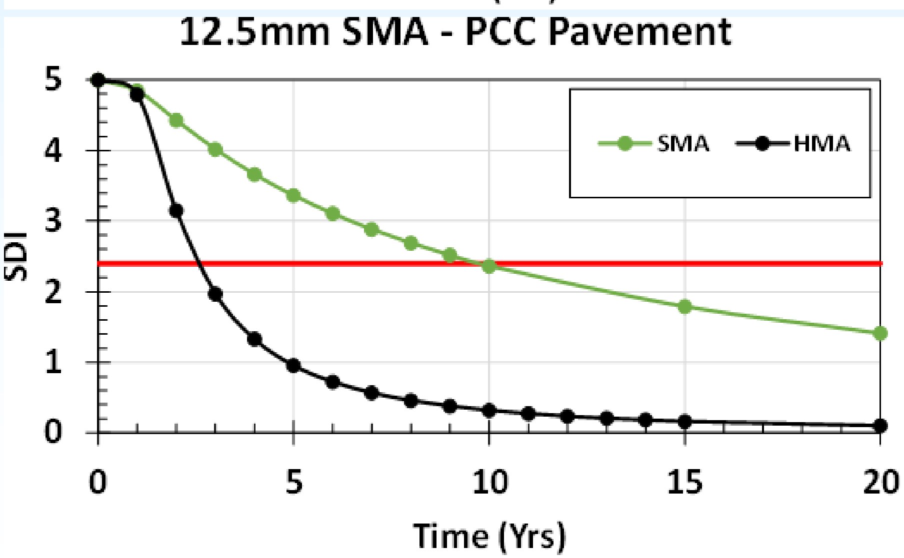
SMA Field Performance - Composite





- Pavement distress curve shows SMA should outperform HMA by 7+ yrs

SMA Financial Impact

- SMA bid prices tend to be approximately 30-40% higher per ton compared to typical HMA Surface Courses but can vary from contract to contract

- Increased life span of SMA reduces the maintenance frequency and cost of paving operations on major highways
  - ✓ Preparation of Contract documents
  - ✓ Additional stress on roadway travelers during construction. Particularly when a major interchange is involved
  - ✓ Time wasted on repetitive maintenance work when the time/resources could be spent on other projects

I-295/I-76/Route 42
Direct Connection
Camden County

Project Team

- A.D. Marble
- Advanced Infrastructure Design
- Advantage Engineering
- A-Tech Engineers
- The Bio Engineering Group
- Dresdner Robin
- GEOD, Corp.
- Howard Stein Hudson
- Infra MAP
- Malick & Scherer
- WSP (Formerly Parsons Brinckerhoff)
- Paul Carpenter Associates
- Stokes Creative Group
- SJH Engineering
- Urbitran/AECOM
- YU Associates

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Questions?

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