
VDOT
Virginia Department of Transportation

PERFORMANCE OF COMPOSITE PAVEMENT AS MAINTENANCE STRATEGY FOR CRCP

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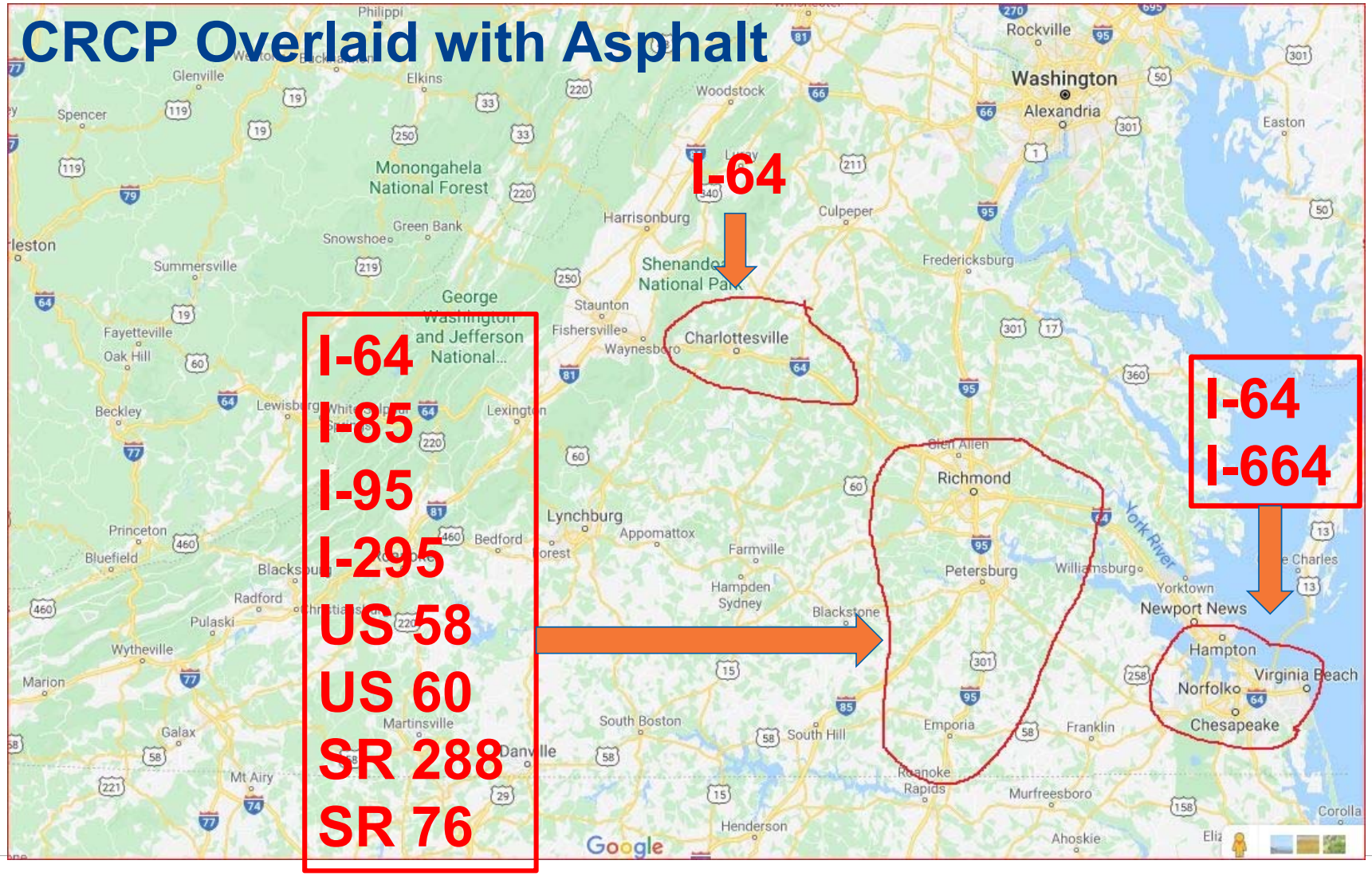
February 12, 2020

53rd Mid-Atlantic Quality Assurance Workshop, Williamsburg, VA

Introduction

- VDOT has more than 500 lane-miles of Continuously Reinforced Concrete Pavement (CRCP) built 1967 to 1992.
- Design life of 20-30 years (?)
- Thickness – 8 to 9 inches
- Needed rehabilitation and repair
  - Patched
  - Overlaid with Asphalt (HMA and/ or SMA)
- I-64, I-664, I-295, I-85, I-95, US-58, US-60, SR-288, SR-76
  - Charlottesville, Richmond (south), Norfolk/ VA Beach

CRCP Overlaid with Asphalt



Introduction

- Many of them are still serving the Transportation need of the public after 20-50 years of service
  - Currently composite pavement
- Focus of this presentation
  - Performance of these Composite Pavements
    - Age of each treatment
    - Traffic level
    - Surface Condition
  - Primarily based on VDOT Pavement Management System (PMS) data

PMS Data

- Pavement construction history
- Maintenance record
- Condition Rating
  - IRI
  - CCI – LDR and NDR
    - Excellent: 90 and above
    - Good: 70-89
    - Fair: 60-69
    - Poor: 50-59
    - Very Poor: 49 or below

Pavement Management Data

- **Condition data collected – semi automated data collection**
- **Data aggregation (state condition rating system and MAP-21)**
- **Quality assurance (certification, sampling, data acceptance)**
- **DQMP for HPMS**
  - Data collection equipment calibration and certification;
  - Certification process for persons performing manual data collection;
  - Data quality control measures to be conducted before data collection begins and periodically during the data collection program;
  - Data sampling, review and checking processes; and
  - Error resolution procedures and data acceptance criteria

Pavement Management Data

- **Condition data collected (distress types, sampling, in-house vs. contracted, cost if available, miles covered, technology utilized)**
- Data aggregation (state condition rating system and MAP-21)
- Quality assurance (certification, parameters comparison, sampling, data acceptance)
- DQMP for HPMS
  - Who is developing
  - Coordination HPMS/PMS
  - Requirements
    - Data collection equipment calibration and certification;
    - Certification process for persons performing manual data collection;
    - Data quality control measures to be conducted before data collection begins and periodically during the data collection program;
    - Data sampling, review and checking processes; and
    - Error resolution procedures and data acceptance criteria

Pavement Inventory (2018)

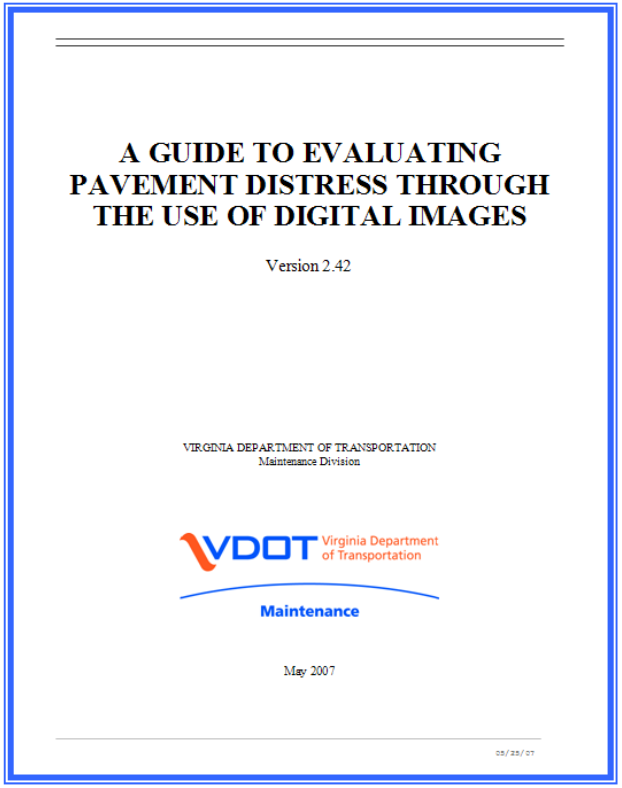
- VDOT Maintained inventory 128,900 lane miles
  - Interstate – 5,600 lane miles
  - Primary – 22,100 lane miles
  - Secondary – 100,600 lane miles
  - Frontage – 600 lane miles

Virginia Department of Transportation (VDOT) Network

- Data is collected every year
  - Data is collected on travel lane (right most) only
  - Data for entire length collected and not on sample-basis
- Total yearly collection: Approx. 20,400 directional miles
  - 100% of the interstate network, approx. 2,200 miles
  - 100% of the primary network, approx. 10,500 miles
  - 20% - 25% of the secondary network, approx. 12,000 miles
- Data collection and processing work is contracted out
  - ARAN data collection vehicles used by contractor
  - A third party consultant performs IV&V
- VDOT performs QA & final acceptance tests

Distress Rating Protocol/Guide

- Distress rating manual – protocol to identify and quantify distresses
- Originated from PAVER manual used by US Army Corps of Engineers
- Modified following guidance from LTPP distress rating manual



Distress Types – Asphalt Surfaced Pavements

- Transverse Cracking
- Longitudinal Cracking
- Longitudinal Lane Joint Cracking
- Alligator Cracking
- Patching
- Potholes
- Delaminations
- Bleeding
- Rutting
- Reflection Cracking

Distress Types – Jointed Concrete Pavements

- Corner Breaks
- Joint Seal Condition
- Spalling of Transverse and Longitudinal Joints
- Transverse Cracking
- Longitudinal Cracking
- Divided slabs
- Blowups
- PCC Patch/Patch Deterioration
- Asphalt Patch

Distress Types – Continuously Reinforced Concrete Pavements

- Transverse Cracking
- Clustered Cracking
- Punchouts
- PCC Patch/Patch Deterioration
- Asphalt Patch
- Longitudinal Cracking
- Longitudinal Joint Spalling
- Longitudinal Pavement/Shoulder Joint Seal Condition

Data Summarization – Data Delivery Formats

- **Summarization of Production Data**
  - **Split by road system**
    - Interstate and Primary are identical but differ from Secondary
    - Secondary lacks distinct pavement management sections and history
  - **Split by pavement type**
    - Asphalt Concrete Pavements (ACP)
      - Bituminous
      - Bituminous over Continuously Reinforced Concrete
      - Bituminous over Jointed Reinforced Concrete
    - Continuously Reinforced Concrete Pavement (CRCP)
    - Jointed Concrete Pavement (JRCP)
  - **Delivered in 0.10 Mile and Summary Homogeneous Sections**

Data Summarization - Pavement Condition Indices

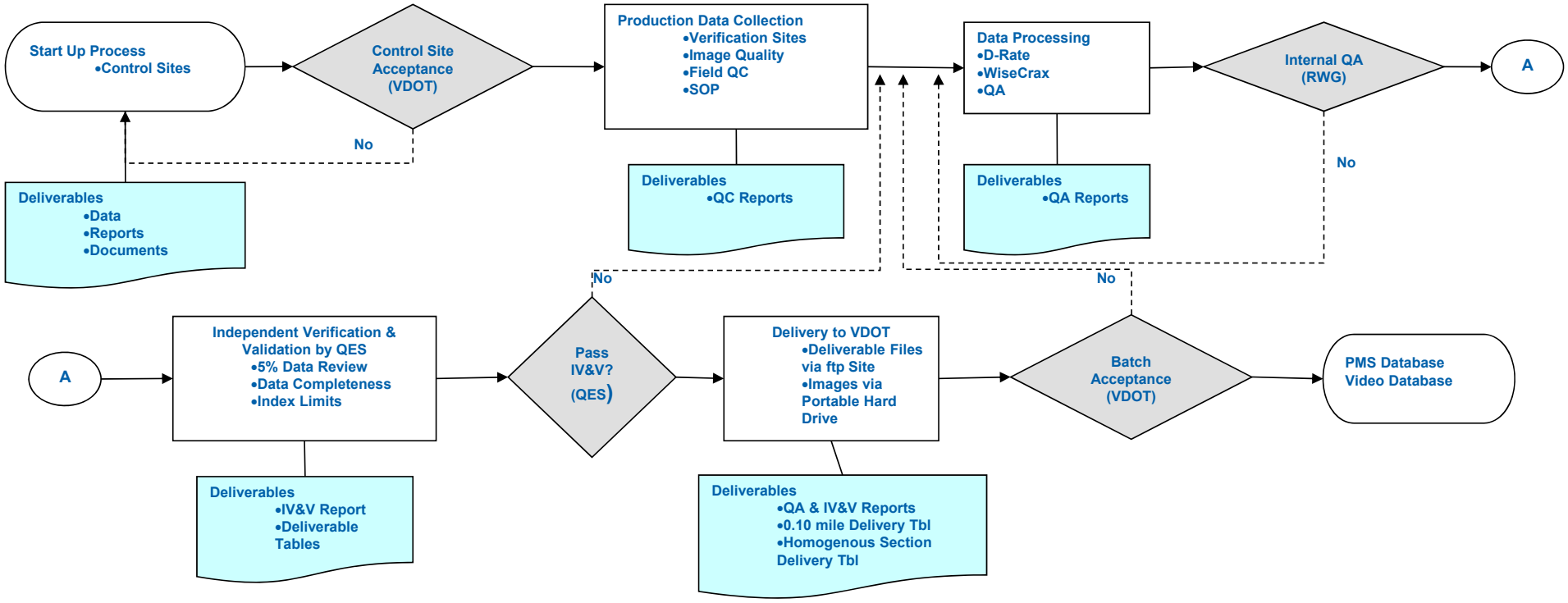
- **Flexible Pavement**
  - **Load Related Distress Rating (LDR)**
    - Alligator (Fatigue) Cracking, Wheel Path Patching, Rutting
  - **Non-load Related Distress Rating (NDR)**
    - Longitudinal and Transverse Cracking, Non-Wheel Path Patching, Bleeding
- **Jointed Concrete Pavement**
  - **Slab Distress Rating (SDR)**
- **Continuously Reinforced Concrete Pavement**
  - **Concrete Distress Rating (CDR)**
    - Longitudinal and Transverse Cracking, PCC patching, AC patching, Longitudinal Joint Spalling
  - **Concrete Punchout Rating (CPR)**
    - Punchouts, Cluster Cracking, PCC patching, AC patching
- **The lower of the two index values is the Critical Condition Index (CCI)**

Data collection, QC/QA and IV&V

- Data collection at control sites
- Production data collection
- Contractor's SOP and internal QA/QC
- Independent Validation and Verification (IV&V) by third party
- QA and acceptance by VDOT

Data collection, QC/QA and IV&V

- **Data quality process flow diagram**



Data Collection at Control Sites: Preliminary IV&V

- **Control Sites**
  - Covers all systems and pavement types with wide range of pavement conditions
- **IV&V review of results from control sites to:**
  - Measure precision and bias values for roughness and rutting measurements
  - Calibrate the pavement distress rating process
    - Contractors ratings are reviewed against reference values (based on average manual rating from four experienced raters)
- **If results are within tolerable limits of variation, contractor moves on to production data collection**

Preliminary Data Collection IV&V: Roughness and Rutting

- **Comparison of each data collection vehicle to reference values**
  - **5 runs per site by each truck**
  - **Results from each truck are reviewed for precision and repeatability**
    - **ASTM E177-14 (Standard Practice for Use of the Terms Precision and Bias in ASTM Test Methods)**
    - **Roughness precision and bias (by wheel path) determined against average value of 10 runs of VDOT truck**
    - **Rutting precision and bias (by wheel path) determined against average values of all runs by all trucks**

Preliminary Data Collection IV&V: Roughness and Rutting Tolerance Limits

- **Accuracy/Precision**
  - **IRI: ± 5% of VDOT Reference Value**
  - **Rut: ± 2mm of VDOT Reference Value**

- **Repeatability/Bias**
  - **5 runs at highway speeds, limit < 5%**

Contractors SOP and Internal QA/QC

- Contractor developed and executed QC Plan : approved by VDOT
  - Certification/training of personnel
  - Validation of equipment
  - Daily equipment QC procedures
  - On-going QC procedures

Third Party IV&V of Production Data

- Reviews a random 5% sample of post-processed production data (distress data)
- Manually rates distresses from images
- Data is looked at and delivered in batches
- If selected samples from a batch pass the test, the entire batch is delivered to VDOT

Independent Verification & Validation - Benefits

- Increases the confidence level in the reported data
- Provides additional QC/QA for vendor
- Modifications to rating protocols if needed
- Increased QA checks prior to data delivery to the Agency

Production Data – VDOT QA

- **VDOT has access to images and ratings from previous years**

- **Summary sections from current delivery compared with previous year**
  - **Review occurs where:**
    - Index changes beyond expected values
    - High or low index values for reported pavement age
  - **VDOT is looking for**
    - Unreported maintenance
    - Problems with distress ratings
  - **Errors reported to the contractor for reprocessing**

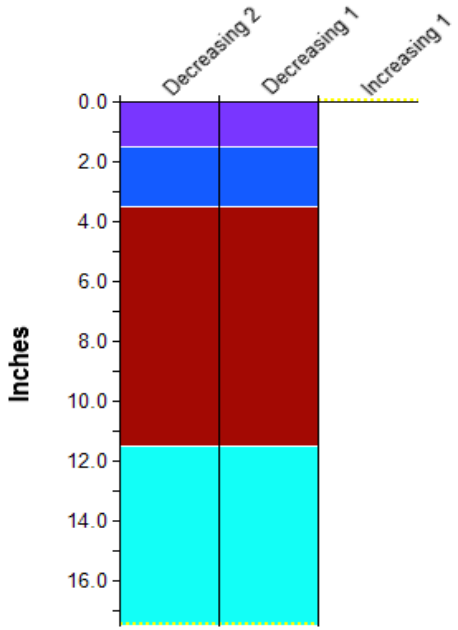
Final Acceptance of Production Data

- **Data is accepted after it passes**
  - IV&V checks
  - Year-to-year comparison and reasonableness checks

- **Data is not delivered (or accepted) all at once**
  - Interstate (statewide)
  - Primary (district by district)
  - Secondary (district by district)

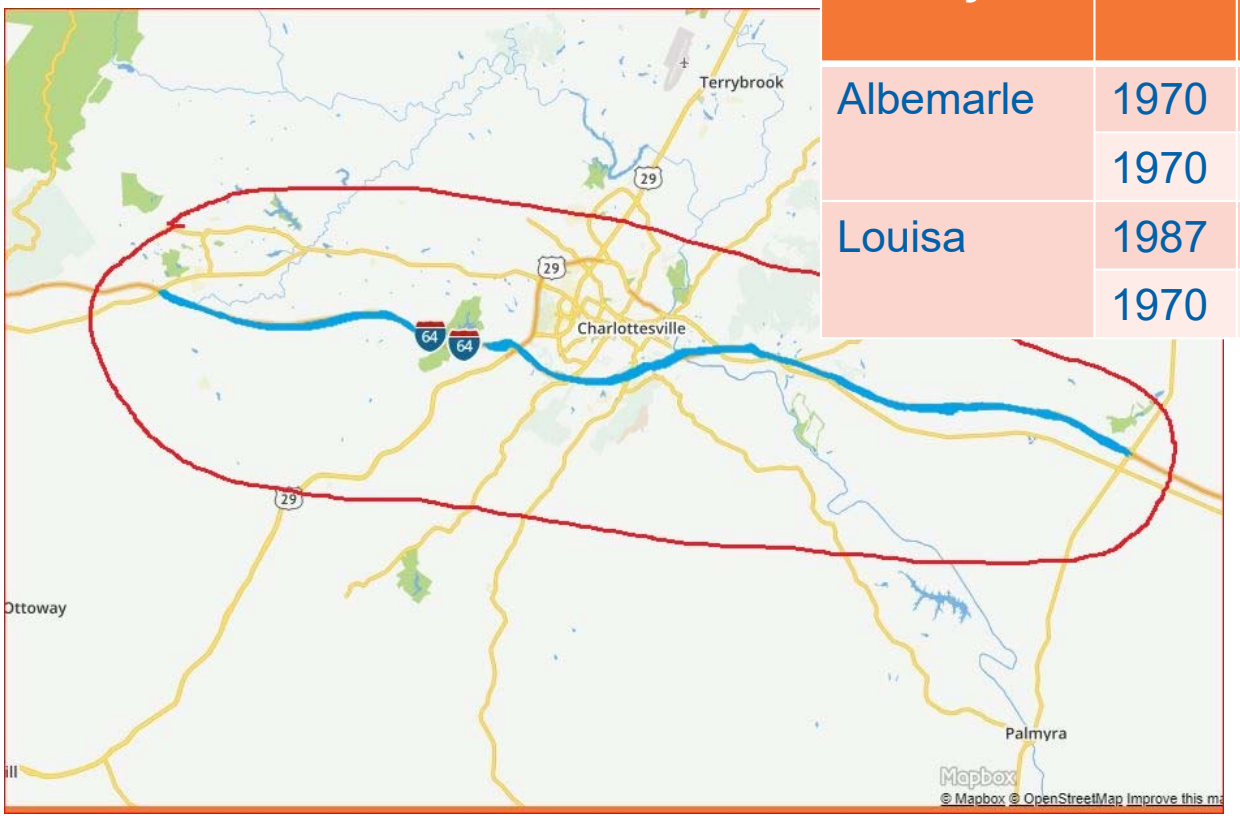
Other Data Used for the Analysis

- Pavement type, Last treatment category, Distresses summarized to feed the decision tree, AADTT (Truck traffic), Surface age, and Pavement structure.
- Age data showing surface life of more than 20 years is likely due to lack of data rather than true life of surface



- SR00288SB 13.63-15.21

CRC Pavements in VDOT System: I-64



County	Year	MP	Lane-miles	AADTT
Albemarle	1970	127-107 W	35	3000
	1970	107-130 E	35	3000
Louisa	1987	136-135 W	2	3000
	1970	131-136 E	10	3000

- 8 inch CRCP
- 32 & 49 Years

Maintenance History: I-64

County	MP	Year	Layer	Age (Y)*	IRI	CCI
Albemarle	127-120 W	1970	8.0” CRCP	26		
		1996	2.5” IM-1A + 1.5” SMA	22 ?	100	58
		2018	2.0” SMA 12.5 (Mill and Fill)	1+	61	93
	119-114 W	1970	8.0” CRCP	23		
		1993	3.0” B-3 + 1.4” SM-2C	6		
		1999	1.5” SMA	18 ?	107	55
		2017	2.0” SMA 12.5 (Mill and Fill)	2+	71	99
	114-107 W	1970	8.0” CRCP	23		
		1993	3.0” B-3 + 1.4” SM-2C	7		
		2000	1.5” SM-9.5D	12	68	43
		2012	: 2.0” SMA 9.5 (Mill and Fill)	7+	71	98

* Age at the end of service

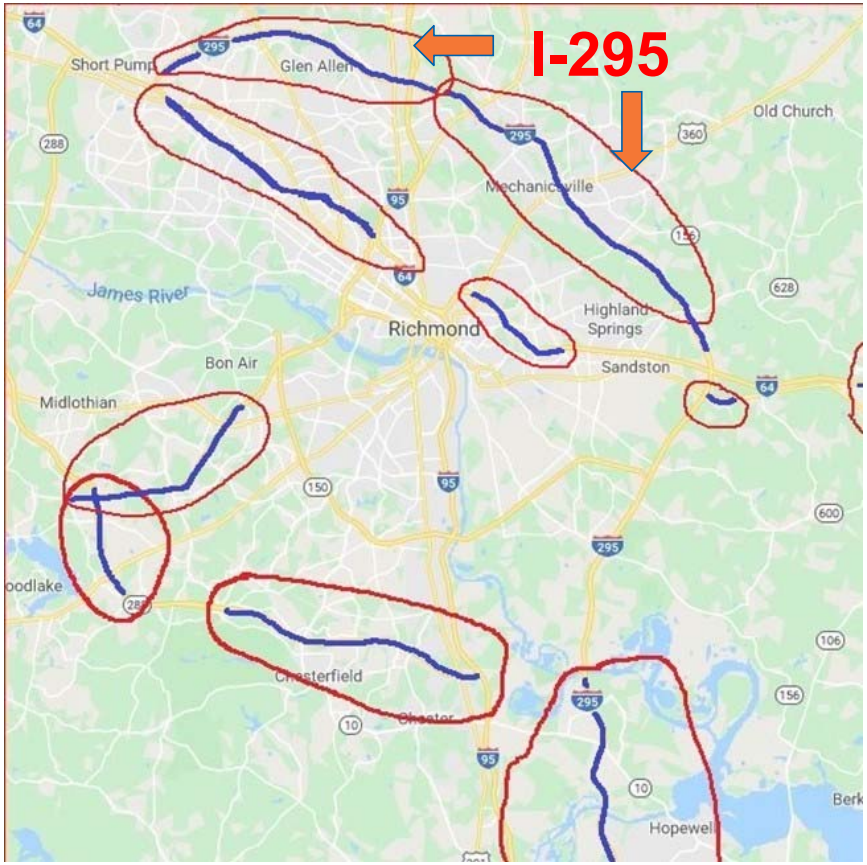
Maintenance History: I-64

County	MP	Year	Layer	Age (Y)	IRI	CCI
Albemarle	107-114 E	1970	8.0” CRCP	22		
		1992	2.9” BM-2 + 1.4” SM-2C	16	85	40
		2008	1.5” SMA 9.5	11+	82	84
	119-127 E	1970	8.0” CRCP	26		
		1996	2.5” IM-1A + 1.5” SMA	18	84	85
		2014	0.75” THMACO	5+	64	97
	127-130 E	1970	8.0” CRCP	24		
		1994	3.0” BM-2 + 1.5” SM-2A	16		59
		2010	1.5” SMA 9.5 (Mill and Fill)	9+	67	95

Maintenance History: I-64

County	MP	Year	Layer	Age (Y)	IRI	CCI
Louisa	136-135 W	1987	8.0” CRCP	18		
		2005	2.0” SMA 19.0 + 1.5” SMA 9.5	8	96	76
		2013	2.0” SMA 12.5 (Mill and Fill)	6+	82	84
	130-136 E	1970	8.0” CRCP	24		
		1994	3.0” BM-2 + 1.4” SA-2A	8		
		2002	1.5” SM 9.5A	10	61	70
		2012	0.3” Latex Modified	5	68	58
		2017	2.0” SMA 12.5 (Mill and Fill)	2+	56	100

CRC Pavements in VDOT System: I-295 (North of I-64)



County	Year	MP	Lane-miles	AADTT
Henrico	1980	29-32 N	11	2350
Hanover	1980	32-36 N	17	2750
	1980	38-42 N	15	3150
Henrico	1980	42-52 N	28	1200
Hanover	1980	32-36 S	17	2750
	1980	36-42 S	19	
Henrico	1980	46-47 S	4	1700

I-295: 9 inch CRCP, 39 Years

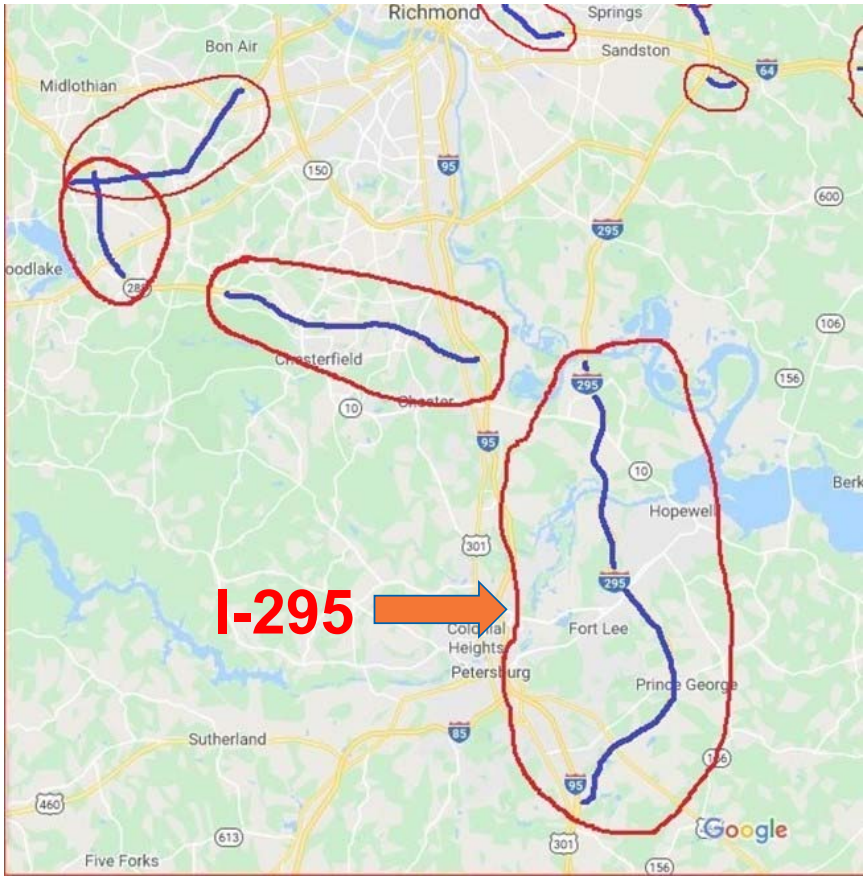
Maintenance History: I-295 (East of I-95; AADTT ≈ 3000)

County	MP	Year	Layer	Age (Y)	IRI	CCI
Henrico	29-32 N	1980	9.0” CRCP	19		
		1999	2.0" IM-1D + 1.5" SM-2D	17	106	33
		2016	2.0" SMA 12.5 (Mill & Fill)	3+	65-93	87
Hanover	32-36 N	1980	9.0” CRCP	16		
		1996	2.0" IM-1A + 1.50" SMA-Surface	23+ ?	72	92
Hanover	38-42 N	1980	9.0” CRCP	27		
		2007	2.0" IM 19.0 + 2.0" SMA 12.5	12+	59-86	81-96
	32-36 S	1980	9.0” CRCP	16		
		1996	2.0" IM-1A + 1.50" SMA-Surface	23+ ?	71-75	89-94
36-42 S		1980	9.0” CRCP	23-30		
	36-38 S	2005	2.0" IM 19.0 + 1.5" SMA 12.5	14+		
	38-40 S	2010	2.0" SMA 19.0 + 1.5" SMA 9.5	9+	71	94
	40-42 S	2003	2.0" SMA 19.0 + 1.5" SMA 12.5	16+		

Maintenance History: I-295 (West of I-95; AADTT ≈ 1500)

County	MP	Year	Layer	Age (Y)	IRI	CCI
Henrico	42-52 N	1980	9.0” CRCP	27		
		2007	2.0" IM-1D + 2.0" SMA-12.5D	12+	56-71	84-92
	46-47 S	1980	9.0” CRCP	16		
		1998	2.0" IM-1D + 1.5" SM-2D	21+ ?	110	21

CRC Pavements in VDOT System: I-295 (South of I-64)



County	Year	MP	Lane-miles	AADTT
Prince George	1992	0-12 N	23	2600
	1992	9-13 S	24	2900
Chesterfield	1990	15-17 N	6	2876
	1990	15-17 S	6	

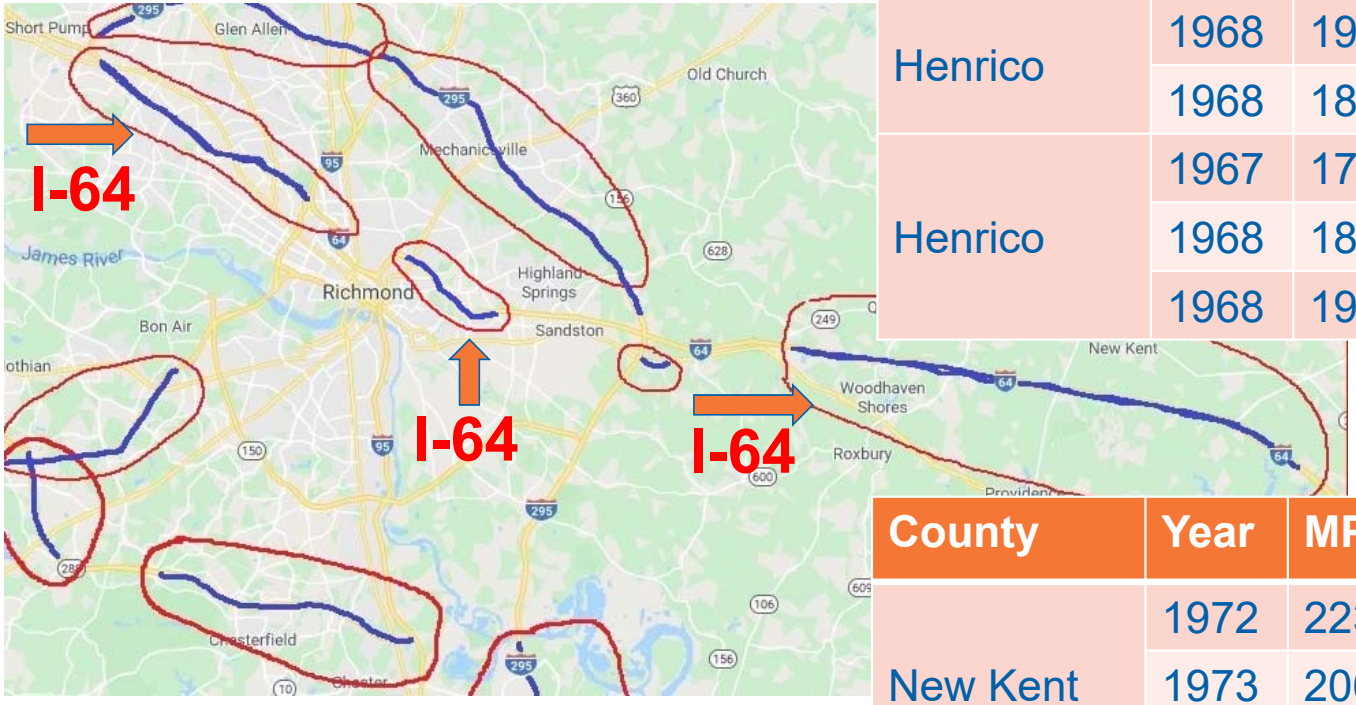
I-295: 8-9 inch CRCP, 27-29 Years

Maintenance History: I-295 (South of I-64; AADTT ≈ 3000)

County	MP	Year	Layer	Age (Y)	IRI	CCI
Prince George	0-12 N	1992	9.0” CRCP	25		
		2017	0.7" THAMCO	2+	49-85	85-91
	9-13 S	1992	9.0” CRCP	24		
		2016	0.7" THAMCO + 2.0" SMA 19.0 + 1.5" SMA 12.5	3+	58-64	97
Chesterfield	15-17 N	1990	9.0” CRCP	27		
		2017	0.7" THAMCO		82	95
	15-17 S	1990	9.0” CRCP	26		
		2016	0.7" THAMCO + 2.0" SMA 19.0 + 1.5" SMA 12.5	3+		

CRC Pavements in VDOT System: I-64

Henrico: 9 inch CRCP, 51 Years



County	Year	MP	Lane-miles	AADTT
Henrico	1968	195-191 W	11	2000
	1968	187-178 W	18	1000
Henrico	1967	178-181 E	5	1000
	1968	183-186 E	8	1400
	1968	191-196 E	13	2000

New Kent: 8 inch CRCP, 46 Years

County	Year	MP	Lane-miles	AADTT
New Kent	1972	223-221 W	3	3000
	1973	206-215 E	18	3000
	1972	215-225 E	18	3000

Maintenance History: I-64 East (Henrico)

County	MP	Year	Layer	Age (Y)	IRI	CCI
Henrico	178-181 E	1967	9.0” CRCP	38		
		2005	2.0” SMA 19.0 + 1.5” SMA 12.5	14+ ?	88	78-85
	183-186 E	1968	9.0” CRCP	42		50
		2010	2.0” SMA 19.0 + 1.5” SMA 9.5	9+	85	84-94
	191-196 E	1968	9.0” CRCP	35		
		2003	2.0” SMA 19.0 + 1.7” SMA 12.5	16	116	78-90
		2019	0.7” THMACO (0.5”Mill)	0+		

Maintenance History: I-64 W (Henrico)

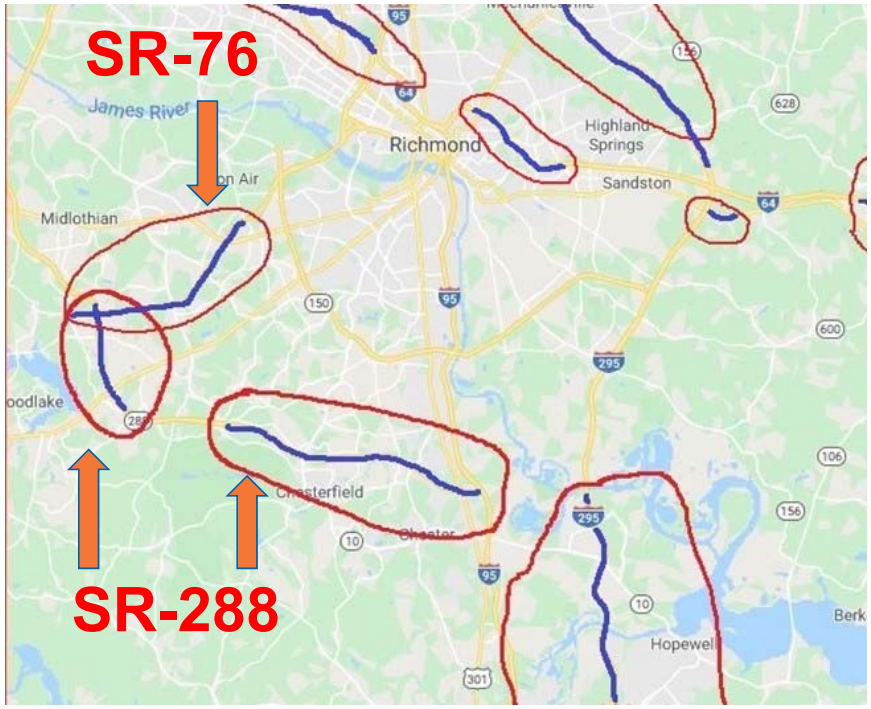
County	MP	Year	Layer	Age (Y)	IRI	CCI
Henrico	195-191 W	1968	9.0” CRCP	35		
		2003	2.0” SMA 19.0 + 1.7” SMA 12.5	16+	102	73-87
	187-186 W	1968	9.0” CRCP	36		
		2004	3.0” SMA 19.0	3		
		2007	1.5” SMA 9.5	12+	141	68
	186-183 W	1968	9.0” CRCP	42		
		2010	2.0” SMA 19.0 + 1.5” SMA 9.5	9+	106	82
	182-178 W	1967	9.0” CRCP	38		
		2005	2.0” SMA 19.0 + 1.5” SMA 12.5	14+	81	80-85

Maintenance History: I-64 (New Kent)

County	MP	Year	Layer	Age (Y)	IRI	CCI
New Kent	206-215 E	1973	8.0” CRCP	20		
		1993	2.5" IM-1B + 1.4" SM-2C	13		
		2006	0.2” Latex Modified	9		59-74
		2015	3.0" SMA 19.0 + 2.0" SMA 12.5 (M &F)	4+	74	97
	215-225 E	1972	8.0” CRCP	18		50
		1990	4.0" IM-1B + 1.4" SM-2C	16		
		2006	0.2” Latex Modified	9		59-70
		2015	3.0" SMA 19.0 + 2.0" SMA 12.5 (M &F)	4+	85	98
	223-221 W	1972	8.0” CRCP	18		
		1990	4.0" IM-1B + 1.4" SM-2C	16		59
		2012	3.0" SMA 19.0 + 2.0" SMA 12.5 (M &F)	7+	87	91

CRC Pavements in VDOT System: SR-288 and SR-76

SR-76: 8 inch CRCP, 31 Years



SR-288: 8 inch CRCP, 30 Years

County	Year	MP	Lane-miles	AADTT
Chesterfield	1988	1-7 N	13	< 300
	1988	1-5 S	6	< 300
	1988	5-8 S	6	< 300

County	Year	MP	Lane-miles	AADTT
Chesterfield	1990	0-8 N	16	1100
	1988	12-16 N	7	1300
	1990	1-8 S	13	1100
	1988	13-15 S	3	1300

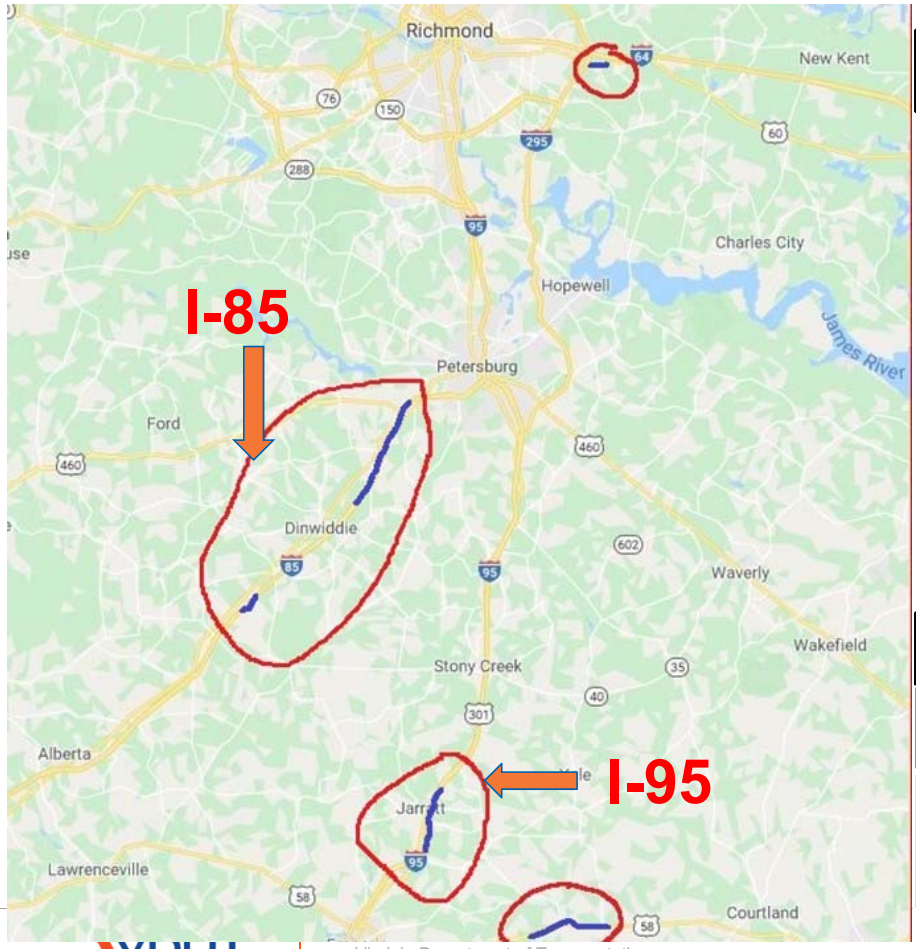
Maintenance History: SR-288 (AADTT ≈ 1200)

County	MP	Year	Layer	Age (Y)	IRI	CCI
Chesterfield	0-8 N	1990	8.0” CRCP	26		
		2016	1.5" SMA 9.5	3+	66	98
	12-16 N	1988	8.0” CRCP	26		
		2014	4.0" SMA 19.0 + 1.5" SMA 12.5	5+	59-73	92
	1-8 S	1990	8.0” CRCP	26		
		2016	4.0" SMA 19.0 + 1.5" SMA 12.5	3+	73	98
	13-15 S	1988	8.0” CRCP	27		
		2015	2.0" SMA 19.0 + 1.5" SMA 9.5	4+	81	97

Maintenance History: SR-76 (AADTT < 300)

County	MP	Year	Layer	Age (Y)	IRI	CCI
Chesterfield	1-7 N	1988	8.0” CRCP	29		
		2017	0.75" THAMCO	2+	88-93	83-97
	1-5 S	1988	8.0” CRCP	27		
		2015	2.0" IM-19.0D + 1.5" SM-9.5E	4+	84	84
	5-8 S	1988	8.0” CRCP	27		
		2015	0.75" THAMCO	3+	72-82	94

CRC Pavements in VDOT System: I-85 and I-95



I-85: 9 inch CRCP, 50 Years				
County	**Year**	**MP**	**Lane-miles**	**AADTT**
Dinwiddie	1969	44-46 N	4	2100
	1969	55-62 N	11	2500

I-95: 8 inch CRCP, 37 Years				
County	**Year**	**MP**	**Lane-miles**	**AADTT**
Sussex	1982	17-22 N	10	3200
	1982	17-22 S	10	3200

Maintenance History: I-85 (AADTT 2100-2500)

County	MP	Year	Layer	Age (Y)	IRI	CCI
Dinwiddie	44-46 N	1969	9.0” CRCP	48 ??		
		2017	2.0" SMA 19.0 + 1.5" SMA 12.5	2+	59	98
	55-62 N	1969	9.0” CRCP	48 ??		
		2017	2.0” SMA 19.0 + 1.5” SMA 12.5	2+	74	94

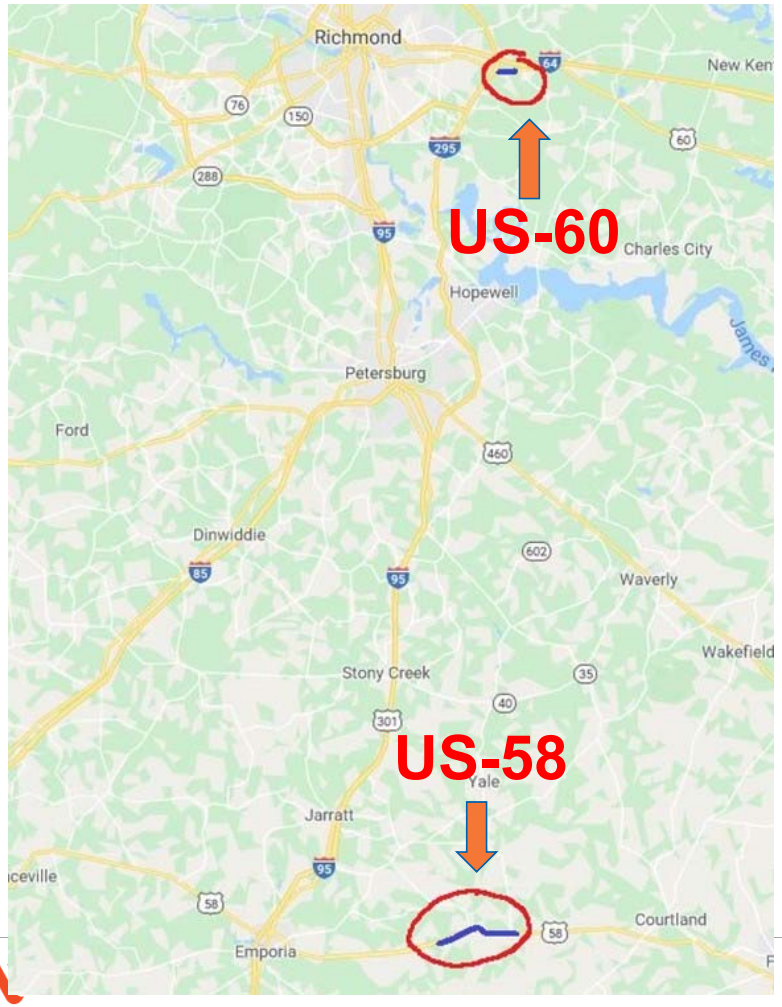
Maintenance History: I-95 (AADTT 3200)

County	MP	Year	Layer	Age (Y)	IRI	CCI
Sussex	17-22 N	1982	8.0” CRCP	17		
		1999	3.0" BM-3 + 2.0" IM-1B + 1.4" SM-12.5D	9		
		2008	0.2" Latex Modified	11	80	64*
		2019	2.0" SM-12.5D (Mill & Fill)	0+		
	17-22 S	1982	8.0” CRCP	17		
		1999	3.0" BM-3 + 2.0" IM-1B + 1.4" SM-12.5D	9		
		2008	0.2" Latex Modified	11+ ??	80	79**

*174-325 transverse cracks/ mile

**137-387 transverse cracks/ mile

CRC Pavements in VDOT System: US-58 and US-60



US-58: 8 inch CRCP, 29 Years				
County	Year	MP	Lane-miles	AADTT
Southampton	1988	423-432 E	17	1200-1750

US-60: 8 inch CRCP, 40 Years				
County	Year	MP	Lane-miles	AADTT
Henrico	1979	200-202 W	2	600

- US-60 (Henrico)– 1st Composite Pavement
- 2 lane-miles: MP 200-199W (AADTT≈600)
- Constructed 2017
- 8 inches CRCP + 2.0” SMA

Maintenance History: US-58 and US-60

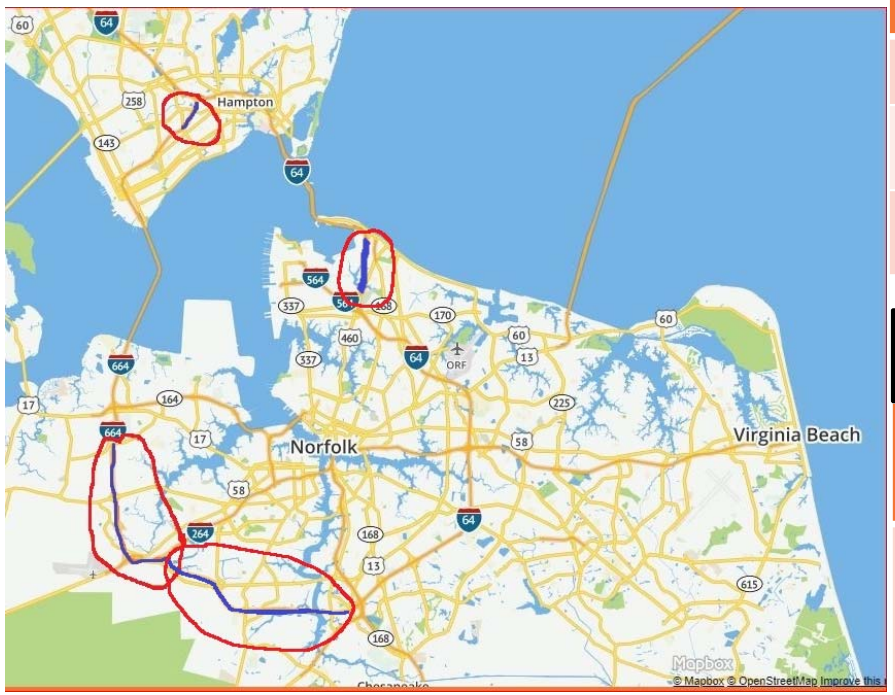
US-58: 17 lane-miles; AADTT ≈ 1500						
County	**MP**	**Year**	**Layer**	**Age (Y)**	**IRI**	**CCI**
Southampton	423-432 E	1990	8.0” CRCP	22		
		2012	3.0" 19.0 SMA + 2.0" SMA 12.5	7+	88	63-77*

*12-27 transverse cracks/ mile

US-60: 2 lane-miles; AADTT ≈ 600						
County	**MP**	**Year**	**Layer**	**Age (Y)**	**IRI**	**CCI**
Henrico	200-202 W	1979	8.0” CRCP	37		
		2016	1.5" SM-12.5E	3+	131	90

*5 transverse cracks/ mile

CRC Pavements in VDOT System: I-664 and I-64



I-664: 9 inch CRCP (28-36 Years)

County	Year	MP	Lane-miles	AADTT
York	1983	1-3 East	7	
Nansemond	1991	11-14 East	10	2000
Norfolk	1991	14-18 East	8	2300-2600

I-64: 8 inch CRCP (44-50 Years)

County	Year	MP	Lane-miles	AADTT
Norfolk	1975	274-277 E	5	1500-2000
	1969	293-300 E	14	2900-5600
	1975	277-274 W	5	1750-2000

Maintenance History: I-64

County	MP	Year	Layer	Age (Y)	IRI	CCI
Norfolk	274-277 E	1975	8.0” CRCP	40		< 25
		2015	0.75" THAMCO + 2.0" SMA 19.0 + 1.75" SMA 12.5	4+	119	83
	293-300 E	1969	8.0” CRCP	42		65-80
		2011	2.0” SMA 19.0 + 1.5” SMA 12.5	8+	75	83
	277-274 W	1975	8.0” CRCP	22		< 50
		2013	0.75" THAMCO + 2.0" SMA 19.0 + 1.75" SMA 12.5	4+	126	85

Maintenance History: I-664

County	MP	Year	Layer	Age (Y)	IRI	CCI
York	1-3 E	1983	9.0” CRCP	32		
		2015	0.7" THAMCO	4+		
Nansemond	11-14 E	1991	9.0” CRCP	22		
		2013	0.7" THAMCO	4	70	86
		2017	2.0" SMA 19.0 + 1.5" SMA 12.5	2+	61	98
Norfolk	14-18 E	1991	9.0” CRCP	22		
		2013	0.7" THAMCO	4		83
		2017	2.0" SMA 19.0 + 1.5" SMA 12.5	2+	63-71	94

Results – Pavement Age

- CRCP Pavement constructed as early as 1967
- More than 500 lane-miles overlaid with asphalt
- In Service Age (Composite Pavement)
  - Average 40 years (Standard Deviation 8.7)
  - Lane-mile weighted average: 40 years
  - Maximum 52 years and Minimum 27 years
- Age at 1st Asphalt Overlay
  - Average 27 years (Standard Deviation 8.5)
  - Lane-mile weighted average: 26 years
  - Maximum 48 years and Minimum 11 years
  - Might have received concrete patching before this!

Results – HMA Overlay (3.5 to 6.5 inch total)

- 2 to 5 inch BM &/or IM + 1.5 inch SM – 119 lane-miles
  - < 3.0” BM &/or IM – 43 lane-miles
  - ≥ 3.0” BM &/or IM – 76 lane-miles
- Mostly 1st Overlay – 1992-1999 – 14 sections
- Truck Traffic – AADTT ≈ 3000
  - Only 25 lane-miles: 275-2700
- Average Service 12 years
  - Max: 22; Min: 6; SD 5; (Received 2nd Treatment – 104 Lane-miles)
  - Still in-service – 15 Lane-miles: 4 to 21+ years
  - IRI ≈ 100 and CCI ≈ 21 to 59 (Only 4 section data)

Results – HMA Overlay (1.5-2.0 inch Surface layer only)

- 1.5 to 2.0 inch Surface Mix – 38 lane-miles
  - Mostly 2nd or 3rd Overlay (except 2 lane-miles)
  - Mostly Mill and Fill
- Constructed after 2000 – Six sections
- Truck Traffic – AADTT ≈ 3000
  - Only 2 lane-miles < 600
- Average Service Life
  - 10 and 12 years – 20 lane-miles (received 3rd treatment)
    - IRI ≈ 61 & 68 and CCI ≈ 70 & 43
  - Still in-service – 18 Lane-miles: 0 to 6+ years
    - IRI ≈ 77-131 and CCI ≈ 78-91

Results – Latex Modified (Surface Treatment)

- 0.2 to 0.3 inch Surface Treatment – 47 lane-miles
  - Mostly 2nd or 3rd Treatment
- Constructed after 2006 – Four sections
  - All overlaid by 2019
- Truck Traffic – AADTT ≈ 3000
- Average Service Life 9 Years
  - Range 5 to 11
  - IRI ≈ 87 and CCI ≈ 65 (before overlaid)

Results – THMACO (Surface Treatment)

- 0.7 to 0.75 inch Surface Treatment – 100 lane-miles
  - Mostly 1st Treatment
  - 2nd Treatment – Two section (29 lane-miles)
- Constructed after 2013 – Nine sections
- Truck Traffic – AADTT ≈ 2500
  - Only 19 lane-miles (2 sections): 200-300
- Average Service Life - > 4 years
  - 4 years – 18 lane-miles (Two sections)
  - Still in-service – 82 Lane-miles: 0-5 years (Seven sections)
  - IRI ≈ 75 and CCI ≈ 89 (mostly still in service)

Results – HMA + SMA Overlay (3.5 to 4.0 inch total)

- 2 to 2.5 inch IM + 1.5 to 2.0 inch SMA – 106 lane-miles
  - Mostly 1st Overlay – Seven sections
- Constructed 1996 and 2007 – 7 sections
  - 1996 – 62 lane-miles (5 sections) & 2007 – 44 lane-miles (2 sections)
- Truck Traffic – AADTT ≈ 2700-3200
  - Only one section (29 lane-miles) – 1300
- Average Service 21 years
  - Max: 23; Min: 18; Received 2nd Treatment – 28 Lane-miles
    - IRI ≈ 94 and CCI ≈ 71 (before overlaid)
  - Still in-service – 78 Lane-miles: 12 to 23 years
    - IRI ≈ 70 and CCI ≈ 91 (still in service)

Results – SMA Overlay (1.5 to 2.0 inch total)

- 1.5 to 2.0 inch SMA Surface 9.5 or 12.5 – 92 lane-miles
  - Mostly 2nd or 3rd – Mill and Fill – 8 sections
  - One as 1st and one as 4th – 2 sections
- Constructed 2006-2019, except one in 1999 (AADTT 3300)
- Truck Traffic – AADTT ≈ 2900-3300
  - One 1300 and another 2300
- Average Service Life
  - One section received treatment after 18 years – 9 Lane-miles
    - IRI ≈ 107 and CCI ≈ 54 (before overlaid)
  - Still in-service – 83 Lane-miles: 0 to 7 years
    - IRI ≈ 73 and CCI ≈ 91 (still in service)

Results – SMA Overlay (3.5 inch total)

- 2.0 inch SMA 19.0 + 1.5 inch SMA 12.5 or 9.5 – 120 lane-miles
  - Mostly 1st Overlay – 15 sections
- Constructed 2003 to 2017
- Truck Traffic – AADTT ≈ 2000
  - Range: 1000-3700
- Average Service life – 2 to 16 (average 12)
  - 2 sections overlaid after 8 and 16 years – 16 lane-miles
    - IRI ≈ 113 & 116 and CCI ≈ 70 & 87 (before overlaid)
  - Still in-service – 104 Lane-miles: 2 to 16 years
    - IRI ≈ 82 and CCI ≈ 89 (still in service)

Results – SMA Overlay (4.5-6.5 inch total)

- 3.0-4.0 inch SMA 19.0 + 1.5-2.0 inch SMA 12.5 – 42 lane-miles
  - 1st , 2nd (Mill & Fill) or even 3rd (Mill & Fill)
- Constructed 2007 to 2015
  - 5 sections
- Truck Traffic – AADTT ≈ 2000
  - Range: 1000-3500
- Average Service life – all in service: 3 to 12 years
  - IRI ≈ 92 (range 141 to 73)
  - CCI ≈ 81 (range 97 to 68)

Results – THMACO (0.75”) + SMA Overlay (<4.0”)

- **THMACO + 2.0 inch SMA 19.0 + 1.5-1.75 inch SMA 12.5**
  - **Mostly 1st Overlay/ treatment – 7 sections, 45 lane-miles**
    - Two sections were overlaid after 4 years of THMACO – 18 lane-miles
  - **THMACO – 0.75 inches**
- **Constructed 2013 to 2017 – 7 Sections – 45 lane-miles**
- **Truck Traffic – AADTT ≈ 2300**
  - **Range: 2000-3000**
- **Average Service life – all in service: 2 to 6 years**
  - **IRI ≈ 93 (range 130 to 61)**
  - **CCI ≈ 91 (range 98 to 83)**

1st Overlay or treatment

Treatment	Total LM	Trucks Per day	In-service			Overlaid/ next Treatment		
			LM	Age, Y	Condition	LM	Age, Y	Condition
HMA (3.5” – 6.5”) (BM+IM+SM)	119	3000	15	4-21	IRI: 100 CCI: 21-59	104	12 (6-22)	
HMA IM (2-2.5”) + SMA Surface (1.5-2”)	106	3000	78	12-23	IRI: 70 CCI: 91	28	21 (18-23)	IRI: 94 CCI: 71
SMA (3.5”) (19.0 + 12.5/ 9.5)	120	2000	104	2-16	IRI: 82 CCI: 89	16	12 (8-16)	IRI: 114 CCI:70-87
THMACO (0.7-0.75”)	100	2500	82	0-5	IRI: 75 CCI: 89	18	4	

2nd or 3rd Overlay or treatment

Treatment	Total LM	Trucks Per day	In-service			Overlaid/ next Treatment		
			LM	Age, Y	Condition	LM	Age, Y	Condition
HMA (1.5” – 2.0”) (Mostly Mill & Fill)	38	3000	18	0-6	IRI: 77-131 CCI: 78-91	20	11 (10-12)	IRI: 61-68 CCI:43-70
SMA Surface (1.5”– 2”) (Mostly Mill & Fill)	92	3000	83	0-7	IRI: 73 CCI: 91	9	18	IRI: 107 CCI: 54
0.2-0.3” Latex Modified	47	3000				47	9 (5-11)	IRI: 87 CCI: 65

CONCLUSIONS

- Composite Pavement in-service for 27 to 52 years
  - Average 40 years
- Age at 1st major asphalt overlay (as reported in PMS)
  - Average 26 years (range 11 to 48 years)
  - Concrete patching is not considered
- Rehab – 1st Treatment
  - HMA (Base Mix + Intermediate Mix + Surface Mix)
  - HMA base mix + SMA surface mix
  - SMA (Base Mix + Surface Mix)
- Rehab – 2nd or 3rd Treatment
  - HMA surface, SMA Surface and Latex Modified ST

CONCLUSIONS

- VDOT maintenance strategies appropriate
- Composite Pavement – longer service life ?