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Giving Low-Volume Roads a Longer Life with Geosynthetics

November 8, 2021

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#TRBwebinar

Learning Objectives

1. Identify current specifications
2. Describe how to use geosynthetics for subgrade separation and stabilization
3. Discuss importance of less prescriptive life cycle cost analysis methods

Giving Low-Volume Roads a Longer Life with Geosynthetics

Edward Hoppe
Research Scientist
Virginia Department of Transportation
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Use of geotextiles in road construction

- Frequently the primary objective is to provide access for heavy construction equipment and establish stable platform (stabilization). Significant cost savings can be realized in the early stages of road construction.
- Separation is the most underrated geotextile function (Koerner, 2005). It is seldom designed on its own merit. Geotextile separator allows water but not fine particles to flow through it, decreasing the potential for granular base contamination by soft subgrade soils.

Use of geotextiles in road construction

- FHWA published a comprehensive set of design and construction guidelines (Holtz et al., 2008). Stabilization is defined as the primary function when the subgrade CBR is less than 3. Separation and filtration are the primary functions when the subgrade CBR ranges between 3 and 7.
- Geotextile functions uniquely as a separator in soil subgrades with soaked CBR values above 3 (Koerner, 2016).

Use of geotextiles in road construction

- AASHTO M 288 - design by specification – application categories are listed in association with physical, mechanical, hydraulic, and endurance properties.
- Geotextile separator is used when CBR of subgrade soils is greater than 3. No upper limit is specified.
- Stabilization geotextile is used when CBR ranges between 1 and 3.
- Strength is considered the principal property required to survive the installation and provide the required functionality. Three distinct classes of material strength are specified.

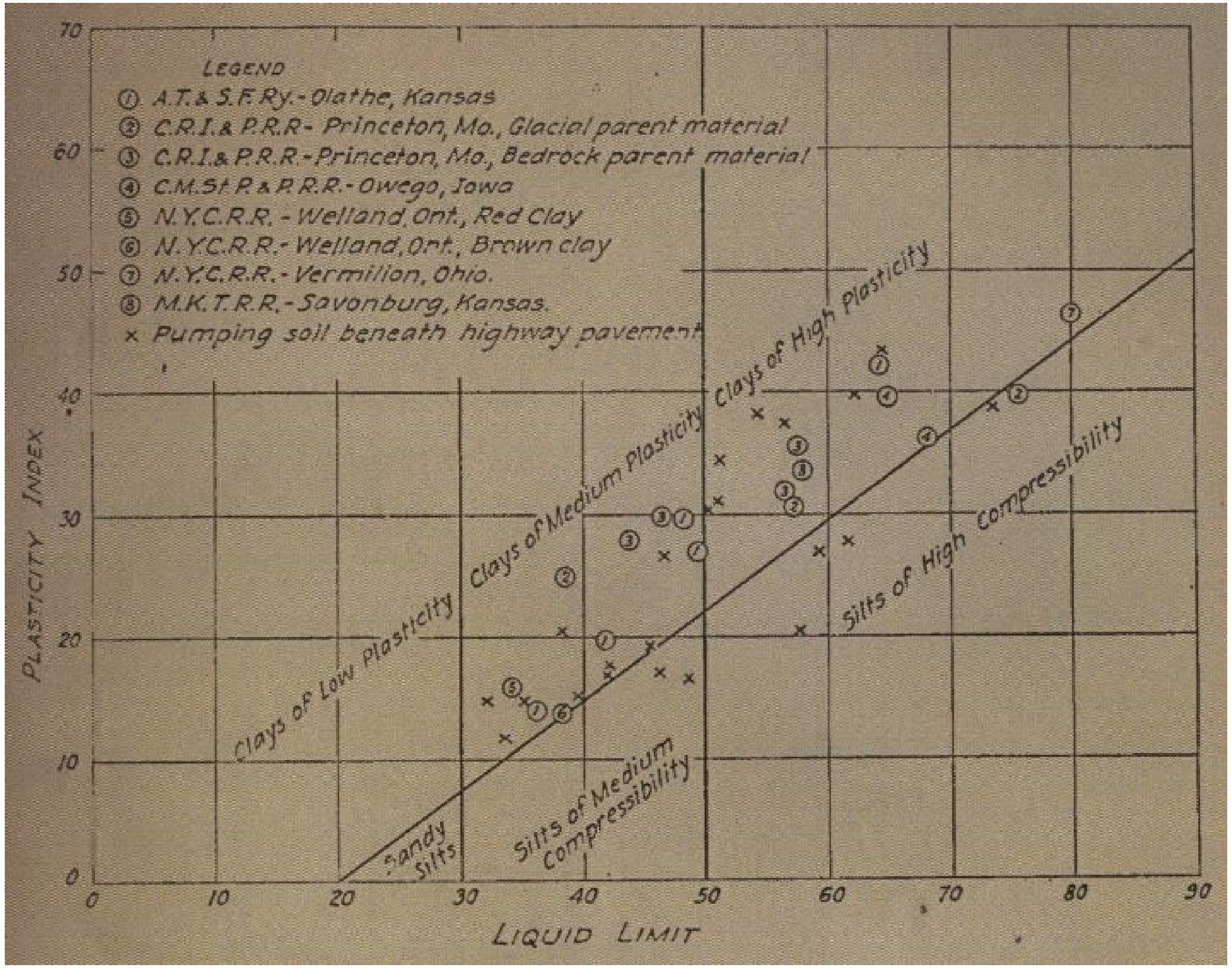
Use of geotextiles in road construction

- State DOT practices generally follow AASHTO M 288. Zornberg and Thompson (2012) conducted a survey of state DOT specifications. The survey indicated that 31 states had specifications for separation, 30 for stabilization, and 19 for both.
- Prior to this study VDOT did not provide design guidance for using geotextile separators in road construction. VDOT specification included only stabilization geotextile.

Migration of fines

- Pioneering study by Woods and Shelburne (1943) – pumping caused by traffic-induced loads. Severe pumping at joints and cracks was observed, mainly in the cut sections with saturated plastic soil subgrades.
- The railway industry consolidated the findings of Woods and Shelburne with their field observations and identified pumping-susceptible soils.

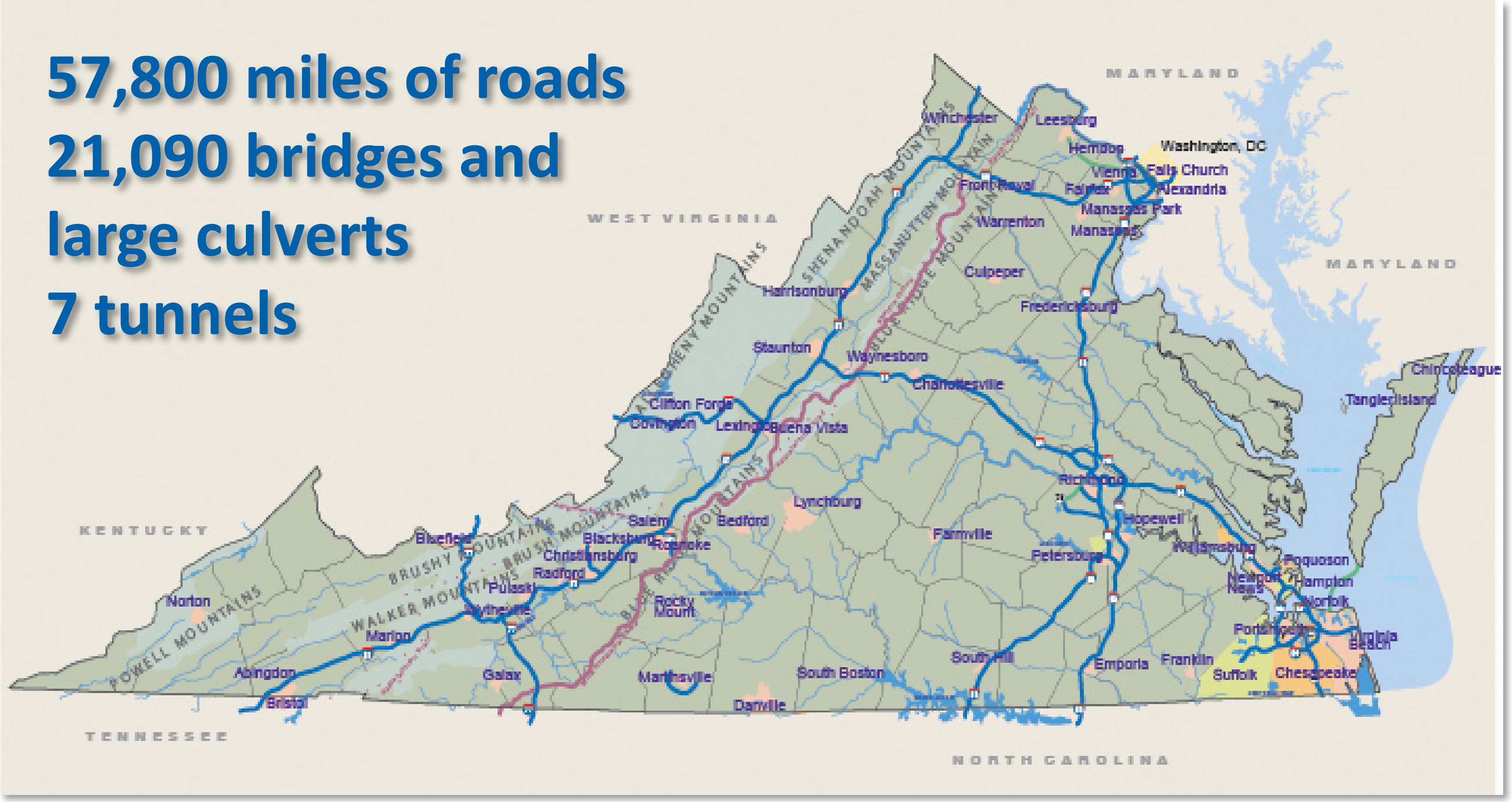
Plasticity Chart for Pumping Soils



Currently, nonwoven geotextile separators are specified at the subgrade and sub-ballast interface (AREMA, 2018).

Source: American Railway Engineering Association, 1946.

VDOT road network

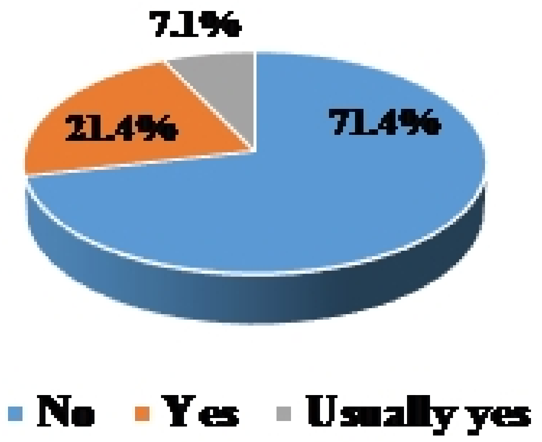


VDOT operates the third largest road network in the U.S.

VDOT road network

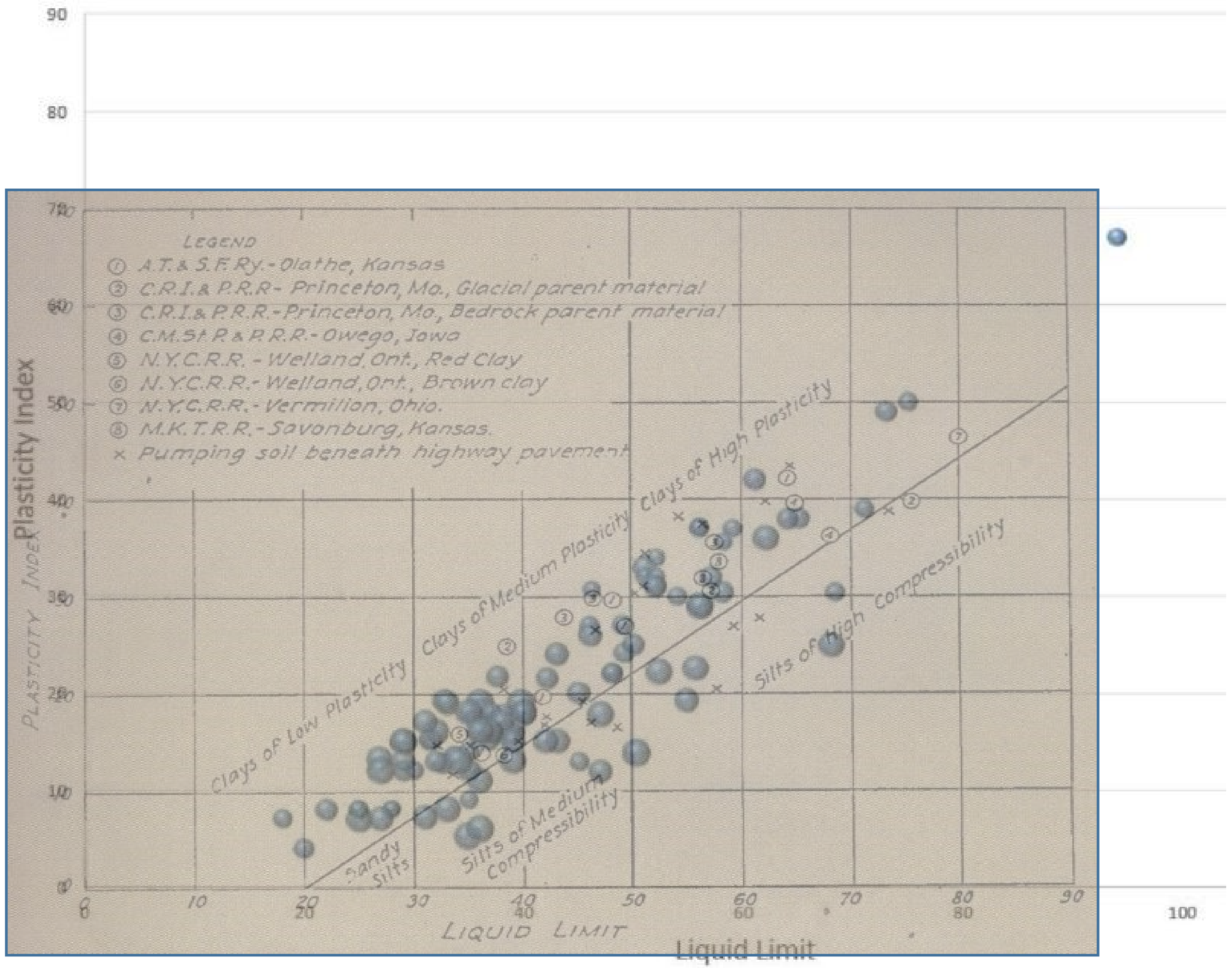
- Secondary and subdivision roads comprise approximately 79% of VDOT's network.
- Subdivision streets constructed to the appropriate standards may qualify for acceptance into VDOT's secondary road system for public maintenance.
- In 2018, only 60% of the secondary road system was rated as sufficient (VDOT, 2018).

Survey of VDOT resident engineers



In general, is it your experience that subdivision streets that are accepted into VDOT's secondary system reach their 20-year design life?

Virginia soils



Data is representative of approximately 41% of Virginia soils

Plasticity chart for Virginia soils with 3 < CBR < 8 and more than 35% fines.

Geosynthetic separator

SEPARATION

Saturated, pumping-susceptible subgrade soils, porous base material, and cyclic loading.

Jorenby and Hicks (1986) concluded that up to 6% added fines can be tolerated without affecting stiffness. Drainage disrupted with 8% fines.

Kermani et al. (2018) reported an approximate 30% reduction in the amount of pavement rutting when geotextile separator is used. The laboratory study concluded that geotextile separator significantly reduces pumping of subgrade fines.

PennDOT published an example of an economic analysis that quantifies the benefits of geotextile separation, finding a cost savings of at least 13% for a collector road (Petrasic, 2017). We performed a similar analysis but used a different LCCA approach with a range of contamination rates.

Geosynthetic separator

- We developed LCCA method that incorporates aggregate contamination pavement layer deterioration detail.
- The benefit of geotextile separator was quantified in terms of reduced pavement subbase deterioration over the analysis period.

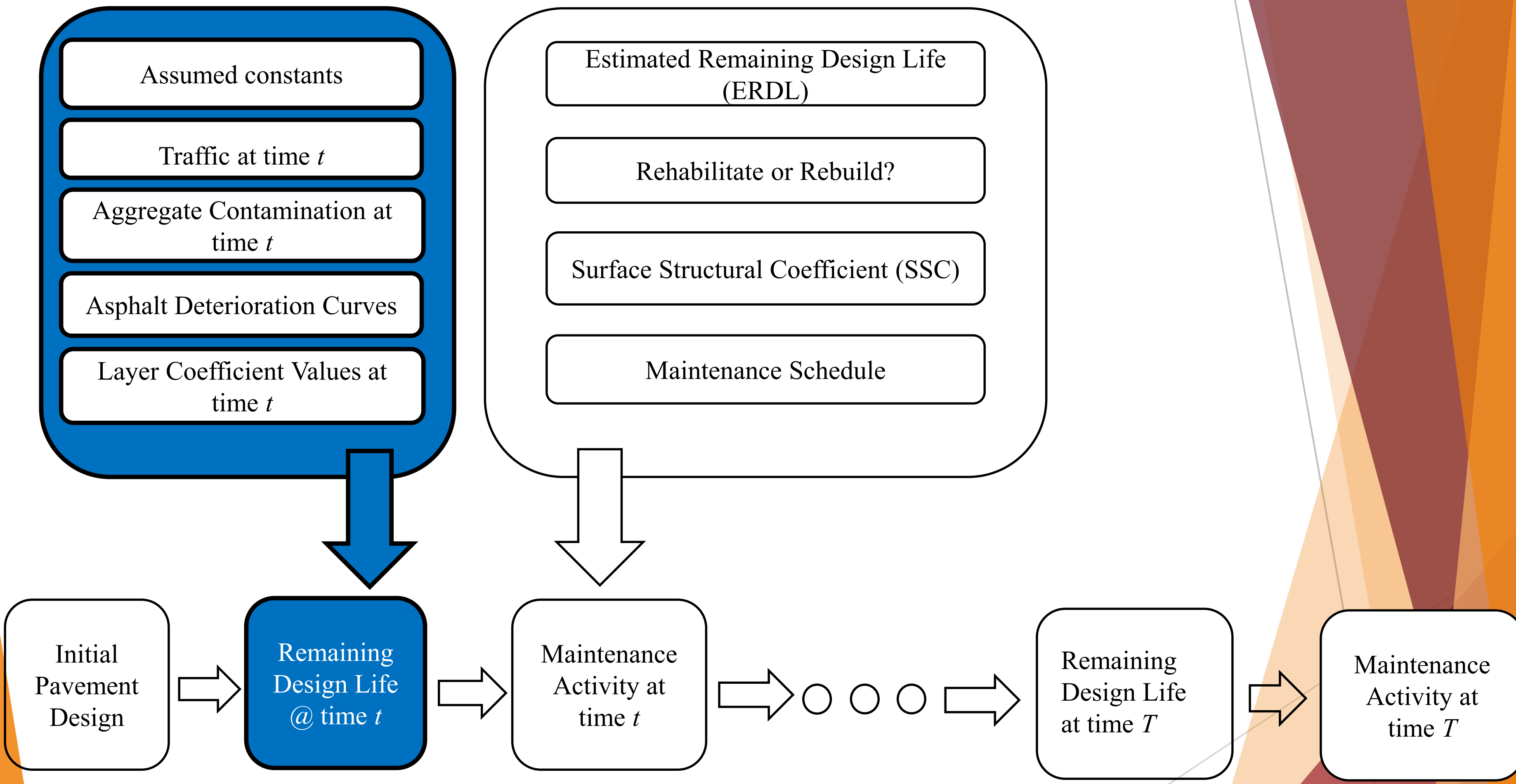
Giving Low-Volume Roads a Longer Life with Geosynthetics

Chaz Weaver, PE, CPEM, F.ASCE

District Materials Engineer

VDOT – Staunton District

PAVEMENT DESIGN* STEPS



*1993 AASHTO Pavement Design Method

PAVEMENT DESIGN INPUT VALUES

Inputs	Values	
Average Annual Daily Traffic (2020)	1500[a]	155[a]
Tractor Trailers (%)	5.0[a]	1.0[a]
Single Unit Trucks (%)	1.0[a]	0[a]
Performance Period (years)	20	
AADT Growth Rate (%)	2.0[a]	
Trucks in Design Direction/Lane (%)	50/100	
Equivalent Single Axle Load Factor	Car: 0.0002 Single Unit Truck: 0.46 Tractor Trailer: 1.05	
Initial Serviceability	4.0	
Terminal Serviceability	2.5	
Reliability (%)	75	
Overall Standard Deviation	0.49	
Subgrade Resilient Modulus (psi)	5000[a]	

[a] Values assumed for the initial pavement design; all other values in accordance with VDOT Materials MOI, Chapter 6 for Farm to Market Secondary Route

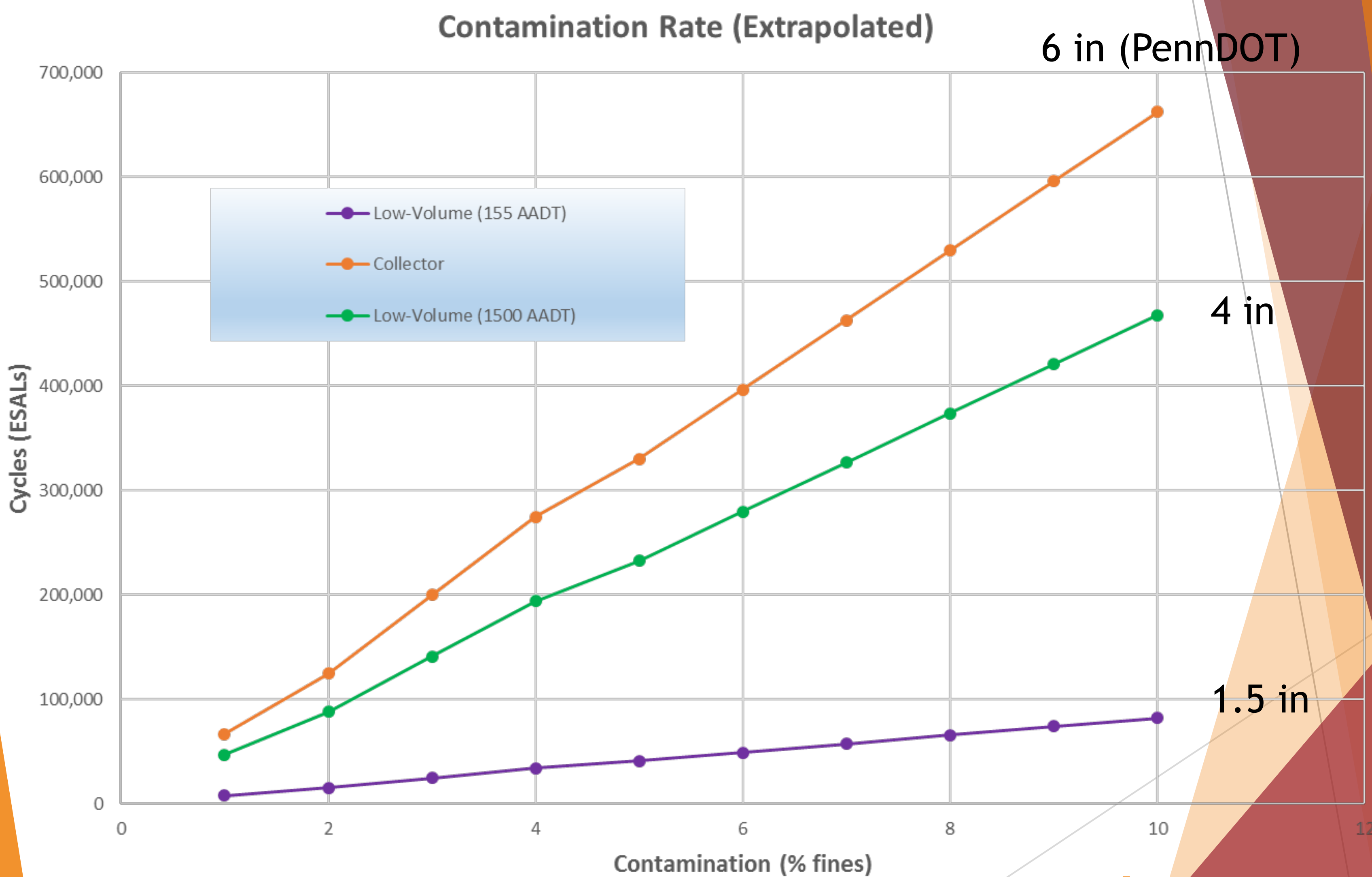
PENNDOT STUDY* v VDOT

Parameter	PennDOT Study	VDOT
Subgrade Soil		
Soil Type	A-4 (ML)	A-4, A-6, A-7-5, -7-6 ML, CL, MH, CH
Fines Content	55.9%	35 – 100%
Density	AASHTO T 180 Proctor	AASHTO T 99 Proctor
Soaked CBR	5 (initial)	3 to 8
Saturation	Inundated	Variable
Aggregate		
Fines Content	6.5%	4 – 7% (2-9%)[a] (No. 21B) 6 – 12% (4-14%)[a] (No. 21A)
Max Aggregate Size	---	1 inch
Pavement Structure		
Aggregate Subbase	6 inches	8 inches (155 AADT); 5 inches (1500 AADT)
Asphalt	8.5 inches	1.5 inches (155 AADT); 6.0 inches (1500 AADT)

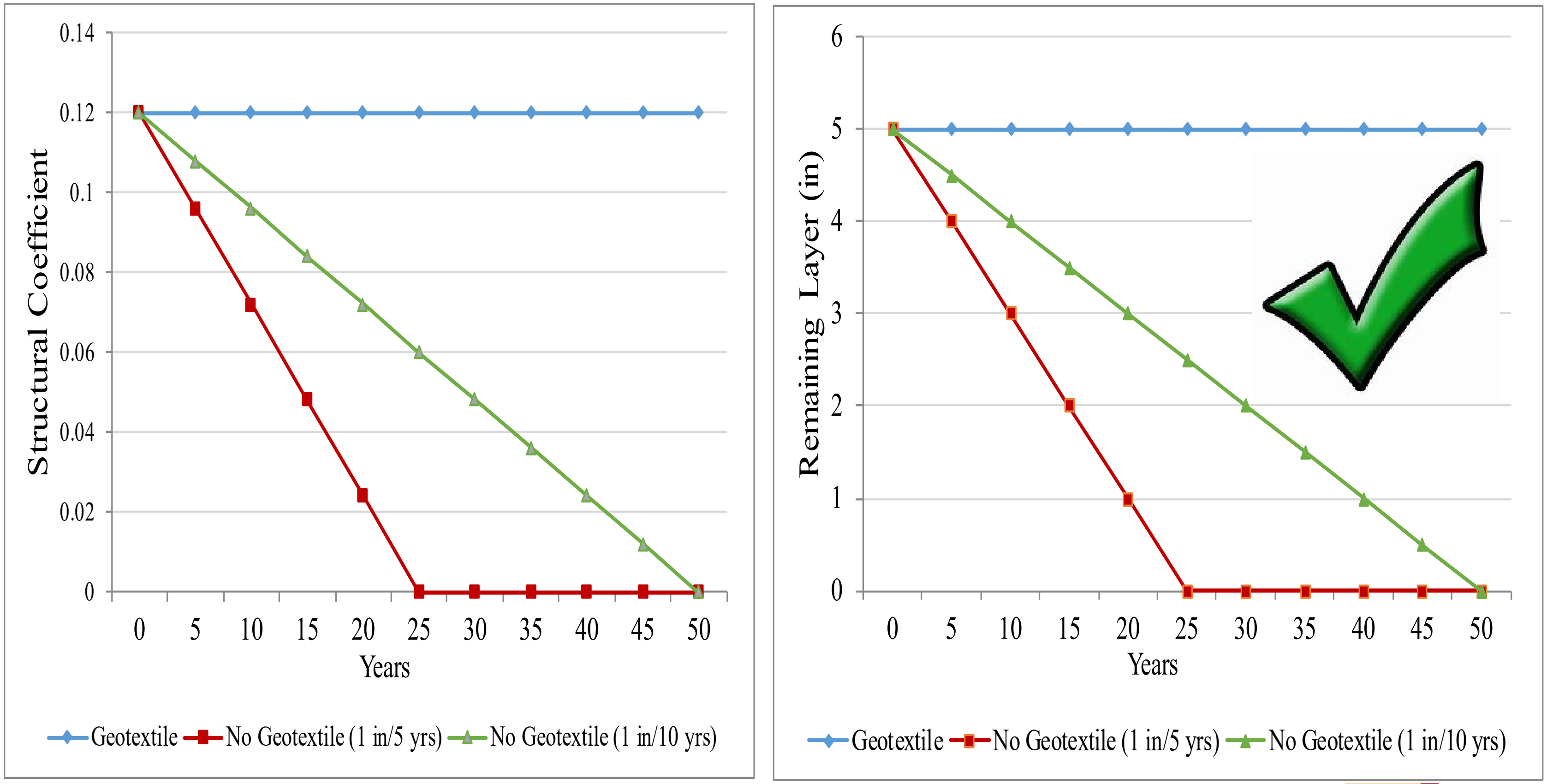
[a] VDOT production tolerance

*Kermani (2018)

CONTAMINATION RATES



CONTAMINATION CURVES

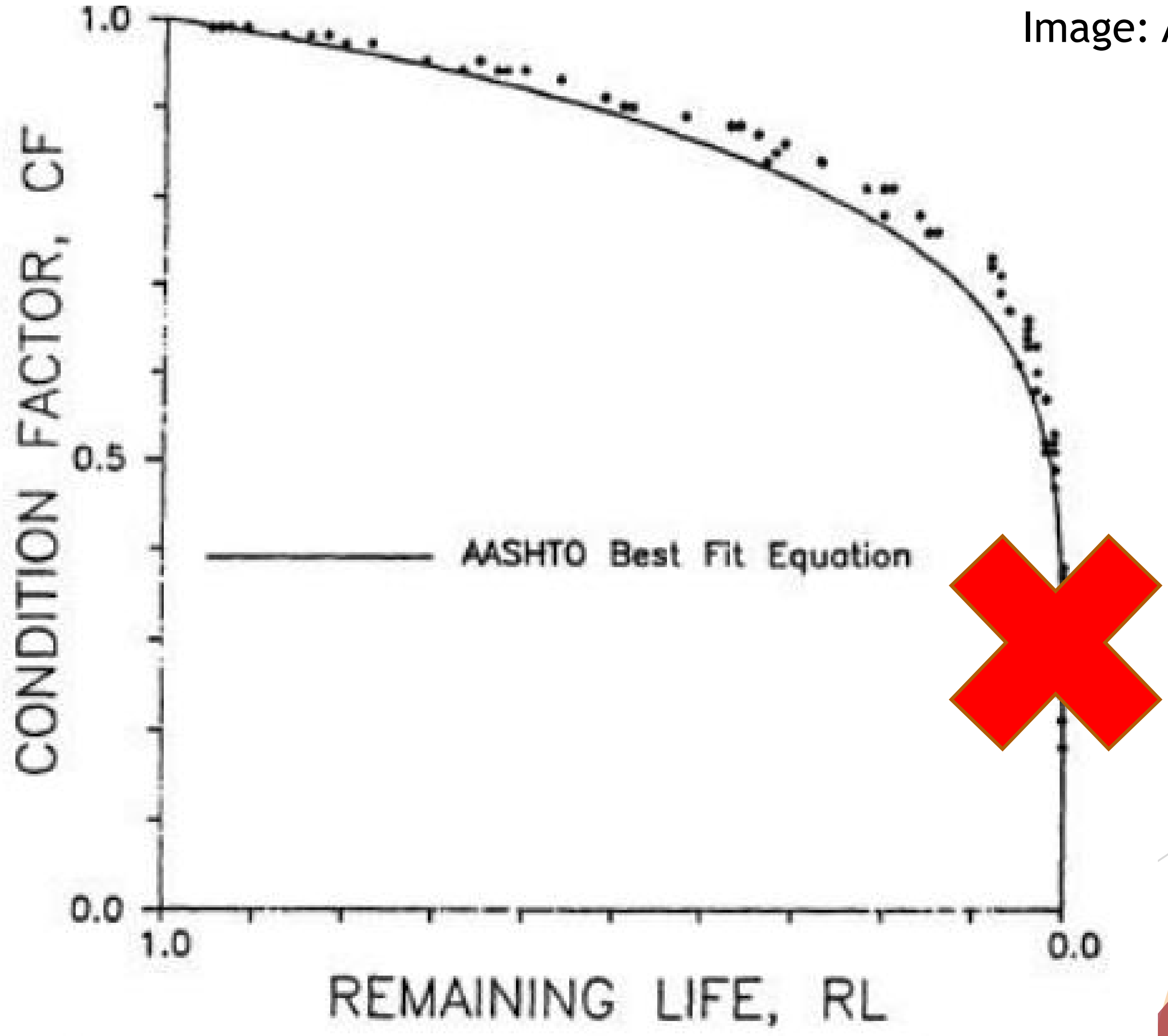


(a) (b)

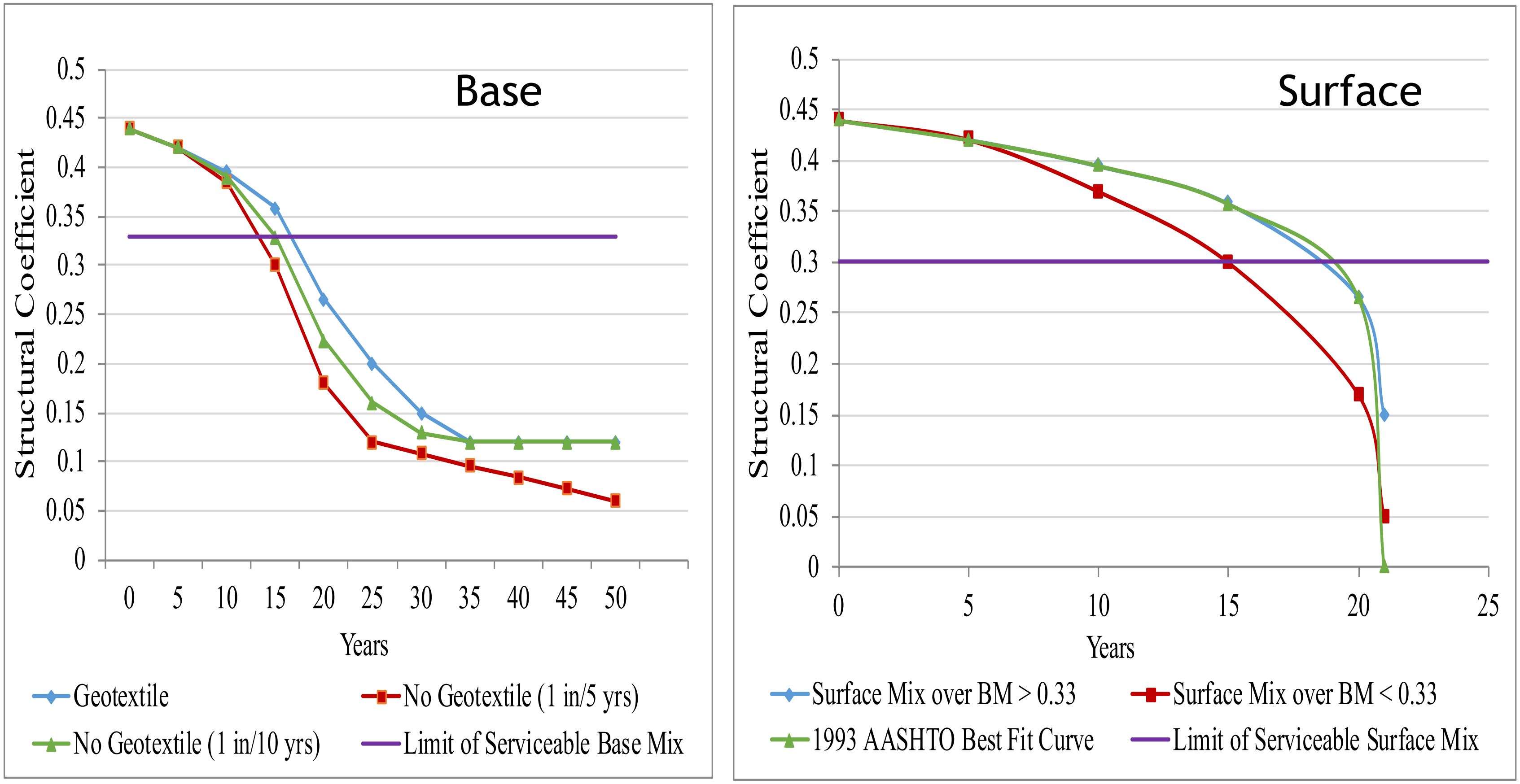
Fig. 1. Conceptualizations of pavement damage: (a) structural coefficient response to aggregate contamination; (b) layer thickness response to aggregate contamination

DETERIORATION CURVES

Image: AASHTO (1993)



DETERIORATION CURVES



(a) (b)

Fig. 2. Pavement layer deterioration curves developed for LCCA: (a) base mix deterioration curve; (b) surface mix deterioration curve

PAVEMENT DESIGN EXAMPLE

1993 AASHTO Pavement Design

DARWin™ Pavement Design
Flexible Structural Design Module

GRAC Geotextile Separator Study
Year 10 - 155 AADT, 1"/5 years contamination, No GTX, No PM
Friday, December 21, 2018

Step 5: Remaining Life

Step 1: Traffic has increased over 10 years

Rigorous ESAL Calculation

Performance Period	6.2
Growth Rate (Calculated)	2
Initial Year ADT	189
% All Trucks in Design Lane	100
% All Trucks in Design Direction	50

Class	% of ADT	% Growth	ESALS/Truck	Accum. 18K ESALs over Perf. Period
Cars	99	2	0.0002	
Single unit	0	2	0.46	
T. Trailer	1	2	1.05	
	100			2,370

Flexible Structural Design Module Data

Accum 18K ESALs over Perf Per	2,370
Intial Serviceability	4
Terminal Serviceability	2.5
Reliability Level (%)	75
Overall Standard Deviation	0.49
Roadbed Soil Reilient Modulus	5000
Calculated Design Structural No	1.31

Step 2: Asphalt has deteriorated over 10 years

Step 4: Change Performance Period until these values are equal

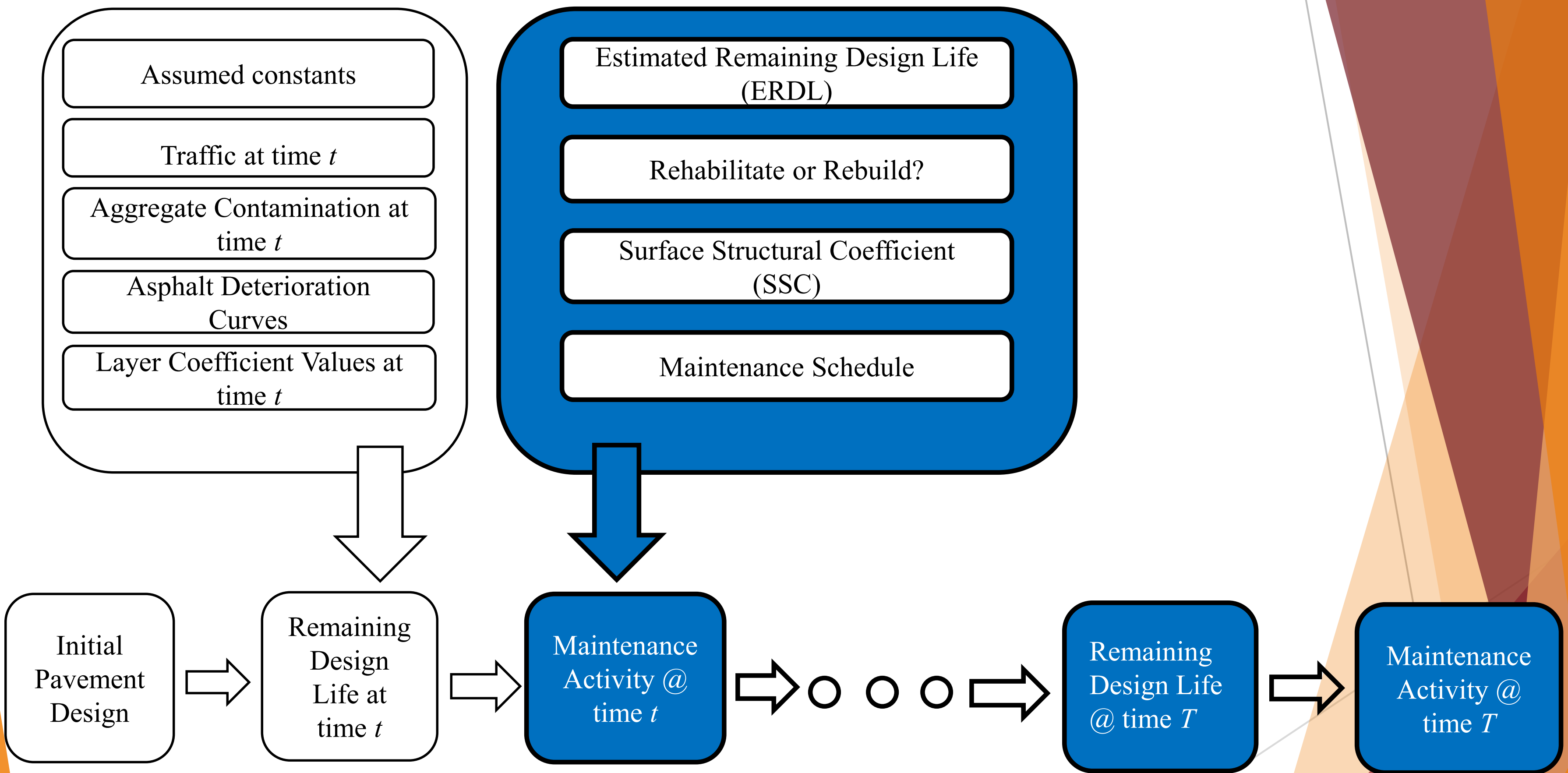
Specified Layer Design

Layer	Mat'l Description	Str. Coef.	Thick.	Width	Calc. SN
1	SM-9.5A	0.395	1.5	24	0.59
2	IM-19.0A	0.44	0	24	
3	BM-25.0A	0.44	0	24	
4	Aggregate No. 21B	0.12	6	24	0.72
Total			7.5		1.3125

Drainage Coefficient = 1.0

Step 3: Aggregate has diminished 2" over 10 years

PAVEMENT DESIGN STEPS



EXAMPLE MAINTENANCE CYCLE

No GTX - No PM, Initial AADT 155, Contamination Rate 0.2-in./yr.				
Year	ERDL	Maintenance	SSC	AADT
2020	20	Construction	0.44	155
2030	6.2		0.395	189
2035	2.8	*Patch*	0.358	209
2040	0.8	Overlay 1.5" (RRDL = 11.4 yrs)	0.266	230
2045	4.3	*Patch*	0.421	254
2050	1.3	*Patch*	0.395	281
2055	0.31	Overlay 1.5" (RRDL = 5.6 yrs)	0.358	310
2060	2.3	*Patch*	0.421	342
2065	0.51	Rebuild 8.5" 21B, 2" SM (RRDL = 20.0 yrs)	0.395	378
2070	12.3	Remaining service life = 12.3 yrs	0.421	417

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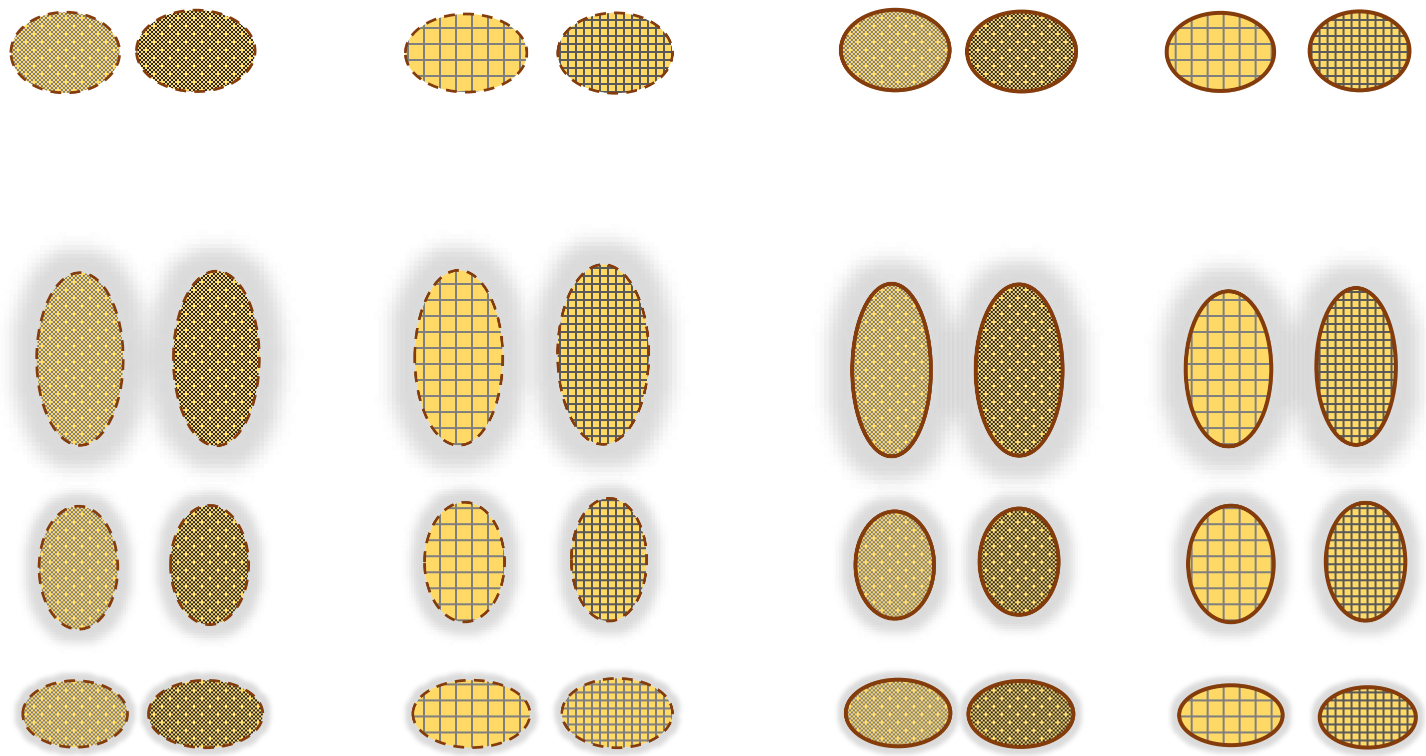
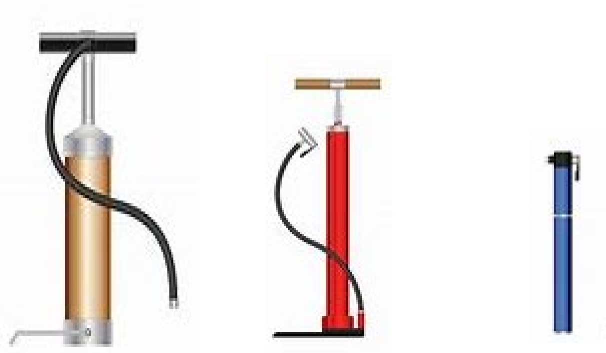
LIFE CYCLE COST ANALYSIS FOR GEOSYNTHETIC SEPARATORS IN LOW-VOLUME ROADS IN VIRGINIA

Audrey Moruza
Research Scientist
Virginia Department of Transportation
Charlottesville, Virginia

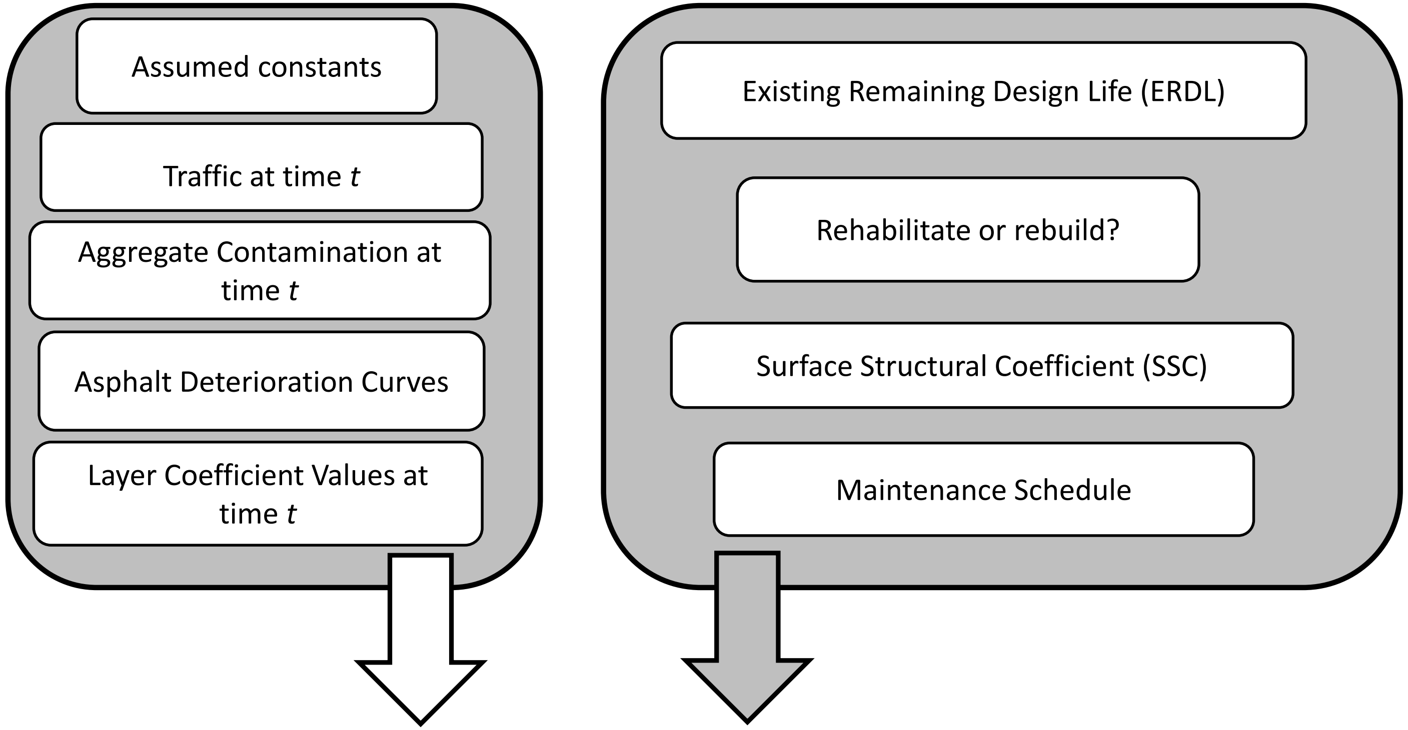
24 SCENARIOS WERE EVALUATED FOR LIFE-CYCLE COSTS

No GTX – No PM | GTX – No PM | No GTX - PM | GTX - PM



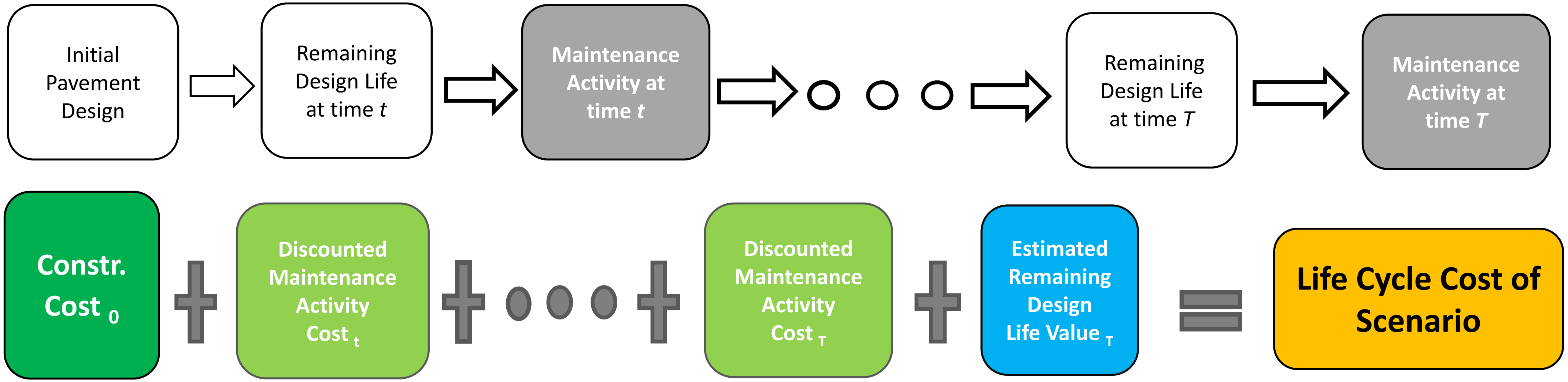


0.2 in/yr | 0.1 in/yr | 0.05 in/yr



USING AASHTO 1993, THE PAVEMENT SCENARIO DETERMINES THE MAINTENANCE ACTIVITIES OVER 50 YEARS.

COSTS OF MAINTENANCE ACTIVITIES ARE INPUTS TO LIFE CYCLE COST.

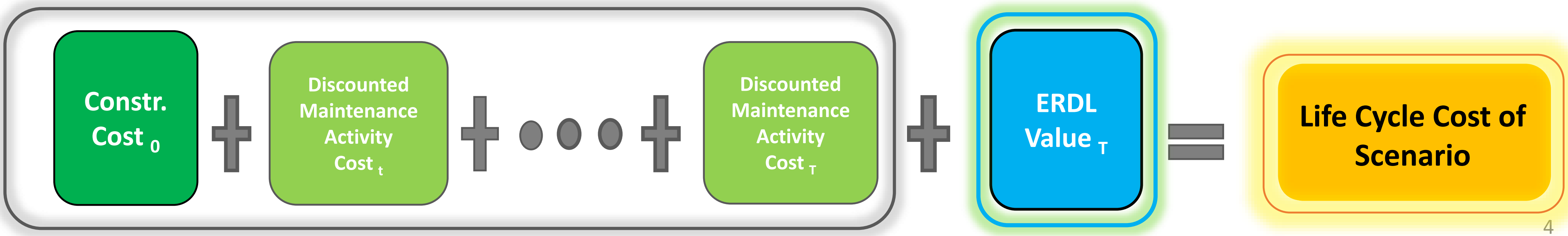


LIFE CYCLE COST ANALYSIS

COSTS OF ORIGINAL CONSTRUCTION + *DISCOUNTED* COSTS OF MAINTENANCE ACTIVITIES FOR A SCENARIO

+ *DISCOUNTED* PAVEMENT VALUE AT END OF ANALYSIS PERIOD TO ACCOUNT FOR ESTIMATED REMAINING SERVICE LIFE (ERDL)

= LIFE-CYCLE COST OF THE SCENARIO



COSTS OF ORIGINAL CONSTRUCTION AND MAINTENANCE ACTIVITIES

ORIGINAL CONSTRUCTION + MAINTENANCE ACTIVITIES

Initial AADT 155, Contamination Rate 0.2 in/yr

(1) No GTX - No PM			(2) GTX - No PM			(3) No GTX - PM			(4) GTX - PM		
Year	**Activity**	**SCC***	**Year**	**Activity**	**SCC***	**Year**	**Activity**	**SCC***	**Year**	**Activity**	**SCC***
2020	**Construction**	**0.440**	**2020**	**Construction**	**0.440**	**2020**	**Construction**	**0.440**	**2020**	**Construction**	**0.440**
2030		0.395			0.395	2030		0.395	2030		0.395
2035	*Patch*	0.358			0.358	2035	*Patch*	0.358	2035		0.358
2040	Overlay	0.266	2040	Overlay	0.266	2040	Mill / Overlay	0.266	2040	Mill / Overlay	0.266
2045	*Patch*	0.421			0.421	2045	*Patch*	0.421	2045		0.421
2050	*Patch*	0.395			0.370	2050	Demo / Rebuild	0.395	2050		0.395
2055	Overlay	0.358			0.300	2055		0.421	2055		0.358
2060	*Patch*	0.421	2060	Overlay	0.170	2060		0.395	2060	Mill / Overlay	0.266
2065	Demo / Rebuild	0.395			0.421	2065	*Patch*	0.358	2065		0.421
2070		0.421	2070		0.370	2070	Mill / Overlay	0.266	2070		0.395
2070	**ERDL** = 12.3 yrs**		**2070**	**ERDL** = 18 yrs**		**2070**	**ERDL** = 3.5 yrs**		**2070**	**ERDL** = 6.8 yrs**	

**Surface Condition Coefficient*

***Estimated Remaining Design Life*

NO PREVENTIVE MAINTENANCE

PREVENTIVE MAINTENANCE

Initial AADT 155, Contamination Rate 0.2 in/yr

(1)

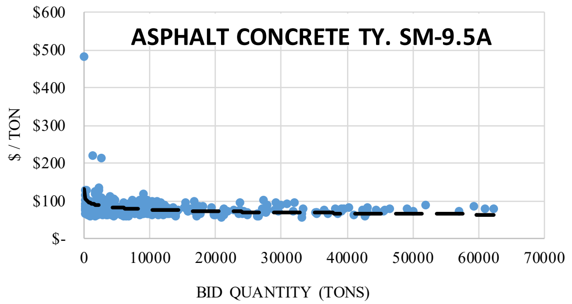
No GTX - No PM		
Year	**Activity**	**SCC***
2020	**Construction**	**0.440**
2030		0.395
2035	*Patch*	0.358
2040	Overlay	0.266
2045	*Patch*	0.421
2050	*Patch*	0.395
2055	Overlay	0.358
2060	*Patch*	0.421
2065	Demo & Rebuild	0.395
2070		0.421
2070	**ERDL** = 12.3 yrs**	

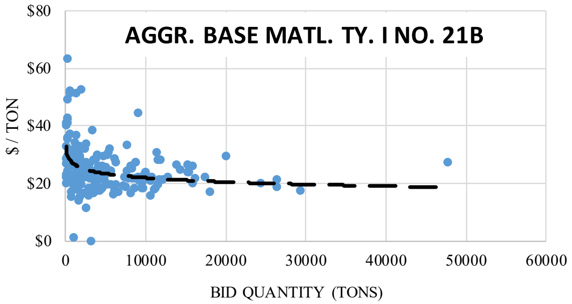
**Surface Condition Coefficient*

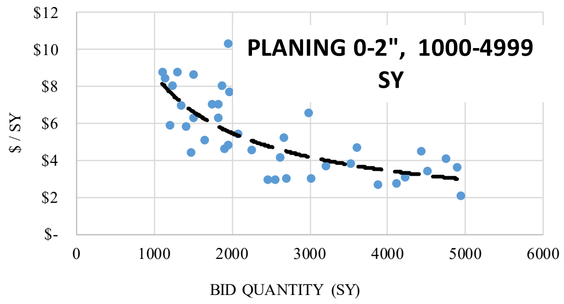
***Estimated Remaining Design Life*

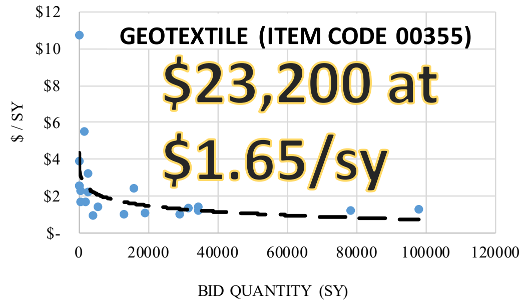
Analysis Year	Calendar Year	Activity	Depth (in)	Quantity	Unit	Unit Cost	Total Cost	Present Value
0	2020	Mainline - HMA Surface	1.5	1,156	Tons	$ 93	$ 107,052	$ 107,052
		Mainline - 21B	8	6,420	Tons	$ 23	$ 146,515	$ 146,515
		Maintenance of Traffic		1.00	LS	$ 10,000	$ 10,000	$ 10,000
							$ 263,567	$ 263,567
		CEI (15%)					$ 39,535	$ 39,535
							$ 303,103	**$ 303,103**
15	2035	Mainline - Patching 44%	1.5	509	Tons	$ 350	$ 178,073	$ 98,878
		Maintenance of Traffic		1.00	LS	$ 10,000	$ 10,000	$ 5,553
							$ 188,073	$ 104,430
		CEI (5%)					$ 9,404	$ 5,222
							$ 197,477	**$ 109,652**
20	2040	Mainline - Overlay HMA S	1.5	1,156	Tons	$ 93	$ 107,052	$ 48,857
		Maintenance of Traffic		1.00	LS	$ 10,000	$ 10,000	$ 4,564
							$ 117,052	$ 53,421
		CEI (5%)					$ 5,853	$ 2,671
							$ 122,905	**$ 56,092**
25	2045	Mainline - Patching 14%	1.5	162	Tons	$ 350	$ 56,660	$ 21,254
		Maintenance of Traffic		1.00	LS	$ 10,000	$ 10,000	$ 3,751
							$ 66,660	$ 25,005
		CEI (5%)					$ 3,333	$ 1,250
							$ 69,993	**$ 26,255**
30	2050	Mainline - Patching 74%	1.5	856	Tons	$ 350	$ 299,487	$ 92,337
		Maintenance of Traffic		1.00	LS	$ 10,000	$ 10,000	$ 3,083
							$ 309,487	$ 95,421
		CEI (5%)					$ 15,474	$ 4,771
							$ 324,961	**$ 100,192**
35	2055	Mainline - Overlay HMA S	1.5	1,156	Tons	$ 93	$ 107,052	$ 27,129
		Maintenance of Traffic		1.00	LS	$ 10,000	$ 10,000	$ 2,534
							$ 117,052	$ 29,663
		CEI (5%)					$ 5,853	$ 1,483
							$ 122,905	**$ 31,146**
40	2060	Mainline - Patching 54%	1.5	624	Tons	$ 350	$ 218,544	$ 45,520
		Maintenance of Traffic		1.00	LS	$ 10,000	$ 10,000	$ 2,083
							$ 228,544	$ 47,603
		CEI (5%)					$ 11,427	$ 2,380
							$ 239,972	**$ 49,983**
45	2065	Demolition of Pavement		14,080	SY	$ 12	$ 168,960	$ 28,926
		Mainline - HMA Surface	2	1,542	Tons	$ 91	$ 139,529	$ 23,887
		Mainline - 21B	8.5	6,822	Tons	$ 23	$ 154,786	$ 26,499
		Maintenance of Traffic		1.00	LS	$ 10,000	$ 10,000	$ 1,712
							$ 473,275	$ 81,024
		CEI (15%)					$ 70,991	$ 12,154
							$ 544,266	**$ 93,178**

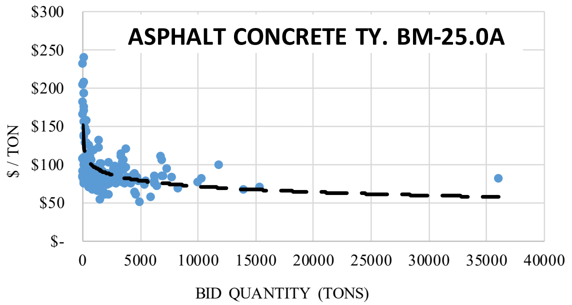
UNIT COSTS

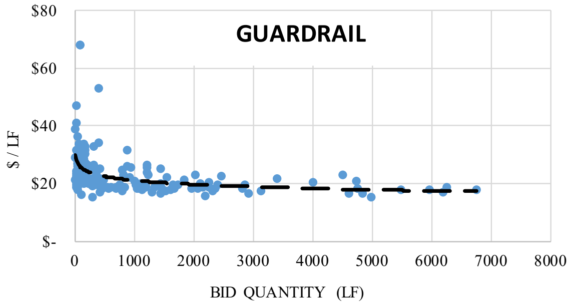


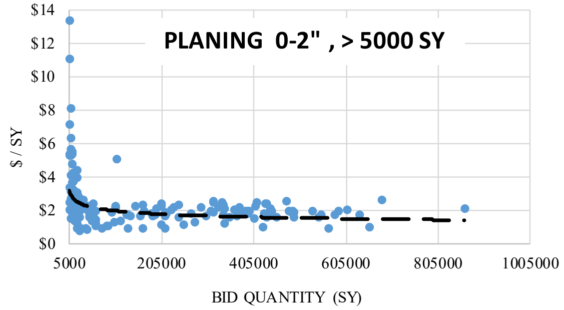




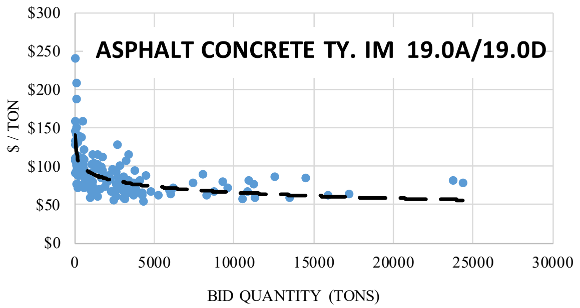


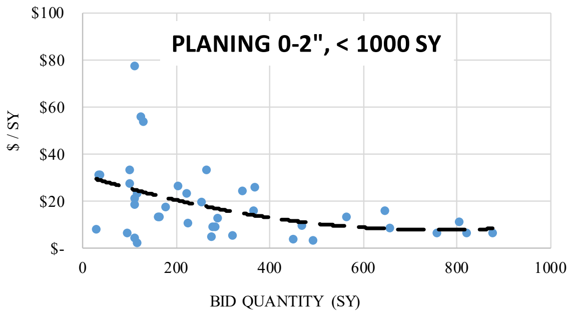


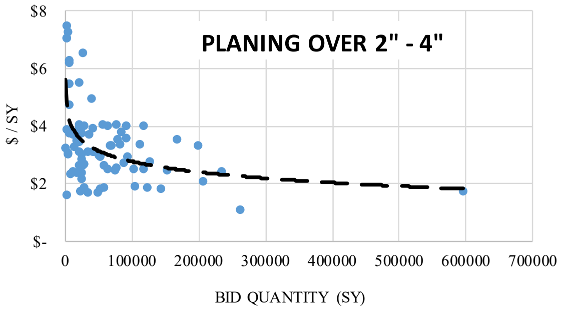




VDOT BID TAB DATA WERE PULLED FROM 2008 – 2018 AND ADJUSTED FOR INFLATION TO 2018 PRICE LEVELS ACCORDING TO THE NHCCI







DISCOUNTED COSTS OF FUTURE MAINTENANCE ACTIVITIES

Initial AADT 155,
Contamination Rate 0.2 in/yr

No GTX - No PM		
Year	**Activity**	**Activity costs (2020)**
2020	Construction	$ 303,103
2030		--
2035	*Patch 44%*	$ 197,477
2040	Overlay	$ 122,905
2045	*Patch 14%*	$ 69,993
2050	*Patch 74%*	$ 324,961
2055	Overlay	$ 122,905
2060	*Patch 54%*	$ 239,972
2065	Demo/Rebuild	$ 544,266
2070		$ 1,925,582

DISCOUNT FORMULA

$$\frac{\textit{Activity costs at current prices}}{(1+d)^{\textit{yrs elapsed since CN}}}$$

RESULTS ARE SENSITIVE TO THE CHOICE OF "d" USED IN DISCOUNT CALCULATIONS

ACTIVITY COSTS DISCOUNTED TO 2020	
d = 1.5%	**d = 4%**
$ 303,103	$ 303,103
--	--
$ 157,952	*$ 109,652*
$ 91,253	*$ 56,092*
$ 48,239	*$ 26,255*
$ 207,898	*$ 100,192*
$ 72,989	*$ 31,146*
$ 132,287	*$ 49,983*
$ 278,509	*$ 93,178*
$ 1,292,230	*$ 769,601*

THE DISCOUNT RATE IS NOT A "WILD CARD"

"...[d] should be selected to reflect both historical trends over long time periods and near-term projections." [FHWA]

e.g., DISCOUNT RATE = NOMINAL RETURN ON ALTERNATIVE ASSET – INFLATION RATE

OMB Circular No. A-94

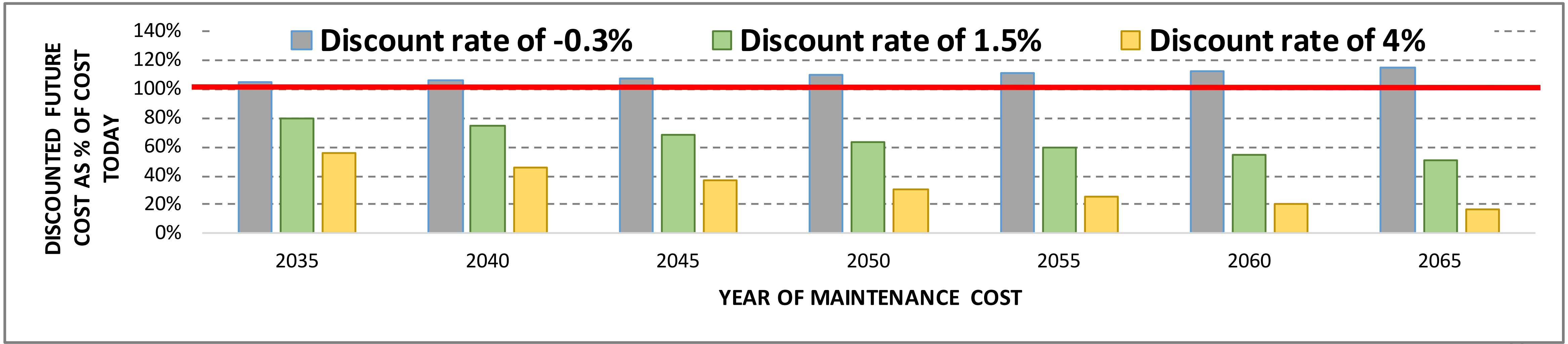
APPENDIX C
(Revised November 2020)

DISCOUNT RATES FOR COST-EFFECTIVENESS, LEASE PURCHASE, AND RELATED ANALYSES

Real Interest Rates on Treasury Notes and Bonds of Specified Maturities (in percent)

3-Year	5-Year	7-Year	10-Year	20-Year	30-Year
-1.8	-1.6	-1.4	-1.1	-0.5	-0.3

NOT A PROBLEM IN THIS LCCA



Initial AADT 155, Contamination Rate 0.2 in/yr

	(1)		(2)		(3)		(4)	
	No GTX - No PM		GTX - No PM		No GTX - PM		GTX - PM	
	Activities	PV of Costs (1.5%)	Activities	PV of Costs (1.5%)	Activities	PV of Costs (1.5%)	Activities	PV of Costs (1.5%)
2020	Construction	$ 303,103	Construction	$ 329,819	Construction	$ 303,103	Construction	$ 329,819
2030								
2035	Pat							
2040	Ove							$ 120,671
2045	Pat							
2050	Pat							
2055	Ove							
2060	Pat							$ 89,594
2065	Dem 2"/							
2070					Mill / Overlay 2"	$ 93,399		
SUBTOTAL	ERDL = 12.3 yrs	$ 1,292,230	ERDL = 18 yrs	$ 488,825	ERDL = 3.5 yrs	$ 1,326,370	ERDL= 6.8 yrs	$ 540,084

TERMINATION OF LIFE-CYCLE COST ANALYSIS REQUIRES RECKONING WITH UNEQUAL ERDL. THIS IS THE PURPOSE OF THE "SALVAGE VALUE" STEP IN LCCA.

“SALVAGE VALUE” IS AN ESTIMATE OF THE

***DISCOUNTED* PAVEMENT VALUE**

AT THE END OF THE ANALYSIS PERIOD

TO ACCOUNT FOR UNEQUAL ERDL.

TWO VIABLE CONCEPTS FOR INCORPORATING THE VALUE OF UNEQUAL ERDL IN LCCA

1. CALCULATE THE VALUE OF REMAINING MATERIALS AT THE END OF THE (50 YEAR) ANALYSIS PERIOD ASSUMING THE PAVEMENT WILL GO OUT OF SERVICE

2. CALCULATE THE VALUE OF THE REMAINING PAVEMENT STRUCTURE AT THE END OF THE ANALYSIS PERIOD ASSUMING IT WILL SERVE AS A SUPPORT LAYER IN ANOTHER 20-YEAR PAVEMENT DESIGNED FOR THE HIGHER AADT LEVEL

METHOD 1: VALUE OF REMAINING MATERIALS

MAINLINE - HMA SURFACE	**2 IN.**	**$139,529**
MAINLINE 21B AGGREGATE	**9 IN.**	**$163,096**
MOT	**LS**	**$10,000**
CEI @ 5%		**$45,894**

$359,519/(1.015)^50 = $170,773

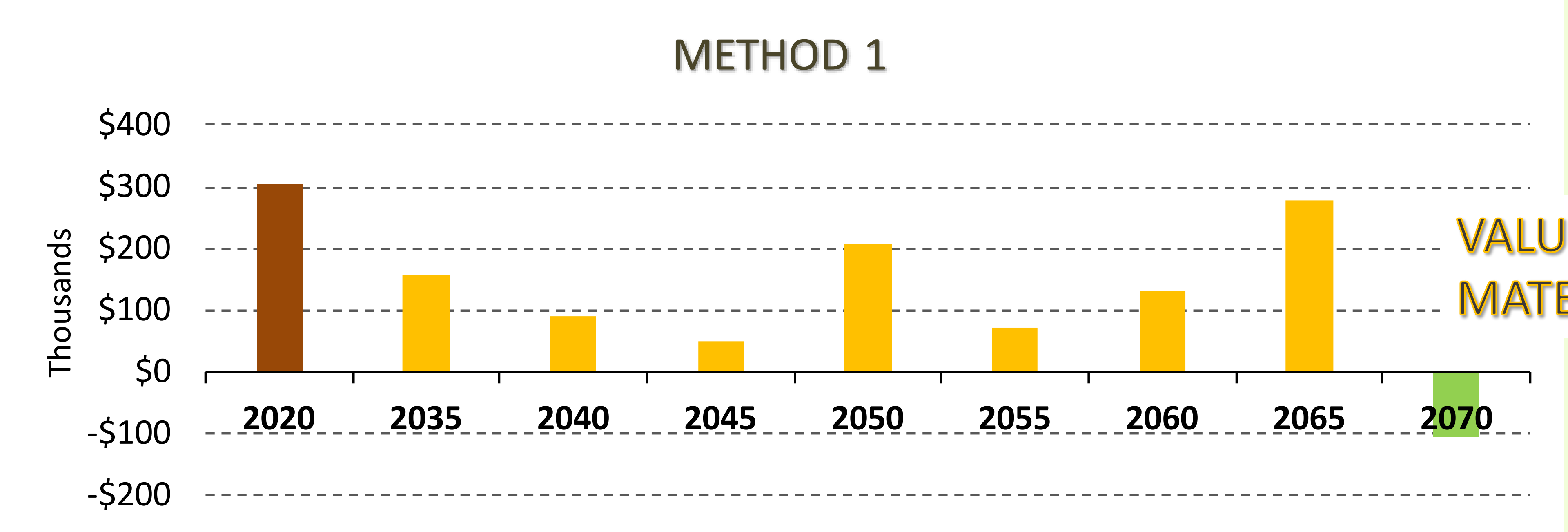
$170,773 * (12.3/20) = $105,026 SUBTRACT FROM LIFE-CYCLE COST

(1)
NO GTX – NO PM
0.2 IN/YR
ERDL = 12.3 YRS
2070 AADT

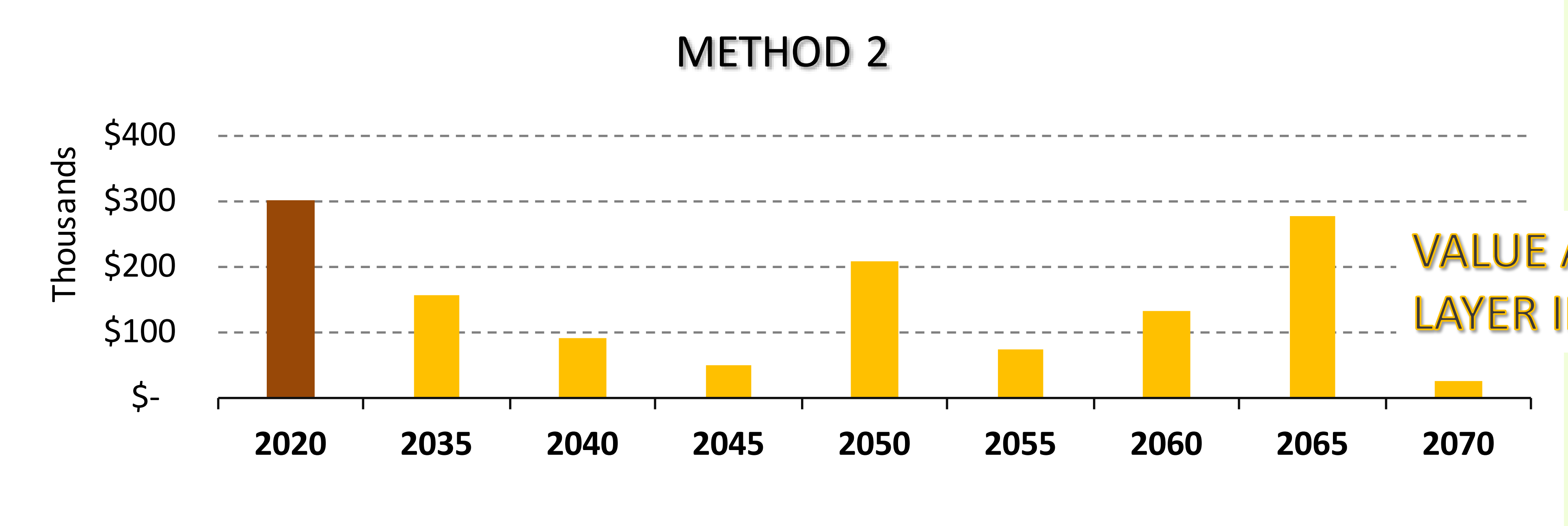
METHOD 2: VALUE OF STRUCTURE AS SUPPORT LAYER

MAINLINE – HMA SURFACE	**0.5 IN.**	**$38,733**
MOT	**LS**	**$10,000**
CEI @ 5%		**$2,437**

$51,170/(1.015)^50 = $24,306 ADD TO LIFE-CYCLE COST



VALUE OF REMAINING MATERIALS



VALUE AS SUPPORT LAYER IN NEW PAVEMENT

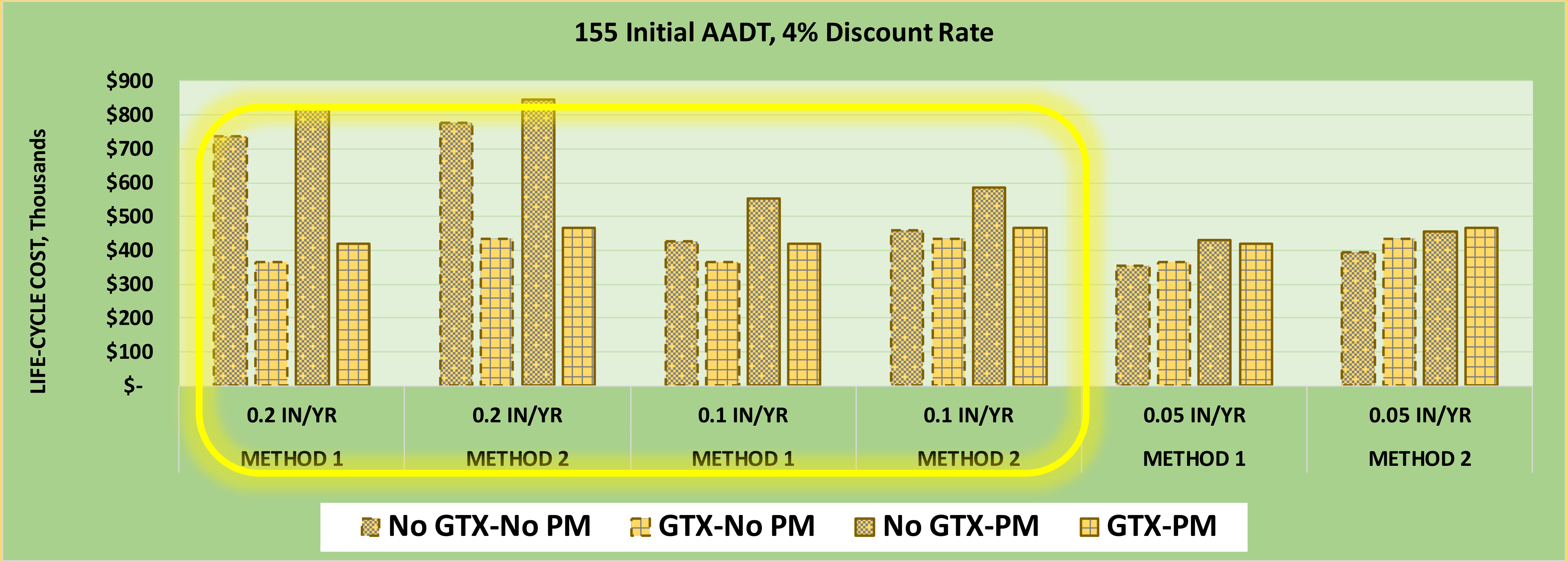
Initial AADT 155, Contamination Rate 0.2 in/yr

	(1)		(2)		(3)		(4)	
	No GTX - No PM		GTX - No PM		No GTX - PM		GTX - PM	
	Activities	PV of Costs (1.5%)	Activities	PV of Costs (1.5%)	Activities	PV of Costs (1.5%)	Activities	PV of Costs (1.5%)
2020								
2030								
2035								
2040								
2045								
2050								
2055								
2060								
2065								
2070								
SUBTOTAL	ERDL = 12.3 yrs	$ 1,292,230	ERDL = 18 yrs	$ 488,825	ERDL = 3.5 yrs	$ 1,326,370	ERDL= 6.8 yrs	$ 540,084
METHOD 1		$ (105,026)		$ (153,696)		$ (29,885)		$ (58,063)
METHOD 2		$ 24,306		$ 77,201		$ 50,106		$ 101,362

THESE 4 SCENARIOS EACH HAVE
3 CONTAMINATION RATES, 2 INITIAL AADT LEVELS,
2 “SALVAGE VALUE” METHODS AND 2 DISCOUNT RATES
= 96 RESULTS.

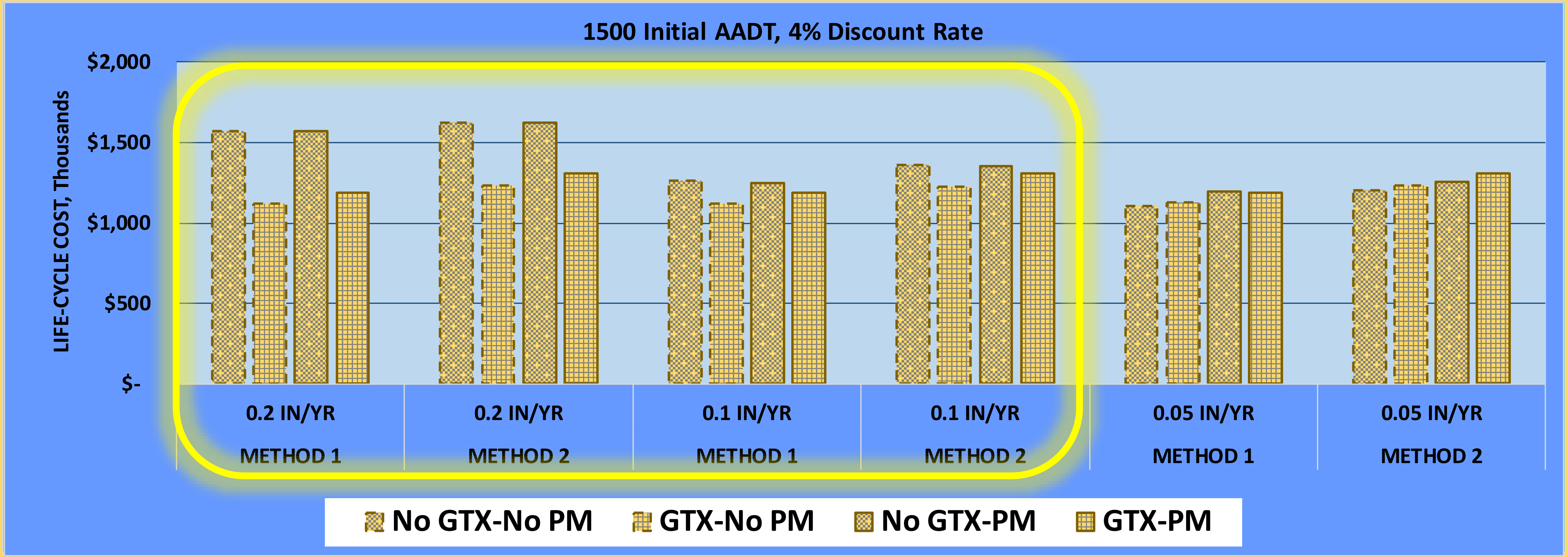
VALID COMPARISONS HAVE
ONE DISCOUNT RATE
AND ONE “SALVAGE VALUE” METHOD.
THE REST IS SENSITIVITY TESTING.

CONCLUSIONS



155 INITIAL AADT, 4% DISCOUNT RATE

CONCLUSIONS



1500 INITIAL AADT, 4% DISCOUNT RATE

Conclusions

- A geosynthetic layer without preventive maintenance is the most cost-effective pavement option over 50 years in *every* combination of factors and assumptions *except* those with the lowest contamination rate. GTX-PM is typically second best at high and middle contamination rates in this analysis.
- GTX – PM will likely have a superior riding surface to GTX – No PM.
- Results are mixed in the lowest contamination rate scenario: the life-cycle costs of GTX – No PM are appreciably lower in only 1 of 8 low-contamination rate scenarios.
- GTX is a low-cost pavement design option with low risk of "wasted expenditure."
- LCCA is *incomplete* without a reckoning for varying ERDL of pavement options by means of a "salvage value" estimate.

CONCLUSIONS

Pavements with separator geotextile are expected to be **consistently more cost-effective** than pavements without separator geotextile at contamination rates above 0.1 inch/year, regardless of whether preventive maintenance is performed or whether initial AADT is set at the lower (155) or higher (1500) level, for discount rates within the range explored in this study (4% and lower).

CONCLUSIONS

Separation geotextile in pavement structure can have a **significant life-cycle cost advantage** over pavement without geotextile for the highest contamination rate tested in this study when both pavements receive preventive maintenance, and the cost advantage of separation geotextile usually increases if neither pavement receives preventive maintenance, regardless of initial AADT.

CONCLUSIONS

The life-cycle cost advantage of separator geotextile decreases with decreasing contamination rate, yet separation geotextile is a relatively low-cost item to install as a preventive measure to mitigate potential premature deterioration. PennDOT estimated that a future reconstruction could cost as much as 211% of the present cost of a road with GTX originally incorporated in construction (K. Petrasic 2017). **Only surficial maintenance is likely to be required with separation geotextile incorporated into the pavement section.**

CONCLUSIONS

Although aggregate contamination by fine-grained subgrade soils is a well-documented problem, **current pavement design methods do not incorporate this knowledge**. Thus, some pavements designed using these methods may deteriorate at a faster rate than anticipated, increasing their life-cycle costs. Aggregate layers protected by means of separator geotextile are more likely to be preserved and reused.

RECOMMENDATIONS

1. *VDOT's Materials Division should revise current geosynthetic specifications to include Subgrade Stabilization and Subgrade Separation Geotextiles as two separate and distinct pay items.*

2. *VDOT's Materials Division should implement changes to the existing geosynthetic special provision, as proposed in Appendix E.*

3. *VDOT's Materials Division should adopt Table 4 guidelines for the use of geosynthetics on low-volume roads.*

REVISED SPECIFICATIONS

Primary Application (pay item)	AASHTO M 288 Class and Material Type	Minimum Permittivity (sec^{-1})	Maximum AOS (mm)	Guidelines for use*
Subgrade Stabilization	Class 1 Biaxial geogrid with nonwoven or woven separator geotextile at the subgrade level. No slit film woven fabrics allowed.	0.1	0.212 (No. 70)	Any of the following: - CH, MH, OH, OL, PT - organic content > 5% - swelling > 5% - LL > 50% and PI > 30% - natural WC > 30% above OWC - subgrade CBR < 3 - CBR or M_R < design value - as judged by the Engineer
Subgrade Separation	Class 2 Nonwoven geotextile only	0.1	0.212 (No. 70)	All of the following: - more than 35% subgrade fines - subgrade CBR between 3 and 8 - no adequate pavement subdrainage - as judged by the Engineer

RESEARCH NEEDS

1. Refinement of LCCA to reflect actual maintenance decisions in lieu of prescriptive or idealized guidelines.

2. Targeted field studies re: subsurface drainage. Current study did not take into account loss of permeability with contamination.

THANKS!

VTRC Report 20-R8 Use of Geosynthetics for Separation and Stabilization in Low-Volume Roadways

[20-r8.pdf (virginiadot.org)]

Today’s Panelists

Moderator:

Jennifer Nicks

U.S. Department of Transportation
Federal Highway Administration
Turner-Fairbank
Highway Research Center

VDOT
Virginia Department of Transportation

Edward Hoppe

Chaz Weaver

Audrey Moruza

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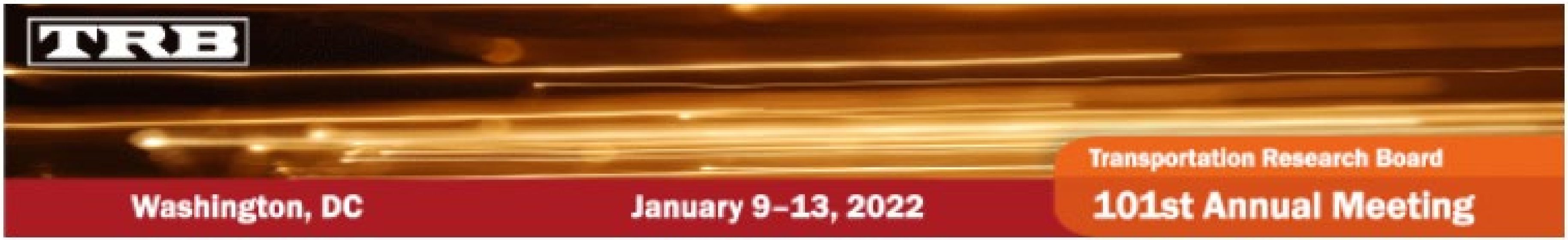

Register now for our January meeting! ***There will be no onsite registration this year.***

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