



# PAVEMENT RESURFACING PROGRAM

## STANDARD OPERATING GUIDELINES

*April 2018*

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# INTRODUCTION AND BACKGROUND

TDOT maintains over 5,700 lane miles of interstate and over 32,000 lane miles of state routes. This document intends to serve as guidelines for the selection of routes to be resurfaced and how resurfacing projects can be developed. This document is intended to serve only as guidance and does not supersede Departmental specifications, supplemental specifications, design guidelines, or other departmental guidance. On all resurfacing projects, it is expected that if conflicts are encountered between with this guidance or Departmental specifications and proper engineering judgement, the latter will precede.

These guidelines do not intend to address concerns or provide guidance for new construction, re-construction, widening or other TDOT projects.

## CURRENT NETWORK

Table 1 outlines the distribution of mileage throughout the state at the date of publication of these guidelines (April 2018). Annual resurfacing project funding is allocated by the TDOT Program Development office and separated based on available National Highway Performance Program (NHPP), Surface Transportation Program (STP) and state funds. The Department allocates a select amount of NHPP funds specifically for resurfacing interstates, which are part of the NHS. NHPP funds may only be used to fund projects on NHS routes. State funding (451) available for resurfacing projects will be allocated at this same time and can be used for projects on any route on the state highway system. All fund categories are allocated to TDOT regions based on regional percentages of qualifying lane miles.

	REGION 1	REGION 2	REGION 3	REGION 4	TOTAL
Interstates	1,603.6	970.0	2,225.6	1,006.7	5,805.9
% of TOTAL	27.6	16.7	38.3	17.3	100.0
All State Routes	7,513.1	6,737.0	9,009.7	8,592.0	31,851.7
% of TOTAL	23.6	21.2	28.3	27.0	100.0
NHS State Routes	2,830.4	2,479.3	3,670.2	3,676.0	12,655.9
% of TOTAL	22.4	19.6	29.0	29.0	100.0
Non-NHS State Routes	4,682.6	4,257.7	5,339.5	4,916.0	19,195.8
% of TOTAL	24.4	22.2	27.8	25.6	100.0

**Table 1.** Distribution of state highway lane miles as of April 2018.

Table 2 defines the current condition of the state highway network as reported by the 2016 and 2017 Departmental Annual Pavement Condition Reports. Additional background

regarding the collection and interpretation of pavement management can be found in annual Pavement Management Reports and in Pavement Management Guidelines, which are currently being developed with an anticipated publish date of Winter 2017/2018.

	Interstates		State Routes	
	2016	2017	2016	2017
<b>Region 1</b>	4.075	4.085	3.642	3.828*
<b>Region 2</b>	4.399	4.227	3.759	3.954*
<b>Region 3</b>	4.223	4.256	3.631*	3.825
<b>Region 4</b>	3.925	3.873	3.139*	3.079

**Table 2.** Sample pavement condition from 2016 and 2017 Annual Pavement Report. (\* - Only NHS state route segments are considered in off-cycle regions [See Table 3 for details])

## PAVEMENT MANAGEMENT

The TDOT Pavement Management office procures collection of pavement management system (PMS) data to monitor the health of all pavements on the TDOT network. Pavement data collected per this contract can be categorized into two groups – roughness and distress. Roughness data includes factors that define pavement smoothness, such as the international roughness index (IRI) which is used to calculate the Pavement Smoothness Index (PSI). Distress data includes metrics that define the physical deterioration of pavements such as cracking, rutting, and other pavement distresses. Pavement data is compiled annually by the Pavement Management office and distributed in an Annual PMS Report. The PMS data collection schedule and a description of the metric provided in the annual PMS report are shown in Tables 3 and 4, respectively.

	Regions 1 &2	Regions 3&4
<b>Interstates</b>	Roughness and distress collected annually, far right lane, both directions	
<b>NHS State Routes and other routes</b>	Roughness and distress annually, far right lane, positive (North or East) direction	
<b>Non-NHS State Routes</b>	Roughness and distress collected on <b>even</b> years, far right lane, positive (North or East) direction	Roughness and distress collected on <b>odd</b> years, far right lane, positive (North or East) direction

**Table 3.** Pavement Management Data Collection Schedule.

<b>IRI – International Roughness Index</b>
<ul style="list-style-type: none"> <li>• Measurement of the number of vertical deviations over a section of road.</li> </ul>
<ul style="list-style-type: none"> <li>• Measured in inches/mile</li> </ul>
<ul style="list-style-type: none"> <li>• Perfect is a “0”</li> </ul>
<b>HC IRI – Half-Car IRI</b>
<p>Half-Car IRI is used by TDOT’s profilers for acceptance testing and warranty jobs. The standard method that is collected by our consultants is Quarter-Car IRI. Half-Car IRI values tend to be slightly better than Quarter-Car IRI values obtained from the same location.</p>
<b>PSI – Pavement Smoothness Index</b>
<ul style="list-style-type: none"> <li>• Measure of the ROUGHNESS of the road on a scale of 0 – 5.</li> </ul>
<ul style="list-style-type: none"> <li>• Perfect is a “5”</li> </ul>
<ul style="list-style-type: none"> <li>• Roughness is defined as: “The deviations of a pavement surface from a true planar surface with characteristic dimensions that affect vehicle dynamics, ride quality, dynamic loads, and drainage; for example, longitudinal profile, transverse profile, and cross slope.”</li> </ul>
<ul style="list-style-type: none"> <li>• Relates to IRI through: <math>PSI = 5 * e(-0.0055*IRI)</math></li> </ul>
<b>PDI – Pavement Distress Index</b>
<ul style="list-style-type: none"> <li>• A measurement of the roadway DISTRESS on a scale from 0 – 5.</li> </ul>
<ul style="list-style-type: none"> <li>• Perfect is a “5”</li> </ul>
<ul style="list-style-type: none"> <li>• Distresses that are evaluated include the following: Fatigue, Rutting, Longitudinal Cracks In the Wheel Path, Patching, Block Cracking, Raveling, Transverse Cracks, Longitudinal Cracks (Non-Wheel Path), &amp; Longitudinal Cracks In the Lane Joints.</li> </ul>
<ul style="list-style-type: none"> <li>• Each individual Distress mentioned above receives a DEDUCT VALUE based on the severity &amp; number of distresses on a given stretch of road surface.</li> </ul>
<ul style="list-style-type: none"> <li>• All of the D.V.s are given a weight and subtracted from 5.</li> </ul>

**Table 4.** Pavement Management Data explanation of terms.



## PQI – Pavement Quality Index

- Overall Index of the roadway on a scale from 0 – 5.
- Perfect is a “5”
- $PQI = PDI 0.7 * PSI 0.3$
- PDI encompasses the largest portion of this index because Pavement Distresses indicate current problems and future deterioration of the roadway surface.

**Table 4.** Pavement Management Data explanation of terms. (continued)

All pavement data is stored in a database and can be queried using the Highway Pavement Management Application (HPMA) software (Figures 1-3). Prior to 2015, less data was collected than what is defined in Table 3, so certain historical data will not be available. For example, NHS state routes were only collected semi-annually prior to 2015.

The screenshot shows the HPMA Highway Data View window. The title bar reads "Highway Data View" and the window content includes a filter and a table of highway segments.

**Highway Data View Filter:** Filter: RT: I , #: 24, Cnty: 33

**Highways to View:** Clear Filter Exclude Overlaps

Route: I Route Number: 24  
 Route Aux ID: Direction:  
 County: 33 Seq: 0  
 Interchange #: 0 Ramp ID:  
 From Distance: 0.000 To Distance: 0.000

Highway	From	To
I 24 M 33 1	0	.31
I 24 M 33 2	0	14.71
I 24 P 33 1	0	.31
I 24 P 33 2	0	14.71

**Log Plot:** Hwy: I 24 P 33 2 : 0.000 - 14.710  
 Graphical reports are log-plots for a single highway (selected in list at left) and viewed in various formats as listed in the Plot Type dropdown list below.  
 Plot Type: Performance History Plot Data

**Data View:** Hwy: I 24 P 33 2 : 0.000 - 14.710  
 The highway data can be viewed for a single highway (selected in list at left) and in various formats as listed in the View Type dropdown list below.  
 View Type: Attribute Segment View View Data...

**Image View:** Hwy: I 24 P 33 2 : 0.000 - 14.710  
 The highway photolog images can be viewed for a single highway (selected in list at left) in various formats as listed in the View Type dropdown list below.  
 View Type: Images View Images... <-Years

**Figure 1.** HPMA Highway Data View window and data filter.

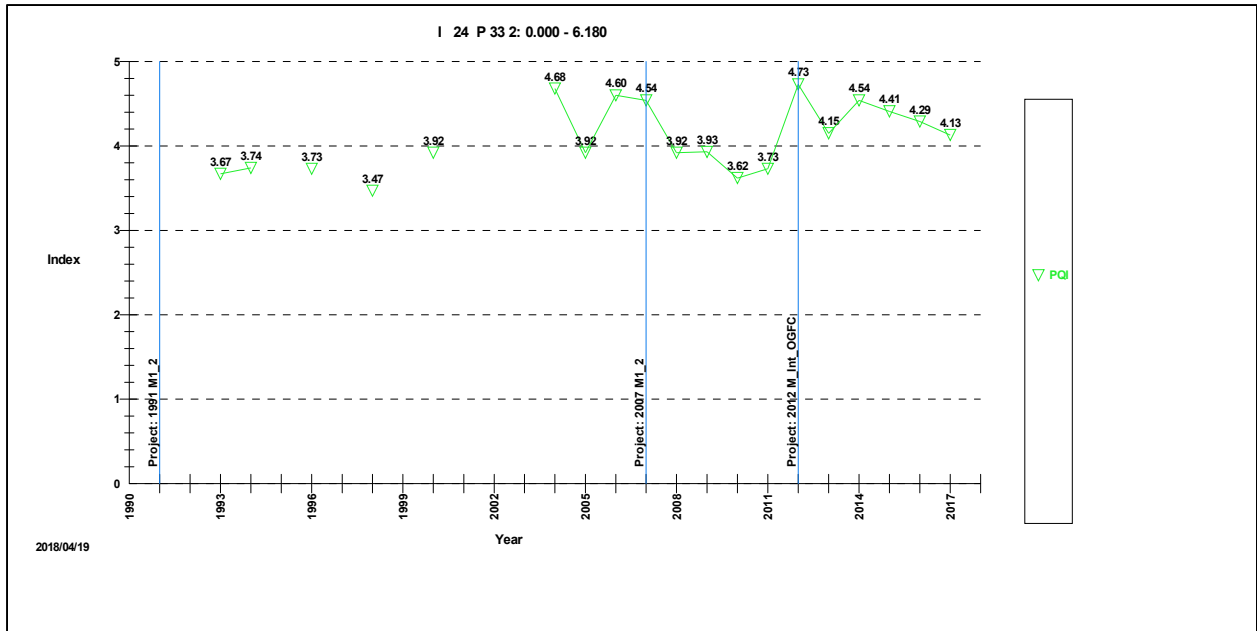


Figure 2. Sample HPMa Performance History log plot.

Figure 3 is a screenshot of the "Highway Data View - Uniform Segment History" software interface. The window title is "Highway Data View - Uniform Segment History". The interface includes a toolbar with icons for print, zoom, and refresh. Below the toolbar, the highway information is displayed as "Highway: I 24 M 33 2 0". The main data area is a table with the following columns: "From", "To", "PSI15", "PSI13", "PSI11", "PDI15", "PDI13", "PDI11", "PQI15", "PQI13", and "PQI11". The data is organized into 1000-foot segments from 0.000 to 14.710 miles.

From	To	PSI15	PSI13	PSI11	PDI15	PDI13	PDI11	PQI15	PQI13	PQI11
0.000	1.000	4.17	4.25	4.06	4.89	0.00	0.00	4.66	4.25	4.06
1.000	2.000	4.16	4.30	3.81	4.76	0.00	0.00	4.57	4.30	3.81
2.000	3.000	3.92	4.09	3.31	4.38	0.00	0.00	4.23	4.09	3.31
3.000	4.000	4.05	4.17	3.60	4.61	0.00	0.00	4.44	4.17	3.60
4.000	5.000	3.94	4.08	3.47	4.83	0.00	0.00	4.54	4.08	3.47
5.000	6.000	3.96	4.19	3.50	4.34	0.00	0.00	4.22	4.19	3.50
6.000	7.000	4.02	4.07	4.09	4.60	0.00	0.00	4.42	4.07	4.09
7.000	8.000	2.57	2.65	2.63	4.24	0.00	0.00	3.65	2.65	2.63
8.000	9.000	3.50	3.55	3.80	4.77	0.00	0.00	4.35	3.55	3.80
9.000	10.000	4.03	4.09	4.12	4.76	0.00	0.00	4.53	4.09	4.12
10.000	11.000	3.35	3.41	3.40	4.83	0.00	0.00	4.33	3.41	3.40
11.000	12.000	2.77	2.92	2.81	4.60	0.00	0.00	3.95	2.92	2.81
12.000	13.000	3.03	3.23	2.97	4.78	0.00	0.00	4.17	3.23	2.97
13.000	14.000	3.10	3.32	3.00	4.99	0.00	0.00	4.32	3.32	3.00
14.000	14.710	4.08	4.13	3.80	4.92	0.00	0.00	4.65	4.13	3.80

Figure 3. Sample HPMa Uniform Length Segment History

## PROJECT IDENTIFICATION

Possible resurfacing projects can be identified with data from the annual Pavement Management System (PMS) report and the regional roadway history. The priority of this identification is age and the overall Pavement Quality Indices (PSI, PDI, PQI). Ad hoc pavement management reports can be made available upon request to assist with project identification and selection.



### **Project History**

Since the implementation of the Interstate System in 1956, TDOT maintained a written database of Interstate Construction and resurfacing known as the Interstate Log Book (Figure 4). All data from this log, which ended in 2007, has since been entered into the HPMa project history database.

DT-1452		COUNTY RUTHERFORD		ROUTE I-24	
Station Length	Station	DESCRIPTION	Lot Miles	Date	
				65	
				66	
				67	
				68	
1757					
1758					
1759					
1760					
1761					
1762					
1763					
1764					
1765					
1766					
1767					
1768					
1769					
1770		14" Base			
1771		I-24-1 (20) 69; 6" Min. Agg. Base, 3 1/2" Bit. Sp., 5 1/2" Bit. Binder, 1 1/2" Bit. Leveling, 1 1/2" Bit. Surface and 3 1/2" B.B.N.			
1772		"B" "C" "E"			
1773		I-24-1 (20) 68 1" BIT. SURFACE "POPCORN"			
1774					
1775					
1776					
1777					
1778					
1779					
1780					
1781		"D"			
1782		1 1/2" Bit. Surface			
1783					
1784					
1785					
1786					
1787		75001-4150-04 "SLURRY SEAL"			
1788					
1789					
1790		COLD PLANE C, 1 3/4" BIT. BINDER, 0.5" C-S, 1 1/4" BIT. SURFACE "D"			
1791					
1792					

Figure 4. Interstate Log Book.

Construction history for state routes was historically maintained in the “Road Life” database, a written log of all known original construction on state routes. Scanned copies of the Road Life database are stored on TDOT network drives, but have not been entered into any electronic database. Data is limited for county roads absorbed by the Department in 1983, also known as “three digit state routes”.

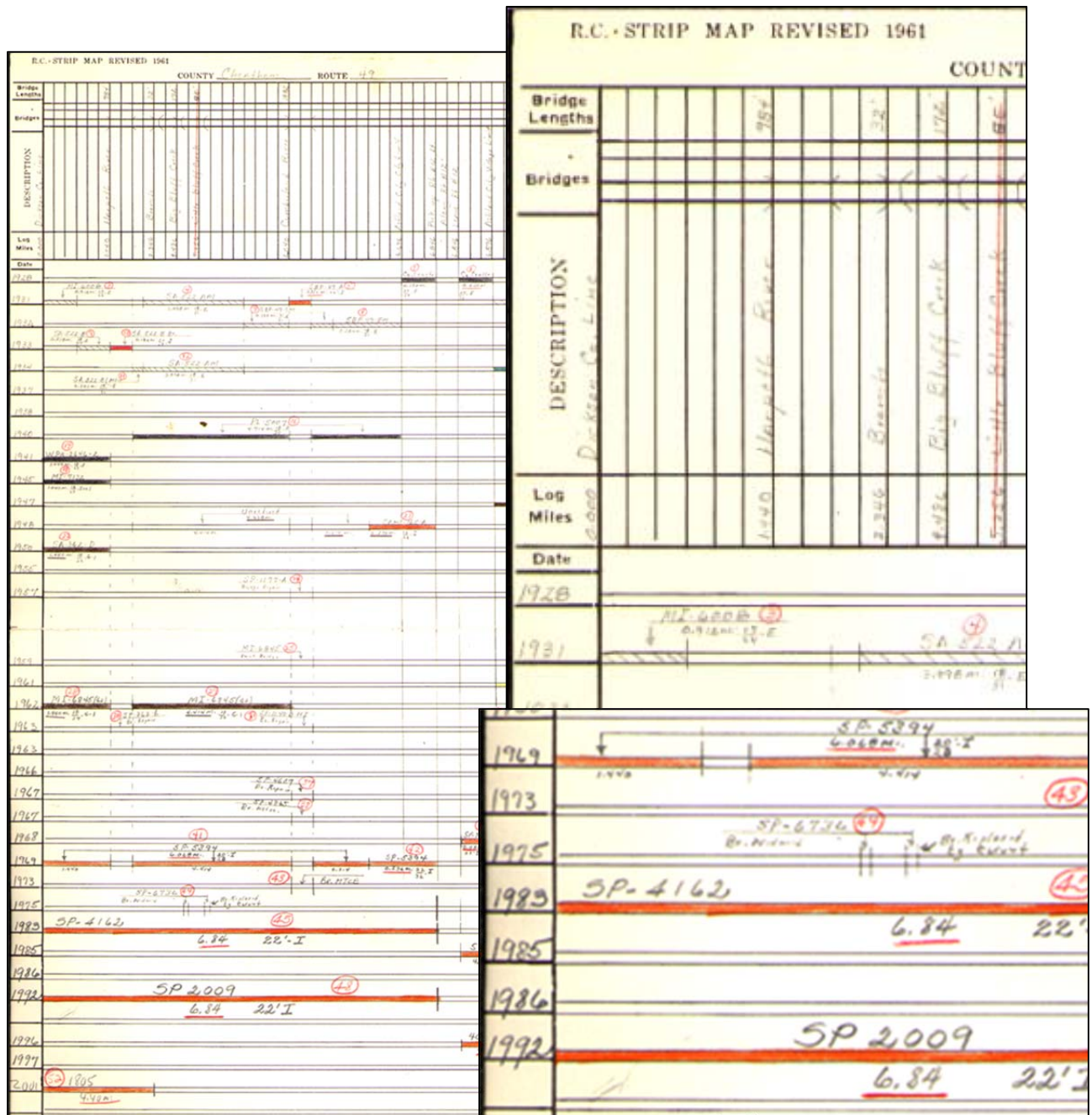


Figure 5. Sample file from Road Life Database, Cheatham SR-49.



## OPTIMIZATION

As yearly work plans are developed, the lane-mile-years for entire work plan can be calculated for an individual region, district or the entire state. By the lane-mile-years approach, a target value for developing work plans is equal to the number of lane miles in the network for that plan. For example, there are 5,195.6 lane miles of interstate statewide. To maintain the current levels of network health, an annual work plan for interstates should calculate to a minimum of 5,195.6 lane mile years.

The benefit of any resurfacing project can be estimated by assuming the number of years a particular project contributes to the life of the pavement being resurfaced. These life extension values, based on past experience, provide the ability to estimate the benefit of a selected treatment. The estimated life extension of various resurfacing treatment types and treatment limitations are provided later in this document, under “Treatments”.

Yearly resurfacing work plans can be optimized by calculating the “lane mile years” (LMY) contributed by the selected project. When calculating lane-mile-years for optimizing work plans, the estimated life extension for each treatment must be multiplied by the total lane miles of the project.

Example: Macon County State Route 262 has a Paving Project with a 411 D overlay. The 2-lane project starts at Log Mile 0.00 and ends at Log Mile 7.00.

Required: Calculate Lane-Mile-Years for this project

Solution: This is a 2-lane Route. Assume a 411-D overlay contributes a life extension of 12 years. Since the project is 7.0 miles along, multiply  $7.0 \times 2 = 14.0$  Lane Miles. Then, multiply the 14.0 Lane Miles  $\times$  12 year life extension from the table above.

14.0 Lane Miles  $\times$  12.0 Years = 168.0 Lane-Mile-Years

At current, this is the default procedure for evaluating draft work plans to ensure resurfacing funding is being spent efficiently and in such a manner that the highest benefit is achieved with available funding. As the resurfacing program matures in the coming years, newer metrics and procedures may be identified which more efficiently identify projects and work plans that deliver the highest overall network quality. If new optimization procedures and metrics are developed which are considered superior to the approach described above, these guidelines will be modified accordingly.



## RESURFACING LIST DEVELOPMENT PROCESS

- 1) Annual Pavement Management System (PMS) reports and available resurfacing budgets are distributed to regional staff in early spring. This data, along with available project history information for pavement age, is used to develop draft resurfacing lists. When applicable, the Pavement Management office may suggest projects for consideration based on HPMA analysis outputs.
- 2) A meeting will be held with district staff to discuss budget restraints and goals.
- 3) A team from the region will visit potential projects to confirm PMS data, evaluate with visual inspection, and decide potential treatments. Visual inspections help estimate the district/Regional priority of a potential project and verify whether marginal projects can be addressed with routine maintenance. Projects that will not last another year without maintenance are given high priority.
- 4) Once the regional team has completed its visit and made recommendations for project selection, the resurfacing coordinator will meet with the district staff to discuss project selection, budget, and lane-mile-year goals. After this process has been completed for each district, the resurfacing coordinator will compile a regional list to be submitted to the State Pavement engineer that satisfies budget allocations and goals.
- 5) Once the Pavement Management Program's proposed work is finalized, the resurfacing coordinator shall submit the region-wide list to the parties listed in "Group A" of the Resurfacing Delivery Schedule (Appendix A). Region resurfacing lists are submitted using the unified resurfacing list format (Appendix B).

Region-wide resurfacing lists should be turned in approximately 33 weeks before the expected letting date of the earliest expected letting on the list, in accordance with the Resurfacing Delivery Schedule (Appendix A). Exact due dates for resurfacing lists will be negotiated between Region Resurfacing Coordinator, Programming, and the State Pavement Engineer to provide enough time to properly enter all information into the

Program/Project/Resource Management System (PPRM). Interstate and State Route lists are submitted separately.

## PROJECT DEVELOPMENT AND DELIVERY

Following submittal of the region resurfacing list, the development of projects should abide by the Resurfacing Delivery Schedule (Appendix A), based on the earliest expected letting for projects on the list. Unified Plans, Specifications, and Estimates (PS&E) forms for resurfacing projects are available in Appendix C.

### SCHEDULE DATES

In an effort to deliver resurfacing projects in an efficient time frame, the Resurfacing Delivery Schedule offers suggested time frames for each activity based on target letting dates. In general, Interstate projects are initially targeted for the October letting, which requires selection of projects by May of the previous year. If Interstate documents are not on track to be complete for October plans turn-in dates, projects can be postponed for December letting, but it is preferred that all interstate projects be let and awarded by December letting. State Route projects initially target the February letting with the understanding that only a select portion of projects will need to be ready for February. Target letting dates are cooperatively set by the Program Development, Estimating, and Pavement Management offices based on regional priorities and recommendations from the Estimating Office and the Pavement Engineer.

### BIKE LANES AND PEDESTRIAN ACCESSIBILITY

The state bicycle and pedestrian coordinator receives resurfacing lists as part of the Resurfacing Delivery Schedule and compares the project lists with state and local bicycle and pedestrian plans, as well as consults with MPO/TPO staff and regional TDOT staff. The bike/ped coordinator then makes recommendations to the resurfacing coordinator for bike/pedestrian upgrades to be included in resurfacing plans. The resurfacing coordinator then works with local governments to determine their desire for upgrade, and coordinates the inclusion of a striping plan (with estimated quantities within the resurfacing plans.

## CURB RAMP INSTALLATIONS AND IMPROVEMENTS

In 2007, in an effort to make TDOT facilities more accessible to users with disabilities and to comply with the 1990 Congressional passing of the Americans with Disabilities Act (ADA) and the Public Rights-of-way Accessibility Guidelines (PROWAG), the Department began assisting local governments in the area of compliance with ADA by addressing needed repair and/or installation of curb ramps (elevating the curb ramps to meet ADA guidelines whenever possible) as encountered through the resurfacing program. Elements are identified during the PS&E process such that potential curb ramp installations or improvements will be made to improve accessibility on all TDOT resurfacing projects near existing sidewalk or other related pre-existing pedestrian elements.

## PS&E KICK-OFF MEETINGS

Once prioritized resurfacing lists have completed the initial conflict and bundling review process, each region and/or district will hold a PS&E Kickoff meeting to discuss projects prior to mobilizing for PS&E field reviews. Representatives from the following regional office should be in attendance during PS&E kickoff meetings:

- Regional Directors and/or Assistants
- District Managers
- Design
- Regional Traffic
- Those completing PS&E forms
- Materials and test

## PS&E FIELD REVIEWS

Field reviews should be completed using the unified PS&E form (Appendix C), which includes fields to be completed to meet Federal and other field review requirements for Low-Cost Safety Improvements, curb ramp/accessibility forms, and bicycle/pedestrian forms. Forms for each previously existed, but were absorbed into the statewide PS&E form in spring 2017.

In general, most observations made during PS&E reviews are recorded for documenting and communicating necessary information to regional design staff for proper development of plans quantities. On most occasions, calculation of quantities should be made using Design Guideline and Standard Drawing formulas. Calculation of quantities should be completed by design staff, using measurements made during PS&E reviews. If quantities are offered in submitted PS&Es – such as striping – design staff should still utilize design standards to check calculations. Some of the elements identified and measured during field reviews include, but are not limited to:

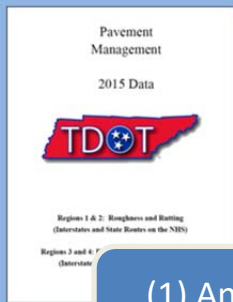
- Measurement of existing/required pavement markings
- Measurement of pavement/shoulder width for cross-section and pavement quantity calculation
- Storm Drain Adjustments
- Utilities – manholes, gas valves, water valves
- Shoulder stone measurements
- Side roads, driveways, intersections and other entrances requiring consideration
- Guardrail repair and upgrades
- Identification of curb ramps requiring repair or installation

Measurements of pavement marking are made under the assumption that layouts of existing pavement markings are correct and quantities required for resurfacing are equivalent. Any assessment for improvement of pavement markings or layouts should be made by regional Traffic or Design staff.

Observations to be made for low-cost safety improvements - such as whether existing horizontal curves, roadside obstacles, or ditches may cause a safety issue - may require assistance from regional Traffic personnel.

### **Spot Milling and Spot Leveling**

On many occasions, a need for small quantity milling or spot leveling or a combination thereof will be identified during development of resurfacing lists. If small areas are identified during PS&Es that require small quantity repair, quantities can be estimated in the field and documented on Page 2 of the PS&E form. Selection of mixtures used for leveling – 307CS, 307BM2, etc – is up to the discretion of regional or district preference. Additional Commentary on Spot Milling is provided herein in the Chapter on *Leveling Courses and Minor Rehabilitation*.



(1) Annual PM Report

(2) Preliminary Resurfacing Lists

PIN (to be created by HQ)	Reg. Pri.	County	Rt.	Beg LM	Termini Description
047453.01	1	Anderson	75	5.23	From North of SR-81 to County Line

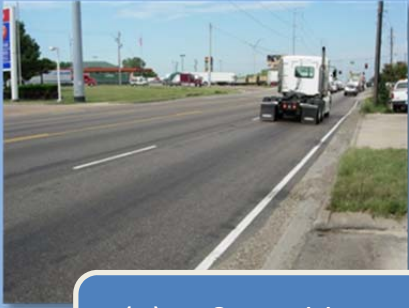
(3) Identify Conflicts and potential bundles (Group 'A')



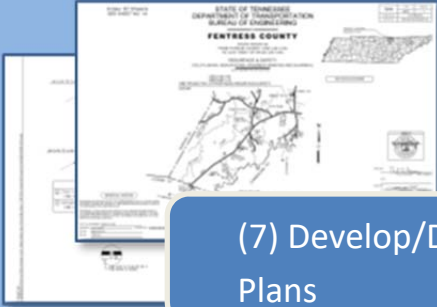
(4) PS&E Kickoff



(5) Notify Local Utilities & Railroad. permits



(6) PS&E Field Reviews



(7) Develop/Deliver Plans

Figure X. Resurfacing Delivery Schedule

## PAVEMENT TREATMENT GUIDELINES

The following Chapter outlines typical pavement resurfacing treatments for potential use on TDOT projects. Existing pavement condition and life extension values are based on historical experience, when available. Existing pavement condition values are to be used as guidance for selection of projects, but are guidance only and not expected to be strictly adhered to if local judgement and circumstances indicate otherwise. Life extension values are the official values to be used for calculation of lane-mile-years.

Suggestions for existing pavement condition are provided in terms of index values, HCIRI, and rut depth; but in all situations individual distresses such as block cracking, transverse cracking, patching, etc. should be considered in the final selection of pavement treatments.



## CRACK SEALING

**Description:** Crack sealing is the placement of specialized materials either above or into working cracks using unique configurations to reduce the infiltration of water and to reinforce the adjacent pavement.

Typically, crack sealing will occur by means of utilizing regional on-call crack sealing contracts administered by TN General Services. Regions have the option of utilizing these contracts for contractor-placed crack seal or crack seal supplied by contract and placed by TDOT forces. If so desired, the Region has the option of developing plans for TDOT letting bid contracts, but utilization of on-call contracts should first be considered before pursuing this option.

**Purpose:** Crack Sealing is used to minimize the intrusion of water through existing cracks. By keeping water out of the pavement, erosion of the mix is kept to a minimum, deterioration of the crack is slowed, and less water is available to saturate the base materials.

**Existing pavement condition:**

There is a wide window of opportunity for cost effective crack sealing of asphalt surfaced pavements. The intent is to select pavements which have sufficient cracking for crack sealing mobilization to be worthwhile, yet preclude excessively cracked pavements. The existing bituminous surface should be on a good base and cross section. On



**Centerline joint sealed**

both a flexible base and a composite Pavement, the bituminous surface should be four to five years old. However, the surface should be inspected when it is two to three years old to detect premature cracking. The visible surface distress may include: fairly straight open longitudinal and transverse cracks with slight secondary cracking and slight raveling at the crack face, and no patching or very few patches in excellent condition.

Pavement	PDI	PQI	HCIRI	Rut Depth	Pavement Age (yrs)
Flexible	n/a	n/a	n/a	n/a	4-5
Composite	n/a	n/a	n/a	n/a	4-5

**Existing pavement surface preparation:** Some air cleaning or routing of cracks may be necessary to

**Performance:** The effectiveness of the seal will greatly depend upon the width of crack being sealed and the movement of the pavement structure at the crack.

**Life Extension – Crack Sealing**

Pavement	Years
Flexible	Up to 3 years
Composite	Up to 3 years

The time range is the expected life extending benefit given to the pavement, not the anticipated longevity of the treatment.

**Performance Limitations:** Generally, all cracks in the traveled lanes and the shoulder areas should be filled. Transverse cracks that have excessive secondary cracking around the main crack should not be individually sealed. The presence of this type of transverse crack is an indication that the pavement surface may warrant a more extensive pavement surface treatment.

Crack sealing materials should be aged at least one year prior to micro-surfacing, any type of Hot Mix Overlay, or other treatment.

This treatment is not a one-shot operation. In order to maintain the sealed pavement surface, this treatment should be followed up by a routine maintenance crack sealing or crackfilling operation when additional cracks develop. Care should be taken when doing additional sealing so as not to seal extensive secondary cracks that will result in a safety problem.



**Excessive crack sealing of secondary cracks creating safety concerns**



**Quantity of crack seal is excellent; however, longitudinal crack seal is too heavy.**

**Items, Guidelines, and Specifications:**

**Item:** 411-04, Crack Sealant

**Unit:** LB

**Specifications:** Specifications are currently being added as plans special notes. Contact the Pavement Management office for a copy of the most recent notes for crack sealing.

**Design Guidelines:** Not available. In general, a rate of 1500 lb/mi has been used.

## FOG SEAL

**Description:** Fog seals are a light application of diluted asphalt emulsion placed directly on the pavement surface.

**Purpose:** Fog seals are used to seal the pavement, inhibit raveling, and provide some enrichment to a hardened and oxidized AC surface.

**Existing pavement condition:** Fog seals are most effective when applied on a pavement in relatively good condition with minor cracks and some surface raveling or oxidation.



Pavement	PDI	PQI	HCIRI	Rut Depth	Pavement Age (yrs)
Flexible	≥ 4.00	≥ 3.70	≤ 75	n/a	n/a
Composite	≥ 4.00	≥ 3.70	≤ 75	n/a	n/a

**Existing pavement surface preparation:** Repair and patch all major pavement defects. All cracks, other than hairline cracks, should be filled with suitable bituminous crack filler. Scrape all oil spots to remove excess oil and dirt. Just before applying the fog sealer clean the asphalt surface of all loose dust, dirt and other debris.

**Performance:** Fog seals generally last about one to four years before the pavement requires either another application or the placement of a more substantial surface restoration treatment. Fog seals are a low-cost means of rejuvenating the surface of the pavement and inhibiting raveling, and when placed early enough in the life of the pavement, can be effective at prolonging its life.

<b>Life Extension – Fog Seal</b>	
<b>Pavement</b>	<b>Years</b>
Flexible	Up to 4 years
Composite	Up to 4 years

**Performance Limitations:** Fog seals are not effective for sealing a pavement surface with cracks. They do not repair potholes, cracks, or major raveling. Repeated applications of a fog seal at regular intervals increases its effectiveness. Fog seals may also be an immediate remedy to address a surface course constructed with low asphalt content. Aggregate shall be included to boost frictional properties if process is used on roadway.

**Items, Guidelines, and Specifications:**

**Item:** 403-05, BITUMINOUS MATERIAL(TC/FOG SEAL)(UNDILUTED)

**Unit:** TON

**Specifications:** TDOT Standard Construction Specifications, SS403

**Design Guidelines:** 4-403.05

**Notes:** The items listed below may be used on shoulders if desired to reference fog seal materials listed on the Qualified Products List (QPL). A footnote should be included with the estimated quantity indicating “Product must be listed on Qualified Products List (QPL) List 40 for High Performance Fog Seals” or “Product must be listed on Qualified Products List (QPL) List 40 for Standard Fog Seals”, respectively.

403-01.10, High Performance Fog Seals, S.Y.

403-01.11, Standard Fog Seals, S.Y.

## LONGITUDINAL JOINT STABILIZATION

**Description:** The weakest section of the pavement is the longitudinal construction joint between traffic lanes. Longitudinal Joint Stabilization (LJS) is a method to rejuvenate and seal longitudinal construction joint. This clear sealing material reduces water intrusion into joints which delays joint failure. This treatment should be applied within two to three years of the pavement's resurfacing.



**Existing pavement condition:** Longitudinal joint stabilization treatment is most effective when applied on a pavement in relatively good condition. Particular attention should be made for condition of existing joints, which are only candidate for stabilization when in very good condition.

Pavement	PDI	PQI	HCIRI	Rut Depth	Pavement Age (yrs)
Flexible	n/a	n/a	n/a	n/a	2-3
Composite	n/a	n/a	n/a	n/a	2-3

**Existing pavement surface preparation:** Ensure surface is in a clean and dry condition.

**Performance:** Properly selected LJS projects will not immediately affect any pavement index values or distress, but should deter joints from deteriorating into cracks.

**Life Extension - LJS**

<b>Pavement</b>	<b>Years</b>
Flexible	Up to 3 years
Composite	Up to 3 years

**Performance Limitations:** Reflectivity of pavement markings is temporarily reduced until material is worn off of pavement markings. Treatment cannot be utilized on lanes adjacent to fog sealed areas.

Items, Guidelines, and Specifications

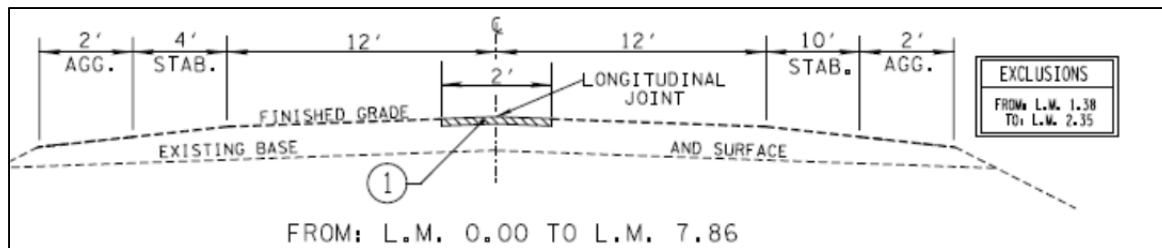
**Item:** 411-01.12, LONGITUDINAL JOINT STABILIZATION

**Unit:** S.F.

**Specifications:** Qualified Products List, QPL.40.004, Pavement Rejuvenators

**Design Guidelines:** Design guidelines are not currently available, but plans typically indicate a 2' wide application over all longitudinal joints. Quantities should be based on existing longitudinal construction joints, i.e. the number of lanes -1 when shoulder joints are not being sealed or the number of lanes +1 when shoulders *are* being sealed.





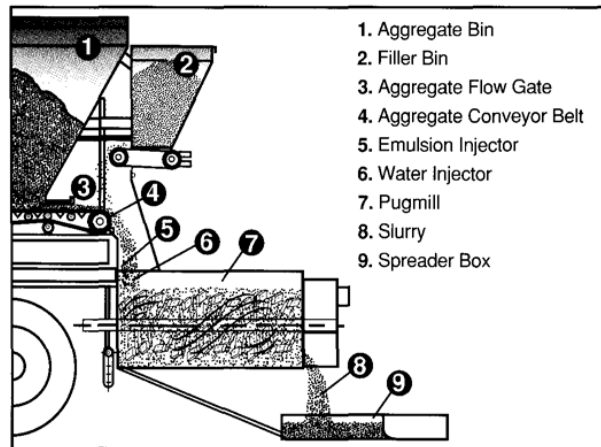
① JOINT STABILIZATION  
ITEM 411-01.12 LONGITUDINAL JOINT STABILIZATION

## SLURRY SEAL

**Description:** Slurry seals consist of a mixture of emulsified asphalt, fine aggregate, water and additives proportioned, mixed and uniformly spread over a properly prepared surface.

**Purpose:** Slurry seals are used to stop raveling and loss of matrix and improve surface friction. They can also be effective at sealing minor surface cracks.

**Existing pavement condition:** They are appropriate when the primary deterioration is related to excessive oxidation and hardening of the existing asphalt.



Pavement	PDI	PQI	HCIRI	Rut Depth	Pavement Age (yrs)
Flexible	≥ 4.00	≥ 3.70	≤ 75	≤ 0.125" (1/8")	≥ 7
Composite	≥ 4.00	≥ 3.70	≤ 75	≤ 0.125" (1/8")	≥ 7

**Existing pavement surface preparation:**

Immediately prior to applying the slurry seal, the surface shall be cleared of all loose material, oil spots, vegetation, and other objectionable material. It is advisable to pre-treat cracks in the pavement surface with an acceptable crack sealer prior to application of the slurry



seal. Tack coat is generally only applied in areas where the existing roadway is extremely dry and raveled.

**Performance:** The performance life of slurry seal is generally reported as three to five years on roads with moderate to heavy traffic. Slurry seals are effective in reducing the development of pavement cracking and raveling. They perform best when applied to pavements in relatively good condition.

### Life Extension – Slurry Seal

Pavement	Years
Flexible	Up to 5 years
Composite	Up to 4 years

**Performance Limitations:** Slurry seals should not be used on deteriorated pavements. Localized areas of severe distress should be patched prior to the application of the slurry seal. Working cracks should be sealed with a crack sealant, and the presence of a substantial number of wide or working cracks may indicate slurry seals are not an appropriate measure.

### Items, Guidelines, and Specifications

**Item:** 414-02.02: EMULSIFIED ASPHALT SLURRY SEAL

**Unit:** S.Y.

**Specifications:** TDOT Standard Construction Specifications, SS414

**Design Guidelines:** Same calculations and rates as 4-414.05, convert to S.Y. A rate of 16 lbs/s.y. is typically used.

## MICROSURFACING

**Description:** Micro-surfacing is a type of slurry seal that uses a polymer-modified emulsion binder, higher quality aggregates, and a set control additive.

**Purpose:** A single course micro-surface has been used effectively to improve surface friction characteristics and to seal the pavement surface, thereby addressing oxidation and raveling. A multiple course micro-surface has been used to correct certain pavement surface deficiencies including severe rutting, minor surface profile irregularities, polished aggregate or low skid resistance and light to moderate raveling.



**Existing pavement condition:** Micro-surfacing does not add significant structure to the existing pavement, so its use should be limited to pavements exhibiting little structural deterioration. The pavement should exhibit a uniform cross-section and a good base. The visible surface distress may include slight cracking, rutting, minor surface irregularities, flushed or polished surface and/or moderate raveling. Tack coat is generally only applied in areas where the existing roadway is extremely dry and raveled. Double applications are capable of improving moderate ruts. If significant rutting ( $>0.5''$ ) exists, additional quantity and notes can be added for a rutfill box.

### *Single Application @ 22 lbs./s.y.*

Pavement	PDI	PQI	HCIRI	Rut Depth	Pavement Age (yrs)
Flexible	$\geq 4.00$	$\geq 3.70$	$\leq 75$	$\leq 0.125'' (1/8'')$	$\geq 7$
Composite	$\geq 4.00$	$\geq 3.70$	$\leq 75$	$\leq 0.125'' (1/8'')$	$\geq 7$

**Double Application @ 32 lbs./s.y. (18 lb. & 14 lb.Lifts)**

Pavement	PDI	PQI	HCIRI	Rut Depth	Pavement Age (yrs)
Flexible	≥ 4.00	≥ 3.70	≤ 75	<0.5" (1/2")	≥7
Composite	≥ 4.00	≥ 3.70	≤ 75	<0.5" (1/2")	≥7

**Existing pavement surface preparation:** Pavements with fatigue cracking and/or significant linear cracking are not candidates for micro-surfacing unless these deteriorated areas are repaired prior to the placement of the micro-surfacing. Micro-surface is well suited to filling ruts on an otherwise sound pavement. Immediately prior to applying the micro-surface, the surface shall be cleared of all loose material, silt spots, vegetation, and other objectionable material.

**Performance:** This treatment corrects rutting, flushing and low friction. The service life of micro-surface is generally reported to be about six to eight years. However, in judging its performance, it must be recognized that micro-surface can be placed for different reasons and therefore its performance is tied closely to its application.

**Life Extension**

**Single Application @ 22 lbs./s.y.**

Pavement	Years
Flexible	6 to 8
Composite	5 to 7

**Double Application @ 32 lbs./s.y. (18 lb. & 14 lb.Lifts)**

Pavement	Years
Flexible	7 to 9
Composite	7 to 9

**Performance Limitations:** A standard micro-surface formulation should not be used on a pavement with moderate to heavy surface cracks. Micro-surface mixes require warm to moderate temperatures for curing; caution is recommended for late season nighttime work.



**SR 290 - Putnam County – Minor rutting and cracking. Single course micro-surface.**

#### **Items, Guidelines, and Specifications**

**Items:** 414-03.01 EMULSIFIED ASPHALT FOR MICRO-SURFACING, TON  
and  
414-03.02 AGGREGATE FOR MICRO SURFACING, TON  
or  
414-03.03 MICRO SURFACING, S.Y.

**Specifications:** TDOT Standard Construction Specifications, SS414

**Design Guidelines:** 4-414.05, convert to S.Y. for Item No. 414-03.03

## SCRUB SEAL

**Description:** The scrub seal process provides an economical treatment that fills cracks, rejuvenates worn asphalt pavement and provides a durable wearing course. Scrub seals are also used to provide a membrane with resistance to reflective cracking.

**Purpose:** The primary purpose of the scrub seal treatment is to fill cracks and seal the asphalt pavement.



**Ribbon of material in front of broom**



**Extensive cracking from oxidized pavement**

**Existing pavement condition:** Scrub seals are capable of improving roadways with a large amount of cracking, with individual cracks up to ¼" wide, but they are not intended to improve the structural condition of pavements. Therefore, the seal should only be used on stable asphalt pavements that are dry, oxidized and cracked.

Pavement	PDI	PQI	HCIRI	Rut Depth	Pavement Age (yrs)
Flexible	n/a	n/a	n/a	≤ 0.125" (1/8")	≥7
Composite	n/a	n/a	n/a	≤ 0.125" (1/8")	≥7

**Existing pavement surface preparation:** The pavement shall be cleaned of all loose dirt, vegetation and other objectionable material prior to the application to the scrub seal.

**Performance:** Scrub seal has an estimated life of six years. The scrub seal rejuvenates the existing pavement, seals existing pavement, fills cracks and voids, and provides a skid-resistant wearing surface.

#### Life Extension – Scrub Seal

Pavement	Years
Flexible	Up to 7 Years
Composite	Up to 7 Years

**Performance Limitations:** The emulsion bonds to the cracks and seals them from water damage. Pavements with a poor subgrade are not good candidates for a scrub seal.

Scrub seals are often combined with other treatments such as a micro-surface or thin overlay. If not, it is good practice to fog seal as described in SS403 for fog sealing of shoulders.



**Application of asphalt sealer**  
sealer



**Aggregate applied to asphalt**





**Brooming of aggregate cover material**



**Rolling of aggregate cover material – 2 passes**



**Scrub Seal approximately one year after placement salt is present  
from winter treatment**

**Items, Guidelines, and Specifications**

**Items:** 405-03.01: PM REJUVENATING SCRUB SEAL

**Unit:** S.Y.

**Specifications:** SP405SS

**Design Guidelines:** When utilizing scrub seal as a part of a combination treatment, tack coat is typically excluded, i.e. no tack is required on top of scrub seal when paving over a scrub seal.

## CHIP SEAL

**Description:** The chip seal process provides an economical treatment that fills cracks, rejuvenates worn asphalt pavement and provides a durable wearing course.

**Purpose:** The primary purpose of the chip seal treatment is to fill cracks and seal the asphalt pavement. When appropriate, chip seal treatments should be considered as a treatment when ADT's are less than 750. Unless the chip seal is to be covered by another treatment, a fog seal is placed immediately following chip seal construction.



**Fog Seal Applied after Chip Seal is complete to help curing and lock aggregate in place**

**Existing pavement condition:**

Chip seals are capable of improving roadways with significant levels of cracking, with individual cracks up to 3/16" wide, but they are not intended to improve the structural condition of pavements. Therefore the seal



should only be used on stable asphalt pavements that are dry, oxidized and cracked.

Pavement	PDI	PQI	HCIRI	Rut Depth	Pavement Age (yrs)
Flexible	n/a	n/a	n/a	≤ 0.125" (1/8")	≥7
Composite	n/a	n/a	n/a	≤ 0.125" (1/8")	≥7

**Existing pavement surface preparation:** The pavement shall be cleaned of all loose dirt, vegetation and other objectionable material prior to the application to the chip seal.

**Performance:** Chip seal has an estimated life of six years. The chip seal rejuvenates the existing pavement, seals existing pavement, fills cracks and voids, and provides a skid resistant wearing surface.

**Life Extension**

Pavement	Years
Flexible	6 Years
Composite	6 Years

**Performance Limitations:** The emulsion bonds to the cracks and seals them from water damage. Pavements with a poor subgrade are not good candidates for a chip seal.



**Aggregate applied to asphalt sealer      Rolling of aggregate cover material – 2 passes**



**Completed Chip Seal w/ Fog Seal**

## Items, Guidelines, and Specifications

<b>Items:</b>	405-01.01, BITUMINOUS MATERIAL (BSC) 405-01.02, MINERAL AGGREGATE (BSC) 403-05, BITUMINOUS MATERIAL(TC/FOG SEAL)(UNDILUTED)
<b>Unit:</b>	TON
<b>Specifications:</b>	TDOT Standard Construction Specifications, SS405, Bituminous Seal Coat
<b>Design Guidelines:</b>	4-405.00

## CAPE SEAL

**Description:** A cape seal is a chip seal treatment that is topped with one layer of micro-surfacing. The chip seal process provides an economical treatment that fills cracks, provides a crack relief layer to mitigate reflective cracking in the future and the micro-surfacing provides a riding surface.

**Purpose:** The primary purpose of this dual treatment is to mitigate top down cracking on an older (but healthy) pavement. This treatment can be a cheaper alternative to a milling and overlay project.



**Chip Seal prior to Microsurfacing Lift being placed**

**Existing pavement condition:** As noted for chip seals, Cape Seals are a reliable method for mitigating non-structural top-down cracking. Roadways with moderate distress and acceptable rideability make good candidates for cape seals.

Pavement	PDI	PQI	HCIRI	Rut Depth	Pavement Age (yrs)
Flexible	≥ 3.60	≥ 3.50	≤ 75	≤ 0.25"	≥9
Composite	≥ 3.30	≥ 3.30	≤ 90	≤ 0.25"	≥9



**Extensive cracking from oxidation, no structural damage**

A cape seal is not intended to improve the structural condition or smoothness of pavements. Therefore, the seal should only be used on stable asphalt pavements with moderate cracking. The existing pavement will need to have a smoother surface (similar to a Microsurfacing candidate) but with top-down cracking.



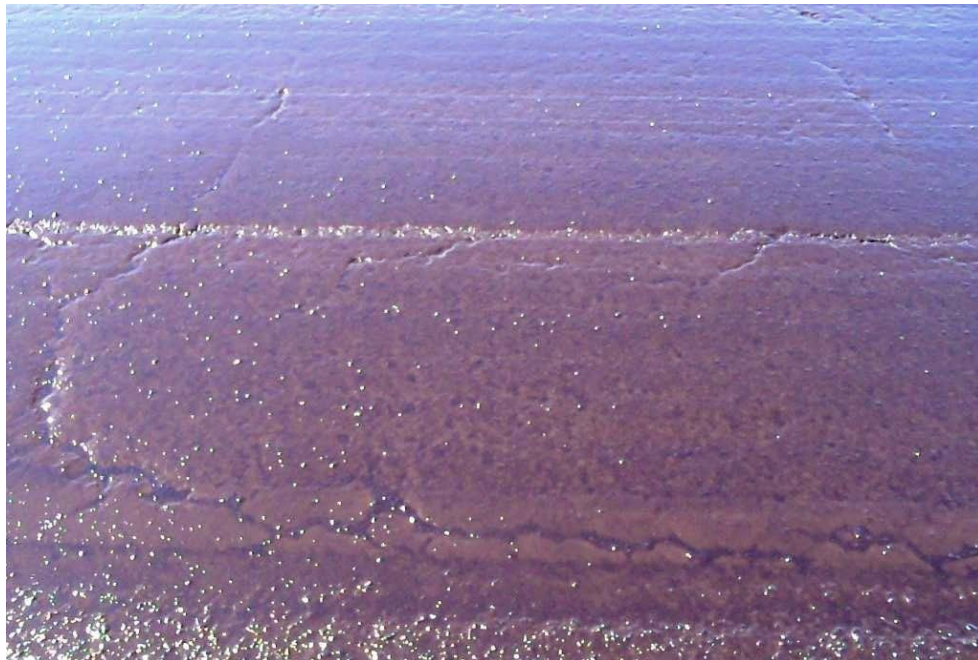
**Existing pavement surface preparation:** The pavement shall be cleaned of all loose dirt, vegetation and other objectionable material prior to the application to the chip seal.

**Performance:** Chip seal and Microsurfacing has an estimated life of ten years. The chip seal rejuvenates the existing pavement, seals existing pavement, fills cracks and voids, and the Microsurfacing provides a very durable and smooth riding surface.

### Life Extension

Pavement	Years
Flexible	10 Years
Composite	10 Years

**Performance Limitations:** The emulsion bonds to the cracks and seals them from water damage. Pavements with a poor subgrade are not good candidates for this process.



**CRS-2P Emulsion filling the cracks prior to aggregate being dropped**



**Completed Chip Seal with 24 lbs/SY Microsurfacing**

## **Items, Guidelines, and Specifications**

**Items:** Chip seal items, rates, and calculations are the same as for *Chip Seals*.

Microsurface items, rates, and calculations are the same as for *Microsurfacing*, with the exception that an aggregate rate of 24 lbs/yd<sup>2</sup> should be used.

**Unit:** See above.

**Specifications:** See above.

**Design Guidelines:** See above.

## THIN OVERLAY TREATMENT

**Description:** Thin hot mix asphalt (HMA) overlays are the most commonly utilized treatments in the pavement preventive maintenance program. A minor amount of structural improvement is provided with this strategy. To qualify as preventive maintenance, an HMA mixture is limited to 1-3/4" in thickness as an overlay.



Use of shuttle buggy on thin overlay

Some of the mixes that meet these guidelines are:

- 1-1/4" (132.5 lbs/yd<sup>2</sup>) of 411-D or 411-TLD mix
- 3/4" (85 lbs/yd<sup>2</sup>) of Thin Lift "D" or "TL" mix
- 5/8" (65 lbs/yd<sup>2</sup>) of Thin Lift "TL" mix

**Purpose:** Thin overlays protect the pavement structure, reduce the rate of pavement deterioration, correct surface deficiencies, reduce permeability and improve the ride quality of the pavement.

**"D" Mix** – This treatment is very commonly used typically used on higher ADT routes and on more heavily distressed roadways. Occasionally "D" Mix is used to add structure to routes inherited from the counties in the 1982 Road Program Act.

**Thin Lift "D" Mix** – This type of mix is similar to the "D" Mix minus the 1/2" aggregate. This treatment is typically applied to roadways with low-to-moderate ADT volumes and minor-to-moderate cracking.

**Thin Lift “TL” Mix** – This treatment is typically applied to routes that exhibit little or no distress and acceptable pavement structure. This treatment is only successful as a preservation treatment to combat oxidation of the wearing. No structural improvement and little or no improvement in roadway smoothness can be anticipated.

**Existing pavement condition:** The existing pavement should exhibit a good base condition and a uniform cross section. The visible surface distress may include moderate raveling, longitudinal and transverse cracks and small amounts of block cracking. Only minor base failures and depressions should be present.

**“D” Mix (1 ¼”)**

Pavement	PDI	PQI	HCIRI	Rut Depth	Pavement Age (yrs)
Flexible	≥ 3.60	≥ 3.50	≥ 75	≤ 0.25”	≥9
Composite	≥ 3.30	≥ 3.30	≥ 90	≤ 0.25”	≥9

**Thin Lift “TL” or Thin Lift “D” Mix (3/4”)**

Pavement	PDI	PQI	HCIRI	Rut Depth	Pavement Age (yrs)
Flexible	≥ 3.90	≥ 3.70	≤ 75	≤ 0.125”	≥7
Composite	n/a	n/a	≤ 75	≤ 0.125”	≥7

**Thin Lift Mix (5/8”)**

Pavement	PDI	PQI	HCIRI	Rut Depth	Pavement Age (yrs)
Flexible	≥ 4.00	≥ 3.70	≤ 65	≤ 0.125”	≥7
Composite	n/a	n/a	≤ 65	≤ 0.125”	≥7

**Existing pavement surface preparation:** The preparation work should be limited to the repair of the minor base failures and depressions, the filling of voids in the pavement

surface, the removal of any patched area with poor adhesion or a very high asphalt content that may bleed up through the new bituminous surface.

**Performance:** This treatment performs best on flexible pavement structures, but is also applicable to composite pavements depending on the extent of the reflective cracking.

**Life Extension (“D” Mix @ 1 ¼”)**

Pavement	Years
Flexible	12 Years
Composite	10 Years

**Life Extension (Thin Lift “D” Mix @ ¾”)**

Pavement	Years
Flexible	9 Years
Composite	n/a

**Life Extension Thin Lift Mix (@ 5/8”)**

Pavement	Years
Flexible	7 Years
Composite	n/a

**Performance Limitations:** A thin HMA overlay should not be placed on the following existing pavement conditions: severely distressed composite pavement, severely raveling or rutted bituminous pavement, pavement with a weak base, or a bituminous surface that is de-bonding.



SR 111 - White County - 1-1/4" "D" Mix with 2-foot taper on shoulders

Items, Guidelines, and Specifications

Items:

ITEM NUMBER	DESCRIPTION
411-01.10	GRADING D SURFACE ( PG 64-22 )
411-02.10	GRADING D SURFACE ( PG 70-22 )
411-03.10	GRADING D SURFACE ( PG 76-22 )
411-03.07	GRADING TL SURFACE ( PG 64-22 )
411-03.08	GRADING TL SURFACE ( PG 70-22 )
411-03.09	GRADING TL SURFACE ( PG 76-22 )
411-03.12	GRADING TLD SURFACE ( ( 64-22 )
411-03.13	GRADING TLD SURFACE ( PG 70-22 )
411-03.14	GRADING TLD SURFACE ( PG 76-22 )

**Unit:** TON

**Specifications:** TDOT Standard Construction Specifications, SS411

**Design Guidelines:** 4-411.00, 4-300.00 (PG Grade Selection)

**Notes:** In the event that 411-TLD or 411-TL is specified at an application rate of 1-1/4", a footnote may be required if there is a desire to require density testing or more than 2 rollers (*See Standard Spec 407.15*)



## CHIP SEAL WITH THIN OVERLAY

**Description:** The chip seal process provides an economical treatment that fills cracks, rejuvenates worn asphalt pavement and provides a durable wearing course. The thin overlay provides a smooth and more durable riding surface that looks similar to a thin mix overlay or to 411 D overlay.

**Purpose:** The primary purpose of this dual treatment is to mitigate top-down cracking on an older (but healthy) pavement. This treatment can be a cheaper alternative to a milling and overlay project and add some additional structure. Chip seals need to be done on the correct route. Not all routes are good candidates due to being in town or in a residential area. These tend to be rural area projects.



Chip Seal prior to Thin Lift of Hot Mix Asphalt being

**Existing pavement condition:**

There are only two sure ways to mitigate top-down cracking in a pavement: By milling and replacing or by using a polymerized chip seal.



Extensive cracking from oxidized pavement, no structural damage

The chip seal will fill cracks and the aggregate will be used as a crack relief layer. A chip seal is not intended to improve the structural condition of the pavement. Therefore, the seal should only be used on stable asphalt pavements that are dry, oxidized and cracked.

***Chip Seal with 5/8" Thin Overlay***

Pavement	PDI	PQI	HCIRI	Rut Depth	Pavement Age (yrs)
Flexible	≥ 3.2	≥ 3.5	≥ 3.50	≤ 0.125"	≥7
Composite	n/a	n/a	n/a	n/a	≥7

***Chip Seal with 3/4" Thin Lift "TL" or Thin Lift "D" Mix (3/4") Overlay***

Pavement	PDI	PQI	HCIRI	Rut Depth	Pavement Age (yrs)
Flexible	≥ 3.50	≥ 3.40	≤80	≤ 0.125"	≥9
Composite	n/a	n/a	n/a	n/a	≥9

***Chip Seal with 1-1/4" 411-D Overlay***

Pavement	PDI	PQI	HCIRI	Rut Depth	Pavement Age (yrs)
Flexible	≥ 3.50	≥ 3.50	≤100	≤ 0.125"	≥9
Composite	n/a	n/a	n/a	n/a	≥9

**Existing pavement surface preparation:** The pavement shall be cleaned of all loose dirt, vegetation and other objectionable material prior to the application to the chip seals.

**Performance:** Chip seal and thin hot mix overlay has an estimated life of 12 years. The chip seal rejuvenates the existing pavement, seals existing pavement, fills cracks and voids, and the thin lift of hot mix asphalt provides a very durable and smooth riding surface.

### Life Extension

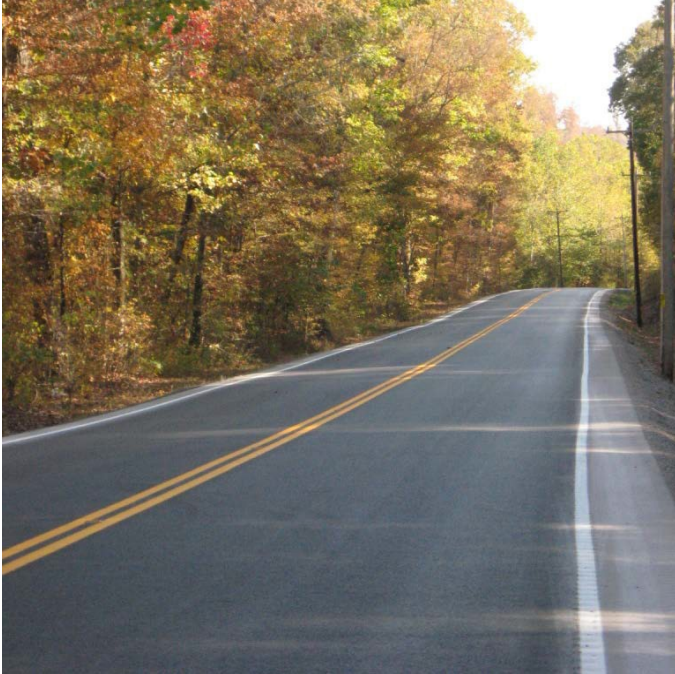
*Chip Seal w/ 5/8" Thin Overlay, 3/4" Thin Lift "D" Overlay,  
or 1-1/4" 411-D Overlay*

Pavement	Years
Flexible	12 Years
Composite	n/a

**Performance Limitations:** The emulsion bonds to the cracks and seals them from water damage. Pavements with a poor subgrade are not good candidates for a chip seal.



**CRS2P Emulsion filling cracks prior to aggregate placement**



**Completed Chip Seal with Thin Overlay**

**Items, Guidelines, and Specifications**

- Chip seal items, rates, and calculations are the same as for **“Chip Seal with a Fog Seal”**
- Thin Overlay items, rates, and calculations are the same as for **“Thin Overlay Treatment”**

## OPEN-GRADED FRICTION COURSE

**Description:** Open-Graded Friction Course (OGFC) pavement is a specialty type treatment used to increase safety in areas where concerns exist for wet-weather safety. The porous nature of OGFC permits rain water to permeate through the surface and drain underneath along the cross slope, minimizing ponding and hydroplaning.

**Purpose:** OGFC treatments are recommended for areas with high posted speeds and traffic volumes.

**Existing Pavement Condition:** Existing pavement condition for OGFC treatments are similar to that described for traditional Mill and Replace treatments. OGFCs should be considered in higher-speed areas as an alternative to Mill and Replace. On most occasions, an interlayer mixture should be placed to seal the existing pavement before placement of the OGFC pavement. Milling 1-1/4" prior to placing OGFCs is common.

### *Mill, CS & OGFC (1/2" 307-CS, 1-1/4" 411-OGFC)*

Pavement	PDI	PQI	HCIRI	Rut Depth	Pavement Age (yrs)
Flexible	<3.50	<3.40	>100	>0.250"	≥9
Composite	<3.50	<3.40	>100	>0.250"	≥9

### *Mill, C & OGFC (1-1/2" 307-C, 1-1/4" 411-OGFC)*

Pavement	PDI	PQI	HCIRI	Rut Depth	Pavement Age (yrs)
Flexible	<3.50	<3.40	>100	>0.250"	≥9
Composite	<3.50	<3.40	>100	>0.250"	≥9

**Existing Pavement Surface Preparation:** None.

**Performance:** OGFC was not a significant part of TDOT's program until 2009, which limits the amount of available data to assess OGFC performance. As of summer 2017, OGFC performance data from Interstate projects is proving to be comparable to Mill and 411D up to 8 years.

**Mill, CS & OGFC (1/2" 307-CS, 1-1/4" 411-OGFC)**

Pavement	Years
Flexible	9 Years
Composite	n/a

**Mill, C & OGFC (1-1/2" 307-C, 1-1/4" 411-OGFC)**

Pavement	Years
Flexible	11 Years
Composite	n/a

**Performance Limitations:** OGFCs typically have higher costs than other pavement treatments, so they should only be used when traffic speeds and volumes indicate a safety benefit may be likely to result from placement.

**Items, Guidelines, and Specifications**

**Asphalt Items:** 411-03.23, ACS MIX (PG76-22) OGFC, TON  
 307-03.10, ASPHALT CONC MIX (PG76-22)(BPMB-HM) GR CS, TON  
 307-03.09, ASPHALT CONCRETE MIX (PG76-22) (BPMB-HM) GRADING C,  
 TON

**Cold Plane Items:** 415-01.01, COLD PLANING BITUMINOUS PAVEMENT, TON  
 or  
 415-01.02, COLD PLANING BITUMINOUS PAVEMENT , S.Y  
 or  
 415-01.03, COLD PLANING BITUMINOUS PAVEMENT, C.Y.  
*(as directed by Design Guidelines)*

**Specifications:** TDOT Standard Construction Specifications, SS415

**Design Guidelines:** 4-307.00, 4-411.00

## MILL AND REPLACE TREATMENT

**Description:** The removal of an existing bituminous surface by the cold milling method and the placement of a HMA mixture limited to a depth of 1-1/4". The new inlay (1 ¼" "D" mix or ¾" Thin Lift "D" mix) replaces the surface removed.

**Purpose:** In preventive maintenance cold milling is used for the restoration of cross-slopes, correct specific existing surface deficiencies, and produces a more economical project as compared to an overlay project. The inlay replaces the surface material removed by cold milling.

**Existing pavement condition:** The existing pavement should exhibit a good base condition. The visible surface distress may include: severe surface raveling, multiple longitudinal and transverse cracking with slight raveling, a small amount of block cracking, patching in fair condition, debonding surface and slight to moderate rutting.

The cold milling operation is used to correct rutting in the existing bituminous surface layer where the rutting is not caused by a weak base and when the condition of the existing pavement has deteriorated to a point where it is not practical to correct the rutting problem by a more economical treatment. The cold milling operation is also used to remove an existing bituminous course that is de-bonding.



**Milling Machine and Water Truck**

Existing pavement crown and super-elevation sections that have been identified as having a relationship to accidents can be modified by cold milling. In a curb-and-gutter section, cold milling can be used to remove a portion of the existing surface to retain the existing

curb face. Cold milling can also be used in those areas where the existing pavement grade cannot be raised.

***Mill and Replace Treatment (1-1/4", 411D)***

Pavement	PDI	PQI	HCIRI	Rut Depth	Pavement Age (yrs)
Flexible	<3.50	<3.40	>100	>0.250"	≥9
Composite	<3.50	<3.40	>100	>0.250"	≥9

***Mill and Replace Treatment (3/4", 411TLD)***

Pavement	PDI	PQI	HCIRI	Rut Depth	Pavement Age (yrs)
Flexible	<3.70	<3.60	>85	>0.250"	≥9
Composite	<3.70	<3.60	>85	>0.250"	≥9

**Existing pavement surface preparation:** None.

**Performance:** This type of treatment will protect the remaining pavement structure, slow the rate of deterioration and improve the ride quality. This treatment performs best on flexible pavement structures, but is also applicable to composite pavements depending on the extent of the reflective cracking. A material transfer device, such as a shuttle buggy, is required on any roadway with sufficient clearance.



**Milling machine in operation**



**Mill and Replace Treatment (1-1/4" 411D or 3/4" 411TLD)**

<b>Pavement</b>	<b>Years</b>
Flexible	12 Years
Composite	12 Years

**Performance Limitations:** This treatment should not be used on an existing pavement that shows evidence of a weak base.

**Items, Guidelines, and Specifications**

**Asphalt Items:** Asphalt, rates, and calculations are the same as for **“Thin Overlay Treatment”**

**Cold Plane Items:** 415-01.01, COLD PLANING BITUMINOUS PAVEMENT, TON  
or  
415-01.02, COLD PLANING BITUMINOUS PAVEMENT , S.Y  
or  
415-01.03, COLD PLANING BITUMINOUS PAVEMENT, C.Y.  
*(as directed by Design Guidelines)*

**Specifications:** TDOT Standard Construction Specifications, SS415

**Design Guidelines:** 4-411.00, 4-415.00

**Notes:** It is recommended that - unless evidence is available indicating the existing total pavement thickness is more than sufficient - spread rates selected for milling depth should be less than or equal to rates select for asphalt paving.

In the event that 411-TLD or 411-TL is specified at an application rate of 1-1/4”, a footnote may be required if there is a desire to require density testing or more than 2 rollers *(See Standard Spec 407.15)*

## HOT IN-PLACE RECYCLING

**Description:** The heating of existing pavement followed by the addition of a polymerized asphalt rejuvenating agent. The heated, rejuvenated mixture is then re-mixed and re-compacted with traditional hot-mix paving equipment

**Purpose:** Restore existing pavement conditions to conditions suitable for use as a base for a new surface layer while minimizing waste material and need for new materials.

**Existing pavement condition:** A hot in-place recycling candidate may have some aggregate raveling, minor to moderate cracking, and the occasional small patched pothole. This treatment should not be selected for roadway segments with a significant amount of high severity cracking or large amounts of patching. The existing surface to be recycled should have retained enough of its original aggregate gradation that it can be recycled into a suitable subsurface layer without a significant need for additional bituminous material.

### *Hot In-Place Recycling Treatment (1-1/4") with either 22 lb/sy micro or 85 lb/sy 411-TLD*

Pavement	PDI	PQI	HCIRI	Rut Depth	Pavement Age (yrs)
Flexible	<3.50	<3.40	>100	>0.250"	≥9
Composite	<3.50	<3.40	>100	>0.250"	≥9

**Existing pavement surface preparation:** None.

**Performance:** Not including earlier variations of this method in which the construction specifications were significantly different, TDOT’s experience with this treatment began in 2013. Consequently, local performance data is limited.

### *Hot In-Place Recycling Treatment (1-1/4") with either 22 lb/sy micro or 85 lb/sy 411-TLD*

Pavement	Years
Flexible	10 Years
Composite	10 Years

**Performance Limitations:** This treatment should not be used on an existing pavement that shows evidence of a weak base.

### **Items, Guidelines, and Specifications**

**Items:** 311-03.01, HOT IN PLACE RECYCLING OF ASPHALT PAVEMENT (1.25IN), S.Y.  
311-03.04 HOT IN PLACE RECYCLING OF ASPHALT PAVEMENT (2.00IN), S.Y.  
311-03.10 Asphalt Rejuvenating Agent, GAL.

**Specifications:** SP407HRA

**Design Guidelines:** The Feb2018 version of SP407HRA lists a rejuvenating rate of 0.10-0.30 gal/sy. The midpoint value may be used for estimating quantities, but other rates within the range may also apply. Check with Regional Resurfacing staff and local Materials and Tests.

## LEVELING COURSES AND MINOR REHABILITATION

On occasion, roadway segments are identified that have deteriorated beyond the preventative maintenance criteria listed above but are not yet candidates for Major Rehabilitation. These segments are categorized as candidates for minor rehabilitation, which includes either a full width leveling course or small quantity for spot milling and/or spot leveling mixture.

Specific metrics for existing pavement condition have not yet been identified by the Department to identify when a full leveling course is merited, but historically a pavement segment with a PQI less than 2.3 will require minor rehabilitation. For a list of possible types of Minor Rehabilitation, see the chapter provided herein titled “Major and Minor Rehabilitation”.

### **Treatments with Full-Width/Full-Length Leveling Course**

If a pavement segment is identified which requires a leveling course for the length of the project, this shall be identified on the resurfacing list during initial project selection. In general, 307-CS and 307-BM2 mixtures are most often used as leveling course. A common minimum spread rate used for CS is 40 lbs/yd<sup>2</sup>, but higher rates can be specified. The minimum spread rate often used for 307-BM2 is 100 lbs/yd<sup>2</sup>, but 170 lbs/yd<sup>2</sup> (1-1/2”) is optimal. The following are common Treatment Types which include leveling courses, not including OGFC treatments:

- Mill, BM-2, & 411D
- Mill, CS, & 411D

### **Spot Leveling**

During field reviews and PS&E reviews, isolated locations of distress may be identified which may benefit from small repairs but are not large or significant enough to merit a full length leveling course. Fields are provided within the PS&E form to permit adding small quantities of milling and/or asphalt mixture to improve these small areas prior to placement of the overall pavement treatment. Mixture can be added to contracts to fill small low spots in the roadway or

matching quantities of milling and asphalt can be added for the repair of small areas with significant distress. Quantities are determined based on field measurement. Mixtures commonly used for leveling include 307-CS and 411-E. In areas where deeper repairs are necessary (>2”) additional quantity of 307-BM2 may be required.

## Performance

For pavement treatments including full-width leveling courses, performance is dependent on the depth of milling, if any, and the depth of interlayer. Life extension values provided below are based on the average of historical experiences. Longer life extension values may be expected if a higher than average thickness leveling course is placed. Since leveling courses and minor rehab are reserved for roadways with higher normal distress, it is common to expect life extension equivalent to what is expected for mill and replace treatments in lesser-distressed areas.

### Life Extension: Mill, BM-2, & 411-D

Pavement	Years
Flexible	12 Years
Composite	12 Years

### Life Extension: Mill, CS, and 411-D

Pavement	Years
Flexible	12 Years
Composite	12 Years

## Items, Guidelines, and Specifications

- See “Mill and Replace Treatment”

## ADDITIONAL COMBINATIONS OF TREATMENTS

On occasion, during development of resurfacing lists, a need may be identified to use a combination of pavement treatments listed herein. For projects such as these, good judgement should be used to estimate the applicability of the combined treatment and the estimated life extension. For record-keeping purposes, the Pavement Management office will make final decisions on estimated life extension values.

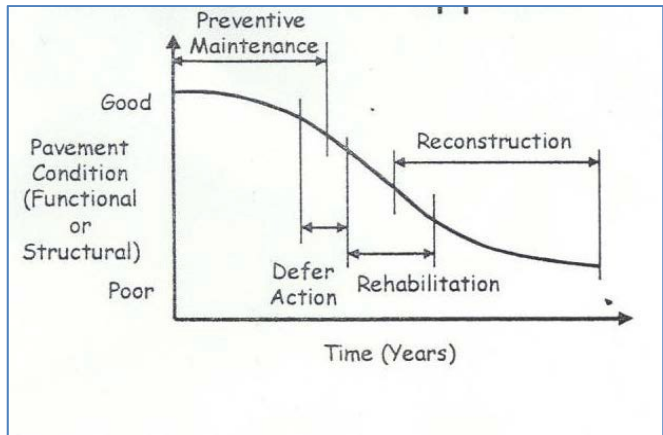
## DEVELOPMENT OF NEW RESURFACING TREATMENTS

The Department encourages innovation and the pursuance of technologies that help deliver our mission. As new technologies are made available for consideration as pavement treatment, a few considerations should be made to ensure proper implementation into projects, avoid conflicts with existing specifications, and minimize plans revisions and subsequent construction risks. Below is a list of items to consider when developing new resurfacing treatments:

- A draft special provision is preferred and should be sent to the state spec-writer for approval, especially when used on Federally-funded projects
  - Plans special notes may be used under select circumstances, but is discouraged.
  - SPs should refer to existing standard specifications whenever applicable.
  - Construction acceptance procedures should be included.
- Draft supplemental design guideline considerations should be developed to ensure proper calculations of quantities and necessary footnotes.
  - An assessment should be made to determine if other design guidelines may need to be revised, such as rates of other treatments being used in combination (i.e. micro rates increase to 22 lbs/yd when used over a chip or scrub seal.)
- An assessment should be made as to whether “Just in Time Training” should be provided to Departmental field staff prior to start of work.

# MAJOR AND MINOR REHABILITATION

On occasion roadway segment are identified that Rehabilitation is the next pavement treatment in the Pavement Management Program following preventive maintenance. Rehabilitation is divided into two (2) categories: (1) Minor rehabilitation & (2) Major rehabilitation. Minor rehabilitation is necessary when repair costs



to the pavement exceed the benefits derived from preventive maintenance treatments or when pavement structure needs to be increased. Major rehabilitation is necessary when the pavement deteriorates due to structural deficiencies or structural failure. Minor rehabilitation is limited to a pavement thickness of 2 ¾", with a possible milling depth of up to 1 ¼". Major rehabilitation requires a pavement thickness greater than 2 ¾", with a possible milling depth greater than 1 - ¼".

Since both types of rehabilitation (minor or major) encompass an extensive amount of work to elevate the pavement to an acceptable service level, as well as an excessive cost to perform the work, these treatments are typically delayed until sufficient funds can be set aside without having a significant impact to the resurfacing program. Therefore, these sections of roadway are generally addressed through routine maintenance until the funding for the extensive work can be obligated. Historically, each region will perform only one of these treatments (either minor or major rehabilitation) once every two to three years.

Looking forward, the Pavement Management office intends to develop a program for quantitatively identifying rehabilitation projects, but the necessary data is not available at this time.

## MINOR REHABILITATION TREATMENTS:

### Flexible and Composite Pavement Treatments

- Leveling Course and Thin Overlay
- Binder Course and Thin Overlay
- Milling ( $\leq 1-1/4"$ ), Leveling Course, and Thin Overlay
- Milling ( $\leq 1-1/4"$ ), Binder Course, and Thin Overlay
- Performance Grade Leveling Course and Performance Grade Thin Overlay
- Performance Grade Binder Course and Performance Grade Thin Overlay
- Milling ( $\leq 1-1/4"$ ), Performance Grade Leveling Course, and Performance Grade Thin Overlay
- Milling ( $\leq 1-1/4"$ ), Performance Grade Binder Course, and Performance Grade Thin Overlay

## MAJOR REHABILITATION TREATMENTS:

### Flexible and Composite Pavement Treatment

- Binder Course and Thin Overlay
- Milling ( $\geq 1-1/4"$ ), Binder Course, and Thin Overlay
- Performance Grade Binder Course and Performance Grade Thin Overlay
- Milling ( $\geq 1-1/4"$ ), Performance Grade Binder Course, and Performance Grade Thin Overlay

Some mixes which are used in addition to the wearing surface treatment can include the following: Binders - "B-M" or "B-M2" mix (1 1/2" to 2" depth) or Leveling - "C-W" mix (1 1/2" depth) or "CS" mix (5/8" depth).



Project selection for both minor and major rehabilitation will use data from the Pavement Management System (PMS) and visual inspection. A high priority for selection will be given to age and the overall pavement quality index (PQI). Both rehabilitation processes requires a PQI of less than 2.3. The PQI is derived from the pavement serviceability index (PSI) and the pavement distress index (PDI).



**DeKalb County - SR 26 – Binder (BM-2)  
Placement**

## LOW COST SAFETY IMPROVEMENTS / HSIP Funding

Currently, upon creation of state project numbers all resurfacing projects receive a federal Highway Safety Improvement Program (HSIP) project number to cover the cost of qualifying safety improvements. If the total safety improvements do not reach a minimum of \$10,000, the cost will be absorbed under the normal resurfacing project number and the HSIP project numbers will be deleted. In the early years of using HSIP funds on resurfacing projects, a “Resurfacing Safety Checklist” was developed, but all qualifying fields have been incorporated into the PS&E form in Appendix C. As safety improvement needs continuously change over time, so does the list of items qualifying for HSIP funds on resurfacing. At current, the items listed below qualify for HSIP funds. This list of items is subject to revision, which will be communicated to regional Resurfacing and Design staff by the State Pavement Engineer.

### **Items Qualifying for HSIP Funds on Resurfacing Projects**

- Quantities added to widen to 2-foot shoulder in situations where the existing shoulder is less than two feet and the widening can occur with minimal grading and no right-of-way acquisition or utility relocations.
- Quantities added to correct superelevation, install high-friction surface treatment (HFST), or install chevrons in areas with concerning crash history and/or substandard geometry.
- Guardrail end terminal improvements per the MASH implementation guidelines (memo attached).
- Curb ramp repairs and new installation per ADA/PROWAG requirements. This includes associated items, such as crosswalk striping or curb items.
- Bike lane signing and pavement markings on projects in which a bike lane is being added.
- Adding centerline rumble strips.
- Replacement of non-frangible sign posts with breakaway posts.
- Adding chevrons or other advance warning signs in areas with poor sight distance.
- Removing vegetation in areas where doing so will improve sight distance.
- Removal or delineation of obstacles within the clear zone.

- Reshaping of ditches as a safety improvement.
- Adding proper safety headwalls to pipe culverts within the clear zone.
- Warning systems and other related items per Railroad Coordination requirements
- Use of Safety Edge, where applicable (There are no charges or items associated with this inclusion)
- Striping, snowplowable markers, rumble strips, and rumble stripes which are:
  - Being installed for the 1st time in accordance with Design Guidelines Table 4-3, attached.
  - Being installed above and beyond what is required per Design Guidelines Table 4-3 as supported by crash history. This includes instances in which these items are pre-existing but are above and beyond what is required per Design Guidelines Table 4-3 and supported by crash history.
  - Any of these items which are pre-existing and are being installed per Table 4-3 do not qualify for HSIP funds.
  - Pavement marking items are listed on a separate portion of the PS&E form. Recommendations for these upgrades should be documented somewhere, such as on the 'Notes-Remarks' page.

If a Roadway Safety Audit (RSA) project is identified within the limits of a resurfacing project and bundled into the resurfacing project, those items obviously still qualify for HSIP funds.

## SPECIAL PROVISIONS FOR SMOOTHNESS ACCEPTANCE

The assignment of the ride quality Special Provisions SP411B or SP411C, as well as the determination of any ride exclusions to the specification, shall be made at the Regional level by those performing PS&E field reviews. Both the applicable Special Provision and the defined exclusions shall be noted during PS&E reviews. The default procedure for selecting smoothness provisions will be for SP411B to be placed on Interstate and controlled access projects and SP411C only be placed on projects with  $\geq 1\text{-}1/4$ " of asphalt. If a need is identified meriting use of SP411C on thinner projects, that recommendation can be made by district staff and approved at the Regional level.

A prioritized resurfacing list shall be furnished by the Director of each region to the Regional Materials and Test (M&T) office. Pre-construction smoothness (Pre-ride) reports shall be completed by the Regional M&T offices for:

- All SP411C single lift overlay projects
- All SP411B and SP411C mill & fill projects on the resurfacing list showing a Pavement Management System (PMS) Half-Car International Roughness Index (HCIRI) greater than 80 inches per mile.

The projects shall be tested within a reasonable time frame, at least two weeks prior to the letting advertise date. In an effort to provide the most current test data, pre-ride data will no longer need to be submitted prior to turn-in date for inclusion in resurfacing plans, but will instead be due two weeks prior to advertising and will be made available to bidders by the Construction Division.

Appendix A – Resurfacing Delivery Schedule

Appendix B – Blank Resurfacing List

Appendix C – PS&E Form

Appendix D – Sample Set of Resurfacing Plans

Appendix E – Additional Information