DEVELOPMENT OF A WEB BASED PAVEMENT MANAGEMENT REPORTING SYSTEM TO ENHANCE THE VIRGINIA DEPARTMENT OF TRANSPORTATION PAVEMENT PERFORMANCE MONITORING PROGRAM

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ABSTRACT

The Virginia Department of Transportation (VDOT) is the third largest state-maintained highway system in the nation. With such a significant taxpayer investment in road infrastructure, VDOT has embarked on a comprehensive pavement management process that includes the use of state of the art optimization analysis software to determine appropriate funding allocation of the pavement network. Since VDOT uses the results of the optimization analysis in determining their paving targets and for determining their funding allocations for the Districts, and because the final project selection is usually done at the District level, it is necessary to track how the scheduled Maintenance & Rehabilitation (M&R) projects being performed in the field align to the targets produced by the optimization analysis and it is also important to track the difference between the targeted, planned and actual performance of the network. This is not a simple process; this also requires an extensive coordination between the Central Office Pavement Management and the Districts.

In this paper, the development of the VDOT Pavement Performance Monitoring Program is described. This Performance Monitoring Program consists of a set of programmed reports that link the VDOT PMS system and database with VDOT contracting system which gives the CO decision makers the ability to efficiently determine whether the funding allocations and performance targets are being met with the Districts project selection. This integration of the network level PMS analysis results with the Districts project selection allows VDOT to "close the loop" between project and network level pavement management.

INTRODUCTION

A Pavement Management System (PMS) is a tool used by transportation agencies to assist in identifying the cost effective strategies for maintaining and preserving a pavement network and to determine the level of funding required to meet the agency's goals *(1,2).* Several programs are available and are used by transportation agencies for this purpose. The Virginia Department of Transportation (VDOT) PMS software is used to perform optimization analysis for determining optimal funding allocations and Maintenance & Rehabilitation (M&R) project selection, as well as assisting in budget allocation to VDOT Districts. The software helps VDOT monitor pavement performance throughout the network and monitor how their M&R strategies improve or change the overall health of the network.

Monitoring and maintaining pavement performance at the network and project level is a complex process. It requires significant PMS implementation to capture the agency's decision making policies for the optimal selection of candidate M&R projects years in advance of the actual project completion. This creates a major challenge for agencies to be able to adequately predict the future condition of the pavement network given current pavement condition and structural data, past construction history data, and future budgetary constraints. Many State DOTs around the country are performing some form of this analysis process. However, few agencies have been able to "close the loop" on the process by determining whether the PMS predictions of condition and M&R needs have met the performance monitoring targets set by the agency. This can be especially difficult when the agency has a decentralized project selection process.

Several non-web-based reports were being created in the past on ad-hoc basis to report the predicted condition of the network that would result from current paving plans. Also, several reports were created to show the condition of the network in different ways that provided required information to personnel at various levels including administrators, managers, planners, engineers, and technicians. Examples of various ways of reporting the data include the percent of network meeting the target, district pavement condition statistics, distress occurrence rate, average IRI, average rutting values, etc., and these can be seen in the annual state of the pavement reports that are being published by VDOT for the past several years (*3*). Several GIS maps were also prepared and published for use at the central office, districts offices, and other field offices, and these maps are placed on the web (*4*). These GIS maps present the pavement condition data and the planned projects under various treatment categories for the next one to two years.

VDOT has a centralized strategic pavement management process in the Central Office (CO) which is responsible for allocating funds and monitoring performance targets. However, VDOT has a decentralized pavement project selection process which relies on the various District Offices (DO) to determine where the funding allocation will be spent. In the past, the disconnect between Central Office planning and District Office project selection has created a gap in the performance monitoring capabilities of VDOT. Because of this, VDOT has created a reporting process that compares various performance targets generated from the optimization against planned and actual targets achieved by the District project selections. With this process, VDOT expects to achieve greater transparency and efficiency of the use of taxpayer dollars as well as determine if changes to the policies for project selection need to be considered.

The Performance Monitoring Program consists of a set of customized reports generated from the VDOT's PMS software. These programmed reports link the data from the PMS database to the VDOT developed Pavement Maintenance Scheduling System (PMSS) database. PMSS is used by VDOT to track project level decision making.

OBJECTIVES

The objective of the Performance Monitoring Program is to formalize the process for establishing annual pavement performance targets for VDOT and monitoring project selection, development and execution to ensure that paving targets are achieved and sustained year to year. The PMS was enhanced with additional reporting capabilities to meet this requirement. The following reports and PMS software configuration were developed for this purpose:

- Detailed Pavement Data Report
- Initial Baseline Performance Targets Report
- Final Baseline Performance Targets Report
- District Paving Status Report
- District Completed Paving Report

PERFORMANCE MONITORING PROCESS

The project level selection process involves decision on funding for projects, whereas the program level decision making involves general budget allocation decisions for the entire pavement network *(5)*. As discussed previously, VDOT Central Office has struggled in the past to identify the effectiveness of project level decisions made at the District level. The Central Office has the capability to develop optimized project work plans through the PMS and determine the pavement network performance from the software's project selections. However, Districts do not use the optimized work plans directly in their project selection process. Therefore, Central Office requires a feedback process to ensure that the projects selected by the Districts are at a minimum meeting the % Sufficient Critical Condition Index (CCI > 60) Performance Targets and Lane Miles per Treatment Category Paving Targets being identified by the PMS optimization (VDOT Treatment Categories: PM - Preventive Maintenance, CM - Corrective Maintenance, RM - Restorative Maintenance, and RC - Reconstruction.) The CCI is defined as the lower of Load Distress Rating (LDR) and Non-Load Distress Rating (NDR) for flexible pavements and is considered a single measure indicator of overall pavement condition *(6)*. Some examples are included here for each treatment category: Preventive Maintenance – crack sealing, minor patching, surface treatment, and joint cleaning/sealing; Corrective Maintenance –partial depth patching, < 2" mill and fill; Restorative Maintenance –Full Depth patching, <4" mill and fill, Reconstruction – mill and fill full depth AC layers, crack and seat, and full depth recycling. Other pavement types take other condition measures into account to calculate CCI. Performance and Paving Targets vary by VDOT System Classification; Interstate, Primary, and Secondary routes have different performance and paving targets. For the scope of this document, only Interstate and Primary paving target reports will be discussed. The Pavement Performance Monitoring process therefore requires the following general steps:

1. Update the PMS with the latest known Projects completed at the Districts.
2. Establish a Baseline of Performance and Paving Targets at the Central Office for Interstate and Primary Routes based on preliminary funding allocations to the Districts.
3. Determine the Final Performance and Paving Targets at the Central Office for

Interstate and Primary Routes based on final funding allocation to the Districts.

4. Monitor the Status of District Paving Projects to determine if the Final Performance Targets are being met. Require the Districts to provide justification for deviation from the Targets established.
5. Compare the Predicted, Planned, and Actual Targets to determine the overall effectiveness of the process.
6. Feed the Actual Projects selected for completion back to the PMS for use in the next year's Performance Monitoring Process.

In order for VDOT to ensure that the District paving projects are kept up to date in the PMS, an interface was created between the VDOT Pavement Maintenance Scheduling System (PMSS), which contains the planned work for each District, and the PMS. The information imported to the PMS system from the PMSS database was then used to update the PMS Master Work Program (MWP), which is a holding table used in the PMS for managing planned projects. By applying the MWP, the planned projects can be accounted for in the optimization analysis results. By ensuring that the District planned projects are included in the optimization, the Predicted, Planned, and Actual Performance Targets can be monitored from the PMS output.

DESCRIPTION OF THE REPORTS

The report layouts were configured using report builder software, consuming data from the PMS database. The reporting software allows users to create customized and standardized report layouts in a number of formats such as tabular and graphical. Through the use of Structured Query Language (SQL), reports can be generated to calculate and display many detailed objects consumed from the connection to the PMS database. The PMS software has the capability of displaying Jasper reports from within the user interface. This is accomplished by providing the user with a Jasper Report building wizard that allows for a mix of required and optional input to generate the desired output in a standardized report format. Additional configuration was also performed on the PMS database to link the VDOT PMSS database to the PMS. This configuration allows for the sharing of project level data with network level data for comparisons in a number of the Jasper Reports detailed in this section, as well as for synchronizing and automating the construction history data entry process into PMS.

Detailed Pavement Data Report

The VDOT PMS is used to maintain and manage a significantly large amount of pavement information, so much so that the occasional user of the system may find it difficult to connect many of the details together for a particular location on the pavement network. It is important, however, that staff with the responsibility of choosing paving projects have as much information as possible available to them to assist in making sound engineering decisions. With that in mind, The Detailed Pavement Data Report has been created to combine the following information from the PMS:

- Management Section Information – Location inventory information such as: Number of Lanes, Lane Miles, Pavement Type, and Most Recent Repair Category.
- Condition Data Information – VDOT's Lane Mile Weighted CCI, International Roughness Index (IRI), and % Sufficient CCI and IRI.
- Treatment Recommendation Information – Latest Treatments and Costs calculated from the Unconstrained Needs Analysis configured in VDOT PMS. The Unconstrained Needs Analysis combines many data decision criteria for the latest

year of condition survey and chooses a treatment and calculates costs for each section in the inventory.

- Supporting Attribute Information – Traffic, Pavement Age, Falling Weight Deflectometer (FWD) information in support of the Unconstrained Needs Calculation.
- Pavement Performance History – Condition Index values summarized over last 10 years from the PMS Performance Master File specific to each Pavement Type.
- Maintenance Construction History – Pavement contract information and structure data such as Year of Contract, Material Layers placed, and Layer Thicknesses maintained throughout the life of the pavement.

The Detailed Pavement Data Report requires only that the user specify the location of the pavement information requested. Depending on whether the user is working in the Base Linear Referencing System (State Milepoints LRS), or the Alternate LRS (County Milepoints LRS), the following minimum location information is provided in the Jasper Report wizard to generate the report as shown in Figure 1.

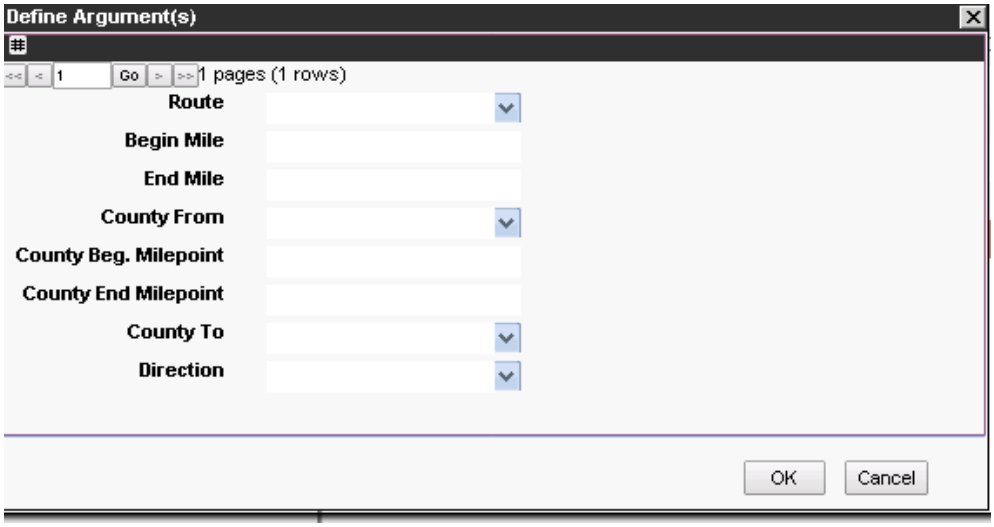


Figure 1 Report Data Entry Form.

The Detailed Pavement Data Report contains two main parts: Location Summary and Location Details. The Location Summary consists of a set of summary tables for the entire Begin and End Milepoints specified as shown in Figure 2. The Location Details generates a separate page for each intersecting management section with the user specified Begin and End Milepoints. Figure 3 is the sample output of the report showing only one location detail; however this report contains multiple pages.

Detailed Pavement Data Report

Report Input Limits Report Date: 08/29/2014

ROUTE	DIRECTION	STATE BEGIN MP	STATE END MP	COUNTY FROM	COUNTY TO	COUNTY BEGIN MP	COUNTY END MP
IS00064EB	Increasing	5.00	15.00	003-Alleghany	003-Alleghany	5.00	15.00

Management Information Summary *(based on most recent, overlapping management sections)*

Total Lane Miles: 20.00 Lane Miles

Summary of Pavement Characteristics

Number of Lanes	*Directional Miles*	*Lane Miles*
1		
2	*10.0*	*20.0*
3		
4		
5+		
Total	*10.0*	*20.0*

Pavement Type	*Lane Miles*	*% Lane Miles*
CRCP	*0.0*	*0.00 %*
JRCP	*0.0*	*0.00 %*
BIT	*20.0*	*100.00 %*
BOC	*0.0*	*0.00 %*
BOJ	*0.0*	*0.00 %*
NPM	*0.0*	*0.00 %*
PM	*0.0*	*0.00 %*
Total	*20.0*	*100.00%*

Last Treatment Category	*Lane Miles*	*% Lane Miles*
CM	*9.04*	*45.20 %*
DN	*10.96*	*54.80 %*
PM	*0.0*	*0.00 %*
RC	*0.0*	*0.00 %*
RM	*0.0*	*0.00 %*
Total	*20.0*	*100%*

Condition Data Summary *(based on most recent, overlapping management sections)*

Percent Lane Miles Sufficient CCI **100 %** ***Lane Mile Weighted Average CCI*** **87**

Percent Lane Miles Sufficient IRI **100 %** ***Lane Mile Weighted Average IRI*** **80**

Summary of Pavement Surface Condition Data

Year	Lane Miles	% Lane
2013	20.0	100.00 %
2012	20.0	100.00 %
2011	20.0	100.00 %
2010	20.0	100.00 %

CCI	*Lane Miles*	*% Lane*
1 - Excellent	*9.04*	*45.20 %*
2 - Good	*10.96*	*54.80 %*
3 - Fair	*0.0*	*0.00 %*
4 - Poor	*0.0*	*0.00 %*
5 - Very Poor	*0.0*	*0.00 %*
Total	*20.0*	*100%*

IRI Condition	*Lane Miles*	*% Lane Miles*
1 - Excellent	*2.90*	*14.50 %*
2 - Good	*17.10*	*85.50 %*
3 - Fair	*0.00*	*0.00 %*
4 - Poor	*0.00*	*0.00 %*
5 - Very Poor	*0.00*	*0.00 %*
Total	*20.00*	*100%*

Treatment Recommendation Summary *(estimated costs are based on the reported section limits)*

Modified Treatment Name	*Lane Miles*	*Estimated Mainline Material Cost*
DN- Do nothing		
PM-Preventative Maintenance.		
CM - Corrective Maintenance		
RM - Restorative Maintenance		
RC- Reconstruction		

Supporting Information *(as summarized from overlapping management section)*

AADTT (Truck Traffic)		
Average	*1133*	Trucks/Day
Minimum	*1042*	Trucks/Day
Maximum	*1577*	Trucks/Day

Surface Age (Years)		
Average:	*5.9*	*Years*
Minimum:	*1.0*	*Years*
Maximum	*10.0*	*Years*

Pavement Structure (FWD)		
Strong:	*0.00*	LM
Weak:	*20.00*	LM
No Test:	*0.00*	LM

1

Figure 2 Detailed Pavement Data Report – Location Summary.

Location Detail

Location Detail Report Date:08/29/2014

ROUTE	DIRECTION	STATE BEGIN MP	STATE END MP	COUNTY	COUNTY BEGIN MP	COUNTY END MP	LANE MILES
IS00064EB	Increasing	5.00	6.96	003-Alleghany	5.00	6.96	3.92

Management Info *(based on most recent, overlapping management section which may extend beyond report limits)*

Collection Year: 2014
Pavement Type: BIT
Surface Mix: SM-12.5D
Last Treatment: DN (Do Nothing)
Year of Last Rehab: 2004

Begin MP: 5.000 (County MP 5.000)
End MP: 6.960 (County MP 6.960)
Total Lanes: 2
Divided / Undivided: Divided
Total Lane Miles: 3.92

Begin Landmark: MM 4.1
End Landmark: MM 7.18
Notes:
HMG Key: 03-00IS00064E-BIT-0000945

2014 Condition Data *(based on distress summarized on most recent, overlapping management section's limits)*

CCI: 71.0 Alligator Freq (R/O/F): R Rutting Freq (N/<10%/>=10%): >=10%
LDR: 85.0 Alligator Sev (NS/S/VS): S Rutting Sev (<0.5" / >=0.5"): <0.5"
NDR: 71.0 Patching Freq (Y/N): Y Transverse Cracks/Mile: 116
Average IRI: 82.0 Patching Sev (=<10%/>10%): =<10% Trans. Cracks Sev (NS/S/VS): NS

2014 Treatment Recommendation *(estimated costs are based on the reported section limits)*

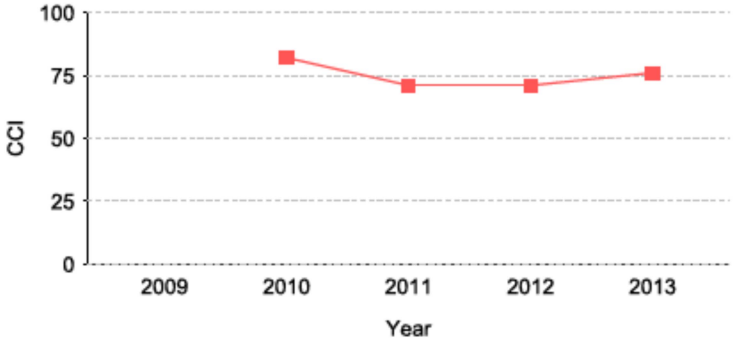
Modified Treatment: CM-BIT *Estimated Mainline Material Cost:* $ 279,422 $ 71,281 /LM)

Supporting Information

AADTT: Level 1 (962 Trucks) *Age:* Old (>6 IS >10 PR) *Structure:* Weak *(SN= 5.80 / M_r = 12.1 ksi)*

Ten Year Performance History

Year	CCI	LDR	NDR
2004	0.00	0.00	0.00
2005	0.00	0.00	0.00
2006	0.00	0.00	0.00
2007	0.00	0.00	0.00
2008	0.00	0.00	0.00
2009	0.00	0.00	0.00
2010	82.00	94.00	82.00
2011	71.00	75.00	71.00
2012	71.00	89.00	71.00
2013	76.00	94.00	76.00



Most Recent Five Layers in Maintenance History

Pavement Layer	Material	Thickness (in.)	Year Completion	Contract ID
Layer 1	SM-2A	2.0	1995	2603149
Layer 2	IM-1B	2.0	1995	2603149
Layer 3	H-3 (3)	5.5	1995	2603149
Layer 4	Select Type I	6.0	1995	2603149
Layer 5	Select Type I	9.0	1995	2603149

2

Figure 3 Detailed Pavement Data Report – Location Detail.

Initial Baseline Performance Targets Report

The Initial Baseline Targets Report is generated in support of the ongoing Pavement Monitoring Process. In order to determine the initial performance targets for each District based on the planned or scheduled paving work uploaded into the MWP from PMSS, five different multi-constraint optimization scenarios were generated for this report. Each scenario is configured in the PMS with an Objective of Maximizing Benefit given Budget and Condition Index Constraints. The five budget scenarios are defined with the previous year's District allocated budget as the midpoint estimated allocation. The remaining scenarios are then defined with two budgets higher and two budgets lower than the previous year's allocation. The resulting projected condition of the District's paving network is then summarized for each scenario in this report. The upper section of this report shows the information and inputs required to compile the report, including the year of condition data, the year of the awarded contracts, as well as the different allocations and scenario numbers used. The % Sufficient Lanes Miles is summarized for each budget allocation scenario in table and graph form to illustrate the effect of increasing or decreasing the budget allocation on the District paving network. The report also shows the Lane Miles per Treatment Category that can be achieved using each budget allocation. The report is generated for the Interstate and the Primary System separately (1 report for each). Figure 4 is a sample output for the Interstate System in one District.

Bristol District - Initial Interstate Baseline Target Report

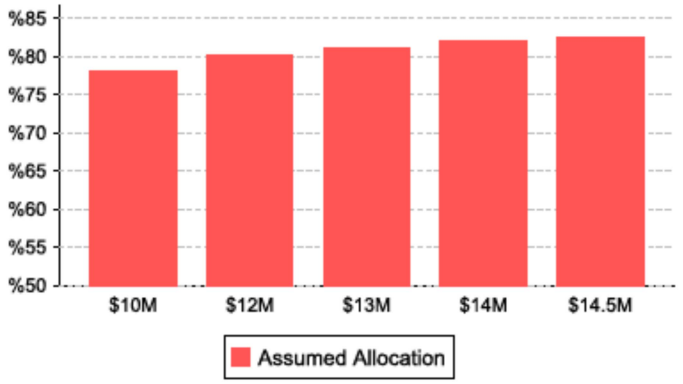
Report Date:07/21/2014

This Report was developed using the following input data:

1. 2013 Condition Data
2. 2013 and 2014 Awarded PMSS Paving Schedules
   - As imported form PMSS into PMS on
3. Initial Interstate Baseline Performance/Paving Targets based on:
   - 2013 and 2014 Awarded PMSS contracts on Interstate System
   - Bristol CY 2015 Assumed Interstate Paving Allocations of
     - $ 10,000,000 (Optimization Analysis # 2004)
     - $ 12,000,000 (Optimization Analysis # 2006)
     - $ 13,000,000 (Optimization Analysis # 2008)
     - $ 14,000,000 (Optimization Analysis # 2009)
     - $ 14,500,000 (Optimization Analysis # 2010)

Bristol District - Initial Interstate Baseline Targets

Initial 2016 Interstate Performance Targets by Assumed CY 2015 Allocation



Initial Performance Targets	
CY 2015 ALLOCATION	Target % Sufficient
$ 10,000,000	78.1 %
$ 12,000,000	80.2 %
$ 13,000,000	81.1 %
$ 14,000,000	81.9 %
$ 14,500,000	82.6 %

Initial 2015 Interstate Paving Targets by Assumed CY 2015 Allocation

Paving Targets (Lane Miles)				
Allocation	Preventive (PM)	Corrective (CM)	Restorative (RM)	Major Rehab (RC)
$ 10,000,000	52	101	6	0
$ 12,000,000	52	101	18	0
$ 13,000,000	52	101	23	0
$ 14,000,000	52	101	27	0
$ 14,500,000	52	101	30	0

Asset Factor Applied to Allocation = 1.0

Reduction Factors Applied to Lane Miles: PM= 0.25 CM= 1.0 RM= 1.0 RC= 1.0

1

Figure 4 Initial Baseline Performance Targets Report.

Final Baseline Performance Targets Report

After showing the different budget options and the performance associated with each in the Initial Baseline Targets Report, the Central Office can obtain the projected performance once the final allocation for each District has been established and relay the performance and paving targets that are expected to be achieved. This includes % Sufficient Lanes Miles for the final targeted budget which can be generated using an optimization analysis scenario considering the paving schedules imported to the MWP from the PMSS. This also shows the Lane Miles per Treatment Category that can be treated using the final targeted allocation. The Interstate and Primary Systems are summarized separately in this report as well. Figure 5 is a sample output in one District.

Richmond District - Baseline Paving Target Report

Report Date: 08/29/2014

This Report was developed using the following input data:

1. 2014 Condition Data
2. 2014 Awarded PMSS Paving Schedules
   - As imported form PMSS into PMS on
3. Interstate Baseline Performance and Paving Targets from PMS Optimization #2143
   - 2014 Awarded PMSS contracts on Interstate System
   - District CY 2015 Interstate Paving Allocations of$ 0
4. Primary Baseline Performance and Paving Targets from PMS Optimization # 2158
   - 2014 Awarded PMSS contracts on Primary System
   - District CY 2015 Primary Paving Allocation of $ 30,000,000

Richmond District - Baseline Paving Targets 2015

Initial 2014 Paving Targets		(Lane Miles)			
System	CY 2014 Allocation	Preventive (PM)	Corrective (CM)	Restorative (RM)	Major Rehab (RC)
Primary	$ 30,000,000	56	394	20	0

Richmond District - Performance Targets 2016

2016	Baseline Performance Targets (% Sufficient)		
System	CY 2015 Allocation	2016	% Sufficient
Interstate	$ 0	62.0 %	
Primary	$ 30,000,000	82.0 %	

Asset factor applied to Interstate Allocations = 1.00

Reduction Factors Applied to Interstate Lane Miles: PM= 0.25 CM= 1.00 RM= 1.00 RC= 1.00

Asset factor applied to Primary Allocations= 1.00

Reduction Factors Applied to Primary Lane Miles: PM= 0.25 CM= 1.00 RM= 1.00 RC= 1.00

1

Figure 5 Final Baseline Performance Targets Report.

District Paving Status Report

The District Paving Status Report brings together the results of the previous reports into one report that compares the pavement performance targets with the predicted pavement performance based on the District planned work. This summary provides the Central Office and District users the ability to identify whether the performance target are expected to be met. The same metrics of % Sufficient Lane Miles and Lane Miles paved by Treatment Category are used to identify any discrepancies. This report also includes comparison tables and comparison bar graphs as shown in Figures 6 and 7.

The District Paving Status Report also shows a comparison between the District treatment selection and the PMS optimization selected treatment. VDOT uses the term "Schedule" to define a paving project, which is shown on this report. The report shows the locations where the District Schedule differs by more than one treatment category from the PMS identified treatment category. This is done by ordering and assigning the VDOT Treatment Categories as follows: 0 – Do Nothing (DN), 1 – Preventive Maintenance (PM), 2 – Corrective Maintenance (CM), 3 – Restorative Maintenance (RM), and 4 – Reconstruction/Major Rehabilitation (RC). For instance, if the District chose to perform Preventive Maintenance (PM), and the Central Office analysis recommended Corrective Maintenance (CM), then the treatment categories are only off by one category and the Schedule passes review. However, if the District chose to perform Preventive Maintenance (PM), and the Central Office analysis recommended Restorative Maintenance (RM), then the treatment categories are off by two categories and the Schedule requires further review and justification by the District. The purpose of this process is to ensure that the Schedules assigned are effectively repairing the locations in a reasonable manner by ensuring the right treatment is being performed at the right place. This process should help to address issues of placing unsubstantial or costly repairs at a location. The report example in Figure 8 shows the list of Schedules Requiring Further Review and the Schedules that Pass Review.

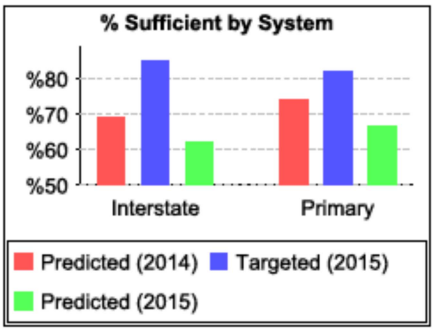
Richmond District Paving Status Report

Report Date:08/29/2014

This Report was developed using the following input data:

1. 2014 Condition Data
2. 2014 and 2015 PMSS Paving Schedules
   - As imported from PMSS into PMS on
3. Interstate Baseline Targets from Optimization Analysis # 2153
   - 2014 Awarded PMSS contracts on Interstate System
   - District CY 2015 Interstate paving allocation of $ 30,000,000
4. Primary Baseline Targets from PMS Optimization Analysis # 2158
   - 2014 Awarded PMSS contracts on Primary System
   - District CY 2015 Primary paving allocation of $ 30,000,000
5. Interstate Predicted Performance from Optimization Analysis # 2154
   - 2014 Awarded PMSS contracts on Interstate System
   - Based on district 2015 planned PMSS schedule work
6. Primary Predicted Performance from Optimization Analysis # 2159
   - 2014 Awarded PMSS contracts on Primary System
   - Based on district 2015 planned PMSS schedule work

Richmond District - 2016 Predicted Performance



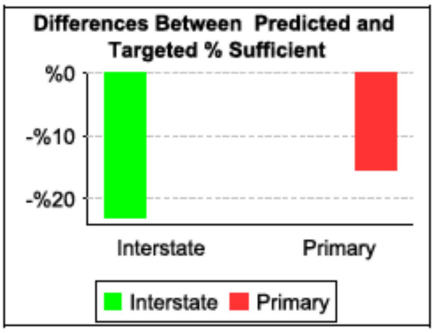
Richmond District Condition Summary

Interstate System

Predicted	2014	% Sufficient	69.2 %
Targeted	2015	% Sufficient	85.0 %
Predicted	2015	% Sufficient	62.0 %

Primary System

Predicted	2014	% Sufficient	74.3 %
Targeted	2015	% Sufficient	82.0 %
Predicted	2015	% Sufficient	66.7 %



Richmond District Predicted vs. Targeted % Sufficient in 2016

Interstate System

(2015) Predicted % Sufficient	62.0 %
(2015) Targeted % Sufficient	85.0 %
Difference:	-23.1 %

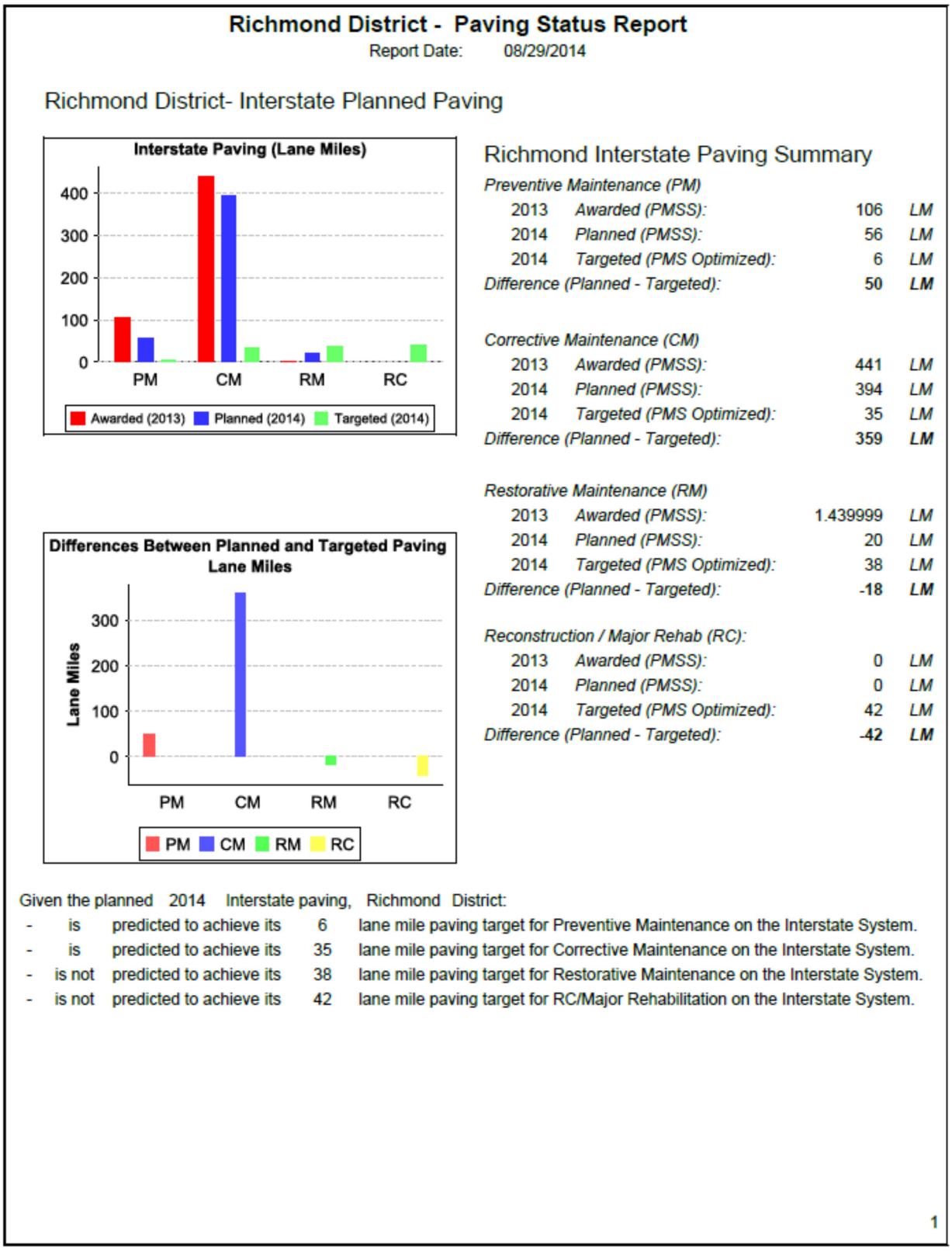
Primary System

(2015) Predicted % Sufficient	66.7 %
(2015) Targeted % Sufficient	82.0 %
Difference:	-15.3 %

Given initial pavement conditions, expected deterioration and planned paving, Richmond District **IS NOT** predicted to achieve its 2015 performance target of 85.0 % of Interstate network in Sufficient Condition and **IS NOT** predicted to achieve its 2015 performance target of 82.0 % of Primary network in Sufficient Condition.

1

Figure 6 District Paving Status Report – Predicted Performance.



Richmond District - Paving Status Report

Report Date: 08/29/2014

Richmond District- Interstate Planned Paving

Richmond Interstate Paving Summary

Preventive Maintenance (PM)			
2013	*Awarded (PMSS):*	106	*LM*
2014	*Planned (PMSS):*	56	*LM*
2014	*Targeted (PMS Optimized):*	6	*LM*
Difference (Planned - Targeted):		**50**	***LM***
Corrective Maintenance (CM)			
2013	*Awarded (PMSS):*	441	*LM*
2014	*Planned (PMSS):*	394	*LM*
2014	*Targeted (PMS Optimized):*	35	*LM*
Difference (Planned - Targeted):		**359**	***LM***
Restorative Maintenance (RM)			
2013	*Awarded (PMSS):*	1.439999	*LM*
2014	*Planned (PMSS):*	20	*LM*
2014	*Targeted (PMS Optimized):*	38	*LM*
Difference (Planned - Targeted):		**-18**	***LM***
Reconstruction / Major Rehab (RC):			
2013	*Awarded (PMSS):*	0	*LM*
2014	*Planned (PMSS):*	0	*LM*
2014	*Targeted (PMS Optimized):*	42	*LM*
Difference (Planned - Targeted):		**-42**	***LM***

Given the planned 2014 Interstate paving, Richmond District:

- is predicted to achieve its 6 lane mile paving target for Preventive Maintenance on the Interstate System.
- is predicted to achieve its 35 lane mile paving target for Corrective Maintenance on the Interstate System.
- is not predicted to achieve its 38 lane mile paving target for Restorative Maintenance on the Interstate System.
- is not predicted to achieve its 42 lane mile paving target for RC/Major Rehabilitation on the Interstate System.

1

Figure 7 District Paving Status Report – Planned Paving.

Richmond District Paving Status Report

Report Date:08/04/2014

Richmond District - Review of 2014 Treatment Selection

The District Treatment Selection was compared against PMS identified, unconstrained needs for each location marked identified as 2014 mainline paving. Where the District treatment selection differed from the unconstrained needs by more than a single Treatment Category, the section has been flagged for district review.

Note: for all locations flagged for further review, the District is responsible to submit a justification of treatment selection to Central Office Pavement Management no later than two weeks prior to submission of schedule work to Scheduling and Contracts Division.

Richmond District 2014 Treatment Selection Review

Schedules Requiring Further Review

All locations on the Interstate and Primary systems of the following schedules have been reviewed and the following locatoins fall outside acceptable tolerance of identified needs.

Schedule Name PM-4B-14

Route	County	Begin MP	End MP	Lane	Aux	District Treatment	PMS Need	District Justification ?	Central Office Concurrence ?
40	055	16.6	16.9	E		CM-BIT	DN (Do Nothing)		

Schedule Passing Review

All locations on the Interstate and Primary systems of the following schedules have been reviewed and fall within acceptable tolerance of identified needs.

LM-4A-14

LM-4B-14

PM-4A-14

PM-4C-14

PM-4D-14

PM-4E-14

PM-4S-14

ST-4B-14

Figure 8 District Paving Status Report – District Justification.

District Completed Paving Report

After the District Paving Status report is generated, the final targets are finalized, and the schedules are completed, the District Completed Paving Report is generated as a comparison between the final predicted performances and the original targets, as well as to the current pavement performance. This report shows if the pavement performance improved or if the targets were achieved for each District. The Targeted % Sufficient and Lane Miles is obtained from the Final Targets identified. The Predicted % Sufficient and Lane Miles is based on the Planned Schedules imported from the PMSS database to the MWP. In addition, a comparison between the targeted performance, the planned schedules, as well as the actual performance based on the final approved projects is provided on this report. Figure 9 and 10 are sample outputs in one District.

Bristol District - Completed Paving Report

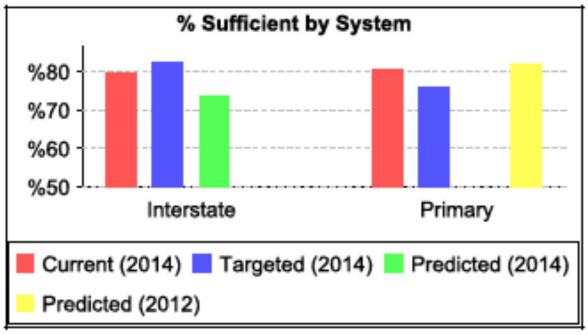
Report Date: 08/29/2014

This Report was developed using the following input data:

1. 2014 Condition Data
2. 2014 PMSS Paving Schedules
   - As imported form PMSS into PMS on
3. 2014 Approved M-20s
   - As stored in the PMS on 08/29/2014

3. Interstate Baseline Targets from Optimization Analysis #2026
   - Based on district CY 2014 Interstate paving allocation of $ 7,000,000
4. Primary Baseline Performance Target from PMS Optimization # 2018
   - Based on district CY 2014 Primary paving allocation of $ 5,000,000
5. Interstate Predicted Performance from Optimization Analysis # 2024
   - Based on district 2014 approved M-20s
6. Primary Predicted Performance from Optimization Analysis # 2032
   - Based on district 2014 approved M-20s

Bristol District 2015 Predicted Performance



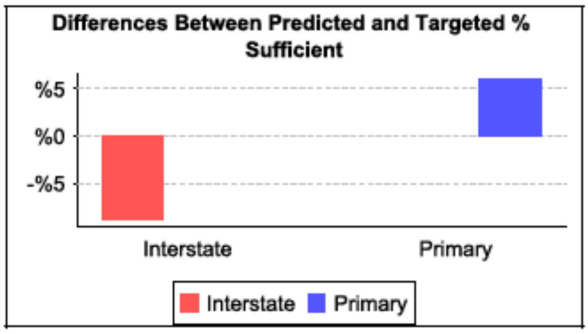
Bristol District Condition Summary

Interstate System

Current	2014	% Sufficient	79.6 %
Targeted	2014	% Sufficient	82.4 %
Predicted	2014	% Sufficient	73.6 %

Primary System

Current	2014	% Sufficient	79.6 %
Targeted	2014	% Sufficient	76.1 %
Predicted	2012	% Sufficient	82.0 %



Bristol District Predicted vs. Targeted % Sufficient in

Interstate System

(2014) Predicted % Sufficient	73.6 %
(2014) Targeted % Sufficient	82.4 %
Difference:	-8.8 %

Primary System

(2012) Predicted % Sufficient	82.0 %
(2014) Targeted % Sufficient	76.1 %
Difference:	5.9 %

Given initial pavement conditions, expected deterioration and planned paving Bristol District:
is not predicted to achieve its 2014 performance target of 82.4 % of Interstate network in Sufficient Condition.
is predicted to achieve its 2014 performance target of 76.1 % of Primary network in Sufficient Condition.

1

Figure 9 District Completed Paving Report – Predicted Performance.

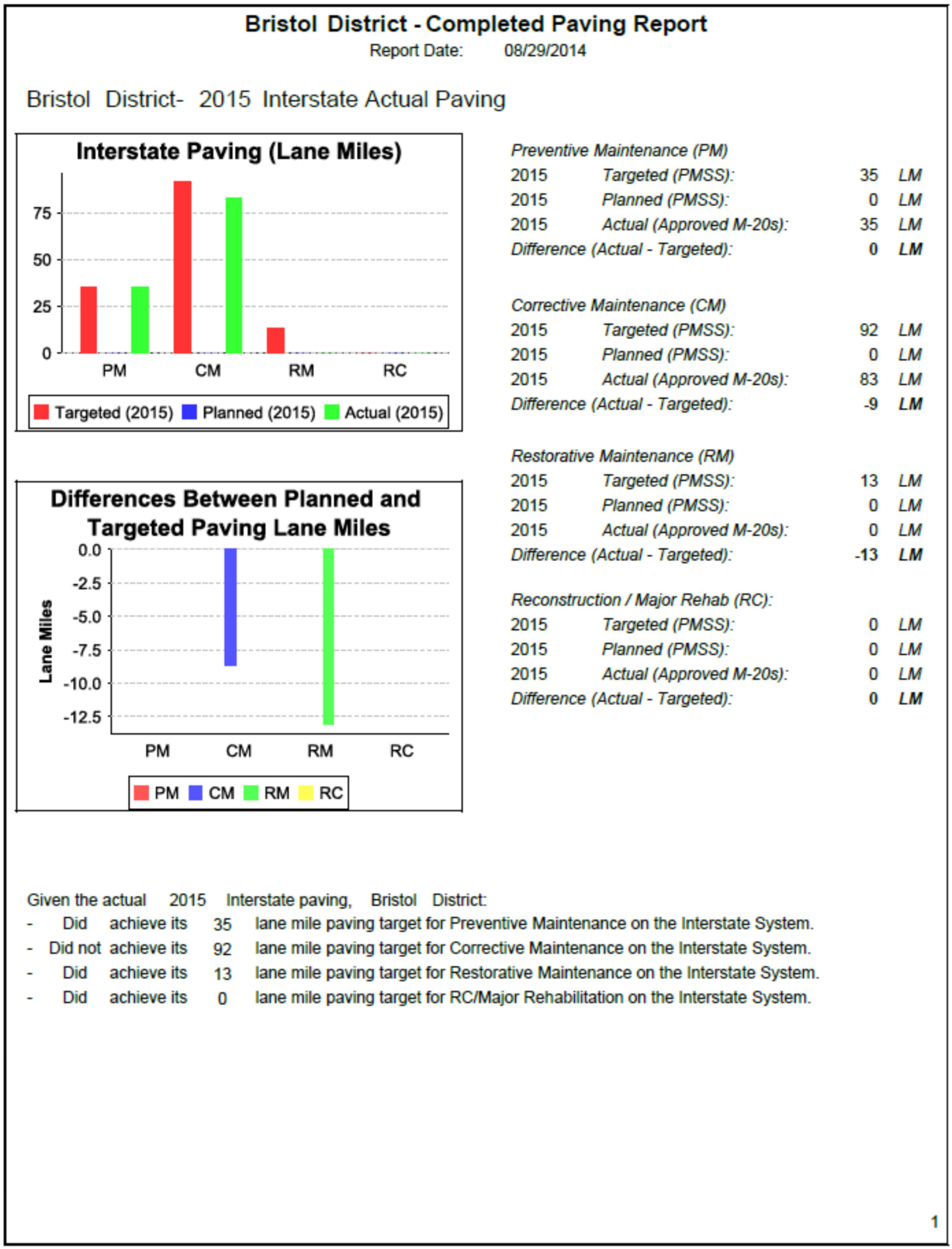


Figure 10 District Completed Paving Report – Actual Paving.

SUMMARY

Implementing a Pavement Management System is a significant task for a State agency. Integrating pavement inventory functional data, condition data, structural data, historical data, predictive modeling, and decision making tools in one application in order to achieve network level multi-constraint optimization analysis and reporting is a very complex process. It is however, a process that is necessary in our ever increasing world of limited budgets and significant infrastructure maintenance needs. VDOT has been developing its PMS optimization functionality to provide this high level of decision making, and they are in a good position to be able to objectively justify their current and future budgeting needs. However, even an agency with advanced tools and processes such as VDOT faces the challenge of marrying the network level strategic plan to the project level realities in the field. With the Performance Monitoring Reports that have been generated as a part of the enhancements to VDOT's Pavement Management process, VDOT is now on the path of holding project level decision makers accountable to the performance goals set by the strategic planners, as well as giving Districts access to as much useful pavement information as possible to make sound project selections. The Performance Monitoring Reports also provide an unparalleled level of transparency to support decision makers in the face of public examination.

REFERENCES

1- Wolters, A., K. Zimmerman, K. Schattler and A. Rietgraf. *Implementing Pavement Management Systems for Local Agencies- State of the Art/ State of the Practice*. Report No. ICT-11-094, Illinois Center for Transportation, 2011.
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3- *http://www.virginiadot.org/info/state_of_the_pavement.asp, accessed November 11, 2014.*
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5- Haas, R., Hudson, W.R., Zaniewski, J., Modern Pavement Management., Krieger Publishing Company, Malabar, Florida, 1994.
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