INTERNAL AUDIT REPORT

2019

SCDOT PAVEMENT MANAGEMENT – DATA QUALITY

An Assessment of:

- ☑ Risks
- ☑ Control Design Adequacy
- ☐ Control Operating Effectiveness

SOUTH CAROLINA OFFICE OF THE STATE AUDITOR

INTERNAL AUDIT SERVICES

April 30, 2019

1 EXECUTIVE SUMMARY

PAVEMENT MANAGEMENT – DATA QUALITY ACTIVITY

OBJECTIVE:

- To facilitate Management's assessment of risks that threaten the achievement of its objectives for the Pavement Management – Data Quality activity and to assess the adequacy of the design of internal controls to manage those risks to an acceptable level.

BACKGROUND:

- Road Data Services houses the Pavement Management department.
- Pavement Management includes the collection, analysis, and reporting of pavement surface distresses across the state of South Carolina.
- Depending on the roadway type, collections will occur every 1-3 years.
- Pavement Management has invested in laser-based collection vans that it believes will result in higher quality data that can be collected timelier than in the recent past.

INTERNAL CONTROL OBSERVATIONS:

1. Driver and Operator Training	**Risk Exposure:**	Medium-Low
Observation: A formalized Driver and Operator program or manuals are not currently in place within the Pavement Management department. Driver training could and should be optimized by formalizing the items that should be reviewed with a driver prior to first experience in driving Pavement Management's specialized vans. Given that this department is spread out across the state, we recommend formalizing a training sheet for a driver to be briefed or instructed on prior to the first drive for each driver.		
(See detailed Observation 5.1 on page 10)		

EXECUTIVE SUMMARY continued

INTERNAL CONTROL OBSERVATIONS continued:

2. HPMA Access Application Controls	Risk Exposure:	Medium-Low
Observation: SCDOT uses HPMA, an application used to process and store pavement data. Unauthorized access to HPMA data could occur and result in corruption or deletion of historical data because system access rights are not updated when an employee is terminated, has a change in roles or no longer uses the system.		
(Detailed in Observation 5.2 on page 11)		

3. Non-Uniform Collection of Data across Vendor versus SCDOT	Risk Exposure:	Medium-Low
Observation: Due to changes in the manner pavement distress data is collected and measured by SCDOT and vendor collection teams, a risk exists that each respective data set is not being applied to the existing pavement rating scale in the same manner.		
(Detailed in Observation 5.3 on page 12)		

PERFORMANCE OPPORTUNITIES:

1. Service Level Requirements and Agreements
Opportunity: At the business level, the lack of a documented agreement of services provided by the Agency's Information Technology Services division (IT) could result in the loss of data or a business interruption due to a miscommunication as to the responsibilities of IT and the business.
(Detailed in Performance Opportunity 6.1 on page 13)

Management Action Plans are included in Sections 5 and 6 following each detailed Observation and Performance Opportunity as referenced above.

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2 FOREWORD

AUTHORIZATION

The South Carolina Office of the State Auditor established the Internal Audit Services division (IAS) pursuant to SC Code Section 57-1-360 as revised by Act 275 of the 2016 legislative session. IAS is an independent, objective assurance and consulting function designed to add value and improve the operations of the South Carolina Department of Transportation (SCDOT). IAS helps SCDOT to achieve its objectives by bringing a systematic, disciplined approach to evaluating the effectiveness of risk management, internal control, and governance processes and by advising on best practices.

STATEMENT OF INDEPENDENCE

To ensure independence, IAS reports administratively and functionally to the State Auditor while working collaboratively with SCDOT leadership in developing an audit plan that appropriately aligns with SCDOT's mission and business objectives and reflects business risks and other priorities.

REPORT DISTRIBUTION

This report is intended for the information and use of the SCDOT Commission, SCDOT leadership, the Chairman of the Senate Transportation Committee, the Chairman of the Senate Finance Committee, the Chairman of the House of Representatives Education and Public Works Committee, and the Chairman of the House of Representatives Ways and Means Committee. However, this report is a matter of public record and its distribution is not limited.

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ACKNOWLEDGEMENT

We wish to thank members of management and staff in the Pavement Management Division for their cooperation in sharing their knowledge and experience and developing actions to improve internal control and enhance operating performance.

3 INTERNAL AUDITOR'S REPORT

April 30, 2019

Ms. Christy A. Hall, Secretary of Transportation
and
Members of the Commission
South Carolina Department of Transportation
Columbia, South Carolina

We have completed a risk and control assessment of the South Carolina Department of Transportation's (SCDOT) Pavement Management – Data Quality activity. The objective of this assessment was to contribute to the improvement of risk management by evaluating SCDOT's exposure to risks and the controls designed by Management to manage those risks. Our engagement included two aspects:

- Facilitation of Management's assessment of risks
- Independent assessment of the design of internal controls established by the Pavement Management Division to determine whether those controls, if operating effectively, are adequately designed to manage the identified risks to an acceptable level. (We did not assess the effectiveness of those internal controls because SCDOT management had not fully implemented them at the time of our engagement.)

We planned and performed the engagement with due professional care in order to obtain sufficient, appropriate evidence to provide a reasonable basis for our observations and conclusions. Observations noted from our assessment of control design are described in Section 5 beginning on page 10 of this report.

While our engagement was primarily focused on risk management, we have identified other matters that may represent opportunities for cost savings, revenue enhancement, process improvement, strengthened control environment, or more effective performance. These matters are detailed in the *Performance Opportunities* section on page 13.

George L. Kennedy, III

George L. Kennedy, III, CPA
State Auditor

4 ENGAGEMENT OVERVIEW

4.1 BACKGROUND

Pavement Management is a unit housed within Road Data Services, a function responsible for collecting, analyzing, and reporting information pertaining to the following functional areas:

- Pavement Management
- Traffic Data
- Roadway Information
- Geographic Information System / Mapping
- Integrated Transportation Management System (ITMS)

The SCDOT Pavement Management System is a set of carefully defined processes for the collection, analysis, and reporting of surface distresses located on interstate, primary, federal-aid secondary, and non-federal aid secondary routes within South Carolina. This system is a very important analysis tool for managers to make consistent, cost-effective and defensible decisions related to the preservation and rehabilitation of the state's road systems.

Pavement Management data, in addition to other data compiled by other units within Road Data Services, is used by SCDOT as well as outside agencies, the public, and the Federal Highways Administration. The data from all units of Road Data Services can be viewed agency-wide in the ITMS.

The collection of pavement data involves the Pavement Management unit and a contractor. The delineation of data collection responsibilities is included in the chart below:

Unit Responsible	Route Type	Collection Frequency	Directional Miles
Fugro (Independent Contractor)	Interstate	Annually	1,701
	Primary	Every 2 years	10,529
	Federal Aid Secondary	Every 2 years	10,399
SCDOT Pavement Management Unit	Non-Federal Aid Secondary	Every 3 years	20,595

Note: Mileages may vary each year due to road inventory changes

The contractor will deliver data to the Pavement Management unit based on agreed-upon timelines included within contract specifications.

Data collectors within Pavement Management are organized into three regions across the state. Prior to 2018, the assessment process was highly manual requiring the data collectors to visibly observe road conditions and manually record the data based on observations by data collector through the windshield. During 2018, Pavement Management procured three specially-equipped vans to allow its regional Data Collectors to assess pavement quality with state-of-the-art road collection tools and tracking devices including:

- Laser-based cracking measurement
- Macrotexture
- High-definition Roadway Imaging

The vehicles have the opportunity to decrease the time and increase accuracy of its data collection operation on its secondary route collection.

4.2 OBJECTIVES

Management's objectives with the Pavement Management activity are to ensure that quality information about the condition of SCDOT's pavement inventory is complete and accurate and can be provided to decision makers in a timely manner. Our objective was to facilitate Management's assessment of risks that threaten the achievement of its objectives and to assess the adequacy of the design of internal controls to manage those risks to an acceptable level.

4.3 SCOPE

Since the new collection vans and internal controls related to the vans were just being implemented at the time of our engagement, we focused our assessment on the design of controls rather than on operating effectiveness. We identified the following processes as significant to Pavement Management:

	Process	Included in Scope
1	Plan Creation for the Collection of Data	X
2	Pavement Data Collection	X
3	Process / Upload Data	X
4	Image Quality	X
5	Data Reporting	X

In collaboration with the Road Data Services team, we determined that the audit scope should include all processes included herein. Each is interconnected and should be evaluated as part of a holistic activity that collects and processes data and reports information for compliance, strategic, and operational purposes.

4.4 METHODOLOGY

For the significant processes included in the engagement scope, we performed the following procedures:

1. We facilitated Management's completion of a process outline that documented the steps in the process and the individuals responsible for those steps.

2. We facilitated Management's completion of a risk and control matrix used to:
   a. Identify risks which threaten process objectives;
   b. Score the risks as to their consequence and likelihood of occurrence using the risk scoring matrix in Appendix B;
   c. Determine if controls are adequately designed to manage the risks to within the Agency's risk appetite; and
   d. Propose design improvements to controls when risks are not managed to within the Agency's risk appetite.

   As shown on the Risk Scoring Matrix in Appendix B, risk significance is rated on a scale of 1 (lowest) to 25 (highest) and is the product of the risk consequence score (1 to 5) multiplied by the risk likelihood score (1 to 5). Risk appetite is the amount of risk exposure Management is willing to accept in pursuit of its objectives. Executive Management has set various risk appetites by risk type as shown in Appendix C. Risks scoring below Management's risk appetite require no further risk management. Controls determined to be inadequate in design result in risk exposure to the Agency if risk scores exceed risk appetite.

3. We observed the discussion by key process owners and other subject matter experts performing the steps in procedure two above.

4. We reviewed key controls for risks with inherent scores of 9 and above [scale of 1 (low) to 25 (high)] to determine if the controls are designed adequately. The review included, inquiry, observation, inspection of documentation, and re-performance of process steps.

5. We developed observations for controls determined to be inadequate in design.

6. We collaborated with management to develop action plans to improve control design.

7. We identified an opportunity to improve performance.

4.5 CONCLUSION

In our opinion, the design of internal controls is mostly adequate to effectively manage risks associated with the Pavement Management - Data Quality activity to within the Agency's risk appetite. Our observations and Management's action plans described in Section 5 are intended to improve the design of internal controls and reduce risk exposure to an acceptable level.

Risk Exposure Range	Number of Observations
Extreme	
High	
Medium-High	
Medium	
Medium-Low	3 Observations
Low	
Minimal	

4.6 DEVELOPMENT OF MANAGEMENT ACTION PLANS

We facilitated Management's development of action plans for each observation to improve control design with practical, cost-effective solutions. These improvements, if effectively implemented, are expected to reduce the overall risk exposure to an acceptable level (i.e. within the Agency's risk appetite).

We will follow up with Management on the implementation of the proposed actions on an ongoing basis and provide SCDOT leadership with periodic reports on the status of management action plans and whether those actions are effectively and timely implemented to reduce risk exposure to an acceptable level.

5 OBSERVATIONS

Observation 5.1 Driver and Operator Training	Risk Exposure Medium-Low
Division: Pavement Management	
Controls Assessed: Control 1 – Driver Training Control 2 – Passenger acting as a trainer (On-the-job training)	
Control Descriptions: Control 1 – Driver training includes a brief training session centering on key traffic laws, safety risks and techniques, and standard operating procedures and safeguards. Control 2 – A less experienced team member is partnered with a teammate with more experience. The role of the more experienced teammate is to share knowledge and experience with the new team member.	
Processes Affected: (See process descriptions in Appendix A on page referenced below) Process 2 – Pavement Collection (Page 14)	
Observation: While driver training includes key traffic laws, safety risks and techniques, and standard operating procedures and safeguards, a formalized program and/or training manual are not currently in place within Pavement Management. Driver training could and should be optimized by formalizing the items that should be reviewed with a driver prior to driving a specially-equipped van. Deviation from these guidelines above could result in expensive repairs and time delays in addition to bodily harm and property damage of the drivers and the motoring public. Given that this department is spread out across the state, we recommend that training be formally written and provided to drivers prior to operating the van. A brief quizzing by the supervisor could enhance the training to confirm that the information is actually retained by the new driver.	
Management Action Plan (MAP) 5.1	
1) Pavement Management will formalize training for drivers so they are instructed on the proper operation of the data collection vehicle prior to their first collection. 2) Each driver and instructor will be provided with a standardized training sheet. 3) A formalized Driver Manual will be created and given to each driver. A copy of the manual will be stored with other Standard Operating Procedures utilized by Pavement Management.	
MAP Owner:	Pavement Management Engineer
Division:	Pavement Management
Scheduled Date:	Completed

Observation 5.2 **HPMA Access Application Controls**	**Risk Exposure** **Medium-Low**
Division: Pavement Management	
Control Assessed: HPMA Application Access Controls	
Control Description: HPMA is an application used by Pavement Management to process and store unprocessed and processed data.	
Process Affected: (See process description in Appendix A on page referenced below) Process 3 – Process / Upload Data and Images (Page 15)	
Observation: Unauthorized access to HPMA data could occur and result in corruption or deletion of historical data because system access rights are not updated when an employee is terminated, has a change in roles or no longer uses the system.	
Management Action Plan (MAP) 5.2	
A formal policy will be implemented to annually review and update employee access to HPMA. As part of the policy, access will be immediately rescinded for any employee that separates from SCDOT.	
MAP Owner:	Pavement Management Engineer
Division:	Pavement Management
Scheduled Date:	Completed

Observation 5.3 Non-Uniform Collection of Data across Vendor versus SCDOT	Risk Exposure Medium-Low

Division: Pavement Management

Control Assessed: None – this observation addresses a risk in which no associated controls were identified.
Risk Identified: Pavement data is not collected uniformly for both contractor data and SCDOT data.

Control Description: Not Applicable.

Process Affected: (See process description in Appendix A on page referenced below)
Process 2 – Pavement Collection Data (Page 14)

Observation: Due to changes in the manner pavement distress data is collected and measured by SCDOT and vendor collection teams, a risk exists that each respective data set is not being applied to the existing pavement rating scale in the same manner. Traditionally, pavement quality scales are based on the total area of pavement distress measured on the road surface. The new measurement systems, both internal and contractor-based, use pavement distress data collected in a linear measure. SCDOT's Pavement Quality Index (PQI) was designed using the area measures traditionally collected by SCDOT. To ensure pavement condition data continues to be reported properly, Pavement Management and its vendor partner, Fugro, must develop and implement logic that translates these linear measurements into the appropriate distribution of area measurements consistent with the traditional measures used in the PQI scale. Until this logic is completely developed and fully implemented an operational risk exists that pavement condition data is not reported uniformly.

This is included as an observation as the risk will remain until the logic is developed and implementation is complete and further controls can be put in place. This observation is derived by management's active acknowledgement during our fieldwork that a control was in development but that it would not be implemented until after this engagement was completed.

Management Action Plan (MAP) 5.3

To ensure that data quality from SCDOT collection teams and contractor collected data is accurate and consistent with existing SCDOT data standards, a series of processes and controls will be implemented and documented as Standard Operating Procedure.

1. Data will be checked for completeness.
2. Data types will be evaluated for consistency (i.e. if the route is concrete, the evaluation is consistent with a concrete evaluation).
3. Data will be evaluated against historical trends.
4. SCDOT teams will perform blind-sampling of contractor collected data.
5. Blind-sampling will occur between SCDOT teams to check internal data quality.
6. Collection of standard samples by all SCDOT will occur to check internal data quality.
7. All quality assurance processes will be continually monitored to identify areas that can be improved.

MAP Owner:	Pavement Management Engineer
Division:	Pavement Management
Scheduled Date:	April 15, 2020

6 PERFORMANCE OPPORTUNITIES

While our engagement was primarily focused on risk management, we have identified other matters that represent opportunities for cost savings, revenue enhancement, process improvement, strengthened control environment, or more effective performance.

Performance Opportunity 6.1
Service Level Requirements and Agreements

Process Affected: (See process description in Appendix A on page referenced below)
Process 3 – Process / Upload Data and Images (Page 15)

Observation: Pavement Management relies on the Agency's Information Technology Division (IT) to support its data collection, maintenance, security, and reporting efforts. A lapse in IT services due to miscommunication or misunderstanding of expectations could result in the loss of data or business interruption. We recommend that IT require the Agency's business units to provide service level requirements to IT. In turn, IT would provide service level agreements describing the nature and timing of the services it will perform to meet the prescribed requirements.

Management Action Plan (MAP) 6.1

At a minimum, IT will require Pavement Management to document and communicate the following:

- The System name and acronym.
- The system data classification {public, internal use, confidential, restricted}
- The criticality of the system to the agency {Mission Critical, Essential Support, or Routine Support}
- System Stakeholders
- Service hours – Hours of operation, allowable service outage, allowable maintenance windows
- Seasonal Exceptions to Service hours – such as federal reporting, or close of year.
- System dependencies (inputs and outputs to other systems)
- System Continuity – Recovery Point Objective (RPO), Recovery Time Objective (RTO), Maximum Tolerable Down Time (MTD)
- Customer support – expected response times for reported issues
- Escalation expectations
- Conflict resolution expectations

At a minimum, Pavement Management will require IT to document and communicate the expected service level to meet the business requirements.

MAP Owner:	IT Director
Division:	IT
Scheduled Date:	June 2020

APPENDIX A PROCESS DESCRIPTIONS

Process 1 Plan Creation

Pavement Management creates a collection plan based on both federal compliance on federal-aid eligible roads and the need for the Agency to collect data to optimize decision-making for projects. A plan is created for each of the following three roads lists that covers all State-owned roads:

- Interstates – The Fixing America's Surface Transportation ("FAST") Act requires the collection of interstate pavement data annually. Pavement Management will create an annual collection cycle for the interstate system. A procured contractor collects the data and images and delivers it to Pavement Management at the end of the cycle for inclusion in SCDOT's annual reporting.

- Non-Interstate National Highway System ("NHS") – The FAST Act requires the collection of pavement data on Non-Interstate NHS on a 2-year collection cycle. A procured contractor collects the data and images and delivers them to Pavement Management throughout the cycle for inclusion in SCDOT's annual reporting.

- Non-NHS System – Pavement Management collects the remaining roads using its own vehicles and relying on its own employees to collect and deliver images and data throughout the cycle for inclusion in SCDOT's annual reporting.

Process 2 Pavement Collection

Pavement collection involves the calibration and maintenance of equipment as well as continuous quality assurance. This process requires accurate and timely collection of data and images. The process can be broken down into three phases:

- Pre-Trip Activities – The Driver and operator perform daily, weekly, and monthly calibration and maintenance checks to provide assurance that equipment is working in accordance with the Quality Assurance Manual. Daily, the operators wipe lasers and camera in addition to van computer system checks.

- On-Road Activities – The operator performs quality assurance on data and images using visual tools within Pavement Management's software during operation. The driver maintains the appropriate speed within the equipment's limits necessary to optimally obtain data. If data deviates beyond limits, the team will re-perform the task as necessary.

- Post-Trip Activities - The driver and operator will return the vehicle to its home site daily. Weekly, the driver and operator will download data to a portable hard drive for submission of data.

Process 3 Process / Upload Data and Images

This process focuses on the quality assurance steps involved from transferring raw pavement data and images from internal collection vans as well as contractors to finalizing data for use in reporting. Once loaded onto the Network and into the Highway Pavement Management Application, the data is analyzed by engineers to provide assurance that data collected is accurate and meets standards adopted by Pavement Management. Any deviations beyond limits are researched and recollected when necessary.

Process 4 Data Reporting

The data reporting process involves maintenance of collected data and the creation and delivery of reports to stakeholders.

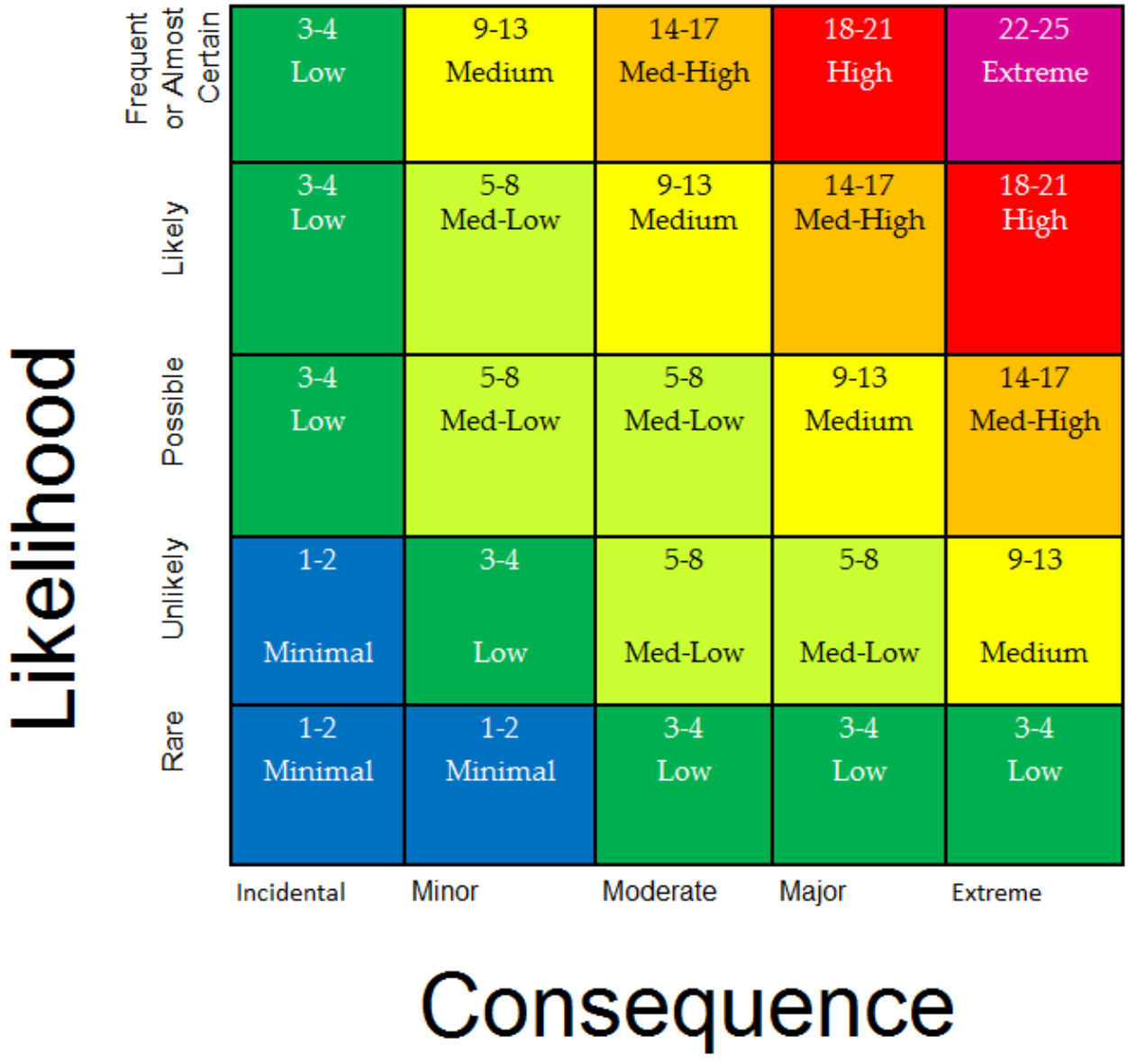
Maintenance of collected data also involves the maintenance of key pavement and road definitions. Data reported is a combination of data collected in the current year as well as archived data. As noted in Process 1 Plan Creation above, collection cycles depend on the road category and can vary from one to three year cycles. Projections based on standard performance curve models are calculated for those roads that are not collected during the current collection cycle based on the original collected data, type, age, time since last collection, and other factors resulting in projected data for the current reporting period. Additionally, if information on maintenance treatments or rehabilitation projects can be captured and entered into HPMA, the Pavement Management software will estimate the route's current road condition using performance curves that reflect the improvement and subsequent deterioration patterns associated with that maintenance activity. Modeling of pavement condition will continue until the route is scheduled for collection based on the collection plan.

Data Reporting includes the reporting of pavement data for federal compliance, internal stakeholders, and ad-hoc requests. From the database, Pavement Management creates section data views that allow the data to be viewed according to the parameters of the requestor. Data is finalized in April annually.

APPENDIX B

RISK SCORING MATRIX

Risk significance is rated on a scale of 1 (lowest) to 25 (highest) and is the product of the risk consequence score (1 to 5) multiplied by the risk likelihood score (1 to 5). The following matrix provides a color scale corresponding to risk significance scores.



APPENDIX C

RISK APPETITE

Risk appetite is defined as the amount of risk the Agency is willing to accept in the pursuit of its objectives. Management's goal is to manage risks to within the appetite where mitigation is cost-beneficial and practical. Management has set the Agency's risk appetite by risk type using scoring methodology consistent with the Risk Scoring Matrix shown in Appendix B. Risk appetites by risk type are as follows:

RISK TYPE	EXAMPLES	RISK APPETITE SCORE 1 = Minimal Risk 25 = Extreme Risk (See Scoring Matrix in Appendix B)
Safety	Employee and Public Well-Being	2
Ethical	Fraud, Abuse, Mismanagement, Conflict of Interest	2
Financial	Funding, Liquidity, Credit, Reporting	4
Strategic	Resources not Aligned, Unclear Objectives	4
Reputational	Unintentional Unwanted Headlines	4
Operational	Delays, Cost Overruns, Waste, Inefficiency	6
Regulatory	Non-Compliance	6
Legal	Lawsuits	10