Performance-Based Budgeting for Maintenance Activities

Requested by
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June 10, 2016

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Executive Summary

Background

Caltrans' Maintenance Program is responsible for the preservation, upkeep and restoration of roadways, bridges and other facilities and structures associated with the state highway system. The Division of Maintenance has determined that the use of performance-based budgeting that applies combinations of expenditures, performance measures and inventory data to project future resource needs will allow for a more effective allocation of resources among the agency's 12 districts.

Caltrans' Division of Maintenance is seeking information about the tools and practices used by other state departments of transportation (DOTs) to allocate resources to maintenance activities based on performance-based needs. The types of maintenance of interest to Caltrans are not associated with major bridge and pavement rehabilitation but include maintenance activities such as:

- Pothole repair, crack sealing and other pavement maintenance.
- Roadside maintenance such as litter removal, graffiti cleanup, tree removal and brush control.
- Maintenance of traffic signs, pavement markings and guardrail.

To assist with this effort, CTC & Associates conducted a survey of state DOTs to gather information about agency use of performance-based budgeting for this subset of maintenance activities. The survey findings are supplemented by the results of a literature search that identified published and in-process research and other relevant publications that address the use of performance-based budgeting to allocate maintenance resources.

Summary of Findings

Survey of State Practice

We distributed an online survey to gather information about the use of performance-based budgeting to allocate resources to maintenance activities. Seven states reported experience with performance-based budgeting, and four states reported plans to implement the practice.

The following summarizes the performance-based budgeting practices of survey respondents from Alabama, Maryland, Pennsylvania, Rhode Island, South Carolina, Utah and Washington.

States Conducting Performance-Based Budgeting

Budgeting Tools

Excel spreadsheets are the most commonly used type of budgeting tool among respondents. Commercial off-the-shelf tools used by respondents include IBM Corporation modeling and statistical programs (Alabama DOT); VueWorks, from Data Transfer Solutions LLC (Rhode Island DOT); and the Maintenance Productivity Enhancement Tool developed by the Four Winds Group for bridge maintenance activities (Washington).

Two states provided details of a vendor product that has been customized for agency use:

- CitiTech Systems, Inc. customized its CitiTech Management Software tool to create Alabama DOT's maintenance management system RoadMAP (Road **M**aintenance **A**ccountability **P**rogram).
- Utah DOT worked with AgileAssets, Inc. to customize the agency's Maintenance Management Quality Assurance Plus software within an AgileAssets module.

Tool Features

Pennsylvania is the only one of the seven states to use a budgeting tool that does not consider level of service (LOS) scores in the budgeting process. None of the state tools associate LOS with climate zones, and only those tools used by Maryland and Pennsylvania respondents associate LOS with traffic volumes.

Budgeting Process

The budgeting processes of selected states are highlighted below:

- *Alabama*. With implementation of RoadMAP, annual work plans are based on target LOSs and can be adjusted using LOS Analysis and Budget Analysis. "What-if" analyses can be performed based on budget constraints, personnel changes, material cost trends and equipment purchases.

- *Rhode Island*. The VUEWorks Budget Forecasting module used by the agency allows users to apply one of the supplied deterioration curves or develop one of their own as a basis for forecasting.

- *South Carolina*. Maintenance activities are tied to the transportation-related elements inspected in connection with the agency's Maintenance Assessment Program (MAP). Results of MAP inspections are used to decide how much to budget for the various maintenance activities that will be completed in the upcoming fiscal year.

- *Utah*. Over time the agency has developed regression curves that are based on expenditures and how those expenditures relate to identified targets. This allows the agency to provide funding for maintenance activities based on target levels. The process also identifies the increases or decreases needed in measured assets to meet the identified targets.

- *Washington*. The agency's budgeting tools are used to identify backlogs of maintenance activities, with each region reporting Maintenance Accountability Process scores and the percent completion of baseline maintenance activities being performed. These backlogs serve as the basis for budget development and allocation of funds.

Benefits

Respondents reported these benefits of performance-based budgeting:

- Maintenance managers have more input on the allocation of their budgets, and are provided with a more accurate assessment of the impacts of their maintenance decisions (Alabama).
- The agency can justify increased staffing, purchase equipment and gain public trust by making information about the allocation of public funds readily available (Rhode Island).

- The practice allows for a focus on areas that have traditionally had a low LOS to make improvements with available funding (South Carolina) and provides for a fairer allocation of funds to DOT regions (Washington).

Challenges

Among the challenges reported by respondents are:

- Collecting up-to-date and accurate information on roadway assets (Alabama).
- Focusing staff on the areas that need improvement rather than conducting, as the respondent noted, “business as usual” (South Carolina).
- Integrating the vendor software with the in-house tool (Utah).
- Obtaining data for a complete inventory of assets (Maryland and Washington).
- Providing funding as recommended by the model’s analysis (Utah).
- Transitioning all maintenance activities to performance-based budgeting given limited resources (Rhode Island).

States Considering Performance-Based Budgeting

In addition to the seven respondents currently applying performance-based budgeting for maintenance activities, four respondents reported plans to implement, or a process underway to conduct, performance-based budgeting for maintenance activities:

- Arkansas State Highway and Transportation Department is considering the use of commercial off-the-shelf systems and the development of in-house tools.
- Tennessee DOT plans to implement performance-based budgeting within the next 12 to 24 months. The process begins in July 2016 with modifications to the agency’s condition assessment scores from pass/fail to LOS grades of A through F; the new budget tool will be implemented using LOS scores in 2017.
- The process to convert to performance-based budgeting is just beginning in Vermont.
- Wyoming DOT conducts a quality control/quality assurance process each year and uses this information in budget preparation. The agency is planning to develop a more comprehensive procedure using an AgileAssets work plan optimization tool.

Related Resources

National Resources

Three NCHRP projects or publications offer guidance to agencies considering performance-based budgeting for maintenance activities:

- A project in process will prepare a guide that addresses performance measures and financial planning in support of transportation asset management.
- A 2012 report provides Excel-based processes to allocate resources among user-defined highway asset/activity groupings.
- A 2012 synthesis examines performance-based management of maintenance and operations.

State Practices

Two documents provide an overview of multiple states' practices:

- A 2012 domestic scan examines the maintenance budgeting practices of multiple states, including three states responding to the survey conducted for this project (South Carolina, Utah and Washington).
- A 2011 conference paper addresses performance-based budgeting practices based on system tiers used by North Dakota, Maine and Utah DOTs.

Among the individual state practices we highlight is a relatively new needs-based maintenance budget allocation model developed for Arizona DOT and described in a 2015 conference poster. North Carolina DOT's efforts to tie maintenance funding to performance are described in recent conference presentations and a web posting from the agency's vendor, AgileAssets Inc.

Tennessee DOT, a survey respondent, reported plans to transition to the use of performance-based budgeting. A March 2016 webinar presentation describes these plans to transition to the use of LOS scores and budget distribution based on LOS condition. Finally, Wisconsin DOT's Compass program, which collects roadway field data that is used to set reasonable maintenance targets and allocate funds, is highlighted in a 2014 report.

Gaps in Findings

The literature search uncovered relatively few details about state practices for performance-based budgeting for the set of maintenance activities of interest in this project. Survey responses varied widely in their degree of detail, with several respondents providing relatively few details of their budgeting systems. Only a third of the states responding to the survey reported the use of performance-based budgeting for the maintenance activities of interest to Caltrans. Other states may have experience with this practice but did not respond to this project's survey.

Next Steps

Moving forward, Caltrans could consider:

- Contacting Alabama and Utah DOTs to learn more about these agencies' use of a customized vendor solution for performance-based budgeting.
- Consulting with Rhode Island DOT to discuss its use of a commercial off-the-shelf solution (VueWorks from Data Transfer Solutions LLC).
- Examining customized Excel-based budgeting processes used by Maryland State Highway Administration and South Carolina DOT for elements that may be applicable to Caltrans.
- Contacting the four state transportation agencies reporting plans to implement performance-based budgeting to learn how these agencies will make this transition (Arkansas, Tennessee, Vermont and Wyoming).
- Contacting other state DOTs that may have experience with performance-based budgeting (Arizona, North Carolina, Wisconsin and possibly others).

Detailed Findings

Survey of State Practice

We distributed an online survey to members of the AASHTO Subcommittee on Maintenance and state DOT asset management contacts to gather information about the use of performance-based budgeting to allocate resources to maintenance activities based on performance-based needs.

The survey consisted of these questions:

1. Does your agency utilize performance-based budgeting to allocate funds associated with maintenance activities? Examples of these maintenance activities include, but are not limited to, pothole repair and crack sealing, litter and tree removal, maintenance of pavement markings and guardrail, etc.
2. Please indicate the type of tool or practice you're using. Select all that apply.
    - Practice/guidance not associated with any tool.
    - Excel spreadsheet.
    - Software developed in-house.
    - Commercial off-the-shelf product.
    - Commercial off-the-shelf product that has been customized for agency use.
    - Other (please specify).
3. Please briefly describe your tool or practice. If you use a commercial product, please provide the product name and vendor.
4. How does the tool or practice relate level of service to available budget?
5. Does the tool or practice consider level of service scores?
6. Does the tool or practice associate level of service with climate zones?
7. Does the tool or practice associate level of service with traffic volumes?
8. Do you have documentation you can share about your agency's tool(s) or practices, such as a user manual or an example of tool outputs? Please provide a link below or send any file not available online to Chris Kline at chris.kline@ctcandassociates.com.
9. What successes have you experienced in utilizing performance-based budgeting for maintenance activities?
10. What challenges have you experienced in utilizing performance-based budgeting for maintenance activities?
11. Please use this space to provide any comments or additional information about your answers above.

The survey received 21 responses in three categories:

- States reporting experience with performance-based budgeting for maintenance activities.

- States reporting no experience with performance-based budgeting for maintenance activities but indicating plans to implement the practice.
- States reporting no experience with performance-based budgeting for maintenance activities.

Presentation of survey results begins with the first category of responses. See **Appendix A** to this Preliminary Investigation for the full text of all survey responses.

States Conducting Performance-Based Budgeting

Seven state DOTs reported experience with performance-based budgeting for maintenance activities:

- Alabama.
- Maryland.
- Pennsylvania.
- Rhode Island.
- South Carolina.
- Utah.
- Washington.

Each state DOT's experience is summarized below using survey responses and supplemental information obtained from a literature search, when available. The topic areas that may be included in each summary include:

- Budgeting tool.
- Tool functionality.
- Budgeting process.
- Benefits.
- Challenges.
- What's next.
- Related resources.
- Contact information.

The summaries below will not include one or more topic areas if that information was not provided by the survey respondent or readily available through a literature search.

Alabama Department of Transportation

Budgeting Tool

The agency uses three commercial products to conduct its performance-based budgeting:

- CitiTech Management Software (CMS) (CitiTech Systems, Inc.).
- SPSS Modeler 15.0 and SPSS Statistics 21 (IBM Corporation).

These tools are supplemented by an Excel spreadsheet, developed by Dye Management Group, Inc., that is used to calculate level of service (LOS) grades.

CitiTech customized its CMS tool to create Alabama DOT's maintenance management system RoadMAP (Road **M**aintenance **A**ccountability **P**rogram). The vendor describes development of the system in a publication cited in **Related Resources** on page 9 (see *User Spotlight/Case Study: Alabama Department of Transportation*):

> In order to implement RoadMAP, ALDOT needed an off-the-shelf solution that could be put into operation quickly and configured to meet their specific requirements. ALDOT found

> what they needed with CitiTech Management Software, which complemented their proposed maintenance management business model. In fact, CitiTech Management Software met 91% of ALDOT's requirements right out of the box! The contract was awarded to CitiTech Systems, Inc. and Exor (which was in the process of being acquired by Bentley Systems, Inc.). Bentley Systems managed the implementation of the software and developed several interfaces, such as a Random Condition Assessment Sample Generator, which continues to save ALDOT much time and effort in preparing for its annual condition assessments. Dye Management Group provided project support, including monitoring and reviewing the implementation, training, user acceptance testing, and roll-out to ensure ALDOT's goals were being met.

The respondent did not provide a launch date for RoadMAP. The earliest publication date for documents supporting the tool is January 2012.

Tool Functionality

RoadMAP ties together funding, maintenance efforts and assets to identify what is needed to maintain a certain LOS. The tool allows for the scheduling and recording of routine maintenance activities performed by maintenance staff throughout the state and for the creation of an annual performance-based budget. IBM's SPSS Modeler 15 and SPSS Statistics 21 are used to pull in data from multiple databases to run statistical analyses on the range of maintenance activities performed by the agency.

An Excel spreadsheet created by Dye Management Group allows the agency to use its LOS data to calculate LOS grades; the data used to populate this spreadsheet is pulled from RoadMAP. The LOS analysis conducted with the contractor-developed spreadsheet tool can also be completed in RoadMAP, and the agency plans to transition to a RoadMAP LOS analysis within the next few years.

While LOS scores are taken into consideration in RoadMAP, climate zones and traffic volumes are not.

CitiTech provides this summary of RoadMAP's functionality (see **Related Resources** on page 9):

> End results of RoadMAP implementation statewide include the ability to link asset LOS to cost, without having to change existing processes. They can now create an annual work plan based on target LOS, and adjust it using LOS Analysis and Budget Analysis. They can also perform "what-if" analyses based on budget constraints, personnel changes, material cost trends, and equipment purchases. They are now able to justify current and planned (future) expenditures. Using RoadMAP, the desired LOS is defined; the annual maintenance programs are designed to provide that LOS, and the resulting conditions of maintenance assets are assessed to determine if the desired outcomes were achieved. This assessment of desired versus actual outcome is then used as the basis for refining the maintenance program for the following year.

Benefits

Performance-based budgeting has allowed maintenance managers to have more input on the allocation of their budgets and provides a more accurate assessment of the impacts of maintenance decisions.

Challenges

Collecting up-to-date and accurate information on roadway assets has been a challenge for the agency. It is also unclear how funding from other sources may contribute to LOS grades as compared to the impact of maintenance activities.

Related Resources

Asset Management Manual, Maintenance Bureau, Alabama Department of Transportation, January 2012.
http://www.dot.state.al.us/maweb/frm/RoadMAP_AssetMgmtManual_20120125.pdf
This manual provides guidance to staff maintaining the agency's roadway asset inventory in RoadMAP. Each RoadMAP asset category is addressed with a description of the asset type, the information required for recording the asset and a description of the data fields storing the information.

Data Collection Manual: Level of Service Condition Assessments, Version 2.2, Alabama Department of Transportation, October 2015.
See **Appendix B**.
From the manual's purpose statement:

> The purpose of this Data Collection Manual is to describe the procedures for collecting road inventory and condition assessment data for assets maintained by the Alabama Department of Transportation (ALDOT). The condition data will be used to develop customer-oriented, performance-based work plans and budgets and to assess results. This exercise is part of a broader project to develop a Maintenance Management System (MMS) based on condition ratings and levels of service.

User Spotlight/Case Study: Alabama Department of Transportation, CitiTech Systems, Inc., 2014.
http://www.cititech.com/cititech-archives/#alabama
This vendor publication summarizes the development of Alabama DOT's RoadMAP, including the other interfaces that were developed to create and/or update records in RoadMAP.

IBM SPSS Statistics 21 Brief Guide, IBM Corporation, 2012.
http://www.sussex.ac.uk/its/pdfs/SPSS_Brief_Guide_21.pdf
This guide provides tutorials for the use of SPSS Statistics that supplement the online tutorial provided with the core system.

"Communicating Maintenance Needs: A Performance-Based Budgeting Model," Dye Management Group, Inc., *AASHTO Subcommittee on Maintenance Conference*, July 2015.
http://maintenance.transportation.org/Documents/2015%20Meeting%20Presentations/Communicating%20Maintenance%20Needs-A%20Performance-Based%20Budgeting%20Model.pdf
This presentation by Dye Management Group, which developed the Excel spreadsheet now used by Alabama DOT to calculate LOS grades, provides a high-level review of the performance-based budgeting process.

Contact Information

Tracy Fletcher, Transportation Manager, Alabama Department of Transportation, 334-242-6765, fletchert@dot.state.al.us.

Maryland State Highway Administration

Budgeting Tool

Maryland State Highway Administration (SHA) uses an Excel spreadsheet in connection with a budgeting system developed in-house. A rolled-up LOS for various maintenance assets is used to allocate a portion of the operating budget. An annual condition assessment contributes to a three-year historical average of condition assessments that is used in conjunction with inventory data to distribute a portion of the operating budget.

In addition to considering LOS, the Maryland tool also considers traffic volumes when allocating funds. Climate zones are not considered.

Challenges

Maryland SHA has not yet been able to tie improved LOS to additional funding. The agency also lacks a complete inventory of assets. Current inventory is limited to lane miles, roadside miles and annual vehicle miles traveled (AVMT). Gathering inventory data for other assets such as signs, pipes and guardrail will be helpful in establishing the funding levels required to improve LOS for those assets.

Related Resources

Peer Review Ratings, Average of 2013, 2014 and 2015, Maryland State Highway Administration, undated.
See **Appendix C**.
This Excel workbook includes spreadsheets that provide three years of data showing the historical LOS of various assets, along with a rolled-up overall LOS used for distributing a portion of the agency's operating budget.

Maintenance Operating Budget FY16 Distribution, Maryland State Highway Administration, undated.
See **Appendix D**.
This Excel workbook examines the roadside and traffic factors (roadside miles, lane miles and AVMT) and the overall LOS for distributing a portion of the agency's operating budget.

Contact Information

Sandi Sauter, Deputy Director, Operations, Maryland State Highway Administration, 410-582-5569, ssauter@sha.state.md.us.

Pennsylvania Department of Transportation

Budgeting Tool

The agency uses a range of tools to conduct its performance-based budgeting, including an Excel spreadsheet, software developed in-house and a commercial off-the-shelf product that has been customized for agency use. Pennsylvania DOT's SAP system manages financial transactions and stores data on maintenance activities, workforce, materials and equipment. Counties use SAP's Plant Maintenance module to create and schedule local maintenance projects and track expenses and materials. The respondent indicated that the agency also uses Engineering and Construction Management System (ECMS), a proprietary Pennsylvania DOT

system that stores project information for Pennsylvania DOT's highway engineering and construction projects. The respondent did not provide details about how these systems are employed in conducting performance-based budgeting.

Budgeting Process

Pennsylvania DOT identifies needs within a county organization; management staff reviews those needs in conjunction with current funding levels. An informal review is conducted by the agency's management team to examine department policies and identify the LOS that can be accomplished within the budgetary guidelines.

LOS scores and climate zones are not taken into consideration during the budgeting process; traffic volumes are considered.

Related Resource

> **Appendix L: PAMS Data Usage and Exchange**, BOMO Pavement Asset Management System, Bureau of Maintenance and Operations, Pennsylvania Department of Transportation, undated.
> http://www.emarketplace.state.pa.us/FileDownload.aspx?file=6100024132/Solicitation_11.doc
> This document that illustrates Pennsylvania DOT's current data repositories used for pavement management includes a description of the two tools cited by the survey respondent as being used to conduct performance-based budgeting—SAP and ECMS.

Contact Information

Kim Martin, Maintenance Performance Chief, Pennsylvania Department of Transportation, 717-787-6899, kimmartin@pa.gov.

Rhode Island Department of Transportation

Budgeting Tool

In 2012, Rhode Island DOT began using VUEWorks, from Data Transfer Solutions LLC, for most of its performance-based monitoring and budgeting. Activities monitored and budgeted for using VUEWorks include pavement striping; guardrail repair; small repairs; and maintenance for bridges, sign replacement and environmental compliance activities. Other unnamed commercial off-the-shelf products are used to track pothole repairs. For activities such as crack sealing, litter removal, graffiti cleanup, tree removal and brush control, the agency applies policies and procedures but no formal tool to monitor and budget for those activities. The agency is moving toward including all of these activities in VUEWorks to permit monitoring and budgeting.

The agency's budgeting model considers LOS. The tool may also allow for an examination of climate zones and traffic volumes, but the respondent has no knowledge of the availability of those system features.

Benefits

Performance-based budgeting has allowed the agency to justify increased staffing, purchase equipment, and gain public trust by making information about the allocation of public funds readily available.

Challenges

While limited resources preclude all units and asset areas in the agency from implementing the budgeting system, the priorities established by the maintenance division have been adopted at the executive level for departmentwide application. Currently, 22 departmentwide activities are in line to use performance-based budgeting in the future.

Related Resources

VUEWorks, Data Transfer Solutions LLC, undated.
http://www.vueworks.com/
From the web site:

> Budget Forecasting: The VUEWorks Budget Forecasting module delivers configurable, multi-year capital improvement planning capabilities to help determine long term budget needs based on deterioration curves. Use one of the supplied deterioration curves or one of your own as a basis for forecasting and then identify at what point on the deterioration curve an asset should be rehabilitated or replaced based on risk and condition.
>
> Features & Benefits
>
> - View how different budget scenarios impact the overall condition of any asset class
> - Select from risk and failure probability criteria to define how rehabilitation will be prioritized
> - Automate the assignment of rehabilitation jobs based on failure modes such as capacity and condition
> - Pre-determine the impact of rehabilitation jobs on the life-cycle of the asset.

"Asset Data Integration," Joseph D. Baker, Rhode Island Department of Transportation, *National Conference on Transportation Asset Management*, April 2014.
http://onlinepubs.trb.org/onlinepubs/conferences/2014/AssetManagement2014/Baker%20-%20Asset%20Data.pdf
This conference presentation highlights Rhode Island DOT's implementation of VUEWorks.

Contact Information

John Preiss, Chief Civil Engineer/Asset Manager, Rhode Island Department of Transportation, 401-222-2023, ext. 4058, john.preiss@dot.ri.gov.

South Carolina Department of Transportation

Budgeting Tool

South Carolina DOT uses an Excel spreadsheet to manage its performance-based budgeting for maintenance activities. Maintenance activities are tied to the transportation-related elements inspected in connection with the agency's Maintenance Assessment Program (MAP). Resident maintenance engineers (RMEs) use the results of MAP inspections to decide how much to budget for the various maintenance activities they plan to perform in the upcoming fiscal year, focusing on the elements that received an LOS grade lower than "C."

Budgeting Process

The budget process begins in November, with budgets due in late January or early February. Each county budget rolls up to a district budget; the district budgets roll up to a statewide budget. The agency has noted gradual increases in MAP scores but reports that improvements are limited by current levels of funding.

The RME begins with a set amount of funding and allocates funds to activities that will help achieve predetermined goals, focusing on elements where a low LOS has been identified. Since this is not a needs-based budget, if adequate funding is not available the RME cannot improve the LOS on every element inspected in the MAP.

While LOS scores are taken into consideration in the agency's budgeting model, climate zones and traffic volumes are not.

Benefits

Use of performance-based budgeting has allowed the agency to focus on areas that have traditionally had a low LOS and make improvements with available funding. MAP reports for each county help the RMEs focus their resources on the areas where the lowest LOSs are being provided.

Challenges

It can be challenging for RMEs to focus on the areas that need improvement, as highlighted in the MAP reports, rather than conducting, as the respondent noted, "business as usual." RMEs can tend to begin the budget process by examining the accomplishments of maintenance crews for the preceding fiscal year rather than determining what crews must accomplish in the current cycle to achieve a specific goal or LOS.

Related Resources

Budgeting Workbook for Richland County, South Carolina Department of Transportation, undated.
See **Appendix E**.

Budgeting Workbook for District One, South Carolina Department of Transportation, undated.
See **Appendix F**.
Budgeting workbooks are created at the county and district levels, with the seven district workbooks rolling up into a statewide workbook. The workbooks above provide an example of how a county workbook (Richland) rolls into a district workbook (District One). The

respondent highlighted a change in how the budgets are reflected in these sample workbooks:

> We used to include salaries for each unit in the budget. However, we now show that as a lump sum budget number. I mention this because the salaries were shown on the "x" sheet of the workbook and this area is now blank or shows a divided-by-zero error.

South Carolina Maintenance Assessment Program, South Carolina Department of Transportation, undated.
http://www.wistrans.org/mrutc/files/SCDOT-Maintenance-Assessment-Program-Manual.pdf
This description of the MAP includes direction for gathering data, the element features and conditions subject to data collection, and a discussion of reporting survey data.

Maintenance Assessment Program Report, South Carolina Department of Transportation, April 2008.
http://www.wistrans.org/mrutc/files/South-CaCarolina-Department-Of-Transportation-Maintenance-Assessment-Program-MAP-Report-1.doc
Currently, South Carolina DOT does not publicly post its annual MAP report. This 2008 report, available through another web site, reviews the seven elements evaluated under MAP—pavement, shoulders/ditches, drainage structures, roadside features, signs, pavement markings and guardrail—in connection with LOS and funding.

Contact Information

Jim Feda, Director of Maintenance, South Carolina Department of Transportation, 803-737-1290, fedajj@scdot.org.

Utah Department of Transportation

Budgeting Tool

Utah DOT worked with AgileAssets, Inc. to customize the agency's Maintenance Management Quality Assurance Plus (MMQA+) software within an AgileAssets module. This vendor-customized operations management system is used with an in-house performance budgeting tool that interfaces with the AgileAssets program. The in-house tool communicates with the AgileAssets software to obtain data and asset information.

Tool Functionality

The agency has used its MMQA+ program in its current form since 2003. Over time the agency has developed regression curves that are based on expenditures and how those expenditures relate to identified targets. This allows the agency to provide funding for maintenance activities based on target levels. The process also identifies the increases or decreases needed in measured assets to meet the identified targets. The current form of the model has been in place for four years. Modifications were made to the MMQA+ program to provide higher quality data for use in the budgeting tool.

While LOS scores are taken into consideration in the agency's budgeting model, climate zones and traffic volumes are not.

Challenges

Current funding levels can make it difficult to provide funding as recommended by the model's analysis. Data quality is an ongoing concern, and integrating the vendor software with the in-house tool can be problematic at times.

What's Next

Utah DOT is considering different ways to measure its assets. Currently, the agency uses asset deficiencies to trigger maintenance work and for analysis. The agency is considering moving beyond its current practice to collect asset data twice a year to a dynamic data collection model where, as the respondent describes it, "asset condition and work accomplishment drive our program in the future. We will also be going to a complete mobile solution for our maintenance division so all our data collection (which is already done through an in-house developed mobile solution) and all our work done on a daily basis will be entered into a GIS-based mobile system that automatically updates our asset condition and accomplishments."

Related Resources

"Managing and Maintaining Roadway Assets: The Utah Journey," *Transportation Asset Management Case Studies*, Federal Highway Administration, 2012.
http://www.fhwa.dot.gov/asset/hif12016/hif12016.pdf
This publication, which addresses Utah DOT's use of transportation asset management, includes a discussion of the agency's use of zero-based budgeting (from page 13 of the PDF):

> Many agencies use sampling and historic trends to establish future budgets and targets for performance of their maintenance features. UDOT has a sophisticated "zero-based" budgeting process. Each year's allocation is computed from a zero baseline and though the process involves reviewing historic trends prior to setting the following year's budget and targets, the new budget is not linked to the previous year's budget allocation. Budgeting is a collaborative process linked to expected outcomes. It involves discussions between central and regional offices about the agency's goals, performance and condition expectations, system needs, deliverability, and resource constraints.

Maintenance Management Quality Assurance Plus (MMQA+) Inspection Manual, Utah Department of Transportation, July 2012.
https://www.udot.utah.gov/main/uconowner.gf?n=12425526747223783
This manual provides a list of the assets for which the agency gathers data and completes LOS grade calculations.

2014 Strategic Direction and Performance Measures, Utah Department of Transportation, January 2014.
https://www.udot.utah.gov/main/uconowner.gf?n=11973015616713803
This annual report provides a concise description of the MMQA+ program and funding distribution for maintenance activities. From page 14 of the report (page 16 of the PDF):

> **MMQA Program:**
> The Central Maintenance Division's Maintenance Management Quality Assurance (MMQA) program is used to identify performance of 19 specific state highway assets. These assets range from pavement striping, litter, drainage features as well as operational performance items such as snow and ice removal. These measures help the UDOT Maintenance Division identify its respective performance based on the current funding levels provided.

Funding Distribution:
Each year the Central Maintenance Division distributes funding provided by the legislature based on MMQA performance levels for performance measured assets and past history for non-measured assets. This distribution is broken into nine groups which helps identify specific areas of funding. The fiscal year (FY) 2013 budget distribution for the maintenance operations statewide was $130,639,100.

Maintenance Manager, AgileAssets, Inc., 2016.
https://www.agileassets.com/products/maintenance-manager/
AgileAssets customized the Utah DOT MMQA+ model within an existing AgileAssets module. This web site provides information about the vendor's off-the-shelf Maintenance Manager tool. The tool's benefits or features as cited by the vendor include:

- **Optimize use of available resources while eliminating redundancies.** Maintenance Manager integrates the planning, scheduling, work recording and reporting phases of your agency's workflow, which enables you to optimize the use of available resources and eliminate redundant work, while providing your team with the reliable information required to make any business decision.
- **Powerful analytical tools.** Maintenance Manager includes powerful and sophisticated analytical tools that enable you to determine the best work plans to deliver the highest level-of-service (LOS) for a fixed budget or determine the required budget to reach a target LOS.
- **Annual maintenance planning.** Maintenance Manager enables you to estimate maintenance needs and then distribute available budget on an optimized basis by jurisdiction, functional class and maintenance service level. You can analyze the effects of various annual maintenance plans and budget scenarios.

Contact Information

Kevin Griffin, Central Maintenance/Director of Maintenance, Utah Department of Transportation, 801-965-4120, kgriffin@utah.gov.

Washington State Department of Transportation

Budgeting Tool

Washington State DOT's Maintenance Accountability Process (MAP), while not highlighted by the survey respondent, was a critical initiative in moving the agency toward performance-based budgeting. A MAP publication describes the significance of this program:

> The 1997 Legislative session was the first time MAP tools were utilized to support the budget request for the maintenance program. WSDOT was able to identify investment choices and the [e]ffects of those choices on the program. WSDOT was the first agency in the state to utilize performance based budgeting. The MAP has since become a model not only for Washington State, but for highway maintenance programs in many other states.

The agency uses a vendor product—the Maintenance Productivity Enhancement Tool developed by the Four Winds Group—for its bridge maintenance activities and an Excel-based tool and other software developed in-house to conduct its performance-based budgeting (some funds continue to be allocated based on inventory and maintenance needs). The agency's tools

are used to identify backlogs of maintenance activities, with each region reporting MAP scores and the percent completion of baseline maintenance activities being performed. These backlogs serve as the basis for budget development and allocation of funds.

While LOS scores are taken into consideration in the agency's budgeting model, climate zones and traffic volumes are not.

Benefits

The agency has identified improvements in the quality and accuracy of budget requests and fairer allocations of funds to DOT regions.

Challenges

Some of the budget continues to be historically based, and the agency lacks complete inventories for some highway assets. One of the agency's in-house databases is fairly new, and staff is still working out the bugs and educating maintenance technicians on its use.

Related Resources

Maintenance Accountability Process Manual, Washington State Department of Transportation, March 2012.
http://www.wsdot.wa.gov/NR/rdonlyres/97DD3129-E385-4C53-A51A-1F081ED1AEA4/0/MAPManualfull.pdf
From the manual's introduction:

> In 1996 the Washington State Department of Transportation embarked on an initiative to employ outcome based performance measures for evaluating the effectiveness of the Maintenance Program. The Maintenance Accountability Process, or MAP as it has become known, is a comprehensive planning, measuring, and managing process that provides a means for communicating to key customers the impacts of policy and budget decisions on program service delivery.

Maintenance Accountability Process Activity Service Level Targets 2015 – 2017, Washington State Department of Transportation, July 2015.
http://www.wsdot.wa.gov/NR/rdonlyres/4C851083-16BF-4526-989F-22B8FC15143D/0/MAPTargetchart.pdf
This document provides LOS scores for a range of Washington State DOT maintenance activities.

Contact Information

Rico Baroga, Highway Maintenance/Maintenance Policy Manager, Washington State Department of Transportation, 360-705-7864, barogar@wsdot.wa.gov.

States Considering Performance-Based Budgeting

Fourteen survey respondents reported no experience with performance-based budgeting. Of these, four respondents reported plans to implement or a process underway to conduct performance-based budgeting for maintenance activities. These plans are summarized below:

- **Arkansas**. The agency is planning to use performance-based budgeting in the future. Commercial off-the-shelf systems are being considered as well as the development of in-house tools.

- **Tennessee**. The DOT plans to implement performance-based budgeting within the next 12 to 24 months. The process begins in July 2016 with modifications to the agency's condition assessment scores from pass/fail to LOS grades of A through F; the new budget tool will be implemented using LOS scores in 2017. Condition-based budgets will be phased in over time. (See page 23 for a presentation describing the agency's transition to performance-based budgeting.)

- **Vermont**. The process to convert to performance-based budgeting is just beginning. A request of the respondent to provide additional information was not addressed at the time of publication of this report.

- **Wyoming**. The agency conducts a quality control/quality assurance process each year and uses this information in budget preparation. Data is reviewed to determine areas where additional resources are required. The agency is planning to develop a more comprehensive procedure using an AgileAssets work plan optimization tool but have not yet implemented it.

States Reporting No Experience with Performance-Based Budgeting

The 10 remaining survey respondents reporting no experience with performance-based budgeting are:

- Connecticut.
- Idaho.
- Illinois.
- Kansas.
- Minnesota.
- Montana.
- Nebraska.
- New Mexico.
- South Dakota.
- West Virginia.

Related Resources

National Resources

Research in Progress: Guide for Financial Planning and Management in Support of Transportation Asset Management, NCHRP Project 19-12.
http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4057
This project is in a pending status. Proposals have been received in response to the RFP; the project panel met in January 2016 to select a contractor to perform the work.
From the project description:

> The research should produce guidance for transportation agencies to use as they develop their asset management plans and will help foster increased emphasis on making investment decisions supported by consideration of financial concerns. Research tasks might include review of the current literature and ongoing research, characterization of the state of practice in financial planning for infrastructure in public and private sectors, review of federal and state regulations influencing financial management of transportation system assets, and analysis of what particular guidance materials would be most helpful to state transportation agencies for financial planning as an element of transportation asset management planning. Guidance materials to be developed might be tested and refined to ensure they are responsive to the needs and interests of agency officials and other potential users. The research may also include development of plans for further work to extend the performance measures and financial planning guidance developed in this research effort.

Resource Allocation Logic Framework to Meet Highway Asset Preservation, John Wiegmann and Balaji Yelchuru, NCHRP Report 736**,** 2012.
http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_736.pdf
From the summary:

> Based on the results of the case studies and recognizing that there is a significant variety of user approaches and taxonomies for preservation resource allocation, the research team developed a streamlined Excel-based model that permits users to enter appropriate preservation program taxonomies, inventory performance and deterioration estimates, priorities, and performance goals. The logic demonstration model is scalable to a wide set of user-defined asset/activity groupings (AAG) and multiple districts. The model offers optimized allocations across all AAGs that are supported by data or reasonable estimates of inventory, average condition, deterioration rates, and unit costs. Alternative allocation solutions are built in for specific AAGs that are not supported by sufficient data or reasonable estimates. The demonstration model is available in Excel workbook format on the NCHRP Project 14-21 web page at www.trb.org.

The following four spreadsheet files offer “functional illustrations” of the procedure developed in this project under a range of conditions. Each scenario is described in NCHRP Report 736 (see Chapter 6, Resource Allocation Logic Framework, which begins on page 44 of the report (page 53 of the PDF)).

- Scenario 1: Base case (fully needs-based allocation).
  http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP14-21_Resource_Allocation_Model_Demo_July2012-Baseline.xlsm

- Scenario 2: Constrained case (fully needs-based allocation). http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP14-21_Resource_Allocation_Model_Demo_July2012-Scenario2.xlsm
- Scenario 3: Percentage-based allocation. http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP14-21_Resource_Allocation_Model_Demo_July2012-Scenario3.xlsm
- Scenario 4: Change in desired time to reach target rating. http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP14-21_Resource_Allocation_Model_Demo_July2012-Scenario4.xlsm

Performance-Based Highway Maintenance and Operations Management, Michael J. Markow, NCHRP Synthesis 426, February 2012.
http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_426.pdf
The focus of this report is the application of performance-based management to highway maintenance and operations. Page 35 of the report (page 43 of the PDF) includes a discussion of Wisconsin DOT's Compass program, including reference to the program's use for budgeting.

Related Resource:

"Performance-Based Maintenance and Operations Management," Michael J. Markow, *Transportation Research E-Circular*, Issue Number E-C163, pages 59-74, July 2012.
http://onlinepubs.trb.org/onlinepubs/circulars/ec163.pdf (page 59 of this document)
This paper provides a summary of NCHRP Synthesis 426, including findings from the project's literature review, survey of state DOTs and case examples.

State Practices

Multiple States

Best Practices in Performance Measurement for Highway Maintenance and Preservation, NCHRP Project 20-68A, Scan 10-03, National Cooperative Highway Research Program, March 2012.
http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-68A_10-03.pdf
This domestic scan report includes a discussion of the use of performance data for budgeting (see page 44 of the PDF). Addressed in the report are the following budgeting practices (the agencies applying them are noted in parentheses):

- Needs-based budgeting (Arizona, South Carolina, Texas and Washington).
- Formula- or history-based approach (Minnesota, Ohio, South Carolina, Wisconsin and others).
- Zero-based budgeting (Florida and Utah).

Related Resource:

"Best Practices in Highway Maintenance Performance Measuring," Kathryn A. Zimmerman and Russ Yurek, *Transportation Research E-Circular*, Issue Number E-C163, pages 75-88, July 2012.
http://onlinepubs.trb.org/onlinepubs/circulars/ec163.pdf (go to page 75 of this document)
This paper provides a summary of the results of the domestic scan project cited above. One of the eight workshop sessions conducted for this project addressed the use of maintenance

quality assurance (MQA) practices for maintenance budgeting and resource allocation. Highlights of this session, which begin on page 81, include:

- At least 11 of the participating agencies (i.e., Kansas, Ohio, Wisconsin, North Carolina, South Carolina, Maryland, Iowa, Missouri, California, Florida and Texas) roll up their results into a single statewide maintenance score with weights to reflect priorities.
- For the most part, agencies are not using MQA results to manage maintenance funds across districts. Instead, the results are used to make better use of funding within a district. However, the Washington State DOT is moving towards a more integrated needs-based budget.
- Good performing districts tend to feel short-changed when money is solely allocated based on the gap between targeted and actual condition. An analysis of the data to determine the factors causing the gap is important to address these concerns. Steps should also be taken to help people avoid future gaps in performance when the gaps can be eliminated by improving the manager's decisions. It is also important that corrections be made to high-priority features.

"System Tiers: Making Tough Choices for Asset Management," Stan Burns, Stephanie Weigel, Scott Zainhofsky, Chip Getchell, Anne Emidy and Jeffrey Zavitski, *Eighth International Conference on Managing Pavement Assets*, 2011.
Citation at http://trid.trb.org/view/2011/C/1136332
From the abstract:

> Revenue shortfalls in some State DOTs are so severe that many miles of pavement are being "turned off" in terms of repair and rehabilitation with routine maintenance as the only option on these miles. Reaping the benefits of an optimized asset or pavement management program under these circumstances can often be difficult when the constraints on that program due to system tiers and varying key performance measure goals are taken into consideration. This paper examines efforts by State DOTs in setting performance goals and budgets based on system tiers and the impacts of those tiers on the systems implemented for pavement (PMS) and asset management (AMS). The paper focuses on efforts by the Utah DOT, the North Dakota DOT and the Maine DOT and discusses their respective management systems. Key components of the PMS and AMS within each DOT are highlighted and the impacts of the system tiers on those systems are discussed and explained.

Arizona

"Arizona DOT: Needs-Based Maintenance Budget Allocation Model," Rob Zilay, Jeff Holabaugh and David Hurst, Dye Management Group, Inc., Poster, *5th International Conference on Transportation Systems Performance Measurement and Data*, June 2015.
http://onlinepubs.trb.org/onlinepubs/conferences/2015/performancemeasurement/Zilay-PosterDD.pdf
This 2015 conference poster includes background on a project to develop a maintenance budget allocation model for Arizona DOT. Included in the poster is a statewide LOS scorecard that includes many of the maintenance activities of interest to Caltrans. From the poster:

> To aid ADOT in meeting its strategic goals for system health and sustainability, Dye Management Group, Inc. (DMG) developed a needs-based, performance-driven, budgeting

model and implementation plan, which included an approach for communicating the resulting budget to decision makers.

Prior to the model, ADOT allocated funds to districts according to historical allocations. A 2007 audit conducted by the Arizona Office of the Auditor General recommended developing a needs-based, systematic approach for allocating maintenance funds at a district level. To meet that recommendation, DMG developed a budget model that compares current condition assessments to level of service (LOS) performance targets and calculates the level of effort required to achieve that target.

North Carolina

"North Carolina DOT's Efforts to Tie Maintenance Funding to Performance," Jennifer Brandenburg, State Asset Manager, North Carolina Department of Transportation, *AASHTO Subcommittee on Maintenance Conference*, July 2015.
http://maintenance.transportation.org/Documents/2015%20Meeting%20Presentations/Efforts%20to%20Tie%20Maintenance%20Funding%20to%20Performance_NCDOT.pdf
The topics addressed in this conference presentation include North Carolina DOT's practices to tie maintenance funding to performance, determining needs, allocation/funding formulas, results and future direction.

"North Carolina DOT Optimizes Budgets and Integrates Asset Management Practices with AgileAssets' Software Solutions," AgileAssets Inc., 2016.
https://www.agileassets.com/2011/08/31/ncdot_chooses_agileassets/
This vendor web posting provides a brief summary of the AgileAssets maintenance management system implemented by North Carolina DOT. This system is examined in the conference presentation cited below.

Related Resource:

"Development of Optimized Work Plans for Non-Pavement and Non-Bridge Assets to Maximize Performance and Achieve Agency Targets," Lonnie Watkins, North Carolina Department of Transportation, and Charles Pilson, AgileAssets, Inc., *10th National Conference on Transportation Asset Management*, April 2014.
http://onlinepubs.trb.org/onlinepubs/conferences/2014/AssetManagement2014/Pilson%20-%20Dev%20Work%20Plans.pdf
This conference presentation describes North Carolina DOT's move toward optimized needs-based allocations and highlights the outcomes of performance-based budgeting, which include an optimized work plan for allocation that identifies recommended budgets per asset and maintenance activities. The tool will help the agency answer these questions:

- What are LOSs under different reduced funding scenarios? For example, consider scenarios at the division level with funding at 90, 80, 60 and 50 percent of need.
- How are allocations determined with reduced funding?
- What is the optimal detailed activity plan for the final, actual allocation?

Tennessee

"TDOT Prescribes MRI for Highways: Road Condition Assessment in Tennessee," Chris Harris, Tennessee Department of Transportation, *Current Practices in Conducting Field Inspections for Maintenance Quality Assurance* (TRB Webinar), March 2016.
http://onlinepubs.trb.org/Onlinepubs/webinars/160301.pdf
See page 37 of this webinar presentation for a discussion of Tennessee DOT's transition to the use of LOS scores and budget distribution based on LOS condition. Desired outcomes described in the presentation include the ability to:

- Predict additional funding required to increase an LOS score.
- Identify potential savings to move down from one LOS to another.
- Establish budgets based on condition of assets.

If a needs-based budget is not possible, the new system will predict the expected LOS based on the funding provided.

Wisconsin

Compass Report (Final), Wisconsin State Highway Maintenance, Traffic and Operations Conditions, Wisconsin Department of Transportation, 2014.
http://wisconsindot.gov/Documents/doing-bus/local-gov/hwy-mnt/programs/compass/reports/compass-2014-annual-report.pdf
This report's executive summary describes Compass as a program that "collects roadway field data each year to help WisDOT understand current infrastructure conditions and trends. The data also helps department managers set reasonable maintenance targets that reflect department priorities and respond to limited resources."

Page 6 of the report describes how Compass data relates to budgeting:

> Compass identifies backlog percentages for each feature at the county, region and statewide level. The data is statistically valid, though, only at the region and statewide levels. Backlog percentages indicate what percent of the roadway feature is in a condition where a maintenance activity is required, assuming available budget. Therefore, an increasing backlog percentage reflects fiscal constraints rather than inadequate work in the field.

The targets for highway maintenance conditions begin on page 13 of the report. These targets include many of the maintenance activities of interest to Caltrans. See the document cited in **Related Resource** below for a concise listing of these activities.

Related Resource:

> **CY 2016 Non-Winter Highway Maintenance Targets**, Wisconsin Department of Transportation, 2015.
> http://wisconsindot.gov/Documents/doing-bus/local-gov/hwy-mnt/programs/compass/docs/2016-final-targets.pdf
> This spreadsheet provides maintenance targets for maintenance categories that include traffic and safety, shoulders, roadside and drainage.

Appendix A: Survey Results

The full text of each survey response is provided below. For reference, we have included an abbreviated version of each question before the response. Responses from states conducting performance-based budgeting begin below; responses from states reporting no experience with performance-based budgeting for maintenance activities begin on page 30. The full question text appears on page 6 of this Preliminary Investigation.

Respondents Conducting Performance-Based Budgeting

Alabama

Contact: Tracy Fletcher, Transportation Manager, Alabama Department of Transportation, 334-242-6765, fletchert@dot.state.al.us.

1. **Use performance-based budgeting?** Yes.
2. **Tool or practice:**
    - Commercial off-the-shelf product.
3. **Tool description:** CMS [CitiTech Management Software] from CitiTech, Inc. Also we use IBM SPSS Modeler 15.0 and Excel. We perform annual condition assessments on our assets; then we utilize our maintenance management software program to create our budgets.
4. **Relate level of service to available budget:** It ties our money, efforts and assets all together to see what it takes to maintain a certain level of effort.
5. **Consider level of service scores?** Yes.
6. **Associate level of service with climate zones?** No.
7. **Associate level of service with traffic volumes?** No.
8. **Documentation:** I will contact you separately from this survey.
9. **Successes:** It allows our managers to have more input on the spending of their budgets as well as gives them a better picture of how they are performing their duties.
10. **Challenges:** Collecting up-to-date and accurate assets has been a challenge. Finding the right consistency with this effort of collection. Also, other funding contributes to the LOS [level of service] grades not just what is performed with maintenance activities.
11. **Additional comments:** [No response.]

Related Resources:

Data Collection Manual: Level of Service Condition Assessments, Version 2.2, Alabama Department of Transportation, October 2015.
See **Appendix B**.
From the document's purpose statement:

> The purpose of this Data Collection Manual is to describe the procedures for collecting road inventory and condition assessment data for assets maintained by the Alabama Department of Transportation (ALDOT). The condition data will be used to develop customer-oriented, performance-based work plans and budgets and to assess results. This

exercise is part of a broader project to develop a Maintenance Management System (MMS) based on condition ratings and levels of service.

IBM SPSS Statistics 21 Brief Guide, IBM Corporation, 2012.
http://www.sussex.ac.uk/its/pdfs/SPSS_Brief_Guide_21.pdf
This guide provides tutorials for the use of SPSS Statistics that supplement the online tutorial provided with the core system.

Maryland

Contact: Sandi Sauter, Deputy Director, Operations, Maryland State Highway Administration, 410-582-5569, ssauter@sha.state.md.us.

1. **Use performance-based budgeting?** Yes.
2. **Tool or practice:**
   - Excel spreadsheet.
   - Software developed in-house.
3. **Tool description:** Maryland SHA [State Highway Administration] conducts an annual condition assessment. A three-year historical average of the assessments [is] used in conjunction with some basic inventory data for use in distributing a portion of the operating budget.
4. **Relate level of service to available budget:** Maryland SHA allocates only a portion of the operating budget to level of service and inventory.
5. **Consider level of service scores?** Yes.
6. **Associate level of service with climate zones?** No.
7. **Associate level of service with traffic volumes?** Yes.
8. **Documentation:** Maryland SHA will forward some documentation on the spreadsheets and in-house application to Chris Kline.
9. **Successes:** Maryland SHA has not yet been able to tie improved level of service to additional funding.
10. **Challenges:** Maryland SHA does not have a complete inventory of assets to tie to the level of service and funding. We use lane miles, roadside miles and AVMT [average vehicle miles traveled] only. Having the inventory of other assets such as signs, pipes, guardrail, etc. would be helpful in establishing funding levels required to improve level of service.
11. **Additional comments:** Maryland SHA uses a rolled-up level of service for various maintenance assets for use in distributing a portion of the operating budget.

Related Resources:

Peer Review Ratings, Average of 2013, 2014 and 2015, Maryland State Highway Administration, undated.
See **Appendix C**.
This Excel workbook includes spreadsheets that provide three years of data showing the historical LOS of various assets, along with a rolled-up overall LOS used for distributing a portion of the agency's operating budget.

Maintenance Operating Budget FY16 Distribution, Maryland State Highway Administration, undated.
See **Appendix D**.
This Excel workbook examines the roadside and traffic factors (roadside miles, lane miles and AVMT) and the overall LOS for distributing a portion of the agency's operating budget.

Pennsylvania

Contact: Kim Martin, Maintenance Performance Chief, Pennsylvania Department of Transportation, 717-787-6899, kimmartin@pa.gov.

1. **Use performance-based budgeting?** Yes.
2. **Tool or practice:**
    - Practice/guidance not associated with any tool.
    - Excel spreadsheet.
    - Software developed in-house.
    - Commercial off-the-shelf product that has been customized for agency use.
3. **Tool description:** Identify needs within a county organization and management staff reviews needs with current funding levels. [Tools/vendors are] SAP [and] ECMS [Engineering and Construction Management System, a proprietary PennDOT system available at https://www.dot14.state.pa.us/ECMS].
4. **Relate level of service to available budget:** Management team reviews department's policies and level of service that can be accomplished within the budgetary guidelines.
5. **Consider level of service scores?** No.
6. **Associate level of service with climate zones?** No.
7. **Associate level of service with traffic volumes?** Yes.
8. **Documentation:** [No response.]
9. **Successes:** Innovative ideas on how best to utilize resources we currently have, i.e., RAP [reclaimed asphalt pavement] material.
10. **Challenges:** Funding levels have been level.
11. **Additional comments:** [No response.]

Rhode Island

Contact: John Preiss, Chief Civil Engineer/Asset Manager, Rhode Island Department of Transportation, 401-222-2023, ext. 4058, john.preiss@dot.ri.gov.

1. **Use performance-based budgeting?** Yes.
2. **Tool or practice:**
    - Practice/guidance not associated with any tool.
    - Commercial off-the-shelf product.
    - Commercial off-the-shelf product that has been customized for agency use.

3. **Tool description:** For a majority of our performance-based monitoring we use VUEWorks by DTS [Data Transfer Solutions LLC; see http://www.vueworks.com/]. VUEWorks is a commercial off-the-shelf product that we use [for] pavement striping, guardrail repair, small repairs and maintenance for bridges, sign replacement and our environmental compliance activities. We have a few other off-the-shelf products for pothole repairs; for crack sealing, litter removal, graffiti cleanup, tree removal and brush control we just have basic policies and procedures in place. However, we are progressively moving all these activities into VUEWorks to monitor and track.
4. **Relate level of service to available budget:** As we start tracking activities, there is no relationship. All these activities were just part of the maintenance program that needed to be completed. Over the past two decades our maintenance division staffing was reduced by 4/5. As a result the division was reduced to just plowing and mowing. Within the past four year[s] we have been growing the division and tracking of the activities. This need (backlog of work orders) versus work performed has allowed us to hire new staff. The performance is measure[d] by the increase in completed work orders and the time it takes to complete. The work orders are detailed work descriptions that are tracked in real time.
5. **Consider level of service scores?** Yes.
6. **Associate level of service with climate zones?** No.
7. **Associate level of service with traffic volumes?** No.
8. **Documentation:** We are working on this but have nothing available at this time.
9. **Successes:** Performance-based budgeting has allowed us to justify the need to increase staffing, purchase equipment and gain public trust in knowing and seeing the results of the expenditure of public funds.
10. **Challenges:** Once we were successful for a few activities, other units and asset areas wanted to implement this system; however, we only have limited resources to ourselves. What was prioritized at the maintenance division level is now prioritized at the executive level for the whole department. We have 22 different departmentwide activities now waiting [to] utilize performance-based budgeting.
11. **Additional comments:** Question 5, 6 & 7. I have no knowledge of the capabilities in these areas. Question 5 is the only one which we use.

South Carolina

Contact: Jim Feda, Director of Maintenance, South Carolina Department of Transportation, 803-737-1290, fedajj@scdot.org.

1. **Use performance-based budgeting?** Yes.
2. **Tool or practice:**
    - Excel spreadsheet.
3. **Tool description:** We budget by maintenance activity. Our maintenance activities are tied to the elements that we inspect in our Maintenance Assessment Program (MAP). The resident maintenance engineers use the results of the MAP inspections to decide how much to budget for the various maintenance activities they plan to perform in the upcoming fiscal year. They are instructed to focus on the elements that received a level of service grade less than a “C.”

4. **Relate level of service to available budget:** The resident maintenance engineer (RME) begins with a set amount of funding available. They allocate that funding to activities that will help them achieve predetermined goals and on elements where a low level of service has been identified. Since this is not a needs-based budget, there is usually inadequate funding available to allow the RME to improve the level of service being provided to every element inspected in the MAP.

5. **Consider level of service scores?** Yes.

6. **Associate level of service with climate zones?** No.

7. **Associate level of service with traffic volumes?** No.

8. **Documentation:** I can provide a copy of the Excel Workbook that we use for each organizational unit's budget. Please contact me if you would like a copy.

9. **Successes:** We are able to focus on areas that have traditionally had a low level of service and make some improvements with the funding we have available. Having the MAP report for each county helps the RME focus his/her resources on the areas where the lowest levels of service are being provided.

10. **Challenges:** Getting the RMEs to review their MAP scores and focus on the areas that need improvement instead of just doing business as usual. They usually begin the budget process by looking at what a crew accomplished the preceding fiscal year instead of determining what a crew needs to accomplish to achieve a specific goal or level of service.

11. **Additional comments:** We begin our budget process in November with budgets due to me in late January or early February. Each county budget rol[l]s up to a district budget with the district budget rolling up to a statewide budget. We have seen gradual increases in the Maintenance Assessment Program scores, but we are limited by our current level of funding.

Related Resources:

Budgeting Workbook for Richland County, South Carolina Department of Transportation, undated.
See **Appendix E**.

Budgeting Workbook for District One, South Carolina Department of Transportation, undated.
See **Appendix F**.
Budgeting workbooks are created at the county and district levels, with the seven district workbooks rolling up into a statewide workbook. The workbooks above provide an example of how a county workbook (Richland) rolls into a district workbook (District One). The respondent highlighted a change in how the budgets are reflected in these sample workbooks:

> We used to include salaries for each unit in the budget. However, we now show that as a lump sum budget number. I mention this because the salaries were shown on the "x" sheet of the workbook and this area is now blank or shows a divided-by-zero error.

Utah

Contact: Kevin Griffin, Central Maintenance/Director of Maintenance, Utah Department of Transportation, 801-965-4120, kgriffin@utah.gov.

1. **Use performance-based budgeting?** Yes.
2. **Tool or practice:**
   - Software developed in-house.
   - Commercial off-the-shelf product that has been customized for agency use.
3. **Tool description:** We use both a combination of a vendor-customized product and home-built applications that interface with the vendor program. AgileAssets is the vendor. Our Operations Management System is from Agile. We had them customize our MMQA+ [Maintenance Management Quality Assurance Plus] program in their software. Our performance budgeting tool was built in-house but communicates with the Agile software for data information and asset information.
4. **Relate level of service to available budget:** We have been using our MMQA program in its current form since 2003. Since that time we have been able to develop regression curves based on expenditures and how those expenditures relate to our identified targets. This gives us the ability to provide funding for our Maintenance Division based on the target levels. It also identifies the increases or decreases needed in measured assets to meet the identified targets.
5. **Consider level of service scores?** Yes.
6. **Associate level of service with climate zones?** No.
7. **Associate level of service with traffic volumes?** No.
8. **Documentation:** Not currently. We could provide screen shots of the analysis output, but the programming and curves are all behind in the programming.
9. **Successes:** UDOT has been using this current model for the past four years. The main issues are data quality. We made changes to our MMQA program to provide higher data quality so this program could be developed.
10. **Challenges:** With current funding levels it is difficult to always provide funding to the proposed analysis. Our budgets have been increasing over the past few years and it is making it possible to fund our four regions to the identified levels. Data quality is always an issue. Program integration with vendor software and in-house programming are also an issue at times.
11. **Additional comments:** UDOT is currently looking at different ways to measure our assets. We currently use asset deficiencies to trigger work and for our analysis. We only collect data two times a year. We are looking at moving to a dynamic data collection model where asset condition and work accomplishment drive our program in the future. We will also be going to a complete mobile solution for our maintenance division so all our data collection (which is already done through an in-house developed mobile solution) and all our work done on a daily basis will be entered into a GIS-based mobile system that automatically updates our asset condition and accomplishments.

Washington

Contact: Rico Baroga, Highway Maintenance/Maintenance Policy Manager, Washington State Department of Transportation, 360-705-7864, barogar@wsdot.wa.gov.

1. **Use performance-based budgeting?** Yes.
2. **Tool or practice:**
    - Excel spreadsheet.
    - Software developed in-house.
    - Commercial off-the-shelf product.
3. **Tool description:** We allocate some funds based on inventory and maintenance needs. Most software is developed in-house. For bridge maintenance, we use the Maintenance Productivity Enhancement Tool (MPET); vendor is Four Winds Group.
4. **Relate level of service to available budget:** Tools are used to identify backlogs of maintenance, which serve[s] as the basis of budget development and allocation.
5. **Consider level of service scores?** Yes.
6. **Associate level of service with climate zones?** No.
7. **Associate level of service with traffic volumes?** No.
8. **Documentation:** http://www.wsdot.wa.gov/Maintenance/Accountability/default.htm
9. **Successes:** Improved quality and accuracy of budget requests and fairer allocations of funds to regions.
10. **Challenges:** Some of the budget continues to be historically based. We do not have complete inventories for some highway assets. One of our in-house databases is fairly new so still working out the bugs and educating maintenance technicians on use.
11. **Additional comments:** Feel free to call if you have questions or would like to discuss.

Respondents Not Conducting Performance-Based Budgeting

Fourteen respondents reported that their states do not conduct performance-based budgeting for maintenance activities. Of these, respondents from four states—Arkansas, Tennessee, Vermont and Wyoming—reported plans to implement this practice.

Arkansas

Contact: Dan DeVore, Staff Maintenance Engineer, Arkansas State Highway and Transportation Department, 501-569-2636, daniel.devore@ahtd.ar.gov.

1. **Use performance-based budgeting?** No.
2. **Future plans?** We are planning to use performance-based budgeting in the future. We are looking into different COTS [commercial off-the-shelf] [systems] as well as developing our own tools.

Connecticut

Contact: Daniel DiReinzo, Transportation Maintenance Planner II, Connecticut Department of Transportation, 860-594-2629, daniel.direinzo@ct.gov.

1. **Use performance-based budgeting?** No.
2. **Future plans?** Currently we do not have any plans to conduct performance-based budgeting.

Idaho

Contact: Steve Spoor, Maintenance Services Manager, Idaho Transportation Department, 208-334-8413, steve.spoor@itd.idaho.gov.

1. **Use performance-based budgeting?** No.
2. **Future plans?** We are in the beginning process of implementing work plan development based on asset condition and performance. Once implemented, we would have a natural trend towards more performance-based budgeting.

Illinois

Contact: Tim Armbrecht, Maintenance Operations Engineer, Bureau of Operations, Illinois Department of Transportation, 217-782-8418, tim.armbrecht@illinois.gov.

1. **Use performance-based budgeting?** No.
2. **Future plans?** At this time, there aren't any plans (that I'm aware of) to conduct performance-based budgeting.

Kansas

Contact: Clay Adams, Bureau Chief of Maintenance, Kansas Department of Transportation, 785-296-3233, clay@ksdot.org.

1. **Use performance-based budgeting?** No.
2. **Future plans?** We do not have not immediate plans, but we do utilize our Maintenance Quality Assurance Program to help prioritize where our budget dollars are spent.

Minnesota

Contact: Steve Lund, Operations/State Maintenance Engineer, Minnesota Department of Transportation, 651-366-3566, steven.lund@state.mn.us.

1. **Use performance-based budgeting?** No.
2. **Future plans?** We distribute operating funds for the referenced maintenance activities on a formula basis. There have been some situations where one-time funds were distributed based on condition/performance.

Montana

Contact: Jon Swartz, Maintenance Administrator, Montana Department of Transportation, 406-444-6158, joswartz@mt.gov.

1. **Use performance-based budgeting?** No.
2. **Future plans?** No plans at this time for performance-based budgeting.

Nebraska

Contact: Tom Renninger, Assistant Operations/Maintenance Division Manager, Nebraska Department of Roads, 402-479-4787, tom.renninger@nebraska.gov.

1. **Use performance-based budgeting?** No.
2. **Future plans?** At this time I am not aware of any.

New Mexico

Contact: Tamara Haas, Asset Management and Planning Division Director, New Mexico Department of Transportation, 505-795-2126, tamarap.haas@state.nm.us.

1. **Use performance-based budgeting?** No.
2. **Future plans?** There are not current plans to conduct performance-based budgeting. We are in the process of developing a Transportation Asset Management Plan, but have set performance targets or based budget decisions on targets.

South Dakota

Contact: Dan Vockrodt, Operations Maintenance Engineer, South Dakota Department of Transportation, 605-773-2615, dan.vockrodt@state.sd.us.

1. **Use performance-based budgeting?** No.
2. **Future plans?** We tried to put together something in the past, but the plan was abandoned. There are no plans to conduct performance-based budgeting at this time.

Tennessee

Contact: Chris Harris, Maintenance/Civil Engineering Manager, Tennessee Department of Transportation, 615-532-3453, chris.harris@tn.gov.

1. **Use performance-based budgeting?** No.
2. **Future plans?** Plan to implement within next 12 to 24 months. Modifying our condition assessment from pass/fail to LOS (A-F) in July 2016, and will implement new budget tool using LOS in 2017. Will likely phase in condition-based budgets over time. [See page 23 of this Preliminary Investigation for a presentation describing the agency's transition to performance-based budgeting.]

Vermont

Contact: Wayne Gammell, Maintenance/Operations, Vermont Agency of Transportation, 802-828-2691, wayne.gammell@vermont.gov.

Note: We sought additional information from this respondent about the process underway but did not receive that information by the time of publication of this report.

1. **Use performance-based budgeting?** No.
2. **Future plans?** We are currently starting the process.

West Virginia

Contact: Kyle Stollings, Director, Maintenance Division, West Virginia Division of Highways, 304-558-2901, w.kyle.stollings@wv.gov.

1. **Use performance-based budgeting?** No.
2. **Future plans?** No plans at this time.

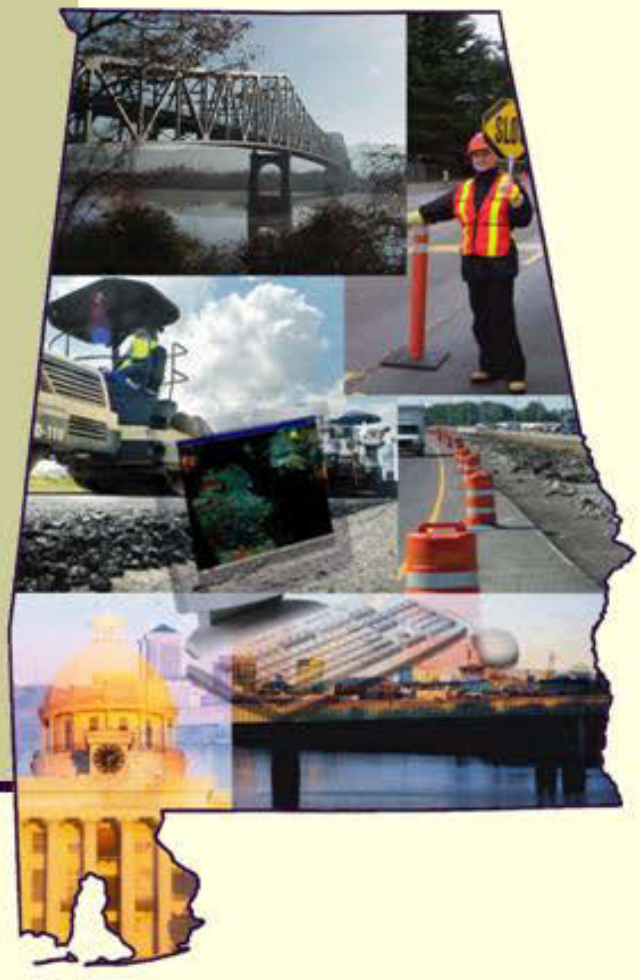
Wyoming

Contact: Kent Ketterling, Field Operations-Maintenance, Wyoming Department of Transportation, 307-777-4051, kent.ketterling@wyo.gov.

1. **Use performance-based budgeting?** No.
2. **Future plans?** We conduct a QC/QA [quality control/quality assurance] process each year and utilize this information in budget preparation. Data is reviewed to determine areas where additional resources need to be directed. We are working to develop a more complete procedure using AgileAssets work plan optimization tool but have not implemented this yet.

Level of Service Condition Assessments

Data Collection Manual



October 2015

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Revision History**:**

Revision date:	Revised By:	Description of Change:
12/28/2009	Dye Management Group, Inc.	**Version 1.0**
01/08/2010	Dye Management Group, Inc.	**Version 1.01:** Minor wording changes
01/15/2010	Dye Management Group, Inc.	**Version 1.02:** Minor wording changes
01/18/2010	Dye Management Group, Inc.	**Version 1.03:** Added QA sample column to Exhibit II-1; removed Exhibit II-2 (Division level data samples); Revised Exhibit II-3 (removed reference to Division level samples); Revised Appendix A.
01/25/2010	Dye Management Group, Inc.	**Version 1.04:** Minor wording changes and clarifications
10/20/2010	Dye Management Group, Inc.	**Version 2.0:** Deleted references to rutting and cracking for asphalt and concrete pavement. Added cable rail data collection criterion.

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Alabama Department of Transportation

Data Collection Manual

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I. Introduction

■

A. Purpose

The purpose of this Data Collection Manual is to describe the procedures for collecting road inventory and condition assessment data for assets maintained by the Alabama Department of Transportation (ALDOT). The condition data will be used to develop customer-oriented, performance-based work plans and budgets and to assess results. This exercise is part of a broader project to develop a Maintenance Management System (MMS) based on condition ratings and levels of service.

B. Project Background

Prior to drafting this manual, strategic meetings were conducted with several of the ALDOT division and district personnel as well as with the project steering committee members to accomplish the following:

- Document the as-is processes,
- Define the future maintenance management process, and
- Develop a method for evaluating and reporting LOS for individual asset classifications and their associated maintenance features

For all the features whose LOS measures were developed, this manual outlines the procedures for collecting their inventory and condition data in the field.

C. General Approach

The general approach for collecting and processing road inventory data consists of the following steps:

- Identify the features and types of measurements or observations needed to establish a complete inventory of all maintainable roadway assets of ALDOT and their condition
- Develop field and office procedures for collecting and maintaining the inventory and condition data, and establish a process for keeping the data up-to-date
- Conduct office and field training for road maintenance personnel
- Collect measurements and observations in the field and record the data
- Collect data that currently exists in office records
- Establish a database to maintain the data in a readily retrievable format
- Provide reporting tools to summarize data on existing roadway assets

- Periodically, at least annually, repeat the collection and processing of condition data
- Follow procedures for keeping the inventory data up-to-date

The Alabama State Highway System consists of approximately 12,000 miles of roadway, for which ALDOT has maintenance responsibility. To the extent possible, inventory and condition data will be obtained from preexisting sources, including office records, application databases, and the mainframe feature inventory. Any field data collection that is required will be done on a statistically significant sampling basis, using randomly selected 0.1-mile sample segments. The maintenance feature condition data to be collected is described in detail in Section III.

II. Data Collection Procedures

■

A. Organizational Considerations

The field data is most efficiently collected by three-person teams. Three-person teams are desirable for the following reasons:

1. One person can drive while the other two are recording data
2. One person can watch for oncoming traffic while the other two are recording data
3. One person can be taking measurements or counting while the other is recording data
4. A second opinion may be advantageous where a judgment call is necessary
5. Three people are less likely to be accosted by evildoers than one person acting alone

It is desirable to collect all the data in as short a time period as possible so that observed quantities and conditions will be a true representation of the road network at the time the analysis is done for planning and budgeting purposes. For this reason it may be desirable to have a two-person team mark the required sections ahead of the data collection team. This approach has been shown to greatly reduce the time required to cover the required number of samples.

B. Field Sample Segments

Statistical methods will identify randomly selected data sample sites along state-maintained highways. The sites are 0.1-mile segments (528 feet) selected in the 12,033 miles of roads (interstate and non-interstate) maintained by ALDOT. For divided highways, both road directions will be sampled as separate roadways.

The following equation was used to determine the minimum sample size necessary to achieve the desired confidence and precision for LOS measures:

$$n = \frac{(z^2)(p)(1-p)}{e^2 + \frac{(z^2)(p)(1-p)}{N}}$$

where:

n = Sample size (for example, number of 0.1-mile increments)
N = Population size (for example, total number of 0.1-mile increments)
z = Standard normal deviate (that is, number of standard deviations for desired level of confidence)
p = Proportion of the population that meets a specified criteria, expressed as a decimal value from 0.0 to 1.0

1 - p = Remaining proportion of the population
e = Allowable sampling error (or precision), expressed as a decimal

A sampling error of 8 percent and confidence level of 95 percent were used for all roads. It was also assumed that Interstates are in better condition than the rest of the roads in the state. Therefore, the proportion of the samples that meets a passing criterion is assumed to be higher for interstate roads. Thus, for interstate, a value of p = 80% was used while a value of p = 70% for the NHS, other state non-NHS and Institution roads was used. It was assumed that Interstates and NHS Non-Interstate routes are divided, requiring separate samples for the northbound and southbound or eastbound and westbound directions. This assumption effectively doubles the number of miles required to sample these road classes. The rest of the roads were not assumed to be divided.

The distribution of these samples by district is shown in Exhibit II-1, and the distribution of samples at the division level is detailed in Exhibit II-2. **Note that in practice the number of samples should be increased by approximately 10 percent to allow for sites that must be rejected due to bridges, construction zones, or unsafe traffic conditions.** As an example, shown below are the calculations carried out to determine the number of samples along Interstate roads for the1st Division, District 1:

1st Division, District 1 consists of 55.43 miles, or 111 miles counting both northbound and southbound sides of interstate roads.

Using 0.1-mile sample sections, the population consists of 1110 potential sample sites. For a sample size that will give 95 percent confidence that the LOS average rating will be within 8 percent of the true value, if the pass/fail rate is 80 percent, then the values for the above equation are: z = 1.96, p = 0.8, e = 0.08, and N = 1110. Using these values, the required sample size is:

$$n = \frac{(1.96)^2(.8)(1-.8)}{(.08)^2 + \frac{(1.96)^2(.8)(1-.8)}{1110}} = 88$$

In this case, 44 samples will be collected in each travel direction. These sample sites will be selected in a random fashion by generating 44 numbers between 0.0 and 1.0. By multiplying these numbers by the total number of miles in each district, the milepoints of the field sample segments will be obtained. For convenience, the roads in each division (or district) will be arranged in numerical order, with each road length noted.

All identified features within each field sample segment will be evaluated. The survey is intended to assess the current condition that exists at the point in time when the evaluation takes place. In the future, two or more surveys per year could be conducted to account for seasonal variations.

In every case, the primary concern of data collectors should be the safety of the team and of the road users (safety responsibilities are identified later in this section). Following are the general procedures for collecting field data:

- Using intersections or state boundaries and the vehicle DMI or GPS device, locate and mark the starting and ending milepoint for each field sample segment. These sample segments will be identified by spray paint at the edge of the shoulder so that they can be located again if needed. Placing a traffic cone on the starting and ending mile points also may help identify the limits of the field sample segment while collecting data.
- If any portion of the field sample segment falls on a bridge, move the sample segment forward or backward as necessary to avoid the bridge. Note any adjustments on the data collection input form, laptop, or PDA.
- Field sample segments falling within construction zones should not be evaluated. Relocate the sample segment outside of the construction area but as close to the original segment as possible. Note any adjustments on the data collection input form, laptop, or PDA.
- If some sample locations that fall on bridges or construction zones, and cannot be relocated due to the proximity of other sample locations, the sample location in question may be rejected. Also, if the working conditions at the site are unsafe for any reason, the sample location may be rejected. The required number of samples was increased by 10 percent to allow for such rejections.
- All linear measurements should be rounded up to the nearest foot. Do not use fractions or increments less than one foot.
- From the starting milepoint, rate all identified features on one side of the roadway in the field sample segment. Return to the starting milepoint and rate the other side from start to end. For safety reasons, walk in the direction facing traffic whenever possible. Distance measurements should be taken from the starting milepoint of the field sample segment in the direction of increasing milepost numbers. The starting and ending milepoints of linear features located within the field sample segment should be measured as distance from the feature's starting milepoint.
- Input each day's condition ratings into the database file.

Exhibit II-1: Number of Samples Required to be Statistically Significant at the District Level
(For 95% Confidence, +/- 8% Precision - QA at 90% Confidence)

Division	District	Type	Samples	Total	QA Samples
1	2	Interstate	72	292	29
		NHS Non-Interstate	114		
		Other State, Non-NHS	106		
	3	Interstate	86	358	36
		NHS Non-Interstate	115		
		Other State, Non-NHS	157		

Division	District	Type	Samples	Total	QA Samples
	4	Interstate	81	348	35
		NHS Non-Interstate	115		
		Other State, Non-NHS	152		
	5	Interstate	81	344	34
		NHS Non-Interstate	115		
		Other State, Non-NHS	148		
2	1	Interstate	0	263	26
		NHS Non-Interstate	117		
		Other State, Non-NHS	146		
	2	Interstate	0	264	26
		NHS Non-Interstate	118		
		Other State, Non-NHS	146		
	4	Interstate	87	349	35
		NHS Non-Interstate	113		
		Other State, Non-NHS	149		
3	1	Interstate	92	354	35
		NHS Non-Interstate	113		
		Other State, Non-NHS	149		
	2	Interstate	87	343	34
		NHS Non-Interstate	102		
		Other State, Non-NHS	154		
	5	Interstate	78	326	33
		NHS Non-Interstate	100		
		Other State, Non-NHS	148		
4	1	Interstate	0	257	26
		NHS Non-Interstate	110		
		Other State, Non-NHS	147		
	2	Interstate	67	315	32
		NHS Non-Interstate	113		
		Other State, Non-NHS	135		
	3	Interstate	66	314	31
		NHS Non-Interstate	101		
		Other State, Non-NHS	147		

Division	District	Type	Samples	Total	QA Samples
	4	Interstate	77	325	33
		NHS Non-Interstate	96		
		Other State, Non-NHS	152		
	5	Interstate	75	319	32
		NHS Non-Interstate	110		
		Other State, Non-NHS	134		
5	2	Interstate	86	347	35
		NHS Non-Interstate	112		
		Other State, Non-NHS	149		
	4	Interstate	81	339	34
		NHS Non-Interstate	109		
		Other State, Non-NHS	149		
	5	Interstate	0	249	25
		NHS Non-Interstate	97		
		Other State, Non-NHS	152		
	6	Interstate	81	329	33
		NHS Non-Interstate	102		
		Other State, Non-NHS	146		
6	1	Interstate	77	332	33
		NHS Non-Interstate	107		
		Other State, Non-NHS	148		
	2	Interstate	82	297	30
		NHS Non-Interstate	63		
		Other State, Non-NHS	152		
	3	Interstate	84	337	34
		NHS Non-Interstate	115		
		Other State, Non-NHS	138		
	4	Interstate	87	238	24
		NHS Non-Interstate	0		
		Other State, Non-NHS	151		
	5	Interstate	0	260	26
		NHS Non-Interstate	114		
		Other State, Non-NHS	146		

Division	District	Type	Samples	Total	QA Samples
	6	Interstate	78	337	34
		NHS Non-Interstate	116		
		Other State, Non-NHS	143		
7	1	Interstate	0	259	26
		NHS Non-Interstate	117		
		Other State, Non-NHS	142		
	2	Interstate	0	250	25
		NHS Non-Interstate	95		
		Other State, Non-NHS	155		
	3	Interstate	0	257	26
		NHS Non-Interstate	111		
		Other State, Non-NHS	146		
	4	Interstate	0	261	26
		NHS Non-Interstate	111		
		Other State, Non-NHS	150		
	5	Interstate	0	253	25
		NHS Non-Interstate	108		
		Other State, Non-NHS	145		
	6	Interstate	0	256	26
		NHS Non-Interstate	107		
		Other State, Non-NHS	149		
8	2	Interstate	0	264	26
		NHS Non-Interstate	112		
		Other State, Non-NHS	152		
	3	Interstate	0	233	23
		NHS Non-Interstate	79		
		Other State, Non-NHS	154		
	4	Interstate	0	266	27
		NHS Non-Interstate	117		
		Other State, Non-NHS	149		
9	1	Interstate	88	347	35
		NHS Non-Interstate	110		
		Other State, Non-NHS	149		

Division	District	Type	Samples	Total	QA Samples
	2	Interstate	88	348	35
		NHS Non-Interstate	107		
		Other State, Non-NHS	153		
	3	Interstate	88	342	34
		NHS Non-Interstate	104		
		Other State, Non-NHS	150		
10	1	Interstate	0	230	23
		NHS Non-Interstate	78		
		Other State, Non-NHS	152		
	3	Interstate	81	329	33
		NHS Non-Interstate	99		
		Other State, Non-NHS	149		
	8	Interstate	86	331	33
		NHS Non-Interstate	99		
		Other State, Non-NHS	146		
	9	Interstate	85	348	35
		NHS Non-Interstate	109		
		Other State, Non-NHS	154		
Total			**12410**	**12410**	**1241**

C. Data Collection Equipment

The necessary equipment for completing field assessments is as follows:

- Notebook, or note pad and clipboard, and several extra pens for recording any pertinent notes about data collection.
- Flexible metal measuring tape, ¾ inch to 1 inch wide by 25 feet long, or a 6-foot folding ruler, graduated in feet and tenths.
- 100-foot cloth or metal measuring tape.
- Measuring wheel, with a capacity of at least 528 feet, for measuring distances longer than the length of the flexible tape.
- Vehicle equipped with:

  - Flashing yellow/orange safety lights on top of vehicle.
  - Distance Measuring Instrument (DMI) capable of recording to the nearest 0.01 mile and calibrated for less than 1.0 percent error under normal operating conditions (i.e., temperature, tire pressure, vehicle load, etc.).
- Handheld laser or infrared range finder (e.g., the type commonly used for hunting or golfing) – Optional.
- Flashlight, for examining the interior of catch basins.
- 12-volt socket "splitter" to allow more than one device to be plugged into the cigarette lighter (available at most automotive supply stores).
- Traffic cones (three minimum).
- Several cans of orange spray-paint to mark sample locations.
- Protective clothing, such as field boots, jeans, hat, safety glasses, and other outdoor wear appropriate for the season.
- Reflective orange or green safety vests, according to ALDOT policy.

As an alternative to using manual data collection methods, electronic handheld devices such as Personal Digital Assistant (PDA) devices can be acquired to record the field data. If such devices are used to collect data, then the corresponding data dictionaries will have to be written.

D. Safety Responsibility

In every circumstance, the primary concern of data collectors shall be the safety of the team and of the road users. The survey teams shall conduct the work to ensure the least possible obstruction to traffic. The team vehicle and team members must be properly outfitted with safety equipment, including flashing lights, traffic cones, and safety vests.

When collecting data and while driving at less than the posted speed limit, the survey vehicle should be in the right lane or on the shoulder with all lights flashing. When parked, the survey vehicle should be off the paved surface whenever possible and, if not, at least as close to the outer edge of the shoulder as possible, with all lights flashing and traffic cones in place to warn approaching traffic.

Perhaps the best safety practice is "situation awareness" (i.e., being aware of where other vehicles and pedestrians are and what they are doing.) Then, if necessary, appropriate action can be taken in time to avoid an unpleasant incident.

If any unsafe roadway condition is observed while the team is in the field, the team will immediately notify the nearest maintenance crew by radio or telephone. The team will describe the problem and request that the appropriate maintenance section respond. The team is not expected to perform maintenance functions while conducting the inventory.

However, if debris that constitutes a safety problem is encountered on the roadway, it should be removed as a matter of courtesy and safety for motorists.

E. Overview of Maintenance Condition Assessment Criteria

As ascertained by discussions held with the project steering committee, Exhibit II-4 illustrates the asset classifications, maintenance features, and types of measurements and observations needed to assess the condition of each feature.

Exhibit II-4: Maintenance Features to Determine Condition Ratings

Asset Classification	Maintenance Feature	Maintenance Feature Condition Measure
Asphalt Pavement	• Potholes (≥ 6x6x1 in.)	• Number of potholes per lane mile
	• Raveling	• % of surface area distressed
	• Shoving (Upheaval/Depression)	• Square feet of deficiencies per lane mile
Concrete Pavement	• Spalling (≥ 6x6x1 in.)	• Number of spalls per lane mile
	• Faulting (≥ 1/4 in. high)	• Number of faulted slabs per lane mile
	• Joint sealing (≥ 1/4 in. wide)	• Linear feet of joints requiring sealing per lane mile
	• Pumping	• Number of slabs deficient per lane mile
	• Punchouts (≥ 6x6 in. surface area with full depth failure)	• Number of punchouts per lane mile
Shoulders	• Potholes (≥ 6x6x1 in.)	• Number of potholes per shoulder mile
	• Edge Raveling (Edge Failure)	• Linear feet per shoulder mile
	• Sweeping	• Linear feet of paved shoulder needing sweeping
	• Non- paved – Drop off (≥ 2 in.) (Low shoulder)	• Linear feet per shoulder mile
	• Non- paved – High shoulder > 1 in. (Built-up shoulder)	• Linear feet per shoulder mile
Drainage	• Side drains	• % of pipes “not functioning as intended” or > 25% blocked
	• Cross drains	• % of pipes “not functioning as intended” or > 10% blocked
	• Unpaved ditches	• % of ditch length “not functioning as intended” (erosion or blockage)

Asset Classification	Maintenance Feature	Maintenance Feature Condition Measure
	• Paved ditches	• % of ditch length "not functioning as intended" or blocked
	• Drop inlets, Slotted Drains, & Catch basins	• % of inlets "not functioning as intended" or blocked
	• Curb and Gutters	• % of length "not functioning as intended" or misaligned
Roadside	• Front slope – Erosion control	• % of shoulder miles deficient – washouts >12 in.
	• Back slope – Erosion control	• % of shoulder miles deficient – washouts >18 in.
	• Mowable Area	• Average height of grass (in.)
	• Brush control (blocking line of sight or signage or within the "clear zone")	• % shoulder miles with undesirable brush
	• Tree removal	• Number per shoulder mile
	• ALDOT Fence	• % of fence miles damaged (functionally deficient - requiring repair)
	• Litter control	• Number of equal to or greater than fist-size objects per shoulder mile
Traffic Services	• Raised pavement markers	• % of RPMs missing or damaged per center line mile
	• Signals (bulbs malfunctioning, structurally deficient, facing wrong direction, etc.)	• % of signals deficient
	• Delineators	• % of delineators deficient
	• Object Markers	• % of markers missing or damaged
	• Signs - warning and regulatory (damaged, missing, illegible, retro-reflectivity)	• % of signs deficient
	• Signs – other (damaged, missing, illegible, retro-reflectivity)	• % of signs deficient
	• Pavement striping (non-visible, missing, faded, chipped)	• % of total length deficient
	• Guardrail	• % of guardrail length deficient
	• Cable rail	• % of cable rail length deficient

Asset Classification	Maintenance Feature	Maintenance Feature Condition Measure
	• Impact attenuators	• % of impact attenuators needing repair
	• Barrier walls	• % of barrier length deficient
	• Highway Lighting (low or high mast)	• % malfunctioning (LOS Condition only, no budgeting initially)
	• Pavement markings and legends (non-visible, missing, faded, chipped)	• % of symbols and legends deficient

F. Inventory Gap

As mentioned earlier, a comprehensive inventory of the existing highway assets maintained by ALDOT is needed in order to determine the condition rating. The first column in Exhibit II-4 lists the inventory needed to develop the condition ratings and work plans, and the second column shows the currently inventoried items. Thus, based on (a) Exhibit II-4 (i.e. the features required to determine condition ratings); and (b) current inventory maintained by ALDOT (i.e. Column II in Exhibit II-5), column III of Exhibit II-5 identifies the gaps in the existing data and lists the additional features whose inventory has to be collected and maintained.

Exhibit II-5: Inventory Gap

Column I	Column II	Column III
Inventory Needed	**Inventory Currently Available**	**Inventory to be Collected**
Asphalt pavement		X
Concrete pavement		X
Paved shoulder	X	
Unpaved shoulder	X	
Side drain		X
Cross drain		X
Paved ditch	X	
Unpaved ditch	X	
Drop inlets & catch basins		X
Curb & gutter		X
Front slopes		X
Back slopes		X
Mowing	**?**[1]	
Brush	**?**[1]	
Trees	**?**[1]	
Fences	X	

Column I	Column II	Column III
Inventory Needed	**Inventory Currently Available**	**Inventory to be Collected**
Litter	X	
Vegetative Roadside	**?[1]**	
Raised pavement markers		X
Signals	X	
Delineators		X
Object markers		X
Signs	X	
Pavement striping	X	
Guardrails	X	
Cable rail		X
Impact attenuators	X	
Barrier walls	X	
Highway lighting	**?[2]**	
Pavement markings & legends		X

[1]The current inventory has a "roadside" category. Are inventory on mowing, brush, trees and undesirable vegetation collected under this category?

[2]The current inventory has a "signals & lights" category. Is inventory on highway lighting collected under this category?

III. Road Maintenance Feature Inventory and Condition Rating – Data Collection Criteria

■

Following is a list of maintenance features and the exhibit number where the definition and inspection procedures for each can be found.

Note that if condition data on a feature exists in any of the current ALDOT systems, the preferred approach would be to extract it from that system. If such data does not exist, then the field data collection procedures outlined in the following exhibits are to be followed. Also, note that road classification and other "header" data must be collected for each sample, such as District, Division, Road Class, Route Number, Starting Milepoint of Sample, Type of Surface, Number of Lanes, Divided Roadway (if applicable), GPS Location of Starting Milepoint (if required), Date of Collection, Name of Team Leader.

Additionally, the sample segment route, starting milepost, and direction of travel will also be recorded.

Asset Classification and Maintenance Feature	Exhibit
Asphalt Pavement	
Potholes	A-1
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Exhibit A-1: Asphalt Pavement, Potholes

Asset Group: Asphalt Pavement
Maintenance Feature: Potholes
Definition: Potholes are bowl-shaped voids or depressions in the pavement surface that are equal or greater than 6 inches by 6 inches by 1 inch deep (6”x6”x1”). Potholes are localized failure areas usually caused by weak base or subgrade layers.
Measurement Unit: Inventory: Asphalt lane-miles. Condition: Number of potholes per asphalt lane-mile.
Inspection Procedure: For each sample on asphalt-surfaced pavements, inspect the surface area and count and record the total number of potholes in all lanes.

Sample Pothole (6”x6”x1”)

To be counted as one (1) **Pothole** if this size or larger.

Exhibit A-2: Asphalt Pavement, Raveling

Asset Group: Asphalt Pavement
Maintenance Feature: Raveling
Definition: Raveling of asphalt pavement is defined as the loss of bond between the asphalt binder and the aggregate through either a cohesion or adhesion failure, usually caused by the action of water. When raveling occurs, the pavement surface appears to be disintegrating.
Measurement Unit: Inventory: Asphalt lane-miles. Condition: Square feet of raveling per asphalt lane-mile.
Inspection Procedure: For each sample on asphalt-surfaced pavements, inspect the surface area for raveling. Measure and record the total square feet of raveling in all lanes. Use the measuring wheel or tape measure, as appropriate; to obtain the length and width of each raveled area.

Sample Asphalt Raveling

Square feet of **Raveling** to be counted if this condition exists.

Exhibit A-3: Asphalt Pavement, Shoving

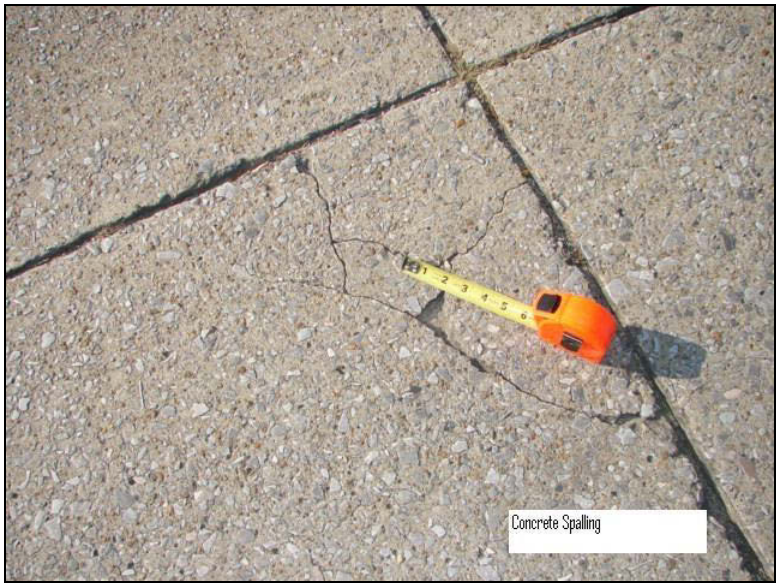
Asset Group: Asphalt Pavement
Maintenance Feature: Shoving (Upheaval/Depression)
Definition: An area of the paved surface that is displaced vertically to cause a hump in the roadway, often along the edge of the travel lanes or at intersections where frequent braking with heavy axle loads causes "pushouts."
Measurement Unit: Inventory: Asphalt lane-miles. Condition: Surface area with shoving, expressed as square feet per asphalt lane-mile.
Inspection Procedure: For each sample on asphalt-surfaced pavements, inspect the paved surface for shoving. Measure the total length and average width of each distressed area. Record the total square feet of shoving for all lanes. It will be helpful to have a clipboard and notepad to jot down the size of each distressed area and calculate the total distressed area in the sample section.

Sample Asphalt Shoving

Square feet of **Asphalt Shoving** to be counted if this condition exists.

Exhibit A-4: Concrete Pavement, Spalling

Asset Group: Concrete Pavement
Maintenance Feature: Spalling
Definition: Spalling is the breakup or disintegration of the concrete surface that are equal to or greater than 6 inches by 6 inches by 1 inch deep (6”x6”x1”). A spall normally does not extend vertically through the slab. Often, spalling is the result of durability cracking (D-cracking) of the pavement. D-cracking is a series of fine crescent-shaped cracks in the concrete surface that usually run parallel to a joint or major crack. D-cracking can eventually lead to disintegration and spalling of the concrete near the joints or corners. Some spalls may resemble potholes.
Measurement Unit: Inventory: Concrete lane-miles. Condition: Number of spalls per concrete lane-mile.
Inspection Procedure: For each sample on concrete-surfaced pavements, inspect the paved surface for spalling. Count and record the total number of spalls in all lanes.



Sample Concrete Spalling (6”x6”x1”)

Concrete Spall to be counted if this condition exists.

Exhibit A-5: Concrete Pavement, Faulting

Asset Group: Concrete Pavement
Maintenance Feature: Faulting
Definition: Faulting is the vertical shift of ¼-inch or more of concrete slabs at a joint or crack.
Measurement Unit: Inventory: Concrete lane-miles. Condition: Number of faulted slabs per concrete lane-mile.
Inspection Procedure: For each sample on concrete-surfaced pavements, inspect the paved surface for faulting. Count and record the total number of faulted slabs in all lanes.

Sample Concrete Faulting

Faulted slab to be counted if this condition exists.

Exhibit A-6: Concrete Pavement, Joint Sealing

Asset Group: Concrete Pavement
Maintenance Feature: Joint Sealing
Definition: All unsealed joints at least ¼-inch wide running generally parallel or perpendicular to the direction of travel, including longitudinal, transverse and edge joints.
Measurement Unit: Inventory: Concrete lane-miles. Condition: Linear feet of deficient concrete joints.
Inspection Procedure: For each sample on concrete-surfaced pavements, measure and record the total length of all joints in all lanes. Inspect the surface area for unsealed joints wider than ¼-inch and measure and record the total length of all deficient joints in all lanes. Use a measuring tape or measuring wheel, as appropriate.

Sample Concrete Joint Sealing

Linear feet of **Unsealed Joint** to be counted if this condition exists.

Exhibit A-7: Concrete Pavement, Pumping

Asset Group: Concrete Pavement
Maintenance Feature: Pumping
Definition: A concrete slab that moves vertically with respect to one or more adjacent slabs when subjected to traffic loads, often exhibiting water or soil pumping movement along the edges of the slab.
Measurement Unit: Inventory: Concrete lane-miles. Condition: Number of pumping slabs per concrete lane-mile.
Inspection Procedure: For each sample on concrete-surfaced pavements, inspect the surface area for evidence of pumping and count and record the total number of all such slabs in all lanes. It will be helpful to watch joints or edges of slabs when trucks are passing to identify slab movement.

Sample Concrete Pumping

Pumping **Concrete Slab** to be counted if this condition exists.

Exhibit A-8: Concrete Pavement, Punchouts

Asset Group: Concrete Pavement
Maintenance Feature: Punchouts
Definition: Punchouts are holes in the concrete slab that penetrate the entire slab. Punchouts are localized failure areas within the slab, where a block of concrete has failed and punched through, often larger than 6x6 surface inches in size.
Measurement Unit: Inventory: Concrete lane-miles. Condition: Number of punchouts per concrete lane-mile.
Inspection Procedure: For each sample on concrete-surfaced pavements, inspect the paved surface for punchouts. Count and record the total number of punchouts in all lanes.

Sample Concrete Punchout (6”x6”)

To be counted as one (1) **Punchout** if this size or larger.

Exhibit A-9: Paved Shoulders, Potholes

Asset Group: Paved Shoulders
Maintenance Feature: Potholes
Definition: Potholes are bowl-shaped voids or depressions on paved shoulders that are greater than or equal to 6 inches by 6 inches by 1 inch deep (6”x6”x1”). Potholes are localized failure areas usually caused by weak base or subgrade layers.
Measurement Unit: Inventory: Paved shoulder-miles. Condition: Number of potholes per paved shoulder-mile.
Inspection Procedure: For each sample with paved shoulders, measure and record the total linear feet of paved shoulder on both sides of the road. Inspect the shoulder surface area and count and record the total number of potholes on both shoulders.

Sample Pothole, Paved Shoulders (6”x6”x1”)

To be counted as one (1) **Pothole** if this size or larger.

Exhibit A-10: Paved Shoulders, Edge Raveling

Asset Group: Paved Shoulders
Maintenance Feature: Edge Raveling (Edge Failure)
Definition: Disintegration of the paved shoulder surface along the edges, usually characterized by a series of irregular cracks, generally oriented with the direction of travel.
Measurement Unit: Inventory: Paved shoulder-miles. Condition: Linear feet of edge raveling per paved shoulder-mile.
Inspection Procedure: For each sample with paved shoulders, inspect the shoulder edges for raveling. Measure and record the total linear feet of raveling along both shoulders. Use the measuring tape or wheel, as appropriate.

Sample Paved Shoulder, Edge Raveling

Linear feet of **Edge Raveling** to be counted if this condition exists.

Exhibit A-11: Asphalt or Concrete Pavement, Sweeping

Asset Group: Asphalt or Concrete Pavement
Maintenance Feature: Sweeping
Definition: Sweeping refers to sections of the roadway that are routinely swept with a power broom to prevent build-up of dirt, sand, or debris. Often, these are curbed sections.
Measurement Unit: Inventory: Linear feet of paved surface or curb subject to sweeping. Condition: Linear feet of paved surface or curb needing sweeping.
Inspection Procedure: Inspect the paved surface area in the sample segment for sweepable areas and areas covered with dirt, sand, or debris. Measure and record the total linear feet of the paved surface, on both sides of the roadway, normally subjected to sweeping. Also, measure and record the total linear feet of paved surface that is covered with dirt, sand, or debris and needs sweeping now. A linear measurement is used because one pass along each sweepable edge of pavement is usually sufficient.

Sample Asphalt or Concrete Sweeping

Linear feet of **Sweeping** to be counted if this condition exists.

Exhibit A-12: Non-paved Shoulders, Drop-Off

Asset Group: Non-paved Shoulders
Maintenance Feature: Drop Off (Low shoulder)
Definition: Shoulder drop-off includes deformation or loss of material along the edge of the paved surface, where there is a vertical drop in elevation of 2 inches or more below the edge of the paved surface.
Measurement Unit: Inventory: Linear feet of unpaved shoulders. Condition: Linear feet of drop-off of unpaved shoulders.
Inspection Procedure: For each sample with unpaved shoulders, measure and record the total linear feet of unpaved shoulder on both sides of the roadway in the sample area. Also, inspect the edges of pavement for drop-offs of 2 inches or more and measure and record the total linear feet of such drop-off along both shoulders. Use the measuring tape or wheel, as appropriate, to measure length and a level or straightedge and metal tape to measure the drop in elevation.

Sample Non-Paved Shoulder, Dropoff

Linear feet of **Dropoff** to be counted if this condition exists.

Exhibit A-13: Non-paved Shoulders, High Shoulder

Asset Group: Unpaved Shoulders
Maintenance Feature: High Shoulder (Built-up shoulder)
Definition: High shoulder is an increase in elevation of 1 inch or more of material within 6 inches of the edge of the paved surface. The build-up of material typically includes soil, gravel, matted vegetation, or other debris that may impede water runoff or present an unsafe condition for motorists.
Measurement Unit: Inventory: Linear feet of unpaved shoulder. Condition: Linear feet of high shoulder.
Inspection Procedure: For each sample with unpaved shoulders, inspect the edges of pavement for high shoulders of 1 inch or more within 6 inches of edge of pavement. Measure and record the total linear feet of unpaved shoulder, and measure and record the total linear feet of high shoulders, along both sides of the road. Use the measuring tape or wheel, as appropriate, to measure length and a level or straightedge and metal tape to measure the height of high shoulders.

Sample Unpaved Shoulder, High Shoulder

Linear feet of **High Shoulder** to be counted if this condition exists.

Exhibit A-14: Drainage, Side Drains

Asset Group: Drainage

Maintenance Feature: Side Drains

Definition:

Side drains are any drainage structures along the side of the road that are essentially parallel with the roadway alignment, including pipes under driveways and side-roads.

Measurement Unit:

Inventory: Number of side drains.

Condition: Number of side drains deficient.

Inspection Procedure:

Inspect all side drains in the sample area for damage or blockage. If necessary, use a probe rod to locate the bottom of the pipe when obscured with sediment.

For the purposes of this survey, a side drain is considered deficient if any one of the following conditions exist:

1. Any portion of the drainage structure is blocked or filled with sediment or debris to more than 25 percent of its diameter.
2. Any portion is sufficiently damaged to weaken its structural integrity.
3. The flow capacity of the inflow or outflow is impeded by external obstructions such as sediment, rocks, vegetation, or woody debris.
4. Any portion of the grate or trash rack is blocked or filled with debris so that the opening is reduced by more than 25 percent.

Count and record the total number of side drains, and the total number deficient, in the sample area.

Functional Side Drain Condition - Do Not Count as Deficient

Deficient Side Drain Condition - Count as Deficient

Exhibit A-15: Drainage, Cross Drains

Asset Group: Drainage

Maintenance Feature: Cross Drains

Definition:

Cross drains are any drainage structures that cross under the road, either perpendicular to or skewed from the roadway alignment, including pipes and culverts (culverts with spans longer than 20 feet are bridges).

Measurement Unit:

Inventory: Number of cross drains.

Condition: Number of cross drains deficient.

Inspection Procedure:

Inspect all cross drains in the sample area for damage or blockage. If necessary, use a probe rod to locate the bottom of the pipe when obscured with sediment.

For the purposes of this survey, a cross drain is considered deficient if any one of the following conditions exist:

1. Any portion of the drainage structure is blocked or filled with sediment or debris to more than 10 percent of its diameter.
2. Any portion is sufficiently damaged to weaken its structural integrity.
3. The flow capacity of the inflow or outflow is impeded by external obstructions such as sediment, rocks, vegetation, or woody debris.
4. Any portion of the grate or trash rack is blocked or filled with debris so that the opening is reduced by more than 10 percent.

Count and record the total number of cross drains, and the total number deficient, in the sample area.

Functional Cross Drain Condition - Do Not Count as Deficient

Deficient Cross Drain Condition - Count as Deficient

Exhibit A-16: Drainage, Unpaved Ditches

Asset Group: Drainage
Maintenance Feature: Unpaved Ditches
Definition: Unpaved ditches are water channels that can be parallel or perpendicular to the roadway and that collect water and transport it to, or from, other drainage structures or waterways, or direct water on and off the ROW. They are unimproved, except for shaping the natural soil or fill material to form a drainage channel.
Measurement Unit: Inventory: Linear feet of unpaved ditch. Condition: Linear feet of deficient unpaved ditch.
Inspection Procedure: Inspect all unpaved ditches on both sides of the roadway in the sample area. An unpaved ditch is considered deficient if it is more than 50-percent filled with sediment, rocks, vegetation or debris - or has areas of erosion - that are impeding water flow. (Note – Rocks used for riprap should not be considered deficient unless more than 50-percent covered with sediment, vegetation, or debris.) Record the total unpaved ditch length and the total length that is deficient in the sample area. Note - Ditches that divide a median on a divided highway should only be included in the sample that is on the side of the roadway in the increasing milepost direction. Otherwise, the feature may be counted and rated twice.

Functional Unpaved Ditch Condition - Do Not Count as Deficient

Deficient Unpaved Ditch Condition - Count Linear Feet of Deficiency

Exhibit A-17: Drainage, Paved Ditches

Asset Group: Drainage

Maintenance Feature: Paved Ditches

Definition:

Paved ditches are water channels that can be parallel or perpendicular to the roadway and that collect water and transport it to, or from other drainage structures or waterways, or direct water on and off the ROW, and have been lined with concrete or asphalt.

Measurement Unit:

Inventory: Linear feet of paved ditch.

Condition: Linear feet of deficient paved ditch.

Inspection Procedure:

Inspect all paved ditches on both sides of the roadway in the sample area.

A paved ditch is considered deficient if any of the following conditions exist:

1. Filled more than 50 percent with sediment, rocks, vegetation, or debris that impedes water flow. (Note – If rocks are being used for riprap, they should not be considered deficient unless more than 50 percent covered with sediment, vegetation, or debris.)

2. Lining is broken, missing, or cracked to the extent that it is not functional or promotes erosion.

Record the total paved ditch length, and the total length that is deficient, in the sample area.

Note - Ditches that divide a median on a divided highway should only be included in the sample that is on the side of the roadway in the increasing milepost direction. Otherwise, the feature may be counted and rated twice.

Functional Paved Ditch Condition - Do Not Count as Deficient

Deficient Paved Ditch Condition - Count Linear Feet of Deficiency

Exhibit A-18: Drainage, Drop Inlets, Slotted Drains, and Catch Basins

Asset Group: Drainage

Maintenance Feature: Drop Inlets, Slotted Drains and Catch Basins

Definition:

Drop Inlets are openings in ditches (grate covered) and gutters (open or grate covered) that allow water to flow vertically down into a catch basin and be routed into another drainage channel. Slotted drains are similar inlets used to remove surface water and are widely used in parking lots. The catch basin is designed to collect sediment while allowing water to pass through. Periodic cleaning is necessary to keep the grates open and remove excessive sediment build-up.

Measurement Unit:

Inventory: Number of drop inlets.

Condition: Number of drop inlets deficient.

Inspection Procedure:

Inspect the sample area for drop inlets on both sides of the roadway.

Drop inlets are considered deficient if any of the following conditions exist:

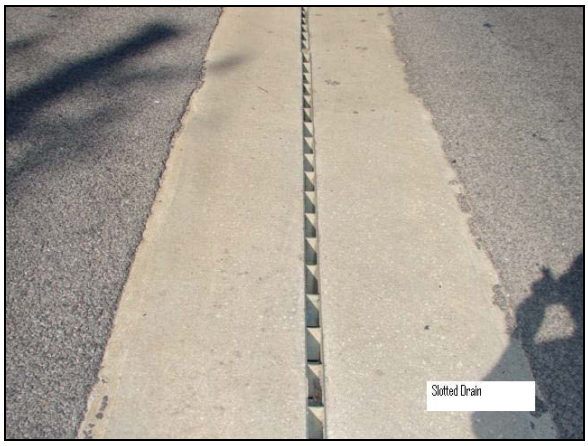
1. Inlet grate is blocked 50 percent or more (for slotted drains, measure the linear distance of exisiting drain and indicate linear distance blocked – if greater than 50%, indicate as deficient).
2. Inlet grate is damaged (broken or missing) or rusted to the extent that the material cross section has been noticeably reduced.
3. Sediment in the catch basin blocks the outlet pipe opening by 50 percent or more (use a flashlight if necessary to observe the amount of buildup).

Record the total number of drop inlets, and the total number deficient, in the sample area.

Functional Drop Inlet Condition - Do Not Count as Deficient

Deficient Drop Inlet Condition - Count as Deficient

Exhibit A-18: Drainage, Drop Inlets, Slotted Drains, and Catch Basins (Continued)



Functional Slotted Drain Condition - Do Not Count as Deficient

Deficient Slotted Drain Condition - Count as Deficient

Functional Catch Basin Condition - Do Not Count as Deficient

Deficient Catch Basin Condition - Count as Deficient

Exhibit A-19: Drainage, Curb & Gutters

Maintenance Group: Drainage
Maintenance Feature: Curb & Gutters
Definition: Gutters are roadside drainage features designed to channel rainwater from the roadway surface into drainage structures.
Measurement Unit: Inventory: Linear feet of curb and gutter Condition: Linear feet of defective curb and gutter (blocked or broken).
Inspection Procedure: Inspect open gutters on each side of the field sample segment. Each segment may contain one or more separate segments of open gutter. Identify the worst condition to be representative of that segment. Record the total length of gutter and the defective length in the sample section.

Functional Curb and Gutter Condition - Do Not Count as Deficient

Deficient Curb and Gutter Condition - Count Linear Feet of Deficiency

Exhibit A-20: Roadside, Erosion Control - Front Slopes

Asset Group: Roadside
Maintenance Feature: Erosion Control – Front Slopes
Definition: Front slopes are the areas between the shoulder of the road and the drainage channel and may occur on cut or fill sections. Erosion is the downslope movement of soil in response to gravitational stresses and/or water, including slides and washouts (gullies). Re-grading and, in severe cases, additional fill material may be needed to correct erosion problems.
Measurement Unit: Inventory: Linear feet of front slopes, measured along each centerline. Condition: Linear feet of deficient front slopes, measured along each centerline.
Inspection Procedure: Inspect the front slopes in the sample area for signs of erosion or slides. Count as deficient any front slope that, at the time of the inspection, is: 1. Jeopardizing the structural integrity of the shoulder or traveled lane(s), 2. Blocking the shoulder or traveled lane(s), 3. Blocking the ditch, or 4. Have gullies deeper than 1 foot. Measure and record the total length of front slopes, and the total length of deficient front slopes, in the sample area.

Functional Front Slope Condition - Do Not Count as Deficient

Deficient Front Slope Condition - Count Linear Feet of Deficiency

Exhibit A-21: Roadside, Erosion Control - Back Slopes

Asset Group: Roadside
Maintenance Feature: Erosion Control – Back Slopes
Definition: Back slopes are the areas along the roadway between the drainage channel and the right of way line, often occurring on roads with cut sections. Erosion is the downslope movement of soil in response to gravitational stresses and/or water, including slides and washouts (gullies). Re-grading or bank stabilization may be needed to correct erosion problems.
Measurement Unit: Inventory: Linear feet of back slopes, measured along each centerline. Condition: Linear feet of deficient back slopes, measured along each centerline.
Inspection Procedure: Inspect the back slopes in the sample area for signs of erosion or slides. Count as deficient any back slope with slides or erosion that, at the time of the inspection, is: 1. Blocking the shoulder or traveled lane(s), 2. Blocking the ditch, or 3. Jeopardizing the integrity of adjacent property. 4. Have gullies deeper than 18 inches. Measure and record the total length of back slopes, and the total length of deficient back slopes, in the sample area.

Functional Back Slope Condition - Do Not Count as Deficient

Deficient Back Slope Condition - Count Linear Feet of Deficiency

Exhibit A-22: Roadside, Mowing

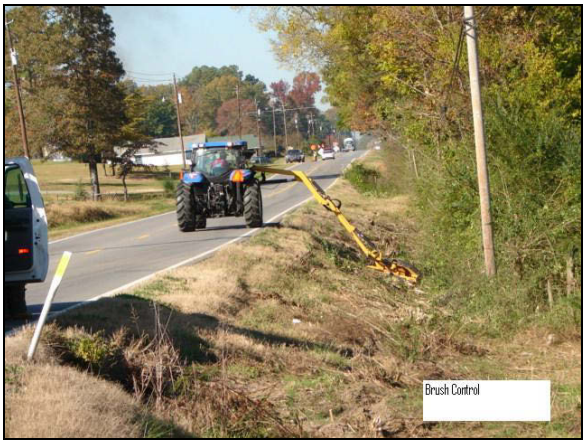
Asset Group: Roadside
Maintenance Feature: Mowing
Definition: Mowing is done to keep roadside grass and other vegetation at a desirable height to ensure the safety of motorists as well as promote an aesthetic view.
Measurement Unit: Inventory: Indicate the presence of a mowable area in the sample site. Condition: Height of grass or vegetation (in inches) in mowable areas (three measurements, each side).
Inspection Procedure: Inspect the mowable areas within the sample area, and measure the vegetation height near the beginning, middle, and end of the sample, using a tape measure or folding ruler. If mowable areas occur on both sides of the roadway, take measurements on both sides (three on each side). The measurements should represent the typical height of vegetation in the sample area, between the edge of pavement and the drainage channel (Vegetation height on the back slopes is not being rated).

Mowable Area Sample -
Height of Grass to be Measured and Recorded

Exhibit A-23: Roadside, Brush Control

Asset Group: Roadside
Maintenance Feature: Brush Control
Definition: Roadside brush needs to be controlled to reduce visibility restrictions and undesirable obstacles for motorists. The difference between brush and trees is that brush generally has stems less than 4 inches in diameter and can easily be cut with hand tools and "brush hogs" or similar heavy-duty mowers. Tree removal, on the other hand, typically requires chain saws.
Measurement Unit: Inventory: Linear feet of roadside with brush-growing areas, measured along both shoulders. Note that brush and tree-growing areas can overlap. Condition: Linear feet of roadside with deficient brush control, measured along both shoulders.
Inspection Procedure: Inspect the roadside within the sample area for any deficiencies in brush control, including restricted visibility of on-coming traffic, impaired visibility of signs and signals, clusters of brush that could be a safety concern for run-off-the-road vehicles, and encroachment over the shoulder of the road. Measure and record the total length of shoulder along brush growing areas, and the total length of shoulder in deficient brush-growing areas, on both sides of the roadway in the sample area. Use the measuring wheel to determine the length to the nearest linear foot.

Functional Brush Control Condition - Do Not Count as Deficient



Deficient Brush Control Condition - Count Linear Feet of Deficiency

Exhibit A-24: Roadside, Tree Removal

Asset Group: Roadside
Maintenance Feature: Tree Removal
Definition: Tree Removal is for removal of dead or diseased trees, or trees that represent a potential safety concern to motorists or adjacent property, including removal of branches or an entire tree. The trees can occur anywhere within the highway right of way, including the right-of-way line. Note that for the purpose of this survey, any woody plant growth with a diameter of 4 inches or more at 4.5 feet above the ground is considered a tree.
Measurement Unit: Inventory: Linear feet of roadside with trees, measured along both shoulders. Note that brush and tree-growing areas can overlap. Condition: Number of dead, diseased, or undesirable trees.
Inspection Procedure: Inspect the trees within the sample area for any that are dead, diseased or present a potential safety concern to motorists or adjacent property. Measure along the shoulder on both sides of the roadway and record the total linear feet of roadside with trees. Count and record the total number of dead/diseased/undesirable trees inside or along the right of way that should be removed.

Sample Tree Removal

Trees meeting criteria marked with "X" should be counted.

Exhibit A-25: Roadside, ALDOT Fences

Asset Group: Roadside
Maintenance Feature: ALDOT Fences
Definition: ALDOT fences are those fences along the right-of-way line of the roadway that are maintained by ALDOT. Typically, such fences are found along Interstate highways and other highways with full control of access.
Measurement Unit: Inventory: Linear feet of right-of-way fence. Condition: Linear feet of right-of-way fence with deficiencies.
Inspection Procedure: Inspect fences along the right of way of the sample area if easily accessible and visible from the shoulder of the road. A fence panel (from post to post) is considered deficient if any of the following conditions exist: 1. Any portion of a fence panel or post is missing or broken (e.g., due to vandalism or run-off-the-road accident). 2. Any portion of a fence panel is less than two-thirds of its original height (e.g., due to fallen tree limb). 3. A hole is found in or under the fence that has an opening of one square foot or more. Record the total linear feet of all right-of-way fences in the sample area and the total linear feet of deficiencies. Note that if any portion of a fence panel is deficient, record the deficiency as the length of the panel, since the repair will probably require replacing the entire panel.

Functional ALDOT Fence –
Do Not Count as Deficient

Deficient ALDOT Fence –
Count Linear Feet of Deficiency

Exhibit A-26: Roadside, Litter Control

Asset Group: Roadside
Maintenance Feature: Litter Control
Definition: Litter and debris consists of any unwanted objects on the highway right of way that are fist-size or larger, including trash, materials that have fallen off vehicles, and dead animals. (Note that rocks and tree limbs are not counted here, unless they are on the travel lanes or shoulders, but are included in the Erosion Control and Tree Removal categories.)
Measurement Unit: Inventory: N/A Condition: Number of fist-size objects.
Inspection Procedure: Inspect the right of way in the sample area for litter and debris. Count and record the total number of fist-size or larger objects. **Note – If more than 100 such objects are found in the sample area, stop counting and record 100.**

Sample Litter

Each item to be counted as one (1) piece of **Litter** if this size or larger.

Exhibit A-27: Roadside, Vegetative Roadside

Asset Group: Roadside
Maintenance Feature: Vegetative Roadside
Definition: Undesirable Vegetation includes noxious weeds, such as Johnson Grass, thistle and nettle, and all broadleaf weeds with height in excess of native grasses.
Measurement Unit: Inventory: Linear feet of vegetated roadside, measured along the shoulder. Condition: Linear feet with undesirable vegetation, measured along the shoulder.
Inspection Procedure: Inspect both sides of the roadway in the sample area and determine the presence of any undesirable vegetation. Measure along the shoulder on both sides of the roadway and record the total linear feet of vegetated roadside. Measure along the shoulder of both sides of the roadway and record the linear feet of undesirable vegetation. In most cases, the measuring wheel will be the preferred measurement device.

Johnsongrass

Thistle

Cogongrass

Kudzu

Exhibit A-28: Traffic Services, Raised Pavement Markers

Asset Group: Traffic Services
Maintenance Feature: Raised Pavement Markers (RPM)
Definition: Reflective devices, typically along the centerline, edge lines, and gore areas, to aid in lane delineation and improve guidance at night and in weather with poor visibility.
Measurement Unit: Inventory: Number of raised pavement markers. Condition: Number of deficient raised pavement markers.
Inspection Procedure: Count and record the total number of raised pavement markers and the total number of missing or deficient pavement markers, where a deficient marker is considered to be any marker that is missing, loose, broken, or non-reflective. Note that at 40-foot spacing, there should be 13 or 14 markers in the sample area, depending on where the first marker falls within the 528-foot section.

Functional Raised Pavement Marker – Do Not Count as Deficient

Damaged Raised Pavement Marker – Count as Deficient

Missing Raised Pavement Marker – Count as Deficient

Exhibit A-29: Traffic Services, Signals

Asset Group: Traffic Services

Maintenance Feature: Signals

Definition:

Signals include all electronic devices that control or warn traffic, except variable message signs. Signals include traffic control signals (stop lights), flashing beacons, and lane-use control signals.

Measurement Unit:

Inventory: Number of signalized intersections.

Condition: Number of signalized intersections not fully functional.

Inspection Procedure:

Signalized intersection condition data will be collected at the sample sites in the field. For each sample with one or more signalized intersections, inspect all signals within the sample area for proper functioning. A signalized intersection is considered to be nonfunctional when any of the following conditions exist:

1. Any two lamps for the same indication and approach are not lit during several cycles.
2. Signal missing or damaged to the extent that traffic is not being effectively controlled.
3. Signal phasing is not cycling properly (e.g., locked into one phase, or displaying conflicting phases).
4. Controller cabinet is damaged to the extent that it affects signal functions.
5. Any signal is misaligned to the point that it may cause confusion to drivers approaching from any direction.

Record total number of signalized intersections and total number of nonfunctioning signalized intersections in the sample area. In the case of an intersection on a divided highway, take measures to insure the signalized intersection is only counted in a single sample direction.

Traffic Signal Sample

Exhibit A-30: Traffic Services, Delineators

Asset Group: Traffic Services
Maintenance Feature: Delineators
Definition: Delineators are retro-reflective devices mounted on posts on the road shoulder, on guardrails, and bridge railings to indicate the alignment of the road, especially at night or in adverse weather conditions. (Does not include raised pavement markers.)
Measurement Unit: Inventory: Number of delineators. Condition: Number of deficient delineators.
Inspection Procedure: For each sample area with delineators, conduct a visual inspection and count and record the total number of delineators and the number of delineators that are deficient. Delineators are considered deficient if they are non-reflective, broken, missing, or improperly spaced.

Functional Delineator –
Do Not Count as Deficient

Deficient Delineator –
Count as Deficient

Exhibit A-31: Traffic Services, Object Markers

Asset Group: Traffic Services
Maintenance Feature: Object markers
Definition: Object markers are used to mark obstructions adjacent to or within the roadway, such as bridge piers and traffic islands. The object marker may be used alone, or mounted below other signs.
Measurement Unit: Inventory: Number of object markers. Condition: Number of deficient markers.
Inspection Procedure: Count and record the total number of obstacle markers and the total number of missing or deficient, where a deficient marker is considered to be any marker that is missing, loose, broken, or non-reflective.

Functional Object Marker -
Do Not Count as Deficient

Deficient Object Marker -
Count as Deficient

Exhibit A-32: Traffic Services, Signs—Regulatory and Warning

Asset Group: Traffic Services

Maintenance Feature: Signs—Regulatory and Warning

Definition:

Regulatory and Warning signs are signs that control a vehicle's movement (e.g., Speed Limit, No Passing, and Do Not Enter) and that caution drivers about obstacles or dangers (Curve, Deer Crossing, etc.). Regulatory and Warning signs may be mounted on posts along the road or mounted on overhead sign or bridge structures. Each sign face is considered a sign.

Measurement Unit:

Inventory: Number of regulatory and warning signs.

Condition: Number of deficient regulatory and warning signs.

Inspection Procedure:

For each sample with one or more regulatory and warning signs, inspect signs for the following deficient conditions:

1. The informational content of the sign is no longer visible or legible to the passing motorist at the posted speed (including damaged sign faces, spray painted, dirty, non-reflective).
2. Sign posts or mounting structures are bent or damaged.
3. Lighted signs are not lit (may require night inspection or bucket truck).
4. Bottom of sign face is lower than 5 feet above edge of pavement, or lower than 4 feet if two sign faces are mounted vertically.

Record the total number of Regulatory and Warning signs, and the total number of deficient Regulatory and Warning signs, in the sample area.

Note: Signs that are hidden by vegetation, but otherwise functional, are addressed under Brush Control.

Functional "Regulatory Sign" Sample – Do Not Count as Deficient

Deficient "Regulatory Sign" Sample – Count as Deficient

Exhibit A-32: Traffic Services, Signs—Regulatory and Warning (Continued)

Functional "Warning Sign" Sample – Do Not Count as Deficient

Deficient "Warning Sign" Sample – Count as Deficient

Exhibit A-33: Traffic Services, Signs—Other

Asset Group: Traffic Services
Maintenance Feature: Signs—Other
Definition: Other signs are any signs with informational messages that are not included in Regulatory and Warning Signs (e.g., Place Name, Route Number, Distance, Exit, Milepost, Services, Attractions). Signs may be mounted on posts along the road or mounted on overhead sign or bridge structures. Each sign face is considered a sign.
Measurement Unit: Inventory: Number of Other signs. Condition: Number of deficient Other signs.
Inspection Procedure: For each sample with one or more Other signs, inspect signs for the following deficient conditions: 1. The informational content of the sign is no longer visible or legible to the passing motorist at the posted speed (including damaged sign faces, spray painted, dirty, non-reflective). 2 Sign posts or mounting structures are bent or damaged. 3 Lighted signs are not lit (may require night inspection or bucket truck). 4 Bottom of sign face is lower than 5 feet above edge of pavement, or lower than 4 feet if two sign faces are mounted vertically. Record the total number of Other signs and the total number of deficient Other signs. Note: Signs that are hidden by vegetation, but otherwise functional, are addressed under Brush Control.

"Other Sign" Sample

Exhibit A-34: Traffic Services, Pavement Striping

Asset Group: Traffic Services
Maintenance Feature: Pavement Striping
Definition: Pavement striping includes all linear markings on the travel lanes, including centerlines, lane stripes, no-passing stripes, and pavement edge lines. Materials may include paint and hot and cold tape applications.
Measurement Unit: Inventory: Linear feet of pavement striping. Condition: Linear feet of deficient striping.
Inspection Procedure: Inspect the pavement stripes within the sample area for deficiencies. Any length of stripe that is faded, worn, or missing is considered to be deficient. Measure and record the total length of all pavement stripes, and the total length of deficient stripes, in the sample area. If a retroreflectometer is available, take two measurements on each of the two edge lines and two measurements on the centerline or the left line of the right lane, if more than two lanes are present. Note that the sample area is 528 feet in length. In most two-lane samples, there will be two edge lines and one centerline, or a total inventory length of 1,584 feet (skip lines are considered to be continuous for condition rating purposes). If the entire sample has a no-passing stripe, then the total inventory would be 2112.

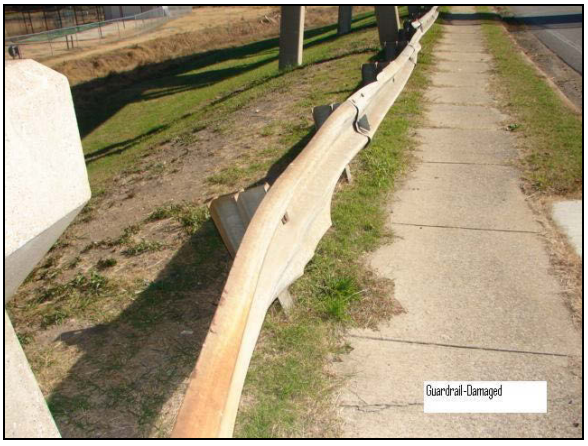
Functional Pavement Striping Sample – Do Not Count as Deficient

Deficient Pavement Striping Sample – Count Linear Feet of Deficiency

Exhibit A-35: Traffic Services, Guardrail

Asset Group: Traffic Services
Maintenance Feature: Guardrail
Definition: Guardrail includes W-Beam, Thrie-Beam, and wood, and also includes posts and end treatments.
Measurement Unit: Inventory: Linear feet of guardrail. Condition: Linear feet of deficient guardrail.
Inspection Procedure: Inspect the guardrail within the sample area. Measure and record the total length of guardrail, and the total length of deficient guardrail, on both sides of the road in the sample area. A guardrail panel is considered deficient if it is broken, missing, detached from the post, or bent to the extent that it cannot re-route errant vehicles back onto the roadway or that its structural integrity is questionable. An end treatment is considered deficient if there is any indication that it has previously been hit, e.g., bent, loose, collapsed, or missing. A guardrail installation is also considered deficient if it is not at the proper height of 27 inches above edge of pavement. Notes: 1. Guardrail panels are typically installed in 12.5 or 25-foot lengths, which makes it convenient to estimate total length and total deficient length. If any portion of a panel is deficient, report the entire panel length as deficient. 2. Guardrails that divide a median on a divided highway should only be included in the sample that is on the side of the roadway in the increasing milepost direction. Otherwise, the feature may be counted and rated twice.

Functional Guardrail Sample –
Do Not Count as Deficient



Deficient Guardrail Sample –
Count Linear Feet of Deficiency

Exhibit A-36: Traffic Services, Cable Rail

Asset Group: Traffic Services
Maintenance Feature: Cable Rail
Definition: All classes of cable rail are included in this guideline, including line posts and anchor posts.
Measurement Unit: Inventory: Linear feet of cable rail. Condition: Linear feet of deficient cable rail.
Inspection Procedure: Inspect the cable rail within the sample area. Measure and record the total length of cable rail, and the total length of deficient cable rail, on both sides of the road in the sample area. Consider the 3 or 4 cables of the system to be a single unit for length measurements. A section of cable rail is considered deficient if has missing or broken line posts or if 1 or more of the cables is broken or slack due to damage to the anchor posts. If line posts have been damaged or are missing, the deficiency length shall be recorded as the distance between the first good posts ahead of and behind the deficient section. If the anchor posts have been damaged to the extent that the system cannot re-route errant vehicles back onto the roadway or its structural integrity is questionable, the cable rail is considered deficient for the entire length up to the next anchor post. The deficiency length in that case would be the total length of cable rail in the section with a maximum length of 528’ on each side of the section. Note that cable rails that divide a median on a divided highway should only be included in the sample that is on the side of the roadway in the increasing milepost direction. Otherwise, the feature may be counted and rated twice.

Functional Cable Rail Sample –
Do Not Count as Deficient

Deficient Cable Rail Sample –
Count Linear Feet of Deficiency

Exhibit A-37: Traffic Services, Impact Attenuators

Asset Group: Traffic Services
Maintenance Feature: Impact Attenuators
Definition: An Impact attenuator may be a group of plastic barrels filled with sand or water acting as a single unit, or it may be an installation of metal units resembling guardrail in a special shock-absorbing configuration. They are typically placed at toll plazas and at potential gore points, usually at on/off ramps, bridge piers, or other obstacles.
Measurement Unit: Inventory: Number of attenuators. Condition: Number of deficient attenuators.
Inspection Procedure: Inspect any impact attenuators in the sample area (or between sample areas during travel) and count and record the total number of attenuators, and the total number of deficient attenuators. An attenuator is considered deficient if any of the following conditions exist: 1. Barrel Installations - One or more barrels are broken, tipped over, or missing any filler material. 2. Metal Units - Any portion of the unit has loose or missing parts, or there is any indication of damage (e.g., damaged parts or collapsed sections). Count and record the total number of attenuators and the total number of missing or deficient.

Functional Impact Attenuator –
Do Not Count as Deficient

Deficient Impact Attenuator –
Count as Deficient

Exhibit A-38: Traffic Services, Barrier Walls

Asset Group: Traffic Services

Maintenance Feature: Barrier Walls

Definition:

Barriers are usually the concrete New Jersey style, used to separate travel lanes from oncoming traffic and to protect traffic from bridge ends and piers, deep fill sections, and other potentially dangerous locations. Note that some institutional or parkway roads may use other shapes and materials, such as masonry barrier walls with a rectangular cross-section.

Measurement Unit:

Inventory: Linear feet of barrier wall.

Condition: Linear feet of deficient barrier wall.

Inspection Procedure:

Inspect the guardrail within the sample area. Measure the total linear feet of all barriers, and the total linear feet of all deficient barriers, on both sides of the roadway in the sample. A barrier is considered deficient if there is structural damage and/or displaced, broken, or missing panels, or if there is severe cracking or spalling, such that the effectiveness of the barrier is reduced and it cannot redirect a vehicle back onto the roadway.

Notes:

1. Most barrier panels are usually installed in standard lengths, making it easy to determine the total length in the sample area by counting the number of panels and multiplying by the length per panel.

2. Barrier walls that divide a median on a divided highway should only be included in the sample that is on the side of the roadway in the increasing milepost direction. Otherwise, the feature may be counted and rated twice.

Functional Barrier Wall Sample – Do Not Count as Deficient

Deficient Barrier Wall Sample – Count Linear Feet of Deficiency

Exhibit A-39: Traffic Services, Highway Lighting

Asset Group: Traffic Services
Maintenance Feature: Highway Lighting
Definition: Highway Lighting consists of high-mast luminaries as well as single-head or multi-head fixtures of the type commonly used for street lighting.
Measurement Unit: Inventory: Number of light fixtures. Condition: Number of deficient light fixtures.
Inspection Procedure: Inspect all lighting within the sample area and record the total number of light fixtures, and the total number of deficient light fixtures. A light fixture is considered deficient if any lamp is out or strobing, or if there are any bent or broken masts, or the cover plate is missing. Note – The inspectors will need to 1) have access to the light fixture's control panel to test the lights during daylight hours, or 2) do the inspections at night.

Highway Lighting Samples

Exhibit A-40: Traffic Services, Pavement Markings, and Legends

Asset Group: Traffic Services
Maintenance Feature: Pavement Markings and Legends
Definition: Pavement markings and legends are any markings applied to the pavement and gore areas for traffic guidance purposes, including crosswalks, stop lines, turn arrows, railroad crossings, gore areas, and other similar markings.
Measurement Unit: Inventory: Number of markings and legends. Condition: Number of deficient markings and legends.
Inspection Procedure: Inspect the pavement markings and legends within the field sample area for deficiencies. A deficiency is considered to be any marking or legend that is more than 50-percent faded, worn or missing. Count and record the total number of markings and legends and the total number that are deficient. Note that an entire crosswalk, or continuous stop line, or one turn arrow, is considered to be one marking and an entire word (e.g., "STOP") is considered to be one legend.

Functional Pavement Marking Sample – Do Not Count as Deficient

Deficient Pavement Marking Sample – Count as Deficient

Exhibit A-40: Traffic Services, Pavement Markings, and Legends (Continued)

Functional Pavement Legend Sample – Do Not Count as Deficient

Deficient Pavement Legend Sample – Count as Deficient

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Appendix A
Data Collection Form

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Sample Number		Begin MP		Div/District	/	Route		Direction	
Number of Lanes		End MP		Crew				Date	

ASPHALT PAVEMENT

Features	Measure	Condition
Potholes	Number of potholes (≥ 6"x6"x1")	
Raveling	Surface area distressed (total sq. ft.)	
Shoving	Deficient surface area (total sq. ft.)	

CONCRETE PAVEMENT

Features	Measure	Condition
Spalling	Number of spalls (≥ 6"x6"x1")	
Faulting	Number of faulted slabs (≥ 1/4" high)	
Joint Sealing	Lin. ft. of joints requiring sealing (≥ 1/4" wide)	
Pumping	Number of slabs deficient	
Punchouts	Number of punchouts (≥ 6"x6")	

SHOULDERS

Features	Inventory (Total Must Not Exceed 2112, 1056' Unpaved/1056' Paved)		Measure (Must Not Exceed Inventory Length)	Condition
Paved Shoulder	Lin. ft. of paved shoulder		N/A	
Potholes	N/A		Number of potholes	
Edge Raveling	N/A		Lin. ft. of edge raveling	
Sweeping (Incl. Curb)	Lin. ft. of shoulder/curb subject to sweeping		Lin. ft. of shoulder/curb needing sweeping	
Unpaved Shoulder	Lin. ft. of unpaved shoulder		N/A	
Shoulder Drop-Off	N/A		Lin. ft. of low shoulder (≥ 2")	
High Shoulder	N/A		Lin. ft. of high shoulder (> 1")	

DRAINAGE

Features	Inventory		Measure	Condition
Side Drains	Number of side drains		Number damaged/blocked (>25%)	
Cross Drains	Number of cross drains		Number damaged/blocked (>10%)	
Unpaved Ditches	Lin. ft. of unpaved ditch		Lin. ft. defective or impeding flow	
Paved Ditches	Lin. ft. of paved ditch		Lin. ft. defective or impeding flow	
Drop Inlets, Catch Basins, and Slotted Drains	Number of inlets, catch basins, and slotted drains		Number defective	
Curb and Gutter	Lin. ft. of curb and gutter		Lin. ft. defective (blocked or broken)	

ROADSIDE

Features	Inventory		Measure	Condition
Front Slope	Lin. ft. of front slope, measured along centerline		Lin. ft. deficient (washouts >12")	
Back Slope	Lin. ft. of back slope, measured along centerline		Lin. ft. deficient (washouts >18")	
Mowable Area	Mowable area present (Yes/No)		(3 samples) Height of grass (inches)	/ /
Vegetative Roadside	Lin. ft. of vegetated roadside, measured along shoulder		Lin. ft. of undesirable vegetation, measured along shoulder	
Brush Control	Lin. ft. of brush growing areas, measured along shoulder		Lin. ft. with undesirable brush, measured along shoulder	
Tree Removal	Lin. ft. of tree growing areas, measured along shoulder		Number of trees to be removed	
ALDOT Fence	Lin. ft. of right-of-way fences		Lin. ft. of fence damaged	
Litter Control	N/A		Number of objects equal to or greater than fist-sized	

TRAFFIC SERVICES

Features	Inventory		Measure	Condition
Pavement Markings & Legends	Number of pavement markings and legends		Number deficient	
Pavement Striping	Lin. ft. of pavement striping		Lin. ft. worn out or missing	
Raised Pavement Markers	Number of required RPMs		Number missing or damaged	
Delineators	Number of delineators		Number deficient	
Object Markers	Number of object markers		Number deficient	
Signals	Number of signalized intersections		Number deficient	
Signs-Warning & Regulatory	Number of signs		Number deficient	
Signs-Other	Number of signs		Number deficient	
Guardrail	Lin. ft. of guardrail		Lin. ft. deficient	
Cable Rail	Lin. ft. of Cable Rail		Lin. ft. deficient	
Impact Attenuators	Number of impact attenuators		Number needing repair	
Barrier Walls	Lin. ft. of barrier walls		Lin. ft. deficient	
Highway Lighting	Number of light fixtures		Number malfunctioning	

COMMENTS

19-Oct-10