JOINT TRANSPORTATION RESEARCH PROGRAM

INDIANA DEPARTMENT OF TRANSPORTATION
AND PURDUE UNIVERSITY

LEVEL OF SERVICE PROGRAM FOR INDOT OPERATIONS

Bob McCullouch
Research Scientist
School of Civil Engineering
Purdue University
Corresponding Author

SPR-3534
Report Number: FHWA/IN/JTRP-2012/16
DOI: 10.5703/1288284314978

RECOMMENDED CITATION

McCullough, B. *Level of Service Program for INDOT Operations*. Publication FHWA/IN/JTRP-2012/16. Joint Transportation Research Program, Indiana Department of Transportation and Purdue University, West Lafayette, Indiana, 2012. doi: 10.5703/1288284314978.

CORRESPONDING AUTHOR

Bob McCullouch
School of Civil Engineering
Purdue University
(765) 494-0643
bgm@purdue.edu

JOINT TRANSPORTATION RESEARCH PROGRAM

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NOTICE

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA/IN/JTRP-2012/16		

4. Title and Subtitle	5. Report Date
Level of Service Program for INDOT Operations	August 2012
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
Bob McCullouch	FHWA/IN/JTRP-2012/16

9. Performing Organization Name and Address	10. Work Unit No.
Joint Transportation Research Program Purdue University 550 Stadium Mall Drive West Lafayette, IN 47907-2051	
	11. Contract or Grant No. SPR-3534

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
Indiana Department of Transportation State Office Building 100 North Senate Avenue Indianapolis, IN 46204	Final Report
	14. Sponsoring Agency Code

15. Supplementary Notes

Prepared in cooperation with the Indiana Department of Transportation and Federal Highway Administration.

16. Abstract

INDOT has used an inspection program named Maintenance Quality Survey (MQS) to perform a state-wide inspection of their roadway assets, right-of-way to right-of-way. This inspection requires two two-person teams approximately 18 months to complete as it determines the condition of individual features and produces a grade for each one. Results from this program were used to define a work program.

INDOT uses the software Work Management System (WMS) for their operations. A WMS feature that has not been utilized is the Level of Service (LOS). LOS establishes performance standards for activities and then uses an inspection program to evaluate compliance with these standards.

The objective of this project was to develop a LOS program at INDOT that utilizes WMS. One key component of this program is a statistical based inspection program that inspects and grades random roadway segments. The development of this inspection program required determining the number of samples per sub-district, the features to inspect, defining the pass/fail criteria for each feature, and field training and testing. Another key part is to develop the required WMS LOS data tables.

Outcomes from the LOS program will be an improved inspection program, a data driven tool that can be used to perform LOS analyses resulting in improved work planning. Looking at operation activities from a LOS perspective provides opportunities to balance resources better and improve the planning aspect. One benefit being experienced with the implementation of the inspection program is inspection personnel time savings in collecting the LOS data.

17. Key Words	18. Distribution Statement
level of service, inspection, maintenance, work planning, random samples	No restrictions. This document is available to the public through the National Technical Information Service, Springfield, VA 22161.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	67	

Form DOT F 1700.7 (8-69)

EXECUTIVE SUMMARY

LEVEL OF SERVICE PROGRAM FOR INDOT OPERATIONS

Introduction

In 2008 the JTRP study SPR-3130, *Performance Based Contracting for Roadway Maintenance Operations*, revealed the state agencies that have developed a Level of Service (LOS) program benefit. A LOS program can evaluate and determine maintenance performance values for the components of the Indiana Department of Transportation's road network. In other words, it can be the report card for calculating performance. Additionally, once a LOS has been defined, budget numbers can be developed and associated with a particular LOS for each element. This is very helpful in determining budget impacts on maintenance operations. When budgets are changed, the impact on operations can be quantified and described. If INDOT looks at using more private contractors to assist in maintenance, a LOS program is essential in determining cost estimates, their performance and corresponding levels of compensation.

Findings

INDOT developed Maintenance Quality Survey (MQS), an inspection or survey program. MQS was used to rate the condition of INDOT's assets in nine roadway services categories and three traffic categories. The inspections created various reports used to direct and guide the work program. MQS is a visual inspection of all six districts' assets and was performed from a moving vehicle using two teams of two inspectors. It took on average 18 months to inspect the complete network. All roads in the state were on a 2-year cycle for MQS inspections.

The MQS approach provides a complete evaluation in these asset areas requiring 2 years of resources. A survey of other state agencies reveals that most other states are using a random sampling approach to collect the same information. Of the nineteen agencies that responded to the study information request, eighteen use the random segment approach. This approach inspects randomly selected segments that represent the overall population at a certain level of confidence. Most of these inspection programs are attempting to achieve 90%–95% confidence in the results. If properly performed, this approach can deliver similar inspection results as the MQS program at lower costs.

Implementation

At the time this report was submitted, INDOT had implemented the LOS field inspection program. INDOT has plans to utilize the data created through this project in the Work Management System (WMS) LOS module.

The LOS inspection program is operational with the two inspection teams and requires 160 segments per sub-district. With 36 sub-districts, the total number of inspection segments at INDOT will be 5,760. Based on daily productivity results (80 inspections for both teams), the estimated time to complete the inspections is 15 weeks, which is approximately 4 months. The previous MQS inspection program took approximately 18 months to complete. Therefore, the LOS inspection program is potentially saving 14 months of time.

Assuming a 14-month time savings for the inspection teams, a cost saving can be calculated. INDOT's finance section estimates the hourly rate for a highway technician to be \$31/hour. Each team is comprised of two technicians, so the total time saved is 4 technicians $\times$ 37.5 hours/week $\times$ 14 months $\times$ 4 weeks/month = 8400 hours. The potential cost savings is 8400 hours $\times$ \$31/hour = \$260,400. Travel and per diem costs will be less as well, and could be calculated after a complete inspection cycle has been performed. When the WMS functions are utilized, INDOT will have in place a complete LOS program that utilizes a random sampling approach and computer capabilities that provide the necessary reports and data to operate a comprehensive LOS program for INDOT operations.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

In 2008 the JTRP study SPR-3130, *Performance-Based Contracting for Roadway Maintenance Operations*, (*1*) revealed the state agencies that have developed a Level of Service (LOS) program benefit in several ways. A LOS program can evaluate and determine maintenance performance values for the components of INDOT's road network. In other words, it can be the report card for calculating performance. Additionally, once a LOS has been defined, budget numbers can be developed and associated with a particular LOS for each element. This is very helpful in determining budget impacts on maintenance operations. When budgets are changed, the impact on operations can be quantified and described. If INDOT looks at using more private contractors to assist in maintenance, a LOS program is essential in determining cost estimates, their performance and corresponding levels of compensation.

2. PROBLEM STATEMENT

In 2003 another JTRP project, SPR-2358, *Maintenance Quality Assurance Program* (*2*), developed inspection criteria and an inspection program that are essential pieces of a LOS program. Results of this project form the foundation for a LOS program. Using the knowledge and understanding collected from the two previous projects provided a good foundation for this study.

Since the completion of these two previous projects, INDOT implemented the software from Agile Assets, Work Management System (WMS) to control and manage operations. WMS possesses the ability to setup and run a LOS program. This project was performed with the goal of establishing the WMS LOS feature for INDOT's use.

Key requirements for establishing this LOS program are:

- An inspection program that defines the appropriate inspection items and their criteria
- An inspection program that uses randomly selected segments
- Developing the necessary data tables to establish the WMS LOS feature
- Training and implementation of the inspection program and WMS LOS feature

This report describes each of these key requirements as well as the needed documentation to support the WMS LOS program.

3. OBJECTIVES

Over the last five years parts and pieces of a comprehensive LOS program have been developed and tested for INDOT. With the implementation of the web-based WMS making it possible to document and provide cost data to a LOS program, INDOT has in place the necessary LOS components. Historically, INDOT has used various means to establish levels of service for Maintenance and Traffic, and currently WMS is the application used to document the performance and allocate the resources using the work plans developed by district and sub-district management. Prior to the implementation of WMS, each individual sub-district and Traffic Office created a plan using Performance Standards and Quantity Guidelines that were provided in policy and manually entered into each location's database. The WMS LOS functionality was purchased with the initial product and INDOT was instructed to only use the functionality after accumulating three years of asset quality data. INDOT has been archiving MQS asset quality data and the WMS Section created preliminary LOS scenarios, and this study will develop the collection procedures, solidify the LOS parameters, and establish the standard index and application processes.

By developing a LOS program INDOT Operations will have a management tool that can be used to develop work programs more efficiently and with more budget certainty and definition. This will give INDOT improved flexibility in developing operation budgets and creating physical descriptions of budget decisions. Therefore the objective of this project is to work with Operations to create a LOS program and to implement at the district level.

4. FINDINGS AND DELIVERABLES

This section will start with a description of the activities performed. These activities were guided by the Study Advisory Committee that consisted of the following INDOT individuals:

Barry Partridge (Research)	Becky Gross (Seymour)
Joe Lewien (Crawfordsville)	Krystal Cornett (Greenfield)
Larry Goode (Central Office)	Phil Springer (CO)
Bob Allman (CO)	Terry George (Greenfield)
Todd Johnson (Fort Wayne)	Todd Shields (CO)

Eight SAC (study advisory committee) meetings (through January 2012) have been held, with an additional one for project closeout. The SAC members were involved and directed the following project activities:

1. The SAC subject matter experts were used to establish and approve the following:
   a. Inspection items and their corresponding criteria.
   b. Operation activities – their defects and corresponding level of effort assignment
   c. For each inspection category determine the OPI score range values
   d. Determine the weight values or priorities of the inspection categories
   e. For each operation activity establish productivity values, equipment and material needs, and unit costs.
2. Review and describe the MQS and MQA (maintenance quality assurance) inspection programs used by other state agencies.

3. Work with the Research Division to approve the random sampling program.
4. Work with the GIS Section, to ensure all enhancements to the MQS Inspection procedures are attainable. These include:

    a. Field inspection procedures; for input on the collection application requirements. Identify the user interface requirements for collection changes and any hardware changes required. Review current collection and scoring documents; provide final copy of LOS Inspection Manual.
    b. Data collection techniques: Discuss changes to the collection parameters with GIS to incorporate into current ArcGIS collection program, on inspectors' laptops and GPS receivers. Define the sampling program, confidence level goal, number of samples and segment length.
    c. A comprehensive LOS program will replace the MQS inspection program, so determine the required level of effort for the LOS Collectors' inspection logistics plan.

5. Training program. Design, develop, test, and implement a training program that will train LOS Collectors on modified inspection procedures. This consisted of field training.
6. Determine the level of effort, time, and required resources (manpower, equipment, money, etc.) to operate the LOS program.

4.1 MQS Inspection Program

INDOT developed an inspection or survey program named Maintenance Quality Survey (MQS). MQS was used to rate the condition of INDOT's assets in nine Roadway Services categories and three traffic categories. The inspections created various reports used to direct and guide the work program. MQS is a visual inspection of all six districts' assets and was performed from a moving vehicle using two teams of two inspectors. All roads in the state were on a 2 year cycle for MQS inspections.

The MQS approach provides a complete evaluation in these asset areas requiring two years of resources. While it takes two years to complete it is not a complete evaluation of today's features (e.g. edge drains require stopping, getting out of vehicle, and a visual inspection). A survey of other state agencies reveals that most other states are using a random sampling approach to collect the same information. This approach inspects randomly selected segments that represent the overall population at a certain level of confidence. Most of these inspection programs are attempting to achieve between 90–95% confidence in the results. If properly performed, this approach can deliver similar inspection results as the MQS program at lower costs. Table 4.1 provides a summary description of agencies inspection program.

4.2 Maintenance Inspection Programs Summary

See Table 4.1 for a summary of the maintenance inspections programs. A more detailed description of these programs is found in Appendix A.

4.3 LOS Inspection Program

4.3.1 Random Sample Program

Table 4.1 summarizes state inspection programs. All the states except for Ohio use a random sample segment inspection approach. Segment lengths vary, with the 0.1 mile segment length the most common. Based on other state inspection programs the SAC committee approved a randomly selected 0.1 mile segment as the basis for LOS inspection. This represents a different approach from the current MQS program of visually inspecting 100% of the routes every two years.

With any random inspection program a sample size that is representative of the overall population and meets a certain confidence level is desired. Looking at other state agency programs the sample size was arrived at by using statistical calculations. For example Mississippi DOT published their methodology and it is shown in the below equation.

The following equation may be 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). See Table 4.2.

p = proportion of the population that meets a specified criteria (for example, pass/fail – 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.

For condition assessments, a confidence level of 95 percent is generally considered sufficient ($z = 1.96$). The value for p was assumed to be 80% for Interstate and U.S. highways and 70% and for other highways. To keep the number of samples at an achievable level and, at the same time, achieve an acceptable level of precision, +/− 7 percent was selected ($e = 0.07$). After some initial data collection in the districts, the value of p can be reviewed and "fine-tuned", if necessary, but these values have worked well in other states.

4.3.2 Sample Sizes

For each district and road class, the number of centerline miles was used to determine the number of required samples. It is recommended that sample sizes should be developed for each road class: interstate and divided, and two lane routes. Using this approach and obtaining centerline miles by sub-district, sample sizes

TABLE 4.1
State Agency Inspection Programs

Agency	Inspection Segment Length	Inspection Scope	Sample Size	Inspection Type	Frequency
Arizona	0.5 mile	R/W to R/W	Approx. 200	Random samples	Annually
California	1.0 mile	R/W to R/W	12% of road miles in each district; statewide 1572 samples	Random samples	Annually
Florida	0.1 mile	R/W to R/W		Random samples	Annually
Kansas	0.1 mile		3360 samples, 112 subareas, 26 areas, 6 districts	Random samples	Annually
Kentucky	0.1 mile			Random samples	Annually
Louisiana	0.1 mile		2423 samples at 95% confidence level; 16,698 road miles	Random samples	Semi-annually
Maryland	0.5 mile	Shoulder Drainage Traffic Control and Safety	30% of each units centerline miles	Random samples	Annually
Michigan	0.1 mile	R/W to R/W		Random samples	Annually
Missouri	0.1 mile		1500 segments statewide	Random samples by road class	Annually
Mississippi	0.1 mile	R/W to R/W	95% confidence level for 13,052 road miles; no. of samples = 2340; requiring 198 crew days	Random samples	Annually
North Carolina	0.1 mile	R/W to R/W		Random samples	Annually
Ohio	Statewide network	from vehicle		Whole network	¼ of network every 3 months
South Carolina	0.2 mile	(1) Pavement, (2) shoulders/ ditches, (3) drainage structures, (4) roadside, (5) signs, (6) pavement markings, and (7) guardrail	1443 segments; represent 1% of the total network	Random samples	Annually
Tennessee	0.1 mile	(1) Traveled pavement, (2) shoulder, (3) roadside, (4) drainage, and (5) traffic services	4000 1-mile sections were evaluated from the inventory of 79,897 roadway miles	Random samples	Monthly
Texas	1 mile			Random samples	
Virginia	0.1 mile		2200 samples taken from a network that has 7700 centerline miles	Random samples	
Washington	0.1 mile			Random samples	Annually
Wyoming	0.2 mile			Random samples	Annually

calculated to be from 150 to 160 inclusive of all road types.

See Appendix B for sample size calculations by sub-district. Based on these calculations, the Research Division statisticians determined the sample size to be 160 per sub-district.

TABLE 4.2
Values of z for Frequently Used Levels of Confidence

Confidence Percentage	z
68.3	1.000
90.0	1.645
95.0	1.960
95.5	2.000
98.0	2.326
99.7	3.000

The GIS map will have 160 points per sub-district. They will be identified by latitude and longitude and reference posts. A request was made to add a bridge layer. The GIS section added a bridge layer and it was revealed that 7% of the bridges will be inspected. This was presented to Research for approval and granted.

4.3.3 Inspection Software

Each two-member team is provided a laptop and a field inspection card. The laptop is equipped with the ArcPad program for capturing data, as shown in Figure 4.1. The reusable field card shown in Figure 4.2 provides a temporary form for recording inspection and eliminates paper forms. This card can be carried by the inspector to record the evaluation over the 1/10th mile segment. As failures are discovered, the inspector marks it on the card with a grease pencil. Each single click

failure is either pass or fail. For example, if one or more bridge bearings are deemed deficient, the category is marked deficient. "Special Markings" falls under the category of multi-click failure.

Upon completion of segment inspection, the inspector will enter the data from the field card into the ArcPad program. Check that the route and travel direction are correct. If a single click failure is marked on the card, the corresponding program button is selected. "Special Marking" falls under the multi-click failure category. On the inspection card, each marking will be marked either deficient or OK. For example, there are seven marks under "OK" and four marks under "Deficient" on the card. That means there were a total of eleven special markings in the segment. The button "Special Marking OK" should be selected seven times and the button "Special Marking Def." should be selected four times. Once all the data from the card is entered, select "New Segment," wipe the field card clean, and proceed to the next location.

By using the field card, the need to carry the laptop during the inspection is eliminated, removing the potential for damage due to inclement weather or dropping. Paper waste is eliminated because the card is reusable. Also, because the card must be cleared before reuse, it requires data to be entered into the program immediately after obtaining it and eliminates the possibility of misplacing the data (as could be the case using multiple sheets) or entering the data at a later time.

4.3.4 Inspection Changes

All guardrail deficiencies/descriptions were consolidated to one guardrail category. Mile marker and sign deficiencies/descriptions were consolidated to one sign category. The items cable barrier, and shoulders cracking were added.

Some deficiency descriptions were modified and others were eliminated, such as pavement deterioration: rutting; pavement failure: non flush manhole. Some deficiencies were moved from one category to another. Examples: potholes: pavement deterioration → pavement failure; rigid pavement: pavement failure → pavement deterioration.

Training

Appendix C contains the LOS Inspection Manual which contains information on inspection criteria and is a training resource for field inspectors.

On August 9, 2011, field training for LOS inspection was performed in the Crawfordsville District. The two inspection teams tested the new software program and field procedures. Some recommendations were generated for the inspection program which was relayed to the GIS section resulting in modifications to the inspection software. The user interface screen is shown in Figure 4.1.

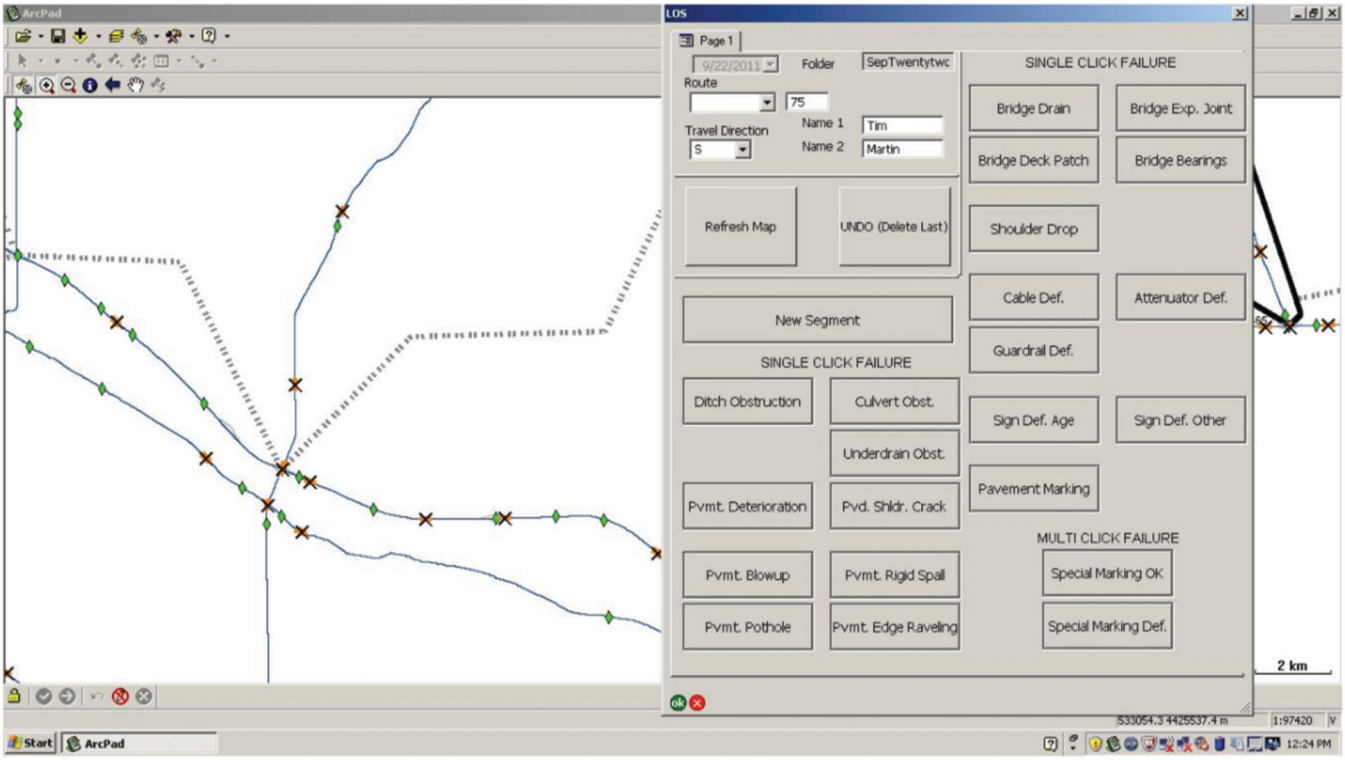


Figure 4.1 Field inspection form.

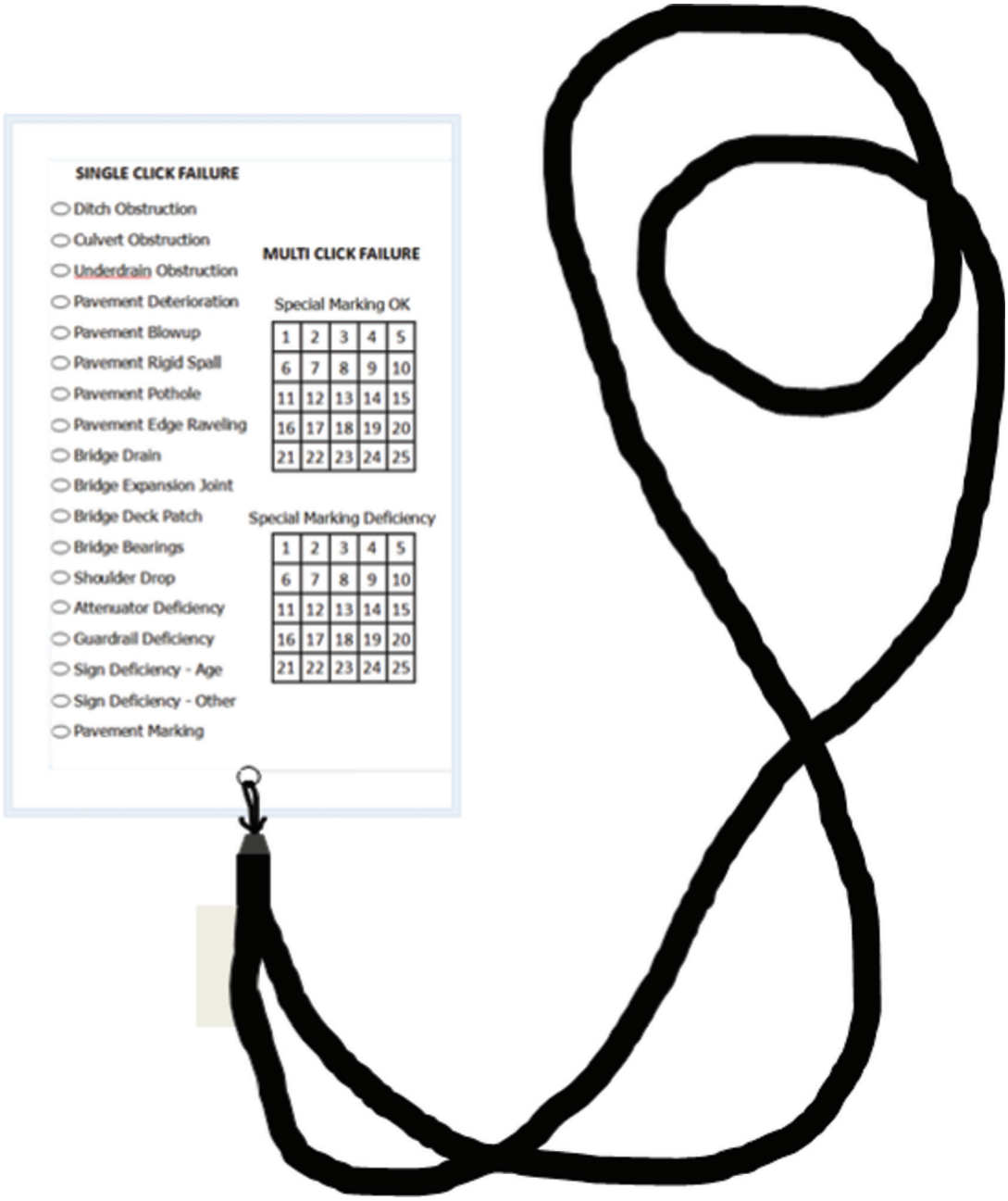


Figure 4.2 Field inspection card.

4.4 WMS LOS Data Needs

WMS has LOS functions that must be populated with INDOT data. The SAC identified four tables to develop which contain the necessary LOS data. These four tables are:

1. Deficiency score index
2. Activity defect assignment
3. Asset deficiency weight scale
4. QG table

Each of these tables is described next.

4.4.1 Deficiency Score Index

This table lists all the LOS inspection categories, the Organizational Performance Index (OPI) Scores and their associated percent deficient ranges.

For each category, an OPI score will be generated based on the percentage of that item found to be deficient in the sub-district. OPI scores range from 1 to 6, where 1 represents the highest range of percent deficiencies and 6 represents the lowest range of percent deficiencies. Six is the highest OPI score and one is the lowest. For example, when an item is found to be

deficient 50% to 100% of the time in a sub-district, an OPI score of 1 is assigned. On the other end of the score scale, when an item is found to be deficient 0% to 4.99% of the time in a sub-district, an OPI score of 6 is assigned. The complete table is found in Appendix D.

4.4.2 Activity Defect Assignment

This table assigns the defect types with a maintenance activity and if multiple defects are associated then their corresponding weight values in percent affecting the activity.

For example, activity 2010 – shallow patching, is performed to repair pothole, spalling, and edge raveling. A weight value is assigned to each defect type for the purpose of establishing a level of effort. The weight values should equal 1.0 for an activity. For 2010, pothole repair is assigned a value of 0.8, spalling a value of 0.1, and edge raveling a value of 0.10, which says that 80 percent of the time activity 2010 is used to repair pothole issues and 10% each for repairing spalling and edge raveling.

Appendix E is the complete table.

4.4.3 Asset Deficiency Weight Scale

A copy of this table is found in Appendix F. This table lists all the inspection categories and their corresponding ranking in terms of perceived importance. The highest ranked defect is pothole which means it comes first in repair and making resources available. The lowest ranked is traffic, which means it is last in repair importance and dedicating resources.

The columns Match Column and Groovy Script ID are WMS information. The best and worst columns are the OPI score range. The MMS Util Function states that in WMS if the OPI score is above 4 then use 6 as the OPI value.

4.4.4 QG Table

The QG Table was previously developed by INDOT and directed by Pavement Preservation Engineer. It plays an important role in the WMS LOS module. It contains a couple hundred activities described by the following:

- Activity description
- Daily production values
- Unit costs
- Crew size and info
- Equipment info
- Material codes
- Material amounts associated with each activity

The table is too large to include in the report and it resides with INDOT Operations.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 GIS Section

The GIS section modified the MQS inspection software program and produced the LOS inspection program. Figure 4.1 shows the Field Inspection form. This form has been tweaked, tested, and is being used to collect field data. One component of this program yet to be defined is the report needs. This will be determined during the implementation phase that will occur in spring 2012.

The GIS section developed the revised Inspection program and MIS services will be needed in the future on a random basis to develop yet to be defined reports and perform expected revisions to the inspection program.

5.2 Field Inspection

The LOS inspection program is operational with the two inspection teams. The LOS inspection program requires 160 segments per sub-district. With 31 sub-districts the total number of inspection segments at INDOT will be 4,960. Based on daily productivity results, 80 inspections for both teams, the estimated time to complete the inspections is 13 weeks, which will be called 4 months. The previous MQS inspection program took approximately 8 months to complete. The LOS inspection program is potentially saving 4 months of time.

Assuming annual four month time savings for the inspection teams a cost saving can be calculated. INDOT's Finance section estimates the hourly rate for a Highway technician to be $31 an hour. Each team is comprised of two technicians so the total time saved is: 4 technicians x 37.5 hours/week x 4 months x 4 weeks/month = 2400 hours. The potential personnel cost savings is 2400 hours x $31/hour = $74,400. This savings will be realized in time and not costs. It will provide the inspection teams time to perform other inspections for QA and High Mast Lighting.

Travel and per diem costs will be less too and are calculated with these assumptions. Four months' time savings is equivalent to 16 weeks. Lodging cost is $80/day and per diem travel cost is $26/day. Estimated travel cost savings is:

- Lodging = 4 nights/week × 4 rooms × $80 × 16 weeks = $20,480
- Per diem = 5 days × 16 weeks × 4 (inspectors) × $26/day = $8,320
- Total estimated travel cost savings = $28,800

This does not include vehicle costs because it is assumed the vehicles will be used in other inspection activities.

Total potential savings (personnel + travel) = $74,400 + $28,800 = $103,200

5.3 WMS LOS

Four tables were developed by the SAC that will be used to populate the WMS LOS data requirements. The four tables: activity defect assignment, deficiency score index, asset deficiency weight scale, and QG data were previously described. INDOT MIS will be responsible for populating WMS with these data. This may require Agile Assets involvement to update the WMS database

and if this is needed there may be an implementation expense. Maintaining LOS data in WMS will be an ongoing requirement for MIS and the Division of Technical Services.

5.4 LOS SAC

The SAC played an important role in the project by providing direction and participating in the development of the inspection program and the LOS data.

The WMS LOS is to be used as a budget and planning tool. Generated reports will provide Operation managers the ability to assess feature condition and compare with budget allocations. LOS projections can be used to populate the WMS Annual Work Plans. Multiple constraint projections can be run to analyze "what if" scenarios and then the optimum projection can be used as a base work plan. Comparing condition ratings with expenditures gives INDOT the ability to allocate budgets that produce more uniform conditions or meet the higher priority features.

REFERENCES

1. McCullouch, B. G., K. C. Sinha, and P. C. Anastasopoulos. *Performance-Based Contracting for Roadway Maintenance Operations in Indiana*. Publication FHWA/IN/JTRP-2008/12. Joint Transportation Research Program, Indiana Department of Transportation and Purdue University, West Lafayette, Indiana, 2009. doi: 10.5703/1288284313438.
2. McCullouch, B. G. *Maintenance Quality Assurance Program*. Publication FHWA/IN/JTRP-2003/18. Joint Transportation Research Program, Indiana Department of Transportation and Purdue University, West Lafayette, Indiana, 2003. doi: 10.5703/1288284313265.

APPENDIX A: STATE INSPECTION PROGRAMS

http://docs.lib.purdue.edu/cgi/viewcontent.cgi?filename=1&article=2973&context=jtrp&type=additional

APPENDIX B: SUB-DISTRICT SAMPLE SIZES

http://docs.lib.purdue.edu/cgi/viewcontent.cgi?filename=2&article=2973&context=jtrp&type=additional

APPENDIX C: LOS INSPECTION MANUAL

http://docs.lib.purdue.edu/cgi/viewcontent.cgi?filename=3&article=2973&context=jtrp&type=additional

APPENDIX D: DEFICIENCY SCORE INDEX

http://docs.lib.purdue.edu/cgi/viewcontent.cgi?filename=4&article=2973&context=jtrp&type=additional

APPENDIX E: ACTIVITY DEFECT ASSIGNMENT

http://docs.lib.purdue.edu/cgi/viewcontent.cgi?filename=5&article=2973&context=jtrp&type=additional

APPENDIX F: ASSET DEFICIENCY WEIGHT SCALE

http://docs.lib.purdue.edu/cgi/viewcontent.cgi?filename=6&article=2973&context=jtrp&type=additional

APPENDIX A

State Inspection Programs

ADOT - Arizona

ADOT is working to tie "levels of service," or LOS, explicitly to maintenance budgeting. Development of a LOS-based budgeting procedure will require some changes in how data on the maintained condition of highway features are collected and reported.

The length of highway covered in each annual survey will be reduced by using a sampling approach. Sample sections will be 0.5-mile long. The samples are randomly generated each year using the Maintenance Budgeting Program (MBS).

In the new approach, LOS will be expressed as letter grades – A, B, C, D and F. Plus-and-minus grades may also be used if finer gradations are needed. The updated data collection procedures will support these graded LOS values.

All field inspections of maintained features will take place in highway "sample sections" that are each 0.5-mile long. A total of a few hundred sample sections will be inspected each year, based on statistical design as well as resources available for conducting the survey. These samples will provide an indication of the total network condition statewide. Samples will be selected in each route under the responsibility of a roadway org – this will ensure that highways of different functional classes and geographic locations are sampled each year. The location of the sample section will be selected randomly each year – this ensures diversity in the sample set and avoids bias due to unique conditions that may exist at particular locations.

- The length of the sample section is 0.5 mile. The width of the sample section extends from right-of-way line to right-of-way line. [(C) And (D) in the sample section on the following page.] Only features that are within this sample area and are maintained by ADOT should be inspected.
- The sample area will contain the mainline highway lanes and shoulders (A), a frontage road if present (B), adjacent right-of-way, and a median in the case of divided highways. The survey will cover features on all these components within the survey area. Quantities of features will be summed across these components if needed (e.g., pavement surface area will include the sum of the paved areas of all roadway lanes and paved shoulders on all roads).

- If the section includes an intersection, inspect all ADOT maintained features within the mainline right-of-way except traffic signal equipment (E) and Bridge Decks.
- Interchange ramps (F), acceleration and deceleration lanes, truck lanes, and turning lanes should be included in the survey. When counting the lanes in the survey section, all of these features should be included as a lane. The sample segment has 7 lanes – 4 mainline lanes, 2 frontage road lanes, and 1 ramp. If at either end of ramp there are multiple lanes, count all lanes. If there is a partial lane and there is 2 tenths of a mile or more count it as a lane.

ADOT Roadway Maintenance Survey Form

Date: _____ **Inspector:** _____ **Phone:** _____

Org Number: _____ **Route:** _____ **Beginning Milepost:** _____ **# of Lanes:** _____

Condition Indicator	N/A	Ratings				
PAVEMENTS AND SHOULDERS						
Asphalt: ☐ Mainline ☐ Frontage ☐ Ramp		Check the box at the left, which describes the portion of the roadway that is being measured.				
1. **Asphalt**: number of unfilled potholes—all lanes		If < 20, enter count: _____		If 20 or more, simply check box at right		☐
2. Percent **asphalt** surface with ***open*** cracks.		***Make sure; a), b), & c) are noted below***				
a) Alligator cracking		0-5%	5-10%	10-30%	30-50%	>50%
b) Other cracking, up to ¼" wide		0-5%	5-10%	10-30%	30-50%	>50%
c) Other cracking, greater than ¼" wide		0-5%	5-10%	10-30%	30-50%	>50%
3. Percent **asphalt** surface with bleeding		0-5%	5-10%	10-30%	30-50%	>50%
4. Percent **asphalt** surface with raveling		0-5%	5-10%	10-30%	30-50%	>50%
PCCP: ☐ Mainline ☐ Frontage ☐ Ramp		Check the box at the left, which describes the portion of the roadway that is being measured.				
5. **PCCP:** number of spalls and faulted or settled joints—all lanes. (Bridge Decks ***NOT*** Included)		If < 20, enter count:		If 20 or more, simply check box at right		☐
6. **Unpaved shoulder**: Overall condition of *Maintained* unpaved shoulder from edge of pavement.		Excellent	V. Good	Good	Fair	Poor
7. **Unpaved shoulder**: Percent length with erosion or edge drop-off > 2"		0-5%	5-10%	10-30%	30-50%	>50%
ROADSIDE, SAFETY AND DRAINAGE						
8. Percent length of **guardrail** with broken or bent rails; broken or bent posts; severe corrosion; or loose or broken bolts		0-5%	5-10%	10-15%	15-25%	>25%
9. Are any **guardrail** or **barrier end treatments** missing or damaged?		No		Yes		
10. Do any **crash attenuator** elements needing repair?		No		Yes		
11. Is **sweeping** of roadway pavement needed? **(Phoenix and Tucson ONLY)**		No		Yes		
12. **Litter**		No litter	Few pieces	Small patches	Unsightly areas	> half the area
13. Percent of **fence panels** missing or damaged		0-5%	5-10%	10-30%	30-50%	>50%
14. Percent length of **lined channels** with debris or vegetation. (3 sided concrete lined channel)		0-5%	5-10%	10-30%	30-50%	>50%
15. Percent length of **unpaved ditches** with rock or mud slides, debris, or vegetation. (This includes overhead crown ditches). Gunite lined ditch		0-5%	5-10%	10-30%	30-50%	>50%
16. **Pipe openings, down drains, other drainage features** silted to >25% depth		0-5%	5-10%	10-30%	30-50%	>50%

July 2006

Manual contains image examples of good and damaged criteria.

CALTRANS

The basic method used to develop data for the LOS2000 Review was the application of randomly generated values that match the desired percentage of one-mile highway segments. The total state highway inventory was divided into one-mile segments (some segments may be less than one mile, but are greater than 0.5 mile) and random samples were selected within each District using the random number function in the LOS2000 automated program. Each District's segments were sorted by random number and the first 12 percent were selected (70 segments for District 12). The first 10 percent of randomly selected segments were evaluated (18% for District 12), with the remainder serving as substitute segments. Table 1 reports the number of segments and centerline miles sampled in each district, and the percentage of each district's total centerline miles that were evaluated.

Table 1

District	Number of Segments Evaluated and Percentage of Total Number of Segments in District (if less than 100%)				
	Roadway	Landscape	Roadside Rest Areas	Vista Points	Park & Ride Lots
1	100 (10%)	39	7	16	6
2	182 (11%)	21 (88%)	19	10	10
3	145 (10%)	52 (49%)	12	10	26
4	144 (10%)	50 (10%)	3	10	44 (98%)
5	140 (12%)	53 (98%)	5	7	9 (90%)
6	177 (10%)	49 (74%)	5 (71%)	3	11
7	113 (10%)	54 (12%)	2	1	47
8	188 (10%)	51 (35%)	13 (87%)	4	14
9	102 (10%)	2	5	17	1
10	132 (10%)	36 (73%)	2 (33%)	23	5
11	99 (10%)	50 (28%)	7	5 (83%)	38
12	50 (18%)	50 (44%)	NA	NA	2 (67%)
Total	**1,572**	**507**	**80**	**106**	**213**

District personnel consisting of the LOS2000 Coordinator and at least one Caltrans Maintenance Supervisor or above administered the field survey. Other District and Headquarters personnel, including District Liaisons, were also invited to participate in the review. The Quality Assurance teams evaluated 10% of the randomly selected segment samples in each district.

Florida

- Rate all sample points from right-of-way to right-of-way, with the exception of rest areas, weight stations, service plazas, welcome centers, and inspection stations.
- If the sample point falls within the gore limits of a rest area, weight station, inspection station, etc. project the right-of-way limits across the ramp and rate for normal maintenance criteria.
- Rate only those items maintained by the district being evaluated.
- A sample is 1/10 mile or 528 feet in length.

Kansas

- 0.1 length samples
- 3360 random samples statewide
    - 112 subareas, 26 areas, 6 districts

Kentucky

Use statistical sampling techniques – random samples

0.1 mile section

After determining the beginning mile point location and the direction in which the section runs, the team will make sure there is not a bridge or other structure, an intersection, or a construction zone within the segment.

Louisiana

Field Sample Segments

Statistical methods will be used to identify randomly selected data sample sites along state highways. The sites are 0.10-mile segments (528 feet) selected in the 16,698 miles of roads (interstate and non-interstate) maintained by LADOTD. For non-interstate, divided highways, both directions of travel will be included in the sample. For Interstate routes, each direction of travel will be considered and sampled as a separate roadway. For a sample size that will give 95 percent confidence that the level-of-service average rating will be within 7 percent of the true value if the pass/fail rate is 80 percent for Interstate and 70 percent for non-Interstate, then the required sample size is 2,423 samples.

A random number table will be used to generate random numbers to select sample sites. Then roads within a district can be assumed to be a single road. For example, non-Interstate roads in District 2 can be assumed to be a single 1071-mile road. The required number of samples will be obtained (163) from the random number tables with values between 0.0 and 1.0. By multiplying these numbers by the total number of miles in each district, the mileposts of the field sample segments will be obtained. For convenience, the roads in each district should be arrayed 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 should be conducted to account for seasonal variations.

Maryland

The Maryland Condition Assessment Reporting System (MCARS) is designed to provide SHA managers with an accurate, reliable evaluation of the condition of SHA's highways and roadsides, and the level of service we are providing our customers. It is critical we maintain our managers' confidence in the accuracy of the data collected in this program.

The MCARS Program will employ teams, composed of three people, reviewing highways maintained by each of SHA's 28 shops. The three person teams will be drawn from a pool of 11 people, four from the Office of Maintenance (OOM) and seven from the districts. Using a limited pool of evaluators helps bring consistency to the program. OOM will designate three of its four participants as MCARS Team Leaders who will lead the three person teams. The fourth OOM participant will serve as an Alternate Team Leader and as a participant on teams.

MCARS Program data collection will occur in the months of June, July, and August. MCARS personnel will spend a minimum of two days evaluating highways in each shop's area of responsibility. In addition, the reviews will be done, when possible, during two different months. The intent is to minimize the effect of weather on a shop's review. In addition, two different teams will evaluate each shop. The intent is to increase the number of people reviewing each shop which will lessen the subjectivity of the review. The teams will evaluate approximately 30% of each shop's centerline miles, ranging from 57 to 213 one-half mile sites. Roadways in remote areas will not be omitted.

The team will review 21 maintenance elements, down from 29 elements in the previous years. The desired maintenance condition or level of service for some of the elements changed as well. The teams will evaluate elements in four major categories:

1. Shoulder
2. Drainage
3. Traffic Control and Safety
4. Roadside

Michigan

All MDOT roadways are divided into 1/10 mile sections and numbered. From these numbered sections, test sites are selected using a random number generator. GPS coordinates are then matched to the beginning point of each selected site. Maps of the selected test sites will be supplied to the evaluating team with test site information including test site number and longitude and latitude coordinates.

Missouri

The size of our system and impracticality of evaluating each mile of roadway necessitates the selection of a statistically valid sample of one-tenth mile segments for each functional roadway class for field inspection. Roadway features within the sample segments are then field inspected using the performance indicators as a basis to determine a LOS expressed as a number between 1 and 100. Individual segment ratings are then averaged to determine LOS ratings. Approximately 1,500 segment inspections stratified by functional class will provide a valid sample for the entire system's LOS, and potentially valid information as to each district's LOS.

Mississippi

The MDOT State Highway System consists of approximately 13,052 miles of roadway. A complete field inventory and condition assessment on a system of this magnitude is not possible within the time constraints of the MMS project. To the extent possible, inventory and condition data will be obtained from office records. The field data collection will be done on a sampling basis, using randomly selected 0.1-mile sample sites. Each feature to be collected is described in detail in Appendix A. A sampling methodology has been established to provide statistically valid results at the 95 percent confidence level with 7 percent precision.

Approach

The current condition, or level of service (LOS), of the various road assets maintained by the MDOT will be estimated using a statistical approach. The usual practice is to collect data on random samples, using 0.1-mile sample sections. A sufficient number of 0.1-mile sample

sections will be selected to provide statistically significant data at the district level and by road classification (Interstate, U.S. and Other).

For each District and road class, the number of road miles was used to determine the number of samples required for roads and the number of bridges was used. It was assumed that Interstate and U.S. roads are divided, requiring separate samples for each direction of travel. The rest of the roads were assumed to be undivided.

Sample Size Formula

The following equation may be 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 (for example, pass/fail – 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.

Values of *z* for Frequently Used Levels of Confidence

Confidence Percentage	z
68.3	1.000
90.0	1.645
95.0	1.960
95.5	2.000

Confidence Percentage	z
98.0	2.326
99.7	3.000

For condition assessments, a confidence level of 95 percent is generally considered sufficient ($z = 1.96$). The value for p was assumed to be 80% for Interstate and U.S. highways and 70% and for Other highways. To keep the number of samples at an achievable level for the study time frame and, at the same time, achieve an acceptable level of precision, +/- 7 percent was selected ($e = 0.07$). After some initial data collection in the Districts, the value of p can be reviewed and "fine-tuned", if necessary, but these values have worked well other states.

Sample Sizes

The inventory of roads maintained by MDOT was obtained from the Pavement Management System. For each District and class of road, the number of miles was used to determine the number of samples required as shown in Exhibit B-2. It was assumed that Interstate and U.S. highways are divided, requiring separate samples for each direction of travel since there are two separate roadway cross-sections. The rest of the roads were assumed to be undivided, i.e., only one roadway cross-section.

Table 2 - Number of Samples Required

(For 95% Confidence, +/- 7% Precision)

District	Highway Class	Centerline Miles	Samples by Class	Total Samples by District	Crew-Days Required [1]
1	Interstate	0	0	288	24
	U.S.	967	125		
	Other	1,612	163		
2	Interstate	261	123	411	35
	U.S.	650	125		
	Other	1,596	163		
3	Interstate	200	122	409	34

District	Highway Class	Centerline Miles	Samples by Class	Total Samples by District	Crew-Days Required [1]
	U.S.	624	125		
	Other	932	162		
5	Interstate	572	125	412	35
	U.S.	480	124		
	Other	1,425	163		
6	Interstate	528	124	412	35
	U.S.	858	125		
	Other	1,268	163		
7	Interstate	118	120	408	34
	U.S.	651	125		
	Other	1,110	163		
Total		13,852		2,340	198

North Carolina

A statistical sample of 0.1 mile segments.

Ohio

The Maintenance Quality Survey (MQS) is a visual inspection conducted from a moving vehicle, of the eight maintenance categories. The MQS Inspection vehicle speed ranges from one mile per hour to a maximum of 20 miles per hour. Two teams consisting of two inspectors, inspect one quarter of every county's state maintained highways every three months. The MQS teams use laptop touch-screen computers with GPS technology to collect the maintenance deficiency data.

South Carolina

The Maintenance Assessment Program (MAP) was developed in response to a need for an objective method of analyzing and measuring the performance of the South Carolina Department of Transportation's (SCDOT) maintenance division. One goal of the program was to determine the level of service that is being provided to South Carolina's motorists. This would also allow a calculation of the amount of improvement that would be required to obtain a higher level of service, and the associated cost of the improvement.

Another benefit of this program is that a consistent expectation of performance has been established for the entire state. Areas that need improvement have been identified and available resources can be directed to these areas. In some cases, improvement plans and programs have been developed in an effort to improve the performance.

The MAP was modeled after a similar program that the North Carolina Department of Transportation was utilizing. The MAP is a random statistical analysis of the South Carolina Department of Transportation (SCDOT) maintenance performance on the primary and secondary highway system throughout the state. Key elements of maintenance were identified for evaluation. Significant indicators were chosen in each of the seven key elements that would be evaluated. Two-tenth mile sections of roadway are randomly selected throughout the state. A two-person inspection team physically inspects these elements on the randomly selected segments of roadway. The inspections are scheduled throughout the year to ensure that they are performed in all seasons. This is done to alleviate any seasonal variances in the key elements inspected.

The seven elements that were evaluated are: (1) Pavement, (2) Shoulders / Ditches, (3) Drainage Structures, (4) Roadside, (5) Signs, (6) Pavement Markings, and (7) Guardrail. Each element is evaluated and the condition is recorded in a database. The elements and their condition indicators are located in Table 1. An evaluation of the maintenance of the state's interstate system and bridge system were not included in the MAP. The bridge maintenance division has a separate program for evaluating the condition and needs of the state's bridges. The interstate system was not included because of the concern for the safety of the raters and motorists, and the ensuing traffic congestion. Therefore, all maintenance needs and funding identified in this report excludes the needs for our interstate and bridge systems.

For both primary and secondary highway systems, a statistical sampling was made to determine the location of sites to be surveyed. Approximately 1,443 sites were randomly selected statewide for inspection. This equates to approximately 1% of the total inventory. During the period between January 2006 and December 2007, survey teams assessed the condition of these 0.2-mile sections. The inventory of each element and the quantity of the deficient conditions were recorded and summarized, and a maintenance condition rating calculated. From this assessment,

the necessary maintenance activities to achieve the various levels of service were determined along with their estimated costs.

The data collected has been used to objectively determine the current level of service provided by the maintenance division. This information permits a projection of the amount of work necessary to bring the entire state's maintenance service to a desirable level. A cost can be associated with this work to assist in identifying funding needs. The program also points out the substandard areas to local SCDOT departments. This information is used to assist with planning and the allocation of existing maintenance resources.

Tennessee

The Maintenance Rating Program will provide a portion of the condition assessment for Roadway assets. This will be in the form of what is referred to as the Maintenance Rating Index, or MRI. The MRI is a numerical score on a 100 point scale, 100 being a perfect score. This score is generated from surveys that are performed each month, by District personnel, to determine the present condition of each roadway segment. The roadway segments measure 0.1 mile and are randomly selected each month. Surveys are conducted on all types of state highway facilities. The type of maintenance required for each roadway segment determines the classification of a particular facility. The current Facility Type classifications are:

1. Interstates
2. State Routes
3. Other (not currently used, but reserved for future use)

Each Facility Type classification is divided into 5 Elements:

1. Traveled Pavement
2. Shoulder
3. Roadside
4. Drainage
5. Traffic Services

Each of the 5 Element listed above are further subdivided into many Characteristics. For example, the Roadside Element is composed of the following Characteristics:

- Grass Height
- Landscaping / Wildflowers
- Litter Pickup
- Access Control Fence

- Roadway Sweeping
- Graffiti
- Vegetation / Brush Removal
- Slopes / Erosion Control

Inspection consists of 0.10 mile segments that are randomly selected.

Texas

Texas Maintenance Assessment Program (TxMAP). TxMAP consists of:

- 1 mile segments randomly selected
- In FY 2007 over 4000 one mile sections were evaluated from the inventory of 79,897 roadway miles.

Virginia

Randomly selected 0.10 mile segments.

Washington

1. Statistical methods are used to identify approximately 2,200 randomly selected data survey sites around the state. These are 0.10 mile sections (528 feet) selected from the approximately 7,000 centerline miles of state highway inventory.
2. Using Milepost Markers and the vehicles DMI, locate and mark the start and end points for each site. Mark the points with paint at the edge of the shoulder so that they can be located again if needed.
3. If any portion of the site falls on a structure, the site should be moved forward or backward as necessary to avoid the structure.
4. Sites in construction zones should not be evaluated. Relocate the site outside of the construction area but as close to the original site as possible.
5. Activate flashing lights on vehicle, place cones for safety, and use appropriate traffic control measures. Always wear required safety equipment, reflective vest, supportive footwear, etc.
6. Conduct field measurements and observations at the sites and record the data. When performing data collection always try to walk facing traffic. On divided highways and freeways it may be necessary to drive around to the lanes in the opposite direction and set points on that side of the road as well. Remember SAFETY FIRST.

Wyoming

1. For each collection team, a list of statistically valid, randomly selected roadway segments to be assessed shall be provided to each district, by Headquarters Maintenance Staff.
2. On segments with Interchange ramps or other such lanes, **"**DO**"** include these when gathering data within the selected segment.
    a. For example if you have an interchange within the selected segment, you would gather all data from the interstate to where the ramp(s) meet the connecting mainline or at the point in line with the selected segment end(s). The same would hold true for such lanes as a free right turn.
3. Should any portion of an approach, culvert, cattle guard be inside the marked segment, it will be counted and the entire item evaluated.
4. The team shall include one team leader that is assigned by the district maintenance engineer, to assure consistent data collection. A collection team of four (4) persons and two (2) vehicles seems to work efficiently, usually completing a segment in about 30 minutes. It should be noted that the size of team can vary, depending on availability of resources during data collecting. Simply put, it can be performed with two (2) persons and one (1) vehicle; it just may take a bit longer.
5. Using the Nearest Increasing reference marker, along with a distance measuring instrument (DMI) or a vehicle's trip odometer, segments shall be located and the beginning and ending points marked with spray paint.
    a. Marking the ends with spray paint will help the validation collection to assure that both teams *(Maintenance Staff and District)* are assessing the exact same area.[1]
    b. A segment equals .20 tenths of a mile or 1,056 feet in length.
    c. A DMI should be checked periodically for proper calibration.

[1]Be sure to also mark segment ends on interchange ramps and other added lanes.

APPENDIX B

Sub-District Sample Sizes

Sub-Districts	Centerline Miles	N - Population Size	Denominator	N - Sample Size	# of Samples
Cloverdale	383	3830	0.005110636	157.8543248	158
Crawfordsville	496	4960	0.005062648	159.3505885	159
Fowler	350	3500	0.005130496	157.2432763	157
Frankfort	347	3470	0.005132489	157.1822244	157
Terre Haute	281	2810	0.005187095	155.527526	156
Angola	343	3430	0.0051352	157.0992366	157
Bluffton	458	4580	0.005076143	158.9269576	159
Elkhart	287	2870	0.005181093	155.7076951	156
Fort Wayne	312	3120	0.005158569	156.3875493	156
Wabash	500	5000	0.005061347	159.3915549	159
Albany	385	3850	0.005109542	157.8881294	158
Cambridge City	338	3380	0.005138679	156.9928681	157
Greenfield	350	3500	0.005130496	157.2432763	157
Indianapolis	159	1590	0.005407381	149.1916291	149
Tipton	340	3400	0.005137275	157.0357736	157
Gary	214	2140	0.005276979	152.8783671	153
Laporte	342	3420	0.005135888	157.0782003	157
Monticello	314	3140	0.005156922	156.4374939	156
Plymouth	271	2710	0.005197689	155.2105307	155
Rensselaer	311	3110	0.005159401	156.3623482	156
Winamac	364	3640	0.005121631	157.5154548	158
Aurora	438	4380	0.005084186	158.6755387	159
Bloomington	397	3970	0.005103208	158.0840895	158
Columbus	304	3040	0.005165374	156.1815368	156
Falls City	352	3520	0.005129186	157.2834252	157
Madison	472	4720	0.005070919	159.0907006	159
Evansville	316	3160	0.005155296	156.4868377	156
Linton	312	3120	0.005158569	156.3875493	156
Paoli	422	4220	0.00509117	158.4578894	158
Tell City	469	4690	0.005072012	159.0564079	159
Vincennes	356	3560	0.005126611	157.3624297	157
Total					**4862**

APPENDIX C

Los Inspection Manual

LOS Inspection Manual

Maintenance/Traffic

Version 05/12

Table of Contents

INDOT Maintenance LOS Manual

1.0 Inspection Program Process

1.1 Introduction

This manual defines the inspection program and criteria for thirteen Maintenance categories.

1.2 Data Collection

The Level of Service (LOS) Survey is a visual inspection, of certain roadway assets, conducted by a walk-through based on criteria defined in this manual. Two teams, consisting of two collectors, are assigned to inspect six Districts' state maintained highways. The inspections consist of 160 0.10 mile random sections in each Subdistrict. The random segments will be identified by route number and GPS coordinates. The inspections should start at given latitude and longitude location and cover 0.10 mile as described in section 1.3. These locations will be provided by the LOS supervisor and shown on the map interface of the inspection software.

1.3 Highway

1.3.1 Divided highways – A LOS inspection will be conducted in both highway directions.

1.3.2 Two-lane highways – A LOS inspection will be conducted in both highway directions.

1.4 Survey Policy During Snow and Ice Operations

A LOS inspection will not be conducted on a route until the pavement is clear. The LOS inspection team will communicate with the supervisor, to establish a course of action until the pavement is clear.

1.5 How INDOT Uses LOS Data

The LOS data provides the information necessary to generate the Organizational Performance Index (OPI). The District OPI is a scoring system index by which system conditions are compared to INDOT goals. Additionally, the LOS data will be used by the District Highway Operations to develop their work plan.

2.0 LOS Recordable Conditions

2.1 Summary of Recordable Deficiencies

2.1.1 Shoulders

Deficiency Description	Deficiency Count
Drop-off or build-up exceeding +/- 2 inches for 15 linear feet on paved shoulders less than 4 feet wide	Each in 1/10 mile (528 feet) segment

2.1.2 Paved Shoulder Cracking

Deficiency Description	Deficiency Count
Unsealed cracks on more than 25% of the shoulder.	Each in 1/10 mile (528 feet) segment

2.1.3 Small Culvert Obstruction

Deficiency Description	Deficiency Count
More than 25% of culvert obstructed	Each culvert in 1/10 mile (528 feet) segment

2.1.4 Underdrain Obstruction

Deficiency Description	Deficiency Count
More than 10% of outlets are closed. Rodent screens are missing. Marking of drain not rated.	Each underdrain in 1/10 mile (528 feet) segment

2.1.5 Ditch Obstruction

Deficiency Description	Deficiency Count
50% or more of ditch filled with debris or standing water 1 inch in depth or greater that covers 6 feet or more. Standing water after a rain is still a deficiency.	1/10 mile (528 feet) segment

2.1.6 Pavement Deterioration

Deficiency Description	Deficiency Count
Rigid pavement – more than 25% of transverse and longitudinal joint material does not appear to keep water out	Each in 1/10 mile (528 feet) segment
Unsealed cracks on more than 25% of roadway Greater than hairline and exceeding 4 feet.	1/10 mile (528 feet) segment

2.1.7 Pavement Failure

Deficiency Description	Deficiency Count
Pavement blow-up exceeding 2 inches	Each in 1/10 mile (528 feet) segment
Pothole exceeding 1 inch in depth	
Rigid pavement spalls – defect exceeding 1 square foot in area and 1.5 inches deep	Each in 1/10 mile (528 feet) segment
Edge raveling exceeding 50 feet in length	1/10 mile (528 feet) segment

2.1.8 Bridge Category

Deficiency Description	Deficiency Count
1 plugged drain	Each
Expansion joint with rubber seal missing or pulled out to a vertical offset exceeding 1.5 inches	Each
1 square foot of delaminated, spalled, or cracked deck	Each
Sand or debris around bearings	Each

2.1.9 Guardrail

Deficiency Description	Deficiency Count
More than one rail panel damaged more than 75%	
Spacer block – rotting or missing block-out	Every 3 continuous block-outs
Two or more consecutive posts missing or rotten	

2.1.10 Cable Barrier

Deficiency Description	Deficiency Count
Cable sagging more than 1/3 of post height	1/10 mile (528 feet) segment
More than 1 post knocked down	Each in 1/10 mile (528 feet) segment

2.1.11 Crash Attenuator

Deficiency Description	Deficiency Count
Damaged or missing	Each in 1/10 mile (528 feet) segment

2.1.12 Sign

Deficiency Description	Deficiency Count
Damaged or faded sign, cannot be clearly read	Each in 1/10 mile (528 feet) segment
Missing sign, excluding 3-button “no passing zone” indicator post	Each in 1/10 mile (528 feet) segment
Sign is older than policy age (currently 18 years) (older stickers no year punched) Missing or damaged mile markers or reference posts	Each in 1/10 mile (528 feet) segment Each in 1/10 mile (528 feet) segment

2.1.13 Pavement Marking

Deficiency Description	Deficiency Count
Excess of 150 linear feet missing	1/10 mile (528 feet) segment

2.1.14 Special Marking

Deficiency Description	Deficiency Count
A total of one half of all markings are missing 50% of the marking on main line or at signalized approaches, stop bars, or cross walks (no stop bars on county road approaches unless at signal)	Each in 1/10 mile (528 feet) segment

2.1.15 Maintenance Work Plan Analysis

Deficiency Description	Deficiency Count
The PM activities will be evaluated comparing the planned versus the actual.	Score assigned to individual PM activities, and then scores are averaged for Sub and District scores,

2.1.16 Traffic Work Plan Analysis

Deficiency Description	Deficiency Count
The PM activities will be evaluated comparing the planned versus the actual.	Score assigned to individual PM activities, and then scores are averaged for Sub and District scores,

2.2 Description of Recordable Deficiencies

2.2.1 Deficiency Type: **Shoulders**

Deficiency Description: Drop-off or build-up from the paved surface exceeding +/- 2 inches in depth and 15 linear feet in length on paved shoulders less than 4 feet wide.

2.2.2 Deficiency Type: **Shoulder Cracking**

Deficiency Description: Unsealed cracks on more than 25% of the shoulder.

2.2.3 Deficiency Type: **Small Culvert Obstruction**

Deficiency Description: Culvert more than 25% obstructed. One deficiency will be recorded for each culvert.

Inspection Limits: INDOT right-of-way excluding ramps

2.2.4 Deficiency Type: **<u>Underdrain Obstruction</u>**

Deficiency Description: More than 10% of outlets are closed and/or unsuitably marked. Rodent screens are missing or torn.

Inspection Limits: INDOT right-of-way excluding ramps.

Plugged underdrain, missing rodent screen

Missing rodent screen

Plugged underdrain

2.2.5 Deficiency Type: **Ditch Obstruction**

Deficiency Description: 50% or more of a ditch is filled with debris or there is standing water 1 inch in depth or greater that covers 6 feet or more.

Note: Cattails will not be recorded as a deficiency.
Inspection Limits: INDOT right-of-way excluding ramps.

Debris obstructing 50% of ditch cross-section

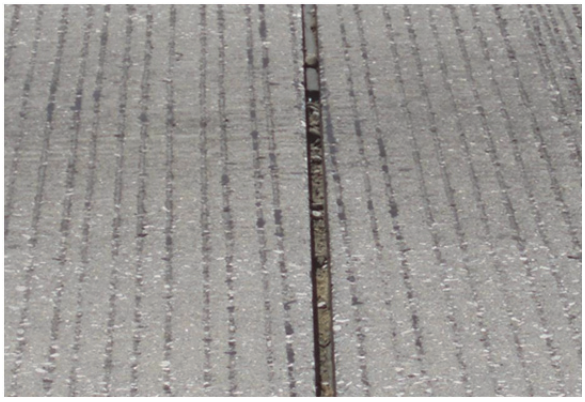
Standing water

Good Ditch Line

2.2.6 Deficiency Type: **Pavement Deterioration**

Deficiency Description: More than 25% of the roadway has unsealed **cracks**.

Rigid Pavement – 25% of transverse and longitudinal joint material does not Appear to keep water out.



2.2.7 Deficiency Type: **Pavement Failure**

***Any of the following four criteria causes the pavement to be deficient.

Deficiency Description: **Pavement blow-up** exceeding 2 inches. One deficiency will be recorded for each blow-up.

Pothole – exceeding 1 inch in depth.

Rigid Pavement Spalls – defect exceeding 1 square foot in area and 1.5 inches deep

Edge Raveling – exceeds 50 feet in length.

2.2.8 Deficiency Type: **<u>Bridge Category</u>**

***Any of the following four criteria causes the Bridge to be deficient.

<u>Drains</u> – 1 plugged drain

<u>Expansion Joint</u> – rubber seal missing or pulled out to a vertical offset exceeding 1.5 inches

Deck Patching – 1 square foot of delaminated, spalled, or cracked deck patching

Bearings – sand or debris around bearing

2.2.9 Deficiency Type: **Guardrail**

***Any of the following three criteria causes the guardrail to be deficient.

Guardrail – More than one rail panel is damaged more than 75%

Crushed rail panel

Double sided rail: Two rail deficiencies

Note: Post deficiencies exist beyond the two damaged rail panels.

Spacer Block – rotting or missing block-out. Every 3 continuous block-outs.

Posts – two or more consecutive posts missing or rotten

Missing posts

Post rot exceeding 50% of cross-section

2.2.10 Deficiency Type: **<u>Cable Barrier</u>**

Deficiency Description: Cable sagging more than 1/3 of post height **or** more than one post knocked down.

2.2.11 Deficiency Type: **<u>Crash Attenuator</u>**

Deficiency Description: Crash attenuator is damaged or missing.

2.2.12 Deficiency Type: **Sign**

- Sign is damaged or faded (it cannot be clearly read).
- Sign is missing, excluding 3 button "no passing zone" indicator post.
- Sign is older than policy age (currently 18 years).

Inspection Limit: All INDOT signs excluding TODS, LOGO, utility marker, and ramp signs.

Multiple element sign: No deficiencies were recorded. A total of 5 multiple element signs were inspected. WEST 22 with the left turn arrow represents one of the multiple element signs. If all 5 of the multiple element signs were significantly faded or could not be clearly read then a deficiency would be recorded.

Sign significantly faded

Damaged sign

Missing sign

Sign older than policy age

2.2.13 Deficiency Type: **Pavement Marking**

Deficiency Description: Excess of 150 feet missing in the segment.

Pavement center line covered in excess of 150 linear feet

Pavement edge line covered in excess of 150 linear feet

2.2.14 Deficiency Type: **Special Marking**

Deficiency Description: A total of one half of all markings are missing 50% of the marking on main line or at signalized approaches, stop bars, or crosswalks.

More than 50% missing/faded

More than 50% missing/faded

APPENDIX D

Deficiency Score Index

Overall Sub*

Description	OPI Score	% Deficient	Index	
Shoulders	1	0.50	1.0 - .50	
	2	0.25	.4999 - .25	Single deficiency fails the segment
	3	0.1501	.2499 - .1501	
	4	0.10	.15 - .10	
	5	0.05	.0999 - .05	
	6	0.0	.0499 - 0.0	
Small Culverts	1	0.50	1.0 - .50	
	2	0.25	.4999 - .25	Single deficiency fails the segment
	3	0.1501	.2499 - .1501	
	4	0.10	.15 - .10	
	5	0.05	.0999 - .05	
	6	0.0	.0499 - 0.0	
Underdrain	1	0.50	1.0 - .50	
	2	0.25	.4999 - .25	Single deficiency fails the segment
	3	0.1501	.2499 - .1501	
	4	0.10	.15 - .10	
	5	0.05	.0999 - .05	
	6	0.0	.0499 - 0.0	
Ditch Obstruction	1	0.50	1.0 - .50	
	2	0.25	.4999 - .25	Single deficiency fails the segment
	3	0.1501	.2499 - .1501	
	4	0.10	.15 - .10	
	5	0.05	.0999 - .05	
	6	0.0	.0499 - 0.0	
Mainline Pavement Cracking or Concrete Pavement Joints	1	0.50	1.0 - .50	
	2	0.25	.4999 - .25	Single deficiency fails the segment
	3	0.1501	.2499 - .1501	
	4	0.10	.15 - .10	
	5	0.05	.0999 - .05	
	6	0.0	.0499 - 0.0	
Paved Shoulder Unsealed Cracks	1	0.50	1.0 - .50	
	2	0.25	.4999 - .25	Single deficiency fails the segment
	3	0.1501	.2499 - .1501	
	4	0.10	.15 - .10	
	5	0.05	.0999 - .05	

Overall Sub*

Description	OPI Score	% Deficient	Index	
	6	0.0	.0499 - 0.0	
Pavement Blowup	1	0.50	1.0 - .50	
	2	0.25	.4999 - .25	Single deficiency fails the segment
	3	0.1501	.2499 - .1501	
	4	0.10	.15 - .10	
	5	0.05	.0999 - .05	
	6	0.0	.0499 - 0.0	
Pavement Pothole	1	0.50	1.0 - .50	
	2	0.25	.4999 - .25	Single deficiency fails the segment
	3	0.1501	.2499 - .1501	
	4	0.10	.15 - .10	
	5	0.05	.0999 - .05	
	6	0.0	.0499 - 0.0	
Pavement Edge Raveling	1	0.50	1.0 - .50	
	2	0.25	.4999 - .25	Single deficiency fails the segment
	3	0.1501	.2499 - .1501	
	4	0.10	.15 - .10	
	5	0.05	.0999 - .05	
	6	0.0	.0499 - 0.0	
Pavement Spalling	1	0.50	1.0 - .50	
	2	0.25	.4999 - .25	Single deficiency fails the segment
	3	0.1501	.2499 - .1501	
	4	0.10	.15 - .10	
	5	0.05	.0999 - .05	
	6	0.0	.0499 - 0.0	
Bridge Drain	1	0.50	1.0 - .50	
	2	0.25	.4999 - .25	Single deficiency fails the segment
	3	0.1501	.2499 - .1501	
	4	0.10	.15 - .10	
	5	0.05	.0999 - .05	
	6	0.0	.0499 - 0.0	
Bridge Joint	1	0.50	1.0 - .50	
	2	0.25	.4999 - .25	Single deficiency fails the segment
	3	0.1501	.2499 - .1501	
	4	0.10	.15 - .10	
	5	0.05	.0999 - .05	
	6	0.0	.0499 - 0.0	
Bridge Patching	1	0.50	1.0 - .50	
	2	0.25	.4999 - .25	Single deficiency fails the segment

Overall Sub*

Description	OPI Score	% Deficient	Index	
	3	0.1501	.2499 - .1501	
	4	0.10	.15 - .10	
	5	0.05	.0999 - .05	
	6	0.0	.0499 - 0.0	
Bridge Bearings	1	0.50	1.0 - .50	
	2	0.25	.4999 - .25	Single deficiency fails the segment
	3	0.1501	.2499 - .1501	
	4	0.10	.15 - .10	
	5	0.05	.0999 - .05	
	6	0.0	.0499 - 0.0	
Guardrail	1	0.50	1.0 - .50	
	2	0.25	.4999 - .25	Single deficiency fails the segment
	3	0.1501	.2499 - .1501	
	4	0.10	.15 - .10	
	5	0.05	.0999 - .05	
	6	0.0	.0499 - 0.0	
Cable Barrier	1	0.50	1.0 - .50	
	2	0.25	.4999 - .25	Single deficiency fails the segment
	3	0.1501	.2499 - .1501	
	4	0.10	.15 - .10	
	5	0.05	.0999 - .05	
	6	0.0	.0499 - 0.0	
Attenuator	1	0.50	1.0 - .50	
	2	0.25	.4999 - .25	Single deficiency fails the segment
	3	0.1501	.2499 - .1501	
	4	0.10	.15 - .10	
	5	0.05	.0999 - .05	
	6	0.0	.0499 - 0.0	
Sign Age	1	0.50	1.0 - .50	
	2	0.25	.4999 - .25	Single deficiency fails the segment
	3	0.1501	.2499 - .1501	
	4	0.10	.15 - .10	
	5	0.05	.0999 - .05	
	6	0.0	.0499 - 0.0	
Sign Deficiency	1	0.50	1.0 - .50	
	2	0.25	.4999 - .25	Single deficiency fails the segment
	3	0.1501	.2499 - .1501	
	4	0.10	.15 - .10	
	5	0.05	.0999 - .05	

Overall Sub*

Description	OPI Score	% Deficient	Index	
	6	0.0	.0499 - 0.0	
Pavement Marking	1	0.50	1.0 - .50	
	2	0.25	.4999 - .25	Single deficiency fails the segment
	3	0.1501	.2499 - .1501	
	4	0.10	.15 - .10	
	5	0.05	.0999 - .05	
	6	0.0	.0499 - 0.0	
Special Marking	1	0.50	1.0 - .50	Total Deficiencies/Total in Segment
	2	0.25	.4999 - .25	>50% failure fails segment
	3	0.1501	.2499 - .1501	
	4	0.10	.15 - .10	
	5	0.05	.0999 - .05	
	6	0.0	.0499 - 0.0	

*Overall Sub is the aggregate of all 160 segments evaluated in the sub.

APPENDIX E

Activity Defect Assignment

Activity	Defect	Pct Applicable
2010-ML - SHALLOW PATCHING (STN - SHORT TON)	pothole, spalling, edge raveling	pothole -.8, spalling -.1, raveling - .1
2010-TL - SHALLOW PATCHING (STN - SHORT TON)	pothole, spalling, edge raveling	pothole -.8, spalling -.1, raveling - .1
2020-ML - DEEP PATCHING (STN - SHORT TON)	blowup, pothole, edge raveling	blowup -.3, pothole -.5, edge raveling - .2
2020-TL - DEEP PATCHING (STN - SHORT TON)	blowup, pothole, edge raveling	blowup -.3, pothole -.5, edge raveling - .2
2030-ML - PREMIX LEVELING (STN - SHORT TON)	blowup, pothole, edge raveling, pavement cracking	blowup - .1, pothole -.4, edge raveling .3, pavement cracking - .2
2030-TL - PREMIX LEVELING (STN - SHORT TON)	blowup, pothole, edge raveling, pavement cracking	blowup - .1, pothole -.4, edge raveling .3, pavement cracking - .2
2040-ML - FULL SHOULDER SEAL (FTM - FEET MILE)	paved shoulder cracking	1
2040-TL - FULL SHOULDER SEAL (FTM - FEET MILE)	paved shoulder cracking	1
2041-ML - SHOULDER FOG SEAL (FTM - FEET MILE)	paved shoulder cracking	1
2041-TL - SHOULDER FOG SEAL (FTM - FEET MILE)	paved shoulder cracking	1
2050-ML - SEAL COATING (LNM - LANE MILE)	pvmt cracking	1
2050-TL - SEAL COATING (LNM - LANE MILE)	pvmt cracking	1
2051-ML - MAINLINE FOG SEAL (LNM - LANE MILE)	pvmt cracking	1
2051-TL - MAINLINE FOG SEAL (LNM - LANE MILE)	pvmt cracking	1
2070-ML - CRACK FILLING (LNM - LANE MILE)	asphalt pavement cracks	1
2070-TL - CRACK FILLING (LNM - LANE MILE)	asphalt pavement cracks	1
2071 – PAVED SHOULDER CRACKING (LNM- LANE MILE	asphalt cracks	1
2090-ML - CRACK SEALING (LNM - LANE MILE)	asphalt pavement cracks or concrete pvmt Joints	1

Activity	Defect	Pct Applicable
2090-TL - CRACK SEALING (LNM - LANE MILE)	asphalt pavement cracks or concrete pvmt joints	1
2100-ML - SPOT REPAIR OF SHOULDERS (STN - SHORT TON)	shoulder drop off	1
2100-TL - SPOT REPAIR OF SHOULDERS (STN - SHORT TON)	shoulder drop off, paved shoulder cracking	shoulder drop off - .8, paved shoulder cracking - .2
2110-ML - BLADING SHOULDERS (SHM - SHLDR MI)	shoulders	1
2110-TL - BLADING SHOULDERS (SHM - SHLDR MI)	shoulders	1
2120-ML - CLIPPING SHOULDERS (SHM - SHLDR MI)	shoulders	1
2120-TL - CLIPPING SHOULDERS (SHM - SHLDR MI)	shoulders	1
2130-ML - RECONDITION SHOULDERS (SHM - SHLDR MI)	shoulder drop off, paved shoulder cracking	shoulder drop off - .8, paved shoulder cracking - .2
2130-TL - RECONDITION SHOULDERS (SHM - SHLDR MI)	shoulder drop off, paved shoulder cracking	shoulder drop off - .8, paved shoulder cracking- .2
2140-ML - JOINT & BUMP REPAIR (BMP - BUMPS)	blowup	1
2140-TL - JOINT & BUMP REPAIR (BMP - BUMPS)	blowup	1
2190-ML - OTHER RDWAY/SHLDR (MHR - WORK HR)		
2190-TL - OTHER RDWAY/SHLDR (MHR - WORK HR)		
2210-ML - MACHINE MOWING (SWM - SWATH MILES)		
2210-TL - MACHINE MOWING (SWM - SWATH MILES)		
2220-ML - BRUSH CUTTING (SQF - SQUARE FT)		
2220-TL - BRUSH CUTTING (SQF - SQUARE FT)		
2230-ML - HERBICIDE SPOT TREATMENT (ACR - ACRE)		
2230-TL - HERBICIDE SPOT TREATMENT (ACR - ACRE)		
2231-ML - HERBICIDE BROADCASTING (ACR - ACRE)		
2231-TL - HERBICIDE BROADCASTING (ACR - ACRE)		
2232-ML - LAWN AND LANDSCAPING (ACR - ACRE)		

Activity	Defect	Pct Applicable
2232-TL - LAWN AND LANDSCAPING (ACR - ACRE)		
2240-ML - BROADCAST SEEDING, FERTILIZING, PLANTING (ACR - ACRE)		
2240-TL - BROADCAST SEEDING, FERTILIZING, PLANTING (ACR - ACRE)		
2241-ML - SPOT SEEDING/FERTILIZING (SQF - SQUARE FT)		
2241-TL - SPOT SEEDING/FERTILIZING (SQF - SQUARE FT)		
2250-ML - TRIM TREE (TRE - TREES)		
2250-TL - TRIM TREE (TRE - TREES)		
2251-ML - TREE REMOVAL (TRE - TREES)		
2251-TL - TREE REMOVAL (TRE - TREES)		
2260-ML - STUMP REMOVAL (STM - STUMPS)		
2260-TL - STUMP REMOVAL (STM - STUMPS)		
2270-ML - MOWING & TRIMMING (SQF - SQUARE FT)		
2270-ML - MOWING & TRIMMING (2010) (LF - LIN FOOT)		
2270-TL - MOWING & TRIMMING (SQF - SQUARE FT)		
2270-TL - MOWING & TRIMMING (2010) (LF - LIN FOOT)		
2280-ML - RIGHT OF WAY FENCE (LF - LIN FOOT)		
2280-TL - RIGHT OF WAY FENCE (LF - LIN FOOT)		
2290-ML - OTHER ROADSIDE MAINT (MHR - WORK HR)		
2290-TL - OTHER ROADSIDE MAINT (MHR - WORK HR)		
2310-ML - CLEAN/RESHAPE DITCH (LF - LIN FOOT)	ditch	1
2310-TL - CLEAN/RESHAPE DITCH (LF - LIN FOOT)	ditch	1
2320-ML - INSPECT SMALL CULVERTS (STR - STRUCTURE)		
2320-TL - INSPECT SMALL CULVERTS (STR - STRUCTURE)		

Activity	Defect	Pct Applicable
2330-ML - PIPE REPLACEMENT (LF - LIN FOOT)	culvert	1
2330-TL - PIPE REPLACEMENT (LF - LIN FOOT)	culvert	1
2338-ML - PIPE LINING (LF - LIN FOOT)	culvert	1
2338-TL - PIPE LINING (LF - LIN FOOT)	culvert	1
2340-ML - MOTOR PATROL DITCH (DMI - DITCH MILE)	ditch	1
2340-TL - MOTOR PATROL DITCH (DMI - DITCH MILE)	ditch	1
2350-ML - CLEAN SMALL CULVERTS (STR - STRUCTURE)	culvert	1
2350-TL - CLEAN SMALL CULVERTS (STR - STRUCTURE)	culvert	1
2360-ML - INSP/CLEAN UNDERDRAINS (STR - STRUCTURE)	underdrain	1
2360-TL - INSP/CLEAN UNDERDRAINS (STR - STRUCTURE)	underdrain	1
2390-ML - OTHER DRAIN MAINTEN (MHR - WORK HR)		
2390-TL - OTHER DRAIN MAINTEN (MHR - WORK HR)		
2410-ML - HAND CLEAN BRIDGES (DCK - DECKS)	bridge drain	1
2410-TL - HAND CLEAN BRIDGES (DCK - DECKS)	bridge drain	1
2440-ML - FLUSHING BRIDGES (BRG - BRIDGES)	bridge drains and bearings	bridge drains - .6 bearings - .4
2440-TL - FLUSHING BRIDGES (BRG - BRIDGES)	bridge drains and bearings	bridge drains - .6 bearings - .4
2450-ML - TEMPORARY PATCH BRIDGE DECKS (SQF - SQUARE FT)	bridge patching	1
2450-TL - TEMPORARY PATCH BRIDGE DECKS (SQF - SQUARE FT)	bridge patching	1
2451-ML - PERMANENT PATCH BRIDGE DECKS (SQF - SQUARE FT)	bridge patching	1
2451-TL - PERMANENT PATCH BRIDGE DECKS (SQF - SQUARE FT)	bridge patching	1
2460-ML - GRAFFITI REMOVAL (MHR - WORK HR)		
2460-TL - GRAFFITI REMOVAL (MHR - WORK HR)		
2490-ML - OTHER BRIDGE MAINTEN (MHR - WORK HR)	bridge joints	1

Activity	Defect	Pct Applicable
2490-TL - OTHER BRIDGE MAINTEN (MHR - WORK HR)	bridge joints	1
2510-ML - NOISE BARRIER MAINTENANCE (MHR - WORK HR)		
2510-TL - NOISE BARRIER MAINTENANCE (MHR - WORK HR)		
2530-ML - CABLE GUARDRAIL REPAIR (LF - LIN FOOT)	cable barrier	1
2530-TL - CABLE GUARDRAIL REPAIR (LF - LIN FOOT)	cable barrier	1
2550-ML - ATTENUATOR REPAIR (UNT - UNITS)	crash attn	1
2550-TL - ATTENUATOR REPAIR (UNT - UNITS)	crash attn	1
2560-ML - RPM CASTING INSP REM (RPM - RPM MILES)		
2560-TL - RPM CASTING INSP REM (RPM - RPM MILES)		
2580-ML - GUARDRAIL MAINTENANCE (LF - LIN FOOT)	guardrail	1
2580-TL - GUARDRAIL MAINTENANCE (LF - LIN FOOT)	guardrail	1
2590-ML - OTHER TRAFF CONTROL (MHR - WORK HR)		
2590-TL - OTHER TRAFF CONTROL (MHR - WORK HR)		
2610 - EMERGENCY MAINTENANCE (MHR - WORK HR)		
2630 - SNOW & ICE REMOVAL (MIL - MILES)		
2640 - WINTER MATERIAL - MIX BRINE (GAL - GALLON (US LIQ))		
2650 - STOCK WINTER MATERIAL (MHR - WORK HR)		
2660 - PATROLLING (MIL - MILES)		
2690 - OTHER WINTER MAINTENANCE (MHR - WORK HR)		
2710 - REST/LFTBRDGE ATTEN (MHR - WORK HR)		
2720 - PRK/RST/WGHT MAINTEN (MHR - WORK HR)		
2750-ML - FULL WIDTH LITTER PU (PM - PASS MI)		
2750-TL - FULL WIDTH LITTER PU (PM -		

Activity	Defect	Pct Applicable
PASS MI)		
2760-ML - SPOT LITTER PICKUP (LB - POUNDS)		
2760-TL - SPOT LITTER PICKUP (LB - POUNDS)		
2770-ML - ROADWAY CLEANING (LMI - LIN MILE)		
2770-TL - ROADWAY CLEANING (LMI - LIN MILE)		
2790-ML - OTHER SERVICE ACTIVITIES (MHR - WORK HR)		
2790-TL - OTHER SERVICE ACTIVITIES (MHR - WORK HR)		
2810 - EQUIPMENT SERVICING (MHR - WORK HR)		
2830 - BLDG & GRND MAINT (MHR - WORK HR)		
2840 - MATRLS HNDLNG/STORNG (MHR - WORK HR)		
2890 - OTHER SUPPORT ACTIVITIES (MHR - WORK HR)		
2900-ML - NOISE BARRIER REPAIR (MHR - WORK HR)		
2900-TL - NOISE BARRIER REPAIR (MHR - WORK HR)		
2991-ML - SURFACE & SHOULDER REPAIR (MHR - WORK HR)		
2991-TL - SURFACE & SHOULDER REPAIR (MHR - WORK HR)		
2992-ML - ROADSIDE IMPROVEMENTS (MHR - WORK HR)		
2992-TL - ROADSIDE IMPROVEMENTS (MHR - WORK HR)		
2993-ML - DRAINAGE IMPROVEMENTS (MHR - WORK HR)		
2993-TL - DRAINAGE IMPROVEMENTS (MHR - WORK HR)		
2994-ML - BRIDGE IMPROVEMENTS (MHR - WORK HR)		
2994-TL - BRIDGE IMPROVEMENTS (MHR - WORK HR)		
7000 - SUPPORT WORK ASSIGNMENTS (MHR - WORK HR)		
8100-ML - SHEET SIGN	sign	1

Activity	Defect	Pct Applicable
MODERNIZATION (SGN - SIGNS)		
8100-TL - SHEET SIGN MODERNIZATION (SGN - SIGNS)	sign	1
8110-ML - SHEET SIGN MAINT (SGN - SIGNS)	sign	1
8110-TL - SHEET SIGN MAINT (SGN - SIGNS)	sign	1
8120-ML - PANEL SIGN MAINTENANCE (SGN - SIGNS)	sign	1
8120-TL - PANEL SIGN MAINTENANCE (SGN - SIGNS)	sign	1
8121-ML - PANEL SIGN OVERLAY (SF - SQ)	sign	1
8121-TL - PANEL SIGN OVERLAY (SF - SQ)	sign	1
8125-ML - PANEL SIGN INSPECTION/MINOR MAINT (SGN - SIGNS)		
8125-TL - PANEL SIGN INSPECTION/MINOR MAINT (SGN - SIGNS)		
8135 - PANEL SIGN FABRICATION (SGN - SIGNS)		
8140-ML - DELINEATION MAINTENANCE PROGRAM (DLN - DELINEATOR)		
8140-TL - DELINEATION MAINTENANCE PROGRAM (DLN - DELINEATOR)		
8150-ML - DETOUR WORK (MHR - WORK HR)		
8150-TL - DETOUR WORK (MHR - WORK HR)		
8200-ML - NEW SIGN INSTALL (SGN - SIGNS)		
8200-TL - NEW SIGN INSTALL (SGN - SIGNS)		
8300-ML - PAINT CENTERLINES (PTM - PAINT MI)	pvmnt markings	1
8300-TL - PAINT CENTERLINES (PTM - PAINT MI)	pvmnt markings	1
8320-ML - PAINT EDGELINES (PTM - PAINT MI)	pvmnt markings	1
8320-TL - PAINT EDGELINES (PTM - PAINT MI)	pvmnt markings	1
8340-ML - RAMP PAINTING (PTM - PAINT	pvmnt markings	1

Activity	Defect	Pct Applicable
MI)		
8340-TL - RAMP PAINTING (PTM - PAINT MI)	pvmnt markings	1
8350-ML - CURB PAINTING (LF - LIN FOOT)		
8350-TL - CURB PAINTING (LF - LIN FOOT)		
8360-ML - SPECIAL MARKING MAINTENANCE (SQF - SQUARE FT)	special markings	1
8360-TL - SPECIAL MARKING MAINTENANCE (SQF - SQUARE FT)	special markings	1
8390-ML - INSPECT/REPLACE REFLECTORS (EA - EACH)		
8390-TL - INSPECT/REPLACE REFLECTORS (EA - EACH)		
8400-ML - NEW SPECIAL MARKING INSTALLATION (SF - SQ)		
8400-TL - NEW SPECIAL MARKING INSTALLATION (SF - SQ)		
8520 - SIGNAL SHOP ACTIVITIES (MHR - WORK HR)		
8535 - EMERGENCY SIG/FLASH INDICATION REPLACEMENT (INDICATIONS)		
8540 - DETECTOR LOOP INSTALL/REPL (LPS - LOOPS)		
8551 - LIGHTING INSPECTION (STR - STRUCTURE)		
8564-ML - UNDERGROUND LIGHTING EQUIP REPAIR / REPLACE (MHR - WORK HR)		
8564-TL - UNDERGROUND LIGHTING EQUIP REPAIR / REPLACE (MHR - WORK HR)		
8581 - SIGNAL OPERATIONS ADMINISTRATION (MHR - WORK HR)		
8610-ML - LIGHTING SURVEILLANCE (FIX - FIXTURE)		
8610-TL - LIGHTING SURVEILLANCE (FIX - FIXTURE)		
8620-ML - LIGHTING REPAIRS (FIX - FIXTURE)		
8620-TL - LIGHTING REPAIRS (FIX - FIXTURE)		
8630-ML - UNDERGROUND LOCATION		

Activity	Defect	Pct Applicable
WORK (MHR - WORK HR)		
8630-TL - UNDERGROUND LOCATION WORK (MHR - WORK HR)		
8920-ML - GATHER FIELD DATA (MHR - WORK HR)		
8920-TL - GATHER FIELD DATA (MHR - WORK HR)		

APPENDIX F

Asset Deficiency Weight Scale

Index Item	Revised Weight Values	MATCH COLUMN	Best Value	Worst Value	Date Update	Groovy Script ID	MMS Util Function
Shoulders	4	IN_MQS_PRCNT_D01	6	1	2/24/2011	LOS_DEFECT_COEF	All above 4 goes to 6
Culvert	6	IN_MQS_PRCNT_D02	6	1	2/24/2011	LOS_DEFECT_COEF	All above 4 goes to 6
Underdrain	12	IN_MQS_PRCNT_D03	6	1	2/24/2011	LOS_DEFECT_COEF	All above 4 goes to 6
Ditch	7	IN_MQS_PRCNT_D04	6	1	2/24/2011	LOS_DEFECT_COEF	All above 4 goes to 6
Shoulder cracking	14						
Blowup	2						
Pothole	1						
Spalling	13						
Pvmnt cracking	3	IN_MQS_PRCNT_D05	6	1	2/24/2011	LOS_DEFECT_COEF	All above 4 goes to 6
Raveling	8	IN_MQS_PRCNT_D06	6	1	2/24/2011	LOS_DEFECT_COEF	All above 4 goes to 6
Bridge drains	15	IN_MQS_PRCNT_D07	6	1	2/24/2011	LOS_DEFECT_COEF	All above 4 goes to 6
Bridge joints	16						
Bridge deck patching	5						
Bridge bearings	17						
Guardrail	10	IN_MQS_PRCNT_D08	6	1	2/24/2011	LOS_DEFECT_COEF	All above 4 goes to 6
Cable barrier	11						
Crash attn	9	IN_MQS_PRCNT_D09	6	1	2/24/2011	LOS_DEFECT_COEF	All above 4 goes to 6
Sign deficiency	18	IN_MQS_PRCNT_D10	6	1	2/24/2011	LOS_DEFECT_COEF	All above 4 goes to 6
Sign age	21						
Pvmnt markings	19	IN_MQS_PRCNT_D11	6	1	2/24/2011	LOS_DEFECT_COEF	All above 4 goes to 6
Special markings	20	IN_MQS_PRCNT_D12	6	1	2/24/2011	LOS_DEFECT_COEF	All above 4 goes to 6
Pavement	25	IN_MQS_PRCNT_RDWY	6	1	2/24/2011	LOS_DEFECT_COEF	All above 4 goes to 6
Traffic	30	IN_MQS_PRCNT_TRAF	6	1	2/24/2011	LOS_DEFECT_COEF	All above 4 goes to 6
Overall		**IN_MQS_PRCNT_OVERALL**	**6**	**1**	**2/24/2011**	**LOS_DEFECT_COEF**	**All above 4 goes to 6**