FINAL REPORT

Florida Maintenance Rating Program (MRP)
Assessment and Enhancement

FDOT Project Number: BD548-28

Submitted to

The Florida Department of Transportation
Research Center
605 Suwannee Street, MS 30
Tallahassee, FL 32399

Timothy Allen
Project Manager
FDOT Maintenance Office

By

Dr. Yasser. Hosni, P.E. and Dr. Ahmed Khalafallah

Center for Advanced Transportation Systems Simulation
University of Central Florida
P.O. Box 162450, Orlando, FL 32816-2450
Phone: (407) 823-5817, Fax: (407) 823-3413, Email: yhosni@mail.ucf.edu

May 28, 2008

Disclaimer

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the State of Florida Department of Transportation

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.

4. Title and Subtitle	5. Report Date
Florida Maintenance Rating Program (MRP) Assessment and Enhancement	May 28, 2008
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
Yasser Hosni, Ahmed Khalafallah,	
9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
University of Central Florida 4440 Central Florida Blvd. Orlando, FL 32816	11. Contract or Grant No. BD548-28
12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

The Maintenance Rating Program (MRP), developed in 1985 by FDOT, is a statewide maintenance system aimed at evaluating the State highway maintenance conditions, and determining FDOT asset maintenance needs. In the quest for continuous improvement and in response to concerns of previous studies, this study evaluates the use of MRP as a measure for Florida highways and roads maintenance needs. The study develops, and documents a method used for assigning weights to the maintenance elements and characteristics. The study examines the statistical and the computational aspects currently used in MRP.

The findings of this study include: (1) the system is based on relatively old technology (mainframe computer), hence it is rigid in its abilities to be used by the State as well as the FDOT districts; (2) the system is limited in its ability to accommodate new road elements, features/ characteristics, modifications to the weights, or changes in the rating computational procedure (True/ false versus rating); and (3) the sampling methodology used in the system does not guarantee proper representation of the evaluated road.

The study concluded that the current MRP sampling mechanism and weights do not adequately address the evaluation of Florida roads and highways. Recommended remedial actions are: (1) develop a new version of Florida MRP system that will adequately address the office of maintenance needs and alleviate current MRP system shortfalls; (2) conduct a study aimed at identifying new road maintenance elements that have become standard features since the initiation of MRP system in 1985; and (3) initiate a number of studies aimed at linking the MRP system rating to the allocation of maintenance budget and resources, streamlining the evaluation procedures of road maintenance and verification of contractors' performance, and investigating the use of new technologies in data collection and inspection processes.

17. Key Word	18. Distribution Statement
Maintenance Rating Program, MRP, Highway Road Maintenance Inspection, Evaluation, FDOT	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
		58	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

Acknowledgements

The authors would like to express their appreciation to the highway maintenance and operations experts who participated in this study. This includes Ddirectors of Operations, maintenance engineers, and traffic operations engineers, in the eight Florida districts as well as consultants and practitioners in the highway maintenance. Without the valuable information provided by the experts, it would have been impossible to carry out this study. The authors would like also to acknowledge the technical and administrative support provided by Mr. Tim Lattner, Director, Office of Maintenance, and Mr. Tim Allen, FDOT Project Manager. Without their support, this study would have never been completed on time. Acknowledgment also goes to our project consultant Mr. George Gilhooley for leveraging his experience in highway maintenance operations and management in support of the study.

Executive Summary

The Maintenance Rating Program (MRP), developed in 1985 by FDOT, is a state wide Maintenance system aimed at assessing the State Highway maintenance conditions, and determine FDOT asset maintenance needs .

The Advisory Memorandum 05f-0006 issued by the inspector general, aimed at reviewing the appropriateness of using the Maintenance Rating Program (MRP) to measure Asset Maintenance, recommended conducting a comprehensive study to determine if the current weights are adequate to address the evaluation methodology used in the MRP and to reevaluate, with the help of district maintenance engineers, the weights assigned to the maintenance elements and characteristics.

Hence, the objectives of this study are to:

(1) Assess, develop, and document the method used for assigning weights to the maintenance elements and characteristics.
(2) Validate the statistical process and the sampling mechanism currently used by FDOT to assess maintenance needs.
(3) Evaluate the use of MRP as a measure for Florida highways and roads maintenance needs.

The methodology used in this study includes, examining the statistical aspects of the sampling mechanism used in the MRP, pooling maintenance experts and engineers input on the facility characteristics weights and the evaluation procedure, and benchmarking against the best practices in road maintenance needs assessment.

The findings included shortfalls of the current MRP system as follows:

(1) The system is based on relatively old technology (mainframe computer), hence it is rigid in its abilities to be used by the State as well as the Florida districts.
(2) The system is limited in its ability to accommodate new road elements, features/ characteristics, modifications to feature weights, or changes in the rating computation (True/ false versus rating).
(3) The sampling methodology used in the system does not guarantee proper representation of the evaluated road. This is mainly due to the high margin of error in calculating the MRP ratings for the cost center and facility type combinations within each district (estimated at 17.7%).

The outcome of the study includes:

(1) Developing and documenting the method used for assigning weights to the maintenance elements and characteristics in the form of questionnaire, analysis, and spreadsheet that can be used periodically to modify weights used in the rating process as technology evolves.
(2) New weight assignments to each of the facility elements, and their associated features.
(3) Devising and testing a new sampling mechanism that will guarantee reliable and accurate road ratings.

The study concluded that the current MRP sampling mechanism and weights do not adequately address the evaluation of Florida roads and highways. The study recommends the following:

1. *Proceed with Phase-2 of this study, with the objective of developing a new version of Florida MRP system that will adequately address the office of maintenance needs; consider Phase-1 study findings and outcomes; and alleviate current MRP system shortfalls.*
2. *Conduct a study aimed at identifying new road maintenance elements that have become standard features since the initiation of MRP system in 1985.*
3. *Initiate a study aimed at linking the MRP system rating to the allocation of maintenance budget and resources.*
4. *Devise a methodology to streamline the evaluation procedures of road maintenance and verification of contractors' performance.*
5. *Investigate the use of new technologies such as high-speed cameras and image analysis in data collection and inspection processes.*

Table of Contents

List of Figures

List of Tables

Florida Maintenance Rating Program (MRP)
Assessment and Enhancement

Chapter One: Introduction

1.1 Background

The Maintenance Rating Program (MRP) is a statewide Maintenance system aimed at assessing the State Highway maintenance condition. MRP is based on a sampling process that rates five primary categories of highway environment three times a year. The items rated are roadway (potholes etc.), roadside (shoulders), vegetation and aesthetics (mowing, litter removal), traffic services (signs, lighting), and drainage (ditches). Each feature or characteristic is rated in the field according to whether it meets a pre-defined condition standard.
An overall maintenance condition is calculated by applying respective element weightings to the individual element ratings, producing one overall MRP rating for for each maintenance area and various combinations of the ratings by maintenance area, district and statewide.
–DOT district combination. A maintenance rating of 80 is considered acceptable. The Department's objective is to ensure that 100 percent of the State Highway System meets the maintenance standard. A complete overview of the MRP system [4] is provided in Appendix 1.

In a recent Advisory Memorandum 05f-0006 issued by the inspector general aimed at reviewing the appropriateness of using the Maintenance Rating Program (MRP) to measure Asset Maintenance contractors' performance and to determine if the MRP adequately addresses Office of Maintenance needs, it was recommended:

(1) To evaluate performance measures and quality control processes to supplement the MRP for Asset Maintenance contracts.
(2) Reevaluate, with the help of District Maintenance Engineers, the weights assigned to the maintenance elements and characteristics.

The purpose of this study is to respond to the advisory recommendation and to recommend updates to the MRP accordingly.

1.2 Objectives of the Project

This study is conducted in two phases:

Phase 1: Assessment of the MRP system as an effective measure of Asset Maintenance contractor performance.

The objective of this phase is to respond to the office of Inspector Advisory Memorandum 05F-0006, titled Maintenance Rating Program, dated March 13, 2006. Specifically this phase aims to:

1. Assess, develop, and document the method used for assigning weights to the maintenance elements and characteristics.
2. Validate the statistical process and the sampling mechanism currently used by FDOT to assess maintenance needs.
3. Evaluate the use of MRP as a measure for Florida highways and roads maintenance needs.

Phase 2: MRP enhancement and its use for Asset Maintenance

The objective of this phase is to enhance the MRP system as a tool for asset maintenance contracts. While the specifics of this phase have not been discussed in details, as it is dependent on the successful completion of phase 1, this phase may include the following:

1. Enhancement of the sampling mechanism through the use of newly developed systems, such as map-based and GPS systems.
2. Introduce additional performance measures to the MRP system for Asset Maintenance contracts.
3. Assess the Asset Maintenance cost efficiency calculations currently used by the FDOT.

This report documents and reports on the findings and outcomes of Phase 1 of the study.

Chapter Two: Literature Review

Florida developed its Maintenance Rating Program (MRP) in 1985, and issued the MRP Handbook [7]. The Handbook contains visual and mechanical evaluation methods used by inspectors in determining the rating of highways in Florida. Though it did not illustrate the computational aspects of the MRP, the handbook served as a solid basis for understanding the method of road evaluation, and later helped inferring how the computational analysis is conducted. The MRP system and its updating(s) served well its intended purpose.

In a paper prepared by members of the Transportation Research Board (TRB) Maintenance and Operations Management Committee in 1999 as part of TRB's Millennium Papers, (later updated in January 2006), to respond to rapid changes in the state of the art and practice in the field of road maintenance and its management [3], Hamilton, and Hyman; recommended that *"Maintenance organizations will no longer be allowed to measure performance solely in terms of budget compliance or units of work performed. The public demands accountability for results and wants assurance that its highway tax dollars are being invested wisely."* Specifically the paper recommended, *"The new paradigm for maintenance management is expected to incorporate performance management and customer service at all organizational levels."*

In February 1999, the PB²Performance Report No. 98-59, Transportation Maintenance Program Meets Standards; Its Accountability System in Need of Strengthening, the Florida Legislature office of Program Policy Analysis and Government Accountability, recommended continuous improvement on the MRP system among other improvement measures [5].

To this end and over the years a number of studies aimed at improving the MRP system have been initiated by FDOT.

In August 1996, Zahn, Wu, and Stein, reported in their final report, *Assessment and Improvement of the Maintenance Rating Program*, FDOT, [6]; on the statistical and computational aspects of MRP system. The report illustrates the basic procedures used in calculating the MRP of all facility types using the current MRP weights.

In July 2003, Smith, Beckemeyer, Bourdon, and Myzie, reported results of their study, *Development And Application Of The Expanded Version Of The Florida Maintenance Rating Program,* [4]; The aim of this study was to evaluate the quality of maintenance on a scale from 1-5 instead of pass/fail evaluation, while the overall rating of facilities lies between 0 and 100. They specified three MRP ratings, one for the features, a second for the element, and another for the overall rating of the facility. This study was conducted on Miami-Dade Expressway.

In August 2006, the FDOT, Office of the Inspector General, issued the Advisory Memorandum 05F-0006, Maintenance Rating Program [1], with the aim of reviewing the appropriateness of using the Maintenance Rating Program (MRP) to measure Asset

Management contractors' performance. The objectives were to determine if the MRP is an appropriate measure to evaluate Asset Management Contractors' performance and to determine if the MRP adequately addresses Office of Maintenance needs. The advisory concluded that the Office of Maintenance did not retain documentation of the MRP development including the method used to assign weights to maintenance elements and characteristics, and without complete documentation to support how the MRP was developed it was unable to make a determination on adequacy of the MRP. It recommended that a comprehensive study should be performed to determine if the current weights are adequate to address the evaluation methodology.

In a review of other states methods of maintenance quality evaluation of different road facilities, Tennessee Department of Transportation proposed a maintenance rating program for the State. The proposal included a pilot project for the analysis of different maintenance activities. The proposed maintenance program divides the roadways into three facility types: Full access controlled highways and interstates, U.S. Routes and all routes on the National Highway System and Non-U.S. Routes and other routes not on the National Highway System. Each facility type was divided into five main elements as follows: Traveled Pavement, Shoulder, Drainage, Traffic Services, and Roadside, which are quite similar to FDOT MRP elements. Each of these elements was broken down to a number of features/characteristics. The features are rated as passing or failing and valued on a scale from 0 to 9. The sampling mechanism is conducted randomly, where each sample represents one tenth of a mile.

Bartlett et al. (2001) conducted a study for determining the appropriate and adequate sample size needed for achieving highly precise results in research analysis [8]. The study utilized Cochran's formulas [9], for determining and adjusting the sample size of the population being investigated.

Ozbek (2007) developed a framework for road maintenance that measures the efficiency of different roadways maintenance processes. The framework is based on score-board approach and accounts for all inputs and outputs of road maintenance methods, and the uncontrollable factors believed to have a major impact on the selection of the appropriate road maintenance strategy. The approach has yet to be proven practically implement-able.

Chapter Three: Research Methodology

The approach used in this study has two folds:

1. Assess the adequacy of the system to evaluate the road maintenance needs by maintenance area (Cost center), district, and Statewide. This was done through the evaluation of the current MRP weights used in the FDOT-MRP system, and the computational method used to determine the rating.
2. Examine the statistical aspects of the current methodology as far as the sampling mechanism, sample size, frequency of sampling, and the statistical confidence of the ratings.

3.1 Assess the Adequacy of the MRP System

3.1.1 MRP Weights Estimation

The methodology adopted for determining the weights used in the computation of the roads MRP was through surveying maintenance experts in Florida districts. A questionnaire was prepared (Appendix 2) and sent to around 40 maintenance experts in Florida. At least three experts from each of the eight Florida districts, as well as practitioners and consultants, were selected for the survey. Pooling experts opinion was recommended in the inspector general report and it is a known method for parameter estimations.

The questionnaire is designed to extract expert estimates to percentage contribution (importance) of road maintenance elements: Roadway, Road Side, Traffic Services, Drainage, and Vegetation and Aesthetics, for each facility type: rural and urban for limited access and arterial roads; in achieving the goals and objectives of maintenance program.

The questionnaire also pools experts' estimates to the weights assigned to each of the 36 features used in the MRP computation. And was a chance to determine experts' input on the Florida maintenance program goals, assessment on the current MRP methodology, the sampling size and frequency.

An attempt was made to measure the relative importance of each of road maintenance elements to enable applying the Analytical Hierarchy Process (AHP); however, the response to the question was poor and could not be incorporated in the study. For each of the questions, provisions were made for the experts to add new objectives, elements, and features.

In the following section, we introduce a brief description of relevant survey questions and their use in the study.

Section I. OBJECTIVES AND THEIR WEIGHTS

Q#1: Provide a percentage value reflecting the relative importance of each of the Road Maintenance Program objectives. Provide additional objectives as necessary.

Safety, protecting public investment, environmental aspects, and minimize expenditure were "loosely" stated as objectives of the MRP in an FDOT document. No ranking or other information are documented. While it is known that safety is the prime objective of MRP, we felt it is important to pool expert opinions on the MRP objectives in their estimate, as well as providing additional objectives they may feel necessary.

SECTION II. ELEMENT WEIGHTS

Q#2: Indicate for every road/ facility type your estimation of the weights that should be assigned to each of the road maintenance elements.
i.e. Indicate as a percentage the contribution of maintaining each of the elements to the achievement of the Maintenance Goals.
For convenience, current percentages for each road facility are provided.

Q#3: Compare the importance of each of the elements to every other element on how important it is to achieve an integrated highway maintenance goal;

This was an optional questions that was meant to measure consistency in the answers. The response for this question was poor. The question was relatively irrelevant due to the large percentage given to Safety as the goal of the MRP. In a more elaborate study with much more conflicting objectives and goals, this question could be relevant.

Section III. FEATURES/ CHARACTERISTICS WEIGHTS

Q#4: a) Provide your own Suggested level of importance of each of the Features/ Characteristics weights for each road category on a scale (0 to 9) where 9 is Extremely important, and 0 is not relevant.

b) Current System uses a pass/ fail inspection for each feature by measuring the feature against a preset level of performance (LOP). It is suggested that some of the features may be more amenable to be evaluated on a scale (Ex: 0 to 5, where 0 means completely failing the LOP, and 5 is meeting or exceeding the LOP.) Mark (X) on the feature, you think its LOP should measured on a scale rather than Pass/ Fail

SECTION IV. THE SAMPLING MECHANISM

In this section, we pool expert opinions on the sample size, the frequency of MRP evaluation, and if sampling should be performed state-wide or district-wide.

SECTION V. OVERALL SYSTEM

The experts are asked to rate the FDOT-MRP system between poor and excellent.

3.1.2 MRP Computation

To enable the analysis, we developed an Excel-based program for computing road ratings from sample data. Program user enters the road type and sample results in the form of pass/ fail for each of the road features. The program computes element ratings as well as the road rating, using weights stored in another sheet of the program. The program uses the same computational procedure outlined in the Overview of the MRP System – Appendix 1.

Figure 1 is a screen shot of the data entry section, and Figure 2 is a screen shot of the elements and road rating section in MRP Excel Program.
Appendix 3 is an applied example for MRP program computation for evaluating a rural arterial road for cost center 59(1) in district 5 using current MRP weights.

District: 5
Cost Center: 1

Facility Type	2	(1= RURAL LIMITED ACCESS; 2= RURAL ARTERIAL; 3= URBAN LIMITED ACCESS; 4= URBAN ARTERIAL)
Road Type	b	(A=Flexible; B= Rigid)

Element	Roadway				24%	Roadside				18%	Traffic Services							27%		Drainage				12%		Veget. & Aesth.					17%	
Feature	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	1	2	3	4	5	6	7
1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	0	1	1	1	1	0	1	1	0	1	1	0	0	1	1	1	1
2	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
4	1	0	1	1	0	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
5	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	0	1	1	0	1	1	1	1	0
6	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1
7	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
8	1	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1
9	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1
10	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	0	1
12	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	o	1	1	1	1	1	1	1
13	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
14	1	0	0	1	1	1	1	0	1	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	0	1	0	1	1	1	1
15	0	1	1	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0
16	1	0	1	1	1	1	0	1	1	1	1	1	1	0	1	0	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	1
17	1	0	1	1	0	0	0	1	1	1	0	1	1	1	1	1	1	1	1	0	0	1	1	1	1	0	1	1	1	1	1	1
18	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	0
19	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
20	0	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
21	1	1	0	1	0	0	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1
22	1	1	1	0	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	1	0	1	1	0
23	1	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1
24	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1
25	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1
26	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	0	1	1
27	1	1	1	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	1	1	1	1	1	1
28	1	1	0	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	0	1	1	0
29	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
30	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
Sum	23	26	25	27	20	24	23	28	25	28	28	29	27	27	30	25	27	26	28	24	25	28	28	25	26	26	25	25	27	29	25	23

Figure 1 Data entry section in MRP Excel Program

OVERALL MRP			
FACILITY TYPE :	RURAL ARTERIAL		
ELEMENT	MRP	Weight	Normalized
Roadway	83.68	24.00%	0.20
Roadside	84.57	18.00%	0.15
Traffic Services	91.58	27.00%	0.25
Drainage	87.16	14.00%	0.12
Vegetation & Aesthetics	86.05	17.00%	0.15
		FACILITY OVERALL MRP	86.86%

Figure 2 Element and Road Ratings Reporting in MRP Excel Program

3.2 Statistical aspects of MRP

3.2.1 Sampling Mechanism

The sampling mechanism used to determine the MRP rating was examined to determine its appropriateness for generating the MRP rating values. The methodology used for validating the sampling mechanism includes checking the current procedure against established scientific sampling procedures. In addition, experts input was solicited about the appropriateness of sample size, frequency, and distribution.

3.2.2 Sample Size

To determine the sample size used in the MRP calculation, the following factors were considered: (1) type of variables (e.g. continuous, dichotomous, or categorical); (2) the acceptable margin of error (in calculating the MRP); and (3) alpha level (the level of acceptable risk that the true margin of error exceeds the acceptable margin of error (Bartlett et al. 2001) [7].
In this regard, Cochran's Formulas (Cochran 1977) [8] are used to determine the appropriate sample size. These formulas utilize parameters of population size, type of data used for sampling, accepted margin of error, and the level of confidence/ risk (1-alpha level) in the analysis.

3.2.3 Frequency of Sampling

Currently, sampling is done 3 times each year. Such was examined both statistically to reflect the facility rating per year, and through pooling maintenance experts opinion. Having expert opinion would reflect the possible constraints such as resources, budget, and time consumed, in performing the sampling with certain frequency.

Chapter Four: Study Findings

4.1. Survey Results and Analysis

There were 23 questionnaires completed by experts (57% response ratio). Questionnaire data and analysis are shown in Appendix 4. Data were verified and examined, and duplicate data and outliers were eliminated. A statistical summary of the questionnaires and the answers to the questions are shown in Tables 4.1 to 4.5.

For questions related to weights, the average, variance, standard deviation, minimum, and maximum were computed. Such were examined and compared with values used in the current MRP computation. Recommended weight values were determined as listed in Tables 4.1 to 4.3.

For frequency questions, Tables 4.4 and 4.5, ratios were computed and actions with the highest ratio or score were recommended. Where there was a score associated with an action, the findings are based on the weighted average.

The details of the survey analysis is in Appendix 4

4.1.1 The Objectives and their weights

Table 4.1 MRP Objective Weights

Objective	Weight
Safety	60
Protecting Public Investment	18
Environmental Aspects	15
Minimize Expenditure	7
Aesthetics	
Determine Work Needs	
Free Flow Movement of Traffic	
Pleasing Experience/Value to Public	
Supporting economic development	
Comfort and Convenience	

Objectives of the MRP system is not included in the MRP computation, however, the elements and feature weights, which are included in the rating, are estimated by experts bearing in mind these goals.
The findings show that experts weigh safety the highest with 60 of a 100 point scale is followed by protecting public investment (18/100), environmental aspects (15/100). and minimize expenditure (7/100).
“Protection of public investment” and “environmental aspects” has higher weights than originally anticipated. Individual experts suggested additional objectives that should be considered in the mission statement of the FDOT office of maintenance.

4.1.2 The Road Elements and their weights

Table 4.2 Element Weights

RURAL			
LIMITED ACCESS		ARTERIAL	
ELEMENT	Weight	ELEMENT	Weight
ROADWAY	20	ROADWAY	20
ROAD SIDE	18	ROAD SIDE	19
TRAFFIC SERVICES	29	TRAFFIC SERVICES	28
DRAINAGE	16	DRAINAGE	17
VEGITATION AND ASTHETICS	17	VEGITATION AND ASTHETICS	16
URBAN			
LIMITED ACCESS		ARTERIAL	
ELEMENT	Weight	ELEMENT	Weight
ROADWAY	20	ROADWAY	20
ROAD SIDE	17	ROAD SIDE	17
TRAFFIC SERVICES	30	TRAFFIC SERVICES	29
DRAINAGE	16	DRAINAGE	17
VEGITATION AND ASTHETICS	17	VEGITATION AND ASTHETICS	17

Table 4.2 shows the weights recommended by the maintenance experts. The main finding with respect to the weights given to the road elements is that the weights assigned for each element do not vary greatly with the type of road (Rural Limited access, Rural Arterial, Urban Limited access, or Urban Arterial). It is also noticed that although the recommended weights are different from the current weights, the ranking of the elements is the same.

4.1.3 The Features and their weights

The new features/ characteristics weights based on the survey results are summarized in Table 4.3.

Table 4.3 New Features/ Characteristics Weights based on the survey results

Roadway	RURAL		URBAN	
	Lim. Access	Arterial	Lim. Access	Arterial
Flexible pothole	9	9	9	9
Flexible edge raveling	5	6	5	5
Flexible shoving	5	6	5	6
Flexible depression/bump	6	6	6	6
Flexible shoulder/turnout	5	6	5	5
Rigid pothole	9	9	9	9
Rigid depression/bump	6	6	6	6
Rigid joint/cracking	7	7	7	6
Rigid shoulder/turnout	5	6	5	5

Drainage	RURAL		URBAN	
	Lim. Access	Arterial	Lim. Access	Arterial
Side/Cross Drain	7	7	7	7
Roadside/Median Ditch	5	5	5	5
Outfall Ditch	6	6	6	6
Inlets	7	8	8	8
Miscellaneous Drainage	5	5	5	6
Roadway Sweeping	5	5	6	6

Roadside	RURAL		URBAN	
	Lim. Access	Arterial	Lim. Access	Arterial
Unpaved shoulder	9	9	9	9
Front slope	6	7	6	7
Slope pavement	6	6	6	6
Sidewalk	0	6	0	7
Fencing	7	6	7	6

Vegetation & Aesthetics	RURAL		URBAN	
	Lim. Access	Arterial	Lim. Access	Arterial
Roadside mowing	7	7	7	7
Slope mowing	6	6	6	6
Landscaping	4	4	5	5
Tree trimming	6	6	7	7
Curb or sidewalk edge	5	5	6	6
Litter removal	4	4	5	5
Turf condition	6	6	6	6
Turf condition	6	6	6	6

Traffic Services	RURAL		URBAN	
	Lim. Access	Arterial	Lim. Access	Arterial
Raised pavement markers	9	9	9	9
Pavement striping	8	8	8	8
Pavement symbols	7	7	7	8
Guardrail	9	9	9	9
Attenuator	9	9	9	9
Signs ≤ 30 ft2	9	9	9	9

Features/ Characteristics MRP Weights

The weights for the roadway features/ characteristics came very close to the current values used in the MRP computation. There was relatively small number of experts who suggested assigning ratings (point scale 0 to 5) for the roadway features.

The weights for the roadside features/ characteristics came very close to the current values used in the MRP computation. Some experts that answered the recommended rating question suggested evaluation through ratings (point scale: 0 to 5) for the roadside features: Unpaved shoulder, and sidewalk, and with a lesser degree for front slope and fencing.

The weights for the traffic services features/ characteristics came very close to the current values used in the MRP computation. Significant number of experts that answered the recommended rating question suggested evaluation through ratings (point scale 0 to 5) for the traffic service features: raised pavement markers and pavement striping.

The weights for the drainage features came very close to the current values used in the MRP computation, Minor difference in two values, and no recommendation for point scale.

The weights for the vegetation & aesthetics features came very close to the current values used in the MRP computation. Significant number of experts that answered the recommended rating question suggested evaluation through ratings (point scale 0 to 5) for the vegetation & aesthetics features: litter removal and turf condition, and to a lesser degree the tree trimming.

4.1.4 The Sampling Mechanism

Table 4.4 Sampling Mechanism Questions

(1) STATE ROADS ARE EVALUATED 3 TIMES A YEAR. IN YOUR OPINION HOW MANY EVALUATIONS SHOULD BE DONE PER YEAR?

# of Evaluations Per Year	Total	Ratio
1	1	5%
2	0	0%
3	14	64%
4	7	32%
	22	100%

Recommended
3

(2) SHOULD SAMPLING BE PERFORMED STATE-WIDE RATHER THAN DISTRICT-WIDE?

Answer	Total	Ratio
YES	2	10.5%
NO	17	89.5%
	19	100%

Recommended
No

(3) IN YOUR OPINION, HOW SHOULD THE SAMPLE SIZE BE?

Number of Samples	Total	Ratio
Should be more than 30	1	5%
Should be 30	1	5%
Should be less than 30	0	0%
Should be proportional to the road length	20	90%
	22	100%

Recommended
Should be proportional

The survey pointed out that 64% of the surveyed maintenance experts feel that evaluating MRP ratings 3 times per year is adequate while 32% of these surveyed experts suggested 4 times a year evaluation.

The surveyed experts were asked if the sampling should be conducted statewide or district-wide for the four facility types. The results indicate that 89.5% of the experts do not agree with this suggestion.

Currently the sample sizes are not proportional to the lengths of strata. This is believed to be a major contributor to the variation in the margin of error among strata.

The current system also does not allow for distributing the samples on the measured object (stratum). This means that the samples could all fall within a limited area or a single road of the stratum leaving the rest of the stratum without sampling. This would not reflect the actual status of the highways within the stratum. Samples should be distributed over strata to guarantee actual depiction of stratum condition. The conducted survey pointed out that 90 % of the surveyed maintenance experts feel that the sample sizes should be proportional to the lengths of facility being sampled.

4.1.5 The Overall System Performance

Table 4.5 Overall System Performance

PLEASE RATE THE ADEQUACY OF MRP SYSTEM FOR ASSESSING FLORIDA HIGHWAY MAINTENANCE NEEDS ON A SCALE FROM 1 TO 5, WHERE 1 IS POOR AND 5 IS EXCELLENT.

Scale	Adequacy Rate	Total	Ratio	W. Average
1	Poor	0	0%	0
2	Average	2	9%	0.17
3	Good	6	26%	0.78
4	Very Good	11	48%	1.91
5	Excellent	3	13%	0.65
		22	96%	3.52

MRP Rating
V. Good

Approximately 35% rated the overall performance of the FDOT-MRP system average to good (2 and 3 on a 5 point scale), while 61% rated the system Very good to excellent (4 and 5 on a 5 point scale).

4.2 Analysis of the Sampling Mechanism

Data for Florida roads and highways are housed and maintained in the Road Characteristics Inventory (RCI) database. In this database, highways are represented by a population of 116890 segments (each segment is 0.1 mile long). This population is partitioned into 93 basic strata; one for each maintenance zone (cost center) and facility type combination. These 93 strata are grouped into 8 districts. MRP rating zones are established based on geography and ratable centerline mileage (i.e., no bridges).

4.2.1 Current Sampling Mechanism

A random sample (without replacement) is taken from each basic stratum. For strata with 10 miles of road or more, 30 road segments are selected. For smaller strata, 30% of the road segments are selected. For the turnpike, 90 segments are selected for each of rural and limited access facility types.

A complete statewide sampling survey is conducted 3 times a year (Jul-Oct, Nov-Feb, and Mar-Jun). Each time period 162 MRP ratings are calculated (93 ratings for basic strata; and 69 ratings for facility-type-wide and cost-center-wide in each district, facility-type-wide for the state, and statewide). The latter 69 levels are obtained by aggregating data over a number of basic strata. The results of these periods are aggregated to produce the annual report.

4.2.2 Sample Size and Error Analysis

The appropriateness of sample size is checked for (1) cost center and facility type combinations; (2) facility-type-wide for each district; (3) cost-center-wide for districts; (4) district wide; (5) facility-type-wide for the state; and (6) the State. This is accomplished by Cochran's Formula for categorical and dichotomous data (Cochran 1977):

$$n_0 = (t)^2 \times (p)\,(q) / (d^2) \qquad (1)$$

Where:

- n_0 = sample size;
- t = t-value for selected alpha level;
- (p) (q) = estimate of variance; and
- d = acceptable margin of error.

If the sample size (n_0) is > 5% the following correction formula is used.

$$n_1 = (n_0) / (1 + n_0/\text{Population}) \qquad (2)$$

Where: n_1 = corrected sample size.

In checking the appropriateness of sample sizes, the following assumptions are made:

- Variance (pq) = 0.25 (dichotomous data).
- The alpha level is 0.05 (recommended for most studies). The t-value for this alpha level is 1.96.

Employing the data used in the FDOT study upon which sample sizes were determined [6], the margins of error are calculated for each of the following:

1. Cost center and facility type combinations
2. Facility-type-wide in districts
3. Cost-center-wide in districts
4. District
5. Facility-type-wide in the State
6. The State of Florida

Findings and analysis are as follows:

4.2.2.1 Cost center and facility type combinations

The margins of error of current MRP sampling mechanism for cost center and facility type combinations range between 15.8% and 23.8%, except for the turnpike. The turnpike has a margin of error of 10.33% for Facility Type 1 and 9.6% for Facility Type 3. The highest margin of error (23.8%) is for Facility Type 3 of cost center 691, District 6. The majority of margins of error are around 17%. This means that the range for the actual MRP ratings is (MRP +/- 17) for these combinations. Appendix 5, Table A5.1 provides the calculations of these margins of error.

It is important to note that these margins of error are considered very high especially when contractors are awarded contracts to raise the MRP 5 to 15 points as this is considered within the margin of error of calculation. As such, the research team believes that using the current sample sizes is not considered appropriate for calculating this category of MRP ratings. A new methodology for sampling is suggested in Chapter 5 of this report.

4.2.2.2 Facility-type-wide calculations in districts

The majority of the margins of error range are within 10%. The exceptions are: Facility Type 1 in District 6 (23.8%); Facility Type 3 in District 2 (17.3%); and Facility Type 3 in District 3 (16.1%). The new sampling methodology suggested in Chapter 5 would address these deficiencies. Calculations of these margins of error are provided in Appendix 5, Table A5.2.

4.2.2.3 Cost-center-wide calculations in districts

The margins of error range between 7.1% and 12.7%. The Turnpike has the least margins of error (7.1%). The highest margin of error (12.7%) is for cost centers 296 in District 2, 391 in District 3, and 595 in District 5. Calculations of these margins of error are provided in Appendix 5, Table A5.3.

4.2.2.4 MRP Error margins by, district, Facility within State, and the State

The margins of error by district range between 4.2% (Districts 2 and 5) and 7.1% (Turnpike). Calculations of these margins of error are provided in Appendix 5, Table A5.4.

The margins of error by facility type in the state range between 3.3% (Facility Type 4) and 4.7% (Facility Type 3). These margins of error are acceptable. Calculations of these margins of error are provided in Appendix 5, Table A5.5.

The margin of error for the state of Florida is estimated to be 1.8%. This is an acceptable margin of error. Calculations of these margins of error are provided in Appendix 5, Table A5.5.

5.1 On additional objectives, elements, and features

The experts' responses regarding the objectives of the MRP system was relatively constructive. Despite the stated goals of safety, protection of public investment, environmental impacts, and cost optimization; were considered inclusive, the additional goals of determine work needs, free flow movement of traffic, and supporting economic development suggested by the experts are believed equally important. These objectives may be added in subsequent studies of MRP as they affect the selection of the elements, the features and their associated weights.

Despite that there were no additional elements and features that were suggested by the maintenance experts, it is believed that the experts may felt that the study is meant to assess the weights of the elements and features in the current MRP.

The advisory memorandum 05F-0006 issued by the office of Inspector General and titled Maintenance Rating Program stated that "Since the development of MRP in 1985, there have been significant improvements in technology that have affected the durability of the roadway surface and other maintenance elements which necessitate the need for reevaluation of the MRP."
The authors of this report concur with the advisory memorandum. Time may have come to examine road features that may currently be evaluated and maintained by specialized FDOT maintenance units. Florida roads have been enhanced since 1985 with elements that were experimental at one point, however, now they may be standards. The Intelligent Transportation Systems (ITS), with all its variants and features should be included in the MRP. Adding new technology elements and features may warrant updating the MRP manual and training inspectors on its evaluation. FDOT may initiate a study to identify elements and features that may be added to the MRP.

5.2 On the MRP Weights

The new recommended element weights came close to the current element weights. In addition, there was no significant differences in element weights between the four road types. The following table summarizes the ranges of the weights elements for the current as well as the recommended weight values:

Table 5.1 Element weights Ranges – Current and New

ELEMENT	Current Ranges	Recommended Ranges
ROADWAY	24 - 25	20
ROAD SIDE	13 - 18	17 - 19
TRAFFIC SERVICES	27 - 30	28 - 30
DRAINAGE	13 - 15	16 - 17
VEGITATION AND ASTHETICS	17 - 19	16 - 17

The weight given to the Roadway was consistently less than the current values, while the roadside weight and the drainage weight was higher than the current.
It is therefore advisable to use the recommended element weights of this study in the MRP computation.

The feature weights for each of the elements vary from the current used values, however in general by not much. It was recommended to use point evaluation on a scale between 0 and 5 (0: Poor, 5: Excellent) for the following features:

Table 5.2 Features Recommended for Scale Rating by Maintenance Experts

Element	Feature
Traffic Services	Raised pavement markers
	Pavement striping
Vegetation & Aesthetic	Tree trimming
	Curb or sidewalk edge
	Litter removal
	Turf condition

If FDOT decides to adopt these findings in the MRP computation, both the MRP manual and the MRP computation will have to be updated to reflect these findings.

5.3 On the MRP Computation

A comparative study was performed using simulated sampling evaluation. The study was meant to compare the MRP values using current MRP weights vs. recommended weights. The study covers the four road categories (Rural Limited Access, Rural Arterial, Urban Limited Access, and Urban Arterial), using sample sizes of 30 and 15. Table 5.3 summarizes the results of the study.

Table 5.3 Comparative Simulation Study Results

Record#	Road Category	Road Type	MRP		Difference
			Current Weights	Recommended Weights	
1	Rural Limited Access	Flexible	82.35	82.28	0.07
2			85.31	85.23	0.08
3			53.23	53.15	0.08
4			65.54	65.48	0.06
5			70.2	70.16	0.04
6		Rigid	70.64	70.6	0.04
7			74.92	74.87	0.05
8			80.9	80.87	0.03
9			88.15	88.13	0.02
10			91.08	91.07	0.01
11	Rural Arterial	Flexible	82.36	82.23	0.13
12			85.22	85.09	0.13
13			53.7	53.48	0.22
14			65.8	65.54	0.26
15			70.54	70.37	0.17
16		Rigid	70.19	70.05	0.14
17			74.81	74.69	0.12
18			80.71	80.65	0.06
19			88.3	88.22	0.08
20			91.31	91.25	0.06
21	Urban Limited Access	Flexible	82.19	82.14	0.05
22			85.29	85.23	0.06
23			53.07	53.14	(0.07)
24			65.37	65.45	(0.08)
25			70.06	70.15	(0.09)
26		Rigid	70.49	70.59	(0.10)
27			74.74	74.8	(0.06)
28			80.81	80.82	(0.01)
29			88.04	88.13	(0.09)
30			90.96	91.07	(0.11)
31	Urban Arterial	Flexible	82.02	82.19	(0.17)
32			85.01	85.16	(0.15)
33			53.86	53.77	0.09
34			65.67	65.59	0.08
35			70.46	70.41	0.05
36		Rigid	74.69	74.68	0.01
37			80.61	80.62	(0.01)
38			88.18	88.21	(0.03)
39			91.21	91.26	(0.05)

Examining the differences between the rating values for the current and the new weights show that the MRP model is not sensitive to the variability in the weights. The reason for this insensitivity is the pass/ fail methodology used in the MRP computation. To realize sensitivity using the current MRP methodology, it would require large number

of inspections by additional inspectors (a constraint for FDOT). The other alternative is to change the rating methodology from using pass/ fail where the total feature weight is "added" or "not added" to the rating based on a scale. i.e. inspectors would rate each factor on a scale from 0 to 5. A proportion of the weight is "added" or "not added" to the score based on the rating. [Ex: feature of maximum weight 9, being rated as 3 out of 5, would be allocated (3/5)*9 = 5.4 for this feature]. This will require experienced inspectors, revision of MRP manual, as well as MRP computational methodology.

5.4 On the sampling Mechanism

From the findings reported in section 4.2, the average margin of error is almost 18%. To obtain an acceptable margin of error of 10% or less, the sample size for calculating MRP ratings should increase.

In addition, the surveyed experts recommend that the sample sizes should be changed to be proportion to the lengths of strata and should be distributed over the highway segments within strata. This recommendation is supported by the evidence of high margins of error for calculating the MRP ratings for the combination of cost-center and facility-type strata.

The investigators of this research developed a methodology to resolve this problem and limit the margin of error to a maximum of 10%.

The new suggested sample sizes for various districts and cost centers, using the roads and highway data originally used in FSU study [8], are provided in Table 5.4

Table 5.4 Suggested sample sizes by Cost Center

Dist.	Cost Center	Facility Type	Miles	Pop.	10% Error		Dist.	Cost Center	Facility Type	Miles	Pop.	10% Error	
					Annual	Every 4 Mos						Annual	Every 4 Mos
D1	190	1	31.8	318	74	25	D4	490	1	69.6	696	84	28
		2	314	3140	96	32			2	205.6	2056	96	32
		3	0	-		0			3	0	-		0
		4	320.6	3206	96	32			4	96.5	965	87	29
	192	1	115.3	1153	89	30		491	1	44.7	447	79	26
		2	280.2	2802	96	32			2	87.8	878	87	29
		3	0	-		0			3	33.7	337	75	25
		4	234.6	2346	96	32			4	225.3	2253	96	32
	194	1	68	680	84	28		492	1	0	-		0
		2	281	2810	96	32			2	166.3	1663	91	30
		3	0	-		0			3	47.9	479	80	27
		4	180.2	1802	91	30			4	214	2140	96	32
D2	291	1	34.9	349	75	25	D5	590	1	93.2	932	87	29
		2	204.4	2044	96	32			2	103.3	1033	88	29
		3	0	-		0			3	0	-		0
		4	124.7	1247	89	30			4	174.8	1748	91	30
	292	1	133.4	1334	90	30		591	1	91	910	87	29
		2	342.4	3424	96	32			2	263.3	2633	96	32
		3	0	-		0			3	0	-		0
		4	82.5	825	86	29			4	102.3	1023	88	29
	293	1	32.4	324	74	25		592	1	28	280	72	24
		2	258.9	2589	96	32			2	239.1	2391	96	32
		3	0	-		0			3	0	-		0
		4	18.2	182	63	21			4	58.8	588	83	28
	294	1	76	760	85	28		593	1	0	-		0
		2	260.2	2602	96	32			2	24.2	242	69	23
		3	54.3	543	82	27			3	27.1	271	71	24
		4	256.9	2569	96	32			4	116.7	1167	89	30
	296	1	0	-		0		594	1	50.8	508	81	27
		2	271.1	2711	96	32			2	118.3	1183	89	30
		3	0	-		0			3	48	480	80	27
		4	17.8	178	62	21			4	121.1	1211	89	30
	297	1	34.6	346	75	25		595	1	38	380		0
		2	242.8	2428	96	32			2	144.5	1445	90	30
		3	0	-		0			3	0	-		0
		4	41.8	418	78	26			4	56.5	565	82	27

Cont. Table 5.4 Suggested sample sizes by Cost Center

Dist.	Cost Center	Facility Type	Miles	Pop.	10% Error	
					Annual	Every 4 Mos
D3	390	1	51.4	514	81	27
		2	272.5	2725	96	32
		3	0	-		0
		4	72.8	728	85	28
	391	1	0	-		0
		2	249.7	2497	96	32
		3	0	-	96	32
		4	108	1080	88	29
	392	1	72.6	726	85	28
		2	489.2	4892	96	32
		3	0	-		0
		4	110.3	1103	88	29
	393	1	64.1	641	84	28
		2	328.3	3283	96	32
		3	0	-		0
		4	61.8	618	83	28
	395	1	29.1	291	72	24
		2	248.6	2486	96	32
		3	15.5	155	59	20
		4	146.4	1464	90	30

Suggested Sample Size for 10% Margin of Errors

Dist.	Cost Center	Facility Type	Miles	Pop.	10% Error	
					Annual	Every 4 Mos
D6	690	1	0	-		0
		2	88.3	883	87	29
		3	39.3	393	77	26
		4	178.9	1789	91	30
	691	1	4.3	43	30	10
		2	6.1	61	37	12
		3	31.3	313	73	24
		4	162.2	1622	91	30
	692	1	0	-		0
		2	81.7	817	86	29
		3	0	-		0
		4	18.1	181	63	21
D7	796	1	64.4	644	84	28
		2	122.3	1223	89	30
		3	31.4	314	74	25
		4	180.8	1808	91	30
	797	1	31.9	319	74	25
		2	226.4	2264	96	32
		3	0	-		0
		4	109.6	1096	88	29
	798	1	17.4	174	62	21
		2	14.7	147	58	19
		3	22	220	67	22
		4	163.4	1634	91	30
D8	853	1	268.6	2686	96	32
		2	0	-		0
		3	68.6	686	84	28
		4	0	-		0
Total # of Samples					**7828**	**2609**

The suggested sample sizes are calculated assuming an annual sampling, collection, and evaluation of the MRP ratings. Generating these samples annually would guarantee the elimination of any double sampling of a segment (true sampling without replacement). The sample size for every period of evaluation is one third of the sample size for the annual evaluation. This would guarantee an appropriate sample size for a more precise calculation of the annual ratings.

A comparison for the number of samples per year on a State level for the current methodology and the new methodology reveals a reduction from 8550 samples to 7828 sample per year. A reduction of 722 sample annually.

Hence, the devised methodology decreases the margins of error without increasing the resources and budget for FDOT, generate samples proportional to the road length, and since its samples are generated on a yearly bases, it insures an even distribution of samples along all segments of the road. An additional measure could be added to the methodology to insure non-selection of samples with close proximity to each other.

It is thus recommended to use this sampling methodology in the FDOT-MRP sampling mechanism to realize the benefits cited above.

5.5 Other Observations

5.5.1 On Setting Road Standards

Current FDOT-MRP system considers an MRP value of 80 and above acceptable. There is no documented procedure on how this value was determined. Such value most likely was determined through an ad-hoc procedure without justification. It is thus suggested that such value be determined through a scientific study. Moreover, that this standard value is revised periodically to reflect the level of maintenance needed to satisfy the maintenance program goals and objectives.

5.5.2 On The Use Of Contractors in Collecting Data

Current procedure relays on maintenance contractors to collect sample data, especially after performing maintenance operations. This is a weak point in the MRP.
To guarantee the integrity of the rating process, FDOT inspectors or consultants should conduct sampling, evaluation, and rating. A complete separation between maintenance contractors and the evaluation process is strongly recommended.

5.5.3 On The Use of Technology for Data Collection

The cost of resources needed for collecting samples and analyzing data could be reduced by investigating the use of automated data collection technologies (e.g. GPS, high speed imaging, and others). The technology in data collection has advanced in the last few years that warrant investigating its use in road rating and maintenance operations.

5.5.4 On Linking the MRP to the Maintenance Budget

There is valuable information that is gathered during the inspection process. It is not clear how this information is used in the allocation of maintenance resources and budget. It may be useful, and contribute to the MRP goal of “protecting public investment”, to qualify the MRP rating with *identification and quantification* of contributing elements and features to a lower or higher rating. Such can be translated to maintenance needs. This will require setting up a level of performance (LOP) associated with each element for each facility type and compare it with the MRP score of the evaluated element. This then would be used to identify features/ characteristics that can be translated into “maintenance needs” on the element and feature level.

The current MRP system is not fully connected to budgeting and allocation of budget and resources such as inspectors. These are among the most important factors that affect the sampling frequency and the sample size.
FDOT should consider linking the MRP to the budget and resource allocation system(s). This should answer to the concern raised by the advisory memorandum 05F-0006 by the Inspector General related to this issue.

Chapter Six: Conclusions and Recommendations

6.1 Conclusions

In this study, a thorough evaluation of the MRP system was conducted. The system was examined statically, computationally and operationally. We developed, documented, and applied a methodology for weight estimation used in the MRP system. New weights were established through surveying the maintenance experts in the state. The new weights were applied and MRP values were compared with the current values.

The study concluded that there are serious limitations associated with the current version of Florida MRP that hinder the ability of the system to adequately evaluate the Florida highway maintenance needs. The limitations spans over the sampling process, the weights, the evaluation methodology of MRP, and the system operation and inflexibility.

Remedial solutions are suggested and experimented with during the study. The solutions, if implemented, could alleviate the shortfalls in the system in a new version of MRP that we are recommending in the next section.

Due to the dynamic nature of highway construction and technological advances in highway construction, maintenance, and operations, the study concluded that periodic updating of the MRP system is warranted.

Realizing the limitation in resources, such as inspectors and budget, and the dependency of successful maintenance operations on accurate evaluation/ rating and adequate resource and budget allocation, the study recommends initiating a number of studies and investigations aimed at linking the MRP system to the maintenance budge, and investigating supporting the inspection process through automated data collection technology.

6.2 Recommendations

The recommendations of this study are:

1. Develop a new version of Florida MRP system. The system will adequately address the FDOT office of Maintenance needs, and will have the following characteristics:
    1. PC- Windows- Based system, that can be used both on State, and district levels through a user-friendly interaction.
    2. Open ended that can accommodate new road elements, features/ characteristics
    3. A modified sampling mechanism that will insure accurate assessment of road conditions while maintaining the simplicity of the current system and considering the availability of resources (sampling: frequency, location, size, and spread-ness)
    4. Include the outcome of this study regarding:
        i. The recommended MRP weights
        ii. Changes in the features/ characteristics evaluation methodology of some features from pass/ fail to a grading methodology (0 to 5 scale)
        iii. Showing the maintenance needs on the element level by comparing it to the element level of performance (LOP), and highlighting the deficiencies.
        iv. Initiate a study aimed at identifying new road maintenance elements that has become standard features since the initiation of MRP system in 1985.

2. Conduct a study aimed at linking the MRP system rating to the allocation of maintenance budget and resources.

3. Devise a methodology to streamline the evaluation procedures of road maintenance and verification of contractors' performance.

4. Investigate the use of new technologies such as high speed cameras and image analysis in data collection and inspection process.

References

1. FDOT, Office Of The Inspector General, Cecil T. Bragg, Jr. Advisory Memorandum 05f-0006, Maintenance Rating Program, August 25, 2006
2. FDOT, Maintenance Office, Maintenance Rating Program, Topic No.: 850-065-002-J, June 19, 2002
3. Transportation Research Board Maintenance And Operations Management Committee, Maintenance And Operations Of Transportation Facilities, 2005 Strategic Vision, Transportation Research Circular E-C092, ISSN 0097-8515, , Original Paper Written In 1999 As Part Of TRB's Millennium Papers By Ronald B. Hamilton, Roy Jorgensen Associates, Inc. William A. Hyman, Booz–Allen & Hamilton, Updated In 2005, and published in January 2006 , www.trb.org
4. Kelly L. Smith, Curt A. Beckemeyer, Robert Bourdon, And David Myzie, Development And Application Of The Expanded Version Of The Florida Maintenance Rating Program, Transportation Research E-Circular, Number E-C052, July 2003, ISSN 0097-8515
5. PB²Performance Report No. 98-59, Transportation Maintenance Program Meets Standards; Its Accountability System in Need of Strengthening, Office of Program Policy Analysis and Government Accountability an office of the Florida Legislature, February 1999
6. Douglas Zahn, Shau-Ming Wu, Jeff Stein, Final Report, Assessment and Improvement of the Maintenance Rating Program, FDOT., August 1996.
7. Florida Department of Transportation (FDOT), 2006. "Florida Department of Transportation Maintenance Rating Program Handbook: Data Collection for Maintenance Rating Program." Florida Department of Transportation, Tallahassee, Fl.
8. Bartlett, J. E., II, Kotrlik, J. W., & Higgins, C. (2001). "Organizational research: Determining appropriate sample size for survey research." Information Technology, Learning, and Performance Journal, 19(1) 43-50.
9. Cochran, W G (1977). Sampling Techniques (3rd ed.), John Wiley & Sons, ISBN 0-471-16240-X
10. Ozbek, Mehmet, (2007) "Development of a Comprehensive Framework for the efficiency Measurement of Road Maintenance using Data Envelopment Analysis", Ph.D. Dissertation in Civil Engineering, Virginia Polytechnic Institute and State University.

Appendices

Appendix 1: Overview of the MRP System
Appendix 2: Expert Questionnaire
Appendix 3: Applied Example for MRP Program Computation
Appendix 4: Questionnaire Data and Analysis
Appendix 5: Sampling Analysis

Appendix 1: Overview of the MRP System

OVERVIEW OF FLORIDA MAINTENANCE RATING PROGRAM

The Florida MRP system consists of a quantifiable process to determine the levels of service (LOS) of various maintenance activities performed on any of five highway facility types—rural limited access, rural arterial, urban limited access, urban arterial, and special facilities. Three times each year, a random number generator program is used to select 0.1-mile (0.16 km) sections on each of the facility types contained within a maintenance unit (Cost Center). The number of samples required for the population (centerline miles) involved is determined using statistical formulas designed to provide accuracy within 3 percent at a confidence level of 95 percent.

The quality of maintenance is evaluated by two-person teams in each of eight districts. Assessments are made using pass–fail ratings that indicate conformance or nonconformance with established agency-wide LOS criteria, which in turn is reflective of long-term, end-result performance.

Maintenance Elements

The Florida MRP is divided into five asset groups or maintenance elements, which represent portions of the highway system that serve similar functions (*3*). The five maintenance elements are as follows:

- Roadway,
- Roadside,
- Traffic Services,
- Drainage, and
- Vegetation and Aesthetics.

Maintenance Features and Characteristics

Each maintenance element is comprised of multiple maintenance features and characteristics that represent specific maintainable items. The features and characteristics evaluated in the Florida MRP are as follows (*3*):

- Roadway
  Flexible pothole, Flexible edge raveling, Flexible shoving, Flexible depression/bump, Flexible shoulder/turnout, Rigid pothole, Rigid depression/bump, Rigid joint/cracking, Rigid shoulder/turnout
- Roadside
  Unpaved shoulder, Front slope, Slope pavement, Sidewalk, Fencing
- Traffic services
  Raised pavement markers, Pavement striping, Pavement symbols, Guardrail, Attenuator, Signs δ 30 ft^2, Signs > 30 ft^2, Object markers/ delineators, Lighting
- Drainage
  Side or cross drain, Roadside or median ditch, Outfall ditch, Inlets, Miscellaneous drainage structure, Roadway sweeping
- Vegetation and aesthetics
  Roadside mowing, Slope mowing, Landscaping, Tree trimming, Curb or sidewalk edge, Litter removal, Turf condition

Each feature or characteristic is rated in the field according to whether it meets a pre-defined condition standard.

Development and Reporting of MRP Ratings

The pass–fail ratings collected in the field from multiple 0.1-mile sample segments are used with level-of-importance weighting factors to develop LOS ratings for individual facility type–DOT district combinations. The weighting factors include feature and characteristic weightings (0-to-10 scale) that reflect how important each feature or characteristic in a maintenance element is to that element, and element weightings (0-to-100 percent scale) that reflect how important each element is to the overall system.

The starting point in the MRP calculation process is identifying, for each feature or characteristic, the percentage of sample segments in which the feature or characteristic met the predefined condition standard. Applying the respective feature or characteristic weightings to these percentages results in individual MRP element ratings for the chosen facility type–DOT district combination. Applying the respective element weightings to the individual element ratings produces one overall MRP rating for the facility type–DOT district combination.

Using the centerline mileage associated with each facility type in a DOT district, an overall MRP rating for the district is computed. Similarly, by using the centerline mileage associated with each facility type for all DOT districts, an overall MRP rating for the entire state is computed.

The completed MRP results are summarized for distribution to all levels of management.

The results, which are shown on a 0-to-100 scale (with 80 and above being considered acceptable), are then used to identify areas (features and characteristics, elements, roadways) that may need additional funding to return to the desired level of compliance.

UNIVERSITY OF CENTRAL FLORIDA

FLORIDA MAINTENANCE RATING PROGRAM (MRP)
ASSESSMENT AND ENHANCEMENT
PHASE I

FDOT#: BD548-28

EXPERT'S OPINION QUESTIONNAIRE

ON

MRP STUDY

Thank you for your cooperation, please provide your contact information:

Name: _____
Position: _____
Phone: _____
e-mail: _____

Please send your response to the questionnaire by e-mail – preferred - to:

MRP-FDOT@cecs.ucf.edu

Or by regular mail to:

Dr. Yasser Hosni
UCF-CATSS
4000 Central Florida Blvd.
Orlando, FL 32816
Tel: (407) 823-5817
Fax: (407) 823-3413
E-mail: yhosni@mail.ucf.edu

Dear Highway Maintenance Expert,

You have been selected to participate in the effort to devise a more robust Maintenance Rating Program (MRP) for the State of Florida. The Current Florida Department of Transportation (FDOT) Highway maintenance program goals include safety, protection of public investment, environmental impacts, and cost optimization. To achieve its goals FDOT uses the ***Maintenance Rating Program*** (MRP) to assess the State Highway conditions.

MRP is based on a sampling process that rates four primary categories of highways three times a year. The four road categories are: Rural Limited Access, Rural Arterial, Urban Limited access, and Urban Arterial. Elements rated for each road category are Roadway (ex.: potholes etc.), Roadside (ex.: shoulders), Traffic Services (ex.: signs, lighting), Drainage (ex.: ditches), and Vegetation and Aesthetics (ex.: mowing, litter removal). Each feature or characteristic is rated in the field according to whether it meets a pre-defined Level of Performance (LOP).

An overall maintenance condition is calculated by applying respective ***element weightings*** to the individual element ratings, producing one overall MRP rating for the facility type (rural and urban arterial highways, rural and urban limited access highways). A maintenance rating of 80 is considered acceptable. The Department's objective is to ensure that 100 percent of the State Highway System meets the maintenance standard. A complete overview of the MRP system is provided in http://www.dot.state.fl.us/statemaintenanceoffice/mrp.htm.

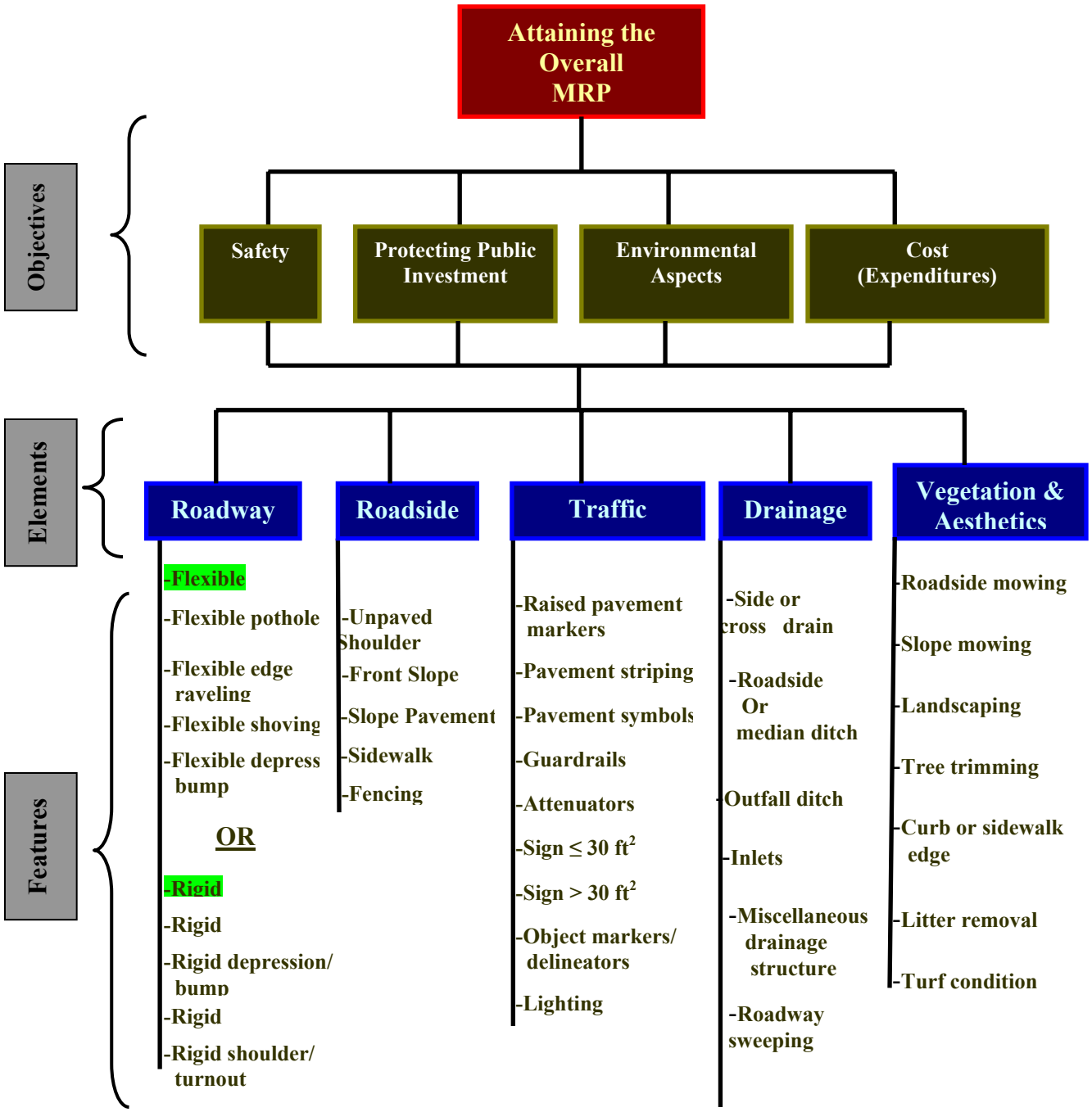
Researchers from the University of Central Florida (UCF) are tasked with devising a more robust MRP. Specifically, UCF researchers are to **develop and document a methodology to determine the element "weights" used in computing the MRP for a road facility.**

This questionnaire is meant to solicit your opinion and evaluation of the following:

I. Additional Objectives for Road Maintenance Program, and the relative importance of each.
II. Additional Maintenance Elements and their respective weights used in the rating system.
III. Additional Features/ Characteristics that should be examined and their contribution to the road Elements.
IV. Sampling Mechanism.
V. Overall Evaluation

The procedure involves pair-wise comparisons between different elements of the system at different levels for every road category.

The following diagram illustrates the structure of the Maintenance Rating Program.


Attaining the Overall MRP
Objectives
Safety
Protecting Public Investment
Environmental Aspects
Cost (Expenditures)
Elements
Roadway
Roadside
Traffic
Drainage
Vegetation & Aesthetics
Features
-Flexible
-Flexible pothole
-Flexible edge raveling
-Flexible shoving
-Flexible depress bump
OR
-Rigid
-Rigid
-Rigid depression/ bump
-Rigid
-Rigid shoulder/ turnout
-Unpaved Shoulder
-Front Slope
-Slope Pavement
-Sidewalk
-Fencing
-Raised pavement markers
-Pavement striping
-Pavement symbols
-Guardrails
-Attenuators
-Sign ≤ 30 ft²
-Sign > 30 ft²
-Object markers/ delineators
-Lighting
-Side or cross drain
-Roadside Or median ditch
-Outfall ditch
-Inlets
-Miscellaneous drainage structure
-Roadway sweeping
-Roadside mowing
-Slope mowing
-Landscaping
-Tree trimming
-Curb or sidewalk edge
-Litter removal
-Turf condition

I. OBJECTIVES AND THEIR WEIGHTS

In the following table provide a percentage value reflecting the relative importance of each of the objectives. Provide any additional objectives that you feel should be included in the objectives

Obj#	Objective	Current Relative Importance Percentage (1)	Your Relative Importance Percentage
1	Safety	70	
2	Protecting Public Investment	10	
3	Environmental Aspects	10	
4	Minimize Expenditure	10	
5			
6			
	TOTALS	100	100

(1) Our assessment on Current Relative Importance
(2) Additional Space for comments (Obj#, Comments)

II. ELEMENT WEIGHTS

Part 1:

In the following table, please provide any additional elements that you think should be added as a road element to be assessed for maintenance. Current Road Elements that are being assessed are Roadway, Road Side, Traffic Services, Drainage, and Vegetation and Aesthetics.

Rational: Over the last decade there have been considerable advances in roads and highways management. Some of these advances may rely on features and elements that need to be maintained.

Element#	Element
1	Roadway
2	Road Side
3	Traffic Services
4	Drainage
5	Vegetation and Aesthetics
6	
7	

Part 2:

In the following table, indicate for every road category your estimation of the weights that should be assigned to each of the road maintenance elements.
i.e. Indicate as a percentage the contribution of maintaining each of the elements to the achievement of the Maintenance Goals.
For convenience, current percentages for each road facility are provided.

	ROAD CATEGORY							
	RURAL				URBAN			
	LIMITED ACCESS		ARTERIAL		LIMITED ACCESS		ARTERIAL	
ELEMENT	Current	Your Estimate	Current	Your Estimate	Current	Your Estimate	Current	Your Estimate
ROADWAY	25		24		25		24	
ROAD SIDE	14		18		13		17	
TRAFFIC SERVICES	27		27		30		29	
DRAINAGE	15		14		15		13	
VEGITATION AND ASTHETICS	19		17		17		17	
TOTAL	100	100	100	100	100	100	100	100

III. FEATURES/ CHARACTERISTICS WEIGHTS

(1) The following table lists the Elements, the Feature/ Characteristics associated with each Element, and the Current "C" level of importance of each Feature/ Characteristic on a scale from 0 to 9 for each of the Facility Types. You are solicited to provide your own Suggested "S" level of importance on the same scale (0 to 9) in columns 1 to 4, where 9 is Extremely important, and 0 is not relevant.

(2) Current System uses a pass/ Fail inspection for each feature by measuring the feature against a preset level of performance (LOP). It is suggested that some of the features may be more amenable to be evaluated on a scale (Ex: 0 to 5, where 0 means completely failing the LOP, and 5 is meeting or exceeding the LOP.) In Column [5] you are requested to Mark (X) on the feature, you think its LOP should measured on a scale rather than Pass/ Fail

FACILITY TYPE KEY

TYPE 1 --- RURAL LIMITED ACCESS

TYPE 2 --- RURAL ARTERIAL
TYPE 3 --- URBAN LIMITED ACCESS
TYPE 4 --- URBAN ARTERIAL

C : Current Value

S : Suggested Value - Your estimation

Roadway	1		2		3		4		5
	C	S	C	S	C	S	C	S	
Flexible pothole	9		9		9		8		
Flexible edge raveling	5		7		5		5		
Flexible shoving	5		6		5		6		
Flexible depression/bump	6		6		6		6		
Flexible shoulder/turnout	5		6		5		6		
Rigid pothole	9		9		9		8		
Rigid depression/bump	6		6		6		6		
Rigid joint/cracking	8		7		8		7		
Rigid shoulder/turnout	5		6		5		6		

Drainage	1		2		3		4		5
	C	S	C	S	C	S	C	S	
Side/Cross Drain	7		7		7		7		
Roadside/Median Ditch	4		4		4		4		
Outfall Ditch	6		6		6		7		
Inlets	7		8		8		8		
Miscellaneous Drainage	5		5		5		6		
Roadway Sweeping	5		4		7		7		

Roadside	C	S	C	S	C	S	C	S	5
Unpaved shoulder	9		9		9		9		
Front slope	6		7		6		7		
Slope pavement	6		6		6		6		
Sidewalk	0		7		0		7		
Fencing	7		6		6		6		

Vegetation & Aesthetics	C	S	C	S	C	S	C	S	5
Roadside mowing	7		7		7		7		
Slope mowing	6		6		6		6		
Landscaping	4		4		5		5		
Tree trimming	6		6		7		6		
Curb or sidewalk edge	6		6		6		7		
Litter removal	3		3		4		4		
Turf condition	6		6		7		7		

Traffic Services	C	S	C	S	C	S	C	S	5
Raised pavement markers	9		9		9		9		
Pavement striping	8		8		8		8		
Pavement symbols	7		7		7		8		
Guardrail	9		9		9		9		
Attenuator	9		9		9		9		
Signs ≤ 30 ft2	9		9		9		9		
Signs > 30 ft2	8		8		8		8		
Object markers/delineators	7		7		7		7		
Lighting	8		8		8		8		

FACILITY TYPE KEY

TYPE 1 --- RURAL LIMITED ACCESS
TYPE 2 --- RURAL ARTERIAL
TYPE 3 --- URBAN LIMITED ACCESS
TYPE 4 --- URBAN ARTERIAL

C : Current Value

S: Suggested Value - Your estimation

IV. THE SAMPLING MECHANISM

(1) Currently, State Roads are evaluated 3 times a year. In your opinion do you think this is adequate or needs a change?

Mark "X" where appropriate:

Number of Evaluations per Year			
1	2	3	4

(2) Should sampling be performed state-wide or district-wide on the 4 main facility types rather than being performed maintenance cost-center-wide on the 4 facility types?
Circle Your Preference!

a- Yes b- No

(3) In your opinion, do you think that inspecting and assessing 30 sample segments per road facility category in each maintenance area is a fair assessment for the conditions of the road types?

Mark "X" in front of your preference:

Number of Samples	Preference
Should be more than 30	
Should be 30	
Should be less than 30	
Should be proportional to the road length	

V. OVERALL SYSTEM

1. Please rate the adequacy of MRP system for assessing Florida Highway Maintenance needs. Mark "X" in front of your preference:

Scale	Adequacy Rate	Preference
1	Poor	
2	Average	
3	Good	
4	Very Good	
5	Excellent	

2. Please comment on changes that you recommend to the MRP system that may enhance its value.

_____

_____

_____

_____

CONTACT INFORMATION

Please send your response to the questionnaire by e-mail - preferred - to:

MRP-FDOT@cecs.ucf.edu

Or by regular mail to:

Dr. Yasser Hosni
UCF-CATSS
4000 Central Florida Blvd.
Orlando, FL 32816
Tel: (407) 823-5817
Fax: (407) 823-3413
E-mail: yhosni@mail.ucf.edu

Appendix 3: Applied example for MRP program computation

FDOT MAINTENANCE RATING PROGRAM (MRP)

District: 5
Cost Center: 1

Facility Type:	**3**	(1= RURAL LIMITED ACCESS; 2= RURAL ARTERIAL; 3= URBAN LIMITED ACCESS; 4= URBAN ARTERIAL)
Road Type	**b**	(A=Flexible; B= Rigid)

INSPECTOR(s):	
FACILITY IDENTIFICATION:	

Feature	Roadway (Flexible/Rigid) 25.00%					Roadside 13%					Traffic Services 30%									Drainage 15%						Vegetation & Aesthetics 17%						
Sample	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	1	2	3	4	5	6	7
1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	0	1	1	1	1	0	1	1	0	1	1	0	0	1	1	1	1
2	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
4	1	0	1	1	0	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
5	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	0	1	1	0	1	1	1	1	0
6	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1
7	0	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
8	1	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1
9	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1
10	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1
11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	0	1
12	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	o	1	1	1	1	1	1	1
13	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
14	1	0	0	1	1	1	1	0	1	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	0	1	0	1	1	1	1
15	0	1	1	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0
16	1	0	1	1	1	1	0	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1
17	1	0	1	1	0	0	0	1	1	1	0	1	1	1	1	1	1	1	1	0	0	1	1	1	1	0	1	1	1	1	1	1
18	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	0
19	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
20	0	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
21	1	1	0	1	0	0	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1
22	1	1	0	0	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	1	0	1	1	0
23	1	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1
24	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1
25	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1
26	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	0	1	1
27	1	1	1	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	1	1	1	1	1	1
28	1	1	0	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	0	1	1	0
29	0	1	1	1	1	0	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
30	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
Sum	**23**	**26**	**25**	**27**	**20**	**24**	**23**	**28**	**25**	**28**	**28**	**29**	**27**	**27**	**30**	**25**	**27**	**26**	**28**	**24**	**25**	**28**	**28**	**25**	**26**	**26**	**25**	**25**	**27**	**29**	**25**	**23**
# Samp.	30																															

This table is to be used in case of "Flexible"

Features	Samples Passed	Weight (10	Score
Flexible pothole	23	9	207
Flexible edge	26	5	130
Flexible shoving	25	5	125
Flexible	27	6	162
Flexible	20	5	100
	30	900	724
Roadway Element MRP			**80.44**

Feature	Samples Passed	Weight (10	Score
Unpaved shoulder	24	9	216
Front slope	23	6	138
Slope pavement	28	6	168
Sidewalk	25	0	0
Fencing	28	6	168
	30	810	690
Road Side Element MRP			**85.19**

Feature	Samples Passed	Weight (10	Score
Raised pavement	28	9	252
Pavement striping	29	8	232
Pavement symbols	27	7	189
Guardrail	27	9	243
Attenuator	30	9	270
Signs ≤ 30 ft2	25	9	225
Signs > 30 ft2	27	8	216
Object	26	7	182
Lighting	28	8	224
	30	2220	2033
Traffic Service Element MRP			**91.58**

Feature	Samples Passed	Weight (10)	Score
Side or cross drain	24	7	168
Roadside or median	25	4	100
Outfall ditch	28	6	168
Inlets	28	8	224
Miscellaneous	25	5	125
Roadway sweeping	26	7	182
	30	1110	967
Drainage Element MRP			**87.12**

Feature	Samples Passed	Weight (1	Score
Roadside mowing	26	7	182
Slope mowing	25	6	150
Landscaping	25	5	125
Tree trimming	27	7	189
Curb or sidewalk	29	6	174
Litter removal	25	4	100
Turf condition	23	7	161
	30	1260	1081
Vegitation & Aesth. Element MRP			**85.79**

This table is to be used in case of "Rigid" Roadway

Features	Samples Passed	Weight (10	Score
Rigid pothole	23	9	207
Rigid depression/bump	26	6	156
Rigid joint/cracking	25	6	150
Rigid shoulder/turnout	27	0	0
	30	630	513
Element MRP			**81.43**

OVERALL MRP			
FACILITY TYPE : URBAN LIMITED ACCESS			
ELEMENT	**MRP**	**Weight**	Normalized
Roadway	81.43	25.00%	0.20
Roadside	85.19	13.00%	0.11
Traffic Services	91.58	30.00%	0.27
Drainage	87.12	15.00%	0.13
Vegetation & Aesthetics	85.79	17.00%	0.15
FACILITY OVERALL MRP			**86.56%**

MAINTENANCE NEEDS BY ELEMENT			
FACILITY TYPE : URBAN LIMITED ACCESS			
ELEMENT	**MRP**	**LOP**	**NEEDS**
Roadway	81.43	60.00	-21.43
Roadside	85.19	80.00	-5.19
Traffic Services	91.58	50.00	-41.58
Drainage	87.12	150.00	62.88
Vegetation & Aesthetics	85.79	90.00	4.21
FACILITY OVERALL MRP	**86.56**	**95.00**	**8.44**

MRP WEIGHTS

ELEMENT	L Access RURAL	ARTERIA RURAL	L Access URBAN	ARTERIA URBAN
	25.00%	24.00%	25.00%	24.00%
	14.00%	18.00%	13.00%	17.00%
	27.00%	27.00%	30.00%	29.00%
	15.00%	14.00%	15.00%	13.00%
	19.00%	17.00%	17.00%	17.00%
	100	100	100	100
ROADWAY				
ROAD SIDE				
TRAFFIC SERVICES				
DRAINAGE				
VEGITATION AND				
TOTAL				

ROAD CATEGORY

TYPE 1 --- RURAL LIMITED ACCESS
TYPE 2 --- RURAL ARTERIAL
TYPE 3 --- URBAN LIMITED ACCESS
TYPE 4 --- URBAN ARTERIAL

	1 C	2 C	3 C	4 C
	9	9	9	8
	5	7	5	5
	5	6	5	6
	6	6	6	6
	5	6	5	6
FACILITY TYPE KEY	9	9	9	8
	6	6	6	6
	8	7	8	7
	5	6	5	6

	1 C	2 C	3 C	4 C
	7	7	7	7
	4	4	4	4
	6	6	6	7
	7	8	8	8
	5	5	5	6
	5	4	7	7

	C	C	C	C
	9	9	9	9
	6	7	6	7
	6	6	6	6
	0	7	0	7
	7	6	6	6

	C	C	C	C
	7	7	7	7
	6	6	6	6
	4	4	5	5
	6	6	7	6

Roadway				
Flexible pothole				
Flexible edge raveling				
Flexible shoving				
Flexible depression/bump				
Flexible shoulder/turnout				
Rigid pothole				
Rigid depression/bump				
Rigid joint/cracking				
Rigid shoulder/turnout				

Drainage
Side/Cross Drain
Roadside/Median Ditch
Outfall Ditch
Inlets
Miscellaneous Drainage
Roadway Sweeping

Roadside
Unpaved shoulder
Front slope
Slope pavement
Sidewalk
Fencing

Vegetation &				
Roadside mowing				
Slope mowing				
Landscaping				
Tree trimming				
Curb or sidewalk edge	6	6	6	7
Litter removal	3	3	4	4
Turf condition	6	6	7	7

Traffic Services	C	C	C	C
Raised pavement markers	9	9	9	9
Pavement striping	8	8	8	8
Pavement symbols	7	7	7	8
Guardrail	9	9	9	9
Attenuator	9	9	9	9
Signs ? 30 ft2	9	9	9	9
Signs > 30 ft2	8	8	8	8
Object markers/delineators	7	7	7	7
Lighting	8	8	8	8

Appendix 4: Questionnaire Data and Analysis

Florida Maintenance Rating System (MRP)

Experts' Survey Data and Analysis

I. OBJECTIVES AND THEIR WEIGHTS

IN THE FOLLOWING TABLE PROVIDE A PERCENTAGE VALUE REFLECTING THE RELATIVE IMPORTANCE OF EACH OF THE OBJECTIVES. PROVIDE ANY ADDITIONAL OBJECTIVES THAT YOU FEEL SHOULD BE INCLUDED IN THE OBJECTIVES

(b	Objective	Current RI	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	#Answered	23						
			3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	Current RI	Average	Difference	Max	Min	Variance	SD	Recommended
1	Safety	70	70	65	70	60	60	50	25	20	25	50	60	100	75	50	40	40	30	70	50	55	65	70	70	70	55	-15	100	20	364.72	19.10	60
2	Protecting Public Investment	10	10	10	10	30	15	25	25	20	25	30	10	0	9	30	10	15	20	10	20	20	20	10	10	10	17	7	30	0	67.95	8.24	18
3	Environmental Aspects	10	10	15	10	5	15	10	25	20	25	10	20	0	8	10	10	20	15	10	10	15	10	10	10	10	13	3	25	0	36.66	6.05	15
4	Minimize Expenditure	10	10	10	10	5	10	10	25	20	25	10	10	0	8	10	10	5	20	10	20	10	5	10	10	10	11	1	25	0	40.08	6.33	7
5	Aesthetics							5											10										10	5			
6	Determine Work Needs									20																			20	20			
7	Free Flow Movement of Traffic																20												20	20			
8	Pleasing Experience/Value to Public																10												10	10			
9	Supporting economic development																	20											20	20			
#	Comfort and Convenience																		5										5	5			
	TOTALS	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100								100

II. ELEMENTAL WEIGHTS

IN THE FOLLOWING TABLE, INDICATE FOR EVERY ROAD CATEGORY YOUR ESTIMATION OF THE WEIGHTS THAT SHOULD BE ASSIGNED TO EACH OF THE ROAD MAINTENANCE

RURAL LIMITED ACCESS		1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	#Answered	21						
ELEMENT	Current	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	Current	Average	Difference	Max	Min	Variance	SD	Recommended
ROADWAY	25	25	5	5	30	25	5	Dlt20	Dlt20	20	25	25	20	22	5	25	25	25	30	20	25	15	27	29	25	20.6	-4.4	30	5	72.55	8.52	20
ROAD SIDE	14	18	30	30	15	14	18	Dlt20	Dlt20	20	15	16	15	16	19	13	18	20	10	20	15	20	14	17	14	17.8	3.8	30	10	23.49	4.85	18
TRAFFIC SERVICES	27	27	35	35	30	27	34	Dlt20	Dlt20	20	30	27	30	28	37	25	25	25	30	20	30	30	27	31	27	28.7	1.7	37	20	19.81	4.45	29
DRAINAGE	15	15	15	15	15	15	19	Dlt20	Dlt20	20	10	16	20	15	20	12	20	20	20	20	15	15	15	18	15	16.7	1.7	20	10	8.83	2.97	16
VEGITATION AND ASTHETICS	19	15	15	15	10	19	24	Dlt20	Dlt20	20	20	16	15	19	19	25	12	10	10	20	15	20	17	5	19	16.2	-2.8	25	5	24.29	4.93	17
TOTAL	100	100	100	100	100	100	100	0	0	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100.0						100.0

RURAL LIMITED ARTERIAL		1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	#Answered	21						
ELEMENT	Current	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	Current	Average	Difference	Max	Min	Variance	SD	Recommended
ROADWAY	24	24	5	5	30	24	5	Dlt20	Dlt20	20	25	25	20	21	5	25	25	25	30	20	25	14	24	28	24	20.2	-3.8	30	5	69.89	8.36	20
ROAD SIDE	18	20	30	30	15	18	23	Dlt20	Dlt20	20	15	16	15	19	19	13	18	20	10	20	17	21	17	19	18	18.8	0.8	30	10	22.46	4.74	19
TRAFFIC SERVICES	27	27	30	30	30	27	34	Dlt20	Dlt20	20	25	27	30	28	37	25	25	25	30	20	28	30	27	31	27	27.9	0.9	37	20	15.89	3.99	28
DRAINAGE	14	16	20	20	15	14	17	Dlt20	Dlt20	20	15	16	20	14	20	12	20	20	20	20	15	15	15	17	14	17.2	3.2	20	12	7.26	2.69	17
VEGITATION AND ASTHETICS	17	13	15	15	10	17	21	Dlt20	Dlt20	20	20	16	15	18	19	25	12	10	10	20	15	20	17	5	17	15.9	-1.1	25	5	22.13	4.70	16
TOTAL	100	100	100	100	100	100	100	0	0	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100.0						100.0

URBAN LIMITED ACCESS		1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	#Answered	21						
ELEMENT	Current	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	Current	Average	Difference	Max	Min	Variance	SD	Recommended
ROADWAY	25	25	5	5	30	25	5	Dlt20	Dlt20	20	25	25	20	22	5	25	25	25	30	20	23	15	27	28	25	20.5	-4.5	30	5	71.06	8.43	20
ROAD SIDE	13	17	25	25	15	15	16	Dlt20	Dlt20	20	15	16	15	15	19	13	20	20	10	20	15	15	13	16	13	16.9	3.9	25	10	13.99	3.74	17
TRAFFIC SERVICES	30	30	35	35	35	30	38	Dlt20	Dlt20	20	30	27	30	30	37	25	25	25	30	20	30	30	28	33	30	29.7	-0.3	38	20	24.13	4.91	30
DRAINAGE	15	15	15	15	10	13	19	Dlt20	Dlt20	20	15	16	20	15	20	12	20	20	20	20	15	15	15	18	15	16.6	1.6	20	10	9.36	3.06	16
VEGITATION AND ASTHETICS	17	13	20	20	10	17	22	Dlt20	Dlt20	20	15	16	15	18	19	25	10	10	10	20	17	25	17	5	17	16.4	-0.6	25	5	27.55	5.25	17
TOTAL	100	100	100	100	100	100	100	0	0	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100.0						100.0

URBAN ARTERIAL		1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	#Answered	21						
ELEMENT	Current	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	Current	Average	Difference	Max	Min	Variance	SD	Recommended
ROADWAY	24	24	5	5	30	24	5	Dlt20	Dlt20	20	25	25	18	21	5	25	25	25	30	20	25	12	24	28	24	20.0	-4.0	30	5	71.55	8.46	20
ROAD SIDE	17	19	20	20	15	17	21	Dlt20	Dlt20	20	20	16	17	17	15	13	15	20	10	20	16	16	17	20	17	17.3	0.3	21	10	8.03	2.83	17
TRAFFIC SERVICES	29	29	30	30	35	29	36	Dlt20	Dlt20	20	25	27	25	30	40	25	25	25	30	20	29	30	29	31	29	28.6	-0.4	40	20	22.86	4.78	29
DRAINAGE	13	14	25	25	10	15	17	Dlt20	Dlt20	20	10	16	20	14	28	12	20	20	20	20	15	17	13	16	13	17.5	4.5	28	10	23.26	4.82	17
VEGITATION AND ASTHETICS	17	14	20	20	10	15	21	Dlt20	Dlt20	20	20	16	20	18	12	25	15	10	10	20	15	25	17	5	17	16.6	-0.4	25	5	26.66	5.16	17
TOTAL	100	100	100	100	100	100	100	0	0	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100.0						100.0

III. FEATURES/ CHARACTERISTICS WEIGHTS

FOR EACH ELEMENT CHARACTERISTICS/ FEATURES OF EACH ROAD CATEGORY PROVIDE YOUR OWN SUGGESTED LEVEL OF IMPORTANCE ON THE SAME SCALE (0 TO 9) , WHERE 9 IS EXTREMELY IMPORTANT, AND 0 IS NOT RELEVANT.

Roadway	**1**	1	1	1	1	0	0	0	0	1	1	1	0	1	1	1	0	1	1	1	1	1	0	0	#Answered	**15**						
RURAL LIMITED ACCESS	**Current**	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	**Current**	**Average**	**Difference**	**Max**	**Min**	**Variance**	**SD**	**Recommended**
Flexible pothole	9	9	9	9	9			Dlt9	Dlt9	9	9	9		9	9	8		9	9	9	9	9			9	8.93	-0.07	9	8	0.07	0.26	9
Flexible edge raveling	5	5	3	3	5			Dlt9	Dlt9	9	5	4		3	5	5		5	5	5	6	4			5	4.80	-0.20	9	3	2.17	1.47	5
Flexible shoving	5	5	5	5	5			Dlt9	Dlt9	9	6	4		3	4	5		7	5	5	5	4			5	5.13	0.13	9	3	1.98	1.41	5
Flexible depression/bump	6	6	5	5	6			Dlt9	Dlt9	9	6	7		4	6	5		7	6	5	6	4			6	5.80	-0.20	9	4	1.60	1.26	6
Flexible shoulder/turnout	5	5	5	4	5			Dlt9	Dlt9	9	5	6		5	5	5		5	4	5	5	5			5	5.20	0.20	9	4	1.31	1.15	5
Rigid pothole	9	9	9	9	9			Dlt9	Dlt9	9	9	9		9	9	8		9	9	9	9	9			9	8.93	-0.07	9	8	0.07	0.26	9
Rigid depression/bump	6	6	5	5	6			Dlt9	Dlt9	9	6	6		4	6	5		7	6	5	6	4			6	5.73	-0.27	9	4	1.50	1.22	6
Rigid joint/cracking	8	8	7	4	8			Dlt9	Dlt9	9	8	7		7	7	7		7	7	5	8	4			8	6.87	-1.13	9	4	2.12	1.46	7
Rigid shoulder/turnout	5	5	5	4	5			Dlt9	Dlt9	9	5	5		4	5	5		5	5	5	5	4			5	5.07	0.07	9	4	1.35	1.16	5
Check		58	53	48	58	0	0	0	0	81	59	57	0	48	56	53	0	61	56	53	59	47	0	0	58							57

Roadway	**2**	1	1	1	1	0	0	0	0	1	1	1	0	1	1	1	0	1	1	1	1	1	0	0	#Answered	**15**						
RURAL ARTERIAL	**Current**	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	**Current**	**Average**	**Difference**	**Max**	**Min**	**Variance**	**SD**	**Recommended**
Flexible pothole	9	9	7	9	9			Dlt9	Dlt9	9	8	9		8	9	8		9	9	9	9	9			9	8.67	-0.33	9	7	0.38	0.62	9
Flexible edge raveling	7	7	3	3	7			Dlt9	Dlt9	9	5	4		7	7	6		6	5	5	7	4			7	5.67	-1.33	9	3	2.95	1.72	6
Flexible shoving	6	6	5	6	6			Dlt9	Dlt9	9	6	5		4	6	5		7	5	5	6	4			6	5.67	-0.33	9	4	1.52	1.23	6
Flexible depression/bump	6	6	5	5	6			Dlt9	Dlt9	9	5	7		4	6	5		7	6	5	7	4			6	5.80	-0.20	9	4	1.74	1.32	6
Flexible shoulder/turnout	6	6	7	4	6			Dlt9	Dlt9	9	6	6		4	5	5		5	4	5	6	5			6	5.53	-0.47	9	4	1.70	1.30	6
Rigid pothole	9	9	7	9	9			Dlt9	Dlt9	9	7	9		9	9	8		9	9	9	9	9			9	8.67	-0.33	9	7	0.52	0.72	9
Rigid depression/bump	6	6	5	5	6			Dlt9	Dlt9	9	5	5		4	6	5		7	6	5	6	4			6	5.60	-0.40	9	4	1.54	1.24	6
Rigid joint/cracking	7	7	7	4	7			Dlt9	Dlt9	9	7	7		6	6	7		7	7	5	7	4			7	6.47	-0.53	9	4	1.70	1.30	7
Rigid shoulder/turnout	6	6	7	4	6			Dlt9	Dlt9	9	6	5		3	5	6		5	5	5	6	4			6	5.47	-0.53	9	3	1.98	1.41	6
Check		62	53	49	62	0	0	0	0	81	55	57	0	49	59	55	0	62	56	53	63	47	0	0	62							61

Roadway	**3**	1	1	1	1	0	0	0	0	1	1	1	0	1	1	1	0	1	1	1	1	1	0	0	#Answered	**15**						
URBAN LIMITED ACCESS	**Current**	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	**Current**	**Average**	**Difference**	**Max**	**Min**	**Variance**	**SD**	**Recommended**
Flexible pothole	9	9	9	9	9			Dlt9	Dlt9	9	9	9		9	9	8		9	9	9	9	9			9	8.93	-0.07	9	8	0.07	0.26	9
Flexible edge raveling	5	5	3	3	5			Dlt9	Dlt9	9	5	4		3	4	5		5	5	5	6	4			5	4.73	-0.27	9	3	2.21	1.49	5
Flexible shoving	5	5	5	5	5			Dlt9	Dlt9	9	6	4		2	4	5		7	5	5	5	4			5	5.07	0.07	9	2	2.35	1.53	5
Flexible depression/bump	6	6	5	6	6			Dlt9	Dlt9	9	6	7		3	6	5		7	6	5	6	4			6	5.80	-0.20	9	3	1.89	1.37	6
Flexible shoulder/turnout	5	5	5	4	5			Dlt9	Dlt9	9	5	5		3	5	5		5	4	5	5	5			5	5.00	0.00	9	3	1.57	1.25	5
Rigid pothole	9	9	9	9	9			Dlt9	Dlt9	9	9	9		9	9	8		9	9	9	9	9			9	8.93	-0.07	9	8	0.07	0.26	9
Rigid depression/bump	6	6	5	5	6			Dlt9	Dlt9	9	6	5		4	6	5		7	6	5	6	4			6	5.67	-0.33	9	4	1.52	1.23	6
Rigid joint/cracking	8	8	7	4	8			Dlt9	Dlt9	9	8	7		7	7	7		7	7	5	8	4			8	6.87	-1.13	9	4	2.12	1.46	7
Rigid shoulder/turnout	5	5	5	4	5			Dlt9	Dlt9	9	5	5		4	5	5		5	5	5	5	4			5	5.07	0.07	9	4	1.35	1.16	5
Check		58	53	49	58	0	0	0	0	81	59	55	0	44	55	53	0	61	56	53	59	47	0	0	58							57

Roadway	**4**	1	1	1	1	0	0	0	0	1	1	1	0	1	1	1	0	1	1	1	1	1	0	0	#Answered	**15**						
URBAN ARTERIAL	**Current**	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	**Current**	**Average**	**Difference**	**Max**	**Min**	**Variance**	**SD**	**Recommended**
Flexible pothole	8	8	7	8	8			Dlt9	Dlt9	9	8	9		7	8	8		9	9	9	9	9			8	8.33	0.33	9	7	0.52	0.72	9
Flexible edge raveling	5	5	3	3	5			Dlt9	Dlt9	9	5	4		2	4	6		5	5	5	5	4			5	4.67	-0.33	9	2	2.52	1.59	5
Flexible shoving	6	6	5	6	6			Dlt9	Dlt9	9	6	4		5	7	5		7	5	5	6	4			6	5.73	-0.27	9	4	1.64	1.28	6
Flexible depression/bump	6	6	5	5	6			Dlt9	Dlt9	9	5	7		4	6	5		7	6	5	6	4			6	5.73	-0.27	9	4	1.64	1.28	6
Flexible shoulder/turnout	6	6	7	4	6			Dlt9	Dlt9	9	6	5		3	5	5		5	4	5	6	5			6	5.40	-0.60	9	3	1.97	1.40	5
Rigid pothole	8	8	7	9	8			Dlt9	Dlt9	9	7	9		7	8	8		9	9	9	9	9			8	8.33	0.33	9	7	0.67	0.82	9
Rigid depression/bump	6	6	5	5	6			Dlt9	Dlt9	9	5	5		3	6	5		7	6	5	6	4			6	5.53	-0.47	9	3	1.84	1.36	6
Rigid joint/cracking	7	7	7	4	7			Dlt9	Dlt9	9	7	7		5	6	7		7	7	5	7	4			7	6.40	-0.60	9	4	1.83	1.35	6
Rigid shoulder/turnout	6	6	5	4	6			Dlt9	Dlt9	9	6	5		3	5	6		5	5	5	6	4			6	5.33	-0.67	9	3	1.81	1.35	5
Check		58	51	48	58	0	0	0	0	81	55	55	0	39	55	55	0	61	56	53	60	47	0	0	58							57

Roadway	**5**	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	#Answered	**4**						
	Current	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	**Total**							
Flexible pothole																		1							1							
Flexible edge raveling			1																		1				2							
Flexible shoving													1												1							
Flexible depression/bump													1												1							
Flexible shoulder/turnout																					1				1							
Rigid pothole																		1							1							
Rigid depression/bump													1												1							
Rigid joint/cracking			1																		1				2							
Rigid shoulder/turnout																					1				1							
Check		0	2	0	0	0	0	0	0	0	0	0	0	3	0	0	0	2	0	0	4	0	0	0	11							

III. FEATURES/ CHARACTERISTICS WEIGHTS

FOR EACH ELEMENT CHARACTERISTICS/ FEATURES OF EACH ROAD CATEGORY PROVIDE YOUR OWN SUGGESTED LEVEL OF IMPORTANCE ON THE SAME SCALE (0 TO 9) , WHERE 9 IS EXTREMELY IMPORTANT, AND 0 IS NOT RELEVANT.

Roadside	1	1	1	1	1	0	0	0	0	1	1	1	0	1	1	1	0	1	1	1	1	1	0	0	#Answered	15						
RURAL LIMITED ACCESS	**Current**	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	**Current**	**Average**	**Difference**	**Max**	**Min**	**Variance**	**SD**	**Recommended**
Unpaved shoulder	9	9	9	8	9			Dlt9	Dlt9	9	9	9		9	9	8		7	8	9	9	9			9	8.67	-0.33	9	7	0.38	0.62	9
Front slope	6	5	7	7	6			Dlt9	Dlt9	9	6	7		7	6	6		5	5	6	6	7			6	6.33	0.33	9	5	1.10	1.05	6
Slope pavement	6	5	5	5	6			Dlt9	Dlt9	9	6	5		5	5	6		5	5	5	6	6			6	5.60	-0.40	9	5	1.11	1.06	6
Sidewalk	0	0	0	0	0			Dlt9	Dlt9	9	0	0		0	0	2		0	0	7	0	0			0	1.20	1.20	9	0	8.03	2.83	0
Fencing	7	6	7	8	7			Dlt9	Dlt9	9	7	8		7	7	6		5	4	6	8	6			7	6.73	-0.27	9	4	1.64	1.28	7
Check		25	28	28	28	0	0	0	0	45	28	29	0	28	27	28	0	22	22	33	29	28	0	0	28							28

Roadside	2	1	1	1	1	0	0	0	0	1	1	1	0	1	1	1	0	1	1	1	1	1	0	0	#Answered	15						
RURAL ARTERIAL	**Current**	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	**Current**	**Average**	**Difference**	**Max**	**Min**	**Variance**	**SD**	**Recommended**
Unpaved shoulder	9	9	9	9	9			Dlt9	Dlt9	9	9	9		9	9	8		7	8	9	9	9			9	8.73	-0.27	9	7	0.35	0.59	9
Front slope	7	5	7	7	7			Dlt9	Dlt9	9	7	7		8	7	6		5	5	6	6	7			7	6.60	-0.40	9	5	1.26	1.12	7
Slope pavement	6	7	5	5	6			Dlt9	Dlt9	9	6	5		5	4	6		5	5	5	6	6			6	5.67	-0.33	9	4	1.38	1.18	6
Sidewalk	7	7	5	8	7			Dlt9	Dlt9	9	7	0		7	7	7		6	0	7	7	8			7	6.13	-0.87	9	0	6.98	2.64	6
Fencing	6	7	5	5	6			Dlt9	Dlt9	9	6	8		7	3	6		5	4	6	6	6			6	5.93	-0.07	9	3	2.21	1.49	6
Check		35	31	34	35	0	0	0	0	45	35	29	0	36	30	33	0	28	22	33	34	36	0	0	35							34

Roadside	3	1	1	1	1	0	0	0	0	1	1	1	0	1	1	1	0	1	1	1	1	1	0	0	#Answered	15						
URBAN LIMITED ACCESS	**Current**	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	**Current**	**Average**	**Difference**	**Max**	**Min**	**Variance**	**SD**	**Recommended**
Unpaved shoulder	9	9	9	8	9			Dlt9	Dlt9	9	9	9		9	9	8		7	8	9	9	9			9	8.67	-0.33	9	7	0.38	0.62	9
Front slope	6	6	5	7	6			Dlt9	Dlt9	9	6	7		7	6	6		5	5	6	6	7			6	6.27	0.27	9	5	1.07	1.03	6
Slope pavement	6	6	5	5	6			Dlt9	Dlt9	9	6	5		5	5	6		5	5	5	6	6			6	5.67	-0.33	9	5	1.10	1.05	6
Sidewalk	0	0	0	0	0			Dlt9	Dlt9	9	0	0		0	0	2		0	0	7	0	0			0	1.20	1.20	9	0	8.03	2.83	0
Fencing	6	6	7	8	6			Dlt9	Dlt9	9	7	6		5	6	6		5	4	6	8	6			6	6.33	0.33	9	4	1.67	1.29	7
Check		27	26	28	27	0	0	0	0	45	28	27	0	26	26	28	0	22	22	33	29	28	0	0	27							28

Roadside	4	1	1	1	1	0	0	0	0	1	1	1	0	1	1	1	0	1	1	1	1	1	0	0	#Answered	15						
URBAN ARTERIAL	**Current**	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	**Current**	**Average**	**Difference**	**Max**	**Min**	**Variance**	**SD**	**Recommended**
Unpaved shoulder	9	9	7	9	9			Dlt9	Dlt9	9	9	9		9	9	8		7	8	9	9	9			9	8.60	-0.40	9	7	0.54	0.74	9
Front slope	7	7	7	7	7			Dlt9	Dlt9	9	7	7		6	7	6		5	5	6	6	7			7	6.60	-0.40	9	5	0.97	0.99	7
Slope pavement	6	6	5	5	6			Dlt9	Dlt9	9	6	5		5	4	6		5	5	5	6	6			6	5.60	-0.40	9	4	1.26	1.12	6
Sidewalk	7	7	9	8	7			Dlt9	Dlt9	9	8	7		8	7	7		6	0	7	7	8			7	7.00	0.00	9	0	4.43	2.10	7
Fencing	6	7	3	5	6			Dlt9	Dlt9	9	7	6		4	5	6		5	4	6	6	6			6	5.67	-0.33	9	3	2.10	1.45	6
Check		36	31	34	35	0	0	0	0	45	37	34	0	32	32	33	0	28	22	33	34	36	0	0	35							35

Roadside	5	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	1	0	0	0	#Answered	6						
	Current	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	**Total**							
Unpaved shoulder																		1		1	1				3							
Front slope																1		1							2							
Slope pavement																									0							
Sidewalk														1						1	1				3							
Fencing			1																		1				2							
Check		0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	2	0	2	3	0	0	0	10							

III. FEATURES/ CHARACTERISTICS WEIGHTS

FOR EACH ELEMENT CHARACTERISTICS/ FEATURES OF EACH ROAD CATEGORY PROVIDE YOUR OWN SUGGESTED LEVEL OF IMPORTANCE ON THE SAME SCALE (0 TO 9) , WHERE 9 IS

Traffic Services	1	1	1	1	1	0	0	0	0	1	1	1	0	1	1	1	0	1	1	1	1	1	0	1	#Answered	16						
RURAL LIMITED ACCESS	Current	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	Current	Average	Difference	Max	Min	Variance	SD	Recommended
Raised pavement markers	9	9	9	9			Dlt9	Dlt9	9	9	9		9	9	8		7	9	9	9	9		9	9	8.81	-0.19	9	7	0.30	0.54	9
Pavement striping	8	8	9	9	8			Dlt9	Dlt9	9	9	7		8	9	8		7	8	7	9	9		8	8	8.25	0.25	9	7	0.60	0.77	8
Pavement symbols	7	7	5	8	7			Dlt9	Dlt9	9	7	5		7	7	7		5	6	7	7	7		7	7	6.75	-0.25	9	5	1.13	1.06	7
Guardrail	9	9	9	9	9			Dlt9	Dlt9	9	9	9		9	9	9		7	9	9	9	9		9	9	8.88	-0.13	9	7	0.25	0.50	9
Attenuator	9	9	9	9	9			Dlt9	Dlt9	9	9	8		9	9	9		7	9	9	9	9		9	9	8.81	-0.19	9	7	0.30	0.54	9
Signs ≤ 30 ft2	9	9	7	9	9			Dlt9	Dlt9	9	9	9		9	9	9		6	9	8	9	9		9	9	8.63	-0.38	9	6	0.78	0.89	9
Signs > 30 ft2	8	9	9	8	8			Dlt9	Dlt9	9	9	7		8	8	8		4	8	7	8	8		8	8	7.88	-0.13	9	4	1.45	1.20	8
Object markers/delineators	7	8	5	7	7			Dlt9	Dlt9	9	7	5		6	7	6		5	6	7	6	6		8	7	6.56	-0.44	9	5	1.33	1.15	7
Lighting	8	7	5	8	8			Dlt9	Dlt9	9	8	9		8	7	8		5	8	7	7	8		8	8	7.50	-0.50	9	5	1.33	1.15	8
Check		75	67	76	74	0	0	0	0	81	76	68	0	73	74	72	0	53	72	70	73	74	0	75	74							74

Traffic Services	2	1	1	1	1	0	0	0	0	1	1	1	0	1	1	1	0	1	1	1	1	1	0	1	#Answered	16						
RURAL ARTERIAL	Current	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	Current	Average	Difference	Max	Min	Variance	SD	Recommended
Raised pavement markers	9	9	9	9			Dlt9	Dlt9	9	8	9		9	9	8		7	9	9	9	9		9	9	8.75	-0.25	9	7	0.33	0.58	9
Pavement striping	8	8	9	9	8			Dlt9	Dlt9	9	8	7		8	9	8		7	8	7	9	9		8	8	8.19	0.19	9	7	0.56	0.75	8
Pavement symbols	7	7	5	8	7			Dlt9	Dlt9	9	7	5		7	6	7		5	6	7	7	7		7	7	6.69	-0.31	9	5	1.16	1.08	7
Guardrail	9	9	9	9	9			Dlt9	Dlt9	9	9	9		9	9	9		7	9	9	9	9		9	9	8.88	-0.13	9	7	0.25	0.50	9
Attenuator	9	9	9	9	9			Dlt9	Dlt9	9	9	8		9	9	9		7	9	9	9	9		9	9	8.81	-0.19	9	7	0.30	0.54	9
Signs ≤ 30 ft2	9	9	7	9	9			Dlt9	Dlt9	9	9	9		9	9	9		6	9	8	9	9		9	9	8.63	-0.38	9	6	0.78	0.89	9
Signs > 30 ft2	8	9	7	8	8			Dlt9	Dlt9	9	8	7		8	8	8		4	8	7	8	8		8	8	7.69	-0.31	9	4	1.30	1.14	8
Object markers/delineators	7	8	7	7	7			Dlt9	Dlt9	9	7	5		6	7	6		5	6	7	7	6		8	7	6.75	-0.25	9	5	1.13	1.06	7
Lighting	8	7	5	8	8			Dlt9	Dlt9	9	8	9		8	7	8		5	8	7	7	8		8	8	7.50	-0.50	9	5	1.33	1.15	8
Check		75	67	76	74	0	0	0	0	81	73	68	0	73	73	72	0	53	72	70	74	74	0	75	74							74

Traffic Services	3	1	1	1	1	0	0	0	0	1	1	1	0	1	1	1	0	1	1	1	1	1	0	1	#Answered	16						
URBAN LIMITED ACCESS	Current	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	Current	Average	Difference	Max	Min	Variance	SD	Recommended
Raised pavement markers	9	9	9	9			Dlt9	Dlt9	9	9	9		9	9	8		7	9	9	9	9		9	9	8.81	-0.19	9	7	0.30	0.54	9
Pavement striping	8	8	9	9	8			Dlt9	Dlt9	9	9	9		8	9	8		7	8	7	8	9		8	8	8.31	0.31	9	7	0.50	0.70	8
Pavement symbols	7	7	7	8	7			Dlt9	Dlt9	9	8	8		8	7	7		5	6	7	7	7		7	7	7.19	0.19	9	5	0.83	0.91	7
Guardrail	9	9	9	9	9			Dlt9	Dlt9	9	9	9		9	9	9		7	9	9	9	9		9	9	8.88	-0.13	9	7	0.25	0.50	9
Attenuator	9	9	9	9	9			Dlt9	Dlt9	9	9	9		9	9	9		7	9	9	9	9		9	9	8.88	-0.13	9	7	0.25	0.50	9
Signs ≤ 30 ft2	9	9	9	9	9			Dlt9	Dlt9	9	9	8		9	9	9		6	9	8	9	9		9	9	8.69	-0.31	9	6	0.63	0.79	9
Signs > 30 ft2	8	9	7	8	8			Dlt9	Dlt9	9	9	7		8	8	8		4	8	7	8	8		8	8	7.75	-0.25	9	4	1.40	1.18	8
Object markers/delineators	7	8	5	7	7			Dlt9	Dlt9	9	7	5		6	7	6		5	6	7	6	6		8	7	6.56	-0.44	9	5	1.33	1.15	7
Lighting	8	7	7	8	8			Dlt9	Dlt9	9	9	9		7	8	8		5	8	7	9	8		8	8	7.81	-0.19	9	5	1.10	1.05	8
Check		75	71	76	74	0	0	0	0	81	78	73	0	73	75	72	0	53	72	70	74	74	0	75	74							74

Traffic Services	4	1	1	1	1	0	0	0	0	1	1	1	0	1	1	1	0	1	1	1	1	1	0	1	#Answered	16						
URBAN ARTERIAL	Current	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	Current	Average	Difference	Max	Min	Variance	SD	Recommended
Raised pavement markers	9	9	5	9	9			Dlt9	Dlt9	9	8	9		9	9	8		7	9	9	9	9		9	9	8.50	-0.50	9	5	1.20	1.10	9
Pavement striping	8	8	9	9	8			Dlt9	Dlt9	9	8	9		8	9	8		7	8	7	8	9		8	8	8.25	0.25	9	7	0.47	0.68	8
Pavement symbols	8	7	9	8	8			Dlt9	Dlt9	9	8	9		8	8	7		5	6	7	8	7		8	8	7.63	-0.38	9	5	1.18	1.09	8
Guardrail	9	9	7	9	9			Dlt9	Dlt9	9	9	9		9	9	9		7	9	9	9	9		9	9	8.75	-0.25	9	7	0.47	0.68	9
Attenuator	9	9	7	9	9			Dlt9	Dlt9	9	9	8		9	9	9		7	9	9	9	9		9	9	8.69	-0.31	9	7	0.50	0.70	9
Signs ≤ 30 ft2	9	9	9	9	9			Dlt9	Dlt9	9	9	8		9	9	9		6	9	8	9	9		9	9	8.69	-0.31	9	6	0.63	0.79	9
Signs > 30 ft2	8	9	5	8	8			Dlt9	Dlt9	9	9	7		8	8	8		4	8	7	8	8		8	8	7.63	-0.38	9	4	1.85	1.36	8
Object markers/delineators	7	8	3	7	7			Dlt9	Dlt9	9	7	5		6	7	6		5	6	7	7	6		8	7	6.50	-0.50	9	3	2.00	1.41	7
Lighting	8	7	9	8	8			Dlt9	Dlt9	9	9	9		7	8	8		5	8	7	7	8		8	8	7.81	-0.19	9	5	1.10	1.05	8
Check		75	63	76	75	0	0	0	0	81	76	73	0	73	76	72	0	53	72	70	74	74	0	76	75							75

Traffic Services	5	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	1	0	0	1	#Answered	7						
	Current	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	Frequency	%age						
Raised pavement markers																1		1		1	1				4	57%						
Pavement striping			1													1		1							3	43%						
Pavement symbols			1											1											2	29%						
Guardrail																									0	0%						
Attenuator																									0	0%						
Signs ≤ 30 ft2																1		1							2	29%						
Signs > 30 ft2																1		1							2	29%						
Object markers/delineators														1										1	2	29%						
Lighting																		1		1					2	29%						
Check		0	2	0	0	0	0	0	0	0	0	0	0	2	0	4	0	5	0	2	1	0	0	1	17							

III. FEATURES/ CHARACTERISTICS WEIGHTS

FOR EACH ELEMENT CHARACTERISTICS/ FEATURES OF EACH ROAD CATEGORY PROVIDE YOUR OWN SUGGESTED LEVEL OF IMPORTANCE ON THE SAME SCALE (0 TO 9) , WHERE 9 IS EXTREMELY IMPORTANT, AND 0 IS NOT RELEVANT.

Drainage	1	1	1	1	1	0	0	0	0	1	1	1	0	1	1	1	0	1	1	1	1	1	0	0	#Answered	15						
RURAL LIMITED ACCESS	**Current**	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	**Current**	**Average**	**Difference**	**Max**	**Min**	**Variance**	**SD**	**Recommended**
Side/Cross Drain	7	7	7	7	7			Dlt9	Dlt9	9	6	8		7	7	7		7	7	7	7	8			7	7.20	0.20	9	6	0.46	0.68	7
Roadside/Median Ditch	4	4	5	5	4			Dlt9	Dlt9	9	5	4		3	4	4		7	4	6	4	5			4	4.87	0.87	9	3	2.27	1.51	5
Outfall Ditch	6	5	5	5	6			Dlt9	Dlt9	9	6	5		5	5	6		5	5	6	6	5			6	5.60	-0.40	9	5	1.11	1.06	6
Inlets	7	7	5	8	7			Dlt9	Dlt9	9	8	8		6	8	7		7	7	8	6	8			7	7.27	0.27	9	5	1.07	1.03	7
Miscellaneous Drainage	5	4	5	5	5			Dlt9	Dlt9	9	6	5		4	5	5		5	4	5	5	6			5	5.20	0.20	9	4	1.46	1.21	5
Roadway Sweeping	5	4	7	4	5			Dlt9	Dlt9	9	5	5		4	5	7		5	4	4	6	6			5	5.33	0.33	9	4	2.10	1.45	5
Check		31	34	34	34	0	0	0	0	54	36	35	0	29	34	36	0	36	31	36	34	38	0	0	34							35

Drainage	2	1	1	1	1	0	0	0	0	1	1	1	0	1	1	1	0	1	1	1	1	1	0	0	#Answered	15						
RURAL ARTERIAL	**Current**	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	**Current**	**Average**	**Difference**	**Max**	**Min**	**Variance**	**SD**	**Recommended**
Side/Cross Drain	7	7	7	7	7			Dlt9	Dlt9	9	6	8		7	7	7		7	7	7	7	8			7	7.20	0.20	9	6	0.46	0.68	7
Roadside/Median Ditch	4	4	5	5	4			Dlt9	Dlt9	9	4	4		4	5	4		7	4	6	4	5			4	4.93	0.93	9	4	2.07	1.44	5
Outfall Ditch	6	5	5	5	6			Dlt9	Dlt9	9	6	5		5	5	6		5	5	6	6	5			6	5.60	-0.40	9	5	1.11	1.06	6
Inlets	8	7	7	8	8			Dlt9	Dlt9	9	8	8		8	8	8		7	7	8	7	8			8	7.73	-0.27	9	7	0.35	0.59	8
Miscellaneous Drainage	5	4	5	5	5			Dlt9	Dlt9	9	5	5		5	5	5		5	4	5	5	6			5	5.20	0.20	9	4	1.31	1.15	5
Roadway Sweeping	4	4	5	3	4			Dlt9	Dlt9	9	4	5		4	4	6		5	4	4	5	6			4	4.80	0.80	9	3	2.03	1.42	5
Check		31	34	33	34	0	0	0	0	54	33	35	0	33	34	36	0	36	31	36	34	38	0	0	34							36

Drainage	3	1	1	1	1	0	0	0	0	1	1	1	0	1	1	1	0	1	1	1	1	1	0	0	#Answered	15						
URBAN LIMITED ACCESS	**Current**	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	**Current**	**Average**	**Difference**	**Max**	**Min**	**Variance**	**SD**	**Recommended**
Side/Cross Drain	7	7	7	7	7			Dlt9	Dlt9	9	7	8		8	7	7		7	7	7	7	8			7	7.33	0.33	9	7	0.38	0.62	7
Roadside/Median Ditch	4	4	5	5	4			Dlt9	Dlt9	9	5	4		3	4	4		7	4	6	4	5			4	4.87	0.87	9	3	2.27	1.51	5
Outfall Ditch	6	6	5	5	6			Dlt9	Dlt9	9	7	5		5	5	6		5	5	6	6	5			6	5.73	-0.27	9	5	1.21	1.10	6
Inlets	8	7	9	8	8			Dlt9	Dlt9	9	9	8		8	8	8		7	7	8	8	8			8	8.00	0.00	9	7	0.43	0.65	8
Miscellaneous Drainage	5	4	5	5	5			Dlt9	Dlt9	9	6	5		4	6	5		5	4	5	5	6			5	5.27	0.27	9	4	1.50	1.22	5
Roadway Sweeping	7	4	7	5	7			Dlt9	Dlt9	9	8	5		7	6	7		5	4	4	8	6			7	6.13	-0.87	9	4	2.55	1.60	6
Check		32	38	35	37	0	0	0	0	54	42	35	0	35	36	37	0	36	31	36	38	38	0	0	37							37

Drainage	4	1	1	1	1	0	0	0	0	1	1	1	0	1	1	1	0	1	1	1	1	1	0	0	#Answered	15						
URBAN ARTERIAL	**Current**	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	**Current**	**Average**	**Difference**	**Max**	**Min**	**Variance**	**SD**	**Recommended**
Side/Cross Drain	7	7	9	7	7			Dlt9	Dlt9	9	6	8		8	7	7		7	7	7	7	8			7	7.40	0.40	9	6	0.69	0.83	7
Roadside/Median Ditch	4	4	7	5	4			Dlt9	Dlt9	9	4	4		4	5	4		7	4	6	4	5			4	5.07	1.07	9	4	2.35	1.53	5
Outfall Ditch	7	5	7	5	7			Dlt9	Dlt9	9	7	5		6	6	6		5	5	6	7	5			7	6.07	-0.93	9	5	1.35	1.16	6
Inlets	8	7	9	8	8			Dlt9	Dlt9	9	8	8		8	8	8		7	7	8	8	8			8	7.93	-0.07	9	7	0.35	0.59	8
Miscellaneous Drainage	6	4	7	5	6			Dlt9	Dlt9	9	7	5		5	7	5		5	4	5	6	6			6	5.73	-0.27	9	4	1.78	1.33	6
Roadway Sweeping	7	7	9	5	7			Dlt9	Dlt9	9	7	5		7	6	7		5	4	4	8	6			7	6.40	-0.60	9	4	2.54	1.59	6
Check		34	48	35	39	0	0	0	0	54	39	35	0	38	39	37	0	36	31	36	40	38	0	0	39							38

Drainage	5	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	1	0	0	0	#Answered	6						
	Current	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	**Total**							
Side/Cross Drain																				1					1							
Roadside/Median Ditch														1											1							
Outfall Ditch														1											1							
Inlets																		1		1					2							
Miscellaneous Drainage																1		1							2							
Roadway Sweeping			1																		1				2							
Check		0	1	0	0	0	0	0	0	0	0	0	0	2	0	1	0	2	0	2	1	0	0	0	9							

III. FEATURES/ CHARACTERISTICS WEIGHTS

FOR EACH ELEMENT CHARACTERISTICS/ FEATURES OF EACH ROAD CATEGORY PROVIDE YOUR OWN SUGGESTED LEVEL OF IMPORTANCE ON THE SAME SCALE (0 TO 9) , WHERE 9 IS EXTREMELY IMPORTANT, AND 0 IS NOT RELEVANT.

Vegetation & Aesthetics	1	1	1	1	1	0	0	0	0	1	1	1	0	1	1	1	0	1	1	1	1	1	0	0	#Answered	15						
RURAL LIMITED ACCESS	Current	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	Current	Average	Difference	Max	Min	Variance	SD	Recommended
Roadside mowing	7	6	5	8	7			Dlt9	Dlt9	9	6	6		6	7	8		5	7	7	7	8			7	6.80	-0.20	9	5	1.31	1.15	7
Slope mowing	6	5	5	7	6			Dlt9	Dlt9	9	6	6		4	5	7		4	5	4	6	6			6	5.67	-0.33	9	4	1.81	1.35	6
Landscaping	4	3	3	4	4			Dlt9	Dlt9	9	4	5		2	3	6		3	3	5	4	5			4	4.20	0.20	9	2	2.89	1.70	4
Tree trimming	6	7	5	7	6			Dlt9	Dlt9	9	5	6		5	7	7		5	5	5	7	7			6	6.20	0.20	9	5	1.46	1.21	6
Curb or sidewalk edge	6	6	3	5	6			Dlt9	Dlt9	9	6	5		4	5	6		3	3	6	6	6			6	5.27	-0.73	9	3	2.50	1.58	5
Litter removal	3	3	3	5	3			Dlt9	Dlt9	9	4	4		3	4	7		3	3	4	3	6			3	4.27	1.27	9	3	3.21	1.79	4
Turf condition	6	7	7	6	6			Dlt9	Dlt9	9	6	5		5	7	6		3	5	6	5	7			6	6.00	0.00	9	3	1.86	1.36	6
Check		37	31	42	38	0	0	0	0	63	37	37	0	29	38	47	0	26	31	37	38	45	0	0	38							38

Vegetation & Aesthetics	2	1	1	1	1	0	0	0	0	1	1	1	0	1	1	1	0	1	1	1	1	1	0	0	#Answered	15						
RURAL ARTERIAL	Current	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	Current	Average	Difference	Max	Min	Variance	SD	Recommended
Roadside mowing	7	6	5	8	7			Dlt9	Dlt9	9	6	6		6	7	8		5	7	7	7	8			7	6.80	-0.20	9	5	1.31	1.15	7
Slope mowing	6	5	5	7	6			Dlt9	Dlt9	9	6	6		4	5	7		4	5	4	6	6			6	5.67	-0.33	9	4	1.81	1.35	6
Landscaping	4	3	5	4	4			Dlt9	Dlt9	9	4	5		2	3	6		3	3	5	4	5			4	4.33	0.33	9	2	2.81	1.68	4
Tree trimming	6	7	5	7	6			Dlt9	Dlt9	9	6	6		5	7	7		5	5	5	7	7			6	6.27	0.27	9	5	1.35	1.16	6
Curb or sidewalk edge	6	6	5	5	6			Dlt9	Dlt9	9	6	5		4	5	6		3	3	6	6	6			6	5.40	-0.60	9	3	2.11	1.45	5
Litter removal	3	3	5	5	3			Dlt9	Dlt9	9	4	4		3	4	7		3	3	4	3	6			3	4.40	1.40	9	3	3.11	1.76	4
Turf condition	6	7	7	6	6			Dlt9	Dlt9	9	6	5		5	6	6		3	5	6	5	7			6	5.93	-0.07	9	3	1.78	1.33	6
Check		37	37	42	38	0	0	0	0	63	38	37	0	29	37	47	0	26	31	37	38	45	0	0	38							38

Vegetation & Aesthetics	3	1	1	1	1	0	0	0	0	1	1	1	0	1	1	1	0	1	1	1	1	1	0	0	#Answered	15						
URBAN LIMITED ACCESS	Current	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	Current	Average	Difference	Max	Min	Variance	SD	Recommended
Roadside mowing	7	6	7	8	7			Dlt9	Dlt9	9	7	6		7	7	9		5	7	7	7	8			7	7.13	0.13	9	5	1.12	1.06	7
Slope mowing	6	5	5	7	6			Dlt9	Dlt9	9	6	6		5	6	7		4	5	4	6	6			6	5.80	-0.20	9	4	1.60	1.26	6
Landscaping	5	3	5	5	5			Dlt9	Dlt9	9	5	5		4	5	6		3	3	5	5	5			5	4.87	-0.13	9	3	2.12	1.46	5
Tree trimming	7	7	5	7	7			Dlt9	Dlt9	9	7	6		6	8	7		5	5	5	8	7			7	6.60	-0.40	9	5	1.54	1.24	7
Curb or sidewalk edge	6	6	3	5	6			Dlt9	Dlt9	9	6	5		4	6	6		3	3	6	6	6			6	5.33	-0.67	9	3	2.52	1.59	6
Litter removal	4	3	5	5	4			Dlt9	Dlt9	9	5	4		5	6	7		3	3	4	4	6			4	4.87	0.87	9	3	2.70	1.64	5
Turf condition	7	7	7	7	7			Dlt9	Dlt9	9	6	5		6	7	6		3	5	6	6	7			7	6.27	-0.73	9	3	1.78	1.33	6
Check		37	37	44	42	0	0	0	0	63	42	37	0	37	45	48	0	26	31	37	42	45	0	0	42							42

Vegetation & Aesthetics	4	1	1	1	1	0	0	0	0	1	1	1	0	1	1	1	0	1	1	1	1	1	0	0	#Answered	15						
URBAN ARTERIAL	Current	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	Current	Average	Difference	Max	Min	Variance	SD	Recommended
Roadside mowing	7	6	9	8	7			Dlt9	Dlt9	9	7	6		7	7	9		5	7	7	7	8			7	7.27	0.27	9	5	1.35	1.16	7
Slope mowing	6	5	7	7	6			Dlt9	Dlt9	9	6	6		5	6	7		4	5	4	6	6			6	5.93	-0.07	9	4	1.64	1.28	6
Landscaping	5	4	9	5	5			Dlt9	Dlt9	9	6	5		4	6	6		3	3	5	5	5			5	5.33	0.33	9	3	3.10	1.76	5
Tree trimming	6	6	9	7	6			Dlt9	Dlt9	9	7	6		7	8	7		5	5	5	7	7			6	6.73	0.73	9	5	1.64	1.28	7
Curb or sidewalk edge	7	6	7	5	7			Dlt9	Dlt9	9	7	5		6	7	6		3	3	6	7	6			7	6.00	-1.00	9	3	2.43	1.56	6
Litter removal	4	3	7	5	4			Dlt9	Dlt9	9	5	4		6	6	7		3	3	4	4	6			4	5.07	1.07	9	3	3.07	1.75	5
Turf condition	7	7	7	7	7			Dlt9	Dlt9	9	6	5		7	8	6		3	5	6	6	7			7	6.40	-0.60	9	3	1.97	1.40	6
Check		37	55	44	42	0	0	0	0	63	44	37	0	42	48	48	0	26	31	37	42	45	0	0	42							42

Vegetation & Aesthetics	5	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	1	0	1	0	0	0	#Answered	6						
	Current	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	Total							
Roadside mowing			1											1					1						3							
Slope mowing			1											1											2							
Landscaping			1											1							1				3							
Tree trimming			1													1		1			1				4							
Curb or sidewalk edge																			1		1				2							
Litter removal			1													1		1	1		1				5							
Turf condition			1											1				1	1		1				5							
Check		0	6	0	0	0	0	0	0	0	0	0	0	4	0	2	0	3	4	0	5	0	0	0	24							

IV. THE SAMPLING MECHANISM

(1) STATE ROADS ARE EVALUATED 3 TIMES A YEAR. IN YOUR OPINION HOW MANY EVALUATIONS SHOULD BE DONE PER YEAR?

# of Evaluations Per Year	Current	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	Total	Ratio
1					1																				1	5%
2																									0	0%
3	1		1	1		1		1	1		1				1	1	1		1	1	1	1	1		14	64%
4		1						1		1		1	1	1				1							7	32%
																									22	100%

Recommended: 3

(2) SHOULD SAMPLING BE PERFORMED STATE-WIDE RATHER THAN DISTRICT-WIDE?

Answer	1	4	7	8	9	17	19	20	21	22	23	25	28	33	36	39	40	41	43	46	50	51	52	Total	Ratio
YES																								0	0.0%
NO			1	1			1	1	1	1						1	1				1		1	10	52.6%
																								10	53%

Recommended: No

(3) IN YOUR OPINION, HOW SHOULD THE SAMPLE SIZE BE?

Number of Samples	1	4	7	8	9	17	19	20	21	22	23	25	28	33	36	39	40	41	43	46	50	51	52	Total	Ratio
Should be more than 30																								0	0%
Should be 30																					1			1	5%
Should be less than 30																								0	0%
Should be proportional to the road length			1	1			1	1	1	1						1	1					1	1	10	45%
																								11	50%

Recommended: 4

V. OVERALL SYSTEM PERFORMANCE

PLEASE RATE THE ADEQUACY OF MRP SYSTEM FOR ASSESSING FLORIDA HIGHWAY MAINTENANCE NEEDS ON A SCALE FROM 1 TO 5, WHERE 1 IS POOR AND 5 IS EXCELLENT.

Scale	Adequacy Rate	3	6	7	8	16	18	19	20	21	22	24	27	32	35	38	39	40	42	45	49	50	51	52	Total	Ratio	W. Average
1	Poor																								0	0%	0
2	Fair																	1	1						2	9%	0.17
3	Average							1				1	1								1	1	1		6	26%	0.78
4	Very Good		1		1			1		1	1			1	1	1	1			1				1	11	48%	1.91
5	Excellent	1		1					1																3	13%	0.65
																									22	96%	3.52

Recommended: V. Good

Appendix 5: Sampling Analysis

A5.1 Margin of Error for Cost Center and Facility Type Combinations

Dist.	Cost Center	Facility Type	Miles	Pop.	Sample Size	Error Margin
D1	190	1	31.8	318	30	0.170596
		2	314	3140	30	0.178923
		3	0	-	0	-
		4	320.6	3206	30	0.178923
	192	1	115.3	1153	30	0.178923
		2	280.2	2802	30	0.178923
		3	0	-	0	-
		4	234.6	2346	30	0.178923
	194	1	68	680	30	0.178923
		2	281	2810	30	0.178923
		3	0	-	0	-
		4	180.2	1802	30	0.178923
D2	291	1	34.9	349	30	0.170596
		2	204.4	2044	30	0.178923
		3	0	-	0	-
		4	124.7	1247	30	0.178923
	292	1	133.4	1334	30	0.178923
		2	342.4	3424	30	0.178923
		3	0	-	0	-
		4	82.5	825	30	0.178923
	293	1	32.4	324	30	0.170596
		2	258.9	2589	30	0.178923
		3	0	-	0	-
		4	18.2	182	30	0.163333
	294	1	76	760	30	0.178923
		2	260.2	2602	30	0.178923
		3	54.3	543	30	0.173241
		4	256.9	2569	30	0.178923
	296	1	0	-	0	-
		2	271.1	2711	30	0.178923
		3	0	-	0	-
		4	17.8	178	30	0.163333
	297	1	34.6	346	30	0.170596
		2	242.8	2428	30	0.178923
		3	0	-	0	-
		4	41.8	418	30	0.173241
D3	390	1	51.4	514	30	0.173241
		2	272.5	2725	30	0.178923
		3	0	-	0	-
		4	72.8	728	30	0.178923
	391	1	0	-	0	-
		2	249.7	2497	30	0.178923
		3	0	-	0	-
		4	108	1080	30	0.178923

	392	1	72.6	726	30	0.178923
		2	489.2	4892	30	0.178923
		3	0	-	0	-
		4	110.3	1103	30	0.178923
	393	1	64.1	641	30	0.178923
		2	328.3	3283	30	0.178923
		3	0	-	0	-
		4	61.8	618	30	0.178923
	395	1	29.1	291	30	0.170596
		2	248.6	2486	30	0.178923
		3	15.5	155	30	0.161111
		4	146.4	1464	30	0.178923
D4	490	1	69.6	696	30	0.178923
		2	205.6	2056	30	0.178923
		3	0	-	0	-
		4	96.5	965	30	0.178923
	491	1	44.7	447	30	0.173241
		2	87.8	878	30	0.178923
		3	33.7	337	30	0.170596
		4	225.3	2253	30	0.178923
	492	1	0	-	0	-
		2	166.3	1663	30	0.178923
		3	47.9	479	30	0.173241
		4	214	2140	30	0.178923
D5	590	1	93.2	932	30	0.178923
		2	103.3	1033	30	0.178923
		3	0	-	0	-
		4	174.8	1748	30	0.178923
	591	1	91	910	30	0.178923
		2	263.3	2633	30	0.178923
		3	0	-	0	-
		4	102.3	1023	30	0.178923
	592	1	28	280	30	0.168069
		2	239.1	2391	30	0.178923
		3	0	-	0	-
		4	58.8	588	30	0.173241
	593	1	0	-	0	-
		2	24.2	242	30	0.168069
		3	27.1	271	30	0.168069
		4	116.7	1167	30	0.178923
	594	1	50.8	508	30	0.173241
		2	118.3	1183	30	0.178923
		3	48	480	30	0.173241
		4	121.1	1211	30	0.178923
	595	1	38	380	0	-
		2	144.5	1445	30	0.178923
		3	0	-	0	-
		4	56.5	565	30	0.173241
D6	690	1	0	-	0	-
		2	88.3	883	30	0.178923
		3	39.3	393	30	0.173241

		4	178.9	1789	30	0.178923
	691	1	4.3	43	12	0.237685
		2	6.1	61	18	0.192194
		3	31.3	313	30	0.170596
		4	162.2	1622	30	0.178923
	692	1	0	-	0	-
		2	81.7	817	30	0.178923
		3	0	-	0	-
		4	18.1	181	30	0.163333
D7	796	1	64.4	644	30	0.178923
		2	122.3	1223	30	0.178923
		3	31.4	314	30	0.170596
		4	180.8	1808	30	0.178923
	797	1	31.9	319	30	0.170596
		2	226.4	2264	30	0.178923
		3	0	-	0	-
		4	109.6	1096	30	0.178923
	798	1	17.4	174	30	0.163333
		2	14.7	147	30	0.158977
		3	22	220	30	0.16565
		4	163.4	1634	30	0.178923
D8	853	1	268.6	2686	90	0.103301
		2	0	-	0	-
		3	68.6	686	90	0.096097
		4	0	-	0	-
Average Margin of Error with Turnpike (D8)						0.174965
Average Margin of Error without Turnpike (D8)						0.175832

A5.2 Margin of Error for Facility-Type-Wide MRP Calculations in Districts

District	Facility Type	Mileage	Pop.	Sample Size	Error Margin
D1	1	215.1	2151	90	0.103301
	2	875.2	8752	90	0.103301
	3	0	0	0	0
	4	735.4	7354	90	0.103301
D2	1	311.3	3113	150	0.080017
	2	1579.8	15798	180	0.073045
	3	54.3	543	30	0.173241
	4	541.9	5419	180	0.073045
D3	1	217.2	2172	120	0.086961
	2	1588.3	15883	150	0.080017
	3	15.5	155	30	0.161111
	4	499.3	4993	150	0.080017
D4	1	114.3	1143	60	0.123468
	2	459.7	4597	90	0.103301
	3	81.6	816	60	0.121554
	4	535.8	5358	90	0.103301
D5	1	301	3010	120	0.089461

	2	892.7	8927	180	0.073045
	3	75.1	751	60	0.121554
	4	630.2	6302	180	0.073045
D6	1	4.3	43	12	0.237685
	2	176.1	1761	78	0.110963
	3	70.6	706	60	0.12063
	4	359.2	3592	90	0.103301
D7	1	113.7	1137	90	0.098995
	2	363.4	3634	90	0.103301
	3	53.4	534	60	0.118842
	4	453.8	4538	90	0.103301
D8	1	268.6	2686	90	0.103301
	2	0	0	0	0
	3	68.6	686	90	0.096097
	4	0	0	0	0

A5.3 Margin of Error for Cost-Center-Wide MRP Calculations in Districts

District	Cost Center	Mileage	Pop.	Sample Size	Error Margin
D1	190	666.4	6664	90	0.103301
	192	630.1	6301	90	0.103301
	194	529.2	5292	90	0.103301
D2	291	364	3640	90	0.103301
	292	558.3	5583	90	0.103301
	293	309.5	3095	90	0.103301
	294	647.4	6474	120	0.089461
	296	288.9	2889	60	0.126517
	297	319.2	3192	90	0.103301
D3	390	396.7	3967	90	0.103301
	391	357.7	3577	60	0.126517
	392	672.1	6721	90	0.103301
	393	454.2	4542	90	0.103301
	395	439.6	4396	120	0.089461
D4	490	371.7	3717	90	0.103301
	491	391.5	3915	120	0.089461
	492	428.2	4282	90	0.103301
D5	590	371.3	3713	90	0.103301
	591	456.6	4566	90	0.103301
	592	325.9	3259	90	0.103301
	593	168	1680	90	0.100546
	594	338.2	3382	120	0.089461
	595	239	2390	60	0.126517

D6	690	306.5	3065	90	0.103301
	691	203.9	2039	90	0.103301
	692	99.8	998	60	0.1225
D7	796	398.9	3989	120	0.089461
	797	367.9	3679	90	0.103301
	798	217.5	2175	120	0.086961
D8	853	337.2	3372	180	0.071097

A5.4 Margin of Error for District MRP Calculations

District	Mileage	Pop.	Sample Size	Error Margin
D1	1825.7	18257	270	0.059641
D2	2487.3	24873	540	0.042172
D3	2320.3	23203	450	0.046198
D4	1191.4	11914	300	0.05658
D5	1899	18990	540	0.042172
D6	610.2	6102	240	0.063259
D7	984.3	9843	330	0.053947
D8	337.2	3372	180	0.071097

A5.5 Margin of Error for Facility-Type-Wide MRP Calculations in State

Facility Type	Mileage	Pop.	Sample Size	Error Margin
1	1545.5	15455	732	0.036222
2	5935.2	59352	858	0.033457
3	419.1	4191	390	0.04726
4	3755.6	37556	870	0.033225

A5.6 Margin of Error for State MRP Calculation

Mileage	Pop.	Sample Size	Error Margin
11655.4	116554	2850	0.018357