

STATE OF NEVADA  
DEPARTMENT OF TRANSPORTATION

# REQUEST FOR INFORMATION

Specifications, Instructions and  
Submitting Information for

Enterprise Asset Management System (EAMS)  
Project

Due Date: April 8, 2015



Rudy Malfabon, P.E., Director  
Department of Transportation

## Table of Contents

<b>1. General Information</b> .....	4
<b>1.1. Introduction</b> .....	4
<b>1.2. Submission of Questions</b> .....	4
<b>1.3. Vendor Submissions</b> .....	4
<b>1.4. RFI Schedule</b> .....	5
<b>1.5. RFI Coordinator</b> .....	5
<b>1.6. Response Format</b> .....	5
<b>1.7. Vendor Presentation</b> .....	5
<b>1.8. Cost of Preparing Response</b> .....	6
<b>1.9. General Terms and Conditions</b> .....	6
<b>1.10. Request for Confidential Treatment</b> .....	6
<b>2. Background</b> .....	7
<b>2.1. Project Background</b> .....	7
<b>2.2. Acronyms and Definitions</b> .....	9
<b>2.3. Current Process</b> .....	10
<b>2.3.1. Maintenance Management System (MMS)</b> .....	10
<b>2.3.2. Pavement Management System (PMS)</b> .....	10
<b>2.3.3. Bridge Management System (BMS)</b> .....	14
<b>2.3.4. Intelligent Traffic System (ITS)</b> .....	15
<b>2.3.5. Fleet and Fuel Management System (optional)</b> .....	16
<b>2.3.6. Needs Repository/Needs Analysis (optional)</b> .....	16
<b>2.4. Functional and System Requirements</b> .....	17
<b>2.4.1. Universal Requirements</b> .....	17
<b>2.4.2. Maintenance Management System (MMS)</b> .....	17
<b>2.4.3. Pavement Management System (PMS)</b> .....	17
<b>2.4.4. Bridge Management System</b> .....	18
<b>2.4.5. Intelligent Traffic System (ITS)</b> .....	19
<b>3. Vendor Responses</b> .....	19
<b>3.1. Section 1 – Executive Summary</b> .....	19
<b>3.2. Section 2 – System Functionality</b> .....	19
<b>3.3. Section 3 – Recommended Solution</b> .....	19

---

3.4.	Section 4 – Concept of Operations .....	20
3.5	Section 5 - Cost .....	20
3.6	Section 6 - Past Performance .....	21
3.7	Section 7 - Vendor Questions.....	22
4	Exhibits .....	25
4.1	DEPARTMENT Organization Chart .....	25
4.2	Functional Requirements by System/Asset Type.....	26
4.3	Interface Requirements by Type, Source and Target.....	46
4.4	Current ITS Assets.....	48

## 1. General Information

### 1.1. Introduction

The purpose of this Request for Information (RFI) is to allow all interested vendors an opportunity to present information of available products and solutions that address the specifications within this RFI. The Nevada Department of Transportation, herein "DEPARTMENT", is seeking information for the purpose of identifying Enterprise Asset Management System (EAMS) solutions for use in the management of DEPARTMENT assets, to meet federally mandated reporting requirements and to replace certain legacy systems.

The intent of this RFI is to elicit the advice and the best recommendations of knowledgeable persons in the vendor community, not to select a proposed solution or a vendor. Subsequently, and depending upon knowledge gained from the response to this RFI, it is the DEPARTMENT's intent to prepare and issue a Request for Proposals (RFP) that will meet the requirements of its stakeholders. The collective information provided by vendors will be used to develop alternatives for consideration and to estimate costs related to acquisition of a proposed solution. Vendors may respond to this RFI with information about deploying an EAMS solution using the latest data governance practices and budgetary costs the DEPARTMENT should expect to incur when procuring, implementing and supporting such an EAMS solution.

### 1.2. Submission of Questions

Any questions raised must be submitted in writing to Agreement Services, 1263 South Stewart Street, Room 101A, Carson City, Nevada, 89712, faxed to (775) 888-7101 or emailed to [agreeservices@dot.state.nv.us](mailto:agreeservices@dot.state.nv.us) **received by 3:00 P.M. PST, on March 9, 2015**. Written responses will be distributed by the DEPARTMENT on or before **March 16, 2015**. Only written questions will be considered.

### 1.3. Vendor Submissions

Vendor responses are due by **3:00 PM PST, April 8, 2015**. Please include **one (1) electronic copy** of the RFI response submitted on a CD. If a vendor has multiple solutions, each solution must be submitted separately. Responses should be submitted addressed **exactly** as follows:

Agreement Services  
Nevada Department of Transportation  
Attn: RFI for EAMS  
1263 South Stewart Street, Room 101  
Carson City, NV 89712

Responses containing confidential information shall have each page marked as confidential to include the front cover of the response.

#### 1.4. RFI Schedule

Description	Timeline
Release of RFI	February 25, 2015
Submission of Questions	March 9, 2015
Responses to Submitted Questions	March 16, 2015
Vendor Submissions	April 8, 2015

#### 1.5. RFI Coordinator

Vendor communications concerning this RFI should be directed to the RFI Coordinator listed below.

RFI Coordinator	Procurement Person
<b>Address</b>	Nevada Department of Transportation Administrative Services Division 1263 S. Stewart Street, # 101A Carson City, NV 89712
<b>Phone</b>	(775) 888-7070
<b>E-mail</b>	<a href="mailto:agreeservices@dot.state.nv.us">agreeservices@dot.state.nv.us</a>

#### 1.6. Response Format

The responses shall be submitted in the following format (see Section 3):

- Section 1 – Executive Summary
- Section 2 – Implementation Approach
- Section 3 – Proposed Solution
- Section 4 – Concept of Operations
- Section 5 – Cost
- Section 6 – Past Performance
- Section 7 – Project Questions

#### 1.7. Vendor Presentation

At the DEPARTMENT's sole discretion vendors **may** be invited to give a presentation at a time and date to be determined after review of the responses. If the DEPARTMENT deems presentations to be desirable the vendor demonstrations may be scheduled between May 15, 2015 and June 15, 2015.

### 1.8. Cost of Preparing Response

The DEPARTMENT assumes no financial responsibility in connection with the vendors' costs incurred in the preparation and submission of the RFI packets, or by attending the presentation, if such presentations are conducted by the DEPARTMENT in its sole discretion.

### 1.9. General Terms and Conditions

Issuance of this RFI shall in no way constitute a commitment by the DEPARTMENT to issue a Request for Proposals (RFP) or execute an agreement. The DEPARTMENT reserves the right to cancel this RFI if it is deemed in the best interest of the State to do so.

Information submitted in response to this RFI will become the property of the DEPARTMENT. The DEPARTMENT will not pay for any information herein requested, nor will it be liable for any other costs incurred by any respondent related to the preparation or delivery of the response to this RFI or any subsequent presentation.

The DEPARTMENT reserves the right to issue addenda to this RFI prior to the closing date. If a vendor chooses to download this RFI from the <http://www.nevadadot.com> website, it is the vendor's responsibility to check for any addendums to this RFI from the <http://www.nevadadot.com> website.

By submitting a response, the vendor agrees that the DEPARTMENT may copy the response information for purposes of facilitating review or to respond to requests for public records. The vendor consents to such copy by submitting a response and warrants that such copying will not violate the rights of any third party. The DEPARTMENT will have the right to use ideas or adaptations presented in the responses.

The DEPARTMENT reserves the right to reject any and all responses to the RFI, in whole and in part, at any time. This RFI is designed to provide vendors with the information necessary for the preparation of informative response proposals and demonstrations of product. This RFI process is for the DEPARTMENT's benefit and is intended to provide information to facilitate the future selection of goods and services. The RFI is not intended to be comprehensive and each vendor is responsible for determining all factors necessary for submission of comprehensive response and complete product capability demonstration. The RFI response and demonstration will not be subject to an RFP type evaluation but only to a review of suggested product performance, cost of processes offered, and abilities to perform services that may be of use to DEPARTMENT. Cost shall be estimated by the vendor. When the estimated cost is submitted, the vendor shall state that it is an estimated or approximate cost.

The DEPARTMENT will not be responsible for any oral exchange or any other information or exchange that occurs outside the official process specified herein.

### 1.10. Request for Confidential Treatment

The State of Nevada will treat all information submitted by a vendor as public information unless the vendor properly requests that the information be treated as confidential at the time of submitting

the response. Any requests for confidential treatment of information must be included in a cover letter with the vendor's RFI response. The request must also include the name, address, and telephone number of the person authorized by the vendor to respond to any inquiries concerning the confidential status of the materials.

A single confidential page in the document will classify the whole document as being confidential. Each page shall be marked as containing confidential information. The confidential information must be clearly identifiable to the reader on the outside of the document, cover letter, and on each page of the document.

## 2. Background

### 2.1. Project Background

This section provides general information regarding the DEPARTMENT and is provided to assist proposers in better understanding the current computing environment and system difficulties.

New Department of Transportation (DOT) Federal regulations, outlined in the Federal Transportation bill, Moving Ahead for Progress in the 21st Century (MAP-21), have mandated that states maintain an asset management system. This mandate requires Nevada to monitor and allocate all of its Transportation resources in the most efficient way. The DEPARTMENT has determined the implementation of an Enterprise Asset Management System (EAMS) is the best way to meet this mandate. The DEPARTMENT is considering the replacement of the following legacy systems as a part of the EAMS:

1. Maintenance Management System (MMS)
2. Bridge Management System (BMS)
3. Pavement Management System (PMS)
4. Intelligent Transportation System (ITS)

The DEPARTMENT is also seeking recommendations on:

1. Fleet and fuel management solutions that may be available as part of, or integrate well with, a vendor's EAMS solution; and
2. Needs repository and Needs analysis solutions.

The DEPARTMENT was established in 1917 and is responsible for the planning, construction, maintenance and operations of 5,400 miles of highway and 1,100 bridges. The DEPARTMENT is divided into 3 districts, each managed by a District Engineer and 2-3 Assistant District Engineers for construction and maintenance operations. Each District is responsible for supervising all state transportation activities within their geographic locations. The DEPARTMENT's headquarters are located in Carson City and the three main District Offices are in Las Vegas, Reno and Elko. An organization chart can be found in the Exhibit section of this document. One of the DEPARTMENT's strategic goals is to effectively preserve and manage its assets and efficiently operate the state

transportation system of Nevada. A new Asset Management System will assist staff in achieving this goal.

MMS and PMS were built or enhanced in-house over 10 years ago and through the years staff has become very comfortable using both of these applications. The systems are very difficult to support from a technical point of view. MMS is one of the most widely used applications in the organization with over 300 employees using it monthly from maintenance crews to maintenance supervisors. While PMS has several specific functions, the majority of the use of pavement data is for planning and budgeting. The majority of the data in MMS is maintenance work performed in the field that includes the cost of labor and materials.

Bridge data has been housed in numerous systems over the years (spreadsheets, PONTIS and InspectTech). The DEPARTMENT's current Bridge Management solution is InspectTech. This application tracks all NBI bridges and culverts. Simple data queries can be handled internally by DEPARTMENT staff but complex queries require assistance from the application software vendor (Bentley) which often result in a time-consuming effort.

ITS assets are managed by the Traffic Operations Division. Partial location information for ITS assets is available and construction dates are not stored in any system but could be researched. The ITS assets are being managed using the Freeway Management Software program. The tracking of ITS assets in Northern Nevada is still being documented.

### **Lack of GIS**

Currently the integration between the DEPARTMENT legacy asset management systems and the Geographic Information System (GIS) is limited. The DEPARTMENT's existing geodatabase and linear referencing initiatives are the responsibility of the Location Division which is part of the Engineering function at the DEPARTMENT. The GIS section is currently operating an ESRI Spatial Database Engine (SDE)/SQL Geodatabase. The Geodatabase is designed to store and manage a linear referenced based centerline network and some associated roadway features and attributes. The linear referenced enterprise geodatabase is built on ESRI technology using ArcGIS and ArcSDE, and resides on an SQL database. The DEPARTMENT has multiple linear reference systems (LRs) and methods (LRMs) used by various divisions. There are also multiple areas where some GIS integration exists and each has a different repository: the vendors are ESRI, Bentley and Integraph. The DEPARTMENT understands much of its data has a geographical component but at this point GIS integration is limited and not consistent. It should be noted that integration of ESRI Roads & Highways with its current road network is under consideration by the DEPARTMENT.

## 2.2. Acronyms and Definitions

<b>Term/Acronym</b>	<b>Definition</b>
AASHTO	American Association of State Highway Transportation Officials
ADT	Average Daily Traffic
DEPARTMENT	Nevada Department of Transportation
EAMS	Enterprise Asset Management System
FHWA	Federal Highway Administration
Flexible Pavement	A hot mix asphalt pavement structure which maintains contact with and distributes loads to the subgrade and depends on aggregate interlock, particle friction and cohesion for stability.
GIS	Geographic Information System
IRI	International Roughness Index, an index derived from a mathematical simulation of vehicle response to the project of a traveled surface.
MAP-21	Moving Ahead for Progress in the 21st Century Act
MMS	Maintenance Management System - tool for planning and budgeting maintenance operations including equipment repair and replacement.
NBE	National Bridge Element
NBI	National Bridge Inventory
NBIS	National Bridge Inspection Standards
NDOT	Nevada Department of Transportation
NHS	National Highway System
NRS	Nevada Revised Statutes
PMS	A legacy application that records and analyzes pavement condition and assists with planning maintenance and rehabilitation. The application has 11 modules that provide all information necessary for the pavement management system.
Preventive Maintenance	Treatments applied to prevent or reduce the rate of deterioration.
PRI	Point Rating Index, DEPARTMENT's in-house developed pavement ride quality rating that has been used for over 30 years to quantify pavement condition.
Rehabilitation 3R Program	Work that restores the serviceability and extends the service life of an existing pavement without affecting the alignment or grade. Rehabilitation, Restoration and Resurfacing Program

## 2.3. Current Process

### 2.3.1. Maintenance Management System (MMS)

The current MMS was implemented about 20 years ago and was last updated in 2003. This upgrade moved the application to an Oracle platform. The update did not include changes in functionality. The original system was developed as a reporting and inventory system and does not include essential functionality needed today like: budgeting, resource planning and scheduling. Due to deficiencies in the current system, the process of evaluating work performed, personnel utilized, equipment needed and materials used is cumbersome and inefficient.

Business processes the DEPARTMENT is seeking to improve as a result of a new EAMS are:

- Field data will be entered once, not multiple times as is done currently
- Managers will have decision-making information in a timely manner, instead of waiting weeks
- Ability to measure performance, effectiveness of work and conditions of infrastructure

Another issue with the current system is the lack of integration with the other management systems like BMS, PMS and ITS. Integration with these systems would benefit maintenance in safety management, scheduling and administering projects.

Field personnel manually report the following information on a daily basis:

- Type of work being completed
- Location of work being performed
- Labor hours
- Equipment used per activity
- Material being utilized

### 2.3.2. Pavement Management System (PMS)

The DEPARTMENT's PMS was developed in-house and currently operates under the general direction of the Pavement Analysis section of the Material's Division. The system serves as the application capable of supporting many users and functions. It is in compliance with federal and state regulations and provides information for use in network and project level planning activities. It also fulfills the requirements for all State and Federal data reporting requirements including the Highway Performance Monitoring System (HPMS).

In the early 1980s the DEPARTMENT recognized the need to establish a system in which the pavement data being collected could be stored and evaluated in order to compare pavement conditions. This was done to provide an improved basis for decision making and analysis and improving the quality and performance of the State Maintained road network while minimizing the costs of repairs. Over the course of the last three decades the DEPARTMENT has worked to improve upon this original vision and has made many major improvements to its pavement management process in order to keep current with changing industry standards and technological growth.

The DEPARTMENT is currently accountable for approximately 5,400 centerline miles of road and relies heavily on the data reported from within the PMS application. The PMS consists of a collection of thirteen different functional areas which, due to the diversity of the data being collected, are contained in individual databases referred to as modules. Each module is designed specifically to facilitate and organize field testing activities, data collection, and data reporting for each functional area of the PMS and allows for flexibility in updating as user needs grow and additional federal requirements become mandated. Each module within the PMS performs processes independently of one another, certain modules are also linked within the PMS enabling the modules to be relational with one another. The combination of these modules creates the foundation of the PMS that supports many network and project level activities.

The following is a summary of the modules contained within the DEPARTMENT's PMS and will be integral parts of a new system.

**1. Condition Module**

The Condition module consists of pavement distress data. Distress data are collected by the DEPARTMENT district personnel on a biennial basis according to the data collection procedures outlined in the *NDOT Flexible Pavement Distress Identification Manual* and the *NDOT Rigid Pavement Distress Identification Manual*. Personnel document distress data on standardized forms which are then forward to the Pavement Analysis section for input into the PMS.

**2. Contract Module**

The Contract module is comprised of an inventory of physical pavement features, traffic characteristics information, a detailed record of the current pavement structural section, and current project information including cost data.

**3. Data Warehouse Module**

The Data Warehouse is a repository of much of the information that is entered or downloaded into the various PMS modules. The Data Warehouse is a read only viewer created for users interested in a "snapshot" of particular pavement segments without having to retrieve individual data class information from other modules.

**4. Friction Module**

The Friction module is where all network level pavement surface friction testing activities are scheduled, organized, and stored. Surface friction testing is performed biennially at the network level for all rigid or concrete pavements. The Friction module contains pavement surface friction testing data, a scheduling feature, calibration records, a reporting feature, and data validation tools. Processed surface friction data are cataloged by routes and includes information about the testing event such as test wheel, air temperature, lane identification, and speed record. The output of the processed data are the raw and adjusted friction numbers for the pavements tested.

**5. HPMS Module**

The HPMS module is where all information is collected, organized and stored for all the HPMS sample segments requiring pavement data. The tables within this module allow for data to be manually entered for each sample segment where applicable according to the requirements outlined in the *Federal Highway Administration (FHWA) HPMS Field Manual*. Functions are also available within this module to import ride and condition data collected and reported in other modules within the PMS.

**6. Rating Segment Module**

The Rating Segment module separates the network into smaller rating segments in order to systematically manage and accomplish work in an organized manner. In addition to route separations with cumulative milepost locations, the routes are divided into rating segments that are based on several factors. Factors include construction contract breaks, maintenance boundary breaks, functional class breaks, one-mile sections for each direction of travel, and pavement type.

The rating segments allow testing and pavement condition data to be collected and analyzed with consistent and repeatable results. The data contained in the Rating Segment module is used synergistically with other modules within the PMS. The information in the Rating Segment module must be linked to each of the other modules in order to ensure that all testing and monitoring activities are scheduled and collected according to the appropriate rating segment locations.

**7. Maintenance Module**

The Maintenance module is where information about preventive surface treatments is incorporated into the PMS based on information provided by the Maintenance and Asset Management Division. The Maintenance module produces a list of all recommended maintenance treatments related to pavement management and the associated average costs required to extend pavement service life based on the average PMS points calculated and predominant distresses reported in other modules of the PMS. Preferred treatments include micro-surfacing and sand, fog, scrub, and chip seals. Patching, crack filling/sealing, base and surface repairs, and joint and spall repair are also used to prolong pavement service life.

**8. Project Level Activities Module**

The Project Level Activities module is storage for all core sampling and surface friction, deflection, and roughness or ride testing results collected for individual projects. For the purposes of data collection the Pavement Analysis section owns and operates two truck mounted core drills, a High Speed Laser Road Profiler manufactured by International Cybernetics Corporation (ICC), a Locked Wheel Friction tester manufactured by ICC, and two Falling Weight Deflectometers (FWD) manufactured by Dynatest.

**9. Project Priority Module**

The Project Priority module is where a list of priority projects to be considered for the 3R work program is generated. Priority is based on the road prioritization category, the number of years since the last rehabilitation treatment, predominate distress modes the pavements are experiencing, and input from district engineers. This module combines project specific data for each priority project so that reports can be generated for pavement managers and pavement structural design engineers. The data contained in the Project Priority module is used synergistically with the Contract module records.

**10. Roadbed History Module**

The Roadbed History module contains the historical pavement structure inventory from previously awarded construction contracts. This inventory has complete construction details of pavement history including the thickness of each layer in the pavement structure, types of materials used, contract award dates, contract completion dates, and any approved pavement related change orders that altered the structural section. The records include several referencing methods such as mileposts, cumulative mileposts, and survey stationing. Data can be queried by contract number, route and milepost, type of asphalt cement binder, type of rehabilitation strategy or material, or type of pavement.

**11. Ride Module**

The Ride module is where all network level roughness or ride data are planned, processed, organized, analyzed, and stored. The ride data consists of the International Roughness Index (IRI), rutting and faulting data. Ride testing is performed biennially on the state-maintained roadway network and annually on the National Highway System (NHS) as required by the HPMS. The Ride module contains ride data, a scheduling feature, and data validation tools. Processed ride data are cataloged by route and includes information about the testing event.

**12. Weather Module**

The Weather module contains all the climate and environmental related data for each pavement segment. The state is divided into zones that share similar climatic conditions and further subdivided into areas relative to elevation, yearly precipitation, maximum and minimum temperatures, number of wet days, number of freeze-thaw days, and regional factors.

**13. PMS Point Calculation Module**

DEPARTMENT has developed its own pavement rating system to quantify pavement condition in terms of a Point Rating Index (PRI) which is used as a means for ranking and comparing the condition of pavement segments with different distresses and road functional classifications. The PRI consists of mathematical formulas and assigned values for specific distresses that are added together resulting in a cumulative PMS point score for each pavement segment. The PMS point score then corresponds to four different condition repair categories: Preventive Maintenance, Corrective Maintenance, Overlay, and Major Rehabilitation.

The PMS is equipped with many universal functions in addition to the programs and processes built into each PMS module for data specific functions. The system allows for administrators to assign user permissions and can track user activity within the system. Within each module there are built-in commands to allow for data and route segment locating, saving, exporting, adding or deleting records, performing queries within the module, user specific and ad-hoc reporting, and data editing. There are also procedures within each module that allow for users to perform QA/QC procedures on the data and test schedules allowing data within the module to be cross referenced with data in other modules to ensure accuracy and completeness.

The PMS is in need of replacement and/or major modification due to its age and incompatibility with newer technologies. Modifications under consideration include the addition of new functionalities such as a GIS component to allow users to easily perform spatial analysis on the pavement data, a more systematic way to handle the new HPMS data collection and reporting requirements, sophisticated predictive analysis tools to determine deterioration rates and to predict pavement performance, and system interfaces which will allow the PMS to access data stored in other DEPARTMENT systems as well as allow other systems to access PMS data.

### 2.3.3. Bridge Management System (BMS)

The current BMS is Bentley's InspectTech version 5.7.0. The InspectTech software was implemented in 2012 to facilitate the collection, management, storage, and reporting of the DEPARTMENT's bridge inventory data. The InspectTech software is currently licensed and maintained by Bentley. This software replaced the previous PONTIS software.

The Bridge Inventory staff begins the bridge management process by assigning a bridge number to the asset after receipt of a contract, or plans by other government agencies. Geometrics of the asset are obtained, element types are determined and quantified plus the location verified. A load rating is then performed and an inventory inspection is scheduled, which involves coordination between equipment operators, a traffic control crew, and the inventory inspectors.

The inventory inspection is performed, verifying the information derived from the plans. Photographs are taken, coordinates are confirmed by GPS, and laser measurements verify the contract plans specifications. All functions performed to this point are manually recorded on paper.

The bridge management data is input from two sources: data from the new assets gathered by the inventory staff inspectors, and data gathered by the staff bridge inspectors from the previously established, older assets. Both sources use the same data collection software at this time. These asset reports are subject to review for quality control.

When the inspection is finished, bridge staff will create the structure and complete a report in InspectTech. Entries, such as Latitude-Longitude fields and current ADT figures, require manual entry across hundreds of units due to lack of integration and inability to affect changes to InspectTech. Lists such as the Initial Bridge Number Assignment List, the Minimum Vertical

Under Clearance List, the Contract Number List, and the Other Agency Plans List are also kept separately, manually and are not available to share.

The current version of InspectTech does not provide the management or reporting capabilities required under MAP-21 and this function must be done manually.

At the end of the inspection year, bridge data is converted into an ASCII file, which is sent to the Federal Highway Administration, satisfying the National Bridge Inspection Program requirements. Any errors encountered in this ASCII file must be manually tracked back to the individual bridge to make the change (Macro's can be used to help but can be just as time consuming to create/use). Sample and population bridge data is made available to Nevada State government, for the purposes of budget allocation, bridge maintenance, rehabilitation and replacement. Statistical data is also provided to other DEPARTMENT divisions, as well as to outside inquiries.

Business processes the DEPARTMENT is seeking to improve as a result of implementing an EAMS are:

1. NBI and element data collection options including tablets and laptop computers
2. Bridge management functionality with NBI and element level data
3. Exporting and importing capabilities with NBI and element level data
4. NBI and element data reporting in accordance with FHWA requirements
5. Integration with management systems of other divisions

#### 2.3.4 Intelligent Traffic System (ITS)

ITS devices are currently tracked and managed manually via Excel spreadsheets provided by the contractor at the end of a project. The DEPARTMENT is in the process of entering these assets into a basic system to meet maintenance, tracking and reporting needs. The current system does not include essential functionality needed today, including: tracking supplier information (cost and warranty), tracking assets within a location (facility or vehicle), and advanced work order management options (maintenance history, work order alerts, scheduled maintenance needs, preventive maintenance and the ability to interface with the financial system). Another functionality that is limited in the current process is the ability to interface with mobile devices in the field, resulting in incomplete and incorrect records, as work orders cannot be completed until the field technician returns to the office. Due to the lack of the above functionalities, maintaining assets and evaluating asset maintenance needs is cumbersome and inefficient.

Several DEPARTMENT ITS assets are managed and maintained by local jurisdictions throughout the state. These types of assets are owned by the DEPARTMENT but maintained by a local jurisdiction; maintenance requirements, warranty and reimbursement of costs are negotiated through a contract for individual or multiple assets. There is currently no system that maintains this information or allows for immediate retrieval of the contract specifics to determine

responsible party requirements. Due to the lack of a central system, research on individual contracts is time consuming and inefficient.

In 2004 The DEPARTMENT and the Regional Transportation Commission of Southern Nevada (RTC) became full-fledged funding partners, contributing to the operations and management of The Freeway and Arterial System of Transportation (FAST). In conjunction with RTC and the DEPARTMENT, FAST is responsible for the management, maintenance and operation of the dynamic message signs, traffic cameras and ramp meters on valley freeways. FAST is also responsible for traffic signal coordination on Southern Nevada's major roadways. Many of the DEPARTMENT's ITS assets are managed through the FAST asset management system. Currently FAST provides electronic reports to the DEPARTMENT regarding ITS assets, maintenance, and operation. Due to the inability to interface with the FAST asset management system or upload updated asset information into the current application, the process is manually done via Excel spreadsheets and then manually entered into the existing asset tracking system.

Business Processes the DEPARTMENT is seeking to improve as a result of implementing an EAMS are:

- Field data will be entered immediately, as it can be done in the field via a mobile device
- Field Managers will be able to more efficiently manage crew time by reviewing all maintenance needs for a given location and proactively complete preventive and scheduled maintenance
- Ability to review ITS asset information including maintenance history, repair costs and time, contract information with responsible party and warranty information
- Ability to update asset information managed by FAST

### 2.3.5 Fleet and Fuel Management System (optional)

AssetWorks FleetFocus M4 is the management application that tracks all functions related to fleet maintenance. FleetFocus M4 tracks preventative maintenance and repairs of DEPARTMENT vehicles and equipment as well as manages inventory of several stockrooms. The current application has been in use by the DEPARTMENT since 1998. The software is application driven and the data is stored on a server. Used in conjunction with FleetFocus M4 are Phoenix Fuel and Petro Vend which are the DEPARTMENT's fuel management systems. The FleetFocus M4 application is close to end of life and is being considered for replacement or upgrade. The DEPARTMENT is seeking information on fleet and fuel management solutions that may be available as part of, or integrate well with, an EAMS solution.

### 2.3.6 Needs Repository/Needs Analysis (optional)

The DEPARTMENT is seeking recommendations on systems that will facilitate a better transportation planning process to enable DEPARTMENT staff to plan the transportation infrastructure based on needs. This should be a comprehensive system to store needs collected from all DEPARTMENT and outside project agencies. The system should provide for early staff

involvement/research, perform analysis and make recommendations based upon statewide transportation needs.

## 2.4. Functional and System Requirements

### 2.4.1. Universal Requirements

1. Integration with the DEPARTMENT's existing geodatabase and linear referencing systems.
2. Integration of data between the MMS, PMS, ITS and BMS such that work orders by maintenance crews can be viewed by staff in other divisions without having to log into another system.
3. Capture and conversion of historical data.
4. Interface with legacy systems prior to new system implementation.

### 2.4.2. Maintenance Management System (MMS)

The DEPARTMENT's high-level, general functional and universal system requirements for the MMS are listed below. Refer to Section 4 for Detailed Functional Requirements by System/Type.

1. The MMS should generate and track work activity based on labor rates, equipment costs and material costs.
2. The MMS should be integrated with Human Resources and Accounting information to allow for such information as timesheet data, employee names, employee location, pay rates, project data, etc.
3. The MMS should be integrated with the bridge information to allow for work orders describing bridge maintenance will be part of MMS and could be planned, budgeted, and tracked in one system.
4. The MMS should be integrated with the Pavement Management System to allow for recommended pavement activities and select those that are funded and programmed. MMS will also provide actual pavement treatment.

### 2.4.3. Pavement Management System (PMS)

High-level, general functional and universal system requirements for the PMS are listed below. Refer to Section 4 for Functional Requirements by System/Type.

1. Data collection and management functionality (e.g., inventory of physical pavement features, project information, condition survey information, traffic characteristics).
2. Data Analysis (e.g., pavement condition analysis).
3. Predictive Analysis (e.g., deterioration rate models and economic analysis).
4. Project Prioritization (e.g., future projects, budget scenarios).
5. Collection of HPMS data as required by FHWA
6. Retention of a static version of the PMS data on an annual basis and be accessible by the DEPARTMENT's Oracle BI tool.
7. Generate standard reports and allow users to create custom queries.

#### 2.4.4. Bridge Management System

The DEPARTMENT's high-level, general functional and universal system requirements for the BMS are listed below. Refer to Section 4 for Detailed Functional Requirements by System/Type.

1. The BMS shall include the capability to collect, maintain, and report bridge condition data in accordance with the National Bridge Inspection Standards as defined in the FHWA Recording and Coding Guide and the National Bridge Inventory Elements as defined in the AASHTO Manual for Bridge Element Inspection.
2. Capability for inspection, measurement, inventory and reporting of all types of infrastructure & structural assets including bridges & tunnels (including understructure), culverts, signs, utility/light poles, antenna towers, waterway (including underwater), storm water, guardrails, retaining walls, noise barriers and other ancillary items and structures.
3. Capability for developing an optimal preservation strategy and analysis to include:
  - a. Scheduled Routine & Capital Preventive Maintenance
    - i. Schedule, manage and coordinate bridge inspections, maintenance requirements, and the bridge inspectors and crews including intelligent tracking of asset inspection type required and when inspections are due and automatic alerts of upcoming and overdue inspections.
  - b. Preservation Prioritization Planning
    - i. Capability for Scenario Modeling & Analysis with time-based deterioration predictions.
  - c. Structural Improvement, Rehabilitation & Replacement
    - i. Capability for Economic Modeling & Analysis to include capital improvements, identification, prioritization and cost of alternative.
4. Capability to perform ad-hoc queries: by districts, counties, states, areas, roads, NBI data points, number elements and inspection reports by date.
5. Capability to scan any document including drawings, sketches, maps, and other important documents and include it as an attachment in reports, including old inspection reports, which can be placed in a database for reference.
6. Include and incorporate an interactive GIS-based map that displays the position of each asset allowing for pinpoint accuracy in locating any asset as well as allowing the user to zoom into the map and view the asset from a street view.
7. Include wireless/advanced mobility using mobile tablets in the field to include iPad and Android (top 3 vendors) with access and capabilities for users to process planning inspections, collecting and managing inspection data, complying with government reporting requirements, in-the-field data collection, automatic uploading of field data to the server and in-context inclusion of photos, audio, video and help/manuals/guides.
  - a. Include real-time synchronization of asset and inspection information.

#### 2.4.5. Intelligent Traffic System (ITS)

The DEPARTMENT's high-level, general functional and universal system requirements for the ITS are listed below. Refer to Section 4 for Detailed Functional Requirements by System/Type.

1. Generate and track work activity based routine, preventive maintenance, emergency repairs and pre-planned work.
2. Allow for work orders to be created with sub tasks for different users and/or crews.
3. Integrate with the Human Resources and Accounting information to allow for such information as timesheet data, employee names, employee location, pay rates, project data, etc.
4. Predictive maintenance, (e.g., preventative and routine maintenance and required maintenance after a device failure).
5. Management of a multi-location inventory database.

### 3. Vendor Responses

Vendor Responses should consist of the following sections. Each section is described below.

#### 3.1. Section 1 – Executive Summary

Vendors shall provide an executive summary written in non-technical language to summarize the overall capacity and recommended approaches for an Enterprise Asset Management System (EAMS) that includes the following systems:

- Maintenance Management System
- Bridge Management System
- Pavement Management System
- Intelligent Transportation System
- Fuel and Fleet Management System (optional)
- Needs repository and needs analysis solutions (optional)

#### 3.2. Section 2 – System Functionality

This section should describe recommended implementation strategies for the EAMS solution including a recommended rollout strategy and potential project plan indicating timeframes for phases as well as the entire project. A suggested resource matrix should be included with defined roles for potential project participants. This will help the DEPARTMENT determine project member needs and availability of project resources.

#### 3.3. Section 3 – Recommended Solution

Vendors should provide detailed information on their proposed solution(s). The information should include recommendations taking into consideration the DEPARTMENT's initially documented functional processes and system requirements – found in Section 4.

### 3.4. Section 4 – Concept of Operations

Describe how the solution would satisfy the DEPARTMENT’s EAMS needs based on background information, requirements, current processes and recommended implementation strategies.

### 3.5 Section 5 - Cost

While this RFI will not result in an award, the DEPARTMENT needs cost estimates in order to proceed with an RFP. The DEPARTMENT’s initial research and investigation of potential costs returned an estimate of \$5 to \$8 million. The DEPARTMENT asks vendors to respond with typical costs for similar implementations. If the proposed solutions are modular in nature the DEPARTMENT asks vendors to respond with costs for each module offered. Cost estimates should include other implementation, maintenance and support costs (e.g., hardware, application software licenses, third party licenses, system maintenance).

#### **3.5.1. Opportunities to share risk or otherwise reduce costs**

Use this section to describe any suggestions on how DEPARTMENT could reduce costs for this project.

### 3.6 Section 6 - Past Performance

Using the categories listed below provide a list of agencies that have implemented the solution and three client references. The descriptions should include current references in the user organizations and sufficient information for the DEPARTMENT to understand the vendor’s capabilities and experience in designing, configuring and implementing an EAMS solution.

Client Name:	
Project Name:	
Primary Contact Information:  <i>Name:</i>  <i>Street Address:</i>  <i>City:</i>  <i>State:</i>  <i>Zip:</i>  <i>Phone, including area code:</i>  <i>Facsimile, including area code:</i>  <i>Email address:</i>	Alternate Contact Information:  <i>Name:</i>  <i>Street Address:</i>  <i>City:</i>  <i>State:</i>  <i>Zip:</i>  <i>Phone, including area code:</i>  <i>Facsimile, including area code:</i>  <i>Email address:</i>
Description of client:	
Brief description of the project/contract:	
Project/contract start date:	
Project/contract end date:	
Length of project/contract:	
Project/contract value:	
Proposer's management personnel/key personnel on the project/contract:	
Size and complexity of the project/contract:	
Application Software (i.e., Java, Cobol, etc.):	
Operating System Software (i.e., Unix):	
Hardware Platform (i.e., IBM RISC 6000):	
Size of Database:	

### 3.7 Section 7 - Vendor Questions

#### 3.7.1 System Functionality and Architecture Questions

Provide an overview of the solution, including a description of which systems can be addressed by it (PMS, BMS, MMS, ITS, Fuel, Fleet)

Identify which functional requirements can be addressed by the solution. Explicitly flag any requirements that cannot be met or that would be cost prohibitive.

Describe system functionalities that the DEPARTMENT has not listed, but should be a consideration.

Describe how the system integrates historic data from management systems operated prior to the launch of the system (e.g., is there a data migration process to move data to the new system or is the recommendation to leave the previous system operational to support data integration?) and describe the anticipated complexity of this effort.

If the solution can serve as a PMS, describe how it predicts pavement condition. For example, does it use a deterministic or probabilistic approach? Describe the process used to develop agency-specific deterioration models, and what types of data are required. How can the DEPARTMENT determine if its existing data is sufficient for this purpose? Based on examples from other DOTs, describe the level of effort required to develop these types of models.

If the solution can serve as a PMS, describe the approach used to recommend treatments. What information and what level of effort are required to develop agency-specific recommendations?

Describe how the system would handle HPMS reporting requirements, and how the system could support the DEPARTMENT in the annual required HPMS reporting process.

Explain how your MMS system tracks human resources, equipment charges and materials.

Describe the system architecture of the solution. For example, what data management system does it use, how can it be integrated with the other systems, etc. Provide examples of integration from other DOTs.

Describe how the solution can integrate with a DOT's existing linear referencing system. Provide examples from other DOTs. Can linear referenced roadway events and attributes (e.g., pavement condition) be input directly into the solution without first converting the linear measures to an internal or proprietary LRS?

Does the solution include any mapping and/or geospatial analysis capabilities, or the ability to generate GIS-compatible output files? If so, what GIS-output files does it support?

Does the proposed solution interface with ESRI Roads and Highways LRS Management software? If so, describe this interface.

Are installations of the Asset Management system typically hosted by the purchasing agency or hosted by the software vendor?

Describe data conversion issues typically encountered with installation, man-hours to complete, and database/data resolution based on prior system conversions.

If the solution can implement more than one of the systems in this RFI, what are implications of implementing of single solution vs multiple solutions? Describe in terms of external costs and internal resources needed to support the solution.

Describe the main drivers that will influence the final solution. What issues could affect the range of cost?

Provide an estimate for the level of effort required by internal DEPARTMENT staff to maintain the system once it has been implemented. Also describe any special training that is necessary with the average number of hours to perform this training.

What other items should the DEPARTMENT consider when developing the RFP?

### **3.7.2 ITS Specific Questions**

What Intelligent Transportation System (ITS) assets are typically tracked using your system?

Have you tracked and maintained radio equipment through your system? Is it capable of tracking these types of assets?

Have you tracked and maintained ITS Electrical Subsystems through your system? Is it capable of tracking these types of assets?

Have you tracked and maintained ITS Equipment Facilities through your ITS system? Is it capable of tracking these types of assets?

Have you tracked and maintained ITS Statewide Telecommunication Subsystems through your ITS system? Is it capable of tracking these types of assets?

Does your system have the ability to manage internal accounting and billing? Example: the DEPARTMENT has three districts that maintain their own assets, if an asset is moved from District 1 to District 3 the asset needs to be billed by District 1 and paid by District 3. The asset will then need to be tracked as an asset that was owned by District 1 and was transferred to District 3, keeping all historical data attached to the asset for both Districts.

Does your system offer the ability to create predictive work orders for standard maintenance of ITS assets? If yes, does your system allow for the generation of predictive work orders as a result of failure events?

**3.7.3 Optional Items**

Does your system offer the ability to manage fleet and fuel assets? If no, does your system offer the ability to interface with a fleet and fuel management system?

Does your system offer a needs repository/database? If yes, does your system offer the ability to perform needs analysis and executive level needs planning and reporting?

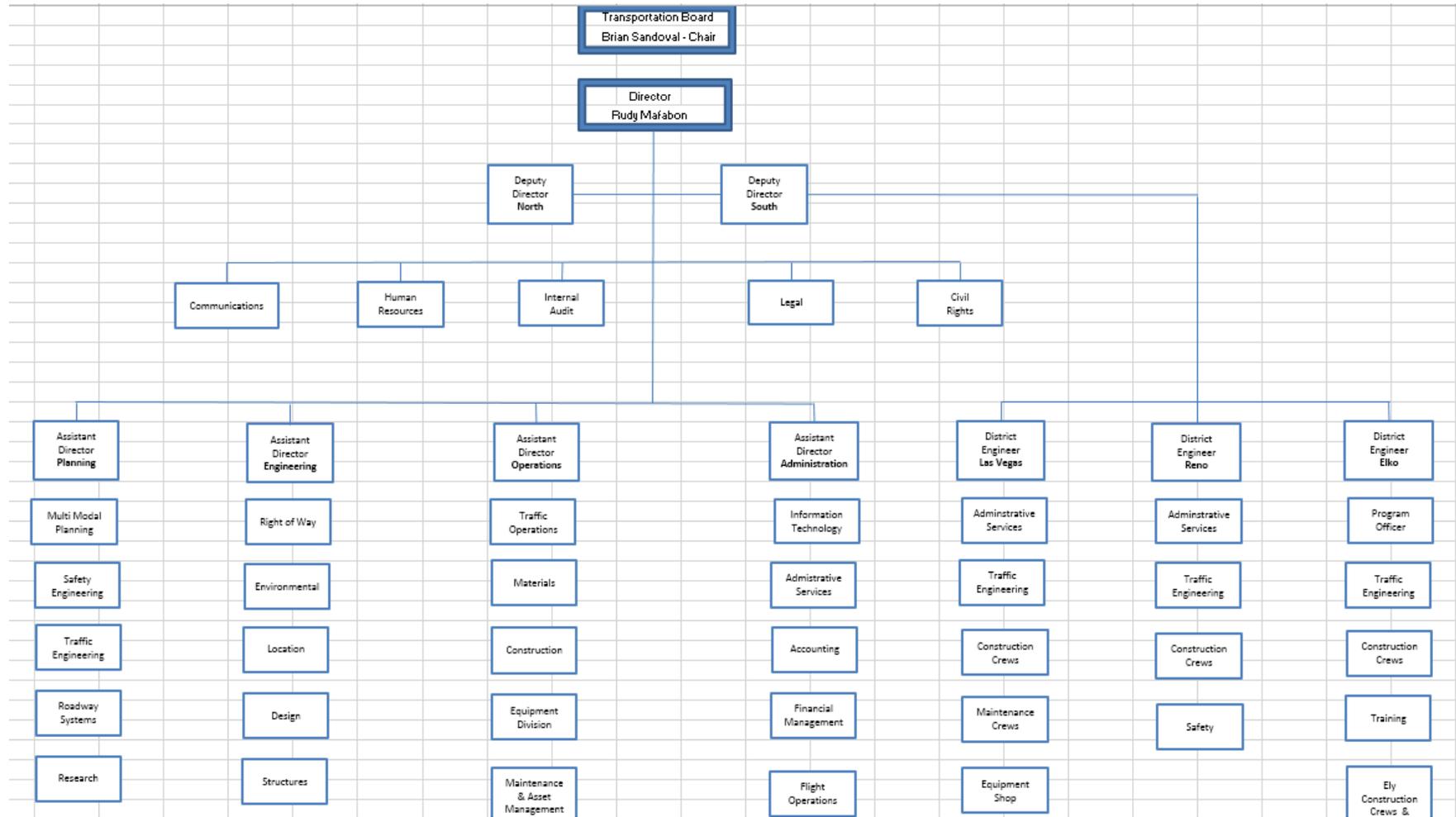
**3.7.4 Vendor Comments**

As part of the response to this RFI, please feel free to include any additional comments or suggestions that your company believes would be helpful to the DEPARTMENT.

Vendors may submit comments and questions to the RFI Coordinator prior to responding to the RFI by the date indicated in the RFI schedule in section 1.3. Responses to vendor questions will be considered addendums to the RFI. Modifications to the RFI that may result from Vendor comments will be posted to the procurement website. Where there appears to be a conflict between the RFI and any addendum issued, the last addendum issued will prevail.

## 4 Exhibits

### 4.1 DEPARTMENT Organization Chart



### 4.2 Functional Requirements by System/Asset Type

\*Note: This list is provided solely as a guide to inform vendors of the current system and functional requirements collected to date. This list is in no way an exhaustive or complete statement of requirements that might be applicable.

Requirement Number	Functional Area	Requirement Type	Requirement Description	Project Priority	System
1	Universal	Functional Global	The system must provide a suite of software solutions to support Pavement Management, Maintenance Management, Bridge Management and Intelligent Transportation Systems (ITS) Management.	Mandatory	All Systems
2	Universal	Functional Global	The system must be integrated within each of the functional areas and share key data so as not to require the entry of duplicate data.	Mandatory	All Systems
3	Universal	Functional Global	The system must interact with additional systems to support asset management (Human Resources and Accounting).	Mandatory	All Systems
4	Universal	Functional Global	The system must integrate with ESRI Roads & Highways so the geodatabase is always synchronized with new asset management system.	Mandatory	All Systems
5	Universal	Functional Global	Most authorized State of Nevada users will need to access the system using the internet. Due to geographical and bandwidth challenges, there are many maintenance sites that operate with low bandwidth and satellite latency limitations. The system needs to allow for off network use and data gathering on tablet type devices for later data upload and down from sites that are on or off the NDOT network.	Mandatory	All Systems
6	Universal	Functional Global	The system needs to provide role-based user authentication and access. Users will range from inquiry users to users with full access to add, change and delete data. User ID's and passwords will be used by users to gain access to the system with the privileges allowed in the users' profile.	Mandatory	All Systems
7	Universal	Functional Global	The system needs to be designed such that data can be entered once and not in each individual system (MMS, PMS, ITS, etc.).	Mandatory	All Systems

Requirement Number	Functional Area	Requirement Type	Requirement Description	Project Priority	System
8	Universal	Functional Global	The system needs to use the existing NDOT geodatabase and linear referencing system as the common core map and roadway attribute source.	Mandatory	All Systems
9	Universal	Functional Global	The system needs to be operational 24/7 as a critical system with safeguards in place such that downtimes are very minimal.	Mandatory	All Systems
10	Universal	Functional Global	The system needs to allow administrators in each functional area the ability to perform the following functions: 1) Identify which users are logged in at any time, 2) Send broadcast messages at any one time, 3) Log off users, 4) Provide a bulletin board function that provides urgent message or calendars of upcoming outages	Mandatory	All Systems
11	Universal	Functional Global	The system needs to be able to store and possibly retrieve large amounts of data.	Mandatory	All Systems
12	Universal	Functional Global	The system needs to be able to comply with federal regulations for reporting (MAP 21). Implementation staff needs to be knowledgeable about federal requirements so the new system can be modified to meet changing federal requirements in the future.	Mandatory	All Systems
13	General	Functional	The system needs to be available for use by a wide range of NDOT maintenance employees from division director to maintenance supervisor.	Mandatory	MMS
14	General	Functional	The system needs to allow maintenance employees to enter start and stop work times for various activities they perform and for foreman to be able to enter start and stop times for employees they supervise.	Mandatory	MMS
15	Maintenance Management Support	Functional	The system shall provide information to support decisions about maintenance activities to be performed including roadway features requiring maintenance by organizational unit.	Mandatory	MMS

Requirement Number	Functional Area	Requirement Type	Requirement Description	Project Priority	System
16	Maintenance Management Support	Functional	The system shall provide information to support decisions about recommended short and long term preservation treatments from PMS.	Mandatory	MMS
17	Maintenance Management Support	Functional	The system shall provide information to support decisions about level of service reports for each inventory feature.	Mandatory	MMS
18	Maintenance Management Support	Functional	The system shall provide information to support decisions about work activity standards, including labor, equipment and materials costs.	Mandatory	MMS
19	Maintenance Management Support	Functional	The system shall provide information to support decisions about planned bridge maintenance activities.	Mandatory	MMS
20	Maintenance Management Support	Functional	The system shall provide for the planning and execution of planned activities by estimating the labor, equipment and materials needs to support planned activities.	Mandatory	MMS
21	Maintenance Management Support	Functional	The system shall track actual labor, equipment, and materials costs on a daily basis and assign these to the appropriate Work Activity and Project.	Mandatory	MMS
22	Maintenance Management Support	Functional	The system shall provide for the tracking of activities to view the extent to which targets are met (budget versus actual).	Mandatory	MMS
23	Maintenance Management Support	Functional	The system will track other direct costs that are entered manually or imported from another system such as human resources or financial system costs such as travel, contractual, supplies, capital equipment and utilities.	Mandatory	MMS
24	Work Activity Standards	Functional	The system shall provide for the tracking of work activity standards to calculate the average daily production of each work activity such as the feature called Potholes and the work activity called Pothole Patching.	Mandatory	MMS
25	Work Activity Standards	Functional	The system shall provide for the creation of labor standards including job classification, number of employees and hours for each job classification.	Mandatory	MMS

Requirement Number	Functional Area	Requirement Type	Requirement Description	Project Priority	System
26	Work Activity Standards	Functional	The system shall provide for the creation of equipment standards for each work activity using class of equipment, number in each class and usage (miles or hours).	Mandatory	MMS
27	Work Activity Standards	Functional	The system shall provide for the creation of material standards for each work activity using material type, quantity and unit cost of the material.	Mandatory	MMS
28	Employee Time Tracking	Functional	The system shall provide the ability for maintenance and operations staff to record their start and stop times, type of activity performed and route which the activity was performed.	Mandatory	MMS
29	Employee Time Tracking	Functional	Employees will have the ability to print out their timesheet enabling them to sign the timesheet.	Mandatory	MMS
30	Employee Time Tracking	Functional	Managers shall have the ability to view employee time worked on different projects including the following summaries: by work activity, by employee, by crew, by project, and crew.	Mandatory	MMS
31	Employee Time Tracking	Functional	The system shall provide for foreman or designated individuals to enter time for multiple employees.	Mandatory	MMS
32	Employee Time Tracking	Functional	The system shall provide for the entry of employees' time worked for an entire group of employees worked together on one activity.	Mandatory	MMS
33	Employee Time Tracking	Functional	The system shall provide for timesheets entered for groups shall print out as individual time sheets for each employee to sign.	Mandatory	MMS
34	Equipment Use and Calculation of Costs	Functional	The system shall provide the ability to record hours per day that individual pieces of equipment use, describe the type of work activity performed and the specific project the equipment was used for.	Mandatory	MMS

Requirement Number	Functional Area	Requirement Type	Requirement Description	Project Priority	System
35	Equipment Use and Calculation of Costs	Functional	The system shall provide for winter maintenance where users assign the roadway that trucks are used when assigning hours per day.	Mandatory	MMS
36	Equipment Use and Calculation of Costs	Functional	The system shall provide for an equipment list that is stored in the system and can be maintained.	Mandatory	MMS
37	Equipment Use and Calculation of Costs	Functional	The system shall perform calculations to determine actual costs to assign to work activities and project based on usage rates that could come from another system.	Mandatory	MMS
38	Equipment Use and Calculation of Costs	Functional	The system will need to provide for allocation of rental costs to multiple projects by percent and dollars. For example a rented roller assigned to 3 projects.	Mandatory	MMS
39	Materials Used and Calculation of Costs	Functional	The system shall provide for the ability to record the amount of material used per day, describe the type of work activity the materials used and specific project the material was used for.	Mandatory	MMS
40	Materials Used and Calculation of Costs	Functional	The system shall provide for a material list that is stored in the system and can be maintained.	Mandatory	MMS
41	Materials Used and Calculation of Costs	Functional	The system shall record and make available information describing the amount of each material used per day including work activity and projects.	Mandatory	MMS
42	Materials Used and Calculation of Costs	Functional	The system shall calculate and make available actual costs to assign to work activities and projects based on reports of materials used per day and materials costs from the procurement system.	Mandatory	MMS

Requirement Number	Functional Area	Requirement Type	Requirement Description	Project Priority	System
43	Materials Used and Calculation of Costs	Functional	The system shall maintain a record of materials in-stock and determine when supplies are getting low. The system should provide for messaging when material supplies fall below a threshold.	Mandatory	MMS
44	Materials Used and Calculation of Costs	Functional	The system shall provide for the creation and use of existing templates that they develop for crews allowing for the selection of employees, start/stop times, equipment used, hours used and materials used.	Mandatory	MMS
45	Bridge Maintenance	Functional	The system shall provide MMS users with the ability to view planned and completed bridge maintenance activities.	Mandatory	MMS
46	Feature Inventory and Treatments	Functional	The system shall calculate the Feature Inventory for all organizational units and allow users to view results.	Mandatory	MMS
47	Feature Inventory and Treatments	Functional	The system shall develop and recommend treatments based on the Feature Inventory and planned work.	Mandatory	MMS
48	Feature Inventory and Treatments	Functional	The system shall store site inspection information each year.	Mandatory	MMS
49	Feature Inventory and Treatments	Functional	The system shall provide for the random selection of sites to be inspected.	Mandatory	MMS
50	Feature Inventory and Treatments	Functional	The system shall provide for the identification of excluded segments. These excluded segments will not be selected in the random generation process.	Mandatory	MMS
51	Feature Inventory and Treatments	Functional	The system shall provide for the entry of data from tablet devices used in the field.	Mandatory	MMS
52	Feature Inventory and Treatments	Functional	The system shall provide for NDOT staff maintenance workers as well as external users who have contracted with NDOT to perform the maintenance work.	Mandatory	MMS

Requirement Number	Functional Area	Requirement Type	Requirement Description	Project Priority	System
53	Feature Inventory and Treatments	Functional	The system shall provide for the entry of roadway attributes, such as driving surface width or shoulder width.	Mandatory	MMS
54	Feature Inventory and Treatments	Functional	The system shall provide for the entry of inventory features including by not limited to: cracks, alligator cracking, potholes, vegetation, chain saw requirements, etc.	Mandatory	MMS
55	General System Functionality	Functional	The ITS system must track all ITS asset inventory examples: Signals, Dynamic Signs, ramp sensors, flow sensors, RWIS Stations.	Mandatory	ITS
56	General System Functionality	Functional	The ITS system must create trouble, maintenance and install tickets based on GPS/Mile Marker location, asset name with priority tracking.	Mandatory	ITS
57	General System Functionality	Functional	The ITS system must allow for creation of tickets, updates to tickets and changes to tickets.	Mandatory	ITS
58	General System Functionality	Functional	The ITS system must allow for the ability to schedule maintenance based on a set of tasks that are individually assigned to multiple users.	Mandatory	ITS
59	General System Functionality	Functional	The ITS system must allow tickets to be created, updated or changed from different platforms (pc, tablet, smart phone).	Mandatory	ITS
60	General System Functionality	Functional	The ITS system should allow for tickets to maintained with or without internet access. (Timestamp will indicate time ticket was maintained).	Mandatory	ITS
61	Reporting	Functional	The ITS system should have the ability to report required maintenance on all equipment in a given location or along a specified route.	Mandatory	ITS
62	GIS	Functional	The ITS system must have the ability to map all devices with the ability to filter by device type.	Mandatory	ITS
63	System Interfaces	Functional	The ITS system must have a web service interface to access and write to the database for 3rd party system access.	Mandatory	ITS

Requirement Number	Functional Area	Requirement Type	Requirement Description	Project Priority	System
64	System Interfaces	Functional	The ITS system must have a web service interface to access and pull from the database to 3rd party system.	Mandatory	ITS
65	General System Functionality	Functional	The ITS system must be compliant with TMDD V3.01 Standards.	Mandatory	ITS
66	System Interfaces	Functional	The ITS system should update 3rd party software that is connected to the Enterprise Asset Management System.	Mandatory	ITS
67	General System Functionality	Functional	The ITS system must maintain a record of the ITS contracts associated with ITS assets.	Mandatory	ITS
68	General System Functionality	Functional	The ITS system should track proposed future ITS asset placement.	Mandatory	ITS
69	General System Functionality	Functional	The ITS system must allow for ITS users to view maintenance records of ITS assets and use these records in future analysis.	Mandatory	ITS
70	General System Functionality	Functional	The ITS system shall recommend standard maintenance activities and costs, with considerations to determination of asset and past maintenance activities.	Mandatory	ITS
71	General System Functionality	Functional	The ITS system shall allow users the ability to enter data and run reports.	Mandatory	ITS
72	Reporting	Functional	The ITS system shall print standard informational reports from all modules.	Mandatory	ITS
73	Reporting	Functional	The ITS System shall allow users to create ad hoc queries and reports.	Mandatory	ITS
74	Data Requirements	Functional	The solution shall include all data requirements mandated by the Federal Highway Administration (FHWA) in the Recording and Coding Guide for the National Bridge Inventory and shall include additional user customizable data fields	Mandatory	Bridge

Requirement Number	Functional Area	Requirement Type	Requirement Description	Project Priority	System
75	Data Requirements	Functional	The solution shall include all data requirements mandated by the Federal Highway Administration (FHWA) in the Specification for the National Bridge Inventory Elements as defined in the AASHTO Manual for Bridge Element Inspection and shall include additional user customizable data fields	Mandatory	Bridge
76	Data Requirements	Functional	The solution shall include the capability for inspection, measurement, inventory and reporting of all types of infrastructure & structural assets including bridges & tunnels (including understructure), culverts, signs, utility/light poles, antenna towers, waterway (including underwater), storm water, guardrails, retaining walls, noise barriers and other ancillary items and structures.	Mandatory	Bridge
77	General System Functionality	Functional	The solution shall include configurable workflow processes	Mandatory	Bridge
78	General System Functionality	Functional	The solution shall include the capability for inspection, measurement, inventory and reporting of all types of infrastructure & structural assets including bridges & tunnels (including understructure), culverts, signs, utility/light poles, antenna towers, waterway (including underwater), storm water, guardrails, retaining walls, noise barriers and other ancillary items and structures	Mandatory	Bridge
79	General System Functionality	Functional	The solution shall include condition summaries by area	Mandatory	Bridge
80	General System Functionality	Functional	The solution shall include condition change trending	Mandatory	Bridge

Requirement Number	Functional Area	Requirement Type	Requirement Description	Project Priority	System
81	General System Functionality	Functional	The solution shall include the capability to attach digital inspection photos directly to a report or link a photo to a specific field to more accurately depict the situation	Mandatory	Bridge
82	General System Functionality	Functional	The solution shall include drop-down boxes that give the inspector choices relevant for specific fields with only valid selections being shown and in-context explanations and information from the integrated bridge inspection manual	Mandatory	Bridge
83	General System Functionality	Functional	The solution shall include built-in error checking with detailed calculations	Mandatory	Bridge
84	General System Functionality	Functional	The solution shall include resource allocation assistance through real-time data and calculations	Mandatory	Bridge
85	General System Functionality	Functional	The solution shall include National Bridge Inventory (NBI) calculations	Mandatory	Bridge
86	General System Functionality	Functional	The solution shall include maintenance needs tracking and prioritization	Mandatory	Bridge
87	General System Functionality	Functional	The solution shall include work order generation, including pictures and descriptions	Mandatory	Bridge
88	General System Functionality	Functional	The solution shall include customizable input fields, forms and report outputs	Mandatory	Bridge
89	General System Functionality	Functional	The solution shall include in-context information from manuals/handbooks	Mandatory	Bridge
90	General System Functionality	Functional	The solution shall include pre-population of fields	Mandatory	Bridge

Requirement Number	Functional Area	Requirement Type	Requirement Description	Project Priority	System
91	General System Functionality	Functional	The solution shall include the capability to either do a tree search which lets a user drill down until you locate the proper asset or do a quick search which allows a user to type a portion of an asset's name and a list will return with assets containing or matching what was typed	Mandatory	Bridge
92	General System Functionality	Functional	The solution shall include an instant search capability across districts/counties/states/areas/roads	Mandatory	Bridge
93	General System Functionality	Functional	The solution shall prompt a user before allowing said user to change data or numbers	Mandatory	Bridge
94	General System Functionality	Functional	The solution shall include integration and organization of all asset photos, reports, sketches, as-built drawings, and other electronic files and structure information into a single location (hosted or in-house)	Mandatory	Bridge
95	General System Functionality	Functional	The solution shall include the capability for Scenario Modeling & Analysis with time-based deterioration predictions	Mandatory	Bridge
96	General System Functionality	Functional	The solution shall include the capability for Economic Modeling & Analysis to include capital improvements, identification, prioritization and cost of alternative	Mandatory	Bridge
97	General System Functionality	Functional	The solution shall include the capability for Life Cycle Cost Analysis to include comparing initial and future cost for the most economical strategy for bridge service life both for in-house costs vs. contract costs; Cost Deferred Maintenance – Relationship between condition and time, cost of deferment vs. benefit of alternative	Mandatory	Bridge

Requirement Number	Functional Area	Requirement Type	Requirement Description	Project Priority	System
98	General System Functionality	Functional	The solution shall include the capability for developing an optimal preservation strategy and analysis to include: (1) Scheduled Routine & Capital Preventive Maintenance (2) Preservation Prioritization Planning (3) Structural Improvement, Rehabilitation & Replacement	Mandatory	Bridge
99	General System Functionality	Functional	The solution shall include a Risk Assessment & Analysis module for seismic risk/ranking, scour risk/ranking, load posting, fracture criticality and fatigue prone	Mandatory	Bridge
100	GIS	Functional	The solution shall include/incorporate an interactive GIS-based map that displays the position of each asset allowing for pinpoint accuracy in locating any asset as well as allowing the user to zoom into the map and view the asset from a street view	Mandatory	Bridge
101	GIS	Functional	The solution shall include geometrics for over-dimensional routing	Mandatory	Bridge
102	GIS	Functional	The solution shall include an interactive GIS map with GIS coordinates for each structure type	Mandatory	Bridge
103	Reporting	Functional	The solution shall include ad hoc queries to include by districts/counties/states/areas/roads, NBI data points and elements plus inspection reports by date	Mandatory	Bridge
104	Reporting	Functional	The solution shall include an executive dashboard for analysis and planning	Mandatory	Bridge
105	Reporting	Functional	The solution shall include summary dashboards in graphical format (bar graphs, pie charts, ECT) for analysis of data sets including percentages, averages, and other critical information such as comprehensive condition and deficiency information	Mandatory	Bridge
106	Reporting	Functional	The solution shall include a reporting capability across districts/counties/states/areas	Mandatory	Bridge

Requirement Number	Functional Area	Requirement Type	Requirement Description	Project Priority	System
107	Reporting	Functional	The solution shall include Report merging; Bridge priority report generation; Category A/Emergency reports; Advanced summary reporting	Mandatory	Bridge
108	Reporting	Functional	The solution shall include the capability to auto-populate inspection reports with data from past reports with any changed fields being highlighted, enabling users to track all changes since the last-time of bridge inspection	Mandatory	Bridge
109	Reporting	Functional	The solution shall include the capability to scan any document including drawings, sketches, maps, and other important documents and include it as an attachment in reports, including old inspection reports, which can be placed in a database for reference	Mandatory	Bridge
110	Reporting	Functional	The solution shall include the capability to create/edit/delete/manage cost estimates and analysis	Mandatory	Bridge
111	Reporting	Functional	The solution shall include the capability to create templates for uniform report generation	Mandatory	Bridge
112	Scheduling	Functional	The solution shall include the capability to schedule, manage and coordinate bridge inspections, maintenance requirements, and the bridge inspectors and crews including intelligent tracking of asset inspection type required and when inspections are due and automatic alerts of upcoming and overdue inspections	Mandatory	Bridge
113	Security	Functional	The solution shall include a level of security that enables the bridge applications security to override that of the central overlying system	Mandatory	Bridge
114	Security	Functional	The solution shall include the capability for the bridge application only, to have full control over the data to include who has access to it	Mandatory	Bridge
115	Security	Functional	The solution shall include the capability to create/delete/manage users, set permissions by inspectors or by asset and assign roles	Mandatory	Bridge

Requirement Number	Functional Area	Requirement Type	Requirement Description	Project Priority	System
116	Technical	Non-Functional	The solution shall include the capability to integrate cloud services for a 24/7 data continuity	Mandatory	Bridge
117	Technical	Non-Functional	The solution shall include real-time synchronization of asset and inspection information	Mandatory	Bridge
118	Technical	Non-Functional	The solution shall include at a minimum field inspection data entry equipment as follows: (1) Headset Hardware – Omni directional wireless microphone headset with Bluetooth compatibility, noise cancelling frequency, speech-to-text competence, variable radius, speech/bridge terminology recognition (2) Inputted Data - Text scan proficiency; ability to match text with inspection coding guide at each element level for automation of condition state (CS) distribution...i.e. Voice prompt – Abutment - Six feet of 1/32" w cracking, Action: 6' in CS 2 (3) Hardware for field entry – Field durable, Touch screen anti-glare display, emissive backlit keys, OS operable across multiple platforms, OS/Hard drive/RAM in the TBs, Wi-Fi/GPS/Bluetooth ready, Camera/Webcam attached	Mandatory	Bridge
119	Technical	Non-Functional	The solution shall include wireless/advanced mobility using mobile tablets in the field to include iPad and Android (top 3 vendors) with access and capabilities for users to process planning inspections, collecting and managing inspection data, complying with government reporting requirements, in-the-field data collection, automatic uploading of field data to the server and in-context inclusion of photos, audio, video and help/manuals/guides	Mandatory	Bridge
120	Data Requirements	Functional	DOT&PF staff need the PMS to import and store pavement data collected during the annual DOT data collection process, as well as data collected in previous years (prior to deployment of the PMS)	Mandatory	PMS

Requirement Number	Functional Area	Requirement Type	Requirement Description	Project Priority	System
121	Function - Contracts	Functional	The PMS shall maintain a record of the roadway inventory data	Mandatory	PMS
122	Function - Contracts	Functional	The PMS shall maintain a record of the paving contracts associated with a roadway	Mandatory	PMS
123	Function - Contracts	Functional	The system must interface with ESRI Roads and Highways in near or real-time to maintain the most recent published database containing the linear referenced centerline network	Mandatory	PMS
124	Function - Contracts	Functional	The PMS shall track the calculated cost of the current maintenance contract for each roadway segment	Mandatory	PMS
125	Function - Contracts	Functional	The PMS shall interface to the Maintenance Division's Seal Cost Completion data in order to track current maintenance work completed	Mandatory	PMS
126	Function - Contracts	Functional	The PMS shall track proposed future construction work	Mandatory	PMS
127	General System Functionality	Functional	DOT planners and program managers need a Pavement Management System (PMS) interface they can log in to see:Current and historic roughness and ruttingProjected pavement conditions, based on a deterioration algorithm (considering current conditions and previous treatments that were performed on the roads)Recommended maintenance activities	Mandatory	PMS
128	General System Functionality	Functional	DOT planners and program managers need the PMS to operate an algorithm/model that determines deterioration rates to predict future pavement conditions	Mandatory	PMS
129	General System Functionality	Functional	DOT planners and program managers need the PMS to recommend maintenance and repair activities that not only repair ruts, cracks, and rough roads; but also that would recommend preventative maintenance to avoid more costly repairs in the future.	Mandatory	PMS

Requirement Number	Functional Area	Requirement Type	Requirement Description	Project Priority	System
130	General System Functionality	Functional	DOT planners and program managers need the PMS to support the budgeting process and condition targets of MAP-21 by identifying 10-year cost scenarios for different preventative maintenance strategies, identifying the expected overall costs.	Mandatory	PMS
131	General System Functionality	Functional	DOT planners and program managers need a PMS to generate recommended pavement management activities (both preventative and repair) to be used in the annual programming process and to allow DOT to select the final programmed maintenance activities.	Mandatory	PMS
132	General System Functionality	Functional	DOT needs the PMS to acquire information about the pavement management activities that actually were performed, and to use these descriptions of maintenance performed in future analysis.	Mandatory	PMS
133	General System Functionality	Functional	DOT needs the PMS to support the annual Highway Performance Monitoring System (HPMS) reporting process by creating files to be used in the reporting process.	Mandatory	PMS
134	General System Functionality	Functional	PMS users need the ability to view future planned projects to understand when construction or reconstruction is planned in order to consider these activities when planning pavement preservation activities. Note: this need may not be addressed by the PMS.	Mandatory	PMS
135	General System Functionality	Functional	DOT needs the PMS to support pavement performance prediction model development and calibration, for pavement design purposes.	Mandatory	PMS
136	General System Functionality	Functional	The PMS shall contain a Pavement deterioration model to predict 10 years of pavement conditions	Mandatory	PMS

Requirement Number	Functional Area	Requirement Type	Requirement Description	Project Priority	System
137	General System Functionality	Functional	The PMS shall generate recommended pavement maintenance activities and costs, considering deterioration model outputs and past activities. The system shall generate 10-year cost comparisons of different pavement maintenance strategies.	Mandatory	PMS
138	General System Functionality	Functional	The PMS shall import yearly pavement condition data as collected and delivered by a pavement data collection vendor. The PMS shall also ingest previous years' pavement condition data.	Mandatory	PMS
139	GIS	Functional	The PMS shall provide an interactive GIS mapping component to allow users a map view of all spatially-enabled data	Mandatory	PMS
140	GIS	Functional	The PMS shall interface with the DOT LRS through the ESRI Roads and Highways interface in real-time or near real-time in order to maintain the most recent published database containing the linear referenced centerline network and associated roadway features and attributes.	Mandatory	PMS
141	PMS - HPMS	Functional	The PMS shall upload sample sections from the HPMS from Roadway Systems and the PMS data is populated for each section for submittal	Mandatory	PMS
142	PMS - Maintenance Management	Functional	The PMS shall provide analysis and reporting based on the predominant distress modes identified through the network PMS testing. From this analysis, maintenance repair strategies can be suggested and their respective costs can be estimated and reported.	Mandatory	PMS
143	PMS - Pavement Analysis	Functional	The PMS shall include a deterioration model. The model will consist of algorithms developed to generate a deterioration index for each segment of pavement.	Mandatory	PMS
144	PMS - Pavement Condition	Functional	The PMS shall maintain a record of Pavement Distress data that is collected for the entire system in the odd years by Maintenance Personnel	Mandatory	PMS

Requirement Number	Functional Area	Requirement Type	Requirement Description	Project Priority	System
145	PMS - Pavement Condition	Functional	The PMS shall allow Maintenance Personnel the ability to enter data and run reports	Mandatory	PMS
146	PMS - Pavement Condition	Functional	The PMS shall provide maintenance crews with standard Condition Rating Forms for data entry	Mandatory	PMS
147	PMS - Pavement Condition	Functional	The PMS shall compare Condition data to the Rating Segment data to ensure all sections have been accounted for and data are accurate	Mandatory	PMS
148	PMS - Pavement Friction	Functional	The PMS shall divide each roadway into 1-mile segments for testing purposes	Mandatory	PMS
149	PMS - Pavement Friction	Functional	The PMS shall compare the data within each rating segment to the contract data	Mandatory	PMS
150	PMS - Pavement Friction	Functional	The PMS shall collect friction data annually on the PCCP sections of roadway	Mandatory	PMS
151	PMS - Pavement Friction	Functional	The PMS shall maintain and organize pavement testing data, including scheduling	Mandatory	PMS
152	PMS - Pavement Friction	Functional	The PMS shall compare Friction data to the Rating Segment data to ensure all sections have been accounted for and data are accurate	Mandatory	PMS
153	PMS - Point Calculation	Functional	The Friction data are processed and uploaded for use in the Point Calculation reporting	Mandatory	PMS
154	PMS - Point Calculation	Functional	The PMS shall provide users with the ability to calculate and total points for Friction, Condition and Rideability of the roadways for use in project prioritization	Mandatory	PMS
155	PMS - Priority	Functional	The PMS shall maintain age data of roadway segments based upon historic and current contract data	Mandatory	PMS
156	PMS - Priority	Functional	The PMS shall prioritize segments with a PMS Point rating of $\geq 400$	Mandatory	PMS

Requirement Number	Functional Area	Requirement Type	Requirement Description	Project Priority	System
157	PMS - Priority	Functional	The PMS shall allow users to export supporting data and reports for each roadway segment for inclusion in the 3R Proposed Project List.	Mandatory	PMS
158	PMS - Priority	Functional	The PMS shall allow users to enter FWD data, Friction data, and Coring data in order to produce reports required for project prioritization.	Mandatory	PMS
159	PMS - Rideability	Functional	The PMS shall maintain Rideability data which is collected for the entire system in the odd years and only for the NHS in the even years.	Mandatory	PMS
160	PMS - Rideability	Functional	The PMS shall interface with the Roadway Systems Division's data in order to obtain HPMS test sections	Mandatory	PMS
161	PMS - Rideability	Functional	The PMS shall maintain and organize rideability testing data, including scheduling	Mandatory	PMS
162	PMS - Rideability	Functional	The PMS shall compare Rideability data to the Rating Segment data to ensure all sections have been accounted for and data are accurate	Mandatory	PMS
163	PMS - Roadbed History	Functional	The PMS shall allow Contract information for the roadway construction section to be entered.	Mandatory	PMS
164	PMS - Roadbed History	Functional	The PMS shall preserve and retain historic data on a yearly basis for use in analysis	Mandatory	PMS
165	PMS - Weather	Functional	The PMS shall contain weather data obtained from the FHWA pertaining to climate zone, elevation and freeze-thaw cycles to be used for informational purposes.	Mandatory	PMS
166	Reporting	Functional	The PMS shall print standard informational reports from all modules	Mandatory	PMS
167	Reporting	Functional	The PMS shall allow users to create ad hoc queries and reports	Mandatory	PMS
168	Reporting	Functional	The PMS shall create and print a PMS Point Summary Report	Mandatory	PMS
169	Reporting	Functional	The PMS shall create and print Flexible and Rigid Data Summary Reports	Mandatory	PMS

Requirement Number	Functional Area	Requirement Type	Requirement Description	Project Priority	System
170	Reporting	Functional	The PMS shall create and print the Predominant Distress Mode Condition Report	Mandatory	PMS
171	Reporting	Functional	The PMS shall create the Suggested Maintenance Repair Strategy Report	Mandatory	PMS
172	Reporting	Functional	The PMS shall create and print the Forest Highway Condition Report	Mandatory	PMS
173	Reporting	Functional	The PMS shall create and print the State Highway Preservation Report	Mandatory	PMS
174	Reporting	Functional	The PMS shall create and print the State Facts and Figures Report	Mandatory	PMS
175	Reporting	Functional	The PMS shall create and print the Governmental Accounting Standards Board (GSAB) Report	Mandatory	PMS
176	Reporting	Functional	The PMS shall create and print the Roadway-Specific Report	Mandatory	PMS
177	Reporting	Functional	The PMS shall create and print the Annual Report of the Entire System	Mandatory	PMS

### 4.3 Interface Requirements by Type, Source and Target

Number	Type	Description	Source	Target
1	Inbound	MMS will interface with ESRI Roads and Highways in near real-time to maintain the most recent published database containing the linear referenced centerline network	ESRI Roads & Highways	MMS
2	Inbound	MMS will import pavement condition feature inventory data from PMS	PMS	MMS
3	Inbound	MMS will import recommended pavement treatments from the PMS	PMS	MMS
4	Inbound	MMS will import recommended bridge maintenance activities from the Bridge System	Bridge Inspect	MMS
5	Inbound	MMS will import data from Bridge System on a periodic basis recording bridge maintenance work that has been done.	Bridge Inspect	MMS
6	Inbound	MMS will import actual cost data for specific vehicles	Equipment Maintenance system	MMS
7	Inbound	MMS will import current employee data from the AMS Advantage HR system	Advantage HR system	MMS
8	Outbound	MMS will export timesheet data to NEATS (Advantage HR) with all appropriate activity, job and project codes.	MMS	NEATS
9	Outbound	MMS will export actual maintenance treatment activities performed to PMS to be considered in the next pavement condition analysis cycle.	MMS	PMS
10	Outbound	MMS will export average labor rates per category to be imported by the PMS to use in estimating the costs of recommended pavement activities?	MMS	PMS
11	Outbound	MMS will export material cost estimates to be imported by PMS to use in estimating the costs of recommended pavement maintenance activities.	MMS	PMS
12	Inbound	MMS will import recommended Pavement Preservation projects and display the projects to MMS users.	PMS	MMS

Number	Type	Description	Source	Target
13	Outbound	ITS will interface with the NDOT Accounting system to provide billing information for recurring billing that is done for intersection maintenance, radio cost distribution and district cost allocation.	ITS	Advantage Financial
14	Inbound	The PMS shall interface with the DOT Traffic Information System for import of the Traffic volume (AADT) data.	Traffic Information System	PMS
15	Inbound	The PMS shall link to PDFs of the 'as-built' information available in the DOT e-Doc system.	Field Manager	PMS
16	Inbound	The PMS shall interface with the DOT E-Bidding system for upload of contract data.	IPD/Field Manager	PMS
16	Outbound	The PMS shall integrate with the DOT data warehouse and with the DOT implementation of Oracle Business Intelligence.	PMS	Oracle BI

## 4.4 Current ITS Assets

### ITS & Signal Device List

- Traffic signal (intersection or ramp)
- Closed Circuit Television Camera (CCTV)
- Vehicle Detection System (VDS):
  - Radar Detection Sensors
  - Video Detection Sensors
  - Pavement Detection Sensors
  - Telemeter Traffic Monitoring Site (TTMS)
- Automatic Vehicle Identification Reader:
  - Bluetooth Sensor
  - License Plate Reader
  - Toll Tag Reader (Receiver Only)
  - Wired Magnetometer
  - Wireless Magnetometer Sensor
- Dynamic Message Sign (DMS)
- Highway Advisory Radio (HAR) Transmitter
- Highway Advisory Radio (HAR) Sign
- Roadway Weather Information System (RWIS)
- Electronic Speed Feedback Sign (ESFS)
- Beacon
- Electronic Display Sign (EDS)
- Safety Barrier Cable System (SBCS)
- Automatic Vehicle Identification (AVI)
- Dedicated Short-Range Communications (DSRC)
- Active Traffic Management (ATM)
- Variable Speed Limit (VLS) sign

### ITS Electrical Subsystem

- Geographic location and attributes for electrical cable, cabinets (load center, meter point and service point)
- Electrical circuits association to equipment cabinets
- Utility service demarcation sites including utility company service information.

### ITS Equipment Facilities:

- Regional Transportation Management Centers
- Communication Hub Sites
- Field Equipment Sites.

### ITS Statewide Telecommunication Subsystem:

- Geographic location and facility attributes for wireless shelters
- Communication terminating equipment type, manufacture, and model (i.e. radio, switch, terminal server etc.)
- Supporting electrical equipment including DC power supplies, batteries, surge protection and stand-by generators
- Tower attributes including coordinates, antennas, cables and warning lights
- Management of radios and FCC licenses
- Wireless paths attributes including span length, frequency band, and polarization