

2011

Idaho Transportation System Pavement Performance Report



SPRAYING 30% LITHIUM NITRATE SOLUTION ON CONCRETE PAVEMENT NEAR MOUNTAIN HOME

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1.0 INTRODUCTION/PURPOSE OF THIS REPORT

The Idaho Transportation Department's (ITD's) Idaho Transportation System Performance Report is a summary of the status of ITD-jurisdiction pavements. We intend to provide the reader with an accurate and useful review of the historical and current condition of Idaho's pavement.

2.0 PURPOSE OF A PAVEMENT MANAGEMENT SYSTEM (PMS)

A Pavement Management System (PMS) is defined as *a system which involves the identification of optimum strategies at various management levels and maintains pavements at an adequate level of serviceability*. These strategies include, but are not limited to, systematic procedures for scheduling maintenance and rehabilitation activities to optimize benefit and minimize cost.

Historically, Idaho has managed about **12,000 lane miles**, with additions and subtractions annually. ITD strives to reduce deficient pavement and give motorists a safer and smoother ride. Pavement deficiencies on the State Highway System have been reduced from 41% in 1993 to **13%** by the end of calendar year 2011. This has been accomplished by:

1. Continuously searching for more efficient ways to program pavement projects
2. Focusing on preservation and restoration before expansion, and applying cost savings to pavement rehabilitation
3. Using a preventative maintenance program which slows the rate of pavement deterioration (a *preservation-first* approach)
4. Improving the way we collect, analyze, and report pavement data
5. Improving and updating project planning and construction project history

In 2009, the Idaho Transportation Department invested in a new pavement management system (PMS). This system became active on December 17, 2010. This new PMS has greatly aided in the storage and analysis of our data by providing a robust database in which to store data from several sections in a central location. The new PMS also contains an analysis engine which accurately and consistently predicts pavement deterioration. The new PMS is further explained in detail in Section 3.0, The Current Pavement Management System (PMS).

3.0 THE CURRENT PAVEMENT MANAGEMENT SYSTEM (PMS)

This section discusses the pavement management systems that ITD has used in the past, and how we have come to use the system we do today. It describes in detail the current pavement management system.

3.1 A BRIEF HISTORY OF IDAHO PAVEMENT MANAGEMENT

In 1977, the Idaho Transportation Department began a review of existing pavement management programs with the goal of adopting one to fit Idaho's needs. The following year, ITD acquired a Pavement Performance Management Information System (PPMIS) and made it operational on ITD's mainframe computer. From 1978, the ITD steadily improved the PPMIS and modified it to meet specific conditions in Idaho. It was tested and refined by both ITD and consultant contract. By 1986, it was able to perform simplistic economic analysis and optimization.

In 2007, ITD began running our pavement data through the HERS-ST (Highway Economic Requirements System, STate model), at <http://www.fhwa.dot.gov/infrastructure/asstmgmt/hersindex.cfm>. This online software from FHWA uses pavement deterioration curves to predict pavement behavior. However, the HERS-ST model results had to be mathematically manipulated by hand in order to meet the conditions of Idaho weather, terrain and other factors, which was a painstaking process.

3.2 THE NEW PMS SYSTEM

In 2009, ITD purchased a pavement management and maintenance management software package. This new software housed a pavement management system (PMS) and a maintenance management system (MMS) to work in tandem as part of the Department's long-term vision for asset management. This software contains a robust database that houses several kinds of data, such as bridges, maintenance activities, pavement condition, traffic data, skid data, R-values, boring logs and several others.

The Pavement Management System (PMS) has allowed ITD to refine the way we calculate and analyze data, by:

- implementing new pavement performance curves calibrated by ITD engineers
- implementing decision trees that mimic District engineering choices
- creating performance models that accurately track and display pavement projects
- employing an analysis engine that uses integer optimization to maximize benefit

These new abilities will help Idaho become an efficient practitioner of preservation-first pavement management.

With all users of the PMS having instant access to all available data, the system has given the District pavement designers and engineers an extensive toolbox at their disposal. The system suggests pavement project choices based on budget constraints and desired deficiency goals, which the engineers balance against needs and their expert knowledge of the system.

4.0 DATA COLLECTED FOR PAVEMENT ANALYSIS

Idaho collects pavement data annually, using two methods: visual survey and a Pathways® Profiler van. The pavement management engineer performs an annual inspection of the state highways by visual (windshield) inspection, and the Profiler van drives the same highways, collecting hundreds of miles of video images, rutting data, and roughness data.

4.1 CRACKING INDEX AND THE IDAHO METHOD

ITD's pavement management engineer uses the Idaho Method to rate the state-jurisdiction roads every year- by either windshield collection (driving the roads) or by using the digital images collected by the Profiler van. The ITD Pavement Rating Manual can be viewed here:

<http://itd.idaho.gov/highways/docs/ITD%20Pavement%20Rating%20Manual%202011.pdf>

A condition index (Cracking Index) between 0.0 and 5.0 is given to the pavement, based on size and location of cracks, percentage of the roadway surveyed that shows distress, and type of road surface. A 5.0 rating is good pavement with no visible distress and 0.0 is maximum distress. Additionally, the roadways are rated for 6 different types of cracking, and each of those cracking types is assessed for severity and extent (low, medium, and high.)

Flexible (asphalt) cracking collected	Rigid (concrete) cracking collected
Alligator	Transverse slab
Block	Spalling
Edge	Scaling
Transverse	Meander
Longitudinal	Faulting
Patching/Potholes	Corner

A roadway that receives a structural improvement (improving the ability of a pavement to support traffic loads through reconstruction or rehabilitation) receives a rating of 5.0 the year that the construction project is open to traffic. A roadway that receives a maintenance project (preserving the structural condition of a pavement at an acceptable level - typically a sealcoat) will raise the crack index 0.3 points.

4.2 THE FIELD RECORDER

The pavement management engineer rides in a car with a District representative, and uses a Field Recorder software program on a laptop computer to record the condition of the pavement distress for each section of state highway. The Field Recorder collects data about several other roadway features: number of lanes, number of railroad crossings, speed limit, shoulder width, and terrain type, to name a few. The pavement management engineer takes note of any changes in the field and updates the records annually.

4.3 THE PATHWAY PROFILER VAN

Since 1995, Idaho has used Pathways® Profiler van technology to gather the majority of the roadway data. In 2008, ITD purchased a new road profiler van to greatly enhance the data quality and quantity that we are able to obtain and process. The profiler van drives every mile of state jurisdiction highway in the State of Idaho and digitally records its condition.

Here is a picture of the current profiler van:



Video images of both the front view out of the van as well as the pavement surface are available online at:

<http://pathweb.pathwayservices.com/idaho/>

With the new 2008 van, the rutting detection lasers are vastly improved (previous versions used 5 laser points to collect rutting data; the new van uses 1280 points). Additionally, the images are of much higher resolution.

4.4 INTERNATIONAL ROUGHNESS INDEX (IRI) AND ROUGHNESS INDEX (RI)

ITD uses a worldwide standard for measuring pavement smoothness called the International Roughness Index, or IRI. IRI was developed by the World Bank in the 1980's and is used in all of the states, as well as several countries. IRI is used to define a characteristic of the longitudinal profile of a traveled wheel track and constitutes a standardized roughness measurement. The commonly recommended units are meters per kilometer (m/km) or millimeters per meter (mm/m). IRI is gathered by the Profiler van.

The index measures pavement roughness in terms of the number of inches per mile that a laser, mounted on the Profiler van, jumps as the van is driven along the roadway. Typically, the lower the IRI number, the smoother the ride; but **IRI is not known as a direct measure of rider discomfort.**

Idaho takes the measured IRI values for pavement and compresses them onto a 0.0-5.0 scale, similar to the Cracking Index scale, where 0.0 is very rough and 5.0 is very smooth. ITD calls this the pavement Roughness Index, or “RI”. These numbers are collected and reported annually.

4.5 FRICTION TESTING

The Department collects friction data by towing a small trailer that measures the force on a wheel that is locked but not rotating (skidding.) Tests conducted on state routes are used in the planning of construction, reconstruction, or rehabilitation of pavements. Most of this data is collected either annually or every other year. The skid measurement provides a friction number, by which pavement engineers can calculate if the pavement needs a sealcoat or other remedy to prevent skidding. The friction number, a value typically between 20 - 100, represents the friction experienced by tires traveling on the pavement surface while wet. The lower values indicate lesser friction between the pavement and the tire. These values are obtained using a locked wheel skid trailer.

Here is a picture of the current friction testing truck and trailer:



4.6 FALLING WEIGHT DEFLECTOMETER (FWD) TESTING

The FWD is a non-destructive testing device that is used to complete structural testing for pavement rehabilitation projects, research, and pavement structure failure detection. The FWD is a device capable of applying dynamic loads to the pavement surface, similar in magnitude and duration to that of a single heavy moving wheel load. The response of the pavement system is measured in terms of vertical deformation, or deflection, over a given area using seismometers. ITD collects this data on sections of state highways that are eligible for paving projects, and uses the results to design the new pavement that is needed.

The FWD consists of a trailer mounted non-destructive pavement testing unit towed behind an F-250 Super Cab pickup. Data collected from this equipment is used to evaluate the strength of both flexible (AC) and rigid (PCC) pavements. The evaluation includes base and subbase materials, checking load transfers across PCC joints, and detecting voids under the pavement. FWD testing provides a tool for designing more efficient pavements.

Here is a picture of the current FWD Trailer:



5.0 HOW DO WE DETERMINE “DEFICIENCY”?

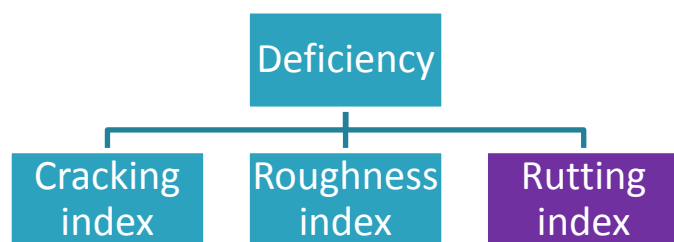
The term “deficient” is used to indicate that a pavement has fallen below a certain threshold and requires a structural remedy. In this section, we outline the Classic Methodology that ITD has used for several years and show how ITD uses the thresholds to determine how to program the right remedy at the right time.

5.1 CLASSIC METHODOLOGY: THE 3-LEGGED STOOL

Historically, the pavement management system has used thresholds in the cracking index and roughness index to determine whether or not a pavement is “deficient.” These thresholds were triggered by two tiers of thresholds, based on the functional class of a roadway. Interstates and arterials were in one class, and collectors were in another class. Districts would use the deficient threshold notification to realize that a roadway was ready for a structural project.

Through 2009, the Classic Methodology employed two measurements for deficiency: cracking index and roughness index. In 2010, our improved Profiler van technology and the new PMS system led to the addition of rutting data deficiency thresholds. These rutting thresholds were applied in 2010 as a third method to rate pavements as deficient.

The 3-legged stool of measuring deficiency looks like this, where the purple shade denotes that rutting was recently added in 2010:



5.2 PAVEMENT CONDITION TABLES BY FUNCTIONAL CLASS: CLASSIC METHODOLOGY

This section contains the tables denoting for Cracking Index, Roughness Index, and Rutting thresholds, divided by functional class. These tables show the tolerated thresholds for Good, Fair, Poor and Very Poor pavements for Idaho using the Classic Methodology.

Note that “poor” and “very poor” constitute our deficient measurement (in grey cells.)

TABLE 5.2.1: DEFICIENT THRESHOLDS, CLASSIC METHODOLOGY, BY FUNCTIONAL CLASS

Condition: Cracking Index		
Pavement Condition	Functional Class	
	Interstate and Arterials	Collectors
Good	CI > 3.0	CI > 3.0
Fair	$2.5 \leq \text{CI} \leq 3.0$	$2.0 \leq \text{CI} \leq 3.0$
Poor	$2.0 \leq \text{CI} < 2.5$	$1.5 \leq \text{CI} < 2.0$
Very Poor	CI < 2.0	CI < 1.5

Condition: Roughness Index		
Pavement Condition	Functional Class	
	Interstate and Arterials	Collectors
Good	RI > 3.0	RI > 3.0
Fair	$2.5 \leq \text{RI} \leq 3.0$	$2.0 \leq \text{RI} \leq 3.0$
Poor	$2.0 \leq \text{RI} < 2.5$	$1.5 \leq \text{RI} < 2.0$
Very Poor	RI < 2.0	RI < 1.5

Condition: Rutting		
Pavement Condition	Functional Class	
	Interstate and Arterials	Collectors
Good	0.00" - 0.24"	0.00" - 0.49"
Fair	0.25" - 0.49"	0.50" - 0.99"
Poor	0.50" - 0.74"	1.00" - 1.49"
Very Poor	$\geq 0.75"$	$\geq 1.50"$

6.0 2011 STATE HIGHWAY CONDITION: CLASSIC METHODOLOGY

The following section details the condition of state highway pavement in Idaho for 2011 and previous years using the methodology outlined in Section 5.0. In 2011, **13%** of the state-jurisdiction roads were considered deficient by the Classic Methodology.

6.1 PAVED LANE MILEAGE INFORMATION FOR 2011

The official paved lane mileage for the State Highway System as of January 3rd, 2012 (according to the PMS) was **12,190**. This is an addition of almost 200 lane miles from previous years for two reasons:

1. Idaho added new route mileage to the system in 2011, including **but not limited to**:

TABLE 6.1.1: MAJOR PROJECTS IN 2011 THAT ADDED LANE MILEAGE

District	Route and Project	Additional Lane Mileage (approx)
1	US-95 Sandpoint Bypass	6.924
4	SH-46 addition	29.504
4	SH-77 Spur addition	31.796
5	I-15 Business Couplet, Pocatello	7.83

- In 2011, the state highway system was painstakingly surveyed by video to capture all passing lanes. All passing lanes that are greater than 0.5 miles in length are now counted as a through lane in a section, and thus count towards total system lane mileage. Passing lanes less than 0.5 miles in length are stored in the system but are not counted towards total lane mileage.

The paved lane mileage by district is presented in Table 6.1.2.

TABLE 6.1.2: PAVED LANE MILEAGE PER DISTRICT, IDAHO STATE HIGHWAY

District	Paved Lane Mileage (as of January 3, 2012)	Unpaved Lane Mileage (as of January 3, 2012)
1	1,496.238	0
2	1,467.383	31.648
3	2,586.468	0
4	2,440.565	0
5	1,878.800	0
6	2,320.389	18.568
Total	12,189.843	50.216

Lane Mileage is from the PMS and is a snapshot from January 3, 2012.

6.2 2011 DEFICIENT LANE MILES: HISTORICALLY AND NOW

Here, the past three years of deficiency, in both lane mileage and percentage, will be displayed in tabular form using the Classic Methodology. 2011 numbers are as of January 2012.

TABLE 6.2.1: DEFICIENT LANE MILES, CLASSIC METHODOLOGY, IDAHO STATE HIGHWAY

DEFICIENT LANE MILES			
District	2009	2010	2011
1	195	206	237
2	274	234	203
3	503	401	352
4	615	477	404
5	260	265	247
6	263	340	181
TOTAL	2110	1923	1625

TABLE 6.2.2: PERCENT DEFICIENT, CLASSIC METHODOLOGY, IDAHO STATE HIGHWAY

% DEFICIENT			
District	2009	2010	2011
1	13%	14%	16%
2	19%	16%	14%
3	20%	16%	14%
4	27%	22%	17%
5	14%	15%	13%
6	11%	14%	8%
TOTAL	18%	16%	13%

6.3 2011 STATEWIDE PAVEMENT CONDITION: CLASSIC METHODOLOGY

The following section shows 2011 pavement condition (Figures 6.3.1 through 6.3.3) as calculated by the Classic Methodology. Remember that “deficient” includes poor and very poor pavement condition.

Through 2009, deficiency was calculated from cracking index and roughness index. Either one could trigger a pavement as deficient, using the thresholds outlined in Section 5.2. In 2010, ITD designated rutting as a third measurement of deficiency. From 2010 forward, deficiency is calculated using cracking index, roughness index and rutting, shown in purple in Figure 6.3.1.

FIGURE 6.3.1: STATEWIDE PAVEMENT CONDITION, CLASSIC METHODOLOGY, 1992 TO 2011

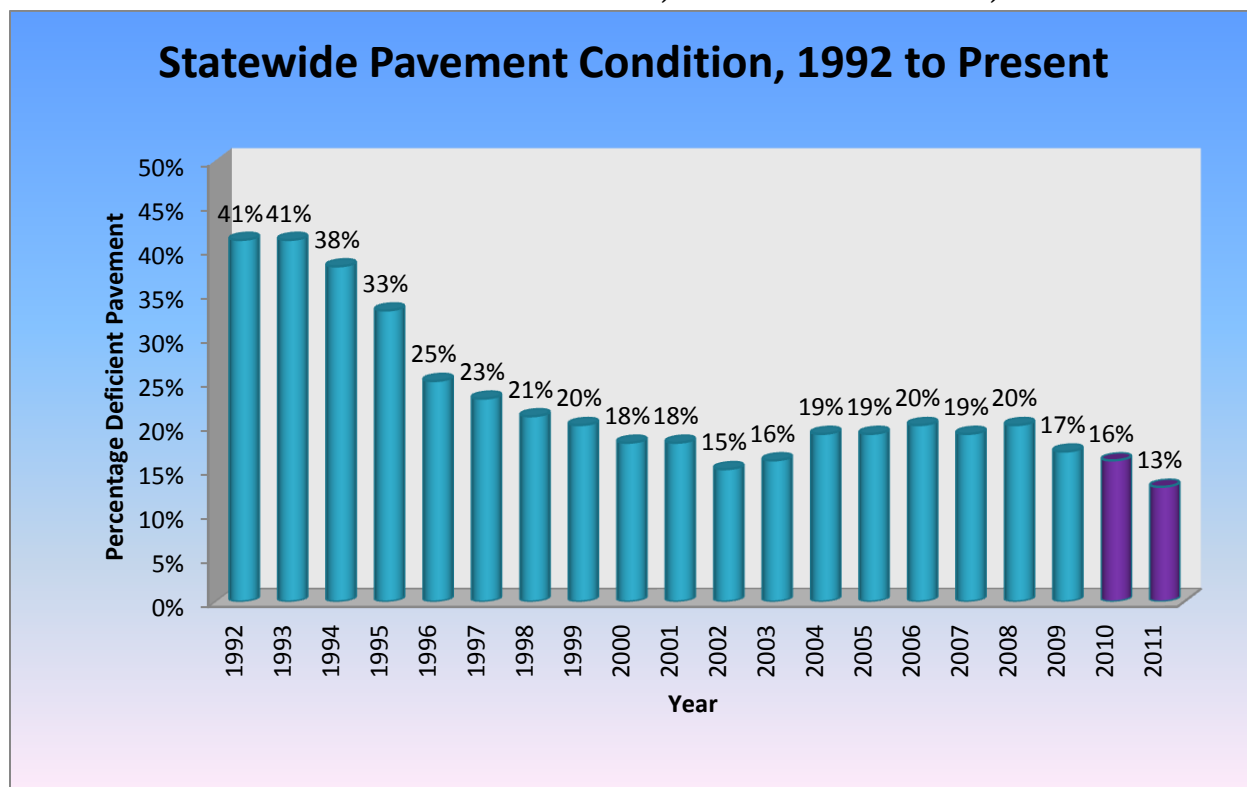
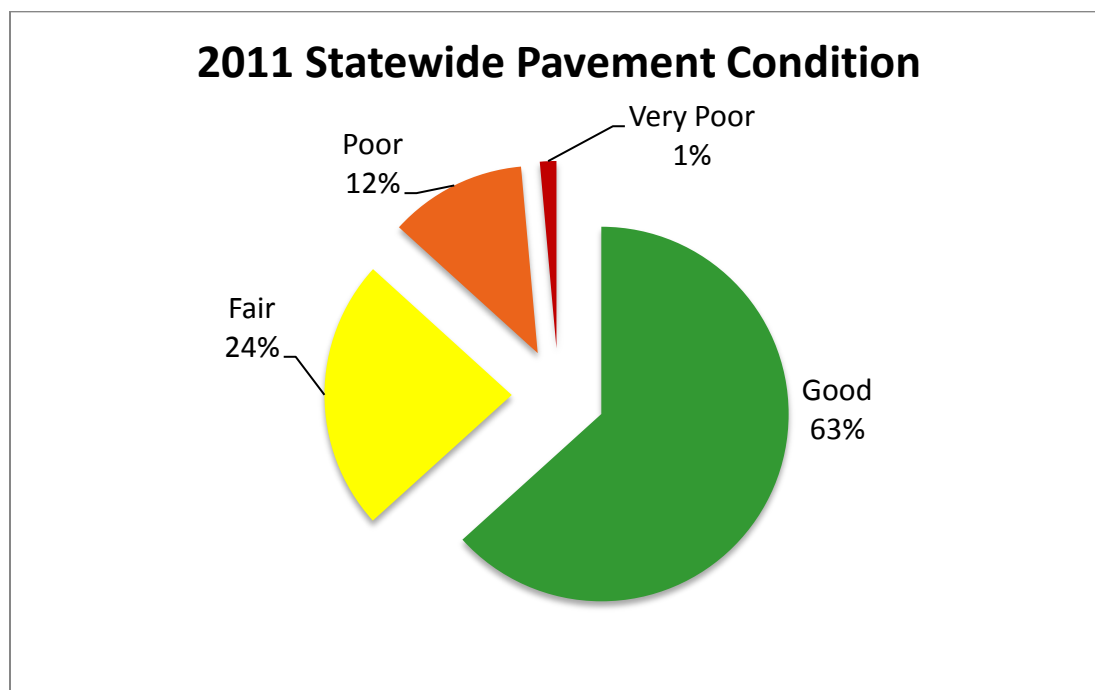


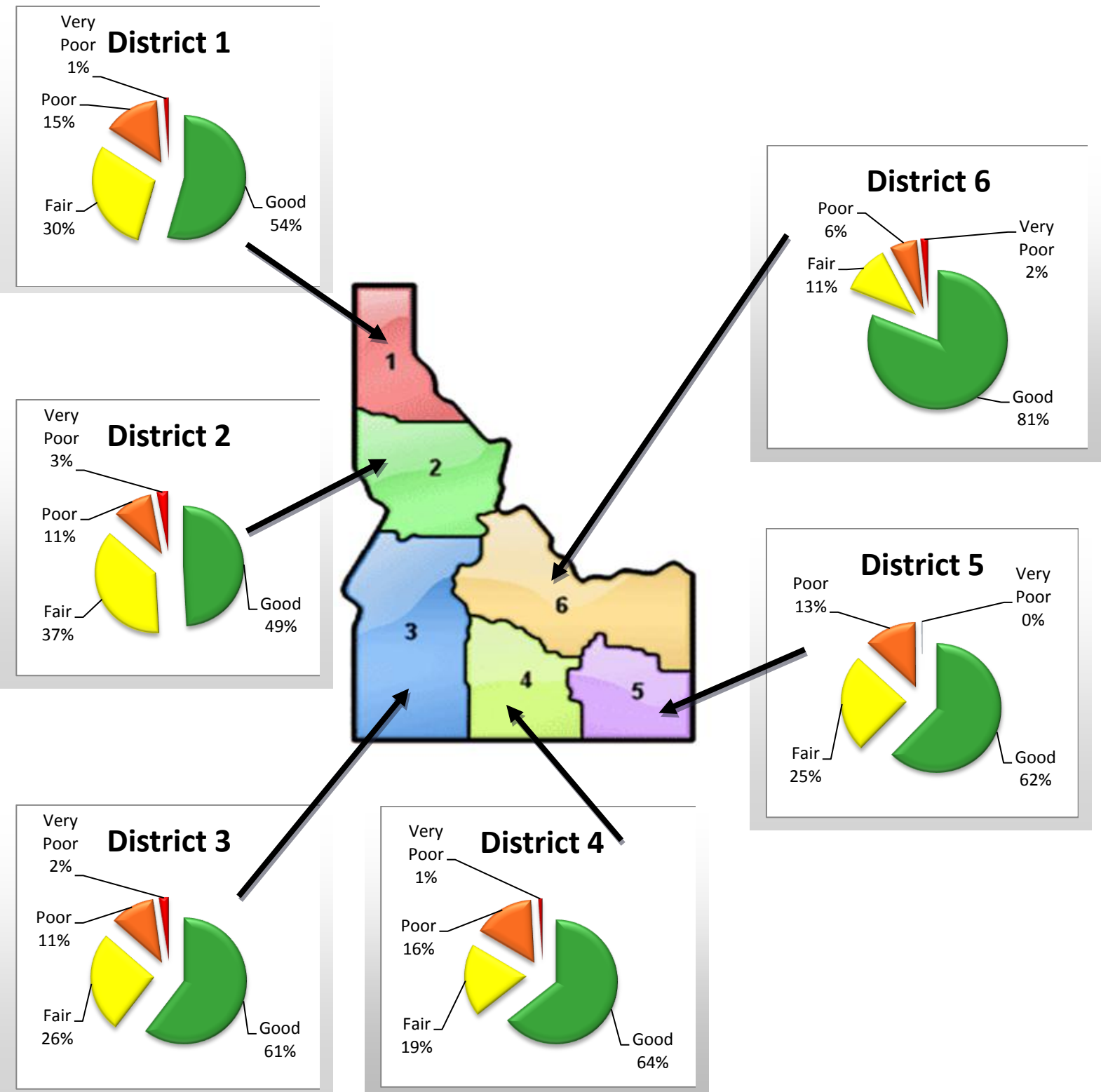
FIGURE 6.3.2: 2011 STATEWIDE PAVEMENT CONDITION, CLASSIC METHODOLOGY, PIE CHART

This figure shows the overall state highway system pavement condition for 2011, using the Classic thresholds outlined in Section 5.2.



The next graphic shows the 2011 pavement condition, calculated with the Classic Methodology, by district.

FIGURE 6.3.3: 2011 PAVEMENT CONDITION BY DISTRICT



7.0 HOW DOES ITD PREDICT AND RECOMMEND PAVEMENT PROJECTS?

This section details how Idaho uses pavement condition data to determine which pavement remedies are appropriate.

7.1 HISTORICALLY

Historically, ITD generated rehabilitation and reconstruction project recommendations from the Highway Economic Requirements System – State Version (HERS-ST). HERS-ST is a federally maintained computer model which was run with data taken from ITD's mainframe.

The model required manual manipulation in order to produce results that were specific to Idaho's weather, climate, terrain, construction practices, and several other variables. The manipulation was a time-consuming process.

The projects that were recommended by HERS-ST were given to staff as project suggestions, and the staff would then weigh the recommendations against construction history, public need, and funding limitations to come up with a project list.

7.2 THE PAVEMENT MANAGEMENT SYSTEM (PMS)

In 2009, ITD purchased new pavement management system software, which was implemented by December 2010. The PMS can now be used to predict pavement deterioration and recommend projects. The PMS has very powerful performance models and decision trees that were directly designed by ITD pavement engineers to mimic their project choices and mimic how Idaho's pavement typically deteriorates. Mathematical manipulation of results is no longer required, as the system is specifically designed for Idaho and provides results that account for our climate, construction history, weather, and other variables.

7.3 THE STATEWIDE TRANSPORTATION IMPROVEMENT PROGRAM (STIP)

The Statewide Transportation Improvement Program (STIP) is created annually by ITD to provide project recommendations for the next 5 years. The 5-year STIP program is directly uploaded into the PMS, where ITD runs the projects in the analysis engine and analyzes how those projects will benefit the system. The analysis uses predicted deterioration of roadways and the budget constraints for the next 5 years, and provides results of how ITD can best optimize their budget. These optimized results are sent to the Districts for review and changes. The Districts then send their final programs back into the PMS. The PMS will run a final analysis with all of the feedback and that information will be sent to the ITIP for programming.

The performance trees and decision trees used in the PMS system use a slightly modified version of determining deficiency when suggesting programmed projects. This is called the Greek Method, which is detailed in Section 8.0.

8.0 HOW DOES THE PMS CLASSIFY AND DETERIORATE PAVEMENT?

This section outlines how the PMS divides up the pavements by traffic volume, truck traffic volume, and speed limit to determine a hierarchy of pavement need. These thresholds, called the “Greek Method”, are used for predicting pavement behavior, but are **not** currently used to calculate deficiency.

8.1 THE GREEK METHOD

The use of functional class to classify deficient pavement has served the Department for a long time and helps us trend how our pavements are behaving. Currently, functional class is still used to report the overall deficiency percentage for the state and districts (Section 5.0.)

However, dividing up pavements by only 2 classes did not maximize the analysis engine capability in the PMS. ITD seized the opportunity to further enhance project prediction by applying a new 4-tier pavement classification system, called the Greek Method. ITD’s district engineers decided that speed limit, Average Annual Daily Traffic (AADT) and Commercial Average Annual Daily Traffic (CAADT) were the best data sources to classify roadways. The Greek Method divides up the pavement according to three items:

- The greater of **speed limit** or **AADT** (Greek functional class)
- Commercial truck traffic (**CAADT**) (Greek structural class)

The pavement is then classified with an Overall Greek Classification based on the higher of these two categories. Thus, if a pavement is classified as Alpha functionally, and Beta structurally, it will be an Alpha road overall.

Roadways with low speed limits or low AADT have manholes and utility patches and other surface deformities that are more easily tolerated at lower speeds. Thus, these roadways can be in a lower classification, where the PMS will not recommend a deep remedy until the roadway deteriorates a little further than a high-speed, high traffic roadway like an interstate.

Truck traffic has been proven to cause the majority of cracking, roughness and rutting on a roadway. Thus roadways with heavy truck traffic will require deeper remedies at a faster pace.

The thresholds in this section reflect the Department’s initial calibration of the Greek Method. Research is ongoing, and we expect to revisit these thresholds periodically as we validate our assumptions.

These four tiers are presented below.

TABLE 8.1.1: THE GREEK METHOD THRESHOLDS FOR THE PMS

Road Tier	Greek Functional Class		Greek Structural Class
	(Take the greater of Speed Limit or AADT)		
	SPEED LIMIT	AADT	DAILY TRUCK TRAFFIC (CAADT)
ALPHA	≥65 MPH	≥6000	≥ 2000 TRUCKS PER DAY
BETA	≥55 MPH	≥2500	≥ 500 TRUCKS PER DAY
GAMMA	≥35 MPH	≥1000	≥ 100 TRUCKS PER DAY
DELTA	<35 MPH	<1000	< 100 TRUCKS PER DAY

8.2 GREEK METHOD CLASSIFICATION THRESHOLDS FOR THE PMS

In this four tier Greek Method system, ITD created deficient thresholds for **four** tiers instead of the two tiers of functional classes shown in Section 5.2. These thresholds are used in PMS analysis, to predict how quickly Idaho's pavements will need repair or maintenance. These thresholds are not used to calculate deficiency of pavement. The thresholds for the PMS system analysis are presented below.

TABLE 8.2.1: GREEK METHOD CRACK INDEX THRESHOLDS

Greek Method Crack Index Thresholds				
Road Classification	Alpha Roads	Beta Roads	Gamma Roads	Delta Roads
Good	5.0 – 4.0	5.0- 3.5	5.0-3.0	5.0- 2.5
Fair	3.9- 3.0	3.4- 2.5	2.9-2.0	2.4- 1.5
Poor	2.9- 2.5	2.4- 2.0	1.9- 1.5	1.4- 1.0
Very Poor	≤ 2.4	≤1.9	≤1.4	≤ 0.9

TABLE 8.2.2: GREEK METHOD ROUGHNESS INDEX THRESHOLDS

Greek Method Roughness Index Thresholds				
Road Classification	Alpha Roads	Beta Roads	Gamma Roads	Delta Roads
Good	5.00 – 3.25	5.00- 3.00	5.00-2.75	5.0- 2.50
Fair	3.24- 3.00	2.99- 2.75	2.75-2.50	2.49- 2.25
Poor	2.99- 2.75	2.74- 2.50	2.49- 2.25	2.24- 2.00
Very Poor	≤ 2.74	≤2.49	≤2.24	≤ 1.99

TABLE 8.2.3: GREEK METHOD RUTTING THRESHOLDS

Greek Method Rutting Thresholds				
Road Classification	Alpha Roads	Beta Roads	Gamma Roads	Delta Roads
Good	0.00" - 0.25"	0.00" - 0.50"	0.00" - 0.75"	0.00" - 1.00"
Fair	0.26" - 0.50"	0.51" - 0.75"	0.76" - 1.00"	1.01" - 1.25"
Poor	0.51"-0.75"	0.76" - 1.00"	1.01" - 1.25"	1.26" - 1.50"
Very Poor	>0.75"	>1.00"	>1.25"	>1.50"

These thresholds are currently in use in the system in 2011. We expect to continue to refine them as we validate the assumptions we have made thus far.

9.0 CONCLUSION

We hope that you have found the information in this report useful and informative. If you have suggestions for additional information you would like to see presented in this report, please contact the Pavement Management Engineer at ITD using the contact information on the cover page of this report.