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Report to Congressional Committees

September 1999

TRANSPORTATION INFRASTRUCTURE

Better Data Needed to Rate the Nation's Highway Conditions

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United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-281731

September 27, 1999

The Honorable John H. Chafee
Chairman
The Honorable Max S. Baucus
Ranking Minority Member
Committee on Environment and Public Works
United States Senate

The Honorable Bud Shuster
Chairman
The Honorable James L. Oberstar
Ranking Democratic Member
Committee on Transportation and Infrastructure
House of Representatives

The International Roughness Index is used throughout the world to measure whether travelers experience a rough or a smooth ride while driving on a highway. The index is a quantitative measure of a vehicle's up-and-down movement while traveling. In the United States, the states use specially equipped vehicles to collect data for the index and report the data to the Department of Transportation (DOT). The Department uses the index to describe the condition of pavement across the nation, to set a performance goal for the quality of the nation's highways, and to project pavement investment needs through a computer model called the Highway Economic Requirements System. The Secretary has delegated responsibility for collecting data on pavement conditions to the Federal Highway Administration (FHWA).

The Transportation Equity Act for the 21st Century (TEA-21) (P.L. 105-178) directed GAO to evaluate how the index is used and how reliable the data are and report the results to the Congress no later than June 9, 2000. Accordingly, this report describes (1) the uses FHWA, the states, and others make of the index to assess highway conditions, (2) the consistency and accuracy of state-reported data on highway roughness, and (3) FHWA's efforts to improve the data across states.

Results in Brief

The International Roughness Index is used widely for federal and state purposes, as well as for independent analyses. At the national level, where the index is the only available statistic on pavement conditions, FHWA uses it to assess changes in the overall condition of the nation's highways and

to forecast future highway investment needs. For example, in 1997, FHWA projected that repairing deficiencies on the nation's highways would cost $70.3 billion annually. Actual expenditures for highways by all levels of government in 1995 were about $29.2 billion, or about $41 billion less than FHWA had projected as needed to repair the deficiencies. In addition, FHWA uses the index to measure progress toward a goal for ride quality in its strategic plan and publishes data from the index for use by the public. At the state level, where other types of data on pavement conditions are available, reliance on the index varies. While some states rely on it to make highway maintenance decisions, others do not consider it an important decision-making tool. The states that rely on the index use it to project highway investment needs and report on pavement performance at the state or district levels. In addition, some states use the index to set standards for construction projects. Independent analysts have used the data to compare pavement conditions across states and to develop "report cards" of state performance.

Critics contend that state comparisons based on the index are flawed because the pavement roughness data reported to FHWA by the states are not consistent or accurate. These problems with consistency and accuracy have occurred for two reasons. First, the states use different methods to gather data and compute the results. The states differ in the devices they use to measure the pavement, the part of the road they measure, and their choice of an appropriate mathematical simulation. As a result, state-to-state comparisons are not valid. Second, the type of surface—asphalt or concrete—influences the results. Concrete roads may produce rougher readings than asphalt roads, even if the concrete road is of very high quality. Features such as joints between sections can contribute to the roughness of concrete highways.

While FHWA has tried to improve the data, these efforts have not been completely successful. The agency developed detailed guidelines for collecting the data and asked the states to apply these guidelines before reporting the data. However, FHWA accepts any data that the states submit, even if they do not meet its data collection guidelines. Accordingly, we are recommending that FHWA revise its data collection guidelines to limit the technology and procedures the states may use in collecting International Roughness Index data and work with the states to seek compliance with these guidelines. Such action will help to ensure the reliability of the index data that the Department uses for several critical activities, including the estimation of the nation's highway investment needs.

Background

In 1993, FHWA adopted the International Roughness Index as a measure for the states to use in assessing and reporting highway conditions in the United States. FHWA viewed the index as an improvement over an earlier, more subjective method that permitted ride and visual evaluations of highways by state inspectors. In adopting the index, FHWA believed it would improve the reliability of national data on pavement conditions. In addition, the index was accepted worldwide and was used by foreign countries and the World Bank as a measure of pavement conditions. FHWA wanted the nation's system of measuring pavement conditions to be consistent with international guidelines.

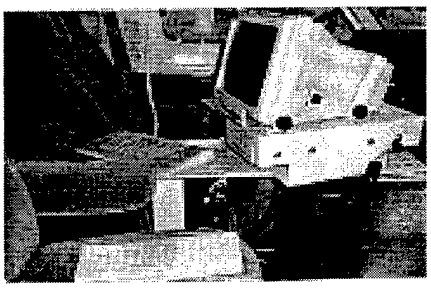
The index is a quantitative measure of a vehicle's up-and-down motion while the vehicle is traveling at a specific speed. Most states collect and measure the data with specially equipped vans, called profilers (see fig. 1). The vans can operate at highway speeds and can cost from $75,000 to $1,500,000.[1] However, these costs are dropping as the costs of computers and sensors decline. A profiler has sensors attached underneath the van that quickly gauge the surface, or "profile," of the road as the van travels at normal speeds in traffic. The vehicle typically has a computer and three types of sensing equipment: a height sensor,[2] an acceleration sensor, and a speed/distance device connected to the profiler's speedometer or to a wheel. Height sensors measure the up-and-down movement of the van, acceleration sensors detect changes in the speed of the van's up-and-down movement, and speed/distance sensors measure how fast the van is traveling and how far it has traveled. All of these measurements are needed to compute an International Roughness Index statistic. On a smooth road, the up-and-down movements are small and the road's index is low, but on a rough road with large cracks and potholes, up-and-down movements are more noticeable and the index is higher. The index is measured in inches per mile; smooth roads have an index of up to 60 inches per mile, while rough roads have an index of about 170 inches per mile or greater.

[1]Most profilers cost under $200,000. The more expensive devices cited here often perform additional functions, such as videotaping and measuring the depth of ruts.

[2]Height sensors use a wide variety of technologies, including laser, infrared, optical, and ultrasonic types.

Figure 1: Profiler Vehicle

Height sensors mounted in the front bumper of this Pennsylvania Department of Transportation road profiler send pavement data to an onboard computer for calculating the International Roughness Index.



Engineering Information

Number of units owned by Pennsylvania Department of Transportation — 3

Months of operation — March to November

Personnel needed for operation — 2 (operator and driver)

Number of test miles measured in 1997 — 14,744

Source: Pennsylvania Department of Transportation.

DOT, the States, and Others Have Various Uses for the Index

DOT uses International Roughness Index data in reports describing the overall condition of the nation's roads and forecasting future highway investment needs. FHWA publishes the data annually in its publication, Highway Statistics, and uses the data to support conclusions in the Department's Conditions and Performance Report, a biennial report to congressional authorizing committees on the state of the nation's roads. (App. I contains an example of the roughness data published in FHWA's Highway Statistics.) The 1997 Conditions and Performance Report contains estimates of the nation's highway investment needs for the next 20 years. For example, in 1997, FHWA projected that repairing deficiencies on the nation's highways, when the repairs were economically justifiable, would cost $70.3 billion annually. In comparison, all levels of government spent $29.2 billion for highways in 1995—a shortfall of about $41 billion. FHWA's computer model, using roughness index and other data, projects this needs estimate.[3]

[3]FHWA also projects pavement investment needs with another computer model, known as the Analytic Process model.

FHWA also uses the data as a performance indicator for the nation's highways. Under the Government Performance and Results Act of 1993, FHWA and the Department use the data to set a goal for ride quality in their performance plans. The performance plans call for 93 percent of the National Highway System[4] to have an index of below 170 inches per mile by 2008. Using 1997 data (the most recent data available), FHWA reported in 1999 that 91.7 percent of the National Highway System had already achieved this goal, and therefore officials believe the goal is achievable. However, FHWA noted that since the index measures only pavement roughness, other measurements of pavement distress would be needed to fully assess the overall condition of the nation's highways.

The states we reviewed vary in the extent to which they rely on the index to make maintenance decisions or manage their construction schedules. For example, three of the seven states we reviewed—Ohio, Pennsylvania, and South Dakota—believe the index is helpful in managing the condition of their pavement and use the data in determining their pavement investment needs. These states use the data as an indicator of pavement performance statewide or at the highway district level. Four of the seven states—Georgia, Pennsylvania, South Dakota, and Texas—currently use or plan to use the index as a construction specification for new pavement construction. For example, in Georgia, contractors must construct new highways with an index reading below 47 inches per mile. Georgia Department of Transportation officials claim that this requirement explains the low roughness of their roads. These officials also stated that contractors in Georgia rarely deliver new pavement that fails to meet this requirement. On the other hand, New York does not use the index for any state purpose; it collects the data only to fulfill FHWA's requirement that the states report index measurements.

Outside analysts also use roughness index data for studies of pavement conditions and performance. Nonprofit organizations and academic institutions occasionally publish "report cards" comparing pavement conditions among the states. For example, the Surface Transportation Policy Project issued reports in 1997 and 1998 based, in part, on FHWA's index data. (App. II contains an example of a Surface Transportation Policy Project report card.) These reports ranked the states on the condition of their roads and estimated how much the condition of the roads cost drivers in repair bills. The Surface Transportation Policy Project report uses FHWA's data to categorize a state's roads as good, fair,

[4]The National Highway System is a federally designated portion of the nation's roads consisting mainly of interstate highways and other arterial roads.

mediocre, or poor. Similarly, the Center for Interdisciplinary Transportation Studies at the University of North Carolina-Charlotte has issued annual reports since 1993 ranking state transportation departments on the cost-effectiveness of their expenditures. The Center's reports use index data and other indicators, such as how much a state highway department spends for administration, to determine how effectively a state spends its transportation dollars. These reports and others like them can be controversial, especially among those states that do not appear high in the reports' rankings. For example, officials from the Maryland State Highway Administration expressed concern over the controversy generated by one such report that the officials felt erroneously portrayed the condition of their highway system. Similar controversies arose in Illinois and Iowa. These reports contrast with those that FHWA publishes. FHWA's Highway Statistics contains an annual listing of state index data but makes no attempt to rank the states according to the condition of their roads. FHWA officials noted that Highway Statistics includes a notice that users need to account for variability in the index data reported by the states. The notice explains that sources of variability include differences in the type of pavement material, in measuring equipment, and in measurement protocols.

Differing State Procedures Produce Inconsistent Data

The states' roughness index data are not comparable because the states differ in the devices and procedures they use to measure the roughness of their highways, as well as in the mathematical simulation they use to calculate the index. Any one of these factors can bias the results, producing inaccurate and inconsistent data. However, the cumulative effect of these differences among states is unknown—some state practices tend to reduce values in the data, while others overstate the values. These known sources of variability reduce the accuracy of the data disseminated by FHWA and limit the comparability of the data from state to state. Furthermore, different types of pavement—concrete and asphalt—may differ in roughness, according to state highway officials. As a result, the states with more concrete pavement may have higher index readings than the states that primarily use asphalt.

The states use laser, optical, infrared, and ultrasonic profilers to assess a road's roughness and determine its index. According to a 1998 survey by the Florida Department of Transportation to which 38 states responded, 28 states used laser devices, 9 used ultrasonic devices, 4 used infrared devices, and 2 used optical devices.[5] The technology used by the profiler

[5]Some states collect index data with more than one type of height sensor.

can affect the measurement of roughness. Laser, optical, and infrared devices all measure roughness by emitting beams of light and measuring the distance between the vehicle body and the road. Ultrasonic sensors measure roughness by emitting a sound wave and measuring how long it takes for the sound wave to travel back to the sensor to compute the distance between the vehicle and the road. Ultrasonic sensors do not sample as much of the pavement as other types of sensors. This limits their ability to measure roughness reliably. For example, a 1998 study for the Florida Department of Transportation showed that a low-cost ultrasonic sensor still in use by some states produced measurements about 25 percent higher than profilers using laser technology. The results were particularly dramatic on certain rough surfaces. States switching from ultrasonic sensors to laser sensors could show a marked "improvement" in their roads, even if pavement conditions stayed exactly the same. None of the states we contacted were using ultrasonic sensors, and four of the seven had replaced old ultrasonic sensors with other types.

The states also differ in their procedures for operating profiler vans, and these differences can affect the data. For example, most states use two technicians to measure roughness. A 1999 study by the University of Michigan Transportation Research Institute recommended the use of at least two people, one to drive and the other to take the readings.[6] The driver can then focus on the van's lane position, speed, and safety while the operator finds landmarks, triggers the system, and conducts quality control steps during measurements. However, according to a Georgia Department of Transportation official, Georgia uses only one person to perform both functions. Of the other states we contacted, Illinois, Ohio, Pennsylvania, South Dakota, and Texas use two people to gather the data. New York officials could not tell us how many people take the readings in their state because private contractors perform that task. FHWA officials said a definitive study has not been done on the effect of a profiler's crew size on roughness index data, but they thought a larger crew might be a good safety factor.

The location of the profiler equipment can also affect the measurement of roughness. Some states measure a highway's roughness over the path of the right wheel, while other states measure the left wheel path or take readings over the paths of both wheels and average the two results. Generally the right wheel path is the roughest part of the highway lane, and thus readings are higher from the right wheel than from the left wheel

[6]This study also addresses other data quality issues, such as standardizing the profiler's design and other system operating practices.

or the average of both wheels. FHWA recommends that the states collect data over the right wheel but allows them to average measurements collected over both wheels.[7] A Florida Department of Transportation study found that 4 states gathered data over the left wheel, 13 gathered data over the right wheel, and 14 averaged the measurements gathered over both wheels. In addition, under FHWA's guidelines, the states are to exclude readings taken when their profilers cross bridges and railroad tracks. However, some states include these readings in their data. For example, Illinois, which has more rail-highway crossings than any other state except Texas, includes readings over bridges and railroad crossings in its data.

FHWA's guidelines contain specific procedures for calculating a roughness index from the raw data collected by the profiler. The guidelines call for the states to use a method known as a quarter-car simulation.[8] However some states have not always used this method. For example, two of the states we contacted, Georgia and Ohio, computed their index using a method known as a half-car simulation.[9] A 1998 University of Michigan report compared the two methods and found that half-car measurements were 11 percent smoother than quarter-car measurements on the same roads. In addition, before 1997, Texas gathered data for a different pavement condition statistic—the Pavement Suitability Index—converted it to an International Roughness Index value, and reported the converted statistic to FHWA. FHWA found that this approach produced unrealistic measurements of roughness for certain pavements. For example, Texas Department of Transportation officials stated that the conversion produced index measurements of zero (a glass highway) for about 40 percent of the state's highways. In response to these results and FHWA's concerns, Texas changed its methods and began to measure the International Roughness Index directly as of 1997.

Finally, the type of pavement can also affect measurements of roughness. Officials from Georgia, Illinois, and New York all stated that concrete pavements generally have higher index readings than asphalt pavements, even when the two types of pavements are in comparable physical condition. For example, a New York official said that past measurements had shown new concrete pavement with index values 30 inches per mile

[7]In early 1999, FHWA announced it would accept index data averaged from the left and right wheels, as authorized by new protocols approved by the American Association of State Highway and Transportation Officials. These protocols differ somewhat from FHWA's current guidelines.

[8]The quarter-car simulation involves modeling the movement of one corner of a passenger car's suspension over the road being profiled.

[9]The half-car simulation involves modeling the movement of half a passenger car's suspension over the road being profiled.

rougher than new asphalt pavement. This difference may have occurred, in part, because some concrete pavement, unlike asphalt, has joints between the concrete sections, and each concrete section has a slight natural curve in it. FHWA does not distinguish between pavement types when it publishes its data, so direct comparisons cannot be made between states that mainly use asphalt and states that mainly use concrete. FHWA officials noted that pavement contractors have developed ways of building concrete highways that can match asphalt highways in terms of roughness.

FHWA Has Not Required the States to Comply With Its Guidelines for Collecting International Roughness Index Data

FHWA has developed guidelines for the states to use in collecting, analyzing, and reporting data on pavement roughness. However, some elements of these guidelines allow for inconsistencies in the way the states collect the data. In addition, while FHWA has emphasized the importance of these guidelines, it does not require the states to follow them. FHWA instead relies on persuasion to get the states to collect data as specified in the guidelines.

In 1993, FHWA developed guidelines on measuring roughness and provided the states with detailed instructions for collecting and reporting the data. FHWA issued its guidelines as an appendix to its Highway Performance Monitoring System field manual. This appendix provides detailed instructions on measuring roughness—where on a roadway the state agencies should measure the pavement, what types of measuring devices are acceptable, how the index is computed, and other technical issues. The appendix also instructs the states to exclude roughness measurements taken at bridges, railroad tracks, and other obstacles designed as part of the roadway. At the same time, the guidelines allow for inconsistencies in collecting the data. For example, the states are allowed to use mechanical roughness meters[10] instead of the more accurate profilers. Also, under the guidelines, the states are allowed to measure roughness in the left wheel path if measuring the preferred right wheel path is not practical. However, FHWA's instructions do not otherwise address deviations from the guidelines.

FHWA expressed its desire for consistency in the states' application of its guidelines in 1994, when it directed its field staff to review the equipment the states used to collect roughness data, the frequency with which they collected data, and the reasonableness of the data they reported. FHWA

[10]Mechanical roughness meters would collect index data by measuring the response of a mechanical device—like a fifth tire riding behind a car—in contact with the roadway as the device traveled on a road. In contrast, the profilers most commonly used today rely on sensors, such as lasers, that are not in contact with the road.

field office staff at one of the states we visited found large-scale errors in their state's reports of roughness data. The state subsequently revised its data collection process to satisfy FHWA.

When the states deviated from FHWA's guidelines, they generally had an engineering reason for doing so. For example, Georgia and Ohio preferred measurements based on half-car simulations rather than quarter-car simulations because they had been collecting pavement roughness data before FHWA introduced its guidelines and the data from half-car simulations better matched their data from prior years. Pennsylvania and South Dakota left the measurements taken over bridges and railroad grade crossings in their data because they considered the information potentially useful in identifying trouble spots.

In general, FHWA has not strictly imposed its data collection guidelines on the states, and it accepts the data the states submit. FHWA has legal authority to impose and enforce requirements for accurate data. FHWA officials stated that the sanction for noncompliance could be for the agency to withhold planning and research funds. However, officials noted that the states use these funds to pay for many other data elements they report for FHWA's Highway Performance Monitoring System field manual, as well as for other planning and research activities, including metropolitan planning, statewide planning, and clean air requirements. FHWA officials also told us that persuasion was their preferred tool for encouraging the states to report roughness index data as specified in the agency's guidelines.

New protocols on measuring pavement roughness issued in early 1999 by the American Association of State Highway and Transportation Officials (AASHTO) could help address the problem of inconsistencies in the states' application of FHWA's guidelines. FHWA supported the development of AASHTO's protocols,[11] believing they would help standardize state data collection practices. FHWA officials told us they plan to issue a new Highway Performance Monitoring System field manual by the end of 1999 that incorporates AASHTO's new protocols, called provisional standards. In addition, to obtain closer compliance with its reporting requirements,

[11]AASHTO's protocols differ from FHWA's guidelines in that they call for the states to measure pavement roughness in both the right and left wheel paths and average the measurement to calculate a roughness index statistic. While FHWA recently agreed to accept data averaged according to AASHTO's protocols, FHWA's current guidelines call for taking measurements from only one wheel path, preferably the right wheel path. Furthermore, AASHTO's protocols do not address what types of profilers the states should use to collect data, whether the states should exclude data collected over bridges and railroad crossings, or how many technicians the states should use to collect index data.

FHWA will include revised instructions on gathering roughness data in the appendix to its new field manual.

Finally, recognizing the importance of consistent roughness data as a performance indicator for FHWA's strategic planning process and as a factor in estimating highway investment requirements for the Congress, FHWA officials said they plan to examine several issues related to collecting more consistent roughness data. Specifically, FHWA plans to

- evaluate the effects of different data collection and analysis protocols on the roughness data,
- assess current practices to identify where changes could significantly improve roughness data, and
- work with its field offices and the state highway agencies to implement changes that would make roughness data more consistent.

Conclusions

The International Roughness Index is a more consistent tool for measuring pavement conditions than the subjective system FHWA previously used. However, the data on pavement roughness that FHWA receives from the states need to be more consistent and accurate. Differences in the states' data collection methods and the resulting lack of comparable data become important when FHWA aggregates the data to the national level, such as when the data are used in the Department's model for projecting the nation's highway investment needs. Unreliable statistics result from aggregating data that are not comparable. For example, FHWA will not be able to determine with confidence that it has met the Department's performance goal for pavement condition set under the Results Act—that 93 percent of the National Highway System have an index below 170 inches per mile by 2008. Without accurate data on pavement roughness, FHWA cannot reliably assess the current condition of the highways relative to the goal or determine whether progress is being made toward the goal. In addition, meaningful comparisons among the states cannot be drawn using the data because the states use different procedures and calculation methods. While FHWA has given the states wide latitude in how they report pavement roughness data, FHWA also has the authority to require that they use accurate equipment and consistent techniques to collect the data.

Recommendations to the Secretary of Transportation

To enable the Federal Highway Administration to reliably report on the condition of the nation's highways and accurately estimate the nation's highway investment needs, we recommend that the Secretary of Transportation direct the Administrator, Federal Highway Administration, to revise the agency's guidelines to exclude profiling technologies known to produce significant errors and achieve consistency with the American Association of State Highway and Transportation Officials' protocols. We further recommend that the Administrator work with the states to implement the revised guidelines.

Agency Comments and Our Response

We provided a copy of a draft of this report to the Department of Transportation for review and comment. We discussed the draft report with Department officials, including the Federal Highway Administration's Director, Office of Highway Policy Information, and Acting Director, Office of Pavement Technology. FHWA generally agreed with the findings and our conclusion that the roughness data reported by the states could be more consistent. However, FHWA disagreed with part of the recommendation in our draft report, which said that FHWA should direct the states to comply with its own and AASHTO's guidelines on reporting data. FHWA believed that it could obtain more consistent roughness index data by working cooperatively with the states rather than by requiring them to comply with a federal mandate. According to FHWA, such a mandate was unwarranted. FHWA further stated that because the Congress in the National Highway System Designation Act of 1995 overturned earlier legislation that mandated state Pavement Management System requirements, FHWA did not believe it was appropriate to impose criteria for measuring roughness. FHWA believes it has worked effectively with the states to obtain better roughness data and that the states have already made great strides in improving their collection and reporting of the data.

FHWA also noted that it has planned several actions to obtain more consistent roughness data from the states. First, it said it plans to adopt AASHTO's recently developed roughness standards as its own. FHWA believes that these new standards will substantially address our concern about the quality of the data. In addition, to obtain closer compliance with its reporting requirements, FHWA said it will include revised instructions on gathering roughness data in the appendix to its new Highway Performance Monitoring System field manual. This appendix contains the guidelines that states use. Finally, FHWA said it plans to evaluate the effects of different data collection and analysis protocols on the roughness data, assess current practices to identify where changes could significantly

improve the data, and work with its field offices and the state highway agencies to implement changes that will improve the consistency of reported roughness data.

FHWA believes that adopting AASHTO's protocols, along with taking the actions it has planned, will address our concerns without imposing a federal mandate. We are encouraged by FHWA's recently stated commitment to work with the states on these issues and agree that a federal mandate may not be necessary. Nevertheless, we believe that following through on plans such as this is often just as difficult as developing them. Accordingly, we have revised our recommendation to reflect FHWA's new plan and this continuing need.

FHWA made a number of additional technical comments on the report, which we incorporated as appropriate.

Scope and Methodology

We contacted FHWA and state transportation department officials to determine how they use International Roughness Index data. We examined state and federal reports based on these data and documentation concerning FHWA's Highway Performance Monitoring System database and the related models for projecting future highway investment needs. Furthermore, to assess independent uses of roughness index data, we reviewed reports by the Surface Transportation Policy Project and the Center for Interdisciplinary Transportation Studies at the University of North Carolina-Charlotte. To obtain information about the reliability of the data, we interviewed FHWA and state transportation department officials about data collection practices and reliability. In particular, we interviewed state transportation department officials from seven states about their experience and concerns with the reliability of the roughness data. The seven states—Georgia, Illinois, New York, Ohio, Pennsylvania, South Dakota, and Texas—were selected to give us a broad cross section of opinions about the reliability and collection of the data. We also spoke with officials from Maryland about applications of the data. In addition, we interviewed experts in the field of pavement monitoring from the University of Michigan, the University of North Carolina-Charlotte, and a profiler manufacturer. We also analyzed pavement data from the Highway Performance Monitoring System database and reviewed reports on the reliability of roughness index data that were presented before the Road Profiler Users Group and the Transportation Research Board. We performed our review from

August 1998 through September 1999 in accordance with generally accepted government auditing standards.

We will make copies of this report available to cognizant congressional committees; the Honorable Rodney E. Slater, Secretary of Transportation, the Honorable Kenneth R. Wykle, Administrator, Federal Highway Administration; and other interested parties. We will make copies available to others on request. Please call me at (202) 512-2834 if you or your staff have any questions. Major contributors to this report were Richard Calhoon, Joseph Christoff, Robert Ciszewski, and Raymond Sendejas. Sincerely yours,

Phyllis F. Scheinberg
Associate Director,
Transportation Issues

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Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
DOT	Department of Transportation
FHWA	Federal Highway Administration
TEA-21	Transportation Equity Act for the 21st Century

Pavement Data Published by the Federal Highway Administration

TABLE HM-47
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OCTOBER 1998

STATE	INTERNATIONAL ROUGHNESS INDEX (IRI) 2/ TOTAL RURAL NHS									
	NOT REPORTED	< 60	60-94	95-119	120-144	145-170	171-194	195-220	> 220	TOTAL REPORTED
Alabama	-	167	1,483	719	201	61	10	2	7	2,650
Alaska	454	1	252	452	510	160	103	22	28	1,528
Arizona	-	787	688	342	196	58	48	6	9	2,134
Arkansas	145	9	578	559	408	288	134	64	32	2,072
California	-	31	1,628	1,374	1,109	552	126	60	29	4,909
Colorado	-	43	506	553	600	330	231	106	237	2,606
Connecticut	-	-	106	116	76	35	13	4	5	355
Delaware	-	4	77	91	22	2	3	3	1	203
Dist. of Columbia	-	-	-	-	-	-	-	-	-	-
Florida	66	264	793	656	670	225	26	27	12	2,673
Georgia 4/	2,909	183	112	14	1	-	-	-	-	310
Hawaii	141	-	-	-	1	1	1	1	-	4
Idaho	1	378	921	555	247	59	26	4	9	2,199
Illinois	-	77	998	1,027	660	383	122	52	53	3,372
Indiana	4	113	1,012	418	280	231	30	25	12	2,121
Iowa	94	195	984	561	357	258	120	35	9	2,519
Kansas	95	732	1,530	527	270	109	35	-	10	3,213
Kentucky	-	387	1,244	307	226	98	5	3	1	2,271
Louisiana	13	71	540	305	279	236	122	77	136	1,766
Maine	84	197	549	167	59	21	11	7	6	1,017
Maryland 4/	-	36	456	195	45	29	11	8	9	789
Massachusetts	30	5	213	154	34	27	11	10	5	459
Michigan	-	294	1,282	659	475	176	114	15	16	3,031
Minnesota	-	482	1,092	817	451	210	92	59	52	3,255
Mississippi	-	27	820	605	444	236	58	39	19	2,248
Missouri	7	92	1,098	1,168	635	246	56	24	54	3,373
Montana	-	522	1,880	700	348	201	58	25	5	3,739
Nebraska	-	750	798	383	344	174	145	57	46	2,697
Nevada	-	392	734	254	380	102	44	4	6	1,916
New Hampshire	-	25	409	122	40	18	12	-	7	633
New Jersey	100	-	75	123	124	82	53	44	64	565
New Mexico	44	43	867	627	536	222	121	79	96	2,591
New York	6	2	1,546	502	248	176	123	66	100	2,763
North Carolina	42	11	469	564	779	590	230	74	50	2,767
North Dakota	-	268	1,349	707	207	37	42	7	2	2,619
Ohio	-	416	1,746	333	141	60	8	2	3	2,709
Oklahoma	-	118	1,293	673	406	200	98	25	18	2,831
Oregon	-	29	692	1,543	755	219	19	6	3	3,266
Pennsylvania	23	144	1,213	906	600	293	147	81	59	3,443
Rhode Island	88	-	-	-	-	-	-	-	-	-
South Carolina	-	145	992	432	231	104	21	13	5	1,943
South Dakota	258	9	592	616	535	490	172	48	98	2,560
Tennessee	1,933	33	154	42	38	7	8	-	-	282
Texas	-	2,452	3,747	1,673	479	122	23	9	20	8,525
Utah	-	616	899	191	50	17	2	8	1	1,784
Vermont	-	55	243	83	88	77	25	14	11	596
Virginia	-	12	893	758	289	134	53	31	25	2,195
Washington	13	27	376	700	808	487	110	47	9	2,564
West Virginia	101	130	654	316	189	94	10	8	7	1,408
Wisconsin	-	238	978	799	554	282	179	101	60	3,191
Wyoming	8	733	1,325	253	72	35	4	-	-	2,422
U.S. Total	6,659	11,745	42,886	25,641	16,497	8,254	3,215	1,402	1,446	111,086
Puerto Rico	18	-	-	12	64	37	12	-	7	132
Grand Total	6,677	11,745	42,886	25,653	16,561	8,291	3,227	1,402	1,453	111,218

Note: In this Federal Highway Administration table on the roughness of rural pavement, the states are listed alphabetically.

Source: Highway Statistics 1997, Federal Highway Administration.

Pavement Data Published by the Surface Transportation Policy Project

State	Percent in Poor or Mediocre Condition	Percent in Fair Condition	Total Percent Not in Good Condition	Percent Unreported
Oregon	22%	70%	92%	0%
Illinois	40%	50%	90%	0%
Colorado	36%	51%	86%	0%
Pennsylvania	34%	50%	85%	2%
Louisiana	16%	68%	85%	0%
Virginia	19%	66%	84%	0%
Mississippi	9%	76%	84%	0%
Oklahoma	41%	42%	83%	0%
Michigan	36%	46%	82%	2%
Wisconsin	30%	48%	78%	5%
Rhode Island	39%	39%	78%	5%
California	13%	63%	75%	0%
New York	35%	39%	74%	6%
Maryland	32%	40%	72%	0%
Connecticut	21%	50%	71%	6%
Arkansas	23%	46%	69%	10%
Nevada	12%	54%	66%	1%
North Carolina	23%	43%	65%	13%
Kentucky	9%	49%	58%	0%
New Jersey	8%	50%	58%	19%
Ohio	12%	46%	58%	0%
Minnesota	7%	50%	57%	0%
Missouri	9%	45%	54%	19%
Indiana	20%	33%	52%	17%
West Virginia	11%	41%	52%	0%
Alabama	2%	50%	52%	0%
Florida	7%	43%	50%	12%
South Carolina	7%	43%	50%	5%
Massachusetts	12%	33%	45%	20%
Utah	2%	42%	44%	0%
Texas	3%	27%	31%	3%
Arizona	4%	25%	29%	0%
United States	**16%**	**41%**	**57%**	**10%**

Note: In this Surface Transportation Policy Project chart, the states are listed by the percentage of pavement not in good condition.

Source: Potholes & Politics 1998, Surface Transportation Policy Project.

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