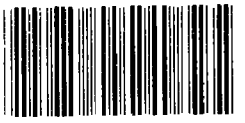
GAO

Report to Congressional Requesters

August 1987

HIGHWAY NEEDS

An Evaluation of DOT's Process for Assessing the Nation's Highway Needs



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GAO

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Resources, Community, and
Economic Development Division

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August 7, 1987

The Honorable James J. Howard
Chairman, Committee on Public Works
and Transportation
House of Representatives

The Honorable Quentin N. Burdick
Chairman, Committee on Environment
and Public Works
United States Senate

This report presents the results of our evaluation of the Department of Transportation's process for assessing national highway capital investment needs. This process produces the report The Status of the Nation's Highways: Conditions and Performance, which the Secretary of Transportation provides the Congress in accordance with Section 307 of Title 23, U.S.C.

We are providing this report to you in response to your November 25, 1985, and December 6, 1985, letters in which you expressed interest in the results of our highway projects. We are also providing copies to the Secretary of Transportation; the Director, Office of Management and Budget; and other interested parties.

This work was performed under the direction of Herbert R. McLure, Associate Director. Other major contributors are listed in appendix V.

J. Dexter Peach
Assistant Comptroller General

Executive Summary

Purpose

By law, the Secretary of Transportation biennially reports to the Congress on the condition and capital investment needs of the nation's highways. The 1987 report, The Status of the Nation's Highways: Conditions and Performance (Highway Needs report), estimated that a capital investment of $315 billion, or nearly $20 billion annually, would be required through the year 2000 to maintain 1983 highway conditions. Additional investments would be required to improve overall highway conditions.

The Highway Needs report is a key tool used by the Congress and others in developing and analyzing policies and programs relating to the nation's highways. GAO examined the Highway Needs report and concentrated on the reasonableness of the process the Department of Transportation uses to produce it. GAO focused on the Highway Performance and Monitoring System (HPMS) because it is the primary data source for the Highway Needs report.

Background

The Federal Highway Administration and the states developed HPMS in the late 1970s to provide a systematic, national approach for identifying highway conditions, estimating capital investment needs, and measuring changes in highway conditions over time. HPMS is based on data from a statistical sample of about 100,000 highway sections. States and the federal agency check and monitor data collection to ensure data quality.

The Federal Highway Administration uses a computer model to analyze the data and develop estimates of capital investment needs. The model identifies current and projects future highway deficiencies, selects projects to correct the deficiencies, and estimates the costs of the corrections. The model also estimates the effects of alternative capital investment levels on highway conditions.

Results in Brief

On the basis of its analysis of the Highway Needs report and the HPMS process, GAO believes that the report presents useful information on the condition and capital investment needs of the nation's highways. The Federal Highway Administration's plan for selecting HPMS sample highway sections is statistically sound in that it is representative of the various types of highways at the nationwide aggregate level. Further, states and the federal agency have reasonable controls and checks to ensure the quality of the data entered into the HPMS model. In addition, the Federal Highway Administration has taken several positive steps to develop, test, and operate the HPMS model.

While the model is a reasonable tool, the Federal Highway Administration has not yet performed certain tests that would provide added confidence in the model's results. Specifically, the agency has not yet conducted detailed tests to determine the model's sensitivity to changes in key input data, nor has it "calibrated" the model to determine how closely past needs estimates have paralleled actual investment practices. In addition, the model's documentation, contained in published technical manuals, either did not cover in detail or omitted entirely some information. The federal agency plans to test the model's sensitivity and to begin calibration tests in 1987.

Although the Highway Needs report contains useful information on total highway needs, the report does not separate existing or backlogged highway needs from future or projected needs. Separating the two would provide a clearer understanding of the nation's highway capital investment needs and the progress made under highway policies and programs.

GAO's Analysis

Data Collection and Control

The Federal Highway Administration provided states a reasonable statistical sampling plan for selecting the highway sections, and officials from the six states GAO reviewed indicated they followed the plan guidelines. The data collection and control procedures for HPMS appear to be reasonable for assuring data quality. The federal agency and the states edit and review the HPMS data as quality control checks, and the federal agency also monitors the states' data gathering at sample highway locations as a further check on the data's quality. Although the states used different methods to collect HPMS data, GAO found no indication that the differences affected the quality of the data.

HPMS Computer Model

The HPMS model is a reasonable tool for translating highway data into capital investment needs estimates because the Federal Highway Administration

- devised a logical framework for key model components and their interrelationships;
- based key engineering elements on generally accepted engineering standards;

- published technical manuals that explain the model's key components and their interrelationships;
- tested the model to verify that key logic and mathematical components have been included and have been properly converted into programming language; and
- established procedures to assure that feedback from appropriate parties is obtained when devising the model.

Model Documentation and Testing

Although the published technical manuals for the HPMS model do a reasonably good job of explaining how the model works, they do not contain some information that would be useful to model users. For example, more detailed information on key model changes, their underlying rationales, and their effect on the model's results would help assure model continuity in the event of key Federal Highway Administration employee turnover. Such information would also assist researchers attempting to study the model's results.

The HPMS model had not been calibrated to determine how closely past highway needs forecasts have paralleled actual state capital investment practices. Although calibration tests are scheduled to start in 1987, the Federal Highway Administration had not developed a test methodology or established a test completion date.

In addition, the model had not been tested to determine how sensitive its results are to changes in key input data. However, the federal agency plans to conduct such tests and report on the results in 1987. In GAO's opinion, the sensitivity and calibration tests along with any necessary refinements, should provide added confidence in the model's results.

Observations on the Highway Needs Report

The Highway Needs report presents useful information on the capital investment needs of the nation's highways. The report has several features researchers consider desirable in such needs assessments. For example, the report presents alternative concepts of need and analyzes the impact of different levels of capital investment on highway performance.

Although the report presents highway needs in total —$315 billion through the year 2000 to maintain 1983 highway conditions—it does not make clear that about one-half of this amount represents backlogged needs that already exist. Not reporting backlogged needs separately clouds the distinction between existing and future highway deficiencies.

In addition, separating the two would allow the measurement of progress in addressing the backlog of the nation's highway needs.

Recommendations

GAO recommends that the Secretary of Transportation direct the Administrator, Federal Highway Administration, to

- include more detailed information on key model changes in published technical manuals to (1) help assure model continuity in the event of key employee turnover, (2) assist researchers attempting to study the model's results, and (3) assist state highway agencies attempting to modify the national model for their own needs;
- develop and document a calibration test methodology and establish a test completion date, because this test, along with any required refinements, should provide added confidence in the model's results; and
- separate current from projected highway capital investment needs in the Highway Needs report to provide a clearer understanding of such needs, and to better demonstrate the extent to which progress is being made under highway policies and programs.

Agency Comments

The Department generally concurred with GAO's conclusions and supported its recommendations relating to the HPMS model, stating that actions were either initiated or were planned for implementation in 1987. The Department also stated that future Highway Needs reports will include information on existing highway deficiencies and the cost of eliminating such deficiencies.

GAO believes that the steps taken or scheduled for implementation in 1987 are consistent with its recommendations. The full text of the Department's comments is included as appendix IV.

Contents

Figures

Abbreviations

AADT	Average Annual Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
ASCE	American Society of Civil Engineers
FHWA	Federal Highway Administration
GAO	General Accounting Office
HPMS	Highway Performance Monitoring System
MTC	Minimum Tolerable Condition

Introduction

The condition of our nation's highways is the subject of widespread concern to the Congress, states, and others. More than $600 billion has been spent by federal, state, and local governments to build and maintain the nation's highways, and billions more will be required to preserve them.

In 1987, the Secretary of Transportation reported that a capital investment of about $315 billion, or $20 billion annually, would be required through the year 2000 to maintain 1983 highway conditions.[1] These estimates come from a biennial report by the Secretary to the Congress in accordance with Section 307 of Title 23, U.S.C. The report, The Status of the Nation's Highways: Conditions and Performance (Highway Needs report), discusses the current condition of the nation's highways and estimates capital investments needed to achieve various levels of highway service.

The Highway Needs Report and Its Basis

The Highway Needs report, which is based primarily on the Highway Performance Monitoring System (HPMS), is an important tool used by the Congress and others in developing and analyzing national policy and programs relating to highways. HPMS was developed in the late 1970s by the Department of Transportation's Federal Highway Administration (FHWA) and state highway agencies to provide a systematic, national approach for assessing highway conditions, estimating highway capital investment needs, and measuring changes in highway conditions.

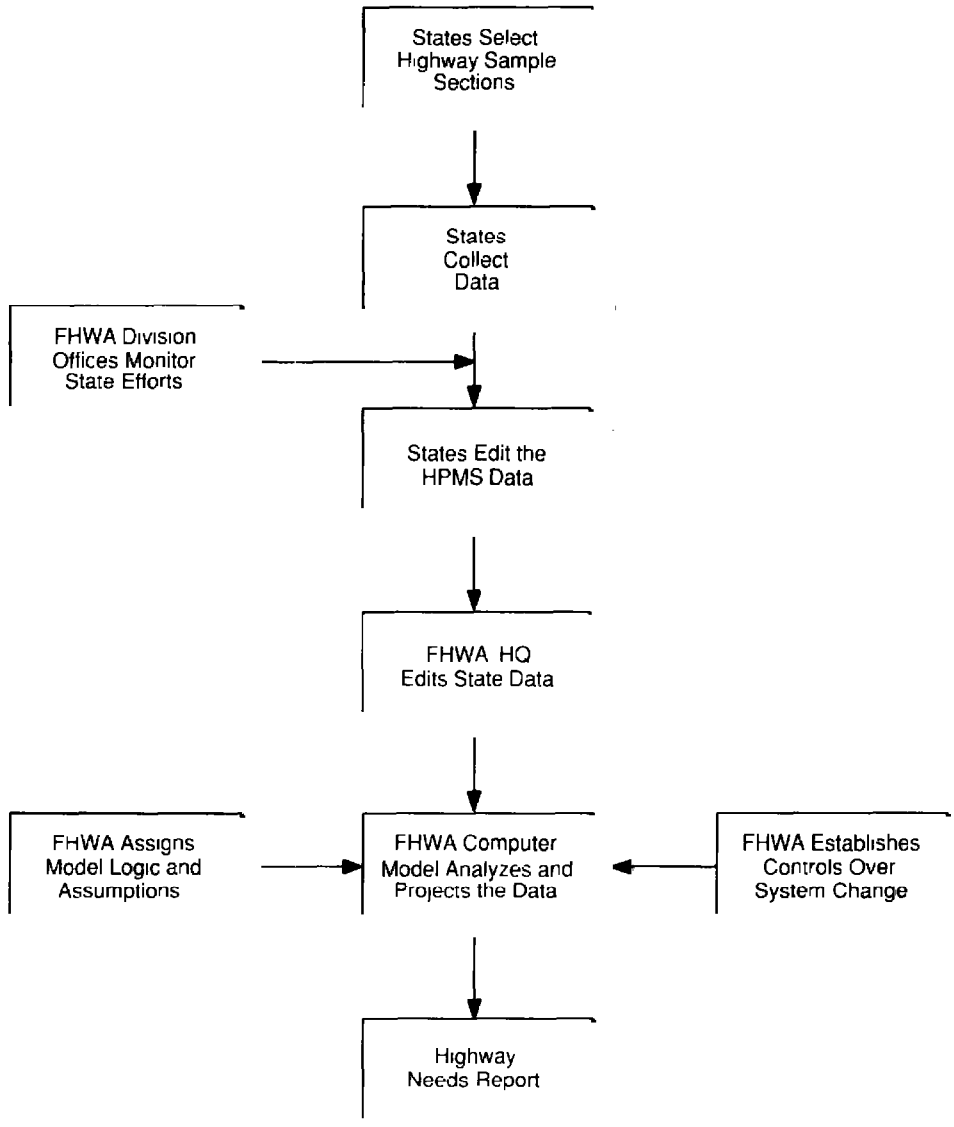
HPMS is based on a statistical sample of about 100,000 highway sections from across the nation. Generally, state highway officials collect information on about 70 data elements for each sample highway section. The data elements include pavement condition, traffic levels, and physical design characteristics. States and FHWA perform certain quality control checks on the data to assure data accuracy. FHWA also monitors state data collection at some sample highway locations as a further quality check.

FHWA uses a computer model to analyze the data states provide. The model conducts a "Needs Analysis" to identify current and future highway deficiencies, determine the work needed to correct the deficiencies, and estimate the cost of the corrections. Among its other components is an "Investment Analysis," which estimates the effects varying capital investment levels can have on highway conditions. This analysis also

[1]These estimates do not include capital investment requirements for local roads, bridges, completion of interstate highways, and construction of new highways

describes the overall quality of the sampled highway sections by evaluating their condition, safety, and service characteristics. Figure 1.1 illustrates the flow of the HPMS process.

Figure 1.1: Highway Performance Monitoring System



Objectives, Scope, and Methodology

Our overall objective was to determine the reasonableness of the federal government's highway needs assessment as presented in the Highway Needs report. We focused our review on HPMS because it is the primary source of the data in the report. We identified how states generated the basic data and assessed how FHWA used that data to estimate highway capital investment needs. Specifically, we assessed

- the reasonableness of FHWA's highway sampling plan,
- how states gather HPMS data,
- federal and state procedures for assuring data quality,
- the reasonableness of the HPMS model, and
- FHWA's model documentation, testing, and controls.

We worked at FHWA headquarters, four FHWA regions, and six FHWA state division offices. Because states collect HPMS data, we selected, with FHWA's assistance, six states for review: California, Florida, Kansas, Kentucky, Nevada, and New York. We chose these states because they are geographically dispersed and they have different size highway systems.

We timed our work to coincide with the HPMS cycle. The discussions on data-gathering and editing, and model framework and operating controls are based on our review and observations of the process that resulted in the 1987 Highway Needs report. We examined the needs assessment process from the sampling of highway sections through the states' gathering and processing of the data, and FHWA's development of the Highway Needs report.

Our main goal in reviewing the plan for selecting HPMS sample highway sections was to determine its reasonableness for developing a national sample. We also interviewed FHWA and state officials about how the sample was developed and tested.

States gather and report over 70 data items for each of 100,000 highway sample sections. To determine how states gather HPMS data, including their procedures to ensure reliability, we reviewed data-gathering and processing at six state highway agencies. At these agencies we focused on 15 key data items. We selected these items, with FHWA's assistance, because they are believed to significantly influence the model's results (see app. III). For analytical purposes we grouped these items into three categories:

- pavement condition ratings, which indicate the physical condition of the highways;

- traffic and capacity items, which indicate how the highways are used; and
- geometric items, which describe the physical configuration of the highways.

In the six states, we interviewed state highway officials from both central and field offices to determine how they collect the data. We reviewed pertinent documents such as pavement condition rating forms and forms used for traffic counting. In each state, we discussed the HPMS edit process and verified edit results. We compared the edit tapes of two states to verify that they used the same edit software. In California, we interviewed local officials who gather HPMS data for the state highway agency. (Local officials generally did not gather HPMS data in the other states.) We also discussed FHWA's monitoring efforts with FHWA division officials in each state. In Kentucky we accompanied FHWA officials as they inspected HPMS sample highway sections.

The states submit HPMS data to FHWA headquarters where the data are further screened and edited. To determine how FHWA handles the HPMS data, we compared the data that two states submitted with FHWA's edited version of these states' data and reconciled the differences. We analyzed the edit results and interviewed FHWA headquarters officials regarding this process.

To judge whether the HPMS model is a reasonable tool for translating highway data into the information contained in the Highway Needs report, we (1) assessed the credibility of the logic framework devised for two of the model's key analyses and the interrelationships between them, (2) examined the model's key economic and modeling assumptions, (3) identified the procedures FHWA uses to test the model's logic structure, and (4) determined the procedures FHWA uses to obtain feedback from model users when revising the model. Our assessment is based on discussions with key FHWA officials responsible for developing and operating the model and a review of available technical documentation.

To further evaluate the model's reasonableness, we studied its engineering components. Although limited documentation precluded us from assessing all of the model's engineering assumptions, formulas, and values, we were able to trace key formulas and values back to their source documents to determine whether they were based on generally accepted engineering standards. We also obtained the views of the American Association of State Highway and Transportation Officials (AASHTO) and

the American Society of Civil Engineers (ASCE) concerning the reasonableness of selected engineering standards and values used in the model.

Our review followed generally accepted government audit standards, and we did our work between November 1985 and March 1987.

Collecting and Controlling HPMS Data

FHWA calculates national highway needs estimates from HPMS data that state highway agencies collect. Each year states collect data on about 100,000 sample highway sections and submit the data to FHWA. The states report almost 70 data elements for each highway section, including traffic and pavement condition data. Both the states and FHWA edit and review the HPMS data to assure their accuracy. FHWA further reviews the quality of HPMS data when it monitors state data-gathering at sample highway locations. We believe that FHWA and state highway agencies had reasonable approaches for assuring the quality of the data in the states we visited. Specifically, we found that

- FHWA provided the states a reasonable statistical sampling plan for selecting HPMS highway sections;
- while the six states we reviewed used different methods to collect HPMS data, there were no indications that the differences affected the quality of the data; and
- controls over HPMS data collection are reasonable, and FHWA monitoring of state data gathering provides a further check on the data's quality.

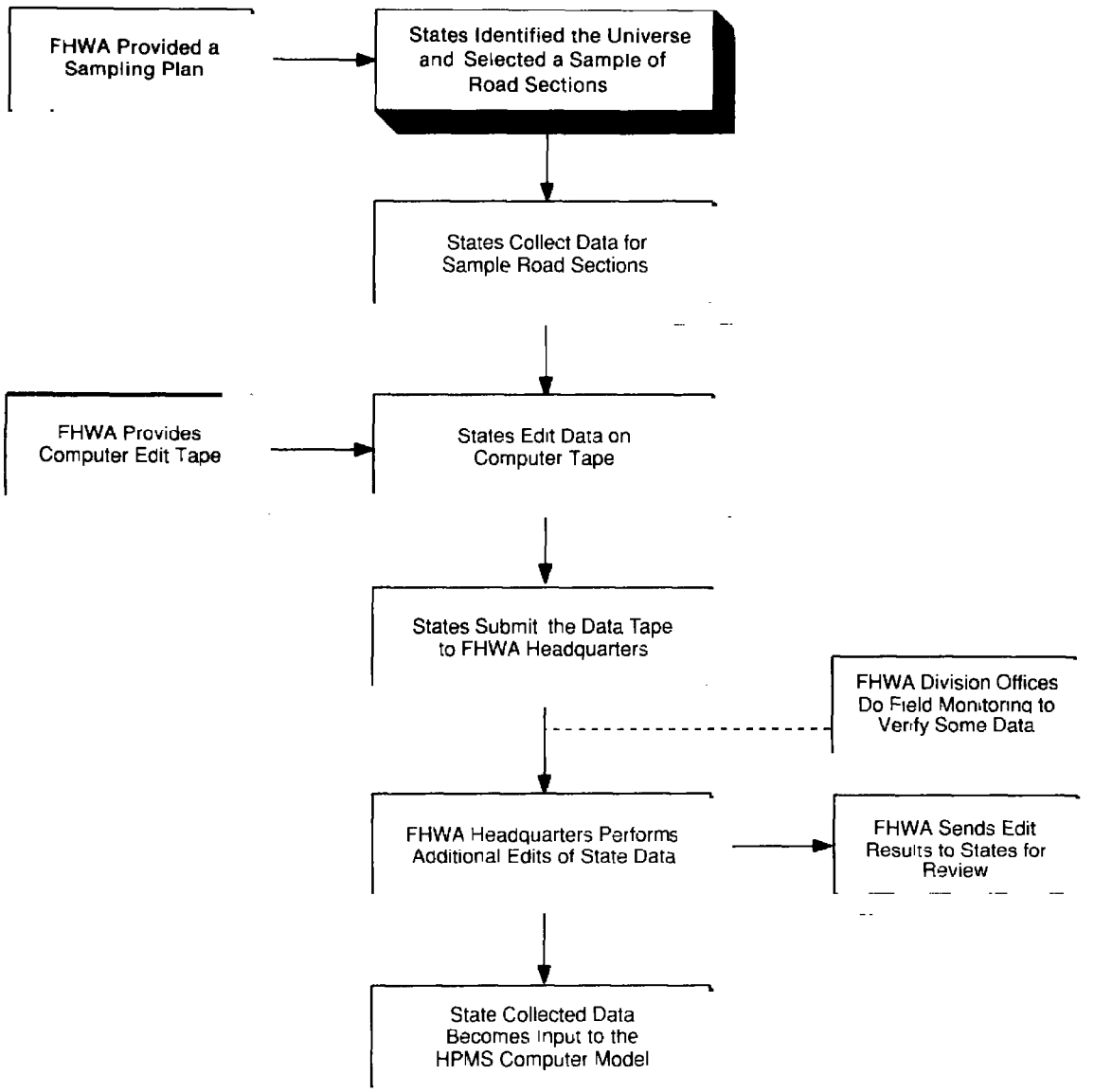
Figure 2.1 on the following page depicts the data collection and control process.

Plan for Sampling Highway Sections Reasonable

FHWA developed the HPMS sampling plan in 1978 and provided state highway agencies with a manual to guide their selection of sample highway sections for HPMS. We analyzed the FHWA sampling plan and found it to be statistically reasonable for selecting highway sections nationally. Officials from the six states we visited stated that they followed FHWA's sampling plan guidance when selecting sample highway sections. We could not verify this, however, because the states did not document their selection process.

The HPMS sample consists of about 100,000 highway sections randomly selected from across the nation. According to FHWA's guidance, each section should be relatively consistent throughout its length in such characteristics as number of lanes and shoulder width. The lengths of the highway sections were to be between 0.3 and 10 miles in rural areas and between 0.1 and 3 miles in urban areas. FHWA instructed states to review the same sections year after year, so changes in highway conditions could be measured over time. The sample is stratified to encompass highways (1) in rural and urban areas, (2) of different functional use, and (3) with different traffic volume levels.

Figure 2.1: Data Collection and Control Process



We believe that FHWA's sampling plan was reasonable because the manual provided guidance covering standard statistical techniques, including

- a random selection approach for selecting HPMS sample sections. This approach assures that highway sections have a known probability of selection, which guards against a bias in the types of highway sections included in the nationwide sample.
- the use of standard statistical formulas for deriving estimates and computing the confidence and precision levels of the estimates. Such information can benefit decisionmakers, since the greater the precision level, the more comfortable they can be in using the estimates for policymaking purposes.
- the stratification of HPMS sample sections by traffic volumes. Dividing the universe of highway sections into non-overlapping, homogeneous groups helps reduce the variability of the data assessed in the sample and thus helps generate more precise estimates.

States Collect HPMS Data

Generally, FHWA relies on state highway agencies to collect HPMS data. Although collection methods differed among the states we visited, we found no indications that the differing methods affected the quality of the data. The key data we focused on were

- pavement condition ratings, which indicate the condition of highways;
- traffic and capacity data, which indicate highway usage; and
- geometric elements, which describe the physical characteristics of highways.

States base pavement condition determinations on measurements of ride roughness and/or observations of highway ruts and cracks. Traffic-counting techniques were similar among the states: each state used continuous machine counts at some locations, supplemented by short-term counts—usually 24 hours—at other locations. Geometric data, such as lane width and shoulder type, were generally extracted from existing files and were not likely to change from year-to-year. FHWA encourages the states to adopt uniform methods for collecting traffic volume data and will require states by 1990 to use a specific pavement condition rating technique to further assure consistency of HPMS data.

FHWA requires states to submit HPMS data for both state-owned highways and highways owned by city, county, or other governmental jurisdictions. States obtain information on state highway sections primarily from existing state data bases such as those for traffic and pavement management. Collecting data for highways owned by other governmental jurisdictions is more difficult, since states generally do not have data

bases on these highways. They obtain the data from physical inspections, highway design plans, and other sources.

Evaluating Pavement Condition

Pavement condition data are important because improvements to pavement condition represent more than half of all national highway needs. The six states we visited used at least one of three methods to evaluate pavement condition: (1) a ride-roughness rating determined by driving a car equipped with a shock-measuring device over the highway, (2) a visual and/or measured evaluation of pavement distress (cracking, ruts, etc.), and (3) a visual observation based on a brief FHWA description of pavement condition with no measurement of pavement distress. Appendix I summarizes the six states' methods of rating pavement condition.

FHWA plans to require states to use a uniform method for determining pavement condition ratings. Over the years, FHWA has been concerned that pavement condition data may be inconsistent from state to state. A FHWA task force report concluded that the best way to obtain consistent pavement information would be to require states to use ride-roughness measurements. In December 1986, FHWA's Executive Director approved the task force's recommendation to require ride-roughness measurements for HPMS sample sections on interstate and other arterial highways. FHWA plans to implement this change by 1990.

Counting Traffic

Since highway expansion—adding lanes to existing highways—accounts for another major share of all HPMS projected needs, the traffic data used to project those needs should be accurate. For HPMS, states collect and report basic traffic information such as the average amount of traffic per day (annual average daily traffic, or AADT) and the type of vehicles using the highways. Appendix II describes the traffic-counting programs in the six states.

How Traffic Counting Programs Operate

While the traffic-counting programs varied among the states we visited, they used some common data collection and projection techniques. All six states counted traffic continuously at a limited number of locations and made short-term counts at a much larger number of locations. They developed seasonal, day of the week, and other adjustment factors from the continuous count data. They then used these factors to adjust the short-term counts to develop AADT and other values. For example, a Kentucky traffic program official stated that the highway agency made

continuous automatic vehicle counts at about 50 locations. It also made short-term counts at about 4,000 locations.

States also make a number of vehicle classification counts that determine the different types of trucks and automobiles using their highways. This information is important because trucks cause greater wear and tear and more congestion on highways. To gauge the mix of trucks and automobiles in Kentucky, manual vehicle counts and classifications were made at about 300 locations for periods of 8, 16, or 24 hours, depending on a highway's traffic volume and pattern.

Some States Adopting New FHWA Traffic Monitoring Procedures

In June 1985 FHWA issued a Traffic Monitoring Guide containing new procedures for collecting and analyzing traffic volume, vehicle classification, and truck weight data. The guide's procedures emphasize the use of statistical sampling tied to the HPMS sample. According to FHWA, the procedures allow known reliability levels to be made from the data collected.

FHWA officials stated that its guide is intended to be a statement of good data collection practice rather than a federal standard. States are encouraged to consider the guide's methods but are not required to adopt them. Of the six states we visited, five were planning to implement the guide's procedures. In the sixth state, New York, officials considered their traffic-counting systems to be adequate.

Obtaining Geometric Data

The HPMS geometric data elements reflect a road section's physical characteristics and affect the cost of highway needs. The geometric data that states report include lane width, number of lanes, shoulder width, and horizontal and vertical alignment (curves and grades). The states we visited obtained geometric data primarily from road construction plans. Geometric characteristics generally change little from year-to-year. Appendix III describes geometric data elements and their sources in the states we visited.

FHWA and States Assure HPMS Data Quality

Controls over the collection of HPMS data are reasonable. While FHWA relies on states to collect the data, states have an interest in gathering quality data for HPMS because much of it is used for their own state highway planning purposes. States and FHWA edit HPMS data, which provide additional checks on data quality. FHWA also monitors state data collection.

State Highway Data Bases

The six states we visited had their own highway data bases, which contained most of the information required for HPMS. State highway agencies use these data bases to manage their state highway systems, including selecting highway improvement projects and determining the type of work to be done. State officials draw from these data bases and reformat the data for HPMS. FHWA officials stated that this approach helps assure the quality of HPMS data because states need quality data for their own highway planning purposes.

State Editing Checks

FHWA provides each state computer software to "edit" the HPMS data. This software is used to check each item in the states' HPMS data bases for valid codes, to cross-check various items for consistency, and to check if they are within a range of reasonable values. When a data item does not comply with edit specifications, it is identified for review and verification or correction.

We reviewed edit checks in the six states we visited and determined that, generally, state highway officials made reasonable efforts to verify or correct the HPMS data. They followed up on the data items by first determining if the data was properly keyed into the data base and then, if necessary, contacted state highway engineers who provided the data.

FHWA Editing Checks

FHWA has a two-step edit process. First, FHWA officials edit the data tapes to confirm that the states sent the correct tapes. FHWA then edits the data a second time to (1) compare the current year's HPMS data with that of the previous year, (2) examine the distribution of pavement condition ratings among the different types of highways, and (3) identify any additional errors and/or unusual conditions.

FHWA officials told us they did not change state data unless state officials agree to the change. In addition, FHWA sends each state a data review package containing its edit results and asks the states to make any necessary corrections before the next HPMS reporting cycle. State officials told us they reviewed the FHWA packages, determined if the state data were accurate, and where appropriate, made corrections to the data base for the next year.

FWHA Monitoring

To further assure the data's quality, FHWA monitors state HPMS data collections at some sample highway locations. This provides a limited check on HPMS data quality because (1) highway conditions can change

between the time the data are collected and the time they are inspected by FHWA and (2) some data items, such as traffic counts, can only be verified by completely duplicating extensive data collection efforts.

In 1984 FHWA headquarters officials issued guidance to their field offices emphasizing the importance of monitoring state data collection activities. The guidance was based on a 1984 Department of Transportation Inspector General report that found that 30 of FHWA's 52 division offices were not performing field checks.

All division offices we visited had monitored state HPMS data-gathering in one way or another. When division officials found discrepancies in state data, they notified state HPMS officials and asked them to review the data and, in some cases, encouraged state officials to improve their data collection systems. For example, based on the FHWA division's field check, the Kentucky highway agency issued instructions to its district offices clarifying how pavement condition should be determined and how the feasibility of widening or adding lanes should be assessed.

Conclusions

The HPMS sampling plan and data collection procedures, along with federal and state editing and control procedures, are reasonable approaches for developing nationwide information. FHWA provided the states a reasonable plan for selecting sample highway sections for HPMS, and states indicated that they followed that plan. The quality of HPMS data is assured by the states' own use of the data; state and FHWA editing checks, review, and verification, or correction of the data; and FHWA field monitoring of state data collection. Although the states used different methods to collect HPMS data, we found no indication that the differences affected the data's quality.

Translating HPMS Data Into National Highway Needs Estimates

The HPMS model analyzes the present condition of the nation's highways and estimates future highway capital investment needs. The model, which is the heart of the HPMS process, appears to be a reasonable tool for translating highway data into the information presented in the Highways Needs report. Our conclusion is based on the steps FHWA has taken in developing, testing, and operating the model. These include

- devising a logical framework for two of the model's most important analyses and the interrelationship between them;
- basing the model's key engineering elements on generally accepted engineering standards.
- publishing a series of technical manuals for model users that explain the model's analytical components and their interrelationships;
- testing the model to verify that key mathematical and logic relationships have been incorporated and that they have been properly converted into programming language; and
- establishing procedures to assure that feedback from appropriate parties is obtained when revising the model.

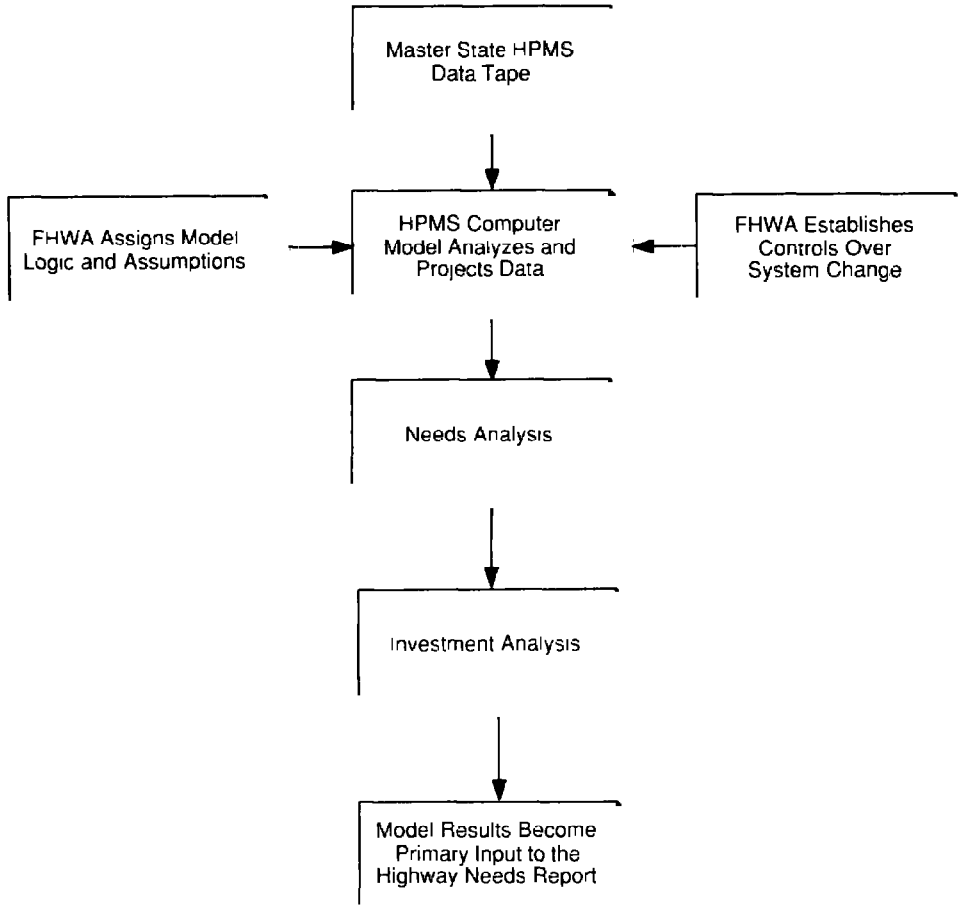
We noted, however, that several areas of the model's development either were not covered in detail or were omitted entirely from the model's documentation. We also noted that FHWA had neither conducted detailed tests to determine the sensitivity of the model's outputs to changes in key input variables, nor had it calibrated the model to determine how closely the model's past capital investment needs estimates paralleled actual highway investment practices. FHWA plans to conduct both sensitivity and calibration tests during 1987. These model tests, along with any needed refinements, should provide added confidence in the model's results.

HPMS Model Framework: An Overview

The HPMS model framework consists of seven interdependent analyses, with the Needs Analysis and the Investment Analysis being two of the most important in generating highway needs estimates. Figure 3.1 illustrates these key analyses.

The Needs Analysis identifies current and future highway deficiencies and selects reconstruction, resurfacing, or widening projects to correct the deficiencies. In addition, the Needs Analysis estimates the total cost of improvement projects.

Figure 3.1: Key Model Analyses



Essentially, there are three steps in the Needs Analysis process:

- identifying current and forecasting future deficiencies;
- selecting projects to correct deficiencies; and
- estimating total project costs.

The Needs Analysis is first done for each of the 100,000 sample highway sections. The results are then totaled, projected to the universe, and presented in various formats in the Highway Needs report. The Investment Analysis uses the results of the Needs Analysis to estimate the

effects of alternative highway investment strategies and budget levels on the quality of highways.

We believe the HPMS model framework is reasonable because of the logic used in these analyses and the interrelationships between the analyses. For example, the Needs Analysis logic framework links highway deficiencies to the selection of improvements designed to correct those deficiences and indicates how the selected improvements may change highway quality.

The Investment Analysis, showing the effects of alternative investment strategies and budget levels on highway performance, can help policymakers make more informed choices concerning the allocation of limited financial resources. We believe this approach is particularly useful since the funding required to correct all highway deficiencies is not attainable in today's constrained fiscal environment.

HPMS Model Uses Accepted Engineering Standards and Practices

We traced key engineering parameters, formulas, and assumptions back to their source documents and found that they are based on generally accepted highway engineering standards and practices. The minimum tolerable conditions (MTCs),[1] design standards,[2] and pavement deterioration formulas are based primarily on the guidance contained in standard highway engineering publications. For example, the formulas used to predict the rate of pavement deterioration are based on road test equations contained in the American Association of State Highway Officials (AASHTO) pavement design guide.

We asked officials from AASHTO and the highway section of the American Society of Civil Engineers (ASCE) for their opinions concerning the reasonableness of several key model components. They told us that overall HPMS is a reasonable analytical device for monitoring trends in highway condition and performance. Regarding technical elements of the model, AASHTO and ASCE officials commented that FHWA should update some of

[1] Minimum Tolerable Conditions. The standards represent minimum acceptable physical, operating, and performance characteristics. Rural MTCs are: right shoulder width, lane width, surface type, shoulder type, pavement condition, volume-to-capacity ratio, operating speed, and horizontal and vertical alignment. Urban MTC's are: operating speed, volume-to-capacity ratio, pavement condition, shoulder type, surface type, right shoulder width, and lane width.

[2] Design Standards. These are geometric, service, and condition standards for new highway construction. Rural standards are: shoulder width, surface type, median width, lane width, and average highway speed. The same standards are used for urban areas except that a differentiation is made for right and left shoulder width.

the model's technical components to better reflect current highway research and practices. Officials from both organizations stated, for example, that FHWA should revise the current MTC values set for lane width and shoulder width.

FHWA officials acknowledged that the model's engineering components require continuous updating as new highway research results become available. They explained that technical model refinements are made once FHWA and the states become familiar with the new information. Regarding changing the MTCs established for shoulder and lane width, an FHWA official stated that FHWA will consider revising these values after it completes a detailed review of the states' HPMS data submissions for the 1987 Highway Needs report.

Model Documentation Should Be More Detailed

FHWA published four technical manuals that do a reasonably good job of explaining the model and its principal components for users of the HPMS model. Compared with the level of documentation often prepared for policy-assisting models, FHWA has expended considerable effort to describe the HPMS analytical process. For example, one manual outlines the purpose and scope of the analytical process and describes key engineering components. Another manual uses narrative and flow charts to describe the overall logic of the HPMS model's key analyses. Again, such information is not often included in documentation prepared for policy-assisting models like HPMS.

Although the HPMS model is relatively well-documented, we noted that several areas either were not presented in detail or were omitted entirely from the model's documentation. This prevented us from assessing all of its engineering parameters, formulas, and assumptions. For example, the published technical manuals we reviewed did not fully describe the engineering rationales and decisions used to develop the model. Additionally, these manuals did not include a detailed discussion and flow-chart of the HPMS model's numerous program subroutines or a computer source code listing.

The FHWA official responsible for overseeing the development and operation of the HPMS model stated and we agree, that reconstructing and fully documenting the original model would be a difficult, costly, and time-consuming task. However, we believe that future versions of the HPMS model should be fully documented in published technical manuals. These manuals should, for example, include more details concerning key model changes and their underlying rationales. Such information would help

FHWA ensure model continuity in the event of key employee turnover. As pointed out by the model's principal systems analyst, even with detailed published documentation and on-the-job training it can take a new employee at least a year to master the intricacies of the model. Additional published documentation would also (1) assist researchers attempting to study the model's results and (2) assist state highway agencies attempting to modify the national HPMS model for their own transportation planning needs.

Model Testing Being Expanded

When FHWA revises the model, it tests the logic of each version, according to agency officials. However, FHWA has not conducted detailed sensitivity tests on the model's key input variables, nor has it calibrated the model. These tests, along with any needed refinements, should provide FHWA and others with added confidence in the model's results. FHWA plans to perform such tests during 1987.

Logic Testing

A series of logic tests are performed on each version of the HPMS model, according to an FHWA official. The official explained that the tests are used to determine whether the model's (1) key input variables and relationships have been included in the software programs, (2) mathematical and logical relationships are internally consistent, and (3) mathematical and numerical results and intermediate computations are correct.

According to the model's principal systems analyst, a building block approach is used to test the logic of the model's major components. For example, a test of the Needs Analysis part of the model may focus on its improvement selection logic to determine if the projects selected by the model are reasonable to correct the identified deficiencies. FHWA's logic testing efforts may also include additional components of the Needs Analysis or may include an increasing number of sample highway sections to ensure that consistent results are generated.

We were unable to review the logic test results for the HPMS model because, according to an FHWA official, the results are no longer available. However, we did discuss the HPMS selection logic process with Texas Transportation Institute researchers who were assessing the process for the state of Texas. The researchers selected several deficient highway sections from the state's HPMS sample, examined the improvement projects selected by the HPMS model, and discussed the results with several state district engineers. The researchers concluded that the HPMS

improvement selection logic was reasonable since, in actual practice, projects similar to those selected by the model were either completed, under construction, or planned.

Sensitivity Testing

FHWA has not tested the HPMS model to determine the proportional impacts of the model's key input variables on the model's results. (These tests are generally known as sensitivity tests.) Since the model is continuously being refined, the results of sensitivity tests are important to developers and users of the HPMS model. They need to know, for example, if relatively small changes in some input variables can result in relatively large increases or decreases in the model's results. Additionally, they need to know whether the model's key outputs (i.e., summaries of improvement cost data by type of highway) are relatively insensitive to changes in certain input variables. Separate testing of each key input variable will provide a greater understanding of how changes in these variables influence the model's results.

According to the model's principal systems analyst, four prior attempts to conduct these tests failed because of staff reductions and revised work priorities. The latest test effort, involving a minimum of 10 key input variables, began in January 1987. An FHWA official anticipated that a report summarizing the test results would be issued during 1987.

Model Calibration

An FHWA official stated that the HPMS model has not been calibrated to determine how closely past HPMS needs estimates have paralleled actual highway investment practices. By comparing 1981 needs estimates against actual events over the subsequent 5-year period, for example, FHWA can better assess whether the model's predictive capabilities are working appropriately or if the model requires refinements so that it generates more realistic estimates. According to an agency official, FHWA plans to begin such tests in July 1987. As of March 1987, however, no test methodology had been developed and no test completion date had been established.

Controls Over Model Changes Adequate

Controls over model changes provide added assurance that the model is adequately maintained and is not modified without appropriate discussions among affected parties. FHWA implemented procedures whereby the model's developers discuss proposed changes with FHWA users of the model's results. An internal memo documents the changes.

In addition, FHWA has obtained technical input from the states before changing HPMS. For example, in April 1986 two FHWA Associate Administrators sent a memo to FHWA offices requesting their comments and those of state highway agencies concerning several proposed changes. One area that FHWA requested and received feedback on was a uniform measurement technique for rating pavement condition. FHWA used the feedback in developing the uniform measurement requirement discussed in chapter 2.

FHWA also solicits input from state highway agencies through technical workshops. For example, FHWA sponsored a workshop in July 1985 to (1) educate the states on how they can use the HPMS model for state-specific policy planning purposes and (2) obtain feedback from the states concerning changes to the current version of the HPMS model. According to the model's principal systems analyst, FHWA revised the model as a result of the workshop. For example, adjustments were made to some values assigned to MTCs that essentially made the MTCs for interstate highways more stringent and those for other types of highways less stringent. These activities enable FHWA to obtain first-hand information on current state highway investment practices and obtain valuable suggestions for improving the model.

Conclusions

The HPMS model is a useful tool for estimating the nation's highway capital investment needs. FHWA has taken or plans to take several steps to develop and maintain the model. The model's overall framework is reasonable, given the logic used in the Needs and Investment Analyses and the interrelationship between these key analyses. The model's key engineering parameters, formulas, and assumptions are based on generally accepted engineering standards and practices. We also believe that FHWA's controls over model changes are adequate, since the model's developers discuss proposed changes with users of the model's results and model changes are documented. In addition, the sensitivity tests and any required refinements, should provide added confidence in the model's results.

Although the model is reasonably well-documented, the inclusion of more detailed information in published technical manuals would benefit model users, including FHWA, state highway agencies, and researchers. These manuals should, for example, include more details on key model changes and their underlying rationales.

We agree with FHWA that the model should be calibrated to provide a greater understanding of its forecasting capabilities. We believe, however, that it is important for FHWA to develop and document a methodology for a calibration test and to commit to a test completion date, since testing the model plus any necessary refinements should provide FHWA and others with added confidence in the model's results.

Recommendations to the Secretary of Transportation

We recommend that the Secretary of Transportation direct the Administrator, FHWA, to

- include more detailed documentation in published technical manuals addressing such things as key model changes, their underlying rationales, and their effect on the model's results. This documentation would help ensure model continuity in the event of key FWHA employee turnover, assist researchers attempting to study the model's results, and assist those states attempting to modify the national HPMS model for their own needs.
- develop and document a methodology for a model calibration test and commit to a test completion date. Test results should provide FHWA and others with a clearer indication of how closely the model's needs estimates have paralleled actual highway investment practices and should help provide added confidence in the model's results.

Agency Comments and Our Evaluation

The Department generally concurs with our findings and recommendations relating to the HPMS model, stating that steps have been taken or are scheduled for implementation in 1987 that cover the areas addressed by our recommendations. (See app. IV.)

Concerning the inclusion of more detailed documentation in published technical manuals, the Department commented that it had initiated steps to better coordinate potential changes with model users and to better document such changes. Regarding the development and documentation of a calibration test procedure, the Department commented that FHWA's 1987 annual work plan includes an effort to develop a calibration methodology.

We agree that the various actions being taken or scheduled for implementation are consistent with our recommendations. At the same time, we want to emphasize the importance of establishing and adhering to a completion date for a calibration test so that the Department and other

users of the model's results can obtain a fuller understanding of the model's predictive capabilities.

Observations on the Highway Needs Report

HPMS is the primary source of data for the Highway Needs report. The Congress uses the report's information when developing national policy and programs relating to highways. Report data are also used by government agencies, researchers, and other parties as they study and comment on highway and other national policy issues. On the basis of our assessment of HPMS and the Highway Needs report, we believe that the report presents useful information on the condition and capital investment needs of the nation's highways. It contains several features cited by researchers as desirable in needs assessments, such as showing the sensitivity of needs to future growth demands and analyzing the effect of not meeting specified needs. FHWA is considering two other suggested features that may further enhance future Highway Needs reports.

While the Highway Needs report has strengths, it also has a limitation. It does not separate backlogged or current highway needs from projected or future needs. As discussed in this chapter, the separation of backlogged from future needs would present a clearer picture of highway needs and would allow decisionmakers to measure progress in addressing backlogged highway needs under current policies and programs.

Description of the Highway Needs Report

The 1987 Highway Needs report includes

- narratives and tables describing the total funds collected and disbursed nationally for highway purposes. For example, the total dollars collected for highway purposes by all units of government exceeded $63 billion in 1986 and disbursements were expected to be $62 billion.
- sections on highway condition and performance data, including narratives on changes in traffic volume levels, pavement conditions, and the minimum tolerable conditions. For example, travel has increased in every region of the country since 1983, with the most pronounced growth in the far west (10.1 percent), the Pacific (14.9 percent), and the southern southeast (10.2 percent). Further, the percentage of highway pavement in poor condition has decreased since 1983 and the percentage in good or excellent condition has increased.
- estimates of highway needs, including a series of tables showing capital spending required for various levels of service, such as maintaining current conditions or eliminating all deficiencies.
- tables showing accident, travel time, and operating costs data, projected to the year 2000.

FHWA has refined the Highways Needs report over the years to more realistically reflect highway conditions and program practices. For example, FHWA established the MTCs to measure highway conditions. Based on the feedback received from state highway agencies, FHWA adjusted the values of the MTCs to reflect how states generally were operating. FHWA also included data on the feasibility of adding highway capacity, especially in heavily congested urban areas. We believe these refinements have enhanced the quality of the Highway Needs report.

Desirable Characteristics of the Report

The Highway Needs report contains several characteristics that researchers have cited as desirable in national needs assessments. In their recent study for the National Council on Public Works Improvement, Urban Institute researchers cite desirable types of analyses or ways of presenting data in a needs report. According to these researchers, a needs study should

- show the sensitivity of needs estimates to future growth demands. (The Highway Needs report does this by including highway needs for two different levels of future traffic growth);
- indicate the difference in cost between maintaining the status quo and improving the infrastructure. (The Highway Needs report estimates the cost of (1) maintaining the current highway conditions, (2) improving conditions by removing deficiencies that can feasibly be removed, and (3) improving conditions by removing all deficiencies, regardless of feasibility);
- present several alternative concepts of need. (The report shows the cost of maintaining highway conditions as one type of need and maintaining highway user travel costs as an alternative concept of need); and
- analyze the impact of not meeting specified needs. (The Highway Needs report shows the varying levels of highway performance that will result from different levels of capital investment).

Two other characteristics the researchers believe should be in needs studies are a benefit-cost analysis and a sensitivity analysis.[1] Although the Highway Needs report does not include these analyses, FHWA is studying the use of benefit-cost analysis and will conduct sensitivity tests in fiscal year 1987.

[1]For more detailed information see, G. Peterson, T. Miller, N. Humphrey, C. Walker, Infrastructure Needs Studies: A Critique, (The Urban Institute, Washington, D.C., 1986).

Highway Needs Report Should Separate Backlogged From Future Needs

Although the Highway Needs report presents useful information in most respects, it does have a limitation in the way data are presented. The report presents highway needs in total—$315 billion through the year 2000 to maintain 1983 highway conditions—but it does not make clear that about one-half of this amount represents backlogged highway needs that already exist. Separating the dollar amount of backlogged needs from future needs would be useful to the Congress and other users since they could then clearly see the effects of policies and programs on the level of deficient highway conditions. Over time, the information would show trends on the increases and decreases in the amount of existing needs. If the Congress established a goal for reducing the backlog of needs, this reporting format could measure progress in achieving the goal. Also, a separation of backlogged needs from future needs could provide a basis for further analysis. For example, backlogged needs, broken out by rural and urban areas, could be compared with rural and urban highway expenditures to analyze the effects of the disbursement of funds. The Urban Institute researchers pointed out that a comprehensive needs analysis should consider both current and future deficiencies, but, almost universally, such analyses do not sufficiently break down the nature of the needs.

FHWA officials acknowledged that reporting the dollar amount of existing highway needs separately from future needs would provide better and more useful information. They also acknowledged that the information is readily available and can be retrieved from the model output with little additional cost and effort.

Conclusions

The Highway Needs report appears to provide useful information on the nation's highway needs. The report has several features that are desirable in needs assessments, and FHWA plans to study other features for inclusion in the report. However, in presenting the data, the report combines backlogged and future needs, which clouds the highway needs picture. The separation of backlogged from future needs would, in our opinion, present a clearer highway needs picture and would enable the measurement of progress in reducing the highway needs backlog under current policies and programs. FHWA officials agreed that reporting backlogged needs would provide more useful information and stated that the data necessary for doing so were readily available from the model's output.

Recommendation to the Secretary of Transportation

We recommend that the Secretary of Transportation direct the Administrator, FHWA, to adjust the Highway Needs report to separate backlogged from future highway needs in order to provide clearer information on highway needs and progress being achieved under current policies and programs.

Agency Comments and Our Evaluation

In commenting on our draft report, the Department stated that in future Highway Needs reports to the Congress, it will include a discussion of existing highway deficiencies and the cost of eliminating those deficiencies. The Department also stated that an explanation will be included covering the composition of the needs estimate and the relationship of existing highway conditions to future investment and performance scenarios. In the Department's view, the inclusion of such information is consistent with our recommendation. (See app. IV)

We agree that the type of information the Department plans to include in future Highway Needs reports is consistent with our recommendation to separate backlogged from future highway needs.

State Methods and Frequencies of Pavement Condition Ratings

State	Rating methodology[a]		Frequency of rating	
	State system	Non-state system	State system	Non-state system
California	Roughness and inspection	Observation	Every other year	Every other year
Florida	Roughness and inspection	Observation	Annual	Annual
Kansas	Roughness and inspection	Inspection and observation	Annual	Every sixth year
Kentucky	Roughness[b]	Observation	About every other year	Every other year
Nevada	Roughness and inspection	Observation	Annual	Every other year
New York	Inspection[c]	Inspection	Every other year	Every other year

[a]HPMS pavement condition ratings in the states we visited were determined on the basis of one of three evaluation methods, or on a combination of those methods: (1) a ride roughness rating determined by driving over the road in a car equipped with a mechanical device that measured the displacement between the vehicle body and the axle housing (2) an evaluation of pavement distress (cracking, ruts, etc.) determined from a close inspection, sometimes including measurements, done by a trained observer and (3) an observation of the road surface using a brief FHWA description of five levels of pavement condition

[b]For state pavement management purposes Kentucky determined a pavement rating based on roughness and inspection, as do four other states However, Kentucky reports only a ride roughness rating for HPMS sample sections because officials believe it is the only measurement with a methodological base and historical data for correlation

[c]The New York state highway agency used a slightly different rating system than did the other states It compared the actual pavement condition with color photographs of pavement in various stages of condition

State Traffic Monitoring

State	Number of continuous count sites	Short-term traffic counts: Number during FY 85[a]	Short-term traffic counts: Duration	Short-term traffic counts: Frequency	Vehicle classification counts: Number of FY 85 counts	Vehicle classification counts: Duration
California	22[b]	5,800	Usually 24 hours	Usually on a 3-year cycle	500	24 hours or less for manual counts and 7 days for machine counts
Florida	86	7,300	24 hours	Annual	250	6 hours
Kansas	102	9,800	24 hours	Varies from annual to every 6 years	46	24 hours
Kentucky	50	4,000	48 hours	Annual for the Interstate and a 3- or 6-year cycle for other roads	300	Either 8, 16, or 24 hours
Nevada	34	2,250	3 times a year for 65 days each	Count from 2,000 to 2,500 of about 3,000 sites each year	67	Either 8, 16, or 24 hours
New York	60	7,200	Varies from 1 to 4 days	Whenever a 15 percent change in traffic volume is projected	30	24 hours or less

[a]Either actual or estimated

[b]California supplements continuous counts with monthly and quarterly counts from which they develop factors for adjusting short-term counts. In 1985, officials counted (1) 63 monthly sites for a period from 7 days to a month long and (2) 1650 quarterly sites for a period of one week each quarter

Fifteen Key HPMS Data Elements

Data elements	Information required	State sources[a]
Access control	One of three codes to indicate either full, partial, or no control of a road's access to vehicles. Full control is defined as giving preference to through traffic by providing interchanges with selected public roads and by prohibiting crossing at grades or prohibiting direct driveway connections. Partial control is similarly defined as giving preference to through traffic, except that, in addition to interchanges, (1) there may be some crossings at grade with public roads and (2) private driveway connections are not prohibited but have been minimized.	State highway agencies obtained this information from highway design and construction plans or from inventory records based on those plans.
Annual average daily traffic (AADT)	A value representing the AADT volume in both directions. States are encouraged to provide values based on adjusted actual traffic counts rather than estimates.	State highway agencies determined AADT values based on their statewide traffic counting programs. States count traffic continuously at some locations to develop seasonal, day of the week and other factors which they use to adjust many additional short-term counts to determine AADT. Sample section AADT values were determined directly from these values or interpolated by state officials in cases where sections were not counted. In this regard, Kentucky, Nevada, and New York included HPMS sections in their counting programs on a regular cycle, and Kansas was in the process of adding sample sections to their traffic counting program.
Average highway speed	A value, to the nearest 5 miles per hour, determined by weighting the design speed of the section's horizontal curves and tangents by their length.	Most states reported that average highway speed values were (1) determined by district office staff using information from road design plans and (2) calculated by FHWA software for some highways on the basis of HPMS curve and grade data. In two states, Florida and Kansas, officials told us that in some circumstances the posted speed limit was reported as the average highway speed.
Capacity	Calculated values representing a road's present hourly capacity for both peak and off-peak periods. Calculations should be done in accordance with the Traffic Research Board's Highway Capacity Manual formulas, which include traffic levels, number of lanes, and other factors.	Rural area capacity values were calculated by states with FHWA software. State highway agency officials calculated urban capacity values using FHWA formulas or their own studies and formulas.
Directional factor (D-factor)	The percentage of the design hour traffic (the 30th highest hour) flowing in the peak direction, to the nearest 5 percent.	State highway agencies generally calculated D-factor values based on information obtained from their traffic programs' continuous count sites and used some judgment in extending this data to HPMS sample sections. Factors considered in determining values for sample sections included the type of highway and traffic officials' knowledge and expertise. In Kansas, officials used a single value of 55-45 for rural and 60-40 for urban sample sections on the state highway system if better data was not available.
Future AADT	The forecasted AADT for the year 2005. Ideally, travel forecasts are for an appropriate 20-year period but should not be for less than 17 years. Beginning with data year 1988, the forecast will be updated from 2005 to 2010.	Projections of future AADT values were generally done by state highway agency officials on the basis of historical traffic growth data and various other data such as population statistics, fuel consumption, and housing density.

(continued)

Data elements	Information required	State sources[a]
Horizontal alignment adequacy	One of four codes to indicate the severity of road's curves in terms of its impact on vehicle speed and safety	State highway agency officials determine the appropriate code primarily based on their review of highway design plans FHWA provides guidance which discusses how the number and degree of curves should be considered by state officials in making this determination
K-Factor	The design hour volume of traffic as a percentage of AADT	State highway agencies generally calculated K-factor values based on information obtained from their traffic programs' continuous count sites and used some judgment in extending these data to comparable HPMS sample sections. Factors considered in determining these values for sample sections included the type of highway and traffic officials' knowledge and expertise
Lane width	The prevailing traffic lane width to the nearest foot	State highway agencies obtained this information from highway design and construction plans or from inventory records based on those plans.
Number of lanes	The prevailing number of lanes in both directions, excluding parking and turning lanes, carrying through traffic in the off-peak period	State highway agencies obtained this information from highway design and construction plans or from inventory records based on those plans
Pavement condition	A pavement rating score ranging from zero to five (in tenths) with zero representing the poorest and five the best pavement condition rating.	Generally state highway agencies extracted pavement ratings from their pavement management system data bases. These data bases were developed from comprehensive rating systems that usually evaluated both road roughness and pavement distress.
Percent trucks	The percentage of commercial vehicles (excluding pickup, panel, and light trucks) to all vehicles for peak and off-peak periods	State highway agencies calculated percent truck values from state traffic program vehicle classification counts. Officials apply these values to HPMS sample sections based on the type of highway and location— being near to or in an area similar to the count site
Shoulder width	The width, to the nearest whole foot, of the shoulder of the road.	State highway agencies obtained this information from highway design and construction plans or from inventory records based on those plans
Typical percent green time	The typical percentage of time that traffic signals are green during peak traffic hours	State highway agency officials generally obtained this information from their district office staffs Some states used other sources or estimated some of the values reported: (1) Florida estimated these values for different types of roads based on a state study and (2) Kansas established an 85-percent value for sample sections on the state highway system
Vertical alignment adequacy	One of four codes to indicate the severity of a road's grades and vertical curves in terms of its impact on safety and the speed of trucks	State highway agency officials determine the appropriate code primarily based on reviewing highway design plans FHWA provides guidance that discusses how the number and degree of grades should be considered in making this determination.

[a]California was unique among the six states we visited in that it obtained virtually all HPMS data for sample sections located off the state highway system from city and county governments We note this here instead of at each data element

Comments From the Department of Transportation

U.S. Department of Transportation

Assistant Secretar,
for Administration

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JUL 7 1987

Mr. J. Dexter Peach
Assistant Comptroller General
Resources, Community, and Economic
Development Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Peach:

Enclosed are two copies of the Department of Transportation's comments concerning the U.S. General Accounting Office draft report entitled, "Highway Needs: An Evaluation of DOT's Process For Accessing the Nation's Highway Needs."

Thank you for the opportunity to review this report. If you have any questions concerning our reply, please call Bill Wood on 366-5145.

Sincerely,

Melissa J. Allen for

Jon H. Seymour

Enclosures

DEPARTMENT OF TRANSPORTATION REPLY TO GAO DRAFT REPORT OF HIGHWAY NEEDS: AN EVALUATION OF DOT's PROCESS FOR ASSESSING THE NATION'S HIGHWAY NEEDS

Summary of GAO Findings

The GAO believes that based on its analysis of the report: The Status of the Nation's Highways: Conditions and Performance (Conditions and Performance Report) and the Highway Performance and Monitoring System (HPMS), that the report, which is referred to by the GAO as the Highway Needs report, presents useful information on the condition and capital investment needs of the nation's highways.

The GAO found the Federal Highway Administration's (FHWA) plan for selecting HPMS sample highway sections to be statistically sound in that it is representative of the various types of highways at the nationwide aggregate level. States and the FHWA have reasonable controls and checks to ensure the quality of the data entered into the HPMS model. In addition, the FHWA has taken several positive steps to develop, test and operate the HPMS model.

The GAO states that although the HPMS model is a reasonable tool, the FHWA has not yet performed certain tests that would provide added confidence in the model's results. The two specific tests are sensitivity to changes in key input data and a calibration of the model to determine how closely past needs estimates have paralleled actual investment practices. In addition, the model's documentation, contained in published technical manuals, either did not cover in detail or omitted entirely, some information.

The GAO also found that the Conditions and Performance Report does not separate existing or backlogged highway needs from future or projected needs. The GAO believes separating the two would provide a clearer understanding of the Nation's highway capital investment needs and the progress made under highway policies and programs.

Based on its findings and conclusions, the GAO recommends that the Secretary direct the Federal Highway Administrator to:

- include more detailed information on key model changes in published technical manuals.
- develop and document a calibration test methodology and establish a test completion date.
- separate current from projected highway capital investment needs in the Conditions and Performance Report.

Department of Transportation Position Statement

The DOT generally agrees with the GAO's conclusions and recommendations regarding key model changes and the development and documentation of a calibration procedure. The FHWA has always conducted limited sensitivity analysis of the HPMS Analytical Process outputs to major parameters and data inputs. A formal sensitivity analysis of the HPMS Analytical Process is currently being conducted. An effort to begin the development of a needs calibration methodology is a part of the FY 1987 work plan. Steps have been taken to better coordinate potential process changes with users and to better document these changes for users.

In regard to the recommendation that calls for the separation of backlog and accruing needs in the Conditions and Performance Report, the Department will include a discussion of existing deficiencies, and the costs to eliminate those deficiencies, in future reports to Congress. We will explain the composition of the needs estimate and the relationship of existing highway conditions to future investment/performance scenarios.

On June 17, representatives from the GAO and the FHWA met to discuss minor technical inaccuracies in the report. The GAO at that time acknowledged the inaccuracies and agreed to make the changes for the final report.

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