Final Report

EFFECTIVE UTILIZATION OF DATA FROM THE HIGHWAY PERFORMANCE MONITORING SYSTEM

by

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(The opinions, findings, and conclusions expressed in this report are those of the author and not necessarily those of the sponsoring agencies.)

Virginia Highway & Transportation Research Council
(A Cooperative Organization Sponsored Jointly by the Virginia Department of Highways & Transportation and the University of Virginia)

In Cooperation with the U. S. Department of Transportation
Federal Highway Administration

Charlottesville, Virginia

October 1984
VHTRC 85-R12

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ABSTRACT

The objective of this research was to investigate the potential uses of the annual submittal and output data that result from the Highway Performance Monitoring System (HPMS), to determine what the data needs and uses of the Virginia Department of Highways and Transportation are, and to make recommendations as to how the HPMS data could be effectively used by the agency. A literature search and a survey of the 50 state transportation agencies were conducted to determine what innovative applications of the HPMS are being developed in the field. The Virginia Department of Highways and Transportation was also surveyed to determine what its current data needs and uses are, and to then relate the HPMS applications to Departmental data needs.

It is recommended that the Department (1) distribute the HPMS report to key persons in the organization as an educational tool, (2) have the districts and divisions review the annual data table summaries for potential applications, (3) review the HPMS data prior to requesting the collection of new data or extensive system level calculations to avoid duplication of effort, and (4) commit itself to maximum usage of the HPMS, keeping abreast of developments in HPMS applications, and integrate the analytical package into Department activities.

TABLE OF CONTENTS

SUMMARY

The effort to find more effective uses for the Highway Performance Monitoring System (HPMS) data the Department collects on an annual basis comprised three principal activities:

1. A survey of the other 49 state transportation agencies to learn what uses they make of the HPMS

2. A survey of the Department's data needs and uses to ascertain if there are areas where the HPMS data could be substituted for other data sources more efficiently and effectively

3. A review of all available literature pertaining to the HPMS

This section of the report summarizes the principal findings from these activities and provides recommendations based upon them.

Survey of HPMS Uses by State Transportation Agencies

Most states are not at the present time using the HPMS or its analytical package to any significant extent. However, many, as is the case with Virginia, are beginning to explore the potential usage of the system. Most generally, states using the monitoring system stated that the thorough commitment and support of top management is essential for implementing HPMS usage. This degree of commitment was seen as necessary due to the amount of staff time demanded and, in many instances, the need to alter traditional modes of operation to integrate HPMS usage into the organizational structure and function.

Conclusions of the Survey

The following conclusions can be drawn from the survey data.

-- While the HPMS has been in place since 1978, it is only now coming to be (1) viewed as a routine part of the state transportation agencies' operations, (2) studied as a potential source of data, and (3) used as a tool for planning, programming, policy analysis, and budget and revenue forecasting.

-- Much of the current effort toward putting the HPMS to use is in integrating the data submittal process into the routine activities of the states.

-- States which have combined the HPMS and state data bases or have gone to automated data management systems appear to have derived the greatest number of applications from the monitoring system.

-- The major deficiency of the system in the eyes of states is that it does not address project level needs. Some states are using 100% samples to alleviate this problem, and are thereby enabled to make project level applications of the system, in addition to using it in planning and policy making.

-- The use of 100% sample sizes on selected road classifications appears to be an attractive alternative for some states and provides them with an increase in the utility of the HPMS at no major increase in expenses.

-- The most consistently cited use of the HPMS data base is either as the basis for or an adjunct to pavement management programs.

-- Many states are considering the adoption of automated data base management systems and are looking at the HPMS as one possible alternative.

-- Some state transportation agencies are considering the use of the HPMS and the analytical process as a mechanism for strategic planning, policy setting, and program development decision making to assist them in programming and prioritizing an optimal project mix within constrained budgets. The HPMS then becomes a tool in the preparation of state transportation plans and needs studies.

-- Most uses being found for the HPMS appear to be for statewide or regional system level analyses, similar to those uses originally recommended by the Federal Highway Administration (FHWA).

Survey of Current Departmental Data Needs and Uses

This survey was intended to provide information concerning not only the types and uses of data in the Department, but also the source of this information and its basis or level of detail.

Conclusions of the Survey

The basic conclusions that can be drawn from this survey are:

-- Data needed at the system level, and to a lesser extent at the district and statewide levels, could be derived from the HPMS, depending upon the requirements and uses of these data.

-- Because of the heavy orientation of the Department's activities to project level work, there appear to be few opportunities for broad applications of the HPMS data, unless the Department would decide to use a 100% HPMS sample size.

-- Pavement management does not appear to be a likely use for the HPMS data, unless one or the other of these programs were altered to accommodate the level of detail of the other.

-- There does not appear to be any particular duplication of effort within the Department in terms of using data from other sources in lieu of HPMS data, since road inventory files are the principal source for the HPMS data base as well as for most of the other data used. Where duplication could possibly be occurring in the divisions and districts is in preparing calculations -- e.g. rates, trends, daily vehicle miles of travel -- from raw inventory data while these same calculations and analyses are being routinely done for the HPMS.

-- It does not appear that the Department is engaged in any system level statewide planning activities. Should such a program be instituted, the HPMS could provide a ready and valuable base for such work, both in terms of a data base and the analytical tools to conduct such planning.

-- Non-project-specific data uses, such as long-range budgeting, programming, or planning, could be uses for the HPMS data, especially the trend and analysis information generated by the monitoring system. In these instances, the need for special field studies could be avoided by taking the trend or average data, such as percentage of commercial traffic, from the HPMS.

-- When special studies are considered, the HPMS data base could first be checked as a potential data source.

Potential Uses of the HPMS

The following discussion of potential uses of the HPMS has been developed from a review of literature regarding the monitoring system.

This listing of potential uses includes those developed in conjunction with the creation of the HPMS at the federal level. Certain of these uses have already been employed by some states.

Not all of these uses may be directly applicable within the Department, given its organizational structure, priorities, and operational characteristics. Potential users of the HPMS should look to this listing as a starting point from which to determine the applicability and desirability of employing the monitoring system data base and outputs.

Potential Uses of the HPMS Submittal Package Output

The submittal package output is essentially a series of tables containing the states' submittal data. In some instances these data are combined to compare or contrast certain aspects of the information. At the national level this information forms the basis for the FHWA's Status of the Nation's Highways reports to Congress. Uses of these data include the following:

-- The tables of data can provide a quick reference source of highway system characteristics to use in reports, inquiries, and general informational requests.

-- Mileage by federal-aid and functional systems, and by governmental control units, can be used in allocating funds or in determining federal matching ratios. These data may also be used to make comparisons among expanded sample, universe, and areawide data, since they have similar formats.

-- The mileage and daily travel summary divides system mileage by Average Daily Traffic (ADT) groups, and can be used to develop travel estimates by functional system and geographic area.

-- The mileage summary output from the submittal package can be used to verify sample data used in the HPMS and sample expansion factors. These data can also be used in the certification of public road mileage reports and to verify county rural and urban mileage figures.

-- System mileage and travel (usage) data by roadway design type and functional class could be used for safety analysis or to examine how mileage and travel vary by facility type, functional system, and geographic area. This information could be beneficial in doing trend analyses or in allocating funds in terms of where projects will serve the greatest number of users.

- System mileage and usage data classed by ADT groups, facility type, and geographic area could be used to develop travel estimates by functional system and area. These data could be used in analyses concerned with prioritizing capital improvements based upon usage and to support the concept of variable design standards for different functional systems. They could also be used to demonstrate relative levels of congestion by facility type and functional system.

- From the lane mileage data classed by facility type, functional class, and usage, comparisons could be developed between systems. The data could be used as a measure of system supply versus demand or as a basis for trend analysis. They could also be a factor in assessing if capital improvement programs are keeping pace with changing demand or in estimating maintenance requirements.

- Average right of way (ROW) width classed by terrain and facility type and by urban/rural area could provide data for comparisons of average ROW widths by functional class or facility type, and in calculating the percentage of land area occupied by highway facilities in varying geographic areas and terrain types.

- Mileage and travel data grouped by terrain type and average highway speed in urban and rural areas could be used to compare alignment characteristics based upon speed in varying topographic areas, as an indicator of what system speeds should be, and, potentially, as input to techniques used for estimating speed in benefit/cost and investment/performance analyses.

- Usage and mileage by terrain type and peak hour speed in urban and rural areas can be used to assess the operational adequacy of highway facilities, to illustrate the effects of terrain on vehicle speed, and to assess relative congestion based upon speed. These data could also be used as input to policy decisions regarding construction, traffic control, and maintenance and enforcement programs. Speed tends could also be used to evaluate the effectiveness of programs and to assess trade-offs between maintenance and capital construction programs.

- System mileage and peak hour volumes aggregated by volume/capacity (V/C) ratios and development levels could be used to illustrate where congestion is most critical on a system basis. The system level V/C ratios could also be used in some traffic analyses and in planning activities.

-- Mileage and usage data grouped by shoulder width and type could be used to determine the system mileage with substandard shoulders or without shoulders, and could serve as a system level inventory log of shoulder characteristics.

-- The data concerning mileage and usage by pavement condition and surface material could be used to correlate travel to pavement type; to project where pavement deficiencies will occur in the system over time; as a monitoring mechanism of maintenance, resurfacing and pavement management systems; and to predict pavement life.

-- Mileage and travel data classified by ADT group and lane width could be used to develop distributions of paved lane widths for safety analysis, to identify and assess the extent of substandard lane widths, and to measure the impact of lane width changes to system operation over time.

-- System mileage categorized by the percentage of truck traffic could be used to demonstrate the portions of the system subject to heavy truck travel, to assess peak and off peak percentages of trucks (useful in capacity determinations), and to develop trends of truck travel for formulating construction and maintenance programs.

-- THE HPMS submittal tables also contain data concerning the number of interchanges, intersections, and structures by miles and functional class. These data could be used to develop measures of safety and to compare operational characteristics between systems based upon access factors.

Potential Uses of the HPMS Analytical Package

The output from the HPMS analytical package models can provide the Department with an array of existing and projected data relating to the condition and performance of the highway system, and the ability to evaluate alternative scenarios, such as variable revenue levels, and trade-offs between capital expenditure and maintenance oriented programs.

-- The analytical package can be used to assess the consequences of alternative program investment levels ranging from no investment to full investment that would be necessary to correct all system deficiencies during an analysis period. This could be used to demonstrate the effect of changes to the fuel tax structure or of inflation on projected revenues, and the ability of the Department to then achieve program goals.

- Increased systemwide costs of deferring various types of improvements can be estimated by the analytical package. For instance, the cost between programs stressing timely roadway surface maintenance versus delayed maintenance resulting in total surface replacement can be computed.

- The analytical package can forecast the effects of alternative future travel estimates on highway system condition and performance. By expanding the sample size of the HPMS data, similar analysis of regional development impacts can also be made.

- The analysis package can also evaluate the consequences of alternative minimum tolerable conditions (MTCs) for the highway system in terms of future travel conditions, system performance, and programmatical impacts. This could be done on a statewide basis or a system level basis to consider alternate MTCs for different functional systems.

- Revenue levels can be forecasted based upon alternative traffic projections and taxing rates.

- Long-range consequences of limiting capital improvement programs to non-capacity related projects can be explored. By adjusting the MTCs to ignore capacity deficiencies, the models can be forced to make only pavement related improvements. The consequences of such a policy and variations of the policy can then be explored.

- By removing the restrictions to capacity improvements or widening programs, especially in urban areas, unconstrained needs estimates and relevant performance conditions can be developed.

- The models could be run with restrictions placed on the maximum number of lanes that could be built on any system. This would then allow for an evaluation of the trade-offs between increased congestion in some areas versus the ability to construct more projects systemwide using those funds no longer committed to widening projects. Such data could be useful in making policy recommendations.

- The HPMS analytical process establishes a composite index or sufficiency rating for each functional class. By varying the points assigned to each component of the index the Department could test the sensitivity of future highway conditions and performance to the rating scheme.

-- The analytical process can also be used to evaluate the funding and revenue implications of additions or deletions to the federal-aid system at either the statewide or functional system level.

-- The realignment of jurisdictional responsibilities for various functional systems can be used to determine the impacts to the highway system, as well as to funding needs. Such data could be useful in negotiations with local governments and provide insight into the impact of such changes on the state's administrative system.

-- The long-range implications of increased truck traffic and of the size and weight of these vehicles to the condition and maintenance of the highway system can be explored. This information could also be used in pavement management and pavement design considerations.

-- By altering the vehicle classification data and fuel consumption and operating cost characteristics used in the models to reflect actual or proposed changes to the vehicle fleet, the future consequences of such changes can be assessed. This could be especially beneficial for fuel consumption, since it and highway revenues are so closely allied.

-- The Impact Analysis Model calculates accident rates for various types of mishaps. The output establishes rates by functional class and severity. These data can be used in evaluating safety improvement programs and developing accident trend data, as well as accident rates, by highway design type, federal-aid system, traffic volume class, vehicle type, and V/C ratios.

-- The Impact Model also calculates ratios for fuel consumption and vehicle emissions which could be useful in comparing present and future consumption rates and emission levels, and the effect of alternative programs and policies on these factors.

-- The Deficiency and Improvement (Needs) Analysis portion of the analytical package determines existing and future roadway deficiencies, selects a logical improvement type, and estimates the costs of the improvement. These data can be used in developing needs studies, system level assessments of the roadway network, and statewide planning analyses. States have found this useful in projecting costs, developing budgets, and, in combination with output from the other models in the package, determining short- and long-range improvements.

-- The analytical package will generate both current and projected DVMT for both system and statewide levels. This information could be used for funds disbursement and for general planning and reference purposes.

RECOMMENDATIONS

1. In view of the general lack of knowledge concerning the HPMS throughout the Department, it is recommended that this report be distributed to all division heads and district engineers.

2. Further, it is recommended that the data summaries developed in the HPMS submittal package be distributed to all division heads and district engineers.

3. Based on findings from the survey of the current uses of data within the Department, which was not a 100% sample, it appears that there may be some duplication of effort in deriving certain data items that are required on a system, route, or district basis. That is, the HPMS develops these data items; yet, it is not listed as the source of the data item. Table 8 in the report cites examples. Accordingly, it is recommended that district engineers and division heads review their data uses in light of the HPMS in order to eliminate a duplication of effort. This report should form the basis of that review.

4. It is recommended that the Department commit itself to maximum utilization of the HPMS. Should this commitment be made, then the following actions are recommended.

   (a) One individual should be assigned the responsibility of monitoring and keeping abreast of developments nationwide concerning the HPMS. This person should probably be in the Transportation Planning Division as it now has primary responsibility for collection and submittal of the HPMS data.

   (b) District engineers and division heads should, in general, review the potential uses of the HPMS submittal and analytical packages outlined in this report to determine potential applications in their areas of concern. Any promising applications should be investigated.

   (c) In particular, the Transportation Planning Division should review the applicability of the analytical package to its planning activities. Since a statewide planning methodology is in place, comparisons of the two procedures offer an excellent opportunity for validating analytical programs.

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INTRODUCTION

Since 1978 the Federal Highway Administration (FHWA) has been using the Highway Performance Monitoring System (HPMS) as a decision making tool. The HPMS has also been a major source of information on which federal policies have been based and has been used to support day-to-day planning activities and miscellaneous special studies. It consists of a continuing, integrated data base updated annually by submittals required from each state and of related analytical models.

The Virginia Department of Highways and Transportation is faced with program concerns and administrative needs similar to those of the FHWA. Therefore, the HPMS has the potential of being a valuable operational and management tool for state level decision making; that is, the models and analytical tools may be applied to the state data base developed in Virginia to evaluate highway programs and policies, and assist in day-to-day planning activities.

The Department has provided the HPMS information since the initial submittal year, 1978. Unfortunately, these data have remained essentially unused by the Department. The HPMS data are not being utilized as a data base for system or program analysis.

Given the fact that an annual HPMS data submittal will continue to be required at an estimated current cost in excess of $400,000, it is important that the Department consider how it can more effectively utilize the HPMS data base.

PURPOSE AND SCOPE

The main purpose of the study has been to determine how the HPMS data can be effectively utilized within the Department in light of the Department's data needs and the capabilities of the HPMS program. Within the context of this primary purpose, three specific objectives of the study were identified and these provided the basic format of the research effort. These were --

1. to provide summary information on the HPMS to Department personnel,

2. to relate the HPMS to existing data requirements, and

3. to provide information on potential uses of the HPMS to Department personnel.

The scope of the study was limited to a review of pertinent information on the HPMS, a review of the Department's current data needs, and a survey of how other states are utilizing or planning to utilize the HPMS data and programs. It is important to note that for the purposes of this research it was assumed that the logic and methodology used in the development of the FHWA's analytical tools are acceptable. Also, as has been the case in some states, these tools may need to be modified to provide the type of data or degree of detail requisite for the intended purposes. An examination of these types of modifications to either the equations or parameters used in the equations was beyond the scope of this research.

OVERVIEW OF THE HIGHWAY PERFORMANCE MONITORING SYSTEM

The HPMS was developed by the FHWA to meet two distinct though interrelated needs. This overview is intended to provide a summary of the rationale for developing the HPMS and of the data base for the system.

Background

The FHWA involvement in highway performance and assessment investigations began in 1974 when it became apparent that the total estimated dollar needs for highway programs could not be met, and, given changing national views, existing programs were not providing acceptable solutions to transportation issues. Investigations were conducted to develop a system for measuring and monitoring the performance of the highway network that could expeditiously supply supporting data for a variety of technical and policy decisions. A basic element of this system was to be a set of sampling procedures for monitoring the operational status and performance capabilities of the nation's highways.

During this same period, the data needs of the FHWA, which were primarily being supplied by the states, were expanding. There was a recognized need to have a consistent, accessible, and economically maintainable highway data base at the federal level. The data needs of the FHWA fell into the following broad categories:

1. Information necessary for the preparation of biennial needs reports to Congress

2. Data for congressionally mandated special studies, often including basic data similar to those required for the biennial needs reports

3. Data for comprehensive assessments of the safety, efficiency, and economy of the highway system

Put in place in 1978, the HPMS is intended to provide the analysis basis for the broad program/policy decision making required of the federal government and to supply the basic data needed by the FHWA for day-to-day operations.

Purpose and Objectives

The purposes of the HPMS, then, are (1) to provide a mechanism for assessing the performance of the highway system and the effectiveness of federal highway programs, and (2) to provide a system for collecting, inputting, and retrieving information for a nationwide highway data base. It is designed to analyze performance, evaluate the effectiveness of existing federal-aid programs, and provide a tool for assessing the potential impact of highway programs and policies. It also reflects efforts to reduce total data reporting, eliminate duplication, and, above all, to coordinate data reporting requirements by the states. The objectives of the system are to --

1. provide current data necessary for meeting congressional requirements and agency needs in a timely fashion;

2. provide current statistics on the mileage and extent of the various highway systems;

3. evaluate highway programs by monitoring changes in highway characteristics and performance based upon detailed, section specific data obtained on a sample basis;

4. minimize the need for special data requests and special national studies; and

5. be compatible with other data systems, so as to permit meaningful comparisons.

Roles of Participants

The HPMS is intended to be a joint effort of the federal, state, and local governments. The system development, organization, guidance, and analysis are the responsibility of the FHWA. It is the responsibility of the states, and in some instances of local governments, to supply the data necessary to drive the HPMS. In Virginia, the Department of Highways and Transportation is the sole agency collecting the HPMS data and organizing them into the required format. Additionally, each state highway agency is responsible for the development of mechanisms necessary for updating the data on a prescribed cycle.

The greatest portion of the data categories that states must supply for the HPMS have been previously required by the FHWA for national needs studies and other specialized programs. The merging of these separate data collection efforts into one system was intended to reduce the overall data collection efforts of the states while enhancing the usefulness of available data by collecting them on a continuing basis. The FHWA estimates that as of the 1982 reporting year, the total reporting burden of the states had been reduced to approximately one-third of that required prior to implementation of the monitoring system.

HPMS Data Base

Three broad monitoring levels are used with the HPMS. These levels, based upon roadway classification, area size, or data type, are as follows:

1. Universe Data -- This level includes selected data for all publically owned road mileage within the state plus any federal-aid system mileage not yet built or open to the public. This level describes the type of facility, functional class, location (state and county), urban/rural designation, section and route number, jurisdictional information, and some physical and operational data such as segment length, laneage, average annual daily traffic (AADT), commercial traffic, reversible or HOV lanes, and tolls.

   Capital and maintenance costs are also reported as part of the universe data. These expenditures are reported by functional class, improvement type, and cost categories on an annual basis for all improvements completed during a reporting year.

2. Sample Section Data -- Sample data are taken from sections of roadway randomly chosen by an FHWA selection program. These samples are chosen by volume group and functional class, and are to be representative of all public roads regardless of jurisdiction. The sampled sections, comprising from 4% to 5% of the state mileage, are intended to remain constant from year to year. Table 1 lists sample section data types.

3. Areawide Data -- This information is primarily intended to be control data for the analytical process against which the sample section data can be measured to determine if they accurately represent roadway characteristics. Areawide data are to be submitted on an annual basis by functional system, and include such types of data as daily travel information and daily vehicle miles of travel (DVMT) for rural, small urban, and urbanized areas, and accidents by rural and urban sections by functional class and federal-aid systems. This data level also includes areawide population and land area information.

Table 1

HPMS Sample Data

Identification
- Year
- State Code
- County Code
- Rural/Urban Designation
- Urban Area Code
- Type of Section
- Section Identification

System
- Functional Class
- Federal-aid System
- Federal-aid System Status
- Route Signing
- Route Number
- Public Road

Identification
- Sample Number & Subdivision
- AADT Volume Group ID
- Expansion

Pavement
- Surface/Pavement Type & Width
- Pavement Section
- Slab Thickness
- Pavement Condition

Geometrics/Configuration
- Access Control
- Lane Width
- Approach Width
- Shoulder Type & Width
- Median Type & Width
- ROW Width
- Widening Feasibility
- Horizontal Align. Adequacy
- Curves by Class
- Vertical Align. Adequacy
- Grades by Class
- Speed Limit
- Average Speed

Travel/Special Data
- Section Group Length
- AADT
- Number of Lanes
- Record Continuation Code

Jurisdiction
- Government Level
- Administrative Class
- Federal/State/Local Domain
- Special Systems

Operation
- Type of Facility
- Reversible Lanes/Roadway
- Trucks/Commercial Vehicles
- Special HOV Lanes
- Toll

Traffic Capacity
- Percent Trucks
- K-Factor
- Directional Factor
- Capacity
- Signalization
- Percent Green Time
- Parking
- Future ADT

Environment
- Drainage Adequacy
- Terrain
- Type Development
- Urban Location
- At Grade/Grade Separated Intersections
- Structures
- At Grade Rail Crossings

Supplemental Data
- Structure ID Numbers
- Rail Crossing ID Numbers
- Type of Improvement
- Capital Improvement Costs
- Accident Data

DESCRIPTION AND USE OF
SUBMITTAL SOFTWARE PACKAGE

The submittal software package of the HPMS is essentially an application or utility package of models using the states' annual submittal data as input, and from this producing summary tables of these data. These tables form the basis of the FHWA's Status of the Nation's Highways reports to Congress. The models do not statistically analyze the data as does the HPMS analytical process, which will be discussed in the next section of this report, but compiles and tabulates them for use in verifying samples, making comparisons between years, and establishing trends.

Two sets of output tables are available from the HPMS submittal software package. The first is a set of universe/sample based mileage and travel tables which can be used to verify the quantity and accuracy of the annual submissions. This data verification function is extremely important both for the federal submittal and for subsequent use of the data by the states. The second set is a series of rural and urban tables that contain summaries of the physical and operational characteristics of a state's functionally classified road mileage. Since these tables reflect the condition and performance of the roads for the data reporting year, they, in conjunction with the tables from prior submittals, form the basis for trend analyses. These same types of analyses can be accomplished at the state level, although use of an expanded sample size might be advisable, depending upon the existing sample size and distribution and the validity of the sample data in comparison to known state characteristics. Tables 2 and 3 contain a listing of these output tables. Actual tables are shown in Appendix A.

Table 2

Universe and Sample Based Mileage and Travel Tables of the HPMS Submittal Package

Table Number	Description	Data Level
1.	Volume Group Expansion Factor Summary	N/A
2.	Mileage by Federal-aid System and Functional System/Government Level of Control	Universe
3.	HPMS Mileage and Daily Travel Summary	Sample
4.	HPMS Mileage Summary Including Interstate Travel	Universe
5.	HPMS Mileage Summary by County	Universe

Table 3

List of Summary Tables in the HPMS Submittal Package

Table Number	Description	Data Set
1	System Mileage and Travel by Facility Type and Functional Class	Rural, Urban
2	System Mileage and Travel (In thousands) by Facility Type and ADT Category	Rural, Urban
3	Lane Miles by Facility Type and Functional Class	Rural, Urban
4	Land Area and Average ROW Width by Terrain Type and Facility Type	Rural
	Land Area and Average ROW Width by Area Type and Facility type	Urban
5	Mileage and Travel (In thousands) by Terrain Type and Average Highway Speed	Rural

Table 3 cont.

	Freeway and Expressway Mileage and Peak Hour Travel by Area Type and Average Highway Speed	Urban
6	Mileage and Travel by Terrain Type and Peak Hour Operating Speed	Rural
	Freeway and Expressway Mileage and Peak Hour Travel by Area Type and Peak Hour Operating Speed	Urban
7	System Miles and Peak Hour Travel by Volume/Capacity Ratio and Development	Rural, Urban
8	Mileage and Travel by Shoulder Width and Shoulder Type	Rural, Urban
9	Mileage and Travel by Pavement Condition and Pavement Type	Rural, Urban
10	Mileage and Daily Vehicle Miles of Travel by Speed Limit and Functional Class	Rural, Urban
11	Mileage and Travel by ADT Group and Lane Width	Rural, Urban
12	System Miles by Percent Trucks (Peak Hour/and Off Peak)	Rural, Urban
13	Mileage and Travel by Functional Class and Horizontal Alignment Adequacy	Rural
14	Mileage and Travel by Functional Class and Vertical Alignment Adequacy	Rural
15	Mileage by Federal-aid System and Jurisdiction	Rural, Urban
16	Number of Interchanges, Intersections, Structures, and Crossings, and Mileage by Functional Class	Rural, Urban

Potential Uses

Potential uses and applications of these tables are discussed in this section; however, the list is not intended to be exhaustive, but rather to provide examples of the potential usefulness of the data. Also, not all of these uses may have direct application in the Department. This information has been derived from the FHWA's Usage/Practical Application Notebook developed by the Office of Highway Safety. The tables are routinely produced by the FHWA on the national level and can be developed for individual states upon request.

Universe and Sample Based Mileage and Travel Tables

The tables produced by this level of analyses are listed below with example uses and applications of the data.

1. Volume Group Expansion Factor Summary Table

   - By illustrating volumes carried by system mileage, these data can be used as background information to support analyses such as safety studies concerned with low volume rural roads.

2. Mileage by Federal-aid System and Functional System/Governmental Level of Control

   - These data can be used to identify what portions of the federal-aid and functional systems are controlled by various governmental levels. This identification can be useful in the fund allocation process and also as input in calculating federal matching ratios.

   - Comparisons between expanded sample, universe, and areawide data are facilitated by the formatting of this table.

3. HPMS Mileage and Daily Travel Summary

   - This information can be used to verify areawide and universe data.

   - It provides travel estimates by functional system and geographic unit useful for planning activities.

4. HPMS Mileage Summary Including Interstate Travel

- These data can be used in the certification of public road mileage.

- Universe interstate DVMT and lane-mile data can be used to develop sample expansion factors.

- These data can be used to verify expanded sample and areawide functional class mileage data by area.

5. HPMS Mileage Summary by County

- In some states these data can be used to provide input to fund distribution formulas.

- The information can be used to verify rural and urban county mileage figures.

Battery of Summary Tables

The HPMS sample data are expanded to represent the overall functional systems and are the sources for these 16 tables produced for rural and urban areas within each state. Urban areas have tables divided by small urban, individual or consolidated urbanized, total urbanized, and total urban. The data for both urban and rural areas are divided into the following functional classes:

Urban	Rural
Interstate	Interstate
Freeway/Expressway	Other Principal Arterial
Other Principal Arterial	Minor Arterial
Minor Arterial	Major Collector
Collector	Minor Collector

These summary tables, as well as charts and graphs developed from the same data, form the basis for federal transportation documents and reports and can provide a quick reference of highway system characteristics.

1. System Mileage and Travel by Facility Type and Functional Class

- The distribution of mileage and travel by functional class is useful in policy decisions concerning the distribution of funds among systems.

- Mileage and travel by design type and degree of access control could be useful for safety analyses.
- This information can be used to examine how mileage and travel vary by facility type, functional system, and geographic analysis area, and in trend analyses.

2. <u>System Mileage and Travel by Facility Type and ADT Category</u>

- The traffic volume ranges by functional class contained in this table can be used to demonstrate the high percentage of mileage with low traffic volumes. Such data can be used in analyses concerned with prioritizing capital improvements based on relative usage.

- These data can be used to evaluate the relative traffic volumes carried by various facility types and thus provide an indication of relative congestion by type on the functional system. Such data are useful in identifying problem areas for planning purposes.

- The correlation of traffic volume groups to functional systems could be used to support the concept of variable standards for different functional systems.

3. <u>Lane Miles by Facility Type and Functional Class</u>

- Lane miles can be used to compare systems and to address trends in system supply.

- Lane miles, as a measure of system supply, can be used to compare demand versus supply. It can then be determined if system expansion and capital improvement programs are keeping pace with changing demand.

- DVMT/lane miles can be an indicator of relative daily usage or congestion that can be used to analyze trends or make system comparisons.

- Lane miles can often be more meaningful than centerline miles in estimating pavement maintenance requirements. This type of data can demonstrate the variations in lane miles between urban areas or districts which have similar centerline mileages.

4. Land Area and Average ROW Width by Terrain Type and Facility Type and Land Area and Average ROW Width by Area Type and Facility Type

- These data can be incorporated into planning analyses such as needs studies.

- This information allows for comparisons of average ROW widths by functional class or facility type and on the basis of type of terrain.

- The percentages of land area occupied by highway facilities in geographic units and terrain type can be compared.

5. Mileage and Travel by Terrain Type and Average Highway Speed and Freeway and Expressway Mileage and Peak Hour Travel by Area Type and Average Highway Speed

- Average highway speed can be used for a comparison of alignment characteristics by terrain and area type.

- These data can be used as an indicator of what system speeds should be.

- These data also have the potential for use as input to speed estimating techniques such as those used in benefit/cost and investment/performance analyses.

- Long-term trends can be shown and can be used to highlight changes to system operation.

6. Mileage and Travel by Terrain Type and Peak Hour Operating Speed and Freeway and Expressway Mileage and Peak Hour Travel by Area Type and Peak Hour Operating Speed

- These data can be used to assess the operational adequacy of highway facilities.

- The distribution of peak hour speeds by terrain can be used to show the effects of terrain and trends in speeds.

- Operating speed data can be used to assess the relative congestion at peak periods by functional system. This information can also provide input to policy decisions on construction, traffic control, and maintenance and enforcement programs.

- Operating speed trends can be used to evaluate the effectiveness of programs and to assess trade-offs of maintaining the existing plant versus capital construction.

7. System Miles and Peak Hour Travel by Volume/Capacity Ratio and Type of Development

   - This table, which shows system congestion during peak periods for both mileage and travel volumes, can be used to evaluate programs and policies over time.

   - These tables provide V/C ratios for analyses of facility adequacy, congestion levels, and needs.

8. Mileage and Travel by Shoulder Width and Type

   - These data can be used to determine the system mileage with substandard shoulders, as well as mileage without shoulders, or mileage with or without curbs.

   - These data can be retained as a system level inventory of shoulder type or as a shoulder improvements log.

9. Mileage and Travel by Pavement Condition and Type

   - This information can be used to explain pavement characteristics of the functional system and to correlate travel to pavement type.

   - Data for various points in time can be used to determine the system mileage expected to become deficient or deteriorate from a good to fair condition, which is basic in assessments of long-range needs.

   - Pavement condition trends and pavement type information can be used to monitor the effectiveness of maintenance, resurfacing, and pavement management systems.

   - These data can be used to predict pavement life for pavement management programs.

10. Mileage and Daily Vehicle Miles of Travel by Speed Limit and Functional Class

   - An important input to speed estimating or monitoring programs is mileage defined by speed limit as provided in this table.

11. <u>Mileage and Travel by ADT Group and Lane Width</u>

- This table provides distributions of paved lane widths for safety analyses.

- These data can be used to identify and assess the extent of substandard lane widths by functional system and ADT group.

- These data can identify the impact of lane width changes, by system, over time.

12. <u>System Miles by Percent Trucks</u>

- By determining the extent of truck usage by miles and functional system, a state can demonstrate the relative portions of the system subject to use by heavy trucks.

- These data can be used to assess the peak and off peak percentages of trucks, which are especially applicable in assessing capacity needs.

- Percent truck data can be used to assess loads being placed on highways.

- As truck weights increase, these annual data can be formulated into trends useful in developing policies and programs for construction and maintenance.

13.&
14. <u>Mileage and Travel by Functional Class and Horizontal Alignment Adequacy by Rural and Urban Areas</u>

- These tables can be used to assess the overall horizontal and vertical alignment adequacy of each functional class by geographic unit.
- These data can highlight the proportion of travel carried by each functional system and thus assist in developing cost-effective improvement programs by showing where projects would benefit the most users.

15. <u>Mileage by Federal-aid System and Jurisdiction</u>

- These data can help describe the interrelationships between federal-aid and functional systems and who has control of those systems. This knowledge can facilitate the planning of capital expenditure programs.

16. Number of Interchanges, Intersections, Structures, and Mileage by Access Point Range by Functional Class

- These data can be used as surrogate measures of safety and operational characteristics of the systems by showing the number of high volume (more than 500/week) access points per mile.

DESCRIPTION AND USES OF THE HPMS ANALYTICAL PACKAGE

In addition to knowing the characteristics of the existing highway systems, it is increasingly important to be able to predict the effects that existing and proposed highway programs and policies are likely to have. Such predictive capabilities enable decision makers to test alternative courses of action to determine which policies will be most effective in accomplishing the desired transportation goals most economically.

The HPMS analytical process was designed to respond to a variety of questions regarding the determination of state and federal levels of investment necessary to accomplish alternative transportation objectives. As such, it is a policy planning tool rather than a project selection mechanism. It is also intended to address questions concerning the possible effects of alternative policy strategies and programs on highway performance. Additionally, the HPMS is to provide fast, efficient responses to legislative requests concerning highway condition and performance based upon actual data.

The analytical package models are tools to enable states to analyze an array of alternative funding levels, MCTs, design standards, and design year travel estimates. The potential results of various emphasis areas used in establishing project priorities can then be shown. These analyses can enable state transportation agencies to logically define the most prudent and effective programs for the expenditure of public funds and for statewide planning activities.

The analytical process is essentially a software package consisting of models which use the HPMS submittal data as their primary input. Each of these models will be discussed individually; however, it should be noted that while each model has its own distinct uses and purposes, it is simply a component of the overall HPMS analytical process. When used in their proper sequence or combination, with successive models deriving their input from the output of the preceding one, they achieve their maximum degree of usefulness to decision makers and legislators in assessing and analyzing policies and programs to achieve an optimal mix of project types. The typical sequence of model usage is presented in

Table 4, while a summary listing of the eight output tables from the analytical package is shown in Table 5. Supplementary discussion of the models is contained in Appendix B and individual output tables are shown in Appendix C. The 1982 FHWA Usage/Practical Application Notebook for the HPMS analytical package was the source for much of this information, as well as the analytical process Technical Manuals.

Table 4

HPMS Analytical Process

Base Year Analyses

- Composite Index Analysis
- Multiple Deficiency Analysis
- Impact Analysis

Investment/Performance Analyses

- Investment Level Analysis
  - Needs Analysis
  - Investment Analysis
- Funding Period Analysis
  - Needs Analysis
  - Investment Analysis
- Summary Analyses
  - Composite Index Analysis
  - Deferred Cost Analysis
  - Multiple Deficiency Analysis
  - Impact Analysis

Table 5

Analytical Package Outputs

1. Miles and Cost by Improvement Type and Year of Improvement (cost in millions)

2. Investment/Performance Composite Index

3. Distribution of Investments by Improvement Type and Improvements Not Funded by Functional Class and Improvement Type

4. Investment/Performance Impact Analysis*

5. Investment/Performance Multiple Deficiency Analysis*

6. HPMS Weighted Index Table, Composite Index by Functional Class Weighted by Mileage and DVMT*

7. HPMS Index Distribution Table

8. HPMS Deferment Cost Table

Note: Tables can be produced for rural, small urban, urbanized, and total urban areas stratified by functional class for the analysis year, the last year of each time period.

*These tables can be produced for the inventory year as indicators of the current conditions and performances.

It is expected that additional analytical tools will be developed and further refinements made to extend the usefulness of the present analytical process.

The analytical process includes the following analyses:

1. Deficiency and Improvement (Needs) Analysis - The purpose of this model is to identify the improvements necessary to keep the physical and the operational condition of a highway system from falling below certain prescribed minimum criteria during the study period (five years into the future). The output generated from this model is a set of area and functional class summaries consisting of (1) miles and costs of improvement by deficiency and year of improvement, and (2) second generation resurfacing miles and costs by year of improvement.

   The primary use of the needs model output is to provide a full needs estimate for subsequent testing of investment scenarios and other analytical purposes. It also establishes relative distributions of the types of deficiencies and improvements under full needs conditions that can be used as a basis for evaluating the consequences of limited investments. It should be emphasized that the needs analysis calculates unconstrained full needs while the investment performance model determines which of the improvements could be implemented under a given funding level.

2. Composite Index (Sufficiency) Analysis -- The Composite Index Model uses the output from the needs model to evaluate, on a point score basis, highway condition, safety, and service on a section-by-section basis, and then aggregates these evaluations by functional system. Section evaluations in the form of composite and component indexes (sufficiency ratings) are developed.

   Two tables are produced by this model, A systemwide Average Rating Summary and a Rating Distribution Summary. Both are produced for each set of indexes for the following conditions: (1) base year, (2) target year without improvements, (3) target year with initial improvements, and (4) target year with initial improvements and subsequent improvements as needed. From these tables one can determine which category of deficiency is in greatest need of attention, the extent of critical deficiencies, and the consequences of various investment levels.

3. Investment Analysis -- This model evaluates the effects of alternative levels of capital investment on highway systems. It has the capability of simulating the future performance of highway systems based on projected levels of capital investment. This information is particularly useful in determining what funding level(s) would be required to attain or maintain a selected level of highway performance.

   The effects of increased or decreased investments on highway improvements or performance can be demonstrated to decision makers and legislators by this process. In addition, the impacts of various assumptions relating to MTCs, design standards, etc., can be tested.

4. Impact Analysis -- The purpose of this model is to calculate performance measures (rates) for each investment level and to summarize them by area and functional class. The Impact Analysis Model calculates rates for fuel consumption, vehicle emissions, vehicle operating costs, effective speeds, and for property damage, injury, and fatal accidents. The output from this model can be used in evaluating improvement programs and, eventually, in developing national and state trends for the topics identified.

   The accident information from this model can be used to evaluate safety improvement programs, and, in time, to develop both national and state accident trends. While the output from the analysis establishes rates by functional class and severity, it can also serve as the data needed to develop rates for highway design type, federal-aid system, traffic volume, vehicle type, and V/C ratio.

   The energy aspects of the model are useful in comparing present consumption to consumption in the target year at various investment levels. Similar comparisons among different types of vehicles and highway designs can be readily developed for the energy parameters.

5. Multiple Deficiency Analysis -- This analysis determines highway system deficiencies for the base year and projected needs under various funding or policy programs, and lists these by functional system and type of area.

6. Deferred Cost Analysis -- As the title implies, this exercise calculates the additional cost for delaying necessary improvements and develops comparisons of costs. An example would be the necessary reconstruction of a roadway due to not resurfacing the facility when needed in an earlier analysis period.

Example Scenarios that Can be Tested Using HPMS

Many types of scenarios can be evaluated with the current models and their consequences can be determined in light of future conditions and performance. Additionally, other scenarios may be evaluated by altering the basic models. Examples of possible applications follow.

- Alternative Funding Estimates (Levels) -- This is one of the primary uses of the analytical package. Future consequences of investment levels can be explored over a range of possible levels from no investment to full investment necessary to satisfy all deficiencies during the analysis period. The user can determine the amount of funds necessary to achieve given performance levels. Such data could be used to show the General Assembly or Highway and Transportation Commission the effect of increased funding or changes to the fuel tax structure. Various mixes of projects could also be explored in developing an investment program.

- Cost of Deferred Capital Investment-- The increased costs of deferring various types of improvements throughout the highway system as deficiencies occur can be estimated.

- Changes in Travel Projections -- Travel projections can be influenced by a wide range of exogenous factors; e.g., the economy, population, and fuel prices. Once a state has projected an estimate of travel for a future study scenario, analyses can be made using both the original estimates and modified travel forecasts to ascertain the impact on the future conditions and performance of the highway system. If a state expands its sample size, analyses of regional development impacts could also be made.

- Change in MTC -- The HPMS analytical process can evaluate the consequences of changing MTCs in terms of future conditions, performance, and system impacts.

- Changes in Design Standards -- A state can use the HPMS to evaluate long-range implications of variable design standards either in response to reduced funding or solely to evaluate the future implications of such an action.

- Limiting Improvement Types to Non-capacity-related Projects -- The long-range consequences of a capital improvement program limited to pavement improvements could be explored. By adjusting the MTCs to ignore capacity deficiencies, the model can be forced to make only pavement related improvements. The consequences of such a policy and variation on this policy can be assessed.

- Widening Restrictions--Restrictions on widening, especially in urban areas, can be removed to establish unconstrained needs and the resulting performance conditions. Such information could be useful in explaining to decision makers the extent to which needs are constrained and the diminishing degree of return from unconstrained capacity improvements.

- Limitations on Maximum Lanes to be Built -- To conserve financial resources, a state could explore limiting the total number of lanes a facility can have after improvement. Such a policy would force more congestion on certain routes but would make additional funds available for other improvements. By evaluating the trade-offs between increased congestion in some areas versus more projects, a state could provide decision makers with well-supported policy recommendations.

- Adjustments to Composite Index Rating Scheme -- The HPMS analytical process establishes a composite index or sufficiency rating for each functional system. A state may wish to vary the points assigned to each component to test the sensitivity of the future conditions and performance to the rating scheme, or to make them more adaptable to special state circumstances.

- Redefinition of the Federal-aid System -- The HPMS could be used to evaluate the funding and revenue implications of additions or deletions to the federal-aid system within a state on a functional system basis. By correlating functional system changes to administrative systems, a state could use this information to support its capital improvements program.

- Realignment of Jurisdictional Responsibility for Various Functional Systems -- This is an issue being explored by several states. If such a realignment is done on a functional class basis, the HPMS can be used to analyze the resulting changes in conditions and performance. Such data could be useful in negotiations with local governments and provide insight into the impact of such changes on the states' administrative systems.

- Changes in Passenger Cars -- By altering the vehicle classification data and fuel consumption and operating cost characteristics to reflect fleet changes, the consequences of such changes could be determined and evaluated, especially as fuel consumption is tied to revenues.

- Increases in the Number, Size, and Weight of Trucks -- The current model will test consequences of increases in the relative number of trucks and will estimate the resultant pavement deterioration and congestion. Modifications to the models could enable the effects of such changes to be tested. Such information can provide input to pavement management and pavement design activities.

USE OF THE HPMS BY OTHER STATES

The second phase of the research effort consisted of a survey of other state transportation agencies to ascertain how they use or anticipate using the HPMS data and analytical programs. Inquiries were made concerning methods of data collection and storage, uses for the annual submittal data, if the states had acquired the analytical package, and if so, what uses were being made of it or were being considered, what modifications were necessary, and what, if any, problems had been encountered. The primary intent of this task was to determine what innovative concepts were being developed that had the potential for application by the Department.

The survey was conducted by telephone, with the interviewer working from a list of persons designated by the FHWA as contact individuals for the HPMS. (An updated version of this list is contained in Appendix D.) A questionnaire was prepared so that a standard set of questions could be posed to each interviewee, and the responses were systematically recorded. Persons interviewed ranged from administrative personnel to people directly involved in the HPMS data management and analytical operations. In most instances, only one person in each state was interviewed; however, occasionally certain questions were referred to other individuals with more direct knowledge in a specific area. The survey questions and a summary of responses are contained in Appendix E.

Of the 50 states, 32, including Virginia, have been submitting HPMS data tapes beginning with the 1978 information, while 12 began with the 1980 data. The remaining states have been phasing into the program since that time. In some instances, initial submittals consisted of partial information, such as only the universe data or portions of the sample data due to a lack of staff or funds to accomplish a full data submittal.

At present, the majority of states, 32, are having to estimate some of the required information in order to submit a complete data tape. The Department is now providing the FHWA with actual survey data. The most frequently cited items being estimated were the following:

- geometric data
- accident information
- vehicle classification
- local area capital expenditures
- local area system data

These are items that either were not normally collected by states or that were collected but not on the same basis as that required by the FHWA for the HPMS.

Existing state data files are the principal source of the HPMS data in 47 of the states, including Virginia. The remaining three states derive data from other sources. One of these three had not been maintaining a state data base, and subsequently began collecting data solely for the federal submittal. In addition, most states augment their own data base files with supplementary field survey information for the HPMS.

Thirty-three of the states maintain the HPMS data base separately from their own state data files. The HPMS base is then updated annually in preparation for submittal to the FHWA. Seventeen states have merged the HPMS data base with their state base. These 17, which include Virginia, are primarily the states that have automated data storage systems with supplementary programs designed to select out the required HPMS information for the annual submittal. In addition, four states are in the process of converting from a manually maintained to an automated data base storage system that will include HPMS data retrieval and tape creation programs. The states that have gone to the automated systems indicated that they have found them to be extremely efficient relative to the HPMS since the submittal process had to be systematized. These were also the states which responded most positively concerning existing or potential benefits of the HPMS.

The interviewer also asked if there had been any discussion of using the HPMS process or a similar automated system for managing the state transportation data base. Of the 50 states, four have adopted the HPMS system. In each instance, the sample size has been expanded to 100% and additional data items included that are either legally required or are in some way integral to state activities. Six states, including

Virginia, have developed similar automated data storage and retrieval systems from which HPMS data can be extracted. Of the 40 other states, nine are considering the possibility of using the HPMS format as an automated data base system. None of these states had a definite schedule for implementing such a program. Most, however, were in the very early stages of discussions. The remaining 31 states are not giving any consideration to such a change, primarily because of staff or funding limitations, they already having satisfactory data programs, or they have concerns about the HPMS format or sample size.

When asked if there had been any particular problems in adapting to the HPMS process, 39 of the states responded affirmatively. The problems typically varied with the peculiarities of individual transportation organizations. Most generally the problems encountered apart from gaining an understanding of the process and submittal format were in regard to:

- local system data
- capital obligation data
- geometric information (curves, grades)
- adequate funding or staff time
- annual changes made by the FHWA to the HPMS process
- timing of submittals in relation to the states' annual data collection cycles
- compatibility of HPMS software with states' computer hardware

Concern was also expressed regarding a lack of confidence in both the accuracy of the data as required and in the statistical reliability of the sample size. For Virginia it was noted that no major problems were being encountered after the Department had acquired an automated data base management system from which the submittal data could be drawn.

The FHWA has suggested that the HPMS would reduce and simplify the state's data reporting responsibility to the federal government. When asked if this was the perception held by state level personnel involved with the HPMS, the response was a firm no from 29 of the states. This response was generally occasioned by inadequate funds or staffing devoted to the monitoring effort or to the previously discussed problems. Nine states, including Virginia, reported that, in general, the system had improved the reporting process. These were also the states that had either adopted the HPMS data base format or a similar automated system with special accommodation for the HPMS, and that had worked to integrate the HPMS process into the normal functions and activities of their agencies. Eleven other states responded that the system had not alleviated any reporting problems or burden, but that in time it would fulfill the FHWA's claims as the states develop and refine their submittal preparation procedures, the federal government becomes more consistent with what it requires, and the states became familiar with the monitoring system and its capabilities. In general, it would appear that through both their experience and perceptions, the states believe that the HPMS can have a positive influence when it is systematized and incorporated into the day-to-day operations of the state transportation agencies.

While the current version of the HPMS analytical package comprised of the six interactive models has been available to the states only since April 1983, 36 states have already acquired it. Of these states, however, only nine are making any use of it. Reasons for nonuse of the model include:

- lack of funds or staff to research and adapt the package to states' needs
- incompatibility of the package with computer hardware
- preference for own analytical programs tailored to individual states' needs
- lack of interest or credibility in the package and the HPMS in general (this most generally stems from a lack of confidence in the data or sample size)
- inability of the HPMS and analytical package to address project level concerns or requirements

Only one of the remaining 13 states indicated that it was planning to obtain the analytical package in the near future.

Nineteen of the states who possess but are not currently using the package indicated that they are beginning, or will begin sometime within the next two years, to assess the usefulness of the programs for their transportation operations and determine if there would be feasible uses for them. Virginia, of course, possesses the package and is assessing its usefulness with this research study.

Of the nine states currently using the model, all cited essentially the same applications at the system-wide or regional levels and none at the project level of analysis. Several states have gone to a 100% sample size in adapting the package to their needs. This would allow for project level analyses. Other states have taken an intermediate step by maintaining a 100% sample on certain classes of roads, such as the state jurisdictional routes, or only on the interstate system. This restriction allows them to test the effectiveness of the HPMS analytical programs at various levels of detail without investing the funds and staff required for a universal 100% sample.

The nine user states have developed or experimented with the following applications for the HPMS analytical package

- Locating and assessing current and future system deficiencies
- Forecasting revenues
- Developing projected costs and budgets based upon projected deficiencies
- Determining short- and long-range needs based upon various sets of operational standards (MTCs)
- Optimizing available revenues through project mix prioritization to maximize benefits of funds expended
- Determining road conditions and evaluating performance for program and policy development
- Projecting revenues using alternative taxation schemes
- Programming and prioritizing projects
- Developing safety condition service ratings
- Evaluating pavement conditions at the system level as an adjunct to pavement management programs
- Developing state transportation plans and needs studies
- Computing current and future vehicle miles of travel data
- Determining air quality at the state, Metropolitan Planning Organizations, and county levels

- Responding to legislative or executive requests concerning highway system or performance (similar to the federal Status of the Nation's Highways data)

The 19 states planning to study the potential for use of the HPMS and analytical package cited four general areas in which they feel the system could benefit them:

- Cost forecasting

- Revenue projections

- Programming/prioritizing

- Program/policy analyses to achieve the greatest transportation impact for public funds expended

These seem to be the same four general categories of application under which the other user states' activities could be grouped and which are generally cited by the FHWA as potential uses for the HPMS.

The states were also asked if, aside from the analytical package, any of the HPMS annual submittal data were being used. Thirty-four of the states responded negatively, stating that they were merely compiling the HPMS annual data, submitting the data as required, and maintaining a log of this information. The remaining 15 states are using the information in some way for their own operations. They listed one or more of the following uses for the submittal data:

- Breaking down capital costs by geographic area

- Inputting information into pavement management programs

- Developing state transportation plans

- Developing alternative proposals for taxing mechanisms or structures

- Preparing needs studies

- Cross-checking against other data to assure confidence levels

- Building a state data base with 100% samples

- Monitoring accidents with 100% samples

- Developing bridge structure reports
- Estimating vehicle miles of travel
- Developing roadway mileage and inventories by functional class
- Analyzing policies, in conjunction with other programs
- Refining state counting programs and count station location selection
- Developing structure deficiency inventories
- Preparing system level reports to state legislatures, governing commissions, or departmental executives
- Responding to requests for non-detailed or non-project-specific data

In summary, the following observations and conclusions can be drawn from the survey data.

- While the HPMS has been in place since 1978, it is only now coming to be viewed as a routine part of the state transportation agencies' operations to be studied as a potential resource for data, and a tool for planning, programming, policy analysis, and budget and revenue forecasting.
- Much of the current effort toward the HPMS is in integrating the data submittal process into the states' routine activities.
- Those states which have combined the HPMS and state data bases or have gone to automated data management systems appear to have derived the greatest number of applications for the monitoring system.
- The major deficiency of the system is that it does not address project level needs. Some states are using 100% samples to alleviate this problem and are making project level applications possible in addition to planning and policy making uses.
- The use of 100% samples on selected road classes appears to be an attractive alternative for some

states and allows an increase in HPMS utility without major increases in costs.

- The most consistently cited use of the HPMS data base is either as the basis for or as an adjunct to pavement management programs.

- Many states are now considering the adoption of automated data base management systems and are looking at the HPMS as one such alternative.

- The changing social, economic, and environmental pressures brought to bear on transportation providers during the 1970's have dramatically altered the traditional mix of capital construction and maintenance projects, as well as significantly restricted funds available to most state agencies. As a result of reduced budgets and escalated project costs, agencies are looking for management tools to assist them in programming and prioritizing an optimal project mix within constrained budgets. This type of strategic planning for policy and programming decision making is seen by some states as a prime use for the HPMS and analytical package.

- States are seeing the HPMS as a resource for state transportation plans and needs studies.

- The increase in use of the HPMS data and analytical package by the states is mostly for system level or regional system analyses, which is similar to uses for which it was intended at the national level.

CURRENT DATA NEEDS AND USES BY THE DEPARTMENT

The third phase of the HPMS research effort was a survey of Virginia Department of Highways and Transportation personnel to ascertain the types of data used in their day-to-day and special activities and the frequency of such use. To accomplish this task, a survey questionnaire was mailed to each of the operating divisions and districts in the Department. The questionnaire listed 63 types of data that could potentially be used by the Department, most of which were drawn from the HPMS data types, and provided space to write in additional items. Respondents were then asked to indicate which data types were used in their activities, giving the source of the data, the basis of this information (project, link, system, etc.), and the use they have for the data. A copy of this questionnaire is included in Appendix F.

Of the 25 survey forms mailed to the divisions and districts, 19 responses were received at the time the analysis was made, three weeks after the deadline for returning the forms. Of these 19 responses, 15 were completed questionnaires, while the remaining four indicated that none of these data items were used.

Tables 6, 7, 8, and 9 contain information obtained in the survey. They list the types, sources, basis, and uses of the data and the number of responses for each type. A more detailed summary of the survey results is contained in Appendix G.

Table 6 summarizes the responses to the question concerning the source of the data used. The 63 data types listed, plus three types added from the survey results, are derived from 23 sources within the Department. It should be noted that the HPMS data base was not cited as a source for any of the data items. Most divisions and districts derive data from more than one source. By far the greatest source is the highway or road inventory, as could be reasonably expected. This source was cited 178 times by the respondents and represented almost 28% of the total responses to the question. Other types of inventory or log data such as signs, railways, bridges, signals, graphic log, and card files comprised an additional 74 responses, or slightly less than 12% of the total. These, combined with the road inventory, accounted for slightly under 40% of all data coming from inventory sources. The next greatest sources of data were field surveys and special studies conducted for specific or unique purposes. These were cited in 155 responses, which was slightly under the number for the road inventory and accounted for almost 25% of the total responses. Construction plans were the third greatest source, being cited 75 times and representing just under 12% of the total. The other sources cited varied little one from another in frequency of use.

Two conclusions can be drawn from this table:

- A major source of data used is the inventory or log that has been compiled over time and is used to maintain a record of the road network.

- Presently, none of the divisions or districts appear to be utilizing the HPMS data base for any of their data needs.

Table 6

Sources of Data Currently Used by the Department

Source	No.of Responses
Road Inventory	178
Bridge Inventory	8
Railway Inventory	3
High Water Inventory	1
Sign Inventory	3
Signal Inventory	2
Pavement Data System	12
Outdoor Advertising Log	1
Graphic Route Log	39
Card File	7
Mileage Tables	6
Accident Summary/File	26
Bridge Inspection Report	5
Wet Accident Report	1
Bridge Replacement List	1
Construction Plans	75
Traffic Counts	49
Special Studies	20
Field Surveys	135
Calculations	34
Estimates	12
U. S. Census	7
Maps	5
	5

Since the HPMS itself constitutes a roadway data inventory system, there would appear to be some potential for using a portion of the HPMS data base as a source.

Perhaps the most critical factor in the use and application of the HPMS data is the basis or level of detail of the Department's data needs. Table 7 is a summary of the responses to the survey question concerning the basis for the 66 data items. These responses have been grouped into the following levels of detail:

- Location specific (project, link, system)
- Route
- System
- District
- Statewide

In answer to this question, approximately 88%, or 430, of the 490 responses indicated that data needed to be location specific. The most heavily location specific data types are generally the ones derived from inventory or file sources. These are obviously types which could not be derived from the HPMS data unless sample based information would suffice, universe data could be used, or the Department use 100% samples for the HPMS.

Table 7

Basis of Data Currently Used by the Department

Basis	No.of Responses
Location Specific (Project, Link, Structure, Section)	430
Route	2
System	52
District	3
Statewide	3

The system basis was cited 52 times, or in slightly over 10% of the responses, as the level of detail needed for some operations. These 52 responses covered 34 data types, or just over one-half of the total data types. These 34 types are listed in Table 8 along with the number of times each was cited. The last three items listed are, however, not part of the HPMS data base. As can be seen from this table, 20 of these data types were cited only once. Those most heavily used at the system level tend to be the ones which describe roadway characteristics such as surface, shoulder or lane width, describe the type and class of the facility, or relate to accident data. The sources for the system level data cited were almost always the roadway inventory files or special field studies.

Table 8

Data Used at the System Level

Data Type	No. Responses	Data Type	No. Responses
Surface Width	2	Improvement Type	1
Shoulder Width	2	Pavement Description	1
Surface & Base Type	1	Structure Number	1
Kind of Highway	2	Slab Thickness	1
Annual ADT	2	Pavement Condition	1
System	3	Skid Resistance	1
Functional Class	4	ROW Width	1
Lane Width	2	% Trucks	1
Approach Width	1	Future Annual ADT	1
Shoulder Type	1	No. Injury Accidents	3
Median Type	1	No. Persons Injured	3
Median Width	1	No. Pedestrians Injured	3
% Passing Sight Distance	1	Peak Hour Volume	1
No. Grade Separated Interchanges	2	High Water Information	1
No. At Grade Intersections		Sign Inventory	2
With Signals	1	Wayside/Historical Markers	1
With Stop Signs	1		
With No Controls	1		

The majority of responses indicating a need for system based data came from the Bristol District and from the Highway and Traffic Safety Division. The predominant use of these data in the Bristol District was for maintenance and construction planning and for safety analyses. Within the Highway and Traffic Safety Division, the dominant application was also for safety analyses, as well as for design criteria, capacity analyses, and general information and reporting criteria. The current sources of these data are inventory files and field surveys. It is these types of uses for which the FHWA designed the HPMS and for which applications might be found within this division and district. Also, since operations are generally similar between districts, similar applications to those at Bristol might be found for the HPMS data base in the other districts.

Route and district bases were cited in only 2 and 3 instances, respectively, as the level of detail used. Only one of the route level items, Development Type, is included in the HPMS data base, while district level data were for population, land area, and route mileage. These same three types were also cited as being used on the statewide level. As with system level data, inventory files and surveys are the sources for these data. Again, the HPMS base could have practical applications for both district and statewide data needs.

Table 9 summarizes the responses to the question of how these data items are being used within the Department. The 609 total responses to this question can be divided into 10 distinct categories, the predominant use being for project level purposes. This use constituted just under 62% of the responses. The budgeting and programming category was the second largest division, but comprised only slightly more than 8.5% of the responses. While budgeting and programming generally require project specific information, long-range programming could benefit from the use of the HPMS data and the analytical package. This use would employ the analytical process and would be dependent upon the Department's choosing to use HPMS to make alternative long-range needs forecasts and alternative program analyses.

Planning was the third greatest data use cited in the survey. The Transportation Planning Division indicated that the data were used for corridor studies, site specific studies, and for the 3-C planning process in urban areas. This last planning type could potentially use HPMS generated trend data for urban or urbanized areas. If a 100% sample size was used, it could also supply the base system data for the 3-C analyses.

For the remaining categories referenced in the survey, namely, inventory, pavement management, accident/safety analysis, traffic analyses, permits, work scheduling, and special studies appear to have relatively limited potential use of the HPMS data. However, trend data could possibly be used in some types of traffic analyses, such as for deriving percentage commercial traffic figures from the HPMS and thus avoid the need for special classification counts.

Table 9

Uses of Data Currently Collected by the Department

Use	No. of Responses
Projects	375
Inventories	39
Budget/Programming	52
Pavement Management	9
Planning (Corridor, 3-C, Special)	46
Special Studies	3
Accident/Safety Analyses	41
Traffic Analyses	23
Permits	11
Work Scheduling	10

As noted in the preceding section, pavement management programs are being linked closely with the HPMS activities in several other states; however, in Virginia the pavement management program would not readily accommodate the HPMS data base. The reasons for this include:

- A 100% sample size is used for both the interstate and primary systems; however, the secondary system data are collected from a 5% sample.

- There is a considerable difference in the pavement rating systems used by the HPMS and Virginia's pavement management program.

- More detailed coding and classification systems are used in Virginia's pavement management system than with the HPMS.

- The use of variable sample sections with each iteration of pavement management is an integral component of the system, while the HPMS uses fixed sample sections.

- Not all of the data items relative to roadway surface characteristics that are used in pavement management are included in the HPMS.

- There is a bureaucratic separation of these two activities into two distinct functional areas within the Department.

In summary, the Virginia pavement management program is more comprehensive and more refined in terms of the data needed to drive it and the classification systems used than would be available through the HPMS. This largely derives from the fact that pavement management and the HPMS as Department activities and programs were developed independently of one another. Only if the state were conducting a 100% sample for the HPMS would there appear to be a duplication of effort between these two programs, both of which currently rely extensively on a common data base, the state's road inventory file.

The following basic conclusions can be drawn from the responses to the survey of current data uses in the Department.

- Data needed at the system basis or level, and to a lesser extent at the district and statewide levels, could be derived from the HPMS data base, depending upon the requirements and uses of these data.

- As a result of the heavy orientation of Department activities to project level work, there appear to be few opportunities for broad applications of the HPMS data, unless the Department should decide to use a 100% sample size for the HPMS.

- Pavement management does not appear to be a likely use for the HPMS data base unless one or the other of these programs is significantly altered to accommodate the level of detail of the other.

- At present, there does not appear to be any particular duplication of effort within the Department in terms of using other data sources in lieu of the HPMS data since the road inventory files are the principal source for the HPMS data base as well as for other data used. Where duplication could be occurring is in divisions or districts preparing calculations, e.g., rates, trends, and DVMTs, from raw inventory files when these calculations are being routinely done for the HPMS.

- It does not appear that the Department is engaged in any system level statewide planning activities. Should such a program be instituted, the HPMS could provide a ready and valuable base for such activities, both in terms of a data base and analytical tools to conduct such planning.

ACKNOWLEDGEMENTS

A number of people helped in the conduct of this study. Thanks go to Eugene Arnold for his assistance, advice, and review of the material; to Susan Kane and Jan Kennedy for typing this volume of material; to Neal Robertson for his review and comments; and to Harry Craft and the report unit staff for editing and reproducing the report.

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APPENDIX A

OUTPUT TABLES FROM THE HPMS SUBMITTAL PACKAGE DATA

AGGREGATE OF STATES

1980 RURAL LAND AREA AND AVERAGE ROW WIDTH
BY TERRAIN TYPE AND FACILITY TYPE

	2 OR 3 LANE			MULTI-LANE					
	MILES	SQ MILES	AV ROW WDH(FT)	MILES	SQ MILES	AV ROW WDH(FT)	MILES	SQ MILES	AV ROW WDH(FT)
INTERSTATE									
FLAT	30	1.17	206	10238	600.43	306	10267	601.61	306
ROLLING	55	3.26	306	10235	650.71	333	10291	653.97	333
MOUNTAINOUS	114	6.14	280	1649	105.07	333	1764	111.21	333
TOTAL	199	10.57	280	22122	1356.22	322	22322	1366.78	322
OTHER PRINCIPAL ARTERIAL									
FLAT	14060	358.08	132	5502	209.60	201	19562	567.67	153
ROLLING	22677	566.01	127	5423	234.82	227	28099	800.83	148
MOUNTAINOUS	3320	76.77	121	838	34.33	211	4158	111.10	137
TOTAL	40057	1000.86	127	11763	478.74	211	51819	1479.60	148
MINOR ARTERIAL									
FLAT	32381	679.92	106	1731	48.89	148	34111	728.81	111
ROLLING	53133	1118.67	111	1465	40.81	143	54598	1159.48	111
MOUNTAINOUS	8105	133.60	84	249	9.43	195	8354	143.03	90
TOTAL	93618	1932.19	106	3445	99.14	148	97063	2031.32	106
MAJOR COLLECTOR									
FLAT	78193	1313.57	84	1197	31.41	137	79390	1344.97	84
ROLLING	166480	2341.33	74	656	18.76	148	167137	2360.09	74
MOUNTAINOUS	20642	235.98	58	39	1.05	137	20681	237.03	58
TOTAL	265315	3890.87	74	1892	51.22	143	267208	3942.09	74
MINOR COLLECTOR									
FLAT	45526	649.29	74	25	.37	74	45551	649.66	74
ROLLING	124938	1595.35	63	39	.81	106	124978	1596.16	63
MOUNTAINOUS	15937	174.76	53	4	.08	95	15941	174.84	53
TOTAL	186401	2419.40	63	69	1.26	95	186471	2420.66	63
TOTAL									
FLAT	170189	3002.03	90	18692	890.70	248	188882	3892.72	106
ROLLING	367284	5624.62	79	17819	945.92	280	385103	6570.53	90
MOUNTAINOUS	48118	627.25	69	2780	149.95	280	50898	777.20	79
TOTAL	585591	9253.89	79	39291	1986.57	264	624882	11240.46	90

1980 RURAL SYSTEM MILEAGE AND TRAVEL (IN THOUSANDS) BY TYPE FACILITY AND FUNCTIONAL CLASS

AGGREGATE OF STATES

RURAL		INTERSTATE		OTHER PRINCIPAL ARTERIAL		MINOR ARTERIAL		MAJOR COLLECTOR		MINOR COLLECTOR		TOTAL	
NO ACCESS CONTROL:		MILES	%	MILES	%	MILES	%	MILES	%	MILES	%	MILES	%
UNDIVIDED:	<4 LANES	0	0.0	36466	70.3	91422	94.1	262463	98.2	184798	99.1	575149	92.0
	4 OR 5 LANES	0	0.0	918	1.7	875	0.9	934	0.3	26	0.0	2753	0.4
	6 OR MORE LANES	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
DIVIDED:	<6 LANES	64	0.2	4728	9.1	1940	1.9	929	0.3	52	0.0	7713	1.2
	6 OR 7 LANES	0	0.0	20	0.0	0	0.0	19	0.0	0	0.0	39	0.0
	8 OR MORE LANES	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
SUBTOTAL:		64	0.2	42132	81.3	94237	97.0	264345	98.9	184876	99.1	585654	93.7
PARTIAL ACCESS CONTROL:													
UNDIVIDED:	<4 LANES	0	0.0	3270	6.3	1900	1.9	2732	1.0	1583	0.8	9485	1.5
	4 OR 5 LANES	0	0.0	58	0.1	68	0.0	0	0.0	0	0.0	126	0.0
	6 OR MORE LANES	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
DIVIDED:	<6 LANES	85	0.3	2110	4.0	617	0.6	65	0.0	0	0.0	2877	0.4
	6 OR 7 LANES	7	0.0	1	0.0	0	0.0	0	0.0	0	0.0	8	0.0
	8 OR MORE LANES	1	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.0
SUBTOTAL:		93	0.4	5440	10.4	2585	2.6	2797	1.0	1583	0.8	12498	2.0
FULL ACCESS CONTROL:													
	<6 LANES	21119	94.6	4073	7.8	239	0.2	65	0.0	12	0.0	25509	4.0
	6 OR 7 LANES	832	3.7	156	0.3	2	0.0	0	0.0	0	0.0	989	0.1
	8 OR MORE LANES	214	0.9	18	0.0	0	0.0	0	0.0	0	0.0	232	0.0
SUBTOTAL:		22164	99.2	4247	8.1	241	0.2	65	0.0	12	0.0	26730	4.2
TOTAL		22322	100.0	51819	100.0	97063	100.0	267208	100.0	186471	100.0	624882	100.0

****

		DVMT	%	DVMT	%	DVMT	%	DVMT	%	DVMT	%	DVMT	%
NO ACCESS CONTROL:													
UNDIVIDED:	<4 LANES	0	0.0	116466	47.0	199464	84.2	247663	93.3	69373	99.3	632967	58.7
	4 OR 5 LANES	0	0.0	6337	2.5	6981	2.9	6997	2.6	29	0.0	20343	1.8
	6 OR MORE LANES	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
DIVIDED:	<6 LANES	366	0.1	45377	18.3	17749	7.4	5306	1.9	44	0.0	68841	6.3
	6 OR 7 LANES	0	0.0	528	0.2	0	0.0	210	0.0	0	0.0	738	0.0
	8 OR MORE LANES	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
SUBTOTAL:		366	0.1	168708	68.1	224194	94.7	260176	98.0	69446	99.4	722889	67.1
PARTIAL ACCESS CONTROL:													
UNDIVIDED:	<4 LANES	0	0.0	10846	4.3	4557	1.9	4178	1.5	398	0.5	19979	1.8
	4 OR 5 LANES	0	0.0	380	0.1	467	0.1	1	0.0	0	0.0	848	0.0
	6 OR MORE LANES	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
DIVIDED:	<6 LANES	1070	0.4	20363	8.2	5493	2.3	501	0.1	0	0.0	27427	2.5
	6 OR 7 LANES	251	0.0	48	0.0	0	0.0	0	0.0	0	0.0	299	0.0
	8 OR MORE LANES	45	0.0	0	0.0	0	0.0	0	0.0	0	0.0	45	0.0
SUBTOTAL:		1366	0.5	31638	12.7	10517	4.4	4680	1.7	398	0.5	48599	4.5
FULL ACCESS CONTROL:													
	<6 LANES	222554	86.4	41502	16.7	1904	0.8	468	0.1	13	0.0	266442	24.7
	6 OR 7 LANES	25219	9.7	3932	1.5	59	0.0	0	0.0	0	0.0	29210	2.7
	8 OR MORE LANES	8027	3.1	1656	0.6	0	0.0	0	0.0	0	0.0	9682	0.8
SUBTOTAL:		255800	99.3	47089	19.0	1963	0.8	468	0.1	13	0.0	305334	28.3
TOTAL		257532	100.0	247434	100.0	236674	100.0	265324	100.0	69857	100.0	1076821	100.0

1980 RURAL SYSTEM MILES AND PEAK HOUR TRAVEL (IN THOUSANDS)
BY VOLUME CAPACITY RATIO AND TYPE OF DEVELOPMENT
(NOTE: TRAVEL FOR MULTILANE FACILITIES IN PEAK DIRECTION ONLY)

AGGREGATE OF STATES

RURAL

TOTAL

	RURAL				DENSE				TOTAL				UNPAVED
	MILES	%	PHVMT	%	MILES	%	PHVMT	%	MILES	%	PHVMT	%	MILES
MULTILANE (>3):													
<.21	20882	56.6	7845	29.3	890	36.5	275	15.3	21772	55.4	8120	28.4	*******
.21-.30	6486	17.5	5184	19.4	407	16.7	235	13.0	6893	17.5	5419	19.0	*******
.31-.40	4438	12.0	4828	18.0	243	9.9	219	12.1	4631	11.9	5047	17.7	*******
.41-.50	2134	5.7	3187	11.9	290	11.8	304	16.9	2424	6.1	3491	12.2	*******
.51-.60	1491	4.0	2568	9.6	195	7.9	236	13.1	1696	4.2	2804	9.8	*******
.61-.70	638	1.7	1265	4.7	115	4.7	93	5.2	752	1.9	1358	4.7	*******
.71-.80	371	1.0	818	3.0	90	3.6	109	6.0	460	1.1	927	3.2	*******
.81-.85	97	0.2	234	0.8	31	1.2	47	2.6	129	0.3	281	0.9	*******
.86-.90	65	0.1	153	0.5	40	1.6	59	3.2	106	0.2	212	0.7	*******
.91-.95	36	0.0	76	0.2	14	0.5	16	0.8	50	0.1	92	0.3	*******
>.95	220	0.5	551	2.0	119	4.9	201	11.2	340	0.8	752	2.6	*******
TOTAL	36858	100.0	26708	100.0	2434	100.0	1794	100.0	39291	100.0	28503	100.0	0000000
2 OR 3 LANE:													
<.21	368867	82.3	32730	46.5	8470	39.4	843	12.2	377336	80.4	33573	43.4	*******
.21-.30	32801	7.3	10534	14.9	2968	13.8	690	10.0	35769	7.6	11224	14.5	*******
.31-.40	20259	4.5	9008	12.8	1753	8.1	641	9.3	22012	4.6	9649	12.5	*******
.41-.50	11243	2.5	6186	8.7	1443	6.7	683	9.9	12686	2.7	6869	8.8	*******
.51-.60	5176	1.1	3384	4.8	1174	5.4	572	8.3	6350	1.3	3956	5.1	*******
.61-.70	3602	0.8	2638	3.7	789	3.6	387	5.6	4391	0.9	3026	3.9	*******
.71-.80	1845	0.4	1606	2.2	696	3.2	314	4.5	2540	0.5	1920	2.4	*******
.81-.85	432	0.0	448	0.6	736	3.4	367	5.3	1168	0.2	815	1.0	*******
.86-.90	459	0.1	547	0.7	155	0.7	102	1.4	614	0.1	649	0.8	*******
.91-.95	619	0.1	578	0.8	391	1.8	223	3.2	1010	0.2	800	1.0	*******
>.95	2484	0.5	2654	3.7	2870	13.3	2054	29.8	5354	1.1	4709	6.0	*******
TOTAL	447787	100.0	70312	100.0	21444	100.0	6877	100.0	469231	100.0	77189	100.0	0116359

1980 RURAL MILEAGE AND TRAVEL (IN THOUSANDS)
BY SHOULDER WIDTH AND SHOULDER TYPE

AGGREGATE OF STATES

RURAL

INTERSTATE

	SURFACED		STABILIZED		EARTH		TOTAL	
	MILES	DVMT	MILES	DVMT	MILES	DVMT	MILES	DVMT
RIGHT SHOULDER WIDTH:								
0	19	125	0	0	0	0	19	125
1 - 2	21	213	37	52	0	0	58	265
3 - 4	85	1208	8	43	0	0	92	1251
5 - 6	125	1369	14	43	6	53	144	1465
7 - 8	753	8386	26	685	0	0	779	9071
9 - 10	17744	197083	666	9161	98	1172	18508	207416
> 10	2508	35539	162	1769	25	261	2695	37569
TOTAL	21254	243924	912	11753	129	1486	22295	257162
LEFT SHOULDER WIDTH:								
0	443	4594	100	1316	28	359	571	6269
1 - 2	1287	14835	226	2701	34	431	1548	17966
3 - 4	13395	140472	277	4132	58	535	13730	145138
5 - 6	4154	50155	109	1617	9	161	4272	51933
7 - 8	1348	21198	98	1295	0	0	1446	22493
9 - 10	583	11669	101	692	0	0	685	12361
> 10	43	1001	0	0	0	0	43	1001
TOTAL	21254	243924	912	11753	129	1486	22295	257162

SHOULDERS DO NOT EXIST:

CURBED:	MILES:	7	DVMT:	102
UNCURBED:	MILES:	18	DVMT:	267

NOTE: LEFT SHOULDER TABULATION FOR DIVIDED ROADWAYS ONLY.

1980 RURAL MILEAGE AND DAILY VEHICLE MILES OF TRAVEL (IN THOUSANDS)
BY SPEED_LIMIT AND FUNCTIONAL CLASS

AGGREGATE OF STATES

RURAL

	INTERSTATE		OTHER PRINCIPAL ARTERIAL		MINOR ARTERIAL		MAJOR COLLECTOR		MINOR COLLECTOR		TOTAL	
	MILES	%	MILES	%	MILES	%	MILES	%	MILES	%	MILES	%
< 21	0	0.0	26	0.0	170	0.1	245	0.0	196	0.1	636	0.1
25	12	0.0	75	0.1	199	0.2	2378	0.8	1811	0.9	4475	0.7
30	1	0.0	404	0.7	970	0.9	3161	1.1	4842	2.5	9377	1.5
35	9	0.0	589	1.1	1789	1.8	5727	2.1	5399	2.8	13514	2.1
40	1	0.0	581	1.1	2595	2.6	7910	2.9	5851	3.1	16938	2.7
45	29	0.1	1334	2.5	3562	3.6	14177	5.3	11280	6.0	30383	4.8
50	30	0.1	1628	3.1	4580	4.7	15447	5.7	17720	9.5	39407	6.3
55	22239	99.6	47181	91.0	83197	85.7	218162	81.6	139372	74.7	510152	81.6
T O T A L	22322	100.0	51819	100.0	97063	100.0	267208	100.0	186471	100.0	624382	100.0

****

	DVMT	%	DVMT	%	DVMT	%	DVMT	%	DVMT	%	DVMT	%
< 21	0	0.0	119	0.0	375	0.1	189	0.0	127	0.1	810	0.0
25	17	0.0	587	0.2	661	0.2	4040	1.5	1663	2.3	6968	0.6
30	8	0.0	1703	0.6	3510	1.4	6316	2.3	3645	5.2	15181	1.4
35	160	0.0	4133	1.6	8136	3.4	12250	4.6	4697	6.7	29377	2.7
40	3	0.0	3721	1.5	11897	5.0	15240	5.7	4968	7.1	35829	3.3
45	261	0.1	11242	4.5	14616	6.1	22142	3.3	5662	8.1	53922	5.0
50	927	0.3	11189	4.5	21615	9.1	17542	6.6	5090	7.2	56362	5.2
55	256156	99.4	214740	86.7	175865	74.3	197606	70.7	44006	62.9	878373	81.5
T O T A L	257532	100.0	247434	100.0	236674	100.0	265324	100.0	69857	100.0	1076821	100.0

AGGREGATE OF STATES
RURAL

1980 RURAL MILEAGE AND [illegible]
BY ADT GROUP AND LANE WIDTH

	PAVED LANE WIDTH <9		9		10		11		>11		TOTAL		UNPAVED
	MILES	%	MILES	%	MILES	%	MILES	%	MILES	%	MILES	%	MILES
INTERSTATE	711	3.2	3	0.0	43	0.2	50	0.2	21516	96.4	22322	100.0	0
OTHER PRIN ART	347	0.7	348	0.7	3614	7.0	7426	14.3	40072	77.3	51807	100.0	12
MINOR ARTERIAL	346	0.4	4970	5.1	19452	20.1	18048	18.6	54139	55.8	96955	100.0	108
MAJOR COLLECTOR:													
>1000	1570	2.1	10141	13.3	25583	33.6	15968	21.0	22868	30.0	76130	100.0	698
400-1000	3163	4.5	14015	19.8	30985	43.8	9941	14.1	12561	17.8	70665	100.0	1040
100-399	5520	7.9	9410	13.5	23441	33.7	9729	14.0	21525	30.9	69526	100.0	15335
<100	395	5.9	860	12.8	1544	23.0	1629	24.3	2272	33.9	6700	100.0	27015
TOTAL	10649	4.8	34425	15.4	81553	36.6	37267	16.7	59226	26.5	223120	100.0	44087
MINOR COLLECTOR:													
>1000	1204	7.8	3129	20.4	6392	41.6	2261	14.7	2388	15.5	15374	100.0	479
400-1000	4898	14.6	11504	34.3	11832	35.2	2820	8.4	2524	7.5	33578	100.0	794
100-399	11297	20.5	18163	32.9	13463	24.4	4878	8.8	7351	13.3	55152	100.0	17571
<100	1272	12.5	1340	13.1	4190	41.0	938	9.2	2474	24.2	10214	100.0	53307
TOTAL	18671	16.3	34137	29.9	35876	31.4	10897	9.5	14738	12.9	114319	100.0	72152
TOTAL COLLECTORS:													
>1000	2774	3.0	13270	14.5	31975	34.9	18228	19.9	25257	27.6	91504	100.0	1177
400-1000	8061	7.7	25519	24.5	42817	41.1	12761	12.2	15085	14.5	104244	100.0	1834
100-399	16818	13.5	27573	22.1	36904	29.6	14607	11.7	28876	23.1	124778	100.0	32906
<100	1667	9.9	2200	13.0	5734	33.9	2567	15.2	4746	28.1	16914	100.0	80322
TOTAL	29320	8.7	68562	20.3	117430	34.8	48164	14.3	73964	21.9	337439	100.0	116239
T O T A L	30724	6.0	73883	14.5	140538	27.6	73687	14.5	139691	37.3	508523	100.0	116359

	DVMT	%	DVMT	%	DVMT	%	DVMT	%	DVMT	%	DVMT	%	DVMT
INTERSTATE	5196	2.0	93	0.0	96	0.0	93	0.0	252054	97.9	257532	100.0	0
OTHER PRIN ART	1701	0.7	1171	0.5	14851	6.0	28356	11.5	201349	81.4	247427	100.0	8
MINOR ARTERIAL	541	0.2	8245	3.5	45032	19.0	47774	20.2	135066	57.1	236659	100.0	15
MAJOR COLLECTOR:													
>1000	3019	1.5	19525	10.0	54782	28.0	40579	20.7	78046	39.8	195951	100.0	1202
400-1000	1905	4.1	9148	19.9	20238	44.0	6545	14.2	8174	17.8	46011	100.0	550
100-399	1371	7.9	2377	13.7	6027	34.8	2440	14.1	5091	29.4	17305	100.0	2340
<100	23	5.2	52	11.6	107	23.6	112	24.7	158	35.0	452	100.0	1514
TOTAL	6318	2.4	31102	12.0	81154	31.2	49676	19.1	91468	35.2	259718	100.0	5606
MINOR COLLECTOR:													
>1000	2033	6.7	5650	18.7	12543	41.6	4055	13.4	5882	19.5	30163	100.0	1245
400-1000	2807	14.2	6753	34.3	6930	35.2	1688	8.6	1533	7.8	19712	100.0	472
100-399	2538	20.7	4325	35.3	2932	23.9	1022	8.3	1432	11.7	12250	100.0	3282
<100	75	12.1	80	12.8	284	45.9	56	9.1	124	20.1	620	100.0	2113
TOTAL	7453	11.9	16808	25.8	22689	36.2	6822	10.9	8972	14.3	62745	100.0	7112
TOTAL COLLECTORS:													
>1000	5051	2.2	25175	11.1	67325	29.8	44635	19.7	83928	37.1	226114	100.0	2447
400-1000	4712	7.2	15901	24.2	27168	41.3	8233	12.5	9708	14.8	65723	100.0	1022
100-399	3909	13.2	6702	22.7	8959	30.3	3462	11.7	6523	22.1	29555	100.0	5622
<100	99	9.2	132	12.3	391	36.5	168	15.7	283	26.4	1072	100.0	3627
TOTAL	13771	4.3	47910	14.9	103843	32.2	56498	17.5	100441	31.1	322464	100.0	12718
T O T A L	21209	2.0	57419	5.4	163822	15.4	132721	12.5	638909	64.7	1064080	100.0	12741

1980 RURAL SYSTEM MILES
BY PERCENT TRUCKS (PEAK HOUR)

AGGREGATE OF STATES

RURAL

	0 - 5	6 - 9	10-13	14-17	18-21	22-25	26-29	> 29	TOTAL
INTERSTATE	1554	3609	3292	4770	3795	2720	1079	1504	22322
OTHER PRINCIPAL ARTERIAL	9001	10590	15689	7975	4915	1882	1084	683	51819
MINOR ARTERIAL	22012	29476	24679	11828	4792	2621	1223	432	97063
MAJOR COLLECTOR	106823	72721	45724	23001	14223	2763	365	1589	267208
MINOR COLLECTOR	86726	42828	32239	10752	10008	3066	102	751	186471
TOTAL	226116	159224	121623	58326	37730	13052	3852	4959	624882

****

BY PERCENT TRUCKS (OFFPEAK)

	0 - 5	6 - 9	10-13	14-17	18-21	22-25	26-29	> 29	TOTAL
INTERSTATE	1064	1710	2972	3182	4283	4288	2685	2137	22322
OTHER PRINCIPAL ARTERIAL	3559	8272	16505	10833	7659	2707	1473	1011	51819
MINOR ARTERIAL	13722	20340	33967	14679	9179	3275	1083	819	97063
MAJOR COLLECTOR	59589	103566	52566	30244	15713	2984	820	1729	267208
MINOR COLLECTOR	64814	53109	41613	12282	10877	2627	163	986	186471
TOTAL	142748	186997	147622	71020	47707	15881	6225	6682	624982

1980 RURAL MILEAGE AND TRAVEL (IN THOUSANDS)
BY FUNCTIONAL CLASS AND HORIZONTAL ALIGNMENT ADEQUACY
PAVED MILEAGE ONLY

AGGREGATE OF STATES
RURAL

	CODE 1		CODE 2		CODE 3		CODE 4		TOTAL	
	MILES	%	MILES	%	MILES	%	MILES	%	MILES	%
INTERSTATE	20886	93.5	1276	5.7	118	0.5	41	0.1	22322	100.0
OTHER PRINCIPAL ARTERIAL	38481	74.2	9277	17.9	2584	4.9	1464	2.8	51807	100.0
MINOR ARTERIAL	68923	71.0	12755	13.1	9293	9.5	5984	6.1	96955	100.0
MAJOR COLLECTOR	93335	41.8	52973	23.7	44041	19.7	32771	14.6	223120	100.0
MINOR COLLECTOR	33526	29.3	31513	27.5	26764	23.4	22516	19.6	114319	100.0
TOTAL	255151	50.1	107795	21.1	82802	16.2	62776	12.3	508523	100.0

****

	DVMT	%	DVMT	%	DVMT	%	DVMT	%	DVMT	%
INTERSTATE	245470	95.3	10969	4.2	903	0.3	190	0.0	257532	100.0
OTHER PRINCIPAL ARTERIAL	198495	80.2	34235	13.8	9786	3.9	4911	1.9	247427	100.0
MINOR ARTERIAL	175883	74.3	28240	11.9	21905	9.2	10631	4.4	236659	100.0
MAJOR COLLECTOR	121388	46.7	71685	27.6	40919	15.7	25727	9.9	259718	100.0
MINOR COLLECTOR	18972	30.2	20541	32.7	14715	23.4	8517	13.5	62745	100.0
TOTAL	760208	71.4	165670	15.5	88227	8.2	49976	4.6	1064080	100.0

CODE 1: ALL CURVES MEET APPROPRIATE DESIGN STANDARDS. REDUCTION OF CURVATURE WOULD BE UNNECESSARY EVEN IF RECONSTRUCTION WAS REQUIRED TO MEET OTHER DEFICIENCIES, I.E, (CAPACITY, VERTICAL ALIGNMENT, ETC).

CODE 2: ALTHOUGH SOME CURVES ARE BELOW APPROPRIATE DESIGN STANDARDS FOR NEW CONSTRUCTION, ALL CURVES CAN BE SAFELY AND COMFORTLY NEGOTIATED AT THE PREVAILING SPEED LIMIT ON THE SECTION. THE SPEED LIMIT WAS NOT ESTABLISHED BY DESIGN SPEED OF CURVES.

CODE 3: INFREQUENT CURVES WITH DESIGN SPEEDS LESS THAN THE PREVAILING SPEED LIMIT ON THE SECTION. INFREQUENT CURVES MAY HAVE REDUCED SPEED LIMITS FOR SAFETY PURPOSES.

CODE 4: SEVERAL CURVES UNCOMFORTABLE AND/OR UNSAFE WHEN TRAVELED AT THE PREVAILING SPEED LIMIT IN THE SECTION, OR SPEED LIMIT ON SECTION IS SEVERELY RESTRICTED DUE TO DESIGN SPEED OF CURVES.

SECTIONS FOR WHICH NO ALIGNMENT DATA IS CODED ARE TREATED AS CODE 2.

APPENDIX B

HPMS ANALYTICAL PROCESS MODELS

Deficiency and Improvement (Needs) Analysis

This model will simulate the improvements needed to keep the physical and operating conditions of a highway system from falling below prescribed minimum criteria during the analysis period. The basic functions of the model are to --

- identify individual highway section deficiencies which occur during the analysis period,
- determine logical improvements to correct deficiencies,
- estimate the costs of the improvements, and
- modify the section record to reflect performance in the target year.

Section deficiencies are identified through comparison of existing and simulated section travel data and characteristics to the minimum tolerable conditions, which include physical condition, geometric design, and operational characteristics. These minimum tolerable conditions vary by functional class and are somewhat below design standards used for new construction or 3R projects. These criteria could be altered by the individual states to reflect their existing or proposed policy or programmatical needs and requirements.

The analysis period for this process can be a single 20-year period or it may be one of up to four separate increments within the overall 20-year period. In either approach, each period is analyzed independently. During each analysis phase, records are developed of what improvements are made and what pavements have deteriorated based upon the amount of traffic forecasted. These records are, in turn, used as input to the subsequent analysis period, if one is specified.

Within each time cycle, deficiencies are sought out, identified, and prioritized. Sections for which only an initial pavement condition deficiency is identified do not go directly into the improvement analysis as do sections with more acute deficiencies. When a pavement deficiency is identified, the model attempts to simulate reality by cycling ahead to determine if other, more serious, deficiencies will be identified. If, however, other deficiencies do occur, the combination of pavement condition and more acute deficiencies dictate the type and year of improvement. Once an initial improvement has been identified for a roadway section, the model continues to forecast traffic, deteriorate the improved pavement condition on the section, and assess the need for a potential "second generation" resurfacing during the analysis period. Target year conditions in each section are simulated assuming (1) no improvement is made, (2) only the identified initial improvement is made, and (3) the identified initial improvement and second generation resurfacing, if necessary, are carried out.

Deficiencies are grouped into the following four types:

- Peak hour operating speeds or volume to capacity ratio
- Lane or approach width
- Pavement type or condition
- Horizontal or vertical alignment conditions.

The improvement type selected by the needs analysis model depends upon the major type of deficiency that occurs and other less serious deficiencies that may exist on the section. The four improvement types include:

1. Reconstruction

    a. Reconstruct to freeway
    b. Reconstruct with additional lanes
    c. Reconstruct with wider lanes
    d. Pavement reconstruction
    e. Reconstruct to same geometrics
    f. Isolated rural reconstruction

2. Widening

    a. Major widening
    b. Minor widening

3. Resurfacing

    a. Resurfacing and shoulder improvements
    b. Resurfacing

4. Traffic Engineering (Urban Only)

    This is used only when capacity deficiencies exist and constraints prohibit overall route widening.

    a. Intersection widening
    b. Parking removal
    c. Signal improvement

High volume to capacity ratios or lane width deficiencies have a traffic engineering improvement simulated to improve traffic flow. There is also a maximum number of lanes to which a particular functional class may be improved.

The output generated from this model is a set of area and functional class summaries consisting of --

- miles and costs of improvements by deficiency type,
- miles and costs by improvement type and year of improvement, and
- second generation resurfacing miles and costs by year of improvement.

Composite Index (Sufficiency) Analysis

Using the data from the Needs Model, the Composite Index or C.I. Model is simply a procedure to evaluate, on a numeric basis, highway condition, geometrics, and usage and operating characteristics on a section-by-section basis, and then aggregate these evaluations by functional system. Composite and component indexes or sufficiency ratings are developed from the section evaluations. These indexes are calculated for base year conditions and for the three potential target year conditions produced by the Needs Model.

Numeric values are assigned to each sample section based upon comparisons of the physical and operational characteristics of a section with specific weights and values. Significant characteristics of a section are selected to represent the following categories:

- Condition
    - pavement condition
    - pavement type
    - drainage adequacy
- Safety
    - lane width
    - shoulder width
    - median width
    - alignment

- Service
  - volume/capacity ratio
  - operating speed
  - access control

Two tables are produced by this model. These include summaries of the three indexes plus a composite index, and can be produced for individual states as well as in the aggregate for national statistics. Both tables are produced for each set of indexes for the following conditions:

- Base year

- Target year without improvements

- Target year with initial improvements

- Target year with initial improvements and second generation resurfacing as needed

The first table, "Systemwide Average Rating Summary," is a compilation by functional system and area of the four indexes weighted by mileage and DVMT. It provides a means to determine the relative differences among categories by functional system. By comparing the average indexes by category within a functional system, one can determine which category is in the greatest need of attention. The ability to produce this table for current and potential improvements provides a means of obtaining information on potential full needs investment benefits. The comparisons of the various increments of improvements can provide information on which functional system or component category would benefit most by making identified improvements.

The second table, "Rating and Distribution Summary," contains the distribution of mileage and DVMT for each of the four indexes by functional system. It can be used to identify the extent of critical deficiencies and make comparisons between base year and target years to determine the consequences of full and no investment strategies. Base year conditions can also be compared to previous submittals to determine developing trends and ongoing program effectiveness.

Investment Analysis

A means of relating investment to highway performance is necessary for the formulation of sound financial policies and viable highway improvement programs. This model provides a means of evaluating the effects of alternative levels of capital investment on the highway systems.

The investment performance analysis first determines priority rankings for all proposed improvements by functional system and urban and rural area through applying user specified ranking factors. Potential improvements can be ranked by one of the following methods:

- a base year composite index
- combination of cost effectiveness index and base year composite index
- a cost effectiveness index
- any one base year component index

Upon completion of the ranking process, the model begins to select and summarize the simulated improvements developed by the needs analysis from the top of the priority list downward until available funds for the given investment are exhausted. The model then continues the summarization process using target year unimproved conditions for the remaining sections since funds would no longer be available for potential improvements. This process is iterated for each functional system and area.

The output from this analysis consists of a series of summary tabulations and investment curves for seven investment levels. These levels are based upon percentages of full needs investment which include 100, 80, 76, 60, 40, 10 and 0 percent of full investment. Within each level, output is presented by --

- investment curves relating dollars invested to various target year composite index values by functional system,
- simulated target year condition summaries by area and functional system,
- a summary of miles and cost improvements made by improvement type and functional system during the analysis period, and
- a summary of mileage and travel served on unfunded or unimproved sections in the target year and the necessary additional funding to satisfy those deficiencies.

Impact Analysis

The impact analysis provides a comparison of vehicle performance measures that would occur under various investment levels and then summarizes them by area and functional class. These comparisons can be made between target years for several scenarios or between a base year and target year to test impacts of existing or proposed funding levels, policies, or programs. Vehicle performance measures used in this analysis are --

- fuel consumption,
- vehicle emissions (carbon monoxide, hydrocarbons, and nitrogen oxide),
- vehicle operating costs,
- effective speeds, and
- accidents (property damage, injury, and fatal).

These vehicle performance measures are estimated by analyzing each sample section and aggregating the results to represent each functional system. Except for accidents, the results of the analysis are listed by the following vehicle types:

- small automobile (3,000 lb. or less)
- large automobile (greater than 3,000 lb.)
- pickups, vans
- truck, single unit, two-axle, six-tire
- truck, single unit, three-axle or more
- truck, combination, four-axle or less
- truck, combination, five-axle or more

Each vehicle type is "driven" by simulation over the highway section to determine the performance measures for that type and section.

Multiple Deficiency Analysis

The multiple deficiency analysis shows the extent of the more common deficiency types and probable combinations of these deficiencies occurring in both the base year and the target year under various funding levels or policies. Five types of deficiencies are considered in this analysis:

- pavement condition
- geometric (rural only)
- roadway cross section
- operational
- access control (interstate and other freeway and expressway only)

Deficiencies are identified by comparing the existing or projected values with the minimum tolerable conditions. The analysis output is measured in both miles and travel for each type of deficiency and by functional system and area.

Deferred Cost Analysis

The deferred cost analysis is used to illustrate the increase in cost due to deferring improvements, including resurfacing, as a result of budgetary constraints. An example would be deferred resurfacing which ultimately results in the need for pavement reconstruction. This analysis produces tables that contain mileage and cost of the initial and proposed improvement and the final simulated improvement by funding period and functional system. Inflation or present worth calculations are not considered. This function is performed automatically when more than one funding period is specified for study.

APPENDIX C

OUTPUT TABLES FROM THE HPMS ANALYTICAL PACKAGE

1980 RURAL MILEAGE
BY FEDERAL AID SYSTEM AND JURISDICTION

AGGREGATE OF STATES
RURAL

	FEDERAL-AID SYSTEM			
	INTERSTATE	FEDERAL-AID PRIMARY	FEDERAL-AID SECONDARY	NON-FEDERAL AID
	MILES	MILES	MILES	MILES
INTERSTATE				
STATE	22318	0	0	0
FEDERAL DOMAIN	0	0	0	0
LOCAL	2	0	0	0
OTHER	2	0	0	0
TOTAL	22322	0	0	0
OTHER PRINCIPAL ARTERIAL				
STATE	0	51348	29	342
FEDERAL DOMAIN	0	17	0	0
LOCAL	0	62	0	3
OTHER	0	18	0	0
TOTAL	0	51445	29	345
MINOR ARTERIAL				
STATE	0	95531	155	70
FEDERAL DOMAIN	0	42	0	116
LOCAL	0	890	0	235
OTHER	0	23	0	0
TOTAL	0	96487	155	421
MAJOR COLLECTOR				
STATE	0	934	117118	4151
FEDERAL DOMAIN	0	0	832	2339
LOCAL	0	103	136330	5242
OTHER	0	0	0	160
TOTAL	0	1037	254279	11892
MINOR COLLECTOR				
STATE	0	0	0	51327
FEDERAL DOMAIN	0	0	0	6642
LOCAL	0	0	2	127282
OTHER	0	0	0	1217
TOTAL	0	0	2	186468
TOTAL				
STATE	22318	147813	117302	55890
FEDERAL DOMAIN	0	59	832	9097
LOCAL	2	1055	136332	132761
OTHER	2	42	0	1377
TOTAL	22322	148969	254466	199125

1980 HPMS INDEX DISTRIBUTION TABLE

FUNDING PERIOD ANALYSIS

RURAL MILEAGE BY INDEX AND FUNCTIONAL CLASS

RURAL
$2,931,417,000 INVESTED

FUNCTIONAL CLASS

BASE YEAR 1995
2000 TARGET-YEAR CONDITIONS

CATEGORY	INTERSTATE			PRINCIPAL ARTERIAL			MINOR ARTERIAL			MAJOR COLLECTOR			MINOR COLLECTOR		
	MILES	% OF TOTAL	CUMU. % OF TOT.	MILES	% OF TOTAL	CUMU. % OF TOT.	MILES	% OF TOTAL	CUMU. % OF TOT.	MILES	% OF TOTAL	CUMU. % OF TOT.	MILES	% OF TOTAL	CUMU. % OF TOT.
AVERAGE SERVICE															
0	0			32	2.2	2.2	17	.9	.9	39	.5	.5	45	.5	.5
1-2	0			4	.3	2.4	6	.3	1.2	40	.5	1.1	31	.3	.8
3-4	0			0		2.4	17	.9	2.2	124	1.7	2.8	0		.8
5-6	0			0		2.4	11	.6	2.8	141	1.9	4.7	53	.6	1.4
7-8	0			12	.8	3.2	2	.1	2.9	1,522	20.9	25.6	230	2.5	3.8
9-10	5	.8	.8	15	1.0	4.2	0		2.9	5,430	74.4	100.0	9,009	96.2	100.0
11-12	4	.7	1.5	37	2.5	6.7	19	1.0	3.9						
13-14	0		1.5	13	.9	7.6	38	2.1	6.0						
15-16	10	1.7	3.2	19	1.3	8.9	23	1.3	7.3						
17-18	0		3.2	85	5.7	14.6	84	4.6	11.9						
19-20	22	3.7	6.9	28	1.9	16.5	378	20.9	32.8						
21-22	11	1.8	8.7	113	7.7	24.2	252	13.9	46.7						
23-24	0		8.7	76	5.2	29.3	605	33.4	80.1						
25-26	0		8.7	6	.4	29.7	360	19.9	99.9						
27-28	48	8.1	16.8	46	3.1	32.8									
29-30	15	2.5	19.2	39	2.6	35.5									
31-32	104	17.5	36.7	20	1.4	36.8									
33-34	35	5.9	42.6	58	3.9	40.7									
35-36	145	24.3	66.8	79	5.3	46.0									
37-38	24	4.1	70.9	115	7.8	53.8									
39-40	173	29.0	99.9	683	46.1	99.9									

INVESTMENT/PERFORMANCE 2000 COMPOSITE INDEX

RURAL

FUNDING PERIOD ANALYSIS: 1955 TO 2000
TOTAL INVESTMENT FOR FUNDING PERIOD($000): $2931417

SERVICE

FUNCTIONAL CLASS	VOLUME CAPACITY RATIO1/							PEAK HOUR OPERATING SPEED2/						
	<.21	.21-.30	.31-.40	.41-.50	.51-.60	.61-.80	>.80	00	01-34	35-39	40-44	45-49	50-54	>54
INTERSTATE														
% OF MILEAGE	03	23	07	19	15	24	10	00	01	02	05	10	24	58
% OF PHVMT	00	10	05	21	17	34	14	00	04	02	07	14	30	44
OTHER PRINCIPAL														
% OF MILEAGE	41	17	12	08	08	07	07	00	07	07	07	09	07	63
% OF PHVMT	30	19	15	08	11	06	10	00	09	05	05	08	11	63
MINOR ARTERIAL														
% OF MILEAGE	30	29	12	13	05	07	04	00	09	10	13	12	20	37
% OF PHVMT	30	26	10	13	05	08	08	00	11	07	13	10	18	41
MAJOR COLLECTOR														
% OF MILEAGE	62	20	02	03	04	04	04	01	13	11	05	24	12	29
% OF PHVMT	33	23	03	08	07	11	15	03	17	11	12	23	14	20
MINOR COLLECTOR														
% OF MILEAGE	96	02	01	01	00	00	00	00	08	07	15	11	19	40
% OF PHVMT	73	06	03	06	01	00	10	02	14	05	10	15	14	40

* * * * * * * * * * * * * * * * * * * *

	COMPOSITE INDEX				COSTS
	CONDITION	SAFETY	SERVICE	COMPOSITE	(IN THOUS)
INTERSTATE					
WTD. BY MILES	15.0	28.8	33.6	77.4	$87766
WTD. BY DVMT	15.0	28.8	31.6	75.4	
OTHER PRINCIPAL ARTERIAL					
WTD. BY MILES	14.9	26.4	31.7	73.0	$451542
WTD. BY DVMT	15.0	27.1	31.7	73.7	
MINOR ARTERIAL					
WTD. BY MILES	19.9	22.9	21.4	64.2	$495374
WTD. BY DVMT	19.9	25.4	20.8	66.1	
MAJOR COLLECTOR					
WTD. BY MILES	29.1	21.6	08.9	59.5	$971279
WTD. BY DVMT	29.7	24.9	07.8	62.4	
MINOR COLLECTOR					
WTD. BY MILES	29.4	21.4	09.3	60.7	$1001302
WTD. BY DVMT	29.5	25.6	08.4	63.4	

1/ INCLUDES ONLY PAVED MILEAGE AND PHVMT. PHVMT INTERSTATE PEAK DIRECTION ONLY; OTHER CLASSES, BOTH DIRECTIONS.

FUNDING PERIOD ANALYSIS

RURAL COMPOSITE INDEX BY FUNCTIONAL CLASS

WEIGHTED BY MILEAGE AND DVMT

RURAL
$2,931,417,000 INVESTED — FUNCTIONAL CLASS — BASE YEAR 1995, 2000 TARGET-YEAR CONDITIONS

CATEGORY	INTERSTATE		PRINCIPAL ARTERIAL		MINOR ARTERIAL		MAJOR COLLECTOR		MINOR COLLECTOR		TOTAL COLLECTOR	
	WEIGHTED INDEX	% OF MAXIMUM	WEIGHTED INDEX	% OF MAXIMUM	WEIGHTED INDEX	% OF MAXIMUM	WEIGHTED INDEX	% OF MAXIMUM	WEIGHTED INDEX	% OF MAXIMUM	WEIGHTED INDEX	% OF MAXIMUM
AVERAGE CONDITION	MAX= 30	100.0	MAX= 30	100.0	MAX= 45	100.0	MAX= 60	100.0	MAX= 60	100.0	MAX= 60	100.0
WEIGHTED BY MILEAGE	15.0	50.0	14.9	49.8	19.9	44.2	29.1	48.5	29.4	49.0	29.3	48.8
WEIGHTED BY DVMT	15.0	50.0	15.0	49.9	19.9	44.3	29.7	49.4	29.5	49.1	29.6	49.3
AVERAGE SAFETY	MAX= 30	100.0	MAX= 30	100.0	MAX= 30	100.0	MAX= 30	100.0	MAX= 30	100.0	MAX= 30	100.0
WEIGHTED BY MILEAGE	28.8	95.9	26.4	87.9	22.8	76.2	21.7	72.2	21.4	71.4	21.5	71.8
WEIGHTED BY DVMT	28.8	96.0	27.1	90.2	25.3	84.3	25.0	83.2	25.5	85.2	25.1	83.7
AVERAGE SERVICE	MAX= 40	100.0	MAX= 40	100.0	MAX= 25	100.0	MAX= 10	100.0	MAX= 10	100.0	MAX= 10	100.0
WEIGHTED BY MILEAGE	33.6	83.9	31.6	78.9	21.4	85.4	8.9	88.5	9.3	93.2	9.1	91.2
WEIGHTED BY DVMT	31.5	78.8	31.4	78.5	20.7	83.0	7.8	78.3	8.4	83.6	8.0	79.8
COMPOSITE INDEX	MAX = 100	100.0	MAX = 100	100.0	MAX = 100	100.0	MAX = 100	100.0	MAX = 100	100.0	MAX = 100	100.0
WEIGHTED BY MILEAGE	77.3	77.3	72.9	72.9	64.1	64.1	59.6	59.6	60.1	60.1	59.9	59.9
WEIGHTED BY DVMT	75.3	75.3	73.4	73.4	66.0	66.0	62.4	62.4	63.3	63.3	62.7	62.7
TOTAL MILEAGE	596		1,481		1,812		7,296		9,367		16,663	
TOTAL DVMT (000)	13,849		13,865		8,974		19,691		7,811		27,503	

FUNDING PERIOD ANALYSIS: 1995 TO 2000
TOTAL INVESTMENT FOR FUNDING PERIOD($000): $2931417

DISTRIBUTION OF THE INVESTMENT BY FUNCTIONAL CLASS AND IMPROVEMENT TYPE

	INTERSTATE		OTHER PRINCIPAL ARTERIAL		MINOR ARTERIAL		MAJOR COLLECTOR		MINOR COLLECTOR	
	MILES	COSTS	MILES	COSTS	MILES	COSTS	MILES	COSTS	MILES	COSTS
RECONSTRUCT TO FREEWAY	0	0	95	406948	0	0	0	0	0	0
RECONSTRUCT W/MORE LANES	0	0	0	1344	65	184880	0	0	0	0
RECONSTRUCT W/WIDER LANES	0	0	5	8571	102	155369	390	591035	789	847980
RECONSTRUCT AS IS	0	0	0	0	1	668	0	0	0	0
ISOLATED RECONSTRUCTION	0	0	0	0	0	0	0	0	0	0
MAJOR WIDENING(ADD LANES)	13	42027	14	30098	58	141515	109	351167	0	0
MINOR WIDENING	0	0	5	3370	0	0	0	0	357	122276
RESURFACING W/SHLDR. IMP.	0	0	0	0	0	0	80	14946	0	0
RESURFACING	86	45739	4	1211	66	12938	244	14131	505	31046
PAVEMENT RECONSTRUCTION	0	0	0	0	0	0	0	0	0	0
NO IMPROVEMENT	399	0	1127	0	1029	0	3565	0	3995	0
TOTAL FUNDS SPENT	498	87766	1251	451542	1320	495374	4388	571279	5646	1001302

IMPROVEMENTS NOT FUNDED BY FUNCTIONAL CLASS AND IMPROVEMENT TYPE

	INTERSTATE		OTHER PRINCIPAL ARTERIAL		MINOR ARTERIAL		MAJOR COLLECTOR		MINOR COLLECTOR	
	MILES	COSTS	MILES	COSTS	MILES	COSTS	MILES	COSTS	MILES	COSTS
RECONSTRUCT TO FREEWAY	0	0	120	452584	0	0	0	0	0	0
RECONSTRUCT W/MORE LANES	0	0	43	152181	156	601842	0	0	0	0
RECONSTRUCT W/WIDER LANES	0	0	0	0	283	455425	2505	3810979	2588	2768627
RECONSTRUCT AS IS	0	0	0	0	1	1489	155	160218	9	7678
ISOLATED RECONSTRUCTION	0	0	0	0	0	0	0	0	0	0
MAJOR WIDENING(ADD LANES)	30	95762	54	206852	50	123073	0	0	0	0
MINOR WIDENING	0	0	0	0	0	0	0	0	0	0
RESURFACING W/SHLDR. IMP.	0	0	0	0	0	0	0	0	0	0
RESURFACING	67	48448	0	0	0	0	0	0	0	0
PAVEMENT RECONSTRUCTION	0	0	14	18272	2	1962	248	304367	1124	927845
TOTAL NOT FUNDED	98	144210	230	829889	492	1183791	2908	4255564	3721	3704150

NOTE: ALL COSTS ARE IN THOUSANDS OF DOLLARS.

INVESTMENT/PERFORMANCE 2000 COMPOSITE INDEX

RURAL

FUNDING PERIOD ANALYSIS: 1955 TO 2000
TOTAL INVESTMENT FOR FUNDING PERIOD($000): $2931417

CONDITION

FUNCTIONAL CLASS	PAVEMENT TYPE: HIGH	INTERM	LOW	UNPAVE	PAVEMENT CONDITION1/: <1.0	1.0-1.4	1.5-1.9	2.0-2.4	2.5-2.9	3.0-3.5	4.0-4.5	>4.5
INTERSTATE												
% OF MILEAGE	100	00	00	00	06	01	05	00	15	54	17	02
% OF TRAVEL	100	00	00	00	03	01	01	00	15	60	19	01
OTHER PRINCIPAL ARTERIAL												
% OF MILEAGE	99	01	00	00	06	02	05	00	01	46	38	01
% OF TRAVEL	100	00	00	00	03	01	03	00	03	55	31	04
MINOR ARTERIAL												
% OF MILEAGE	97	03	00	00	23	01	03	02	08	25	30	03
% OF TRAVEL	99	01	00	00	13	01	03	02	10	37	29	05
MAJOR COLLECTOR												
% OF MILEAGE	74	25	02	00	40	00	00	15	08	21	10	05
% OF TRAVEL	91	08	00	00	15	00	00	27	13	23	10	13
MINOR COLLECTOR												
% OF MILEAGE	32	67	01	00	39	00	00	07	13	17	18	05
% OF TRAVEL	55	44	00	00	17	00	00	17	18	25	18	04

* * * * * * * * * * SAFETY * * * * * * * * * *

	LANE WIDTH: <9	9	10	11	>11	CROSS SECTION: UNDIVIDED	DIVIDED ACCESS CONTROL: NONE	PARTIAL	FULL
INTERSTATE									
% OF MILEAGE	00	00	00	00	100	00	00	00	100
% OF TRAVEL	00	00	00	00	100	00	00	00	100
OTHER PRINCIPAL ARTERIAL									
% OF MILEAGE	00	04	02	04	89	31	03	07	59
% OF TRAVEL	00	02	01	03	94	22	05	13	61
MINOR ARTERIAL									
% OF MILEAGE	00	19	14	10	57	80	00	19	01
% OF TRAVEL	00	11	08	09	73	63	01	35	02
MAJOR COLLECTOR									
% OF MILEAGE	11	21	18	07	43	98	00	02	00
% OF TRAVEL	02	12	15	10	61	94	01	04	00
MINOR COLLECTOR									
% OF MILEAGE	25	18	03	01	53	100	00	00	00
% OF TRAVEL	11	08	03	01	77	98	00	02	00

1/ INCLUDES ONLY PAVED MILEAGE AND TRAVEL.

RURAL

MILES AND COST BY IMPROVEMENT TYPE
AND YEAR OF IMPROVEMENT
(COSTS IN MILLIONS)

ANALYSIS PERIOD: 1995 TO 2000

OTHER PRINCIPAL ARTERIALS

	1995-1995		1996-1996		1997-1997		1998-1998		1999-2000		TOTAL	
	MILES	COST	MILES	COST	MILES	COST	MILES	COST	MILES	COST	MILES	COST
RECONSTRUCT TO FREEWAY	187	771	2	7	0	0	12	38	13	43	215	860
RECONSTRUCT W/MORE LANES	43	154	0	0	0	0	0	0	0	0	43	154
RECONSTRUCT W/WIDER LANES	5	9	0	0	0	0	0	0	0	0	5	9
RECONSTRUCT AS IS	0	0	0	0	0	0	0	0	0	0	0	0
ISOLATED RECONSTRUCTION	0	0	0	0	0	0	0	0	0	0	0	0
MAJOR WIDENING(ADD LANES)	51	171	0	0	12	50	2	8	3	8	68	237
MINOR WIDENING	0	0	0	0	0	0	0	0	5	3	5	3
RESURFACING W/SHLDR. IMP.	0	0	0	0	0	0	0	0	0	0	0	0
RESURFACING	0	0	0	0	0	0	0	0	4	1	4	1
PAVEMENT RECONSTRUCTION	14	18	0	0	0	0	0	0	0	0	14	18
NO IMPROVEMENT	0	0	0	0	0	0	0	0	0	0	1127	0
TOTAL	301	1123	2	7	12	50	14	46	25	56	1481	1281

192.1 MILES INCLUDED IN THE TABLE ABOVE HAVE CAPACITY-RELATED DEFICIENCIES WHICH CANNOT BE CORRECTED DUE TO WIDENING LIMITATIONS.

ANY IMPROVEMENT WITH AN IMPROVEMENT YEAR LESS THAN THE CALENDER YEAR IS BACKLOG.

RECONSTRUCT AS IS INCLUDES MILEAGE WITH CAPACITY DEFICIENCIES WHICH CANNOT BE CORRECTED DUE TO WIDENING RESTRICTIONS.

PAVEMENT RECONSTRUCTION INCLUDES MILEAGE WHERE THE PAVEMENT REQUIRED RECONSTRUCTION, UNPAVED MILEAGE TO PAVED OR FOR RURAL ALIGNMENT INTOLERABLE & PAVEMENT REQUIRED RECONSTRUCTION.

APPENDIX D

STATE TRANSPORTATION AGENCY HPMS CONTACT PERSONS

State	Contact	Telephone Number
Alabama	Harold Nabors	(205) 261-6420
Alaska	Les Lutchansky	(907) 465-3900
Arizona	Robert Ohnleiter	(602) 255-7893
Arkansas	Minnie Beth Delavera	(501) 569-2246
California	Lee Ballard	(916) 322-6032
Colorado	Charles Gibson	(303) 757-9277
Connecticut	Jack Bonfoey	(202) 666-7226
Delaware	Robert Shiuh	(302) 736-3164
Florida	David Runyan	(904) 488-4827
Georgia	Scott Harris	(404) 656-6034
Hawaii	Vern Nakamura	(808) 548-3827
Idaho	Kieth Longenecker	(208) 334-2580
Illinois	Ray Caldieraro	(217) 785-2795
Iowa	Gordon Peterson	(515) 239-1354
Indiana	Larry Scott	(317) 232-5533
Kansas	Glen Anschultz	(913) 296-3841
Kentucky	Mohammed Taqui	(502) 564-7183
Louisiana	Carl Rasco	(504) 342-7792
Maine	Gillis Gilbert	(207) 289-2942
Maryland	Thomas Newman	(301) 659-1369
Massachusetts	Phillip Hughes	(617) 727-4910
Michigan	Kenneth Johnson	(517) 373-2236
Minnesota	William Strand	(612) 296-1658
Mississippi	Lowell Livingston	(601) 354-7172
Missouri	James Summer	(314) 751-2551
Montana	Robert Keck	(406) 444-6120
Nebraska	Jerry Miller	(402) 473-4670
Nevada	Gene McDowell	(702) 885-3447
New Hampshire	James Langley	(603) 271-3344
New Jersey	Louis Whittey	(609) 295-5251
New Mexico	Robert Marris	(505) 983-0325
New York	David FiField	(518) 457-2811
North Carolina	Charles Atkins	(919) 733-3141
North Dakota	Robert O'Chesky	(701) 224-2512
Ohio	Charles Groves	(614) 466-4224
Oklahoma	Jerry Cannedy	(405) 521-2175
Oregon	Robert Blensly	(503) 378-8272
Pennsylvania	George Wass	(717) 727-5123
Rhode Island	Tony Winiarski	(401) 277-2694
South Carolina	Phillip Ross	(803) 758-3001
South Dakota	Dean Schoefield	(605) 773-3265
Tennessee	Kenneth Arnold	(615) 741-1816
Texas	Ben Barton	(512) 465-7493
Utah	Ronald Delis	(801) 965-4351
Vermont	Wayne Gilman	(802) 828-2676
Virginia	Bruce Clark	(804) 786-7354

State	Contact	Telephone Number
Washington	Isau Nakagawara	(206) 753-6100
West Virginia	Joseph Martin	(304) 348-3165
Wisconsin	John Pamperin	(608) 267-7755
Wyoming	Lee Garrett	(307) 777-4180

APPENDIX E

SUMMARY OF THE STATE TRANSPORTATION AGENCY HPMS QUESTIONNAIRE RESPONSES

1. When did the STA begin submitting HPMS data to the FHWA?

   1978; 32 by 1980; 12 after 1980; 3

   (Additionally, three states were uncertain as to what the first submittal year was.)

2. Data collection and submittal.

   A. What is the source of the HPMS data submitted?

      state data files; 47 other sources; 3

      (In addition, 21 states are using local sources to augment state files.)

   B. Are any of these data being estimated?

      yes; 32 no; 18

   C. Did HPMS require the development of new or modified data collection procedures?

      yes; 36 no; 14

      - local agency data

      - special new state field surveys

      - new formatting or data basis

   D. Did the HPMS result in a change in the way the state stores its own data base?

      yes; 4 no; 46

      (HPMS has typically necessitated the creation of new programs to select out submittal data from automated data files.)

   E. Does the state maintain a separate or combined data base for its own and HPMS uses?

      separate; 33 combined; 17

      (Four states are currently developing a combined data base.)

F. Is there any discussion of using the HPMS system for state data base management?

yes; 4 (have already done so) no; 30

have a similar system; 7 potentially, in the future; 9

3. A. Has the state acquired the analytical package?

yes; 37 no; 13

B. Do you intend to acquire the package?

yes; 1 no; 12

4. A. Is the analytical package being used?

yes; 9 no; 28

B. Are there plans to use the analytical package?

yes; 19 no; 9

5. What types of uses are seen for the analytical package? (See main text on pages 28-29.)

6. Has the state experienced any major problems in supplying the HPMS data or using the analytical package?

yes; 39 no; 11

General problems cited:

- local system data acquisition; 14
- capital cost data (local & state); 9
- geometric data (esp. curves and grades); 8
- funding and staff; 8
- accident data (basis of data); 7
- continual FHWA changes; 7
- compatibility of computer systems; 5
- timing of annual submittals; 4

7. Has the HPMS in fact reduced or simplified the STA's data reporting responsibilities to the FHWA?

yes; 9 no; 29 potentially; 12

8. Are the HPMS data being used for any of your state transportation activities, e.g., statewide plans or needs studies?

yes; 15 no; 35

In what ways?

- policy analyses

- revenue/tax structure

- pavement management

- programming

- planning

- needs studies

- data base

- verification of other data

- responding to data requests from outside the STA

APPENDIX F

VIRGINIA DEPARTMENT OF HIGHWAYS AND TRANSPORTATION'S CURRENT DATA NEEDS AND USES SURVEY QUESTIONNAIRE

QUESTIONNAIRE ON CURRENT DATA NEEDS

Division/District____________________ Name__________________________

Telephone No.__________________

Instructions: Complete the information on the attached sheets for those data items which your division or district uses in its day-to-day operations. For those items used, please indicate the source of the data (e.g., road inventory, special studies, in-house calculations, etc.), basis of the data (e.g., by link, by project, by system, by area, etc.), and a brief explanation of how the data item is used. Many data items have likely been omitted; therefore, please add these on the last page and furnish the requested information. ; Should you have any questions, please contact Gene Arnold at SCATS 745-1931. Thank you in advance for your assistance.

Data Item	Source of Data	Basis of Data	How are data used?
Surface Width			
Shoulder Width			
Surface and Base Type			
Kind of highway; e.g., 4-lane divided no access control			
Annual ADT			
System			
Roadway Operation			
Functional Classification			
Lane Width			
Approach Width			
Shoulder Type			
Median Type			
Median Width			
Widening Feasibility			
Horizontal Align adequacy			
Vertical Align adequacy			

Data Item	Source of Data	Basis of Data	How are data used?
% Passing Sight Distance	______	______	______
Speed Limit	______	______	______
Avg. Highway Speed	______	______	______
Signal Type	______	______	______
% Green Time	______	______	______
Parking Description	______	______	______
Terrain Type	______	______	______
Development Type	______	______	______
Urban Location; e.g., CBD	______	______	______
No. Grade-Separated Interchanges	______	______	______
No. at-Grade Interchanges:			
With Signals	______	______	______
With Stop Signs	______	______	______
With no Control	______	______	______
No. Commercial Access Points	______	______	______
No. Structures	______	______	______
No. at-Grade RR Crossings	______	______	______
Improvement Type	______	______	______
Pavement Description	______	______	______

Data Item	Source of Data	Basis of Data	How are data used?
Structural number (SN)			
Slab Thickness (D)			
Pavement Condition			
Skid Resistance			
ROW Width			
% Trucks			
K-Factor/design hour volume			
Directional Factor			
Capacity			
Future Annual ADT			
Drainage Adequacy			
Curves by Class			
Grades by Class			
Improvement Cost			
Population			
Land Area			
Daily VMT			
Road Mileage			

Data Item	Source of Data	Basis of Data	How are data used?
No. Injury Accidents			
No. Persons Injured			
No. Pedestrians Injured			
No. Veh. by Functional Class			
Peak-Hour Volume			
Travel Time			
Occupancy			
High Water Information			
Highway Lighting			
Sign Inventory			
Wayside/Historical Markers			

OTHER DATA ITEMS USED:

Data Item	Source of Data	Basis of Data	How are data used?

APPENDIX G

SUMMARY OF THE RESPONSES TO THE THE VIRGINIA DEPARTMENT OF HIGHWAYS AND TRANSPORTATION CURRENT DATA NEEDS AND USES SURVEY

TABLE G-1

SOURCES OF DATA

DATA ITEM \ SOURCE	ROAD INVENTORY	BRIDGE INVENTORY	RAILWAY INVENTORY	HIGH WATER INVENTORY	SIGN INVENTORY	SIGNAL INVENTORY	PAVEMENT DATA SYSTEM	OUTDOOR ADVER. LOG	GRAPHIC ROUTE LOG	CARD FILE	MILEAGE TABLES	ACCIDENT SUMMARIES	BRIDGE INSPECT. REPORT	WET ACCIDENT REPORT	BRIDGE REPLAC. LIST	CONSTRUCTION PLANS	TRAFFIC COUNTS	SPECIAL STUDIES	FIELD SURVEY	CALCULATIONS	ESTIMATES	U. S. CENSUS
SURFACE WIDTH	10						1		2		1					2			6			
SHOULDER WIDTH	10										1					2			6			
SURFACE & BASE TYPE	10						2		1		1					2			4			
KIND OF HIGHWAY	8						1		3		1					3			4			
ANNUAL ADT	2																12		1			
SYSTEM	10						2										1					
ROADWAY OPERATION																						
FUNCTIONAL CLASS	11																					
LANE WIDTH	10								2							2			6			
APPROACH WIDTH	5	2							1	1			2			2			4			
SHOULDER TYPE	5								1	1						3			4			
MEDIAN TYPE	6								3	1						3			4			
MEDIAN WIDTH	6								3	1						3			4			
WIDENING FEASIBILITY	5								2							3		1	4	1		
HORIZONTAL ALIGN. ADEQUACY	5															3		1	5	1		
VERTICAL ALIGN. ADEQUACY	5															4		1	6	1		
% PASSING SIGHT DISTANCE	2																	2	4	1		
SPEED LIMIT	3								2	1								2	4	1		
AVERAGE SPEED (HWY)	3															2		1	2		1	
SIGNAL TYPE	1					1			1	1	1							1	2			
% GREEN TIME						1												1	2	1		
PARKING DESCRIPTION	2																	1	4			
TERRAIN TYPE	5																	1	5			

Table G-1 cont.

ATA ITEM / SOURCE	ROAD INVENTORY	BRIDGE INVENTORY	RAILWAY INVENTORY	HIGH WATER INVENTORY	SIGN INVENTORY	SIGNAL INVENTORY	PAVEMENT DATA SYSTEM	OUTDOOR ADVER. LOG	GRAPHIC ROUTE LOG	CARD FILE	MILEAGE TABLES	ACCIDENT SUMMARIES	BRIDGE INSPECT. REPORT	WET ACCIDENT REPORT	BRIDGE REPLAC. LIST	CONSTRUCTION PLANS	TRAFFIC COUNTS	SPECIAL STUDIES	FIELD SURVEY	CALCULATIONS	ESTIMATES	U. S. CENSUS
'ELOPMENT TYPE	2																	1	4	1		
AN LOCATION																		1	2		1	
. GRADE SEPARATED INTERSECTIONS	3								1							2			3			
. AT-GRADE INTERSECTIONS																						
WITH SIGNALS	3								2							3			3			
WITH STOP SIGNS	3								2							3			3			
WITH NO CONTROLS	1								2							3			3			
. COMMERCIAL ACCESS POINTS	2								2							2			3			
. STRUCTURES	1	3							2				3			1			2			
. AT-GRADE RAILWAY CROSSINGS	1		3						4							1			2			
PROVEMENT TYPE	1															2			1			
VEMENT DESCRIPTION	8						1		1							1			1			
RUCTURE NUMBER (SN)	1	2												1	1							
AB THICKNESS (D)	1	1					3									2						
VEMENT CONDITION	2						2												3	1		
ID RESISTANCE	2																	3				
O.W. WIDTH	3															8			4			
TRUCKS																1	11					
FACTOR/DESIGN HOUR VOLUME																	5			2		
RECTIONAL FACTOR	1																4			2		
PACITY																1	2			5	1	
TURE ANNUAL ADT																3	3			6		
AINAGE ADEQUACY	4																	1		3		

Table G-1 cont.

DATA ITEM \ SOURCE	ROAD INVENTORY	BRIDGE INVENTORY	RAILWAY INVENTORY	HIGH WATER INVENTORY	SIGN INVENTORY	SIGNAL INVENTORY	PAVEMENT DATA SYSTEM	OUTDOOR ADVER. LOG	GRAPHIC ROUTE LOG	CARD FILE	MILEAGE TABLES	ACCIDENT SUMMARIES	BRIDGE INSPECT. REPORT	WET ACCIDENT REPORT	BRIDGE REPLAC. LIST	CONSTRUCTION PLANS	TRAFFIC COUNTS	SPECIAL STUDIES	FIELD SURVEY	CALCULATIONS	ESTIMATES	U. S. CENSUS
URVES BY CLASS	1															2			1	1		
RADES BY CLASS	1															2			1	1		
MPROVEMENT COST																				4	9	
OPULATION																						7
AND AREA																						
AILY VMT																	2			2		
OAD MILEAGE	5								2		2											
IO. INJURY ACCIDENTS	1											10										
IO. PERSONS INJURED	1											9										
IO. PEDESTRIANS INJURED	1											7										
IO. VEHICLES BY FUNCTIONAL CLASS																	4					
EAK-HOUR VOLUME																	4		4			
RAVEL TIME																		1	1			
CCUPANCY																		1				
IGH/WATER INFORMATION*	3			1															5			
IGHWAY LIGHTING*																1			3			
IGN INVENTORY*					2					1						2	1		3			
AYSIDE/HISTORICAL MARKERS*					1			1														
ORIZONTAL UNDER CLEARANCE																			1			
ERTICAL CLEARANCE																			1			
RIDGE SKEW																1						
OTALS	178	8	3	1	3	2	12	1	39	7	6	26	5	1	1	75	49	20	135	34	12	7

*Items not included in the HPMS Data Base

TABLE G-2

BASIS OF DATA

DATA ITEMS \ BASIS	LOCATION SPECIFIC	ROUTE	SYSTEM	DISTRICT	STATEWIDE
RFACE WIDTH	13		2		
OULDER WIDTH	12		2		
RFACE & BASE TYPE	11		1		
ND OF HIGHWAY	12		2		
NUAL ADT	14		2		
STEM	9		3		
ADWAY OPERATION					
NCTIONAL CLASS	9		4		
NE WIDTH	10		2		
PROACH WIDTH	7		1		
OULDER TYPE	9		1		
DIAN TYPE	8		1		
DIAN WIDTH	8		1		
DENING FEASIBILITY	10				
RIZONTAL ALIGN. ADEQUACY	11				
RTICAL ALIGN. ADEQUACY	9				
PASSING SIGHT DISTANCE	7		1		
EED LIMIT	8				
ERAGE SPEED (HWY)	6				
GNAL TYPE	5				
GREEN TIME	4				
RKING DESCRIPTION	4		1		
RRAIN TYPE	8				

Table G-2 cont.

DATA ITEMS \ BASIS	LOCATION SPECIFIC	ROUTE	SYSTEM	DISTRICT	STATEWIDE
EVELOPMENT TYPE	9	1			
RBAN LOCATION	4				
O. GRADE SEPARATED INTERSECTIONS	7		2		
O. AT-GRADE INTERSECTIONS					
WITH SIGNALS	6		1		
WITH STOP SIGNS	6		1		
WITH NO CONTROLS	6		1		
O. COMMERCIAL ACCESS POINTS	5				
O. STRUCTURES	8				
O. AT-GRADE RAILWAY CROSSINGS	11				
MPROVEMENT TYPE	8		1		
AVEMENT DESCRIPTION	7		1		
TRUCTURAL NUMBER (SN)	8		1		
LAB THICKNESS (D)	6		1		
AVEMENT CONDITIONS	6		1		
KID RESISTENCE	5		1		
.O.W. WIDTH	9		1		
TRUCKS	9		1		
-FACTOR/DESIGN HOUR VOLUME	5				
IRECTIONAL FACTOR	6				
APACITY	7				
UTURE ANNUAL ADT	9		1		
RAINAGE ADEQUACY	5				

Table G-2 cont.

BASIS / TA ITEMS	LOCATION SPECIFIC	ROUTE	SYSTEM	DISTRICT	STATEWIDE
VES BY CLASS	3				
DES BY CLASS	3				
ROVEMENT COST	9				
ULATION	4			1	1
D AREA	2			1	1
LY VMT	4				
D MILEAGE	5			1	1
INJURY ACCIDENTS	9		3		
PERSONS INJURED	8		3		
PEDESTRIANS INJURED	8		3		
VEHICLES BY FUNCTIONAL CLASS	4				
K-HOUR VOLUME	6		1		
VEL TIME	2				
UPANCY	1				
H/WATER INFORMATION*	4		1		
HWAY LIGHTING*	3				
N INVENTORY*	5		2		
SIDE/HISTORICAL MARKERS*		1	1		
IZONTAL UNDER CLEARANCE*	1				
TICAL CLEARANCE*	1				
DGE SKEW*	1				
ALS	430	2	52	3	3

EMS NOT INCLUDED IN THE HPMS DATA BASE

Table G-3

USES OF DATA

DATA ITEMS \ Use	PROJECTS	INVENTORIES	BUDGET/PROGRAMMING	PAVEMENT MANAGEMENT	PLANNING	SPECIAL STUDIES	ACCI/SAFETY ANALYSIS	TRAFFIC ANALYSIS	PERMITS	WORK SCHEDULING
SURFACE WIDTH	12	4	4	1	1		3		3	1
SHOULDER WIDTH	11	1	3		1		3		2	1
SURFACE & BASE TYPE	11	2	2	1	1		2		1	1
KIND OF HIGHWAY	10	2	3	1	1		1	1	2	1
ANNUAL ADT	12	3	5	1	1		1	1	1	
SYSTEM	7	2	3	1			1	1	1	1
ROADWAY OPERATION							1			1
FUNCTIONAL CLASS	11	2	2		1			1		1
LANE WIDTH	11		2	1	1		1		1	
APPROACH WIDTH	7	1			1		2	1		
SHOULDER TYPE	7	1	2							
MEDIAN TYPE	9		1		1		1			
MEDIAN WIDTH	9		2		1		1			
WIDENING FEASIBILITY	10		1		1					
HORIZONTAL ALIGN. ADEQUACY	11		1		1					
VERTICAL ALIGN. ADEQUACY	11		1		1					
% PASSING SIGHT DISTANCE	8		1		1		1	1		
SPEED LIMIT	7	1	1		1	1				
AVERAGE SPEED (HWY)	6		1		1					
SIGNAL TYPE	4				1	1	1			
% GREEN TIME	4				1		1			
PARKING DESCRIPTION	3				1		1	1		
TERRAIN TYPE	7				1		1			

Table G-3 cont.

USE / DATE ITEMS	PROJECTS	INVENTORIES	BUDGET/PROGRAMMING	PAVEMENT MANAGEMENT	PLANNING	SPECIAL STUDIES	ACCI/SAFETY ANALYSIS	TRAFFIC ANALYSIS	PERMITS	WORK SCHEDULING
VELOPMENT TYPE	7	1	1		1		1	1		
BAN LOCATION	2				1		1	1		
. GRADE SEPARATED INTERSECTIONS	4	1			1		1	1		
. AT-GRADE INTERSECTIONS										
WITH SIGNALS	5	1			1	1	1	1		
WITH STOP SIGNS	5	1			1		1	1		
WITH NO CONTROLS	5	1			1		1			
. COMMERCIAL ACCESS POINTS	5	1			1		1			
. STRUCTURES	6	1			1		1	1		
. AT-GRADE RAILWAY CROSSINGS	7	1	1		1		2	1		
PROVEMENT TYPE	4	1					1	1		
VEMENT DESCRIPTION	4	1	1		2		1			
RUCTURE NUMBER (SN)	6		2		1					
AB THICKNESS (D)	4			2						
VEMENT CONDITION	4		1	1	1					
ID RESISTENCE	3				1		2			
O.W. WIDTH	11				1					
TRUCKS	9	1			1			1		
FACTOR/DESIGN HOUR VOLUME	5				1					
RECTIONAL FACTOR	6				1			1		
PACITY	7				1			1		
TURE ANNUAL ADT	8				1			1		
AINAGE ADEQUACY	7							1		

Table G-3 cont.

DATA ITEMS \ USE	PROJECTS	INVENTORIES	BUDGET/PROGRAMMING	PAVEMENT MANAGEMENT	PLANNING	SPECIAL STUDIES	ACCI/SAFETY ANALYSIS	TRAFFIC ANALYSIS	PERMITS	WORK SCHEDULING
CURVES BY CLASS	3							1		
GRADES BY CLASS	3									
IMPROVEMENT COST	8	1								
POPULATION	3		2							
LAND AREA	1		2		1					
DAILY VMT	2									
ROAD MILEAGE	4	1	4					1		
NO. INJURY ACCIDENTS	4	2	1		1		2			
NO. PERSONS INJURED	4	1	1		1		2			
NO. PEDESTRIANS INJURED	5	1	1		1		1			
NO. VEHICLES BY FUNCTIONAL CLASS	3				1					
PEAK-HOUR VOLUME	4				1			1		
TRAVEL TIME	3									
OCCUPANCY	1									
HIGH/WATER INFORMATION *	5									
HIGHWAY LIGHTING*	2	1								
SIGN INVENTORY*	6	2								
WAYSIDE/HISTORICAL MARKERS*	2									
HORIZONTAL UNDER CLEARANCE*										1
VERTICAL CLEARANCE*										1
BRIDGE SKEW*										1
TOTALS	375	39	52	9	46	3	41	23	11	10

*ITEMS NOT INCLUDED IN THE HPMS DATA BASE