HPMS Reassessment 2010+

Final Report

Prepared by:
Office of Highway Policy Information
Federal Highway Administration

September 2008

HPMS Reassessment 2010+

Final Report

Prepared by:

Office of Highway Policy Information
Federal Highway Administration

Date:

September 2008

Table of Contents

EXECUTIVE SUMMARY **1**

1.0 INTRODUCTION **5**

2.0 BACKGROUND **7**

2.1 HIGHWAY PERFORMANCE MONITORING SYSTEM (HPMS) 7
2.2 REASSESSMENT 11
2.3 USES OF HPMS DATA 14

3.0 STAKEHOLDER INPUT **19**

3.1 DESCRIPTION OF INPUT PROCESS 19
3.2 SUMMARY OF INPUT 19

4.0 DATA CHANGES **25**

4.1 STRUCTURE OF HPMS 26
4.2 DATA ITEMS 33
4.3 DATA QUALITY AND PROCESS IMPROVEMENT 37
4.4 SUMMARY OF DATA CHANGES 39
4.5 HPMS DATA OVERVIEW 44
4.6 SAMPLE DATA 48

5.0 IMPACTS OF REASSESSMENT **53**

5.1 OVERVIEW 53
5.2 ANALYSIS OF HPMS ITEMS RECOMMENDED FOR CHANGE 54
5.3 HPMS ITEMS RECOMMENDED FOR ADDITION 55
5.4 FUNDING THE CHANGES TO HPMS 55

6.0 NEXT STEPS **57**

APPENDIX A: ACRONYMS AND ABBREVIATIONS **59**

APPENDIX B: DEFINITIONS **61**

APPENDIX C: REGIONAL WORKSHOP SUMMARY **69**

APPENDIX D: ISSUE PAPERS **71**

PAVEMENT-RELATED DATA ISSUES 71
FREIGHT RELATED DATA ISSUES 71
CAPACITY RELATED DATA ISSUES FOR HPMS REASSESSMENT 71
BOUNDARIES AND FUNCTIONAL CLASSIFICATION 71
PROCESS IMPROVEMENT BACKGROUND PAPER 71
DATA QUALITY BACKGROUND PAPER 71
NEW DATA MODEL 71
SAMPLING BACKGROUND ISSUE PAPER 71

Executive Summary

Since late 2005, The Highway Performance Monitoring System (HPMS) has undergone a Reassessment to ensure it best meets the needs of its users and customers in 2010 and beyond. The Reassessment was intended to respond to current and future business needs, address any new data needs in the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) legislation, capitalize on changing technology and where possible address resource constraints and institutional changes.

Purpose of the *HPMS Final Report*

This report summarizes the changes to HPMS. The goals of this report are to:

- Indicate a picture of HPMS in 2010;
- Summarize data additions, deletions, and changes;
- Explain why these data are needed and how they will be used;
- Address questions and concerns raised by States and others in response to the issuance of the draft Recommendations Report in January 2007; and
- Quantify the impact and subsequent cost of the HPMS changes.

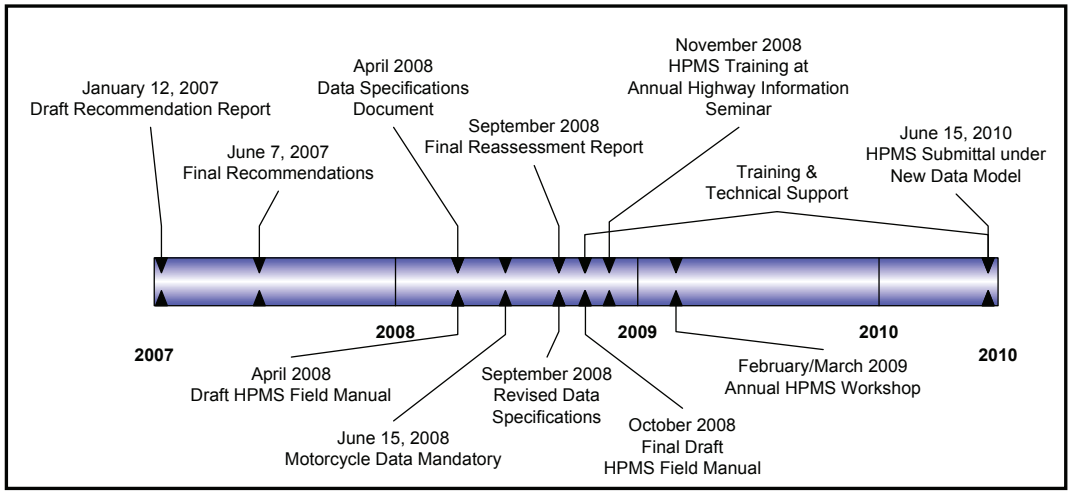
This report is one of three documents describing the Reassessment and the subsequent changes to HPMS.

Other Related HPMS Reassessment 2010+ Documents

The *HPMS Data Specifications* document describes in detail where HPMS data are required; the frequency of data collection; data collection and reporting standards; and, any applicable metadata.

The *HPMS Field Manual* describes in detail the collection and reporting requirements; provides descriptions and examples for the data items; and provides more detail on internal processes such as the sample adequacy procedures and the determination of sampling confidence intervals.

HPMS Reassessment Timeline



From the inception of the Reassessment, FHWA undertook a very open, interactive approach. Major emphasis has been directed towards determining the data needs of FHWA's partners, stakeholders, and customers, as well as the various uses of the existing HPMS, as well as the ability of data providers to support these data needs.

HPMS 2010+ has been refined to eliminate some no longer needed data items; include new ones to ensure that appropriate needs especially in the pavement area, can be adequately addressed; and feature a geographic data model that allows for more efficient reporting of HPMS for both data collectors and users.

The HPMS changes can be classified into three broad categories: structure, data items, and data quality/process improvement. The following summarizes the recommended changes:

- **Federal Needs:** The Federal needs for HPMS require that a number of items be changed and additional items be added.
  - **Pavement:** Critical information on pavement conditions is being added so the National assessment of pavement condition will be more comprehensive and more analogous to the pavement condition analyses performed by state and regional agencies. This will give Congress and the highway community a more thorough representation of the condition of the Nation's highways.
  - **Legislation:** SAFETEA-LU requires an extensive evaluation of safety data needs to meet the new Safety requirements in the legislation. The new safety data needs will be developed cooperatively with HPMS to assure consistency.
  - **EPA:** The Environmental Protection Agency (EPA) Air Quality Conformity regulations specify that HPMS estimates of VMT shall be considered as the primary measure of VMT within the nonattainment or maintenance area where Conformity must be determined. [40 CFR 93.122 (b)(3)]

- **New Data Model:** A new data model has been developed for the structure of HPMS which will allow for geographic locating, analysis, comparison, and reporting of data.
- **Data reporting schedule:** The only change to take affect before 2010 is the reporting of motorcycle travel data, which are to be implemented immediately for reporting in June 2008. Except for functional class and a few phased data items, reporting of the remaining data items are mandatory in June 2010. Functional class changes can begin immediately, but will not be mandatory until June 2013.
- **Interchanges & ramps:** Of the data pertaining to interchanges and ramps. FHWA will collect the three data items for interchanges; States will be responsible for collecting the five data items for ramps.

While the total number of data items in HPMS are essentially the same, the number of data items that States will need to report for each section has decreased. In the new HPMS, the software will calculate 23 data items compared to 11 in the current software. Furthermore, FHWA will provide 6 data items, where previously it didn't provide any. The following table shows the distribution of data items in the current and new HPMS.

Data Sources in the Current and New HPMS

Data Source	Current HPMS	New HPMS
State Provided	87	68
Software Calculated	11	23
FHWA Provided	0	6
Total	**98**	**97**

The revision of this document in 2007 and 2008 parallels the efforts to revise the *HPMS Field Manual* and the *Highway Functional Classification: Concepts, Criteria, and Procedures* documents, and the new *HPMS Data Specifications* document. Both the *Data Specifications* and *Field Manual* were released as draft documents in February and March 2008, respectively.

The "final" *Data Specifications* is expected in September 2008. The *HPMS Data Specifications* will be a dynamic document that continually changes with HPMS.

The revision of the *HPMS Field Manual* began in earnest in December 2007. This has been a cooperative effort between the Office of Highway Policy Information, FHWA, a number of State DOTs, and several FHWA Division Offices. The draft version of the document released in March 2008 will be replaced by a final draft in the fall of 2008 and ultimately the final version in December 2008.

1.0 Introduction

The availability of accurate, representative national transportation data is critical to informing decisions across all levels of transportation agencies. The Highway Performance Monitoring System (HPMS) is a key national transportation data program that provides highway inventory, condition, performance, and operating characteristics data to national, state, and regional customers. Examples of the type of data available through HPMS include pavement condition and travel by vehicle type. It is used at the national level for apportionment, performance measures, highway statistics, and conditions reporting.

The goal of the HPMS Reassessment has been to ensure it best meets the needs of its users and customers in 2010 and beyond. The Reassessment was intended to respond to current and future business needs, address new data needs in the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) legislation, capitalize on changing technology and, where possible, address resource constraints and institutional changes.

The Reassessment process began in late 2005 and will conclude with the release of this report in the fall of 2008. Critical to the success of the Reassessment has been the ongoing communication and coordination with both HPMS users and State data collectors. The outreach conducted has been extensive and resulted in an evolutionary development of recommendations related to proposed changes to the HPMS database and process.

This report summarizes the Reassessment changes and is organized as follows:

- **Background of HPMS –** This section contains a brief history of HPMS, describes the mission and goals, and highlights the contents and use of the database. It also refers to previous Reassessments and highlights the purpose of this Reassessment.
- **Stakeholder Input –** This section documents the meetings and outreach that have occurred. Comments and concerns in response to the draft report are addressed throughout this report.
- **Data Changes –** Early in the Reassessment, ten detailed Issue papers were written, which were then revised and summarized in the January 2007 draft of this report. This section summarizes the data changes.
- **Impacts of the Reassessment –** This section describes the potential impacts of the Reassessment. Direct impacts resulting from data collection changes, when provided by States, are summarized and used to provide an estimate of the cost to States to implement these changes.
- **Next Steps –** This section describes the remaining HPMS efforts that have already begun, in response to the Reassessment changes, and will continue through the submittal of the new, revised and dropped HPMS data items starting in June 2010.

2.0 Background

2.1 HIGHWAY PERFORMANCE MONITORING SYSTEM (HPMS)

2.1.1 History of HPMS

The HPMS was developed in 1978 as a national highway transportation system database. In its current configuration, it includes limited data on all public roads, more detailed data for a sample of the arterial and collector functional systems, and area-wide summary information for urbanized, small urban, and rural areas. The HPMS replaced numerous uncoordinated annual state data reports as well as biennial special studies conducted by each state. These special studies had been conducted to support a 1965 Congressional requirement that a report on the Nation's highway needs be submitted to Congress every two years. The first such *Conditions and Performance Report* was compiled in 1968. The first report to make use of the HPMS database was the 1980 Conditions and Performance Report, which was forwarded to Congress in January 1981.

Providing a snapshot of highway conditions was another reason for the original development of HPMS. In the 1970s, FHWA discovered that it had to respond to Congressional inquiries about the status of the Nation's highways. HPMS provides a way to measure and track trends in highway characteristics, pavement conditions, and congestion at a national level.

The major purpose of the HPMS is to provide data that reflects the extent, condition, performance, use, and operating characteristics of the Nation's highways. To meet this primary objective, the HPMS has gone through an evolutionary process that has recognized over time the changing needs for data related to these purposes.

2.1.2 Mission and Goals of HPMS

It is the mission of the Highway Performance Monitoring System (HPMS), as an integral part of the Nation's suite of transportation databases, to provide a database and analysis process for assessing and reporting the extent, condition and performance of the Nation's highway system in the most cost-effective manner consistent with the following goals:

- Meet FHWA's highway stewardship responsibilities, including preserving the national interest in the NHS;
- Support Federal transportation policy analysis, planning, and performance measurement activities;
- Provide data for Apportionment formulae;

- Meet the various congressional requirements, including apportionment and the C&P report;
- Provide a publicly accessible, consistently high-quality, objective, and timely national highway database;
- Provide a database, analytical tools, and FHWA technical support that meets the needs of state, regional, and local agencies; and
- Evolve to a data system which:
  - Builds from the data systems of local, regional, and state governments;
  - Is connected with a common geo-referencing system; and
  - Avoids, whenever possible, collecting data which is not used by the collecting agency.

Appendix A contains a list of commonly used acronyms and abbreviations.

2.1.3 HPMS Description

The HPMS is a key national transportation data program that provides national-level highway inventory, condition, performance, and operating characteristics data to national, state, and regional customers. Examples of the type of data available through HPMS include pavement condition and travel by vehicle type.

There are three primary functions involved with HPMS: data collection, processing/reporting, and analyzing/applying. Although there is some overlap among functions, each function is primarily conducted by a different stakeholder group. Data collectors are state departments of transportation, metropolitan planning organizations, and local governments such as counties and cities. The processing and reporting of HPMS occurs within the FHWA Office of Highway Policy Information. Finally, users consist of a wide variety of customers, including U.S. DOT Federal Program Offices, other Federal agencies, U.S. Congress, states, MPOs, counties, and cities.

HPMS is used at the federal level for apportionment, performance measures, highway statistics and conditions reporting, and analytical models; it is one of the primary databases used by FHWA for conducting national-level surface transportation planning and policy studies. It is also used by a variety of state and local transportation agencies as well as other transportation interests. Some of these uses are extremely important for highway financing. For example, the biennial *Conditions and Performance Report (C&P)* to Congress documents future highway funding needs and HPMS-derived vehicle-miles traveled (VMT) estimates are used in the annual apportionment of Federal Aid highway funds to the states.

VMT estimation is probably the most ubiquitous use of HPMS – VMT is calculated and used at the national, state, and local levels. This is not surprising since the original primary intent of HPMS, when it was conceived in the late 1970s, was to provide a consistent basis for VMT estimation nationally. This is reflected in the sampling frame and the strong linkage to the *Traffic Monitoring Guide* for supplying traffic counts to HPMS.

The data also are used for assessing highway system performance under FHWA's strategic planning process. Pavement condition data, congestion-related data, and traffic data are used extensively by the Administration to measure FHWA's and the State's progress in meeting the objectives embodied in the Vital Few, FHWA's Performance Plan, and other strategic goals.

Over time, many applications have been developed that use HPMS as their source of data. These applications further demonstrate the utility of HPMS and have also put increasing demands on it. For example, the HERS model has become FHWA's tool for developing the highly visible *C&P Report* and the Freight Analysis Framework (FAF) is used extensively for estimating current and future freight movement at the national-level such as in the *Freight Facts and Figures* series.

In addition, the HPMS serves needs of the states, MPOs and local government, and other customers in assessing highway condition, performance, air quality trends, and future investment requirements. Some states rely on traffic and travel data from the HPMS to conduct air quality analyses and make assessments related to determining air quality conformity. Others are using the same analysis models used by FHWA to assess their own highway investment needs using HERS-ST, which is the state version of the HERS model used by FHWA. As a result of these uses, states have an additional stake in assuring the completeness and quality of these data.

Finally, these data are the source of a large portion of information included in FHWA's annual *Highway Statistics* and other media and publications. They are widely used in both the national and international arenas by other governments, transportation professionals, and industry professionals to make decisions that impact national and local transportation systems and our transportation dependent economy.

Table 2.1 summarizes the uses and users of HPMS.

Table 2.1.3 Users and Uses of HPMS Data

User Group	Type of Application	Description
FHWA	Forecasted highway investment needs and performance (user costs and impacts)	HPMS is the data source for the HERS model, which produces the information for the Biennial *Conditions and Performance Report* to Congress.
	Annual reporting of highway conditions	HPMS is the basis for much of the information produced in *Highway Statistics,* which includes trends in highway conditions, performance, and usage.
	Freight planning	HPMS data and the National Highway Planning Network are used by the Freight Analysis Framework for calibrating base year assignments and forecasting future freight flows.
	Special policy and planning studies	HPMS data are used in a variety of national studies every year. An example is 2004's *Traffic Congestion and Reliability Report.*
	Travel monitoring	HPMS is the official source of VMT estimates, which are used throughout FHWA and U.S. DOT. VMT from HPMS is a factor for allocating highway funds to the states.

	Public Road Mileage	HPMS data is the official source of roadway mileage by jurisdiction.
State DOTs	Forecasted highway investment needs and performance (user costs and impacts)	State-HERS is used by many states for investment planning.
Metropolitan Planning Organizations	Air quality conformity and planning	HPMS is used for local VMT estimation.
Texas Transportation Institute	National congestion monitoring	HPMS Universe data is the basis for the annual *Urban Mobility Study*.
Transportation Research and Interest Groups	Planning and policy analysis	HPMS is used by many transportation professionals to produce various reports, including AASHTO's "Bottom-line" reports, the Transportation Research Board's policy studies, and the American Highway Users Alliance bottleneck studies.

The FHWA OHPI is not involved directly in data collection but relies on State DOTs for HPMS Data. OHPI performs data quality checks, and provides technical support and software to ease reporting requirements. The fact that FHWA relies on other agencies to provide data is highly significant since FHWA must balance the needs of its users (internal and external) with the capabilities of its providers to provide data at a reasonable level of effort. The difference in views between data needs and collection capabilities is the crux of the issue addressed during the Reassessment. A large number of data issues were considered and explored, and the organization and prioritization of the issues from a user and provider standpoint are key elements of the Reassessment.

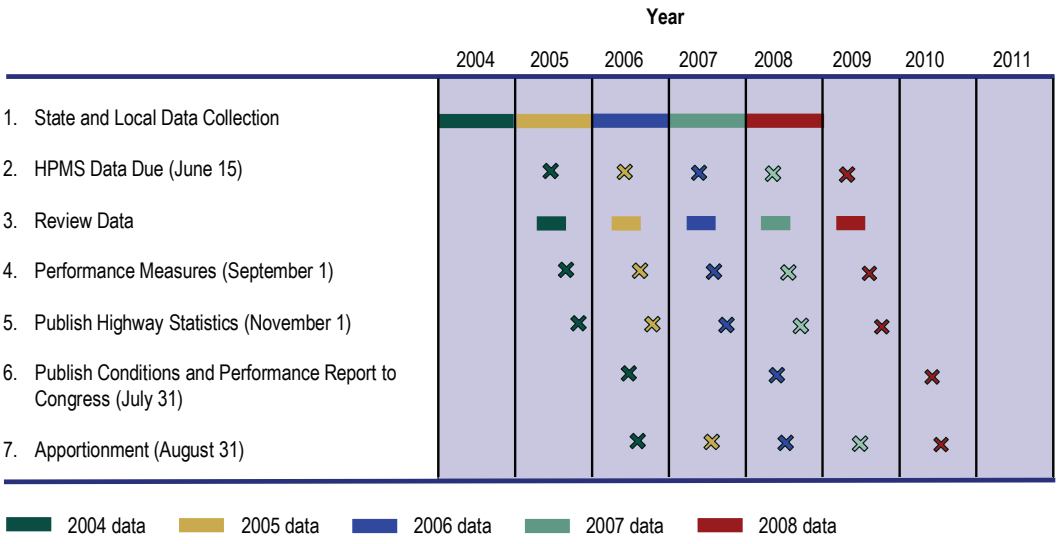
Several reference documents describing HPMS are located on the FHWA HPMS web site (http://www.fhwa.dot.gov/policy/ohpi/hpms/index.htm).

They include:

- *HPMS Field Manual*, May 2005, Office of Highway Policy Information, Federal Highway Administration; and
- *HPMS Primer – Overview of the HPMS for FHWA*, September 2006, Office of Highway Policy Information, Federal Highway Administration.

There is generally a lag between data collection in the field and the data showing up in a report. The following table indicates the timing of data collection and reporting.

Table 2.1.3 HPMS Timeline



2.2 REASSESSMENT

2.2.1 Background of HPMS Reassessments

The HPMS has been modified several times since its inception. Changes in coverage and detail have been made since 1978 to reflect changes in highway systems; legislation and national priorities; to reflect new technology; and to consolidate or streamline reporting requirements.

Recognizing that needs and capabilities change over time, FHWA initiated a periodic review process for HPMS many years ago ("Reassessment"). The Reassessment process considers what changes should be made to HPMS data elements and collection procedures, including:

- Should existing data elements be eliminated because they are not needed for most applications or because they are too onerous a burden on data collectors?
- Are new data elements needed to support current and emerging applications? If so, can they be prioritized or limited to certain functional systems?
- Should data elements be redefined (e.g., valid values) to match applications' needs?
- Should data be collected in a different manner (e.g., the factoring and reporting of traffic counts)?
- What changes in the sampling schema should be made? Are the minimum VMT-based sample sizes adequate for providing system-level estimates of other highway conditions?

The last Reassessment was completed in 1999 and utilized a comprehensive stakeholder outreach process. In 1999, there was some question as to the need for HPMS, whereas this Reassessment is being performed in an environment where HPMS is recognized as an important program that needs some modifications to accommodate changing technological and application needs.

2.2.2 Purpose of this Reassessment

The purpose of this Reassessment is to review the HPMS in light of contemporary issues and anticipated future needs. The reauthorization of the Federal-aid highway program, as contained in SAFETEA-LU, provided an appropriate opportunity for the FHWA to undertake a Reassessment of the HPMS. Other reasons to reexamine the HPMS are further advancements in technology, changes to state data requirements, increased use of performance measures, and changes in the various uses of HPMS data by government, academia, and the private sector.

The vision for this Reassessment is *for HPMS to meet the transportation community's data needs in 2010 and beyond.*

The mission is to *respond to current and future business needs, address new data needs in SAFETEA-LU, capitalize on changing technology and, where possible, address resource constraints and institutional changes.*

The objectives are to:

- Meet new Federal needs including but not limited to: Policy, Safety, Operations, and Infrastructure;
- Explore potential changes to HPMS to be more useful for most states and MPOs;
- Capitalize on changing technology to enhance quality, efficiency, and data integration; and
- Ensure data items meet all required needs (definitions/standardization/ change, new items, delete items.)

The process for this Reassessment was carefully planned and implemented to ensure consistency with the process used for the last Reassessment. It also was designed to address policy/institutional (state and national) issues, data collection, data analysis tools/applications, emerging issues (such as safety), and all other issues related to HPMS users and collectors.

The first phase of the Reassessment was to identify what needed to be changed in coordination with Federal agencies. The second phase was to work with stakeholders to identify how the needs can be met and balanced with collection requirements. The third phase is the implementation of the identified needs within the context of the new data model.

2.2.3 How HPMS Addresses National Transportation Data Needs

The Federal need for transportation data transcends functional classification, ownership, and jurisdiction. While functional class, ownership, and jurisdiction

are important categories, for which HPMS data are often summarized, they do not define the limits of FHWA's needs for these data. Each issue area explored in this reassessment has had to consider the differing Federal and state data needs, while weighing these needs against the states' ability (or willingness) to provide these data.

The ability to provide data, especially on roads not owned by the states (off-system), was often cited as being an area of concern. This was neither a surprise nor a new topic in the Reassessment; this has been a concern of the states since the inception of HPMS in 1978. However, to get a complete picture of the highway system in each state it has always been necessary for FHWA to have data on off-system roads.

The existing HPMS structure attempts to balance the need for off-system data with the States ability to provide these data, by dividing the HPMS data into three levels. Sample data are the most detailed, with each sample section being comprised of up to 98 data items. In the 2006 HPMS data, there are approximately 120,000 sample sections, with a total length of 137,000 miles. These sections represent approximately 980,000 miles of roads functionally classified from Interstate through (Major) Collector.

The next level is the universe data. Universe sections can contain a maximum of 46 data items on NHS sections, to a minimum of 28 data items on local roads. It should be noted that currently, most of the data on local roads are identification, system, jurisdictional, or ITS in nature. The "section length" data item is the only apportionment item (from these data) for local roads. Nationwide, there are approximately 1.13 million universe sections that represent all 4.012 million miles of public roads (2006 HPMS).

The final HPMS data level is the summary data. These data provide travel data for all functional systems, as well as the distribution of travel by six vehicle classes for all functional systems. Additional summary data are collected by urban/urbanized area, and for air quality non-attainment and maintenance areas.

These data are used individually or in combination to satisfy the various Federal data needs. The apportionment of Highway Trust Funds relies on all three data levels. Performance measures can use either the sample data alone or in combination with the universe data. Much of the HERS analysis for the C&P Report utilizes just sample data.

Key to the multilevel structure of HPMS is the national uses of these data; the quality of data; and the types of analyses performed using these data. The multilevel approach also helps compensate for variability between state transportation data collection efforts. States typically focus their data collection efforts on roads owned and maintained by the state. The following is from the 2006 HPMS data and illustrates the variability in state owned highway systems nationwide:

- The degree of state ownership ranges from a low of 6.0 percent of the mileage carrying 41.8 percent of the VMT to a high of 92.8 percent of mileage carrying

93.4 percent of VMT. The national averages are 19.4 percent of mileage and 64.2 percent of VMT.

- State ownership by Federal-aid highways is 90.4 percent for Interstate, 95 percent for other NHS and 49.3 percent for other Federal-aid highways.
- While states generally have responsibility for higher functionally classified highways, 159,574 miles of state highways are functionally classified as Local highways and 80,999 miles are urban Collectors and rural Minor Collectors.

It is important to note that increasingly states are relying on other governmental agencies to provide HPMS data on off-state system roads. Cities, counties, and MPOs frequently provide HPMS data to the states, which then combine it with state-collected data before submitting it to FHWA. Ideally, FHWA would like all data to be of equally high quality, but it realizes that this is not always possible across all functional systems. FHWA continues to support the utilization of locally collected data in states' HPMS submittals.

States generally follow the guidance and criteria, such as for functional class, but each state is different because of internal state and non-state highway organizations, highway system definitions, and operating procedures and regulations. To better accommodate these differences, FHWA is proposing several improvements to HPMS that will increase the ability of states to more efficiently provide quality, timely, and complete HPMS data. These improvements discussed in this report include:

- New data model;
- Metadata for pavements and traffic;
- Coordination with safety, bridge, finance, and other databases;
- Boundaries and functional classification.

Sample size and national/state system sampling schema are two areas that could be improved to address this issue, but due to budget and time limitations are being retained as long-term research projects for implementation in the mid to long term; beyond year 2010.

2.3 USES OF HPMS DATA

2.3.1 Needs Assessment

The methods and assumptions used to analyze future highway, bridge, and transit investment scenarios are continuously evolving. Since the beginning of the highway report series in 1968, innovations in analytical methods, new empirical evidence, and changes in transportation planning objectives have combined to encourage the development and application of improved data and analytical techniques. Estimates of future highway investment requirements, as reported in the 1968 *National Highway Needs Report to Congress*, began as a combined "wish list" of State highway "needs." As the focus of national highway investment changed from system expansion to management of the existing

system during the 1970s, national engineering standards were defined and applied to identify system deficiencies, and the investments necessary to remedy these deficiencies were estimated. By the end of the decade, a comprehensive database, the Highway Performance Monitoring System (HPMS), had been developed to monitor highway system conditions and performance nationwide.

By the early 1980s, a sophisticated simulation model, the HPMS Analytical Process (AP), was available to evaluate the impact of alternative investment strategies on system conditions and performance. The procedures used in the HPMS-AP were founded on engineering principles. Engineering standards were applied to determine which system attributes were considered deficient, and improvement option "packages" were developed using standard engineering practice to potentially correct given deficiencies, but without consideration of comparative economic benefits and costs.

In 1988, the FHWA embarked on a long-term research and development effort to produce an alternative simulation procedure combining engineering principles with economic analysis, culminating with the development of the HERS model. HERS was first utilized to develop one of the two highway investment scenarios presented in the 1995 C&P report. In subsequent reports, HERS has been used to develop all of the highway investment scenarios.

The HERS model initiates the investment analysis by evaluating the current state of the highway system using information on pavements, geometry, traffic volumes, vehicle mix, and other characteristics from the Highway Performance Monitoring System (HPMS) sample dataset. Using section-specific traffic growth projections, HERS forecasts future conditions and performance across several funding periods. As used in this report, the future analysis covers four consecutive 5-year periods. At the end of each period, the model checks for deficiencies in eight highway section characteristics: pavement condition, surface type, volume/service flow (V/SF) ratio, lane width, right shoulder width, shoulder type, horizontal alignment (curves), and vertical alignment (grades).

Once HERS determines a section's pavement or capacity is deficient, it will identify potential improvements to correct some or all of the section's deficient characteristics. The HERS model evaluates seven kinds of improvements: resurfacing, resurfacing with shoulder improvements, resurfacing with widened lanes (aka minor widening), resurfacing with added lanes (aka major widening), reconstruction, reconstruction with widened lanes, and reconstruction with added lanes. For improvements that add travel lanes, HERS further distinguishes between those that can be made at "normal cost" and those on sections with limited widening feasibility that could only be made at "high cost." HERS may also evaluate alignment improvements to improve curves, grades, or both.

When evaluating which potential improvement, if any, should be implemented on a particular highway section, HERS employs incremental benefit-cost analysis. The HERS model defines benefits as reductions in direct highway user costs, agency costs, and societal costs. Highway user benefits are defined as reductions in travel time costs, crash costs, and vehicle operating costs. Agency benefits include reduced maintenance costs (plus the residual value of projects

with longer expected service lives than the alternative). Societal benefits include reduced vehicle emissions. Increases in any of these costs resulting from a highway improvement (such as higher emissions rates at high speeds or the increased delay associated with a work zone) would be factored into the analysis as a "disbenefit."

These benefits are divided by the costs of implementing the improvement to arrive at a benefit-cost ratio (BCR) that is used to rank potential projects on different sections. The HERS model implements improvements with the highest BCR first. Thus, as each additional project is implemented, the marginal BCR and the average BCR of all projects implemented decline. However, until the point where the marginal BCR falls below 1.0 (i.e., costs exceed benefits), total net benefits will continue to increase as additional projects are implemented. Investment beyond this point would not be economically justified, since it would result in a decline in total net benefits.

Additional information on the HERS model can be found in the *HERS Technical Report*. The latest published version dated December 2000, is based on HERS version 3.26, which was utilized in the development of the 1999 edition of the *C&P Report*.

2.3.2 Performance Measures

HPMS data are used for a number of performance measures in FHWA, the National Highway Transportation Safety Administration (NHTSA), and the Federal Motor Carrier Safety Administration (FMCSA). For most of the performance measures, HPMS data are combined with other data, but there are some that rely solely upon HPMS. While data on the use and extent of the nation's highway system are commonly cited in FHWA documents and in the media, they are not typically considered performance measures. The term refers to measures or goals established by the U.S. Department of Transportation or one of the individual agencies such as FHWA or NHTSA. The following is a brief description of some of the more commonly referenced performance measures and the HPMS data used.

2.3.2.1 FATALITY RATES – SAFETY

The FHWA Office of Safety and NHTSA use VMT data derived from HPMS as the denominator in calculating fatality rates. This is done by dividing the total number of fatalities by the total VMT. VMT is determined for each section in HPMS by multiplying the AADT by the length of the section. The VMT are then summed for the various systems for which a fatality rate is desired; typically by State, functional class, and vehicle type. HPMS universe, sample, and summary data are all utilized for this analysis.

2.3.2.2 PAVEMENT SMOOTHNESS – MOBILITY AND PRODUCTIVITY

The FHWA Office of Pavement Technology reports the pavement smoothness performance measure, which is the percent of VMT on the NHS with pavement smoothness (IRI) of 95 inches/mile or better. HPMS universe data are used for

this analysis, which involves determining 1) which sections on the NHS have an IRI of 95 in/mi or better, 2) calculating the VMT for each section, and 3) summing of VMT for these sections.

2.3.2.3 CONGESTION – MOBILITY AND PRODUCTIVITY

The Office of Operations is responsible for the congestion performance measure, which is the percent of travel that occurs under congested conditions and is determined by the Texas Transportation Institute (TTI) and reported in their annual Urban Mobility Report. TTI uses HPMS sample data for approximately 403 urbanized areas within the United States on the freeways and arterial streets. Addition information on the Urban Mobility Report can be found on the TTI web site at: http://mobility.tamu.edu.

2.3.2.4 SPECIAL ANALYSES

HPMS data are routinely used for special analysis of highway system extent, condition, performance, and use. Some of these are recurring such as the analysis done for the Highway Cost Allocation Study or the Freight Analysis Framework. Of the non-recurring, some are very complex, but most are rather simple. The Strategic Multimodal Analysis (SMA) is an example of more complex analysis to use HPMS sample data, which builds off of the HERS analysis. Most, however, are along the lines of estimating the extent of access controlled Principal Arterials, or summing highway mileage by special traffic volume or pavement condition groups. The FAF uses HPMS passenger traffic data in assembling the freight corridors and determining freight movement performance.

2.3.2.5 REPORTS

HPMS data are cited in numerous DOT and FHWA publications. Some, such as *Highway Statistics* and the *Conditions and Performance Report*, which are produced by the Office of Policy and Governmental Affairs, have entire chapters dealing with HPMS data. The Bureau of Transportation Statistic's *Pocket Guide to Transportation* is an example of a DOT report that summarized some of the HPMS data for multiple years. Most reports cite key statistics, such as the miles, lane-miles, or VMT for all public roads, or a portion as in the case of the Interstate System or National Highway System.

3.0 Stakeholder Input

3.1 DESCRIPTION OF INPUT PROCESS

The FHWA has undertaken a very open, interactive approach to this Reassessment. Major emphasis has been and will continue to be directed towards determining the data needs of FHWA's partners, stakeholders, and customers, the various uses of the existing HPMS, as well as the ability of data providers to support these data needs.

HPMS Reassessment efforts to date have included the following:

- Several meetings with national level users;
- Development and use of an Executive Resource Committee (ERC);
- Regional workshops;
- Presentations at national Transportation Research Board (TRB) meetings;
- Extensive conduct of webinars;
- Development of Issue papers covering all pertinent technical issues and data areas, including: Sampling, Boundaries and Functional Classification, Safety, Pavements, Interchanges, Freight, Capacity, Data Quality, Process Improvement, and New Data Model;
- Docket posting;
- Receipt of comments through e-mail; and
- Discussion of Reassessment comments and feedback with several data collection stakeholders.

Each of these input mechanisms are discussed in the following section.

3.2 SUMMARY OF INPUT

3.2.1 National Users

An HPMS Reassessment Scoping Session was held on February 1, 2006 with FHWA and other U.S. DOT program users of the HPMS data. The purpose of the meeting was to discuss openly the intention of the Office of Highway Policy Information to conduct a Reassessment of the HPMS and learn of the concerns and issues it would raise from those within U.S. DOT, especially FHWA. Detailed discussions were held on the following topics: Planning, Environment, and Real Estate (rural/urban designations, linear referencing system, air quality conformity, capacity analysis); Infrastructure (HERS-ST, data integration and pavement management); Operations (freight analysis, vehicle classification, and ITS); Safety (roadway characteristics) and Policy (HERS and traffic Monitoring). Subsequent meetings were held with individual stakeholders regarding specific

data needs and issues. For example, the FHWA Offices of Pavement Technology and Safety were consulted concerning the additional pavement data items and mandatory motorcycle travel data, respectively.

3.2.2 Executive Resource Committee

An Executive Resource Committee (ERC) was formed at the beginning of the process. The ERC was formed to assist FHWA staff with identifying present and future data needs for FHWA and users, and balance needs and resource requirements. The ERC is comprised of five state members, one Metropolitan Planning Organization, three FHWA Division Representative, eight FHWA Data Customers and three internal customers.

The role of the ERC was to:

- Actively participate in the development of Issue papers as reviewers and technical experts;
- Participate in Regional Workshops;
- Act as a sounding board at the end of Regional Workshops to assess future action on issues identified at Workshops; and
- Assist with recommendations regarding a full range of options that need to be considered in the Reassessment.

The ERC met four times in 2006 prior to the release of the *Draft Recommendations Report* and only a couple of times since then. While the ERC provided some excellent input into the Reassessment, the HPMS staff within FHWA found organizing and conducting meetings exceedingly difficult following the loss of the FHWA staff assigned to the Reassessment in mid 2006 and the primary Reassessment support contractor in December 2006. ERC meetings were held as follows:

- March 15, 2006 – Orientation Meeting;
- March 22-30, 2006 – Issue Module Meetings to review mission and goals of Reassessment;
- April 12, 2006 – Project Kickoff; and
- October 24, 2006 – Review of Progress.

3.2.3 Regional Workshops

Initially five Regional Workshops were held as follows:

- March 10-11, Washington, District of Columbia;
- April 26-27, 2006 in Newington, Connecticut;
- May 10-11, 2006 in Atlanta, Georgia;
- May 24-25, 2006 in Portland, Oregon; and
- May 31-June 1, 2006 in Lincoln, Nebraska.

A total of 92 people attended, and six of them were ERC members. Twenty-three states were represented (Oregon, Washington, Texas, Idaho, Nevada, Arkansas, Colorado, Montana, Florida, Georgia, South Carolina, Virginia, Kansas, Michigan, Minnesota, Nebraska, New York, Wisconsin, Wyoming, Virginia, Pennsylvania, Massachusetts, and Connecticut). Three MPOs also were represented (Portland, Dallas/Fort Worth, and Southwestern Pennsylvania (SPC)). Nine FHWA Division offices also attended.

In general, states expressed that they would like a better explanation of the connection between HPMS and apportionment. They also requested a table to show existing HPMS items – what they are used for and who needs them along with Reassessment items – who needs them, what they will be used for, cost/benefit of collection, details related to collecting (where), and want versus need. The burden for collection on lower functionally classified roads also was an issue. Some expressed concern over the perception that HPMS is getting down to a project level, despite the program not being intended for that level of analysis. Finally, there was a concern that program changes would create a burden and subsequently lower overall data quality. It was clear from the workshops that the *HPMS Field Manual* needed to be revised and many states indicated that they would like to be involved in that effort.

All of this feedback was considered in the development of the Issue papers and is summarized in Appendix C.

Following the release of the *Draft Recommendations Report*, three additional Regional Workshops were held as follows: March 7-8, 2007 in Baltimore, MD; March 13-14, 2007 in Sacramento, CA; and March 27-28, 2007 in Topeka, KS.

3.2.4 National Transportation Research Board Meetings

The Office of Highway Policy Information, FHWA, staff responsible for HPMS and the Reassessment consultants attended numerous national meetings in 2006 and 2007. FHWA staff and/or the consultants tried whenever possible to get on the agenda and deliver a presentation or briefing on the Reassessment. Below is a list of some of the larger events at which a presentation on the HPMS Reassessment was given.

- March 2006 at the annual Geospatial Information System for Transportation (GIS-T0 conference in Columbus, OH). FHWA staff attended and participated in discussion of material relating to HPMS reassessment, GIS concepts, and the State Network Project.
- On June 5, 2006 at the North American Travel Monitoring Exhibition and Conference in Minneapolis (NATMEC). FHWA staff also attended the following Transportation Research Board committee meetings to brief them: Statewide Data and Information Systems and Traffic Monitoring.
- July 10, 2006 at the (TRB) Midyear meeting in La Jolla, California. In addition to a dedicated session, FHWA staff and consultant attended the following Committee meetings to brief them on the HPMS Reassessment: Statewide Multimodal Transportation Planning Committee, Performance Measurement

Committee, Freight Data, and Transportation Programming, Planning and Systems Evaluation.

- September 2006 at the annual Road Profilers User's Group (RPUG) conference in Ames, IA. FHWA staff presented preliminary information relating to the HPMS reassessment effort regarding pavement data.
- November 2006 at the annual FHWA Highway Information Seminar (HIS) meeting in Rosslyn, VA. The entire HPMS staff from FHWA presented detailed material relating to the HPMS reassessment effort as well as basic training and current topic areas of interest relating to HPMS in general.
- January 2007 at the annual Transportation Research Board (TRB) conference in Washington, DC. FHWA staff gave a presentation on the Reassessment at an evening session.
- March 2007 at the annual GIS-T conference in Nashville, TN. FHWA staff gave a presentation on proposed changes to HPMS resulting from the implementation of the New Data Model.
- May 2007 at the National Conference on Pavement Management in Norfolk, VA. FHWA staff gave a presentation on the HPMS changes, specifically in the pavements area.
- August 2007 at the AASHTO Subcommittee on Materials meeting in Lincoln, NE. FHWA staff gave a presentation on the HPMS data changes.
- October 2007 at the annual Road Profilers User's Group (RPUG) meeting in Danville, VA. FHWA staff presented detailed information relating to the HPMS reassessment effort regarding pavement data.
- October 2007 at the Motorcycle Travel Symposium in Washington, D.C. FHWA staff presented material related to collection and reporting of motorcycle travel data for HPMS and worked with the participants to develop a short- and long-term research agenda to improve the quality of these data.
- November 2007 at the annual FHWA Highway Information Seminar in Rosslyn, VA. Several FHWA staff presented detailed material relating to the HPMS reassessment effort as well as basic training and current topic areas of interest relating to HPMS in general.
- March 2008 at the HPMS Reassessment Workshop in Denver, CO. FHWA staff presented comprehensive HPMS reassessment materials and training, and provided participants with the *HPMS Data Specifications* and draft version of the *HPMS Field Manual*.

3.2.5 Webinars

Fourteen issue-specific webinars were held over the summer of 2006. Attendance averaged about 100 people, with most States in attendance at each one. Interactive presentations and surveys were used to gather input. The poll

questions used along with the feedback received during the webinars have been posted on the Docket.

Feedback from the webinars was particularly useful in further refining the Issue papers and developing the *Draft Recommendations Report*.

Webinars were also used throughout 2007 as a means of helping State data providers understand the proposed HPMS changes and soliciting feedback. FHWA staff made extensive use of webinars for providing support and training for States that had specific questions or concerns in a particular data area. The new data model and pavements were two of more frequently requested data areas for which webinars were provided.

3.2.6 Issue Papers

The initial Reassessment outreach conducted with program managers within FHWA and the customers/users of HPMS information through a series of Regional Workshops with state and local data providers revealed 10 major issue areas. Issue papers were written by the Office of Highway Policy Information with extensive coordination with HPMS users. The Issue papers are provided in Appendix C and help the reader gain a better understanding of changes to HPMS that were originally being contemplated in the fall of 2006.

3.2.7 Other Input

In addition to the aforementioned input mechanisms, feedback was provided directly to the FHWA project manager in the form of documents posted directly to the Docket, No. 23638 (http://www.regulations.gov/search/index.jsp). Additional e-mails and phone calls were submitted to the project manager.

AASHTO Standing Committee on Planning (SCOP) conducted a survey of the states regarding the HPMS Reassessment. The information and feedback received from the states was combined and presented to FHWA. The survey findings are also available at the above-listed location on the Docket.

All were taken into consideration in developing this report, but some may have been withheld at the senders' request. To the extent possible, all e-mails to the project manager have been put on the Docket with approval of the sender.

4.0 Data Changes

This section describes and summarizes the changes that were originally developed through the Issue papers and later released in the draft *HPMS Reassessment Recommendations* report in January 2007.

Beginning in the spring of 2006, issue papers were developed for each of the major subject areas of the Reassessment. The purpose of the issue papers was to convey to the HPMS community the data changes being considered in the Reassessment, thus providing the data providers and users with firm recommendations on which they could provide FHWA comments. The 10 Issue paper areas were grouped into three categories as follows:

1. Structure of HPMS (one Issue paper for each):
   - New Data Model (formerly Linear Referencing and Data Integration);
   - Sampling; and
   - Boundaries and Functional Classification.
2. Data Items (one Issue paper for each):
   - Safety;
   - Freight;
   - Pavements;
   - Interchanges; and
   - Capacity.
3. Data Quality and Process Improvement (one Issue paper for each):
   - Data Quality; and
   - Process Improvement.

For clarification, collecting year refers to the year in which the data are collected, where reporting year refers to the year in which these data are reported to FHWA. HPMS data are expected to be collected over a one-calendar-year period and be reported to FHWA by the following June 15th. For example, data collected by a state in calendar year 2006 is reported to FHWA on June 15, 2007. The timing for HPMS data changes is very important and there are four basic levels of changes being made in the Reassessment:

1. Early Implementation – These data changes are mandatory in the 2008 Reporting Year and optional for the 2007 Reporting Year. The only data items in this category are motorcycle travel data.

2. Immediate Implementation - This is the last possible year for reporting new and changed data not listed in one of the other three levels. States that have collected these data items in 2008 may report them in the 2009 Reporting Year. All States will be required to collect these data in 2009 for the 2010 Reporting Year. To the extent possible, similar data items should be dropped and added in the same year. For example, pavement structural number should not be deleted until the new pavement data items are added. Pavement and traffic metadata will be required in 2010.

3. Phased Implementation – Certain sample pavement condition data are required to be collected on a two-year cycle. Therefore, States will be expect to report data for half of their sample sections in Reporting Year 2010, and the remaining half in Reporting Year 2011. This does not apply to pavement condition data that are required to be collected on an annual basis.
4. Late Implementation – Since most States review and revise their adjusted small urban/urbanized area boundaries and functional class two to three years following the decennial Census, the reporting of the new functional classes (except the OFE in rural which is based on design criteria) and updated adjusted small urban & urbanized boundaries will not be required until Reporting Year 2013. States are encouraged to not wait till after the decennial Census to begin reviewing and revising their functional classes, since these data are no longer dependant on the adjusted boundaries.

There are a number of data recommendations studied in the Reassessment that were ultimately not adopted. Of these recommendations, a number have been identified for future study, and are categorized in this report under each section as "Deferred for Future Research."

Sections 4.1, 4.2, and 4.3 summarize the recommendations for the structure of HPMS, data items, and data quality/process improvement respectively. The results were used to arrive at recommendations regarding level of effort to change and/or add certain items. Section 4.4 summarizes all of the recommendations in a table format.

4.1 STRUCTURE OF HPMS

This section deals with the changes to the structure of HPMS, which includes the database and methods of submitting HPMS data to FHWA. These changes directly address two of the HPMS goals to evolve HPMS to a data system which:

- Builds from the data systems of local, regional, and state governments; and
- Is connected with a common geo-referencing system.

The ability to connect HPMS data items with a common geo-referencing system was also identified as an outstanding need in the last Reassessment. An important mission of this Reassessment is to capitalize on changing technology to enhance quality, efficiency, and data integration.

The three main areas being considered in Section 4.1 are a new data model, sampling, and boundaries/functional classification.

4.1.1 New Data Model

The basic concept for a new data model was originally proposed in an Issue paper and further described in the draft report. The primary objectives of the data model are:

- Improve data quality;
- Enhance analytic capabilities; and

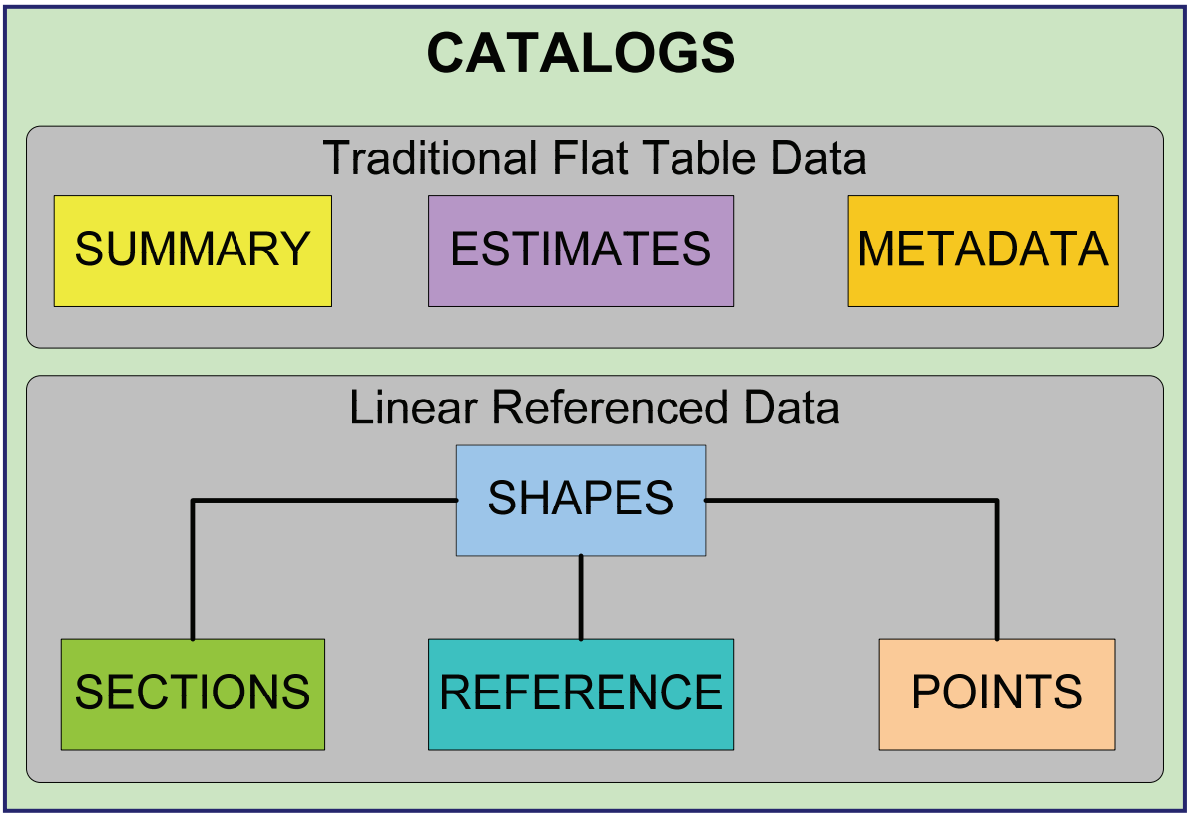
- Reduce data reporting burden.

The data model will accomplish these objectives by organizing the HPMS data into program areas, and link them together through a Geographic Information System (GIS) using spatial relationships. The new model treats each data item independently, thus removing all unnecessary data dependencies inherent in the old data model. Each data item could be represented by its own layer with its own rules.

4.1.1.1 IMMEDIATE IMPLEMENTATION

The overall structure of HPMS will be organized in catalogs representing different levels of data detail. Summary data are represented in tables within the Summary Catalog, Section specific data is represented in the Sections Catalog. The Shapes Catalog holds the key to linking the data together through polygon and polyline geometric files. The specific data structure and reporting requirements are identified in the *HPMS Data Specifications*.

Figure 4.1 Conceptual Overview of the New Data Model



The structure for the HPMS of 2010 goes a long way toward achieving the goal of HPMS being built from the data systems of local, regional, and state governments, and connected with a common geo-referencing system. The Data Model has the following attributes:

- The scope of HPMS remains the same. HPMS includes all public road mileage.
- The scale of the HPMS also remains the same. There are Universe data items, sample information for a portion of the Universe and area wide summary information for Minor Collector and Local roads. Universe AADT coverage is extended through Minor Arterials and (Major) Collectors to include all Federal-aid eligible roads.
- New elements of the structure are:
  - GIS-based framework; and
  - Multi-dimensioned tables linked to a state-supplied network.
- Benefits of the new structure include:
  - Expands the coverage of "linkable" HPMS data. HPMS 2010 can more easily link to other Federal highway data files such as the Bridge Inventory system and the Highway safety systems, and can provide data to "routable" Federal transportation networks such as NHPN and FAF.
  - Improves state feedback mechanisms.
  - The GIS approach may allow a different approach for populating urban/urbanized attributes.
  - Information on ramps associated with all grade separated interchanges will be added for all functional systems.

The changes are to:

- Implement a New Data Model, a GIS or geospatial database with multiple layers, for implementation for 2010;
- A pilot was conducted to develop how this will be implemented:
  - Creating multiple tables within the HPMS submittal similar to the current table that states submit; or
  - Allowing states to submit their HPMS data as a GIS file or geospatial database with multiple layers; each layer representing a logical grouping of data (pavement, traffic, ITS, etc.); and
  - Establish the minimum criteria for the road geometry. Preliminary attributes regarding the network have been proposed and are included below. The FHWA and the Pilot States have worked on refining these attributes in developing the new data model.
    - » **Scope –** States can supply either a single or dual carriageway geospatial network.
    - » **Extent –** The State supplied geospatial network will need to include all roads that are eligible for Federal-aid. This includes the entire NHS and all roads functionally classified as Interstate through Rural Major Collector and Urban Minor Collector regardless of ownership.

» **Intrastate Connectivity –** States are encouraged to use an LRS for HPMS reporting that is consistent with the LRS being used for all other Federal data reporting. Through the HPMS Reassessment, FHWA is proposing "one network and one LRS for all Federal data reporting." This theme has been widely embraced by most States and most if not all of the Federal agencies engaged through the Reassessment.

» **Maintenance –** The proposed data model will use the State supplied geospatial networks, which need to correspond to the HPMS data being submitted that year. To ensure a 100 percent match between the HPMS data and the geospatial network, States are encouraged to submit a new network every year.

– Develop new submittal package to include:

» A geometry file in the form of a shapefile or other acceptable format that has measured and calibrated routes;

» A multi-dimensioned event table using the LRS field as a common identifier to link all data tables; and

» Global Information which would include information that applies to every record (such as Units, Year or Data, Summary Data, etc.).

4.1.2 Sampling

The general recommendations that were evaluated include:

- Modifying traffic volume groups to be consistent across rural and urban functional classes;
- Expanding upper and lower traffic volume groups; and
- Extending universe AADT coverage to all roads eligible for Federal-aid.

It was concluded that the basic standard sampling scheme for HPMS remain unchanged. Benefits of applying the following changes as described include the:

- Flexibility to readily calculate a VMT value based on defined air pollutant boundaries (multiple pollutants/boundaries),
- Ability to calculate a VMT value for areas split by one or more nonattainment or maintenance area boundaries, and
- Elimination of donut samples in nonattainment or maintenance areas.

4.1.2.1 IMMEDIATE IMPLEMENTATION

The following changes are for immediate implementation:

- **Eliminate Donut Area Sample**[1] – Present scheme of standard sampling within urbanized areas, small urban areas, and rural by functional system

[1] Donut Area refers to the portion of a non-attainment or maintenance area that is outside an small urban or urbanized area boundary. The Donut Area Sample is a

and by volume strata will be retained. However, the requirement for the Donut Area Sample AADT Volume Group Identifier (Item 31) as well as the entire donut sampling procedure will be deleted.

- **Universe AADT required for all roads eligible for Federal-aid –** The elimination of the Donut Area Sample and the need for robust VMT data for geospatial analysis led to the change in AADT (Item 33) reporting. Inclusion of AADT for all Minor Arterials and (Major) Collectors segments will greatly simplify the estimation of VMT for specific geographic areas as well as nonattainment or maintenance areas by pollutant. Please note that AADT reporting has always been required on a universe basis for all Principal Arterials, NHS, STRAHNET, and for sample sections on Minor Arterials, rural Major Collectors, and urban Collectors.
- **Modify Summary AADT Template** - The current Summary Template used for the air quality nonattainment and maintenance areas will be modified to accommodate reporting a combined estimate of DVMT for the lowest systems by area and pollutant; these lowest systems would include any rural Minor Collectors and rural and urban Locals located within the nonattainment or maintenance area.
- **Drop the Urbanized Area Sampling Technique Code (Item 14)**.

4.1.2.2 DEFERRED FOR FUTURE RESEARCH

The following were considered and discussed in the Reassessment webinars and workshops and ultimately deferred. The availability of qualified staff and the reduction in the Reassessment budget ultimately led to the conclusion to defer these for future research. Some of these could easily be implemented, while others should be addressed as part of a future Reassessment.

- **Alternative Sampling Scheme –** The new GIS data model presents the possibility of sampling each data area independently in the future.
- **NHS Sample –** A NHS sampling scheme by state could be implemented using the existing standard samples supplemented with extra standard samples where needed. A separate Item would be retained for the NHS expansion factor such as the standard sample expansion factor. An in-depth analysis is needed to verify the proposed results. NHS Expansion Factors (applicable to the non-Interstate parts) will be developed.
- **Sample Panel –** A recommendation needs to be made regarding how to keep the sample panel representative of the entire urbanized area in cases where large additions are added to an existing urbanized area sample panel. The recommendation needs to address the issue of sub-area sampling within a large urbanized area.

---

supplementary sample that is used to determine travel in the Donut Area, so when combined with the travel for the small urban or urbanized area, is representative the entire non-attainment or maintenance area.

- **Standard Sample AADT Volume Group Identifier (Item 32) –** Common generic AADT Volume Groups. FHWA proposed establishing a single AADT Volume Group stratification that would apply across all geographic area types (i.e., rural, small urban, urbanized, nonattainment, etc.)
- **National Sample –** This option deals primarily with obtaining those data items required only for national level analysis (e.g., HERS, FAF, Highway Cost Allocation etc). There are two scenarios that need to be further studied:
  - Collect the sample data items only used for national-level analysis as a national sample for all functional systems; or
  - Create a national sample for data on those functional systems currently not covered by the existing sample. Under this scenario, the national sample would compliment the existing sample.
- **Alternative Sampling Methods –** Alternative variable schemes, if viable, could be reviewed and proposed. Levels of precision needed for FHWA purposes need to be visited, since the level of precision directly affects the amount of samples required. If a commitment is made, then criteria would be very helpful in deciding the alternative schemes as well as the appropriate levels of precision to employ.

The suggested AADT volume group strata shown in the table below should be evaluated to determine the impact of various options (i.e., wider volume ranges as the volume increases, use same volume ranges across urban/rural, etc.). AADT volume group strata adjustment should be tested to determine the impact of various options (i.e., wider volume ranges as the volume increases, use same volume ranges across urban/rural, etc.). States were generally in favor of this change, but once again, FHWA was not able to complete an in-depth study of the impact of implementing this change; however, FHWA felt compelled to make the change based on a minimum analysis anyway.

Table 4.1.2 AADT Traffic Volume Groups and Codes

Code	AADT Volume Groups
1	Under 500
2	500-1,999
3	2,000-4,999
4	5,000-9,999
5	10,000-19,999
6	20,000-34,999
7	35,000-54,999
8	55,000-84,999
9	85,000-124,999
10	125,000-174,999
11	175,000-249,999
12	250,000 and more

4.1.3 Boundaries and Functional Classification

The benefits of moving from State adjusted urban/urbanized boundaries to a different boundary (i.e. Census, or MPO) were discussed. The general consensus among the States and the data users was that adjusted urban/urbanized boundaries were preferred. Most often, the reason cited was the fact that adjusted urbanized boundaries are "transportation" oriented, meaning they have been adjusted to capture transportation characteristics not represented in the Census or MPO boundaries. Ultimately no change was made to the urban/urbanized boundaries, but it was agreed that FHWA would need to take a more active role in providing guidance to the States following the next decennial Census.

Eliminating the urban versus rural designation from highway functional classification and collapsing the number of classification codes from the current 12 to 7 will improve the accuracy and consistency of these data. Since the inception of functional class, the coding of these data has had both a rural/urban component and a functional component. Unfortunately, how a road functions is not necessarily related or dependent on it being urban or rural. Removing the rural/urban bifurcation will eliminate the need to update the functional class field whenever a change occurs in an urban or urbanized area boundary, and will hopefully lead to more consistent reporting of highway functional classes across and within States. The revised set of functional classes and associated codes are shown in the table below.

4.1.3.1 IMMEDIATE IMPLEMENTATION

- **Eliminate urban/rural bifurcation** - Revise functional classification codes to eliminate separate urban and rural classifications (please note the rural, small urban, and urbanized area designation is kept as a separate item);
- **Disaggregating of Urban Collectors –** Allow for the disaggregating of urban Collectors into Major and Minor Collectors.
- **Add Field for Pollutant Type –** Add additional data item describing type of pollutant to summary form.
- **Adjusted Urban/Urbanized Boundaries –** FHWA will issue instructions on adjusting small urban/urbanized area boundaries to Division Offices and States prior to the next decennial Census.

Table 2.1.3 Functional Classification Codes

Code	Functional Class Description
1	Interstate
2	Other Freeways & Expressways
3	Other Principal Arterial
4	Minor Arterial
5	Major Collector

6	Minor Collector
7	Local

4.1.3.2 DEFERRED FOR FUTURE RESEARCH

Research options for updating the geo-spatial information of the current urban and urbanized areas and air quality boundaries.

4.2 DATA ITEMS

The following data items are being modified or added to better meet FHWA business needs. The business needs have been discussed in detail earlier in this report. For background information, review the appropriate Issue papers in Appendix C: for safety, pavements, interchanges, freight and capacity. For a list of items giving data names and structures, the *HPMS Reassessment 2010+ Data Specification* document can be referenced.

Changes for of each of the main areas are detailed below.

4.2.1 Immediate Implementation

The mandatory Reporting Year for the following data is 2010 unless otherwise indicated in parenthesis.

4.2.1.1 SAFETY

Motorcycles (2008 Reporting Year)

- Beginning in 2008, the reporting of motorcycle travel data for data year 2007 is mandatory. All States are expected to begin reporting motorcycle travel data as a percent of total travel in the area wide summary table.

  FHWA realizes that there are currently some concerns about the quality and consistency of these data. The concerns are often centered on the ability of traffic equipment to detect motorcycles, when and where States typically count traffic, and the methods used for factoring short-term counts. FHWA is committed to working with the States to help improve the quality of these data through the dissemination of best practices, revised guidance, training, and modifications to existing equipment, or research into new equipment and technologies.

Coordination of HPMS with other Safety Databases

- The Office of Safety and the Office of Highway Policy Information will continue to coordinate regarding HPMS and Minimum Inventory of Required Elements (MIRE) standards. The new data model has been modified for States who wish to provide FHWA with some or all of their MMIRE to do so at the time they submit their HPMS data. These optional data would not be considered HPMS data, and would only receive a cursory review; these data would be passed along to the FHWA Office of Safety.

4.2.1.2 PAVEMENT

IRI data

- Collect and Report IRI and IRI Year *annually* on a universe basis on the NHS. FHWA realizes that some states do not currently collect 100% of the state NHS network on an annual basis and that it may be difficult to procure and implement the resources necessary to meet this requirement by the 2009 data collection year. In these cases, States should develop an implementation plan to document the steps that will be taken to meet the NHS annual data collection requirement. This plan should identify when and how the state will be able to provide annual monitoring of the NHS. The implementation plan should be submitted to the FHWA for review and approval before the beginning of the 2009 data collection year. The collection of IRI data for non-NHS samples will remain on a two-year cycle. IRI Year is a new data item, which represents the year that the IRI data was collected, compared to the year that it is reported.
- States are to continue reporting the average of both right and left wheel path quarter-car IRI in HPMS as a Mean Roughness Index (MRI); and
- Report IRI data on structures and railroad crossings where IRI is required.

Consistency of pavement data

- Beginning in data reporting year 2010, the optional IRI metadata currently being reported will be eliminated and replaced with metadata on the new pavement condition data items (cracking, rutting, and faulting). In 2010, FHWA will begin more strictly enforcing the IRI data requirements as described in the *HPMS Field Manual*. Compliance with the data requirements will be determined in the FHWA Division Offices' annual assessment and review[2] of each States' HPMS data program. These assessments are to be submitted to the Office of Highway Policy Information (OHPI) no later than November 1st of the data reporting year. For example, a Division's review of their States 2009 HPMS data, submitted to FHWA June 15, 2010, should be received by FHWA no later than November 1, 2010.
- The pavement metadata has been published in the *HPMS Data Specifications.* The *HPMS Field Manual* will also contain a description of the metadata when it is released later this year.

Additional pavement data items and dropping of less useful ones

- The data items listed below are required for all sample sections in a phased approach. In Reporting Year 2010, States are expected to report the additional pavement data items for half of their samples sections. Preferably these sections will be equally distributed across functional systems. States are encouraged to do this by dividing their State in two e.g. by county,

[2] HPMS Assessment and Review Guidelines for the FHWA Division Offices is available on the HPMS web site at: http://www.fhwa.dot.gov/policy/ohpi/hpms/reviewguide.cfm

district etc and collecting the sample data for all the sections in one half in 2009 and the second half in 2010; Reporting Years 2010 and 2011 respectively.

- Drop reporting of Structural Number (SN). Need for this data item is obsolete and redundant based on acquisition of new data items.
- Collect additional pavement data items through a mix of required fields, mixed fields, phased-in reporting, and statewide default tables.
  - Rutting/Faulting – Add as required sample data items (data to be collected via profilometer at same time as IRI).
  - IRI Year – Add for all sections where IRI is required (including structures).
  - Cracking – Add percent cracking (regardless of severity) as a sample data item.
  - Add Date of Last Overlay and Date of Last Reconstruction – Code where know, leave blank if unknown.
  - Thickness of Latest Overlay – Optional sample data field until next post-2010 overlay.
  - The following data items are be required for all sample sections (phased in as described above) beginning in Reporting Year 2010. It is realized that many of these data items may not currently be available for individual sections; therefore the reporting of default values will be acceptable until such time as the State has developed a system to populate these data. Default values are acceptable for both on-state and off-state sections, and can be based on typical design defaults (statewide, functional system etc). To facilitate the reporting of these data, FHWA has added tables to the data model that allow states to code these data on a functional class basis.
    - » Asphalt Bound Thickness;
    - » Concrete Thickness;
    - » Base Type;
    - » Base Thickness;
    - » Asphalt Mix Binder Type;
    - » Dowel Bars; and
    - » Joint Spacing.
  - Subgrade AASHTO Soil Type: FHWA would code a default from maps while allowing states to override based on readily available local information.

4.2.1.3 INTERCHANGES & RAMPS

Interchanges

- FHWA will collect and report the location and type of Interchanges nationwide. States that have a database of Interchanges can optionally submit these data to FHWA

Ramps

- States to report ramp location, length, number of lanes, AADT and functional classification data for all grade separated interchanges on all functional systems (2010 Reporting Year)
- Ramps, as defined by AASHTO in the publication *A Policy on Geometric Design of Highways and Streets* "…includes all types, arrangements, and sizes of turning roadways that connect two or more legs at an interchange." Where a ramp connects two facilities with different functional classifications, the ramp will be coded with the functional classification of the "higher" facility. For example, a ramp that connects an Interstate and a Principal Arterial would be coded as an Interstate ramp.

4.2.1.4 FREIGHT

Truck Volumes as Universe Data on the NHS

- Report the actual truck AADTs for two categories of trucks, single unit, and combinations.
- Continue to report the percent single unit and combination trucks during the peak hour for all sample sections (rounded to the nearest 10th).
- Report average truck volumes that represent average conditions for that location. This means that the actual truck counts obtained would need to be adjusted just as volume data is adjusted to represent average conditions or an Annual Average Daily Truck Traffic (AADTT) as promoted in the 2001 TMG. States would be allowed to use existing procedures or may need to develop an interim process to adjust raw truck count data to represent average conditions until their traffic monitoring programs have collected sufficient data to calculate reliable AADTT.

4.2.1.5 CAPACITY

Highway surveillance systems (2009 Reporting Year)

- Delete these data items from HPMS – there are other sources for these data.

Capacity calculations

- Change edit routines in the submittal software so V/SF calculations less than 1.4 would be accepted as accurate; and
- Require states to explain their process(es), in the data narrative, used for calculating capacity and the override values reported in HPMS.

Widening Obstacle

- This is a new field to be used by States to identify obstacles within a specific distance from the roadway that would greatly complicate widening, and report this condition as a separate data item.

Widening Potential

- Formerly called Widening Feasibility – while this data item still represents the number of lanes that can be added to a given section, the coding has changed. States are now asked to code the number of whole lanes that could be added from 0 (zero) to 9 (nine).

Counter-Peak Lanes

- Add a new data item to indicate number of lanes in the counter-peak direction.

4.2.2 Long-Term Study

4.2.2.1 CAPACITY

K and D – Factors

- FHWA, along with interested states, will explore improving the data collection and reporting of K-factors pending the availability of research funds.

4.2.2.2 FREIGHT

Truck Volume Data

- Research may be needed to develop a process to easily calculate truck AADTs, to standardize peak hour definitions, explore use of ITS technology, and relevance to truck commodity surveys.

4.3 DATA QUALITY AND PROCESS IMPROVEMENT

The discussions at the workshops and webinars identified a concern for improving the quality of the data provided by state and local governments and for process improvements. These recommendations will be initiated by FHWA to assist the data providers to improve the overall quality and consistency of the data and to improve the quality of the analysis and use for FHWA business purposes. Exploration of data quality and process improvement ensures adherence to afore mentioned HPMS and Reassessment goals.

4.3.1 Data Quality

4.3.1.1 IMMEDIATE IMPLEMENTATION

Field Manual

The guidance to the states in the *HPMS Field Manual* appears to be the source of some data consistency and quality concerns. The Office of Highway Policy Information is working with data users and data providers to rewrite the *Field Manual* as part of the HPMS Reassessment. The revised *Field Manual* will employ additional, more detailed descriptions and where appropriate, more illustrations. Whenever possible, actual state examples will be incorporated. A team of data users and state data providers will be put together to rewrite the manual. The target completion data for the new Field Manual is fall 2008.

Data Validation

FHWA will continue to improve its validation software to make certain that invalid data does not appear within any field in the database (e.g., a 4 is not coded in a field with valid inputs of 1, 2, or 3). FHWA also will work with users of the HPMS data to determine if/what invalid data may be appearing in the database that is sent to the users.

4.3.1.2 LONG-TERM STUDY

Oversight

The review of the HPMS validation software should be an ongoing activity, especially in light of the data adjustments that appear to be taking place in order to resolve data verification errors. The verification software is intended to improve data quality, but it appears that in some instances it is encouraging just the opposite. FHWA needs to determine the extent to which this is happening, and if there is anything that can be done at the administrative level to alleviate this.

4.3.2 Process Improvement

4.3.2.1 IMMEDIATE IMPLEMENTATION

Pavement Metadata

The pavement metadata describe the processes used for collecting and reporting some of the pavement data items. Currently States are optionally submitting to FHWA metadata on their IRI data. The IRI metadata are being reduced and additional metadata added for rutting, faulting, and cracking. The metadata are required beginning in data reporting year 2010. A complete list of the pavement metadata can be found in the *HPMS Data Specifications*.

Traffic Metadata

As with the pavement metadata, the reporting of traffic metadata is required beginning in data reporting year 2010. The traffic metadata focuses on the reporting of quality traffic data in accordance with the HPMS Field Manual, the Traffic Monitoring Guide (TMG), and the Traffic Monitoring System for Highways (TMS/H) regulations. The questions to be answered include:

- What portion of current year AADTs are based on actual current year counts? On factored prior year counts?
- How many vehicle classification stations are used for each functional system in the "Travel Activity by Vehicle Type" summary data form?
- How is the travel determined for motorcycles, buses, and trucks (AADT and percent of travel)?
- Describe the quality assurance program for both State and non-State traffic data collection.

Government Ownership Code

Finally, it is being proposed that the Governmental Ownership code be changed to match the coding of Ownership in the NBI. Governmental Ownership would be changed from a one to two-digit field with the following coding options:

Table 4.3 Government Ownership Codes

Code	Government Agency	Code	Government Agency
01	State Highway Agency	60	Other Federal Agency (not listed below)
02	County Highway Agency	62	Bureau of Indian Affairs
03	Town or Township Highway Agency	63	Bureau of Fish and Wildlife
04	City or Municipal Highway Agency	34	U.S. Forest Service
11	State Park, Forest, or Reservation Agency	66	National Park Service
12	Local Park, Forest, or Reservation Agency	67	Tennessee Valley Authority
21	Other State Agency	68	Bureau of Land Management
25	Other Local Agency	69	Bureau of Reclamation
26	Private (other than railroad)	70	Corps of Engineers
27	Railroad	72	Air Force
31	State Toll Authority	73	Navy/Marines
32	Local Toll Authority	74	Army
40	Other Public Instrumentality (i.e., Airport, School/University, etc.)	80	Unknown
50	Indian Tribal Nation		

Toll Facility Identifier

The FHWA Office of Highway Policy Information will develop the toll facility identifier codes as part of developing the new data model, and published in future *Toll Facility* Reports. Each toll facility will be represented as single record with a beginning and ending LRS, and the toll facility codes. The toll facility identifier codes will be used for linking the toll sections in HPMS with other FHWA toll databases including the toll facility finance data and the database used for developing the *Toll Facilities* report.

4.4 SUMMARY OF DATA CHANGES

There are a significant number of data items that have been deleted and changed as a result of the Reassessment. Furthermore, the data model will allow the HPMS software to calculate or derive more data than was done in the existing software. The tables in the following sections list the deleted, changed, calculated, new, and unchanged data items. FHWA provided data are noted where applicable. States are responsible for collecting and reporting the remaining changed, new, and unchanged data items.

4.4.1 Changed or Deleted Data Items

Table 4.4.1 shows which of the existing HPMS data items have been deleted or changed. Most of the deleted data items are either a direct result of the new data model or the elimination of the ITS data. It should be noted that Future AADT Year, which is shown as being deleted, still exists in the new data model.

However it is now an attribute or metadata for the Future Year data item. The IRI data item now has an attribute for the year IRI was collected which is a new requirement for this data element.

Table 4.4.1 Deleted and Changed HPMS Data Items

Deleted Data		Changed Data	
Old Data Number	**Data Item Description**	**Old Data Number**	**Data Item Description**
3	Reporting Units	10	Route ID
5	Section ID	11	Begin Point
6	Is Standard Sample	12	End Point
7	Is Donut Sample	15	Urban Code
8	State Control Field	17	F System
9	Is Section Grouped	19	NHS[1]
14	Urbanized Area Sampling Tech	24	Route Number
18	Generated Functional Sys	25	Ownership
21	Official Interstate Route No	26	STRAHNET[1]
31	Donut Area Volume Group	27	Facility Type
38	Electronic Surveillance	33	AADT
39	Metered Ramps	35	IRI
40	Variable Message Signs	37	HOV Type
41	Highway Advisory Radio	50	Surface Type[1]
42	Surveillance Cameras	52	Climate Zone[1]
43	Incident Detection	56	Median Type
44	Free Cell Phone	62	Widening Potential
45	On-Call Service Patrol	81	Pct Peak Single
46	In-Vehicle Signing	82	AADT Single
48	Donut Expansion Factor	83	Pct Peak Combination
51	Structural No/Depth	84	AADT Combination
98	Future AADT Year	97	Future AADT

[1] – FHWA provided data items

4.4.2 Software Calculated Data Items

The new geospatial data model has increased the number of data items that the HPMS software will be able to calculate when putting together the Standard Sample file. Some of these data will be calculated from other data sources within HPMS e.g. metadata, summary tables, or geospatial files. Others will come from the data that States code for individual sections of roadway, which the software will summarize for the Standard Sample sections.

States will also have the option of submitting measured data and having the HPMS software calculate the HPMS, which is described in section 4.4.5.

Table 4.4.2 Software Calculated HPMS Data Items

Old Data Number	Data Item Description
4	County Code
13	Rural/Urban Code
16	NAAQS Codes
32	Standard Sample Volume Group
47	Sample Identifier
49	Standard Sample Exp Factor
63	Length Class A Curves
64	Length Class B Curves
65	Length Class C Curves
66	Length Class D Curves
67	Length Class E Curves
68	Length Class F Curves
69	Horizontal Alignment Adequacy
71	Vertical Alignment Adequacy
72	Length Class A Curves
73	Length Class B Grades
74	Length Class C Grades
75	Length Class D Grades
76	Length Class E Grades
77	Length Class F Grades
79	Weighted Design Speed
95	Peak Capacity
96	Volume/Service Flow Ratio

4.4.3 New Data Items

Listed below are the new HPMS data items. Most of these data items were discussed in the Issue Papers or during the Reassessment webinars and workshops. However, there are some that were identified much later in the Reassessment, during the development of the data model. An example would be curves and grades, previously discussed in this document. Others are the result of working with the data users and discovering that something new or a little different would better serve their needs. HOV Lanes for example came about through discussions with data users in the Office of Policy and Governmental Affairs, FHWA and the Office of Operations, FHWA. Both groups indicated that knowing the actual number of HOV lanes is very important to their programs.

Table 4.4.3 New HPMS Data Items

Data Item Description
Curves
Grades
Is Structure
HOV Lanes
Counter Peak Lanes
Special Toll Lanes
Route Prefix
Route Suffix
Alternative Route Name
Widening Obstacle
Rutting
Faulting
Cracking Fatigue
Cracking Transverse
Year Last Construction
Last Overlay Thickness
Thickness Rigid
Thickness Flexible
Base Type
Base Thickness
Soil Type

4.4.4 Unchanged Data Items

It is important to note that even though these data items *were not* changed or deleted, they did undergo a thorough review and evaluation. Not only was the coding for each item reviewed, but the overall Federal needs for these data were also considered. At no time was it assumed that any data would be "automatically" included. For example, Year Record and State Code are two data items that would appear to be mandatory. However, the HPMS Team within the Office of Highway Policy Information spent much time discussing and evaluating a number of ways to eliminate these data items. The team concluded that while these data are redundant (they appear in every single record) the minor reduction in coding effort was not worth the increased risk of having a data record or records associated with the wrong State and/or year.

Table 4.4.4 Unchanged Data Items

Old Data Number	Data Item Description
1	Year Record
2	State Code
20	Future Facility[1]
22	Route Signing
23	Route Qualifier
28	Truck Net[1]
29	Toll
30	Section Length
34	Through Lanes
36	PSR
53	Year Last Improvement
54	Lane Width
55	Access Control
57	Median Width
58	Shoulder Type
59	Shoulder Width R
60	Shoulder Width L
61	Peak Parking
70	Terrain Type
78	Pct Pass Sight
80	Speed Limit
85	K Factor
86	Dir Factor
87	Peak Lanes
88	Turn Lanes L
89	Turn Lanes R
90	Type Signal
91	Pct Green Time
92	Number Signals
93	Stop Signs
94	At Grade Other

[1] – FHWA provided data items

4.4.5 Optional Data Items

The new data model has been structured to allow States to submit optional data through HPMS to FHWA. Some of these data are directly related to the HPMS data, while others are not. Each type of optional data is briefly described below.

HPMS Optional Data: The first type of optional data is one that FHWA no longer requires, but States would like to have maintained in HPMS. The descriptive data item State_Control_Field is no longer required, but due overwhelming feedback from States to maintain this data item, it has been

reclassified as optional data since FHWA does not need it. The other type of optional HPMS data includes raw or unprocessed data that States would like to use to calculate required HPMS data items. For example, States that have the actual locations of stop signs or measurements of pavement grade can submit these data in a supplemental table and have the HPMS software determine the number of stop signs for each sample section or the classes of grades for each sample section. Software tools to provide this type of functionality would be part of a future development.

Non-HPMS Optional Data: The second type of optional data is collected through HPMS for other program offices in FHWA. These data are not reviewed by the HPMS Team and are simply passed along to the program office for which they are collected. The purpose for these data is to address the myriad of data currently being collected by other program offices that also include some of the HPMS data items. By doing this, FHWA hopes to reduce the collection of redundant data and further minimize the data reporting burden for States. This also addresses a long term goal of the Office of Highway Policy Information, which has been to "Collect data once and use it often."

4.5 HPMS DATA OVERVIEW

The majority of HPMS data are associated with a given section of road. Some of these data are required for all roads, while others are only required for a portion of roads. In the existing HPMS data model, the first types of data are called "universe data" while the second types are called "sample data." The existing HPMS requires States to create sections that are homogenous for certain data. For each section, some of the universe and most of the sample data are either summarized or averaged. The new data model has eliminated the need for these sections and the summarization of data when States prepare their HPMS submittal. For most data items, States are encouraged to submit only actual, measured values and not summarized or averaged data.

The new data model allows States greater flexibility in collecting and reporting their data. The following is a summary of all the data items contained in HPMS.

4.5.1 Overview of Data Items

The new HPMS will be able to determine 97 data items at the highway section level; these data will come from the following sources:

- State Provided: 68
- Software Calculated: 23
- FHWA Provided: 6

Table 4.7 provides an overview of the HPMS data items, the format of the data value(s), and the source of the data. Numeric data can be either a numeric code indicated by the text "Codes:" prior to the valid codes, or a number entered as a series of nines. For example, a field that allows a number with three digits left of

the decimal and two digits right is indicated as "999.99." The number in the "Text Data" column indicates the number of text or numeric characters permissible. For both numeric and text data, the number of digits and characters indicated is a maximum.

Table 4.5 HPMS Data Items, Formats, and Source

Data Item	Numeric Value	Text Value	Date Value	Software Calculated	FHWA Provided
Year_Record			yyyy		
State_Code	Codes: 1 - 76				
Route_ID		32			
Begin_Point	99999.999				
End_Point	99999.999				
Section_Length	99999.999				
Sample_Identifier				Yes	
Standard_Sample_Exp_Factor				Yes	
Standard_Sample_Volume_Group				Yes	
County_Code [1]				Yes	
Urban_Code	99999				
Rural_Urban				Yes	
F_System	Codes: 1 - 9				
NonAtt_Code [1]	99999	Code		Yes	
NHS	Codes: 1 - 9		mm/yyyy		Yes
Future_Facility	Codes: 1 - 2				Yes
STRAHNET	Codes: 1 - 2		mm/yyyy		Yes
Truck_Net	Code: 1		mm/yyyy		Yes
Route_Signing	Codes: 1 - 10				
Route_Qualifier	Codes: 1 - 10				
Route_Prefix		2			
Route_Number	99999	Char(50)			
Route_Suffix		2			
Alternative_Route_Name		50 (optional)			
Ownership	Codes: 1 - 80				
Facility_Type	Codes: 1 - 5				
Is_Structure	Codes: 0 - 1				
Through_Lanes	99				
Toll	Codes: 1 - 2	Toll ID: 20	mm/yyyy		
Special_Toll_Lanes	Codes: 1 - 2				
Turn_Lanes_L	Codes: 1-7				
Turn_Lanes_R	Codes: 1-7				
Peak_Lanes	99				
Counter_Peak_Lanes	99				
HOV_Lanes	99				
HOV_Type	Codes: 1 - 3				
AADT	999999				

Table 4.5 HPMS Data Items, Formats, and Source

Data Item	Numeric Value	Text Value	Date Value	Software Calculated	FHWA Provided
Future_AADT	999999		yyyy		
Pct_Peak_Single	99.9				
AADT_Single	999999				
Pct_Peak_Combination	99.9				
AADT_Combination	999999				
K_Factor	99.9				
Dir_Factor	99.9				
Peak_Capacity	999999			Yes	
Volume/Service_Flow_Ratio	999.99			Yes	
Access_Control	Codes: 1 - 3				
Lane_Width	99.9				
Median_Type	Codes: 1 - 7				
Median_Width	99.9				
Shoulder_Type	Codes: 1 - 7				
Shoulder_Width_R	99.9				
Shoulder_Width_L	99.9				
Peak_Parking	Codes: 1 - 3				
Widening_Obstacle		Codes: X,A-G			
Widening_Potential	9				
IRI	999		mm/yyyy		
PSR	99.9				
Rutting	99.9				
Faulting	99.9				
Cracking_Fatigue	99.9				
Cracking_Transverse	99.9				
Surface_Type	Codes: 1 - 12				
Climate_Zone	Codes: 1 - 4				Yes
Year_Last_Improvement			yyyy		
Year_Last_Construction			yyyy		
Last_Overlay_Thickness	99.9				
Thickness_Rigid	99.9				
Thickness_Flexible	99.9				
Base_Type	Codes: 1 - 80				
Base_Thickness	99.9				
Soil_Type	Codes: 1 - 2				Yes
Curves [1]	Codes: 1 - 6				
Length_Class_A_Curves	Codes: 1 - 6			Yes	
Length_Class_B_Curves	Codes: 1 - 6			Yes	
Length_Class_C_Curves	Codes: 1 - 6			Yes	
Length_Class_D_Curves	Codes: 1 - 6			Yes	
Length_Class_E_Curves	Codes: 1 - 6			Yes	

Table 4.5 HPMS Data Items, Formats, and Source

Data Item	Numeric Value	Text Value	Date Value	Software Calculated	FHWA Provided
Length_Class_F_Curves	Codes: 1 - 6			Yes	
Horizontal_Alignment_Adequacy	Codes: 1 - 4			Yes	
Terrain_Type	Codes: 1 - 3				
Vertical_Alignment_Adequacy	Codes: 1 - 4			Yes	
Grades [1]	Codes: 1 - 6				
Length_Class_A_Grades	Codes: 1 - 6			Yes	
Length_Class_B_Grades	Codes: 1 - 6			Yes	
Length_Class_C_Grades	Codes: 1 - 6			Yes	
Length_Class_D_Grades	Codes: 1 - 6			Yes	
Length_Class_E_Grades	Codes: 1 - 6			Yes	
Length_Class_F_Grades	Codes: 1 - 6			Yes	
Pct_Pass_Sight	99.9				
Weighted_Design_Speed	99.9			Yes	
Speed_Limit	99				
Type_Signal	Codes: 1 - 5				
Pct_Green_Time	99.9				
Number_Signals	99				
Stop_Signs	99				
At_Grade_Other	99				

1 – Data Items not included in Sample Panel.

4.5.2 Coding of Section Data

As previously mentioned, each data item in the new data model is treated as an independent value. This means that when coding the data, States only need to indicate where data are present and where the values change. Each data item will contain five common fields that are used for linking the data to the State provided geospatial network. These linking variables are: Year Record, State Code, Route ID, Begin Point, and End Point. In addition, each record will also contain the variable Section Length.

All data records will have the following format:

Year Record, State Code, Route ID, Begin Point, End Point, Section Length, Data Item Code, Numeric Value, Text Value, Date Value.

For example, the functional classification for Interstate 80 in Nebraska would be coded as:

2009, 31, 80, 0, 455.27, F_System, 1, ,

The *HPMS Data Specifications* and *Field Manual* both provide additional examples and instructions on the proper coding of the section specific data.

4.6 SAMPLE DATA

A primary requirement for HPMS is to provide an input file for various FHWA models including those used to for the Biennial *Conditions and Performance Report to Congress*, often referred to as the *C&P Report*. These models include the Highway Economic Requirements System (HERS) and the FAF. The models produce Nationals level estimates of current and future highway system conditions and needs. Statistically accurate results are obtained by modeling highway system use and performance using a set of sample data, which in whole is referred to as the "sample panel." The sample panel typically comprises roughly 10% of all Federal-aid eligible roads.

The method for determining the sample panel has its roots in standard statistical principles. The number of samples required is based on the variability of the traffic counts (AADT) within a given Functional System. The current HPMS data model requires States to determine each sample and collect the individual data items based on the limits of that sample. Often States have to summarize data for each sample section since most data items don't have concurrent termini.

The new data model will make greater use of "raw" non-summarized HPMS data and build the sample panel as a view or extract of data that falls within calculated and selected limits. The same statistical principles using AADT will be used to stratify each functional system and determine the number of necessary samples. The limits of the randomly selected samples will be applied to the raw data and values for each data item will be aggregated for each sample section. The sample panel is only a view, so there is no modification or destruction of data. Expansion of the sample sections will not change from the existing data model.

4.6.1 Creation of the Sample Panel

As previously described, the sample panel will be a virtual file or "view" of calculated values within the new data model. The limits of the sample panel are created using a set of "core" data items. The resulting sample sections are homogenous for these core data items. The data model will create a universe of potential sample sections based on the spatial intersection of the core data. These data items are NHS, F_System, Urban_Code, Through_Lanes, Facility_Type, Is_Structure, and AADT. The Ownership data item will be aggregated between state and off-state and be used as the last core data item. Figure 4.6.1 illustrates how breaks in the core data, represented by the orange, green, and blue bars are used to determine the limits for the sample sections represented by the red bar.

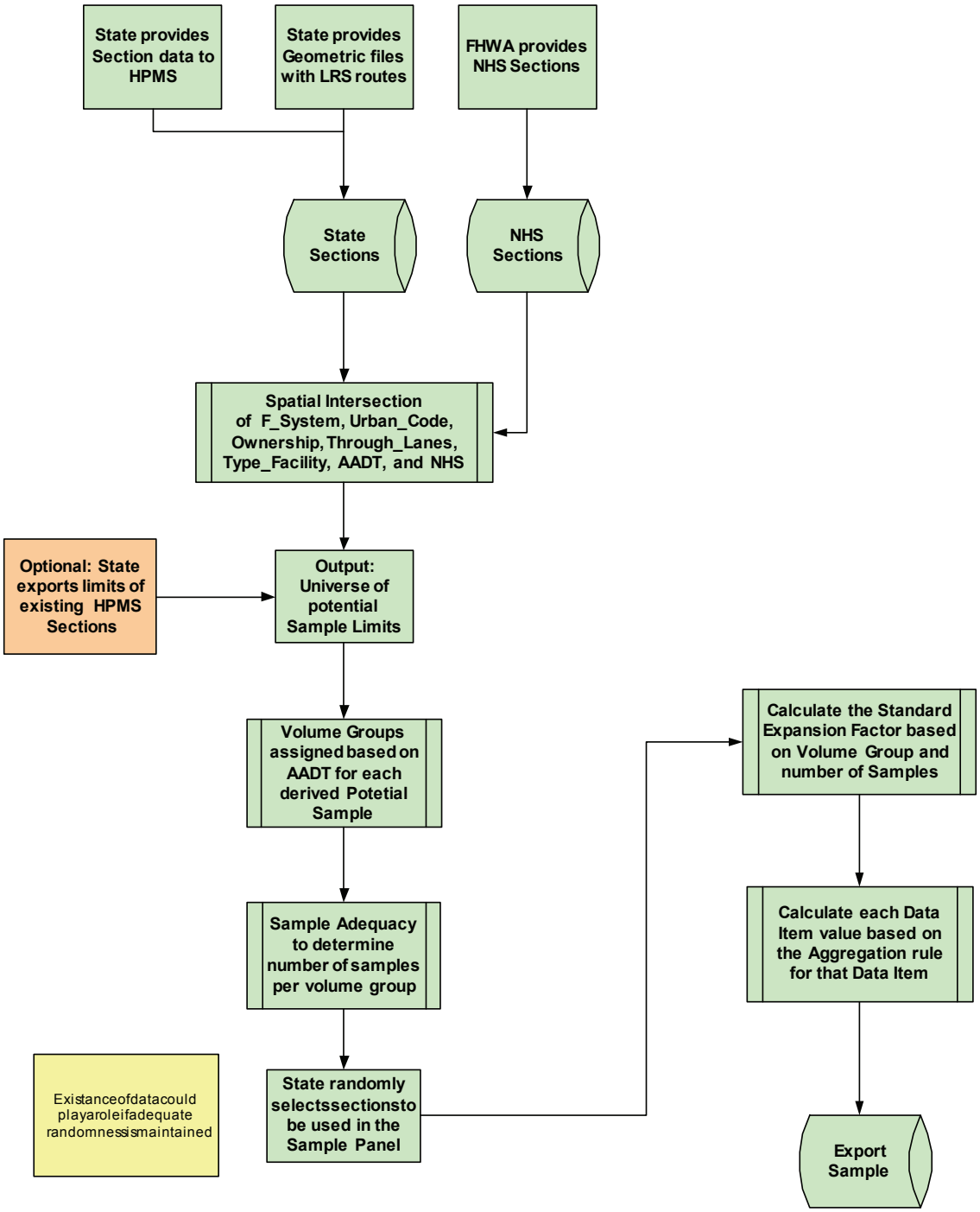
Figure 4.6.1 Determining the Sample Sections

As the pool of potential samples is created, volume groups are assigned, and sample adequacy procedures are run to determine the necessary number of samples per volume group. At this point the sample sections are ready to be randomly selected, either by the HPMS software or the State. All efforts are being made to accommodate the use of existing State sample panels within the data model.

Once the sample sections have been selected, the limits of each sample section are used to summarize information from the section data. This is done using the aggregation rules to determine one value that is represents the entire sample section. The data model also uses section data to calculate some additional data fields, which include Capacity, Design_Speed, and Volume/Service Flow.

Figure 4.6.2 provides an overview of the process used for creating the Sample Panel.

Figure 4.6.2 Sample Panel Determination



The following table contains a list of the data items that are used by the data model to create the sample panel. Please refer to the *HPMS Data Specifications* and *HPMS Field Manual* for a description of each data item, where they are required, and the proper coding.

Table 4.6 Data Items Used in Creating the Sample Panel

Year Record	Counter Peak Lanes	Rutting
State Code	HOV Lanes	Faulting
Route ID	HOV Type	Cracking Fatigue
Begin Point	AADT	Cracking Transverse
End Point	Future AADT	Surface Type
Section Length	Pct Peak Single	Year Last Improvement
Urban Code	AADT Single	Year Last Construction
F System	Pct Peak Combination	Last Overlay Thickness
Route Signing	AADT Combination	Thickness Rigid
Route Qualifier	K Factor	Thickness Flexible
Route Prefix	Dir Factor	Base Type
Route Number	Access Control	Base Thickness
Route Suffix	Lane Width	Terrain Type
Alternative Route Name	Median Type	Pct Pass Sight
Ownership	Median Width	Speed Limit
Facility Type	Shoulder Type	Type Signal
Is Structure	Shoulder Width R	Pct Green Time
Through Lanes	Shoulder Width L	Number Signals
Toll	Peak Parking	Stop Signs
Special Toll Lanes	Widening Obstacle	At Grade Other
Turn Lanes L	Widening Potential	Curves
Turn Lanes R	IRI	Grades
Peak Lanes	PSR	

The export of the sample panel in the new data model will be very similar to the existing export function and will be in the same comma separated variable format.

5.0 Impacts of Reassessment

5.1 OVERVIEW

As stated earlier, the HPMS Reassessment process has been iterative. Comments, questions, and concerns from data users and collectors have been considered and addressed throughout. The Issue papers were established as the main vehicle for communicating recommended changes. They were initially written to reflect HPMS user needs at the Federal level. The Office of Highway Policy Information acted as a neutral party to identify necessary changes to HPMS and then to obtain feedback regarding the changes under consideration with HPMS data collectors. The Issue papers were subsequently revised and rewritten to take into account comments and concerns from data collectors during the extensive feedback process (workshops, webinars, surveys, docket, etc.)

In many cases, recommendations were changed significantly to address collector concerns. For example, original recommendations suggested obtaining off-system traffic and roadway data to support safety analysis. Subsequent concerns from state data providers resulted in concluding that off-system data should be sought from other non-HPMS sources. In some cases, surveys and feedback revealed that data previously assumed not to be available, are actually available. The example of interchange data is appropriate here. The process was a constant balancing act between needs at the Federal level and abilities to collect data at the state level.

The potential impact of the recommended changes on the states varies considerably. The surveys conducted during the webinars revealed that many states are well positioned to report on some additional data items. For example, most are in a good position to transition to spatial submittal of HPMS data while other states are not as advanced in terms of Geographic Information System (GIS) development and use within their states.

As discussed in Section 4.0, the recommended changes fall into three categories. Analysis of the overall potential impacts is difficult because one must take into account different timeframes for changes as well as changes to both collection and processing of HPMS data. Some perceived negative impacts of additional data items may potentially be offset by positive changes in the processing of HPMS data. For example, the impact of the collecting of pavement data on a more regular cycle may result in an increased collection burden to some states. In many states, the additional burden may be offset by the reduced amount of data processing and manipulation required with the new data model as the model is solidified and states' processes to submit are programmed, tested and become routine. Additionally, states should consider the benefits the additional data will have on improved analysis capabilities of pavement needs, both at the state and national levels. Even more important to the states is the fact that the HPMS Reassessment as a complete package will result in positive impacts to users. Unfortunately, the timing of Reassessment changes varies considerably as

well. While additional collection may be requested within the next year or two, improvements to processing and sampling may not occur for three to five years. The schedule of implementation will depend on funding available to continue research and develop solutions in the areas of Data Quality and Process Improvement.

5.2 ANALYSIS OF HPMS ITEMS RECOMMENDED FOR CHANGE

The following table (Table 5.2) shows the items to be changed and those recommended for short-term study. It includes specific changes recommended, proposed timing for the change, and an estimate of level of effort to collect the data. Level of effort is a qualitative assessment derived from webinars and other stakeholder feedback.

Table 5.2 Estimated Level of Impact for New and Changed Data Items

New / Change	Date item description	Description of change or new data	Level of effort
Change	Route ID	Route identification portion of LRS	-1
Change	Begin Point	LRS beginning point	-1
Change	End Point	LRS ending point	-1
Change	Urban Code	Adopt new Census Urban Codes	0
Change	Functional System Code	Eliminate rural / urban bifurcation	1
Change	National Highway System Code	FHWA to provide	-1
Change	Route Number	Slight change to coding	1
Change	Ownership	Make consistent with bridge	1
Change	Facility Type	Slight change to coding, added ramps as type of facility	2
Change	HOV Type	Slight change to coding	1
Change	AADT	Require for all Federal-aid eligible roads	2
Change	Future AADT	Add future AADT year as attribute	0
Change	Percent Peak Single Trucks	Carry to nearest 0.1%, not rounded and not zero	1
Change	AADT Single Trucks	Report actual volume, not percent	1
Change	Percent Peak Combination Trucks	Carry to nearest 0.1%, not rounded and not zero	1
Change	AADT Combination Trucks	Report actual volume, not percent	1
Change	Median Type	Slight change to coding	0
Change	Widening Potential	Slight change to coding	1
Change	IRI	Report annually for NHS and include bridges and RR crossings	3
Change	Surface Type	Change in code, can provide estimate if unknown	1
Change	Climate Zone	FHWA to provide	-1
New	Route Prefix	Where applicable, add route prefix	1
New	Route Suffix	Where applicable, add route suffix	1
New	Alternative Route Name	Optional field	0
New	Is Structure	Location of bridges, currently included in Facility Type	1
New	Special Toll Lanes	Where applicable, identify if toll in both directions or only one	1
New	Counter Peak Lanes	Identify number of lanes in counter peak direction	1
New	HOV Lanes	Where applicable, identify number of toll lanes	1
New	Widening Obstacle	Identify obstacle to widening	1
New	Rutting	Measured pavement rutting	2
New	Faulting	Measured pavement faulting	2
New	Cracking Fatigue	Measured pavement fatigue cracking	2
New	Cracking Transverse	Measured pavement transverse cracking	2
New	Year Last Construction	Year of last construction, leave blank if unknown	1
New	Last Overlay Thickness	Thickness of last overlay, can provide estimate if unknown	1
New	Thickness Rigid	Rigid pavement thickness, can provide estimate if unknown	1
New	Thickness Flexible	Flexible pavement thickness, can provide estimate if unknown	1
New	Base Type	Type of base material, can provide estimate if unknown	1
New	Base Thickness	Base thickness, can provide estimate if unknown	1
New	Soil Type	FHWA to provide	-1

New / Change	Date item description	Description of change or new data	Level of effort
New	Curves	Location and severity or class of curves	2
New	Grades	Location and severity or class of grades	2

Level of Effort Scale
-1 – Improvement, less effort than now.
0 – Relatively no change in level of effort
1 – Can be generally accommodated within the current or planned data collection structure within most state DOTs.
2 – May result in some burden to some states (will require change to collection process and/or additional resources).
3 – Will result in additional collection/coordination burden on most states i.e., pavement.

5.3 HPMS ITEMS RECOMMENDED FOR ADDITION

Table 5.3 shows which data items are proposed to be added to HPMS. The items are sorted by type of item (traffic, pavement, interchanges, capacity, and inventory) and by proposed year of implementation. The table indicates the item name; timing, level of effort (as defined above) whether the universe or sample is impacted; and if a table description is being requested.

Table 5.3 New Data Item - Timing, Level of Effort, and Extent

Data item	Reporting year	Level of effort	Universe	Sample	Summary/ Description
Route Prefix	2010	1	X		
Route Suffix	2010	1	X		
Alternative Route Name	2010	0	X		
Is Structure	2010	1	X		
Special Toll Lanes	2010	1	X		
Counter Peak Lanes	2010	1		X	
HOV Lanes	2010	1	X		
Widening Obstacle	2010	1		X	
Rutting	2010 & 2011	2		X	
Faulting	2010 & 2011	2		X	
Cracking Fatigue	2010 & 2011	2		X	
Cracking Transverse	2010 & 2011	2		X	
Year Last Construction	2010 & 2011	1		X	
Last Overlay Thickness	2010 & 2011	1		X	X
Thickness Rigid	2010 & 2011	1		X	X
Thickness Flexible	2010 & 2011	1		X	X
Base Type	2010 & 2011	1		X	X
Base Thickness	2010 & 2011	1		X	X
Soil Type	2010	-1		X	
Binder Type	2010	1			X
Dowel Bars	2010	1			X
Joint Spacing	2010	1			X
Curves	2010	2		X	
Grades	2010	2		X	

Level of Effort Scale
-1 – Improvement, less effort than now.
0 – Relatively no change in level of effort
1 – Can be generally accommodated within the current or planned data collection structure within most state DOTs.
2 – May result in some burden to some states (will require change to collection process and/or additional resources).
3 – Will result in additional collection/coordination burden on most states i.e., pavement.

5.4 FUNDING THE CHANGES TO HPMS

Throughout the HPMS Reassessment there have been discussions regarding data collection burden and funding the changes to HPMS. FHWA realizes that States

are working under constrained budgets and that any increase in the cost of collecting and reporting data is a concern. These concerns have been taken very seriously and FHWA has worked very hard to minimize the data collection burden while still providing the data needed for national-level transportation analysis. The anticipated burden, however, may provide many states and stakeholders with more easily reportable data, thus reducing the HPMS reporting burden.

Unlike other Federal data programs, there are no dedicated (earmarked) funds for the collection, reporting, and maintenance of HPMS. Within FHWA, the primary source of funding for HPMS is discretionary research funds. States are able to use a number of different types of federal funds for collecting and reporting HPMS data. Most often, States use their State Planning and Research (SPR) funds for collecting HPMS data. SPR funds are distributed to States by apportionment formula from the Highway Trust Fund by FHWA. One of the intended uses of SPR funds is the collection of HPMS and other data. However, States are not required to use these or any other Federal funds for collecting HPMS data; how States fund their data collection activities is left entirely to the discretion of each State.

Decisions that States make can have a direct impact on the amount of Federal-aid funds they receive as well as on the resources needed to collect data. As previously mentioned, HPMS data are used in many of the apportionment formulae. The quality of the HPMS data therefore has a direct impact on the Federal funds that they receive. By not funding data collection, States run the risk of not receiving their fair share of Federal Funds.

Furthermore, the systems for which States are required to submit HPMS data are directly correlated to those functional systems that are eligible for Federal funds. States, in cooperation with their cities and counties, are responsible for determining the functional classification of every public road; thus determining what roads will be eligible for Federal funds, and where HPMS data are ultimately required. In 2006, approximately 25% of all public roads were eligible for Federal-aid based on their functional classification. However, this number varied significantly from State to State ranging from 18% to 36%, with seven States less than 20% and 5 States with more than 30%. The impact on States varies by data item, with AADT data being required for 100% of all Federal-aid eligible roads, to the pavement data items that are only required on a sample of all Federal-aid eligible roads.

6.0 Next Steps

The second phase of HPMS Reassessment activities should completely wind down by the end of summer 2008 with the final phase (implementation) beginning at roughly the same time. The following is a brief summary of the remaining phase two activities:

- The HPMS Field Manual is in the process of being rewritten. A draft version was distributed at the HPMS Reassessment Workshop in March 2008; the final version will be available by late summer 2008.
- The HPMS Data Specifications (version 9) have been finalized and distributed to States and FHWA Division Offices; the document has also been posted on the HPMS web site.
- A memorandum to the FHWA Division Offices and States concerning the changes to the coding of Functional Classification will be sent out in the near future.

The phase three implementation activities generally fall under two broad categories: training and research. The distinction between the two categories is that research projects are dependant on the availability of discretionary research funds, where the training activities are not. Within the training category are formal and in impromptu training, which cover the gamut of HPMS topics from data collection, to using the HPMS software. The following table outlines the types of training and research currently planned or under consideration, and the approximate beginning and end dates where applicable.

Table 6.1 Overview of Future HPMS Training and Research

Category	Description	Begin	End
Impromptu Training	FHWA remote training & support	Immediately	Ongoing
	FHWA onsite training & support	October 2008	Ongoing
Formal Training	Highway Information Seminar	Annually each November	
	HPMS Workshop	Annually each February or March	
	Software and Data Model Webinars	January 2009	Ongoing
	Data Collection Webinars	January 2009	Ongoing
	National or regional training	January 2009	As needed
	Develop NHI Course	January 2009	June 2009, ongoing
Research	Computer or web based training	January 2009	June 2009, ongoing
	Feasibility of national sample	Fall 2009	Fall 2010
	Impact of revising K & D Factors	Summer	Fall 2010
	Feasibility of new sampling schema	Spring 2011	Spring 2012

As previously mentioned, the availability of discretionary research funds will determine the amount of research that FHWA will be able to undertake. Regardless of funding, FHWA is committed to providing training and technical support to the States and data users. In the absence of research funds, FHWA will pursue a pooled-fund study to develop the web based training application that would allow State and Division Office staff to learn about the new HPMS at their own pace.

For further information, contact the Office of Highway Policy Information at 202-366-0175 or go to the FHWA Site at http://www.fhwa.dot.gov/policy/ohpi/hpms/hpmsreassessment.cfm. Detailed meeting notes and summaries can be found on the Docket at http://www.regulations.gov/search/index.jsp. Once there, please refer to Docket # 23638.

Appendix A:
Acronyms and Abbreviations

AADT:	Annual Average Daily Traffic
AASHTO:	American Association of State Highway Transportation Officials
AC:	Asphalt "Bituminous" Concrete
AP:	Analytical Process
ARS:	Average Rectified Slope
ASTM:	American Society for Testing and Materials
ATR:	Automatic Traffic Recorder
AWT:	Average Weekday Traffic
BTS:	Bureau of Transportation Statistics
CAAA:	Clean Air Act Amendments
CD:	Collector-Distributor
CFR:	Code of Federal Regulations
CO:	Carbon Monoxide
Col:	Collector
CRCP:	Continuously Reinforced Concrete Pavement
CSV:	Comma Separated Value
C.V.:	Coefficient of Variation
DLG:	Digital Line Graphs
DOT:	Department of Transportation
DVKT:	Daily Vehicle-Kilometers of Travel
DVMT:	Daily Vehicle-Miles of Travel
EPA:	Environmental Protection Agency
ESAL:	Equivalent Single Axle Load
FA:	Federal-Aid
FAF	Freight Analysis Framework
FAP:	Federal-aid Primary
FHWA:	Federal Highway Administration
FIPS:	Federal Information Processing Standards
FMCSA:	Federal Motor Carrier Safety Administration
GIS:	Geographic Information System
GPRA:	Government Performance & Results Act
HCM:	Highway Capacity Manual
HERS:	Highway Economic Requirements System
HOT:	High Occupancy Toll
HOV:	High Occupancy Vehicle
HPMS:	Highway Performance Monitoring System
ID:	Section Identification
IM:	Interstate Maintenance
Int:	Interstate
IRI:	International Roughness Index
ITS:	Intelligent Transportation System
JPCP:	Jointed Plain Concrete Pavement
JPEG:	Joint Photographic Experts Group
JRCP:	Jointed Reinforced Concrete Pavement
KMPT:	Kilometer point
Loc:	Local
LRS:	Linear Referencing System
LTPP:	Long Term Pavement Performance
MA:	Minor Arterial
MaC:	Major Collector
MiC:	Minor Collector
MPH:	Miles per Hour
MPO:	Metropolitan Planning Organization
MPT:	Mile point
MRI:	Mean Roughness Index
NAAQS:	National Ambient Air Quality Standards
NCHRP:	National Cooperative Highway Research Program
NHPN:	National Highway Planning Network
NHS:	National Highway System
NHTSA:	National Highway Traffic Safety Administration
NIST:	National Institute of Standards and Technology
NN:	National Freight Network
OFE:	Other Freeways and Expressways
OPA:	Other Principal Arterial
PAS:	Principal Arterial System
PAS/NHS:	Principal Arterial System/National Highway System
PC:	Personal Computer
PCC:	Portland Cement Concrete
PK:	Primary Key
PMS:	Pavement Management System
PSI:	Present Serviceability Index
PSR:	Present Serviceability Rating
ROW:	Right-of-Way
RTRRM:	Response Type Road Roughness Meter
R/U:	Rural/Urban
SAFETEA-LU	Safe Accountable Flexible Efficient Transportation Equity Act: A Legacy for Users
SHA:	State Highway Agency
SHRP:	Strategic Highway Research Program
SI:	International System

SN or D:	Structural Number (SN) of Flexible Pavement or Thickness (D) of rigid Pavement
SPR:	Statewide Planning and Research
STAA:	Surface Transportation Assistance Act
STP:	Surface Transportation Program
STRAHNET:	Strategic Highway Corridor Network
TEA-21:	Transportation Equity Act for the 21st Century
THS:	Territorial Highway System
TMG:	Traffic Monitoring Guide
TMS:	Traffic Monitoring System
UK:	Unique Key
U.S.:	United States
U.S.C.:	United States Code
USGS:	United States Geological Survey
VDT:	Vehicle Distance Traveled
VKT:	Vehicle Kilometers of Travel
VMT:	Vehicle-Miles of Travel
V/SF:	Volume/Service Flow Ratio
WDS:	Weighted Design Speed
4D:	Four Dimensional
90-10:	90-Percent Confidence Level with 10-Percent Allowable Error

Appendix B:
Definitions

This appendix contains definitions to be used in preparing HPMS data for FHWA. Specific details addressing summary, universe, and sample data, and LRS (linear referencing system) data are later in this document and in the forthcoming *HPMS Field Manual*. This chapter along with the subsequent chapters provides necessary definitions, guidelines, coding instructions, reporting formats, and update specifications necessary to facilitate the reporting of current, consistent, and uniform data on a nationwide basis.

Aggregation Business Rule: It describes how the HPMS database and software will aggregate data as the sample view is created. Typically rules include: weighted average, predominance, proportional, or sum.

Certification of Public Road Mileage: An annual document furnished by each state to FHWA certifying the total public road length in the State as of December 31st. This document is to be signed by the Governor of the State or by his/her designee and provided to FHWA by June 1st of the year following (23 CFR 460). See the definition of "Public Road".

Collection Cycle: The period for which the data are collected; typically annually or every 2- or 3-years.

Collection Requirements: Description of data collection requirements to ensure consistency. For example, for IRI, we will be requiring States to include bridges. This goes beyond a reporting requirement in that we expect every State to follow these procedures when collecting the data.

Combination Truck: Any multi-unit vehicle described by vehicle types 8-13.

Comment File: A text file that accompanies the HPMS data submittal to FHWA. It explains data issues, problems, deficiencies, unusual conditions, and any significant changes from the previous HPMS submittal. It should be provided as an electronic file attached to the HPMS submittal.

Confidence Level/Precision Level: The degree of accuracy resulting from the use of a statistical sample. For example, if a sample is designed at the 90-10 confidence (precision) level, the resultant sample estimate will be within ±10 percent of the true value, 90 percent of the time.

(Data) Description: Short description of the data and where used. The bulk of the *HPMS Field Manual* work will revolve around expanding on this text.

D-Factor: The proportion of traffic moving in the peak direction of travel during peak hours is denoted as D-factor. The D-factor is an important factor in highway capacity analysis, especially for two-lane rural highways.

Divided Highway: A multi-lane facility with a curbed or positive barrier median or a median that is at least 1.2 meters (4 feet) or wider.

Valid values: Describes the actual data to be coded; includes the range of expected values and possible codes.

English Units: The term "English" refers to the United States legislative interpretation of the units as defined in a document prepared by the National Institute of Standards and Technology (NIST), U.S. Department of Commerce, Special Publication 330. Commonly used English units in HPMS are miles, feet, and inches.

Expressway: A divided highway facility with partial control of access and two-or-more lanes for the exclusive use of through traffic in each direction; includes grade separations at most major intersections.

Extent: Where the data are required: functional system, NHS, Sample, paved etc.

Federal-Aid Highways: All NHS routes and other roads functionally classified as Interstate, Other Freeways & Expressways, Other Principal Arterials, Minor Arterials, Major Collectors, and Urban Minor Collectors.

FHWA-Approved Adjusted Census Urban Boundary: Designated boundaries of a Census urban place or urbanized area as adjusted by responsible State and local officials in cooperation with each other, subject to the approval by FHWA (23 U.S.C. 101). Urban and rural data in HPMS must be reported in accordance with FHWA-approved adjusted boundaries.

Freeway: A divided highway facility with full control of access and two or more lanes for the exclusive use of through traffic in each direction.

Functional Systems: Functional systems result from the grouping of highways by the character of service they provide. The functional systems designated by the States in accordance with 23 CFR 470 are used in the HPMS. Guidance criteria and procedures are provided in the FHWA publication *Highway Functional Classification: Concepts, Criteria, and Procedures*, March 1989, as amended. In addition, interim guidance has been issued by FHWA, spring 2008.

Geographic Information System (GIS): A system for the management, display, and analysis of spatial information.

Geospatial Data: The HPMS geospatial data provide a linear referencing system for the universe and sample data on selected highway functional systems. The represented functional systems include Interstate, Other Freeways & Expressways, Other Principal Arterials, Minor Arterials, Major Collectors, Urban Minor Collectors, and all National Highway System (NHS) routes and connectors. This permits the analyses of HPMS data in a GIS environment.

Highway: The term highway includes roads, streets, and parkways and all their appurtenances (23 U.S.C. 101).

K-Factor: The proportion of annual average daily traffic occurring in the analysis period. For rural highways, the proportion has often been assumed to occur at the 30th highest hour, which is often used as the basis for estimates of design-hour volume. For urban roadways, a design hour for the repetitive weekday peak periods is common.

Linear Referencing System (LRS): A set of procedures for determining and retaining a record of specific points along a highway. Typical methods used are kilometerpoint (milepoint), kilometerpost (milepost), reference point, and link-node.

LRS Data: Provides a linear referencing system for the universe and sample data on selected highway functional systems.

Maintenance Area: Any geographic region of the Unites States previously designated non-attainment pursuant to the CAA Amendments of 1990 and subsequently redesigns Ted to attainment subject to the requirement to develop a maintenance plan under Section 175A of the CAA, as amended. HPMS data are used for travel tracking for air quality assurance purposes in non-attainment and maintenance areas as required by EPA under the 1990 CAAA (Section 187) and the Transportation Conformity Rule, 40 CFR parts 51 and 93. More specifically, these data are used primarily for establishing regional transportation-related emissions for transportation conformity purposes. Estimated travel based on these data is used for calibration and validation of base-year network travel models when required for non-attainment or maintenance areas.

Metadata: Describes how data are collected or converted for reporting; explains variations in data that do not warrant the establishment of a collection requirement e.g. type of equipment used, sampling frequency etc.

Metric Units: The term "metric" refers to the modernized metric system known as the International System (SI). Further information is available under Nest's Special Publication 811, titled *Guide for the Use of the International System of Units: the Modernized Metric System* and *the American Society for Testing and Materials (ASTM) Standard E380-89a*. Commonly used metric units in the HPMS are kilometers, meters, and millimeters.

Metropolitan Planning Organization (MPO): The term MPO is used in HPMS as defined in 23 U.S.C. 134.

National Ambient Air Quality Standards (NAAQS) Non-attainment Area: Any geographic region of the United States which has been designated under Section 107 of the Clean Air Act for any pollutant for which a national ambient air quality standard exists. HPMS data are used for travel tracking for air quality assurance purposes in non-attainment and maintenance areas as required by EPA under the 1990 CAAA (Section 187) and the Transportation Conformity Rule, 40 CFR parts 51 and 93. More specifically, these data are used primarily for establishing regional transportation-related emissions for transportation conformity purposes. Estimated

travel based on these data is used for calibration and validation of base-year network travel models when required for non-attainment or maintenance areas.

National Highway System (NHS): The National Highway System is a network of nationally significant highways approved by Congress in the National Highway System Designation Act of 1995. It includes the Interstate System and over 116,000 miles of other roads and connectors to major intermodal terminals. All NHS routes and connectors must be identified in the HPMS.

National Network: These are the routes designated for use by dimensioned commercial vehicles under the Surface Transportation Assistance Act (STAA) of 1982 as identified in 23 CFR 658, Appendix A. Nationally designated truck routes include the Interstate System (a few sections are exempted by Federal law in Minnesota, Virginia, and District of Columbia); non-Interstate routes specifically listed in 23 CFR, Appendix A, as amended, and the other non-Interstate existing Federal-Aid Primary (FAP) routes as defined prior to June 1, 1991, that STAA-dimensioned commercial vehicles may legally operate on.

Some States have allowed STAA-dimensioned commercial vehicles to operate on other State routes. These and other non-national truck network roads used between the STAA national network and terminals and facilities for food, fuel, repairs, and rest under the reasonable access rule are not nationally designated truck routes. These routes are not to be included.

PK: Primary Key – It indicates the data fields used for linking data in a table with data in other tables.

Public Road: A public road is any road or street owned and maintained by a public authority and open to public travel. [23 U.S.C. 101(a)] Under this definition, a ferryboat route is not a public road.

- The term "maintenance" means the preservation of the entire highway, including surfaces, shoulders, roadsides, structures, and such traffic-control devices as are necessary for safe and efficient utilization of the highway. [23 U.S.C. 101(a)]
- To be open to public travel, a road section must be available, except during scheduled periods, extreme weather or emergency conditions, passable by four-wheel standard passenger cars, and open to the general public for use without restrictive gates, prohibitive signs, or regulation other than restrictions based on size, weight or class of registration. Toll plazas of public toll roads are not considered restrictive gates. [23 CFR 460.2(c)]
- A public authority is defined as a Federal, State, county, town or township, Indian tribe, municipal or other local government or instrumentality with authority to finance, build, operate, or maintain toll or toll-free facilities. [23 U.S.C. 101(a)]

Roadway: The portion of a highway intended for vehicular use.

Rural Areas: All areas of a State outside of the FHWA-approved adjusted Census boundaries of small urban and urbanized areas.

Single-Unit Truck: Any single-unit vehicle described by vehicle types 4-7.

Small Urban Areas: Small urban areas are defined by Census as places of 5,000 to 49,999 urban populations (except in the case of cities in Maine and New Hampshire) outside of urbanized areas. As a minimum, a small urban area includes any place containing an urban population of at least 5,000 as designated by Census. Designated boundaries of an urban place (or urban cluster) can be adjusted by responsible State officials subject to approval by FHWA (23 U.S.C. 101). Urban and rural data in HPMS must be reported in accordance with FHWA-approved adjusted boundaries. Area revisions as needed are expected to be submitted especially shortly after the latest Decennial (or special) Census information becomes available.

Sample Data: These data consist of additional inventory, condition, use, pavement, operational, and improvement data that complement the universe data for those sections of roadway that have been selected as samples. When expanded through use of an appropriate expansion factor, the data represents the entire universe from which the sample was drawn, permitting evaluation of highway system performance. The sample sections form nominally "fixed" panels of road segments that are monitored on an established cyclical basis. Samples can be added or deleted from the sample panels as the need arises.

Panels of roadway sections are established using a statistically designed sampling plan based on the random selection of road segments at predetermined precision levels. The sample is stratified by area, by functional system, and by traffic volume group. Sample selection is done randomly within each stratum (a predetermined AADT volume group) for each arterial and major collector functional highway system in rural, and for each arterial and collector functional system in small urban and urbanized areas of the State.

Each urbanized area needs to be sampled individually. Rural and small urban areas (populations of 5,000 to 49,999) are sampled collectively statewide.

Sample Sections: Sections selected at random from the universe of arterial and collector systems (excluding rural minor collector) for which additional physical and operational data elements are reported along with the universe data.

State (Codes): The term "State" refers to any one of the 50 States, the District of Columbia, or the Commonwealth of Puerto Rico. The Federal Information Processing Standard Codes for States (FIPS PUB 5-2) are included in Appendix A.

Strategic Highway Network (STRAHNET): The STRAHNET includes highways which are important to the United States strategic defense policy and which provide defense access, continuity, and emergency capabilities for the movement of personnel, materials, and equipment in both peacetime and war time.

Structures: A structure including supports erected over a depression or an obstruction, such as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads, and having an opening measured along the center of the roadway of more than 20 feet (6.1 meters) between under copings of abutments or spring lines of arches, or extreme ends of openings for multiple boxes; it may also include multiple pipes, where the clear distance between openings is less than half of the smaller contiguous opening. Structures can include tunnels.

Summary Data: These data consist of annual summary reports for certain data not included in the HPMS universe and sample data set for the rural minor collector and local functional systems. Summary data must be coded manually onto the several summary screens contained in the HPMS submittal software. These additional data are derived from State and local sources such as statewide highway databases, management systems, Intelligent Transportation Systems (ITS) and traffic monitoring systems, and data made available from local governments and MPOs.

System Length: The total length of public roads as of December 31st of a data year that is to be reported via HPMS (see definition of public road). System length includes all public roads owned by Federal, State, and local governments, or instrumentality thereof, within the boundaries of the reporting State. Planned, un-built facilities on the NHS are also reported in the HPMS system length.

UK: Unique Key – It is used to uniquely identify each section record in the table. There can be one and only one row with each unique key value.

Universe Data: Data representing total system length including National Highway System length not yet built or open to traffic. These data consist of a complete inventory of length (kilometers or miles) by functional system, jurisdiction, geographic location, (rural, small urban and urbanized areas) and other selected characteristics. Universe data fully reflect all open-to-traffic public roads in the State and contain basic information for planned, un-built future NHS. Universe data can be reported in **either** of the following ways:

- Section Data: Data reported for a continuous length of roadway that is homogeneous with respect to the physical, operational, administrative, and jurisdictional characteristics being reported. All Federal-Aid Highways must be reported in section data form.

- Grouped Data: The Summaries_County table will accepted individual or grouped highway sections, not necessarily contiguous, with length aggregated with respect to the homogeneous administrative, physical, and jurisdictional characteristics being reported. Grouped data can only be reported for the non-Federal-Aid Highway sections.

Urban Areas: All urban places (or clusters) of 5,000 or more population and Urbanized areas. These are the small urban and urbanized areas within the State.

Urbanized Areas and Codes: Areas with a population of 50,000 or more, as designated by the Census. An FHWA-approved adjusted urbanized area includes the Census urbanized area plus transportation centers, shopping centers, major places of employment, satellite communities, and other major trip generators near the edge of the urbanized area, including those expected to be in place in the near future. Urbanized area codes are included in Appendix C. For multi-State urbanized areas, each State must report HPMS information for the portion of the FHWA-approved adjusted urbanized area within its State boundary. Area revisions as needed should be submitted especially shortly after the latest Decennial (or special) Census information becomes available. New codes for new or modified areas will be issued based on Census changes.

U.S. Territories: The U.S. Territories include American Samoa, Guam, the Commonwealth of the Northern Marianas, and the Virgin Islands of the United States. The Federal Information Processing Standard Codes (FIPS PUB 5-2) are included in Appendix A.

Vehicle Distance Traveled: This term refers to vehicle-miles/kilometers traveled.

Weighted Average: An average of a group of positive values where each is assigned a weight. For example, the user desires to find the weighted average of group of IRI values collected for a group of sections.

Value:	100,	109,	130,	140
Length:	1.233,	1.566,	3.555,	7.100

To find the weighted average: Compute the average using the length of each section as the weight. Get the sum of the products of each value times its section length. Divide the sum of the products by the total length of the group of sections. The weighted average in this case is 130.

Appendix C:
Regional Workshop Summary

Four Regional Workshops were held as follows:

- April 26-27, 2006 in Newington, CT
- May 10-11, 2006 in Atlanta, GA
- May 24-25, 2006 in Portland, OR
- May 31-June1, 2006 in Lincoln, NE

A total of 92 people attended, six of them were ERC members. Twenty three states were represented (OR, WA, TX, ID, NV, AK, CO, MT, FL, GA, SC, VA, KS, MI, MN, NE, NY, WI, WY, VA, PA, MA and CT). Three MPOs were also represented (Portland, Dallas/Fort Worth, and SPC). Nine FHWA Division offices also attended.

The following summarizes major comments received by Issue area.

PROCESS IMPROVEMENT

The idea of multi-tables and/or submitting the data in a spatial format was very well received. States see it as a way to reduce their burden and like the idea of FHWA being able to more closely report data consistent with their state's data.

Most states represented believe that a requirement or guidance from FHWA to move in the direction of spatial submittals will help them to obtain upper management support and move more quickly toward getting common LRS and GIS capabilities. It will be important to obtain AASHTO's support early on regarding process improvement.

FHWA should work with a few States this year to ask them to provide their data in a multi table format as well as in a spatial format. This would allow FHWA an opportunity to evaluate the level of effort involved with States submitting their data in these formats.

OPERATIONS

Most states are somewhat reluctant to provide truck AADT. They tend to store percentage rather than actual AADTTs and it is easier to estimate percentages. Technical issues associated with equipment and placement of classification sites were cited as the main impediments. Where states have classifiers within their coverage program and for samples, truck AADT would be available.

This group was not aware of truck forecasts; perhaps state planners should be consulted regarding the availability of this information.

Regarding ITS data, the states generally agreed that it is difficult to obtain the data in the field. On the other hand, they recognize that ITS information is very important and should be tracked somewhere. It was suggested that State Operations staff should report this information directly to the Federal Operations office.

There appears to be a need to change the TMG to be consistent with the HPMS Field Manual. Several States reported that their traffic people do not give them classification counts for sample sections since the TMG says that classification counts are only required for 30% of their counts (this is a rule of thumb, not a requirement). The TMG also states that truck AADT should be developed on a 6 year basis.

Note – the speed limit issue is not currently addressed in the Issue paper. Also, the need for combo trucks is not clear in the issue paper.

DATA QUALITY

States generally want to submit quality data and are concerned about having specific guidance on issues such as through/auxiliary lanes.

The Field Manual came up a number of times. Most feel that it is partially to blame for data inconsistencies and poor data quality. A number of States said that they would be interested in helping to rewrite the manual. What they would like is primarily more clarification on certain data items and more examples, including pictures, where applicable.

Many states indicated they felt that increasing the total number of data items would result in an overall decrease in the quality of all data.

There was no general agreement regarding bridges in versus bridges out.

Regarding growth factors, many states do not agree that they must enter a growth factor when they do not have other information available. They are comfortable showing no growth.

The states questioned whether it is worth spending time on local roads (growth factors, etc.) They want to see the "bang for the buck" of improving quality. They also want to know if certain data elements are more important than others (priority list).

States generally want some standards to improve quality but not if they go beyond state business needs.

The definition of metadata was also discussed – perhaps using a word such as "process description" would be more appropriate.

CAPACITY/CONGESTION

Some states were surprised by how important widening feasibility is.

There appears to be a disconnect as to whether widening is feasible from an engineering, modeling, or political standpoint.

It would make sense to look at a corridor level analysis to determine widening feasibility to take into account state policies and planning. Planning offices and MPOs in the states should also be involved with this data item. There may be other sources in long-range plans related to widening feasibility that would be more appropriate. More coordination with planning at state and national levels is necessary.

FEDERAL AGENCIES

There are several issues related to Ownership: What to do about privately owned roads, how to record BLM mileage, and definitions in the Field Manual.

INTERCHANGES

Most of the states have locations of ramps, although not necessarily point locations for the interchanges. Some have traffic data, but it is not consistent. All states would like guidance related to coding interchange types. All agreed that HPMS may be the appropriate reporting vehicle for interchange data, particularly as HPMS moves to spatial submittal.

SAFETY

The general feeling of the States regarding safety was relatively negative because not much of the data is readily available. (particularly on the local system)

Most states have motorcycle data, however, the quality is questionable due to classification and equipment limitations.

Curve and Grade data is collected in many states and used for more than just HPMS in only a few states.

Rumble strips and friction data is variable across states.

Safety and MIRE came up a number of times; people are concerned about this. While FHWA is planning on working closely with Safety and their contractor on this, it may be a good idea to find a way to bring in a number of States.

PAVEMENT

The states were fairly divided on the pavement issue. There was a range of in-depth knowledge of the topic from some states and little knowledge from other states that were represented. The issue of needing data on local roads was a concern.

Automated data collection does not appear to be occurring in all states – many need to defer to the pavement staff.

There does not appear to be consistent use of PSR – most report it and there was no real opinion on SN.

Left and Right wheel path does not appear to be a problem.

Data may be available from construction plans to start phased in reporting.

The reaction to the additional pavement items was focused primarily on the increased burden, especially on the off State system. The condition data items didn't receive the harsh criticism that the structural items did. It was pointed out by one State that it is just as easy for them to take their pavement data and calculate the structural number. They couldn't see the benefit of providing the individual data items so that HERS can calculate the SN. Note – Participants may not be familiar with the new Design Guide.

Everyone agreed that it would be good to have a clear standard so everyone would be aware of what is needed regarding cracking. The issue of a national sample for this item was generally discussed.

BOUNDARIES

There is a definite need for a distinction between urban and rural, many states appear to be using the adjusted census boundary for planning and design purposes (design standards and at the local level for funding). When asked if other boundaries would work, the general response was probably not.

There was a general consensus that it takes to long to adjust the boundaries due to coordination issues and lack of guidance.

Most states agree that it would be a major effort to go to one functional classification across the boundary (and do away with urban vs. rural), however, that would make it easier in the long run.

The general consensus was to stick with the adjusted urban boundaries and provide more guidance.

We definitely need to ask work program, policy, planning oriented staff in DOTs to determine what the use of the boundaries really is and if a different boundary could be appropriate.

We should come up with a short list of questions for upper management in states (through SCOP?) – related to boundaries, capacities, widening feasibility, etc.

SAMPLING

Most states are comfortable with existing sampling schema. Sample data is generally not being used.

The states clearly need more explanation regarding the importance of sampling on lower classified roads. Narrowing the groups at the lower end and widening them at the higher groups was discussed.

States would prefer providing the entire database rather than providing sample data where they have it available on the SHS.

GENERAL COMMENTS

States would like a better explanation of the connection between HPMS and apportionment.

A table needs to be created to show:

- Existing HPMS items – what they are used for and who needs them.
- Reassessment items – who needs them, what they will be used for, cost/benefit of collection, details related to collecting (where), and want versus need.

The burden for collection on lower functionally classified roads was an issue.

The Field Manual needs to be revised – states want to be involved.

There was a concern that HPMS is getting to a project level (not originally intended for that level of analysis).

There was a concern that the increased items will create a burden and subsequently lower quality data overall.

Appendix D:
Issue Papers

PAVEMENT-RELATED DATA ISSUES

Options/Recommendations:

1. Frequency of submitted/reported IRI data.

- Require States to report **IRI** and **IRI Year** annually on a universe basis on the NHS. (The collection of **IRI** data off the NHS could remain on a 2-year cycle, since its primary use is to support a biennial report and is published in tables).

2. Consistency of submitted/reported IRI data.

- Better "enforce" the current collection procedures and requirements of **IRI** in the HPMS based on AASHTO PP37-04.
- Report various metadata and date of collection, including **IRI Year,** on **IRI** from the States (as currently defined in HM-66 of *Highway Statistics* or modify).
- Continue reporting average of both right and left wheel path quarter-car **IRI** in HPMS (MRI).
- Report **IRI** data on structures and railroad crossings where **IRI** is required.

3. Collect additional pavement data items and drop less useful ones.

- Implement standards (AASHTO) and collection procedures in HPMS for the collection of all of the defined additional pavement data items as required sample data items. Define and require reporting of metadata for applicable data items.
- Drop reporting of **SN.** Need for this data item is obsolete and redundant based on acquisition of new data items.
- Collect additional pavement data items through a mix of required fields, optional fields, phased-in reporting, and Statewide default tables.
    - **Rutting/Faulting**: Add as required sample data items (data to be collected via profilometer at same time as **IRI**).
    - **IRI Year**: Add for all sections where IRI is required (including structures).
    - **Cracking**: Add % cracking (regardless of severity) as an optional sample data item, to allow States to provide information if their data is consistent with a standard FHWA definition.
    - Add a separate HPMS table for data items that only change when an improvement occurs. Include the historic data items as listed above and shown in the table on page 9.
    - **Date of Last Overlay** and **Date of Last Reconstruction**: Add as required sample data items.

- **Thickness of Latest Overlay**: Optional sample data field until next post-2010 overlay.
- Existing **Asphalt** Bound **Thickness**, Existing **Concrete Thickness**, **Base Type**, **Base Thickness**: Optional sample data fields until next post-2010 reconstruction. For off State-system, allow States to code based on State design standards (i.e., the standards that the local governments would have been expected to follow), if these types of data are not readily available from local governments.
- Asphalt Mix **Binder Type**, **Dowel Bars**, **Joint Spacing**: Add a separate HPMS table to collect Statewide defaults by functional class.
- Sub-grade AASHTO **Soil Type**: FHWA would code from maps while allowing States to override.

FREIGHT RELATED DATA ISSUES

Options/Recommendations

A. Truck Volume Data

Since states already collect this information to meet the TMG guidelines that 30 percent of all volume counts should be classification counts, the requirement would be to report the actual **truck AADTs** for two categories of trucks, single unit and combinations. The percent single unit and combination trucks during the peak hour would continue to be reported for all sample sections. The vehicle classification categories on the HPMS Summary Form will be redefined to agree with the single unit trucks definition of categories 4-7.

States would be required to report average **truck volumes** that represent average conditions for that location. This means that the actual truck counts obtained would need to be adjusted just as volume data is adjusted to represent average conditions or an **AADTT** as promoted in the 2001 TMG. States would be allowed to use existing procedures or may need to develop an interim process to adjust raw truck count data to represent average conditions until their traffic monitoring programs have collected sufficient data to calculate reliable **AADTTs**.

Research may be needed on a process to easily calculate **truck AADTs**, to standardize peak hour definitions, explore use of ITS technology, and relevance to truck commodity surveys.

B. Truck Forecast Data

This additional data collection activity would not be added to HPMS reporting requirements. Other sources of this data would be used by those that have a need for it from State procedures. Another option would be to use either the State's process or the values used by their pavement design section to estimate future axle loadings derived from existing truck loading information to estimate future truck traffic.

C. Truck Parking

Information on truck parking facilities may be available from other sources, such as Rand McNally, and would not be added to HPMS. Other databases and publications illustrating locations and descriptions of truck routes and other information useful to truckers may be a source of truck parking information.

CAPACITY RELATED DATA ISSUES FOR HPMS REASSESSMENT

Options/Recommendations

A. Highway surveillance systems

There are other sources of information for this data besides HPMS that should be used. These data items would be deleted from HPMS.

B. Capacity calculations

Overridden **capacity values** may already exist at the state or may need to be a separate calculation. The edit routines in the submittal software would be changed so that the V/SF calculations of less than 1.4 would be acceptable as accurate data. States would be asked to explain their process for calculating **capacity** and the override values reported in HPMS.

C. K and D factors

It appears that coding **K and D factors** is not an issue for States since this data is readily available from existing databases including many off State system locations. States are encouraged to continue using existing procedures for collecting this data based on guidance from the Highway Capacity Manual and other documents. Since capacity is usually not an issue on lower functional classes, estimates currently being used appear to meet the user needs. It is recommended that there be no change in the collection and coding of this data for HPMS.

D. Widening feasibility

Since this is already a data item, a better description of how to code it would be developed for both data collectors and data users. The number of lanes that could be added would still be coded and if **widening** is not feasible, then code the features that are an obstacle to **widening**.

Information would be developed on the cost to widening, which features could be eliminated to allow **widening,** and the cost to eliminate these features. States would identify obstacles within a specific distance from the roadway that would greatly complicate **widening**, and report this condition as a separate data item.

E. Counter-peak lanes

This would be a new data item to add the number of lanes in the **counter-peak** direction.

BOUNDARIES AND FUNCTIONAL CLASSIFICATION

Options/Recommendations

- Allow options for updating **urban and urbanized areas and air quality boundaries**
- Revise functional classification codes to eliminate separate **urban and rural** classifications (please note the rural, small urban, and urbanized area designation is kept as a separate item)
- Allow designation of **Other Freeways & Expressways** in **rural** and as an option **Minor Collectors** in **rural**
- Update the guidance and provide additional training
- Develop **functional classification** for non-centerline facilities (discussed in Interchanges paper)

Boundaries:

HPMS needs to evolve towards a geo-spatial data submission format in which HPMS data records are linked to a well-defined geo-spatial highway network base map: therefore, many of the geographic identifier fields in the current HPMS record will become unnecessary. Geo-spatial analysis tools will be further developed to allow the data to be selected and summarized by any geographic area. CAUTION: Geo-spatial (i.e., GIS) analysis techniques enable spatially referenced data to be summarized by any geographic area, as long as that area has well defined geographic **boundaries**, represented in a geo-spatial database. Additional efforts would be best spent to assist States that were unable to reach a satisfactory level of geo-spatial reporting.

Adjustments to the latest Census-defined **urban and urbanized area boundaries** would be optional by State. The minimum default **boundaries** would be the most recent Census-defined **urban and urbanized area boundaries**. If a State chooses to adjust **boundaries**, then it would be given a very tight schedule (TBA) for submitting them following the release of information from Census.

After a grace period (TBA) and with no submittal of revised **boundaries** since the last decennial Census, FHWA would proposed to use the latest Census-defined **urban and urbanized area boundaries** to bump out existing adjusted **urban and urbanized area boundaries** as well as to define any new **small urban** or **urbanized areas** in order to prepare the HPMS data for purposes such as Highway Statistics, performance trends, etc. One of the HPMS goals is to maintain consistency of definitions for performance trends and Highway Statistics as well as use by the general public.

States that submit their HPMS data using a geo-spatial format would not be required to report the following data items on each HPMS record: Donut Sample (Item 7), **Rural/Urban** Designation (Item 13), **Urbanized Area** Code (Item 15),

Nonattainment Area Code (Item 16). These data items, along with **Urban/Rural and Nonattainment Area** expansion factors, would be calculated automatically by FHWA as part of the HPMS data preparation process. Those States that do not submit their HPMS data using a geo-spatial format would continue to code these geographic identifiers in each HPMS data record.

Functional Classification:

Functional System	**Code**
Principal Arterials:	
Interstate	1
Other Freeways & Expressways	2
Other	4
Minor Arterials	6
Collectors (Major)	7
Minor Collectors	8
Locals	9

Functional Classes (Item 17) would be consolidated to eliminate the distinction between **urban and rural** classes (i.e. a segment could be coded as "**minor arteria**l", not "**urban minor arterial**" or "**rural minor arteria**l." Classes could be reduced to only **Interstate**, **Other Freeways & Expressways**, **Other Principal Arterials, Minor Arterials, Collectors (Major), Minor Collectors,** and **Locals**. The **Major Collectors** in rural and **Collectors** in urban would be combined under one code. Those States that do classify public roads as **Minor Collectors** could as an option report them as **Minor Collectors** in HPMS. Any public roads not classified as **Arterials** or **Collectors** would be classified as **Locals**.

States would classify all the facilities that are considered **Freeways & Expressways** in **urban** and **rural**. The **rural/small urban/urbanized** area information would be reported in the **Rural/Urban** Designation Item or as part of the geo-spatial code.

Update the **Functional Classification** Guidance and applicable administrative instructions and provide the appropriate **functional classification** training to staff.

The **generated functional system** (Item 18) would be dropped.

Any decision for reporting the non-centerline facilities, i.e., ramps and other intermittent auxiliary roads, as well as number of lanes and AADT on them would be stated in the Interchanges paper. Development of some **functional class** guidance for coding of non-centerline auxiliary facilities may be considered if such facilities are to be reported (see Interchanges paper). No decision has been made to add any other private roads, except those that already are considered as public roads because they serve the public, i.e., toll facilities that operate under the State's or local government's blessing.

PROCESS IMPROVEMENT BACKGROUND PAPER

Options/Recommendations

Metadata

The pavement **metadata** that are being proposed describe the processes used for collecting and reporting the **IRI** data. These data would need to be expanded if additional pavement data items are added to HPMS. Also, if the **IRI** requirements are changed, some of these data items could be eliminated. It has been proposed that the following data items be optional with the submittal of the 2006 HPMS data in June 2007 and required for the data reported in 2008 and beyond:

- Type of vehicle (sonar, multi-laser, scanning laser, other)
- Inclusion of structures
- Inclusion of railroad crossings
- Measurement wheel path
- Measurement lane
- **IRI** simulation (half-car, quarter-car, other)
- Adherence to provisional standard AASHTO PP37-04 (yes, no, partially)

Like the pavement **metadata**, the reporting of traffic **metadata** would also be optional in 2007 and required in 2008 and beyond. These data primarily look at compliance of the State's traffic data collection processes with those outlined in the *Traffic Monitoring Guide* (TMG) and the *Traffic Management Systems for Highways* (TMS/H) guidance produced by FHWA.

- Current years data – all sections updated
- Traffic program meets TMS/H requirements
- Use of short-term counts (< 48 hrs.)
- All sample sections counted at least once every three years
- Process in place to verify data, including local data where used

Government Ownership Code

Finally, it is being proposed that the **Governmental Ownership** code be changed to match the coding of Ownership in the NBI. **Governmental Ownership** would be changed from a one to two digit field with the following coding options:

01 – State Highway Agency	63 – Bureau of Fish and Wildlife
02 – County Highway Agency	64 – U.S. Forest Service
03 – Town or Township Highway Agency	66 – National Park Service
04 – City or Municipal Highway Agency	67 – Tennessee Valley Authority
11 – State Park, Forest, or	68 – Bureau of Land

Reservation Agency	Management
12 – Local Park, Forest, or Reservation Agency	69 – Bureau of Reclamation
21 – Other State Agency	70 – Corps of Engineers (Civilian)
25 – Other Local Agency	71 – Corps of Engineers (Military)
26 – Private (other than railroad)	72 – Air Force
27 - Railroad	73 – Navy/Marines
31 – State Toll Authority	74 – Army
32 – Local Toll Authority	75 – NASA
60 – Other Federal Agency (not listed below)	76 – Metropolitan Washington Airports Service
61 – Indian Tribal Government	80 – Unknown
62 – Bureau of Indian Affairs	

Toll Facility Identifier

The FHWA Office of Highway Policy Information will develop the **toll facility codes** as part of developing the new data model, and published in the 2007 *Toll Facility Report*. Data on toll facilities are proposed to be collected in a separate table in HPMS as outlined in the new data model. Each toll facility will be represented as single record with a beginning and ending LRS, and the **toll facility code**.

DATA QUALITY BACKGROUND PAPER

Options/Recommendations

A few of the recommendations voiced by the state DOT's and FHWA are listed below regarding data quality for new data elements and existing data.

New Data Model

State DOT's are hoping that the use of already-existing GIS-based databases from each state will allow for a smoother transition for the new data requirements. The pilot program, which is described in the Data Model issue paper, along with input from a team of State GIS and HPMS staff should help insure that the new data model will not be extensively burdensome for most States.

Field Manual

The guidance to the States in the HPMS Field Manual appears to be the source of some data consistency and quality concerns. The Office of Highway Policy Information will work with the data users and data providers to rewrite the Field Manual as part of the HPMS Reassessment. The revised Field Manual will employ additional, more detailed descriptions and where appropriate, more illustrations. Whenever possible, actual State examples will be incorporated. A team of data users and State data providers will be put together to rewrite the manual. The target completion data for the new Field Manual is December 2007.

Oversight

Each state DOT will continue to work with their District offices and data collection contractors to guarantee that the data is collected correctly and timely and is input properly for submittal.

The new risk assessment based HPMS Field Reviews will be conducted by FHWA Division Offices on an annual basis. These reviews will focus less on reviewing actual data and more on the data collection and reporting processes. Staffing and SPR program reviews will also be included in these reviews. The detection of possible program deficiencies will trigger a more in-depth process review. The results of the Field Reviews are to be submitted to the Office of Highway Policy Information by November 1st.

Data Validation

FHWA will continue to improve its validation software to make certain that invalid data does not appear within any field in the database (e.g., a 4 is not coded in a field with valid inputs of 1, 2, or 3). FHWA will also work with users of the HPMS data to determine if/what invalid data may be appearing in the database that is sent to the users.

The role of the validation software should be reviewed, especially in light of the data falsification that appears to be taking place in order to resolve data verification errors. The verification software is intended to improve data quality, but it appears that in some instances it is doing just the opposite. FHWA needs to determine the extent to which this is happening, and if there is anything that can be done at the administrative level to alleviate this. This appears to be as much an education and outreach issue as it is a data validation issue.

NEW DATA MODEL

Options/Recommendations

There are two possible approaches to disaggregating the current HPMS submittal file that have been discussed in the outreach workshops and in subsequent webinars. While there are some subtle differences between the two approaches, they both are essentially the same and both would employ the same **data model**. The first would create multiple tables within the HPMS submittal similar to the current table that States submit. These tables would be functionally grouped, comma delimited files. These files would then be combined through a process known as dynamic segmentation within the HPMS software using the State provided geospatial networks and the State's LRS. The uniformity of the LRS across the tables would be critical for this method to be successful. An advantage of using comma-delimited files is that the existing HPMS software, especially the Oracle database, would not require major changes. As the Reassessment has progressed, this previous statement has proven to not be entirely correct. While it is true that converting the HPMS database from a flat-file database to a geospatial database would be a sea change, both would require about the same level of effort. It appears at this time that converting the database to a geospatial database would provide benefits exceeding any extra costs that might be incurred.

Currently, LRS is only collected on Principal Arterials and the NHS. It is being proposed that this would be expanded to include all functional classes through rural Major Collector and urban Collector, since this would cover all roads that are eligible for federal funds. The States' geospatial networks would also need to include all these roads. It was initially thought that this might be a concern for some States, especially for those sample sections off the State network, but in the workshops and webinars most States indicated that they have a complete geospatial network or networks through Major Collector. A couple of States indicated that they have two separate networks, one for State system roads and the other for off-State system roads. The HPMS software and database would probably be able to handle two networks and data for one State, but this will need to be explored further in the pilot.

The second approach that is being considered would allow States to submit their HPMS data as a GIS file or geospatial database with multiple layers; each layer representing a logical grouping of data (pavement, traffic, ITS etc). As previously mentioned, from the FHWA perspective, this is the desired approach. Most States indicated that they would be supportive of providing the HPMS data in a GIS format; with most agreeing that this is probably the best method to employ for future data submittal. However, there were a few States that indicated that they would have trouble linking data for sample sections off the State highway system to their existing State network. Additionally, there are a couple of States that currently would not be able to provide data in a GIS format. Most, if not all of these States did indicate that

changing HPMS to a GIS format might provide the impetus that they need to develop a State GIS system, which most seemed to feel was desirable.

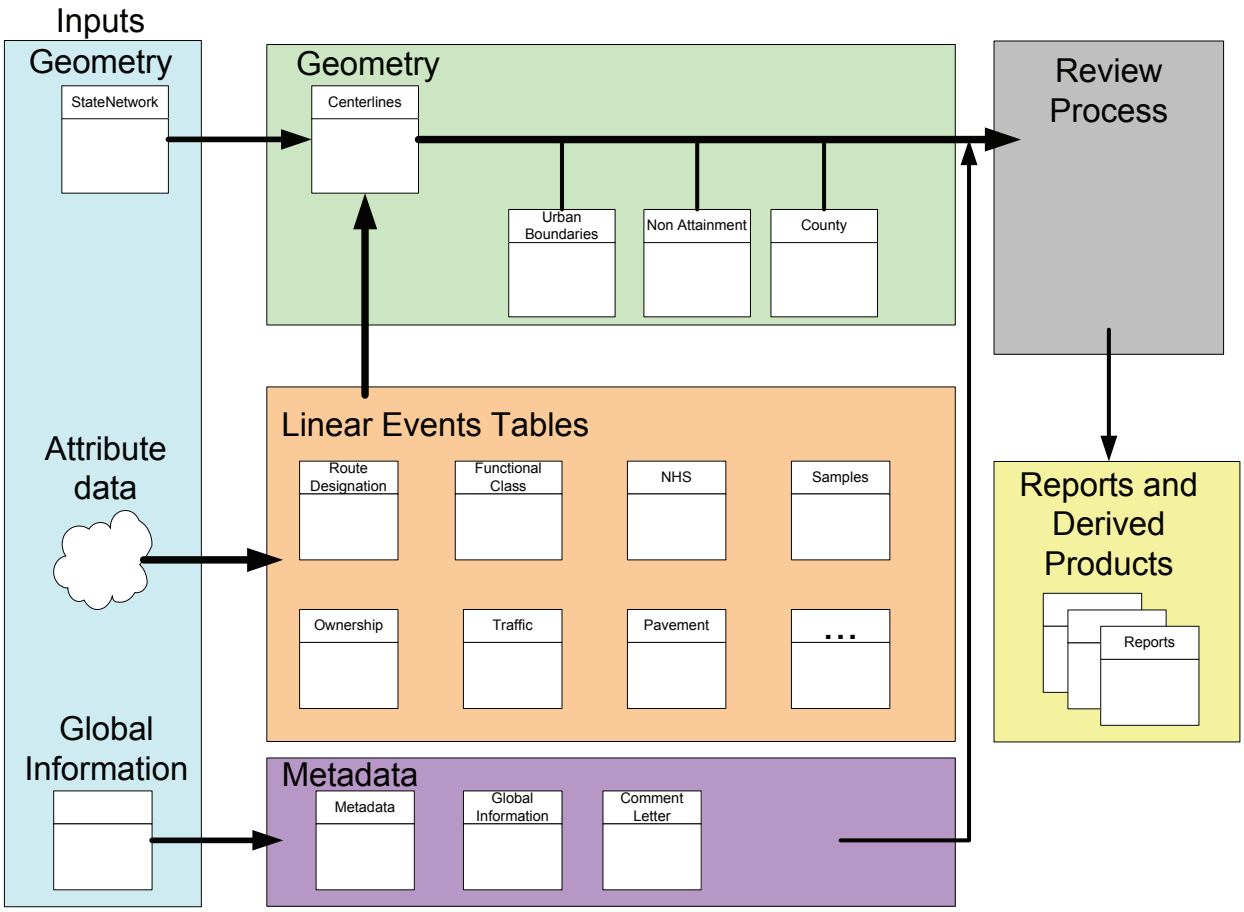


Figure 1 - Data Model

It's possible to implement this approach while still allowing States to submit their data in the current format. Depending on how the HPMS database is structured, the submittal file could be used as submitted, or it could be disaggregated. The possibility also exists for States to submit a disaggregated file for the sample and universe sections on the State highway system along with a second file, in the current format, for those sample sections off the State highway system. This would be more complicated to implement within the HPMS software and database, but would likely be easier for many States since these data for the HPMS sections off the State highway system often only exist in the State's HPMS database, and not in the State's separate management systems. This will have to be explored as part of the pilot.

The Submittal Package

The submittal package would include a geometry file in the form of a shapefile or other acceptable format that has measured and calibrated routes. The package would also contain a series of event tables. These tables would contain the core of the HPMS data that would link to the geometry file. For example, the Lanes table will have a record that has the LRS, BEGIN_LRS, END_LRS, THROUGH_LANES, and TYPE_FACILITY. The LRS field would serve as a common identifier that would be used for linking all data tables and attaching them to the State provided geospatial

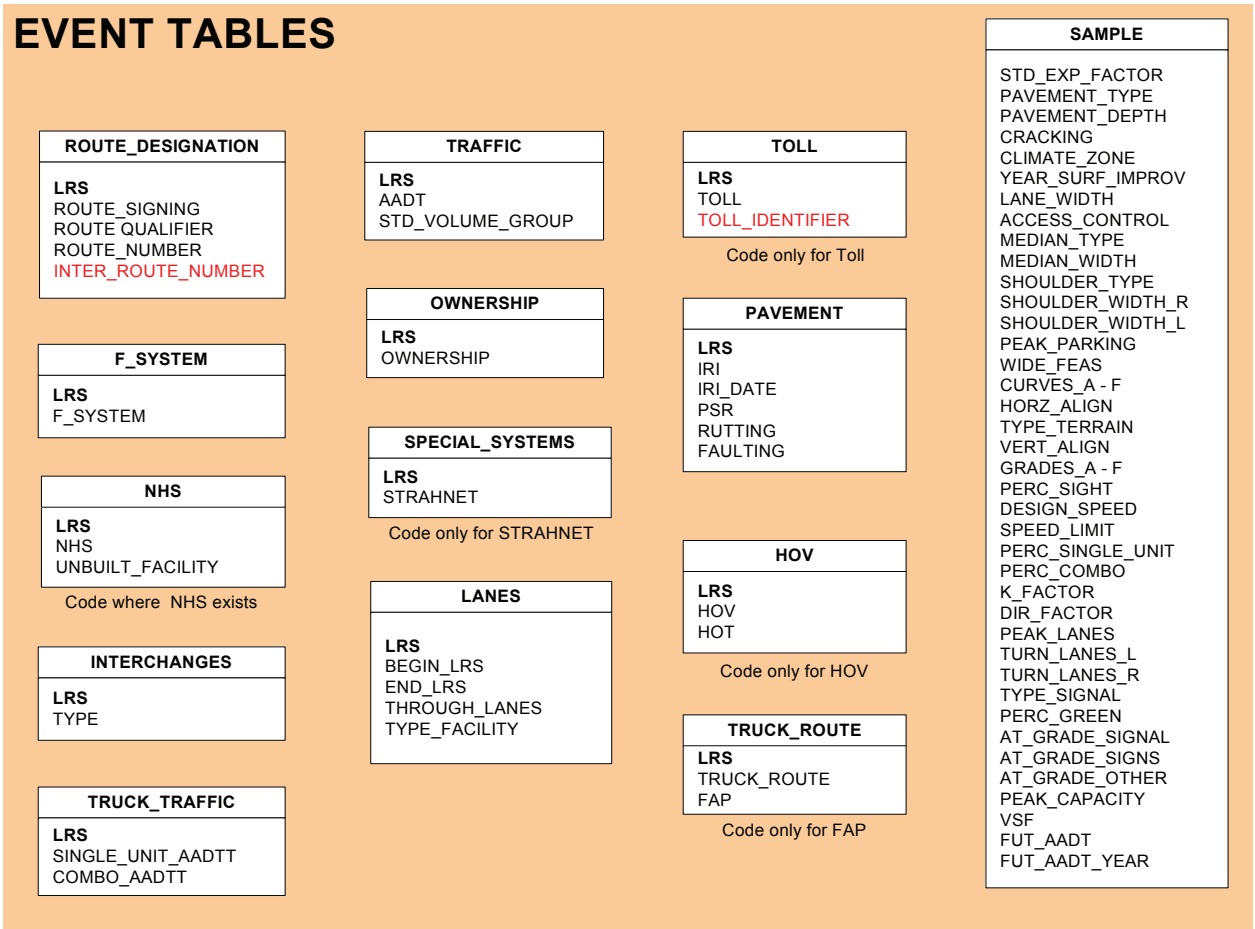


Figure 2 - Proposed HPMS Event Tables

network.

The submittal package would also contain a Global Information which would include information that applies to every record such as Units, Year or Data, Summary data etc. This would also include the comment letter and submittal history information.

While States are welcome to use an existing public or commercial network, FHWA is not at this time considering using a single network (TIGER, Commercial) to create a national backbone network. The benefits of using State provided networks out weigh the costs associated with creating and maintaining a national backbone network. While FHW does have a business need for a routable national network, the primary geospatial need is for State networks that can be used for integrating various datasets and for performing data analysis at the State level and national level. Since States are already maintain a geospatial network for their own business needs, it makes sense to modify HPMS to use these networks rather than duplicating this effort at the national level for a very minimal increase in geospatial data analysis and reporting capabilities.

The following are the requirements for the State geospatial networks. It should be noted that these recommendations take into consideration the comments provided by the data users and data providers in the Reassessment workshops and webinars. At this time, FHWA is not prepared to further define the many other "attributes" of the State geospatial networks. The State pilot will attempt to identify those network attributes that need to be standardized in HPMS. Data providers and data customers not involved in the State pilot are encouraged to submit their recommendations on additional network standards.

- Scope – It is recommended that the State supplied geospatial networks be dual carriageway. The State pilot should consider if this could be a phased implementation that would allow States with single line networks time to develop a dual carriageway network. A dual carriageway network will ensure that the HPMS data and the associated networks will be linkable with all data sets. States will need to indicate the inventory direction in their metadata.
- Extent – The State supplied geospatial network will need to include all roads through rural Major Collector and urban Collector both on and off the State highway system. For those States that maintain the roads functionally classified below rural Major Collector and urban Collector in their State network, these systems can also be included in their HPMS submittal and do not have to be taken out.
- Accuracy – It is desirable that the State supplied geospatial networks have an accuracy of 1:10,000, although networks up to 1:24,000 will be accepted. Through the survey of State GIS staff at GIS-T, 50% of the States indicated that their networks have an accuracy of 1:10,000 or better, with all but three of the responding States indicating that they have a network with an accuracy of 1:24,000 or better.
- Interstate Connectivity – While there are offices within the FHWA that require a routable national network, it is anticipated that the previously mentioned research project will result in a method that can be used to convert the individual State networks into a routable national network; this should address the State-to-State connectivity need of all FHWA users. The connectivity of the data to the network will be through the States' own LRS.

- Intrastate Connectivity - States are encouraged to use an LRS for HPMS reporting that is consistent with the LRS being used for all other federal data reporting. Through the HPMS Reassessment, FHWA is proposing "one network and one LRS for all Federal data reporting." This theme has been widely embraced by most States and most if not all of the Federal agencies engaged through the Reassessment.

  Maintenance – The proposed data model will use the State supplied geospatial networks, which need to correspond to the HPMS data being submitted that year. To insure a 100% match between the HPMS data and the geospatial network, States are encouraged to submit a new network every year.

SAMPLING BACKGROUND ISSUE PAPER

Options/Recommendations

Below is a summary and discussion of various recommendations and options for consideration in the current HPMS reassessment effort or for future consideration and study. The basic sampling scheme for HPMS is not recommended for significant change at this time. Below are three sections into which the issues are separated: Immediate implementation is applicable only to #1 below, short-term study is applicable for #2 (completed by September 2007), and long term study is recommended for the remainder until which time a further/future in-depth study can be made.

Immediate Implementation

Universe/Summary **AADT**: Present scheme of sampling within urbanized areas, small urban areas, and rural by functional system and by volume strata could be retained (a study proposal should be scheduled for a future years when more research monies would be expected to be available). The State should report estimated **AADT's** at least within a special study area(s) to populate the rest of the **Minor Arterials and Collectors (Major)** universe not already reported with **AADTs** (Data Item 33) for any **NHS** or **STRAHNET** or standard sample segment in order to avoid having to develop **donut areas** and add **donut** samples. If this would be an acceptable option, the **Donut Area Sample AADT Volume Group Identifier** (Item 31) as well as the entire donut sampling procedure could be deleted. FHWA also proposes to include **AADT** (Item 33) as a required item for all reported Federal-aid highway segments. Inclusion of **AADT** for all Minor Arterials and Collectors (Major) segments would greatly simplify the estimation of VMT for specific geographic areas as well as **nonattainment or maintenance** areas by pollutant. Currently, only the standard and donut samples required AADTs to be reported on all Minor Arterials, rural Major Collectors, and urban Collectors. Please note that **AADT** reporting was already required on a universe basis for all Principal Arterials and **NHS** and **STRAHNET** and samples on Minor Arterials, rural Major Collectors, and urban Collectors.

The current Summary Template used for the **air quality nonattainment & maintenance areas** would be modified to accommodate reporting a combined estimate of DVMT for the lowest systems by area and pollutant; these lowest systems would include any rural Minor Collectors and rural/urban Locals located within the **nonattainment** or **maintenance** area. The **Donut** scheme would be deleted in favor of reporting **estimated AADTs** in special study areas to populate the rest of the **AADT** cells on the minor arterials and collectors (major) segments that are not already samples or part of the NHS or STRAHNET.

The statisticians need to make a recommendation how to keep the sample panel representative of the entire urbanized area in cases where large additions are added to an existing **urbanized area** sample panel. The **Urbanized Area Sampling Technique** (Item 14) would be dropped. A decision needs to be made regarding allowance of sub-area sampling within a large urbanized area.

- Item 7 -- **Is Donut Sample –** eliminated
- Item 14 -- **Urbanized Area Sampling Technique –** eliminated
- Item 31 -- **Donut Area Sample AADT Volume Group Identifier –** eliminated
- Item 33 -- **AADT –** estimated AADTs would be allowed to populate the minor arterials and (major) collectors at a minimum for **nonattainment/maintenance areas** that are not on a sample, **NHS**, or **STRAHNET**
- Item 48 **– Donut Area Sample Expansion Factor –** eliminated

Short Term Study

AADT volume group strata adjustment: FHWA proposes establishing a single **AADT Volume Group** (Item 32) stratification that would apply across all geographic area types (i.e., **rural, small urban, urbanized, nonattainment**, etc.) The suggested **AADT volume group** strata shown below should be evaluated to determine the impact of various options (i.e., wider volume ranges as the volume increases, use same volume ranges across **urban/rural**, etc.). **AADT volume group** strata adjustment should be tested to determine the impact of various options (i.e., wider **volume** ranges as the **volume** increases, use same **volume** ranges across urban/rural, etc.). The expectation is that this change has the green light. A generic set of common **AADT Volume Groups** is recommended. Adjustments in volume ranges might be made if the studies confirm further change is needed.

AADT Volume Groups	Code
Under 500	1
500 – 1,999	2
2,000 – 4,999	3
5,000 – 9,999	4
10,000 – 19,999	5
20,000 – 34,999	6
35,000 – 54,999	7
55,000 – 84,999	8
85,000 – 124,999	9
125,000 – 174,999	10
175,000 – 249,999	11
250,000 and more	12

- Item 32 **– Standard Sample AADT Volume Group Identifier** -- Common generic **AADT** Volume Groups

Long Term (Future) Study

National sample: Further exploration of obtaining additional items on a sample basis for the non-Federal-aid Highways would be looked at most likely on a case study basis. No final decision has been made.

Alternative sampling methods: Alternative variable schemes, if viable, could be reviewed and proposed. Levels of precision needed for FHWA purposes need to be visited, since the level of precision directly affects the amount of samples required. If a commitment is made, than criteria would be very helpful in deciding the alternative schemes as well as the appropriate levels of precision to employ.

NHS sample: A **NHS** sampling scheme by State would be implemented using the existing standard samples supplemented with extra standard samples where needed. A separate Item would be retained for the **NHS** expansion factor as like the standard sample expansion factor. An in-depth analysis is needed to verify the proposed results. Also, a decision would need to be made whether to sample on the **NHS Locals** and **Rural Minor Collectors**. A final decision should be made regarding the scheme and levels of precision. Nobody has stated which HPMS Items would be applicable with the **National** sampling scheme; this needs to be worked out.

- New Item – **NHS Expansion Factors** (applicable to the non-Interstate parts)

  Geospatial expansion factors: When the results of a study of allowing expansion factors to be created separately for each set of items reported by a particular shop are available, then appropriate decisions can be made.

- Item 16 – **NAAQS Nonattainment/Maintenance Code** (option) -- These items would not be needed for States that submit HPMS using a geospatial format – It could include up to 6 possible pollutants using the EPA-named area name (entry means yes the segment is within the affected area).

  Sample size formula: No decision has been made of the exploration of the sample size formula and how it is used to calculate the required sample size within each volume group. Logically, it should be considered early if some fine tuning adjustments are to be taken.