Guidelines for the Collection of Long-Term Pavement Performance Data

PUBLICATION NO. FHWA-HRT-06-067

MARCH 2006

U.S. Department of Transportation
Federal Highway Administration

Research, Development, and Technology
Turner-Fairbank Highway Research Center
6300 Georgetown Pike
McLean, VA 22101-2296

FOREWORD

The Long-Term Pavement Performance (LTPP) program is ongoing and active. To obtain current information and access to other technical references, LTPP data users should visit the LTPP Web site at http://www.fhwa.dot.gov/pavement/ltpp. LTPP data requests, technical questions, and data user feedback can be submitted to LTPP customer service via e-mail at ltppinfo@fhwa.dot.gov.

Gary L. Henderson
Director, Office of Infrastructure
Research and Development

Notice

Quality Assurance Statement

The Federal Highway Administration (FHWA) provides high-quality information to serve Government, industry, and the public in a manner that promotes understanding. Standards and policies are used to ensure and maximize the quality, objectivity, utility, and integrity of its information. FHWA periodically reviews quality issues and adjusts its programs and processes to ensure continuous quality improvement.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA-HRT-06-067		

4. Title and Subtitle	5. Report Date
GUIDELINES FOR THE COLLECTION OF LONG-TERM PAVEMENT PERFORMANCE DATA	March 2006
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
A. L. Simpson, B. K. Ostrom, P. N. Schmalzer	

9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
MACTEC Engineering and Consulting, Inc. 12104 Indian Creek Court, Suite A Beltsville, MD 20705-1242	11. Contract or Grant No. DTFH61-02-C-00007

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
Office of Infrastructure Research and Development Federal Highway Administration 6300 Georgetown Pike McLean, VA 22101-2296	Final Report, July 2005 to December 2005
	14. Sponsoring Agency Code

15. Supplementary Notes

Contracting Officer's Technical Representative (COTR): Aramis Lopez, Jr., HRDI-13

16. Abstract

A set of data collection guidelines has been provided for the collection of all data obtained for the Long-Term Pavement Performance (LTPP) program. These guidelines were provided to the Regional Support Contractors (RSC) to facilitate data collection on a uniform basis. Over time, additional documents were developed providing more specific requirements for the collection of LTPP data. The primary purpose for the various data collection guides is to provide a uniform basis for data collection during long-term monitoring of the performance of pavement test sections under study by the LTPP program initiated under Strategic Highway Research Program (SHRP) and continued under the Federal Highway Administration (FHWA). As methods for collection of the data have changed and improved over the years, the guidelines used in obtaining these data have changed. The objective of this document is not to provide the exact guidelines, but rather to provide references for the guidelines and revisions to those guidelines used in collecting each type of data for LTPP over the lifetime of the LTPP program.

17. Key Words	18. Distribution Statement
asphalt concrete, automated weather station, climatic data, data collection, distress, falling weight deflectometer, field sampling, General Pavement Studies, inventory, joint faulting, laboratory testing, longitudinal profile, LTPP, maintenance, materials testing, monitoring, portland cement concrete, rehabilitation, seasonal monitoring, Specific Pavement Studies, subgrade, traffic, transverse profile, treated base, unbound base	No restrictions. This document is available to the public through the National Technical Information Service, Springfield, VA 22161.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	61	

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
	NOTE: volumes greater than 1000 L shall be shown in m^3			
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	$candela/m^2$	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	$candela/m^2$	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

AADT	average annual daily traffic
AASHTO	American Association of State Highway and Transportation Officials
AC	asphalt concrete
AWS	automated weather station
CCC	Canadian Climatic Center
CPR	concrete pavement restoration
DCG	Data Collection Guide
FHWA	Federal Highway Administration
FWD	falling weight deflectometer
GPS	General Pavement Studies
ICC	International Cybernetics Corporation
IMS	information management system
JCP	jointed concrete pavement
LTPP	Long-Term Pavement Performance
NOAA	National Oceanic and Atmospheric Association
NCDC	National Climatic Data Center
PCC	portland cement concrete
RSC	Regional Support Contractor
SHA	State highway agency
SHRP	Strategic Highway Research Program
SMP	Seasonal Monitoring Program
SPS	Specific Pavement Studies
STRS	Strategic Transportation Research Study
TDR	time domain reflectometry
TRB	Transportation Research Board
TMG	Traffic Monitoring Guide
WIM	weigh-in-motion

CHAPTER 1. INTRODUCTION

1.1 INTRODUCTION TO LTPP

Faced with the need for a better understanding of the parameters affecting pavement performance, the pavement community mounted an organized, massive, and multiyear project to study the effects on pavement performance of diverse environmental conditions, traffic, materials, pavement designs, construction techniques and quality control, maintenance strategies, and other important parameters. During the 1980s, the Transportation Research Board (TRB), along with the Federal Highway Administration (FHWA) and with the cooperation and support of the American Association of State Highway and Transportation Officials (AASHTO), began the Strategic Transportation Research Study (STRS) of the deterioration of the Nation's highway and bridge infrastructure system. The results of this study were published in TRB Special Report 202, "America's Highways, Accelerating the Search for Innovation." One of the primary recommendations from the study was the long-term monitoring of inservice highways. As a result of their recognition of the need for a national database containing long-term data from highway monitoring, the major agencies involved in pavement design, construction, and management joined together to develop plans for a Long-Term Pavement Performance (LTPP) study.

AASHTO approved the recommendations of the STRS and established the Strategic Highway Research Program (SHRP) to carry them out. As the result of the enthusiasm for this program expressed at a national workshop on long-term pavement monitoring sponsored by FHWA in October 1984, FHWA offered to fund transition activities to maintain the momentum until SHRP was approved by the U.S. Congress and funded in its own right. A SHRP Advisory Committee for Pavement Performance was appointed to provide guidance for this transition planning, including experiment designs and implementation planning.

1.2 OBJECTIVES OF LTPP

The objective of the LTPP program adopted by the Advisory Committee for Pavement Performance was:

> "To increase pavement life by investigation of various designs of pavement structures and rehabilitated pavement structures, using different materials and under different loads, environments, subgrade soil, and maintenance practices."

The specific objectives developed by the advisory committee are:

- Evaluate existing design methods.
- Develop improved design methodologies and strategies for rehabilitation of existing pavements.
- Develop improved design equations for new and reconstructed pavements.

- Determine the effects of (a) loading, (b) environment, (c) material properties and variability, (d) construction quality, and (e) maintenance levels on pavement distress and performance.
- Determine the effects of specific design features on pavement performance.
- Establish a national long-term pavement database to support SHRP objectives and future needs.

The LTPP program included two types of studies: General Pavement Studies (GPS) and Specific Pavement Studies (SPS). The GPS experiments include nearly 800 inservice pavement test sections that encompass a large array of site selection factors throughout the United States and Canada. The SPS generally were aimed at more intensive studies of a few independent variables for each of a number of study topics.

The great majority of test sections for the GPS have been selected from existing highways, but most of the test sections used in the SPS have been specifically designed and constructed pavements with the characteristics needed for the studies being undertaken. The sections for a specific SPS project are built at a single location with multiple projects constructed around the Nation and Canada. A single location is selected to maintain as much uniformity as possible in factors such as subgrade, traffic, and environment. The multiple projects provide data on the effects of variations in these subgrade, traffic, and environmental factors. It is expected that there will also be a number of custom designed and constructed sections to fill important cells for which existing highway sections are not available.

While considered separately for clarity of understanding and planning, the results from GPS and SPS will be very interactive, and some of the test sections will be shared between experiments.

1.3 Objective of the Guidelines for Data Collection

One of the primary difficulties in utilizing data collected before the LTPP program has been lack of uniformity. Another serious deficiency has been the omission of data that is significant to the performance of the pavements. The LTPP experiments have been designed carefully to ensure appropriate distributions of significant variables to support the objectives of these studies. Over a period of years a set of data collection guides has been developed that provides methodologies for the collection of all data required by the LTPP program—from construction to materials and traffic to distress—to support these experiment designs, as well as to provide a uniform basis for the collection of other detailed data that have not been identified as necessary for the LTPP studies. The philosophical approach taken has been not only to identify those data items that are considered to be of high priority for achieving the goals of the LTPP studies, but also to provide for a very comprehensive set of other data items that may be desirable in the LTPP Information Management System (IMS) for other purposes. These purposes include pavement management; very detailed studies of pavement components, construction techniques, design features; and other studies that may be conceived in the future.

The data collection guidelines were provided to the Regional Support Contractors (RSC) to facilitate data collection on a uniform basis. The original Data Collection Guide (DCG), referenced below, covered all types of LTPP data.

Data Collection Guide for Long-Term Pavement Performance Studies, Operational Guide No. SHRP-LTPP-OG-001, SHRP, National Research Council, Washington, DC, January 1988.

Over time, additional documents have been developed that provide more specific requirements and guidelines for the collection of LTPP data. The primary purpose of the various data collection guides is to provide a uniform basis for data collection during long-term monitoring of the performance of pavement test sections under study by the LTPP program that was initiated under SHRP and continued under FHWA.

The guides used in the LTPP studies are intended to provide sufficient detail for implementation of the LTPP studies; but it is recognized that future modifications and the addition of new documents will be necessary as the requirements for instrumentation and other LTPP research areas become more defined, and as automated distress and performance measures are applied. Emphasis has been given to ensuring the data items identified will be satisfactory over the long term so that critical data will not be missing from the LTPP IMS when it is used in the future to develop pavement performance models.

As methods data collection have changed and improved over the years, the guidelines used in obtaining these data have been modified. In some cases, actual changes were required to the guidelines to improve data collection; in other cases, the need was to clarify the guidelines. These changes and clarifications have been provided to the regions in the form of directives. This document provides references for the guidelines and subsequent revisions to those guidelines used in collecting each type of LTPP data over the lifetime of the LTPP program.

1.4 Categories of Data Collected

For data collection purposes, the data have been categorized as follows:

- Automated Weather Station (AWS).
- Climatic Data.
- Inventory Data.
- Maintenance Data.
- Monitoring Data.
- Rehabilitation Data.
- Seasonal Monitoring Program (SMP) Data.
- SPS Construction Data.
- Traffic Data.
- Field Materials Sampling and Laboratory Testing Data.

A chapter for each type of data collected is provided in the following pages. Within each chapter, references are provided detailing the methods used to collect the data in accordance with LTPP standards and specifying the timeframe during which those standards were relevant or the date at which current standards became relevant.

CHAPTER 2. AUTOMATED WEATHER STATIONS

2.1 Introduction to AWS

Beginning in 1994, AWS were installed near almost all SPS–1, SPS–2, and SPS–8 projects to collect data on onsite weather conditions at each location. Data collected by the stations include air temperature, relative humidity, windspeed and direction, solar radiation, and precipitation. These data are recorded at intervals of 15 minutes and stored. The accumulated data are downloaded at a frequency not to exceed 6 months.

The short interval data are accumulated into hourly statistics of mean, minimum, and maximum temperature and windspeed, minimum and maximum humidity, and total amount of precipitation and solar radiation. These hourly statistics are then accumulated into a set of daily statistics, and at the highest level, monthly values are available for each of these parameters. These monthly statistics are directly comparable to those contained in the climatic data module.

2.2 References for AWS

2.2.1 Installation of AWS Instrumentation

The following document provides a description of the installation process and the first installation of an AWS for LTPP.

> *LTPP-SPS Automated Weather Stations: Automated Weather Station (AWS) Installation,* Arizona Department of Transportation Open House, Phoenix, AZ, July 20–21, 1994.

A directive that governs the installation and collection of data from the AWS instruments was prepared and submitted to the RSCs.

> *Installation, Data Collection, and Maintenance of Automated Weather Stations at SPS–1, SPS–2, and SPS–8 Projects*, Directive AWS–1, FHWA, Pavement Performance Division, McLean, VA, September 12, 1994.

A second directive submitted to the RSCs required the installation of modems at each of the AWS locations to allow for remote data collection.

> *Remote Collection of AWS Data*, Directive AWS–9, FHWA, Pavement Performance Division, McLean, VA, November 17, 1997.

2.2.2 AWS Software

The following document describes the use of the software program that performs the initial quality control checks on the AWS data. This program was created to detect anomalies and other equipment-related issues in the collected data while in the field, allowing onsite corrective actions to be performed.

LTPP-SPS Automated Weather Stations: AWSScan Program Background and Users Guide, Version 0.5, FHWA, Pavement Performance Division, McLean, VA, October 1995.

In February 1996, the AWSScan software and the user's guide were updated, and a revised version of the 1995 document (referenced below) was submitted to the RSCs.

LTPP-SPS Automated Weather Stations: AWSScan Program Background and Users Guide, Version 1.11, FHWA, Pavement Performance Division, McLean, VA, February 1996.

The AWSCheck program was written to automate quality checks and process weather station data collected as part of the LTPP program. This software program performs the basic quality control checks on the data before its upload into the LTPP database, data backup and archiving, and creation of data files that are filtered into the database.

LTPP-SPS Automated Weather Stations: AWSCheck Users Guide, Version 1.0, FHWA, Pavement Performance Division, McLean, VA, August 1996.

In November 1996, the AWSCheck software and the user's guide were revised and submitted to the RSCs for all future use.

LTPP-SPS Automated Weather Stations: AWSCheck Users Guide, Version 1.1, FHWA, Pavement Performance Division, McLean, VA, November 1996.

CHAPTER 3. CLIMATIC DATA

3.1 Introduction to Climatic Data

The climatic data include the data necessary to characterize the environment in which the pavement has existed since its construction and throughout the monitoring period. The climatic data elements include:

- Weather Station Identification/Location.
- Average Monthly Temperature.
- Average Maximum Daily Temperature by Month.
- Average Minimum Daily Temperature by Month.
- Average Monthly Maximum Relative Humidity.
- Average Monthly Minimum Relative Humidity.
- Average Monthly Precipitation.
- Average Monthly Percent Sunshine.
- Average Monthly Windspeed.
- Average Annual Number of Days of Precipitation.
- Latitude.
- Longitude.
- Freezing Index.
- Average Number of Annual Freeze-Thaw Cycles.
- Average Annual Number of Days with Temperature Below Freezing.
- Average Annual Number of Days with Temperature Above 32 °C.
- Elevation above Sea Level.

LTPP climatic data have been developed from data obtained from the National Climatic Data Center (NCDC) and the Canadian Climatic Center (CCC). For each GPS test section and SPS project, up to five nearby weather stations were identified. Daily measurements for the selected data items were obtained for each of the identified weather stations. The data for these weather stations were used to estimate site specific climatic stations referred to as virtual weather data. The daily values are summarized to monthly and annual statistics including the mean, standard deviation, minimum, and maximum.

3.2 References Used for Climatic Data

The general reference for the collection and accumulation of climatic data is provided by:

> *Data Collection Guide for Long-Term Pavement Performance Studies*, Operational Guide No. SHRP-LTPP-OG-001, SHRP, National Research Council, Washington, DC, January 1988, chapter 5.

This chapter provides a brief overview of the efforts involved in obtaining climatic data for LTPP GPS test sections. It was updated as referenced below:

Data Collection Guide for Long-Term Pavement Performance Studies, Operational Guide No. SHRP-LTPP-OG-001, SHRP, National Research Council, Washington, DC, October 1993, chapter 5.

A separate set of documents was prepared in 1993 to describe data obtained from the National Oceanic and Atmospheric Association (NOAA). It also provides details describing how the data obtained were accumulated and stored in the LTPP database. These data were available in a standard release of LTPP data until 1999. The first document is specific to GPS test sections, and the second is specific to SPS projects. The SPS document dated January 1993 was revised and re-released in May 1993.

Development of the LTPP Climatic Database, SHRP Report SHRP-P-621, SHRP, National Research Council, Washington, DC, January 1993.

Climate Data Collection for SPS Test Sites, FHWA, Pavement Performance Division, McLean, VA, January 1993.

Climate Data Collection for SPS Test Sites, FHWA, Pavement Performance Division, McLean, VA, May 1993.

Environmental data from each test section were replaced with a revised and more complete set of data in 1999. The following document describes how these data were accumulated into the set of statistics that were subsequently stored in the LTPP database.

LTPP Climatic Data Revision and Expansion, Draft Report, FHWA, Pavement Performance Division, McLean, VA, July 1999.

CHAPTER 4. INVENTORY DATA

4.1 Introduction to Inventory Data

The basic inventory data includes the data necessary to: (1) identify the test section, (2) describe the geometric details of its original construction and the material properties of its structural constituents at that time, and (3) identify construction costs of maintenance and repair performed before the long-term monitoring effort. All of these data should remain constant throughout the monitoring period. Data concerning the construction of any rehabilitation or maintenance treatment placed after the start of the LTPP program is stored in accordance with the guidelines outlined in the respective chapters of this document.

4.2 References Used in Collecting Inventory Data

Chapter 2 of the original DCG covers the collection of the inventory data from the State highway agency (SHA). The following list provides a reference for each version of the DCG in which changes were made to chapter 2 of the DCG. The month and year noted in each reference provides the timeframe during which each revision was relevant to the program and the point at which the previous version was no longer to be used.

> *Data Collection Guide for Long-Term Pavement Performance Studies*, Operational Guide No. SHRP-LTPP-OG-001, SHRP, National Research Council, Washington, DC, January 1988.
>
> *Data Collection Guide for Long-Term Pavement Performance Studies*, Operational Guide No. SHRP-LTPP-OG-001, SHRP, National Research Council, Washington, DC, January 1990.
>
> *Data Collection Guide for Long-Term Pavement Performance Studies*, Operational Guide No. SHRP-LTPP-OG-001, FHWA, Pavement Performance Division, McLean, VA, October 28, 1993.

In 2005, chapter 2 of the DCG was separated into its own distinct document. Information was updated to incorporate all revisions made by directive since the previous issue of the revised chapter in 1993.

> *Inventory Data Collection Guide for the Long-Term Pavement Performance Program*, FHWA, Pavement Performance Division, McLean, VA, June 2005.

CHAPTER 5. MAINTENANCE DATA

5.1 Introduction to Maintenance Data

Determining the data elements to be collected to reflect maintenance activities on LTPP test sections included in the GPS experiments was one of the more difficult tasks in planning the LTPP program and in developing the DCG. The complications include the wide variations in maintenance policy and data collection procedures among various SHAs, and the need to coordinate maintenance activities within the test sections themselves. Maintenance includes construction activities on LTPP test sections that do not alter the pavement structure significantly. Examples include seal coats, crack sealing, patching, joint sealing, grinding, milling less than 25 millimeters (mm) (1 inch) deep, and grooving. The collected maintenance data provides such information as when the activity was performed and the materials and construction practices used.

A maintenance control zone has been established around each test section. This zone was established to closely coordinate routine and preventive maintenance activities, and reduce the influence of other activities on the performance of the test section.

The SHAs may decide to provide more extensive maintenance for the project in which the test section is located, and are free to do whatever they wish for pavements outside the maintenance control zone. However, they are asked to comply with a maintenance policy that requires coordination with the RSC office responsible for data collection at that location. Without this coordination, the value of the data obtained from a test section after it has been monitored for a number of years is reduced greatly, and the possibility of a final set of measurements at that level of deterioration before covering the manifestations of distress may be lost. In general, more extensive maintenance activities than those allowed before the decision point should be deferred as long as possible to allow the collection of critical data as deterioration accelerates. The Joint Pavement Performance/Maintenance Subcommittee expected that these decisions and agreements could be worked out as long as SHA and LTPP personnel approach the issues involved with respect for the needs of the other agency and a cooperative spirit.

5.2 References Used in Collecting Maintenance Data

Procedures for the collection of maintenance data were governed by chapter 6 of the DCG as referenced below. As with the inventory data guidelines, the date at the end of each reference provides the starting point at which each new revision was relevant. Data collected before that time were subject to the procedures set forth in the previous version.

> *Data Collection Guide for Long-Term Pavement Performance Studies*, Operational Guide No. SHRP-LTPP-OG-001, SHRP, National Research Council, Washington, DC, January 1988.

Data Collection Guide for Long-Term Pavement Performance Studies, Operational Guide No. SHRP-LTPP-OG-001, SHRP, National Research Council, Washington, DC, August 30, 1989.

Data Collection Guide for Long-Term Pavement Performance Studies, Operational Guide No. SHRP-LTPP-OG-001, FHWA, Pavement Performance Division, McLean, VA, October 28, 1993.

As with the inventory data, chapters 6 and 7 from the DCG, covering collection of rehabilitation data, have been combined to create a separate guide for maintenance and rehabilitation data collection. Further information regarding collection of rehabilitation data is provided in chapter 7 of this document.

Maintenance and Rehabilitation Data Collection Guide, FHWA, Pavement Performance Division, McLean, VA, June 2005.

CHAPTER 6. MONITORING DATA

6.1 Introduction

Monitoring data are collected on a periodic basis throughout the life of the test section as a means of tracking the structural and functional condition of the pavement sections over time. These collection activities provide a historical database that helps establish relationships among distress, performance, traffic and axle loads, age, maintenance, and other significant variables.

Monitoring data collected on LTPP sections include deflection measurements, surface friction measurements, surface distress evaluations, and longitudinal profile measurements. Each of these elements is governed by a different collection manual.

A general set of guides for the collection of the monitoring data is provided by chapter 3 of the original version of the DCG. This chapter also provides instructions for completing some of the data forms for monitored data. The versions of the DCG providing information for monitored data collection are as follows. The revision dates listed as part of the reference provide the timeframe during which each version of the document was relevant for the collection of monitoring data and the point at which the previous version was no longer relevant.

> *Data Collection Guide for Long-Term Pavement Performance Studies*, Operational Guide No. SHRP-LTPP-OG-001, SHRP, National Research Council, Washington, DC, January 1988.
>
> *Data Collection Guide for Long-Term Pavement Performance Studies*, Operational Guide No. SHRP-LTPP-OG-001, SHRP, National Research Council, Washington, DC, November 6, 1989.
>
> *Data Collection Guide for Long-Term Pavement Performance Studies*, Operational Guide No. SHRP-LTPP-OG-001, FHWA, Pavement Performance Division, McLean, VA, October 28, 1993.

Each of the specific areas of data collection along with the appropriate references are discussed in the following sections.

6.2 Deflection Data

6.2.1 Introduction to Deflection Data

Deflection data are collected using FHWA-owned falling weight deflectometers (FWD) for the purpose of evaluating the pavement section structural condition. The field data collection software provided with the FWDs allows for thorough identification of the test data and for automatic collection of time, air and pavement temperature, location, deflections, load, and

selected load and deflection time history data. In addition to the collected data, data that provide information about the calibration of each FWD are stored.

6.2.2 References Used in Collection of Deflection Data

Collection of FWD Data

Any LTPP FWD data collection activity conducted for inclusion in the IMS must be performed in strict accordance with the appropriate FWD manual as referenced below.

> *Strategic Highway Research Program: Manual for FWD Testing: Operational Field Guidelines, Version 1.0,* SHRP, National Research Council, Washington, DC, January 1989.

This manual was in use from January 1989 until the release of Version 2.0 in May 1993. In April 1992, a series of documents was released that addressed data collection on the projects associated with the various SPS experiments.

> *Strategic Highway Research Program: FWD Test Plan for Experiment SPS–1: Strategic Study of Structural Factors for Flexible Pavements*, SHRP, National Research Council, Washington, DC, April 1992.
>
> *Strategic Highway Research Program: FWD Test Plan for Experiment SPS–2: Strategic Study of Structural Factors for Rigid Pavements*, SHRP, National Research Council, Washington, DC, April 1992.
>
> *Strategic Highway Research Program: FWD Test Plan for Experiment SPS–5: Rehabilitation of Asphalt Concrete Pavements*, SHRP, National Research Council, Washington, DC, April 1992.
>
> *Strategic Highway Research Program: FWD Test Plan for Experiment SPS–6: Rehabilitation of Jointed Portland Cement Concrete Pavements*, SHRP, National Research Council, Washington, DC, April 1992.
>
> *Strategic Highway Research Program: FWD Test Plan for Experiment SPS–7: Bonded Portland Cement Concrete Overlays*, SHRP, National Research Council, Washington, DC, April 1992.
>
> *Strategic Highway Research Program: FWD Test Plan for Experiment SPS–8: Study of Environmental Effects in the Absence of Heavy Loads*, SHRP, National Research Council, Washington, DC, April 1992.

The 1993 version of the manual replaced the previous version from January 1989 and incorporated not only the various elements provided by the FWD directives between January 1989 and May 1993, but also the various SPS experiment documents.

Manual for FWD Testing in the Long-Term Pavement Performance Study, Operational Field Guidelines, Version 2.0, FHWA, Pavement Performance Division, McLean, VA, May 7, 1993.

Manual for FWD Testing in the Long-Term Pavement Performance Study, Operational Field Guidelines, Version 3.0, FHWA, Pavement Performance Division, January 2000.

Manual for FWD Testing in the Long-Term Pavement Performance Study, Operational Field Guidelines, Version 3.1, FHWA, Pavement Performance Division, October 31, 2000.

Manual for FWD Testing in the Long-Term Pavement Performance Study, Operational Field Guidelines, Version 4.0, FHWA, Pavement Performance Division, April 1, 2005.

Table 1 shows the timeline of the release of the FWD manuals; these detail how the deflection data should be collected for the LTPP program.

Table 1. Timeline of FWD Testing Manual Releases

1988	**FWD Manual Version 1.0 released January 1988**	
1989		
1990		
1991		
1992		**SPS Guidelines for FWD Testing released April 1992**
1993	**FWD Manual Version 2.0 released May 1993**	**SPS Guidelines were combined into FWD Manual and no longer required after May 1993.**
1994		
1995		
1996		
1997		
1998		
1999		
2000	**FWD Manual Version 3.0 released January 2000**	
	FWD Manual Version 3.1 released October 2000	
2001		
2002		
2003		
2004		
2005		
	FWD Manual Version 4.0 released April 2005	
2006		
2007	–	

Software Used in Processing Deflection Data

Other FWD documentation provides instruction for using software to perform quality control checks on the data before entry into the IMS. Specifically, FWDSCAN provides an initial review of the data before its being loaded into the database. This program also prepares the files for loading into the IMS. FWDCheck provides additional review of data; its use has been optional for much of the LTPP program. FWDConvert creates the standard FWD PDDX files from the database files created during data collection and incorporates the additional data elements required by LTPP. The final document provides information for using the FWD data collection program to obtain the FWD data required for the LTPP program.

> *Strategic Highway Research Program: FWD Data Readability and Completeness—FWDSCAN, Version 1.30—Program Background and User's Guide*, SHRP, National Research Council, Washington, DC, April 1992.
>
> *FWDScan Data Readability and Completeness, Version 3.0*, FHWA, Pavement Performance Division, McLean, VA, November 1995.
>
> *FWDScan Users Manual, Version 4.0*, FHWA, Pavement Performance Division, McLean, VA, April 1, 2005.
>
> *Strategic Highway Research Program: Analysis of Section Homogeneity, Non-Representative Test Pit and Section Data, and Structural Capacity—FWDCheck, Version 2.00*, SHRP, National Research Council, Washington, DC, April 1992.
>
> *FWDConvert Users Manual, Version 1.0*, FHWA, Pavement Performance Division, McLean, VA, April 1, 2005.
>
> *LTPP FWD Data Collection Software Manual, Version 1.0*, FHWA, Pavement Performance Division, McLean, VA, April 1, 2005.

6.3 Distress Data

6.3.1 Introduction to Distress Data Collection

Distress data for the LTPP program include information about type, severity, and amount of cracking on the test section; and about surface defects, transverse profile, faulting, patching, and other miscellaneous types of distress. Distress data for LTPP are collected using both semiautomated photographic equipment and manual methods. The methodologies used in collecting these data attempt to provide uniformity not only within each survey method, but also between the two survey methods.

6.3.2 References for All Distress Data Collection

The information contained in the IMS is intended to be common to both the automated and manual data collection methods. All pavement distress monitoring is performed using the *Distress Identification Manual* as referenced below. The manual contains definitions, severity

level descriptions, and measurement methods for the pavement distresses identified for inclusion in the LTPP monitoring.

> *Strategic Highway Research Program: Distress Identification Manual for the Long-Term Pavement Performance Studies,* SHRP Report No. SHRP-LTPP-OG-002, SHRP, National Research Council, Washington, DC, June 1989.
>
> *Strategic Highway Research Program: Distress Identification Manual for the Long-Term Pavement Performance Studies,* SHRP Report No. SHRP-LTPP/FR-90-001, SHRP, National Research Council, Washington, DC, October 1990.
>
> *Distress Identification Manual for the Long-Term Pavement Performance Project,* SHRP-P-338, FHWA, Pavement Performance Division, McLean, VA, May 1993.

A draft version of the revised manual was released to the RSCs in April 2002 for use in collecting distress data. The revised manual was officially released for publication in October 2003.

> *Distress Identification Manual for the Long-Term Pavement Performance Project, Draft,* FHWA, Pavement Performance Division, McLean, VA, April 2002.
>
> *Distress Identification Manual for the Long-Term Pavement Performance Project,* FHWA-RD-03-031, FHWA, Pavement Performance Division, McLean, VA, June 2003.

6.3.3 References Specific to Manual Distress Data Collection

At the time of the manual surveys, the surveyor also collects transverse profile data on asphalt surfaced pavements and joint faulting on portland cement concrete (PCC) surfaced pavements. The following guidelines provide instruction on how these data are to be collected. They were incorporated into the 1993 version of the *Distress Identification Manual*. Additional information specific to the collection of transverse profile data also can be found in the field guidelines used in the collection of longitudinal profile data as referenced under section 6.4.2.

> *Strategic Highway Research Program: SHRP-LTPP Manual for Dipstick® Profile Measurements: Operational Field Guidelines, Version 1.0,* SHRP, National Research Council, Washington, DC, September 1990.
>
> *Strategic Highway Research Program: Manual for Dipstick® Profile Measurements: Operational Field Guidelines, Version 1.1,* SHRP, National Research Council, Washington, DC, January 1991.
>
> *Strategic Highway Research Program: Manual for Faultmeter Measurements: Operational Field Guidelines, Version 1.1,* SHRP, National Research Council, Washington, DC, June 1991.

Table 2 provides a timeline for the use of all of the guides on manual distress data collection.

6.3.3 References Specific to Semiautomated Distress Data Collection

Semiautomated distress data collection involves the collection of 35-mm photographic images of the pavement surface and images for determining the transverse profile of the pavement surface. The collection of these images and analysis/interpretation of the transverse profile are governed by the following reference.

> *Photographic Pavement Distress Record Collection and Transverse Profile Analysis*, SHRP Report No. SHRP-P-660, SHRP, National Research Council, Washington, DC, June 1993.

The methodology used for interpreting the distresses observed on the pavement surface from these images is provided by the following reference. In addition to this document, the interpretation procedure also uses the distress and severity level definitions provided by the *Distress Identification Manual* as previously referenced.

> *Distress Interpretation from 35-mm Film for the LTPP Experiments*, SHRP Report No. SHRP-P-642, SHRP, National Research Council, Washington, DC, May 1993.

6.4 Longitudinal Profile Measurement

6.4.1 Introduction to Profile Measurement

Longitudinal profile data is collected for LTPP to provide information about the ride quality of the pavement surface. The primary means of collecting longitudinal profile data for LTPP has been through the use of vehicle-based longitudinal profilers. Over the years of the LTPP program, three sets of profilers have been used by each of the RSCs to collect these data. Procedures for collecting longitudinal profile data are referenced below. Each of the documents addresses collection of the data not only with the inertial profiler, but also with the FACE® Dipstick, which is used when collection with the inertial profiler is not feasible.

Table 2. Timeline of Revision to Distress Data Collection Procedures

1988			
1989	**Distress Identification Manual released June 1989**		
1990	**Revised Distress Identification Manual released October 1990**		
1991		**Dipstick Manual released January 1991**	**Faultmeter Manual released June 1991**
1992			
1993	**Revised Distress Identification Manual released May 1993 incorporated Dipstick and Faultmeter Manuals**	**Dipstick Manual combined with Distress Identification Manual in May 1993**	**Faultmeter Manual combined with Distress Identification Manual in May 1993 release**
1994			
1995			
1996			
1997			
1998			
1999			
2000			
2001			
2002	**Revised Distress Identification Manual released April 2002**		
2003	**Revised Distress Identification Manual released October 2003**		
2004			
2005			
2006	–	–	–
2007	–	–	–

6.4.2 References Used in Profile Measurement

Field Manuals Used in Profile Measurement

Collection of longitudinal profile data with the 690DNC model KJ Law profilers was governed by the following three versions of the guidelines.

> *Strategic Highway Research Program: SHRP-LTPP Manual for Profile Measurements: Operational Field Guidelines, Version 1.0,* SHRP, National Research Council, Washington, DC, December 1989.
>
> *Strategic Highway Research Program: Long-Term Pavement Performance Manual for Profile Measurement, Operational Field Guidelines, Version 2.0*, SHRP, National Research Council, Washington, DC, 1993.
>
> *Manual for Profile Measurement: Operational Field Guidelines*, SHRP Report SHRP-P-378, SHRP, National Research Council, Washington, DC, March 9, 1994.

The four T6600-model KJ Law profilers were implemented officially by directive on October 14, 1996. The following manuals provide the guidelines used in collecting longitudinal profile data with the T6600s.

> *LTPP Manual for Profile Measurements: Operational Field Guidelines, Version 3.0*, FHWA, Pavement Performance Division, McLean, VA, July 17, 1997.
>
> *LTPP Manual for Profile Measurements: Operational Field Guidelines, Version 3.1*, FHWA, Pavement Performance Division, McLean, VA, January 29, 1999.

Collection of longitudinal profile data with the International Cybernetics Corporation (ICC) MDR4086L3 inertial profilers began on October 9, 2002, by directive. The following manuals provide the guidelines used in collecting data with these units.

> *LTPP Manual for Profile Measurements: Operational Field Guidelines, Version 4.0*, FHWA, Pavement Performance Division, McLean, VA, October 9, 2002.
>
> *LTPP Manual for Profile Measurements and Processing, Version 4.1*, FHWA, Pavement Performance Division, McLean, VA, May 25, 2004.

Software Manuals Used in Profile Measurement

Each of the following manuals is provided for use with the software used to review and prepare the longitudinal profile data for entry into the database.

> *PROQUAL V1.4—User Documentation*, Stantec, Amherst, NY, June 1992.

PROQUAL V2.05—User Documentation (Draft), Report 97-00-01, Stantec, Amherst, NY, March 1997.

PROQUAL V2.06—User Documentation, Report 97-00-01, Stantec, Amherst, NY, July 1997.

PROQUAL V2.08—Users Documentation, Report 98-00-01, Stantec, Amherst, NY, June 1998.

PROQUAL2002—Overview Documentation, FHWA Report TS-01-01-01, FHWA, Pavement Performance Division, McLean, VA, December 2001.

PROQUAL2002—User Guide Documentation, FHWA Report TS-01-01-02, FHWA, Pavement Performance Division, McLean, VA, December 2001.

PROQUAL2002—Utilities Documentation, FHWA Report TS-01-01-03, FHWA, Pavement Performance Division, McLean, VA, December 2001.

PROQUAL2005—Overview Documentation, FHWA Report TS-05-00-01, FHWA, Pavement Performance Division, McLean, VA, April 2005.

PROQUAL2005—User Guide Documentation, FHWA Report TS-05-00-02, FHWA, Pavement Performance Division, McLean, VA, April 2005.

PROQUAL2005—Utilities Manual, FHWA Report TS-05-00-03, FHWA, Pavement Performance Division, McLean, VA, April 2005.

In 2005, software was provided to the regions to facilitate additional review of the profile as required. This software exports the data into a format commonly used by several other different pieces of software for manipulation and evaluation of longitudinal profile data.

PROXPORT User Guide, FHWA Report TS-05-00-04, FHWA, Pavement Performance Division, McLean, VA, April 2005.

6.4 Surface friction Measurements

Friction measurements on LTPP test sections were originally required. Data were to be collected with a locked wheel skid tester. Collecting these data as part of the LTPP program is now optional. Collection of surface friction data is governed by section 3.2 of the DCG as referenced at the beginning of this chapter.

CHAPTER 7. REHABILITATION DATA

7.1 Introduction to Rehabilitation Data

Because all of the sections in the LTPP program are located on public roads, some form of modification to the pavement structure will likely be needed to keep the road in a safe and serviceable condition for the traveling public. The data collected will pertain to rehabilitation that has occurred after initiation of monitoring for the test section. Most rehabilitation procedures, such as recycling or overlay, produce a test section having a modified pavement structure, while other procedures, such as undersealing, may be considered to restore the existing pavement structure. Reworking shoulders and placement of edge drains are other examples of improvements that may be made without changing the primary pavement structure; however, any such rehabilitation converts the pavement from an original pavement to a rehabilitated pavement. In other words, rehabilitation activities change the structural response of the pavement test section.

7.2 References Used in Collection of Rehabilitation Data

When a test section is modified by application of a rehabilitation treatment, some minimum requirements must be met for it to continue to be monitored as part of the LTPP program. Chapter 7 of the DCG as identified by the following reference governs the collection of data with respect to rehabilitation of the test sections.

> *Data Collection Guide for Long-Term Pavement Performance Studies*, Operational Guide No. SHRP-LTPP-OG-001, SHRP, National Research Council, Washington, DC, January 1988.

Chapter 7 of this document provides the forms and specific guidelines for collection of information about rehabilitation treatments on test sections. Each of the following versions of the DCG had updates to chapter 7 governing collection of rehabilitation data.

> *Data Collection Guide for Long-Term Pavement Performance Studies*, Operational Guide No. SHRP-LTPP-OG-001, SHRP, National Research Council, Washington, DC, December 15, 1989.

> *Data Collection Guide for Long-Term Pavement Performance Studies*, Operational Guide No. SHRP-LTPP-OG-001, FHWA, Pavement Performance Division, McLean, VA, October 28, 1993.

> *Data Collection Guide for Long-Term Pavement Performance Studies*, Operational Guide No. SHRP-LTPP-OG-001, FHWA, Pavement Performance Division, McLean, VA, February 19, 2004.

Some of the rehabilitation treatment types cause a section to be removed from further study. Others will cause the test section to be moved to a new experiment. The following document

provides guidelines for types of rehabilitation treatments that do not require that the test section be removed from future study.

> *Policies and Procedures for the Acceptance of Modified General Pavement Studies (GPS) Test Sections*, FHWA, Pavement Performance Division, McLean, VA, April 1993.

The following two documents superseded the April 1993 document regarding when a section that has undergone rehabilitation will continue to be monitored as a part of the LTPP program. Both of these documents were effective, via directive, as of September 24, 1998. The policy on monitoring continuation was further modified by directive GO–28 on November 7, 2001 to remove test sections from further study for any rehabilitation construction activity performed after January 1, 2004.

> *Long-Term Pavement Performance Guidelines for Monitoring Continuation on Rehabilitated Test Sections*, FHWA, Pavement Performance Division, McLean, VA, August 1998.

> *Long-Term Pavement Performance Guidelines for Classification of Rehabilitated Test Sections*, FHWA, Pavement Performance Division, McLean, VA, August 1998.

As stated previously, chapter 7 of the original DCG in combination with DCG chapter 6 has been organized into a separate document. Chapter 7 of the DCG and the two policies identified above have been superseded by the following document.

> *Maintenance and Rehabilitation Data Collection Guide for Long-Term Pavement Performance*, FHWA, Pavement Performance Division, McLean, VA, June 2005.

CHAPTER 8. SEASONAL MONITORING PROGRAM

8.1 Introduction to SMP

The purpose of the SMP is to obtain a fundamental understanding of the magnitude and impact of temporal variations in pavement response and material properties due to the separate and combined effects of temperature, moisture, and frost/thaw variations.

The SMP program includes an increased monitoring frequency of deflection, longitudinal profile, and distress surveys on selected sites in the LTPP program. The collection of deflection data involves a different protocol requiring testing to be performed on a portion of the test section using different test spacing than was used for the routine testing on the full test section. In addition to the increased monitoring frequency, other measurements—including prevailing weather conditions at the site, depth of frost penetration, temperature gradient, soil moisture, rainfall, ambient temperature, and surface elevation measurements—are also made at these sites. SMP data collection activities have been terminated per directive GO–36 effective October 31, 2004.

8.2 References Used in Collecting SMP Data

In 1995, section 3.5 was added to chapter 3 of the DCG to provide for collection of data as part of the SMP. The reference for this section is as follows. This section provides a general overview of data to be collected at these sites.

> *Data Collection Guide for Long-Term Pavement Performance Studies*, Operational Guide No. SHRP-LTPP-OG-001, FHWA, Pavement Performance Division, McLean, VA, January 1995.

8.2.1 References Detailing the SMP Instrumentation and Data Collection

The following documents provide specific information about the instrumentation and data collection efforts related to the SMP.

> *LTPP Seasonal Monitoring Program: Instrumentation, Installation, and Data Collection Guidelines, Version 2.1*, FHWA, Pavement Performance Division, McLean, VA, April 1994.

> *LTPP Seasonal Monitoring Program: Instrumentation, Installation, and Data Collection Guidelines*, FHWA Report No. FHWA-RD-94-110, FHWA, Pavement Performance Division, McLean, VA, January 1995.

This set of guidelines was modified August 7, 1998 by adding appendix A: “Time Domain Reflectometry (TDR) Classification and Interpretation.”

> *LTPP Seasonal Monitoring Program: Instrumentation, Installation, and Data Collection Guidelines*, FHWA Report No. FHWA-RD-94-110, FHWA, Pavement Performance Division, McLean, VA, August 7, 1998.

In 1999, a second phase was developed for the SMP. The objective was to provide additional information about the diurnal, seasonal, and annual variations in pavement response. Appendix C: "Guidelines for SMP Phase II Equipment and Instrumentation Installation" was added to the guidelines as of April 10, 2000. This appendix covered the data collection requirements for the second phase of the SMP.

> *LTPP Seasonal Monitoring Program: Instrumentation, Installation, and Data Collection Guidelines*, FHWA Report No. FHWA-RD-94-110, FHWA, Pavement Performance Division, McLean, VA, April 10, 2000.

8.2.2 References for SMP Software Manuals

Several pieces of software were used by the SMP. Documentation for these software items includes the following.

> *LTPP Seasonal Monitoring Program ONSFIELD Users Guide, Version 1.2*, FHWA, Pavement Performance Division, McLean, VA, June 1996.
>
> *LTPP Seasonal Monitoring Program: ONSFIELD Users Guide, Version 2.0*, FHWA, Pavement Performance Division, McLean, VA, December 1999.
>
> *LTPP Seasonal Monitoring Program MOBFIELD Users Guide, Version 2.4*, FHWA, Pavement Performance Division, McLean, VA, January 10, 1997.
>
> *LTPP Seasonal Monitoring Program: MOBFIELD Users Guide, Version 3.0*, FHWA, Pavement Performance Division, McLean, VA, December 1999.
>
> *LTPP Seasonal Monitoring Program ONSPLUS Users Guide, Version 1.05*, FHWA, Pavement Performance Division, McLean, VA, April 14, 2000.
>
> *LTPP Seasonal Monitoring Program ONSPLUS Users Guide, Version 1.08*, FHWA, Pavement Performance Division, McLean, VA, February 23, 2001.
>
> *LTPP Seasonal Monitoring Program SMPCheck Users Guide, Version 2.5*, FHWA, Pavement Performance Division, McLean, VA, October 28, 1996.
>
> *LTPP Seasonal Monitoring Program: SMPCheck Users Guide, Version 5.0*, FHWA, Pavement Performance Division, McLean, VA, January 2000.

CHAPTER 9. SPS CONSTRUCTION DATA

SPS experiments are comprised of projects incorporating multiple test sections at a specific location. The test sections at each project site include variations in structural design (thickness and materials), maintenance treatment, or rehabilitation treatment. The test sections in each project are built to meet a specific set of requirements. Because these sites are at the same location, they are expected to be subject to the same traffic and climate conditions, thus allowing for direct comparisons between the different pavement structures.

The document below describes the general requirements incorporated into the experimental design for each SPS experiment.

> *Specific Pavement Studies, Experimental Design and Participation Requirements*, Operational Memorandum SHRP-LTPP-OM-005R, SHRP, National Research Council, Washington, DC, July 1990.

Because these sections are built to meet specific requirements, there are data associated with the construction of each project that are recorded for evaluating the performance of each test section within the project.

For each experiment, with the exception of the SPS–3 and SPS–4 experiments, there are four types of documents used in developing these projects. The first document defines the experimental design, the second provides guidelines for nominating a new project, the third provides guidelines to be used in constructing projects, and the fourth document provides the information required to be collected on each project. There is a fifth document for each experiment concerning the sampling and testing of material used on each project. This document is covered under chapter 11, sections 11.2 and 11.3 of this document.

9.1 SPS–1, Strategic Study of Structural Factors for Flexible Pavements

9.1.1 SPS–1 Introduction

The SPS–1 experiment, Strategic Study of Structural Factors for Flexible Pavements, requires constructing multiple test sections with similar design details and materials at each of 16 sites distributed in 4 climatic regions. The SPS–1 experiment has been developed as a coordinated national experiment to investigate the effect of selected structural factors on the long-term performance of flexible pavements constructed on different subgrade types in different environmental regions. The structural factors include surface layer thicknesses, base type (material), drainability (permeability), and base course thicknesses. Characterization of the material properties and the variations in these properties between test sections provide a basis for improving current structural design methods.

9.1.2 SPS–1 References

The following references govern the experimental design, nomination, construction, and collection of construction data on each SPS–1 project.

SPS–1 Experiment Design

The experimental design provides basic information regarding the experiment, the factors included in the study, and the levels of each factor.

> *Specific Pavement Studies, Experimental Design and Research Plan for Experiment SPS–1, Strategic Study of Structural Factors for Flexible Pavements*, SHRP, National Research Council, Washington, DC, February 1990.

Guidelines for Nomination of SPS–1 Projects

The nomination guidelines provide the information and forms needed by the SHAs to nominate a project for inclusion in the experiment.

> *Specific Pavement Studies, Guidelines for Nomination and Evaluation of Candidate Projects for Experiment SPS–1, Strategic Study of Structural Factors for Flexible Pavements*, Operational Memorandum SHRP-LTPP-OM-008, SHRP, National Research Council, Washington, DC, February 1990.

This document was modified by directive S–1 on November 27, 1992. This modification involved the allowance of traffic variations along the length of an SPS–1 project under certain conditions.

Data Collection Guidelines for SPS–1 Projects

The data collection guidelines provide the data forms to be completed during the construction of each project and the instructions for completing these forms.

> *Specific Pavement Studies, Data Collection Guidelines for Experiment SPS–1, Strategic Study of Structural Factors for Flexible Pavements*, Operational Memorandum SHRP-LTPP-OM-026, SHRP, National Research Council, Washington, DC, December 1991.
>
> *Specific Pavement Studies, Data Collection Guidelines for Experiment SPS–1, Strategic Study of Structural Factors for Flexible Pavements*, Operational Memorandum SHRP-LTPP-OM-026, FHWA, Pavement Performance Division, McLean, VA, November 27, 1992.
>
> *Specific Pavement Studies, Data Collection Guidelines for Experiment SPS–1, Strategic Study of Structural Factors for Flexible Pavements*, Operational Memorandum SHRP-LTPP-OM-026, FHWA, Pavement Performance Division, McLean, VA, January 31, 1997.

Construction Guidelines for SPS–1 Projects

The construction guidelines provide the specific requirements on the individual material types and any specific required construction practices to be used in the construction of each project.

> *Specific Pavement Studies, Construction Guidelines for Experiment SPS–1, Strategic Study of Structural Factors for Flexible Pavements*, Operational Memorandum SHRP-LTPP-OM-017, SHRP, National Research Council, Washington, DC, December 1990.
>
> *Specific Pavement Studies, Construction Guidelines for Experiment SPS–1, Strategic Study of Structural Factors for Flexible Pavements,* FHWA, Pavement Performance Division, McLean, VA, December 1993.

9.2 SPS–2, Strategic Study of Structural Factors for Rigid Pavements

9.2.1 SPS–2 Introduction

The SPS–2 experiment, Strategic Study of Structural Factors for Rigid Pavements, requires constructing multiple test sections with similar details and materials at each of 16 sites distributed in the 4 climatic regions. The primary SPS–2 experiment requires the construction of 12 test sections at each of the test sites. The experiment addresses doweled jointed plain concrete pavements. The study factors are grouped into structural factors that relate to the base and concrete materials, and site factors that relate to the climate and subgrade.

9.2.2 SPS–2 References

SPS–2 Experimental Design

> *Specific Pavement Studies, Experimental Design and Research Plan for Experiment SPS–2, Strategic Study of Structural Factors for Rigid Pavements,* SHRP, National Research Council, Washington, DC, April 1990.

Nomination Guidelines for SPS–2 Projects

> *Specific Pavement Studies, Guidelines for Nomination and Evaluation of Candidate Projects for Experiment SPS–2, Strategic Study of Structural Factors for Rigid Pavements*, Operational Memorandum SHRP-LTPP-OM-009, SHRP, National Research Council, Washington, DC, April 1990.

This document was modified by directive S–1 on November 27, 1992. This modification involved the allowance of traffic variations along the length of an SPS–2 project under certain conditions.

Data Collection Guidelines for SPS–2 Projects

Specific Pavement Studies, Data Collection Guidelines for Experiment SPS–2, Strategic Study of Structural Factors for Rigid Pavements, Operational Memorandum SHRP-LTPP-OM-028, SHRP, National Research Council, Washington, DC, December 1991.

Specific Pavement Studies, Data Collection Guidelines for Experiment SPS–2, Strategic Study of Structural Factors for Rigid Pavements, Operational Memorandum SHRP-LTPP-OM-028, SHRP, National Research Council, Washington, DC, February 1992.

Specific Pavement Studies, Data Collection Guidelines for Experiment SPS–2, Strategic Study of Structural Factors for Rigid Pavements, Operational Memorandum SHRP-LTPP-OM-028, FHWA, Pavement Performance Division, McLean, VA, January 31, 1997.

Construction Guidelines for SPS–2 Projects

Specific Pavement Studies, Construction Guidelines for Experiment SPS–2, Strategic Study of Structural Factors for Rigid Pavements, Operational Memorandum SHRP-LTPP-OM-018, SHRP, National Research Council, Washington, DC, November 1990.

Specific Pavement Studies, Construction Guidelines for Experiment SPS–2, Strategic Study of Structural Factors for Rigid Pavements, Operational Memorandum SHRP-LTPP-OM-018, FHWA, Pavement Performance Division, McLean, VA, November 27, 1992.

Specific Pavement Studies, Construction Guidelines for Experiment SPS–2, Strategic Study of Structural Factors for Rigid Pavements, FHWA, Pavement Performance Division, McLean, VA, December 1993.

9.3 SPS–3, Pavement Maintenance Effectiveness of Flexible Pavements

SPS–3 projects are part of the Pavement Maintenance Effectiveness of Flexible Pavements study. These projects were selected from inservice roadways, and a specific maintenance treatment was applied to each test section in the project.

The objective of the SPS–3 experiment is to compare the effectiveness and mechanisms by which selected maintenance treatments preserve and extend pavement service life, safety, and ride quality on asphalt concrete (AC) pavements. The experiment includes a variety of environmental conditions, traffic volumes, and other factors that are incorporated into the analysis through the experimental design. The effectiveness of preventive maintenance treatments is determined by comparing the performance of the SPS–3 experiment sections with an equivalent control section that does not receive any treatment. The impact of individual materials or construction processes is not a part of this study. Sites to be included in the SPS–3 experiment were selected based on moisture climatic data (moisture and temperature), subgrade type, traffic level, surface condition, and structural adequacy. Within each site a variety of preventive maintenance methods were applied, including crack sealing, chip seal, slurry seal, and

thin overlays.

> *Specific Pavement Studies, Data Collection Guidelines for Experiment SPS–3, Maintenance Effectiveness for Asphalt Concrete Pavements*, SHRP, National Research Council, June 1990.

9.4 SPS–4, Pavement Maintenance Effectiveness of Rigid Pavements

SPS–4 projects are part of the Pavement Maintenance Effectiveness of Rigid Pavements study. These projects were selected from inservice roadways, and a specific maintenance treatment was applied to each test section in the project.

The objective of the SPS–4 experiment is to compare the effectiveness and mechanisms by which selected maintenance treatments preserve and extend pavement life, safety, and ride quality on jointed concrete pavements (JCP). The experiment includes a variety of environmental conditions, traffic volumes, and other factors that are incorporated into the analysis through the experimental design. The effectiveness of preventive maintenance treatments is determined by comparing performance of the SPS–4 experimental sections with an equivalent control section that does not receive any treatment. The impact of individual materials or construction processes is not a part of this study. Sites to be included in the SPS–4 experiment were selected based on moisture climatic data (moisture and temperature), subgrade type, traffic level, pavement type, and subbase type. Within each site, two preventive maintenance methods were applied: crack/joint sealing and undersealing.

> *Specific Pavement Studies, Data Collection Guidelines for Experiment SPS–4, Maintenance Effectiveness for Portland Cement Concrete Pavements*, SHRP, National Research Council, November 1991.

9.5 SPS–5, Rehabilitation of Asphalt Concrete Pavements

9.5.1 SPS–5 Introduction

The objective of the SPS–5 experiment, Rehabilitation of Asphalt Concrete Pavements, is to investigate the performance of selected AC pavement rehabilitation treatments. A variety of rehabilitation techniques can be applied to AC pavements to restore condition and extend service life. The techniques included in this experiment involve a combination of types and thicknesses of AC overlays using either virgin or recycled AC mixes. Another variable being examined is the extent of surface preparation. Characterization of the materials and their variation between test sections is required to explain performance differences between test sections and provide a basis for improvement of rehabilitation design strategies and methods.

Criteria for selection limit the sites to a single structural cross section, constructed of the same materials throughout, under a single contract. The flexibility in location of test sections is restricted to avoid cut/fill transitions, bridges, culverts, and side hill fills, and also to ensure

inclusion of additional test sections constructed by the SHA that will affect the potential for variability of the subgrade soils.

9.5.2 SPS–5 References

SPS–5 projects are part of the Rehabilitation of Asphalt Concrete Pavements study. These projects involve the construction of overlays of varying thicknesses and materials as well as differing pre-overlay strategies. The following references govern the experimental design, project nomination, construction, and collection of construction data on each SPS–5 project.

SPS–5 Experiment Design

> *Specific Pavement Studies, Experimental Design and Research Plan for Experiment SPS–5, Rehabilitation of Asphalt Concrete Pavements,* SHRP, National Research Council, Washington, DC, April 1989.

Nomination Guidelines for SPS–5 Projects

> *Specific Pavement Studies, Guidelines for Nomination and Evaluation of Candidate Projects for Experiment SPS–5, Rehabilitation of Asphalt Concrete Pavements,* Operational Memorandum No. SHRP-LTPP-OM-006, SHRP, National Research Council, Washington, DC, November 1989.

Data Collection Guidelines for SPS–5 Projects

> *Specific Pavement Studies, Data Collection Guidelines for Experiment SPS–5, Rehabilitation of Asphalt Concrete Pavements,* Operational Memorandum No. SHRP-LTPP-OM-015, SHRP, National Research Council, Washington, DC, October 1990.

The construction data sheets were revised according to directive S–01 on November 27, 1992. Further revision was made to construction data sheet 7 according to directive S–03 on February 10, 1993.

Construction Guidelines for SPS–5 Projects

> *Specific Pavement Studies, Construction Guidelines for Experiment SPS–5, Rehabilitation of Asphalt Concrete Pavements,* Operational Memorandum No. SHRP-LTPP-OM-012, SHRP, National Research Council, Washington, DC, June 1990.

9.6 SPS–6, Rehabilitation of Jointed Portland Cement Concrete Pavements

9.6.1 SPS–6 Introduction

The objective of the SPS–6 experiment, Rehabilitation of Jointed Portland Cement Concrete Pavements, is to investigate the performance of selected PCC rehabilitation treatments. A variety of rehabilitation techniques can be applied to JCP to restore condition and extend service life. The techniques included in this experiment involve a combination of levels and types of pavement preparation with and without the application of AC overlays. Pavement preparation may range from minimal treatment of the original PCC pavement to cracking/breaking and seating to full concrete pavement restoration (CPR). Depending on the extent and type of pavement preparation, AC overlays of appropriate thickness may or may not be applied.

On an SPS–6, there are seven experimental test sections and one control section. Two pavement types (jointed plain concrete and jointed reinforced concrete) are constructed in both fair and poor conditions in three climatic regions (wet-freeze, wet-no freeze, and dry-freeze). One pavement type (jointed plain concrete) is constructed in both fair and poor condition in the fourth climatic region (dry-no freeze). Due to the greater investment in construction of experimental test sections, the opportunity to collect a complete historical data record starting from construction, and the greater yield of information due to multiple test sections on the same site, a more rigorous overall testing program is used on SPS projects than is currently used on GPS projects.

9.6.2 SPS–6 References

SPS–6 projects are part of the Rehabilitation of Jointed Portland Cement Concrete Pavements study. The following references govern the experiment design, project nomination, construction, and collection of construction data on each SPS–6 project.

SPS–6 Experiment Design

> *Specific Pavement Studies, Experimental Design and Research Plan for Experiment SPS–6, Rehabilitation of Jointed Portland Cement Concrete Pavements*, SHRP, National Research Council, Washington, DC, April 1989.

Nomination Guidelines for SPS–6 Projects

> *Specific Pavement Studies, Guidelines for Nomination and Evaluation of Candidate Projects for Experiment SPS–6, Rehabilitation of Jointed Portland Cement Concrete Pavements*, SHRP, National Research Council, Washington, DC, April 1989.
>
> *Specific Pavement Studies, Guidelines for Nomination and Evaluation of Candidate Projects for Experiment SPS–6, Rehabilitation of Jointed Portland Cement Concrete Pavements*, Operational Memorandum SHRP-LTPP-OM-007, SHRP, National Research Council, Washington, DC, November 1989.

Data Collection Guidelines for SPS–6 Projects

Specific Pavement Studies, Data Collection Guidelines for Experiment SPS–6, Rehabilitation of Jointed Portland Cement Concrete Pavements, Operational Memorandum SHRP-LTPP-OM-023, SHRP, National Research Council, Washington, DC, May 1991.

The construction data sheets were revised per directive S–01 on November 27, 1992. Construction data sheet 7 was updated per directive S–03 on February 10, 1993.

Construction Guidelines for SPS–6 Projects

Specific Pavement Studies, Construction Guidelines for Experiment SPS–6, Rehabilitation of Jointed Portland Cement Concrete Pavements, Operational Memorandum SHRP-LTPP-OM-013, SHRP, National Research Council, Washington, DC, July 1990.

9.7 SPS–7, Bonded Portland Cement Concrete Overlays of Concrete Pavement

9.7.1 SPS–7 Introduction

The objective of the SPS–7 experiment, Bonded Portland Cement Concrete Overlays of Concrete Pavement, is to evaluate the effectiveness of bonded concrete overlays as a rehabilitation technique for existing concrete overlays. The experiment attempts measures the additional pavement life that results from the use of bonded concrete overlays, evaluates the effectiveness of surface preparation techniques, and investigates the influence of climate on the performance of bonded concrete overlays. The experiment involves overlays on jointed plain, jointed reinforced, and continuously reinforced concrete pavements. There are a variety of factors to be addressed in this experiment, including surface preparation, use of bonding grout, and overlay thickness.

On an SPS–7, there are eight experimental test sections, one control section, and one additional supplemental section for use by local agencies to evaluate features of regional interest. All of the pavement sections will have PCC overlays of either 76.2 or 127 mm (3 to 5 inches) in thickness, and two methods of surface preparation will be used (cold milling or shot blasting). Due to the greater investment in construction of experimental test sections, the opportunity to collect a complete historical data record starting from construction, and the greater yield of information due to multiple test sections on the same site, a more rigorous testing program is used on SPS projects than is currently used on GPS projects.

Criteria for selection limit the sites to an original pavement with a single structural cross section, constructed of the same materials throughout under a single contract. Flexibility in location of test sections is necessary to avoid cut/fill transitions, bridges, culverts, and side hill fills and also enable inclusion of additional test sections constructed by the SHA. These requirements will affect the potential for variability of the subgrade soils.

9.7.2 SPS–7 References

SPS–7 projects are part of the Bonded Portland Cement Concrete Overlays of Concrete

Pavements study. The following references govern the experimental design, project nomination, construction, and collection of data on each SPS–7 project.

SPS–7 Experimental Design

Specific Pavement Studies, Experimental Design and Research Plan for Experiment SPS–7, Bonded Portland Cement Concrete Overlays, SHRP, National Research Council, Washington, DC, April 1989.

Specific Pavement Studies, Experimental Design and Research Plan for Experiment SPS–7, Bonded Portland Cement Concrete Overlays, SHRP, National Research Council, Washington, DC, February 1990.

Nomination Guidelines for SPS–7 Projects

Specific Pavement Studies, Guidelines for Nomination and Evaluation of Candidate Projects for Experiment SPS–7, Bonded Portland Cement Concrete Overlays, Operational Memorandum No. SHRP-LTPP-OM-011, SHRP, National Research Council, Washington, DC, June 1990.

Data Collection Guidelines for SPS–7 Projects

Specific Pavement Studies, Data Collection Guidelines for Experiment SPS–7, Bonded Portland Cement Concrete Overlays, Operational Memorandum No. SHRP-LTPP-OM-024, SHRP, National Research Council, Washington, DC, July 1991.

Specific Pavement Studies, Data Collection Guidelines for Experiment SPS–7, Bonded Portland Cement Concrete Overlays, Operational Memorandum No. SHRP-LTPP-OM-024, FHWA, Pavement Performance Division, McLean, VA, November 27, 1992.

The SPS–7 construction data sheets were updated per directive S–7 on February 4, 1994.

Construction Guidelines for SPS–7 Projects

Specific Pavement Studies, Construction Guidelines for Experiment SPS–7, Bonded Portland Cement Concrete Overlays, Operational Memorandum No. SHRP-LTPP-OM-016, SHRP, National Research Council, Washington, DC, December 1990.

9.8 SPS–8, Study of the Environmental Effects in the Absence of Heavy Loads

9.8.1 SPS–8 Introduction

The SPS–8 experiment, Study of the Environmental Effects in the Absence of Heavy Loads, was developed to investigate the performance of selected flexible and rigid pavement structures constructed on different subgrade types in different environmental regions. For flexible pavements, the structural factors include different surface and base layer thicknesses. For rigid pavements, the concrete slab thickness is the only structural factor considered.

As with other SPS new construction experiments (SPS–1 and SPS–2), SPS–8 starts with controlled construction of multiple test sections co-located on a project. Specifically, on an SPS–8 project, there are at least two experimental test sections and possibly four if both rigid and flexible sections are built.

9.8.2 SPS–8 References

SPS–8 projects are part of the Study of Environmental Effects in the Absence of Heavy Loads. Each of these projects consists of at least two test sections identical to those constructed as part of the SPS–1 or SPS–2 experiment constructed on low volume roadways. The following references govern the experimental design, project nomination, construction, and collection of construction data on each SPS–8 project.

SPS–8 Experiment Design

Specific Pavement Studies, Experimental Design and Research Plan for Experiment SPS–8, Study of Environmental Effects in the Absence of Heavy Loads, SHRP, National Research Council, Washington, DC, August 1991.

Nomination Guidelines for SPS–8 Projects

Specific Pavement Studies, Guidelines for Nomination and Evaluation of Candidate Projects for Experiment SPS–8, Study of Environmental Effects in the Absence of Heavy Loads, SHRP, National Research Council, Washington, DC, August 1991.

Data Collection Guidelines for SPS–8 Projects

Specific Pavement Studies, Data Collection Guidelines for Experiment SPS–8, Study of Environmental Effects in the Absence of Heavy Loads, Operational Memorandum No. SHRP-LTPP-OM-031, SHRP, National Research Council, Washington, DC, December 1991.

Specific Pavement Studies, Data Collection Guidelines for Experiment SPS–8, Study of Environmental Effects in the Absence of Heavy Loads, Operational Memorandum No. SHRP-LTPP-OM-031, SHRP, National Research Council, Washington, DC, September 1992.

In accordance with directive S–12, revisions were made to construction data sheets 7 and 19 on January 31, 1997.

Construction Guidelines for SPS–8 Projects

> *Specific Pavement Studies, Construction Guidelines for Experiment SPS–8, Study of Environmental Effects in the Absence of Heavy Loads*, Operational Memorandum No. SHRP-LTPP-OM-029, SHRP, National Research Council, Washington, DC, March 1992.

9.9 SPS–9, Validation of SHRP Asphalt Specifications and Mix Design and Innovations in Asphalt Pavements

9.9.1 SPS–9 Introduction

The primary objective of the SPS–9 experiment, Validation of SHRP Asphalt Specifications and Mix Design and Innovations in Asphalt Pavements, is to validate the performance-based SHRP asphalt binder specifications and asphalt-aggregate mixture specifications. Additionally, this experiment was intended to provide for inservice field evaluation of innovative materials.

The SPS–9A experiment, Superpave Asphalt Binder Study, was developed as a subset of the SPS–9 experiment. Its primary objectives are to validate the SHRP binder specifications, allow direct comparison of asphalt mixtures designed using SHA procedures and the newly developed SHRP procedures, and provide initial data for use in refining the mixture performance models also developed as part of the SHRP research. Initial performance-based specification limits and requirements were developed by the SHRP Asphalt Research Program from a database of accelerated, standardized tests using established performance prediction models and validated by correlation with inplace field pavement data. The SPS–9A experiment is needed to expedite the analyses and further validate these products. SPS–9A allows SHAs and contractors to have hands-on experience in utilizing and implementing the Superpave technology and allows for direct comparison with current SHA standards.

The SPS–9A test pavements may be built either as part of a new, reconstructed roadway or overlay, or as a parallel test road. If built as part of a reconstructed or resurfaced roadway, the reconstruction should include all lanes. In all cases, the cross section must be uniform. These projects involve constructing a minimum of three test sections with a layer of asphalt concrete with varying binder types in each test section. Construction of the test sections in a lane that is added to an existing pavement are not suitable for this experiment because of the difficulty of discerning the relationship between distresses developed in the existing lanes and those developed in the widened test sections.

9.9.2 SPS–9 References

SPS–9 Experimental Design

Specific Pavement Studies, Experimental Design and Research Plan for Experiment SPS–9, Validation of SHRP Asphalt Specifications and Mix Design and Innovations in Asphalt Pavements, SHRP, National Research Council, Washington, DC, February 1993.

Specific Pavement Studies, Experimental Design and Research Plan for Experiment SPS–9A, Superpave Asphalt Binder Study, FHWA, Pavement Performance Division, McLean, VA, January 1995.

Specific Pavement Studies, Experimental Design and Research Plan for Experiment SPS -9A, Superpave Asphalt Binder Study, FHWA, Pavement Performance Division, McLean, VA, September 1995.

Nomination Guidelines for SPS–9 Projects

Specific Pavement Studies, Guidelines for Nomination and Evaluation of Candidate Projects for Experiment SPS–9, Validation of SHRP Asphalt Specifications and Mix Design and Innovations in Asphalt Pavements, SHRP, National Research Council, Washington, DC, February 1993.

Specific Pavement Studies, Guidelines for Nomination and Evaluation of Candidate Projects for Experiment SPS–9A, Superpave Asphalt Binder Study, FHWA, Pavement Performance Division, McLean, VA, August 1994.

Guidelines for Nomination and Evaluation of Candidate Projects for Experiment SPS–9A, Superpave Asphalt Binder Study, FHWA, Pavement Performance Division, McLean, VA, September 1995.

Data Collection Guidelines for SPS–9 Projects

Specific Pavement Studies, Data Collection Guidelines for Experiment SPS–9A, Superpave Asphalt Binder Study, FHWA, Pavement Performance Division, McLean, VA, April 1996.

Construction Guidelines for SPS–9 Projects

Specific Pavement Studies, Construction Guidelines for Experiment SPS–9A, Superpave Asphalt Binder Study, FHWA, Pavement Performance Division, McLean, VA, August 1994.

Specific Pavement Studies, Construction Guidelines for Experiment SPS–9A, Superpave Asphalt Binder Study, FHWA, Pavement Performance Division, McLean, VA, September 1995.

CHAPTER 10. TRAFFIC DATA

10.1 Introduction to Traffic Data

Traffic data are collected separately for the lanes (or lane) being monitored. Because each lane experiences different traffic, each should be considered as a separate test section. For LTPP, data collection is planned only for the outside lane in one direction.

The traffic data include distribution of traffic by vehicle classes; days of data collected; and distribution of axle loads for single, tandem, and tridem axles by vehicle class. For locations where traffic data have been submitted for all lanes, the data may include average annual daily traffic (AADT) and percent trucks.

Data forms have been developed to capture information on sections inservice before the start of monitoring in 1990. Data collected from 1990 forward been submitted in one of the electronic record formats documented in FHWA's *Traffic Monitoring Guide* (TMG), second through fourth editions. Data are submitted between twice a month and annually depending on the practices of the individual agencies. Except for special cases, monthly submittal is preferred, and quarterly is typical. In the absence of electronic data on a section, a set of data forms has been provided for recording estimates of traffic during that timeframe.

Data for individual vehicles require considerable computer storage, so these are expected to be stored offline rather than directly in the LTPP IMS. Appropriate summary data such as numbers of axles in certain weight categories, vehicles in certain classes, equivalent axle loads, etc., are to be calculated from the raw data and stored in the LTPP IMS. The raw data will be available for use when needed.

The traffic data file will include both historical data before initiation of the monitoring activity and data collected throughout the monitoring period. Data have been submitted using the TMG classification schemes (Truck Weight Study 6-digit and 13-bin) as well as agency-defined schemes. All offline data and daily summaries are provided in the classification scheme used for submission. All data provided from online sources summarized at the monthly or annual level are in the TMG 13-bin classification scheme. The database does not contain information on the algorithms used or the changes that may have been made to the algorithms over time. Thus, for example, the impact of large pickups cannot be explicitly traced in the data.

Traffic data reporting for LTPP is separated into two categories: historical and monitoring. Historical traffic data are defined to cover the period from the dates the pavement sections were initially opened to traffic (or from the date of the most recent overlay or rehabilitation project) through 1989. The overall purpose of historical traffic data collection is to obtain the best estimate of annual traffic levels on each test section before the time monitoring began on that section. The monitored traffic data cover traffic data collection activities initiated for monitoring the LTPP test section.

10.2 References Used in Collecting Traffic Data

10.2.1 Traffic Data Collection Plans

The DCG provides a detailed description for collecting historical data and a general description for collecting monitored traffic data.

> *Data Collection Guide for Long-Term Pavement Performance Studies*, Operational Guide No. SHRP-LTPP-OG-001, SHRP, National Research Council, Washington, DC, January 1988, chapter 4.
>
> *Data Collection Guide for Long-Term Pavement Performance Studies*, Operational Guide No. SHRP-LTPP-OG-001, FHWA, Pavement Performance Division, McLean, VA, October 1993, chapter 4.

The following document provided a revised and more detailed plan for the collection and processing of traffic data to prepare the data for entry into the IMS.

> *Revised Data Collection Plan for LTPP Sites*, FHWA, Pavement Performance Division, McLean, VA, April 1998.

Additionally, a separate document was issued providing a procedure to check the equipment used in traffic data collection.

> *Long-Term Pavement Performance Program Protocol for Calibrating Traffic Data Collection Equipment*, FHWA, Pavement Performance Division, McLean, VA, April 1998.

The Revised Data Collection Plan and the Protocol for Calibrating Traffic Data Collection Equipment were subsequently combined into a single document along with all the additional required information used in collecting traffic data for the LTPP program.

> *Guide to LTPP Traffic Data Collection and Processing*, FHWA, Pavement Performance Division, McLean, VA, April 2000.
>
> *Guide to LTPP Traffic Data Collection and Processing*, FHWA, Pavement Performance Division, McLean, VA, March 2001.

A separate set of documents was prepared to provide guidelines for collecting data at SPS projects. The following references provide specific requirements for performance of weigh-in-motion (WIM) equipment at these locations and collection of data at SPS projects.

> *Pavement Smoothness Specifications for LTPP SPS WIM Locations, Version 1.0*, FHWA, Pavement Performance Division, McLean, VA, August 2001.
>
> *WIM Calibration Check Specifications Check for LTPP SPS Sites, Version 1.0*, FHWA, Pavement Performance Division, McLean, VA, August 2001.

Draft—Data Collection Guide for SPS WIM Sites, Version 1.0, FHWA, Pavement Performance Division, McLean, VA, August 2001.

The following two documents provide details on equipment installation requirements for bending plate WIM equipment.

LTPP Bending Plate Weigh-in-Motion System: Model Specifications for Equipment—Hardware and Software, Version 1.0, FHWA, Pavement Performance Division, McLean, VA, August 2000.

LTPP Bending Plate Weigh-in-Motion System: Model Specifications for Pavement and Installation, Version 1.0, FHWA, Pavement Performance Division, McLean, VA, August 2000.

The following document, which will codify a range of operational practices, is under development.

Traffic Operations Guide, Version 1.0, FHWA, Pavement Performance Division, McLean, VA, June 2005.

10.2.2 Software Guides

Software to perform quality control checks and process/accumulate the desired data to be stored in the IMS has been a very important part of traffic data collection.

The first set of software guides was issued in 1997.

LTPP SPS Traffic Processing Users Guide, FHWA, Pavement Performance Division, McLean, VA, June 1997.

LTPP Traffic Software Users Guide, FHWA, Pavement Performance Division, McLean, VA, June 1997.

LTPP Traffic Software Technical Documentation, FHWA, Pavement Performance Division, McLean, VA, July 1997.

LTPP Traffic QC Software, Technical Documentation, FHWA, Pavement Performance Division, McLean, VA, 1997.

LTPP Traffic Database Librarian Software, Version 4.0, FHWA, Pavement Performance Division, McLean, VA, April 24, 1997.

LTPP Level 4 Traffic Quality Control Analysis Users Manual, FHWA, Pavement Performance Division, McLean, VA, June 1997.

Running the Level 4 Traffic Quality Control Filter Program, FHWA, Pavement Performance Division, McLean, VA, June 1997.

Users Manual for Level 3 through 1 LTPP Traffic Quality Control Software, FHWA, Pavement Performance Division, McLean, VA, July 1997.

Managing Purge Document Using Purge Operations Software, FHWA, Pavement Performance Division, McLean, VA, February 1998.

The software for performing quality control checks and data analysis has been revised and reissued. The documents referenced below provide the guidelines for use with this revised software.

LTPP Traffic QC Software Volume 1: Users' Guide, Version 1.5, FHWA, Pavement Performance Division, McLean, VA, December 2000.

LTPP Traffic QC Software Volume 1: Users' Guide, Version 1.6.1, FHWA, Pavement Performance Division, McLean, VA, November 2001.

Traffic Analysis Software, Volume 1—Users' Guide, Version 1.0, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, February 28, 2002.

Traffic Analysis Software, Volume 1—Users' Guide, Version 1.0, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, April 10, 2002.

Traffic Analysis Software, Volume 1—Users' Guide, Version 1.1, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, August 1, 2002.

Traffic Analysis Software, Volume 1—User's Guide, Version 1.2, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, November 1, 2002.

Traffic Analysis Software, Volume 1—Users' Guide, Version 1.2.1, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, January 10, 2003.

Traffic Analysis Software, Volume 1—Users' Guide, Version 1.3, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, March 7, 2003.

Traffic Analysis Software, Volume 1—Users' Guide, Version 1.3.1, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, August 29, 2003.

Traffic Analysis Software, Volume 1—Users' Guide, Version 1.3.3, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, October 21, 2003.

Traffic Analysis Software, Volume 1—Users' Guide, Version 1.4, FHWA, Office of

Infrastructure Research, Development, and Technology, McLean, VA, May 14, 2004.

Traffic Analysis Software, Volume 1—Users' Guide, Version 1.4.1, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, October 1, 2004.

Traffic Analysis Software, Volume 1—Users' Guide, Version 1.5, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, February 4, 2005.

Traffic Analysis Software, Volume 1, Appendix A—Database Manipulation and Troubleshooting, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, October 1, 2004.

Traffic Analysis Software, Volume 1, Appendix A—Database Manipulation and Troubleshooting, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, February 4, 2005.

LTPP Traffic Analysis Software Volume 3—ORACLE Table Specifications, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, March 14, 2002.

LTPP Traffic Analysis Software Volume 3—ORACLE Table Specifications, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, March 7, 2003.

LTPP Traffic Analysis Software Volume 3—ORACLE Table Specifications, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, September 14, 2004.

LTPP Traffic Analysis Software Volume 3—ORACLE Table Specifications, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, February 4, 2005.

LTPP Traffic Analysis Software Volume 3, Appendix A—Table Schemas, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, March 14, 2002.

LTPP Traffic Analysis Software Volume 3, Appendix A—Table Schemas, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, March 29, 2002.

LTPP Traffic Analysis Software Volume 3, Appendix A—Table Schemas, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, July 30, 2002.

LTPP Traffic Analysis Software Volume 3, Appendix A—Table Schemas, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, March 7, 2003.

LTPP Traffic Analysis Software Volume 3, Appendix A—Table Schemas, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, May 6, 2004.

LTPP Traffic Analysis Software Volume 3, Appendix A—Table Schemas, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, September 14, 2004.

LTPP Traffic Analysis Software Volume 3, Appendix A—Table Schemas, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, January 25, 2005.

LTPP Traffic Analysis Software Volume 3, Appendix B—Codes Listing, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, March 27, 2002.

LTPP Traffic Analysis Software Volume 3, Appendix B—Codes Listing, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, July 30, 2002.

LTPP Traffic Analysis Software Volume 3, Appendix B—Codes Listing, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, March 7, 2003.

LTPP Traffic Analysis Software Volume 3, Appendix B—Codes Listing, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, May 14, 2004.

LTPP Traffic Analysis Software Volume 3, Appendix B—Codes Listing, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, September 14, 2004.

LTPP Traffic Analysis Software Volume 3, Appendix B—Codes Listing, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, January 25, 2005.

LTPP Traffic Analysis Software Volume 3, Appendix C—QC Specifications, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, March 27, 2002.

LTPP Traffic Analysis Software Volume 3, Appendix C—QC Specifications, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, April 30, 2002.

LTPP Traffic Analysis Software Volume 3, Appendix C—QC Specifications, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, July 30, 2002.

LTPP Traffic Analysis Software Volume 3, Appendix C—QC Specifications, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, March 7, 2003.

LTPP Traffic Analysis Software Volume 3, Appendix C—QC Specifications, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, May 7, 2004.

LTPP Traffic Analysis Software Volume 3, Appendix C—QC Specifications, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, September 30, 2004.

LTPP Traffic Analysis Software Volume 3, Appendix C—QC Specifications, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, January 26, 2005.

LTPP Traffic Analysis Software Volume 3, Appendices D through F—Table Population and Maintenance, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, March 27, 2002.

LTPP Traffic Analysis Software Volume 3, Appendices D through F—Table Population and Maintenance, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, July 30, 2002.

LTPP Traffic Analysis Software Volume 3, Appendices D through F—Table Population and Maintenance, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, August 30, 2004.

LTPP Traffic Analysis Software Volume 4—Design Specifications, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, January 14, 2002.

LTPP Traffic Analysis Software Volume 4—Design Specifications, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, June 29, 2003.

LTPP Traffic Analysis Software Volume 5—Specifications for Graphics, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, August 3, 2001.

LTPP Traffic Analysis Software Volume 5—Specifications for Graphics, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, May 9, 2002.

LTPP Traffic Analysis Software Volume 5—Specifications for Graphics, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, September 17, 2002.

LTPP Traffic Analysis Software Volume 5, Appendix A—SPS Graphs, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, March 29, 2002.

LTPP Traffic Analysis Software Volume 5, Appendix A—SPS Graphs, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, August 1, 2002.

LTPP Traffic Analysis Software Volume 5, Appendix A—SPS Graphs, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, October 31, 2002.

LTPP Traffic Analysis Software Volume 5, Appendix A—SPS Graphs, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, October 21, 2003.

LTPP Traffic Analysis Software Volume 5, Appendix B—Agency Graphics, FHWA, Office of Infrastructure Research, Development, McLean, VA, March 29, 2002.

LTPP Traffic Analysis Software Volume 5, Appendix B—Agency Graphics, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, August 1, 2002.

LTPP Traffic Analysis Software Volume 5, Appendix B—Agency Graphics, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, October 31, 2002.

LTPP Traffic Analysis Software Volume 5, Appendix B—Agency Graphics, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, October 21, 2003

LTPP Traffic Analysis Software Volume 5, Appendix C—13-bin Graphs, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, March 29, 2002.

LTPP Traffic Analysis Software Volume 5, Appendix C—13-bin Graphs, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, August 1, 2002.

LTPP Traffic Analysis Software Volume 5, Appendix C—13-bin Graphs, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, October 21, 2003.

LTPP Traffic Analysis Software Volume 5, Appendix D—Classification Error Graphs, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, March 29, 2002.

LTPP Traffic Analysis Software Volume 5, Appendix D—Classification Error Graphs, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, August 1, 2002.

LTPP Traffic Analysis Software Volume 5, Appendix D—Classification Error Graphs, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, October 21, 2003.

LTPP Traffic Analysis Software Volume 5, Appendix E—ESAL Graphs, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, March 29, 2002.

LTPP Traffic Analysis Software Volume 5, Appendix E—ESAL Graphs, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, May 19, 2002.

LTPP Traffic Analysis Software Volume 5, Appendix E—ESAL Graphs, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, August 1, 2002.

LTPP Traffic Analysis Software Volume 5, Appendix E—ESAL Graphs, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, October 21, 2002.

LTPP Traffic Analysis Software Volume 5, Appendix E—ESAL Graphs, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, March 7, 2003.

LTPP Traffic Analysis Software Volume 5, Appendix E—ESAL Graphs, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, October 21, 2003.

LTPP Traffic Analysis Software Volume 5, Appendix F—STAT_QC Graphs, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, March 29, 2002.

LTPP Traffic Analysis Software Volume 5, Appendix F—STAT_QC Graphs, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, August 1, 2002.

LTPP Traffic Analysis Software Volume 5, Appendix F—STAT_QC Graphs, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, October 23, 2002.

LTPP Traffic Analysis Software Volume 5, Appendix F—STAT_QC Graphs, FHWA, Office of Infrastructure Research, Development, and Technology, McLean, VA, October 21, 2003.

CHAPTER 11. FIELD MATERIALS SAMPLING AND LABORATORY TESTING DATA

11.1 Introduction

Materials data include the data necessary to characterize the various layers of each test section. The following categories of materials data are collected:

- Field Materials Sampling and Testing Data (include field sampling logs, in-situ density and moisture tests, and log of shoulder probe).
- General Laboratory Data (include information on pavement layers as identified from inventory records and as identified in the laboratory).
- AC Test Data.
    - AC Core Thickness.
    - AC Bulk and Maximum Specific Gravities.
    - Asphalt Content.
    - AC Resilient Modulus.
    - AC Moisture Sensitivity.
    - Viscosity of Extracted Binder.
    - Gradation of Extracted AC Aggregate.
    - National Aggregate Association Test for Fine Extracted Aggregate.
- Treated Base/Subbase Test Data.
    - Material Description.
    - Compressive Strength.
    - Resilient Modulus.
- Unbound Base/Subbase Test Data.
    - Gradation and Hydrometer Analysis.
    - Atterberg Limits.
    - Moisture Density Relations.
    - Resilient Modulus.
    - Classification and Description.
    - Natural Moisture Content.
    - Specific Gravity.
- PCC Test Data.
    - Compressive Strength.
    - Splitting Tensile Strength.
    - Static Modulus of Elasticity.
    - Core Examination and Thickness.
    - Coefficient of Thermal Expansion.

The material testing data represent the condition of the material at the time of sampling and testing. Therefore, these results may incorporate the effects of the season and the pavement age at time of sampling and testing.

The primary objective of this testing program is to provide a comprehensive evaluation of the

pavement layer structure and layer thicknesses of the pavement materials used in each section or project. The work is accomplished by core drilling, augering, test pit opening, sampling, and nuclear density testing along with the subsequent performance of a suite of laboratory material characterization tests. To facilitate the collection of these data, standard laboratory testing protocols and data entry sheets have been developed for recording all data collected in the field and in the laboratory.

The DCG provides some general information regarding the collection of materials data with respect to the LTPP program. Other documents, referenced below, provide more detailed information about the appropriate methodologies to be used in obtaining and reporting these data.

> *Data Collection Guide for the Long-Term Pavement Performance Studies*, Operational Guide No. SHRP-LTPP-OG-001, SHRP, National Research Council, Washington, DC, January 1988, chapter 8.
>
> *Data Collection Guide for the Long-Term Pavement Performance Studies*, Operational Guide No. SHRP-LTPP-OG-001, SHRP, National Research Council, Washington, DC, June 13, 1988, chapter 8.
>
> *Data Collection Guide for the Long-Term Pavement Performance Studies*, Operational Guide No. SHRP-LTPP-OG-001, FHWA, Pavement Performance Division, McLean, VA, October 1993, chapter 8.

11.2 Sampling

A different approach has been taken in the materials sampling for the GPS experiments and the SPS experiments. In addition, the sampling approach for each SPS experiment is different. Therefore, a separate materials sampling guide was prepared for the GPS test sections, and there is a specific guide for each of the SPS experiments. For each SPS project, a unique sampling and testing plan was prepared before construction of the project. The SPS experiment-specific guidelines provide the approach to be used in preparing the project-specific plans.

11.2.1 GPS Sampling Guidelines

> *SHRP-LTPP Guide for Field Materials Sampling, Testing and Handling*, Operational Guide No. SHRP-LTPP-OG-006, SHRP, National Research Council, Washington, DC, May 1990.
>
> *SHRP-LTPP Guide for Field Materials Sampling, Handling, and Testing*, Operational Guide No. SHRP-LTPP-OG-006, SHRP, National Research Council, Washington, DC, February 1991.

11.2.2 SPS Sampling Guidelines

Below are the references for the sampling guidelines for use in each SPS experiment.

> *Specific Pavement Studies, Materials Sampling and Testing Requirements for Experiment*

SPS–1, Strategic Study of Structural Factors for Flexible Pavements, Operational Memorandum No. SHRP-LTPP-OM-021, SHRP, National Research Council, Washington, DC, February 1991.

Specific Pavement Studies, Materials Sampling and Testing Requirements for Experiment SPS–1, Strategic Study of Structural Factors for Flexible Pavements, FHWA, Pavement Performance Division, McLean, VA, January 1994.

Specific Pavement Studies, Materials Sampling and Testing Requirements for Experiment SPS–2, Strategic Study of Structural Factors for Rigid Pavements, Operational Memorandum No. SHRP-LTPP-OM-022, SHRP, National Research Council, Washington, DC, April 1991.

Specific Pavement Studies, Materials Sampling and Testing Requirements for Experiment SPS–2, Strategic Study of Structural Factors for Rigid Pavements, FHWA, Pavement Performance Division, McLean, VA, November 27, 1992.

Specific Pavement Studies, Materials Sampling and Testing Requirements for Experiment SPS–2, Strategic Study of Structural Factors for Rigid Pavements, FHWA, Pavement Performance Division, McLean, VA, March 30, 1994.

Specific Pavement Studies, Materials Sampling and Testing Requirements for Experiment SPS–2, Strategic Study of Structural Factors for Rigid Pavements, FHWA, Pavement Performance Division, McLean, VA, June 1994.

Specific Pavement Studies, Materials Sampling and Testing Requirements for Experiment SPS–5, Rehabilitation of Asphalt Concrete Pavements, Operational Memorandum No. SHRP-LTPP-OM-014, SHRP, National Research Council, Washington, DC, October 1990.

Specific Pavement Studies, Materials Sampling and Testing Requirements for Experiment SPS–6, Rehabilitation of Jointed Portland Cement Concrete Pavements, Operational Memorandum No. SHRP-LTPP-OM-019, SHRP, National Research Council, Washington, DC, January 1991.

Specific Pavement Studies, Materials Sampling and Testing Requirements for Experiment SPS–7, Bonded Portland Cement Concrete Overlay of Concrete Pavements, Operational Memorandum No. SHRP-LTPP-OM-020, SHRP, National Research Council, Washington, DC, January 1991.

Specific Pavement Studies, Materials Sampling and Testing Requirements for Experiment SPS–8, Study of Environmental Effects in the Absence of Heavy Loads, Operational Memorandum No. SHRP-LTPP-OM-030, SHRP, National Research Council, Washington, DC, August 1992.

Specific Pavement Studies, Materials Sampling and Testing Requirements for Experiment

SPS–9, Validation of SHRP Asphalt Specifications and Mix Design and Innovations in Asphalt Pavements, SHRP, National Research Council, Washington, DC, February 1993.

Specific Pavement Studies, Materials Sampling and Testing Requirements for Experiment SPS–9A, Superpave Asphalt Binder Study, FHWA, Pavement Performance Division, McLean, VA, February 1996.

11.3 Testing

This guide provides detailed instructions for performing and documenting laboratory testing and information on laboratory processing of samples. It also contains the individual protocols used in laboratory testing along with the methods for disposing of the samples once testing has been completed. The revisions listed below generally include the submittal of a new or revised protocol for a particular test via a materials directive.

SHRP-LTPP Interim Guide for Laboratory Materials Handling and Testing (PCC, Bituminous Materials, Aggregates and Soils), Operational Guide No. SHRP-LTPP-OG-004, SHRP, National Research Council, Washington, DC, November 1989.

SHRP-LTPP Interim Guide for Laboratory Materials Handling and Testing (PCC, Bituminous Materials, Aggregates and Soils), Operational Guide No. SHRP-LTPP-OG-004, SHRP, National Research Council, Washington, DC, April 1990.

SHRP-LTPP Interim Guide for Laboratory Materials Handling and Testing (PCC, Bituminous Materials, Aggregates and Soils), Operational Guide No. SHRP-LTPP-OG-004, SHRP, National Research Council, Washington, DC, June 1990.

SHRP-LTPP Interim Guide for Laboratory Materials Handling and Testing (PCC, Bituminous Materials, Aggregates and Soils), Operational Guide No. SHRP-LTPP-OG-004, SHRP, National Research Council, Washington, DC, December 1990.

SHRP-LTPP Interim Guide for Laboratory Materials Handling and Testing (PCC, Bituminous Materials, Aggregates and Soils), Operational Guide No. SHRP-LTPP-OG-004, SHRP, National Research Council, Washington, DC, February 1991.

SHRP-LTPP Interim Guide for Laboratory Materials Handling and Testing (PCC, Bituminous Materials, Aggregates and Soils), Operational Guide No. SHRP-LTPP-OG-004, SHRP, National Research Council, Washington, DC, November 1991.

SHRP-LTPP Interim Guide for Laboratory Materials Handling and Testing (PCC, Bituminous Materials, Aggregates and Soils), Operational Guide No. SHRP-LTPP-OG-004, SHRP, National Research Council, Washington, DC, January 1992.

SHRP-LTPP Interim Guide for Laboratory Materials Handling and Testing (PCC, Bituminous Materials, Aggregates and Soils), Operational Guide No. SHRP-LTPP-OG-004, SHRP, National Research Council, Washington, DC, May 1992.

Additional revisions were made to the guides via directive. Table 3 provides the date, directive number and basic description of each of these revisions.

Table 3. Revision to Interim Guide for Laboratory Materials Handling and Testing

Directive	Date	Description
M–01	October 1, 1992	Revised protocol P07
M–02	October 1, 1992	Revised protocol P42
M–03	July 15, 1993	Revised protocols P05, P06, P07, P14, P14A, P24, P33, P46, P67
M–04	March 1, 1994	Protocol P60 and revised protocol P61, P62, and P64
M–07	February 8 ,1995	Revised protocol P68
M–08	November 30, 1995	Revised data sheet H01, protocol H01L, and protocol H02L
M–09	March 18, 1996	Form L03 for SPS–1 and forms H02L, H03L, and H04L
M–10	June 6, 1996	Revised protocol P05
M–11	August 8, 1996	Revised protocol P46
M–13	January 8, 1997	Revised protocol data sheet T56
M–14	July 21, 1997	Added table 1B providing testing program for asphalt overlays to appendix G
M–17	December 11, 1997	Deletion of test procedure AE04
M–21	October 12, 1999	Transmittal of protocol P63
M–22	March 10, 2000	Revised protocol P05
M–34	September 28, 2001	Revised protocol P07

A separate document has been prepared to provide guidance on the methodology used in establishing the pavement structure on the various test sections at SPS projects.

Specific Pavement Studies, Pavement Layering Methodology, FHWA, Pavement Performance Division, McLean, VA, January 1994.

Specific Pavement Studies, Pavement Layering Methodology, FHWA, Pavement Performance Division, McLean, VA, December 1994.