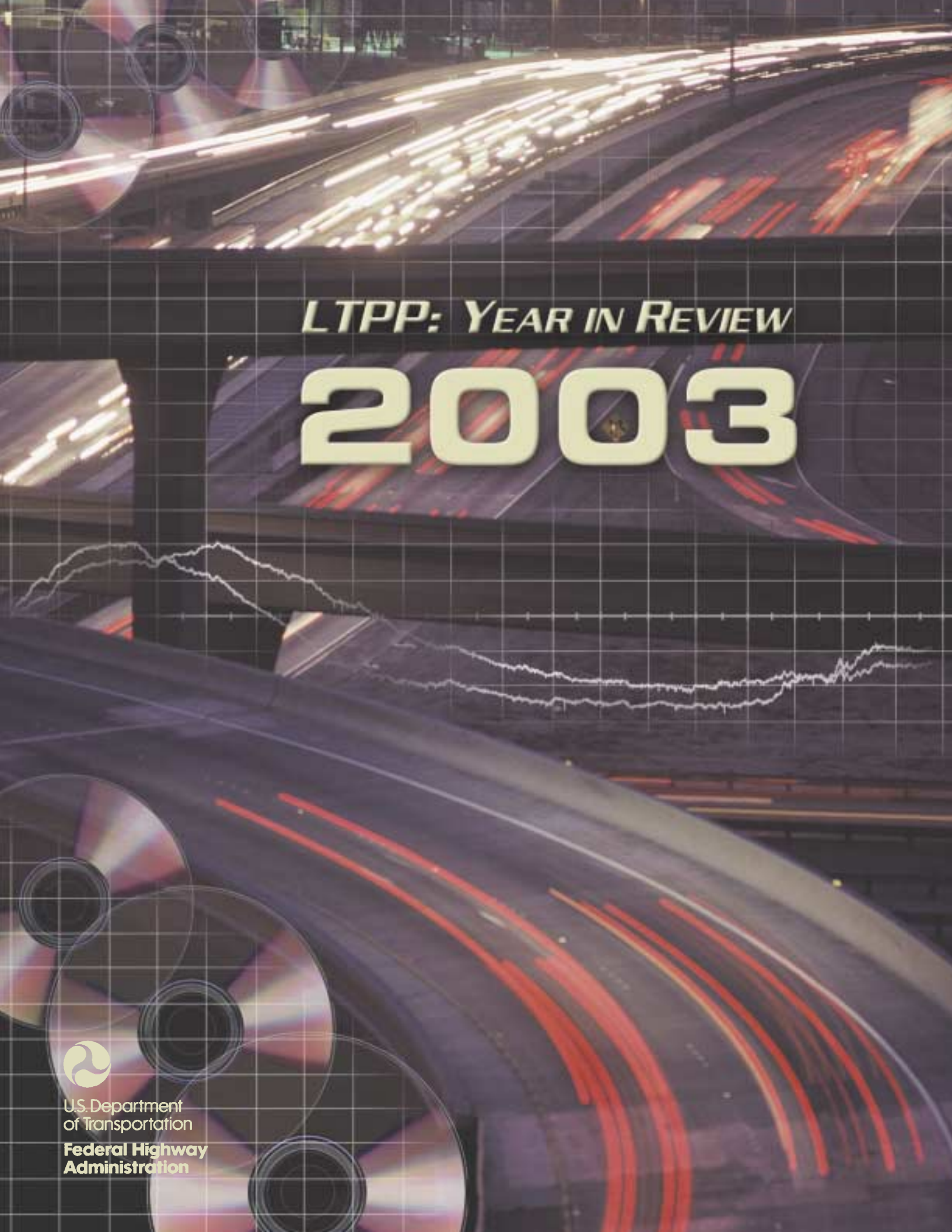




LTPP: YEAR IN REVIEW

2003



U.S. Department
of Transportation
**Federal Highway
Administration**





INTRODUCTION

In 2003, as in previous years, the Long-Term Pavement Performance (LTPP) Program continued working to provide a better understanding of the “hows” and “whys” of pavement performance. This report outlines LTPP’s 2003 program area accomplishments and previews the year ahead.

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Understanding pavement performance is vital to building and maintaining highway systems. Pavements carry all kinds of vehicular traffic for commerce and recreation, and they are critical to our Nation’s economic well-being. Understanding how and why pavements perform as they do can improve the productivity and mobility of the national highway transportation system.

LTPP collects data from more than 1,800 active pavement sections in the United States and Canada, analyzes these data, and then translates these insights into products and information for pavement design, rehabilitation, maintenance, and management. LTPP’s partners remained strong in their support of the program in 2003, as in previous years. The States and Provinces, American Association of State Highway and Transportation Officials (AASHTO), Canadian Strategic Highway Research Program (C-SHRP), Transportation Research Board (TRB), and Federal Highway Administration (FHWA) all continued to play key roles in helping the program achieve its goals.



2003 ACCOMPLISHMENTS

FEATURED ACCOMPLISHMENT

In 2003, LTPP continued to emphasize the importance of collecting reliable and adequate data to help researchers answer how and why pavements perform the way that they perform. LTPP collects most of these data elements, although the State Highway Agencies (SHA) provide the traffic data and most of the materials data for the Specific Pavement Studies (SPS) projects to LTPP. The materials data action plan has begun to address the gaps in the material database for SPS projects; however, traffic data, vital to pavement design, continues to be the most challenging to collect and process consistently nationwide. LTPP recognized this challenge and partnered with the States to develop a pooled fund study to address the issues of inconsistent and inadequate traffic data for the SPS projects. To date, nearly half of the States with an SPS project have contributed \$1.9 million to this study.

The “Long-Term Pavement Performance (LTPP) Specific Pavements Study (SPS) Traffic Data Collection” pooled fund study, TPF-5(004), was initiated in 2000 to improve the quality and quantity of monitored traffic data (volumes, classifications, and weights) from the program’s SPS-1, -2, -5, -6, and -8 projects. This is a two-phase project. Phase I consists of assessing, evaluating, and calibrating current LTPP Weigh-in-Motion (WIM) systems (both piezo and bending plate). Phase II involves procuring, installing, and maintaining the LTPP WIM equipment. FHWA awarded the Phase I contract in August and expects to award the Phase II contract in

early 2004. Phase I traffic evaluations were completed in a few States and will continue in 2004. FHWA will present the results from these initial evaluations during the TRB annual meeting in January 2004.

In addition to awarding the Phase I contract and soliciting proposals for Phase II, FHWA made an ambitious effort to process the 1999–2001 traffic data for all LTPP test sections nationwide by December 2003. Improvements made to the LTPP Traffic Quality Control and Analysis software helped the LTPP regions achieve this goal. The regions also processed the 2002 traffic data. Because of this significant effort, in January 2004, the pavement community will have access to a large amount of monitored traffic data that was not available previously.

DATA COLLECTION

LTPP continued to develop the materials data action plan in 2003. This plan was designed to address gaps in the SPS materials data. The States have been working to complete their SPS project material testing, and resilient modulus testing on bound and unbound materials is progressing. New protocols for bending beam rheometer, dynamic shear rheometer, dynamic cone penetrometer, soil suction, and specific gravity for unbound materials were developed.

In addition to ongoing development for the materials data action plan, data collection for the edge drain project continued. The functioning levels of drainage conditions at the SPS-1, SPS-2,



and some of the SPS-6 sites were observed to ensure that LTPP drainage analysis is complete and relevant. As a result, new tables and data collection categories were added to the LTPP database to include this data.

Layer thickness for test sections was obtained from cores taken in the transition sections, but no measurements had been taken from inside the test sections. To verify the layer thickness within the test sections, LTPP awarded a contract in 2003 to collect layer thickness data using ground-penetrating radar (GPR). Data was collected at all SPS-1 projects and one each of the SPS-2, SPS-5, and SPS-6 projects. Although GPR provides accurate layer thickness measurements for flexible pavements, it may not provide accurate measurements for rigid pavements, so LTPP began a pilot study at the end of 2002 to obtain layer thickness measurements at an SPS-2 project using an impact echo hammer. This study continued in 2003.

LTPP began operating four new high-speed inertial road-profiling systems in 2003. Before the new profilers were introduced, researchers conducted performance-based acceptance testing. This included testing the profilers on five test sections to verify that the profilers were collecting accurate data. Later in 2003, the Minnesota Road Research facility conducted a profiler comparison test to verify that the four new profilers were collecting similar data. LTPP developed a new version of the profiler manual that outlines the operational procedures for these new profilers, and created new office procedures and documentation for processing and performing quality assurance checks on profile data.

Closeout activities began on the seasonal monitoring test sites. The Seasonal Monitoring Program (SMP) has been operating for 11 years and has generated much valuable data regarding the impact of moisture and temperature variations on pavement performance—data that will be used in years to come. The official SMP completion date is scheduled for October 1, 2004.

As more LTPP sections approach the end of their service life, they no longer will be an active part of the program. However, valuable information can be collected through forensic investigations into why a particular section performed as it did. In 2003, the framework for conducting these investigations was completed. Discussions with States that are interested in pursuing such investigations began in 2003 and will continue in 2004.

All test sections that receive a rehabilitation treatment after January 1, 2004, will be placed out-of-study and classified as a General Pavement Studies (GPS) project. The monitoring frequency of GPS projects will not allow enough pavement performance data to be collected by 2009 for these test sections.

ANALYSIS

Findings from LTPP analysis projects help highway engineers in their day-to-day operations. LTPP continued data analysis projects that began in 2002 and worked to review and publish the results of studies already completed. To keep the highway community apprised of the results of LTPP's analysis efforts over the past several years, LTPP conducted a major review of completed analysis projects in 2003.



The findings from these projects were compiled and have been published in *Key Findings from LTPP Analysis 2000–2003*. This document contains many new findings regarding pavement performance, and supplements the findings published in the first volume, *Key Findings from LTPP Analysis 1990–1999*. These findings illustrate not only the immediate value of the LTPP database, but also its potential use for improving pavement technology.

The TRB Data Analysis Expert Task Group (ETG) reviewed and updated the FHWA and TRB *Strategic Plan for Long-Term Pavement Performance Data Analysis* (Strategic Plan) and the TRB ETG *Long-Term Pavement Performance Data Analysis Strategic Plan Objectives, Analysis Outcomes, and Supporting Projects Chart*. A Web version of the Strategic Plan was developed to improve access to information about ongoing and completed analysis projects. The current versions of both documents are posted at www.fhrc.gov/pavement/ltp/analysis.htm.

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2003 LTPP ANALYSIS PROJECTS	
INITIATED	PLANNED
■ Optimization of Traffic Data Collection for Specific Pavement Applications ■ Review of LTPP Backcalculation Results ■ Effect of Multiple Freeze-Thaw Cycles vs. Deep Frost Penetration on Pavement Performance ■ Integrating Condition Measurement Variability in Network Pavement Management Systems ■ Quantification of Smoothness Index Differences Related to LTPP Equipment Type	■ Confidence of WIM Axle Load Data ■ Review of Laboratory Resilient Modulus Testing for HMA Mixtures ■ Relationship between Laboratory-Measured and Field-Derived Properties of Pavement Layers ■ Evaluation of LTPP Site-Specific Climatic Data ■ Characterization of Portland Cement Concrete Pavement Curvature ■ Simplified Techniques for Evaluation and Interpretation of Pavement Deflections for Network-Level Analysis ■ Evaluation and Characterization of Pavement Drainage



PRODUCTS

In 2003, the change in the data release policy was an important development for the LTPP program. This change allowed for the release of data at all status levels, resulting in the distribution of a new standard data release package after each semiannual data upload. The data is provided on CD-ROM in Microsoft® Access format and includes reference documents and software, such as the *Table Navigator*, *Data Dictionary*, *Pavement Performance Database User Guide*, and the *LTPP Information Management System: IMS Quality Control Checks* manual. Similar information also is available now on DataPave Online.

In addition to making the most current LTPP data available via the Internet, LTPP soon will produce CD-ROMs to provide and distribute data that previously was unavailable due to size constraints. This valuable data includes raw (25-millimeter) profile data; raw (time-history) deflection data; distress photographs, videos, and maps; and profile data from WIM pavement evaluations. To receive this data, users must submit a “Custom Data Extraction” request to the LTPP Customer Support Service Center at ltppinfo@fhwa.dot.gov.

Also in 2003, researchers wrote the *LTPP Guide to Asphalt Temperature Prediction and Correction*. This guide presents methods devel-

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The LTPP DataPave Online Web site received a total of 514 registered users from October 2002 to July 2003. A total of 4,191 data exports were performed during this period. The volume of data exported was 3.14 gigabytes. The most requested data was “Monitoring,” and the most exported file format was “Compressed Microsoft Excel.”

DataPave, which previously was available only on CD-ROM, is now available on the Web. Users can access DataPave Online anytime, anywhere. It is a simple, user-friendly Web application that contains the most current LTPP data for viewing and downloading. These data include inventory, materials testing, pavement performance monitoring, climatic, traffic, maintenance, rehabilitation, and seasonal testing data from more than 2,500 pavement test sections at 932 locations on in-service highways throughout North America. The Web address for DataPave Online is www.datapave.com. In 2004, FHWA plans to award a 5-year contract for maintenance of the Web site.

oped using LTPP data to calculate representative pavement temperatures and temperature correction factors. The Pavement Profiler Viewer and Analyzer (ProVAL) software was another key product that was completed in 2003. This software can help improve the quality of pavement construction by analyzing profile data quickly and providing results in a number of formats.

The LTPP Customer Support Service Center continued to provide excellent service to LTPP data users. The service center completed 452 requests in 2003. Of those requests, 151 were questions about the LTPP program and data, 148 were data requests from the pavement



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performance and central traffic databases, 95 were for the DataPave software, and 58 were for materials related to the LTPP program. The service center also began distributing the standard LTPP data release, which includes all of the pavement performance data in a five-CD-ROM set.

FIELD OPERATIONS

In 2003, LTPP, in conjunction with the Colorado Department of Transportation (DOT), opened a new Falling Weight Deflectometer (FWD) Calibration Center in Denver, CO. The new center replaced the previous Reno, NV facility and will serve the LTPP Western region. Facility evaluation, testing, and training began in the spring, and initial calibrations for one State DOT and one private firm were conducted in September. Contact information for appointment scheduling at all LTPP FWD calibration

centers is available on the LTPP Web site at <http://www.tfhrc.gov/pavement/ltp/fwdcont.htm>.

Effective July 1, 2003, a new regional support contract was awarded in the North Central region. The contractor change did not affect data collection activities for the LTPP test sites in this region, because LTPP ensured timely communication with the States and Provinces affected by the change.

In August 2003, a new contract for the Materials Reference Library (MRL) operation was awarded. The MRL is a storage facility that houses many of the pavement and subsurface materials sampled under both the GPS and SPS experiments. LTPP film, seasonal monitoring, and weather equipment are also stored at this location.



POOLED FUND STUDIES

Pooled fund activities for the LTPP program continued in 2003. LTPP continued to seek State partnerships to conduct studies that will further help to answer the “hows” and “whys” of pavement performance.

In 2003, work began on LTPP's first data analysis pooled fund study, “Effect of Multiple Freeze-Thaw Versus Deep Frost Penetration on Pavement Performance,” TPF-5(013). The objective of this study is to determine the relative importance of deep freezing versus multiple shallow freezes on the performance of flexible pavements. To date, eight States have committed \$430,000 to this project.

In 2003, final preparations were made for establishing the “Falling Weight Deflectometer (FWD) Calibration Centers and Operational Improvements” pooled fund study, TPF-5(039). This study was initiated to perform software and hardware upgrades; improve the operation processes at the existing centers; establish new centers; and explore financial support mechanisms for the future, beyond LTPP.

The FWD pooled fund study will proceed in two phases. The first phase will focus on financial support and upgrades, and the second phase will focus on implementing the improvements, possibly expanding the number of centers, and

identifying the types of equipment that can be calibrated at the centers. Thirteen States have pledged \$475,000 for this effort. An advertisement for the first phase is expected in the beginning of 2004.

Several States have contributed a total of \$1.3 million to the pooled fund study, “Improving the Quality of Pavement Profiler Measurement,” TPF-5(063). The goals of this study are to deliver sample procurement specification, maintenance guidelines, and a profile analysis software program; establish criteria for verification centers and help develop these locations; develop and deploy a traceable verification center; and provide technical review of software development.

LTPP encourages more States to join in these important projects. States interested in participating in these studies are encouraged to contact the study managers and can find more information on the LTPP Web site's pooled fund studies page at www.tfhr.gov/pavement/ltp/pooled.htm or www.pooledfund.org.



GETTING THE WORD OUT

LTPP announces research results through its Web site, meetings, publications, research reports, and interactions with SHAs, industry trade associations, and professional societies. In 2003, LTPP continued to spread the word about the program and its results through as many venues as possible.

WEB SITE

In 2003, LTPP made some enhancements to its Web site, www.fhrc.gov/ltp.htm, to provide better service and support to its customers. A search feature was added so that users may search by keyword to find information quickly. The new Pooled Fund Studies section provides technical and background information, as well as current status, for pooled fund research. Direct links to new Web sites for DataPave Online (www.datapave.com) and the LTPP Technical Support Services Contractor (TSSC) homepage (www.ltp.org) were established. The TSSC Web site is an important new resource for pertinent LTPP information, and provides valuable tools for using the LTPP data, including the revised *Data Users Manual*, the *Data Dictionary*, and the *Table Navigator* program.

As in previous years, LTPP continued to publish the results of its analytical findings in its Web site's Library section. Viewers can access information quickly about the latest LTPP research reports, product briefs, application notes, and resource documents in this section.

MEETINGS

Each year, FHWA LTPP staff members make presentations at various industry trade associ-

ation and governmental meetings throughout the United States. In 2003, these activities began with an LTPP team presentation at the 82nd Annual Meeting of the Transportation Research Board in Washington, DC. LTPP staff and contractors made several presentations regarding the LTPP program's progress and data findings during this meeting. Presentation sessions included the LTPP State Coordinators Meeting and the LTPP Box Session.

The LTPP team visited many States to discuss data collection issues, products, and pooled fund studies. The State visits were overwhelmingly positive. These visits also allowed FHWA to thank the States for their support of the LTPP program and to let them know that their continued involvement is vital to completing the LTPP program.

PUBLICATIONS

Of special note on the list of 2003 accomplishments is the publication of the *Distress Identification Manual for the Long-Term Pavement Performance Program* (FHWA-RD-03-031), fourth edition. This descriptive manual, which includes extensive illustrations of various distress types in color photographs and drawings, is a valuable tool used by many highway agencies as

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a consistent, uniform basis for collecting distress data. It provides a common language for describing cracks, potholes, rutting, spalling, and other pavement distresses that the LTPP program monitors. This new version is the result of 8 years of practical experience using the previous version, and incorporates refinements, changes, and new LTPP distress directives issued since the publication of the last manual.

The *Long-Term Pavement Performance Information Management System: Pavement Performance Database User Reference Guide* (FHWA-RD-03-088) was completed and published in 2003. This document provides in-depth references to the LTPP pavement performance database structure and content, and explains how to obtain and use the data. The publication is distributed with the standard data release form and also is available for download at DataPave Online.

LTPP also continued to update the highway community on LTPP research findings, products, and field applications through its TechBriefs, Product Briefs, and Application Notes. TechBriefs provide concise summaries of recent LTPP data analysis projects. Product Briefs provide overviews of specific products, along with the product's technical background, key features, and benefits. Application Notes describe how some States are using LTPP products or analysis findings and benefiting from these applications. See the last page of this document for a list of LTPP publications issued in 2003.

RESEARCH REPORTS

FHWA published several research reports documenting FHWA-sponsored LTPP data analysis in 2003. The published reports contain research findings that are of broad interest. Copies of the reports are distributed to State and Provincial highway agencies, FHWA headquarters and field offices, members of TRB committees advising LTPP, and other interested parties. Reports for smaller audiences are distributed on a limited basis. LTPP research reports with a limited interest and distribution are submitted to the National Technical Information Service to provide a readily accessible public record of work that was completed, but not formally published.

WORKSHOPS/CONTESTS

FHWA held a pilot workshop for the ProVAL software. The objectives of this workshop were to familiarize users with the software; review some of the key fundamentals of pavement profiling and analysis methods; inform users of the advantages, limitations, and pitfalls related to analyzing and interpreting pavement profiles; and provide an interactive and hands-on training. Additional workshops will be scheduled in 2004 to introduce State and industry personnel to the software and demonstrate its capabilities.

FHWA and the American Society of Civil Engineers completed the fourth International Contest on LTPP Data Analysis in 2003. For the first time, the contestants used DataPave Online as a tool in their analysis. Six prizes were awarded in four categories.

THE PARTNERSHIP

LTPP is a partnership with State and Provincial highway agencies, C-SHRP, TRB, AASHTO, and FHWA, all of which are deeply involved in and essential to the program's success.

THE STATES AND PROVINCES

As owners of the LTPP test sections, the State and Provincial highway agencies have a significant investment in the program. These agencies designated the test sites, constructed the test sections, supplied test materials, and collected data. As in the past, the agencies continue to provide traffic data and monitor test section performance. Because they use and apply program results, State and Provincial highway agencies are LTPP's primary customers. Provinces participate through C-SHRP. Launched in 1987, C-SHRP coordinates Canadian involvement in the U.S. Strategic Highway Research Program.

TRANSPORTATION RESEARCH BOARD

Several TRB committees provide input and advice regarding LTPP research and implementation activities. Committee members represent the State and Provincial highway agencies, industry, academia, and the international highway community. The TRB-LTPP Committee provides management-level input on LTPP's conduct. In addition, there are several topic-specific ETGs and a product subcommittee that supply technical review and input for key program areas. The dedicated volunteers who serve on these committees are tremendous assets to LTPP.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS

AASHTO plays a critical role in LTPP. From recruiting test sections to adopting LTPP-developed methods, procedures, and guidelines as standards for pavement engineering, AASHTO provides the collective leadership for many of the program's successes to date.

In 2003, LTPP worked with the AASHTO Subcommittee on Materials to address resilient modulus for unbound materials. LTPP representatives also served on the AASHTO Technology Implementation Group's panel for the implementation of GPR technology for pavement evaluation. LTPP will continue to work with AASHTO through the Technology Implementation Group, the Subcommittee on Materials, the Joint Task Force on Pavements, and other committees as needed.

FEDERAL HIGHWAY ADMINISTRATION

FHWA's Office of Infrastructure Research and Development manages LTPP's day-to-day research operations. Specific activities include collecting, processing, and disseminating data; orchestrating national analysis activities; coordinating the LTPP program; and communicating results. FHWA's Resource Centers, Division



Offices, and the Office of Pavement Technology also play key roles in the LTPP program. The Office of Pavement Technology leads LTPP product development and directs product packaging for delivery. FHWA Resource Centers help collect LTPP data and deliver LTPP products

to the States, Divisions, and highway industry. In addition to helping facilitate product delivery, technical support, and overall coordination and communication, the Division Offices work directly with the States that support LTPP data collection efforts.

FUNDING

Approximately \$8.94 million of LTPP funding in 2003 was authorized by the *Consolidated Appropriations Resolution of 2003* (Omnibus Appropriations 108th: H.J.Res.2). As stated in 2002, the Appropriation Act for Fiscal Year (FY) 2002 changed the funding by providing an additional \$10 million in Revenue Aligned Budget Authority (RABA) for the LTPP and Superpave® programs for both FY 02 and FY 03. FY 03 RABA allocation for the LTPP program was \$3.8 million.

Approximately \$7.69 million of Transportation Equity Act for the 21st Century (TEA-21) funds and \$3.1 million of RABA funds were used for LTPP data collection field operations in 2003. The additional RABA funding enabled LTPP to finish collecting all the needed data.

Approximately \$1.1 million from TEA-21 and RABA funds were allocated to LTPP's analysis program in FY 03. Product development received \$300,000 from RABA and \$64,000 from TEA-21 funds.



THE FUTURE

In 2004, LTPP will continue its mission to provide a better understanding of the “hows” and “whys” of pavement performance. It will do so by supplying the information and tools highway engineers and managers need to design, build, and maintain long-lasting and cost-effective pavements.

Throughout 2004, LTPP will continue to develop a plan for complete program documentation, including the LTPP database, research reports, experiment design documents, and other important information, so that these resources will be accessible to research analysts in the future. The ultimate objective of this effort is to create an LTPP electronic library.

The LTPP program is now 13 years into its 20-year data collection effort; it rapidly is approaching a crucial moment. The Federal-aid

highway authorization legislation that supported the program expired on September 30, 2003. A sound plan and budget have been developed to ensure that LTPP work is completed and program expectations are met by 2009. The work ahead for LTPP, simply stated, is to complete data collection on all pavement test sections, conduct data analysis according to the defined plan, and develop products in a disciplined manner. To execute the developed plan, LTPP will need sufficient funding during FY 04 through FY 09.



SELECTED LTPP 2003 PUBLICATIONS

Brochures

- *Key Findings from LTPP Analysis 2000–2003* (HRT-04-032)
- *LTPP: 2002 Year in Review* (FHWA-RD-03-045)

TechBrief

- *Help with Converting Pavement Smoothness Specifications* (FHWA-RD-02-112)

Product Briefs

- *DataPave Online: Improving Pavement Design Through Performance Data Analysis* (FHWA-RD-03-079)
- *Pavement Profile Viewer and Analyzer* (FHWA-RD-03-070)

User Reference Guides

- *Distress Identification Manual for the Long-Term Pavement Performance Program* (FHWA-RD-03-031)
- *Long-Term Pavement Performance Information Management System: Pavement Performance Database User Reference Guide* (FHWA-RD-03-088)

Research Reports

- *Assessment of Selected LTPP Material Data Tables and Development of Representative Test Tables* (FHWA-RD-02-001)
- *Distress Data Consolidation Final Report* (FHWA-RD-01-143)
- *Evaluations of Joint and Crack Load Transfer Final Report* (FHWA-RD-02-088)
- *Highway Concrete Technology Development and Testing, Volume I: Field Evaluation of SHRP C-202 (ASR) Test Sites* (FHWA-RD-02-082)
- *Highway Concrete Technology Development and Testing Volume II: Field Evaluation of SHRP C-203 (Freeze-Thaw Resistance) Test Sites* (FHWA-RD-02-083)
- *Long-Term Effectiveness of Cathodic Protection Systems on Highway Structures* (FHWA-RD-01-096)
- *Long-Term Performance of Corrosion Inhibitors Used in Repair of Reinforced Concrete Bridge Components* (FHWA-RD-01-097)
- *Structural Factors for Flexible Pavements—Initial Evaluation of the SPS-1 Experiment Final Report* (FHWA-RD-01-166)



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