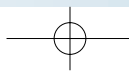
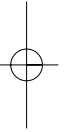
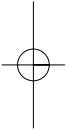
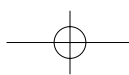
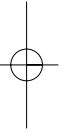
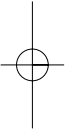
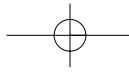


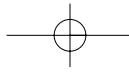
Pavement Preservation Research Problem Statements

**Federal Highway Administration
and The Foundation for
Pavement Preservation**

*Research Problem
Statement Workshop
Sacramento, California
JUNE 21-22, 2001*







Pavement Preservation Research Problem Statements

Research Problem Statement Workshop

Sacramento, California

June 21–22, 2001

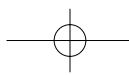
By James S. Moulthrop, R. Gary Hicks,
and Jon A. Epps



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



December 2001



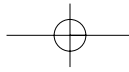


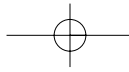
TABLE OF CONTENTS

Acknowledgments

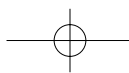
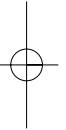
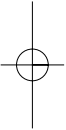
Executive Summary	
1. Introduction	1
2. Background	3
3. Mission Statement/Goals	5
4. Research Workshop	6
5. Strategic Programs/Projects	10
6. References	17

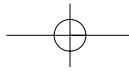
Appendices

A. List of Participants	18
B. Research Topics	20
C. First Round Balloting of Issues	24
D. Draft Problem Statements	28
1.0 Construction	30
1.1 QC/QA for Pavement Preventative Maintenance (PM) Treatments	31
1.2 Standardized Field Sampling Methods for Slurry Seal and Microsurfacing	32
1.3 Use of the Ignition Oven to Determine Percentage of Asphalt Concrete (AC) in Slurry, Microsurfacing, and Other Emulsion Mixes	33
2.0 Materials Selection and Mix Design	34
2.1 Development of a Cost-Effective Chip Seal System for Pavement Preservation	35
2.2 Concrete Materials for Maintenance Applications	36
2.3 Performance and Specifications of Crack and Joint Sealants	38
2.4 Mix Design Procedures, Engineering Properties, and Performance Characteristics of Emulsion Mixes with and without RAP	39



3.0	Treatments and Selection Strategy	40
3.1	Timing of Preventative Maintenance Applications to Effectively Extend Pavement Service Life	41
3.2	Maximizing Pavement Preservation Strategies through Cost Effectiveness Research	42
3.3	Appropriate Maintenance Treatments for Urban Areas (Window of Opportunity)	43
3.4	Development of Preventive Maintenance Guidelines for Pavement Blow-Ups	44
3.5	Development of Integrated Databases To Make Pavement Preservation Decisions	45
4.0	Performance	46
4.1	Guidelines for Effective Maintenance Treatment Evaluation Test Sections	47
4.2	Performance Measures/Criteria for Conventional and Warranted Preservation Treatments	48
4.3	Treatments and Quantification for Noise Reduction and Improved Surface Characteristics	49
4.4	Documentation of Pavement Performance Data Based on the Application of Pavement Preservation Strategies	50
5.0	Training	52
5.1	Design and Construction of High Quality Preventive Maintenance Treatments	53
5.2	Training and Certification of Technicians	54
5.3	Training to Present the Results of Research and Development (R&D) and to Facilitate Implementation	56
6.0	Policy	58
6.1	Innovation in Preventative Maintenance through Performance-Based Specifications	59
6.2	Implementation Guidelines for a Pavement Preservation Program	61
7.0	Other	62
7.1	Effectiveness of Retrofit Edgedrains	63





ACKNOWLEDGMENTS

The authors would like to take this opportunity to thank all the many people involved with the planning, execution, and documentation of the Workshop.

Workshop Organization

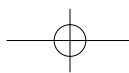
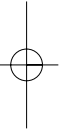
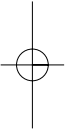
The Research Problem Workshop was a joint effort among the Federal Highway Administration (FHWA), American Association of State Highway and Transportation Officials (AASHTO), and the Foundation for Pavement Preservation (FPP). The California Department of Transportation (DOT) agreed to host the meeting and arrange for facilities.

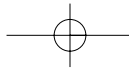
Meeting Participants

The organizers and participants in the Workshop are noted in Appendix A.

Document Preparation

The preparation of the Workshop report was done by Dr. Jon Epps, Dr. R. Gary Hicks, and James S. Moulthrop. The editing was done by Woodward Communications and the report was published through the auspices of FHWA.





Executive Summary

A workshop was held in Sacramento on June 21-22, 2001, to develop research problem statements related to pavement preservation. The workshop was a joint effort among the Federal Highway Administration (FHWA), American Association of State Highway and Transportation Officials (AASHTO), and the Foundation for Pavement Preservation (FPP). The California Department of Transportation hosted the 2-day meeting. Participants at the workshop included FHWA, AASHTO members, FPP members, and academia. Dr. Jon Epps of Granite Construction, Inc., facilitated the meeting.

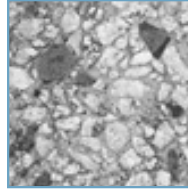
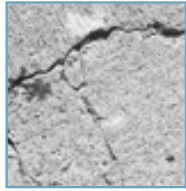
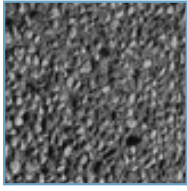
The purpose of the workshop was to gather practitioners from various maintenance disciplines around the United States to discuss research needs in the pavement preservation arena. The outcome was to be a series of problem statements that the partners could promote for funding and study.

A total of 50 research problem statements were initially identified and grouped in the following areas:

1. Construction practices,
2. Materials selection and design,
3. Treatment strategies and selection,
4. Performance evaluation,
5. Training, and
6. Policy.

The participants prioritized the projects and the number of projects was then reduced to a total of 22. Project statements were prepared for each of these topics.

This report was prepared documenting the findings of the workshop and the resulting research project statements. The report is available from FHWA or FPP.



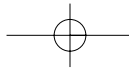
one — *introduction*

Very little research has been conducted recently regarding pavement preservation practices used in the United States and elsewhere. Most of the maintenance techniques have evolved through the shared experience of practitioners. In contrast, a tremendous amount of research expenditures in the past 50 years has been spent on pavement materials characterization, construction practices, and pavement management techniques. In the United States, this is due in part because of the needs associated with the planning and execution of the Interstate Highway System. During the Strategic Highway Research Program, some research funds were expended to improve techniques for patching and sealing of cracks and joints. Recently, agencies have begun to invest research and development funds into new preservation techniques and practices. This has been spurred by several surveys indicating lack of customer satisfaction with pavement conditions, safety, and congestion.



Commitment to Pavement Preservation

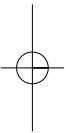
The importance of maintaining the U.S. highway infrastructure was first recognized by Congress in the 1978 Surface Transportation Act, which provided an emphasis on maintaining the Interstate System and permitted Federal funds to be used for such activities for the first time. More recently in the reorganization of FHWA, an Office of Asset Management was established with the clear vision, among other goals, of promoting



the benefits of pavement preservation to States. Since 1997, FHWA has partnered with the FPP and AASHTO in sponsoring seminars, training courses, publications, and other forms of outreach to emphasize the needs and benefits of a sound pavement preservation program.

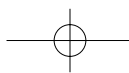
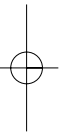
Strategic Pavement Preservation Research

Studies have indicated that the funding needed to keep the current National Highway System in good condition amounts to nearly \$50 billion annually, with current expenditures standing only at \$25 billion. With this shortfall and the likelihood of significant increases not very good, it's obvious that new and improved treatments and techniques are required if we expect to keep the system in an acceptable condition. By wisely spending resources on research to improve practices and techniques for pavement preservation, we hopefully can close the gap between needs and condition in order to better serve the traveling public.



Purpose of the Workshop

The principal reason for the Workshop was to gather practitioners from various maintenance disciplines around the United States and create an atmosphere where research needs could be discussed, debated, and challenged. The outcome was envisioned to be a series of strategic problem statements that the partners could promote for funding and study.



two — background

Current Situation

As the Nation's transportation infrastructure carries us into the 21st century, highway officials are faced with the challenges of an ever expanding, still evolving, yet aging highway network. The nation's largest public works project—the Interstate System of National and Defense Highways—is now complete. The Federal-aid program is undergoing a significant transition from its original focus on building the Nation's highway network to one of preserving our investment in, and improving the quality of, our infrastructure. The demands on our highway network are greater than ever, and they will continue to grow. With this increasing demand comes the expectation of a higher standard of performance. A 1995 National Quality Initiative survey found that pavement condition was the number one concern of highway users. This concern translates into the general perception that highway agencies are not doing a very good job of maintaining the public's highways. Although the levels and volumes of traffic on highways today far exceed design expectancy, preventive maintenance strategies may allow us to meet the needs of the traveling public.

FPP-FHWA Partnership

FHWA, in partnership with other members of the highway community, AASHTO, and FPP, has been championing the need for continuous improvements to the quality, performance, and safety of the streets and highways in the United States. Until now, the primary goal of the FHWA and State highway agencies has been to complete the Interstate highway system. With the system now complete, FHWA and many States are redefining their goals to support continual improvements in quality—in terms of comfort, convenience and safety—on our Nation's highway system. Pavement preservation is key to accomplishing this goal.



Need for Coordinated Effort to Identify Research Needs

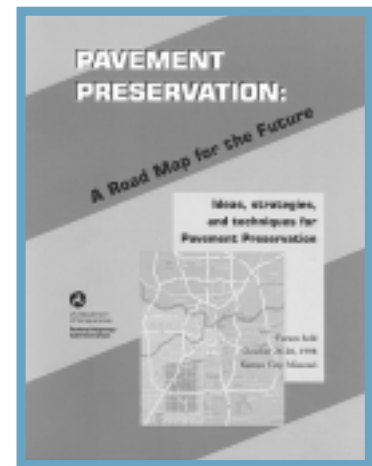
Pavement preservation is at the core of all future highway programs. It calls for a concerted effort by industry and Federal, State, and local highway agencies to generate support for a program of activities that will provide highway users with the highest level of quality and cost effectiveness. To accomplish this, all parties must clearly identify needed preservation activities, and then implement them. A key step in this effort is to identify research needs to improve upon current practices.

Forum for the Future I

This forum, held in 1998 in Kansas City, laid out a road map of ideas, strategies, and techniques for pavement preservation. Key action areas included:

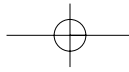
- Better understanding of pavement preservation activities, which in turn will lead to more broad-based support for preventive maintenance.
- Integrated pavement performance data, including costs, benefits, and effectiveness of preventive maintenance activities.
- Greater understanding of the need for dedicated funds for pavement preservation and top management support for the same.
- Performance specifications, improved quality control/quality assurance procedures, and readily available state-of-the-practice training materials.

Research was also considered a key to the future. Appendix 1 of the forum proceedings describes some of the important research issues.



Research Workshop—Sacramento

As a result of the partnership among FHWA, AASHTO, and FPP, and the issues outlined in the proceedings of Forum for the Future I, a workshop to identify the important research needs was held in Sacramento in June 2001.



three — *mission statement/goals*

The FPP mission statement, vision, and objectives are given below. They were developed as part of a continuous strategic planning effort within the organization.

Mission Statement

To continuously improve the quality and understanding of pavement preservation technologies through outreach, education, research, public-private partnering, and international exchange.

Goals

Providing the resources and support necessary to advance knowledge and support for managing and preserving pavements.

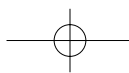
Objectives

To support research to educate the public, government, and industry in the economic, safety, and performance advantages of pavement preservation.

At an FPP Board of Directors meeting in San Diego, California, in early 2001, the Foundation and FHWA recognized the need for a coordinated approach to identify research needs and periodically publish a research needs document, so as to attract attention and funding to address these needs.

The research needs document is an effort that has been assigned to the research committee of the Foundation. These research needs statements will be revisited periodically and an updated research needs document will be issued.

The FPP and FHWA recognized the need for a coordinated approach to identify research needs and periodically publish a research needs document.



four — research workshop

Introduction

The FHWA/FPP Research Planning Workshop was held on June 21 and 22, 2001, in Sacramento, California. The participants at the workshop are shown in Appendix A. Representatives from the public sector, including FHWA, State highway agencies, and local governments, as well as representatives from industry, including the FPP, materials suppliers, consultants, and contractors, attended the meeting.

The purpose of the workshop was to identify, prioritize, and draft research problem statements in the area of pavement preservation. An information package was prepared and sent to the participants prior to the meeting. Among other things this package contained background papers and potential research problem statements. The key background papers included the following:

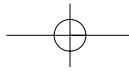
- Moulthrop, J.S. and Hicks, R.G., *Pavement Maintenance: Preparing for the 21st Century*.
- Federal Highway Administration, *Pavement Preservation: A Road Map for the Future*.
- Transportation Research Board, *Maintenance Research Master Planning Workshop*.

Several research problem statements were then prepared and submitted for consideration. The problem statements included those prepared by the International Slurry Surfacing Association, the University of California at Berkeley, and the North Central States Consortium.

General Considerations

The scope and purpose of the workshop were defined for the participants. The participants reconfirmed that the purpose of the workshop was to identify, prioritize, and prepare draft research, development, and implementation problem statements in the

The purpose of the workshop was to identify, prioritize, and draft research problem statements in the area of pavement preservation.



pavement preservation area. Both rigid or Portland cement concrete surfaced pavements and flexible or asphalt bound materials surfaced pavements were to be considered. In addition, nonstructural activities (noise, safety, smoothness, aging, etc.) were to be considered, as well as drainage considerations and thin surfacing materials.

All participants agreed that “champions” were needed if funding was to be obtained to support the many research, development, and implementation needs. Joint funding, such as State highway agency pooled-fund studies and joint public and private sector projects, will be needed to fund and complete the research effort. Both short- and long-term research, development, and implementation projects were considered during the workshop.

The participants agreed that the Transportation Research Board research problem statement format was acceptable for use.

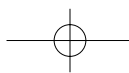
Identification of Research, Development, and Implementation Topics

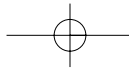
Considerable effort was devoted to identifying potential research, development, and implementation topics. Initially the topics were identified by each participant by title. Information contained in the information package was also considered. A list of 57 topics was initially identified and then narrowed down to 50. These topics are shown in Appendix B.

The 50 topics were grouped into six areas as shown below:

- 1.0 Construction Practices
- 2.0 Materials Selection and Mixture Design
- 3.0 Treatment Strategies and Selection
- 4.0 Performance Evaluation
- 5.0 Training
- 6.0 Policy

All participants agreed that “champions” were needed if funding was to be obtained to support the many research, development, and implementation needs.





Additional discussion increased the original 57 topics by 15 as shown in Appendix B. Additional topics included training programs, field validation, paints and markings, joint sealants, and application of preventive maintenance to local roads.

Prioritized Topics

Appendix C contains a listing of the grouped and combined research topics. Shown on the listing are the votes received from the first ballot used to prioritize the topics. The first ballot votes together with the original topic number identification are shown in the Appendix.

Based on the results from this first ballot, additional discussions were held relative to the elimination of topics. Those topics that received relatively low numbers of votes were then evaluated. If champions were not identified for the low vote topics, the topics were eliminated from further consideration. This process was completed for all of the research areas and the high priority topics were identified.

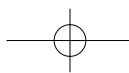


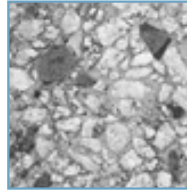
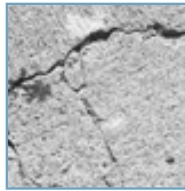
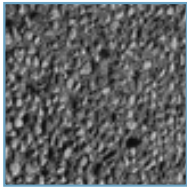
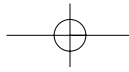
High priority topics
for each of the
research areas
were identified.

Draft Problem Statements

Each of the high priority research topics identified in the process described above was assigned to one or more participants for preparation of the research problem statement. The problem statement format was revised slightly at this time in the discussions and the key outline areas used to prepare the problem statements are listed below:

1. Title
2. Introduction/Background
3. Scope/Objective
4. Work Plan
5. Proposed Deliverables (products)
6. User Community





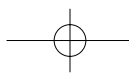
7. Estimated Cost (range) and Duration
8. Potential Partners
9. Implementation Statement

Report Preparation

The areas used to group the problem statements were agreed upon as follows:

- 1.0 Construction
- 2.0 Materials Selection and Mix Design
- 3.0 Treatments and Selection Strategy
- 4.0 Performance
- 5.0 Training
- 6.0 Policy
- 7.0 Other

Jim Moulthrop, Gary Hicks, and Jon Epps were charged with preparing the report that resulted from the workshop. Individual problem statements were to be submitted and reviewed for inclusion in the draft report. All participants were asked to review and revise the final report from the workshop.



five — *strategic programs/projects*

Seven research, development, and implementation areas were identified by the participants at the June 2001 conference. These program areas are:

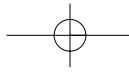
1.0 Construction

As the demands on our national highway network continue to grow, so does the need for construction and maintenance practices that will help extend the life of pavements. State highway agencies are increasingly using a variety of pavement preventive maintenance treatments to keep pavements in good condition longer, including slurry seal and microsurfacing applications. To ensure that these treatments are used to their maximum effectiveness, however, further research is needed on standardizing such practices as field sampling methods and quality control/quality assurance procedures. Standardization of field sampling methods, for example, will help agencies verify that a field mix is consistent with the laboratory mix design. Standard test methods for such procedures as using an ignition oven in preparing slurry, microsurfacing, and other emulsion mixes, meanwhile, would be a valuable quality control tool. Standardization will also help to encourage highway agencies to adopt comprehensive pavement preventive maintenance programs.

2.0 Materials Selection and Mix Design

The materials selection and mix design of a pavement preventive maintenance treatment are crucial to the success of that treatment. For example, an improperly applied chip seal can result in the early failure of the pavement and costly corrective maintenance. In other cases, such as the use of asphalt emulsion treated mixes, the lack of a standard design method can make it difficult to determine how a mix design will perform. Determining best practice materials selection and mix design procedures for these and other treatments must be a high priority if we are to achieve ultimate effectiveness for pavement preventive maintenance. This information will help highway agencies make informed, cost-effective decisions about preventive maintenance.





3.0 Treatments and Selection Strategy

To be effective, preventive maintenance treatments must be implemented at the right time. Unlike routine maintenance, which is usually performed when the pavement is failing, preventive maintenance treatments must be applied when the pavement is still in good condition, with no structural damage. In order to minimize costs, it is also important that highway agencies choose the right treatment for the right road, taking into account such variables as climate, traffic levels, and traffic delays.

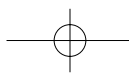
In making these pavement preservation decisions, highway agencies use a broad spectrum of data that often exists in many disparate databases, such as ones for pavement and maintenance management systems, traffic volumes, and construction and materials quality assurance records. Integrating or linking these databases is increasingly critical to making informed pavement preservation decisions.

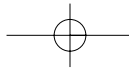
4.0 Performance

As pavement preventive maintenance treatments become more widely used, it is important to evaluate their performance. However, the evolutionary nature of new treatments that have been introduced means that performance measures and criteria are often lacking. Research is needed into developing guidelines and criteria for maintenance treatment performance evaluations. These guidelines should include procedures for collecting pavement data. Such procedures and guidelines are essential to the continued successful implementation of pavement preservation initiatives nationwide.

5.0 Training

A well-trained workforce is a more efficient and effective workforce. As highway agencies place more emphasis on using preventive maintenance treatments, it has become evident that training is needed on the design and construction of these treatments. Training courses should be modular in nature, so that highway agencies can select the modules of interest to them. This training will provide a first introduction to





those unfamiliar with the new preventive maintenance techniques, as well as serve as a refresher for those who would like to improve the performance of their maintenance treatments. Ultimately, training will improve the overall construction quality of treatments, helping to ensure that they perform for the length of or beyond their expected life span.

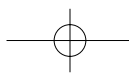
6.0 Policy

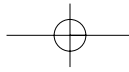
For pavement preservation programs to succeed, they must be sustained efforts with support and funding from all involved stakeholders. Loss of support or changing DOT or legislative priorities can result in the loss of the accumulated benefits of pavement preservation. To ensure the continued support of stakeholders, research efforts must identify and address their needs.

Another policy area that can affect the success of pavement preservation programs is specifications for preventive maintenance applications. Traditional rigid specifications can stifle the innovative approaches that often produce a better finished product. Specifications for some pavement preventative applications, therefore, need to be more flexible.

7.0 Other

An additional area of preventive maintenance research that should be considered is the effectiveness of retrofit edgedrains. These have been used by many highway agencies to reduce or prevent pumping and associated faulting in Portland cement concrete pavements. However, some questions have been raised about the need for this technique, as well as its cost effectiveness over time.

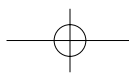




These program areas represent themes for research, development, and implementation needs in the pavement preservation industry. Based on the program areas, specific project needs were identified at the June 2001 meeting. The projects represent both short- and long-term needs (See Table 5.1 on Page 14).

Detailed discussions of each of the seven program areas, as well as detailed project descriptions, can be found in Appendix D. For ease of reference, each program is given a number and each project is given a subset project number. For example, 1.1 identifies the first project (QC/QA for Pavement Preventative Maintenance Treatments) in the Construction Program Area (1.0). Each program area and project has been prepared to be a stand-alone document.

The program areas and projects are expected to change in scope and objective, as well as priority, with time. However, the workshop participants believe the prepared document will help guide the research, development, and implementation efforts in pavement preservation over the next several years. It should also be recognized that research is underway in some of the areas identified in this document. Upon completion, some of these projects will satisfy the objectives identified by the workshop participants.



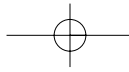
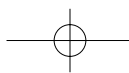


Table 5.1 Program Areas and Project Summaries

Program Objective	Project Number	Project Name	Project Objective
1. Construction			
Development of tests and procedures to ensure quality in all treatments.	1.1	QC/QA for Pavement Preventative Maintenance Treatments	Develop QC/QA methodology for PM treatments.
	1.2	Standardized Field Sampling Methods for Slurry Seal and Microsurfacing	Evaluate current practices and develop standards.
	1.3	Use of the Ignition Oven to Determine Percentage of Asphalt Concrete in Slurry, Microsurfacing, and Other Emulsion Mixes	Develop a standard method for determining the percentage of asphalt concrete for PM treatments.
2. Materials Selection and Mix Design			
Evaluation of a variety of PM treatments and development of improved systems, mix design methods, and specifications.	2.1	Development of a Cost-Effective Chip Seal System for Pavement Preservation	Document best practices for design of chip seals.
	2.2	Concrete Materials for Maintenance Applications	Document best practices for use of PCC materials.
	2.3	Performance and Specifications of Crack and Joint Sealants	Document effectiveness of seals and develop criteria for evaluating seals.
	2.4	Mix Design Procedures, Engineering Properties, and Performance Characteristics of Emulsion Mixes with and without RAP	Develop an improved mix design procedure for emulsion mixes.
3. Treatments and Selection Strategy			
Selection of treatments and timing based on cost effectiveness; development of guidelines/tools to make better decisions on appropriate treatments.	3.1	Timing of Preventative Maintenance Applications to Effectively Extend Pavement Service Life	Evaluate the benefits of timely PP strategies.



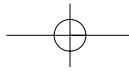
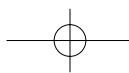


Table 5.1 Program Areas and Project Summaries

Program Objective	Project Number	Project Name	Project Objective
3. Treatments and Selection Strategy (cont'd)			
Selection of treatments and timing based on cost effectiveness; development of guidelines/tools to make better decisions on appropriate treatments.	3.2	Maximizing PP Strategies through Cost Effectiveness Research	Evaluate the cost effectiveness of PP strategies.
	3.3	Appropriate Maintenance Treatments for Urban Areas (Window of Opportunity)	Identify the most appropriate treatments for urban areas.
	3.4	Development of PM Guidelines for Pavement Blow-Ups	Document best practices for maintenance of blow-ups.
	3.5	Development of Integrated Databases To Make PP Decisions	Inventory existing database systems for making PP decisions.
4. Performance			
Evaluation of the performance and other benefits of preventive maintenance treatments.	4.1	Guidelines for Effective Maintenance Treatment Evaluation Test Sections	Develop a set of guidelines for evaluating PM treatments.
	4.2	Performance Measures/Criteria for Conventional and Warranted Preservation Treatments	Identify performance measures for various PM treatments and guide specs.
	4.3	Treatments and Quantification for Noise Reduction and Improved Surface Characteristics	Quantify the noise reduction and improved surface characteristics for PM treatments.
	4.4	Documentation of Pavement Performance Data Based on the Application of PP Strategies	Develop procedures for collecting and documenting performance data.
5. Training			
Development and delivery of training on all aspects of pavement preservation	5.1	Design and Construction of High Quality PM Treatments	Provide training on design and construction of PM treatments.
	5.2	Training and Certification of Technicians	Improve the skill level of technicians.
	5.3	Training to Present the Results of R&D and to Facilitate Implementation	Early implementation of research findings.



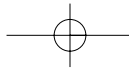
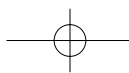
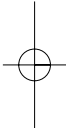
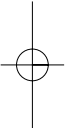
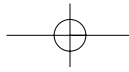


Table 5.1 Program Areas and Project Summaries

Program Objective	Project Number	Project Name	Project Objective
6. Policy			
Development of emerging issues and guidelines for PP programs.	6.1	Innovation in PM through Performance-Based Specifications	Develop performance-based specs for all types of PM treatments.
	6.2	Implementation Guidelines for a PP Program	Develop guides for agencies wishing to develop PP programs.
7. Other			
Improvements in drainage, equipment, and other miscellaneous issues.	7.1	Effectiveness of Retrofit Edgedrains	Document current practices and develop improved guidelines for design, construction, and maintenance.

PM = Preventive Maintenance
 PP = Pavement Preservation





six — references

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3. Federal Highway Administration, *Pavement Preservation—A Road Map for the Future, Proceedings, Forum of the Future I*, October 26–28, 1998.
4. Innovative Pavement Research Foundation, *Creating a New Generation of Pavements*, August 1998.

